Status of Coral Reefs in Malaysia, 2018

Reef Check Malaysia

Contents

Executive Summary

1. A total of 212 sites were surveyed in 2018 (2017: 227), 95 in Peninsular Malaysia and 117 in East Malaysia. The surveys are a continuation of a successful National Reef Check Survey Programme that has now run for twelve 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 commitment from the Government in further improving management of Malaysia's coral reefs. Surveys were carried out on several islands off Peninsular Malaysia's East and West coast, covering both established Marine Protected Areas and non-protected areas, and in various parts of East Malaysia, both Sabah and Sarawak.

3. The results indicate that Malaysian reefs surveyed have a relatively high level of living coral, at 42.42% (2017: 42.53%). The low level of recently killed corals indicates few immediate threats and 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.

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.

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 RM150 billion per annum. Coral reefs are threatened by global warming, overfishing, pollution and sedimentation.

11. Reef Check is a coral reef monitoring methodology used worldwide to assess the health of coral reefs in over 95 countries and territories worldwide, and in Malaysia since 2001. The non-profit Reef Check Malaysia (RCM) is available to oversee training and surveys in Malaysia.

This report is available for download at:

http://www.reefcheck.org.my/reports-downloads/annual-survey-reports

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

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 alter 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 reef areas 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 2018, the twelfth year of surveys.

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 95 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 eleven years, RCM has trained over 800 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 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 its first community programme, the Cintai Tioman Campaign in Tioman, with funding from Yayasan Sime Darby. 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 joined RCM in the programme, with funding support from the Small Grants Programme to implement a number of economic and social development programmes.

In 2016, RCM started two new community-based projects. A project in Mantanani Island brings all the stakeholders together to establish a community-led marine managed area, leading to sustainable economic development on the island. We also joined the Department of Marine Parks Malaysia (DMPM) as a project partner in The Mohamed bin Zayed Species Conservation Fund and UNEP-GEF grant to operationalise the Malaysian National Plan of Action for Dugong in Pulau Sibu and Pulau Tinggi, Johor. This is a part of a bigger national project which involves 4 other sub-projects.

This report is the twelfth annual Malaysia coral reef survey report and details the results of Reef Check surveys carried out during 2018. 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 5 m, 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.

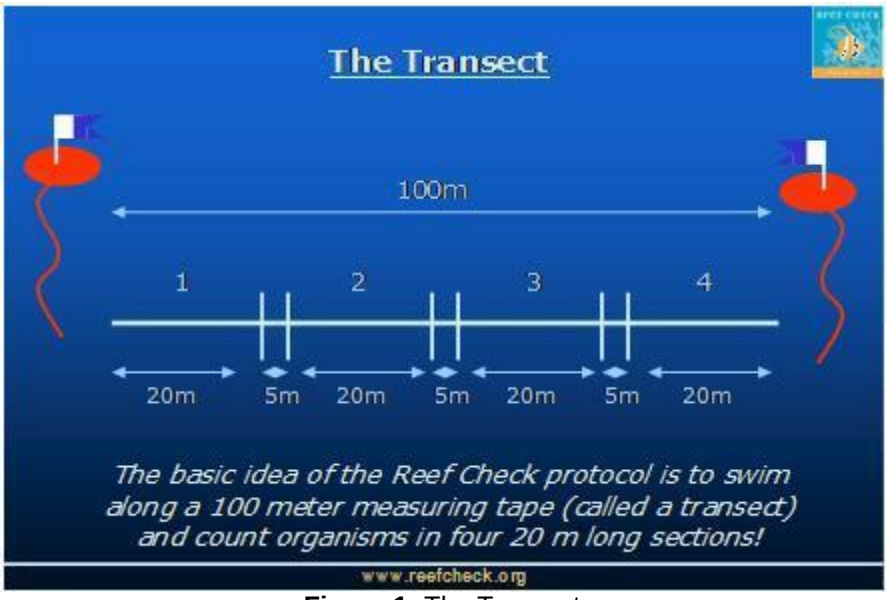


Figure 1: The Transect

2.3 Survey Sites

In 2018, a total of 212 sites were surveyed, 95 of which were in Peninsular Malaysia and the remaining 117 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, Sibu, Tinggi, Tenggol, Tioman, Rawa and Lang Tengah). Numerous sites were also surveyed around islands off the West coast (Sembilan, Pangkor Laut and Payar). In East Malaysia, a large percentage of the surveys were conducted by a number of dive operators, notably in Lankayan and Mataking in Sabah and Miri in Sarawak, and by Sabah Parks, in Pulau Penyu, TSMP 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.

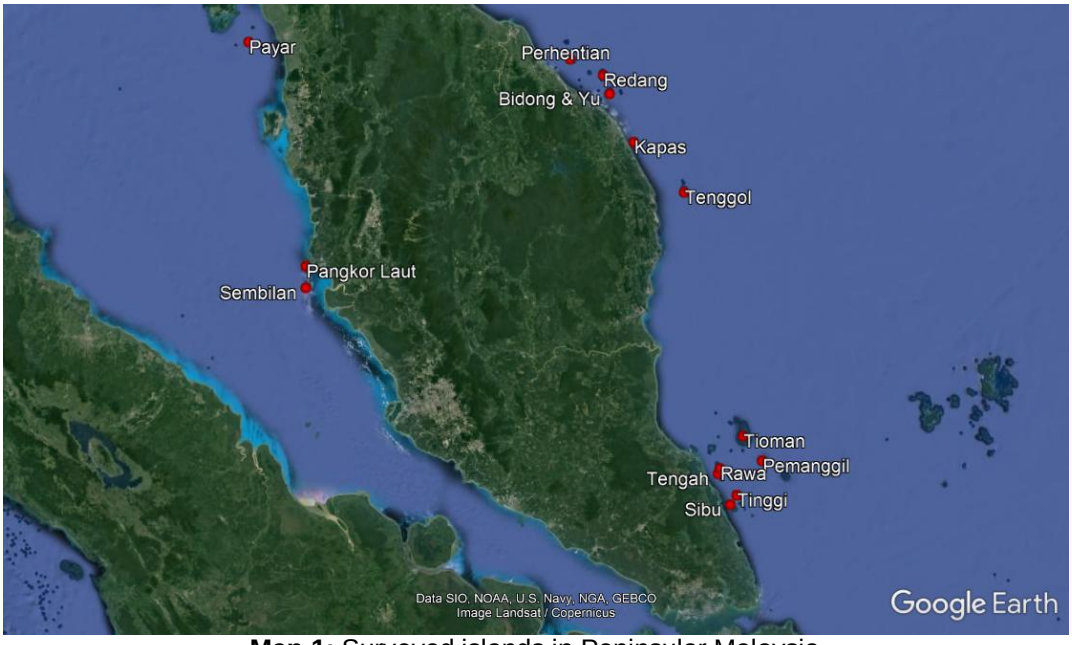
The list of sites surveyed is shown in appendix 1.

3. 2018 Survey Results and Analysis

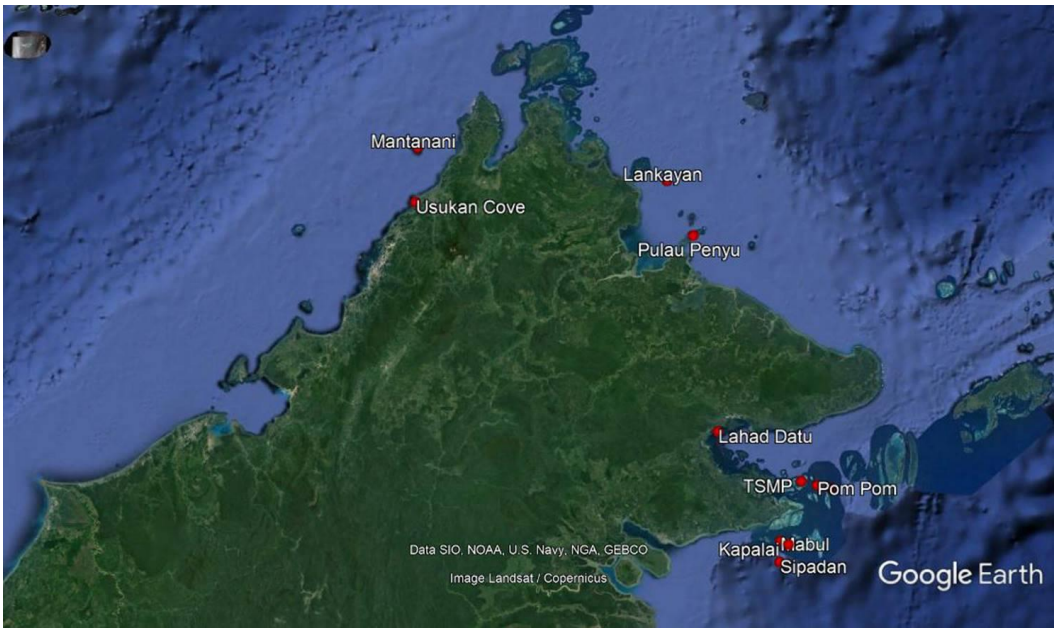
This section presents the results from surveys conducted in 2018, providing an overview of the condition of coral reefs in Malaysia as a whole, and a detailed analysis of the health of reefs in surveyed reef areas.

3.1 Status of Coral Reefs in Malaysia 2018

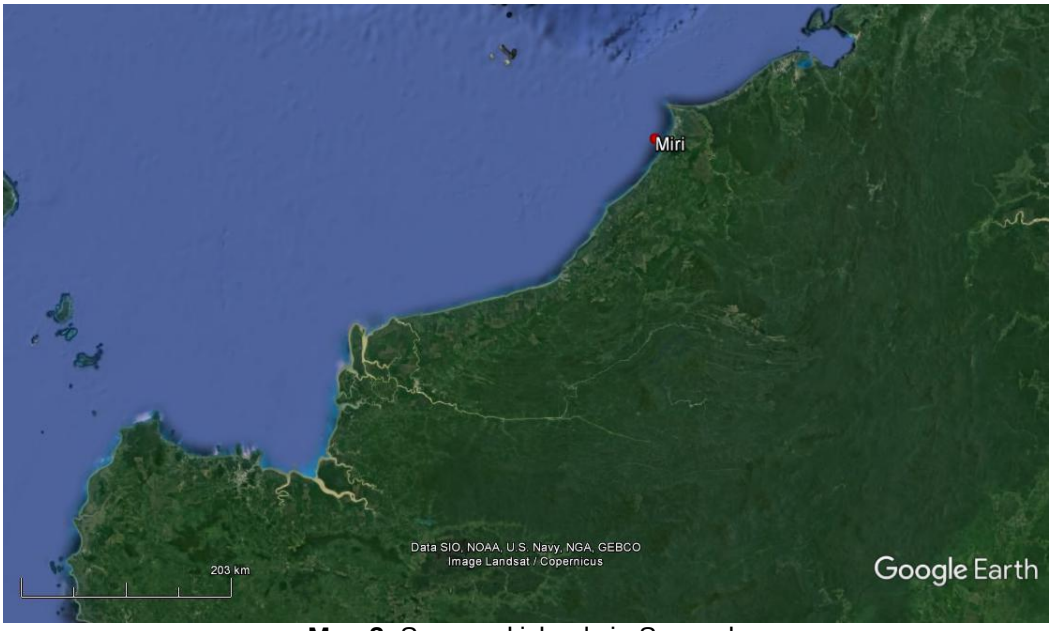
The results from all 212 surveys were compiled to provide an overview of the status of coral reefs around Malaysia. Sites surveyed off Peninsular Malaysia are mostly islands which are important tourist destinations while the islands and reefs off Sabah and Sarawak are less frequently visited but face other problems such as destructive fishing practices.



Map 1: Surveyed islands in Peninsular Malaysia



Map 2: Surveyed islands in Sabah
(Note: TSMP= Tun Sakaran Marine Park)



Map 3: Surveyed islands in Sarawak

3.1.1 Substrate

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

Table 1: Coral Reef Health Criteria

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

According to these ratings, Malaysian reefs are considered to be in "fair" condition, with average live coral cover (Hard Coral + Soft Coral – see Chart 1) of 42.42% (42.53% in 2017). This minor change in LCC from 2017 suggests there have been insignificant changes in reef health overall during the last 12 months.

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 fish bombing, anchoring 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 13.21% in 2018 and has not changed much over the last few years. Nearly 32% of reefs in Malaysia had RB in the range 10-29% of RB and 8.5% of reefs recorded RB in the range 30-49%. 4% of the reefs recorded as high as 50-80% RB. Sites of most concerned were North Tip (Pom Pom) 81.25% Mandarin House Reef (Pom Pom) 76.25%, Cliff Hanger (Pom Pom) 68.75%, House Reef (Pom Pom) 62.50%, Spongebob (Pom Pom) 61.88% and Labas (Tioman) 51.25%. Many of these (excluding Labas) are areas in which fish bombing is known to occur.

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 are a natural and essential part of the coral reef ecosystem, but if allowed to grow un-checked, they 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 in 2018 was low at 2.96% (2017: 2.18%); algae 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. Nearly 10% of reefs in Malaysia recorded NIA in the range 10-35%.

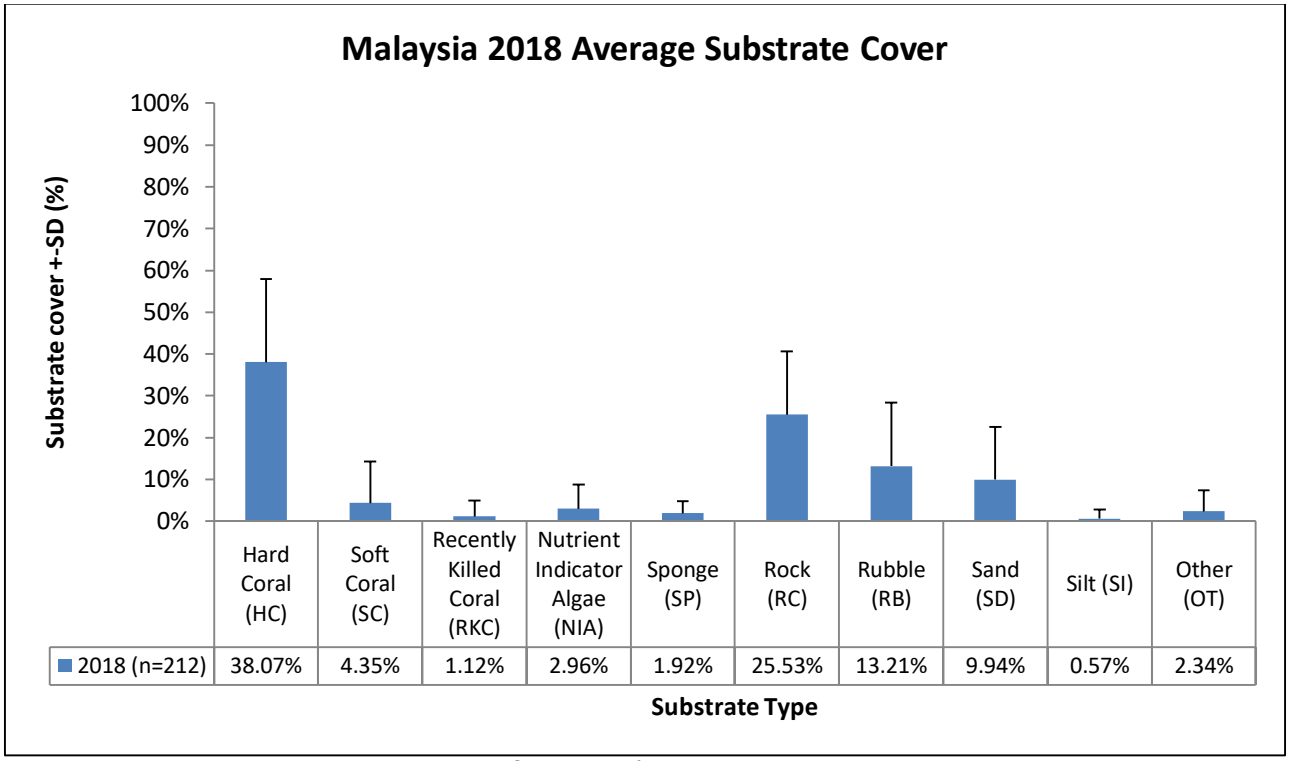


Chart 1: Substrate Cover

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, Drupella snails) and other local stressors (e.g. sedimentation, disease). The low level of RKC (1.12%) indicates there were few local impacts on Malaysian reefs. At some sites, the level of RKC was significantly higher such as 31.88% at Poduko (Usukan Cove), 30% at Selingan (Pulau Penyu) and 26.88% at Sibuan (TSMP).

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 0.57%. 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 level of SI in a specific area can indicate a local impact and it is this change that should be monitored.

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 1.92%, 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 2018 the average cover of RC on Malaysian reefs was 25.53%. 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.

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.

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 2.34% in 2018.

3.1.2 Fish

Reef Check indicator fish species were chosen on the basis of targeted demand for:

- Aquarium trade: Butterflyfish
- Food fish: Sweetlips, Snapper, Barramundi Cod, Parrotfish, Moray Eel, Grouper
- Live-food fish trade: Humphead Wrasse, Bumphead Parrotfish.

The average abundances of indicator fish counted during the 2018 surveys are shown below (Chart 2).

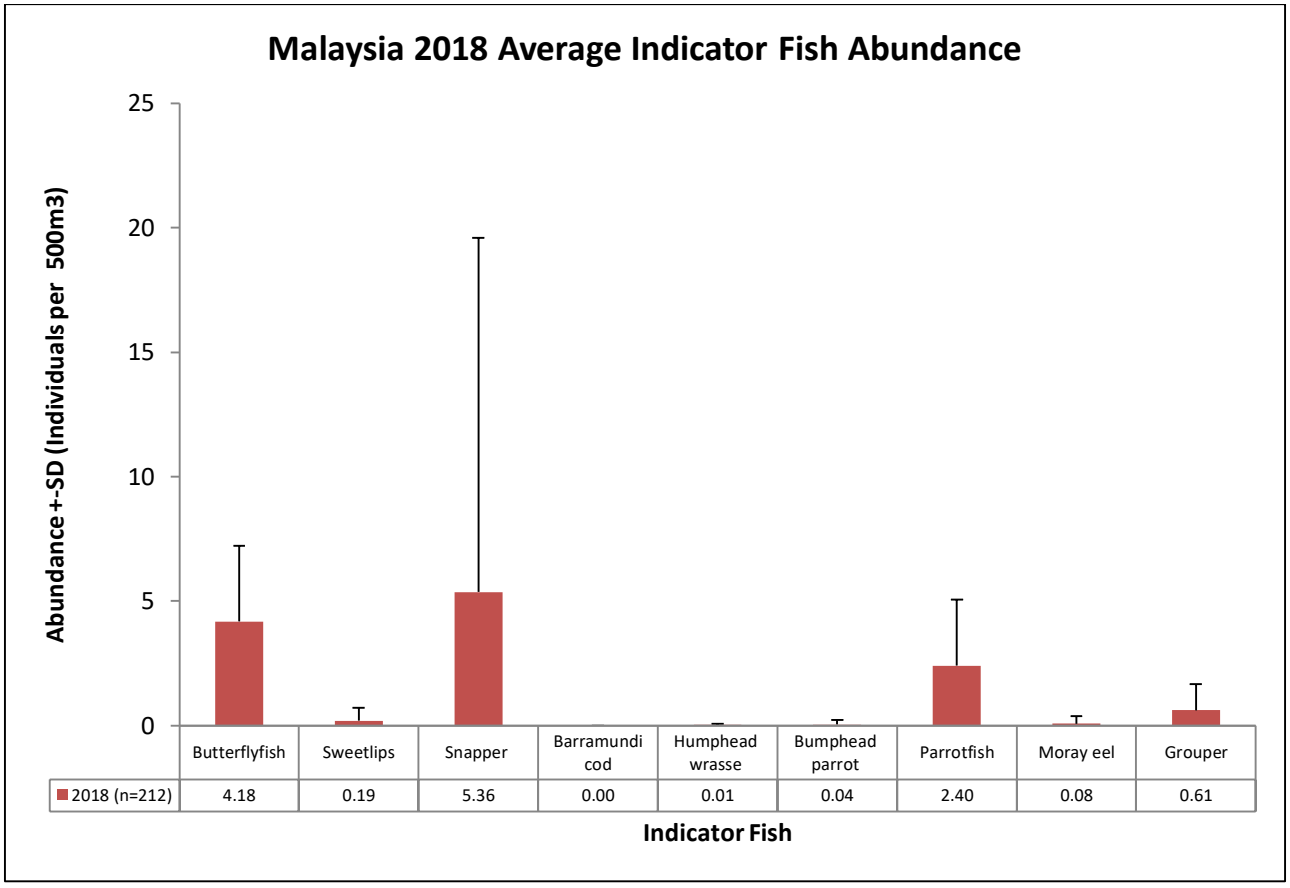


Chart 2: Indicator Fish Abundance

Humphead wrasse, Bumphead parrotfish, Groupers, Sweetlips and Moray eels recorded an average abundance of less than 1 individual per 500m^3 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 from most surveys. Barramundi Cod was not recorded at any survey sites.

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 4.18 individuals per 500m^3 in 2018 (2017: 5.13), showing a slight decrease from previous years. 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.

Parrotfish are important herbivores, controlling algal growth on reefs thus avoiding competition with corals. The national average in 2018 was 2.4 individuals per 500m^3, a slight decrease from last year (2017: 3.95).

3.1.3 Invertebrates

The invertebrate indicators are targeted for different reasons:

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

The abundance of indicator invertebrates documented during the 2018 surveys is shown in Chart 3 below.

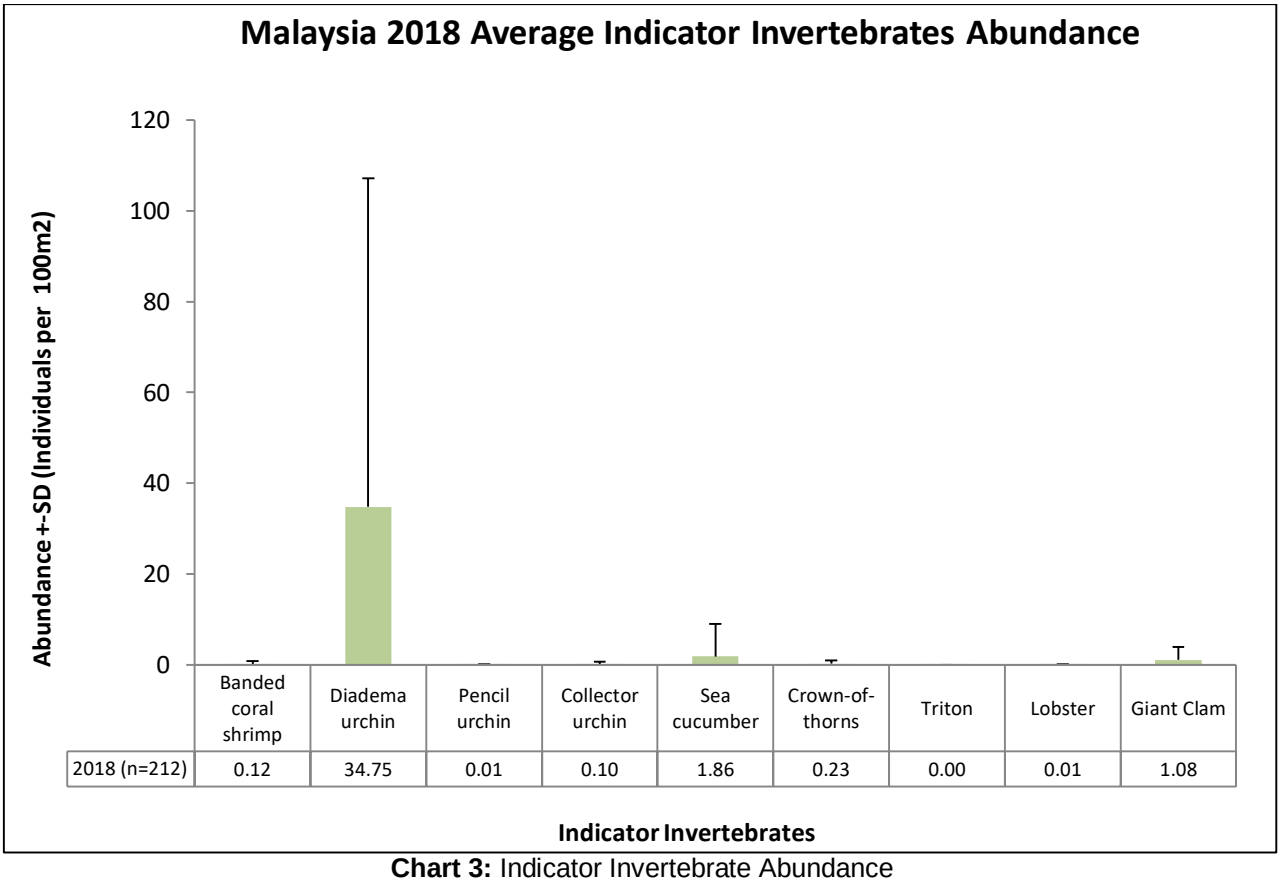


Chart 3: Indicator Invertebrate Abundance

The average abundance of invertebrates targeted for the aquarium and curio trade was less than one individual per 100m^2. While this may be partly explained by low natural abundance and cryptic behaviour, historical overexploitation of invertebrates such as Triton and Pencil Urchin may have had a significant impact on their populations.

Similarly, several species targeted for the food trade are at or near zero (Lobster 0.01 individuals per 100m^2 survey transect; Collector Urchin – 0.1). The abundance of Sea Cucumber is low at 1.86 individuals per 100m^2. Giant Clam recorded an average of 1.08 individuals per 100m^2. This includes both mature breeding adults as well as juveniles. The low numbers of giant clams within 100m^2 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-spine sea urchin *(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* Urchin, 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 macro- algae, 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 rate of coral growth. Controlling nutrient pollution as well as maintaining a healthy population of herbivorous fish can contribute to reducing the scale of 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 COTs per hectare (10,000m^2), or 0.2-0.3 individuals per 100m^2 (Harriott et al., 2003) The abundance of COTs found during surveys, 0.23 per 100m^2, suggested that COT numbers are not a threat to the reefs. However, there are some islands where COT numbers are an issue and action is needed to control the high number. The islands are Kapas 1.9 individuals per 100m^2, Redang 1.67, Bidong and Yu 0.83 and Aur 0.38; where all islands recorded above the acceptable limit.

3.2 Status of Coral Reefs in Key Eco-regions in Malaysia

The data below provide an overview of the health of coral reefs surveyed in three Eco-regions in Malaysia, using Live Coral Cover as a key indicator. An Eco-region is defined as an area of relatively identical species composition, clearly distinct from adjacent regions (Spalding et al, 2007).

The marine eco-regions relevant to Malaysia are based on the “Marine Eco-regions of the World” system (Spalding et al, 2007). They are:

- Malacca Strait (West coast of Peninsular Malaysia, Eco-region 118)
- Sunda Shelf (East coast of Peninsular Malaysia and Sarawak, Eco-region 117)
- North Borneo (Sabah, Eco-region 126)

Focusing management efforts at an eco-region level can provide benefits as reefs in a given region are similar; therefore, the results of this report have been delineated into these three eco-regions.

Figure 2: Eco-regions of Malaysia; 118 = Malacca Strait, 117 = Sunda Shelf and 126 = North Borneo

The results highlight the different problems each island/area is facing. Islands/regions covered in each Ecoregion are shown in Table 2 below.

Data on LCC indicate that in general sites in Peninsular Malaysia have higher LCC than in East Malaysia. Furthermore, sites in protected areas (e.g., Marine Parks, SIMCA, TSMP) have higher LCC than sites outside protected areas (e.g., Sembilan, Kapalai, Mabul), suggesting that protected areas are having some beneficial impacts on coral reefs in Malaysia.

Table 2: Site Coverage by Ecoregion

Islands/Areas	No. of sites	Protection Status	LCC (%)
Sunda Shelf			
Perhentian	10	Marine Park	43.69
Redang	12	Marine Park	44.22
Tioman	18	Marine Park	62.60
Kapas	5	Marine Park	44.88
Bidong and Yu	6	Marine Park	51.98
Tenggol	6	Marine Park	51.77
Pemanggil	4	Marine Park	55.78
Tinggi	4	Marine Park	60.63
Sibu	6	Marine Park	56.88
Pulau Aur and Dayang	6	Marine Park	44.58
Pulau Rawa	1	Marine Park	60.63
Lang Tengah	2	Marine Park	36.88
Miri	6	Miri-Sibuti Coral Reefs National Park	46.98
Malacca Strait			
Sembilan	9	No protection	25.49
Pangkor Laut	1	No protection	28.75
Payar	5	Marine Park	53.38
North Borneo			
Lankayan	15	SIMCA	43.67
Mataking	6	No protection	23.02
Mabul	5	No protection	34.50
Kapalai	4	No protection	18.44
Mantanani	12	No protection	30.83
Usukan Cove	6	No protection	34.17
Lahad Datu	15	No protection	24.67
Tun Sakaran Marine Park	12	Tun Sakaran Marine Park	54.38
Sipadan Island	12	Sipadan Island Park	62.40
Pulau Penyu	9	Turtle Islands Park	45.76
Pom Pom	9	No protection	12.01
Labuan	4	Marine Park	23.44
Total	**212**	**Average**	**42.42**

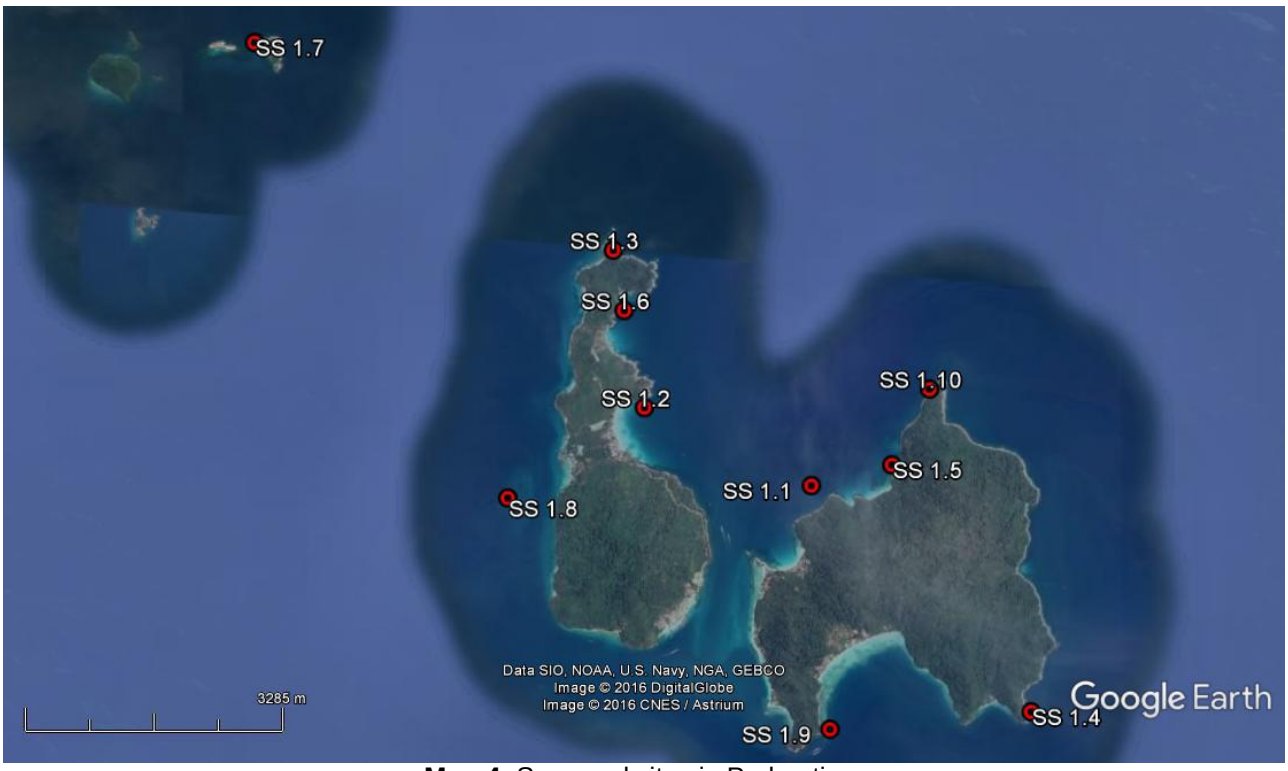
Sunda Shelf Region

3.2.1 Perhentian

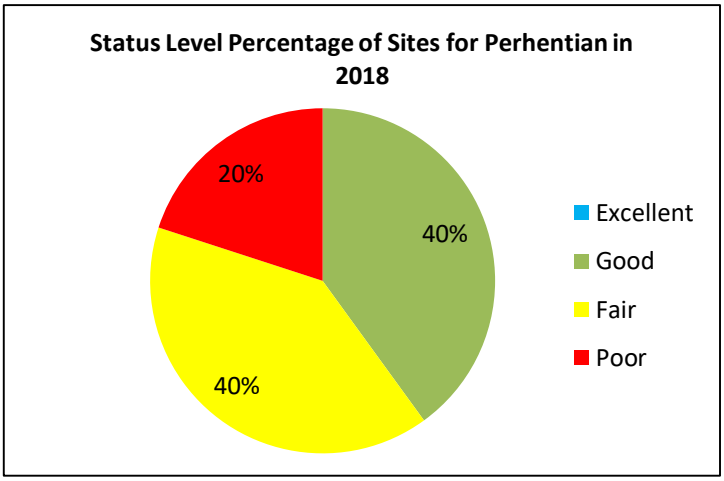
The Perhentian islands are located some 20km from Kuala Besut off the East coast of Terengganu, Malaysia. The islands have one village with a population of approximately 2,300, most of whom work in tourism, the main industry on the islands. The islands are gazetted as a Marine Park (since 1994).

A popular tourist destination, particularly among backpackers, there are over 40 resorts, mainly small, family run chalets with a couple of large resorts, and over 20 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.

Reefs are mainly fringing off-shore reefs, with some submerged reefs.

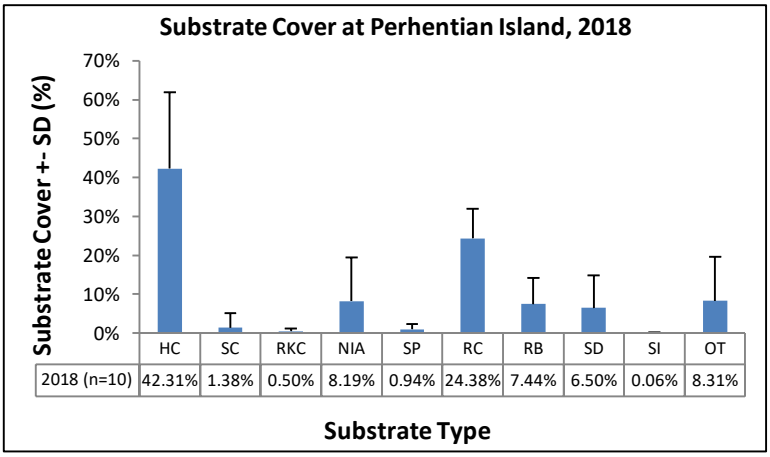


Map 4: Surveyed sites in Perhentian



A total of 10 coral reef sites were surveyed in Perhentian and 40% of the reefs were in good condition. 40% were in fair condition and the remaining 20% were in poor condition. No reefs were in excellent condition.

Substrate



Coral reefs around the Perhentian islands are considered to be in 'Fair' condition, with 43.69% live coral cover, below the average (51.53%) for reefs within the Sunda Shelf region.

HC cover has increased slightly and RB level has decreased significantly compared to last year. The level of RB has decreased from 23.56% in 2017 to 7.44% in 2018. RKC and SI levels have decreased slightly while level of NIA has increased.

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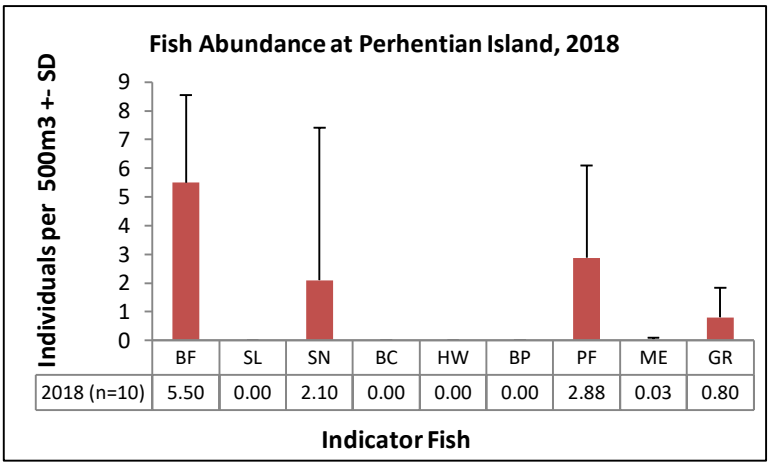
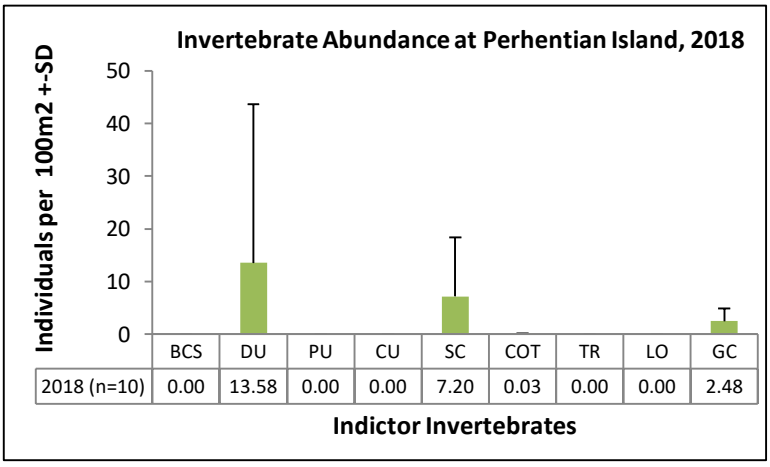
Fish



Five indicator fish were recorded during surveys. The most abundant fish recorded was Butterflyfish, followed by Parrotfish and Snapper. Moray Eel and Grouper were present in low number.

High value fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were completely absent from surveys.

Invertebrates



None of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster which are targeted for food also absent from the surveys.

Diadema Urchin, Sea Cucumber and Giant Clam were common on most reefs.

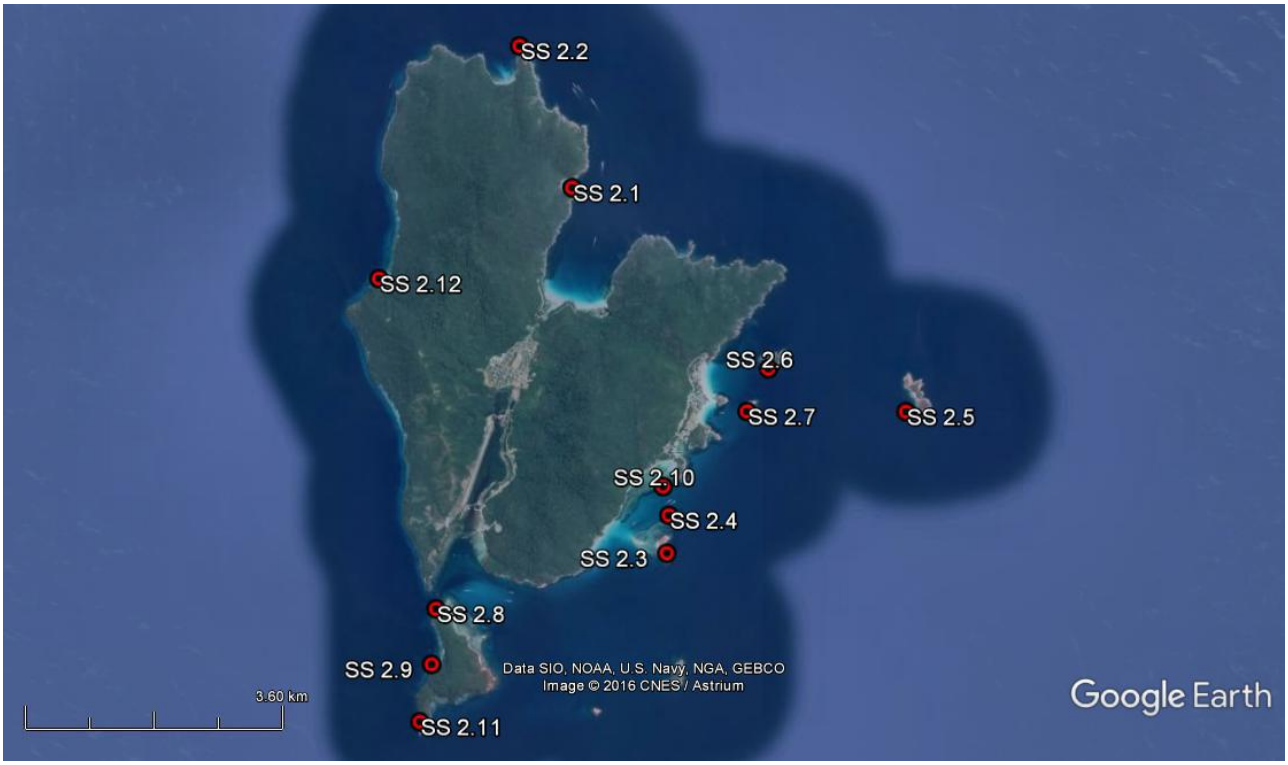
Discarded fishing nets and trash were recorded at many sites. On a positive note, turtle was recorded during surveys and a pod of dolphins were spotted at one site before survey started and surveyors were able to hear dolphins' clicking sound during surveys.

