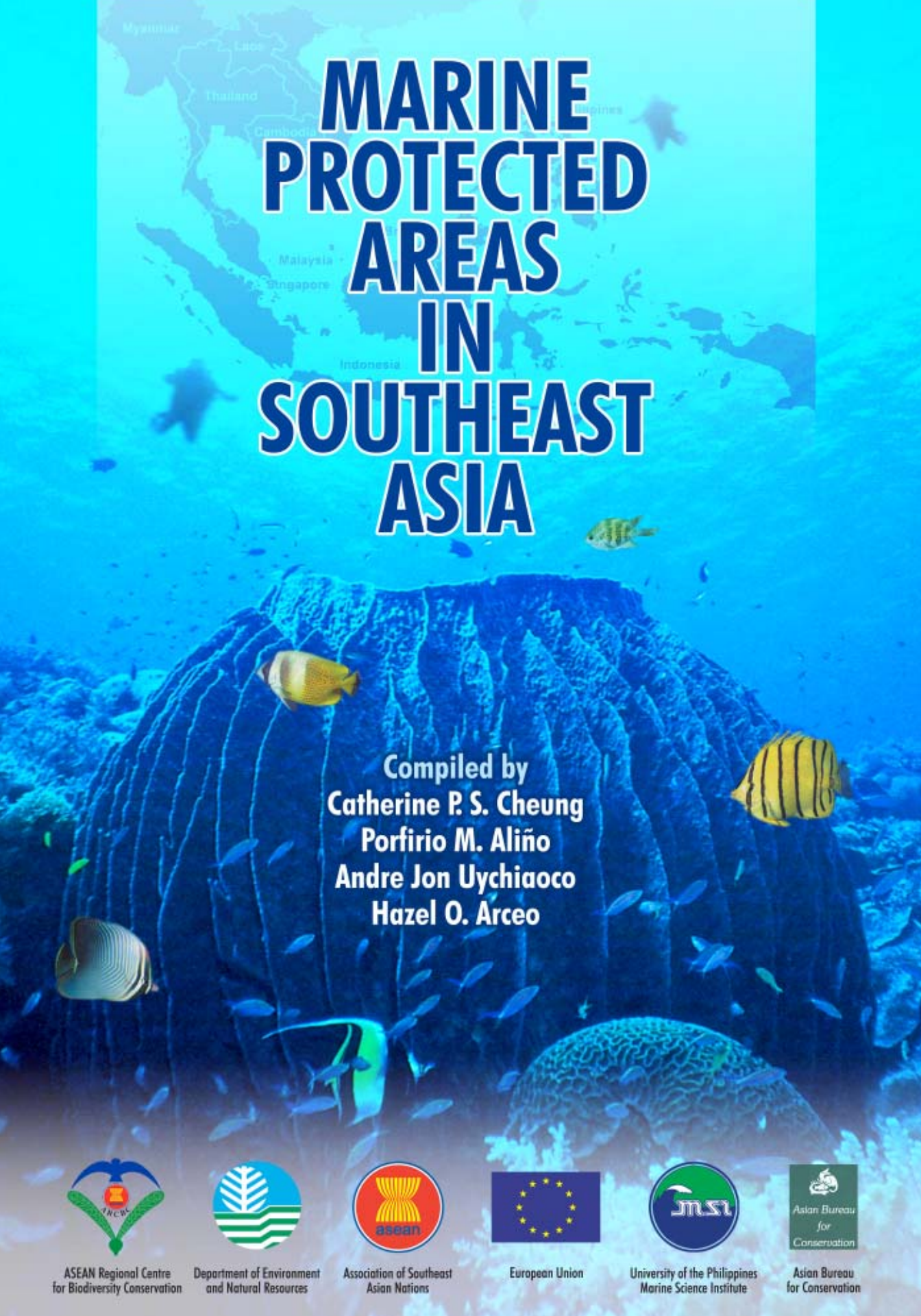




MARINE PROTECTED AREAS IN SOUTHEAST ASIA



Compiled by
Catherine P. S. Cheung
Porfirio M. Aliño
Andre Jon Uychiaoco
Hazel O. Arceo



ASEAN Regional Centre
for Biodiversity Conservation



Department of Environment
and Natural Resources



Association of Southeast
Asian Nations



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MESSAGE



The ASEAN region has the richest biodiversity, the most extensive coastline and most diverse coral reefs in the world. However, it is also one of the most threatened regions in terms of coastal marine resources degradation.

Marine protected areas in Southeast Asia were assessed and reviewed to analyze the increasing threats such as coastal development, collecting of endangered species, ornamental trading, overexploitation, pollution and tourism that lead to the depletion of the biodiversity resources of the marine protected areas in the region. Without proper knowledge regarding conservation of biodiversity, degradation of resources will escalate.

The ASEAN Regional Centre for Biodiversity Conservation (ARCBC) was established since 1999 to strengthen biodiversity conservation in the ASEAN region. We hope this publication will serve as a valued reference to the policy makers, planners, fishermen and other stakeholders as well as students, scientists and park managers. This assessment and its timely publication will be useful in the continuing efforts to plan for management that will save, rehabilitate and safeguard our coastal marine resources in the region.

A handwritten signature in black ink, appearing to read 'Gregorio I. Texon'.

GREGORIO I. TEXON

ASEAN Co-Director, ARCBC

A handwritten signature in black ink, appearing to read 'John R. Mackinnon'.

JOHN R. MACKINNON

EU Co-Director, ARCBC

FOREWORD

The last decade has seen a burgeoning of marine protected areas (MPAs) in the Southeast Asian (SEA) region, in particular member countries of the Association of South-east Asian Nations (ASEAN), where it has been known to be the heart of highest marine biodiversity. Perhaps due to the great value and importance of marine biodiversity to hundreds of millions of diverse peoples, these resources have been considered to be at greatest risk.

The tremendous challenges in marine biodiversity conservation have been met with an equally diverse way of doing things, from the large MPAs of Indonesia to the many small community based no-take marine sanctuaries of the Philippines. Eco-tourism may have shown some promising results in an increasing number of areas, but the number of species still under threat from overexploitation is also increasing. The bilateral agreements between the Philippines and Malaysia on the Turtle Islands are exemplary examples of promising efforts for endangered species and the beckoning need to scale up the effectiveness of MPA management efforts. The constraints prevalent in a region of diverse cultures provide opportunities where potential global conflicts may be prevented by establishing joint cooperative stewardship arrangements through MPAs such as those in the disputed islands of the Spratly's. Transboundary opportunities may also be through the Sulu-Sulawesi ecoregion approach and those in the South China Sea. Other areas in the Indian Ocean and the Pacific Seaboard also show connectivity of marine organisms that indicates potential MPA corridors. Indeed, there is a greater demand to forge an ASEAN effort for marine conservation and a functional network of MPAs beyond the SEA region.

This review is both timely and appropriate for the SEA region. Past efforts have been made in MPAs, and various good global synopses have provided impetus for more extensive regional cooperation and deeper commitments in biodiversity conservation. The ratification of the Convention of Biological Diversity by most countries in the region and the establishment of the ASEAN Regional Centre for Biodiversity Conservation (ARCBC) are indicative major responses by the region. The need for examples of best practices in MPA management makes this review of MPAs in SEA important testaments of small steps that may contribute to great strides in understanding the significance of MPAs.

The continuous journey of the ASEAN in its common seas is on a sturdy boat; the ARCBC is one of its important engines. These MPA vignettes are important knowledge stars and lessons for us to navigate through a sea of change where MPAs help sustain biodiversity, the life support system of people.

Porfirio M. Aliño

University of the Philippines—Marine Science Institute

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Many hands and flippers have worked on this book. After some years as an unpublished report covering an initial 14 countries, the ASEAN Regional Centre for Biodiversity Conservation (ARCBC) agreed to revamp the report, update and publish the accounts for the 9 ASEAN member countries with marine areas. The ARCBC wishes to thank the following individuals and institutions for their major and invaluable inputs:

- the **Asian Bureau for Conservation (ABC)** for executing the original work and **Catherine Cheung** of the ABC for preparing the original country drafts that formed part of the Indo Malayan Protected Areas Review. Much of the input resulted from an initial workshop that ABC had organised in Cisaua, Bogor, Indonesia from 23 – 25 January 1995;
- the participants from Indonesia, Malaysia, the Philippines, Thailand and Vietnam at the above-mentioned workshop and to several international experts for their inputs especially **Chris Bleakley** from the IUCN-CNPPA MPA Programme, **Prof. Chou Loke Ming** from the National University of Singapore, **Nopadol Briksvan** of Thailand, **Arief Wicaksono** and **Graham Usher** of the Bunaken Park in Manado, N. Sulawesi. Much of the background data on Indonesia was based on the earlier work of **Dr. Rod Salm**;
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ABSTRACT

Marine Protected Areas (MPAs) of nine member countries of the Association of South-east Asian Nations (ASEAN) were reviewed. These countries are the Philippines, Malaysia, Thailand, Indonesia, Vietnam, Brunei, Singapore, Cambodia and Myanmar. Different issues pertaining to MPAs of each country are assessed and their management concerns evaluated. The pressures (i.e. threats) on the marine environment, the state of their habitats and the important management needs are examined. A priority action agenda and a regional strategic MPA framework are also proposed.

The ASEAN region contains some of the most extensive coastlines and diverse coral reefs in the world but remains the most highly threatened. A proliferation of MPAs in the ASEAN shows a growing consciousness on the need to deal with the increasing threats (e.g. coastal development, sedimentation and over-exploitation), leading to the degradation of the coastal and marine resources of the region. Although MPAs are recognized as crucial to conserving biodiversity, only a few (around 10-20%) of the MPAs are effectively managed and as such, MPA management remains inadequate. Some of the suggested priority actions are the following: 1) improve and effectively implement legislative reforms to enhance MPA effectiveness, 2) incorporate MPA planning and management into an Integrated Coastal Management framework, 3) enhance sustaining mechanisms to enable managers and institutions to continue adaptive management, 4) fill in gaps in the establishment and understanding of representatively adequate MPAs in the various biogeographic zones (e.g. W. Sumatra, E. Philippines and Myanmar), and 5) improve and establish joint research and cooperative management areas (e.g. the Turtle Islands and the Spratlys).

AN OVERVIEW

Catherine Cheung and Porfirio M. Aliño
Contributors: Andre J. Uychiaoco and Hazel O. Arceo

The Southeast Asian region is well known for its rich marine biodiversity, attributed largely to its abundant coral reefs. The compilation of known ranges and field records of hermatypic coral genera indicates that Indonesia, Malaysia and the Philippines form the centre of coral diversity of the world together with Papua New Guinea (Veron 2000; **see also Figure i.1**). Reef fish diversity follows a similar trend as shown from the analysis by FishBase, a worldwide database on inland and marine fish (**Table i.1**). Reef fisheries supply a large proportion of protein to many countries in the region, especially archipelagic (island) states like the Philippines and Indonesia. Reef fisheries, composed of fish, invertebrates and seaweeds, are not only essential for subsistence livelihood but are also important sources of income domestically and through exports. Hard corals and coral reefs also provide raw materials for construction, protect the shoreline from erosion and generate income through tourism. Seagrass, like coral reefs and mangroves, has a centre of generic diversity in the Indo-West Pacific, especially in the Philippines and west Australia where most species are found (Fortes 1989). Seagrass beds are important habitats for the endangered sea cow (*Dugong dugon*) and green turtles (Groombridge

1993). They also serve as nursery grounds for fish. The complementary importance of mangrove swamps and tidal marshes to the aforementioned habitats (e.g. for fisheries sustainability, nursery and feeding areas) also cannot be neglected. Other ecological functions of the coastal and marine habitats like coastal protection and greenhouse gas stabilisation have been recognised but remains to be fully evaluated (Costanza 1996).

Table i.1. Counts of reef-associated fish in FishBase as of 21 March 1995, for the nine ASEAN member countries (FAO areas 51, 57 and 71). Since FishBase does not contain all species for any of these countries and is constantly being updated, the actual counts will be higher.

Country	No. of Reef-associated Fish Genera
Philippines	307
Indonesia – East	268
Indonesia – West	179
Malaysia – East	144
Malaysia – West	118
Vietnam	83
Singapore	77
Thailand – East	77
Thailand – West	70
Brunei	38
Cambodia	56
Myanmar	86

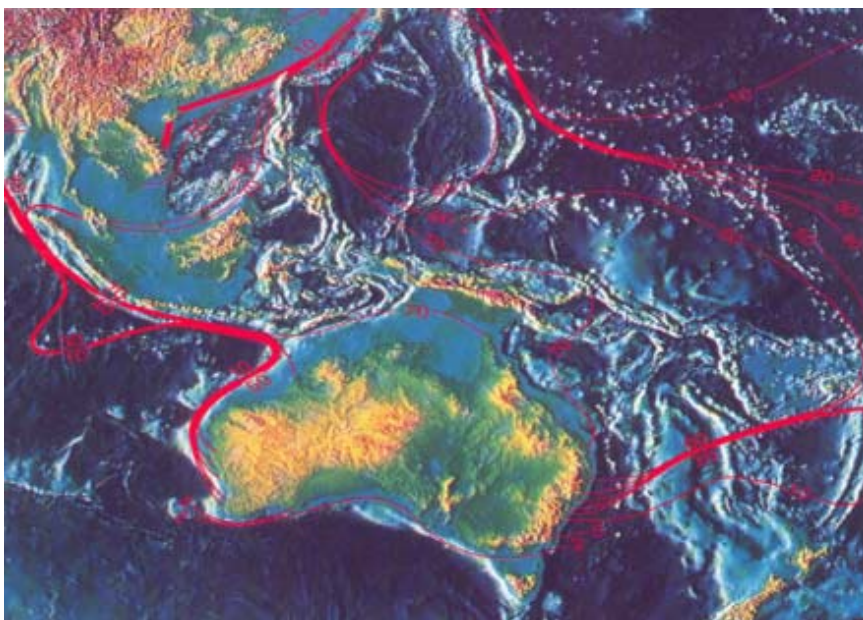


Figure i.1. Clinal distribution of the scleractinian coral genera showing the highest generic distribution in the vicinity of the ASEAN region (from Veron 1993).

All six marine turtles: Loggerhead (*Caretta caretta*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*), Flatback (*Natator depressus*) and Leatherback (*Dermochelys coriacea*), are found in the region.

These are classified as endangered or vulnerable in the IUCN Red List of Threatened Animals (Groombridge 1993). Turtles, in particular, are very much like birds because of their faithful nesting behaviour, which makes them vulnerable to hunters and egg collectors.

Dugong dugon and other marine mammals found in the region are also included in the Red List. Many of these species are comparable to migratory birds in their cross-country migratory behaviour and wide range. The transboundary habits of these species make research and actions for conservation strategies extremely difficult unless regional and international cooperation can be reached.

Marine ecosystems are by far the least known among the ecosystems in the world, especially in developing countries where research is often not a priority. Information on the marine environment and species in Myanmar and Cambodia are especially scarce. Nevertheless, new species continue to be discovered worldwide. Which marine species of these little-known countries of the region are in a critical state either due to human threats or to naturally restricted range, and how many are only beginning to be explored. What we know are wide under-estimations.

It is also significant to note that the Southeast Asian region, which is considered an area of the highest marine biodiversity, is the most seriously threatened (see also Burke et al. 2002). Like its terrestrial counterpart, the marine biodiversity of the region suffers from high human density and heavy human dependence on natural resources. Poverty and hunger remain to be a main concern in most countries of this region, leading to the exacerbation of pressures on the marine environment. The rapid increases in human population, coastal urbanisation and development, and demand for export and cash economy have contributed to the overexploitation and degradation of the coastal and marine environment and resources. It has been estimated that 11% of the world's coral reefs have already been degraded and about 16% are no longer fully functional; 14% are in a critical state such that they are likely to collapse within 2-10 years; and another 18% are also threatened and may probably be destroyed in 10-30 years (Wilkinson 2000).

The Philippines, Indonesia and Malaysia derive 60-70% of their animal protein intake from marine fisheries (McManus 2000). With the onset of overfishing coupled with wealth disparity, subsistence and artisanal fishermen are often forced into destructive fishing techniques such as blastfishing and poisons (Pauly et al. 1989). Poisons like cyanide are generally used for catching aquarium fish and highly priced food fish such as groupers and the maori wrasse (*Cheilinus undulatus*) for live fish exports for restaurants.

Other techniques being used such as *muro-ami* in the Philippines are also destructive, especially to coral reefs. The recent alternative gear, *Pa-aling*, is highly efficient in catching fish but also does not seem to be sustainable (Miclat et al. 1991; Abesamis et al. in press). Illegal trawling by commercial fishers, which is of particular concern in

Thailand and Malaysia, also causes serious damage to the habitat and overexploitation. Increased siltation and commercial fishing using push net and bottom trawl are believed to have caused the degradation and destruction of seagrass beds in the Andaman Sea (Chansang & Poovachiranon 1992). The loss of seagrass beds has led to the slow disappearance of the dugong, especially in the Gulf of Thailand, where they are not only killed accidentally by fishing gear, but also hunted (Nateekanjanalarp & Sudara 1992). Terrestrial impacts on coastal habitats and biodiversity, often caused by river runoffs carrying pollutants and sediment from deforested hills, and coastal development have been widely documented in the Philippines and the region as a whole (Hodgson & Dixon 1988; Chou 1994). Degradation caused by coal and sand mining, port development, marine traffic and overuse by tourism have been addressed nationwide in Vietnam (Biodiversity Action Plan Planning Team 1994). The conversion of mangrove areas for shrimp ponds and other development projects, not only destroys the mangrove habitats but also causes siltation of the water, which in turn can kill corals and seagrasses.

The countries of the region exhibit a wide range of legal and management frameworks and strategies for MPAs and marine conservation in general. Due to the longer history of terrestrial protected areas than MPAs, the mandate for the planning and management of MPAs in most countries lies upon the Departments of Forestry or Environment, which are traditionally the authority for nature reserves and national parks on land (**see Table i.2**). Such an arrangement is far from ideal since, in most cases, the legal framework and personnel capacity of these departments are inadequate or inappropriate for marine environmental issues. The governments of the Philippines and Singapore receive a lot of assistance on MPA planning, monitoring and awareness promotion from scientific institutions and non-government organisations. However, jurisdictional problems occur due to unclear mechanisms for coordination among the government agencies. In the Philippines, complicated issues on coordination exist between the Department of Environment and Natural Resources (DENR) and the Bureau of Fisheries and Aquatic Resources (BFAR) under the Department of Agriculture (DA), in addition to the concerns of the local government.

Likewise for Peninsular Malaysia, MPAs are managed by the Fisheries Department, which has the knowledge on fisheries resources management although a change in perspective is now beginning. However, this arrangement is hampered by the fact that the Fisheries Department does not have any jurisdiction over the terrestrial portions of the MPAs, hence negative impacts from terrestrial activities such as deforestation and coastal development within MPAs are often difficult to control. On the other hand, in Sabah of Eastern Malaysia, such problems are less serious as all state-owned land or MPAs are managed by a single authority, the Sabah Parks Wildlife Department. Protected areas outside of the state land are managed by the Wildlife Department.

Due to the different culture, tradition, land and marine tenure systems, management capabilities and the nature of threats imposed upon the marine environment, the strategies for planning and management of MPAs also vary widely from country to country and among sites. Government support is important for the management of MPAs in Malaysia and most parts of Thailand and Indonesia. Community-based management of MPAs and marine resources is very much advocated and practised in the Philippines and some parts of Thailand (e.g. in dugong areas around Trang in the Andaman Sea).

Table i.2. Government Authorities for MPAs of nine ASEAN member countries

Country	Government Authorities for MPAS
Brunei	Department of Fisheries; Department of Forestry; National Committee on the Environment
Indonesia	Ministry of Environment; Directorate for Forest Protection and Nature Conservation (PHPA), Ministry of Forestry; Ministry of Marine Affairs
Malaysia—Peninsula	Fisheries Department, Ministry of Agriculture; Department of Wildlife and National Parks and Department of Environment, Ministry of Science, Technology and Environment
Malaysia—Sabah	Sabah Park Wildlife Department, Ministry of Tourism Development, Environmental, Science and Technology
Philippines	Protected Areas and Wildlife Bureau (PAWB), Department of Environment and Natural Resources (DENR); Bureau of Fisheries and Aquatic Resources (BFAR), Department of Agriculture (DA)
Singapore	Ministry of National Development
Thailand	Marine National Parks Division, Royal Forestry Department (RFD); Department of Fisheries
Vietnam	Ministry of Science, Technology & Environment (MoSTE); Department of Fisheries Resources Protection, Ministry of Fisheries (MoF); Ministry of Forestry
Cambodia	Ministry of Environment (MoE); Ministry of Agriculture, Forestry and Fisheries (MAFF)
Myanmar	National Commission for Environmental Affairs (NCEA); Ministry of Forestry

Traditional management practices also occur in the Maluku of eastern Indonesia although, in some areas, financial constraints, inadequate developmental capability and undue government interference have impaired management effectiveness.

I. Scope and Methodologies of the Review

Marine Protected Area (MPA) is defined as any area of inter-tidal or sub-tidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by legislation to protect part or all of the enclosed environment (IUCN 1988). This review will focus on sub-tidal areas and inter-tidal areas essential for marine species, such as coral reefs and turtle nesting beaches.

The Review follows the biogeographic division system adopted by the IUCN/CNPPA MPA Programme, which has classified the globe into 18 regions, each of which is further subdivided biogeographically (Kelleher *et al.* 1995). The IUCN East Asian Seas Region encompasses all of the nine Pacific Ocean countries/territories except Papua New Guinea, which falls under the IUCN South Pacific Ocean Region. The East Asian Seas Region is divided into 8 first-order and 22 second-order subdivisions. For this overview, the region of the Western Coast of Myanmar is included even though it is considered under the Central Indian Ocean region (see Map 7).

In order to gather local knowledge and perception on the conservation values of and human-induced threats to the MPAs (declared and undeclared) of the region, a questionnaire has been designed for national experts to rank the different values of and threats to individual MPAs in their own countries. These data are presented in the form of tables listing the main habitats, species of significance and threats of high/medium/ low intensities to each MPA. Data on threats are added and averaged over the number of sites analysed, thus giving the overall relative frequency of different types of threats in that particular country. To make comparisons more meaningful, only coral reef sites with good knowledge are analysed and the results presented in the form of histograms (e.g. **Figure i.1**). The total impact (I) of a particular threat (T) of different intensities is obtained by the following:

$$\text{Impact} = 3xH + 2xM + L$$

Where:

H = averaged frequency of high intensity T

M = averaged frequency of medium intensity T

L = averaged frequency of low intensity T

As different types of threats cause different types and levels of impacts under different environmental conditions, the total impact derived from this formula is a hypothetical figure designed to emphasize the differences in the intensities of threats and to facilitate comparisons between threats. Instead of seeking a definitive measurement, the analysis seeks to understand and display the perceptions of the informants. These include the problems of their marine areas, which reflect not only the actual situation of the sites, but also, to some extent, the persons' cultural, academic and political background. To reduce the effects of the latter, an equal number of representatives both from the government and NGO/scientific communities have been asked to complete the questionnaire wherever possible.

Histograms derived from Reefs at Risks exercises undertaken for the Southeast Asian region provide a context of how these threats on MPAs relate to the overall national risk level perceived and modelled through the World Resources Institute (WRI) and its collaborators (Burke *et al.* 2001).

For comparisons among countries, the 13 types of threats are grouped into major categories related to the following and presented in pie charts:

- a) Fisheries (overexploitation and destructive methods; dynamite & poison fishing, coral mining)
- b) Ornamental trade (including aquarium fish and coral and shell souvenirs)
- c) Hunting of endangered species (mainly turtles, also dugongs, whales and sharks)
- d) Tourism (damage of habitats by tourists, anchors, pollution, and constructions)
- e) Environmental degradation (siltation, pollution, coastal development, mining, dredging, etc.)

II. Summary of Results

Results from the countries with sufficient threat data indicate that environmental degradation is causing the most impacts on the marine environment and MPAs in almost all the countries analysed, although the results are based on the perceptions of the informants (Burke *et al.* 2001).

Environmental degradation is the most prominent in Malaysia where coastal development and economic growth are rapid. Most of the activities that cause environmental degradation are land-based, notably siltation from river runoffs and coastal construction. Environmental degradation is less prominent in Vietnam and Indonesia where impacts from fishing activities appear more serious. Impacts from tourism are most prominent in Thailand and Indonesia. It is important to note that the relatively low tourism impact presented in the case of Malaysia is an underestimation, possibly due to the masking effect of environmental degradation, which is often related to tourism development.

In addition, the array and intensity of threats vary from one site to another site. For example, sites in Peninsula Malaysia suffer much more from development than those in Sabah where coral mining is a bigger problem.

II.A. Evaluation of Current Coverage by MPAs

The amount, completeness and accuracy of the data on MPAs vary among countries, depending on the amount of research and government interest in the subject. Protected areas data held by different agencies are not always consistent. The confusion is more notable in the case of MPAs primarily due to inconsistent and ambiguous definitions and terminologies for marine areas. Due to the inadequate inventory of the marine habitats and inaccessibility of available data, a number of MPAs in the database have no data input for habitat types, species and threats. Some of the MPAs lack information on their exact locations and most do not have a defined boundary or size, making quantitative coverage comparisons impossible. The present analysis of coverage by the MPA system is therefore restricted to only those sites with available information. The integration and interpretation of such data into useful and applicable information require caution.

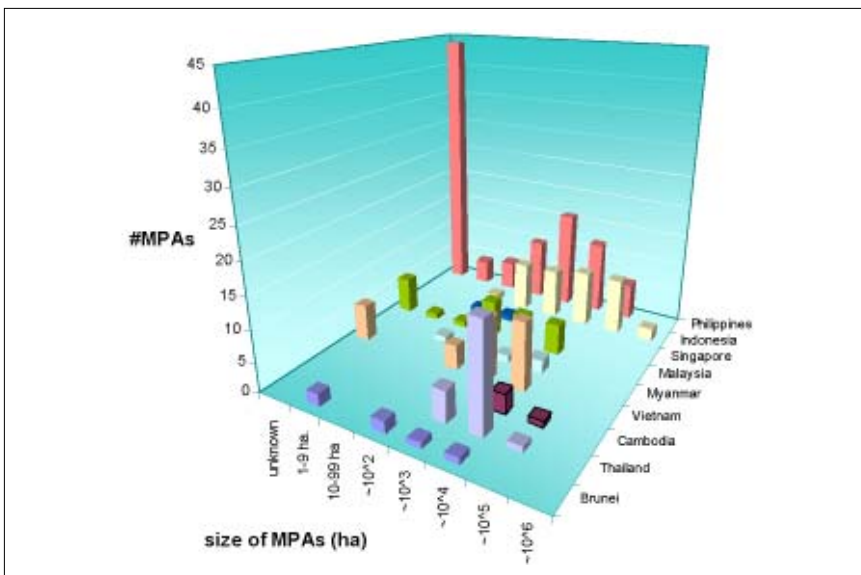
II.B. National Coverage

Each of the nine ASEAN member countries has declared MPAs (see **Figure i.2** and **Table i.2**). The Philippines has the longest official MPA listing although Indonesia probably has a similar total number if local MPAs not recognised by the central government are also counted. Brunei, Cambodia and Singapore, with very few MPAs (declared or proposed), have relatively short coastlines while Myanmar and Vietnam possess long coastlines and a variety of coral reefs and other marine ecosystems. These countries however, have major gaps in terms of MPA establishment on a national level.

Table i.3. Representation of marine protected areas (MPAs) in the nine ASEAN member countries. MPAs refer only to protected areas with substantial marine areas; mangrove reserves with little marine areas are not listed. Proposed MPAs both include official and unofficial proposals.

Country	Declared MPAS	Proposed MPAS	Length of Coastline (km)
Brunei	6	2 +	161
Indonesia	29	14 +	80,791
Malaysia	40 +	3 +	4,675
Philippines	180 +	100+	22,540
Singapore	2	4	193
Thailand	23	0	3,200
Vietnam	22	7	3,260
Cambodia	4	1	435
Myanmar	4	1	2,278

Figure i.2 Indicative size frequency of some marine protected areas in the ASEAN region.



II.C. Habitat Coverage

All the declared MPAs that have habitat data contain coral reefs. Meanwhile, seagrass and other marine habitats such as tidal mud flats and marshes, especially those that are not particularly important for birds, are inadequately covered by the MPA system. Documented records pertaining to seagrass, estuaries and tidal flats have been minimal. The low numbers do not only reflect the fact that these habitats are under-represented in the MPA system, but also indicate the general negligence of these habitats by scientists and conservationists. Some of these habitats, noticeably tidal flats that occur within the MPAs, may not have been recorded. Without figures on the actual areas of different habitats in

individual MPAs and in the whole region, it would not be possible to come up with a quantitative answer as to how much each type of habitat is covered by the MPA system.

The initiatives by the World Conservation Monitoring Centre (WCMC) (WCMC, *undated*) and the WRI (Burke et al. 2002) provide a good start in estimating the coverage of the various marine habitats of the world.

II.D. Management Levels

Of the declared MPAs in the region that have entries for management levels on the questionnaires, 46% has no or very little management; 28% is under moderate management and only a handful is well managed. The proportions of unmanaged and poorly managed MPAs are expected to be higher because sites that do not have management data are unlikely to receive any management. The Global Representative System of Marine Protected Areas (Kelleher, Bleakley and Wells 1995) concluded that 90% of the MPAs in the East Asian Seas region generally fail to, or only partially, achieve management objectives. The implication is that the present MPA system is extremely ineffective in terms of marine biodiversity conservation and that an increase in the physical coverage of the MPA system alone will not improve marine conservation. Future actions should therefore strengthen the management of existing MPAs and establish new MPAs of high conservation priority. There are many different approaches to MPA management from top down, government-dominated approach to grass-root, community-based management, depending on local circumstances, government capability, and local culture. Limited by human and financial resources, the prioritisation of sites and concentration of efforts become indispensable if conservation by MPA management is to be cost-effective.

Several international efforts can be invoked to strengthen and support various local and regional initiatives such as the International Coral Reef Initiative (ICRI) and the Convention on Biological Diversity (CBD). The recently established ASEAN Regional Centre for Biodiversity Conservation (ARCBC) and the ASEAN working group of the World Commission on Marine Protected Areas (WCMCA) are good developments that could help facilitate activities to improve MPA planning and management in the region.

II.E. Identification of Gaps in the MPA System

The third sub-regional workshop held in Indonesia has rightly pointed out the obvious gap in the present MPA system of the region, namely western Sumatra and eastern Philippines where few MPAs and no priority sites have been identified (Cheung 1995). These two areas face intense oceanic actions and deep-sea trenches, and represent three distinct biogeographic divisions (13-VI-19, 13-VII and 13-IV) with very few MPAs in relation to the size of these divisions. Further examination of the system reveals that Myanmar (Divisions 10-III and 10-IV) is very much under-represented (**see Map 7**) because the country lacks field knowledge, conservation expertise and government interest. Finer gaps have been identified for individual countries. Some of the lesser known areas and MPA gaps, e.g. Sulu-Tawi-Tawi (SW Philippines) and eastern Indonesia, are the results of political or other security problems, which make them inaccessible to re-

searchers. In terms of habitat coverage, the seagrass and coastal ecosystems without mangroves, are poorly represented by the existing MPA system. Description of ecosystem functional attributes (e.g. nesting site, spawning area, connectivity, and resilience to natural catastrophic stresses like El Niño) needs to be improved in the future.

III. Priority Marine Areas

The MPAs (declared and proposed) have been classified as global/regional (A), national (B) and local (C) priorities based on the following: i) the biodiversity and ecological values of MPAs; ii) consideration of the threats (existing and potential) imposed upon them, and iii) feasibility of management (i.e. including the social environments that will determine the likelihood of success). An absolute distinction between global and regional priorities was not made because comparison of sites on the global scale is beyond the scope of this Review. The majority of the A sites refers to regional priority areas except for those that have been internationally recognised (e.g. Mu Ko Similan, Surin and Tubbataha as World Heritage Sites; Khao Sam Roi Yot and Olango as RAMSAR Sites). The prioritisation process provides guidelines for resource allocation especially at the international levels. International or bilateral programmes should support MPAs of global/regional priority that contain high biodiversity values with a good chance of being successfully conserved, and hence contribute effectively to global biodiversity conservation. Greater national efforts, with or without foreign assistance, should be exerted on sites rated as nationally important to strengthen their management. Rather than being obsolete or unimportant, the remaining MPAs of local priority are essential in forming a healthy network of sites needed for marine conservation nationally and regionally, as well as for sustaining fisheries resources that local villagers depend upon (Aliño *et al.* 2000).

Several of the reviewed countries have already begun their own process of MPA prioritisation. The Biodiversity Action Plans for Indonesia (Haeruman 1993, as cited by Cheung 1995) and Vietnam (BAP Planning Team, 1995 draft), for example, present the national views on the priority sites and actions needed for biodiversity conservation. The Philippines has recently reviewed its priority areas (including MPAs) for protection under the National Priority Setting for Biodiversity Conservation (DENR 2000). Care is needed during the MPA rating process of the Review so that local and national opinions would be well-represented while regional expertise would be brought in to verify sites that have been rated globally or regionally important. Other regional programmes with shared objectives such as the IUCN/CNPPA Global MPA Programme have been consulted during the rating process.

Some 27 “A” and 41 “B” priority MPAs or marine areas have been identified in the region (**Table i.4**). At least one regional priority site has been chosen from each country to encourage national conservation efforts and regional exchange and cooperation. Indonesia, being at the centre of marine biodiversity and having the widest spread geographically, has the most “A” sites. The Philippines also has a large number of priority sites. Note that some of the MPAs are very small and may be grouped to form a single priority site of greater size and sustainability (**see also Figure i.2**).

Country/ Territory	Regional Global "A"	National "B"	Total
Brunei	No Information	1	1+
Indonesia	10	7	17
Malaysia	2	6	8
Philippines	5	17	22
Thailand	4	7	11
Vietnam	1	8	9
Singapore	1	1	2
Cambodia	2	2	4
Myanmar	2	2	4

Table i.4. Number of priority MPAs of global/regional (A) and national (B) significance. MPAs refer primarily to Protected areas with substantial marine areas while mangrove reserves with little marine area are not counted. Both declared and proposed MPAs are included.

Table i.5 presents the list of Existing (E) and Proposed (P) MPAs of regional (A) and national (B) conservation priorities. In addition to their high biodiversity, complexity of ecosystems, habitat extensiveness as well as intactness (e.g. islands of the Spratly and Tubbataha Reef), some sites are rated highly due to their significance for endangered migratory species (e.g. turtles and dugongs). Some are situated close to national borders and hence require trans-frontier cooperation in management (e.g. Pulau Semama and Sangalaki in Indonesia, the Turtle Islands in Eastern Malaysia and SW Philippines and the disputed islands in the Spratlys). The list of priority sites is not definitive or complete as there are still many unexplored areas and sites with insufficient data for assessment. For example, Teluk Raja Ampat and Kepulauan Karimata are believed to be high priority areas but very little is known about them. Such sites require urgent field surveys in order to re-assess their importance. Similarly, many of the marine areas in Myanmar fall under this category. It is just as important to note these "unknown" areas as to identify well-accepted priority sites. This prioritisation process serves to provide a broad overview of the conservation priorities of the region, pinpoint gaps in information and forgotten areas, and emphasize priority actions needed. Protected area establishment thus requires institutional, policy and scientific support both within and beyond the site boundary.

In addition to the priority sites of the East Asian Seas region, the Spratly Archipelago is one of the richest in terms of marine biodiversity, extensiveness and fisheries resources, and hence a site of very high regional priority if political obstacles could be overcome. Currently, six countries lay claim on the archipelago: China, Philippines, Taiwan, Vietnam, Malaysia and Brunei. Frequent disputes arise among China, Philippines and Malaysia. An international marine park has been proposed at Spratly as a means to sustain fisheries and prevent environmental disasters due to oil exploration in the area (McManus 1994). A study on pelagic larval movements suggested that the area, which is comparable to the size of the Great Barrier Reef Marine Park, could play an important role in replenishing fisheries stocks in nearby countries of the South China Sea. If political

hurdles can be overcome to materialize the proposal, marine conservation in the region would benefit to a large extent.

Table i.5. List of existing (E) and proposed (P) MPAs of regional (A) and national (B) conservation priorities. MPAs refer primarily to protected areas with substantial marine areas; mangrove reserves with little marine area are not listed.

Country	Name of MPA	E/P	Priority
Brunei	2. Palau Punyit	P	B
Indonesia	13. Bunaken National Park	E	B
	14. Jamursba Medi Nature Reserve	P	B
	15. Karimunjawa National Park	E	A
	16. Kepulauan Aru Tenggara Nature Reserve	E	B
	17. Kep. Karimata	E	B
	18. Kep. Taka Bone Rate National Park	E	A
	19. Kep. Togian Marine Recreational Park	P	B
	20. Komodo National Park	E	A
	21. Laut Banda Recreational Park (RP)	E	A
	22. Pulau Krakatau Marine Nature Reserve	E	A
	23. Pulau Semama Wildlife Reserve	E	A
Philippines	24. Pulau Sangalaki RP	E	A
	25. Tanjung Putting	P	A
	26. Teluk Cenderawasih National Park	E	A
	27. Teluk Raja Ampat Wildlife Reserve	E	B
	28. Tujuh Belas Pulau Marine Nature Reserve	E	B
	29. Ujung Kulon National Park	E	A
	62. Batanes Islands PLS	E	B
	63. El Nido—Bacuit Bay MR/TZMR	E	B
	64. Apo Reef TZMR/PLS/CEP/IPAS	E	B
	65. Turtle Islands	E	A
	66. Tubbataha Reef NMR/NMP	E	A
67. Apo Island TZMR	E	B	
68. Sumilon Island FS/NMP/MCRP/CEP	E	B	
69. Pamilacan Island MCRP/MP	E	B	
70. Panglao-Balicasag Island TZMR	E	B	
71. Taklong Island NMR	E	B	
72. Guiuan TZMR/PLS	E	B	
73. Sabgaku Cove—Sacol Island TZMR	E	B	
74. Sta. Cruz (Big & Small) Bay	E	B	
75. Samal Island TZMR	E	B	
76. Talicud Islands TZMR	E	B	
77. Siargao Island MSFR/WA	E	B	
Malaysia	31. Layang-layang Island Marine Park	P	B
	32. Mersing Marine Park	E	B
	33. Pulau Talang—Talang Besar Fisheries Protected Area	E	B
	34. Pulau Redang Marine Park (+ Perhentian & Kapas Island)	E	B
	35. Pulau Tiga Marine Park	E	B
	36. Semporna Islands Marine Park	P	A
	37. Sipadan Island Marine Park	P	B
	38. Turtle Islands (Pulau Penyu) Marine Park	E	A
Singapore	78. Southern Islands (Include 4 sites: Pulau Hantu, Sudong, Semakau and St. John)	P	B

Country	Name of MPA	E/P	Priority
Thailand	88. Ao Phangna National Park	E	B
	89. Hat Chao Mai National Park	E	B
	90. Hat Nophrat Thara—Mu Ko Phi Phi National Park	E	B
	91. Khao Lam Pi Hat Thai Muang National Park	E	B
	92. Khao Sam Roi Yot National Park	E	A
	93. Laem Son National Park	E	B
	94. Mu Ko Chang National Park	E	B
	95. Mu Ko Similan National Park	E	A
	96. Mu Ko Surin National Park	E	A
Vietnam	97. Sirinath National Park	E	B
	98. Tarutao National Park	E	A
	99. An Thoi (South Phu Quoc) Fisheries Sanctuary	P	B
	100. Bach Long Vi	P	B
Cambodia	101. Cat Ba National Park	E	B
	102. Con Dao National Park	E	A
	103. Nam Du Islands	P	B
Myanmar	104. Preah Sihanouk National Park		
Disputed	105. Lampi Marine National Park		
	106. Mergui Archipelago		
	107. Moscos Islands		
	108. Thamihia Kyun Game Sanctuary		
	Spratly Archipelagos	P	A

IV. Priority Actions and Recommendations

Actions to Strengthen MPA Management:

1. Improve and enforce existing laws and regulations on marine resources and MPA management, taking into account impacts from terrestrial sources.
2. Provide adequate training for MPA planners and managers.
3. Develop and implement comprehensive management plans for declared MPAs. Incorporate buffer zones for MPA management, especially for inhabited and heavily used sites. Utilise integrated coastal management (ICM) principles into MPA zoning, e.g. including a landscape approach from the watershed to the offshore areas.
4. Design strategies to resolve overlapping jurisdiction on MPAs and improve coordination between related agencies to allow effective management. Promote integrated coastal zone management and take into account influences from destructive activities on land.
5. Study and monitor carefully the development of marine ecotourism in and close to MPAs to avoid degradation of MPAs.
6. Consider traditional knowledge and resource management practices in developing management strategies. Encourage stakeholder participation and involvement in management.

