

THE CONDITION AND COMMUNITY STRUCTURE OF CORAL REEFS IN PATHEW DISTRICT, CHUMPHON PROVINCE

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ABSTRACT

The studying along coral reefs in Pathew District, Chumphon Province were conducted in 2002-2004. The objective of this study was to investigate condition of coral reefs and coral community structure. Manta-tow technique and Line intercept method (English *et al.*, 1994) were used in this study. The result showed that condition of the reefs varied. Most of reefs around islands were in very good condition, whereas reefs along shoreline were in very poor condition. In conclusion, the reef condition was very poor and still in same condition compared to the result in 2000-2001. The major components of coral community were branching form, *Pocillopora damicornis* and massive form, *Porites lutea*. The cause of degraded condition are discussed and considered the possibility of reef restoration.

Key words: Coral, coral reef, community structure, condition of coral reef, Chumphon

I. INTRODUCTION

This study was an activity under the Integrated Coastal Resources Management (ICRM-PD) project which participated between SEAFDEC/TD, Department of Fisheries (DOF) and Department of Marine and Coastal Resources (DMCR). A baseline and monitoring survey on status of coastal marine environment is important for aquaculture management. The reefs provide coastal populations with important resources, especially fisheries. Most fishermen are supported by reef fisheries. Coral reefs worldwide are experiencing substantial degradation (Wilkinson 2004). Extensive coral mortality can be attributed to natural stress such as coral bleaching, storms and catastrophic low tide events (Done, 1999; Brown *et al*, 2000). Human play a large role in reef degradation by dredging, destructive fishing method, over-fishing, sewage run-off such as nutrients and tourist-related activities. The effects are pollution, damage to reef, increased sedimentation, increased nutrients which can change community structure and reduce fish stock (Birkeland, 1997). Therefore, this study provides change in condition of reefs and a quantitative of coral community structure.

II. OBJECTIVE

The objective of this survey is to investigate the present condition of coral reefs, also the change of the status of reefs and coral community structure of the reef in Pathew District, Chumphon Province.

III. MATERIALS AND METHODS

1. Manta-tow technique

Study sites

The study was carried out in 2004. A total of 9 reefs along the islands and shorelines in Pathew District, Chumphon Province. The reefs along islands were Ko Si Kong, Ko Rang, Ko Eiang, Ko Phra, Ko Ran Pet, Ko Ran Kai, Ko Khai, Table Rock and Ko Chorakhe. The reefs along shoreline were Khao Tham Thong, Khao Laem Yai, Ban Thung Khai Nao to Ban Buek Khlong, Laem Taen, Laem Yang, Laem Sa Phli, Khao Pho bae and Khao Lan. (Fig. 1)

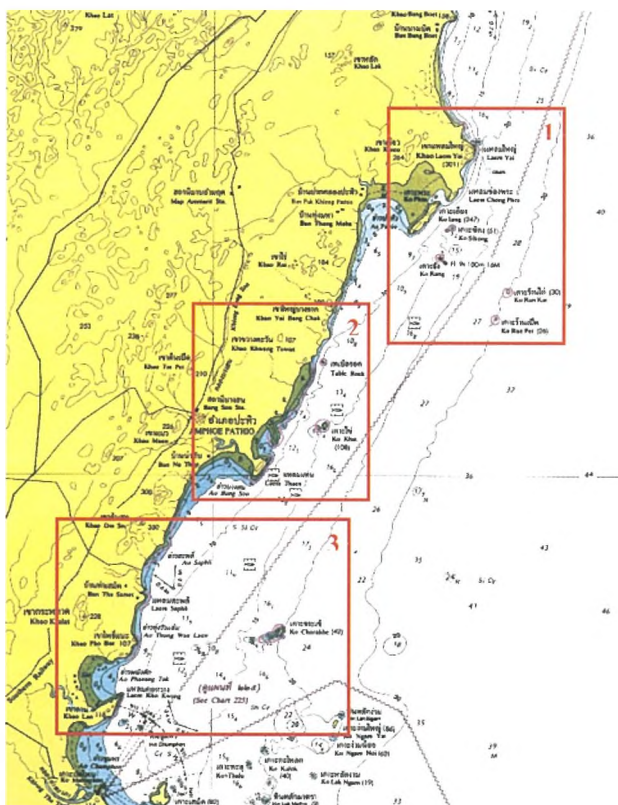


Fig. 1 Map showing location of study sites of reefs along the islands and shorelines in Pathew District, Chumphon Province.

