General Fisheries Commission for the Mediterranean (GFCM)

Scientific Advisory Committee (SAC)

Subcommittee on Marine Environment and Ecosystems (SCMEE)

SCMEE Transversal Workshop on Ecosystem Approach to Fisheries

Institut National des Sciences et Technologies de la Mer (INSTM)

Salammbô, Tunisia, 7-9 September 2005

1. Opening of the Meeting

The SCMEE Transversal Workshop on Ecosystem Approach to Fisheries was held in the Institut National des Sciences et Technologies de la Mer (INSTM) headquarters in Salammbô, Tunisia, from 7 to 9 September 2005.

Twenty participants attended the meeting (Appendix A).

The Director of INSTM, Mr. Ridha M'Rabet, opened the meeting. The full text of his opening speech is included as Appendix B.

Apologies were presented by J. Lleonart on behalf of the SCMEE coordinator A. García who was unable to attend (Appendix C). G. Le Corre was assigned to chair the Session and T. Bahri and G. Bianchi acted as Rapporteurs.

2. Adoption of the agenda and arrangements of the session

The agenda was adopted (Appendix D)

A set of documents related to EAF were available before the meeting in the CSMEE ftp site (http://www.cmima.csic.es/pub/scmee/EAF_2005/References/), some of them were also distributed as hard copy during the meeting (Appendix E). F. Simard from IUCN distributed copies of documents relevant to the ecosystem approach, which are also available on the internet (Appendix F).

3. Introduction to EAF principles and tools (based on FAO guidelines)

Two presentations were envisaged under this point to contribute to building a common understanding of EAF.

G. Bianchi provided an overview of the main factors that have lead to the development of EAF, operational aspects of its implementation and of the science needs.

> The concept of ecosystem approach is quickly developing in many regions and areas of human activities. It has hardly been fully implemented in any country in the world and for this reason there is limited expertise and experience as regards its implementation.
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> There are various expressions that are used to indicate this new management framework that places fisheries into an ecosystem context, e.g. ecosystem management, ecosystem-based management, ecosystem approach to fisheries, integrated ocean management etc., which mostly differ in nuances as regards the emphasis given to various aspects of resources management. In this context, it is perhaps relevant to distinguish between two main categories. One is related to the sectoral approach, that places a given human activity (in this case fisheries) into an ecosystem context (e.g. the EAF, as defined by FAO, 2003). The other, the cross-sectoral approach, considers in an integrated and holistic manner, all human activities impacting on a given ecosystem simultaneously.
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> The definition of EAF adopted by FAO puts people and livelihoods into focus and imply a fair utilization of marine resources across society(ies) and generations, in addition to having as objective

the protection of ecosystem structure and functioning. These principles have to be translated into policy goals, which, in turn are to be integrated into the management process and the FAO guidelines provide a good introduction on how this can be achieved. Important elements in this process is the active participation of stakeholders in the formulation of objectives and in the management process.

A method for identifying and prioritizing issues to be addressed for managing under an EAF framework was presented. This is based on the Australian experience where the hierarchical component tree method is used. Three main components (ecological well being, human well being and ability to achieve) are "deconstructed" into more specific and detailed issues. These are then prioritized using risk analysis.

In summary, this type of planning (that also provides a framework for reporting), largely based on the Australian ESD framework, provides a way for a management agency to systematically address ecosystem sustainability as part of managing fisheries. Furthermore, it provides justification for current and proposed management actions (or inactions), given the levels of risk and current knowledge available.

Priority areas for research should be tightly associated with what the priority issues are.

FAO is now using this framework in a number of developing countries through the implementation of trust fund projects. As the framework and the methods consolidate, this will probably become part of the routine assistance of FAO's Regular Programme to developing countries, in addition to the conventional type of assistance such as in resource assessments, fishery policy and legislation.

The knowledge base for an EAF will require an expanded scope of science and additional layers of complexity. However, it is important that, as already observed in the early 1970s by John Gulland, we do not fall into the trap of believing that complete scientific understanding is necessary for effective management (Gulland, 1971) and avoid the basic misconception that management and decision making can only be undertaken on the basis of the results of complete and exact analyses and he notes that this has also often been used as an excuse not to take decisions. This observation was made under the conventional paradigm but it is even more valid under an EAF.

Main challenges for the science relevant to EAF include:

a. The increased scope and the complexity of the science needed

b. Because of increased scope and complexity, increase in uncertainty, expected both because of limited data availability but also because it will be inherent to complex systems.

c. Need to provide advice also in data-poor situations

d. Because of the complexity of the issues and the difficulty in developing models, identify useful indicators fro ecosystem effects of fishing and for ecosystem monitoring

e. Ecosystem effects can often only be addressed at longer time scales than those that are typical of decision-making cycles characteristic of conventional fisheries management.

f. The increase in scope and complexity in most countries will not lead to increased research budgets and a formal process of prioritization will be needed

The complexity and the uncertainty related to ecosystem models will increase. Uncertainty is due both to limitations in the current scientific tools but also to the nature of complex systems. Some of the uncertainty can be assessed and reduced by further scientific enquiry. Some is inherent to the systems themselves (indeterminacy). An increasing investment in research can reduce uncertainty but only to a certain point where a great investment will not result in a significant reduction in uncertainty).

Finally it was noted that the EAF would solve the main problems that have characterized conventional fisheries management such as growing demand/poverty, excess fishing capacity/subsidies and political/societal will to implement sustainable policies.

A. Laskaratos provided a presentation on "Application of the ecosystem approach to the management of human activities, in the marine environment of the Mediterranean Sea. Definitions, Implications and tentative road map."