7. Monitor the state of the marine environment and socio-economic impacts of MPA management. Document and disseminate successful stories of MPA management and other conservation efforts to encourage possible replication in other areas.
8. Map existing coastal and marine resources, threatened species, habitats (both unspoiled and degraded) and MPAs for long-term monitoring. Such information should be popularly distributed among the countries involved and periodically reviewed to accommodate changes.
9. Incorporate a response feedback system into the monitoring and evaluation mechanism (e.g. MERFS *sensu* Aliño *et al.* 2000b). On a regional basis, establish a collaborative monitoring and evaluation (CoME) akin to those regional nodal networks proposed in the Global Coral Monitoring Network (GCRMN) and the ASEAN regional network of the World Conservation of Protected Areas (WCPA). These should incorporate the concept of adaptive management in the monitoring and evaluation of MPAs where management measures are not delayed but instead serve as natural experiments to be tested (Walters and Hilborne 1978).
10. Promote education and awareness programmes for decision-makers, administrators, politicians as well as users of MPAs at the local, sub-national, national and regional scales.
11. Effectively manage human access and immigration to MPAs.
12. Form a network of NGO institutions concerned with the protection of natural resources to facilitate exchange and strengthen conservation effort, and implement a science-based functional network of MPAs.
13. Ensure country specific conservation planning and strategies so as to incorporate their unique cultural, social, economic and political backgrounds.
14. Develop mechanisms for sustainable financing of MPAs, and enhance the capabilities of people and institutions managing MPAs.

Actions to Fill Gaps in MPA System Establishment:

15. Gazette and manage proposed high priority MPAs as soon as possible. Re-assess when necessary.
16. Carry out biodiversity surveys and assessment in potential MPAs with no or little information available, especially where gaps have been identified in the Review; e.g. W. Sumatra, E. Philippines and Myanmar.
17. With the increased knowledge available, design, establish and implement a system of MPAs with representative sites from all biogeographic zones.

Actions on Regional Cooperation:

18. Establish transfrontier MPAs in areas essential to the survival of species and habitats of global or regional significance; e.g. Spratly Islands, Turtle Islands

between Sabah and the Philippines. Coordinate conservation activities and management in cross-boundary MPAs.

19. Develop joint research and conservation programmes between countries for threatened, migratory species. Utilise the scientific basis for a network of MPAs and facilitate cooperation based on the connectivity and functional attributes of a large marine ecosystem.
20. Establish international linkages to assist countries with little experience in MPA management, by means of technical transfer and financial assistance. This may include cross visits and trainings.
21. Develop and maintain an up-to-date regional database network on marine resources and MPAs to facilitate information exchange and monitoring. Country members involved should be kept in contact to allow inputs of new information. Organise and institutionalise regular venues for cooperation.

The existing ReefBase and FishBase at the International Centre for Living Coastal Resources Management (ICLARM), the ASEAN - Coastal Living Resources project database in Thailand, and BIMS - Biodiversity Information Management System being developed by the Asian Bureau for Conservation, provide some good starting points. The World Commission on Protected Areas (WCPA) has established a regional committee, and the Association of Southeast Asian Nations (ASEAN) Senior Officers for the Environment (ASOEN) has established through funds from the European Union (EU), the ASEAN Regional Centre for Biodiversity Conservation (ARCBC). These are the possible venues for sustaining MPA implementation. Other venues for cooperation are the ASEAN dialogue partners forum, UNCLOS, ICRI, UNEP-East Asian Seas and other conventions.

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BRUNEI DARUSSALAM

BRUNEI DARUSSALAM

Andre Jon Uychiaoco, Catherine Cheung and Sabri Haji Mohd. Taha

Background Facts

Coastline	: 130 km (MacKinnon 1997) – 161 km (Tan 2000a)
Population	: 338,480 (Gazetteer no date)
Population density	: 53 to 58/km ² (as of 1997)
Land area	: 5,765 km ² – 5,270 km ² (Tan 2000a)
Shelf to 200m depth	: 9,390 km ² (continental shelf, IUCN/WCMC 1992)
EEZ	: 38,600 km ² (Brunei Darussalam Fishery Limits)
Est. Coral Reef Area	: 4.5 km ² (Chou et al. 1987) to 45 km ² (DOF-MIPR 1992)
Est. Mangrove Area	: 184 km ² (Zamora 1992)
MPA Coverage	: 50% of mangroves in 1 MPA, 10 ha. of coral reefs in 2 MPAs

(Refer to **Map 2** of Appendix for MPA sites and other relevant areas)

1.1 Coastal and Marine Ecosystems

Sandy beaches, mud flats and estuaries with mangrove and peat swamps dominate the coastal zone of Brunei Darussalam (e.g. IUCN/WCMC 1992). Of the 33 islands in the country, all except two are located in river or estuarine environments consisting of mangrove swamps or shifting vegetation (Chua, Chou and Sadorra 1987; DOF-MIPR 1992). Brunei Darussalam is estimated to have 184 km² of mangroves. These are mostly found on the coast of Temburong (East Brunei Darussalam) and between Tutong and Telisai (West Brunei Darussalam) (Spalding et al. 1997).

The only two oceanic islands, Pelong Rocks and Pulau Punyit are fringed with corals. Coral reefs are not well developed due to the high turbidity caused by runoff from four major rivers and coastal development projects. Total known reef area is merely 45 km² and is mostly confined to five areas far from the shore on offshore islands and shoals (the two largest areas being Ampa and Victoria patches off the coasts of Tutong and Telisai) (DOF-MIPR 1992). The reefs of the Champion Central Reef complex, Pelong Rocks, Pulau Punyit and Two Fathom Rocks have been studied by UP-MSI (*unpublished*) and Chou et al. (DOF-MIPR 1992). Seagrass beds are uncommon. The only reference to seagrasses in Brunei Darussalam is on *Halophila* on the sandy shores of south Brunei Darussalam (DOF-MIPR 1992).

1.2 Species of Significance

Mangroves along the coast and on the islands together with other coastal vegetation harbour at least four species of mammals (e.g. proboscis monkey (*Nasalis larvatus*) and flying foxes), nine birds and two reptiles, all listed in the IUCN Red List (DOF-MIPR 1992). For the coral reefs, 185 species from 71 genera of hard corals and over 150 species of fish from 30 families have been recorded. The number of fish species is likely

to be much higher than reported. Three species of marine turtles, namely the Green Turtle (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*) and the Olive Ridley (*Lepidochelys olivacea*), are found nesting along the beaches mainly on the western part of Brunei Darussalam. The entire country is part of biogeographic sub-region I-8, which it shares with Eastern Malaysia (Kelleher et al. 1995).

1.3 Legislation and Management Framework

The Brunei Museum is responsible for wildlife protection, the Department of Fisheries, for the protection of living marine resources, and the Department of Forestry, for forest (including mangrove) reserves (IUCN/WCMC 1992). The latter two departments are within the Ministry of Industry and Primary Resources. Up until 1992, there was no single environmental authority. The Ministry of Industry and Primary Resources and the Ministry of Development dealt with issues concerning the coastal zone (DOF-MIPR 1992). The National Committee on the Environment (NCE) is an inter-agency consultative body established in 1993 with representation from the relevant government departments and units that are concerned with the environment. The NCE, which is chaired by the Minister of Development, is tasked with providing the framework and coordinating environmental management. The Environment Unit within the Ministry of Development serves as the NCE’s secretariat. In 1994, the NCE formed both the Solid Waste Management and Water Resources Management working groups (Tan 2000).

“Non-government conservation organisations include the Brunei Nature Society, based in Bandar Seri Begawan and the Panaga Natural History Society, based in Seria and run under the auspices of the Brunei Shell Petroleum Company Sdn Bhd.” (IUCN/WCMC 1992).

Logging as an industry and export-earner has been stopped, and the remaining rainforests are protected by law (Tan 2000). Commercial fisheries, mainly trawlers and purse seiners owned by Malay and Thai expatriates, are not allowed to operate less than 3 miles from the coast. Several NGOs (e.g. Brunei Nature Society, Brunei Yacht Club and Brunei Sub-Aqua Club) are interested in promoting environmental awareness.

The Convention on Biological Diversity has not yet been ratified by Brunei Darussalam (as of January 1999) although the ASEAN Convention on the Conservation of Nature and Natural Resources, UNCLOS and MARPOL have been ratified. No World Heritage or UNESCO MAB sites have been declared in Brunei Darussalam.

1.4 Extent of Existing Marine Protected Areas (MPAs) System

Table 1.1. Environmental legislations in Brunei Darussalam.

Year	Legislation
1934	(revised 1984) Forest Act – establishment of forest reserves with the following classifications: protection forest, conservation area, recreational area, production forest and national park
1972	Fisheries Enactment – areas may be closed to fishing
1978	(revised 1984) Wildlife Protection Act – establishment of wildlife sanctuaries

Two small marine wildlife sanctuaries (islands) with coral reefs, Pelong Rocks (2 ha.) and Pulau Punyit (8 ha.), have been protected as historical sites through the Antiquities and Treasure Trove Enactment (1967), with a view of protecting their fauna and flora. One nature reserve, Pulau Berembang Nature Reserve (721 ha.), contains mangroves. Pulau Siarau has unofficially been declared by the Brunei Museum as a conservation area to protect flying foxes and proboscis monkeys therein (488 ha., including mangrove). Labu Selirong, which contains a large area of mangrove, is a production forest reserve (14,348 + 2,566 ha.). Spalding *et al.* (1997) reported that a total of 50% of Brunei Darussalam's mangroves has been set aside for conservation but it could not be determined whether this referred to a portion of the mangroves in Labu Selirong, which is actually a production forest reserve. A Pulau Chermin Reserve has been cited by Bleakley and Wells (1995) though this has not been retained in the WCMC database of protected areas.

1.5 Proposed Marine Protected Areas (MPAs)

The Integrated Management Plan for the Coastal Zone has proposed that all 33 islands of the country be classified into any of three categories: General use, Conservation and Protection (DOF-MIPR 1992). Twenty-one islands have been selected for protection (i.e. highest level of protection is afforded for biodiversity preservation), 10 for conservation (i.e. where regulated ecotourism, education, research and sustainable resource exploitation are allowed) and two for general use. Pelong Rocks has been classified for Conservation, and Punyit, for Protection.

1.6 Evaluation of MPAs - Status, Threats and Management

About 85% of the population lives in the coastal area. The major threats to the coastal and marine environment are coastal erosion and increased siltation from gravel and beach sand mining, and quarrying on hillsides (DOF-MIPR 1992). The continuous demand for sand and gravel for landfills and construction is likely to intensify the problems of soil and coastal erosion and increased siltation in the coastal waters. Coastal development, and domestic, agricultural and oil pollution are also major threats to the coastal environment of Brunei Darussalam. The active petroleum industry and marine traffic locally and in neighbouring Malaysia impose tremendous hazards of oil pollution. This hazard has been recognised and a National Oil Spill Contingency Plan has been approved.

There appears to be little, if any, threat from destructive fishing (**Figure 1.1**; WRI 2002) or overfishing (Chou *et al.* 1992), although shrimp resources are believed to be over exploited. The limited coral reefs are not heavily exploited but are under increasing threats from environmental degradation. There may be some blast fishing, possibly by foreign fishermen, but this has yet to be verified. The Department of Fisheries has deployed a large number of artificial reefs around patch reefs to deter commercial vessels and attract marine life.

Mangroves outside reserves are mainly used for timber (Spalding *et al.* 1997). Bark stripping, encroachment by aquaculture farms, settlement or other uses are also com-

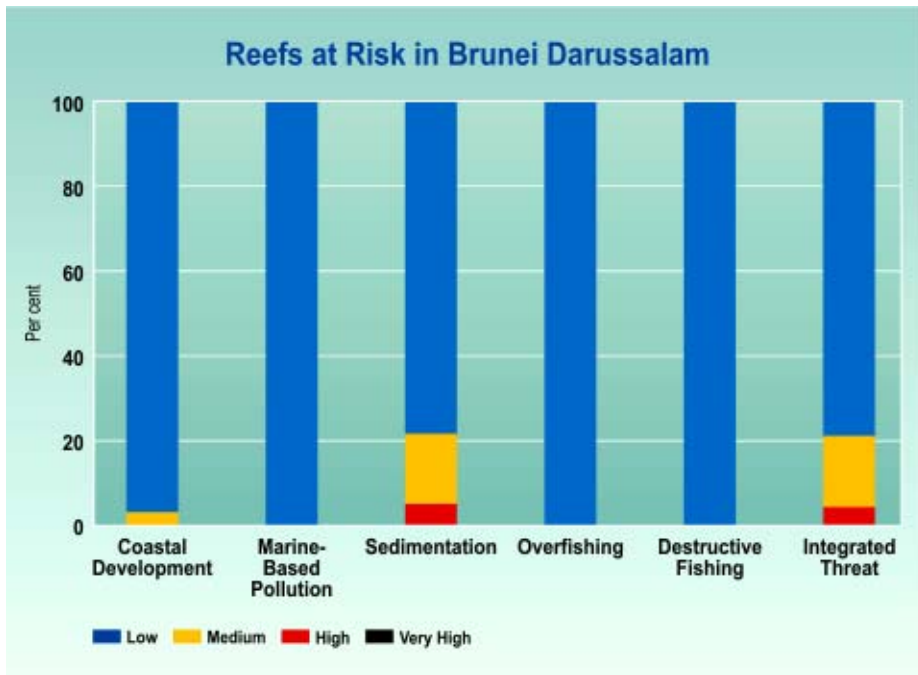


Figure 1.1. The different environmental threats that affect the coral reefs of Brunei Darussalam (Burke *et al.* 2002).

mon outside reserve areas.

The Coastal Zone Management Plan prepared under the ASEAN-US Coastal Resources Management Project has been implemented on a case-to-case basis. The Department of Fisheries has been implementing some of the Plan's recommendations (Sabri Haji Mohd. Taha. *pers. comm.*).

1.7 Priority Sites

Based on limited information, the 21 islands proposed for protection warrant high priority. Of these islands, only Pulau Punyit is fringed with coral reefs while the rest are primarily mangrove areas.

1.8 Priority Actions

- A. Fully implement the comprehensive Integrated Management Plan for the Coastal Zone of Brunei Darussalam, which stipulates a wide range of programmes covering water quality control, marine resource exploitation, island management, transnational collaboration (with Malaysia), research, and legal provisions (DOF-MIPR 1992).
- B. Reclassify Labu Selirong from a production forest reserve to a protection forest or conservation area.

- C. "One of the strategies included in the National Environment Strategy of Brunei Darussalam is the Strategy on Protection of Coastal and Marine Environmental Resources. This strategy comprises the following programmes:
- 1) Strengthen Coastal Water Quality Management Programme;
 - 2) Operationalise the National Oil Spill Contingency Plan;
 - 3) Examine IMO conventions for their possible ratification;
 - 4) Strengthen mangrove management;
 - 5) Strengthen coral / artificial reef management;
 - 6) Designate marine wildlife sanctuaries; and
 - 7) Prevent coastal erosion.
- D. Develop fisheries and MPA legislation and policies, water quality and MPA management plans and personnel (ICRI 1997).



CAMBODIA

CAMBODIA

Hazel O. Arceo and Catherine Cheung with contributions from Kol Vathana and Has Vibol

Background Facts

Biogeographic Divisions	: East Asian Sea I-3
Coastline	: 435 km (MacKinnon 1997)
Population	: 11.3 M
Population density	: 62/ km ²
Land area	: 181,035 km ² (MacKinnon 1997)
Shelf to 200m depth	:
EEZ	: 55,600 km ²
Est. Coral Reef Area	:
Est. Mangrove Area	: 467 km ² (MacKinnon, 1997)
No. of MPAs	: 4
Total Area of MPAs	: 3,887 km ²

(Refer to **Map 3** of Appendix for MPA sites and other relevant areas)

2.1. Coastal and Marine Ecosystems

The coastline of Cambodia contains sandy beaches, muddy and rocky shores that are fringed by coral reefs and seagrass beds. Some 52 islands occur in near- and offshore waters and many are uninhabited. Islands are wooded and a number of them have fringing coral reefs with seagrass beds developing on reef flats. Aerial surveys done in 1994 showed that coral reefs exist around much of Koh Rong, Koh Rong Samlem, Koh Sdach, Kos Pos, Koh Ta Kiev, Koh Thmey and Koh Seas (UNEP 2000).

Coastal mangroves are divided into four zones: a) the *Avicennia-Sonneratia*; b) the *Rhizophora*; c) the *Brugieria-Kandelia-Ceriops*; and d) the *Lumnitzera-Xylocarpus-Bruguiera*. To the rear of the mangroves is a distinctive habitat dominated by *Melaleuca leucadendron* often with the presence of the large fern *Acrostichum* sp., some palms and *Nypa fruticans*, and other trees and shrubs characteristic of mangroves.

Seagrass beds occur throughout the coastal zone of Cambodia but are most extensive in Kampot province and Kep municipality. There are two types of seagrass habitats: a) extensive seagrass meadows along the mainland, and b) patches of seagrass intermingled with corals around the islands.

2.2 Significant Species

A brief survey at Koh Tang identified around 70 species in 33 genera and 11 families of corals (UNEP 2000). Coral diversity is higher in offshore reefs while inshore areas have low species diversity and dominated by massive corals (Wilkinson 2000). There are 435 fish species from 97 families in the waters falling within Cambodia's exclusive

economic zone. Some 30 species of true mangroves have been recognised and eight species of seagrass have been identified so far.

Four species of marine turtles have been reportedly seen in the country's waters in the past. These include the Hawksbill (*Eretmochelys imbricata*), Green (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacea*), and Leatherback (*Dermochelys coriacea*) turtles. Fishers have reportedly sighted crocodiles probably Saltwater Crocodiles (*Crocodylus porosus*) in Koh Kong estuaries and Prek Toek Sap.

The endangered dugong (*Dugong dugon*) was reportedly abundant in parts of the coast especially near Pre Ksach in Koh Kong District, and in Kampot Bay. The more endangered Irrawaddy Dolphins (*Orcaella brevirostris*) have been reported in many places within the Cambodian coastal zone. Other cetacean species known to occur in the country's coastal zone are Indo-Pacific Humpback Dolphin (*Sousa chinensis*), Common Dolphin (*Delphinus delphis*), Bottle-nosed Dolphin (*Tursiops truncatus*), Spinner Dolphin (*Stenela logirostris*), and Finless Porpoise (*Neophocaena phocaenoides*) (Vathana and Vibol, pers.comm).

2.3 Legislation and Administrative Framework

On 1 November 1993, His Majesty King Norodom Sihanouk issued a Royal Decree, "Creation and Designation of Protected Areas", designating 23 areas, covering some 3.3 million hectares or almost 19% of Cambodia's total land area, as National Parks, Wildlife Sanctuaries, Protected Landscapes, and Multiple Use Areas. Most of these areas have yet to be properly surveyed and demarcated. Minimal conservation management has actually been implemented on the ground. It should be noted that all the Coastal Protected Areas are part of the National Protected Area System.

Categories of Cambodia's Protected Area (Royal Decree, 1 November 1993):

- National Park – National and scenic area of significance for their scientific, educational and recreational values (equivalent to IUCN Category II – National Park);
- Wildlife Sanctuary – Natural area where nationally significant species of flora and fauna, natural communities, or physical features require specific intervention for their perpetuation (equivalent to IUCN Category IV – Wildlife Sanctuary);
- Protected Landscapes – Nationally significant natural and semi-natural landscapes that must be maintained to provide opportunity for recreation and tourism (equivalent to IUCN Category V – Protected Landscapes); and,
- Multiple-Use Management Areas – The areas that provide for the sustainability of water resources, timber, wildlife, fish, pasture, and recreation with the conservation of nature primarily oriented to support these economic activities (equivalent to IUCN Category VIII – Multiple-Use Management Area).

Special International Categories:

- UNESCO Man and the Biosphere Reserve (MAB Reserve) – The Tonle Sap Multiple-Use Management Area was nominated as Cambodia's first MAB Reserve in

1997 and was approved by UNESCO in 1997; the MoE serves as the National Focal Point for this MAB Reserve;

- Ramsar Site – The Boeng Chmar portion of Tonle Sap Multiple-Use Management Area (28,000 ha.), the Koh Kapik wetland and associated islets in the Peam Krasop WS (12,000 ha.), and the Middle Stretches of the Mekong River Area between Stoeng Treng and the border with Laos (14,600 ha.) were designated as Ramsar Sites.
- ASEAN Heritage Site – Candidate sites could be National Parks (NPs) and Nature Reserves that deserve the highest recognition so that their importance can be recognized regionally and internationally. On 20–23 September 2000, the Ministry of Environment (MoE) sent its own delegation to attend the Workshop on the Guidelines and Criteria for the Selection of ASEAN Heritage Parks in Hanoi; most of the Candidate sites submitted are terrestrial.

Other major environmental legislation

- Law on Environmental Protection and Natural Resource Management (1996)
- Law on Protection of Cultural and National Heritage
- Praka No. 1033 on the Protection of Natural Areas (3 June 1994)
- Decree No. 33 on Fishery Management and Administration;
- New Fisheries Policy and Fisheries Law (in the state of flux at the moment);
- Policy and Planning currently center on policy definition through the revision and elaboration of the public administration structure and legal framework of the country, such as:
 - New version of the Forestry Law, Fisheries Law, Land Law, and Water Law, as well as associated Sub-Decrees such as the Protected Areas Sub-Decree, Community Forestry Sub-Decree, and Tonle Sap Protected Area (PA) Sub-Decree (all are still under preparation);
 - The creation of new ministries whose mandates are likely to have a bearing on coastal and marine environment management – Ministry of Water Resources and Meteorology and the Ministry of Land Management, Urbanization, and Construction; and
 - The formation of various inter-ministerial committees as a means to achieve inter-agency coordination – National Committee for Forest Management Policy, National Committee for PA Management, National Coastal Steering Committee, etc.
- National Environmental Action Plan (1998-2002):
 - First phase (1–2 yrs) – strengthening government policy, regulatory framework, and preparation and enactment of a law on PA management
 - Second phase (3–5 yrs) – human resource development, mobilizing financial resources, preparation and implementation of PA management plans for selected reserves [e.g. Preah Sihanouk (Ream) National Park, Phnom Bokor National Park, and the Koh Kapik Ramsar Site].

- National Wetland Action Plan (1997) – is of high importance to PA design and management countrywide as it alerts designers to areas of high biodiversity significance to assure that these special sites are included within the PA system and receive appropriate management attention.

The seven government institutions responsible for coastal and marine resources in general are:

- Ministry of Environment;
- Ministry of Agriculture, Forestry, and Fisheries;
- Ministry of Rural Development;
- Ministry of Tourism;
- Ministry of Land Management, Urbanization, and Construction;
- Ministry of Water Resources and Meteorology; and
- Provincial / Municipal Authorities.

The Ministry of Environment (MoE) and Ministry of Agriculture, Forestry, and Fisheries (MAFF) are the main government agencies responsible for biodiversity conservation.

The MoE oversees the following matters: (i) policy and planning; (ii) natural resource management; (iii) nature conservation and protection; (iv) environmental impact assessment (EIA) and pollution control; (v) education and communication; and (vi) legal affairs. The MAFF is mandated to manage the country's forests, including inundated forests, mangroves, primary and secondary forests, forest concession management, as well as wildlife and fisheries. Two technical departments of MAFF are directly relevant to biodiversity management and protection. Administratively, the Fishery Department is responsible for the marine water and mangrove areas while the MoE is responsible for protected areas, whether terrestrial or marine.

Several on-going projects in coastal areas deal with environmental management. Specifically, the project on Coastal and Marine Environmental Management in the South China Sea includes the development of a marine protected area plan for Cambodia (UNEP 2000).

2.4 Extent of Existing Marine Protected Areas (MPAs) System

Marine conservation through MPAs is a new concept to Cambodia despite the long history of terrestrial protected areas. The present system of coastal and marine protected areas in Cambodia comprises six reserves, but two are wholly terrestrial. The four other reserves that have marine components are:

- Botum Sakor National Park (171,250 ha, including terrestrial): encompasses wetland sites of international importance including Stoeng Taak and Stoeng Kol;
- Preah Sihanouk (Ream) National Park (21,000 ha): including offshore islands and surrounding waters, although the marine boundary has never been precisely defined;

- Dong Peng Multiple Use Area (27,700 ha): includes wetland sites of international importance including Prek Chrey, Prek Thnung, and Prek Kampong Som;
- Peam Krasop Wildlife Sanctuary (23,750 ha-terrestrial): encompasses the Koh Kapik Ramsar Site.

All coastal and marine protected areas need to undergo detailed resources and ecological survey to configure their boundaries, and to include fully participatory community involvement in finalising these boundaries.

The 15,000 ha. Ream National Park has recently been extended to include marine areas and renamed as Preah Sihanouk National Park in March 1995. The 23,750-ha Peam Krasop Wildlife Sanctuary (declared in 1993) includes a narrow strip of coastal waters, tidal flat, mangrove, *Melaleuca* forest and watershed areas. Preah Sihanouk (Ream) National Park and Koh Kapik were found to meet the international requirement to be included as regionally Important Bird Areas (IBAs).

2.5 Proposed MPAs

The coastal areas and associated islets of Kaoh Kapik close to the border with Thailand have been proposed for recognition as a RAMSAR site. The area has abundant sand flats and some mud flats between the alluvial islands, mangrove, *Melaleuca* and beach vegetation.

2.6 Evaluation of MPAs - Status, Threats and Management

Most of the coastal wetland areas are threatened by encroachment of intensive shrimp ponds, repeated burning of *Melaleuca* areas, and to a lesser extent, fuelwood and timber cutting. Blast fishing, cyanide and coral collection, trawling and sewage run-off are major threats to corals (UNEP 2000). Blast fishing and extensive coral collection seem to be the most alarming threats to country's reefs, and have extensively damaged many reef areas. Overfishing is also prevalent (UNEP 2000; WRI 2002, **see Figure 2.1**).

The tourism industry made a comeback along the coast during the early 1990s but recent violence directed at foreigners has slowed these activities. Should political stability be achieved, coastal resources would clearly come under pressure from the development of the tourism industry in a manner similar to Thailand.

2.7 Gaps in MPA System

Status and Inventory. Much of the coastal and marine biodiversity information is anecdotal and not sufficient for obtaining a clear understanding of spatial and temporal trends on coastal and marine biodiversity. No recent comprehensive coastal and marine surveys have been undertaken and there is a tremendous shortage of available data and records. Since 1993, donors and non-government organisations (NGOs) have financed most of the information on coastal and marine biodiversity, but these efforts have been somewhat disparate, not comprehensive, and oftentimes not documented.

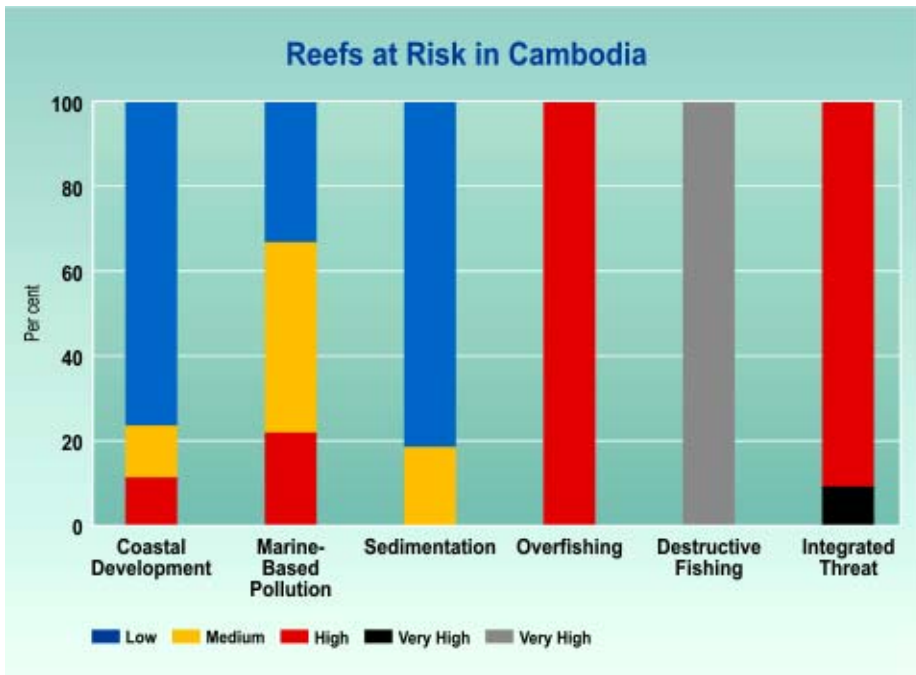


Figure 2.1. The different environmental threats that affect the coral reefs of Cambodia (Burke *et al.* 2002)

Other important issues related to data and information include: very limited technical comprehensive capabilities in many institutions, general weakness in existing statistical data, and limited information sharing among agencies.

2.8 Priority Sites

The only protected area with a substantial marine area, Preah Sihanouk National Park, is rated as national priority. No regional marine priority site can be identified at this stage. Together, the Kaoh Kapik and Pream Krasop areas will form a high priority wet-land site.

2.9 Priority Actions

The Government recognizes the serious degradation of the country's natural resource base and increasing environmental deterioration of urban areas. With the assistance of UNDP, the government is currently preparing an Environmental Action Plan (UNEP 2000).

- A. Carry out biodiversity survey and feasibility studies to evaluate the conservation potential of the marine areas of the country. Cooperation with Thai and Vietnamese scientists is recommended.
- B. Develop sustainable utilization of mangrove and *Melaleuca* resources. Control the spread of intensive shrimp culture and reforest with local species where necessary.

- C. Promote exchange of scientific findings and management examples on coastal resources and shrimp culture with Thailand and Vietnam.
- D. Provide training to MPA and coastal protected areas planners and managers.



INDONESIA

INDONESIA

Andre J. Uychiaoco and Catherine Cheung with contributions from Suharsono(2001 paper), Lida Pet-Soede and Rili Djohani (2002)

Background Facts

Coastline	: 80,791 km (Moosa 1995) to 204,000 km (Tomascik et al. 1997)
Population	: 213,524,012 (World Gazetteer, no date)
Population density	: 109.3/km ² ; coastal (w/in 60 km of coast) pop. density 93/km ² (Bryant et al. 1998)
Land area	: 1,919,445 km ² (IUCN/WCMC 1992)
Shelf to 200m depth	: 2,776,900 km ² (World Resources Institute 1994)
EEZ	: 5.8M km ² (Priyono and Sumiono 1997)
Est. Coral Reef Area	: 42,000 km ² (Bryant et al. 1998) to 85,700 km ² (Tomascik et al. 1997)
Est. Mangrove Area	: 38,000 km ² (Spalding et al. 1997)
MPA Coverage	: 8 (2,538 km ² , SME-GOI 1992); 30 (26,000 km ² , Bleakley and Wells 1995); 26 (30,405 km ² , Bryant et al. 1998); 34 (46,190 km ² , Moosa et al. 1996, cited in Nontji 2000)

(Refer to **Maps 4, 5 & 6** of Appendix for MPA sites and other relevant areas)

3.1 Coastal and Marine Ecosystems

Comprised of some 17, 508 islands (Hopley & Suharsono 2000), the archipelagic state of Indonesia spans a vast area across seven of the eight biogeographic divisions (1st order) of the East Asian Seas (i.e. I, II, III, V, VI, VII, VIII; Hayden *et al.* 1984 cited in Bleakley and Wells 1995), from the Indian Ocean to the Pacific Ocean. The archipelago rests upon two continental shelves: the Sunda Shelf where Sumatra, Java and Kalimantan are, and the Sahul Shelf, which carries Irian Jaya and the islands nearby. Between the two continental shelves are the islands of the Sulawesi, Maluku and Nusa Tenggara provinces surrounded by very deep, clear water seldom affected by the NW or SE monsoons (UNEP/IUCN 1988). Coral reefs may be found all around Sulawesi, Nusa Tenggara, Bali and Maluku; some reefs are also found in West Irian Jaya, islands East and West of Sumatra and East of Kalimantan. Reef fisheries are especially important for food in East Indonesia.

Seagrasses have been reported from all Indonesian biogeographic sub-zones except from Irian Jaya (V and III-14) and north Sumatra (VI-19) (Kiswara 1994). However, this absence may be due to the remoteness of these locations and lack of research or publications rather than the actual absence of seagrasses there. Studies on seagrass are mainly concentrated at Banten Bay in west Java and in south Sulawesi (Kiswara 1992; Verheij and Erftemeijer 1993; Erftemeijer and Allen 1993). Twelve seagrass species have been recorded in Indonesia (Fortes 1990), in varied habitats such as intertidal mudflats, shallow sandy beaches and reef flats.

In areas affected by large rivers such as most of Kalimantan, eastern Sumatra and southern Irian Jaya, mangroves are predominant. The estimated total area of mangroves in Indonesia is 38,000 km² but other estimates range from 21,763 km² to 42,550 km² (Soemodihardjo *et al.* 1993; Spalding *et al.* 1997). Most mangroves are found in Irian Jaya (29,000 km²), Sumatra (4,170 km²), Kalimantan (2,750 km²) and Java (343 km²) (Priyono and Sumiono 1997).

The country has the most coral reefs and mangroves in the region. The distribution of coral reefs, wetland, endangered species, as well as the basic physical and socio-economic environments have been mapped in the Conservation Atlas of Salm and Halim (1984). More recently, the status, threats and management of reef ecosystems in Eastern Indonesia have been reviewed by Hopley and Suharsono (2000).

3.2 Species of Significance

Indonesia is a megadiversity country and is currently the top among Southeast Asian countries for marine biodiversity. Endangered marine species that may be found here include dugongs, turtles (all six species found in the East Asian seas are also found in Indonesia), whales and dolphins (29 species) (Moosa 1999). At least 25 species and taxa, including the dugong (*Dugong dugon*), six species of turtles, whales and 12 molluscs, have been listed for protection under various government decrees. The distribution of dugongs is fairly widespread across the country although in low numbers as a result of hunting and accidental catch. The major populations are in western Cenderawasih in Irian Jaya and Kepulauan Aru in the Arafura Sea (Husar 1978). Around 140 turtle nesting sites have been mapped (Salm and Halim 1984; Soehartono 1994), but the degree of usage of these sites by substantial nesting populations is not clearly known though it is thought to be declining due to widespread habitat destruction and disturbances.

The most common turtles are the wide-ranging Green (*Chelonia mydas*), followed by the Hawksbill (*Eretmochelys imbricata*) and Loggerhead (*Caretta caretta*) turtles. The Olive Ridley (*Lepidochelys olivacea*), Flatback (*Natator depressus*) and Leatherback (*Dermochelys coriacea*) turtles are rare and have been recorded only in south Sulawesi, Maluku and Irian Jaya. The major regular nesting site of the Leatherbacks is on the northern Irian Jaya coast.

The deep seas of Maluku and the Straits of Flores and Lombok form important migratory routes between the Pacific and Indian Oceans for whales, including the endangered Blue whale (*Balaenoptera musculus*) and the vulnerable Fin (*B. physalus*) and Humpback (*Megaptera novaeangliae*) whales.

Some 2,140 fish species (Hopley and Suharsono 2000), 782 algal species (green, brown and red) (Sugiarto and Polunin 1981), 13 seagrass species (Moosa 1999), 38 mangrove species (Moosa 1999) and 450 scleractinian coral species (Tomascik *et al.* 1997) have been reported from Indonesia. Moosa (1999) cited or estimated species diversity of other marine organisms in Indonesia.

3.3 Legislation and Management Framework

The Ministry of Environment is the key national sustainable development coordination body. The Ministry of Forestry, specifically its Directorate General for Forest Protection and Nature Conservation (PHPA), now known as the PKA, and the Ministry of Agriculture also play important roles in coastal environmental matters. The newly established Ministry of Marine Affairs and Fisheries might prove to be the most relevant for the coastal environment.

The Directorates under the PHPA are:

- (1) Nature Conservation - Provides overall planning of the terrestrial and marine protected areas network, drafting of conservation legislation and the proposal, establishment and management of individual protected areas.
- (2) National Parks and Recreation Forest – Oversees the development of the national parks programme.

The provincial offices of the PHPA, work with the regional planning boards (BAPPEDA).

Indonesia has established the National Clearing House on Biodiversity at the Ministry of Environment. Discussions are underway to form the National Coordinating Body on Biodiversity to supervise and plan all activities related to the conservation and sustainable use of biodiversity (SME-GOI 1992).

The Marine Conservation Data Atlas (Salm and Halim 1984) produced as a collaborative action between the PHPA, the IUCN and the WWF has provided the basis and guidelines for the development of marine conservation programmes and policies. In the late 80's, the government declared a policy to protect 10 M ha of marine and coastal areas by the end of REPELITA V (the 5th Five Year Development Plan, 1989-1994) and 30 M ha by year 2000 (Hutomo *et al.* 1993).