Methodology

According to the Manta-tow technique (English *et al.*, 1994) involves towing 3 skin-diving observers, using a rope and manta-board behind a dinghy. Tows were carried out at a constant 2-knot speed around the perimeter of a reef edge-slope zone and were broken into units of 2 minutes duration. On board, the surveyors controlled the direction and recorded the position from GPS relating to underwater recorded data. During each 2-minute tow, observers made visual census then recorded data onto slate board. In addition, when the manta-tow was not possible due to either high turbidity of water, the spot-check was made instead. The 3 observers investigated the reefs at a covering area of about 120x10 m.². Several variables including percentage cover of the coral, dead coral, sand and rock were recorded. To The data of 3 observers was analyzed into average. The ratio of live to dead coral cover was used for interpreting the condition of the reefs as follows:

Live coral cover : Dead coral cover	Reef status	Legend in map
≥ 3 : 1	very good reef	1
2 : 1	good reef	2
1 : 1	fair reef	3
1 : 2	poor reef	4
1 : ≥3	very poor reef	5

2. Line intercept method

Study sites

The study was carried out at the west coast of Ko Khai (Lat.10 °42' Long. 99 °24') in 2004.

Methodology

The line intercept method (English *et al.*, 1994) was used to reef assessment. The 30 m. long transect, 5 replicates were laid on slope zone of the reefs. All lines were laid parallel to the rim of the reefs. During measurements of reef substrate of a colony of live coral and other attached reefal organisms, such as zoanthid, corallimorphs, sea anemone, sponges and macroalgae as well as abiotic substrate such as sand and rock which intersected measuring tape, were recorded. The percentage cover of live corals (identified to the species level), other benthic organisms, sand and rock substrate and dead coral was collective calculated relative to the whole length of the transect. Since dead coral, was not measured, its cover was calculated by subtracting the cover of all measured substrate types from the total length of transect line. The condition of reefs was used the same criteria as those of the manta-tow data.

Additionally, profile of the reef was established by laying the transect from the shore to the end of slope, and recording the depth of the reef at 10 m. intervals. Whereas the percentage cover of corals and substrate along the whole profile line was observed separately at every 10 m. intervals by recording the absolute length of coral and substrate in the same manner as the line intercept assessment explained above.

Basic statistics to describe and compare the coral community were calculated: (1) number of species; (2) percent of coral cover; (3) Shannon-Weaver's species diversity index (H') by

$$H' = - \sum p_i \ln p_i \text{ (Shannon and Weaver, 1949).}$$

IV. RESULTS

1. Reef condition surveyed by Manta-tow technique

The condition of reef was divided into 2 groups. The first group was the group of the reefs along islands and the second group was the group of the reefs along shorelines of mainland. (Table 1 and Fig. 2-4)

1.1 The group of the reefs along islands

Table 1. Showing coral reef area, towing distance and reef condition in Pathew District, Chumphon Province in 2004.

