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APPLYING THE ECOSYSTEM APPROACH IN THE MEDITERRANEAN

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EXECUTIVE SUMMARY

The ecosystem approach is a strategy for the comprehensive integrated **management of human activities** affecting the marine ecosystem based on the best available scientific knowledge. In other words, the ecosystem approach strives to ensure that those human activities and demands that have an actual or potential impact on the marine environment are **managed effectively**. Moving to the ecosystem approach is an evolutionary step, not a revolutionary one. The ecosystem approach just highlights the need to approach the goals systematically and in a coordinated manner. The overarching argument in favour of the ecosystem approach is that only by maintaining the functional and structural integrity of the ecosystem can the protection of its individual components be achieved.

A major step towards its implementation is the establishment of a vision for the marine ecosystem and its transformation in a step-wise manner (vision → strategic goals → ecological objectives → operational objectives → indicators → target levels) from a descriptive status to a quantified target. The desired ecological quality status (i.e. the quality of the ecosystem **structure and function**) of the marine ecosystem aimed for is usually defined by ecological quality objectives (target levels).

Once the suite of ecological quality elements and objectives (indicators and target levels) has been adopted, management objectives are set and the management tools are applied to continually move the ecosystem closer to the target levels.

The large amount of work performed and the vast experience gained within MAP will allow it to move to this approach easier and faster. However, MAP proceeded with management actions without setting objectives in relation to the ecosystem structure and function (ecological quality objectives). The information available and the preparatory work done will enable MAP to proceed immediately with the setting of the ecological quality elements and objectives (indicators and target levels) which are now missing. It is, however, probable that in some sub-regions scientific information will not be sufficient and that the capabilities of some laboratories will have to be enhanced to undertake monitoring of indicators.

Integration of policies within MAP is not at the desired level, so it is proposed that once the objectives are set, only one integrated action/management plan is prepared (taking into account the existing ones) having in mind the ecosystem approach principles in order to reduce the impact from human activities affecting the indicators. The action plan should

also contain chapters on supporting activities such as monitoring and research, information and capacity building. No institutional changes are proposed for the time being but the role of the Coordinator should be strengthened so that cooperation between RACs is enhanced and the duplication of work is avoided.

Decision-making on management actions should preferably be supported by scenario studies with quantitative predictions. How well the effects of management actions can be quantified will rely on the availability of proper data and a good understanding of the major processes controlling the ecosystem components. In addition, the socio-economic consequences of each management action should be studied before implementation and proposals put forward for alleviating possible consequences without compromising the ecological objectives.

Monitoring and assessment of the current status of the indicators is important to see the progress achieved in meeting the objectives. Based on the outcome of these assessments, updates of the management measures should be considered and a new set of measures and actions, where and if needed, should be planned for the next cycle.

1. Introduction

The need for integration of sectoral policies affecting the marine environment was recognized in Chapter 17 of Agenda 21 of the United Nations Conference on Environment and Development (Rio de Janeiro, 1992). UNCED also adopted the Convention on Biological Diversity (CBD). The Convention itself refers simply to the "ecosystem approach" and defines it as "Ecosystem and natural habitats management… to meet human requirements to use natural resources, whilst maintaining the biological richness and ecological processes necessary to sustain the composition, structure and function of the habitats or ecosystems concerned. Important within this process is the setting of explicit goals and practices, regularly updated in the light of the results of monitoring and research activities".

The Ecosystem Approach was first "officially" adopted by the 5th Conference of the Parties to the Convention on Biological Diversity held in Nairobi, in May 2000 as the fundamental tool for delivery of the Convention's three primary objectives. It was later endorsed by the World Summit on Sustainable Development (WSSD) in Johannesburg (2002) and features strongly in the subsequent Plan of Implementation which encourages its application in the marine environment by 2010. The Ecosystem Approach has also been recommended as a strategic approach to implementing the requirements of the Ramsar Convention, as well as numerous other international agreements on the marine and coastal environment. The term is usually used in the form of "ecosystem approach to…" as, for instance, ecosystem approach to environmental protection or to fisheries or to management of human activities.

The 5th Conference of the Parties to the Convention on Biological Diversity (Nairobi, 2000) described ecosystem approach as "a **strategy** for the integrated **management** of land, water and living resources that promotes conservation and sustainable use in an equitable way" and expected that its application will help to reach a balance of the Convention's three primary objectives: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of the genetic resources. According to the Convention on Biological Diversity, ecosystem means "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit".

In the HELCOM and OSPAR Commissions, as well as in North Sea conferences of Ministers, the ecosystem approach is defined as "the comprehensive integrated **management** of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity."

The same definition as above was used for the purposes of the European Marine Strategy but specifying the ecosystems as **marine** ecosystems. This description clearly places humans as part of natural ecosystems, and stresses that human activities in these ecosystems must be managed so that they do not compromise ecosystem components that contribute to the structural and functional integrity of the ecosystem.

The concept of ecosystem-based approach is not new and goes back to the beginning of the 90's or even earlier. However, management issues were discussed

and included in the ecosystem approach later. Today, as we can see from the above definitions, it is considered a **management tool**. It is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.

The 5th Conference of the Parties to the Convention on Biological Diversity (Nairobi, 2000), when endorsing the ecosystem approach, adopted, at the same time, twelve complementary and interlinking principles (**Annex I**) which should be considered in a holistic way and appropriate weight given to each according to local circumstances. In addition, it proposed five points as operational guidance in applying the principles (**Annex II**). The 7th Conference of the Parties to the Convention on Biological Diversity (Kuala Lumpur, 2004) provided further guidance on the implementation of the ecosystem approach principles (**Annex III)**.

The ecosystem approach strives to ensure that those human activities and demands that have an actual or potential impact on the marine environment are managed effectively. The ecosystem approach does not require control of the natural processes of ecosystems; only that these must be considered in managing human activities.

The ecosystem approach being a management tool should be applied in the framework of a 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.

2. Relevant activities within the European region

The European Union is promoting the use of the ecosystem approach as a management tool to be applied in the framework of a marine strategy. During the process for the development of a European Marine Strategy (EMS), a document on ecosystem approach was prepared by a core group established jointly by ICES and the European Commission. The report entitled “Guidance on the application of the ecosystem approach to management of human activities in the European Marine Environment” was published in 2005 as ICES Cooperative Research Report no. 273.

The European Commission recently adopted a Green paper on a Future Maritime Policy for the European Union and a Thematic Strategy for the Protection and the Conservation of the Marine Environment. The latter includes a proposal for a marine strategy directive to be adopted by the States. The Thematic Strategy will deliver the environmental pillar of the future EU Maritime Policy. Both initiatives open up the way to new approaches as regards oceans policy and constitute a firm engagement in new ways of decision making, concretely implementing the ecosystem approach.

The idea of a system of Ecological Quality Objectives (EcoQOs) as a means of applying the ecosystem approach to the management of human activities has a long pedigree within the North Sea process. In the North European Regional Seas Conventions (HELCOM for the Baltic Sea and OSPAR for the North East Atlantic) discussions on the ecosystem approach have started long before 2000. However, the first workshop specifically on Ecological Quality Objectives was organised in 1999 in Scheveningen, the Netherlands. This workshop concluded that EcoQOs should be developed for ten ecological issues ranging from oxygen consumption to commercial

fish species and covering objectives needed at the species, community and ecosystem level.

Work for the development of EcoQOs for all the issues continued within the Oslo and Paris Commission (OSPAR) and the International Council for the Exploration of the Sea (ICES) and the results were presented at the Fifth North Sea Conference (Bergen, 2002). It's at this Conference that the North Sea States and the European Community committed themselves to implementing an ecosystem approach and to developing a coherent and integrated set of EcoQOs. The results of the North Sea Pilot project on Ecological Quality Objectives are found in a report published by the OSPAR Commission in March 2006 (publication number 239/2006).

For the Baltic Sea, the development of objectives is going on within the Helsinki Commission (HELCOM). A decisive step towards the implementation of a regional Baltic Sea specific ecosystem approach to the management of human activities was made at the First Joint OSPAR and HELCOM Ministerial Meeting (Bremen, June 2003) where it was agreed that the ecosystem approach and the setting of ecological quality objectives are key to improving the protection of the North-East Atlantic and the Baltic Sea.

A pilot project was established on developing the objectives necessary for the implementation of the ecosystem approach, immediately after the Bremen meeting in 2003. The pilot project adopted a step-wise approach in developing quantitative definitions of good ecological state and presented drafts for comments at various HELCOM meetings during 2003-2005 as well as for the general public during a workshop event within the 2005 Baltic Sea Science Symposium in Sopot, Poland. The HELCOM ecosystem approach document was also open through an internet consultation after the Sopot symposium.

The pilot project produced a draft Vision (adopted by the Helsinki Commission in 2004), and during 2004-2005 drafted the four strategic goals and 18 objectives (HELCOM 27/2006 document 2/6) which were adopted by the Helsinki Commission in 2006 (HELCOM 27/2006 Minutes of the Meeting). Thus, HELCOM is presently past the descriptive phase and is in the process of defining quantitatively the good ecological status of the Baltic Sea ecosystem. In addition to this normative work, HELCOM has also launched the next step in implementing ecosystem approach: an ad-hoc task force within HELCOM is presently drafting action plan based on the adopted objectives. The Baltic Sea Action Plan, to be agreed by the Baltic Sea Ministers of Environment in autumn 2007, will consist of targeted management actions for reaching good ecological status of the Baltic Sea. The Baltic Sea Action Plan is a proactive regional implementation of the proposed EU Marine Strategy.

As far as MAP is concerned, ecosystem approach appeared for the first time in the Catania Declaration of the Contracting Parties (13th Ordinary Meeting, Catania, November 2003). In the declaration, the Contracting Parties agree that the initiative of the European Community to develop a European Marine Strategy should be encouraged, that cooperation with the European Community in its efforts to develop and implement the European Marine Strategy should be strengthened and that joint answers should be fully explored, such as, *inter alia*, the application of the ecosystem approach, taking into consideration the legislation and capabilities of concerned countries.

Consequently, MED POL staff participated in the EC meetings for the development of the European Marine Strategy. MED POL Phase IV envisages the

application of the ecosystem approach to the management of human activities in the marine environment and a relevant document was prepared and presented to the Meeting of MED POL Coordinators (Barcelona, May 2005) as document UNEP(DEC)/MED/WG.264/Inf.3.

At their 14th Ordinary Meeting (Portoroz, Slovenia, November 2005) the Contracting Parties endorsed the cooperation with the EC in a project to be implemented by MED POL to review the implications of applying the ecosystem approach to the management of human activities in the Mediterranean region. The project should be implemented in cooperation with all Regional Activity Centres, with a view to the possible application of the ecosystem approach by the whole MAP system. Soon after, the European Community signed an agreement with the Mediterranean Action Plan to contribute towards the implementation of an action entitled: "Implementation of the ecosystem approach in the Mediterranean sea. Development of Environmental Quality Objectives."

According to the project document, the aim of the EC/MAP project is to facilitate the implementation of the ecosystem approach by MAP and specifically to identify the implications of the implementation of the ecosystem approach upon the formulation and implementation of MAP policies, strategies and activities and on its working system and structure. The results of the project are expected to facilitate the implementation of the ecosystem approach by MAP and its components. The main product of the project is the present document which includes a road map for the implementation of the ecosystem approach by MAP and a proposal for the development of Mediterranean EcoQOs.

3. A roadmap for the implementation of the ecosystem approach in the Mediterranean

Decision VII/11 of the Seventh Meeting of the Conference of the Parties to the Convention on Biological Diversity states that: "When initiating the ecosystem approach, the first task is to define the problem that is being addressed. In doing so, the scope of the problem and the task to be undertaken has to be well specified. The strategy to be followed to promote the ecosystem approach has to be clearly defined with contingencies for unforeseen situations incorporated into the strategy. The approach should consider all principles as a package but depending upon the task at hand emphasis on particular principles may be warranted. A collective ownership for **the vision, strategy and parameters** for the ecosystem approach relevant to the task has to be developed, communicated, and facilitated among partners and sponsors. Collectively, developing the overarching **goals, objectives, targets** for the exercise is important before applying the ecosystem approach."

ICES (2005) recommend that in applying the ecosystem approach at a regional scale, the following steps should be followed:

Step 1: Scoping the current situation
Step 2: Contrasting with the Vision
Step 3: Identifying important ecosystem properties and threats
Step 4: Setting ecological objectives
Step 5: Deriving operational objectives with indicators and reference points
Step 6: Ongoing management
Step 7: Periodic updates

In the framework of the European Marine Strategy, work undertaken by the European Commission and Member States has concluded that the "**roadmap**" for implementing the Ecosystem Approach should have the following characteristics. It should:

- Have a vision, high level principles and strategic goals.
- Have regionally-based operational objectives.
- Set out clear limits, targets and indicators.
- Be common across all areas, all users and all sectors, and acknowledge that people are intrinsic components of ecosystems.
- Be characterized by simplicity.
- Set out landmarks and principal routes, with a strategy to deliver them.
- Have actions with associated delivery tools.
- Undertake assessment, monitoring and scientific research.
- Embrace regional diversity through a regional approach.
- Embrace the principles of adaptive management as a progressive approach.
- Have pre-agreed risk management actions.

