UNEP

CBD

CONVENTION ON BIOLOGICAL DIVERSITY

Distr.
GENERAL

UNEP/CBD/SBSTTA/8/INF/12
3 March 2003

ENGLISH ONLY

SUBSIDIARY BODY ON SCIENTIFIC, TECHNICAL AND TECHNOLOGICAL ADVICE
Eighth meeting
Montreal, 10-14 March 2003
Item 5.2 of the provisional agenda *

MARINE AND COASTAL BIODIVERSITY: REVIEW, FURTHER ELABORATION AND REFINEMENT OF THE PROGRAMME OF WORK

The value and effects of marine and coastal protected areas on marine and coastal biological diversity: a review of available information

Note by the Executive Secretary

I. PURPOSE AND SCOPE

1. The present note was originally prepared by the Executive Secretary as a background document for the Ad Hoc Technical Expert Group on Marine and Coastal Protected Areas. It has now been modified, for the information of participants in the eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), to provide supplemental background information to the documents produced by the expert group. Original content already discussed in the expert group documents has been deleted. The note provides a review of the information available from international and regional partner organizations, Party national reports, and the scientific literature, in relation to:

(a) The definition of "marine and coastal protected area";

(b) The number and extent of existing MCPAs;

(c) The distribution of existing MCPAs;

(d) Representation of existing MCPAs;

(e) The value of marine and coastal biological diversity;

(f) The effects of MCPAs;

(g) The effectiveness of MCPAs;

* UNEP/CBD/SBSTTA/8/1.

/…

(h) Linkages between MCPAs and sustainable use of marine and coastal biodiversity.

(i) International and regional Initiatives designating MCPAs.

II. DEFINITION OF "MARINE AND COASTAL PROTECTED AREA"

Definition in the Convention

2. Article 2 of the Convention defines a protected area as "a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives". Although the Convention does not specifically define a marine or coastal protected area, the general definition of Article 2 easily applies to marine and coastal areas. Because of the lack of definition for an MCPA, the Ad hoc technical expert group developed a working definition, which is modelled on the IUCN definition below, and presented in the summary report of the Ad Hoc Technical Expert Group on Marine and Coastal Protected Areas (UNEP/CBD/SBSTTA/8/9/Add.1).

IUCN definition

3. The World Conservation Union (IUCN) has developed a more technical definition for a marine protected area (MPA): "Any area of inter-tidal or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment".

Common usage

4. The term MPA is commonly used, but the areas so labelled may have varying degrees of protection, ranging from fully protected reserve areas to areas that permit various user activities.

Classification systems

5. There are several classification systems that have been applied to MCPAs in an attempt to compensate for the variety of terminology, conservation objectives and designs, and to facilitate some standardization.

6. IUCN has developed one such system for protected areas based on the primary management objectives of sites. Six categories are recognized within the classification system on the basis of the relative importance of primary management objectives.

Management objective	**IUCN category**						
	Ia	**Ib**	**II**	**III**	**IV**	**V**	**VI**
Scientific research	1	3	2	2	-	2	3
Wilderness protection	2	1	2	3	3	-	2
Species/genetic diversity	1	2	1	1	1	2	1
Environmental services	2	1	1	-	1	2	1
Natural/cultural features	-	-	2	1	3	1	3

Management objective	**IUCN category**						
Tourism and Recreation	-	2	1	1	3	1	3
Education	-	-	2	2	2	2	3
Sustainable Use	-	3	3	-	2	2	1
Cultural Attributes	-	-	-	-	-	1	2

Key: 1 – primary objective, 2 – secondary objective, 3 - potentially not applicable, - not applicable
(Green and Paine, 1997)

IUCN protected area management categories:

CATEGORY I - Strict Nature Reserve/Wilderness Area: protected area managed mainly for science or wilderness protection

- **CATEGORY Ia** – Strict Nature Reserve: protected area managed mainly for science
  Definition: Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.
- **CATEGORY Ib** – Wilderness Area: protected area managed mainly for wilderness protection
  Definition: Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

CATEGORY II – National Park: protected area managed mainly for ecosystem protection and recreation
Definition: Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

CATEGORY III – Natural Monument: protected area managed mainly for conservation of specific natural features
Definition: Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

CATEGORY IV – Habitat/Species Management Area: protected area managed mainly for conservation through management intervention
Definition: Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

CATEGORY V – Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation
Definition: Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and /or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

CATEGORY VI – Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems
Definition: Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

7. Application of the IUCN categories is widely accepted as a workable framework for terrestrial protected areas, although not as widely applied in practice. Their application and relevance to marine and coastal protected areas is still unclear, however, and is currently under discussion by the IUCN World Commission on Protected Areas. In theory, such a system facilitates accounting and monitoring of marine

and coastal protected areas at the national, regional and international levels. However, assignment of any individual MCPA to an individual category within the system is difficult, since the objectives of MCPAs are varied and often multiple (Walls, 1998; King and Faasili, 1998; Idechong and Grahm, 1998; Petersen *et al*, 1998; Enemark *et al*, 1998).

The Leigh Marine Reserve in New Zealand was established primarily for scientific purposes as stated in the New Zealand Marine Reserves Act of 1971 and therefore, would be considered within Category Ia under the IUCN classification system. However, the rights of New Zealanders to access the coastal marine area were preserved in the Act and access for viewing marine life is essentially unrestricted. Category I of the IUCN system provides that public access be limited and therefore, Leigh cannot truly be considered a Category Ia area (Walls, 1998). Additionally, the primary activities at the site have changed over time. Initially, research was the main activity, but this has now changed to include a variety of no-take visitor activities (although the statutory objective remains the same).

Classifying large, multiple-use MCPAs into the IUCN system can prove particularly difficult. The Breidafjordur Conservation Area in Iceland is a multiple-use area preserving traditional use, and supporting some extraction activities and fisheries (Petersen *et al*, 1998). The area is considered an IUCN Category IV protected area, but also contains elements of Categories Ib and V. In some areas, there is intervention to protect the common eider duck *Somateria mollissima* population, while access to other areas is allowed only for science. Additionally, some locations within Breidafjordur Conservation Area prioritize conserving cultural elements and allow for recreation and tourism (Petersen, *et al*, 1998).

8. Some have judged the IUCN categories to be generally applicable to marine and coastal protected areas, but suggest that the current classification system be expanded to include an indication of the different types of zones that occur within MCPAs (Kelleher and Recchia, 1998). One example offered would classify the Great Barrier Reef Marine Park as VI (Ia, Ib, II, III, IV), to indicate both the appropriate categorization of the entire area as well as the various zones within.

9. There is, and will continue to be a variety of multidisciplinary objectives for which MCPAs are established. This will preclude any classification system based on management objectives from perfectly fitting every MCPA. Consideration must also be given to the value of applying such a system. Knowing that a particular MCPA falls within a particular category under the IUCN system is not necessarily an indication of its size, design, degree of protection, or even of the full extent of its management objectives. Additionally, interpretation of data derived from any such system should be done with caution, as to not assume effective biological representation within MCPAs or effective management of those MCPAs.

III. NUMBER AND EXTENT OF EXISTING MCPAs

Number and extent

10. As of the end of 1996, the World Conservation Monitoring Centre (WCMC) protected areas database held 30,350 records of protected areas extending over a total area of 13,232,275 sq km. Of those, 2,149 are sites known to have at least some marine element, such as open sea, kelp-beds, or coral formations. These sites cover a total of 2,552,609 sq km. This includes 824 records classified as islands where the entire island is protected, of which 583 are not additionally indicated to be marine (Green and Paine, 1997). Some care should be taken in interpreting these figures based on current limitations of this dataset. Particularly, the two largest protected areas included as being "marine" by the dataset are Greenland National Park (972,000 sq km), which is predominantly terrestrial, and Great Barrier Reef Marine Park (344,800 sq km), which is predominantly marine. With the inclusion of Great Barrier Reef Marine Park as "marine" and exclusion of Greenland National Park, the total area of marine protected

areas is 1,580,609 sq km and that of terrestrial protected areas is 11,651,666 sq km (Green and Paine, 1997).

11. Additionally, the geographic coordinates of over 20,000 protected areas in the WCMC dataset are unknown, limiting the extent to which terrestrial and marine protected components can be treated separately or compared. Geographic Information System (GIS) analysis of 8,055 protected areas whose coordinates are known shows marine components to total 552,238 sq km, while terrestrial components total 6,642,121 sq km (Green and Paine, 1997). Based on this limited spatial data, twelve times more terrestrial area is protected than marine area. The treatment of data in terms of terrestrial and marine components, in itself, precludes analysis of marine and coastal protected components together, as called for under programme element 3 of the programme of work on marine and coastal biological diversity adopted by the COP under decision IV/5.

