Marine Protected Areas as a tool for Ecosystem Conservation and Sustainable Development: the case of the National Marine Park of Zakynthos

Laurent Sourbes
NATIONAL MARINE PARK OF ZAKYNTHOS (NMPZ)
Manager Director of the Management Body of NMPZ
El. Venizelou, 29100, Zakynthos, info@nmp-zak.org, sourbes@nmpz.gr

Associate Professor DROSOS KOUTSOUBAS
UNIVERSITY OF THE AEGEAN
Department of the Marine Sciences, School of Environment
University Hill, 81 100,Mytilini, drosos@aegean.gr
            &
*NATIONAL MARINE PARK OF ZAKYNTHOS (NMPZ)*
El. Venizelou, 29100, Zakynthos, info@nmp-zak.org

1. Introduction

The lack of rational management of coastal areas and marine resources, the "*opportunistic*" development without planning, the partial response to conflicting interests and especially the lack of participative process for all involved stakeholders regarding management decisions constitute a very serious threat resulting to the degradation of most of Mediterranean coastal and islands areas. The marine biological resources that traditionally ensured the economic independence and the cultural identity of local societies and could be, linked with sustainable tourism activities, the basis for sustainable economic development, are disappearing because of the over-fishing.
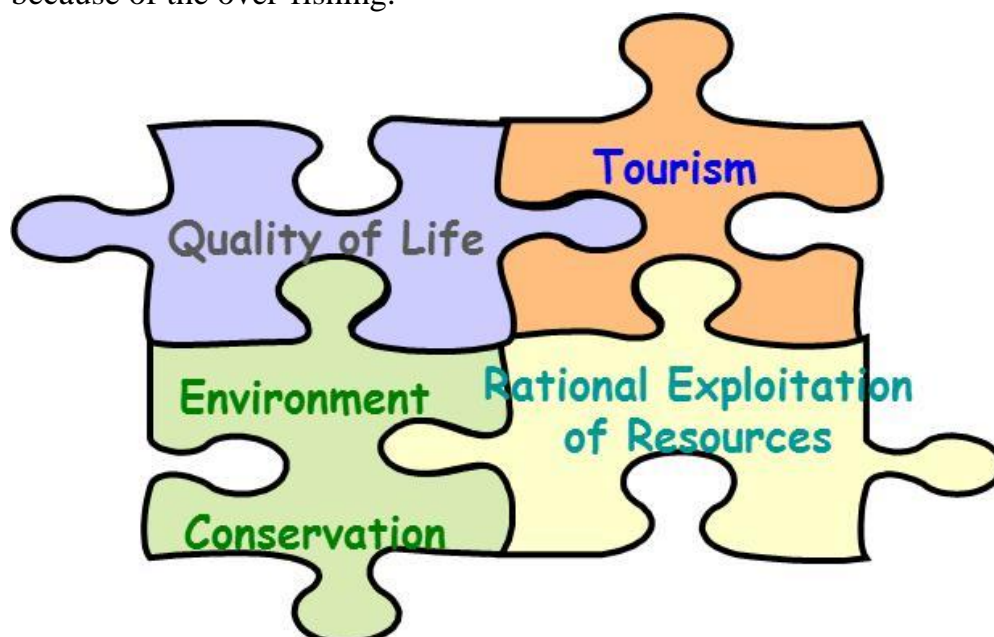
Furthermore, the habitats and the diversity are facing intense pressure from different anthropogenic activities, resulting in the decreasing of commercial marine resources and general habitat's degradation, fact that is leading to the incapacity to develop activities in coastal and insular areas that could be sustainable. The aforementioned issues can be successfully faced with the support of specific measures within the framework of Integrated Sustainable Management - ICZM since the impacts of conflicting interests from different stakeholders in coastal areas can be lessened.

2. Establishment and Management of Marine Protected Areas

The last twenty years, it has been proposed to establish more and more Marine Protected Areas (MPAs) at the international level, as a tool for the protection and conservation of the marine environment (Dixon et al., 1993; Ballantine, 1995; Agardy, 1997). Thus, the International Union for Conservation of Nature (IUCN, 1998) called Governments, International Organisms and Non Governmental Organizations (NGOs) to "*contribute to the protection, restoration, rational use, understanding and enjoyment of the World Marine Heritage through the establishment of a international and representative system of MPAs and through the management with respect to recommendations of the World Conservation Strategy for human activities that are exploiting or affecting the marine environment*". Moreover, and according to the Article 8 of the 'Convention on Biological Diversity' (Rio de Janeiro, 1992) that was adopted by more than 150 states including Greece, "*….Each Contracting Party shall, as far as possible and as appropriate: (a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity; (b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity; (c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use; (d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings; (e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas; (f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies; (g) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge,*

innovations and practices and (i) Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations (Gaston & Spicer 2004).....".

