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Sub-regional report on the "Identification of important ecosystem properties and assessment of ecological status and pressures to the Mediterranean marine and coastal biodiversity in the Ionian Sea and Central Mediterranean"

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INTRODUCTORY NOTE

At their Fifteenth Meeting of the Contracting Parties to the Barcelona Convention (Almeria, Spain, 15-18 January 2008), the Contracting Parties decided to gradually apply the ecosystem approach to managing the human activities that could affect the Mediterranean's marine and coastal environment (Decision IG 17/6). They even set up a 7-phase road map for the gradual application of the approach.

The present report was crafted as part of RAC/SPA's active involvement in the process, and its contribution to carry out Step 3 of the road map, which consists of identifying the ecosystem's important properties and assessing the state of the environment and the pressure exerted on it. This contribution particularly involves assessing the ecological state and pressure exercised on marine and coastal biodiversity in the Ionian sea and the Central Mediterranean.

The document summaries and extrapolates to the countries of Ionian Sea and the Central Mediterranean, the ideas presented in the national reviews.

- Greece (Ionian sea), prepared by Argyrou Zenetos
- Libya, prepared by Esmail Shugman,
- Tunisia (eastern and southern areas), prepared by Mohamed Salah Romdhane

For Italy and Malta, there has been no recruitment of National Consultants. Thus, no reports have been prepared and the information included in the present document regarding these two countries, when available, are taken from:

- National Action Plans and Reports prepared as part of the Strategic Action Programme for the Conservation of Marine and Coastal Biodiversity in the Mediterranean Region (SAP BIO);
- RAC/SPA's 2009 national reports on vulnerability and the impacts of climate change on marine and coastal biodiversity in the Mediterranean;

When crafting the national reviews, the authors informed and consulted the various national leaders (SPA Focal Points, national correspondents for SAP BIO, ministries,...) plus many national experts. However, the thoughts and suggestions included in the national reviews remain the opinions of experts.

Thus, the present document is a summary of the state of the ecosystems in the Ionian sea and the Central Mediterranean, particularly the biological features and types of habitat that exist there. A second part deals with the analysis of the pressures and impacts on these ecosystems, essentially as regards biological disturbance and emerging problems such as the effects of climate change and modifications of the deep sea ecosystems, given the interest they are arousing worldwide.

This report was drafted for the Regional Activity Centre for Specially Protected Areas (RAC/SPA), by Mr Sami Ben Haj (International Consultant, Cabinet Thetis, Bizerta, Tunisia), supported by Atef Limam (RAC/SPA Project officer) and Daniel Cebrian (SAP BIO Programme officer).

METHODOLOGY

Participatory approach

To carry out step 3 of the road map for applying the ecosystem approach, related to identifying the important properties of the ecosystem and assessing the state of the environment and the pressure exerted on it, the Mediterranean Sea was subdivided into four regions, as a result of a consensus based on biogeographical and oceanographic considerations (2nd Meeting of Government-designated Experts on the Application of the Ecosystem Approach, Athens, 9-10 July 2008). The four regions identified are (i) Region 1: Western Mediterranean; (ii) Region 2: Adriatic Sea; (iii) Region 3: Ionian Sea and central Mediterranean; and (iv) Region 4: Aegean Sea-Levant Sea.

All the Mediterranean countries in their quality as Contracting Parties to the Barcelona Convention were invited to take part in this process, to reach the major objective of Step 3 of the road map, which consists of conferring with each other and gathering pertinent data and recommendations at national, sub-regional and regional level.

The Mediterranean countries were distributed around the four biogeographical and oceanographic regions as follows:

(i) Western Mediterranean: Algeria, France, Italy (Tyrrhenian-Ligurian area), Monaco, Morocco, northern Tunisia and Spain
(ii) Region 2 (Adriatic Sea): Albania, Bosnia Herzegovina, Croatia, Italy (Adriatic Sea), Montenegro and Slovenia
(iii) Region 3 (Ionian Sea and central Mediterranean): Greece (Ionian Sea), Italy (Ionian Sea), Libya, Malta and eastern and southern Tunisia, and
(iv) Region 4 (Aegean Sea-Levant Sea): Cyprus, Egypt, Greece (Aegean and Cretan Seas), Israel, Lebanon, Syria and Turkey.

The national consultants were selected in close consultation with the SAP BIO National Consultants and the SPA/BD Protocol's National Focal Points to ensure an assessment at national level.

For the Ionian Sea and central Mediterranean, in Greece (Ionian Sea), Libya and Tunisia (eastern and southern Tunisia), National Consultants were hired right from the start of the process. For Italy and Malta, there has been no recruitment of National Consultants.

At sub-regional level, the role as sub-regional consultant is to give the necessary technical assistance to the National Consultants to draft the national reports and to draw up a sub-regional assessment documents regarding the Ionian Sea and central Mediterranean sub-region.

Tasks and anticipated outcomes

1. National level

Each National Consultant has to draft a national report on an assessment of the state of the ecology and identification of any lacunae concerning the major properties of the ecosystems and associated pressures. The parts to be prepared deal with (i) a section on the state of the ecosystems, particularly their biological features and habitat types, and (ii) a section on pressures and impacts involving biological disturbance and emerging problems such as the effects of climate change and modifications of deep sea ecosystems.

2. Sub-regional level

The Sub-regional Consultant is responsible for (i) coordinating, assisting, guiding and harmonizing the work of the National Consultants in the region under his responsibility, (ii) looking into, revising and ensuring the consistency of the received inputs, and (iii) preparing a consistent draft report for each sub-region and presenting this to RAC/SPA, and then finalizing it in compliance with the remarks made at possible work meetings and RAC/SPA's recommendations.

RAC/SPA has provided the various actors with the necessary advice and directives and helped in harmonizing the work and the inputs. It has indeed provided annotated contents and structures of the national and sub-regional reports.

1. CONTEXT

The ecosystem approach was introduced to improve the way in which human activities are managed in order to protect the natural environment. As with the World Summit on Sustainable Development (Johannesburg 2002), the ecosystem approach has been adopted by many international conventions and regional seas organisations. Its implementing aims to help reach a balance between the needs of human activities and the conservation of the natural environment.

Box 1: The 12 principles of the Ecosystem Approach (CBD Secretariat, 2004)

Principle 1: The objectives of management of land, water and living resources are a matter of societal choice
Principle 2: Management should be decentralized to the lowest appropriate level
Principle 3: Managers should consider the effects of their activities on adjacent and other ecosystems
Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any management programme should:

a) reduce market imbalances which have harmful effects on biological diversity
b) harmonize incentives to encourage the conservation and the sustainable use of biological diversity
c) as far as possible, integrate the costs and advantages within the managed ecosystem.

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target
Principle 6: Ecosystems must be managed within the limits of their functioning
Principle 7: Action should be undertaken at the appropriate spatial and temporal scales
Principle 8: Objectives for ecosystem management should be set for the long term
Principle 9: Management must recognize that change is inevitable
Principle 10: Action should seek the appropriate balance between, and integration of, conservation and use of biological diversity
Principle 11: Action should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices
Principle 12: The approach should involve all relevant stakeholders of society and scientific disciplines

The Mediterranean, an ecoregion that is remarkable for its climate and the common sea that links three continents, for the richness of its biodiversity, for its classical heritage and the diversity of its landscapes and its cultural places (UNEP/MAP-Plan Bleu, 2009)..

The Mediterranean sea shows the importance of the sustainability of use of goods and services and the potential interest in applying an ecosystem approach and conservation- and management-related measures not only to the areas under state jurisdiction but also to the habitats and ecosystems that lie in waters outside national jurisdiction.

The Central and Ionian Mediterranean

The shores and marine areas of the Ionian Sea and Central Mediterranean contain a rich and extremely diversified biodiversity. This heritage is already subjected to great pressure deriving mainly from the human activities that contribute to its erosion.

The central area of the Mediterranean is a transitory zone between the occidental basin, under Atlantic influence and the oriental basin, under the influence of changes between the red sea and the Mediterranean and incomes of the black sea on the other hand.

On this account, the Contracting Parties to the Barcelona Convention, in their Almeria Meeting (15-18 January 2008) decided to gradually apply the ecosystem approach to the management of human activities that could affect the Mediterranean marine and coastal environment (Decision IG 17/6) and adopted a road map for this purpose (Box 2 below).

Box 2: Steps of the ecosystem approach road map (ECAP)

The ECAP road map adopted by Decision IG 17/6 of the 15th Meeting of Contracting Parties (2008) consisted of the following 7 steps:

Step1: Definition of an ecological Vision for the Mediterranean.

Step 2: Setting of common Mediterranean strategic goals.

Step3: Identification of important ecosystem properties and assessment of ecological status and pressures*.

Step 4: Development of a set of ecological objectives corresponding to the Vision and strategic goals.

Step 5: Derivation of operational objectives with indicators and target levels.

Step 6: Revision of existing monitoring programmes for ongoing assessment and regular updating of targets.

Step 7: Development and review of relevant action plans and programs.

Step 3 of the road map aims at identifying the major properties of the ecosystems and assessing the state of the ecology and pressures has also been discussed and is being implemented. RAC/SPA has been actively involved in the phases of this approach, in particular as regards Phase 3 of the road map, and it is in this context that the present document has been prepared as RAC/SPA's contribution to this phase.

This contribution consists of preparing a sub-regional documents on 'identifying major properties of the ecosystems and assessing the state of the environment and the pressures exercised on marine and coastal biodiversity in the Ionian sea and the Central Mediterranean', as described in the methodological approach.

In joint agreement with the other MAP elements, the sections handled by RAC/SPA in the present report basically dealt with (i) the state of the ecosystems, especially their biological features and habitat types, and (ii) pressures and impacts, particularly biological disturbance, and emerging issues like the effects of climate change and modifications of the deep sea ecosystems.

* From this step onwards, it is necessary to consider the appropriate spatial and temporal scale of application of the approach

2. SCIENTIFIC KNOWLEDGE AND AVAILABLE INFORMATION

2.1. Reference documents and available information

RAC/SPA made available to all the national and sub-regional consultants a wide variety of pertinent documents having international, regional, sub-regional and national pertinence.

A particular attention was paid to the :

- National Action Plans and Reports prepared as part of the Strategic Action Programme for the Conservation of Marine and Coastal Biodiversity in the Mediterranean Region (SAP BIO);
- RAC/SPA's 2009 national, sub-regional and regional synthesis reports on vulnerability and the impacts of climate change on marine and coastal biodiversity in the Mediterranean;
- Reports defining and explaining the ecosystem approach – how it works and is implemented

On the basis of these documents, important information, especially very recent information on the state of the ecosystems, impacts and pressures, was gathered and integrated within the national reports. The documents also constituted a source of vital information for identifying gaps noticed as regards knowledge, funding issues, the expression of urgent actions and needs, conclusions and recommendations.

Documents defining and dealing with the ecosystem approach as a concept were also used by the national experts to set the crafting of the documents within this context. Integrating this conceptual information underlies the entire process as undertaken by RAC/SPA in this third phase of the road map, and will enable the products expected from this activity (national and sub-regional contributions) to be grasped within this perspective. The document produced by the CBD[1] Secretariat is in itself an excellent reference work.

Detailed information of local and national pertinence used in this document mostly comes from the national contributions devoted to the ecosystem approach in Greece, Libya and Tunisia. For Italy and Malta, informations of local and national coastal and marine biodiversity come from national reports devoted to the effects of climate change on marine and coastal biodiversity

2.2. Comments

In the bulk, the documentary base used and the knowledge available is relatively rich, especially that on biodiversity and those on pressures and impacts, but disparities and gaps still exist at both national and sub-regional level:

[1] The Secretariat of the Convention on Biological Diversity (2004), Approach by Ecosystem (CBD Guidelines), Montreal: Secretariat of the Convention on Biological Diversity, 51 p.

Variable availability of information at geographical level

- From one country to the next, the information needed for documentation for the national documents sometimes appears in documents that are difficult to access
- The bibliographical references used vary from one national contribution to the next;

Variable availability of information at subject level

- The number of subject-based or sector-based bibliographic sources varies considerably from country to country and subject to subject. This variability results from the disparity of national capacities generally and the relative availability of specialists for certain subjects. Some subjects are sometimes not well documented because they are expensive to handle or require equipment that is not available to certain countries or regions
- For some countries, priority issues are linked to natural resources of commercial interest, and most of the means are devoted to such aspects
- The inventories and data are fragmentary and often do not concern the totality of the marine and coastal places
- Data and cartography is very poor concerning issues related to high seas and deep seas (status, pressures and impacts)

3. STATUS OF COASTAL AND MARINE ECOSYSTEMS

3.1. Biological characteristics

Similar to the whole Mediterranean, biodiversity hotspots in the Ionian sea and the Central Mediterranean are characterized by both high levels of endemism and critical levels of habitat loss, and it is thus on them that conservation efforts mainly focus.

