

7. SOUTHEAST ASIAN REEFS - STATUS UPDATE: CAMBODIA, INDONESIA, MALAYSIA, PHILIPPINES, SINGAPORE, THAILAND AND VIETNAM

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ABSTRACT

Southeast Asian reefs continue to face development and exploitation pressures in spite of greater awareness of their ecological and economic importance. Reefs that were once considered remote have not escaped destruction from poison or blast fishing. Common threats from human activities are spreading throughout the region and there are no apparent signs of reversals or reductions in the trends of increasing reef degradation. Monitoring efforts on reef health status are expanding in tandem with increasing numbers of rehabilitation projects. Monitoring data are available for more and more reefs for which there was little previous information, and many countries have established national reef monitoring programmes. Reef Check surveys have increased steadily in the region. Monitoring by volunteers indicates little difference in reef condition between reefs in marine parks and non-protected areas. This confirms earlier observations that most marine protected areas are not meeting management objectives. Countering the patterns of losses



in reef integrity, there are isolated instances of management by local communities and coastal resorts. In addition to the impacts of human stresses, many Southeast Asian reefs were affected by severe bleaching in 1998 with recovery ranging from marginal to almost complete. Stronger, more effective and perhaps innovative management measures are necessary to facilitate the survival of Southeast Asian reefs in this new millennium.

INTRODUCTION

This report updates the information presented in the first edition in 1998, and focuses on changes since that time, which are unfortunately mostly negative. It also draws on recent assessments made by the World Resources Institute - Reefs at Risk project and another by UNEP on trans-boundary problems. The coral reefs of Southeast Asia are renowned for their exceptionally high biodiversity. Although the marine environment of Southeast Asia occupies 2.5% of the global ocean, it contains 27% of the world's coral reefs, including two large archipelagos which have 22% the global total; Indonesia has close to 18,000 islands, and the Philippines has over 7,000 islands. The extensive Sunda and Sahul continental shelves offer large shallow areas that favour reef development and all major reef formations (oceanic atolls, platform and barrier reefs) are represented, along with large areas of shallow fringing reefs on the coasts, which receive the full impacts from human activities from the land.

Economic growth and coastal population expansion have resulted in serious degradation of many reefs, and the trend continues in spite of increased awareness of the value of reefs to people. The coral reefs in the Malacca and Singapore Straits alone have a total assessed economic value of US\$563 million for their roles and values as carbon sinks, tourist attractions, shoreline protectors, fishery resources and research potential. The problems of reef degradation are compounded by unabated and widespread destructive fishing practices, particularly poison and blast fishing. Unless sustainable management practices are implemented, the high biodiversity reefs of Southeast Asia will succumb further to economic development pressures in spite of quantified values. Various reef management models exist throughout the region, ranging from national government initiatives to local community involvement, and the successes of community-based management continues to spread throughout the region. Of the growing number of nationally legislated marine parks, less than 10% are adequately managed to meet protection objectives, and the situation does not seem to be improving sufficiently rapidly as Reef Check global analyses indicate little difference in the condition of reefs between protected and non-protected areas

STATUS OF CORAL REEF BENTHOS

This section highlights updates information from the previous status reports in 1998, showing a continuation of decline in many of the reefs of the region from many similar causes. The national reports of natural disturbances and community structure of the reefs are available and will be published in the Proceedings of the 9th International Coral Reef Symposium in Bali.

Cambodia

The amount of information on Cambodian reefs is very limited, but recent efforts have assembled the most comprehensive information to date. However, there is still insufficient data on the status of coral reefs, their distribution and species composition. There are coral communities growing on rocky bottoms along much of the 435km coastline and some of the 52 islands, where there are often fringing reefs. Coral diversity is higher on the offshore reefs, whereas those inshore are in poor condition with low species diversity, dominated by massive corals.

