



SUMMARY OF STATUS OF CORAL REEFS IN MALAYSIA

2014





Summary of Status of Coral Reefs in Malaysia, 2014

Reef Check Malaysia



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Ministry of Natural Resources and Environment
Malaysia

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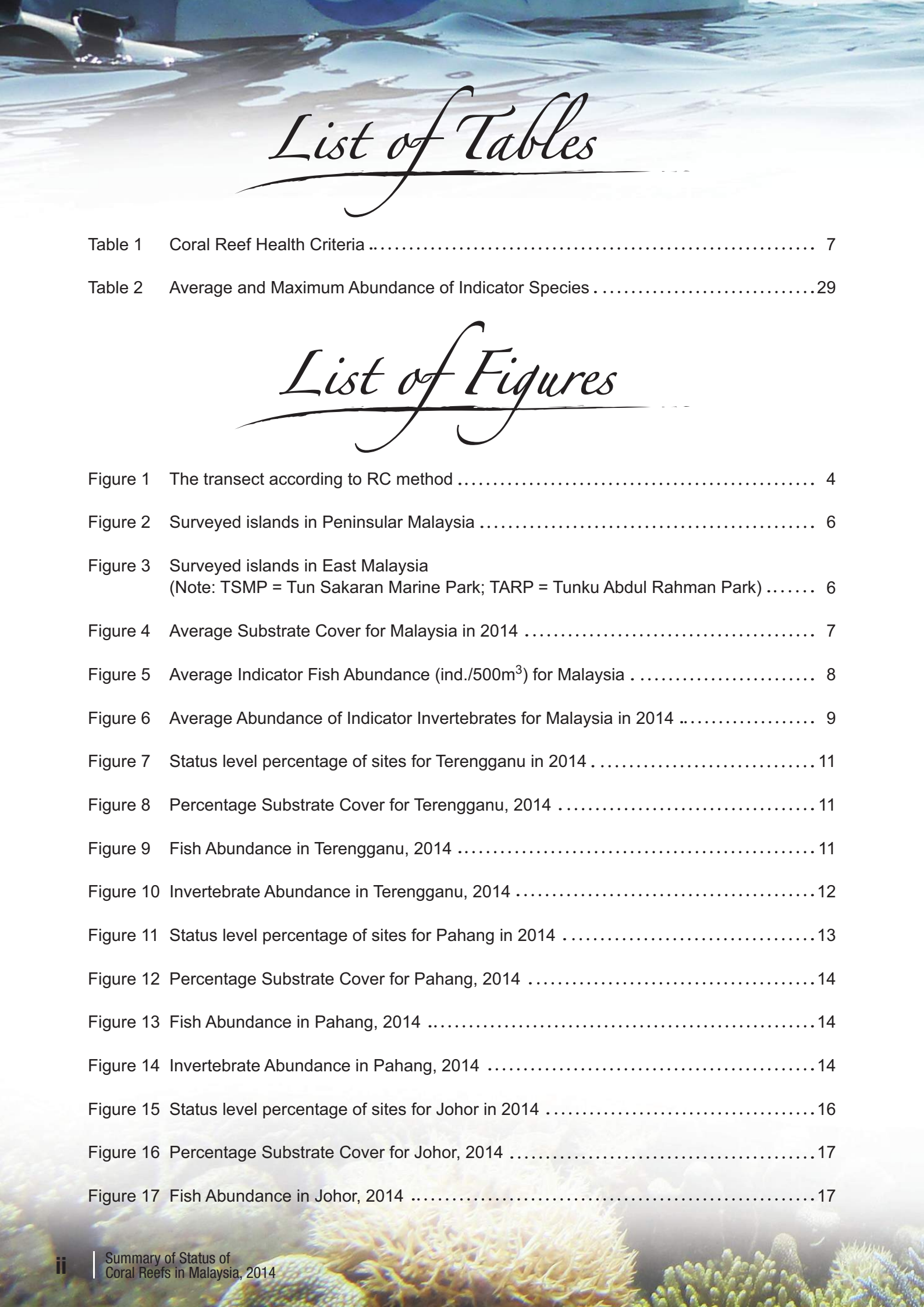
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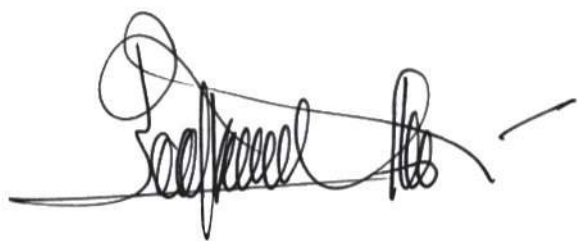
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Foreword

Assalamualaikum w.b.t and Salam Sejahtera.

Alhamdulillah, I am grateful to the Allah s.w.t. with for His blessing the Department of Marine Park Malaysia (DMPM) and Reef Check Malaysia (RCM) has successfully published the Eighth Annual Report on The Status of Coral Reef in Malaysia, for the year 2014. This report is a result of detail monitoring surveys of the coral reef that have been conducted in 2014 using Reef Check Method at the Key Eco-regions in Malaysia. I hope this survey will be beneficial in the effort to achieve conservation targets and the effectiveness management of protected areas. Ultimately, this will be benefit to the surrounding communities as well. This will also support the DMPM's mission to "Conserve and Manage Marine Recourses in Marine Park Scientifically for Sustainability to Generate the Country's Economy". Finally, I would like to convey a full appreciation to RCM especially Mr. Julian Hyde, his staffs and DMPM staffs who have given full commitment in completing coral reef surveys and making this report become reality.



DR. SUKARNO BIN WAGIMAN
DIRECTOR GENERAL
DEPARTMENT OF MARINE PARK MALAYSIA
APRIL 2015





Foreword

With increasing awareness of the impacts of global warming and climate change on our ecosystems, there is growing evidence that coral reefs are one of the marine habitats most affected.

Research has proven that changes in temperature, pH and salinity are affecting corals, thus changing the reef scene. A healthy coral reef is important in assuring stable fish stock as well as providing a nursery for many commercial organisms such as lobster and sea cucumbers. The 'spill-over' from a protected coral reef ecosystem is vital in combating fish stock depletion due to overfishing. There have been countless reports of declining coral reef coverage globally, and this is especially true in Southeast Asia where the numbers are alarming.

Reef Check Malaysia was registered as a non-profit organisation in 2007, with the goal to educate and spread awareness to Malaysians about the value of coral reefs. We at RCM seek in particular to bring together scientists, businesses, government and other non-profit organisations in a united effort to sustainably manage Malaysia's coral reefs. Since 2007, RCM has progressed from solely conducting monitoring surveys to include outreach, coral bleaching monitoring, coral reef rehabilitation, ecological and social resilience programmes. Besides the importance to other marine organisms, many stakeholders such as local island communities, fishermen and tourism operators are dependent on coral reefs for their livelihoods.

In 2014, Reef Check Malaysia completed a total of 184 surveys across Malaysia, under the National Reef Check Survey Programme. These surveys were carried out by trained volunteers working together with government officials from the Department of Marine Parks Malaysia and Sabah Parks. We also successfully trained 128 new EcoDivers and certified 10 new EcoDiver trainers who join a growing band of dedicated "citizen scientists", helping us to monitor Malaysia's reefs. We have seen positive results in our reef rehabilitation efforts and also continued our education and awareness programmes with schools and universities. Our five-year "Cintai Tioman" programme has just completed a very successful first year and we hope that the local community will increasingly be involved in managing the Marine Park.

Reef Check Malaysia has successfully made it through its 8th year and we could not have done it without the support from our friends, supporters and a group of generous sponsors. The Department of Marine Parks Malaysia has also been one of our very valuable partners, collaborating with us on several of our major projects throughout the years.

The monitoring of coral reefs around Malaysia became more significant than ever in 2014, when the year started with severe haze to warming seas by mid-year and finally ending with massive floods on the east coast of Peninsular Malaysia. As challenges to conservation grow, our annual survey data becomes increasingly important as the basis for comparing changes in the uncertain years ahead, and helping managers to make informed decision on conservation programmes.

Julian Hyde
General Manager
Reef Check Malaysia
2015

Executive Summary

1. A total of 184 sites were surveyed in 2014 (2013: 196), 77 in Peninsular Malaysia and 107 in East Malaysia. The surveys are a continuation of a successful National Reef Check Survey Programme that has now run for eight years.
2. The surveys were carried out by trained volunteers as well as government officials from the Department of Marine Parks Malaysia and Sabah Parks, reflecting growing interest from the Government in further improving management of Malaysia's coral reefs. Surveys were carried out on a number of islands off Peninsular Malaysia's East and West coasts and in various parts of East Malaysia, both Sabah and Sarawak, covering both established Marine Protected Areas and non-protected areas,.
3. The results indicate that Malaysian reefs surveyed have a relatively high level of living coral, at 48.11% (2013: 48.33%). The level of recently killed corals indicates continuing recovery from the 2010 bleaching event that killed coral reefs around South East Asia.
4. Low levels of abundance of high-value species of fish (such as grouper) and shellfish (such as lobster) were recorded, indicating slow recovery from past overfishing and possible continuing problems with poaching inside Marine Protected Areas.
5. Some coral reefs show increasing amounts of algae, suggesting that they are suffering from an ecosystem imbalance due to elevated nutrient inputs, possibly from sewage and agriculture activities (particularly plantations), coupled with low herbivory by fish and sea urchins.
6. A series of recommendations is provided with a focus on better education and enforcement of existing laws to protect and conserve coral reefs, as well as the importance of involving local communities in decision making.
7. Of particular importance is the need to build resilience of coral reefs, in the face of growing global threats from climate change (bleaching and ocean acidification). Managing local threats will ensure coral reefs are in the best possible condition to resist these growing external threats. The Aichi Biodiversity Targets set national level targets for biodiversity conservation and **we recommend that the government invest in achieving Aichi Target 10** to reduce anthropogenic pressure on coral reefs and related ecosystems.
8. The government is asked to **support further survey programmes**, to take steps to build resilience of coral reefs and to establish a comprehensive Bleaching Response Plan as well as Reef Resilience Surveys to enable it to better respond to future mass coral bleaching events.
9. While tourism is a valuable source of income, the government is asked to **require hotels and dive facilities to follow best practices including careful attention to sewage treatment** and discharge, and education of clients so as to avoid damage to reefs.
10. Coral reefs are a valuable economic and biological resource in Malaysia, where they are a major attraction for the tourism industry, serve as a protein source for millions of people and are a major source of biodiversity. One estimate puts the economic value of well-managed coral reefs in Malaysia at RM 50 billion per annum. Coral reefs are threatened by global warming, overfishing, pollution and sedimentation.

This report is available for download at:



For further information, please contact Reef Check Malaysia at: ecoaction@reefcheck.org.my

CHAPTER

01

Introduction



Please note: Each Annual Survey Report is written as a stand-alone document that can be read without having to refer back to previous reports. As such, much of this and the following section, which remains valid and relevant, is a repetition from previous reports, copied here to provide the reader with an uninterrupted flow of argument and rationale.

1. Introduction

Coral reefs are an important ecological and economic resource in many countries around the world, providing a range of valuable ecosystem services to millions of people. Coral reefs provide jobs, food and coastal protection, among other benefits, to over 100 million people in South East Asia. They are the most diverse marine ecosystems on earth.

Despite being recognised for their economic and aesthetic value, coral reefs are being damaged by a variety of both local and global threats:

- The 2008 “Status of Coral Reefs of the World” report stated that the world has effectively lost 19% of the original area of coral reefs and that 15% are seriously threatened with loss within the next 10-20 years, with a further 20% under threat of loss in the next 20-40 years.
- In 2011, “Reefs at Risk Revisited” stated that more than 60% of the world's reefs are under immediate and direct threat from one or more local sources.

These threats arise largely as a result of human activities and land use changes along coastlines adjacent to coral reefs. Local threats to coral reefs are many, and are reasonably well understood. They include:

- Over-fishing, which can result in detrimental changes to reef ecology
- Destructive fishing (such as dynamite and cyanide fishing), which destroy the reef structure
- Coastal development, releasing silt and sediment that can smother reefs and altering hydrological flows
- Pollution, from industrial and agricultural activities as well as sewage pollution
- Physical impacts from tourism, including divers, snorkelers and boats.

In Malaysia, the Department of Marine Parks (Federal), Sabah Parks and Sarawak Forestry are tasked with managing these local threats to their protected reef areas.

However, against these *local* threats, mass coral reef bleaching has emerged over recent years as a *global* threat that is difficult to manage locally and which can have potentially devastating effects. The first significant mass coral reef bleaching event reported in Malaysia was in 1998, as a result of which an estimated 40% of corals in reefs around Peninsular Malaysia died. Reefs had barely recovered before the 2010 mass coral reef bleaching event occurred, which fortunately saw lower coral death rates.

Scientists agree that mass coral reef bleaching is likely to occur with increasing frequency in the coming decades, and there is an urgent need to put in place plans to:

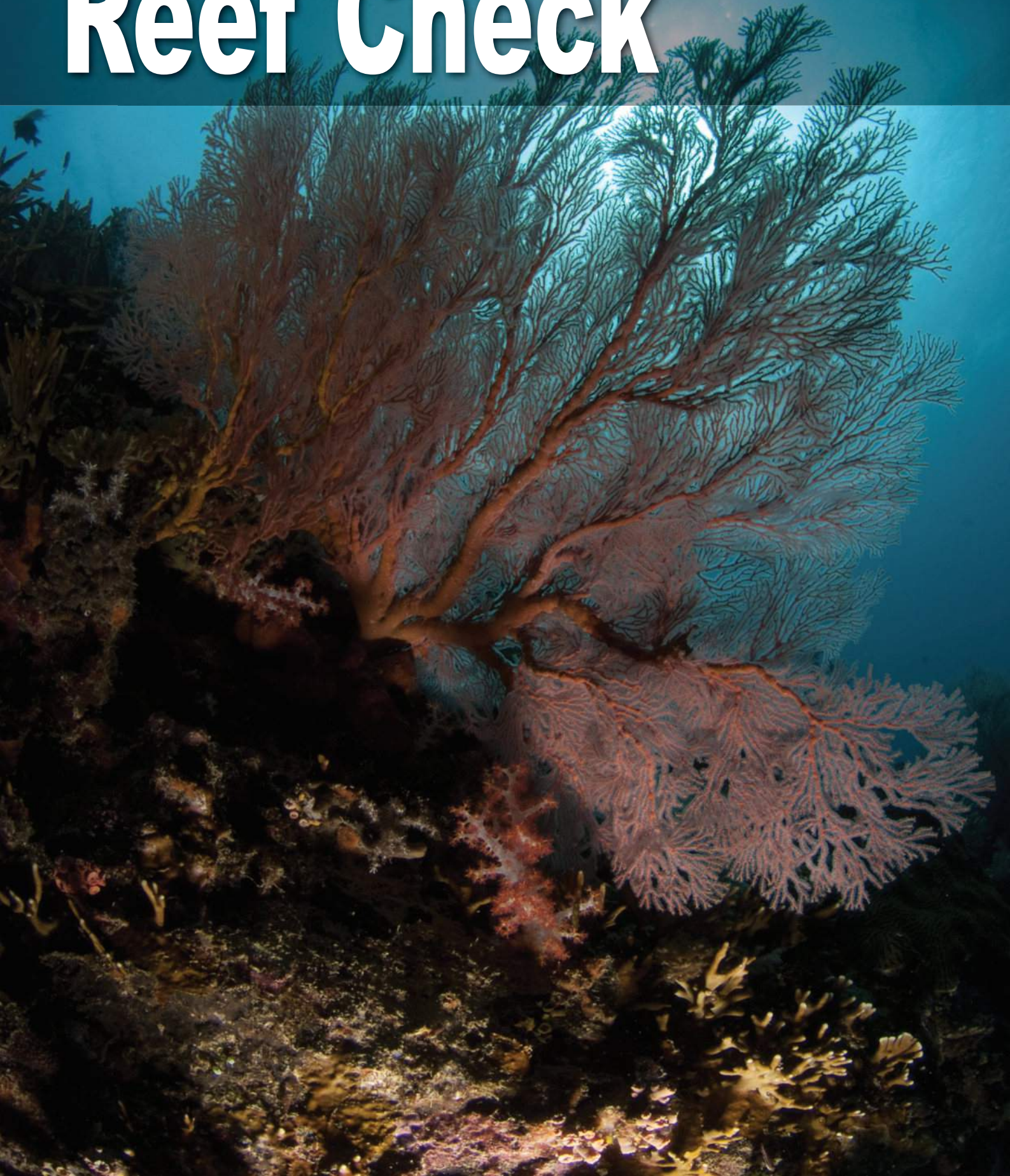
- Respond effectively to mass coral reef bleaching events with management interventions to protect reefs during bleaching events
- Build the “survivability” of coral reefs to better withstand future bleaching events.

