

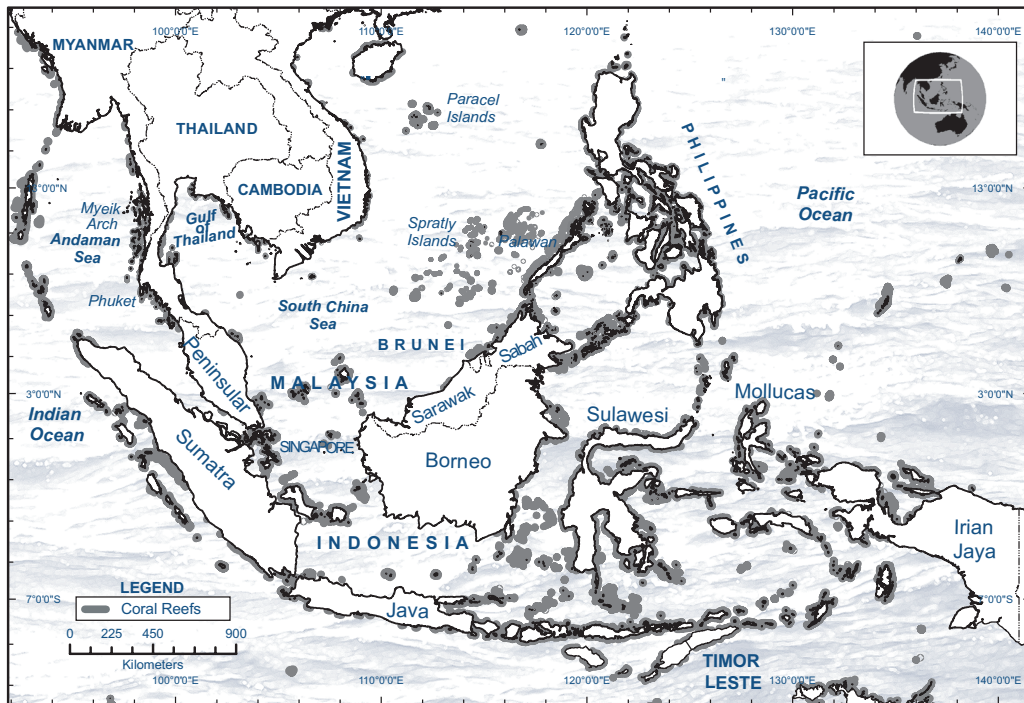
## 9. STATUS OF CORAL REEFS IN SOUTHEAST ASIA

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### ABSTRACT

- Between 2004 and 2008, the condition of coral reefs improved in Thailand, Philippines, Vietnam and Singapore but declined in Indonesia and Malaysia (however, many reefs were not assessed);
- Coral reef status in Cambodia, Myanmar and Timor-Leste (p. 176) is largely unknown, there is no new information from Brunei, but little change is expected;
- Timor-Leste is included for the first time as the tenth Southeast Asian coral reef country;
- Coral reef area estimates of just under 100 000 km<sup>2</sup> for the region are probably a gross overestimate; recent GIS analysis in Thailand and Singapore shows reef area is approximately 10 times lower, possibly because non-reef sea areas were previously included;
- The 2004 Indian Ocean tsunami caused localized coral reef damage in Indonesia, Thailand and Malaysia. Post-tsunami assessments indicate there was severe localised damage in a few areas, and minimal damage on most reefs. Recovery from the tsunami is expected to take 5–10 years for most affected reefs, and 20 years for severely damaged reefs;
- Fish stocks in the Gulf of Thailand and South China Sea assessed under the UNEP/GEF South China Sea Project indicate that most stocks are under high fishing effort, with most target species considered fully fished or over-fished;
- Losses of seagrass habitats are estimated at 30 – 60% in Indonesia, Philippines, Thailand and Singapore; but largely un-assessed in other SEA countries;
- More than 50% of the region's mangroves have been lost, with 10% of the losses occurring between 1993 and 2003;

- Socioeconomic assessment has expanded greatly since 2004 in Southeast Asian countries, particularly Indonesia and the Philippines;
- An assessment of MPAs of East Asia in 2005–2007 showed the number of MPAs with coral reefs increased from 178 in 2003 to 403 in 2007;
- Large-scale, multi-agency projects have increased, including: The Coral Triangle Initiative; UNEP/GEF South China Sea Project; WWF Sulu-Sulawesi Marine Ecoregion Programme; GEF Coral Reef Targeted Research for Capacity Building and Management; EU project on Developing Ubiquitous Practices for Restoration of Indo-Pacific Reefs and Green Fins Programme;
- Coral reef management has improved in most countries, but is still lacking in Cambodia, Myanmar and Timor Leste;
- The first Asia Pacific Coral Reef Symposium in Hong Kong in June 2006 was spearheaded by the GCRMN Nodes of East Asia and Southeast Asia; the second symposium is scheduled for Phuket, Thailand in 2010;
- A region-specific meta-database and summary programme is needed to be integrated into the ReefBase platform for better data awareness and management.



## INTRODUCTION

South-east Asia (SEA) contains the largest area of coral reefs with 34% of world's total; the region is regarded as the global centre of tropical marine biodiversity, with 600 hard coral species and more than 1300 reef-associated fish species. 'Hot spots' of hard coral diversity are widely distributed within the region, with many sites containing more than 200 coral species. Most reefs within SEA are on the continental Sunda and Sahul Shelves, with all reef types found here – fringing, platform, barrier reefs and atolls.