At Koh Tang, an offshore island group in clearer water, there are 70 hard coral species including *Acropora* and *Montipora* which are absent on the inshore reefs, which in turn are dominated by *Porities*, mussels and faviids. *Acropora* spp. are now much less common on Cambodian reefs. Coral cover of up to 50% was found at Koh Rong Samlem in spite of the extensive bleaching impacts during 1998. This site also has few human impacts; therefore, these healthy reefs are not representative of the state of most coral reefs throughout Cambodia, which are more degraded. The reefs at Koh Tres, Poi Kompenhl and Koh Thas had live coral cover ranging from 21% to 70%. The black spiny sea urchin, *Diadema setosum*, is abundant at Koh Rong, Koh Tang and Koh Damlung.

There was bleaching in 1998 at reefs on Koh Rong Samlem, Koh Rong, Koh Tang, Koh Damlung and Koh Thas, but studies at Koh Rong Samlem suggest that recovery was strong. Crown-of-thorns starfish are not known on inshore reefs and their presence on the outer reefs is limited to small numbers. An outbreak was observed in February 1998 at a site on Koh Tong (20 adults within an area of 100m²).

Indonesia

A comprehensive review of coral reef conditions in eastern and central Indonesia has just been completed by international and local experts for the Packard Foundation. This included considerable data from the Pusat Penelitian dan Pengembangan Oseanologi-LIPI reef monitoring database that covers 400 stations from 48 sites, as well as information from programme activities by local and international agencies. Indonesian reefs contain the richest species diversity of corals (450 species) and other reef-associated groups in the world. For example, a single reef can have more than 140 species of hard coral. About 40% of reefs reviewed are listed in the 'poor' category with live coral cover less than 25%, and only 29% considered as good to excellent (live coral cover above 50%), whereas previous reports suggest that most of Indonesian reefs were above this many years ago as there are few destructive storms and waves impacting on these reefs. Thus, there are clear indications of rapidly declining reef health throughout this area with the proportion of degraded reefs increasing from 10% to 50% over the past 50 years. The reefs of eastern Indonesia are in comparatively better condition, but are also declining quickly. There are many instances where blast fishing has reduced coral cover by 50-80%, and the widespread use of cyanide has resulted in large areas of dead coral. For example, reefs on Bali that had good coral cover of 73% with colonies 17-24cm in diameter on average in 1992, now have cover of 15% or less, with colonies averaging 2-3cm. Population outbreaks of crown-of-thorns starfish have been reported but appear scattered and not serious. The bleaching events of 1987-88 and 1992-93 did not appear to affect Indonesian reefs on a wide scale, however the 1998-99 bleaching event had a greater impact with many reefs affected.

Malaysia

There have been extensive surveys of the reefs of East Malaysia particularly in Sabah since 1996. The best reefs are the oceanic reefs at Sipadan (far east coast) and Layang Layang (southern Spratlys). Reef condition throughout East Malaysia varies widely, with an alarming amount of recently dead and shattered coral. Only 10% of reefs had dead coral cover of less than 10%, while dead coral cover of 10 to 20% was found for 70% of the reefs. At least 10% of reefs had approximately 40% dead coral cover, indicating recent losses. Evidence of destructive fishing practices was found on all reefs, except those under strict protection (e.g. Sipadan and Semporna Islands), and there are reports of more than 4 bomb blasts per hour in many offshore reef areas. In large areas of the Tunku Abdul Rahman Park, live coral cover has dropped due to a combination of storms, blast fishing and pollution from a mean of 30% in 1994, to less than 5% now. Some of the individual reef statistics from this park are illuminating, with only one reef, Manukan, remaining stable.

| Live coral cover changes | 1987 | 1991 | 1994 | 1999 |
|--------------------------|------|------|------|------|
| Merangis Reef | 40.5 | 41.5 | 34.5 | 14.2 |
| Sapi Reef | 47.0 | 30.5 | 37.5 | 4.1 |
| Staghorn Patch Reef | 30.0 | 36.5 | 33.0 | 1.6 |
| Manukan Reef | 30.0 | 36.5 | 38.5 | 35.0 |
| Sulug Reef | - | 32.5 | 19.0 | 2.9 |
| Mamutik Reef | - | 18.0 | 19.5 | 12.3 |
| Tanjong Wokong Reef | - | - | 31.0 | 5.4 |

This summarises changes in coral cover on reefs in the Tunku Abdul Rahman Park, Sabah, Malaysia over more than 10 years, with unfortunately a decline at most sites.

