



UNIVERSITI SAINS MALAYSIA



**FINAL REPORT ON THE MARINE
BIODIVERSITY OF PULAU INTAN
BESAR AND PULAU INTAN KECIL
AND THEIR POTENTIAL IN BECOMING
MARINE PARKS**

by

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1.0 INTRODUCTION

Malaysia's international commitment requires her to invariably increase the numbers and acreage of her marine protected areas – 10 % of her territorial seas by the year 2015 and by 2020. Thus, this study was conducted to determine the status of the coral reefs and their associated biological diversity at Pulau Intan Besar and Pulau Intan Kechil waters for the purpose of establishing a marine park.

Both islands are uninhabited and harbour some unique diversity on their coral reefs, despite the turbid water environment. The area is also a traditional fishing ground for the artisanal and bilis fisherman with other multiple uses that needs to be considered.

This report details the biological diversity findings of the Pulau Intan Besar and Pulau Intan Kechil and its potential of becoming a marine park. It will reveal a study case of a non-protected area subjected to chronic uses of environmental resources and its implications to the ecosystem.

2.0 LOCATION OF THE STUDY SITE

The study site is located in the northern section of the Straits of Malacca within the coastal waters of Kedah and Langkawi. The Pulau Intan Besar and Pulau Intan Kechil island group can be approached by Pantai Cenang or through the port of Kuah, but the nearest port to these islands is from the Awana Porto Malai Resorts (Figure 2.1). This section describes the detail location and coastal habitats of the islands.

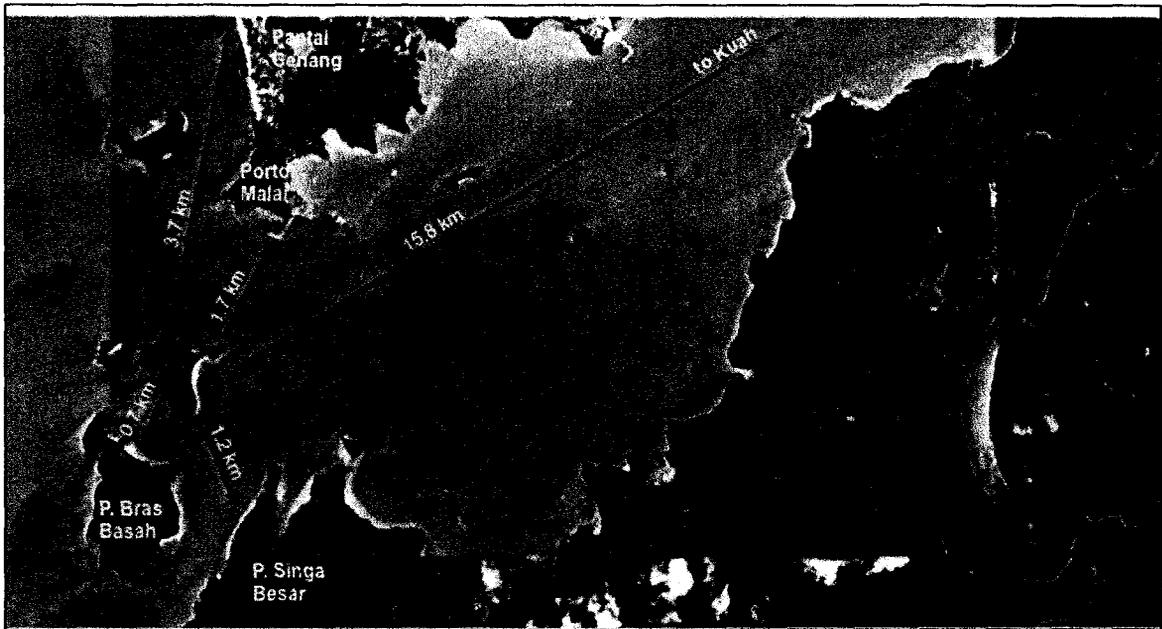
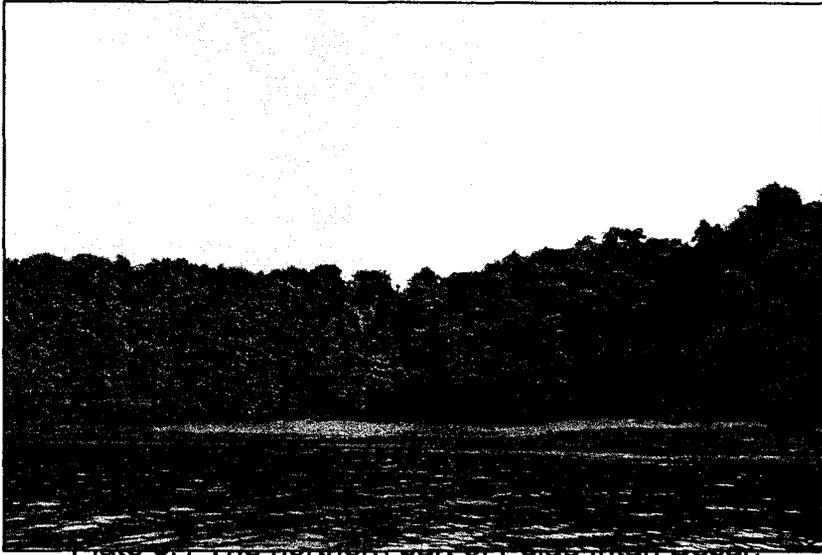


Figure 2.1. Approaches to Pulau Intan Besar and Pulau Intan Kecil group of islands.