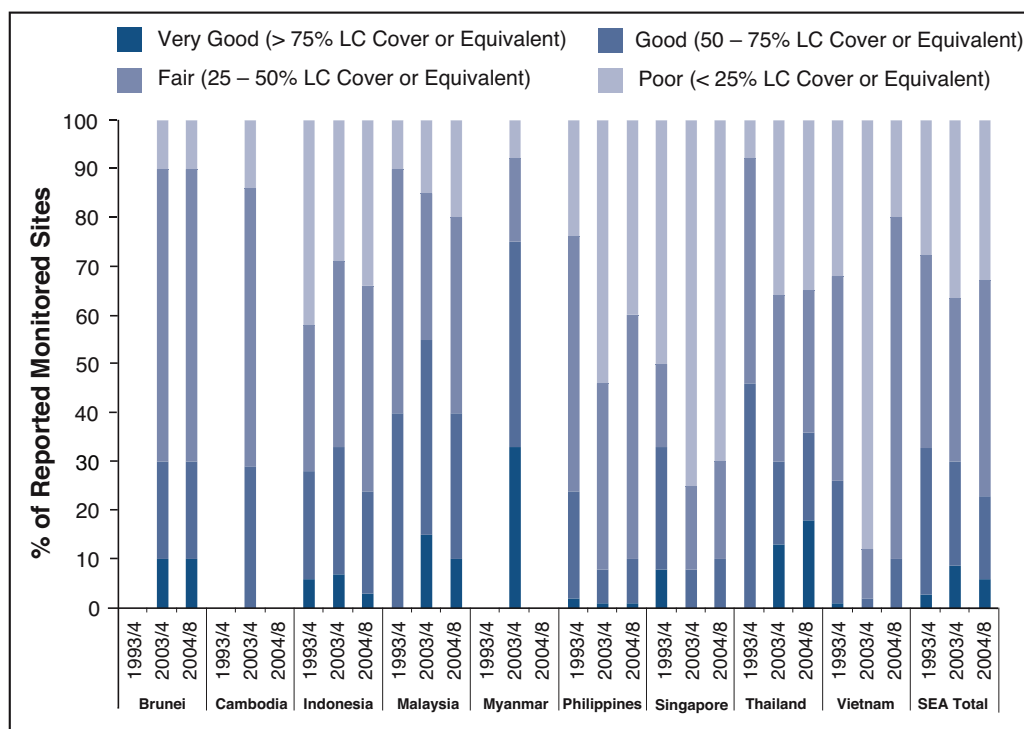
More than 60% of the 557 million people of SEA (Population Reference Bureau, [www.prb.org/](http://www.prb.org/)) live within 60 km of the coast and many of these are intrinsically linked to the resources of the coast, especially coral reefs. Although many cities in SEA are developing and growing rapidly, most people of Indonesia, Philippines, Thailand, Vietnam and Cambodia remain highly dependent on coastal resources for their livelihoods, especially through fisheries. In 2002 an assessment of the potential economic value of well managed coral reefs in SEA was US\$12.7 billion, representing more than 40% of the estimated global value. With current global financial instability characterized by increasing inflation and a depreciating US dollar, the estimated potential economic value is expected to be higher.

The global 'Reefs at Risk' (R@R; [www.reefsatrisk.wri.org](http://www.reefsatrisk.wri.org)) assessment in 2002 'red-flagged' SEA coral reefs as the most threatened in the world and identified over-fishing and destructive fishing as the main threats, along with sedimentation and pollution, facing the reefs, with coastal development fast becoming a major threat in many coastal areas. The 'Status of Coral Reefs of the World: 2004' report echoed this sentiment of continual reef decline; but it also highlighted increasing awareness and management initiatives within the region.

## STATUS OF CORAL REEFS IN 2008

The biodiversity value of SEA coral reefs is unparalleled in the world with more coral and fish species than anywhere else including a high proportion of endemic species of corals, fishes, echinoderms and other reef species. Over the last 30 years there has been rapid population growth across the region resulting in a corresponding increase in coastal resource exploitation. Over-fishing and unsustainable fishing practices have led to declining fish stocks in almost all SEA countries, pushing many fishers to resort to destructive fishing practices like bomb and cyanide fishing to obtain food and fish to sell. This is especially evident in Indonesia, Philippines, Thailand, East Malaysia (Sabah) and Vietnam. An unfortunate outcome from this coastal fisheries dilemma is damage or destruction to coastal habitats like mangroves, seagrass beds and coral reefs. While efforts to restore or rehabilitate damaged or destroyed mangroves and seagrass beds have seen encouraging success, recovery of coral reefs has been far less successful.

Coral reef monitoring between 2004 and 2008 indicate that reefs continue to show an overall decline in condition in Indonesia and Malaysia, while there have been slight improvements in the overall reef condition in Philippines, Singapore and Thailand. The greatest improvement in reef condition however, was in Vietnam where most reefs in the 'poor' category shifted to the 'fair' category. This may not be a true reflection of the status as data for 2005–2006 were based on data summaries of 10 areas extracted from the UNEP/South China Sea Project GIS database and may not match the sites reported in previous status reports. Although updated coral status information was not available for Brunei, the reef conditions are expected to have remained unchanged, thus reflecting the same estimates reported in 2004.