In 1990, the "Conservation of Living Natural Resources and their Ecosystem Act" concerned with sustainable resource utilization and ecosystem maintenance, was passed and has become the fundamental legislative tool for the management of protected areas. Based on this Act, the various MPAs of the country fall under four categories that correspond with the IUCN (1994) classification (see Park Designations below). The Act also transferred the responsibility for the drafting and implementation of the management plans from the national PHPA to the Regional Forestry (KANWIL-Forestry) in cooperation with the Regional Development Planning Boards (BAPPEDA I). While the designation of sites remains under the national PHPA, the BAPPEDA I and local, sub-regional administrator's office (Bupati) are consulted during the selection processes.

Other departments and institutions are also involved in marine conservation and protected areas, e.g. the Ministry of State for Population and Environment's (KLH) Management of Environmental Impacts (Bappedal), the Department of Agriculture's Directorate of Fisheries, the Department of Communications' Directorate of Marine Communications, and the Indonesian Institute of Science (LIPI). The Bappedal coordinates coastal zone management issues and assesses development projects through the Analysis of Environment Impacts (Amdal). LIPI's Research and Development Centre for Oceanology provides scientific advice to other agencies

Apart from legislative control and government management, conservation programmes run by NGOs play an important role in awareness promotion, community building, resource planning and management, both within and outside MPAs. Some 400 NGOs carry out various land and marine-based conservation activities in different parts of the country (Ministry of National Development Planning 1993). The major conservation NGOs are the WWF-Indonesia Programme (which has a large marine conservation programme), The Nature Conservancy and Conservation International (which appear to focus more on terrestrial issues), and the local-run WALHI, MPLH and HUALOPU that have launched varied conservation education, turtle and dugong protection activities.

Traditional community management of marine resources exists in some areas. For example, marine “sasi” is an old community management practice of the central Maluku whereby a marine area owned by a particular coastal village with traditional use rights, is closed from harvest periodically (Zerner 1994). The exploitation of the mother-of-pearl shell (*Trochus niloticus*) from the 1960s to the 90s revealed that traditional community management has been subjected to influence from government and market interference both positively and adversely. Progressive development of a revised sasi, incorporating contemporary environmental knowledge and strategies may generate effective ways of community-based resource management in some areas. The Coastal Resources Management Project (Indonesia) has facilitated the establishment of a couple of community-based (village level) marine sanctuaries in North Sulawesi.

Park Designations:

Nature Sanctuary

A specific terrestrial or aquatic area having protection as its main function to preserve the biodiversity of plants and animals, as well as their ecosystems that also act as life support systems.

Cagar Alam (Nature reserve). IUCN category I nature sanctuary which, because of its characteristic plants, animals and/or ecosystems, must be protected and allowed to develop naturally. Activities permitted are non-manipulative research, monitoring and the development of science, education and other activities protecting breeding stock. The government shall manage such areas in order to preserve the species diversity of plants and animals and their ecosystems.

Suaka Margasatwa (Wildlife/Game reserve). IUCN category IV nature sanctuary having high species diversity and/or unique animal species, in which the habitat may be managed to assure the continued existence of these species. Activities are limited to research, monitoring and education. The government shall implement management activities in an effort to preserve the diversity of plant and animal species and their ecosystems. Most of these areas are land-based and designated to protect exploited species such as birds and turtles.

Biosphere Reserve. An area of unique and/or degraded ecosystems, which needs to be protected and conserved for its research and education value. Within the framework of international conservation and for those activities defined in Article 17, “sanctuary reserves” and other specified areas can be established as biosphere reserves.

Table 3.1. Legislative measures in relation with the management and protection of Indonesia's marine and other natural resources.

Year	Legislation
1932 & 1941	Colonial Nature Protection Ordinances of 1932 and then 1941 (Staatsblad No. 17 & 167) provided for nature reserves (Cagar Alam) and game reserves (Suaka Margasatwa) and their management by the Forest Department of the Ministry of Agriculture
1945	Constitution
1949	Independence
1971	Establishment of the Directorate of Nature Conservation and Wildlife (PPA) in whom rested responsibility for establishing and managing protected areas (then under the Directorate General of Forestry which in turn was under the Ministry of Agriculture)
1980	Trawling ban (Sardjono 1980)
1982	Basic Environmental Law
1985	Directorate General for Fisheries Law No. 9. Ban on blast fishing
1990	Conservation of Living Natural Resources and their Ecosystems Act provides for nature sanctuaries (nature and game reserves) and nature conservation areas (national parks and grand forest parks) including additional designation as biosphere reserves (UNESCO MAB, n=6+)...includes marine and terrestrial. Directorate General of Forest Protection and Nature Conservation (Director of Nature Conservation)
1992	(Act No.24) Spatial Planning Act specifies that land, sea and air resources must be managed in a coordinated, integrated and sustainable manner (Abdullah and Hutomo, 1995)
1997	(Act No. 23) The Management of the Living Environment
1999	(Act No. 22) Decentralization of a lot of authority from the central government to the provincial and district governments
1999	Creation of the Ministry of Marine Affairs and Fisheries

Kawasan Pelestarian Alam (Nature Conservation Area)

A specific terrestrial or aquatic area where the main functions are to protect life support systems, to preserve diversity of plant and animal species, as well as to conserve living natural resources and their ecosystems for sustainable utilization.

Taman Nasional (National park). IUCN category II nature conservation area of outstanding natural value of national, regional or global significance, which must be large enough for recreational and educational use without affecting the conservation values. These parks are managed through a zoning system for research, science, education, supporting cultivation, recreation and tourism purposes. All national parks must have an approved management plan following the PHPA National Park Planning Guidelines (PHPA 1992) including a zoning plan, an outline of a 25-year strategy for park management, an initial five-year work plan and the first annual management work plan.

Taman Hutan Agung (Grand forest park). A nature conservation area created to provide a collection of indigenous and/or introduced plants and animals for research,

science, education, supporting cultivation, culture, recreation and tourism purposes.

Taman Wisata Alam (Nature recreation park). IUCN category V nature conservation area which may not have very high conservation value but is managed mainly for recreation and tourism purposes.

Marine protected area categories are Marine Nature Reserve, Marine Wildlife Reserve, Marine National Park and Marine Recreation Park.

Indonesia participates in the World Heritage Convention, the UNESCO Man and Biosphere Programme and the ASEAN Convention on the Conservation of Nature and Natural Resources.

3.4 Extent of the Existing MPA System

Information on the MPAs is abundant but sometimes with discrepancies. Lists sometimes include sites with no marine area. Total area figures for MPAs are even more difficult to verify because they may refer to the total area of a coastal protected area or only the marine extension of the reserve. Some sites are primarily terrestrial and encompass less than 30% marine areas. **Table 3.3** includes all protected areas that are predominantly marine, are small islands or have a significant marine component (Suharsono, 2001 review). Given the size of Indonesia, this list is considered a small start to the long-term process of MPA establishment. This review does not assess the hundreds of coastal protected areas that have a small marine component not recognized by the national government.

3.5. Proposed MPAs

Among the hundreds of proposed MPAs, some of which have been surveyed by local institutes, only few have been endorsed by the national government. Among the proposed protected areas endorsed are those in or close to Irian Jaya, in northern and southern Sulawesi, in southwest Kalimantan and on the islands west of Sumatra. Most of these areas have coral reefs except Jamursba Medi, which is a sandy coast important for Leatherback turtles and Tanjung Puting, a mangrove area. Most areas lack detailed information on the habitat, species and threats although some might have inaccessible survey reports and notes in Indonesian.

3.6 Evaluation of MPAs - Status, Threats and Management

Indonesian fisheries (for the country as a whole) used to be underexploited (mainly because of underexploited pelagic fisheries; GOI 1997, Hopley and Suharsono 2000). However, the number of motorised fishing boats and overfishing has rapidly increased especially in the west (Priyono and Sumiono 1997). In particular, the threat of overfishing is estimated to be high or moderate around Indonesia except in Kalimantan and Irian Jaya (see **Figure 3.1**). Attracted by quick economic return, local fishermen sometimes follow illegal fishing practices introduced by outsiders despite being aware of the long-term impacts on the environment and resources (WWF Indonesia 1994). Fishing with explosives, cyanide and bottom trawl are the main types of destructive fishing. There

has been an increasing use of hookah and scuba for highly priced products such as groupers, maori wrasse, lobsters and various shells. Destructive fishing is high around Sulawesi, Northwest Sumatra and some areas of West Irian Jaya and moderate in Southeast Sumatra, Nusa Tenggara, Jakarta, between East and West Malaysia and North Irian Jaya (WRI 2002). Turtles and dugong are also being caught illegally. While turtles have been traditionally hunted as part of the rituals and diet, most are now slaughtered for sale to restaurants or souvenir shops in cities. Mining of corals is also a major problem (SME-GOI 1992), e.g. in Seribu, Mentawai (West Sumatra), Riau and Bali (Nontji 2000). The intrusion of technologically sophisticated foreign fishing boats in Indonesian waters is yet another problem (SME-GOI 1992). Law enforcement is weak in eastern Indonesia (GOI 1997).

The top source of domestic, agricultural and industrial pollution is Java. This is where ~55% of the country's population is concentrated such as in Jakarta and Surabaya. The population of eastern Indonesia is estimated to be 35 million (Hopley & Suharsono 2000). Java and Bali also produce ~70% of the national food supply largely through agriculture (IIED/GOI 1985). Phosphate and nitrate from agriculture and sediments from logging and conversion of salt marshes and mangroves to rice paddies also flow into the marine estuaries (SME-GOI 1992). Land reclamation and other coastal development activities also contribute to poor water quality. World Resources Institute (2002) estimates that Java, Bali, Sulawesi, Northwest and Southeast Sumatra, Nusa Tenggara, Maluku and West Irian Jaya are under high threat from sedimentation and moderate to high threat from coastal development.

Transmigration has also distributed some of this population to other parts of the country with consequent spread of degradation. Already, 60% of Indonesia's population lives on the coasts. Only 40% of the urban population has their solid wastes collected, while it is much less in rural areas. These wastes are typically burned or dumped in streams or open land (SME-GOI 1992). Shipping, mining and oil exploitation are also potentially significant sources of pollution since oil and tin are among Indonesia's top exports and ships also frequently traverse the archipelago. Sedimentation due to deforestation is also a significant problem since timber is one of Indonesia's top exports.

Recent estimates show that 40% of Indonesian coral reefs is in poor condition ($\leq 25\%$ coral cover) and only 6% is in excellent condition ($> 75\%$ coral cover) with W Indonesia in the worst shape (Suharsono 2000, in Nontji 2000). It has been estimated that 30-40% of original seagrass meadows has been degraded (Fortes 1995) primarily due to sedimentation (Talaue-McManus 2000). Threats to mangroves are mainly due to conversion to shrimp ponds and logging (Spalding et al. 1997)

Global warming and sea level rise are other potential problems (GOI 1997) as had already been evidenced in the past (Pulau Seribu; Brown and Suharsono 1990) and by the mass bleaching event of 1998 (Bali; Zamany et al. 1999). Volcanoes, earthquakes, and tsunamis are natural disturbances to Indonesia's coral reefs (Nontji 2000).

Information on the status of the coral reefs and other habitats within MPAs is scarce, except for the marine national parks where management plans have been or are being developed, and at a few other sites that have been studied by research institutes or environmental NGOs for their outstanding conservation values and threats. For ex-

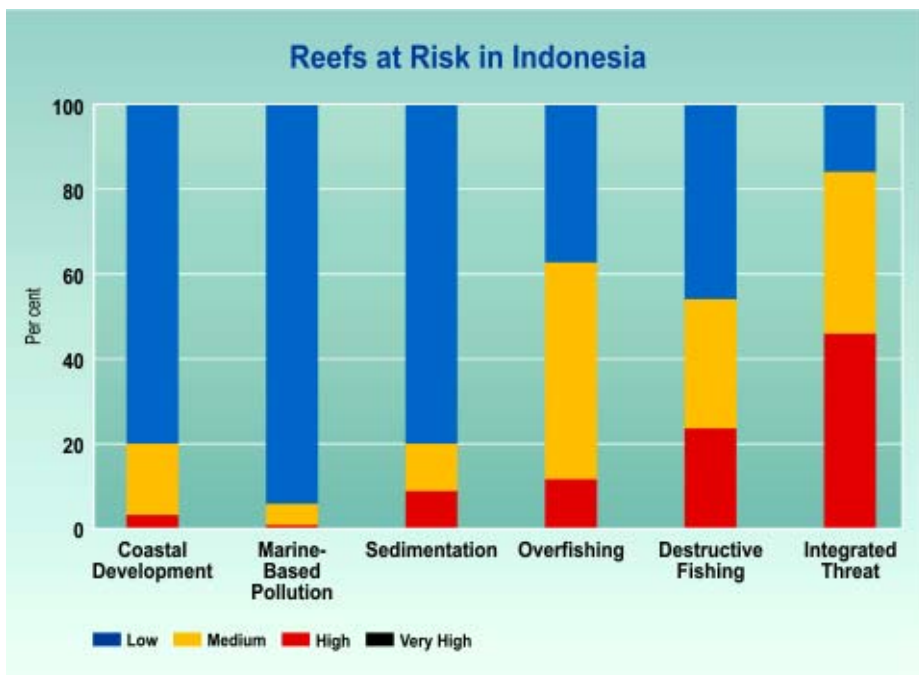
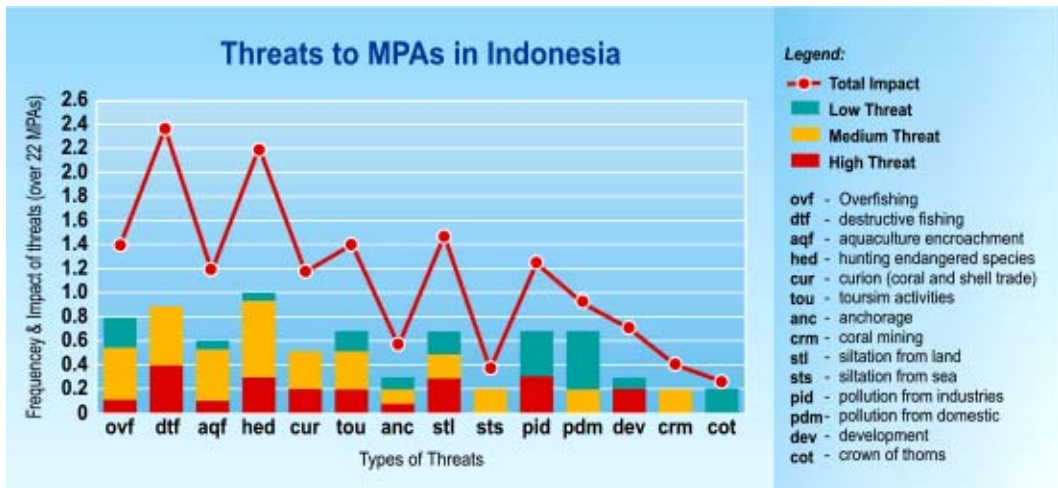


Figure 3.1. Threats to MPAs of Indonesia (top) (Cheung 1995) and to the country's coral reefs in general (bottom) (Burke *et al.* 2002).

ample, the escalating pressure from tourism development and pollution at Kepulauan Seribu has triggered intensive studies and monitoring by UNESCO and LIPI since the 80's (Harger 1988). The situation both at Pulau Sangalaki and Pulau Semama is fairly well understood because of the turtle conservation projects of WWF and PHPA. Laut Banda has attracted the attention of international and local scientific communities because of its special geological and ecological characteristics as demonstrated by the rapid regeneration of coral reefs after a major volcanic eruption in the late 80's.

Siltation from land-based sources, tourism activities and overfishing are the next most serious threats to most sites, notably Kepulauan Seribu and Bunaken Manado Tua National Parks. Impacts from these threats are often inter-related; development of tourist resorts often leads to increased coastal erosion and siltation as well as the demand for seafood. Industrial pollution including oil is particularly serious at sites near major cities, ports or marine traffic routes.

There are no management activities for majority of the MPAs; only minimal levels of management in the marine national parks and some NGO activities are evident in a few sites. Despite the drafting of a management plan in 1982 and a zoning plan in 1986, Kepulauan Seribu National Park is not fully managed as of 1995. The decade-long delay was a result of unsolved inter-agency jurisdictional disputes and island ownership confusion, lack of financial and human resources, and inability to reach consensus over the zoning plan (Hutomo *et al.* 1993). Although conflicts over the zoning plan appeared to have been solved in 1992, the revised zoning plan has yet to be implemented. As in many other popular tourist destinations, Kepulauan Seribu suffers a great deal of environmental impacts as tourism grows hastily without comprehensive planning. Despite the tremendous growth in revenue derived from tourism (80,000 visitors in 1991), less than 5% of the local population is employed in this industry. This has important implications as it worsens the conflicts of interest between the two major users – local fishermen and tourism developers/operators; stimulates resentment among the local community, and is unable to substantially reduce fishery pressure by taking away parts of the fishing labour.

At Bunaken Manado Tua National Park, disagreement among national and local agencies over the jurisdictional boundary of the park and responsibility sharing has been the major obstacle to management. As in Kepulauan Seribu and many other heavily used sites, a conflict exists between maximizing economic development and sustaining natural resources and environmental integrity. The lack of a clear land tenure system and site-specific strategy for tourism development often resulted in competing land-uses and environmental degradation because of overuse. Management however has since improved.

The draft management plan of Taka Bone Rate National Park completed in 1994 awaits implementation (EMDI 1994). The plan points out repeatedly the importance of inter-agency coordination and the role of NGOs and community groups in the planning, implementation and development of the park. WWF had launched two community marine conservation awareness programmes at Taka Bone Rate and Aru Strict Nature Reserve in 1994 that would contribute to the future development of the two areas (WWF 1994, Hitipeuw *et al.* 1994). The other two marine national parks, Karimunjawa and Teluk Cenderawasih do not yet have a management plan and are not being managed. The marine extensions of Ujung Kulon declared in 1992 receive minimal protective effort. In contrast to all the above, Bali Barat Marine Reserve is afforded an effective level of protection. Upon the request of the Department of Forestry and since 1995, The Nature Conservancy (TNC) has been assisting the Komodo National Park's (KNP) authority in developing the marine component of the park. A combination of strategies that include enforcement, monitoring, and alternative livelihood strategies are being tested and implemented. A 25-year management plan has recently been developed for the marine area of Komodo and was signed June 2000 by the local government, head of the park, and the central government (Pet *et al.* 2000).

Despite a very early start in the traditional “sasi” and much aid from intergovernmental (Food and Agriculture Organization, and United Nations Development Programme), international (WWF, and The Nature Conservancy) and national non-government organisations, management has not been able to keep pace with the expanding protected areas network. Causes include the lack of funds, training and capable managerial personnel and consequent lack of organisational capability, technical personnel, motivation and enforcement. Personnel and capabilities were originally oriented towards the management of the terrestrial environment. There is also an inadequate management framework for identifying and controlling resource use, excessive centralization in management and low local community participation (SME-GOI 1992)

The total number of existing and proposed parks, reserves and protected areas, for example, is over 700, including marine areas. Mangroves are not well represented in the current protected areas system. Of the 700, some 79 sites are priority in terms of biodiversity protection, but only 31 (including terrestrial) have complete management plans, and not all have been implemented (World Bank 1994). Specifically, of the six Marine National Parks, only three have management plans being implemented (Hopley and Suharsono 2000). A large part of the 368 established protected areas has not been surveyed, mapped or has clear boundaries (ADB 1995). Most other sites have not even been accurately surveyed or mapped. There are also conflicts between national and local plans, conservation objectives and actual use (including mining and oil exploration initiatives). Fortunately, management is being directed towards greater integration; local communities are being involved and their concerns addressed (SME-GOI 1992).

Poverty, low public awareness and participation are also major stumbling blocks. The Government of Indonesia launched the Coral Reef Rehabilitation and Management Program (COREMAP) in 1998 for the protection, rehabilitation and sustainable use of coral reefs and associated ecosystems through co-management (i.e. with local government and local communities). This 15-year programme (1998-2013) covers 10 provinces (Maluku, Irian Jaya, South, Southeast, North Sulawesi, East and West Nusa Tenggara, Riau and North and West Sumatra). The major initiatives of COREMAP Phase 1 included public awareness campaigns, pilot community-based management, institutional development activities, an information and training network and development of a Monitoring, Control and Surveillance system.

The Indonesian Institute of Science has field stations in the vicinity of coral reefs and monitors some of these areas: Ambon and Tual (Maluku), Biak (Irian Jaya), Bitung (North Sulawesi) and Mataram (Lombok). Six state universities assigned to develop marine science have field stations as well (though it is not known whether they monitor such areas): Universitas Riau in Pekanbaru (Sumatra), Bogor Agricultural University (West Java), Diponegoro University in Semarang (central Java), Hasanuddin University in Makassar (South Sulawesi), Sam Ratulangi University in Manado (North Sulawesi), Pattimura University in Ambon (Maluku). Patrolling and law enforcement have been intensified in the waters of KNP. Researches in KNP directed at identifying reef fish spawning aggregation sites and at understanding the patterns in use in these sites by different fish indicate that protection of these sites from intensive fishing is vital for the reef fish stocks.

3.7 Gaps in the MPA System

The existing MPAs are quite well spread across the archipelago and cover all biogeographic divisions except Division I, with more in the larger and more complex divisions such as Divisions II and III and some concentration in western Java (Table 3.2).

With the proposed MPAs gazetted and effectively managed, the major gap, i.e. west Sumatra, will be represented by the MPA system. However, the gap in Biogeographic Division I, the islands between the southern tip of Peninsular Malaysia and western end of Kalimantan, will remain unrepresented. The political situation of these islands may have to be considered.

3.8. Priority Sites

This Review has rated 10 of the MPAs as having regional/global significance (Table 3.3). The number of selected sites may increase, especially when sites in east Indonesia are better known. Although Pulau Krakatau Strict Marine Nature Reserve has been declared part of Ujung Kulon National Park in 1983 (UNEP/IUCN 1988), it is not managed as such because it falls under a different province. Among these high priority sites, Teluk Cenderawasih, Laut Banda and Karimunjawa have been given regional priority in the IUCN/CNPPA Global Representative MPA System Programme, based largely on their complex and relatively pristine ecosystems and biogeographic representativeness (Kelleher et al. 1995). Ujung Kulon National Park was approved as a World Heritage Site; Komodo National Park was declared a World Heritage site and a Man and Biosphere Reserve, and Tanjung Puting has been proposed as Biosphere Reserve. These global recognitions are attributed mainly to the presence of significant wetland or endangered and endemic fauna, noticeably the Javan Rhino (*Rhinoceros sondaicus*) in Ujung Kulon, Komodo Dragon (*Varanus komodoensis*) in Komodo and the Orangutan, and extensive mangrove and swamp forests in Tanjung Puting. Although there is limited detailed information on the marine ecosystems of these three sites, Ujung Kulon (including Pulau Krakatau) is known to have rich coral reefs, and provides nesting sites for green and hawksbill turtles and the estuarine crocodile (*Crocodylus porosus*). The waters around Komodo have rich coral reefs and are frequented by dugong, sperm whales (*Physeteridus macrocephalus*), blue whales and turtles (UNEP/IUCN 1988). Being an

Biogeographic Division	No. of Existing MPAs	No. of Proposed MPAs
I (I-Indonesia)	0	0
II (9,10,11,12)	10	3
III (13,14,15,16)	9	3
V	1	2
VI (19,20)	1	1
VII	5	2
VIII	3	0

Table 3.2 Distribution of Existing and Proposed MPAs in the Different Biogeographic Divisions (Cheung 1995)

extensive mangrove system, Tanjung Puting undoubtedly plays a vital role in sustaining many marine species and resources.

Taka Bone Rate, the largest atoll in Indonesia and one of the largest in the world, is rated highly as it is still in relatively good condition despite facing increasing exploitative pressure, especially from external fishing companies (WWF Indonesia 1994). Sangalaki and Semama are important green and hawksbill turtle nesting sites, which if managed as one, and jointly with the turtle conservation programmes in Sabah and the Philippines, would yield high conservation achievement. There may, however, be some difficulties in managing Semama because of local objections to discontinue turtle egg concessions.

Seven nationally important sites have been identified including Jamursba Medi (proposed nature reserve), which is a very important Leatherback turtle nesting site, and Bunaken Manado Tua National Park, which may be used as a management demonstration site for many of the MPAs not yet managed, especially sites with coral reefs suitable for marine tourism that are also exploited for local fisheries. Three other sites – Teluk Raja Ampat at the northwest tip of Irian Jaya, Kep. Karimata west of Kalimantan and Tujuh Belas Pulau Nature Reserve off southern Sulawesi – require immediate surveys to confirm their conservation potential to warrant national priority.

3.9. Priority Actions

- A. Update and complete the national inventory of all existing and proposed MPAs and protected areas on the coast and verify their official and management status.
- B. Review the designation of existing MPAs, and revise these to accommodate traditional uses and sustainable development where appropriate. Many of the Strict Nature Reserves will probably have to be re-designated as Multiple-Use Reserves or Parks to make their management feasible.
- C. Define clear boundaries in the gazettment of new MPAs and revise boundaries and zonation of existing MPAs where necessary. Manage adjacent and linked PAs as one and emphasise buffer zone planning and management.
- D. Considering the vulnerability of MPAs to external influences (including terrigenous processes and hydrological forces that may carry pollutants from outside), employ integrated coastal zone management, incorporating integrated buffer zones linking land and sea, and improve communication and cooperation between authorities responsible for land and sea.
- E. Switch the emphasis on small, isolated, highly protected MPAs to a system of MPAs allowing multiple-use principles and networking.
- F. Conduct strategic assessment of manpower requirements during the planning and management of individual MPAs and the MPA system.
- G. Develop unified survey and monitoring procedures, mapping, GIS and database systems within PHPA to facilitate overall planning of and exchange within the MPA system.

- H. Strengthen NGO capabilities in community conservation programmes.
- I. Consider the need for more and more effective marine protected areas where these are least represented especially the bull's eye of coral reef diversity in the world (Wallace 2000, East Sulawesi sub-zone III-15), and also the Indonesian waters between East and West Malaysia (I-Indonesia, where destructive fishing is also high) and the Strait of Malacca (transboundary VI-20 and VI-22).
- J. Continue to pursue the goal of PHPA (1992) to establish a 30 M-ha. network of marine protected areas by the year 2000.
- K. Other priority action points identified are: (SME-GOI 1992)
 - 1) Integrated Planning and Resource Development in Coastal Zones;
 - 2) Monitoring and Protecting Coastal and Marine Environments;
 - 3) Sustainable Utilization of Marine Resources;
 - 4) Strengthening and Empowering Coastal Communities;
 - 5) Sustainable Development of Small Islands;
 - 6) Maintaining Security of the Exclusive Economic Zone (EEZ);
 - 7) Managing the Impacts of Climate Change and Tidal Waves.
 - 8) Managing the Protected Areas System More Effectively (see above);
 - 9) Conserving Biodiversity in Agroecosystems and Non-Protected Production Areas;
 - 10) Ex Situ Conservation of Biological Diversity;
 - 11) Protecting Traditional Community Knowledge and Improving Knowledge on Conservation of Biodiversity;
 - 12) Developing and Maintaining a Sustainable Biological Diversity Utilization System, Including Equitable Sharing of Benefits.
 - 13) Data for management and continued training of scientific and management personnel (Hopley and Suharsono 2000)
 - 14) Training of managers and facilitators for community-based coastal management (ICRI 1997)
- L. See also the "National Policy and Strategy for Coral Reefs in Indonesia" being prepared by COREMAP and Bogor Agricultural University.

Based on the questionnaire results for 10 better known coral reef sites, the hunting of endangered species (turtles, dugongs and sharks) and destructive fishing practices have been perceived as causing the most serious impacts (Figure 3.1).



MALAYSIA

MALAYSIA

Andre Jon Uychiaoco, Catherine Cheung and Annadel Cabanban, with contributions from Jamili Nais

Background Facts				
	National	Peninsular	Sarawak	Sabah
Coastline	: 4,675 km (WRI no date)			
Population (Gazetteer, no date)	: 22,679,516M	18.309M	2.1279M	2.242M
Population density	: 61/km ² (as of 1997, World Bank, 1999)			
Land area (km ²)	: 330,355	132,750	123,985	73,620
Shelf to 200m depth	: 373,500 km ² (Abu Talib and Alias 1997)			
EEZ	: 475,600 km ²			
Est. Coral Reef Area	: 4,000 (Burke <i>et al.</i> 2002)			
Est. Mangrove Area	: 6,412 km ² (Chan <i>et al.</i> 1993)	1,090 km ²	1,667 km ² (Spalding <i>et al.</i> 1997)	3,655 km ²
MPA Coverage	: 54 km ² (0.8%) of mangroves in 12 MPAs	0.3% of sub-zone VI-22's mangrove	0.2% of sub-zone 8's mangrove	1.3% of sub-zone III-18's mangrove

(Refer to **Map 2** of Appendix for MPA sites and other relevant areas)

4.1 Coastal and Marine Ecosystems

The coastlines of Malaysia vary widely from the west, bordered by the Straits of Malacca to the east, facing the deep Sulu and Sulawesi Seas. Coral reefs may be found around the islands off the coast of East and Northeast Peninsular Malaysia and less so in areas fringing East Peninsular Malaysia and in small patches fringing West Peninsular Malaysia (Abu Talib and Alias 1997). However, majority of Malaysia's coral reefs is found in the North peak (sub-zones I-8 and III-18) and Southeast of Sabah (sub-zone III-18, including Sipadan, Semporna and Layang-Layang) (WCMC/WRI 2002). The West Coast of the Peninsula is less favourable to coral growth due to its turbid water, muddy substrates and exposure to the Southwest monsoon. Coral reefs around Semporna and Sipadan Islands in Southeast Sabah are the most well-developed due to the very clear water and oceanic influence from the deep sea in the east. Fringing reefs are the most common but patch and barrier reefs are also present. The only coral atoll is Pulau Layang-Layang among the Spratly Archipelago far north from Sabah (UNEP/IUCN 1988). Veron (1993) estimated that 70 coral genera may be found in Malaysia but recent surveys in Darvel Bay (Sabah) yielded 67 genera (Ditlev *et al.* 1999).

Seagrasses can be found in all Malaysian biogeographic sub-zones or in East and West Peninsular Malaysia, Sabah and Sarawak (Japar 1994; EAS-TDA 1999, as cited

by McManus, 2000). Ten seagrass species have been reported from West Peninsular Malaysia, 11 from South Peninsular Malaysia (sub-zone VI-20) and seven from East Peninsular Malaysia (sub-zone I-6 and I-7). One seagrass species has been reported from Sarawak, nine from West Sabah (sub-zone I-8) and six species from East Sabah (Japar 1994).

Total estimated mangrove area is 6,412 km² (Chan *et al.* 1993). Majority (57%) of Malaysia's mangroves is found in Sabah especially in the northeast (Bio-geographic sub-zone III-18). Due to the numerous rivers present, the coastline of Sarawak is predominantly swamps, mangrove and sandy beaches. Sarawak holds 26% of Malaysia's mangroves near the Rajang and Sarawak rivers (sub-zone I-8) while some 17% of Malaysia's mangrove forests are in Peninsular Malaysia mostly on the west (near Matang and Kuala Lumpur), and on the southern tip near Singapore (i.e. mostly in biogeographic sub-zone VI-22) (Spalding *et al.* 1997).

4.2 Species of Significance

Malaysia, one of the 12 megadiversity countries of the world, spans five biogeographic sub-zones (VI-22, I-6, I-7, I-8 and III-18) in three zones (I, III, VI). It has several marine turtles. Green turtles (*Chelonia mydas*) nest on Sabah and Sarawak; the Hawksbill (*Eretmochelys imbricata*), on Sabah; the Olive Ridley (*Lepidochelys olivacea*), mainly in Sarawak, the northeast coast of the Peninsula and infrequently on Sabah, while the Leatherbacks are known to nest only on Terengganu. Dugongs and dolphins have also been reported in Malaysian waters. The Estuarine Crocodile (*Crocodylus porosus*) is present in the Rejang River of Sarawak and is rare in Sabah (UNEP/IUCN 1988).

4.3 Legislation and Management Framework

Malaysia is a federation of 13 states and two federal territories. Eleven states and the federal capital territory of Kuala Lumpur are on Peninsular Malaysia (West Malaysia) while the more autonomous states of Sabah and Sarawak and the federal territory of Labuan are on northern Borneo (East Malaysia). The two laws applied nationally are the Environment Quality Act and the Fisheries Act. The federal government has jurisdiction over all living resources in the estuarine and marine waters, while the various state governments hold jurisdiction over all land, including the foreshore (Yaman 1993).

The Department of Wildlife and National Parks of the Ministry of Science, Technology and Environment is the federal government agency tasked with the management of Taman Negara (a national park in Peninsular Malaysia) and the implementation of the Protection of Wildlife Act (1972) and National Parks Act (1980). The Department of Fisheries of the Ministry of Agriculture is the federal government agency tasked with the protection of marine resources including marine parks. States also have control over their coastal waters and can legislate protected areas as well (IUCN/WCMC 1992). The Department of Environment of the Ministry of Science, Technology and Environment is responsible for environmental protection especially pollution and waste management (Tan 2000).

The Fisheries Department manages areas prohibited for fishing activities in all States. In Peninsular Malaysia, only the Leatherback turtle is completely protected; for the other turtle species, only the adults are protected. Eggs are allowed to be sold except for a small proportion, which is left to incubate in hatcheries for later release. It is not clear whether the habitats of the nesting sites are protected. This policy needs to be re-evaluated.

Sabah and Sarawak aim to keep their parks in their natural condition but open these also for recreation.

On Sabah, the Sabah Parks Board of Trustees (under the Ministry of Tourism Development, Environment, Science and Technology) is responsible for state parks including marine parks. Sabah Parks is divided into four divisions (administration, finance and development, park management and enforcement, and research and education). The central office is based in Kota Kinabalu while each of the six parks has its own headquarters. Sabah Parks owns the park areas and has the mandate to control activities both in the terrestrial and marine portions. State Parks on Sabah are therefore protected from harmful land-based activities to some extent, and are more effectively managed for conservation than the parks in peninsular Malaysia. The Department of Wildlife (of the Ministry of Tourism Development, Environment, Science and Technology), which implements the Fauna Conservation Ordinance (1963), is responsible for the management of

Table 4.1 Federal laws relevant to parks and especially marine areas.

Year	Legislation
1954	(Act 134, revised 1974) Aboriginal Peoples Act – No land within an aboriginal area can be declared as a wildlife reserve or sanctuary (Peninsular Malaysia)
1959	(Act No. 298, revised 1983) Protected Areas & Protected Places Act
1963	(Act 210, amended 1985 by Act 317) Fisheries Act – establishment of marine (high tide and deeper only) parks and reserves anywhere in Malaysian waters for conservation and recreation
1972	(Act 76, revised 1976 and 1991) Protection of Wildlife Act – establishment or closure of wildlife reserves in Peninsular Malaysia by state governments and management by the federal government
1974	(Act 127, amended 1985 by Act A636 and again in 1996 by Act A953) Environmental Quality Act – regulates pollution by requiring EIAs and providing for licenses and penalties
1976	(Act 171) Local Government Act - Parts VII and XII give local authorities the powers to establish and manage parks
1980	(Act 226 amended in 1983) National Parks Act – Establishment and management of national parks in Malaysia (except Sarawak, Sabah and Taman Negara) including any marine area but this requires permission from the relevant state and so has not been used.
1984	(Act 313) National Forestry Act – classification of permanently reserved forests (i.e. forest sanctuary, virgin jungle reserve, amenity forest, education forest and research forest) although these are not defined in the Act. States formally adopted the categories and specified restrictions for each category though restrictions vary slightly between states.

Table 4.2 Sabah laws relevant to parks and marine areas.

Year	Legislation
1962	(amended 1996) National Parks Ordinance replaced by the National Parks Enactment (1977) and again by the Parks Enactment (1984) – established Sabah Parks Board and Sabah state parks for conservation and recreation
1963	(amended 1979) Fauna Conservation Ordinance – conserve wildlife and establish protected areas for wildlife
1968	(amended 1984) Forests Enactment. Classified forests - Class V is mangrove forest. Previous forest reserves not explicitly included in the 1984 amendment were de-gazetted as reserves.
1997	Wildlife Conservation Enactment provides for the conservation and management of wildlife and its habitats in the state of Sabah.

Table 4.3 Sarawak laws relevant to parks and marine areas.

Year	Legislation
1954	Forest Ordinance
1954	(Natural Resources Ordinance amended 1993) Natural Resources and Environment Ordinance
1956	(amended 1990) National Parks and Reserves Ordinance – establishment and management of national parks
1990	Wildlife Protection Ordinance – protection of wildlife and its habitat (including through sanctuaries) from exploitation (including tourism).
1993	Public Parks and Greens Ordinance
1994	Natural Resources and Environment Order

wildlife including the establishment of sanctuaries (e.g. bird sanctuaries). The Sabah Wildlife Department does not have the strong and clear-cut authority that Sabah Parks has. At present, tourist operators voluntarily manage the surrounding reefs of Sipadan.

On Sarawak, the National Parks and Wildlife Office of the Sarawak Forestry Department is responsible both for the wildlife and their habitat in its implementation of the National Parks Ordinance (1956) and the Wildlife Protection Ordinance (1990). On Sarawak, the Turtle Board Trust and the Sarawak Museum are both involved in turtle conservation on the shore while the Fisheries Department controls fisheries.

Park Designations

FEDERAL/PENINSULAR MALAYSIA

National Forestry Act 1984

Classifications: *Timber production forest under sustained yield, Soil protection forest, Soil reclamation forest, Flood control forest, Water catchment forest, Forest sanctuary for wildlife, Virgin jungle reserved forest, Amenity forest, Education forest, Research forest, and Forest for federal purposes*

Protection of Wildlife Act 1988

Wildlife reserve. Declared by the Ruler, or State Governor, on any state land, which allows licensed hunting, but any species may be declared as protected from hunting. The Protection of Wildlife (Amendment) Act 1988 prohibits the disturbance, cutting or removal of vegetation.

Wildlife sanctuaries. It is prohibited to shoot, kill or disturb any animal, or disturb or remove any vegetation.

Department of Fisheries

Marine Parks. All fishing and extractive activities are prohibited within two nautical miles around islands declared as marine parks (DOF-Malaysia, *undated*)

SABAH

Parks Enactment (Amendment) 1996

Park. Any land or state lands may be constituted as a park. Forest reserves declared under the Forest Enactment (1968), or any game sanctuary or bird sanctuary declared under the Fauna Conservation Ordinance (1963) may also be converted to a park.

Within a park, it is forbidden to hunt, damage vegetation, introduce or remove animals or vegetation, remove minerals, or archaeological objects, etc; erect buildings or clear land, without prejudice to rights gained prior to commencement of the enactment, and to provisions of any written law relating to mining, or prospecting for metals or minerals in any park.