There are few reefs in Sarawak because of high levels of sediment runoff from several large rivers. On the Talang Talang islands, there are occasional patches of coral cover of about 30%, but most do not exceed 20%. There was large scale bleaching in 1998 with close to 40% of coral colonies in shallow water (10m) and 25% in deeper water 10-20m bleached. By late 1999, colonies either recovered or were overgrown by zoanthids or soft corals. Bleaching in Tunku Abdul Rahman Park was up to 30-40%, but 6 months later, all colonies had recovered except for very few that had died.

Philippines

There are over 400 hard coral (scleractinian) species known from the Philippines, of which 12 are endemic. Data from the 1990s show a decline in reef condition, with reefs in the Visayas area most at risk. An analysis of more than 600 data sets showed that 'excellent' reefs (live hard and soft coral cover above 75%) has reduced from 5.3% to 4.3% since the late 1970s. If hard corals alone are considered, only 1.9% of the reefs can be called 'excellent', with average hard coral cover on all reefs at 32.3%, whereas it used to be much higher. *Acropora* covered 8.1% of Philippines reefs, and the decline is thought to be due primarily to human impacts, particularly blast fishing, as well as infestations of coral eating crown-of-thorns starfish and drupellids. The 1998 bleaching started at Batangas in June 1998 and other reefs were affected in an almost clockwise sequence around the Philippines. Most reefs in northern Luzon, Palawan, most of the Visayas, northern and eastern Mindanao were affected. The most severe impact occurred at Bolinao, Pangasinan

where 80% of the corals were bleached. Most vulnerable were *Acropora* and pocilloporids and even *Porites*, faviids, fungiids, caryophilids and hydrocorals were seen to bleach.

Singapore

Continued monitoring in 1998 and 1999 of permanent locations at 5 reefs showed no reversal in the declining trend of live coral cover. Most reefs have lost up to 65% of live coral cover since 1986. The best reef at Pulau Satumu, furthest from the mainland, also showed a reduction in live coral cover of 37% over the past 13 years. The 1998 bleaching affected all reefs at a scale never previously experienced. About 90% of all corals bleached of which 25% failed to recover. The prognosis for these reefs is not good, when coupled with national strategies to expand the island into the ocean and increase shipping activities.

Thailand

A comprehensive reef survey programme, using primarily manta tows, was conducted between 1995 and 1998 at 251 sites in the Gulf of Thailand and 169 sites in the Andaman Sea. All sites were fringing reefs, with most less than 1km², within the total reef area of Thailand estimated at 153km², distributed equally between both seas. The condition of reefs in the Gulf of Thailand were: 16.4% excellent, 29% good, 30.8% fair, 23.8% poor. In the Andaman Sea, 4.6% were excellent, 12% good, 33.6% fair, and 49.8% poor. Reef condition in the Gulf of Thailand has worsened compared to the late 1980s, while that of the Andaman Sea remained comparable or improved slightly. About 80 permanent study sites at the Andaman Sea side of Thailand have been established during long-term monitoring programmes, which began in 1981 by the Phuket Marine Biological Center.

The 1998 bleaching event affected reefs in the Gulf e.g. at the Sichang Islands, 40-50% of live coral cover was affected with no sign of recovery. Few *Acropora* survived while *Porites* and faviids were slightly affected, and there are no signs of coral recovery or coral recruitment. The bleaching killed 60-70% of live coral at Sattahip with *Acropora* being most affected. The reefs at Rayong Chantaburi were similarly affected, however, there was strong coral recruitment at both sites. In most cases, the loss of live coral cover did not appear to affect reef fish communities.