A. Pulau Intan Besar

This is the biggest island in the group covering approximately 0.45 km² (Figure 2.2 and Plate 3.1). It is located to the southwest of Pulau Langkawi, and to the northeast of Pulau Beras Basah. The longest sandy beach is situated on the eastern part of the island that stretches out approximately 1 km along the coastline. A few more sandy beaches can be found on the northern side of the island facing the main island of Langkawi. The western part of the island has sheer rock walls and is exposed to high waves. The island itself is covered in vegetation but there is no freshwater source.



B. Pulau Intan Kechil

This island is located on the west of Pulau Intan Besar and covers an area of 0.05 km² (Figure 2.2 and Plate 3.2). There is a prominent sandy beach on the eastern side of the island and rocky escarpment on the western side, which are also exposed to high and strong waves. Between these two islands is a small and narrow passage that channels strong water current, which perturbed the silty substrate at the bottom and contributes to the turbid water condition in the area.

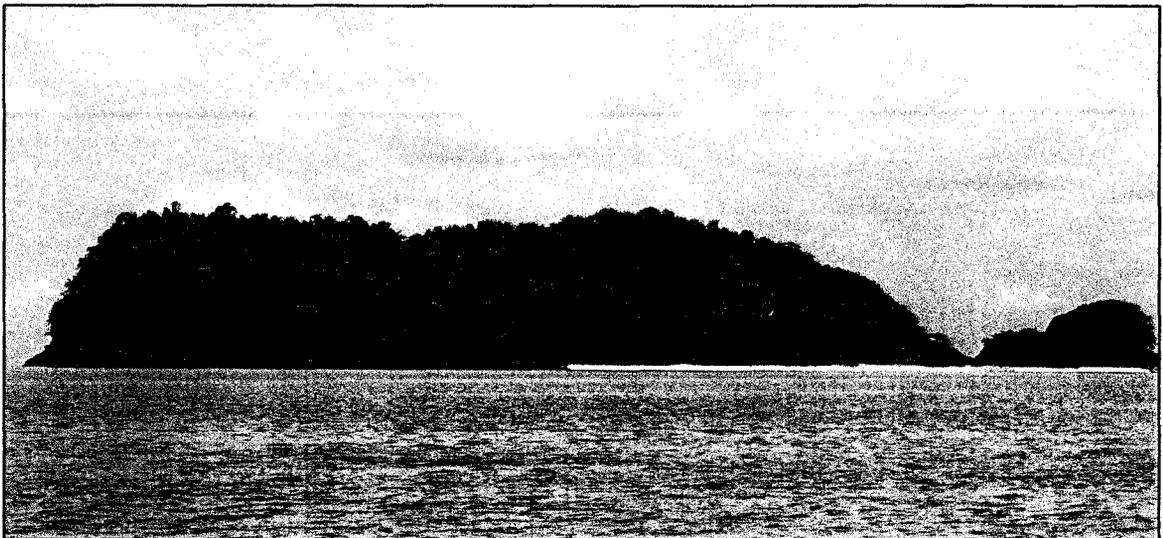


Plate 3.2 The island of Pulau Intan Kechil.