12. An inventory of existing sites by Kelleher et al (1995) for WCPA identified a total of 1,306 MPAs around the world with a sub-tidal component; the large number of coastal protected areas that include only terrestrial or intertidal features were not included. It should be noted that this inventory is currently being updated.

Trends in number and extent

13. Based on the WCMC dataset, there has been a steady rise in the number of marine protected areas from 1970 onwards (Green and Paine, 1997). In the period from 1990-1994, there was a decline in the number of marine protected areas established; however, the total extent of protected area has continued to expand, suggesting a trend of establishing fewer but larger new marine protected areas (Green and Paine, 1997).

IV. DISTRIBUTION OF EXISTING MCPAs

Distribution

14. An analysis for WCPA of the existing global representative system of marine protected areas was published by Kelleher *et al* in 1995. It found that MPAs are not evenly distributed around the world's oceans. The researchers divided the marine area of the world into 18 regions based on biogeographical criteria, with some considerations to political boundaries. They analysed the distribution of the 1,306 MPAs in their inventory (those with a sub-tidal component).

Marine Region	**Number of MPAs**	**Percentage of Total**
Antarctic	17	1.3
Arctic	16	1.2
Mediterranean	53	4.0
N.W. Atlantic	89	6.8
N.E. Atlantic	41	3.1
Baltic	43	3.2
Wider Caribbean	104	7.9
West Africa	42	3.2
South Atlantic	19	1.4

Marine Region	**Number of MPAs**	**Percentage of Total**
Central Indian O.	15	1.1
Arabian Seas	19	1.4
East Africa	54	4.1
East Asian Seas	92	7.0
South Pacific	66	5.0
Northeast Pacific	168	12.8
N.W. Pacific	190	14.5
S.W. Pacific	18	1.3
Australia/N.Z.	260	19.9
Total	**1,306**	

15. The number of sites per region range from 260 to 15. Fifty-five per cent of MPAs were in only four regions (the Wider Caribbean, Northeast Pacific, Northwest Pacific, and Australia/New Zealand). Six regions (the Arctic, South Atlantic, Central Indian Ocean, Arabian Seas, and Southeast Pacific) had fewer than 20 MPAs each, and together accounted for less than 10 percent of the total.

V. DATA LIMITATIONS RELATING TO THE NUMBER, EXTENT AND DISTRIBUTION OF EXISTING MCPAs

16. Kelleher et al (1995) is the only existing global inventory of MPAs, and plans are underway to update it within the next year or two.

17. New marine and coastal protected areas are designated worldwide every year, and this makes an analysis of the coverage offered by them increasingly difficult. An evaluation of the extent and distribution of existing marine and coastal protected areas can be difficult in regions where dozens, or even hundreds, of areas are designated under different regulatory regimes.

18. Inventories of marine and coastal protected areas are necessary for effective planning, and national and regional MPA databases are becoming more common. Some examples include a database of marine protected areas for the Wider Caribbean Region (over 300 marine protected areas listed), and the online GIS database created by Canada's Department of Fisheries and Oceans (DFO). This database provides an inventory in the context of integrated coastal management (Hale and Farrow, 2001).

VI. REPRESENTATION OF EXISTING MCPAS

Rationale

19. Representativeness at the genetic, species and ecosystem levels is a useful measure of the extent to which MCPAs protect the full range of biological diversity. The following discusses representativeness on the ecosystem level, which provides the broadest scale for such measurement. However, representativeness on the species and genetic levels is also important for design of MCPAs.

Ecosystem level

Problems of classifying ecosystems/biogeographic units

25. For the terrestrial environment, numerous biogeographical classification systems currently exist, although no one system is universally accepted. Such previously established systems have not proved sufficient when applied to the three-dimensional and dynamic-natured marine environment. In such an environment, boundaries to the dispersal of organisms exist, but are much more subtle, and those of inter-tidal, shallow-waters, and deep-sea species are not necessarily in the same geographic location.

26. Although some regional classification systems have been developed for marine and coastal biological diversity, there is presently no generally accepted global system, making consistency and comparison a concern. Existing classification systems have been developed for a variety of purposes and at a variety of spatial and resolution scales, accounting for the lack of commonality.

27. Systems which have been developed include the following:

(a) For a recent study, reported by Kelleher *et al* (1995), 17 regional working groups developed or adopted a classification system that it considered the most appropriate for its marine region. It was not feasible to adopt such a system for the 18th region, the Antarctic, because there was no agreement on an appropriate classification system;

(b) The EUNIS classification is being developed for the European Union in the framework of the European Union Habitat Directive;

(c) The Biomar classification system was developed for the United Kingdom and Ireland;

(d) The United States National Oceanographic and Atmospheric Administration (NOAA) has developed marine habitat classification schemes for Florida, the United States Caribbean, and Hawaii;

(e) Holthus and Maragos (1995) published a tropical marine ecosystem classification for the insular Pacific based upon workshops and reviews at UNEP regional seas, and Pacific Science Association meetings;

(f) The French have developed extensive classifications for coral reefs in the Indian and Pacific oceans

28. Other factors which may be relevant in assessing ecosystem representativeness are spawning areas or other recruitment sites, key breeding and migration areas, and areas of high productivity.

29. In addition, the relation of biogeographic units or habitats to each other should form a part of the assessment process when considering connectivities between MCPAs.

Coverage in terms of biogeographic units

30. The study by Kelleher *et al* (1995) assessed the degree to which existing Marine Protected Areas (MPAs) represent major marine biogeographic types in each of the 18 marine regions used.

Marine Region	**Number of MPAs**	**Number of Biogeographic Zones with at least one MPA**	**Number of Biogeographic Zones with no MPAs**	**% of Biogeographic zones with at least one MPA**
Antarctic	17			
Arctic	16	4	1	80
Mediterranean	53	8	2	80
Northwest Atlantic	89	10	0	100
Northeast Atlantic	41	5	1	83
Baltic	43	8	1	89
Wider Caribbean	104	5	1	83
West Africa	42	4	1	80
South Atlantic	19	4	1	80
Central Indian Ocean	15	4	2	67
Arabian Seas	19	8	5	62
East Africa	54	3	2	60
East Asian Seas	92	8	0	100

/…

Marine Region	Number of MPAs	Number of Biogeographic Zones with at least one MPA	Number of Biogeographic Zones with no MPAs	% of Biogeographic zones with at least one MPA
South Pacific	66	12	8	60
Northeast Pacific	168	8	1	89
Northwest Pacific	190	7	1	88
Southwest Pacific	18	3	3	50
Australia/New Zealand	260	17	2	90
Total	**1,306**	**118**	**32**	**79**

31. Across all regions, 118 out of 150 zones (about 79%) had at least one MPA, while 32 (about 1%) zones had no MPAs. Two regions, Northwest Atlantic and East Asian Seas, were identified as having MPAs in every zone. For those zones that had MPAs, the median number of MPAs per biogeographic zone was four.

Coverage in terms of extent within biogeographic units

32. Although the lack of a global classification system makes comparisons difficult, Kelleher et al, 1995 found that in the overwhelming number of cases much less than one percent of the total area of each marine biogeographic zone was included in MPAs. Note that the recommendations of the IVth World Congress on National Parks and Protected Areas (IUCN 1993) call for ten per cent of each biome of the world to be included in protected areas.

Other gaps in coverage

33. There are clearly many gaps in the biogeographic coverage. For example, although 50% of the earth's surface is occupied by high seas areas (open ocean and deep sea environments lying beyond the 200 nautical mile limit of the Exclusive Economic zones of coastal states), very few MPAs extend to or cover these areas.

VII. THE VALUE OF MARINE AND COASTAL BIOLOGICAL DIVERSITY

Introduction

34. Approximately 66% of the human population, or close to four billion, now live within 80 kilometres of the coast, with this figure expected to increase to 75% by 2020. Marine and coastal ecosystems and the biological diversity that comprise them hold significant direct and indirect values for local communities using the resources, as well as for global humankind:

Marine and coastal biological diversity

35. Of the currently described 1.7 million species, only 15 % are marine; yet the oceans contain more animal phyla than their freshwater or terrestrial counterparts. Thirty-five animal phyla are found in marine habitats and of these, 14 have no representatives in freshwater or terrestrial habitats. This is in

contrast to the 14 animal phyla found in freshwater habitats, with none being endemic; and the 11 animal phyla found in terrestrial habitats, with only one being endemic (Briggs, 1994; Ray and Grassle, 1991 both in Gray, 1997). This rich diversity described at the phylum level may be an indication of greater species level diversity in the oceans than is currently known. Coral reef ecosystems are already known to be among the richest habitats in species diversity. Hydrothermal vents are currently poorly understood, yet are already demonstrating unique diversity and reshaping knowledge of biological processes. Recent research on deep-sea ecosystems indicates that far more species may exist there than were previously thought, with estimates ranging from 500,000 to 10 million species (Gray, 1997).