Vietnam

Coral reefs are the richest marine habitats in Vietnam and extend along the 3,260km coastline and on more than 3,000 inshore and offshore islands. Reefs in the north support fewer species and are mainly fringing reefs, whereas in the south, there are also platform reefs. Of the 300 coral species, 277 species (72 genera) are found on reefs in the south, while reefs in the north have 165 species in 52 genera. Surveys of 142 sites from 15 of the 28 reef areas between 1994 and 1997 show that only 1.4% have live coral cover above 75%. 'Poor' reefs with less than 25% coral cover occurred at 37.3% of the sites. Of the remaining sites, 48.6% had coral cover between 25 and 50%, and 31% between 50 and 75%. There is a distinct correlation between healthier reefs and remoteness from human population centres with the best coral cover on offshore islands or remote coastal locations.

Typhoon 'Linda' caused extensive damage to the best protected reefs at Con Dao islands in November 1997. Bleaching also affected the reefs of Con Dao islands, north Binh Thuan province and Nha Trang bay during the summer of 1998. Monitoring in 1999 showed very slow

THE SPRATLYS AND PARACEL ARCHIPELAGOS

These islands sit across major shipping lanes in the South China Sea, hence are of great strategic importance. Ownership of them is currently disputed with Brunei, China, Malaysia, Philippines, Taiwan and Vietnam having claims on all or part of the Spratlys; and China, and Vietnam claiming the Paracels. These are coral reef islands that sit on seamounts rising from oceanic depths in clear waters remote from continental influences, except for fishers that come out using dynamite and cyanide to catch reef fish, and the construction of military installations. The reefs are thought to be significant as possible sources of larvae for nearby reefs and are important in completing reef connectivity throughout the South China Sea. Proposals that they should be declared a 'global' marine protected area are not supported by all of the claimant states. Malaysia, Vietnam and the Philippines have conducted some joint studies on some of these reefs in recent years, however, it is essential that more joint efforts be initiated so that the full significance of these reefs can be understood.

recovery of the Con Dao reefs from the double impacts of typhoon and bleaching. The reefs at north Binh Thuan however recovered well due to the June-September annual upwelling.

STATUS OF CORAL REEF FISHES

Southeast Asian reefs contain a rich diversity of reef fish and other reef species, including many endemic species. The region's reefs have also been described as an important source of larval recruits to reefs in adjacent regions. The joint project between ASEAN and Australia reported 787 reef fish species, including 41 species of butterflyfish at study sites in Indonesia, Malaysia, Philippines, Singapore and Thailand. However, a recent analysis in the Philippines revealed 915 species from 63 families, including 48 species of butterflyfish. This clearly indicates that with more intensive studies, many more species will be found.

Indonesia has the richest reef fish diversity in the world, particularly on the eastern reefs, e.g. 123 pomacentrid species, and 83 species of angelfishes and butterflyfishes, far exceeding other areas of the world. The offshore reefs and less disturbed reefs have higher species diversity and abundance, e.g. in Vietnam there is higher reef fish diversity in the south and central regions, but offshore reefs have higher fish abundance. The reefs of the Gulf of Tonkin have low species richness. The oceanic reefs of Sipadan and Layang Layang (Sabah), have higher numbers of butterflyfish and groupers and other species compared to inshore sites. In Cambodia, fish diversity is low, particularly at inshore reefs, characterised by few fish, mainly damselfish and butterflyfish. Some reefs such as Poi Tamoung about 50m from shore with better corals support greater diversity, including angelfish, butterflyfish, rabbitfish and parrotfish. Thus there appears to be a clear correlation between healthy corals, larger fish diversity, abundance and lower levels of human interference at these sites.

Throughout the region, reef fish diversity and abundance are threatened by reef degradation, destructive fishing and over-fishing. Cambodian reefs are affected by over-

fishing of large commercial fishes and invertebrates. Only 11% of the Philippine reef sites had high standing stocks of fish above 35mt km². Species richness was poor for 35% of the sites (27-47 species 1000m²) and high for 25% of the sites (>75 species 1000m²). Fish abundance was high at 31% of the sites (>2268 indiv. 1000m²) and poor at 24% of the sites (<676 indiv. 1000m²). High species diversity was observed on the reefs of Palawan, Tubbataha and Turtle Islands – all remote and mostly protected sites. Fish abundance was high at Cagayan, Calauag Bay, Palawan, Bais Bay, Surigao del Norte and Tubbataha reefs. The Bolinao reefs had poor fish abundance.

