THE SOUTHERN AND EASTERN MEDITERRANEAN SEA AND THE BLACK SEA: NEW CHALLENGES FOR MARINE BIODIVERSITY RESEARCH AND MONITORING

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Over the last ten years, the Convention on Biological Diversity has been ratified by most European countries and the European Union, reflecting the increasing awareness of the magnitude of the biodiversity crisis worldwide. Many national and international agencies and the framework programmes of the EC now support biodiversity research. However, the scientific knowledge on which nature conservation and the sustainable use of biodiversity must be based is still weak, and the scientific capacity in Europe is still much fragmented.

Moreover, public concern about biodiversity at the beginning centred mainly on the rapid disappearance of a number of large vertebrate and plant species from the terrestrial biosphere. There was no concern about changes in marine biodiversity since the oceans were considered to be immune to human induced extinction. But this intuition was not supported by data; on the contrary, alarming signs of change have been coming from the fisheries since a long time and it was also realised since the 1960s that many coastal areas worldwide are under significant and increasing pressure. For some reason, this did not translate into concern about marine biodiversity change until well into the 1990s.

The lack of public and political attention to marine biodiversity has also hindered the development of the underlying science. Even now marine biodiversity research is fragmented and uncoordinated at the European level, and moreover mainly based on ideas and paradigms developed for terrestrial systems. We do not know the real extent of marine biodiversity change very well, not even in Europe's best-known areas.

What is needed therefore are research programmes that increase our basic knowledge of biodiversity addressing the right scales of space and time, and this includes evaluation of the role of biodiversity to produce goods and services that support human health and living conditions. Also needed is a much better understanding of the complex interactions between environmental and societal dynamics that depend on many psychological, ethical, political and economic issues. Biodiversity science must develop into a truly multidisciplinary science and become an integrated part of the Earth System Approach, in which biology, ecology and biogeochemistry are intrinsically linked to the human dimension (economy, sociology, ethics).

MARBENA (Creating a long term infrastructure for Marine Biodiversity research in the European economic area and the Newly Associated states) is a project within the 5th framework programme of the European Union that specifically addresses the fragmentation of biodiversity research in Europe. The objectives of the Marbena project are:

– to create the infrastructure for marine biodiversity research in Europe, by creating a pan-European network of marine scientists; improve the science by cataloguing the existing expertise and infrastructure, by defining and prioritising the issues at stake; provide an intellectually attractive environment for young scientists and a discussion forum for all;
– to create awareness on the issues at stake and enlarge the visibility of marine biodiversity research in Europe: communicate with EU policy makers and politicians (presentation of marine biodiversity issues at the European Platform for Biodiversity Research Strategy meetings), liaison with global organisations and programmes, and dissemination of information to the public at large.

Both objectives are served by the organisation of electronic conferences on different subjects that are perceived by managers and policy makers as areas where scientific knowledge is missing or insufficient. These electronic conferences are summarized and presented at the half yearly meetings of the European Platform for Biodiversity Research and Strategy, which aims at providing a functional interface between research and policy making. The summary of all eight e-conferences that have been organized until now can be found on the web at http://www.vliz.be/marbena.

In the Marbena project, a couple of workshops have also been organised aiming at networking scientists from different regions. The first was held in Sopot, Poland, and addressed the scientific community in the Baltic Sea area. The present (second) workshop was held in Piran, Slovenia, from 28–30 November 2004 and addressed the scientific communities from the Eastern Mediterranean and Black Sea. Of special importance to the Piran workshop was the Seventh Marbena e-conference on Marine biodiversity research and monitoring in the Mediterranean and Black Seas; New challenges for marine biodiversity research and monitoring. This e-conference was especially important as scientists from the Middle East and North Africa participated for the first time in the discussions.

The agenda of marine biodiversity research in Europe has been the subject of a number of documents released by the European Science Foundation. These include four documents, *i.e.* science plan http://www.esf.org/generic/626/EmapsPlan.pdf, implementation plan http://www.esf.org/publication/151/marinebiodiversity.pdf for marine biodiversity research, Europe's contribution to global change research http://www.esf.org/publication/181/GlobalChange.pdf, and integrated marine science plan http://www.esf.org/generic/626/EmapsPlan.pdf. Together, these four documents very well present the critical points on which marine biodiversity research should be focused, the Mediterranean and Black Seas included. Still, there are several points which are of special interest to these regions and that have been debated during the seventh Marbena e-conference and during the Piran workshop (see this volume).

The major scientific issues that have been identified in these recent documents from the European Science Foundation are:

What is the biodiversity of the European Seas?

A number of recent initiatives (European Register of Marine Species, Natura 2000, the Census of Marine Life) have produced, or will produce in the near future, lists of the known species in Europe. Over the coming years, this information will become accessible in databases that also contain additional information, *e.g.* on environmental variables (OBIS, GBIF). For most European marine areas, the inventory of marine life is much closer to completion than for any other area in the world, although some geographic areas such as the Eastern Mediterranean have not been explored so well and still need some basic inventory. What is still lacking is the synthesis of such inventories and the link with environmental data to describe bio-geographical patterns and their change at the European scale. Whereas the flora and fauna of Europe are reasonably well known, this is not the case as far as large scale patterns in the distribution of plant and animal species and ecological communities are concerned. This is due to the fact that most of the effort in the few hundreds of years of classical biological exploration and research has been local and restricted in time. Gradients in space (longitudinally, latitudinally, and vertically) and time (from geological to more recent time scales) influence biodiversity considerably. Studies of gradients should be supported by putting together data from long-term local and regional monitoring programs.

What is the functional role of biodiversity?

The overall functioning of an ecosystem is often impacted by a few key species that exert a major impact on overall metabolic processes, such as primary and secondary production, remineralisation, vertical export and bioturbation. This impact can be disproportionate to their abundance or biomass. Key species exist in the pelagic and benthic realms. The characteristics of these habitats differ fundamentally. The pelagic habitat is renewed continuously by advection and mixing, whereas the benthic habitat is more heterogeneous but stable for longer periods of time. Hence dominant organisms in the benthos tend to be competitive space-holders, whereas dominant planktonic species either have high growth rates, low mortality rates or life cycle strategies that enable them to maintain populations in a given locality. Consequently, the attributes of the key species in both habitats are very different.

Diversity is related to stability, *i.e.* the persistence of an ecosystem. Whereas genetic diversity may stabilise a population, additional functional diversity stabilises the ecosystem. The main question in this context is the role of redundant species, which take over certain functions in the case of species loss due to reduction or succession. Are weak links in the food web the major reason for stability and what is the importance of co-dependency? The overall question is how many species and functional groups are needed to sustain a stable ecosystem.

Microbes and viruses

Molecular techniques now allow the characterisation of non-cultivatable, morphologically indistinguishable microbes (viruses, bacteria, archaea and protists). This molecular approach has already revealed the enormous richness of bacteria, the ubiquitous presence of archaea, and the phylogenetic heterogeneity of picoeukaryotes in the ocean.

The major scientific challenges for the near future are to determine the key "species" among the bacteria and archaea focusing on the abundance of these key species and their role in biogeochemical cycling. The microbial environment needs to be investigated at the appropriate microbial scale. There is evidence that microbes are structuring their microenvironment leading to a larger spatial heterogeneity than we anticipated in the past. The role of microbial-derived substances controlling intra- and interspecific interaction with other organisms might be a research area with a high potential for biotechnological applications. The lack of information on the role of viruses in regulating microbial populations needs to be addressed and virus-host systems established for the key species. This has the potential to reconstruct the occurrence of specific organisms in the past if sediment cores are analysed for the presence of the specific virus. Together with sediment dating, this allows retrospective analysis of events of specific interest for humans such as harmful blooms, even if the particular species does not leave any marker in the sediment.

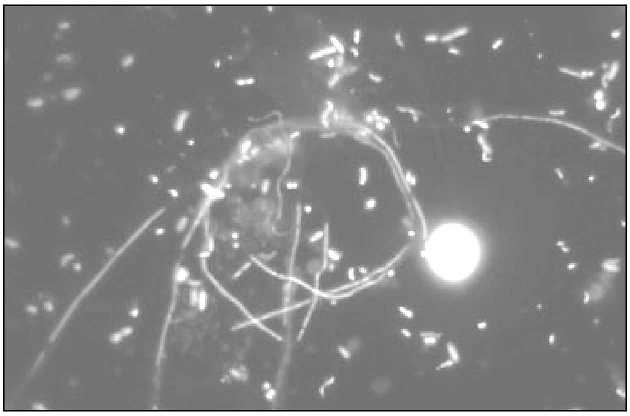
How will global and local environmental changes affect species composition and its role in ecosystem function and services?

The response of marine ecosystems to global and local environmental changes and the consequences of changes in marine ecosystems on climate and human societies along the coastlines of the world are major issues faced by marine science. Numerous biotic and abiotic factors control, often interacting, the structure and function of marine ecosystems. Natural and human forcing affects most of them and there is no doubt that the properties of marine ecosystems will be altered, with consequences through feedback processes on climate patterns and human societies. These alterations are poorly understood; yet management and policy initiatives are critically required either to prevent or minimize them, or to enable adaptation of human society if the expected consequences appear inevitable.

Additional to these general questions are the numerous 'problems' that are specific to the Mediterranean and Black Sea areas and that require specific actions and solutions. Many of those have been discussed during the Piran workshop and deal with items such as the eutrophication of the Adriatic and Black Seas, the threats to critically endangered species, the changes in the food web due to invading species, including those coming from the Red Sea through the Suez Canal (Lessepsian migration), the impacts of tourism and coastal fisheries.

One problem in the study of these and other changes is that they concern phenomena on large spatial scales and long temporal scales. This requires setting up a system of observational networks that is sustained for a long period of time (at least a decade). It is clear that governmental agreements would be the best basis for such a system, but until now most work has been carried out without such a framework as it appears exceedingly difficult to create formal cooperation between all or even most of the Med and Black Sea countries at the governmental level. While in the Atlantic Ocean and its regional seas there has been a long-standing cooperation, dating from the creation of the International Council for the Exploration of the Sea in the beginning of the 20^{th} century, and despite the fact that the CIESM (Conseil International pour l'exploration scientifique de la Mer Méditerranée) started not much later, the Mediterranean and Black Sea areas have been a case of great political divide for many decades now. It is therefore extremely difficult to create the necessary links between the countries and scientists within them, the best successes having been achieved by the Mediterranean Action Plan of the Barcelona Convention and by the CIESM.

A programme such as Marbena can only hope to create the personal links between scientists in the region that are necessary for any programme in the future to be successful. The EU BIOMARE project has set the first steps by defining a number of biodiversity research sites and identifying a number of biological indicators. These lists have to be extended with sites, for instance, in the Adriatic and, hopefully, in the Eastern and Southern Mediterranean as well. Therefore much remains to be done. Both the Sopot and the Piran workshops have set the first steps in this direction.



