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ΜΑΡΙΑ Η. ΛΑΛΟΥΣΗ
Α.Μ.: ΜΝ/04010
4ος ΚΥΚΛΟΣ ΣΠΟΥΔΩΝ

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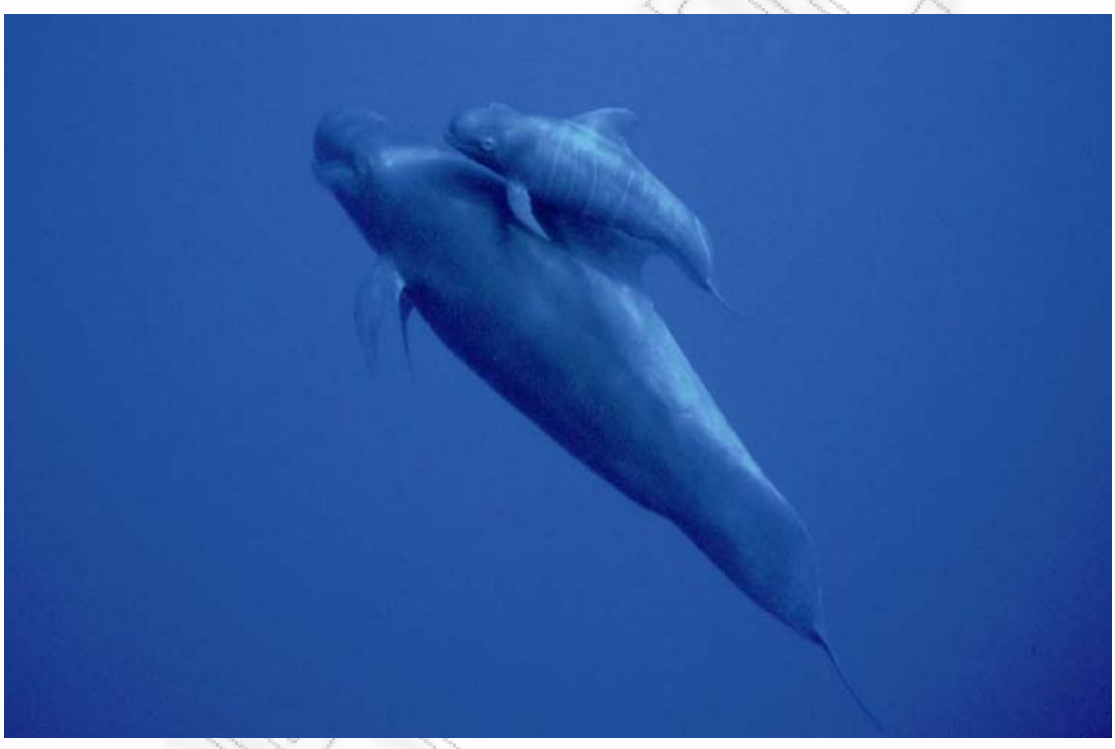
COASTAL AND MARINE PROTECTED AREAS (MARINE SANCTUARIES, MARINE RESERVES, MARINE PARKS, ARTIFICIAL REEFS) – RECENT TENDENCIES AND PROCESSES IN ENVIRONMENTAL PROTECTION, INSTITUTIONAL AND LEGAL FRAMEWORKS MATTERS



MARIA E. LALOUSI

MN/04010

4th PERIOD OF STUDIES

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Dedicated to my beloved parents…

SUMMARY

Many conflicting and controversial activities take place along the coast, with direct impact on the environment, as well as the sustainable development of these areas. Environmental deterioration caused by the concentration and sheer magnitude of human activities along the coastline, subverts the very essence of important economic activities, which are directly dependent on the sea, by negating their basic requirements. Many countries around the world, encourage the preservation, protection, development and, where possible, restoration or enhancement of valuable natural coastal resources. Planning and establishing such areas, often referred to as marine reserves, sanctuaries or parks, seems to be successful and highly topical, in an era where effective sustainable development policies and tools are sought. Scientific data have shown that, within a reasonably short period (3 – 5 years), restoration of marine life, in areas which became part of this ecological management program, has been unexpectedly successful. The fact that these areas prior to becoming part of a marine reserve, were extremely degraded and could not contribute to the welfare of the local community, leads us to believe that implementation of such coastal zone management options, could bring about positive results. Greece has been extremely slow in introducing the concept of marine reserves. During the past few years, changes in the institutional and legal framework governing marine and coastal environmental protection have begun to take place. These changes address the issues of sustainable development and seem to indicate that a viable national tool can be developed.

This thesis discusses these changes and presents a recently developed management tool, in an effort to contribute to the attempts aimed at resolving the conflicts that arise between human activities along the coastline and environmental sustainability.

Keywords: *marine reserves, marine protected areas, marine sanctuaries, marine ecosystems, sustainable coastal development.*

ΠΕΡΙΛΗΨΗ

Πολλές μη συμβατικές και αντιφατικές δραστηριότητες λαμβάνουν χώρα είτε κατά μήκος των ακτών είτε άμεσα στο θαλάσσιο χώρο, με άμεσο αντίκτυπο στο περιβάλλον, καθώς και στην βιώσιμη ανάπτυξη αυτών των περιοχών. Η περιβαλλοντική υποβάθμιση που προκαλείται από την ανθρώπινη παρέμβαση κατά μήκος των ακτών, υπονομεύει την ύπαρξη πολύ σημαντικών οικονομικών δραστηριοτήτων που εξαρτώνται άμεσα από την θάλασσα, δείχνοντας την αρνητική πλευρά των βασικών απαιτήσεων τους. Πολλές χώρες σε όλο τον κόσμο, ενθαρρύνουν την προσπάθεια για διατήρηση, προστασία, ανάπτυξη, και όπου είναι εφικτό, αποκατάσταση ή εμπλουτισμό των πολύτιμων φυσικών πόρων των ακτών. Ο σχεδιασμός και η εγκαθίδρυση τέτοιων περιοχών, που συχνά αναφέρονται ως θαλάσσιοι οικοδιαχειριζόμενοι βιότοποι, καταφύγια ή πάρκα, φαίνεται να είναι επιτυχής και μεγάλης τοπικής σπουδαιότητας, σε μια εποχή όπου αναζητούνται αποτελεσματικές πολιτικές και εργαλεία για την βιώσιμη ανάπτυξη. Επιστημονικά δεδομένα έχουν δείξει πως, μέσα σε ένα εύλογο χρονικό διάστημα (3-5 χρόνια), η αποκατάσταση της θαλάσσιας ζωής, σε περιοχές που έχουν συμπεριληφθεί σε ένα τέτοιο πρόγραμμα, είναι αναπάντεχα επιτυχής. Το γεγονός ότι, αυτές οι περιοχές προτού γίνουν μέρος ενός θαλάσσιου οικοδιαχειριζόμενου βιότοπου, ήταν εξαιρετικά υποβαθμισμένες και δεν μπορούσαν να συμβάλλουν στην ευημερία της τοπικής κοινωνίας, μας οδηγεί στο συμπέρασμα ότι η εφαρμογή ενός τέτοιου σχεδίου διαχείρισης των ακτογραμμών μπορεί να επιφέρει θετικά αποτελέσματα. Η Ελλάδα είναι εξαιρετικά αργή στο να εισάγει το πλάνο διαχείρισης των θαλάσσιων οικοδιαχειριζόμενων βιοτόπων. Κατά τη διάρκεια των τελευταίων ετών, η αλλαγές στο καθιερωμένο νομικό πλαίσιο που ελέγχει την προστασία των θαλασσών και των ακτών έχει αρχίσει να λαμβάνει χώρα. Αυτές οι αλλαγές απευθύνονται σε θέματα βιώσιμης ανάπτυξης και φαίνεται να υποδεικνύουν ότι ένα βιώσιμο εθνικό εργαλείο μπορεί να αναπτυχθεί.

Αυτή η διπλωματική εργασία παραθέτει αυτές τις αλλαγές και παρουσιάζει αυτό το πρόσφατα ανεπτυγμένο εργαλείο διαχείρισης, σε μια προσπάθεια να συμβάλλει στις προσπάθειες που στοχεύουν να επιλύσουν τις αντιπαραθέσεις που ανέρχονται μεταξύ των ανθρωπίνων δραστηριοτήτων κατά μήκος των ακτών και της περιβαλλοντικής βιωσιμότητας.

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List of Abbreviations

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area, www.accobams.org
CBD	Convention on Biological Diversity, www.biodiv.org
EU	European Union, www.europa.eu.int
GFSM	General Fisheries Commission for the Mediterranean, www.fao.org/fi/body/rfb/GFCM/gfcm_home.htm
IMO	International Maritime Organization, www.imo.org
IUCN	The World Conservation Union, www.iucn.org
MPA	Marine Protected Area
SPAMI	Specially Protected Areas of Mediterranean Importance, listed under the above protocol of the Barcelona Convention
UNCLOS	United Nations Convention on the Law of the Sea, www.un.org/depts/los
WWF	World Wide Fund for Nature, formerly known as the World Wildlife Fund, www.panda.org

1. Introduction

During the last 15 years it has been clearly understood that human activities pose a serious threat to coastal biodiversity and the ability of the seas to support productive fisheries, recreation, water purification and other services that we take for granted. Marine ecosystems around the world are being intensively altered by coastal development, commercial fishing, recreational fishing, pollution, tourism, shipping and a variety of other human activities. This environmental deterioration undermines important economic activities, which are directly dependent on the sea, by devaluing the assets on which development is based.

For this reason, a way had to be found to conserve marine biodiversity, restore dwindling fish stocks, promote sustainable tourism and safeguard ecosystem integrity. A successful management tool has proven to be the characterization of certain coastal seas as marine protected areas, achieving, as will be shown in this thesis, both ecological sustainability as well as local economic benefits. Unfortunately, less than half a percent of the seas lie within marine protected areas, and most of them are under-resourced, poorly managed and offer little protection (20).

During the last decade the development of marine reserves all over the world has proven that such initiatives seem to be successful and highly topical in the era of sustainable development. Scientific data have shown that within a reasonably short period (3 – 5 years) a restoration of marine life, in areas which became part of this ecological management program, is unexpectedly successful. The fact that, these areas prior to becoming part of a marine reserve, were extremely degradated and could not contribute to the welfare of local community, leads us to believe that this management tool, could bring about positive results. There is an urgent need for more reserves in order to adress the developing crisis in our seas.

Marine reserves, as national parks and wilderness areas, are coastal seas where only recreational and research activities are permitted. Marine reserves prohibit destructive activities like dredging and oil exploration, and safeguard marine wildlife by excluding fishing. The result is a more diverse underwater realm, relative to exploited areas, with more large fish and pristine habitat (29). Wherever reserves have been established properly, and have existed for a number of years with full protection, they have proven to be very successful. They have achieved significant conservation goals, like maintaining marine biodiversity and protecting marine habitats, as well as

social and economic benefits. Tourists travel to dive and snorkel in fully protected reserves, attracted by the prospect of seeing marine life at its best. Great effort is being exercised not to exclude people from marine reserves, but to provide greatly needed refuge for marine life with overall advantages to society (20).

The following chapters discuss the basic characteristics and benefits of marine reserves, the management options available, the institutional and legal frameworks to be developed and implemented, in order that marine reserves deliver the results that they are capable of. Some case studies are described and presented and also a suggestion for the creation of a marine reserves network in the Mediterranean Sea. Finally, the needed conclusions and suggestions are cited.

2. Marine Reserves

2.1 Introduction to marine reserves and basic characteristics

2.1.1 Defining marine reserves

There is a bewildering variety of terms and definitions currently in use to denote marine and coastal conservation areas. They include marine protected areas (MPAs), marine reserves, fully protected marine reserves, marine sanctuaries, ocean sanctuaries, ocean wilderness areas, marine parks, underwater parks and no-take zones. Many of them have very different levels of associated protection, and the range of activities allowed or prohibited within their boundaries varies considerably (8).