The Forests (Amendment) Act 1984

Classifications: **Forest reserve (Protection forest (I), Commercial forest (II), Domestic forest (III), Amenity forest (IV), Mangrove forest (V), Virgin jungle reserve (VI), Wildlife reserve (VII)).**

Malaysia participates in the World Heritage Convention and the UNESCO Man and Biosphere Programme.

4.4. Extent of Existing Marine Protected Areas (MPAs) System

The MPA system in Malaysia is relatively well developed with MPAs in most areas of the country. In late 1994, the total number of islands included in the marine park system of federal Malaysia was increased to 38 from the original 22 in 1985 (Hiew 1995). Today, about 40 Marine Parks are being managed by the federal Department of Fisheries (all rated well-managed "A"). In addition, there are three State Parks on Sabah and three Fisheries Prohibited Areas (also protected as turtle sanctuaries) on Sarawak. The three state Parks on Sabah islands, all without mangrove but reported to have corals (22,533 ha.), are all rated "A" (one of which is Malaysian Turtle Islands). The federal Marine Parks and Sarawak MPAs are demarcated as the marine area within two nautical

miles around the specified islands, excluding the coastal land. On Sabah, all MPAs contain a small portion of the coast.

There are also three marine bird sanctuaries on Sabah (Pulau Mantanani, Kota Belud and Pulau Sipadan) with an aggregate area of 12,515 ha; the largest (12,200 ha.) contains mangroves (first two rated "B", Sipadan rated "A"). Other MPAs, including Layang-Layang and Sipadan (Sabah), are practically though not legally protected because of dive-tourism (UNEP 2000). Pulau Sipadan is known for its good corals and diverse marine life and has a dive resort (Best Dive Sites of the World). Semporna Mangrove Forest Reserve is rated "B" while Kulamba Wildlife Reserve, with a mangrove, on Sabah is also rated "B". There are two Wildlife Reserves on Sarawak: Samunsam (6,092 ha.) with mangrove, and Pulau Tukong Ara-Banun, a 1 ha. island without mangrove. Two Sarawak "National" Parks: Bako and Similajau are both rated "A". Bako is reported in the WCMC database to have mangroves but appears to have none on the ABC/WCMC map (i.e. MacKinnon 1997). On the other hand, Similajau is reportedly without mangroves in the WCMC database but actually contains mangroves on the ABC/WCMC map. Kuala Selangor Nature Park (rated "A") in Selangor (Peninsular Malaysia) is also reported by the database to contain mangroves but doesn't appear so on the ABC/WCMC map. The rest are forest reserves of various classifications (including the well-managed 407-km² Matang Forest Reserve on the NW coast of Peninsular Malaysia) and with mangroves assumed to be included in Spalding et al.'s (1997) estimates of protected mangrove areas.

The Philippines' Department of Environment and Natural Resources and Sabah Parks have both established the transboundary Turtle Islands Heritage Protected Area (2,446 km²).

4.5 Proposed Marine Protected Areas (MPAs)

The Sabah Conservation Strategy has recommended the marine environments both of Sipadan Bird Sanctuary and Semporna Mangrove Forest Reserve for inclusion into the comprehensive and integrated system of conservation areas in Sabah (WWF Malaysia 1992). The Sabah Wildlife Department is considering the recommendation (Bleakley and Wells 1995). The Sipadan Bird Sanctuary was originally designated in 1933. The historical dispute between Indonesia and Malaysia over these islands appeared close to final resolution in 1995.

The Kuala Setiu Baharu Turtle Sanctuary in Terengganu has been recommended by WWF to protect the largest populations of the nesting Painted Terrapin (*Callagur borneoensis*) and Olive Ridley Turtle of Peninsular Malaysia and the Green Turtle (Sharma 1994). Other turtle nesting sites in Peninsula Malaysia and Sarawak that may be proposed for protection are listed in the following table.

Table 4.4 Turtle nesting sites in Peninsula Malaysia and Sarawak that may be proposed for protection.

	Olive Ridley	Hawksbill	Leather-back	Green	Terrapin
Peninsular Malaysia:					
Setiu	x	x			
Rantau Abang			x		
Paka			x	x	x
Chendor				x	
Pulau Kernet & Teluk Belanga		x			
Pantai Pasir Panjang (Perak)				x	
Pantai Keranchut (P. Pinang)		x			
P.Telur & P.Bidan (Kedah)		x			
Sarawak:					
Coast from P.Badar to P. Satang				x	
Coast from Bintulu to Beting				x	

4.6. Evaluation of MPAs - Status, Threats and Management

Extensive surveys from 1984–1994 under the ASEAN–Australia Living Coastal Resources (LCR) Project have yielded a large quantity of data on the status of the coral reefs in Malaysia. Majority (64%) of the coral reefs surveyed is in fair condition (25-50% coral cover) (Rahman, *in press*). Coral reefs in the offshore islands on the east coast of peninsular Malaysia are in good condition (50-75% coral cover) while the fringing reefs on the west coast of the peninsula and most of the reefs in Sabah are fair (25-50% cover). Most of the fringing reefs in Sarawak have good coral cover despite the high sediment load in the water due to their proximity to land and rivers. In general, the reefs of east Malaysia, including Layang-Layang, 130 nautical miles off the West Coast of Sabah, harbour higher fish diversity than the peninsular sites (Muhamad *et al*, *in press*).

Fisheries are more of a threat to East Malaysia [sub-zone I-8 and III-18] while sedimentation is more of a threat to West Peninsular Malaysia [sub-zone VI-22] (UNEP 1997). Dredging, domestic and agricultural pollution are threats to both areas, and industrial pollution is a threat to West Peninsular Malaysia (UNEP 1997). In the questionnaire for rating threats, coastal development, tourism activities, and crown-of-thorns starfish (COTS, *Acanthaster planci*)-infestation have been rated as high or medium level threats for most of the marine parks of peninsular Malaysia. Generally, coral mining, hunting of endangered species (including turtle egg consumption) and destructive fishing (mainly using dynamite) were more serious in the parks of east Malaysia. Much of the overfishing (mainly sports fishing) and siltation problems occur in Sarawak sites. Overall, the questionnaire indicated that coastal development is the most serious and common threat, followed by overfishing, tourism activities and siltation from land, and third by pollution from domestic sources (Figure 4.1).

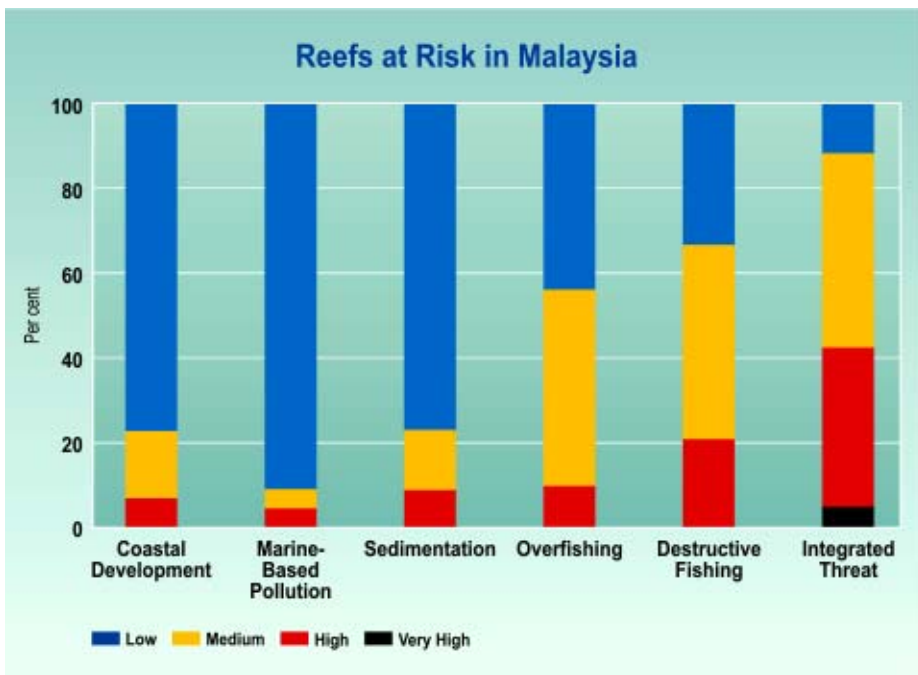
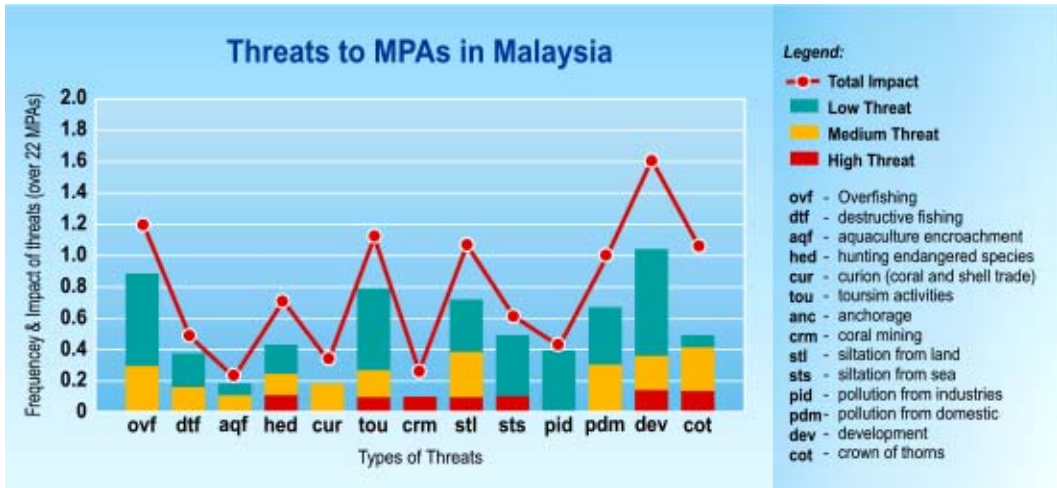


Figure 4.1. Threats to MPAs of Malaysia (top) (Cheung 1995) and to the country's coral reefs in general (bottom) (Burke *et. al* 2002).

Coastal development, including tourism-related development, is especially apparent on the peninsula. As noted above, both at Pulau Redang and Tioman Marine Parks, large resorts including golf courses increase sediment loading in the sea. This sedimentation was linked with increases in percentage of dead coral cover near the development sites (Ibrahim, Japar and Aikanathan 1993). The coral reefs at Pulau Tioman have also suffered from pollution (Aikanathan and Wong 1994) and commercial coral collection (Doug 1993). The rapid growth of reef-related recreational and tourism activities such

as SCUBA diving, swimming and boating, may damage MPAs because of too many divers. The COTS has also infested most of the reefs surveyed on the east coast of the peninsula (Rahman, *in press*). A recent visit to Pulau Redang in early 1995 also revealed extensive coral damage by COTS in many sites (Cheung, *pers. comm.*).

The threats of overfishing, sedimentation and coastal development are estimated to be high around Sabah (especially on the west [bio-geographic sub-zone I-8] where there are two Parks, two Bird Sanctuaries and three Marine Parks) [sub-zone I-8 and III-18], Melaka, south Johor and Selangor [sub-zone VI-22] (see Figure 4.1, WRI 2002). There is also a moderate threat of destructive fishing South of Johor [sub-zone VI-22], in the waters between East and West Malaysia (actually Indonesian waters [sub-zone I-Indonesia], Burke *et al*, 2002) and in East Malaysia [sub-zone I-6 and I-7] (UNEP 1997). In Labuan, a Federal Territory off Brunei Bay, fisheries exploitation and coral mining appear to be serious threats (Rahman, *in press*) although these activities are on the decline.

Mangroves are primarily threatened by agriculture, urban development, shrimp ponds, and deforestation (Spalding *et al.* 1997).

Management (from IUCN/WCMC 1992)

The management of Turtle Islands by means of hatchery and tagging programmes is intensive (Basintal and Lakim 1993) though the effectiveness of such programmes for turtle conservation is controversial (Mortimer 1992). The three areas prohibited for fisheries in Sarawak are not yet managed although some turtle research and protection activities have already begun. The management plan for Semporna is in its final stage of evaluation for approval.

Management on land is controlled by individual states while management of Marine Parks in peninsular Malaysia is regulated by the Fisheries Act of 1985, which authorises the Department of Fisheries (Ministry of Agriculture) to control activities at sea. Lack of coordination has resulted in land activities affecting marine parks at sea. Two recent cases, Pulau Redang (Mohd.Ibrahim *et al.* 1992) and Pulau Tioman Marine Parks, demonstrate how this lack of integrated management and control over the land adjacent to marine parks can result in damages to the marine environment. In both cases, resort development involving large-scale land clearing, road and marina building and construction are taking place (both legally and illegally), despite predicted negative impacts on the marine environment. In practice, environmental protection is hampered by jurisdictional issues between federal and state authorities and also between different sectoral agencies (e.g. Departments of Wildlife and National Parks, Environment and Fisheries).

Non-government organisations concerned with the environment include World Wide Fund for Nature – Malaysia, the Malaysian Nature Society, Sahabat Alam Malaysia (Friends of the Earth Malaysia), the Environmental Protection Society of Malaysia, the Consumers' Association of Penang, the Sabah Society, Sarawak Nature Society and the Malaysian Society for Marine Sciences.

As of 1997 (Spalding *et al.* 1997), only 0.3% of W. Malaysia's mangroves, 0.2% of

Sarawak's mangroves and 1.3% of NE Sabah's mangroves were within protected areas (12 MPAs containing mangrove). However, the mangroves of Matang on NW Peninsular Malaysia have been sustainably managed since the turn of the century (Spalding et al. 1997).

Sabah Parks monitors the three marine parks in Sabah; University Pertanian Malaysia monitors Pualu Redang (Terengganu, West Malaysia); Universiti Malaysia Sabah, the coral reefs in Sabah; and Universiti Malaysia Sarawak, the Terumbu Layang-Layang (Spratly Islands). The Department of Fisheries monitors the Marine Parks of Peninsular Malaysia, Labuan and Terumbu Layang-Layang.

4.7. Gaps in the Marine Protected Area (MPA) System

Looking at the spread of the existing and proposed MPAs in the country, one obvious gap in the system is that only three of the islands of Sarawak are protected despite its long coastline as compared to that of Sabah. Although nearshore coral reefs in the vicinity of river mouths are unlikely to flourish, islands and submerged banks, such as the Lucania shoal, far from the shore have yet to be explored and their conservation potential assessed. In addition to the existing turtle sanctuaries of the three prohibited areas for fisheries, the stretch of coast from Bintulu to Beting towards central-east Sarawak also serves as a frequent turtle-nesting site. More attention needs to be focused on the identification and designation of MPAs in Sarawak.

The areas least represented by MPAs are the Strait of Malacca transboundary (VI-20 and VI-22) and Southeast Peninsular Malaysia (sub-zone I-7).

4.8. Priority Sites

Several priority sites have been selected including the regionally significant sites, Semporna and Turtle Islands, off Sabah (Table 4.4). Both Semporna and Sipadan are rich coral reef areas with near-pristine status, and are important nesting sites for the Green and Hawksbill turtles. Sipadan is renowned as a world-class dive destination, and the management of activities in Sipadan is under Sabah Parks and Wildlife. Layang-Layang situated at the southern end of the disputed Spratlys may also warrant high priority but little information is available for assessment. The island has recently been developed for dive tourism. Turtle Islands, together with their neighbouring nine Turtle Islands of the Philippines, contribute a substantial proportion of the region's Green turtle nesting population, and hence warrant regional priorities for joint conservation efforts. It has been approved as a transboundary Turtle Islands Heritage Protected Area.

4.9. Priority Actions

The main obstacle in the effective management of MPAs in Malaysia (except Sabah) is the Federal Government's lack of jurisdiction over coastal land adjacent to MPAs. Until this limitation is rectified, the critical coastal areas within the marine parks should be clearly identified and the State Governments advised on the positive protective controls needed to prevent degradation of the nearby marine areas and conflict with MPA

objectives. Such a process has been launched for the marine parks of peninsular Malaysia through the management conceptual plan (Aikanathan and Wong 1994).

The plan contains detailed descriptions and analysis of the status of the marine resources and land use of the marine park islands of peninsular Malaysia as well as comprehensive recommendations for each of the island groups, with special reference to the management of critical habitats. In addition, the general negligence of the economic value of ecological resources is another major cause of poor planning of resources and development. Site-specific studies on the economics of conservation should therefore be encouraged as part of the management plan design for MPAs. A series of four case studies on tin mining, development industries in place of quarrying, and the value of Matang mangroves and prawn culture in Perak, W. Malaysia are examples of how economic analysis can be used to help plan resource use (Cheng 1994). The following recommendations summarise the major recommendations listed in the conceptual plan and highlight some other site-specific issues:

- A. Incorporate the protection of critical land adjacent to marine parks, including watersheds, into the land-use planning of the islands. Wherever possible, State governments should declare all unalienated land on islands surrounded by marine parks designated by the Federal government protected, and should buy private lands for inclusion in the State parks.
- B. Do not allow development on very small islands within the marine parks.
- C. Integrate the environmental assessment of development projects, including the tourism-related ones, with the impacts on both land and in the sea. Mitigation plans should seek to minimise irreversible impacts on the marine environments of the parks. EIAs must be carried out before the projects begin and subsequent activities should be carried out in line with the findings of the approved EIA. The economic cost of environmental degradation/loss due to development projects should be taken into account prior to project approval.
- D. Develop and carry out monitoring programmes to investigate the carrying capacity of coral reefs for tourism use and to prevent further degradation. Develop and enforce a quota system that limits the number of visitors and vessels to popular marine parks.
- E. Revise existing boundaries for commercial and other fishing zones in the marine parks. No commercial fishing should be allowed within the parks.
- F. Re-evaluate existing practices at turtle hatcheries and develop improved hatching techniques. Re-evaluate the regulations regarding turtle-egg collection to protect turtle eggs *in situ* wherever possible. In areas where only a portion of the turtle eggs are hatched and the rest allowed for sale, hatching programmes may be strengthened by a seasonal ban on the sale of turtle eggs to raise the incentive of licensed egg collectors to return the eggs to the hatcheries.
- G. Designate Semporna and Sipadan Islands as State Parks and implement management plans. Plan and regulate tourism development and activities at Sipadan through negotiations with dive operators.

- H. Prepare and implement MPA management plans for Pulau Tioman, Mersing, Labuan, Turtle Islands, Pulau Tiga and Sipadan.
- I. Develop joint research and turtle conservation programmes between the Turtle Islands of Sabah and the Philippines, including the enforcement of the trade ban on turtle eggs. This may be expanded throughout the Sulu Sea and even east Kalimantan of Indonesia.
- J. Upgrade the three Fisheries Prohibited Areas of Sarawak to Marine Parks and strengthen their management.
- K. Survey the coral reef and coastal sites of Sarawak to identify those with conservation potentials.
- L. Additional recommendations (from ICRI 1997)
- Formulate marine park zoning and management plans.
 - Develop innovative sustainable financing for management and research.
 - Monitor and evaluate the effectiveness of marine parks.
 - Train managers and rangers.
 - Conduct social and economic monitoring and evaluation.
 - Conduct research and training on coral reef restoration techniques.
 - Conduct training in the use of databases and in biostatistics.

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MYANMAR

MYANMAR

Hazel O. Arceo and Catherine Cheung

Background Facts

Biogeographic Divisions	: Central Indian Ocean III and IV
Coastline	: 2,278 km (MacKinnon 1997)
Population	: 46.5 M (as of 1995, Clarke 1999)
Population density	: 67/km ²
Land area	: 676,577 km ² (MacKinnon 1997)
Shelf to 200m depth	: 229,500 km ²
EEZ	: 509,500 km ²
Est. Coral Reef Area	: 1,500 km ² (Spalding 2000)
Est. Mangrove Area	: 4,219 km ² (MacKinnon 1997)
No. of MPAs	: 4
Total Area of MPAs	: 387.5 km ²

(Refer to **Map 7** of Appendix for MPA sites and other relevant areas)

5.1 Coastal and Marine Ecosystems

With a coastline of 2,278 km, several large estuarine and delta systems, and numerous offshore islands, Myanmar possesses a considerable diversity of coastal wetland habitats, including coral reefs, sandy beaches and mudflats (MacKinnon 1997). Several major rivers including the Ganges in the north and Irrawaddy, Sittang and Salween in the Gulf of Martaban have created soft shores where mangroves develop extensively. Total mangrove area covers about 4,219 km², and only 0.6% is protected (MacKinnon 1997).

Coral reefs are only found away from river deltas and mainly around islands along the southern coast, particularly in the Mergui Archipelago. This string of over 800 islands has not been studied properly since the 1800s (IUCN/UNEP 1988). Coral reefs are also found around the Coco Islands north of the Andaman Islands of India.

5.2 Significant Species

There are no data on the ecology of coral reefs but 61 species in 31 genera have been described in a study (Kyi 1985, *in* ICRI 1997), suggesting a moderate diversity. More recently, Spalding (2001) reports that there are around 97 scleractinian coral species and 67 hermatypic coral genera. Twenty-four mangrove and three seagrass species have been described in Myanmar (Spalding 2001).

Four species of marine turtles have been recorded in the country: Green, Olive Ridley, Hawksbill and the very rare Leatherback. The Estuarine Crocodile (*Crocodylus porosus*) and the river terrapin (*Batagur baska*) occur in the Irrawaddy Delta al-

though the latter's population has declined to possible extinction. Dugongs are rare and are mostly found west of the Irrawaddy Delta and further north of the main coastline.

5.3 Legislation and Management Framework

There is no current legislation for establishing marine protected areas (IUCN/WCMC 1992). The titles used in the protected area list supplied by the Forest Department (including their brief descriptions) are as follows (from Clarke 1999):

- **National park.** Maintained for biodiversity conservation and representativeness. Firm management control. No settlement or resource harvesting allowed. Visitors permitted.
- **Marine national park.** The same as national park but in marine, island and coastal environments.
- **Wildlife sanctuary.** Species conservation. No settlement or resource harvesting allowed. Visitors permitted.
- **Bird Sanctuary.** The same as wildlife sanctuary but birdlife conservation is paramount.
- **Wildlife Park.** Wild animals held in captivity and in the wild but on a fairly small range. For recreation and education. No settlement or resource harvesting allowed. Visitors encouraged.
- **Mountain Park.** Maintained to conserve landscapes, geomorphological features, and sites of religious significance. No settlement allowed. Visitors permitted, including pilgrims who are allowed to harvest limited supplies of natural resources – bamboo shoots, mushrooms and edible fruits.
- **Elephant range.** A means of conserving the Asian elephant. Can include villages, and may overlap with other protected areas although the only one that exists at present does not overlap. Covers a range over which elephant herds move.
- **'Protected area'.** A misnomer adopted by the Planning and Statistics Division of the Forest Department, which failed to consult WNCDC when drawing up the declarations. This is to be corrected, and the areas are likely to become wildlife sanctuaries.

The enactment of the Myanmar Fisheries Law in 1990 clearly prohibits the use of explosives, poisons and toxic chemicals, harmful agents and damaging gears, and thus prohibits fisheries that can destroy coral reefs (ICRI 1997).

The National Commission for Environmental Affairs (NCEA) is the focal point for all environmental affairs, including management (ICRI 1997). It is mandated to advise the Cabinet on formulating policy, issue guidelines for implementing policy, guide and advise regulatory agencies on legal matters, and formulate policies and strategies that take into account environmental and developmental priorities (Clarke 1999). Four specialised committees report to the Commission:

- Committee on Conservation of Natural Resources.
- Committee on Control of Pollution.
- Committee on Research, Education and Information.
- Committee on International Cooperation.

One other technical department is the Ministry of Forestry, whose mandate includes governing all natural protected areas, both terrestrial and marine, and biodiversity.

5.4 Extent of Existing Marine Protected Areas System

There are two declared wildlife sanctuaries for turtle protection in the country: Thamihla Kyun or Diamond Island (88 ha) and Moscos Islands (4924 ha), but the marine habitats are not protected. There is also one mangrove forest reserve, Wunbaik (22,919 ha). Lampi Island Marine National Park (112.5 km²) was established in 1996 to preserve the island's vast flora and fauna and coral reefs.

5.5 Proposed Marine Protected Areas

Three wildlife sanctuaries are being recommended for establishment, namely, Meinmahla Kyun, Kadonlay Kyun and Letkokken Islands at the mouth of the Irrawaddy Delta, for the protection of turtles, crocodiles and shorebirds (Wells 1988; Scott 1989). There are also proposals to extend Thamihla Kyun and Moscos Island Wildlife Sanctuaries to include their surrounding marine areas and coral reefs.

5.6 Evaluation of Marine Protected Areas - Status, Threats and Management

Little is known about the status of the marine environment of the country. The 90% loss of turtle nesting population at Thamihla Kyun and the serious decline in dugong and river terrapin populations suggest overexploitation. While mangrove cutting and encroachment by shrimp farming have degraded some of the mangrove and estuarine areas (IUCN/UNEP 1988), dynamite fishing and sedimentation due to upland logging have disturbed the coral reefs. Dynamite fishing, mainly by foreign poachers because explosives are not readily available to Myanmar fishers, anchor damage, trampling, overfishing and over-harvesting have seriously degraded coral reefs and associated flora and fauna (ICRI 1997; see also **Fig. 5.1**). Unconfirmed reports reveal harvesting of live coral (for marine aquarium) and of coral skeletons (for use as souvenirs or medicine). The offshore reefs at the southern end of the Mergui Archipelago are already exploited for dive tourism from Thailand.

The government of Myanmar has encouraged rapid exploitation of natural resources. When the universities were closed, many natural scientists became involved in the timber and marine products trade to survive. Large government joint ventures with foreign companies have been formed to exploit commercial fisheries. There is little support from the government for conservation.

5.7 Gaps in the Existing Marine Protected Area System

Status and Inventory. Gaps in the existing system coincide closely with the lack of inventory data of sites. Lack of information on the marine flora and fauna as well as lack of trained divers to conduct surveys, especially in inaccessible areas, have hindered the effective management of resources (ICRI 1997). Most of the islands of the Mergui Archipelago have not been surveyed although they are believed to have substantial coral reefs (UNEP/IUCN 1988). Cheduba Island and the islands off Akyab in the north, and the islands between Thamihla Kyun and the Andaman Islands are also not well studied.

Enforcement. Political instability has basically made the management of protected areas difficult. This has hindered progress in establishing more protected areas and in enforcing existing legislation (Clarke 1999).

Public Awareness and Support. Rural inhabitants in general are not in sympathy with government attempts to manage protected areas and conserve biodiversity, or are completely unaware of why these initiatives are being taken. Many groups are downright antagonistic towards any government action (Clarke 1999).

5.8 Priority Sites

Based on the limited information available, the Lampi Islands and the Mergui Archipelago further north have been selected as regional priority areas whereas Thamihla Kyun and Moscos Islands warrant national priority.

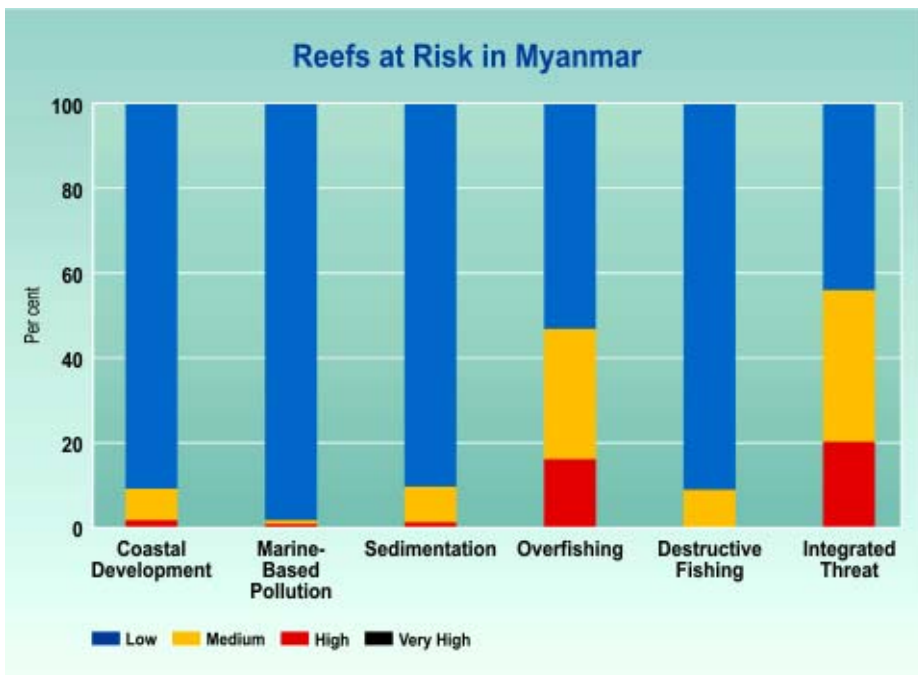


Figure 5.1. Environmental threats to the coral reefs of Myanmar. (Burke *et al.* 2002)

5.9 Priority Actions

- A. Secure technical and financial assistance from experienced countries for institutional strengthening and capacity building of the Myanmar government. The government of Myanmar is many years behind its neighbours in recognizing and meeting the need to identify and preserve natural resources.
- B. Conduct major surveys to determine where various ecosystems are found and the status of each. Surveys should focus on little known areas, especially the Mergui Archipelago, to determine its conservation potential.
- C. Train local scientists to survey and monitor coral reefs and other marine environments. The university system in Myanmar was closed for several years, and many well-trained scientists have already retired.
- D. Organise training courses and study tours for MPA planners and managers to neighbouring countries with established MPAs.



PHILIPPINES

PHILIPPINES

Andre Jon Uychiaoco, Hazel O. Arceo, Porfirio M. Aliño and Catherine Cheung with contributions from Nadia Palomar (MPA database)

Background Facts	
Biogeographic Division	: East Asian Seas – I (UC), III (16,17) and IV (UC)
Coastline	: 18,000 km to 22,540 km (World Resources Institute 1994)
Population	: 75,579,487 (National Statistics Office website, 2000)
Population density	: c. 234/km ² ; coastal (w/in 60 km of coast) pop. density 174/km ² (Bryant et al. 1998)
Land area	: 299,000 km ²
Shelf to 200m depth	: 178,400 km ² to 184,600 km ²
EEZ	: 1,786,000 km ² to 2.2 M km ²
Est. Coral Reef Area	: 13,000 km ² (Bryant et al. 1998), 24,000 km ² (Gomez et al. 1994) to 27,000 km ² (White and Cruz-Trinidad 1998)
Est. Mangrove Area	: 1,380 km ² (White and De Leon 1996, cited in White and Cruz-Trinidad 1998); 1,607 km ² (Spalding et al. 1997)
No. of MPAs	: >500
Total Area of MPAs	: unknown

(Refer to **Map 8** of Appendix for MPA sites and other relevant areas)

6.1 Coastal and Marine Ecosystems

The Philippines is an archipelago consisting of over 7,100 islands. It is located entirely in the tropics in the western Pacific Ocean, near the centre of diversity for many marine organisms such as molluscs and corals. Most types of tropical coastal ecosystems such as coral reefs, seagrass beds and mangrove forests are found in the country. Coral reefs are widespread, and may be found around almost the entire archipelago except perhaps in some portions of north and south central Mindanao and east of northern Luzon. It has an estimated total area of 25,000 km², which is almost 10% of the total land area (Gomez *et al.* 1994). Well-developed reefs are found in the Visayan Islands, around Palawan, on shoals in the Sulu Sea and the South China Sea. In addition, more mangroves may be found in west Visayas and west of southern Luzon (WCMC, *undated*). The few primary stands of mangroves left are mostly found in Palawan, Samar (west Visayas) and Mindanao (Spalding *et al.* 1997).

6.2 Species of Significance

The Philippines is one of the megadiversity countries (Roberts *et al.* 2002) but is also one of the most highly threatened. The country is at the junction of three bio-geographic zones: I (west), III (south and central) and IV (east). The nation includes three sub-zones of zone III: III-16, III-17 and III-X (central Visayas). Sixteen out of the 20 seagrass species in the East Asian region have been found here (Fortes 1994). The country is part of the

world's centre of marine biodiversity—the coral triangle—with at least 410 coral and 1030 coral reef fish species (Jacinto *et al.* 2000). After Indonesia, it has the most coral reefs in the region.

Five species of turtles: Green, Hawksbill, Olive Ridley, Loggerhead and Leatherback, have been recorded, with the Green and Hawksbill being the most common. A total of 22 species of marine mammals has been recorded (Jacinto *et al.* 2000). It is believed that dugongs used to be found throughout the archipelago but excessive hunting and destruction of seagrass beds have reduced their range. At present, Palawan and Sarangani are the only provinces where regular sightings of dugongs occur. The Tanon Strait between Negros and Cebu Islands, and the Bohol sea are considered the most important cetacean sites in the country although dolphins and whales can be found in other areas in Central Visayas, Palawan and Northern Mindanao. Important species being hunted are whale sharks, manta rays, giant clams and all turtle species.

6.3 Legislation and Management Framework

The Philippines has a long history in marine environment management. In addition to traditional tribal customs dating hundreds of years back, as early as the 1870s, fishing was regulated in milkfish-fry collection areas. The first marine park in Southeast Asia is believed to be the Hundred Islands National Park on the west coast of Luzon Island, established in 1940 (White 1988). In addition to National Parks, a loose system of Municipal Marine Parks has been growing since the late 1970s (Castañeda and Miclat 1981, Gomez *et al.* 1984), and new parks are in the planning stage (McManus *et al.* 1992). Since 1980, a large number of many different types of MPAs have been declared in the Philippines.

The Department of Environment and Natural Resources (DENR) and the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR) are the two government agencies mainly responsible for the national planning, policies and evaluation of the Philippine marine environment. In particular, the DENR's Protected Areas and Wildlife Bureau (PAWB) is responsible for marine protected areas and wildlife; the DENR's Coastal Environment Project, for coastal monitoring and evaluation, and the DENR's Environmental Management Bureau, for pollution management. However, much of the actual management authority and implementation has been decentralized to the local government units (especially the Municipal level) after the ratification of the Local Government Code of 1991. In 1992, Republic Act 7586 provided for the establishment and management of a National Integrated Protected Areas System (NIPAS). The Fisheries Code of 1998 (Republic Act 8550) mandates in Section 80 the setting aside of 15% of municipal waters for fish sanctuaries and allows 25-40% of fishing grounds beyond municipal waters for fish sanctuaries or mangrove reserves.

The three major DENR marine protected area/coastal management projects – PAWB's Conservation of Priority Protected Areas Project (CPPAP), National Integrated Protected Areas Programme (NIPAP) and the Coastal Resources Management Project (DENR/USAID), co-funded by the World Bank-Global Environment Facility, the European Union and United States Agency for International Development (USAID) respectively – are all winding down. It remains to be seen if the DENR will be able to sustain the momentum of

Table 6.1 Environmental legislations in the Philippines.

Year	Legislation
1964	National Water and Air Pollution Control Commission Act
1974	Revised Coast Guard Law
1976	Marine Pollution Decree
1976	National Pollution Control Commission
1978	The Water Code of the Philippines
1979	Environmental Impact Statement System
1980	Regulations for the Conservation of Marine Turtles
1981	The Coral Resources Development and Conservation Decree
1984	Environmental Impact Statement System – Areas/Types of Projects
1988	Small Scale Mining Law
1990	Philippine Environment Code
1992	National Integrated Protected Areas System
1992	Toxic Substances and Hazardous and Nuclear Wastes Control Act
1992	Strategic Environment Plan for Palawan Act
1995	Guidelines on Biological and Genetic Resources
1995	Philippine Mining Act
1995	The Water Crisis Act
1996	Preferential Treatment of Small Fisherfolks
1997	Agriculture and Fisheries Modernization Act
1997	Philippine Environment Policy
1998	Philippine Fisheries Code
1999	Philippine Clean Air Act
2001	Wildlife Resources Conservation and Protection Act

these largely foreign-funded initiatives. Currently, the Fisheries Resource Management Program (FRMP), which is the second phase of the Fisheries Sector Program (FSP), is the major DA-BFAR initiative. FRMP aims to help manage the fisheries resources in 18 of the country's bays/gulfs. In the FSP, the various components of its strategy in each bay/gulf were sub-contracted to several parties whose activities were not necessarily always well coordinated or integrated. It remains to be seen if FRMP would suffer the same flaw. The Agriculture and Fisheries Modernization Act (AFMA) also has initiatives aimed to advance the nation's fisheries management, specifically projects on marine fishery reserves, fisheries and oceanography, and upgrading of the national fisheries monitoring and evaluation database.

The activities of local non-government organisations (NGOs) have risen in the country especially since the late-Marcos and early-Aquino periods. Established local NGOs with a history of working on coastal issues include the Haribon Foundation for the Conservation of Nature, the Philippine Rural Reconstruction Movement, Tambuyog Development Center, Centre for Empowerment and Resource Development, Environmental

Legal Action Center, World Wide Fund for Nature–Philippines (*a.k.a. Kabang Kalikasan ng Pilipinas*) and some of the various members of PHILDHRRRA in the Visayas and Mindanao.

The passage of the NIPAS Act and the Local Government Code, the formation of the PAWB, and the Adoption of the Strategic Environmental Plan for Palawan (1992), are examples of a stronger PA management system (Baling 1995). The NIPAS will be applied to “outstanding remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals, bio-geographic zones and related ecosystems, whether terrestrial, wetland or marine, all of which shall be designated as protected areas” and can only be effectively administrated “through co-operation among national government, local government and concerned private organizations” (DENR 1992). The ten priority sites of the Integrated Protected Areas System (IPAS) Project administrated by DENR, include four marine sites: Batanes Islands (N. Luzon), Apo Reef (Mindoro), Turtle Islands (Sulu Sea) and Siargao Island (N. Mindanao). Including these IPAS priority sites, there are 12 different types of MPAs in the country (**Table 6.2**). A detailed description of the legal framework, jurisdiction, implementing agency and objectives of each type is beyond the scope of this Review.

Among the Southeast Asian countries, the Philippines has the most number of marine protected areas: over 500 as of last count (Aliño *et al.* 2000). Its environmental legislation (**Table 6.1**) is also probably one of the most advanced in the region (Tan 2000, Jacinto *et al.* 2000).

The country has also ratified the Convention on Biological Diversity, the ASEAN Convention on the Conservation of Nature and Natural Resources, UN Convention on the Law of the Sea and MARPOL. World Heritage or UNESCO Man and Biosphere sites have also been established.

Table 6.2 A summary of the total number of MPAs of different categories (data derived from Kelleher *et al.* 1995).

