MARBENA

# Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring'

## 6 to 24 September 2004

## Summary of discussions

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National Institute of Biology; Marine Biological Station Piran (NIB)

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# [*]Welcome and introduction

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Dear Friends and Colleagues

This is already the seventh E-conference from MARBENA and a very special one indeed. Whereas previously the electronic conferences were held in preparation of the half yearly meetings of the European Platform for Biodiversity Research and Strategy, this one is in preparation of a workshop that will be held in Slovenia in October. In this workshop we will discuss the possibilities, opportunities and problems of networking marine biodiversity research beyond the borders of the European Union.

The southern and eastern Mediterranean and the Black Sea are biologically extremely interesting and they are of great economic importance to the countries bordering them. Microbes, plants and animals do not respect borders and many problems dealing with their ecology, exploitation and conservation cannot be tackled in a national context. Although the Med and Black Sea form geographical units, the administrative and political situation is very complex and there are many obstacles, political ones and the traditional gap between the north and the south, that are hindering the fruitful cooperation of scientists and other stakeholders in the regions involved.

Organisations such as CIESM and UNEP have played an extremely important role in the Mediterranean area but the link with the European Union has not always been very strong. MARBENA is an infrastructure project from the Fifth Framework Programme of the EU and has as its principal objective to network biodiversity research and infrastructures. From the beginning the participants in the project have made it one of their key objectives to extend this networking to all countries where there is an interest.

MARBENA is not an organisation but a project from and for scientists and its objectives are simple. We believe that marine biodiversity is an important issue and that it is in the common interest of the people and countries in and outside the European Union that it is dealt with in a constructive and effective way. We believe that networks of professional scientists are an important means to reach that goal. Networks need time to be built, but one has to start somewhere. MARBENA can help with that.

Dear Colleagues. It is my sincere hope that MARBENA gets a strong response from you on what you consider important, what you think is the way forward and where we can get around the difficulties. Please let your voice be heard.

Prof. Carlo Heip, General Coordinator

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# Session 1: Eastern and Southern Mediterranean

# [*]Introduction to Topic 1.1: The role of top predators (incl. gelatinous organisms) and large nekton (incl. whales & dolphins, seals, sharks, turtles) in biodiversity

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Unlike to most other disciplines, in biological sciences, there are only a few scientific "theories" which are not contradicted with variable number of (not necessarily exceptional) cases. This is also valid with "The role of top predators on biodiversity". Even in the case of the impact of the "super-predator" (i.e. the man), we cannot say its role on biodiversity is always negative. It is true that, overall, human accelerated the rate of extinctions (e.g. 100 times for mammals compared to background levels of 0.5 extinctions per 100 years, Barbault et al. 1995), but it increased also biodiversity in many parts of the world with introductions. For example the number of introduced mammals is close to the native ones in Britain. Focusing on our region, the number of introduced species known is quite high (i.e. 146) for the Aegean, Marmara, Black, Azov and Caspian Seas (Zaitsev & Ozturk 2001). In the case of Levantine Sea, this number could be even higher due to the Lessepsian migration since the man opened Suez canal in 1869 causing Indo-Pacific species to settle in the eastern Mediterranean. Fifty-seven fish species alone, denoting about 10% in the entire Mediterranean are Lessepsian migrants here (Golani et al 2002). Some of these species, such as the lizardfish *Saurida undosquamis* are now often dominant in trawl catches providing a good income to the fishery sector. Based on the increased number of species diversity (as well as economical income), CAN WE SUGGEST THAT THE "SUPER-PREDATOR, MAN" IS INCREASING THE BIODIVERSITY (and economical income) IN THE EASTERN MEDITERRANEAN ?

Regarding the effect of removal of native predators from the trophic network, there could be two options which are both observed in nature. In certain ecosystems particularly for those with high biodiversity, the removal of predator may not have any apparent effect (i.e. redundancy hypothesis). However, in many cases removal of predation will decrease the bioversity (note that there is no case of predator removal increasing the biodiversity!). With the pioneering study of Paine (1969) in the intertidal shores of the northwestern America, the role of predation in maintaining the biodiversity is clearly understood, at least for some marine ecosystems. Paine removed the starfish (the top-predator) from the system and observed that the number of prey species collapsed from 15 to eight, and a single species, a mussel, covered almost all the experimental site. The starfish was thus a "keystone species" for this ecosystem. Unfortunately, similar studies are lacking with respect to gelatinous organisms and large nekton in the world seas.

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So we cannot clearly validate the importance of these top predators on the ecosystems of the eastern Mediterranean. Until now, no study looked at the problem of, for example overexploitation of mammals and sharks, with respect to its cascading biodiversity effects along the trophic levels. Here is a targeted question: DO WE EVEN KNOW WHICH METHODS TO USE TO UNDERSTAND THE ROLE OF THESE TOP PREDATORS ON BIODIVERSITY? For example, could a comparison of long term data on whale and dolphin landings (which was particularly low during the Second World War) with respective species diversity data (if present) from different ecosystems in the eastern Mediterranean give us the first evidences on this problem? What about the role of the Monk Seal on biodiversity which disappeared from the Black Sea entirely by the 1980s and only several tens left in the Levantine today? Based on studies of model communities, Pimm (1986) suggests that species-rich communities are more sensitive to the loss of top predators. Does this mean, the Aegean Sea, being one of the highest diversity in the eastern Mediterranean basin, has been effected worst (for biodiversity) from the continual decrease numbers of top predators from the ecosystem, say compared to the Black Sea?

Among the top predators, while cetaceans and sea turtles are protected and the bony fish fishery is partially regulated in the Mediterranean. Very few countries (Italy, Malta) have specific (but not strictly obeyed!) laws for shark protection, and the species protected by these laws are only the white shark (*Carcharodon carcharias*) and the basking shark (*Cetorhinus maximus*). We should stress that protection only from targeted fishery does not mean a real protection and therefore due to other reasons (habitat loss, pollution, bycatch etc), the population size of all these large nekton are decreasing. Once upon a time, due to natural mortality, the carcase of these large animals were the food of several bacteria (some of which are sulphur-reducing chemosynthetic) and animals on the sea bottom. Now, we could only speculate about this biota that their species diversity must have been affected badly.

The role of introduced top predators on biodiversity is also subject of debate. Pimm (1986) suggests that species-rich communities are more resistant to invasions and hence invasive predators may not have apparent functional role on ecosystem dynamics. Barbault (1995) extrapolates Pimm's findings suggesting temperate biomes (with lower species richness) should be more susceptible to invasions. The ctenophore invasions occurred in the eastern Mediterranean and the Caspian Sea provides us extremely valuable information to produce theoretical generalisations on the ongoing debate. As it is known, the ctenophore *Mnemiopsis leidyi* was transported via ballast waters from the northwestern Atlantic to the Black Sea where caused an unprecedented havoc in the pelagic ecosystem causing a dramatic decrease in fish catches and hence fishery economy (for a summary see Kideys 2002 - #18 at http://www.ims.metu.edu.tr/cv/kideys/Publ.htm#rij). During its peak periods of development, several zooplankton species noted to be either very low in abundance or even disappeared (Kideys 2000). For example there were 11 common copepod species in the Sevastopol Bay in 1976 but only six during 1990. Although pollution (as well as eutrophication) was blamed for the disappearances, *M. leidyi* might have also a contribution in this event. After this ctenophore accidentally transported to the Caspian in late 1990s, its adverse impact on the biodiversity in this new environment was a clear-cut case: intense monitoring data (unpublished data of A.E. Kideys, R. Abolghaseem and S. Bagheri) revealed that during 2000 and 2001, a mere of four species belonging to copepods and cladocerans occurred in the samples compared to a total of 29 taxa in previous years! Its effect on benthic biodiversity is also unprecedented (Hashimian, unpublished data). Based on some other components too, it appears that the Caspian Sea is even much worst affected than the Black Sea. So, in this case there seems a good correlation with the species-richness and impact of the invasive top predator. The biodiversity is lower in the Caspian (542 free-living metazoan spp) compared to the Black Sea (1729 spp). Although *M leidyi* was also transported to the Levantine and the Aegean Sea, no adverse effect was observed in these areas with higher species richness. Based on the eastern Mediterranean experience, however, we can suggest a new generalisation:

ANOTHER MOST IMPORTANT FACTOR ABOUT THE SENSITIVITY TO INVASIVES, MUST BE THE IMMUNITY OF A SYSTEM. THE MORE IT IS EXPOSED TO THE INVADER (OR INVADER-LIKE), THE MORE THE SYSTEM GAINES IMMUNITY (Any opposition?). With respect to Caspian, it has no connection to world oceans and hence no immunity to several marine species withstanding low salinity (14‰) which could be transported only by man.

We would like to finish our discussion with the controversial subject of biocontrol. After *M. leidyi* another ctenophore, *Beroe ovata* accidentally transported to the Black Sea, apparently from the northwest Atlantic (Bayha 2004). The impact of this predatory ctenophore (feeding on *M. leidyi*) has been very positive for the Black Sea ecosystem (see Kideys 2002 as given above). Several copepod species disappeared are now again present in the samples, higher biomass of zooplankton, higher pelagic fish catches, etc. *B. ovata* exclusively feeds on ctenophores (the only other ctenophore species in the Black Sea is the *Pleurobrachia rhodopis* which is more restricted to deeper waters). In the Caspian there are no other ctenophores except *M. leidyi*. We tested *B. ovata* if it would feed on some other potential organisms which was not the case. Our results show that *B. ovata* could be an ecosystem-saving agent in the Caspian Sea (Kideys et al. 2004) for fishery but more importantly for its valuable biodiversity (most of which are endemics) which is at risk. Based on our several years of laboratory experiments, natural experiment results from the Black Sea and huge literature information, we see further risk to the Caspian ecosystem extremely low (in the world there is no action carrying zero risk!). Biocontrol, including use of alien species, is a method used extensively in agriculture, but so far no successful (or unsuccessful) example exists for the marine environment. There are several bad experiences with introduction of new species to aquatic environments, making many scientists not only sceptical but against any such action. So far hundreds species intentionally introduced to these ecosystems, and in no case, scientific background was, as well established as in *B. ovata*. We cannot say there is zero risk from *B. ovata*, but we can say that the native biodiversity (most of which are endemics) will greatly benefit from such introduction. Our scientific ethics necessitates such action to save biodiversity (as well as economical problems of the fishery sector). We believe that scientists should not always be observant, but actively guide the managers responsible for action. AT DELAYED OR NO ACTION, IF SOME ENDEMIC COPEPODS OR CLADOCERANS ARE BEING LOST FOREVER FROM THE ECOSYSTEM, WHO SHOULD WE BLAME FOR?

# [*]Introduction to Topic 1.2: Monitoring studies on marine biodiversity in the Mediterranean, with special reference to Southern and Eastern countries

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In a general way one can say that marine biodiversity in the Mediterranean has never been well studied and in several domains data are lacking. Obviously the situation is different in each country and in function of the available means in each of the countries and this for what the standard for the equipment is concerned as for the financial resources and the competences. This situation, being a large handicap for preservation programmes and sustainable management of living marine resources is rather explicit for the southern and eastern Mediterranean.

In countries were fishery has national economic importance, the species with importance to the fishery industry have been studied in terms of biology and stocks. Often these studies are mono-specific and do not integrate ecological dimension and species interaction with its ecosystem.
To convince decision makers in the southern and eastern countries of the Mediterranean to attach more importance to programmes studying and following up marine biodiversity, it is necessary to explain the necessity and importance of these programmes. There is, of course, the scientific interest, but this is largely insufficient to convince decision makers. These last one have to counter the social and economical development interests of their country and therefore do not attach any importance to follow-up programmes on marine biodiversity except when they can be convinced that these programmes can contribute to the countries development. The participants to this conference are invited to argument on this subject preferably supported by examples showing how follow-up on biodiversity can contribute to the economical and social development and its sustainability.

The lack of financial and human means is not the only reason why we have gaps in study and follow-up on marine biodiversity on the level of southern and eastern countries of the Mediterranean. The lack of exchange and coordination between scientists is another factor often cited amongst the handicaps for the development of coordination in study and follow-up programmes on marine biodiversity in our region. It is true that the political context in the southern and eastern Mediterranean, characterised by conflicts and crises between certain countries is of no help to get a system of collaboration and coordination for the study of marine biodiversity installed. Some international organisations (CIESM, PAM, FAO, IUCN, ACCOBAMS, WWF) managed to install joint programs with the collaboration of several countries but these initiatives are limited and do not assure sufficient coordination and collaboration. Moreover, thanks to European programs it has been possible to launch several research and follow-up programs on marine biodiversity in the Mediterranean conducted with the participation of scientist from several countries in the region. Nevertheless opportunities for collaboration and exchange between specialists on Mediterranean marine biodiversity are rare and occasional. In the Mediterranean

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there is an urgent need to install mechanisms in order to assure more exchange and especially more coordination for what the study of marine biodiversity is concerned. There is no need to create new structures or organisations but only to be able to rely on the existing organisations. The question is: which types of mechanisms do we need (thematic networks, regional study programmes, etc.)?
At several occasions the question of standardisation of methods for study and follow-up of marine biodiversity has arisen. In other domains such as supervision of pollution, it has been necessary to standardise sampling and analysing methods in order to be able to compare the results of the different laboratories participating in PAM's surveillance programme MEDPOL.

- Is it necessary, see desired to standardise study of follow-up methods on marine biodiversity in the Mediterranean?
- Do we need to standardise sampling methods, return of results (cartography, etc.)?

One of the most difficult points in treating matters such as study and follow-up of marine biodiversity is the one of setting priorities. Several scientists are of the opinion that it is not necessary to determine priorities and that some themes are no more important than others. At the same time, we unfortunately have to accept that due to a lack of means it is impossible to treat all themes. Therefore, it would be wise to concentrate on certain priorities rather than disperse the available means. Do we need to give way to the study of marine biodiversity in the southern and eastern Mediterranean? This aspect is worthwhile being discussed by the participants of the conference who are invited to express their points of view on this subject and to propose themes that, in their eyes, are priorities.

Next to the priority question it is worthwhile to question the feasibility: technical, financial and organisational feasibility. For example, this is the case for deep sea ecosystems or pelagic zones situated far off-shore. None of the southern and eastern Mediterranean countries have developed, to a certain extent, a programme to study biodiversity in zones reaching further than its national jurisdiction borders. A recent, nearly finalised, study by IUCN and WWF takes stock of the biodiversity in the deep ecosystems of the Mediterranean and maps the lack of information for several of these habitats. But the study and monitoring of biodiversity in the deep Mediterranean zones and in areas far from the coast is not within the range of all countries in the region, not in financial means nor regarding the available competences. Taking into account these difficulties and the specific legal status of the high sea areas wouldn't it be wise to consider biodiversity studies and monitoring in the framework of common regional or sub-regional programs, with the participation of scientists from all concerning countries?

One needs to stress that several other themes benefit when being studied in the framework of regional and/or sub-regional programs. This is the case for example for the exotic species. Indeed the invasion of non-native species in the Mediterranean is an expanding phenomenon especially in the eastern part of the Mediterranean. This theme, which will be thoroughly discussed in session 2 of this conference, has taken such proportions that it is now mandatory to be undertaken in a coordinated way between scientists from the different countries in the region. A solution to another problem: the lack of taxonomists, can only be found in the framework of a common program between several countries in the region. It is now clear that the taxonomist of the marine environment is a "species threatened with extinction" in the Mediterranean countries. But taxonomy is an indispensable tool to conduct programs for the study and monitoring of marine biodiversity. Taxonomy is also such a ramified science that countries even cannot hope to have specialists in all domains. Again, the only way to fill this enormous gap is to treat it in a framework programme coordinated between several countries.

# [*]Introduction to Topic 1.3: Historical data sets and grey literature: the value of 'real' data and the need for quality control

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The importance of having chronological data series at hand does not need to be demonstrated. This aspect of biodiversity knowledge is a key element in the plans for ecological surveys and is even more relevant to every prospective study on the evolution of medium- and long-term trends in marine population and community structures and consequently for the quality of the environment. Good management of the coastal marine area and its living resources largely depends on the quality of the data and the available knowledge.

The findings from studies and research conducted between 1950 and 2000 has allowed a better understanding of the organisation of so called "stable" populations. This issue seems to be even more sensitive for certain countries in the eastern Mediterranean basin (*e.g.* Syria) which, unfortunately, started very late to investigate and study marine biodiversity along their coasts. On the other hand, in Syria, great efforts are now exerted to monitor and assess the actual state of marine communities and to detect the impacts of human activities on the marine environment. Documentation and exploitation of these "accumulated" results is desired and necessary. Most of these results are hidden at the regional level, since the authors use the Arabic language in their publications, while there is the need and priority to publish them in English. Furthermore, cooperation between the specialists is required to put in place a larger data-base. It is also important to maintain periodicity in documenting these data in order to have a more accurate perspective on the new impacts of man on the environment due to new activities and the use of a wider variety of products for agricultural exploitations. This information is even more valuable for the southern and eastern Mediterranean countries which often lack sufficient control and supervision over marine and coastal activities. Regional planning would be a good moving force to update the marine and coastal data. All MEDSTAT, MEDAR-MEDATLAS initiatives, as well as databases and GIS systems that were introduced, should be rethought with regards to this approach.

The availability of long-term data on an important coast implies that the required competences, exploration means, data sampling and treatments are at one's disposal, but this is not always the case. To this end, the institutional framework needs to be adapted together with a clear and voluntarist ecological policy with planned actions and priorities.

To make the environmental planning in the Mediterranean successful, it firstly has to be integrated in a regional development plan, encouraging and aiming for the highest level of integration in existing surveillance networks. Secondly, it needs to systematically promote sub-regional

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initiatives and introduce small networks in order to create a standardising methodology and approach. Networks related to *Posidonia oceanica* seagrass meadows, marine phanerogams, macrozoobenthic bio-indicators of soft bottom sediments, invasive species and toxic algae, ballast waters and bio-accumulation would benefit enormously from extension to the southern and eastern Mediterranean. At the moment, the search for means and financing necessary for this integration would become a priority.

Assurance of sustainability of surveillance plans would guarantee the chronological data required to control environmental quality. In this respect, new coordinating mechanisms aiming to reach the requested objectives in environmental performance in general, and in the coastal marine domain in particular, need to be invented. This progress will have the advantage of regaining control on critical processes, which produce a rapid degradation of the Mediterranean coastal marine ecosystems.

# [*]Introduction to Topic 1.4: New techniques, tools and approaches to study marine biodiversity at the regional (Mediterranean) scale

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During the past few decades knowledge of marine fauna and flora and other aspects of marine biodiversity in the Mediterranean substantially increased. This increase may be attributed to several factors, however an increase in the research effort and the use of newer techniques seem to be the most important. Researchers began to study marine biodiversity in vivo, e.g. in the natural environment, with the aid of SCUBA equipment. New techniques and tools, associated with SCUBA diving (visual census, underwater filming, use of narcotics, etc.) allowed the exploration of otherwise inaccessible habitats (Quignard & Tomasini, 2000).

The use of SCUBA techniques revealed that the infrequent capture of small fish in the past using traditional fishing gear is not always an indication of true numerical rarity in the ecosystem. By the use of such methods new species of gobiids were discovered over the last thirty years, such as *Speleogobius trigloides*, *Didogobius schlieweni* and *Gobius kolombatovici*, all in the Northern Adriatic area (see works of Miller, Kovačić, Ahnelt, Patzner, Zander & Jelinek and others). Most new recordings made using these newer techniques are of the cryptobenthic fishes, those that always live inside burrows (such as caves, cavities, holes, clefts) or below cover (stones, boulders, shells) and are therefore not visible from above. Recently adopted techniques, such as visual census, non- destructive diving (for example Harmelin-Vivien & Francour, 1992), and the use of narcotizers, enabled the recording of some apparently "rare" benthic fish species in the Mediterranean. However, only a small number of institutes are currently using these techniques.
Nowadays, potential deleterious impacts on investigated ecosystems make the use of traditional sampling techniques and approaches unsuitable or even unacceptable for intensive studies of fish assemblages, and also for other aspects of marine biodiversity.

With the increasing number of marine protected areas in the Mediterranean, traditional fishing devices –prohibited in protected zones – could easily be supplanted by visual count methods.
When research indicates that traditional techniques as mentioned above can take us no further, then DNA taxonomy and associated molecular tools might be the only way to reveal the true level of biodiversity (Proudlove & Wood, 2003). Moreover, the study of biodiversity using genetic tools without previous detailed studies of systematic, biogeography and taxonomy will not accumulate much new knowledge.

An array of techniques and genetic markers are now available to study biodiversity at different levels of biological organization (Féral, 2002) and new tools and approaches will continue to emerge. One of such tools are markers linked with quantitative trait loci (QTL) in an individual, which enable us to assess ecologically important traits.

[*] Please refer to this section as:

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Molecular markers have been successfully employed in studies of biodiversity in the Mediterranean, some of them focused on a wider area and others to more restricted areas. Their use has probably been most frequent in analysing the biodiversity of commercially important fish species. Fragmentation of sea bass population (Patarnello et al. 1993, Garcia de Leon et al. 1997, Bahri-Sfar et al. 2000) and subpopulations of anchovies (Bembo et al. 1995, 1996) and sardines in the Adriatic and Ionian sea (after Hauser and Ward 1998, Carvalho et al. 1994) are examples. Recently, the genetic structure of geographic samples of *Loligo vulgaris* and *Sepia officinalis* shared stocks in the Adriatic Sea were revealed (Garoia et al., 2004 in press) and more studies are ongoing for different species. There are also numberless species of tiny and morphologically simple organisms whose identity and biodiversity could be revealed only by using molecular genetic tools (Pace, 1997).

The decision to use molecular tools and genetic markers depends on the research problem. Each of those techniques has advantages and also weaknesses such as high cost, training staff, sophisticated equipment etc.. To overcome these obstacles concerted action is necessary to share knowledge, costs and sampling facilities. Example of this is the project AdriaMed, whose principal aims are to promote scientific cooperation among Adriatic countries and to improve the management of fishing resources and activities (AdriaMed, 2000). During this program, sharing knowledge was the top priority and after gaining knowledge and acquiring appropriate equipment, work on molecular markers proceeded. Microsatellite markers were isolated from several economically important species, which are on a priority list of shared stocks. The program also shares sampling facilities and countries around the Adriatic basin (Albania, Croatia, Italy and Slovenia) have participated from the very beginning in sampling and in the laboratory work.

Questions:

1. At what level of biological organization we need to assess biodiversity and at which level is assessment of biodiversity more informative?
2. Which genetic markers are most appropriate for each biological level of organization?
3. On which species should we focus our attention (commercially exploited, endangered indicator species, species important in ecosystem functioning
4. How could we sensible incorporate new tools and approaches in the research and monitoring of biodiversity?
5. How should we design concerted action in biodiversity assessment and sensible incorporate new tools and approaches (non-destructive methods, SCUBA mapping & monitoring, genetic markers)?

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# [*]Introduction to Topic 1.5: Do we need a revision of our biodiversity research agenda?

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The perception of biodiversity started with the question how many species are there on earth? (thus focusing on species) and then headed towards larger (habitat) and smaller (genes) perspectives.
Many projects aim at making an inventory of all species on a global scale but this objective is still very far from being reached. Species lists should be the result of thorough taxonomic revisions, with the cleaning up of synonymies and the description of new species. This objective is not feasible over the short term and requires well-trained taxonomists. This is the strategy envisaged by the Partnership for Enhancement of Expertise in Taxonomy (PEET). An inventory of all species and of their distribution will be complete (if we will invest proper funds) in several decades. We cannot wait that long for the conservation and management of biodiversity. Habitat loss is the main problem to face in order to preserve biodiversity. This has been understood by the European Community that issued the Habitat directive. The definition of habitat, however, is still rather vague (sometimes habitats are physical entities, e.g. fine sand, at other times they are communities, e.g. sea grasses) and, furthermore, the diversity of marine habitats has not been formalised unambiguously on a European scale.

The first target of a biodiversity agenda might be a list of habitat types which is agreed upon by all specialists, involving both ecologists and taxonomists. The second target is to map the distribution of these habitats. Then we must compile accurate species lists for each habitat and its community(ies). Such species lists should be derived from both original and literature-based research. Each habitat type, using this sort of information, would become a hypothesis: if a given habitat type occurs, then a set of species should be found. Of course, not all species can be found at the same station, but it is reasonable that an accurate sampling should yield a relevant number of the expected species.

**The historical biodiversity index (HBI)**
The ratio between the species that have been found via sampling and the species that should be found, based on previous knowledge, testifies the state of a given habitat and of the community inhabiting it.

HBI = realised biodiversity/potential biodiversity

If the sample yields all the species that have been previously found in that habitat type, then the value of the index is 1, and if no species are found, then the value of the index is 0. If there are new species, unrecorded previously from that particular habitat type, then we can try to understand if

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they are simply rare species that suddenly became abundant (having always been there, albeit unrecorded) or if they arrived recently from some other geographical location (aliens). These species cannot be immediately incorporated in the original master list, since their history will have to be understood. Diversity indexes are usually based on what is found at each station in comparison with what has been found at other stations. This tells us something about that sampling session, and about what has been found. It does not tell us much about what has not been found at any station and nor what has been found previously in that particular habitat type. We need some history in our observations. Species loss is usually perceived only for charismatic taxa, whereas inconspicuous species are recorded only if they are found (if the sample is studied by a specialist) but, when they are missing, their absence is not recorded as relevant. In spite of the widespread concern about species extinction, there is not much proof that species are actually becoming extinct (besides the usual cases). This is probably not because they are not becoming extinct but simply because we are unable to perceive their extinction. The HBI, comparing what is being found with what should be found, will be a first step to highlight species losses, especially for inconspicuous species (the great majority within biodiversity). On one hand, it is true that species extinction is usually linked to habitat extinction, but it is also possible that species start to become extinct before the disappearance of a given habitat type, so that the absence of some species might be a warning signal for the impending disappearance of a given habitat type.

Of course, while we wait for a complete list of all species (all-taxa inventories), we have to use the lists for the taxa we know better. These lists must be made by taxonomists working together with ecologists. Master lists for all taxa, for instance, might be derived from the European Register of Marine Species, assigning each species to the habitat type(s) from which it has been recorded. Then the list of species and habitat types might be turned into a list of habitat types with their master list of species.

Boero (1981), (Boero F., 1981. Systematics and ecology of the hydroid population of two *Posidonia oceanica* meadows. P.S.Z.N. I: Mar.Ecol., 2 (3): 181-197) for instance, compiled a master list of all the hydroid species that have been recorded on the Mediterranean seagrass *Posidonia oceanica*; some of these species live exclusively on the leaves of Mediterranean seagrasses. The absence of specialised species, living only on *Posidonia* leaves, might be an early warning about the state of *Posidonia* meadows even before the plant itself shows any sign of suffering. This example tells us that, according to the habitat type, some species might be more important than others and that all species on a list cannot be treated as equals.

**From analysis to synthesis**

The historical biodiversity index merges biodiversity measurements at both habitat and species level. Genetic approaches, furthermore, will tell us the compactedness of species populations across the same range of habitat types over a geographic scale and will help in tracing the routes followed by fast-moving species. Knowing a species, furthermore, is just the beginning in biodiversity estimates. Each species has a role and, according to niche theory, coexisting species should have different niches and so different roles. In spite of this, however, rare species can easily survive with not much competition from other species with very similar requirements to theirs, being ready to take their place in the case of the failure of the dominant one. We know the role of very few species, despite continuous reference to biodiversity and ecosystem functioning.