Reef Check Malaysia Bhd (RCM) works with various stakeholders to conserve coral reefs. Since it was registered in 2007, RCM has established an annual, national coral reef monitoring programme. This report presents the results of coral reef surveys conducted in Malaysia during 2014, the eight year of surveys.

CHAPTER

02

Reef Check



CHAPTER 02

2. Reef Check

2.1 Background

Reef Check Malaysia is part of the world wide Reef Check network. Established in 1997 in the USA, Reef Check now has Coordinators in over 80 countries worldwide. Reef Check was established by a group of scientists who developed a simple, rapid method of surveying coral reefs. It is the name both of the organisation and the survey methodology.

Reef Check Malaysia (RCM) was registered in Malaysia as a non-profit company in 2007, and since then has established an annual survey programme to assess the health of coral reefs around Malaysia (reports are available for download from the website: www.reefcheck.org.my). In the last eight years RCM has trained over 550 divers to conduct reef surveys at over 150 permanent monitoring sites on coral reefs off the East coast of Peninsular Malaysia and at sites around East Malaysia.

RCM is also active in education and awareness programmes, and has a long term education programme for schools. In addition, we have worked with stakeholders in the Perhentian islands and in Pangkor to involve local communities in coral reef management.

In 2010, RCM established its first coral reef rehabilitation programme in Pangkor, to assist local snorkelling guides to improve sites. In 2011 and 2012, the programme was replicated, on a larger scale, in Tioman, Perhentian and Redang. These rehabilitation programmes were continued in 2014 and have contributed to our understanding of coral reef ecology, and provide an ideal vehicle to educate local populations, businesses and tourists on the benefits and value of coral reefs and how human activities are damaging them.

In 2014, RCM initiated the Cintai Tioman Campaign in Tioman, with funding from Yayasan Sime Darby and HSBC Amanah Takaful. The goal of the programme is to build ecological and social resilience on the island, with particular emphasis on involving the local community in managing the islands' reefs. In 2015, EcoKnights will join RCM in the programme, with funding support from the Small Grants Programme to implement a number of economic and social development programmes.

This report presents a State by State summary of data from the eighth annual Reef Check Malaysia coral reef survey programme in 2014. It represents a continuation of the reef monitoring effort started by RCM in 2007. The information shown highlights key concerns and identifies steps that need to be taken to contribute to the conservation of Malaysia's coral reefs.

2.2 Survey Methodology

Reef Check surveys are based on the philosophy of "Indicator Species". These are marine organisms that:

- are widely distributed on coral reefs
- are easy for non-scientists to identify
- provide information about the health of a coral reef.

Using a standardized methodology, data from surveys in different sites can be compared, whether it be on an island, regional, national or international basis (see www.reefcheck.org for more details).

The Reef Check monitoring methodology allows scientists and managers to track changes to coral reefs over time. By surveying reefs on a regular basis, deleterious changes can be highlighted early, before they become problems. This gives managers the opportunity to intervene, carry out additional more detailed studies and/or initiate management actions to try to reverse the change before permanent damage is done to the reef.

Reef Check surveys are conducted along two depth contours (3 m to 6 m and 6 m to 12 m depth). A 100 m transect line is deployed and along it four 20 m transects are surveyed, each separated by 5m, which provides four replicates per transect (8 per complete survey) for statistical analysis (see Figure 1).

Four types of data are collected:

- Fish abundance: the fish survey is carried out by swimming slowly along the transect line counting the indicator fish within each of the four 20 m long x 5 m wide x 5 m high corridors
- Invertebrate abundance: divers count the indicator invertebrates along the same four 20 m x 5 m belts
- Substrate cover: collected by the Point Intercept method whereby the substrate category such as live coral is noted every 0.5 m.
- Impact: the impact survey involves the assessment of damage to coral from bleaching, anchoring, destructive fishing, corallivores such as *Drupella* snails or crown-of-thorns starfish, and trash.

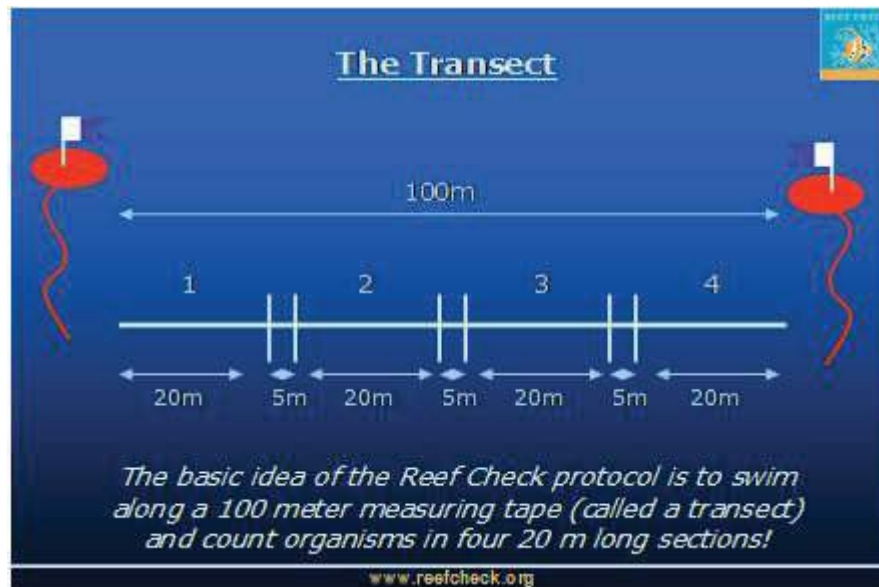


Figure 1: The transect according to RC method

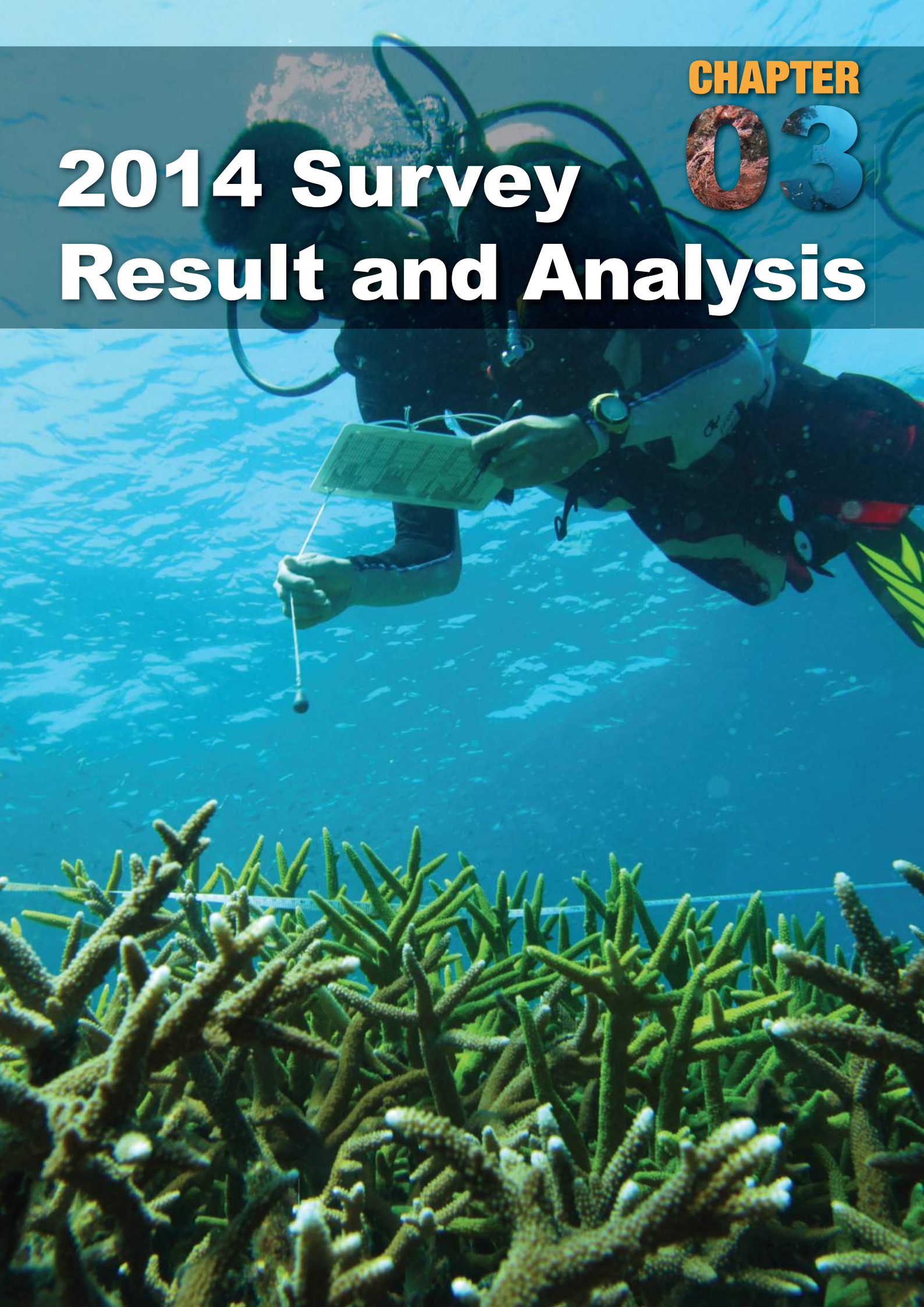
2.3 Survey Sites

In 2014, a total of 184 sites were surveyed, 77 of which were in Peninsular Malaysia and the remaining 107 in East Malaysia. As far as possible, the same sites are visited each year to provide consistent data over time.

In Peninsular Malaysia, surveys were conducted at sites around several islands off the East coast (Bidong, Yu, Kapas, Pemanggil, Perhentian, Redang, Sibul, Tinggi, Tenggol, and Tioman). Numerous sites were also surveyed around islands off the West coast (Sembilan and Pangkor Laut). In East Malaysia, a large percentage of the surveys were conducted by a number of dive operators, notably in Lankayan and Matakang, and by Sabah Parks, in TSMP, TARP and Sipadan in Sabah. This is one of the success stories of getting local stakeholders, especially governments, dive operators and local community, to be involved in monitoring and management of their own local reefs.

2014 Survey Result and Analysis

CHAPTER
03



CHAPTER 03

3. 2014 Survey Results and Analysis

This section details the results from surveys conducted in 2014, providing an overview of the condition of coral reefs in Malaysia as a whole, and a more detailed analysis of surveyed reef areas.

3.1 Status of Coral Reefs in Malaysia 2014

The results from all 184 surveys were compiled to provide an overview of the status of coral reefs around Malaysia. Sites surveyed off peninsular Malaysia are mostly developed islands which are important tourist destinations while the islands and reefs off Sabah and Sarawak are less frequently visited but face other problems such as destructive fishing practices.

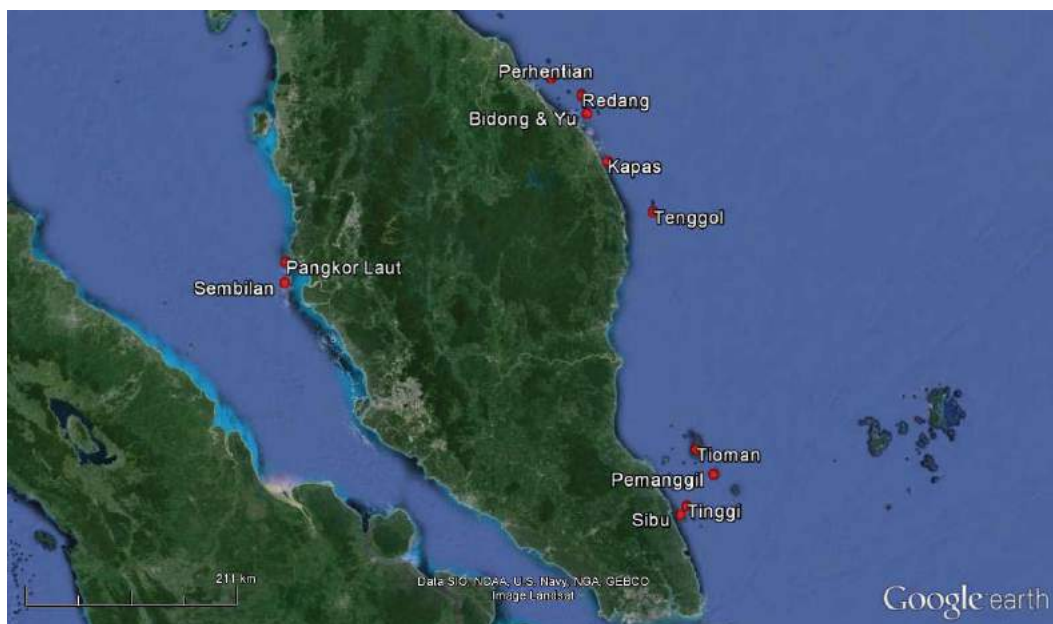


Figure 2: Surveyed islands in Peninsular Malaysia

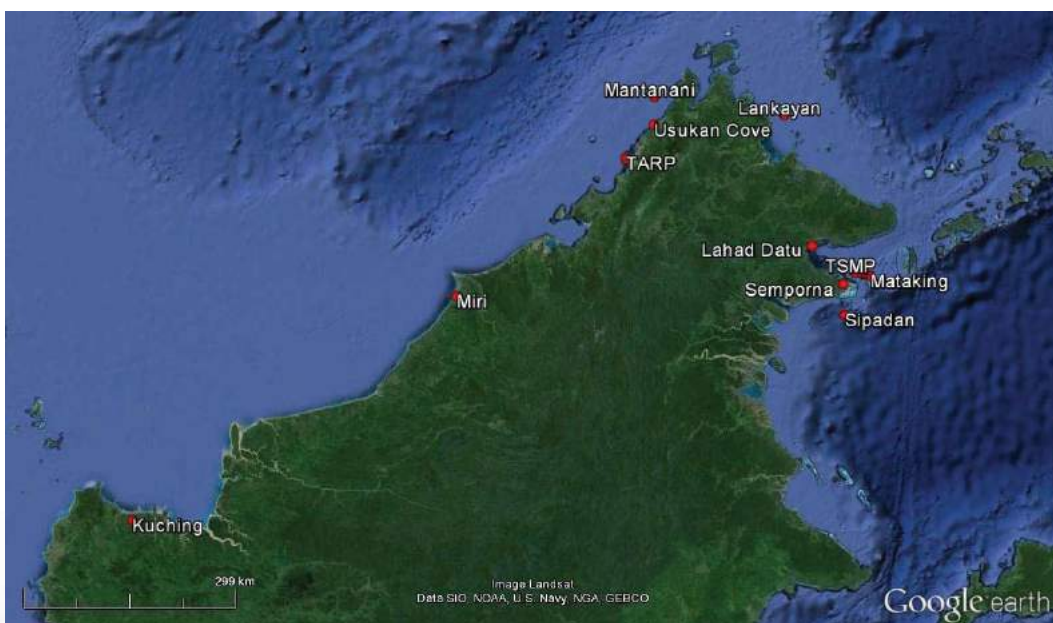


Figure 3: Surveyed islands in East Malaysia

(Note: TSMP = Tun Sakaran Marine Park; TARP = Tunku Abdulrahman Park)

3.1.1 Substrate

The table below shows the Coral Reef Health Criteria developed by Chou *et al*, 1994.