The functions of these designations have included: enhanced tourism, habitat protection, refuge for intensively fished species, preservation of biodiversity, increased target species productivity, identification of a framework for sustainable use management; and illustration of human impacts on marine environments (1). Marine reserves prohibit extractive activities and keep the area undisturbed. They provide permanent designations, like parks, not temporary closures. When this thesis refers to an area as a marine reserve, it refers to how the area functions in a practical sense, not what it is named or, necessarily, why it was established. Some people also use "ocean wilderness" to refer to marine reserves. Another common term is "marine protected area" or MPA. Like marine reserves, MPAs target a location, not a single activity or species. However, MPA is a blanket term covering all areas with any amount of protection. Marine reserves are one kind of MPA. Because MPA is a general term, it can and does have different meanings in different countries.

The World Conservation Union defines a marine protected area (MPA) as:
"Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical, and cultural features, which have been reserved by law or other affected means to protect part or all of the enclosed environment" (6).

For the purposes of this thesis, marine reserves will simply be defined as "Protected areas in which all extractive activities, including the taking of marine species, and other activities that upset the natural ecological functions of the area are prohibited. While, to the extent feasible, the area shall be open to the public for managed enjoyment and study, the area shall be maintained to the extent practicable in an undisturbed and unpolluted state" (29).

Marine reserves are just one of the many tools for managing the sea. Their strength lies in protecting the biodiversity of a location, rather than trying to address each individual human impact separately. Imagine a series of ocean zones similar to zoning on land. At one end of the zoning spectrum are areas completely off-limits and at the other end is completely open access. In between sit different zones, managed for purposes such as improving recreational and commercial fishing, education, or use by native tribes. Some of these zones would have few restrictions and be heavily used, while others would limit certain activities. Marine reserves or wilderness areas—places that are strictly "look but don't touch"—offer a high level of protection while providing an opportunity for people to visit and explore the sea (29).

By protecting all organisms within an area rather than individual species, marine reserves provide a multi-species approach to management, allowing a reserve to do the work of several single-species regulations. Because of this multi-species aspect, in addition to protecting species that are currently in need of management, marine reserves also provide a pro-active approach to help keep healthy resources from becoming stressed (10).

The need to create Marine Protected Areas is being acknowledged at a national and international level, with fora such as the United Nations World Summit on Sustainable Development stating the need for the creation of marine protected areas, and setting targets and timelines for this (9).

As it was referred before, marine reserves are one tool for managing ocean and coastal ecosystems, but they cannot protect oceans from all human influences. Reserves alone may not address such pervasive problems as pollution and climate change, and they may have fewer direct benefits to some fishes and mammals that move long distances. However, the most recent scientific research shows that marine reserves usually boost the abundance, diversity, and size of marine species living within their borders.

The World Parks Congress recommended that a global system of effectively managed, representative networks of marine protected areas should be developed by 2012. Strictly protected areas would form the basis of this network, with the Congress recommending that at least 20-30% of the world's seas and oceans should be fully protected (9).

2.1.2 Marine reserves as a tool for conservation

Conservation is about protecting the diversity and abundance of life on earth. This means protecting not just single species, but the full variety of species and their habitats, as well as preserving the complex interactions between species that make up an ecosystem. To do so requires an approach that considers all these aspects. Marine reserves, which protect entire areas from a range of human impacts, do just this, which makes them a unique tool for conservation. In addition, an ecosystem approach should be extended to activities outside of marine reserves; for example by considering not just the direct impacts of fishing on a single target species, but on other species that are caught, the impacts on the habitat, and changes to the balance between species.

Marine reserves are primarily a tool for conservation, and despite the additional benefits they bring for fisheries, recreation and other uses of the marine environment their conservation benefits alone are important enough to warrant the creation of a global network. It is unthinkable that on land, an entire region would be utilised for urban development, industry and agriculture, without making a provision for wild spaces to ensure the survival of natural ecosystems. Likewise, this must be the case for the oceans. However when national parks and wilderness areas were being created on land, this was not thought to be necessary in the oceans - their resources were considered unlimited. Certainly in the past there were many natural refuges for marine species provided by areas that were simply inaccessible. However coastal environments and species were already being threatened, and now with the advent of new technology, even the most remote of these refuges have become accessible to exploitation (9).

The world's governments have recognised the importance of leaving a healthy and viable world to future generations and maintaining its ecological basis. Under the Convention on Biological Diversity, countries are committed to stemming the loss of biodiversity and to establishing a comprehensive, effectively managed and ecologically representative network of national and regional protected areas, including areas where extractive uses are excluded. In the marine environment, this means a commitment to establish a global network of marine reserves.

The establishment of marine reserves has been shown to result in long-lasting and often rapid increases in the abundance, diversity and productivity of marine organisms. While the benefits of protection are more apparent for species that spend

much or all of their time within a marine reserve, reserves can also offer protection to migratory species if they are protected at vulnerable stages, such as spawning and nursery grounds (9).

In order to protect the whole spectrum of marine biodiversity it is vital that all major habitats should be represented within a regional network. Scientists have developed useful criteria to help identify priority areas of the marine environment that should be protected to achieve the greatest effects (21). These are:

- Sites that include vulnerable habitats e.g. seamounts
- Sites that contain vulnerable life history stages e.g. fish spawning and nursery grounds
- Sites that are capable of supporting exploited species or rare species
- Sites that provide ecological services

Marine reserves can also restore the ecosystem balance lost through human activities. For example fishing target species can upset the balance of predator/prey relationships, and result in habitat change. As these changes can occur over a long period of fishing at unsustainable levels, the altered habitat is sometimes not recognised as un-natural, and not until marine reserve is declared and larger fish return and restore balance. For example a marine reserve created in an area with over fifty percent bare rock grazed by sea urchins was restored to seaweed beds once populations of large fish and crayfish (predators of the sea urchins) recovered (9).

2.1.3 Marine reserves as a tool for fisheries management

Marine reserves are by definition closed to fisheries but the establishment of a network of marine reserves can benefit fisheries in a number of ways. Marine reserves enable exploited populations to recover and habitats modified by fishing to regenerate. As unexploited areas, marine reserves act as valuable reference areas that can be used to help understand the effects of fishing outside and inform management decisions, so underpinning the ecosystem approach.

In addition, there is a growing body of evidence to suggest that the establishment of a network of marine reserves can lead to enhanced yields in adjacent fishing grounds. This can be the result of either the spillover of adults and juveniles across reserve boundaries or from the export of larvae or eggs from reserves to fished areas (9).

One of the major problems with fish stocks that have been depleted by overfishing is that there are very few large fish remaining in the population. Large females are essential, because they produce many eggs of better quality. Generally when a female doubles in length, she produces eight times more eggs (20). These eggs show a higher level of fertilisation and better survival rates. So, a few large mature females may contribute far more to reproduction than a large number of first-time spawning females. In marine reserves some female fish will over time grow large and make very significant contributions to the eggs and larvae that may be exported out of the reserve.

Marine reserves can be sited to protect specific areas that are important to key life stages of targeted species such as spawning and nursery grounds, migration routes and feeding grounds.

Marine reserves can help provide a more predictable catch from year to year, hence enhancing fisheries stability. They also serve as a form of insurance against uncertainty and reduce the probability of overfishing and fishery collapse.

2.1.4 Size and scaling of marine reserves

Greenpeace, concerning the size of marine reserves, has given the below definitions:

Large-scale marine reserves are areas that are closed to all extractive uses, such as fishing and mining, as well as to disposal activities. Within these areas there may be core zones where no human activities are allowed, for instance areas that act as scientific reference areas or areas where there are particularly sensitive habitats or species.

Some areas within the coastal zone may be opened to small-scale, non-destructive fisheries, provided that these are sustainable, within ecological limits, and have been decided upon with the full participation of affected local communities (8).

Reserve size affects the level of protection for ecosystems. Decisions about the size and number of marine reserves for a given place often depend on local environmental, socioeconomic, and regulatory factors. However, several general ecological concepts based on scientific studies can help guide these decisions on reserve size and location.

Even small marine reserves can have positive effects on the abundance, size, diversity, and biomass of animals and plants within their boundaries. However, large reserves include more and larger habitats, more species, and a greater number of individuals of each species. Thus, large reserves protect more of the local ecosystem. In addition, larger populations are less likely to be wiped out by catastrophic events such as big storms and oil spills.

To receive full protection from fishing, a particular animal or plant must be able to complete all vulnerable stages of its life cycle inside a reserve. A large reserve or several reserves, located in critical habitats, may be necessary to protect populations of animals that move long distances. A few species complete their life cycles in very small areas (less than 1 square mile) and smaller reserves can protect such species. In many cases, however, scientists do not know how far species actually move during their lives. One strategy to protect these species is to set aside a portion of all habitats that are necessary for the species to complete its life cycle. As the reserve size increases, the number of different kinds of species protected also increases. Large reserves that encompass and protect many different kinds of habitats are most effective for conservation, but large reserves also may concentrate fishing into small areas (18).

Despite the above facts, since most reserves are small, it is difficult to determine the effect of size on reserve performance. However, as more reserves of different sizes have become established, answers are at last beginning to emerge. In Halpern's (2003) recent review of reserve performance, he found that abundance, biomass, size and diversity of organisms increased in almost every case. Interestingly, the magnitude of these effects was independent of reserve size. In other words if the biomass of fish were to double as a result of protection it would double in a small reserve and double in a large reserve. From this it might seem that size does not matter. However, in order for small reserves to provide as great an overall benefit (i.e. combined benefits aggregated across reserves) as large there would need to be more of them.

The bigger an area protected, the more species it will contain and the more likely their populations are to survive periodic disturbances. In small reserves, disturbances might wipe out entire protected populations. Additionally, species whose populations naturally fluctuate widely, need larger protected areas than those that fluctuate less. This is because their persistence depends upon regular recolonization of

habitat patches from which they have disappeared. Larger protected areas make it more likely that such sources will exist. For these reasons, conservationists generally want reserves to be large not small. However, for any given total area to be protected, several small reserves may prove more beneficial than a single large one. Large reserves tend to cause more disruption to existing human activities, like fishing. Consequently, from a fishery perspective it would be better to have a network of smaller reserves rather than a single large area. Such a network would probably create less opposition. It would also spread the benefits from spillover and export of offspring over a management area rather than concentrating them in one place. The rates of spillover and export would also be greater from small reserves than large due to their greater edge to area ratios. However, it is important not to go too small with reserves, since if they are too leaky fish stocks will not build up (20).

The following factors, and their associated implications for scaling, will all need to be taken into account when determining the appropriate size of marine reserves and of marine reserve networks:

• physical regime (currents, geomorphology, climate)

• variation of habitats/geo-structure (compare coral reefs to estuaries to deep sea mounts to the open ocean)

• size of ecosystems (mangroves, coral reefs, sea mounts, etc can be quite small, while open ocean systems are huge)

• life history strategy of species (territory size, migration)

• geographic units (countries, islands, EEZs: the Great Barrier Reef forms a single MPA, while many of the islands in the Caribbean are separate states)

• variation in human influence (e.g. a sewage pipe, river outflow and pollution through the air) and

• variation in human use (e.g. small-scale local fisheries compared to large industrial trawlers) (8).

2.1.5 Marine reserves networks

By themselves, small reserves do not tend to support fish and invertebrate populations that are large enough to sustain themselves. To ensure that young are available to replenish and sustain populations within reserves, the area protected within reserves must be fairly large. However, in some regions, economic constraints may make it impractical to create a single large reserve that can support viable

populations. Establishing networks of several smaller reserves can help reduce economic impacts without compromising conservation and fisheries benefits.

A network includes several reserves of different sizes, located in critical habitats, and interconnected by movement of animals and plant propagules. A network can contain critical components of a particular habitat type, or portions of different kinds of important habitats, depending on the goals for the network. To be an effective network, animals and plant propagules must be able to travel beyond the boundaries of a single reserve into other reserves. To facilitate this movement, a network should be designed within a naturally defined ecosystem, such as a bay, gulf, sound, or biogeographic region.

By using different sizes and spacing of reserves, a network can protect species with different characteristics. For example, a network of reserves may include feeding habitats in open waters and breeding and nursery grounds in shallow bays. If marine reserves protect these critical habitats, the resident animals are likely to grow larger and have greater reproductive success (18).