ANTHROPOGENIC THREATS TO CORAL REEF BIODIVERSITY

Over-exploitation of fishes was identified by 6 countries (Cambodia, Malaysia, Indonesia, Philippines, Thailand, Vietnam) as the most serious cause of reef degradation in an assessment of trans-boundary problems with the help of UNEP. Next were destructive fishing methods, and sedimentation with equal weighting, and then pollution associated with coastal development. This over-exploitation has led to the collapse of many local fisheries e.g. sea cucumbers are rare on most reefs in Cambodia, Thailand and Vietnam, and many Indonesian reefs face similar fates. Target species are being totally removed in response to external market demand. The consequences of destructive fishing methods (blast and cyanide fishing and the ‘muro ami’ method of bashing the corals to drive fish into nets) are well documented and in widespread use throughout the region, including remote reefs and those within protected areas.

In Cambodia, dynamite fishing is the most pressing problem and has extensively damaged many reefs off the coastal towns of Kep, Sihanoukville and some of the reefs in the Gulf of Thailand. Reef damage at other areas such as the Koh Sdach group is not as serious, although blast fishing is reported. Dynamite fishing has had moderate to serious impacts on the reefs around Sihanoukville, with many areas reduced to rubble. On Koh Rong, over-

| | Over-exploitation | Destructive Fishing | Sedimentation | Pollution |
|-------------|--------------------------|----------------------------|----------------------|------------------|
| Cambodia | x | x | | |
| Malaysia | x | x | x | x |
| Indonesia | x | x | x | |
| Philippines | x | x | x | x |
| Thailand | x | | x | x |
| Singapore | x | | x | |
| Vietnam | x | x | x | x |

Countries in the region, in association with UNEP, assessed the critical anthropogenic threats to coral reefs in their areas. In all cases, over-exploitation topped the list.

fishing has depleted stocks of large fish of commercial value (e.g. humphead wrasse, grouper, sweetlips), sea cucumbers and giant clams. Cyanide fishing is a relatively new threat targeting fish such as groupers and snappers for grow-out in cages at Tumnup Rolork and Stoeng Hav, although the Fisheries Department is discouraging this practice. Coral collecting was a large threat between 1995 and 1997 when foreign companies collected and exported container-loads of corals, but the business has been suspended by the Ministry of Environment and the confiscation of corals on sale in Sihanoukville has reduced this trade. Selective coral collecting for the marine ornamental trade is regarded as a cause for reduced *Acropora* abundance on many reefs.

Over-fishing and use of destructive methods (poison, blast and fine mesh nets) has resulted in widespread destruction of reefs in Quang Ninh, Nghe An, Quang Binh, Thua Thien-Hue, Quang nam, Da Nang, Quang Ngai and Khanh Hoa provinces, Vietnam. Cyanide fishing for groupers for the live fish trade is widespread in the northern and central parts of Vietnam, and even near the Con Dao National Park. Sea cucumbers are heavily exploited, and collection of ornamental fish for the aquarium trade is a rising problem as poisons are used to stun fish. Lobsters have declined from some reefs e.g. at Cu Lau Cham, and pearl shell (*Pinctada martensii* and *Lutraria philippinarium*) have disappeared from many reefs in the north. Exploitation of species listed as endangered in Vietnam's Red Book still occurs (e.g. four lobster species, two abalone species, the squid *Loligo formosana*, and three clupeid species). Non-resident marine fishers from China and Hong Kong compete with local fishermen in offshore waters. Marine tourism is fuelling the demand for souvenirs, including endangered and protected species such as turtles. *Acropora* is becoming rare in places such as Nha Trang, the centre of coral trade in Vietnam, and other invertebrates are also harvested as curios.

