EP

United Nations Environment Programme

UNEP(DEPI)/MED WG 359/Inf.12
October 2010

ENGLISH
ORIGINAL: ENGLISH

MEDITERRANEAN ACTION PLAN

Tenth Meeting of Focal Points for SPAs
Marseille, France 17-20 May 2011

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 Aegean Sea-Levant Sea"

In the framework of a sustainable development approach, this document will be available only in electronic format during the meeting

PNUE
CAR/ASP - Tunis, 2011

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INTRODUCTION

Decision IG 17/6 of the Contracting Parties of the Barcelona Convention (Almeria, Spain, 15-18 January 2008), requires the application of the ecosystem approach to manage the human activities affecting the Mediterranean marine and coastal environments. This report is part of RAC/SPA's involvement in this strategy, identifying the relevant features of ecosystems and assessing their state by considering the pressure they are subjected to. This report deals with the state of the biodiversity of marine and coastal environments of the Aegean Sea-Levant Sea.

The report is based on the work of national focal points who summarized the knowledge available for their area:

- Greece (All seas except Ionian), by Argyro Zenetos, Panayotis Panayotidis, Nomiki Simboura, Maria Salomidi, Nikos Streftaris
- Turkey, by Bayram Özturk,
- Syria, by Amir Ibrahim
- Lebanon, by Ghazi Bitar
- Israel, by Bella Galil
- Egypt, by Joussef Halim

The national reviews are also based on the inputs of various national experts (e.g., SPA Focal Points, national correspondents for SAP BIO, ministries, scientists and stakeholders). It was responsibility of the experts to synthesize the available knowledge and to organize it according to the required formats, hence the reports must be considered as a product of their expertise and they are responsible for them.

After the analysis of the biological features and the habitat types of the Eastern Mediterranean basin, both the pressures and impacts on these ecosystems are synthesized.

This report was drafted for the Regional Activity Centre for Specially Protected Areas (RAC/SPA), by prof. Ferdinando Boero.

METHODOLOGY

Participatory approach

To carry out step 3 of the road map adopted by the contracting parties of the Barcelona Convention, 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, was applied to four biogeographical and oceanographic regions of the Mediterranean Sea (as proposed at the 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 (all seas except Ionian), 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.

Tasks and anticipated outcomes

1. <u>National level</u>

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. <u>Sub-regional level</u>

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 considers humans as part of ecosystems and, hence, their activities must be managed so to cause the lowest possible impact on natural environments and, also, to protect them. The World Summit on Sustainable Development (Johannesburg 2002), induced many international conventions and regional seas organisations to adopt the ecosystem approach, so to cope human activities with the preservation of ecosystems.

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 region is characterized by the presence of a sea enclosed among Africa, Asia, and Europe, determining a particular climate, conducive to the establishment of a particular biodiversity (see Bianchi and Morri 2000, Boero, 2003, UNEP/MAP-Plan Bleu, 2009, for reviews).

As in every other corner of the planet, also in the Mediterranean sea the sustainability of the use of goods and services is a crucial issue. Since the environment does not know political boundaries, the application of the ecosystem approach, and conservation- and management-related measures, is advisable not only to areas under state jurisdiction but also to the habitats and ecosystems that lie in waters outside national jurisdiction.

The Aegean Sea-Levant Sea

The shores and marine areas of the Aegean Sea and the Levant Sea contain a biodiversity heritage that is still rather underexplored and that is very sensitive to global change and biological invasions, due to the immediate connection with the Red Sea through the Suez

Canal and, hence, to the arrival of a rich contingent of alien species. These features exhert great pressure on this basin, impacts derive both from local human activities and to global scale activities, such as those determining global warming.

The Eastern part of the Mediterranean is the first recipient of biological invasions from the Indo-Pacific region, through the Suez Canal, and could be considered as an acclimatation area for the species that might then spread to the rest of the basin.

The Contracting Parties to the Barcelona Convention, during a Meeting at Almeria (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.

RAC/SPA has been actively involved in the phases of the road map, and especially in Phase 3. The present document is RAC/SPA's contribution to this phase.

The contribution is made of sub-regional documents 'identifying major properties of the ecosystems and assessing the state of the environment and the pressures exercised on marine and coastal biodiversity in the Aegean and Levant Seas'.

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

National and sub-regional consultants received from RAC/SPA a wide variety of documents of international, regional, sub-regional, and national pertinence, with particular attention to:

- 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

These documents provide important information on the state of the ecosystems, impacts and pressures, integrating national reports. The documents are a precious source of information for identifying gaps in knowledge, funding patterns, the fulfilment of urgent actions and needs, providing conclusions and recommendations.

The national experts also used the documents defining and dealing with the ecosystem approach as a guideline to 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 framed within this perspective. The document produced by the CBD[1] Secretariat is in itself an excellent reference work.

2.2. Comments

Due to historical reasons, with some noticeable exception, research efforts have been very limited in this part of the Mediterranean area, if compared with the rest of the basin. Hence, the documentary base used and the knowledge available is relatively poor and the knowledge limits require great investments to fill he gaps at both national and sub-regional level:

- Low availability of information
    - In most of the countries of this part of the Mediterranean basin, the information is contained in documents of difficult access, both due to the publication strategies of the scientific community and to the employed languages. A treasure of information is hidden in the grey literature and, anyway, it is difficult to ascertain the validity of reports that are seldom validated by peer review in an international context.

[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 subject level
  - The number of subject-based or sector-based bibliographic sources varies considerably from country to country and subject to subject. This variability, as remarked by the report by Boero (2003) is due to the lack of strategies in planning research efforts at bot national and regional level. Furthermore, scientific expertise is scant in many branches of biodiversity research.
  - In most countries, contrary to the ecosystem approach, nature is seen as a mere source of goods of commercial interest, and the urge of its proper management is not felt in terms of priority in resource investment.
  - Data of any kind are fragmentary and never cover thoroughly neither marine nor coastal places
  - Knowledge of both the deep and the high seas is very poor (status, pressures and impacts)

The present synthesis is based on the reports prepared by the regional consultants, but stems also from work carried out by the responsible of the study while accomplishing the above mentioned contract for RAC-SPA, several projects of the European Union, and many workshops and meetings carried out under the umbrella of the Mediterranean Commission (CIESM).

The literature cited in this report is kept to a minimum, since the national reports already contain a wealth of references and the reader is addressed there for a complete bibliographic list.

3. STATUS OF COASTAL AND MARINE ECOSYSTEMS

3.1. Biological characteristics

During its long history, the Mediterranean Sea (as the Tethys Sea) once connected the Atlantic and the Indo-Pacific Oceans, then it went through the Messinian Crisis (CIESM, 2008a) and was finally re-colonized by Atlantic biota, through the Strait of Gibraltar. After the Messinian crisis (5 MY BP), the basin was interested by cold and warm periods. Overall, the perception of biodiversity by the scientific community is that the species numbers are higher in the Western than in the Eastern part of the basin, so that, as the distance from the source (i.e. the Atlantic biota, through Gibraltar) increases, the conditions are less and less favourable for the establishment of the whole set of species that recolonized the basin after the Messinian crisis. The eastern basin, and especially the southern shore, are much warmer than the western basin, and have almost tropical conditions for most of the year. The explanation of the reduction in biodiversity going from the West to the East, thus, was based on the assumption that the conditions of the Levantine Basin are not conducive for the thriving of the Atlantic contingent, being so biased by a founder effect. Furthermore, the floods of the Nile deeply affected the biology of this part of the Mediterranean sea but, after the construction of the Aswan Dam, in the Seventies, the bearing of the Nile on the Mediterranean was severely reduced.

The opening of the Suez Canal, in 1869, reconnected the Mediterranean Sea with the Indo-Pacific Ocean, through the Red Sea, but the Bitter Lakes constituted an almost insurmontable barrier to the passage of species through the newly available water way. The salinity of the Bitter Lakes gradually decreased and, in the last decades, the passage of species through the canal has become impressive. The passage was and still is almost one-way, from the Red Sea to the Mediterranean Sea. The entrance of Red Sea species through the Suez canal has been called Lessepsian Migration. This term, however, is not right. Migration, in fact, implies a back and forth movement of organisms that pass from one part of the world to another, and back. The Red Sea species that enter the Mediterranean, however, do not perform migrations, and they are properly labelled as immigrants, hence: Lessepsian Immigration.

The arrival of species from the Red Sea has been considered in different fashions by the scientific community and even by different countries. Some authors consider the arrival of “aliens” as a terrible event, whereas some other authors salute the new contingent as an enrichment of Mediterranean biodiversity.

The Eastern Mediterranean, thus, is currently experiencing an increase in the number of species, since the aliens are often added to the indigenous ones. So far there are no cases of extinction of indigenous species due to the arrival of the aliens, and it is not clear if the decline of some species is due to climatic deterioration (in terms of fulfilment of their requirements) or to competition with newly arrived species that are preadapted to the new conditions. Biodiversity, anyway, is not just species and, when wider concepts are adopted to measure its state, it is a common perception that habitats are deteriorating, related to various human activities, basically uncontrolled urbanisation and coastal development, ports, fish farming, pollution and fishing, and overall, by the arrival of alien species.

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.

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

Planktonic communities are variable by definition, being characterized by pulses of phytoplankton (in the late winter, early spring, and in early autumn) followed by pulses of zooplankton. This production sustains most of the other components of marine biota. Interannual variability is very sharp and it is very seldom that a situation observed in one year, is repeated in the following years. For this reason, many countries developed plans of long term monitoring of plankton diversity, since this knowledge is a prerequisite to the understanding of the rest of the functioning of marine ecosystems. Due to general decisions in research priorities, however, long term monitoring of any biodiversity feature almost ceased in any state, being replaced by satellite observation which, however, refers just to the ocean surface and to a limited set of features. If in other states these researches have been abandoned, in the Eastern Mediterranean they have never been carried out. Almost all the available information is based on episodic samplings that are often biased towards some groups and disregard other groups.

Proliferations of certain life forms, leading to Harmful Algal Blooms and Jellyfish outbreaks have become increasingly common over the past few years, even though detailed reports are scant from most states.

The following data stem from the national reports (in abridged form) and exemplify the disparity in the treatment of the various topics, very evident also for all other topics covered in the reports. If detailed data are given, and I left some of them also in this report, they derive from episodic campaigns and do not necessarily represent the present situation.

Greece

Apart from copepoda and cladocera, macrozooplankton diversity is poorly known. Other taxonomic groups should be inventoried. Studies on copepod production, grazing impact and metabolism should be carried out in more areas. The role of mesozooplankton as a link between the lower trophic levels (phytoplankton, microbes) and the higher trophic level (fish) has to be investigated in both coastal and offshore waters. Attempts should also be made to relate phytoplankton to the food web of the pelagic ecosystem. Population explosions, especially in connection with red tide phaenomena, should be studied further.

Turkey

430 phytoplankton taxa have been recorded from the Turkish coast of Mediterranean and Aegean Seas, comprising: Dinophyceae (Dinoflagellates), Bacillariophyceae (Diatoms), Cyanophyceae (Cyanophytes, blue-green algae), Dictyocophyceae (Silicoflagellates), Prymnesiophyceae (including coccolithophores), Euglenophyceae (Euglenoids), Prasinophyceae and Chlorophyceae (Chlorophytes, green algae), Crysophyceae (Crysophyts), Xanthophyceae (Xanthophyts) and small planktonic marine flagellates (<20µm). Dinoflagellates were dominant (50%), followed by diatoms (46%) in term of species number. The other groups were not important as they represented only 4% of total phytoplankton. The contribution of small groups, mostly coccolithorids and small flagellates to the total phytoplankton were evaluated in recentmost studies, dating back to at least ten years ago.

Different phytoplankton composition and abundance were recorded during research periods and sites. The most widespread species of the phytoplankton belonged to the genera: *Ceratium* (80 species), *Protoperidinium* (29 species), *Dinophysis* (26 species) among the dinoflagellates, and *Chaetoceros* (41 species), *Rhizosolenia* (21 species) among the diatoms. Diatom species diversity decreased in summer, being high in spring. Dinoflagellates increased during summer and autumn, while they were scant in winter. In recent years increasing eutrophication resulted in algal blooms and a decrease in species diversity. 174 taxa are reported from the Levantine Basin. Among them *Scrippsiella trochoidea* and *Prorocentrum micans* are known as red tide species. However, there are no data on inter annual or intra annual variation on phytoplankton distribution or blooms.

Data on zooplankton are virtually absent.

Cyprus

Data not available.

Syria

Phytoplankton species recorded totalled 152 species, representing 6 classes, 19 orders and 36 families. Based on a single study, carried out in the late Nineties, phytoplankton density ranged from 2522 ind/m3 in the offshore water of Banias during summer, to 236111ind/m3 in the area facing Aisin river estuary during spring. Spatial variations showed that the dominant species are mostly the same but differ in timing of appearance. More recent studies showed that density variations in different offshore stations depend on the human land-based activities and the dimensions and nature of the continental shelf, which influenced the hydrology and population composition of the marine waters.

Information on total phytoplankton production and biomass estimations are very scarce. A study carried out in the marine waters of Banias area showed that the area facing Aisin river is the most productive averaging to 55mg C./m3/day with a peak reaching of 285.1mg C./m3/day during Spring. Further offshore, a reduced average phytoplankton production of 15.9mg C./m3/day was recorded. On some occasions during winter, the average phytoplankton production was very close to 0.0 C./m3/day. The waters facing the refinery and the waste water discharge pipeline was lower (24.8-26 C/m3/day) comparing to the other reference stations (33.3-35.7 C./m3/day). Usually, phytoplankton production values were the lowest during summer and winter. These data are a snapshot of a situation that, however, might be much changed in recent years.

Recent Chlorophyll-a concentration measurements indicate the oligotrophy of Syrian marine waters with high seasonal and spatial variability, being 0.052±0.01 µg/l during Dec. 2006, 0.08±0.01 µg/l during Mar. 2009 and 0.049±0.01 µg/l during Oct.2009 .

The deep Chl-a maxima in Lattakia area (0.08 µg/l during Dec. 2006, 0.1 µg/l during Mar. 2009) were observed between100-50 m water depth. These maxima were associated with the cyclonic and anticyclonic eddies at 75-40 m and at 80-105 m water depth respectively .However, when measured during Oct.2009 in various stations along the Syrian margin, the Chl-a maxima (0.07-0.12 µg/l) were observed at 25-100 m indicating the oligotrophy of Syrian marine waters. The pattern of vertical distribution of Chl-a was close to uniform throughout Syrian marine waters during Oct. 2009.

When two stations in the south (facing Tartous port) and the north (facing Lattakia port) were compared during Oct.2009 ,Chl-concentrations were 0.20 and 0.51 µg/l respectively at 1m depth but were 0.04 and 0.22 µg/l respectively at 10m depth. This indicates higher effects of human activities on the coastal waters facing the port and particularly in the marine waters facing Lattakia city.

There were certain areas along the Syrian shoreline where high Chl-a concentrations (above 0.1 mg.m-3) exist. They were mainly near Lattakia port, at sewage discharge regions and at the north of Al-Kabir Al-Shimali River mouth Tartous port and other similar areas. Because of the small sizes of the plumes, these high Chl-productive areas appear to be related to land source anthropogenic nutrients. In addition, comparison of Chl-a data with those from other Mediterranean sites revealed that the concentrations measured in the study area were relatively lower than those reported from southern Levantine Basin. Furthermore, these concentrations are even much lower than those reported from the western Mediterranean.

Despite its importance in the functioning process of the ecosystem, information on phytoplankton cells grazed by micro-zooplankton is lacking in Syrian marine waters.

Zooplankton species in Syrian marine waters were estimated to be of some 300 species, representing 10 phyla, 13 classes and 21 orders, Arthropods species representing about 40% of the total species composition. Strong positive correlation was observed between species richness and composition and water temperature during all months except during summer, when the correlation was negative, with the spring months being the richest. Accordingly, zooplankton density in Banias area, for example, ranged from 37-3088 Ind./m3. Big variation was found among the study sites with a large deviation from other sites from the Syrian coast.

A field study carried out during the period June1995-June 1996 showed that zooplankton density has two peaks: one in spring (18.5°C) and the other in autumn (on 25°c). This density is reduced during summer and winter. Total zooplankton biomass ranges from 0.9-34.3mg DW/m3; 88% of the samples had total biomass less than 11mg DW/m3. Thaliacea group largely contributed more than 50% to the total zooplankton. The jellyfish *Rhopilema nomadica* was most abundant at water temperature 23-28°C., with the peak being at 31°C.

Lebanon

The Levantine basin is oligotrophic and is characterized by the succession of two annual thermal phases: cold phase in winter and warm phase in summer, separated by two short inter-seasonal periods in spring and autumn. Due to its low productivity, this basin shows relatively clear and transparent waters. In the winter season, the water turbidity is higher after storms due to fresh water input from rivers and from disturbance of the sea bed while the summer season shows a water transparency of 25 m.

The marine flora and fauna in Lebanese waters belong to the Atlanto-Mediterranean species with some sub-tropical elements. Lebanese plankton communities have been studied by several scientists over several decades. An inventory of these species already exists but regular updating is missing.

The number of planktonic primary and secondary producers is over 1250 species with the main groups studied being Diatoms, Dinoflagelles, Silicoflagellates, Coccolithophoride. Despite a relatively narrow coastal zone, this richness varies in density and abundance of species.

The annual cycle of phytoplankton is characterized by seasonal and geographical distribution in species and biomass. Geographical distribution studies revealed an annual mean of total number of cells estimated at around 9 x 10^6 cells L^{-1} in central Lebanon and a density in North Lebanon ranging between 100 x 10^3 and 4.5 x 10^6 cells.L^{-1}.

Seasonal distribution was more pronounced where the winter period (December-March) is characterized by its relative cold water with an important mixing of sea water masses bringing nutrient from deep layers to the euphotic zone in addition to important fresh water input coming from rivers. Phytoplankton displays moderate density but high richness of species. Chlorophyl a (CHL-a) is low during this period of the year, averaging 0.09±0.04 mg.m^{-3}. The main species recorded in this season belong to *Thalassionema, Thalassiothrix, Chaetoceros, Biddulphia, Coscinodiscus, Leptocylindrus, and Ceratium.*

The spring season (March-May) is marked by a significant bloom of phytoplankton with optimum conditions for the development of cells. The average density is estimated between 400 and 500,000 cells L^{-1} of sea water. CHL-a reaches its peak values of 0.41 ±0.12 mg.m^{-3} during this period. Nevertheless, this season is marked by the lowest species diversity where a dozen of species prevail among the existing population. This bloom is directly related to most favorable conditions in temperature, nutrients and hydrological stability. The main genera observed during that period are: *Skeletonema, Chaetoceros, Rhizosolenia, Bacteriatrum, Nitzschia, Ceratium, Dinophysis, Protoperidinium.*

The summer period (May-September) is marked by a low level of nutrients and an increase in water temperature generating a clear thermocline (between 35m and 75m) and stratification of water column. Therefore the phytoplankton biomass and richness drops and the CHL-a is at its lowest levels of the entire year reaching as low as 0.05±0.07 $mg.m^{-3}$. The dominant genera are: *Protoperidinium, Ceratium, Dinophysis, Oxytoxum, Pyrocystis* and *Podolampas*.

During the autumn period (October-November) a slight increase of nutrient level and a moderate bloom of certain genera like *Chaetoceros, Rhizosolenia, Ceratium,* and *Protoperidinium* are usually observed.

Diatoms & Dinophyceae are the most common groups found in the coastal waters of Lebanon. Diatoms correspond to 75% of the phytoplankton biomass and 40% of the total species number found in Lebanese coastal waters. The Dinophyceae are the most abundant group representing 60% of the total number of phytoplankton species but form only 25% of the total biomass. This group has an affinity to proliferate in oceanic waters.

Zooplankton species are highly abundant and of various types in Lebanese waters. They include Protista, Cnidaria, Ctenaria, Crustacea, Chaetognatha, Mollusca as well as meroplanktonic *Pisces*, as ichtyoplancton. Their population dynamics are largely related and similar to the phytoplankton cycles.

The most recent comprehensive plankton inventory is the 1996 MoA National Biodiversity Report that lists 747 species divided as follows: Foraminifera (12 species); Actinopoda (66 species); Tintiniidae (99 species); Hydromedusa (68 species); Scyphozoa (5 species); Siphonophora (28 species); Copepoda (173 species); Cladocera (6 species); Ostracoda (6 species); Amphipoda (25 species); Euphausiaceae (5 species); Mysidacea (4 species); Cirripedia larva (4 species); Decapoda larva (106 species); Chaetognatha (10 species); Pteropoda (9 species); Heteropoda (9 species), Polychaeta (4 species); Appendicularia (15 species); Thaliacea (6 species); Pisces Ichtyoplancton (84 species). These numbers are way far from the real numbers present in the coastal environment due to several constraints and difficulties spanning from sampling, to preservation and identification of several species.

The hydro-climatic factors (water stratification, heavy thermocline) and nutrient cycles have a direct impact on the distribution of plankton throughout the water column. The high water temperature and salinity in the summer phase with the formation of a thermocline (35-75 m) creates a hydrothermal barrier preventing exchange of water masses and vertical movement of planktonic species. Consequently a low diversity and biomass is recorded during that period. Vertical distribution and seasonal variations of plankton are distinct mainly in the euphtoic zone with a clear regularity for minima and maxima of species and biomass. These characteristics are mostly pronounced in the euphotic and neritic zone than in the oceanic zone.