The role of bacterial biodiversity in the marine realm is still poorly understood (Photo: V. Turk).

THE MEDITERRANEAN SEA: A MODEL REGION FOR MARINE BIODIVERSITY RESEARCH AND MONITORING

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Over 500 leading marine scientists, policy-makers and representatives of the marine industry sector from larger EU (25 countries) that gathered in Galway, Ireland, in May 2004 addressed the issue *how marine science and technology can contribute to achieve the EU goal to become the most competitive knowledge-based economy in the world* (The Galway Declaration, Anon., 2004a). Noting that EU has significant marine dimension extending from the Baltic through Atlantic to the Mediterranean and the Black Sea, the participants listed a number of future challenges: from implementation of an ecosystem-based approach to sustainable development to development of new paradigm to promote inter-institutional co-operation in the context of an expanded Europe (EU+25). Among the listed future challenges, several address marine biodiversity. Further on, during international seminar "The Ocean and Future Aspects of the European Marine Research, organised in Brussels and attended by 130 participants from 20 countries, it was concluded that marine science should be given high priority in the European research programmes. Two recent strategic documents on biodiversity (Malahide Stakeholders' Conference, Anon., 2004b and Killarney Declaration, Anon., 2004c) stressed the importance of knowledge for conservation and sustainable use of biodiversity and the need for research actions to fill the gaps in current cognition. Besides curiosity-driven research, there are other reasons that justify investment into marine research from economic and social to cultural ones as "better knowledge enables better choices about the use of our oceans" (Rice, 2004). What kind of knowledge is required for sustainable use and conservation of marine biodiversity? The list is rather long, from status, trend and distribution of habitats and organisms to impacts of most significant pressures (pollution, habitat destruction and fragmentation, over-exploitation, introduction of non-indigenous species, *etc.*). In this context, the objective of MARBENA, the project supported by the European Commission under 5th Framework Programme, was to create the infrastructure for marine biodiversity research in Europe that would cover European seas spanning from the Arctic to the Atlantic, the Mediterranean and the Black Sea.

An important activity within the MARBENA work programme is organisation of electronic conferences and workshops. Among eight MARBENA electronic conferences, three focused also on the Mediterranean Sea: one organised in 2002 (22 April – 3 May), second in 2003 (7 – 20 April) and one in 2004. The last, *i.e.* the 7th MARBENA e-conference, took place from 6 to 24 September 2004 and addressed in particular the southern and eastern Mediterranean Sea and the Black Sea region ("The Southern and Eastern Mediterranean Sea and the Black Sea: New challenges for marine biodiversity research and monitoring"). It was moderated by two Mediterranean (Foundation International Marine Centre, Oristano, Italy, Marine Biology Station, NIB, Piran, Slovenia) and one Black Sea (Bulgarian Academy of Science, IO-BAS, Varna, Bulgaria) institutions. In contrast to other MARBENA e-conferences, those run only in English, this e-conference enabled discussion also in French and Arabic during the sessions devoted to the Mediterranean region and in Russian for the session concentrated on the Black Sea region. Announcing this e-conference, the moderators agreed with Klaus Tőpfer, UNEP Executive Director, who referred to the Mediterranean as a "region-laboratory": *here we find rich and less rich countries, ancient traditions and modern technologies, different cultures and diverse perceptions, political tensions and an uneven course of economic growth and social development, not to mention the environmental challenges,* and added (Magni *et al.*, 2004): *among the most important environmental challenges for Mediterranean as well as Black Sea countries is how to manage valuable marine biodiversity and at the same time achieve the best economic development.*

During the three sessions of 7th MARBENA e-conference (one Mediterranean, one Black Sea and one joint session) we discussed: some research issues like the role of top predators, climate change and biological invasions for marine biodiversity in the Mediterranean and Black Sea regions, innovative approaches and new techniques, neglected microbiota and deep sea biodiversity, possible need for revision of regional biodiversity agenda, monitoring of biodiversity, impact of human activities, biodiversity indicators and conservation and, in particular, the need for a better regional and international cooperation. Electronic conference was very successful, attracting 1,250 registered participants from 46 countries (Vanden Berghe, 2004), and set the stage for the second MARBENA workshop, which was held in November in Piran (Slovenia).

The Mediterranean and the Black Sea: the region-laboratory

MARBENA e-conferences identified the Mediterranean and the Black Seas as a unique model region for the marine biodiversity research and monitoring for several reasons:

- this region hosts several traditional marine research centres that posses long-term data sets on environment and biota;
- we may find the whole range of pristine to very impacted areas;
- region has a wide variety of habitats and organisms and high percentage of endemism;
- strong environmental and trophic gradients (south-north, east-west, vertical: oxyc-anoxic);
- a range of top predators, some of these are endangered species, while in contrast some increase in numbers (gelatinous predators);
- un-explored or ill-known environments and organisms (anoxic areas, microbiota).

Following major gaps in knowledge of the Mediterranean and Black Sea biodiversity were identified:

- deep-sea biodiversity and biodiversity in specific environments;
- biodiversity on different spatial scales;
- long-term biodiversity trends;
- role of physical processes and anthropogenic impacts;
- coupling of biodiversity with ecosystem functioning;
- role of top predators and, in particular, role of invasive species;
- role of the smallest biological components.

Additionally, a need to integrate the non-EU Mediterranean and Black Sea current biodiversity research activities into European Research Area was stressed. The last was the main goal of the MARBENA workshop held in Piran, Slovenia, focusing on three major issues: long-term changes and biodiversity research, priorities for biodiversity research and monitoring in the Mediterranean and the Black Sea region and conservation and management of protected areas. Workshop that took place from 27 to 30 November 2004 was attended by participants from 14 countries (including 10 Mediterranean and Black Sea countries, and 3 North Sea specialists) and coordinator of MED POL programme of the Mediterranean Action Plan Secretariat. Through presentations and discussion it was revealed that in the region there were good observational series (inventories) and databases at several Mediterranean and Black Sea institutions and, moreover, that UNEP/MAP may offer institutional framework for future biodiversity monitoring activities.

Future research direction certainly includes bio-invasions and the role of large top predators in relation to changes in the trophic status and environmental conditions. Examples such as combined effects of eutrophication, over-fishing and invasion by the comb jelly (*Mnemiopsis*) in the Black Sea that profoundly changed ecosystem structure and function (Kideys, 2002) or Levantine basin of the Mediterranean where littoral and infralittoral are dominated by Erythrean (Red Sea) alien organisms (Galil, 2004) call for in depth research of these phenomena on biodiversity and functioning of ecosystems. Similar examples come from the Adriatic Sea, where introduction of non-resident jellyfish into the northern Adriatic (Malej & Malej, 2004) caused significant changes in plankton community; similarly, drastic reduction in number of species of small gelatinous zooplankton (Hydromedusae, Siphonophora, Thaliacea) was noted in the presence of large-scale mucilage accumulations (Miloš, 2003). Another example from the same area concerns the impacts of red-tide causing dinoflagellate *Noctiluca scintillans* on microbial plankton (Fonda Umani *et al.*, 2004), and on other side of size-spectrum the role of large pelagic predators like sharks (De Maddalena & Kideys, 2004) just to list few recent studies.

Conclusions

The non-EU Mediterranean and Black Sea current biodiversity research activities need to be integrated into European Research Area and the region may be considered as region-laboratory for many biodiversity-related research topics particularly of the ecological significance of environmental gradients (including trophic gradients), the role of top (large) predators and their impact on biodiversity; this region is also ideal for long-term studies as many historical marine institutions posses long-term data sets on environment and biota. As the first step, Mediterranean and Black Sea partners should be included in the newly funded (EC 6th Framework Programme) Network of Excellence Marine Biodiversity and Ecosystem function; further, preparations for an integrated project for the coming 7th Framework programme should be initiated.

Key words: marine biodiversity, research, monitoring, Mediterranean and Black Sea

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The black scorpionfish** (Scorpaena porcus) **in the environment invaded by non-idigenous tropical algae Caulerpa taxifolia (Photo: T. Makovec).

CONSERVATION AND MANAGEMENT OF MARINE PROTECTED AREAS: ON LESSONS LEARNT?

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In presenting this paper, I am drawing from our experience in setting up and managing a coastal/marine protected area in Cyprus. This is the Lara/Toxeftra Turtle Reserve, a 10 km long coastal/marine reserve, which was set up in 1989. The terrestrial part covers only the foreshore (100m), while the marine area extends to the 20m isobath (about 1–1.5 km from the shore). In the Protected Area, from June to the end of September, it is forbidden to:

– Place any sunbed, umbrella, caravan, tent, *etc.* on, or near, the beaches;
– Stay on the beaches or the coastal area at night;
– Drive any vehicle on a beach or tolerate such action;
– Fish, except with rod and line;
– Use or anchor a boat or tolerate such action.

What the present paper is aimed at is highlighting what are considered to be the key elements in setting up and managing marine protected areas, so that effective conservation can be achieved. What is being presented here is of course not a manual on setting up and managing protected areas, which is a much wider issue and on which much has been published. What is mentioned below is more of a list of "lessons learnt" from experience. Though much of it may of course not be applicable in all situations and areas it is worth keeping in mind. Our own experience in setting up and managing the Lara Reserve may be mentioned explicitly in some cases; in others it is just implicit.

Clear objectives

The objectives of setting up a protected area need to be assessed and clearly stated. Much effort and money can be saved by clear and appropriate objectives. In our case, the objectives were to protect the main nesting beaches of Green and Loggerhead turtles, in such a way as to ensure that turtles could continue nesting there successfully. A prerequisite for this was knowledge of the issues and, in particular, of the biology and needs of turtles. These were achieved in the preceding years, as the turtle conservation project was operating since 1978, while the protected area was set up in 1989. For the new EU countries, the Habitat Directive provides ample guidance (and responsibilities) on objectives, *etc.*

Assessing and minimizing conflicts

Managing a protected area in effect means primarily controlling human activities. Assessing possible conflicts and ensuring a dialogue with the stakeholders is therefore needed. Though the assessment of possible conflicts and obstacles can fairly easily be made, the support of all people affected cannot be expected in all cases, however much it may be desirable. Compensation may in some cases be the only option.

In our case, the stakeholders with whom conflict was expected were fishermen (professional and sport), boat tour operators, beach facility (sun beds and umbrellas) operators and of course the public at large.

Setting up the management measures in such a way as to minimize conflicts with fishermen, boat tour operators and the public were reasonably successful in that these measures were restricted to the nesting season only (four months). For the rest of the year the measures are not applicable as they are largely unnecessary. Conflicts were initially faced in varying degrees and it was not for three years that all the measures could be effectively implemented (after some court cases and fines).

Major conflicts were faced in extending the area to the hinterland in an effort to set up a protected area and limit tourism/urban development that would impact the coastal area. Obviously the short term economic benefits of a coastal/marine protected area cannot always compete with those from coastal tourism and different weights need to be used to justify conservation at the political level.