***This graph shows the changes in live coral cover (as %) at reported monitoring sites in the Southeast Asian region between 1994 and 2008. There has been a general decline in those reefs previously with 'Very Good' and 'Good' coral cover, with a parallel increase in reefs with 'Fair' cover.***

The status of coral reefs in Cambodia, Myanmar and Timor-Leste (p. 176) remains largely unknown. There were status summaries in 2004 for Myanmar and Cambodia; but no verification or 'guesstimates' can be provided for this 2008 report. Assessments in 2004 and 2006 of the coral reefs in Timor-Leste around Atauro Island are summarized in the Box p. 176. These gaps for Myanmar, Cambodia and Timor-Leste emphasise the need for improved monitoring in the future.

The deadly Indian Ocean Tsunami of 26 December 2004 caused massive death and destruction on land but did not cause similar damage underwater. Post-tsunami assessments between 2005 and 2006 showed that the earthquake and resulting tsunamis damaged exposed areas in Indonesia, Thailand and Malaysia, with damage to coral reefs reported to be severe but localised in a few areas and minimal in most areas. Recovery from tsunami reef damage is expected within 5–10 years for most affected reefs, and up to 20 years for more severely damaged reefs. These results of post-tsunami country assessments were published in a 2006 GCRMN publication, '*Status of Coral Reefs in Tsunami Affected Countries: 2005*'.

The current published estimates of coral reef area for SEA is about 100 000 km<sup>2</sup> (R@R in Southeast Asia, 2002; MPAs of Southeast Asia, 2002). Recent GIS assessments by Thailand

and Singapore indicate that actual coral reef areas are about 10 times less, probably because the published estimates include sea areas surrounding the coral reefs in the assessment; the lagoons and not just the coral growth areas. Presumably, estimates for the other countries are similarly overestimated. A regional assessment to determine actual coral reef area will provide crucial information to determine coral reef status in the region. For example, threats to coral reefs may be more significant if actual estimates of coral reef area are lower than the reported estimates of 100 000 km<sup>2</sup> for the region.

Estimation of the proportion of reefs lost, and those under immediate and longer-term threat of loss should be based on a valid assessment matrix, similar to that developed for the R@R assessments. The current loss estimates are opinions of national experts based on their experience and local knowledge. These estimates are a mix of quantitative and qualitative assessment and increase confidence that they reflect the status of reefs in the region.

#### **GREEN FINS – A NEW PROGRAMME FOR CORAL REEF CONSERVATION**

*‘To protect and conserve coral reefs by establishing and implementing environmentally friendly guidelines to promote a sustainable diving tourism industry’*: that is the mission of the Green Fins Programme, initiated in 2004 by the UNEP Coordinating Body for the Seas of East Asia (COBSEA) to address the impacts of the diving and snorkelling industry on the coral reef habitats. The programme now operates in the Philippines, Thailand, Indonesia and Malaysia; all countries with large diving and snorkelling tourist industries. The unique angle of Green Fins is that it targets the environmental practices of dive operators and organisers of snorkelling groups by promoting environmentally friendly guidelines for divers. By involving dive operators as partners in the sustainable use of coral reefs, they also hope to raise the environmental awareness of the diving community. This is achieved through capacity building, training, certification programmes and the distribution of educational material:

- They have published a ‘Code of Conduct’ for 15 critical issues affecting reefs, including water quality, garbage/food waste management, mooring buoys, and boat discharges;
- Green Fins operators sign a pledge to manage and improve environmental practices and agree to be assessed and involve their staff and guests in on-going reef projects, such as the Reef-World ADOPT-A-REEF project with regular reef monitoring; and
- In Thailand, the Green Fins teams use the Reef Watch monitoring method, which is a one-dive-one-survey method for commercial operators and their guests (see data on [www.greenfins-thailand.org](http://www.greenfins-thailand.org)).

More information on Green Fins can be found on [www.greenfinsphilippines.com](http://www.greenfinsphilippines.com) or [www.greenfins.net](http://www.greenfins.net).