Code	MPA Designation Status/ Category	Total Number
ECA	Environmentally Critical Area	1
FS	Fish Sanctuary	31
MCRP	Municipal Coral Reef Park/ Marine Park	7
MR	Marine Reserve	1
MTS	Marine Turtle Sanctuary	7
MSFR	Mangrove Swamp Forest Reserve	83
NMP	National Marine Park	1
NMR	National Marine Reserve	1
PLS	Protected Landscape and Seascape	2
SP	Seashore Park	1
TZMR	Tourist Zone Marine Reserve	65
WA	Wilderness Area	52

6.4 Extent of Existing Marine Protected Areas (MPAs) System

Due to overlapping jurisdictions among management agencies, the total number of MPAs designated in the Philippines can only be estimated. **Table 6.3** shows an increase in the number of MPAs from 1995 to 2000. A non-exhaustive compilation by Kelleher *et al.* (1995) listed a total of 252 coastal and marine protected areas. This compilation includes protected areas that are not strictly marine, such as the 83 Mangrove Swamp Forest Reserves (MSFR) and 65 Tourist Zone Marine Reserves (TZMR). It should also be noted that some of the sites belong to more than one category such as Sumilon Island, which has been designated as FS, NMR, MCRP and CEP (Baling 1995). The coverage of the MPA system is skewed in favour of the Visayas (see also Aliño *et al.* 2000). MPAs have been designated in 37 of the 54 coastal provinces of the country (**Table 6.3**). Two thirds (69%) of these MPAs are found in the central and eastern Philippines (Visayas region) and less than a quarter (22%) in the south and southeast (Mindanao region). There are relatively few MPAs in the west and southwest Philippines (Palawan and Sulu Sea region) or in the far north (only five on the west coast and four on the east coast of Luzon). Note, however, that despite the large number of MPAs in the Visayas region, about half is mangrove sites (MSFR) or tourist zones (TZMR), which receive relatively little protection. Although there are relatively few MPAs in Palawan, the entire province has been designated as an MSFR. The feasibility of managing such a large area in the framework of the Strategic Environment Plan for Palawan will be tested by the rapid population growth there. (Refer to **Table 6.5** and **Map 8** for a condensed list of the 100 most significant MPAs – in terms of prominence, size and provincial representation.)

Table 6.3 A summary of Philippine MPAs recorded 1995, 1997 and 2000 (from Aliño *et al.* 2000)

Political Regions	Indicative No. of Existing MPAs (Cheung 1995)	Indicative No. of MPAs (Pajaro <i>et al.</i> 1999)		Indicative No. of MPAs (this study)	
		Existing	Proposed	Existing	Proposed
I	3	6	4	4	0
II	4	4	0	5	0
III	2	6	9	7	1
IV	60	77	10	106	11
V	36	41	13	34	9
VI	3	18	11	88	10
VII	68	106	27	33	25
VIII	14	77	21	98	21
IX	7	23	15	29	13
X	4	16	6	20	5
XI	7	14	12	19	11
XII	1	3	5	5	4
CARAGA	38	44	3	46	3
NCR	0	2	0	1	0
ARMM	0	2	3	3	3

6.5 Evaluation of MPAs - Status, Threats and Management

Conditions: Due to the leadership of the University of the Philippines-Marine Science Institute (MSI), the Silliman University Marine Laboratory and the Coral Reef Division of the Bureau of Fisheries and Aquatic Resources, the Philippines has the strongest coral reef research programme in Asia. This has resulted in most sections of the country being well surveyed, some repeatedly and in great detail although many study sites were not within protected areas. Most marine survey work in the Philippines have concentrated on coral reef resources, but, considerable attention has been given to seagrass, mangrove communities as well as particular organisms of interest such as dugongs, sea snakes and algae. Extensive surveys of coral cover in 735 coral reef sites between 1987 and 1994 showed that 30.5% of the sites had live coral cover greater than 50%, the rest <50% (Gomez *et al.* 1994; Wilkinson *et al.* 1994). Fish populations were reported to be low at all sites. Based on the results, it was concluded that many Philippine reefs were in "critical" condition. However, Gomez *et al.* (1994) pointed out that live coral cover is not the sole indication of the healthiness of coral reefs as the cover can be affected by physical factors such as substrate types and exposure to waves and typhoons.

Threats: About two-thirds of the Philippines' 70M population live in the coastal area (Chua 1997); this translates to around 174 persons/km² (Bryant *et al.* 1998). Over 10 million people live in the National Capital Region (Manila and the surrounding area). Philippine coral reefs are mainly threatened by fishing (overfishing and destructive fishing), sedimentation and pollution (domestic, agricultural and industrial [including mining]). Pollution is most intense in the centres of coastal development: Metro Manila and Cebu and nearby major Visayan cities; however, coastal development threat is moderate in all areas except E Luzon and W Mindanao. Coastal overfishing and sedimentation threats are high nationwide, except in northern Palawan and far western Mindanao where overfishing is moderate and sedimentation is low. However, destructive fishing is also most prevalent in northern Palawan, far western Mindanao and central Visayas (WRI 2002). The loss of mangroves has mainly been due to their conversion to fishponds.

Threats to the successful implementation of MPAs in the Philippines are rapid population growth, high demand for marine products, lack of employment other than marine resource extraction, law enforcement constraints, and poverty (McManus 1988). The Philippines has the highest per capita seafood consumption rate in Southeast Asia (33.8 kg/year) and a high ratio of people to coastline (3,000/km²) (Wilkinson *et al.* 1994). The number of coastal inhabitants dependent on coral reef resources may reach several tens of thousands per square kilometer of coral reef. This situation places intense pressure on the remaining resources.

Anthropogenic impacts on coral reefs in the Philippines cover the full range from direct exploitation to indirect damage (Hodgson 1992). The most serious anthropogenic threat to coral reefs in the Philippines is believed to be siltation from poorly managed land uses (Hodgson and Dixon 1988; Hodgson and Dixon 1992). Other serious impacts are caused by pollution, mining, and destructive and unsustainable fishing methods (Gomez *et al.* 1994).

Nationwide, sedimentation due to poorly controlled land use is one of the major

threats to MPAs as it threatens the coral reefs themselves (Gomez *et al.*, 1994; Hodgson, *pers.com*). Poorly planned tourism development is another major threat to MPAs in the Philippines. The specific effects are building of piers and bunds that block water flow on the reef flat, discharging of untreated sewage, and providing reef access to large numbers of tourists without giving proper training on how to avoid damaging the reef. Still another threat to MPAs is pollution, primarily due to domestic sewage, which sometimes leads to toxic algal bloom. Industrial pollution in the form of mine tailings, is often compounded with excessive sedimentation after dredging operations; e.g. in Calancan Bay (Gomez *et al.* 1994). On the fisheries side, the major threat is overfishing due to high local and international demand. Although the curio trade causes exploitation of a wide variety of invertebrate and vertebrate species, it is not clear if the level of extraction is above a sustainable rate in or outside MPAs. Mangrove forests are under heavy pressure due to timber extraction for rough lumber, for charcoal making and to make way for fishponds. The first two threats are most important with respect to MPAs. Within MPAs, the major threats to seagrass beds are dredging of the seabed to create navigation channels (**Figure 6.1**).

The problem of destructive fisheries is strongly emphasised. Some of the tourism-related impacts are exemplified as siltation, pollution and environmental destruction caused by development, and hence there is no peak in the tourism bar of the histogram. Notably, the impacts of human-induced threats are often compounded with natural to “semi-natural” events such as episodic storms, floods and crown-of-thorn starfish infestation. Marine scientists at the University of the Philippines-Marine Science Institute (UP-MSI) and other institutions have been investigating and comparing the impacts of storms on shallow reefs at a large number of sites, and hold a database on site-specific coral reef stresses but are not presented here.

Management: The Philippines, like many other countries, has a problem with “paper parks”; i.e. those that have been legally designated on paper, but for which insufficient resources have been allocated to implement the protected area management strategy (Hodgson 1992). The problems can range from a lack of funds to buy gasoline for patrol boats, to a complete lack of any resource to carry out any action. As in developed countries (McNeill 1994), the management of Philippine MPAs and achievement of conservation goals suffer to some extent from legislative and administrative instability, overlapping responsibilities among a large number of government agencies and NGOs with varying objectives and priorities.

An example of the successful cooperation of NGOs and government agencies in managing an MPA is the El Nido Marine Reserve in northern Palawan (Hodgson and Dixon 1988). In the early 1980s, tourist resorts established in El Nido have worked together with NGOs to plan and manage tourist activities in Bacuit Bay. The resort owners recognized that any damage to the marine life in the bay would be detrimental to their business. When threatened by illegal trawling and dynamite fishing inside the bay, the resorts provided logistic support (primarily food, gasoline and boats) to the enforcement agencies to enable them to carry out their enforcement roles.

Perhaps one of the nations’ strongest points has been its history of developing community-based coastal resources management. In two well-documented cases – Sumilon

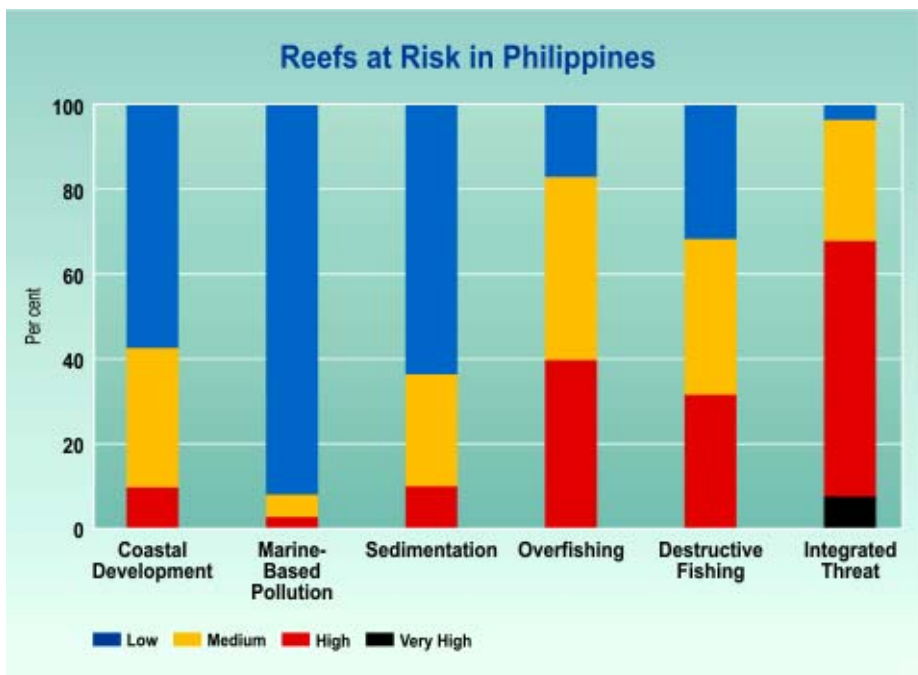
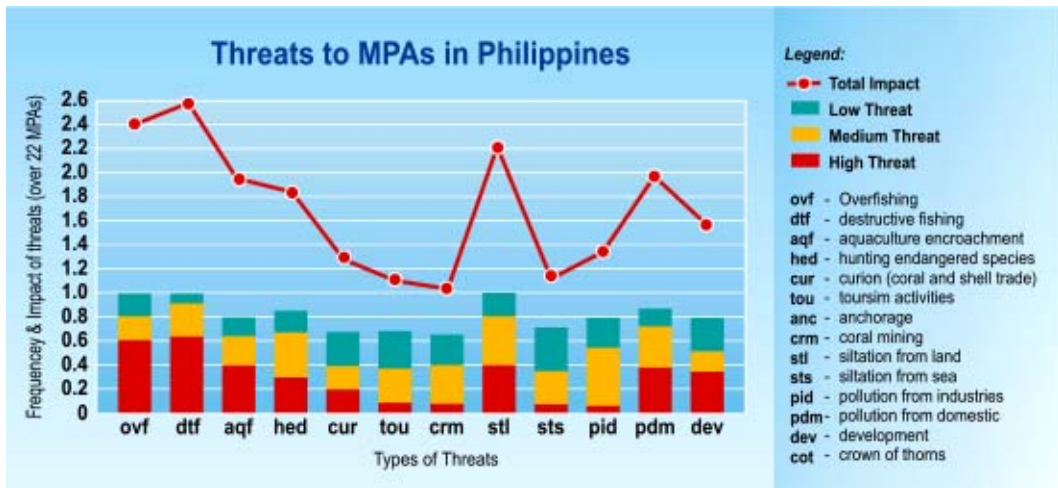


Figure 6.1. Threats to MPAs of the Philippines (*top*) (Cheung 1995) and to the country's coral reefs in general (*bottom*) (Burke *et al.* 2002).

Island (Cebu) and Apo Island (Negros) in the Visayas – MPAs have been successful in achieving management objectives (Russ and Alcala 1999; White 1989). In both these cases, however, the MPAs were geographically isolated. It has proven difficult to replicate these MPA models in other areas of the Philippines without natural barriers to exploitation by outsiders. Brief reviews of the status of MPAs in the Philippines have been given by White, (1988), Gomez *et al.* (1982), UNEP/IUCN (1988), and Aliño *et al.* (2000).

The UP–MSI, the Silliman University, the UP–Visayas (Institute of Marine Fisheries and Oceanology and College of Arts and Sciences), the University of San Carlos Marine Biology Section and the Mindanao State University–Naawan are among major academic institutions involved in Coastal environment research; some even have MPA monitoring programmes. The DENR’s Coastal Environment Project, the Earthwatch Institute (c/o Alan T. White) and the DENR/US-AID’s Coastal Resource Management Project are other organisations with MPA monitoring programmes. (Refer to Uychiaoco *et al.* (2002) for an updated assessment of Philippine MPAs, and Ong (2002) and Ong *et al.* (2002) for the results of the National Biodiversity Priority Setting Workshop.

6.6 Proposed Marine Protected Areas (MPAs)

From a marine bio-geographical perspective, there are three major regions in the Philippines: the East Coast, the central islands, and the West Coast including Palawan and the Spratly Islands (Hodgson, *pers.comm*). This division is overlain by a north-south latitudinal gradient with cooler water and fewer species in the far north than in the south. The IPAS project distinguished six bio-geographic divisions (Aliño *et al.* 1992) while Gomez *et al.* (1994) developed a more detailed bio-geographic classification of the country. Although the exact locations of many MPAs are not clear, all the bio-geographic divisions, whichever classification system is used, contain gazetted MPAs in widely varying numbers. However, there are three obvious gaps where few or no MPAs have been established: the East Coast of the Philippines, the Celebes Sea, and the reefs and islands of the Spratly Islands under Philippine claim. Due to difficult access and/or rebel activity and/or political instability, these areas are poorly studied except for parts of the Spratly Islands where Filipino, Vietnamese, Russian and Chinese scientists have conducted surveys.

6.7 Gaps in the Marine Protected Area System

The national parks system needs strengthening through application of the community-based approaches, which have mostly been successfully applied but only on very small scales.

6.8 Priority Sites

Priority MPAs have been selected (**Table 6.2**) from a preliminary list of 30 priority sites of Aliño and Uychiaoco (**Table 6.3**), including two of regional priority. Tubbataha Reef warrants global priority as it has been accepted as a World Heritage Site since 1993 due to its extensive coral reefs and active community and government support. The Turtle Islands (composed of nine islands), which harbour 80% of the country’s population of nesting Green Turtles, can contribute substantially to turtle conservation if joint management plans are effectively implemented with the three neighbouring turtle islands of Sabah, Malaysia.

A number of the priority MPAs selected are very small and in close proximity to each other. These may be grouped as a bigger priority site to strengthen their priority and integrity. For example, Apo Island, Sumilon Island, Panglao-Balicasag and Pamilacan Islands in the C. Visayas could form one priority network that is managed as a unit.

Putting aside political criteria, the Sulu and Tawi-tawi area at the southernmost end of the Philippines may be rated as regional priority as well. This large area is extremely difficult to manage however, due to the insurgency problems that can effectively place them out of government control. At a minimum, special educational efforts will be needed to reach the disparate cultural groups inhabiting these areas if any support for government plans is to be gained. It is not sure if there is any existing MPA among these islands. If better information could be obtained, conservation efforts could be concentrated on specific islands chosen in the area. Conflicting territorial disputes have made it difficult to declare the Spratlys as an MPA despite the area's importance in sustaining fisheries in the Asian Seas region (McManus 1994). If political stability can be reached, however, such declaration jointly agreed and managed by the countries of interest will greatly benefit fishermen as well as regional marine biodiversity.

Few priority sites have been selected from areas of the country that are poorly known such as NE Luzon and SE Philippines and where few MPAs exist. More surveys are needed to gather baseline information to assess the conservation potential and priorities of these little-known areas. Also, few MPAs have been established in the northeastern part of the Philippines, specifically the coast facing the Pacific Ocean, and in the South China Sea region.

6.9 Priority Actions

The following recommendations are listed in order of priority.

- A. Establish one well-planned, well-funded, and well-implemented MPA in each bio-geographic region to serve as an example for the public, the media, business, politicians and enforcement agencies to gain widespread support for the idea.
- B. Establish an MPA working group including representatives from the academe, the private sector (tourism), politicians, and the media to:
 1. review the current administrative framework; design strategies to resolve overlapping legal authority, and jurisdiction in MPAs;
 2. identify which MPAs are working and which are not, and why;
 3. design a management plan for each existing and planned MPA that includes an identified source of operational funding (i.e. well beyond the initial few years funded by overseas donor agencies); and
 4. design and recommend the implementation of a system whereby each municipality or village (barangay) is empowered to manage the reefs within its own municipality or barangay.
- C. Encourage the government and business to carry out integrated coastal zone planning and management (e.g. including upland watershed) as a method of avoiding damage to critical marine resources.
- D. Document successful case histories of MPA management and disseminate these as guidance and encouragement for MPA managers and for possible replication in other areas.

- E. Establish an annual national monitoring programme at a few selected sites to document natural and anthropogenic changes in coral reefs, seagrass beds and other habitats, and publish the results each year.
- F. Re-evaluate research priorities. Research on the distribution of marine resources should be extended to include poorly known areas such as the east coast of Luzon and Mindanao and the Spratlys, and the results should be mapped and disseminated. Research should be divided between examining “pristine” sites such as Tubbataha and damaged sites such as the west coast of Mactan Island to determine how heavily exploited reefs and those exposed to pollution have fared. In addition, marine biological research should be combined with socio-economic research to determine how to maximize the chances for conserving high priority sites.
- G. Use ASEAN and bilateral programmes to develop joint marine research and conservation programmes with Malaysia, Vietnam and China.
- H. Sustain and institutionalise support and participation in global coral reef monitoring and assessment efforts such as the International Coral Reef Initiative, International Year of the Reef, Reefbase and IOC’s Global Coral Reef Monitoring Network.

Aliño *et al.* (2000) has also proposed the following 5-point agenda to serve as guidelines for future direction in MPA initiatives.

1. Work for more effective MPAs facilitated under a National Coral Reef Management Strategy.
2. Advocate for at least one MPA per coastal municipality to be integrated into Coastal and Land Use Development Plans.
3. Facilitate comparable (if not common) monitoring and evaluation methods linked to capacity-building for enhanced cost effectiveness of MPA benefits.
4. Develop criteria for a “successful” MPA to popularise the lessons learned and lead to a harmonised vision of coral reef management.
5. Look on how MPAs fit into the bigger picture of people and nature.

Table 6.4 Priority Sites for Marine Biodiversity Conservation in the Philippines (Aliño & Uychiaoco, 1995)

Biogeographic Zone	Name of Site /MPA	Category	Priority	Remarks
Luzon	Batanes Group of Islands	PLS	National	Very Exposed Reefs; Spectacular Landscapes & Seascapes
	Fuga Island	TZMR	National	Coral Reefs; Manta Rays
Western Palawan	Spratly Archipelago	Not Designated	Global	Extensive Reefs (Shoals) & Islands
	El Nido/ Bacuit Bay	MR/TZMR	National	Coral Reefs

Biogeographic Zone	Name of Site /MPA	Category	Priority	Remarks
Western Palawan	Malampaya Sound	TZMR/FR	National	Mangroves; Birds
	Ulugan Bay		National	Mangroves; Birds
	Busuanga Island	TZMR	National	Dugong; Seagrass
Sulu Sea	Apo Reef & Mindoro Is.	TZMR/PLS/CEP/IPAS	National	Coral Reefs; Seabirds
	Turtle Islands	IPAS	Regional	Green Turtles (80% of the Region's Nesting Population)
	Binunsalian (Honda) Bay & Oyster Bay	MP/MCRP	National	Mangroves; Coral Reefs
	Tubbataha Reef & Basterra Island Group	NMR/MCRP	National	Mangroves; Coral Reefs
Central Visayas	1 Apo Island (Negros)	TZMR	National	Coral Reefs
	1 Sumilon Island	FS/NMP/MCRP/CEP	National	Coral Reefs
	1 Panglao-Balicasag Is.	MCRP/MP/TZMR	National	
	1 Pamilacan Island	MCRP/MP	National	Coral Reefs
	Bais Bay	MSFR	National	
	Mactan & Olango Islands	TZMR/NMP/CEP	National	
	Taklong Island	NMR/IPAS	National	Mangroves; Coral Reefs
Eastern Visayas	Guiuan	TZMR/PLS	National	Coral Reefs
	Rapu Rapu Island		National	Coral Reefs
	Polilio Island	MSFR	National	Seabirds; Coral Reefs
Northern Mindanao	Siargao Island	MSFR/WA/IPAS	National	Coral Reefs; Marine Lake
	2 Initao	PSL/CEP	National	
	2 Talisayan—Medina	MR/CEP	National	
SW Mindanao	Sacol Is., SabgakuCove Sakol Is., Big & Small Sta. Cruz Is.	TZMR	National	Coral Reefs
	Sulu & Tawi- tawi	Not Designated	Regional	Extensive Coral Reefs
	Saranggani Bay	PLS/CEP		Tuna Stocks
	Pujada Bay	PLS	National	Dugong

Biogeographic Zone	Name of Site /MPA	Category	Priority	Remarks
SW Mindanao	3 Samal & Talicud Is.	TZMR	National	Tuna Stocks
	4 Kalamansig	CEP	National	Tuna Stocks

The above selection of sites was based on biodiversity richness, importance for endangered species, habitat intactness and biogeographic representation. Socio-economic and political environments were not taken into account. Some sites may be grouped as one priority site of 1-Central Visayas; 2-Gingoog Bay; 3-Davao Bay, or 4-Moro Gulf.

LEGEND:

ECA	Environmentally Critical Area
NMR	National Marine Reserve
FS	Fish Sanctuary
PLS	Protected Landscape & Seascape
MCRP	Municipal Coral Reef Park/ Marine Reserve
MR	Marine Reserve
SP	Seashore Park
MTS	Marine Turtle Sanctuary
TZMR	Tourist Zone Marine Reserve
MSFR	Mangrove Swamp Forest Reserve
WA	Wilderness Area
NMP	National Marine Park



SINGAPORE

SINGAPORE

Chou Loke Ming, Hazel O. Arceo, Catherine Cheung and Porfirio M. Aliño

Background Facts

Biogeographic Divisions	: East Asian Seas VI (22)
Coastline	: 193 km (WRI 1994)
Population	: 2.9 M (MacKinnon 1997)
Population density	: 4600/km ²
Land area	: 636 km ² (MacKinnon 1997)
Shelf to 200m depth	: 640 km ²
EEZ	: none
Est. Coral Reef Area	:
Est. Mangrove Area	: 22 km ² (MacKinnon 1997)
No. of islands	: 60
No. of MPAs	: 2 (2 others are terrestrial parks with marine components)
Total Area of MPAs	: 1,067 km ²

(Refer to **Map 2** of Appendix for MPA sites and other relevant areas)

7.1 Coastal and Marine Ecosystems

The coastal and marine ecosystems of Singapore are very limited and modified by development and the port industry, which is one of the biggest income-earning businesses in the country. Port limits extend to almost all the entire territorial waters, and reclamation has transformed almost the entire southern and northeastern coasts of the main island considerably (Chou 1995).

The steep beach front along the southeastern coast was once composed of sandy beaches and mudflats. Original rocky shores are found mainly on the southern offshore islands and small parts of the northern coast. Around 22 km² of mangroves (or less than 1% of the original mangroves) remain in Singapore and none is protected (MacKinnon 1997), except for 87 ha at the Sungei Buloh Nature Park. These are confined to isolated patches on the northern coast and northern offshore islands of Pulau Ubin and Pulau Tekong, and the eastern shore of Pulau Semakau in the south. The mangroves of Pulau Semakau have since been cleared for the large offshore landfill, but the project involves replanting of mangroves at other sites of Pulau Semakau in order to maintain the ecosystem. Seagrass beds can be found on the extensive reef flats of Cyrene reef and west of Pulau Semakau.

7.2 Significant Species

The coral reefs are exceptionally diverse (197 species of scleractinian corals from 55 genera) despite the high turbidity in Singapore waters (Chou 1995). There are 31 man-

grove and 11 seagrass species found in the country (Spalding 2000). Marine turtles (Green, Hawksbill, Ridley's), dugongs, dolphins (Indo-Pacific humpback) and four species of giant clams are also known to occur.

7.3 Legislation and Management Framework

The most significant government document regarding nature conservation and environmental management is the national concept plan "Living the Next Lap" or Green Plan" of 1991 (Chou and Goh 1998). The Plan mandates that 5% (3,310 ha) of the total land area be set aside for nature conservation. It has been further developed for implementation by an Inter-Ministerial Steering Committee, under which the Ministry of National Development and other government agencies and a non-government organisation (NGO) form a workgroup. In 1993, an Action Programme of the Green Plan was passed to ensure the designation of 19 land conservation areas and protection of four coral reef areas against commercial harvesting. The latter involves strengthening enforcement by the Coast Guard, monitoring of water quality and reclamation projects, and awareness programmes. The Land Office grants coral collect permits only for scientific, conservation and research purposes. The "Green Plan" is presently under review and public consultation is being sought for the preparation of "Concept 2001".

There are currently no specific laws for the protection of mangrove forests and existing seagrass beds (ICRI 1997).

The Maritime and Port Authority (MPA) of Singapore is responsible for marine environment protection from sea-based activities. MPA espouses a comprehensive approach towards the protection of the marine environment, based on prevention and preparedness.

Non-government organisations (NGOs) such as the Nature Society (Singapore) and the Singapore Environmental Council are actively assisting in raising public and government awareness on environmental protection and nature conservation. The Republic of Singapore Yacht Club, Singapore Institute of Biology, and Singapore Underwater Federation jointly launched a reef survey and conservation planning programme in 1987, which resulted in the proposal of the four coral reef areas for conservation. Current NGO initiatives include coral translocation, reef protection, and education projects. Since 1996, a Singapore Reef and Marine Conservation Committee was formed to coordinate reef and marine conservation efforts. It is composed of representatives from Raffles Marina, Republic of Singapore Yacht Club, Singapore Institute of Biology, Singapore Underwater Federation and Nature Society (Singapore).

7.4 Extent of Existing Marine Protected Areas (MPAs) System

A network of 259 ha. of mangrove areas (about 50% of all remaining mangrove areas) is conserved, many of which are integrated into development projects nearby.

Only two locations are considered as MPAs. The first is the 87-ha Sungei Buloh Nature Park located along the northern coast of the mainland. It is a coastal mangrove habitat. The second is a group of southern offshore islands (St. John's, Kusu, Lazarus and Sister's) designated as a Marine Nature Area in 1996. These extend to about 500 ha.

7.5 Proposed Marine Protected Areas

Khatib Bongsu mangrove is being proposed to be designated as a nature park (Chou 1995). Four coral reef areas (total 3,725 ha) have been identified for protection in the Action Programme of the Green Plan: St. John's Islands, Pulau Hantu, Pulau Semakau and Pulau Sudong, all in the south (Cheung 1995). Of these, the St. John's group of Islands was designated as a Marine Nature Area in 1998. There are no other MPAs in Singapore.

7.6 Evaluation of MPAs - Status, Threats and Management

The Sungei Buloh Nature Park is effectively managed and backed by adequate surveillance and enforcement. It has a suitable monitoring and research programme to support management planning. In contrast, the St. John's group of islands, designated as Marine Nature Area, has no clear management plan. Whatever form of management there is appears to be confined to the terrestrial component of the islands where certain trees/plants considered to be of natural heritage value cannot be destroyed. Little can be said about the management of the marine component except for the insistence of Environmental Impact Assessments (EIAs) in connection with the proposed development on the islands (EIAs are not mandatory in Singapore). Furthermore, there is no surveillance or enforcement activity for the marine environment. Over the past few years, the reefs have suffered from the impacts of heavy sedimentation from human activities (land reclamation and dumping of earth spoils) at locations beyond the islands' grouping.

Coastal development stands as the most serious threat to the coastal and marine environment (**Figure 7.1**). At least 60% of the fringing reefs in the south have been buried by reclamation or transformed into swimming lagoons (Chou 1995). Dredging and marine dumping have also greatly contributed in increasing the sedimentation loading of the waters.

7.7 Gaps in the Existing Marine Protected Area System

Considering the intense competition among users of the limited coastal and marine areas, few areas can be identified for complete protection. Any reef area identified for protection will have to permit multiple use. There is then a growing need to address the lack of institutional mechanisms to establish an integrated management strategy for coastal waters and resources (ICRI 1997).

Enforcement/Management. Marine park management has often focused on accommodating visitor use rather than on resource protection and enforcement (ICRI 1997). Serious conflicts between resource users as well as jurisdictional conflicts have also limited the effective management of MPAs. Another problem is the lack of marine conservation interest on the part of various agencies with jurisdiction over different islands. Most are developing the islands for purely economic reasons and appear unaware of the spirit of the Convention on Biological Diversity, and Chapter 17 of Agenda 21 of the United Nations Conference on Environment and Development (Rio de Janeiro 1992).

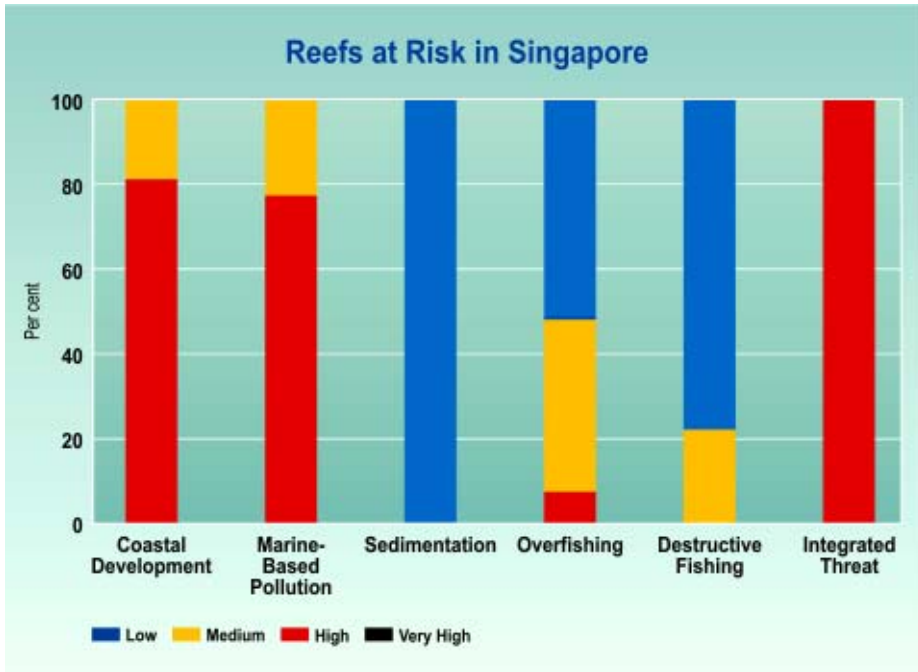


Figure 7.1. The different environmental threats that affect the coral reefs of Singapore (Burke *et al.* 2002)

7.8 Priority Sites

The Sungei Buloh Nature Park (87 ha) declared in 1993 may be considered of regional priority due to its importance for migratory birds. The three proposed coral reef areas that have yet to be declared for protection are of national significance as they contain the only substantial reefs remaining in the country. Their value in terms of biodiversity, education and awareness building is highly significant despite their small size and disturbed state.

7.9 Priority Actions

The current review of the Green Plan will address the deficiencies that became apparent over these years. These include the lack of a relevant management agency particularly for marine nature conservation. This is a major problem, as no agency appears willing to handle the responsibility of managing marine living resources.

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THAILAND

THAILAND

Hazel O. Arceo and Catherine Cheung with contributions from Hansa Chansang and Piyathip Eawpanich

Background Facts

Biogeographic Divisions	: East Asian Seas – I (3,4,5), VI (21)
Coastline	: 3,200 km (MacKinnon 1997)
Population	: 60.8 M (1997) – (Clarke 1999)
Population density	: 118/ km ²
Land area	: 513,517 km ² (MacKinnon 1997)
Shelf to 200m depth	: 257,600 km ²
EEZ	: 85,800 km ²
Est. Coral Reef Area	: 153 km ² with 40.3% under protection (Chansang 2000)
Est. Mangrove Area	: 1,946 km ² (MacKinnon 1997)
No. of islands	:
No. of MPAs	: 23 (2 designated as non-hunting areas)
Total Area of MPAs	: 5,819 km ²

(Refer to **Map 9** of Appendix for MPA sites and other relevant areas)

8.1 Coastal and Marine Ecosystems

The coastline of Thailand falls under the influence of two oceans; the East Coast forms the Gulf of Thailand, which belongs to the Pacific, and the West Coast borders the Andaman Sea facing the Indian Ocean. The coral reefs, which are mostly small fringing reefs, are found both in the Gulf of Thailand (74.8 km²) and the Andaman Sea (78.56 km²) (Chansang 2000). Due to the strong Southwest monsoon especially from May to October, most reefs are found on the eastern sides of these islands, notably along the Surin-Similan chain of islands. Mangrove development is favoured in the Gulf of Thailand due to high sedimentation rates while the growth of corals is limited to islands far from the shore and at lower diversity than in the Andaman Sea. Around 1,946 km² of mangroves remain, and only 2.2% (or 261 km²) of these is protected (MacKinnon 1997).

8.2 Significant Species

A total of 240 species of scleractinian coral in 67 genera have been recorded in Thailand (Spalding 2000). There are over 300 major reef groups covering an estimated area of 12,000 km² divided into four areas: i) inner part of the Gulf of Thailand (Chonburi); ii) east side of the Gulf (Rayong and Trad); iii) west side of the Gulf (Prachuap Kirikhan, Chumporn, and Surathani); and iv) along the Andaman Sea coastline (Ranong, Phuket, Phang-Nga, Krabi, Trang, and Satun), where about 55% of Thailand's reefs occur (Wilkinson 1998). About 35 species of mangroves and 15 species of seagrass have been reported (Spalding 2000).

Five species of marine turtles (Green, Hawksbill, Loggerhead, Olive Ridley and Leatherback) have been recorded in Thailand (UNEP/IUCN 1988). Dugongs are found mainly along the southern part of the West Coast in the Andaman Sea and the eastern part of the Gulf of Thailand (Nateekanjanalarp and Sudara 1992).

8.3 Legislation and Management Framework

The establishment of national parks and fish sanctuaries falls under the National Park Act of 1961 and Fisheries Law of 1947. Furthermore, under the National Environment Quality Act, certain areas can be declared as “areas under protection,” and any measures deemed necessary can be imposed (Chansang 2000).

In 1993, the Department of Fisheries initiated a programme for marine and fisheries protected areas to enhance the protection and conservation of breeding grounds in the Gulf of Thailand (Agenda 21). Since 1995, the Department also has been implementing a coral reef management programme, which includes research, training and public education, for reefs outside marine parks (Chansang 2000).

There are five categories of protected areas: national parks, national marine parks, wildlife sanctuaries (in some translations, “wildlife conservation areas”), forest parks and non-hunting areas. National marine parks exist primarily to protect areas of coastal habitat and islands, and appear to have little relevance to watershed management; some, however, extend inland to include even mountainous terrain (from Clarke 1999):

The National Park Act of 1961 states that a national park is to be, ‘*preserved in its natural state for the public’s education and enjoyment*’. National marine parks have similar functions. Most are former national parks that have been reclassified.

The Wildlife Protection and Preservation Act of 1960 states that wildlife sanctuaries are areas for, ‘*the conservation of wildlife habitat so that wildlife can freely breed and increase their populations in the natural environment*’.

Forest parks are forested areas that have at least one significant feature such as waterfalls, large trees or geomorphologic formations. These are provided for under the National Reserve Forest Act of 1964, with the chief purpose of providing sites for local tourism and recreation.

Non-hunting areas protect land that is open to consumptive uses such as fishing and gathering of non-timber forest products but from which hunting is excluded.

The government agencies responsible for MPA management are the Royal Forest Department (RFD), which is responsible for marine park management, and the Department of Fisheries, which is responsible for aquatic resource management (Chansang 2000). The Marine National Park Division of the RFD is mandated to manage marine parks and implement the relevant laws and regulations.

The National Mangrove Committee formed in 1978 screens development projects to be located in mangrove areas and acts as a policy advisory body to the government. The National Park Committee focuses more on marine parks.

There is a growing trend of community-based management of coastal and marine resource conservation with the assistance of NGOs, especially in southern Thailand where trial projects have been encouraging (Sudara 1995). An active non-government organisation (NGO) network in Thailand is assisting communities with the local management of coral reefs, and restoration of forests and mangroves (Wilkinson 1998). DANCED has funded NGOs to strengthen their activities but most of these activities are not in MPAs (Piyathip, *pers. comm.*)

8.4 Extent of Existing Marine Protected Areas (MPAs) System

Twenty-one National Marine Parks have been declared (Piyathip, *pers comm.*; Chansang 2000). Two other MPAs have been designated as non-hunting areas but also encompass coral and mangrove habitats (see **Table 8.1**). Of the 21 National Marine Parks, 13 parks include coral reef areas, most of which are located in the Andaman Sea and only five are located in the Gulf of Thailand (Chansang 2000). Approximately 60% of the coral reef area is included within a protected area. There is no available information on the Fisheries Sanctuaries.

8.5 Proposed Marine Protected Areas (MPAs)

There are no known officially proposed MPAs in the country.

8.6 Evaluation of MPAs - Status, Threats and Management

Conditions and Threats: Reef surveys under the ASEAN–Australian–LCR Project indicated that over 60% of the major reefs had poor (<25%) or fair (25-50%) coral cover, and less than 36% had good (50-75%) or excellent (>75%) coral cover (Wilkinson *et al*, 1994). In the Gulf of Thailand, coral cover and overall reef fish abundance were both found to be higher on the west coast than on the east where fishing pressure, including destructive methods using dynamite, poison, traps and spear guns, was higher (Satumanatpan and Sudara 1992).

Sedimentation, nutrient pollution from development on the land and overfishing (particularly by large trawlers now fishing close to the reefs) are causing major damage to the reefs of Thailand, and over 60% of the reefs has less than 50% live coral cover (Wilkinson 1998). Other activities such as conversion of mangrove forest to shrimp farms, excessive tourism activities, and improper management of pollution in the areas have further contributed to the degradation of coastal habitats and resources. Furthermore, oil and gas operations and transportation also increase the risk to the coastal and marine environment (Agenda 21). Agenda 21 also mentions the main sources of pollution affecting ocean and coastal resources. For land-based pollution, the primary sources are domestic sources, industrial development and tourism areas, especially beach resorts and agriculture and aquaculture activities. Pollution from non-point sources include agriculture and urban runoff and coastal erosion. The primary sources of sea-based pollution are offshore oil and gas operations, wastes from maritime transportation, shipping, oil spills, dredging and the red tide and harmful algal bloom.