He explained that the concept of Ecosystem Approach (EA) goes back to the beginning of the 90's. It was originally viewed as a novel tool for the scientific study of various ecosystems. During the years it has evolved and today it is considered mainly as a management tool. It relies on a sound scientific knowledge of the ecosystem itself but it has incorporated and developed a large number of concepts regarding the management of human activities that impact on the ecosystem.

There are a number of definitions or descriptions of the EA. In all of them, humans are considered As part of natural ecosystems. The EA being a management tool should be applied in the framework of

the Marine Strategy, which would set up a number of goals and objectives to be achieved . It is the main tool for the application of such a marine strategy at any level, including the regional one. Since the EA will be implanted at many scales, ranging from regional to local, to achieve consistency it will be necessary to identify individual management regions for which ecological and operational objectives will be defined in order to achieve the strategic goals set up by the Marine Strategy. We could call these geographic areas as "Eco-regions". The Eco-regions are the smaller scale geographical areas where regional ecological operational objectives will apply.

The management measures needed to meet Ecological Objectives will be determined by Operational Objectives, which are specific and tractable objectives that can achieved through the application of management measures with a specific time frame. For each such objective, associated indicators and reference points will have to be developed.

The EA should take account of the natural variability, in marine ecosystems, as well as that scientific knowledge is always incomplete in other words that the efforts of specific management actions cannot be precisely predicted. This implies that management frameworks cannot be static but continuously reassed and updated as circumspances change. The alternative to rigid and inflexible management frameworks is Adaptive Management which is "learning by doing" process which can be summarised as a six step cycle:

- assess problem
- design management measures
- implement measures
- monitor results
- evaluate
- adjust measures

A question was asked on the validity of the approaches that have been adopted so far, e.g. classical models of population dynamics, and of the decisions taken on the basis of the results provided by such methods. There was a general agreement that conventional assessments continue to be important also under an EAF framework.

EAF takes into account information on relationships between components of the ecosystem including biological, environmental, economic, social and technical aspects. Single species assessments are considered as an important source of information also under an EAF. Moreover, it was underlined that redundancy is intrinsically precautionary and that it is important to use all information available. Classical indicators may become ecosystem indicators if reference points are calculated in an EAF framework. It was strongly advised to adopt an overall strategy for the application of EAF in the Mediterranean, as it would be meaningless to put effort only on fisheries without taking into consideration other human activities impacting ecosystems.

A remark was made on the fact that market demands may result in fishing practices that are incompatible with ecological sustainability and this issue is almost never considered in scientific assessments. This underlined the importance of the participation of all stakeholders, which would contribute to highlight factors that may be important but usually not considered, such as market requests.

4. Main exploited ecosystems in the GFCM area and the possible relevance of EAF. And 5. Identification of priority EAF issues for the main fished systems (including a preliminary exercise in risk analysis for priority setting)

It was agreed to discuss both points 4 and 5 in a single session.

J. Lleonart presented a communication on "Main exploited ecosystems in the GFCM area: An attempt of classification"

From the definitions of ecosystem and large marine ecosystem (LME) and according to the FAO fisheries terminology, two main ways of defining ecosystems in the Mediterranean are described, i.e. geographically and ecologically.

From the geographical point of view FAO divides the Mediterranean into 10 statistical divisions and 30 GFCM geographical sub areas (GSAs). From the ecological viewpoint, three main criteria (however related among them) were considered: linkage to the bootom (i.e. pelagic vs demersal),

distance to the coast (littoral, neritic, oceanic) and depth (coastal, shelf, slope and deep sea). Using the ecological approach, Lleonart identified seven possible ecosystems to be studied: (1) pelagic shelf, (2) pelagic oceanic, (3) coastal, (4) demersal shelf soft bottom, (5) demersal shelf hard bottom, (6) demersal slope and (7) demersal deep sea.. A brief description was given to each of these proposed ecosystem taking into consideration target and non-target species, fishing gears, impacts of fishing and other impacts.

Lleonart analysed some of the principles of relevance to EAF regarding their particular application to the Mediterranean: avoiding overfishing, ensuring reversibility and rebuilding, minimizing fisheries impact, considering species interactions and applying the precautionary approach.

He also presented the management instruments currently available to put into practice the EAF: control gear selectivity and sizes, regulate operational units (Ous), control areas, scientific research and enforcement of existing rules.

Some final considerations about facing overfishing protecting ecosystem and past experiences of positive response of Mediterranean fisheries to management were presented.

The presentation was followed by a discussion on the definition and classification of ecosystems. There is no unique definition of an ecosystem, the definition is conditioned by the underlying scientific or management issue and/or by geography.

The first two principles of the Ecosystem Approach of IUCN were recalled: "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". Doubt was expressed on the relevance of leaving to societal choices the setting of the ultimate goals of EA; there are clear restrictions to what can be done to ecosystems, as they can not be "engineered" according to choices. The relevance of the second principle was also challenged given that ecosystem considerations often require management actions from the local to the regional scales.

The relevance of taking into account issues such as exotic species introduced in the Mediterranean and ballast waters was discussed. Even though it is recognized that a wide variety of parameters, among which ballast waters and exotic species, may affect ecosystems, it was agreed that, at least to start with, one should focus on fisheries and on fisheries impact. However, in a further step of EAF implementation, attention should be paid to other parameters that may affect fisheries (recreational fisheries, tourism…). In the context of uncertainty the precautionary approach was recalled.