As an example of a regional implementation of this approach, HELCOM roadmap for the Baltic Sea Action Plan includes the following steps to fulfill the characteristics above:

- A vision
- Strategic goals
- Ecological objectives
- Indicators
- Target levels
- Actions

The Mediterranean Action Plan has a long history in generating environmental information regarding the Mediterranean and in promoting action plans for its protection. So the issue here is not to start something from zero but basically to redirect some policy practices and approaches in dealing with the issues and redraft the existing action plans. However, an attempt to actually modify the existing action plans could create confusion and therefore it is proposed that a new integrated action plan is drafted on the basis of the ecological quality objectives to be developed but taking also into consideration the existing ones. Important ecosystem properties and threats have already been defined and a lot of work has taken place on indicators; however, there are no decisions by the Parties on specific indicators and target levels (ecological quality objectives). In this context, it is proposed that the roadmap includes the following broad lines:

- **Definition of a vision**
- **Setting strategic goals**
- **Development of ecological quality objectives**
- **Redrafting of an integrated action plan**
- **Promotion of management plans**

On the basis of the work already carried out, the first two steps could be completed very quickly. Work should be initiated as soon as possible for specific ecological **quality** objectives to be proposed to the Parties on the basis of which a new action plan should be prepared. While undertaking the steps above, the

ecosystem approach principles should be kept in mind and the relevant management practices should be employed. Implementing the ecosystem approach means inter alia: involvement of all stakeholders at all levels and stages, decentralization of management to the lowest appropriate level, management of the ecosystem in an economic context, implementation of an adaptive management approach, setting long term objectives for ecosystem management on temporal and spatial scales, good governance, monitoring the degree of achievement of objectives and if necessary review measures, dissemination of information, research and development and capacity building.

3.1. A vision for the Mediterranean

As one can see from the objectives of MAP Phase II, the Mediterranean countries are cooperating for the protection of their common sea but also have wider aspirations of strengthening solidarity to protect their common heritage and to generally improve the quality of life of their people.

In a document entitled “Mediterranean vision for sustainable development” which has been adopted by the Parties in 2005 it is clear that there is a great ambition for social issues such as removing inequality and poverty and political issues such as peace and security. In fact, the document deals with a common environmental vision for development and environment protection, a common social vision for alleviating poverty and inequality, a vision for innovation and more dynamic economic entrepreneurship**,** a common cultural vision for cultural diversity and a common ethical vision for governance.

Sustainable development requires that the needs of future generations are not compromised by the actions of people today. The ecosystem approach is embedded in the concept of sustainable development. It puts emphasis on a management regime that maintains the health of the ecosystem alongside appropriate human use of the marine environment, for the benefit of current and future generations. It also implies a series of reforms requiring the active participation of all stakeholders and actors.

Regional Seas Conventions have set their vision for the sea they are responsible, and as one could expect they are all similar as all people share basically the same dream for healthy and productive seas. For the Baltic Sea, article 3 of the 1992 Helsinki Commission refers to the restoration and preservation of the ecological balance of the Baltic Sea. In 2004, the Meeting of the Helsinki Commission adopted the following overall vision: “Healthy Baltic Sea environment, with diverse biological components functioning in balance, resulting in a good ecological status and supporting a wide range of sustainable human economic and social activities”.

For the North-East Atlantic, the third recital to the OSPAR Convention says, the aim is to manage “human activities in such a way that the marine ecosystem will continue to sustain the legitimate uses of the sea and will continue to meet the needs of present and future generations”. The underlying concept is that of a “healthy and sustainable marine ecosystem”.

The Vision of the European Marine Strategy is “to protect and restore Europe’s oceans and seas and ensure that human activities are carried out in a sustainable manner so that current and future generations enjoy and benefit from biologically diverse and dynamic oceans and seas that are safe, clean, healthy and productive.”

In addition to what has already been adopted by the Contracting Parties to the Barcelona Convention, it is considered pertinent that a specific ecological vision should be adopted on the basis of which strategic goals could be set.

For the Mediterranean States, the ecological vision could be to protect the Mediterranean Sea and its coasts so that present and future generations can enjoy and benefit from a clean, safe, healthy, productive and biologically diverse sea.

3.2. Setting strategic goals

When adopting the second phase of the Mediterranean Action Plan, the Contracting Parties adopted at the same time the following as its main objectives:

- To ensure sustainable management of natural marine and land resources and to integrate the environment in social and economic development, and land-use policies;

- To protect the marine environment and coastal zones through prevention of pollution, and by reduction and, as far as possible, elimination of pollutant inputs, whether chronic or accidental;

- To protect nature, and to protect and enhance sites and landscapes of ecological or cultural value;

- To strengthen solidarity among Mediterranean coastal States in managing their common heritage and resources for the benefit of present and future generations; and

- To contribute to the improvement of the quality of life.

Further, at their 14th Ordinary meeting (Portoroz, November 2005) they decided "to adopt a Mediterranean Strategy for Sustainable Development and make the commitment to do their utmost to implement its objectives, orientations and proposed actions as appropriate." The Mediterranean Strategy for Sustainable Development (MSSD) proposes four major objectives and seven priority fields of action. Only one of the priority fields of action refers to marine and coastal ecological issues. This is "to promote sustainable management of the sea and coastal zones and take urgent action to put an end to the degradation of coastal zones." The objectives, orientations and actions adopted for this field of action appear in **Annex IV**. Ecological strategic goals for the Mediterranean could be set on the basis of the objectives of this priority field of action, which are:

- To promote integrated management and development of coastal zones;
- To prevent and reduce pollution from ships;
- To prevent and reduce land-based pollution; and
- To protect marine and coastal biodiversity and marine resources

It must also be noted that within the process of developing a Thematic Strategy for the Protection and Conservation of the European Marine Environment (Marine Strategy), the following four Strategic Goals were proposed which should be common across all areas, all uses and all sectors:

- To protect, allow recovery and, where practicable, restore the function and structure of marine biodiversity and ecosystems in order to achieve and maintain good ecological status of these ecosystems.
- To phase out pollution in the marine environment so as to ensure that there are no significant impacts or risk to human and/or on ecosystem health and/or on uses of the sea.
- To contain the use of marine services and goods and other activities in marine areas to levels that are sustainable and that do not compromise uses and activities of future generations nor the capacity of marine ecosystem to respond to changes.
- To apply the principles of good governance, both within Europe and globally.

The first two goals above (the one on biodiversity and the other one on pollution) could also be strategic goals for the Mediterranean Sea for which the ecosystem approach could be applied. For the Mediterranean a third one on coastal zones is also proposed even though is not strictly an ecological state. These are:

a) **To protect, allow recovery and, where practicable, restore the function and structure of marine and coastal biodiversity and ecosystems in order to achieve and maintain good ecological status of these ecosystems.**
b) **To phase out pollution in the marine environment so as to ensure that there are no significant impacts or risk to human and/or on ecosystem health and/or on uses of the sea.**
c) **To promote the balanced and integrated management and development of coastal zones in order to preserve, enhance or restore the coastal heritage and reduce the vulnerability of sensitive areas to natural risks.**

3.3. Ecological objectives or ecological quality objectives

Once the vision has been decided and the goals have been set, the next step is the setting of ecological objectives that are consistent with the Vision and strategic goals. The management measures needed to meet ecological objectives will be determined by operational objectives. **Ecological objectives relate to ecosystem health, structure and/or function.** Operational objectives are SMART objectives (see below) that can be achieved through the application of management measures. For each operational objective, there will be associated indicators and reference points. This is the approach described by ICES (2005).

OSPAR uses presently slightly different terminology in defining the elements necessary to implement ecosystem approach.

OSPAR introduced earlier, in the 1990s, the terms ecological quality and ecological quality element. **Ecological quality** (EcoQ) was defined by the Ministerial Declaration of the Fifth International Conference for the Protection of the North Sea ("the Fifth North Sea Conference" – Bergen, Norway, March 2002) as *"an overall expression of the structure and function of the marine ecosystem taking into account the biological community and natural physiographic, geographic and climatic factors as well as physical and chemical conditions including those resulting from human activities."*

An **ecological quality element** was likewise defined as *"an individual aspect of overall ecological quality"*.

An **ecological quality objective** (EcoQO) was consequently defined as *"the desired level of an ecological quality (EcoQ)"*. The definition added that "*Such a level may be set in relation to a reference level*".

The first step is to select the quality issues, e.g. eutrophication. The next step is to decide for each of these issues the ecological quality elements, i.e. the individual aspects of ecological quality on which it is appropriate to focus, e.g. dissolved oxygen, dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP)), chlorophyll **a** and phytoplankton indicator species. The number of elements selected under each of the issues will vary.

For each quality element an ecological quality objective is set. EcoQOs can take the form of targets (values where there is a commitment to attain them) or indicators (values which simply show what is happening). For example, the objective for chlorophyll **a** could be a target to keep its concentration below a percentage deviation from background levels not exceeding 50%.

HELCOM basically followed the concepts outlined in ICES (2005). However, the strategic goals in fact define the major areas of concern (e.g. eutrophication), and the ecological **o**bjectives describe the topics perceived as central in a healthy sea (e.g. clear water). The final normative step is the definition of the indicators with target levels i.e. quality elements and EcoQOs in the OSPAR terminology and thus the final products will be similar.

It must be noted that OSPAR has agreed to undertake further work on how to develop a full suite of EcoQOs covering all the aspects of the marine environment and on how to harmonize the terminology with that which will be developed for the European Marine Strategy.

Within MAP, the terms "objective", "overall objective", "goal" "target" and even "action' and "activity" are used with no real distinction between them. On the same list it is possible to see goals, ecological objectives, operational objectives and actions. For example, the MSSD proposes four so-called major objectives but also priority fields of action and under each one of them a list of "objectives, orientations and actions". Most objectives (MED POL, SAP MED, SAP BIO) are activity-oriented and in many cases no distinction is made between those actions which contribute directly to the improvement of the marine environment, those which belong to the assistance component and those which relate to monitoring and research.

For example, the objectives of SAP MED and BIO either aim at generating information (mapping, NDA, BB), concern activities that countries should undertake or relate to management. Basically, the overall objectives of MED POL IV aim at generating information (monitoring and research) and at assisting the countries. However, the objective "assessment of the effectiveness of measures taken" is an important component in the application of the ecosystem approach provided ecological indicators are used. In the case of SAP MED, the overall objective is to reduce pollution from land-based activities, which is a management strategic goal. Almost no objective relates to ecosystem health, structure and/or function i.e. ecological objective. The strategy is to reduce inputs and thus improve the status of the marine environment. In this case, monitoring the objectives means to assess by how much inputs were reduced**. Ecosystem approach sets ecological quality**

objectives and monitors ecological indicators to see the improvement in the ecological status of the ecosystem.

The same applies for SAP BIO which aims at generating missing information, provides capacity building and promotes management actions.

Moreover, it appears that not enough attention was paid in the setting of SMART objectives. According to ICES (2005) SMART means:

Specific. Objectives should clearly specify the state to be achieved and be interpreted unambiguously by all stakeholders.

Measurable. Good objectives should relate to measurable properties of ecosystems and human societies, so that indicators and reference points can be developed to measure progress towards the objective.

Achievable. Good objectives should not conflict. Within an effective management framework, it should be possible to achieve all objectives. Good objectives should describe a state of the ecosystem, including the position and activities of humans within it, which accurately reflects the values and desires of a majority of stakeholders.

Realistic. Good objectives will be implementable using the resources (research, monitoring, and assessment and enforcement tools) available to managers and stakeholders. Good objectives should reflect the aspirations of stakeholders, such that the majority of stakeholders will strive to achieve them and ensure sustainable development.

Time bound. There should be a clearly defined time scale for meeting objectives.

3.3.1 Selection of priority ecological quality issues

For the North Sea pilot project ten ecological quality issues were selected. After evaluation of the North Sea Pilot project by OSPAR in 2005, the list was slightly re-organized and covers the following issues:

a) Commercial fish species
b) Marine mammals
c) Seabirds
d) Fish communities
e) Benthic communities
f) Plankton communities
g) Threatened and/or declining species
h) Threatened and/or declining habitats
i) Eutrophication

The issues adopted by HELCOM are:

a) Eutrophication
b) Hazardous substances
c) Biodiversity
d) Maritime activities

It must be noted that the issue of maritime activities, has been added even though is a pressure acting on the marine environment and not an ecological state, because it is a core area of HELCOM work.

It wouldn't be difficult to select the priority issues for the Mediterranean as a number of UNEP/MAP publications deal with the state of the Mediterranean marine environment and the main concerns. One of them, namely, the Transboundary Diagnostic Analysis for the Mediterranean Sea (UNEP/MAP/MEDPOL, 2005), identified the following major environmental concerns (for details see **Annex V**):

a) Decline in biodiversity
b) Decline of seawater quality
c) Decline in fisheries
d) Human health risks

The main environmental Mediterranean issues of concern according to EEA (2006) are (for details see **Annex VI**):

a) Sewage and urban run-off
b) Solid waste
c) Industrial effluents including oil processing
d) Urbanisation
e) Eutrophication
f) Sand erosion
g) Marine transport
h) Biological invasions
i) Harmful Algal Blooms (HABs).
j) Exploitation of marine resources
k) Expansion of aquaculture
l) Natural hazards

However, using OSPAR terminology, not all of the above could be considered ecological quality issues. Most of them are either activities or pollutant sources and therefore they should be modified.