This high biological diversity is to be related to the specific geomorphological and hydrographical features of the Mediterranean basin, its geological history and its position as interface between temperate and tropical biomes that allow it to host both cold- and hot-affinity species (UNEP/MAP-Blue Plan, 2009).

The Central Mediterranean, as same as the whole Mediterranean, is currently experiencing a decline in the number of species and a deterioration of habitats, related to various human-origin activities, basically uncontrolled urbanization and coastal development, ports, fish farming, pollution and fishing.

In the sections below, a synthesis summary will be given regarding each item followed by a summary of the main features and characteristics that have been presented in the available national reports. For Malta and Italy, there were no available national reports, a tentative of synthesis will be done, when possible based on the information taken from the National Action Plans and Reports prepared as part of the Strategic Action Programme for the Conservation of Marine and Coastal Biodiversity in the Mediterranean Region (SAP BIO) and also RAC/SPA's 2009 national reports on vulnerability and the impacts of climate change on marine and coastal biodiversity in the Mediterranean;

3.1.1. Description of water column biological communities (basically phyto- and zooplankton)

Broadly speaking in the Ionian sea and the Central Mediterranean, the planktonic element (phytoplankton and zooplankton) remains little studied. In general, there is a low primary production, linked to low development of the higher levels of the trophic chain, including low production of fishes, are the main features that characterize the Mediterranean. The growth in oligotrophy from the west to the east is reflected in the abundance of the zooplanktonic biomass.

'Bloom'/proliferation of certain life forms in the has become increasingly common over the past few years, in the Gulf of Gabes in the southern area of Tunisia.

Greece:

- Both the Ionian and the Aegean offshore waters are oligotrophic, while most coastal areas are mesotrophic (Gotsis-Skretas and Ignatiades, 2007; Siokou-Frangou *et al*., 2005).
- Within the pelagic food web mesozooplankton is the link between the lower level producers (phytoplankton, microbes) and the top predators (fish)

- Mesozooplankton abundance and biomass and species composition present the same trends of the rest of the Mediterranean; enclosed or semi-enclosed bays and gulfs affected by anthropogenic inputs, such as the Amvrakikos (Ionian Sea) and Thermaikos as well as Elefsis Bay are the most productive whereas in offshore waters, the Ionian sea is characterized by a low mesozooplankton abundance values.

Libya:

- No comprehensive study has been done on the Libyan coast about plankton,
- The last survey done in the Libyan coast (Med-Sud-Med 2006) pointed out that the phytoplankton of the Libyan western coast is characterized by abundant diatoms and dinoflagellates, rare coccolithophores and very rare Silicotlagellates. A very high concentration of phytoplankton is located in Musrata area with diatoms are the most dominant phytoplankton, followed by coccolithophores and then Silicoflagellates.
- As for the Zooplankton, few studies have been undertaken. The Med-Sud-Med 2006 survey have focused on the location areas of major concentration of Ichthyoplankton (eggs, and larvae of fish). The predominant species recorded were anchovy (Engraulis encrasicolus) representing 51% of the collected larvae, round sardine (Sardinella aurita) with 9.6% of the larvae and minor fraction of other species (Serranidae, Gobidae and Labridae).

Tunisia:

Phytoplankton

- On the specific level, the number of phytoplankton species identified in Tunisia is about 493 species distributed over 11 groups and mainly dominated by *dinoflagellates (259 species) and diatoms (198 species)*
- In the Gulf of Gabes, the summer season characterized by high temperatures and salinity, promotes stratification of the water column and induces the appearance of phytoplankton blooms with prominent presence of dinoflagellates, diatoms and cyanobacteria,
- The phenomena of phytoplankton blooms have been recorded, however. Summer 1994 seems to be the most momentous season in the Gulf of Gabes. These episodes accompanied by a mortality and stranding large quantities of fish (eels, cuttlefish ...). The phenomenon had continued for a week and microscopic observation revealed the proliferation of a monospecific population of *Gymnodinium* sp. very similar to *Gymnodinium nagasakiense.* The highest concentrations are recorded in the order of 4 to 6 ×. 10^{7} cells. $l^{-1.}$ In the Offshore area of Kerkennah islands, an overgrowth of cyanobacteria of the genus *Trichodesmium* (called "Muffa") is common
- Generally in the Gulf of Gabes, the confined areas or tidal lagoons often show signs of eutrophication, such as the case of the Sea Bougrara where level of chlorophyll a is moderate to fairly high, plankton communities are typically Mediterranean with some alien species including dinoflagellates.
- In Tunisia, a national network for monitoring of production areas of bivalve mollusks has been established since 1995 to ensure continuous monitoring of toxic plankton.

Zooplankton

- The Zooplankton of Tunisian coast is quite diverse, represented by 269 species distributed over 23 groups dominated by tintinnids and copepods,
- In the Gulf of Gabes, the zooplankton is distributed over 11 groups dominated by copepods, which represent 69-83% of the total zooplankton. Both species *Oithona nana* and *Acartia clausi are* particularly abundant along the coast and up to 50 m depth.

3.1.2. Information on invertebrate bottom fauna, macro-algae and angiosperms

A large number of invertebrate bottom fauna, macro-algae and angiosperms groups have been studied:

Greece:

- *Polychaeta :*According to an annotated list of Polychaetes found in the Hellenic marine waters, 220 species are found in the Ionian Sea and 13 of them are exclusively reported from the Ionian Sea. Most of them characterize sandy, biogenic and generally coarse substrate reflecting high dynamic littoral environment or angiosperm coverage.
- Mollusca: A total of 1160 mollusc species have been recorded so far in Hellenic seas with an increasing trend in bivalvia species recorded in Hellenic waters is most apparent since 1980.
- Crustacea: In a recent assessment of the decapod fauna of Hellenic waters (Kitsos, *et al.,* 2006), a total of 250 species was recorded with the predominance of the true crabs (brachyurans) followed by caridean shrimps and anomurans(hermit crabs, squat lobsters).
- *Anthozoa:* Contrary to the Aegean Sea, the anthozoan diversity of this region, and especially its deeper parts, is yet to be explored (Vafidis *et al.*, 2006; Salomidi *et al.*, 2010).
- *Porifera:* Much of our knowledge on the Ionian sponge fauna comes from the Italian coasts, while the Hellenic (eastern) Ionian side remains poorly known, with only few and scattered relevant information (e.g. Tsoukatou *et al.*, 2003; Vacelet *et al.*, 2008;)
- *Macroalgae:* Case studies in the Hellenic part of the Ionian Sea estimated similar (163 taxa; Tsekos and Haritonidis 1977) or higher (265 taxa; Schnetter and Schnetter 1981) trend in seaweed diversity than in Aegean.
- *Seagrasses:* On soft substrates of the Ionian the angiosperms *Posidonia oceanica* and *Cymodocea nodosa* are widespread, whereas the angiosperms *Zostera noltii* and *Halophila stipulacea* are restricted to specific areas.

Libya:

Studies regarding these aspects have to be conducted to further investigate the Libyan costs. The results coming from few studies have revealed the following:

- About 24 species of the cephalopods were recorded in the Libyan coast (Ben Abdalha et al., in press), belonging to 8 families and 3 orders. Although most of these species are commercial and have economic value in the Libyan market, no comprehensive study exists about these specie till now.
- The study that has been done from Al-Gomas to Musrata regarding sponges reported many species such as the economic species Spongia afficinalis and Hippospngia communis and other species like Arcorina cerebum, Axinella sp, Petrosia sp and Calyx nicaensis (Report 2009, MBRC).
- In the western part of the Libyan coast, 38 species of mollusca were found in the rocky zones, (27 Gastropoda, 10 Bivalva and 1 Polyplacophora). 37 species of Crustaceans were recorded (6 Isopoda, 23 Decapoda, 7 Amphipoda and 1 Balanomorpha).
- The macroalga diversity in Libya is not rich. Fifteen genera (29 species) of Chlorophyta, 19 genera (34 species) of Phaeophyta, 76 genera (112 species) of Rhodophyta and 2 genera of Cyanophyta (3 species) were recorded according to Nizamaldeen (1979). Introduced species have been also recorded such as *Halophila stipulacea* in Ain-Al-Ghazala marine area, introduced from the Red sea through the Suez canal and *Halimeda sp*.

Tunisia:

- Sponges: Sponges are represented in an uneven manner across the regions of Tunisia; the southern region is the richest at both generic and specific levels. 115 species of sponges are identified in the eastern and southern Tunisia. Among the Tunisia sponges, at least six species are considered as endangered or threatened species including *Aplysina sp. , Axinella cannabina, Axinella polypoid, Geodia cydonium, Tethya Ircinia and foetida sp.* Ten species are designated as protected by the SPA/BD of the Barcelona Convention, namely *Aplysina aerophobia, Axinella polypoid, Geodia cynodium, Hyppospongia communis, Ircinia foetida, Spongia agaricina, S. officinalis, S. zimocca, T. citrina and Tethya auranium. One specie, Calyx nicaeensis* deserves also to be protected according to Tunisian experts

- Echinodermata: In Eastern and Southern regions of Tunisia, studies revealed the presence of 52 species of echinoderms. Three species are mentioned in lists of the Barcelona Convention *(Asterina Panceri, Centrostephanus longispinus, Paracentrotus lividus).* One species *(Hacelia attenuata)* and the type Holothuria are on the specific Tunisian list of species to be protected. Only *Centrostephanus longispinus* is considered threatened in the Mediterranean (Annex 1 of the SPA/BD protocol)

- Annelids: Annelids specified in the eastern and southern regions amounted to 105 species. The sedentary polychaete annelids represent 64% of the total annelids against 35% of errant polychaetes and 1% of oligochaetes.

- Bryozoans: In Eastern and Southern regions, 83 bryozoans are identified. *Hornera lichenoides* is listed in Annex II of the SPA/BD protocol of the Barcelona Convention, while Electra posidoniae, Pentapora fascialis and Reteporella grimaldii appear into the specific Tunisian list of species to be protected.

- Mollusks: In Eastern and South regions, 328 species are recorded, distributed in 188 snails, 126 bivalves, 6 Polyplacophora, 4 scaphopods and 4 cephalopods. Seven species have heritage value and are subject to protection state, namely *Luria lurida, Tonna galea, Zonaria pyrum, Pinna nobilis, Pinna rudis, Haliotis tuberculata and Spondylus gaederopus.* Thirteen introduced species are reported in the Gabes Gulf, namely *Cellana radiata radiata, Crepidula fornicata, Cerithium scabridum, Erosaria Turdus, Bursatella leachii, Acteocina mucronata, Chromodoris quadricolor, Melibea viridis, Musculista senhousia, Crasostrea gigas, Pinctada radiata, Fulvia fragilis and Ruditapes philippinarum).* Among these shellfish, octopus, cuttlefish, squid, clams and snails are commonly used as a fishing product in this region.

- Crustaceans: For crustaceans, various groups were studied for exploitation and management. A total of 167 species of crustaceans are identified in the Gulf of Gabes. Two species of amphipods and isopods, Ten inventoried in the Gulf, are exotic. Penaeus kerathurus is considered as a species to be protected by the Tunisian experts while Maja squinado is listed on Annex III of the SPA/BD protocol of the Barcelona Convention.

- The Ascidians: 77 ascidians are present in the Gulf of Gabes. Only four species are listed as Tunisia species that deserve protection: *Clavelina nana, Halocynthia papillosa, Microcosmus sabatieri* and *Microcosmus vulgaris.* Two exotic species are reported, namely *Cystodytes philippinensis and Microcosmus exasperatus*

3.1.3. Information on vertebrates other than fish

Greece:

- In Hellas, the population of the monk seal (*Monachus monachus*) is estimated to represent ca 90% of its total Mediterranean abundance (Notarbartolo di Sciara *et al.*, 2009). Although the Aegean Sea is known to be one of the most important areas for the species' conservation worldwide (Cebrian et al 1995), an approximate 15-20% of the Hellenic population lives and breeds in the Ionian Sea (Cebrian 1998a). The best studied seal concentrations until now are those found along the coasts of Zakynthos, Kefallonia, Ithaca and Lefkada islands (Panou *et al.* 1993, Cebrian 1998b).
- The Ionian Sea, hosts an important part of the total Mediterranean populations of the sperm whale (*Physeter macrocephalus*), the bottlenose dolphin (*Tursiops truncatus*) and the common dolphin (*Delphinus delphis*). Regarding the latter, the Inner Ionian Archipelagos - a Natura 2000 Site of Community Importance- used to be one of the last places in the central Mediterranean Sea where abundant common dolphins would be found (Politi *et al.* 1999). However Bearzi *et al.* (2008) showed recently a dramatic decline of the species' local population (from 150 to 15 recorded individuals in the last 13 years), urging for direct management measures for the conservation of this endangered species. Another exceptional and rare characteristic of the cetacean fauna of the Ionian Sea, is the permanent presence of mixed groups of striped dolphins with short-beaked common dolphins and even -occasionally- Risso's dolphins in the semi-enclosed Korinthiakos Gulf (Frantzis & Herzing, 2002).
- Three species of marine turtles, namely the loggerhead turtle *Caretta caretta*, the green turtle *Chelonia mydas*, and the leatherback turtle *Dermochelys coriacea* are encountered in the Hellenic seas. *For the* loggerhead populations (*Caretta caretta)* in the Mediterranean Hellas is among the major nesting sites (Margaritoulis, 2007). According to same source, one among the highest nest density, is Laganas Bay on the Ionian island of Zakynthos. Other nesting areas are found in Peloponessos (Bay of Kyparissia, Bay of Lakonikos). For the foraging species available data from Hellas indicate that juvenile green turtles (C. *mydas)* have been recently identified in Lakonikos Bay, southern Hellas (Margaritoulis, 2007).