The loss of seagrass beds in the Andaman Sea has been attributed to increased siltation and use of push nets and bottom trawls in fishing (Chansang and Poovachiranon 1992). This may have contributed to the slow decline of the dugong population, especially in the Gulf of Thailand, where they are not only killed accidentally by fishing gear, but are also intentionally hunted for food (Nateekanjanalarp and Sudara 1992).

Results from the questionnaire for ranking the threats to MPAs indicate that overall, domestic pollution and development are perceived as the most serious threats, followed by tourism activities, siltation at sea and destructive fishing (**Figure 8.1**). The latter includes not only dynamite and cyanide fishing, but also illegal trawling at a few sites, though these activities are becoming less of a threat as tourism becomes heavier. In general, over fishing and destructive fishing intensify at sites in the Andaman Sea where development and pollution are less prominent than in the Gulf of Thailand (**Table 8.2**). Although not indicated in the graph, local outbreaks of the crown-of-thorn starfish have been reported in the Gulf of Thailand and the outbreaks in the Andaman Sea have increased significantly since 1982 (Sudara 1995).

Collection of other marine resources (particularly seashells) as tourist souvenirs and for export and aquarium fish trade seems to have an equally damaging impact as that of destructive fishing outside established parks. Despite the ban on coral collection since 1978, local collection of coral for sale as souvenir and for export still existed in the late 80's (Sudara and Nateekarnchanalarp 1988). When tourism boomed in the 1980s, there was a rush for development resulting in a lack of planning. Beach areas such as Pattaya, became internationally infamous as examples of how development can lead to environmental degradation and pollution. These problems have now shifted to the islands in the Gulf of Thailand and Andaman Sea. In recent years, Hat Nopharat Thara - Mu Ko Phi Phi and Khao Laem Ya - Mu Ko Samet have been affected by the rapid growth in tourism activities (**Table 8.2**). In just one year of tourist resort development on the islands of Samui, Pha Ngan, Tao and Ang Thong Marine National Park, coral reefs were significantly degraded to a cover of 20% (Sudara 1995). Although the revenue generated from the tourism industry is high (e.g. Phuket earned 127 M baht or US\$ 5M a year from tour companies, tour boat operators, dive shops and curio shops; CRMP, 1991), environmental damage through habitat loss is usually not counted.

The large-scale clearance of mangroves for shrimp pond and development projects, though not directly addressed in this section, is one of the major causes of siltation on the marine environment and coral reefs. The destruction of mangroves is most severe in the Gulf of Thailand where only 0.5–8% of the original mangroves remains, the worst situation being in the inner part (Sudara 1995). Tin mining in mangrove swamp areas and shallow waters by dredging have also caused the siltation and smothering of corals, notably in NW Phuket and Phangnga Bay (Chansang 1988; Chansang and Phongsuan 1994).

Management: Management of MPAs is generally weak, as the Marine National Division has a limited number of qualified staff and expertise and funds for marine resources and MPA management. Encroachment into and vandalism within MPAs often occur with little control. Mu Ko Similan and Mu Ko Surin are believed to be the best managed marine parks in the country although some degrees of degradation have occurred due to frequent tourism activities.

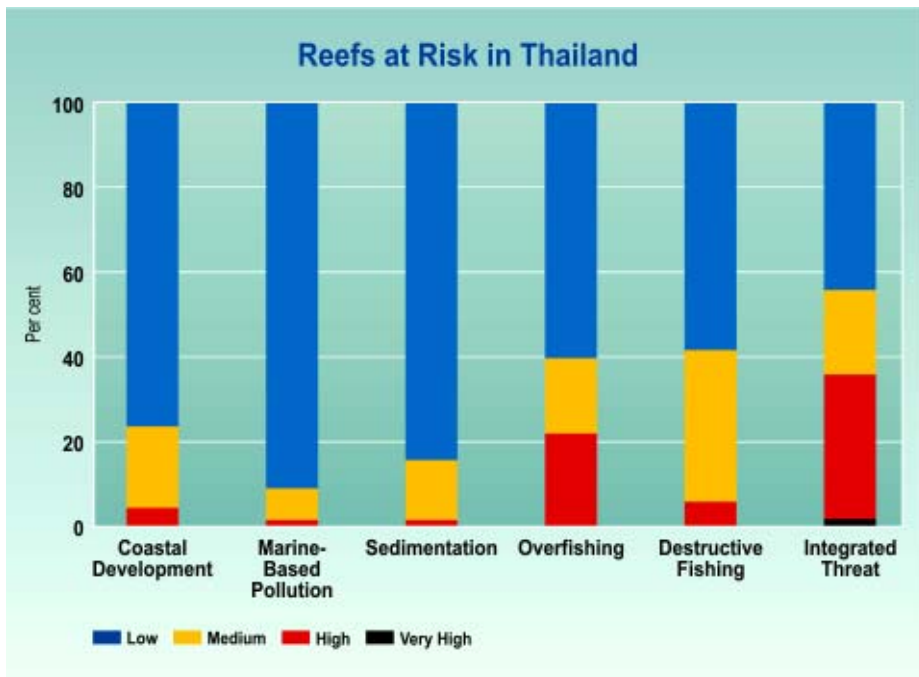
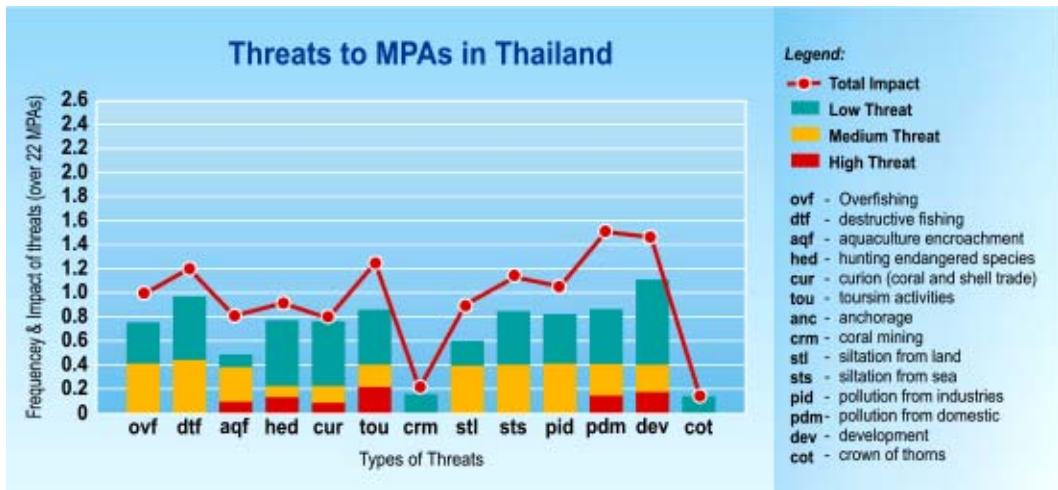


Figure 8.1. Threats to MPAs of Thailand (*top*) (Cheung 1995) and to the country's coral reefs in general (*bottom*) (Burke *et al.* 2002).

At Sattaheep south of Pattaya in the eastern Gulf of Thailand, the Navy strictly patrols the islands for turtle conservation, which also keeps the coral communities in very good condition (Sudara 1995). The proposed management plan of the west Gulf of Thailand (including Ang Thong, Samui and Pha Ngan Islands) divided the coral reefs into three zones for preservation, common uses or conservation, and private development (Sudara *et al.* 1991).

8.7. Gaps in the MPA System

The National Park Act does not currently have specific provisions for marine parks (Wells 1988).

Enforcement/Management. Marine park management has often focused on accommodating visitor use rather than on resource protection and enforcement (ICRI 1997). Serious conflicts between resource users as well as jurisdictional conflicts have also limited the effective management of MPAs. The major problems in marine park management has been improper planning in designating park areas, lack of manpower and equipment, lack of proper management plan, and inadequate technical know-how of park officials (Chansang 2000).

Public Participation and Education. Public participation or involvement in all aspects of marine resources management, from policy formulation to actual management, should be encouraged and continued. Public involvement is starting to be employed in coral reef management, especially in reef areas outside marine parks (Chansang 2000). Awareness campaigns may also need to be strengthened to facilitate public involvement in management matters.

8.8 Priority Sites

Among the 16 national parks, three are recognised internationally as globally significant: Mu Ko Similan and Mu Ko Surin form a World Heritage Site and Khao Sam Roi Yot is a RAMSAR site. Tarutao, though rejected as a World Heritage Site, is now an ASEAN Heritage Site and warrants regional priority due to its relatively undisturbed reefs despite the occurrence of crown-of-thorns infestation, some dynamite fishing and siltation from logging. Ao Phangna, which contains the last remaining substantial stand of mangroves in the country and Hat Chao Mai, which is important for dugongs and has relatively undisturbed coral reefs, are rated as national priority sites. Changthaburi-Trat is another priority area for dugong conservation.

8.9. Priority Actions

Many of the recommendations focus on finding ways to strike a balance between short-term economic benefits and sustainable environment and development, which has been identified as the major obstacle against success in the management of MPAs and marine conservation as a whole.

- A. Carry out research on economic gains from conservation versus costs due to environmental degradation and/or loss, and disseminate the findings to government and decision makers.
- B. Study the issue on eco-tourism development to generate guidelines that would minimise impacts on the environment.
- C. Develop monitoring and restoration programmes on critical and damaged habitats.
- D. Promote informal public education with emphases on protected areas and endangered species; strengthen dugong conservation activities.

Table 8. National marine parks (IUCN category II) of Thailand.

The first 16 national marine parks listed below were former national parks from varying times between 1966 (when Khao Sam Roi Yot was declared) up until 1993, when a separate management structure was created.

MPA Name	Size (km ²) (land + marine areas)	Area of marine* (km ²)	Area of coral reefs** (km ²)
1. Khao Sam Roi Yot	98	21	No data
2. Tarutao	1,490	1,264	12.58
3. Thaleban	196	2	No data
4. Mu Ko Ang Thong	102	84	3.54
5. Ao Phang Nga	400	347	No data
6. Mu Ko Surin	135	103	12.01
7. Sirinath	90	68	2.06
8. Khao Laem Ya-Mu Ko Samet	131*	123	2.03
9. Hat Chao Mai	231*	137	1.29
10. Mu Ko Similan	140**	124	3.39
11. Mu Ko Chang	650	458	4.49
12. Laem Son	315	267	No data
13. Hat Noppharat Thara-Mu Ko Phi Phi	388*	326	7.77
14. Mu Ko Phetra	494	468	4.77
15. Khao Lam Pee-Hat Thai Muang	72	0	none
16. Mu Ko Lanta	134	109	8.24
17. Khao Lak-Lam Ru	125	0	none
18. Had Vanakorn	38	15	No data
19. Mu Ko Chumporn**	317**	0	3.52
20. Tarn boke Khoranee**	104**	266	0.42
21. Lam Nam Kraburi	160*	64	No data
Total national marine parks	5810	4246	66.11
22. Thale Sap	364.7		
23. Pa Len Pak Phanang-Pa Len Ko Chai...	56.7		
Total non-hunting areas	421.4		

(Clarke 1999)

* Piyathip, pers.comm.

** Chansang 2002

- E. Develop national and regional databases on MPAs with frequent inputs from and exchange among nationals.
- F. Strengthen networking of environmental NGOs within the country.
- G. Review the MPA system and identify where MPA plans are being implemented and where enforcement is working. Use these MPAs as models for others.

A National Coral Reef Monitoring Program has been proposed, especially as Thailand's tourism industry and coastal development continues to expand in the coming years (ICRI 1997).



VIETNAM

VIETNAM

Hazel O. Arceo, Vo Si Tuan and Catherine Cheung

Background Facts

Biogeographic Divisions	: 1 (1) and 1 (2)
Coastline	: 3,260 km
Population	: 78 M (1998)
Population density	: 217/ km ²
Land area	: 332,000 km ² (MacKinnon 1997)
Shelf to 200m depth	: 3,279,000 km ² (WRI 1994)
EEZ	: 1,000,000 km ²
Est. Coral Reef Area	: 1,300 km ² (Spalding 2000)
Est. Mangrove Area	: 1,100 km ² (ADB 5712 - REG)
No. of islands	: 3,000+
No. of MPAs	: 22
Total Area of MPAs	: 2,576.5 km ²

(Refer to **Map 10** of Appendix for MPA sites and other relevant areas)

9.1 Coastal and Marine Ecosystems

The coastline of Vietnam extends for some 3,260 km through more than 15 degrees of latitude from 8°30' N to 23° N and shows a variation in climate and biodiversity along this broad N-S cline. The country has more than 3,000 inshore and offshore islands and islets that extend to claims covering the Spratly and Paracel Islands. Coral reefs are the richest marine habitats in the country with the greatest diversity of species. All coral reefs in the north are fringing; the more complex coastline and insignificant effect of rivers in the south has also favored the development of fringing as well as platform reefs. Atolls in the Spratly Islands enclose reefs hundreds of meters long and have a high species diversity and cover. The most extensive tracts of seagrass occur in the Thuy Trieu lagoon of Khanh Hoa province with some 800 ha. The offshore islands of Con Dao and Phu Quoc also have extensive tracts of seagrass beds of 200 ha and 300 ha, respectively. Estuaries, river deltas, coastal lagoons and river mouths, tidal marshes, mud and salt flats are the other coastal and marine habitats of the country; it is in these areas where the country's mangroves can be found.

Mangrove formations now cover less than 150,000 ha and can be found in many areas along Vietnam's coastline. Extensive mangroves occur on Mekong Delta in the south and Red River Delta in the north. The southern estuaries of the Mekong and Dong Nai rivers are the most favorable for mangrove growth. The lower temperatures and poorer soils in the north have limited the height of trees. Although mangroves occur along the central coast, the narrow tidal flats in this region combined with poor sedimentation from rivers, and exposure to typhoons and floods offer less favourable conditions for growth in some of the regions that are most disaster prone.

9.2 Species of Significance

Over 300 species of scleractinian corals are found in Vietnam's coastal waters with 277 species belonging to 72 genera identified in the south, compared with the less diverse areas in the north of the country with 165 species in 52 genera. Fourteen seagrass species have been recorded in the shallow coastal waters of Vietnam, with species diversity increasing from the north with nine species, and to the south with 13. There are around 32 true mangrove species and another 32 associate mangrove species.

Marine turtles include the Green (*Chelonia mydas*), the Hawksbill (*Eretmochelys imbricata*), the Loggerhead (*Caretta olivacea*) and the Olive Ridley (*Lepidochelys olivacea*), all of which have traditional nesting sites along the coast. Despite legal protection, the turtles are still hunted and their eggs collected. Northern populations are almost wiped out so most of the catch now comes from the south and mainly on islands and waters far from the mainland. They are very rare along the coast now except at Con Dao islands where they are protected by the National Park. Today, the endangered Dugong (*Dugong dugon*) is known to inhabit the waters of Con Dao islands. A dugong was captured near Nha Trang in 1962, and the animals were previously known to occur in the Tonkin Gulf, Phu Quoc islands of Thailand Gulf. Sixteen Cetaceans including one baleen whale and 15 toothed whales (dolphins and porpoises) have thus far been sighted in Vietnamese waters, though other species are likely to occur.

9.3 Legislation and Management Framework

The Law on Environmental Protection (LEP), which was passed by the National Assembly on 27 December 1993 but came into effect on 10 January 1994, sets out a broad and basic framework for policies on environmental protection. Chapter II provides for the prevention of and combat against "environmental degradation, pollution and incidents". Chapter III outlines the remedies to be adopted against these environmental threats. The state apparatus and institutions for environmental protection are set out in Chapter IV, and the country's international obligations with respect to environmental protection treaties are established by Chapter V. Chapter VI deals with breaches and violations of the LEP, and Chapter VII anticipates implementing provisions to enforce the LEP. However, the lack of specificity of the LEP has resulted in many environmental issues left without legal regulation. These include overlapping jurisdiction amongst government bodies, EIA requirements for specific industries, international treaty obligations, harmonisation of liability for environmental violations, and new issues such as trade and the environment and the use of economic instruments to motivate compliance (Tan 2000).

In addition, the Ordinance on Fisheries Resource Protection contains specific regulations on fish catch, methods, seasons, etc. that are being enforced by the Department of Fisheries Resources Protection, which was established in 1993 under the Ministry of Fisheries (MoF).

The Ministry of Forestry has the mandate and responsibility over nature reserves, national parks and other protected areas on land including mangrove areas. However, there is as yet no government department clearly authorised to manage MPAs although the Ministry of Fisheries and the Ministry of Science, Technology and Environment (MOSTE)

have both shown concern about the issue. Management of existing island reserves tends to be more focused on the terrestrial area since these are run by the Forestry Department. The lack of a clearly identified responsible authority has been repeatedly emphasized as the major obstacle against marine conservation, and specifically on MPA viability (Biodiversity Action Plan Planning Committee, 1994 draft; Roop *et al.* 1994).

Institutional and administrative complications have been an impediment to effective protected area design and management in the country. The planning process is sectoral-driven and centrally-oriented, often resulting in planning conflicts at the provincial level and little recognition of real on-the-ground needs at the district level. The Ministry of Agriculture and Rural Development (MARD) through its Forest Protection Department (FPD) is the designated management authority for all protected areas in the country, but is primarily focused on the terrestrial (forested) ecosystems. There remains an institutional vacuum and a limited management capacity to cover the needs of the MPA component. The initial result has been that all coastal protected areas lacked marine components; when extensions to cover the marine environment were confirmed (as in the case of Cat Ba), management and staff on the ground were ill-prepared to carry out the activities necessary in managing the marine environment. The staff were mainly trained for terrestrial conservation. Up to the present, there is no agency solely responsible for marine conservation. This means that management effectiveness for marine environment may be lower than as discussed.

Recently, the Vietnam Government authorised the Ministry of Fisheries (MoFi) to develop a National Plan for Marine Protected Areas. The results of the project, ADB 5712-REG, have been used in this plan. The MoFi plan has put emphasis on areas (15 areas listed) with dominantly marine components, particularly coral reefs and seagrass beds, and also includes a marine protected area in the Spratly archipelago. The plan, which is pending approval by the government, will consequently address the problem of institutional vacuum. This means that Vietnam will have two systems responsible for managing PA systems in the future. The FPD of MARD will continue to manage terrestrial PAs including mangroves, and the coastal forest ecosystem while MoFi will be responsible for the MPAs with the objective of conserving mainly coral reefs, seagrass beds, island ecosystems and marine living resources, some of which the FPD presently manages.

9.4 Extent of Existing Marine Protected Areas (MPAs) System

Establishing protected areas was considered as a tool toward the conservation of coastal and marine ecosystems in Vietnam in 1986 when some reserves dominated by mangroves such as Ca Mau cape, Bac Lieu were established. In the same year, the 15, 043-ha Cat Ba National Park was approved. The Park included some 5, 400 ha of coastal waters, making it the first protected area in the country with an approved marine component. Further, based on the marine surveys they conducted, the Oceanographic Institute in Haiphong had recommended an expanded marine component for the park but which is awaiting formal approval.

At present, there are 31 existing protected areas considered relatively as coastal and marine protected areas with the purpose to conserve coastal forest, mangroves, seagrass

beds and wetlands (WCMC/WRI 2002). Besides Cat Ba and Con Dao National Parks and Halong Bay World Heritage, the others do not include marine areas. Marine components of former terrestrial reserves such as Cat Ba and Con Dao national parks have only recently been recognized as integral components of these protected areas, but even so they still need to undergo further expansion to cover critical marine habitats. Presently, only a nominal proportion of Vietnam's coastal and marine resources are included in the existing protected areas system.

Of these MPAs, three are designated as protected landscape, two as national parks, and 16 as nature reserves (WCMC/WRI 2002). Halong Bay, which surrounds around 3,000 islands, was approved in 1994 as an UNESCO World Heritage Site and established for its landscape qualities. The famous site covers up to 43,700 ha, including the marine environment. The Red River Estuary is included as a Ramsar site (Kelleher *et al.* 1995).

Based on the criteria of the project of Reefs at Risk in Southeast Asia, only two areas (Con Dao National Park and Can Gio Biosphere Reserve) are considered as having good management, while 13 others belong to the medium level of management effectiveness. Meanwhile, almost all MPAs (18 out of 22) still need highly enforced protection.

It should be noted that all existing areas have been mainly designed for terrestrial biodiversity conservation.

9.5 Proposed Marine Protected Areas (MPAs)

Six of the seven MPAs proposed as a result of the World Wildlife Fund (WWF) Marine Conservation Project (1992-1994) that was launched to carry out biodiversity, socio-economic surveys and conservation potential, have already been established. Through subsequent surveys conducted by the Institute of Oceanography in large level at the sites proposed by the WWF project and other sites, MPAs representative for the coastal ecosystems of Vietnam have been selected.

9.6 Evaluation of MPAs - Status, Threats and Management

By the end of the American war, some 105,000 ha of mangroves or 36% of the total mangrove formation in South Vietnam have been destroyed by herbicides. Since then most of the mangroves that were defoliated have recovered naturally or through replanting. However, human migration to the coast has since caused serious negative impacts to the mangrove and other coastal ecosystems. Mangroves have been cleared for aquaculture (shrimp and fish) in most coastal provinces, and have even replaced areas formerly used for agriculture. These activities impact even on mangroves inside protected areas such as Ca Mau and Can Gio.

The development and expansion of industry along the coast is beginning to add to the pollution load, particularly poisonous heavy metal waste, which is often released into the sea without any attempts to reduce toxicity. The expansion of ports and unregulated bilge cleaning is now becoming a more frequent source of coastal pollution,

particularly in the northern areas of Quang Ninh and Haiphong. Other MPAs, such as Cat Ba, Ha Long Bay, are also vulnerable to this threat.

Overfishing, especially non-selective and illegal forms using poisons, explosives and fine mesh nets, had decreased somewhat but is still serious in some provinces. Other forms of non-selective fishing such as sluice traps, electric fishing, gill nets and the traditional *gia cao* (pelagic trawling net) continue to take their toll on marine fisheries. Rapid resource assessment (RRA) interviews conducted in early 1999 revealed that destructive fishing methods were an issue in 21 to 29 provinces. The magnitude of this issue not only encompasses the indiscriminate killing of incidental species, small fry and seedlings necessary for stock regeneration, and environmental damage, but also the source of community conflict both for resident and non-resident marine harvesters that has arisen due to the use of these methods.

Live trade of groupers and other fish species for the Hong Kong and Chinese markets operate with impunity in the northern and central parts of the country, and even in the productive waters near the Con Dao National Park. Figures are difficult to determine, but fishermen in these areas illegally take the fish and sell them at sea to larger 'tenders' for onward transport. Divers use cyanide to poison and stun the fish, which in turn kill coral and other biota outright. This is one reason why the density of commercial fish is very low even in the waters of many MPAs.

Management of the marine areas at all three sites is minimal or non-existent. This is largely because the two national parks are under the Forestry Department, which has no authority in the sea and no expertise in marine resource management. Local expatriates and scientists at Hon Mun had done some voluntary activities including the installation of moorings and awareness programs, which were supported by provincial departments, but the government had not provided official management or protection effort. Status and threats at other undeclared MPAs also vary. Overall, overfishing, hunting of endangered species, destructive fishing and the curio trade have been identified as causing the most serious impacts on both the existing and undeclared coral reef MPAs (**Figure 9.1**).

Institutional Responsibility. The lack of any legal framework for MPAs means that, at the moment, no government agency has the clear mandate for MPA management in Vietnam.

Protected Area Boundaries. At present, there are no regulations specifying the process and materials required for submitting boundaries of candidate sites as MPAs when proposals are being made. A number of existing MPAs and current reserve proposals are without specific boundaries or have only vague boundary descriptions. Should conflicts arise with other forms of coastal development (i.e. locations of factories, ports, or shipping routes), MPAs with ambiguous boundaries will be open to compromise.

Status, Condition, and Biodiversity Significance of Existing Reserves. Many of the existing coastal and marine protected areas in the country are relatively small compared to what is required to support biodiversity conservation or protection objectives. Generally, a minimum size of about 10,000 ha is required for these types of ecosystems to ensure ecosystem and biodiversity integrity; for the protection of far-ranging species, the area should be much larger. The average size of Vietnam's 20 existing coastal and

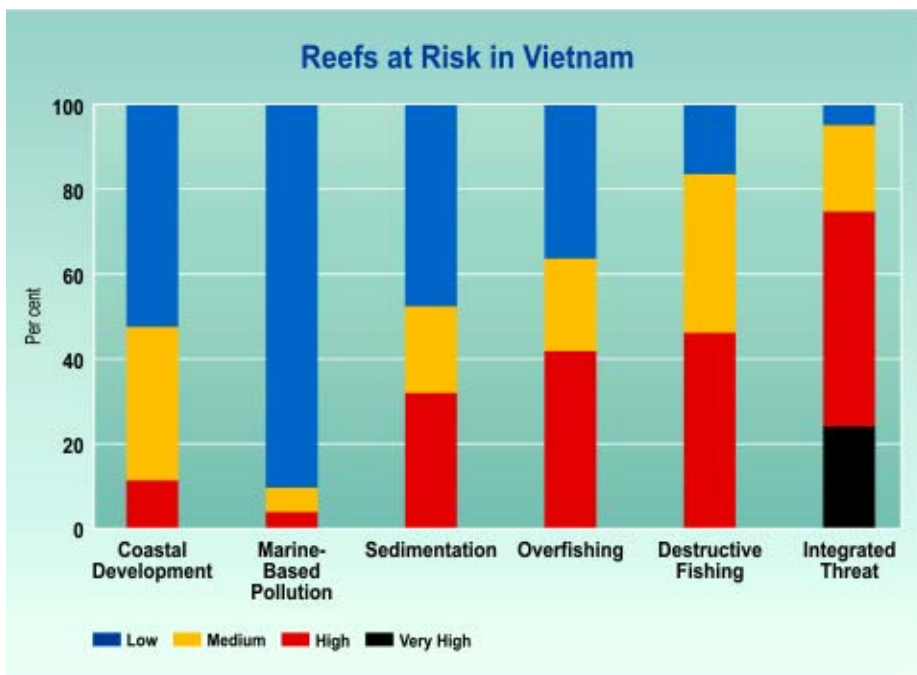
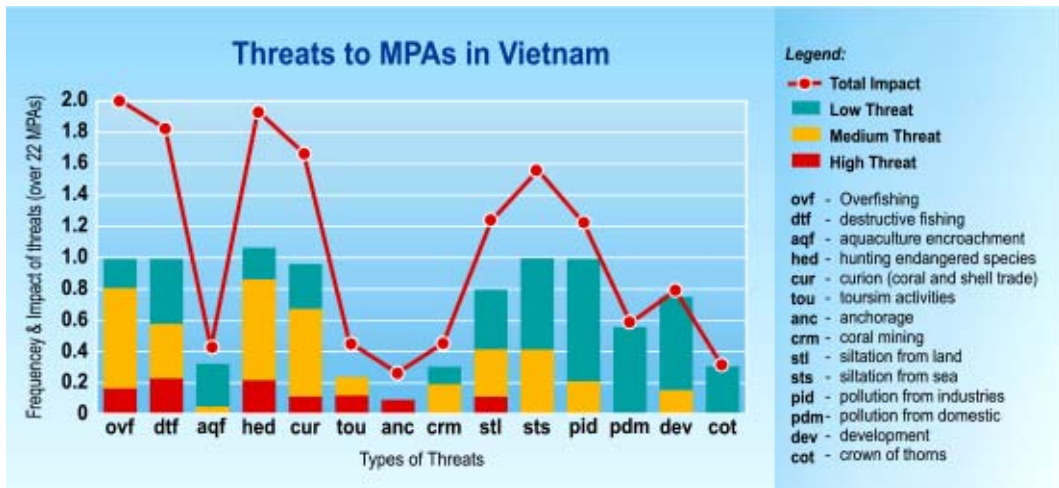


Figure 9.1. Threats to MPAs of Vietnam (top) (Cheung 1995) and to the country’s coral reefs in general (bottom) (Burke et.al 2002).

marine protected areas is slightly more than 11,000 ha, which is encouraging.

However, none of the coastal and marine protected areas is in pristine condition, and many are degraded. The significant threats to coastal and marine ecosystems of Vietnam in general are unregulated access, over-exploitation of ecosystem resources, and habitat destruction. Marine resources are being exploited everywhere along the coasts of the country. As these resources decline, harvesting efforts increase, leading to

increasing use of destructive fishing methods. Low returns on inshore harvesting efforts are due to declining marine resources, primitive fishing methods, and increased competition. The declining marine resources are in turn linked to the overall poverty context of inshore marine harvesting households to fishing methods and to changes in the marine environment. The situation is further exacerbated by competition and conflicts for provincial territorial resources by outsiders, especially fishers from other provinces and also, to some degree, by non-Vietnamese fishers.

Awareness and Knowledge of Coastal and Marine PAs. There is a lack of awareness and knowledge of coastal and marine protected areas among coastal communities in Vietnam. Most of those interviewed during the surveys had virtually no idea of what a marine protected area is, even if a marine protected area exists in their province. Those who ventured to guess were familiar with land-based protected areas. More importantly, many coastal communities' concept of what a protected area might be is strongly tied to the notion of restrictions on fishing, whether these restrictions are season, fishing method and gear type, or species and size. Coastal communities are familiar and comfortable with this notion of a protected area. Also, this understanding of restrictions on resource use in a protected area does not necessarily mean permanent prohibition of access to and harvesting of biological resources. A number of communes indicated reluctance to support a coastal and marine protection area if it meant that part of the marine area would be permanently off limits to biological resource harvesting. As the existence and maintenance of MPAs largely depend upon strong public support, any programme or project relating to MPAs must focus on raising community support to overcome the information vacuum at the outset.

Biological Basis for Protected Area Planning. Vietnam's present system of coastal and marine protected areas has evolved through a series of proposals made over the years by different government departments including MARD, MoF, MOCI, and the provinces. The resulting system is a collection of protected areas that have been established for diverse purposes. It is not certain if the current system has developed from a consistent physical, biological, and socio-economic information base with an objective of ensuring representative ecosystem coverage. For example, the last comprehensive biological surveys of the existing protected areas were conducted about ten years ago, with only a few conducted in the last three years and some with incomplete surveys. This means that the current coastal and marine protected area system for Vietnam may not be completely representative of the biodiversity of these ecosystems. In the absence of such a systematic analysis, it cannot be confirmed if the requirements for an ecologically meaningful system of coastal and marine protected areas is being met in Vietnam.

Financial Support. One of the biggest constraints to the correct management of coastal and marine protected areas in Vietnam (as elsewhere in the region) is financial. Public sector financing of investments is insufficient to establish and effectively manage reserves. Even the bigger national reserves such as Cat Ba and Con Dao National Parks are underfunded – now receiving US \$10/ha each year from the public sector for capital and operating expenses. Reserves that are not national parks receive even less. This low level of funding places constraints on what could be achieved with respect to effective protected area management.

All protected areas are severely understaffed. Currently, slightly more than 685 permanent staff are charged with protecting and managing some 226,400 ha of coastal and marine environment in Vietnam's 20 existing coastal and marine protected areas.

The low levels of public sector funding mean that very little is left for protected area management itself: equipment and facilities; public awareness programs; reserve infrastructure; and monitoring, let alone basic operation and maintenance. The result is a coastal and marine protected area system in Vietnam that is under-equipped, lacking in basic infrastructure and facilities, and consequently limited in its capacity to achieve management, conservation, and protection objectives. An unfortunate consequence of all this is that opportunities for local participation in protected area planning and management have been very limited.

Management Capacity. Most of the staff in Vietnam's reserves have limited formal education and are guided by managers who lack formal training in protected area management. Even in the most important reserves, only one or two university level staff are among the officers assigned to the protected areas. Training and capacity building is required at all levels of marine protected areas management, but present opportunities for the type and quality of training required are limited in the country.

9.7 Priority Sites

The draft Coastal and Marine Protected Areas Plan made by the project ADB 5712 - REG (Phase 2) had ranked 20 areas as priority. This proposed national system includes coastal and marine protected areas. Six MPAs have been prioritised for management strengthening, and eight others for expansion and management strengthening; six new MPAs will be established. Among these MPAs, eight are being considered of highest priority. These include the Con Dao and Cat Ba National Parks, the Ca Mau and Phu Quoc-An Thoi Reserves, the Ha Long Bay World Heritage Site, the proposed Phu Qui Nature Reserve, the Cu Lao Cham Nature Reserve, the proposed Hon Mun Marine Park, and the proposed Cu Lao Cau Habitat Protected Area. The Draft Plan made by the Ministry of Fisheries agreed with this list. Although not listed here, the Spratly Islands is of great regional (if not global) significance for marine biodiversity and resources conservation if sovereignty disputes can be settled.

With this plan, the areas of marine ecosystems will be increased significantly. The objectives and details of the plan were summarized by Vo Si Tuan *et al.* (*in press*). The report is available at Vietnam's MOSTE or WWF-Indochina in Ha Noi.

9.8 Priority Actions

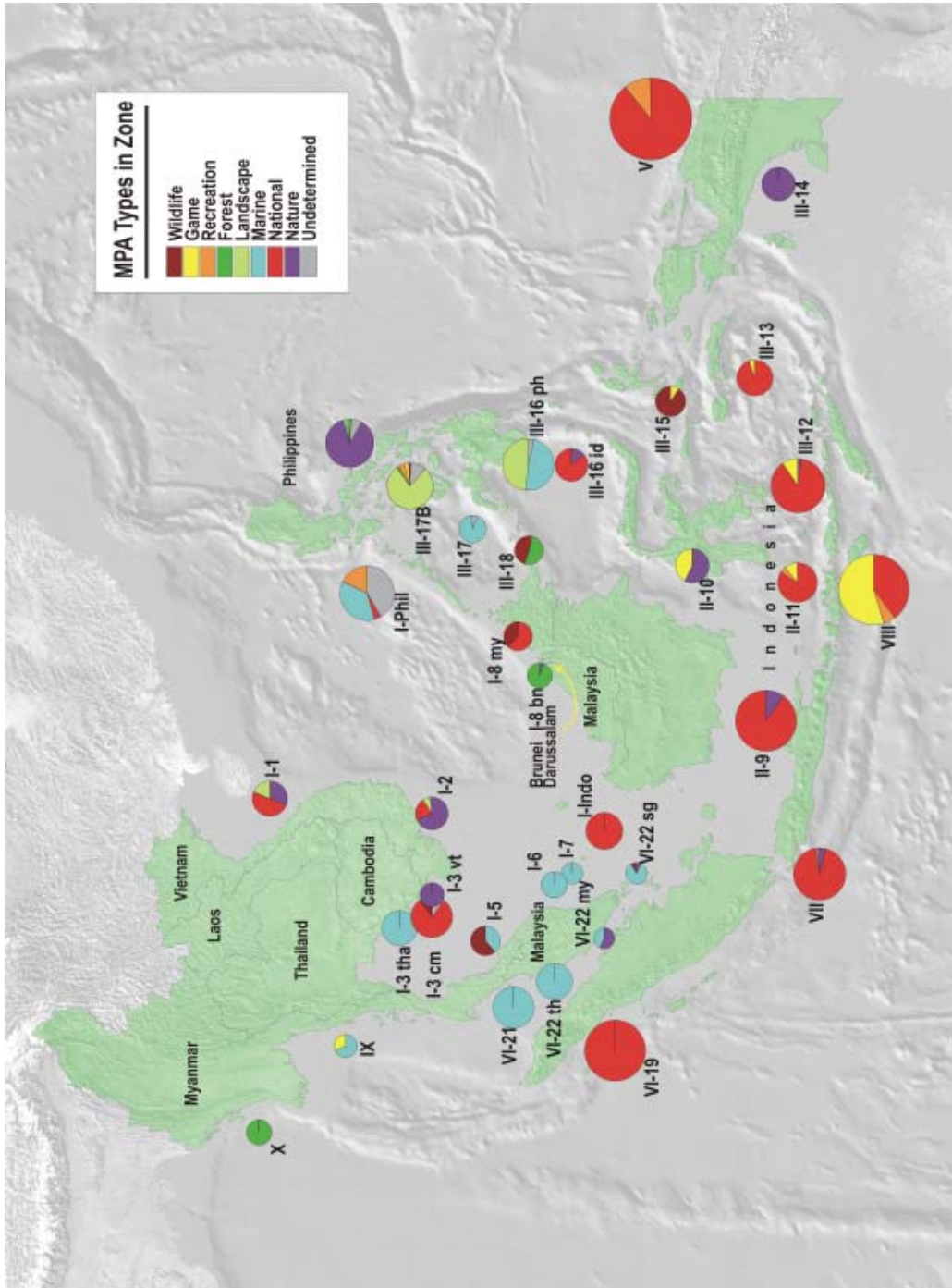
- A. Identify a government body or a consortium of government bodies to be responsible for the planning, implementation and coordination of MPA establishment and management.
- B. Revise laws and regulations to accommodate MPA management.
- C. In the planning and management of MPAs, take into account ongoing and planned coastal development and master plans. The formulation of coastal master plans

should in turn consider the existence of MPAs.