Structure and function depend on each other. Overspecialisation is required to deepen our knowledge on particular issues, but then we need to integrate approaches into a common view. This common view is lacking. Biodiversity is not like, for instance, temperature. The manifold meanings and measures of biodiversity cause great confusion not only for scientists but also for decision makers. The different views of biodiversity proceed more or less independently and specialists of

different biodiversity-related topics often cannot even communicate, due to overspecialised jargon and technicalities.

We need a common philosophy based on a common theory. The approach I depicted here is by no means the solution of these problems, it is just a hint to show that we have to use all available information to understand biodiversity issues, and that the specialists in the different facets of biodiversity have to combine their efforts, and join in common projects, bridging the gaps that are now dividing the subfields of biodiversity.

# Session 2: Joint session on Eastern and Southern Mediterranean, and Black Sea

# [*]Introduction to Topic 2.1: Endangered biodiversity and management of marine protected areas, wetlands, lagoons, estuaries and seagrass meadows

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To have a knowledge of the most remarkable components of marine biodiversity, in its broadest sense, supposes there to be a thorough knowledge, acquired earlier, of the totality of the biodiversity elements without statute at neither national nor at regional (Mediterranean) level. In the southern and eastern part of the Mediterranean this is not always the case. Very often fragmented, disparate and delocalised data, both in time and in space, render the elaborate management plans "hypothetic". This fragmentation makes it difficult to standardise criteria for the classification of national or regional sites of interest. The essence of these criteria is in fact based on the density or the size of the remarkable or endangered species population, data that most often are incomplete if not entirely unavailable. Under these conditions it is rather difficult to devise management plans for potential areas of protection and to develop efficient practical instruments for the protection of one or another remarkable population.

For these reasons, it has always been recommended to conform to strict criteria of the presence of remarkable species when establishing a reserve, at least in the case of Algeria. In a second phase, we suggest to push the knowledge on species having a statute in order to dispose of elements that can help establish the most useful management plan.

Another gap is undoubtedly participation in the dynamics of the process of the assimilation of a reserve. Too often, people considered as "key-persons" in the system are not consulted until the end of the process, which makes their participation rather incidental because, in most of the cases, these people don't feel at all or any longer included in the dynamics started by the authorities.

In addition, the interests for economical development must be considered when generating the most appropriate mechanisms for the protection of endangered species and landscapes of major interest. The search for balance between the protection of the most symbolic species and the most rational exploitation of the species and the resources of commercial interest should be the guide while establishing the management plans for areas to be protected. That's why, on a national scale, protected areas should not be considered as isolated and autonomous entities, but more as elements or systems being part of one huge functional system where the fixed objectives for either area are complementary and are part of a global and even cross-border vision, as this is the case for a semi-closed sea like the Mediterranean.

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The Convention relative to biological diversity recognizes the urgency in implementing concrete and efficient actions for marine biodiversity protection. The actions undertaken, on a Mediterranean scale, such as the programmes on integrated management for coastal zones (GIZC and GIZL) as well as the performance objectives on protected marine and coastal areas fit in this process. At the moment, the most adapted framework to this strategy is the strategic action plan for the conservation of biological diversity in the Mediterranean region. However, the process of assimilation as a reserve needs to be accelerated taking into account that in most of the Mediterranean countries the time between the declaration of intent and the actual protection measures can be that long that valuable ecosystems have time to degrade even up to the point of irreversibility.

A modern approach to coastal marine environment protection and biodiversity requests more than just species conservation, it would need an action more related to man or, in some countries where environmental aggressive practises (e.g. fishing using dynamite,…) stay anchored, even a change of mentality. The increasingly threatened living marine resources reveal the extent of the challenges which arise to us.

As the limits of the national strategies implemented in a partitioned way seem to be reached, on a regional and world level there seems to be a serious will to establish a consensus on an integrated and global development which traces contours of a strategy on a broader geographical scale, but takes into account the characteristics of the various areas and regions.

Several Mediterranean countries are well advanced in the generation of national strategies for marine and coastal biodiversity preservation. These strategies are globally based on knowledge, awareness, and the role of participants. This last point highlights the shared responsibility in the implementation of one conservation strategy for natural elements. This responsibility needs a hierarchy from the bottom to the top of the political decision-making process at a national level, which will subsequently be put forward to the international community. This process should be the driving power behind any strategy.

Here we must say that where the number of the Marine Protected Areas of the Mediterranean is in continuous growth, this development has mainly started in the 80’s or 90’s in the western basin and has also included, in the last years, the countries of the oriental sector. Syria, with its 183 km of coast, has recently recognized the importance of the Marine Protected Areas and has begun to select some coastal areas to be protected. in the northern sector. The Syrian government took vast steps to generate these MPAs, but sometimes irresponsible works (e.g. marine transportation disasters) may cause the failure of any plan or strategy and the loss of all official and public efforts. Can we avoid these problems? Or at least, how would we deal with them?

At last, the time has probably come to review, in the light of the data gathered during the last decade, the list of endangered species as well as those whose exploitation is regulated in the Mediterranean, this also being one of the stakes for a better management of protected zones.

# [*]Introduction to Topic 2.1 part Black Sea: Ecological changes in the Black Sea

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During the last 23 - 35 years, as a result of a severe and permanently increasing interference of human population metabolism into the marine environment, deep changes have occurred both in the structure and functions of the coastal ecosystems. Ecosystem distortions result both by extraction, but more by addition from and to the marine environment substances and energies; there are nowadays processes having general global distribution and a law character.

The Black Sea ecosystems, particularly those in its North-Western part including the Romanian sector, were not excepted from the rule of deformations, registering multiple and complex changes, affecting all sides of the general ecological frame as follows: geo-morphological (changes in coastal line and bathymetry under the processes of erosion and deficits in sediment balance), sedimentologic (changes in the sediment type structure), physico-chemical (modifications in thermic structure, optic properties, chemical concentrations or loadings etc.) and biological conditions. The biological changes in the Black Sea, which have been described as a result of eutrophication or pollution, started in the second half of the 1970's. The new dominating processes in the coastal ecosystems could be compared with a chain reaction, triggered by the increase in nutrient and other chemical substances in the waters, followed by a series of phenomena whose main link is the excessive development of phytoplankton and ending in benthos obliteration by mortalities and loss of biodiversity.

In the 1960's the Black Sea was known as one of the most productive seas having a luxuriant development of both pelagic and benthic life, a vast distribution of *Phyllophora* red algae, a remarkable abundance of bottom filter-feeders (*Mytilus*, *Modiolus* and other species) and being an ideal feeding ground for many commercial fishes. This situation can be considered, for reference, as a base line reflecting a "round - cyclical" function of the ecosystems at all trophic levels. For the Black Sea ecosystems the present ecological state compared with that of the 1960's is strongly deformed. The Black Sea represents today one of the most seriously damaged seas in the world, the state of its ecosystems being considered as catastrophic, which is evident firstly in the actual qualitative and quantitative scarcity of biodiversity and implicitly in the biological resources of economic interest (collapse of fisheries).
In conclusion the most important change refers to biodiversity; species diversity, both as variety and equitability component, is low. That is why nowadays biological diversity is a subject much spoken about, and often in a confusing way.

**Species population diversity - fundamental "bricks" of the ecosystems**
After 1990, the efforts to study the Black Sea problems have been better coordinated at the international level, the Black Sea Environmental Program (World Bank - GEF) and other programs

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("COMSBlack", "NATO - TU Black Sea", UE - EROS 2000 Program "European River Ocean System" - being launched and financed in order to help Black Sea inhabitants fight the destruction of their natural inheritance and try to restore their economic assets (MEE, 1994).
All these short-term or long-term programs refer, directly or indirectly, to the problem of biodiversity conservation in the Black Sea (GEF - BSEP, 1994).

In a very clear way biodiversity is defined as "the sum total of all plants, animals, fungi and microorganisms in the world, or in a particular area; all of their individual variations; and all the interactions between them" (RAVEN, 1994). But the concept of biodiversity conservation is so complex that the very essential element of the problem - the species with its populations - is often neglected. Biodiversity can be defined also as the characteristic of groups or classes of biological entities to vary, each class of entity - genes, cells, individuals, species, community or ecosystem - contains more than a single type. Diversity is certainly a basic property of all biological systems, as they are hierarchically ordered, diversity itself being present at each level of biological hierarchy from molecules to ecosystems (Solbrig, 1991). Moreover, at each hierarchical level, diversity can refer to three major aspects - composition, structure, functions (Savard, 1994).

When studying and maintaining biodiversity, which hierarchical level shall we start with? Shall we start with genetic diversity? This would be very important, but the conclusions might come too late if we want to know the number of genotypes, the frequency of genotypes or the results after comparing the populations in order to find out their genetic resources. Shall we start with ecological diversity, with the associations of populations and the controlling factors, which determine their dynamics and/or their deterioration? It would be very useful, but only knowledge of species and populations could help to establish the diversity of trophic chains and relationships, the supply diversity or food diversity, the diversity of nutrient necessity, the diversity of the ecosystems - the support systems of life.

In our opinion, biodiversity evaluation and the whole action plan for its conservation should begin with the evaluation of the accumulated knowledge, therefore from the species level; an inventory of the species is absolutely necessary at first, even though there can be several populations for a species, in a large zone as the Black Sea is, belonging to different breeds. The species, with their populations, are the concrete fundamental "bricks" which form the ecosystems, provide the "biological indicators" or form the generative basis of the resources or the basis to supply economically usable services.

Starting with the list of species recorded at a certain area of the littoral and/or in the Black Sea, we can easily register the distribution and the qualitative and quantitative state of their populations (at the latest record in their specific habitat) and then we can establish the reference points, appreciate the biodiversity state and establish the structure of its categories:

- Has the species disappeared from this certain area or the whole Black Sea? Where? When? How?
- Is the species threatened? How? Is there a critical danger?
- The species is not threatened or the risk of threat is small. Why? Does it resist or is it not threatened? Could there be any threat? How?
- There are not sufficient data and knowledge concerning species or reference zones.

The knowledge of the Black Sea diversity is certainly a specific problem which must be an integrant part of both a national program of biodiversity research and a regional international program of biological diversity conservation; it is a real and prior problem as it reflects the diversity state accurately, the health state, the structure and productivity of the Black Sea

ecosystems, of the goods and the renewable resources especially and of the services offered by this sea.
The specific biodiversity closely connected with the structure and dynamics of state parameters, including biota populations, which define the environment and life conditions, is historically generated by genetic biodiversity and generates biocenotic diversity.

A comprehensive program, realistic and coherent, referring to biodiversity must challenge first the Academic community whose mission is to supply the decision factors with all the necessary data for an efficient conservation and/or a sustainable exploitation of biological resources.

Until a national or regional coherent program on the knowledge of the Black Sea biodiversity is elaborated, we have considered that it is useful to elaborate a list of taxa recorded along the time at the littoral of our country, of the riparian countries and in the Black Sea on the whole.

**Black Sea historical biodiversity**
The list of the Black Sea species comprises 5275 taxa, out of which 3389 were recorded at the Romanian littoral. A series of species were recorded for other sectors of the Black Sea (Bulgaria, Turkey etc.) but this is a future objective to be fulfilled by the scientists studying in these sectors.

The about 5300 taxa catalogued are grouped in 92 systematic units of superior order whose rank varies. The richest represented groups in the Black Sea are: Bacillariophyta - over 550 species, Ciliata - over 400 species, Copepoda - over 300 species, Rhizopoda, Annelida, Gastropoda with over 200 species for each of them, then Pyrrophyta, Rhodophyta, Nematoda, Rotatoria, Ostracoda, Amphypoda, Bivalvia, Pisces - with over 100 species for each of them.

Out of the 3389 taxa recorded at the Romanian littoral about 11.1% are terrestrial forms from coastal zones and 88.9% aquatic forms in the Black Sea. The groups richest in species are Bacillariophyta (12.8%), Cilliata (9.06 %), Copepoda and Annelida (each of them with 5.3 %) etc.

It comes out that whole groups of organisms are either entirely unknown or insufficiently known in the Romanian sector of the Black Sea (Bacteria, Amoebozoa - Testacea, Plathelminthes, Nematoda etc.).

The list of species in the Black Sea must be considered a preliminary one, open for improvement; it is an open list, incomplete at the moment, containing some synonymies which were not eliminated (specialists in various groups are in charge of this task) and consequently it will have to be completed in the future, checked and improved, completed with information on the distribution and present abundance of species in various zones of the Black Sea and their level of conservation. It seems that at present, the populations of many species at the Romanian littoral have disappeared or decreased in number, some groups hardly counting 20% of their species.
The completion of the list of marine and coastal organisms of species at the Romanian littoral and in other Black Sea zones is the result of minute documentation after consulting many scientific papers and works (mostly in Romanian, Russian and Bulgarian) especially monographs such as “Romanian Fauna”, “Romanian Flora”, the “Marine Ecology” series, key books for the identification of the Black Sea fauna and flora, check list of the marine species and other publications referring to the Black Sea biodiversity.

In most cases, the names of taxa (genre, species, varieties etc.) were taken over right from the reference papers, the preliminary list not aiming at updating the nomenclature, which is the specialists’ task. The list might contain some synonymies resulting from giving the same taxon different names by different-authors, without indicating the synonymies. The elimination of synonymies is one of the future objectives.

The list includes: typical marine and brackish water species from the Black Sea, - typical brackish and freshwater or phreatic forms from the paramarine basins and from the Black Sea zones strongly influenced by freshwater and ® terrestrial species (cormophytes, birds, insects etc.) having frequent occurrence in the coastal zones on sand dunes, sand bars, rocky or clay cliffs.

Among the aquatic species known at present, there are entire groups of organisms hardly or insufficiently known (Bacteria, Rhizopoda, Plathelminta, Nematoda, Copepoda, Chelicerata - Acarina etc.); other groups very successfully studied in the 1960's later on were almost completely neglected (Ciliata, Hydrozoa, Gastrotricha, Rotatoria, Annelida etc.).

Terrestrial biota characteristic of the ecotonal littoral zones, listed in parallel with the aquatic species (mainly marine ones) is insufficiently presented. The list of terrestrial forms will certainly increase if we consider the high diversity of wetland habitats around the Black Sea. A few examples casually taken from the Danube Delta are illustrative in this respect: Lichens - 110 species, terrestrial plants - >730 species, worms - >250 species, Arachnida - >130 species, Insecta - >1,200 species, Aves - >170 species etc., in total more than 3,600 species of plants and animals.

**Changes in the populations of Plants and Animals at the Romanian Black Sea Coast**

A comparison between the present situation of the populations of species belonging to various taxonomic groups and the former situation, points to the appearance of changes in many cases, most of them in the sense of considerable decrease in their number. The lack of information about many groups of organisms does not allow us to have a general view of the population size of all marine and paramarine species. However, the number of species under anthropic impact is great and thus the situations are rather numerous. In the following lines, some examples from well-known groups are presented.

The group the macrophytic algae was one of the most affected by the changes in sea water quality as a result of human activity. Among the algae, the Rodophyta was most affected as an important number of taxa either has disappeared from the Romanian Black Sea Coast or has not been found for a long time. The same happened with *Dasya baillouviana, Chondria tenuissima, C. dasyphylla, Laurencia coronopus, L. paniculata, L. obtuza, L. pinnatifida, Gelidium latifolium, G. crinale, Peysonnelia rubra, Corallina elongata, C. officinalis* to name only some of these species .

The group of brown algae did not escape the impact either. Thus species such as *Sphacelaria cirrosa, Cladostephus verticillatus, Zanardinia prototypus, Scytosiphon lomentaria, Stilophora rhizoides, Petalonia zosterifolia, Dilophus fasciola* etc. have disappeared from the zones of the Romanian littoral. Similary the massive strips of *Cystoseira barbata* have completely disappeared. This species formed until the early 1970's large patches in the infralittoral zone, the *Cystoseira* strip being so dense in some sectors that these could hardly be penetrated. At the moment these associations with the whole adjacent fauna are absent, the mentioned species being found in isolated small bushes.

If until 1980, 122 species of macrophyta algae could be recorded at the Romanian littoral, after this date only 70 species were registered, out of which only 20-30 forms have important frequencies. A few marine cormophyta shared the same fate, the meadows of *Zostera marina* and *Zostera noltii* also disappearing from the Romanian littoral of the Black Sea.

Among the invertebrates numerous examples can be presented to illustrate the aspects under discussion. *Lucernaria campanula* (Coelenterata-Scyphozoa), *Ophelia bicornis*, *Arenicola marina* (Polychaeta), *Ostrea sublamellosa*, *Solen vagina* (Mollusca-Bivalvia), *Phasianella pontica*, *Gibulla divaricata* (Mollusca-Gasteropoda), *Chtamalus stellatus* (Crustacea-Cirripedia), *Hippolyte inermis*, *Lysmata seticaudata*, *Pontophylus fasciatus*, *P. trispinosus*, *Processa pontica*, *Calianassa*

*pontica*, *Upogebia pusilla* (Crustacea-Decapoda), are only a few examples of species which either disappeared from the Romanian littoral or became very rare.

With reference to fish species, an almost general decrease in their stocks was observed, some of them being threatened with extinction. In this respect we present a few examples without the pretension of exhausting the list: *Acipenser nudiventris*, *A. sturio* - in fact all the sturgeon species are menaced by abusive fishing and by hydroenergetic works along the Danube River - *Alosa caspia bulgarica*, *Anguilla anguilla*, *Atherina boyeri*, *Clupeonella cultriventris*, *Pungitius platigaster*, *Scomber scombrus*, *Neogobius syrman*.

The brackish water forms of some marine species, as well as brackish water species formed in paramarine lakes isolated from the sea are also in a delicate situation. Such taxa, were endangered by hydroenergetical works made for fisheries, which caused the replacement of brackish water of paramarine lakes (the lagoon complex of Razelm) with fresh water or by eutrophycation. An example is offered by *Neogobius cephalargoides* in Siutghiol lake (near Constantza). Another situation is offered by *Scomber scombrus* (the blue mackerel), which ceased its annual migration into the Black Sea basin after 1970.

The few species of marine mammals recordered in the Black Sea were also severely affected. The sea seal *Monachus monachus* seems to have disappeared from the breeding zones at the Bulgarian littoral, and the dolphins *Phocaena phocaena* and *Tursiops truncatus* have dramatically decreased in number in consequence of the reckless fishing.

The usually slow penetration of new species into the Pontic basin was intensified; this is one of the features characteristic of the ecological changes in the past decades. More than 30 species of immigrants have been reported from the Black Sea basin in the last hundred years. About 45% of them originate from North Atlantic (North America) and 35% from Indo-Pacific. Introduced species are mainly benthic, restricted to littoral or shallow ecosystems; some of them penetrated into the freshened lakes or along the Danube River.

**Measures for eco-diversity protection**

Taking into consideration the precarious ecological situation of the Black Sea coastal ecosystems as well as the necessity for the protection and regeneration of its resources, biodiversity and life suport systems it is very important for the decision factors to take urgent measures, both nationally and internationally, not only in the countries riparian to the Black Sea, but in all the countries in its catchments basin, including them in the strategy and joint action plan as follows:

1. Anticipating and limiting the impact of human activity upon marine coastal ecosystems by reducing the disturbing activities, by observing the standards and norms of “clean” functioning and by the obligation to periodically organise environmental audit and ecological risk studies for all the activities interfering in the marine coastal ecosystems and their resources.
2. Studying and better understanding complex ecosystemic processes within an integrated program of ecological monitoring, which must also issue medium-term and short-term predictions. The permanent monitoring of principal biotic and abiotic factors of marine coastal ecosystems and the steady research of the complex eutrophication and blooming phenomena are main necessities.
3. Identifying, and evaluating patterns of optimal use of marine environment in parallel with applying new technologies, non-pollutant and non-stressing for the coastal ecosystems.
4. Improving the state of coastal ecosystems by works and actions of ecological reconstructions.
5. Creating educational programs to support the conception according to which the sea must no longer be considered as an unlimited collector of wastes resulted from human activities.
6. Developing international cooperation and organising joint activities in accordance with a plan which should contain aspects of monitoring, research and prediction of the structure and

functioning of the ecosystems, information exchange, decisions and regulations, standardization and inter-calibration of methods etc.

All these measures should belong to a vast and complex program of ecological reconstruction of the Black Sea littoral spaces, which should also contain measures and actions in the whole catchments basin.

The preliminary conclusions concerning the ecological diversity in the Black Sea can be summarised as follows:

1. Starting with the awareness of the fact that the problems of the study and conservation of biological diversity are complex and real, replete with great present interest, it is considered that specific biodiversity must be prior in any program of research and solving of these problems.

2. The knowledge and conservation of specific diversity in the Black Sea represents a specific problem that must be an integrant part of both a national research program and a regional international program; a comprehensive programme, realistic and coherent, well coordinated and properly financed must involve and form specialists.

3. The study of ecological diversity in the Black Sea requires the zoning of this basin in ecoregions and to this end a scheme is suggested, which comprises 12 units of 1st rank: 4 pelago-benthic ecoregions only on the continental platform, 4 ecoregions situated on the narrow continental platforms and continued with the continental gradient, a pelagial ecoregion situated in the zone of the west continental gradient, 2 pelagial ecoregions situated in the eastern and western halistatic zones and an ecoregion representing the Azov Sea.

4. Parallel to the continuation of this researches it is urgently necessary to carry out practical actions in order to draw the attention of the leading forms and the public opinion upon the necessity of stopping and preventing pollution, stopping new species from penetrating into the pontic basin, protecting and improving scarce populations, ensuring the financial support and the suitable technology for the problems of the ecological monitoring, ensuring the scientific basis of the management decisions for marine resources, making citizens aware of these problems and persuading them to take active part in the decisions.

5. Applying the biological criteria, established by the Declaration of Alghero Convention, to the conservation of the coastal and marine habitats in the Black Sea, as the genetic annex of the Mediterranean is an urgent requirement for all the countries riparian to the pontic basin, which are expected to join in the European efforts in the field.

# [*]Introduction to Topic 2.2: Biodiversity conservation, impact of human activities, environmental policy and public awareness

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Much attention has, for some years, been paid to the shift in ecological equilibria in the Mediterranean Sea, resulting from human activities. Particular attention has been paid to the effects of pollution and to the introduction of marine alien species into this sea and the prevention of such introductions. This interest in alien species is reflected in recommendations and activities of many bodies; the Convention on Biological Diversity (CBD), the Bern and Barcelona conventions, IMO, the Global Environment Facility (GEF) and others. Much has been done towards controlling and minimising the introduction of alien species. Much, however, remains to be done. Public awareness of the problem of alien species has been catalysed by the introduction and spread of the alga *Caulerpa taxifolia*.

The aim of the current text is to focus on what is seen as a major threat, if not the major threat, to ecological equilibria in the Mediterranean. This is the effect of the Suez Canal in the introduction of Indo-pacific species into the Mediterranean. This is a threat that so far has received little attention, though much work has been carried out on studying and documenting the immigration of species into the Mediterranean. The Canal is a man-made structure, and it is therefore an inescapable conclusion that the species coming through the Canal are introductions. Many hundreds of species have already come through the Canal and have successfully colonised or invaded the Mediterranean. If the Canal was to be constructed today any environmental impact assessment study would undoubtedly highlight the dangers posed by the connection of the Red Sea and the Mediterranean and measures would be proposed for controlling the migration of species through the Canal. As this migration is ongoing and as it is revolutionizing the Mediterranean, it needs, therefore, to be addressed in the same way - and addressed as an urgent issue. (Demetropoulos and Hadjichristoforou, 2002)

**Background**

The Mediterranean, as we know it to day, was formed about 5.3 million years ago. At that time movements in the earth's crust opened up the Gibraltar straits enough for the Atlantic waters to fill the enormous salt depression that was the more or less dry Mediterranean basin. In parts this was a few kilometres below the level of the Atlantic Ocean. This water brought with it living organisms that were the precursors of today's Mediterranean marine fauna and flora.

The Gibraltar straits, until the opening of the Suez Canal, formed the Mediterranean's only link with the other oceans. Through it entered many species of fish and other marine animals and plants. Evaporation maintains an incoming current from the surface Atlantic into the Mediterranean, a current that brought - and brings - with it plants and animals that went on colonising this sea, as its environment changed through geological times. This colonisation is natural and part of the

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evolution of the Mediterranean ecosystem. With the advent of the last major ice age, about 40,000 years ago, the Mediterranean started warming up. Marine turtles for example colonised this sea about 10,000 years ago when this sea warmed up enough to sustain nesting on its beaches.

The hydrography of the Mediterranean, is such that it does not allow, the passive at least, outflow of organisms back into the Atlantic except in a very limited way through the lower strata of the Gibraltar Straits. This has enhanced the relative isolation of the Mediterranean and the consequential evolution of many endemic species in this sea.

**The Lessepsian migration**

The opening of the Suez Canal in 1869, has led to the connection of the Mediterranean with the Red Sea. For the first time the Mediterranean's pure Atlantic-origin fauna, faced competition from invading Indo-pacific animals and plants that established themselves first in the Canal and later in the Mediterranean Sea. Several hundred species have since established themselves in the Eastern Mediterranean and the number is growing fast. This immigration, has been the subject of many studies during the last half of last century (e.g., Steinitz, 1967). These Indo-pacific species now form over 12% of the marine fauna of the East Mediterranean and 5% of the entire Mediterranean marine fauna (Fredj et al., 1990; Bellan-Santini, 1992; Fredj et al., 1992). Many species, some well known, such as two Siganids (Rabbit Fish) are now common in the commercial fish catches of Cypriot fishermen. Many species of benthic organisms have also colonised the island (Hadjichristohorou et al., 1997). Several other species are common in the catches of fishermen in the east Mediterranean., such as *Upeneus moluccensis* which has been replacing the more valuable local Red and Striped Mullets. These are of course by now well known. Many species, some of them nuisance species (e.g., some jellyfish) and some very invasive (e.g., *Caulerpa racemosa*), are now well established in the east Mediterranean and are spreading west.

A newcomer to the Cyprus coastline can now be found on this *Vermetus* shelf and lower down on shallow rocky substrates practically anywhere on the island. This is a Stromb shell, *Strombus persicus* (= *S. decorus*), a Red Sea immigrant, that has colonised the shallow waters of the island during the last decade or so. It seems to be competing with the Mediterranean Cone Shell (*Conus mediterraneus*), which it seems to have replaced in some areas.

*Caulerpa racemosa*, has spread in a very explosive fashion since about 1990, to cover very large areas of sea bed in many areas around Cyprus (Argyrou et al., 1997) and elsewhere. This *Caulerpa* covers the sea bed and especially soft substrates, in a mat a few centimetres thick competing very successfully with species such as *Caulerpa prolifera* and *Cymodocea nodosa* which it replaces. Apparently this species has as yet no enemies in the Mediterranean and if its proliferation continues it is likely to revolutionise the whole East Mediterranean shallow water ecosystem, with far reaching effects not only on the native marine flora but also and perhaps more significantly, on the marine fauna of the area. The reduction for example of *Cymodocea nodosa*, in the key feeding areas of the Green Turtle, *Chelonia mydas*, in the Levantine Basin, will inevitably have an effect on the survival of this species in the Mediterranean. This turtle feeds practically exclusively on this sea grass in the Mediterranean, at least up to its sub-adult stage.