Libya:

- As regards the marine mammals in Libya, there is a vast gap of knowledge and very few studies or confirmed observations.
- Eight species of cetaceans are present in Libya, namely: Striped Dolphin (*Stenella coeruleoalba),* Sperm Whale (*Physeter macrocephalus),* Risso's Dolphin (*Grampus griseus),* Pilot Whale (*Globicephala melas),* Bottlenose Dolphin (*Tursiops truncates*), Cuvier's beaked whale (*Ziphius cavirostris*), Common Dolphin (*Delphinus delphus*) and Fin Whale (*Balenoptera Physalus)*. Except for bottlenose and striped dolphins, all of the other species are mainly offshore and seldom found near the coast.
- Regarding the Monk Seal, there are only few documented sightings for this species in Libya and mostly in the areas of Tubruk and Bombah gulf (60 km east of Derna) (Norris1972; Sergeant et al., 1978; UNEP 2003). In the Green Mountain, there are two areas that might still hold a potential habitat for the Monk Seal. The first one is between Derna and Rass Ateen and the second is between Haboon and Al-Uglah. The shear costal cliffs of these areas hold caves that can be used by this species for breading and resting. There is a running project at the moment between EGA, IFAW and UNEP-MAP-RAC/SPA to fit camera traps in selected caves in order to monitor the population (Hamza et al., 2003).

- Concerning the sea turtles, the Gulf of Sirt is considered as the most important area for sea turtle feeding, wintering and breeding on the national level. Thus, Environment General Authority (EGA) have started an initiative to protect three nesting beaches in west of Sirt (Libyan Sea-turtle Program). Finally, In April 2006 (prior to nesting season) two loggerhead females and one male were released with satellite transmitters from Gulf of Sirt area. The two females remained around the Gulf area, whereas The male headed north to Italian waters (Pers. Comm., Hamza, 2007).
- Aquatic birds: A regular survey of birds in Libya has started on 2005 aiming at the census of the wintering birds along the coast of Libya. This project is conducted by local and international team and sponsored by EGA, UNEP-MAP-RAC/SPA and AEWA. The objectives of these surveys (2005 – 2010) were to investigate whether a critical threatened species Slender – billed Curlew exist in Libyan habitat and accounting water birds wintering in Libya.

Tunisia:

- The sea turtles present in Tunisia are mainly present in the east and south of the country. They include *Caretta caretta* (common in Tunisia), *Chelonia mydas* (rare species) *and Dermochelys coriacea* (regularly observed).
- Mammals observed in the region are Minke whale *(Balaenoptera acutorostrata),* the fin whale *(Balaenoptera physalus),* the Risso's dolphin *(Grampus griseus),* the Humpback whale *(Megaptera novaeangliae),* the Striped dolphin *(Stenella coeruleoalba),* the bottlenose dolphin *(Tursiops truncatus);* these mammals are rather large pelagic, some may attend coastal waters for food. Apart from the common dolphin, the other species are rare to very rare.
- Aquatic birds: Tunisia is an important wintering site for Palearctic waterbirds and an important port of call for trans-Saharan-Palaearctic migration. However, studies on biodiversity of aquatic birds are limited.

3.1.4. Temporal occurrence, abundance and spatial distribution of exotic, non-indigenous and invasive species

Same as habitat destruction through pollution or anthropogenic effects, the introduction of species is considered as a nuisance and disruption to biodiversity.
The number of introduced species in the Mediterranean has increased spectacularly since the start of the last century. Their distribution varies from country to country. They have been mainly introduced through two pathways: (i) by maritime transport and fish farming and (ii) through the Suez Canal.

Greece:

- In the Hellenic Ionian Sea, 60 alien species have been recorded. they are in all belonging mostly to zoobenthos (24 Species) and phytobenthos (18 species).
- Studies directly investigating the impact of alien species on the diversity of native biota as well as socio-economic impact of invasive alien species are missing.
- Monitoring of alien species and their impact in hot spot areas for biological introductions such as ports and lagoons none exists.

Libya:

- In the Libyan coast, 22 exotic fish species have been recorded
- Most of the studies have focused on the Lessepsian fish species, Status, Biology, Ecology (Shakman, 2008).
- In the Libyan coast, the most abundant herbivorous fish were the Indo-Pacific fish species S. rivulatus and S. luridus, which are more numerous than the native fish species S. cretense and S. salpa (Shakman and Kinzelbach, 2007b).
- Two ectoparasite species Anilocra physodes (Linnaeus, 1758) and Nerocila bivittata (Risso 1816) belonging to the subfamily Anilocrinae are the first records of cymothoids from the Libyan fauna.

Tunisia:

- Introductions recorded in Tunisia come mainly through the Suez Canal and the Strait of Gibraltar (Indo-Pacific marine species and Eritrean origin or Atlantic)
- Besides the Suez Canal and the Strait of Gibraltar, other routes of introduction are identified:
    - Clinging or fouling (on the hulls of ships)
    - Ballast water
    - Leaks from aquaculture
    - The accidental introduction of species
    - The unknown vectors
- Introduced species in Tunisia are mainly observed in the Gulf of Gabès, which has suffered from the consequences of several disturbances and changes in habitats. Introduced species have increasingly recorded in recent decades, probably due to of maritime traffic, accidental introductions or ballast water.

3.1.5. Fish including mollusks and shellfish species of commercial interest

In the Central Mediterranean, marine fisheries are characterized by a large number of species caught per main fishing gear (i.e. multi-species fisheries) as well as by a variety of species that are exploited concurrently by different fishing gears (i.e. multi-gear fisheries)

Fish farming is a relatively ancient practice in the Mediterranean basin. It has expanded enormously since the 1990s, particularly marine fish farming. This involves farming the gilthead sea bream Sparus aurata, the sea bass Dicentrarchus labrax, the mussel Mytilus galloprovincialis and the flat oyster Crassostrea gigas. Greece is the first offshore marine fish farming producer country in the sub-region but also in the whole Mediterranean with over 120,000 tons per year of sea bass and gilthead sea bream. As for the raising of bivalve molluscs, mussels and flat oysters hold respectively first and second place.

Greece:

Existing fishery assessments from research surveys indicate that most of the existing stocks are being overfished. This is causing growing concerns with regard to the sustainability of both commercial catches and the aquatic ecosystem from which they are extracted, as well as to safeguarding the livelihoods of fishermen. Fishing impact on the demersal resources of Hellenic waters could be considered strong for depths shallower than 500 m. Deep water fisheries in the Ionian recently under exploitation deserve proper ecosystem approach management.

- *Fish:* The Hellenic Seas are characterized by a thermophilic tropical and subtropical fish fauna originating from two different sources: i) relicts of the Tethys Sea and ii) immigrants of various origin arriving at different times from the Indian Ocean and the Red Sea (SoHelFi, 2007). According to the latest update of the IMAS-Fish database (IMAS-Fish, 2007), the total number of recorded fish species in Hellenic waters collected from experimental and onboard sampling by trawls, purseseines, nets and beachseines, since 1983 is 393 (S. Kavadas pers. commun.) of which 300 occur in the Ionian Sea (and 365 in the Aegean). Theminimum size allowed for fisheries and the closed fisheries period for selected species is regulated according to the Presidential Degree 227/03 and EU Regulation 1967/2006.
- Mollusca: A total of 1160 mollusc species have been recorded so far in Hellenic seas. Twenty one species of mollusca (other than cephalopoda) have a commercial interest particularly in fisheries and aquaculture since they are collected and/or cultivated for human consumption. Fisheries of these species is regulated by the Ministry of Agriculture (General Directorate of Fisheries) and supported by the relative legislation (Presidential Degree 86/98 as it has been recently reformed 227/03). Population assessment exist only for few species e.g., *Pinna nobilis, Lithophaga lithophaga, Donacilla cornea* in Hellenic seas, and these only at a local scale.
- *Crustacea :* In a recent assessment of the decapod fauna of Hellenic waters (Kitsos, *et al.*, 2006), a total of 250 species was recorded. In the upper slope of the Ionian Sea, thirty species of megafaunal decapods have been reported from trawl catches. Most abundant are the shrimps *Parapenaeus longirostris* and *P. heterocarpus*. The main Hellenic fishing grounds of the Norway lobster N. norvegicus are located in Ionian Sea. In the 500-700 m zone, the giant red shrimp *A.foliacea* and the pandalid shrimp *P. martia* predominate in the experimental catches of the Ionian Sea. The former species and the blue and red shrimp *Aristeus antennatus* are the dominant decapods found in the 700-900 m zone.

Libya:

- Fish: The highest fish species diversity in the coastal area is in the eastern region (45.65% corresponding to 42 fish species) while in the Gulf of Sirt and western regions the averages are are 23.91% and 30.43% respectively corresponding to 21 and 28 species,
- Chondrichthyan in the Libyan coast: Few surveys conducted by Ben Abdallha et al., (in press). have permitted to list 55 species and reported that the fishing activity of these species were concentrated on the middle of the Libyan coast from Musrata in the west up to Benghazi in the East. Most of these species were caught by special gill net named KELLABEI in local, using seasonal landing sites

Tunisia:

- Fish: The fishery production in Tunisia has reached 100,578 tons in 2008 against 90,039 in 1998 with a rise of 11%, primarily due to pelagic species. The eastern and southern areas provide 87,693 tons of catches, representing 87% of national production. The active fleet in this area consists of 10,214 active units (90% of the national fleet) and the maritime population of the area has 43,583 fishermen representing 84% of the national population. The Gulf of Gabes represents the most exploited area for fishing followed by the Eastern Zone.

- The latest estimates of pelagic resources, conducted by the Institut National des Sciences et Technologies de la Mer (INSTM) in order to develope the small pelagic fishery, have clearly shown the existence of significant resources of which only a part of this potential is currently worth. Indeed, the exploitable biomass in this resource is greater than 80,000 tons while the domestic production does not exceed 45,000 tons. This situation of underexploitation is due to several factors, among them the exploitation of traditional fishing areas and the low efficiency of some fishing gears used.

3.2. Habitats

The Mediterranean continental shelf possesses rich and important habitats. In the context of the tools developed by the Regional Activity Centre for Specially Protected Areas (RAC/SPA), a reference list of 27 major types of benthic habitat was made, to help the Mediterranean states in drawing up inventories of natural sites of conservation interest (UNEP-MAP RAC/SPA, 2002). The SAP BIO Programme (UNEP-MAP RAC/SPA, 2003) had identified among its priority actions the making of a complete, integral inventory of its Mediterranean habitats, including mapping their spatial distribution and the cohort of species associated with each habitat.

The marine and coastal area of the central Mediterranean sub-region contains the most typical marine and coastal Mediterranean habitats. We will present hereinafter the most known ones present in the Central Mediterranean and the Ionian sea:

- **Magnoliophyte meadows:** These are among the most productive ecosystems in the marine environment. Their economic value is estimated at over 15.000 euros per hectare, i.e. 100 times greater than that of their terrestrial equivalents (UNEP/MAP-Plan Bleu, 2009). The available data on these habitats is very heterogeneous on a regional scale, and in certain countries even does not exist. In the following part, we will pay a particular attention to the meadows having been cited in the national reports
    - The *Posidonia oceanica* meadows are considered to be the Mediterranean's most important ecosystems. The most extensive meadows are those in the Gulf of Gabès (Tunisia). Posidonia meadows are the most common biological feature on the Aegean as well as on the Ionian coasts. It is present in Libya (Bamabah Bay, Farwa, Ain Elghazala and El-Bardyya, Al Elghazalaha Bay) and the Italian waters. In Malta (www.mepa.org.mt/SOER_Documents/Posidonia_survey.pdf'; Mifsud, 2006) and in Morocco near the Chafarin Islands (Bazairi, 2010). The meadows present in the Malta-Comino Channel are dense and show a high degree of shoot density, it has been recorded to host probably the highest shoot density in the Mediterranean. (Micallef, S. (1996). The area also hosts the deepest records for Posidonia, in Malta, off the south coast of Comino. *Posidonia oceanica* is endemic in Mediterranean. Annex I of Directive 92/43/EEC describes meadows of *Posidonia oceanica* as a priority habitat type. Posidonia meadows do not appear in areas with low salinity and weak light penetration due to pollution. The ecological parameters that affect the distribution of the upper and lower limit of the meadows as well as their density are light and hydrodynamic conditions. According to the Barcelona Convention typology, in the habitat type "Posidonia meadows" (BC type III. 5. 1) two ecomorphosis are described: The ecomorphosis of striped meadows (III. 5. 1. 1.) and the ecompphosis of barrier-reef meadows (III. 5. 1. 2.). A facies of dead "mattes" without much epiflora and an association with *Caulerpa prolifera* has also to be added.