Percentage of live coral cover	Rating
0-25	Poor
26-50	Fair
51-75	Good
76-100	Excellent

Table 1: Coral Reef Health Criteria

According to these ratings Malaysian reefs are considered to be in “fair” condition, with an average live coral cover (Hard Coral + Soft Coral – see Figure 4) of 48% (similar to 2013).

Recently Killed Coral (RKC) shows the amount of coral killed within the last 12 months due to a variety of impacts, including bleaching, predation (e.g. by Crown of Thorns starfish and *Drupella* snails) and other local stressors (e.g. sedimentation and disease). The low level of RKC (1%) in 2014 mirrored that of 2013 (2%).

Nutrient Indicator Algae (NIA) is a measure of the amount of algae growing on reefs, and can provide an indication of the health of herbivorous fish and invertebrate populations on reefs and of the level of nutrient input to reefs. Algae is a natural and essential part of the coral reef, but if allowed to grow unchecked algae can shade corals from the sunlight they need for photosynthesis, smothering and eventually killing them. This can lead eventually to a phase shift from coral to algae dominated reefs, which are much less productive than coral-dominated reefs. NIA level increased slightly from 2013 (3%), but at 3%, it is still low and does not appear to be a threat in most places. However, it should be noted that this average figure masks a wide range and there are some sites where the proliferation of algae is becoming an issue that needs more attention, for example 44% at Roach Reef (Semporna), 35% at Yoshi Point 1 (Semporna) and 32% at Freshwater Bay (Tenggol).

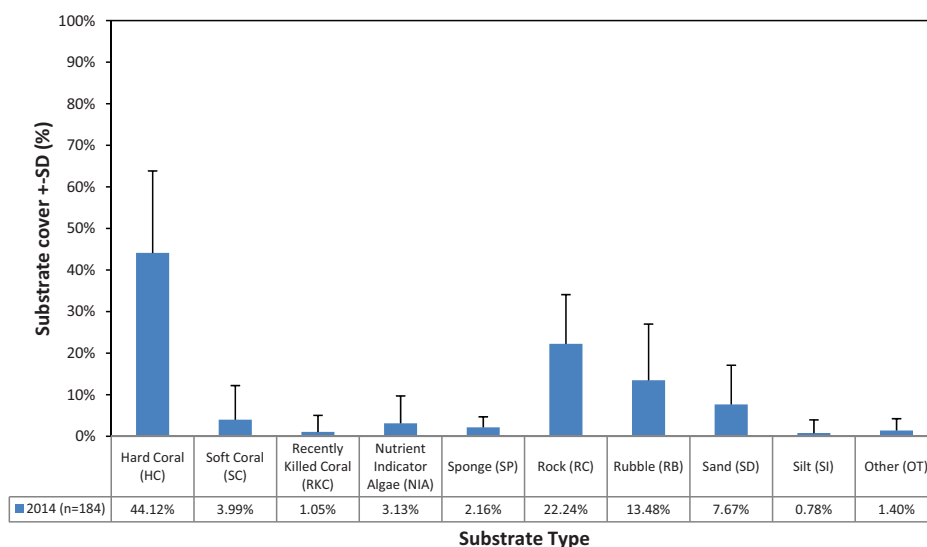


Figure 4: Average Substrate Cover for Malaysia in 2014

Sponges (SP) are another normal component of coral reefs that, under the right conditions, can proliferate in the presence of high levels of nutrients. At 2%, the level of SP does not appear to be a threat.

Rock (RC) comprises both natural rock and dead coral. Bare RC can be re-colonised by coral recruits and is critical for reef recovery, regeneration and extension. In 2014 the average cover of RC on Malaysian reefs was 22%. It should be noted that new coral recruits cannot settle onto RC that has significant

algae cover; and under these conditions settlement of new recruits will be reduced. This demonstrates the importance of healthy herbivore populations, which graze on algae and keep it under control, providing clean surfaces for coral recruits.

Rubble (RB) comprises small pieces of rock, coral fragments, dead shells and other small pieces of substrate. RB is created by a number of factors, some natural such as wave action and storms, while others result from human activities, including fishing, boating and SCUBA diving. On reefs with high levels of RB, coral regeneration is slow due to the difficulty of corals recruiting onto a mobile substrate: recruits are easily damaged or displaced from mobile substrate moving around on the seabed. The average cover of RB on reefs around Malaysia was 14% in 2014, and this has not changed much over the last three years. This relatively

high average level of RB is in part due to very high RB levels at some sites. Although 54% of reefs surveyed had RB level below 10%, at some sites it was significantly higher, including 89% at Matakong House Reef (Matakong), 60% at South Rim (Tun Sakaran Marine Park) and 57% at Coral Garden Matakong (Matakong). These are sites where fish bombing was previously commonplace.

Sand (SD) is a natural component of reefs, and can be expected to be found on any survey. Increasing amounts of SD in a given coral reef can be an indication of disturbance as dead coral breaks off and is eroded into fine particles (sand) by wave action. The average has not differed much since 2012 and is considered normal.

Silt (SI) arises from a variety of natural sources (e.g. mangroves and mud flats) as well as from land use changes, including agriculture, forestry and development. Silt can smother corals, depriving them of sunlight and causing coral death. The average level of SI for Malaysia is low at 1%. It appears that corals in some areas (e.g. West coast of Peninsular Malaysia) have adapted to high natural levels of SI, so average levels of SI are not necessarily a good indicator of reef health. However, changing levels of SI in a specific area can indicate a local impact.

The category Other (OT) includes all other sessile organisms that do not indicate any impacts, but are natural components of coral reefs. The average level of OT in Malaysia was 1% in 2014.

3.1.2 Fish

Reef Check indicator fish species were chosen because of their desirability for various types of fishing, for example:

- Targeted for the aquarium trade: Butterflyfish
- Targeted as food fish: Sweetlips, Snapper, Barramundi Cod, Parrotfish, Moray Eel, Grouper
- Targeted for the live-food fish trade: Humphead Wrasse, Bumphead Parrotfish

The average abundances of indicator fish counted during the 2014 surveys are shown below (Figure 5).

Barramundi cod, Humphead wrasse, Bumphead parrotfish, Groupers, Sweetlips, and Moray eels recorded an average abundance of less than 1 individual per 500m³ survey transect. High value fish such as these, which are specially targeted for the international live food trade, recorded the lowest average abundance and were absent on most surveys.

With restaurants willing to pay up to US\$ 10,000 for a single adult Humphead wrasse, it is not surprising that poachers target these fish even inside marine protected areas. Greater protection (including enforcement

of Marine Park regulations and trade restrictions) will be necessary to aid recovery of populations of these iconic species, and on-going monitoring will help to track recovery in populations.

Butterflyfish recorded a national average of 4.75 individuals per 500m³ in 2014 and this mirrored the average abundance of 2013. Butterflyfish is used as an indicator of fishing pressure for the aquarium trade as well as an indicator of reef health as they feed on coral polyps, and only healthy reefs can sustain a large population of these fish.

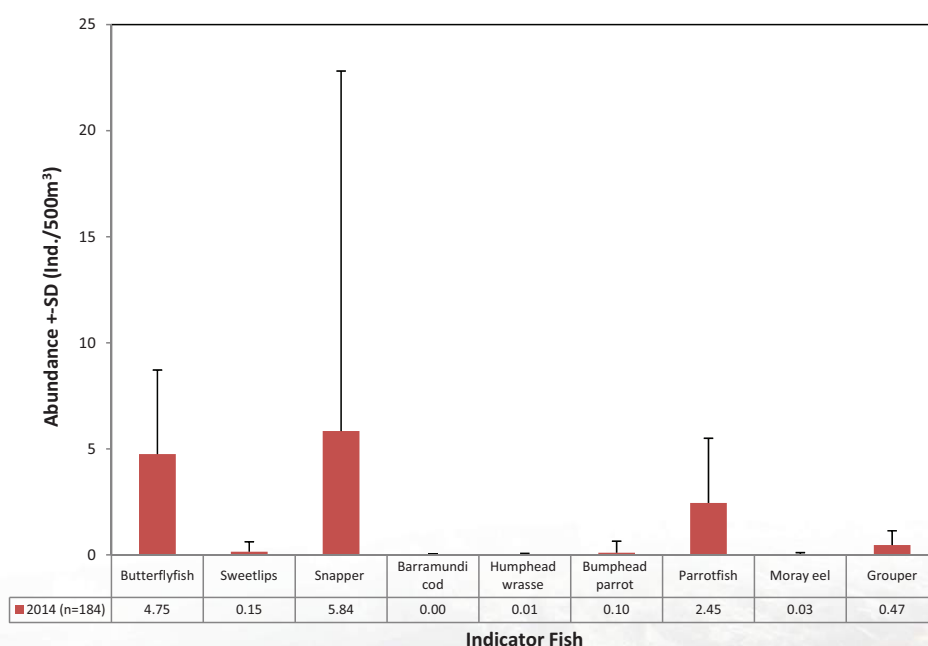


Figure 5: Average Indicator Fish Abundance (ind./500m³) for Malaysia

Parrotfish are important herbivores, controlling algal growth on reefs thus avoiding competition with corals. The national average in 2014 was 2.45 individuals per 500m³ and is similar to that of 2013.

3.1.3 Invertebrates

The invertebrate indicators are targeted for different reasons:

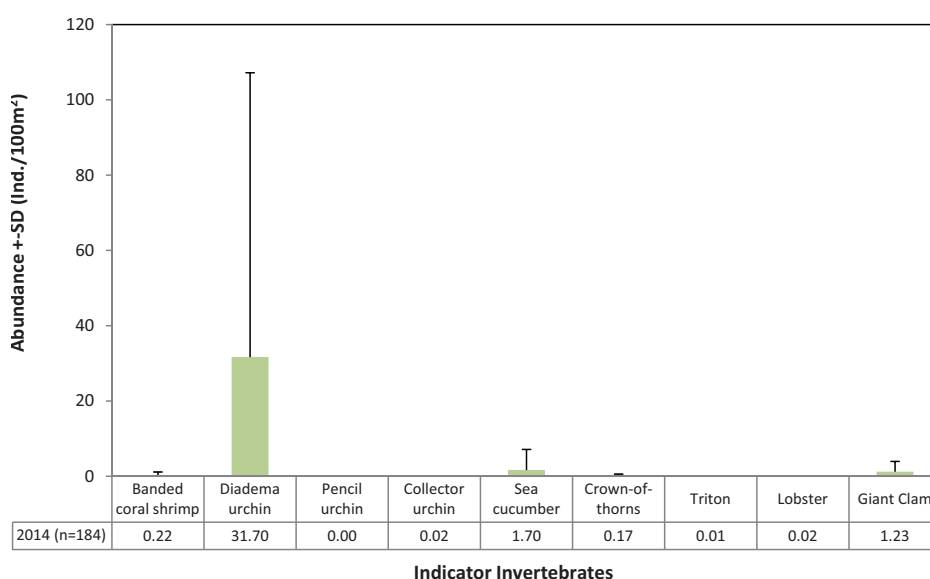
- Collected for Curio trade: Pencil Urchin, Triton Shell
- Collected for Food: Banded Coral Shrimp, Collector Urchin, Sea Cucumber, Lobster, Giant Clam
- Ecological Imbalance/predator outbreaks: *Diadema* Urchin, Crown of Thorns

The abundance of indicator invertebrates documented during the 2014 surveys is shown in Figure 6 below.

National abundance average of invertebrates targeted for the aquarium and curio trade was less than one individual per 100m². While this may be partly explained by low natural abundance and cryptic behaviour, the overexploitation of invertebrates such as Tritons and Pencil urchins may have had a significant impact on their populations.

Similarly, several species targeted for the food trade are at or near zero (Lobster 0.02 individuals per 100m² survey transect; Collector Urchin – 0.02 individuals per 100m²). Giant Clam recorded an average of 1.23 individuals per 100m². This includes both mature breeding adults as well as juveniles. The low numbers of giant clams within 100m² is something to take note of as the sessile nature of these organisms would make breeding difficult if distances between breeding adults are too large.

The abundance of long-spined sea urchins (*Diadema* sp.) varies widely between survey sites, and in some sites they are present in unusually high numbers. In a balanced reef ecosystem, the numbers of *Diadema* urchins, in combination with herbivorous fish, keep algal growth in check. However, these urchins can reproduce rapidly in conditions in which their main food source (micro- and macroalgae, which proliferate in nutrient rich water) is abundant. Thus, high numbers of *Diadema* could indicate eutrophication or overfishing of herbivores.



While grazing algae on coral reefs, *Diadema* cause some damage to reefs, scraping the top layer of the coral skeleton. However, in high numbers, *Diadema* can have two further negative impacts. First, if algae are scarce, their feeding preference can change to coral tissue, and large numbers actively grazing can cause a weakening of the hard coral structure. Secondly, their spines scrape corals as they move over the surface of the reef, potentially damaging the reef structure if the rate of bio-erosion exceeds the

Figure 6: Average Abundance of Indicator Invertebrates for Malaysia in 2014

rate of coral growth. Controlling nutrient pollution as well as maintaining a healthy population of herbivores fish can contribute to reducing this problem.

Crown-of-thorns starfish (COT) feed on corals and can cause significant damage to coral reefs, destroying large areas in a short period of time. According to CRC Reef Research Centre (Australia), a healthy coral reef can support a population of 20-30 COT per hectare (10,000m²), or 0.2-0.3 per 100m². The abundance of COTs found during surveys, 0.17 per 100m², suggested that COT numbers are not a threat to the reefs. On some of the islands off the East coast of Peninsular Malaysia, considerable efforts have been made by Marine Park authorities and local dive centres to control COT numbers by organising annual COT extractions to reduce the threats posed by these creatures. Continued monitoring is essential to track and help to manage significant outbreaks of this corallivore.