**Perspectives/practicalities**

It is not the purpose of this paper to list the species that have come into the Mediterranean, extensive lists and related papers exist elsewhere. CIESM, for example, has now established a web-searchable database of exotic (mainly Lessepsian) species in the Mediterranean for fish, molluscs and decapod Crustacea, giving detailed information on a multitude of alien species (CIESM 2002).
The purpose of this paper is to underline the need to control this immigration, the impact of which is both obvious and unpredictable, as it is obvious that whatever other measures are taken to curb the introduction of alien species, through ballast water etc, such measures will be of little value in

the end, if the door left wide open by the opening of this canal is not controlled. The Canal, especially since the drop of the salinity of the Bitter Lakes, provides not just a narrow path for alien/invasive species but a highway for them into the Mediterranean, as is witnessed by the flood of new records of new immigrant species in this sea. The magnitude of the problem, or perhaps better, the need to do something about it seems to have escaped the serious attention of the environmental and scientific community, which so far has focussed on studying the immigration and spread of these species. The public is of course little aware of what is happening underwater - with complex ecological processes - and can hardly be expected to participate in debates in which even scientists do not easily venture – let alone policy makers. Biodiversity issues such as those relating to marine turtles and the conservation of their nesting habitats attract more public attention as they are more clear-cut – and are hence more controversial. The general lack of focus on the issue of the Suez Canal is probably due to the fact that the Canal has been there for so many years that it is taken for granted - and the "inflow" of organisms taken as inevitable and "natural". Is the magnitude of the problem too big to envisage solutions to? Or is ecological change of little interest compared to the impact of pollution – which can have other effects also - effects on human health and tourism? Solutions to the problem may at first seem to be utopian or too expensive, but they are probably neither. Focussing on the problem will generate simple solutions. Salinity or other barriers, perhaps linked to (solar powered?) desalination - and fresh water production - may be feasible and do not seem to be beyond the scope of the funding capabilities of GEF or the EU for example – and could be self financing.

If no measures are taken to stop further immigration of Red Sea organisms into the Mediterranean, by creating suitable barriers to living organisms in the Suez Canal, further instability of the Mediterranean ecosystem is inevitable. The ecological effects are already much greater than the effects of any pollution, about which much has been said and much is being done about. What is even more important is the fact that introductions into the marine environment are permanent and cannot be reversed, as can be witnessed by the futile attempts to eradicate *Caulerpa taxifolia* from this sea. Pollution effects, though no doubt important and should not be overlooked, are largely reversible, though recovery can be very slow in some cases.

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# [*]Introduction to Topic 2.3: Climate change and exotic/invasive species (including lessepsian migration)

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Changes in marine flora and fauna (mostly in ichthyofauna) have been associated with climatic and oceanographic changes in various studies (Francour et al., 1994; Astraldi et al., 1995; Galil and Zenetos, 2002). During the last 30 years, changes in the quantitative and qualitative composition of the Adriatic ichthyofauna (as well as complete flora and fauna) have been noted (Dulčić et al., 1999). The numbers of thermopile species have increased; several species previously scarce or rare, have become more abundant, while others are new records. The hypothesis of an expansive northward movement of thermopile species and changes in marine biodiversity is nowadays supported with numerous records of fish species (and other organisms) previously characteristic to the more southern area. Obviously, this is happening in the Adriatic sea as well, where numerous new species in the area or in the northern sectors were recorded. Good correlation between mean annual air and sea surface temperature and yearly total number of specimens, as well as between annual sea surface temperature and species richness is obtained for the period 1973-2003. The variations in Adriatic temperature conditions correlate well with the North Atlantic Index (NAO) variations showing that local temperature changes at least partly result from hemispheric one. Variations in sea surface temperature conditions mostly result from the heat flux exchanges on the air-sea interface, and since net heat flux is under NAO influence, there is no doubt that recent changes of Adriatic ichthyofauna are partly controlled by hemispheric climate changes (Dulčić et al., 2004). Distribution of warm-water fish records is influenced by overall cyclonic circulation in the Adriatic Sea. As fish (or any other organism) appear to respond to warming, as evident by the northerly advance of the distributions of the southern species in systematic way, they may provide a useful index of the effects of warming in the Adriatic. Incoming northwestward current along the eastern Adriatic coast carries food and plankton organisms and favours entrance of the species from the southern areas. Species introductions into the Adriatic have not been studied systematically as yet. Some reports are at hand referring to: the spreading of some algal species towards the north (*Caulerpa taxifolia* and *Caulerpa racemosa*), the occurrence of at least 12 alien mollusc species, recorded in the Northern Adriatic, and occurrence of 31 new fish species for the Adriatic ichthyofauna (of which half of them could be connected with previous subjects) (Dulčić et al., 2002). The invasion of Red Sea organisms through the Suez canal, known as "Lessepsian migration", has profoundly modified the ecosystem of the Eastern Mediterranean. This migration, the result of major man-made changes in the area, has given us a unique opportunity to study the process of invasion and colonization by tropical biota of a sub-tropical region populated by temperate biota (Golani, 2002). Nine (9) species (Lessepsian migrants) were recently recorded in the Adriatic and most of those records represent the northernmost record of those species in the

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world. There is a clear east-west and west gradient in the distribution of Lessepsian migrant species in the Mediterranean. There are very few studies which directly investigate the impact of Lessepsian migrants on the autochtonous species (goatfishes and lizardfishes). The difficulty lies mainly in the lack of information available from the period prior to invasion. The present research on Lessepsian fish focuses on three major areas: a) identifying the characteristics distinguishing colonizer species from closely related non-colonizer species in the Red Sea, b) assessing the colonizer populations responses to the new environmental conditions, and c) studying the impact of the Lessepsian migration on the Eastern and Adriatic ecosystem.

In general, alien or immigrant species have not caused significant impacts on the Mediterranean marine ecosystems. However, it is cause for concern the increasing record of non-indigenous species in the Mediterranean whose ecological role and effect on biodiversity conservation is unknown. Present knowledge and reliable data on species identity, introduction date, geographic origin, dispersal vectors and distribution ranges are very limited. The ecological impact of invasive species is poorly known because it is rarely investigated. Both planktonic and benthic communities appear to be equally affected by invasive events. More joint research is necessary for obtaining a better knowledge of the present and future impacts caused by immigrant species. Invasion affects biodiversity by adding species that may outcompete and displace autochthonous ones. Most allochthonous species that establish reproducing populations within the Mediterranean constitute neither a nuisance nor have commercial value. Most allochthonous species do not undergo outbreaks that would turn even an innocuous species into a "pest". However, the number of allochthonous species that develop populations is increasing. The special vulnerability of the Mediterranean Sea to invasion by allochthonous species stems from its position between the Atlantic, Pontic and Erythrean regions, its history, and heavy anthropogenic impact. It is believed that impoverished biotas are more prone to invasions. The Levantine Sea has less than half the number of benthic species found in the Mediterranean Sea. This faunal impoverishment has been attributed to its comparatively late recolonisation following the Messinian crisis, to Pleistocenic climatic fluctuations and to the basin's extreme oligotrophy. The prevailing high temperature and salinity may prevent the arrival of Atlantic species. When tropical organisms arrive, few ecological obstacles prevent their successful implantation. Increased pollution (from agricultural run-offs to industrial wastes), unsustainable fishing practices and engineering projects (dams, landfills etc) have caused wide spread disruption of the littoral ecosystem and decimation of the Mediterranean biota. It is difficult to provide conclusive data on the possible scenarios deriving from the introduction of species in the Mediterranean. Not enough data are available to forecast the effect of invading species on marine communities. However, some previsions may be attempted based on the general ecological characters of invaders. Taking into account the main source of human-mediated invasions (ballast waters, aquaculture, etc), invaders are apparently represented by resistant, fast growing, adaptable species to variate conditions and stressed environments. There are marked differences about the impact of invasive species between eastern and western Mediterranean. The eastern basin is mainly invaded by Lessepsian immigrants. In the western basin the most important invader, the algae *Caulerpa taxifolia*, was apparently released from a public aquarium. Considering that ship ballast water affects equally both basins, western countries are more proned to introductions through aquaculture. The cold seawater temperature of the western basin in winter is not a barrier for the arrival and settlement of some Lessepsian immigrants. Since the fifties *Caulerpa racemosa* has reached the Italian coast and Mallorca. The seagrass *Halophila stipulacea* has passed the Siculo-Tunisian sill as other organisms like the fishes *Leiognathus klunzingeri*, *Pomadasys stridens*, *Fistularia commersoni*, the gastropod *Cerithium scabridum*, and the pearl oyster *Pinctada radiata*. No taxonomic surveys are made in areas highly sensitive to alien species introductions, as harbours and aquaculture sites. None study on the transport of organisms in ballast-water has been attempted in the Mediterranean.

There are so many things that we do not know about exotic/invasive species that it is difficult to pinpoint just a few research priorities for invasive species.

The questions that seem most urgent are:

In general terms, what makes an ecosystem invasible? What makes a species invasive? Can we predict which species will prove to be successful invaders in particular communities? If so, can we develop effective screening procedures that will tell us how likely it is that a species will become invasive in particular environments? Why do hitherto benign species suddenly become invasive? Can we model invasive spread, both in homogeneous and heterogeneous environments, perhaps based on existing models? Can we predict the impact of invaders on other organisms and ecosystems? Can we formulate a general theory of biological invasions?

Perhaps we can summarise these questions into three priorities:

1. Monitoring, modelling and predictions of the behaviour or invasive species.
2. Tests to control invasive species using appropriate control and evaluation.
3. The establishment of a philosophy of modifying policies and practices in the light of experience – the experimental approach to the implementation of policy.

How should Mediterranean and Adriatic Marine Biodiversity be monitored? How to Develop and use Early Warning Indicators? What is the real effect of climate changes on the exotic/invasive species? What are the effects of exotic/invasive species on the food web interactions?

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# [*]Introduction to Topic 2.3 part Black Sea: Climate change and exotic/invasive species

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The Seas of Mediterranean basin as the system of semi-closed seas with their geographical isolation and natural barriers (first of all salinity, which is in any case different from the oceanic one) conserved their biodiversity created during their geological history. In XX century changes in biodiversity of flora and fauna of the seas occurred due to different kind of anthropogenic effect and climatic changes.

Comparative analysis of the variability of plants and animals abundances, species diversity, dominated species in space and time in the Mediterranean and the Black Sea is of primary importance in the perspective of global climate trends, regional climate variations and anthropogenic impact. Human activities such as increasing intensity of shipping, development aquaculture and aquarium trades were resulting in exchange of aquatic species between Mediterranean and the Black Sea and in global scale for both seas. Biological invasions of aquatic species associated with human activities might be determined as one of the major point of global change.

The Black Sea is a part of Mediterranean basin and one of the largest semi□closed basins in the World. The Black Sea may be considered one of the best marine examples of anthropogenic effects on its ecosystem superimposed on climate changes.

Global warming provoked penetration warm-water Mediterranean mainly zooplanktonic species in the Black Sea (Kovalev et al., 1998). Penetration of these species was not harmful for the Black Sea ecosystem; new edible organisms appeared in the sea.

But invasion of the exotic species with ballast waters and attached at ships' hulls were in the most cases harmful for the Black Sea ecosystem. The biodiversity of the Black Sea as a water body with low salinity is much lower than biodiversity in the seas with fully marine water body like the Mediterranean. In similar sea invasion even one species may affect total structural alteration in ecosystem functioning and even its degradation.

In second part of XX century the Black Sea together with the brakish Sea of Azov became recipient areas for many exotic species of plants and animals, accidental or intentional introduced there. Shipping activity greatly increased in the Black Sea. Total amount of ships that pass Bosphorus for the period 1995-2000 was 47-51 thousands per year. However the real risk of exotic species invasion may be estimated from the total volume of ballast water transportation. There were more than 11 mln. m-3 of ballast water that was discharged in all Ukrainian Black Sea ports during 2001 (Alexandrov, 2003).

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The main reason for successful introduction of many exotic species in the Black Sea was wide diversity of habitats, both in the sea itself and in its coastal limans, lagoons and rivers' deltas. Simultaneously the Black Sea became also donor area spreading these exotic species and own Ponto-Caspian species further through Volga-Don Canal to the Caspian Sea and even further through system of Volga –Baltic canals to the Baltic Sea and further to the North American Great Lakes (Ojaveer et al., 2002). Many brakish eurigaline Ponto-Caspian species immigrated to the eastern and western European rivers, reservoirs and lakes after opening Volga-Baltic system of canals and Main-Danube Canal in southern Germany (Leppakoski, 2004; Ketelaars, 2004).

If we take into account microorganizms such as protozoa, fish parasites, planktonic algae (often toxic) and bacteria the numbers of invasive species can be estimated in thousands organisms. The most pronounced among invaders are the large gastropod *Rapana thomassiana* and ctenophores *Mnemiopsis leidyi* Agassiz 1865, *Beroe ovata* Mayer 1912. *Rapana thomassiana* was introduced from the Sea of Japan; this is a notorious predator that feeds on oysters, mussels and other bivalves. It is believed that gastropod was introduced into the Black Sea by the ship carrying its eggs attached to its hull (Drapkin, 1953; Mamaev & Zaitzev, 1997).

The ctenophore *Mnemiopsis leidyi* (A.Agassiz) was introduced with ballast water of the ships from the Atlantic coast of North America in early 1980s (Vinogradov et al., 1989). *M. leidyi* had explosive outbreak in the Black Sea in 1988 and expanded into the Azov, Marmara, eastern Mediterranean through the straits, and recently into the Caspian Sea with ballast waters of oil tankers (Shiganova, 1993; Studenikina et al., 1991; Shiganova et al., 2001 a; 2001b). This invasion was a real catastrophe for the Black and Azov Sea ecosystems and fisheries, and now situation is getting even worse in the Caspian Sea (Shiganova et al., 2004b). After *M. leidyi* population development in the Black sea cascading effect occurred at the higher trophic levels, from a decreasing zooplankton stock to collapsing planktivorous fish to dolphins (bottom-up). Similar effects occurred at lower trophic levels: from a decrease in zooplankton stock to an increase in phytoplankton, relaxed from zooplankton grazing pressure (top-down) and from increasing bacterioplankton to increasing zooflagellata and infusoria (Shiganova et al., 2004a,b).

The measurements to control *M.leidyi* population size did not implement on time in the Black Sea. But in 1997 a new invader another ctenophore *Beroe ovata* Mayer 1912 again accidentally appeared in the Black Sea from the same northern American coastal area, which feeds exclusively ctenophores, first of all *M. leidyi* (Konsulov & Kamburska, 1999). The Black Sea ecosystem rapidly began to recover (Shiganova et al., 2000, 2001; 2004b; Finenko et al., 2000; 2001).

These events combine two important ecological problems of the World Ocean - gelatinous blooms as response on climatic changes of environments and distribution of alien species with ballast waters. Global warming stimulated increasing in gelatinous species populations in native habitats effects local ecosystems and creates possibility easier to spread these species in other seas and coastal areas with ballast waters of ships. In these areas population explosion of nonindigenous species occurred due to their disturbance and overfishing in larger scale.

*M. leidyi* and *B. ovata* outbreaks in nonnative areas has made significant advanced into understanding the role of invasive species for ecosystem of the inland seas. This is a great example how only one invader - low organize gelatinous animal could affect total ecosystems: one of them completely suppressed and simplified productive ecosystems and another one recovered them for short period of time.

We try to identify the main invasive corridors of the exotic species into the Black Sea. The Atlantic coast of North America has exported more species to the Black Sea than any other donor area due

to the successive opening of commercial routes (about 45%) . Other important donor areas are Atlantic European coastal areas and the Mediterranean Sea, the most Mediterranean accidental invaders were introduced into the Black Sea from Adriatic Sea ( Shiganova et al., 2005). One more important donor area is Indo-Pacific region, mainly Japan Sea, but most of invasions from this area were intentional acclimations (Zaitzev &Mamaev, 1997).

Once established the most eurigaline and euriterme invasive species have spread rapidly to adjacent seas and via system of canals to the Caspian Sea and some of them to the Baltic Sea (Shiganova et al.2001a, 2005, Leppakosky & Olenin,2000) like gelatinous species *Mnemiopsis leidyi*, *Blackfordia virginica*, *Bouganvilla megas* to the Caspian Sea; Ponto-Capian species from the Black and Azov Seas spread to the Caspian and inland waters of Europe and American lakes. Among them several species included in the list of the most unwanted: Cladocera *Cercopagis pengoi*, Round Goby *Neogobius melanostomus*, zebra mussel *Dreissena polymorpha* (from the list of Global Invasive Species Programme)

Thus the Black Sea became natural laboratory for invasive biology as recipient and donor area. Some invasions were useful like intentional introduction mulet *Mugil soiuy* and accidental invasion of ctenophore *Beroe ovata*, but most of invaders were harmful for ecosystem, ctenophore *Mnemiopsis leidyi* was worst of them, suppressing total ecosystems of several seas.
The key questions of the topic:

- What makes ecosystem sensitive for invasions? (disturbance, such as euthrophication, overfishing etc)
- What makes species invasive? (increasing population in native habitat, etc)

Summarising my introduction I would like to propose the following actions:

1. An understanding of invasion patterns: evaluations of described records, specimens' collections, field surveys, targeting those habitats and areas most closely linked with known introduction vectors, molecular analyses.
2. Supporting and development management for control ballast water and ship hulls floating in local areas.
3. Monitoring and modeling role of an invasive species in recipient ecosystem and its effect on its trophic web.
4. Comparative analysis of the variability of species diversity, dominated species in space and time and environmental processes in the Mediterranean and Black Seas in the context of global climate oscillations, their effect on regional climate variations and exotic species.

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# [*]Introduction to Topic 2.4: Environmental variability and biodiversity predictability: data collection and ocean models– what to do?

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## 1. Environmental variability

Environmental variability is a key feature of exploited ecosystems and has very significant implications for production, development and management of fisheries. Environmental variability encompasses spatial and temporal changes with a wide range of frequency and amplitude, which are introduced into the marine ecosystems by means of human-induced, anthropogenic perturbations and natural climatic fluctuations. Major anthropogenic perturbations are eutrophication generated by massive land-based nutrient and pollution input from rivers, over-fishing, introduction and population grow of alien species. In the Black Sea they, together with climate-induced changes, resulted in major transformations in the form of regime shifts, and quasi-periodic fluctuations. Detecting changes and identifying their causes (natural climatic or anthropogenic) form the basis for effective management strategies for sustainable use and protection of marine environment.

## 2. Biodiversity

Biodiversity refers to habitat and species richness and composition. Thus, at species level, biodiversity has two main components: "richness" (i.e. number of species) and "composition" (i.e. identity of these species). The number of species in the ecosystem, irrespective of their identities, can significantly influence ecosystem functioning (i.e. the cycling of energy, nutrients and organic matter that keeps ecosystems working). Biodiversity may influence standing stocks, biomass or production. It may influence as well rates of ecosystem processes, with increasing, decreasing or stabilizing rates.

Although exact numbers and timescales are difficult to estimate, biodiversity in the Black Sea has been declining for several decades. It is generally found that a reduction in biodiversity does have a negative impact on ecosystem function. Empirical evidence suggests that the loss of species brings about complex and dramatic reorganizations of ecosystems, including trophic cascades, cascading extinctions and rapid shifts to undesirable stable states. Trophic interactions play important roles in most of these processes. The major research topics are:

- how much biodiversity matters for the Black Sea ecosystem?
- how did biodiversity losses at higher trophic and/or lower trophic levels influence other trophic levels diversity, productivity and stability?
- how will biodiversity be critical for future functioning of the Black Sea ecosystem?

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Despite conceptual simplicity of these questions, it is rather difficult to find out quantitative explanations. The effects of biodiversity loss on community and ecosystem are complex, owing to indirect effects and feedbacks mediated by changes in community stability, productivity and food web interactions.

**3. Predicting ecosystem alterations by environmental and biodiversity variability**

3.1. Data constraints: A major barrier to the goals of predicting alterations in the ecosystems introduced by environmental and biodiversity changes, and assessing consequences of these changes is the scarcity of observations of sufficient duration, spatial extent, and resolution. Studying the past and present environmental variability, and changes in the state of living marine resources and ecosystems requires to obtain long-term data from various sources, to compile and analyze these data, to identify and describe the varying states. However, resource requirements for obtaining accurate and high resolution regional-scale three- and four-dimensional maps, and time series of fields via direct sampling on an observational network are generally prohibitive. Measurement and monitoring of the marine environment by survey vessel alone is often costly, time-consuming and provides a relatively infrequent dataset against which to assess environmental change. Measurement difficulties increase as one moves beyond the lower trophic level. Distributions become more patchy in space and variable in time so that sampling as well as measurement becomes more problematic. It is now widely accepted that in order to quantify the influence of physical processes on ecosystem, biological sampling must be matched to the appropriate temporal and spatial scales for relevant properties and processes.

3.2. Models and data assimilation: Dynamical models provide a powerful tool for conveying oceanographic information for scientific and practical applications, and for overcoming limitations of direct observations and measurements. They are also an important tool for extrapolating results, for testing hypotheses, and for developing theories that can be applied to a broad range of ecosystems with sufficient certainty to be credible. By melding observations from some limited set of more easily monitored physical and ecosystem variables with dynamics, it is feasible to identify the present state of the ecosystem reasonably well, and to predict future state of ecosystems with some success. For this purpose data assimilation provides the only feasible basis for obtaining accurate and reliable synoptic realizations over the space-time scales and domains of interests. Data assimilation is a technique to insert data into models by dynamically adjusting and interpolating into the model network. The models blended with observations are then used to predict future states of the ecosystems on useful time scales.

Using this approach it is possible to support a variety of critical activities in the sea, including fisheries management, navigation and marine operations, response to oil and hazardous material spills, search and rescue, and prediction of harmful algal blooms and other ecosystem and water quality phenomena. It is also possible to say, for example, that during a given physical regime in a given region, certain fish stocks might be expected to prosper while others would decline. The challenge here is to sharpen such predictions and to be able to provide more quantitative and detailed predictions, which often dictates a broader knowledge including those on variability of lower and intermediate trophic levels. Some important research issues are:

- to what extent can the ecosystem changes be predicted from the observed variables?
- can predictability be improved if additional or different variables are monitored?
- if observed changes are not predicted good enough, is it because of inadequate monitoring, inadequate analysis, or inadequate understanding?

3.3. Predictability: Predictability is an important issue for model predictions of atmospheric and oceanic events. It refers to maximum allowable time period in which model predictions are close

enough to the events actually occurring at that time in nature. Beyond this time period (i.e. Predictability time scale), errors and noise in the data and model are transferred nonlinearly into the fields to be predicted and give rise to unrealistic results. For example, today, the predictability time scale for accurate forecasting of weather systems is generally about 5 days.

Loss of predictability can be controlled by sequential updating of the model forecast with new observations. The relative weights of the data and the forecast when the observations are melded with dynamics are based on estimates of both observational errors and model errors. Thus error models are an intrinsic element of data assimilation schemes, and errors are propagated together with the forecast fields.

3.4. Ocean prediction systems: A permanent, continuously operating near-real time regional ocean prediction requires to establish an advanced technology observing system, numerical models and data assimilation, as well as the infrastructures necessary to use them.

In the Black Sea, some work has already been accomplished through retrospective data analysis and process-oriented model simulations using our existing coupled physical-biogeochemical models. Implementation of a long-term, multi-disciplinary, operational oceanographic monitoring and forecasting system is now underway to produce reliable assessments and predictions of future ecosystem changes, and to guide the direction of research and training to facilitate development of the system. These efforts are realized in collaboration with various institutions around the Black Sea, and are supported internationally by the Black Sea-GOOS and the EU 5th Framework ARENA project.

**4. Priority research foci**

The priority research foci, where the Black Sea and the Eastern Mediterranean Sea marine science have considerable general experience but lacks adequate detail, are summarized below.

1) PATTERNS OF COMMUNITY STUCTURE: Develop better understanding of the processes that drive patterns of marine populations and communities (e.g., through surveys of habitat-species associations).
2) ENVIRONMENTAL VARIABILITY: Continue theoretical and empirical research about how environmental variability contributes to the structuring marine populations and communities through time.
3) CONNECTIVITY: Further understanding of the processes and mechanisms that connect marine populations and communities (e.g., improve existing models and expand empirical studies of demographic and oceanographic linkages).
4) MONITORING AND EVALUATION: Continue to monitor important regions and hot spots as they are established, but also evaluate and strengthen the biogeophysical and socioeconomic bases of existing monitoring programs.
5) MAPPING: Compile the existing biogeophysical information in a comprehensive geographic information system (GIS). Use GIS to identify gaps in the information and initiate expert workshops and field studies to fill those gaps.
6) PREDICTION: Use the available data to assess the future state of the ecosystem through the help of models.
7) INTEGRATION OF INFORMATION: Bring together the currently disparate sources of biogeophysical and socioeconomic information.
8) COMMUNICATION: Share the relevant science about marine ecosystems and management tools with policymakers, resource practitioners, and the public.

# [*]Introduction to Topic 2.5: Regional and international cooperation and comparative situations in the Mediterranean and Black Seas

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In 2003 UNEP-WCMC/UNEP/UNESCO-IOC published »Global Marine Assessment: a survey of global and regional environmental assessments and related scientific activities« in which it was clearly stated: the high seas and open oceans are poorly covered as are marine areas around small island states. The coastal waters of developing nations are also poorly covered, due to lack of resources and capacity, both human and institutional. Among geographical gaps in the coverage of regional assessments this report identified part of the Mediterranean coast, while ecosystem function (including biodiversity) was the principal thematic gap. Both gaps are certainly not due to lack of international (global and regional) agreements as there are today over 500 international agreements on different aspects of ocean protection and the use of marine resources. The Mediterranean and Black seas are covered not only by global agreements (like UNCLOS, CBD, etc.), but also by several regional ones. There are now 140 countries participating in 18 regions (including the Mediterranean and the Black Sea) within the Regional Seas Programme established under UNEP auspices. Regional Seas Programmes are underpinned with a strong legal framework (regional conventions and associated protocols). Conservation and management of marine and coastal ecosystems including biodiversity have been among the priority issues of the Regional Seas Programmes and new strategic directions (2004 – 2007) include science based and ecosystem based management as two of the central elements. The Mediterranean Regional Sea Programme was one of the first to be established in the mid-seventies (Mediterranean Action Plan – MAP) and one of the first to include biodiversity issues. Activities for conservation of marine and coastal biodiversity in the Mediterranean culminated in the elaboration of the Strategic Action Plan, a base for implementing the 1995 Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean. A regional organisation that promotes marine research CIESM (Commission International pour l'Exploration Scientifique de la Mer Mediterranee) had been established as early as the beginning of the 20th century. It has now grown to 23 Member States which cover most of the Mediterranean and Black Sea shores. The Commission aims to promote research cooperation by initiating international projects, by organising conferences and workshops and by publishing scientific information, reports, bibliographic data bases etc. To better the understanding between the two shores of the Mediterranean, enhanced cooperation between the MAP and the Euro-Mediterranean partnership has been established. On a pan-Mediterranean scale, a good example of

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regional co-operation is the MAMA project ('The Mediterranean network to Assess and upgrade Monitoring and forecasting Activity in the region'), an ongoing thematic network project funded by the 5th EU Framework Programme, involving, for the first time, all Mediterranean Countries. Through the MAMA Consortium, awareness is also being raised on the need to assess biological indicators of ocean health as an aid for monitoring the coastal marine ecosystem. Within this context, countries in the entire Mediterranean basin are encouraged in order to share in similar efforts and resource availability, and as an important path to capacity building, quality control and assessment processes.