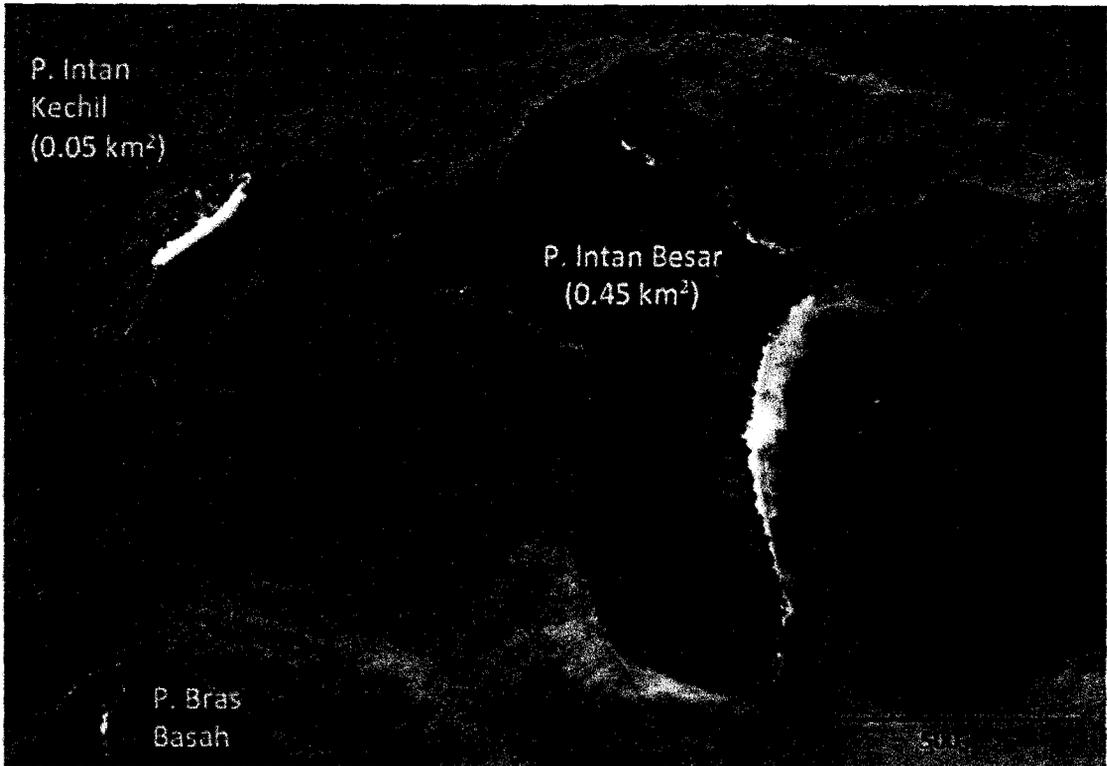


Figure 2.2. The proximity and size of Pulau Intan Besar and Pulau Intan Kechil.

3.0 THE STATUS OF THE REEFS AND CORALS

A detail assessment of the coral reefs of Pulau Intan Besar and Pulau Intan Kechil were done using the photo transect method. Due to the low visibility of the waters surrounding the islands, this method was deemed suitable for assessing coral reefs condition here. Overall, the reef condition in these islands can be divided into three main sections: the eastern, western and northern reefs (Figure 3.1).

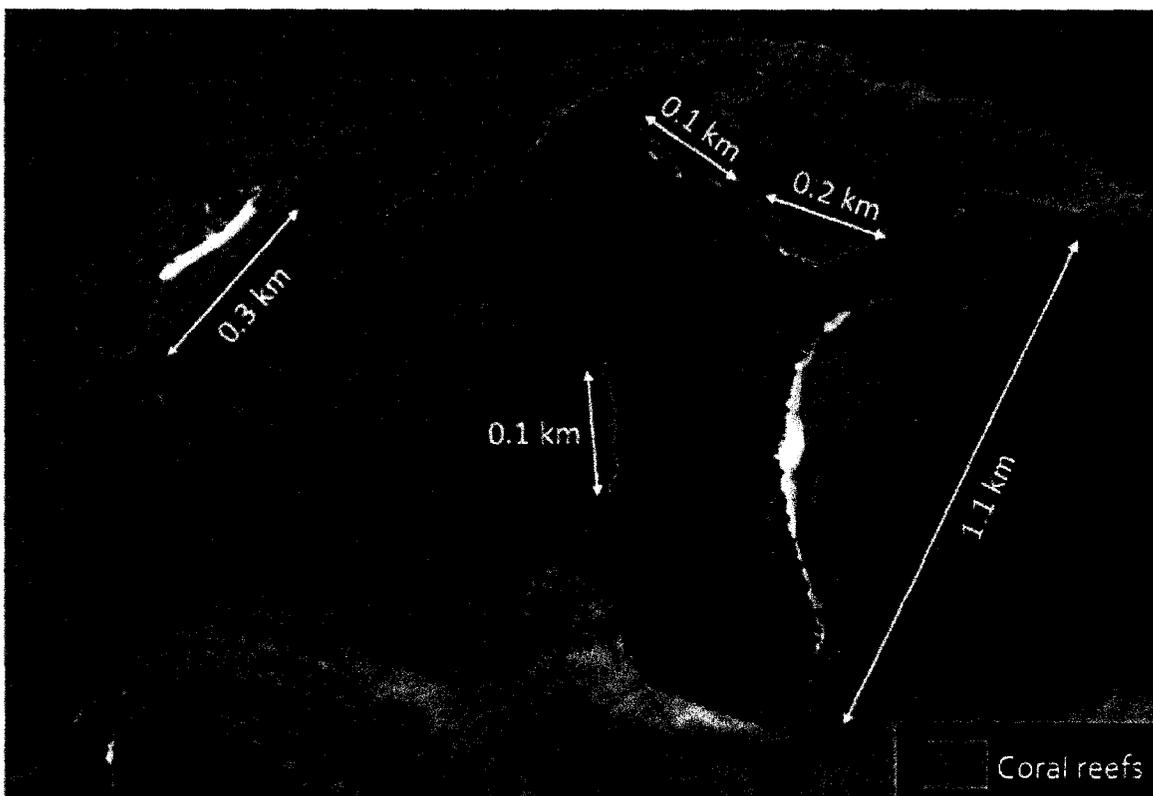


Figure 3.1. The coral reefs area at Pulau Intan Kechil and Pulau Intan Besar.

a) Eastern reef

The main reef of Pulau Intan Besar is located on the eastern shore of the island fronting the long beach and rocky shore here (Plate 3.1). The reef created at the northern section of the beach is an extended sand flat, which has been formed of fine sand and sediment. The live coral cover and coral diversity increases steadily towards the east. The live coral cover is between 40 - 55% at the reef flat. The reef flat extends for about 100 m before the reef edge is reached. At the reef edge, coral diversity is the highest and live coral cover is from 40 - 70%. Corals such as *Porites* are larger here but

crenulations on the surface of the *Porites* boulders and the partial death of the specimens indicated high sedimentation rates in the environment (Plate 3.2).