3.2 Status of Coral Reefs in Terengganu

Terengganu has several clusters of islands with coral reefs. Reefs around the Terengganu islands are fringing off-shore reefs, with submerged reefs found in some areas. Most of the islands were gazetted as Marine Parks in 1994.



The Perhentian islands are located some 20km from Kuala Besut off the East coast of Terengganu, Malaysia. The islands have one village with a population of approximately 1,500, most of who work in tourism, the main industry on the islands.

A popular tourist destination, particularly among backpackers, there are some 40 resorts, mainly small, family run chalets with a couple of large resorts, and 15 dive operators, spread around the two main islands. Diving and snorkelling are the main tourist activities. Growth in tourism has been rapid on the islands, and resort development continues. There is no grid-supplied electricity, nor centralised sewage treatment; groundwater supplies are limited in Perhentian and fresh water is supplied from the mainland.

Redang Island is located some 25km from Merang, off the East coast of Terengganu, Malaysia. The island has a population of approximately 1,500, only a small proportion of who work in tourism, the main industry on the islands.

The island is a popular resort destination, with a more upmarket image than nearby Perhentian. Diving and snorkelling are the main tourist activities. There are 10 medium-large size resorts, mainly on Pasir Panjang. Most resorts have an in-house dive operator. There is no mains electricity, water is supplied by pipeline from the mainland and each resort has its own sewage treatment facilities. The island is served by an airport as well as boat services.

The Bidong and Yu archipelago comprises several small islands, located 15-25km from Marang, off the East coast of Terengganu, Malaysia. The islands are unpopulated, though from 1978 to 1991 Bidong was a centre for Vietnamese refugees. The islands are now gazetted as a Marine Park. Bidong has mainly been a research base for University Malaysia Terengganu but has recently grown in popularity as a diving destination. Bidong has some sandy beaches and fringing reefs while Pulau Yu Besar and Kecil are mainly small rocky islands, with boulder slopes dropping to 25-30m, with some coral reef areas.

Kapas Island is located just 6km from Marang, off the East coast of Terengganu, Malaysia. This small island has no local population. The island is not a major tourist destination due to its small size, but does have an established tourist market, with four resorts and one dive operator. Diving and snorkelling are the main tourist activities. There is no mains electricity, groundwater supplies are limited and there is no centralised sewage treatment.

Tenggol Island is located approximately 30km from Dungun, off the East coast of Terengganu, Malaysia. This small island has no local population. It is a very popular diving destination due to the surrounding deep water which attracts more mega fauna than other islands (whale sharks are common around the island). There are four resorts on the island, each with its own dive operator. There is no mains electricity, groundwater supplies are limited and there is no centralised sewage treatment. Much of the islands' coastline is rocky, besides a couple of sandy beaches.

Overall Health

A total of 38 coral reef sites were surveyed in Terengganu, of which 58% were in excellent (19%) or good (39%) condition. 39% of reefs were in poor condition, with only 3% of reefs in poor condition (see Figure 7).

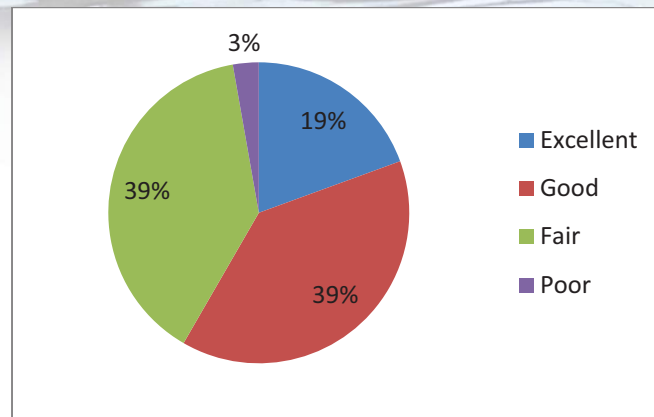


Figure 7: Status level percentage of sites for Terengganu in 2014

Substrate

Coral reefs in Terengganu are considered to be in 'Good' condition, with 56% live coral cover, slightly above the average (54%) for reefs in Peninsular Malaysia (Figure 8).

The level of SC was the highest amongst Peninsular reefs, exceeded only by Sarawak. The level was especially high at Redang Kalong (75%) which appears to be a recovering reef, now overgrown with soft coral. Several sites in Tenggol also show higher than average SC, probably due to the deeper water and stronger currents experienced there.

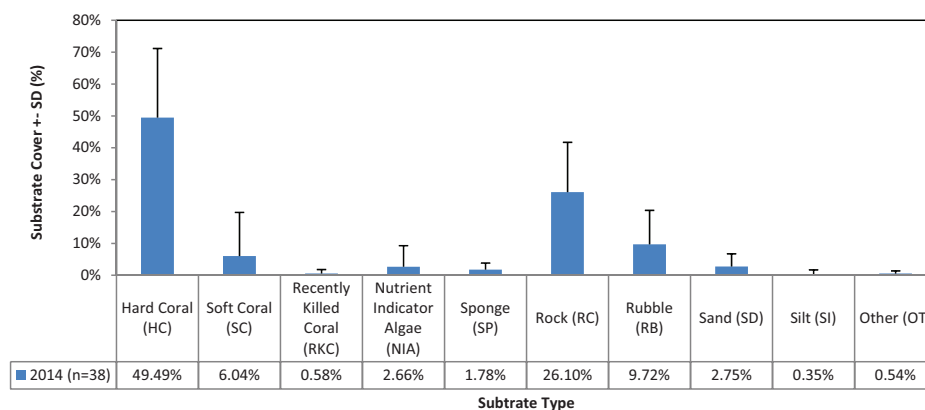


Figure 8: Percentage Substrate Cover for Terengganu, 2014

Indicators of recent disturbance (e.g. RKC, NIA) are within the average range, suggesting that there have been no recent significant impacts to reefs in Terengganu. However, the amount of RB (10%) is somewhat raised above some other reef areas, perhaps indicating an impact from the large number of divers visiting the islands.

Fish

Seven out of nine indicators were recorded during surveys in Terengganu (Figure 9). The most abundant fish were Snapper (second highest of all states), followed by Butterflyfish.

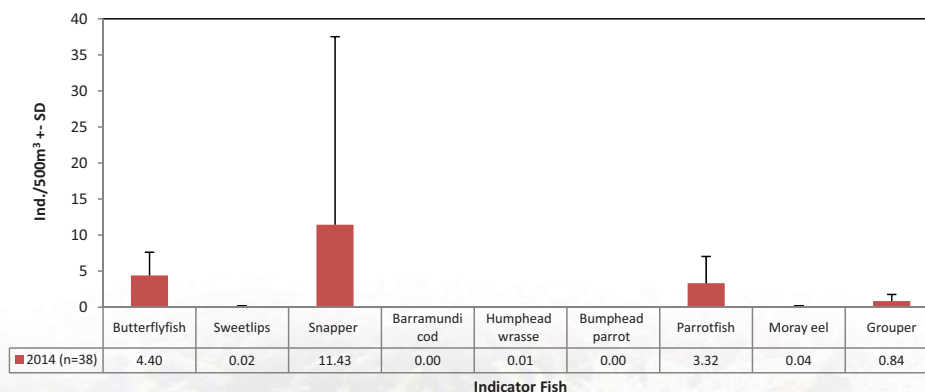


Figure 9: Fish Abundance in Terengganu, 2014

The abundance of Parrotfish was the highest of all states.

High value fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were either completely absent during surveys, or detected in very small numbers.

Invertebrates

Four out of nine indicator invertebrates (Banded Coral Shrimp, Collector Urchin, Triton and Lobster) were absent from all surveys (Figure 10).

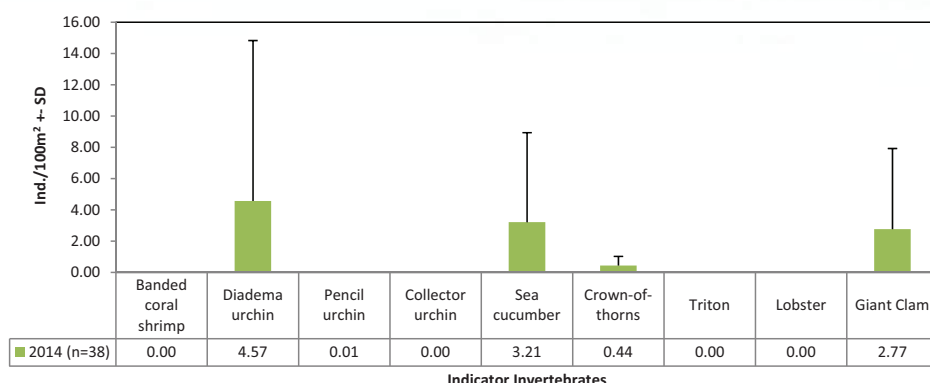


Figure 10: Invertebrate Abundance in Terengganu, 2014

Diadema Urchin were the most abundant, though only slight higher than Sea Cucumber and at much lower levels than other states. Terengganu had the highest abundance of Giant Clams and was the only state in which Pencil Urchins were observed.

However Terengganu also had the highest abundance of Crown of Thorns, the coral-eating starfish.

Although DMPM conducts annual COT cleanups around the East coast islands, COT abundance was still high, and the number is above what it is estimated that a healthy reef can sustain (0.2-0.3 individuals/100m²). Nutrient runoff into the sea must be managed and fish feeding must be stopped to avoid COT blooms in the future.

Impacts/Mega Fauna

There is little damage to reefs, mainly due to warm water bleaching was observed at all sites. There is some evidence of fishing inside the marine parks, with fish nets found at some survey sites. Trash was only occasionally spotted.

Few mega-fauna were observed during surveys, limited to the occasional sighting of a black-tip reef shark and hawksbill and green turtles.

Summary & Threats

Reefs in Terengganu are in good condition, with average fish and invertebrate diversity (though generally low abundance). Impacts to reefs are limited, with little trash or other man-made damage.

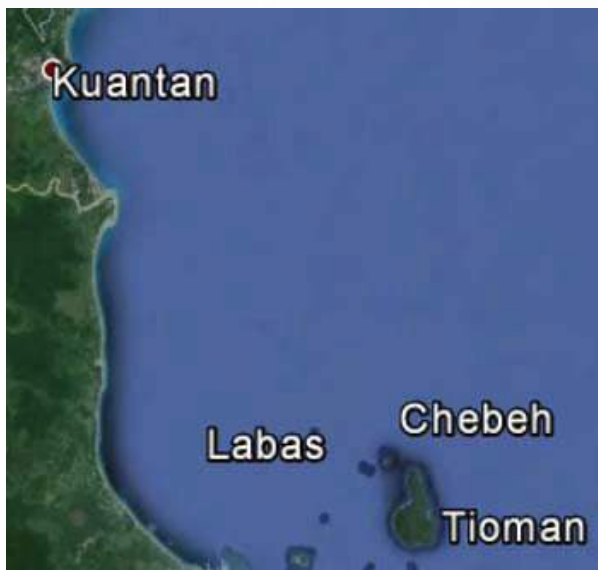
The main threat to coral reefs in Terengganu appears to be growth in tourism and the related development such as resorts and infrastructure. The annual number of visitors is large and continues to grow. In Perhentian, the number of resorts has doubled in 15 years. In Redang, some resorts often accommodate 3-4 or even more people per room, catering for package tourists and providing little supervision over the activities of large numbers of visitors (though there are notable exceptions that do manage numbers and visitors well).

In both islands, the number of tourists is putting pressure on ecosystems and infrastructure, particularly solid waste management and sewage treatment. In time, it is very likely that these pressures will degrade the condition of coral reefs, threatening both livelihoods and the local fishery.

It is recommended that the State government urgently reviews the islands' capacity to absorb current or projected tourism numbers, either through a Carrying Capacity study of Limits of Acceptable Change study. This will provide guidance on the impact resulting from growing tourism and provide a basis for decision making on future tourism development and growth.

3.3 Status of Coral Reefs in Pahang

Pahang has one principal cluster of islands – those around Tioman Island, some 50km from Mersing.



Two other islands in Pahang – Pulau Sembilang and Pulau Seri Buat – are not included in the survey programme.

Tioman is the largest island off the East coast of Peninsular Malaysia. The island has five villages, with a total population of approximately 3,000, most of whom work in the tourism industry, the main industry on the islands. The island has been gazetted as a Marine Park since 1994. Reefs are mainly fringing off-shore reefs with some submerged reefs.

Diving and snorkelling are the main tourist activities. The island has long been a popular tourist destination, though in recent years it has been eclipsed by other destinations (particularly Redang and Perhentian). As a result, resort development has been at a slower pace, with no significant new resorts in the last 12 years. There are some 60 resorts on the island, mainly small

family run operations, and 15 dive operators.

There is a small power generation station on the island, supplying electricity to all areas. The island has abundant fresh water, and a municipal incinerator was constructed some years ago. The island is served by an airport as well as boat services.

Overall Health

A total of 19 coral reef sites were surveyed in Pahang and 26% of the reefs were in excellent condition (Figure 11). 37% were in good condition, while 32% were in fair condition. 5% of the reefs were in poor condition.

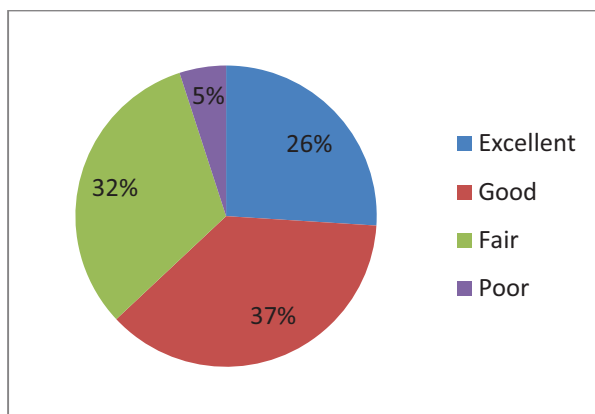


Figure 11: Status level percentage of sites for Pahang in 2014

Substrate

Coral reefs in Pahang are considered to be in 'Good' condition, with 60% live coral cover, the highest of all states surveyed (Figure 12).

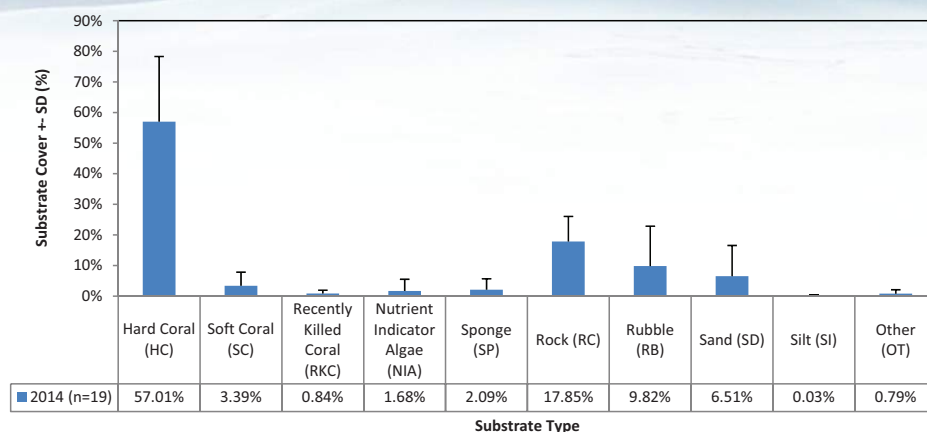


Figure 12: Percentage Substrate Cover for Pahang, 2014

The level of RB (10%) is considered slightly higher than the norm and this reflects some recent disturbances, possibly resulting from increasing numbers of divers or damage caused by fishing boats – one site registered over 50% RB.