- The *Cymodocea nodosa* meadows are second after *Posidonia*. These meadows wre recorded in the Aegean and Ionian Seas, where it is widely found on loose substratum (Zenetos *et al*., 2010a and b); in Libya (Al Elghazalaha Bay) (Shakhman, 2010) in Tunisia (Romdhane, 2010) and in Malta.
- The *Halophila stipulacea* meadows. This Lessepsian specie, restricted to specific areas has been sighted in Greece (Zenetos *et al*., 2010a and b); and in Tunisia in the Gulf of Gabès (Romdhane, 2010). It was also spotted in central Italy in 2006.
- Coralligenous communities: These biogenic constructions constitute the second most important hotspot of specific biodiversity in the Mediterranean after the Posidonia meadows (Boudouresque, 2004). The coralligenous habitats and bioconcretions (pre-coralligenous populations, shelf coralligenous, associations with rhodoliths – maërl facies, association with rhodoliths – *pralines* facies, association with rhodoliths – *Lithothamnion minervae* facies, association with *Peyssonnelia rosa-marina* – free Peyssonneliaceae facies and big bryozoan facies of the coastal detrital bottoms) are being studied in the Ionian Sea. They have been also recorded in Tunisia (from El Haouaria to La Chebba) (Romdhane, 2010) and in Maltese waters where an extensive maerl bed covering 20km² of the seabed occurs at depths of between 40 and 80m off the northeastern coast of Malta and Gozo (Borg et al., 1998), whilst other studies have identified another extensive maerl bed off the eastern part of Malta (Dimech et.al., 2004). The main rhodolith forming algae in the Maltese maerl beds are Lithothamnion corallioides, Lithothamnion minervae and Phymatholithon calcareum (Lanfranco et al., 1999)..
- Cystoseira forests: They can occupy large areas in the marine ecosystems, where they form highly productive communities with remarkable biodiversity. Species of the *Cystoseira* genus species are in a speciation process which has led to many varieties within a single species and these algae present significant morphological variability. Cystoseira forests have been reported in Ionian Sea of Italy, in the in the Aegean and Ionian Seas; in many areas around the Maltese Islands. (*Sargassum vulgare) and* in Tunisia
- Concretion with *Neogoniolithon brassica-florida*: The habitat known in the hypersaline lagoon of Bahiret-el-Bibane in the south of Tunisia (where it can be as long as 31 km) has no parallel in the entire Mediterranean

In the Central Mediterranean and the Ionian sea, outside these habitats, the available knowledge is extremely fragmentary and very variable (UNEP/MAP-Plan Bleu, 2009). In the context of the ECAP process, the national reports, without being exhaustive, allow information to be gained on some habitats as well as the above-mentioned ones.

In the coastal strip, there are few ecosystems of world interest for the conservation of biodiversity. These are basically coastal sand dunes and coastal wetlands, especially coastal lagoons. The lagoons present diversified, rich habitats that deserve more specific study.

Finally, in the high seas, thermal fronts correspond to areas of contact between two masses of water of different temperatures. These regions are often the site of vertical mixtures likely to bring to the surface mineral salts that encourage plankton development and help install a food chain. Upwellings are considered as being among the most productive ecosystems in the marine environment.

4. PRESSURES AND IMPACTS

The ecological disturbances are several and diverse. The erosion of coastal and marine biodiversity has specific origins probably amplified by the concomitant causes and effects. The most noticeable disturbance is the one caused by overfishing and illegal fishing, which strongly affects the fishing activity and the availability of seafood in the markets. The impacts of certain fishing gears are evident through the presence of litter on benthic organisms and fish in the wrong ports and their environments, showing the damage caused by certain types of fishing on marine biodiversity in general. Also strongly perceived are the temporal appearances as green tides reflecting the eutrophication of environments, red tides and blooms of toxic plankton. furthermore, the increasingly apparitions of jellyfish on coastal areas are often noticed in the coastal resorts.

It will also highlight the impact of pollution, development and change of vocation on coastal sites and coastal wetlands.

Among other changes affecting global biodiversity: the increased frequency of signs of alien species and invasive organisms more visible and latent expected effects of climate change on marine and coastal biodiversity.

On a more global, it is necessary to emphasize the impacts of anthropogenic disturbances or others, not only on organisms but on the breeding, spawning, nursery and feeding. These aspects remain little known and inadequately quantified and contribute undoubtedly to the biological impoverishment of the Mediterranean.

4.1. Biological disturbance

The biological disturbances described below focused on non-native species, the impacts of fishing activities and aquaculture and address the effects of climate changes on biodiversity as an emergent issue. Unevenly documented, data and information are at varying stages of elaboration and development but may nevertheless exhibit with interesting trends to understand.

4.1.1. Non indigenous and invasive species

The alien species and invasive species are recognized as a major cause of biodiversity loss, although the establishment of non native species is sometimes considered an enrichment factor of biodiversity.

It is important to remember that all exotic species are not always invasive, as some native species may be considered invasive when they proliferate excessively in favor of changes or disturbances having often directly or indirectly anthropogenic origins

Nevertheless, the impacts of invasive species and exotic species on native biodiversity are recognized even if no native species extinction has been reported to date neither proven indeed. These impacts result from various mechanisms such as food or space competition, changes in the intensity of predation and vegetable consumption. The impacts of genetic pollution and introduced pathogens remain poorly documented to date.

Inventories of alien species have been unevenly documented in national reports.

Aspects related to the impacts of invasive species and introduced species are little known and poorly documented in national reports and have mostly been collected from the literature.

Among the most pertinent broader impacts are included:

- The contraction of populations of native species, including those of heritage value
- Changing landscapes and coastal and marine habitats
- The introduction of pathogens
- Impacts on human health
- The impacts on fishery resources of commercial value

On land, the factors promoting species introductions and invasive proliferation of numerous and diverse and often man-made (accidental introduction of black rats on the islands, planting of *Carpobrotus* for ornamental plantations alien species for sand dune fixation ...)

At sea, the main agents of introduction are known, but the trend is to thermophilisation or southernalization with a gradual and regular spatial extension of the species observed from east to west and from north to south. Introductions are identified primarily through the Suez Canal and to a lesser extent through the Strait of Gibraltar (marine species of Indo-Pacific or Atlantic and Eritrean). In addition to the Suez Canal and the Strait of Gibraltar, important pathways have been identified:

- The fouling or Clinging (on the hulls of ships)
- Ballast water
- The aquaculture farms of nonnative species
- The accidental introduction of species
- The unknown vectors

Finally, among the proliferation of invasive species native, we would stress that if the exact causes of these phenomena are sometimes known as for example the green tides *Ulva* and *Enteromorpha* are generated by eutrophication of coastal waters and lagoons , others are only partially known (jellyfish blooms, red tides ...).

These phenomena are causing large disruptions of ecosystems (dystrophies, anoxia) and their effects on biodiversity and human health are recognized.

The main effects and impacts of invasive exotic and native species are outlined below:

- **In coastal areas and wetlands**

In the terrestrial environment, introductions and their impacts are many and varied; they fall under the human impact on coastal areas through the development of sea side areas but also because of forestry, soil and shorelines conservation. It is mainly forest and ornamental plant species introduced or naturalized as the Aleppo pine and eucalyptus which grow naturally on the spaces occupied by the maquis or garrigue. These plantations cause the limitation of the environment and the decline of indigenous species. The characteristics of the litter of some of these species decrease very noticeably the development of annual and woody plant cover.

These most salient and most iconic impacts of the coastal environments in the central Mediterranean are the presence of *Carpobrotus edulis*, used for its decorative qualities in urban and peri-urban coastal and whose rapid expansion is to cover completely originally laid open spaces covered by native species.

The black rat *Rattus rattus*, is another pest species by definition. Its negative effects are seen on the flora but also and especially on fauna in particular on invertebrates, herpetofauna and many species of birds, some of heritage value.

The black rat and *Carpobrotus* support each other: the black rat spreads the seeds of *Carpobrotus* which provides shelter and water supply for the black rat.

In terms of wetlands, there is no relevant data on invasive species or exotic species introductions at the salt pans. In lagoons, the phenomena described as biological invasions, exotic species introductions and temporal appearances are often similar to what happens in the coastal environment. What particularly distinguishes the lagoons is the presence of intentionally introduced species for aquaculture (*Crassostrea gigas, Ruditapes philippinarum*), which spread out through the facilities and come into competition with local species.

Furthermore, we highlight the vulnerability of certain areas of operation paralic endorheic or semi-endorheic to eutrophication which causes green tides with a net spread of native species such as *Ulva* and *Enteromorpha*, sometimes causing dystrophy and asphyxiation of the ecosystem. The degradation of this biomass at the end of cycle is the source of emanation of sulfur dioxide to the adverse effects on biodiversity and human health.

- **Coastal waters**

National reports have helped to highlight the magnitude of the establishment of exotic coastal waters. These statistics remain more or less incomplete and need to be to updated and completed.

In the Greek Ionian Sea, there are 3 species of phytoplankton, 3 zooplankton species, 17 benthic plant, 24 species of invertebrates and 13 fish species. On the eastern and southern coasts of Tunisia, 21 plant species are listed, 51 invertebrates and 24 fish species. 22 exotic fish are cited in the Libyan national report. In the Maltese national report of SAPBIO, reference is made of 10 species of plants, 6 invertebrates and 1 fish. In Italian waters, 34 species of algae, 70 invertebrates and 19 fish were identified in the national report of SAP BIO.

These statistics do not definitely reflect the reality; the level of knowledge is very uneven from one country to another and from one group of species to another.

The impacts of most of these species remain poorly studied and misunderstood.

Regarding the phytobenthos the presence of *Caulerpa taxifolia* is reported but its distribution and extension remains anecdotal. If considered as potentially invasive, it does not cause known effects due its sporadic character. The potential invasive *Caulerpa racemosa* is more important. The new signs are numerous in both Greece and Tunisia and the effects of this

species are noticeable. The rapid growth of stolons resulting in almost total coverage of the substrate, mainly muddy sands at the expense of seagrass, algae but encrusting organisms. Its proliferation leads to difficulties in the fishing activity because large quantities contribute to clogging of the nets.

Cases of inter-specific competition are also well shown among the invertebrates such as the compatition of *Percnon gibbesi* with native species (Malta and Italy) and also in fish populations. In Libya, rivalry between the two lesseptien species *Siganus luridus* and *Siganus rivulatus* and native species *Sarpa salpa* and *Sarpa cretans* is a prominent example.

Other phenomena due to the proliferation of invasive have direct effects on human health and economic activities. We mention in particular the increase in outbreaks of jellyfish blooms, including *Pelagia noctiluca* causing inconvenience to many holidaymakers. The proliferation of jellyfish significantly affects marine biodiversity, including commercial interest; these animals feeding on larvae and fish fry.

Also in terms of impacts on human health, some cases of tetrodotoxin poisoning have been reported recently in Libya.

Economically, the case of the establishment *of Metapenaeus monoceros* in the Gulf of Gabès reveals sometimes the paradoxical economic impacts that invasive species could cause on economically and socially levels. This species has partially replaced the native prawn *Penaeus kerathurus*. In this region, catches of shrimp have not declined but are composed 50% of non-native species. The economic loss is due to the fact that the commercial price of the new species is seven times lower than that of native shrimp, in the benefit of the less affluent consumers.

- **Open seas**

The data on the impacts of invasive alien organisms are even more scarce in the deep and high seas

These changes are mainly due to the slow but perceptible thermophilization of the Mediterranean in general but also in the central Mediterranean.

Phenomena of competition are duly recognized such as the retreat to the deep waters of native species *Merluccius merluccius* and *Mullus barbatus* under pressure from exotic *Upeneus moluccensis* and *Saurida undosquamis* in the Hellenic Ionian waters.

The by-catches of thermophilic fish *Coryphaena hyppurus* and barracudas have increased in the region. These super-predators fall certainly compete with native fish, but the effects are not measured.

4.1.2. Fisheries on target and non-target species

It is clear that intensive fishing has a significant impact at all levels of biological organization of Marine Life (EEA 2006). The impacts of some inappropriate practices on marine biodiversity are outlined in the reports prepared under the SAP BIO programme, but also in the present process leading to an observed decline of fish stocks and degradation of ecosystems.

Advances in navigation and localization of resources contribute to the escalation of this situation.