An issue which should be touched upon here is whether the ecosystem approach will be applied considering the entire Mediterranean as one region or whether it will be applied on a sub-regional basis. If it is decided that the ecosystem approach will be applied sub-regionally in the Mediterranean Sea, it is anticipated that priority issues will vary from area to area. For example, almost certainly, eutrophication will top the priorities for the Adriatic Sea. **Issues such as eutrophication, marine mammals and benthic communities could be of interest to the entire region.**

3.3.2 Ecological quality elements and EcoQOs (indicators and target levels)

Once the quality issues have been selected (or ecological and operational objectives set) a number of quality elements (indicators) should be decided for each one. This number will vary. Indicators are needed to monitor the progress being made towards meeting operational objectives and to guide management decision-making. Indicators may describe ecosystem state, activity-specific ecosystem properties, or impacts. According to ICES (2005) effective indicators should have the following properties:

(a) **Measurable**. Indicators should be measurable in practice and in theory. They should be measurable using existing instruments, monitoring programmes, and analytical tools available in the regions and on the time-scales needed to support management. They should have minimum or known bias, and the signal should be distinguishable from noise.
(b) **Cost-effective**. Indicators should be cost-effective because monitoring resources are limited. Monitoring should be allocated in ways that provide the greatest benefits to society and the fastest progress towards sustainable development.
(c) **Concrete**. Indicators which are directly observable and measurable rather than reflecting abstract properties which can only be estimated indirectly are desirable. This is because concrete indicators are more readily interpretable by the diverse stakeholder groups that contribute to management decision-making.
(d) **Interpretable**. Indicators should reflect properties of concern to stakeholders, and their meaning should be understood by as wide a range of stakeholders as possible. Public understanding of the indicator should be consistent with its technical meaning.
(e) **Grounded in theory**. Indicators should reflect features of ecosystems and human impacts that (according to well-accepted peer-reviewed scientific theory) are relevant to the achievement of operational objectives. They should not be based on theoretical links that are poorly defined or validated.
(f) **Sensitive**. Trends in the indicator should be sensitive to changes in the ecosystem properties or impacts, which the indicator is intended to measure.
(g) **Responsive**. Indicators should be responsive to effective management action and provide rapid and reliable feedback on the consequences of management actions.
(h) **Specific**. Indicators should respond to the properties they are intended to measure rather than to other factors, and/ or it should be possible to disentangle the effects of other factors from the observed response.

Few indicators will have all the properties listed above, and thus several indicators with complementary properties may be needed to provide strong and effective support for management decision-making.

For the Baltic Sea, indicators will be selected for the following ecological objectives:

<u>Eutrophication</u>
a) Concentration of nutrients close to natural levels.
b) Clear water
c) Natural level of algal blooms
d) Natural distribution and occurrence of plants and animals.
e) Natural oxygen levels

<u>Hazardous substances</u>
a) Concentrations of hazardous substances close to natural levels
b) All fish safe to eat
c) Healthy wildlife
d) Radioactivity at pre-Chernobyl levels

<u>Biodiversity</u>
a) Natural landscapes and seascapes
b) Thriving and balanced communities of plants and animals
c) Viable populations of species

Some objectives, such as “clear water” and “nutrient concentrations close to natural levels” can be assessed with one or few indicators while some objectives may need several indicators, especially such as healthy wildlife and the objectives under biodiversity.

Examples of quality elements (indicators) proposed for the North Sea are:

For eutrophication: dissolved oxygen concentration, winter nutrient (DIN and DIP) concentrations, phytoplankton indicator species and chlorophyll **a**.
For marine mammals: seal population trends, by-catch harbour porpoises.
For commercial fish species: spawning stock biomass.

The selection of indicators is very important as these indicators will be used to decide on the progress made in meeting the objectives and will affect management action. During the last few years discussions have been going within MED POL and the relevant RACs but no decisions have been taken on ecological indicators to be used. During this process, excellent documents have been produced (e.g. MTS 154 and the fact sheets on pollution indicators) which could form the background for the decision making. Each ecological indicator proposed must have a scaling system which should be tested by all laboratories involved before put in actual use. Discussion on their selection for the Mediterranean Sea will certainly take into consideration the existing monitoring programmes, data validation and data interpretation. It is possible that new monitoring or research activities will be initiated. Usually the scientific view is that “more work is needed” but a decision on their selection should not be delayed. They can be improved on the way by “learning by doing”. Selecting them as soon as possible will enable an early preparation of the necessary capacity building in certain countries and possible modifications to the monitoring programmes accordingly.

Once the quality elements (indicators) have been decided, an EcoQO (target level) should be set for each one.

A good EcoQO will unite the following qualities:

a) the EcoQO will have a clear scientific basis, linking it to significant aspects of the quality of a marine ecosystem;
b) data on the EcoQO can be collected effectively and economically across the whole range to which it applies;
c) there is a clear reference level or target against which the data on the EcoQO can be evaluated;
d) there is general acceptance of the validity of the EcoQO by all relevant stakeholders.

To achieve these qualities, EcoQOs will be better the more that they are:

a) relatively easy to understand by non-scientists and those who will decide on their use;
b) sensitive to manageable human activity;
c) relatively tightly linked in time to that activity;
d) easily and accurately measured, with a low error rate;
e) responsive primarily to a human activity, with low responsiveness to other causes of change;
f) measurable over a large proportion of the area to which the EcoQ metric is to apply;

g) based on an existing body or time-series of data to allow a realistic setting of objectives.

HELCOM is in the process of setting quantitative targets i.e. for each objective a number of indicators with target levels will be agreed upon. Target levels specify good status for a given indicator. For eutrophication parameters a draft set of target levels have already been produced; e.g. for the objective “clear water” long-term averages of open sea summertime Secchi depth has been proposed. The target (how many meters?) to define the indicator value will represent an acceptable deviation from historical background levels (reference levels) for a given geographical area (sub-region within the Baltic Sea).

Within MAP, the TDA identified the following three “overarching Environmental Quality Objectives” but based on the terminology described are not really “quality” objectives:

- Reduce the impacts of LBS on Mediterranean marine environment and human health;
- Sustainable productivity from fisheries;
- Conserve the marine biodiversity and ecosystem.

However, a lot of work has taken place and a number of recommendations were made to the Contracting Parties to promote legislation on limit discharges and maximum permissible levels of contaminants in seafood. So certain limits and environmental quality standards (management tools) have been proposed. However, little is known about the fate and the results of these proposals.

It is recommended that scientific working groups are set up as soon as possible to decide on ecological quality issues, quality elements and quality objectives which are missing. This is not an easy exercise but it can be done for many regions of the Mediterranean where sufficient scientific information exists. This should be taken into consideration when discussing whether the ecosystem approach should be applied sub-regionally.

3.4 An integrated action plan and management plans

Once the indicators and target levels (ecological quality objectives) have been agreed upon, an action plan with management actions will be prepared aiming at achieving the objectives. Operational objectives should be converted to specific management actions (e.g. the objective of reducing nutrient inputs could be broken down to construction of sewage treatment plants, treatment of industrial effluents, reduction of fertilizer use, etc.) and management tools and instruments should be devised (see **Annex VIII** for details) to manage human activities in a way which is consistent with the operational objectives.

It is not easy to decide what specific management actions should be implemented unless there is a way to predict their effects. Decision-making should preferably be supported by scenario studies with quantitative predictions. This ability of how well one can quantify the effects of management actions relies on the availability of proper data and a good understanding of the major processes controlling the ecosystem components affected by management action. In addition, the socio-economic consequences of each management action should be studied before

implementation, and proposals put forward for alleviating possible consequences without compromising the ecological objectives.

MAP has well studied all human activities impacting on the marine ecosystem and the action plan should manage those which have an effect on the indicators (quality elements of the ecosystem) agreed. This is the field where MAP has a lot of experience. A number of action plans and management tools have been devised; however, in most cases the plans were not drafted on the basis of ecosystem targets but relate solely to the management objective of reducing inputs. This way the degree of achievement was related to a percentage of reduction of inputs rather than to a change in the ecosystem status. Also management actions were proposed without really studying their implications or knowing what the results would be in the ecosystem status.

Another issue is integration. For example, SAP MED and SAP BIO are based on sectoral policies and in certain cases duplication exists as regards management actions. The Secretariat for the Barcelona Convention should prepare only **one** action plan encompassing all actions relevant to the Mediterranean Sea and coasts. The practice of addressing diverse uses and different components of the ecosystem separately should be abandoned. However, within the action plan, a distinction should be made between actions which contribute directly to the achievement of the objectives, and the supporting activities. Supporting activities, which are as essential as direct actions, could be divided into monitoring and research, capacity building, and information. The information component will also be responsible for the involvement of all stakeholders.

Assessment, monitoring, and scientific research will continue to provide a sound scientific basis for identifying ecological objectives, selecting indicators, and assessing the effectiveness of measures taken by providing regular evaluations of the ecosystem status.

When preparing the action plan, one must have in mind that MAP does not have the power to implement management measures which will actually bring the desired results. MAP, acting as the secretariat, uses its coordination role to help the countries to agree on a number of actions and then assists certain countries to fulfill their obligations. It must be pointed out that existing action plans also include MAP activities and many objectives relate to the tasks of the secretariat e.g. MED POL. However, the ecosystem approach being a management tool will mostly be applied by governmental authorities on the ground and this is where MAP could assist.

4. Implications on MAP and adaptation strategies

All throughout the document one can find comments relating to the capacity of MAP to implement the approach and on how it should proceed. This section will try to summarize the points risking their repetition.

4.1 Capacity, institutional framework and governance

In general, MAP has the capacity to implement the ecosystem approach but a special effort will be required as its application is **very demanding**. A new roadmap has to be followed and some of the work will have to be repeated more systematically, coherently and in a coordinated manner. Possible weaknesses in less developed countries are the capacity to monitor the ecological indicators, the lack of

sufficient reliable scientific information and the administrative structures and financial capabilities to implement management actions.

One of the questions which arise is whether the existing institutional framework will deliver the integration and coherence required to achieve the goals and objectives. At this stage no modifications to the legal texts or the MAP structure are proposed but they may be necessary in the future. However, the tendency of some of the RACs handling various policy issues, to operate largely independently has to be reversed. Sectoral approaches focusing on the protection of species, habitats, biodiversity, or elimination of specific pollutants should be abandoned. All new work should be decided at the Coordinator's level and the Coordinator's role should be strengthened so that cooperation between RACs is enhanced and the duplication of work is avoided. Interactions and cumulative effects among multiple policy instruments (e.g. protocols) responsible for the management of the uses of the marine ecosystem should be addressed in a coordinated manner.

MED POL and SPA/RAC will have the main responsibility of promoting the development of ecological quality elements and objectives (indicators and target levels). PAP/RAC will lead the way for the achievement of the third strategic goal on coastal zones, but all RACs will be involved in the development of the action plan. It is understood that after everything has been prepared on paper, work will be shared between RACs. REMPEC, CP/RAC and INFO/RAC have specific roles to play. However, BP/RAC could undertake cost-benefit studies to convince the countries to invest the necessary funds and devise economic incentives to promote management actions. They could also assist countries in promoting measures to alleviate possible socio-economic consequences resulting from management actions. It must, however, be stressed that the socio-economic objectives should be met without compromising ecological objectives.

Also, the concept of a 'healthy' ecosystem needs to be reconciled across sectors and policy instruments. For most users, a "healthy" ecosystem is an un-impacted one but from the fisheries point of view a "healthy" ecosystem is one that is impacted until the fishery provides the maximum sustainable economic and social benefits to society.

Good governance is essential for the successful application of the ecosystem approach. Good governance includes sound environmental, resource and economic policies and administrative institutions that are responsive to the needs of the people. Robust and sound resource management systems and practices are required to support these policies and institutions. Decision-making should account for societal choices, be transparent and accountable and involve society. Accountability for making decisions has to be placed at the appropriate level that reflects that community of interest.

4.2 Application of the approach at the sub-regional level and pilot projects

Another important question is whether the approach should be applied on a Mediterranean wide scale. This will probably be a very hard job to do, if not impossible, both scientifically and management wise. The entire basin is a large area to be managed efficiently at the level demanded by the ecosystem approach. The differences between the regions are not only ecological but could also relate to priorities and technical capabilities. Working on a sub-regional level, not only efficiency will be enhanced in a smaller manageable area but local societies will have

the freedom to make their own choices. The Mediterranean could be divided into four or even six regions with distinct boundaries.

It is also pertinent to mention here that Malawi principle no. 2 states that "management should be decentralized to the lowest appropriate level". Principle no. 7 states that "the ecosystem approach should be undertaken at the appropriate spatial and temporal scales". In addition, the fourth point of operational guidance proposes management actions at the scale appropriate for the issue being addressed, with decentralization to the lowest level, as appropriate.

What about initiating first a pilot project? The pilot project can either be

a) restricted to one or two sub-regions of the Mediterranean basin covering a wide range of issues, or

b) restricted to a small number of issues common to the entire Mediterranean basin.

If (a) is selected, the idea is that the experience gained will be extended to all the Mediterranean. However, if (a) is selected it might be a challenge to apply the findings or the experience to the rest of the Mediterranean as most of these may be specific to the region. The most important drawback is the imminent danger that the sub-regions not participating will fall out of the process, especially if these are the less developed regions.

However, if the Contracting Parties insist to select version (a), the sub-regions should be well studied areas. There must be ample information regarding the ecological status and the impacts and threats as well as sources. One other advantage would be that countries in the sub-region should have previous experience in regional common projects and good cooperation.

Probably the best approach is (b) i.e. to divide the Mediterranean into four or even more manageable areas with distinct boundaries and initiate the application of the approach simultaneously in all areas but covering only a small number (three?) of issues of common interest to the entire basin. Sub-regions will be free to choose their own ecological quality objectives and the pace of work according to their own capabilities.

This approach will also enable the necessary capacity building to be initiated as soon as possible.

4.3 On-going programmes

The monitoring, assessment and research components of MAP (basically MED POL and SPA/RAC) will have to focus on the definition and determination of the indicators agreed not neglecting quality control and auditing, so that they are of sufficient accuracy and precision to enable detection of trends. In addition, methods should be devised (e.g. modeling) to enable prediction of effects on the marine ecosystem resulting from the application of management measures. However, scientific knowledge may not always be complete, and the extent to which it is incomplete will vary among regions and for different ecosystem components. Therefore, managers will have to base their decisions on the best available scientific information.