Except from the 'Convention on Biological Diversity', Mediterranean countries committed themselves to establish and sustainably manage Protected Areas with respect to the protection of marine and coastal environment in the Mediterranean ('Barcelona Convention', 1995). Within the MPAs, habitats such as reefs, *Posidonia* beds, caves, coastal shifting ecosystems but also shipwrecks or underwater archaeological sites can be included (Commonwealth of Australia 2003). The role of MPAs regarding the protection of marine biodiversity, of habitats and biological resources is (Riggio, 1989; Boudouresque & Ribera, 1993; Agardy, 1994; Stoner 1996):

- to conserve representative samples of species and ecosystems
- to protect important areas for the reproduction and development of marine organisms (i.e. fish nurseries)
- to constitute an educational spot concerning the marine environment and the anthropogenic influence on it.
- to constitute natural conservation areas for leisure and sustainable tourism activities.
- to constitute the touchstone of scientific research and a prototype for the planning and management of other marine areas.

A common worldwide trend is to protect areas considered as "Biodiversity Hot-Spots" (Basset, 1999; Harmelin 2000). This approach is supported by Maurer (1999), considering that a Biodiversity Hot-Spot is in fact a "*biological abstract*" of different adjacent areas, potentially with a smaller biodiversity, but much more larger. Subsequently, the acquired ecological knowledge from the monitoring of such an area concerns a larger geographical area whilst the protection itself contributes to a larger production and dissemination of the biodiversity and biomass. Furthermore, the conservation of a marine species '*gene pool*', protecting their living area and ecological habits, can contribute to ensuring a high level of biodiversity in the future. Those gene pools can also constitute the basis for strengthening and restoring biological populations in areas that were affected by marine pollution, over fishing and natural disasters. Such natural shelters that are functioning as "*gene pools*" were always a part of the marine environment. Those areas were traditionally remote areas because of their specific natural characteristics (e.g. geomorphology), thus limiting human activities and access. However, natural shelters are disappearing nowadays due to the fact that modern technology (e.g. fishing methods and modern equipment) allows human interventions and access. The establishment of no-fishing areas and/or areas were the removal of natural resources is prohibited ('*no-take zones'*) in Marine Protected Areas, is the prerequisite for the protection and conservation of marine ecosystems. The lack of management measures such as the aforementioned ones is putting in danger natural assets of the marine biodiversity, without giving the opportunity to know their real importance to humankind (Commonwealth of Australia 2003).

Two broad approaches are usually followed for the creation of an MPA system: (a) establishing a series of relatively small MPAs as part of a broader framework of integrated ecosystem management, or (b) establishing a large, multiple zones MPA encompassing a large part of a marine ecosystem (McArthur & Wilson, 1967; Rosenzweig, 1995; López Ornant, 2006). The creation of a large MPA in a particular area is often not practical due to socioeconomic and political restrictions while the establishment of several smaller marine reserves seems to be more economically sustainable as far as they are more easily managed with regard to the surveillance and the acceptance of local communities (IUCN, 2008). Moreover, in cases where it is not feasible to include a portion of each habitat within a single MPA without interrupting human activities at the intermediate areas, ecological benefits can be maximised by creating multiple reserves that are close enough together to function as a Network. Current experience has proved that in some cases a well-designed Network of several small or medium sized MPAs may accomplish the same goals as a single very large MPA, such as conservation of biological populations and spill over effects to the adjacent areas (Underwood & Keough, 2001). Additionally, well managed Networks of MPAs offer spatial links which are absolutely necessary for the maintenance of ecological connectivity, ecosystem functions and services (NRC, 2000; PISCO, 2007; Parker et al., 2008).

It is estimated that a Network of MPAs, with the aim of conserving 20-30% of the seas and oceans, could cost between 3 – 13bn€, but help to safeguard 48-54bn€ worth of fish catches, and other marine ecosystem services valued at 3-5 trillion€ (2010 International Year of Biodiversity). However, less than 0.01% of the world's oceans exhibit a Marine Reserve status, while coastal MPAs cover only 0.4% of the Mediterranean Sea (Abdulla et al., 2008). Furthermore, the current Mediterranean MPA system is not representative or coherent, while the management in MPAs has proved to be ineffective due to the lack of: a) management plans, b) quantitative information regarding the spatial distribution of biodiversity and marine resources, c) socioeconomic information, d) facilities and equipment, and e) appropriate enforcement and surveillance (López Ornant, 2006). For example, the NATURA 2000 network constitutes the main conservation strategy for protected areas in Europe, and specific policy and financial instruments have been developed to ensure proper implementation and management of the sites included in the network (Miller & Kettunen, 2005). However, coastal and marine NATURA 2000 sites in many areas of the Mediterranean Sea including Greece were not identified based on a systematic conservation planning approach, most areas still remain poorly studied, species' and habitats' inventories remain incomplete, while no monitoring schemes are being applied and no appropriate management plans are properly implemented.

## 3. Marine Protected Areas in Greece: The current state

In Greece, there are currently two important Marine Protected Areas (MPAs) with a Management Body which are: a) the National Marine Park of Alonnisos

Northern Sporades (NMPANS) that mainly aim at protecting the endangered species of the monk seals (*Monachus monachus*) and b) the National Marine Park of Zakynthos (NMPZ) aiming to the protection of the Loggerhead sea turtle *Caretta caretta*. Except from the aforementioned MPAs, more than 130 Natura 2000 areas (including Sites of Community Importance – SCI and Special Protected Areas – SPA) which encompass coastal and marine sites, without having been adopted, until now, a strict protection and management legal framework and there are no Management Bodies to manage those areas (Thessalou-Legaki & Legakis, 2005).