	BN	KH	ID	MY	MM	PH	SG	TH	TP	VN
<b>General Reef Demographic Statistics</b>										
Reef area (km <sup>2</sup> ) - Global Est.	187	150	50 875	4006	1686	25 819	50	2,130	Currently Unknown	1122
Reef area (km <sup>2</sup> ) - Country Est.	187	28↓*	50 875	4006	1686	25 819	<5↓*	150↓*	Currently Unknown	1122
Est. % Reefs lost (cf. reefs 100 yrs ago)	-	-	-	-	-	-	60	-	Currently Unknown	-
Est. % Reefs under immediate threat of loss	-	-	-	-	-	-	<10	-	Currently Unknown	-
Est. % Reefs Under Long-Term Threat of Loss	-	-	-	-	-	-	<25	-	Currently Unknown	-
<b>Overall Reef Condition</b>										
No. of Hard Coral Species	185	111	590	400	64	464	197	250	Unknown	400
Very Healthy (>75% LC cover or equivalent measure)	10↔ <sup>1</sup>	No new data	3↓ <sup>2</sup>	10↓ <sup>3</sup>	Not known	1↔ <sup>4</sup>	0↔ <sup>5</sup>	18↑ <sup>6</sup>	Not reported	0↔ <sup>7</sup>
Healthy (50–75% LC cover or equivalent measure)	20↔ <sup>1</sup>	No new data	21↓ <sup>2</sup>	30↓ <sup>3</sup>	Not known	9↑ <sup>4</sup>	10↑ <sup>5</sup>	18↑ <sup>6</sup>	Not reported	1↓ <sup>7</sup>
Fair (25–50% LC cover or equivalent measure)	60↔ <sup>1</sup>	No new data	42↑ <sup>2</sup>	40↑ <sup>3</sup>	Not known	50↓ <sup>4</sup>	20↑ <sup>5</sup>	29↓ <sup>6</sup>	Not reported	70↑ <sup>7</sup>
Poor/Very Poor (<25% LC cover or equivalent measure)	10↔ <sup>1</sup>	No new data	34↑ <sup>2</sup>	20↑ <sup>3</sup>	Not known	40↓ <sup>4</sup>	70↓ <sup>5</sup>	35↓ <sup>6</sup>	Not reported	20↓ <sup>7</sup>
<b>Reefs at Risk 2002 (Integrated Threat Index)</b>										
% Low	79	0	14	13	44	2	0	23	-	4
% Medium	16	0	39	44	36	27	0	24	-	22
% High	5	90	46	38	20	63	100	51	-	49
% Very High	0	10	1	4	0	7	0	1	-	25
<b>Expert Projections in Ranking of the 5 R@R Threats Indicators (2008 VS 2002 Assessment)</b>										
Coastal Development	High#	High#	Low	High#	Low	High#	High	Low	Low◇	Low-Med
Marine-Based Pollution	Low	High#	Low	Low	Low	High#	High	Low	Low◇	Low-Med
Sedimentation	Low	High#	Low	Low	Low	Low-Med	High▲	Low	Low◇	Med-High
Over-fishing	Low	High	Med-High	Med-High	Low-Med	Med-High	Low▲	Low-Med	Low-Med◇	Med-High
Destructive Fishing	Low	High	Med-High	Med-High	Low-Med*	Med-High	Low▲	Low-Med	Low-Med◇	High

**BN:** Brunei; **KH:** Cambodia; **ID:** Indonesia; **MY:** Malaysia; **MM:** Myanmar; **PH:** Philippines; **SG:** Singapore;

**TH:** Thailand; **TP:** East Timor; **VN:** Vietnam

1 Data based on 2004 status report - reefs not expected to have changed since 2004

2 2007 Data from COREMAP Long-Term Monitoring Site; arrow indicates direction of change

3 2007 Data from UM, UMS, MoNRE, RCM, SIP, SP using LIT and Reef Check; arrow indicates direction of change

4 2004–2007 Data summaries from various projects; arrow indicates direction of change

5 2006–2008 Data from country-wide surveys; arrow indicates direction of change

6 2006–2007 Data from country-wide manta-tow surveys; arrow indicates direction of change

7 2002–2005 Data extracted from UNEP/SCS Project's GIS Database for 10 sites

\* Indicates updated country estimates based on GIS data; arrow indicates direction of change in updated value

# Indicates a change in threat level compared to the 2002 assessment; arrow indicates direction of change

▲ Threat indicator rankings based on local expert opinion

◇ Threat indicators assessed based on authors opinions from preliminary data collected from East Timor surveys in 2004

**The data compiled in this table are based on direct monitoring data and national expert opinion and reflect the status of the reefs in the Southeast Asia Region**

## CORAL REEF DIVERSITY

Parts of Indonesia, Malaysia and the Philippines, together with Papua New Guinea, Solomon Islands and Timor-Leste constitute the 'Indo-Pacific Coral Triangle', a biodiversity 'hot spot' containing 500 or more species of reef-building coral and high fish diversity. The Coral Triangle is considered the epicentre of global marine diversity and abundance, however, these resources are under serious threat with increased exploitation fuelled by an exploding human population. This was the catalyst for the formation of the 'Coral Triangle Initiative' (p. 55). Corals, fishes, molluscs and lobsters all have maximum species richness in the Coral Triangle, with richness falling rapidly moving east across the Pacific, and less rapidly to the west across the Indian Ocean.

Despite the widespread destruction of coral reefs and the continuing threats to the reefs within and adjacent to the Coral Triangle, it is unlikely that any hard coral species have become extinct and coral species diversity is still high in all SEA countries. However, this may not be the case for other taxa like fishes, molluscs, echinoderms and other invertebrates. Most coral species have a widespread range in the region, whereas all lobster species and half the fish and snail species have relatively restricted geographic ranges, which indicate that reef degradation could lead to associated extinction of other taxa.

Hard coral diversity remains high in Indonesia, Philippines, Malaysia and Vietnam, with almost 600 species recorded in Indonesia. Many site specific hot spots of coral diversity (with more than 200 species of hard coral) occur in all SEA countries, with most hot spot areas occurring on deeper offshore reefs. However, there are more than 250 hard coral species in a small, shallow reef area of Singapore that is subject to high sedimentation rates. Similar coral species diversity occurs in sedimented waters along the northern coast of Pulau Bintan, Indonesia.