CP/RAC will focus on best available technology to help managers to decide on the best management actions.

BP/RAC, as already pointed out, could assist in studying the socio-economic consequences of all actions.

INFO/RAC should not only deal with dissemination of information but should devise methods of receiving input from the society, e.g. through internet or public meetings.

4.4 Ecosystem approach principles

In implementing the ecosystem approach the following should be followed: All stakeholders should be involved at all levels and stages, management should be decentralized to the lowest appropriate level, the ecosystem should be managed in an economic context, the adaptive management approach should be followed, and objectives for ecosystem management should be set for the long term, temporal and spatial scales. Also apply good governance and, monitoring and review. Components should also include information, research and development and capacity building.

MAP should study and apply the ecosystem approach principles to a higher extent. Emphasis should be given to integration which is in fact the heart of the approach but also to the following three for which not much has been said so far throughout the document.

Adaptive management

One of the prerequisites in the application of the approach is the use of adaptive management which is the alternative to rigid and inflexible management frameworks. Adaptive management is probably not something new but in most cases it was applied only when it became necessary to shift deadlines for completing actions.

Adaptive management is a form of learning by doing, with structured feedback and decision-making. The adaptive approach requires that monitoring and assessment are of sufficient accuracy, precision, and frequency to ensure that the effects of management measures can be evaluated in a timely manner, and adjusted as necessary. In order to make adaptive management efficient, the indicators should provide rapid and reliable feedback on activities and management measures.

Adaptive management requires less stringent assumptions about scientific understanding of ecosystem processes but requires an ability to predict the trend and general magnitude of the effects of management actions.

The ecosystem approach should also take account of the natural variability in marine ecosystems and management should recognize that ecosystems are dynamic. This implies that management frameworks will not be static, but continually reassessed and updated as circumstances change.

Monitoring and review

Monitoring and review are crucial components in implementing the ecosystem approach. They allow a responsive and adaptive management capability to be developed. Monitoring and assessment of the current status of the indicators is important to see the progress achieved in meeting the objectives. Based on the outcome of these assessments, updates of the management measures should be

considered and a new set of measures and actions, where and if needed, should be planned for the next cycle.

Scoping of the current situation needs to be repeated at intervals, to review ongoing changes in ecosystem status that may be influenced substantially by processes such as climate change. Only by comparing the changes in ecosystem status and human activities, over time and in relation to the Vision, strategic goals, and ecological objectives, is it possible to determine whether the ecosystem approach to management has been implemented successfully.

Such periodic re-evaluations also allow the effects of inevitable and often unforeseeable natural variability in ecosystems to be considered in management. Environmental changes may even require adjustments to the ecological objectives. Similarly, changes in social and economic conditions may result in changes to human activities affecting the marine ecosystem, whether the social and economic objectives have been changed explicitly or not. Periodic updates allow changing societal needs to be reconciled with changing ecological conditions.

Finally, each periodic update provides an opportunity for new scientific knowledge to be incorporated into the ecosystem approach. Where possible, of course, new knowledge is applied as quickly as it becomes available. Periodic revisions allow for the updating of the entire system, keeping practice as close to the state of knowledge as possible.

Decentralization

Malawi principle no. 2 states that “management should be decentralized to the lowest appropriate level”. Principle no. 7 states that “the ecosystem approach should be undertaken at the appropriate spatial and temporal scales”. In addition, the fourth point of operational guidance proposes management actions at the scale appropriate for the issue being addressed, with decentralization to the lowest level, as appropriate.

Considering that an ecosystem is a functioning unit that can operate at any scale, depending upon the problem or issue being addressed, this can be used to define the appropriate level for management decisions and actions. This approach implies decentralization at a very low level e.g. local community.

5. Recommended actions in chronological order

5.1 Endorse the ecosystem approach and decide to implement it at the sub-regional level dividing the Mediterranean basin into four or six manageable areas with distinct boundaries. The proposal for the division of the Mediterranean Sea could come from a scientific workshop.

5.2 Decide to initiate simultaneously a pilot study in all sub-regions covering only three quality issues (eutrophication, benthic communities and marine mammals). The proposal for the issues could come from a scientific workshop.

5.3 Despite the fact that a lot of work has been done within MAP, decide to follow the recommended road map from the start by defining an ecological vision and setting strategic goals common to all the Mediterranean.

5.4 As MAP has proceeded with management actions without setting objectives in relation to the ecosystem structure and function (ecological quality objectives), decide, as a first step, on the ecological indicators to be used for each issue selected.

5.5 Ensure that each participating laboratory will be capable to determine the indicators at the required accuracy, precision and frequency, providing, if necessary, capacity building.

5.6 Ensure that the available scientific reliable information in every region is sufficient to enable setting of the target levels with prediction capabilities for various management actions, initiating, if necessary, relevant research or capacity building activities.

5.7 Decide on the associate target levels (ecological quality objectives) for each indicator in each region.

5.8 Develop operational and management objectives on the basis of the ecological quality objectives and decide on the management tools.

5.9 Prepare an information package on the objectives for the benefit of the stakeholders.

5.10 Ensure the integration of sectoral policies through the preparation of a common action plan for achieving the objectives and include in the plan, chapters on capacity building, monitoring and research, and information.

5.11 Obtain feedback from all stakeholders on the management actions and tools proposed.

5.12 Study the socio-economic consequences of the proposed management actions and put forward ideas for alleviating them.

5.13 Assist countries, where necessary, in the implementation of the management actions.

5.14 In implementing the management programme, apply the ecosystem approach principles especially adaptive management and periodic reviews and updates.

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When the step-wise approach has been followed, the extent of progress towards the implementation of the ecosystem approach can be measured using the check list in **Annex VIII** proposed by ICES (2005).

ANNEX I

The twelve principles/characteristics of the ecosystem approach adopted by the Fifth Meeting of the Conference of the Parties to the Convention on Biological Diversity (Nairobi, 2000)

Principle 1: The objectives of management of land, water and living resources are a matter of societal choice.

Rationale: Different sectors of society view ecosystems in terms of their own economic, cultural and societal needs. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognised. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.

Principle 2: Management should be decentralized to the lowest appropriate level.

Rationale: Decentralised systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Rationale: Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organisation for institutions involved in decision-making to make, if necessary, appropriate compromises.

Principle 4: Recognising 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:

(a) Reduce those market distortions that adversely affect biological diversity;

(b) Align incentives to promote biodiversity conservation and sustainable use;

(c) Internalize costs and benefits in the given ecosystem to the extent feasible.

Rationale: The greatest threat to biological diversity lies in its replacement by alternative systems of land use. This often arises through market distortions, which undervalue natural systems and populations and

provide perverse incentives and subsidies to favour the conversion of land to less diverse systems.

Often those who benefit from conservation do not pay the costs associated with conservation and, similarly, those who generate environmental costs (e.g. pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Rationale: Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater significance for the long-term maintenance of biological diversity than simply protection of species.

Principle 6: Ecosystems must be managed within the limits of their functioning.

Rationale: In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits to ecosystem functioning may be affected to different degrees by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious.

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Rationale: The approach should be bounded by spatial and temporal scales that are appropriate to the objectives. Boundaries for management will be defined operationally by users, managers, scientists and indigenous and local peoples. Connectivity between areas should be promoted where necessary. The ecosystem approach is based upon the hierarchical nature of biological diversity characterised by the interaction and integration of genes, species and ecosystems.

Principle 8: Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.

Rationale: Ecosystem processes are characterised by varying temporal scales and lag-effects. This inherently conflicts with the tendency of humans to favour short-term gains and immediate benefits over future ones.

Principle 9: Management must recognize that change is inevitable.

Rationale: Ecosystems change, including species composition and population abundance. Hence, management should adapt to the changes. Apart from their inherent dynamics of change, ecosystems are beset by a complex of uncertainties and potential “surprises” in the human, biological

and environmental realms. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored. The ecosystem approach must utilise adaptive management in order to anticipate and cater for such changes and events and should be cautious in making any decision that may foreclose options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Rationale: Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems.

Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Rationale: Information from all sources is critical to arriving at effective ecosystem management strategies. A much better knowledge of ecosystem functions and the impact of human use are desirable. All relevant information from any concerned area should be shared with all stakeholders and actors, taking into account, *inter alia*, any decision to be taken under Article 8(j) of the Convention on Biological Diversity. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.

Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Rationale: Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.

ANNEX II

Five points of operational guidance provided by the 5th Conference of the Parties to the Convention on Biological Diversity (Nairobi, 2000) for the application of the twelve ecosystem approach principles

Focus on the functional relationships and processes within ecosystems

The many components of biodiversity control the stores and flows of energy, water and nutrients within ecosystems, and provide resistance to major perturbations. A much better knowledge of ecosystem functions and structure, and the roles of the components of biological diversity in ecosystems, is required, especially to understand: (i) ecosystem resilience and the effects of biodiversity loss (species and genetic levels) and habitat fragmentation; (ii) underlying causes of biodiversity loss; and (iii) determinants of local biological diversity in management decisions. Functional biodiversity in ecosystems provides many goods and services of economic and social importance. While there is a need to accelerate efforts to gain new knowledge about functional biodiversity, ecosystem management has to be carried out even in the absence of such knowledge. The ecosystem approach can facilitate practical management by ecosystem managers (whether local communities or national policy makers).

Enhance benefit-sharing

Benefits that flow from the array of functions provided by biological diversity at the ecosystem level provide the basis of human environmental security and sustainability. The ecosystem approach seeks that the benefits derived from these functions are maintained or restored. In particular, these functions should benefit the stakeholders responsible for their production and management. This requires, inter alia: capacity-building, especially at the level of local communities managing biological diversity in ecosystems; the proper valuation of ecosystem goods and services; the removal of perverse incentives that devalue ecosystem goods and services; and, consistent with the provisions of the Convention on Biological Diversity, where appropriate, their replacement with local incentives for good management practices.

Use adaptive management practices

Ecosystem processes and functions are complex and variable. Their level of uncertainty is increased by the interaction with social constructs, which need to be better understood. Therefore, ecosystem management must involve a learning process, which helps to adapt methodologies and practices to the ways in which these systems are being managed and monitored. Implementation programmes should be designed to adjust to the unexpected, rather than to act on the basis of a belief in certainties. Ecosystem management needs to recognise the diversity of social and cultural factors affecting natural-resource use. Similarly, there is a need for flexibility in policy-making and implementation. Long-term, inflexible decisions are likely to be inadequate or even destructive. Ecosystem management should be envisaged as a long-term experiment that builds on its results as it progresses. This "learning-by-doing" will also serve as an important source of information to gain knowledge of how best to monitor the results of

management and evaluate whether established goals are being attained. In this respect, it would be desirable to establish or strengthen capacities of Parties for monitoring.

Carry out management actions at the scale appropriate for the issue being addressed, with decentralization to lowest level, as appropriate

As noted in section A above, an ecosystem is a functioning unit that can operate at any scale, depending upon the problem or issue being addressed. This understanding should define the appropriate level for management decisions and actions. Often, this approach will imply decentralisation to the level of local communities. Effective decentralisation requires proper empowerment, which implies that the stakeholder both has the opportunity to assume responsibility and the capacity to carry out the appropriate action, and needs to be supported by enabling policy and legislative frameworks. Where common property resources are involved, the most appropriate scale for management decisions and actions would necessarily be large enough to encompass the effects of practices by all the relevant stakeholders. Appropriate institutions would be required for such decision-making and, where necessary, for conflict resolution. Some problems and issues may require action at still higher levels, through, for example, transboundary co-operation, or even co-operation at global levels.

Ensure inter-sectoral co-operation

As the primary framework of action to be taken under the Convention, the ecosystem approach should be fully taken into account in developing and reviewing national biodiversity strategies and action plans. There is also a need to integrate the ecosystem approach into agriculture, fisheries, forestry and other production systems that have an effect on biodiversity. Management of natural resources, according to the ecosystem approach, calls for increased inter-sectoral communication and co-operation at a range of levels (government ministries, management agencies, etc.). This might be promoted through, for example, the formation of inter-ministerial bodies within the Government or the creation of networks for sharing information and experience.

ANNEX III

Further guidance on the implementation of the ecosystem approach principles provided by the 7th Conference of the Parties to the Convention on Biological Diversity (Kuala Lumpur, 2004)

1. In applying the operational guidance of the ecosystem approach ecosystem approach, the following cross-cutting issues need to be considered.

Initiating the approach

2. When initiating the ecosystem approach, the first task is to define the problem that is being addressed. In doing so the scope of the problem and the task to be undertaken has to be well specified. The strategy to be followed to promote the ecosystem approach has to be clearly defined with contingencies for unforeseen situations incorporated into the strategy. The approach should consider all principles as a package but depending upon the task at hand emphasis on particular principles may be warranted. A collective ownership for the vision, strategy and parameters for the ecosystem approach relevant to the task has to be developed, communicated, and facilitated among partners and sponsors. Collectively developing the overarching goals, objectives, targets for the exercise is important before applying the ecosystem approach.

Capacity-building and collegiate will

3. To apply the ecosystem approach successfully it is critical to investigate what resources and sponsorship are required to undertake the exercise. This can be in the form of capacity-building and fostering collegiate will.

