9. Status of Coral Reefs, Coral Reef Monitoring and Management in Southeast Asia, 2004

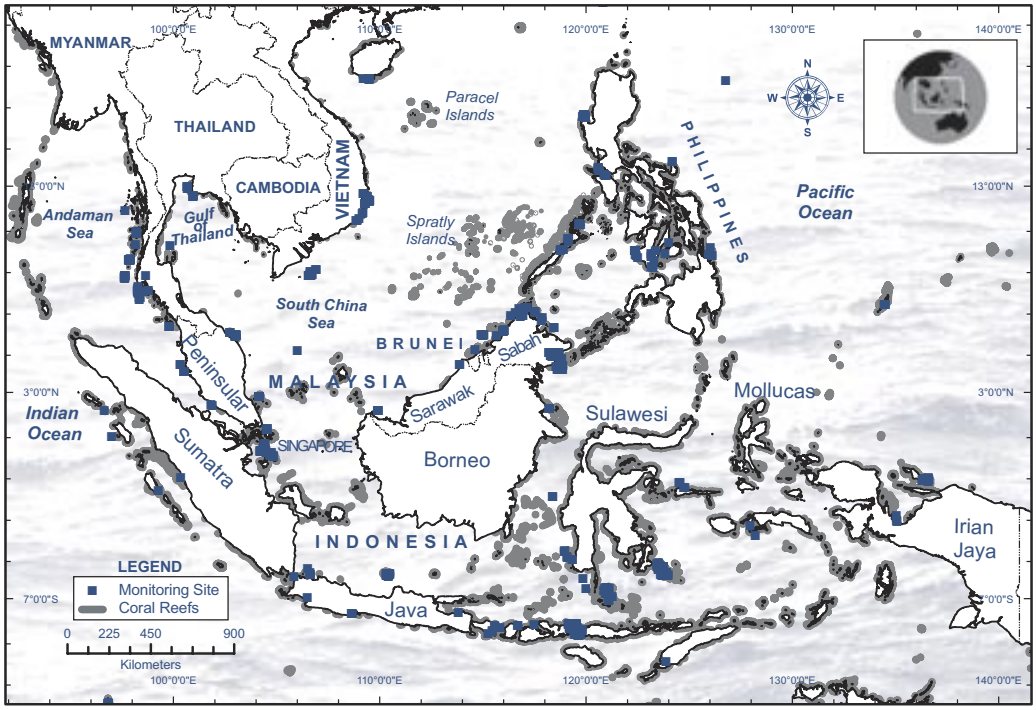
Karenne Tun, Loke Ming Chou, Annadel Cabanban, Vo Si Tuan, Philreefs, Thamasak Yeemin, Suharsono, Kim Sour and David Lane

Abstract

This 2004 assessment of coral reefs in Southeast Asia (SEA) continues to show an overall decline in reef condition, but it does offer a glimmer of hope for the future. While the decline is regional, it is not reflected in the reef status in all countries. For example, Indonesia continues to show slight, but definite improvements in reef condition from 1999, while preliminary data from Myanmar show that the reefs surveyed are relatively healthy, with most of the reefs surveyed having more than 75% live coral cover. The continued decline in reef in the Philippines, Vietnam, Thailand and Singapore is still a major concern, and although threats to reefs remain high and dominated by anthropogenic factors, more active management initiatives are being implemented throughout the region, which provides a sense of optimism for the coral reefs of SEA.

Coral reef monitoring in SEA started more than 20 years ago, with the Philippines starting in the late 1970s. Monitoring in a core regional network of Indonesia, Malaysia, Philippines, Singapore and Thailand started in 1986 with funding from the ASEAN-Australia Living Coastal Resources (LCR) project, until 1994. Monitoring since has varied between countries; some have continued and expanded monitoring programs and strengthened in-country coordination and capacity building; others have reduced monitoring and fragmented or weakened coordination. However, SEA countries have begun to re-examine their monitoring since 1999, and started re-building partnerships and establishing new ones within and outside the region. Countries outside this core network have begun to establish their own monitoring programs, such that there are now 8 countries with coral reef monitoring programs, leaving only Myanmar without monitoring in ASEAN (Association of Southeast Asian Nations).

This assessment highlights the urgent need for an in-depth and extensive review of all coral reef monitoring efforts since the late 1970s, in an attempt to establish a regional standardisation of methods, data archiving, analysis, interpretation and reporting. There is a critical lack of effective coordination in SEA, even though the region is the centre of global coral reef biodiversity. All countries in ASEAN are currently making this call, and it is accompanied by



Map courtesy of The WorldFish Center

a strong commitment to work together as a regional team. The new energy that is emerging within the region provides hope for the conservation and improved management of coral reefs in SEA.

100 Years ago: Virtually all reefs were healthy with normal fish populations, and high diversity and abundance of reef organisms. Pressure on the reefs was low, and any pressure was isolated and concentrated around population centres.

In 1994: Coral reefs in Southeast Asia showed severe degradation, with experts estimating about a 20-fold decrease in coral reef condition from 100 years ago. Coral reef monitoring had been ongoing for almost 10 years in some countries, and monitoring data showed that only 3% of the reefs surveyed in SEA had live coral cover of more than 75%, and reefs with less than 25% cover had increased to almost 30%. There were many MPAs, but almost all were 'paper parks'.

In 2004: Coral reef monitoring slowed from 1994 to 1998 in many countries, but increased again following the 1998 global mass bleaching event which raised awareness on the need for improved coral reef management. Monitoring programs improved and expanded, but a lack of sufficient expertise was still a concern in many countries. Coral reefs continued to show an overall decline, with a few exceptions. The greatest declines were in the Philippines, Vietnam, Malaysia and Singapore.

Predictions for 2014: The future of coral reefs in SEA is not very promising, with even the optimistic estimates not expecting coral cover to return to the 'early' levels even if management

measures are improved, implemented and enforced. Slight improvements in reef condition may be seen in well-managed MPAs, but the possibility of future bleaching and other natural events may halt the possible recovery. The pessimistic estimates follow the 'business as usual' scenario, with little or no improvements in management, and possibly further declines in coral cover and reef health, with further collapses in fish stocks.

Introduction

Southeast Asia (SEA) is a region of high biological significance, as it contains some of the most extensive coastlines and diverse coral reefs in the world, with Indonesia, Malaysia and the Philippines (together with Papua New Guinea) forming the centre of global coral diversity; the Indo-Malayan Triangle. Reef fish diversity also follows a similar trend, with more than half of global reef fish species found in SEA. The potential economic value of well-managed coral reefs in SEA is estimated at 42.5% of the global total of US$29.8 billion attributed to coral reef values. The potential value of coral reef fisheries is 38.5% of the global total of US$5.7 billion, while the potential value of tourism is 50% of the global total of US$9.6 billion. This reflects the continued high dependence of SEA countries on coral reefs for food security and increasing tourism-related revenue.

Management of coral reefs has improved since 2002, resulting from more active governance and better management of MPAs in several SEA countries. However, gaps in the management of existing MPAs in many countries are still apparent, with many MPAs lacking the resources necessary for effective implementation of management measures. The ICRAN (International Coral Reef Action Network) 'Lessons Learned' project implemented in 2001 has contributed to increased awareness and better management of the selected MPAs.

Another critical initiative was the 2002 World Commission on Protected Areas (WCPA) SEA Marine Working Group meeting, which developed the 'Regional Action Plan to Strengthen a Resilient Network of Effective Marine Protected Areas in Southeast Asia: 2002-2012'. This developed a partnership between The Nature Conservancy and NOAA (U.S. National Oceanic and Atmospheric Administration) as a 'comprehensive and collaborative effort intended to co-ordinate, guide and implement existing and new plans of action related to the strengthening and networking of representative MPAs in SEA'. This called on all stakeholders to support the Regional Action Plan and ensure effective implementation by 2012, to coincide with the World Summit on Sustainable Development objective of a global network of MPAs.

Significant progress has been made to improve conservation in the Sulu-Sulawesi Marine Ecoregion (SSME), with a Biodiversity Vision formulated in 2001. The vision was based on: biodiversity conservation; maintenance of productivity to sustain human needs; and stakeholders' participation in management across boundaries (i.e. cultural and political). An Ecoregion Conservation Plan (ECP) was developed in 2003 to involve government, NGOs (represented by WWF), and other stakeholders in regional conservation efforts.

Another stimulus was the appointment of a GCRMN regional coordinator in early 2004, resulting in the launching of a network identity (SEACORM Net - Southeast Asia Coral Reef Monitoring Network) and a website. The network was strengthened when national monitoring coordinators participated in the 10th International Coral Reef Symposium in Okinawa, Japan using support from the Japanese Ministry of the Environment (through the Japan Wildlife

Basic demographic statistics of Southeast Asian coral reef countries compared to the global values.

Coral Reef Statistics	Global	Southeast Asia	SEA % of Global
Coral reef area in km^2	284,300	91,700	32.3
Coral diversity	approx 800	>600	>75
Reef fish diversity	approx 4000	>1300	>33
Potential economic value of well managed coral reefs (US$ billion)			
Sustainable Coral Reef Fisheries	5.7	2.2	38.5
Coastal Protection	9.0	5.0	55.5
Coral Reef Tourism/Recreation	9.6	4.8	50.0
Biodiversity (e.g. pharmaceuticals)	5.5	0.5	9.0
Total	29.8	12.7	42.5

Research Center). Southeast and East Asian GCRMN Node participants discussed wider East Asian regional collaboration and the production of a comprehensive Status of East Asian Coral Reefs report in early 2005. The Symposium helped progress this regional report, based on national reports prepared using a standardised reporting template.

Geographic Reef Coverage and Extent

SEA contains 11 countries, 10 with coral reefs plus the land-locked Laos. East Timor, the world's newest democracy, has been excluded from this report as information on the coral reef status is currently unknown.

Total coral reef area is almost 100,000km^2, being almost 34% of the world's total coral reef area, with all major reef types represented within the region. Indonesia and the Philippines are large archipelagic nations with extensive coastlines and 75% of the region's coral reefs, whereas Cambodia, Singapore and Brunei combined have less than 0.5% of the regional total.

Status of Coral Reefs in Southeast Asia - Past, Present and Future

This 2004 report differs from those in 2000 and 2002 in that it adopts a more regional approach, rather than focusing on individual country status. The aim is to provide a wider regional picture on outlooks and trends. A major obstacle is that the data and information are heterogeneous, therefore a standardised reporting format has been attempted to clarify the regional status. The data standardisation, however, does not permit direct comparisons between countries on specific themes and some statistics may over-represent the status in some countries, and under-represent it in others. By 2006, comparisons at regional and global scales will be facilitated through efforts to provide all countries in the GCRMN with easy to use, and standardised reporting and analysis tools.

Coral reefs in Southeast Asia are the most biologically diverse and productive reef systems in the world, but are also the most threatened and damaged reefs, with unprecedented rates of coral reef destruction from anthropogenic pressures accelerating over recent decades. Prior to 1970, there were few quantitative reports and publications of the extent, condition and status of the coral reefs. The assessments of early coral reef status is drawn from the observations

The amount of coral reef area in SEA varies considerably between countries.

	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Coastline Length (km)	269	435	95,181	9,323	14,708	36,289	268	2, 614	11,409
Coral Reef Area (km^2)	210	<150	51,020	3,600	1,870	25,060	<100	2,130	1,270
Coral Reefs Present	Fringing, patch, atoll	Fringing, patch	Fringing, atolls, barrier reefs	Fringing, patch atolls	Fringing, patch	Fringing, atolls, barrier reefs	Fringing, patch	Fringing, patch	Fringing, patch

and reports of early explorers and anecdotal observations from people with experience in these coral reefs areas.

Around 1900, the coral reefs throughout SEA were mostly in pristine condition. The words of the English naturalist Alfred Russell Wallace attest to this. He visited Ambon, Indonesia in the mid-1800s and wrote: "The bottom was absolutely hidden by a continuous series of corals, sponges, actiniae, and other marine productions, of magnificent dimensions, varied forms and brilliant colours". Those reefs are now severely degraded; heavily polluted and damaged by bomb fishing. Most of the people in SEA were thinly spread along the extensive, and virtually undisturbed, coastlines, living by subsistence and simple trading. There was minimal coastal development and that was concentrated around the emerging city-centres. Fishing pressure was not high, and the methods were largely non-destructive. Thus, most coral reefs would have probably looked like the pristine reefs found in a few areas today, in clear waters with high diversity and abundance of corals and fish e.g. Bunaken National Park or Layang-Layang in the South China Sea. At least 60% of all coral reefs in SEA were believed to be in excellent condition 100 years ago, with live coral cover exceeding 75%, and reefs with less than 25% live coral cover did not exceed 10% of the total.

The countries of SEA began an economic and population boom in the second half of the 20th century with rapid growth and development in all sectors of society and the economy. Population growth expanded from 178 million in 1950, to 321 million in 1975, to 522 million in 2000. While there was rapid modernization and development, poverty still remained prevalent with most countries classed as 'developing'. Modernization also brought more efficient ways to harvest resources and this led to unregulated over-exploitation and, frequently, serious degradation of ecosystems. As catches diminished, more and more destructive methods of harvesting emerged in the1970s and 1980s, like bomb and cyanide fishing, thereby accelerating the destruction of coral reefs.