Direct values

36. Marine and coastal biological diversity offers many direct physical, economic, social and cultural benefits to humankind, as sources of food, medicine, natural and industrial products, and as locations for education, recreation and tourism. The Executive Secretary produced two previous notes that offer greater detail regarding some of the direct values of marine and coastal biological diversity: UNEP/CBD/SBSTTA/4/11 on the development of approaches and practices for the sustainable use of biological resources including tourism; and UNEP/CBD/COP/5/INF/7 on the applications of marine and coastal genetic resources and their derivatives.

- Sixteen percent of all animal protein consumed worldwide comes from the ocean (NOAA, 1998).

- In 1994, nearly 32 million tonnes of fish, representing nearly 30 percent of the total world fisheries production, were used for livestock feed (FAO, 1998).

- The fisheries industry provides employment for 28.5 million fishermen worldwide (van der Heijden and van Zwol, 2000).

- No less than 195 countries exported part of their fisheries production in 1996, earning US$ 52.5 billion, representing 11% of the value of agricultural exports (FAO, 1998).

- Arabinosides extracted from the sponge, *Tethya crypta,* have led to more than US $50 million annual sales in antiviral medicines (NOAA, 1998).

- In the United States, the National Cancer Institute (NCI) indicates at least a dozen agents from marine sources currently in pre-clinical or clinical development to treat cancer (NCI, 2000).

- In 1992, marine organisms and aquarium products accounted for over 23% of the US$ 900 million in United States retail sales in pet supplies, or US$ 207 million (Baquero, 1999).

- Nature-based tourism is a growing segment of the tourism industry, which accounted for US$ 260 billion in 1995 (McNeely, 1997). Coastal destinations are the primary destination for this growing sector.

Indirect values

37. The indirect values of marine and coastal biological diversity to humankind are realized through the environmental services provided by healthy ecosystem function. These environmental services have recently been valued at US$ 5.2 trillion per year for open ocean systems and US$ 11.7 trillion for coastal ecosystems (Costanza *et al,* 1997). Examples of these services include nutrient cycling, protection of

coastal regions and resources, pollutant detoxification, waste assimilation, microclimate stabilization and carbon sequestration.

- Support by mangroves of agriculture, fishing and cottage industries in Indonesia has been valued at US$ 536 million (Ruitenbeek, 1992 in UNEP, 1995).

- Watershed protection for marine tourism in the Philippines has been valued at US$ 13.9-19.2 million (Hodgson and Dixon, 1988 in UNEP, 1995).

- Watershed protection for fisheries in the Philippines has been valued at US$ 6.2-8.1 million (Hodgson and Dixon, 1988 in UNEP, 1995).

- Marine plants produce 30-50% of the global oxygen supply (NOAA, 1998), while removing carbon dioxide.

- The ocean reservoir contains 75-80% of global carbon (Eichbaum et al., 1996) and gross productivity in coral reef and estuarine ecosystems can reach 20 g of carbon per square metre per day (Norse, 1993).

Option values

38. The option value of biodiversity refers to the possibility of a natural resource having some value in the future. Each extinction therefore represents a loss in future options (IUCN, 2001).

Existence values

39. Existence value refers to the value of simply knowing that certain species and other components of biodiversity exist. This value is an intrinsic one, meaning that biodiversity is worth protecting regardless of its value to humans. Marine and coastal biological diversity and the ecosystems they compose hold cultural and aesthetic values for humankind. The regard that society places on retaining these ecosystems for future generations demonstrates the recognition of their intrinsic value.

VIII. EFFECTS OF MCPAs

Introduction

40. MCPAs may be created for a range of potential management purposes. Any assessment of effectiveness of MCPAs needs to focus on the extent to which they achieve their intended management purpose.

Protection of biological diversity

41. A strong endorsement of the effectiveness of marine protected areas, and in particular marine reserves (no-take areas) was recently given by an international team of scientists convened at the National Center for Ecological Analysis and Synthesis (NCEAS). According to the "Scientific Consensus Statement on Marine Reserves and Marine Protected Areas" written and signed by the group, marine reserves have a number of ecological effects. Within the reserve boundaries, these include:

- Long-lasting and often rapid increases in the abundance, diversity and productivity of marine organisms, due to decreased mortality, decreased habitat destruction and indirect ecosystem effects;

- Reduction in the probability of extinction for marine species resident within reserves.

Outside the boundaries of a reserve, its ecological effects include:

- According to the few studies that have examined spillover effects, the size and abundance of exploited species increase in areas adjacent to reserves;

- There is increasing evidence that reserves replenish populations regionally via larval export.

The statement also noted that full protection is critical to achieve the full range of benefits, and that marine protected areas do not provide the same benefits as marine reserves.

42. There is strong evidence demonstrating the conservation of species within "no-take" protected areas, and thus, conservation of biological diversity (Allison *et al*, 1998; Bohnsack, 1998; Russ and Alcala, 1998, 1997, 1996). Therefore, the protection of "critical habitat" for commercially important species or the identification of "flagship species" for preservation within "no-take" MCPAs may facilitate the conservation of all components of an ecosystem. However, as the Ngerukewid Islands Wildlife Preserve demonstrates (Idechong and Graham, 1998), gazetting of an area, in itself, does not protect that area from illegal activities and a management capacity must exist to facilitate compliance.

43. Protected areas that restrict or prohibit fisheries uses can protect the respective marine habitats from degradation caused by destructive fishing practices (NRC, 1999; Allison *et al*, 1998; Bohnsack, 1998), and thus preserve ecosystem function. Trawling for bottom-living fish species destroys habitat for many non-target species and alters ecosystem dynamics (Dayton, 1993). It has been estimated that the entire seabed of the North Sea is trawled over at least twice per year (Sydow, 1990 in Gray, 1997). Also, the common use of explosives for fishing on coral reefs reduces the structural complexity of the habitat (Roberts and Polunin, 1993), which has been shown to have a strong positive correlation with species diversity (Roberts and Ormond, 1987). Chemical use for fish collection for human consumption (King and Faasili, 1998; Gray, 1996) and for the marine ornamental trade further threatens ecosystem dynamics through the resulting damage to ecosystem components.

Ngerukewid Islands Wildlife Preserve, Palau: (Idechong and Graham, 1998)

Objective: With its 40-year history as a strict nature conservation area, the Ngerukewid Islands Wildlife Preserve in the Rock Islands of the Republic of Palau is one of the longest standing protected areas in the Pacific Islands region. The enabling legislation declares that the single objective of the preserve to be **wilderness preservation**. The law prohibits the taking and disturbance of any terrestrial or marine life in the Preserve, but does not prohibit entry.

Effects: The primary use of the Rock Islands is **tourism**, with about 60,000 visitors per year. Tourists come mainly to dive the barrier reef surrounding Palau's Rock Islands, an activity not available in the shallow reef platform of the Ngerukewid Islands.

A 1988 resource survey of the **biological diversity** of the Ngerukewid Preserve identified three major marine habitat types within the Preserve. The survey indicated that the Preserve contains 200–300 of the approximately 1,400 species of fish, and about 82 species of the 400 species of hard corals reported in Palau. Overall, the survey found that this diversity was in unusually pristine condition. The Ngerukewid Preserve is largely representative of the habitats of the high limestone islands and surrounding reefs and lagoons of Palau's southern barrier reef system; but lacking a large variety of habitat types, the Preserve is not considered particularly biologically diverse compared with the whole of Palau. In spite of this, the Ngerukewid Islands are the least modified of the Rock Islands and thought to have the greatest chance of maintaining their diversity because of the protected status. The survey contributed to the enactment in 1991 of the Natural Heritage Reserves System Act, a legal framework for establishing a more representative system of protected areas within Palau.

The Rock Islands contain Micronesia's most important nesting beaches for the hawksbill. Although the taking of turtles and turtle eggs from beaches is prohibited in Palau, poaching is common. Surveys of Rock Islands beaches have found a high degree of poaching in the Preserve, but have also suggested that the proportion of nests poached in the Preserve is less than outside the Preserve (Guilbeaux *et al*, 1994 in Idechong and Graham, 1998). Nevertheless, the population of nesting hawksbills has dwindled substantially both within and outside the reserve. It is possible that the preserve is too small to stop or reverse the downward trend in nesting hawksbills.

Following the 1988 survey of Ngerukewid, the government undertook an environmental **education** campaign. Centered on a video that highlighted the values of Ngerukewid, the campaign sparked a growth in public pride in Palau's environment.