3.1 The National Marine Park of Zakynthos

A Presidential Decree, signed in December 1999 (Official Journal of the Hellenic Republic 906D, 22/12/1999), resulted in the establishment the National Marine Park of Zakynthos (NMPZ) and its Management Agency (2000), with the purpose to protect and conserve the most important loggerhead sea turtle (Caretta caretta) nesting beaches in the Mediterranean, a population of Mediterranean monk seals (Monachus monachus), resident and migratory bird species and rare and endemic plants. The primary aim of the NMPZ is to monitor various aspects of the natural environment (e.g. species, habitats and impacts), to capacitate the growth of environmentally compatible activities, such as sustainable tourism and recreation, whilst simultaneously safeguarding the natural and cultural landscape through activities such as environmental education, provision of information and public awareness activities.

Zakynthos Island is 406 km^2, of which 45.4 km^2 (or 11% of landmass) falls within the National Marine Park of Zakynthos (NMPZ) and borders the region of Laganas Bay. This area is divided into three terrestrial zones: a) the *Core Zone* (Nature Protection Areas) (14.2 km2), b) the *Buffer Zone* (Protected Natural Landscapes) and c) the *Peripheral Zone* (Eco-development Zone and Tourist Development Zone) (Buffer & Peripheral: 31.2 km2), with an additional 89.2 km^2 forming the Marine Protection Area of Laganas Bay and the nearby Strophadia islands. The Strophadia Islands which are also included in the National Park are located 40 nautical miles south of Zakynthos. According to the census 2001, about 6300 people are living in the peripheral and core area of the NMPZ, that is to say 16% of the Zakynthos' island total population.
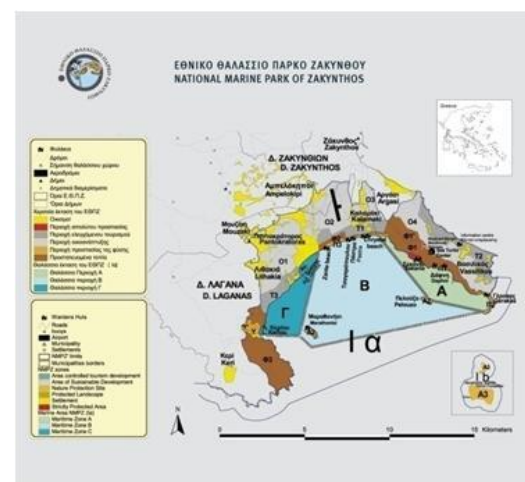
The National Marine Park of Zakynthos encompasses three Natura 2000 areas:

1. 'Laganas Bay including Marathonisi and Pelouzo islets' on Zakynthos (GR2210002) (69.57 km^2) is a Site of Community Importance (SCI)
2. The 'Strofadia islands' 40 nautical miles south of Zakynthos comprise a Site of Community Importance (GR2210003) and a Special Protection Area (SPA) (GR2210004).

Within the NMPZ area three wildlife species (the loggerhead sea turtle *Caretta caretta*, the Mediterranean monk seal *Monachus monachus* and the Cory's shearwater *Calonectris diomeda*) and one marine habitat (sea grass *Posidonia oceanica* beds) have been given priority protective classifications under Annexes I and II of the 92/43 Directive and Annex I of 79/409 EEC Directive.

The Marine Park's objectives are to preserve the natural environment and conserve the ecological balance of the marine and coastal area of Laganas' Bay and Strophadia Islands. Simultaneously it aims to develop new initiatives and/or maintain economic activities compatible with the principles of Integrated Management and Sustainable Development (such as fishing activity, tourism, sustainable and biological agriculture).

Since it was the first National Park in Greece managed by a Management Agency (July 2000), it represents the first innovative step for nature conservation in Greece, by setting an example how nature protection can be harmonized with anthropogenic activities by creating sustainable development for the wider region.

In order to cover the management and scientific monitoring needs as well as the environmental education and public awareness needs, specialized staff (such as Biologists, Environmentalists, Agriculturists, Civil Engineers, Environmental Economists) was hired. Furthermore, the wardening of the whole area is ensured by about 20 Park Rangers that are supported by seasonal guards because of the simultaneous intense tourism activity (more than 600.000 visitors) and the sea turtles breeding activity during summertime. Most of the activities developed by the NMPZ Management Agency are financed by European Projects such as the Community Structural Funds (CSF), INTERREG, Med, LIFE, 7th Framework Programmes. Basic but very important infrastructure and equipment was acquired such as the Thematic Exhibition Centre of the Sea Turtle *Caretta caretta* (located in Daphni), the Information Center, Warden huts, Cars, Patrol Boats, Scientific equipment and Public awareness material that is constantly updated.