Israel

The mean high temperatures prevailing in the eastern Mediterranean, especially the Levantine basin, impart to this region a tropical character in regard to the planktonic biota: several species of dinoflagellates and diatoms are most common and widespread in the Indian Ocean. Notwithstanding the low biological productivity, the diatom and dinoflagellate flora is characterized by a wealth of species, generally characteristic of tropical and subtropical seas, with an increasing number of species of Indo-Pacific origin which have entered over the years through the Suez Canal and established populations in the Levant Basin. In the pre-Aswan Dam period, the diatoms formed up to 99 % of the total algal biomass during late summer, when the Nile's nutrient-laden water reached the sea. These algal blooms were stimulated by the nutrients, mainly silicates and phosphates. Post- Aswan Dam, these blooms are less apparent and predictable, largely due to the fairly constant salinity and low nutrient load. In general, the dinoflagellates consist of tropical-subtropical species, together with eurythermal species.

Most data on Zooplankton stem from the Pillsbury cruise to the eastern Mediterranean in 1965 with information on the bathymetric distribution of some of the Microzooplankton species: as in the case of the Ceratiaceae and Dinophysiaceae, many of the winter epipelagic species of Acantharia and Spumellaria migrate to deeper levels during the summer months. Among the Acantharia recorded at great depths was *Lychnaspis giltschi* (at 2000-3000 m). Some of the deep water. The tintinnid fauna of the Levant is remarkably similar to that of the Red Sea.

Several taxonomic groups of macrozooplankton had been studied both from regular collections along the coast of Israel and from collections carried out within the framework of projects supported by various agencies, notably the Smithsonian Institution in Washington D.C. The latter supported a 5-year (1967 to 1972) project entitled "Biota of the Eastern Mediterranean and the Red Sea". It would far surpass the scope of this report to refer to all the results of these investigations. Therefore, only a few examples are given, resulting from the work of several local and foreign scientists that could best emphasize the peculiarities of the zooplankton assemblages of the Levant Basin as seen in Israel waters.

One of the most striking characteristics of the zooplankton of the eastern Mediterranean is its chaetognath fauna. Only one of the five most abundant species in Israel, *Sagitta enflata*, is common to both the Mediterranean and the Red seas. The principal neritic Levantine species, *Sagitta friderici*, is unknown from the Gulf of Elat. It was assumed that the Bitter lakes of the Suez Canal formed an insurmountable obstacle in the dispersal of these species, but as their salinity has decreased it may opportune to re-examine the biota. A similar picture of dissimilar taxa in the two adjacent marine environments, connected as they are by the Suez Canal, is provided by the appendicularian fauna: *Oikopleura longicauda* and *O. dioica* prevailing in the Levant and *O. rufescens, Megalocercus huxleyi* and *M. abyssorum* in the Red Sea. The thaliacean fauna of the Levant, though essentially Mediterranean in character, with the exception of *Salpa cylindrica*, an Erythrean alien. The Cladocera, consisting of few neritic, thermophilic and euryhaline species, provide additional examples of the region's biogeographical aflinities: the prevailing species of the genus *Evadne*, *E. tergestina* and *E. spinifera*, are common in both inshore and offshore waters of the Levant Basin, and *Podon polyphemoides* used to thrive in the coastal waters of Israel at the time of the Nile floods. However, the species *Penilia avirostris*, so common in other parts of the Mediterranean, is conspicuous by its absence.

In all neritic and offshore plankton samples the copepods often form up to 80-90 % of numerical abundance and displacement volumes. The neritic element in the copepod fauna are *Paracalanus parvus, Euterpina acutifrons, Acartia clausii* and *Centropages kroyeri*. Offshore, and occasionally recorded inshore as well, are *Temora stylifera*, *Clausocalanus furcatus, Acartia negligens* and *Centropages violaceus*, the latter species considered an indicator of Atlantic waters. Some deep water species of the genera *Pleuromamma*, *Luciculia* and *Euaelidus* have been recorded in the surface waters in winter.

Of special interest for the changing biogeography of this region is the occurrence of copepod species of Indo-Pacific origin in the inshore waters of the Levant Basin, such as the calanoids *Acartia centrura, Calanopia media* and *C. elliptica*. The pelagic flora and fauna show some affinities to the adjoining Red Sea. The causes are probably twofold: an invasion of species through the Suez Canal, enhanced by the decline of the former salt barrier and the disappearance of the freshwater barrier following the damming of the Nile; coupled with the hydrographic heterogeneity of the Mediterranean, with higher temperatures in the Levant.

The first record of Scyphomedusae from the Israeli coast dates back to 1935, reporting *Rhizostoma pulmo* and *Aurelia aurita* washed on beaches. Then, in the following decades, *Pelagia noctiluca* and *Cotylorhiza tuberculata* were reported, with the the first record of *Cassiopea andromeda*, an alien from the Red Sea, in the Eighties. In the Nineties, seven species of Scyphomedusae were recorded off the Mediterranean coast of Israel, including three alien species: *Rhopilema nomadica*, *Phyllorhiza punctata* and *C. andromeda.* Several recent records suggest that the vessel-transported *P. punctata* may have established a local reproducing population. The American comb jelly, *Mnemiopsis leidyi*, was first noted off the central Mediterranean coast of Israel in March 2009, when a swarm interfered with the operation of a desalination plant. Throughout that year dense populations have been recorded along the entire Israeli coast, and the population has been present to June 2010.

A quantitative species analysis of the phytoplankton populations off the Mediterranean coast of Israel was carried out during the years 1981 -1983. At all pelagic stations (> 100m), a deep chlorophyll maximum (DCM) was observed at depths ranging between 75 and 125 m. In these layers, the chlorophyll concentrations ranged from 0.09 to 0.21µg/l as compared to near surface (NS) concentrations of 0.03-0.07 µg/l. These findings accord with results of an earlier study, that the phytoplankton peaks, based on cell counts, occurred at depth of 80—100 m. This depth corresponds roughly with the base of the euphotic zone, although the DCM is occasionally located either above or below the 1 % surface irradiance level. The coccolithophorids and the monads represent the greatest percentage composition numerically of the nano and picoplankton, respectively. These formed the bulk of the phytoplankton, with the greatest contribution to total chlorophyll concentrations and photosynthetic activity. The monads constituted the dominant component of the phytoplankton in the near surface layer (NSL). The pennate diatoms predominate over centric diatoms at the DCM, the latter often being more abundant at the NSL: the pennate *Nitzschia seriata* and *Asterionella glacialis* recorded at the DCM were absent from the NSL. Among the pennate diatoms, naviculoid forms were the most common, often accompanied by *Thalassiothrix frauenfeldii* and *Nitzschia seriata.* The centric diatoms recorded in the NSL were representative species of the *Rhizosolenia — Chaetoceros* association characteristic of the Levantine Basin. Among the dinoflagellates, *Gymnodinium* sp. prevailed in the NSL although recorded occasionally at the DCM. Among the taxa >65 µm, the occurrence of *Halosphaera viridis* was noted chiefly at the DCM layer. While its occurrence at both deep and surface levels points to its eurybathic character, the species shows a distinct preference for the greater depths.

A biweekly sampling program from neritic (30 m depth) and pelagic (>250 m deep) stations was carried out during 1983. It was found that during summer the pelagic station waters had chlorophyll *a* concentrations comparable with the most oligotrophic regions of the world's oceans. During winter and spring, profound fluctuations in response to heavy rains or storms, were observed in both phytoplankton standing crop and primary productivity at the shallow station. The picoplankton size fraction (<3 µm) dominated at the neritic station during summer and fall, while the nanoplankton fraction (3—20 µm) dominated during spring. At the pelagic station the picoplankton fraction dominated nearly year round.

The Levantine Basin is unusual, with a nitrate:phosphate ratio in the deep layers of ca. 28:1, far in excess of the Redfield ratio of 16, and with DON:DOP and PON:POP $\gg$16:1. This results in the system being both P-limited and P-starved. In the surface mixed layer, the microbial community is dominated by heterotrophs (on average 56% of total C biomass). These findings are consistent with a systemic shift in structure of marine plankton communities, in which relative heterotrophic biomass is higher in less productive regions. Despite the large and increasing human population around the Mediterranean this ultra-oligotrophic system is probably maintained by a rapid and efficient transfer of added nutrients through the microbial food web to zooplankton from the euphotic to the deeper layers.

Egypt

Research on phytoplankton was mostly concerned with the species composition and their distribution in time and space around Alexandria.

A- Offshore Phytoplankton. The only available studies date back to 1977, with reports on the distribution of phytoplankton west of Alexandria, and to 1981-1982, with the study of the phytoplankton community, the carbon-14 productivity and the chlorophyll biomass. Several monitoring programmes have also been carried out since. The most recent survey is based on satellite imagery.

A total of 446 species and varieties were recorded from the offshore waters. The community consisted of diatoms, dinoflagellates, silicoflagellates. coccolithophores and chrysophytes. cyanophytes and chlorophytes contributed only about 1% of the total number of species.

Diatoms represented about 94% of the phytoplankton community in the western section, while in the eastern section, diatoms and dinoflagellates are equally Important, both contributing 49%.

The majority of the diatoms recorded are interoceanic to neritic warm water species. However few species such as *Streptotheca thamesis* and *Chaetoceros decipiens* are boreal or cold water forms. Only 2 diatom species are considered as subsurface water forms of shade-loving species, whereas dinoflagellate species are 12. They are all recorded in autumn and winter among surface phytoplankton. Their presence is an indication of vertical mixing in this season.

Only few species are known to have brackish or estuarine affinities.

Meroplanktonic forms such as *Chaetoceros laciniosus, Asterionellopsis danicus, Skletonema costatum, and Rhizosolenia setigera* are common both inshore and offshore.

A small number of dinoflagellate species were found only in the eastern sector and may possibly be considered as immigrants from the Red Sea via the Suez Canal: *Ceratium breve, C. egyptiacum, C. schmidtii* and *Pyrodinium schilleri*.

In the western sector, the phytoplankton standing crop is poor and sustains low densities not exceeding 2 thousand cell/l. In the eastern sector, no numerical standing crop values are available. Higher values of chlorophyll a and primary production were generally observed in the upper 50m. In the offshore water, a deep chlorophyll maximum was observed at depth ranging between 70-150m. At many stations the deep chl. maximum was approximately associated with the depth of I% surface irradiance.

The annual average concentration of chlorophyll a biomass in the upper 0-10m of the area amounted to 0.86 mg.m-3 Maximum concentrations occurred in winter (average 1.89 mg.m-3).

The seasonal distribution of C14 assimilation (mgcm-3 h-1) in the surface waters is similar to that of the chlorophyll biomass. The primary productivity of the slope water was remarkably low. The rate of C14 uptake in the circum-littoral zone was much higher, particularly in autumn.

Based on the average values, the inshore zone is 10- 14 times more productive than the offshore water. The average primary productivity in the surface water of the coastal zone amounted to 2.39 mgC.m-3. h-1 as compared with 0.18 mgCm-3 h-1 in the slope water. Contrary to the seasonal pattern shown by the chlorophyl biomass, the highest values of primary productivity in the euphotic zone of both inshore and offshore waters were recorded in autumn.

Red tides. Heavy algal blooms, in summer causing discolouration were observed in the Eastern Harbour of Alexandria since 1956. They were due to the proliferation of the dinoflagellate *Alexandrium minutum* Halim and remained a recurrent summer phenomenon since. Such heavy blooms are triggered by the continuous input to the Eastern Harbour of biogenic substances, which maintain a high and unlimiting level of nutrients, accompanied by a stable stratification of the water column in summer.

The most important feature in recent years is the disappearance of *Alexandrium minutum* from its type locality, the Eastern Harbour. The last red tide caused by this species was recorded in 1994. The bloom extended out of the harbour along 20km of coast and was this time accompanied by massive fish and invertebrate kills within and without of the harbour. The species became replaced by other harmful species which often form red tides.

Surface chlorophyll computed from a 10-year time series (September 1997-December 2006) of satellite Glob colour monthly averaged data by applying the MedOC4 regional bio-optical algorithm showed an ***increasing trend of chlorophyll biomass over the ten years***. It also shows winter as the season of greatest concentrations in both coastal and offshore waters, the bloom decaying in summer and autumn, despite the occurrence of hot spots close to the shore.

Overall, the observed pattern indicates that the bloom has been shifted temporally and spatially as compared to the pre-Dam conditions.

The coastal region has a larger range of chl-a concentrations, about 1 to 3.25mg/m-3, compared to the outer shelf and open sea, 0.03 to 0.15mg/m3.

In conclusion, the Nile bloom has been subjected to regime alterations more than once in the last half century. Three phases can be distinguished. In the pre-Dam phase the south Levantine waters were periodically enriched with nutrients in autumn. In the immediate post-Dam phase and until the 1980s the shelf waters experienced a dramatic drop in phytoplankton chl-a concentrations and the near collapse of the fisheries. The third phase which started in the 1980s and continues until present has seen a rise in productivity and a change from a periodical pattern to a continuous one with pronounced peaks in mean surface chl-a in winter and spring instead of autumn. Higher chl-a concentrations are found in areas under the influence of land-based run off and lake outlets.

This recovery can be assumed to be controlled by two different drivers, the **physical oceanographic processes** in the outer shelf and the surface **runoff** from the Delta. In the outer shelf in deeper waters, with the rise in salinity hence in density post-Dam, convective mixing during severe winters may reach down the nutricline and hence nutrient rich water be brought to the photic layer. This could explain why the outer shelf has its higher chl-a content in winter. Convective mixing is confirmed by the presence of shade loving species in surface water. The decline in the warm season can be ascribed to stratification and the absence of vertical mixing.

On the other hand, the upward trend of the mean chl-a concentrations in the coastal waters is to be attributed to the increasing addition of nutrients from land-based run off.

Continuous surface run-off from eight land based effluents, including the lake outlets, urban outfalls and agricultural drain channels supply the coastal belt with organic and inorganic nutrients. As a result the bloom spreads across the inshore waters most of the year being no more restricted to the autumn.

Investigations on the zooplankton in Egyptian waters began in 1965, followed by several investigations scattered in the subsequent decades. With few exceptions, investigations cover the neritic waters in the vicinities of Alexandria.

The emphasis is on the faunistic composition of the community, the numerical abundance of the species and their variations in space and time. The interactions with the environmental aspects are missing.

Earlier results, allowed some comparison between the pre- and the post – High Dam numerical abundance of the community.

In the pre-dam period, zooplankton density was exceedingly high culminating in an outstanding peak of 85100 individuals m^{-3} during autumn (September-October), in association with the simultaneously- developed phytoplankton bloom. Shortly after construction of the dam, average annual zooplankton density sharply decreased to 7450 individuals m-3, compared to 1962 (28750 individuals m-3). The average annual standing crop also decreased in the offshore zone, from 1174 specimen m-3 in 1966 to 618 specimen/m-3, in 1970-71, reaching a minimum in 1984-85 (302 specimen/m-3). The ratio during the years 1966, 1970-71 and 1984-85 was 3.2 to 1.7 to1.

Not only was the density of the zooplankton community greatly reduced, but the seasonality of the annual peak also changed. Before construction of the dam, the annual cycle of zooplankton was bimodal with peaks in spring and autumn. In 1966, the cycle was similar to that in 1962 but the density of the autumn peak was greatly reduced. This picture completely changed in 1970-71 when the minimum zooplankton density occurred in autumn. During 1984-85, the only conspicuous peak occurred in winter.

Five holoplanktonic groups were more comprehensively studied; the copepoda, the pelagic tunicates, the pelagic cnidaria the pelagic amphipods and the Chaetognatha. Only copepods have been studied in detail.

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

The study of benthic systems is very varied, with differences among states that are probably more due to available expertise than to actual bio-ecological differences. The presence of taxonomic expertise usually leads to overestimate specific groups, whereas the others remain unstudied, or are studied at a lower level of detail.

Greece

Despite the well established oligotrophy of the eastern Mediterranean, a term mostly used to denote waters with low primary productivity, the Hellenic Seas are by no means a poor area (in terms of species diversity). A series of biogeographic studies published recently, show that the Aegean is the second richest area in species numbers among the Mediterranean and Black Sea regional seas. It is also demonstrated that the biodiversity indices (as calculated from polychaetes) are higher than expected and that this extreme biodiversity richness can be partly attributed to the number and total surface of the Aegean islands. The pattern of both species' number and abundance is the same in the north and south Aegean (Cretan Sea). Recent studies showed a pronounced difference between the two seas. As exhibited with other biological parameters, benthic diversity in the north Aegean is always richer in comparison to that in the south Aegean. Recent investigations provide rich and detailed information about the main benthic taxa.

Porifera

Of the 589 hitherto known Mediterranean Demosponges, 200 occur in the Aegean Sea. The percentage of the Aegean endemic sponges is rather low for the Mediterranean as a whole. The sponge fauna presents a clear distinction between the North and South Aegean basins, the former being much more species diverse.

Anthozoa (Hexacorallia and Octocorallia)

A review of the Hellenic Anthozoan fauna yielded 90 species in the Aegean Sea, a number accounting for at least 57.5% of their total Mediterranean biodiversity. Most species are of Atlanto-Mediterranean origin (65.6%), followed by a high percentage of endemic (17.8%) and cosmopolitan (13.3%) species. This ranking is quite similar to the one estimated for the majority of the macrobenthic taxa in the wider Aegean and Cretan Seas. Representatives of the class Anthozoa occur mostly on hard substrates, where quantitative studies are very limited in Greece. The endemic actinia *Paranemonia vouliagmenensis* is the only species so far to have been classified as vulnerable in Hellenic waters. Until today, no extensive *Lophelia-Madrepora* mounds have been discovered in the Aegean Sea, although the species' presence has been long verified by some broken but live colonies dredged off Thassos island. Numerous findings of loose coral rubble and coral-bearing hardgrounds confirm the previous occurrence of cold-coral reefs in this region and suggest that live coral grounds may still persist in some hitherto unexplored areas.

Considering the fact that direct and indirect trawling effects pose a major threat for these highly vulnerable deep-water communities, further scientific effort is currently needed in order to timely detect, map and effectively protect these remarkable biogenic formations.

Polychaeta

Summing up to more than 700 species, the polychaete biodiversity of the Aegean Sea is higher than that of the Ionian Sea. In fact, based on the number of species hosted in each biogeographic area within the Mediterranean, a west-east gradient with decreasing values can be observed, with the exception of the Aegean Sea that is classified as second in species richness after the Western Mediterranean.

Mollusca

A total of 1160 mollusc species have been recorded so far in the Hellenic seas.
According to an updated list, the Aegean Sea has not only the largest distribution of species, but also has the largest increase of species diversity between 1995 and 2004. It is noteworthy that research in the deep international waters between Rhodes and Cyprus has revealed a new species to science, *Lucinoma catzani,* collected from several mud volcanoes at different depths between 1700-2030m in the Anaximander Mountains.

Crustacea Decapoda

A recent assessment of the decapod fauna in the Hellenic waters reported a total of 250 species. The most diverse in terms of species number are the true crabs (brachyurans) followed by caridean shrimps and anomurans (hermit crabs, squat lobsters), while Dendrobranchiate shrimps and macrurans (lobsters and relatives) contribute to a lesser extent to the decapod species diversity.

Echinodermata

108 echinoderm species (70.1% of the known Mediterranean fauna) have been recorded in the Aegean Sea.

Macroalgae

The total macrophyte taxa inhabiting the Hellenic coasts are estimated to ca. 500 species, referred to different geographic elements, e.g. Mediterranean Endemic, Eastern Atlantic warm-temperate, Amphi-Atlantic tropical to (warm-) temperate and Indo-pacific tropical to (warm-) temperate. Species endemic to the Eastern Mediterranean are very scarce. Many records are problematic since morphological descriptions and voucher material is limited. The Aegean Sea is by far the better-investigated area of the Hellenic coasts.

The *Cystoseira crinita* algal community was studied at different pristine Aegean Sea sites in order to describe the NATURA 2000 sites. In total 113 taxa (73 Rhodophyceae, 25 Phaeophyceae, 15 Chlorophyceae) were identified.

Sea grasses

On soft substrates of the Aegean Sea, the angiosperms *Posidonia oceanica* and *Cymodocea nodosa* are widespread, while angiosperms *Zostera noltii* and *Halophila stipulacea* are restricted to specific areas.

Turkey

Porifera

A total of 132 sponge species are known from the Aegean and Mediterranean Seas of Turkey: 47 species have been recorded from Izmir Bay, including 18 new records for the Turkish fauna; 34 species were Gökçeada Island and production possibilities and recorded 34 sponge species in the area. In a monograph on sponge fisheries 73 species were recorded, whereas 13 sponge species were recorded from the north shore of Gökçeada Island.

Cnidaria

Anthozoa species sum up to 131, whereas 23 hydroid species are reported from the Aegean Sea. The Scyphozoans *Pelagia noctiluca, Chrysaora hysoscella, Aurelia aurita, Rhizostoma pulmo,* and *Cotylorhiza tuberculata* are native species in the Aegean and Levantine coasts. No gelatinous plankton bloom has been reported from the Turkish part of the Aegean and Mediterranean Seas. Sea fans, such as *Eunicella singularis* and *E. cavolinii,* are under threat due to mass diving tourism in some areas such as Ayvalık, Bodrum and Datça.

Bryozoa

42 bryozoa species are reported from the Mediterranean and 112 species from the Aegean Seas.

Polychaeta

570 polychaeta species are recorded from the Aegean and Mediteranean part including alien species.

Crustacea

The most complete study reported 220 decapod crustacean species, among which there are 75 natantia, 15 reptantia, 36 anomura and 94 brachyura from the Aegean and Mediterranean Sea.