Island	Coral reef area (km ²)	Estimated* towing distance (km.)	Reef condition**				
			Very good	Good	Fair	Poor	Very poor
			(%)	(%)	(%)	(%)	(%)
Khao Tham Thong	0.04	0.6	12.50	37.50	50.00	-	-
Khao Laem Yai	0.04	0.8	28.57	14.29	57.14	-	-
Ko Eiang	0.01	0.2	100	-	-	-	-
Ko Phra	0.01	0.1	100	-	-	-	-
Ko Si Kong	0.02	0.1	50	50	-	-	-
Ko Rang	0.02	0.4	100	-	-	-	-
Ko Ran Kai	0.01	0.2	100	-	-	-	-
Ko Ran Pet	0.01	0.4	100	-	-	-	-
Table Rock	0.01	0.4	100	-	-	-	-
Ko Khai	0.15	1.3	42.86	0.00	28.57	7.14	21.43
Ko Chorakhe	0.19	2.2	37.04	11.11	37.04	-	14.81
Pathew shoreline	2.63	9.6	2.86	0.00	18.57	14.29	64.29
Laem Thaen	1	0.5	-	-	-	-	100
Laem Yang	1.5	0.6	-	5.13	15.38	38.46	41.03
Laem Sa Phli	0.5	0.4	8.33	8.33	33.33	25.00	25.00
Khao Pho Bae	1	2	-	17.65	52.94	17.65	11.76
Khao Lan	1.2	2.5	-	23.81	76.19	-	-
Total/ Average	8.34	22.3	15.64	7.82	28.81	13.17	34.57

* Calculated base on, estimated towing distance 120 m. at every 2 minutes

** Calculated from percent of towing number that surveyed in each location



Fig. 2 Map showing condition of reefs along Khao Tham Thong to Ko Ran Pet



Fig. 3 Map showing condition of reefs along Table Rock to Laem Thaen

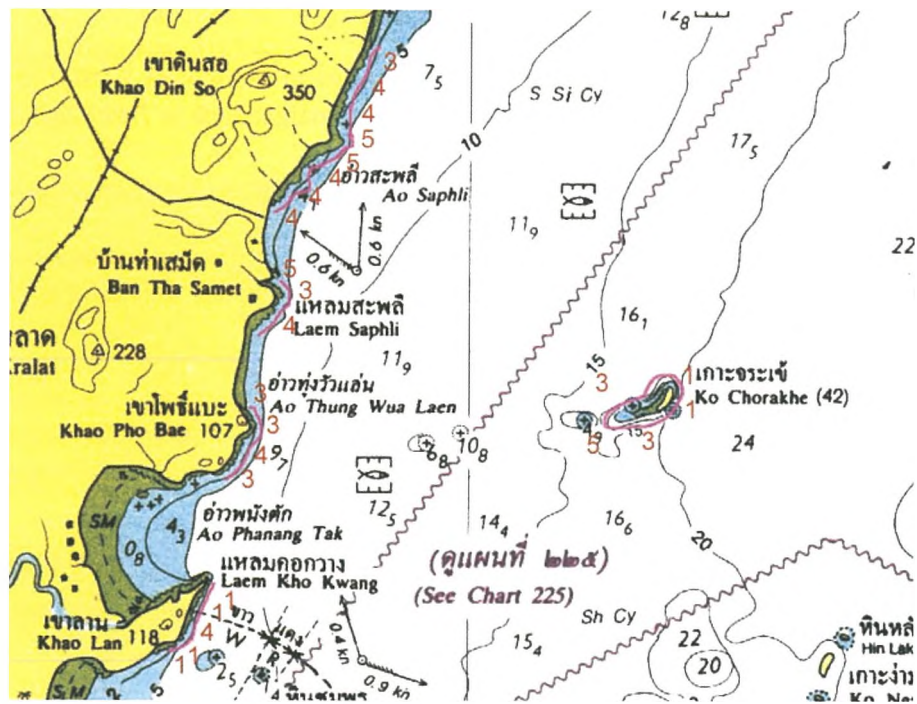


Fig. 4 Map showing condition of reefs along Laem Sa Phli to Khao Lan

Ko Si Kong and Ko Rang

The reef condition was very good. The average live coral cover was 30-60% and average dead coral cover was 5-25%. *Porites lutea*, *Pocillopora damicornis* and *Acropora* spp. were dominant species in these reefs.