3.2.2 Redang

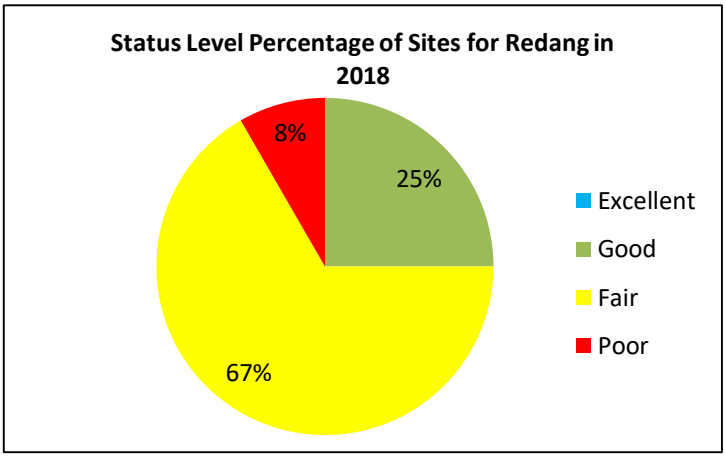
Redang Island is located some 25km from Merang, off the East coast of Terengganu, Malaysia. The island has a population of approximately 1,500, only a small proportion of whom work in tourism, the main industry on the islands. The islands are gazetted as a Marine Park (since 1994).

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 centralised electricity supply, resorts operate their own generators for power. Water is supplied by pipeline from the mainland and each resort has its own sewage treatment facilities. The island is served by an airport (flights to KL and Singapore) as well as boat services from the mainland.

Both fringing off-shore reefs and submerged reefs can be found in the area.

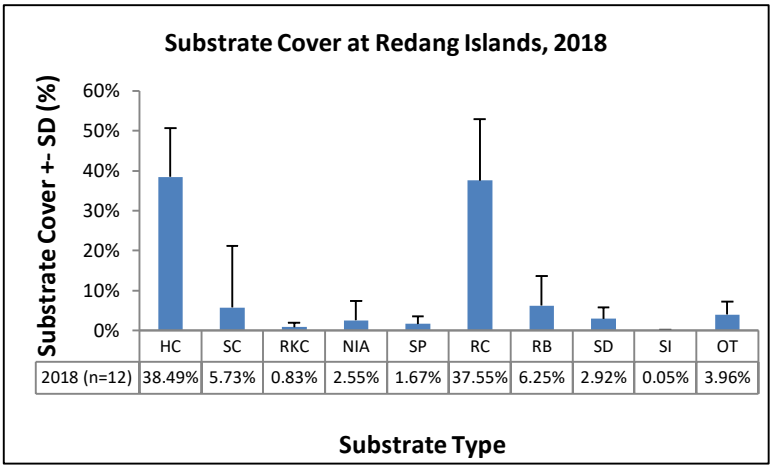


Map 5: Surveyed sites in Redang



A total of 12 coral reef sites were surveyed in Redang and 25% of the sites were in good condition. 67% were in fair condition and the remaining 8% were in poor condition. No reefs were in excellent condition.

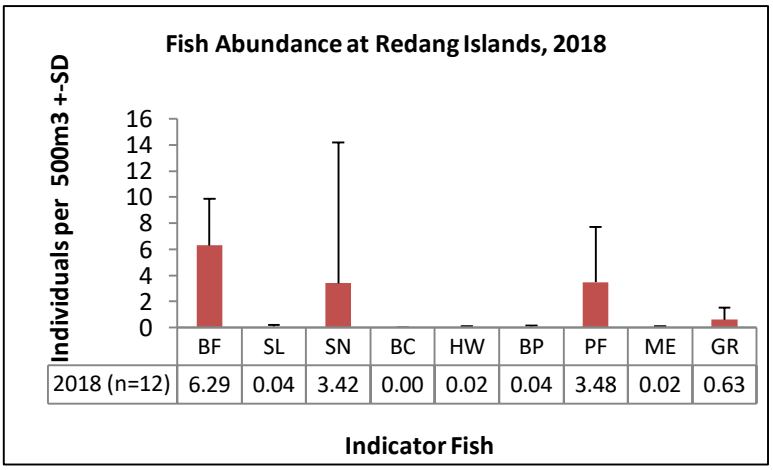
Substrate



The reefs around Redang islands are considered to be in 'Fair' condition, with live coral cover of 44.22% and below the average (51.53%) for reefs within the Sunda Shelf region.

HC cover has decreased from 44.53% in 2017 to 38.49% in 2018. The increase in NIA and OT levels probably attributed to the decrease in HC level. While the average level of RB has decreased compared to last year, the level is still very high at some sites; 24.38% at SS2.4 Kerengga Kecil and 16.25% at SS2.8 P. Pinang Marine Park Centre.

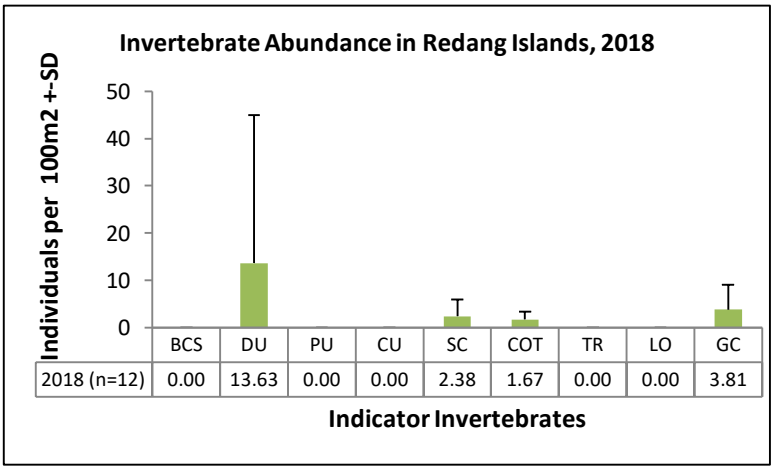
Fish



Only Barramundi Cod was absent during surveys.

Butterflyfish recorded the highest number, followed by Parrotfish and Snapper. Sweetlips, Moray Eel and Grouper recorded low abundance. Highly prized fish such as Humphead Wrasse and Bumphead Parrotfish were also recorded in low abundance.

Invertebrates



Numerous targeted species were absent, including Banded Coral Shrimp, Pencil and Collector Urchin, Triton and Lobster.

Although DMPM conducts annual COT cleanups around the island, COT abundance is still very high at 1.67 ind./100m^2. The number is way above what a healthy reef can sustain (0.2-0.3 ind./100m^2). Within the Sunda Shelf region, Redang recorded the second highest number of COT and action must be taken to control the increasing COT population in Redang.

Boat anchor damage, discarded fishing nets and trash were recorded during surveys. COT predation was also observed during surveys. On a positive note, blacktip reef sharks were recorded during surveys.

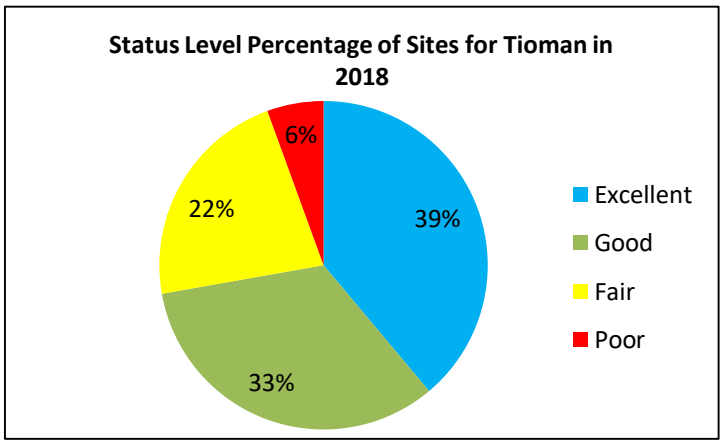
3.2.3 Tioman

Tioman Island is located some 50km from Mersing, off the East coast of Pahang. It is the largest island off the East coast of Peninsular Malaysia. The island has five villages, with a total population of approximately 3,700 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 at one point it has been eclipsed by other destinations (particularly Redang and Perhentian). However, in recent years, tourism on Tioman Island has picked up again and now there are some 72 resorts on the island and 34 dive operators.

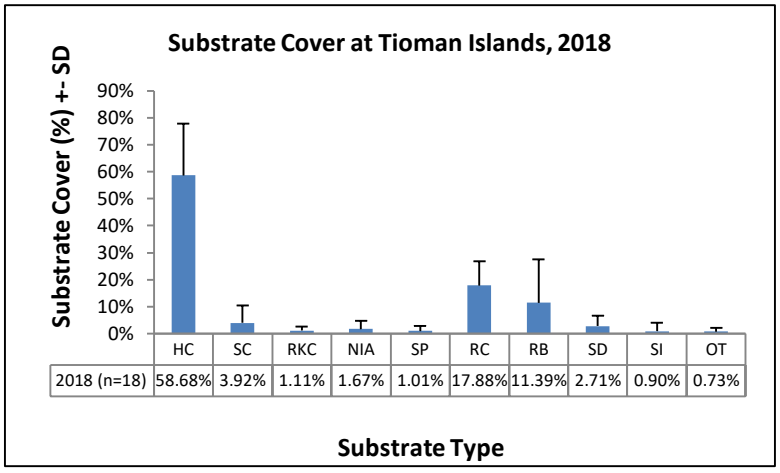
There is a small power generation station on the island, supplying electricity to all areas. Freshwater on the island depends mainly on several river systems coming from the hilly forested areas. A municipal incinerator was constructed some years ago. The island is served by an airport as well as ferry services.

Map 6: Surveyed sites in Tioman



A total of 18 coral reef sites were surveyed in Tioman and 39% of the reefs were in excellent condition. 33% were in good condition, while 22% were in fair condition. The remaining 6% were in poor condition.

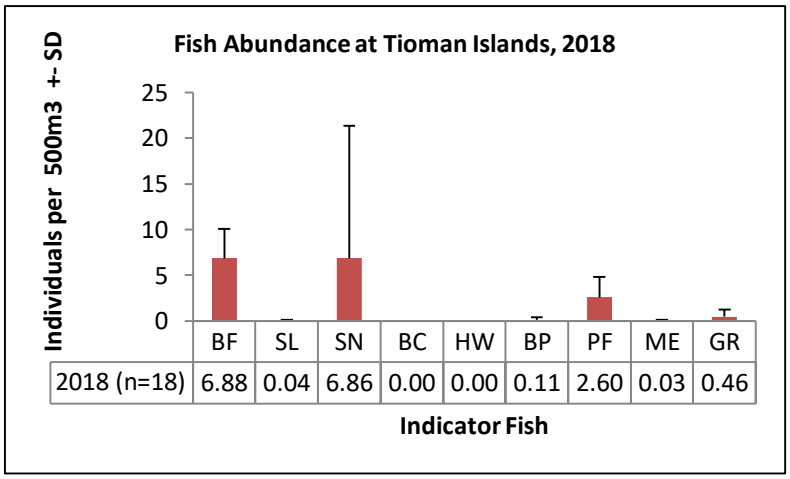
Substrate



The reefs in Tioman are considered to be in 'Good' condition, with 62.60% live coral cover, above the average for reefs of the Sunda Shelf region (51.53%).

Level of RB was high but has decreased compared to last year. Three of the survey sites recorded more than 35% of RB and the level was exceptionally high at SS3.12 Labas (51.25%) and SS3.4 Soyak South (45%).

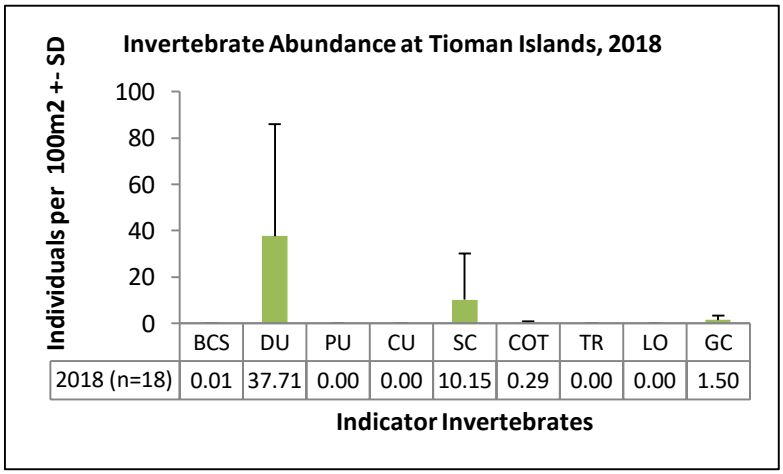
Fish



Only Barramundi Cod and Humphead Wrasse were not recorded during surveys.

Butterflyfish recorded the highest number, followed Snapper and Parrotfish. Other indicators were present in low number, less than 1 ind./500m^3.

Invertebrates



None of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster which are targeted for food also absent from the surveys.

The number of Diadema was the highest, followed by Sea Cucumber. The number of COT is within what a healthy reef can sustain (0.2-0.3 ind./100m^2).

Discarded fishing nets and trash were recorded during surveys. Some of the reefs were also impacted by disease and overgrowth of sponge. On a positive note, shark and turtle were observed at a few survey sites.

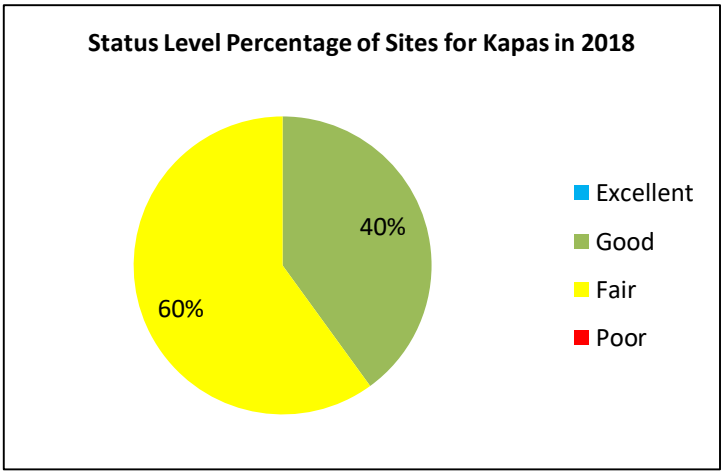
3.2.4 Kapas

Kapas is a small island located just 6km from Marang, off the East coast of Terengganu, Malaysia. There is no resident local population but several resorts provide accommodation for tourists. The island is gazetted as a Marine Park (since 1994).

The island is not a major tourism destination due to its small size, but does have an established tourist market, with less than ten resorts and one dive operator. Diving and snorkelling are the main tourist activities. There is no centralised electricity supply, resorts operate their own generators for power. Groundwater supplies are limited and there is no centralised sewage treatment, each resort having its own sewage treatment facilities.

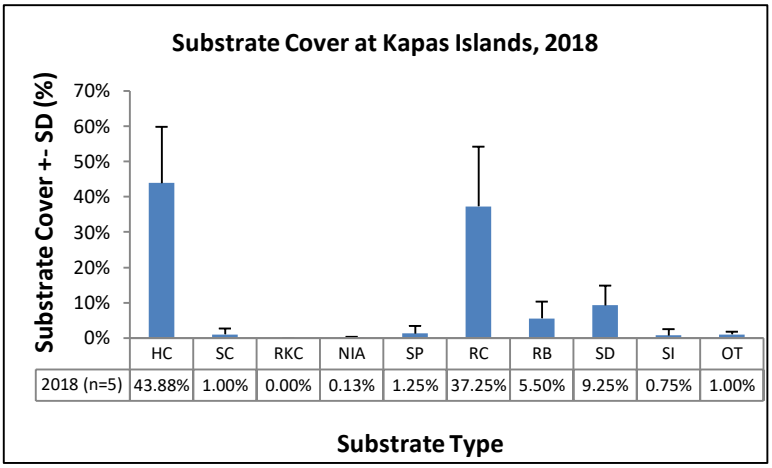
Reefs are mainly fringing off-shore reefs, with some submerged reefs.

Map 7: Surveyed sites in Kapas



A total of 5 coral reef sites were surveyed in Kapas. 40% of the reefs were in good condition, while 60% were in fair condition.

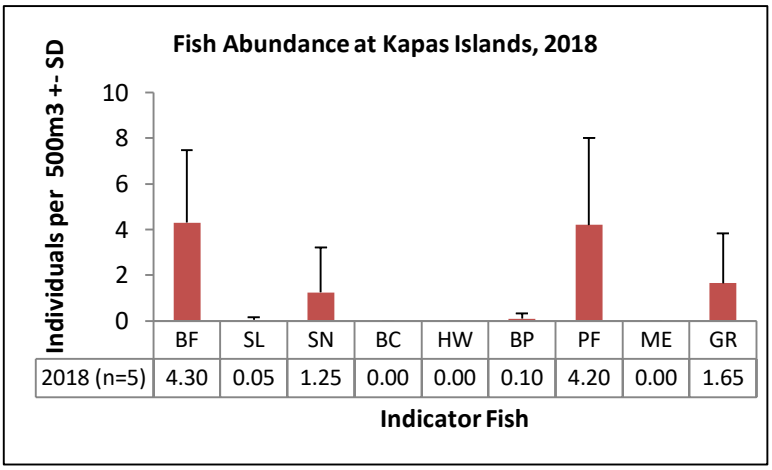
Substrate



Coral reefs around Kapas islands are considered to be in 'Fair' condition, with 44.88% live coral cover (2017: 50.00%), below the average (51.53%) for all islands surveyed in the Sunda Shelf region.

The level of RKC, NIA and RB has decreased slightly compared to last year. This indicates lesser disturbances on the reefs and is reflected in the increased proportion of RC (37.25%, up from 29% in 2017).

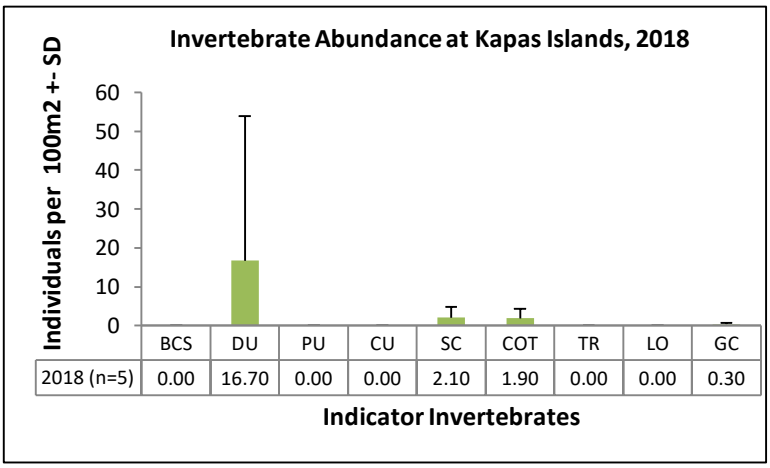
Fish



The most abundant fish were Butterflyfish, followed by Parrotfish. Sweetlips, Snapper and Grouper were present in low number.

On a positive note, highly prized fish such as Bumphead Parrotfish was recorded during surveys although the abundance was low.

Invertebrates



None of the indicator invertebrates targeted for the curio trade (Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster, which are targeted for food, were also absent from the surveys

Abundance of Diadema Urchin was the highest. Sea Cucumber and Giant Clam were present in low numbers. COT abundance has increased from last year, it is now way above what a healthy reef can sustain (0.2-0.3 ind./100m^2) and is the highest of all islands surveyed in the Sunda Shelf region.

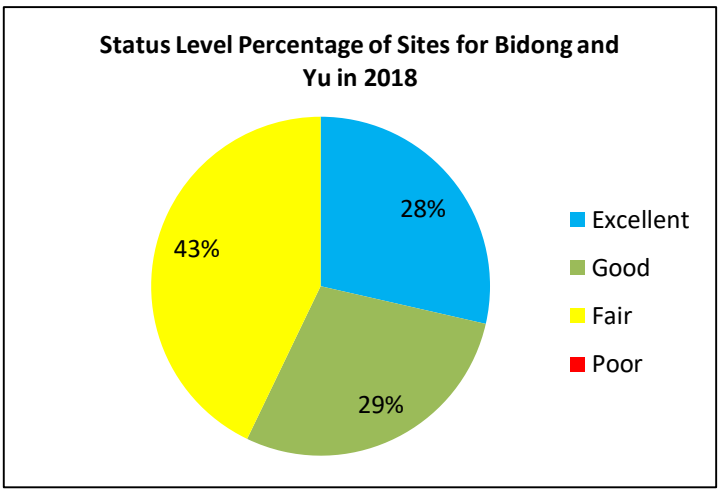
Discarded fishing net was recorded during surveys.

3.2.5 Bidong and Yu

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.

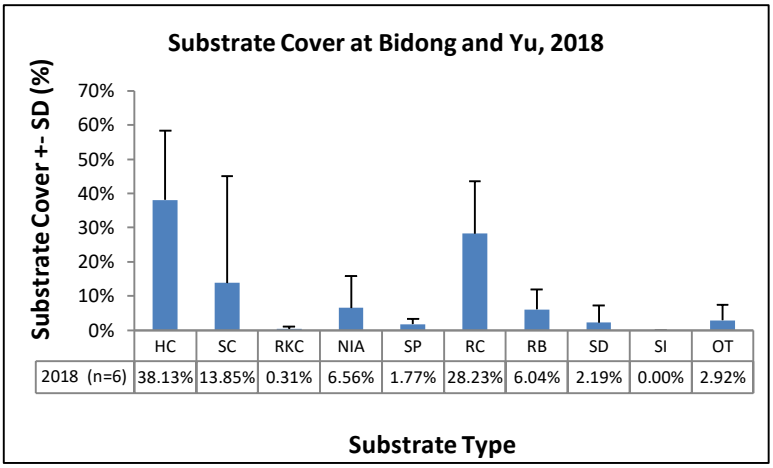
Bidong has mainly been a research base for University Malaysia Terengganu but has recently grown in popularity as a diving destination. Bidong has some sandy beaches and fringing reefs while Pulau Yu Besar and Kecil are mainly small rocky islands, with boulder slopes dropping to 25-30m, with some coral reef areas.

Map 8: Surveyed sites in Bidong and Yu



A total of 6 coral reef sites were surveyed in Bidong and Yu. 28% of the reefs were in excellent condition, 29% in good condition and 43% in fair condition. No reefs were in poor condition.

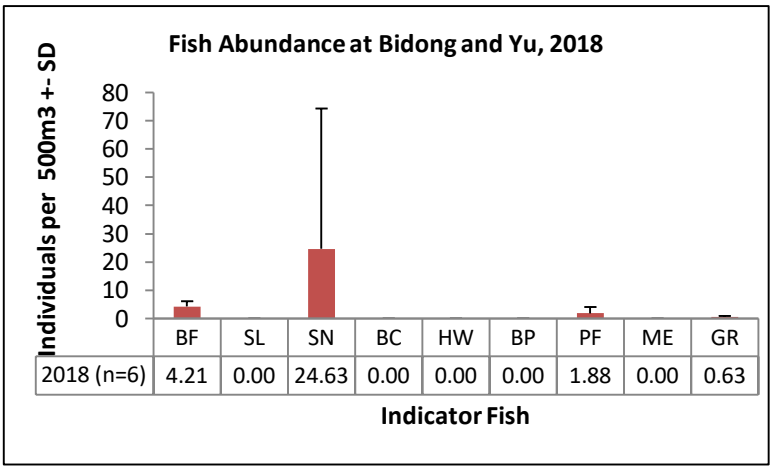
Substrate



Coral reefs around Bidong and Yu islands are considered to be in 'Good' condition, with 51.98% live coral cover, slightly above than the average (51.53%) for reefs in Sunda Shelf region.

SC cover increased significantly from 7.50% in 2017 to 13.85% in 2018; largely caused by the sharp increase (mainly zoanthid) at SS5.2 Pasir Tenggara (43.75% in 2017 to 77.50% in 2018). RKC and RB levels have decreased from last year while NIA level has increased.

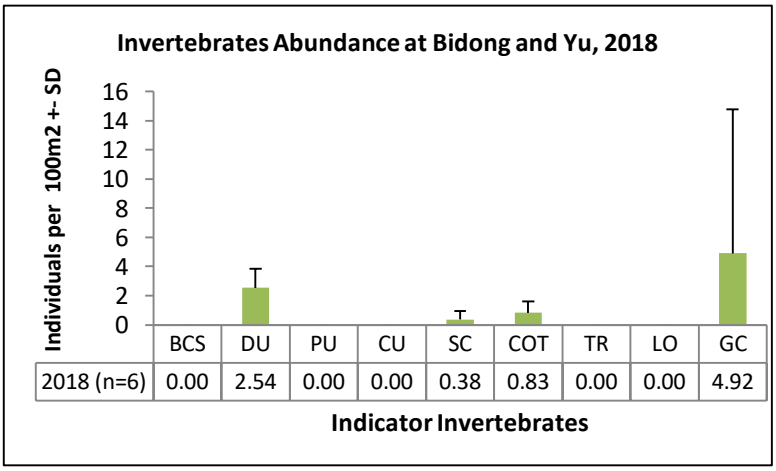
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were absent from surveys. Sweetlips and Moray Eel were also not recorded during surveys.

Abundance of Snapper is the highest, followed by Butterflyfish and Parrotfish. Abundance of Grouper was low.

Invertebrates



As in most sites, none of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster which are targeted for food were also absent from the surveys.

Although the abundance of COT has decreased from last year, the level is still way above acceptable limits (0.2-0.3 ind./100m^2). COT population in Bidong and Yu is the third highest of all islands surveyed in the Sunda Shelf region and this is a cause for concern.

Boat anchor damage, discarded fishing nets and trash were recorded during surveys. Predation by COT was also observed. On a positive note, turtle was recorded during surveys.

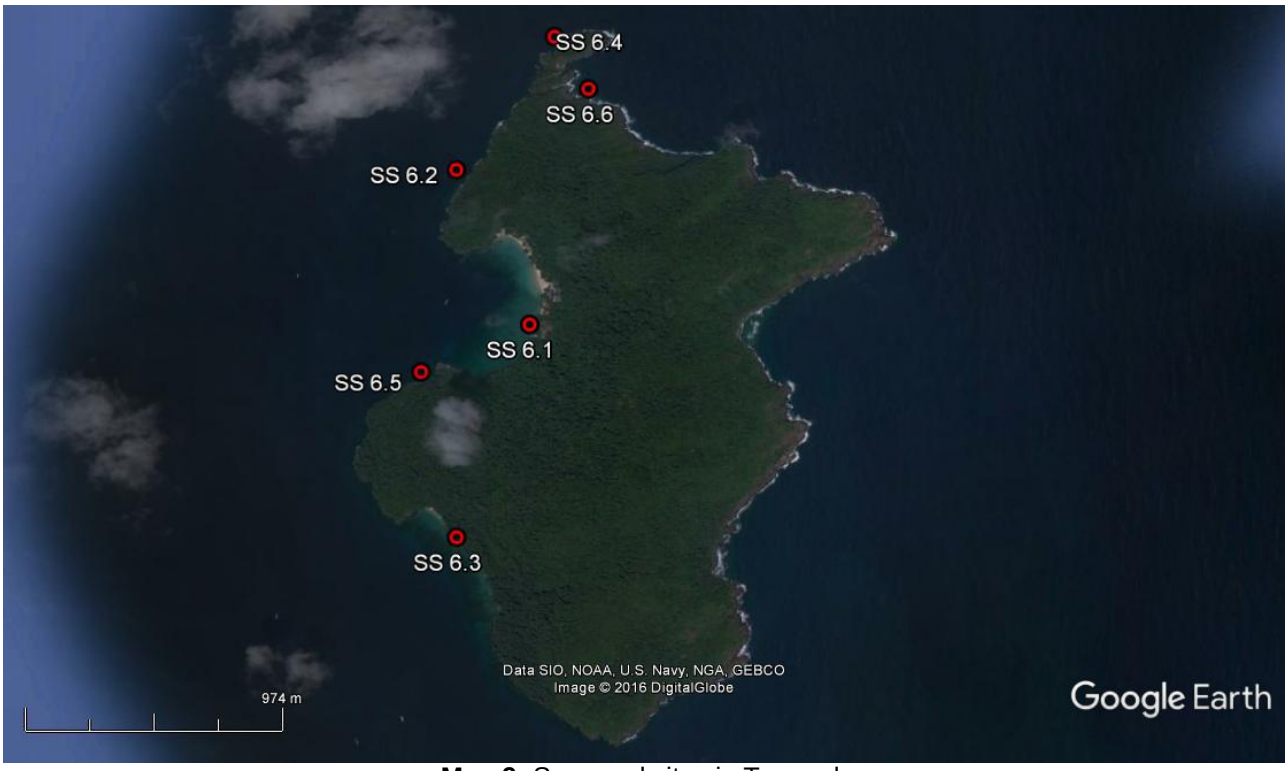
3.2.6 Tenggol

Tenggol Island is located approximately 30km from Dungun, off the East coast of Terengganu, Malaysia. This small island has no local population. The island is gazetted as a Marine Park (since 1994).

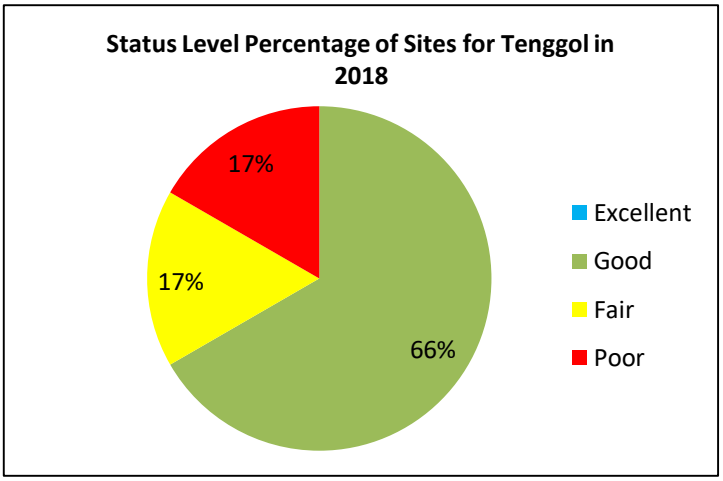
The island is a popular diving destination due to the surrounding deep water which attracts more mega fauna than other islands (whale sharks are common around the island). There are four resorts on the island, each with its own dive operator. There is no centralised electricity supply, resorts operate their own generators for power. Groundwater supplies are limited and there is no centralised sewage treatment, each resort having its own sewage treatment facilities.

Tenggol Island has gained popularity in the last few years and a number of dive and snorkel operators have started to operate from Dungun, the nearest town on the mainland, offering day trip packages to divers and snorkelers alike.

Much of the island's coastline is rocky, besides a couple of sandy beaches. The reefs are mainly fringing reefs and rocky reefs.

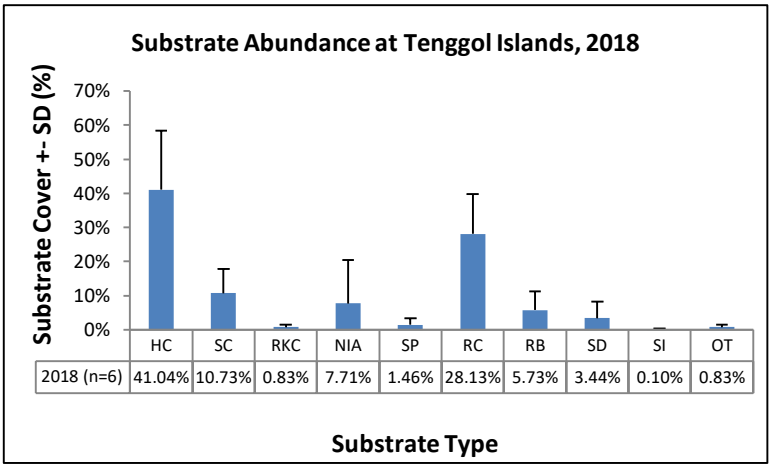


Map 9: Surveyed sites in Tenggol



A total of 6 coral reef sites were surveyed in Tenggol. 66% of the sites were in good condition and 17% were in fair condition. The remaining 17% were in poor condition.

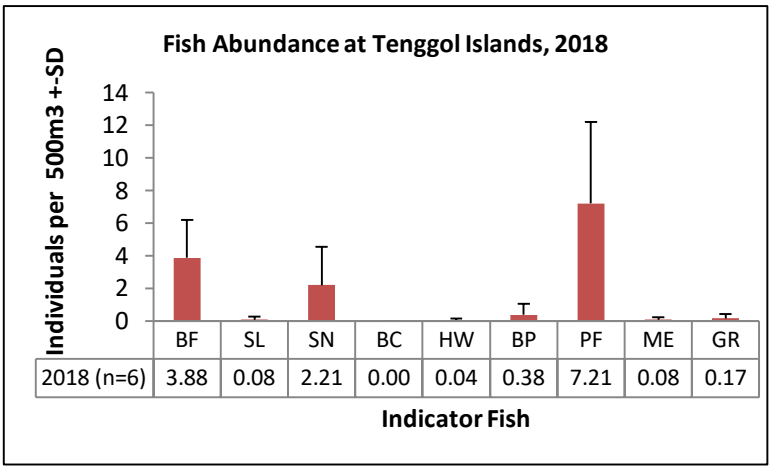
Substrate



The reefs in Tenggol were considered to be in 'Good' condition, with 51.77% live coral cover, slightly above the average (51.53%) for reefs of the Sunda Shelf region.

The level of RKC, NIA and RB has reduced slightly. Although the average level of NIA showed some reduction, the level of NIA at SS6.1 Freshwater Bay has increased further from 25.63% in 2017 to 33.13% in 2018 and this need to be monitored closely.

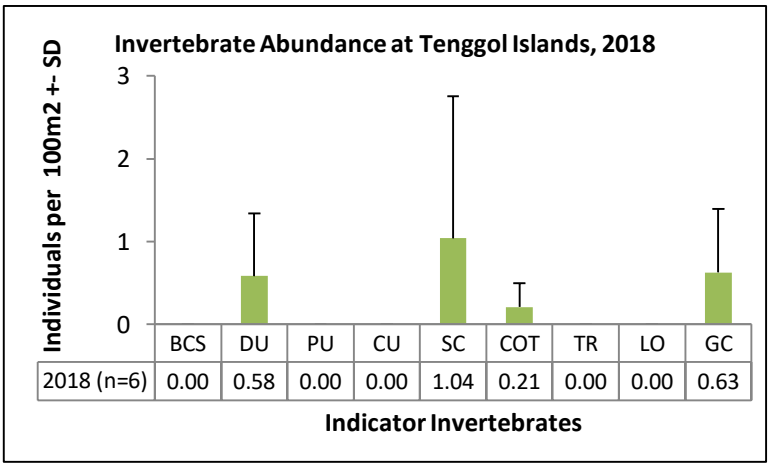
Fish



Abundance of Parrotfish was the highest, followed by Butterflyfish and Snapper. Other indicators such as Sweetlips, Moray Eel and Grouper were present in low number.

Highly prized fish such as Bumphead Parrotfish and Humphead Wrasse were also recorded in low number.

Invertebrates



None of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster which are targeted for food also absent from the surveys.

Sea Cucumber recorded the highest abundance. Abundance of other indicator species was very low. The abundance of COT has increased and is now above what a healthy reef can support (0.2-0.3 ind./100m^2).

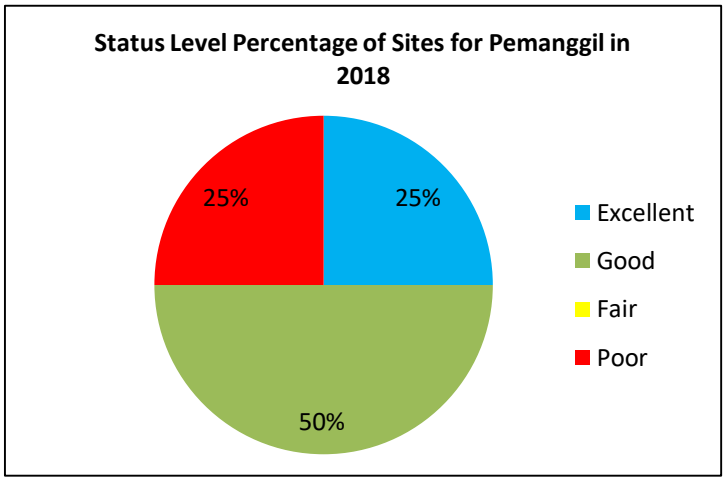
Boat anchor damage, discarded fishing nets and trash were recorded during surveys. COT predation was also observed. On a positive note, turtle was recorded during surveys.

3.2.7 Pemanggil

Pemanggil Island is approximately 45km east of Mersing off the East coast of Peninsular Malaysia. The island and its surrounding waters were gazetted as a Marine Park in 1994 under the Fisheries Act 1985 (Amended 1993).

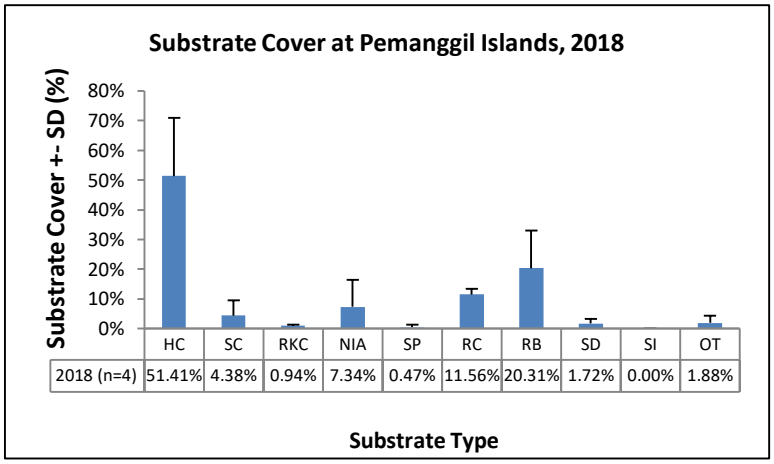
The island is sparsely populated and has for many years been a frequent stopover point for fishermen.

Map 10: Surveyed sites in Pemanggil



A total of 4 coral reef sites were surveyed in Pemanggil and 50% of the sites were in good condition. 25% were in excellent condition and the remaining 25% were in poor condition.

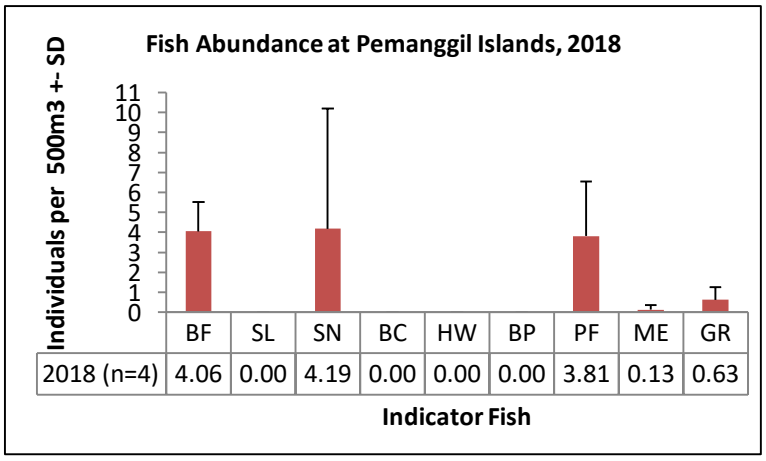
Substrate



The reefs in Pemanggil are considered to be in 'Good' condition, with 55.78% live coral cover, above the average (51.53%) for reefs of the Sunda Shelf region.

Both RKC and NIA level has increased slightly from last year, while RB level has decreased. However, RB level maintained at very high level around Pemanggil. The site of most concern was NB7.3 Pemanggil Village South with 20.63% NIA and 34.38% RB.

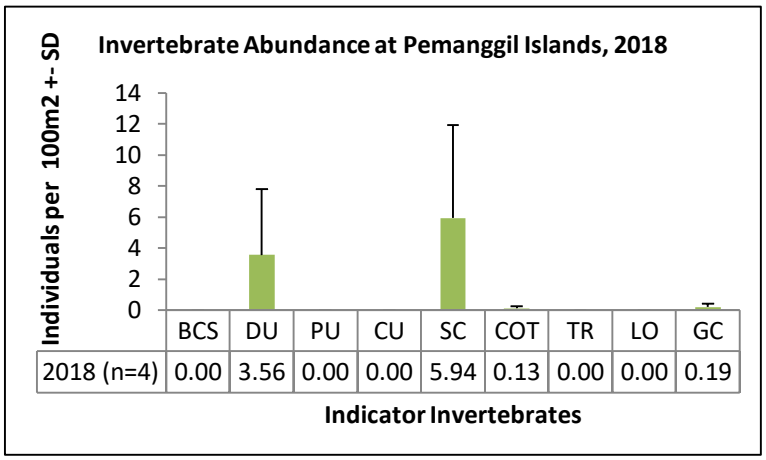
Fish



Highly prized fish were absent during surveys (Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish).

The most abundant fish was Snapper, followed by Butterflyfish and Parrotfish. Moray Eel and Grouper were present in low number.

Invertebrates



Similar to other islands, several targeted species were absent, including Banded Coral Shrimp, Pencil and Collector Urchin, Triton and Lobster.