The EU Acquis Communitaire and, in particular, the Habitat Directive (where applicable) now fortunately provide solutions and the rationale for conservation, so that the wheel does not have to be reinvented in each case.

Boundaries

It is necessary to define correctly the boundaries of any MPA, especially its coastal ones and of any zones in it. At times it may be more effective to accept a smaller area, provided this does not seriously jeopardize conservation, so as to embark as soon as possible on conservation actions, and to pursue any expansion of the area at a second stage. Time is often critical in conservation – as in our case with the turtles. Pursuing the protection of the entire area including the hinterland has taken decades and even now this has not been finalized – in the meantime turtles would have become extinct in that area.

Research/Conservation

In most cases, there is plenty of information (scientific data, *etc.*) on which to set up and manage an MPA. The often stated need for more information is invariably a way of postponing decisions. It is critical to distinguish between conservation actions and research, as the two are often confused. Though both are necessary, it needs to be kept in mind that no amount of research will conserve anything. What research can do is provide information on which to base conservation actions.

Legislation

It is more effective, especially in enforcement, to have all the key elements included in the legislation, including boundaries and the basic management measures themselves, so that they cannot be disputed or be easy waved, as could be the case if these were just decisions of a management body. Some secondary ones of course will inevitably be taken at that level. In the case of the Lara/Toxeftra Reserve, all the above were included in the legislation (under the Fisheries Law), though, even in this case, initial enforcement problems were faced.

Management measures

The management measures themselves need to be well thought out and appropriate, so as to address the critical issues/activities. Inappropriate or "over the top" measures will in the long run jeopardize credibility and may lead to backtracking steps – with all the implications that may bring about.

Monitoring

Monitoring in an MPA is important and a monitoring programme needs to be set up. Monitoring needs, however, to address primarily the critical parameters and priority issues in an MPA. These are obviously specific to each MPA (status of species/habitats, threats, trends, *etc.*). A very elaborate monitoring programme may not only be unnecessary, if it deals with a multitude of tangential issues, but it may well detract from essential data collection. It can moreover upset the financial sustainability of an MPA by overburdening its budget.

It needs also to be kept in mind that, in some cases at least, there is a lapse in time between detecting something through monitoring and taking action. For example, simply monitoring the advance of tourism development and keeping an eye on the impact, so as to gauge the carrying capacity of a turtle nesting beach, will inevitably result in a post-mortem examination of the situation. The built-in inertia of any government machinery in decision making, especially when much is at stake, and the built-in momentum of tourism development would guarantee that.

Tourism – Ecotourism/Adventure tourism

Ecotourism/Adventure tourism can help in the economic sustainability of MPAs. Nonetheless, they need to be strictly controlled, as there are pitfalls in these, too, not the least of which is their tendency towards mass tourism, as market forces push them that way.

Tourism, in all its forms, however desirable, is also often blamed for many ills. It is important to remember that the root issues lie with governments/local authorities, not with the tourists. Conservation in the Mediterranean, in particular, often finds itself in competition with powerful actors and forces (the tourist economy) which governments are often unable or reluctant to control. The existing conflicts in Zakynthos and Akamas and elsewhere and the related government indecisions and deliberations on the fate of these areas, are evidence of this problem (Demetropoulos, 2000). Tackling this at source is much more cost effective (and effective) than trying to solve the problem by raising public awareness in millions of tourists – as has been attempted in some cases.

Public awareness/Education

Much is said about the need for raising public awareness and not enough can be said about it. It is, however, a much larger issue than can be tackled by any single MPA. Nonetheless, information centres in MPAs will help in a multitude of ways and will help in bringing the public near the needs of conservation. Explaining the objective of each management measure in a protected area will help get the cooperation of the public. It is also necessary to keep in mind that there is a fine dividing line between raising public awareness in an area and it becoming a tourist attraction. This fine line is often ignored if there is a pressing need for funds. This will inevitably be detrimental to conservation, and could lead to loosing sight of the objectives of the MPA.

Mediterranean realities

Political decisions are often taken on balance of the forces that act on governments and administrations at various levels and these are, not infrequently, responding to particularistic interests, in disregard of the common good. Providing effective justification for nature conservation to decision makers, in this area in particular, is not easy. For the countries in the EU and, in particular, for the new accession countries the Habitat and Bird Directives go a long way in providing such leverage.

Key words: marine conservation, protected areas, management, loggerhead turtle, *Caretta caretta*, Cyprus

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LONG-TERM CHANGES AND BIODIVERSITY RESEARCH – HYDROMEDUSAN TIME SERIES

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The first account of hydromedusae of the Adriatic Sea came from the Gulf of Trieste (Will, 1844). Further results originated mostly from the shallow North Adriatic, but until recently a few investigations had also been carried out in deep waters of the Central and South Adriatic.

Claus (1877, 1880) described medusan fauna with special reference to Aequoridae; Graeffe (1884) gives description of medusan fauna and its development in the Gulf of Trieste; Stossich (1885) gave a comprehensive account on coelenterata; Neppi (1912) published results from coastal and open waters of the entire Adriatic Sea; Neppi & Stiasny (1913) presented the best review of hydromedusan fauna of the Gulf of Trieste; Babić (1913) published results from the coastal waters of Kvarner; Grobben (1915) and Neppi (1922) analysed the medusae from the open Adriatic waters; Pell (1938) presented the medusae collected during the Hungarian expedition by R/V "Najade"; Babnik (1948) published results on the central and southern Adriatic. Since 1965, Benović and collaborators have published a number of papers dealing with the systematics, distribution, abundances and vertical migration. The most comprehensive literature data are given in the papers by Benović & Bender (1987), Benović & Lučić (1996) and Purcell *et al.* (1999). The most recent paper by Benović *et al.* (2004) describes medusae from the open waters of the central and southern Adriatic.

By quoting the entire list of published resources on hydromedusae in the Adriatic Sea, we can clearly see that intensive research took place only during certain periods, especially when large expeditions were organized. The historical record is therefore characterized by periodic publication of data collected for different goals and using different methods. The resulting record is so variable that the only consistent data that can be extracted through time are species names.

Comparative examination of the records (Tab. 1) suggests that some inferences can be made about patterns of hydromedusan distributions in the Adriatic Sea. In the entire Adriatic Sea, 66 species have been recognised. There are differences between northern, central and southern Adriatic populations. The indicator species are those that are present consistently through the time in a specific area and depths. Thus, their occurrence in other regions probably indicates shift of water masses (Vučetić, 1969; Kršinić & Grbec, 2002). The clearest evidence of this is the case of *Persa incolorata*, the greatest population densities of which were found in deeper layers of the central Adriatic, where the lowest temperatures were recorded (Benović *et al.*, 2004). This species is found frequently in the northern Adriatic as well, but during the winter (Benović & Lučić, 1996). The association of these species with cold-water layers had been observed previously (Goy, 1987; Buecher & Gibbons, 1999). However, since the rare species occur very infrequently, it can be assumed that we missed them because of time gaps during the research (Seguera-Puertas, 1992). An additional limitation of the intermittent hydromedusan record is that little or no evidence may be available regarding the "bloom" events of various medusae.

Benović *et al.* (1987) analysed the hydromedusan fauna and environmental factors in the northern Adriatic Sea. Based on comparisons of species composition from almost 100-year research with recent data, they suggested that changes in the environmental factors resulting from the discharge of terrigenous material by the northern Adriatic rivers probably caused changes in hydromedusan fauna and depletion of many species. In addition, they predicted that environmental changes would take place on a large scale in the northern Adriatic in the future. Other papers (Degobbis *et al.*, 1995) dealing with blooms of plankton, mucilages and other disturbances in the northern Adriatic that were published after 1987, confirmed these predictions.

Can a hydromedusa be an indicator species of long-term changes of an ecosystem? The analyses of the species list and attempts to understand populations in different regions of the sea (Benović & Lučić, 1996; Benović *et al.*, 2004) speculated about possible repopulations of the northern Adriatic and introduction of new species in its central and southern regions. Though some species appeared, they were in very small numbers, thus not having a potential for repopulation of the altered environment in the northern Adriatic. Contrary to Gili *et al.* (1988), only a small number of species of low abundance were found close to the coast and in the shallower central Adriatic. It seems that the composition of medusans in the Adriatic's southern and central areas is stable and that occasional occurrence of typical coastal species is probably due to their transport either from nearby coastal waters or from the northern Adriatic *via* transverse currents. These species can be considered as indicator species of some regions, but they cannot serve as indicators of the entire given environment. This could be done only by studying the entire populations.

In all aquatic ecosystems, hydromedusae represent one of the oldest and most primitive of metazoan animal taxa (Buecher & Gibbons, 1999), which in their long-time existence developed specific adaptations that fit into the niches in vertical and horizontal sea horizons. The previous observations and knowledge about the Mediterranean Sea, as one of the oldest known marine ecosystems (Gili *et al.*, 1998), contributes greatly to our current studies of hydromedusae and their use as indicators of the quality of marine ecosystem.

In conclusion, studies of hydromedusae may be useful tools in marine ecosystem studies. However, only knowledge of entire populations can enable us to make "feeble" predictions that are expected from marine scientists.

Key words: Hydromedusae, Cnidaria, long-term changes, Adriatic Sea

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Tab. 1: Hydromedusae recorded in the northern and southern Adriatic Sea. Compilation of data from: A – Neppi, 1912; B – Neppi & Stiasny, 1913; C – Neppi, 1922; D – Pell, 1938; E – Benović, 1973; F – Benović, 1976; G – Benović & Bender, 1986; H – Benović & Bender, 1987; I – Benović & Lučić, 1995; J and K – Benović & Lučić, 1996; L – Benović* et al.*, 2004.
(+ northern Adriatic species, * southern Adriatic species)