Scientific research

44. Areas set aside for strict conservation through the establishment of MCPAs may serve as sources of vital baseline data on individual species and ecosystem function (NRC, 1999; Bohnsack, 1998; Allison *et al*, 1998; Dayton, 1993). They may serve as monitoring sites to evaluate both human-induced and natural changes in the marine environment. In this capacity, they can allow for estimates of sustainable use of living resources and further provide undisturbed locations to monitor global scale change (Agardy, 1994).

Leigh Marine Reserve, New Zealand: (Walls, 1998)

Objectives: The Leigh Marine Reserve was gazetted in 1975, over long-standing concerns regarding the level of harvesting of marine life and the effect this may have on **scientific research** at the nearby University of Auckland marine laboratory.

Effects: Creese and Jeffs (1993 in Walls, 1998) summarized the **scientific research** conducted within the Leigh Marine Reserve between 1975 and 1991. They found that the reserve provided significant opportunities for scientific research. The close proximity of the laboratory to the reserve facilitated research on ecological interaction, particularly for commercially exploited species. The protected status of the area allowed the area to serve as an experimental control area.

Although the main objective of the area was research, the numbers of visitors to the reserve began to increase around 1984 and soared to an estimated 100,000 by 1993. The increase in **recreation and tourism** to the reserve was attributed to the large number and easy accessibility to rocklobster *Jasus edwardsii*, snapper *Pagrus auratus* and red moki *Cheilodactylus spectabilis* for a growing number of divers and snorkellers. Several local businesses opened to capture the potential market: SCUBA shops and fill stations, snorkel equipment rental shops, cafes, a marine education centre, a camp ground, and a glass bottom boat operation. A socioeconomic study of the reserve showed that residents of the nearby township believed the community would be worse-off economically if the reserve did not exist (Cocklin and Fllod, 1992 in Walls, 1998).

Since the establishment of the reserve, **marine life** within the reserve has increased. The density and mean size of rocklobster in the reserve increased substantially over populations in similar, but fished, habitats (MacDiarmid and Breen, 1993 in Walls, 1998). The abundance of red moki increased and an obvious trend in increased snapper size was observed (Cole *et al*, 1990 in Walls, 1998).

In 1985, commercial rocklobster fishermen began targeting the boundaries of the reserve and later tagging studies concluded that the reserve enhanced the local fishery (Kelly *et al*, 1997 in Walls, 1998).

The immense popularity of the area among the public has altered the behaviour of some fish, snapper and blue cod *Parapercis colias* in particular, because fish feeding became popular at the heavily used access

point. However, this feeding only occurred at this one location, which is less than 5% of the reserve area and well away from sites used for scientific research.

Tourism and recreation

45. MCPAs may provide areas in which the public and tourists can experience the marine environment and enjoy water-based recreational activities.

46. Tourism may provide significant economic benefits to the nation and local community. Caribbean countries, which attract million of visitors annually to their beaches and reefs, derive one half of their gross national product from the tourism industry, valued at US$ 8.9 billion in 1990 (Jameson *et al*, 1995). Several examples from within that region demonstrate the economic value of MCPAs when properly incorporated into a management strategy (IUCN, 1999):

- Virgin Islands National Park, with 750,000 visitors per year, produces 11 times more economic benefits than it costs;

- Divers at the Bonaire Marine Park (Netherlands Antilles) pay a US$ 10 fee each year, which covers all the operational expenditure of the park, and one estimate shows that divers contribute approximately US$ 30 million per year to the islands' economy;

- The relatively small marine protected areas in the Cayman Islands attract about 168,000 divers a year, who spend about US$53 million.

Great Barrier Reef Marine Park, Australia: (Tanzer, 1999)

Objectives: The Great Barrier Reef Marine Park is a multiple-use protected area supporting a wide variety of human activities. Commercial and recreational fisheries within the park are of critical importance economically, culturally and ecologically. Within the area, 16,398 sq km are closed to fishing and 88,679 sq km are closed to bottom trawling; fishing in the remaining areas is regulated through permits and zoning.

Effects: Studies of the ecological impacts of trawling and line-fishing are ongoing, but identified concerns to marine and coastal biological diversity include bycatch, especially of vulnerable and threatened species, excess capacity in some fisheries, and the need for increased surveillance and enforcement. The results of an integrated monitoring programme over the last eight years indicate that the general ecological state of the park is good and that human use is increasing at generally sustainable levels. However, it has been identified that a management framework needs to be implemented to deal with problems of excess capacity and the environmental impacts of the trawl fishery. Also, the need for careful monitoring of the growing reef line fishery has been recognized as well as the need for the development of a precautionary approach towards the sustainability of the fishery.

Education

47. As in the Leigh Marine Reserve, New Zealand (Walls, 1998) and Ngerukewid Islands Wildlife Preserve, Palau (Idechong and Graham, 1998), MCPAs can play a valuable role in the education and training of the public regarding the threats to biological diversity and the opportunities for its sustainable use (Gubbay, 1995). UNESCO's Man and the Biosphere Programme, with almost 400 sites, specifically delineates one of the functions of biosphere reserves to be environmental education and training. The involvement of stakeholders and user groups in the MCPA planning process itself has been an effective educational tool, instilling greater stewardship among users (Agardy, 1994), while the resulting visible improvements in ecosystem health serve as a continuing reminder (Eichbaum *et al*, 1996).

Wilderness protection

48. As the Ngerukewid Islands Wildlife Preserve in Palau demonstrates (Idechong and Graham, 1998), MCPAs may be effective in the protection of wilderness areas, conserving the unmodified character of those areas. The idea of wilderness protection implies minimal human impact on those sites or at least portions of those sites, and therefore consideration in management plans must be given to limit human impact in MCPAs established for this objective. The impacts from activities on land and in the sea outside the boundaries of MCPAs, such as pollution and over-exploitation, or directly from allowed access within MCPAs, have the potential to relegate MCPAs ineffective for wilderness protection, particularly if they are small.

Conflict mitigation and resolution

49. In managerial terms, MCPAs may offer an opportunity for the integrated management of multiple resources concerning multiple stakeholders (Agardy, 1994). The use of such a mechanism can serve to minimize jurisdictional disputes in management and provide a means for stakeholder involvement, thus reducing user conflict. Stakeholder involvement facilitates economic valuation for users, creating opportunity for both conservation of biological diversity and truly sustainable use (Kelleher, 1999; Dixon *et al,* 1993). This is the case with the management of the blue mussel in the Wadden Sea. In order to maintain a natural system and a sustainable mussel fishery it was agreed at the 1991 Ministers conference to limit the negative ecological impact of mussel fishery on the environment and therefore, close some inter-tidal and sub-tidal areas (Enemark *et al,* 1998). Without the existing Wadden Sea Cooperation and Management Area, such coordinated effort between three WHAT? would certainly have been more complicated.

Environmental services

50. Through the preservation of all components of an ecosystem, MCPAs can maintain ecosystem dynamics and thus protect the various environmental services that marine and coastal habitats provide. Although these effects of MCPAs are difficult to physically measure and economically assess, their significance to human well-being is worthy of consideration. These services include local nutrient cycling, shoreline protection functions, waste assimilation functions such as detoxification of pollutants; and wider functions such as microclimate stabilization and carbon storage (NRC, 1999; NOAA, 1998, Eichbaum *et al,* 1996). Several valuations of these services on a regional scale are offered in the Global Biodiversity Assessment (UNEP, 1995).

Natural/cultural features

51. Recognition by the Parties of the intrinsic and cultural values of biological diversity is evident in the preamble of the Convention. The Parties further identified in annex I, that ecosystems and habitats of cultural importance be established under Article 8. MCPAs may facilitate the preservation of cultural heritage developed over generations around marine and coastal resources, by providing designated areas of traditional use by local and indigenous peoples (Eichbaum *et al*, 1996; Agardy, 1994; Salm and Clark, 1989). The 38 small community-owned village fish reserves in Samoa (King and Faasili, 1998) were established in traditional fishing areas in an effort to allow for sustainable use of traditional living marine resources.

IX. EFFECTIVENESS OF MCPAs

Asessments of effectiveness

52. As part of a recent report, field surveys were performed on 383 MPAs (Kelleher *et al*, 1995), to assess management effectiveness, or how effective MPAs were in achieving the objectives for which they were intended.