Some experts have stressed the importance of making the reserves in a network of different sizes. Marine reserves should typically increase in size moving from nearshore to offshore. Small reserves will be harder to identify in offshore areas, harder for fishers to comply with, and thus harder to enforce. Also, as a rule of thumb, protected areas will need to be larger in offshore regions because scales of animal movements tend to be larger offshore.

Building a network of smaller marine reserves in the coastal zone will have the advantage of spreading fishery benefits to fishing communities along the coast rather than concentrating them round a few large marine reserves with some communities losing their fishing grounds altogether. Greenpeace is campaining for a global network ot marine reserves covering 40% of world's oceans, in order to have clean and healthy oceans and seas (9).

2.1.6 Can artificial reefs be used as marine reserves?

The possibility of using artificial reefs as marine reserves has been used in many countries and has proven to enhance diving and tourism since these reefs can accomplish rich underwater environments. Artificial reefs are usually deployed in areas where traditional and commercial fishing has declined, due to diminished fish stock, and thus poses no serious treat to local inhabitants that exploited the coastal

sea. No-take artificial reefs also can potentially increase public understanding and appreciation of marine ecosystems and their management. Recent studies have shown that in order for artificial reefs to increase total fishery yields, large areas would have to be used thus increasing total costs and local inhabitant's resentment. Artificial reefs are used, however, to mitigate areas lost to fishing by creating marine reserves. A limitation of artificial reefs is that they are not effective for all ecosystems and can only benefit benthic and reef dweling species, but if associated to a marine reserve the benefit to a wider range of species and habitats is obvious. It must be stressed that these management tools can not substitute other forms of management nor solve regional problems of pollution and coastal development, and thus a comprehensive marine ecosystem-based management tool has to be developed in order to achieve sustainable fishing stocks, ecosystem protection, and provide a basis for viable human activities along the coast.

In Greece, pilot studies on artificial reefs have been initiated by the F.R.I (Fisheries Research Institute) and the H.C.M.R. (Hellenic Centre for Marine Research). The exact title of the project is : "Construction of artificial reefs and the creation of protected zones in the whole area from the bay of Vistonida to the cape of Maronia, northern Greece. " Its aim is to evaluate the abundance of species in the broader area, the specification of the seasonal gatherings of species and generally the alteration on the bio-society after the creation of the reef. Scientific data on the environmental effects of these interventions has shown that the total amount of biomass of all the thirteen trading fish species, between the years 2001-2002 increased by 218% during the last year (http://www.fishri.gr).

2.1.7 Scientific criteria for reserve design

The question now arises as to what scientific criteria can be used to evaluate different areas in order to develop potential marine reserves. Many studies have already developed chart lists that define important criteria, and explain how and why they should be applied in marine reserve design. It is important to note that all approaches stress that the all the criteria should be considered when designing a marine reserve, otherwise ecosystem protection may be hindered. Table 2-1 presents some of the very basic criteria that most researchers use in their studies.

Table 2-1: Scientific criteria for the establishment and further application of a marine reserve (adapted from *PISCO 2002*)

Scientific Criteria	Benefit
Biogeography of different regions which are characterized by particular sets of habitats, environmental conditions, and species	Protection of biological communities associated with each region.
Habitats such as estuaries, rocky shores, kelp forests, sandy bottoms etc	Protection of plants and animals in these habitats to complete their life cycles.
Vulnerable habitats which are rare or threatened or susceptible to stresses	Marine reserves integrated into other environmental protection programs (NATURA 2000 etc.).
Vulnerable life stages such as breeding, juvenile growth and migration periods	Increase abundance, size, and population growth rates of specific species that may also have economic and recreational value.
Land and marine area covered - reserve size	Depending on size and network complexity, different protection goals can be achieved.
Ecosystem interaction including exchange of nutrients, flora and fauna	Serious and painstaking research to identify important linkages among ecosystems can help locate potential reserve sites.
Marine reserve networks that link habitats	A network of marine reserves protects critical habitats used in different stages of fauna and flora life cycles.
Human activities and threats (pollution and habitat loss) that endanger an ecosystem	A register of sites affected by human activities, as well as an aspects register of activities and services that produce environmental pressures on the area of interest.
Natural disasters such as large storms, harmful algae blooms, disease epidemics, and climate changes	The establishment of multiple reserves in different locations reduces the risk from natural disasters.
Social and economic criteria expressed by community members and stakeholders	Maximize social and economic benefits by incorporating the local community in marine reserve design and operation.

2.1.8 Potential benefits of marine reserves

Marine reserves work on many different levels of biological organization, affecting individual animals and plants, populations, communities, and ecosystems.They offer many potential benefits which include: protecting ecosystem functions, improving recreational and educational opportunities, improving fishery yields, and increasing knowledge and understanding of marine ecosystems.

I. Protect Ecosystem Structure, Function, and Integrity (26)

- Protects physical structure of habitat

- Protects ecological processes
- Restores population structure of fisheries (size and age)
- Restores community composition (presence and abundance of plant and animal species)
- Protects biodiversity at all levels
- Protects important species
- Protects vulnerable species
- Protects threshold effects
- Protects food web and trophic structure
- Reduces incidental damage
- Facilitates ecosystem recovery after major human or natural disturbances.

II. Improve Support to Human / Economic Systems (26)

- Reduces fishing gear impacts
- Maintains high quality feeding areas for fish and wildlife
- Improves non-consumptive opportunities, especially recreation
- Enhances and diversifies economic activities
- Enhances and diversifies social activities
- Enhances aesthetic and spiritual experiences
- Improves wildlife opportunities
- Provides opportunities for education
- Increases sustainable employment opportunities
- Creates public awareness about environment
- Reduces the impacts from irresponsible development activities
- Encourages holistic approach to natural resources management
- Stabilizes the local economy

III. Improve Fishery Yields (26)

- Protects spawning fish stocks
- Increases spawning stock biomass
- Provides undisturbed spawning conditions, habitats, sites
- Increase egg and larval production
- Enhances recruitment
- Provides spill-over of adults and juveniles to areas outside reserves

- Reduces chances of recruitment overfishing
- Reduces overfishing of vulnerable species
- Protects diversity of fishing opportunities
- Enhances recovery from stock collapses and management failures
- Reduces bycatch fishing mortality
- Simplifies enforcement and compliance
- Reduces conflicts among users
- Maintains sport trophy fisheries
- Reduces variance of yield
- Allows increased fish outside reserves
- Facilitates stakeholder involvement in management
- Provides fishery management data to improve fisheries
- Increases understanding and acceptance of fishery management
- Reduces impacts of environmental viability
- Provides some protection with limited resources and without data or information.

IV. Increase Knowledge and Understanding of Marine Ecosystems (26)

- Provides long-term monitoring sites
- Provides focus for study
- Provides continuity of knowledge
- Provides opportunity to restore or maintain natural behaviors
- Reduces risks to long-term experiments
- Provides experimental sites needing natural areas
- Provides controlled natural areas for assesing anthropogenic impacts, including fishing and other impacts
- Provides sites for enhanced primary and adult education
- Provides sites for high-level education

Marine reserves produce this unique combination of benefits because they limit where fishing, drilling for oil or gas, and other extractive activities can occur, rather than how much or when those activities occur. Moreover, they prohibit other activities such as dumping, which can pollute or destroy habitat. By eliminating extractive and other destructive activities in particular locations, reserves can protect significant portions of entire ecosystems at once. Traditional approaches tend to focus

on single species independent of other elements of the ecosystem. The most effective protection for even a single species requires an ecosystem approach, because every species interacts with numerous other species and the environment (18).

Reserves can protect habitat and produce dramatic increases in populations living inside their borders, offering insurance against local extinctions and declines. Marine reserves also may affect areas beyond their borders by supplying larvae, juveniles, and adults to adjacent waters.

Non-extractive uses of the sea can also benefit from marine reserves. Activities such as diving, snorkelling, underwater photography and whale watching all benefit from diverse and abundant marine life. Such activities can provide alternative economic opportunities for coastal communities, and do not come at the expense of the marine environment, but these matters will be referred analytically in a following chapter where the tourism sector will be analysed. The positive impacts of marine reserves could also include appreciable economic benefits, although few systematic studies have been carried out. Increases in fish populations could be a key economic advantage, but further studies are needed (9)

2.2 Education and research

Monitoring the biodiversity of marine ecosystems that are protected against extractive activities has great educational value and provides an opportunity for local communities to gain ownership of marine reserves in their area. From schools to universities and research institutions, marine reserves provide a venue for research and discovery.

Public education is usually organized around on-site interpretive programmes in the protected areas. Such programmes may take the form of guided or self-guided trails, for example: boardwalks through coastal wetlands, underwater trails like those through the reefs at Buck Island National Monument in the U.S. Virgin Islands, and underwater viewing chambers like those found at Green Island on the Great Barrier Reef (Australia) and in several marine parks in Japan. Off-site interpretive programmes involve publications, lectures, and film or slide shows provided at visitor centres, schools, and other institutions, or through television (23).

Field trips to marine protected areas and research stations by school and university students exemplify their use for formal training. Natural areas can serve as

"outdoor laboratories", providing living examples of ecological principles taught in class.

Marine protected areas offer opportunities for academic research (e.g., on specific behavioural or physiological subjects), applied research (on resource management needs and the biomedical applications of reef biocompounds), and monitoring of specific events (e.g., coral bleaching, crown-of-thorns outbreaks) or long term trends (such as the impact of silt linked to land fill and dredging on corals of the Ste. Anne Marine National Park in Seychelles), or the recovery of corals following control of blast fishing as in Komodo National Park, Indonesia. The particular advantage of protected areas for research is that they enable long-term continuing studies of the same group of organisms or of the same plot of habitat without the disturbance of inquisitive visitors, poachers, or vandals.

Marine reserves provide a benchmark or baseline, showing what the sea is supposed to be like. This can have scientific benefits - providing the necessary "control" with which to compare the effect of fishing and other activities outside of marine reserves. It can also help to prevent the effect of "shifting baselines" whereby the concept of what is natural gradually changes over years and between generations as the environment is degraded (23).

2.3 Recreation and tourism

Scuba diving, snorkelling, swimming, fishing, beach walking, surfing, and sunbathing bring tourists to small island nations that have attractive shorelands. For example, the natural beauty, coral sand beaches, reefs, and rich natural history of the Seychelles Islands and Mauritius are these countries' major attractions for European tourists. Each year millions of North Americans and Europeans visit Caribbean and Pacific islands, Mediterranean coasts, and Florida's beaches to relax in the sun at the water's edge, dive over wrecks and reefs, sail and water ski, fish, and feast on seafood. Bali's reef protected beaches draw hundreds of thousands of tourists (23).

Tourism is a major industry in these places, bringing to the countries scarce jobs, revenue, and foreign exchange. The creation of protected areas should thus be considered in national planning for tourism development in coastal countries. Marine parks not only arouse interest but also may help to maintain the quality of the recreational resources that attract tourists.

Where there is tourism in marine reserves, it is useful to set aside special tourism zones for swimming, snorkelling, and other water sports. This will encourage tourists and minimize conflicts with other uses, such as fishing. Also it can separate conflicting tourism uses such as between speedboats and swimmers.

The great interest of people for marine reserves leads to the development of tourism offering prosperity to the local communities. Fishers are offered an alternative way of life, easier and safer. Instead of fishing they can use their boats as water taxis. They take people out to the sea where they can engage to different activities such as diving, bird watching, visiting places of interest always depending on the area. This is though only one side of the local development. Reserves are popular destinations for tourists and the community can also be benefited by job opportunities in hotels, restaurants and of course the diving industry. Consequently unemployment is reduced and economy flourishes (23).

Despite the many advantages of tourism in marine reserves there are also certain drawbacks. Tourist activity can also damage the environment especially the most susceptible such as the coral reefs. The construction of hotels is part of the problem since the sediment kills corals. Boats can also cause great damage because anchoring may destroy a reef. In addition to these, divers themselves may do serious damage. In many cases they are breaking corals while snorkeling. The result of this destruction is not only the fact that in a short time the reef is not attractive but that there is also a spread of coral diseases leading to possible infections (20).