Νεοσσοί της *Caretta caretta*
Hatchlings of the loggerhead sea turtle (*Caretta caretta*)

The NMPZ Management Agency is also involved in Environmental Education Programmes, VolunteersPprogrammes and has organized several National and International Scientific and Thematic Conferences and Workshops with main themes the protection and management of the environment and the promotion of sustainable development. Its contribution to scientific research related to its area of competence is expressed through the cooperation with Research Centres and Universities (memorandum of cooperation, papers in Conferences and Journals, partnerships, internships, thesis, summer schools), the participation to Scientific Conferences (e.g. Annual Sea Turtle Symposium) and the publication of scientific papers (e.g. *Journal of Experimental Marine Biology and Ecology, Diversity and Distribution, Journal of Animal Ecology, Conservation Biology*). In order to contribute to the promotion of sustainable development principles, the NMPZ Management Agency is also participating to different Committees and Think tank Organizations, International Tourism Exhibitions (London, Berlin, Amsterdam). Last, the NMPZ is a founding member of the International Organization MedPAN that was established in 2008, an organization dedicated to supporting MPAs Managers in the Mediterranean through the know-how and experience exchange.

In the area of NMPZ there is an important biodiversity since as it has been reported above with a variety of Ecotopes of Community Interest such as Sand Dunes in Kalamaki Beach, extended seagrasses of *Posidonia oceanica* and *Zostera* sp. in the Laganas Bay. Furthermore, a great number of plants (among which is included the endemic species *Limonium zakynthium*), algae, invertebrates and vertebrates have been recorded in the coastal and marine ecosystem of the Park along with a rich bird fauna (more than 50 migrating species have been recorded from Zakynthos and Strofadia Islands). The National Marine Park of Zakynthos and in particular the Laganas Bay host one the most endangered species of the Mediterranean fauna which is the Loggerhead Sea Turtle *Caretta caretta*. This constitutes an '*umbrella species*' for the Park since the number of individuals which reach the Laganas Bay for reproduction every year represent the 25% of the Mediterranean population of this species (and more than 50% of the individuals visiting different parts of the Greek Seas). Furthermore the high productive beds of *Posidonia* covering big parts of the Laganas sea bottom offer an ideal habitat not only for *Caretta caretta* but they also host an important number of flora and fauna species (more than 400 algae species and 500 fish and invertebrate species have been recorded to form the *Posidonia* communities). Finally, the variety of geomorphological features (e.g. reefs, underwater caves) not only in Laganas Bay (e.g. in Pelouzo and Marathonisi islets) but also the western parts of the Island of Zakynthos (which are NATURA 2000 sites) provide the perfect habitat for certain individuals (estimated to more than 15 according to a survey contacted in 1994) of the Monk Seal *Monachus monachus*.

The Management Body of NMPZ has a lot of actions not only towards ecosystem conservation but also to the strengthening of sustainable development in the island of Zakynthos. To achieve this the park has a considerable contribution in a series of activities such as: a) development of Environmental Educational Tourism (e.g. collaboration with the Primary Schools, Gymnasiums and Lyceums as well as the Environmetal Education Centre of Lithakia for organization of thematic summer

schools, eco-friendly activities in the nesting beaches of the Loggerhead Sea Turtle *Caretta caretta*), b) promotion of the Cultural and Traditional characteristics of the Island of Zakynthos (e.g. alive performances of local music and theatre groups, promotion of biological local products – olive oil, wine), c) the enforcement of Eco-touristic activities (e.g. Diving Tourism, Fishing Tourism, Bird Watching) and d) promotion of alternative methods of agriculture (e.g. biological culture of local products).

3.2 Application of Management Plans in the National Marine Park of Zakynthos

The Management Body of the NMPZ applies a series of Management actions on an annual basis aiming to achieve an effective conservation of the Loggerhead Sea Turtle *Caretta caretta* and its habitats (i.e. Laganas Bay and nesting beaches). The Management actions in both the nesting beaches and the marine environment are the synergistic effect of three different but interactive programmes: a) The Wardening of Activities and Public Awareness Programme, b) the Scientific Monitoring Programme and c) the Volunteers Programme.

a) Wardening and Public Awareness Programme.

This Programme (which is the application of the legal framework and measurements included in the Presidential Degrees 906/Δ/1999 and 1272/Δ/2003) has the following major activities: 1) Wardening of the nesting beaches of the Loggerhead Sea Turtle *Caretta caretta* in Laganas Bay, 2) Wardening of the marine environment in Laganas Bay which is the major area for reproduction of the Loggerhead Sea Turtle *Caretta caretta*, 3) Wardening of the Strofadia Islands for monitoring of activities related to fishing and hunting, 4) Public Awareness of the local community and the visitors of the island.