Mollusca

The mollusca fauna in Turkish Seas comprises over 800 species hitherto been recorded along the Turkish coasts. Among these, 174 species are endemic to the Mediterranean and 55 species are Lessepsian migrants originating from the Indo-Pacific region. The Mediterranean Sea takes the first place among the Turkish seas with 457 identified species of mollusks. In these studies, the number of Lessepsian migrants mostly reported along Mediterranean coasts decreases towards the Aegean Sea and Sea of Marmara due to the ecological differences. Interestingly, no caudofoveata species has been reported from the Turkish part of the Mediterranean Sea.

Echinodermata

The echinoderms of The Turkish coasts have been studied between 1987 and 1993 with special emphasis on The Aegean Sea, and 47 species have been identified. Later, 71 echinoderm species from the Aegean and 42 from the Levantine coasts of Turkey. The total number of echinoderm species in Turkey is 80. The estimated number of the Mediterranean echinoderm species is 143.

Algae

In 1984, a comparison of the algae collected in Izmir Bay over the space of a year with records from the 1970s, it was shown that pollution-indicating groups had increased, and that species such as *Cystoseira* which are indicative of clean coasts, had either migrated to cleaner waters, or had disappeared altogether. *Caulerpa taxofolia* and *Caulerpa racemosa* (Forsskal) J.Ag. was as spreading and threatening biodiversity in the Eastern Mediterranean part of Turkey mostly in İskenderun Bay. Recently, the endangered species *Tenarea tortuosa* (Esper) Lemoine has been observed in the Mediterranean around Kalkan, where it forms barriers. Various species have been observed forming Maerl on coralligenous and sandy substrates in deep or shallow water in the middle and south Aegean. Nine coralline macroalgal genera (*Corallina, Amphiroa, Lithophyllum, Titanoderma, Haliptilon, Jania, Hydrolithon, Pneophyllum, Neogoniolithon*) have been recorded on the Mediterranean coastline.

Sea grasses

Flowering and fruiting of sea grass, *Posidonia oceanica*, is observed in Izmir Bay. The rate of flowering plants was found to be much greater than the value reported in French water (flowering rate 4.3%). In the same way, this value was found to be low in Seferihisar Bay (flowering rate 2/1-2/2%). Flowering of *P. oceanica* has also been recorded at various points on the Turkish coast. The regulation of all fishing in beds of *P. oceanica* and *Zostera noltii* under the fishery regulations of the Ministry of Agriculture and the Environment is the first step to minimising damage ensuing from fisheries.

Reduction of the Macrophytes Species and the Situation on the Turkish Coast

Sea grass and *Cystoseira* communities, *Laminaria rodriguezii*, and coralligenous biotopes and Maerl Beds were at the point of disappearance because of anthropogenic impacts on the whole Turkish coasts. Some species of seaweeds are disappearing from where they were previously recorded, others are migrating. Some populations are re-declining in particular the sea grass *P. oceanica*, which has been seriously affected by pollution from urbanisation and tourism development along the coasts, coastal modifications and fishing.

Even though taxonomic work on algae is largely complete, shortcomings still remain in the identification of deep-sea species. In particular, in the highly diverse coralligenous biocenosis around Ayvalık and nearby islands in the Aegean Sea need protection from the unreported and illegal trawl fishing. On the south coasts of Turkey, *Posidonia* beds are negatively affected by such activities as fish farming, coastal mass tourism and the coastal development associated with it, marina construction, yachting and anchoring. Fish farming installations is widespread in the Aegean and Mediterranean part of Turkey. Unregulated and uncontrolled feeding leads to eutrophication and the retreat of sea grass beds. These effects will be compared with damaged and undamaged areas, and legislation and regulations will be prepared at a national level.

In 2008, a special regulation was issued by the government and it set the criteria for establishing fish farming plants for the sea bream and sea bass. According to the new regulation, minimum depth of cage will be 30 meters, distance from the shores 0.6 n.miles and water current speed will be > 0.1 S/. This new regulation will be useful to protect marine biodiversity, mostly Sea grass, in the coastal areas.

Cyprus

Data not available

Syria

The National Country Study For Biological Diversity (NCSBD) recorded 1027 faunal species, benthic fauna species comprised 34 Nematoda, 10 Annelida, 166 Arthropoda, 315 Mollusca, 7 Chaetognatha, 12 Echinodermata, 13 Tunicata, 40 Cnidaria, 1 Ctenaria and 15 Porifera. Most species are regarded as rare in the Syrian coast, and only 8 species of gastropods, 1 bivalve, 5 crustaceans, 1 echinoderm, 1 cnidarian and 2 ascidiacea were abundant.

Particular attention was given to sponges, with the record of 14 in a comprehensive survey: 6 species were found throughout the coast, 5 are localized on specific sites and 3 either on 2 or 3 localities.

In general, due to the lack of proper equipment and sampling methods, most of the work carried out so far on benthic species did not consider clearly substrate types that accommodate the species nor specify clearly the habitat boundaries. In other cases the substrate types were classified in an arbitrary way, Such situation calls for a proper methodology and programs to deal correctly with the problem.

Algae

173 macro-algal species have been identified from various littoral terraces along Syrian coast: they are 79 from Rhodophyta, 34 Chlorophyta, 32 Fucophyta and 28 Cyanophyta. They are distributed as 109 species in the infralittoral zone, 50 species in the Mediolittoral zone, 3 in the supralittoal zone, 8 in both infralittoral & Mediolittoral zones and 3 in both the Mediolittoral & supralittoal zones.

Invasive species such as *Galaxaura lapidescens* and *G. rugosa* flourish in some areas, where *Cystoseira amentacea*, a sensitive species to pollution, diminished.

Angiosperms:

Three angiosperm species are present in the Syrian marine ecosystem, *Cymodocea nodosa*, *Halophila stipulacea*, *Zostera noltii*. Studies have shown that *Posidonia oceanica,* which was present in Syrian waters in the seventies of the last century, is no longer present in any part of Syrian marine waters. The disappearance of *Posidonia* meadows may indicate habitat degradation at large scale and may lead to disappearance of many species associated with it.

In general, 35% of marine algal species and 75% of spermatophytes are now regarded as threatened species (NCSBS, 2002). Coastal activities and the associated sedimentation, beside other unfavourable conditions such as pollution and climate change will accelerate local extinctions.

Lebanon

In Lebanon, studies on benthic species are scant. About 243 species of macrophytes have been identified in Lebanese waters: Cyanophyta (25 species), Xanthophyta (1 species), Chlorophyta (58 species), Phaeophyta (29 species), Rodophyta (127 species) and Monocotyledones (3 species).

In addition, 662 species macrozoobenthic species were identified in Lebanese coastal waters: Polychetes (136 species), Mollusks (298 species), Crustacea (104 species), Echinoderms (16 species), Nematodes (2 species), Sipunculoidea (2 species), Ascidiacea (26 species), and Porifera (33 species). Comprehensive studies on the population dynamics and the biomass of benthic organisms are lacking.

Angiosperms

According to literature there are three main species of angiosperms in the Lebanese coastal waters:

- *Zostera nana (=Zostera noltii)* does not form dense meadows.
- *Halophila stipulacea* is rare, it has Indo-Pacific origin
- *Cymodocea nodosa* inhabits the Mediolittoral and Infralittoral zones and occupies a relatively low percentage cover

The scarcity of extensive areas of sandy seabed and the destruction of existing ones by anthropogenic activities and pollution may be the main factors limiting the distribution of angiosperms in Lebanese coastal waters.

Israel

Macroalgae

About 300 macroalgal species have been recorded from the Mediterranean coast of Israel – a number that falls far short of the more than 1,100 species known for the entire Mediterranean. This may be due to the small number of specialists and the meager number of studies conducted throughout the 20th century, but may reflect also lower biodiversity due to the extreme oligotrophic conditions, paucity of shallow rocky habitats, and recently, to the rapid degradation of the littoral.

Though the macroalgae are recognized for their high rate of endemism in the Mediterranean, only a single species was recognized as endemic off the Israeli coast, *Cystoseira rayssiae* Ramon, 2000. The rapid physical modification of the coastline and pressures of land and sea-based pollution, destructive trawling, dredging in addition to the establishment of alien seaweeds mean that the makeup of the flora has been altered.

Angiosperms

The main feature is the total absence of *Posidonia oceanica*

Invertebrates

Surveys of the Israeli Mediterranean coast date back to the Fifties, covering only the invertebrates considered as important links in the food chain. In the sixties an extensive program was undertaken to describe the marcrobenthal communities, albeit being based on subjective judgements in the recognition of associations and the selection of characterizing species.

Amost all subsequent studies highlighted the importance of alien species that entered from the Suez canal and formed sometimes very important populations.

In recent years the once-abundant echinoderms – *E. cordatum, B. lyrifera, S.canaliferus, A. mediterranea* – are recorded only as few juveniles, as well as a significant loss in populations of the octocorals *Alcyonium palmatum* and *Pennatula rubra.*

Egypt

Knowledge about the benthic ecosystem in Egyptian Mediterranean waters is almost restricted to the Alexandria region with but one exception, the site of El Dabaa 160 km west from Alexandria. Although much less work has been done on the benthic than on the pelagic ecosystems, some surveys led to results such as those along the coast in the vicinity of Alexandria:

Site:	AQ1	AQ2	SG	MX1	MX2
Species	63	43	31	19	17

But the range of examined benthic groups is very scant.

Long term changes appear to have taken place in the structure and composition of the benthic communities in the last few decades. With regard to the algal flora, several macroalgal species which were obviously common in surveys carried out in the Fourties appear to be absent at present. *Cystoseira compressa*, a previously common species is no more to be found. In the meantime, *Caulerpa racemosa* and *Tricleocarpa oblongata*, not recorded in the Fourties, are commonly found at present.

Similar observations are made regarding the microfauna. It remains to be seen whether such changes should be interpreted as the result of a natural process of succession or an effect of environmental variability.

The phanerogame *Posidonia oceanica* grows in patchy meadows, west of Alexandria.

3.1.3. Information on vertebrates other than fish

Greece

The Greek populations of the monk seal (*Monachus monachus*) are estimated to represent ca 90% of the total Mediterranean abundance of the species. In particular, the Aegean Sea is known to host more than 78% of the species' total Hellenic population (about 200-250 individuals; Cebrian, 1998). The Northern Sporades, the Kimolos-Polyaigos and the Karpathos-Saria complexes as well as Gyaros island are prominent for resident and breeding populations in the Aegean Sea. So far, only the Northern Sporades Islands enjoy a legal protection framework, formally established in 1992 (PD 519/28-5-92) as the first Hellenic Marine Park to protect the population of the monk seal.

Out of the 12 cetacean species reported from Greek seas, seven are represented by permanent and commonly observed populations. The most abundant one is the striped dolphin (*Stenella coeruleoalba*), followed by the bottlenose dolphin (*Tursiops truncatus*), the common dolphin (*Delphinus delphis*), the sperm whale (*Physeter macrocephalus*) and the Risso's dolphin (*Grampus griseus*)**.** The Aegean Sea is an area of particular importance for the harbour porpoise (*Phocoena phocoena*), which is strictly limited in the north and mainly in the shallow plateau of the Thracian Sea. This rare species is not to be found anywhere else in the Mediterranean but the Black Sea.

Until today, no quantitative data regarding cetacean species abundance are available and no critical areas have been defined for their conservation.

Three species of sea turtles, *Caretta caretta*, *Chelonia mydas*, and *Dermochelys coriacea* are encountered in Greek seas. The loggerhead turtle and the green turtle occur regularly in Hellenic territorial waters while *Dermochelys coriacea* is infrequently encountered. Only *C. caretta* is known to nest in Hellas, concentrating about 60% of the total documented nesting of this species in the Mediterranean.

Caretta caretta is listed as Endangered and *D. coriacea* as Critically Endangered in the IUCN Red List of Threatened Species. The major threat to marine turtle populations originates from their interaction with fishing activities. Conservation efforts in a sea turtle nesting area can be undermined by the impact caused by fisheries by-catch on the same population in another area or country.

Turkey

Cetacea

In the Greek Aegean Sea and Mediterranean Sea, nine cetacean species have been known to occur: *Delphinus delphis, Tursiops truncatus, Stenella coeruleoalba, Globicephala melas, Grampus griseus, Pseudorca crassidens, Physeter catodon, Ziphius cavirostris* and *Balaenoptera physalus.* In the northern Aegean Sea, *Phocoena phocoena* is known to occur but only occasionally. All these cetacean species are found in the Turkish waters and, as a result, all have been under legal protection since 1983. In January 2009, a rare beaked whale species, *Mesoplodon europaeus,* stranded alive in Fethiye Bay in southwestern Turkey. A national cetacean protection strategy was established in 1994. During 1990-1997, 23 stranded cetaceans were recorded. Whereas 20 strandings were reported during 2001-2003 in the Aegean Sea, including four strandings of the sperm whale. Effective cetacean protection in the Turkish Aegean and Mediterranean Seas, basic information on their population size, distribution, and ecology is necessary. But very little is available at the moment.

Monk seal

Among the Mediterranean countries, Turkey is one of the few places that still have a monk seal population. The Mediterranean monk seal have been under legal protection since 1977. A national strategy has been prepared in order to coordinate all the efforts for the survival of this species and to develop a comprehensive policy. The Aegean Sea, with small, quiet and isolated islets and islands, calm beaches and underwater caves, is the most important monk seal habitat in Turkish waters. However, due to tourism and fishing pressure and over-urbanization, the monk seals are losing their habitats, this being the greatest cause of their decline. Other important threats are deliberate killing and entanglement in fishing gears and there have been several reports of seals killed by drowning in the nets. The Aegean Sea population is viable, as indicated by the presence of pups. The establishment of special protected areas should help the in situ protection of the monk seals in the Aegean Sea. A census for the exact number of Monk seals in the whole Agean Sea is urgently needed.

Sea turtles

According to investigations made so far, 19 *Caretta caretta* and 5 C*helonia mydas* nesting sites have been identified in the Turkish part of the Aegean and Mediterranean Seas. The major nesting beaches identified for *C. caretta* are in Turkey and Greece, with smaller numbers recorded in Cyprus, Libya, Tunisia, Israel and Italy. The general reasons for decline and current threats are direct exploitation in the past, incidental capture, pollution and plastic wastes, tourism and related activities. Problems include sand extraction, photopollution from hotels, beach traffic, night access to the nesting beaches, predation of nests by foxes, dogs and jackals, sun beds and umbrellas on the nesting beaches, speed boats near the beaches and other fishery activities near the nesting grounds. Turkish law has several sections about conservation of natural and cultural heritage. The status "Marine Turtle Nesting Beach" provides no direct protection, but facilitates the declaration for formal protective status. Most of the marine turtle nesting beaches in Turkey are Natural SIT areas as they have scientific, ecological or aesthetically important areas on land or underwater.

Trionyx triunguis (The Nile Soft-shelled turtle)

This species of fresh water turtle is listed by IUCN as "critically endangered" in the Red Data Books and the Mediterranean population has been classified in category "CR C2A" which means that the population suffers from a continuing decline in numbers of mature individuals and population structure, and that the (sub-) population does not contain more than 1000 mature individuals. This species is also included in Appendix II of the Bern Convention and Appendix III of CITES. It is often caught as by-catch in fisheries together with marine turtles, and even shares some nesting beaches with marine turtles such as the Dalaman and Dalyan beaches.

Birds

Turkey is a natural corridor for many species of migratory birds and their protection has been developed in recent years. However, habitat loss due to drainage, water diversion, changes in annual water regime, eutrophication, reed cutting, and land fills, chemical pollution, and hunting are main threats for the sea birds in Turkey. Coastal wetlands and islands off the coast are important habitats for birds. Many of them host significant bird communities, some of which include threatened species. Among such species, pygmy cormorant, dalmatian pelican, marbled teal and Audouin’s gull are particularly important both regionally and nationally. *Larus audouinii* and *Falco eleono*rae are endangered species.

Cyprus

Data not available

<u>Syria</u>

<u>Monk Seal</u>

Monachus monachus occurred more than 38 years ago and is still present. Arwad, Tartous port, Lattakia port, Fanar Ibn Hani, Afamia, Borj Islam Oum Altiur, Ras AlBassit and Alhamam Islands are places the Monk seal is mostly encountered. The monk seal sightings during the period 2000-2010 are totaled to about 28. Due to the presence of suitable caves and beaches, monk seals probably breed in the area.

<u>Cetaceans</u>

Collection of field data on cetacean stranding along the Syrian coast during the period 2003-2009 reported 15 stranded dead individuals: *Tursiops truncatus* (6 cases), *Ziphius cavirostris* (5 cases), *Megaptera novaeangliae*, *Physter catodon*, *Balaenoptera physalus*, *Grampus griseus* were represented by one individual each.
One live sighting of a single bottlenose dolphins and one single short-beaked common dolphin were encountered in the northern coast during the year 2002. Local fishermen reported undocumented encounters with live fin whales in offshore waters and with live short-beaked common dolphins and striped dolphins, with groups of offshore dolphins made by as many as over 100 individuals.

<u>Turtles</u>

The sea turtles present in the Syrian marine waters are :*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*. Only the first two do reproduce along the Syrian coast. Considerable numbers of turtle hatchling were annually lost by the ghost crab *Ocypode cursor* predation. These crabs were numerous, probably due to the high levels of beach litter. Another identified threat of greatest concern was the deliberate killing or boat collision. Little has been done to estimate sea turtle populations in Syria. Estimates report 104 nests of green turtle in a 12 km sandy beach south of Lattakia. The loggerhead turtle nesting had previously been reported, making this site the most important green turtle nesting site in Syria. It is also of major regional importance as it ranks in the top 10 Mediterranean nesting beaches in terms of maximum number of nests recorded.

<u>Lebanon</u>

<u>Cetaceans</u>

Data on Cetaceans in Lebanon are very poor and regard *Delphinus delphis*, *Stenella coeruleoalba*, *Tursiops truncatus* and *Physeter macrocephalus.*

<u>Monk seal</u>

Monk seals (*Monachus monachus*) used to be observed along several beaches in Lebanon (latest record of 9 individuals at Amchit, Mount Lebanon in 1970), but there have not been any recent sighting of this species.

<u>Sea turtles</u>

Three species of sea turtles are present in Lebanese waters: *Chelonia mydas* and *Caretta caretta* nest on Lebanese beaches, while *Dermochelys coriacea* is only a visitor. Assessment studies indicated that there are currently 19 beaches (12 south of

Beirut and 7 north of Beirut) that represent potential nesting habitats. This was one the reasons for declaring two coastal nature reserves by law: "Tyre Coast Nature Reserve" (Decree 708, 12/11/1998) and the "Palm Islands Nature Reserve" (Decree 121, 12/03/1992). Annual nesting numbers remain speculative due to lack of standardized monitoring of the main nesting areas. Catching turtles, whales and seals is strictly prohibited throughout Lebanese territorial waters, but accidental catches in the nets of fishermen occur on a regular basis.

Sea birds

Lebanon is a main route for the migration of birds in the East Mediterranean making it rich in avifauna. The revised checklist of the birds of Lebanon lists 395 species that includes 144 coastal species belonging to 12 orders (marine or of marine affinity) of which five are threatened at the global level and 90 are classified of high significance according to the AEWA Convention. The most threatened coastal and marine avian species belong to the Pelecaniformes, Anseriformes, Accipitriformes, Gruiformes, and Charadriformes. Few of these species breed in the coastal belt of the country. The relative poverty in breeding birds can be attributed to disappearance of coastal wetlands, extensive urban development along the coastline, hunting and continuous anthropogenic disturbances.

Israel

Marine mammals

Of the 14 cetacean species listed from the Mediterranean, ten are known from the Levantine Basin: five may be considered residents: *Tursiops truncatus, Stenella coeruleoalba, Grampus griseus, Delphinus delphis,* and *Ziphius cavirostris*, and five visitors, *Steno bredanensis, Pseudorca crassidense, Physeter macrocephalus, Balaenoptera acutorostrata* and *Balaenoptera physalus*. *T. truncatus* is by far the most common, associated with commercial trawlers and accounting for nearly all reported net entanglements.

A cetacean survey over the Israeli continental shelf was conducted during September 2005, yielding 14 cetacean sightings (53 individuals) on five out of the 15 survey days. They included the first sightings of off-shore *T. truncatus* and a group of 25 *G. griseus* sighted already in June 2005, suggesting a long-term residence of the species in the area. In 2009 surveys along 1,608 km sighted 39 *T. truncatus* individuals. The population is estimated at 360 individuals. The low overall sighting rate (0.088 animals per nm) is in line with the extreme oligotrophy of the Levant.

Many of the stranded dolphins suffer anthropogenic impacts: the cause of death of a *G. griseus* specimen was attributed to bacterial bronchopneumonia in combination with endotoxemia, resulting in disseminated intravascular coagulation. Plastic bags found in its stomach contributed to the dolphin's poor physical condition. An examination of the alimentary canal of a dead *T. truncatus* revealed stranded-cordage, nylon filaments wrapped around the larynx, cutting through the soft tissue, and extending down into a large tarry mass in the forestomach, composed of scraps of nine different types of gillnet.