At the extreme end of the reef edge, the reef slopes abruptly to 4 m. The upper slopes are composed of *Porites*, *Goniopora* and some plate-like *Acropora*. Two species of sea anemone with their resident clownfish were also found here. At the bottom of the slope, the live coral cover decreases (relatively less than on the upper slope). Some brain corals were found here despite the high sediment environment. Beyond the lower slope, the bottom is composed of silty sand. The depth of this sediment extends beyond a foot deep. The predominant fauna are the octocorals such as sea fans. These are found on dead coral boulders and are often home for the bivalves.

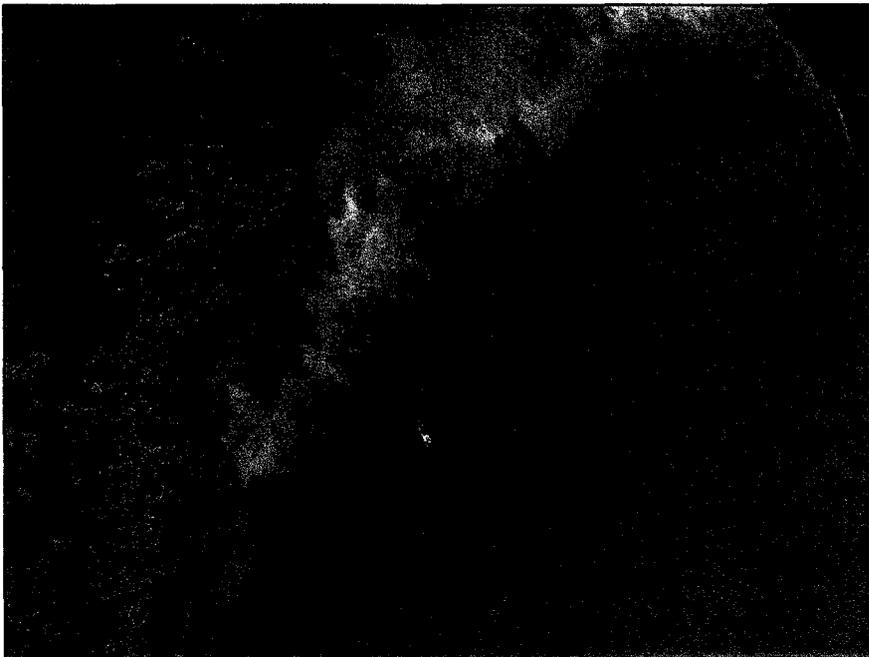


Plate 3.1 The coastline of the eastern side of Pulau Intan Besar lined with sandy beach and reef area.

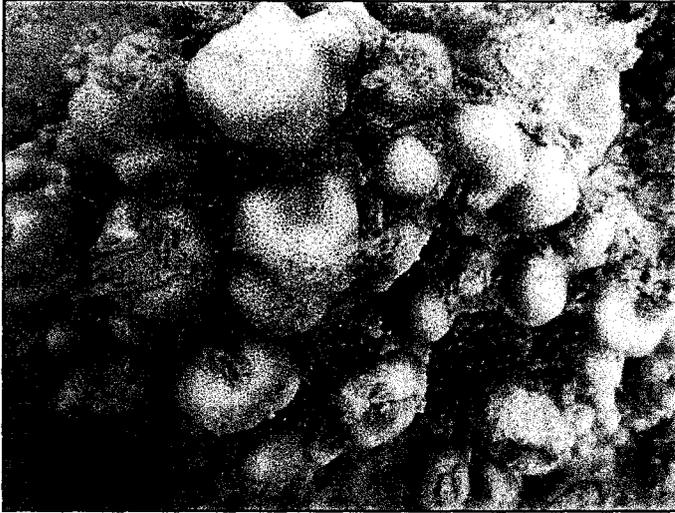


Plate 3.2 Crenulations on the surface of a specimen of *Porites* boulder and fine sediment trapped in between the coral lobes.

b) Western reef

On the western side of Pulau Intan Besar there is no developed reef. Live coral cover is from 0 – 20%. Small coral colonies are found on the rock wall that extends below the waters surface. These are found on the shallow areas less than 2 m. Beyond this, the predominant forms are the gorgonians and sea whips (Plate 3.3). This reflects the very turbid waters, which are not conducive for the hard corals. Beyond the boulders, the sediment is composed of fine silt. They are resuspended with the fast flowing current found here. On the soft sediment, there are clumps of oysters forming small beds. On the sea fans are rich fauna of bivalves. No crinoids were observed although a few specimens of the sea cucumber *Holothuria leucospilota* were seen. Fish life was poor. No large specimens were seen.