Many of these problems though can find solutions easily. Adopting better building practices, educating tourists and using mooring buoys to prevent damage caused by anchors are some of these solutions. Another aspect that requires great concern is the number of people visiting reserves. It is only logical that being popular, especially to divers such places may become overcrowded. However the problem of high densities of visitors is not one-sided. As well as threatening the habitat, the congregation of boats and divers in one area may result to conditions dangerous for them too. The Hol Chan Marine Reserve in Belize is an example of such problems since the corals have been damaged due to the large amounts of divers. It is therefore of extreme importance that the number of visitors does not exceed the capacity of the environment.

The possible damage caused by tourists, shows that it is essential for agencies creating reserves to cooperate. Prohibiting fishing is only one part of creating a

balanced environment. After the creation of reserves other needs such as building up of fish stocks and habitat recovery will arise asking for a more careful management and a closer cooperation among those responsible for marine reserves.

Even though there are some problems caused by tourism there are many who believe that the benefits are greater than the defects. It has been shown that the elimination of these problems can be achieved by careful management leading to a better protected environment. Thus we can say that the development of tourism is one of the most important assets of marine reserves.

2.4 Social and Economic Impacts

There is a growing need to justify protected areas economically; that is, to show that an area's monetary benefits can exceed its monetary costs. This is a difficult task. It is always easier to describe the values of protected areas than to quantify them. For example, we can say that a particular coastal or marine protected area is a source of inspiration, spiritual enrichment, and recreation and enjoyment or that it serves as a nurturing place for commercial species, a sanctuary for endangered species, and a protector of migrating species. All these are the heritage of both a nation and the world regardless of economic costs and benefits (23).

However, it is very difficult to put monetary values on such inspirational, natural, and cultural heritage benefits, or on those of national pride and international obligation. Nevertheless, there is an increasing demand to counter mariculture proposals or development schemes that promise large financial returns with solid arguments based on valuations of the social and economic benefits of natural production and the costs of degraded systems. These arguments should include the benefits of marine protected areas and demonstrate that they can be self-financing, especially in the developing world.

Some of the values can be easily measured as "marketplace transactions"; that is, people pay specific amounts of money for specific benefits. In an economic analysis, the costs of providing the benefits are subtracted from what people have paid to obtain them (a cost-benefit analysis). Other economic benefits are more difficult to express in monetary terms, e.g., the additional food provided for a village by protecting and managing a coastal area. Economists can create simulated measures (e.g., "shadow prices" or "willingness to pay") to judge such benefits in monetary

terms. But there are many types of benefits that cannot, and should not, be measured in conventional monetary terms. These include most ethically based values like protecting endangered species and conserving communities' "way of life" (23).

A review of some recent methods of economic valuation, with specific references for marine biodiversity, coral reefs, and mangrove valuations, is given in Chapter 3. A warning of the numerous pitfalls of such valuations, also given, should be taken seriously. A comprehensive economic valuation of protected area benefits should not be undertaken lightly, and should be done by competent specialists according to the most recent techniques.

3. Management Bodies and Economics of Marine Reserves

3.1 Who should manage marine reserves?

There are several schools of thought concerning who is ultimately responsible for natural resource management. Governmental institutions have, in many countries, been responsible with differing levels of success. Although governments often take this view, they can be very ineffective in this role. There are three root causes for their failure. Firstly, government bureaucracies often think that protection is achieved once a reserve has been legally declared. They fail to appreciate that legislation must be backed up by significant resources to establish and patrol a reserve in the field, and to support and educate users. Without this back up, reserves are nothing more than paper parks. Secondly, governments are too distant from local users. Governmental control often becomes polarized into an issue of 'them' against 'us' no matter how closely allied environmental and community goals may be. Finally, control from "above" has proved to be open to corruption and inefficiency in spotting and handling violations (20).

Community-based management has been exercised in many situations, as an alternative to governmental control. It is obvious that this management option has many strengths, since when reserves have the support of local users the best way to monitor the area is when the by local community undertakes and coordinates the efforts. For example, no-fishing regulations are maintained by education and peer pressure in the Edmonds Underwater Park in Washington State, USA. Community initiatives can be very useful for building broad local support for environmental management options as well as provide an effective way to return benefits arising from the reserve to the local community.

The disadvantages associated with community-based management refer to the fact that in order to be effective it requires a strong sense of community and also supported by strong institutions with the authority to enforce the law and punish those who disregard regulations. Problems can also arise if reserve management is too dependent on volunteers, since it depends heavily on the support and enthusiasm of people that have loose links to the management authority. Finally, it seems that an integrated system which involves a strong community involvement but also backed by legal instruments that can ensure environmental protection, is an effective way to manage such areas. Such combined management arrangements are also greatly

strengthened with the establishment of non-governmental, but government supported, bodies (20).

In the Dutch Antilles, in the Caribbean, non-governmental organizations (NGOs) have been set up to manage marine parks. NGOs are supported by the government, but are able to pursue their resource management goals without being dependent on party politics and central government, since they also receive financial support from users and other organizations, such as the Saba Marine Park which encircles the entire island of Saba in the eastern Caribbean. NGOs are highly effective in devoting much time and effort to public education, and can be funded equally from private and public sources. In the other hand the Medes Islands Marine Reserve is managed by the government of Catalonia via the Department of the Environment and Housing.

Greece has little experience in the management of protected areas (except Alonissos and Zakynthos, where two National Marine Parks have been established). Recently, steps have been taken to solve such problems by introducing Law 3044/2002 which establishes directly the management authorities of the top 25 most important protected areas in our country (3). It is hoped that this law will help to create a framework within which a sustainable management plan can be created and implemented to marine protected areas.

3.2 Economic innovations

Traditionally, marine conservation has been based on ecological concerns and goals. But, as the human pressures on marine and coastal ecosystems have intensified, so economic approaches have come to play an increasingly important role in the establishment and operation of MPAs. In particular, it is now recognized that questions of financial viability and economic sustainability are of central importance to the success of marine protected areas. This chapter describes some of the innovations which have taken place over the last decade in the application of economic tools and measures to marine management problems, especially their use to justify the existence of protected areas, to guard against marine degradation and loss, and to raise the funds necessary to conserve the marine environment.

3.2.1 Valuation: a means of justifying the existence of marine protected areas

It has become increasingly difficult to justify the existence of marine protected areas on biological and ecological grounds alone. Coastal communities need to earn a living, marine-based industries need raw materials and other infrastructure, and governments need to generate income, employment and foreign exchange, as well as to win votes. The needs of these producers and consumers often provide powerful arguments—and form influential lobby groups—against the reservation of land and sea areas, or against the protection of marine resources against exploitation. Approval for the establishment of MPAs does not depend just on the decisions of conservationists or environmental protection agencies. It has become apparent that they must also be acceptable to other political and economic interests, and have the potential to compete against the development imperatives that apply to most coastal and marine areas (23).

In order to be politically and economically acceptable marine protected areas must be able to demonstrate themselves to be a worthwhile use of funds and natural resources, as entities in themselves as well as in comparison to any opportunities for exploitation, production or consumption that their establishment precludes (in economic terms, this is known as their "opportunity cost"). MPAs must be seen as financially and economically attractive options to other government sectors, to private companies and to the human populations who live in coastal and marine areas. The need to justify MPAs in social, economic and developmental terms has become almost universal. It is however particularly intense in developing countries, where coast-dwelling communities typically have few sources of income and subsistence aside from the exploitation of marine resources and where government budgets are particularly low.

Economic valuation has proved to be an extremely useful tool in providing this broader justification for the establishment of MPAs. Just as conservationists have been slow to see the importance of taking economic factors into account in marine management, so economists have, conventionally, had a very blinkered view of the value of marine resources. Slowly this view has been broadened, and applied to marine management problems. Traditionally, economic valuation of marine ecosystems has focused almost entirely on commercial fisheries and tourism which can easily be measured in monetary terms. Although these sources of income still play an important role in economic valuation, it is now increasingly recognized that marine

economic benefits extend far beyond these direct values. Looking at fisheries and tourism alone hugely underestimates the economic importance of marine and coastal ecosystems (23).

Economic views of marine areas have gradually come to rely on a much broader definition of benefits and productivity—that of total economic value. Total economic value includes, as well as the direct use of marine products and areas for income and subsistence (for example through fisheries, tourism, and the exploitation of other resources such as shells and corals), the "indirect economic values" associated with marine ecosystem services (such as coastal protection, storm control, carbon sequestration and the provision of breeding grounds and habitat for fish, bird and mammal species), their "option value" (the premium placed on maintaining coastal and marine ecosystems and their component species for possible future uses and developments) and their "existence values" (their intrinsic value, irrespective of use, including cultural, aesthetic, scientific, bequest and heritage significance).

As perceptions of the economic value of marine ecosystems have moved forward, so have a range of new methods been developed to quantify these economic benefits and express them as monetary values. In turn, these values have provided an extremely convincing—and much needed—way of demonstrating the desirability of marine reserves in social, economic and development terms. Economic valuation highlights that marine protected areas are much more than a static biological or ecological pool of resources, but should rather be seen as stocks of natural capital which if properly managed can yield a wide range of economic benefits to human populations—often to a value which is far higher than the income accruing from unsustainable exploitation and development.

3.2.2 Economic instruments and incentives: guarding against marine degradation

The preceding paragraphs have described the important role that economic valuation plays in justifying actions to conserve marine and coastal environments. However, even if conservation is broadly justifiable to government policy-makers and decision-makers, the establishment of marine reserves often does not make economic sense to the people whose activities have the potential to impact negatively on the integrity of marine and coastal ecosystems. Although marine degradation incurs high social and economic costs, it may still be economically desirable to individual producers and consumers. It is frequently more profitable for people to degrade

marine ecosystems than to conserve them, because they feel no private cost—and may even be able to generate higher profits—from doing so. Fishermen, the harvesters of mangrove poles, shells, corals, seabirds and other resources, the people who wish to develop marine and coastal areas for tourism, settlement, industry and mariculture, as well as all the ultimate consumers of marine products, often continue to contribute to marine degradation through their economic activities. Even the very people who are attracted by MPAs, most notably tour operators and their clients, may contribute to marine degradation (23).

All too often the need to make marine protected areas economically desirable, or to make marine degradation economically non-viable to these other groups has been ignored. Although many countries have a complex body of laws relating to fisheries, resource utilization and to the implementation of developments in marine and coastal zones, without supportive economic measures these prohibitions are difficult to enforce. The legal establishment of MPAs, and restrictions on the utilization of marine resources, is frequently seen as an end in itself, rather than as a means to an end, to the detriment of marine conservation. By themselves command and control measures are often ineffective in ensuring that marine protected areas stay protected because they provide no positive encouragement or inducement, and are often difficult and costly to enforce. It is increasingly being realized that people are far more likely to conserve marine resources if it is more profitable, or economically desirable, for them to do so, or if a personal cost accrues to them from degrading the marine environment.

Here again economics plays an important role in marine reserves management. Unless there is a clear benefit, or a clearly enforced financial penalty against doing so, there is no reason why people should limit profitable production and consumption activities that harm MPAs. It simply does not make economic sense to do so. Setting in place economic incentives for conservation forms an important strategy for marine protected area management. Incentives can be defined as specific inducements designed and implemented to influence government bodies, business, non-governmental organizations, or local people to conserve marine ecosystems or to use their components in a sustainable manner. This involves not only setting in place positive economic incentives, or rewards, for marine conservation, but also overcoming the disincentives and perverse incentives which encourage people to degrade the marine environment. These disincentives and perverse incentives

typically result from much broader social and economic forces which cause marine resources to be undervalued, over-consumed and under-conserved—for example subsidies and concessions made to industrial development on coastal strips, the promotion of commercial fisheries or mariculture development, or tax breaks provided for the development of export fisheries (23).

3.3 Marine reserves' financing

Proving the total economic value of marine ecosystems and setting in place economic incentives for marine conservation, although necessary, do not usually by themselves provide sufficient conditions to ensure that marine protected areas are practically viable, or can be sustained over the long-term. Showing that marine protected areas benefit the wider economy and society, or can be made to be profitable to individual producers and consumers, is not the same thing as capturing these benefits as real cash values. The establishment and maintenance of marine reserves incurs tangible cash expenditures, as well as giving rise to more intangible opportunity costs in terms of resource uses and productive opportunities foregone or diminished. Making sufficient funds available to cover these costs is a major issue in marine reserve management.