Sea turtles

Up to the mid 20th century hundreds of *Caretta caretta* nested along the Mediterranean coast of Israel. In the 1950's, some 200 nests with a density of about 15 nests per km were recorded on 15 km of typical beach in northern Israel. However, the number declined rapidly thereafter. Along some 55 km of coastline, which include the area surveyed in the Fifties, between 10 and 16 nests were annually found between 1984 and 1989. The decline is attributed to overfishing, injuries caused by vessels, entanglement in fishing gear, destruction of nesting habitat due to beach sand extraction, development and vehicular traffic. Both *Chelonia mydas and C. caretta* nest in small numbers on the Mediterranean coast of Israel. A national management program was prepared and implemented since 1993 by the NNPPA. The main threat to turtle nests is the intensive traffic of four wheel drive vehicles on the beaches. Other threats are predation by foxes, inundation by sea water during summer storms, growing urbanization along the coastal plain threaten nestlings with disorientation by anthropogenic light sources, traffic, as well as nighttime human activity, may disturb nesting female turtles. During nesting season, the entire coast, excluding urban areas, is surveyed and the eggs in the nests discovered are translocated to hatcheries. From 1993 to 1998 between 10 and 46 nests of *C. caretta* (597-2743 hatchlings) were translocated annually, as well as few nests of *C. mydas*. The summer of 2008 saw a dramatic rise in the number of nests (*C. caretta* 186 nests, 9,210 hatchlings; *C. mydas* 16 nests, 1,346 hatchlings). The number of nests in 2006-2008 was twice as high as in the years since active management began in 1993. This was ascribed to the successful implementation of the management program over the past 15 years, success of awareness and education programs, higher seawater temperature. However, in 2009 the number of nests declined by half (*C. caretta* 98 nests; 5,559 hatchlings). It was proposed that a cyclicity of 3-5 years is the cause of the decline. It was estimated that the nesting population numbers 140 females. There was no decline in the number of *C. mydas* (18 nests, 1,314 hatchlings). It is estimated that the population reproducing in Israel numbers no more than 12 females. The monthly average of stranded and beached turtles in 2007-8 was 14.2, most strandings occur in summer. From data gathered from stranded carcasses 60% of the injuries were fishing related (Levy, 2008).

Seabirds

Pond farming along the northern and central coastal plain expanded during the 1970's, and attracted many species of water birds, especially during migration. Eleven marine and coastal threatened and endangered species (*Calonectris diomedea, Puffinus yelkouan, Hydrobates pelagicus, Pelecanus onocrotalus, Phoenicpterus rubber, Pandion haliaetus, Falco elenorae, Larus audouinii, Sterna bengalensis, S. sandwicensis, S. albifrons*) have been recorded along the Mediterranean coast of Israel, in addition to 73 native, migrant and visiting species (Shy, 2002). Marine birds nest on some islets off the Mediterranean coast of Israel, and about 2,000 *Phalancrocorax carbo* overwinter on islets off Rosh Hanikra.

The threats to coastal and marine birds stem from coastal urbanization, natural habitat despoliation and degradation, with much of the coastal streams reduced or badly polluted; direct anthropogenic interference with nesting, feeding, roosting and resting; increased predation by species attracted to litter (jackals , foxes, Egyptian mongoose, feral dogs, black rats, brown common rats, black kites and hooded crows) that impact also the birds' breeding success.

As Israel is on a major flyway for migratory birds, the aquaculture farms in Israel are susceptible to damage from piscivorous waterfowl during migration stopovers. Some 75,000 *Pelecanus onocrotalus* migrate twice annually through Israel. In addition, tens of thousands of piscivorous waterbirds, like *Phalacrocorax carbo* and *Nycticorax nycticorax* over-winter in Israel. The NNPPA formulated guidelines for using netting over fishponds in Israel in order to reduce the mortality of piscivorous waterbirds and tries to reduce the damage caused to pond farmers by piscivorous birds, and to limit the use of guns and netting.

Egypt

Marine turtles

Knowledge about marine turtles in Egyptian waters remained anecdotal and fragmentary until when all beaches between Aleaxandria and Sallum on the border with Libya were surveyed for the occurrence of marine turtle nests during the peak nesting season in June-July 1993. Of the 602 km surveyed, only 255 km consist of sandy beaches forming a potential nesting area for marine turtles, the remaining coast being rocky. All tracks of nesting turtles were identified as tracks of *Caretta caretta*. That was the first time that nesting of marine turtles on this coast was observed. All potential nesting beaches are threatened by the intensive urban and touristic infrastructures and by oil pollution. The unexpectedly small number of nesting turtles compared with other East Mediterranean beaches (Greece, Turkey) has been tentatively interpreted as being probably due to unsuitable beach material for marine turtle nesting; the sea off the Western coast might not provide enough food for marine turtles.

Monk seal

The study area, the coast West from Alexandria, does not provide a suitable habitat for the monk seal *Monachus monachus*. The rocks are mostly flat and no coastal caves were seen and none of the fishermen or the local inhabitants interviewed had seen any.

Birds

Ornithological knowledge about birds on the coast between Alexandria and Sallum is very poor. The area has hardly been visited by birdwatchers. The regular presence of the Greater Sand Plovers, *Charadrius leschenaultii* is noticeable. A total of 59 birds were recorded, mainly on flat beach rocks. There is no confirmation that it breeds on this coast although the flat salt lakes between the ridges provide an excellent habitat for this bird.

On the other hand, the number of gulls and terns is relatively low. Only common and little terns were seen and Yellow-legged Gulls were the only gulls.

During the autumn and spring migration, however, the Mediterranean coast receives vast numbers of Palearctic migrants. The Nile Delta wetlands are of particular importance for a large number of migrant water bird species. According to several bird counts hundreds of thousands of wintering waterfowl visit these wetlands every year. The Egyptian wetlands therefore proved to be one of the most important areas for waterfowl in the Eastern Mediterranean region and the entire continent of Africa. The numbers of Whiskered Tern *Childonias hybridus* wintering in Lake Borullos is one of the largest concentrations of this species in the world. The largest bird count of water birds in any of the wetlands of Egypt was counted in Lake Manzala, with prominence of cormorants, waders, gulls and terns. Large numbers of water birds, notably herons, egrets, ducks, waders, gulls and terns pass through the Zaranik area at the eastern end of the lake. The breeding population of Little Tern, Sterna albifrons and the Kentish Plover *Charadrius alexandrinus* at L. Bardawil are among the largest in the Mediterranean. Populations of the Greater Flamingo *Phoenicopterus ruber* are among the largest in the country.

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

Most information on Non-Indigenous-Species regards their mere record, and it is seldom the case that some more information is reported, unless the species do have some commercial effect or are of some harm to human activities. Species numbers are underestimated, since only the obvious species are usually recorded whereas, due to lack of expertise on most of marine taxa, inconspicuous species are very probably passing unnoticed.

<u>Greece</u>

172 alien species have been recorded in the Aegean Sea, 145 of which occur in the South Aegean and 72 in the North Aegean. Of them, 101 species are well established and spreading. They are mostly zoobenthic species, followed by phytobenthic and Fish.

Several Indo-Pacific species of fishwere reported in the Dodecanese (SE Aegean) almost simultaneously as in the coasts of Israel. Such are the cases of *Siganus rivulatus*, *Upeneus moluccensis*, *Sargocentron rubrum*, *Pteragogus pelycus* and *Fistularia commersonii.* The trend in fish species introduction and establishment success is increasing; *Scomberomorus commerson* was recorded in 2007, *Lagocephalus sceleratus* spread rapidly in the Aegean; *Upeneus pori, Scomberomorus commerson* and *Torquigener flavimaculosus* are recorded more and more often. Their mode of introduction is mostly through the Suez Canal. With regard to the origin of species, 98 species (56%) are of Indo-Pacific origin, 27 species (16%) come from the Atlantic, and 10 species (6%) originate in the Pacific, while the rest are mostly warm water species having a subtropical, circumtropical or pantropical distribution.

Turkey

In 2005 a list of alien species reported from the Turkish coasts yielded 263 species belonging to 11 systematic groups, of which Mollusca had the highest number of species (85 species), followed by Crustacea (51), fishes (43) and phytobenthos (39). The Black Sea hosts a total of 20 alien species, the Sea of Marmara 48 species, the Aegean Sea 98 species and the Levantine Sea 202 species. The majority of aliens found in the Black Sea and the Sea of Marmara were transported via shipping, whereas the Levantine coast is extensively subjected to Lessepsian migration. Benthic habitats (soft and hard substrata) host 76% of the total alien species and the pelagic environment is inhabited by thirty-nine species. Almost 50% of aliens collected from the Turkish coasts were found only at 0-10 m depth. Eight species occur at depths deeper than 100 m, 202 species were identified solely from the Turkish part of the Eastern Mediterranean Sea (Levantine coast of Turkey).

The Black Sea and Mediterranean Sea are interconnected by the Turkish Straits System. These narrow straits act as a biological corridor, a barrier or an acclimatization zone for some marine species. Since the Suez Canal opening, the Mediterranean Sea has been connected also to the Red Sea, thus the Indian Ocean. Some Indo-Pacific species (Lessepsian migrants) have entered and started to colonize in the Black, Marmara, Aegean and Mediterranean Seas. Besides, ship-transported species, such as *Rapana venosa*, or introduced species, such as *Mugil souyi* to the Black Sea, dispersed to the Mediterranean Sea. The routes of the access of alien species by ship transportation may be categorized such as transportation with ballast water, sessile (fouling) and vagile (clinging) form on ship hulls. International straits used for navigation in the Mediterranean and Black Sea are biological corridors at the same time from the biogeographical pont of view. For example, one of the intentionally introduced fish species, *Mugil souyi,* was first introduced to the Azov Sea and after the successful colonization there, entered to the Black Sea via the Kerch Strait. Later it entered the Turkish Straits (Istanbul and Çanakkale) and is presently found in Mediterranean Sea. There are some other examples such as *Rapana venosa* and *Mnemiopsis leidyi*. Their first record was in the Black Sea and after the successful migration through the Turkish Straits, they penetrated to the Aegean and Mediterranean Seas. The Gibraltar Strait also important for the Atlantic originated species distribution inthe Mediterranean and Aegean Sea. Through the Suez Canal, several marine species migrate to the Mediterranean Sea such as marine phanerograms, macrophytes, coelenterates, molluscs, crustaceans and echinoderms as well. In Iskenderun Bay, 67 of the 181 molluscan species are exotic, which consists 37% of total fauna, a percentage by far higher than those reported elsewhere. Besides fish, molluscs and crustaceans, some other alien taxa are also found mostly in the eastern Mediterranean Sea, such as several jellyfishes, ctenophores, polychaetes, ascidians and echinoderms. Alien fish species entered the Mediterranean Sea via four pathways: a) via the Strait of Gibraltar, b) via the Suez Canal, c) via the Çanakkale Strait (Dardanelles) and d) via human activities such as ship-meditated transportation, mariculture and others. Red Sea fish species in the total demersal fish biomass was 62% in the Gulf of Iskenderun, 34% in Mersin Bay and 27% in the coastal strip between Incekum and Anamur. *Upeneus moluccensis* and *Saurida undosquamis* have economical values in the eastern Mediterranean trawl fisheries, 22 fish of Indo-Pacific origin were recorded in Iskenderun Bay, one of the important fishing grounds for Turkey in the eastern Mediterranean Sea. Among crustaceans, *Fenneropenaeus merguiensis, Marsupenaeus japonicus, Melicertus hathor, Petapenaeus monoceros, Metapenaeus stebbingi, Penaeus semisulcatus, Callinectes sapidus* and *Portunus pelagicus* have commercial importance in the Turkish Aegean and Mediteranean Seas. In Iskenderun Bay *Penaeus kerathurus* was substantially caught by fisherman but it replaced by *M japonicus.* Similarly the blue crab is common in Turkey. Off the southeastern coast of Turkey, the alien shrimps *M. japonicus* and *P. semisulcatus* are the most important species in the landings.

Cyprus

Data not available

Syria

Out of the 227 fish species recorded from Syrian marine waters, 54 (23.7%) entered the area either from the Red Sea through Suez Canal (39 species, 17.1%) or from the western Mediterranean and the Atlantic through strait of Gibraltar (15 species, 6.6%). The Indo-Pacific originated invasive fish species are common in the Syrian marine ecosystem, especially in the recent years. Now, new records are obtained every 7-10 fishing field trips. Recently, species never seen before in the Mediterranean started to invade the area; the most recent example is the streaked spine foot *Siganus javus*, which was recorded for the first time from Syrian waters and the Mediterranean in Oct. 2009. The cornet fish, *Fistularia commersonii*, which was recorded in Syrian waters is known to form a noticeable proportion of the total fish catch in many places along Syrian coast.

Regarded the non-indogenous bottom fauna species, 30 species of Indo-pacific orign were recorded, among which some prominent examples are: *Cerithium scabridum, Strombus decorupersicuss, Gafrarium pectinatum*, *Brachidonta pharaonis, Spondyllus spinosus*, *Charybids helleri*, *Portunus pelagicus, Penaeus japonicus, Phallusia nigra*.

Lessepsian Macro-algae include *Caulerpa racemosa var. lamourouxii, Stypopodium schimperi*, *Asparagopsis taxiformis*, *Neomeris annulata, Caulerpa scalpelliformis*, *Caulerpa mexicana* and *Galaxaura rugosa*. Other new record of macro-algae for Syrian waters and even for the Eastern Mediterranean include: *Acetabularia parvula, Cystoseira balearica, C. caespitosa, C. barbatula*. On the other hand, *C. amentacea* diminished in favour of the dominance of invasive species such as *Galaxaura rugosa* and *G. lapidescens*, which are recorded in Syrian waters since 1990 and that in recent years became widespread on coastal marine terraces.

Some Lessepsian Macroalgal species were studied for their distribution in the northern coastal sea of Syria:

1. *Stypopodium schimperi* growing period in the area extends from the end of February to September and reaches 25 cm towards the end of June and end of August, the community regresses to disappear completely in November and diminishes in November. It colonizes the major part of the hard substrates of the photophilous algae biocenosis. Its proliferation in Eastern Mediterranean waters is because of the powerful ichthyotoxine which retards its predation by possible grazers.
2. *Galaxaura rugosa* first recorded in the area between Banias and Lattakia and reported in Ras Ibn Hani (Northern Lattakia) in June 1999 and speeded later on into the north in various places of the littoral zones.
3. *Neomeris annulata* is a new record for Syria and the Mediterranean area, found in 2003 at 2-15 m water depth in the biocenosis of the photophilous algae on rocky substrates of various gradients (vertical and horizontal) and on the Molluscs, *Chama pacifica* (Lessepsian species) and *Hexaplex trunculus*. This species was only found around Arwad Island where it is well established and forms real faciess. It accompanies the colonies of *Jania rubens, Corallina elongata, Padina pavonica, Padina boergeseni, Liagora sp., Amphiroa sp., Sargassum vulgare and Stypopodium schimperi*. Lessepsian migrant crustacean totalled 11 species*: Portunus pelagicus, Charybdis hellerii, Atergatis roscus, Leucosia signata, Myra fugas, Squilla massavensis, Pontocaris lacazei, Leptochela pugnax, Penaeus japonicus, Trachypenaeus curvirostris* and *Metapenaeus stebbingi.* Many of the identified planktonic species (Durgham, 1998) were from Atlantic or Indo-pacific & Red Sea origins: the most important species are *Lucicutia clause, Pontella brevicornism Pontella brevicornis, Temora longicornis, Calanopia elliptica, Sagitta fridirici*.

Lebanon

The Lebanese coast which at its southern end is about 400 Km from the Suez Canal, is fully exposed to the arrival of exotic tropical species. In addition, the Lebanese coast has also been colonized by species of other origin carried accidently by ships.
In Lebanon, studies concerning exotic, non-indigenous and invasive species are scant. There are several scientific publications reporting new sightings of alien species in the coastal waters of Lebanon; but there is no official comprehensive list adopted for all alien species recorded in Lebanon. A small number of non-indigenous species were studied in terms of behavior, population trend, impact and catch like the *Siganus luridus* and *Siganus rivulatus*.

Israel

Molluscs are prominent aliens in Israeli waters, since 120 of the 322 alien species recorded off the Israeli coast are molluscs that had entered the Mediterranean through the Canal. The littoral and infralittoral biota of the Levantine basin have been undergoing a rapid and profound change: the shallow benthic communities along the Mediterranean coast of Israel have no known parallel outside the Levant because of the great number of Erythrean aliens. Yet, no concerted effort had been undertaken to survey the entire coast since the early 1970s, and most of the records stem from fortuitous finds. A national targeted effort to survey the presence and abundance of the Erythrean species and study their biology and ecology is wanting.

The 322 species identified at present as alien off the Israeli coast are limited to multicellular organisms because the identity of many unicellular organisms is still in doubt, as well as their native range and distribution. A taxonomic classification of the alien species shows that the alien phyla most frequently recorded are Mollusca (43%), Chordata (22%), Arthropoda (16%), and Annelida (7%). Phyla not represented in the list include the little studied Porifera, Nemertea, Priapula, Nematoda, Entoprocta, Pogonophora, Sipuncula, Echiura, Brachiopoda and Phoronida. The data are presumably most accurate for large and conspicuous species, which are easily distinguished from the native biota.

The native range of the alien taxa recorded in Israel is most commonly the Indo-Pacific Ocean (48%), the Indian Ocean (24%), the Red Sea (17%), and pantropical (6%). Caution should be exercised when using these data: the true origin of the Israeli populations of a species widely distributed in the Indo-Pacific Ocean may be either its populations in the Red Sea or further in the Indian Ocean, or secondarily from other established Levantine populations. The source populations or means of introduction of alien species in Israel have not yet been successfully ascertained by molecular means. But even taking into account these caveats, it is quite clear that most of the alien species off the Israeli coast are thermophilic, originating in tropical seas.

The great majority of aliens off the Israeli coast entered through the Suez Canal, whereas vessels and mariculture contributed only a small number of aliens. Here too, caution should be exercised when using these data: only rarely are the means and route of introduction known from direct evidence. Mostly they are deduced from the biology and ecology (if known) of the species, the habitats and locales it occupies in both the native and introduced range, and its pattern of dispersal (if known), i.e., for a fouling species frequently recorded from ports, shipping is assumed to be the most probable vector. It is has been assumed that Erythrean aliens progress through the Suez Canal and along the coasts of the Levant as a result of “natural” dispersal, by autochthonous active or passive larval or adult movements, unaided further either directly or indirectly by human activity. Indeed, a temporal succession of directional (“stepping stones”) records from the Red Sea, the Suez Canal, and along the coasts of the Levant confirms a species status as a naturally dispersing Erythrean alien. However, vessel-transported dispersal is feasible as well. Even where records are consistent with long-shore dispersal, there might be a degree of uncertainty where fouling organisms (such as serpulid polychaetes or mussels) are concerned, as they are more susceptible to shipping-mediated transfer. In some cases we suspect simultaneous mechanisms of transport.

Of the 56 alien species known in 1950, 93% entered the Mediterranean through the Suez Canal, 7% were possibly canal/vessel-transported; of the 240 alien species recorded since 1950, 80% were Erythrean aliens, 9% were canal/vessel-transported, 10% and 1 % respectively were vessel-transported and mariculture introductions. The increase in vessel-transported aliens may be attributed to the increase in shipping volume throughout the region.

Since the probability of collecting a vagrant incursion in the sea is diminishingly small, most recorded alien species are considered as 'established' species that have self-maintaining populations of some duration. It is recognized that some alien species may fail to maintain populations over time and thus a single record dating back several decades may be considered an ephemeral entry. We list 36 species known from single records, most of them recorded in the last decade. The distinction between the 'established' and 'ephemeral' aliens is sometimes difficult to discern and circumscribed in large part by our ignorance of the marine environment. Even once established in the Mediterranean, the alien species differ markedly in their histories.

Egypt

The presence of alien species in Egyptian waters is poorly documented but it is probably similar to that reported from nearby countries. Among newly recorded Erythrean invertebrates from Alexandria waters, the Gastropoda *Diodora ruppellii, Smaragdia souverbiana*, *Nerita sanguinolenta,* and *Trochus erythraeus* are prominent, together with the Polychaetes *Pseudonereis anomala, Pseudopolydora paucibranchiata*, *Spirobranchus tetraceros, Pomatoleis kraussii*, *Hydroides elegans,* and *Syllis (Typosyllis) schulzi*. According to Egyptian scientists, the Canal has created a high pressure-low pressure gradient between the highly diversified Red Sea –Indo-Pacific fauna and the impoverished Levantine fauna. The result is a gain in Biodiversity and an economic enrichment in marketable fish and shrimp resources.

3.1.5. Fish including mollusks and shellfish species of commercial interest

Fisheries data are usually very abundant due to the regulations that control this human activity. In many parts of the world, however, the official data on the yields of fisheries are far from being realistic and are biased by national or international regulations. Some fisheries are greatly underestimated due to limits posed to resource extraction and to taxation, whereas other fisheries might even be overestimated due to national targets that are to be met in terms of production. It is more probable, however, that Mediterranean fisheries are largely underestimated. The yields, furthermore, should be related to fishing effort and gear efficiency.

Greece

Hellenic 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).

In the mean landings per fishery over the 1982-2003 period, more than 30% of the mean trawl landings was dominated by five species (*M. merluccius*, *M. barbatus*, *T. mediterraneus*, *S. smaris*, and *Micromesistius poutassou*). For purse-seiners, five species (*E. encrasicolus* and *S. pilchardus* and, to a lesser extent, *T. mediterraneus*, *B. boops* and *S. japonicus*) cumulatively contributed more than 84% of the mean total landings. For beach-seiners, more than 60% of the landings were comprised mainly by *S. smaris*, *S. pilchardus* and *B. boops*. Finally, only 30% of the mean 'other coastal boats' landings was comprised of five taxa (*S. pilchardus*, *B. boops*, Mugilidae, *S. smaris* and *E. encrasicolus*).