By 1994, the proportion of coral reefs that were seriously deteriorated was probably 20 times more than the levels for 1900; this was revealed after 8 years of coral reef monitoring. These showed that 3% of the few reefs surveyed in SEA had live coral cover of more than 75%, and reefs with less than 25% cover had increased to almost 30%.

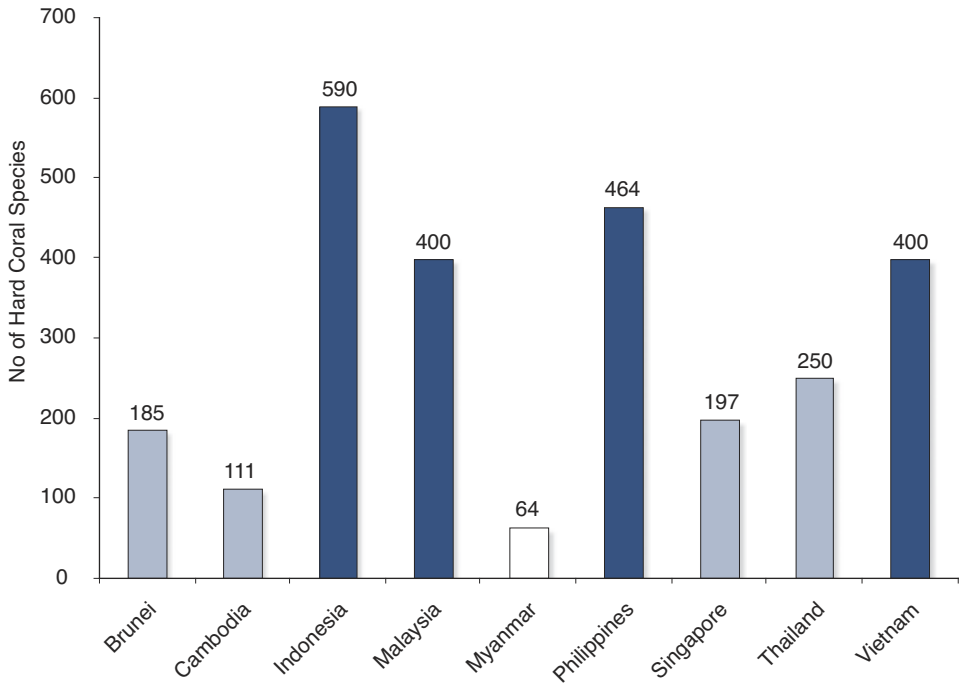
By 2004, there were more coral data for assessments of reef condition and these showed a slight improvement for reefs with an increase from 3% in 1994, to 9% of reefs with more than

75% live coral cover in 2004. However, the general downward trend of degraded reefs continued with decreased health and coral cover. The greatest declines between 1994 and 2004 were in the Philippines, Vietnam, Malaysia and Singapore. Thailand showed a mixed pattern, with improvements on some reefs and deterioration in many others within the Gulf of Thailand, and relatively unchanged status on Andaman Sea reefs. Indonesia was the only country that showed improvements across the board, with reef condition improving in all categories.

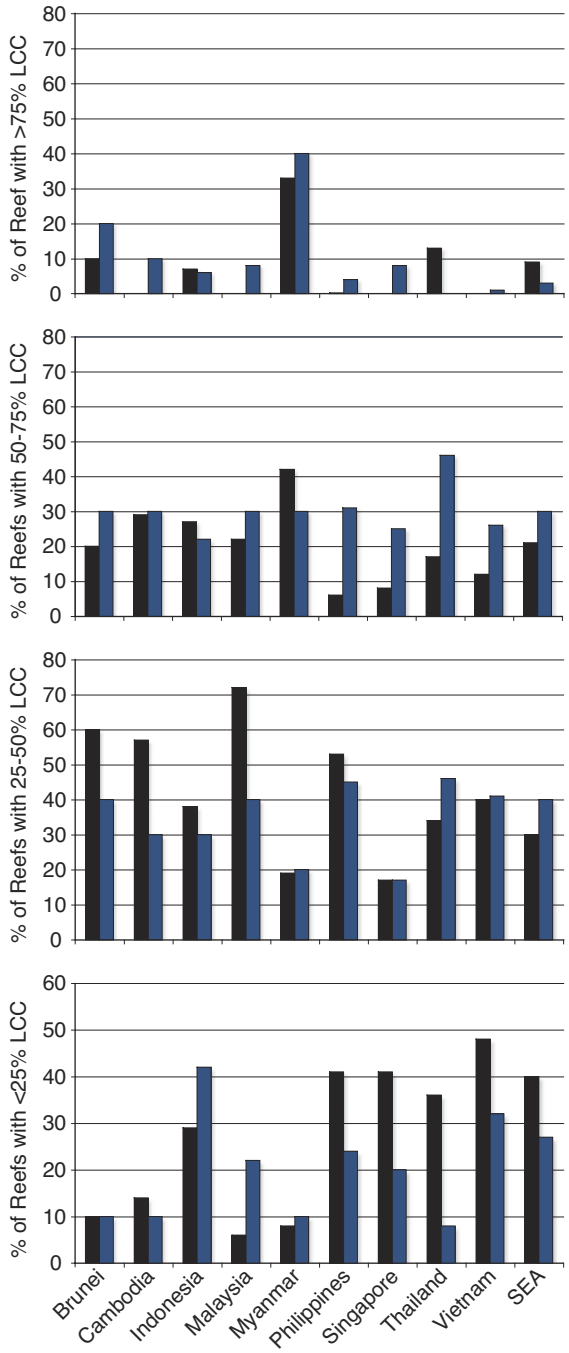
Projecting 10 years from now to 2014, optimistic estimates do not show coral cover returning to the early values even if management measures are improved, implemented and enforced. The pessimistic estimates follow the 'business as usual' scenario, with no improvements in management, and possibly further decline in coral cover.

Brunei

There is little coral reef monitoring information for Brunei, despite coral reef monitoring being considered an ongoing activity under the Department of Fisheries and Universiti Brunei Darussalam. The most recent information on coral reef status is from a 1992 publication, which reports 185 hard coral species. Coral reef condition was considered to be good to fair, with at least 50% of reefs having more than 50% live coral cover. The condition of the reefs in Brunei is not expected to have changed, as pressures on the reefs have not been high during the last decade.



Estimates of hard coral species indicate that 50% to 75% of the global total occur in four Southeast Asian countries



Changes in percent coral cover between 1994 (dark bars) and 2004 (light bars) show that coral reefs in Southeast Asia were already in poor condition by 1994, and deteriorated further by 2004. 1994 is an indicative year with data extracted from available survey data from 1992-1994; similarly 2004 data are estimates drawn from 1999-2004 data. LCC - live coral cover; SEA - Southeast Asia combined.

RAPID BIODIVERSITY ASSESSMENT OF WAKATOBI, CENTRAL INDONESIA:

The Wakatobi Marine Park reefs are between the Banda and Flores Seas, southeast Sulawesi where circulating and seasonally changing currents bring in large amounts of coral reef larvae that facilitate fast recovery after disturbance. There are also cool water upwellings from the south, which probably protect the area from coral bleaching events. These reefs were formally known as the Tukang Besi Islands and are already targeted as an MPA. A Rapid Ecological assessment (REA) was conducted by TNC in 2003 to assist in the revision of management and zonation plans. The reefs were surveyed at 33 stations covering most of the park, with the exception of far southeastern and northeastern atolls. They recorded 396 species of hard (hermatypic scleractinian) corals with an average of 124 species per station in an area of relatively low habitat diversity. They also catalogued 10 species of non-scleractinian hard coral species and 28 soft coral genera were recorded. These numbers confirm the position of Wakatobi near the centre of high coral biodiversity. There was widespread, but not severe, coral damage mostly from fish bombing, crown-of-thorns starfish and coral bleaching. Poison fishing was probably practiced in the area, but there was no clear evidence. The reefs were in relatively good health, probably because there is such a large area to provide larvae and few major disturbances in the last decades. From: Lida Pet-Soede and Mark Erdmann.

Cambodia
Coral reef monitoring in Cambodia is a recent activity, with the first surveys starting in 2000. So far, only one data set for each monitoring site is available, so there is no trend information. To date 111 hard coral species have been identified with average live coral cover for the whole coastline ranging from 23% to 58%.

Indonesia
The high biodiversity is evident with 590 hard coral species catalogued, including more than 480 species in Eastern Indonesia. More reefs are being monitored under the COREMAP (Coral Reef Rehabilitation and Management Program) program which indicates that overall reef condition has been showing improvement year on year since 1999, with a definite shift from reefs with less than 25% to reefs with 25-50% live coral cover.

Malaysia
Extensive coral reef survey data exist for Malaysia, with the earliest records from 1977, but much of these data are unreported and dispersed among institutions. Efforts are currently being made to collate and analyse all existing monitoring information. To date, more than 350 hard coral species have been recorded and preliminary analyses of monitoring data indicate that reefs in Eastern Malaysia are in much better condition than those of Peninsular Malaysia. Overall reef condition in Malaysia shows that almost one third of the reefs have between 25-50% live coral cover, and very few reefs with more than 75% live coral cover.

Myanmar
This is the only country in the region without a coral reef monitoring program. Government officials responsible for coral reefs are keen to establish coral reef monitoring, but they lack

RAPID BIODIVERSITY ASSESSMENT OF SANGIHE-TALAUD, NORTHEAST INDONESIA

Another Rapid Ecological Assessment was undertaken by The Nature Conservancy in the Sangihe-Talaud archipelago; a chain of islands off Northeast Sulawesi, Indonesia stretching towards the Philippines. This assessment provided few encouraging results to designate this area as MPA status. They surveyed 19 sites above water, and 53 sites by scuba or snorkel over 4 weeks in 2001. In most areas, there was little reef development although 445 hard coral species were found mostly growing on volcanic rock. The exceptions were Pasige reef, and some sites in Eastern Kerakelong, Nanusa where there were true reefs. This coral diversity was comparable to Milne Bay in Papua New Guinea (379 species), the Great Barrier Reef, and Komodo National park (253 species), however, the average species count per site of 100 was much lower. There was extensive damage from coral bleaching and bomb fishing in the Nanusa Archipelago, where over 60% to 80% of the corals in most of the sites were recently dead. The level of human impact was also high, with evidence of deforestation on the islands and severe over-exploitation of the reef fish populations. Heavy fishing activity was observed everywhere. Some areas (East coast of Talaud) were also affected by siltation, and turtles are under servere pressures through egg collection and hunting of the adults for meat and shells. The REA teams reported serious and immediate threats to biodiversity, with high biodiversity areas fragmented and dispersed. Thus there are no contiguous, large areas that are likely candidates for an intensive marine conservation program. A more detailed REA may find localities that are suitable candidates for smaller MPAs, as the attitude of the local communities towards conservation is quite positive, and they may take the opportunity to assist in the management of smaller MPAs.

the capacity. Current information on coral reef status in Myanmar is limited to 2 expeditions by Reef Check Europe between 2001 and 2003 to western areas of the Mergui Archipelago. Only 65 hard coral species have been catalogued, which is almost certainly an underestimate. Reef Check reports that the reefs in the southern Mergui Archipelago are relatively healthy, with about 75% of reefs having more than 50% live coral cover.

Philippines

They have identified 464 hard coral species, which amounts to about half of the global reef-building coral diversity. Current data suggest that the reefs are experiencing a steady decline of 3 to 5% reduction in coral cover at all sites examined. This degradation trend is corroborated with 33% of reefs in the 'poor' condition category in the 1980s increasing to nearly 40% two decades after.

Singapore

Despite the small coral reef area in Singapore, hard coral diversity is relatively high, with almost 200 species recorded. Reef status in 2004 is mixed with reefs close to shore and adjacent to high coastal development and land reclamation showing clear degradation, with deeper parts of the reefs almost completely buried under sediments. Reefs further from shore and provided with the protection from nearby military bases, have shown improvement in live coral cover on the shallow reef areas.

RAPID BIODIVERSITY ASSESSMENT OF BANDA ISLANDS, EAST INDONESIA

The rapid biodiversity assessment of the Banda Islands, Eastern Indonesia, was carried out in 2002 to evaluate the possibility of listing these Islands as a Natural World Heritage Site by the Government of Indonesia. The reefs were generally in good condition, with only scattered and minor levels of damage observed. Over 300 hard coral species were recorded, which is high on such small areas of reef which consists mostly of narrow fringing reefs with no intertidal reef flat. There were 4 coral communities identified: 2 on the deep slopes; and 2 in shallower areas. Coral growth was very fast as there were few old corals seen e.g. over 100 years. There were also 500 fish species from 50 families, and the estimated fish diversity rates fifth among 32 sites in the Asia-Pacific region. This diversity is extremely high considering the small surface area of the Banda Islands and the limited range of habitats. There were many of the highly valued Napoleon wrasse (Cheilinus undulates) compared to the heavily exploited area of Indonesia, but the populations of large groupers (Serranidae) clearly showed signs of exploitation. These Islands were considered to be of great global biodiversity significance and worthy of World Heritage Listing. From: Peter Mous, TNC Indonesia, pmous@TNC.ORG

Thailand
Only the 1999 coral reef monitoring data are available, but these report more than 250 species of hard corals in both the Andaman Seas and the Gulf of Thailand. About 15% of the reefs in the Gulf of Thailand have more than 75% live coral cover, whereas about 25% of the reefs have less than 25% live coral cover. 2003-4 monitoring data are also available for certain sites.