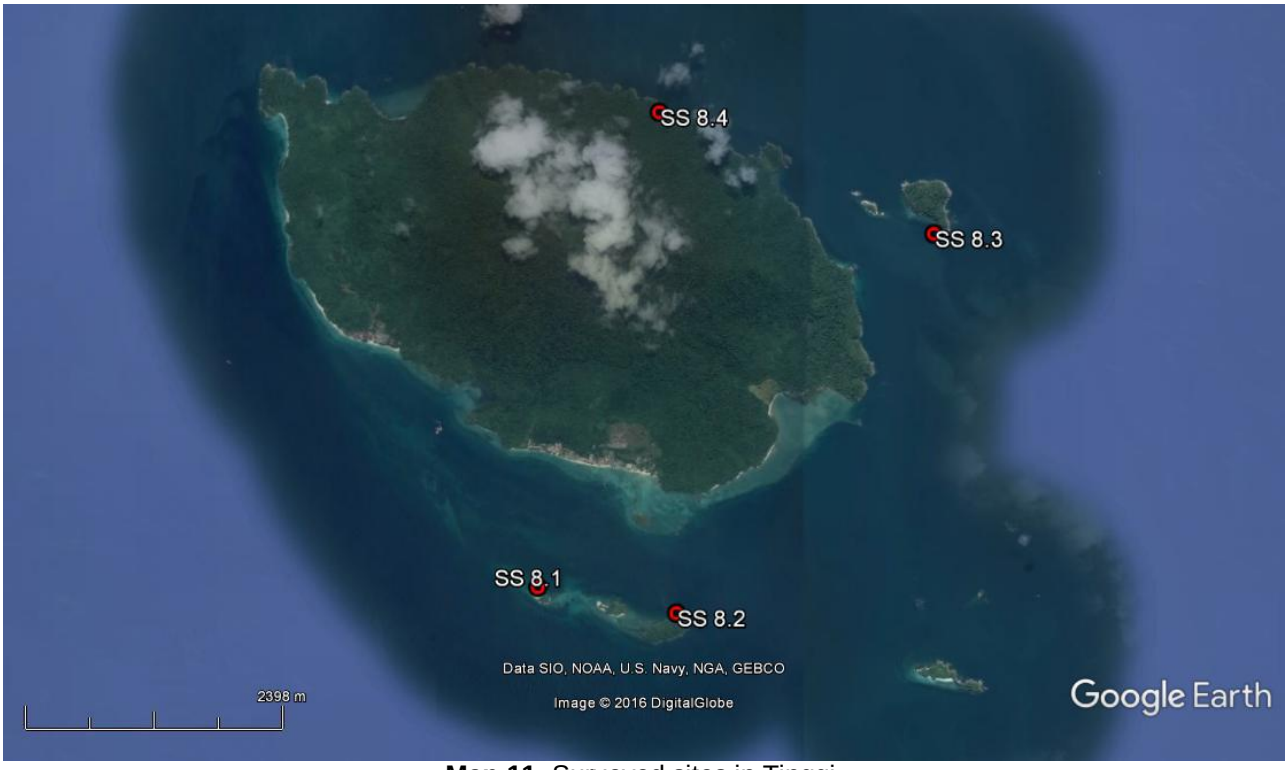
Sea Cucumber recorded the highest number, followed by Diadema Urchin. COT does not seem to pose any dangers as the abundance was within the healthy range.

Discarded fishing nets and trash were recorded during surveys. On a positive note, Hawksbill and Green turtle were also observed.

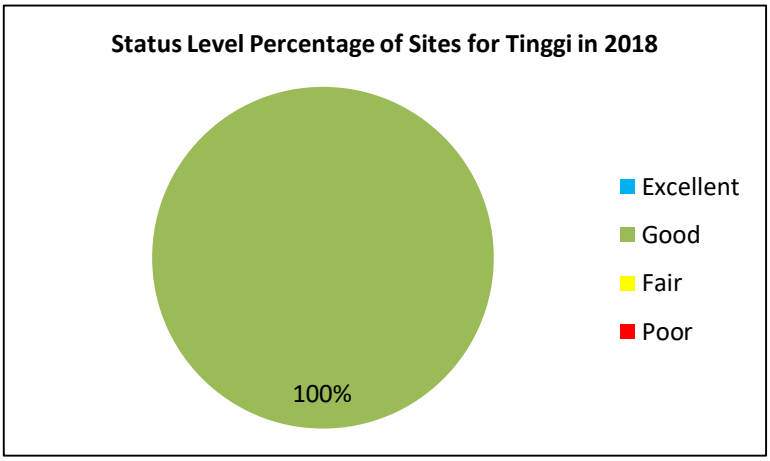
3.2.8 Tinggi

Tinggi Island is located less than 15km off the East coast of mainland Peninsular Malaysia. The island and its surrounding waters were gazetted as a Marine Park in 1994 under the Fisheries Act 1985 (Amended 1993).

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.

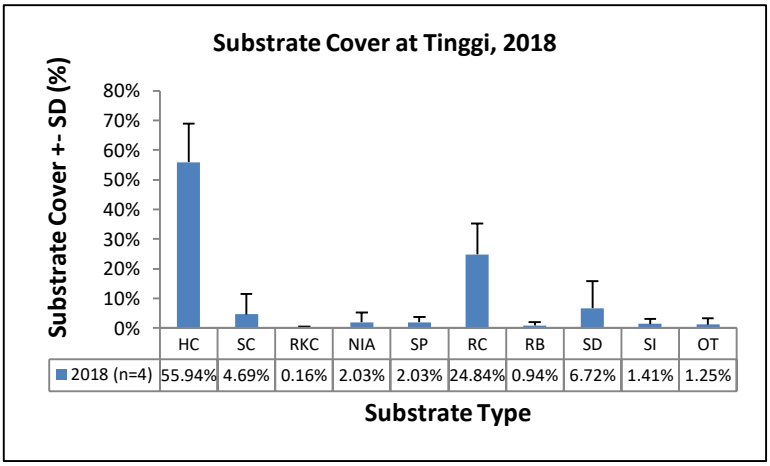


Map 11: Surveyed sites in Tinggi



A total of 4 coral reef sites were surveyed in Tinggi and 100% of the reefs were in good condition.

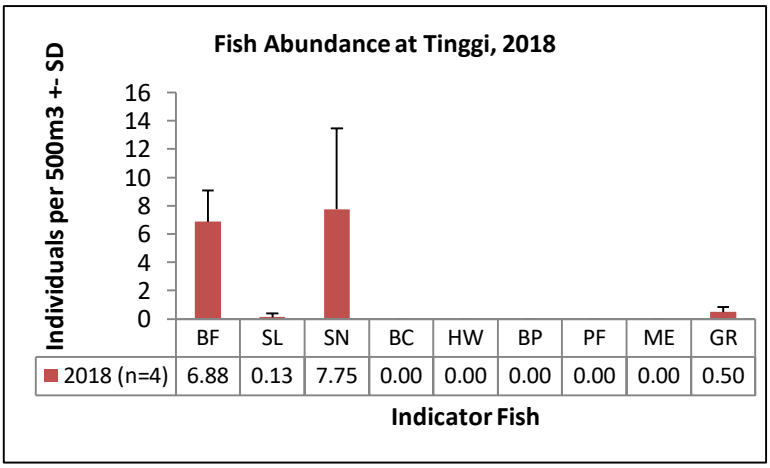
Substrate



Coral reefs around Tinggi Island were in 'Good' condition, with 60.63% live coral cover, above the average (51.53%) for reefs in the Sunda Shelf region.

The level of RKC, NIA, RB and SI has dropped slightly compared to last year. This indicates lesser disturbances on the reefs.

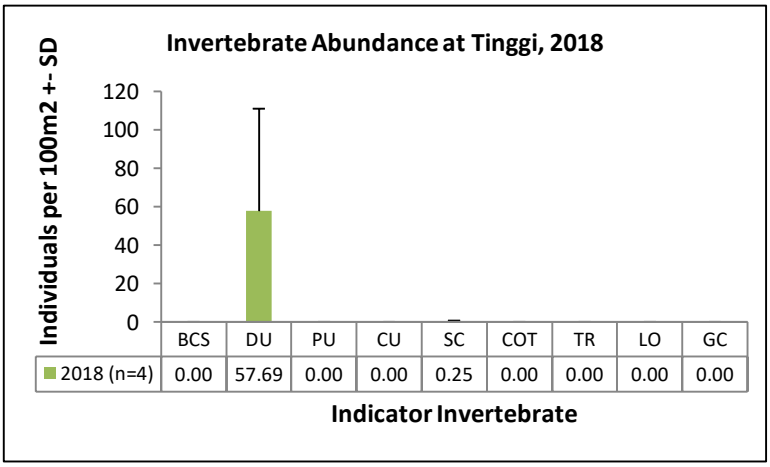
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were not recorded during surveys. Parrotfish and Moray Eel were absent too.

Snapper was the most abundant targeted fish, followed by Butterflyfish. The abundance of Sweetlips and Grouper was low, less than 1 ind./500m^3.

Invertebrates



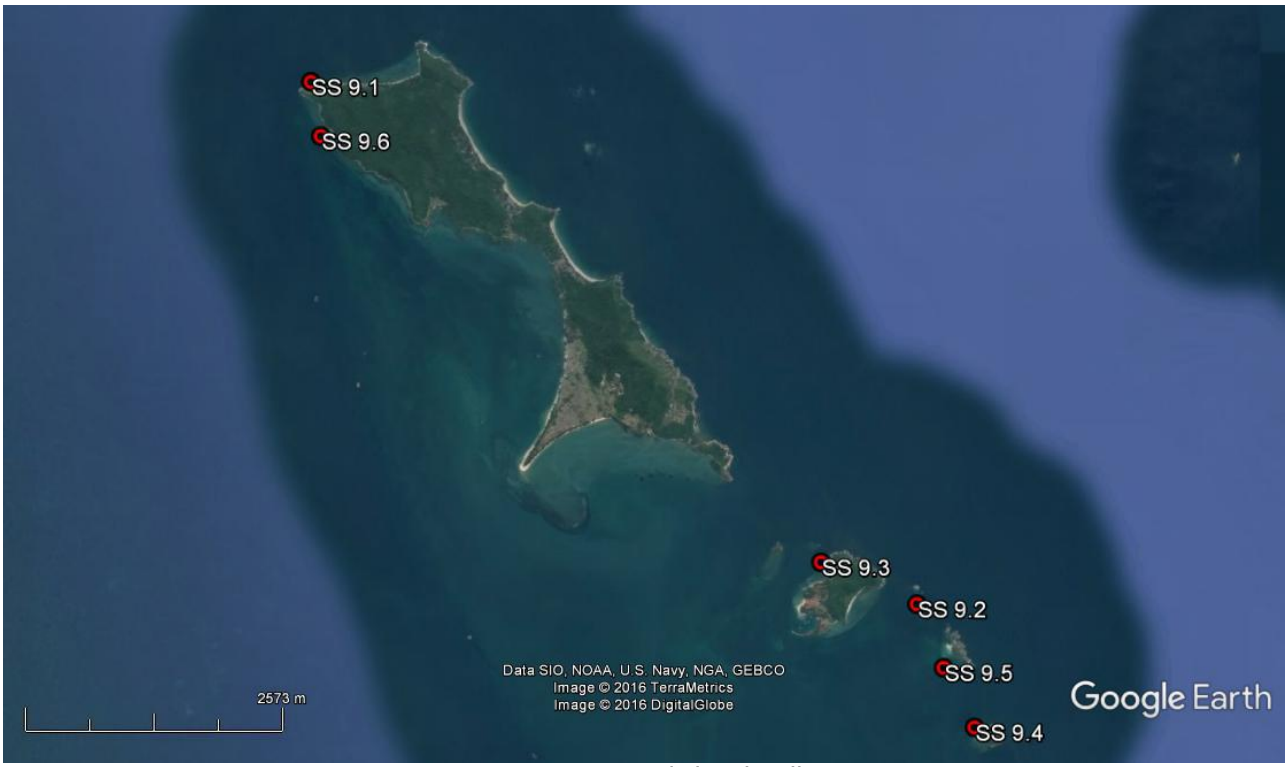
Only Diadema Urchin and Sea Cucumber were recorded during surveys. The abundance of Diadema Urchin was high at 57.69 ind./100m^2 while the abundance of Sea Cucumber was very low, less than 1 ind./100m^2.

Coral predation by drupella, as well as trash were seen during surveys.

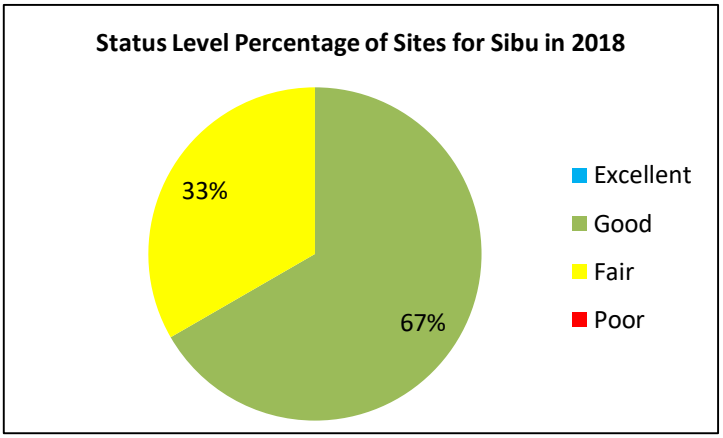
3.2.9 Sibu

The Sibu archipelago, known locally by the name of the largest island, Sibu, is located less than 10km off the East coast of mainland Peninsular Malaysia. The waters surrounding the island group were gazetted as a Marine Park in 1994 under the Fisheries Act 1985 (Amended 1993).

Sibu island is not as popular among tourists as other islands off the East coast, but the tourism industry here is growing. The island is sparsely populated with few villages and a number of small resorts.

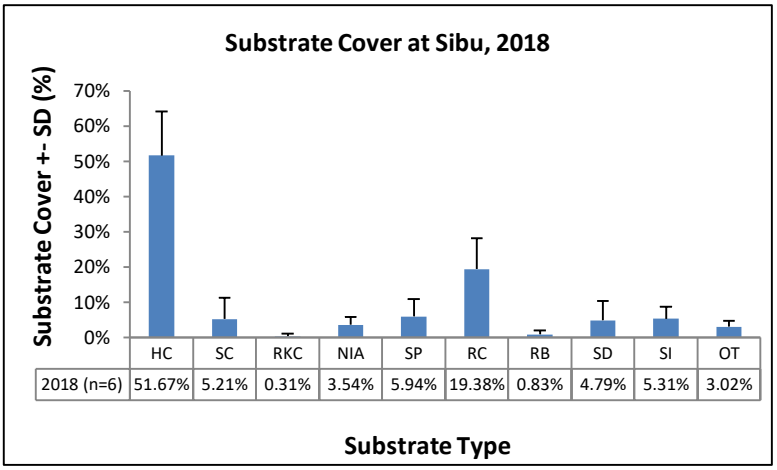


Map 12: Surveyed sites in Sibu



A total of 6 coral reef sites were surveyed in Sibu Island. 67% of the reefs were in good condition and 33% were in fair condition.

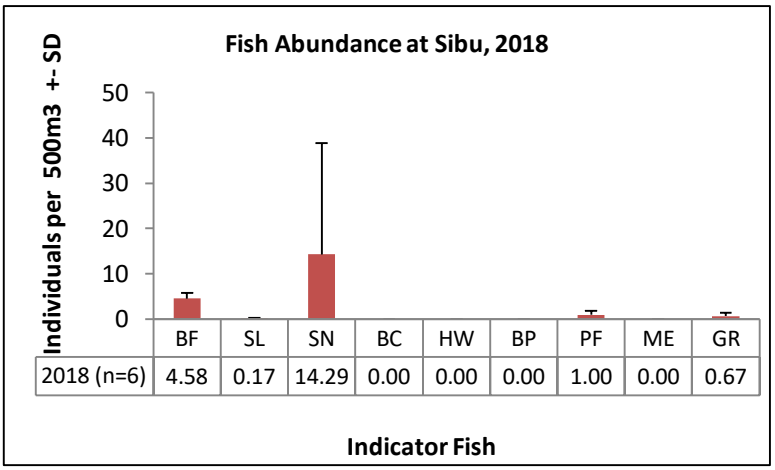
Substrate



Coral reefs around Sibu were in 'Good' condition, with 56.88% live coral cover, above the average (51.53%) for reefs in the Sunda Shelf region.

The levels of RKC, NIA and SI have increased slightly. This shows that there are some disturbances on reefs around the Sibu Islands.

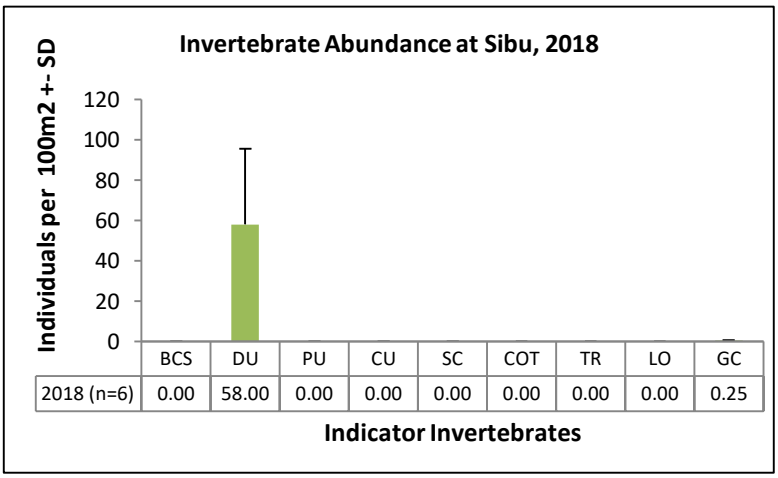
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were not recorded during surveys.

Snapper was the most abundant targeted fish recorded, followed by Butterflyfish. Abundance of other indicators was very low, including Sweetlips, Parrotfish and Grouper.

Invertebrates



None of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin, Sea Cucumber and Lobster, which are targeted for food, were also absent from the surveys.

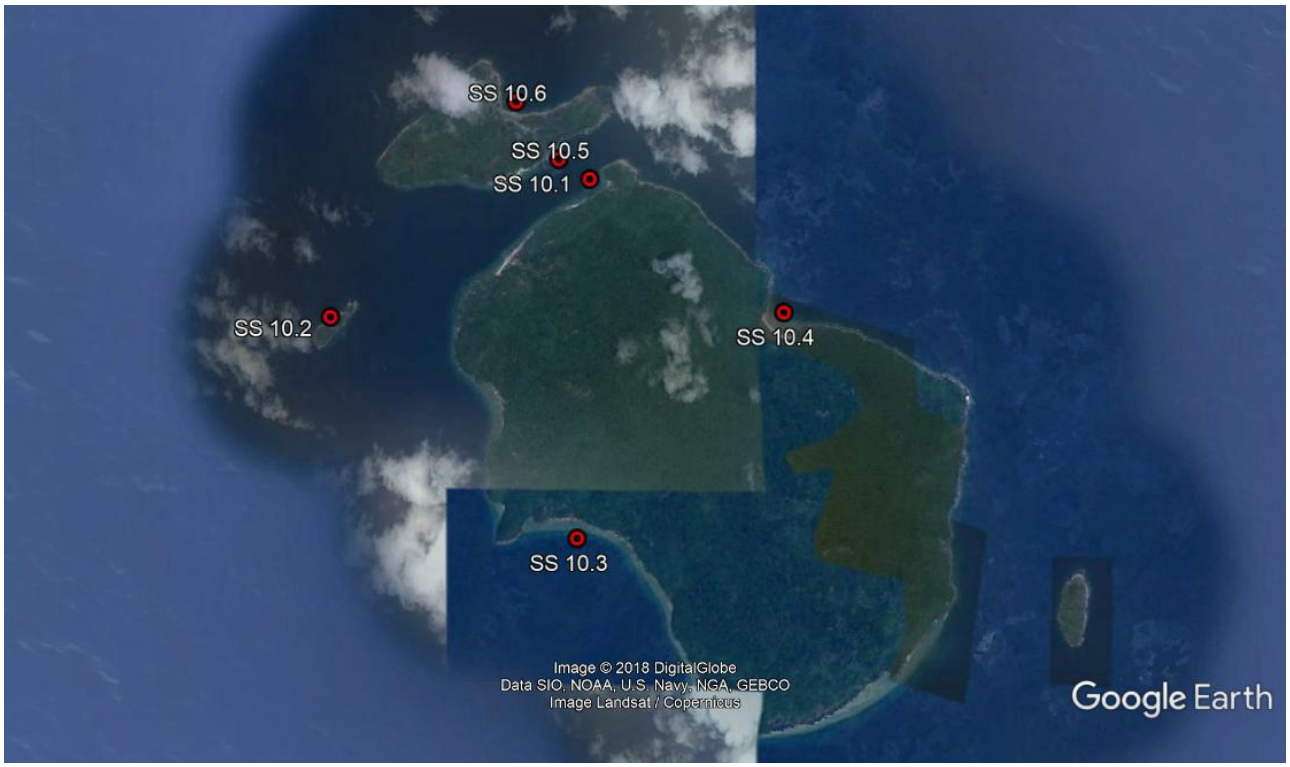
The abundance of Diadema Urchin was high while the abundance of Giant Clam was very low.

Human impacts such as discarded fishing net was observed.

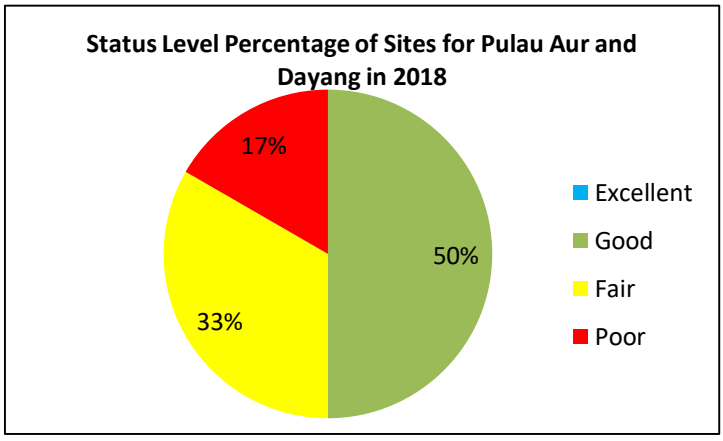
3.2.10 Pulau Aur and Pulau Dayang

Pulau Aur and Pulau Dayang are adjacent islands in Mersing District, Johor. They lie about 76km east of Mersing off the East coast of Peninsular Malaysia and were gazetted as a Marine Park in 1994 under the Fisheries Act 1985 (Amended 1993).

Their corals, lagoons and offshore pools make these islands a tourist attraction. The islands are sparsely populated with few villages and have for many years been a frequent stopover point for fishermen. Pulau Aur and Pulau Dayang used to be a popular diving destination among tourists from Singapore.

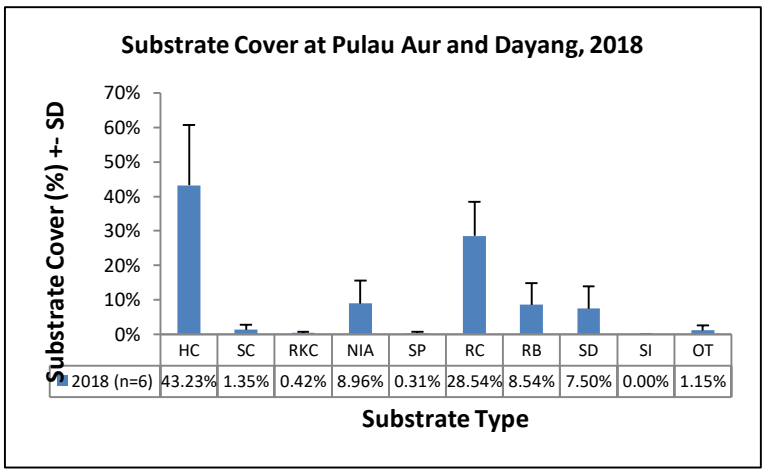


Map 13: Surveyed sites in Pulau Aur and Dayang



A total of 6 coral reef sites were surveyed in Pulau Aur and Dayang and 50% of the reefs were in good condition. 33% were in fair condition and the remaining 17% were in poor condition.

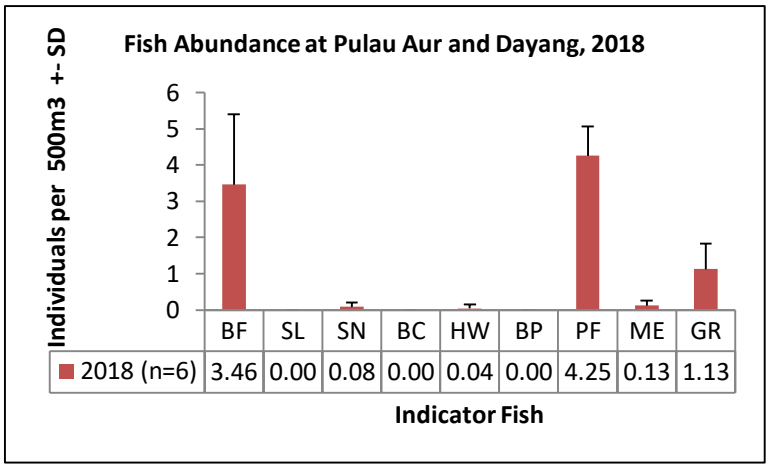
Substrate



Coral reefs around Pulau Aur and Dayang are considered to be in 'Fair' condition, with 44.58% live coral cover, lower than the average (51.53%) for reefs of the Sunda Shelf region.

The level of NIA and RB is high at 8.96% and 8.54%, respectively. The level of SD is also considerably high at 7.50%.

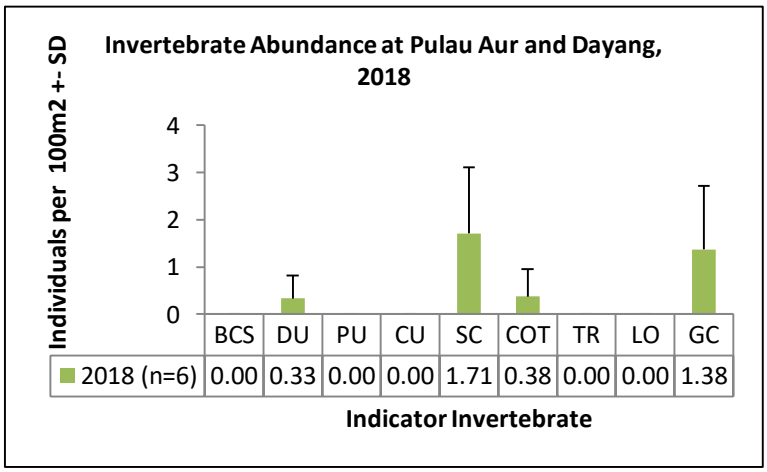
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were not recorded during surveys. Sweetlips was absent as well.

Abundance of Parrotfish was the highest, followed by Butterflyfish and Grouper. Other indicator species were present in very low number such as Snapper and Moray Eel.

Invertebrate



None of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster, which are targeted for food, were also absent from the surveys.

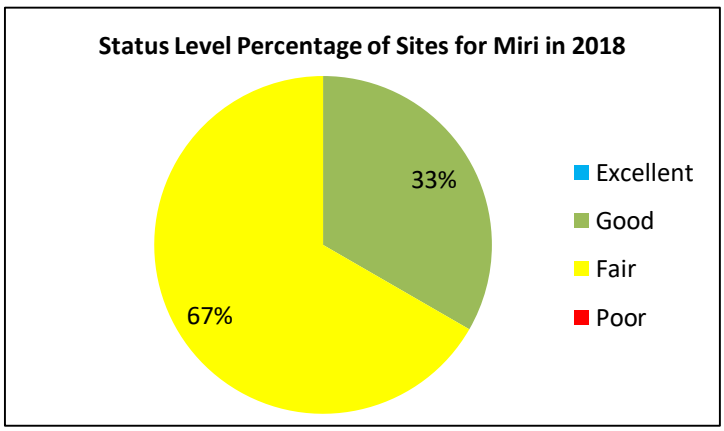
Four indicator invertebrates were recorded during surveys but all were present in low number. The abundance of COT on the other hand was above the range of what a healthy reef can support (0.2-0.3 ind./100m^2).

3.2.11 Miri

Miri is located in the north 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.

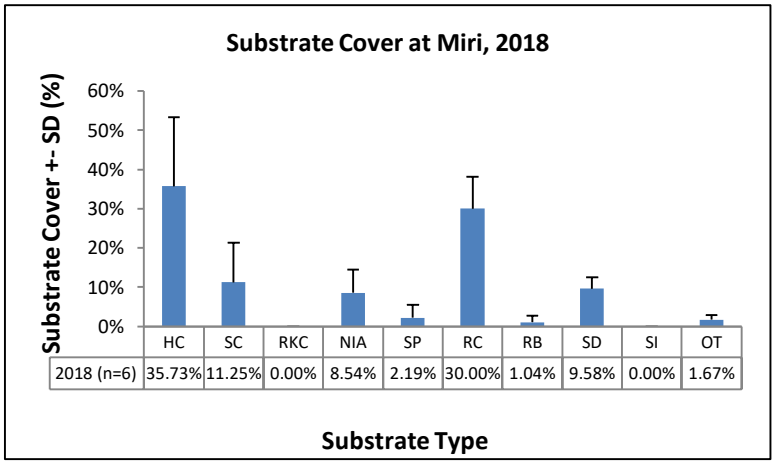
Miri has extensive submerged offshore reefs, generally flat in profile, in depths ranging from 7 to 30m. The reefs and surrounding waters cover an area of 186,930 hectare areas in the Miri and Sibuti districts, were gazetted as the Miri-Sibuti Coral Reef National Park in 2007 under the National Parks and Nature Reserves Ordinance. The national park is located in the maritime boundary between Bintulu town and Miri City and is the largest offshore national park created in this state. Petroleum and gas mining, archaeological excavations, fishing and waste dumping are among the activities prohibited in the area. Those that do not threaten the undersea environment, like diving, boating and snorkelling, are allowed.

Map 14: Surveyed sites in Miri



A total of 6 coral reef sites were surveyed in Miri and 33% of the sites were in good condition. The remaining 67% were in fair condition.

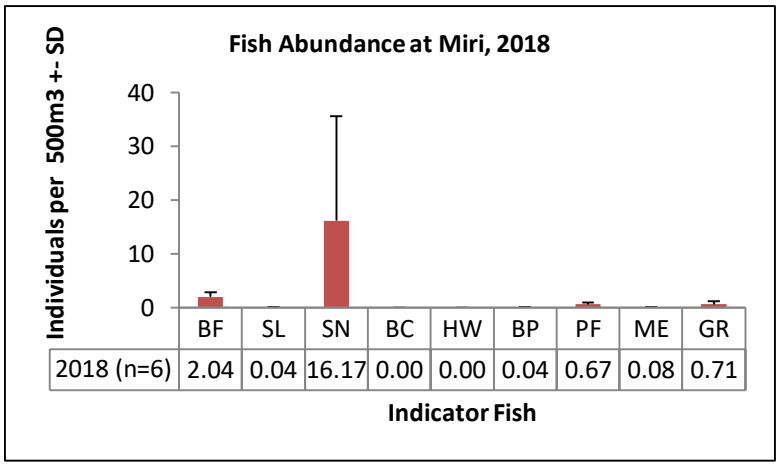
Substrate



Coral reefs around Miri were in 'Fair' condition with 46.98% of live coral cover, below the average (51.53%) for the Sunda Shelf region.

The level for NIA and RB has increased from last year. Miri reefs have the highest level of SD of all islands surveyed in the Sunda Shelf region.

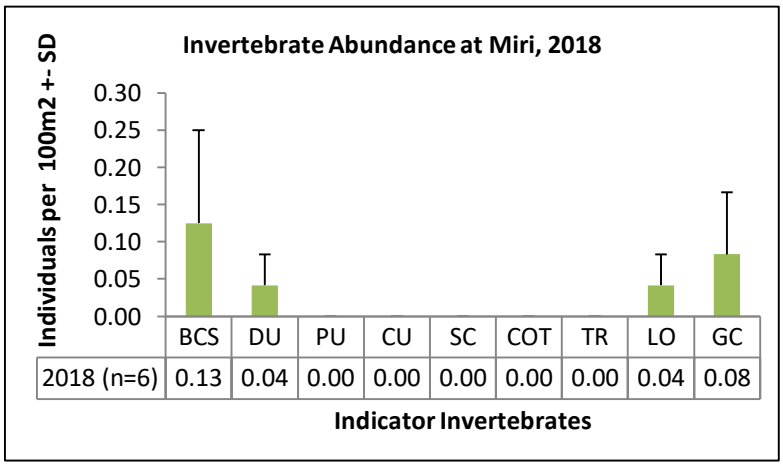
Fish



Highly prized fish such as Barramundi Cod and Humphead Wrasse were not recorded during surveys.

The abundance of Snapper was the highest, followed by Butterflyfish. Others were recorded in low abundance. Bumphead Parrotfish was also recorded during surveys.

Invertebrates



Only four indicators were observed during surveys, which are Banded Coral Shrimp, Diadema Urchin, Lobster and Giant Clam. All indicators were present in very low number.

Human impacts such as boat anchor damage, discarded fishing net and trash were observed during surveys. Natural impacts such as warm water bleaching and storm damage were also observed. On a positive note, large school of Spanish mackerel and batfish were observed.

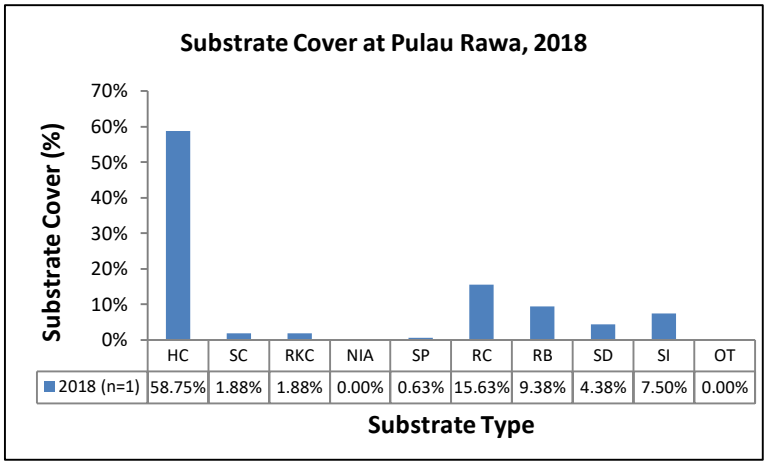
3.2.12 Pulau Rawa

Pulau Rawa is under Mersing District, Johor and is accessible by speedboat from Mersing (20-30 minute boat ride). Rawa is the local term for white doves, which are abundant on the island. Pulau Rawa is a small island and there are no proper roads, only a few walkways. One side of the island is a beach covered with white sand and the other side is a rocky vertical cliff. The island and its surrounding waters were gazetted as a Marine Park in 1994 under the Fisheries Act 1985.

Only one site has been surveyed at Pulau Rawa, a very limited sample. Further sites will be added in future.

Map 15: Surveyed site in Pulau Rawa

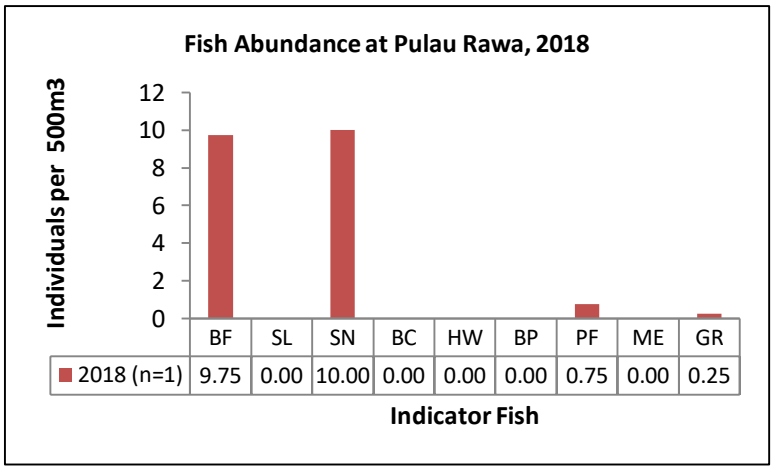
Substrate



The coral reef surveyed at Pulau Rawa was in 'Good' condition with 60.63% of live coral cover, above the average (51.53%) for the Sunda Shelf region.

The level of RB and SI is high at 9.38% and 7.5% respectively. The high SI level is probably due to the close proximity of Pulau Rawa to the mainland and a likely source of this high SI level is terrestrial runoff from the Mersing River.

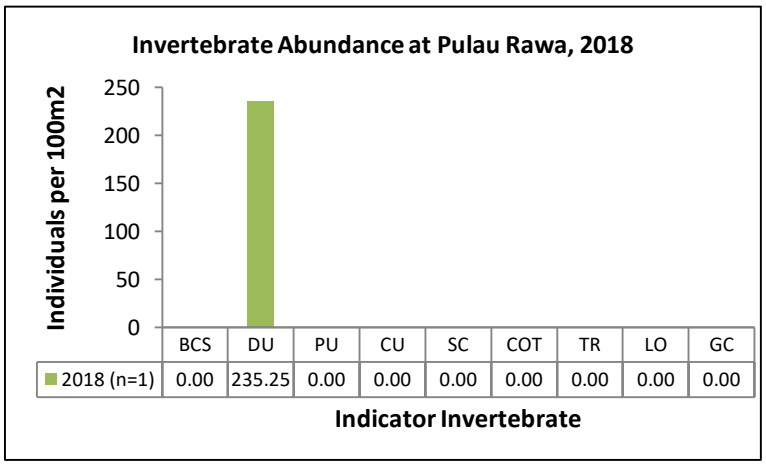
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were not recorded during the survey. Sweetlips and Moray were absent too.

The abundance of Snapper was the highest, followed by Butterflyfish. Parrotfish and Grouper were recorded in low abundance.

Invertebrate



Only Diadema Urchin was recorded and the abundance is high at 235.25 ind./100m^2.

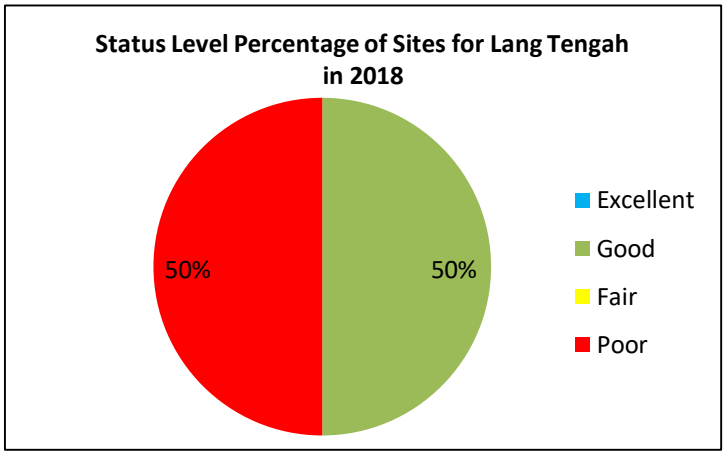
Impacts from boat anchor damage and discarded fishing nets were recorded, however they were old damage. A turtle was also recorded during survey.

3.2.13 Lang Tengah

Lang Tengah is located about 40km northeast of Kuala Terengganu on the east coast of peninsular Malaysia. It was gazetted as a Marine Park in 1994 under the Fisheries Act 1985 (Amended 1993). It is connected to the mainland by ferries to Merang. Lang Tengah appeals to holiday goers who are looking for a quiet tropical island getaway. Lang Tengah is much quieter, with less development, compared to nearby islands. There are only 4 resorts located on the island.

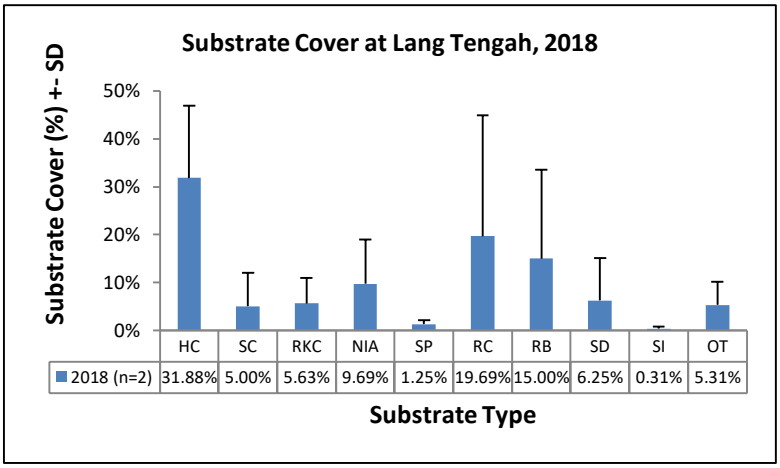
Coral reefs on Lang Tengah are teeming with fish life and occasional sharks and rays. The island has nesting green turtle from April to October. Occasionally, hawksbill turtle will also nest on Lang Tengah. The island is also covered with primary forest and has a wide variety of flora and fauna.

Map 16: Surveyed sites in Lang Tengah



A total of 2 coral reef sites were surveyed in Lang Tengah and 50% of the reefs were in good condition. The remaining 50% were in poor condition.

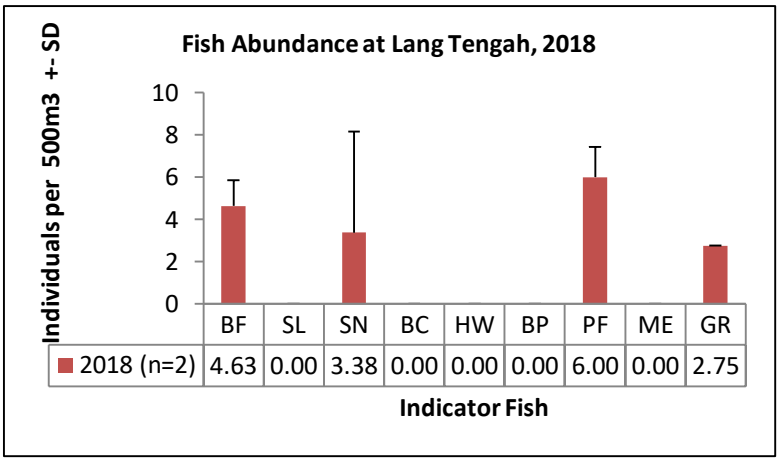
Substrate



Coral reefs around Lang Tengah are considered to be in 'Fair' condition, with 36.88% live coral cover, lower than the average (51.53%) for reefs of the Sunda Shelf region.