SPECIES	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
ANTHOMEDUSAE												
1. *Dicodonium adriaticum*		+			+							*
2. *Dipurena halterata*	+	+		*	+							
3. *Sarsia gemmifera*		+	*	*	+		+ *	+ *	+	+		
4. *Stauridiosarsia producta*		+			+							
5. *Ectopleura dumortieri*		+			+		+	+ *				
6. *Eucodonium brownie*	+	+	*		+							
7. *Euphysa aurata*	+*				+	*	+ *	+ *			*	
8. *Rhabdoon singulare*	+					*	+ *	+ *			*	*
9. *Corymorpha nutans*	+	+	*	*	+		+ *	+ *	+			*
10. *Zanclea costata*	+	+	*	*	+	*	+ *	+ *				*
11. *Cladonema radiatum*		+										
12. *Eleutheria dichotoma*		+										
13. *Cytaeis tetrastyla*	+		*	*	+							
14. *Oceania armata*			*	*			*	*				*
15. *Turitopsis nutricula*		+										
16. *Podocoryne carnea*		+	*		+							*
17. *Podocoryne areolata*		+						*				
18. *Podocoryne minima*					+		+ *	+ *	+	+		
19. *Podocoryne minuta*	+	+	*		+	*	+ *	+ *	+	+		*
20. *Rhatkea octopunctata*		+	*	*								
21. *Bougainvillia ramosa*	+*	+	*	*	+		*	+ *	+			
22. *Koellikerina fasciculata*			*	*								
23. *Lizzia octostyla*		+										
24. *Lizzia blondina*	+*	+			+			+				
25. *Thamnostoma dibalia*		+		*	+	*			+	+		
26. *Amphinema dinema*	+	+						+ *				*
27. *Leuckartiara octona*				*			*	+ *			*	*
28. *Merga tergestina*	+	+	*		+							
29. *Neoturris pileata*	*	+		*	+		+	+*				
30. *Pandea* sp.		+										
31. *Protiara tetranema*				*								
32. *Bythotiara murrayi*			*			*	*	*				
LEPTOMEDUSAE												
33. *Orchistomella graeffei*		+										
34. *Krampella dubia*							*	+ *				
35. *Laodicea ocelata*							*	*				
36. *Laodicea undulata*	+*	+	*			*	*	*			*	*
37. *Melicertissa adriatica*			*									

38. *Mitrocoma annae*			*									
39. *Octogonade mediterranea*				*								
40. *Obelia* spp.	+*	+	*	*	+	*	+ *	+ *	+	+	*	*
41. *Clytia hemisphaerica*	+*	+	*	*	+	*	+ *	+ *	+	+	*	*
42. *Eucope picta*		+		*								
43. *Eucheilota maasi*		+		*								
44. *Octophialucium funerarium*						*	*					*
45. *Eirene viridula*	*	+				*	*	*	+	+	*	
46. *Helgicirrha schultzei*		+	*		+		+ *	+ *	+			*
47. *Eutima gegenbauri*	+	+	*		+		+ *	+ *				
48. *Eutima gracilis*	+		*	*				+ *	+			*
49. *Eutonina scintillans*		+										
50. *Tima luculana*		+										
51. *Aequorea aequorea*		+		*					+			
52. *Proboscidactyla ornata*	+*	+	*									
TRACHYMEDUSAE												
53. *Haliscera bigelowi*												*
54. *Geryonia proboscidalis*		+	*									*
55. *Liriope tetraphylla*	+*	+	*	*	+	*	+ *	+ *	+	+	*	*
56. *Aglaura hemistoma*	+*	+	*	*	+	*	+ *	+ *			*	*
57. *Arctapodema australis*				*			*	*				*
58. *Homoeonema platygonon*			*	*								
59. *Persa incolorata*					+	*	+ *	+ *			*	*
60. *Rhopalonema funerarium*				*			*	*			*	*
61. *Rhopalonema velatum*	+*	+	*		+	*	*	+ *			*	*
62. *Sminthea eurygaster*			*	*		*	*	*			*	*
NARCOMEDUSAE												
63. *Solmundella bitentaculata*	*		*			*	+ *	+ *			*	*
64. *Solmaris* spp.	+*	+	*		+	*	+ *	+ *	+	+	*	*
65. *Cunina globosa*			*									*
66. *Solmissus albescens*			*	*		*	*	*				*
TOTAL SPECIES	**25**	**41**	**31**	**27**	**27**	**18**	**31**	**35**	**14**	**9**	**15**	**28**

THE IMPACT OF TOP PELAGIC PREDATORS ON MARINE BIODIVERSITY, WITH A NOTE ON THE CONTROL OF AN INVASIVE GELATINOUS CTENOPHORE USING ANOTHER ALIEN SPECIES

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Unlike the majority of other disciplines, in biological sciences, there are only a few scientific "theories" that are not contradicted with variable number of (not necessarily exceptional) cases. The same holds good for "The impact of top predators on biodiversity". Even in the case of the impact of the "super-predator" *(i.e.* man), we cannot say that his role in 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 also increased 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 man opened the Suez Canal in 1869 causing the 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 for the fishery sector. Based on the increased number of species diversity (as well as economic income), can we suggest that the "super-predator, man" is increasing the biodiversity (and economic income) in the eastern Mediterranean?

Regarding the effect of removal of native predators from the trophic network, there could be two options that 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 biodiversity (note that there is no case of predator removal increasing the biodiversity!). With the pioneering study of Paine (1969) on the intertidal shores of 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 8, and a single species, the mussel, covered almost the entire 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 for the ecosystems of the eastern Mediterranean. Until now, no study has dealt with 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 impact 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 evidence on this problem? What about the role of the Monk Seal in biodiversity, which disappeared from the Black Sea entirely by the 1980s and only several tens are left in the Levantine today? Based on studies of model communities, Pimm (1987) suggests that species-rich communities are more sensitive to the loss of top predators. Does this mean that the Aegean Sea, with the highest diversity in the eastern Mediterranean basin, has been affect worst (for biodiversity) from the continual decrease numbers of top predators from the ecosystem, say compared to the Black Sea?

Among top predators, 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 great white shark *(Carcharodon carcharias)* and 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, by-catch, *etc)*, the population size of all these large nekton are decreasing. Once upon a time, due to natural mortality, the carcasses of these large animals were food for several bacteria (some of which are sulphur-reducing chemosynthetic) and sea bottom animals. 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 a subject of debate. Pimm (1987) suggests that species-rich communities are more resistant to invasions and hence invasive predators may not have apparent functional impact 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 with 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 it caused an unprecedented havoc in the pelagic ecosystem, which in turn caused a dramatic decrease in fish catches and hence fishery economy (for a summary see Kideys, 2002). During its peak periods of development, several zooplankton species noted to be either very low in abundance or even disappeared (Kideys *et al.*, 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* may have also contributed to this event. After this ctenophore was 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 (A.E. Kideys, R. Abolghaseem & S. Bagheri, *unpubl. data)* revealed that during 2000 and 2001, a mere four species belonging to copepods and cladocerans occurred in the samples compared to a total of 29 taxa in the previous years! Its effect on benthic biodiversity is also unprecedented (Hashimian, *unpubl. data*). Based on some other components, too, it appears that the Caspian Sea is affected even much more badly 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 has been 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 invasiveness must be the immunity (being one of the resilience mechanisms) of a system: the more it is exposed to the invader (or invader-like), the more the system gains immunity. With respect to the Caspian, it has no connection with world oceans and hence no immunity to several marine species withstanding low salinity (14%), which could have been transported only by man.

We would like to finish our discussion with the controversial subject of biocontrol. After *M. leidyi,* another ctenophore, *Beroe ovata,* was accidentally transported to the Black Sea, apparently from the northwest Atlantic (Bayha *et al.*, 2004). The impact of this predatory ctenophore (feeding on *M. leidyi)* has been very positive for the Black Sea ecosystem (see Kideys, 2002). Several copepod species that 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 and discovered that it did not. 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 endemic) 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 have been several unpleasant experiences with the introduction of new species to aquatic environments, making many scientists not only sceptical but against any such actions. So far, hundreds of species have been intentionally introduced to these ecosystems, and in no case the scientific background was so well established as in *B. ovata*. We cannot say there is zero risk from *B. ovata*, but we can say that the native biodiversity (predominantly endemic) will greatly benefit from such introduction. Our scientific ethics necessitates such action to save biodiversity (as well as economic problems of the fishery sector). We believe that scientists should not always be observant, but that they should 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?

Key words: top predators, alien species, Ctenophora, biodiversity, Mediterranean and Black Sea

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REKA – TIMAVO: BIODIVERSITY FROM SPRING TO SOURCE

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The main river in the south-western part of Slovenia is the Reka. Its spring is located on the border between Slovenia and Croatia at an altitude of 710 m a. s. l. The total length of the river from its spring to the estuary is 110 km as the crow flies and it is divided into epigean and subterranean parts. After about 50 km of its epigean flow it sinks in Škocjan Caves. It re-appears in an array of springs along the coast north of Trieste. The most important spring is near Duino, about 50 km north-west from the sink in Škocjan Caves. The epigean part of the river has a catchment area of 323 km^2 and a network of rivers with a total length of about 600 km. Most of the area is covered with mixed or broad-leaved forest, interrupted with patches of grassland. Prevailing geology is limestone with karst features (right side of the river) and impermeable layers of flysch (left side of the river). An average annual precipitation in the epigean part is 1577 mm and average discharge of 8.2 m^{3}s^{-1} at the sinkhole. After heavy rain or snowmelt it can rise up to 380 m^{3}s^{-1} in a very short time, giving the river a character of a torrent. Normal water level oscillations in the Caves are about 20 m, with a maximum up to 100 m.

Only one part of the subterranean river is accessible to man. In Škocjan Caves it can be followed through a subterranean canyon (Hanke's channel; 15 m wide and 95 m high) for about 1km. The flow is quite steep (drop for 80 m at a distance of 1 km) and interrupted by several small pools. The river can also be reached in two more caves (Kačna jama – 2 km from Škocjan Caves, and Labodnica = Grotta Gigante – about 20 km from Škocjan Caves), but the access to it is either technically very difficult (Kačna jama) or feasible only at a short section (Labodnica).

Important hydrological system, also from a standpoint of biodiversity, is percolating water in small cracks and channels conducting rain water from the surface in more or less vertical direction through unsaturated (vadose) zone to saturated (phreatic) zone in the karst. On its way down, water can enter cave galleries where it is temporarily retained in small pools on the floor before it reaches the saturated zone. Intensity of percolation is related to precipitation and fragmentation of limestone strata. The topmost part of the karst, just below the soil, is usually called epikarst.

Since the second part of the 20th century, the Reka has been heavily polluted by waste water from industry of organic acids in Ilirska Bistrica. The severest pollution was recorded in the lower part of the epigean flow as well as in its almost entire subterranean part. After closing down the industry in the 1990s, the situation in the river improved dramatically.

Fauna in the epigean part of the river is rich and characteristic of southern Europe. Prevailing elements are larvae and adults of aquatic insects, followed by snails, several groups of crustaceans, flatworms, round worms and other smaller groups of animals. Fish fauna is represented by salmonids, ciprinids and some bottom-dwelling species. Algae, mosses and macrophytes provide epigean fauna with food and shelter.

Epigean fauna is washed permanently or accidentally as drift into the subterranean part of the river. Most of the epigean species sooner or later vanish in the subterranean environment and become source of food for the subterranean fauna. Epigean fauna (qualitatively and quantitatively) decreases along the subterranean flow of the river and the number of stygobionts (exclusive inhabitants of subterranean environment) increases. In Hanke's channel, stygobionts are hardly present and epigean representatives are common. Downstream parts of the Reka and some tributaries (in Kačna jama, Labodnica and springs at Duino) are inhabited by stygobionts, represented by numerous crustaceans, such as the endemic *Niphargus timavi* (Amphipoda), *Sphaeromides virei* and *Asellus aquaticus cavernicolus* (Isopoda), *Troglocaris* sp. (Decapoda). Mollusca (Gastropoda) are present but not well studied. Among the rare stygobionts are *Marifugia cavatica* (Polychaeta) and *Dedrocoelum spelaeum* (Turbellaria). *Proteus anguinus* (Amphibia – Urodela) was found in some caves near Škocjan Caves as well as in springs near Duino. This is the northwesternmost location of the species.