Other indicators of recent disturbance (RKC, NIA) are within average ranges.

Fish

All indicator fish were observed except for Barramundi Cod (Figure 13). However, although diversity is wide, abundances are low.

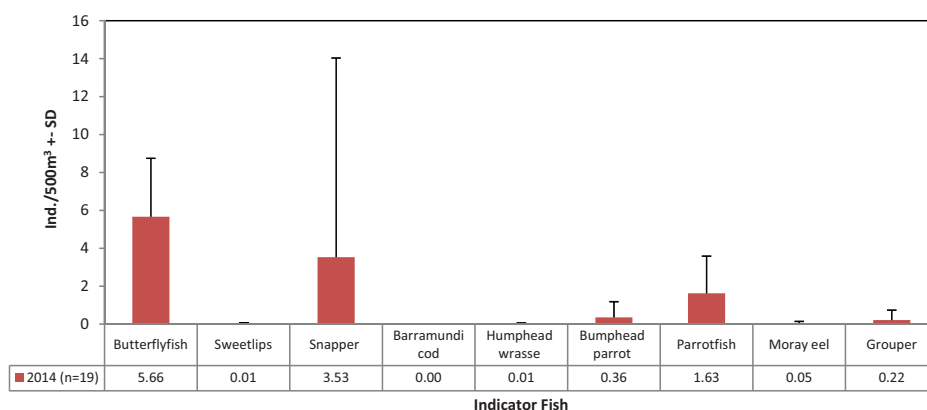


Figure 13: Fish Abundance in Pahang, 2014

Butterflyfish recorded the highest abundance in Pahang, followed by Snapper and Parrotfish. The number of Butterflyfish in Pahang is the highest recorded in all states. Other indicators were recorded in very low numbers.

Of all states surveyed, only Pahang and Sabah recorded both Humphead Wrasse and Bumphead Parrotfish, prized food fish and targeted for the live

food fish market.

Invertebrates

Four of nine indicator species were absent, including Pencil Urchin, Collector Urchin, Triton and Lobster (Figure 14).

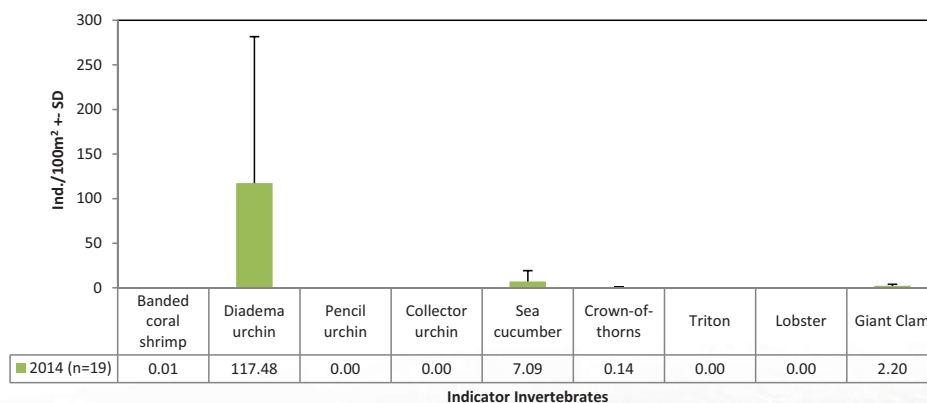
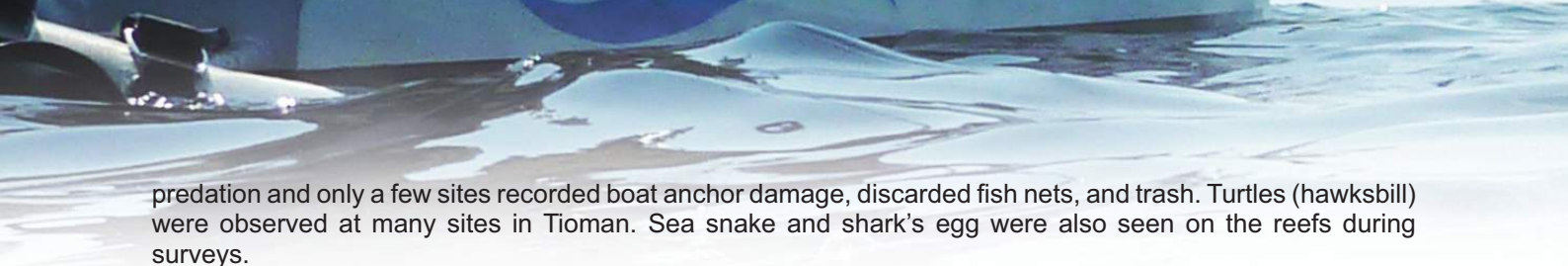


Figure 14: Invertebrate Abundance in Pahang, 2014

The number of Diadema in Pahang was the highest of all states surveyed, as was the number of Sea Cucumbers. The number of COT appears to be under control, which reflects the Annual COT cleanup organised by DMPM is keeping them within acceptable numbers.

Impacts/Mega Fauna

Damage on the reefs due to warm water bleaching was observed during some surveys. A few of the sites were impacted by *drupella*



predation and only a few sites recorded boat anchor damage, discarded fish nets, and trash. Turtles (hawksbill) were observed at many sites in Tioman. Sea snake and shark's egg were also seen on the reefs during surveys.

Summary & Threats

Reefs in Pahang are some of the best on the East coast and generally in good condition. Fish and invertebrate diversity are average (though generally low abundance). Impacts to reefs are limited, with little trash or other man-made damage.

The main threat to coral reefs in Pahang appears to be growth in tourism and the related development such as resorts and infrastructure. Tioman has the largest number of visitors annually of all the East coast islands (over 214,477 in 2012, compared to 207,769 in Terengganu). Although development pressure in recent years has been low due to the greater popularity of the Terengganu islands, three new resorts have been built in the last two years, indicating that Tioman is again becoming a target for growth.

While it has the best infrastructure of the East coast islands (incinerator, marina, airport and limited road network), increasing numbers of tourists will put pressure on ecosystems and infrastructure, particularly sewage treatment and internal transportation. In time, it is very likely that these pressures will degrade the condition of coral reefs, threatening both livelihoods and the local fishery.

It is recommended that the State government urgently reviews tourism growth and manages it within realistic ecological limits. It is also recommended that the State government establish Tioman as an "eco-tourism" destination. Tioman is the largest of the East coast islands, and has undisturbed rainforest and numerous indigenous species. The southern half of the island is largely undisturbed and could be an ideal destination for high end eco-tourism resorts and products. This market attracts low volume, high value tourists, allowing economic growth without environmental degradation.

3.4 Status of Coral Reefs in Johor

Johor has several offshore islands with coral reefs. The reefs around the Johor islands are fringing off-shore reefs, with submerged reefs found in some areas. Most of the islands were gazetted as Marine Parks in 1994.



Pemanggil Island is approximately 45km east of Mersing off the East coast of Peninsular Malaysia. The island is sparsely populated and has for many years been a frequent stopover point for fishermen.

Tinggi Island is located less than 15km off the East coast of mainland Peninsular Malaysia. The island is not as popular among tourists as other islands off the East coast, but the tourism industry here is growing. There is no dive operator on Tinggi Island.

Sibu Island is located less than 10km off the East coast and the closest of all the islands to mainland Peninsular Malaysia. The islands are not as popular among tourists as other islands off the East coast, but the tourism industry here is growing. There are only two dive operators on Sibu Island.

All the Johor islands are sparsely populated with few villages and a number of small resorts, typically used as a weekend or short vacation destination from Singapore.

Overall Health

A total of 11 coral reef sites were surveyed in Johor. 18% of the sites were in excellent condition (Figure 15). 45% were in good condition and 36% were in fair condition. No reefs were in poor condition.

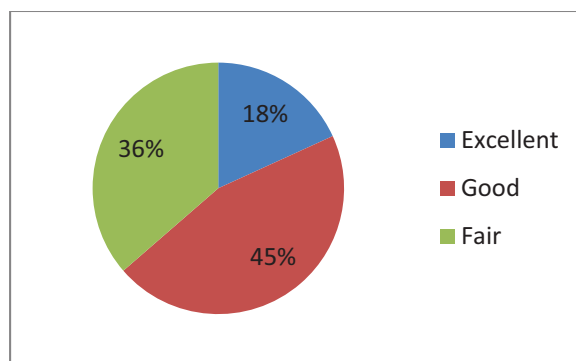


Figure 15: Status level percentage of sites for Johor in 2014

Substrate

The reefs in Johor are considered to be in 'Good' condition, with 55% live coral cover, similar to the average (54%) for reefs in Peninsular Malaysia (chart 13).

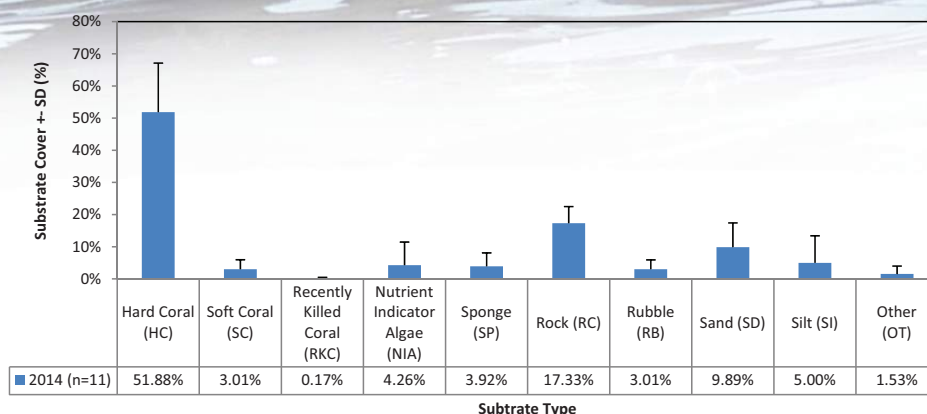


Figure 16: Percentage Substrate Cover for Johor, 2014

However, NIA and SP levels are high, which perhaps indicate the presence of nutrients in the water.

Further, the state recorded the highest level of SI, which is perhaps accounted for by the proximity of some islands to the mainland. This could be a result of run-off from rivers on the nearby mainland, as well as other terrestrial run-off.

Fish

Only five indicator species (Butterflyfish, Sweetlips, Snapper, Parrotfish and Grouper) were observed during surveys (Figure 17).

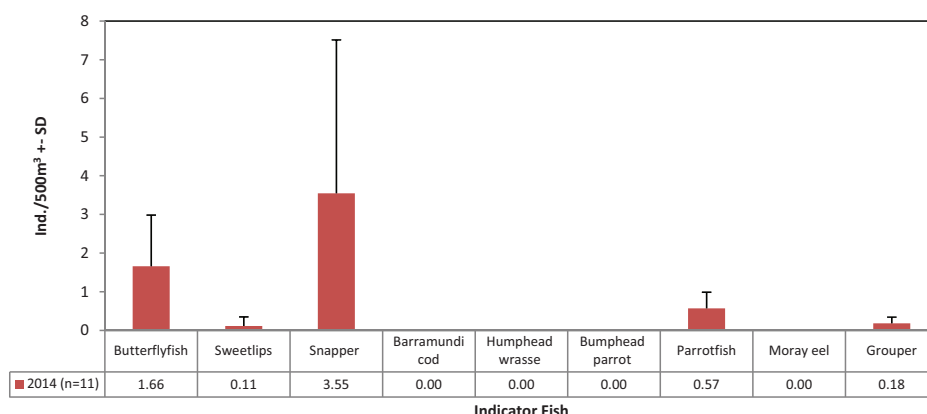


Figure 17: Fish Abundance in Johor, 2014

Snapper were most abundant, but abundance of all indicators – including Snapper – is low, with most recording less than 1 individual/500m³. Fishing around some of the Johor islands is widespread as there is no effective presence of Marine Park officers on some of the islands.

Invertebrates

In common with other states, several targeted species were absent, including Banded Coral Shrimp, Pencil and Collector Urchin and Triton (Figure 18).

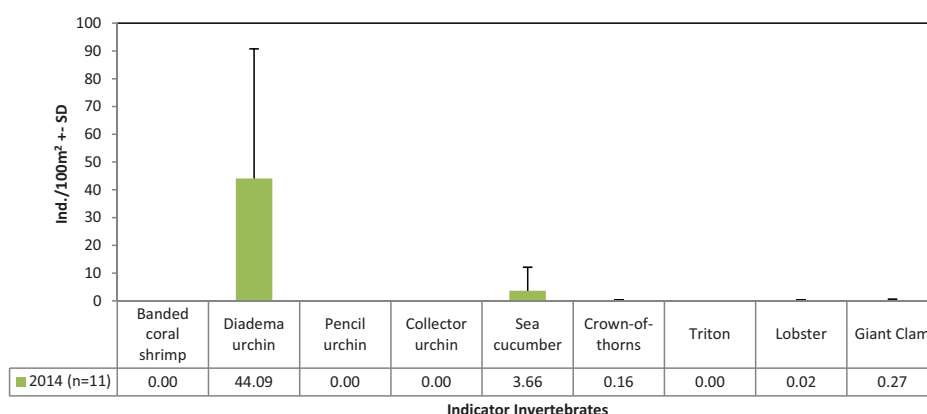


Figure 18: Invertebrate Abundance in Johor, 2014

Diadema Urchin recorded the highest number followed by Sea Cucumber.

Apart from these two, abundance of all indicators is low, with most recording less than 1 individual/500m³.

Impacts/Mega Fauna

Very few natural or direct human impacts were observed during surveys, with the occasional

exception of coral damage caused by anchors or boats.

No mega fauna were recorded during surveys.

The background of the page is a composite image. The top half shows the surface of the water with gentle ripples. The bottom half is an underwater scene featuring a vibrant coral reef with various types of coral and some small fish swimming in the clear water.

Summary & Threats

Reefs in Johor are generally in good condition. Fish and invertebrate diversity are slightly below average for the East coast and populations are generally low in abundance. Impacts to reefs are limited, with little trash or other man-made damage.

The main threats to coral reefs in Johor appear to be tourism and habitat destruction caused by development both on the islands and on the mainland, which is nearer than for many of the East coast islands.

Tourism in the Johor islands is not as developed as other States, with the islands receiving only 82,240 visitors in 2012 (compared to 214,477 in Pahang). However, extensive developments have been proposed for the islands near Mersing and there is significant potential on the more distant islands (Pemanggil and Aur) which are currently not highly developed. Growth in tourism would likely put pressure on both infrastructure (sewage treatment, solid waste management, water) as well as ecosystems (e.g. siltation arising from construction projects).

The Johor islands appear to be unique in having the most extensive seagrass beds on the East coast (particularly adjacent to P Sibu), with a significant Dugong population living nearby. However, the seagrass beds are outside existing protected areas.