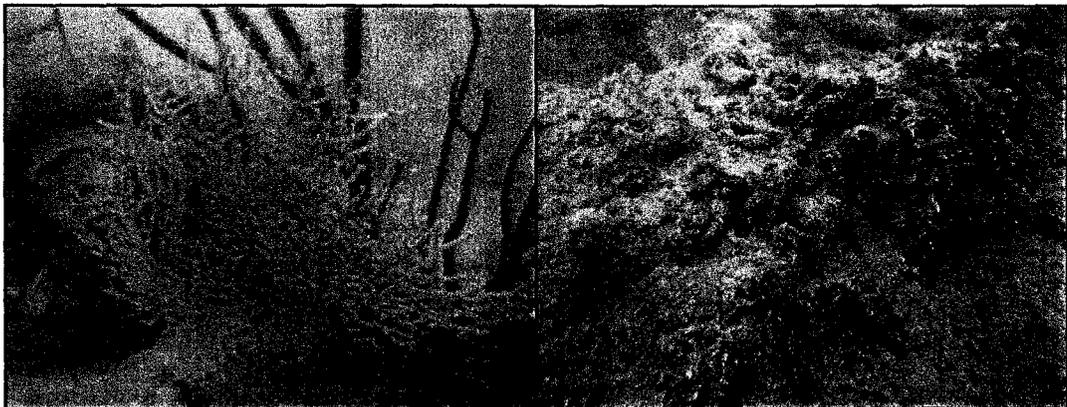


Plate 3.3 Soft corals of Pulau Intan Besar.

c) Northern reef

The northern reef of Pulau Intan has high diversity of hard corals and the size of reef here is second compared to the eastern reefs. The live coral cover is from 20 – 40%. The species composition is similar to that on the eastern reef. Fishing debris is quite common here and these do significant damage to the reef.

Figure 3.2 showed the percentage of different types of substrates that can be found in Pulau Intan Besar and Pulau Intan Kechil, whereas Figure 3.3 showed the main geomorphologic features of the islands.

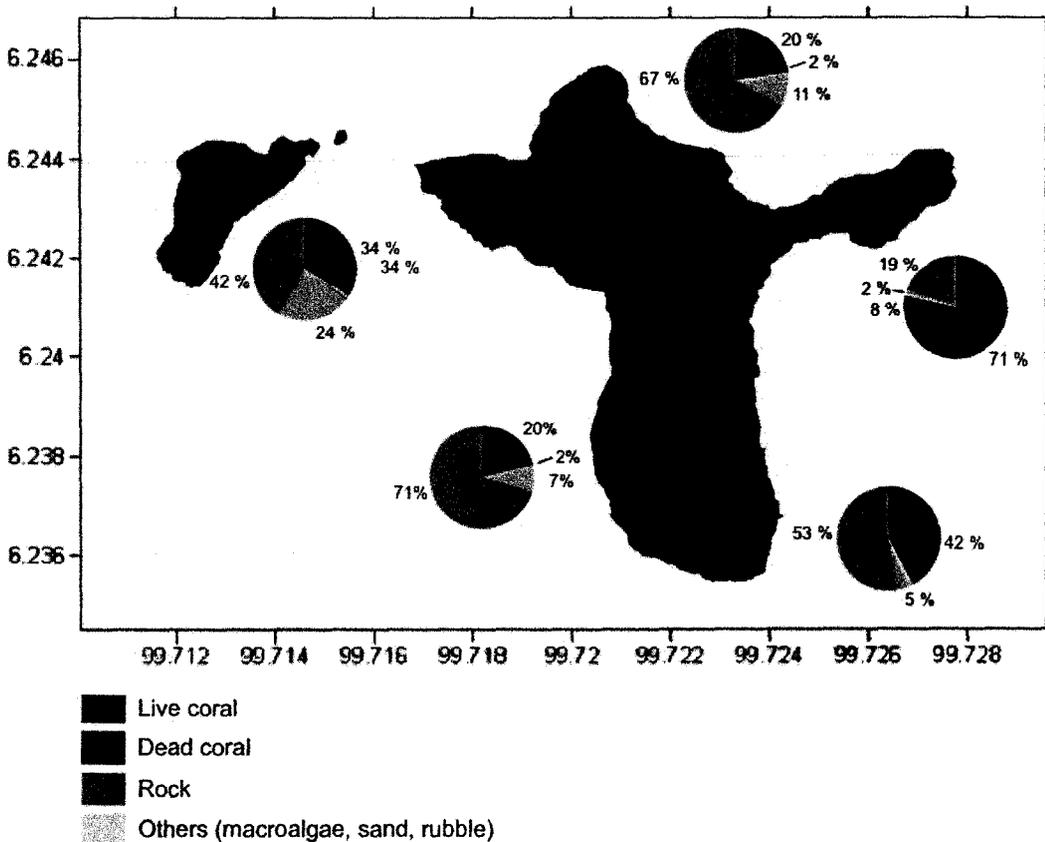


Figure 3.2. The coverage of different substrate type at different reef area of Pulau Intan Besar and Pulau Intan Kechil.