MARINE ENVIRONMENT

The marine protection regulations operate from May to October every year whereby:

- in Zone A of the NMPZ all seacraft are prohibited
- in Zone B of the NMPZ sea craft are permitted at a speed limit of 6 miles per hour but no anchoring
- in Zone C of the NMPZ sea craft are permitted at a speed limit of 6 miles per hour and may anchor

COASTAL ENVIRONMENT

Laganas Bay contains six ('Area of Absolute Protection' – Sekania and other 5 'Nature Protection Areas' – Gerakas, Dafni. Kalamaki, Marathonisi and Keri), primarily small, sandy nesting beaches for the Loggerhead Sea Turtle (in addition to

several other shingle beaches), which are separated from each other by rocky outcrops. The National Park also includes the Strophadia Islands, which are located 40 nautical miles south of the island of Zakynthos.

The coastal protection regulations operate through the whole year whereby:

- in the 'Area of Absolute Protection' (Sekania) access to the beach is only permitted for research activity that is specially authorised from the NMPZ Management Body
- in the other 'Nature Protection Areas', the following is prohibited:

  - ✓ the Public access to the nesting beaches from 19.00 to 7.00
  - ✓ the use of umbrellas, except in the region of 3-5 metres above the waterline
  - ✓ the digging on the beach, especially where turtle nests are located
  - ✓ the disturbance of cages protecting the nests
  - ✓ the use of any vehicle (bicycle, motorbike, car, etc.)
  - ✓ the access to horses
  - ✓ the access to dogs without a leash
  - ✓ the use of any light source at night

b) Scientific Research Monitoring Programme.

The Scientific Research Monitoring Programme aims to establish a standard quantitative method of monitoring the quality of the Loggerhead Sea Turtle *Caretta caretta* nesting beaches with respect to conservation management, and is performed on an annual basis in 5 important beaches (Geraks, Sekania, Dafni, Kalamaki and Marathonisi) in the period from the 15th of May till the 15th of October every year.

This is achieved through:
- Monitoring sea turtle nesting activity (numbers and spatial distribution), incubation periods, and hatching activity to establish success rates
- Assessing environmental factors (e.g. temperature, sediment type, humidity) that are considered to influence the sea turtle nesting activity, egg incubation and hatchling success
- Quantitative evaluation of the information collected to improve area management with respect to monitoring practices and improving the quality of the nesting environment

:

In action the following activities are performed:

ADULT SEA TURTLES

- ✦ Counting of the total number of emergences and estimation of the total number of nests per beach ('*nesting success*').
- ✦ Recording of the nest location with respect to distance from the sea

- Recording of the nest location with respect to elevation above sea
- Determination of the spatial distribution of nesting and assess with respect to environmental and anthropogenic factors
- Determination of the spatial distribution of failed nesting attempts and assess with respect to environmental and anthropogenic factors
- Recording and evaluation of the importance for failed nesting attempts
- Recording of the degree of multiple beach use in successful and failed nesting emergences
- Pit-tagging of female sea turtles for population and behavior studies

INCUBATION AND HATCHLING SEA TURTLES

- Recording of the location of hatched nests and match up with laid nests for determination of the incubation period
- Recording of emergence patterns of hatchlings from nests
- Evaluation of the incubation period with respect to environmental parameters (i.e. against date of egg laying, sand depth of egg chamber top eggs at egg laying, total egg chamber depth, distance from sea, beach slope, water table, etc.)
- Calculation of the number of laid nests that hatched and determination of the reasons for failure of nests hatching and if changes in beach management procedures could impact this
- Determination of the '*hatchling success rate*' from nest excavations and determine reasons for failed hatching (i.e. inundation, heavy clay, rocks, roots in nest, etc.)
- Determination of the sex ratios of hatchlings produced from the different beaches and influence of environmental factors

ENVIRONMENTAL FACTORS AFFECTING SEA TURTLES

- Beach size (length & width)
- Beach slope
- Natural available nesting area: beach composition i.e. sand/stones, vegetation line, wet sand line, sea line, river beds, etc
- Sand composition (particle size, organic content, pH, etc.)
- Sand compaction
- Sand moisture levels
- Light pollution (with & without moon)
- Noise pollution (taking into account wind direction)
- Offshore factors that could affect between beach and on beach spatial nesting distribution (i.e. reefs, sea currents, wind direction, etc.)

ANTHROPOGENIC FACTORS AFFECTING SEA TURTLES

- Total number of visitors on beach each day and at any one time
- Spatial distribution of visitors on the beach

- Awareness of visitors of the rules and willingness to comply
- Total number of participants in public awareness activities, i.e. beach tours
- Obstacles on the beach (i.e. sun beds, humans on the beach, etc)

The aforementioned Scientific Research Monitoring Programme is performed in close collaboration (established via an MOU from 2002 onwards) with the Environmental NGO for the Protection of the Sea Turtle 'ARCHELON'.

Apart the Monitoring Programme targeting the sea turtle there are a lot of other Research Programmes aiming to record flora and fauna species of the beaches and the marine environment as well as the significant Ecotopes of Community Interest (92/43 Ecotopes Directive EU). These scientific activities are performed via collaboration with National (e.g. the Hellenic Centre for Marine Research - HCMR) and International Research Centres and Universities (e.g. the Kapodestrian University of Athens, the Aristoteleion University of Thessaloniki, the University of the Aegean, the Technical Institute of Ionian Islands in Zakynthos) as well as Environmental NGOs such as the Hellenic Ornithological Society (HOS), the Society for the Protection of the Monk Seal (MOM), the Cetacean Institute (PELAGOS), etc..

c) Volunteers Programme.