Management effectiveness level of MCPAs: (Kelleher *et al*, 1995)

Management effectiveness	Number of MPAs	Percentage of MPAs
Achieved objectives	117	31%
Partially achieved objectives	155	40%
Failed to achieve objectives	111	29%

53. This data would suggest that nearly one third of existing MCPAs fail to achieve their management objectives.

Reasons for lack of effectiveness

54. Little social science research exists to explain the variation in MCPA performance. Kelleher *et al* (1995) reported commonly recurring themes for the failure of MPAs in achieving their objectives:

(a) Insufficient financial and technical resources to develop and implement management plans or lack of trained staff;

(b) Lack of data for management decisions, including information on the impacts of resource use and on the status of biological resources;

(c) Lack of public support and unwillingness of users to follow management rules, often because users have not been involved in establishing such rules;

(d) Inadequate commitment to enforcing management;

(e) Unsustainable use of resources occurring within MPAs;

(f) Impacts from activities in land and sea areas outside the boundaries of MPAs, including pollution and overexploitation;

(g) Lack of clear organizational responsibilities for management and absence of coordination between agencies with responsibilities relevant to MPAs.

55. A recent comparative study of three MPAs in the Wider Caribbean suggested that positive social and biological outcomes for those areas were correlated with clear boundaries, well-defined resource-use rights, accessible conflict-resolution mechanisms, and user self-governance rights (Mascia, 2000).

Paper parks

56. Many marine and coastal protected areas exist on paper, but offer little protection to an area in practice. These “paper parks” are relatively common. For example, estimates of the percentage of some

countries' MPAs that exist primarily on paper range as high as 80-90% (Hockings *et al*, 2001). Reasons for the high percentage of paper parks ranges from funding shortages to lack of community support. Many MCPAs are under-resourced, lacking sufficient trained staff, funding, management guidance and evaluation.

Lack of enforcement

57. Lack of enforcement is often cited as a reason for MCPA failure, and policing is usually necessary to prevent poaching or other breaching of MCPA regulations. In some cases, for example at the Port Honduras Marine Reserve in Belize and the Portland Bight Sustainable Development Area in Jamaica, local fishermen work as rangers, and the protected areas enjoy a high level of community support. Such acceptance by the local community can indeed be important for the success of a MCPA. Other actions to improve effectiveness include making the MCPA financially sustainable and strengthening management effectiveness through training and other mechanisms.

Conflicts between objectives

58. A potential source of failure is conflicts between objectives. For example, there are potential conflicts between scientific research and recreational use, or between the conservation of biodiversity and recreational use. For example, fish feeding may change fish behaviour and distribution, and trampling may damage coral and other sensitive biota. These potential conflicts are not inevitable, and can be minimised through mangement. For example the Leigh Marine Reserve demonstrates (Walls, 1998) that MCPAs may incorporate recreational and tourism activities with minimal impact.

Measuring effectiveness

59. Biodiversity objectives of marine protected areas tend to be diffusively defined and thus assigning objectives and targets to measure effectiveness can be somewhat complicated. The scale at which biodiversity is defined and measured, whether it is on the level of genes, species or ecosystems, must form a key component of any target. The central uncertainty in developing conservation targets for biodiversity MCPAs is whether the habitats, and biota within these habitats, are in fact representative of the larger system. In addition, ecosystem-level alterations might generate non-linearities due to changes in trophic structure. A recent study by Syms and Carr (2001) discussed targets for evaluating MPA effectiveness. Some suggested targets are reviewed here.

60. At the genetic level, suggested targets include intra-population genetic diversity of endangered and threatened species.

61. At the species level, possible targets include increased diversity in species composition; increased local population viability of endangered or threatened species; and increased stability and abundance of indicator, keystone, umbrella or flagship species.

62. At the community level, effectiveness parameters should be chosen to reflect processes that operate above the level of individual species. Species richness and diversity are such measures, but usually include only a subset of the community. For example, microbial diversity is rarely incorporated into measures of community richness. In addition, taxonomic differences might result in different researchers reporting different richness values. An alternative would be the measurement of species richness with respect to ecological role or trophic organization.

63. Landscape properties are particularly important for evaluating networks of protected areas. Measures would include habitat types, size, number, shape and arrangement. A stable landscape would require a balance of redundancy (i.e. the loss of one habitat type will not lead to loss of landscape

integrity) and complementarity (ie. many different habitat types must be incorporated into the landscape to ensure representativeness and diversity).

X. LINKAGES BETWEEN MARINE AND COASTAL PROTECTED AREAS AND SUSTAINABLE USE OF MARINE AND COASTAL BIODIVERSITY

Problems in sustainable use

64. Marine and coastal ecosystem functioning and resilience depend on a dynamic relationship within species, among species and between species and their physical environment. The current state of worldwide fisheries shows that single species management strategies that assume equilibrium between exploitation and stock replenishment without considering ecosystem dynamics, are failing. Among the major fish stocks for which information is available, an estimated 44% are fully exploited, 16% are over fished and another 6% appear to be depleted (FAO, 1998). Multi-species management requires a wider understanding of ecosystem dynamics and physical oceanography, or an integrated management strategy that conserves ecosystem structure and function, in order to maintain ecosystem benefits.

Providing refuges for vulnerable portions of fish stocks

65. The ecological value of MCPAs in fisheries management is through the provision of refuges in which commercially important stocks grow and reproduce without interference. There is evidence that MCPAs can conserve some commercially important species through the preservation of reproductive populations (NRC, 1999; Allison *et al*, 1998; Bohnsack, 1998; Agardy, 1994), with marked increases in average size and density of individuals (IUCN, 1999; NRC, 1999; Roberts, 1995). For example, empirical evidence from monitoring density and biomass of large predatory coral reef fish, Serranidae, Lutjanidae, Lethrinidae and Carangidae, in two small marine reserves and at two control sites in the Philippines from 1983-1993, demonstrated a significant positive linear correlation between the mean density of large predators and the period of protection at both sites (Russ and Alcala, 1996). This supports the modeling performed by Holland and Brazee (1996), which suggests that MCPAs can sustain or increase yields for moderate to heavily fished fisheries. This same modeling, however, suggests that MCPAs may not be effective in the management of lightly fished fisheries; and in some cases MCPAs have not resulted in a higher density of target species (Ruckelshaus and Hays, 1997 in NRC, 1999).

66. Properly placed protected areas have been shown to be especially effective for large, long-lived fish, like groupers which become sexually mature after the age at which they become vulnerable to fishing pressure; or in species that demonstrate sequential hermaphroditism, where a single sex is subject to greater fishing pressure (Bannerot *et al*, 1987). Commercial fishing of some species has been shown to significantly alter the genetic composition of populations, through selection by size (Elliot and Ward, 1992). Additionally, fishing methods that do not discriminate by species make it possible for the most "catchable" species to become over-fished to the point of local extinction while the overall volume of the catch is not significantly decreased. This process may lead to the progressive elimination of those species (Munro, 1999). As in some parts of South Africa, recovery of over-exploited inshore fisheries such as galjoen, *Coracinus capensis*, may be possible through the establishment of MCPAs (Msiska *et al*, 2000).

67. Many have suggested that MCPAs that do not allow any harvesting of species may sustain or increase fishery harvests in the region outside of the protected area (Bohnsack, 1998, 1993; Roberts and Polunin, 1993). The concept is based on the idea that protected areas act as a natural hatchery and nursery in which reproduction and growth are not impeded. Populations that develop in reserves supplement surrounding fisheries through export of larvae, as well as adults. In addition to the evidence with rock lobster in the Leigh Marine Reserve previously presented (Walls, 1998), tagging studies in South Africa support that excess stocks of fish in reserves have moved to adjacent exploited areas (Attwood and Benett, 1994 in King and Faasili, 1998).

68. However, in consideration of protected areas as a tool for living resource management, species' life history, natural barriers, spatial and geographic distribution, and oceanic variables all must be considered. Species with a pelagic phase in their life history makes determination of boundaries for MCPAs difficult. MCPAs are ineffective for conservation of species with both planktonic larvae and planktonic or pelagic adults. However, species with planktonic larvae or large adult ranges may have stages dependent on some critical habitat such as nursery areas or spawning sites. For species that are predominantly sessile, MCPA effectiveness will be highly dependent on the larval dispersal pattern. Understanding the relationship of protected area size and design to the movement of individuals, particularly the dispersal of juveniles, is a critical step in understanding the value of MCPAs on sustainable use of marine and coastal living resources (Allison *et al*, 1998; Russ and Alcala, 1998).

Other contributions

69. Increasingly, MCPAs are being recognized as useful supplements to other methods of fisheries management. Evaluations of the economic value of MCPAs are becoming increasingly informed by empirical biological data and increased understanding of socio-economic values, leading to new methodologies for assessment. One evaluative technique, the Rapid Appraisal for the Status of Fisheries (Rapfish), has recently been adapted to allow for the measurement of MCPAs performance in regards to the following: maintenance of living and non-living resources; market value of the MCPA and its resources; social expectation; maintenance of ecosystem function; and management (Alder *et al*, 2000). Such methodologies and their resulting assessments will allow for increased evaluation of MCPA effectiveness towards the sustainable use of commercially important species.