The level of NIA and RB is high at 9.69% and 15%, respectively. The level of RKC is also rather high at 5.63%.

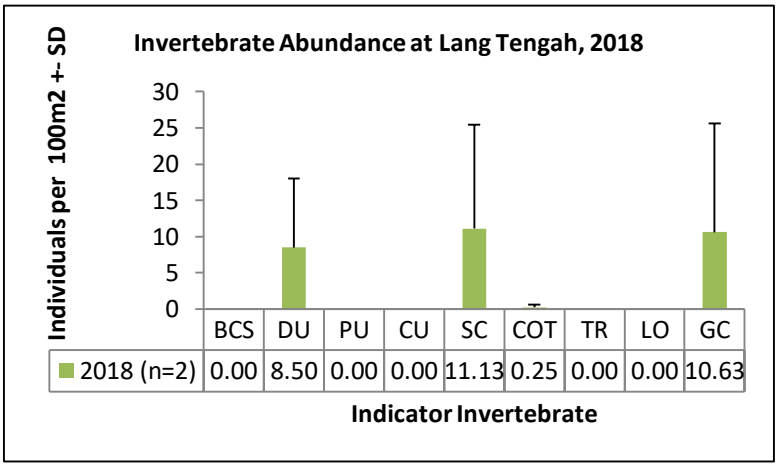
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were not recorded during surveys. Sweetlips was absent as well.

Abundance of Parrotfish was the highest, followed by Butterflyfish, Snapper and Grouper.

Invertebrate



None of the indicator invertebrate targeted for curio trade (Banded Coral Shrimp, Pencil Urchin and Triton) was recorded during surveys. Collector Urchin and Lobster, which are targeted for food, were also absent from the surveys.

The abundance of Sea Cucumber was the highest, followed by Giant Clam and Diadema Urchin.

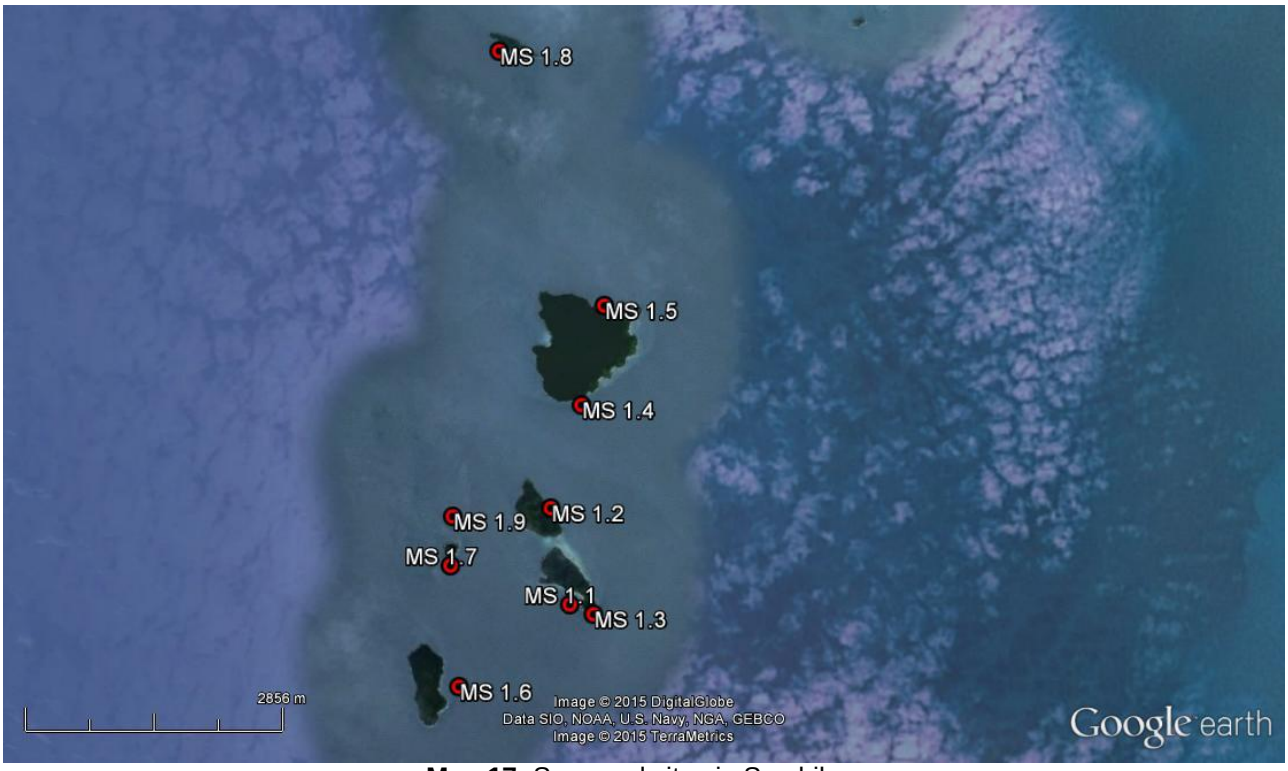
No natural nor human impacts were recorded during surveys.

Straits of Malacca

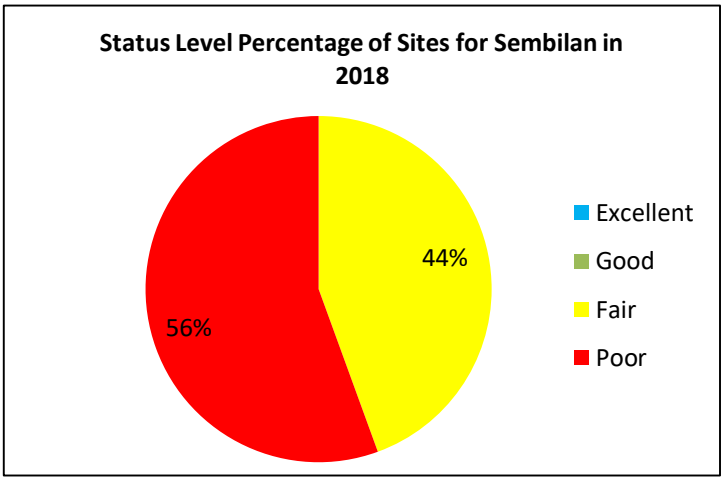
3.2.14 Sembilan Islands

The Sembilan Islands 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) which are located some 20km from the coast of Perak (Lumut), 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.

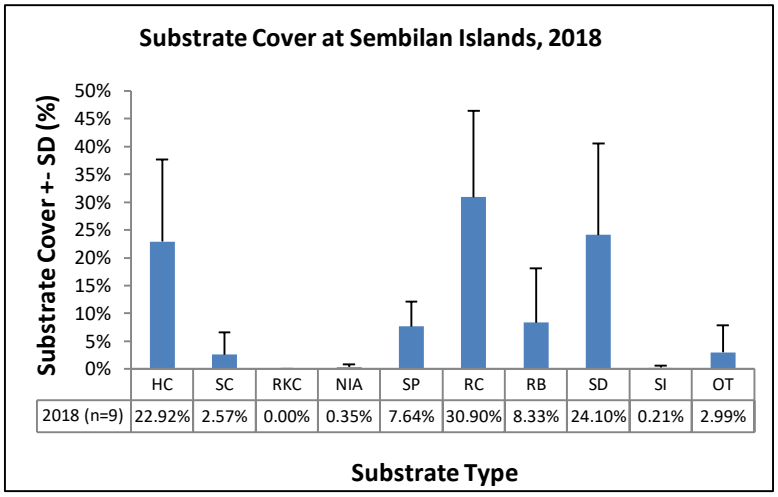


Map 17: Surveyed sites in Sembilan



A total of 9 coral reef sites were surveyed in Sembilan islands and 44% of the reefs were in fair condition. The remaining 56% were in poor condition. No reefs were in excellent or good condition.

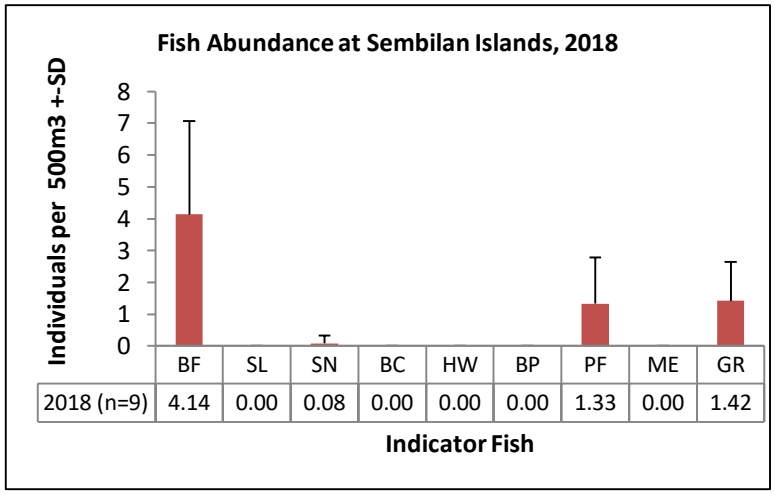
Substrate



Coral reefs around Sembilan islands are considered to be in 'Fair' condition, with 25.49% live coral cover, lower than the average (35%) for reefs of the Malacca Strait region.

The level of RB has decreased significantly from 25.97% in 2017 to 8.33% in 2018 while the level of SD has increased significantly from 11.88% in 2017 to 24.10% in 2018.

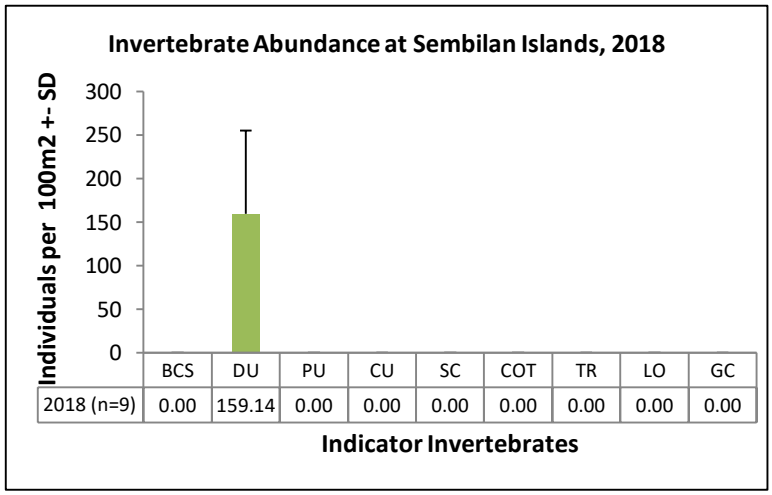
Fish



Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were not recorded during surveys. Sweetlips was absent as well.

Abundance of Butterflyfish was the highest. Other indicator species were present in very low number such as Snapper, Parrotfish and Grouper.

Invertebrates



Only Diadema Urchin was recorded during surveys and the abundance was high, the highest within the Malacca Strait region.

Discarded fishing nets and trash were recorded at many surveyed sites. On a positive note, highly prized sea cucumber was observed during surveys.

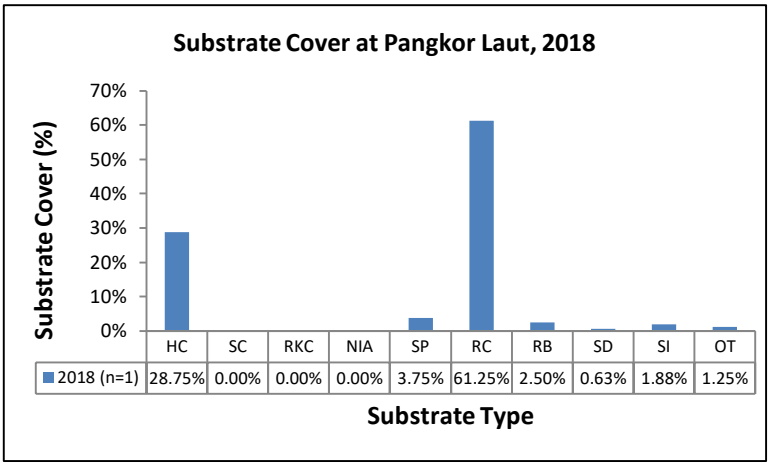
3.2.15 Pangkor Laut Island

Pangkor Laut Island is a small island, privately owned and located 3 miles off the coast of Perak, along the Straits of Malacca. Of the island's 300 acres, a fraction has been developed to house a premier resort.

Only one site has been surveyed at Pulau Pangkor Laut, a very limited sample. Further sites will be added in future.

Map 18: Surveyed site in Pangkor Laut

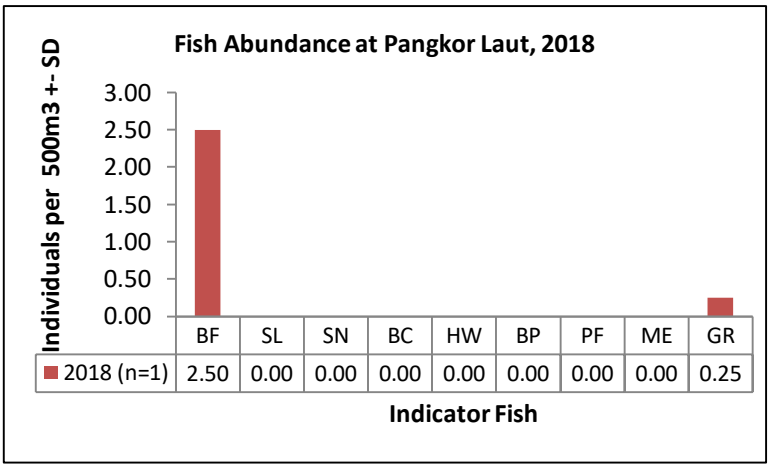
Substrate



The coral reef surveyed at Pangkor Laut is considered to be in 'Fair' condition, with 28.75% live coral cover, below the average (35%) for reefs of the Malacca Strait region.

HC cover has decreased significantly from 66.25% in 2017 to 28.75% in 2018 while RC cover increased significantly from 10% in 2017 to 61.25% in 2018. Although the level of RB has decreased significantly from 18.75% in 2017 to 2.5% in 2018, the drastic decrease in HC cover is a cause for concern and needs to be monitored closely.

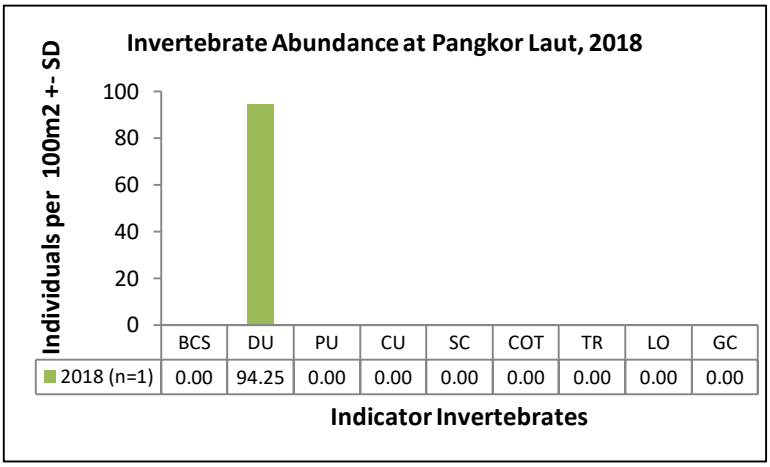
Fish



Only two indicator fish were recorded during the survey. Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were absent.

The abundance of Butterflyfish was the highest. Grouper was present in very low numbers, less than 1 ind./500m^3

Invertebrates



Similar to previous years, the only indicator species observed was Diadema Urchin and the abundance was high.

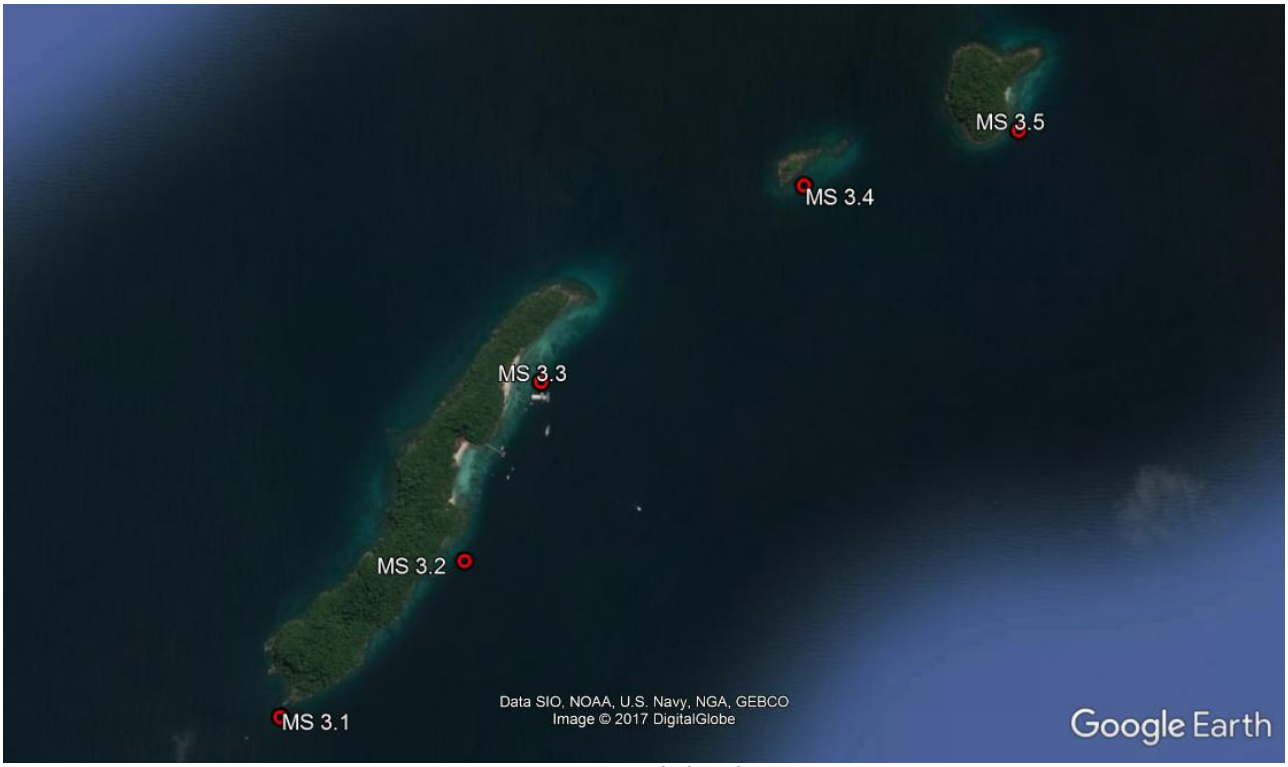
Discarded fishing net was recorded during the survey.

3.3.16 Payar

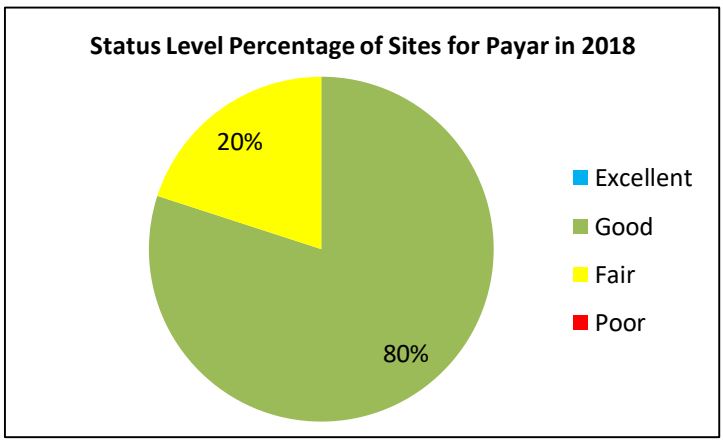
Payar is one of many islands off the West coast of mainland Kedah in the Straits of Malacca. It is situated 35km south of Langkawi, 59km north of Penang and 28km west of Kuala Kedah. It was gazetted as a Marine Park in 1994 under the Fisheries Act 1985 (Amended 1991).

The island is a popular destination for tourists (mainly from Langkawi) famous for its corals and reef fishes. Measuring 2km long and 0.25km wide, its sheltered waters are ideal for snorkelling, diving and swimming.

The island is uninhabited and the only operating structures on the island are the Marine Park centre with facilities for day trip visitors such as gazebos, picnic tables and restroom facilities at selected areas. There is also an old abandoned resort. A floating platform moored just off Payar serves as a restaurant and dive platform for tourists.

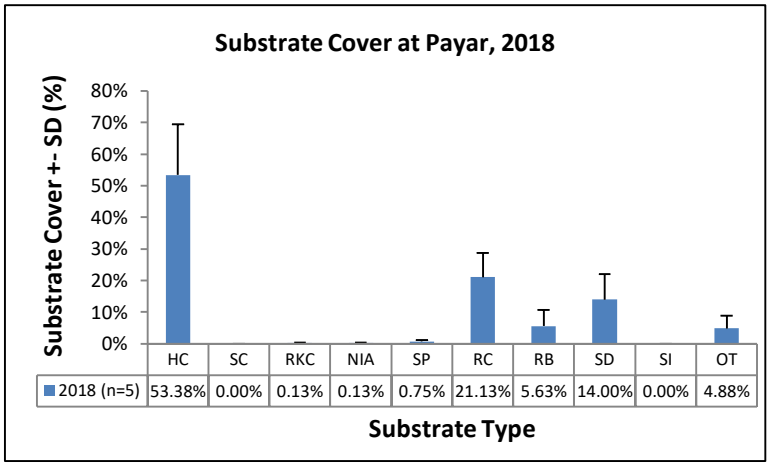


Map 19: Surveyed sites in Payar



A total of 5 coral reef sites were surveyed in Payar and 80% of the reefs were in good condition. The remaining 20% of the reefs were in fair condition.

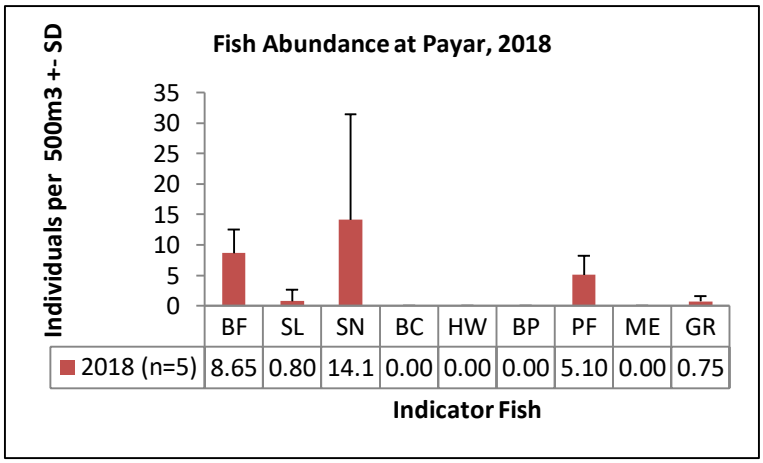
Substrate



Coral reefs around Payar are considered to be in 'Good' condition, with 53.38% live coral cover, way higher than the average (35%) for reefs of the Malacca Strait region.

The island in general has high level of RC and SD. The level RB has increased from 2.25% in 2017 to 5.63% in 2018, indicating recent disturbances in the area.

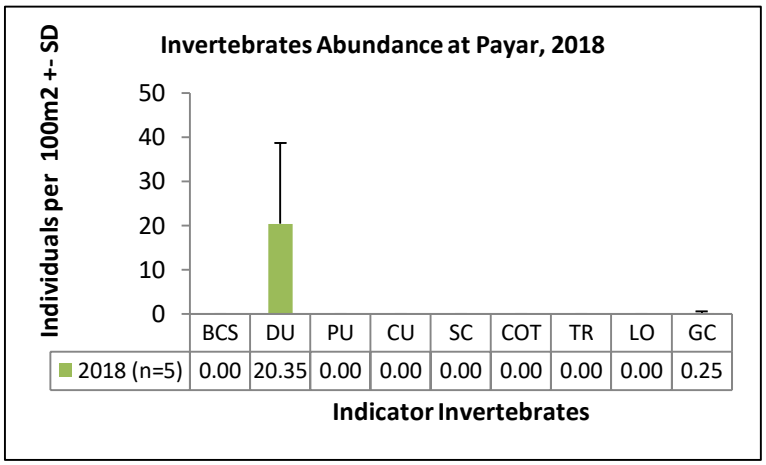
Fish



Five indicator fish were recorded during surveys: Butterflyfish, Sweetlips, Snapper, Parrotfish and Grouper.

The abundance of Snapper was the highest, followed by Butterflyfish and Parrotfish; all recorded the highest within the Malacca Strait region. Grouper was present in low numbers.

Invertebrates



Only two indicator invertebrates were recorded; Diadema Urchin and Giant Clam.

The abundance of Diadema Urchin was high while the abundance of Giant Clam was very low, less than 1 ind./100m^2.

Discarded fishing nets and trash were recorded during surveys. On a positive note, blacktip shark was observed during surveys.

North Borneo

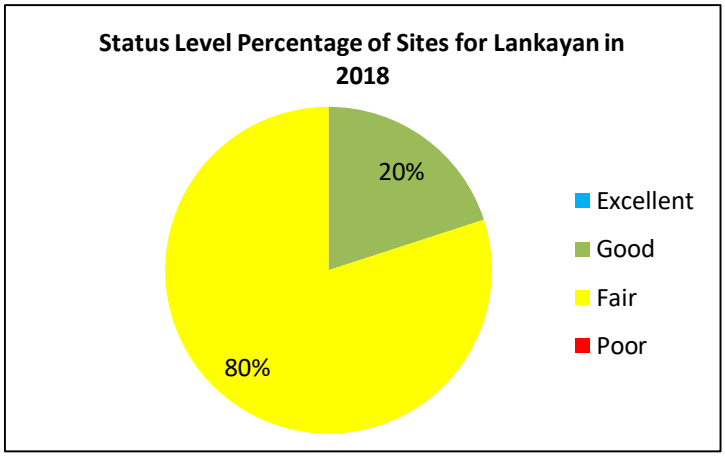
3.2.17 Lankayan

Lankayan is a small island in the Sulu Sea, a 1.5hour 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.

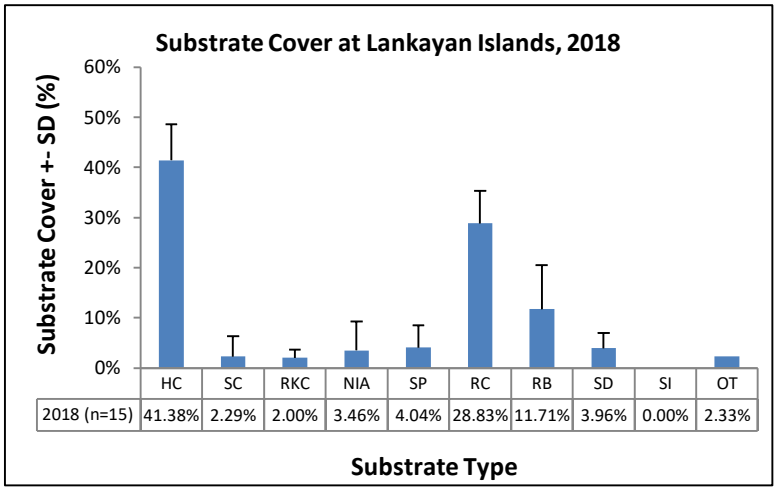
Before the creation of SIMCA, blast fishing was a constant problem, and turtle eggs were poached on a regular basis. Lankayan Island is the only developed island within SIMCA. The 0.05 km^2 island is the site of the Lankayan Island Dive Resort (LIDR), which is the only structure on the otherwise uninhabited island.

Map 20: Surveyed sites in Lankayan



A total of 15 coral reef sites were surveyed in Lankayan islands and 20% of the reefs were in good condition. The remaining 80% of the reefs were in fair condition.

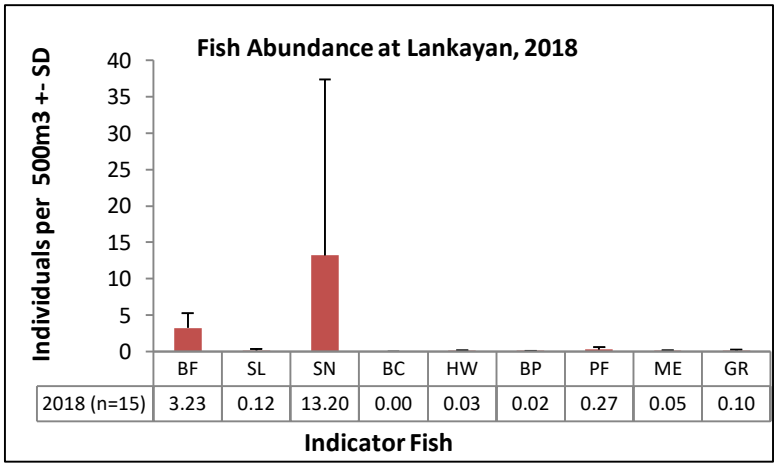
Substrate



The reefs in Lankayan islands are considered to be in 'Fair' condition, with 43.67% live coral cover, above the average (36.36%) for reefs within the North Borneo region.

The level of RKC, NIA and RB has decreased compared to last year. These indicate disturbances on the reefs has decreased.

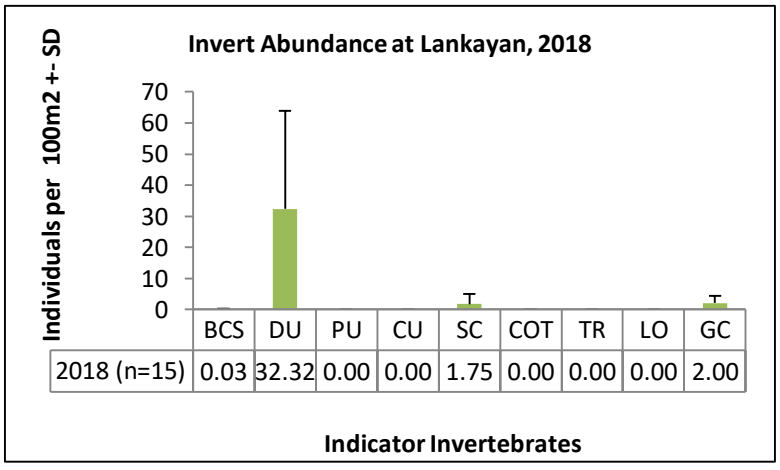
Fish



Only Barramundi Cod was absent.

The abundance of Snapper was high and was still the highest of all islands surveyed in North Borneo region. The abundance of other indicators was generally low, with the exception of Butterfly fish.

Invertebrates



Four indicator invertebrates were present during surveys:Banded Coral Shrimp, Diadema Urchin, Sea Cucumber and Giant Clam.

The abundance of Diadema Urchin was the highest. Other indicators were present in low number.

Trash and warm water bleaching were recorded at some survey sites. On a positive note, sharks were observed during surveys.

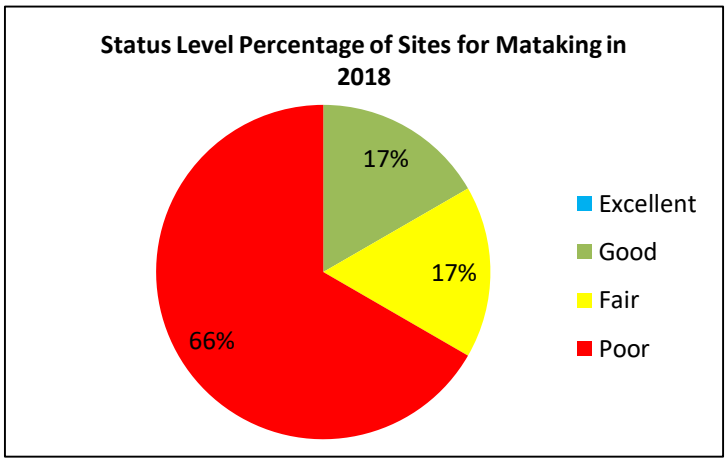
3.2.18 Mataking

Mataking Island is approximately 35km east from the major town of Semporna in the South of Sabah. It is a well-known tourist spot and has one resort. Diving and snorkelling are the main activities on the island.

While the island has no legal protected status, the presence of the resort has effectively created a small protected area, keeping fishermen (including fish bombers) away from parts of the reefs surrounding the island.

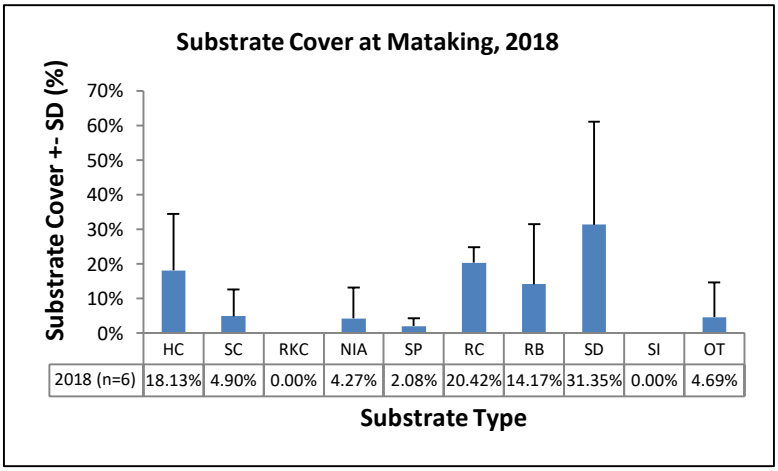
The island has fringing reefs, and coral extends down to almost 30m. Coral reefs around this, and surrounding islands have been extensively damaged by fish bombing in the past, and fish bombing continues in some areas nearby.

Map 21: Surveyed sites in Mataking



A total of 6 coral reef sites were surveyed in Mataking. 17% of the reefs were in good condition and 17% were in fair condition. The remaining 66% of the reefs were in poor condition.

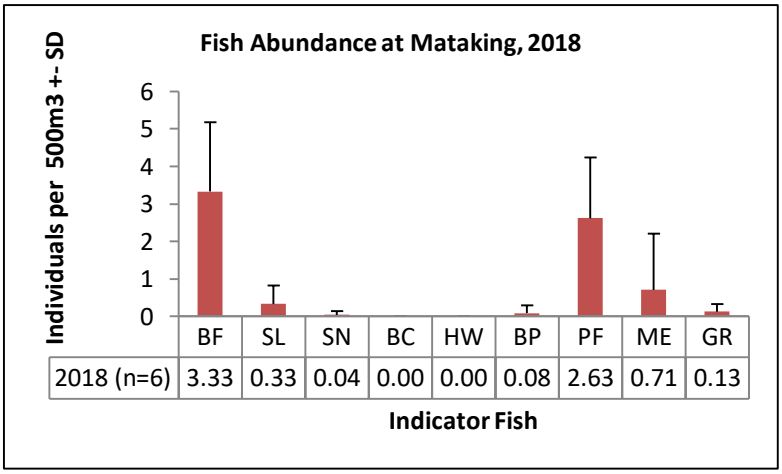
Substrate



The reefs around the island were considered to be in 'Poor' condition, with 23.02% live coral cover, below the average (36.36%) in the North Borneo region.

While the level of RB has decreased considerably, the level of SD has increased considerably. NIA level has also increased slightly.

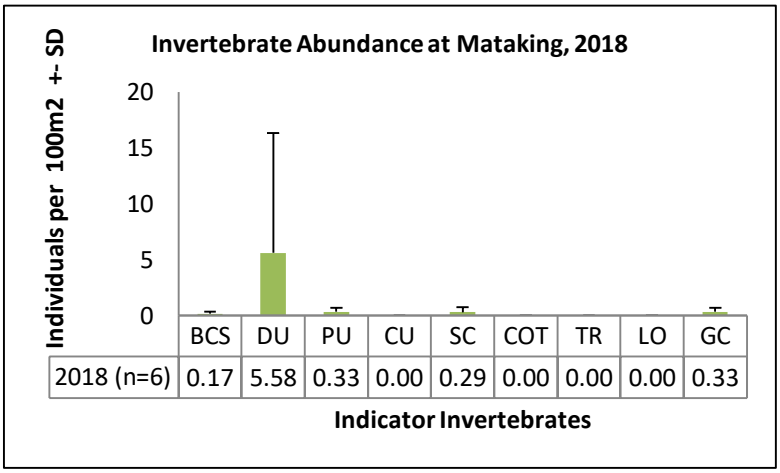
Fish



Only two indicator fish were absent during the surveys (Barramundi Cod and Humphead Wrasse).

The abundance of Butterflyfish was the highest, followed by Parrotfish. Other indicator fish were present in low numbers, less than 1 ind./500m^3, including Sweetlips, Snapper, Moray Eel and Grouper.

Invertebrates



Three indicators were absent from surveys (Collector Urchin, Triton and Lobster).

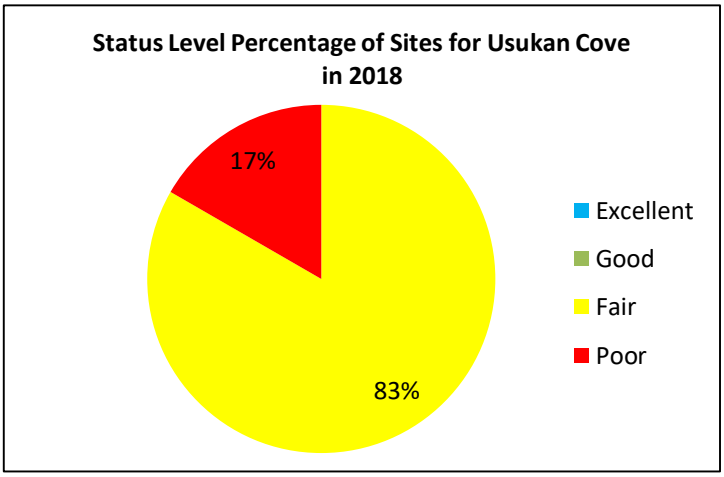
The abundance of Diadema was the highest. Abundance of other indicator was very low, less than 1 ind./100m^2.

Boat anchor damage, fish bombing, discarded fishing nets and damages by divers and snorkelers were recorded during surveys. On a positive note, turtles were observed during surveys.

3.2.19 Usukan Cove

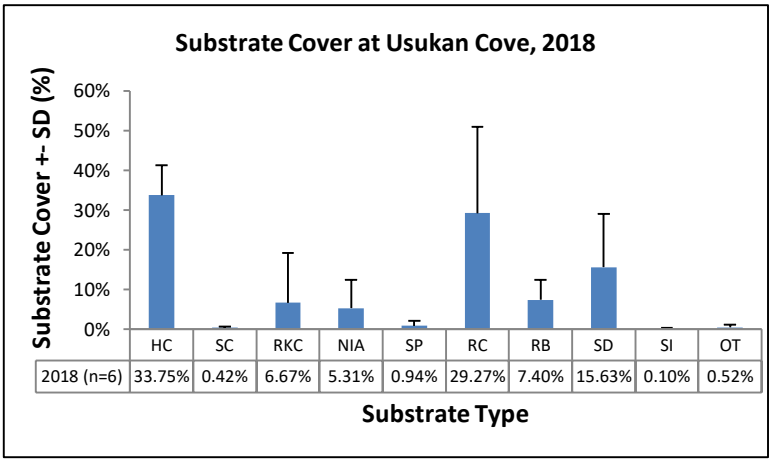
Usukan Cove is located on the North West coast of Sabah approximately half way between Kota Kinabalu and Kudat, in a district called Kota Belud, just beside Kampung Kuala Abai where the jetty to Mantanani Island is situated. Diving and snorkelling as well as fishing are the main activities offered in Usukan Cove.

Map 22: Surveyed sites in Usukan Cove



A total of 6 coral reef sites were surveyed in Usukan Cove and 83% of the reefs were in fair condition. The remaining 17% were in poor condition.

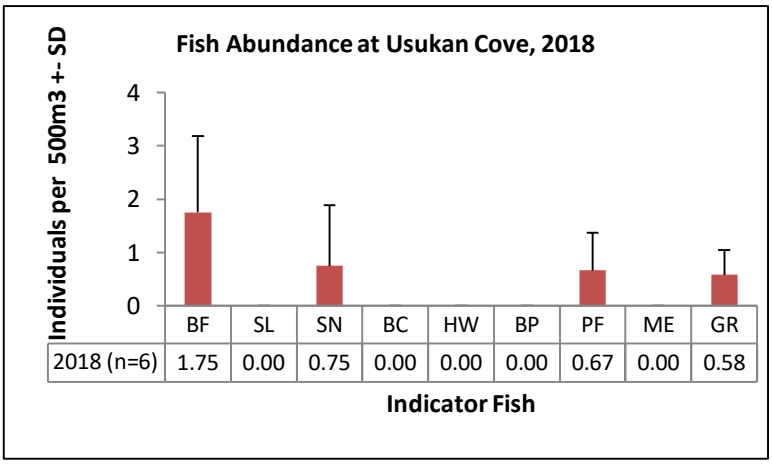
Substrate



Reefs in Usukan Cove are considered to be in 'Fair' condition with 34.17% live coral cover, slightly below the average (36.36%) for North Borneo region.

RB level is high at 7.40% and the site of most concern is NB3.1 Usukan Cove Lodge (15%). RB level at NB3.2 Uban-Uban is also high at 10%. SI level has decreased significantly from 11.46% in 2017 to 0.1% in 2018.