Discussion on geographical partition

The importance of spatial issues was recalled, geographical areas of interest should be defined for management purposes. After discussion, the current division in 30 GSAs was considered as the most relevant one, as it is the result of a compromise between administrative, economic, ecological, bathymetric considerations that were discussed in detail during an ad hoc meeting of experts (Alicante, 2001). However, it was strongly suggested that in parallel with the use of GSAs, further work on the description of operational units should be made. This would allow crossing administrative borders to deal with shared stocks. In this perspective, the work conducted in the Adriatic sea was cited as an example to be followed. Furthermore according to the questions addressed other geographical subdivisions could be considered (LME, MAP, FAO statistical areas, etc.)

Time scales

It was pointed out that socio-economic and biological management objectives could be difficult to reconcile in the short term, but they would converge in the long term. EAF implies both strategic (long-term) objectives and operational or tactical (short-term) objectives, and these should be consistent with each other.

Classification of ecosystems

The meeting explored different ways of classifying ecosystems. A proposal was made to classify ecosystems according to bathymetric and ecological considerations, e.g.:

- Pelagic, shelf
- Pelagic oceanic
- Coastal or littoral
- Demersal shelf, soft bottoms
- Demersal shelf, hard bottoms
- Demersal, slope
- Demersal, deep sea

It was noted that there are interactions between pelagic and demersal components. Therefore, while it may be relevant to separate pelagic and demersal in the oceanic domain, this would be less meaningful in the neritic region where these interactions are stronger.

In view of analysing the impact of fisheries, alternative ways could be to consider e.g. the main fisheries as OUs in each GSA, rather than classifying ecosystems on the basis of bathymetric or ecological criteria. This would allow providing relevant information for management.

6. Review of the outputs of the transversal activities by the other Sub-Committees (SCSI, SCSA, SCESS) and compare with priorities identified in 5

The coordinator of the SCSA informed the meeting that no transversal activity was organized in 2005. Presentation was made of the Synthesis of the Workshop on Reference Points (held in Rome on April 20-21, 2004). Observations made during the workshop, including identified gaps and recommendations related to EAF were highlighted. Among these, experts discussed issues related to the standardization of indices and reference points, multispecies approaches, relevant characteristics of indicators, the importance of taking into consideration socio-economic aspects, biotic and abiotic influencing factors, examination of historical data sources, use of diversity indices as overall indicators of ecosystem change, consideration of basic ecosystem productivity and environmental data.

The chairman of SAC informed that 2005 saw the organisation of only one transversal activity by the SCSI (Workshop on Operational Units and fishing effort measurement, Tangiers, Morocco; 4-6 July 2005).

There is currently work in progress on the identification of indicators dealing with different topics (status of stocks, environment, socio-economy) that should be conducted by all Sub-Committees. Regarding this issue the need of coordination between subcommittees was underlined. The process should take place following 2 steps: identification of indicators and reference points, followed by provision of relevant data by SCSI. SAC should be regularly informed on the progress, so that the Commission can have relevant tools to assess the fisheries situations and take the required measures as needed. In this perspective, the Tangiers meeting represented an important step to generalise the concept of OUs in the context of EAF.

7. EAF tools for the analysis of exploited ecosystems

7.a) Essential and sensitive habitats

The MedSudMed staff informed on the activities that are currently conducted in the framework of the Project in relation to fish habitats. It was recalled that the MedSudMed Project operates in the GSAs 12, 13, 14, 15, 16 and 21. After a brief summary of the Project objectives, the meeting was informed that the scientists involved in the Project are currently working on the identification of the main spawning and nursery areas of selected demersal and small pelagic species. These areas will eventually be characterized in terms of sediment structure, bottom types and oceanography wherever data are available. The meeting was also informed on the pilot study which is currently conducted in GSA 15 (Malta Island) on the basis of an important amount of data provided by different sources. The pilot study will describe the spatial distribution of selected demersal species, *i.e.* abundance and density of different life stages, localization of spawning and nursery areas, fish assemblages' characteristics. The study will also deal with spatial information on fishing activity, as well as with the bottom characteristics in terms of sediments, benthos and macroinvertebrate communities. In addition, the study will provide a picture of the abiotic factors characterizing the area of interest. It is expected that the outputs of the study will contribute to enhance the understanding of the ecosystem structure and functioning.

The participants were also informed of the ongoing benthos monitoring project (REBENT) in the Atlantic and the Mediterranean (GSAs 7 and 8) conducted by IFREMER in collaboration with the Universitiy of Perpignan and of Marseille. Another project (CHARM) focusing on the identification of critical habitats for a limited number of demersal species chosen on the basis of ecological characteristics (spatial distribution, trophic competition…) was conducted in the Channel in collaboration with bordering European countries.

Similar studies are also in progress in the Adriatic Sea where a series of data collected through 20 surveys at sea are being processed in view of mapping the benthic communities.

It was highlighted that there are few studies on habitats in the Mediterranean, probably due to the high costs and the great amount of work that they require. Moreover, it was noted that poor attention is given to EFH (Essential Fish Habitat) issues in the Mediterranean. Yet, spatial consideration will certainly become a major issue for management, and knowledge on habitats and on their characterisation will need to improve. The meeting recommended that further studies are conducted on this issue to improve the available knowledge.

Mention was made on the existing catalogue/classification on coastal habitats in the Mediterranean. (www.rac-spa.org) and it was suggested that SCMEE collaborates with RAC-SPA. The RAC-SPA officer also mentioned the possibility of creating interactive maps, on the RAC-SPA website. Its interoperability allows it to combine data stored in different hosts, from different sources and on different topics (habitats, FAO statistics, protected areas, pollution…). The CIESM data base on habitat and biology of a number of species was also mentioned (www.ciesm.org).

The need to distinguish two complementary notions, sensitive habitats (bottom characterisation) versus EFH (required environment for the completion of species life cycle), was underlined. However there is currently an important gap on EFH in the Mediterranean.