4. Collegiate will can be in terms of community partnerships, stakeholder engagement, political and institutional will, and the commitment of donors or sponsors. An important consideration is the length of time such collegiate will is required; that is, it may be required in the initiation phase, assessment phase or the phase associated with implementation of outcomes. Examples of where the ecosystem approach has been compromised can be from a loss of allegiance from one or more of the community, other stakeholders, the political establishment and institutions, or sponsors and donors.

5. Capacity-building is also important for the success of the ecosystem approach. Adequate financial support and appropriate infrastructure support are important requirements to the success of an approach. So too is access to suitable expertise and the sharing of knowledge and experience. In undertaking the ecosystem approach it is useful to build from lessons learnt from other undertakings applying the ecosystem approach. Technology, including decision support tools and inventory systems, which have been developed in other applications of the ecosystem approach, may be transferable or can be adapted.

Information, research and development

6. The collection of resource, biophysical, social, and economic information is important to the successful completion of the ecosystem approach. Research and development is needed to target strategic gaps in knowledge that are important for addressing the exercise at hand. Knowledge derived from research and information from other sources has to be integrated and

packaged into information products (including decision-support systems) that allow and provide for interpretation, and which facilitate their use in applying the ecosystem approach. Information products are necessary for communicating with stakeholders, planners, managers and decision makers. Consideration should be given to enhancing the access of stakeholders to information because the more transparent the decision-making is, based on information at hand, the better the ownership of the resultant decisions between partners, stakeholders and sponsors. Priorities for research and development are likely to be clearer once the ecosystem approach begins to be applied and implementing actions are put in place.

Monitoring and review

7. Monitoring and review are crucial components in implementing the ecosystem approach. They allow a responsive and adaptive management capability to be developed. Monitoring and review are also useful in reporting performance and the resultant outcomes of the approach. Indicators of performance should be defined, developed and implemented. Appropriate monitoring and auditing systems need to be implemented to support reporting on indicators of performance. Periodic reviews of these indicators need to be undertaken to assess performance and whether adaptive management needs to be applied. Strategies, practices and processes may need to be modified depending upon the findings from monitoring and auditing.

Good governance

8. Good governance is essential for successful application of the ecosystem approach. Good governance includes sound environmental, resource and economic policies and administrative institutions that are responsive to the needs of the people. Robust and sound resource management systems and practices are required to support these policies and institutions. Decision-making should account for societal choices, be transparent and accountable and involve society. Accountability for making decisions has to be placed at the appropriate level that reflects that community of interest. For example strategic land-use planning and management might be taken by central government, operational decisions taken by local government or management agency, whereas decisions associated with the sharing of benefits could be taken by a community organization.

9. Good governance at all levels is fundamental for achieving sustainable use and conservation of biodiversity. It is important to ensure intersectoral cooperation. There is a need to integrate the ecosystem approach into agriculture, fisheries, forestry and other production systems that have an effect on biodiversity. Management of natural resources, according to the ecosystem approach, calls for increased intersectoral communication and cooperation at a range of levels (government ministries, management agencies).

Table 1: The 12 Principles of the ecosystem approach and their rationale (decision V/6 of the Conference of the Parties) suggested annotations to the rationale and implementation guidelines.

Principle 1: The objectives of management of land, water and living resources are a matter of societal choice.

Rationale

Different sectors of society view ecosystems in terms of their own economic, cultural and societal needs. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.

***Annotations to the rationale**:*

The objectives for managing land, water, and living resources is a matter of societal choice, determined through negotiations and trade-offs among stakeholders having different perceptions, interests, and intentions. In this regard it should be noted that:

- *Human society is diverse in the kind and manner of relationships that different groups have with the natural world, each viewing the world around them in different ways and emphasising their own economic, cultural, and societal interests and needs.*
- *All relevant sectors of society need to have their interests equitably treated, which may involve providing for different outcomes in separate locations or at different times.*
- *It is also necessary to ensure that the needs of future generations and the natural world are adequately represented.*
- *Given this diversity, good decision-making processes that provide for negotiations and trade-offs are necessary to establish broadly acceptable objectives for the management of particular areas and their living resources.*
- *Good decision-making processes incorporate the following characteristics:*
    - *All interested parties (particularly including indigenous and local communities) should be involved in the process,*
    - *It needs to be a clear how decisions are reached and who the decision-maker(s) is(are),*
    - *The decision-makers should be accountable to the appropriate communities of interest,*
    - *The criteria for decisions should be appropriate and transparent, and*
    - *Decisions should be based on, and contribute to, inter-sectoral communication and coordination.*
- *Good decisions depend on those involved having access to accurate and timely information and the capacity to apply this knowledge.*

Implementation guidelines

1.1 Involve all stakeholders (interested parties) (including indigenous and local communities) in:
- clearly articulating, defining and agreeing upon the goals of management
- defining problems
- making choices (in principle 12).

1.2 There need to be clearly defined boundaries (in time and space) for the management unit that is the subject of the societal choice process.

1.3 Ensure that those stakeholders that cannot directly represent themselves are adequately represented by someone else.

1.4 Ensure that all stakeholders have an equitable capacity to be effectively involved, including through ensuring equitable access to information, ability to participate in the processes, etc.

1.5 Ensure that the decision-making process compensates for any inequities of power in society, in order to ensure that those who are normally marginalized (e.g. women, the poor, indigenous people) are not excluded or stifled in their participation.

1.6 Determine who the decision-makers are for each decision, how the decisions will be taken (what process will be used), and what are the limits on the discretion of the decision-maker (e.g. what are the criteria for the decision in law, what is the overall policy guidance within which the decision must fit, etc).

1.7 Ensure that the recognition of stakeholder interests occurs within the full range of decisions over time and space and levels. In doing so, however, ensure that "stakeholder fatigue" does not develop, by incorporating known stakeholder views into future decisions, and allowing efficient stakeholder input.

1.8 Where possible, use existing societal mechanisms, or build new mechanisms that are compatible with existing or desired societal conditions.

1.9 Ensure that decision-makers are accountable to the appropriate communities of interest.

1.10 Develop the capacity to broker negotiations and trade-offs, and manage conflicts, among relevant stakeholder groups in reaching decisions about management, use and conservation of biological resources.

1.11 There need to be mechanisms in place to ensure that, once an appropriate societal choice has been made, the decision will be able to be implemented over the long term, i.e. policy, legislative and control structures need to be in place.

1.12 Undertake assessment at the national level to analyse effects of ecosystem management practices on society, with a view to find ways and means to mitigate possible constraints between stakeholders in the implementation phase.

Principle 2: Management should be decentralized to the lowest appropriate level.

Rationale:

Decentralized systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.

***Annotations to the rationale**:*

Decisions should be made by those who represent the appropriate communities of interest, while management should be undertaken by those with the capacity to implement the decisions. In this regard it should be noted that:

- *There are usually many communities-of-interest in ecosystem management. These can be compatible, complimentary, or contradictory. It is important to ensure that the level of decision-making and management selected maintains an appropriate balance among these interests.*
- *Often, but not always, the closer the decision-making and management are to the ecosystem, the greater the participation, responsibility, ownership, accountability and use of local knowledge will be, all of which are critical to the success of management.*
- *Because there are several levels of interests with people who have varying capacities to address different aspects of ecosystem management, there are often multiple decision-makers and managers with different roles for any individual place or resource.*
- *Decisions made by local resource managers are often affected by, or even subordinate to, environmental, social, economic and political processes that lie outside their sphere of influence, at higher levels of organisation. Therefore there is a need for mechanisms to coordinate decisions and management actions at a number of different organisational levels.*

Implementation guidelines

2.1 The multiple communities of interest should be identified, and decisions about particular aspects of management assigned to the body that represents the most appropriate community of interest. If necessary, management functions/decisions should be subdivided. For example, strategic decisions might be taken by central government, operational decisions by a local government or local management agency, and decisions about allocation of benefits between members of a community by the community itself.

2.2 The potential adverse effects of fragmented decision-making and management responsibilities should be compensated for by:

- ensuring that decisions are appropriately nested and linked
- sharing information and expertise
- ensuring good communication between the different management bodies
- presentation of the overall combination of decisions/management to the community in an understandable and consolidated form so they can effectively interact with the overall system.
- supportive relationships between the levels.

2.3 Good governance arrangements are essential, particularly:

- clear accountabilities
- accountabilities of the necessary authorities
- accountabilities of competent bodies or persons

Note that this is not a complete enough list, and there seems no good reason to particularly identify these.

2.4 Achieving an appropriate level of decentralization requires taking decisions at a higher level to create an enabling and supportive environment, as well as a commitment to devolve those decision-making responsibilities that are currently situated at too high a level.

2.5 In choosing the appropriate level of decentralization, the following are relevant factors that should be taken into account in choosing the appropriate body. .

- whether the body represents the appropriate community of interest
- whether the body has a commitment to the intent of the function
- whether the body has the necessary capacity for management
- efficiency (e.g. by moving the function to a higher level you may have sufficient work to allow maintenance of the necessary level of expertise to do the function efficiently and effectively).
- whether the body has other functions which represent a conflict of interest
- the effect on marginalized members of society (e.g. women, marginalized tribal groups)

In some cases problems could be corrected, such as through capacity-building. If no appropriate body is available at the level, a new body might be created, or an existing body modified, or a different level chosen.

2.6 Where functions are to be moved to another level, it is necessary to ensure that the body receiving the responsibility has sufficient capacity to fulfil that responsibility (e.g. resources, systems, authority), and that any risks arising from the transition can be managed. This means doing capacity-building if necessary to allow the decentralization to occur.

Institutional arrangements are the key. If you don't have the institutional structure that supports and coordinates the decision-making authorities then their work is worthless.

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Rationale:

Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organization for institutions involved in decision-making to make, if necessary, appropriate compromises.

Annotations to the rationale*:*

Ecosystems are not closed systems, but rather open and often connected to other ecosystems. This open structure and connectedness of ecosystems ensures that effects on ecosystem functioning are seldom confined to the point of impact or only to one system. In this regard it should be noted that:

- *The effects of management interventions, or decisions not to intervene, are therefore not confined solely to the point of impact.*
- *The effects between ecosystems are frequently non-linear and will likely have associated time-lags.*

Implementation guidelines

3.1 Natural resource managers, decision makers and politicians should consider the possible effects that their actions could have on adjacent and downstream ecosystems (river basins and coastal zones) so that effects inside and outside the ecosystem are determined.

3.2 Where impacts of management or use of one ecosystem has or is projected to have effects elsewhere, bring together relevant stakeholders and technical expertise to consider how best to minimize adverse consequences.

3.3 Environmental impact assessment (EIAs), including strategic environmental assessments

- *Management systems need to be designed to cope with these issues.*

There is a need for this to reflect the fact that impacts are in both directions – into and out of a particular ecosystem. Not just adjacent and downstream, but those have other connections as well (e.g. systems linked by migratory species).

(SEAs) should be carried out for developments that may have substantial environmental impacts taking into account all the components of biological diversity. These assessments should adequately consider the potential offsite impacts. The results of these assessments, which can also include social impact assessment, should subsequently acted upon. When identifying existing and potential risks or threats to ecosystem, different scales need to be considered.

3.4 Establish and/or maintain national and regional, where applicable, feed-back mechanisms to monitor the effects of management practices across ecosystems.

Principle 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:

(a) Reduce those market distortions that adversely affect biological diversity;

(b) Align incentives to promote biodiversity conservation and sustainable use;

(c) Internalize costs and benefits in the given ecosystem to the extent feasible.

Rationale:

The greatest threat to biological diversity lies in its replacement by alternative systems of land use. This often arises through market distortions, which undervalue natural systems and populations and provide perverse incentives and subsidies to favour the conversion of land to less diverse systems. Often those who benefit from conservation do not pay the costs associated with conservation and, similarly, those who generate environmental costs (e.g. pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay.

***Annotations to the rationale**:*

Many ecosystems provide economically valuable goods and services and it is therefore necessary to understand and manage ecosystems in an economic context. Frequently economic systems do not make provision for the many, often, intangible values derived from ecological systems In this regard it should be noted that:

- *Ecosystem goods and services are frequently undervalued in economic systems.*
- *Even when valuation is complete, most environmental goods and services have the characteristic of "public goods" in an economic sense, which are difficult to incorporate into markets.*
- *It is often difficult to introduce new uses of ecosystems, even where these are less impacting or provide wider benefits to society, because economic and social systems exhibit significant inertia, particularly where strong existing interests are affected by and resist change.*
- *Many stakeholders with strong interests in the ecosystem, but having limited political and economic influence, may be marginalized from the relevant economic systems.*
- *Where those who control use of the land do not receive benefits from maintaining natural ecosystems and processes, they are likely to initiate unsustainable land use practices from which they will benefit directly in the short term. To counter this,*

Implementation guidelines

4.1 Develop an understanding of the social and economic context of the issue to which the ecosystem approach is being applied

4.2 Apply appropriate practical economic valuation methodologies for ecosystem goods and services (direct, indirect and intrinsic values); and for the environmental impacts (effects or externalities).

4.3 Aim to reduce those market distortions that adversely affect biological diversity

4.4 Align economic and social incentives to promote biodiversity conservation and sustainable use.

4.5 Internalize costs and benefits in the given ecosystem to the extent feasible.

4.6 Evaluate the direct as well as indirect economic benefits associated with good ecosystem management including biodiversity conservation and environmental quality.

4.7 Enhance benefits of using biological diversity.

more equitable sharing of benefits is advised.

- *International, national and sub-national policies, laws and regulations, including subsidies may provide perverse incentives for unsustainable management of ecosystems. Economic systems therefore need to be redesigned to accommodate environmental management objectives.*
- *Addressing the issue of market distortions that adversely affect biodiversity will require establishing dialogue with other sectors.*

Deriving economic benefits is not necessarily inconsistent with attaining biodiversity conservation and improvement of environmental quality.