The Black Sea Environmental Programme (BSEP) was established in 1993 with a Programme Coordination Unit and a work-plan agreed on by National Coordinators (Ministers of the Environment). On October 31, 1996, (declared as "Black Sea day"). The Strategic Action Plan, (Convention for the Protection of the Black Sea against Pollution) preliminary adopted in Bucharest, 1992 (Bucharest Convention) and Odessa, 1993 (Odessa declaration) was signed by the 6 Black Sea countries. Recently the text of the Strategy on Biological Diversity and Landscape Protection was drafted and will be finalized to act as a Regional Biodiversity Protection Action Plan. In the BSEP Project report, finalized in 1996, it was stated that "the Black Sea can only be saved if all the countries in the region work together towards a common goal." The first attempt to integrate the Black Sea scientific efforts after "perestroika" was the HydroBlack-CoMSBlack NATO Program (initiated by an American), followed by 2 NATO Projects, co-ordinated by Turkey. Meanwhile the Black Sea countries were partners in a number of regional projects with external financial support, GEF-UNDP Regional Project on Biodiversity and the Black Sea Mussel Watch Project just to mention two. Among others, the core achievements related to biodiversity research were the Country Reports on biodiversity published in 1997, as well as the Black Sea Red-data book, a collaborative effort of the 6 Black Sea countries – in 1999. The NATO TU-Black Sea Project compiled the first common interdisciplinary data-base. The current flagship regional activity is the GEF/UNDP Black Sea Recovery Project aimed at assessing the present state of the Black Sea ecosystem, with biodiversity and ecosystem health being targets of primary importance. Implementation of the BS Integrated Monitoring and Assessment Programme (BSIMAP) in compliance with the Bucharest Convention will be revised based on the GEF Project results of the pilot surveys, the national monitoring programmes and the principles of the WFD. As a final target a "State of the Black Sea Environment" Report will be prepared which is intended to provide adequate information on biodiversity issues and on the state of the Black Sea ecosystem. The setting up of an affordable monitoring program in order to harmonize assessment methodologies, analytical techniques, commonly agreed upon reporting formats etc. as well as the elaboration and maintenance of the Black Sea Information System for supporting the decision making processes of the Black Sea Commission are in progress.

Have all these legal and institutional frameworks helped build bridges between north and south, east and west in the Mediterranean and the Black Sea regions? How efficient are all these activities in dissolving borders in an environment of such high political and cultural diversity? Can we take further steps to enhance regional collaboration and which financial mechanisms can support it? Do scientific initiatives matter? What can we do to improve communication not only among researchers separated by geographic, cultural, and other borders but also researchers and policy makers in order to establish common research priorities?

# Session 3: Black Sea

# [*]Introduction to Topic 3.1: From taxonomy to patterns and processes – the problem of "classical taxonomist guild extinction" and the need to advance biodiversity research in the Black Sea

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"The future historians of science may well find that a crisis that was upon us at the end of the 20th century was the extinction of the systematist, the extinction of the naturalist, the extinction of the biogeographer, those who would tell the tales of the potential demise of global marine diversity" (Carlton,1993 in "Uhnderstanding marine Biodiversity"). During the last 3 years in the field of phytoplankton taxonomy only we have lost 3 of the most eminent systematists from the Northwestern Black Sea forever, the average age of the currently working is over 40, without any fresh recruitment. It has taken biologists some 230 years to identify and describe three quarters of a million insects, (if they are 3 million!) then, working as they have in the past, insect taxonomists have ten thousand years of employment ahead of them. Ghilean Prance…estimates that a complete list of plants in the Americas would occupy taxonomists for four centuries if working at historical rates (Leakey, R. and R. Lewin, 1995).

Understanding which species are critical in energy flow from lower to higher trophic levels in a food chain, for example, may be nearly impossible if many members of a particular group of prey or predators are undetected or undescribed and at the same time the question remains do we have to know the name of every species in order to understand ecosystem? This dichotomy has been debated long enough and the answer is not that simple. A useful working definition of the ecosystem approach has been developed by the Convention on Biological Diversity (CBD 1998): "The ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass the essential processes and interactions amongst organisms and their environment. The ecosystem approach recognizes that humans are an integral component of ecosystems."

With new molecular techniques surprising levels of genetic diversity are now being discovered in marine organisms often calling into question critical concepts of speciation in the sea. Evidence from mitochondrial DNA (mtDNA) analysis of humpback whales has shown, for example, genetic differences over surprisingly short distances with important implications for conservation. Species Diversity Molecular genetic techniques combined with classic morphometric approaches are now revealing numerous sibling species complexes within what were frequently believed to be single species. A particularly striking example is one of the world's best-known marine invertebrates, the mussel *Mytilus edulis*, now known to be three distinct species and yet this mussel has formed the basis, on the presumption that it was one species, for the pollution-monitoring "International

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Mussel Watch Program". The different growth rates of at least two of these cryptic species evidently result in observed different body burdens of some contaminants. The marine worm *Capitella "capitata"* once regarded as a cosmopolitan "indicator" species of disturbed, organic-enriched sediments, is now known to be 15 or more sibling species that occur from the intertidal zone to the deep sea. Use of molecular techniques has also suggested that the common dolphin (*Delphinus delphis*) is actually two species that may have different distributions and abundances and therefore different requirements for protection (Committee on Molecular Marine Biology, 1994).

Molecular techniques provide one of the most powerful means for revealing a new understanding of the ocean's complexity. Habitat and Ecosystem Diversity Advanced instrumentation and sampling have revealed new species assemblages in novel habitats in the oceans, such as sites of hydrothermal, brine, and hydrocarbon seepage which is a striking reminder that the biodiversity of the majority of the Earth's surface may be dependent on yet undiscovered and unanticipated habitat diversity (Pimm, S.L. and T.M. Brooks. 1999).

Environmental genomics allow to obtain an important insight into natural populations such as gene flow, mixing of different gene pools, effective population size, inbreeding rate, genetic loss, assignment of individuals to a population, the action of natural selection, gene introgression and hybridisation, taxonomic position (Maltagliati, F.; Backeljau, T., 2003) thus contributing to delineate the structure and dynamics of biodiversity in marine ecosystems. The functional and adaptive aspects of intraspecific biodiversity acquire knowledge about patterns and processes that rule biological diversity. It is only by considering this entire complexity, too often neglected by stakeholders, that a given plan for management will have long-term success.

Our knowledge in the Black Sea is based more on the spatial distribution or temporal trends of the biota whereas the experimental studies are in minority. Questions why are some populations of a species toxic and others aren't, which suites of genes get turned on, what environmental factors trigger increased production of secondary metabolites, coupled with rigorously controlled experiments and call for proactive and efficient scientific research (the yeoman work in any science, is done by the experimentalist, who must keep the theoreticians honest - Kaku M., 1995).

Obviously the time has come for rethinking and reconsidering our strategy of capacity building and biodiversity research in the Black Sea to understand the patterns, processes, and consequences of changing marine biological diversity:

- What are the alternatives in facing "graying taxonomist" crisis in the Black Sea? How to raise the standard of taxonomic competence in all marine ecological research;
- How to provide opportunities for a new generation of systematists, focused not only on counting species, but understanding the ecological role that species play in marine communities?
- What are the threshold effects of the critical environmental issues
- What is the connectivity of local, smaller- scale biodiversity patterns and regional, larger-scale oceanographic patterns and processes that may directly impact local phenomena, e.g. the dimension of biodiversity
- How to encourage the incorporation of new technological advances in sampling and sensing instrumentation, experimental techniques, and molecular genetic methods, and to develop predictive models for hypothesis development, testing, and extrapolation
- Are we doing enough for promoting the research results among the global scientific community (I wonder what is the number of Black Sea papers related to biodiversity published in peer reviewed journals, and at the same time high-level scientific results are

published in Russian- “Multidisciplinary investigations in the North-Western Black Sea, Ed. A.G. Zatzepin, M.V. Flint, Nauka, Moscow, 2002, for example)

- Where are we on the way of developing Computer-Aided Identification (CAI) and databasing Biological informatics? Do we use efficiently what has been already developed.

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# [*]Introduction to Topic 3.2: Microbiota, deep sea biodiversity and unexploited habitats – the neglected biodiversity

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Bacteria are responsible for most of the biogeochemical cycles that shape the environment of Earth and oceans. However marine microbial ecology is a relatively new discipline, dating back to the end of the 1970s. Today we know, on average, bacteria exist 106 ml-1, are the most abundant oceanic biomass, and perform majority of metabolic activity. Even more recent is our information on marine viruses not studied until 1989 which are the most abundant biological entities in the sea (107 ml-1). Their main role is "killing the winner" thus maintaining bacterial diversity by not allowing one species to overwhelm a community.

We are still at the very beginning of a golden age of biodiversity discovery driven largely by advances in molecular biology and a new open mind about where life might be found. But for this golden age to be as widely appreciated as it should, our view of the natural world must change, because all of the marvels in biodiversity's new bestiary are invisible. It is now time for biologists – by whom I mean people who think of themselves as biologists, zoologists, botanists and ecologists – to cease presenting to their students and the public a perspective of life on Earth that is so biased toward the visible. In the universal phylogenetic tree visible life consists of barely noticeable twigs (plants, animal and fungi, most of which are not visible). This should not be surprising: invisible life had more than three billion years of diversity and explored evolutionary space before "visible" life arrived. The biological and geological history of Earth can be separated into two super eons: the first, beginning ≈3.8 billion years ago and lasting until ≈2.3 billion years ago when oxygen in the atmosphere and oceans increased substantially, was characterized by metabolic experimentation and innovation. During this 1.5-billion-year interval, life consisted of aquatic microbes that evolved a large array of metabolic processes, which, in turn, changed the atmosphere and oceans into oxic environments. To cope with these changes, microbes became adapted to an aerobic environment. This accommodation has been manifested over the past 2 billion years. Arguably, nowhere on Earth is this microbial diversity more apparent though poorly understood, than in the contemporary oceans (Falkowski and de Vargas, 2004).

However, only about 4500 species have been characterized, leaving most of the diversity of prokaryotes unexplored. Prokaryotes constitute the domains Archea and Bacteria and consist of possibly millions of different species. Traditionally, the unit of diversity is the species, but we do not know whether any naturally occurring entity of prokaryotic species exists, and a variety of definitions for the concept are used for these organisms. First, the "phylophenetic" definition circumscribes the species as a "monophyletic and genomically coherent cluster of individual organisms that show a high degree of overall similarity in many independent characteristics, and is diagnosable by a discriminative property". Second, a species can be defined as an assemblage of

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strains sharing 70 % (but perhaps as much as 97%) DNA homology. Third, in an ecological definition, a species consists of the organisms occupying the same niche (Torsvik et al., 2002).
Much of life's diversity is microbial, but most microbes cannot be grown in culture. Present estimates suggest that >99% of the microorganisms in most environments are not amenable to growth in pure culture, therefore, very little is known about their physiology and role in these environments. These organisms can, however, be categorized into phylotypes (the equivalent of species for microbiologists) according to their ribosomal RNA genes, which can be amplified directly from environmental DNA extracts, then cloned and sequenced. Although this approach has provided information on the identity and distribution of microbial species, rRNA gene sequences alone do not reveal the physiology, biochemistry or ecological function of uncultivated microorganisms. This problem can now be addressed by isolating the genomes of these microorganisms and, through the identification of protein-coding genes and biochemical pathways, we can shed light on their physiological properties and ecological function. We can now use several bacterial artificial chromosome (BAC) and fosmid libraries, which have already been used to discover a novel light-driven proton pump (proteothodopsin) in a marine bacterium (which has now been found in different oceans and in genomes of widely divergent bacterial groups). Recently Craig Venter used a shotgun sequencing approach to assess marine microbial populations collected in the Sargasso Sea. From only 1500 litres of surface water, a total of 1.054 billion base pair sequences were generated with an estimated 1800 genomic species, including 148 novel bacteria phylotypes (Bèjà, 2004).

In agreement with Azam and Worden (2004) I would stress that there is an excellent opportunity to consider the ocean as dynamic molecular architecture and appreciate real time expression as the mechanistic basis of ecosystem dynamics. They wrote "Although the goal of treating organisms and the environment as a molecular continuum is huge, the rate of progress in genomic and proteonomics and its integration into oceanography promises success. Ecosystem biology offers a framework for integrating genomic, biochemical, and environmental data. This framework will also unify efforts for biodiversity conservation and conservation of desirable biogeochemical states of the ocean".

Actually it seems that microbial biodiversity is not neglected at all. On the contrary, looking at the short list of citations, it seems to have provoked great scientific excitement and intellectual effort in the past few years, but certainly the path ahead is long and hard.

- Now the question is: how much effort should (and will) we devote to understanding microbial diversity at both the taxonomic and functional levels?
- How many experts, belonging to many different scientific branches (which have to become accustomed to working together) do we need to achieve this goal?
- How can we pique interest in young scientists for these new conceptual models?

To focus on the Black Sea in this context, I must say that the road will be even longer. The Black Sea is the largest surface-exposed permanently anoxic basin on this planet. It was considered to be a most hostile environment, absolutely inadequate to support any form of life, when we thought of life as only associated with the visible part of our world. In this area, the high intensity of photosynthetic primary production in the surface waters, the associated flux of organic carbon and the shallow sill depth has led to the development and maintenance of the largest, stable oxic/anoxic interface on the planet. This interface, or chemocline, is located at a depth of 81 to 99 m. A 20 – 30m deep sub-oxic layer depleted in both O2 and H2S overlays the sulphide zone. The stratified water column in the Black Sea is believed to host a more active and diverse microbial assemblage than anywhere else in the pelagic ocean. Nevertheless, today very little is known about this rich-in-diversity community. To my knowledge (maybe some grey literature is available to some readers) there is only a vertical profile of microbial diversity assessed by Vetriani et al. (2003) on old

samples kept frozen for 10 years, a fact that, from personal experience, might lead to a serious under-estimation of some bacterial groups (and give an unnatural advantage to other groups). There is another study on methane oxidizing Archea, most likely in consortium with sulphate reducing bacteria that was demonstrated to occur the sediment of the Black Sea. Almost nothing has been done in the last years to undiscover the biodiversity of these peculiar communities. To appreciate biogeochemical cycles in this extreme environment we need to put more effort into understanding the composition and function of the microbial assemblage.

I am wondering, if Craig Venter sailed these waters, and looked into the deep, how many new genes and phylotypes he would find. But probably he prefers mild Caribbean waters to search for some other billions of genes!

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# [*]Introduction to Topic 3.3: In search of pressure-state-response biodiversity indicators - extending science to policy

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It is commonly accepted by many scientists and politicians that Biodiversity has been one of the overriding global environmental concerns during the last decade and this is unlikely to change in the foreseeable future. The importance and the urgent need for action on biodiversity has been recognized at the international level, with ecosystem destruction and species distinction recognized on a global, epic scale (Ormund et al., 1997). The Convention on Biological Diversity of Rio focused on the need for the inventorying, monitoring the changes and conservation of all components of Biodiversity while at the second meeting of the Convention in Jakarta it was particularly recommended that special focus should be given to the Marine and Coastal Biodiversity (Jakarta Mandate).

Biodiversity, which may be defined as the variety of life and the interactions between life and the environment (Reaka-Kudla et al., 1997), encompasses all species of plants, animals and micro-organisms found in the ecosystems, as exemplified in the NRC definition: collections of genomes, species and ecosystems (National Research Council, 1995).

Although various levels of biological organization can be recognized (molecules, cells, individuals, populations, species, communities and ecosystems) diversity has been traditionally studied at the following three levels: genetic diversity, species diversity and ecosystem diversity (Warwick, 1996). A fourth level, the sea- (land-)scape diversity, which integrates the type, condition, pattern and connectivity of natural communities or ecosystems, has also been recognized recently. Historical, biogeographic and oceanographic factors have structured biodiversity at the $\alpha$ (local habitats), $\beta$ (between habitats) and $\gamma$ (regional) levels (Ormund et al., 1997).

To monitor the changes, control, manage, restore and conserve biodiversity it is imperative that we know how to measure it. The profound difference between terrestrial and marine systems on one hand (open nature of marine systems, less distinct boundaries and different scales of change in time and space) and on the other usually remote sampling in the marine environment has resulted in the development of specific methodology and approaches for studying marine biodiversity. Reviews of species diversity measures – indices and distribution plots are provided by Magurran (2003), Clarke & Warwick (1994), Gray (2000), etc. These cover the traditional components of diversity – species richness and heterogeneity/equitability. Newly-developed Taxonomic Distinctness indices offer additional information, which has to do not only with the species richness component of the

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diversity but also with the “phylogenetic/taxonomic relatedness” of the species; this information is “hidden” behind species’ names and none of the previously-used traditional diversity indices make use of it. Taxonomic diversity implies also a measure of genetic diversity and constitutes the overlap point of species and genetic levels of diversity. In recent years, powerful tools have become available to the marine science community to describe within-species diversity and address how human activities may be affecting genetic diversity in the seas. Investigations directed to studying spatial genetic variability, measure within- and among-population genetic diversity, and estimating phylogeographic/phylogenetic relationships among populations/taxa provide essential knowledge for informed management and conservation of biological marine resources. Genetic monitoring methodologies allow assessment of the effects of environmental stress on population level but are still scarce and should be further developed (Hiscock et al, 2003).

The identification and selection of biodiversity indicators, in order to develop guidelines for ecosystem evaluation and assessment, is one of the operational objectives of the Jakarta mandate. Although the Pressure-State-Response (PSR) model provides an intellectual concept of causality, which has been proved to be useful in other disciplines, the nature (traits) and the information included in biological/ecological measures (e.g. rates of energy transformation, indices, coefficients, etc.) already in use in the field of marine biodiversity make the application of the PSR model very difficult.

BIOMARE (www.biomareweb.org) was one of the main European initiatives, focusing on this particular issue. This Project resulted in quite a different classification and connections of the hitherto known marine biodiversity indicators and associated methodology, which is schematically provided in the attached figures (Féral et al., 2003).

In February 1998, the European Commission produced a strategy document on Biodiversity in context of the CBD. This document was accepted by the EU Parliament (20th of October, 1998) and now is policy, which the EU will implement. The document encourages Member States to have Action Plans in place, in order to implement this EU strategy. It particularly focuses on the need for Biodiversity to be addressed by all sectors, including Fisheries, Forestry, Agriculture, Energy, Transport, Tourism, and aid to the developing parties. The EU Strategy document provides criteria for the identification of priority areas of biodiversity research and management, in relation to species, biotopes and ecosystems. Marine Biodiversity per se and the negative ecological, economical and societal consequences were not considered in none of the European Action Programmes. EEA (European Environmental Agency) has just released a call for Proposals for the development of the European Topic Center on Marine Biodiversity, a fact indicating that European Policy on Marine Biodiversity Indicators is still in its infancy. However, the application of some biological/ecological measures used for the assessment of the water quality, is encouraged in the EU Water Framework Directive.

Based on the above background, we believe that the basic questions for the discussion today are:

1. Do we really lack Marine Biodiversity Indicators?
2. If so, what kind of information should be included in the new Indicators?
3. How robust are Indicators in distinguishing between anthropogenic impacts and natural impact on biological diversity?
4. Should the Indicators be the only communication tools between scientists and politicians?
5. What kind of legislative Instruments should be developed in order to integrate the corresponding issue of MBI?

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# Summaries of the discussions

# Session 1: Eastern and Southern Mediterranean

# [*]Summary of discussions on Topic 1.1: The role of top predators (incl. gelatinous organisms) and large nekton (incl. whales & dolphins, seals, sharks, turtles) in biodiversity

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The session was introduced by Ahmet Kideys and Alessandro de Maddalena that suggested that the role of the "super-predator" (i.e. the man) on biodiversity is not always negative. While human accelerated the rate of extinctions (e.g. 100 times for mammals compared to background levels of 0.5 extinctions per 100 years, Barbault et al. 1995), it also increased biodiversity in many parts of the world with introductions. In the case of Levantine Sea, the phenomenon is especially important due to the Lessepsian migration since the man opened Suez canal in 1869 causing Indo-Pacific species to settle in the eastern Mediterranean. Fifty-seven fish species alone, denoting about 10% in the entire Mediterranean are Lessepsian migrants here (Golani et al., 2002). Some of these species, such as the lizardfish *Saurida undosquamis* are now often dominant in trawl catches providing a good income to the fishery sector.

Martin Bilio suggested that the fact that the man may increase biodiversity depends on the situation. It needs to know what type of top predator is being introduced and which trophic levels does it influence directly. If the top predator is of commercial importance, much would depend on the degree of exploitation. Also, it would be important to know whether this top predator is mono- or multiphageous, as well as which and how many trophic levels would its preying activity affect.
Kerim Ben Mustapha suggested that our background is probably insufficient for evaluating if man is increasing biodiversity. The lack of historical data and actual studies that aren't wide enough to give us a real overview of marine ecosystems' functioning and therefore of their state. Impact of man's activities can be seen as positive, if we stand to fisheries, invasive "commercial" species increased fisheries income but it's worst to stop at this point. The problem is global, as Prof. Carlo Heip wrote it "Microbes, plants and animals do not respect borders and many problems dealing with their ecology, exploitation and conservation cannot be tackled in a national context", and as such, we should not answer this question without having in mind the global changes that are affecting our seas/life see for instance the Eu report on climate changes, predicting an important increase in Europe's temperature during the next 50 years (EEA, 2004). Therefore Kerim Ben Mustapha suggested that there is no need of man's intervention to "advisedly" increase BD, since there is enough changes nowadays (natural and artificial) to weaken the natural imunities of the ecosystems.

Igor Mitrofanov underlined the fact that it needs to speak about human influence, not only as a "predator", since there are different types of activities with different results. As a "super-predator" he can only reduce the biodiversity by over-exploitation. Introducing of valuable species is another

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type of activity, as well as it is accidental introduction with ballast waters or by constructing channels. In this case man plays a role of geological factor. In this sense, Alessandro De Maddalena, underlined the problem of the species accidentally killed by commercial fishermen and thrown-back into the sea because they are considered of none interest for fisheries or are protected, and those caught by recreational anglers, often not to be consumed. Humans also have a less direct but just as harmful effect on marine life because of depletion of resources, environmental pollution and habitat destruction.

Ferruccio Maltagliati, considering factors that increase biodiversity (mutation, genetical drift, natural selection, speciation, habitat ecological diversity) concluded that while man cannot directly increase biodiversity by means of his activities, there can be some instances of indirect increase of levels of biodiversity. For example, the presence of a man made barrier to gene flow can (theoretically) promote population divergence, namely an increase of biodiversity at population-level. Ferruccio Maltagliati, proposed the problem should be shifted toward the problem of acceptability of a given human impact on marine natural systems. Unfortunately, economic interests very often assume priority higher than ecological interests. In the same direction, Daphne Cuvelier arised the question if do we want to maintain or create high biodiversity per se (introductions of species by man) or do we want to maintain a 'natural' situation with possibly lower biodiversity but with less human impact? Ferruccio Maltagliati underlined the fact that an increase of local biodiversity does not mean that the total biodiversity will be positively affected. In best cases the total biodiversity does not increase but remains constant. Therefore we should always reason in terms of total biodiversity, and in this sense introductions cannot increase the biodiversity.

Ahmet Kideys suggested that however in some cases the introduction of species from an area to another may have positive effects, especially when the species is disappearing from the area where it is endemic. An example may be the cladoceran Centropages, lost from the samples in the Caspian, but widespread causing problems in introduced areas such as Baltic and Great Lakes: the introduced populations gives man opportunity to repopulate the Caspian with the cladoceran.
M. Khalil, on the introduction of indo-Pacific origin species via the Red Sea and Suez Canal and its success of colonizing the Eastern Mediterranean shores, stressed that he most important factor which help these invaders to colonize the region is their high possibility to compete with native species, to tolerate pollution and their feeding habits as most of them are predators. M. Khalil judged that these predator invaders are reducing biodiversity and Nejla Deeb suggested that ecological monitoring programs are required to control this phenomenon. A. Badr concluded that since marine ecosystems attempt to obtain balance and stability, we have to allow the environment to regain its balance without human disturbance.

Anthony Moss suggested that man will never serve as a biodiversity enhancer, because of the crude fishing mechanisms he uses. Anyway Ahmet Kideys note that a crude fishing practice with lots of discarded bycatch is the trawling, but according to Zenetos (1996-1997) species number and abundance were higher in the regularly trawled area (466 species) than in the untrawled (174 species). In this sense, Ferruccio Maltagliati, cited that Connell (1978) and, successively, many other ecologists have taught us that intermediate levels of disturbance can enhance biodiversity. There is therefore a theoretical possibility that a crude fishing determining intermediate disturbance could increase biodiversity, but definitive evidences lack if we reason in terms of total biodiversity instead on a local scale. Kolbe et al. found that the increase of genetic variation in a Cuban Lizard is due to multiple introductions from different geographical sources. This produces introduced populations that are more genetically variable than each of the source populations. So, reasoning in local terms, genetic variation (ultimately, "biodiversity") is enhanced. However, strictly speaking, from a total biodiversity perspective, the total within-population genetic variation of the species is

not enhanced because the introduced population is only a mere rearrangement of pre-existing genotypes.

Ahmet Kideys and Alessandro de Maddalena presented two options regarding the effect of removal of native predators from the trophic network. In certain ecosystems particularly for those with high biodiversity, the removal of predator may not have any apparent effect (i.e. redundancy hypothesis). However, in many cases removal of predation will decrease the bioversity. With the pioneering study of Paine (1969) in the intertidal shores of the northwestern America, the role of predation in maintaining the biodiversity is clearly understood, at least for some marine ecosystems. Paine removed the starfish (the top-predator) from the system and observed that the number of prey species collapsed from 15 to eight, and a single species, a mussel, covered almost all the experimental site. The starfish was thus a "keystone species" for this ecosystem. Unfortunately, similar studies are lacking with respect to gelatinous organisms and large nekton in the world seas. So we cannot clearly validate the importance of these top predators on the ecosystems of the eastern Mediterranean.

Ahmet Kideys and Alessandro de Maddalena also asked for ideas about which methods have to be used to understand the role of the top predators on biodiversity.

Martin Bilio pointed out that it depends on the type of top predator and on the type environment (ecosystem). Factors to be studied would be (a) trophic relations, (b) spatial distribution of the components, concerning preferences of the respective range of environmental conditions.
Carna Milos proposed the example of the gelatinous zooplankton's predatory role, of which the knowledge derives mainly from studies of large Scyphomedusan species. On the other hand small hydromedusae are the most diverse gelatinous plankton group (Boero & Bouillon, 1993) being themself endangered by ecosystem crises like hypoxia / anoxia (Benovic & Lucic, 2000) and mucilage phenomenon. In comparison with investigations of composition and abundance of gelatinous zooplankton in the gulf of Trieste (northern Adriatic) in 70'ties (Malej, 1977) and in 80'ties (Benovic et al., 1987) Milos (2003) listed less species and their abundance was lower in year 2001. Although the composition and abundance of gelatinous organisms may change from year to year the phenomenon of mucilage that was quite intensive during 2001 was the major reason for this reduction.

Alenka Malej underlined the fact that massive outbreaks of native and introduced gelatinous organisms, particularly of large scyphomedusae and ctenophores, are well documented in many areas including the southern and eastern Mediterranean Sea and the Black sea (CIESM, 2001). Sometimes the outbreaks are sporadic events and of short duration. In other cases a more sustained increase in gelatinous organisms has been related to the regime shift (i.e. change in atmospheric and oceanic conditions, Mills, 2001, Malej & Malej, 2004, Niermann, 2004). Field studies done in different marine environments indicated that outbreaks of gelatinous organisms had similar effects on pelagic food web: a decrease of mesozooplankton biomass accompanied by plankton community changes (Purcell et al., 1999, Brodeur et al., 2002). For example: a shift from copepod-dominated community towards predominance of some small gelatinous taxa (*Noctiluca scintillans*, and Thaliacea) and increased importance of Cladocera was observed during outbreak of the jellyfish *Pelagia noctiluca* in the northern Adriatic (Malej 1989). These community changes that were associated with reduction of zooplankton biomass indicated a change in ecosystem functioning. On the other hand, it is more difficult to demonstrate the effect of gelatinous predators on species richness. Moreover, in contrast to benthic environment where exclusion experiments were used to demonstrate the role of top predators in maintaining biodiversity, such experiments with multispecies pelagic communities are much more difficult. More recently, CAS (complex adaptive system) theory has been proposed as useful framework that could contribute to understanding the role of biodiversity for ecosystem functioning (Norberg, 2004).