Development of Ecosystem Reference Points in the SCMEE, in cooperation with the SCSA, was recommended. This issue is particularly relevant, as economic, biological and ecological indices need to be assessed jointly and reconciled under an EAF.

As a result, habitat appears to be a combination of stable features (bottom types) and variable ones (environmental factors, ex. river plumes) and it would be appropriate to consider the potential habitat, the realised habitat and the effective habitat.

7.b) Modelling

The meeting was informed on current studies on the application of mass balance modelling in southern Catalan Sea and in the Adriatic Sea. An important amount of information is available to construct this type of models in the Mediterranean. It was noted that in addition to this global approach, analytical models are also utilized, such as the Mefisto model, that can handle multispecies/multigear fisheries, including bioeconomic data. In 2002, a synthesis paper was presented at the SAC session that showed the wide variety of models that can potentially be used. IBM (Individual Based Models) were also mentioned. There is a general need of developing skills on these models in the Mediterranean, as well as GIS tools that allow both empirical and analytical modeling.

It was underlined that the usefulness of the various models needs to be assessed in relation to the objectives and the time scales involved. ECOPATH models for example appear to be less useful in tactical (annual) management while the information they provide is more useful in relation to strategic (long term) management.

7.c) Ecosystem indicators

Sergi Tudela presented the point of the agenda on ecosystems indicators. A summary of the main principles and management implications of the EAF was given to remind the conceptual framework shaping the use of ecosystem-based indicators.

> The presentation focused on 1) the importance to distinguish between different levels of EAF management for the setting of EAF-based indicators and related reference limits and 2) the description of a new composite index on ecosystem impact and its possible use to create a reference framework for EAF-based management in the Mediterranean.
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> Mr Tudela emphasized that different levels have to be differentiated in EAF management (as in any kind of rational fisheries management), namely strategical and tactical/operational. Obviously, different time scales apply to these levels (much longer for strategical management). This implies that ecosystem-based management should be done simultaneously at all these levels, using adequate indicators and related operational frameworks as defined by specific reference levels. Ecosystem-based indicators useful for strategic management are likely to be “complex” ones, being potentially obtained from ecosystem modeling and informing on structural and functional properties of the exploited ecosystem. Indicators for tactical/operational ecosystem-based management, however, can be much simpler; they can even be the same as those used in classical TROM, though associated to different new, ecosystem-based reference points (for example, stock biomass with the amount of biomass needed to allow the species to play its functional role in the ecosystem as a reference point).
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> Tudela summarized the major findings of the paper from Tudela et al. recently appeared at ICES J Mar Sci (issue 62: 585-591, 2005) on a new ecosystem-based indicator potentially useful for strategic ecosystem-based fisheries management. In this work, a composite quantitative index for the percentage of primary production required to sustain fisheries and the average trophic level of catch (%PPReTLc) was employed to develop ecosystem-based reference functions suitable for fisheries management. Established ecosystem models (a total 49 exploited ecosystems from all over the world), characterized by pairs of %PPReTLc, were classified as either sustainably exploited or ecosystem overfished, on the basis of the results of factorial correspondence analysis applied to selected ecological indices, and on information from various sources. Canonical discriminant analysis of these pairs was applied to establish the discriminant function to separate the two exploitation classes. Next, reference functions related to different probabilities of ecosystem overfishing were developed to obtain an operational framework for ecosystem-based fisheries management. Values of ecosystem-based maximum sustainable catches associated with different probabilities of belonging to a

sustainable situation were calculated. Overall, results show that most current fishing scenarios entail high risks of ecosystem overfishing, which is particulary true in the case of some highly exploited Mediterranean ecosystems (like the Southern Catalan Sea). This indicator has now been further improved by Libralato et al. (in press) by including the mean transfer efficieny of the food web as well. This indicator informs on the ecosystem overfishing status of any given exploited ecosystem/fishery and can also be coupled to the outputs of Ecosim simulations to assess the effectiveness of different possible management measures, has it has already been done for the Catalan Sea fishery.

Mr. J. Bertrand presented a method for combining individual indicator results into a comprehensive diagnostic of fishing impacts on fish populations and communities (in press in the ICES Journal of Marine Science).

A conceptual framework for interpreting combined trends in a set of simple indicators is proposed, relying beforehand on qualitative expectations anchored in ecological theory. The initial state of the community is first assessed using published information. Which combinations of trends are acceptable or undesirable is decided, depending on the initial status. The indicators are then calculated from a time-series and their time trends are estimated as the slopes of linear models. Finally, the test results are combined within the predefined framework, providing a diagnostic on the dynamics of fishing impacts on populations and communities. The method is demonstrated for nine coastal and shelf-sea fish communities monitored by French surveys. Most communities were found to be persistently or increasingly impacted by fishing. In addition, climate change seems to have contributed to changes in East Atlantic communities.

Discussions that followed the presentation dealt with the data required to calculate this type of indicators. It was specified that estimates of landings, by-catch, trophic level of species, and information on IUU were necessary; the reliability of the indicators strongly depends on the quality of the information available.

The presented indicators were considered to be a good basis for the measurement of ecosystem health; a debate was held on their relevance for tactical management, as well as their capacity to reflect abiotic environment fluctuations and address multispecificity. It was recalled that indicators should be easily understandable by managers. The important amount of work (data, scientific hypothesis…) that was required to design and test these indicators was acknowledged. This highlights the need for continued work to develop operational ecosystem indicators that take into consideration additional issues such as biodiversity and economic income. There was a general agreement to say that the two indicators that were presented represent an important step in this direction.