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. Overall, the total number of marine fish species reaches 485. Among these, according to the latest update of the IMAS-Fish database, the total number of recorded Hellenic fish species collected from experimental and onboard sampling by trawls, purseseines, nets and beachseines, since 1983 is 393. Of these, 365 occur in the Aegean Sea. The following species are included in the Red list of threatened animals in Greece: Critically endangered: *Carcharias taurus, Isurus oxyrinchus, Lamna nasus, Oxynotus centrina & Dipturus batis*; Endangered: *Carcharodon carcharias, Carcharhinus plumbeus, Thunnus thynnus & Mobula mobular*; Vulnerable: *Heptranchias perlo, Cetorhinus maximus, Alopias vulpinus, Centrophorus granulosus* & *Alosa macedonica*

Available data on the number of species and diversity patterns of soft bottom demersal fish assemblages in Hellenic waters are derived from experimental trawl surveys conducted on a seasonal basis. These studies have shown that the number of demersal fish of interest to fisheries is positively correlated with increasing latitude (increasing form south to north) and negatively related with increasing longitude (decreasing from west to east).

Anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) are the two most important small-sized pelagic species in the Mediterranean, making up 18-25% of the total Hellenic landings and 60% to 70% of the total purse seine landings.

The daily egg production method (DEPM) survey of two eastern Mediterranean sardine, *Sardina pilchardus* stocks, conducted during the peak of the spawning period showed that it occurs earlier in the Aegean Sea (December) than in the less-productive Ionian Sea (February). Single-parameter quotient analysis showed that the preferred bottom depth for spawning was 40–90 m in both areas but sardine selected sites of increased zooplankton in the Aegean Sea during December and increased fluorescence in the Ionian Sea during February. Spawning was restricted to nearshore waters and no embryos were found in open sea areas.

Systematic recording of cephalopod species began only in 1990 in the framework of trawl surveys undertaking the assessment of commercially important species' stocks in the North Aegean Sea. During these surveys, 17 new species for the Aegean Sea were identified from a total of 29 collected species.

Studies on demersal cephalopod assemblages are available only from the northernmost part of the Aegean Sea. *A. media*, *L. vulgaris*, *E. moschata*, *O. vulgaris* and *S. elegans* dominated catches on the upper shelf of both studied areas, with *S. officinalis* showing a very high abundance on the coastal shelf areas of the North Aegean Sea. It's interesting that the Aegean Sea harbours 20 species, 62.50% of the known Mediterranean Teuthoidea (squid) fauna.

Out of a total of 1160 molluscan species recorded so far in Hellenic seas, 21 (besides the Cephalopoda) have a commercial interest particularly in fisheries and aquaculture since they are collected and/or cultivated for human consumption. Additional species have been either traditionally harvested as food resources, collected for use as fish baits, or intentionally imported for culture during the last decades are still exploited in certain coastal areas of Hellas. Apart from a few species and only at a local scale (e.g., *Pinna nobilis, Lithophaga lithophaga, Donacilla cornea*), there is no population assessment in the Hellenic seas. Existing legislation for eleven of these species is not enforced in practice, and seems insufficient to guarantee their conservation.

Molluscan species of major commercial value in the Hellenic Seas (more than 90% of the total production) are the gastropod *Hexaplex trunculus* and the bivalves *Modiolus barbatus*, *Mytilus galloprovincialis* (both collected from natural banks and aquaculture units), *Arca noae*, *Cerastoderma glaucum*, *Donax trunculus*, *Chlamys glabra*, *Ostrea edulis*, *Callista chione*, *Ruditapes decussatus* and *Venus verrucosa*.

Populations of *P. nobilis* have been greatly reduced over the past few decades, but important local populations still exist in Hellenic seas. Nowadays it has been declared an endangered species and its exploitation has been banned.

L. lithophaga is endemic to the Mediterranean Sea. In the Aegean Sea, the species is found in the N Sporades Islands, the Dodecanese, Kriti, Lesvos island, Maliakos and Argolikos gulfs, and the Chalkidiki penninsula. The population density of this species is high in the N. Evvoikos Gulf (36 inds/dm^3). In the past, *L. lithophaga* was extensively exploited in the Hellenic seas and it was found in seafood markets and fish restaurants at many locations. It is still exploited by divers (illegally). This species is under strict protection.

The caramote prawn, *Penaeus (Melicertus) kerathurus*, lives in coastal marine or brackish waters on muddy sand or sand, usually at depths between 5 and 50 m. It prefers areas in the vicinity of estuaries where its nursery grounds are located. The shrimp is fished both by trawlers and the artisanal fleet. Trawl catches in the Thermaikos Gulf vary greatly inter and intra-annually, with maximum catches of up to 7.5 kg/h occurring at the beginning of the fishing season.

Other exploited invertebrates

In Greece, exploitation of the red coral (*Corallium rubrum*) is regulated by the Hellenic Ministry of Rural Development and Food**.** According to the national legislation, all non-selective gears (i.e. Saint Andrews' cross are strictly banned and a rotating harvest system has been established since 1994. This system divides the Hellenic territorial waters into five large geographical sectors, allowing only one of them to be harvested for a five year period, by up to ten licensed vessels. Although this system ensures a 20 year coral fisheries moratorium for each region, 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. Moreover, all the available data show that the shallow water red coral stocks (up to 50-60 m) are almost depleted, while poaching has not yet been properly impugned. 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.

Despite the small number of the hard substrate invertebrate organisms exploited in the Aegean Sea and the fact that their total production/year is rather small (3000 tonnes/year), their economic value is considerable (over 17 million EURO/year). In addition to Mollusca and Crustacea, exploited species in the Aegean Sea include different groups of invertebrates such as sponges, echinoderms, cnidaria, and ascidians. The mean annual production of these species is 7000 tonnes (less than 10% of the total fisheries production).

The availability of Mediterranean commercial bath sponges was dramatically decreased by the depletion of natural banks due to high fishing pressure and devastating epidemic events. A survey of the diversity and population density of sponges with manifest or potential economical interest was conducted in the area of Dodecanese in 2004-2005. Results showed that although bath sponges occurred at a restricted number of stations and in relatively low population densities, they revealed signs of recovery after the devastating epidemic events.

Turkey

There are about 500 fish species recorded in the Turkish part of the Mediterranean coastal waters and 300 in the Aegean Sea, Among these species, about 100 species of fish and invertebrates have potential commercial value. Contribution of the Aegean Sea and Mediterranean Sea to the fishery production of Turkey is 12 % and 10 %, respectively. Fishing licenses are given according to four gear classes: purse seine, trawl, carrier /assistance vessel and other. In addition, combinations of these gears are possible. All small scale/multipurpose vessels are licensed as ‘other’. The vast majority of the Turkish fishing fleet, almost 90 percent, are licensed as ‘other’. In the Aegean Sea approximately 20 percent of the vessels are registered. The Fisheries Economics Section (Aquaculture Department, DG Production and Development, Ministry of Agriculture and Rural Affairs (MARA)) keeps records of the production data from all fisheries, focusing on inland fisheries and aquaculture. Data were collected on a trial basis for three-month periods by provincial MARA staff. Data from small-scale fishermen (vessels smaller than 12 m) are obtained through samples, while data from large vessels are collected through enumeration (logbook) and recall. The data consist of value and quantity landings per vessel per species. These data are aggregated to the provincial level and sentto the Fisheries Economics Section in Ankara. All fishing vessels in Turkey are registered by the Maritime Affairs office of the Prime Ministry. The main fish species caught by artisanal fisheries in the Aegean and Mediterranean part of Turkey are red mullet *Mullus barbatus,* surmullet *Mullus surmuletus,* gilthead seabream *Sparus aurata,* seabasses *Dicentrarchus labrax* and Atlantic horse mackerel *Trachurus trachurus.* These fish were caught by set nets, trammel nets and long lining in the Turkish waters. Fisheries is one of the sustantial sector in Turkish economy, sustainablity of the fishing mainly highly migratory fish such as bluefin tuna, swordfish, albacore tuna and others are under the threat due to overfishing and illegal, unreported, and unregulated fisheries. Besides, the stocks of small pelagics like anchovy and sardine were depleted over the years. Deep Sea shrimps, lobsters and Norway’s lobster stocks need urgent assesments. Among demersal fishes, mullets, skates, whiting stocks also need to be evaluated. Today, nearly 250 registered trawlers operate in the Aegean and the Turkish Mediterranean coast putting heavy fishing pressure on the fish stocks. This increase in industrial fishing power and the subsequent reduction in the total catch of main target species by small-scale coastal fishermen is well studied. The CPUE (catches per unit effort) has dropped 10 times during the last 15 years in the Mediterranean Sea. Furthermore, not only has the size of the individuals been remarkably reduced in the last two decades, but also low-value "trash" fish has replaced large valuable commercial fish species. Today, there is a remarkable decline in the stocks of large sized species like sharks, groupers (Serranids) and in rare species such as sea horses (*Hippocampus* spp.). Use of detrimental fishing gears is increasing threat to diminishing fish stocks. Use of dynamite for fishing purposes is reported from some areas on the near shore rocky littoral zones, a favourable settlement and nursery ground. Law prohibits the use of explosives so they can only be used in remote and hidden areas, which are the last remaining refuges for fragile species. The shock not only kills the juvenile fish but also destroys the entire rock littoral assemblages. Consequently, the marine ecosystem in the Turkish Mediterranean coast is in a fragile state and facing collapse. When the food web structure carrying capacity of the Mediterranean fisheries ecosystem, and the amount of fish removed by the fishing fleet are taken into account, the future of any large apex predator population, such as the monk seal and the dolphins, is threatened. Furthermore, the monk seals, sea turtles, and coastal small-scale artisanal fishermen are in increasing conflict with each other due to lack of management, enforcement, protection zones and due to illegal fishing.

Cyprus

Data not available

Syria

Syria has a coastline of 183 km with a very narrow continental shelf. The trawling grounds on the shelf are ≈300 km^2. Most grounds are unsuitable for trawling, but may be exploited by other means of fishing. The continental slope is very steep with some trawling grounds between 200 and 400 m. It is estimated that the surface of deep trawlable grounds (100–600 m) is about 850 km^2. The official figures of marine fish landing is totalled to 2500-3000 t/y, the amount which is believed to be underestimated since not all fish catch passes through the landing points and fisherman usually do not declare the actual amount of catch, to escape taxation. Overall the fish stocks in Syrian waters is overexploited; evident signs of this are: the decrease of catch per unit effort from year to year, the increase of smaller size classes, and the decrease of larger size classes of a given fish species. The official data provided by the Fisheries Statistics Section (FSS) at the General Commission of Fisheries Resources (GCFR), indicates that this amount is far more than what is previously permitted (Korean Mission 1976).

The artisanal fishing fleet (1850 boat; GDP, 2009) is operated from seven main harbours: Tartous, Arwad, Banias, Jable, Latakia (Alugslafia) Borj Islam and Al Bassit. More than 70 commercial fish species representing more than 30 families. The amount landed and the fish species varies according to season and area. In summer, *Sardinella* species are caught with small purse seines. Predominantly, Carangidae, Sparidae, Scaridae, Mullidae, Serranidae and Siganidae families are the most encountered.

The estimated total area previously trawled along the Syrian coast is estimated to be 20% (≈200km^2). The Syrian fishing fleet in the territorial waters is composed of about 1850 “artisanal” fishing boats using various gear (e.g. gillnets, trammel nets, longlines). 55 purse seiners fishing at night targeting epipelagic fish, 25 bottom trawlers and 25 beach seines. From 2005, Syrian bottom trawlers are only allowed to fish in international waters (Ministerial Decree No. 15/T of March 19th, 2004). Trawling within the territorial waters (12 nm) was banned to avoid further damage to the marine ecosystem (including seagrass damage). This ban currently gives long-term protection to inshore and estuarine fish habitats that are important for sustaining local fisheries.Data on the biological status assessments species of commercial interest for fishing are obtained from the research projects carried out at HIMR in Lattakia, the newly established "Syrian Fisheries Statistics Program" logbook, angler diaries, and the questionnaire prepared for the purpose of this study.

114 fish species, belonging to 47 families, are usually caught by the fishing gears used in Syrian coast, 84 were spread along the whole coast, the others were found at specific locations. Out of these species, 17 (14.9%) were non-indigenous species from Indopacific-Red Sea or Atlantic-western Med. origin. The species of commercial interest are totalled to 62 (54.3%) in AlBassit fishing area (N Syria). Other fish species either contribute little to the total catch or have no commercial potential.

Total annual fish landings were (in decreasing order) from the families: Scombridae, Clupeidae, Carangidae, Sparidae, Labridae, Serranidae, Mullidae, and Mugilidae

Ten species (8.7%) are seasonal, fished at specific seasons of the year (*Trachurus trachurus, Sriola dumerili, Alosa fallax, Sardinella aurita*, *Coryphaena hippurus*, *Merluccius merluccius*, *Saurida undosquamis*, *Synodus saurus, Sarda sarda*, and *Scomber scombrus*).

Total length of the fish caught varied according to the season, locality, fishing gear and weather conditions. As for example, the following lengths (total length) distributions were encountered: *Alosa fallax* (10-17cm), *Dicentrarchus labrax* (10-24cm), *Phycis phycis* (12-35cm), *Mugil cephalus* (13-34), *Merluccius merluccius* (20-45cm), *Sphyreana sphyraena* (25-43cm) and *Fistularia commersonii* (25-75cm).

Due to the appropriate sea bottom characteristics along the Syrian coast, some fish families are represented by many species, with a good contribution to total marine biodiversity.

The predominant species found almost year round are from the families Sparidae (mainly *Boops boops*, *Pagellus acarne* and *Sparus auratus*), Scombridae *(Euthynnus alletteratus* and *Katsuwonus pelamis*) Carangidae) ,mainly *Caranx crysos*) Labridae (mainly *Xyrichthyes novacula*). On the other hand, nine main species of seasonal variability were: *Scomber scomber*, *Sardinella aurita*, *Alosa fallax, Trachurus trachurus*, *Coryphaena hippurus*, *Seriola dumerili*, *Merluccius merluccius, Synodus saurus,* and *Sarda sarda*.

Molluscs and shellfish fishing is not practiced in Syria and the available species in the landings represent what is accidently caught by fishing gears. However, 26 species of gastropods, 39 species of Bivalvia and 14 species of Crustacea suitable for human consumption are available in the Syrian waters.

Artisanal Fishing Gears include Trawl Net, Burse Seines, Trammel nets, Beach Seines, Gillnets, Long lines and others.

The studies on Chondrichthyes revealed that 39 species representing 18 families and 23 species are present in Syrian marine waters. They represent 22 species of sharks, 16 species of rays & skates and 1 species of *Chimaeras*. Out of these, 19 species were recorded for the first time in the Syrian waters and 7 species were recorded for the first time in the eastern Mediterranean. Cartilagineous fish accounted to 3.7% of the total marine bony fish caught and 0.6% of the total fish caught from marine and freshwaters. Some of the catch was achieved accidentally while fishing for bony fish. Some species (such as *Galeus melastomus* and *Chimaera monstrosa*) are usually returned to sea because they are undesirable for consumption.

Marine species (especially fish) populations are threatened and some species became particularly vulnerable; generally those with long period of immaturity such as Chondrichthyes (sharks, rays, skates) and deep water Osteichthyes. In addition, there can be unintended effects of fisheries such as by-catch that further reduce populations of larger marine species such as Mediterranean monk seal, dolphins and whales.

Although no longer practiced today, sponge fishing was common till 1970s leading to severe sponge diversity degradation that preceded what we are doing now to sponges, in the form of MPAs establishment.

From a conservation viewpoint, many threatened marine species (such as certain species of sponges and molluscs) are endemic to the area of eastern Mediterranean and might be considered as very important for conservation. Regional cooperation is therefore needed to get better conservation result.

Lebanon

Lebanese fisheries are artisanal or traditional in nature. The country's coastal sea comprise 1685 fauna species with more than 50 of which are fish of commercial importance. The main gear includes trammels, longlines, purse seine nets (lampara) and beach seines. Fishing usually occurs to a maximum depth of 200m while most activities take place at an average depth of 50 m. The Lebanese fishing fleet is made of 4800 fishing boats spread all over the coast, only 2700 are officially registered. Even-though it is prohibited by law, spear fishing using scuba diving gear is widely practiced. Furthermore, fishing nets with illegal mesh sizes are widely available on the black market increasing the by-catch of immature organisms and leading to negative impacts on recruitment rates.

Few scientific studies addressed fisheries in Lebanon, therefore data concerning structure of populations, their abundance, spatial distribution and age/size structure if available is very scarce and localized. There are no national fisheries statistical system, no biological fishery surveys and no socio-economic surveys that will allow the proper development of management plans for the sector.
Two non indigenous Siganid species, *Siganus luridus* and *Siganus rivulatus*, were lately the subject of detailed research. Their reproductive cycles and spawning periods were assessed and discussed according to the prevailing ecological conditions. The abundance, settlement patterns and microhabitat of these two Lessepsian siganid species were compared with the two main native herbivores, *Sparisoma cretense* (Scaridae) and *Sarpa salpa* (Sparidae). These herbivorous invasive fish species settled in protected shallow areas with hard substrates and algal communities. *S. rivulatus* was the most abundant, tolerant and adaptable species, able to settle on a wide range of substrates and habitats, including rock pools, muddy harbours and sea grass beds. In the eastern Mediterranean Sea, *S. rivulatus* might have benefited from a release of competition pressure due to the low diversity and abundance of native herbivores. It has probably replaced *S. salpa* on the coast of Lebanon, being more competitive than the native sparid.

Israel

The overall composition by species of the Mediterranean catch has remained more or less steady for most of the 1960s-1970s with two major exceptions: the sardine catches, which fluctuated around the 1,000 t level, dropped sharply in 1977 to 340 t, steadying at 400-500 t up to 1981. Since 1982, stocks seem to recuperate providing annual catches of 680 t in 1982, 870 t in 1983, 1,030 t in 1984. Surveys conducted by the Department of Fisheries indicated larger stocks that are left alone due to low market value. The Erythrean alien lizardfish, *Saurida macrolepis*, once constituting nearly 30% of the trawl catch, dropped in the 1980s to 6.5% of the total trawl catch. The main species of interest in 1984 (total catch 4,200 t) were *Sardinella aurita*, mullids, sparids, *Epinephelus, Trachurus* and *Siganus* spp.. In 1998 the total catch still stood at 4,136 t, but has since declined precipitously – in 2006 (the last year for which the Department of Fisheries published records) it was but 2,219 t. The main species of interest in 2006 were cephalopods (235 t), sparids (185 t), mugilids (183 t), mullids (182 t), elasmobranchii (179 t), penaeid shrimps (145 t), and *Saurida* still constitutes 7% of the total trawl catch.

Knowledge on the size of stocks of commercially important fish is very limited. Some mullidae, penaeid shrimps, sardines, and to some extent, hake (*Merluccius merluccius*) have been subject of biological studies, but the size of these stocks and the maximal sustainable yields have not been defined. …Analysis of statistical data seems to indicate that the common demersal commercial stocks are exploited near the maximum permissible level. The state of knowledge is poor and a recent Mediterranean fish stock assessment has cited no data from Israel. The Department of Fisheries has no long-term monitoring projects, no formal stock and fisheries assessments, and made no attempt to maintain and update series of biological data, size frequency distributions, etc. of the main commercially important species.

Despite the fact that alien Erythrean species have been noted in landings since the 1930s, the Fishery Department has failed to analyze landings fully and distinguish between native and alien species. Thus it is impossible to follow long-term changes on the specific level, nor follow the establishment of invasive aliens of commercial interest.

Egypt

The Soviet-Egyptian survey in 1970-71 recorded a more diversified population compared to an earlier survey in 1966. This enrichment in species consisted of neritic mixed with open-sea species plus new erythrean migrants. The post-High Dam rise in salinity allowed a shifting of the offshore habitat nearer to the coast, creating more favorable conditions for the erythrean migrants.

The fisheries yield went through two distinct phases since the completion of the High Dam, The statistics of GADFR show a phase of dramatic decline since 1966, followed by a phase of recovery from about 1980 to 1990. During the latter phase the landings increased steadily so that by 1998 they had exceeded the pre-High Dam level.

The collapse of 1966-1980 was caused by the combined effects of environmental changes and of the severe security regulations of the fishing activities following the 1967 war. The recovery and the improvement of the fisheries are the result of the synergy of several factors: the restoration of normal fishing activities, the increase of the fishing effort with the use of modern fishing techniques and the increase in the size of fishing fleet. A most effective factor in sustaining the shelf fisheries of Egypt is the increased agricultural drainage to the sea. The shelf fisheries are driven by runoff. The outstanding peaks in 1997-99 are associated with the release of larger volumes of Nile water necessitated by exceptionally high floods. On the other hand, the fleet is immensely more developed in size. It comprises 3196 motorized boats, including 1136 trawlers, of which 231are purse-seiners, 1734 hook and line and trammel net boats. Comparison with the size of the pre-High Dam fleet is compelling: 30 motorized boats in 1930, 482 in 1952 and 622 in 1961. As a consequence of over fishing, the yield per unit effort is falling (see under 3.1.2, this report). Fishing activities now extend beyond Egyptian waters. It is essential to realize that the statistics include a large, but unaccounted for, proportion of fish caught from beyond Egyptian waters, namely from Libya, Tunisia, Malta and even from the Red Sea. This is why the drop in fishing yield does not reflect on the statistics. In spite of this, however, there can be no doubt that the rise in productivity in the Egyptian shelf waters is a fact (see under chlorophyll biomass).