Similarly bleak pictures of over-fishing and destructive fishing apply throughout East Malaysia, Philippines and Indonesia. Blast fishing and the use of cyanide for the live fish and aquarium trade has destroyed many reefs in East Malaysia, often with losses of 80% of original coral cover. There have been reports of decreased blast fishing in most parts of the Philippines. However this practice is still common in the Palawan group of islands, Sulu Archipelago and western Mindanao, and coral recovery from blasting in these areas remains slow. Two other fishing practices can potentially deplete marine resources; spearfishing using scuba or hookah, and drift net fishing. Blast fishing however is not practiced in West Malaysia possibly due to strong enforcement, and also in Singapore due to all reefs being close to major shipping activities.

A special problem has occurred in Indonesia since the economic downturn since the late 1990s. Many people who were employed in industries have returned to exploiting coral reef resources as industries closed. Moreover, the collapse in local economies has meant that population control programmes have stopped and the population of over 200 million is likely to expand further. Also funding for government conservation measures has decreased, with parallel increases in deforestation, including mangrove forests, such that runoff of sediments and nutrients are impacting heavily on coastal reefs.

Other anthropogenic impacts in the region include coastal development and marine pollution with primary sources from industry, agriculture, shrimp pond effluent, unsustainable logging, and domestic waste; all of which increase sedimentation, nutrients

and other pollutants in the water. Heavy sedimentation has degraded Vietnam's reefs at Cat Ba Islands and Ha Long Bay.

CURRENT AND POTENTIAL CLIMATE CHANGE IMPACTS

The 1998 bleaching of corals was widespread and on a scale and intensity not previously encountered in the region. This has highlighted the potential for climate change to impact on coral reefs. Slow rates of sea level rise will provide the necessary environmental conditions for reefs to optimise structure and orientation. However, erosion factors caused by increased rainfall may reverse this upward growth. Sea surface temperature changes will trigger further bleaching events, which are expected to be more severe than the 1998 bleaching. The rapid recovery of reefs from the 1998 bleaching at north Binh Thuan in Vietnam was attributed to the annual upwelling, which brought cold waters to the surface. Reefs elsewhere in Vietnam recovered at a slower rate, implying that reefs near major upwelling areas may suffer less from bleaching events.

The collapse of reef systems can be translated directly to loss of goods and services that they generate. In terms of carbon sequestration alone, using the avoided future cost of climate change of \$20/tonne of carbon, the estimated carbon storage value of coral reefs is US\$240/ha/year. Thus, just the reefs of the Malacca Straits have annual values of US\$237,000 for the coral reef area of 1,317.5ha on the Malaysian side, US\$93,863,000 for 521,462ha of Indonesian reefs and US\$51,700 for the 287ha of Singapore reefs.

Sea-level rises will have a magnified impact in this region as 70% of the population live in the coastal area. In December 1999 abnormally high tides and waves caused extensive flooding and erosion of coastal areas in many parts of the region. High tides resulted in floating fish farms being pulled from their anchoring points, coastal resorts being flooded, rivers overflowing their banks, and disruption of basic infrastructure services throughout the area. Submergence of coastlines considered well above high tide level resulted in excess nutrient runoff and macroalgal blooms in some coastal lagoons in Singapore. There was complete flooding of the Turtle Islands by up to 50cm for 5 hours resulting in significant erosion of shoreline and loss of an inland turtle hatchery.

CURRENT MPAs AND MONITORING AND CONSERVATION MANAGEMENT CAPACITY

A variety of reef management systems exist in the region, with an increasing number of Marine Protected Areas (MPAs) being declared throughout Southeast Asia. Unfortunately many occur only on paper with only limited government commitments to staffing and operational funding, thus few MPAs are effectively managed. Of the 109 MPAs established by ASEAN countries as of 1994, 65% contained coral reef resources. Many of these MPAs were former terrestrial reserves with jurisdiction only recently extended to include marine resources. Vietnam has only 3 protected areas (Cat Ba, Con Dao and Halong bay) that include marine components and reefs are not adequately represented in the country's protected areas.