	BN	KH	ID	MY	MM	PH	SG	TH	TP	VN
<b>Total number of actively managed MPAs</b>	6	2	114	83	6	339	3	23	0	36
<b>Total number of MPAs with coral reefs</b>	3	1	38	43	2	294	2	16	1	4
<b>Total number of MPAs established ≤5yrs</b>	0	0	12	0	0	Unk	0	0	1	21
<b>% of Reefs within MPAs</b>	0	Unk	9%	7%	2%	1%	0	50%	Unk	11%
<b>% of MPAs with good management rating</b>	0	10%	<3%	16%	0	20–30%	50%	18%	0	8%

**BN:** Brunei; **KH:** Cambodia; **ID:** Indonesia; **MY:** Malaysia; **MM:** Myanmar; **PH:** Philippines; **SG:** Singapore; **TH:** Thailand; **TP:** East Timor; **VN:** Vietnam **Unk** = Unknown

***This table summarises the status of MPAs in SEA (data extracted from 'Coral Reef MPAs of East Asia and Micronesia, 2007'.)***

## **SOCIOECONOMIC MONITORING**

Socioeconomic monitoring has occurred throughout Southeast Asia since 2004, particularly Indonesia and the Philippines. More than 9000 households and individuals have been surveyed, representing 40 communities: 21 in Indonesia; 27 in the Philippines; 2 in Thailand; and 3 in Vietnam. More than half the households are dependent upon fishing for their primary income, clearly demonstrating the importance of healthy coral reefs and fisheries to coastal villages. Unfortunately, these households also indicated a decline in resource conditions. While it is difficult to compare information across sites due to the different questions asked and choices provided, some trends are evident; most of the identified threats in Southeast Asia are in-water threats such as over-fishing, destructive fishing such as cyanide fishing, dynamite fishing, and use of fine mesh nets. Broader scale threats such as climate change and land-based sources of pollution were rarely mentioned, indicating a disconnect in local perceptions of the most severe threats facing the region. Socioeconomic monitoring (SocMon) training programs by NOAA and Conservation International, Philippines, have increased capacity in the region, especially in the Philippines, but more training is required.

## **MANAGEMENT AND CONSERVATION**

Management and conservation of coral reefs have generally improved in SEA within the last 10 years, with increased awareness from legislators, resource management agencies and the public. Numerous local and grassroots organizations have been established to address coral reef conservation and management concerns, thereby complementing existing institutional programmes. These include Reef Check Indonesia, The Indonesian Coral Reef Foundation (TERANGI), Malaysian Coral Reef Society (CoRal Malaysia), Reef Check Malaysia, Reef Check Philippines, Blue Water Volunteers, Singapore and Green Fins Thailand. In addition, The Nature Conservancy Southeast Asia Center for Marine Protected Areas (SEACMPA), World Commission on Protected Areas (WCPA) and UNEP have raised the profile of MPAs, with many projects being initiated to focus on establishing a network of MPAs in Southeast Asia, and improving the management effectiveness of existing MPAs.

A 2005–2007 collaborative effort between The WorldFish Center (ReefBase Project) and Japan Wildlife Research Center (JWRC), funded by the Japanese Ministry of the Environment, updated the regional coral reef MPA database to produce the report, ‘Coral Reef MPAs in East Asia and Micronesia’, that showed an increase in MPAs with coral reefs in SEA from 178 in 2003 to 403 in 2007. Despite the increased number of coral reef MPAs, many of these remain largely ineffective and unmanaged.

## **REGIONAL PROGRAMMES**

Numerous regional programmes have been implemented recently on conservation of coastal habitats, including coral reefs. The UNEP/Global Environment Facility South China Sea (UNEP/GEF SCS) project, ‘Reversing Environmental Degradation in the South China Sea and Gulf of Thailand’, runs from 2002 to 2009 in Cambodia, China, Indonesia, Malaysia, Philippines, Thailand, and Vietnam. The project includes a habitat component to establish a network of demonstration sites for coral reef, mangrove, seagrass habitats and wetlands around the region. One of the coral reef demonstration sites is highlighted on p. 144 (see [www.unepscs.org](http://www.unepscs.org)).

The WWF Sulu-Sulawesi Marine Ecoregion (SSME) Conservation Programme was launched in 1999 in partnership with Indonesia, Philippines and Malaysia. The goals involve planning for the conservation of the SSME through the formation of 50-year conservation Biodiversity Vision and the implementation of immediate conservation actions on the ground. The countries are the main drivers, working together to facilitate the establishment of interim governance mechanisms to ensure coordination in the development of the Ecoregion Conservation Programme (see [www.panda.org/about\\_wwf/where\\_we\\_work/ecoregions/index.cfm](http://www.panda.org/about_wwf/where_we_work/ecoregions/index.cfm)).

In 2006, the University of the Philippines Marine Science Institute became one of 4 global Centers of Excellence under the GEF Coral Reef Targeted Research and Capacity Building Management Project that will improve infrastructure in the centres to promote scientific research to address local coral reef-related problems, provide training and help other working groups in their research (see [www.gefcoral.org](http://www.gefcoral.org)).

To address the impacts of the diving and snorkelling industry on the coral reef habitats, the Coordinating Body for the Seas of East Asia (COBSEA) initiated a Green Fins Programme in 2004 'To protect and conserve coral reefs by establishing and implementing environmentally friendly guidelines to promote a sustainable diving tourism industry'. The programme involves partners from Thailand, Philippines and Indonesia; countries with large diving and snorkelling tourist industries. The programme aims to involve dive operators as partners in the protection, conservation and sustainable use of coral reefs, and to raise the environmental awareness of the diving community. This is achieved through capacity building, training, certification programmes and the distribution of educational materials (see [www.greenfins-thailand.org/mainPage.php](http://www.greenfins-thailand.org/mainPage.php)).