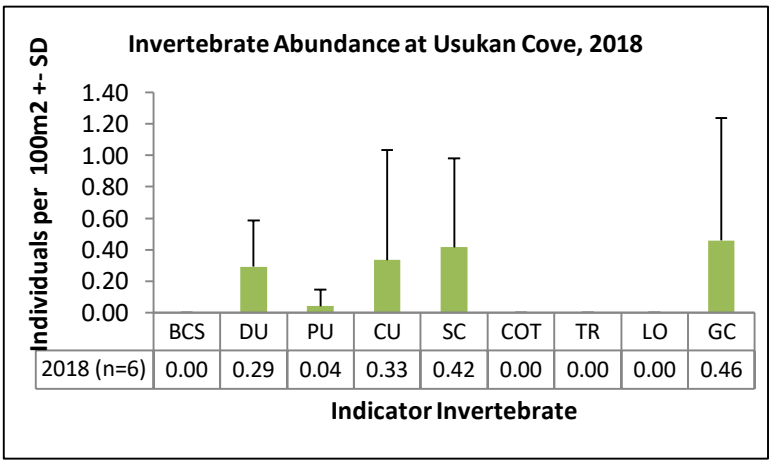
Fish



Five indicator fish were absent from surveys (Sweetlips, Barramundi Cod, Humphead Wrasse, Bumphead Parrotfish and Moray Eel).

Other indicator fish were present in low abundance.

Invertebrates



Five indicator invertebrates were observed during surveys (Diadema, Urchin, Pencil Urchin, Collector Urchin, Sea Cucumber and Giant Clam) and their abundance was low.

All survey sites were either affected by boat anchor damage, dynamite fishing, siltation, storm, discarded fishing net, trash or warm water bleaching. Impact from cyanide fishing was recorded at NB3.4 Poduko.

3.2.20 Mantanani

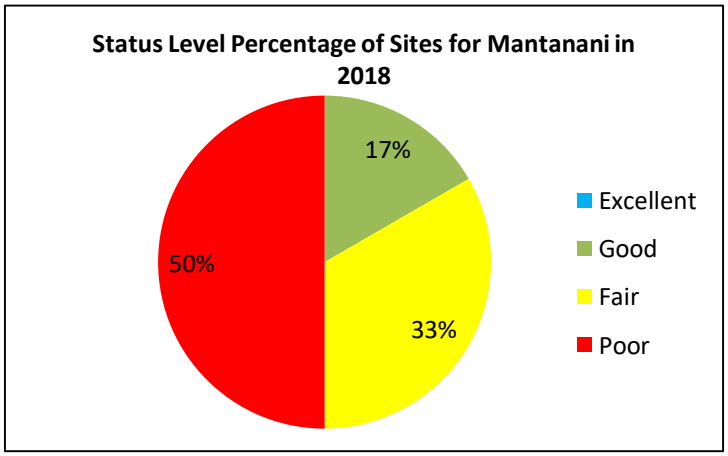
The Mantanani archipelago is located some 30km off the north-west coast of the state of Sabah, opposite the town of Kota Belud. The largest island is Mantanani Besar; the other two are Mantanani Kecil and Linggisan.

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.

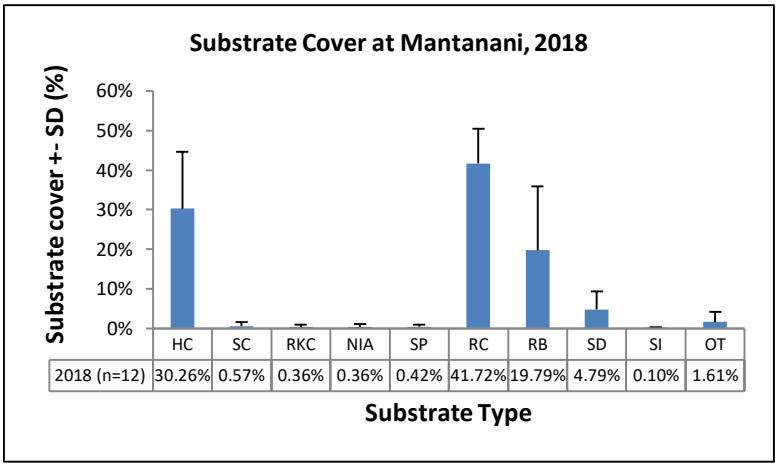
Fish bombing is a major problem in the area. This destructive fishing method has damaged large areas of reef around the islands.

Map 23: Surveyed sites in Mantanani



A total of 12 coral reef sites were surveyed in Mantanani islands and 17% of the reefs were in good condition. 33% were in fair condition and the remaining 50% of the reefs were in poor condition. No reefs were in excellent condition.

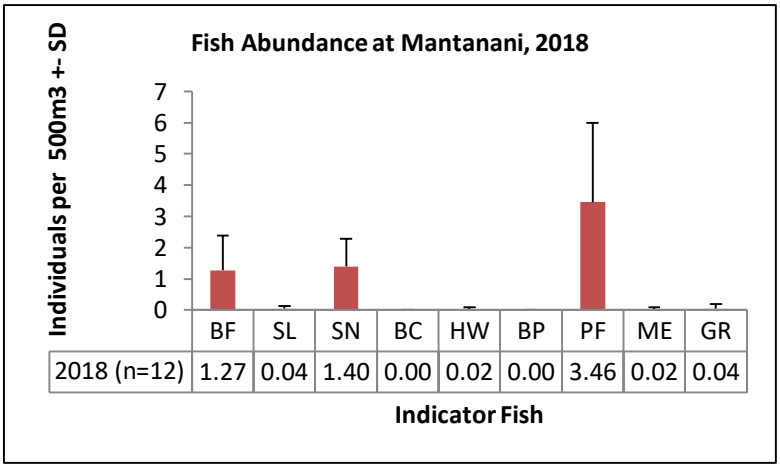
Substrate



Coral reefs around Mantanani islands are considered to be in 'Fair' condition, with 30.83% live coral cover, below the average (36.36%) for reefs in the North Borneo region.

The level of HC has dropped quite significantly from 39.74% in 2017 to 30.26% in 2018 while the level of RC has increased from 33.59% in 2017 to 41.72% in 2018. The level of RB is high at 19.79%, with most sites recorded 10-50%. Fish bombing was likely to have caused the damage as dynamite dishing impact was recorded at many sites.

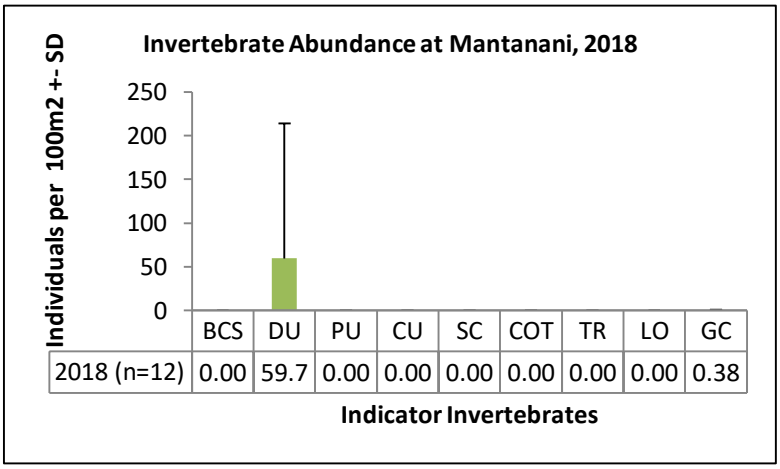
Fish



Only two indicator species were absent from surveys (Barramundi Cod and Bumphead Parrotfish).

The abundance of Parrotfish was the highest, followed by Snapper and Butterflyfish. All indicators were present in low number. These islands are not gazetted as a Marine Protected Area and are impacted by fishing pressure and destructive fishing method (fish bombing).

Invertebrates



Banded Coral Shrimp, Pencil Urchin and Triton which are targeted for curio trade were not recorded during surveys. Collector Urchin, Sea Cucumber and Lobster which are targeted for food was also absent from the surveys.

Abundance of Diadema Urchin was high. Giant Clam was present in very low numbers, less than 1 ind./100m^2.

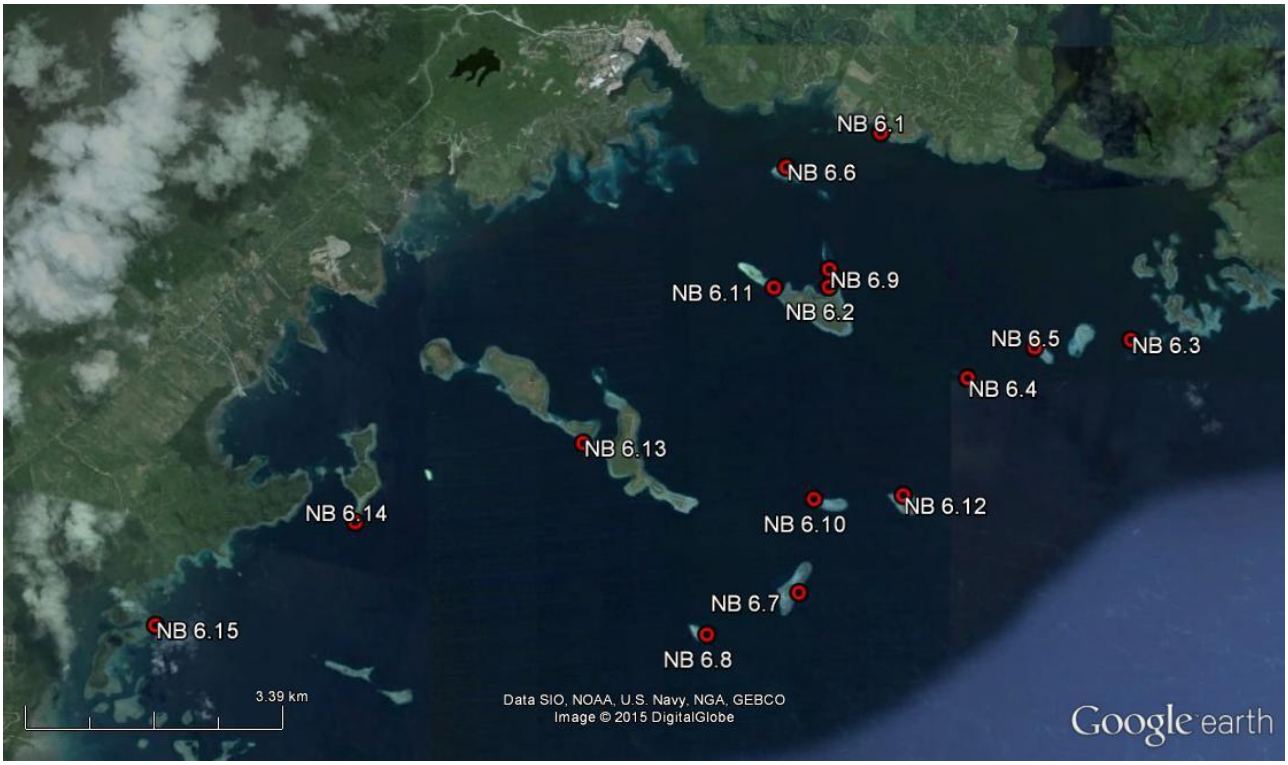
Extensive human impacts were seen on most of the reefs; boat anchor damage, dynamite fishing impact, siltation, discarded fishing nets and trash. Damage due to bleaching was also observed at many sites. On a positive note, shark and turtle were observed during surveys.

3.2.21 Lahad Datu

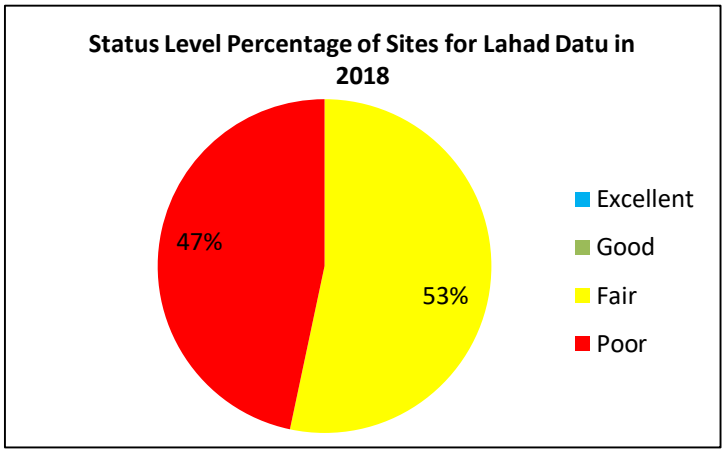
Lahad Datu is a town located in the east of Sabah, Malaysia, on the island of Borneo. It occupies the peninsula on the north side of Darvel Bay – the largest semi-enclosed bay on the east coast of Borneo islands. Administratively, it falls within the Tawau Division and is estimated to have a population 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.

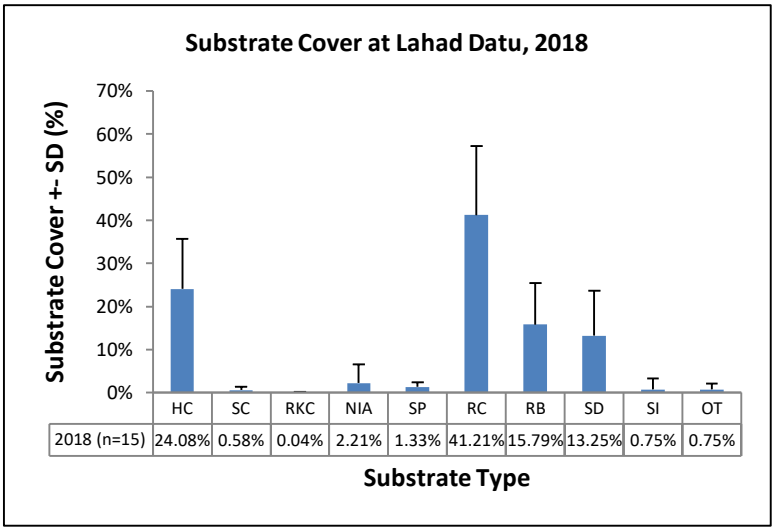


Map 24: Surveyed sites in Lahad Datu



A total of 15 coral reef sites were surveyed in Lahad Datu and 53% of the reefs were in fair condition. The remaining 47% were in poor condition. No reefs were in excellent and good condition.

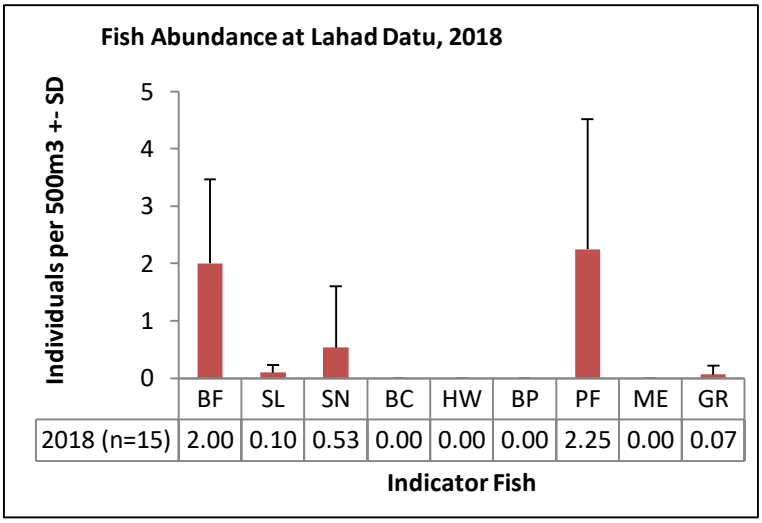
Substrate



Reefs in Lahad Datu are considered to be in 'Poor' condition with live coral cover of 24.67%, below the average (36.36%) for reefs in the North Borneo region.

HC cover has dropped from 30.42% in 2017 to 24.08% in 2018. While the level of RB has decreased, the level of NIA has increased. The decrease in HC cover and increase in NIA level are due to sedimentation and pollution which are recorded at almost all survey sites.

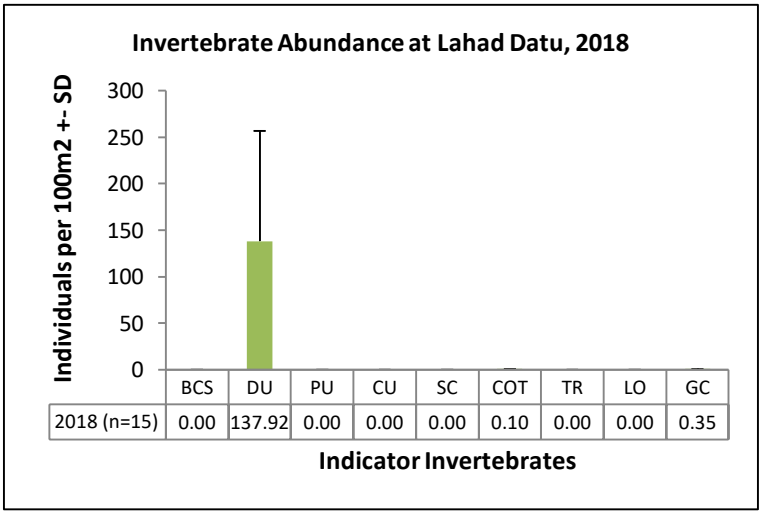
Fish



Only two indicator fish were absent during surveys (Barramundi Cod and Moray Eel).

Parrotfish recorded the highest number, followed by Butterflyfish and Snapper. Other indicators were present in very low numbers, less than 1 ind./500m^3.

Invertebrates



Only three indicator invertebrates were present during surveys, Diadema Urchin, Crown-of-thorns and Giant Clam.

The abundance of Diadema Urchin was high and the highest of all islands surveyed in North Borneo region.

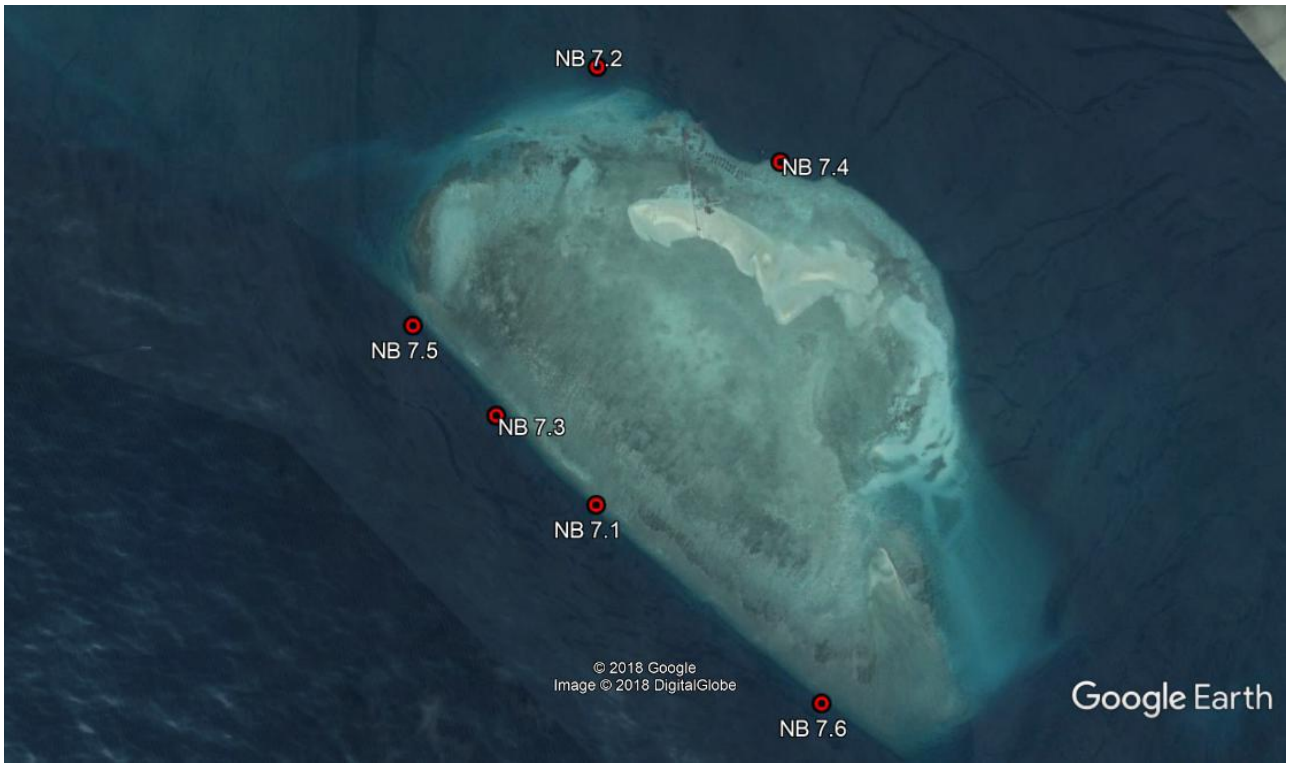
The abundance of Crown-of-thorns has reduced from last year and is now within what a healthy reef can sustain (0.2-0.3 ind./100m^2).

Discarded fishing nets, fish cages, trash, pollution and high amount of sediments in the water column were recorded on many of the survey sites.

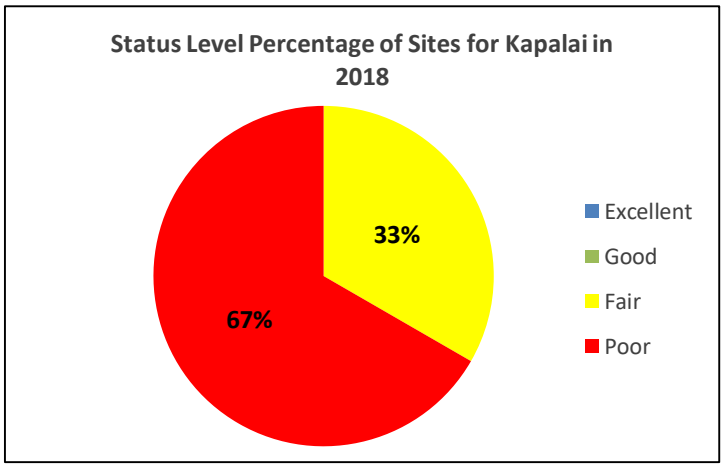
3.2.22 Kapalai

Kapalai Island is located near Semporna, Sabah and is 15 kilometres from Sipadan Island. Though it is called an island, it is actually a sandbar situated on Ligitan Reef. Kapalai used to be a real island with vegetation but erosion over the last few hundred years has reduced the island to sea level. All of the buildings are on stilts resting on the underwater reef.

Kapalai is mostly known for its scuba diving. There is only one private resort on the island while the rest of the island is uninhabited.

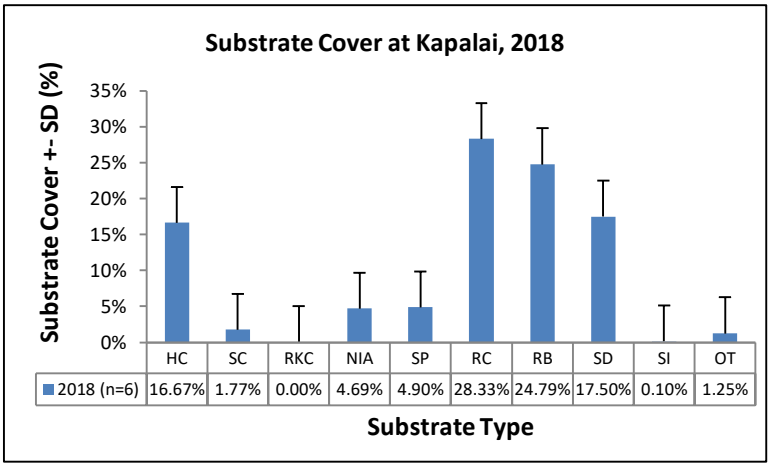


Map 25: Surveyed sites in Kapalai Island



A total of 6 coral reef sites were surveyed in Kapalai Island and 33% of the reefs were in fair condition. The remaining 67% were in poor condition.

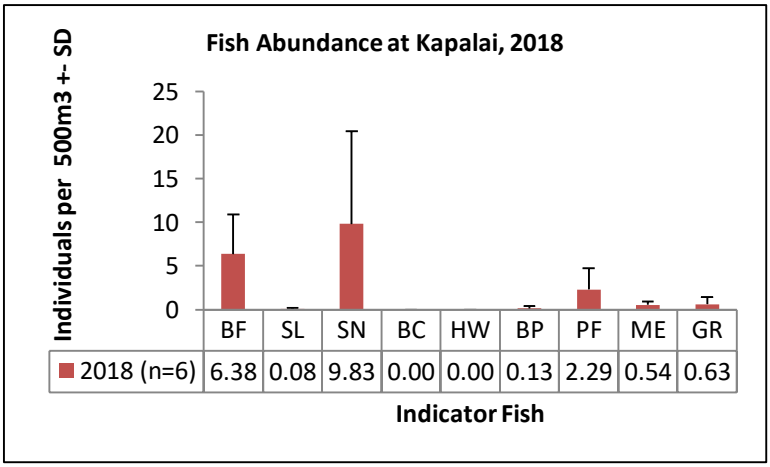
Substrate



Reefs in Kapalai were considered to be in 'Poor' condition with 18.44% live coral cover and were way below the average (36.36%) for North Borneo Region.

The level of RB has increased from 19.53% in 2017 to 24.79% in 2018. This indicates recent disturbances in the area.

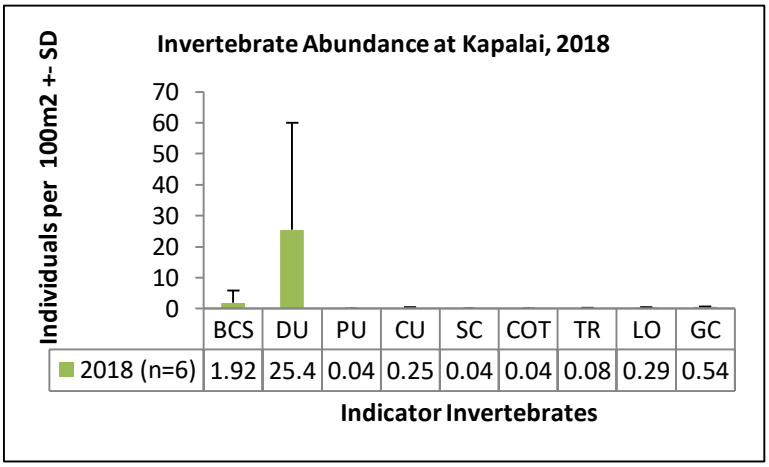
Fish



Only two fish were absent during surveys (Barramundi Cod and Humphead Wrasse).

The most abundant fish was Snapper, followed by Butterflyfish and Parrotfish. Other indicators such as Sweetlips, Bumphead Parrotfish, Moray Eel and Grouper were present in low number.

Invertebrates



All indicators were present during surveys and the abundance of Diadema Urchin was the highest.

The abundance of other indicators was very low, less than 1 ind./100m^2, except for Banded Coral Shrimp.

Kapalai recorded the highest number of Banded Coral Shrimp of all islands surveyed in North Borneo region

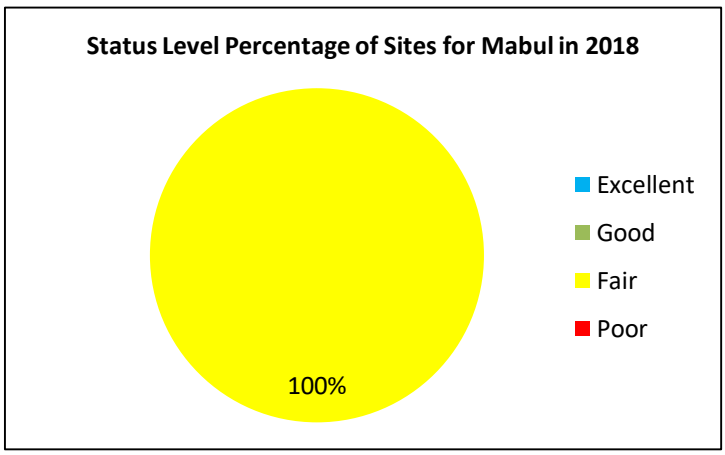
Human impacts such as boat anchor damage, dynamite fishing and trash were recorded at many sites. Natural impact such as warm water bleaching was also recorded. On a positive note, many turtles were recorded during surveys.

3.2.23 Mabul

Mabul is a small island off the south-eastern coast of Sabah. The island has been a fishing village since the 1970s. In the 1990s, it first became popular to divers due to its proximity to Sipadan Island. Located 15 km from Sipadan, this 20-hectare piece of land surfaces 2–3 m above sea level, consists mostly flat grounds and the aerial view is oval-shaped. Surrounding it are sandy beaches, perched on the northwest corner of a larger 2 km^2 reef. The reef is on the edge of the continental shelf and the seabed surrounding the reef slopes out to 25 to 30 m deep.

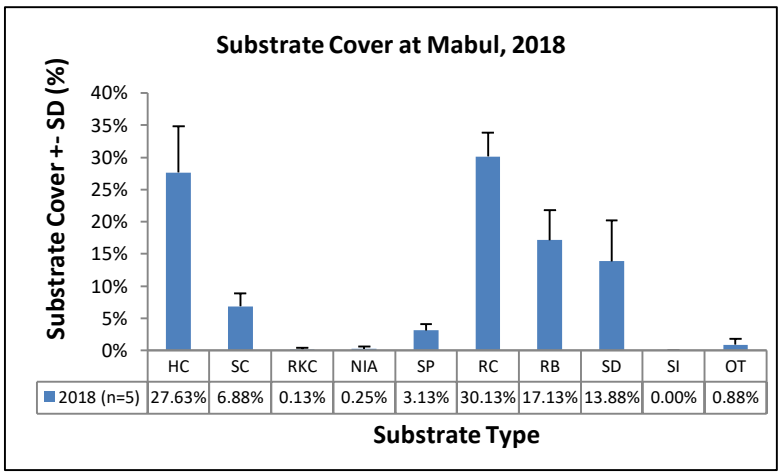
There are several dive resorts operating on Mabul Island, which provides accommodation for scuba divers - most located on the island or on stilts over the water, while one is on a converted oil platform about 500 meters from the beach. There are also several home stay and backpacker accommodations which also arrange diving trips.

Map 26: Surveyed sites in Mabul



A total of 5 coral reef sites were surveyed in Mabul and 100% of the reefs were in fair condition.

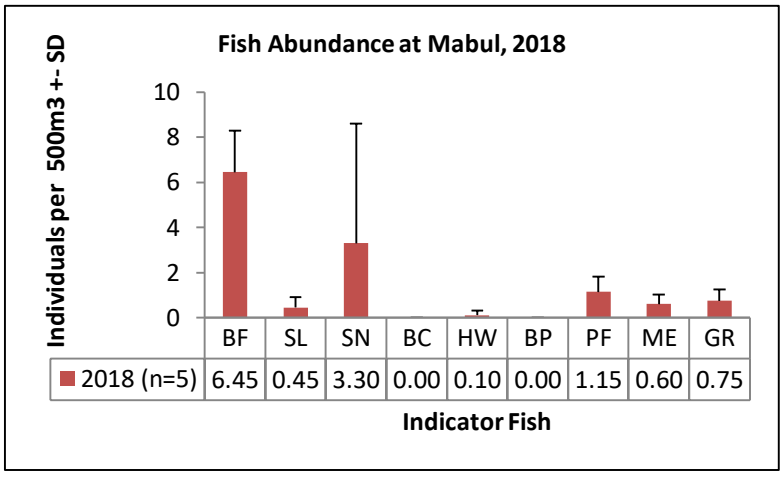
Substrate



Reefs in Mabul were considered to be in 'Fair' condition with 34.50% live coral cover and were slightly below the average (36.36%) for North Borneo Region.

The high level of RB was likely due to the ongoing practice of fish bombing within the region. All sites recorded more than 10% RB.

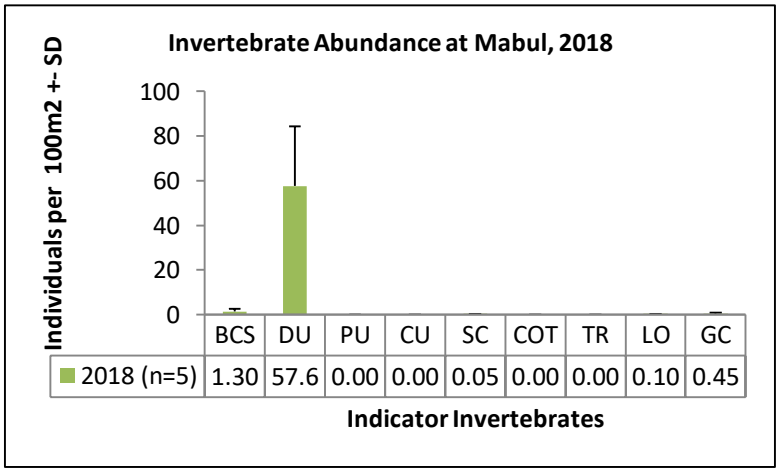
Fish



The abundance of Butterflyfish was the highest, followed by Snapper and Parrotfish. Sweetlip, Moray Eel and Grouper were recorded in low number.

Humphead Wrasse was also recorded but in low number.

Invertebrate



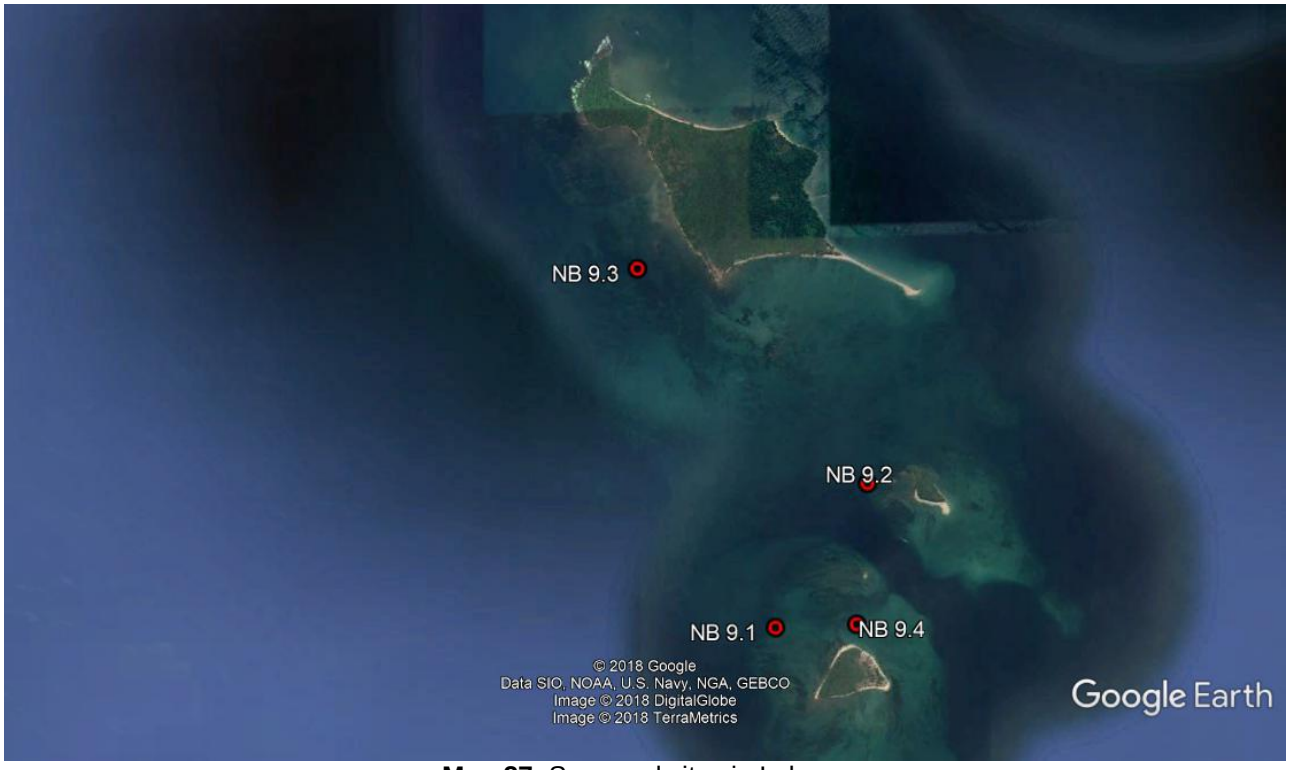
Five indicator invertebrates were observed during surveys. Abundance of Diadema Urchin was high. The abundance of other indicators was very low.

Damage by human and natural impacts was observed during surveys. Signs of coral damage due to boat anchor, dynamite fishing, trash and discarded fishing nets were seen at few sites. Three sites were impacted by Drupella predation. On a positive note, turtles were recorded at many sites during surveys.

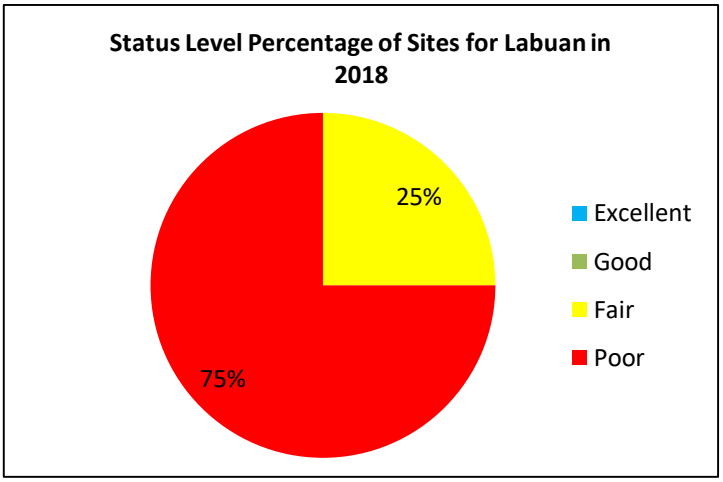
3.24 Labuan

Labuan, officially the Federal Territory of Labuan, is a federal territory of Malaysia. Labuan is made up of one large island and six smaller islands (Pulau Daat, Pulau Burung, Pulau Kuraman, Pulau Papan, Pulau Rusukan Besar and Pulau Rusukan Kecil), and is located off the west coast of Sabah. Labuan is best known as an offshore financial centre offering international financial and business services since 1990 as well as being an offshore support hub for deepwater oil and gas activities in the region. It is also a tourist destination for people travelling through Sabah and for scuba divers.

Three out of the six smaller islands form the Labuan Marine Park; they are Pulau Kuraman, Pulau Rusukan Besar and Pulau Rusukan Kecil. These three islands are located 2km off the southern part of Labuan Main Island. These islands are sparsely populated and are popular with expatriates, divers and those who travel between Labuan and Brunei.

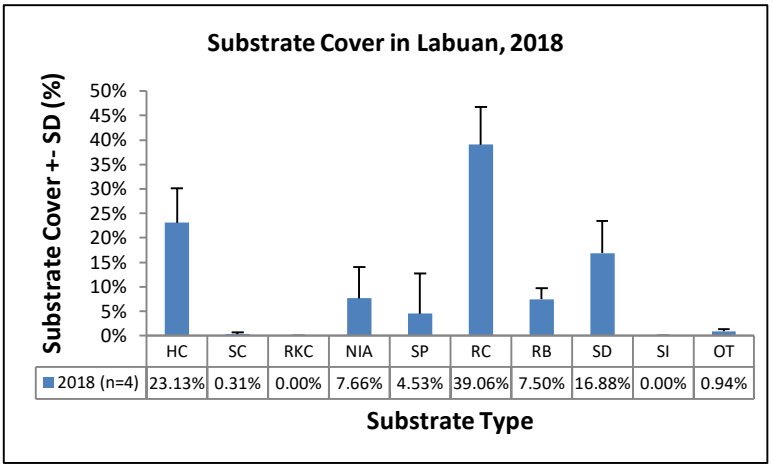


Map 27: Surveyed sites in Labuan



A total of 4 coral reef sites were surveyed in Labuan and 25% of the reefs were in fair condition while the remaining 75% were in poor condition.

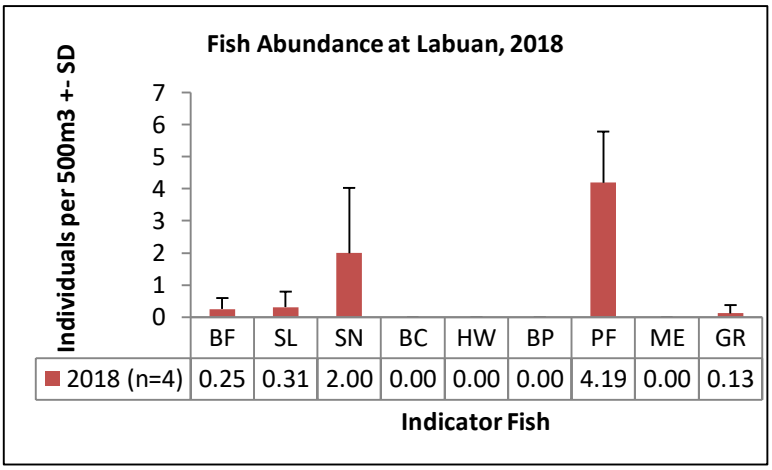
Substrate



Coral reefs in Labuan were considered to be in 'Poor' condition with 23.44% live coral cover and below the average (36.36%) of reefs within the North Borneo region.

The level of NIA and RB was high, indicating high level of recent disturbances in the area.

Fish

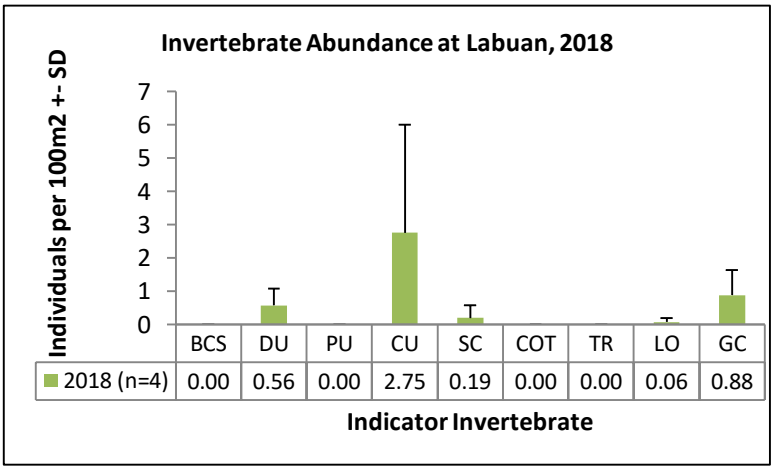


Parrotfish was the most abundant indicator recorded during surveys, followed by Snapper.