Vietnam
The latest survey data has confirmed higher coral diversity with species numbers ranging from 300 to 350 in southern areas. Data from 2003-4 indicate that most reefs have less than 25% live coral cover.

The perspective for 2014 is uncertain, with both optimistic and pessimistic predictions provided by regional experts. With improved regional coordination, awareness and more proactive measures implemented or planned, there is optimism that reef health will improve throughout the region, with measurable increases in the number of reefs with higher live coral cover and corresponding decreases in reefs with lower coral cover. However, if management measures do not keep pace with the rate of reef deterioration, then the future for coral reefs in SEA looks bleak, with a possible total loss of reefs with more than 75% live coral cover and an increase in the number of severely damaged and dead reefs. The effects of future El Niño and global warming leading to potential bleaching events are future threats, and could potentially have serious impacts on the coral reefs of Southeast Asia.

Status of Coral Reef Fish and Fisheries

Despite a long history of coral reef monitoring, reliable and consistent quantitative data on status of coral reef fishes are scarce for most countries in SEA, with the Philippines being the exception. Fish biodiversity and distribution patterns are well documented, but reef fish

INDONESIAN MARINE PROTECTED AREAS: EVALUATION OF FISHING GEAR

Regulation of fishing effort in Indonesia is difficult, as the local fisheries agencies do not have adequate resources to monitor and collect information on effort, numbers, and distribution of fishing communities. The major gears used in Indonesia are purse seine and drift nets, but a variety of other gears are used on coral reefs, including hook and line, spearguns, hand spears, traps, gill nets, and muro-ami. The damaging practice of muro-ami is widespread throughout Karimunjawa National Park, Central Java; this involves divers driving fish into a large seine-like nets set on the reef. The species selectivity and catch composition among gears showed that 204 fish species from 37 families were recorded from 187 landings. Net fisheries caught the most species (127 species per day), while hand spears caught the least number of species (14 species per day). Muro-ami fishing caught the highest numbers of fish per fisherman (11.2 ± 4.4 individuals per day) and the smallest size fish (28.3 ± 0.64 cm). Net fishers caught a mean of 12 species during a single fishing trip, while other gears caught 4-6 species. Predatory fish species caught by hand lines and gill nets had the highest (3.82 and 3.78 respectively) trophic diversity (different levels of fish on the food chain), while spear guns had the lowest (2.69). The mean trophic level of fish caught by muro-ami (3.39), suggested that muro-ami caught a wider variety of species. The high numbers of individuals and species, and low size of fish caught by muro-ami indicated it was a non-selective gear, but with high species overlap with other gear types, notably traps. Therefore, muro-ami fishing is likely to compete with other more benign gear and be unsustainable. Interviews with 119 local fishers showed that 80% supported regulations to abolish muro-ami fishing; a restriction that will reduce the catch of small fish and species overlap in selectivity among gears used. Tim McClanahan, Wildlife Conservation Society, Kenya, tmcclanahan@wcs.org

population size data are lacking for most countries. A contributing factor is poor capacity, because conducting fish visual census surveys requires high technical ability and considerable experience. Thus most countries have focused on the corals and other bottom organisms.

Reef fish diversity is high; and the reported numbers are increasing as more reef areas are assessed. However, reef fish abundance, especially for economically important species (food fish and aquarium fish), is declining on most reefs. Fewer and fewer species like the barramundi cod, the bumphead parrotfish, the napoleon wrasse and grouper are being recorded during reef surveys. Detailed information on coral reef fish for 2004 is only available for Cambodia, Malaysia, Philippines and Vietnam.

Cambodia

Marine fish are primarily harvested using traps, gillnets and hook and line, however, some illegal bomb and cyanide fishing is targeting commercially important species. Juveniles and pre-adults of reef fish are also collected for grow-out in cages along the coast, where they are sold live in local markets and in markets of Hong Kong, China and Taiwan.

RAPID BIODIVERSITY ASSESSMENT OF RAJA AMPAT, WEST PAPUA

The Raja Ampat Islands, off the northwest coast of Papua, Indonesia (near the 'bird's head' of New Guinea) have a reputation for beauty and high coral reef biodiversity; likely candidates for conservation. The Nature Conservancy and partners did Rapid Biodiversity Assessment (REAs) over 3-weeks following similar assessments by Conservation International, the University of Cenderawasih and LIPI-Oseanologi and earlier TNC assessments with the Henry Foundation and NRM/EPIQ. They surveyed the eastern and southern areas of Raja Ampat during a cruise in late 2002 in association with WWF Sahul. Focal areas of the research were marine species biodiversity and ecosystems quality, terrestrial ecosystems and threats, and socio-economic studies of local communities using the resources. These islands have one of the world's highest coral reef fish species lists, with at least 1,074 species of which 899 (84%) were observed or collected during the surveys, including 104 new records for Raja Ampat. The CI surveys reported 970 species from this area. This is the third highest count for any similar-sized location, surpassed only by Milne Bay Province, PNG (1,109 species) and Maumere Bay, Flores, Indonesia (1,111 species), which were from longer, more intense surveys. Thus the Raja Ampat total was a global record for a visual survey. Raja Ampat is also known for high diversity of hard corals with the total in the archipelago expected to be over 75% of world's known coral species. There were 488 hard corals identified during this REA, with a further 35 species awaiting identification using reference collections. There are probably 13 new species. The Raja Ampat count compares to 445 species in North Sulawesi, 379 species in Milne Bay and 347 in Kimbe Bay, PNG. The counts in 2001 and 2002 bring the total for Raja Ampat to at least 537 coral species. In addition there was high diversity of soft corals with at least 41 of the 90 Alcyonacean known genera being found. The reefs in the Raja Ampat area were in very good health, with about 33% average coral cover and no evidence of serious damaging effects like coral bleaching, recent crown-of-thorns starfish outbreaks or sediment and pollution. The REAs showed that conservation of the area is an overriding priority for the global community, especially 4 areas: the islands of eastern and southern Misool, Kofiau, Sayang and Pulau Ai, and the Wayag islands. From: R. Donnelly, D. Neville and Peter Mous, TNC Indonesia, pmous@TNC.ORG

Malaysia

The coral reefs in Peninsular Malaysia are mostly protected as Marine Parks under the Fisheries Act (1985) and managed by the Department of Fisheries. Fishing is not allowed on the reefs within the Parks, except for non-extractive activities, and reef fisheries are currently non-existent and unmonitored. In Eastern Malaysia, heavy exploitation of coral reef fishes (and invertebrates) occurs outside of the Parks. Studies have estimated that coral reef fisheries contributed about 7.26 to 22.63 % mt to marine fish production from 1980 to 1990, but these estimates are considered under-estimates because some of the coral reef fish families (e.g. Acanthuridae, the surgeonfish, Scaridae, parrotfish) and catch taken for the live-fish trade were not considered. The live reef-fish food fish trade (and culture of *Tilapia* spp. and *Lates calcarifer*) begun in mid-1980s and generated income of valued at RM 0.35 M (USD 1 = RM 2.5) from 3,000 metric tons, in 1992. This increased to 7,000 mt, valued at about RM 0.78 M

in 1994. In 2001, the contribution of cage-culture of coral reef fishes alone was 550 mt, valued at RM 9 M.

Vietnam

Fish data are grouped into target fish groups, with low abundance of predatory reef fish like groupers, snappers and sweetlips in almost all coastal reefs. Only reefs in a few areas in the Gulf of Thailand (Phu Quoc, Nam Du and Tho Chu) had good to moderate densities of predators. Small fish like Pomacentrids are abundant only in the Gulf, while grazing reef fish are abundant in all areas.

Philippines

The most reliable data on reef fish are available from the Philippines, with calculations of derived biomass in addition to species diversity, abundance and density estimates. Reefs with l - 5 metric tons km^{-2} (very low) and 5.1 to 10 mt km^{-2} (low) are considered as over-fished; reefs with 11 - 20 mt km^{-2} (medium) are considered as slightly or moderately fished; and those with 21 - 40 mt km^{-2} (high category) and >40 mt km^{-2} (very high) estimates are considered as having very minimal fishing and/or have been protected as an MPA for at least 5 years.

There are large differences in the annual catch of marine fish and the amount produced by aquaculture in the countries of SEA. Coral reef fish constitute a large proportion of the catch.

	Brun	Camb	Indo	Mala	Myan	Phil	Sing	Thai	Viet
No. Marine Fish Species	Unknown	520	>1,650	>1,000	Unknown	>1000	>130	>350	411
Marine Fisheries Production (x1000 mt)									
-Average Annual Catch	2	22	3,705	1,257	879	1,742	5	2,649	1,281
- Aquaculture Production	0	-	187	13	-	162	1	6	-

mt-metric tons; Brun=Brunei; Camb=Cambodia; Indo=Indonesia; Mala=Malaysia; Myan=Myanmar; Phil=Philippines; Sing=Singapore; Thai=Thailand; Viet=Vietnam

They have assessed that more than 50% of the reef sites in the Philippines, with the exception of the Sulu Sea, surveyed between 1991 and 2004 are in the very low and low categories i.e. over-fished. The high fish biomass category was more common in the Visayas and Sulu Sea areas, comprising 25.8% and 32.9% of reefs, respectively. Very high fish biomass categories were observed where there was also high species diversity, such as the South China and Sulu Sea, each containing 15% of the total reef area. These regions contain large MPAs, such as the Tubbataha Reef National Marine Park in the Sulu Seas region and many reefs in the South China Seas (i.e. Spratly Islands). Thus, the only reefs with healthy fish populations are either in MPAs or are remote with 'political' protection. Efforts are currently being made to use the same criteria to assess the status of coral reef fish in the rest of Southeast Asia.

Small-scale subsistence reef fishing is a major activity in most coastal communities, thus comprehensive and reliable reef fisheries statistics are not available. The only comparable data available for all countries were extracted from the EarthTrends World Resources Institute

PUERTO PRINCESA SUBTERRANEAN RIVER NATIONAL PARK

The St. Paul Bay Coral Reef consists of a number of coral colonies scattered within a 2,700 hectare area in the South China Sea, adjacent the Puerto Princesa Subterranean River National Park. The bay is an important fishing area for local residents who compete with migrant fishermen from other parts of the country for access to the resources. However, the area is remote and this makes law enforcement difficult; the coral reefs have deteriorated due to destructive fishing methods. Initial plans between management and the community to establish a Marine Reserve in the entire bay started with an agreement with both parties to restrict fishing in the bay to traditional fishing methods. The Park management protects 2 292 ha of inter tidal zones, seagrass beds and coral reefs of the marine reserve out to1 km offshore. A no-fishing policy is being implemented in the reserve, although it is not supported by any legal arrangement. The corals in the reserve are in better condition compared to areas outside in the bay, and 65 species of fish have been identified in the reserve. There are also rays, sharks and dolphins, and the Bay is a known feeding ground for the endangered turtles and dugongs. The progress of fully establishing the MPA has been hampered and delayed by the limited management resources.

website. The 2000 data indicated that the average annual catch in Indonesia is highest followed by Thailand and the Philippines. Malaysia and Vietnam catch similar tonnage, while catches in Cambodia, Brunei and Singapore were insignificant. Aquaculture production of marine fish is still low in all countries, and usually involves grow-out of wild captured juveniles.

Most coral reef fisheries are multi-gear, small-scale operations targeting many species. Different fishing methods are used to harvest a variety of marine organisms, including hookah air diving (in Vietnam), purse seine and gill nets, light fishing at night for anchovies and cuttlefish, drift nets, long lines, trawling and gleaning on tidal flats. Destructive fishing methods like bomb and poison fishing have been heavily used recently and have caused massive reef destruction. Although such methods have been banned in all countries, illegal fishing continues almost unabated in many areas.

Monitoring Capacity in Southeast Asia

Current monitoring capacity within SEA countries varies greatly, with the Philippines having the longest history in monitoring and research, which started in the late 1970s. In contrast, Myanmar has no national monitoring program and there is minimal available information on the reefs, with only volunteer monitoring by Reef Check Europe providing some data. Cambodia started a monitoring program in 2000 through capacity transfer from within the region, especially from Singapore, with UNEP and Japanese Ministry of Environment funding. Efforts are underway in Brunei to initiate monitoring, with the first surveys planned for late 2004 to early 2005. National level monitoring commenced in 1998 in Vietnam through support from UNEP, Total Foundation, WWF, DANIDA, Reef Check and NOAA-USA.

Coral reef monitoring has expanded over the last 10 years in most SEA countries, with many programs being funded by national and international agencies, but predominantly through

Coral reef monitoring capacity in Southeast Asia varies greatly from country to country.