The pressure of fishing activity can be classified as follows:
- Commercial fishing,
- Recreational fishing,
- Aquaculture.

In spite of stringent laws and efforts in order to ensure fleet reduction, these activities generate direct and indirect effects on resources and ecosystems.

4.1.2.1. Direct effects of over-fishing on the target species

The main species threatened by overfishing and illegal fishing are: *Anguilla anguilla*, *Epinephelus marginatus*, *Sciaena umbra, Thunnus thynnus, Xiph gladius, Mullus barbatus, Mullus surmuletus, Merluccius merluccius, Sarda sarda,* some species of cartilaginous fishes, crustaceans as *Homarus gammarus*, *Palinurus Elephas* and *Scyllarides latus*, bivalves such as *Lithophaga lithophaga*, sponges (*Hypospongia communis, Spongia spp*.) and red coral (*Corallium rubrum*).

The fisheries of the region are characterized by a high level of exploitation, often resulting in overfishing. The target species are dominated by juveniles.

The trophic level of exploited species is clearly decreasing. Due to the modernization of fleets for longer campaigns and navigation in rough seas, a tendency to increase the exploitation of species living in open ocean and deep water is noticed.

The use of non-selective fishing methods often illegal contribute to the destruction of marine organisms in general and particularly juvenile fish, decreasing significantly the maintaining or recovery of the stocks. For instance, the use of dynamite or kyss (gear used in waters of southern Tunisia) is a significant example.

The spear fishing is one of the causes of overfishing of protected species such as grouper.

Finally, it is noted that a recent fish activity dedicated to the maintaining and growth of tuna *Thunnus thynnus*, contributes noticeably to the collapse of this species and an increased pressure on drilling fish.

4.1.2.2. Indirect effects of fishing

Several techniques of fishing and aquaculture techniques contribute directly or indirectly to the disruption of ecosystems, habitats and species.

Among the most harmful fishing gears is include the "tonailles" (nets for tuna), long lines and drift nets, fine mesh nets and all trawling arts. Other fishing techniques, such as totally illegal use of poison or dynamite, significantly affect the entire natural environment.

The most egregious damage is caused on benthic habitats and associated communities.

The indirect effects of fishing on biodiversity include the impact on non-commercial species (discards), habitat structure and ecosystem functioning. Some indirect impacts of fishing are listed below:

- The decline of populations (either commercial or not), due to by-catch fish, discarding, ghost fishing, etc. .. ;;
- Decrease of populations of non-commercial endangered and protected species such as cartilaginous fish, sea turtles, sea birds…
- The disturbance or destruction of habitats such as *Posidonia oceanica* meadows, coral and maêrl beds; this impact is mainly due to trawlers, often illegally used in shallow waters and certain practices such as illegal collection of date shells *Lithophaga lithophaga*;
- alteration of functioning and structure in other marine habitats such as sandy and muddy bottoms by trawling in particular because of sediment resuspension which causes extensive damage to non-target species.
- Cascading effects on trophic structure of the marine ecosystem by the harvesting of top predators, either pelagic or demersal. Overfishing reduces the populations of more valuable large fish that are at higher trophic levels, such as piscivorous, significantly reducing the average level of catches.
- The establishment of exotic species such as *C. racemosa* following the deterioration of seagrass beds. Some species overfished also yield up to non-native species.

Jellyfish blooms are reported by certain authors as consequences of overfishing.

Moreover, aquaculture can contribute, along with other numerous human pressures, to causing high nutrient concentrations in the water and in the sediment of lagoons.

4.1.2.3. Open seas

The main direct effects of fishing on marine resources are over-fishing of large pelagic inducing a highly significant decrease in stocks for the following species: *Xiphias gladius, Thunnus thynnus* and *Thunnus alalunga.*

Fishing gear such as drift nets and long lines may cause serious mortality to marine turtles and marine mammals.

The following heading further treats this issue, together with the deep seas topics

4.2. Emerging issues

4.2.1. Climate changes effects

The shores and marine areas of the countries of central Mediterranean contain a rich and extremely diversified biodiversity. This heritage is already subjected to great pressure. But the inventories are generally sketchy, incomplete and/or obsolete for few countries, and thus do not enable us to envisage a systematic, exhaustive monitoring of the effects of CC on MCBD.

Many analogies have been noticed when setting out the eloquent stakes, stressing their pertinence at national, sub-regional, Mediterranean and world level. They concern more particularly:

- the effects CC on the physical environment are already being detected, especially related with increase in surface sea temperature, hydrological and hydrodynamic changes, sea level rise and the expected repercussions on the integrity of the coastline, wetlands generally and more particularly lagoons, salty lakes (sebkhas), and estuaries, supra- and midiolittoral zones and the ecological and economic values thereof, – with particular emphasis on the threats to islands, and changes in the nutrient supply and dynamics of coastal and high-sea waters and increased frequency of extreme events –winds and storms.

- At medium term, more complex phenomena are expected, such as changes in the life cycle of marine species, distributional range shifts of species and habitats, local extirpation of vulnerable species and, ultimately, decrease in the resilience (i.e. resistance and reversibility to disturbance) as well as profound changes in the functioning of marine ecosystems, which at present are difficult to forecast with the adequate level of accuracy

- the rising risk of forest fires

- the impacts on coastal and marine natural resources

- the amplifying of the effects of CC by human activities

- the thermophylous non-native species, especially Lessepsian, Special emphasis has been putted on the occurrence and spread of thermal species (both by colonisation of new species originating from the Atlantic through the Gibraltar strait and principally the Indo-Pacific through the Suez Canal,. Other phenomena such as mucilage events, harmful algal blooms and mass occurrence of scyphomedusae are likely to be facilitated by CC in synergy with other anthropogenic impacts (e.g. overfishing, nutrient load and other sources of pollution, etc.). Another ongoing phenomenon, increasingly frequent in coastal waters of the countries, is the occurrence of mass mortality of structural species (e.g. gorgonians, octocoral colonies, sponges, etc.)

4.2.2. Open seas and Deep seas ecosystems modifications

The Mediterranean deep sea comprises a high diversity of habitats, because of its geological history (Bianchi & Morri 2000). In particular, geomorphologic structures, such as submarine canyons, seamounts, mud volcanoes and deep trenches can harbor important biological communities.

In general, deep sea Mediterranean biological communities are adapted to an oligotrophic environment; local areas of higher productivity and biodiversity hotspots are present.

The Mediterranean deep sea is physically split into two basins separated by the shallow Straits of Sicily (about. 400 m dept). Important differences between the eastern and the western basins, both in species composition and abundance have been observed (Sardà *et al.* 2004).

The Mediterranean deep sea is considered by some authors to be among the most heavily impacted deep-sea environments in the world, and at the same time among the least known areas in terms of biodiversity (UNEP-MAP-RAC/SPA, 2010): the risk is that a significant loss of biodiversity occurs before scientists have had time to document its existence (Briand 2003, Cartes *et a*l. 2004).

The main pressures affecting deep seas can be graded as below:

- trawl bottom fishery
- other fishing practices
- waste disposal (solid refuse)
- other marine pollutants
- oil exploration and exploitation
- deep pipeline laying
- climate change

In a worldwide context the deep seas are considered (among other definitions) to be the marine environment that extends downwards from the continental shelf break, i.e. waters deeper than 200 m to its maximum depth. Deep-sea fisheries currently only operate at depths of less than 1000 m in the Mediterranean, but that might exploit many SH, i.e. seamount fisheries could be exhausted in a period of time as short as three to four years (Johnston & Santillo 2004). The potential fishing interest of the currently unexploited bottoms below 1000 m depth (towed gears banned by GFCM, 2005) is very limited. This is so because the overall abundance of crustacean species is considerably lower, and fish communities are largely dominated by fish either of non-commercial interest (like the smooth head *Alepocephalus rostratus*) or of a small size (such as the Mediterranean grenadier *Coryphenoides guentheri*). If these species ever become of economic interest and trawlers could reach deeper areas, then the ecosystem could be rapidly deteriorated by fishing.

Pelagic fishing in the Mediterranean open seas, targeting large pelagic species (with few exceptions targeting small pelagic, eg. anchovy and sardine, in the Adriatic Sea), is the only industrial fishing; it takes place mainly at international waters and even non-Mediterranean countries can be involved (Cacaud 2005).

Most information on the activity of the fishing fleets in the Mediterranean comes from the working group STECF and the GFCM Demersal Working Group, of the Subcommittee on Stock Assessment, and ICCAT for large pelagics, which relates the activity of the fleets from member countries. Therefore, there is a lack of reported information of fishing activity of EU non-member countries (e.g. North Africa) in STECF, although GFCM task 1, and the cooperation projects (Medfisis, COPEMED II, ADRIAMED and EASTMED) work on this direction.

The most important negative consequence of fishing activities is the degradation of marine ecosystems by the removal of target or non-target species and by physical disturbance inflicted by some fishing gears. Essential Fish Habitats (EFH) are those habitats necessary for feeding, refuge or reproduction of the species; and Sensitive Habitats (SH) consist on those areas with endemic species, high biodiversity or high productivity and vulnerable to fishing practices. The degradation of ecosystems by fishing indirectly affects the commercial species if the habitat is not longer adequate for these species. In this context, there is a necessity of regulating fishing activities to reduce the ecosystem degradation by the establishment of an Ecosystem Approach to Fisheries (EAF), which considers not only the protection of target species, but the ecosystem as a whole. Within the EAF framework the Precautionary Approach considers the most restrictive measures for fisheries management (including the establishment of areas closed to fishing, or Marine Protected Areas) against a general lack of knowledge on the functioning of many ecosystems that sustain fisheries resources.

Most Mediterranean waters constitute open seas. The Mediterranean open seas encompass a high diversity of habitats, both pelagic and demersal (deep seas). These habitats are poorly known in relation to coastal and continental shelves ecosystems, which are more easily surveyed, while at the same time there is a good knowledge of their commercial species stocks status, by means of fisheries surveys and commercial captures. The protection of fauna at those areas is important for fisheries and ecosystem conservation because organisms can determine the healthiness of an ecosystem. Sessile benthic fauna play an important role as habitat structuring organisms providing refuge for many marine species (e.g. cold coral reefs, deep sea sponges, crinoidea beds).

Deep bottoms consist on wide extensions of soft sediments interrupted by geological features like submarine canyons, brine pools, seamounts, hydrothermal vents, cold seeps and mud volcanoes, that create a special habitat that harbour high diversity and endemism; many of these habitats have been only recently discovered and must be protected after the Precautionary Approach.

Demersal fisheries operating in Mediterranean high seas can be summarized as: bottom trawling, bottom long line, and gillnet. Deep-sea fisheries currently operate on continental shelves and some slopes, down to depths of less than 800m. Bottom trawling is a highly damaging practice that was banned in 2005 to Mediterranean bottoms deeper than 1000m, aiming to protect the vulnerable deep sea fauna.

Amongst benthic habitats at Mediterranean open seas, the components most vulnerable to fishing are coralligenous facies, the crinoidea *Leptometra phalangium,* and the cnidaria *Funiculina quadrangularis* and *Isidella elongata*, facies of sessile organisms that have been so far detected in continental shelves and the shelf break in the Western basin, although the location and extent of these habitats in the whole region is still poorly known.

At the deep seas there are several areas with considerable abundance of the highly vulnerable cold coral reefs, mostly detected in continental slopes, seamounts and on the walls of submarine canyons (e.g. off Cape Santa Maria di Leuca, in the Central basin, or at numerous submarine canyons and seamounts scattered along the Alboran Sea, in the West basin). Several abyssal plains, that harbour poorly known and vulnerable deep sea fauna, are located throughout the Mediterranean, with the deepest grounds found in the Central basin (e.g. Calypso depth in the Ionian Sea, SW of Greece). Other geological features might be vulnerable to fishing as they are hotspots of diversity and are habitat of vulnerable fauna like cold corals. The massive Eratosthenes seamount in the East basin (south of Cyprus) and numerous scattered seamounts in the Alboran Sea and south Tyrrhenian; cold seeps, brine pools and hydrothermal vents have been mostly located in the East Mediterranean basin (south of Crete and Turkey, and near Egypt). The Western Mediterranean basin harbours numerous submarine canyons that are EFH for red shrimp, like numerous canyons in the Gulf of Lions that sustains important fisheries of red shrimp, Norway lobster, hake, monkfish, among other important commercial species; hake nursery areas are mainly located on wide extensions of continental shelves or banks, highlighting the south of Sicily, central Adriatic in the Jabuka Pit, and Thracian sea, whereas hake spawning grounds seem to be located on the shelf break and slope canyons, being the Gulf of Lions the clearest example.