The top commercial species for 2007 are:

Trawl

Cartilaginous fish	*sharks, rays*
Lizard fish	*Saurida undosquamis*
Sole	*Solea aegyptiaca*
Grey gurnard	*Eutrigla gurnardus*
Bivalves	*Paphia textile*
	Donax variabilis
	D. variegatus
Shrimps	*Marsupenaeus japonicus, Metapenaeus spp*
Cephalopoda	*Sepia officinalis*

Trawl/Trammel Net

Gilt Head Sea Bream	*Sparus auratus*
Bogue	*Boops boops*
Red mullet	*Upenaeus moluccensis*
	U. barbatus
	U. asymetricus
	U. surmuletus
Crab	*Portunus pelagicus*

Purse-Seine

Silver sides	*Atherina sp*
Sardinella	*Sardinella aurita*
	S. maderensis
Blue scads	*Trachurus mediterraneus*
Barracuda	*Sphyraena sphyraena*
	S. chrysotaenia

Hook And Line

King fish	*Scomberomoris commerson*
Cutlass fish	*Trichurus lepturus*

Hook / Trammel Net

Grouper	*Epinephelus alexandrinus*
Sea bass	*Dicentrarchus labrax*

Hook / Trawl

Sea bream	*Pagellus erythrinus*

Trammel

Mullets	*Mugil spp, Liza sp*

3.2. Habitats

The European Union, with the **Habitats Directive**, identified the Habitat as a feasible **conservation unit** to preserve biodiversity. Species, in fact, are not isolated entities that might be preserved in splendid isolation. Species need a habitat to thrive in, and preserving habitats is a prerequisite to the preservation of species. RAC SPA (2006) published a detailed inventory of **Mediterranean Habitat Types**, much improving the poor list of marine habitat types of the EU Habitats Directive (covering just nine marine habitat types). A further input to the protection of marine Mediterranean environments is, of course, the Barcelona Convention. It is very evident, however, that there is a big difference between signing a document and the real application of its principles.

The principle of identifying habitats as a primary conservation target is a very wise start of a sound **conservation policy**, and RAC SPA implemented it in a consistent way. The lists of Mediterranan marine habitat types have been recently revised by Fraschetti et al. (2008) with an attempt at **integrating** all the lists available so far in the scientific literature. Whatever the list, however, it is very important to **map the habitats** so to have a clear figure of the surface of their extension and their state of conservation. Habitats must not be confused with the species assemblages inhabiting them, even though some species are **persistent habitat formers** (like the bioconstructors) whereas others are **temporary habitat formers** (like many algae), so that the **primary substrate** is often changed radically, as habitat for other species, by the habitat formers that colonize it during a given season. Most lists are biased in favour of algae, and have been clearly compiled by phycologists. This **unbalance** with animals must be settled, but the starting point is a very solid one. All country reports stated that the distribution and state of conservation of their habitats are poorly known and set **GIS-based habitat mapping** as a stringent priority. This basic information is a prerequisite to any effective policy of marine conservation. In many countries, for example, **Marine Protected Areas** have been instituted without a prior detailed knowledge of the habitats comprised in their area. This led to uneffective zonation of the protected area, with little representativeness of the habitat diversity within its boundaries.

A strong priority is to be given to **bioconstructors**, from vermetid reefs to *Lythophillum* trottoirs, to *Posidonia* meadows, to coralligenous formations in general. Some of these bioconstructions are almost extinct in the easternmost part of the basin (e.g. *Posidonia* meadows) whereas others are still thriving, albeit being threatened by anthropogenic activities.

The very first priority is, thus, to map benthic habitats and, from this, start to inventory the species inhabiting them.

Most habitat types are referred to the sea bottom, and the **water column** is often considered as a simple medium for the organisms living in it. The water column, however, is far from being uniform. The features of the coast, in fact, often do interfere with the main current patterns, forming conditions that, albeit temporary, might be of great importance for many species. Gyres, eddies, upwellings, downwellings, sites of intense terrestrial runoffs, among others, set particular oceanographic conditions that determine peculiar features for at least some portions of biodiversity. These **pelagic habitats** are more elusive than benthic ones, but are presumably even more important.

The ecosystem approach to the management and protection of biodiversity was invoked by the Rio Convention on Biological Diversity. The rationale behind this is that species, and even habitats, cannot be either protected or managed *per se*, with *ad hoc* practices, but that they are part of larger systems (**ecosystems, including humans**) that should become the proper units for management and conservation.

This vision is rarely enforced in a consistent way, and the very definition of what is a sound ecosystem approach is rather elusive.

The ecosystem approach to fisheries, for instance, cannot be applied to fisheries without considering also the jellyfish that feed on the eggs and larvae of fish (Boero, 2009) since the mortality of the fish might be caused both by fisheries (acting on adults) and by predation and/or competition by gelatinous plankton (acting on eggs, larvae and juveniles). Furthermore, due to the widespread shift from fisheries to **aquaculture**, also the impact of aquaculture on wild fish populations is to be taken into account, since the aquacultured fish are often carnivores and they are fed with pellets that derive from the treatment of smaller fish taken from wild populations.

All these activities, when put into an ecosystem framework, form a much **tangled scenario** that requires a completely different approach from the so-far accepted visions on how to tackle these problems. It is often the case, thus, that the ecosystem approach is invoked but, then, the previous reductionistic approach is still widely adopted, just with another label.

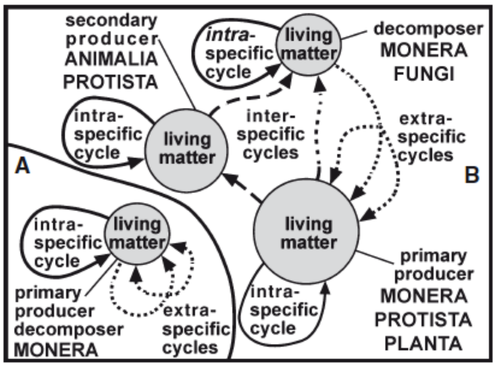
The link between biodiversity and ecosystem functioning is another buzz-concept that permeates the most recent approaches to biological conservation (Boero and Bonsdorff 2007).

Any approach of this kind should rely on solid and unambiguous definitions of the adopted terms.

Biodiversity is a rather elusive concept, ranging from genes to populations, species, communities, their habitats, ecosystems, landscapes. In such a framework, the concept becomes all-embracing and, according to the available expertise or even the adopted philosophy, one of the current definitions is often taken for the whole concept.

Species and habitats, however, are the most commonly adopted descriptors of biodiversity. All regional reports concur in stating that the knowledge of both species and habitats is scant and, in most cases, outdated. So, one of the components of the BEF approach is not well defined. This situation is not limited to this part of the basin but, instead, is the rule throughout the world ocean, in spite of many projects aimed at studying species. The paradox, as denounced by Boero (2010) is that, in spite of these big efforts in studying biodiversity, the science of species diversity (taxonomy) is almost extinct. It is not understandable, then, how biodiversity is to be protected if the expertise to recognize it is almost vanished (besides the knowledge of the most obvious and flagship species). Even the habitat level, which is of much easier implementation than the species level, is rather unexplored.

If biodiversity is the **structure** of the environment, then the ecosystems represent its **functioning**. Also ecosystem functioning is a rather elusive concept, often defined as "the efficiency of biogeochemical cycles" (Boero and Bonsdorff 2007). When defined as such, however, ecosystem functioning becomes a matter of microbial ecology, since microbes are the main responsible for the cycling of living and non living matter. It is also true, however, that microbes are the most resilient part of ecosystem functioning and that the basis of these processes is hardly affected by our action. The rest of the functions, that are based on microbial efficiency, however, can be much affected by us. These functions have been categorised by Boero and Bonsdorff (2007) as **intraspecific cycles** (the life cycles of the organisms, allowing for species persistence, with passages of matter from one generation to the next), **interspecific cycles** (the passage of matter from one species to another, that is: food chains), **extraspecific cycles** (the passage of state of living matter to a non living state, and back: biogeochemical cycles). These cycles are played by different actors, as shown in the figure on the side (after Boero and Bonsdorff 2007) and, togheter, are a more feasible representation of the functioning of an ecosystem than the current definitions of ecosystem functioning.



From the above, it is obvious that a long way is to be run before biodiversity and ecosystem functioning are really appreciated, not to say preserved or managed. This overwhelming ignorance about the patterns and processes of the structure and function of ecological systems is to be coped with by proper policies aimed at mitigating the currently low level of understanding of these phenomena.

The country reports provide some more details about specific situations, but, overall, the general picture denotes high human pressures on the coast and the marine environment, ensuing environmental degradation that is perceived in a qualitative way, and that should be quantified in a more stringent way.

Greece

Some good examples of the habitat types described in the Annex I of the EU "Habitats" Directive (92/43/EEC) occur on Hellenic coasts. Although these types are described under geomorphological terms, there is a direct link between them and the biological communities included in the Barcelona Convention. The following paragraphs present the biological information under the codes of the EU "Habitats" Directive.

The habitat type 1110 "Sandbanks which are slightly covered by sea water all the time" is is common in many sites in the Ionian and Northern Aegean, it is usually not covered by vegetation or the vegetation is not permanent. When vegetation occurs two types of sea grass meadows are present: *Cymodocea nodosa* and *Halophila stipulacea,* a Lessepsian migrant that appears only in the eastern Mediterranean.

The Habitat type "*Posidonia oceanica* meadows" (code 1120) is the most common biological feature on the Aegean as well as on the Ionian coasts. Most of the meadows are found between 5 and 35m depth.

The habitat type "Mudflats and sandflats not covered by seawater at low tide" (code 1140) occurs on shallow and flat bottom covered with mud. Typical examples occur in sites of the north Aegean coasts (Thessaloniki Gulf, Porto Lagos) and north Evvoikos coasts (Atalanti).

The habitat type "Large shallow inlets and bays" (code 1160) occurs at semi closed bays where the depth does not exceed 10-15m. Good examples occur in many gulfs of the Aegean (Thessaloniki, Gera, Kalloni, and Elefsis). Meadows of the Angiosperm *Cymodocea nodosa* are the dominant vegetation elements, as well as the populations of some *Cystoseira* species, such as *Cystoseira barbata* and *Cystoseira schiffneri*, growing on small stones and shells in low hydrodynamic conditions. During the last decade of the 20th century the invasive Lessepsian Chlorophyte *Caulerpa racemosa* is rapidly covering the muddy sands of habitat type 1160.

The habitat type "Reefs" (code 1170) describes isolated rocky substrata surrounded by deeper waters, near the coast or offshore. The alga *Cystoseira* is a prominent inhabitant of "Reefs".

The habitat type "Marine caves submerged or semi-submerged" (code 8330) occurs along many rocky calcareous coasts. Good examples of the this habitat type 8330 in the Aegean occur in the marine park of Sporades archipelago and the Kyklades archipelago.

Based on the derived typology, analysis of pressures and ecological status classification, the Hellenic coastal waters were distinguished into 233 coastal water bodies and these were classified into 4 main units: 1. Water bodies in the Hellenic coasts of the Northern Aegean Sea and its embayments, 2. Water bodies in the Hellenic coasts of the Central Aegean Sea and its embayments, 3. Water bodies of the Hellenic coasts of Southern Aegean and its embayments, and 4. Water bodies in the outer Deinaro-Tauric arc.

Allthough the above typological scheme and related methodology is linked to the definition of the general Biological Reference conditions following the results of the Phase I Intercalibration exersice (GIG, 2008), it seems that most classification indices tested are not depending on this kind of typological characterization. On the other hand it seems more relevant to derive for all biological quality elements types similar to those defined for Phytoplankton, for the larger Mediterranean ecoregion that is types related to hydrological factors and mainly the degree of fresh water influence and salinity. Nevertheless, the distinction of the country into water bodies units follows largely hydrological similarities and is practical for managerial reasons.

Turkey

Studies on habitat types in Turkey are sparse, there exists some research in the form of local inventories. These are mostly gray literature such as postgraduate thesis, unpublished project reports, and proceedings of national symposiums.

RAC/SPA's list of habitat types, associations and facies, has not been applied yet to the whole Turkish water. The Turkish seas have not yet been evaluated according to this habitat classification system.

In terms of ecoregion, the Turkish coast in question may be divided into four ecoregions; *i*) North of Lesvos Island in the Aegean that is under the Black Sea influence, *ii*) South of Lesvos down to Datca Peninsula in the Aegean, *iii*) East of Datca peninsula to Cape Anamur, *iv*) East of cape Anamur to Syrian border that is a part of the Lessepsian province.

Cyprus

Cyprus is in the middle of the Levantine Basin, and is characterized by a high percentage of alien species (Lessepsian immigrants). The Cyprus coastal and marine areas have a large number of habitats ranging from rocky cliffs with caves and sandy beaches and sand dunes on the coast to underwater reefs with submerged caves and extensive *Posidonia* meadows. The coastal strip is now fragmented, with precious coastal habitats, an expanding urban sprawl and an increasing number of coastal works (breakwaters, etc). Cyprus is one of the very few Mediterranean States that has an EEZ (off its southern coast so far). There is very little or no information on the biota of these deeper waters so far.

Wetlands/Coastal Lagoons

The Larnaca Salt Lake Complex is one of the two main wetlands in Cyprus which are of international ecological significance. It consists of four main lakes, the main Salt Lake (Alyki), Orphani, Soros and the small Airport Lake.. The lakes, though inter-related, vary significantly among them. Alyki, the main Salt Lake, has a very high salinity regime, hence its use in the past for salt collection. This salt collection stopped in 1986, due to the discovery that the salt was unsuitable for human consumption. The lakes are seasonal drying up in summer

The alga that forms the basis of the food chain here is mainly *Dunaliella salina,* this alga is fed upon by *Artemia salina,* the Brine shrimp, and *Branchinella spinosa*, which lives mainly in the other Larnaca lakes, which generally have a lower salinity regime. The Larnaca Salt Lakes are mainly known for their waterfowl. Many birds overwinter here, such as the Flamingo and various species of duck and seagulls. Many other birds also stop-over in the area during their spring migration, while other species nest and reproduce there.

Syria

Following the disappearance of *Posidonia* meadows from the Syrian marine ecosystems, it is estimated that few areas are left without compromised resilience due to the increasing threats of overfishing, bioinvasion, pollution …etc.

Many monk seal habitats present along the Syrian coast could be of interest as eventual resting and/or haul-out areas.

The Levantine Vermetid Terraces (LVTs) distributed almost everywhere at 20-30cm above the sea level of the rocky coasts are found mostly along the northern parts of the Syrian coast, starting from Lattakia district northwards till the Turkish border. Such terraces have a rich biodiversity.

The large number of rivers and streams, combined with the sandy structure of soil (on the shoreline and in the lower coastal plain) make the land susceptible to various levels of erosions, especially where the coastal mountains steeply project towards the sea (e.g. in the northern parts between Oum Al Tiur & Al-Bassit and near Banias city). This situation much impacts the marine environment by more loads of suspended materials.

Some habitats from the coastal area are of particular importance due to their sensitivity or they serve as breading grounds for other species: Emerged sandy beaches: important as nesting sites for marine turtles, frequently visited by Green and loggerhead turtles ; marine caves present in the south of Ras AlBassit and in Oum Tiur should be conserved as good habitats of Monk seal ; platforms with *Dendropoma petraeum* in Ras El Bassit reef and in other similar places along the coast. In many places, such platforms are of small sizes due to habitat fragmentation; Facies with the calcareous algae Titanoderma bissoides which can be found at low densities in many zones along the Syrian coast. Such facies are rich in fauna and accommodates a variety of organogenic structures and associated calcareous algae & molluscs (such as *Tonna galea* and *Erosaria spurge*).

Habitat surveys at limited locations have identified common habitat types that much probably do not cover the whole habitat diversity of Syrian waters.

Lebanon

The Lebanese coastline is about 220 km long along a north-south axis in the eastern Mediterranean. Along the coastline there are 3 bays, 12 prominent headlands headlands and several river deltas.The continental shelf is widest in the north (12 km), narrows down in a north-south axis, and widens up again to 8 km in the south. The sea cliffs are normally associated with wave washed terraces that show typical erosion patterns with potholes, blowholes and narrow channels.

The existing seabed along the Lebanese coastline is a mixture of bare rock, boulders, gravel and sand. Several types of marine biotopes including rocky, sandy, sludgy, coastal, neritic and oceanic can be found in neritic and oceanic waters, where biocenoses develop according to the prevalent geological, physical and chemical conditions.

The main habitat types are:

Sandy and pebble beaches, found only in a few areas protected from currents and wave action, and estimated at about 20% of the total Lebanese coast. Most of the sand and pebble beaches have been lost to quarrying activities with a reported loss of 462,022 m^3 of sand in eight coastal locatlities.

Zostera meadows: the infralittoral zone with a soft sediment structure shows several types of unique habitats occupied by phanerogame species (*Zostera nolti*). In Lebanon, this type of habitat is threatened by sand dredging, water pollution and a wide range of anthropogenic activities.

Sand dunes are one of the unique habitats in Lebanon is coastal formed by natural processes. They are under the influence of a set of dynamic processes that cause shifting in their geography. The coastal sand dunes are of great ecological importance and provide a niche for several special plants that also stabilize them in addition to being the first line of defense against storms generated at sea. In Lebanon, unfortunately, this ecosystem is threatened due to land appropriation, coastal sand extraction for construction and erosion of beaches caused by both natural and anthropogenic factors. One of the major problems facing the Lebanese coast is a deficiency in sediment loading leading to erosion of sandy beaches. Since the construction of the Aswan High dam in Upper Egypt in 1964, erosion has increased greatly in the Nile Delta as sediments are trapped in Nasser Lake. Yet, since no monitoring of coastline retreat has been carried out in Lebanon including its causes, it is difficult to ascertain the extent to which beach erosion along the Levant coast can be attributed to the Aswan dam. Apart from this possible sediment loss, three kinds of extracting activities cause or exacerbate coastal erosion in Lebanon: sediment dredging offshore, sand extraction on beaches and gravel quarrying in river beds. Exacerbating an already bad situation, sea-filling activities for coastal land expansion is affecting the direction and speed of currents as well as the intensity of waves leading to erosion of soft shorelines. Currently, no studies exist on the impact of coastal sea filling activities on erosion rates on the Lebanese coast.

Rocky shorelines show unique characteristics. They are well-developed platforms of a particular biological construction: facies with vermetids. An association of several species (*Vermetus triqueter* and *Dendropoma petraeum*) builds up these organogenous formations very slowly. This habitat constitutes a major element in the rocky coast landscape, and is considered as a biological marker for water level and a fine indicator for the shoreline. In Lebanon, similar fossil platforms can often be found, but are threatened by anthropogenic activities including pollution, sea filling, and artificialization of the coast. In addition, the entire reef system functions as an important wave barrier and protects the coast from erosion and breaching from waves generated by storms.

Israel

The rapid increase in population density along the Israeli coastal plain in the past half-century, and its consequent urbanization, generated land reclamation schemes. Sand mining in the past and the existing marine structures along the coast have depleted sand reserves and increased coastal erosion. Effluents, such as sewage, agricultural run-off or industrial wastes increase nutrient loading locally, most notably in Haifa Bay and in some lower reaches of the coastal streams. In such nutrient-enhanced sites, appropriate ambient physical conditions may cause the development of toxic algal blooms. Yet, overall, levels of toxic contaminants are low, except for Haifa Bay with its concentration of heavy industries.

The most remarkable characteristic of the Levantine littoral biota is the intrusion of Erythrean species that have entered the Mediterranean through the Suez Canal.

The predominant habitat types along the Israeli coastline comprise :

Vermetid reefs composed of a series of offshore rounded platforms with raised rims, running parallel to the coast. The reef platforms (0-1m) are formed by the gregarious sessile vermetid gastropods *Dendropoma petraeum* and *Vermetus triqueter*, endemic to the Mediterranean ; *Sublittoral, well sorted sands* ; *coastal silty-sand bottom* ; *coastal detritic bottom* ; *coastal sandy-silt bottom* ; *coastal silty-clay bottom* ; *Coralligenous formations* ; *bathyal muds*.

It is noteworthy that *Posidonia* meadows have never been reported from Israel.

Egypt

The five coastal wetlands ("lagoons" or "lakes") of the northern coast of Egypt owe their outstanding importance to their high biodiversity and productivity. Four of them belong to the Nile Delta system, Maryut, Edku, Burullos and Manzala. The fifth, L.Bardaweel, on the Sinai coast, is independent from the Delta. The four lakes or lagoons are shallow brackish depressions (1-1.5m depth) located at the northern rim of the cultivated lands. They depend almost entirely on agricultural wastewater delivered through several drain canals. Except for L.Maryut, which is land-locked, there is also a limited tidal mixing with sea water around the lake-sea connections.

They act therefore as transition basins where active biotransformations take place between inland waters and the coastal Mediterranean Sea.

The coastal lagoons provide the usual services typical of transitional waters

In the area off Alexandria *Posidonia* grows in scattered patches in shallow waters at 2-8m, the deeper water meadows covering more extensive areas. Meadows also grow west from Alexandria at depths down to 26m. The western beds are in continuity with the North African beds along Libya, Algeria, Tunisisa. The Alexandria meadows represent the eastern-most extension of this phanerogam an along north Africa as it is absent from the Nile Delta, and the coast of Israel. Only the Alexandria beds and those of El-Dabaa have been studied. The western meadows are more healthy and more dense than the Alexandria meadows.

Key habitats on the west Coast.