	Brun	Camb	Indo	Mala	Myan	Phil	Sing	Thai	Viet
National coral reef monitoring program statistics:									
1st local monitoring program initiated	2004	2000	1986	1986	NA	1977/8	1986	1986	1998
Ongoing monitoring	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Existing funding for monitoring	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
No. of permanent monitoring sites/ areas	4	7	>500	7	NA	>80	9	250	10
Estimated number of trained personnel for core monitoring methods in 2004 (including NGOs & volunteers)									
LIT (AIMS Method)	0	7	U	<20	NA	60	8	30	U
Reef Check	U	10	U	<100	NA	>250	>100	>200	U
FVS (AIMS Method)	0	0	U	<20	NA	60	2	20	U
Coral ID (Genera or Species)	3	0	U	<10	NA	15	8	25	U

U = Unknown; NA = not applicable; LIT = line intercept transect; FVS = fish visual census; ID = identification to Genus or Species level
Brun=Brunei; Camb=Cambodia; Indo=Indonesia; Mala=Malaysia; Myan=Myanmar; Phil=Philippines; Sing=Singapore;

international assistance. Greater effort is required within the region to highlight the importance and significance of monitoring to government agencies, to ensure that more national resources are provided for effective long-term monitoring and data management. This is essential for long-term management of the coral reefs.

The number of permanent coral reef monitoring sites surveyed in 1994 compared to 2004 were in a wide range: 0 to 0 in Myanmar; 10 to 0 in Malaysia; 0 to 4 in Brunei; 6 to 6 in Singapore; 0 to 7 in Cambodia; 3 to 11 in Vietnam; 10 to 36 in Philippines; 420 to 250 in Thailand; and 340 to 583 in Indonesia. Thus monitoring has increased in Indonesia, the Philippines and Vietnam. The amount of monitoring, however, bears little relationship with the area of coral reefs, with both Indonesia and the Philippines having enormous reef areas. Most countries reported a lack of trained people for monitoring, with a range of 10-60 people in each country. The only major increases in recent years are in those trained in Reef Check methods. Few, however, have sufficient training in coral and fish identification.

Brunei

Routine monitoring is the responsibility of the Department of Fisheries in Brunei, but a lack of capacity and commitment has resulted in minimal monitoring over the past 8 years. Previous reports on coral reef status date to 1992 only; however, the Universiti Brunei Darussalam is planning a monitoring program to start in 2004 at 4 sites.

Cambodia

The first monitoring started in 2000 with training of Department of Fisheries staff at 7 sites, which were monitored using both Reef Check and Line Intercept Transect methods for coral, invertebrates and fishes. The data in this 2004 report are the first on coral reef status from Cambodia and more training of volunteers and government staff is planned.

RAPID MARINE BIODIVERSITY ASSESSMENT OF RAJA AMPAT ISLANDS, INDONESIA

The Marine RAP survey by Conservation International in 2001 of the Raja Ampat Islands assessed 45 sites in an area of approximately 6,000 km^2, including the coral reefs of the Dampier Strait between northern Batanta and Waigeo. They found:

- *Corals:* 456 species of hard corals; more than half of the world's total and richer than any other comparable area;
- *Molluscs:* comparatively high diversity with 699 species, surpassing previous RAP surveys in Papua New Guinea and the Philippines;
- *Reef Fishes:* 828 fish species, raising the total for the islands to 972 species. By extrapolating this based on 6 key indicator families, they estimate that there could be at least 1,084 species in the area;
- *Reef Fisheries:* 196 species are targets for reef fisheries, and the mean total biomass for sites in the Raja Ampat Islands is considerably greater than other surveyed areas, including Milne Bay Province, PNG, Togean-Banggai Islands 1998 (Indonesia), and Calamianes Islands 1998 (Philippines);
- *Coral Condition:* 60% of the surveyed reefs were in good to excellent condition based on coral and fish diversity, benthic community structure and evidence of damage and disease. The major threats were destructive fishing and siltation from numerous logging activities;
- *Community Issues:* The community liaison team visited 22 villages and identified that the villagers were in urgent need of income; they lacked knowledge of conservation law and had little awareness of conservation needs. The high prices for marine resources relative to traditional community incomes provided strong incentives for illegal overuse of marine resources.

The findings from this survey by Conservation International and others helped to catalyse local communities, local, national and international governmental and NGOs to develop a strategic conservation plan for this region. The survey was supported by the David and Lucile Packard Foundation, Henry Foundation, and the Smart Family Foundation Inc. Participants came from the University of Cenderawasih, Papua State University, Indonesian Institute of Sciences, Research and Development Center for Oceanography and CI-Indonesia, as well as the Australian Institute of Marine Science, Western Australian Museum, and CI. The results are available in the RAP Bulletin #22. From: Irdez AzharRaja Ampat, Corridor Manager, Conservation International Indonesia – Papua Program, Sorong 98413, Papua – Indonesia.

Indonesia

Monitoring in Indonesia has been coordinated under COREMAP (Coral Reef Rehabilitation and Management Program) since 1994. In addition, other international agencies also conduct coral reef monitoring e.g. Project Wallacea in Wakatobi, TNC in Komodo and WWF in Bali and Karimunjawa. The data in this report are from COREMAP, which has increased capacity and resources for coral reef monitoring, with 648 established sites across Indonesia, almost double the 340 sites in 1994, with 582 sites monitored in 2004. This strong, localised program is providing training and coordination across the archipelago.

Malaysia
Malaysia's coral reef monitoring program is coordinated by several agencies. In Peninsular Malaysia, the Department of Fisheries (DoF) staff conducts regular monitoring at limited areas in Marine Parks. In addition, DoF works with local universities and international agencies (CCC, WWF), which have monitoring programs of their own. In Eastern Malaysia, the DoF-Sarawak, monitors the reefs in Northeast and Southwest Sarawak with universities and the private sector, while in Sabah, Pulau Tiga Marine Park, Tunku Abdul Rahman Park, Turtle Islands Park, and Tun Sakaran Park are monitored by Sabah Parks. In addition, two other coral reef areas are being protected and monitored by other governmental agencies: 1) Sugud Islands Marine Conservation Area by Sabah Wildlife Department enactment; 2) Sipadan Island by National Security Department. Sabah Parks works with local and international universities, while the Sabah Wildlife Department works with the private sector. Data from coral reef monitoring over the last 8 years are substantial, but the biggest obstacle that faces Malaysia is the coordination of the data. Currently, all agencies, organisations and institutions manage their own data, with no centralized coordination for data archival or analysis. Efforts are currently being made by the DoF to establish a national database to archive all data from Malaysia. Data in this report are derived from a variety of data sources, collated towards the end of 2004. This is not a comprehensive or representative survey. A more detailed synthesis of the existing data is currently being conducted.

Myanmar
There is no national coral reef monitoring program in Myanmar, and data reported here were derived from two Reef Check Europe expeditions to the southern Mergui Archipelago.

Philippines
Coral reef monitoring is coordinated by the coral reef information network of the Philippines (PhilReefs), with the Marine Science Institute of the University of the Philippines serving as the coordinating agency responsible for GCRMN reporting. There is also active monitoring by several local and international agencies and organisations, and data reported here are from all these agencies.

Singapore
Most coral reef monitoring and coordination has been through the National University of Singapore, until early 2004. Now the National Parks Board is establishing a national coral reef monitoring program linking those of the University and other volunteer groups and organisations. This will include the establishment of a National Biodiversity Reference Center, which will also be involved in capacity building.

Thailand
The Department of Marine and Coastal Resources (DMCR) is the coordinating body for coral reef monitoring in Thailand, but there is little effective coordination to collate the extensive data held by many organisations. Unfortunately the data in this report were derived from 1999 statistics, hence do not adequately reflect the status of coral reefs in Thailand in 2004.

Vietnam
The Institute of Oceanography in Nha Trang conducts and coordinates coral reef monitoring, and facilitates data management and reporting.

Threats to Coral Reefs in Southeast Asia – Past, Present and Future

'Reefs at Rsk' Threat Estimates

The 2002 Reefs at Risk (R@R) assessment in SEA by the World Resources Institute estimated that 88% of the reefs were at 'medium' to 'very high' risk of damage. Among the greatest threats were over-fishing and destructive fishing estimated to be threatening 64% and 56% of the reefs respectively. These data indicate significant socio-economic and governance issues related to the high dependence of coastal communities on reef resources, and the increasing market demands of growing economies. Coastal development impacts are more focused, especially in the Philippines, Singapore, Thailand and Vietnam, where there are rapid expansions.

A panel of regional scientists revised the 2002 R@R assessment and threat indices in 2004. There were slight (1-5%) to moderate (5-15%) increases in all 5 key indices, especially coastal development, marine-based pollution and sedimentation (Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam), with lesser increases in over-fishing and destructive fishing (Cambodia, Indonesia, Philippines, Vietnam). The leading threats in 2004 continued to be over-fishing and destructive fishing, with coastal development starting to become a greater threat.

The opinions of local experts were compiled on possible changes in the 5 R@R threat indicators in SEA in the next 10 years (to 2014) compared to the 2002 analysis performed by the World Resources Institute. Most of the threats are predicted to remain the same or increase in all countries, with no indications of improvements.

	Brun	Camb	Indo	Mala	Myan	Phil	Sing	Thai	Viet
Coastal Development	≈	↑	≈	↑	Unknown	↑	↑	≈	≈
Marine-Based Pollution	≈	↑	≈	≈	Unknown	↑	≈	≈	≈
Sedimentation	≈	↑	≈	≈	Unknown	≈	≈	≈	≈
Over-fishing	≈	Unknown	Unknown	≈	Unknown	≈	≈	≈	≈
Destructive Fishing	≈	Unknown	Unknown	≈	Unknown	≈	≈	≈	≈

↑ - increasing threats; ≈ - no observable change; Unknown – no expert opinion available
Brun=Brunei; Camb=Cambodia; Indo=Indonesia; Mala=Malaysia; Myan=Myanmar; Phil=Philippines; Sing=Singapore; Thai=Thailand; Viet=Vietnam

Measurable Threats

Quantitative data on measurable threats, like crown-of-thorns starfish (COTS), bleaching, coral damage due to bomb fishing, ship groundings, anchor damage, storms and sedimentation are not readily available, with most reports being predominantly anecdotal. The 1998 mass bleaching event was serious for many reefs around the world, but did not have a severe impact on reefs in the Eastern Indian Ocean and the South China Sea (i.e. west coast Malaysia, Thailand, Myanmar and the Andaman Islands). There has been no repeat of the 1998 mass coral bleaching event, although several smaller and dispersed events were reported over the past 6 years in Indonesia, Philippines, Thailand and Malaysia. There is however, a possibility that future El Niño events may have more severe impacts on the reefs of Southeast Asia.

NINH THUAN, VIETNAM – ICRAN TARGET SITE

Coral has been used to make cement in Ninh Thuan since 1979, with the Phuong Hai Cement Company mining dead coral on land. Supplies dwindled, so they started mining corals off My Hoa beach. When the local villagers saw the damage done to a 1 hectare plot of coral, they protested by lying in front of the mining trucks. The community had been made aware of the need to protect marine resources by a WWF Sea Turtle Conservation project. Furthermore, when Ninh Thuan was selected as an ICRAN target site in 2002 (Box p 272) the level of awareness increased even more. Coral exploitation in My Hoa was stopped by the Provincial People's Committee and is strictly controlled by the local community.

"Being part of ICRAN has changed my thinking on how the reefs in our province should be managed. It has also unified local government agencies and ministries for the first time and provides the central core for other projects which are related to coral reefs," said Tran Phong, Director of the Ninh Thuan Department of Science, Technology and Environment. The Ninh Thuan Provincial authorities have strong determination to protect their coral reefs and in consultation with local communities are are preparing their own regulations for protection. A legislation signing ceremony was held in September 2004. The advice of community elders, that was previously ignored but reinforced in the ICRAN project, is now influencing the fishermen who have formed volunteer patrols to protect their coral reefs and fisheries.

Capacity building has been a special feature of the ICRAN project with 10 training workshops on coral conservation and socio-economic impacts for more than 900 participants, and exchange visits with other successful MPAs like Apo Island (Philippines). A Disney Wildlife Conservation Fund project on coral mapping for management is now developing user-friendly GIS maps for managers and policy makers. The 'Coral Reef Monitoring for Management' manual has been translated into Vietnamese and many other communication materials have been designed specifically for the children and the community. Two communes have established their own reef management programs and established volunteer teams for coral reef protection and awareness raising, including assessing alternative income opportunities, legislation and management practices. Algal aquaculture was trialled unsuccessfully at two sites, but has provided valuable insights for future aquaculture and possible community-based eco-tourism ventures. The community and WWF have started monitoring corals at 23 sites in 18 coastal fringing reefs in the Nui Chua Nature Reserve. They identified 307 coral species, with 46 new distribution records for Vietnam. These coral reefs are quite different from those further north (Hon Mun MPA, Na Trang Bay) and south (Con Dao National Park), indicating that the Ninh Thuan area will be a valuable component of a national MPA network. Contact: Kristian Teleki, icran@icran.org, www.icran.org

Outbreaks of COTS have been reported in several countries, including significant damage to the reefs around Tioman Island, Malaysia and to several reefs in Indonesia, the Philippines, Thailand and Vietnam. Increased sedimentation was reported to be a problem in many countries, with reports of decreasing water visibility along coastal areas, which was attributed to increasing rates of development, dredging and reclamation.