The large pelagic species that inhabit the open seas, mainly bluefin tuna, swordfish, and albacore, but also pelagic sharks (short fin mako, blue shark and porbeagle) are of high conservation interest and have long been overexploited by pelagic fishing gears. The main fishing gears for large pelagics are purse seines and pelagic longlines. Pelagic long lining fleets operate in Mediterranean waters, ranging from local coastal state fleets to large industrial foreign fleets; these are highly mobile, and cover almost the whole Mediterranean basin. Drift nets have been banned in the Mediterranean in 2005, although this activity is still practiced. The Mediterranean high sea is also the habitat of endangered cetaceans and turtles that are a common by-catch of pelagic fisheries and deserve special protection. Important EFH for large pelagic species are mostly determined by oceanographic features like upwelling areas or gyres, creating productive areas important for feeding and breeding; these areas that act as EFH must be identify to define protection measures for pelagic species. The main spawning areas for bluefin tuna have been located south of the Balearic Islands, Alboran Sea and Strait of Sicily, whereas swordfish spawns in almost all the Mediterranean area and albacore overlap with the bluefin tuna spawning grounds.

4.2.3. Critical areas vulnerable to effects of open seas fishing on marine and coastal biodiversity

Those critical areas considered as EFH and SH that receives fishing impacts in the Mediterranean open seas, could represent an essential tool for managing fisheries in Mediterranean open seas within an EAF and Precautionary Approach; however, these areas might imply effective restriction of fishing activities, needing an adequate surveillance system and a long-term monitoring.

The following sites are considered critical areas in the subregion, regarding fishing impacts in Mediterranean open seas, including demersal and pelagic ecosystems:

Demersal priority areas:

- South of Sicily, Adventure and Malta banks. Demersal ecosystem important as hake nursery areas where bottom fishing activities, specially trawling, should be restricted.
- Cold coral reefs (Lophelia pertusa) off Cape Santa Maria di Leuca. SH highly vulnerable to any physical disturbance inflicted by bottom trawling. Already adopted as FRA (Fishery Restricted Area) by GFCM.

Pelagic priority areas:

- Strait of Sicily. It is an important migratory route for tuna-like species.

Both areas

- Mediterranean Bottoms beyond 1000m. Habitat of poorly known and vulnerable fauna that encompasses the four Mediterranean sub-regions. Fishing using towed gears in this area has been prohibited by GFCM.

5. EVALUATION OF GAPS

Overall, the coastal and marine biodiversity as well as the pressures and impacts exerted on of the Mediterranean Sea remains relatively little known despite the increasingly considerable efforts made by the international scientific community to grasp it.

5.1. Concerning status of coastal and marine ecosystems

Knowledge of marine and coastal biodiversity is not homogeneous throughout the Central Mediterranean and the Ionian Sea and has many gaps. In the bulk, data is patchy and does not allow us to pronounce on the many marine species, habitats and communities on a sub-regional scale, in particular the MAP Protocol species and habitats that are of conservation interest in the Mediterranean. The availability of reliable information varies from country to country and the available information on marine and coastal biodiversity cannot be considered to be satisfactory, for it is neither complete nor systematic and gaps are obvious at both population/individual level (genetic diversity) and at that of species and habitats/communities.

Broadly speaking, the main gaps identified at sub-regional level can be summarized as follows:

- Lack of clear national strategy to systematically inventory marine and coastal biodiversity in many countries. Marine and coastal biodiversity -linked aspects do not have priority in political decisions, as is the case for social aspects

- The national inventories of marine and coastal species and habitats are not homogeneous. For most countries they are incomplete; the effort made is more focused on the north-western Mediterranean

- Many Mediterranean sectors and/or ecosystems remain little studied, even per country. Prospecting is usually done in areas that are easily accessed. The inventories drawn up in some countries (bibliography, site prospecting, updating etc.) are usually made in sectors concerned by programmes or action plans. Knowledge of the presence, distribution, abundance and conservation status of Mediterranean coastal and marine species is uneven for taxa and regions

- Deep sea and high seas reference habitats have commonly been little explored

- Lack of national taxonomic skills for many groups of marine flora and fauna. This inevitably results in dubious identification of species. Experts in taxonomy of most groups are strongly concentrated in a few countries, mostly lying in the northern part of the Mediterranean

- Little sharing of recent knowledge within scientific circles in the various countries of the northern and southern Mediterranean

- Absence of programmes for monitoring non-native species in many countries, particularly the countries of the southern Mediterranean

- Patchy mapping of marine and coastal species and biocenoses, particularly those of conservation interest for the Mediterranean

- Research done on marine and coastal biodiversity is compartmentalized, restricted to very narrow aspects, and lacks interdisciplinarity

- Absence of coordinated and cross-border scientific research, probably related to financial and administrative constraints.

5.2. Gaps regarding impacts on coastal and marine ecosystems

Gaps about “impacts and effects on marine and coastal biodiversity” can be observed at several levels: scientific knowledge; legal tools availability; enforcement of existing laws; public awareness; concrete actions and operative plan implementations.

Specifically, the main gaps, issue by issue, can be summarized as follows:

- Invasive species: (i) a lack of a mechanism for collecting, compiling and circulating information on invasive non-indigenous species still exists, (ii) a lack of knowledge still exists, in particular about impact on structures and functioning of the ecosystems despite the fact that several studies and research programmes have been carried out during the last decades and knowledge about non indigenous invasive species has improved. For instance, the Delivering Alien Invasive Species Inventories for Europe (DAISIE) project provides consolidated information aimed at creating an inventory of invasive species that threaten European biodiversity. This can be used as the basis for the prevention and control of biological invasions, to assess the ecological and socio-economic risks associated with most widespread invasive species, and to distribute data and experience to member states as a form of early warning system. (Secretariat of the Convention on Biological Diversity, 2010). (iii) the real extent of the phenomenon of exotic species’ transfer is not known, (iv) lists of exotic species are available only for few taxa and often regard a limited geographic extent, (v) studies directly investigating the impact of exotic immigrants on the diversity of autochtonous biota as well as socio-economic impact from alien species causing, (vi) co-ordinated, cooperative regional research is needed to investigate the phenomenon, particularly in pollution susceptible areas such as ports and lagoons and (vii) a lack of long term monitoring programs on invasive species must be emphasized too…

- Impact of fishery on target and non-target species : (i) An important lack regarding the limitation of the ecosystem approach application in fishery management, (ii) discards composition and quantification needs particular attention, (iii) Gaps in the fisheries research include assessing the level of damage that can be sustained and/or is acceptable by the ecosystem through fishing practices (ex fishing gears); also secondary effects such as the impact of the partial removal of a predator or a part of a life cycle of one species are unclear.(iv) Recreational fishery gaps as regards both control of composition, abundance and size of catch and scientific data about landings, (v) gaps about the knowledge of possible interactions between eutrophication and fish cultivation practices in coastal lagoons and other marine sites,

(vi) lack of enforcement of control and surveillance of fishery regulations and (vii) lack in monitoring, control and surveillance is particularly evident for high seas…

- Microbial pathogens: The main gaps to bridge in order to enhance knowledge of microbial pathogens have to be distinguished among classical and new ones as follows:

  (i) *"Classical" pathogens :* (i) low level of monitoring plans is generally found, (ii) a lack of basic knowledge of classical pathogens in sediments and beaches, (iii) an important gap is constituted by the lack of law enforcement to prevent or reduce the pathogens concentration in the sea water, (iv) a lack of knowledge on the consequences and impacts of pathogens on ecosystems and habitats…

  (ii) *"New" pathogens:* (i) lack of basic knowledge on new pathogens, (ii) the lack of legislation enforcement in controlling the vectors of introduction into the Mediterranean of non indigenous species and invasive marine species (i.e. mariculture) constitutes a significant issue, (iii) a lack of public awareness on health and safety issues for hazard species, gaps on knowledge regard consequences and impacts on ecosystems and habitats, (iv) a lack of effective scientific monitoring for Harmful Algal Blooms (HABs), especially for Southern Mediterranean waters…

- Climate change: the magnitude of Mediterranean marine biodiversity in response to climate change remain largely unknown due to (i) the lack of consistent long-term monitoring of Mediterranean marine biota and ecosystem processes; and (ii) the scarce information available on climate change impacts on marine organism physiology, population demography, reproduction, species distribution and ecosystem function, (iii) lack of monitoring, targeted research, institutional scientific capacities, technical expertise, national polices and priorities, critical area identification and studies and funding opportunities at national level, (iv) lack of studies on the socio-economical consequences of the impact of climate change on marine and coastal biodiversity, (v) lack of knowledge on the consequence of climate change on biodiversity due to the changes in the chemistry and biogeochemical cycling of carbon and carbonate (ocean acidification)…

- Deep sea: (i) The main gaps about deep sea deals with the very limited knowledge of this environment, particularly poor are data and scientific researches below 1000 m depth, (ii) especially for several areas of Eastern Mediterranean and in Southern waters, nothing is known about deep-sea biology, (iii) gaps exist also about the effects of anthropogenic pressures on deep sea species and habitats, where few data are available for fishery and no data are available about the effects and consequences on deep biodiversity of waste accumulation, (iv) an important gap, not specific for the Mediterranean sea, but in any case relevant also to the Mediterranean region, regards the lack of emergency technology and plans to deal with petrol spillage in deep water.

6. PRIORITY NEEDS

6.1. Needs

Greece:

- Better consideration to taxonomy issues in the framework of the two HCMR initiatives (State of the Hellenic Marine Environment and State of Hellenic Fisherie)
- Better consideration to climate changes effects. Hence the need for regular assessments presenting the national picture to all interesting bodies is paramount.
- Integration of fishery-based approach in the future collection of bio-economic data. In addition to statistical analysis, it provides advanced modelling and predictions made with the help of GIS.
- There is a need to expand existing data collection and analysis programs to assure an adequate knowledge base that can efficiently support sound scientific advice to decision makers, and they even provide suggestions that may contribute to the improved management of fishery resources, highlighting the importance of developing such management mechanisms that will promote the sustainable exploitation of marine resources to optimally accommodate the increasing demands from diverse stakeholders.
- EL-NET Database has been constructed as a biodiversity transitional waters information system for the development of distributed information in Hellas. The system is a functional application consisting of a comprehensive database and an online interface with an interactive map, and search capabilities for biological and environmental data on Hellenic transitional waters. Results from a case study carried out on the macrobenthic inventories of the lagoonal systems included in the system demonstrate the potential use of this simple type of information by environmental managers and scientists. The system, still in its initial phase, will be improved by integrating new datasets and developing tools for data retrieval and analyses. The database should be linked to other biodiversity databases to participate in a distributed information network and disseminate the information through other global biodiversity portals.
- Expand knowledge about the systematic of zooplankton and phytoplankton communities and improve knowledge on the ecology of phytoplankton species and the place of phytoplankton in the food chain of the pelagic ecosystem and on the blooms, particularly of red tide phenomena.
- Defining the composition and ecology of mesozooplankton including groups other than copepods and Cladocera and the role of mesozooplankton as a link between the lower trophic levels (phytoplankton, microbes) and higher trophic levels (fish). These aspects should be studied in both inshore and offshore.
- The implementation of the Water Framework Directive, through a program of large-scale sampling, will help fill gaps in knowledge in some areas and water bodies with unknown ecological status and biodiversity.
- Gaps exist in understanding of climate change and its impact on biodiversity. What remain to be implicitly addressed are the implications of changes in the water mass characteristics and the influence of the modified water masses to the biology of the Hellenic Seas' as assessed through experimental and modelling studies. Long-term data on climate change and on communities changes in the Hellenic seas and an appropriate framework are required.

Libya

There are no comprehensive studies especially in the diversity, ecology and biology for marine fauna and flora examples of needed studies:

- Ecological and biological study of Mollusca in certain area like Sirt gulf in the Libyan coast,
- Species and distribution of crustaceans
- Implementation of Chondrichthyan fishes project along the Libyan coast presented by RAC-SPA, 2005
- study of the sea turtle nesting sites (monitoring for the whole summer season (EGA),
- Study on the sea grass Posidonia oceanica ecosystem,
- A project for defining and studying the ecosystem of Libya
- Studies of wetlands at various areas
- Fish stock assessment along the coastal water
- Studies on cold water and hot water springs and their economic value
- Impact of fisheries on sea turtle
- National survey of wetlands
- Studies of marine pollution and its impact on marine life and environment
- Studies of fish diseases
- Studies marine phyto-and zooplankton
- Studies the marine benthos along the Libyan coast
- Studies of growth and productions of fish
- Studies sea grass, algae and sponge
- Training of some individuals to carry out and solve certain environmental problem.

Such plans need cooperation between the institutions in Libya and international institution.

Projects: Three projects have been recently accepted by the National Authority for Scientific Research (NASR) – Libya, these projects are as follows:

- Biology and Ecology of flowing ecosystem in eastern part of Libya,
- impact of the Lessepsian marine species on the Libyan coast,
- The third dealing with fish diseases along the Libyan coast.

Genetic studies for different marine species are important to make barcode for different species and study the gene populations.