The west coastline includes several biodiversity hotspots, in particular the Mersa Garbub-Ishaila Rocks. (31^{o} 31;N,26^{o} 37^{o}) and the Gulg of Sallum (31^{o} 35.N,25^{o} 7;E to 25^{o}30'E)

Ishaila Rocks are a series of numerous offshore rocky islands which have never been submitted to any studies. Being proximal to great depths, their ecosystem is most probably very different from that of the rocky coasts elsewhere along Alexandria and the east coast. They are also expected to be an important sea bird sanctuary. Sea grass meadows (*Posidonia oceanica*) with their associated fish and invertebrate fauna extend in the shallow waters.

The sandy beaches along Mersa Garbub have been identified as a nesting area for marine turtles. The site of Mersa Garbub-Ishaila Rocks is recommended as a marine reserve to protect an important biodiversity hotspot and a breeding area for birds, fish, invertebrates and marine turtles. It lies 65 km west from Marsa-Matrouh.

The Gulf of Sallum is characterized by several hundred meters high sea cliffs with several endemic plant species. The sea cliffs and caves could be a suitable habitat form Mediterranean Monk Seals, but this needs confirmation. The sandy beaches of the gulf are quite suitable for marine turtle nesting and tracks have actually been observed. *Posidonia oceanica* grows in lies 200km west from Marsa-Matrouh, remains untouched by tourism investors. Its protection therefore presents some urgency.

The designation of the Gulf of Sallum as a Protected Area has recently been approved by the Parliament and is awaiting final ratification.

4. PRESSURES AND IMPACTS

Systematic studies on the assessment of pressures and impacts are scant in all reports, and the listed threats to nature integrity are reported with different levels of both accuracy and precision. The main pressures and impacts are listed below, providing a very general account of the situation of the basin, since detailed information is missing or very fragmentary.

4.1. Pollution

All reports denounce alarming increases in pollution rates, with local emergencies linked to specific phenomena, such as the after-war oil pollution that greatly affected and still affects the Lebanese coast.

The search for marine resources on the sea floor is leading to **drillings** aimed at finding oil or gas, with risks that are becoming increasingly apparent after the disaster in the Gulf of Mexico. **Oil tanker traffic** is extremely intense in the area, and the risk of accidents is not negligible. **Oil pollution**, deriving from oilspills from the tanker traffic that crosses the Mediterranean Sea at an increasing rate, is to be more and more expected, both to “normal” (albeit illegal) discharges and to accidents that, from time to time, do occur. These ships transport ballast waters, even though the risk of **alien transport by ballast waters** is intense only at the harbors of destination, where the ballasts are disposed and the oil is uploaded.

Industrial pollution is rising almost in all countries, as is **urban pollution**. Under some circumstances, however, the organic load of towns (e.g. Cairo) might replace the organic load that enriched waters due to floods of the River Nile before the construction of the Aswan Dam.

New types of pollution are now being added to the “classical” industry, agriculture, and urban pollution. **Aquaculture**, for instance, is a highly polluting enterprise, due to the rejects of the reared fish (especially for cage mariculture), the unused food that fells on the bottom, the antibiotics etc. Furthermore, cultured fish are spreading **diseases** that affect the natural populations, with severe effects on their viability.

Some anti-pollution measures have been taken, as the ban of tributyl tin from antifouling paints but, overall, these countries are going through fast “development” and pollution might be a logical consequence of these choices.

Due to the scarcity of freshwater, **desalinization firms** are present in some states. Cyprus, for instance, reports on three plants functioning with the reverse osmosis process. Their waste includes concentrated brine, antifouling chemicals, washing liquids containing antiscalants, etc. Such waste is discharged in most cases into the sea, leading to an increase in the surroundings in salinity etc. The **brine** of the Cyprus desalination plants has a salinity of about 70 ppt compared to about 39 ppt of the Cyprus seas, causing serious osmotic problems to benthic marine organisms, because brines are denser than seawater and constitute water masses difficult to mix. Special attention is being paid to the location of outfalls in relation to the impact of the brine on the *Posidonia* meadows.

4.2. Coastal development and management

Human intervention, coupled with **sea level rise**, is greatly altering coastal habitats. The traditional reaction to sea level rise is **coastal defences**, often to protect settlements that have been placed very near to the coast line. Coastal development, in terms of **settlements on the shore**, for both touristic and industrial reasons, is a common way of using the land. Furthermore, especially in the past, **coastal lagoons were radically altered or even destroyed** for the management of mosquito presence, once linked with malaria. This led to widespread hydrogeological unbalance. The development of tourism is heavily affecting the coast line, with increasing settlements right on the shore. Both railroads and motorways are almost invariably built in direct proximity with the coast line. Coastal erosion, thus, is often perceived as a negative pressure, disregarding the natural processes that continuously alter the coastline. Furthermore, sandy habitats are often intensively exploited by **sand mining**, for the construction of buildings.

From one side the **construction of dams** brings less sediments to the sea, from another side **the extraction of sand** further removes sediments, and, as a final blow to coastal integrity, coastal “development” is so intense that the word “**coastal dynamics**” loses its meaning, since the expectation is “**coastal statics**”.

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 caused by **overfishing** and **illegal fishing**, which strongly affect 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 **Harmful Algal Blooms** 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.

4.3. Alien species.

The Egyptian report, for instance, reports much about the benificial effects of the arrival of Non Indigenous Species (NIS), with the proposal of compiling a list of the 100 most beneficial aliens, to oppose to the available list of the 100 worst aliens.

NIS, furthermore, arrived and still arrive to the Mediterranean also by other means, and not only through the Suez Canal (CIESM, 2002). Most authors (e.g. Galil 2000) consider the spread and settlement of alien species as a menace to the integrity of biodiversity and, in many reports, alien species are seen as one of the worst threats to the environment, if not The worst. Especially in recent times, some authors (e.g. Por, 2009) argue that this part of the Mediterranean has been impoverished by the Messininan crisis and that its tropical vocation could not be fulfilled due to the constraint of having been colonized, from Gibraltar, by a contingent that was not preadapted to the local conditions of this part of the Mediterranean. The opening of the Suez Canal, in this way, allowed the fulfilment of the unexpressed tropical features of an environment that had been colonized by an “alien” biota after the Messinian crisis! The present situation should bring the Eastern Mediterranean biota back to the state they were when the Mediterranean was the Tethys Sea, connected with the Indo-Pacific! With this vision, the resident species in the Mediterranean are the “invaders” whereas the Red Sea species entering from Suez are the descendants of the original biota of the Tethys sea.

Of course, this position is not tenable, since one cannot expect today that the conditions of the past are to be restored. History is a one-way process and it is tenuous to hope that it can be brought to former states. It is true, however, that the Mediterranean is shifting from a temperate to a tropical condition at a very fast pace, and that the prevalence of NIS of tropical affinity is a clear adaptation of the Mediterranean biota to the new situation.

The issue of NIS is not of easy resolution, and calls for a deep analysis on a case by case basis. One aspect is the possibility for species to reach a place, and this occasion is offered by the Suez Canal, another aspect is to have the possibility of forming thriving populations in the newly reached place. This depends on tolerance to chemico-physical conditions (interactions with abiotic environmental features) and on the competitive efficiency with the local biota (interactions with biotic environmental features).

All national reports describe a dramatically changed situation in the composition of the local biota, when known, in respect to some decade ago. The changes are invariably linked to the prevalence of alien species that are more or less rapidly replacing native ones. The spread goes in both directions, starting from the Suez Canal and proceeding both northwards (Israel, Lebanon, Syria, Turkey, Greece) and westwards (in this case Egypt, but the phenomenon is going on also in Tunisia and Algeria, whereas little is known about Libya). Some of these species are a nuisance and even a danger for humans (see the problem of jellyfish below), but others are a resource for local populations that are very happy to harvest them, and some are even cultured after their establishment. A parallel phenomenon, denounced at least by some reports, is the regression of the native species.

In a way, biodiversity might be unaltered in respect to the past, at least in terms of species numbers, but the quality of the species is much different. A key question is: did the alien species became successful due to the preceeding insuccess of the resident ones that, with their absence, made ecological space available for new colonizers? Or did the new colonizers cause the regression of the resident species by competing with them?

If the first option is met, the Mediterranean biota would be much impoverished if the NIS hadn’t occupied the vacant ecological space of the species in distress, and the aliens are not the cause of the regresson of the residents. If the secon option is met, the aliens are the cause of the regression of the residents. Chances are good that both explanations might be valid and the evaluation of the impact of NIS on the local biodiversity and on ecosystem functioning must be covered at the level of individual species.

The resolution of this issue is important also for management reasons. Some people, in fact, call for the eradication of aliens, as soon as their presence is detected, considering them as negative *a priori*. Investments in this direction might be more negative than positive and, anyway, it is very difficult to eradicate a species if it becomes invasive. We are very powerful with vulnerable species (e.g. cetaceans) but we end up being harmless with species with more subtle ways of performing their activities (e.g. jellyfish).

All reports admit that some NIS are beneficial and some are dangerous to the status quo. The issue about how to manage this phenomenon requires deep knowledge at a case by case level.

The construction of the Suez Canal is a product of human activities and, thus, the arrival of NIS through that waterway is considered as the result of human impact. It is true, however, that the Canal connects two seas that have much in common, in terms of abiotic features, and this explains why Red Sea species are thriving in the Eastern Mediterranean Sea. The low diversity of the recipient basin, in respect to that of the donor basin, and the preadaptation of the Red Sea biota to Eastern Mediterranean conditions, coupled with the maladaptation of Mediterranean species to Red Sea conditions, explain why the circulation of species through the Canal is a one-way process.

4.4. Climate change and the problem of multiple stressors

All reports contain information about the impact of global warming on coastal ecology. This is linked, of course, to increased temperatures but, also to the rising of the sea level and, hence, of coastal erosion.

In the rest of the Mediterranean, two main biotic events are referred to the impact of global warming. One is **Meridionalization**, i.e. the northward widening of the distribution of species of warm water affinity that usually thrive in the southern, and warmer, part of the basin (i.e. meridional species). Of course this means that the conditions that are met in the Eastern sector of the Mediterranean are widening northwards and, with the establishing of new physical conditions, also the preadapted species follow. These southern species are thus favoured by the new conditions that are met in the northern part of the basin.

The other reaction to global warming is **Tropicalization**, i.e. the establishment of tropical species that were previously absent from the basin. Of course, these species usually start their colonization in the Esternmost part of the Mediterranean, i.e. the warmest one and, also, the one in direct contact with the Suez Canal, the main conveyor of tropical species to the Mediterranean Sea. Meridionalization and Tropicalization occur because the climate is warming and this response is an adaptation of the Mediterranean biota, both with its internal resources (Meridionalization) and with the acquisition of other contingents (Tropicalization). On the other hand, the cold water species are regressing (Boero and Bonsdorff, 2007; CIESM 2008b) so leaving an ecological vacuum that is being filled by the new tropical contingent. In a way, it is to be expected that, if climate becomes warmer, species of warm water affinity tend to become dominant, whereas those of cold water affinity tend to regress.

This part of the Mediterranean is the "**source**" of meridionalization processes and, also, is the **carrefour** where the tropical species first converge, to be eventually "distributed" throughout the basin.

If the Mediterranean Sea is a miniaturized ocean, where we can find in advance what will happen in the future to the oceans of the world (Lejeusne et al. 2010), the Eastern Mediterranean is the portion of the basin where these changes will become more apparent, and deserves, thus, the greatest attention by the scientific community, so to give proper management inputs to the rest of the basin. The first settlement of tropical NIS, in fact, occurs here, and the resident species are the most probable colonizers of the northern part of the basin (as suggested by Galil in the Israel report).

The problem of **multiple stressors** is very important and emerges from the national reports. For instance, the typical Mediterranean seagrass (*Posidonia oceanica*) is almost extinct in the easternmost countries. The Syrian report declares the complete disappearance of the species from Syrian waters, Lebanon declares its great regression, Israel does not even mention about its presence. In Egypt, *Posidonia* meadows start at Alexandria, to expand then westwards.

The **absence of *Posidonia*** from the easternmost corner of the Mediterranean is often ascribed to global warming, but chances are good that this is not the case. Just in concomitance with global warming, in fact, *Posidonia* meadows are blooming in the northern part of the basin, where flowers, seeds and seedling were unrecorded prior the global warming period that is currently affecting the basin. *Posidonia*, thus, might be even favoured by the warming of the waters. All these countries, however, denounce a great development of coastal settlements, with increases in coastal erosion.

It is true that **coastal erosion** might ensue from the **rising of the sea level**, but it is also true that the impairing of the dynamics of coastlines by **irrational coastal development** might be a major cause of coastal erosion. Erosion, furthermore, increases the turbidity of coastal waters and, also, sedimentation rates, so affecting the viability of *Posidonia* meadows.

It is very probable that the regression of *Posidonia* meadows is due more to coastal development than to global warming.

The problem of **multiple stressors** is very important, since a strong correlation might be found between one event (e.g. *Posidonia* regression) and a putative cause for it (e.g. global warming) but the comparison with other situations might lead to the individuation of other causes (i.e. coastal development) that are co-occurring with the one individuated in the first place.

It is important, thus, to carry out experimental studies to ascribe with some certainty a detected event to its putative causes. Comparisons with other areas of the Mediterranean might also lead to single out the real processes leading to the observed patterns.

Multiple stressors (e.g. coastal development and global warming) might even act in **synergy**, leading to tangled situations that should be completely understood before any proposal of mitigation measures since, if the identified cause is not the right one, all management actions might prove ineffective.

4.5. From fish to jellyfish

Overfishing is another issue that is denounced by all reports. The use of wild fish populations to satisfy the protein needs of every country is becoming unbearable, with a trend to shift from fisheries to **aquaculture**, at least in some countries. The impoverishment of fish populations is considered as one of the causes of the increase in jellyfish presences worldwide (Boero et al 2008). The ecological vacuum ensuing from the removal of large carnivores from marine biota is being filled, in fact, by jellyfish which, in their turn, exacerbate the predatory pressure on fish, preying on fish eggs and larvae, and competing with their larvae and juveniles for the use of planktonic resources, especially crustaceans. One of the **worst invaders** in this part of the Mediterranean, the alien scyphozoan *Rhopilema nomadica*, forms huge populations that, since almost a decade, strongly affect coastal economies in terms of nuisance both to **tourism** (swimmers are stung) and to **fisheries** (for the above mentioned reasons). *Rhopilema* is a warm water animal, and, so far, it did not spread to the rest of the Mediterranean due to the presence of lower temperatures there than in the Levant basin. In this case, thus, global warming might be the first cause for the success of this species, followed by overfishing. Again, the presence of multiple stressors might determine a given situation.

In the regional reports, the problem of jellyfish has received different treatment. If a specialist is present in the country (e.g. Israel and Turkey) the presence of jellyfish is evidenced and is considered as an important issue, in other countries it was not even mentioned in the first draft, to be then introduced when the rapporteur was asked directly if there was no jellyfish problem in his or her country. Besides the tropical jellyfish, like *Rhopilema nomadica* and *Cassiopea andromeda*, last year another gelatinous plankter reached the easternmost coasts of the Mediterranean: the ctenophore *Mnemiopsis leidyi* (Galil et al. 2009). *Mnemiopsis* reached the Black Sea in the early Eighties, presumably through the ballast waters of US oil tankers, since the invader is from the Eastern coast of the American continent. For decades *Mnemiopsis* remained confined to the Black Sea, to be sparingly recorded right outside it, along the Turkish and Greek coasts, but with no large populations. The reason invoked for this lack of spread to the Mediterranean was that the conditions of the Mediterranean presumably did not meet its physiological and ecological requirements. The extablishment of this species in Israel (the Israel report states that *Mnemiopsis* is thriving also in 2010) means that it became acclimated to the warmer conditions of the Mediterranean Sea and, as a matter of fact, in 2009 it also reached the Western Mediterranean coasts, having been recorded from Italy, France and Spain, so having spread throughout the basin.

The sooner this jellyfish problem will be properly perceived, the better it will be.

Fishermen, tourists, coastal managers are perfectly aware of this situation, whereas the least prepared to tackle it are both the scientific community (lack of specialists) and the funding agencies (lack of funds).

When, in the Eighties, the swarms of *Pelagia noctiluca* became a constant in a series of summers, UNEP made money available to study the phenomenon. But when a whole task force had been assembled to tackle the problem of jellyfish, the jellyfish disappeared and remained rare for many years, going through some local bursts that were not as important as the swarms of the early Eighties. Now jellyfish are back, and not with a single, indigenous species. And they come both from warm places, like the newly recorded *Phyllorhiza punctata* (Galil et al. 2009), and from temperate ones, like *Mnemiopsis*. As stated by Boero et al (2008) the problem of jellyfish is affecting the whole world, and chances are good that it will not fade away as it happened in the early Eighties.

4.6. Flagship species

Species declared as having a great conservation interest are present in this part of the Mediterranean Sea.

The most important one is the **Mediterranean monk seal** (*Monachus monachus*), still present in Greece and Turkey. This part of the Mediterranean is also very important for the great availability of nesting sites for **marine turtles**, especially *Caretta caretta*, and for the presence of many species of **cetaceans**. Local governments are aware of the importance of these species, and special regulations have been issued, also with the institution of Marine Protected Areas focused at the conservation of these species. In spite of stringent regulations, it is reported that human activities deeply interact with these species and it is possible that more stringent application of the protection measures is to be attempted, so to make them effective.

Much attention is dedicated to these species, whenever they are present in a country. This is due to their high visibility, to their status of protected species in international treaties, and to their popularity. It is obvious; however, that a species cannot be protected if its habitat is mismanaged and if the ecosystem that supports it does not work properly. These stringent requirements for the effective protection of these important species are usually not met.

4.7. Limited knowledge

The great importance of the Eastern Mediterranean for the understanding of the patterns and processes of change of the whole Mediterranean Sea, unfortunately, is counterbalanced by the scarcity of information on its biology and ecology, and this is recognized by all national reports. The **inventory of biodiversity**, both at species and habitat level, is scant and is linked to contingencies. The various countries, in fact, do have some expertise in some aspects of biodiversity but a choerent vision is lacking. It is true that, in the last decades, great advances have been accomplished, especially by the countries that had easier access to EU funding (with the remarkable example of Greece) but, in general, all reports highlight the **lack of taxonomic expertise** covering the most important taxa. Every country has own highlights (for instance the study of Harmful Algal Blooms in Egypt, or the study of NIS in Israel and Turkey), often focusing on flagship species such as cetaceans, marine turtles or seals, but it is evident that a great investment is needed to fill the many gaps in knowledge that characterize this sector of the Mediterranean Sea. All the local scientific communities are willing and able to contribute to fill these gaps, but more resources are needed than those made available by the local governments.

5. EVALUATION OF GAPS

The following gaps are denounced in every report since decades, and are affecting almost every country, not only in this area:

5.1. Species

The knowledge of species is scant. The available species lists are obtained by adding new records to the old ones, giving the impression that biodiversity is steadily increasing. This procedure does not allow for the real inventory of the biodiversity present in a country in a given period.

Much emphasis is given to flagship species (seal, marine turtles, cetaceans) and to commercial or obvious species, the rest being known in a very fragmentary way. Fisheries statistics are far from being reliable, with hints at high rates of illegal fisheries and, thus, at unfaithful evaluation of the pressures experienced by commercial species.

All-species inventories should be accomplished, based on actual samplings, so to build a baseline of knowledge for future monitorings of the species richness as a descriptor of biodiversity.

Taxonomic monographs, covering all groups, should be published. It is not important to prepare one for each country, but it would be important to have them for the region (and also for the Red Sea, the donor sea that is rapidly colonizing the Mediterranean with its biota).

Besides recording aliens, it should be extremely important to know about the state of conservation of indigenous species, from algae, to seagrasses, to animals.

Some lists of planktonic organisms are present in some reports. Besides being outdated, these reports highligh their gaps, mostly due to lack of taxonomic expertise.

Overall, most reports provide lists of the most common species and of flagship ones. In no record there were hints at the meiofauna, a very important component of the bottom fauna, containing exclusive phyla.

Knowledge about the basic biology and ecology is completely lacking even for commercial species that receive much attention in terms of management of stocks. Of course, it is tenuous to manage resources while ignoring their basic features.

All these gaps are linked to the chronic gap of taxonomic expertise throughout the whole scientific community, in spite of the sustainment of biodiversity research with generous international funding. In the era of biodiversity, the study of species through taxonomy is in severe distress. Naming species and listing them, furthermore, is just the beginning of the knowledge of biodiversity and it is obvious that the autoecology of species is also very important, leading to the appreciation of their roles in communities and ecosystems. The genetic make up of species and populations is almost completely unknown.

5.2. Habitats

An agreed upon list of Mediterranean habitats (integrating the one already prepared by RAC SPA), representing better all the components of marine biodiversity, should lead to extensive coastal and deep sea cartography of marine habitats. This will lead to know where the habitats are, and their putative importance, inferred from their availability and distribution.

The distinction between “primary substrate” (sand, rock, mud, etc.) and “habitat fomer” (a species or a group of species, living on a primary substrate) must be very clear.

The seasonality of many habitat formers (e.g. some *Cystoseira*) represents a limit to the delimitation of habitats, since the species assemblages describing the primary habitats (either as facies or associations...) are often inconstant in presence. The same primary habitat, thus, can host much different species assemblages in the different periods of the year.

All reports highlighted that habitat maps are not available. The reports contain different level evaluations of the presence and distribution of habitat types in the various countries, with no hint at georeferenced mappings.