Ko Eiang and Ko Phra

The reefs of Ko Eiang and Ko Phra was not true reefs. It was the community on rock. The reef condition was very good. The average live coral cover was 10-75% and average dead coral cover was 5-20%. *Turbinaria frondens*, *Pocillopora damicornis*, *Favia speciosa* and *Favites abdita* were dominant species in these reefs.

Ko Ran Kai and Ko Ran Pet

The reef condition was very good. The average live coral cover was 50-60% and average dead coral cover was 5-20%. *Porites lutea*, *Pocillopora damicornis* and *Acropora* spp. were dominant species in these reefs.

Ko Khai and Table Rock

The reef of Ko Khai was a true fringing reef. Most of reefs were 100-200 m. wide and end at 5-8 m. in depth. The reef condition was very good by the reef on south coast was in better condition than other area. The average live coral cover was 40-60% and average dead coral cover was 10-20%. Most of dominant species was *Turbinaria frondens*, *Pocillopora damicornis* and *Platygyra daedalea*.

The reef condition of Table Rock was very good. The average live coral cover was 25-40% and average dead coral cover was 5-15%. Most of dominant species was *Turbinaria frondens*, *Platygyra daedalea* and *Pocillopora damicornis*.

Ko Chorakhe

The reef was a true fringing reef. The reef expanded to cover an area 150 m. from shoreline and end at a depth of 3-5 m. The reef condition on north coast and east coast was very good. The average live coral cover was 30-60% and average dead coral cover was 5-15%. Most of dominant species was *Turbinaria frondens*, *Pocillopora damicornis*, *Platygyra daedalea* and *Porites lutea*.



1.2 The group of the reefs along shoreline

In general, the reefs along shoreline were true reef. The Most of reefs were 50-100 m. wide. Coral growth ended at a depth of 2-3 m. Many reefs covered with macroalgae such as *Turbinaria* sp., *Halimeda* sp. and *Sargassum* sp.

Khao Tham Thong and Khao Laem Yai

The reef condition of Khao Tham Thong and Khao Laem Yai was fair. The average live coral cover was 15-70% and average dead coral cover was 15-50%. Most of dominant species was *Galaxea* spp., *Acropora* spp., *Porites lutea* and *Platygyra daedalea*.

Pathew shoreline around Ban Thung Khai Nao to Ban Buek Khlone

The reef condition was very poor. The average live coral cover was 5-20% and average dead coral cover was 25-70%. Most of dominant species was *Porites lutea*, *Favia* spp. and *Platygyra daedalea*.

Laem Thaen, Laem Yang and Laem Sa Phli

The reef condition of Laem Thaen was very poor. The average live coral cover was 5-10% and average dead coral cover was 65-85%. Most of dominant species was *Porites lutea*, *Platygyra daedalea* and *Favia* spp.

The reef condition of Laem yang was very poor. The average live coral cover was 15-35% and average dead coral cover was 40-60%. Most of dominant species was *Porites lutea*, *Platygyra daedalea* and *Favia* spp.

The reef condition of Laem Sa Phli was fair. The average live coral cover was 45-50% and average dead coral cover was 35-40%. Most of dominant species was *Turbinaria frondens*, *Porites lutea* and *Galaxea* spp.

Khao Pho Bae and Khao Lan

The reef condition of Khao Pho Bae was fair. The average live coral cover was 15-40% and average dead coral cover was 35-40%. Most of dominant species was *Turbinaria frondens*, *Pocillopora damicornis* and *Galaxea* spp.

The reef condition of Khao Lan was fair. The average live coral cover was 30-60% and average dead coral cover was 10-40%. Most of dominant species was *Turbinaria frondens*, *Favia speciosa* and *Galaxea fascicularis*.