4.8 Ensure equitable sharing of costs and benefits.

Incorporate social and economic values of ecosystem goods and services into National Accounts, policy, planning, education and resource management decisions

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Rationale:

Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater significance for the long-term maintenance of biological diversity than simply protection of species.

***Annotations to the rationale**:*

Biodiversity conservation and the maintenance of human wellbeing depend on the functioning and resilience of natural ecosystems. In this regard it should be noted that:

- *Ecosystem services – the benefits people obtain from ecosystems by way of resources, environmental regulation including, support of biospheric processes, inputs to culture, and the intrinsic values of the systems themselves – depend on maintaining and, where appropriate, restoring particular ecological structures and functions.*
- *Ecosystem functioning and resilience depend on inter-relationships within and among species, between species and their abiotic environments, and on the physical and chemical interactions within these environments.*
- *Given this complexity, management must focus on maintaining, and where appropriate restoring, the key structures and ecological processes (e.g., hydrological systems, pollination systems, habitats and food webs) rather than just individual species.*
- *Given that the loss of genetic diversity predisposes populations and species to local extinction, the conservation of ecosystem composition and structure requires monitoring of population sizes of vulnerable and economically important species.*

Management of ecosystem processes has to be carried out despite incomplete knowledge of ecosystem functioning.

Implementation guidelines

5.1 Improve understanding of the interrelationship among ecosystem composition, structure and function with respect to (i) human interaction, needs and values (including cultural aspects), (ii) conservation management of biodiversity, and (iii) environmental quality, integrity and vitality.

5.2 Determine and define conservation, social and economic objectives and goals that can be used to guide policy, management and planning using participatory processes.

5.3 Assess the extent to which ecosystem composition, structure can function contribute to the delivery of goods and services to meet the desired balance of conservation, social and economic outcomes.

5.4 Expand knowledge of the responses of ecosystems, in terms of changes in composition, structure and function, to both internally and externally induced stresses caused by, *inter alia*, human use, disturbance, pollution, fire, alien species, disease abnormal climatic variations (drought, flood) etc.

5.5 Develop and promote management strategies and practices that enable and ensure conservation of ecosystem service and take account of, or minimize, risks/threats to ecosystem function and structure.

5.6 Apply instruments to maintain and/or restore ecosystem service.

5.7 Where required, develop management strategies and practices to facilitate recovery of ecosystem structure and function (including threatened components) to generate or enhance ecosystem services and biodiversity benefits.

5.8 Develop and apply instruments that contribute to achievement of conservation management goals through a combination of managing protected area networks, ecological networks and areas outside of such networks to meet both short-term and long-term requirements and conservation outcome in accordance with VII/28.

5.9 Monitoring population sizes of vulnerable and important species should be linked to a management plan that identifies appropriate response measures and actions.

Principle 6: Ecosystems must be managed within the limits of their functioning.

Rationale:

In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits to ecosystem functioning may be affected to different degrees by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious

***Annotations to the rationale**:*

There are limits to the level of demand that can be placed on an ecosystem while maintaining its integrity and capacity to continue providing the goods and services that provide the basis for human wellbeing and environmental sustainability. Our current understanding is insufficient to allow these limits to be precisely defined, and therefore a precautionary approach coupled with adaptive management, is advised. In this regard it should be noted that:

- *Just as there are limits to the demands (production, off-take, assimilation, detoxification) that can be made on ecosystems, so too there are limits to the amount of disturbance that ecosystems can tolerate, depending on the magnitude, intensity, frequency and kind of disturbance.*
- *These limits are not static but may vary across sites, through time, and in relation to past circumstances and events.*
- *Cumulative effects of interventions over time and space should be assessed when considering ecosystem limits.*
- *If these limits are exceeded, an ecosystem undergoes substantial change in composition, structure and functioning, usually with a loss of biodiversity and a resulting lower productivity and capacity to process wastes and contaminants*
- *There is considerable lack of knowledge and uncertainty about the actual limits (thresholds for change) in different ecosystems. While further research can reduce these uncertainties, given the dynamic and complex nature of ecosystems we may never have perfect understanding.*
- *Given the pervasiveness of uncertainties in managing ecosystems, management will need to be adaptive, with a focus on active learning derived from monitoring the outcomes of planned interventions using a sound experimental approach that allow*

Implementation guidelines

6.1 Identify practices that are not sustainable and develop appropriate mechanisms for improvement involving all stakeholders.

6.2 Given the uncertainty associated with defining the limits to ecosystem functioning under most circumstances, the precautionary approach should be applied.

6.3 Implement an adaptive management approach.

6.4 Develop understanding of the limits of ecosystem functioning and the effects of various human use on the delivery of ecosystem goods and services.

6.5 Where permissible limits to change in specific ecosystem components can be agreed, manage within these but monitor and assess the ecosystem response. Feedback the information at regular intervals to those responsible for setting the off-take or other limits.

6.6 Encourage the use of environmental assessments and monitoring to establish ecosystem responses to disturbance, in order to provide management feedback and develop appropriate responses.

6.7 Develop and promote appropriate management strategies and practices that sustain resources and maintain ecosystems within the limits of their functioning.

6.8 Sustainable use management goals and practices should avoid or minimize adverse impacts on ecosystem services, structure and functions as well as other components of ecosystems.

6.9 Formulate, review and implement regulatory framework, codes of practice and other instruments to avoid using ecosystems beyond their limits.

the effects of the intervention to be accurately determined.

Management to restore lost capacities or control use should be appropriately cautious and apply an adaptive management approach.

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Rationale:

The approach should be bounded by spatial and temporal scales that are appropriate to the objectives. Boundaries for management will be defined operationally by users, managers, scientists and indigenous and local peoples. Connectivity between areas should be promoted where necessary. The ecosystem approach is based upon the hierarchical nature of biological diversity characterized by the interaction and integration of genes, species and ecosystems.

***Annotations to the rationale**:*

The driving forces of ecosystems, including those due to human activities, vary spatially and through time, necessitating management at more than one scale to meet management objectives. In this regard it should be noted that:

- *Ecosystems are made up of biotic and abiotic components and processes, which function at a range of spatial and temporal scales, within a nested hierarchy.*
- *The dynamics of human social and economic systems also vary across scales of space, time and quality.*
- *How components are perceived spatially depends partly on the scale of observation. At one scale, individuals of a species may seem relatively regularly and continuously distributed; at another the distribution may be discontinuous. Likewise with time, for example, at one time scale (e.g., monthly, annually) a component or process may appear predictable; at another, longer or shorter time scale, the temporal dynamics may be unpredictable.*
- *Management processes and institutions should be designed to match the scales of the aspects of the ecosystem being managed. More importantly, perhaps, given that ecosystem components and processes are linked across scales of both space and time, management interventions need to be planned to transcend these scales.*
- *Failure to take scale into account can result in mismatches between the spatial and time frames of the management and those of the ecosystem being managed. For example, policy makers and planners sometimes may have to consider shorter time frames than the time frames of major ecosystem processes. The reverse can also be true, for example, where bureaucratic inertia can delay the quick management response needed to address a rapidly changing environmental condition. Spatial mismatches are also common, such as when administrative boundaries and those of ecosystem properties or related human activities that they are designed to regulate do not coincide.*

Implementation guidelines

7.1 Enhanced capacity is required to analyse and understand the temporal and spatial scales at which ecosystem processes operate, and the effect of management actions on these processes and the delivery of ecosystem goods and services. Identification of spatial patterns and gaps in connectivity should be included in this analysis.

7.2 Functional mismatches in the administration and management of natural resources should be avoided by readjusting the scale of the institutional response to coincide more closely with spatial and temporal scales of processes in the area under management. This logic underpins the current global trend towards decentralized natural resource management.

7.3 Given that ecosystem components and processes are linked across scales of both time and space, management interventions need to be planned to transcend these scales. Developing a nested hierarchy of spatial scales may be appropriate in some circumstances.

7.4 Managing large areas such as river basins or large marine areas may require development of new institutional mechanisms to engage stakeholders across administrative borders and different levels of administration.

7.5 Attention to spatial and temporal scales is needed in the design of assessment and monitoring efforts.

7.6 Concepts of stewardship, intergenerational equity and sustainable yield need to be applied to considerations of the temporal scale.

7.7 Regional collaboration is necessary to deal with large-scale changes.

Principle 8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Rationale:

Ecosystem processes are characterized by varying temporal scales and lag-effects. This inherently conflicts with the tendency of humans to favour short-term gains and immediate benefits over future ones.

***Annotations to the rationale**:*

Time needs to be considered explicitly in formulating management plans, and in longer-scale processes need to especially considered and planned for because these are otherwise often neglected. In this regard it should be noted that:

- *People find long-term trends more difficult to detect than short term trends, particularly in complex systems.*
- *Management systems tend to operate at relatively short time scales, often much shorter than the timescales for change in ecosystem processes.*
- *Where there is a lag between management actions and their outcomes, it is difficult to take reasoned management decisions.*
- *Long-term ecological processes, which can be very important, are therefore likely to be poorly accommodated in management systems, unless these are explicitly and carefully designed to address long-term issues.*

Awareness of long-term processes is important because it is the long-term, spatially, extensive processes that both characterize and determine the broad ecosystem properties.

Implementation guidelines

8.1 Adaptive management processes should include the development of long-term visions, plans and goals that address inter-generational equity, while taking into account immediate and critical needs (e.g., hunger, poverty, shelter).

8.2 Adaptive management should take into account trade-offs between short-term benefits and long-term goals in decision-making processes.

8.3 Adaptive management should take into account the lag between management actions and their outcomes.

8.4 Monitoring systems should be designed to accommodate the time scale for change in the ecosystem variables selected for monitoring. Alternatively, if the monitoring cannot be adjusted, a more appropriately scaled but still relevant variable should be selected to monitor.

8.5 The capacity to monitor and detect long-term, low frequency changes in ecosystem structure and functioning should be strengthened.

8.6 To implement long-term management requires stability of institutions, legal and policy frameworks, monitoring programs, and extension and awareness-raising programs.

Principle 9: Management must recognize that change is inevitable.

Rationale:

Ecosystems change, including species composition and population abundance. Hence, management should adapt to the changes. Apart from their inherent dynamics of change, ecosystems are beset by a complex of uncertainties and potential "surprises" in the human, biological and environmental realms. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored. The ecosystem approach must utilize adaptive management in order to anticipate and cater for such changes and events and should be cautious in making any decision that may foreclose options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change.

***Annotations to the rationale**:*

Change in ecosystems is both natural and inevitable, and therefore management objectives should not be construed as fixed outcomes but rather the maintenance of natural ecological processes. In this regard it should be noted that:

- *Ecosystems change constantly as a result of natural processes. Those changes include shifts in species composition, population abundance, and physical characteristics.*
- *Such changes are not necessarily constant, variable, dynamic and usually difficult*

Implementation guidelines

9.1 Adaptive management is needed to respond to changing social and ecological conditions, and to allow management plans and actions to evolve in light of experience.

9.2 Natural resource managers must recognise that natural and human-induced change is inevitable and take this into account in their management plans.

9.3 Adaptive management should be encouraged when there is a risk degradation or loss of habitats, as it can facilitate taking early actions in response to change.

to predict at any point in time.

- *It is therefore difficult to select an appropriate outcome or future state of an ecosystem as a static management goal. Instead, in addressing this and Principle 8, management should focus on maintaining the natural processes, which drive those changes.*
- *This focus on processes requires a management approach that is flexible and adaptive, both as a response to changing circumstances and to take account of new knowledge and understanding. Adaptive management should generate new knowledge and reduce uncertainties, thereby allowing the manager to anticipate and cater for change.*
- *Ecosystem management must therefore involve a learning process that will help to adapt methods and practices to improve the ways in which these systems are being managed and monitored. Flexibility is also needed in policy-making and implementation. Long-term, inflexible decisions are likely to be ineffective or detrimental.*

9.4 Monitoring systems, both socio-economic and ecological, are an integral part of adaptive management, and should not be developed in isolation from the goals and objectives of management activities.

9.5 Adaptive management must identify and take account of risks and uncertainties.

9.6 Where changes occur across national borders, the scale of adaptive management may need to be adjusted.

9.7 While ecosystems are inherently dynamic and resilient, special adaptation and mitigation measures are needed when ecosystems may be pushed beyond the limits of natural variation. Capacity-building efforts are needed to address highly vulnerable areas such as small island states and coastal areas.

9.8 Capacity-building efforts are needed to address highly vulnerable areas such as small island states and coastal areas.

9.9 Traditional knowledge and practice should be used to enable better detection and understanding of ecosystem change, and to develop appropriate adaptation measures.

9.10 Adaptive management should recognize the resilient capacity of ecosystems in response to natural disturbances, and should be aimed at maintaining or restoring this capacity so as to reduce the risk of adverse social and economic consequences of natural variability in ecosystems.

9.11 Awareness-raising measures are needed to enhance public knowledge that ecosystem change is a natural phenomenon, and to build support and capacity for adaptive management.

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Rationale:

Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems

***Annotations to the rationale**:*

Biological resources play a role in providing the ecosystem goods and services on which humans ultimately depend. In this regard it should be noted that:

- *The ecosystem approach is designed to support the conservation of biodiversity, the sustainable use of its components, and the equitable sharing of benefits derived from the use of biodiversity.*
- *Sustainable use and management depends on also achieving conservation objectives.*

Implementation guidelines

10.1 Develop integrated natural resource management systems and practices to ensure the appropriate balance between, and integration of, the conservation and use of biological diversity, taking into account long- and short-term, direct and indirect, benefits of protection and sustainable use as well as management scale.