Coral reef restoration is viewed as a possible management measure to reverse coral reef degradation in SEA. A 4-year European Union project started in 2006 with Philippines, Thailand, and Singapore to develop suitable reef restoration practices for Indo-Pacific reefs. This involves the growth and maintenance of some coral species fragments and natural rubble recruits grown in aquaria and in field coral nurseries for subsequent transplantation to denuded or degraded reefs.

## STATUS OF MANGROVES, SEAGRASSES AND FISHERIES: 2008

There have been few national or regional assessments on the status of mangroves and seagrasses in SEA: a review of mangroves and seagrasses was published in 2006 during the UNEP/GEF SCS project. In contrast, there have been numerous fisheries assessments in the countries, and the region, with most of the information presented here coming from UNEP/GEF SCS reports.

**Mangroves:** There are 41 genera of true mangroves in the Indo-West Pacific region with SEA containing most of these. By 1998 it was estimated that more than 50% of the original mangrove area in SEA was lost, totalling a staggering 4.2 million hectares, with approximately 10% destroyed between 1993 and 2003 alone. Most of the losses were due to extensive coastline destruction and modification, including conversion to pond aquaculture, particularly for shrimp; clear felling of timber for woodchip and pulp production; land clearance for urban and port development; human settlements; and harvesting of timber products for domestic use.

**Seagrasses:** The region has 18 of the world's 60 seagrass species, however, destruction is similar to mangrove habitats: seagrass beds are subjected to threats from bottom trawling and extensive coastline destruction and modification. The loss of seagrass habitats is between 30–60% in Indonesia, Philippines, Thailand and Singapore but largely unmeasured in other SEA countries.

**Fisheries:** The seas of the region, especially the South China Sea and the Gulf of Thailand, still support a significant proportion of the world's fisheries and constitute the primary source of food protein security and income for most coastal communities in SEA. However, fisheries management is inadequate in most countries with problems arising from multiple jurisdiction conflicts, over-fishing and destructive fishing; and complicated by trans-boundary issues.

It is projected that increasing fishing pressure coupled with declining stocks of demersal fish species will increase the 'fishing down the food chain' effect, resulting in increased catches of small pelagic fish in the future. This can potentially lead to a downward spiral of declining fish populations and near-shore habitat deterioration, as small-scale coastal fisheries shift towards destructive fishing practices to maintain short-term income and food production.

The UNEP/GEF SCS Regional Working Group on Fisheries, partnered by the Southeast Asian Fisheries Development Center (SEAFDEC) is establishing a regional system of fisheries refuges in the South China Sea and Gulf of Thailand to build resilience in fisheries, especially focusing on critical links between fish stocks and their habitats. The 3 year project started in 2006 and involves Thailand, Vietnam, Philippines, Malaysia and Indonesia – countries with substantive coastal fisheries. The project aims to build resilience in the fisheries to counter high and increasing fishing effort; and to improve the understanding of ecosystem and fishery linkages amongst stakeholders, including fishers, scientists, policy-makers, and fisheries managers as a basis for integrated fisheries and ecosystem and habitat management with improved capacity of fisheries departments and ministries.

## CONCLUSION AND RECOMMENDATIONS: 2008

Recent assessments of coral reef areas in Thailand and Singapore indicate that the previous global estimates probably exceed actual area about tenfold. A regional assessment of the actual coral reef area will provide crucial information to determine status of coral reefs in the region. Threats to coral reefs may be more significant if actual estimates of coral reef area prove to be much lower than the long-standing global estimate of about 100 000 km<sup>2</sup> for the region.

The Myeik Archipelago in Myanmar contains a large area of coral reefs, most of which are probably in pristine condition. In the face of the declining coral reef condition in many areas, these reefs of Myanmar could prove to be critical refuges for coral reef species. However, the status is largely unknown, and therefore mid- to long-term programmes are needed to assess Myanmar coral reefs, and recommend management measures to conserve these reefs.

Although coral reef surveys have been initiated in Cambodia and East Timor, they are occasional and not supported by in-country programmes. Assistance is needed for mid- (5 years) to long- (10 years) term monitoring programmes supported by in-country commitment.

There are numerous, small-scale coral reef monitoring programmes undertaken by various agencies within the region, employing a variety of survey techniques. A combination of these programmes provides a relatively comprehensive picture of the status of coral reefs within each country, however, there is insufficient integration in the information collected by the projects, making it difficult to prepare country-specific assessments. The tasks of GCRMN country coordinators to collate national status information are hampered by insufficient resources to maintain databases on on-going programmes. This could be solved at the regional level with the development of a region-specific meta-database and summary data coordination programme integrated within ReefBase to improve access of data by resource managers. Socioeconomic monitoring programs, shown to be successful in Indonesia and the Philippines, should be expanded to include the rest of Southeast Asia.