Percolating water and pools filed by it are inhabited by rich and specific fauna. The main component of this fauna are representatives of Harpacticoida and Cyclo-

poida (both belonging to the group Copepoda). Much rarer are representatives of other groups like Ostracoda, Amphipoda, Bathynellaceae or Mollusca. So far, seventeen taxa of Harpactioida and Cyclopoida have been found in percolating water within Škocjan Caves and about half of them are endemic. Three of them have been found in the Škocjan Caves for the very first time *(Speocyclops infernus*, *Morariopsis scotenophila* and *Elaphoidella karstica = kieferi).*

Key words: cave biodiversity, epigean fauna, Reka/Timavo River, Slovenia

LONG-TERM STUDIES OF MARINE BENTHOS: NOT SEXY

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Biodiversity is sexy, long-term studies or monitoring is not. Nonetheless, researchers from all marine biological disciplines clamor for long-term data and profess the importance of the long-term perspective. Are these two viewpoints reconcilable?

Research in the Northern Adriatic Sea can be viewed as a case study. Investigations spanning three decades on the sublittoral benthic communities have revealed a wealth of interesting information. The macroepibenthos consists of complex, highly structured multi-species aggregations composed predominantly of sponges, ascidians and brittlestars. Topographic or structural complexity, along with the associated microhabitat heterogeneity, are known to be correlated with biodiversity in coral reefs and elsewhere, and the hypothesis is that the "multi-species clumps" in the Northern Adriatic fulfil a corresponding role. This structure, however, has been severely impacted by a series of disturbances involving mucilage events, oxygen deficiencies and benthic fisheries. These developments have qualified the Northern Adriatic as one of the increasing number of periodic "dead zones" recognized worldwide. It would be imperative to study the recovery of these communities, outline recolonization processes, and identify successional stages. This would provide crucial information on the stability and resilience of endangered coastal marine ecosystems in general. In fact, however, attempts to do precisely this have been rejected as not being "innovative" by national and international funding agencies. Reconciling this cleft will be a major task for marine scientists and science policy makers in the future.

Key words: long-term research, marine biodiversity, macroepibenthos, Adriatic Sea

MARINE BIOLOGY STATION (MBS): DATA INVENTORY

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From the time the MBS was founded (35 years ago), more than 250,000 data have been produced, mainly covering the area of the Gulf of Trieste. They have been obtained through various monitoring activities, research and application projects and lately (from 2001 on) implemented by an additional continuous data acquisition system on the Coastal Oceanographic Buoy (situated 1.5 km offshore the city of Piran).

These data can be divided into three main groups:

a) Physical and chemical parameters in the water column (BOD, chlorophyll *a*, COD, density, dissolved oxygen, hydrogen sulphide, nitrate, nitrite, organic nitrogen, orthophosphate, oxygen saturation, pH, salinity, silicate, temperature, total alkalinity, total ammonium, total CO_2, total nitrogen, total oxidised nitrogen, total phosphorus, urea, etc.);
b) Biological parameters and results of various biological analyses (phytoplanctological, benthological, bacteriological);
c) PAH and trace elements in water, sediment and tissue samples.

The data have been lately passed through a serious quality check procedure and will be available to the public within a year or two. In addition to the laboratory analyses we measured over 1500 CTD profiles in the last 13 years. Depth profiles like temperature, dissolved oxygen, salinity and chlorophyll *a* give an additional overview of the situation in the Gulf of Trieste during the last decade.

Near real time observation on sea is the scope of the Coastal Oceanographical Station-Piran (bouy) (http://buoy.mbss.org/). It measures meteorological parameters in the air, temperature & salinity 2 m bellow the sea surface and at the bottom, and currents at different levels above the sea floor. The data are promptly presented on our homepage as 30-minute average values. Here the quality check routine is an essential part of data transmission to different datausers (governmental and non-governmental). Once divided into regional or national research areas with data spreading into various local, regional or national databases, the Gulf will eventually become part of an integrated common research area. For the common wealth, all the data will have to be subjected to objective long-term analyses for the condition in this northern part of the Adriatic.

Key words: data base, monitoring, abiotic parameters, biological parameters, Gulf of Trieste

USE OF GENETIC STRUCTURE ANALYSIS FOR RESPONSIBLE FISHERIES IN THE ADRIATIC SEA

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Stock identification and structure are integral components of fisheries stock assessment and are required for effective fisheries management. Moreover, stock identification and stock structure help determine the appropriate scale for development of monitoring and fishery harvest strategies. On the other hand, misidentification of population structure within and among stock complexes can lead to the erosion of genetic resources by depleting spawning components even when fishery is tightly regulated and controlled. Special care to stock assessment should be given to shared stocks, which are transboundary and exploited by more than one country (Vrgoć *et al.*, 2004). Such is the situation in the Adriatic Sea, where fishery stocks are exploited by fleets of Albania, Croatia, Italy, Montenegro and Slovenia. There is, therefore, a great need to define "shared stocks" and "biological units of management" to enable sustainable management of resources and promote cooperative exploitation of shared stocks. To conceive and promote cooperative fishery management between the countries around the Adriatic Sea in line with the Code of Conduct for Responsible Fisheries, the regional programme AdriaMed, funded by the Italian Ministry of Agriculture and Forestry Policies (MiPAF) (AdriaMed, 2000), has been implemented by FAO. AdriaMed programme includes the IPUAS project (Identification of Population Units in Adriatic Sea Shared Stocks by Genetic Structure Analysis), its purpose being to identify population units in species whose stocks are shared by at least two Adriatic countries according to the AdriaMed Working Group on shared demersal resources (AdriaMed, 2000), and approved during the Second meeting of the AdriaMed Coordination Committee, November 2000 (AdriaMed, 2001). Species with a top priority were on list A (http://www.faoadriamed.org/html/tb1_shared_stock.html), which includes, amongst other species, *Eledone cirrhosa*, *E. moschata*, *Loligo vulgaris*, *Merlangius merlangus*, *Pagellus erythrinus*, *Sepia officinalis* and *Solea vulgaris*. Several laboratories participated in the IPUAS project (two molecular genetic laboratories and four marine fishery laboratories).

Sampling sites were defined on the basis of species distribution and according to the sampling design of the scientific survey of MEDITS 2001 programme in the Adriatic Sea. Sampling of population of the target species was carried out through MEDITS 2001 fish surveys in the Adriatic Sea covering international and territorial waters (Italy, Slovenia, Croatia, and Albania). Microsatellites were used to infer genetic population structure of the chosen demersal species. Species-specific microsatellite markers were isolated for the most species using enrichment protocol (Zane *et al.*, 2002) and optimised for PCR amplification. Allele frequencies were calculated, as well as polymorphism parameters (observed and expected heterozygosity, number of allele per locus). Fixation indices (F_{ST}) and partition of molecular variance among samples (AMOVA) were estimated using population genetic programmes. Allele polymorphism, heterozygosity and fitting to Hardy-Weinberg equilibrium were used as estimators for genetic variability among samples. Fixation indexes and gene flow were used for genetic structure differentiation calculated using specific statistical software.

Genetic structure and population units were establish for the cuttlefish *(Sepia officinalis)* (Garoia *et al.*, 2004a), European squid *(Loligo vulgaris)* (Garoia *et al.*, 2004a), red mullet *(Mullus barbatus)* (Garoia *et al.*, 2004b), Norway lobster *(Nephrops norvegicus)* (Guarniero, 2004), and angler *(Lophius budegassa) (unpubl. data).*

Key words: marine biodiversity, genetic structure, fisheries, Adriatic Sea

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SOME NEW ELEMENTS OF THE ADRIATIC ICHTHYOFAUNA: A REVIEW

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Although the Adriatic Sea is considered to be a relatively well-studied part of the Mediterranean Sea, this review has underlined the significant number of new fish species still being recorded. Particular emphasis has been given to the rising number of new records of fish in the last thirty years, including some undescribed species *(Gobius kolombatovici, Coelorinchus mediterraneus).* At least 30 new species have been added to the Adriatic ichthyofauna representing 21 families (7 of which are new for the Adriatic: Hemiramphidae, Leiognathidae, Haemulidae, Siganiidae, Ipnopidae, Zoarcidae, Monacanthidae), thus increasing the number of fish species recorded in the Adriatic to 440. This has been attributed in part to the increased prospection activity, coupled with changes in techniques, which allow access to the previously inaccessible habitats. It is also clear, however, that these changes are also attributable to real changes in fish community during this period. Most importantly, the increase in the number of species correlates with interannual shifts in climatic and oceanographic processes. The impact of other potential factors is less understood at present, but it is likely that biological invasions (particularly after the construction of the Suez Canal, 9 lessepsian migrants have reached the Adriatic), overfishing and changes in food chain have had a significant impact on fish populations and communities over the last few decades. After some taxonomic revisions it was also established that 4 species of gobiids do not belong to the Adriatic ichthyofauna, bringing the number of species found in the Adriatic to 436.

Key words: ichthyofauna, recent changes, lessepsian migrants, Adriatic Sea

MARINE BIODIVERSITY RESEARCH IN SERBIA AND MONTENEGRO

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While marine biodiversity has been generally well studied in the Adriatic, much remains to be done in this respect in its south-eastern region (coast of Montenegro). The Institute of Marine Biology in Kotor was founded in 1961. Since then we have attempted to fill certain gaps in the knowledge of this area, but due to the lack of financial support and personnel, data are still missing. Two years ago we embarked on the project "Biodiversity of Montenegrin Sea" with the purpose to collect all the available data on Montenegrin marine biodiversity and to publish a book on this topic. Unfortunately, this project has not been implemented considering that there is no published checklist of organisms, but only a preliminary list. There are 26 species that belong to the IUCN Red List of threatened species, about 20 species are from the List of endangered or threatened species, and about 10 species from the List of species whose exploitation is regulated. But without having chronological data series (or without any data at all for some groups of organisms), talking about long-term series is impossible. There is also the issue of "standard" methods and possibilities of comparing the gathered data. Improvement of the equipment is a very fast process, but the country in transition, such as Serbia and Montenegro, cannot follow this process. Therefore, the gaps in knowledge are even more obvious.

One of the possible solutions to overcome these problems could be a project whose aim would be to distribute, in exchange for the available data, the type of equipment missing in a particular country. For example, in Serbia and Montenegro there is an ample amount of data on *Posidonia* meadows (phenology, anatomy, physiology, heavy metals), on demersal biomass of the Montenegrin shelf and population structure for some species and, in the last two years, on biomass and population structure for small blue pelagic fishes. Also, data on pollution bio-indicators (heavy metals, particularly enzymes…), on phyto- and zoo-plankton and few smaller groups of organisms are available, but there are no data on physical-chemical quality of water. It could be a good base for preparing projects whose aim would be to provide conditions to collect information for a large database with easily accessible and comparable data.