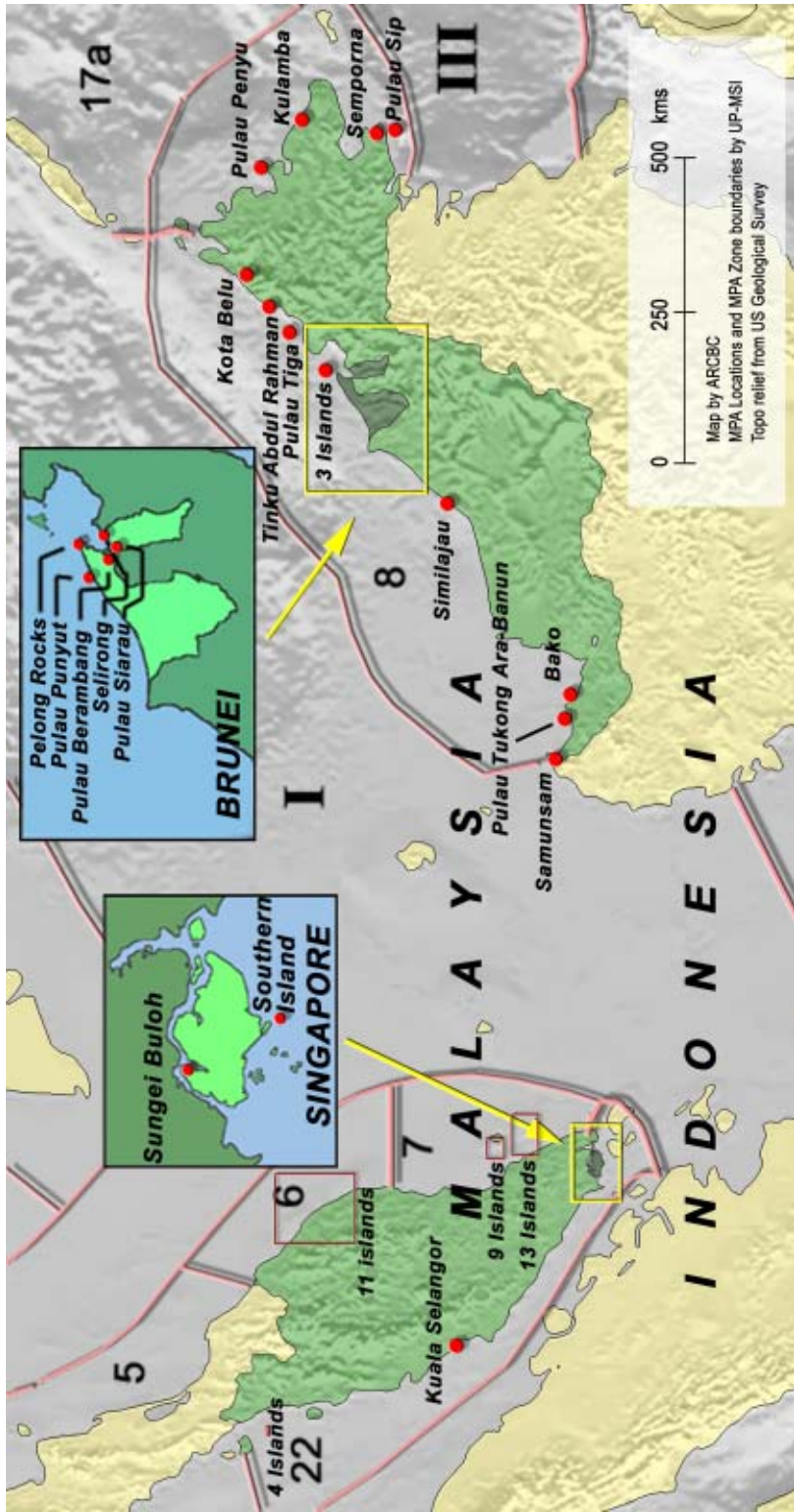
- D. Quickly select pilot sites for MPA management. Document the ecological and socio-economic outcome at these sites in detail for dissemination to the government and local communities so as to encourage follow-up activities and new MPA sites to be managed. Small and easily managed sites such as Hon Cau and Hon Mun would be suitable pilot sites.
- E. Provide training for MPA planners, managers and staff.
- F. Promote non-destructive fishing techniques and alternative livelihood programmes, especially in and around MPAs.
- G. Promote public awareness on marine conservation and sustainable resource utilization.
- H. Carry out baseline surveys and feasibility studies to less-known sites, especially non-coral reef areas, to identify sites of high conservation priorities.
- I. Promote Integrated Coastal Zone Management (ICZM) in MPA management (Tuan, *pers. comm.*).



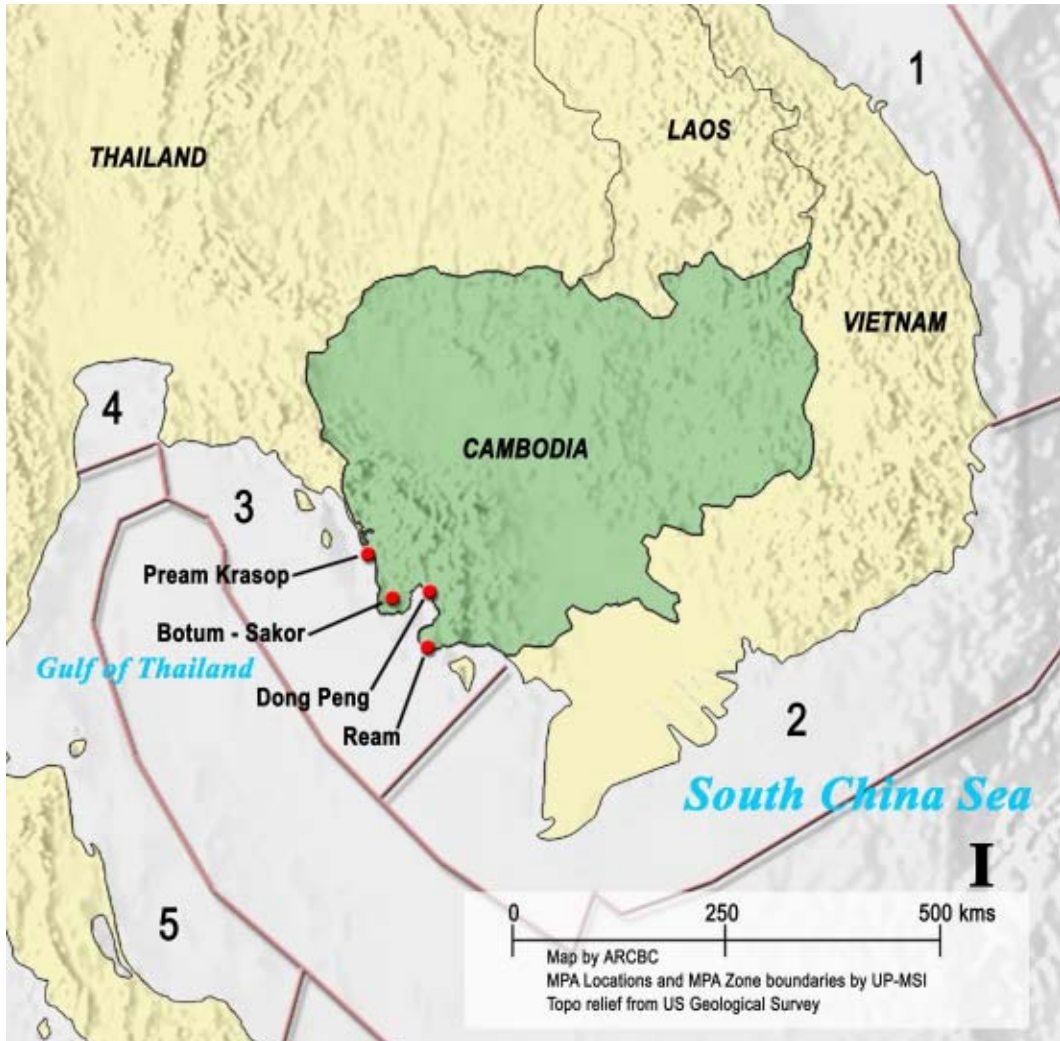
MAPS



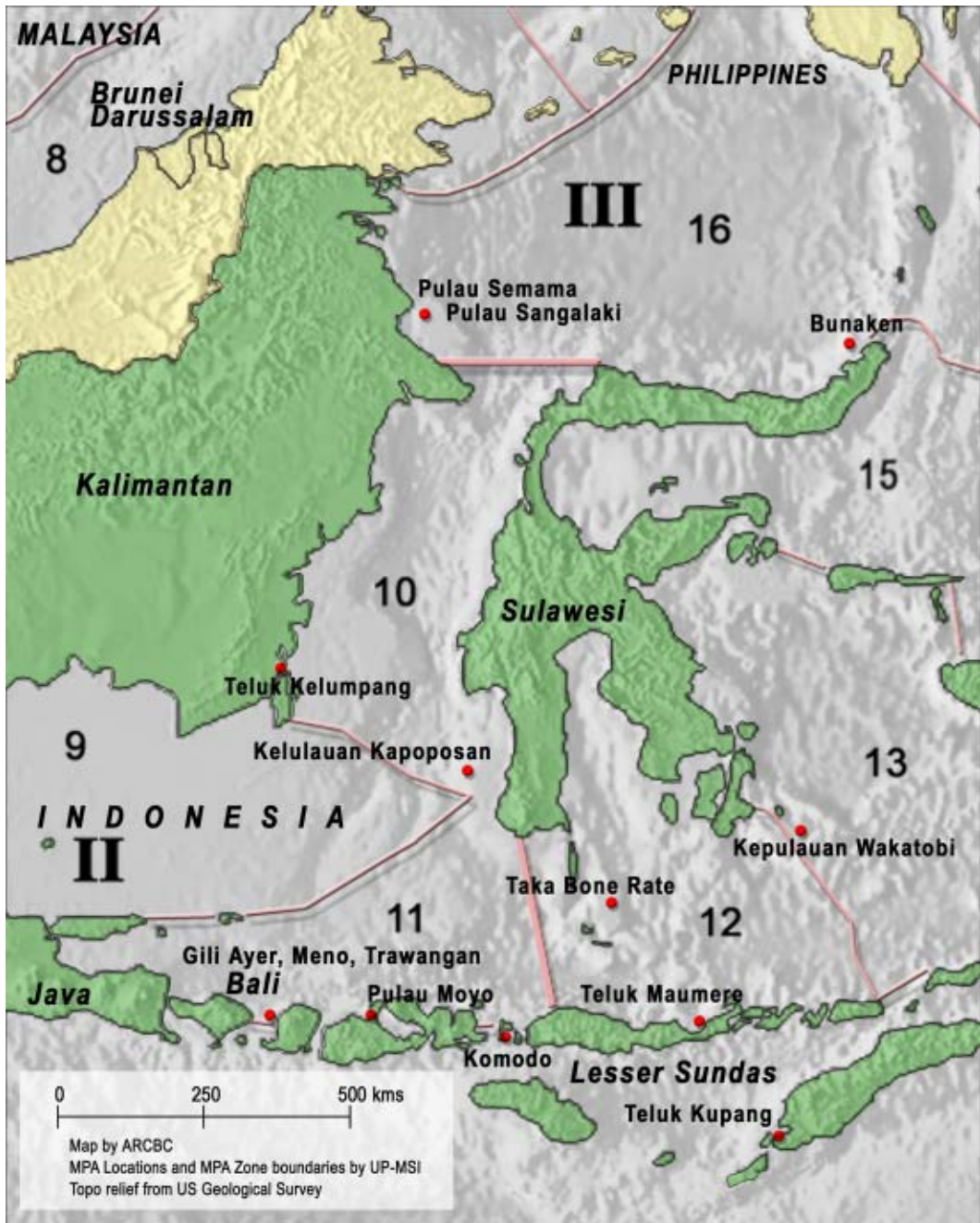
Map 1. Types of Marine Protected Areas in Southeast Asia



Map 2. Marine Protected Areas in Brunei Darussalam; Malaysia and Singapore



Map 3. Marine Protected Areas in Cambodia.



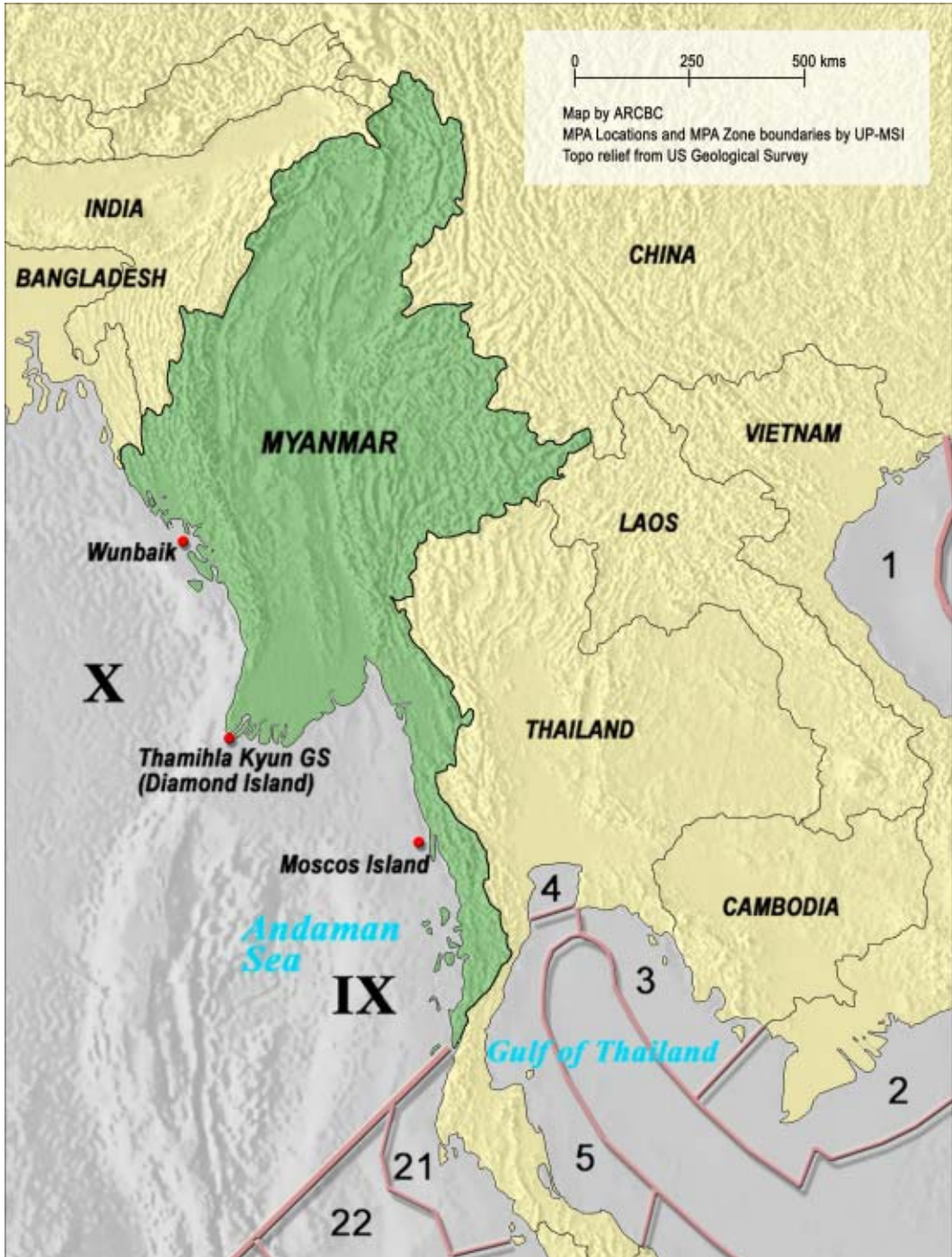
Map 4. Marine Protected Areas in Central Indonesia



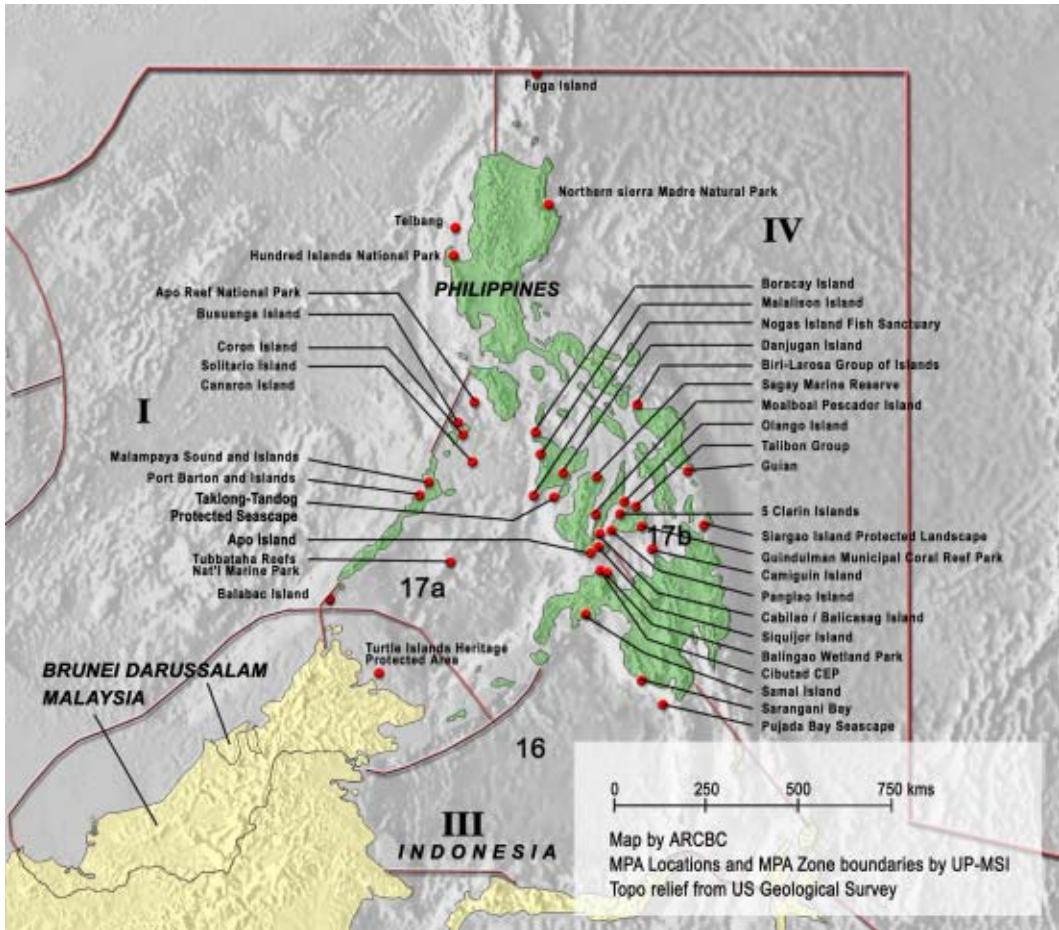
Map 5. Marine Protected Areas in Western Indonesia.



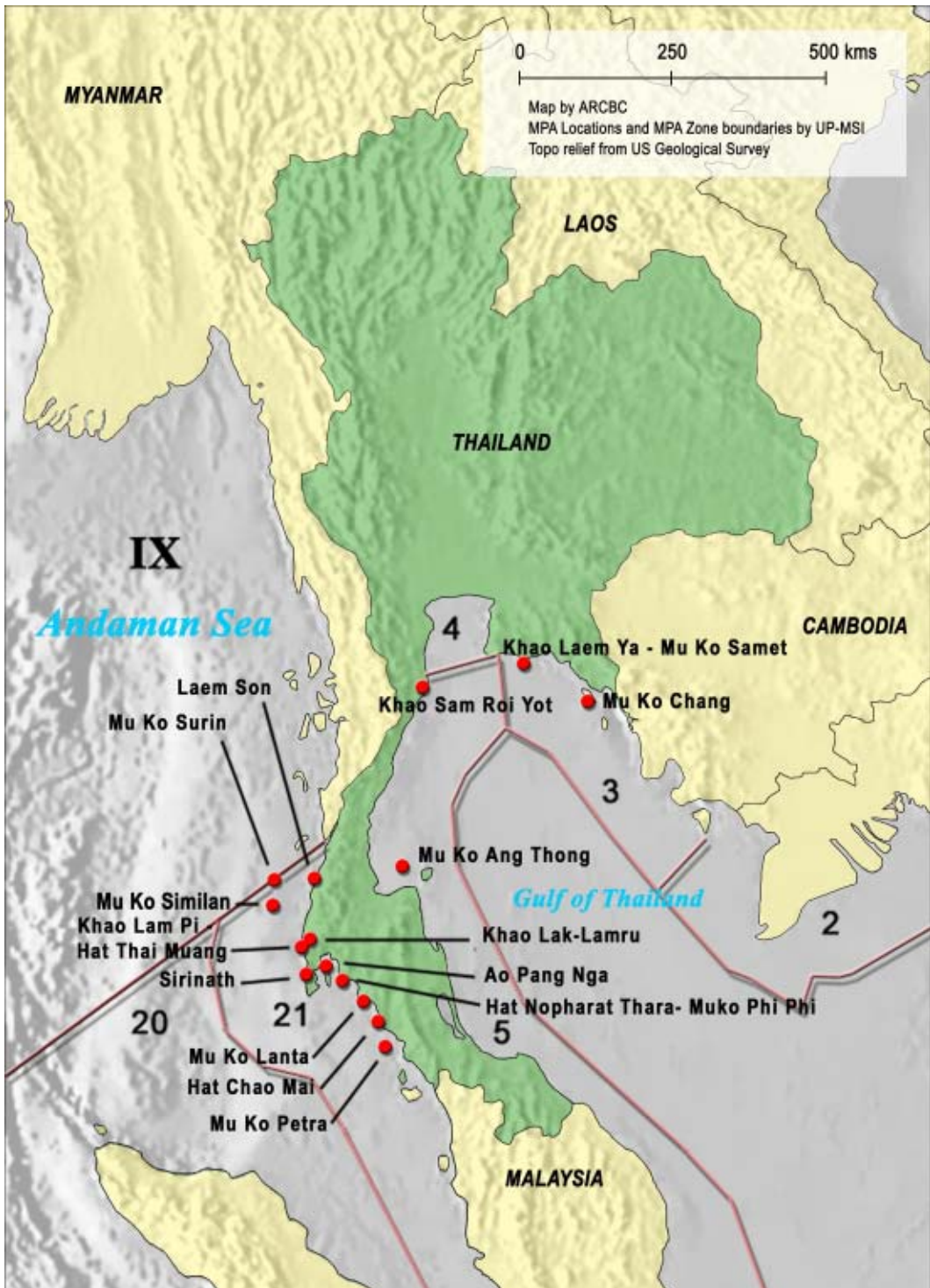
Map 6. Marine Protected Areas in Eastern Indonesia.



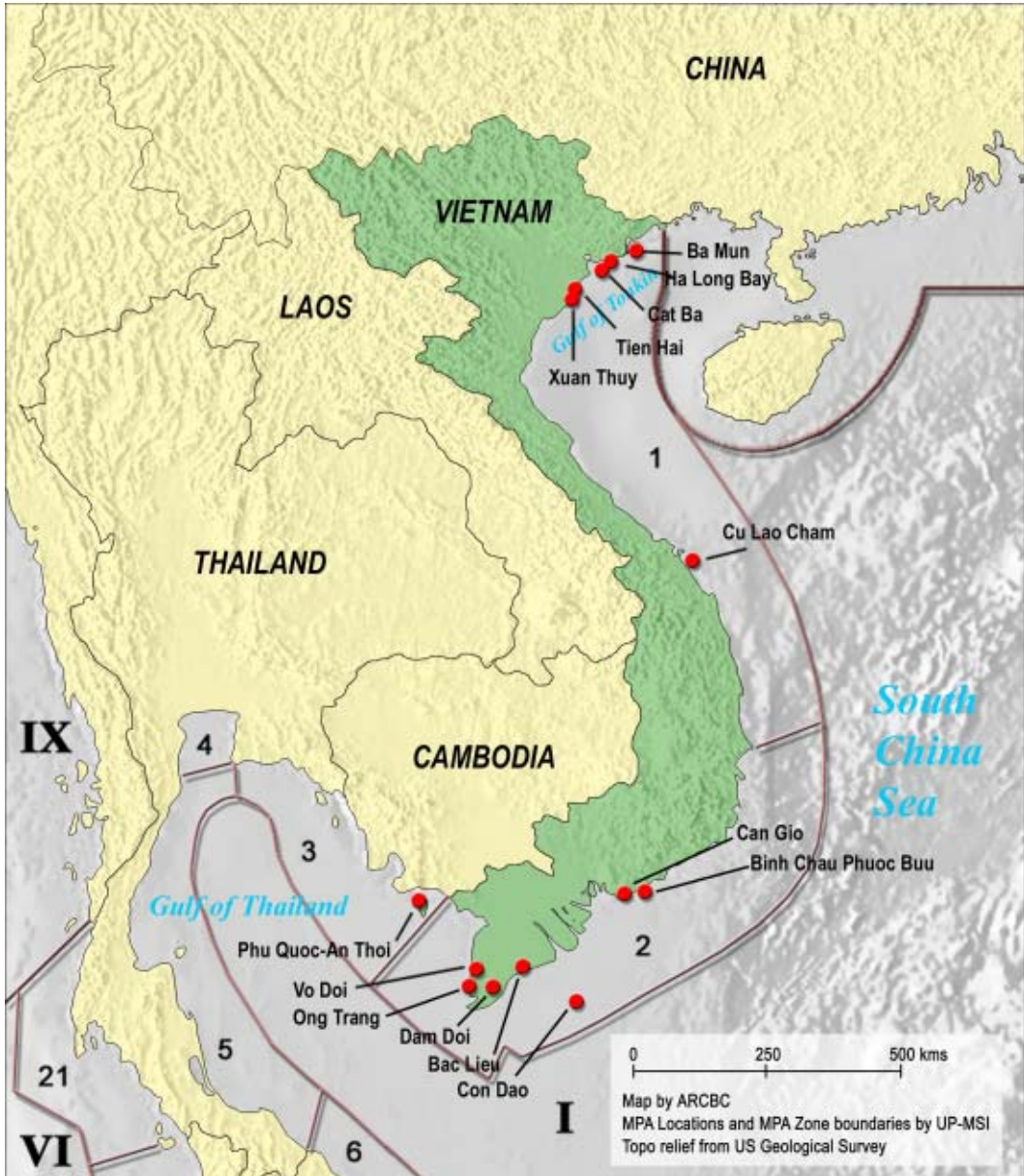
Map 7. Marine Protected Areas in Myanmar.



Map 8. Marine Protected Areas in the Philippines.



Map 9. Marine Protected Areas in Thailand.



Map 10. Marine Protected Areas in Vietnam.

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REFERENCES

- Abdullah, A. and M. Hutomo**, 1995. Indonesian Marine Conservation Areas - Status, Problem and Development. *In*. Proc. of Third Regional Workshop for the Review of the Protected Areas of the IndoMalayan Realm, 23-25 Jan. 1995, Cisarua, Bogor, Indonesia. Asian Bureau for Conservation, Hong Kong and PHPA-Directorate of Forest Protection and Nature Conservation, Indonesia.: 17pp.
- Abesamis, R.A., P.M. Aliño and D.G. Jocson**, (*in press*). From Muro-ami to Pa-aling: More than just a Question of Destructive Fishing. *Mar. Poll. Bull.*
- Abu Talib, A. and M. Alias**, 1997. Status of Fisheries in Malaysia – An Overview. *In*: Silvestre G, Pauly D. Status and Management of Tropical Coastal Fisheries in Asia. ICLARM Conf. Proc. 53: 47-61.
- Agardy and Pernetta**, 1993. Papua New Guinea Conservation Needs Assessment Report. Biodiversity Support Program, and Department of Conservation and Environment of Papua New Guinea
- Agenda 21**, (*undated*). Natural Resource Aspects of Sustainable Development in Thailand
- Aikanathan, S. and E.F.H. Wong**, 1994. Marine Park Island Management Conceptual Plan for Peninsular Malaysia. Report produced under Project MYS 256/93 by the Department of Fisheries, Malaysia and the World Wide Fund For Nature (WWF)-Malaysia, sponsored by Canada Fund-Malaysia. 136 pp.
- Alcala, A.C.** 1988. Effects of Marine Reserves on Coral Fish Abundances and Yields of Philippine Coral Reefs. *Ambio* vol. 17 no.3., pp. 194-199.
- Alcala, A.C. and G.R. Russ**, 1990. A Direct Test of the Effects of Protective Management on Abundance and Yield of Tropical Marine Resources. *J. Cons. int. Explor. Mer.* Vol.46: 40-47.
- Aliño, P.M.**, 1984. The Effect of Mine Tailings on the Structure of Coral Communities at Toledo, Cebu. *In*. Koh, L.L. and C.S.Hew (eds) 1984. Proc. 3rd Symposium on Our Environment. National University of Singapore.: 281-292.
- Aliño, P.M., H.O. Arceo, N. Palomar and A.J. Uychiaoco**, 2000. Challenges and Opportunities for Community Participation for the Management of Marine Protected Areas (MPAs) in the Philippines. Paper presented at the 9th International Coral Reef Symposium, Bali, Indonesia, 23-27 October 2000.
- Aliño, P.M. and A.J. Meñez**, 1999. Cooperative monitoring and evaluation in the South China Sea: An opportunity for adaptive management of biodiversity. Paper presented at the 4th International Conference on the Biology of the South China Sea, Diliman, Quezon City, Philippines, 20-22 October 1999, p.2.4.
- Aliño, P.M., A.J. Uychiaoco, N.A. Bermas and E.D. Gomez**, 1992. Assemblage Structure of Coral Reef Fish: Multi-scale Correlations with Environmental Variables. *In* Chou, L.M. & C.R. Wilkinson (eds). Third ASEAN Science and Technology Week Conf. Proc. Vol.6, Marine Science: Living Coastal Resources, 21-23 September 1992, Singapore. Dept. of Zoology, National University of Singapore & National Science & Technology Board, Singapore, pp 119-124.
- Aliño, P. M, A.J. Uychiaoco, and R. T. Campos**, (*undated*). The Relevance of Philippine Coral Reef Community Ecological Research to Coastal Zone and Resource Management Issues and Challenges. (*Unpublished*). Paper presented at the 1st National Symposium-Workshop on Coral Reef Resources Management and Conservation, Olongapo, Philippines.
- Allison, W.R.**, 1995. Changes in the Maldivian Reef System. *Coastal Management in Tropical Asia*. No.4, March 95, Colombo, Sri Lanka:6-8.

Andau, P.M., D.L.A. Alisaputra, J. Payne and J.B. Sale, 1993. Marine Protected Areas in Sabah, Malaysia. *In* Report of the EAS 25 Workshop: Case Studies on Marine Protected Areas in the East Asian Seas & The Workshop on a Global Representative System of Marine Protected Areas in the Southeast Asian Region, 8-12 Feb. 93, Penang, Malaysia. UNEP-COBSEA/MOSTE/DOF and IUCN/World Bank/GBRMPA.: 106-115.

Anderson, R.C. and Hudha Ahmed, 1993. The Shark Fisheries of the Maldives. Ministry of Fisheries and Agriculture, Republic of Maldives, and Food and Agriculture Organization of UN. 76pp.

Arceo, H.O., M.C. Quibilan, P.M. Aliño, G. Lim and W.Y. Licuanan, 2002. Coral Bleaching in Philippine Reefs: Coincident Evidences with Mesoscale Thermal Anomalies (Bull. MarSci 69 (2): 579-594

Arceo, H.O., M.C. Quibilan and P.M. Aliño, 2000. Patterns of Recovery of Bleached Reefs in the Philippines: The Importance of Management Strategies. (abstract). *In*: Proceedings of the 9th International Coral Reef Symposium, Bali, Indonesia. 23-27 Oct. 2000. D. Hopely and P.M. Hopely, J. Tamelander and T. Done. p.261.

Asian Development Bank (ADB), 1995, cited in GOI, 1997 but exact citation is not available

Asian Development Bank, 2000. Coastal and Marine Environment Management in the South China Sea (East Sea), Phase 2. Viet Nam Coastal and Marine Protected Areas Plan.

Bagarinao, T.U., 1984. The Natural Life History of Milkfish. SEAFDEC Asian Aquaculture Publication. Southeast Asian Fisheries Development Center, Tigbauan, Iloilo. 8(3):3-6.

Baldwin, M.F. (Ed.), 1991. Natural Resources of Sri Lanka - Conditions and Trends. A report prepared for the Natural Resources, Energy and Science Authority of Sri Lanka.: 280 pp.

Baling, N., 1995. Philippine Marine Protected Area Management. *In*: Proc. of the 3rd Regional Workshop for the Review of the Protected Areas of the IndoMalayan Realm, 23-25 Jan 95, Cisarua, Bogor, Indonesia. Asian Bureau for Conservation, Hong Kong, and PHPA— Directorate of Forest Protection and Nature Conservation, Indonesia.

Basintal, P. and M. Lakim, 1993. Population Status and Management of Sea Turtles at the Sabah Turtle Island Park. *In*: Proc. of 1st ASEAN Symposium-Workshop on Marine Turtle Conservation, Manila, Philippines, 1993. WWF and USAID in cooperation with PCP-PAWB-DENR Pawikan Conservation WB-DENR (Pawikan Conservation Project- Protected Areas & Wildlife Bureau) & Marine Turtle Foundation, Inc. (.MTF). pp 139-146.

Best, M.B., R.H. Djohani, A. Noor and G. Reksodihardjo, 1992. Coastal Marine Management Programs in Indonesia: Components for Effective Marine Conservation. *In* Proc. of 7th International Coral Reef Symposium, Guam, 1992, Vol.2.: 1001-1006.

Biodiversity Action Plan Planning Committee, 1994. Biodiversity Action Plan for Vietnam (Draft). 210 pp.

Bleakley, C. and S. Wells (eds.), 1995. East Asian Seas. *In*: Kelleher G, Bleakley C, Wells S (eds.). A Global Representative System of Marine Protected Areas, Vol. III. World Bank, Washington, DC, USA

Burke, L., E. Selig and M. Spalding, 2002. Reefs at Risk in Southeast Asia. World Resources Institute, Washington D.C., U.S.A. 72pp.

Bohnsack, J.A. 1994. Marine Reserves: They Enhance Fisheries, Reduce Conflicts and Protect Resources. Naga, ICLARM Q. 17 (3): 4-7.

Brown, B.E. and Suharsono, 1990. Damage and Recovery of Coral Reefs Affected by El Nino- related Seawater Warming in the Thousand Islands, Indonesia. *Coral Reefs* 8:163-170.

Bryant D, L. Burke, J. McManus and M. Spalding, 1998. Reefs at Risk. A Map-based Indicator of Threats to the World's Coral Reefs. World Resources Institute, Washington D.C., U.S.A. 56pp.

Cabanban, A.S. and A.C.Alcala, 1992. The Status of Coral Reef Resource Systems and Current Research Needs in the Philippines. *In: Munro, J.L. and P.E. Munro (Eds). The Management of Coral Reef Resource Systems. ICLARM Conference Proc. 344. ICLARM, Philippines.: 16-18.*

Carpenter, Richard A. & J.E. Maragos, 1989. How to Assess Environmental Impacts on Tropical Islands and Coastal Areas - South Pacific Regional Environment Programme (SPREP) Training Manual. Sponsored by Asian Development Bank, prepared by Environment and Policy Institute, East-West Center: 345pp.

Castañeda, P.G. and R.I. Miclat, 1981. The Municipal Coral Reef Park in the Philippines. *Proc 4th Int. Coral Reef Symp.*, 1:283-285.

CCD - Coastal Conservation Department, 1990. Coastal Zone Management Plan. CCD and Coastal Resources Management Project of the University of Rhode Island, Colombo, Sri Lanka.: 80pp.

Chan, H.T., J.E. Ong, W.K. Gong and A.Sasekumar, 1993. The Socio-Economic, Ecological and Environmental Values of Mangrove Ecosystems in Malaysia and their Present State of Conservation. *In: The Economic and Environmental Values of Mangrove Forests and their Present State of Conservation in the South-East Asia/Pacific Region. Clough, B. (Ed.). Mangrove Ecosystems Technical Reports. International Society for Mangrove Ecosystems, Okinawa, Japan.pp.41-81.*

Chansang, H. 2000. Coral Reef Management in Thailand. Presented presented at the 9th International Coral Reef Symposium, Bali, Indonesia, Oct. 23-27, 2000.

Chansang, H. 1988. Coastal Tin Mining and Marine Pollution in Thailand. *Ambio* 17(3):223-228.

Chansang, H. and N. Phongsuan, 1994. Health of Fringing Reefs of Asia through a Decade of Change: A Case History from Phuket Island, Thailand. *In: Ginsbury, R.N. (compiler) 1993. Proc. Colloquium on the Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosenstiel School of Marine and Atmospheric Science, University of Miami. pp 286-292.*

Chansang, H. and S. Poovachiranon, 1992. Distribution of Seagrass Beds in the Andaman Sea. *In: Chou,L.M. and C.Wilkinson (eds), 1992. Third ASEAN Science and Technology Week Conf. Proc., Vol.6, Marine Science: Living Coastal Resources, 21-23 Sept 92, Singapore. Dept of Zoology, National University of Singapore and National Science and Technology Board, Singapore. pp 277-280.*

Cheng, H.K. 1994. The Economics of Conservation in Perak: Integrating Environmental Economics Analysis into Resource Use and Planning - A Series of Four Case Studies. WWF Malaysia Project Report, August 1994.

Cheung, C. 1995. Review of the Protected Area System of the Indo-Malayan Realm. Asia Bureau for Conservation, Hong Kong.

Chou, L.M. 1995. Efforts to Conserve Singapore's Marine and Coastal Ecosystems. Regional Seminar on Conservation of Marine and Coastal Ecosystems, 16-17 March 1995, Kuala Lumpur. Malaysian Institute of Maritime Affairs.

Chou, L.M., M.W.R.N De Silva and A. T. White, 1992. Coral Reefs, Algae and Seagrasses. *In: Chua TE, Chou LM, Sadorra MSM (eds.) Coastal Environment Profile of Brunei Darussalam: resource assessment and management issues. ICLARM Tech. Rep. 18. 193 pp.*

- Chou, L.M. and B.P.L. Goh**, 1998. Singapore Coral Reefs – Balancing Development and Conservation. *In*: Morton, B. (ed). The Marine Biology of the South China Sea, Proceedings of the Third International Conference on the Biology of the South China Sea, 28 Oct. – 1 Nov. 1996, Hong Kong, Hong Kong University Press, pp.355-368.
- Choudhury, B.C., C.S. Kar and Bivash Pandav**, 1994. A Status Survey of Olive Ridley Sea Turtle (*Lepidochelys olivacea*) and its Nesting Habitats along the Orissa Coast, India. Wildlife Institute of India.: 30pp.
- Chua, T.E.** 1997. Marine Pollution Prevention and Management in the East Asian Seas: A Paradigm Shift in Concept, Approach and Methodology. (Cited in Philippines TDA-SAP)
- Chua, T.E., L.M. Chou and M.S.M. Sadorra**, 1987. Coastal Environment Profile of Brunei Darussalam: Resource Assessment and Management Issues. ICLARM Tech. Rep. 18. 193 pp.
- Chua, T.E., M.A.A. Agulto, F.Y. Guarin and S.C. Guerrero**, 1989. Directory of Institutions and Scientists in the ASEAN Region Involved in Research and/or Management related to Coastal Areas. 378pp. International Center for Living Aquatic Resources Management, Manila, Philippines: 373.
- Clarke, J.E.** 1999. Biodiversity and Protected Areas. Regional Environmental Technical Assistance 5771: Poverty Reduction & Environmental Management in Remote Greater Mekong Subregion (GMS) Watersheds Project (Phase I).
- Clark, J.R.**, 1994. Report of Consultant on Coastal Wetlands and Coastal Zones. : 30pp.
- Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton and M. van den Belt**, 1997. The Value of the World's Ecosystem Services and Natural Capital. *Nature* 387:253-259.
- Crosby, M.P. and K.S. Geenen**, 2000. Implementation, Chapter 6. *In*: Alternative Access Management Strategies for Marine and Coastal Protected Areas. A reference manual for their development and assessment. M.P. Crosby, K.S. Geenen and R. Bohne (eds). 80-93.
- Dalzell, P. and A. Wright**, 1986. An Assessment of the Exploitation of Coral Reef Fishery Resources in Papua New Guinea. *In*: J.L. Maclean, L.B. Dizon and L.V. Hosillos (eds). The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.: 477-481.
- De Silva, M.W.R.N. and A. Rajasuriya**, 1985. Management Plans for the Proposed Marine Park at Hikkaduwa. Paper presented at the 41st Annual Session of Sri Lanka Association for Advancement of Science, 9-13 December, Colombo. :
- Ditlev, H., M.W. Ranjith De Silva, A.R. Ridzwan, D. Toerring and S. Widt**, 1999. Hard Corals of Darvel Bay. pp. 73-84. *In*: De Silva, M.W.R., R.A. Rahman, S. Mustafa and A.S. Cabanban (eds.). Ekspedisi Galaxea '98: A study of living marine resources of Darvel Bay, Sabah, Malaysia. Kota Kinabalu: Bizrank Sdn. Bhd. 116 pp.
- Djohani, R.** 2002. Protected Areas in the 21st Century: Strengthening a network of protected areas in Indonesia. *In*: Tsai H-M (Ed.) Proceedings of the Fourth Conference on the Protected Areas of East Asia: Benefits Beyond Boundaries in East Asia. Taiwan Organizing Committee for the Fourth Conference of the Protected Areas of East Asia, Taipei, Taiwan.
- DOF-Malaysia** (undated). Marine Parks of Malaysia. Department of Fisheries Malaysia, Ministry of Agriculture, Kuala Lumpur, Malaysia.
- DOF-MIPR** (Department of Fisheries-Ministry of Industry and Primary Resources), 1992. Integrated Management Plan for the Coastal Zone of Brunei Darussalam. ICLARM Tech. Rep. 29. 122 pp.