XI. INTERNATIONAL AND REGIONAL INITIATIVES DESIGNATING MARINE AND COASTAL PROTECTED AREAS

70. Many international, regional and national initiatives currently facilitate the designation and management of marine and coastal protected areas. Gazetting of such sites provides mechanisms for recognizing the importance of key sites that meet certain minimum criteria and for promoting conservation. Some initiatives further facilitate access to funding for biological diversity conservation. The largest international source of funding for biological diversity conservation is the Global Environment Facility (GEF), administered by the World Bank, United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). It presently provides about US$ 100 million annually to marine conservation projects in over 30 countries. Other sources of international funding include the regional development banks, such as the Asian Development Bank (ADB), the UNDP, bilateral-aide agencies and international non-governmental organizations.

International initiatives designating marine and coastal protected areas

United Nations Educational, Scientific and Cultural Organization's Man and the Biosphere Programme (UNESCO/MAB)

71. The UNESCO Man and the Biosphere Programme (MAB) establishes "Biosphere Reserves" of various types throughout the world, currently nearly 400 sites. The "World Network of Biosphere Reserves" is comprised of reserves having one or more core areas, which are securely protected sites for conserving biological diversity, monitoring minimally disturbed ecosystems, and undertaking non-destructive research; and a combination of multi-use buffer zones and transition areas surrounding those core zones, managed for the economic benefit of local populations. Article 3 of the Statutory Framework of the World Network of Biosphere Reserves delineates three functions of biosphere reserves: to conserve landscapes, ecosystems, species and genetic variation; to foster economic and human development which is socio-culturally and ecologically sustainable; to support for demonstration projects, environmental education and training, and research and monitoring related to local, regional, national and global issues of conservation and sustainable development. The combination of these three functions and the design

concept biosphere reserves is very appropriate for marine environments where boundaries are difficult to delineate. Kelleher *et al* (1995) report 90 Biosphere Reserves, or about 26%, with a marine or coastal component.

United Nations Educational, Scientific and Cultural Organization's Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO/WHC) (1972)

72. The establishment and management of World Heritage Sites under the World Heritage Convention (WHC) is a mechanism to provide identification, protection and preservation of cultural and natural heritage considered to be of outstanding value to humanity. Accepted sites are inscribed on the World Heritage List as natural, cultural, or mixed natural/cultural sites. Under Article 2 of the WHC, natural heritage is considered: natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view; geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation; or natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty. In 1995, Kelleher *et al*. reported there to be 31 World Heritage Sites having marine or coastal components, 14 marine and 17 coastal.

Convention on Wetlands of International Importance especially as Waterfowl Habitat (The Ramsar Convention)(1971)

73. The Ramsar Convention seeks to develop and maintain an international network of wetlands that are important for the conservation of global biological diversity and for sustaining human life through the ecological and hydrological functions they serve. Article 2 of that Convention calls upon each Contracting Party to designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance. The boundaries of each wetland may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands, especially where these have importance as waterfowl habitat. Although initially focused on wetlands for migratory birds, the Convention now takes into account the full range of wetland functions. At its seventh Conference of Parties (COP) in 1999, Ramsar Contracting Parties recognized that many marine and coastal wetland types are under-represented in the current designations, and placed particular emphasis on further designations for mangroves and coral reefs. As part of further assistance to contracting Parties in addressing this, the Convention's Scientific and Technical Review Panel is currently developing guidance on the selection and designation of mangrove and coral reef sites, for consideration by COP8 in 2002.

74. To date, there are 1045 designated wetlands of international importance (Ramsar sites), of which 479 sites in 79 countries include coastal/marine habitats (and of these 428 are listed primarily for coastal/marine habitats. The combined area of the marine and coastal habitats protected under Ramsar exceeds 210,000 sq km. These include sites that meet the following habitat criteria: shallow marine waters, marine beds (seagrass and algal beds), coral reefs, rocky shores, sand/shingle, estuarine waters, tidal mudflats, salt marshes, mangrove/tidal forest, coastal brackish/saline lagoons, and coastal fresh lagoons (Kelleher *et al, 1995).*

Convention on the Conservation of Migratory Species of Wild Animals (CMS, 1979)

75. The Convention on the Conservation of Migratory Species is one of five global biodiversity-related treaties. It aims to conserve migratory species (avian, marine and terrestrial). It requires parties that are range States of appendix 1 migratory species (those in danger of becoming extinct) to take strict protection measures including conserving and restoring important habitats. This may include creating protected areas. Parties that are range States of appendix II species conserve and manage individual of groups of migratory species. The agreements are to address, among other things, a network of suitable

habitat, as well as for conservation, restoration and protection of suitable habitat, including creating protected areas. Three instruments within the Convention deal directly with marine and coastal species and provide for the establishment of protected areas: seals in the Wadden Sea (1990); small cetaceans in the Baltic and North Seas (ASCOBANS, 1991); and cetaceans in the Mediterranean and Black Seas (ACCOBAMS, 1996). Additionally, the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) addresses migratory water birds whose migratory ranges include marine and coastal ecosystems. The Wadden Sea Seal Agreement includes a set of seal reserves closed to all activities during the main birthing and nursing period. ASCOBANS encourages Parties to work with others to develop criteria to define marine protected areas for small cetaceans. ACCOBAMS, although not yet in force, calls upon its Parties to create a network of specially protected areas that correspond to the needs of cetaceans. AEWA calls upon its Parties to identify sites and habitats for migratory waterbirds and encourage the protection, management, rehabilitation and restoration of these sites; and further to coordinate their efforts to ensure that a network of suitable habitats is maintained or, where appropriate, re-established throughout the entire range of each migratory waterbird species concerned.

The International Maritime Organization (IMO)

76. The International Maritime Organization (IMO) is responsible for the administration of a number of Conventions that address the prevention of marine pollution. IMO offers some degree of protection to areas under three designations.

77. "Special seas areas" (SSAs), defined in annexes of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), are established where the particular region has specific environmental concerns such as those due to a high density of shipping traffic. In these areas, more stringent standards for the discharge of pollutants are applicable: annex I applies to oil; annex II to noxious liquid substances; and annex V to garbage. Nine SSAs have been designated:

(a) North Sea (annex V);

(b) Baltic Sea (annex I, II, V);

(c) Mediterranean Sea (annex I, V);

(d) Black Sea (annex I, II, V);

(e) Red Sea and Gulf (annex I, V);

(f) Gulf of Oman (annex I, V);

(g) Gulf of Aden (annex I, V);

(h) Wider Caribbean (annex V);

(i) Antarctic (annex I, V).

78. Under the IMO General Provision on Ships Routing, "areas to be avoided" by ships of a certain size may be designated. There are 21 areas to be avoided, 12 of which have been established for protection of the environment:

(a) Grassholm Island and Small Lighthouse (United Kingdom);

(b) Shetland Islands (United Kingdom);

(c) Rochebonne Shelf, Bay of Biscay (United States of America);

(d) Cape Terpeniya (Russian Federation);

(e) Nantucket Shoals (United States of America);

(f) Channel Islands NMS (United States of America);

(g) Florida coast (United States of America);

(h) North-west Hawaiian islands (United States of America);

(i) Capricornia section of Great Barrier Reef (Australia);

(j) Aldabra and Assumption (Seychelles);

(k) Mahe (Seychelles);

(l) Bermuda (United Kingdom).

79. IMO also recognizes "particular sensitive seas areas" (PSSAs). Under resolution A.885 (21) on procedures for the identification of particularly sensitive sea areas and the adoption of associated protective measures and amendments to the guidelines contained in resolution A.720 (17), the General Assembly identifies a PSSA as an area, which needs special protection because of high ecological, socio-economic or scientific importance and because it may be vulnerable to environmental damage by maritime activities. Only the Great Barrier Reef in Australia and the Sabana-Camaguey Archipelago in Cuba have been so designated.

Regional initiatives designating marine and coastal protected areas

80. There are a number of regional agreements under which MCPAs can be established or that call upon Parties to establish MCPAs. These include the European Commission Habitats Directive, the Antarctic agreements, regional seas programmes of the United Nations Environment Programme (UNEP) and other regional seas programmes.