Ensuring the necessary funding is indisputably an important step towards the stability and the achievement of the goals of a marine reserve. Thus it should be carefully planned throughout the three basic steps involved in the process of establishing and running a marine reserve. On a first level there are many consultations and discussions for reserves. This initial stage is relatively inexpensive although the cost may vary depending on the local situation. Secondly there are the start-up costs. This is the most expensive stage of the process. During this period meetings are organized, visits on the sites are made and people are hired. The third stage concerns the running costs. Although these are lower, they prove to be the hardest to find. It is this final stage that determines whether a reserve can function properly or not.

The objectives of reserves are those defining the sources of start-up funds. A first idea is that since in many cases reserves are intended as fishery management tools they should depend on those government departments responsible for fisheries. However there are many problems resulting. Not only are those departments

underfunded but also highly inappropriate to manage reserves on the basis that they lack both the experience and the willingness to undertake such a duty. So it's obvious, that the options for funding shouldn't be so narrow and that other sources should be pursued. There are plenty conservation organizations or philanthropists always ready to offer their help and support. However even with their valuable, the initial stage is always a period of hard work. The establishment of a protected area requires a lot of effort and devotion. Many problems may arise and these won't be only economical. There are many examples of marines where people started full of enthusiasm but were discouraged by difficulties. Experience has shown that the long term success of most marine reserves are a result of years of straggle and commitment.

Despite the tremendous help offered by conservation organizations it is evident that reserves cannot base their funding on them. As time goes by marine habitats should find ways to ensure financing sources. A very interesting example are the parks in Caribbean which are the first self funding reserves in the world. Their funds are mainly based on fees from scuba divers, snorkelers and yachts and are supplemented by sales of souvenirs. As presented by the example of parks in the Caribbean's tourists can be an excellent source of income for marine reserves. Surveys have shown that with scuba divers in particular are people who have large incomes and are always in search of high quality diving destinations.

There are information from the American UGO Coral Reef Alliance that show that people visiting reserves and especially divers are willing to pay for the protection of marine habitats. Surveys show that in most cases scuba divers pay $20 -30 per trip. This makes clear that tourists can be a significant source of income for marine reserves. However promising this may sound, most tourist operators insist on maintaining low prices for fear of undermining their competitive edge. Of course this is obviously short – sighted. It shows a complete disregard for the fact that this extra money can be used for more effective recourse protection, thus improving the environment and making the resourse a favorite destination for a larger amount of visitors.

An important factor closely associated with people's willingness to pay for the protection of reserves is where this money would go. In most cases people appear to be reluctant to trust government when they are involved with money management. Thus the creation of an independent body seems to be a logical solution.

Environmental trust funds is a very useful idea for funding protected areas, which has found successful application in Egypt's South Sinai. These trust funds can be in different forms such as donations, loans from organizations and taxation. In Egypt an "Environmental Cost Recovery Charge" has been introduced on all visitors, levied by hotels for every night they stay and collected by the Environmental Affairs Agency directly. The advantage of these funds is not restricted to the fact that they add another source of money. What is more important is that they become an instrument used for the protection of the general region and not only for those areas which attract tourists' interest (23).

However important tourism may be, not all types of reserves can base their financial support on it. There are many cases in which reserves have to rely either partly or even heavily on government sources. It's also natural that governments share responsibility for the right organization and the funding of reserves especially when such an action contributes to their commitments to conserve biodiversity. A typical example of such reserves are the offshore reserves which cannot support themselves and turn to the government for additional funding.

Thorough search and experience have provided many evidence that the financing mechanisms supporting a reserve are essential for its ultimate success and therefore have to be carefully considered and planned. Although commonly and optimistically assumed that a combination of central government subventions, donor grants and loans and tourist revenues will provide adequate funds to cover the costs of running marine protected areas, this is mistaken. This is rarely the case. Just as many of the economic benefits associated with marine protected areas have traditionally been underestimated and underemphasized, so have many more of the more imaginative and sustainable ways of raising finance also been ignored.

Over recent years a wide range of more innovative financing mechanisms have started to be used to raise funds for marine conservation. These are mainly based on capturing as real income some of the economic values associated with the consumption of marine goods and services. Although many groups and individuals benefit from marine goods and services, for which they would be both willing and able to pay, mechanisms do not exist by which they can be charged for their consumption, or can invest in the provision of marine goods and services (23).

4. Institutional and Legal Framework

Modern protected areas were first established on land. Institutional and legal frameworks originally were formulated to suit these land areas, first for national parks and then for other types of protected areas. In many instances the same approaches were applied to coastal and marine environments, with varying success, and did not necessarily account for the particular aspects of marine resources. Among these characteristics, it is identified the fact that marine systems: are not as well understood as terrestrial ones; have nebulous boundaries; exhibit wider geographical and spatial scales in which environmentally induced changes are common and almost immediate; are driven by largely changeable and unpredictable processes; have largely unstructured food webs; are characterized by varying degrees of linkage between communities of organisms in the water column and those of the benthos; and are generally more non-linear than terrestrial systems. All these differences point to the necessity ultimately of designing protected areas in marine and coastal systems differently than terrestrial protected areas.

4.1 The legal basis of coastal and marine protection

The establishment of a marine protected area more often than not requires the drafting and adoption of appropriate supportive legislation. Marine area protection has sometimes been accomplished through existing legislation that regulated other uses; for example, programmes for marine fisheries, forestry (of mangroves), and land use (of barrier islands and salt marshes). Yet, experience has shown that laws established specifically for land areas do not usually address the specific characteristics of marine and coastal environments, or the peculiarities of their use. It should be noted that in the past some MPAs might have been set up before legislation was passed but this state of affairs is not sustainable. By definition, the designation of an area as an MPA will restrict activities, which will ultimately call for some degree of enforcement and such measures are impossible in the absence of a legal text that recognizes the authority vested in the managers of the MPA (23).

Any authority in charge of establishing, and maintaining, an MPA will need to achieve the following:

1. Define institutional responsibilities and relations
2. Establish priorities and mechanisms for selecting, establishing, and developing

marine protected areas

3. Protect species and their critical habitats adequately

4. Conserve threatened, rare, endemic, and commercial marine species and threatened, unique, representative, and valuable marine habitats

5. Ensure permanent protection

6. Provide mechanisms for developing management plans for each protected area, based on scientific data

7. Enable the control of developments and activities outside the protected area that may adversely affect it

8. Regulate exploitation in protected areas and their adjacent buffer zones

9. Provide enforcement mechanisms

10. Restore damaged ecosystems

Attaining these objectives will provide a sound foundation for a protected areas programme. The law then becomes the instrument through which these objectives can be recognized, explained and respected (and to some extent, funded). This does not necessarily mean that the absence of new legislation should preclude the establishment of the MPA. In fact, in some cases where the need to act is pressing, it might be more appropriate to designate the area as protected, even if the enforcement of the protective measures is deferred until the appropriate law is passed. One of the first steps to be taken is to carry out an assessment of the laws that are already in place, and which may be adapted to incorporate the marine reserve elements. For instance, legislation for an MPA set up to protect important fisheries resources may well be incorporated within an existing fisheries law. Likewise, if the MPA is set up to preserve an area for tourism development, it could well be part of a broader tourism development law (23). The legal diagnosis stage will give an indication of the legal system in place and may suggest the appropriate approach to take when drafting new, MPA-specific, law. An important consideration in that regard is the legal and political state of the country in which the MPA is to be set up.

4.2 Different laws for different countries

Mechanisms to implement MPA programmes can be incorporated in a legal system appropriate to each individual country. This section is based on the understanding that it cannot be too prescriptive since there are probably as many

approaches to MPAs as there are coastal countries. Provincial or local planning and management can be more responsive to local needs and changing circumstances, but, in contrast, national agencies usually have access to greater financial resources and expertise and have a more comprehensive view of conservation needs. Resource protection is often, if not always, seen to be more stringent in national protected areas than in locally organized ones. In any event, national governments usually have jurisdiction over marine waters and will have to be involved in some way.

Institutional arrangements will vary from one country to another according to traditional tenure patterns, colonial experience, and cultural heritage. Initially it may be best to experiment with one or a few protected areas as a trial toward evolving new administrative and management arrangements. International non-governmental organizations (NGOs) can offer advice, assistance, and specialists to help develop coastal and marine conservation programmes (23).

Most coastal and marine waters (including wetlands) come under the public domain and are treated as a "commons". There are exceptions; such as in the Pacific islands where rights to fish certain areas are vested by custom with individuals. In principle, the public authorities have jurisdiction over the seabed and the surface of the sea. There are a number of traditional interests bound up with seacoasts that legislators must address: the livelihood of inhabitants of the protected area, water sports and recreational activities, economic interests and shipping.

Administrative, scientific, managerial, enforcement, financial, and other responsibilities may be delegated to various divisions of the appropriate authority structure. Advisory bodies and consultative organizations may be used to ensure representative participation and technical assistance by public, scientific, governmental, and other concerns (23).

It is important to note that the institutional arrangements selected will actually depend on the purpose of the MPA. Each marine reserve will vary in size and set-up, depending on whether it aims to protect a critical ecosystem, a traditional activity, tourism development or an important breeding or feeding ground. The key to the establishment of the MPA is that it represents a compromise between the uses that are permitted therein and the degree of protection afforded the resources. Depending then on the uses that will be permitted, different institutional structures become appropriate. The Authority in charge needs to balance conflicting interests and establish the required degree of protection, thus restricting uses that were customary

prior to the enactment of the MPA. As a result of the diagnosis stage, marine reserves managers will have a better sense of what uses are already taking place in the area to be protected and will assess whether these uses are sustainable or not.

Recreational activities, including water sports, are usually regulated by zoning the protected area and controlling people's movements. The movement of vessels through the waters of coastal or marine protected areas is encompassed by most coastal and marine protected area legislation. The common purpose of this legislation is to allow free passage of vessels according to the rules of maritime law. "The right of the coastal state to restrict navigation by *foreign* flag vessels is circumscribed by international ocean law" (1982 UN Convention on the Law of the Sea). "But vessel traffic may be controlled by shipping lanes, speed limits, discharge restrictions and other measures, in accordance with international law." It could be noted that the power to regulate foreign vessels by the Great Barrier Reef Marine Park Authority is granted through the internationally-agreed International Marine Organization (IMO) "Areas to be Avoided." Similarly, with respect to regulating passage by foreign aircraft (airspace), this, too, is restricted by international law outside of national territory (and the territorial sea). Because of the damage anchoring causes to bottom-living plants and animals, it is expressly prohibited by Seychelles and New Zealand laws and is covered by the general power to regulate vessels given by the Great Barrier Reef Marine Park Act of Australia (23).

Control of some coastal and marine protected areas is empowered through direct legislation detailing restrictions, as in the New Zealand Marine Reserves Act of 1971. Other legislation, like the Great Barrier Reef Marine Parks Act of 1975, assigns this task to the rule-making authority. In the latter case the legislature may list in detail the restrictions and prohibited activities about which rules are to be made. The legislature usually also authorizes the administering agency to take any necessary steps to ensure observance of the legislative directives, thus safeguarding the agency's freedom of action.

More and more, MPAs are being designated as part of fisheries management policies to protect marine ecosystems critical to the fish stocks being managed. For instance, breeding grounds, feeding grounds or aggregation areas may need to be protected because harvesting of the species at that particular stage of their lives would be to harmful. Furthermore, considerable work has recently gone into studying the effects of "no-take zones" or fish refugia on the global health of the stocks. Several

examples have shown that preserving a stock in one area can have beneficial effects outside that area (the so-called spillover effect). Fish refugia are mere complements to sound fisheries management, but if they are designated appropriately and strictly enforced, their impact can be substantial (23).

Another important consideration can be whether the marine reserve is set up as a stand alone or within a network of marine reserves. Whether or not the MPA is set up within a network will here again depend on the goal one aims to achieve. For instance, if the goal is the protection of an important reef or an ecosystem important to a given species, this network often needs to cross boundaries. There is mounting evidence from physical oceanography in the Caribbean that in order to protect coral reefs in some areas, seed sources of recruits need to be identified and protected in other areas, sometimes a hundred miles removed.