Dolar , M.L.L., W.F. Perrin, A.A. Yaptinchay, S.A. Jaaman, M.D. Santos, M.N. Alava and M.S. Suliansa, 1997. Preliminary Investigation of Marine Mammal Distribution, Abundance and Interactions with Humans in the Southern Sulu Sea. *Asian Mar Biol* 14:61-81.

Doug, T. 1993. Vanishing coral reefs - Plundering threatens Tioman and other Asian tourist centres. *Far Eastern Economic Review*, 7 Jan 1993. pp 24-25.

EMDI (Environmental Management and Development in Indonesia) Project, 1994. Taka Bone Rate National Park Management Plan Draft (1994- 2019) Vol.1 Management Plan. EMDI in collaboration with Ministry of Forestry & Ministry of State for Environmentm & WWF-Indonesia Prog. 81 pp.

Environment Planning and Coordination Section, 1994. Fisheries Statistics 1989-1993. Ministry of Fisheries and Agriculture, Male, Republic of Maldives.: 23pp.

EPU-GOM (Economic Planning Unit-Government of Malaysia), 1997. Implementation of Agenda 21 : Review of Progress Made Since the United Nations Conference on Environment and Development, 1992. Malaysia Country Report. URL <http://www.un.org/esa/agenda21/natinfo>

Erftemeijer, P.L.A. and G.R.Allen, 1993. Fish Fauna of Seagrass Beds in South Sulawesi, Indonesia. *Rec.West.Aus.Mus.* 16(2): 269-277.

Fattah, Q. A., 1979. Protection of Marine Environment and Related Ecosystems of St.Martin's Island. Proc.. National Seminar Protection Marine Environment Rel. Ecosystems, Dhaka 27-29 November.: 104-108.

Fortes, M.D.1995. Seagrasses of East Asia: Environmental and Management Perspectives. RCU/EAS Technical Report Series No. 6. UNEP, Bangkok, Thailand.

Fortes, M.D.1994. Philippine Seagrasses: Status and Perspectives. *In: Wilkinson, C.R., S. Sudara and L.M. Chou (eds.)*. Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources Vol. 1, Australian Institute of Marine Science, Townsville, Australia.

Fortes, M.D. 1990. Seagrasses: A Resource Unknown in the ASEAN Region. ICLARM Education Series 5. International Center for Living Aquatic Resources Management, Manila, Philippines. 46pp.

Ginsburg, Robert N. (Compiler), 1994. Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami.: 420pp.

GOBD,1997. Government of Brunei Darussalam's Agenda 21 Report Update. updated Dec. 1998.

GOI, 1997.(Government of Indonesia). Implementation of Agenda 21: Review of Progress Made Since the United Nations Conference on Environment and Development, 1992. Indonesia Country Report. URL <http://www.un.org/esa/agenda21/natinfo/countr/indonesa/natur.htm>

Ginsburg, Robert N. (Compiler), 1994. Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami.: 420pp.

Gomez, E.D., P.M. Aliño, H.T.Yap and W.Y.Licuanan, 1994. A Review of the Status of Philippine Reefs. *Marine Pollution Bulletin*, Vol.29, Nos 1-3: 62-68.

Gomez, E.D., P.M.Aliño, W.Y.Licuanan, and H.T. Yap, 1994. Status Report on Coral Reefs of the Philippines 1994. *In: Wilkinson CR, Sudara S, Chou LM (eds.)* Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources Vol. 1, Australian Institute of Marine Science, Townsville, Australia.

Gomez, E.D., A.C. Alcalá, and A.C. San Diego, 1982. Status of Philippines Coral Reefs. *In: Gomez ED (ed.) Proc. 4th Intl. Coral Reef Symposium, Manila, 1981.* 1:275-285.

- Gomez, E.D, R.T. Biña and C.A. Rodriguez**, 1984. Marine Parks in ASEAN Countries. In: Proc First Asian Forestry Congress, Book III, 6:811-820.
- Government of the Socialist Republic of Vietnam and Global Environment Facility**, 1995. Biodiversity Action Plan of Vietnam. Ha Noi. VIE/91/g31.
- Grandperrin, R.** 1978. Importance of Reefs to Ocean Production. In: Crossland J, Granperrin R. South Pacific Commission (Noumea, New Caledonia) Fisheries Newsletter 16:11-13.
- Groombridge, B.** (ed.). 1993. 1994 Red List of Threatened Animals. IUCN, Gland, Switzerland and Cambridge, U.K.
- Hayden, B.P, G.C.Ray and R. Dolan**, 1984. Classification of Coastal and Marine Environments. Environmental Conservation 11 (3):199-207.
- Hiew, W.P.** 1995. Marine Protected Areas in Malaysia. In: Proc. of 3rd Regional Workshop for the Review of the Protected Areas of the IndoMalayan Realm, 23-25 Jan 95, Cisarua, Bogor, Indonesia. Asian Bureau for Conservation, Hong Kong, and PHPA - Directorate of Forest Protection and Nature Conservation, Indonesia.:
- Hitipeuw, C., C. Raymakers, V.S. Ruhunlela, K.S. Putra, J.Lefmanut and M.van der Wal**, 1994. Awareness and Education Programme for a Community Based Management of the Marine Resources in Southeast Aru Strict Nature Reserve. A Collaboration between PSL/EPM, Yayasan HUALOPU and PHPA/WWF. 21 pp +.
- Hodgson, G.** 1992. An Alternative to Paper Parks. In: Yap Son Kheong & Lee S.W. (Eds) 1992. Proceedings of the International Conference - "In Harmony with Nature", 12-16 June 1990, Kuala Lumpur, Malaysia. : 158-165.
- Hodgson, G. and J.A. Dixon**, 1992. Sedimentation Damage to Marine Resources: Environmental and Economic Analysis. In: Marsh, J.B. (Ed.) Resources and Environment in Asia's Marine Sector. Taylor and Francis, Bristol, PA, USA. 488pp.: 421-445.
- Hodgson, G. and J.A.Dixon**, 1988. Logging Versus Fisheries and Tourism: Environmental and Economic Dimensions. Occasional Paper 7. Environmental and Policy Institute, East-West Center, Honolulu, Hawaii, USA. : 95pp.
- Hopley, D. and Suharsono** (eds.), 2000. The Status of Coral Reefs in Eastern Indonesia. Australian Institute of Marine Science, Townsville, Australia.
- Huber, M.E.,** 1994. An Assessment of the Status of the Coral Reefs of Papua New Guinea. Marine Pollution Bulletin, Vol.29, Nos.1-3: 69-73.
- Husar, S.L.** 1978. Mammalian Species. *Dugong dugon*. Am Soc Mammalogists 88: 1-7.
- Hutomo, M., H.Uktolseya, N.A.Sloan, A.Abdullah, R.H.Djohani, J.Alder, M.H.Halim and Sutardjo**, 1993. Marine Conservation Areas in Indonesia: Two Case Studies of Kepulauan Seribu, Java and Bunaken, Sulawesi. Paper presented at the UNEP-COBSEA/MOSTE Workshop EAS25: Case studies in planning and management of marine protected areas/parks/ reserves, Penang, Malaysia, Feb 1993. 24pp.
- ICRI**, 1997. Report of the International Coral Reef Initiative (ICRI). Second Regional Workshop for the East Asian Seas held in Okinawa. Environmental Agency, Government of Japan, Tokyo, March 1997.
- IIED/GOI**, 1985. A Review of Policies Affecting the Sustainable Development of Forest Lands in Indonesia. Vol. III. Background paper. International Institute for Environment and Development/Government of Indonesia, Jakarta. 142 pp.
- IUCN**, 1988. 1988 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland and Cambridge, U.K.: 154 pp.

IUCN, 1991. IUCN Directory of Protected Areas in Oceania. Prepared by the World Conservation Monitoring Centre. IUCN, Gland, Switzerland and Cambridge, UK.: 447pp.

IUCN, 1994. Guidelines for Protected Area Management Categories. CNPPA with assistance of WCMC. IUCN, Gland, Switzerland and Cambridge, UK.: 261pp+.

IUCN/WCMC, 1992. Protected Areas of the World: A Review of National Systems. Volume 1: Indomalaya, Oceania, Australia and Antarctic. Prepared by the World Conservation Monitoring Centre (WCMC). IUCN, Gland, Switzerland and Cambridge, UK. xx+352pp.

Jacinto, G.S., P.M. Aliño, C.L. Villanoy, L.Talau-McManus and E.D. Gomez, 2000. The Philippines. *In*: Sheppard CRC. Seas at the Millenium: An Environmental Evaluation. Volume II Regional Chapters: The Indian Ocean to the Pacific. Pergamon Press (Elsevier).

Jackson, J. (Consultant), 1997. Top Dive Sites of the World. New Holland of (Publishers) Ltd., Singapore.

Japar, S.B. 1994. Status of Seagrass Resources in Malaysia. *In*: Wilkinson, C.R, S. Sudara and L.M. Chou (eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources Vol. 1, Australian Institute of Marine Science, Townsville, Australia.

Kelleher, G. 1999. Guidelines for Marine Protected Areas. IUCN, Gland, Switzerland and Cambridge, UK. xxiv+107pp.

Kelleher, G., C. Bleakley and S. Wells (eds), 1995. A Global Representative System of Marine Protected Areas. Great Barrier Reef Marine Park Authority, The World Bank and The World Conservation Union, Washington, D.C., USA, Volume 3, 147pp.

Kelleher, G. and R. Kenchington, 1992. Guidelines for Establishing Marine Protected Areas. A Marine Conservation and Development Report. IUCN, Gland, Switzerland. vii + 79pp.

Kenchington, Richard A., 1990. Managing Marine Environments. Taylor & Francis Pub.: 248pp.

Khan, M.A.R., 1985. St.Martins - A Vanishing Coral Island of Bangladesh. Tigerpaper 12(4): 6-12.

Khan, M.A.R., 1986. Wildlife in Bangladesh Mangrove Ecosystem. J.Bomb.Bat.Hist.Soc. 83(1): 32-48.

Kiswara, W. 1994. A Review: Seagrass Ecosystem Studies in Indonesian Waters. *In*: Wilkinson, C.R., S. Sudara, L.M. Chou (eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources Vol. 1, Australian Institute of Marine Science, Townsville, Australia.

Kiswara, W. 1992. Community Structure and Biomass Distribution of Seagrasses at Banten Bay, West Java, Indonesia. *In* Chou, L.M. and C.R. Wilkinson (eds), 1992. Third ASEAN Science and Technology Week Conference Proceedings, Vol. 6, Marine Science: Living Coastal Resources, September 1992. Dept. of Zoology, National University of Singapore and National Science & Technology Board. pp.241-250.

Kwapena, N., 1995. Papua New Guinea Status Report on Marine and Coastal Zone Management and Protected Areas. *In*: Proceedings of the Review of the Protected Areas System of the IndoMalayan Realm Regional Workshop, 23-25 Jan 95, Indonesia. Asian Bureau for Conservation and Conservation and PHPA-Directorate for Forest Protection and Nature Conservation, Indonesia.: 9pp.

Latin, Howard, 1994. Why Conservation By Legal Fiat Does Not Work? *In*: Ginsbury, Robert N. (Compiler), 1994, Proc. of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami: 113-119.

- Low, J., A. Arshad and K.H. Lim**, 1994. ASEAN Mangroves as Important Centers of Biodiversity and Habitats for Endangered Species. *In: Living Coastal Resources of Southeast Asia: Status and Management*. Report on the Consultative Forum, Bangkok, Thailand. Wilkinson, C.R. (ed.). May 1994. pp. 71-76.
- MacKinnon, J.** (ed.), 1997. Protected Areas Systems Review of the Indo-Malayan Realm. Asian Bureau for Conservation Ltd., Hong Kong, China and World Conservation Monitoring Center, Canterbury, United Kingdom. 198 pp.
- McManus, J.W.** 1985. Marine Speciation, Tectonics and Sea Level Changes in Southeast Asia. *Proc 5th Int. Coral Reef Cong* 4:133-138.
- McManus, J.W.**, 1994. The Spratly Islands: A Marine Park?. *Ambio*. Vol.23, No.3.: 181-186.
- McManus, J.W., C.L. Nanola, R.B. Reyes Jr, and K.N. Kesner Jr.** 1992. Resource Ecology of the Bolinao Coral Reef System. *ICLARM Study Review* 22. ICLARM, Philippines. 117pp.
- McManus, L.T.** 2000. Transboundary Diagnostic Analysis of the South China Sea. UNEP/EAS/RCU, Bangkok. Thailand. 84pp + annex.
- McNeil, S.E.** 1994. The Selection and Design of Marine Protected Areas: Australia as a Case Study. *Biodiversity and Conservation*. 3:586-605.
- Mahmood, N. and S.M.B. Haider**, 1992. A Preliminary Study on Corals of St Martin's Island, Bangladesh. Institute of Marine Sciences University of Chittagong.:
- Marine Research Section**, 1995. Protected Marine Areas in the Maldives (Dive Sites). Ministry of Fisheries and Agriculture, Male, Republic of Maldives: 40pp.
- Mee, J.K.L.**, 1993. An Overview of the Ornamental Aquatics Sector in Sri Lanka. The Agro-Enterprise Development Project, Colombo, Sri Lanka. *AgEnt* 08-93; *AgEnt* Consultant Report No.01.: 50pp.
- Mendoza-Robertson, D. and O.T. Giba**, 1994. Resource Development and Economic Growth in Papua New Guinea. *East Asian Executive Reports*: 6-24.
- Miclat, R.I., P.M. Aliño, N. Aragonés, C. Nañola Jr, and E. Aguilar**, 1991. *Pa-aling: An Alternative to Muro-ami?* *Philippine Journal of Fisheries*. 22:29-38.
- Ministry of Fisheries (Vietnam)**, 2000. Draft Plan to Develop the National System of Marine Protected Areas.
- Ministry of National Development Planning/National Development Planning Agency**, 1993. Biodiversity Action Plan for Indonesia. Ministry of National Development Planning/National Development Planning Agency, Jakarta. 141 pp.
- Ministry of Science, Technology and Environment**, 1992. Red Data Book of Vietnam. Volume 1. Animals. Science and Technics Publishing House.: pp.396.
- Ministry of Fisheries (Vietnam)**, 2000. Draft Plan to Develop the National System of Marine Protected Areas.
- Mohd. Ibrahim Hj., Japar Sidik Bujang Mohamed and S. Aikanathan**, 1993. Development Impact on the Coral Reefs and Mangroves of Palau Redang - Palau Revisited (Data till Feb. 1993). Report produced under Project MYS 223/91. WWF Malaysia, Kuala Lumpur, Malaysia. 37 pp.
- Mohd. Ibrahim Hj, and Yusoh M. Mohamed**, 1992. Monitoring the Development Impacts on the Coastal Resources of Palau Redang Marine Park by Remote Sensing. *In: Chou, L.M. and C. Wilkinson* (eds), 1992. Third ASEAN Science and Technology Week Conference Proceedings, Vol. 6, Marine Science: Living Coastal Resources, 21-23 September 1992, Singapore. Dept. of Zoology, National University of Singapore and National Science & Technology Board, pp.407-414.

Mohamed Shiham, Adam, 1994. Report of the Preliminary Assessment of the Status of some of the Ornamental Fish Holding Facilities, July 1994. Marine Research Section, Ministry of Fisheries and Agriculture, Male, Republic of Maldives.: 15pp.

Moosa, M.K. 1995. cited in Hopley and Suharsono 2000 but exact citation is missing from their reference list.

Moosa, M.K. 1999. The Extent of Knowledge About Marine Biodiversity in Indonesia. *In: Rais, J., I.M. Dutton, L. Pantimena, J. Plouffe and R. Dahuri R (eds.) Integrated Coastal and Marine Resource Management Proc. Inter. Symp. Malang, 1998, 126-153.*

Moosa, M.K., R. Dahuri, M. Hutomo, I.S. Suwelo and S. Salim (eds.), 1996. Indonesian Country Study on Integrated Coastal and Marine Biodiversity Management. Ministry of State for Environment, Republic of Indonesia, in cooperation with Directorate for Nature Management, Kingdom of Norway: 189 pages, Annexes 166 pages.

Mortimer, J.A. 1992. Marine Turtle Conservation in Malaysia. *In: Yap Son Kheong and S.W. Lee (Eds), 1992. Proceedings of the International Conference on Tropical Biodiversity - "In Harmony with Nature", 12-16 June 1990, Kuala Lumpur, Malaysia. pp. 353-361.*

Mortimer, J.A., 1991. Recommendations for the Management of Turtle Islands Park, Sabah. Report produced under WWF Project No.3868. WWF Malaysia, Kuala Lumpur, Malaysia. March 1991.: 28pp.

Murdy, E.O. and C.J. Ferraris, 1980. The Contribution of Coral Reef Fisheries to Philippine Fisheries Production. ICLARM Newsletter No.3. Intl' Center for Living Aquatic Resources Management.: 11-21.

Nakatani, K., A.Rajasuriya, A.Peremaratne and A.T.White (Eds.), 1994. The Coastal Environmental Profile of Hikkaduwa, Sri Lanka. Coastal Resources Management Project, Colombo, Sri Lanka.: 70pp.

Nateekanjanalarp, S. and S. Sudara, 1992. Dugongs and a Plan for their Management in Thailand. *In: Chou, L.M. and C. Wilkinson (eds), 1992. Third ASEAN Science and Technology Week Conference Proceedings, Vol. 6, Marine Science: Living Coastal Resources, 21-23 September 1992, Singapore. Dept. of Zoology, National University of Singapore and National Science & Technology Board, pp. 459-462.*

Nontji, A. 2000. Coral Reefs of Indonesia: Past, Present and Future. Paper presented at the 9th International Coral Reef Symposium, Bali, Indonesia, 23-27 October 2000.

Nystrom, M., C. Folke and F. Moberg, 2000. Coral Reef Disturbance and Resilience in a Human-dominated Environment. *Trends in Ecology and Evolution. Vol. 15, No. 10. 413 – 417.*

ONEB - Office of National Environmental Board, 1991. A National Coral Reef Strategy for Thailand, Volume 1. Statement of Nced. Office of National Environmental Board, University of Rhode Island, and U.S. Agency for International Development. : 33pp.

Ong, P.S. 2002, Current Status and Prospects of Protected Areas in the light of the Philippine Biodiversity Conservation Priorities. *In: Tsai H-M (Ed.), Proceedings of the Fourth Conference on the Protected Areas of East Asia: Benefits Beyond Boundaries in East Asia. Taiwan Organizing Committee for the Fourth Conference of the Protected Areas of East Asia, Taipei, Taiwan.*

Ong, P.S., L.E. Afuang and R.G. Rosell-Ambal (Eds.) (2002). The Philippine Biodiversity Conservation Strategy and Action Plan. Conservation International, Manila, Philippines.

Olsen, S., D. Sadacharan, J.I. Samarakoon, A.T. White, H.J.M. Wickremeratne and M.S. Wijeratne., 1992. Coastal 2000: A Resource Management Strategy for Sri Lanka's Coastal Region, Volumes 1 and 2. Coastal Resources Management Project and CCD, Sri Lanka.: 81 + 21 pp.

Pajaro, M., F. Olano and B. San Juan, 1999. Documentation and Review of Marine Protected Areas in the Philippines – A Preliminary Report. Haribon Foundation for the Conservation of Natural Resources.

Pauly, D., and V. Christensen, 1993. Stratified Models of Large Marine Ecosystems: A General Approach and An Application to the South China Sea, pp. 148-174, *In*: K.L. Sherman, M. Alexander and B.D. Gold (eds.), Large Marine Ecosystems: Stress, Mitigation and Sustainability, Washington, D.C.: American Association for the Advancement of Science, AAAS Press, 376pp.

Pauly, D., G. Silvestre and I.R. Smith, 1989. On Development, Fisheries and Dynamite: A Brief Review of Tropical Fisheries Management. Natural Resource Modeling. 3: 307-329.

Pernetta, J.C. (ed.), 1993a. Marine Protected Area Needs in the South Asian Seas Region. Volume 5: Sri Lanka. A Marine Conservation and Development Report. IUCN, Gland, Switzerland.: 67pp.

Pernetta, J.C. (ed.), 1993d. Marine Protected Area Needs in the South Asian Seas Region. Volume 1: Bangladesh. A Marine Conservation and Development Report. IUCN, Gland, Switzerland.: 42pp.

Pernetta, J.C., 1993b. Marine Protected Area Needs in the South Asian Seas Region. Volume 2: India. A Marine Conservation and Development Report. IUCN, Gland, Switzerland.: 77pp.

Pernetta, J.C., 1993c. Marine Protected Area Needs in the South Asian Seas Region. Volume 3: Maldives. A Marine Conservation and Development Report. IUCN, Gland, Switzerland.: 38pp.

Pernetta, J. and D. Elder, 1993. Cross-Sectoral Integrated Coastal Area Planning: Guidelines and Principles for Coastal Area Development, IUCN, Switzerland.

Pet, J.S. and C. Yeager (Eds), 2000. 25-Year master Plan for Management, Komodo National Park (Book 1-3). Department of Nature Protection and Conservation, Ministry of Forestry, Jakarta. The Nature Conservancy and Komodo National Park.

PHPA, 1995. (Directorate-General of Forest Protection and Nature Conservation) cited in GOI 1997 but exact citation is not available

Prioyono, B.E. and B. Sumiono, 1997. The Marine Fisheries of Indonesia, with emphasis on the Coastal Demersal Stocks of the Sunda Shelf. *In*: Silvestre, G., and D. Pauly: Status and Management of Tropical Coastal Fisheries in Asia. ICLARM Conf. Proc. 53: 38-46.

Ramsar Convention Website. http://ramsar.org./wwd2000_index.htm

Rajasuriya, A. and M.W.R.N. de Silva, 1988. Stony Corals of Fringing Reefs of the Western, South-western and Southern Coasts of Sri Lanka. In Proceedings of the 6th International Coral Reef Symposium, Australia, Volume 3.: 287-296.

Rajasuriya, A. 1993b. Present Status of Coral Reefs in Sri Lanka. In Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards & History, 10, 11 June 1993. Compiled by R.N. Ginsburg. University of Miami and International Society for Reef Studies. *r Reef Studies.* : 410-415.

Rajasuriya, A. 1993a. Distribution of Butterflyfish (Family Chaetodontidae) on Reefs in the West Coast of Sri Lanka. Paper presented at the Annual Scientific Sessions, National Aquatic Resources Agency, Colombo, Sri Lanka.:

- Rajasuriya, A.** 1994. Three genera and twelve species of stony corals new to Sri Lanka (abs). Paper presented at the 2nd Annual Scientific Sessions of the National Aquatic Resources Agency (NARA), Colombo, Sri Lanka. :
- Rajasuriya, A.** 1995. The Present Status of Marine Protected Areas in Sri Lanka. In Proceedings of the Marine Sessions of Third Regional Workshop for the Review of the Protected Areas System of the IndoMalayan Realm, 23-25 Jan 95, Cisarua, Bogor, Indonesia. Compiled by Catherine Cheung.: 20pp.
- Rajasuriya, A. and A.T. White,** 1994. Coral Reefs of Sri Lanka: Review of their Extent, Condition and Management Status. Coastal Resources Management Project, Colombo, Sri Lanka. Working Paper No. 05/1994.: 18+.
- Reese, Ernst S.,** 1994. Reef Fishes as Indicators of Conditions on Coral Reefs. In Ginsburg, Robert N. (Compiler), 1994, Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami.: 59-65.
- Republic Act. 8550.** 1998. The Philippine Fisheries Code.
- Richards, A.** 1994. Live Reef Fish Exports to S.E. Asia from the South Pacific. South Pacific Commission Fisheries Newsletter.
- Richards, A.** 1993. Live Reef Fish Export Fisheries in Papua New Guinea: Current Status and Future Prospects. FFA Report No.93/10. Forum Fisheries Agency.: 15pp.
- Risk, Michael J., J.J.Dunn, W.R.Allison and C.Horrill,** 1994. Reef Monitoring in Maldives and Zanzibar: Low-Tech and High-Tech Science. In Ginsburg,R.N. (Compiler) 1994. Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami.: 66-72.
- Roberts, C.M., J.M. Colin, J.E.N. Veron, J.P. Hawkins, G.R. Allen, D.E. McAllister, C.G. Mittermeier, F.W. Schueller, M. Spalding, F. Wells, C. Vynne, and T.B. Werner,** 2002. Marine Biodiversity Hotspots and Conservation Priorities for Tropical Reefs. *Science* 295:1280-1284
- Roop, J., A.Bansgrove, S.England, N.N.Sinh and H.C.Thang** (eds), 1994. State of the Coastal and Marine Environment Report, Viet Nam - 1994. Prepared by ESSA Technologies Ltd., Vancouver, Canada for Vietnam-Canada Ocean Cooperation Program (VCOP) 93pp.
- Russ, G.R. and A.C. Alcalá,** 1999. Management Histories of Sumilon and Apo Marine Reserves, Philippines, and their Influence on National Marine Resource Policy. *Coral Reefs* 18:307-319.
- Sardjono, I.**1980. Trawlers Banned in Indonesia. *ICLARM Newsletter* 3(4):3.
- Satumanatpan, S. and S. Sudara,** 1992. Reef Fish Communities in the Gulf of Thailand. In: Chou, L.M. and C. Wilkinson (eds), 1992. Third ASEAN Science and Technology Week Conference Proceedings, Vol. 6, Marine Science: Living Coastal Resources, 21-23 September 1992, Singapore. Dept. of Zoology, National University of Singapore and National Science & Technology Board, pp. 145-150.
- Scott, D.A.** (Ed), 1989. A Directory of Asian Wetlands. IUCN, Gland, Switzerland and Cambridge, U.K. 1181 pp.
- Sharma, Dionysius S.K.** 1994. Management Recommendations for the Establishment of a Turtle Sanctuary at Kuala Setiu Baharu, Terengganu. WWF-Malaysia project Report (Produced under Project MYS 255/93), March 1994. 34 pp.
- SME-GOI,** 1992. Agenda 21. Indonesia Country Report. URL <http://www.un.org/esa/agenda21/natlinfo>
- Soehartono, T.** 1994. Marine Turtle Conservation in Indonesia. In: Proceedings of the First ASEAN Symposium-Workshop on Marine Turtle Conservation, Manila, Philippines, 1993. WWF and USAID in cooperation with PCP-PAWB-DENR and MTF. pp 75-86.

- Soemodihardjo, S., P. Wiroatmodjo, A. Abdullah, G.M. Tantra and A. Soegiarto**, 1993. Condition, Socio-Economic Values and Environmental Significance of Mangrove Areas. *In: The Economic and Environmental Values of Mangrove Forests and their Present State of Conservation in the South-East Asia/Pacific Region*. Clough, B. (Ed.). Mangrove Ecosystems Technical Reports . International Society for Mangrove Ecosystems, Okinawa, Japan. pp.17-40.
- Spalding, M., F. Blasco and C. Field**, 1997. World Mangrove Atlas. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.
- Spalding, M., C. Ravillious and E.P. Green**, 2001. World Atlas of Coral Reefs. University of California Press, California, USA.
- Sudara, S.** 1995. Management of Marine Protected Areas in Thailand - Striking a Balance Between Conservation and Development. Paper presented in the Regional Seminar on Conservation of Marine and Coastal Ecosystems, 16 March 1995, MIMA-Malaysian Institute of Maritime Affairs, Kuala Lumpur, Malaysia.
- Sudara, S. and S. Nateekarnchanalap**, 1988. Impact of Tourism Development on the Reef in Thailand. *In: Proc. 6th International Coral Reef Symposium, Australia, 1988* 2: 273-278.
- Sudara, S., T. Thamrongnawasawat, S. Nateekarnchanalap and P. Kuanman**, 1991. Coral Reef Management Plan for Conservation and Tourism Development in the Ang Thong, Samui and Pha Ngan Islands, in the Gulf of Thailand. *In: Proc. Regional Symposium on Living Resources in Coastal Areas, Philippines*. pp. 573-579.
- Suharsono**, 2001. Marine Protected Areas in Indonesia: Country Report. Presented at the Regional Workshop on Networking of Marine Protected Areas (Coral Reefs) in the East Asian Seas, held at the Universiti Sabah Malaysia, Kota Kinabalu, Sabah, Malaysia, 8-12 October 2001.
- Swartzendruber, J.F.**, 1993. Papua New Guinea Conservation Needs Assessment - Synopsis Report. Government of Papua New Guinea, Dept. of Conservation & Environment; Biodiversity Support Program.: 24pp.
- Talaue-McManus, L.** 2000. Transboundary Diagnostic Analysis for the South China Sea. EAS/RCU Technical Report Series No. 14. UNEP, Bangkok, Thailand.
- Tan, A.K.J.** 2000. Preliminary Assessment of ASEAN Environmental Law. Asian Pacific Center for Environmental Law, National University of Singapore, Singapore. URL <http://sunsite.nus.edu.sg/apcel/index.html>
- Tomascik, T., A.J. Mah, A.Nontji and M.K. Moosa**, 1997. The Ecology of the Indonesian Seas. Periplus, 2 vols. 1388 pp.
- UNEP**, 1986. Environmental Problems of the Marine and Coastal Area of Sri Lanka: National Report. UNEP Regional Seas Report and Studies No.74.:
- UNEP**, 1997. Integrated Management of Watersheds in Relation to Management and Conservation of Nearshore Coastal and Marine Areas in the East Asian Seas Region: Phase 1 – Assessment of effects of river discharges of sediments, nutrients and pollutants on coastal wetlands, seagrass beds and coral reefs. A regional overview. RCU/EAS Technical Reports Series No. 13. UNEP, Bangkok, Thailand
- UNEP**, 2000. Report on the Workshop of Coral Reef Monitoring and Data Acquisition, Phuket, Thailand, 9-11 May, 2000. EAS/RCU, UNEP, Bangkok, Thailand (32 pages)
- UNEP/IUCN**, 1988. Coral Reefs of the World. UNEP Regional Seas Directories and Bibliographies. IUCN, Gland, Switzerland and Cambridge, U.K./UNEP, Nairobi, Kenya. Volumes 1-3
- UNEP: Chia, L.S. and H. Kirkman**, 2000. Overview of Land-Based Sources and Activities Affecting the Marine Environment in the East Asian Seas. UNEP/GPA Coordination Office & EAS/RCU (2000) Regional Seas Report and Studies Series. 74pp.

- Uychiaoco, A.J., P.M. Aliño and A.T. White**, 2002. Marine Protected Areas in the Philippines: Towards Harmonizing Goals and Strategies. In: Tsai H-M (Ed.). Proceedings of the Fourth Conference on the Protected Areas of East Asia: Benefits Beyond Boundaries in East Asia. Taiwan Organizing Committee for the Fourth Conference of the Protected Areas of East Asia, Taipei, Taiwan.
- Valencia, M.J., J.M. van Dyke and N.A. Ludwig**, 1997. Sharing the Resources of the South China Sea. Kluwer Law International, The Hague, Netherlands, 280pp.
- Verheij, E. and P.L.A. Erftemeijer**, 1993. Distribution of Seagrasses and Associated Macroalgae in South Sulawesi, Indonesia. *Blumea*, 38 (1993): 45-64.
- Veron, J.E.N.** 2000. Corals of the World. Australian Institute of Marine Science, Townsville, Australia. Vol. 1., 463 pp.
- Veron, J.E.N.** 1993. A Biogeographic Database of Hermatypic Corals. Species of the central Indo-pacific genera of the world. Australian Institute of Marine Science, Townsville, Australia.
- Vietnam Forestry Science – Technology Association**, 1995. The National Conference on National Parks and Protected Areas of Viet Nam. Agricultural Publishing House. Ha Noi.
- Vo Si Tuan**, 2000. Ranking and Prioritizing the Coastal and Marine Protected Areas of Viet Nam. Collection of Marine Research Works. X. Institute of Oceanography, Nha Trang: 246-253.
- Wallace, C.C.** 2000. Journey to Centre of the Centre: Origins of High Marine Faunal Diversity in central Indonesia from the perspective of an Acropologist. Paper presented at the 9th International Coral Reef Symposium, Bali, Indonesia, 23-27 October 2000.
- Walters, C.J. and R. Hilborn**, 1978. Ecological Optimization and Adaptive Management. *Annu Rev Ecol Syst* 9:157-188.
- WCMC (undated)**. Coral Reefs and Mangroves of the World (Poster). World Conservation Monitoring Center, Canterbury, United Kingdom http://www.wcmc.org.uk/marine/data/coral_mangrove/marine.maps.main.html
- Wells, S.M.** (Ed) 1988. Coral Reefs of the World. Vol. 2. Indian Ocean, Red Sea and Gulf. UNEP Regional Seas Directories and Bibliographies. IUCN, Gland, Switzerland and Cambridge, UK/UNEP, Nairobi, Kenya.
- White, A.T.** 1989. Two Community-Based Marine Reserves: Lessons for Coastal Management. In: Chua, T. E. and D. Pauly (Eds). Coastal Area Management in Southeast Asia: Policies, Management Strategies and Case Studies. ICLARM Conf. Proc. 19. 245 pp. Ministry of Science, Technology and Environment, Kuala Lumpur: Johor State Economic Planning Unit, Johore Bahru and ICLARM, Manila. pp. 85-96.
- White, A.T.** 1979. Marine Park Management in the Philippines. *Likas Yaman* 2(1):13-46.
- White, A.T. and A. Cruz-Trinidad**, 1998. The Values of Philippine Coastal Resources: Why Protection and Management are Critical. Coastal Resource Management Project, Cebu City, Philippines. 96 pp.
- White, A.T. and A. Cruz-Trinidad**, 1998. The Values of Philippine Coastal Resources: Why Protection and Management are Critical. Coastal Resource Management Project, Cebu City, Philippines. 96 pp.
- White, A.T. and R.O. De Leon**, 1996. Mangrove Resource Decline in the Philippines: Government and Community Look for New Solutions. *Tambuli* 1996:6-11.
- Wilkinson, C.** (ed), 2000. Status of Coral Reefs of the World: 2000. Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Australia, 363p.
- Wilkinson C.W.** (ed), 1998. Status of Coral Reefs of the World: 1998. Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Australia.

Wilkinson, C. (Ed.) 1994. Living Coastal Resources of Southeast Asia: Status and Management. Report of the Consultative Forum Third ASEAN-Australia Symposium on Living Coastal Resources. Australian Agency for International Development, Bangkok, Thailand, 16-20 May 1994, 133pp.

Wilkinson, C.R., L.M. Chou, E. Gomez, A.R. Ridzwan, S. Soekarno and S. Sudara, 1994. Status of Coral Reefs in Southeast Asia: Threats and Responses. *In:* Ginsburg, R.N. (Compiler), Proc. of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida, USA: 311-318

World Bank, 1994. cited in GOI 1997 but exact citation is not available

World Gazetteer (undated) <http://www.gazetteer.de>

WRI, 2000. (World Resources Institute), People, Communities and the Coastal Environment – Reefs at Risk Southeast Asia. October 2000.

WRI (undated) <http://www.org/facts/cs-asia.html>

WWF-Indonesia Programme, 1994. Taka Bone Rate National Park - Community Marine Conservation Awareness Program. WWF-Indonesia Programme, Jakarta, Indonesia.: 53pp.

White, A.T. and A. Rajasuriya, 1995. South Asian Regional Report on the Issues and Activities Associated with Coral Reefs and Related Ecosystems. Working Paper, No.04: 34pp.

Wilkinson, C.R., L.M. Chou, E. Gomez, A.R. Ridzwan, S. Soekarno and S. Sudara, 1994. Status of Coral Reefs in Southeast Asia: Threats and Responses. *In:* Ginsburg, Robert N. (Compiler), 1994. Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History, 1993. Rosentiel School of Marine and Atmospheric Science, University of Miami.: 311-317.

Wright, A. and A.H. Richards, 1985. A Multi-species Fishery Associated with Coral Reefs in the Tigak Islands, Papua New Guinea. *Asian Marine Biology* (1985), 2: 69-84.

WWF-Malaysia, 1992. Sabah Conservation Strategy. Final Report, Volume 2-Action Plan. A report submitted to the Ministry of Tourism and Environment Development.

Yaman, Ab. Rahim Gor, 1993. Planning and management of Marine protected Areas in Peninsular Malaysia: Case Study for the Pulau Redang Marine Park. *In:* Report of the EAS25 Workshop: Case Studies on Marine Protected Areas in the E. Asian Seas and the Workshop on a Global Representative System of Marine protected Areas in SE Asian Marine Region, 8-2 Feb. 1993, Penang, Malaysia. UNEP and IUCN. pp. 116-134.

Zamany, N., M. Nurlidiasari, and K.S. Putra, 1999. Fenomena bleaching di perairan Amed, Bali: Monitoring 1997-1999. Lokakarya Pengelolaan dan Iptek Terumbu Karang Indonesia, Jakarta 22-23 Nopember 1999. Program Rehabilitasi dan Pengelolaan Terumbu Karang (COREMAP), Lembaga Ilmu Pengetahuan Indonesia.

Zamora, P. 1992. Coastal Resources: Mangroves. *In:* Chua, T.E., L.M. Chou and M.S.M. Sadorra (Eds), Coastal Environment Profile of Brunei Darussalam: resource assessment and management issues. ICLARM Tech. Rep. 18. 193 pp.