Frequently when there are management-oriented staff in MPAs, they lack adequate training and skills and are not provided with logistic resources. In addition, many problems arise

due to conflicting responsibilities for management of the resources within the MPAs because responsibilities are often based on different sectoral interests, e.g. exploitation agencies attempt to maximise fisheries and act against environmental bodies seeking conservation. Frequently agencies managing different aspects of the coastal area have poor communication between them, resulting in uncoordinated efforts which undermine conservation and protection of reef resources. Increased political commitment is necessary to address the deficiency seen in these MPAs and respective links with broader coastal management strategies.

Community-based management systems are apparently having more widespread success and different models have been applied to suit local situations. Successes in the Philippines, Thailand and Indonesia show that it is effective for small areas where local communities are directly involved in management. Community-based management provides users with a better sense of propriety and greater motivation to manage the very resources that they themselves are dependent on. Such communities are effective in controlling destructive activities caused by other users as well as themselves. For larger areas, the co-management system approach is more effective where management is shared between government agencies, local communities and non-governmental organisations.

Many Southeast Asian countries are signatories to international conventions and agreements to maintain natural ecosystems. Of relevance to coral reefs is the Convention on International Trade in Endangered Species (CITES), which has been effective in slowing the export of live and dead corals and other reef organisms from the region. Another international convention addressing the global loss of plant and animal species is the Convention on Biological Diversity which the majority of the states have signed and ratified. Informal regional agreements such as the 1989 Langkawi Declaration on the Environment, the 1990 Baguio Resolution on Coastal Resource Management, the 1990 Kuala Lumpur Accord on Environment and Development, and the 1994 Bangkok Resolutions on Living Coastal Resources, all attest to increased regional awareness of the need to manage coastal resources including coral reefs for sustainable use.

GOVERNMENT POLICIES, LAWS AND LEGISLATION

Some countries have numerous policies and laws relating directly to coral reef conservation, while others do not. For example, in Cambodia and Singapore the only laws pertinent to coral reefs relate to fishing and not directly to conservation. More targeted national policies or conservation strategies for coral reefs are required to ensure that reefs are given the deserved protection, including clear goals for the conservation and sustainability of reef resources. Laws for many marine parks were extensions of laws establishing terrestrial parks and did not contain relevant or applicable provisions to cover the marine environment and respective ecological and economic management differences. Such policies and laws for reef conservation need to be drafted within the context of integrated coastal management to be effective and ensure that development and conservation concerns are reconciled in the interest of sustainable development. Indonesia did not establish a systematic coastal and marine management regime before 1999 even though over 12 national Ministries have coastal and marine management responsibilities. To address this need for better co-ordination and effective management, the Indonesian government created a new Ministry of Marine Exploration and Fisheries. Regardless of

adequate administrative and legal framework, problems will arise from lack of political will, corruption, lack of resources, and lack of understanding of the role of coral reefs. These are issues that are best addressed through the adoption of an integrated coastal management strategy.

GAPS IN CURRENT MONITORING AND CONSERVATION CAPACITY

Coral reef monitoring has expanded throughout the region during the 1990s with reef surveys increasingly being used for management assessment. However, it is clear that monitoring capacity varies widely between the countries based on those participating in an ASEAN-Australian cooperation project (Indonesia, Malaysia, Philippines, Singapore, Thailand), even though most of these countries have institutions with trained staff capable of monitoring reefs and are jointly using accepted methodology. The use of common survey methods permits comparisons and regional analysis of trends in reef health, and monitoring is conducted fairly routinely. The capacity in Brunei Darussalam, Cambodia, Myanmar and Vietnam is developing as well, albeit at different levels, e.g. some countries require not only trained personnel, while others need equipment and facilities. For countries with regular monitoring programmes, the sites selected are sometimes not well distributed. In some cases there are clusters of intensively studied sites, while large areas of reefs remain un-monitored. Thus compiling an adequate picture of reef status throughout the region is not possible. The addition of Reef Check surveys involving volunteer divers has supplemented national programmes.