5. Case studies

5.1 Medes Islands Marine Reserve, Catalonia

5.1.1 Introduction

The small archipelago of the Medes islands (area of 21.5 ha), formed by seven islets (Medellot, Meda Gran, Meda Petita, Farrenelles, Tasco Gros, Tasco Petit and Carall Bernat) and some reef, is located less than a mile from the coast of the massif of Montgrí - which geologically constitutes a place of extraordinary biological and ecological value due to a variety of species and environments. The landscape is characterized by great beauty and great scientific interest, and is a unique spot and one of the most interesting in the Mediterranean. The vegetation and specially the terrestrial fauna are worthy of study, but what determines the exceptional value of the Medes in the Mediterranean is its marine environment. The proximity of the coast and the outlet of the Ter river which contributes the necessary organic nutrients, the influence of winds and currents from the north enriches further with organic contributions of the Rhone, the different depths and the diverse habitats (sandy and rock), combined with cavities and tunnels, give rise to an extraordinary ecosystem with high productivity and a variety of species (1345 marine taxons of flora and fauna identified) (http://www.medi-ambient.net/pn/espais/medes-esp.htm).

This wealth of resources in the Medes complex has been under constant exploitation for many years by fishermen and especially by coral divers. In the mid-19th century these activities intensified along the entire coast resulting in serious damage to the barrier reef of the Medes. Protection of the islands began in 1983 with an Order of the Government of Catalonia. In 1985 a resolution established compulsory rules in the restricted area and in 1990, Law 19/1990 became the legal framework for the protection and conservation of the flora and fauna of the Medes Islands and part of the Montgrí coast, between La Roca del Molinet and Punta Salines. The application of this law turned the Medes islands into the greatest marine reserve of Catalonia and one of most important in the Mediterranean sea.

Map 5-1: Medes Islands Marine Reserve

(Source: http://www.medi-ambient.net/pn/espais/medes-esp.htm#mapa)

5.1.2 Natural interest

Studies in the area have provided interesting biological and ecological data which are summarized below:

- There are 8.000 pairs of yellow-legged gulls *(Larus cachinnans)*
- There are ten (10) endemic species of invertebrates
- There are 1345 marine species
- Below the 20 m depth line, a Mediterranean landscape exclusively present in the Medes exists, known as the "coralígeno" after the red coral *(Corallium rubrum)* which inhabits the semidark caves.

Figure 5-1: Medes Islands Marine Reserve

(Source: http://mediambient.gencat.net)

5.1.3 Impact of the marine reserve

Other studies have provided interesting economic and social data, which are summarized below:

- Due to the increased tourist trade from visitors to the marine reserve 30.000 more beds have been added to the hotel capacity of the area
- Also 740 more yacht berthing places have been created
- 120 new employment opportunities have been created
- A revenue of 3 million Euro per year from diving activities and tourist accommodation has been attained
- A revenue of 2,5 million Euro per year has been created from visitors to the marine reserve (TERRA 2003).

Important lessons can be drawn from the Isles Medes project, since through the cooperation of the responsible scientists and the local authority, a Management plan that promotes rational use of resources and provides the support and commitment of local management, has been established with very positive results for the whole area.

5.2 Ras Mohamed National Park, Egypt

5.2.1 Introduction

Ras Mohamed is a very thin strip of land at the southern tip of the Sinai Peninsula at the Northern end of the Red Sea. In itself a peninsula, it is bordered to the west by the relatively shallow waters of the Gulf of Suez, and to the east by the deep waters of the Gulf of Aqaba. Here the water reaches depths of up to 2000 meters as this is the beginning of an enormous cleavage in the earth's crust that separates the, African and Eurasian continental plates. The island Tiran and Sanafir are part of the site.

Due to its position, strong currents prevail throughout the year which makes the waters around it very rich in nutrients and due to this huge numbers of schools of pelagic and reef fish are being attracted (somewhere in the range of 1,000 different species). The Peninsula is surrounded by high reef tables which provide some of the best diving spots in the world. The most prominent of these are Yolanda Reef at the extreme southern tip, and Shark Reef. Littoral habitats include a mangrove community, salt marshes, inter-tidal flats, a diversity of shoreline configurations and

coral reef ecosystems that are internationally recognized as among the world's best. In addition a diversity of desert habitats such as mountain and wadis, gravel plains and sand dunes (www.rasmohamed.com).

Ras Mohammed was notified as a national marine park under *Decree No.1067* in 1983. Subsequently, in 1989, it was classified as a national park and extended to 61,500ha to encompass Tiran Island, becoming the largest marine park in the region. The site is protected under *Presidential Law concerning Natural Protectorates No. 102, 1983* and *Decree No. 1067, 1983*. Hunting and fishing are prohibited, as is the removal of any material from the park, or the construction of buildings or roads, and only 12% of the park is accessible to visitors. It's management is undertaken by The Egyptian Environmental Affairs Agency (EEAA).

Map 5-2: Ras Mohamed Natural Park

(*Source: http://www.rasmohamed.com/rasita3c9.html*)

5.2.2 Natural interest

Studies in the area have provided interesting biological and ecological data which are summarized below:

- There are more than 200 species of corals
- There are around 1200 marine species
- It is an important bottleneck for migratory soaring birds
- The islands of Tiran and Sanafir hold important breading populations of the threatened white-eyed gull *(Larus leucopthalamus)* and osprey *(Pandion haliaetus).*

Figure 5-2: Anemone city in Ras Mohamed Natural Park
(Source: http://www.rasmohamed.com/rasita4a1.html)

5.2.3 Impact of the marine reserve

The period since the establishment of the Park has seen a remarkable growth in coastal and reef-related tourism to the area. Whereas in 1988 there were 5 international hotels using 5 dive centres serviced by 23 dive boats to cater for ca. 20,000 visitors, the numbers of visitors and facilities in 1998 included >40 international hotels, 32 dive centres, 240 dive boats, 690,337 visitors (1996) and 16,564 beds (data from National Parks of Egypt, Governorate of South Sinai). To put these figures into perspective, for example, with approximately 20% of visitors carrying out an estimated 1.5 million dives per year, the area has become one of the most dived tourist resorts in the world.

5.3 Hol Chan Marine Reserve, Belize

5.3.1 Introduction

The Hol Chan Marine Reserve is situated approximately 4km south of San Pedro, a small but prosperous tourist town on Ambergris Caye, an island in the northern section of Belize's barrier reef. It was established in 1987 in response to a growing concern for the area's marine environment. Overfishing had seriously depleted valuable conch and lobster fisheries, and caused the disappearance of several species of large, easily caught fish. Mangroves were being cleared for development and increasing numbers of tourists were starting to have visible impacts on the reef, for example by breaking corals and collecting marine curios.

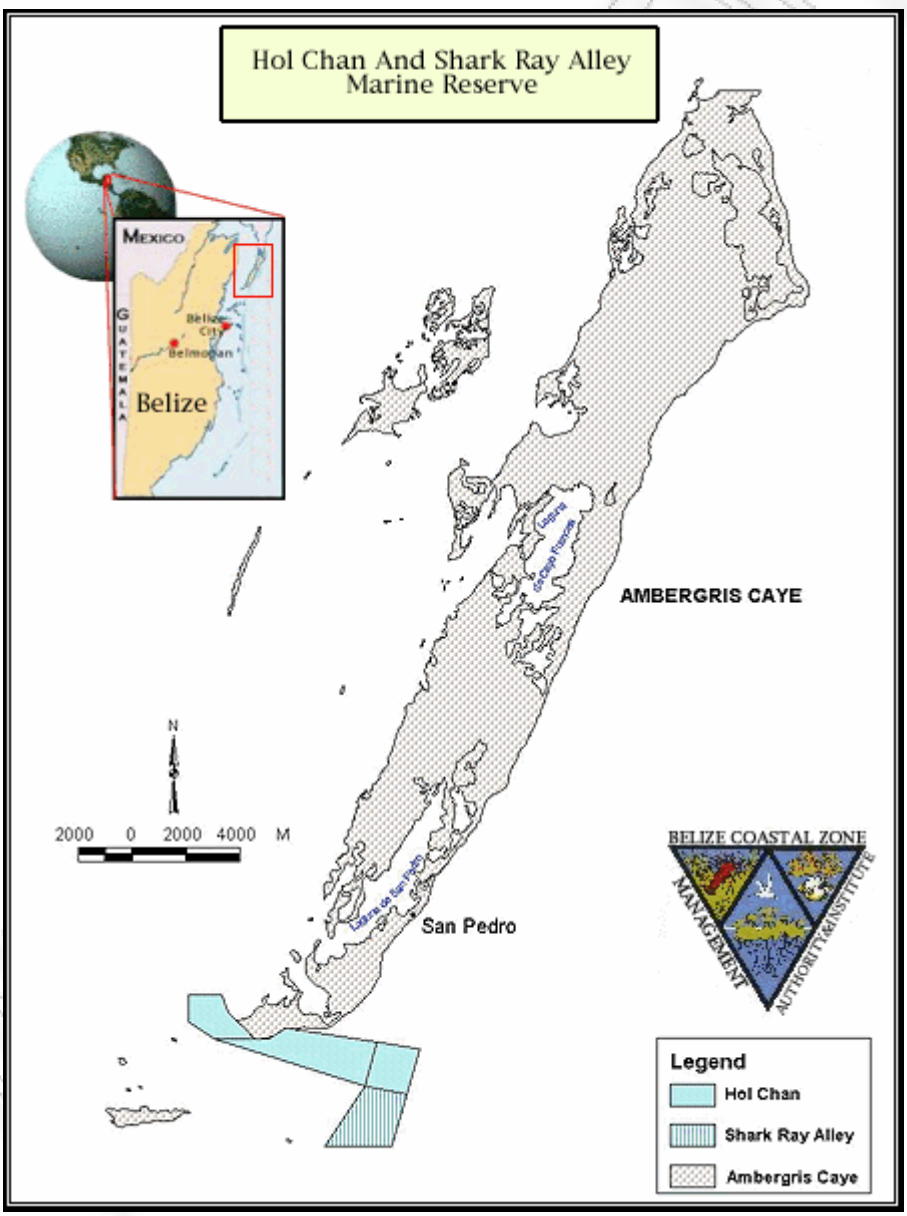
The marine reserve was set up to encompass coral reef, seagrass and mangrove habitats and was zoned for different uses. Fishing activities are restricted throughout the reserve, but only banned in Zone A, a small fully-protected area of 2.6km2. The fully-protected zone is centred around a channel that connects the lagoon with the outer reef. Even before it was protected, this channel was an excellent place for fish and because of this had become a key attraction for tourists. Although the channel was also a good spot for fishing it was felt to be more valuable as a tourist asset, and deserving of full protection (20).

5.3.2 Natural interest

'Walls' of fish can now be found inside the fully-protected zone. In the channel itself, fish schools are so dense that they literally obscure the reef. Build-up of fish biomass was exceptionally fast, partly due to immigration of large animals like groupers to the site. Four years after protection began the total biomass of commercially important, reef-associated fish was 50% greater at the edges of the fully-protected zone than in surrounding fished areas. In the central channel it was six to ten times higher! On average, 25% of reef fish species had significantly higher abundance, size or biomass in the fully-protected zone. Several species once favoured by fishermen were not present in fishing grounds but were found in the fully-protected zone. They included the gray snapper *(Lutjanus griseus),* black margate *(Anisotremus surinamensis),* and saucereye porgy *(Calamus calamus).* All but one

commercially important species of fish was bigger in the fully-protected zone than in fishing grounds (www.holchanbelize.org).

Densities of conch and lobster are also higher inside the fully-protected zone. For these species in particular, people 'fish the line'. That is, they fish close to reserve boundaries to get better catches. Spillover occurs when individuals from more closely packed populations in the reserve emigrate into the less densely-packed fishing grounds.