10.2 Develop policy, legal, institutional and economic measures that enable the appropriate balance and integration of conservation and use of ecosystems components to be

- *Management for conservation and sustainable use are not inherently incompatible, and can be integrated.*
- *Integration can be achieved at various scales and in various ways including both spatial and temporal separation across the landscape as well as through integration within a site.*

determined.

10.3 Promote participatory integrated planning, ensuring that the full range of possible values and use options are considered and evaluated.

10.4 Seek innovative mechanisms and develop suitable instruments for achieving balance appropriate to the particular problem and local circumstances.

10.5 Manage areas and landscapes in a way that optimises delivery of ecosystem goods and services to meet human requirements, conservation management and environmental quality.

10.6 Determine and define sustainable use objectives that can be used to guide policy, management, and planning, with broad stakeholder participation.

Identify solutions which relieve sectoral pressure on existing resources

Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Rationale:

Information from all sources is critical to arriving at effective ecosystem management strategies. A much better knowledge of ecosystem functions and the impact of human use is desirable. All relevant information from any concerned area should be shared with all stakeholders and actors, taking into account, *inter alia*, any decision to be taken under Article 8(j) of the Convention on Biological Diversity. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.

Annotations to the rationale*:*

Ecosystems can be viewed at various scales and from different perspectives, each yielding unique information and insights. Good management should therefore consider all relevant information. In this regard it should be noted that:

- *The ecosystem approach is designed to accommodate a range of values and associated goals, and the information and perspectives of the communities that hold those values are therefore important in designing and implementing management.*
- *There is no single level of organisation at which one can understand and optimize management of ecosystem functioning. Different information sources will address issues at different levels, providing complementary perspectives to support integrated management.*

Implementation guidelines

11.1 Relevant information should be shared with other stakeholders and actors and technical and scientific information be made available in an accessible way (indigenous and local knowledge should be treated with full respect of Article 8(j) and further decisions of the CBD).

11.2 Assumptions behind proposed management decisions should be made explicit based on the best available expertise, explicitly regard scenarios of future change and include the knowledge and views of stakeholders.

11.3 Appropriate mechanisms should be developed to document and make more widely available the information from all relevant disciplines (including natural and social sciences) and from relevant knowledge systems, particularly those based on local and traditional practices. This guideline should be implemented consistent with any decision to be taken under Article 8(j) of the CBD.

11.4 The implications for ecosystem management of different ”world views” based on different knowledge systems should be evaluated.

11.5 Good management depends upon improving the information base and scientific understanding of ecosystems through the promotion, implementation and application of research and integrating this information into decision-making.

Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Rationale:

Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.

***Annotations to the rationale**:*

The complexity of ecosystem management for sustained use and conservation requires integrating the activities and actions of many different stakeholders. In this regard it should be noted that:

- *The activities of all sectors affect biological diversity, and can contribute to, or detract from, the achievement of the objectives of the Convention.*
- *The management of biodiversity, because of its complexity, and the significance of human impacts, requires a wide range of scientific and management skills, including those located in sectors that have not traditionally been involved in biodiversity conservation or management.*

For these reasons the ecosystem approach should provide a framework for fostering greater involvement of all relevant stakeholders and technical expertise in planning and carrying out coordinated activities, sharing management resources, or simply exchanging information.

Implementation guidelines

12.1 The integrated management of land, water and living resources requires increased communication and cooperation, (i) between sectors, (ii) at various levels of government (national, provincial, local), and (iii) among governments, civil society and private sector stakeholders. Increased communication among international and regional organisations also.

12.2 Further incorporation of the ecosystem approach as an integral part of planning in, among others, the agriculture, fisheries, forestry and other natural resources management sectors potentially affecting biodiversity and ecosystem functioning, should be encouraged, following the example, for instance, of the Code of Conduct for Responsible Fisheries, Sustainable Forest Management or others. Sectors other than the primary production sectors may also have major effects but are often less recognized in this respect.. These include sectors such as the judicial sector, which affects governance, as well as those such as energy and transport, which are managing or affecting resources either directly or indirectly.

12.3 Procedures and mechanisms should be established to ensure effective participation of all relevant stakeholders and actors during the consultation processes, decision making on management goals and actions, and, where appropriate, in implementing the ecosystem approach.

12.4 The effective implementation of the ecosystem approach may require involving multidisciplinary professional and scientific expertise, including such disciplines as economic, social and natural sciences.

12.5 When assessing the costs and benefits of conserving, maintaining, using and restoring ecosystems, the interests of all relevant sectors should be taken into account for equitable sharing of the benefits according to national law.

ANNEX IV

Objectives, orientations and actions of the priority field of action of the Mediterranean Strategy for Sustainable Development (MSSD) adopted by the Contracting Parties in 2005 regarding the sustainable management of the sea and coastal zones

1. Strengthening regional cooperation

Improve regional cooperation and promote the implementation of regional programmes of action with adequate means.

- Ensure the implementation of the Barcelona Convention, its Protocols and action plans and the related recommendations adopted by the Contracting Parties. Support actively the elaboration and implementation of the EU Marine Strategy.
- Actively support the formulation and implementation of the EU Marine Strategy.
- Strengthen subregional approaches.
- Strengthen regional solidarity, synergies between MAP, METAP and the various regional cooperation frameworks and financial mechanisms to help developing countries attain the objectives set out in this Strategy. Support capacity building for integrated coastal management, raise public awareness and consider the establishment of a fund to enable private sources and local communities to finance the conservation and sustainable management of the Mediterranean coast. Ensure the constant monitoring of the actions and measures implemented.

2. The integrated management and development of coastal zones

Promote the balanced and integrated management and development of coastal zones. Guarantee unhindered access to the coast for everyone. Preserve, enhance or restore the coastal heritage. Avoid linear and continuous urbanization. Reduce the vulnerability of sensitive areas to natural risks.

- Adopt by 2007 a Protocol for the Integrated Management of Mediterranean Coastal Zones and implement the related regional strategy.
- Take account of the fragility of the environment in planning and development. Prevent continuous and linear urbanization of coastal areas by avoiding the construction of new roads parallel to and alongside the coast. Enhance the heritage of coastal areas, including traditional productive activities which form part of its identity, maintain agricultural and wooded green belts and establish ecological corridors.
- Carry out environmental impact studies for projects and strategic environmental assessments for plans and programmes affecting the sea or coastal zones, and continue to develop tools for integrating environmental concerns into policies, programmes and projects.
- Insofar as possible, adopt laws, mechanisms and tools for integrated coastal zone management by 2012 in countries which do not yet have them.

- Promote integrated management approaches and projects for coastal zones and catchment areas, with the involvement of local authorities, enterprises and NGOs, so as to achieve greater efficiency, coordinate a limited number of practical issues and mobilize donors.
- Assess the vulnerability of coastal zones to natural and technological risks, prohibit construction in high-risk areas and integrate risk prevention into urban development plans. Adopt contingency plans for all vulnerable coastal spaces by 2010, including the implementation of prevention exercises to mobilize the populations concerned.
- Implement specific plans for the sustainable management and development of islands.
- Make the best use of the Euro-Mediterranean SMAP programme to promote integrated costal zone management.

3. Preventing and reducing pollution from ships

Prevent and combat marine pollution from ships by achieving the goals set out in the Regional Strategy for Prevention of and Response to Marine Pollution from Ships, which is currently being finalized. Eliminate operational pollution from ships by 2025.

- Fully implement the Regional Strategy for Prevention of and Response to Marine Pollution from Ships. Increase EU aid and support for its implementation.
- Identify, as a priority, in conjunction with the appropriate MAP Regional Activity Centres, those areas which should be designated by the IMO as Particularly Sensitive Sea Areas (PSSAs), and obtain the necessary support from concerned countries.
- Request the Mediterraneran and Black Sea coastal States (in particular through MAP and the Black Sea Environmental Programme) to engage in coordinated action for the prevention and reduction of pollution from ships, taking into account the similarities between the situations in the Mediterranean Sea and the Black Sea and the needs for common actions.

4. Preventing and reducing land-based pollution

Prevent and reduce land-based pollution by achieving the goals set out in the Strategic Action Programme to address Land-based Sources of Pollution, adopted in 1997.

- Implement without delay the National Action Plans for combating pollution from land-based sources in order to meet the objectives set out in the Strategic Action Plan adopted in 1997 for the implementation of the LBS Protocol. Reduce pollutants from industrial sources, such as the reduction of BOD by 50% by 2010 and the reduction of the generation of hazardous waste by 20% by 2010. Equip all coastal cities with over 10,000 inhabitants with systems for the environmental management of solid waste by 2015. Halve by 2015 the number of coastal urban inhabitants with no access to sanitation.
- Identify bilateral and international funding for the establishment of a system to provide support for the implementation of the National Action Plans and help equip coastal cities in developing countries to address land-based sources of pollution, giving preference to cost-effective technologies. Invite the EU to

strengthen its support for the related public investments through partnerships with Mediterranean countries.

- Continue and increase capacity-building programmes for developing countries, cities and enterprises for the management and treatment of waste and effluent by mobilizing international environment funds and maximizing synergies with MAP, and the various networks of local and professional actors. Promote environmentally sound production processes, products and services through the development of voluntary initiatives and reduce waste generation by adopting the "3R" approach (reducing, reusing and recycling).

5. Protection of marine and coastal biodiversity and marine resources

Halt the loss of marine and coastal biodiversity by 2010 in EU Member States and reduce it substantially in other countries, in accordance with international and European commitments.
Ensure the development of fishing in the Mediterranean towards an ecosystem approach and restore the stocks as far as possible by 2015, in accordance with the commitment of the Johannesburg World Summit on Sustainable Development. Promote sustainable aquaculture techniques that minimize their impact on the environment and conflicts with other users of the coast.

- Accelerate implementation of the Strategic Action Programme for the Preservation of Biological Diversity in the Mediterranean Region (SAP-BIO), adopted in 2003. Prepare for its updating by inserting the recommendations adopted by the Parties to the Convention on Biological Diversity. Adopt national action plans for marine and coastal biodiversity.
- Encourage fishing and aquaculture practices that are compatible with the protection of biodiversity and the sustainable management of marine resources. Strengthen implementation of commitments undertaken within the framework of the Code of Conduct for Responsible Fisheries (FAO, 1995), the General Fisheries Commission for the Mediterranean (GFCM), the International Commission for the Conservation of Atlantic Tunas, the declaration of the Ministerial Conference on the Sustainable Development of Fisheries in the Mediterranean (Venice, November 2003) and the Common Fisheries Policy of the European Union.
- Actively implement the programme of work on protected areas adopted by the Convention on Biological Diversity, taking into account the agreed timetable and objectives.
- Identify the Mediterranean sites in which the sustainable management of biodiversity would be advanced by the creation of marine and coastal protected areas, including in particular pelagic and deep habitats, within and beyond zones of national jurisdiction, on a scientific basis and in accordance with the Law of the Sea.
- Increase the number of protected areas throughout the Mediterranean significantly, to cover at least 10% of coastal and marine habitats with forms of protection that meet the criteria of the IUCN.
- Promote a representative network of protected marine and coastal areas that makes up an ecologically representative regional system, and increase their protection by adding them, when necessary, to the SPAMI list.

- Promote the creation of new types of protected spaces (public-private-local community partnerships; partnerships with owners of coastline property; mobilization of local NGOs), and invite the managers of protected areas to play a more active role in promoting local sustainable development.
- Strengthen cooperation between MAP and the GFCM and, at the local and national levels, cooperation between fisheries operators and the managers of protected areas.
- Strengthen institutional and human capacity for management of the interactions between human activities and marine and coastal biodiversity.
- Strengthen the synergies between international organizations and networks (such as the Barcelona Convention, IUCN, MedWET, the Bern Convention, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (UNEP/CMS/ACCOBAMS), the Natura 2000 Network and the EU Marine Strategy).

ANNEX V

Major environmental concerns in the Mediterranean Sea according to the Transboundary Diagnostic Analysis (UNEP/MAP/MEDPOL, 2005)

According to the Transboundary Diagnostic Analysis for the Mediterranean Sea (UNEP/MAP/MEDPOL, 2005), the major environmental concerns are:

Decline in biodiversity: Some critical habitats are severely threatened by a variety of human activities. Major threats to the biodiversity of the area include pollution (sewage, oil, nutrients), invasive species, introduced species, land reclamation, river damming and flow modification, over-fishing, by-catch, and adverse effects of fishing gear and uses on marine habitats (e.g., bottom trawling), solid waste disposal at sea, uncontrolled tourist presence in ecologically sensitive areas as well as inadequate public and stakeholders awareness, and inadequate or nonexistent legislation and available enforcement means. Ecological effects include disruption of biocenosis; dramatic change in community structure; disruption of key ecotones, some of which are globally valuable; and adverse impacts on endangered species. Socio-economic impacts of decline in biodiversity include loss of high value ecological services; reduction in nearshore fisheries, particularly for artisanal fisheries; loss of tourism and its documented economic benefits; and loss of cultural heritage.