A discussion was held on distinction between ecological indicators and indicators needed for ecosystem approach for fishery management.

8. EAF tools for the management of exploited systems in the Mediterranean

8. a) MPAs/NFZs (spatial and temporal effort of fishing effort)

D. Cebrian presented the point of the agenda on Marine Protected Areas (MPAs) and Non Fishing Zones (NFZs).

The role of habitat protection on fisheries recovery has been demonstrated in several cases and involve several different and usually accumulative benefiting factors. A MPA may favour the recovery of fish populations among others by:

Increasing size and abundance of individuals; allowing fish to reach older age, which in many species may exponentially increase their fecundity; preserving a more diverse genetic pool. Restoring the populational structure, helping specially species which change sex; helping the recovery of depleted stocks, specially when spawning aggregations, migration stopovers or nursery grounds are embraced; spillover effect, which restocks with larvae and fish adjacent and other areas.

Restriction to fisheries may involve different degrees from temporary closures to different fishing gears, definitive ones to specific gears and permanent banning of fishing (no-take areas). Further degree of protection are MPAs where other concrete protection measures related to habitat and non exploited species are considered. They usually include an spatial zoning where different measures in addition to fishery related ones apply.

The consideration of socio-economic factors as components which interact within the ecosystem plays a major role to help managing fisheries in the Mediterranean. It can be illustrated with the example of the Marine Park of Northern Sporades, in Greece, where the effect of spatial closures to sport fishing and industrial fisheries, while allowing artisanal, ones was studied along eight years. The implementation of restrictions, enforced by a warding body agreed to local fishing cooperative members during three years, yielded along that period a significant recovery of most of the commercial fish species exploited by those locals. However the concession of guarding tasks to a body foreign to those islands community after that period provoked again a sharp decline of local captures. Full local commitment to the guarding of their own resources along the first period - involving the difficult control of illegal fishing actions perpetrated by their own members- was interpreted as the reason of a efficient protection of shoals. Reluctance to denounce local illegalities to "foreigners" seemed to play a major role afterwards. Unchanged decline of certain species during all the study period showed that those species (including lobsters; the source of their highest revenue) were being depleted by the artisanal community and needed other ways of management.

It was noted that marine protected areas have existed in the Mediterranean for a long time. These were established with different objectives, while the practice of utilising MPAs to protect fisheries resources is more recent. MPAs are considered by many as a useful tool for fisheries management. It was also noted that today there is a convergence of objectives in establishing MPAs, following a more holistic approach to management, where protection of biodiversity and sustainability of fishery resources are dealt with simultaneously.

No useful indicators have been identified yet to monitor the performance of MPAs and this should be a priority research issue. The difficulty related to surveillance was stressed as well as the desirability of allocating resources and responsibility to local communities.

Examples of MPAs in the Mediterranean where provided that have resulted in positive outcomes. The marine reserve of Port-Cros, France seems to play a positive role for fishing activities in its vicinity. In Croatia, areas have been closed to trawling which has resulted in increased size of the resources. In Italy there are many areas closed to fisheries but there is a need for improved control and for a greater participation of fishermen in their management. It may be useful to make an inventory of all established protected areas in the Mediterranean, including location, size, and objectives.

The examples that were presented clearly illustrated the need to quantify the supposed benefits of MPAs. Furthermore, it was noted that in those cases where local communities control the resources, these are usually well managed, while industrial fisheries and a centralised management system often lead to overexploitation. The desirability of a greater participation of stakeholders in managing the resources was stressed.

Point 8.b). Selectivity and gears

Jacques Sacchi presented the selectivity as EAF management tool. He point out the importance of the role of the technology in the fishing activities and the possibility to use selectivity both as leading angle of the fishery analysis and reference point. The knowledge of the effects of the technology on ecosystem must be studied with the other external components within an EAF framework.

The exploitation of fishery resources has several consequences on populations and on ecosystem notably in terms of catch selection and physical impacts on the habitat. These effects are mainly depending on physical characteristics of the fishing gear and of their operating mode but also of the local fishing practices and market demand.

Taking account of all these features selectivity can be an efficient tool for the EAF with selectivity parameters which can be considering both as ecosystemic indicators and reference points. However, if intra specific selectivity is quantifiable there is not today any standardized methodology for describing inter-specific selectivity.

An overview on the selectivity of main gear type and of their physical impact shows that their knowledge is unequal and often insufficient for the majority of the cases and must progress. If for

gillnet and trawl selectivity can be more or less easily estimated from the relation between fish length and mesh size but for the other gear fish behaviour and tactics play a most important role and make difficult the estimation of its parameters.

Same considerations can be made for physical impacts of fishing techniques. Research on indicators and reference points are also needed.

Technical solutions for improving selectivity based only on the increase of the escapement may be questioned by the fish ability to survive after and the difficulty to tackle multispecific fisheries problem. Management approach requiring active participation of stakeholders and combining fishing gear technology improvement with access limitation and fishing effort control would be more advisable.

Gear technology can play a key role in the implementation of fishing practices that are environmental friendly. For example, the use of circle hooks in longline fisheries seems to be very promising in reducing bycatches of some species of sea turtles. Preliminary experiments with circle hooks in the Mediterranean have not brought convincing enough results and other modifications are being tested.

Experiences in developing, testing and introducing gear modifications as tool for fisheries management have shown the importance of the full involvement of fishermen in this process. This leads to better results and greater acceptance by the industry at the implementation stage.

Point 8.c). by catch of vulnerable and protected species.

D. Cebrian presented the point of the agenda on by catch of vulnerable and protected species.

Fishing fleets in the Mediterranean are assessed at some 140,000 units carrying on fishing that is essentially coastal and multiespecific. Offshore fishing targets a smaller number of species.