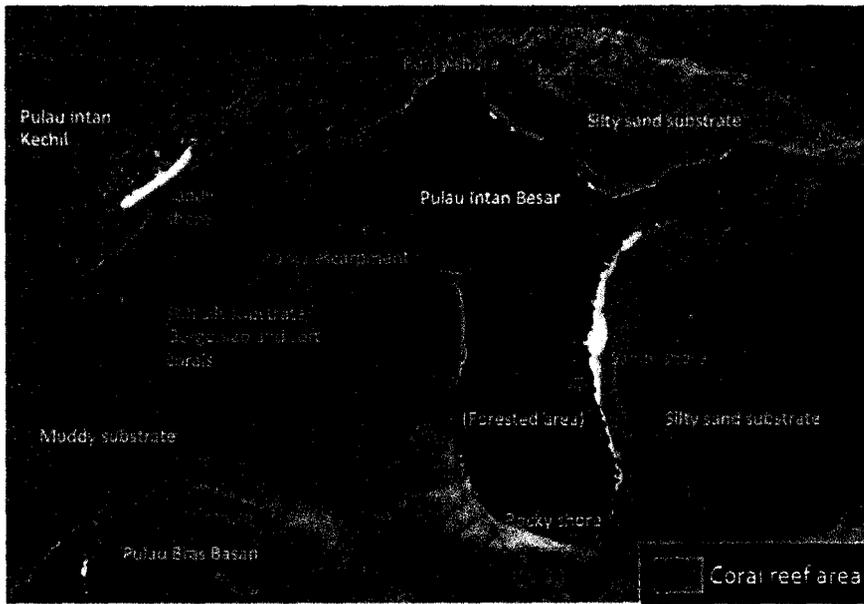


Figure 3.3. Position of coral reefs and main geomorphologic features.

4.0 BIODIVERSITY OF HARD AND SOFT CORALS

Overall, there are 29 genera from 12 families of hard corals were recorded in the islands. Faviidae, which is the common corals of turbid waters, is the most dominant hard corals found in this study. Meanwhile, Ellisellidae and Melithaeidae are the most commonly found soft corals. Altogether, 6 families and 11 genera of soft corals were found here. Table 4.1 and 4.2 showed the biodiversity of hard and soft corals that can be found in Pulau Intan Besar and Pulau Intan Kechil.

Table 4.1. Hard corals of Pulau Intan Besar and Pulau Intan Kechil.

Family	Genus
Acroporidae	<i>Acropora</i>
	<i>Astreopora</i>
Agariciidae	<i>Leptoseris</i>
	<i>Pachyseris</i>
	<i>Pavona</i>
Dendrophylliidae	<i>Turbinaria</i>
Faviidae	<i>Cyphastrea</i>
	<i>Diploastrea</i>
	<i>Echinopora</i>
	<i>Favia</i>
	<i>Favites</i>
	<i>Goniastrea</i>
	<i>Leptoria</i>
	<i>Oulophyllia</i>
	<i>Montastrea</i>
	<i>Platygyra</i>
	Fungiidae
<i>Lithophyllon</i>	

Merulinidae	<i>Hydnophora</i>
Mussidae	<i>Symphyllia</i>
Oculinidae	<i>Galaxea</i>
Pectiniidae	<i>Echinophyllia</i>
	<i>Oxypora</i>
	<i>Pectinia</i>
Pocilloporidae	<i>Pocillopora</i>
	<i>Stylophora</i>
Poritidae	<i>Goniopora</i>
	<i>Porites</i>
Siderastreidae	<i>Psammocora</i>

Table 4.2. Soft corals of Pulau Intan Besar and Pulau Intan Kechil.

Family	Genus
Ellisellidae	<i>Dichotella</i>
	<i>Junceella</i>
	<i>Viminella</i>
Subergorgiidae	<i>Subergorgia</i>
Melithaeidae	<i>Acabaria</i>
	<i>Melithaea</i>
	<i>Mopsella</i>
Anthothelidae	<i>Alertigorgia</i>
Nidalidae	<i>Siphonogorgia</i>
	<i>Nephtyigorgia</i>
Plexauridae	<i>Paraplexaura</i>