Ahmet Kideys and Alessandro de Maddalena, stated that among the top predators, while cetaceans and sea turtles are protected and the bony fish fishery is partially regulated in the Mediterranean, very few countries (Italy, Malta) have specific (but not strictly obeyed) laws for shark protection (but only for the *Carcharodon carcharias,* and *Cetorhinus maximus*). Protection only from targeted fishery does not mean a real protection and therefore due to other reasons (habitat loss, pollution, bycatch etc), the population size of all these large nekton are decreasing. Once upon a time, due to natural mortality, the carcase of these large animals were the food of several bacteria (some of which are sulphur-reducing chemosynthetic) and animals on the sea bottom. Now, we could only speculate about this biota that their species diversity must have been affected badly. Alessandro De Maddalena underlined that sharks are more vulnerable to fishery than bony fishes. Since few species prey on them, sharks are naturally highly vulnerable to overexploitation as they have long sexual maturation period, low fecundity, long gestation periods and they produce small numbers of young. Moreover many shark species segregate by size and sex and exploitation of sharks in a nursery area can be particularly devastating. These fishes are unable to withstand long periods of overexploitation since this has long term effects and rebuilding shark populations takes many years. Most commercial shark fisheries collapse within a few years (Watts, 2001).

Adib Saad presented the situation of cartilaginous fish on the Syrian coast. In the course of 3 years of observation (2000-2003), 37 species of Chondrichtyes are inventoried (Saad et al., 2004). In this study, 2 species were found in the Eastern Mediterranean for the first time, namely *Carcharhinus obscurus* and *Torpedo* (*Torpedo*) *sinuspersici*, the latter represents a new lessipian migration. Several species, that were reported previously, were not observed again, this concerns relatively common species like *Scyliorhinus stellaris, Mustelus asterias, Torpedo torpedo, Myliobatis aquila, Sphyrina zygaena*. This phenomenon can most likely be attributed to a decline in their population. An important decrease in the stock of *Rhinobatos rhinobatos* has been noted too. To mark out the biodiversity of the Chondrichtyes in a decent way in the Eastern Mediterranean, research efforts in deep waters and continuing surveys in the framework of a programme for regional cooperation is necessary.

Lovrenc Lipej stressed that while we are aware of the population estimates of the fin whale in the Mediterranean (Notarbartolo di Sciara et al., 2003) and of the status of the monk seal, this is certainly not the case with sharks, and especially in the Adriatic Sea and the eastern part of the Mediterranean Sea. In the Adriatic sea, at least 28 shark species are reported to date (Bello, 1999). However, among them many are recorded very rarely and we lack any data on some species in the last fifty years. Such species were only rarely reported, since they are inhabiting deep water waters, obviously of less importance for fishermen. The rest of the Adriatic shark assemblage is represented by commercial shark species, which are heavily fished, especially *Squalus acanthias, S. blainvillei, Scyliorhinus canicula, S. stellaris, Mustelus mustelus, M. asterias* and *M. punctulatus*. Today, the most studied shark species are the last mentioned ones. The majority of works are dealing with reproductive biology (Zupanovic, 1961, Jardas, 1972), while only few works are speaking of feeding preferences of the mentioned species. Such situation is not the peculiarity of the Adriatic, but it can be stated also for the whole eastern Mediterranean.

Lovrenc Lipej indicated three main reasons for this paucity of data: a lack of financial support for projects on the biological aspects of sharks in the Adriatic, a lack of specialists, and the obvious difficulties encountered to study sharks in their environment. But without a basic knowledge on shark biology and ecology we certainly cannot asses their role in structuring biodiversity. As Alessandro De Maddalena pointed out, in the Mediterranean region, despite their being important parts of marine ecosystems, shark research is often neglected in favour of study of the more commercially important bony fishes. It is also necessary to better manage fisheries in which sharks constitute a significant bycatch. In the Mediterranean, lack of management is leading to extinction

of many shark species, therefore the stability of the marine ecosystems is in serious danger. Obviously, as indicated by Ferruccio Maltagliati, different species of sharks need different protection measures, given their ecological, biological, behavioural and demographic characteristics. Unfortunately, as Alessandro De Maddalena underlined, at the present, the number of species needing some kind of protective measure is very high: Cugini & De Maddalena (2003) cited 11 shark species that need immediate protective measures (*Echinorhinus brucus*, *Carcharias taurus*, *Odontaspis ferox*, *Carcharodon carcharias*, *Isurus oxyrinchus*, *Lamna nasus*, *Galeorhinus galeus*, *Carcharhinus plumbeus*, *Prionace galuca*, *Sphyrna zygaena*, *Oxynotus centrina*), that is 22,4% of the 49 shark species recorded in the Mediterranean area. We must add that most of other Mediterranean shark species need also fishery regulation measures accompanied by an effective control. Alessandro De Maddalena suggested that a strong reduction of by-catch captures is the first step in conservation of Mediterranean shark populations, since species such as *P. glauca* and *I. oxyrinchus* are strongly affected by fishing for other species such as tuna and swordfish (Buencuerpo et al., 1998).

The number of papers on sharks published in recent years has grown noticeably (see for example Slovenian journal Annales, Series historia naturalis), and this is surely an excellent thing, but the works produced are mostly based on the kind of studies that a researcher can carry with its own personal resources (morphology, reproduction, distribution, etc.). Producing works on population estimates is another thing, that need other, much more expensive, methods. Alessandro De Maddalena stated that the partial lack of shark specialists is simply a result of the lack of funds. The possibilities of working on sharks in Mediterranean countries are almost inexisting. We told about a "partial lack" of shark specialists, because really we have a good number of ichthyologists working on sharks (most of them now united in the Mediterranean Shark Research Group), but even them are hardly hindered in their work because lack of funds from their Governments. Therefore Alessandro De Maddalena concluded that the main problem is to find the way to force our governments in changing their politics of fund investing in marine biological area before it is too late. Piia Tuomisto pointed out the existence of the INCO Call FP6-2004-ACC-SSA-2, Specific Support Actions (SSA) for Associated Candidate Countries, with a budget of 19.8 Million Euro, targeted at research institutes in Bulgaria, Romania and Turkey.

Michael Stachowitsch considered that sea turtles are unique in that they face threats from two ecosystems, terrestrial and marine. Researches on sea turtles in Turkey showed an insidious deterioation of the situation, visibly evident in the state of the nesting beaches, for example. Despite their status as Special Protected Areas, these beaches are, from year to year, declining with respect to construction, light pollution, jetskiing, sand removal, etc. While we trying to save nesting beaches and helping help a few thousand hatchlings reach the sea hundreds of adults are being killed every year.

Bjorndal & Jackson (2003) treat hawksbills and green turtles and make reconstructions based on past and present population estimates and the ecological roles of the two species in the Caribbean. Accordingly, the removal of hawksbills (95% reduction from preexploitation levels) probably has a major effect on the balance between sponges and corals in coral reefs (hawksbills consume sponges, and sponges are main space competitors with corals). An equally convincing argument is made for the effect of removing green turtles, which once had a major impact on Caribbean sea grass beds as grazers; this role has been minimized and may explain some of the deleterious developments recently recorded in sea grass beds. If we transpose such new knowledge to the Mediterranean and include a host of other highly impacted top predators, we may get some kind of idea about the terrible, ongoing, and irreversible damage being done to the marine ecosystem and to biodiversity here.

Sawsan Hassan pointed out that the presence of predators such as marine mammals, sharks and turtles indicates a healthy and 'safely' marine ecosystem. Many exploiters see in the existence of top predators an encouraging cause for touristic investment, and ecologists suggest that the presence of these animals warrants the establishment of Marine Protected Areas.

Pimm (1986) suggests that species-rich communities are more resistant to invasions and hence invasive predators may not have apparent functional role on ecosystem dynamics. Barbault (1995) extrapolates Pimm's findings suggesting temperate biomes (with lower species richness) should be more susceptible to invasions. The ctenophore invasions occurred in the eastern Mediterranean and the Caspian Sea provides us extremely valuable information to produce theoretical generalisations on the ongoing debate. As it is known, the ctenophore *Mnemiopsis leidyi* was transported via ballast waters from the northwestern Atlantic to the Black Sea where caused an unprecedented havoc in the pelagic ecosystem causing a dramatic decrease in fish catches and hence fishery economy (Kideys, 2002). During its peak periods of development, several zooplankton species noted to be either very low in abundance or even disappeared (Kideys, 2000). Although pollution (as well as eutrophication) was blamed for the disappearances, *M. leidyi* might have also a contribution in this event. After this ctenophore accidentally transported to the Caspian in late 1990s, its adverse impact on the biodiversity in this new environment was a clear-cut case: intense monitoring data (unpublished data of A.E. Kideys, R. Abolghaseem and S. Bagheri) revealed that during 2000 and 2001, a mere of four species belonging to copepods and cladocerans occurred in the samples compared to a total of 29 taxa in previous years! Its effect on benthic biodiversity is also unprecedented (Hashimian, unpublished data). Based on some other components too, it appears that the Caspian Sea is even much worst affected than the Black Sea. So, in this case there seems a good correlation with the species-richness and impact of the invasive top predator. The biodiversity is lower in the Caspian (542 free-living metazoan spp) compared to the Black Sea (1729 spp). Although *M. leidyi* was also transported to the Levantine and the Aegean Sea, no adverse effect was observed in these areas with higher species richness. Based on the eastern Mediterranean experience, however, we can suggest a new generalisation: another most important factor about the sensitivity to invasives, must be the immunity of a system. The more it is exposed to the invader, the more the system gaines immunity. With respect to Caspian, it has no connection to world oceans and hence no immunity to several marine species withstanding low salinity (14%o) which could be transported only by man.

Alenka Malej asked if biocontrol (i.e. introduction of predator of invasive organism) as a part of strategy for control of invasions of alien species can be accepted. Ahmet Kideys and Alessandro de Maddalena noted that after *M. leidyi* another ctenophore, *Beroe ovata* accidentally transported to the Black Sea, apparently from the northwest Atlantic (Bayha, 2004). The impact of this predatory ctenophore (feeding on *M. leidyi*) has been very positive for the Black Sea ecosystem (Kideys, 2002). Several copepod species disappeared are now again present in the samples, higher biomass of zooplankton, higher pelagic fish catches, etc. *B. ovata* exclusively feeds on ctenophores (the only other ctenophore species in the Black Sea is the *Pleurobrachia rhodopis* which is more restricted to deeper waters). In the Caspian there are no other ctenophores except *M. leidyi. B. ovata* was tested if it would feed on some other potential organisms which was not the case. Results show that *B. ovata* could be an ecosystem-saving agent in the Caspian Sea (Kideys et al. 2004) for fishery but more importantly for its valuable biodiversity (most of which are endemics) which is at risk. Anthony Moss suggested that biocontrol may be a reasonable proposal only if we can exhaustively demonstrate that the predator of choice is extremely specific in prey choice. Considering the impact of *Mnemiopsis* on the Black Sea and the Caspian. Anthony Moss agrees that *Mnemiopsis* spp. are largely responsible for a drop in biodiversity in those bodies of water, because *Mnemiopsis* is a particularly broad-spectrum feeder. In contrast, *Beroe ovata*, which has been proposed to be used as a predator for *Mnemiopsis* in the Caspian, indeed appears to be a monospecific feeder; it feeds only on ctenophores. However Anthony Moss also noted that larval

feeding has to date been examined by only Sullivan and Gifford (2004), that observed it consumes large quantities of dinoflagellates, flagellates and ciliates, while displaying food selection behavior. *Mnemiopsis*, then, does more than simply preys on fish stocks, copepods and the like. In such an circumstance, *Beroe*, if it behaves as expected, will be expected to selectively crop the *Mnemiopsis* spp. while not affecting other species. In such a case, by reducing the broad spectrum feeding effect at that trophic level, biodiversity could very well be expected to increase, as long as there are embayments, deep water locations, cysts or long-lived eggs, that can recruit eventually back into their original distribution. Indiginous species, realizing less severe selection pressure, would be able to once again play their normal role. However *Beroe* may have sufficient plasticity in its feeding habits so that it might be able to crop at some other level in the trophic ladder. We won't know until *Beroe* is introduced, whether it may find alternative food once the *Mnemiopsis* is heavily cropped. Even so, *Mnemiopsis* will probably not be completely eliminated, so that *Beroe* should be able to maintain a population, and rapidly respond to increases in *Mnemiopsis* populations.

However, Ahmet Kideys sees further risk to the Caspian ecosystem extremely low. Biocontrol, including use of alien species, is a method used extensively in agriculture, but so far no example exists for the marine environment. So far hundreds species intentionally introduced to these ecosystems, and in no case, scientific background was, as well established as in *B. ovata*. We cannot say there is zero risk from *B. ovata*, but we can say that the native biodiversity (most of which are endemics) will greatly benefit from such introduction. Our scientific ethics necessitates such action to save biodiversity (as well as economical problems of the fishery sector).

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Messages that were posted on this topic:

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|---|---|---|
| Introduction in English (original) | 05 Sep 04 | Forum Admin |
| From Martin Bilio | 06 Sep 04 | Ahmet Kideys |
| Introduction en Français | 05 Sep 04 | Forum Admin |
| Introduction in Arabic | 05 Sep 04 | Forum Admin |
| Topic of Kideys and de Maddalena | 06 Sep 04 | Èarna Miloš |
| Response to Milos | 07 Sep 04 | Anthony Moss |
| Mucilage events.. | 08 Sep 04 | Ahmet Kideys |
| Mucilage | 08 Sep 04 | Èarna Miloš |
| Comment to introduction by Kideys & de Maddalena | 06 Sep 04 | Alenka Malej |
| “SUPER-PREDATOR, MAN” | 06 Sep 04 | Igor Mitrofanov |
| Not only a real "predator" | 07 Sep 04 | Alessandro De Maddalena |
| No Need for man | 07 Sep 04 | Kerim Ben Mustapha |
| CONSIDERATIONS ON BIODIVERSITY | 07 Sep 04 | Ferruccio Maltagliati |
| Another consideration | 07 Sep 04 | Daphne Cuvelier |
| Introductions do not create biodiversity | 07 Sep 04 | Ferruccio Maltagliati |

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|---|---|---|
| LOCAL vs TOTAL biodiversity... | 08 Sep 04 | Ahmet Kideys |
| lizard introductions | 09 Sep 04 | Anthony Moss |
| Sharks in the Adriatic Sea: why there is still a lack of kno | 07 Sep 04 | Lovrenc Lipej |
| MEDITERRANEAN SHARKS IN DECLINE | 07 Sep 04 | Alessandro De Maddalena |
| Different sharks need different protection | 07 Sep 04 | Ferruccio Maltagliati |
| Which sharks need "protection" | 07 Sep 04 | Alessandro De Maddalena |
| Resuming our questions: main discussion points | 07 Sep 04 | Alessandro De Maddalena |
| One more question | 07 Sep 04 | Alenka Malej |
| invasive predators as biological controls | 07 Sep 04 | Anthony Moss |
| Biodiversity issues | 07 Sep 04 | Anthony Moss |
| Re: Man as a super-predator | 07 Sep 04 | Anthony Moss |
| "Crude fishing" sometimes increase biodiversity ! | 08 Sep 04 | Ahmet Kideys |
| MAN AND BIODIVERSITY | 08 Sep 04 | Ferruccio Maltagliati |
| crude trawling | 09 Sep 04 | Anthony Moss |
| increase of genetic variation in an introduced lizard | 14 Sep 04 | Ferruccio Maltagliati |
| Lack of funds: the main problem | 07 Sep 04 | Alessandro De Maddalena |
| EC FP6: INCO Call for Bulgaria, Romania and Turkey , SSA | 07 Sep 04 | Piia Tuomisto |
| Situation dea poissons cartilagineux (with Eng. Summary)... | 11 Sep 04 | Adib SAAD |
| English summary of Arabic message from M. Khalil | 13 Sep 04 | Forum Admin |
| English summary of Arabic message from Dr. Nejla Deeb | 13 Sep 04 | Forum Admin |
| English summary of Arabic message from Sawsan Hassan | 13 Sep 04 | Forum Admin |
| English summary of Arabic message from Badr A. | 13 Sep 04 | Forum Admin |
| sea turtles Mediterranean | 23 Sep 04 | Michael Fornahl |
| turtles in the Med | 24 Sep 04 | Ahmet Kideys |

# [*]Summary of discussions on Topic 1.2: Monitoring studies on marine biodiversity in the Mediterranean, with special reference to Eastern and Southern countries

**Chedly RAIS**

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Making reference to the topic's introduction, the debate addressed the following main issues:

Do we need to standardise sampling methods, return of results (cartography, etc.)?
Standardization of sampling and further procedures is important. Otherwise it is sometimes very difficult to compare results of different studies, especially for species needing special way of sampling, and could be easily missed, or their abundance could be estimated in wrong way. But standardization is a long way, especially in regions with political problems. Exchange of data (and any scientific networks and joint programmes) in such regions is also problematic. The first step could be detail description of sampling and proceeding methods.

The elaboration of sampling guidelines could help standardising the monitoring of marine biodiversity, but the reality of the field, the specific target of each study could make it very difficult, sometimes senseless, to follow the guidelines because too generalist. It is a long and hard task to produce guidelines that find the balance between general and specific needs in scientific samplings. Such guidelines for sampling methods should be at the same time sufficient clear to be a good starting point to set up a sampling protocol, but also enough flexible to adapt them to the subject of the study and to the context in which it is carried out (available resources in form of people, time, sampling tools and funds).

As it is the case in other fields in Biodiversity Information, also in Marine Biodiversity there are a lot of results/Data sleeping out there, which are not enough visible. A lot might have been partly used for scientific publications, but are not accessible in a standardized and summarized way to the decision makers to in some way prove them the value of this kind of studies for economical and social purposes, that for example the whole throphic chain matters and not just the target "commercial" species. In that way already existing data could be valorised and already spend funds justified, Information or knowledge gaps detected and submit targeted and well argumented projects to the decision makers and fund raising agencies. This would be more cost effective

It was also underlined that we should consider older data that are not taken in a "standard" way, be it for lack of resources or evolution of the techniques. While these data often prove to have a great value, it may take more efforts to validate them and make them public in a proper way.

[*] Please refer to this section as:

Rais, C. (2004). Summary of discussions on Topic 1.2: Monitoring studies on marine biodiversity in the Mediterranean, with special reference to Eastern and Southern countries. Pp 64-66 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

For some participants, before harmonisation and setting up standardized methods and guidelines, we should take stock of what we have, list the species and habitats already recorded to date per country (or update existing listing); their geographical location, the bibliography dealing with the issue etc.

Gaps in Taxonomy and lack of taxonomists
The participants highlighted the importance of taxonomy. One participant suggested consulting the Case studies of Bionet-International with the topic: Why taxonomy matters (A series of case studies highlighting Taxonomy's Value to Society at http://www.bionet-intl.org/case_studies/).

Considering that taxonomy is such a ramified science, no one country (and region) could have high-qualified taxonomists for all groups of plants and animals. Collaboration projects under certain International organizations (CIESM, FAO, WWF, UNDP, etc.) are the right way to joint efforts in strengthening our capabilities in taxonomy.

Priorities for monitoring programmes
Even if all is important, the discussion allowed highlighting some priority fields. In this context, taxonomy and mapping species and habitat distribution were felt as matter of primary priority. It was also underlined that scientific work should be done on the ground for recording the biodiversity in southern and eastern Mediterranean especially Levantine Basin. Special attention has to be paid to the role of Suez Canal and Lessepsian migration and the role of the High Dam (Asswan) and their effects on the communities of the eastern Mediterranean. The monitoring of the impact of the civil constructions on the coast and spreading of cities, tourist villages or new harbours, deserves to be addressed as priority.

Some participants stressed the need for joint, cooperative and synchronized work through well-organized projects addressing all targets of marine ecology in this area.

Considering the significant decline of biodiversity noticed in the eastern Mediterranean and the changes in the fauna and flora composition caused by the exotic species, the participants to the debate recommended to focus the scientific work on the following issues:

- How can we stop deterioration of the ecosystem and coastline erosion?
- How to reconstruct our marine ecosystem?
- Protecting the vermitid terraces as important natural heritage of the Eastern Mediterranean
- Could the study of the inherent interactions controlling gas exchange at the atmosphere/water interface help better understanding biodiversity?

More visibility for the monitoring achievements and role.
There is an urgent need for a very important effort targeted at valorising research in the direction of the public opinion and the decision makers. Yet, as biodiversity has never made any factory turn, apart for a limited number of pharmaceutical compounds, focus has to be put on the ‘Ecosystem’ importance. As it is necessary to have healthy ecosystems for sanitary, tourist and patrimonial aspects and as there is no healthy functional ecosystem without biodiversity, this can be the way to get people convinced. In this context, marine scientists should work jointly with economists and functional ecology specialists to promote the maintenance of a certain biodiversity, otherwise they will be seen as people trying to get money for the sake of their narrow interests.

There is a need for a stronger "Mediterranean voice" advocating needs of this region. It may come from strengthening of the research component of MAP (Mediterranean Action Plan) in collaboration with the "ICES Mediterranean counterpart" CIESM.

Messages that were posted on this topic:

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| Monitoring of Radio-Nuclides Levels in Marine Environment as | 06 Sep 04 | MORAD AWAD |
| ?? | 07 Sep 04 | Igor Mitrofanov |
| Abiotic measurements ... | 08 Sep 04 | Patricia Mergen |
| Reply on importance of marine survey by radio-nuclide | 08 Sep 04 | MORAD AWAD |
| Introduction in English | 07 Sep 04 | Forum Admin |
| Standardise return of results and valorisation of biodiversi | 07 Sep 04 | Patricia Mergen |
| Standardise return of results and valorisation of biodiversi | 07 Sep 04 | Chedly RAIS |
| Do we need to standardise sampling methods? | 08 Sep 04 | Igor Mitrofanov |
| standardise sampling methods | 08 Sep 04 | Patricia Mergen |
| Mediterranean voice | 08 Sep 04 | Alenka Malej |
| Introduction en Français | 07 Sep 04 | Forum Admin |
| Listing | 14 Sep 04 | Kerim Ben Mustapha |
| Introduction in Arabic | 07 Sep 04 | Forum Admin |
| Décider les décideurs [with English summary] | 07 Sep 04 | François Bonhomme |
| Important effort oui, mais comment? [with English summary] | 07 Sep 04 | Chedly RAIS |
| EC FP6: INCO Call for Bulgaria, Romania and Turkey , SSA | 07 Sep 04 | Piia Tuomisto |
| Biodiversité - espèces introduites [with English summary] | 08 Sep 04 | Ghazi BITAR |
| Main points discussed so far | 08 Sep 04 | Chedly RAIS |
| Joint research needed | 09 Sep 04 | Ali Ali Abdel-Fattah Ali Gab-Alla |
| For the project support | 10 Sep 04 | MORAD AWAD |
| English summary of Arabic message from A. Nassir | 13 Sep 04 | Forum Admin |
| English summary of Arabic message from A. Kamal | 13 Sep 04 | Forum Admin |

# [*]Summary of discussions on Topic 1.3: Historical data sets and grey literature: the value of "real" data and the need for quality control

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A general consensus was reached on the importance and need of historical data sets in assessing medium- and long-term trends in marine populations and community structures and ultimately the quality of the environment. Patricia Mergen of the Belgian Biodiversity Information Facility (Belgium) stressed the importance of cooperation among specialists, as in many cases the information is spread regionally and locally. As a matter of fact, the value of similar biological and environmental data obtained across different research programmes for specific areas can be greatly increased by merging them into common data sets to determine more broadly applicable relationships or trends. At the same time, Izhihar Ammar of the Tishreen University (Syria) pointed out the lack of historical data sets which may also occur, especially in some eastern Mediterranean countries, such as Syria, where the study of marine biodiversity started relatively recently. Additional drawbacks include the fact that storage and preservation of historical information or data occur in many different ways (e.g. written archives, word, excel, access or more elaborated data basing system) and for many different purposes. Last but not least, in the southern and eastern Mediterranean basin much work and information is only available in languages other than English. Thus, setting up large and centralized databases may prove to be very time and effort consuming, often even frustrating. To cope with such difficulties, Mergen suggested an alternative solution where every local or regional institution or even an individual scientist can keep his way of working, his own database system, etc. A software is installed on top of the database which enables to give correspondences with standard data exchange schemas. A central portal uses the software and the information that has been entered. From the portal, the distributed data can be queried and shown. It is important to note that in this way the data remain with its owner.

Edward Vanden Berghe of the Flanders Marine Data and Information Centre (Belgium) indicated that the best way to integrate individual data sets in large consolidated data systems is through a system of distributed, interlinked databases. Modern technology, making use of XML over the web, has made this easily achievable. Vanden Berghe cited two major global activities which have been initiated along this line, such as the Global Biodiversity Information Facility (GBIF, http://www.gbif.org) and the Ocean Biodiversity Information System (OBIS, http://www.iobis.org). Also at a European scale, relevant international initiatives include the International Council for the Exploration of the Sea (ICES, http://www.ices.dk) and the Marine Biodiversity and Ecosystem Functioning Network of Excellence (MarBEF, http://www.marbef.org). Finally, Paolo Magni (IMC – Oristano, Italy) mentioned the Study Group on Benthic Indicators of the Intergovernmental Oceanographic Commission (IOC) of UNESCO as an example of merging synoptic information on benthic faunal condition (e.g. measures of community composition) and environmental variables (e.g. sediment organic matter) from different

[*] Please refer to this section as:

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coastal regions world-wide to look for consistent patterns of response in selected indicators (http://www.ioc.unesco.org/benthicindicators).

Kerim Ben Mustapha of the Institut National des Sciences et Technologies de la Mer (Tunisia) agreed on the fact that large data bases and networks, such as ICES and MarBEF, already exist, but also affirmed that they are not accessible for southern-eastern institutions/scientists, at least for project proposals. Mergen replied that "free access to data" was indeed one of the most discussed topic in GBIF and ENBI meetings. A solution suggested at the last ENBI meeting in Prague was to give free access to data and to earn money if needed by offering services related to the data. Mergen also indicated that all the data that can be found now at www.GBIF.net are accessible and free of charge, provided that data use agreement and citation of the providers are made when the data are used.