Key words: marine biodiversity, research, status, Serbia and Montenegro, Adriatic Sea

PERSPECTIVES OF COOPERATION BETWEEN SLOVENIA AND THE CZECH REPUBLIC IN MARINE BIODIVERSITY RESEARCH OF SLOVENIAN PROTECTED COASTAL WETLANDS

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Every year, teachers and students of the Department of Biology of the Faculty of Education of the Masaryk University in Brno come to Slovenia for 10 days to carry out comprehensive field exercises in geology, botany and zoology there. The last three days they usually spend at the seaside to study submediterranean vegetation and terrestrial animals, and marine ecosystem in particular. Besides visiting Marine Biology Station and the Piran Aquarium, and snorkelling along the beaches near Izola, they pay a visit to two protected coastal wetlands: the Strunjan and Sečovlje salinas.

These two mentioned localities are in the centre of our interest there. For that reason the author of this contribution is really pleased that he was able to participate, during his study visit at MBS in Piran, in the survey of habitat types and infauna biodiversity of the Stjuža lagoon along the Strunjan salt-pans.

The Czech Republic is an inland country, with no access to the sea, which means that we have practically no experts in marine animal groups. We do have, however, traditionally good background – scientific potential in different terrestrial invertebrate groups, especially insects. The participation by the author, an experienced entomologist, and other Czech experts in inventarization of biodiversity of insects and other terrestrial invertebrates at the Sečovlje salina is a good opportunity for a solid cooperation between Slovenia and the Czech Republic, as a NAS, in biodiversity research of Slovenian protected coastal wetlands.

Perhaps, we should act to take the protection of the Adriatic Sea to be also a part of our Czech national interest, considering that in May of the year 2004 it became part of our mutual European space. From the long-term point of view, the possibility of cooperating in this sphere is very perspective indeed. Cooperation could begin in joint grant projects, not only in the fields of biodiversity research, nature protection or education. These projects could be of bilateral or multilateral character and supported by European or international institutions.

Key words: coastal wetland, protected areas, biodiversity, international cooperation, Slovenia, Czech Republic

SHARK RESEARCH AND MONITORING IN THE ADRIATIC

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54 different cartilaginous species have been reported in the Adriatic so far. Within this number, 29 species are sharks, 24 belong to batoids (skates and rays) and 1 to chimaeroids. Some of those species are constantly present in the Adriatic, while some are reported only occasionally. The above number of shark species is highly probable, as recently 28 species have been reported with an exception of smalleye hammerhead, *Sphyrna tudes* (Valenciennes, 1822), whose occurrence in the Adriatic Sea still needs to be confirmed.

Some lists of reported sharks include 31 species with data on two additional species, *i.e.* oceanic whitetip shark, *Carcharhinus longimanus*, and little gulper shark, *Centrophorus uyato*, but these data are very questionable and uncertain.

Since 1999, monitoring of large sharks in the Adriatic has been carried out by members of the Institute of Oceanography and Fisheries, based on voluntary collaboration by marine scientists, fishermen, journalists, marine police, harbour offices, private citizens, etc. Records collected illustrate the status of six large sharks in the Adriatic since the 19th century till today.

As most of the large sharks are highly migratory species, they deserve attention of all researches in the entire Mediterranean. Therefore, the Mediterranean Shark Research Group was established in the summer 2000 as an initiative by some researchers interested in promoting, in close collaboration, a web of information exchange between ichthyologists studying sharks of the Mediterranean Sea.

Ecologists classify sharks as strong "K selected species" due to their life history characteristics, such as slow growth rates, relatively late sexual maturation, long reproductive cycles, low fecundity potential, and long life spans. Such life history characteristics, combined with integrated effects of mainly unmanaged and irresponsible fishing, pollution and habitat destruction, are causing changes in abundance, size structure and biological features of shark populations, which in the extreme could lead to the extinction of some species in the Mediterranean.

Comparison of catches of chondrichthyan fishes caught by research trawls – one from 1948–49 and the other from the "MEDITS" program from 1997–98 – shows considerable decline in abundance of 26 chondrichthyan species as well as reductions in their distribution area. For example, the thornback ray, which shares similar life characteristics as sharks, has gone from high abundance and widespread distribution throughout the Adriatic Sea to being restricted to a small area with low abundance.

Therefore, different measures should be applied in order to ensure shark conservation. For example, management programs should guarantee precise fisheries statistics of catches and landings of different species. Critical habitats, namely mating areas, spawning and nursery grounds should be identified. Hence, scientific studies on biology and ecology of sharks should be continued and new developed at the same time. Fishing gear and techniques that reduce shark bycatch and/or make possible live release should be encouraged, while wasteful fishing practices as finning should be banned. By regularly reviewed status of sharks, threatened species should be legally protected by national and international legislation. As many sharks are cosmopolitan migratory species, for all these actions, a thorough regional coordination would be required. Generally, all management programs should respect the principles of sustainability, precautionary principle and conservation measures as defined in the FAO Code of Conduct for Responsible Fisheries and in the International Action Plan for the Conservation and Management of Sharks. Such approach will, hopefully, ensure conservation of shark populations and biodiversity of marine ecosystem of the Mediterranean Sea.

Key words: sharks, research, monitoring, conservation, Adriatic Sea

ANALYSIS AND EVALUATION OF THE STATUS OF MARINE ZOOBENTHOS WITHIN THE SYRIAN NORTHERN COAST

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The Mediterranean Sea covers only 0.7% of the world's oceans. It hosts 7.5% of the world's marine animal taxa and 18 % of the world's marine flora, and is possibly one of the richest seas for biodiversity in the world. Main threats affecting the Mediterranean marine and coastal biodiversity are uncontrolled coastal development and coastal tourism, fishing in sensitive ecosystems, invasion by non-indigenous species, damming, pollution, global phenomena, and trade in endangered species. One of the responses is to declare additional protected areas and thus to increase the number of Mediterranean marine protected areas.

Three scientific projects are aimed at assessing the presence, distribution, abundance and conservation status of biodiversity on the Syrian northern coast. These projects are being carried out in collaboration with the High Institute of Marine Research (Syria) and some national and regional organizations.

Syria has recently recognized the importance of marine protected areas and has already selected some coastal areas for this purpose in its northern sector, *i.e.* Omm Toyour – Al Bassit areas. Twenty marine cruises and seasonal sampling were carried out in Ras Al-Bassit area during the September 2002 – August 2003 period. Samples were collected from the littoral and sublittoral zones to the depth of 70 m with SCUBA, Van Veen grab and dredge.

Environmental factors such as temperature, dissolved oxygen, salinity, conductivity, pH, grain size composition, type of substratum and depth were evaluated during the sampling.

The most frequent species were *Strombus persicus, Cerithium scabridum, C. kochi, Ergalatax obscura, Brachidonta variabilis* among Mollusca, *Penaeus japonicus* and *Charybdia helleri* among Crustacea, and few species of fishes and seaweeds, with notable absence of *Posidonia oceanica*. During cruises, numerous turtles were sighted in the area. No seals were registered. Finally, 15 species of Indo-Pacific origin were recorded.

Overall the area is intact, but some recommendations are necessary to sensitise the population and to control certain human activities, such as fishing, tourism and waste disposal.

Key words: marine biodiversity, zoobenthos, status, Syria

THE DISTRIBUTION AND STATE OF HEALTH OF THE *POSIDONIA OCEANICA* (L.) DELILE MEADOWS IN MALTESE TERRITORIAL WATERS

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A cartographic assessment to determine the distribution of *Posidonia oceanica* in Maltese territorial waters was carried out during a baseline survey conducted between spring and summer 2002 by G.A.S. s.r.l. (Geological Assistance & Services of Bologna).

On the basis of the lepidochronological and phenological descriptors investigated at 15 specific sites, the *Posidonia* meadows surrounding the Maltese Islands appear to be in a good state of health. Approximately 3.6% of Maltese territorial waters are colonized by this sea-grass, representing a total coverage of 142.56 km^2. With the Maltese Islands having a total coastline of 270 km, the extent of the *Posidonia* meadows is thus quite considerable, although not so extensive. Shoot density values are classed in the "normal density classes" according to Giraud's classification (Giraud, 1977) and some meadows show quite high values. Leaf Area Index (L.A.I.) was frequently over 10 m^2/m^2 and comparable to the values observed along the coasts of Sicily. 25% of the meadows show values of primary production that exceed those present elsewhere and exhibit signs of a high degree of vitality. In fact, previous studies had shown that the *P. oceanica*'s density in two particular sites had one of the highest values ever recorded (Micallef, 1996).

Moreover, in certain areas around the Maltese Islands the depth limit of *P. oceanica* meadows is greater than 40 m (Borg & Schembri, 1995a). However, considerable meadow regression or complete extirpation has been observed in some areas, even prior to the 2002 survey (Borg & Schembri, 1995b).

Key words: *Posidonia oceanica*, cartography, phenology, Maltese Islands

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PROTECTION OF MLJET LAKES (NATIONAL PARK OF MLJET) FROM THE PROPAGATION OF THE TROPICAL ALGA *CAULERPA RACEMOSA* (CAULERPALES: CHLOROPHYTA)

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The western part of the island of Mljet with its surrounding area was proclaimed a National Park in 1960. Apart from the obvious natural and historical values of the land area, the protection includes the coastal area, together with a sea belt of 500 m from the coast including isles and rocks in the surrounding sea. A particular natural phenomenon in the Park are the two saltwater lakes, Veliko and Malo (the Big and the Small Lake) with a series of specific features that distinguish them from the rest of the Adriatic Sea. The lakes were formed some 5,000 years ago through the sinking of Karst depressions.Veliko jezero, with a surface area of 145 ha, a coastline of 9,240 m, a volume of 36,730,000 m^3 and a total depth of 46 m, communicates with the open sea through the Soline channel no deeper than 2.5 m. A shallow channel no deeper than 75 cm connects Veliko jezero to Malo jezero, which has a surface area of 0.24 km^2, a coastline of 2.6 km, a volume of 3,350,000 m^3 and a total depth of 29.4 m. Malo jezero has two depressions, probably submarine freshwater springs with rocky bottom at a depth of 35 m.

Due to the fact that the communication of the lakes with the oligotrophic open sea only takes place in the surface layers, both lakes exhibit a pronounced stratification of the hydrographic parameters at 17 to 20 m. This is particularly pronounced during the summer. The deeper layer, with an average yearly temperature of 12.1 °C, falls within the limits of the lowest values of the deep waters in the Mediterranean.