2. Line intercept method

The reef on the west coast of Ko Khai was approximately 150 m. wide. It gently sloped down and ended at about 1.5 m. at spring low water. In the section of the reef from 0 m. to 120 m., coral colonies were dense with dead corals averaged 77.3%, only few of live cover 1.2% and sand 13.4%. Most of live coral was small colonies such as *Porites lutea*, *Favia speciosa* and *Pocillopora damicornis*. In the section from 120-150 m. was the rim of the reef. The coral community became denser with an average total live coral cover 10-15%, dead coral approximately 75% and sand 11.5%. Live coral colony size such as *P. lutea*, *F. speciosa*, *P. damicornis* and *Acropora* sp. was bigger than the first section. (Fig. 5)

Five transects of 30 m. long were laid at a distance approximately 160 m. from shore at 1 m. depth. The composition of coral reef was coral branching (CB) 57%, coral massive (CM) 36%, coral encrusting (CE) 4% and coral foliose (CF) 3%. Most of coral life form was coral branching (CB) i.e. *P. damicornis* and the second one was coral massive (CM) i.e. *P. lutea*. (Fig. 6) Ten coral species, *Cyphastrea serailia*, *F. speciosa*, *Favites abdita*, *F. halicora*, *Montipora turtlensis*, *M. peltiformis*, *M. crassituberculata*, *Platygyra daedalea*, *P. damicornis* and *P. lutea* were found. They contribute to a cover of 4.51%. The cover of dead corals, sea anemone, macroalgae, giant clam, zoanthid and sand were 78.55%, 0.48%, 1.8%, 0.13%, 0.27% and 14.27%, respectively. (Table 2)

The coral species diversity was 1.5. The status of the reef at this site was very poor since the ratio of live to dead coral cover was 1:17.4.