Many threatened species, such as chondrichthyans, sea turtles, sea birds, marine mammals, etc., experience the impact of fishing although they are not the direct targets of fishing (collateral –not indeed accidental- catch.)

It is worthy to recall the following principles of relevance to an ecosystem approach to fisheries, in relation to bycatch:

- Minimizing fisheries impacts
  - Do not threaten bycatch species
  - Avoid injury to endangered, vulnerable or protected species
  - Minimise general impact of fishing operations on the ecosystem
- Considering species interactions
  - Take account of species associated with or dependent upon harvested species
- Maintaining ecosystem integrity
  - Biodiversity
  - Ecological processes that support biodiversity and resource productivity

Following these principles, fisheries management plans aiming at restoring exploited ecosystems in the Mediterranean have to require that information on bycatch is collected and that specific operational objectives are defined to tackle the problem of bycatch.

Management measures are diverse, but the following are the main ones:

- Gear modifications (to improve selectivity and therefore address the issue of bycatch)
  - Circle hooks: efficient for loggerhead turtles; inefficient for leatherback turtles
  - Excluder devices and sorting grids
  - Scaring devices, invisible setting (UW, darkness, etc) on longlines: good results on birds
  - Scaring devices on nets (pingers and Acoustic harassing devices -AHDs): so far for cetaceans, the first ones very species –specific; the AHDs are too prejudicial for the species being scared
  - Purse seine modified operations or gear modifications: positive results on cetaceans
- Measures to address ghost fishing
  - Biodegradable materials
  - Measures to reduce gear loss

  - Measures to recover gear
- Spatial and temporal controls on fishing (to reduce the probability of undesirable interactions)
  - (e.g. entanglements in nets of the critically endangered Mediterranean monk seal are positively correlated to spatial proximity to used caves and temporal proximity to whelping and nursing season).

The need for research on the biology of the bycaught species so as to optimise the efficiency of measures implemented to mitigate interactions with fisheries targeting other species, should be underlined. As an example, recent studies undertaken on the genetic structure of the loggerhead turtles showed that turtles of Atlantic origin concentrate offshore the northwest coast of Africa, while the more threatened Mediterranean-born ones remain in other areas of the Mediterranean. Such result help to concentrate mitigation efforts where these are most needed.

Possible positive effects of discards from the fisheries have to be considered. For example, an endangered Mediterranean bird species, the Audouin's gull, has been favoured by facilitated feeding from trawler discards.

Mitigating the impact of interaction between fishing activity and endangered or rare species is a key point in preserving marine biodiversity and promoting co-existence of fishing with healthy ecosystems. In this context, for the Mediterranean region, the SPA Protocol of the Barcelona Convention and the ACCOBAMS Agreement are particularly relevant. The SPA Protocol includes in its annexes about 125 marine species in need of special care. It invites the Mediterranean countries to promote exploitation practices that are not harmful to the endangered species. The ACCOBAMS agreements stresses that the use of non-selective fishing gear has negative impact on cetacean populations and provides in its conservation plan for the development and the implementation of measures to minimize adverse effects of fisheries on the conservation status of cetaceans.

Finally, a key aspect to be included on the ecosystem approach to fisheries is stakeholder participation. Fishers are probably the most important group, given their knowledge on the marine ecosystem and the fact that only their positive involvement may allow a proper implementation of measures.

9. Develop a strategy/workplan for supporting implementation of EAF within the GFCM area

The main objective of this item was to discuss and identify a road map for appropriate actions that would contribute to the implementation of EAF in the GFCM area.

After a discussion on various ways of addressing this complex issue, it was agreed that as a first step recommendations should be addressed to the existing thematic subcommittees. Furthermore, given the importance of stakeholder participation in the process of developing and implementing the framework for an EAF, actions should be identified in this direction.

The meeting recommends to:

- all subcommittees : SCMEE, SCSA, SCESS, SCSI
  - continue the work on indicators, considering that these should be robust and reflect ecosystem properties, including the human component of the ecosystem; they should be linked to management objectives and be acceptable and easily understood by stakeholders
  - reinforce the transversal collaboration in order to produce integrated advice for management, in particular through intercommittee activities
- SCMEE and SCSA
  - invite to test and discuss the use of the two ecological indicators presented at the meeting: %PPR-TLc and synthetic trend indicator (MEDITS) with the final objective to obtain adequate tools for EAF in GFCM.

- SCMEE
  - review and consolidate information and classification of bottom habitats in the Mediterranean basin.
  - improve knowledge on and characterization of essential fish habitats.
- SCSA
  - promote that assessments also incorporate ecosystem considerations (e.g. predator-prey considerations, bycatches, impact of the environment on the stock, description of the environment, biotic and abiotic, in which the fishery is developed etc).
  - produce a reference document on the environmental impact of the different gears and explore the possibility of implementing mitigation measures, where relevant.

In order to start to implement the EAF, it is necessary to:

- revise the global strategic objectives for the region so as to ensure consistency with the principles of EAF
- organize consultative meetings with stakeholders in the Geographical Subareas (GSAs) with the aim of sensitising/informing on the ecosystem approach and jointly identify priority issues to be dealt with. This work could start in selected regions that would serve as case studies.

10. Closure

The president closed the session and expressed his gratitude to the Director of INSTM and its personnel for hosting the workshop and its excellent organization, It also addressed his appreciation to all participants for the quality of the presentations and their active participation to the debates which made it possible to the Transversal Workshop on Ecosystem Approach to Fisheries to make significant progresses.