Butterflyfish, Sweetlips and Grouper were present in low numbers, less than 1 ind./500m^3.

Highly prized fish such as Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were absent.

Invertebrate



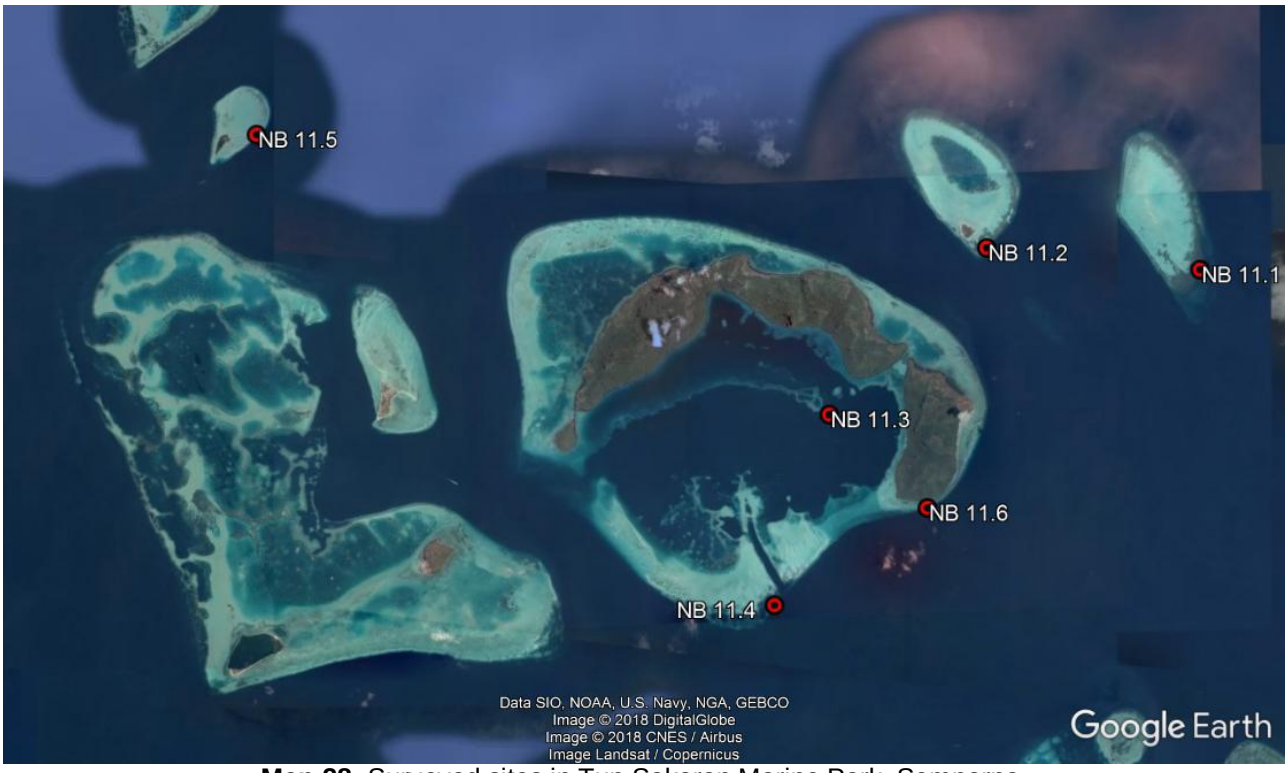
Collector Urchin was the most abundant indicator recorded. The abundance of Diadema Urchin, Sea Cucumber, Lobster and Giant Clam was low.

Boat anchor damage was observed during surveys.

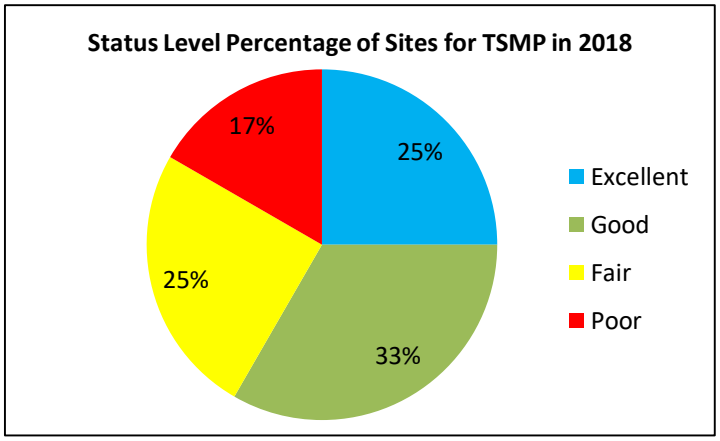
3.2.25 Tun Sakaran Marine Park, Semporna

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.

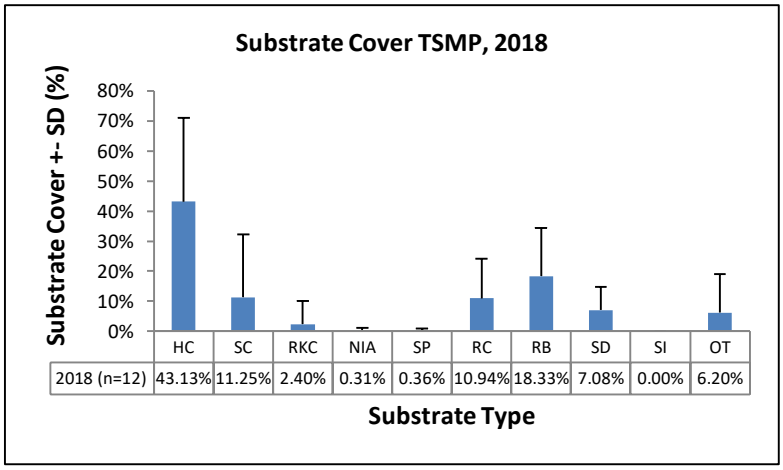


Map 28: Surveyed sites in Tun Sakaran Marine Park, Semporna



A total of 12 coral reef sites were surveyed in TSMP and 25% of the reefs were in excellent condition. 33% were in good condition and 25% were in fair condition. The remaining 17% were in poor condition.

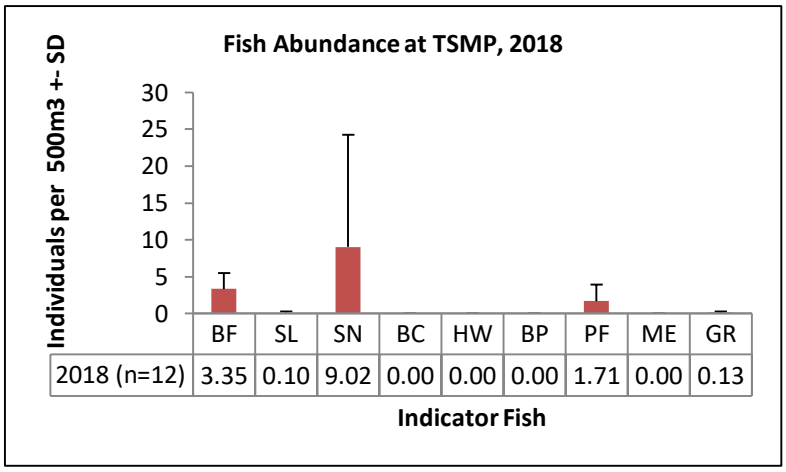
Substrate



Coral reefs within the TSMP were considered to be in 'Good' condition with 54.38% live coral cover, above the average (36.36%) for reefs within the North Borneo region.

The level of RB has decreased significantly from 28.65% in 2017 to 18.33% in 2018. However, the level is still considered high and four of the sites recorded more than 25% RB.

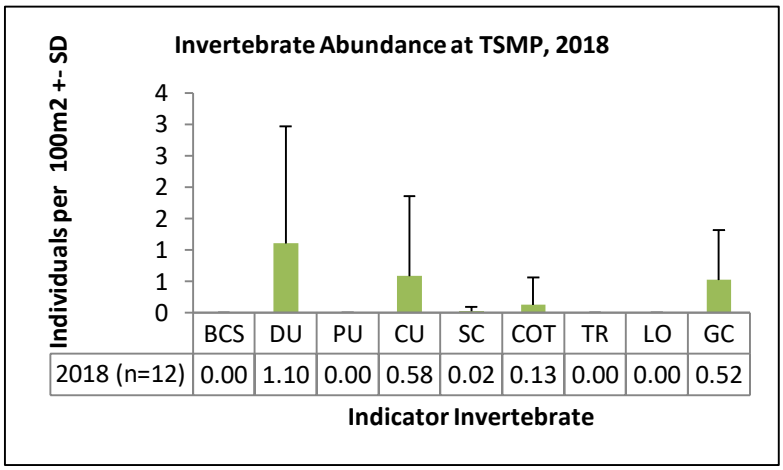
Fish



Snapper was the most abundant indicator fish recorded during surveys, followed by Butterflyfish and Parrotfish.

Barramundi Cod, Humphead Wrasse and Bumphead Parrotfish were absent during surveys while other indicators were present in low numbers.

Invertebrates



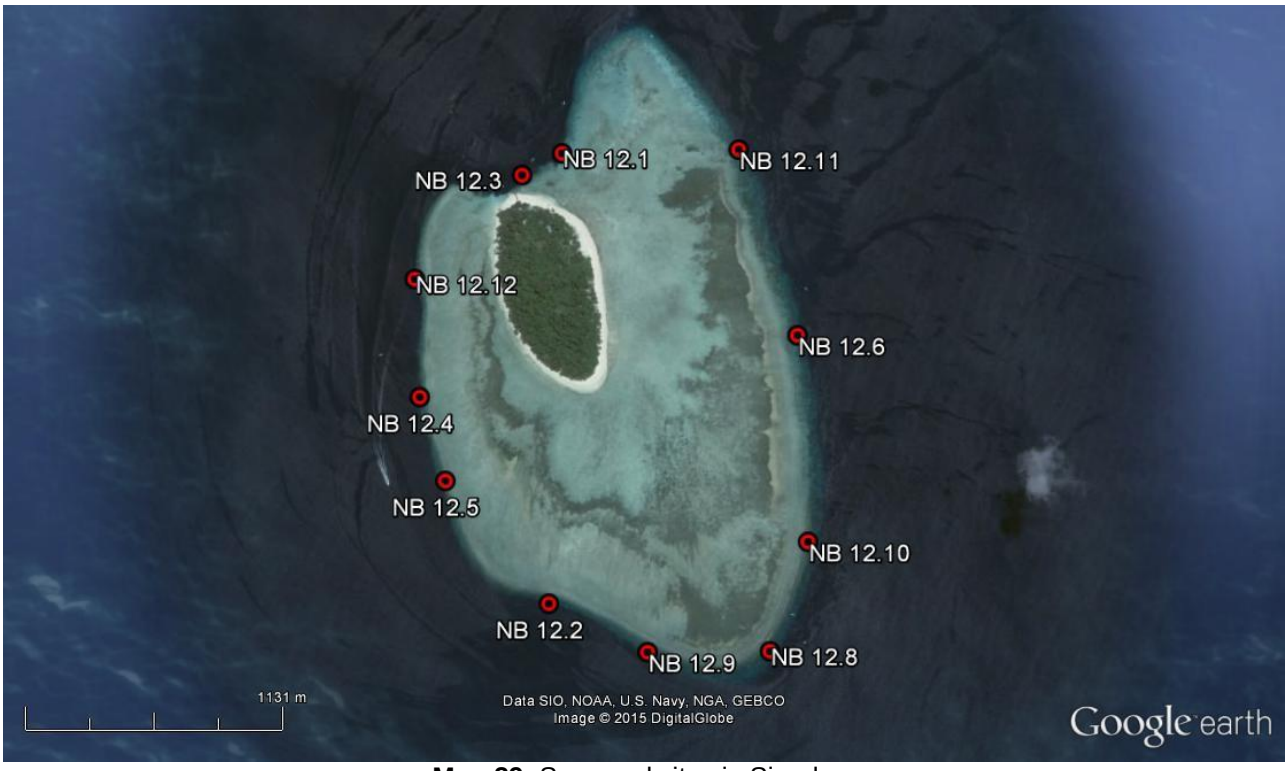
All indicators were recorded in low abundance.

Boat anchor damage, damage from dynamite fishing, storm, tourism and sedimentation were recorded. On a positive note, turtle was observed during the surveys.

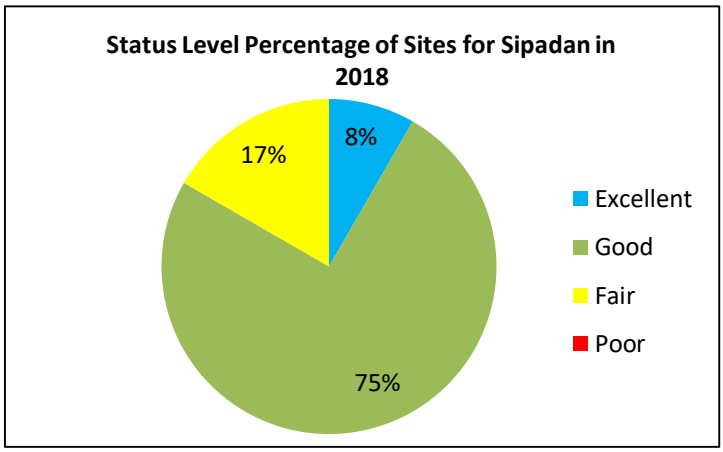
3.2.26 Sipadan

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

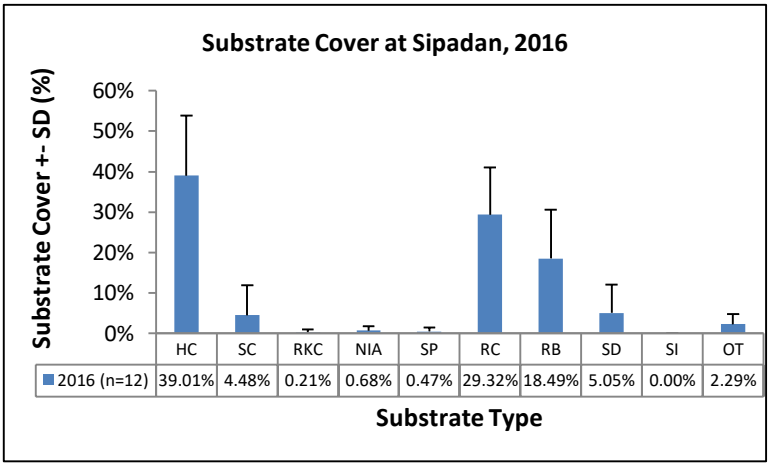


Map 29: Surveyed sites in Sipadan



A total of 12 coral reef sites were surveyed in Sipadan and 75% of the reefs were in good condition. 17% were in fair condition and the remaining 8% were in excellent condition. No reefs were in poor condition.

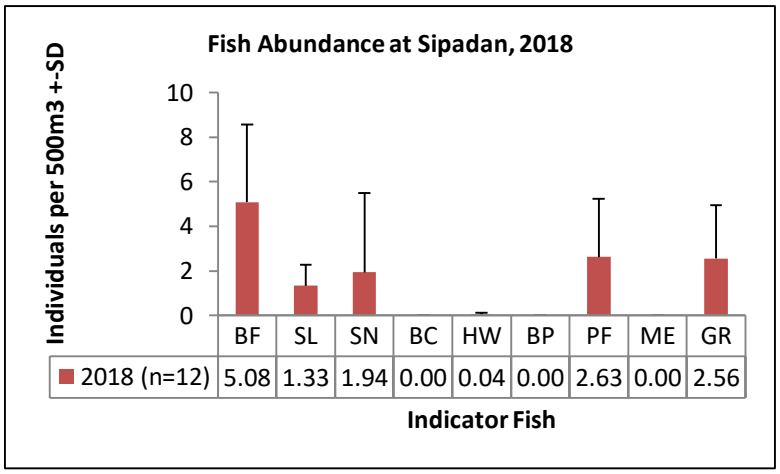
Substrate



Coral reefs within the Sipadan were considered to be in 'Good' condition with 62.40% live coral cover and above the average (36.36%) of reefs within the North Borneo region.

RB level had decreased compared to last year (18.49%), however the level is still high at 14.27%. Seven sites recorded 10-40% RB. The level of RB at Sipadan need to be monitored closely.

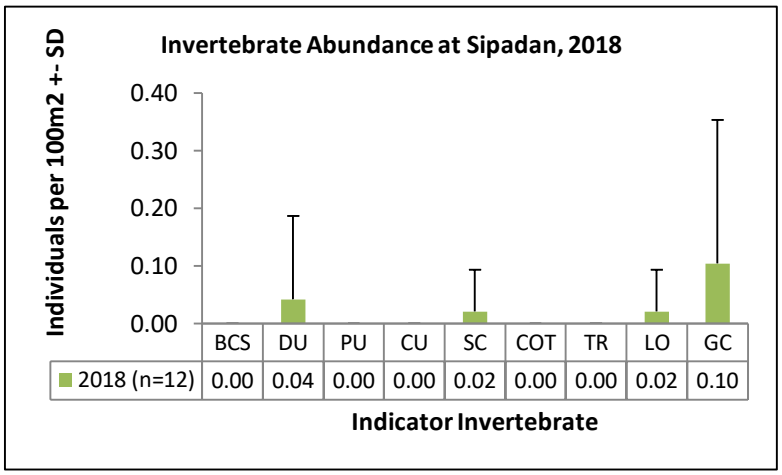
Fish



Butterflyfish was the most abundant indicator recorded during surveys, followed by Parrotfish and Grouper.

Barramundi Cod, Bumphead Parrotfish and Moray Eel were absent during surveys. Other indicators such as Sweetlips and Snapper were present in low number.

Invertebrate



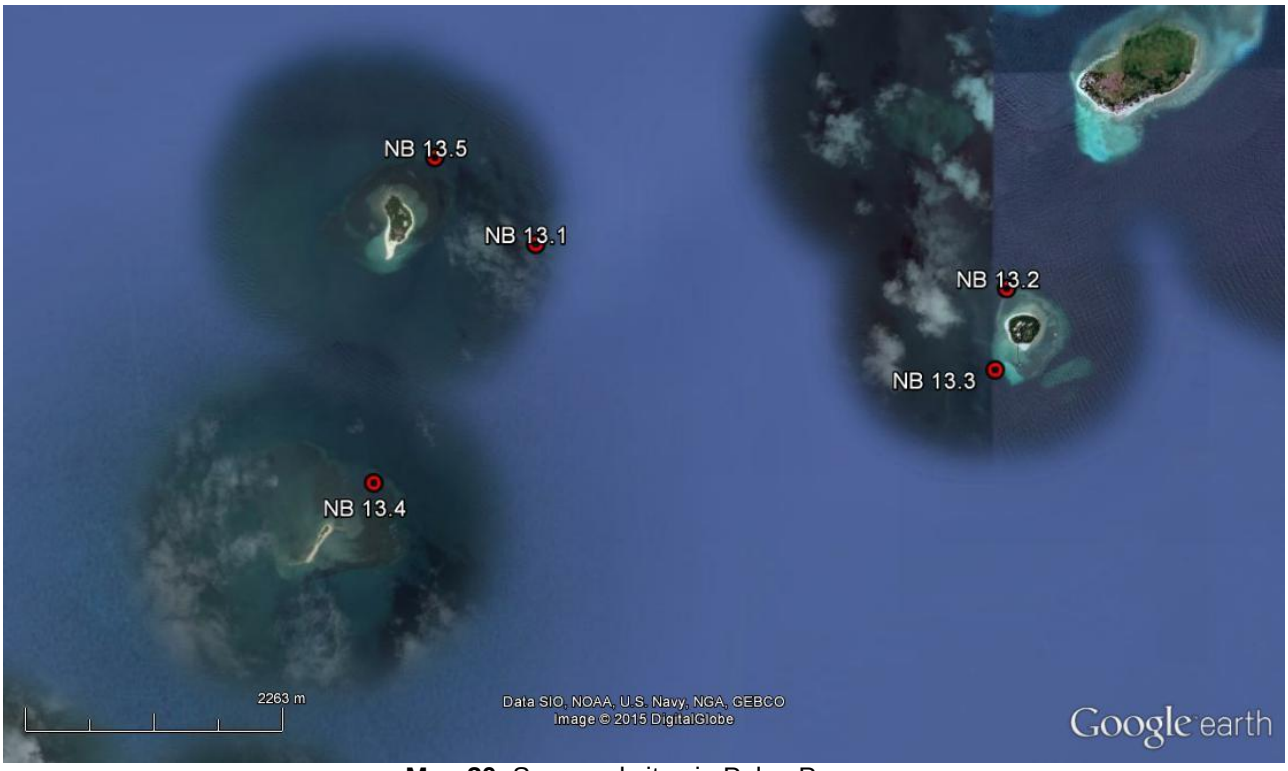
All indicator invertebrates were present in very low abundance, less than 1 ind./100m^2.

Turtle and shark were recorded at many sites during surveys.

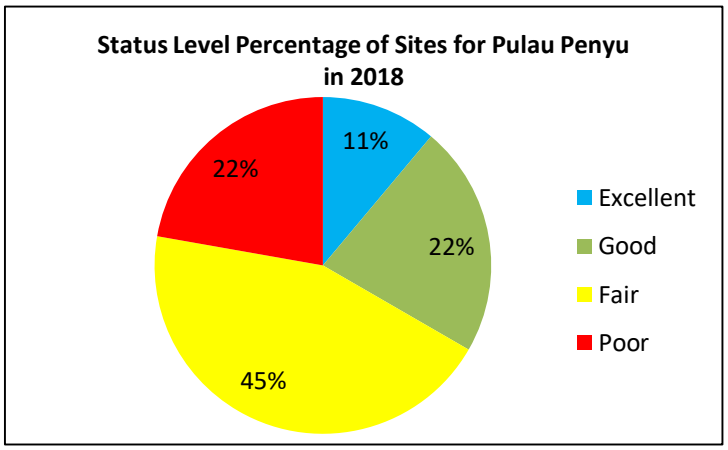
3.2.27 Pulau Penyu

Pulau Penyu lies in the Sulu Sea some 40km north of Sandakan, Sabah. It comprises of three islands; Pulau Selingan, Pulau Bakungan Kecil and Pulau Gulisan. The park gained its popularity from the green and hawksbill turtles which lay their eggs on the beaches of the islands. All the three islands are protected within marine parks on both sides of the Malaysian and Philippine borders. The park covers an area of 17.4km^2 and administered by Sabah Parks.

Only on Selingan are there chalets for overnight visitors, and those who wish to see the turtles laying eggs must stay overnight. However, park rules and regulations are strictly enforced and visitors are not allowed on the beach from sunset to sunrise so as not to disturb the turtles. A ranger will call all visitors to observe only one turtle laying eggs per night.

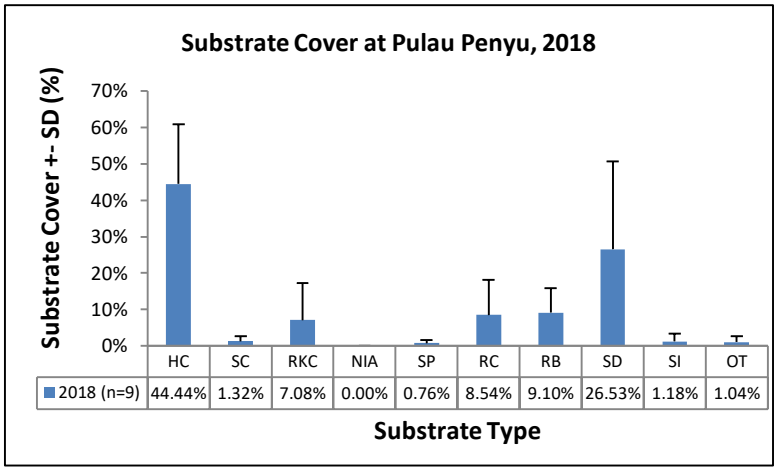


Map 30: Surveyed sites in Pulau Penyu



A total of 9 coral reef sites were surveyed in Pulau Penyu and 11% of the reefs were in excellent condition. 22% were in good condition and 45% were in fair condition. The remaining 22% were in poor condition.

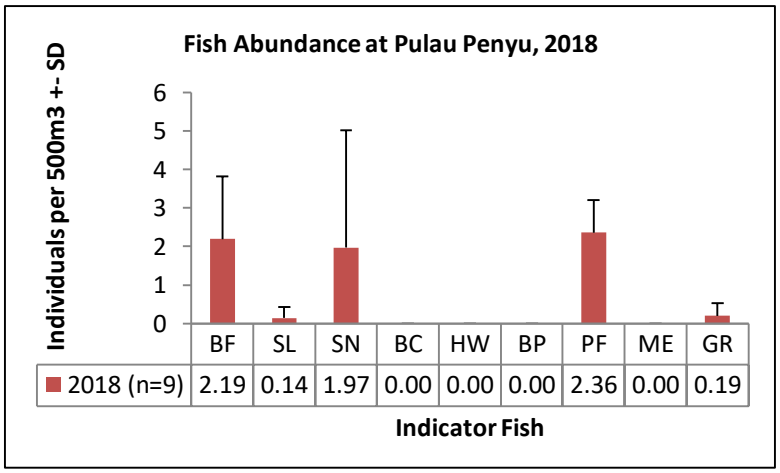
Substrate



Coral reefs in Pulau Penyu were considered to be in 'Fair' condition with 45.76% live coral cover and above the average (36.36%) of reefs within the North Borneo region.

The level of SD had increased a lot from 19.10% in 2017 to 26.53% in 2018. The level of RB on the other hand had decreased from 13.13% in 2017 to 9.1% in 2018.

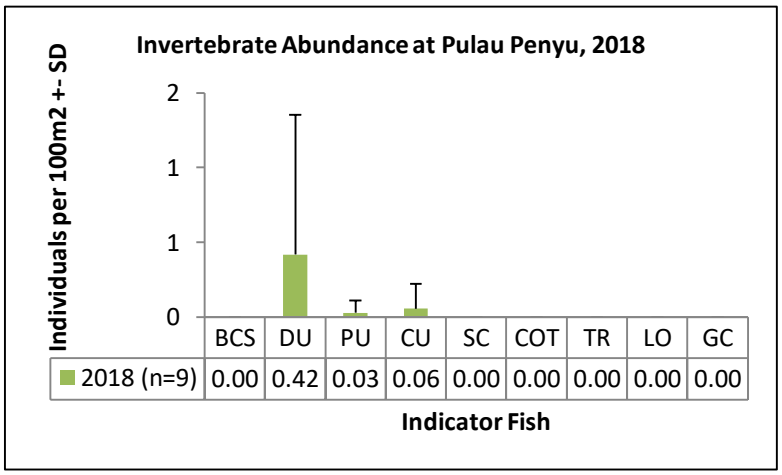
Fish



Parrotfish was the most abundant indicator recorded during surveys, followed by Butterflyfish and Snapper.

Sweetlips and Grouper were present in low number. Highly prized fish such as Humphead Wrasse and Bumphead Parrotfish were not recorded.

Invertebrate



Only three indicator invertebrates were observed during surveys, including Diadema Urchin, Pencil Urchin and Collector Urchin.

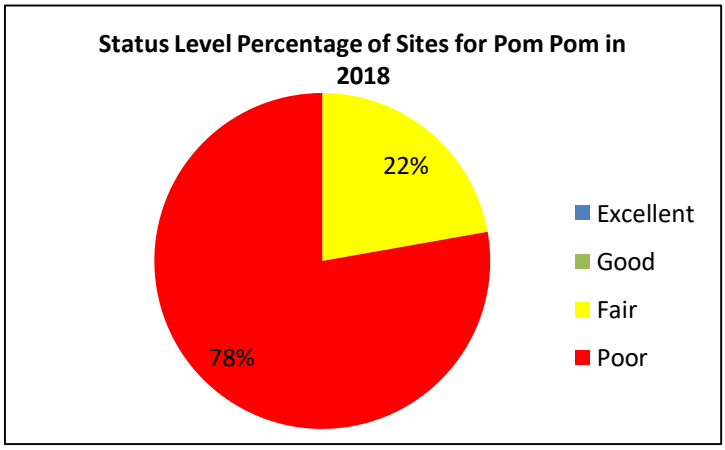
Human impact was very low and only recorded at one site. Rare animals

3.2.28 Pom Pom

Pom Pom Island is a small coral reef island approximately 30km North East of Semporna, Sabah. The island is 2.3km in circumference at the high tide line with a fringing coral reef 4km long. The island is flat sand with a maximum elevation of less than 2m above the high tide line. The reef flat is only 50-75m wide to the west and several hundred metres wide around most of the island. The island has a white sand coral beach and is a significant nesting location site for Green and Hawksbill turtles.

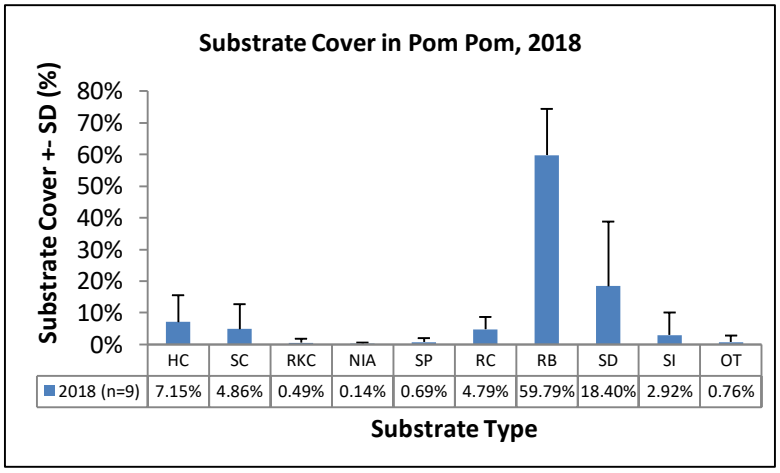
Pom Pom Island is one of the popular dive destinations in the Semporna district. The island has no village, only one resort and one research centre. There is no public transport to the island, the resorts carry their own guests and the research centre arranges transportation for its own students and volunteers. There are occasional day trips from dive centres in Semporna. The boat trip, by speedboat, takes about 35–60 minutes depending on weather.

Map 31: Surveyed sites in Pom Pom



A total of 9 coral reef sites were surveyed in Pom Pom and 22% of the reefs were in fair condition. The remaining 78% were in poor condition. No reefs were in good and excellent condition.

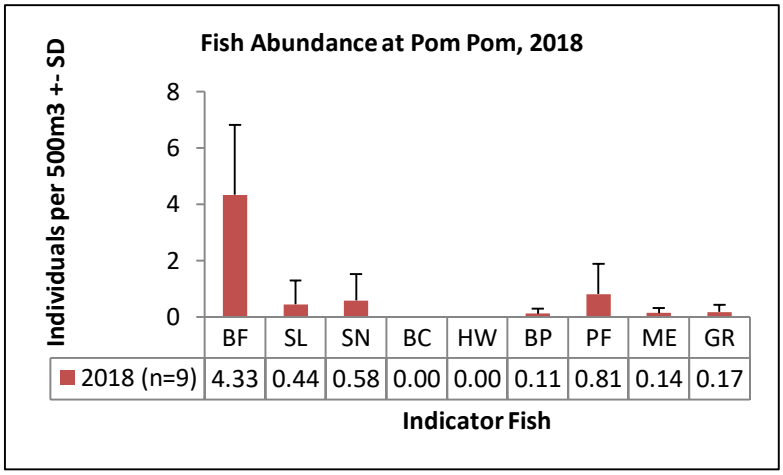
Substrate



Coral reefs in Pom Pom were considered to be in 'Poor' condition with 12.01% live coral cover and way below the average (36.36%) of reefs within the North Borneo region.

The island has very high level of RB with all sites (except two) recorded more than 50% RB. Some sites recorded over 75% RB. The islands have been extensively damaged by fish bombing in the past, and fish bombing continues in some areas nearby.

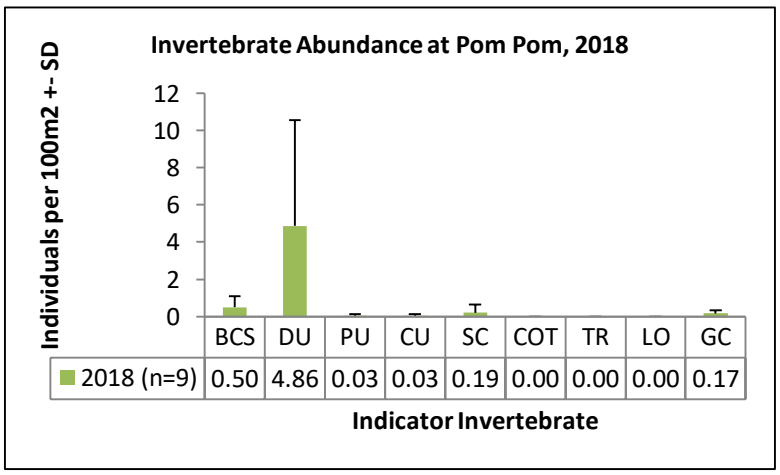
Fish



Butterflyfish was the most abundant indicator recorded during surveys.

Sweetlips, Snapper, Parrotfish, Moray Eel and Grouper were present in low number, less than 1 ind./500m^3. Bumphead Parrotfish was recorded during surveys too.

Invertebrate



Six indicator invertebrates were observed during surveys: Banded Coral Shrimp, Diadema Urchin, Pencil Urchin, Collector Urchin, Sea Cucumber and Giant Clam. Their abundance was recorded in low number, less than 1 ind./100m^2, except for Diadema Urchin.

Boat anchor damage, dynamite fishing, trash, discarded fishing nets and warm water bleaching were recorded during surveys. On a positive note, turtles were recorded at all sites.

4. Twelve Years of Reef Check Data

Reef Check data are primarily used for monitoring coral reef health and comparisons of data over time can highlight significant changes and indicate potential problems. This section reviews data collected over the last 12 years to assess changes to Malaysia's reefs over the period.

4.1 Peninsular versus East Malaysia over 12 years

The charts below show changing substrate cover, fish and invertebrate abundance over the last 12 years, separated into Peninsular Malaysia and East Malaysia.

4.1.1 Substrate

As stated in section 3.1.1, LCC can be used as a broad indicator of coral reef health. Data from surveys conducted around Peninsular Malaysia over the last 12 years show that there has been some variation in coral reef health.

The decline in LCC from 2009 to 2011 probably reflects the impact of the major bleaching event that happened in 2010. In 2012, LCC in Peninsular Malaysia showed a substantial recovery. This is mirrored by concomitant changes in level of RKC, showing a significant increase in 2010 and decrease in 2012. The level of LCC maintained more or less the same from 2013 to 2015. From 2015 to 2018, LCC dropped slightly mainly due to increase in the amount of NIA, RB and RKC, all indicators of recent disturbances to reefs. The 2016 El Nino phenomenon and bleaching event might also contribute to the drop.

From 2007 to 2012, the level of NIA showed a large decline. However, in the last 7 few years NIA level increased gradually. Although slight, the levels of RB and SD have also been increasing steadily over the last 12 years, especially for RB level which has increased from 9.79% in 2016 to 13.50% in 2017. In 2018, RB level had dropped to 7.78%, however this still needs to be monitored closely

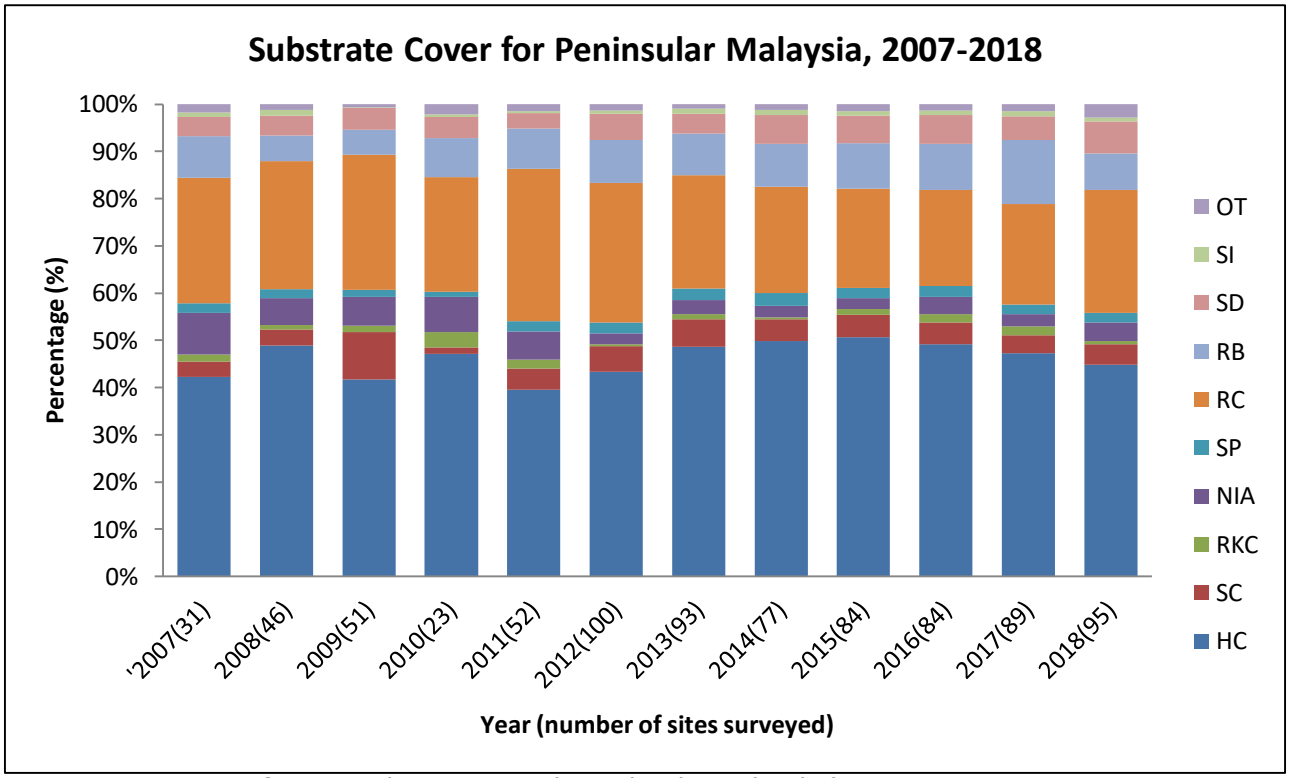


Chart 4: Substrate Cover in Peninsular Malaysia from 2007 to 2018

In East Malaysia, LCC has been consistently in fair condition (see chart 5). The low LCC data point in 2007 and 2008 can probably be ascribed to the small size of the data set in the early years of monitoring. However, the decline in LCC in 2010 probably reflects the impact of the major bleaching event that happened during that period. By 2012, LCC in Sabah showed a recovery but since then there has been a decline in LCC over the last 4 years, which is a cause for concern.

The reduction in LCC in 2016 may have been caused by the El Nino weather phenomenon that hit the region last year. However, the increased levels of NIA, RB and RKC at the same time, all negative indicators suggesting recent disturbances to reefs, is perhaps more indicative of declining reef health.

The level of NIA in Sabah gradually increased from 2013 to 2016, in the last 2 years NIA level showed some reduction. The level of RB has been consistently high over the last 12 years. These indicators support the argument that the level of disturbances on reef in Sabah is high and that some attention to reef health, and management of impacts, is required.

Low fish and invertebrate populations also support this.

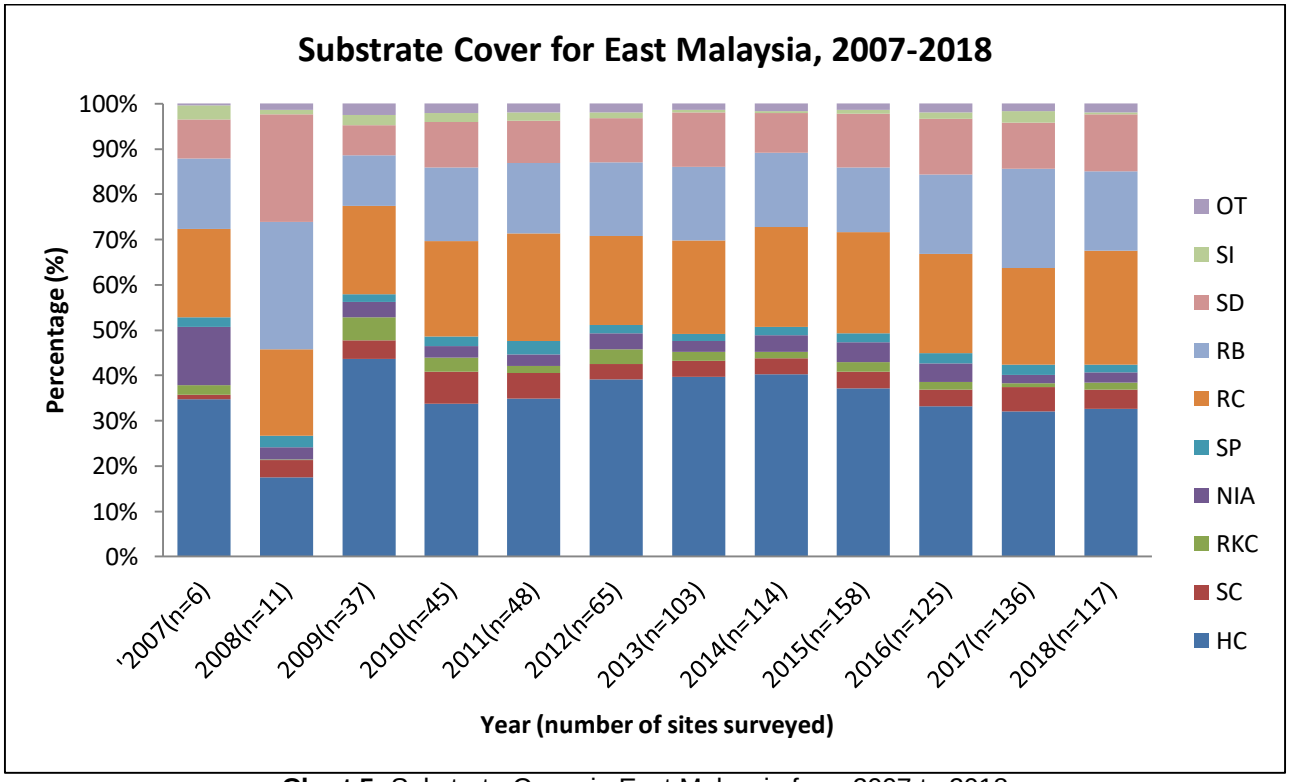


Chart 5: Substrate Cover in East Malaysia from 2007 to 2018

4.1.2 Fish

Over the last 12 years, fish abundances in both Peninsular and East Malaysia show little variation. Most of the indicator fish remain in very low abundance with no signs of recovery, despite the fact that most sites surveyed (particularly in Peninsular Malaysia) were located within marine protected areas.