This Programme aims to support the Wardening/Public Awareness and the Scientific Research Monitoring Programmes performed by the Management Body of the NMPZ. The activities of this Programme are realized through a considerable number of volunteers from Greece and abroad (an average of 20 people on an annual basis). The majority of these volunteers are coming from Universities (mostly undergraduate students) and Social NGOs. An important axis of the Programme, are the activities in collaboration with professional from the local community (e.g. owners of agro-touristic houses for rent in the vicinity of the nesting beaches, small farmers of biological products).

4. The Network of Marine Protected Areas in the Mediterranean Sea (MedPAN)

The lack of coordination and common strategic policy regarding management issues in the Marine Protected Areas of the Mediterranean has led to the creation of a social scientific network i.e the Network of Marine Protected Areas in the Mediterranean Sea (MedPAN). This Network is a Legally independant NGO, which has been created (2008) in response to the demand of the Mediterranean MPA managers. MedPAN partners (NMPZ is among the founding ones) and members share common initiatives across the Mediterranean Sea for an Ecological Network of MPAs and perform concrete actions in the framework of International (e.g. CBD - Rio 1992) and European (e.g. Barcelona Convention and its 1995 BD/SPA Protocole, ACCOBAMS – 1991, Natura 2000, Action Plan for Biodiversity, Marine

Directive, CFP) Legislation and Policies in order to reinforce the management of existing MPAs based on a bottom up approach.

The MedPAN network has developed an MPA Database with different sets of information concerning geographical, hydromorphological, biological, ecological, sociological and economic characteristics of the MPAs in the Mediterranean. An important activity of the network is the production of different status reports concerning various issues of the MPAs, while there is a continuous support of the MPA managers through organization of Training Workshops, facilitation of exchanges, provision of small grants for monitoring issues in MPAs. Finally there is a significant role of the network on issues related to public awareness through its website (www.medpan.org, e-bulletion, etc), while a continuous exchange of knowledge with other ecological and conservation networks in all over the world.

MedPAN	MedPAN Database 2012 Objectives
Defining common MPA identification criteria	• Identifying sites to be included in the database • Identifying sites to be taken into account in the 2012 status report (to be published) • Identifying types of sites to be transmitted to the CBD (COP)
Developing in 2011 a common database of Mediterranean MPAs	• Making access to data easier • Supporting the assessment of the progress of the MPA network • Highlighting main issues at a supra-MPA scale
Carrying out a new analysis of the Mediterranean system of MPAs, to be published in 2012	• Assessing the progress of the Mediterranean MPA network towards international objectives • Identifying gaps at various scales • Proposing strategic lines and priority actions
Identifying ecological and socio-economic monitoring programs carried out on MPAs in the Mediterranean	• Identifying gaps in terms of monitoring • Implementing relevant monitoring programs on the network scale

5. A Network of Marine Protected Areas (MPAs) in the Greek Seas: perspectives for the future

The Greek Seas (mainly the two major archipelagos Aegean and Ionian respectively) are identified as among the main biodiversity hotspots within the Mediterranean (Coll et al., 2010), exhibiting high habitat diversity encountered over small distances, hosting more than 3500 of benthic species and presenting an almost exponential rate of new species records, from 1980 onwards (Papathanasiou & Zenetos, 2005; Zenetos et al., 2009). Still, existing scientific knowledge is rather limited and estimates of marine diversity in this area are considered incomplete, as, many species remain un-described, communities diversity patterns are poorly studied, and several areas and difficult to approach habitats remain unexplored. For example, the North Aegean is only locally studied and there are still poorly explored and unmapped habitats of high conservation value, such as sea-grass meadows, coralligenous formations, submerged caves, and deep sea coral communities. This lack of complete scientific knowledge along with the lack of an effective management of the coastal areas and their resources due to inappropriate application of the existing legislation regarding the NATURA 2000 network, has resulted the 80% of the marine and coastal ecotopes and habitats expanding in the Greek Seas and included in the Annex of the EU Directive 92/43/EE (i.e. these are under a protection status) are not in a good conservation status. According to the National Report to the EU (2006) the conservation status of 65% of the endangered marine species is considered to be between a 'bad' and a 'non-effective' level, while for the rest 35% the conservation status is 'unknown'(WWF Hellas et al., 2008). Fisheries in our seas constitute an important sector of primary production for the Greek economy, despite its small contribution to the annual GNP (0.6-0.7%), as it facilitates social and economic cohesion, by creating jobs and income security, that are especially important for rural areas and remote islands. However, Greek fisheries suffer several problems, and a high exploitation rate has been estimated for most commercial stocks (Papacostantinou et al., 2007).