Coral Reef Management Status in Southeast Asia

Coral reef management in Southeast Asia has received poor press coverage for over a decade due to weak and ineffective management that is failing to reverse the alarming decline in reef health and resources. A comprehensive assessment of the status of MPAs of 9 of ASEAN has evaluated the threats to the marine environment, the status of the resources and the degree of management needs, along with recommendations for priority action. Over the last 15 years, there has been a proliferation of MPAs established and proposed in the region e.g. in 2002, over 630 declared and 185 proposed MPAs that included substantial marine areas and mangrove forests were identified. Philippines has the most, accounting for almost 80% of the total, and Indonesia, with the largest area of coral reefs, has only 29 declared and recognised MPAs. There are none in Myanmar.

Although the establishment of MPAs reflects growing awareness among governments of the need to solve the problems of environmental degradation, e.g. 88% of all coral reefs are under threat; good management and enforcement measures rarely accompany MPA declarations. Management in most MPAs remains inadequate, with 46% of declared MPAs having no or very little management, and only 10-20% are considered to be managed effectively. All these MPAs contain less than 11% of the coral reef area of SEA, with the exception of Thailand where 50% of the reefs are in reserves. More effort is required to strengthen planning and management of existing MPAs, and to establish new MPAs to cover areas of high conservation value. Coordination and sharing of experiences among the network of MPAs needs to be heightened, with a strong role envisaged for the ASEAN Regional Centre for Biodiversity Conservation (ARCBC) and the ASEAN working group of the World Commission on Marine Protected Areas (WCMPA), United Nations Environment Program (UNEP) and SSME-Network of MPAs.

Although there are many MPAs in Southeast Asia, the % of coral reefs within the MPAs is generally low and few MPAs have effective management.

	Brun	Camb	Indo	Mala	Myan	Phil	Sing	Thai	Viet
Total MPAs - Declared	6	1	29	16	4	500+	2	23	22
Additional MPAs - Proposed	2+	2	14+	1	1	150+	4	3	7
% Reefs Within MPAs	0	Unknown	9%	34%	2%	1%	0	50%	11%
% MPAs with good management	0	0	<3%	18 %	0	10%	50%	18%	8%

Brun=Brunei; Camb=Cambodia; Indo=Indonesia; Mala=Malaysia; Myan=Myanmar; Phil=Philippines; Sing=Singapore; Thai=Thailand; Viet=Vietnam

PARADISE ON EARTH – CON DAO, VIETNAM

Con Dao is one of the few remaining places in Vietnam where endangered animals like dugong, turtles, and dolphin occur, and where the biodiversity on the coral reefs is comparable with the best tourism destinations in Southeast Asia. Con Dao was declared a protected area in 1984 and a national park in 1993 to protect 20,000 ha; 14,000 ha of marine ecosystems, including mangroves, coral reefs, and seagrass beds, and 6,000 ha of land on 14 islands, surrounded by a 20,500 ha marine buffer zone. Since 1995, WWF has trained the park staff and local communities to conserve Con Dao's marine biodiversity. They have held technical workshops including hands-on experience with conserving marine turtles and dugong, marine biodiversity and environmental education, as well as study tours to Thailand, Malaysia, and the Philippines. Con Dao is a leading national park for marine biodiversity in Vietnam, and the park staff are training in other provinces, and are drawing on their staggering breadth of experience with their resource to assist with tackling problems and challenges raised during international conferences. Con Dao is being used as an example to demonstrate the importance of conservation for many Vietnamese. "I have never seen anything this beautiful. How valuable and wonderful are the things granted to us by nature. I am sure that snorkeling to see the coral reefs can be promoted on Phu Quoc Island, and will definitely attract a lot of tourists. This will both ensure the conservation of marine biodiversity and help the local economy," said Nguyen Hong Cuong, head of the District Department of Agriculture, Forestry and Fisheries of Phu Quoc Island District. The vice-chair of the People's Committee of Van Don District in Quang Ninh Province, Nguyen Hai Ly said, "Before we used to feel puzzled and lost because we thought that nature conservation conflicted with the needs of local people who in our coastal areas rely mainly on marine natural resources. But now we already see the solutions. We will definitely invite Con Dao National Park staff to our district to help us replicate their marine biodiversity conservation model." From: Keith Symington Marine Program Coordinator, WWF Indochina, keith@wwfvn.org.vn

Several new MPAs, such as Hon Mun and Cu Lao Cham, have been established in Vietnam by the Ministry of Fisheries, and others that were previously designated for terrestrial conservation have been amended to include conservation of coral reefs and related ecosystems e.g. Con Dao, Nui Chua, Phu Quoc, Cat Ba National Parks and Ha Long World Heritage site. However, the effectiveness of marine management is limited due to the low capacity for marine conservation. Only Hon Mun and Cu Lao Cham MPAs, and Con Dao National Park have implemented biodiversity surveys and zoning for resource use within the management plan. Several provinces and cities are preparing management plans for their coral reefs. The model for effective coral reef management is being developed in Ninh Hai district (Ninh Thuan) province where attempts are being made to resolve economic conflicts between different stakeholders using and conserving the reefs. Plans to establish small-scale 'no-take' zones are being developed for Ninh Hai and Van Phong Bay as the first-step towards more effective measures for integrated management of coral reefs.

In the Philippines, over 600 MPAs have been established, but only 10% of these were assessed as being managed effectively, primarily due to ineffective enforcement and confusion in designating

who is responsible for enforcement of MPAs under national programs. The management of many MPAs has been handed over to local community organisations, but monitoring is still lacking in most MPAs.

Government Legislation and Policy on Coral Reef Conservation in Southeast Asia

Numerous policies, programs and guidelines have been formulated over the last two decades for environmental conservation, but these are mostly 'soft' instruments like Memorandums, Declarations, and Resolutions. The 'ASEAN Declaration on Heritage Parks and Reserves' in 1984 provided guidelines and criteria to: select and establish ASEAN Heritage Parks; select ASEAN Marine Heritage Parks; and declare national MPAs. A preliminary list of ASEAN Heritage Parks, including MPAs, has been drafted but there are no current management plans.

The 'ASEAN Strategic Plan of Action on the Environment' (ASPAE) was established following recommendations of Agenda 21. Under the plan, several programs and strategies were drafted to address issues of biodiversity conservation and sustainable use, and protection and management of coastal zones and marine resources. The ARCBC working group aims for better cooperation in ASEAN on biodiversity conservation.

Most ASEAN countries have signed and ratified the major Multilateral Environmental Agreements and made attempts at aligning policies towards compliance. In addition, ASEAN has developed policies and legal responses relating to protected areas, including: Bangkok Declaration on the ASEAN Environment, 1984; Manila Declaration, 1987; Jakarta Resolution on Sustainable Development, 1987; Singapore Resolution on Environment and Development, 1992; Bandar Seri Begawan Resolution on Environment and Development, 1994; ASEAN Criteria for Marine Heritage Areas (AHP), 2002; ASEAN Agreement for the Conservation of Nature and Natural Resources, 1985 (not yet in force); ASEAN Agreement on Transboundary Haze Pollution, 2002; Hanoi Plan of Action, 1999–2004; and the Putrajaya Declaration of Regional Cooperation for the Sustainable Development Strategy of the Seas of East Asia (the PEMSEA Declaration), 2004.

There has been an increase in environmental consciousness within governments in the region, such that there are specific government ministries or agencies dedicated to environmental protection and natural resource management. These are replacing the previous system where many sectors had conflicting responsibilities for coastal and marine areas. However, there are still disputes over authority between national agencies, as well resistance from regional, state or provincial authorities if the programs clash with local interests.

Brunei

Coral reefs come under the jurisdiction of the Department of Fisheries, Ministry of Industry and Primary Resources with the inter-agency National Committee on the Environment providing some environmental coordination in association with the Shell petroleum company. Recent positive outcomes in Brunei, include a move by the Government to introduce a mandatory environmental impact assessment on major coastal projects.

Cambodia

The management of coral reef conservation is not well developed and is shared between many departments, including the Department of Fisheries of the Ministry of Agriculture, Forestry and Fisheries, and provincial governments and district governments. The Ministry of Environment

KOMODO NATIONAL PARK FINANCING AND MANAGEMENT: CONCESSIONS FOR ECO-TOURISM

The funding provided through the Government of Indonesia for Komodo National Park is insufficient for the needs of management. The revenues collected in the Park are not returned for management, which reduces the incentives to increase the infrastructure to attract more eco-tourists. The Ministry of Finance selected the Park as a pilot site for new MPA financing mechanisms and privatisation of tourism management. The strategy to sustain Park operations suggested by The Nature Conservancy (TNC) is to develop eco-tourism, and use some of the revenue to finance Park management. They have granted a tourism concession to a joint venture 'PT Putri Naga Komodo', with 60% of the shares held by TNC and 40% by an Indonesian tourism company, PT Jaytasha Putrindo Utama. The aim is to improve tourism infrastructure, collect tourism revenues, return revenue to Park management, and use some of the revenue for a community development fund. The Park management will assess options for gate fees to include a conservation fee and change the distribution system within the Park. Studies show that 'willingness-to-pay' is much higher than the present entrance fee of Rp 30,000 (about US$ 4) for 3 visitor days. To help set up the tourism concession, the Global Environmental Facility and TNC provided US$ 10 million over 7 years for start-up costs, operating expenses and carrying capacity studies for Park management. During this time, the Park will generate eco-tourism revenues of nearly US$ 8 million for management and district, provincial and central governments. The Park is expected to be financially self-sustaining after 7 years with an operational budget of US$ 2 million per year. The increasing revenue will be achieved through a combination of higher visitor numbers and a gradual introduction of additional fees.

The aim of the Komodo Collaborative Management Initiative (KCMI) is to ensure long-term effective management of Komodo National Park, through a collaborative management approach. KCMI will enhance stakeholder involvement in Park management, which is the exclusive mandate of the Komodo National Park authority (Balai Taman Nasional Komodo) at the moment. All important stakeholders will be involved, including the Park authority, local government, the Joint Venture PT Putri Naga Komodo, local communities, other government agencies and private sector organizations. A very important milestone was achieved in June 2004, when the Nature Tourism Enterprise License (IPPA) was signed by the Legal Bureau of the Forestry Ministry, which will enable the venture company, PT Putri Naga Komodo, to operate. From: Peter Mous, The Nature Conservancy, Bali Indonesia, pmous@TNC.ORG.

manages protected areas including coral reefs, seagrasses and mangroves. This creates overlap, moreover there are no effective laws to protect coral reefs, although fisheries laws do include protection of marine living resources. Fisheries staff members are tasked with enforcement, and protecting critical fisheries habitats such as mangroves, seagrasses and coral reefs. Coral harvesting was an important threat until 1997, but controls have tightened and corals have been confiscated from vendors.

TUN SAKARAN MARINE PARK, MALAYSIA

About 120 years ago, early explorers described *Semporna,* meaning a place of rest, as the most romantic place in Sabah. "Here turquoise blue seas are dotted with innumerable fantastic-shaped islands, spotted with verdure, and fringed with white sandy beaches, and coral reefs bearing Pearls, Pearlshells, Beche-de-Mer, and other valuable sea products are seen lying fathoms deep in its pellucid waters."

About 25 years ago, *Semporna* and the coral reefs were surveyed by marine biologists and described in similar way: "All the islands have considerable scenic appeal, and much to offer the visitor. The central islands are particularly dramatic, and also have an interesting flora and fauna. Surrounding waters are clear and the development of coral reefs extensive. The quality of the reefs, richness and diversity of marine life and variety of underwater habitats are superior to other areas around the coast of Sabah, and probably to Malaysia as a whole." They recommended that 8 islands, with Pulau Bodgaya and Pulau Boheydulong at the centre, be designated as the Semporna Marine Park.

In 1998, Sabah Parks, the Marine Conservation Society, WWF Malaysia, local government agencies, and island communities formed the Semporna Islands Project (SIP) to develop a plan to conserve the resources and provide for the people who depend on them. They formed a Local Community Forum of community workers and educational experts as well as scientists and environmentalists, using funds from the European Community. During the first phase (1998-2001) they assessed the status of the islands, reefs and resources, and the threats and problems. The site contained unique geology, high biodiversity, valuable natural products and stunning scenery on land and underwater. The surveys highlighted the threats to the attributes of the area, with special concern about the level of over-harvesting, and reef damage from fish bombing.

The Tun Sakaran Marine Park was gazetted in July 2004 as a 'biodiversity hotspot' and one of the most important sites for nature conservation in Sabah. The earlier attempts were unsuccessful, mainly due to fears about a loss of land and fishing rights by the local communities. The Park set a precedent because it is a mix of State Land, plus land with Native Titles and land claimed under Customary Rights. Special provisions were made in the Declaration to guarantee the rights and privileges of local people, assuring them that privately-owned land would not be acquired by the Government, and ensuring that owners of land and customary rights would be involved in all development proposals.