5.0 MARINE WATER QUALITY ASSESSMENT

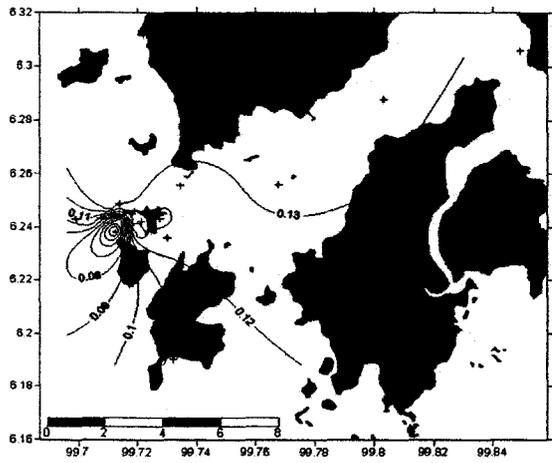
The results obtained from the physical and chemical parameters are summarized in Table 5.1. Variations were observed in both physical and chemical parameters from coastal area to the coral reef islands. The average surface temperature was recorded in the range of 30.63 - 31.59 °C. Results obtained for total suspended solid (TSS) indicated mean values ranging from 0.14 - 0.20 mg/L.

Generally, water quality of Pulau Intan Besar and Pulau Intan Kechil is in poor condition. The level of chemical parameters exceeded the Malaysian Marine Water Quality Criteria and Standard Class 1 (for preservation, marine protected areas, and marine parks) from DOE. The distribution of chemical nutrients showed an average value of 0.07 - 0.40 mg/L for phosphate, 0.01 - 0.10 mg/L for ammonium, 0.04 - 0.11 mg/L for nitrate, and 0.00 - 0.01 mg/L for nitrite. The distribution of all the nutrient concentration showed a declining trend from the coast to the coral reef islands (Figure 5.1). The nutrient concentration near the coastal waters indicated that areas with extensive human activities showed a higher nutrient concentration level in the water.

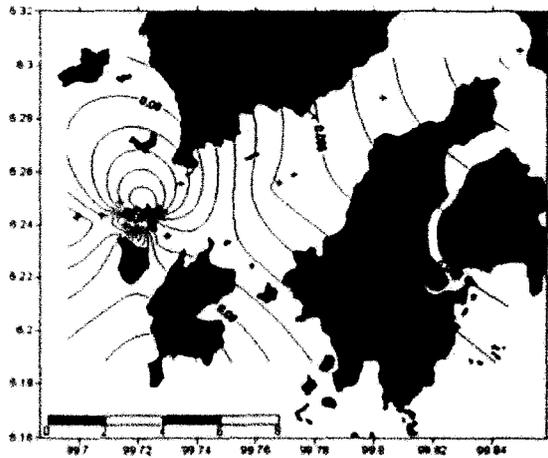
Table 5.1. Comparison of the measurements of water quality parameters at Pulau Intan Besar and Pulau Intan Kechil with the Malaysian Marine Water Quality Criteria and Standard from DOE and ASEAN Marine Water Quality Criteria.

Parameter	Measurements	DOE Criteria (Class 1)	DOE Criteria (Class 2)	ASEAN Marine Water Quality Criteria
Temperature (°C)	30.63-31.59	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient
TSS (mg/L)	0.14-0.20	25 mg/L or ≤ 10% increase in seasonal average	50 mg/L or ≤ 10% increase in seasonal average	≤ 10% increase in seasonal average
Ammonia (mg/L)	0.01-0.10	0.035 mg/L	0.070 mg/L	0.07 mg/L
Nitrite (mg/L)	0.00-0.01	0.01 mg/L	0.055 mg/L	0.055 mg/L
Nitrate (mg/L)	0.04-0.11	0.01mg/L	0.06mg/L	0.06 mg/L
Phosphate (mg/L)	0.07-0.40	0.005 mg/L	0.075 mg/L	0.015 mg/L (Coastal) 0.045 mg/L (Estuarine)

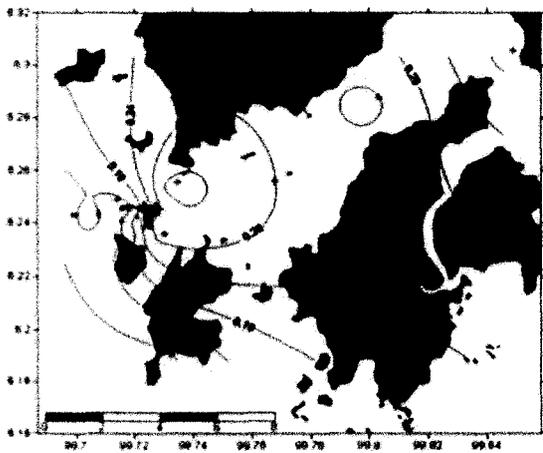
Total Suspended Solid (mg/L)



Nitrate (mg/L)



Phosphate (mg/L)



Ammonia (mg/L)

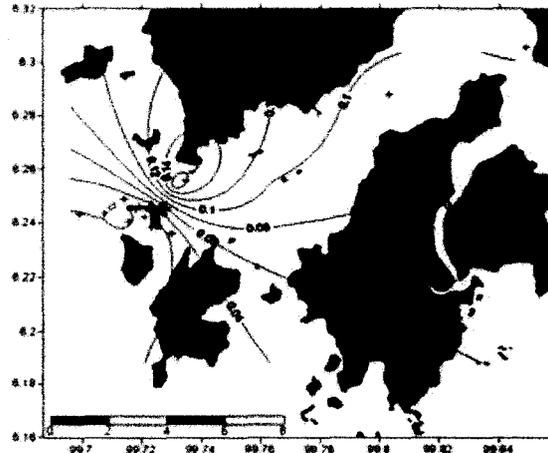


Figure 5.1. Contour map of total suspended solid, nitrate, phosphate and ammonia concentration obtained by interpolation of field observations using kriging.