Tunisia

Needs concern globally:

- Improved knowledge on biodiversity
- A conservation action and management of marine protected areas
- A reduction of human pressures and human impacts on the environment

More specifically, the needs can be expressed in terms of:

- strengthening of conservation and protection structures, particularly by establishing a program to protect species and habitats in danger, through the development and creation of marine protected areas
- strengthening the role of institutions involved in conservation based on the improvement of capacity building of staff specialized in the conservation
- establishment of reference collections of endangered or vulnerable species
- inventory of endangered species and / or vulnerable species
- creation of a Museum of Natural History
- establishment of management structures for marine protected areas

Highlighting links between ecosystems, ecological functions and ecosystem services, by developing the concept of information monitoring, which allow collecting, analyzeing, synthesizing and disseminating useful informations.

6.2. Urgent actions

Greece

The main objectives of the National Strategy for the sustainable development have set towards the protection and conservation of the marine environment, the prevention of its degradation and, wherever possible its restoration, where it has been unfavorably affected. To achieve this target the following actions are proposed:

- Adoption of measures for the control of pollution from land based sources such as best agricultural practice in river basin catchments for the control of pollution of marine coastal areas from the unsustainable use of fertilizers and pesticides and the adoption of best available techniques in industry. Correlation with the respective measures that are being undertaken in the framework of the implementation of the Community Water Framework Directive (2000/60/EC) and implementation of the respective actions that have been adopted in the framework of the Barcelona Convention (Land Based Sources protocol and respective action programmes).
- Integrated management and identification of suitable uses in the coastal zone, adoption of the respective Community and Regional (UNEP/MAP) provisions. Strengthening of mechanisms for the effective control of illegal construction and development of illegal activities in the coastal zone areas.
- Development of a strategy for the marine waters for each marine area with independent characteristics with the intention to achieve a good environmental status by 2020, adopting an ecosystem approach to the management of human activities that exert an effect on the marine environment.
- Promotion of basic research to fill the knowledge gaps concerning the status of the marine environment of Hellas as well as the adoption of applied research for the development of suitable tools for monitoring, detection (eutrophication, oil spills etc,), upholding the relevant legislation and control concerning the development of cleaner and more environmentally friendly technologies and production procedures (for fisheries, aquaculture etc.)
- Identification and carrying out the studies required for the introduction of new marine areas into the Natura 2000 Network (SCI and SPA).
- Systematic inventorying and mapping (scale 1:10.000) of the Posidonia meadows at a national scale, with suitable storage of the inventory data to support management and monitoring.
- Implementation of effective programmes for the management, wardening and monitoring of the most important Hellenic lagoons.
- Implementation of programmes for systematic monitoring and collection of data to evaluate the status of threatened marine species populations, identification and application of measures and actions for their sustainable management and the preparation of the respective national legislation wherever this is required.

- Systematic monitoring of the phenomenon of the introduction of alien species into the marine environment and in the framework of the implementation of the Water Framework Directive, international cooperation to study the effects and interactions of the introduced alien species with the natural environment and native species covering the entire Mediterranean (species fished, possible effect on human health) and wherever possible development of a strategy to confront the phenomenon. Adoption of measures for prevention of the transfer of alien species through maritime activity.
- Evaluation of the magnitude and effect of the interactions between fisheries and marine species populations (monk seal, sea turtles, cetaceans, etc.), identification and application of action plans for the normalization of conflicts.
- Application of measures for the sustainable use of fisheries resources in the sense of the Community Regulation for the Mediterranean (EC) 1967/2006.
- Effective reduction of fishing capacity in the direction of stock recovery, applying a targeted enforcement of measures for the permanent termination of fishing activity on vessels that exert the greatest pressure on fisheries stocks.
- • Evaluation of the fisheries stocks and carrying capacity of lagoons, drawing up plans for fisheries management of lagoons, giving priority to Natura 2000 areas. Control of small scale interferences in lagoons linked to aquaculture such as the construction of embankments, and the opening up of dikes and channels.
- The intensification of controls and inspections in support of the sustainable use of fisheries resources, the effective protection aquatic resources of fishery interest and the application of the principles of responsible fishing and aquaculture, including the compliance with conditions for environmental use.
- Promotion of fisheries research to support the formulation of fisheries policy, for more effective management of common fisheries resources and best use of resources for the protection of stocks, through the realization of reliable scientific evaluations and analyses.

- **Specific Conservation needs**

Turtles

Management plans have been elaborated for the major nesting areas of *C, caretta* (Crete and Peloponnesus) but there is not a National Action Plan for the conservation of marine turtles in Hellas. Management plans for the “major” nesting beaches of Crete and Peloponnesus exist, whereas nesting beaches of Zakynthos are protected since they are included within the limits of the National Marine Park of Zakynthos. However, the enforcement of existing legislation and the implementation of management plans by the local authorities are not at a satisfactory level, allowing the persistence of threats to the nesting populations (SAP BIO, 2002). In the SAP-BIO it has been proposed that ‘*The National Action Plan will provide guidelines and measures for the conservation of marine turtles and for addressing emergency local incidents. It could also be used by the central and regional government and by local authorities during the preparation of development plans in areas hosting marine turtle habitats’*. Margaritoulis et al (2007) have also suggested framework actions to be implemented as a simple fundamental approach towards the assessment, and the reduction of turtle by-catch and associated mortalities in fishing gears used in Hellas.

Seals

Notarbartolo di Sciara G., (2009) provided a Critical analysis on the conservation status of the monk seals that stated that '*based on the very large number of international agreements and conventions that Hellas has adhered to, which explicitly require endeavouring to protect and strive to recover Mediterranean monk seals and their habitat, undoubtedly Hellas is formally fully committed to monk seal protection on the international scene. Such condition, however, clashes resoundingly with the disappointing lack of factual commitment by the Hellenic State, in terms of direct, practical and effective initiatives, that comes in direct contrast with the achievements of the work of NGOs working for the conservation of the species*. The authors then suggested in agreement with previous long term research for the species in the country (Cebrian, 1998a) that ' *The only aspect that seems important addressing is the possibility of conceding exclusive fishing rights to local fisheries within specially zoned MPAs, established to protect monk seals and other endangered species or habitats. Such possibility is apparently excluded by the current Hellenic constitutional law'.*

Furthermore they set up four objectives to be reached by 2015:

1. Monk seal conservation is established as a national priority.
2. Knowledge of monk seal ecology and biology important for the conservation of the species is secured.
3. Areas containing monk seal critical breeding habitat in Hellas are identified, legally protected and organised into a functional network of protected areas in which monk seal numbers are stable or increasing.
4. Monk seal conservation measures are legally adopted and effectively implemented throughout national waters, so that threats are diminished and monk seal populations and habitat nation-wide are not lost.

Cetaceans

According to Fratzis (2007) '*although still not complete, the existing image of the Hellenic cetacean fauna, in terms of species presence and distribution, is now close to the real situation. Nevertheless, quantitative data regarding the absolute abundance and the population status of any species do not exist and are urgently needed. Without such data, it is very difficult to place conservation priorities. Thus decisions regarding the proper conservation policy for cetaceans have to be based on assumptions. Further, the effectiveness of any conservation measure cannot be monitored and assessed*'.

The author then suggested that future effort has to focus on: i) the estimations of abundance for each cetacean species, ii) the assessment of population status and trends for cetacean species that constitute conservation priorities at the local or regional level, iii) the identification of critical areas for these species, and iv) the establishment of a properly organised, national stranding network, in collaboration with the secretariat of ACCOBAMS. This network should be based on strictly scientific methods and rules, according to the international standards (Fratzis, 2007).

Fisheries & Biodiversity

The waters east of Lefkada and around Kalamos are an important spawning area for epipelagic schooling fish (Somarakis *et al*. 2000, 2006a,b) and a nursery area for hake (Politou *et al*. 2006), making this Natura 2000 Site of Community Importance a candidate for special protection based on EC Regulations for the sustainable exploitation of fishery resources in the Mediterranean.

In addition to common dolphins, the area is home to a resident community of bottlenose dolphins *Tursiops truncatus*. Endangered species such as monk seals *Monachus monachus* and loggerhead sea turtles *Caretta caretta* are also regularly sighted. All these species are included in Annex II to the Habitats Directive. Fishery management measures are needed to reduce current over-exploitation, protect the local biodiversity, ensure continued ecosystem services, achieve sustainability, and allow for the recovery of endangered marine megafauna.

Deep water resources

A number of recommendations have been suggested based on the results from projects dealing with the resources in the Ionian Sea. These included the increase of the cod-end mesh size and the closure of trawling during the reproductive period and recruitment of the red shrimps.

More studies should be carried out to protect areas of particular interest (e.g. corals, nursery and spawning grounds). Since a Hellenic deep-water trawl fishery could be developed in the future, more detailed studies should be promoted to investigate the pristine Hellenic deep-water stocks (ANON., 2001a).

Red coral- Corallium rubrum

In Hellas, exploitation of the red coral (*Corallium rubrum*) is regulated by the Hellenic Ministry of Rural Development and Food. However, the absolute lack of scientific data on red coral distribution, abundance and population dynamics in the Hellenic seas, renders any such management scheme rather uncritical. The need for an international research programme aiming at investigating the spatial distribution and population structure of red coral in the Hellenic Seas is, thus, urgently recommended in order to address proper and effective management measures.

- **Specific Actions**

Fisheries within the Lefkada and around Kalamos Natura 2000 Site

With reference to Council Regulation (EC) No 1967/20063 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea and considering that fisheries management measures within "Natura 2000 sites" are possible under the Common Fisheries Policy the following urgent actions have been proposed to be taken within this Natura 2000 Site (Notarbartolo *et al.*, 2009) :

1. Strict enforcement of national legislation and of Council Regulation 1967/2006, and appropriate penalties for illegal fishing.
2. Immediate temporal restrictions on purse seining and trawling, to ensure that these fisheries are fully sustainable and do not harm the ecosystem and its biodiversity, as well as endangered dolphin populations (either directly or indirectly). In addition to existing regulations, purse seining should only be allowed from May to October, trawling from November to March.

3. Prompt implementation of the ban of beach seining by May 31st, 2010, as demanded by Council Regulation 1967/2006. Beach seining is known to devastate ecosystems and has been banned in most EU Countries.
4. Adoption of larger mesh size for all bottom-set nets than what is being used by coastal fishermen (current practice is 20-22 mm knot-to-knot minimum), in order to increase selectivity.
5. Current fishing capacity in the Natura 2000 area should not increase.
6. Restrictions on recreational fishing, which should be carefully regulated to minimize impact on the ecosystem, according to the available scientific evidence.

Coralligenous concretions and maërl beds

UNEP has proposed that "*Coralligenous/maërl assemblages should be granted legal protection at the same level as Posidonia oceanica meadows. A first step would be the inclusion of coralligenous concretions and maërl beds as a priority natural habitat type in the EU Habitats Directive (92/43/EEC), which would enable EEC countries to undertake surveillance of the conservation status of coralligenous/maërl assemblages and also to set an ecological network of areas of conservation (LICs/ZECs) hosting coralligenous/maërl assemblages, which would ensure their conservation or restoration at a favourable conservation status.*" (UNEP, 2007)

Alien species

The monitoring of alien species should be one of the priorities of any strategy to protect biodiversity and should be promoted outside the scientific community. Sports clubs, SCUBA divers, naturalists, fishermen, aquaculture farmers must be encouraged to either look for specific species, report unusual findings of species or to carry out specific recording duties where possible. Apart form the designated 'hot spots', the NATURA 2000 sites and other marine protected areas (MPA) should be the focus of such monitoring scheme. Data on NIS from these sites could be reported and could be adapted for bioinvasion assessments. WFD monitoring should also be used to provide additional data where possible.

The monitoring of alien species should be one of the priorities of any strategy to protect biodiversity and should be promoted outside the scientific community. The ongoing assessments should report: the inventory of newly arrived NIS and areas of their origin; vectors associated with new introductions; changes in power of pathways and their vectors; account of newly colonised localities as a result of primary introduction and secondary spread;impacts of newly established IAS;and changes in bioinvasion impacts of previously established IAS.

Climate change

Gaps exist our understanding of CC and its impact on biodiversity. Long-term data on climate change and on communities changes in the Hellenic seas through an integrated framework are required.

Endangered species

The current Red list of threatened animals in Hellas (Legakis & Maragou, 2009) includes 27 species (see table 10). It is obvious that the majority of the Hellenic fauna has either not been evaluated for the Red List or there have been no sufficient data for safe evaluation (for example there are only 3 invertebrates in the current list). The evaluation should be extended to increase the coverage of most species in the marine environment

Libya

- Status condition of heavily polluted area and future studies to improve the conditions, such as in Alburdiy bay near the Libyan east border.
- Tubruk harbour needs the urgent action. It has oil port and sewage pollution and the population is increasing in this area.
- Brackish water area near Benghazi city needs urgent action. It is polluted by sewage; this area is considered as sanctuary city for migratory birds.
- Coast of Al-brgia and Ras Lanouf need urgent action to assist their impact on the marine environment.
- The coast of Musrata needs urgent action to assist its impact on the marine environment.
- Accurate Mapping of the Libyan coast to describe the exact coast.
- Survey the available Seagrass (distribution and abundance).
- Ghost crap needs an action plan especially in the east part of Libya.