The most exciting challenge is that this is the first MPA in Malaysia to be zoned for multiple-use, with zones created to separate potentially conflicting activities and ensure that the conservation objectives are met. The zone boundaries are based on an understanding of the ecology, conservation and human needs, and the opportunities and threats of the different activities. They include a pelagic use/buffer zone, general use zones (e.g. for recreation and licensed, sustainable fishing), and no-take zones (to promote recovery of natural resources and maintenance of biodiversity). The main goal of the Tun Sakaran Marine Park is to ensure that the beauty, diversity, and bounty of coral reefs seen a

hundred years ago, remain for centuries. From: Elizabeth Wood, Marine Conservation Society, UK, e-wood@globalnet.co.uk); and Annadel Cabanban, Borneo Marine Research Institute, Universiti Malaysia Sabah, Malaysia, annadelc@ums.edu.my.

TUN SAKARAN MARINE PARK

	Physical Features
Geographical location	South-east coast of Sabah, near Darvel Bay, between 4°33'N to 4°42'N, and 118°37'E to 118°51'E. The closest island is Sebangkat (10km from Semporna); the furthest is Mantabuan (25km away).
Size	Total area 35,000 ha, with 954 ha of land (8 islands) surrounded by 34,046 ha of sea and coral reefs.
Geomorphology	The central islands (Bodgaya, Boheydulang, Tetagan) are the rim of an extinct volcano, inundated by the sea. The outer islands are low limestone platforms or sand cays.
Islands: physical features	The largest island is Bodgaya (795 ha; about 8 km long and 1.5 km wide) has 3 peaks between 455 m and 360 m high. Boheydulang is 313 ha and its highest peak is 353 m. The other islands (Tetagan, Sebangkat, Selakan, Maiga, Sibuan, Mantabuan) are less than 50 ha and no higher than 80 m. Mantabuan is the smallest (10 ha), with an elevation of 1-2m.
Reefs: physical features	The length of the reef front is more than 100 km, with one section 31 km long surrounding Sebangkat and Selakan, and enclosing an extensive shallow reef. Fringing coral reefs surround each island, and there are 2 patch reefs; Church Reef and Kapikan, and the bank reef of Mantabuan. A ribbon reef and submerged reefs exists in the Bodgaya-Boheydulang lagoon.
Water depth	The Park is on the edge of the Borneo Island Shelf; average water depth is 50 m off the western edge and 130 – 145 m off the eastern edge. The reefs extend to 20 m in the west (e.g. Sebangkat) and 50 m in the east (e.g. Kapikan).

Indonesia

The Office of the State Minister for the Environment has overseeing responsibility for environmental concerns, while the Directorate General for Forest Protection & Nature Conservation, the Ministry of Environment, the Ministry of Forestry and the Ministry of Marine Affairs are all linked to marine and coral reef management. Indonesia is implementing a Decentralized Environmental and Natural Resources Management Program, to devolve responsibility to regional and local government bodies for the protection of the environment and natural resources.

Malaysia

Restructuring of various ministries within the Malaysian government following the 2004 general election, has resulted in the formation of the newly created Ministry of Natural Resources and Environment (2004). This is the overall authority for environmental management in the

ACHIEVING SUSTAINABILITY IN MPA MANAGEMENT AFTER THE FUNDING STOPS: MABINI-ANILAO, PHILIPPINES

Implementing a 'Pay Before You Play' scheme with scuba divers solved the problem of achieving sustainability in the management of the 57,319 ha Mabini MPA. The Mabini local government in Batangas province, near Manila, Philippines charges divers who come from all over the world to view the beauty and high biodiversity of the reefs a modest fee of US$1 per day (locals pay the same rate and there is a cheaper annual pass), with 85% of this money being used for the conservation and monitoring of the area.

Mabini was not always an attractive dive site. The reefs had been scarred by heavy pressure from a growing population and by illegal destructive fishing methods, such as bomb and cyanide fishing. The local authorities and WWF combined in 1998 to conserve the vital marine resources and prevent further loss of coral cover. Their efforts stopped destructive fishing methods, and resulted in a significant reduction in illegal fishing. The reefs have largely recovered, and now there are 319 coral species, 262 fish species and more sightings of turtles, whales and dolphins. The bay waters are key migratory pathways for economically important tuna populations, and they are also a major fishing ground with 8,000 registered fishers around the bay. Although fishing intensity has not changed, the fish catch rates are higher using the traditional methods of nets and traps.

When the contributions from the major donor funds were ending in 2003, the Mabini municipality and WWF, along with divers, resort owners, boat operators, NGOs, fishers, and scientists established a dive tourist fund to support operations of the Bantay Dagat (Bay-Watch) in protecting corals and other marine resources in Mabini. Funds were particularly used for patrols, scientific monitoring and enforcement by providing patrol boats to catch the law-breakers. Thus the frequent problem of non-sustainability following withdrawal of government aid or private foundation donor funds was avoided. This funding issue is common in projects that have achieved the conservation goals. The park managers recognised that diving is a rapid growing industry with 600,000 new divers joining the 9 million registered scuba divers in the world each year. These divers look for the 'best' sites and are prepared to pay significant sums to protect marine habitats – as long as the money goes directly to reef protection.

Joey Fullon, the 'Planet Dive' operator on Mabini says "As a diver, I pay because I can tell my kids that if we had not started paying for the corals, there would be no coral reefs worth diving on." From: Ed Tongson, WWF Philippines; etongson@wwf.org.ph

country, while the management and conservation of coral reefs still falls under the Department of Fisheries in Peninsular Malaysia, and Sarawak and Sabah Parks and Department of Fisheries, Sabah. Various laws and regulations contribute to the management of marine resources.

Myanmar
The National Commission on Environmental Affairs handles environmental protection under the environmental policy document, the 'Myanmar Agenda 21', prepared for the Rio Summit of 1992. No framework for environmental laws exists, even though there is legislation relating to forestry and wildlife conservation. Coral reef management is under the jurisdiction of the Department of Forestry.

Philippines
Two government agencies (Environment and Fisheries) have the mandate to establish MPAs or fishery refuges. This leads to some jurisdictional issues. Coral reef management has been strengthened through a National Marine Policy aimed at developing a comprehensive program to manage coastal and marine resources in compliance with the United Nations Convention on the Law of the Sea. This requires that at least 15% of the coastal area in each municipality has to be declared as a fish sanctuary. A National Coral Reef Strategy is being prepared to provide an integrated management framework for the protection, conservation and rehabilitation of all coral reefs.

Singapore
Environmental management is under the jurisdiction of the National Environment Agency under the Ministry of the Environment and Water Resources. Recent progress has been made via the formation of Action Program Committees on Conserving Nature led by the National Parks Board to achieve the objectives of the Singapore Green Plan. This is a blueprint for environmental sustainability including programs to conserve coral reefs.

Thailand
There are laws and regulations that apply to all coral reefs, and additional measures for MPAs. Central agencies, provincial governments and the private sector have attempted coral reef conservation through restoration, preventive measures and education. Jurisdiction over marine resources is unclear and there have been conflicts with fisheries regulations, with the emphasis of marine park management being to support tourism, rather than protect resources or enforce regulations. The Department of Marine and Coastal Resources, Department of Fisheries and Marine National Park Authorities have laws to protect coral reefs; however, enforcement is weak, due to confusion and unclear understanding of the regulations.

Vietnam
Environmental protection is under the new Ministry of Natural Resources and Environment, assisted by the Vietnam Environment Protection Agency. Coral reef protection, however, is under the Department of Fisheries, which only recently has been provided with effective laws that include a comprehensive basis for marine resource management. They are tasked with developing a MPA network to include existing protected areas on the coast and islands.

Gaps in Monitoring and Conservation Capacity

Despite a long history in coral reef monitoring in SEA, gaps still remain to be addressed. There are initiatives under way to coordinate monitoring activities and information within the region, including collating information on past and present monitoring programs, archiving summary level information, establishing a database of organisations involved in coral reef monitoring and management, and developing plans for a coral reef monitoring network to focus regional activities.

SUSTAINING CORAL BIODIVERSITY IN MPAS: CASE STUDIES FROM INDONESIA AND VIETNAM

Bunaken National Park (N Sulawesi, Indonesia) is within the 'coral triangle', the centre of the world's tropical marine biodiversity, and Nha Trang Bay (formerly Hon Mun) Marine Protected Area (Khanh Hoa, Vietnam) is adjacent to the centre. Both MPAs encompass a group of islands just offshore from a major city (Manado in Indonesia and Nha Trang in Vietnam), and are subject to a number of mainland influences, including river run-off. The parks host rapidly developing national and international tourism operations, but importantly support significant local communities that are reliant on natural goods and services. The tourists now provide an increasing share of the operating costs, but can threaten the park's natural attractions unless well managed.

Both parks are considered 'flagship' MPAs and successful models for future implementation in the expanding global MPA network. They have adopted a co-management approach, with regular consultation and involvement of local villagers in decision-making via village MPA committees. Regular surveillance patrols enforce regulations in these MPAs, but both are subject to illegal fishing and poaching which are seriously reducing target fish stocks and overall diversity in Nha Trang Bay MPA. The MPA Authorities, local villagers and dive operators are working together to control destructive fishing and crown-of-thorns starfish (COTS) outbreaks, which are damaging the corals.

The initial phase of international support to implement these MPAs, primarily from US-AID Natural Resources Management Project III (Bunaken) and IUCN, World Bank and DANIDA (Nha Trang Bay), will cease in 2004-05. Thus it is timely to review progress towards sustaining a key biodiversity component, the reef-building corals. Like many parks, both were established without detailed assessment of biodiversity. The planning of boundaries and initial zones was based mostly on pragmatic socio-economic grounds even though both areas were recognised as having diverse reefs. Yet little was actually known of their particular biodiversity attributes, or whether the initial zoning schemes would be effective in conserving biodiversity.

Both parks are highly diverse, and host more than half of all Indo-Pacific reef-building coral species, including some which are globally rare. The richest locations are spectacularly diverse, supporting more than 190 coral species in less than 1 ha. These attributes strongly supported the selection as MPAs. Coral community analysis indicated, however, that the most diverse community type was not represented well in protected zones of either park. The management boards of the MPAs immediately set to work rectifying this situation based on detailed recommendations supported by good science, and all coral communities are now well-represented following an effective participatory process.

In Bunaken NP, coral cover, diversity and other indicators of ecological status demonstrate that present management initiatives are proving effective. The Bunaken reefs lie in the path of strong ocean currents that facilitate larval dispersal and enhance connectivity locally and among other coral populations in the region (a strong 'source and sink' function). The

currents are also important in alleviating heat stress and minimizing bleaching-related mortality, particularly during the recent major events. The selection of Bunaken NP as a flagship MPA in Indonesia and the developing MPA network for the region is well justified, especially given the increasing concern about global warming. The park provides a useful model for existing and planned MPAs, although its natural attributes place it at the higher end of the scale for resistance and resilience to disturbance; much higher than other parks.

In Nha Trang Bay, coral cover was much reduced by a combination of recent impacts. Despite the high overall diversity, local population sizes of many reef species are small in comparison with Bunaken NP, which is larger in area (approx. 7 times), and has stronger current flows that enhance connectivity. Consequently, reef communities in Nha Trang Bay may have lower resistance and resilience to disturbance, and more concerted management efforts may be required to rebuild ecosystem integrity. Issues of scale may prove to be very important, and a strong case can be made for expanding Nha Trang Bay MPA to include more reef habitat, thereby increasing local population sizes for corals, fish and other reef species in protected zones. However this will require more political will, management capacity, and stakeholder agreement. Importantly, Nha Trang Bay is the first in Vietnam's planned network of MPAs, and management capacity is thus expanding rapidly from a low base. Hence the park also provides a useful model for developing a regional network.

Significant national and local management capacity has been developed in both MPAs, however it remains to be seen whether this is sufficient to manage the parks effectively, while also contributing to the development of the larger network. The MPAs have demonstrated management flexibility, host significant tourism that contributes to sustainable financing, and also have a strong co-management focus. Yet both face enormous challenges in controlling threats such as inappropriate development and illegal fishing. Increased responsibility and 'ownership' by the local communities will be essential if the joint objectives of ecosystem protection and socio-economic development are to be achieved. Provincial and national governments, particularly in relation to fisheries and Integrated Coastal Management, can foster this through continued support.

Ongoing monitoring of the ecology of these MPAs is crucial to supporting management, and involving international donors. The coral reef science and conservation community is invited to offer continued assistance and guidance, if requested by the MPA managers.
From: Lyndon DeVantier, Emre Turak, Glenn De'ath, Vo Si Tuan, Bernard O'Callaghan, Chu Tien Vinh, Mark Erdmann, Reinhart Paat; contact l.devantier@aims.gov.au

MPA RATING AND DATABASE TO IMPROVE CORAL REEF CONSERVATION IN THE PHILIPPINES

The Philippines developed a national coastal resource management framework for sustainable use and conservation of the coastal and marine environment. The establishment of MPAs is one of the most effective strategies for biodiversity conservation and fisheries management. Since the 1970s, more than 600 MPAs have been legally established in the Philippines, however, fewer than 20% of these are fully enforced, and very few protect habitats or fisheries.