Since MPAs have gained worldwide recognition as effective tools for the protection and management of marine biodiversity and fisheries resources, as they enhance productivity through the protection of areas suitable for settlement and growth of marine species, and the subsequent spill-over effects to adjacent areas, while additionally contribute significantly in the preservation of artisanal fishermen lifestyles and incomes, provision of recreational and cultural opportunities, and reduction of the anthropogenic impacts, there is an urgent need to move towards the development of an effective Network of small scale Marine Protected Areas in the Greek Seas. In order to create such an MPA Network that will serve as an effective management tool, their planning and design has to be based on multidisciplinary scientific considerations regarding the biological, oceanographic and socio-economic characteristics of the area of interest according to the established practice worldwide (Tunesi & Diviacco, 1993; Kelleher, 1999; Roberts et al., 2003). This approach allows the assessment of current ecological conditions, ensures good representativeness of marine resources in the MPAs, determines the important attributes of the MPA Network (e.g. number, size, spacing, placement and total area of MPAs), enhances the involvement of the local communities, and finally improves the chances of success and the long-term viability of any future development plan in collaboration with the local society (Badalamenti et al., 2000; Browman & Stergiou, 2007; Gerovasiliou et al., 2009; Γεροβασιλείου κ. α., 2007; 2009).

LITERATURE - REFERENCES

INTERNATIONAL

Abdulla A., Gomei M., Maison E. & C. Piante, 2008. Status of Marine Protected Areas in the Mediterranean Sea. IUCN, Malaga and WWF, France, 152 pp.

Agardy, M.T. (1994). Advances in marine conservation: the role of marine protected areas. *Trends in Ecology and Evolution,* 9(7):267–70.

Badalamenti F, Ramos A, Voultsiadou E, Sánchez Lizaso J, D'anna G, Pipitone C, Mas J, Fernandez J, Whitmarsh D, Riggio S (2002). Cultural and socio-economic impacts of Mediterranean marine protected areas. Environmental Conservation 27: 110-125

Ballantine, W.J. (1995). Networks of 'no take' marine reserves are practical and necessary. In N.L. Shackell & J.H. Martin Willison (Eds.), *Proceedings of the Symposium on Marine Protected Areas and Sustainable Fisheries Conducted at the Second International Conference on Science and the Management of Protected Areas* (pp. 12–20). Halifax, Canada: Dalhousie University.

Basset A. (1999). Structure versus organization and function: an approach for the evaluation of a site for marine protection. *In: Scientific design and monitoring of Mediterranean MPAs. CIESM Workshop Series,* Porto Cesareo 21-24 Oct.1999. F.Briand (ed.). 8: 25-27.

Boudouresque, C.F. and Ribera, M.A. (1993). Les espèces et les espaces protégés marins en Méditerranée, situation actuelle, problèmes et priorités. *Les Zones Protegées en Méditerranée*. Actes de colloque, Tunis-Novembre 1993, pp: 94–141. Centre d'Etude, de Recherches et de Publications (C.E.R.P.) et Comité pour Les Etudes Méditerranéene (C.E.M.).

Browman, H.I. and Stergiou, K.I. (2004). Marine protected areas as a central element of ecosystem-based management: defining their location, size and number. In H.I. Browman and K.I. Stergiou (Eds.). 2004. *Perspectives on ecosystem-based approaches to the management of marine resources*. *Marine Ecology Progress Series*, 274: 271-272.

Coll M., Piroddi C., Steenbeek J., Kaschner K., Ben Rais Lasram F., et al., 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. *PLoS ONE* 5: e11842.

Commonwealth of Australia, (2006). Review of the Great Barrier Reef Marine Park Act 1975. Review Panel Report.

Dixon, J. A., Scura, L. F. and van't Hof, T. (1993). Meeting ecological and economic goals: Marine parks in the Caribbean. *Ambio*, 22: 117-125.

Ehler, C. and Douvere, F. (2009). Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 53, ICAM Dossier No. 6., UNESCO, Paris, 99 pp.

Gaston, J.K. and Spicer, I.J. (2004). Βιοποικιλότητα. Μια εισαγωγή, Επιμέλεια Ελληνικής Απόδοσης: Χιντήρογλου, Χ. και Βαφείδης, Δ.: University Studio Press, Θεσ/νίκη.

Gerovasileiou, V., Koutsoubas, D., Sini, M. and Paikou, K. (2009) *Marine Protected Areas & Diving Tourism in the Hellenic Seas: Practices and Perspectives*. 4th International Scientific Conference 'Planning for the Future - Learning from the Past: Contemporary Developments in Tourism, Travel & Hospitality', 3-5 April 2009, Rhodes, Greece.

Guidetti P, Milazzo M, Bussotti S, Molinari A, Murenu M, Pais A, Spanò N, Balzano R, Agardy T, Boero F (2008) Italian marine reserve effectiveness: Does enforcement matter? Biological Conservation

Harmelin J-G., (2000). Mediterranean marine protected areas: some prominent traits and promising trends. *Environmental Conservation* 27(2): 104-105.

Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics* 4: 1-23.

2010 International Year of Biodiversity http://www.cbd.int/2010/welcome/ (accessed on 22/10/10).

IUCN World Commission on Protected Areas (IUCN-WCPA) (2008). Establishing Marine Protected Area Networks—Making It Happen. IUCN-WCPA, NOAA and The Nature Conservancy, Washington, D.C., 118 p.