The average abundance recorded for Sweetlips, Barramundi Cod, Humphead Wrasse, Bumphead Parrotfish and Moray Eel was below 1 individual per 500m^3 throughout the survey period. Snapper, Butterflyfish and Parrotfish were the most abundant fish recorded in both Peninsular and East Malaysia.

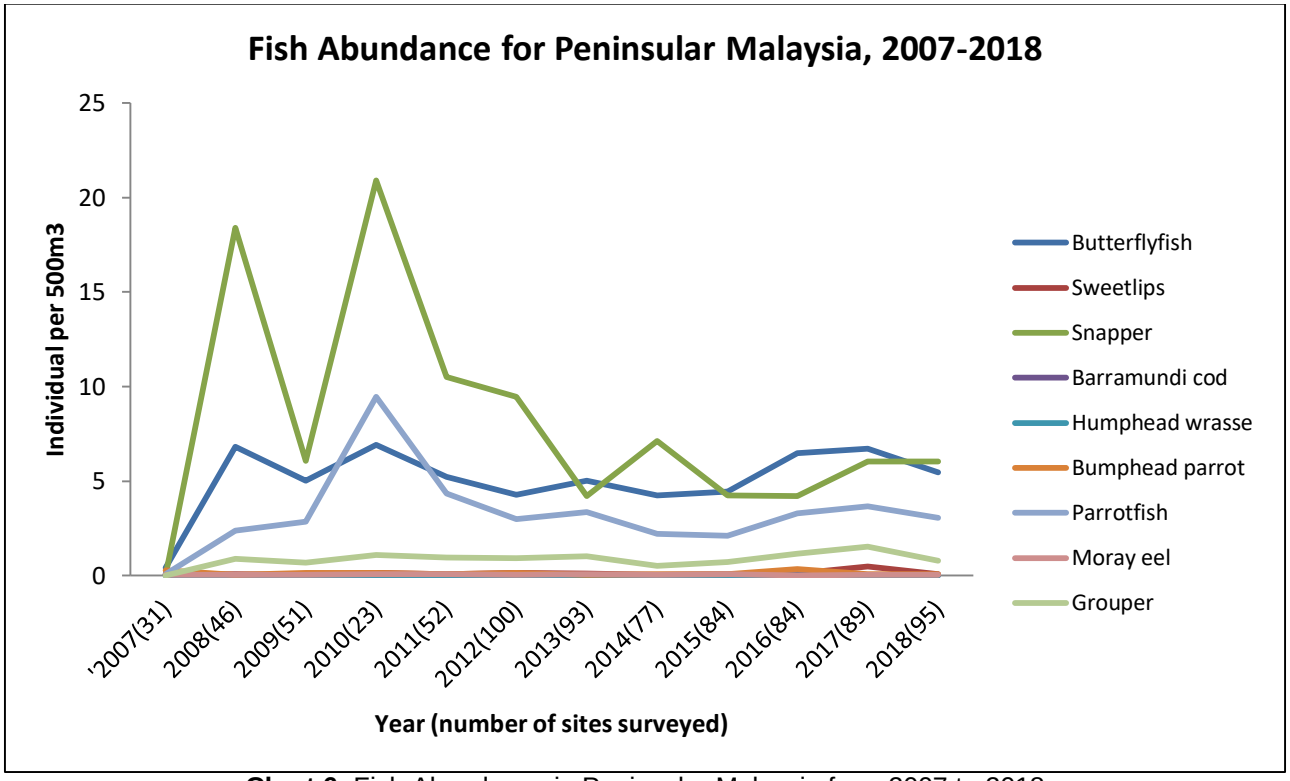


Chart 6: Fish Abundance in Peninsular Malaysia from 2007 to 2018

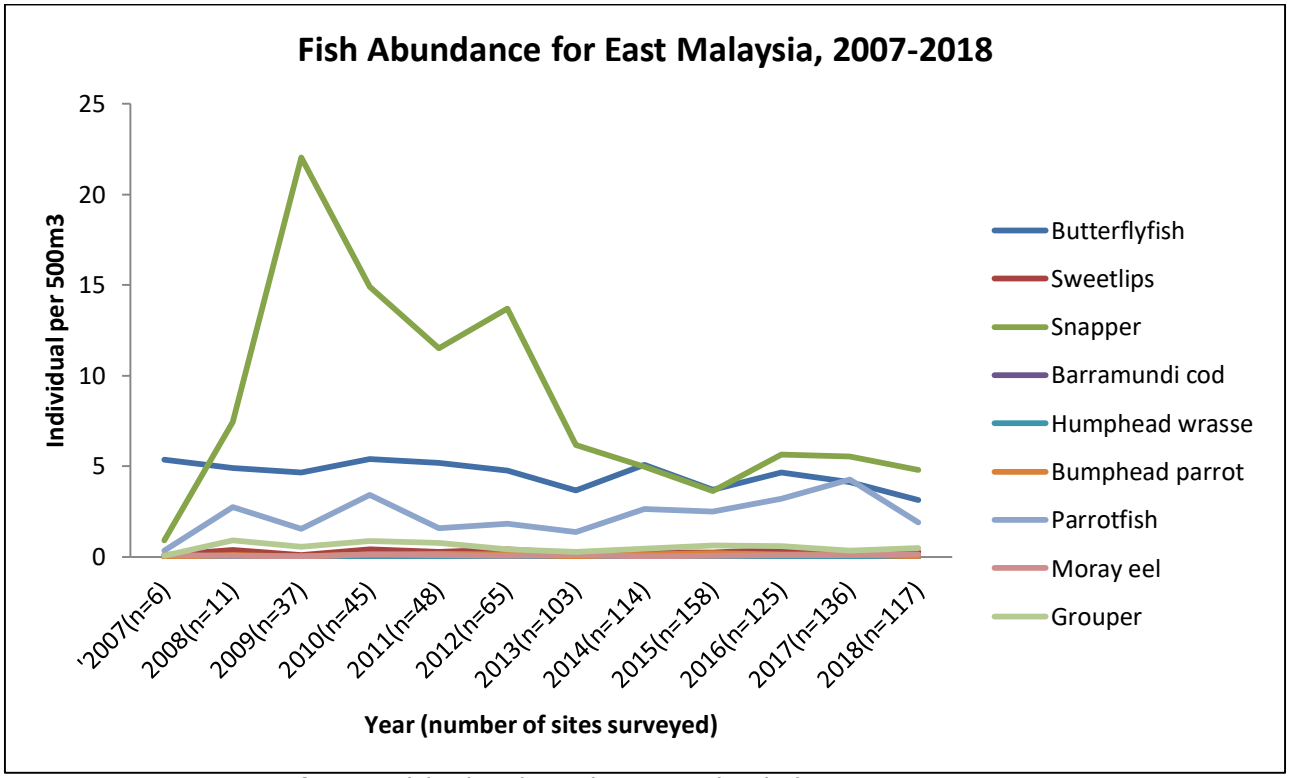


Chart 7: Fish Abundance in East Malaysia from 2007 to 2018

4.1.3 Invertebrate

Similar to fish indicators, invertebrate abundances in both Peninsular and East Malaysia show little variation with most of the indicator invertebrate remaining at very low abundance, with no signs of recovery despite the fact that most of the sites surveyed were located within marine protected areas. The average abundance recorded for Banded Coral Shrimp, Pencil Urchin, Collector Urchin, Triton and Lobster was below 1 individual per 100m^2 throughout the survey period.

Diadema Urchin was the most abundant invertebrate recorded in both Peninsular and East Malaysia with East Malaysia showing an increase over the last 7 years, populations perhaps responding to the above noted increase in NIA level.

The number of Crown-of-Thorns recorded in Peninsular Malaysia is a cause for concern. Although their abundance in the last 7 years was less compared to the period 2008 to 2011, their population remains above what a healthy coral reef can support and has been increasing steadily every year. This is an issue and action is needed to control the high number of Crown-of-Thorns in Peninsular Malaysia. Collector Urchins were not recorded in Peninsular over the last 8 years. Pencil Urchin, Triton and Lobster were only occasionally observed over the last 12 years.

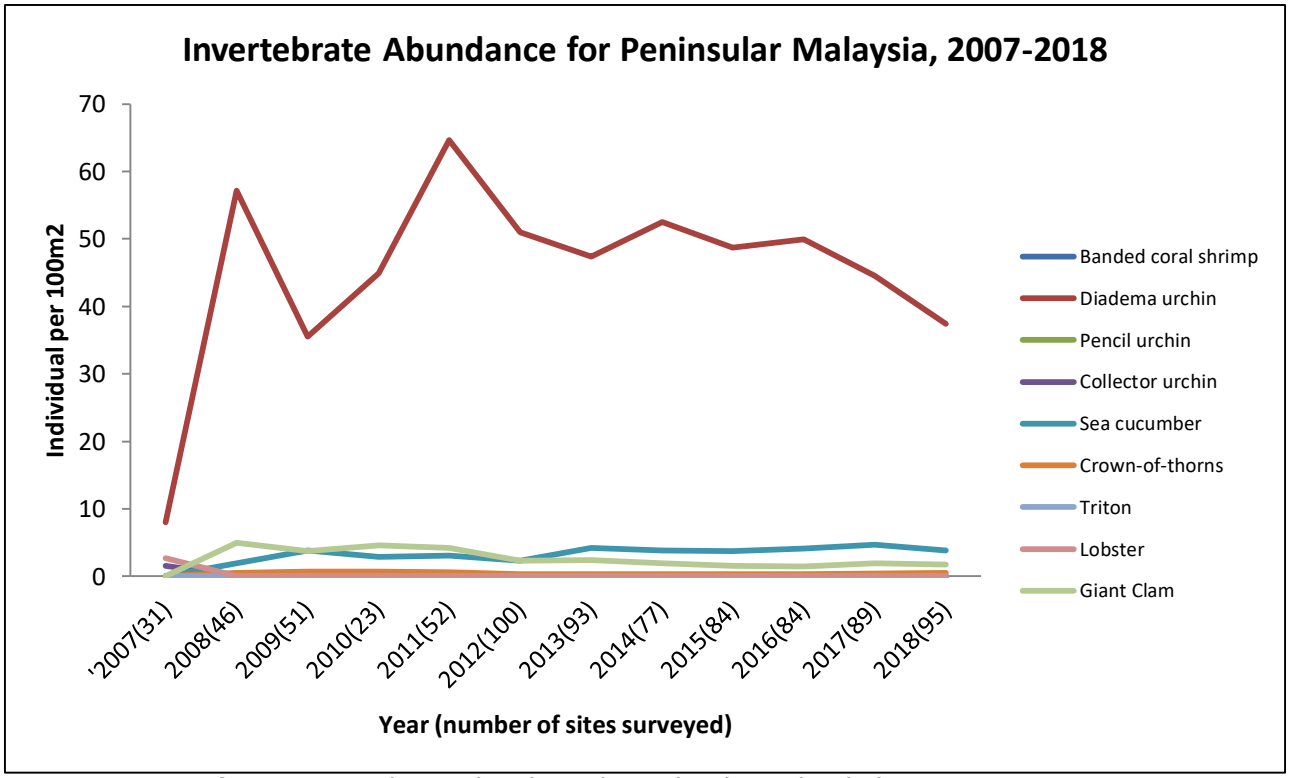


Chart 8: Invertebrate Abundance in Peninsular Malaysia from 2007 to 2018

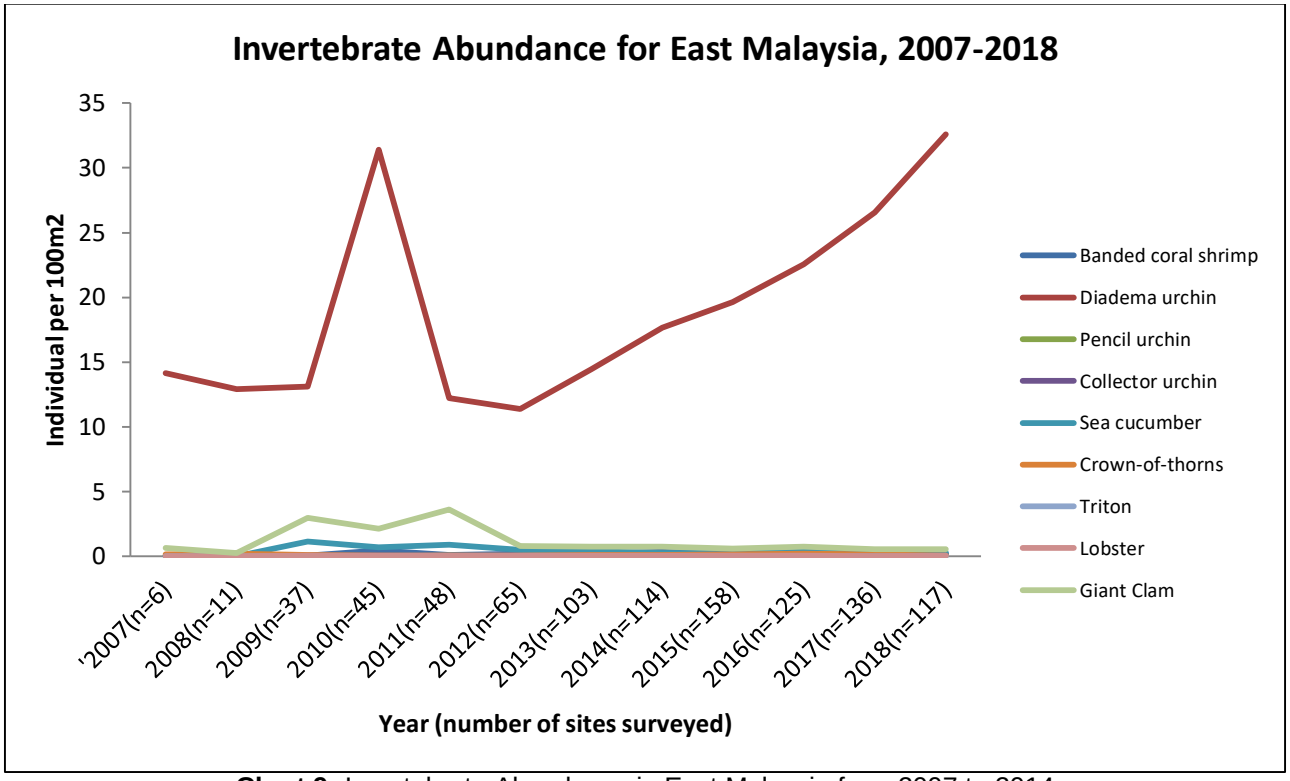


Chart 9: Invertebrate Abundance in East Malaysia from 2007 to 2014

4.2 Changing Reef Health in Selected Areas

This section provides details of the health of selected coral reefs in nine reef areas around Malaysia over the eight-year period from 2011 to 2018. Only sites that were surveyed every year over the period are included in this section, as listed below:

Perhentian (10) Batu Nisan, D' Lagoon, Sea Bell, Tanjung Besi, Batu Layar, Sharkpoint, Batu Tabir, Tukas Laut, Tiga Ruang and Pulau Rawa

Redang (10) Chagar Hutang East, Pulau Lima Southern Tip, P. Paku Kecil, P. Pinang, P. Paku Besar, Redang Kalong House Reef, P. Kerengga Besar, P. Kerengga Kecil, Pasir Akar and Terumbu Kili

Tioman (12) Teluk Kador, Batu Malang, Pirate Reefs, Renggis North, Soyak, Soyak South, Tekek House Reef, Sepoi, Chebeh, Tomok, Labas and Fan Canyon

Tenggol (6) Turtle Point, Gua Rajawali, Teluk Rajawali, Rajawali Reef, Freshwater Bay and Pasir Tenggara

Bidong & Yu (6) Heritage Row, P. Karah, P. Tengkorak, Pasir Tenggara, P. Yu Kecil and P. Yu Besar

Kapas (4) Teluk Jawa, Coral Garden 1, Silent Reef, Coral Garden 3

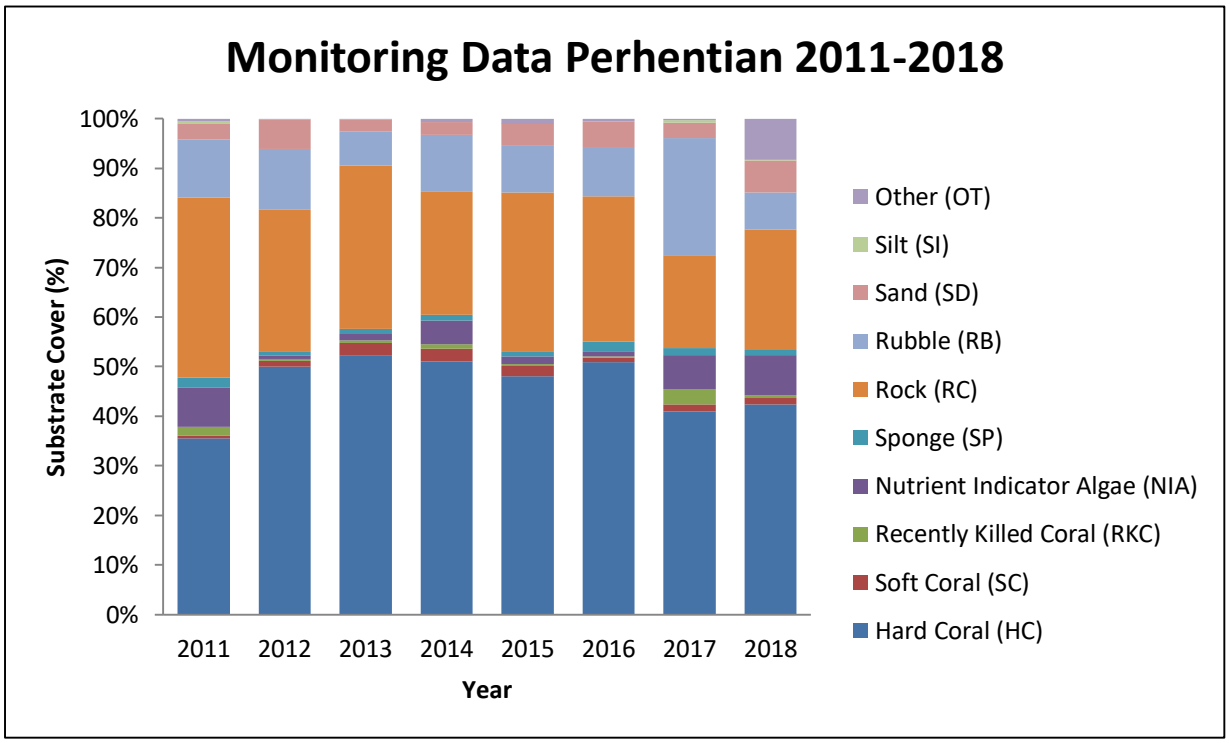
Mataking (6) Cahaya Way, Sting Ray City, Pandanan Bay, Coral Garden, Mataking House Reef and Sweetlips Rock

Lankayan (15) Bimbo Rock, Edwin Rock, Froggie Fort, Goby Rock, Jawfish, Ken's Rock, Lycia Garden, Mel's Rock, Moray Rock, Pegaso, Reef 38, Reef 77, Sandbar S, Veron and Zorro

Miri (6) Siwa 4A, Siwa Penyu, Anemone Centre, Anemone North, Eve's Garden and Sunday Reef

4.2.1 Perhentian

Data from surveys conducted on Perhentian over eight years show that there has been some variation in reef health over that period of time. The low HC cover in 2011 (35.38%) probably reflects the impact of the major bleaching event experienced in 2010. 2012 surveys then show a substantial recovery and HC cover has remained more or less the same until 2016. In 2017, HC cover has decreased significantly by 10% due to increase in RKC, NIA and RB level. The level of RB has maintained at 9 to 12% from 2011 to 2016, but has increased significantly from 9.94% in 2016 to 23.56% in 2017. The sites of most concern are Batu Nisan, Seabell and Tiga Ruang which recorded over 40% RB. In 2018, HC cover and RB level showed some improvement; slight increase in HC cover and significant decrease in RB level. RB level at Batu Nisan and Tiga Ruang has dropped to just below 20% and the level at Seabell has dropped to below 10%.



The level of NIA has been very inconsistent over the years. In 2011 the level of NIA was high at 7.94%, followed by a substantial decrease in 2012 to 0.75% and increased again in 2013 and 2014 to 4.75% in 2014. In 2015 and 2016, NIA level decreased again to around 1% and increased to 8.19% in 2018. These relatively high levels of NIA are probably indicative of raised levels of nutrient in the waters around the islands. This is supported by water testing data (2009) that indicate the presence of sewage pollution around Perhentian, and a review of sewage treatment systems (2011) that highlighted the inadequate sewage treatment systems at many resorts.

The level of SD had been increasing gradually over the last 6 years since 2012. Although the increase is very slight each year, over the 6 years the increase can be an indication of disturbance as dead coral breaks off and is eroded into sand by wave action.

From a management perspective, this wide variation presents some challenges as it suggests that the reefs, while being damaged by anthropogenic impacts (particularly sewage pollution and tourism impacts) can recover quickly once stressors (e.g., bleaching) are removed. Control of tourism activities, development and improving sewage treatment could have significant benefits for coral reefs around the islands.

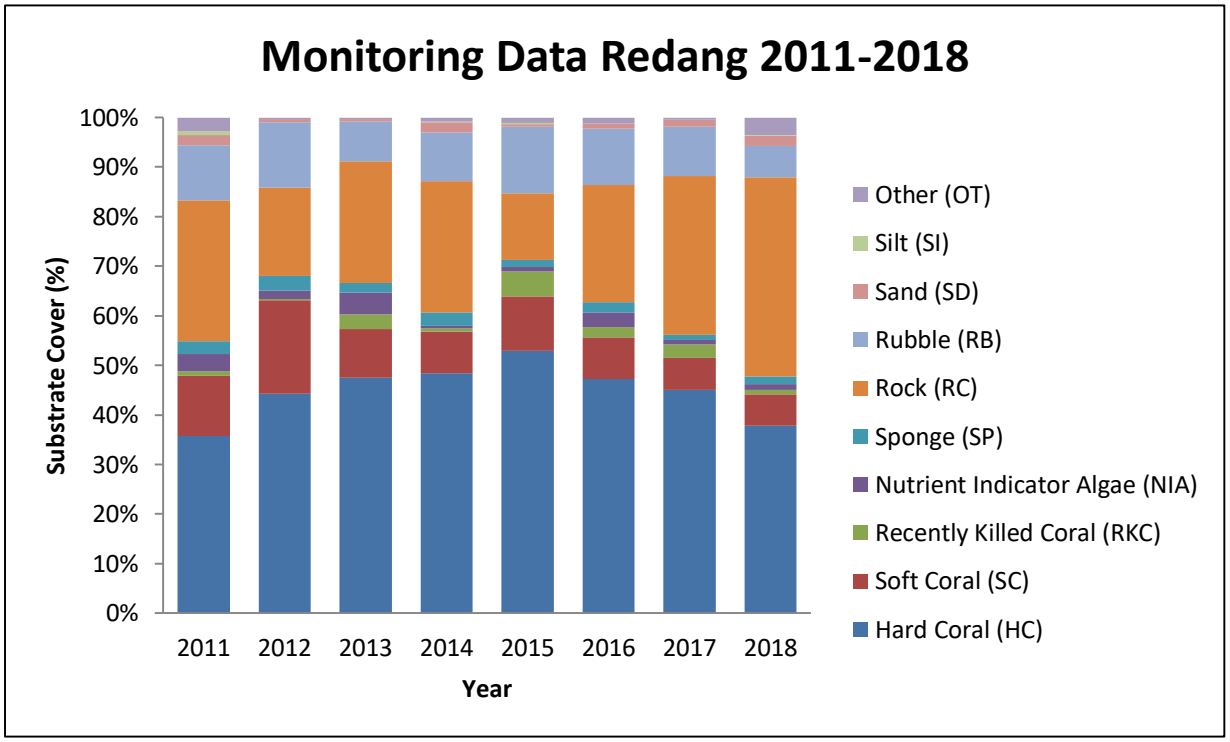
4.2.2 Redang

The overall condition of coral reefs around Redang Island has generally been good since 2011 with average LCC at or above 50% in most years. The low HC cover in 2010 and the increase by 2012 are similar to that for Perhentian, indicating recovery from the 2010 bleaching event. However, over the last 4 years, LCC at Redang has been decreasing steadily every year, from 63.88% in 2015 to 44.19% in 2018, from good to fair condition.

The wide variation in SC, from a high of nearly 20% in 2012 to a more typical 10% after 2013 perhaps reflects opportunistic growth of SC in some areas damaged by the bleaching event, which has subsequently been re-colonised by HC.

The level of RB in Redang has remained high in the range of 8 to 14% over the last seven years. In 2018, the level has dropped to 6.31%. However, Pulau Kerengga Kecil still records RB level above 20% and the level at Marine Park Jetty Centre is high at 16.25%. This situation needs to be monitored as it could have a negative impact on the reefs over the long term.

There is only one significant anomaly in the data – the spike in RKC in 2013 and 2015, which showed a significant increase from 0.31% in 2012 to 3.59% in 2013 and from 0.63% in 2014 to 5.86% in 2015. In the last 3 years, the results showed some good recovery – decrease in RKC level to below 1%. The data are indicative of the value of long term monitoring, which allows changes like this to be tracked and provides opportunities for intervention if necessary.

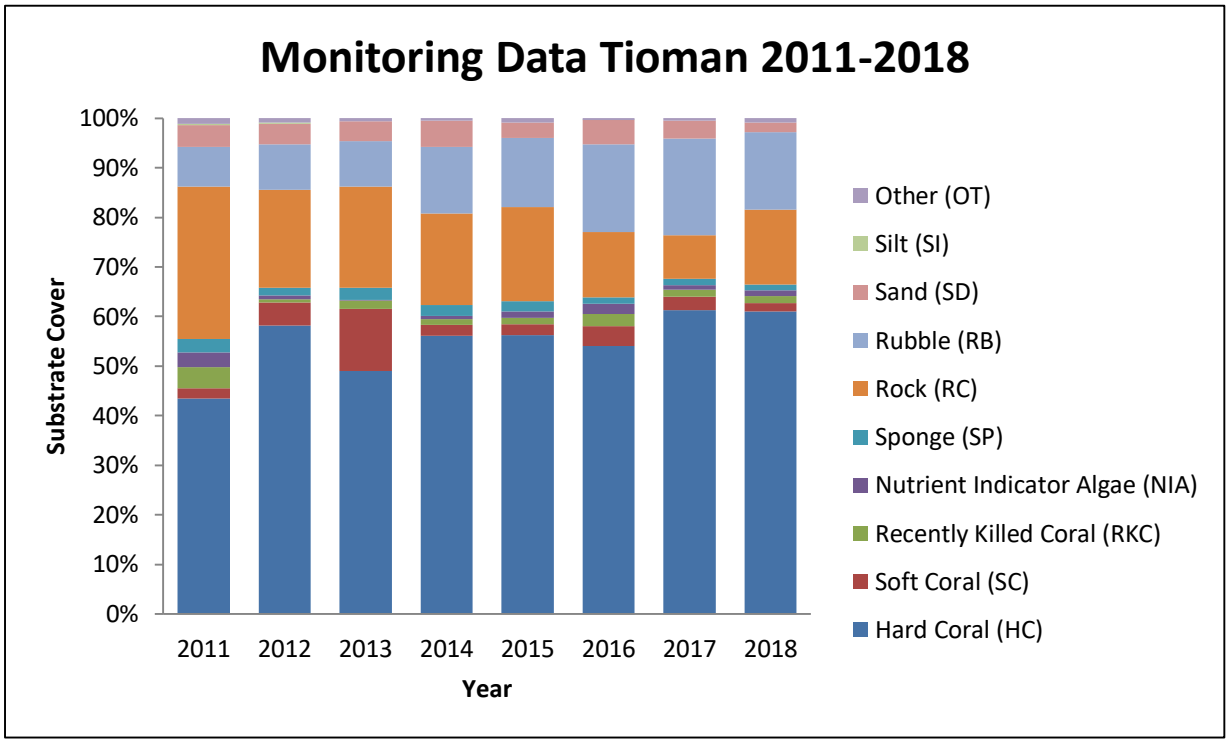


4.2.3 Tioman

The data from surveys conducted on Tioman over the last eight years show that there has been some variation in LCC over that period of time. The condition of the coral reefs surveyed around the island has been consistently good over the years, with LCC cover above 50% with the exception of 46.79% in 2011 – again reflecting the mortality caused by the 2010 bleaching. In subsequent years, LCC has been consistently above 58%.

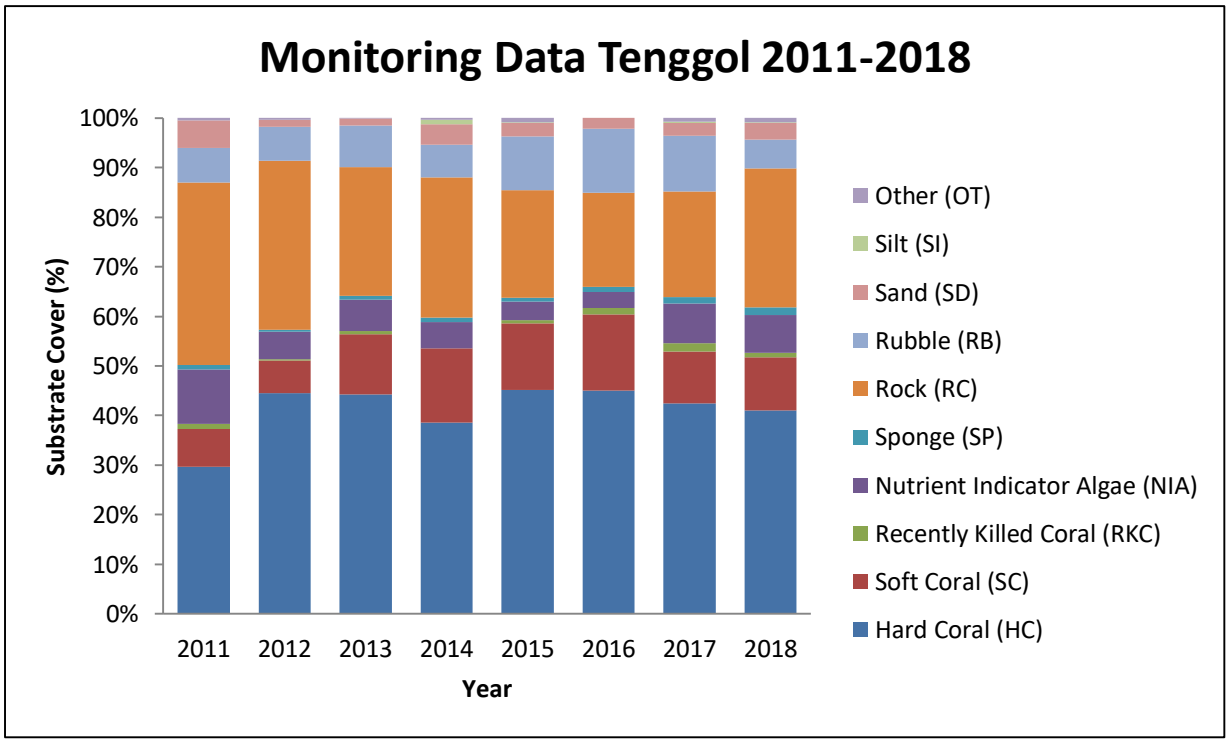
The level of RB in Tioman is a cause for concern. The level remains in the range of 8 to 10% over the first three years of the survey period. However, the average level has increased substantially in 2014 and 2015 to over 13%. In 2016 and 2017, RB level increased further to 17.66% and 19.43% respectively. In 2018, the level has dropped to 15.63%; which is still very high. The sites of most concern are Soyak South and Labas with RB level recorded over 45%. Other sites which recorded worrisome level of RB are Fan Canyon, Tekek House Reef and Teluk Kador. As noted previously, RB can be an indicator of recent and long term disturbances. The continuous increase in RB level suggests there is a need for management intervention, to ascertain the cause and find solutions to reduce damage to these reefs.

The level of RKC and NIA in Tioman finally saw a dip in 2017 after it has been increasing over the last 3 to 4 years, however this still need to be monitored closely.



4.2.4 Tenggol

The data from surveys conducted at Tenggol since 2011 show a similar pattern to other locations – recovery in LCC since the 2010 bleaching event followed by stabilisation at pre-bleaching levels. The overall condition of coral reefs around Tenggol Island since then has been good, with average LCC above 50%. However, in the last 3 years, it was observed that LCC at Tenggol showed a steady decline.



In the last 6 years there appears to have been a shift from RC to SC. In some reefs we have observed such changes as being due to zoanthid soft corals colonizing long dead branching hard corals, so that while the "headline" LCC appears healthy, the reef is actually undergoing a significant shift to a potentially less stable state – soft coral does not contribute to reef extension. The colonisation of zoanthid on long dead branching hard corals reduces available space for hard coral recruits (new hard corals) to attach themselves and grow, thus potentially impeding reef recovery and extension. However, some recent publications suggest that SC "cleans and prepares" dead coral for new HC recruits, leading to reef recovery. This needs to be reviewed after future surveys.

A further concern is the relatively high level of RB over the years. From 2011 to 2014, the level of RB remained in the range of 6.6 to 8.5%. In 2015, RB level increased to 10.94% and has maintained more or less the same. In 2018, RB level showed improvement and has dropped to 5.73%. However, one site still need to be monitored closely due to its high level of RB. The site is Pasir Tenggara which recorded 3.75% RB in 2011 and substantially increased to 14.38% and 20.63% in 2012 and 2013 respectively. In 2015 and 2016, the level had increased further to over 40%. In 2017 and 2018, the level has decreased to 31.88% and 15.63% respectively.

NIA level showed improvement from 2014 to 2016 but deterioration in 2017 and 2018. In 2011, NIA in Tenggol recorded 10.94% and decreased to 5.52% in 2012. Although the level increased slightly in 2013 to 6.35%, it decreased the next year to 5.31% and had been decreasing gradually ever since and in 2016 surveys, the level of NIA recorded 3.23%. In 2017, the level increased to 8.02% and maintained high at 7.71% in 2018. Freshwater Bay and Turtle Point recorded huge increase in NIA level in 2017 and the level continued to increase further in 2018.

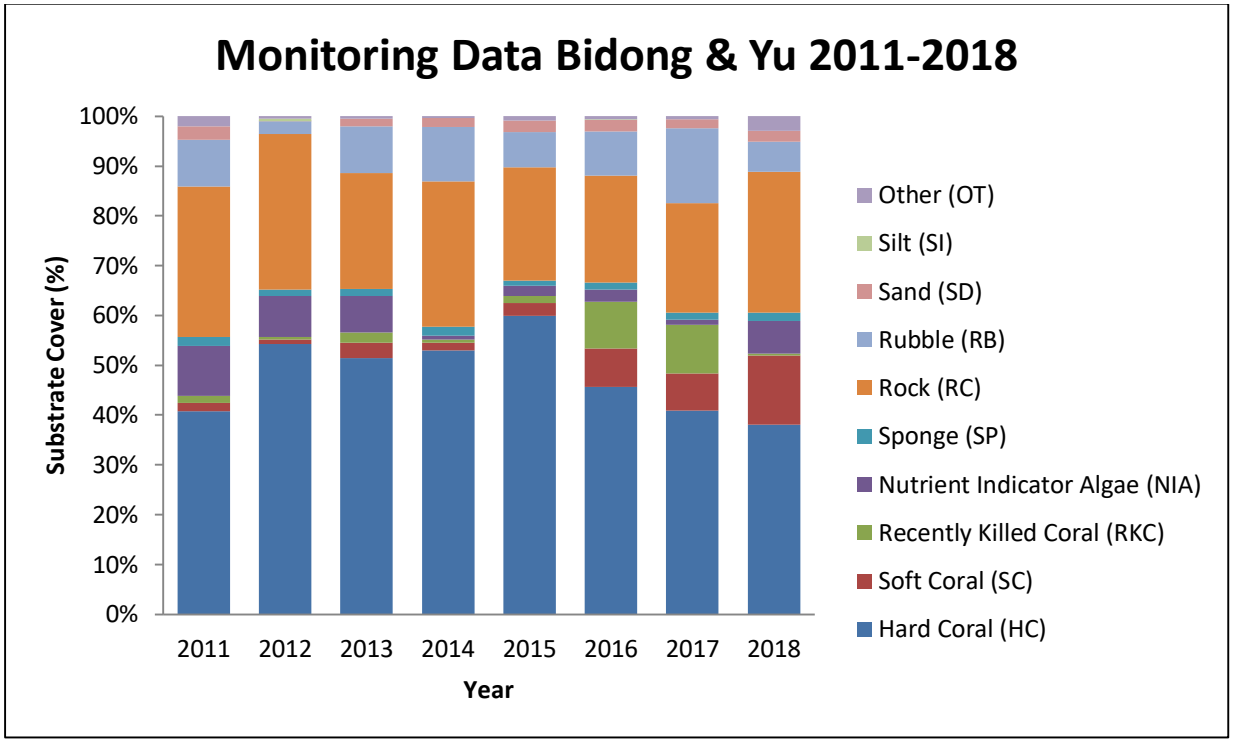
4.2.5 Bidong & Yu

The sites around the two islands show a similar trend in LCC to other East coast sites, increasing from 2011-2012 after recovering from the 2010 bleaching event. Further recovery is apparent through to 2015. However, LCC level dropped considerably in 2016 and further in 2017. In 2018 LCC increased, however it did not signify reef recovery as the increase was due to large amount of zoanthids colonising dead coral. HCC has decreased from 59.90% in 2015 to 38.13% in 2018. This was highly likely due to the increase in COT abundance over the last few years. Since 2013, the abundance of COT was above what a healthy reef can sustain. Since 2016 surveys, damage due to COT and Drupella predation was recorded. The drop in LCC in 2017 is also largely due to the sharp increase in RB level (8.96% in 2016 to 15.10% in 2017). Bidong and Yu appear to be undergoing a shift from RC to SC where zoanthid is colonising dead corals. As a result, the level of SC increased considerably from 2.6% in 2015 to 13.85% in 2018. At Pasir Tenggara, 77.50% of the reefs were SC which was mostly zoanthid and only 8.75% of the reefs were HC.

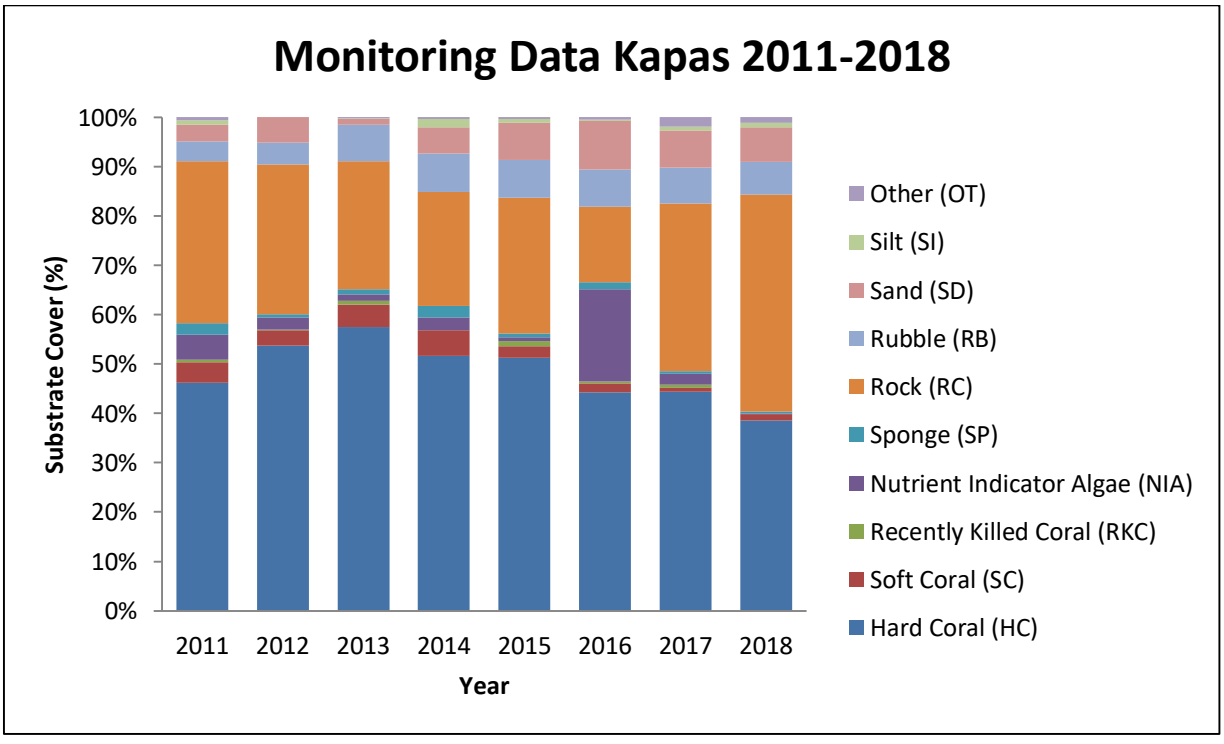
However, the data show some inconsistencies over the 8 years with varying levels of RB and NIA. While RB level has dropped considerably from 15.1% in 2017 to 6.04% in 2018, NIA level has increased considerably from 1.04% in 2017 to 6.56% in 2018. These trends should be monitored to identify the cause and ensure reefs remain healthy.