The Marine Protected Coast, Reef and Management Database (MPA Database) was developed by the Coastal Conservation and Education Foundation, Inc. (CCE Foundation) in 2001 to provide information on the effectiveness of MPAs in the Philippines. The MPA Database is a basic framework to monitor and evaluate MPA effectiveness against a minimum set of criteria on the success of management programs and public compliance. There is management rating to guide managers in implementation to increase the potential of MPA success. The system encourages regular ecological and socio-economic monitoring to measure actual success of the MPA and presents the data for easy access. The MPA Database has increased awareness and improved understanding on the functions and benefits of MPAs; focussing on 60 MPAs in 20 municipalities in the provinces of Cebu, Negros, Oriental, Bohol, Siquijor, Batangas, and Palawan, with collaboration with 7 national government agencies, 10 NGOs, 4 academic institutions and 5 coastal resource management projects. These partners added information on 200 more MPAs in 11 provinces. The MPA Database System is being expanded and provided to all user groups to improve education, adaptive management, policy recommendations and MPA management nationwide.

The MPA Database surveyed half of the 600 MPAs in the Philippines, with the majority (91%) being small community-based managed MPAs declared under the Local Government Code of 1991 that decentralizes the authority to manage municipal waters to local governments. About 9% are large parks declared by Protected Area Wildlife Bureau of the Department of Environment and Natural Resources within the National Integrated Protected Areas System Act in 1992. A major reason why many of the MPAs failed after establishment was that management groups did not know how to move to the next phase of management. The MPA Database will allow managers to evaluate their progress and identify weaknesses in implementation. The majority (57.5%) of 212 MPAs are still in levels 1 and 2; 33% are at level 3 with evidence of good enforcement; and very few (9%) are at levels 4 and 5. Many MPAs have difficulties in sustaining management efforts due to the lack of technical support, insufficient budget, and weak law enforcement. From: Alan White, Anna Blesilda Meneses, Melody Ovenden. The Marine Protected Area Project, Coastal Conservation and Education Foundation, Cebu City, The Philippines

Result of the management rating system for 212 MPAs in the MPA Database.

Rating Level	MPA Records #	%	Management Performance	Implications
Level 1	29	13.7%	Passing	MPA is in initiated phase; establishment activities have begun.
Level 2	93	43.9%	Fair	MPA is in established phase; the MPA is legalized and management activities have started.
Level 3	71	33.5%	Good	MPA is in enforced phase; MPA regulations are implemented and management activities maintained for 2 years or more.
Level 4	14	6.6%	Very good	MPA is in sustained phase; MPA is well enforced over the years; participation and support from the LGU and community is consistent.
Level 5	5	2.4%	Excellent	MPA is in institutionalised phase; management and enforcement is consistently maintained and assured by additional legal support.

Summary of coral reef surveys for 66 MPAs in 8 different provinces, with the emphasis on the health of corals.

Province	No. of MPAs with coral data	Area covered (ha)	Status of coral cover*							
			Poor		Fair		Good		Excellent	
			# of MPA	Area (ha)	# of MPA	Area (ha)	# of MPA	Area (ha)	# of MPA	Area (ha)
Palawan	1	33,200			1	33,200				
Batangas	5	37			2	12	3	25		
Bohol	18	315	8	225	4	50	6	40		
Cebu	18	317			6	143	9	144	1	10
Negros Oriental	10	187	1	6	5	76	4	105		
Siquijor	9	112	5	56	1	27	3	29		
Davao del Sur	2	70	1	20	1	50				
Sarangani	3	35					2	25	1	10
Total	66	34,273	15	307	20	33,558	27	368	2	20

* Poor – 0-25% coral cover; Fair – 26-50% coral cover; Good – 51-75% coral cover; Excellent – 76-100% coral cover

Initial information has highlighted key areas for immediate action to maintain coral reef management and conservation as a top priority. There is a critical lack of coral reef data storage facilities and data management systems in countries, as well as the region. Some countries, like Philippines and Indonesia, have well established data management facilities, making these the exception. Reporting on the regional coral reef status this time was difficult, and contradictory information was often presented because the data were not organised. Thus, a recommendation will be to form a regional network to strengthen the data management capacity of the countries. An initial attempt has been made, but more resources are needed to achieve this within the next two years.

An assessment of the current capacity and future needs for coral reef monitoring in SEA showed that there were requirements for more monitoring, especially of fishes and socio-economic parameters, as well as considerable capacity building across virtually all countries.

	Brun	Camb	Indo	Mala	Myan	Phil	Sing	Thai	Viet
CR Monitoring Sites & Methods Needs									
No of Monitoring Sites	+	0	+	+	+	+	0	0	+
Spread of Sites	0	0	+	+	+	0	0	0	0
Variety of Methods	+	+	0	0	+	0	+	0	0
Required Monitoring	Fish, S-E, P-C	Fish, S-E, P-C	Fish, S-E, P-C	Fish, S-E, P-C	Fish, Algae, Inverts, S-E, P-C	P-C	Fish, Algae, P-C	Fish, S-E, P-C	Fish, S-E, P-C
CR Monitoring Expertise & Training Needs									
Benthos Surveys: "High-level"									
Expertise	+	+	+	+	+	N	+	+	+
Training	+	+	+	+	+	N	N	+	+
Benthos Surveys: "Entry-level"									
Expertise	+	+	+	+	+	N	N	+	+
Training	+	+	+	+	+	N	N	+	+
Fish Surveys: "High-level"									
Expertise	+	+	+	+	+	N	+	+	+
Training	+	+	+	+	+	N	+	+	+
S-E Surveys: "High-level"									
Expertise	+	+	+	+	+	N	NA	+	+
Training	+	+	+	+	+	N	NA	+	+
Coral ID: "High-level"									
Expertise	+	+	+	+	+	N	N	N	+
Training	+	+	+	+	+	N	+	N	+
CR Monitoring Infrastructure & Funding Needs									
Dive equipment	N	+	+	+	+	N	N	N	+
Operational Costs (fuel, tank fills, etc)	+	+	+	+	+	+	+	+	+
Local Funding	+	+	+	+	+	+	+	+	+
International Funding	N	+	+	+	+	+	N	+	+

+ = An increase needed; 0 = Sufficient Monitoring; N = Not Necessary; NA = Not Applicable; S-E = Socio-Economic; P-C=Physico-Chemical; Brun=Brunei'; Camb=Cambodia; Indo=Indonesia; Mala=Malaysia; Myan=Myanmar; Phil=Philippines; Sing=Singapore; Thai=Thailand; Viet=Vietnam

NATIONAL POLICIES AND CORAL REEF MANAGEMENT IN THAILAND

A National Coral Reef Strategy: The Thai cabinet adopted the Policies and Action Plan in 1992. However, this failed to reverse coral reef degradation because it was not functional at the local level. The National Coral Reef Strategy: Policies and Action Plan is under revision, with new directions being mapped over 5 years, based on the national meeting held in January 2004. Ninety-eight projects were identified under 6 policy actions, with specific action measures. From: Thamasak Yeemin, Marine Biodiversity Research Group, Ramkhamhaeng University Huamark, Bangkok, Thailand, thamasakyeemin@yahoo.com

Policy	Measures	No. Projects
1) Manage coral reefs according to different ecological and economic values to maintain a balance of uses	1) Improve coral reef classification	3
	2) Determine criteria and measure for each management category	2
	1) Successful implementation of methods to prevent coral reef degradation from the pilot study sites to other areas	6
2) Reduce reef degradation by increasing the effectiveness of existing laws management plan and application of appropriate technology	2) Prevent impacts from new coastal developments	7
	3) Reef 'code of conduct'	3
	4) Expand local extension programs in fisheries habitat conservation	7
	5) Enforce more effectively existing laws against illegal activities	4
	6) Strengthen the capacity of local government in site planning and management	2
3) Build and maintain strong and broad public support	1) Launch national and local public information campaigns	7
	2) Encourage volunteer groups, user and public participation in reef management	11
	3) Coral reef curriculum in schools and colleges	6
4) Revise Royal Thai Government legal, regulatory, and institutional framework	1) Amend law and regulation concerning coral reef management	3
	2) Improve coral reef management processes	2
	3) Provide interagency leadership and coordination	6
	4) Develop marine national park system plan	4
5) Monitor and evaluate progress	1) National monitoring program	7
6) Support management through scientific research and innovation	1) Basic coral reef research program	9
	2) Applied coral reef research program	5
	3) Promote and develop researchers in the fields of reef and marine ecology	3

A needs assessment for SEA showed that the number of monitoring sites were sufficient for some counties, although some adjustments of sites may be required for better geographical analysis. The distinction between the terms *areas, sites, stations* and *transects* needs to be standardised, to facilitate comparisons between countries and to remove the biases in this report. For example, more sites are monitored in MPAs, or close to research stations and near tourism resorts, while remote sites are rarely visited.

Another area requiring attention is the standardization of monitoring methods, where possible, to minimise the increasing diversity, especially those used to monitor corals and other benthos. This assessment shows that several parameters (like % coral cover) are consistently monitored, whereas fishes and indicators to assess coral bleaching, diseases, invasive species and plague outbreaks, sea surface temperatures and socio-economic indicators are rarely included.

All countries reported a critical lack of coral reef monitoring expertise (but less so in the Philippines) to make meaningful assessments; therefore capacity building needs to be increased as a matter of urgency. In some of the less developed countries like Cambodia, Myanmar and Vietnam, there is insufficient infrastructure, basic equipment and funding for effective monitoring.

Recommendations to Improve Coral Reef Conservation and Management

The conservation and management of coral reefs is a priority issue in many SEA countries, and efforts are being made to enhance activities, programs and legislation to ensure better management of the resources. Despite an increased awareness and the implementation of proactive measures, more needs to be done at a regional level to integrate information and efforts. To this end, the following recommendations are proposed:

- Increase monitoring efforts and initiate integrated capacity building programs, which should include MPA management options. Ongoing monitoring programs are still insufficient and under-represented in some countries;
- Establish better coordination and cooperation within regions. SEA countries need to work more closely, exchange lessons learned and establish more joint-programs;
- Work towards better MPA effectiveness in coral reef protection and expand the network of MPAs. Coral reefs are not well represented in MPAs and more legislation is needed to protect coral reefs;
- Develop Reef Health Indices. Monitoring groups require robust and effective universal reef health indices to assess the status of reefs;
- Develop data management systems for coral reef information. Many countries lack data management systems, and are unable to contribute effectively to a regional database; and
- Increase public awareness and education programs. The public can have a strong influence on policy and legislation, and more efforts are needed to involve the public by keeping them better informed on coral reef issues.

Reviewers

Barbara Brown, Centre for Tropical Coastal Management Studies, University of Newcastle, UK, b.e.brown@ncl.ac.uk; Lyndon DeVantier, International Marine Project Activities Centre, Townsville Australia, l.devantier@aims.gov.au; Beverly Goh, National Institute of Education, Nanyang Technological University, Singapore, bgoh@nie.edu.sg; Maylene Loo, South Australian Research and Development Institute, Adelaide, Australia, Loo.Maylene@saugov.sa.gov.au.

Author Contacts

Karenne Tun, The WorldFish Center, Penang, Malaysia, k.tun@cgiar.org; Loke Ming Chou, Department of Biological Sciences, National University of Singapore, Singapore, dbsclm@nus.edu.sg; Annadel Cabanban, Borneo Marine Research Institute, Universiti Malaysia Sabah, Malaysia, annadelc@ums.edu.my; Vo Si Tuan Institute of Oceanography, Nha Trang, Vietnam, thuysinh@dng.vnn.vn; Cleto Nanola for PHILREEFS, Marine Science Institute, University of Diliman, Quezon City, Philippines, ting@upmsi.ph; Thamasak Yeemin, Ramkhamhaeng University, Faculty of Science, Huamark, Bangkok 10240, Thailand, thamasakyeemin@hotmail.com; Suharsono, COREMAP, Jakarta, Indonesia, harsono@coremap.or.id; Kim Sour, Department of Fisheries, Cambodia, sourkim@hotmail.com; David Lane, Universiti Brunei Darussalam, Brunei Darussalam, davelane@fos.ubd.edu.bn.

Supporting Documents

(A full list of references can be obtained from www.reefbase.org**)**

Key websites for Southeast Asia: Fishbase, www.fishbase.org; Reefbase, www.reefbase.org, World Resources Institute, www.wri.org.

The following National Status of Coral Reef Reports are lodged on Reefbase, www.reefbase.org:

Cheung CPS, Alino PM, Uychiaoco AJ, Arceo HO (2002). Marine Protected Areas in Southeast Asia. ASEAN Regional Centre for Biodiversity Conservation - Department of Environment and Natural Resources, 128 p.

Chou *et al*, (in prep). Coral Reefs in One of the World's Busiest Ports.

Hidayati, 2003. Coral Reef Rehabilitation and Management Program in Indonesia.

Kim *et al*, (in prep). The Coral Reefs of Cambodia: Present State of Information and Management Capacity.

Koh, 2003. Change and Protected Areas: The Legal and Policy Response in ASEAN.

Nañola C, (submitted). Status Report On Coral Reefs Of The Philippines-2004.

Tan, 2003. Recent Institutional Developments on the Environment in Southeast Asia – A Report Card on the Region.

Tuan, VS(in prep). Coral reefs of Vietnam: Recent Status and Conservative Perspectives.

Yeemin T, (in prep). Status of Coral Reefs in Thailand.