The first Asia Pacific Coral Reef Symposium (APCRS, similar to the European Coral Reef Symposium) was hosted in Hong Kong in 2006. This symposium fills a gap for the exchange of research findings and ideas among the coral reef community in this region, which has the largest area and highest coral reef biodiversity. Unfortunately, APCRS is largely unknown to the global community, and more support and acknowledgement is required to ensure it achieves adequate regional and global recognition. Ideally, the APCRS will become part of the ICRI agenda with additional support, starting with the second APCRS scheduled for 2010 in Phuket, Thailand.

#### ACKNOWLEDGEMENTS

The authors particularly acknowledge the UNEP/GEF SCS project, with these reports providing a large proportion of information on the status of mangroves, seagrass and fisheries.

#### AUTHOR CONTACTS

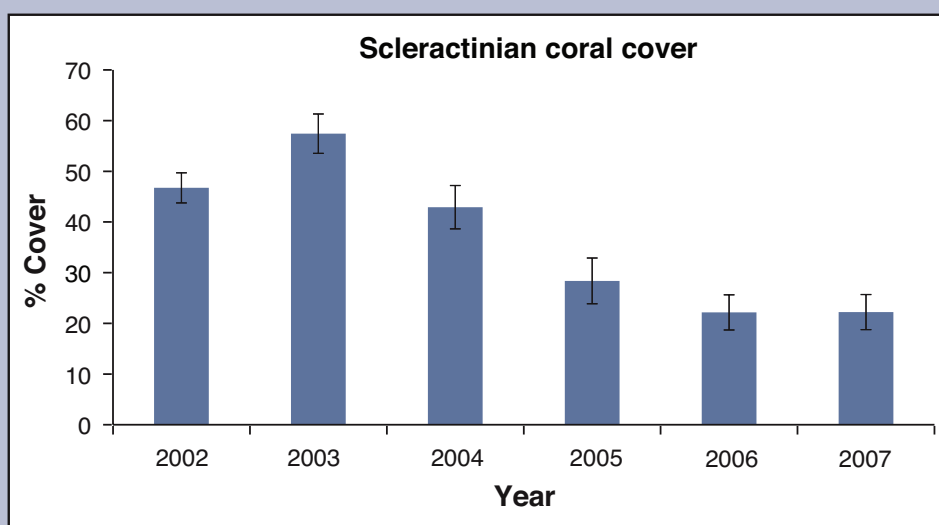
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#### KEY SUPPORTING DOCUMENTS

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UNEP/GEF/SCS Technical Publications No. 1, 2 and 3 on coral reefs, mangroves and seagrass beds. Available on: [www.unepscs.org](http://www.unepscs.org).

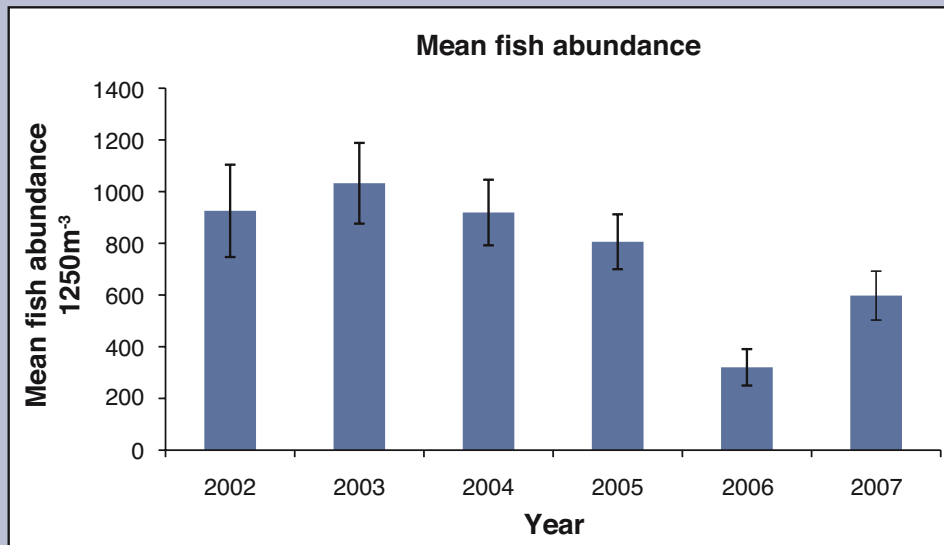
### REEF STATUS IN THE WAKATOBI MARINE NATIONAL PARK, INDONESIA 2002 -2007

There are abundant coral reefs within the Wakatobi Marine National Park, south of Sulawesi, Indonesia, with at least 400 species of hard coral and 600 fish species (and still counting). This large park encompasses 4 of the Tukang Besi Islands: Wangi Wangi, Kaledupa, Tomia and Binongko. These findings are from Operation Wallacea which has assisted in establishing the Park for 11 years. Monitoring of 6 separate sites in the park using 9 by 50 m transects at 3 depths (1–2m; 2–6 m; 9–12 m) found a significant drop in coral cover at all sites within the park.