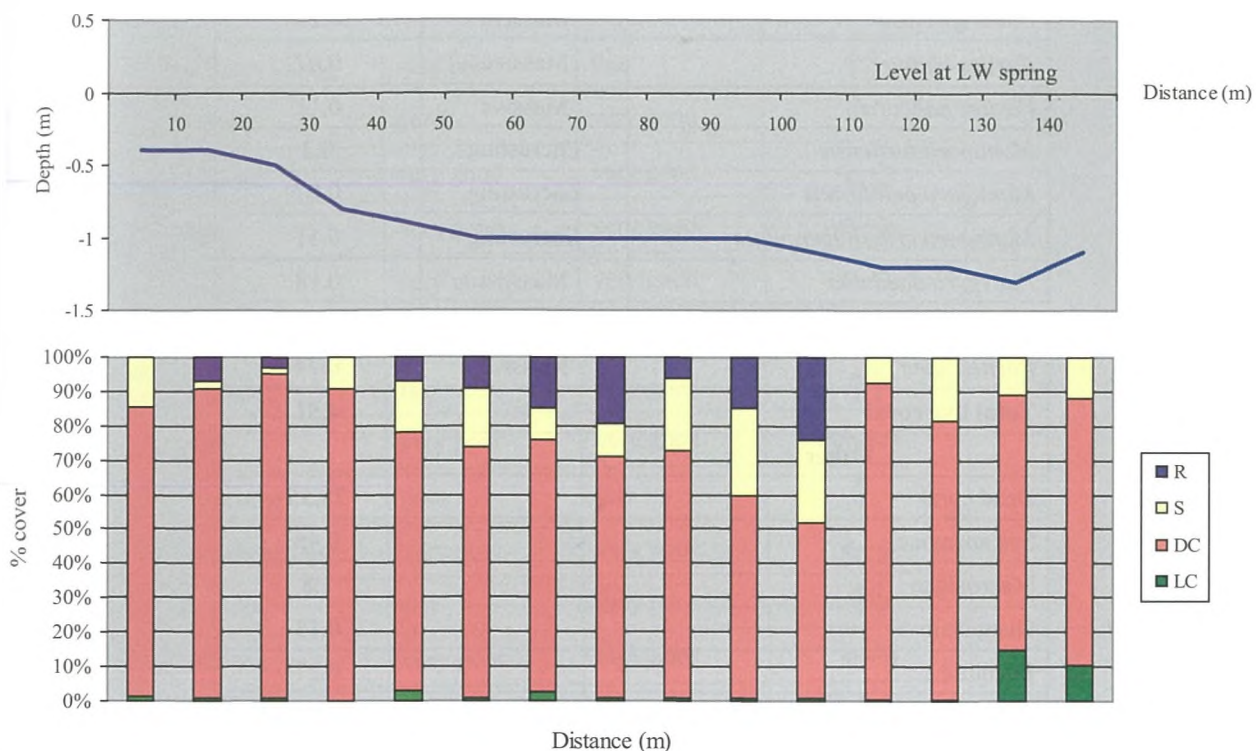


Fig. 5 Showing the coral reef profile on the west coast of Ko Khai (above) and percentage cover of live coral (LC), dead coral (DC), sand (S) and rock (R) at every 10 m. interval along reef profile (below)

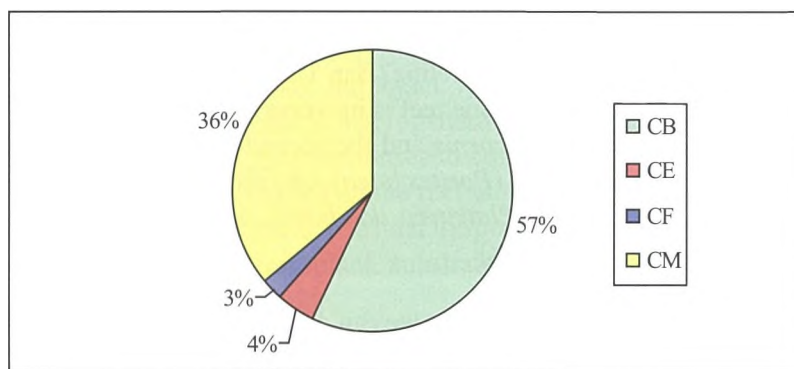


Fig. 6 Percentage life form of coral at the west coast of Ko Khai

Table 2. Percentage cover of live corals and other components under the transect line.

Coral species	Life form	%cover
<i>Cyphastrea serailia</i>	Massive	0.17
<i>Favia speciosa</i>	Massive	0.29
<i>Favites abdita</i>	Massive	0.07
<i>Favites halicora</i>	Massive	0.11
<i>Montipora turtlensis</i>	Encrusting	0.2
<i>Montipora peltiformis</i>	Encrusting	0.07
<i>Montipora crassituberculata</i>	Encrusting	0.11
<i>Platygyra daedalea</i>	Massive	0.18
<i>Pocillopora damicornis</i>	Branching	2.57
<i>Porites lutea</i>	Massive	0.74
Total live coral		4.51
Other		
Dead coral		78.55
Sea anemone		0.48
Macroalgae		1.8
Giant clam		0.13
Zoanthid		0.27
Sand		14.27

V. CONCLUSION AND DISCUSSION

In general, the coral reefs along Pathew District, Chumphon Province were in fair to very poor condition. The results from both manta-tow survey and line intercepts indicate the same trend of reef condition. In conclusion, the reef condition was very poor. To compare to past survey in 2000-2001 (Chankong, 2004), the reefs were still in same condition. Six locations of reef i.e. Khao Tham Thong, Ko Eiang, Table Rock, Ko Khai, Ko Chorakhe and Laem Sa Phli are in better condition. Six locations of reef i.e. Ko Si Kong, Ko Rang, Ko Ran Kai, Ko Ran Pet, Pathew Shoreline (Ban Thung Khai Nao to Ban Buek Khlone) and Laem Yang remain the same condition. Only one reef is in worse condition (Table 3). Most of coral life form was coral branching (CB) i.e. *P. damicornis* and the second one was coral massive (CM) i.e. *P. lutea*. The dominant species was hump coral (*Porites lutea*), cauliflower coral (*Pocillopora damicornis*), ring coral (*Favia speciosa*), brain coral (*Platygyra daedalea*), staghorn coral (*Acropora* spp.) and dish coral (*Turbinaria frondens*). (Appendix)