It is recommended that the State government urgently reviews plans to develop new tourism facilities and ensure they are within realistic ecological limits. It is also recommended that the State government consider opportunities to expand existing protected areas, to incorporate and protect the seagrass beds near Pulau Sibu, and the associated Dugong population.

3.5 Status of Coral Reefs in Perak

Coral reefs in the State of Perak can be found along various islands off the coast, including fringing and submerged reefs. However, in most places reef extension is limited to shallow depths due to high levels of turbidity – both natural from the extensive mangrove forests along the costs, and from pollution from rivers and shipping.



The majority of the state's reefs are to be found at the Sembilan Islands, which consist of a cluster of nine islands (Pulau Agas, Pulau Payong, Pulau Nipis, Pulau Rumbia, Pulau Lalang, Pulau Saga, Pulau Buluh, Black Rock and White Rock) located some 20km from the coast of Perak (Lumut) and 15km south of Pulau Pangkor off the west coast of Peninsular Malaysia, in the Straits of Malacca.

The islands are uninhabited and the only structures on the islands are small rest areas on Pulau Saga, constructed for the use of tourists and fishermen. The islands are a favourite fishing spot among sport and commercial fishermen. They are also occasionally visited by snorkelers and divers from Pangkor and Lumut. They have no protected status; hence tourist and fishing pressure are neither controlled nor monitored.

In addition to the Sembilan islands, there is a cluster of small islands just off the coast of Perak around Pangkor Island, including Pangkor Laut Island. These are resort islands and Pangkor Laut Island is a small island, privately owned and located 3 miles off the West Coast of Malaysia along the Straits of Malacca. Of the island's 300 acres, a

fraction has been developed to house a premier resort.

Although the reefs of Perak have lower tourism value than those on the East coast (possibly due to poor water visibility), they are nonetheless considered to be important ecologically, as one of the last major areas of coral reef on Malaysia's west coast.

Overall Health

A total of 9 coral reef sites were surveyed in Perak, mainly around the Sembilan islands. None of the reefs were in excellent condition, reflecting the location (Figure 19). Only 22% of the reefs were in good condition, with the remainder in fair (44%) or poor (33%) in condition.

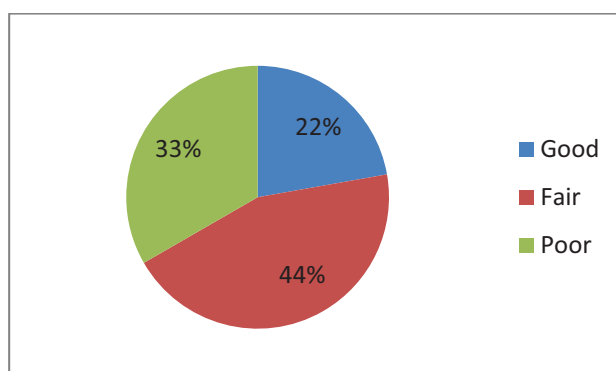


Figure 19: Status level percentage of sites for Perak in 2014

Substrate

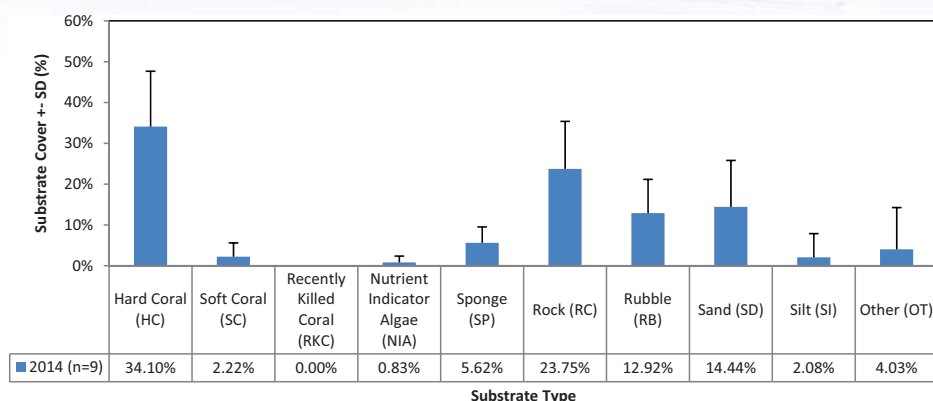


Figure 20: Percentage Substrate Cover for Perak, 2014

Coral reefs in Perak are considered to be in 'Fair' condition, with 36% live coral cover, the lowest in Peninsular Malaysia (Figure 20).

Figure 20. Percentage Substrate Cover for Perak, 2014

The low level of NIA perhaps reflects the lack of habitation on the islands, reducing nutrient input to the reefs and therefore

keeping NIA levels low.

However, the level of SI is the second highest of all states, indicative of the proximity of two large rivers on the mainland, and the natural high silt levels from the mangrove coastline. These combine to cause the high levels of turbidity at the reefs, limiting reef extension to shallow depths.

None of Perak's islands are gazetted as Marine Protected Areas and all are heavily impacted by development (on the mainland), fishing pressure as well as shipping activity in the Malacca Strait.

Fish

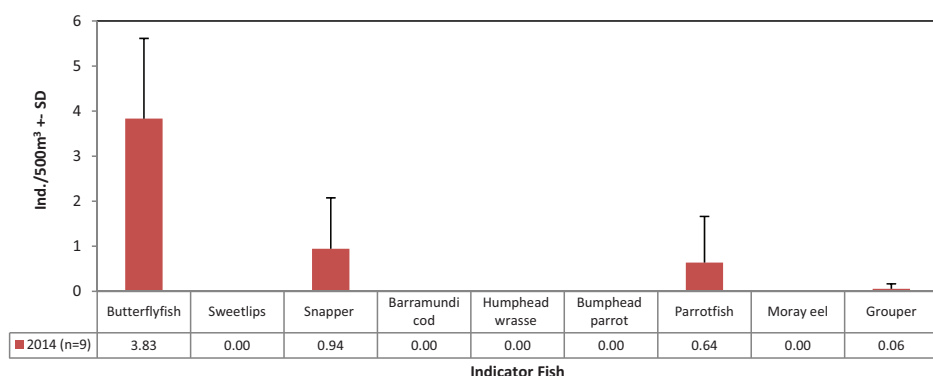


Figure 21: Fish Abundance in Perak, 2014

1 individual/500m³. On a positive note, many juvenile groupers were observed, thus indicating a possible recovery in population abundance. However this can only happens if the fishing pressure in Sembilan islands is controlled.

Only four indicator species were present during surveys (Butterflyfish, Snapper, Parrotfish and Grouper), the lowest of all states surveyed (Figure 21).

Abundance of Butterflyfish was the highest of all indicator species. Other indicator species were present in very low number, less than

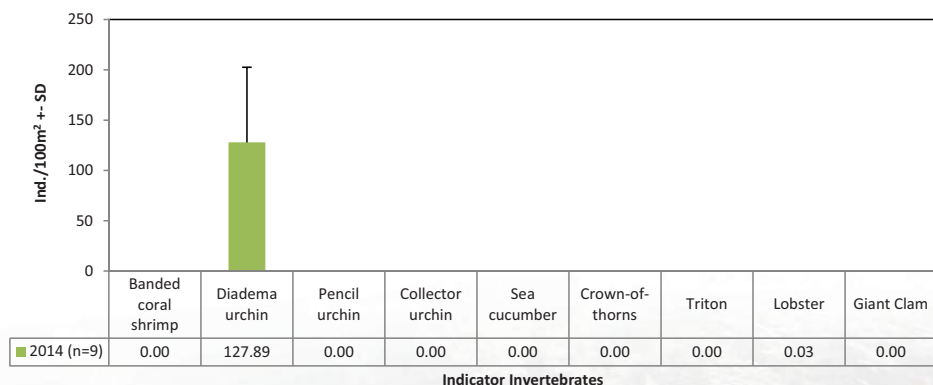



Figure 22: Invertebrate Abundance in Perak, 2014

Invertebrates

Only two indicator invertebrate species were observed, Diadema Urchin and Lobster (Figure 22). The abundance of Diadema Urchin was very high while the abundance of Lobster was very low. Numerous non-indicator invertebrates were noted during the surveys.



Impacts/Mega Fauna

Trash, discarded fishing lines and nets were common on the reefs. Many of the reefs were also impacted by anchor and boat damage. Two seahorses were recorded during surveys and other research indicates that the Sembilan islands have a significant seahorse population.

Summary & Threats

Reefs in Perak are generally in fair condition. Fish and invertebrate diversity are slightly below average for Peninsular Malaysia and populations are generally low in abundance. Reefs appear widely impacted by fishing lines and nets, reflecting their popularity as a fishing ground. Furthermore, water quality is poor (due to made-made pollution and natural sources) and the reefs have low tourism value.

This said, the Sembilan islands do harbour significant biodiversity value. Also, they appear to have an important sea horse population, which according to researchers could be regionally significant.

The main threats appear to be fishing (encroachment of fishing boats using inappropriate gear) and development along the mainland. There is no tourism development on the Sembilan islands, save for a few temporary facilities for occasional tourists. However, Pangkor has been heavily developed for tourism and there are industrial facilities along the coast around Manjung. All these have heavily impacted reefs, particularly around Pangkor itself, where little coral reef remains compared to 15 years ago.

Coral reefs in Perak are not protected. It is strongly recommended that the State government urgently consider establishing the Sembilan islands as a Managed Area, with a view to designating zones for conservation, fisheries, tourism and development. Such a move would help to protect the reefs, while ensuring economic development opportunities for local communities and industries (particularly fisheries).

3.6 Status of Coral Reefs in Sarawak

Miri is located at the northern end of Sarawak and is the State's second largest city. Miri is the birthplace of Malaysia's petroleum industry, which remains the major industry in the city, alongside timber and oil palm production and a growing tourism sector.



Miri has extensive submerged off-shore reefs, generally flat in profile, in depths ranging from 7 to 30m. In many areas, the presence of oil production facilities creates effective Marine Protected Areas, as boats are not allowed in the area due to security concerns.

Kuching is located at the southern end of Sarawak and is the capital of the state. This developed city is also the most highly populated area in Sarawak.

Kuching is not well known for diving but there are some fringing and submerged reefs off the shores of this city.

Overall Health

A total of 7 coral reef sites were surveyed in Sarawak (Figure 23). 57% of sites were in good condition, with the remaining 43% in fair condition.

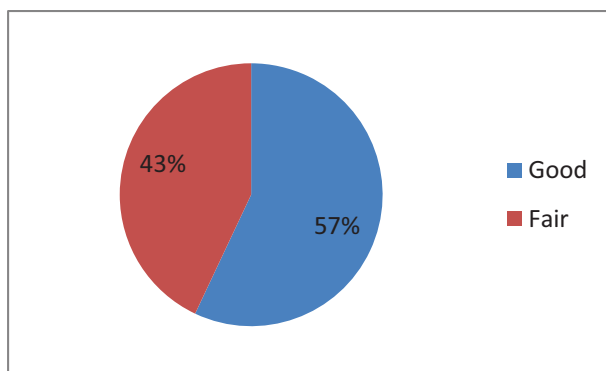


Figure 23: Status level percentage of sites for Sarawak in 2014

Substrate

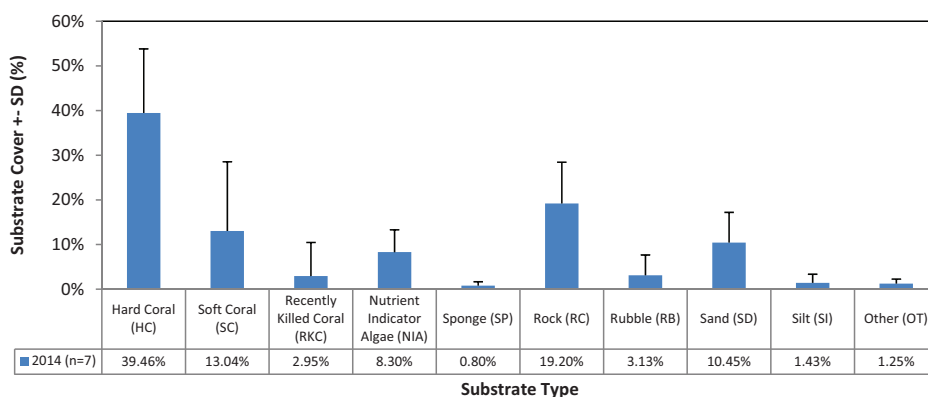


Figure 24: Percentage Substrate Cover for Sarawak, 2014

Reefs in Sarawak are in 'Good' condition with 53% of live coral cover (Figure 24). The level of NIA in Miri has increased significantly from 1% in 2013 to 8% in 2014. RB cover has also increased from last year, from 1% in 2013 to 4% in 2014. These increases need to be monitored closely especially for NIA level.

Coral reefs around Kuching are considered to be in 'Good' condition, with 55% live coral cover. However, the level of RKC in Kuching was very high at 20%, indicating recent disturbances in the area. NIA level was also high at 8%

Fish

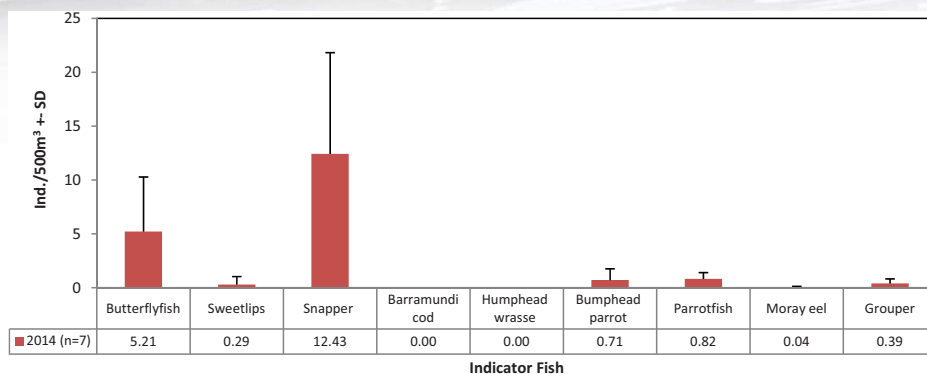


Figure 25: Fish Abundance in Sarawak, 2014

Fish populations were less diverse and abundant in Kuching than in Miri, where only two indicator fish were observed during the surveys (Butterflyfish and Snapper). Abundance of Butterflyfish was high at 16.25 individuals/500m³.

Only two indicator species (Bumphead Parrotfish and Humphead Wrasse) were absent from surveys (Figure 25).

Snapper was the most abundant indicator fish recorded although the number has dwindled by half compared to last year. Abundance of other indicators was generally low.