APPENDIX A: LIST OF PARTICIPANTS

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APPENDIX B : DISCOURS DE MR . RIDHA MRABET, DIRECTEUR GENERAL DE L'INSTM

Monsieur le Président du SAC

Messieurs les Représentants de la FAO

Honorables invités,

Mesdames et messieurs,

Il m'est particulièrement agréable d'être parmi vous aujourd'hui pour cet important événement que le SAC et l'INSTM organisent conjointement, à savoir : **l'atelier de travail relatif à l'approche écosystémique pour les pêcheries en Méditerranée**.

Je voudrais, tout d'abord, remercier tout particulièrement le SAC et ses deux Sous-Comités : Ecosystème et Environnement Marin et Evaluation des Stocks d'avoir pensé et programmé cette importante manifestation scientifique. Il faut dire que j'étais présent lors de la dernière réunion du SAC, c'est là que nous avons tous recommandé l'organisation de cet atelier et la Tunisie a tout l'honneur de vous avoir sur ses terres aujourd'hui pour concrétiser cette précieuse recommandation.

Mesdames et Messieurs

Il faut dire que l'élaboration de politique ainsi que des mesures de gestion basées sur une information inadéquate donne souvent lieu à une gestion non durable des ressources. Dans les cas extrêmes elle peut même être la cause de l'effondrement d'écosystèmes et d'économies régionales. Le plus souvent, des signes chroniques sont évidents; tels que l'épuisement des ressources, alors que des écosystèmes encore intacts peuvent généralement satisfaire les besoins fondamentaux de la population humaine.

Il faut également souligner que la gestion des ressources marines vivantes et de la biodiversité en vue de leur utilisation par les générations futures est un des principes directeurs de la Convention des Nations Unies sur la diversité biologique dont la Tunisie est signataire.

C'est ainsi, et afin de contribuer le mieux possible à la préservation de ses ressources et de leur habitat, la Tunisie a développé une conjoncture favorable qui fait de la recherche scientifique et technique dans le domaine des sciences de la mer un soutien indispensable au développement durable souhaité.

A titre indicatif et pour asseoir le secteur de la pêche et renforcer ses fondements, notamment en vue de son exploitation durable, la Tunisie a dernièrement investi plus de 3 millions de dollars pour la réalisation de nombreux projets nationaux de recherches menées à l'Institut National des Sciences et Technologies de la Mer, intéressant divers domaines comme ceux de l'évaluation des stocks, de la pêche responsable, de la biodiversité, de la biotechnologie, de l'aquaculture et de l'océanographie et visant une meilleure exploitation de ces ressources, saine, équilibrée et adéquate.

En effet, la recherche scientifique et technique marine figure parmi les priorités stratégique de la Tunisie. L'institution principale opérant dans ce domaine est l'Institut National des Sciences et Technologie de la Mer, dont le budget global est passé de 400 milles dinars en 1996 à 3 millions de dinars en 2004. Cet institut, dont le nombre de chercheurs a vu un accroissement de près de 100% pendant la même période travaille en partenariat avec au moins 20 institutions nationales et 15 internationales.

Par ailleurs, l'un des vecteurs principaux de soutien à cette activité de recherche a été l'acquisition dans le cadre de la coopération Tuniso-Japonaise, du navire de recherche océanographique « Hannibal », en 1998. Ce bateau de 34 m de long et de 1000 CV de puissance motrice, est équipé d'un matériel scientifique moderne capable d'assurer le bon

déroulement des campagnes multidisciplinaires en vue d'étudier les écosystèmes marins et de préconiser des modes de gestions durables.

Il est donc clairement établi que la recherche marine scientifique et technique en Tunisie est une tradition qui vise aujourd'hui à atteindre l'excellence. C'est grâce à cette recherche qu'il est possible d'aménager et de gérer nos ressources marines de manière harmonieuse et durable.

Honorables invités,

Une pêche responsable doit d'abord être basée sur une évaluation des stocks de poissons disponibles et sur les écosystèmes qu'ils colonisent, cela signifie une actualisation et un suivi des données biologiques et dynamiques des ressources marines vivantes les plus importantes; sans pour autant négliger la totalité des biotopes et des écosystèmes marins ainsi que les différents facteurs environnementaux qui règnent. C'est l'ordre du jour de votre atelier de travail.

Mesdames et Messieurs,

Il m'est agréable de profiter de cette occasion pour rendre hommage à la collaboration et à la solidarité qui nous unit, nous autres riverains de cette belle mer Méditerranée. Je remercie vivement en mon nom et au nom de mon pays les projets régionaux FAO/COPEMED et FAO/MEDSUDMED. Je remercie également la FAO et plus particulièrement la Commission Générale de la Pêche pour la Méditerranée (CGPM) et les gouvernements espagnol et italien pour la mise en oeuvre et le financement de ces importants projets de coopération scientifique.

Honorables invités,

Pour terminer, il m'est agréable de renouveler mes remerciements aux organisateurs de cette importante manifestation et je vous souhaite à tous un excellent séjour parmi nous en Tunisie.

Merci à tous

APPENDIX C: LETTER OF MR. ALBERTO GARCIA, COORDINATORS OF THE SCMEE

Dear all,

Due to an unmovable and unavoidable commitment, I sincerely regret that I will not be able to attend such an important meeting that I believe can eventually lead to the implementation of ecosystem approach measures towards a rationalization of the exploitation of fishery resources of the Mediterranean. It is my hope that the invited speakers and participants lead the discussion towards a fruitful debate turning out with important and applicable recommendations.