Particularly heavily impacted are seagrass habitats (including *Posidonia* meadows and eelgrass meadows, *inter alia*) that have been affected by eutrophication, bottom trawling, dredging, and other human activities. These are high ecological service habitats. Additional habitats include biogenic constructions by both vegetal and animal coral builders, and comprise also some very sensitive deep-water coralline habitats, though these effects are less well known. Coastal wetlands, including lagoons and estuaries, are adversely affected by pollution, land reclamation, mismanagement of the phreatic basins (aquifers), and river diversion / loss of flow. Invasion by alien species is an ongoing process, and forms part of the basis for the Mediterranean's high biodiversity. Although introduction of alien species by humans is a priority problem to be addressed, preventing invasion by new species by natural means is not. Primary causes of decline in biodiversity include excess supply of nutrients, bottom fishing, by-catch, and degradation and uncontrolled human presence of breeding and / or nursery areas for marine pulmonata and fish, pollution, solid waste disposal, competing land uses including land reclamation, alteration of river flows and constituents, and introduction of alien species. Root causes for this concern include poor stakeholder awareness and participation, inadequate control over fishing effort and gear employed insufficient scientific knowledge and monitoring of the biodiversity in the region and related processes, as well as inadequate implementation of treaties and international agreements, lack of investment in wastewater treatment, and poor solid waste disposal practices.

Decline of seawater quality: Increasing trends in eutrophication and its related oxygen deficiency and bloom of nuisance species (e.g., jellies such as Pelagia

n*octiluca*); presence of hot spots of pollution leading to decline in biodiversity, fisheries, diseases or loss of health in marine organisms, and overall water quality; human health problems from consuming fish and shellfish or contacting polluted waters; loss of endangered species; and overall imbalance of some eco-tones (e.g., seagrass meadows) all result from decline in seawater and sediment quality. Although many of these effects are local in extent, they have transboundary consequences. Important transboundary consequences arise due to ocean currents transporting pollutants throughout the Sea; migration and transport of various life stages of marine organisms (e.g., dinoflagellate cysts) to other parts of the Sea from polluted areas; marine transport through shipping; and transport through the atmosphere.

Budgets for heavy metals, organochlorines, hydrocarbons, nutrients, pesticides, and other pollutants entering the Mediterranean Sea from land, from the atmosphere, and from sea (shipping), have already been developed. At the same time, limited but available data and observations on declining health of marine populations (ecotoxicology) linked to various pollutants point to ecosystem effects from declining seawater quality. Increases in frequency, intensity, duration, and spatial extent of eutrophication have raised alarms about pollution. A large number of land-based pollution hot spots has been identified around the Mediterranean. These hot spots were identified geographically, and classified as to cause of the hot spot (industry, sewage, agriculture, etc.). In addition to these hot spots, ecosystems have been identified that are associated with the hot spots with the highest pollutant loads.

Decline in fisheries: Various threats to fisheries include pollution, overfishing, loss of habitat, excessive by-catch, deleterious fishing gear, lack of enforcement of laws and agreements in the high seas, and sophisticated methods to find and catch fish. Concern has arisen that there is an underlying problem of long-term depletion in Mediterranean marine catches. In fact, most of the Mediterranean fishery resources, be they demersal, small pelagic or highly migratory species, have long been considered overexploited. The issue is transboundary because many fish are either migratory or represent shared stocks. Overall, the fisheries are overseen by the General Fisheries Commission for the Mediterranean (GFCM).

Fish catch information shows some remarkable constancy on time periods of decades, and even more so in years, fluctuating only by a factor of two or less in total catch. However, the number of fishing vessels has increased markedly during this time, increasing in some countries by a factor or three or four. Composition of the catch has also changed with time, though not as dramatically as in some areas such as the Yellow Sea. The most targeted species already show signs of intensive exploitation. Catch-per-unit effort (CPUE) and other measurements and biological indicators such as reduction of individual fish sizes led the GFCM to conclude that most of the commercial fish stocks are considered fully or over-exploited. Major causes of decline in fisheries include pollution (especially eutrophication leading to loss of suitable benthic habitat), loss of habitat, overfishing, antiquated (not habitat friendly) fishing methods (primarily in southern countries), overly sophisticated and hence efficient fishing methods (in some countries). Root causes include inadequate stakeholder awareness and involvement; lack of enforcement and monitoring; insufficient alternatives to fisheries employment; and lack of regulation in some countries.

Environmental impacts of decline in fisheries include imbalance in some ecosystems due to loss of top predators; other environmental impacts are related to fisheries impacts such as destruction of bottom habitat (seagrass beds) by bottom trawling and excessive bycatch including endangered species (such as turtles, scarce bird and elasmobranch species, etc.). Socio-economic impacts of declining fisheries include loss of income and employment; loss of cultural practices; possible decline in food security.

Human health risks: Chemical pollutants such as heavy metals, organochlorines, pesticides, and petroleum hydrocarbons, but also microbial and viral pollution may present risks to human health. In addition, the response of the ecosystem to stress may induce toxicity that may affect humans, such as toxic dinoflagellates that arise from eutrophic conditions in some instances. Primary pathways for human health risks include ingestion of water or seafood products, contact with contaminated seawater (or in some cases, beaches), and perhaps contact with contaminated sea food (for marine products workers). Those at risk include marine products workers, recreational beach users, swimmers, divers, and consumers of marine food products.

There are no ecosystem health risks arising from the human health risks (though the two are related). However, there are serious socio-economic impacts, such as loss of tourist revenue, loss of sales of marine products (such as when bivalves are contaminated and the industry is shut down), and loss of cultural use of the marine resources.

ANNEX VI

The main environmental Mediterranean issues of concern according to EEA (2006)

Sewage and urban run-off. From 601 coastal cities with a population of more than 10 000 inhabitants (total resident population of 58.7 million) only 69 % operate a wastewater treatment plant. However, the efficiency of the plants to remove pollutants is often rather low and inadequate. The problem is exacerbated by the rapid growth of many coastal cities and towns, especially on the southern Mediterranean coast.

Solid waste produced in urban centres along the Mediterranean coastline is often disposed of in dumping sites with minimal or no sanitary treatment. Discharge of fine solids from coastal industrial plants or discharge of inert material from construction activities may lead to blanketing of the sea-bed with land-based material.

Industrial effluents including oil processing. Most of the Mediterranean coastal areas host chemical and mining industries that produce significant amounts of **industrial wastes** (e.g. heavy metals, hazardous substances, and persistent organic pollutants (POPs) which may reach the marine environments of the Mediterranean Sea directly or indirectly (i.e. through rivers and run-offs). In addition, stockpiles of **obsolete chemicals** (such as POPs and pesticides) are considered a significant source of contaminants into the marine environment. Most of these compounds are presented during the discussion on the occurrence of POPs in the Mediterranean region. In many cases, no measures have been taken to control and treat leachates from the dumping sites which are polluting groundwater and/or the coastal marine environment with organic pollutants and heavy metals. Furthermore, accidental fires emit smoke particles, polycyclic aromatic hydrocarbons (PAHs) and dioxins, seriously affecting air quality.

Urbanisation of the coastline is one of the major problems in the Mediterranean region, often leading to loss of biodiversity due to habitat destruction and physical alteration. Problems related to the concretisation of the coastline are encountered through the Mediterranean. This is usually due to uncontrolled development, especially tourist infrastructure. Both wetland and salt-marsh destruction for land reclamation and mining of coastal resources (sand and rock quarrying) for construction needs are also altering irreparably the natural Mediterranean coastline.

Eutrophication is very common in sheltered marine water bodies such as harbours and semi-enclosed bays along the Mediterranean coast, mainly in the vicinity of coastal towns. Untreated or partly treated urban effluents contain significant loads of nutrients and suspended matter (degradable or inert). They largely contribute to the accumulation of deposits rich in organic matter and contaminated with metals and other pollutants.

Sand erosion is a common problem in many Mediterranean countries. Although it is rooted in natural causes, such as marine sediment transport, it can be amplified by human activities (e.g. sand quarrying). Sand erosion may have a multitude of impacts on the coastal ecosystem; destroying soil surface layers leading to groundwater pollution;

degrading the dune system leading to reduction of sedimentary resources; and desertification and reduction of biological diversity.

Marine transport is one of the main sources of petroleum hydrocarbon (crude oil) and PAH pollution in the Mediterranean Sea. It is estimated that about 220 000 vessels of more than 100 tonnes each cross the Mediterranean annually. These vessels discharge approximately 250,000 tonnes of oil due to shipping operations such as deballasting, tank washing, dry-docking, and fuel and oil discharges. In addition, approximately 80,000 tonnes of oil have been spilled in the years 1990–2005 from shipping accidents. Finally, incidents at oil terminals, together with routine discharges from land-based installations, are estimated at 120 000 tonnes/year, thus leading to elevated oil concentrations in their vicinity.

In addition to land-based and shipping-related threats, a number of issues have been recognised as being of concern to the health of marine ecosystems in the Mediterranean.

Biological invasions. Climatic changes in conjunction with deteriorated ecosystems near ports and lagoons have resulted in significant changes of biodiversity due to the introduction and establishment of exotic species. The majority of exotics are found in the eastern basin (Levantine). The introduction of exotic species (more than 600 records in 2004) is a dynamic non-stop process with approximately 15 new species reported each year. It is noteworthy that in the 21st century, 64 new species have been reported in the Mediterranean, 23 of them recorded in 2004.

Harmful Algal Blooms (HABs). In the Mediterranean, increasing appearance of HABs has led to significant public health problems caused by the consumption of seafood contaminated by toxic algae. Based on the outcome of the EU-funded research project ECOHARM, it has been estimated that the socio-economic impact of HABs for three evaluated Mediterranean countries — Italy, Greece and France — was around 329 million euro per year.

Exploitation of marine resources. Fishing down the marine food web has a negative impact on whole ecosystems. According to the FAO fisheries statistics, the mean trophic level of Mediterranean catches has declined by about one level during the last 50 years, e.g. there has been a significant loss of top predators from the ecosystem. Another documented impact of fishing relates to changes observed in the structure of fish populations. Demersal stocks in the Mediterranean are dominated by young fish indicative of high fishing pressure. There is a high economic interest in small fish, leading to high catches of undersized fish in some bottom trawl-fisheries. High discard rates of undersized targeted species are also contributing to a loss of biodiversity of non-target species.

Expansion of aquaculture. According to UNEP/MAP/MEDPOL, intensive aquaculture is 'undoubtedly a matter of concern for the Mediterranean', for a regional sea where aquaculture increased overall from 19 997 tonnes in 1970 to 339 185 in 2002. The changes in diversity (reduction in abundance, diversity and biomass of macrofauna and flora as well as in abundance and diversity of organisms living in the sediments and bottom habitats) are among the negative effects of aquaculture that have been

documented. However, severe effects are generally confined to local areas, i.e. a few hundred metres at most. Recovery of the local ecosystem, albeit at slow rates, can follow if the farm operation ceases.

Natural hazards. The social and economic impacts of major earthquakes can be devastating, particularly in coastal urban areas. Enhanced seismicity in certain Mediterranean regions and subsequent tsunami activity intensifies the need for better coastal protection.

ANNEX VII

Different management tools according to ICES (2005)

(1) **Input controls**. Management measures that influence the amount of a human activity that is permitted. These include controls on emission levels of contaminants, on fishing capacity and activity, on numbers of tourists, and on vessel sizes or numbers in shipping.

(2) Output controls. Management measures that influence the degree of perturbation of an ecosystem component that is permitted. Controls include nutrient input limits for land-based activities, limits of concentration of contaminants in water, sediment, and biota, allowable catches and by-catch limits in fisheries, tonnage allowances in sediment extraction, regulation of coastal development, tourism, and ballast water exchanges rules for shipping.

(3) **Spatial and temporal distribution controls**. Management measures which influence where and when an activity is allowed to occur. These include regulations for the localization of industrial installations, closed areas for fisheries, defined shipping lanes for transportation, and zoning and marine protected areas for regulation of multiple uses.

(4) **Integrated planning tools.** These are not management *measures*, but are tools to ensure that management is coordinated. Coordination can be achieved by using integrated planning mechanisms that ensure that management actions complement each other both across multiple human activities and diverse ecosystem effects. Integrated planning tools include strategic environmental assessment, integrated coastal zone management, and systems of spatial planning**.** It is important that these Integrated Tools take full account of land-based activities that affect marine ecosystems.

(5) **Remediation tools**. Management tools which guide human activities to restore damaged components of marine ecosystems. These include clean-up operations on polluted sites, recovery plans for species at risk and for depleted fish stocks, and shoreline restoration programmes for damaged habitats.

(6) **Economic incentives.** Management measures which make it in the economic interest of those using the marine ecosystem to act in ways which help to achieve the ecological objectives for the ecosystem, rather than pursue selfish goals. Eco-certification schemes and economic sector-based instruments such as the FAO Code of Conduct have both contributed to placing fisheries in a broader ecosystem context. Such tools have the potential to integrate the planning and management of other human activities as well.

ANNEX VIII

Tests proposed by ICES (2005) for checking the progress towards the implementation of the ecosystem approach

1. Have management regions with unambiguous boundaries been defined and have responsibilities for the management of all activities at all scales been identified?

2. Has the current status of the ecosystem been described and contrasted with the Vision?

3. Have the properties of the ecosystem and the associated threats been fully documented and likely additive or synergistic threats identified?

4. Have ecological objectives and operational objectives with appropriate properties (SMART) been identified and agreed in all regions, based on an inclusive and consultative process?

5. Have all incompatibilities of ecological objectives, operational objectives, and scales of management been identified and rectified?

6. Have indicators, limits, and targets been established for each operational objective and are they inter-compatible?

7. Have sufficient management tools to support the operational objectives been identified and put in place?

8. Will all proposed management tools be effective in supporting the ecological objectives and operational objectives of management and are the management methods coordinated and compatible?

9. Has a process for providing quality-controlled supporting science been established, and is there a clear route by which the science is fed into the decision-making process?

10. Is the science advice supported by adequate monitoring and assessment and are the monitoring and assessment procedures also quality controlled?

11. Has a process for management feedback and decision-making been established and will it ensure ongoing compatibility of management methods?

ANNEX IX

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