6.0 THE VIABILITY OF PULAU INTAN BESAR AND PULAU INTAN KECHIL AS MARINE PARK

The strengths, weaknesses, opportunities, and threats (**SWOT**) framework is recommended in this study to categorize significant environmental factors both internal and external to the issue that is being discussed – prospects of Pulau Intan Besar and Pulau Intan Kechil to become marine parks. The SWOT framework analysis will lead to the obtainment of quantitative results useful in the management planning by the calculation of environmental quality (strengths) and territory vulnerability (weaknesses) using environmental indicators. External analysis will be then made through the analysis of threats (relation between human activities and natural environment) and opportunities (optimization of strengths and threats). The derivation of the key strategies from SWOT framework analysis are summarized below:

Strengths

- High biodiversity of corals and soft corals.
- Presence of luminescent coral.
- Reef flat and upper reef edge can be approached at low spring tide providing visitors the opportunity to experience the reef without diving.
- Close proximity to the Langkawi main island providing excellent accessibility.
- Unique new habitats such as the turbid water coral communities and the soft coral/sea fan community.

Weaknesses

- Small in size (needs further scientific investigation for self sustainability in ecosystem maintenance).
- Damage to reefs by fishing activity.
- Low diversity of fish.
- Solid waste from the Langkawi mainland.
- Sedimentation problems from the main island activities especially in elevated sedimentation and turbidity.
- The high water turbidity of the surrounding waters makes it unsuitable

for diving

- No natural surface freshwater source with probably a limited supply of groundwater.
- The island in the past has experienced several fires in the past during the dry season.

Opportunities

- Conservation of a new type of reef habitat – the turbid water reef.
- Potential of a good logistics support.
- Support of the Malaysian national CBD commitment.
- Contribution to the Malaysian national CTI-CFF goals.
- First marine park on the main Langkawi island group and second marine park in the Straits of Malacca.
- Fisheries resource protection and rehabilitation (as the current fish diversity are exceptionally low) will benefit the fishing community.
- A potential for an excellent education venue and Malaysia's showcase on conservation efforts.

Threats

- Some scientific issues are unresolved that will introduce uncertainty to the park management such as sustainability and connectivity of these islands to nearby island habitat.
- Possible reaction from the fishers' community.
- Cleaning up of the sea bottom has to be done with care as many areas are already stressed by the high sedimentation.
- Potential increase in the number of tourist visitations requires careful planning

7.0 RELEVANT RECOMMENDATIONS

This study also points to several key gaps in our understanding of the damage and possible evolution of the reef here with respect to the influences from the mainland, the tourism activities and the current events. Future research directions will have to be addressed on the following issues for the better understanding and management of these islands.

- i. Try to include more of the nearby islands or part of these islands into the marine park system.
- ii. Engage and sensitise the fishermen and tourism stakeholders (especially at Pantai Cenang, Porto Malai and Kuah) to the benefits of including the islands and its waters into the Marine Park system
- iii. Explore the possibility of a new type of park that emphasize value added education supporting the tourism trade of Langkawi.
- iv. Take the opportunity to engage a holistic study on the effects of a Marine Park establishment based on the Malaysian model on the economy and environment of southern Langkawi.

Comparison of Gonadal Development of Blood Cockle (*Anadara granosa*) in East Coast Sumatera, Indonesia and Pulau Pinang, Malaysia Using Condition Index

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The gonad development of *Anadara granosa* found in East Coast Sumatera (Indonesia) and Pulau Pinang (Malaysia) using condition index (CI) was compared. Sampling was collected July 2009 until March 2010. Two sites were selected in east coast Sumatera, namely Banda Aceh and Lhokseumawe and one site in Pulau Pinang. The highest condition index in Banda Aceh sampling site was observed in June (10.74 ± 5.71 g/mL) whereas the lowest was observed in October (8.27 ± 3.03 g/mL). In Lhokseumawe sampling site, the highest CI was observed in October (13.97 ± 3.49 g/mL) and the lowest showed in January (6.76 ± 1.13 g/mL). The fluctuated in CI was shown in Pulau Pinang sampling site which the highest CI in the Pulau Pinang cockle population was observed in March (15.74 ± 2.95 g/mL) and the lowest in November (9.50 ± 2.15 g/mL). The blood cockle population in Lhokseumawe and Banda Aceh seemed to reach the highest condition index earlier compared to Pulau Pinang. These two populations eventually spawned earlier and showed the lowest condition index earlier compared to Pulau Pinang. The different rate of Condition Index was influenced by the environmental parameters.