European Commission Habitats Directive (1992)

81. The aim of this directive is to ensure the maintenance of biological diversity through the conservation of natural habitats and of wild fauna. It provides for the establishment of a network of protected areas throughout the European Community. Commonly referred to as "Natura 2000", this network is designed to maintain the distribution and abundance of threatened species and habitats in both terrestrial and marine environments. Natura 2000 is comprised of "special areas for conservation". A special area for conservation is a site of community importance designated by the member State through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration of the natural habitats and/or the populations of the species for which the site was designated. Member States are obliged to contribute to Natura 2000 in proportion to the representation of the natural habitat types and species listed in two separate annexes within their territories.

Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol, 1991)

82. The Protocol on Environmental Protection to the Antarctic Treaty contains, in its annex V, provisions for the establishment of Antarctic specially protected areas (ASPAs) and Antarctic specially

managed areas (ASMAs). The main difference between them is that ASPAs may be designated to protect environmental, scientific, historic, aesthetic or wilderness values, while ASMAs are to protect activities. ASPAs include specially protected areas (SPAs), sites of special scientific interest (SSSIs) and specially reserved areas. There are 23 listed SPAs, a number of which can be considered coastal protected areas, and 36 SSSIs. Nomenclatural practice regarding SSSIs in the marine environment has not been consistent; there are five such sites: Chile Bay, Port Foster, South Bay, Bransfield Strait and East Dallmann Bay; but only the last two sites have been called "marine sites of special scientific interest". Although no reference was made in annex V to the category of specially reserved areas, it has been noted that such areas were to be managed by application of a permit system and were, therefore, most likely to be considered under the heading of ASPAs rather than ASMAs.

Regional seas programmes

83. The UNEP regional seas programme at present includes 12 regions, with two more currently under development. Additionally, there are three non-UNEP regional seas programmes, covering the Arctic, the North-east Atlantic (OSPAR), and the Baltic (HELCOM). These 17 regional seas currently cover the marine environment of more than 150 coastal States, as follows:

(a) UNEP regional seas programmes:

(i) Black Sea;

(ii) East Asian seas;

(iii) Eastern Africa;

(iv) Mediterranean;

(v) North-west Pacific;

(vi) Red Sea and Gulf of Aden;

(vii) Kuwait region;

(viii) South Asian seas;

(ix) South Pacific;

(x) South-east Pacific;

(xi) West and Central Africa;

(xii) Wider Caribbean;

(b) Other regional seas programmes:

(i) Arctic;

(ii) Baltic;

(iii) North-east Atlantic;

(c) Under development:

(i) North-east Pacific (i.e., Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama);

(ii) Upper South-west Atlantic.

84. Regional seas protocols concerning specially protected areas and wildlife (SPAW) have been adopted by the Parties of four UNEP regional seas conventions: Mediterranean, Caribbean, South-east Pacific and Eastern Africa.

Protection of the Arctic Marine Environment (PAME)

85. The Working Group on Protection of the Arctic Marine Environment (PAME) was established by Arctic Ministers at the second Arctic Ministerial Meeting in Nuuk, Greenland in September 1993. PAME addresses policy and non-emergency response measures related to protection of the marine environment from land and sea-based activities. PAME cooperates with the other working groups under the Arctic Environmental Protection Strategy (AEPS), but tasks do not currently address the establishment of MCPAs.

OSPAR Convention for the Protection of the Marine Environment of the Northeast Atlantic (1992)

86. The Convention for the Protection of the Marine Environment of the North-East Atlantic was opened for signature at the Ministerial Meeting of the Oslo and Paris Commissions in Paris on 22 September 1992. The Convention has been signed by all of the Contracting Parties to the Oslo or Paris Conventions. Under the OSPAR Convention, Parties are called upon to identify those marine species, habitats or ecosystems that need to be protected, conserved or restored; and to promote the establishment of a network of marine protected areas to ensure the sustainable use and protection and conservation of marine biological diversity and its ecosystems.

Convention of the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention, 1974/1992)

87. The 1992 Helsinki Convention was signed by all countries bordering on the Baltic Sea and by the European Community. It includes provisions for nature conservation. Under the Convention, Contracting Parties are obliged to gradually establish a system of coastal and marine Baltic Sea protected areas.

Annex

Authors cited in Jones, 1994:

A. NERC. (1973). *Marine wildlife conservation: an assessment of evidence of a threat to marine wildlife and the need for conservation measures.* NERC publications, Series B, No. 5.

B. Ray, C. (1976). *Critical marine habitats.* In *Marine parks and reserves, Tokyo, Japan.* IUCN Publication No. 37, Gland, Switzerland: IUCN.

C. Allen, R. (1976). *Urgent need: a global system of marine parks and reserves.* Parks 1(3): 1-3.

D. Ballantine, W. (1980). *The need for marine reserves in New Zealand.* In *Proceedings of Coastal Zone Management Seminar 3 (marine reserves):1-9*. Wellington, New Zealand: Ministry of Transport.

Ballantine, W. and D. Gordon. (1979). *New Zealand's first marine nature reserve: Cape Rodney to Okari Point, Leigh.* Biological Conservation. 15: 273-280.

E. Silva, M. and I. Desilvestre. (1986). *Marine coastal protected areas in Latin America: a preliminary assessment.* Coastal Zone Management Journal. 14(4): 311-347.

F. Lien, J. and R. Graham. (1986). *Marine parks and conservation: challenge and promise.* Volumes I-II. St. John's, Newfoundland: National and Provincial Parks Association of Canada.

G. Sybesma, J. (1988). *Marine resource protection versus marine tourism in Curacao: a management problem.* In *The Proceedings of the Sixth International Symposium.* 2: 411-414. Townsville, Australia.

H. Bohnsack, J., Kumpf, H., Hobson, E., Huntsman, G., Able, K. and S. Ralston. (1989). *Report of the concept of marine wilderness.* Fisheries. 14(5): 22-24.

I. Tisdell, C. and J. Broadus. (1989). *Policy issues related to the establishment and management of marine reserves.* Coastal Management. 17: 37-53.

J. Dhargalkar, V. and A. Untawale. (1991). *Marine biosphere reserves – need of the 21st century.* Journal of Environmental Biology. 12:169-177.

K. Kelleher, G. and R. Kenchington. (1992). *Guidelines for establishing marine protected areas.* Gland, Switzerland: IUCN Publications.

Literature cited

Agardy, T. (1994). *Advances in marine conservation: the role of marine protected areas.* Trends In Ecological Evolution. 9(7):267-270.

Agardy, T. (2000) *Site selection criteria and constraints for MPAs*. Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Alder, J., Sumaila, U., Pitcher, T. and D. Zeller. (2000). *Evaluating the performance of MPAs: a new approach. International conference on the economics of marine protected areas.* Fisheries Centre of the University of British Columbia.

Allison, G., J. Lubchenco and M. Carr. (1998). *Marine reserves are necessary but not sufficient for marine conservation.* Ecological Applications. 8(1) Supplement;79-S92.

Bannerot, S., W. Fox and J. Powers. (1987). *Reproductive strategies and the management of snappers and groupers in the Gulf of Mexico and Caribbean.* In *Tropical snappers and groupers: biology and fisheries management.* J. Poloviva and S. Ralston eds. Boulder, Colorado: Westview Press.

Baquero, J. (1999). *Marine ornamentals trade: quality and sustainability for the pacific region.* South Pacific Forum Secretariat and the Marine Aquarium Council - position document.

Barber, P.H. and S.R. Palumbi (2000). *What molecular genetics can contribute to the design of sustainable marine protected areas.* Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Bohnsack, J. (1998). *Application of marine reserves to reef fisheries management.* Australian Journal of Science. 23:298-304.

Bohnsack, J. (1993). *Marine reserves: they enhance fisheries, reduce conflicts, and protect resources.* Oceanus. Fall:63-71.

Bohnsack, J., B. Causey, M. Crosby, R. Griffis, M. Hixon, T. Hourigan, K. Koltes, J. Maragos, A. Simons, and J. Tilmant (2000). *A rationale for minimum 20% no-take reef protection*. Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Bryant, D., L. Burke, J. McManus, M. Spalding eds. (1998). *Reefs at Risk: A map-based indicator of threats to the world's coral reefs.* World Resources Institute: Washington DC USA.

Carr, M.H. and D.C. Reed (1993) *Conceptual issues relevant to marine harvest refuges: Examples from temperate reeffishes.* Canadian Journal of Fisheries and Aquatic Sciences 50: 2019-2028.

Castilla, J. and M. Fernandez. (1999). *Coastal marine community-ecosystem approaches in invertebrate multispecies management: "take" and "no-take" areas network and territorial use rights in fisheries (TURFs).* In *Proceedings of the Norway/UN conference on ecosystem approach for sustainable use of biological diversity.* Trondheim, Norwway: Norwegian Directorate for Nature Management and Norwegian Institute for Nature Research.