Invertebrates

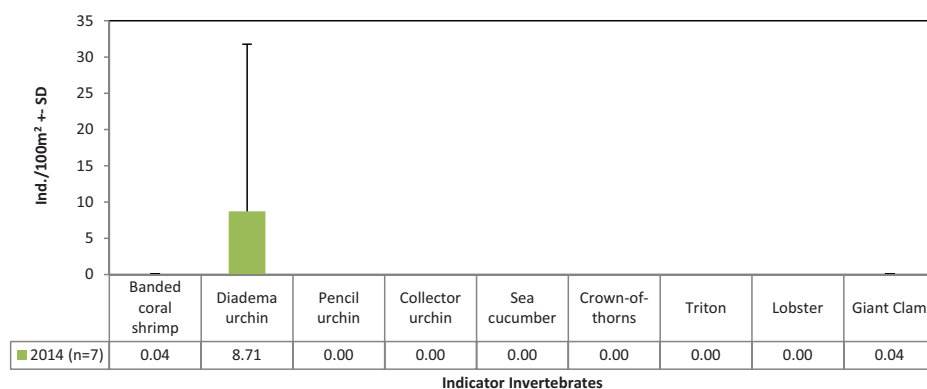


Figure 26: Invertebrate Abundance in Sarawak, 2014

Most of the indicator invertebrates were absent during surveys (Figure 26). Only Banded Coral Shrimp and Giant Clam were recorded and their abundance was very low.

As with fish indicators, populations of invertebrates were less diverse in Kuching than in Miri, with only *Diadema* Urchin was recorded during the surveys in Kuching, where

the abundance was high at 61 individuals/100m².

Impacts/Mega Fauna

Discarded fish nets were the main impacts seen on reefs during surveys, observed at 5 out of 7 sites surveyed. Trash was also seen at 3 sites. The reefs monitored in Miri were not inside protected areas and thus fishing activities were common. Damage due to warm water bleaching was also observed. On a positive note, turtles were observed at 3 out of 7 sites surveyed.

Summary & Threats

Reefs in Sarawak are generally in good condition. Fish diversity is slightly above average for Malaysia and populations are generally low in abundance. Reefs surveyed appear widely impacted by fishing nets, reflecting their unprotected status.

The main threat, particularly in the vicinity of Miri, appears to be fishing. Most reefs are sufficiently offshore not to be affected by pollution from land sources, and tourism development is limited.

Covering such a large coastline, it is appropriate to consider reefs in the two main areas separately. In Kuching, where water quality is adversely affected by natural siltation, it is recommended that the State government focus on enforcing the protected area around the Talang-Satang Park.

In Miri and the coast to the South, it is recommended that the State government consider increasing the amount of reef inside suitable protected/managed areas, involving local communities in relevant consultations. Such a move would help to protect the reefs, while ensuring economic development opportunities for local communities and industries (particularly fisheries).

3.7 Status of Coral Reefs in Sabah

The coastline of Sabah has extensive coral reefs, accounting for some 75% of the total in Malaysia. Surveys focused on eight reef areas. Tunku Abdul Rahman Park is located between 3 to 8 km off Kota Kinabalu, the capital of Sabah, and covers an area over 4,929 hectares, two thirds of which covers the sea. There is a cluster of islands in the Park comprising Pulau Gaya, Pulau Sapi, Pulau Manukan, Pulau Mamutik and Pulau Sulug. The reefs generally lie in shallow water with little current.



All five islands have tourist facilities such as chalets/resthouse, jetty, picnic shelters, barbecue pits, tables, changing rooms and toilets, except for Pulau Sulug which is relatively untouched, remote and undeveloped. The islands receive large numbers of day tourists from Kota Kinabalu.

Usukan Cove is located on the North West coast of Sabah approximately half way between Kota Kinabalu and Kudat.

The Mantanani archipelago is located some 30km off the north-west coast of the state of Sabah, opposite the town of Kota Belud. The largest island is Mantanani Besar; the other two are Mantanani Kecil and Linggisian.

Mantanani is mainly populated by Bajau Ubian, with a small population of about 1,000 in two

villages. The three main economic activities are fishing, drying salted fish and collecting shellfish.

Mantanani is an increasingly popular snorkelling and diving destination, and tourist numbers have grown four-fold in the last three years, mainly day trippers from Kota Kinabalu. The number of resorts is increasing and there are plans for further development. Fish bombing is a major problem in the area. This destructive fishing method has damaged large areas of reef around the islands.

Lankayan is a small island in the Sulu Sea, a 1.5 hour boat ride north of Sandakan. A resort island, Lankayan is part of the Sugud Islands Marine Conservation Area (SIMCA), a large, privately managed MPA off the East coast of Sabah. SIMCA is remote and distant from populated areas and no communities exist on the islands within the protected area. However, the SIMCA area is known to be a traditional fishing ground and is fished by both artisanal and commercial fishers from Sandakan, Kudat and the Philippines. Before the creation of SIMCA, blast fishing was a constant problem, and turtle eggs were poached on a regular basis. Lankayan Island is the only developed island within SIMCA. The 0.05 km² island is the site of the Lankayan Island Dive Resort (LIDR), which is the only structure on the otherwise uninhabited island.

The two islands of Matakang and Pom Pom, which are 8km apart, are approximately 35km East from the major town of Semporna in the South of Sabah. Both islands are a well known tourist spot and have two resorts each. Diving and snorkelling are the main activities on both islands, and they access the same coral reef dive sites. While the islands have no legal protected status, the presence of the resorts has effectively created small protected areas, keeping fishermen (including fish bombers) away from parts of the reefs surrounding the island. Both islands have fringing reefs, and coral extends down to almost 30m. Coral reefs around this, and surrounding, islands have been extensively damaged by fish bombing in the past, and fish bombing continues in some areas nearby.

Lahad Datu is a town located in the east of Sabah, Malaysia, on the island of Borneo. It occupies the peninsula on the north side of Darvel Bay – the largest semi-enclosed bay on the east coast of Borneo islands. Administratively, it falls within the Tawau Division and is estimated to have a population of over 156,000 (2000 census). Currently, there is little development along the coastal areas of Lahad Datu. In Lahad Datu itself, tourism is still limited, though Sabah Urban Development Corporation is trying to promote greater investment in infrastructure. There are two well known nature-based tourism attractions near to

Lahad Datu: Tabin Wildlife Reserve and the Danum Valley Conservation Area, and the wider Kinabatangan river basin is also nearby. Darvel Bay has yet to become established as a popular diving destination. The area includes both fringing and submerged reefs.

Semporna is located at the South Western tip of Sabah, south of Lahad Datu. The economy of this town is driven by marine products especially pearl farming and seaweed farming. Tourism is also an important element of the economy. Semporna is a popular base for tourists visiting Sipadan, Mabul and other islands nearby.

Tun Sakaran Marine Park is a marine park located off the east coast of the state of Sabah in Malaysia. It consists of the islands of Bodgaya, Boheydulang, Sabangkat, and Salakan, the sand cays of Maiga, Sibuan, and Mantabuan, and the patch reefs of Church and Kapikan. In 2004, the park became the seventh gazetted area under Sabah Parks with a total area of 100.8 km². There are approximately 2,000 people living within the park.

Sipadan is the only oceanic island in Malaysia, rising 600 metres from the seabed. Sipadan is located in the Celebes Sea off the east coast of Sabah, Malaysia. It was formed by living corals growing on top of an extinct volcanic cone that took thousands of years to develop. Sipadan is located at the heart of the Indo-Pacific basin, the centre of one of the richest marine habitats in the world. More than 3,000 species of fish and hundreds of coral species have been classified in this ecosystem. Sipadan has been rated by many dive journals as one of the top destinations for diving in the world.

Overall Health

A total of 107 coral reef sites were surveyed in Sabah (Figure 27). Only 7% were found to be in excellent condition, with the majority being either good (30%) or fair (46%). 18% were found to be in poor condition.

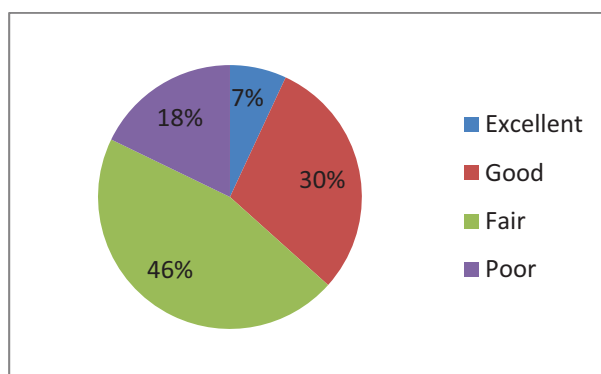


Figure 27: Status level percentage of sites for Sabah in 2014

Substrate

Coral reefs around Sabah are considered to be in 'Fair' condition with 43% live coral cover (Figure 28).

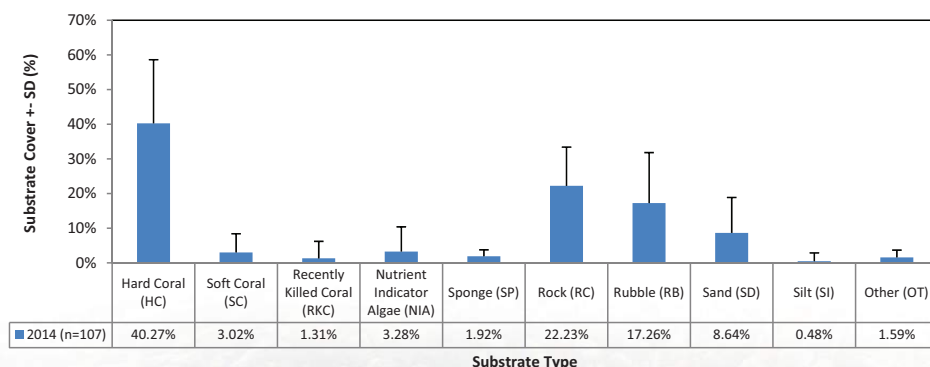


Figure 28: Percentage Substrate Cover for Sabah, 2014

The average masks a wide range, with the lowest LCC recorded at South Rim in the Tun Sakaran Marine Park, one of several areas in which fish bombing is known to be common. Other similar areas include sites around Mantanani and Matakang islands. In these sites, the level of RB is high, typically over 40%, pushing the average up to 17%, the highest in any

State.

Although the overall level RKC is low, it was particularly high in some sites around Lankayan, indicating recent disturbances. This is possibly caused by fish bombing which has historically been a problem in the area and further efforts are necessary to stamp out this practice. Equally disturbing is elevated levels of RKC at some sites in Sipadan which could be a result either of fish bombing or diver damage. Either way, extra efforts should be made to protect this very important site.

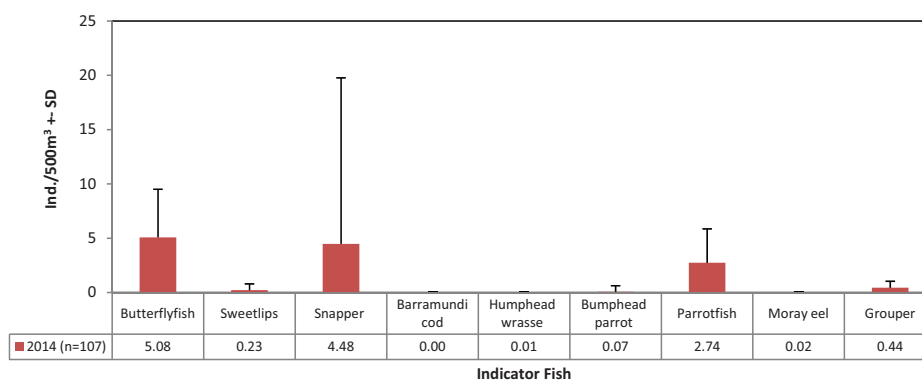
The level of NIA (3%) is second only to Sarawak, and was found to be very high (over 15%) at several sites around Lahad Datu. This is probably a reflection of the high levels of fish farming near those reefs, which are probably releasing nutrient into the water from fish feed, that subsequently causes growth of algae on the reefs surveyed. Efforts should be made to address this issue before the reefs become overgrown with algae.

The level of RC recorded indicates that there is suitable substrate for coral recruits to settle and grow, providing a basis for future reef regeneration if all other impacts are managed.

Other substrate categories are at levels similar to other States.

Fish

Only one indicator species was completely absent from all surveys (Barramundi Cod), the highest diversity of all States surveyed. However diversity and abundance vary widely among sites (Figure 29).

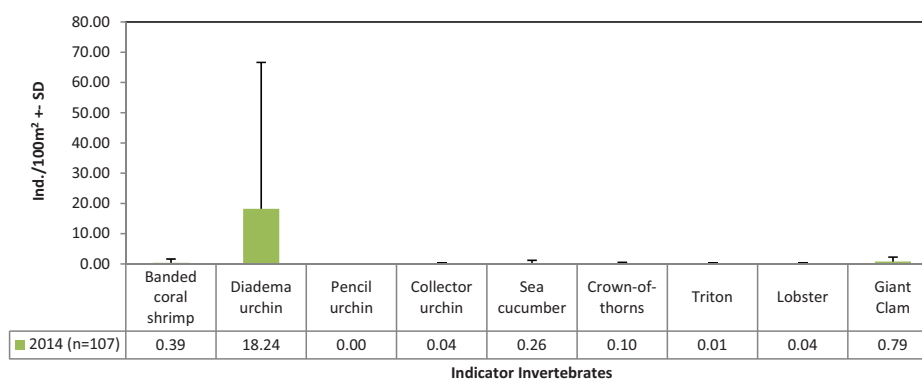


Butterflyfish was the most abundant indicator fish, followed by Snapper and Parrotfish. Sabah has the second highest abundance of Sweetlips, Parrotfish and Grouper among all States. Abundance of all other indicators were low (Sweetlips, Humphead Wrasse, Moray Eel and Grouper).

Figure 29: Fish Abundance in Sabah, 2014

Invertebrates

Only one indicator species was completely absent from all surveys (Pencil Urchin), the highest diversity of all States surveyed. However diversity and abundance vary widely among sites (Figure 30).




Diadema Urchin was the most abundance indicator invertebrate. Sabah has the highest abundance of all States of Banded Coral Shrimp, Collector Urchin, Triton and Lobster, though abundance of all these indicators is very low.

At Sipadan, all indicator invertebrate were recorded, albeit in low abundance, less than 1 ind./100m2.

Figure 30: Invertebrate Abundance in Sabah, 2014

Impacts/Mega Fauna

A wide variety of impacts were noted, though impacts were generally noted at low levels. Exceptions were Mantanani, Usukan Cove, Matakang, Lahad Datu and Semporna. Most visible impacts were boat anchor damage, dynamite fishing, discarded fishing nets and trash.



Damage due to warm water bleaching was observed at several reef areas.

Numerous mega fauna were noted during surveys in Sabah including turtles, black tip reef sharks and occasionally large rays (Eagle Rays).

Summary & Threats

Reefs in Sabah are generally in fair condition. However, in such an extensive reef area, this average disguises a wide range of reef health in different areas. Fish and invertebrate diversity are high and populations are generally low in abundance. Impacts are widespread and include numerous serious threats including fish bombing.

The main threats to coral reefs in Sabah appear to be related to population and livelihoods. In many areas, tourism development is limited (Mantanani, Sandakan, Lahada Datu) and local communities still rely extensively on fishing for their livelihoods. In remote areas habitat destruction caused by destructive fishing is common. Even in tourism areas, population pressure appears still to be driving over-fishing.

It is recommended that the State government give immediate consideration to extending protected/managed areas, where possible incorporating local communities into the management function. At the same time, the government should promote alternative/supplementary livelihoods, working together with tourism bodies to promote tourism and create economic opportunities for local communities to reduce pressure on coral reefs.