Vladimir Vladymyrov of the IOC/UNESCO IODE Project Office highlighted that in comparison with physical and chemical data, the sources of historical biological data and the most interesting combined biological / physical / chemical data are very limited. He indicated the grey literature as a potentially important source of information, which has not been explored properly yet. As an example, he mentioned the data obtained within the Former Soviet Union in the form of so-called "preprints" and "deposited papers" that were not limited in volumes and contained often very interesting data. Some of these publications have been already lost, others are in growing danger of being lost. Vladymyrov suggested to arrange a project or a series of projects to find, collect, translate to English, digitize, and make available as soon as possible all still available publications that contain historical biological data. Ahmet Kideys of the Institute of Marine Sciences, METU (Turkey), argued that while the main problem with not publishing the data in the Former Soviet Union was the "security", in many cases in the eastern and southern countries an individual investigator wants to hide the data from others, so only he could use them. Kideys cited, as an example of a potential solution to this problem, what occurs in his country (Turkey), where the TUBITAK (Turkish Research Council) is the governing body for research and distribution of funds for this. In this case, the reports prepared at the end of any project could be requested and made available via the web sources. Kideys also acknowledged that there is a need for action from a central body to encourage research bodies in different countries to cooperate. A suggestion concerning the access to data was made at this point by Mergen who proposed that when starting projects, greater care should always be put on longer term issues, including the use of standard and compatible IT tools, to ease the work of potential partners in these kind of projects and reduce long term costs to maintain and upgrade the system and delays in the production of deliverables.

Kerim Ben Mustapha pointed out that in the list of networks and topics to be enhanced there should be not only those "a la mode" (*Posidonia*, exotic species, population of soft bottoms, etc.), but also indicators from the high seas and habitats off the coastline (au large), such as bancs/"sea-mountains/hills", as any disturbance of these ecosystems which should be considered as "Monument naturel" will have a strong impact on littoral ones. Maltagliati (Pisa University, Italy) asked whether we could find a link between the more classical ecological-historical data sets and DNA-based data sets, in order to obtain sound information on the recent historical aspects of the biota of a given region.

Sami Lakkis of the Lebanese University (Lebanon) and Waad Sabour (Syria) also contributed to the discussion on Topic 1.3 by responding to and commenting on the “Main lines so far” highlighted by the session’s Chairs. They especially agreed on the need for integration of existing surveillance networks and parallel promotion of sub-regional initiatives. The search for means and financing necessary for this integration was considered a priority.

Vlado Malacic of the National Institute of Biology (Slovenia) argued on a better clarification of the term "real" data indicated in the Introduction to Topic 1.3. Malacic rightly pointed out a distinction between data obtained by some "hard and solid" work and data obtained "instantaneously" and in "continuous" with a high repetition rate, that are used in oceanography and meteorology, so that

many phenomena occurring at different frequencies could be extracted. These are "real time" data as opposed to "near real time" data, i.e. those that are retrieved with some (fixed) delay, and still enable periodical analysis and forecast of phenomena. Malacic also introduced the concept of "reliable" data, further expanded by Vladymyrov in terms of quality assurance and quality control of biological data.

Vladimir Vladymyrov drew our attention to the quality assurance and quality control (QA & QC) of biological data. He mentioned a simple quality code system recommended by GETADE group (IOC's Group of Experts on the Technical Aspects of Data Exchange) which was used for physical, chemical and biophysical (optical and chlorophyll) data. However, this was impossible for biological data, as there were no established procedures/algorithms for such and biologists had not manage to establish any. Vladymyrov indicated that there are some guidelines for preparation and submission of biological data mostly dealing with provided metadata and data formatting, for example, ICES MDM guidelines for plankton data (http://www.ices.dk/committe/occ/mdm/guidelines/), but there are apparently no guidelines for biological data QA and QC. Vladymyrov finally stressed that this problem is of great importance and special urgent efforts are needed to try to solve it.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English | 07 Sep 04 | Forum Admin |
| Put in Place large databases | 08 Sep 04 | Patricia Mergen |
| Larger data sets: an UNESCO/IOC initiative | 08 Sep 04 | Paolo MAGNI |
| Different types of historical data sets | 08 Sep 04 | Ferruccio Maltagliati |
| Large databases are being built | 08 Sep 04 | Edward Vanden Berghe |
| And the high seas? | 10 Sep 04 | Kerim Ben Mustapha |
| Introduction en Français (original) | 07 Sep 04 | Forum Admin |
| Introduction in Arabic | 07 Sep 04 | Forum Admin |
| Historical data sets, | 08 Sep 04 | Vlado Malacic |
| Historical and ‘real’ data: Old fashion research? | 08 Sep 04 | Paolo MAGNI |
| Historical and ‘real’ data: Old fashion research? | 08 Sep 04 | Alberto RIBOTTI |
| Grey literature | 09 Sep 04 | Vladimir Vladymyrov |
| Where is it? How to use it? | 09 Sep 04 | Paolo MAGNI |
| Ownership of data... | 10 Sep 04 | Ahmet Kideys |
| NIH proposal would free up funded research | 11 Sep 04 | Paolo MAGNI |
| Access to data | 13 Sep 04 | Patricia Mergen |
| Main lines so far… | 09 Sep 04 | Paolo MAGNI |
| East/South missing from large Dbase | 10 Sep 04 | Kerim Ben Mustapha |
| Access to data | 10 Sep 04 | Patricia Mergen |
| Re: Main lines so far.. | 12 Sep 04 | Sami LAKKIS |
| Quality control of biological data | 13 Sep 04 | Vladimir Vladymyrov |

# [*]Summary of discussions on Topic 1.4: New techniques, tools and approaches for the study of marine biodiversity on the regional (Mediterranean) scale

**Lovrenc Lipej & Andreja Ramšak**

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Although the use of non-destructive techniques somewhere still causes some strong debate regarding biases and accuracy, no one of contributors discussed this methodology. Only two contributors have discussed the use of new techniques in vivo. Adib Saad considered the multilevel approach as the proper one, e.g. compiling classic methods and new techniques. He thinks that for the use of new techniques for studying marine biodiversity in vivo or in vitro, specialists of traditional systematics are needed, because how can an unqualified diver identify a marine organism at sight? In a reply, Lovrenc Lipej and Andreja Ramšak pointed out that only qualified, trained researchers are able to identify fishes and other organisms at sight. According to them, such techniques could give satisfactory answers on the status and diversity of infralittoral fish assemblagess. Morad Awad reported on the new technique, GIS associated with acoustic surveys. Marine GIS technology associated with recent submarine acoustic survey are essential and helpful tools, showing the distribution and conservation of several components of biodiversity, helping to identify species that should be present in the regional and local seas.

Alexis Zrimec proposed the use of biophotonics as a new approach in the biodiversity research. The mentioned approach has a potential to be closely related with the biodiversity, not only at species but also at subspecies levels.

One of the discussion points was the international standardization of sensitive analytical techniques that should be carried out to ensure their repeatability. As we stressed, standardization could be achieved more easily in coordinated collaborative projects where partners use the same methodology.

It seems that the majority of contributors are more or less favouring the multilevel approach, although that could be a very expensive job. Others are including cooperation as an important factor, which can be as much important as the use of new tools, practices and approaches. A coordinated research work in the region is perhaps a good solution. The majority of contributors are thinking in that way. Some examples of co-operations were pointed out such as network of excellence MARBEF (http://www.marbef.org/), where each partner offers sampling facilities to another partner in the network and the Mediterranean Shark Research Group.

Some discussion points still remain unanswered. More thoughts should be given to design concerted actions in biodiversity assessment and incorporation of new approaches such as use of

[*] Please refer to this section as:

Lipej, L.; Ramsak, A. (2004). Summary of discussions on Topic 1.4: New techniques, tools and approaches for the study of marine biodiversity on the regional (Mediterranean) scale. Pp 70-71 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

non-destructive methods (e.g. SCUBA mapping) and incorporation of modern genetic methods. The study of species that are not so “funding attractive” must became more frequent, because biodiversity of those species is practically unknown.
An interesting question was posted under topic 1.3 by Prof. Sami Lakkis and Dr. Waad Sabour about finding a link between classical ecological-historical datasets and DNA-based datasets in order to obtain sound information on the recent historical aspects of the biota. One of the possibilities would be the use of genetic markers for ecologically important traits through targeting of specific genes or gene families instead of using neutral markers such as microsatellites. Variations in functional regions of genes which enable species and individuals to survive in certain geographic range or niche could be more informative than neutral markers and their quantitative genetic variations could be measured directly (van Tienderen et al., 2002). This approach demands knowledge from several disciplines of biology; at first we have to find out which species and traits are ecologically important, following the identification of genes which affect particular traits, develop the markers within genes or in the regions flanking the genes.

**Reference:**

van Tienderen, P.H., de Haan, A.A., van der Linden, C.G., and Vosman B. (2002). Biodiversity assessment using markers for ecologically important traits. Trends Ecol. Evol., 17(12):577-582.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English (original text) | 08 Sep 04 | Forum Admin |
| How to study biodiversity? | 09 Sep 04 | Ferruccio Maltagliati |
| Collaboration among researchers: a powerful tool | 09 Sep 04 | Alessandro De Maddalena |
| On Emergency Marine GIS for biotic sea bed classification us | 10 Sep 04 | MORAD AWAD |
| Introduction en Français | 08 Sep 04 | Forum Admin |
| Introduction in Arabic | 08 Sep 04 | Forum Admin |
| Prof. Adib SAAD wrote ..[with English summary] | 09 Sep 04 | Adib SAAD |
| Response to Adib Saad | 10 Sep 04 | Andreja Ramsak |
| Collaboration and standardization | 09 Sep 04 | Andreja Ramsak |
| Biophotonics for biodiversity | 10 Sep 04 | Alexis Zrimec |
| Main points discussed so far | 10 Sep 04 | Andreja Ramsak |

# [*]Summary of discussions on Topic 1.5: Do we need a revision of our biodiversity research agenda?

**Ferdinando BOERO**

Consorzio Nazionale Interuniversitario per le Scienze del Mare; University of Lecce; Dipartimento di Scienze e Tecnologie Biologiche e Ambientali; Laboratory of Zoology and Marine Biology, Italy – (boero@unile.it)

The introduction to the session tried to highlight possible novel approaches to the study of biodiversity, giving proper value to the amount of information "hidden" in taxonomic literature. The proposal aimed at putting to-day biodiversity data (in form of species lists) into a historical framework, comparing what is being found in a given sampling session with what has been found in the past. Taxonomic papers are a treasure of information and usually refer the record of each species to a given habitat type. Of course we need to build a "taxonomy" of habitat types, and this is far from being settled at a European level. Catalogued habitat types can be either too detailed, or too general, providing a blurred picture of biodiversity at habitat level. Taking the taxonomic literature on each species, a taxonomist is able, for his own group, to build a matrix of habitat types against the list of the species recorded from each habitat type. Every time a given habitat type is sampled, we have a species list and report on what we find, but we do not care much about what we do not find. Since the greatest bulk of biodiversity is made of inconspicuous species, if is very difficult to perceive the "absence" of "tiny things". Threatened species are usually conspicuous and well known, and this probably does not reflect the extent of the biodiversity crisis.

There is a great need of finding proper ways to give value to historical data on biodiversity, so that taxonomy is not simply a tool to identify specimens.

Linking species lists to habitat types, furthermore, joins two levels of the perception of biodiversity (the third is the genetic diversity within species). A further step of the European Register of Marine Species, for instance, might be to ascribe each species to one or more habitat types and to calculate how many times each species has been recorded, so to identify more or less frequent species. This exercise might even highlight great changes in the species composition of the various habitat types, since taxonomic literature formally starts with Linnaeus.

Ahmet Kideys lamented that, besides species, also taxonomists are disappearing and that all this concern about taxonomy usually does not imply proper funding to the training and the availability of job opportunities for taxonomists. This is the main problem of the biodiversity agenda: train people that are able to recognise biodiversity at a species level and use them! This problem is being tackled by the National Science Foundation of the United States of America with the Partnership for Enhancing Expertise in Taxonomy, but such project has no counterpart in Europe!

Manos Koutrakis expressed disagreement in considering some species as more important than others, just because they are better known (i.e. we have historical records on them). This is another

[*] Please refer to this section as:

Boero, F. (2004). Summary of discussions on Topic 1.5: Do we need a revision of our biodiversity research agenda?. Pp 72-74 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

relevant part of the biodiversity research agenda: we should arrive to a satisfactory level of knowledge for all species. We cannot say that a species is not important because we do not know much about it!

Kerim Ben Mustapha lamented the difficulties in having access to international journals for publication, and also the (useless) complications of most procedures for applying to Research Project Funding. He also remarked that literature coming from countries such as Tunisia is ignored by authors of "general" reports, so that relevant data are not incorporated in papers that should cover a given aspect on a geographical scale (e. g. the status of Mediterranean sea grasses).

Jan Haspelagh, the Librarian of Flanders Marine Institute (VLIZ), remarked that modern librarians have the tools to dig out information even from "non conventional" sources and that there are databases devoted to solve such problem. As an example, he contributed with this list of sites:

· http://ioc.unesco.org/iode/

The website to IOC's International Oceanographic Data and Information Exchange. ODINAFRICA and ODINCARSA are part of this network.

· http://www.iamslic.org
· http://www.euraslic.org

The websites of respectively the international, and European networks of marine information centres and experts

· http://www.openarchives.org/

The Open Archives Initiative community supports the establishment of open-access institutional archives, containing a wide array of scientific literature from peer-reviewed papers to reports, symposium papers, theses, etc.

· http://oaister.umdl.umich.edu/o/oaister/

This harvesting tool searches 17 Open Archive collections simultaneously.

·http://eprints.soton.ac.uk/

A very good example of an institutional open archive at a renowned oceanographic research centre (Southampton Oceanography Centre, UK), that is highly succesfull due to the cooperation of all researchers.

F. Boero remarked that the presence of a good librarian (information specialist) is not the rule in most scientific institutions. By the way, in the catalogue of VLIZ the publications of F. Boero are 32, whereas he has 172 published papers! It is not easy to find everything! Taxonomists, however, must be aware of all taxonomic literature on their group, due to the law of priority and the Zoological Record is The tool to have access to this kind of information.

Jakov Dulcic lamented that "scientists" with low or non-existent publication scores can be consulted as "experts" to run international projects. The competence of any scientist is evident from his/her publication score, so it is our duty to publish biodiversity papers in the best journals. If this practice is not followed, any person can pretend to be a specialist and receive attention from funding agencies.

This discussion on how to publish own results went on also in other sections of the forum. Boero remarked that some countries suddenly became very represented in international journals (for instance with articles dealing with the invasion of the ctenophore *Mnemiopsis* in the Black Sea); he also remarked that international journals are very keen to accept contributions from countries that are not the "usual" ones, but the quality standards have to be respected. Maybe there is also a need of courses in scientific writing, so to provide the formal tools to give proper value to own work, especially in the countries that do not have a tradition of presence in international journals.
Mohamed Nejmeddine Bradai summarised the outcome of the discussion with these four points:

(1) give proper importance to taxonomy, not only with kind words but also with solid facts.
(2) availability and use of historical data, which are often lacking
(3) habitat awareness, to protect biodiversity as a whole, we have to protect the natural habitats from overexploitation.
(4) For the Mediterranean and more specifically for the Eastern Basin, we have to make a joint effort to study exotic species and above all their impact on native species and total biodiversity.

A fifth point might be to give proper dignity to biodiversity literature, helping scientists to publish their results in international journals.

Almost all participants to the discussion expressed some doubts about the way scientific projects are funded, sometimes providing direct evidence of what is a "general" impression.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English [original text] | 09 Sep 04 | Forum Admin |
| What about disappearing taxonomists? | 10 Sep 04 | Ahmet Kideys |
| Indicators species for habitat degradation | 10 Sep 04 | Manos Koutrakis |
| answer from fboero | 11 Sep 04 | Ferdinando Boero |
| Introduction en Français | 09 Sep 04 | Forum Admin |
| Yes but..;; | 10 Sep 04 | Kerim Ben Mustapha |
| publications and lists | 11 Sep 04 | Ferdinando Boero |
| National revues | 14 Sep 04 | Kerim Ben Mustapha |
| national revues | 14 Sep 04 | Ferdinando Boero |
| Task of the information centre | 15 Sep 04 | Jan Haspeslagh |
| References | 15 Sep 04 | Jan Haspeslagh |
| thanks for the information | 16 Sep 04 | Ferdinando Boero |
| procedures for funding | 11 Sep 04 | Ferdinando Boero |
| Realities | 13 Sep 04 | Kerim Ben Mustapha |
| scientists ranking | 13 Sep 04 | Ferdinando Boero |
| Do we need a revision of our biodiversity research agenda? - | 13 Sep 04 | Jakov Dulcic |
| scientists and politicians | 13 Sep 04 | Ferdinando Boero |
| Re: Introduction par F. Boero (With English summary] | 10 Sep 04 | Mohamed Nejmeddine Bradai |
| Introduction in Arabic | 09 Sep 04 | Forum Admin |

# Session 2: Joint session on Eastern and Southern Mediterranean, and Black Sea

# [*]Summary of discussions on Topic 2.1: Endangered biodiversity and management of marine protected areas, wetlands, lagoons, estuaries and seagrass meadows

**Izdihar AMMAR[1], Marian-Traian GOMOIU[2] and Paolo MAGNI[3]**

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[3]Foundation IMC – International Marine Centre, Italy – (p.magni@imc-it.org)

Several contributions were given to this rather broad topic. Following the Introduction by Grimes et al., Ferdinando Boero of Lecce University (Italy) started the discussion with an interesting title, "people, biodiversity and culture", and the assertion that the more we institute MPAs (Marine Protected Areas) the more we see that their presence is useless unless the people (both local and tourists) are aware of the importance of protecting biodiversity and landscapes in general. In Boero's view, locals are irritated by limits to their freedom and do not want to wait for the promised medium-long term advantages. Even when a policy of intensive use of television to promote biodiversity protection has started, like in Italy, apparently this tool reaches only those who are already sensitive to the problem. Boero indicated that we should press our governments to introduce the respect of nature as an important part of school curricula, including the proper training of teachers, so that all individuals are exposed to some sort of environmental education. Boero concluded that no policy will ever succeed if there is no culture backing it. Izdihar Ammar of the Tishreen University (Syria) replied that the scientific, economic and social characters of the MPAs are the main issues, but in any case, it is necessary to put specials laws and quality terms for every MPA. This should lead to the desired success. Ammar cited the case of Syria with the successful case study in the Ibn-Hani protected area. Conviction of the beneficiaries and strictness in respecting protection terms allowed reform to that area which has now started to show a return of a lot of species from different taxa, after it had begun to deteriorate. This reality was also acknowledged by those working in scientific research and fisheries. Ammar hopes that, in this region of the Mediterranean sea, national administrations will coordinate their actions with each other to join a net of MPAs on the bases of international laws and status. Ammar concluded with the wish that humans should stay away from these matters for some time in order to allow the marine environment to recover its health.

Morad Awad of the National Institute of Oceanography and Fisheries (Egypt) affirmed that the attitudes of the non-living resources are opposite to the trends of the living resources. As an example, Awad indicated that the hydrocarbon marine exploitation, accompanied by organic and oil pollution as well as the establishment of numerous platforms and associated utility buildings, is nowadays increasing enormously in the southeastern Mediterranean waters. This is affecting directly or indirectly the living resources existing in the that region, and hence its biodiversity. Awad also mentioned the continuous development of touristic activities and the human impacts on the marine environment, with a substantial increase of domestic pollution. Awad gave further

[*] Please refer to this section as:

Ammar, I.; Gomoiu, M.-T.; Magni, P. (2004). Summary of discussions on Topic 2.1: Endangered biodiversity and management of marine protected areas, wetlands, lagoons, estuaries and seagrass meadows. Pp 76-78 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

examples, such as navigation, maritime transport and the harboring facilities, that negatively affect the existing life stocks, acting against the protection and reservation of our natural resources. On the other hand, Awad acknowledged that it is impossible to defeat the promotion and development of civilization; and enhancement of human modern culture, keeping in mind the necessity of fishing as an industry and fish a popular source of human protein. A fundamental question which Awad raised was how to make the balance between these two major and contrasting attitudes. He indicated that we need extra comprehensive tools, e.g. simulation models, modern technology in marine satellite imageries, state of the art aquatic fish hybridization, excessive marine remote sensing monitoring, as well as the enhancement and promotion of human resources in a good, qualitative manner (e.g. through higher education, training, high building capacity, public awareness, etc.).

Ahmet Kideys of the Institute of Marine Sciences, METU (Turkey) indicated that setting up MPA's around the Mediterranean was a goal planned by the surrounding countries at the PAM in 1985, which established the RACSPA for that purposes (entre autre) and which ended with the SPA-biodiversity protocol of the 90's. Kideys pointed out that the number of SPA had been raised, but questioned how efficient they are in terms of conservation of biodiversity, export of productivity, public awareness and marine sciences. He concluded by saying that we can't be satisfied and that we need a monitoring/control organism in order to see how much countries are really ready to go in that direction. He believed that the lack of financial support can not be seen yet as a valid argument. Kerim Ben Mustapha of the Institut National des Sciences et Technologies de la Mer (Tunisia) agreed on the main lines discussed, but indicated that we should also take the opportunity of the protocol on PSA-biodiversity to setup MPA's in the High Seas, which are urgently needed for several reasons.

A remark was made by Glamuzina Branko of the University of Dubrovnik (Croatia) who asked: who needs protection? Branko indicated that we have to make detailed cost-benefit analysis and to involve the influence on local people's lives before we initiate the process of protection. Otherwise, it doesn't work and we have numerous examples. Speaking of the long-term benefit of developing eco-tourism and other eco-friendly activities is not enough. Branko thinks that we have to develop middle-term compensation funds for locals in order to protect and enhance their living conditions, before a positive influence of protection becomes a reality. Therefore, we have to develop this method and include it in a strategy of protected areas development. Ali Gab-Alla of the Suez Canal University (Egypt) highlighted that the Suez Canal convoy many species to the eastern Mediterranean. In addition, the High Dam effects the water quality of this basin changing the geology, hydrology, hydrography, fish communities and benthic communities also. Gab-Alla indicated that we should consider the filling operations of lagoons and lakes. These wetlands are very important areas for marine organisms to breed and spawn. They are also stop sites for migrating birds. We should study carefully these areas, which represent a route for migrating European birds. We should protect these fragile and very sensitive coastal habitats.

Ahmet Kideys asked whether the Black Sea is today one of the most seriously damaged seas in the world and added some points to the Introduction by Gomoiu relevant to the Black Sea. Kideys cited a question he was asked by a prominent marine ecologist from the eastern Mediterranean: are any fish surviving in the Black Sea? This question was a clear example of the lack of knowledge, accompanied by a negative idea that very significant negative events occurred in the Black Sea in the last decades, of scientists who have never been to this sea nor have been exposed to the publications available. Kideys indicated that we should differentiate two phenomena here: (1) The events taking place in the shallow northwestern shelf are the extreme cases and do differ significantly from the entire basin. (2) The Black Sea still provides the highest fish catch among all Mediterranean countries due to the abundance of anchovy. Kideys also cited and mentioned that recently several publications appeared in peer-viewed journals stating that the open Black Sea

pelagic ecosystem has been recovering speedily. He gave the example of Turkish anchovy catches: after its fishery almost collapsed to about 50 thousand tons (from about 280 thousand tons), the average annual catch value of this fish during 1995-2001 was above 270 thousand tons! Kideys concluded his remarks by saying that if he would classify a sea being one of the most seriously damaged seas in the world, today we would put the Caspian Sea at the top.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English | 13 Sep 04 | Forum Admin |
| people biodiversity and culture | 13 Sep 04 | Ferdinando Boero |
| Two Major Attitudes of Marine Activities in the South-easter | 13 Sep 04 | MORAD AWAD |
| It is necessary to put specials laws for every MPA | 14 Sep 04 | Izdihar Ammar |
| MPA | 14 Sep 04 | Kerim Ben Mustapha |
| Introduction en Français (original) | 13 Sep 04 | Forum Admin |
| MPA | 14 Sep 04 | Kerim Ben Mustapha |
| Introduction in Arabic | 13 Sep 04 | Forum Admin |
| Introduction in Russian | 13 Sep 04 | Forum Admin |
| Introduction to Black sea (English) | 13 Sep 04 | Forum Admin |
| Is The Black Sea today one of the most seriously damaged sea | 13 Sep 04 | Ahmet Kideys |
| Who needs protection? | 14 Sep 04 | Glamuzina Branko |
| RE: Introduction | 15 Sep 04 | Ali Ali Abdel-Fattah Ali Gab-Alla |
| Introduction to Black Sea (Russian) | 16 Sep 04 | Forum Admin |

# [*]Summary of discussions on Topic 2.2: Biodiversity conservation, impact of human activities, environmental policy and public awareness

**Andreas DEMETROPOULOS**

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The introduction to the subject of biodiversity conservation in relation to human activities focused on alien species coming in through the Suez Canal. This acted as a forum for discussions on introductions and the need for more comprehensive policy decisions on the introduction of alien species in the Mediterranean. The permanence of such introductions in the Mediterranean marine environment and the futility of eradication measures were highlighted. Inevitably there was an overlap in the discussions with Topic 2.3 "Climate change and exotic/invasive species" which however did not detract in any way from the substance of the discussions - but in effect helped these in a synergistic way. The significance of alien species as the main threat to biodiversity, after habitat destruction, was highlighted in the discussions.

It was apparent from the discussions that though there was wide agreement that all man made introductions had to be controlled, irrespective of the pathways of introduction, the immigration through the Canal was contested by some participants as a special case, some arguing that this needs to be considered as a "natural process". This generated wide ranging discussions on basic issues, including the "negative and positive merits" of introductions and on the role of scientists (ethical etc) and of plate tectonics. There was also some obvious divergence of opinion on the issue, which perhaps reflects the more general lack of public awareness of the fact that the Suez Canal is man made and that it is acting as a permanent conduit for Erythrean and Indo-Pacific biota into the Mediterranean. It was put forward that Lessepsian immigrants need, inevitably, to be considered as introductions. It was also highlighted that this immigration process is ongoing and that new species are arriving in the Mediterranean Sea all the time. In the introduction it was stressed that not controlling this immigration was like "leaving the door open while closing the windows". The ecological revolution, which is obvious in the eastern basin, was highlighted and it was mentioned that this revolution is inevitably spreading to the west Mediterranean.

The possibility and feasibility of controlling the invasion, so as to stop additional species from entering the Mediterranean, by suitable salinity barriers in the Canal was proposed in the introduction to the Topic. In the discussions the causes for the increasing rate of inflow of organisms into the Mediterranean through the Canal were brought up - and the need for controlling the immigration underlined. Salinity barriers were mentioned as they are the simplest, but others may be studied.

In addition the Black Sea Red Data Book was mentioned and the need for additional marine protected areas in this sea was brought up. The need for revising this book in order to reassess the species included was pointed out. The invasions and the sources of at least some invasive species in the Black Sea, through aquaculture practices, were also mentioned, as was the special nature of this sea.

Tourism in the Mediterranean was briefly discussed with deliberations as to whether this was an opportunity for conservation or a threat to biodiversity.