The density differences between layers are so pronounced that they actually condition the specific ecological particularities that significantly differ from those of other bays in the Adriatic as well as in the Mediterranean. This is most pronounced in the constitution and quantity of all categories of plankton communities. Due to excessive production in the deeper layers, the oxygen levels become occasionally depleted in the bottom layers, leading to anoxia and even production of hydrogen sulphide (H_2S). The constantly higher concentrations of nutrients, ammonia, chlorophyll *a*, nanophytoplankton and zooplankton species, similar conditions as in the deep furrows of the Mediterranean Sea, never or very rarely rise in the winter above 20 m depth during daytime.

The natural characteristics of the stratification of the sea are most clearly reflected in the fauna, particularly in the benthic community. The strong currents in the surface layer have resulted in the creation of a large colony of the coral *Cladocora cespitosa* with a surface area of 800 m^2 at a depth between 4 and 18 m, which makes it the largest colony of this species ever recorded in the Mediterranean Sea.

Of the plankton species, the quantities of some copepod species are significant, and the density of the not yet defined jellyfish species *Aurelia* sp., with more than 500 individuals/m^3, is a rarity on a global scale. Other than this species, some other unrecorded species have been discovered, such as the jellyfish *Tima* sp. The quantity of bivalves in Malo jezero with over 40 species is distinguished by the density of the ark shell (*Arca noae*) and the noble pen shell *(Pinna nobilis),* the latter a protected species (NN, 23/1977). In Veliko jezero, the quantities of the scallop *Pecten jacobaeus* are significant, always at a depth greater than 17 m. Individuals of up to 17 years of age have been found.

In 2003, the invasive algal species *Caulerpa racemosa* began to settle around the isle of Glavat in the southeastern part of the National Park. Its aggressive covering of all types of sea bottom substrate directly changes the constitution of the biodiversity of the benthic communities creating a monocultural growth reaching the thickness of 7 cm. The measured daily growth of cauloids during the summer is up to 2.7 cm. On 1 m^2 of the bottom surface, up to 1,600 cauloids and 25,000 phylloids were found.

The occurrence of this species in the Soline channel in July 2004 directly endangers the natural phenomenon of Mljet Lakes. The discovered colonies of the alga, an area of 87 m^2, have been covered with sheets of black plastic. Previous experience using this method has proved successful, as the lack of light makes photosynthesis impossible, thus killing the algae.

In the future, a constant control of the sea bottom in the Soline channel and in Veliko jezero is indispensable, as new colonies of *C. racemosa* may occur. The destruction and prevention of the propagation of this exceptionally dangerous alga in the waters of Mljet Lakes is of extreme importance if the original ecosystem is to be conserved.

Key words: bioinvasion, *Caulerpa racemosa*, protected areas, Lake Mljet, Adriatic Sea

MARINE AND COASTAL SITES OF CONSERVATION INTEREST IN SLOVENIA

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The Slovenian coastal area covers southern part of the Gulf of Trieste in the Northern Adriatic. The Gulf of Trieste is a shallow marine ecosystem, where characteristics of the Northern Adriatic's coastal and open waters are combined. With few exceptions, the depth does not exceed 25 m. Due to its shallowness and freshwater inputs, the Gulf's waters experience considerable temperature and salinity variations. Also remarkable are the tidal amplitudes. Besides its physical, chemical and biological characteristics, there is yet another important feature that threatens the uniqueness of this northernmost part of the Adriatic – the intensive urbanisation of its coastline and, in turn, a serious degradation of the coastal ecosystems.

The Slovenian coast is 46 km long and intensively urbanised. It has four major urban settlements, *i.e.* Koper, Izola, Piran and Portorož. There is an important harbour in the town of Koper and a shipyard in Izola. Most of the industrial plants are located around the two towns. Tourist facilities are primarily located in the southernmost part of the coastal area, in the towns of Piran and Portorož. The last is a typical summer resort with hotels and all the appertaining facilities. There are also four yacht harbours, one in each town.

Of the 46 kilometres long coast, less than 8 kilometres of natural coastline have been preserved. It is obvious, however, that even these eight kilometres long stretch has not retained its true natural character, since it is subjected to numerous indirect and direct impacts from various human activities. Indirect impacts are mainly those caused by sewage and industrial outlets, traffic and other activities taking place in the urbanised part of the coastal area. Direct impacts on the remaining parts of the natural coastline come primarily from tourism (leisure boat traffic, anchoring), fishing and collecting mussels. Ten marine and coastal sites of conservation interest have been listed so far. With few exceptions, they cover most of the typical marine and coastal habitat types. Seven sites have been legally protected, and two of them already have their management bodies.

The future activities concerning the conservation of marine and coastal biodiversity will be targeted mainly on the completion of the inventory of sites of conservation interest and in the implementation of the Nature Conservation Act – particularly with regard to the management conservation measures and monitoring. Much attention is also to be paid to public awareness building and to international cooperation – mainly within the framework of the Barcelona Convention and its Protocol on Specially Protected Areas and Biological Diversity in the Mediterranean.

Key words: marine biodiversity, protected areas, conservation, management, Slovenia

SEČOVLJE SALINA NATURE PARK – CASE STUDY

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Salt production is one of the oldest industries known to man and of the thousands of traditional salinas once numerous throughout the Mediterranean region, only few have survived.

Most important for the salinas are wetland sites containing a unique variety of habitats with shallow ponds offering bird feeding areas as well as nesting and resting sites on dykes and islands, which are safe from predators, and they host a very special biodiversity due to the hypersaline character of the salt basins that are maintained at constant water levels which are ecologically invaluable during dry Mediterranean summers.

The combination of micro-climatic conditions found at Sečovlje, and the fact that the shallow salt water in the southern part of the park, which forms its core nature conservation zone, does not freeze in winter, attracts large numbers of migrating waders and has made it one of the most important bird breeding sites in Slovenia.

Of the 270 bird species observed at this Ramsar site, 90 breed in and around the Park, 25 of which are strictly salina-breeding species. Among these are between 35 and 50 pairs of Kentish Plover; 60 pairs of Common Tern; 15 pairs of Little Tern and a colony of Black-winged Stilt. The first breeding pair of this rare passage bird was observed in the Park in 1990, and in 2004 its numbers have increased to 60 breeding pairs. Other notable passage birds that attract visiting birdwatchers include Great White and Little White Egrets, Avocet, various duck species (including Wigeon, Teal, Mergansers, *etc.*), Divers, Grebes and many songbirds. 100 breeding pairs of Yellow-Legged Gulls, not found breeding in any other part of Slovenia, find the shallow water in the old salinas a safe haven during their moulting phase, while the pollution risk to salt-making activities posed by the regular arrival in late summer of up to 15,000 other gulls has been eliminated by setting aside an area of the abandoned salt-pans, which they are now allowed to occupy.

Located at the southern extremity of Slovenia's short 40 km Adriatic coastline, the Sečovlje Salina near Piran, the northernmost salt-pans still functioning in the Mediterranean region, has been a salt-making centre since the 12th century and its unique "petola" based process of salt production has remained unchanged throughout the centuries. At its peak, the salina gave employment to a 1000 strong community of salters and their families, but as the competition by cheaper mined salt from North Africa and Eastern Europe grew, the production was reduced. Then the investment in maintaining the salt-pans was halted, and in 1967 the large salt-pan complex in the southern part of the salina was finally completely abandoned. In recognition of the area's exceptionally rich natural and cultural heritage, Sečovlje Salina Nature Park was designated as a regional landscape park by Piran Council in 1990, and in 1993 it was listed as Slovenia's first Ramsar wetland site. Three years later, the Slovene Government assumed responsibility for nature conservation in the area and in 2002 it was officially designated as a Nature Park.

Now this 6.5 km^2 protected area, which is situated along the Dragonja river estuary and has a southern perimeter that overlaps the border with Croatia, is in the centre of a ground-breaking agreement that has resulted in the State authorities handing over the Park's management last month to a telecommunications company (Mobitel d.d.), which has contracted to invest substantial sums of money in the Park's protection and conservation for up to 20 years. Although it had not been previously involved in nature conservation, Mobitel has agreed to allocate a high sum of money for this project. It is the first time that a commercial company has invested in a protected area in Slovenia.

The Park's area is an extremely important landscape, in terms of both cultural and natural biodiversity. It is only as a result of it being a man-made and managed ecosystem that it supports such a rich diversity of flora and fauna. Thus a continuing human interaction is necessary to preserve the area.

The salt-making process has to be maintained to ensure the survival of this special wildlife habitat. Without it, the area would again be subjected to natural succession. It would quickly become overgrown and inundated, which would result in biodiversity loss and habitat deterioration.

Over the last 30 years, little has been invested in the salina infrastructure and the company has undertaken to invest money in the Park for at least some years, at which point they have the right to continue or withdraw, depending on the progress made in a number of areas, including income earned from tourism and salt production.

Following the restoration of a number of salt-pans, a total of 18 people were employed in 2002, since then producing some 100 tons of salt. This year, a further dozen young unemployed men have been recruited and a new production target of 1,500 tons is expected to be met.

The goal of the Park's management activities is both to protect nature and provide job opportunities particularly for young local people.

A vital element in the protection of the Park is the ongoing restoration of its infrastructure. European funding has been given for the maintenance of some embankments and dykes and for the renewal of a short section of the breakwater that protects this low-lying wetland from stormy seas, but additional money is urgently needed to upgrade a further 4.5 km of this sea wall.

Another high priority is the provision of suitable access and facilities for visitors. A shop offering salt products and local arts and crafts is already open for business, a new multi-media visitor centre housed in a renovated salt-pan building is set to open next spring, and there are plans to build a new footpath around the Park's perimeter and a cycle route.

The Park is visited by about 30,000 people a year, although largely in the summer tourist season. This is the reason why we have to find a way to spread the visitor load more evenly throughout the year. The income generated from visitors is seen as an important source of funding for the maintenance of the salina ecosystem.

Key words: coastal wetland, protected areas, management, conservation, Sečovlje salina

MALTESE COASTAL AND MARINE PROTECTED AREAS – AN INVENTORY ON A NATIONAL SCALE

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Malta is made up of an archipelago of three main inhabited islands and a number of small-uninhabited islets and rocks. Malta, being the largest, covers an area of 246 km^2. Comino, the smallest islet, lies between the islands of Malta and Gozo. The other small islets are Cominotto (Kemmunett in Maltese), St. Paul's Islands (Selmunett or Il-Gzejjer ta' San Pawl in Malt.) and the islet of Filfola (Filfla in Malt.) off the mainland's southern coast.

Despite the archipelago's size, the islands offer quite a rich variety of habitat types and affluent flora and fauna. In fact, the Maltese Islands have rich endemic flora and fauna with at least 25 species of tracheophytes and at least 85 taxa of endemic fauna. Since Malta lies at the centre of the Mediterranean it has interesting biogeographic affinities. In fact, one can find flora and fauna with elements of western, eastern, North African and Sicilian affinities. Human impact is significant; the population density is the second highest in Europe after Monaco and the third in the whole world.