THE ASEAN-AUSTRALIA LIVING COASTAL RESOURCES PROJECT

The effects of a collaborative project between 5 ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, Thailand) and Australia between 1984 and 1994 are still having an influence in the region. These countries have considerable capacity to monitor coral reefs and all continue monitoring at many of the sites that were established in 1986 or earlier. The emphasis, under funding from Australian AusAID, was on developing capacity to research and monitor coral reefs, mangrove forests, seagrass beds and the fisheries over soft bottoms. A major task was to develop common methodologies and this resulted in a manual now in global use. A common reef survey method was proposed, tested and developed to monitor reefs over spatial and temporal scales throughout the region. Using this Line-Intercept Technique, participating countries implemented reef monitoring programmes and gathered information on the condition of reefs and how they changed over time. Use of common methods facilitated comparisons across the region. While the project enhanced reef monitoring capacity in these countries and enabled reef condition to be quantified, the sites selected did not provide an even distribution throughout the region. Most reef sites surveyed were within convenient reach of participating agencies, resulting in thorough information of some reefs and none of others. English, S., Wilkinson, C. and Baker, V. 1997, Survey Manual for Tropical Marine Resources. Australian Institute of Marine Science, Townsville, 390 pp.

CONCLUSIONS AND RECOMMENDATIONS

Southeast Asian reefs continue to face increasing threats from economic and population growth, and these pressures are overriding the increasing numbers of conservation initiatives at national, local and community levels. The benefits and significance of reef systems are now better known and there is greater awareness of the importance of managing and protecting the resources; however, reef degradation continues to outpace reef protection, as the former is driven by short-term economic development and market pressures.

Management capacity is clearly insufficient in a region heavily reliant on natural resource exploitation and where large segments of the population derive a subsistence living from direct exploitation of these resources. During the Asian economic crisis since 1997, economic recovery took priority and slowed down most reef management activities. However, the Blongko Marine Sanctuary in North Sulawesi, which is fully managed by the local community, demonstrated that effective reef resource management ensured the continued generation of goods and services to the community and provided the locals with adequate financial security throughout the crisis. All levels of management capacity need strengthening, whether at community, local government or national government levels. Management at community level can be relatively straightforward and simpler to implement provided conflicts amongst groups or individuals do not override the larger goals. At local government and national government levels, reef conservation should be implemented within the context of integrated coastal management approaches. Many large marine parks not only have problems with surveillance and enforcement deficiencies, but also the lack of recognition of local community needs. Both integrated coastal management and community-based management approaches can be combined to provide greater and more effective management efficiency as they involve the local government and local communities.

This region illustrates a wide diversity of reef management experiences. Dive resorts for example, appear to perform a more active role in conserving the core resources, which attract their visitors. Many 'house reefs' are well-protected and some resorts provide help (e.g. fast boats and fuel) to local agencies to improve surveillance. Systematic and innovative approaches should be considered to compile all types of reef management models operating within the region and to analyse what works best for certain situations. There are numerous case studies, but the lessons from failures or successes have not been fully synthesised and applied.

A more coordinated approach to coral reef monitoring should be established and a regional mechanism will permit more effective sharing of information at national and regional levels. This will enable the region as a whole to adopt better strategic approaches to protect reefs. Areas that have little or no monitoring, but are thought to have a strategic role in larval supply routes, need to be identified and targeted for investigation. Public education will remain an important process to reef management. It has to be promoted, expanded and implemented with greater urgency.

ACKNOWLEDGEMENTS AND SUPPORTING DOCUMENTATION

I must record my full appreciation to all colleagues for responding to my request for information and/or for making their national reports available. The report would not have been possible without their full cooperation. They are: Annadel Cabanban, Ian Dutton, Edgardo Gomez, David Hopley, Hugh Kirkman, Al Licuanan, Jeffrey Low, Vipoosit Manthachitra, Nicolas Pilcher, Karenne Tun, Vo Si Tuan, Matt Wheeler, Clive Wilkinson.

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