The present summary may not reflect all the views expressed in the discussions as these ranged widely.
Messages that were posted on this topic:

[*] Please refer to this section as:

Demetropoulos, A. (2004). Summary of discussions on Topic 2.2: Biodiversity conservation, impact of human activities, environmental policy and public awareness. Pp 79-80 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

| | | |
|---|---|---|
| Introduction in English | 13 Sep 04 | Forum Admin |
| Erythrean species in the MED | 20 Sep 04 | bella galil |
| On leaving the door open while closing the windows | 22 Sep 04 | Andreas Demetropoulos |
| Introduction en Français | 13 Sep 04 | Forum Admin |
| You are right | 14 Sep 04 | Kerim Ben Mustapha |
| There is plenty of information for decisions | 14 Sep 04 | Andreas Demetropoulos |
| Invasions négatives ou Introductions positives (with English | 14 Sep 04 | François Bonhomme |
| Plate tectonics and positive and negative introductions | 15 Sep 04 | Andreas Demetropoulos |
| Plate tetonics and positive and negative introduction | 16 Sep 04 | Jakov Dulcic |
| addition | 16 Sep 04 | Jakov Dulcic |
| Introduction in Arabic | 13 Sep 04 | Forum Admin |
| Tourism in the Mediterranean - an opportunity or threat for | 13 Sep 04 | Forum Admin |
| Tourism and Biodiversity | 15 Sep 04 | Andreas Demetropoulos |
| tourism | 15 Sep 04 | Andrej Sovinc |
| Introduction in Russian | 14 Sep 04 | Forum Admin |
| Re: | 15 Sep 04 | Ali Ali Abdel-Fattah Ali Gab-Alla |
| Natural phenomenon? | 15 Sep 04 | Andreas Demetropoulos |
| lessepsian migration | 16 Sep 04 | Ferdinando Boero |
| Cetaceans as Lessepsian migrants | 18 Sep 04 | Tilen Genov |
| Correction of the reference | 20 Sep 04 | Tilen Genov |
| Re: from Prof. Boris Alexandrov (Russian and English) | 15 Sep 04 | Boris Alexandrov |
| Eutrophication & biological invasions | 22 Sep 04 | Dragos Micu |
| Black Sea Red Data Book and some protected sites in Bulgaria | 16 Sep 04 | Valentina Todorova |
| Black Sea Red Data Book? | 21 Sep 04 | Dragos Micu |

# [*]Summary of discussions on Topic 2.3: Climate change and exotic/invasive species (Southern and Eastern Mediterranean Sea and Black Sea)

**Jakov DULCIC[1] andTamara SHIGANOVA[2]**

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[2]Russian Academy of Sciences; P. P. Shirshov Institute of Oceanology, Russia – (shiganov@sio.rssi.ru)

The session was introduced by Jakov Dulčić who outlined current knowledge on changes in quantitative and qualitative composition of the Adriatic ichthyofauna and possible effects of climate changes (such as NAO variations) on such changes. Northward spreading of thermophilic species in the Adriatic and possible impact of allochtonous on the autochtonous species were also outlined. Than session was introduced by Tamara Shiganova who outlined current knowledge on the invasive species problem in Black Sea and their effect on the Black Sea ecosystem. It was stressed that the problem of invasive species in the Black Sea is a real problem for all region due to penetration many of invasive species further to the Caspian Sea and sometimes to the Baltic Sea, therefore the Black Sea became very important recipient and donor area. During last decades the great problem was created due to penetration Ponto-Caspian species from the Black Sea to the Baltic Sea, lakes, reservoirs and rivers of Europe. The introduction was ended by a series of questions regarding climate change and invasive species (including Lessepisan migrants), which opened the floor for discussion.

According to the contributions posted by different colleagues we should pointed next main topics discussed: a) northward spreading of warm-water species, b) influence of new species on ecology and fisheries, c) terminology (exotic, lessepsian migrants, aliens, erythrean aliens, invasive, non-native) and d) biological invasions in Black Sea. But in general, the topic included two important problems which overlap in one hand and could be separated in two main problems for ecosystem. Therefore discussion was separated on two main problems: invasive species and climate change. The most inputs were devoted to invasive/exotic/nonindigenous species (NIS). First contributions were concern the role of climate change in penetration of species in the adjective areas (northward) (Mediterranization of the Black and Adriatic Sea, Lessepsian migrations).

Many fish species may move towards high latitudes, as the sea becomes warmer. Year-to-year changes in sea surface temperature closely related to climate fluctuations may be responsible for these longitudinal range extensions. The main problems in discussing records of southern species northwardly are probably the spareseness of the data and that many of the records, especially the old ones, are often incomplete. It is often impossible to know exactly the year of occurrence of a certain species, because authors of systematic and/or floro-faunistic works do not always state how long before publishing they collected their specimens. Similarly, findings of the adults of long-living species give no information about the exact year of settling. The main problem could be connected with no real historical series of surveys. In many surveys, the recording of a species

[*] Please refer to this section as:

Dulcic, J.; Shiganova, T. (2004). Summary of discussions on Topic 2.3: Climate change and exotic/invasive species (Southern and Eastern Mediterranean Sea and Black Sea). Pp 81-84 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

greatly reflects the presence of a relevant specialist! However, in some areas there are many years of experience in monitoring "unusual" or "alien" species with different techniques. Many of the records are of great interest (in Adriatic for example), especially of three species: *Thalassoma pavo*, *Sparisoma cretense* and *Pomatomus saltatrix*, which are in great abundances moving to the northern parts of the Adriatic. Main discussion was taken in distinguishing two types of northward spreading of warm-water species in the Adriatic Sea. Several questions arised during discussion: "Could we attribute the same phenomena, e.g. northward spreading, to species such as *Balistes carolinensis* and *Trachipterus trachypterus*, as well? How many records are enough to judge whether a species is spreading versus north? Can we take into consideration as the northward migrants only species, established in the new area, such as Balistes?"

During last decades, different interesting phenomena were recorded in the northern Adriatic. One of them is certainly the "typical" northward spreading of southern species. If there is an indicator of such events, such as *Balistes carolinensis*, that we can take this as a fact, especially since the species is now established in this area. However, the occurrence of some deep-waters species such as *Trachipterus trachypterus*, could be more easily attributed to the ingression of south Adriatic waters, which is an event happening in peculiar years. During last decades, different interesting phenomena were recorded in the northern Adriatic. One of them is certainly the "typical" northward spreading of southern species. If there is an indicator of such events, such as *Balistes carolinensis*, that we can take this as a fact, especially since the species is now established in this area. However, the occurrence of some deep-waters species such as *Trachipterus*, could be more easily attributed to the ingression of south Adriatic waters, which is an event happening in peculiar years. It was also point out some evidence of very unusual records, such as the occurrence of a dozen basking sharks in the northern Adriatic Sea in 2001, but also in subsequent years. And there is also the increasing number of records even of such big animals, fin whales (*Balaenoptera physalus*) certainly are. Obviously, temperature is the main factor (and a direct evidence of climate change), however, in the case of basking sharks and whales, probably also proper zooplankton availability could have some rule among other factors. Finally contributors agree that perhaps in this case we should speak about northward spreading only in such cases, when the newcomer really enlarged his areal and should be therefore considered as an established species. Some authors noted that spreading organisms northward probably could be explained that it is easier for euriterm species to establish in biotope with lower temperature. There are several species which were introduced and established in the Black Sea (temperate water body) from Adriatic Sea. Among them were representatives of different group benthic *Cunearca cornea* and small fish *Gambusia affinis*. Some contributions noted significant changes, in the area of southeastern Adriatic, in some ecological parameters (i.e. instead of sparids we have significant abundance of new serranids) what surely influence food web chains, as now dominance of top predators is present - as groupers (mainly *Epinephelus* ssp.) are. But this on the other hand creates new rich fishery resources and benefit to welfare of local people. However, the "ecological price" or influence on local fish community is not investigated. As this process is still in front of our eyes, we will have the opportunity to record these changes and later to approximate influences in upper parts of Adriatic. Then discussion was connected with the role of devoted effect of invaders on ecosystems (examples of *Rhopilema nomadica*, *Rapana venosa*, *Caulerpa taxifolia*, *Mnemiopsis leidyi* were pointed). New species in a given area are usually seen as undesired additions to some sort of ideal fauna and flors. Some cases of pests, such as *Mnemiopsis*, are surely a nuisance to the functioning of the ecosystem they are thrown in, and the call for controlk of ballast waters is to be carefully enforced. The introduction of species beyond their natural range is rising sharply, due to increased transport, trade, travelling, and tourism and the unprecedented accessibility of goods resulting from globalisation. These activities provides vectors and pathways for living plants, animals and biological material to cross biogeographical barriers that would usually block their way. Most alien species do not become invasive or cause problems in their new locations: many have considerable benefits to society. However, the subset of alien species that are invasive can have

significant environmental, economic and public health impacts and present a significant risk of the wholesale homogenisation of ecosystems. Invasive alien species are now considered to be the second cause of global biodiversity loss after direct habitat destruction and have adverse environmental, economic and public health impacts from the local level upwards. The part of discussion was spawned by a question how to correct say: invasive, exotic or non-indigenous species and which species we can identify as invasive and which may say just alien.

At the end some priorities and actions could be propose: a) an understanding of invasion patterns: evaluations of described records, collection of specimens, field surveys, targeting habitats and areas which are most closely linked with known introduction vectors and molecular analyses, b) supporting and development management for control ballast waters and ship hulls floating in local areas, c) monitoring, modelling and predictions of the behaviour of an invasive species in recipient ecosystem and its effect on its trophic web, d) comparative analysis of the variability of species diversity, dominated species in space and time and environmental processes in the Mediterranean, Adriatic and Black Sea in the context of global climate oscillations, their effect on regional climate variations and exotic species, and e) the establishment of a philosophy of modifying policies and practices in the light of experience-the experimental approach to the implementation of policy.

Messages that were posted on this topic:

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|---|---|---|
| Introduction in English by Jakov Dulcic | 14 Sep 04 | Forum Admin |
| "In general, alien or immigrant species have not caused sign | 17 Sep 04 | Ahmet Kideys |
| Introduction in English by Tamara Shiganova | 14 Sep 04 | Forum Admin |
| Introduction en Français par Jakov Dulcic | 14 Sep 04 | Forum Admin |
| Introduction en Français par Tamara Shiganova | 14 Sep 04 | Forum Admin |
| Introduction in Russian (amended version) | 14 Sep 04 | Forum Admin |
| Northward spreading of warm-water species | 15 Sep 04 | Jakov Dulcic |
| Northward spreading of southern species | 15 Sep 04 | Lovrenc Lipej |
| answer | 15 Sep 04 | Jakov Dulcic |
| northward spreading of southern species - again | 16 Sep 04 | Lovrenc Lipej |
| northward spreading of southern species-again-answer | 17 Sep 04 | Jakov Dulcic |
| Dr. Tamara Shiganova | 16 Sep 04 | Tamara Shiganova |
| Northward spreading of warm-water species Suppl. | 15 Sep 04 | Jakov Dulcic |
| Influence of new species on ecology and fisheries | 15 Sep 04 | Glamuzina Branko |
| Influence of new species on ecology and fisheries | 15 Sep 04 | Jakov Dulcic |
| Introduction in Arabic | 15 Sep 04 | Forum Admin |
| Aliens and exotic, menace or enrichment? | 15 Sep 04 | Ferdinando Boero |
| aliens and exotic, menace or enrichment | 16 Sep 04 | Jakov Dulcic |
| Introductions and the Lessepsian immigration | 16 Sep 04 | Andreas Demetropoulos |
| Any invasion should be under control | 16 Sep 04 | Tamara Shiganova |
| I agree | 16 Sep 04 | Ferdinando Boero |
| exotic, aliens, lessepsian migrants | 17 Sep 04 | Izdihar Ammar |
| Non-native species | 17 Sep 04 | Ward Appeltans |
| non-native, invasive or alien species | 17 Sep 04 | Tamara Shiganova |
| non-native versus invasive | 17 Sep 04 | Ward Appeltans |

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|---|---|---|
| definitions | 20 Sep 04 | Ferdinando Boero |
| Erythrean aliens - drivers and risks | 20 Sep 04 | bella galil |
| Mediterranean and the Red Sea | 20 Sep 04 | Ferdinando Boero |
| On leaving the door open while closing the windows | 22 Sep 04 | Andreas Demetropoulos |
| About terms exotic, Alien, autocton , invasive, etc. | 18 Sep 04 | Adib SAAD |
| Les espèces exotiques/invasives en Méditerranée orientale (l | 18 Sep 04 | Ghazi BITAR |
| Biological invasions in the Black Sea | 22 Sep 04 | Dragos Micu |

# [*]Summary of discussions on Topic 2.4: Environmental variability and biodiversity predictability: data collection and ocean models – what to do?

**Temel OGUZ[1], Izdihar AMMAR[2] and Paolo MAGNI[3]**

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[2]Tishreen University; High Institute of Marine Research, Syria – (izdi5@scs-net.org)
[3]Foundation IMC – International Marine Centre, Italy – (p.magni@imc-it.org)

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This topic raised a rather controversial and fast moving debate with a drastic response from Ferdinando Boero (Lecce University – Italy) to the Introduction by Oguz et al. Boero argued that ecological systems are historical and non linear and that history cannot be predicted and non linear systems are chaotic and predictions fail over the medium-long term. He asserted that when variables are more than two, the prediction is fundamentally impossible. Several examples were given to show the difficulty, if not the impossibility, to predict biodiversity such as the little success of modelling of fisheries. Boero explained that a very small event can have an impact that is disproportionate to the size of the event itself and that models are alright until a little event arrives and disrupts them. He acknowledged that we have to learn modelling, but we have also to identify proper variables to include in the model. As an example, Boero indicated that a fisheries model without larval mortality and gelatinous zooplankton outbreaks is not very informative. Boero concluded his first intervention on Topic 2.4 with the paradox on his view that, in the era of biodiversity, the people who know biodiversity are vanishing and we produce models on biodiversity without actually knowing about it. Maltagliati (Pisa University, Italy) replied and agreed with Boero's assertion that reliable previsions cannot be made on a historical scale. Maltagliati however acknowledged that, on a smaller scale, somethings can be quite reliably predicted by ecologists if you know exactly which is (are) the causative factor(s). Maltagliati suggested that maybe climate is the most important factor ruling ecosystems, but it is certainly not the only one. Climate cannot be predicted but, for instance, certain human-provoked alterations of natural systems are well known. For example, the effects that the release of a given contaminant have on organisms can be predicted. Ecotoxicologists, community ecologists and population geneticists can give great contributions to that. Maltagliati concluded wondering whether the problem is in the ecological modeling and cited what he was told by a statistician teacher that: "...all models are not realistic but somehow useful". In response, Boero stressed the fact that we are speaking of environmental variability and biodiversity predictability. He indicated that the difficulties stand with the high number of variables affecting the environment and their impact on biodiversity. Boero affirmed that the reductionistic approach of taking one variable at a time (the single contaminant) conflicts with the emerging properties of ecological systems and of complex systems in general. Boero said that it is alright to produce reductionistic models, but then we have to merge them. Otherwise we have only elegant exercises that work until one condition fails: that the rest of the system remains unvaried while we make change only one variable at a time.

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[*] Please refer to this section as:

Oguz, T.; Ammar, I.; Magni, P. (2004). Summary of discussions on Topic 2.4: Environmental variability and biodiversity predictability: data collection and ocean models – what to do?. Pp 85-86 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

Boero finally acknowledged that whereas models and predictions are not useless, we have to develop also a complementary view of how the environment works, a new natural history. In a subsequent and final message, Boero indicated that there is a great need for a new theoretical framework aimed at putting different approaches (of experimental ecologists and modellers) together but that, unfortunately, people want to continue to do what they usually do. Boero suggested that the solution is to make funds available to bridge these gaps and to force people to integrate approaches because it is rewarding from a funding point of view. Boero indicated that we usually make projects aimed at producing factual results via experimentation, but we need also projects aimed at producing conceptual results based on brain use, so to produce new hypotheses to test with experimental projects. He concluded saying that what we have to envy in physics is: theoretical physics determines the course of experimental physics. On the other hand he affirmed that our theoretical ecology cannot be purely equational, in the way theoretical physics is.

Temel Oguz generally shares Boero's opinion about predictability of ecological systems. He also believes that at the moment we are far from making real predictions in ecosystems, except maybe in some simple and observationally well-studied regions. The ecosystem models at the moment are too simplistic to identify small details of ecosystem functioning which are, on the other hand, quite important for the success of prediction. Considering the fact that after 50 years of investment in meteorology, our successful prediction capability at present is not more than 5 days. So, prediction of ecological systems is even more challenging and it is now time to face this challenge.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English | 15 Sep 04 | Forum Admin |
| predicting history | 15 Sep 04 | Ferdinando Boero |
| we can predict something... | 16 Sep 04 | Ferruccio Maltagliati |
| of course we can predict something | 16 Sep 04 | Ferdinando Boero |
| usefulness of models | 16 Sep 04 | Ferdinando Boero |
| Introduction in Russian | 15 Sep 04 | Forum Admin |
| Introduction in Arabic | 16 Sep 04 | Forum Admin |
| Introduction en Français | 16 Sep 04 | Forum Admin |

# *Summary of discussions on Topic 2.5: Regional and international cooperation and comparative situations in the Mediterranean and Black Seas

**Izdihar AMMAR[1], Paolo MAGNI[2], Alenka MALEJ[3] and Snejana MONCHEVA[4]**

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[2]Foundation IMC – International Marine Centre, Italy – (p.magni@imc-it.org)
[3]National Institute of Biology, Marine Biological Station Piran, Slovenia – (malej@mbss.org)
[4]Bulgarian Academy of Sciences; Institute of Oceanology, Bulgaria – (snejm@mail.varna.techno-link.com)

The last topic of the joint Eastern and Southern Mediterranean and the Black Sea session addressed the issue of regional and international cooperation in these two marine basins. Introducing this topic, the Chairs stressed that despite many international agreements on different aspects of ocean monitoring, research, and sustainable use and some successful regional programmes, there is a need of a concerted cross-nation effort of researchers and decision makers to improve communication and to establish concrete biodiversity research and monitoring priorities in the two regions. A series of questions were posed in particular on how to bridge north and south, east and west in the Mediterranean and Black Sea regions. This challenging issue stimulated a very lively discussion on the theme which continued till the end of e-conference. Oksana Tarasova from the Commission on the Protection of the Black Sea against Pollution (Turkey) expressed her opinion that the legal and international frameworks are aimed at building such bridges. She explained that the Black Sea Commission, through its institutional network, is making attempts to clearly formulate the needs in scientific research aimed at reducing scientific uncertainty and on integration of new knowledge into the work program of the Commission. The Black Sea information system that is being created and is expected to be finalized in one year will give an opportunity for the Black Sea scientists. On the other side, the knowledge obtained by scientific research shall be formulated in a manner that will allow translating scientific findings in policies and actions for relevant information. She believes that the financial sources for such activities could be national, regional, international or private but clearly stated and justified research priorities will help to identify which source could be used for a specific purpose. As an example of the Commission's activity taking advantage of new electronic tools, Tarasova mentioned establishment of a zooplankton expert network of which Ahmet Kideys of the Institute of Marine Sciences, METU (Turkey), who has been working extensively on zooplankton of the Black Sea for a long time was unaware. Kideys remarked that inclusion of majority of good scientists and institutes from the region is essential for success of the programme and gave the NATO programme as positive case.

Ferdinando Boero (Lecce University – Italy) agreed with the situation depicted in the introduction about many agreements but much less integration. He went further in stating that protocols signed by authorities rarely started factual cooperation among the scientific communities. His experience

* Please refer to this section as:

Ammar, I.; Magni, P.; Malej, A.; Moncheva, S. (2004). Summary of discussions on Topic 2.5: Regional and international cooperation and comparative situations in the Mediterranean and Black Seas. Pp 87-90 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

when preparing a report on Mediterranean biodiversity for the Mediterranean Regional Activity Centre on Specially Protected Areas (RAC/SPA) indicated that there were scientists in all Mediterranean countries but the state of knowledge was sparse and there was no strategy. Boero suggested that the scientific community should identify some issues of high priority and inform decision makers that this information is most needed. As a first step, he proposed the preparation of a formal description of habitat types in the Mediterranean followed by reconstruction of their distribution; by Boero's opinion this is doable in relatively short time if proper funds become available. He also came up with the proposal that we should try to establish world-wide activities to assess marine biodiversity in a similar manner as geophysical mapping was done in the sixties during the International Geophysical Year. And finally he called for a strong theoretical effort and for building of a conceptual model regarding marine biodiversity. In reply to Boero's message, Kerim Ben Mustapha of the Institut National des Sciences et Technologies de la Mer (Tunisia) suggested to start with the "easiest" issues, i.e. each country should start by recording all the lists and bibliography related to marine biodiversity. This would give more accurate picture of the actual state and would also help to identify gaps. Kerim Ben Mustapha also advocated the need for joint field work either bilateral or multilateral/regional that would help to harmonise scientific culture among scientists from different countries. By his opinion increasing number of regional/international fora/agreements has not brought concrete cooperation of scientists from different countries on field; therefore he called for proposals for joint field campaigns focusing on biodiversity. His ideas were supported by Morad Award of the National Institute of Oceanography and Fisheries (Egypt) who stressed the importance of initiating a project on sensitivity mapping covering the whole southern and eastern Mediterranean shores. This major project would be contributed and participated by all the surrounding countries, as well as by the international agencies and organizations. Furthermore, Morad Award gave the MAMA project (1st MedGOOS network project) as a good example of coordination; this project established the multi-national network with a partnership from all riparian countries and a regional platform for marine observations and forecasts. He also believes that cooperation and communication could be improved through enhancing cooperation among MAP countries and the Euro-Mediterranean partnership, by creating European/Northern/Southern Mediterranean Centres, launching technology platforms, increasing mobility and improving coordination of national and international research programmes. Ahmet Kideys underlined the importance of the NATO Science for Stability projects in the Black Sea region with very successful cooperation of scientists from riparian countries that produced hundreds of good quality publications and also helped create the environmental database for the Black Sea.

Aldo Manos of the NAGREF - Fisheries Research Institute (Greece) argued that one of the functions of marine environment research, though not the main one, is to influence policies that can correct undesirable trends which have been identified and quantified, and for which clear links have been established with specific human activities. In order to influence policy the results of research must reach decision makers in a form that are both understandable and relevant to them. He suggested that transparency has to be improved particularly between programmes since they are developed without an over-all picture of all the other relevant activities in the same field. Duplication of efforts by the same research institutions, in the same areas, and on the same subjects, is thus hard to avoid. Manos questioned whether requirement of full disclosure and exchange of information between programmes when planning and financing new research should become a routine. This would promote specialization in research and ensure that a critical mass of resources is devoted to priority subjects. He also highlighted transparency of research to the general public as a prerequisite of long-term political and financial support, therefore the provision of information to the media and NGO should become a standard feature built into research projects.
MAP / MED POL views on regional cooperation on Mediterranean marine diversity monitoring were communicated by Colpan Polat Beken, MED POL programme officer (Greece). Marine biodiversity is not included in the core objectives and activities of MED POL as these issues are

handled by MAP/SPA/RAC. Anyhow, Polat Beken referred to monitoring and research components of the two strategic action programmes SAP-MED and SAP-BIO. In particular, SAP-BIO programme aims to protect the biodiversity and living resources of the Mediterranean, as well as their habitats. The programme was approved recently (2003) and it defines the overall needs and gaps at the regional level. Inventorying, mapping and monitoring of Mediterranean coastal and marine biodiversity are defined as one of the top priorities of the programme. National reports provided during the preparation of the SAP-BIO commonly highlighted the need to establish regional and national monitoring programme on biodiversity and to enhance research efforts to further improve the knowledge. For a better management of the monitoring activities within the frame of MAP mandate and activities, cooperation between the regional activity centres and MED POL is essential. SAP-MED and SAP-BIO need to be interactively implemented and some of the programme objectives, for example those of monitoring, could be bilaterally checked and common technicalities and needs of information should be discovered.

Izdihar Ammar of the Tishreen University (Syria) raised the point that the lack of knowledge and absence of strategy to work jointly is a responsibility of institutional administration and not only of the researchers themselves. Many steps have been taken by the Syrian government to encourage and support scientific collaboration with other universities and scientific institutions and centres in and outside the country. In the field of marine sciences, there are now many scientific cooperation programmes between Syrian researchers and researchers from Lebanon, Egypt, Oman, Greece, Tunisia, Italy and France. The list of joint projects which are being carried out by national and non-national efforts indicates that despite limited coast and financial and other problems, Syria is putting a lot of effort into the study of the marine ecosystem; she supplemented her statements with an extensive list of publications in Arabic. Nevertheless, Ammar was not optimistic concerning the future of marine biodiversity and called for action by competent authorities. In reply to her message, Boero stated that the long list of contributions on Syrian biodiversity is not available to most people. The documents in Arabic are not understandable by most of the scientific community, and the contributions to CIESM and SIBM societies are available only to those who attend the congress and to the associates of the society. He believes that very important information is published in a way that is not easy to find. In contrast to Boero, Kerim Ben Mustapha understood Ammar's pessimism, which, he believes, can be linked to the lack of involvement of the scientific communities in thinking globally. He also argued that the SPA & BD protocol of the Barcelona convention, which rules the implementation of MPA in high seas and countries bordering waters (SPAMI), should be better explored as a tool for multilateral cooperation. Further to this, Amir Ibrahim of the Tishreen University (Syria) suggested joint research projects carried out under the umbrella of the regional organization and authorities are the direct and most effective way of cooperation. In reply to Ibrahim's message, Kideys invited Ibrahim and his colleagues to the Middle East Technical University, Erdemli in Turkey, to discuss bilateral cooperation.

Messages that were posted on this topic:

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|---|---|---|
| Introduction in English (original) | 16 Sep 04 | Forum Admin |
| the extremely important conference! | 17 Sep 04 | Oksana Tarasova |
| zooplankton expert network ! | 17 Sep 04 | Ahmet Kideys |
| common projects on priorities | 17 Sep 04 | Ferdinando Boero |
| Let us lists | 17 Sep 04 | Kerim Ben Mustapha |
| For the project support on Integarted Senistivity maps | 20 Sep 04 | MORAD AWAD |
| NATO contribution | 17 Sep 04 | Ahmet Kideys |
| IMPORTANT QUESTIONS? AND TRYING TO ANSWER | 20 Sep 04 | MORAD AWAD |
| Introduction en Français | 16 Sep 04 | Forum Admin |

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| mailling lists | 20 Sep 04 | Kerim Ben Mustapha |
| Introduction in Russian | 17 Sep 04 | Forum Admin |
| Introduction in Arabic | 17 Sep 04 | Forum Admin |
| improving transparency | 18 Sep 04 | aldo manos |
| MAP/ MED POL voice | 20 Sep 04 | Sevcan Colpan Polat Beken |
| Sub-regional cooperation | 20 Sep 04 | Izdihar Ammar |
| Cousteau and the mediterranean | 20 Sep 04 | Ferdinando Boero |
| marine organizations?? | 20 Sep 04 | Izdihar Ammar |
| SPAMI | 21 Sep 04 | Kerim Ben Mustapha |
| EU Conferences | 22 Sep 04 | Iouri Oliounine |
| Sharing the idea on regional cooperation | 23 Sep 04 | Amir Ibrahim |
| Syria-Turkey cooperation | 24 Sep 04 | Ahmet Kideys |

# Session 3: Black Sea

# *Summary of discussions on Topic 3.1: From taxonomy to patterns and processes - the problem of "classical taxonomist guild extinction" and the need to develop advance biodiversity research in the Black Sea

**Snejana MONCHEVA**

Bulgarian Academy of Sciences; Institute of Oceanology, Bulgaria – (snejm@mail.varna.techno-link.com)

In the introduction to the session the view that rethinking and reconsidering the strategy of capacity building and biodiversity research in the Black Sea is the stairway to understand the patterns, processes, and consequences of changing marine biological diversity was expressed, formulating a number of questions to discuss alternatives in facing “graying taxonomist” crisis in the Black Sea, the need of new generation of systematists, understanding the dimension of biodiversity, progress in sampling and sensing instrumentation, experimental techniques and molecular genetic methods, predictive models. Are we doing enough for promoting the research results among the global scientific community, where are we on the way of developing Computer-Aided Identification (CAI) and data-basing Biological informatics in the Black Sea were part of the themes to streamline discussion.

The session received a response by 10 participants and among all taxonomy emerged as one of the core discussion topic in three major aspects – causes of decline of systematic studies, the need of new generation of taxonomists and possible solutions.