A great stress is being put on Maltese biodiversity from a number of activities and practices, such as coastal development, agriculture, soil degradation, use of marine sites for bunkering, fish farming, introduction of alien species, and harmful fishing practices. This implies a great demand for integrated sustainable management of activities, through the setting up of different coastal and marine protected areas and marine parks for the conservation, protection and/or management of living resources, although to date Malta still lacks any formal declared marine protected area (with the possible exception of Filfla). Both the Environment Protection Act [EPA] (1991, and its new version, 2001) and the Development Planning Act [DPA] (1992) have permitted the creation of protected areas. The Environment Protection Act also protects many different flora and fauna species occurring locally, particularly endemic and/or threatened or vulnerable taxa of international importance.

There are different categories of protected areas in the Maltese Islands. To date, Malta has acquired three strict nature reserves, where all the flora and fauna are protected. These are the island of Filfla, Selmunett and Fungus Rock. They have all been declared SPA sites under the auspices of the Protocol concerning Specially Protected Areas in the Mediterranean.

Various other sites have been protected as "nature reserves" by virtue of the 1991 EPA; these sites are actually 'bird-sanctuaries', where shooting and trapping of birds is prohibited. Many of these areas have also been incorporated into international networks, including those set by the Ramsar Convention and the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean.

Regulation LN 144 of 1993 declares some 22 sites as nature reserves. There are also several tree protection areas, which due to the small size of the Maltese Islands (since Malta is considered a coastal area) may be considered as 'coastal' protected areas. Other sites like Il-Ballut (l/o San Pawl il-Bahar) and Buskett (l/o Rabat & Dingli) have also been protected through the Antiquities Protection Act since they have species of antiquarian importance.

A number of localities are also scheduled through the DPA, including almost all of the Maltese sand dunes and saline marshlands, as well as all the cliffs of the island of Malta. To date, more than 29 coastal areas have been scheduled as Areas of Ecological Importance and/or sites of Scientific Interest in terms of the DPA.

Although there are currently no strict marine protected areas, the area of one nautical mile around the islet of Filfla served as a strict marine reserve from 1987 to 1990 (through the provisions of the Local Notice to Mariners No. 16 from 1987 and Government Notice 473 from 1987). Between 1997–1990, no fishing and any other activity were permitted, and the sea around Filfla functioned effectively as a strict marine nature reserve. Still, this legal notice was revoked in 1990 (LN 173 from 1990) and fishing was again permitted. At the moment, however, no one can carry out activities (except fishing) such as underwater diving, swimming, sea-sport or berthing, mooring or anchoring in the sea around Filfla. Measures are now being taken to carry out

further studies (through EU funds) in this marine area to be able to declare it a marine protected area. 14 sites have also been proposed as "candidate marine conservation areas", in the "Structure Plan for the Maltese Islands" 1990. However, the Structure Plan does not give protection to the candidate MCAs. Subsequently, in 1994, a report commissioned by the Regional Activity Centre on Specially Protected Areas identified 27 marine and 17 coastal sites that were recommended as deserving protection by virtue of the Environment Protection Act.

A management plan is also being prepared for the North West of Malta, so that this area may be declared a marine protected area, and it may function as such, through a number of small no take and no entry zones in this area, which encompasses an 11-km coastal stretch.

Through the Natura 2000 Network/ Emerald Network project, Malta has just submitted some 31 sites of international importance and 7 sites of national importance to the EU as part of the Nature 2000 obligation to declare N2K sites. Data generated from the baseline mapping of the *Posidonia* survey will also serve for the N2K process for the marine sites.

Key words: biodiversity, protected areas, inventory, Malta

BIODIVERSITY ASPECTS OF MYSID AND DECAPOD CRUSTACEAN FAUNA (CRUSTACEA: MYSIDACEA, DECAPODA) IN THE SLOVENIAN PROTECTED COASTAL WETLAND

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During the summer period of 2004, comprehensive research of habitat types was carried out in the area of Strunjan salina and Stjuža lagoon (northern Adriatic, Slovenia). At the same time, epifauna and infauna were sampled in Stjuža lagoon and in the adjacent estuary. Both habitats belong to the "Undersea meadows with species of the genera *Cymodocea* and *Zostera* and/or coastal lagoons" habitat type. Mysid and decapod crustaceans were selected from samples taken mostly by standard dredging. Altogether, 4 species of Mysidacea and 18 species of Decapoda were recorded in the study area.

Inside the lagoon, only 2 mysid species of the genus *Paramysis* were recorded: *P. arenosa* and *P. helleri*, whereas in the estuary 2 species of the genus *Siriella* were present: *S. armata* and *S. clausi*. The most common decapod inside the Stjuža lagoon was *Hippolyte longirostris*, which was also present outside the lagoon in the estuary, although *H. holthuisi* was dominant there. *Palaemon adspersus* and *Crangon crangon*, which were common in the lagoon, were not recorded in the estuary. For all these 4 species, the combination of sea meadows and brackish lagoons or river estuaries presents a typical habitat.

The most important species inside the Stjuža lagoon is *Upogebia pusilla*, which is, amongst all the species of the genus present in the northern Adriatic, particularly connected with shallow areas. It usually occurs in lower mediolitoral and upper infralitoral. Considering the relatively high density of its burrows per square meter, this species is very abundant in the lagoon. However, the species is facing some threat by the fishermen, collecting it in high numbers as fish bait. Amongst the crabs, only *Carcinus aestuarii* was common in both lagoon and the estuary.

Altogether, 97 invertebrate species and at least 15 fish species were recorded inside the Stjuža lagoon during the present study. Group of authors reported on only 53 invertebrate species and 13 fish species in a more than thirty-year-old paper. Only 4 species of Decapoda were recognised, some of them with certain doubt (e.g. *Upogebia littoralis*). A comparison with the older study suggests that the biodiversity may be nowadays even higher than in previous times, perhaps due to better connection of the lagoon with the gulf outside or better prospecting of the area.

Despite the fact that Stjuža is a relatively small lagoon, it has to be considered as an important protected wetland with high reported infauna biodiversity. Legal protection gives this natural heritage a good chance to survive in the years to come.

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Key words: marine biodiversity, Mysidacea, Decapoda, coastal wetland, protected area, Slovenia

THE LOGGERHEAD TURTLE *(CARETTA CARETTA)* IN SLOVENIA

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The loggerhead turtle *Caretta caretta* is the only marine Mediterranean turtle that occurs in the Slovene part of the Adriatic Sea. The activities concerning its conservation are being carried out within the framework of the Mediterranean Action Plan and, to be more specific, in accordance with the Action Plan for the Conservation of Mediterranean Marine Turtles, initially adopted by the Contracting parties to the Barcelona Convention in 1989 and amended in 1999. The main priorities of the Action Plan are:

- protection and management of the known nesting, feeding and wintering areas, and migration routes;
- restoration of degraded nesting beaches;
- banning of its exploitation and minimization of incidental catches;
- identification of feeding and wintering areas, and migration routes;
- investigation of new nesting areas;
- more knowledge on the biology of the species, in particular aspects related to its life cycle.

The conservation activities in Slovenia started in 1995 and include collaboration with fishermen, tagging, data gathering, and public awareness building. They are carried out by the Institute of the Republic of Slovenia for Nature Conservation, the Piran Aquarium and the Marine Biological Station. At the beginning (1995 – 2002), the activities were rather sporadic, there were relatively few data, and the presence of the loggerhead turtle was largely underestimated.

Un important shift in the activities came in 2003, with the signing of an agreement between the Institute of the Republic of Slovenia for Nature Conservation, the Ministry of Environment and Physical Planning and, last but not least, the company PETROL d.d., which was willing to give a financial support to the activities carried out within the project called "Turtles are looking for friends". The project resulted in intensified activities, in a better organization and finally also in a very positive feedback from the fishermen and the general public. It enabled permanent contacts with fisherman, the printing of a leaflet and a poster and, above all, it granted reimbursement for the expenses and a T-shirt with the logo of the project for the fishermen. The results of the tagging and data gathering show that the loggerhead turtle is a regular guest in the Slovene part of the Adriatic Sea. 50 turtles were tagged from 1995, twenty of them only in the last two years.

The aim and goals for the future are to carry on with the good collaboration with fishermen and data gathering. The main purpose of the activities is to propose adequate conservation measures and to reduce by-catch mortality. Finally, the results should serve as a basis for drafting a national action plan for the conservation of the loggerhead turtle.

In the last biennium, the activities were limited to gathering information on turtles caught by fishermen (mainly in Piran area), their tagging and release. The activities are carried out by the Piran Aquarium in collaboration with the Institute of the Republic of Slovenia for Nature Conservation, Regional Office Piran. The results of this work were presented at the First Mediterranean Symposium on Marine Turtles held in Rome. New development is foreseen in 2003 and, hopefully, in the years to come. The implementation of the Action Plan was agreed to be financed by the Ministry of Environment, Physical Planning and Energy, and the company Petrol. The agreement (signed for 2003 but hopefully with a follow-up in the next years) includes awareness building activities, targeted particularly at fishermen (with leaflets, awards for data on turtles, etc.), compiling of data, and elaboration of a database and presentation of the results.

Key words: loggerhead turtle, *Caretta caretta*, conservation activities, monitoring, Slovenia

SEA TURTLES: THE EMBODIMENT OF MARINE CONSERVATION AND MANAGEMENT EFFORTS

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Sea turtles are an optimal case study in the field of conservation and management – they combine the features of endangered species with the issues of habitat loss. The situation is further aggravated because they are threatened by habitat loss in two ecosystems, terrestrial and marine.

Ten years of research on the endangered loggerhead turtle *Caretta caretta* in Fethiye, one of 14 key nesting sites in Turkey, reveal the full pallet of problems that sea turtle conservationists and researchers face worldwide: light pollution, sand removals, heavy use by tourists and local inhabitants, construction on the beach, tree planting, recreational water sports and boating, and fisheries. This is accompanied by large-scale habitat destruction in wetlands adjoining the beach, pointing to crucial habitat mosaic issues. A 10-year analysis of nest numbers reveals an increasingly dampened oscillation around a decreasing mean. The data raise the issue of the definition of "long-term" in ecological studies and must also be seen against the backdrop of the "shifting baseline" syndrome. The status of sea turtles addresses an underlying dilemma: virtually no marine biologist today works in a pristine environment, and the results obtained in degraded habitats must be interpreted with caution. Elsewhere, historical data show key ecosystem effects from the near-extinction of sea turtles. Such an effect is probable in the Mediterranean as well, but declining populations, habitat loss and a wide range of additional disturbances may prevent us from reconstructing that role. This has direct implications for management decisions. The urgency for action is reflected in the recent literature on sea turtles: it has overwhelmingly shifted from basic research to conservation-related matters.

Key words: loggerhead turtle, *Caretta caretta*, conservation, management, Turkey