López Ornat, A. (2006). *Guidelines for the Establishment and Management of Mediterranean Marine and Coastal Protected Areas*. Tunis: MedMPA project, UNEP-MAP RAC\SPA.

Maurer B. (1999). *Untangling ecological complexity: the macroscopic prospective*. The University of Chicago Press, Chicago, 251pp.

MacArthur, R. H. and Wilson, E. O. (1967). The Theory of Island Biogeography. Princeton University Press, Princeton, NJ.

Miller C. & M. Kettunen, 2005. Financing Natura 2000: Guidance handbook. European Commission General Directorate for the Environment, Bruxelles.

Papaconstantinou C., Zenetos A., Vassilopoulou V. & G. Tserpes (eds), 2007. State of Hellenic Fisheries. HCMR Publ., 466pp.

Papathanasiou E. & A. Zenetos (eds), 2005. '*SoHelME, 2005. State of the Hellenic Marine Environment*', H.C.M.R. Publications, 360 pp.

Parker, K., Heada, L., Chisholm, L.A. and Feneley N. (2008). Conceptual model of ecological connectivity in the Shellharbour Local Government Area, New South Wales, Australia. *Landscape and Urban Planning*, 86: 47–59.

PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans) (2007). *The Science of Marine Reserves*. http://www.piscoweb.org/outreach/pubs/reserves. [Accessed the 10th of December 2008, 15:00

Riggio, S. (1989). Parchi marini del Mediterraneo. Aspetti naturalistici e gestionali. *Atti del 1° Convegno Internazionale San Teodoro,* pp. 171–81. Sassari, Italy: Chiarella.

Rosenzweig, M.L. (1995). *Species Diversity in Space and Time.* Cambridge University Press, Cambridge, 436 pp.

Roughgarden, J., Gaines, S. D. and Pacala, S. W. (1987). Supply side ecology: the role of physical transport processes. In: Gee, J. H. R. & Giller, P. S. (Eds.), *Organization of Communities: Past and Present*, Blackwell, Oxford, 491–528.

Stoner, A.W. (1996) Queen conch, *Strombus gigas*, in fished and unfished locations of the Bahamas: effects of a marine fishery reserve on adults, juveniles, and larval production. *Fishery Bulletin* 94(3): 551–64.

Thessalou-Legaki, M. and Legakis, A. (2005). Biota of the Sea Bed: Conservation of the Hellenic marine biodiversity. In V. Papathanasiou, and A. Zenetos (Eds.), S*tate of the Hellenic Marine Environment* (pp 254-263). Greece: H.C.M.R. Publications

Tunesi, L. and Diviacco, G. (1993). Environmental and socio-economic criteria for the establishment of marine coastal parks. *International Journal of Environmental Studies*, 43: 253-259.

Underwood, A.J. and Keough, M.J. (2001). Supply-side ecology: the nature and consequences of variations in recruitment of intertidal organisms. In: Bertness, M.D., Gaines, S.D. & Hay, M.E. (Eds.), M*arine Community Ecology*, Sinauer Associates, Sunderland, Maine, 183-200.

WWF (2008). Conclusions of the Workshops of the INTERREG IIIC MedPAN Project; 2005 – 2007, 33 p.

Zenetos A., Pancucci-Papadopoulou M.A., Zogaris S., Papastergiadou E., Vardakas A.L., Aligizaki K. & A.N. Economou, 2009. Aquatic alien species in Greece: tracking sources, patterns and effects on the ecosystem. *Journal of Biological Research*, 12: 135-172.

NATIONAL

Γεροβασιλείου, Β., Σίνη, Μ.Ι., Πουρσανίδης, Δ., Λέκκας, Β., Φιλιός, Γ. και Κουτσούμπας, Δ. (2007). *Καταγραφή της βιοποικιλότητας σε υποθαλάσσιες περιοχές της Λέσβου με δυνατότητα ανάπτυξης καταδυτικών πάρκων (Προκαταρκτικά αποτελέσματα)*. 13ο Πανελλήνιο Συνέδριο Ιχθυολόγων του Πανελληνίου Συλλόγου Ιχθυολόγων, 27-30 Σεπτεμβρίου 2007, Μυτιλήνη.

Γεροβασιλείου, Β., Κουτσούμπας, Δ., Πουρσανίδης Δ. και Σίνη, Μ.Ι. (2008). *Οικολογικές προσεγγίσεις & διαχειριστικές προτάσεις για την ανάπτυξη οργανωμένων καταδυτικών δραστηριοτήτων σε Θαλάσσια Πάρκα στο ΒΑ Αιγαίο*. 4ο Πανελλήνιο Συνέδριο της Ελληνικής Οικολογικής, Βοτανικής, Ζωολογικής και Φυκολογικής Εταιρίας με θέμα «Σύγχρονες τάσεις της έρευνας στην οικολογία», 10-12 Οκτωβρίου 2008, Πανεπιστήμιο Θεσσαλίας, Βόλος.