Costanza, R. *et al.* (1997). *The value of the world's ecosystem services and natural capital.* Nature. 387: 253-260.

Dayton, P. (1993). IUCN Marine Conservation and Development Report. In *Proceedings of the IVth World Conference on Parks and Protected Areas.* (Agardy, T. ed), 50-55. Gland, Switzerland: IUCN.

DeMartini, E.E. (1993). *Modeling the potential of fisheries reserves for managing Pacific coral reef fishes*. Fishery Bulletin 91:414-427.

Dixon, J., L. Scura and T van't Hof. (1993). *Meeting ecological and economic goals marine parks in the Caribbean.* Ambio 22 (2-3):117-125.

Eichbaum, W., M. Crosby, T. Agardy and S. Laskin. (1996). *The role of marine and coastal protected areas in the conservation and sustainable use of biological diversity.* Oceanography. 9(1):60-70.

Elliot, N. and R. Ward. (1992). *Enzyme variation in orange roughy, Hoplostethus atlanticus (Teleostei: Trachichthyidae), from southern Australian and New Zealand waters.* Australian Journal Marine and Freshwater Res. 43:1561-1571.

Enemark, J., Wesemuller, H. and A. Gerdiken. (1998). *The Wadden Sea: an international perspective on managing marine resources.* Parks. 8(2):36-40.

FAO (Food and Agriculture Organization of the United Nations). (1998). *The state of the world fisheries and aquaculture*. Rome, Italy: FAO.

Figueira, W.F. (2000) *Source/sink population structure of coral reef fish: the importance of patch quality versus patch location and implications for management.* Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Gray, J. (1997). *Marine biodiversity: patterns, threats and conservation needs.* GESAMP Reports and Studies No. 62. International Maritime Organization.

Green, M. and J. Paine. (1997). *State of the world's protected areas at the end of the twentieth century. IUCN World Commission on Protected Areas (WCPA) symposium on protected areas in the 21st century: from islands to networks.* Albany, Australia.

Gubbay, S. ed. (1995). *Marine protected areas: principles and techniques for management.* Conservation Biology Series. London: Chapman and Hall.

Hale, P. and Farrow, D. (2001). *Creating MPA Inventories: How Canada and the US are meeting the challenge.* MPA News. 3(2):1-3.

Halpern, B. (2000). *The impact of marine reserves: a review of key ideas.* Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Hockings, M., White, A., Polino, M., Pet-Soede, L., Pollnac, R., Garbutt, L., Hoetjes, P. and M. va der Velde (2001). *Paper Parks: Why they happen and what can be done to change them.* MPA News 2(11):1-4.

Holland, D. and R. Brazee. (1996). *Marine reserves for fisheries management.* Marine Resource Economics. 11:157-171.

Holthus, P.F. and J.E. Maragos. 1995. *Marine ecosystem for the tropical island Pacific*, In*:* pp 239-278 Marine and Coastal Biodiversity in the Tropical Island Pacific Region: Volume 1: Species

Systematics and Information Management Priorities. Maragos, Petersen, Eldredge, Bardach, and Takeuchi (eds). East-West Center, Honolulu

Idechong, N. and T. Graham. (1998). *The Ngerukewid Islands of Palau: 40 years of managing a marine protected area.* Parks. 8(2):17-22.

IUCN (The World Conservation Union) (1999). *Parks for biodiversity.* Cambridge,UK: The World Commission on Protected Areas of IUCN.

Jameson S. *et al.* (1995). *State of the reefs: regional and global perspectives.* Background paper. Washington, DC: Executive Secretariat, International Coral Reef Initiative of the United States National Oceanic and Atmospheric Administration.

Jones, P. (1994). *A review and analysis of the objectives of marine nature reserves.* Ocean and Coastal Management. 24:149-178.

Kelleher, G. (1999). *Guidelines for establishing marine protected areas.* IUCN Best practice protected area guidelines series No. 3. Gland, Switzerland and Cambridge, UK: World Commission of Protected Areas (WCPA).

Kelleher, G. and C. Recchia. (1998). *Editorial – lessons from marine protected areas around the world.* Parks. 8(2):1-4.

Kelleher, G., C. Bleakley and S. Wells eds. (1995). *A global representative system of marine protected areas.* Volumes I-IV. Washington, DC: GBRMPA/World Bank/IUCN.

King, M. and U. Faasili. (1998). *A network of small, community-owned village fish reserves in Samoa*. Parks. 8(2):11-16.

Mascia, M. (2000). (unknown title) *The Coastal Society's 17th International Conference.* Portland, Oregon. In MPA News. 2(2).

Mascia, M. (2001) *Designing effective coral reef marine protected areas: A synthesis report based on presentations at the 9th International Coral Reef Symposium in Bali, Indonesia, October 2000*. A Special Report to the IUCN WCPA.

McNeely, J. (1997). *Tourism and biodiversity: a natural partnership.* Symposium of tourism and biodiversity. Utrecht.

Misiska, O., Jiddawi, N. and U. Sumaila. (2000). *The potential role of protected areas in managing marine resources in selected countries of east and southern Africa. International conference on the economics of marine protected areas.* Fisheries Centre of the University of British Columbia.

Munro, J. (1999). *Effects of fishing on coral reef ecosystems.* In the *Proceedings of the Norway/United Nations Conference on the ecosystem approach for sustainable use of Biological diversity.* Schei, P., O. Sandlund and R. Strand eds. Trandheim, Norway: Directorate for Nature Management and Norwegian Institute for Nature Research.

NCEAS (2001) Scientific Consensus Statement on Marine Reserves and Marine Protected Areas. http://www.nceas.ucsb.edu/

NCI (National Cancer Institute – United States). (2000). NCI Fact Sheet. http://www.oncolink.upenn.edu

NOAA (United States National Oceanographic and Atmospheric Administration). (1998). En*suring the sustainability of ocean living resources.* Year of the ocean document. http://www.yoto98.noaa.gov.

Norse, E. ed. (1993). *Global marine biological diversity: a strategy for building conservation into decision making.* Washington, DC: Island Press.

NRC (National Research Council – United States). (1999). *Sustaining marine fisheries: Committee on ecosystem management for sustainable marine fisheries.* Washington, DC: National Academy Press.

Petersen, A., Porvardardottir, G., Pagnan, J. and S. Einarsson. (1998). *Breidafjordu, West -Iceland: an Artic marine protected area*. Parks. 8(2):23-28.

Polacheck, T. (1990) *Year around closed areas as a management tool.* Natural Resource Modeling 4:327-354.

Roberts, C. (1995). *Rapid build-up of biomass in a Caribbean marine reserve.* Conservation Biology. 9(4):815-826.

Roberts, C. (2000) *Biophysical design of marine pretoected areas.* Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Roberts, C. and R. Ormond. (1987). *Habitat complexity and coral reef fish diversity and abundance on Red Sea fringing reefs.* Marine Ecology Progress series. 41:1-8.

Roberts, C. and N. Polunin. (1993). *Marine reserves: simple solutions to managing complex fisheries?* Ambio. 22(6):363-368.

Russ, G., and A. Alcala. (1998). *Natural fishing experiments in marine reserves 1983-1993: community and trophic responses.* Coral Reefs. 17:383-397.

Russ, G., and A. Alcala. (1997). *Do marine reserves export adult fish biomass? Evidence from Apo Island, Central Philippines.* Marine Ecology Progress series. 132:1-9

Russ, G., and A. Alcala. (1996). *Marine reserves: Rates and patterns of recovery and decline of large predatory fish*. Ecological Applications. 6(3):947-961.

Salm, R. and J. Clark. (1989). *Marine and coastal protected areas: a guide for planners and managers.* Second edition. Gland, Switzerland: The World Conservation Union (IUCN).

Syms, C. and M. Carr (2001) *Marine Protected Areas: Evaluating MPA effectiveness in an uncertain world* . Document presented at the Workshop of the North American Marine Protected Areas Netowrk. Commission for Environmental Cooperation (CEC).

Tanzer, J. (1998). *Fisheries in the Great Barrier Reef marine Park – seeking the balance.* Parks. 8(2):41-46.

UNEP United Nations Environment Programme. (1995). *Global Biodiversity Assessment.* Cambridge, UK: University Press.

Uychiaoco, A.J. (2000). *Increase of fishes in coral reef fishery reserves: A combined analysis.* Paper presented at the 9th International Coral Reef Symposium, October 23-27, Bali, Indonesia.

Van der Heijden, P. and C. van Zwol eds. (2000). *Marine biodiversity.* Policy and Best Practice Document 5. Hague, Netherlands: Ministry of Foreign Affairs.

Walls, K. (1998). *Leigh Marine Reserve, New Zealand.* Parks. 8(2):5-10.