Map 5-3: Hol Chan Marine Reserve

(Source: http://www.holchanbelize.org/loc.html)

5.3.3 Impact of the marine reserve

The Hol Chan marine reserve has overall been a great success. In addition to protecting marine life, it now attracts over 35,000 visitors a year. Many local people have given up fishing to take tourists snorkelling and scuba diving and this has further reduced pressure on reef fisheries. However, it has increased the need to protect the reef from tourists. Because the reserve is small there are problems caused by overcrowding and too many boats in the water. Damage is especially noticeable in the Hol Chan channel which is the most popular place of all. Here many corals have been broken and abraded by tourists. It is thought that a localized outbreak of black band disease, which occurred in the reserve in the early 1990s, might have been due to corals damaged by tourists becoming more susceptible to infection.

Efforts are now being made to educate tourists on how not to damage the reef, and several other reserves with fully-protected zones have been established to help divert tourist pressure away from Hol Chan. This is important because tiny fully-protected zones, within larger marine reserves where fishing is allowed, still mean that the greater part of the sea is essentially unprotected. A national network of fully-protected areas that is currently being developed in Belize should provide widespread benefits of the sort that the Hol Chan reserve has already achieved (20).

Figure 5-3: Diving in Shark-Ray Alley

(Source: http://www.holchanbelize.org/zoned.html)

6. Potential Marine Reserves for the Mediterranean Sea

6.1 Introduction

This chapter sets out the need for urgent establishment of a network of marine reserves across the Mediterranean Sea to safeguard its productivity, its marine life and its ecosystems for the many millions of people who rely on it for their health and wellbeing - now and in the future. It is not a random fact that I chose to mention the Mediterranean Sea, as our country (Greece) is affected straightforward by any potential possitive or negative situation occuring in the Mediterranean.

The Mediterranean Sea is a rich and diverse environment, home to many unique species and important ecosystems. Being an enclosed sea, and the majority of the Mediterranean being beyond the control of any one country, it truly represents a shared resource - and a shared responsibility - for the region (9).

The Mediterranean Sea is threatened by many damaging human impacts, including over-fishing, destructive fishing techniques, pollution and climate change. Steadily, these are degrading the shared resource and treasure that the Mediterranean Sea represents.

A network of large scale marine reserves will represent a shift in the balance of human impacts, from damage and harm to protection and conservation. This network must cover a representative range of marine ecosystems, both in coastal waters and on the high seas.

Greenpeace believes that in the face of the damage that has been done to the Mediterranean, this network of marine reserves must cover around 40% of the Mediterranean Sea in order to protect it for generations to come (9).

Because it is virtually enclosed and its habitats inter-connected, the Mediterranean Sea is a prime example of why marine management must take account of whole ecosystems, not single species or areas. A marine reserve network will create a sound basis upon which to build sustainable, precautionary and ecosystem-based management of the Mediterranean's marine resources.

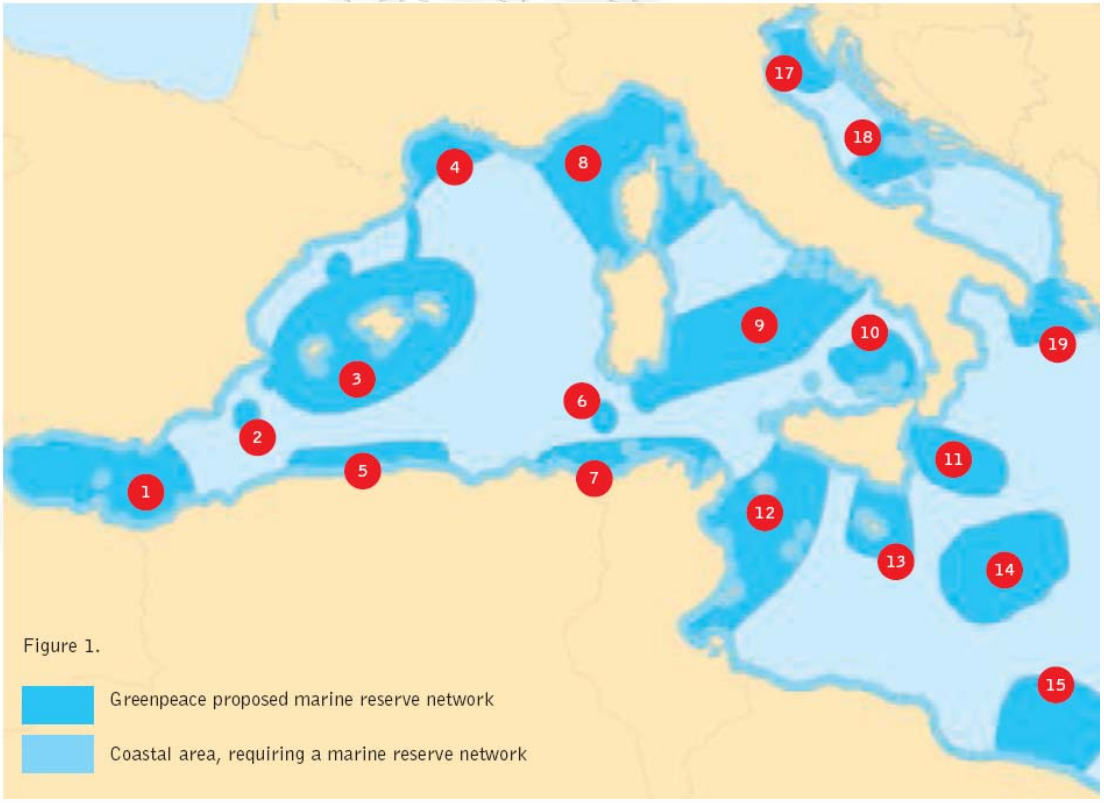
Experience of marine reserves elsewhere in the world has shown an increase in the number, size and diversity of species within the reserves. They therefore represent our most valuable tool in conserving biodiversity and making ecosystems more resilient to change or damage. This, combined with sustainable management, also brings benefits of precaution and insurance to fisheries management for the

surrounding seas. Marine reserves also have many other positive benefits for science, education and recreation.

6.2 Proposed marine reserve sites

As a first step towards establishing a Mediterranean network, Greenpeace has drawn up a map showing a number of key areas appropriate for designation as marine reserves. The proposed network includes examples of the different habitats found in the region, as well as areas known to be important spawning and nursery grounds, which are necessary for proper functioning of the ecosystem. Although a paucity of detailed data was found for some parts of the region (especially the eastern basin) and for some species and habitats, this is not a block to designing a network. One of the beauties of a network of marine reserves as a conservation tool is that as long as the network is of sufficient scale and includes a comprehensive selection of habitats spread through the region it will achieve its goals (9).

The areas suggested for a regional network of marine reserves has been based on extensive data collected over a number of months relating to the biological diversity and physical oceanography of the Mediterranean.



Map 6-1: Proposed marine reserve sites (9)

1. Alboran Sea

The Alboran Sea is the meeting point for the cold waters of the Atlantic Ocean and the warmer waters of the Mediterranean Sea, and a migratory route for many species of fish, whales, dolphins and turtles. The Alboran contains regions of upwelling, where marine life thrives. The area is a spawning area for pilchards and anchovy and an important area for a number of whale and dolphin species, including the striped, common, bottlenose and Risso's dolphins, and the long-finned pilot whale. Vulnerable deep-sea features are found in the Alboran Sea, including seamounts and deep-sea corals.

2. (& 6) Seamounts

These areas represent individual seamounts in the Mediterranean Sea (seamounts are also included in many of the other proposed marine reserve areas). Seamounts are home to many unique and vulnerable species. In addition to the important seabed communities found on seamounts, they also provide important breeding and feeding grounds for species in the waters above.

3. Balearic Islands

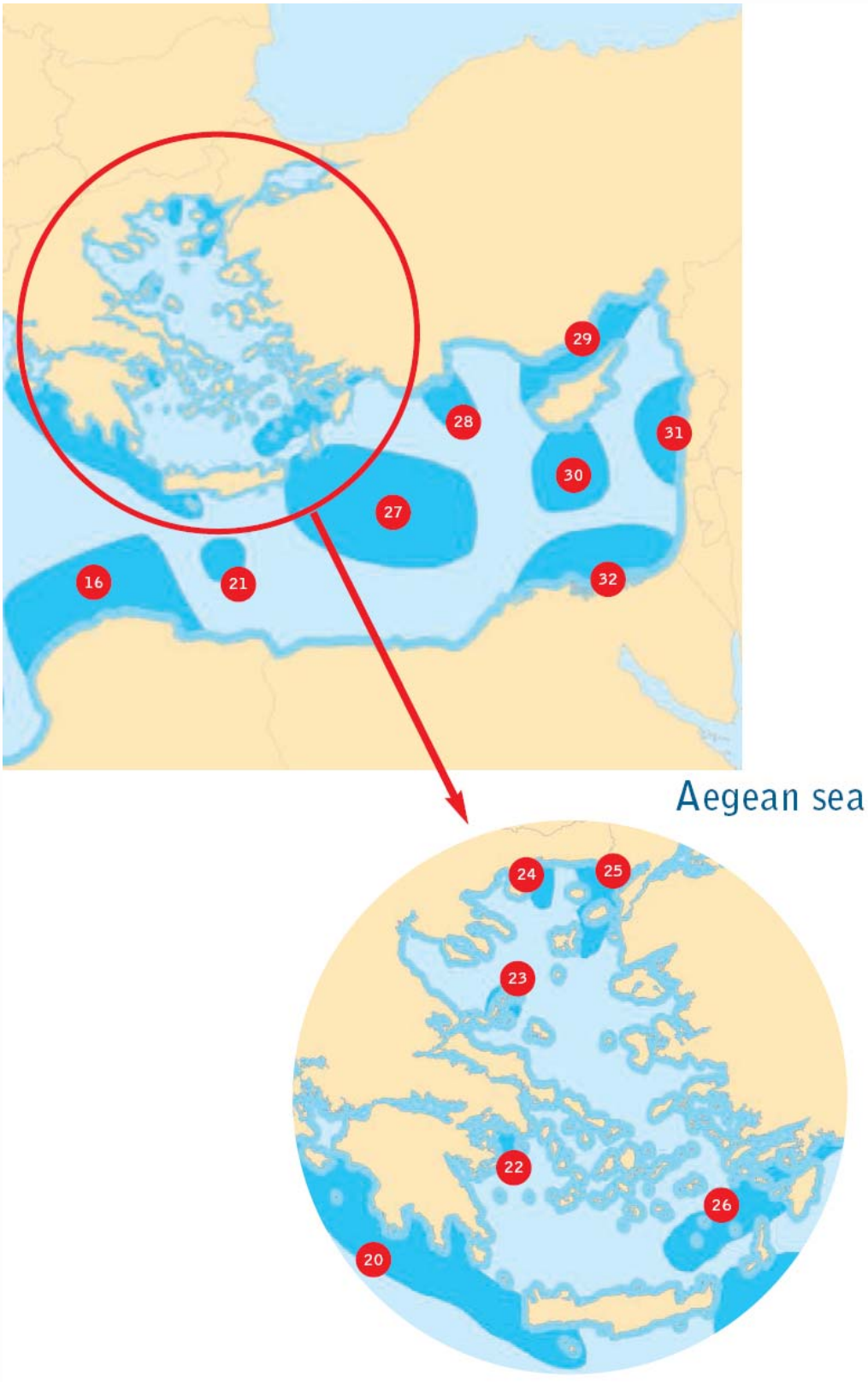
The waters surrounding the Balearic Islands are an important spawning area for tuna and swordfish, two over-exploited migratory species, as well as many other species including pilchards, round sardinella and anchovies. The area contains deep-sea corals and cold seeps, and is an important area for sperm whales. The great white shark, a vulnerable species, is recorded in the area.

4. Gulf of Lions

The Gulf of Lions is influenced by the Rhône Delta, which is designated a UNESCO Biosphere Reserve and Ramsar site. This marine area is an important spawning ground for pilchards, anchovy, round sardinella and shrimps. It is also an important sperm whale area, and contains cold seeps and deep-sea corals.

5. Algerian stretch

This area is a spawning ground for anchovy, and an important area for sperm whales. Deep-sea corals are found here.



Map 6-2: A closer look to the Aegean Sea (9)

7. Carthagian stretch

This area is important for sperm whales, and is a spawning ground for anchovy. Pilchards, round sardinella, blue whiting, and blue and red shrimps, and bottlenose dolphins are found here. The coastline is a nesting and migratory route for sea turtles.