“The death of taxonomy” was related to competition (Ferdinando Boero) -competition for projects (e.g. money to fuel research) and carrier building. The “paradox that taxonomists are becoming extinct in the era of biodiversity” was linked to misuse of biodiversity, substituting the role of taxonomy in studding biodiversity. The fact that it takes a long-time to train a decent taxonomist, and the difficulties to publish papers on taxonomy in high impact factor journals was specifically underlined as one of the key reasons making taxonomy less attractive. The possible solution given was to follow the practice in United States - promoting taxonomy with special projects aimed at training taxonomists that are both molecular and traditional. Biodiversity money is to be labeled taxonomy explicitly and the selection of partners in networks should be based on relevant expertise. The appeal for larger support for training marine taxonomists - the 'old-fashioned' and the 'new-fashioned' ways together was supported by Bella Galil, stressing that MARBENA could help in this mission.

Ferruccio Maltagliati opposed that funding for taxonomy and crisis of taxonomists are two separate problems, the latter one related more to the choice of research fields by young researchers rather than funding for taxonomic research. New-fashioned taxonomists (sensu Boero and Galil) could (better, should) be involved in biodiversity conservation programs at equal bases. The low rank of taxonomic studies was associated in a way to the low competitiveness due to lack of flexibility of

* Please refer to this section as:

Moncheva, S. (2004). Summary of discussions on Topic 3.1: From taxonomy to patterns and processes - the problem of "classical taxonomist guild extinction" and the need to develop advance biodiversity research in the Black Sea. Pp 92-95 in Magni, P. *et al.* (eds): Electronic conference on ‘The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring’ - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

those involved in the policy of science. The result is that young people are not attracted by taxonomy because those who compel it are not powerful enough to warrant a perspective future. It was emphasized that scientific community needs taxonomists, but dealing with a sub sub sub species only is not enough to explain ecosytem functioning (one may call this reductionism Donatella Del Piero -about taxonomists). The existing confusion in taxonomic nomenclature and the need of updated inventory and revision was strongly underlined. Violeta Velikova pointed out the lack of contemporary identification books and modern manual for the Black Sea phytoplankton based on both LM and SEM to fill in the gaps of knowledge especially regarding taxonomy of small flagellates, which bloom so often, being so diverse and so "wonderfully unknown" , including all the difficult for identification naked dinoflagellates (for example genus *Karenia*, *Takayama*, *Karlodinium* have not yet "arrived" to the Black Sea inventory) together with a number of misidentified or unknown species.. The lack of interest to taxonomic research was again stressed as the most serious problem in the Black Sea region. The need of national programmes, that may allow scientists to devote time and money for species identification as well as the study of rare species (the problem of time-scales) in order to understand the ecosystem performance were advocated in particular. Kerim Ben Mustapha shared the difficulties the Black Sea and the south-eastern Med countries experience in publishing papers in specified high ranked journals, based on less advanced methods ("while I have problems in identifying the different categories of sponges cells, colleagues are able to follow larval stages and integrate their findings in phylogenic-taxonomic papers; not to speak about biochemical/gentic patterns...and so on"). A possible solution to overcome the lack of proper equipment and expertise was found in international collaboration (Bryozoans -with the support of Prof. Cocito, Italy; Ascidians - with the support of Prof. Ramos from Alicante, Spain, etc.).

Valentina Todorova promote further the discussion on systematic research, taxonomic competence and collaboration. Within the UNDP-GEF Black Sea Ecosystem Recovery Project (BSERP) a joint Research Cruise aimed at assessing the benthic diversity and recent ecological status in the North-western Black Sea area was an excellent opportunity for an international team of scientists from Bulgaria, Romania and Ukraine to harmonize sampling and processing procedures but also to compare taxonomic expertise while identifying species onboard. The first results reported manifested that each of the teams had identified different number of species despite the equal sampling effort and harmonized procedures. It was clearly evident that a taxonomic revision of the fauna in the Black Sea was needed calling imperatively on raising the standard of taxonomic competence in order to produce comparable results and consistent conclusions. Inter-laboratory training, exercises and testing was suggested as a powerful mechanism to increase the quality and precision of taxonomic identification.

Dragos Micu (a young scientist) gave a strong support to taxonomy raising the point of preserving and building on the wealth of taxonomic knowledge accumulated by our predecessors. The setting of several taxonomically oriented databases (CLEMAM, ERMS, etc.) undertaken during the last 10 years was given as a good example as an excellent basis for regional and international scientific communication and cooperation. Again it was underlined that the taxonomy of Black sea biota is more or less in a state of "chaos". The published work "Annotated Checklist of the Marine Mollusca from the Romanian Black Sea" was suggested as a good initiative to follow with other phyla as well.

The persistence of a "taxonomical iron curtain" between Russian scientists and the rest Black Sea taxonomists was viewed as one of the main difficulties on the way to taxonomic unification while communication and scientific networking at basin-wide scale - one of the best solutions. Two important issues were also advocated – the proper selection of experts responsible to communicate results and acting as policy-maker's advisers ("bad information is worse than no information") and making research results available to the scientific community - considered at least as important as

the quality of the work itself. Publishing in national journals in English was envisaged as an alternative.
The voice of another young scientist, Luydmila Kamburska was also in full support of traditional taxonomy giving at least a breath of hope for the future of systematics (‘still the science is a passion, and taxonomy is a challenge”). Although difficult to be an expert in both traditional and “modern” taxonomy, young scientists willing to study taxonomy and go deeply with the ecological meaning of that are already prepared for the long way to go -first to get the taxonomic knowledge and then trying with computers and modeling.

A social anthropologist, Ivelina Moncheva gave a little bit different flavor to join efforts - to follow the historical experience in ancient culture (from chronology to synchronicity). A chronic of abrupt biodiversity changes existing within the same time-frame (data matrix), might help elucidating similarity (synchrony) between different geographical locations and basins. Thus similar questions and problems could be identified that will help scientists to look for general patterns, common answers and forecast.

Dragos Micu proposed a generalization as a Black Sea “to do” list:

- UNIFICATION OF TAXONOMY modern, up-to-date identification manuals for the Black Sea biota.
- BIODIVERSITY INVENTORIES (accurate!) for all the national sectors of the Black Sea.
- STANDARDIZATION OF METHODS FOR BIODIVERSITY RESEARCH on a basin-wide scale.
- IMPLEMENTING NEW METHODS based on SCUBA, non-destructive sampling, in-situ experments, molecular biology.
- RED LISTS for all national sectors, elaborated in compliance with the new IUCN categories and criteria and guidelines for application at regional level, provided that the species status is determined on the basis of extensive fieldwork with appropriate evaluation methods
- COOPERATION AND NETWORKING: workshops where the young scientists from the Black Sea countries get a chance to know each other and set common goals, possibly leading to joint research projects.

I personally fully agree that taxonomy is in need of recognition from the funding agencies, but I am also in favor of what we call "scientific initiative" or "scientific dedication" in order to be part of the solution. And I am extremely happy to hear the voices of young scientists advocating this, and still rather disappointed from the limited participation by the Black Sea scientists. May be the establishment of Regional taxonomic centres could help to concentrate the available potential as an appropriate tool to promote the systematic research in the Black Sea riparian countries at relatively low cost.

**References:**

Boero F., 1994. Bright young people, biodiversity and species lists. Trends Ecol. Evol., 9 (10): 399.
Boero F., 2001. Light after dark: the partnership for enhancing expertise in taxonomy. Trends Ecol. Evol. 16 (5): 266

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English | 19 Sep 04 | Forum Admin |
| the death of taxonomy | 20 Sep 04 | Ferdinando Boero |
| not a voice in the wilderness | 20 Sep 04 | bella galil |
| Funding for taxonomy and crisis of taxonomists are two separ | 21 Sep 04 | Ferruccio Maltagliati |
| is it the market or? | 20 Sep 04 | Snejana Moncheva |
| it is the market, in a way | 20 Sep 04 | Ferdinando Boero |
| a voice of a young taxonomist | 20 Sep 04 | Luydmila Kamburska |
| about taxonomists | 23 Sep 04 | Donatella Del Piero |
| Keep the Faith | 21 Sep 04 | Dragos Micu |
| What we shall do? | 23 Sep 04 | Kerim Ben Mustapha |
| Make the best of what you have | 23 Sep 04 | Dragos Micu |
| The need to advance phytoplankton taxonomical research in th | 25 Sep 04 | Snejana Moncheva |
| Introduction in Russian | 19 Sep 04 | Forum Admin |
| Introduction en Français | 20 Sep 04 | Forum Admin |
| How to promote sytematics research and raise taxonomic compe | 20 Sep 04 | Valentina Todorova |
| from chronology to synchronicity | 26 Sep 04 | Ivelina Moncheva |
| Black Sea “to do” list | 27 Sep 04 | Dragos Micu |

# *Summary of discussions on Topic 3.2: Microbiota, deep sea biodiversity and unexploited habitats – the neglected biodiversity

**Serena FONDA-UMANI**

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One of the most noticeable results of this topic discussion is that we are still far away from a general consensus on the importance of the smallest biological components in controlling the whole marine system. This topic indeed obtained only few reactions (by Khatuna Akhalaia, Snejana Moncheva, Lyubomir Dimitrov&Valentina Doncheva and Valentina Turk) compared to some others devoted to taxonomy or top predator management. Mediterranean scientists are still more involved in the visible world than in its microbiology or biochemical pathways. This lack of interest (or expertise) builds up one of the largest scientific gaps in the Mediterranean area compared to what is going on in other European scientific communities, not to mention the USA. Marine biologists (or better marine ecologists) should know the role of microbial world since the beginning of their career, and "Microbial ecology" has to become one of the main courses of the second level degree in Marine Biology. We are still too few in each of our Mediterranean countries (if any in some of them) to force people at the large to think also to the invisible world in the ocean. It still difficult to think at the ocean because our lack of the third dimension, usually common people experience the ocean from the shore or (few) from a boat, which means the very narrow coastal system (where they can appreciate seaweeds, macroalgae, crabs, shells, etc.) or the ocean surface (where they can see fish or dolphins). It is very difficult for them to think at other bacteria than pathogens and usually they simply do not know how many "good" bacteria the ocean can host. It is the duty of marine scientists to introduce at every level this basic knowledge to improve our efforts in maintaining high marine biodiversity also in the prokaryotic realm, which is the most important one in controlling the general health of the marine ecosystem.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English | 20 Sep 04 | Forum Admin |
| Introduction en Français | 20 Sep 04 | Forum Admin |
| Introduction in Russian | 21 Sep 04 | Forum Admin |
| When you know the problem, it is half a solved problem. | 21 Sep 04 | Khatuna Akhalaia |
| main problems | 21 Sep 04 | Serena Fonda Umani |
| Unexpected Deep Black Sea Meiobenthos | 21 Sep 04 | Eleonora Racheva |
| The need of joint efforts for exploration of Black Sea sea-b | 21 Sep 04 | Eleonora Racheva |
| two additional comments | 23 Sep 04 | turk valentina |
| our future duties | 24 Sep 04 | Serena Fonda Umani |
| let | 25 Sep 04 | Snejana Moncheva |

* Please refer to this section as:

Fonda-Umani, S. (2004). Summary of discussions on Topic 3.2: Microbiota, deep sea biodiversity and unexploited habitats – the neglected biodiversity. Pp 96 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

# *Summary of discussions on Topic 3.3: In search of pressure-state-response biodiversity indicators: extending science to policy

**Christos Arvanitidis[1] and Valentina Todorova[2]**

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Almost three weeks after the start of the seventh MARBENA e-Conference obviously there was some weariness in the participants to which I render the small number of contributions received in response to topic 3.3.

Dr. Maria Ketsetzopoulou provided very useful comment on the importance of communication between scientists and politicians. She discussed about the environmental consequences of economic growth and about the importance of sustainable development. There is a broad consensus that development has an economic, a social and an environmental dimension and will only be sustainable if there is a balance between the different factors that contribute to the overall quality of life. According the related EC documents, all policies must have sustainable development as their core objective. A sustainable development strategy should be a catalyst for the policy- makers and public opinion in the coming years and become a driving force for institutional reforms and for changes in corporate and consumer behaviour. Policy should focus on steady long-term management strategy which allows business and individuals to plan better and adjust gradually, thereby greatly reducing the costs of change. Systematic dialogue with representatives of consumers, whose interests are often overlooked, should improve the quality of regulation and accelerate its implementation. Sustainable development calls for sweeping economic reform to create new markets and 'get prices right', for example, by ensuring that prices paid for goods and services include the costs of damage caused by pollution. In this way, markets will stimulate companies and consumers to take better account of the effects of their behaviour. Science and research also have a central role to play in guiding political decisions. To assess progress toward these objectives, they need to be supplemented by a set of accurate indicators, measuring sustainable development at an aggregate level the economic, environmental and social changes. Finally, as the success of any sustainable development depends on changes in people's behaviour, governments must do more to educate ad inform business and citizens. All these presuppose at least three successive steps of a common algorithm: support of research progress, interactive socio-economic environmental scientific options, translated into appropriate management tools. The critical point in this cycle is the close interaction between researchers and decision-makers, both still in need of continuous learning how to communicate and work together. Thus joint training and workshops involving scientists and stakeholders might prove efficient.

Christos Arvanitidis responded to the above with the suggestion that one potential step forward to break the ice between science and policy is the valuation of the Marine Biodiversity. This can be

* Please refer to this section as:

Arvanitidis, C.; Todorova, V. (2004). Summary of discussions on Topic 3.3: In search of pressure-state-response biodiversity indicators: extending science to policy. Pp 97-99 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

achieved by implementing either monetary or non monetary values to all goods and services provided by the Marine Ecosystems. Valuation of the Marine Biodiversity is the main focus of the Theme 3 of the MarBEF Network of Excellence. Yet, it is at least encouraging to know that the algorithm has been already initiated.

Ferdinando Boero opposed that ecological economics is not a satisfactory approach because it is morally wrong to valuate people's life against economic profit. "What is the value of YOUR life?" he provoked. In the era of political correctedness, the life of a person should have the same value throughout the world. However, it is a common practice countries from the so called "first world" to settle their most polluting enterprises in "emerging" countries, since the price they should pay for environmental accidents (including the death of people) is much lower. He warned that we should not rely on lawyers and accountants to solve the environment related issues or we will be in trouble.

Kerim Ben Mustapha suggested some relevant references, which reflect on how to give an economical value to the "indirect" natural ecosytem functioning: World watch institue reports : «State of the earth 1997; 1998 », L. Brown, 2003, and "adbusters" magazine of 1997 and 1998.

In further input Ferdinando Boero reminded that giving a monetary evaluation to the "goods and services" that biodiversity is providing us is very risky, because often pollution is economically convenient. He gave his preference of ecological ethics to ecological economics approach, despite his agreement that nowerdays money is the value of everything, including our lifes.

Ferruccio Maltagliati's view of economic ecology was not so pessimistic. In his opinion ecologists can fight the dangerous contradictions between ecology and economy by providing sound ecological ethics to economists.

The relevance of indicators as communication tools between science and policy was highlighted by Kremena Stefanova who commented that indicators synthesize complex data into integrated surrogates that are understandable to management and more applicable in environmental policy and decision making. She considered that a great variety of indices of species diversity exist that are useful as ecological state indicators but these are usually not sensitive in distinguishing the impact on diversity of different environmental pressures. I would emphasize on the continued need for further standardization of diversity indices and quality assurance of data.

In addition to indices I would suggest that full species lists are very appropriate indicator for assessment of marine diversity of certain marine areas, habitats, etc. For the conservation of marine communities a full community analysis has to be done. Focusing on sensitive species might be given priority. I want to stress the importance of adequate taxonomic determination, hence taxonomic revision, harmonization and expertise enhancement within the Black Sea and between Black Sea and other European seas is recommended in such a way that neighboring countries identify down to the same taxonomic levels according to the same taxonomic standard.

Messages that were posted on this topic:

| | | |
|---|---|---|
| Introduction in English | 21 Sep 04 | Forum Admin |
| to brake the ice between science and policy | 23 Sep 04 | Snejana Moncheva |
| Valuation of Marine Biodiversity | 23 Sep 04 | CHRISTOS ARVANITIDIS |
| money for nothing | 27 Sep 04 | Ferdinando Boero |
| State of the world | 27 Sep 04 | Kerim Ben Mustapha |

| | | |
|---|---|---|
| ecological economics | 27 Sep 04 | Ferdinando Boero |
| considerations on economic-ecological approaches | 27 Sep 04 | Ferruccio Maltagliati |
| Introduction in Russian | 21 Sep 04 | Forum Admin |
| Introduction en Français | 21 Sep 04 | Forum Admin |
| What scientific tools for managing biodiversity can be offer | 23 Sep 04 | Kremena Stefanova |

# *Common discussion and synthesis Summary

**Paolo Magni[1], Alenka Malej[2], Snejana Moncheva[3]**

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During the common discussion an outline of the main issues addressed during the Conference was introduced by the MARBENA7 organisers, formulating the main challenges in future perspective "What directions do we have to take further? Which research questions to put on the top of the priority list? How could we enhance co-operation among countries within the Mediterranean and Black sea regions and co-operation with EU? Which financial and policy instruments could be used to promote this co-operation?".

*Christos Arvanitidis* stressed the need to focus on the main gaps that emerge from the discussions and provided a very comprehensive "what to do" shopping list to serve as a guideline for the future activities:

• Networking: joining efforts, setting the essential questions, re-developing the Regional Strategy for the Southeastern Mediterranean and the Black Sea, in compliance with EU and International Treaties and Conventions
• DBase development; central depository of data from the Marine Environment; digitalization of existing historical data stored on paper for long time
• Common Large-Scale-Long-Term Projects
• Linking with other disciplines (e.g. socio-economics, decision making, integrated coastal zone management)
• Vast unexplored geographic areas
• Lack of expertise in several disciplines; the need to capacity building of new generation of scientists, based on multi-disciplinary education
• Development of Rapid Assessment Techniques (RATs) for the assessment of the Marine Environment, integrating multidisciplinary knowledge

*Amir Ibrahim* elaborated further on the data-base development and regional collaboration.
Taking into account the wide cultural and language diversity in the Mediterranean basin and the great number of publications in native languages, he suggested to include in the data-base a list of published papers with extended abstracts in English in order to make them available to a wider scientific community and readers. This activity has been already initiated at Tishreen University in Syria and in the near future all the information will be placed on a specially designed web site devoted to marine science. In addition due to the diversity of political status (some Mediterranean countries being EC members are obliged to strictly follow the European legislations approaching specific environmental issues, such as bathing water criteria for example, while others are not) the

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* Please refer to this section as:

Magni, P.; Malej, A.; Moncheva, S. (2004). Common discussion and synthesis - Summary. Pp 100-102 in Magni, P. et al. (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

harmonization of environmental legislation is seen as a crucial step towards effective regional cooperation.

*Ferdinando Boero* extended the discussion from “what to do” to "how to do it". Among the two options - a top down attitude or a bottom up approach he gave preference to the second one, considering the forum to be the first step. He emphasized that English is the language of science and strongly supported the idea of translating non-English papers. The Mediterranean, furthermore, is a mini-ocean and is a model of what will happen in the future to the rest of the world ocean. It is the best European sea for this purpose, since it has a very high biodiversity and is going through the greatest biogeographic event in the recent times: the entrance of tropical species through the Suez Canal. The other issue he stressed is predictability, which should be added to the list of future perspectives. The main concern is that the paucity of variables is conducive making predictability more feasible in simple systems, with a low number of variables. The problem is that Mediterranean science is more descriptive than predictive, compared to some other seas. The second concern is related to the applicability of models developed in other basins – is a Baltic model applicable to the Mediterranean? The possible solution could be to have "northern" scientists coming down to the Med and perform some Mediterranean ecology, leaving the inter-tidal aside. And the third concern expressed is that the habitat directive seems to have left Mediterranean marine biodiversity aside. Can we do something to give the Mediterranean the importance it deserves?

*Morad Awad* gave his full support to the enhancement of cooperation between Mediterranean countries in general and between its Northern and Southern borders in particular.

*Kerim Ben Mustapha* suggested that a possible way of attracting students to work on taxonomy is to link taxonomic studies to "attractive" projects and programs that are of high potential to raise money from politicians (ex MPA). SPA (SPAMI) has been foreseen to play an important role in strengthening regional cooperation as a high priority issue for the progress of biodiversity studies and conservation. Rather than focusing on old literature, an inventory of biodiversity by each country, following a common format will help better the setting of regional data-base and assist attracting money from EU projects; GEF; CBD; foundations etc.

In support of this, *Ahmet Kideys* reminded that EU has already opened a special call for Turkey, Romania and Bulgaria which could be extended to include other countries in the Black Sea and eastern (and southern) Mediterranean to enlarge cooperation. In addition, bilateral agreements between research organizations might prove very useful, advocated by the results achieved within a number of joint research projects between Ukraine and Turkey.
A Georgian NGO representative, Khatuna Akhalaia appealed for improved information flow and increased public awareness on environmental problems, reporting the approach of the Association 'Colchis Medea' for Atlantic, Colchis sturgeon protection.

*Snejana Moncheva* summarized that we need SMART scientific objectives - Specific, Measurable, Attainable, Resoursed and Time foreseenable that we have to go for, based on WISDOM - Will (scientific and political), Insight (thorough knowledge), Social perception in order to Develop Options for Management (sustainable) the marine environment And biodiversity protection.

**Contributors**

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Khatuna Akhalaia, NGO, Union of Georgian Ichtiologists, Tbilisi, Georgia

Messages that were posted on the last topic for general discussion and synthesis:

| | | |
|---|---|---|
| Towards final conclusions | 23 Sep 04 | Paolo MAGNI |
| focus | 23 Sep 04 | CHRISTOS ARVANITIDIS |
| I agree | 24 Sep 04 | Amir Ibrahim |
| some more | 27 Sep 04 | Ferdinando Boero |
| maybe there is more | 27 Sep 04 | Ferdinando Boero |
| "SMART" and "WISDOM" instead of epilogue | 27 Sep 04 | Snejana Moncheva |
| Contnueous support | 24 Sep 04 | MORAD AWAD |
| Contribution | 25 Sep 04 | Kerim Ben Mustapha |
| cooperation in the Med | 25 Sep 04 | Ahmet Kideys |
| Atlantic sturgeon program | 24 Sep 04 | Khatuna Akhalaia |

# Organisation and Statistics

# [*]Practical organisation and statistics

**Edward Vanden Berghe**

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The conference was organized as a moderated bulletin board. Both the introduction to the themes and topics, and summaries of the discussions, were available on the Internet, (www.vliz.be/marbena). Contributions to the conference were posted through a form on the web site.

A total of 13 topics, split up into three sessions, were discussed in three weeks (table 1). This conference was multilingual. The introductions were posted in the following languages:

- Session one: English, French and Arabic
- Session two (joint): English, French, Arabic and Russian
- Session three: English and Russian

For practical reasons, only English and French messages were accepted to be posted on the forum. French and Arabic messages were translated/summarised into English. No contributions in Russian were sent.

The co-chairs were responsible to open the discussion by making their opening statements and to follow up the discussion. They were also responsible to provide a general summary and synthesis of the discussions.

**SESSION 1: Eastern and Southern Mediterranean**

| Topic | Starting date | Title | Introduced by |
|---|---|---|---|
| 1 | 6 September | "The role of top predators (incl. gelatinous organisms) and large nekton (incl. whales & dolphins, seals, sharks, turtles) for biodiversity" | Ahmet KIDEYS & Alessandro DE MADDALENA |
| 2 | 7 September | "Monitoring studies on marine biodiversity in the Mediterranean, with special reference to Eastern and Southern Countries" | Chedly RAIS |
| 3 | 8 September | "Historical data sets and grey literature: the value of 'real' data and the need for quality control" | Samir GRIMES, Izdihar AMMAR, Paolo MAGNI |
| 4 | 9 September | "New techniques, tools and approaches to study marine biodiversity at the regional (Mediterranean) scale" | Lovrenc LIPEJ & Andreja RAMSAK |
| 5 | 10 September | "Do we need a revision of our biodiversity research agenda?" | Ferdinando BOERO |

[*] Please refer to this section as:

Vanden Berghe, E. (2004). Practical organisation and statistics. Pp 104-106 in Magni, P. *et al.* (eds): Electronic conference on 'The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring' - Summary of discussions, 6 to 24 September, 2004. Flanders Marine Institute: Oostende, Belgium.

**SESSION 2: Joint session on Eastern and Southern Mediterranean, and Black Sea**

| Topic | Starting date | Title | Introduced by |
|---|---|---|---|
| 1 | 13 September | "Endangered biodiversity and management of marine protected areas, wetlands, lagoons, estuaries and seagrass meadows" | Samir GRIMES, Izdihar AMMAR, Marian GOMOIU & Paolo MAGNI |
| 2 | 14 September | "Biodiversity conservation, impact of human activities, environmental policy and public awareness" | Andreas DEMETROPOULOS |
| 3 | 15 September | "Climate change and exotic/invasive species" | Jakov DULCIC & Tamara SHIGANOVA |
| 4 | 16 September | "Environmental variability and biodiversity predictability: data collection and ocean models - what to do?" | Temel OGUZ, Izdihar AMMAR, Samir GRIMES & Paolo MAGNI |
| 5 | 17 September | "Regional and international cooperation and comparative situations in the Mediterranean and Black Seas (CIESM, Regional Seas Programmes: MAP, Black Sea Programme, IOI, MAMA network, etc.)" | Izdihar AMMAR, Samir GRIMES, Paolo MAGNI, Alenka MALEJ & Snejana MONCHEVA |

**SESSION 3: Black Sea**

| Topic | Starting date | Title | Introduced by |
|---|---|---|---|
| 1 | 20 September | "From taxonomy to patterns and processes - the problem of "classical taxonomist guild extinction" and the need to develop advance biodiversity research in the Black Sea" | Snejana MONCHEVA |
| 2 | 21 September | "Microbiota, deep sea biodiversity and unexploited habitats - the neglected biodiversity" | Serena FONDA-UMANI |
| 3 | 22 September | "In search of pressure-state-response biodiversity indicators: extending science to policy" | Christos ARVANITIDIS, Valentina TODOROVA & Luydmila KAMBURSKA |

Table 1. Time table including schedule, titles of topics and chairs

The basic flow of information of the conference was through the WWW. This was done to stimulate 'external' parties to participate in the discussion. To make sure the conference was widely known, mailing lists of several organizations and activities were used to invite all interested parties to register. Access to the general pages of the conference, and to the summaries, is open to everyone. To be able to post messages and also to view posted messages, registration through a form on the web site was necessary. The requests for registration were handled individually; applicants were informed of successful registration in an e-mail. Once registered, access to the forum was possible by logging-in with user-defined username. The obliged login username aids in referring to the authors' details by linking to IMIS (Integrated Marine Information System), and in addition enables us to score participation during the course of the conference.

**Statistics**

Registered participants: 1250
Number of countries: 46
Participants requesting summaries through e-mail: 322
Numbers of addresses on the general circulation list: 2878
Number of messages: 256
Number of contributors: 68
Number of contributing policy makers: 5
Number of contributing NGO's: 6

Hits on marbena web site: 41,723 (from 15 Augustus to 15 October 2004)
Hits on /cgi-bin/marbena.exe: 15,398
Hits on /marbena: 26,325 or 5,401 html pages
Total number of pages requested: 20,799

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A total of 68 persons participated actively and sometimes very lively to Marbena 7. Amongst them there were 5 policy makers who contributed and 6 NGO’s were represented.