ICRAN

BUNAKEN NATIONAL PARK, INDONESIA – ICRAN DEMONSTRATION SITE

Bunaken National Park (BNP) is on the northern tip of Sulawesi and covers 890 km^2 of diverse reefs and large mangrove forests. The initial management problems included destructive fishing and farming practices, poorly planned coastal development and unethical business and political practices. These problems lead to mistrust amongst local stakeholders and managers, which, combined with disorganised management strategies, resulted in poor compliance with management objectives and unclear zoning regulations. In response to stakeholder demands for fair and accountable management, a representative management advisory board (effectively a co-management strategy) was developed to manage revenues generated from the new park entrance-fee system, and to coordinate patrols and conservation and development activities.

The goal of the fee system was to fully support the BNP Authority , with an annual target of US$250,000. Now, 80% of the revenue supports conservation programs, including enforcement, education, waste management, and village development, while the remaining 20% is divided among the local, provincial, and national governments. Stakeholders also demanded that the 8 zone system be simplified to reflect the 3 primary values: conservation; tourism; and fisheries. The conservation and tourism zones are 'no-take' and include reef fish spawning aggregation sites and long-established dive sites. A joint patrol system has significantly reduced blast fishing and cyanide fishing, illegal coral mining and mangrove cutting. Higher compliance has resulted in an increase in coral cover and abundance of commercial fish species.

The key to achieving sustainable management has been a massive effort to create a single 'community' with a strong sense of awareness and ownership of the marine resources. To facilitate co-management, the management advisory board consists of government agencies, village stakeholders and representatives of the tourism sector, academia, and NGOs. Furthermore, all 22 villages are represented in the BNP Concerned Citizen's Forum, which allows villager input into management decisions as well as serving to socialise management policy to its constituents and improve communication among all interest groups. Strong private sector participation in park management has resulted in a commitment to increase employment of locals, participation in educational programs, and assistance with park enforcement.

Ecological Monitoring: The Bunaken National Park Office has monitored reefs for the last 5-6 years, and conducted training on coral identification, monitoring and mapping. There is a need for additional benthic, fish and spawning site monitoring.

Socio-economic Monitoring: There has been minimal monitoring of villager income.

Contact: Widodo Ramono, Department of Forestry, wsramono@eudoramail.com

Coral reefs are **60%** of the natural resources.
Ecological Monitoring is **occasional**.
Socio-economic Monitoring is **occasional**.

ICRAN

MU KOH SURIN, THAILAND –ICRAN DEMONSTRATION SITE

Mu Koh Surin National Park is in the Andaman Sea, 50 km off of Thailand's western coast. The Surin Islands are the southerly extension of the Mergui Archipelago and are surrounded by extensive reefs, mangroves and seagrass beds. A population of sea gypsies inhabits the islands and is responsible for much of the target species fishing. The primary resource users, however, are tourists and associated Park fees, dive fees and boat permits contribute significantly to the Park budget. The Marine National Park Division of the National Park, Wildlife and Plant Conservation Department currently manages the park.

The current management plan details the division of the park into 6 areas: mooring buoy installation and maintenance; patrolling of the marine area; enforcing fisheries regulations; temporary closure of areas for rehabilitation of the reefs; and no-commercial fishing regulation within 3 km offshore. Tourism and public education elements of the management plan include the park fees (an entrance fee and scuba diving fee), park permits for tour boats, public education and media awareness programs, and community programs. Finally, the management plan includes an economic incentive program for the Sea Gypsies. As part of the ICRAN project, Mu Koh Surin National Park, together with volunteers and universities, has developed a series of reports on: the status of coral reefs of the Surin Islands; management recommendations and indicators; student research on coral reef fish and scleractinian corals; local communities and other management issues. Researchers have completed a baseline assessment of the ecology, objectives, management activities and current legislation of the national park, and have refined future management plans. Studies on coral recruitment have helped park managers predict natural recovery and aid in reef restoration efforts. A public awareness program was developed, including the installation of permanent signs and a Thai translation of the "Coral Reef Monitoring for Management". A database of articles and research has been developed and a geographic information system including underwater video images was completed for Mu Koh Surin.

Ecological Monitoring: The Phuket Marine Biological Center, Kasetsart University, and Reef Check are responsible for much of the ecological monitoring in Mu Koh Surin, with help from volunteer groups supported by the Singapore International Foundation and Ramkhamhaeng University.

Socio-economic Monitoring: Socio-economic evaluation of indigenous sea gypsy livelihood has been conducted, and established monitoring programs are jointly managed by Singapore International Foundation and the Park.

Contact: Thamasak Yeemin, Ramkhamhaeng University (thamasakyeemin@yahoo.com)

Coral reefs are **60%** of the natural resources.
Ecological Monitoring is **effective.**
Socio-economic Monitoring is **effective**.

ICRAN

APO ISLAND, PHILIPPINES – ICRAN DEMONSTRATION SITE

Apo Island is of one of the earliest community-based marine reserves. Reef protection began informally when Silliman University initiated the Marine Conservation and Development Program in 1982. Years later, the island community and the local council formally agreed to the establishment of a marine reserve surrounding the entire fringing coral reef of the island and a smaller (0.45 km^2) 'no take' fish sanctuary. The island is now managed by the Marine Management Committee of the Apo Island community with support from the Municipal Government and Silliman University. The community is now prospering in a sustainable way with a steady increase in the standard of living, evidenced in the growing number of houses made from cement. Studies on Apo fishery management have presented some of the first evidence that Marine Protected Areas can create a sustainable fishery: an increased catch per unit effort, maintenance of fish yields (19-25 t km^2 per year) for the past 2 decades, and a change in fishing patterns; drift gill-nets, used in deeper offshore water, are no longer commonly used.

As part of the ICRAN project Apo Island is paired with Ninh Thuan, Vietnam (Box p 253) to share knowledge and experiences. Site visits between key stakeholders have involved the transfer of lessons learned from Apo, specifically the importance of 1) communication amongst communities, 2) designation of a community organiser to lead, and 3) involvement of local communities in protecting their marine resources. Apo Island also hosted a "Workshop on Capacity Building in Community-Based Coastal Resources Management" focusing on the role of the community organiser, enhancement of community-based management, the role of mass communication in building public awareness, and development of sustainable tourism. Additionally, Apo Island has completed a baseline assessment of existing management schemes as well as an assessment of contamination in the coastal waters to analyse the impact of resort waste . Other activities have included a poster contest to increase public awareness, with the proceeds contributing to the communities' alternative livelihood project, and tourism impact studies which examined coral breakage and tourist numbers and activities.

Ecological Monitoring: A fish monitoring program is in place. Reef Check surveys have been undertaken since 1998 and studies have been done by Silliman University.

Socio-economic Monitoring: A monitoring program that examines the impacts of tourism on the coral reef was planned to commence in 2003.

Contact: http://mozcom.com/~admsucrm/apo.htm

Coral reefs are **70%** of the natural resources.
Ecological Monitoring is **effective.**
Socio-economic Monitoring is **planned.**

ICRAN | WHS | MAB

KOMODO NATIONAL PARK, INDONESIA – ICRAN DEMONSTRATION SITE

Komodo National Park, in the Lesser Sunda Islands of Indonesia, encompasses a number of islands, the largest of which are Komodo (34,000 ha) and Rinca (20,000 ha). While it is best known for the large endemic lizard, the Komodo dragon, the waters are very rich in marine life, supporting more than 200 hard coral species, seagrasses, mangroves, manta rays, 16 species of cetaceans, turtles, and over 1000 fish species. Nearly 113,500 ha of waters surrounding the island are under the jurisdiction of the park. Komodo National Park was established as a Biosphere Reserve by the United Nations in 1977, pronounced a National Park in 1980, and declared a World Heritage Site in 1991. A 25-year management plan was developed for the park in 1995 with the goal of obtaining a well-managed, self-sustaining park that effectively protects biodiversity, enhances fisheries and ensures sustainable use (tourism and education) of the Park resources, whilst maximising benefits to the local communities.

The park is still threatened by over-exploitation of the natural resources and destructive fishing. In an effort to reduce these threats, managers of Komodo conduct comprehensive community outreach and conservation awareness campaigns, promote sustainable livelihood activities, have a strong patrolling and enforcement program, and encourage ecotourism. Komodo also promotes public awareness through events such as Dive In To Earth Day cleanup dives and a Crown-of-thorns removal event. Park staff and dive operators have participated in a workshop coordinated and hosted by the Coral Reef Alliance on best practices for dive operators.

Komodo is focused on MPA development and helping its paired site from China (Sanya Nature Reserve) to improve management. During a manager's workshop, Komodo prepared a rough guide to assist Sanya in assessing the sources of stress to corals. After a change in the ICRAN pairs of East Asian sites, the Koh Rong delegation from Cambodia visited the activity sites of The Nature Conservancy (TNC) in and around Komodo, such as the community-based fish growout farms, pelagic fisheries alternative livelihood, mooring buoy program, fish monitoring training, spawning aggregation site, and seaweed culture project to pass on their experiences and lessons learned.

Ecological Monitoring: Every 2 years TNC monitors 185 sites for corals, fish, and grouper and wrasse spawning aggregation sites.

Socio-economic Monitoring: TNC conducts socio-economic studies regularly and undertook a baseline assessment of existing management schemes of the ICRAN project.

Contact: Rili Djohani, The Nature Conservancy (rdjohani@attglobal.net)

Coral reefs are **40%** the natural resources.
Ecological Monitoring is **effective.**
Socio-economic Monitoring is **effective**.

WHS

TUBBATAHA REEF NATIONAL MARINE PARK, PHILLIPPINES

The Tubbataha Reef National Marine Park consists of 2 uninhabited coral atolls in the Sulu Sea, 92 miles southeast of Palawan. The coral reef biodiversity is outstanding, making the location important ecologically and a popular dive site. The park covers 33,200 ha with many species: 379 corals; 441 fish; 6 sharks; 7 seagrasses; 79 algae; and 8 cetaceans. The islets are important nesting sites for sea birds and turtles. Despite being remote, the Tubbataha reefs were damaged in the 1980s by bomb fishers from the Philippines, Taiwan and China. Although fishing was limited by the monsoons, living coral on the reef-flats decreased by 24% in 5 years. The reefs are managed by the multi-sectoral Tubbataha Protected Area Management Board under the auspices of the Palawan Council for Sustainable Development and the Department of Environment and Natural Resources. Technical assistance is provided by research institutions and NGOs, with financial support from the government, external grants, and user fees.

Long-term collaboration by the stakeholders reversed the damage from illegal fishing, anchors, and collection of marine animals. Dedicated NGOs conducted research, installed mooring buoys, built a field station, and are responsible for park management with the Philippine government. Tubbataha is the only MPA in the Philippines, which is routinely patrolled by the Philippine Navy and Coast Guard. Private tourism operators assist in law enforcement and management decision-making. This strong collaboration between government, NGOs, and the private sector is critical for the conservation of this valuable marine resource.

Ecological Monitoring: WWF-Philippines have conducted substantial, annual monitoring since 1997; this is now included in the annual work and financial plans of the management board.

Socio-economic Monitoring: The need for socio-economic monitoring and sustainable resource management on Cagayancillo Island, 120 km northeast of Tubbataha is recognised in Management Plan. Information, education and communication activities have strengthened local law enforcement and support for marine conservation initiatives. Local marine reserves and training packages have been established in partnership with the local government, which conducts socio-economic monitoring in collaboration with the Park managers and WWF.

Monitoring Effectiveness: Baseline data from 1997 to the present contribute to management decision-making. Socio-economic monitoring has identified the community interventions needed improve the standard of living in Cagayancillo.

Contact: Angelique Songco, (tmo@mozcom.com).

Coral reefs are **30%** of the natural resources.
Ecological Monitoring is **effective.**
Socio-economic Monitoring is **effective**.

MAB

PALAWAN, PHILIPPINES – MAN AND THE BIOSPHERE RESERVE

The Palawan Biosphere Reserve includes the entire Province of Palawan, in the Philippines, covering around 14,000km^2 and populated by 750,000 people. Palawan has 1,700 islands and islets, and was declared as a Biosphere Reserve, one of only two in the country, by UNESCO in 1991. Within its territory is the Tubbataha Reef Marine Park which was inscribed on the World Heritage list in 1993. The province has a unique and diverse fauna and flora and is known as a 'last ecological frontier'. Palawan has some of the best developed coral reefs in the country, with fringing and patch reefs along most of the coast and live coral cover reaching between 50 - 90% in some places. However, agriculture, fishing (especially with explosives and poisons), mineral extraction and offshore oil and natural gas, as well as tourism, threaten the environment.

In 1992, a 'Strategic Environmental Plan' for Palawan was adopted and through it an 'Environmentally Critical Areas Network' is being implemented. The Environmentally Critical Areas Network is a system of management zones graded from strictly protected to development areas. The terrestrial component has a core zone, a buffer zone (divided into restricted, controlled and traditional use areas) and a multiple/manipulative use zone. The coastal/marine component also has a core and multiple use zone.

Ecological Monitoring: Reef Check has been conducted in Palawan since 1997 and the Marine Science Institute of the University of the Philippines has included Palawan in their occasional nation wide surveys of coral reef health.

Socio-economic Monitoring: Rapid Rural Assessment (RRA) of the coastal areas of in Palawan is currently ongoing.

Coral reefs are **30%** of the natural resources.
Ecological Monitoring is **effective**.
Socio-economic Monitoring is **effective**.