8. Ligurian Sea

The Ligurian Sea contains a frontal system, pushing up deep waters rich in nutrients. This makes the area highly productive, with a diversity of species present. It is an important feeding area for whales and dolphins, with around 13 cetacean species found there. The Mediterranean population of fin whales *(Balenoptaera physalus)* may be becoming a separate "new" species. Seamounts and deep-sea corals are also present in the area. The Ligurian Sea was designated as a sanctuary under the SPAMI system due to its importance for whales and dolphins, however a marine reserve is required to fully protect the diversity of marine life and habitats there.

9. Central Tyrrhenian Sea

The central Tyrrhenian Sea, between Sardinia and mainland Italy, is an important area for cetacean species including fin and sperm whales and common dolphins. The area has been proposed as an MPA for whales and dolphins. The central Tyrrhenian is a spawning ground for anchovy, and an important area for pelagic fish, such as blue whiting and round sardinella. It is a migratory route for tuna, and an important area for seabirds. The area has a significant concentration of seamounts including the Vavilov Seamount.

10/11. Messina Strait (north and south)

This is an important area both for the huge upwelling system present here, and because it is a migratory route for pelagic fish, whales and dolphins. The area contains a large number of seamounts, including the Marsili Seamount - one of the largest volcanic structures in the Mediterranean, rising 3,000 meters from the seabed. The area is important for sperm whales and fin whales, and is a spawning area for tuna and swordfish.

12. Sicilian Channel

The Sicilian channel between Sicily and Tunisia joins the west and east Mediterranean basins, and hosts many species from both areas. It is a highly productive area and represents a biodiversity hotspot within the Mediterranean. The area is important for sperm whales and fin whales, and the great white shark.

Seamounts and deep-sea corals are found close to Sicily, and the Tunisian coastline has turtle nesting beaches, seagrass meadows and sponge communities.

13. Maltese slope

This area, extending from the south of Sicily to include the waters surrounding Malta, is an area of high biodiversity within the Mediterranean. It contains an important area for juvenile anchovy. It is important for common dolphins, and was proposed as a marine protected area by ACCOBAMS. The waters around Malta are also thought to be a breeding area for great white sharks.

14. Medina Ridge

This is an important area containing deep-sea habitats as well as the Medina (Malta) Ridge and a number of seamounts, including the Epicharmos and Archimedes Seamounts.

15. Gulf of Sirte

This area is an important feeding ground for the northern bluefin tuna. The adjacent coastline hosts turtle nesting beaches and seagrass meadows.

16. Libyan head

The coastal and marine area of East Libya has been described as one of the “last ten paradises” of the Mediterranean. The coastal area contains seagrass meadows, making it an important fish nursery area. Turtles nest on the adjacent beaches, and further offshore are seamounts, including the Herodotus Seamount, and cold seeps.

17. Upper Adriatic

The upper Adriatic is an important spawning area for pilchards and anchovy. An adjacent Croatian coastal area has been proposed as a bottlenose dolphin reserve by Tethys Research Institute. The area also hosts a high diversity of fish species including tuna, swordfish and sharks, and seagrass meadows are present along the Croatian and Italian coasts.

18. Pomo/Jabuca Trench

This area is an important spawning area for Mediterranean hake, anchovy and other species, and is vital for many Adriatic fish populations. Due to its importance, trawling was banned from part of this area in 1998. There is also a cold seep area found here.

19. Otranto channel

The marine area off the 'heel' of Italy contains an important site of deep-sea corals, including the rare white coral, Lophelia. The area was recommended for protection by WWF and IUCN, and partially protected in 2006 by a GFCM ban on trawling.

20. Hellenic trench

The Hellenic Trench is an important area for sperm whales, as well as Cuvier's beaked whale, and was recommended for protection by Pelagos, a marine NGO. The area south-west of Crete was recommended as a marine protected area for sperm whales by ACCOBAMS. The area contains deep-sea features including the Calypso Deep, the deepest part of the Mediterranean Sea, and important habitats such as cold seeps and seamounts. The adjacent Greek coastline contains turtle nesting beaches, and a number of coastal protected areas.

21. Olimpi

This area south of Crete contains important deep-sea features in the Olimpi mud field. This includes mud volcanoes, cold seeps and brine pools, and hosts microbial communities.

22. Saronikos Gulf

This is an important area for common dolphins, and is part of a larger proposed MPA for common dolphins (recommended by ACCOBAMS). It is a nursery ground for hake *(Merluccius merluccius)*, one of the most commercially important species in the Mediterranean.

23. Sporades Islands

This area is an important area for Mediterranean monk seals, and is designated as an IUCN protected area, and Greek Natura 2000 site. It is part of a larger proposed MPA for common dolphins, recommended by ACCOBAMS.

24. Thrakiko Pelagos

This area is considered an important nursery ground for many species, including hake, prawn and anchovy. The north Aegean is the last remaining area in the Mediterranean where harbour porpoise are still found. Mediterranean monk seals *(Monachus monachus)* and Common dolphins are also present. The adjacent coastline is included in the Greek Natura 2000 network.

25. Limnos - Gökçeada

The north Aegean is the last remaining area in the Mediterranean where harbour porpoise are still found. The proposed reserve in the north-east Aegean is an important area for common dolphins, and is part of a larger proposed MPA for common dolphins, recommended by ACCOBAMS. Adjacent coastline is included in the Greek Natura 2000 network.

26. Crete to Turkey

This area contains seamounts, and is an important area for common dolphins (part of a proposed MPA for common dolphins recommended by ACCOBAMS). Adjacent coastal areas are included in the Greek Natura 2000 network, and turtles nest along the adjacent Turkish coastline.

27. Central Levantine Sea

An important deep-sea area containing numerous seamounts and cold seeps. This area is a spawning ground for swordfish, a commercially important species in the Mediterranean.

28. Anaximander Mountains

This area south of Turkey contains the Anaximander Mountains, with seamounts, mud volcanoes and methane cold seeps. The adjacent coastline has a number of sea turtle nesting beaches.

29. Cypriot Channel

The waters between Cyprus and southern Turkey are a spawning ground for bluefin tuna *(Thunnus thynnus)*, frigate tuna *(Auxis rochei)* and Atlantic black skipjack *(Euthynnus alleteratus)*. The adjacent coastlines of Cyprus and Turkey have nesting beaches of the endangered loggerhead turtle *(Caretta caretta)* and green turtle *(Chelonia mydas)*.

30. Eratosthenes Seamount

The Eratosthenes seamount is located south of Cyprus and north of the Nile delta, and it rises up from the seafloor to 800m below sea-level. Here rare coral species can be found, such as *Caryophyllia calveri* and *Desmophyllum cristagalli*. The area is also important for whales and dolphins, including sperm whales, fin whales, striped and bottlenose dolphins. The coastline of Cyprus has a high concentration of turtle nesting beaches.

31. Phoenician coast

This area is an important migratory route for tuna, and breeding area for loggerhead turtles *(Caretta caretta)*, green turtles *(Chelonia mydas)* and sharks. The threatened sandtiger shark *(Carcharias taurus)*, gulper shark *(Centrophorus granulosus)* and angelshark *(Squatina squatina)* are present in the area. Adjacent coastal waters contain hydrothermal vents, and their associated communities.

32. Nile fan

The deep waters of the Nile fan, with their associated submarine canyons and cold seeps, are areas of high biodiversity. Cold seeps emit mud, gas and fluids and support high microbial diversity. These important and vulnerable seabed features have prompted the GFCM to create a protected area where trawling is banned. The area is also an important feeding ground for fish, including tuna.

6.3 Conclusions

There is no shortage of international and regional commitments and agreements and scientific advice declaring the need for a network of marine reserves. What is lacking is the political will to make this a reality. This must change, and Greenpeace believes that the people of the Mediterranean will play a crucial role in bringing this about.

All the countries of the Mediterranean are parties to the Convention on Biological Diversity (CBD), with the aim of halting the loss of biodiversity on land and in the seas and oceans. Greenpeace believes that the best pathway to honour the CBD commitment to protect marine biodiversity is to create an implementing system under the United Nations Convention on the Law of the Sea, UNCLOS. The laws created must allow for full protection from damaging activities, and provide enforcement mechanisms.

Promising steps towards a network of marine reserves have already been taken in the Mediterranean; the Barcelona Convention creates a regional agreement under which marine protected areas can be created within and beyond national jurisdiction. The European Union, which includes seven of the Mediterranean countries as its members and has regional partnerships with non-member countries, has made progress towards creating a network of marine protected areas (9).

However the steps taken to date fall far short of what is needed. The Ligurian Sea Sanctuary, the first High Seas “specially Protected Area of Mediterranean Interest” created under the Barcelona convention covers just over 3% of the waters of the Mediterranean, but is designed to protect only whales and dolphins, and does not restrict fisheries beyond pre-existing measures such as a ban on driftnets. The Natura 2000 network, being created within European Union countries, covers less than 1% of the waters of the Mediterranean.

Internationally, the European Union has taken a leading role in discussions on creating a network of marine protected areas on the high seas. At a recent meeting under the CBD process, the EU called for an interim goal of creating 5-10 high seas marine protected areas by 2008. Such calls are meaningless unless there is the political will to begin this process in their own seas - the Mediterranean Sea is a perfect place to start (9).

Mediterranean countries must work together to protect the Mediterranean, our shared resource and treasure.

It's Our Sea - let's protect it.

7. Conclusions

Marine reserves work on many different levels of biological organization, affecting individual animals and plants, populations, communities, and ecosystems. In summary the benefits arizing from marine reserves include:

- Habitat concervation
- Plant and animal conservation within areas that contain important habitats
- Recovery of depleted populations of commercially important fish species
- Free movement of animals and plants from reserves to surrounding waters
- Guarantee against environmental damage
- Provision of a risk management tool
- Provision of ecosystem monitoring
- Protection of places to provide baseline information
- Provision of sites for scientific research and recreation
- Local community involvement
- Education and sensitization areas
- Pilot studies for further advancement of management tools and application to new areas and coastal zones (18).

Marine protected areas seem to provide the most powerful coastal management tool but currently cover a small fraction of the coastal zone. It is also accepted, throughout the world, that the majority are poorly managed.

Protecting areas of the sea from fishing has shown dramatic benefits, leading to swift and spectacular increases in abundance, biomass and average size of commercially interesting species. Reserves create mosaics of conditions that favour those species most affected by fishing, and so help sustain biological diversity and ecosystem functioning. Ideally every marine protected area should have at least one zone that is priviledged with full protection. It is obvious that protection against harmful activities will have extra beneficial value when and if, these efforts are integrated into a network of marine reserves. These networks perform best when reserves are sufficiently close for protected populations to interact and thus increase the likelihood that species will persist and fisheries be sustained over the long-term.

Furthermore, reserve networks will become more effective when supplemented by other forms of management.

Successful reserves require a great deal of effort to establish followed by long-term commitment from local communities and decision makers to maintain effective protection. Time after time, experience has shown that reserves are unlikely to be successful unless there is close involvement of all stakeholders throughout the full establishment process. In the long run, reserves depend on their support. Full stakeholder participation does not guarantee success, but lack of it almost invariably leads to failure.

These considerations suggest that a future for our seas includes a dense network of fully protected marine reserves that sits within a regulatory framework of local communities and agencies with regional responsibility. Reserve systems should be self-seeding regionally and have the potential to export significant diversity and biomass into surrounding areas. There should be enough replication of reserves so that their diversity is buffered against local human-caused impacts and natural disasters. Reserve design should allow for enforcement and monitoring with the potential for non-damaging recreational and professional use. The same regional and local authorities should adress other threats to marine ecosystems in a coordinated way.

In many ways this is a special time in the history of the sea. Humans have developed the ability to disrupt entire seas and oceans. Yet, when human impact ceases, many marine ecosystems rebound prodigiously. It is unclear how long this good luck will continue. Some rebounds, such as those of turtles and sharks, may never occur. However, if the sea is protected now, it is reasonable to expect that it will recover a substantial part of its former glory. Capturing that glory is a legacy for the future – not only in terms of the species it protects but also in terms of the human lifestyles it will preserve. The tool to protect our seas' future is marine reserves.

Our seas deserve a better future...

Let's make it happen!

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