I would like to express in my name and that of the SCMEE my gratitude to the Director of the Salammbô Oceanographic Laboratory of the INSTM of Tunisia for hosting the meeting and all the hosting authorities. Likewise, my thanks to the FAO officers, A. Bonzon and J. Lleonart, and to the head of SAC Prof. C. Piccinnetti for their support in the organization of the meeting. And most of all, to the all the participants of different organizations and institutions whose collaboration is essential for adding a milestone towards the application of the Ecosystem Approach to Fisheries.

Best wishes for a fertile and positive discussion.

Alberto Garcia.

APPENDIX D: AGENDA

1. Opening of the meeting by the Directeur Général de l'INSTM, Mr. Ridha M'Rabet
2. Adoption of the agenda and arrangements of the session
3. Introduction to EAF principles and tools (based on FAO guidelines)
4. Main exploited ecosystems in the GFCM area and the possible relevance of EAF
5. Identification of priority EAF issues for the main fished systems (including a preliminary exercise in risk analysis for priority setting)
6. Review of the outputs of the transversal activities by the other Subcommittees (SCSI, SCSA, SCESS) and compare with priorities identified in 5.
7. EAF tools for the analysis of exploited ecosystems in the Mediterranean:
    a) essential and sensitive habitats
    b) modelling
    c) ecosystem indicators
8. EAF tools for the management of exploited ecosystems in the Mediterranean:
    a) MPAs/NFZs (spatial and temporal management of fishing effort)
    b) Selectivity and gears
    c) by catch of vulnerable and protected species.
9. Develop a strategy/workplan for supporting implementation of EAF within the GFCM area.
10. Any other matters
11. Adoption of the report

APPENDIX E: LITERATURE AVAILABLE

* Available in: http://www.cmima.csic.es/pub/scmee/EAF_2005/References/ or in the web site indicated

‡ Hard copy distributed during the meeting

EAF General publications

* ‡ FAO Fisheries Department. (2003) The ecosystem approach to fisheries. *FAO Technical Guidelines for Responsible Fisheries*. No. 4, Suppl. 2. Rome, FAO. 2003. 112 p. ftp://ftp.fao.org/docrep/fao/005/y4470e/y4470e00.pdf

* ‡ FAO. (1995) Precautionary approach to capture fisheries and species introductions. Elaborated by the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6-13 June 1995. *FAO Technical Guidelines for Responsible Fisheries*. No. 2. Rome, FAO. 1996. 54p. ftp://ftp.fao.org/docrep/fao/003/W3592e/W3592e00.pdf

* ‡ Garcia, S.M.; Zerbi, A.; Aliaume, C.; Do Chi, T.; Lasserre, G. (2003) The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. *FAO Fisheries Technical Paper*. No. 443. Rome, FAO. 2003. 71 p. ftp://ftp.fao.org/docrep/fao/006/y4773e/y4773e00.pdf

Sinclair, M. & Valdimarsson.- 2003. *Responsible Fisheries in the Marine Ecosystem*. FAO and CABI, 425 pp

Publications concerning Mediterranean EAF

* Anon. (2001) *Towards Holistic Fisheries Management: A Mediterranean Perspective*. Report of a workshop held in Heraklion Crete 27-29 March 2001 under the auspices of the European Union. Accompanying Measures programme, Contract No. Q5AM-2000-00002. 22 pp. ftp://cucafera.icm.csic.es/pub/lleonart/Divulgaci%F3/holisticreport.pdf

* CIESM (1999). Precautionary approach to local fisheries in the Mediterranean Sea - Kerkenna Island (Tunisia), September 1999, 96 p., 126 refs. *CIESM Workshop Series* n°7 http://www.ciesm.org/online/monographs/kerkenna.pdf

* CIESM (2000) Fishing down the Mediterranean food webs? Kerkyra, Greece, 26-30 July 2000, 99 p. (190 ref.), *CIESM Workshop Series* n°12 http://www.ciesm.org/online/monographs/Corfou.pdf

* CIESM (2003). Mare Incognitum? Exploring Mediterranean deep-sea biology- Heraklion, 2-5 July 2003, 126 p. (540 refs.), *CIESM Workshop Monographs* n°23: http://www.ciesm.org/online/monographs/Heraklion03.pdf

* ‡ Ramos-Esplà, A.A., Valle-Pérez, C., Bayle Sempere, J.T. et Sáncez-Lizaso, J.L.- 2005. Zones marines protegés comme outils de géstion de pêche Méditerranée (Zone COPEMED). *Informes y Estudios COPEMED*, No 11 – Version Française. [La versión española puede descargarse de ftp://ftp.fao.org/docrep/fao/007/ae360s/ae360s00.pdf]

* ‡ Tudela, S.(2004) Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 74. Rome, FAO. 2004. 44p. ftp://ftp.fao.org/docrep/fao/007/y5594e/y5594e00.pdf

* WWF/IUCN (2004). *The Mediterranean deep-se ecosystems: an overview of their diversity, structure, functioning and anthropogenic impacts, with a proposal for conservation*. IUCN, Malaga ans WWF Rome. 64 pp http://www.panda.org/downloads/marine/bookmeddeepsea.pdf

APPENDIX F: DOCUMENTS PROVIDED BY IUCN

Integrated marine and coastal area management (IMCAM) approaches for implementing the conservation on biological diversity
http://www.biodiv.org/doc/publications/cbd-ts-14.pdf

The Ecosystem Approach, Five steps to implementation
http://iucn.org/dbtw-wpd/edocs/CEM-003.pdf

The Ecosystem Approach, Coherent actions for marine and coastal environments
http://www.english-nature.org.uk/pubs/publication/PDF/EcosystemApproach.pdf

And this link for the Ecosystem approach programme at CBD
http://www.biodiv.org/programmes/cross-cutting/ecosystem/default.asp