Tunisia

Protection of habitats:

- For the marine area, measures to be undertaken will involve firstly the reduction and mastery of the form of "classic" pressures represented by the fishery, namely the strict enforcement of regulations regarding prohibited gear, fishing areas and specific campaigns and the size of catches of species. The results of research on overfished stocks should be taken into account.

- Control of pollution in all its forms, industrial (especially in the Gulf of Gabès, Sfax, Gabès and Skhira), wastewater and solid waste.

- The monitoring of developments and the occupation of habitats by invasive species, in particular the vegetation (Halophylla) and benthic.

- Ecological keeping up to maintain the water quality balanced with respect to, the physical chemistry of water, nutrients and phytoplankton primary production, to reduce the phenomenon of eutrophication often accompanied by proliferations of toxic algae .

- It is also essential to consider the effects of the sea level rise and consequently the adaptation to climate change during the implementation of these actions.

- For areas of high biodiversity including *Posidonia* meadows on the one hand and various anthropogenic pressures and impacts on the other hand, actions should be focusing on:

    - The conservation of species and habitats, in particular those of Posidonia and Magnoliophyta, taking into account the evolution of lower and upper limits of seagrasses. Particular attention should focus on the waterbirds (Thyna, Kneis, Bin el Oudiene etc...)
    - Monitoring and management of the evolution at the foreshore and coastal wetlands (marshes and salty lakes, islands and islets, estuaries)

Protection of species:

- In terms of species, the starting point is the database or inventory of marine and coastal biodiversity of Tunisia, who despite the updating efforts still needs to be developed. The inventory should emphasizes especially the list of species already under threat, and the list of introduced species given that this area (particularly the Gulf of Gabès) represents the centre of the intrusion.
- Alien species that have reached commercial biomass shall deserve even more interest and follow-up as threatened species.
- For both habitats and species, mapping and spatial representation of the observations and monitoring have to be developed.

Actions to preserve fisheries in the open seas including the deep seas

General management failure for Mediterranean marine resources implies the necessity of urgently adopting an EAF. The Mediterranean open seas, including deep seas, are still poorly known, which implies that the precautionary approach has to be applied.

Marine Protected Areas (MPA) help fisheries management by providing local release from fishing and maintaining undisturbed areas favouring the prevalence of vulnerable ecosystems. But in order to evaluate the efficiency of MPAs for fishery purposes, it is essential to have a good knowledge on the ecosystem components and functioning, and to promote a continuous monitoring.

In order to select the most adequate areas as candidate sites for MPAs, we need to identify sites addressing ecological importance, including the uniqueness or rarity, of special importance for life history stages of species, importance for threatened, endangered or declining species and/or habitats, the vulnerability, fragility, sensitivity or slow recovery of the ecosystem, its biological productivity and biological diversity. Furthermore the establishment of a MPA must carefully consider its location (after the criteria mentioned above), but also its size and connectivity. In the Mediterranean, most MPAs have been located around coastal rocky bottoms or islands, despising the importance of open seas ecosystems.

There is only one protected area embracing the Mediterranean high seas, so there is an urgent need of planning and implementing protection zones under the SPAMI criteria, and that should be correctly surveyed and scientifically monitored. Within this framework, a consistent and well monitored network of SPAMIs located in open seas, including deep seas (comprising both pelagic and demersal ecosystems) should be proposed by the concerned Party/Parties, according to the five possible SPAMI status regarding the area of location (area under one national jurisdiction, mixed national jurisdictions area, mixed national jurisdiction and beyond national jurisdiction area, mixed national jurisdictions and beyond national jurisdiction area, area fully beyond any national jurisdiction).

7. FUNDING PROBLEMS AND OPPORTUNITIES

7.1. Regular national sources that are potentially available

As quoted by all the national sources of information, sources of national funding are specific to each country. In some Mediterranean countries of the central area, such as Libya and Tunisia, national funding is extremely limited and do not allow ambitious research programmes to be undertaken. However, in others countries, it is guaranteed, even if it is irregular and insufficient, by the state via the various national ministries, centres or agencies, as in Greece and Italy. In Greece, for instance, none of the Greek funded projects has so far focused on marine and coastal biodiversity issues but rather on the environment generally.

Potential private sources of funding as identified by all the countries are not generalized. Being usually local in nature (although they can cover critical / sensitive areas), they can provide only limited information on marine biodiversity. Moreover, they are unrealistic for some countries but possible in others through private national funds. This essentially concerns the fishery-linked private sector and environmental impact studies, which constitute a source of funding for research laboratoriesin Greece.

7.2. International funds, projects, programmes

These constitute the major contribution to funding research on marine and coastal biodiversity. The main sources of funding identified by the different countries come mainly from the EU via its framework programmes on the environment and biodiversity, the World Bank, the African Development Bank, the UN Environment Programme (UNEP), the UN Development Programme (UNDP), and the Regional Activity Centre for Specially Protected Areas (RAC/SPA). Also, many international NGOs (BirdLife International, WWF, IUCN etc.) were identified by certain countries as important funding sources for marine and coastal biodiversity aspects-linked research

It is also important to mention that with some exceptions directly related to marine and coastal biodiversity, most projects include biodiversity issues only as supplementary issues. Furthermore, EU funded projects being competitive in nature, diverse in topic, with a wider area in scope and with a rather limited time span cannot be considered as a regular source of funding. On the other hand, as the EU becomes more concerned about ECAP, more funds are expected to become available on related research topics in the Mediterranean.

8. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations constitute a synthesis emerging from the national contributions as regards the marine and coastal biodiversity in the Central and the Ionian Mediterranean sea areas and the pressures and impacts exerted on them. They have been completed with relavant data as regards Taking into account the analysis made in the previous pages of this document and the Italy and Malta.

8.1. Conclusions

Although knowledge concerning marine and coastal biodiversity is more or less satisfactory in the Central and Ionian Mediterranean, there are considerable gaps regarding the distribution, range, populations and conservation status for the majority of species and habitats. Inventories are rare, and scientific research, in this field, is very limited and uncoordinated, probably due to financial and administrative constraints. Therefore, research and systematic monitoring of marine and coastal biodiversity must be supported. The adoption of the National Biodiversity Strategies and Action Plans, elaborated within the SAP BIO Programlme, the integration of biodiversity concerns into sectoral policies combined with the effective operation of the Natura 2000 European ecological Network, especially for the Mediterranean Europrean countries, will be decisive for its preservation.

The current trend, related to global change, reveals a considerable change in the marine and coastal biodiversity in the Central and Ionian Mediterranean. This is shown both in the marked erosion of biodiversity so that many species that appear in many international treaties aiming at protection are currently threatened, and in the fact that marine habitats are undergoing alarming pressure, which is expressed in the alteration and destruction of these habitats.

During the last 20 years, the state of the Central and Ionian Mediterranean fisheries, similarly to the whole Mediterranean resources have shown negative trends, despite the reduction of the fishing capacity in accordance to national efforts and EU regulations for the management of the fishing fleets of the member states, aiming at the reduction of the fishing pressure on stocks. Moreover, the Mediterranean fisheries' sector's viability appears to be pessimistic, influenced by a variety of factors related to the capacity to produce sufficient amounts of fisheries' products and the conditions of the market. The above underline the complexity and the sensitivity of the problem and denote that management of Mediterranean fisheries should be based on both the sustainable exploitation of resources and the viable development of the sector.

The estimates of the Mediterranean marine resources are limited and are based on information gathered within research projects which are funded by national or community sources and therefore, the information we have is scarce and geographically limited. This makes the management of the fisheries' resources rather difficult, complicated and of high cost.

Fisheries, in particular inappropriate fishery practices, strongly impact marine biodiversity. Over-exploitation is responsible for the decline of many fish stocks. Particularly harmful to biodiversity is the direct impact of fishing on the seabed (mainly by trawl) and the fact that fishing practices lead to discards.

Gaps exist regarding our understanding of CC and its impact on biodiversity. What remain to be implicitly addressed are the implications of changes in the water mass characteristics and the influence of the modified water masses to the biology of the Mediterranean sea as assessed through experimental and modelling studies. Long-term data on climate change and on communities changes in Central and whole Mediterranean seas and an appropriate framework are required.

As regards non-indigenous and invasive species, several authors consider invasive species one of the biggest causes of losing of biodiversity. However, up today, even if rapid decline in abundance, till local extirpations of native species are been documented, no extinction of native species is known. The presence of non-indigenous and invasive species represents a growing problem mainly due to the unexpected impacts that these species can have on ecosystems and consequently on the economy and human health. Recognizing the need for collaboration in research and management of aquatic alien species at both national, sub-regional and international level and in particular for data exchange is a major issue. The case of the Hellenic network for Aquatic alien species in Greece is the best example.

Measures for the minimization of the adverse effects of human activity on the marine environment, such as the implementation of restrictions on solid and liquid waste disposal, are required to be implemented along with effective measures for the protection and conservation of endangered marine species and important marine sites.

Finally, an attention should be also paid to the deep sea, hosting some important ecosystems, habitats and assemblages (cold seeps, brine pools, seamounts, cold-water coral reefs). Deep sea species and habitats are, in general, particularly sensitive. Several pressures threaten this environment, in particular fishing practices (especially trawl bottom), pollutants, oil exploration and exploitation and climate change.

8.2. Recommendations

Taking into account the analysis made in the previous pages of this document and the main relevant national reports and consulted documents for Italy and Malta, the following recommendations can be made.

- Knowledge on marine and coastal biodiversity should be improved and extended for the field of studies on an ecosystem scale through multidisciplinary projects. Investigation of the diversity of little studied and/or unexplored groups in each country and in unexplored geographic areas and habitat types e. should also be addressed.

- Extension of the scope of studies beyond the level of species matrices, incorporating more data on size, life cycle, trophic relations, productivity, ecophysiology and genetics.

- Promotion of basic research to fill the knowledge gaps concerning the status of the marine environment of the Central and Ionian Mediterranean sea as well as the adoption of applied research for the development of suitable tools for monitoring, detection (eutrophication, oil spills etc.), upholding the relevant legislation and control concerning the development of cleaner and more environmentally friendly technologies and production procedures (for fisheries, aquaculture etc.).

- Promotion of training and capacity building, especially in: monitoring, planning, co-operation, project formulation and training of specialists

- Application of measures for the sustainable use of fisheries and aquaculture assessing the level of damage that can be sustained and/or is acceptable by the ecosystem through these practices, including also secondary effects such as the impact of the partial removal of a predator or a part of a life cycle of one species, information on fate and survival of discards and the impact on epifaunal benthic communities.

- Promote researches, in particular on by-catch, discard, ghost-fishing and technology, in particular necessary gear modifications to limit discards, by-catch, impacts on endangered species and on biodiversity in general (e.g. modifications of gears, increase of mesh size of trawl net, repellent devices).

- Improve controls and promote awareness campaigns in order to eradicate illegal fishing practices (i.e. trawl within 50 m depth, driftnets, dynamite fishing, poison fishing, date extraction).

- Co-ordinated, cooperative multidisciplinary research is to understand and investigate the impact of CC on the marine ecosystem. Long-term data on climate change and on communities changes in the national, sub-regional and Mediterranean areas through an integrated framework are required.

- A regional awareness raising program in order to influence decision makers to put climate change impacts on marine and coastal biodiversity as high priority in national agendas should be planned and implemented.

- Co-ordinated, cooperative regional research is to investigate the phenomenon of introduced species, particularly in hot spot areas such as ports and lagoons.

Particularly studies on the pelagic ecosystem presumably affected by ballast waters are urgently needed.

- Particular importance should be paid for studying, understanding and protecting deep ecosystems. Action plans and scientific research for the sustainable management of deep water fisheries with emphasis on the protection highly vulnerable deep-water communities, either by immediate removal of (erect, slow growing) organisms and/or by habitat and trophic level modifications. Studies on the deep water coral mounds in the areas must be intensified.

- Networking: joining forces, setting the essential questions, developing the National Strategies in compliance with the International Treaties and Conventions, linking with the relevant EU Networks

- Establishment of national working groups addressing various biodiversity issues meeting regularly and reporting once a year.

- Since marine protected areas are becoming an important tool for preserving biodiversity and for managing fisheries, there is an urgent need for studies to determine baseline information such as size, number and location in order to improve the efficiency of these areas.

Finally, it is very important to mention that the ecosystem approach must be implemented in order to improve the knowledge of the marine and coastal ecosystems and to better understand and evaluate the effects of pressures and impacts on biodiversity. In particular, indirect ecosystem consequences and cascade effects can be interoperated only through an ecosystem approach. Ecosystem approach to fishery management is accepted as the necessary framework to secure sustainable use of marine ecosystems

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