***This graph shows a general decline in hard coral cover from an average at 6 different locations of 49.7% (± 2.9) in 2002 to just 22.0% (± 3.5) by 2007. In 2002 the Hoga No-Take Area had the highest cover at 56.8% and Sampela showed the least cover with 32.6%. This is slightly lower than the 2007 highest cover, again in the Hoga NTA of 34.2%, with Sampela still having least cover at 11.0%. This is a 40% decrease in coral cover at the Hoga site and a 66% decrease at the most impacted site, Sampela.***

Genus richness of hard corals along the 50 m line transects has not really changed ( $12.0 \pm 0.2$  in 2002; and  $12.4 \pm 0.4$  in 2006, while the total cover dropped. The coral decline is predominantly due to increased sedimentation from mangrove removal, agar farming and reef-flat gleaning which is also damaging seagrass beds near villages. Over-exploitation of reef resources combined with destructive techniques such as blast and muro-ami fishing is also damaging the corals occurs in more remote areas.



***This shows that the mean abundance of fish was 935.9 (± 138.2) per 500m<sup>2</sup> in 2002, but has dropped by nearly two thirds to 326.4 (± 65.8) /500 m<sup>2</sup> in 2006; or an annual reduction of 13% per year from 2002. Similarly, the mean number of species observed also reduced from 49.32 (±3.59) /500 m<sup>2</sup> in 2003 to 33.07 (±3.82)/500 m<sup>2</sup> in 2006.***

Declines in fish diversity and abundance around Kaledupa are attributed to rapid expansion in fish fence traps around Kaledupa and Hoga islands since 2005, such that there is a direct correlation between the number of fish fences and the abundance of reef fish. These highly efficient fish traps remove both adult and juvenile fishes, with a cascading loss in future years. It is clear that if the over-exploitation from fish fences, blast and muro-ami fishing continues to increase, both the coral reefs and their fish populations will continue to decline, threatening the viability of the Wakatobi Marine National Park (from Steve McMellor, Coral Reef Research Unit, University of Essex, UK, [smcmellor@Lycos.co.uk](mailto:smcmellor@Lycos.co.uk)).

#### POST 2004 TSUNAMI RECRUITMENT IN MU KO SIMILAN, THAILAND

The 2004 tsunami scoured out about 2 m of sand and rubble at 30 m depth at Snapper Alley Point (8° 40'N, 97° 39'E). Within one month of the tsunami, green algae covered the bare rocks. Two years later the sand had not returned but there was considerable new settlement and growth of sea fans, soft corals, coralline algae and sponges on the bare rocks. A totally new community has been created out of the chaos of 2004 (from Suchana Chavanich, Department of Marine Science, Chulalongkorn University, Bangkok, Thailand, email: [suchana.c@chula.ac.th](mailto:suchana.c@chula.ac.th)).

### REEF MORTALITY EVENT AT HIN MUANG/HIN DAENG, THAILAND, IN 2007

A mass mortality event occurred in early 2007 on many reefs around the Thailand Andaman Sea provinces of Krabi, Trang, and Satun. The mortality coincided with abnormally low temperatures, around 23–24°C down to 30 m depth (normal temperatures are 27–29°C). Dive operators described brown plumes in the water and dead fish, invertebrates and soft corals, especially at Hin Muang and Mu Koh Ha reefs. The Phuket Marine Biological Center could not pinpoint the cause of death in samples from dive operators; however dissolved oxygen levels were very low (range 1.5 to 2 mg per litre; normal sea water is about 7 to 9); this was the probable cause for the die-off. The question was asked: why would offshore islands have such low levels of dissolved oxygen? The cold temperatures point to upwelling bringing low temperature and low oxygen water up from very deep water. These waters usually contain more nutrients which stimulate plankton blooms, possibly around these offshore islands. The cause of the upwelling possibly resulted from internal ocean waves that move towards the Andaman Coast and, in early 2007, such internal waves were observed at around 100 m depth and arriving at the surface with cold bottom waters. These waves may be related to large scale oceanographic changes with the Indian Ocean Dipole (similar to the El Niño Southern Oscillation in the Pacific) operating at the end of 2006 – sea level was higher in the western Indian Ocean, around Thailand, than in the east. This probably resulted in upwelling of cold, low oxygen water which stressed soft corals and other animals, resulting in death. Many corals in the Andaman Sea died during previous ENSO events in 1994–1995 and 1997–1998 (from Nippon Phongsuwan, Phuket Marine Biological Center, Thailand; [nph1959@gmail.com](mailto:nph1959@gmail.com)).

### MU KOH CHANG CORAL REEF DEMONSTRATION SITE

Mu Koh Chang National Park in the eastern Gulf of Thailand, was established in 1982 and is currently a new tourism destination receiving more than 1 million visitors per year. The Park was designated a Demonstration Site for Coral Reefs under the UNEP/GEF South China Sea project with the goal of removing or reducing causes of coral reef degradation by applying a new model of co-management in the area and restoring certain degraded areas for education and tourism purposes. The Thai Government is developing Mu Koh Chang as an important regional eco-tourism site. The project highlights the importance of co-ordination among government institutions, the private sector, and local communities for sustainable tourism development. The success of Mu Koh Chang management model could be applied to other areas with similar problems in Thailand and in other countries bordering the South China Sea.

Major achievements of the project include increased public awareness of the ecological importance of coral reefs; the establishment of a network of government institutions, private sectors and local communities for coral reef management and conservation; the development of a sustainable ecotourism program for Mu Koh Chang and the vicinity; capacity building; the development of alternative income generating programmes for fishermen; and providing support for coral reef monitoring and rehabilitation (from Thamasak Yeemin, Ramkhamhaeng University, Thailand [thamasakyeemin@hotmail.com](mailto:thamasakyeemin@hotmail.com)).