CHAPTER

04

Summary and Recommendations



4. Summary and Recommendations

4.1 Summary

- 4.1.1 On average, reefs in Malaysia are in fair to good condition, as measured by widely used coral reef health criteria. Average Live Coral Cover (LCC) for Malaysia is 48%. However, it should be noted that the average masks a wide range of variation in reef health, from reefs with over 85% live coral cover (LCC) to reefs with below 10% LCC.
- 4.1.2 Using LCC as a measure, coral reefs in Peninsular Malaysia can be said to be in “better condition” than reefs in East Malaysia. In contrast, diversity and abundance of most fish and invertebrate indicators are higher in East Malaysia.
- 4.1.3 Average populations of both fish and invertebrate indicators are universally low. Assuming the maximum abundance of any given indicator is an estimate of the potential abundance for any reef, the average abundance of all indicators is several magnitudes lower than the potential (see table below).

Fish				Invertebrates			
Indicator	Abundance			Indicator	Abundance		
	Avg.	Max.	Max. Site		Avg.	Max.	Max. Site
Butterflyfish	4.75	20.75	Pandanan, Matakang	Banded Coral Shrimp	0.22	9	Pom Pom
Sweetlips	0.15	4	Barracuda Point, Sipadan	Diadema	31.70	663	Soyak South, Tioman
Snapper	5.84	132	Yu Besar, Yu	Pencil Urchin	0	0.25	Tengkorak, Bidong
Barramundi Cod	0	0.25	Pegaso, Lankayan	Collector Urchin	0.02	2.75	Denawan, Semporna
Hump Head Wrasse	0.01	0.5	Goby Rock & Lycia Garden, Lankayan	Sea Cucumber	1.70	45.50	Soyak South, Tioman
Bump Head Parrotfish	0.10	5.75	Barracuda Poin, Sipadan	Crown of Thorns	0.17	4.25	Kapikan Reef, TSMP
Parrotfish	2.45	20	Mid Reef, Lahad Datu	Triton	0.01	0.5	Timba-Timba, Matakang
Moray Eel	0.03	0.5	Pandanan Bay, Matakang	Lobster	0.02	1.5	Yoshi Point 1, Semporna
Grouper	0.47	3.5	Hanging Garden, Sipadan	Giant Clam	1.23	22.75	Matakang House Reef

Table 2: Average and Maximum Abundance of Indicator Species

- 4.1.4 Historical data are available for some reef locations in Peninsular Malaysia since 2009. For these areas, the data show few significant changes over time. The data highlight the differences between reefs in different areas, and support the need for local management as conditions vary in each reef area.
- 4.1.5 Key threats facing coral reefs in Peninsular Malaysia are development and tourism related, with most impacts arising from land-based pollution, sewage pollution, land use change or direct impacts (boats, anchors, users).
- 4.1.6 Coral reefs in East Malaysia face different threats. In Sabah and Sarawak, threats appear to be population related, with impacts arising from resource use (over-fishing and destructive fishing) and lack of management (few MPAs, limited enforcement and patrolling of extensive coastline).

4.2 Recommendations

Threats facing reefs in Malaysia can be divided into local and global impacts:

- Local threats are those that arise within coral reef areas due to human intervention and activity. They include pollution, sedimentation, over-fishing and direct impacts by reef users
- Global threats arise outside coral reef areas. They are associated with climate change and include coral bleaching and ocean acidification.

There is little local coral reef managers can do about the global threats and coral reef management strategies should focus on addressing the local threats. A number of recommendations are made below.

4.2.1 Monitoring & Awareness

Several steps should be taken to make information on coral reefs and reef health available to all stakeholders.

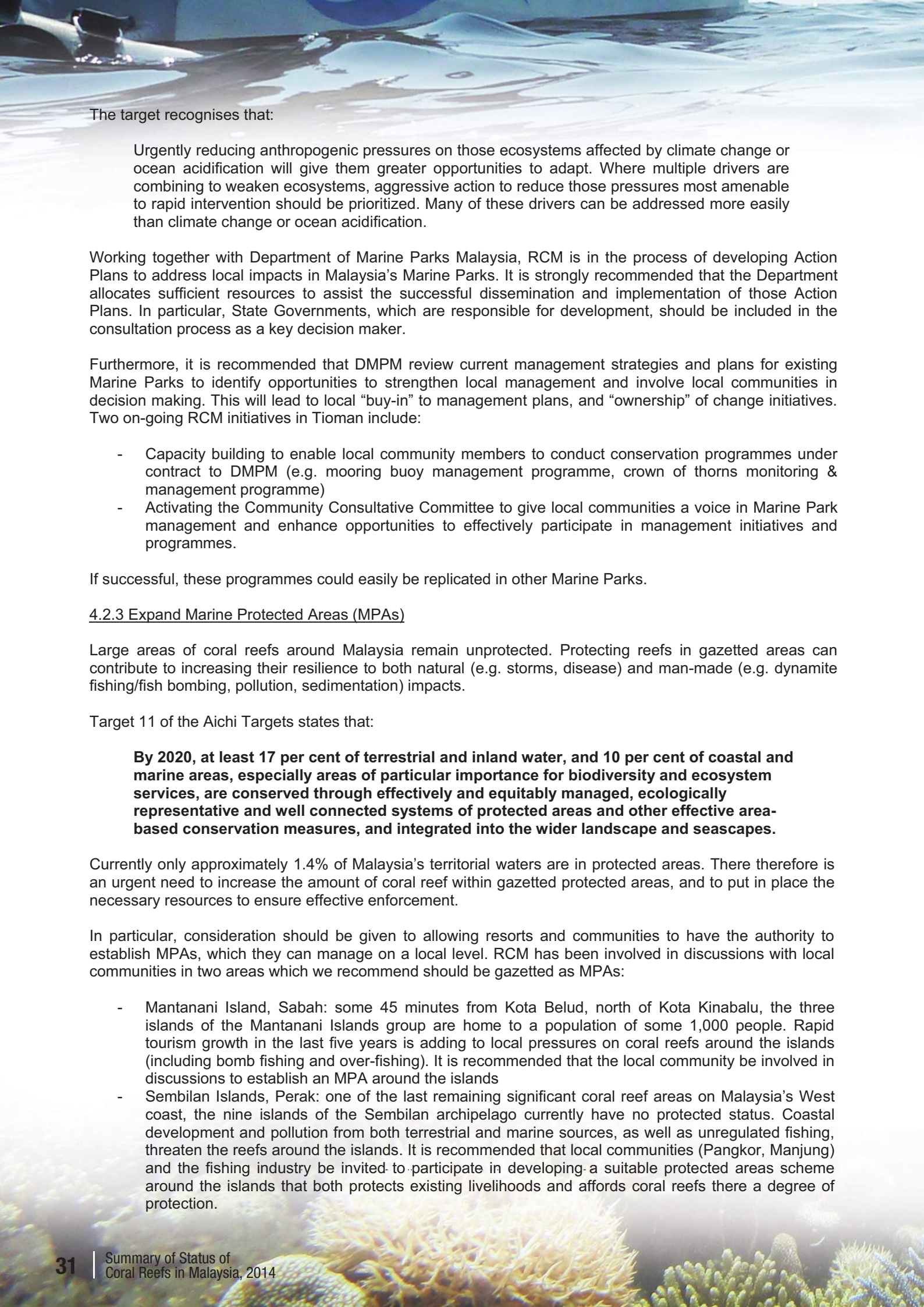
- Increase the scale and scope of the existing reef monitoring programme by:
 - o Increasing the number of sites covered by the programme in both Peninsular and East Malaysia, and include sites outside existing Marine Protected Areas
 - o Encouraging more dive operators to participate in monitoring programmes and train staff as EcoDivers
 - o Establish permanent transects for surveys and disseminate details widely among dive operators and government agencies.
- Improve the availability of timely and relevant information to all reef users, including:
 - o Install better signage (where relevant) to ensure that visitors realize that ALL waters surrounding the islands form part of the Marine Park, rather than only the area immediately adjacent to the marine park centre; include signs of “do’s and don’ts” in coral reef areas
 - o Make available handouts to be given to each visitor to coral reef areas (e.g. “do’s and don’ts” and how and where to report any offense observed).
- Implement more education and awareness campaigns and talks for visitors and operators alike in coral reef areas:
 - o Encourage resorts to apply Responsible Tourism guidelines to their operations and improve management practices
 - o Establish a rating system for resorts operating in coral reef areas, to provide information to customers on the degree to which operators care for the environment
 - o Encourage dive operators to join reef management programmes such as Green Fins and improve education to customers
 - o Encourage wise usage of fresh water (storing rainwater from roofs, recycling water for watering plants etc.)
 - o Install recycling bins and improve collection of rubbish in all areas.

4.2.2 Local Threats, Local Management

Many threats to coral reefs arise within existing Marine Parks in Malaysia, due to tourism development and local community activities. Addressing these threats needs action at the local level.

During the tenth meeting of the Conference of the Parties (COP) to the Convention on Biodiversity (CBD), held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan, a revised and updated Strategic Plan for Biodiversity was adopted, which included the Aichi Biodiversity Targets for the 2011-2020 period. As a signatory of the Convention on Biological Diversity (CBD), Malaysia is bound by the Aichi Targets. Several of the Aichi Targets relate to conserving marine biodiversity, including Target 10 which states that:

By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.



The target recognises that:

Urgently reducing anthropogenic pressures on those ecosystems affected by climate change or ocean acidification will give them greater opportunities to adapt. Where multiple drivers are combining to weaken ecosystems, aggressive action to reduce those pressures most amenable to rapid intervention should be prioritized. Many of these drivers can be addressed more easily than climate change or ocean acidification.

Working together with Department of Marine Parks Malaysia, RCM is in the process of developing Action Plans to address local impacts in Malaysia's Marine Parks. It is strongly recommended that the Department allocates sufficient resources to assist the successful dissemination and implementation of those Action Plans. In particular, State Governments, which are responsible for development, should be included in the consultation process as a key decision maker.

Furthermore, it is recommended that DMPM review current management strategies and plans for existing Marine Parks to identify opportunities to strengthen local management and involve local communities in decision making. This will lead to local "buy-in" to management plans, and "ownership" of change initiatives. Two on-going RCM initiatives in Tioman include:

- Capacity building to enable local community members to conduct conservation programmes under contract to DMPM (e.g. mooring buoy management programme, crown of thorns monitoring & management programme)
- Activating the Community Consultative Committee to give local communities a voice in Marine Park management and enhance opportunities to effectively participate in management initiatives and programmes.

If successful, these programmes could easily be replicated in other Marine Parks.

4.2.3 Expand Marine Protected Areas (MPAs)

Large areas of coral reefs around Malaysia remain unprotected. Protecting reefs in gazetted areas can contribute to increasing their resilience to both natural (e.g. storms, disease) and man-made (e.g. dynamite fishing/fish bombing, pollution, sedimentation) impacts.

Target 11 of the Aichi Targets states that:

By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.

Currently only approximately 1.4% of Malaysia's territorial waters are in protected areas. There therefore is an urgent need to increase the amount of coral reef within gazetted protected areas, and to put in place the necessary resources to ensure effective enforcement.

In particular, consideration should be given to allowing resorts and communities to have the authority to establish MPAs, which they can manage on a local level. RCM has been involved in discussions with local communities in two areas which we recommend should be gazetted as MPAs:

- Mantanani Island, Sabah: some 45 minutes from Kota Belud, north of Kota Kinabalu, the three islands of the Mantanani Islands group are home to a population of some 1,000 people. Rapid tourism growth in the last five years is adding to local pressures on coral reefs around the islands (including bomb fishing and over-fishing). It is recommended that the local community be involved in discussions to establish an MPA around the islands
- Sembilan Islands, Perak: one of the last remaining significant coral reef areas on Malaysia's West coast, the nine islands of the Sembilan archipelago currently have no protected status. Coastal development and pollution from both terrestrial and marine sources, as well as unregulated fishing, threaten the reefs around the islands. It is recommended that local communities (Pangkor, Manjung) and the fishing industry be invited to participate in developing a suitable protected areas scheme around the islands that both protects existing livelihoods and affords coral reefs there a degree of protection.

4.2.4 Networking MPAs

Scientists increasingly recognise the benefits of incorporating individual MPAs into networks. Networks can be more representative of marine habitats and therefore are more resilient to major environmental changes.

Malaysia currently has a number of individual Marine Parks off the East coast of Peninsular Malaysia that are all treated separately. It is recommended that DMPM consider creating larger managed areas, with zones for multiple users (as is the case with the Great Barrier Reef), by networking existing Marine Parks together with related ecosystems (seagrass beds, mangroves) and fisheries management areas. Such a managed area could be created off the East coast of Peninsular Malaysia, incorporating the entire coastal area, and with no-take zones for conservation (existing Marine Parks), fisheries protected areas (e.g. submerged reefs off the East coast) and fisheries areas. Establishing such a managed area would have numerous benefits, including:

- Coordinating management of related marine ecosystems (coral reefs, seagrass beds, mangroves)
- Leveraging financial resources from tourist islands to protect submerged, non-tourist reefs
- Protecting food security
- Assisting in the introduction of EAFM (Ecosystem Approach to Fisheries Management)
- Contributing to Aichi Target 11, requiring 10% of coastal waters to be incorporated into managed areas.

Such an initiative would require extensive consultation with local communities, fishing communities and state planning departments, as well as other stakeholders.

4.3 Conclusion

The 2014 review of the health of coral reefs around Malaysia indicates that reefs are generally in “fair” or “good” condition, though it is acknowledged that these averages mask variations in different reef areas.

Coral reefs are an important biological and economic resource in Malaysia, providing food and jobs for thousands of people. Reefs must be conserved for the benefit of future generations.

While the current status of Malaysia’s reefs appears relatively stable, there is no room for complacency. All stakeholders, particularly management agencies (DMPM in Peninsular Malaysia and Sabah Parks/Sarawak Forestry Corporation in East Malaysia) and State governments must take action to reduce local threats in order to ensure reefs are strong and resilient, and able to withstand major disruptions from global threats in the future.

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	The Khazanah Grants Programme aims to guide all its Civil Society Partner Organisations towards achieving sustainable funding, operational excellence and organisational development
	KPMG in Malaysia: since 2007 has been donating funds to support a Corporate Reef Check team and education programmes in two schools in KL.
	Sime Darby Foundation: supporting the five year Cintai Tioman programme to build reef and community resilience and empower the local community to play a greater role in managing the Marine Park.
	HSBC Amanah Takaful: supporting school education programme and school waste recycling programme as part of the Cintai Tioman programme
	Murphy Oil Corporation: supporting reef rehabilitation efforts in Mantanani island, Sabah
	YTL: Supporting efforts by RCM to improve coral reefs around Malaysia, including through its Pangkor Laut Resort which supports surveys at the Sembilan islands.
	SGP: funding a programme of work in Sabah to raise awareness of the negative impacts of fish bombing, including education and public awareness campaigns.
	La Mer: donates funds to support a Reef Check survey programme in Lahad Datu, Sabah
	Kose: supporting reef rehabilitation programmes in Tioman
	F & N: funding recycling and awareness campaign in Redang.
	PAM: Pertubuhan Akitek Malaysia is funding reef rehabilitation programmes in Tioman and Pangkor
	Shell Malaysia: supporting community programme in Sabah
	Russell Bedford LC & Company: Since 2007, has been providing <i>pro bono</i> company secretarial services for RCM.



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