The extension of available mappings is very limited, and the maps are invariably coastal, whereas the deep sea is largely unexplored.

The filling of the gap in knowledge about habitat distribution is the most urgent one, throughout the Mediterranean Sea.

5.3. Ecosystems

Every report highlights scant knowledge of the functioning of ecosystems, due to lack of information of the primary features of ecosystem structure (species and habitats). The suggested patterns of ecosystem functioning derive from hypotheses that are far from being tested with experimental evidence, even though it is highly probable that the pervasive presence of alien species is heavily affecting the functioning of ecosystems. Tropicalisation (i.e. the establishment of many tropical NIS) is changing the structure of ecosystems and chances are good that these will cause changes in their functioning. The swarms of the tropical jellyfish *Rhopilema nomadica* are probably affecting in a dramatic way the species composition of both the plankton and the nekton of the Levantine basin. But how this is taking place is still largely unexplored.

The interaction of multiple stressors, from NIS species, regression of indigenous species, anthropogenic impact of many kinds, are creating a network of causes and effects that is difficult to disentangle. The clearing of these issues, however, is a prerequisite to the enforcement of the ecosystem approach.

Overall, the coastal and marine biodiversity as well as the pressures and impacts exerted on the Mediterranean Sea remain relatively little known despite the increasingly considerable efforts made by the international scientific community to grasp their features. This gap is not a fault of the scientific community of the Eastern Mediterranean basin. It is seldom the case that those studying biodiversity at species and habitat level deal with ecosystem functioning, and vice versa. This cultural gap, in spite of repeated calls to a timely synthesis, is still to be filled at global level.

5.4. National strategies

Besides measures to protect flagship species and habitats, most states do not have a conservation or management policy of their natural heritage. The laws of economy are considered as having primacy over the laws of nature, so that human pressures (from overfishing to coastal development) providing immediate income do not encounter any opposition in favour of nature preservation. The reports, furthermore, candidly declare that it is often the case that the regulations issued to protect the biota are not really enforced.

In some countries, efforts are being undertaken to enhance public awareness about the importance of environmental issues. This is almost invariably stemming from the appreciation of the presence of flagship species, but this first step might be conducive to cultural changes that might induce bottom up pressures urging politicians to issue legislation (and its enforcement) aimed at preserving nature or, also, to make conservation measures acceptable by the population through a top down information strategy.

6. Priority needs

Each country listed a series of priorities that are often overlapping. The following is the list of all the individuated priorities. Some priorities were not explicitly listed in some regional reports, but all reports highlighted important gaps in other sections, so hinting that their filling is a priority.

6.1. Needs

Synthetic reports about the state of the environment

The exercise of compiling periodic and sound reports about the state of the environment, stemming from financed research projects, is seldom if ever practiced. The mosaic of knowledge on specific topics is almost never assembled and the bits of available information are almost never leading to sound knowledge. The present investigation is highlighting that even the effort of assembling disconnected information can be very useful and that it should become a normal practice in every country. A conference on the "state of the Mediterranean Sea" should be a stringent priority, allowing the scientific community to inform decision makers so to increase their awareness about environmental problems and priorities. Each portion of the scientific community, instead, often remains self-referential and syntheses are not even attempted. The enforcement of the ecosystem approach cannot be effective if the barriers among disciplines remain unbroken.

The listed priorities are obviously calling for the filling of the gaps and so it is redundant to repeat each gap stressing that its filling is a priority.

It is important to stress the difference between the establishment of Marine Protected Areas and the adoption of Integrated Coastal Zone Management. In many cases, MPAs are proposed to protect outstanding features of the environment either as flagship species (e.g. seals and turtles) or habitats (e.g. coralligenous formations). These actions are focused on specific sites. The general management of the environment, instead, is aimed at having effects on all types of habitats and species, for instance by regulating fisheries, coastal development, aquaculture, waste disposal, tourism, etc. The institution of MPAs, in other words, is not enough to warrant ecosystem health. Some reports, for instance, complain that NGOs are very active in urging the conservation of outstanding environmental features (so embracing the philosophy of MPAs) while disregarding the general management of the environment (ICZM). The result is that some areas are protected and the rest is left behind, being subjected to very high pressures that, eventually, will affect also the protected areas.

It is important that the ecosystem approach is enforced also at the level of conservation, and not only of management of specific resources such as the populations of commercial species (ecosystem approach to fisheries). Hence, Marine Protected Areas and Integrated Coastal Zone Management should be merged into a single concept.

Capacity building

Many gaps are simply due to the lack of expertise (from ecology, to taxonomy, to management). Capacity building, thus, is a prerequisite for any further action. It is tenuous, however, to prepare skilful people if there is no market for their skills. This is very obvious, for instance, for taxonomists. In many countries, a training in taxonomy is leading to a future of unemployment. Any policy of capacity building, thus, is to be enforced by having created the possibility of actually using the people who have been trained.

Monitoring and descriptors

Besides making inventories of species and habitats and of having observed their state of conservation and their distribution, it is essential to continue to evaluate that state through proper monitoring.

Monitoring, however, is often based on a fixed list of descriptors and, again, many reports ask for the definition of good **indicators**. Each country, for instance, used the available information to make judgements about the state of the environment, and this information depends on the available expertise, leading to much different criteria. The evaluations, in this case, are not easily comparable, since the set of indicators is not coherent across countries.

Furthermore, in this period of rapid change, the scientific community must be prepared to face the unexpected. Instead of monitoring, in this case, it might be advisable to use the concept of “observatories”. The difference is subtle, but also substantial. The descriptors used to monitor the state of a given environment might not contain a “novelty” that might become very important within a short time. The rigidity of a monitoring program might not allow for the registration of changed situations simply because the new features were not comprised in the adopted monitoring protocol. Information on jellyfish blooms, for instance, are not so available because, even when monitoring programs are carried out, the presence of gelatinous plankton is seldom taken into consideration.

An observatory (or an observation program) should report about a given set of descriptors and, in addition, about any other change that might be observed during monitoring, from the presence of alien species to the unusual abundance of some resident species, or about any other feature of the environment that might become evident. Apparent anecdots might lead to build history, if put in a spatial and temporal framework.

Improvement of environmental quality

Obviously most records ask for a reduction of all negative pressures on marine and coastal environments. The first step to avoid them is to issue proper legislation, but the countries where this legislation is available do lament that the law is not enforced. Urbanization of the coast, industrial, agricultural and urban pollution should be reduced, just as overfishing. Again, some countries ask for effective measures to reduce pressures on flagship species and habitats, or for a more rational use of the goods and services that the environment is providing us.

I can add that these actions usually stem from political decisions and that political decisions usually stem from the public perception of the problem. Sometimes the politicians can use their influence to convince the general people that protection actions are urgent, with a top-down flow of decisions, and at other times it might be the public to press on the politicians, with a bottom-up flow of requests, to ask for these measures. In the experience of other parts of the Mediterranean Sea, it is tenuous to enforce protection measures if the general public (and the stakeholders in general) is not culturally ready to embrace a life style that translates into concrete action the widespread concern about the state of the environment.

Cultural changes might occur rather rapidly if proper outreach strategies are accomplished. In the recent past, whales were considered as monsters (Moby Dick) and now they are considered as something to protect at any cost.

The first and most stringent measure, thus, is to modify our culture. The ecosystem approach, asking for inserting humans in the ecosystem, is implicitly asking this. We have to insert the humans in the ecosystem and we have also to insert the ecosystem in human culture.

6.2. 6.2. Urgent actions

Some reports provide a detailed list of specific actions to protect sites or species in the national territory; other reports (or other parts of the same reports) list generic measures that just repeat the previously listed priority needs. The problem is that the state of the environment is not so well known to lead to the identification of specific actions, besides the most obvious ones. Furthermore, due to the scant knowledge of species, habitats, and ecosystem functioning, the choice of what is urgent might be based on contingencies that lead to give high-priority to simply what is known, with lack of action about issues that might be even more important but that are still poorly known.

Action, in this framework, should be based on knowledge and not on scattered information about a limited number of issues.

From what I grasped from these reports, irrational coastal development and overexploitation of natural resources are the main problem in this part of the Mediterranean. It is true, however, that the natural heritage of many of these countries is rather high and that the presence of flagship species such as marine turtles and seals is an evident sign of the presence of “pristine” environments.

On the one hand, it is urgent that these environments are preserved. On the other hand, it is urgent to limit the degradation of heavily populated areas. Some countries cannot afford to avoid overpopulation since very large towns are deeply affecting the environment and it is impossible to ask for their dismantlement, but some other countries are developing uncontrolled urbanization due to the building of leisure houses that are not essential for the residential needs of the population. These houses are built in the most beautiful places (condemning them to ugliness) and are used for a few weeks per year. This pattern of urban development occurred already in many parts of the western Mediterranean, and it is crucial to treasure this bad experience so not to repeat it where the natural capital is still very rich.

7. FUNDING PROBLEMS AND OPPORTUNITIES

The following two sentences, extracted from two reports, well exemplify the situation in this part of the Eastern Mediterranean:

« There is little regular national source for monitoring yet for the marine biological diversity and climate change and impacts of this phenomenon. »

« The impacts of Climate Change on Ecosystems and on the socio-economic system

are going to be inequitable. Developed industrial nations have contributed more to

Climate Change than the developing countries and yet, the impacts will be more severe on the latter. There is a moral, ethical, dimension to be addressed and translated in terms of technical and financial assistance. »

Being a member of the European Union, Greece is in a better situation in respect to other countries in terms of funding opportunities, even though also the other countries of the basin are entitled to participate to EU programs.

RAC/SPA, IUCN, WWF, the World Bank and other international organizations, governmental, intergovernmental or nongovernmental, sometimes issue programmes of environmental relevance, but these are episodical and non coordinated. There are bilateral programs that encourage scientific collaboration among countries. For instance, Italy and Israel do have programs that involve exchange of scientists and common work in the field. All actions, however, are not responding to a single and well designed strategy, but answer to contingent urgencies (e.g., save the seals, save the sea turtles, halt the aliens).

During economic crises, furthermore, the first cuts affect environmental protection and research.

Private donors are very rare or, if they are available, they are not known.

The bureaucratic impediment is extremely heavy also in this part of the Mediterranean area, as in any other part of the basin (and also elsewhere). It might happen, thus, that money is made available and that the scientists or organizations that might benefit from it do not even apply for getting it due to the overly complicate procedures that are required to ask for it.

Researchers are asked to become bureaucrats and some are very successful in doing so, with the risk that, to acquire this skill, they tend to lose the expertise that should characterize them as good scientists.

8. CONCLUSIONS AND RECOMMENDATIONS

The following section stems from the corresponding parts of the reports and from personal experience.

8.1. Conclusions

All reports were very well written and covered in detail the available information about each Country.

Even if most aspects were lacking high quality information, important key features were evidenced.

All reports denoted profound awareness of the limits characterizing our knowledge about marine and coastal life and the authors proposed right remedies to fill these gaps.

All this means ability of self-evaluation, gap identification and proposal of remedies to these gaps, so to increase the level of awareness of environmental features and of the pressures on them, leading to effective coastal management, based on the ecosystem approach.

Some countries enjoyed long periods of huge financial support from the EU (especially Greece, but also Turkey and Israel). This led to prodigious advancements in the building of both expertise and research infrastructures. This large investment is giving its fruits especially in the recent years.

As chair of two CIESM committees within a period of 12 years, I have witnessed an impressive rise in the quality of the presences of these Countries to CIESM big meetings and focused workshops. Some Countries are deeply nested in international collaboration (i.e. Greece, Turkey, Israel), whereas others are often underrepresented in both scientific journals and in international projects (i.e. Syria, Lebanon and, to a lesser extent, Egypt). It is suggestive that the higher the investments in research, the faster the development is.

The presence in international projects, and the participation to international congresses, is crucial to amalgamate the area, bring internationality in the local scientific community, and obtain precious expertise to tackle environmental problems of each country.

8.2. Recommendations

Revive taxonomy. Taxonomy is disappearing in all these countries and, for many groups, it was never developed. Capacity building in taxonomy is a priority if biodiversity is considered as an important issue. It is unwise to plan to protect biodiversity while destroying the expertise that is necessary for its basic evaluation.

The only way to relaunch a discipline is to make money available for the results that it can provide. Contrary to all expectations, the expertise in taxonomy is becoming extinct in a period in which funding agencies are investing a lot in the study of biodiversity. Evidently these funds are not being used to study biodiversity, in spite of their destination. It is crucial, then, to control if money is really employed for the scopes it was made available.

The financing of regional species lists (including NIS), and of monographs for all the major groups will provide a strong impulse to the development of taxonomy. If Institutes become aware that taxonomy is attracting research funds, they will be induced to hiring taxonomists. So far, all measures to revive taxonomy have been unsuccessful. The request for the revival of taxonomy is being made in every report and in every recommendation, but then it is never satisfied, in spite of fund availability. I want to stress once more that, evidently, there is a mismatch between the objectives of funding and the obtained results.

Map habitats. Terrestrial habitats have been mapped in many states and this result is easily obtained due to the modern techniques employing satellites. The bottom of the sea cannot be studied by satellites, and the mapping of benthic habitats requires much more work in the sea than on land. The availability of a list of habitat types is an important step towards the fulfilment of this requirement. The available lists still need some refinement, but this will require a small investment since most of the work is done.

Funds must be made available for the mapping of both benthic (including the deep sea) and open water habitats, with GIS-based approaches. This is extremely important for the protection of biodiversity through Marine Protected Areas and for any other initiative aimed at the management of biodiversity (e.g. fisheries management and ICZM). The knowledge of habitat distribution is then to be matched with the knowledge of species distribution.

Link biodiversity to ecosystem functioning. The knowledge of the structure of biodiversity (in terms of both species and habitats) must be linked to the way ecosystems function. This is not an easy task and the link is not clear to the whole scientific community. Some species are obviously important for ecosystem functioning, for instance the species that have important roles for the definition of habitats (i.e., permanent and temporary habitat formers, such as coralligenous formations, or seasonal algae and animals), whereas others have important functional roles that are not linked to their abundance (e.g. keystone species).

The disentangling of the relationships between biodiversity and ecosystem functioning requires long and complex experimental work which is being carried out by the scientific community at large.

Identify trends, and their causes. Many descriptors of biodiversity (from species composition to habitat and species distribution) vary with time and the reconstruction of the history of biota is a stringent priority for the identification of trends.

This will be possible when careful time series will be carried out, with long periods of monitoring (and of observation) of the state of biodiversity. This activity is not being accomplished for almost any descriptor of biodiversity, with some outstanding exception. Fisheries statistics, for example, allow to reconstruct the history of fish populations. The reports, however, denounce high rates of illegal fisheries, and the statistics might not be a faithful representation of the actual trends. The perception is almost invariably towards a decrease of the yields of fisheries, compensated by increases in fishing efforts. Fish populations, thus, are declining, at least for the indigenous species.

NIS are providing precious resources to local fisheries, so a parallel trend to the decline of fisheries of indigenous species, is the increase in yields of NIS fisheries. In general, NIS are increasing their presences, and this is a very definite trend.

A trend towards an increase in jellyfish presences, also in impressive swarms, is parallel to the trend in fish depletion.

Another important trend is the degradation and fragmentation of habitats, with the outstanding example of the disappearance of *Posidonia* meadows in the Easternmost corner of the Mediterranean Sea.

Coastal erosion is on the increase, with a clear tendency towards a retreat of the coastline, with important losses for human activities.

The causes of all these trends are not easily detected, even if many reports attempt at ascribing the observed patterns to definite processes. The problem of multiple stressors, however, makes it difficult to understand what are the real drivers of the changes that are affecting the Mediterranean. Some drivers might be global (e.g. global warming, sea acidification, sea level rise) others might be local (e.g. coastal development, overfishing, pollution).

Of course, management is required so to mitigate negative trends but, before doing so, the real causes for them must be singled out, otherwise the measures will be uneffective.

The application of the Ecosystem Approach and of Integrated Coastal Zone Management will be crucial in order to enforce effective management practices, but this will require a big investment in both basic and applied research. Applying sound principles (e.g. the ecosystem approach) to insufficiently known situations might lead to mismanagement.

A key principle, in addition to the ecosystem approach, should be that of knowledge-based approach. Information is very often confused with knowledge.

Depict scenarios. The knowledge of the present state of ecosystems and the comparison with past states (the history of the ecosystems), with the identification of trends and of their causes will allow inference about the future of ecosystems. Since ecological systems are non-linear due to their historical nature, it is tenuous to try to predict future history with precision (i.e. with algorithms). It is however possible to depict scenarios of future possible states of Mediterranean ecosystems, such as the following ones:

tropicalization **-** the establishment of species of warm water affinity (hence tropical) is radically changing the biota. This is already very evident at species level, but chances are good that these species will start to form different communities, and will change ecosystem functioning. How species will assemble, however, is very difficult to say.

meridionalization **-** the species that usually thrived on the southern part of the basin are expanding northwards, adding to the tropical contingent in changing northern biota.

impairment of cold water engines **-** The Eastern Mediterranean Transient (not covered in the reports from this part of the Mediterranean) showed that the Northern Adriatic can stop to play its role of originator of deep waters for the Eastern Mediterranean basin. This role was luckily taken by the Northern Aegean (an area included in the Mediterranean sector considered in this report). If global warming will increase, and these phenomena will occur in the three sites of deep-water formation, what will be the outcome? A worst scenario suggests permanent stratification, with widespread anoxia in the deeper portions of the whole basin.

extinction of cold water species **-** the species endemic to the areas of the “cold engines” will be pushed in deeper waters or, when this is not possible (i.e., the Northern Adriatic) they will become extinct. This prediction, however, might not occur if some species evolve and become adapted to the new conditions, as is possibly happening for the Northern Adriatic endemic *Fucus virsoides* which, instead of disappearing due to higher temperatures, is now particularly abundant. Also the non-tropical ctenophore *Mnemiopsis leidyi* recently arrived to the Easternmost (and warmer) part of the Mediterranean sea, showing a potential for adaptation at non-optimal conditions of early colonizers. Some temperate species, such as sea fans, are experiencing mass mortalities due to the deepening of the summer thermocline.

less fish, more jellyfish **-** the fish-jellyfish transition is becoming evident at a world scale, and it is particularly dramatic in the Mediterranean, where tourism and fisheries are very developed. Fisheries are heavily affected by jellyfish blooms, but chances are good that overfishing is one of the causes of gelatinous plankton outbreaks. Since jellyfish are beautiful, and very few species are really dangerous, we must learn to cope with them, since in other parts of the world (e.g., Palau) they are touristic attractions. Whereas, in other parts of the world (e.g., China) they are delicacies.

habitat destruction **-** economy wants all its indicators to rise, with the expectation of infinite growth. This hope is infantile: since the world is finite, infinite growth is an illusion. Our growth occurs at the expenses of the rest of Nature, and the destruction of habitats is the most dramatic outcome of this trend.

Create networks. There are no countries that express a scientific community able to explore and study biodiversity in a completely autonomous way. And it would be unwise to attempt at creating such expertise in every country, since the diversity of the approaches is probably unbearable by the small funding that is traditionally allocated to these enterprises. The only way to solve this problem is to create networks, so to merge the available expertise in more than one state and to build on it the filling of knowledge gaps, by a serious policy of capacity building.

Such networks need a well defined architecture, with a careful identification of roles that must be played by the members. The word “excellence” is often used to define such networks, and this stems from a terminology adopted by the European Union. Excellence, however, is often self-referential and is not based on actual measurements of the performances of the so-called “excellent” members.

If such networks are aimed at increasing our knowledge so to advise management, the label of excellence should be appointed upon measurements in terms of contributions to the increase of knowledge generated by the members of the network, and also by the relevance that this increase has gained in the international scientific community. The status of “excellent”, thus, must stem from a substantial scientific production in peer-reviewed journals (the repositories of new knowledge) and by other measurements of scientific production.

The credentials of the experts must be checked very carefully.

Each country, thus, must incentivate own scientists to improve their scientific performances, not only in terms of what is done but also in terms of how it is spread throughout the scientific community.

Courses in scientific publishing, agreements with peer-reviewed journals, and similar initiatives might lead to rapid improvement of local scientific communities.

Access to internet-based libraries is crucial for the advancement of science in countries that do not possess huge scientific libraries on biodiversity.

The implementation of networks of scientists will surely foster collaboration among countries that have historical difficulties in relating to each other.

The problem of environmental integrity knows no political boundaries and cannot be tackled with fragmented actions.

Link science with politics - Increase public awareness. Decisions about how to manage the environment must be taken by informed politicians, and the information they need is provided by the scientific community. Scientists are saying since a very long time that building houses and infrastructures directly on the shore will lead to coastal erosion and to great management problems. Scientists are saying since a very long time that overfishing is a problem and that fish stocks are going to be depleted. Scientists are launching signals but they are usually unheard. Politicians often do support the scientists that tell them what they want to hear, and this game is played in far too many countries. Politicians are interested in short-term results and disregard the long-term. Sort-term solutions, however, often do end up in long-term problems that will be tackled with a short-term attitude, in a vicious circle of unwise decisions.

This attitude is becoming unbearable by the planet as a whole, and also by the Eastern Mediterranean.

A cultural evolution is badly needed and this evolution cannot take place if the public at large do not understand that preserving the environment is preserving ourselves.

This cultural change is the prerequisite to any policy aimed at implementing a plethora of treatises and conventions that are a bureucratic response to a problem that requires strong pragmatism. Treaties and conventions will become effective when politicians, and the people, will have understood the importance of respecting them.

9. LIST OF REFERENCES

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