Due to the condition of reefs available in this study, we can divide into 2 groups. The first group was the group of reefs along the islands. Most condition of these reefs was better than in the latter group which was the group of reefs along shoreline of mainland. Together with the condition of reef at west coast of Ko Khai was very poor. Moreover, the coral species diversity index was 1.5 that was low. These results can be described that condition and coral community have been controlled by many environmental factor. Most of these reefs are shallow reef. Shallow reef areas are influenced by physical factors such as wave action, extreme low tides, while the deeper reef areas are controlled by biological factors such as predation (Guzman and Cortes, 1989, cited after Yeemin et al., 1994).

In addition, anthropogenic factor such as discharges of human waste and chemical pollution are both potential culprits for the decline in coral reef environment. The water quality including the physical, chemical and biological indice of Pathew bay showed that the bay is at risk from phytoplankton blooms and accumulation of nutrients (Kajonwattanakul and Singharachai, 2007). Effects of eutrophication on coral communities, in all instances eutrophication was found to have directly or indirectly negative effects

Table 3. Showing conclusion of reef condition and comparing of change of reef condition in Pathew District, Chumphon Province between 2000-2001 and 2004.

Location	Reef condition		Change of reef condition
	2000-2001	2004	
Khao Tham Thong	very poor	fair	↑↑
Ko Eiang	good	very good	↑
Ko Si Kong	very good	very good	↔
Ko Rang	very good	very good	↔
Ko Ran Kai	very good	very good	↔
Ko Ran Pet	very good	very good	↔
Table Rock	fair	very good	↑↑
Ko Khai	very poor	very good	↑↑↑↑
Ko Chorakhe	poor	fair	↑
Pathew shoreline	very poor	very poor	↔
Laem Taen	fair	very poor	↓↓
Laem Yang	very poor	very poor	↔
Laem Sa Phli	poor	fair	↑

on the coral reef. Local nutrient enrichment led to increase in growth of macroalgae, which smothered the coral polyps. Increasing of phytoplankton population led to water turbidity and decreasing of light. Coral vary in their ability to tolerate differences in temperature, salinity, light, turbidity, sedimentation, wave exposure (Woesik, 1994). In benign environments the availability of light is probably the most important resource on a coral reef. In order to obtain this light the corals need to occupy space. Change in these conditions can interfere with vital physiological process that can alter the ability of a species to exist in any one niche dimension. (Coles and Jokiel, 1978) Indeed, slight variations in habitat such as light, sedimentation, substrate stability *that* is heterogeneity, may allow the existence of the variety of coral community. Due to substrate stability responses to coral recruitment, this reason may cause that only small number of new colonies recruited on the reef at the west coast of Ko Khai. As coral reef in such a degraded condition, it is worthwhile to consider the possibility of reef restoration. The methods used for restoration vary including direct transplant, substrate enhancement for coral settlement and allowing natural colonization by suitable condition.

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APPENDIX



Hump coral (*Porites lutea*)



Staghorn coral (*Acropora* spp.)



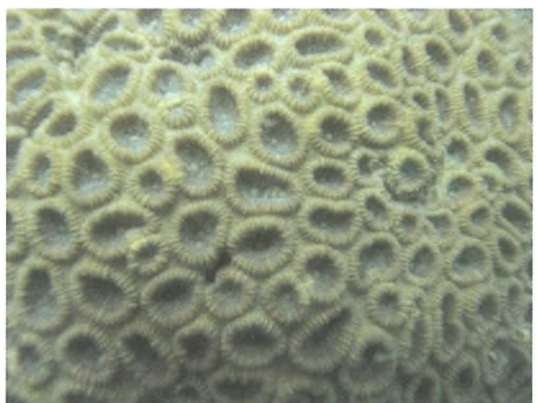
Cauliflower coral (*Pocillopora damicornis*)



Brain coral (*Platygyra daedalea*)



Dish coral (*Turbinaria frondens*)



Ring coral (*Favia speciosa*)