4.2.6 Kapas

The data on coral reef health in Kapas show a similar pattern to other areas, with a recovery since the bleaching of 2010. Following a peak of LCC in 2013, there has been an apparent decline in coral reefs health through to 2018 with no signs of recovery.



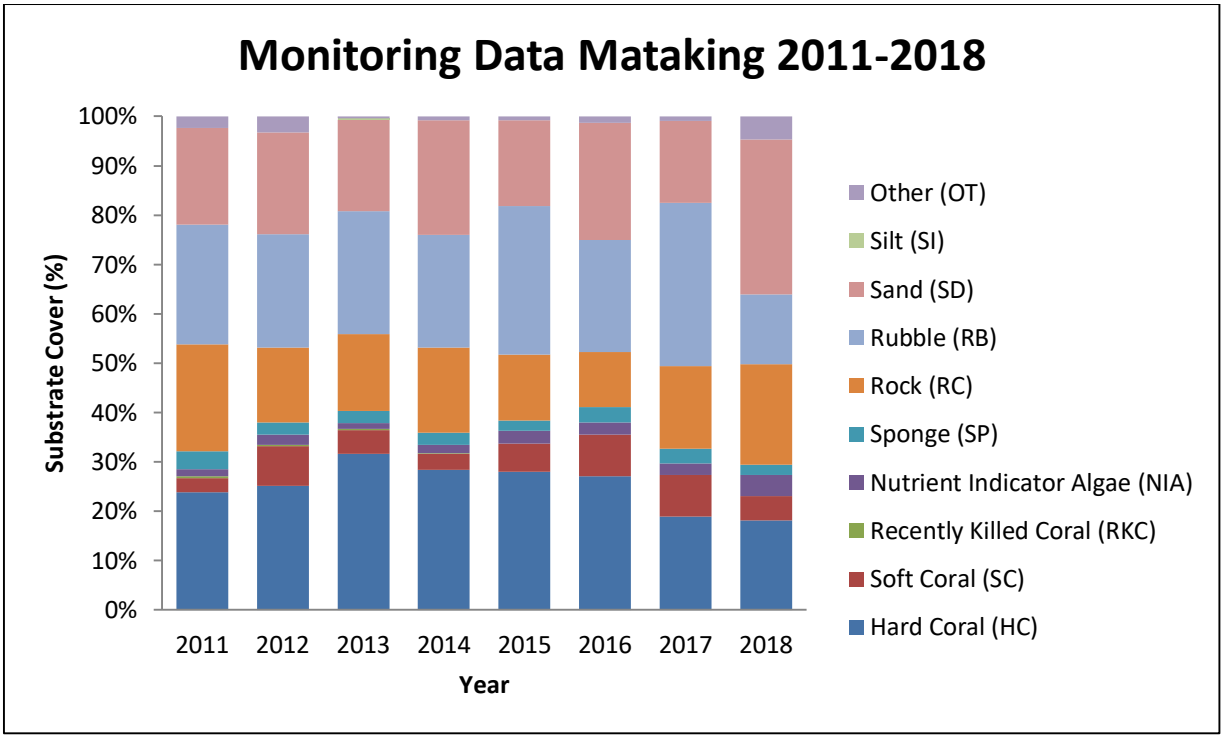
The other significant changes over the period are an increase in RB and SD level. The level of RB increased considerably from around 4% in 2011-2012 to around 7-8% in 2013 and had maintained at that level through 2018. SD level also recorded similar pattern; increased considerably from around 1% in 2013 to around 5% in 2014. In 2015, it increased further to around 7% and had maintained at that level through to 2018. On the other hand, the level of NIA showed a gradual decline from 5% in 2011 to less than 1% in 2018, however there was a very significant increase in 2016 (18.75%). The cause of these changes needs to be determined, especially for RB and SD level, so that preventive measures can be taken to ensure no continuing damage to the reefs around the island.



4.2.7 Mataking

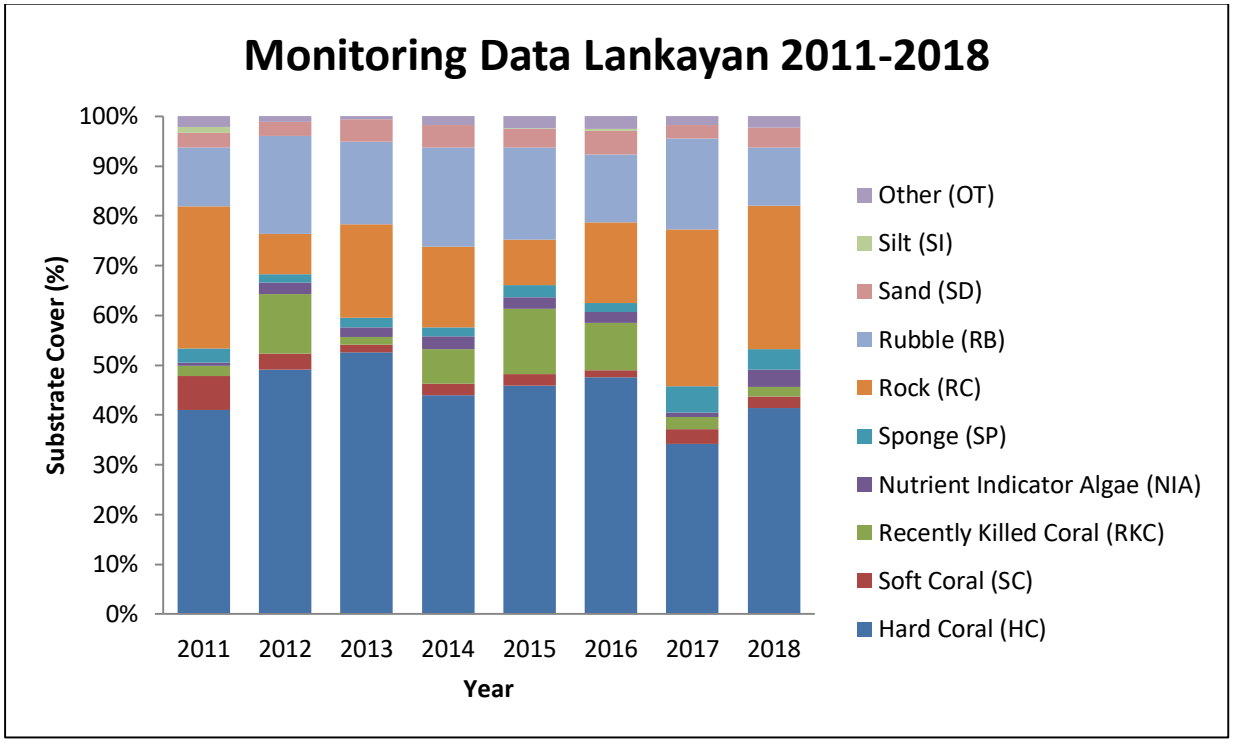
The data from surveys conducted on Mataking show little significant change for the first six years of surveys, with the overall condition of reefs around the island remaining fair (average LCC above 25%). In 2017, LCC dropped greatly although the reefs still remained in fair condition. In 2018, LCC dropped further and the reefs are now in poor condition category. The level of RB has remained very high in the range 22 to 33% in the first seven years. In 2018, RB level has dropped to below 15%. Although some of the variability results from lack of permanent transect markers, most of this is a result of known historical and on-going fish bombing in the area. The site of most concern is Coral Garden where RB level recorded during the 2018 survey was 44.38%.

It is unlikely that reefs in the area will have the chance to regenerate unless the problem of fish bombing is addressed. This is a common problem in Sabah, and is seen elsewhere in our results. Urgent action is required by the relevant authorities to address the issue.



4.2.8 Lankayan

There is wide variation in data from Lankayan. HC cover increased significantly from 2011 (41.13%) to 2013 (52.58%), but then reduced considerably in 2014 to 44%. From 2015 to 2016, the reefs showed gradual recovery and recorded 47.58% in 2016. In 2017, HC cover decreased again and recorded the lowest in seven years of surveys at 34.25%.in 2018, HC cover increased again. The other wide variation over the period is RKC level; varies from 2 to 13% over the last seven years. Same goes to RB level which varies from 11 to 20%. Overall, reefs around Lankayan are healthier than other areas of Sabah (higher LCC), probably due to the presence of the SIMCA protected area.

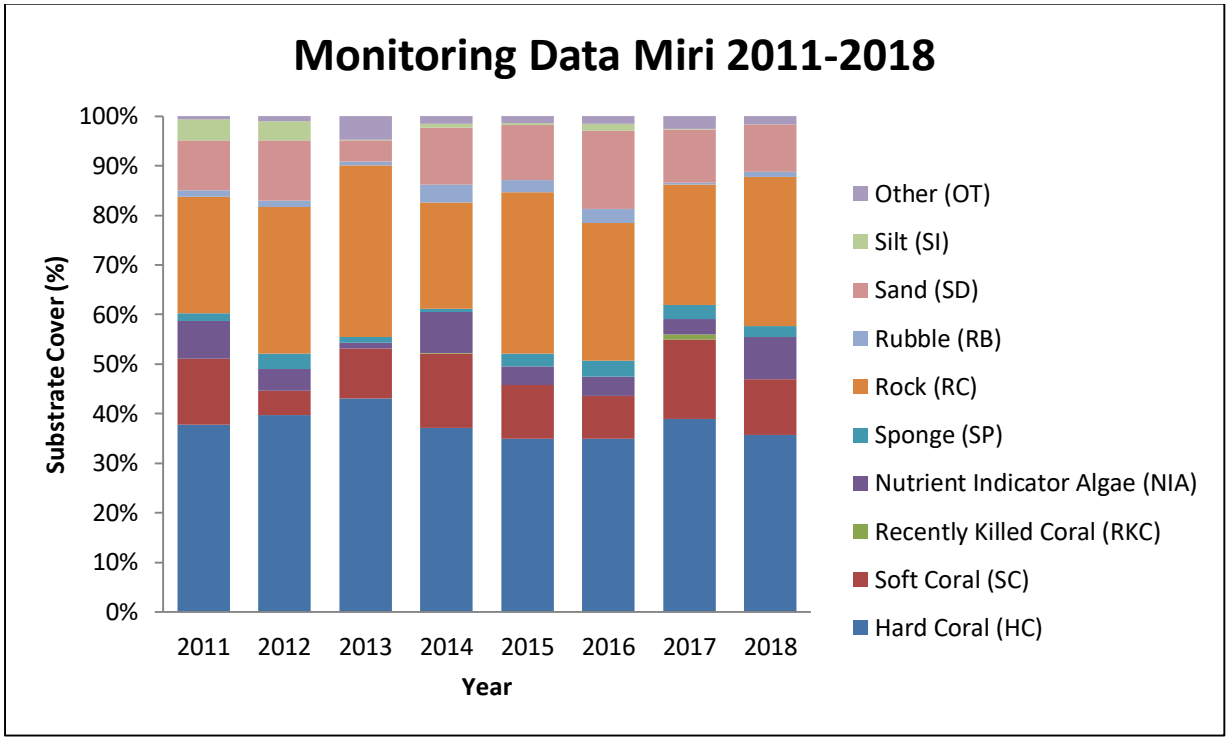


4.2.9 Miri

Surveys conducted in Miri show that the health of reefs varies between fair and good. It is thought that some of the variability in data is a result of not having fixed transects: all the reefs surveyed off Miri are submerged and in open ocean locations, in which it is difficult to establish fixed transects. Although GPS coordinates are used to identify reef areas, locating specific start points can be challenging, hence the variation in data.

Most sites are some distance off shore, and few areas suffer significantly from the impacts of siltation/sedimentation (with the obvious exception of those close to the shore). The main impact to reefs in Miri appears to be over-fishing, with fish populations consistently low. Controlling fishing will have the impact of allowing fish populations (particularly herbivores) to recover, preventing the increase in NIA seen in two of the five years of surveys.

New reef areas are being opened up for leisure diving and there is a need to increase the number of sites surveyed in Miri to ensure a consistent picture of reef health can be developed.


Monitoring Data Miri 2011-2018
Substrate Cover (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2011
2012
2013
2014
2015
2016
2017
2018
Year
Other (OT)
Silt (SI)
Sand (SD)
Rubble (RB)
Rock (RC)
Sponge (SP)
Nutrient Indicator Algae (NIA)
Recently Killed Coral (RKC)
Soft Coral (SC)
Hard Coral (HC)

5. Summary and Recommendations

5.1 Summary

5.1.1 On average, reefs in Malaysia are in fair condition, as measured by widely used coral reef health criteria. Average Live Coral Cover (LCC) for Malaysia is 42.42%. However, it should be noted that the average masks a wide range of variation in reef health, from reefs with over 85% LCC to reefs with below 1% LCC.

5.1.2 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.

5.1.3 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).

Table 3: Average and Maximum abundance of Indicator Species

Fish				**Invertebrates**			
Indicator	Abundance			Indicator	Abundance		
	Avg.	Max.	Max. Site		Avg.	Max.	Max. Site
Butterflyfish	4.18	23.5	Coral Garden, Payar	Banded Coral Shrimp	0.12	9.75	Lost World, Kapalai
Sweetlips	0.19	4	Lembu, Payar	Diadema	34.75	543	Riza Garden, Mantanani
Snapper	5.36	124.25	Yu Kecil, Yu	Pencil Urchin	0.01	0.75	Cahaya Way and Stingray City, Mataking;
Barramundi Cod	0	0	n/a	Collector Urchin	0.10	7.5	Amoi Cantik, Labuan
Humphead Wrasse	0.01	0.5	Panglima, Mabul; Edwin Rock, Lankayan	Sea Cucumber	1.86	78.25	Soyak South, Tioman
Bumphead Parrotfish	0.04	1.75	Freshwater Bay, Tenggol	Crown of Thorns	0.23	6	Coral Garden 3, Kapas
Parrotfish	2.4	16	Kerengga Besar, Redang	Triton	0	0	n/a
Moray Eel	0.08	3.75	Pandanan Bay, Mataking	Lobster	0.01	0.5	Little Okinawa and Siu Siu, Kapalai
Grouper	0.61	7.5	Lobster Lair, Sipadan	Giant Clam	1.08	25	Yu Besar, Yu

5.1.4 Analysis of data from surveys conducted since 2011 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.

5.1.5 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).

5.1.6 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).

5.1.7 The "snapshot" of reef health provided by the 2018 survey data suggests reefs in Malaysia are relatively healthy ("fair" LCC, high diversity of fish and invertebrate indicators). However, an analysis of 12 years of Reef Check surveys shows changes in indicator species abundance over the period that suggest possible declining reef health across Malaysia in recent years. Some concerning trends can be identified:

- Level of LCC, which recovered after the 2010 bleaching event, has been declining for the last four years, as levels of negative indicators (NIA, RB, RKC) have been increasing
- Food fish abundance is decreasing, while at the same time Parrotfish abundance – an algae grazer – is increasing
- Invertebrate indicators are scarce, with the exception of Diadema Urchin, the abundance of which has increased over the last five years.

Such trends, should they continue, could have very serious consequences for both those communities that rely on reefs for their food supply, as well as the tourism industry, which relies on healthy reefs to attract millions of tourists to Malaysia every year.

5.2 Recommendations

Our recommendations remain largely the same as in previous years, and focus on improving management to reduce local impacts to coral reefs and involving local stakeholders in management. We recommend that:

- Management should be local – we have not made recommendations for particular islands, but we strongly recommend local managers work with local stakeholders to review changes to reef health on an island by island basis, using the data presented in this report to help to identify key threats, and develop action plans for each island to reduce local impacts and contribute to long term reef health.

- Management should be appropriate – there is a need to agree what good management is; currently the management agencies focus mainly on patrolling and enforcement but management requires more than this, and we recommend that programmes are strengthened in the following areas:

    - Stakeholder relations and communications
    - Communication, Education and Public Awareness
    - Conservation programmes
    - Monitoring and research
    - Management effectiveness assessment.

    Tools such as Green Fins and the ASEAN Green Resorts standards can be used to establish management initiatives with selected stakeholder groups and we recommend that MOTAC be invited to participate in discussions on how these programmes can be rolled out more widely.

- Management should be participatory – local stakeholders (island communities, tourism operators) should have a greater say in management, because decisions made by managers affect their livelihoods. There is growing evidence that involving local stakeholders in management brings numerous benefits to management, including improved compliance and better conservation outcomes. But it is not just local stakeholders: management should also involve all agencies that have a voice in reef conservation; these include State governments, who are responsible for land matters, and whose policies could have significant implications for reef health. Other government agencies such as MMEA should also be involved in management.

- Management should be sustainable – both managers and local stakeholders should develop long term conservation programmes to ensure coral reefs will be as healthy – or healthier – in 20 years as they are today.

- Management should be comprehensive – the focus of management is on coastal resources and islands; but many marine ecosystems remain submerged and these areas are not managed. Managers should consider including open sea, submerged ecosystems into appropriate managed areas.

- Management should be integrated – current management is on a site by site/island by island basis. While appropriate for managing local threats, this approach misses an opportunity to view management from a wider perspective. The whole of the East coast of Peninsular Malaysia can be viewed as one large single biological system, with genetic connectivity between north to south, and ecosystem connectivity from west to east. Similar comparisons can be drawn for the West coast and East Malaysia. Using this “seascape” approach could provide opportunities to integrate other aspects of management, such as fisheries and coastal ecosystems, into a broader management plan.

Success in implementing these recommendations will require a variety of skills and competencies, some of which are outside the scope of existing management agencies. We recommend that government collaborate with non-traditional partners (i.e. non-governmental agencies) to broaden management capacity and bring a wider range of skills and experience to bear on marine management issues. Our on-going programme in Tioman, for example, has encouraged both the local community and tourism operators to become involved in the management process and we recommend that government consider new approaches and institutional arrangements for management, including participation by the private and non-profit sectors.

Finally, while much of the emphasis above is on management, consumers can play an important role in conservation. We recommend that government:

- Fund education and awareness programmes that encourage appropriate behaviour changes
- Inform consumers how they can support "green" operators (e.g. Green Fins members)
- Support campaigns such as the International Coastal Clean-up Day that help to raise awareness of marine conservation issues among non-traditional marine users (e.g. in urban centres);

5.3 Conclusion

The 2018 review of the health of coral reefs around Malaysia indicates that reefs are generally in "fair" 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.

An analysis of 12 years of monitoring data highlights some potentially worrying trends. Management authorities and other government agencies are encouraged to take action now to protect Malaysia's remaining reefs, safeguarding the huge economic benefits they provide. Improving management and reducing local threats should help to ensure reefs are strong and resilient, and able to withstand major disruptions from global threats in the future.

Acknowledgements

We are grateful to the following sponsors for their support during 2018:

Yayasan Sime Darby: supporting a five year programme on Tioman island to build reef resilience and social resilience.

Yayasan Hasanah: supporting the development of a community managed marine area in Mantanani, Sabah

KPMG in Malaysia: donates funds to support a Corporate Reef Check team and education programmes in two schools in KL.

Royal Bank of Canada: collaborating with RCM on a long term programme to address impacts to coral reefs in Tioman island.

Estee Lauder Malaysia donates funds to support a Reef Check survey programme in Lahad Datu, Sabah.

Coca-Cola Foundation: Funding the purchase of a plastic processing machine for Mantanani island.

British High Commission: Funding an investigation into how to reduce marine debris, particular plastics.

KWAP: Funded a community assistance programme on Mantanani island, including on-going support to the Youth Group.

YTL: Supporting efforts by RCM to improve coral reefs around Malaysia, including through its Pangkor Laut Resort which supports surveys at the Sembilan islands.

Kose: supporting reef rehabilitation programmes and Reef Check surveys in Lang Tengah.

Russell Bedford LC & Company: provides *pro bono* company secretarial services for RCM.

Reef Check Malaysia cannot work in isolation. We continue to maintain a close working relationship with the **Department of Marine Park Malaysia**, Ministry of Natural Resources and Environment, and **Sabah Parks,** both of whom make significant contributions to this annual survey programme by conducting surveys at some of the sites, as well as assisting in reef rehabilitation programmes and school education projects.

In addition, we work with scientists at several universities and our **Scientific Advisory Council** (current members are Affendi Yang Amri and Jillian Ooi at UM, and Gopinath Nagaraj at FanLi Consulting) to ensure our work is scientifically robust. Finally our **Board of Trustees** (Lim Jit Cheng, Kevin Hiew, Ruth Yeoh and Datuk Hiswani Harun) provides advice on governance and fund raising. We are grateful to them for their guidance and expertise.

Particular thanks go to:

- **Reef Guardian**, Lankayan, who have been conducting the survey programme around SIMCA for many years
- **Mataking Reef & Dive Resort**, Mataking who organise and conduct a survey programme around Mataking
- **Tioman Dive Centre**, Tioman, who provide RCM with facilities for EcoDiver training and also assist in other activities such as beach clean ups and rehabilitation programmes
- **Scuba Junkie**, Mabul, who promote Reef Check through their Eco Dive Master programme and also conduct school education and awareness programmes as well as clean-ups etc.
- **Bubbles Dive Centre**, Perhentian, who fully sponsored the 2018 Perhentian surveys for RCM volunteers
- **Angela and Neil Hadfield** who have been conducting the survey programme around Miri for the last 2 years
- **Little Planet**, Tioman, who partly sponsored Pemanggil surveys

We work through a small network of dive centres and NGOs who continue to support our work:

Reef Check Certified Facilities

Bubbles Dive Centre, Perhentian
Scuba Junkie, Mabul/KK
Tioman Dive Centre, Tioman
Reef Guardian, Lankayan
Mataking Reef & Dive Resort
Usukan Cove Lodge Dive Centre

Other dive operators

Aqua Sports Divers, Kapas
Kapalai Resort
Scooba Tank and Mari Mari Dive Lodge, Mantanani
Darvel Bay Diving, Lahad Datu
Pelangi Resort, Redang

NGOs

Juara Turtle Project, Tioman
FUZE Ecoteer

Finally, thanks to the many EcoDivers who give up their time to help us with surveys. Our small team could not possibly manage all those surveys ourselves, and we really appreciate your efforts. To you, and the many other volunteers who have helped in our work, we are grateful.

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Alberto Garcia
Smita Jairam Viswanath
Joshua O'Neill
Loh Wan Yeng
Noor Atika Abdullah
Nara Ahmad
Rizan Jonggi
Hamka Bin Juhuri
Joe Michael
Mabel Tan
Rhesa Adythia
Tengku Hussein
Ton Abdullah
Chia Yew Choy
Daniel Yong
Fong Ken Ling
Catherine Cassidy
Arnaud Charles Simons
Muhammad Rafiq Hakimi
Dominic Monteroso
Freddy Joliver
Jalil Mapait
Safiq Apik Izan
Marcia Maikel
Johnny Hasbullah Buis
Yon Soon Guan
Mohd Hasrul bin Jali
Abdul Manap Abdullah
Idris Muda
Tan Wei Seong
Rasyid Kasman

Gordon Reid
Wong Si Peng
Ng Heng Oon
Teo Sze Qin
Kee Alfian
Saipullah Jamaludin
Mohd Baktiar bin Md Desa Bakar
Lim Yong Fei
Sebastian Szereday
Davies Austin Spiji
Aarston Friend Dickson
Suhaimi Ishak
Faathir Redzuan
Nur Izzati Roslan

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Christian Schneid
Teo Sze Ping
Lau Chak Onn
Rizal Bin Muhamad
Zulkifly Bin Mohd Supri
Abdul Shukor Bin Abu
Abdul Hadi bin Roslan
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Leony Sikim
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Daniel
Mohd Ramdhan

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Alen San
Teo Sze Min
Ng Liang Giap
Mohd Syarin Bin Moktar
Muhamad Fairus Bin Khalit
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Lee Sao Man
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Appendix 1: Survey Sites (2018)

Sunda Shelf

No.	Site Name	Island	Coordinate
SS 1.1	Batu Layar	Perhentian	5 54.722 N 102 44.693 E
SS 1.2	Batu Nisan	Perhentian	5 55.259 N 102 43.536 E
SS 1.3	Batu Tabir	Perhentian	5 56.345 N 102 43.321 E
SS 1.4	Tukas Laut	Perhentian	5 53.162 N 102 46.216 E
SS 1.5	Tiga Ruang	Perhentian	5 54.867 N 102 45.244 E
SS 1.6	D' Lagoon	Perhentian	5 55.927 N 102 43.395 E
SS 1.7	P. Rawa	Perhentian	5 57.777 N 102 40.833 E
SS 1.8	Sea Bell	Perhentian	5 54.636 N 102 42.589 E
SS 1.9	Shark Point	Perhentian	5 53.044 N 102 44.821 E
SS 1.10	Tanjung Basi	Perhentian	5 55.387 N 102 45.518 E
SS 2.1	Teluk Mat Delah	Redang	5 47.970 N 103 01.017 E
SS 2.2	Chagar Hutang East	Redang	5 49.038 N 103 00.597 E
SS 2.3	P. Kerengga Besar	Redang	5 45.261 N 103 01.737 E
SS 2.4	P. Kerengga Kecil	Redang	5 45.519 N 103 01.751 E
SS 2.5	P. Lima Southern Tip	Redang	5 46.397 N 103 03.553 E
SS 2.6	P. Paku Besar	Redang	5 46.777 N 103 02.557 E
SS 2.7	P. Paku Kecil	Redang	5 46.305 N 103 02.338 E
SS 2.8	P. Pinang Marine Park Centre	Redang	5 44.814 N 102 59.987 E
SS 2.9	Pasir Akar	Redang	5 44.398 N 102 59.955 E
SS 2.10	Redang Kalong HR	Redang	5 45.660 N 103 01.584 E
SS 2.11	Terumbu Kili	Redang	5 43.928 N 102 59.825 E
SS 2.12	Mak Simpan	Redang	5 47.302 N 102 59.556 E
SS 3.1	Pirates Reef	Tioman	2 49.428 N 104 09.445 E
SS 3.2	Renggis North	Tioman	2 48.594 N 104 08.183 E
SS 3.3	Fan Canyon	Tioman	2 54.650 N 104 06.753 E
SS 3.4	Soyak South	Tioman	2 52.480 N 104 08.810 E
SS 3.5	Soyak North	Tioman	2 52.560 N 104 08.884 E
SS 3.6	Batu Malang	Tioman	2 54.139 N 104 06.148 E
SS 3.7	Tekek House Reef	Tioman	2 48.960 N 104 09.062 E
SS 3.8	Chebeh	Tioman	2 55.946 N 104 05.814 E
SS 3.9	Sepoi	Tioman	2 53.883 N 104 03.100 E
SS 3.10	Teluk Kador	Tioman	2 54.891 N 104 06.507 E
SS 3.11	Tumuk	Tioman	2 47.581 N 104 07.335 E
SS 3.12	Labas	Tioman	2 53.318 N 104 03.920 E
SS 3.13	Teluk Dalam	Tioman	2 52.456 N 104 11.254 E
SS 3.14	Jahat East	Tioman	2 40.127 N 104 10.518 E
SS 3.15	Munjor South	Tioman	2 44.492 N 104 13.068 E
SS 3.16	Nayak	Tioman	2 46.758 N 104 12.760 E
SS 3.17	Saing	Tioman	2 45.502 N 104 11.950 E
SS 3.18	Batu Nipah	Tioman	2 43.928 N 104 08.125 E
SS 4.1	Coral Garden 1	Kapas	5 14.113 N 103 15.678 E

SS 4.2	Coral Garden 3	Kapas	5 14.149 N 103 15.782 E
SS 4.3	Silent Reef	Kapas	5 13.785 N 103 16.079 E
SS 4.4	Teluk Jawa	Kapas	5 12.526 N 103 16.165 E
SS 4.5	Jellyfish City	Kapas	5 13.468 N 103 15.658 E
SS 5.1	Heritage Row	Bidong/Yu	5 36.922 N 103 03.412 E
SS 5.2	Pasir Tenggara	Bidong/Yu	5 36.607 N 103 03.780 E
SS 5.3	P. Karah	Bidong/Yu	5 35.935 N 103 03.851 E
SS 5.4	P. Tengkorak	Bidong/Yu	5 39.967 N 103 04.277 E
SS 5.5	P. Yu Besar	Bidong/Yu	5 38.615 N 103 09.063 E
SS 5.6	P. Yu Kecil	Bidong/Yu	5 37.533 N 103 09.570 E
SS 6.1	Freshwater Bay	Tenggol	4 48.546 N 103 40.669 E
SS 6.2	Gua Rajawali	Tenggol	4 48.768 N 103 40.556 E
SS 6.3	Pasir Tenggara	Tenggol	4 48.021 N 103 40.456 E
SS 6.4	Rajawali Reef	Tenggol	4 49.037 N 103 40.755 E
SS 6.5	Turtle Point	Tenggol	4 48.364 N 103 40.468 E
SS 6.6	Teluk Rajawali	Tenggol	4 48.931 N 103 40.824 E
SS 7.1	Bumphead Bay	Pemanggil	2 35.066 N 104 20.180 E
SS 7.2	Lobster Bay	Pemanggil	2 34.237 N 104 19.306 E
SS 7.3	Pemanggil Village South	Pemanggil	2 34.761 N 104 18.945 E
SS 7.4	Tridacna Bay	Pemanggil	2 35.790 N 104 19.588 E
SS 8.1	P. Mentinggi	Tinggi	2 16.405 N 104 06.940 E
SS 8.2	P. Nanga	Tinggi	2 16.274 N 104 07.640 E
SS 8.3	P. Ibol	Tinggi	2 18.183 N 104 08.935 E
SS 8.4	P. Tanjung Gua Subang	Tinggi	2 18.792 N 104 07.552 E
SS 9.1	Buntut Meriam	Sibu	2 13.860 N 104 03.130 E
SS 9.2	Malang Acha	Sibu	2 11.040 N 104 06.409 E
SS 9.3	Beach 3	Sibu	2 11.268 N 104 05.888 E
SS 9.4	Sibu Hujung	Sibu	2 10.374 N 104 06.721 E
SS 9.5	Sibu Kukus	Sibu	2 10.696 N 104 06.553 E
SS 9.6	The Coconut	Sibu	2 13.567 N 104 03.184 E
SS 10.1	Atlantis Bay	Aur	2 28.271 N 104 30.633 E
SS 10.2	Pulau Lang	Aur	2 27.594 N 104 29.358 E
SS 10.3	Teluk Meriam	Aur	2 26.509 N 104 30.571 E
SS 10.4	Teluk Teluran	Aur	2 27.617 N 104 31.587 E
SS 10.5	Teluk Batu Kapal	Dayang	2 28.368 N 104 30.481 E
SS 10.6	Teluk Jawa	Dayang	2 28.651 N 104 30.271 E
SS 11.1	Siwa 4A	Miri	4 16.383 N 113 48.883 E
SS 11.2	Siwa Penyu	Miri	4 16.583 N 113 49.050 E
SS 11.3	Anemone Centre	Miri	4 17.550 N 113 49.550 E
SS 11.4	Anemone North	Miri	4 17.616 N 113 49.566 E
SS 11.5	Eve's Garden	Miri	4 20.583 N 113 53.900 E
SS 11.6	Sunday Reef	Miri	4 17.217 N 113 49.167 E
SS 14.1	Rock Bar	Pulau Rawa	2 31.164 N 103 58.435 E
SS 15.1	Batu Bulan	Lang Tengah	5 47.807 N 102 53.978 E
SS 15.2	House Reef	Lang Tengah	5 47.666 N 102 53.531 E

Malacca Strait

No.	Site Name	Island	Coordinate
MS 1.1	Pasir Tengkorak P. Lalang	Sembilan	4 00.162 N 100 32.802 E
MS 1.2	Site 1 P.Saga	Sembilan	4 00.732 N 100 32.694 E
MS 1.3	Site 2 P. Lalang	Sembilan	4 00.099 N 100 32.945 E
MS 1.4	Site 2 P. Rumbia	Sembilan	4 01.344 N 100 32.874 E
MS 1.5	Zoanthid Garden P. Rumbia	Sembilan	4 01.926 N 100 33.000 E
MS 1.6	P. Buluh	Sembilan	3 59.650 N 100 32.048 E
MS 1.7	Anemone Garden P. Saji	Sembilan	4 00.390N 100 32.088 E
MS 1.8	Frogfish P. Nipis	Sembilan	4 03.450 N 100 32.382 E
MS 1.9	Rock Garden	Sembilan	4 00.684 N 100 32.106 E
MS 2.1	Pangkor Laut	Pangkor	4 11.393 N 100 32.899 E
MS 3.1	Coral Garden	Payar	6 03.371 N 100 02.157 E
MS 3.2	Singapore Bay	Payar	6 03.639 N 100 02.472 E
MS 3.3	Langkawi Coral	Payar	6 03.951 N 100 02.606 E
MS 3.4	Kaca	Payar	6 04.389 N 100 03.444 E
MS 3.5	Lembu	Payar	6 04.293 N 100 03.067 E

North Borneo

No.	Site Name	Island	Coordinate
NB 1.1	Bimbo Rock	Lankayan	6 31.240 N 117 55.763 E
NB 1.2	Edwin Rock	Lankayan	6 30.806 N 117 55.499 E
NB 1.3	Froggie Fort	Lankayan	6 30.806 N 117 54.337 E
NB 1.4	Goby Rock	Lankayan	6 28.745 N 117 53.448 E
NB 1.5	Jawfish	Lankayan	6 29.182 N 117 54.670 E
NB 1.6	Ken's Rock	Lankayan	6 30.393 N 117 55.651 E
NB 1.7	Lycia Garden	Lankayan	6 29.895 N 117 55.634 E
NB 1.8	Mel's Rock	Lankayan	6 29.140 N 117 53.584 E
NB 1.9	Moray Reef	Lankayan	6 33.125 N 117 56.141 E
NB 1.10	Pegaso	Lankayan	6 33.726 N 117 55.210 E
NB 1.11	Reef 38	Lankayan	6 32.619 N 117 55.201 E
NB 1.12	Reef 77	Lankayan	6 33.124 N 117 55.482 E
NB 1.13	Sandbar S	Lankayan	6 29.900 N 117 54.681 E
NB 1.14	Veron	Lankayan	6 31.259 N 117 54.944 E
NB 1.15	Zorro	Lankayan	6 30.470 N 117 55.218 E
NB 2.1	Cahaya Way	Mataking	4 30.252 N 118 56.504 E
NB 2.2	Coral Garden	Mataking	4 34.212 N 118 57.415 E
NB 2.3	Mataking House Reef	Mataking	4 34.758 N 118 56.415 E
NB 2.4	Pandanan Bay	Mataking	4 34.907 N 118 54.795 E
NB 2.5	Stingray City	Mataking	4 33.359 N 118 55.627 E
NB 2.6	Sweetlips Rock	Mataking	4 35.960 N 118 56.454 E
NB 3.1	Usukan Cove Lodge	Usukan Cove	6 22.455 N 116 20.586 E
NB 3.2	Uban-Uban	Usukan Cove	6 23.442 N 116 19.342 E
NB 3.3	Pandan-Pandan	Usukan Cove	6 21.265 N 116 18.666 E

NB 3.4	Poduko	Usukan Cove	6 22.322 N 116 19.438 E
NB 3.5	Lok Liak	Usukan Cove	6 22.126 N 116 19.101 E
NB 3.6	Keramat	Usukan Cove	6 23.635 N 116 19.637 E
NB 4.1	Sahara	Mantanani	6 43.295 N 116 20.905 E
NB 4.2	Abalone	Mantanani	6 43.207 N 116 22.105 E
NB 4.3	Police Gate	Mantanani	6 42.730 N 116 20.313 E
NB 4.4	Italian Place	Mantanani	6 42.308 N 116 19.232 E
NB 4.5	Riza Garden	Mantanani	6 42.136 N 116 21.812 E
NB 4.6	Linggisan	Mantanani	6 42.832 N 116 20.084 E
NB 4.7	Stingray Point	Mantanani	6 42.764 N 116 19.771 E
NB 4.8	Indian Brothers	Mantanani	6 43.191 N 116 20.454 E
NB 4.9	Mari Mari House Reef	Mantanani	6 42.396 N 116 19.275 E
NB 4.10	Coral Reef	Mantanani	6 42.389 N 116 20.840 E
NB 4.11	Kolam	Mantanani	6 43.930 N 116 21.567 E
NB 4.12	South East Point	Mantanani	6 42.454 N 116 22.329 E
NB 6.1	House Reef	Lahad Datu	4 58.027 N 118 15.841 E
NB 6.2	Cabbage Reef	Lahad Datu	4 56.927 N 118 15.470 E
NB 6.3	Paradise	Lahad Datu	4 56.548 N 118 17.637 E
NB 6.4	Lam's Point	Lahad Datu	4 56.275 N 118 16.464 E
NB 6.5	Nemo Garden	Lahad Datu	4 56.494 N 118 16.945 E
NB 6.6	Fish Eyes	Lahad Datu	4 57.782 N 118 15.165 E
NB 6.7	Mid Reef	Lahad Datu	4 54.740 N 118 15.256 E
NB 6.8	Small Reef	Lahad Datu	4 54.444N 118 14.595 E
NB 6.9	Adam's Point	Lahad Datu	4 57.052 N 118 15.473 E
NB 6.10	Ira's Reef	Lahad Datu	4 55.412 N 118 15.363 E
NB 6.11	Light House	Lahad Datu	4 56.922 N 118 15.076 E
NB 6.12	Pulau Burung	Lahad Datu	4 55.439 N 118 16.003 E
NB 6.13	Pulau Laila	Lahad Datu	4 55.811 N 118 13.711 E
NB 6.14	Pulau Tabun	Lahad Datu	4 55.246 N 118 12.076 E
NB 6.15	Tumunong Hallo	Lahad Datu	4 54.510 N 118 10.644 E
NB 7.1	Kapalai Rock	Kapalai	4 12.615 N 118 40.797 E
NB 7.2	Great Wall	Kapalai	4 13.767 N 118 40.800 E
NB 7.3	Little Okinawa	Kapalai	4 12.850 N 118 40.533 E
NB 7.4	Cleaning Station	Kapalai	4 13.517 N 118 41.283 E
NB 7.5	Siu Siu Point	Kapalai	4 13.087 N 118 40.313 E
NB 7.6	Lost World	Kapalai	4 12.093 N 118 41.392 E
NB 8.1	Eel Garden	Mabul	4 13.883 N 118 38.017 E
NB 8.2	Ribbon Valley	Mabul	4 14.046 N 118 38.255 E
NB 8.3	Stingray City	Mabul	4 14.222 N 118 37.641 E
NB 8.4	Panglima	Mabul	4 14.922 N 118 37.529 E
NB 8.5	Paradise	Mabul	4 14.989 N 118 37.830 E
NB 11.1	Kapikan Reef	TSMP, Semporna	4 37.698 N 118 50.112 E
NB 11.2	Mantabuan	TSMP, Semporna	4 37.933 N 118 47.798 E
NB 11.3	Ribbon Reef	TSMP, Semporna	4 36.135 N 118 46.090 E
NB 11.4	South Rim	TSMP, Semporna	4 34.078 N 118 45.498 E

NB 11.5	Sibuan	TSMP, Semporna	4 39.154 N 118 39.884 E
NB 11.6	Tanjung Kenangan	TSMP, Semporna	4 35.127 N 118 47.155 E
NB 12.1	Barracuda Point	Sipadan	4 07.130 N 118 37.745 E
NB 12.2	Coral Garden	Sipadan	4 06.342 N 118 37.722 E
NB 12.3	Drop Off	Sipadan	4 07.092 N 118 37.675 E
NB 12.4	Hanging Garden	Sipadan	4 06.703 N 118 37.495 E
NB 12.5	Lobster Lair	Sipadan	4 06.557 N 118 37.540 E
NB 12.6	Mid Reef	Sipadan	4 06.812 N 118 38.158 E
NB 12.8	South Point	Sipadan	4 06.258 N 118 38.110 E
NB 12.9	Staghorn Crest	Sipadan	4 06.257 N 118 37.895 E
NB 12.10	Turtle Patch	Sipadan	4 06.450 N 118 38.177 E
NB 12.11	White Tip	Sipadan	4 07.137 N 118 38.055 E
NB 12.12	West Ridge North	Sipadan	4 06.910 N 118 37.487 E
NB 13.1	Mid Reef	Pulau Penyu	6 10.402 N 118 04.287 E
NB 13.2	Pulau Bakungan 1	Pulau Penyu	6 10.192 N 118 06.538 E
NB 13.3	Pulau Bakungan 2	Pulau Penyu	6 09.805 N 118 06.483 E
NB 13.4	Pulau Gulisan	Pulau Penyu	6 09.268 N 118 03.512 E
NB 13.5	Selingan	Pulau Penyu	6 10.813 N 118 03.803 E
NB 14.1	Mandarin House Reef	Pom Pom	4 35.414 N 118 51.849 E
NB 14.2	House Reef	Pom Pom	4 35.837 N 118 51.678 E
NB 14.3	Cliff Hanger	Pom Pom	4 35.729 N 118 52.181 E
NB 14.4	Twin Pom Pom Housereef	Pom Pom	4 35.643 N 118 51.675 E
NB 14.5	North Tip	Pom Pom	4 36.225 N 118 51.918 E
NB 14.6	Spongebob	Pom Pom	4 35.432 N 118 51.833 E