Community-driven coral conservation in Aceh, Indonesia

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A Report to Rufford Small Grant (for Nature Conservation)

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Summary

Coral reefs support over 25% of all known marine species, but over the past 30-50 years anthropogenic threats have caused a global reef decline of nearly 50%. The Iboih community of Weh Island, Aceh, has a direct incentive to conserve their coral reefs because the local economy is mainly derived from coral-related activities (tourism and fishing). Through wide collaboration, this project will raise stakeholder awareness about coral conservation importance, increase local livelihoods through improved coral tourism management and evaluate these conservation strategies through the implementation of the first coral biodiversity monitoring programme. Through wide community participation, the proposed project has been designed to be a participatory and low cost initiative run by the local community and a local university. Consulting the various stakeholders and incorporating their needs into the project design, will help to ensure that all stakeholders have a greater commitment to the long-term goals of the project. Anticipated future benefits should be provided through empowering community members to be involved in coral biodiversity and environmental management for tourism and other livelihood benefits.

Introduction
Current Project Status

The Iboih Reefs in Sabang Nanggroe Aceh Darussalam (NAD), Sumatra, are an important protected area for marine conservation because they are rich in living corals. The reefs are also important for the local economy that is largely derived from coral-related activities (tourism and fishing). These reefs were damaged in the December 2004 tsunami, but the actual extent to the reefs and local livelihoods is not clearly understood. After tsunami the perception and protection of coastal areas has to be considered because as long as the coastline of Aceh have opportunity of the increasing damage because have destroyed coastal zone, mangrove and coral reefs. Coastal area, coral reefs, mangrove and sea grass are important component in Aceh ecosystem. During the time a lot of factor as coral reefs damage in Iboih reefs such as boat anchor, intake of corals as aquarium decoration, as place boat park and tourism activities without take care of coral reefs. In order to assess the reef condition and impact of these different threats and the conservation strategies aimed at reducing them, reliable, scientific information is needed on the biodiversity of Iboih reefs. This report highlights project activities complete over the past a year of Project Year (PY) 1, which aimed to collect data on coral reefs biodiversity in Ibioh Reef.

A multi-stakeholder, multidisciplinary approach to coral conservation is required if both coral conservation and local livelihoods are to benefit in Iboih. Within this Rufford grant, this project aimed to increase local stakeholder capacity to conserve their natural resources, as a basis for sustainable (non-consumptive) utilization, through the following five objectives:

- Raise stakeholder awareness about coral conservation;
- Create a more enabling environment for coral biodiversity;
- Conduct survey of coral reefs biodiversity;
- Increase local livelihood benefits from coral-related tourism; and,
- Monitor and evaluate project results and effectiveness.

The monitoring programme in PY1 was conducted under the following time scale (Table 1). This report covers all project activities conducted within one year (12 months).

Table 1. Revised program activities from Month 1 (1st July 2006) to 12 (30th June 2007)

	Month											
Activity	1	2	3	4	5	6	7	8	9	10	11	12
1.1. Stakeholder meeting												
1.2. Community questionnaire survey												
1.3. Coral reef education to Community												
2.1. Reducing anchor-related damage												
3.1. Coral biodiversity survey training												
3.2. Coral biodiversity surveys												
4.1. End of year project review												

Activity 1.1. Stakeholder meeting

The stakeholder meeting with representatives from local community, tourism bungalows owners and their employees (Yulia's, O'Ong, Fatimah and Mamamia), dive instructors, fisherman, University of Syiah Kuala staff and local tour operator met in Iboih village during First Month. Formal and informal meeting with stakeholder were held to discuss the project and their ideas about coral conservation and how we can work with them to better conserve the coral. During this time, overall project planning, including the allocation of mooring buoys and coral biodiversity survey (activities 1.3-3.2), were discussed. Local fishermen and tour operators were specifically asked to identify the problems that they thought needed to be addressed to improve coral conservation in the project area.

Activity 1.2. Community questionnaire surveys

Community questionnaire surveys identified were conducted in month 2 and 3, these activity following principal threats to corals in Iboih Reef and some solutions:

- Collecting and touching of corals by tourists snorkeling was caused by a lack of tourist awareness and knowledge about the importance of taking care of coral reefs. In response the dive shop owner gave advice about not touching the reefs to any tourists renting equipment from him.

- Many tourists were said to throw rubbish onto the beach area due to a lack of awareness and also because at the start of the surveys there were not many rubbish bins available in public places. In response, many rubbish bins and posters advising the correct disposal of rubbish in the bins were established.

- Most resident houses do not have permanent ash cans, to burn rubbish, so that rubbish left out often ends up scattered around the island (by wind, as well as domestic cats and dogs and wild pigs searching for food).

- Many fishermen lay down fishing nets over the coral reefs were causing corals damage. This matter was considered to be caused by a lack of knowledge by fisherman concerning location of corals. Recently have fisherman seldom coming near area of coral reefs after there is activity socialize shallow area and there are a lot of corals.

- During the 1970s and 1980s, dynamite fishing was used around the Iboih reefs, but now this type of fishing is no longer used around the reefs. Since Indonesia government prohibit fishing by using dynamite.
- Increasing sedimentation in the water caused by development (bungalows and shops, lodging, road development and other infrastructure) which is conducted at the coastal edge and in nearby villages.

- People living near coastal areas dispose of their liquid wastes (e.g. washing liquids) which enters directly into the sea and can effect water salinity, and poisonous materials are a direct threat to coral health.

- Oil waste from fishing boats and tourist boats.

- Early survey many fisherman and society do not know impact of coral reefs to fishery resource. During the project, we have socialized the impact damage of coral reefs and their availability as a resource for fisherman, residents ashore, as well as students that take a holiday in Iboih.

- These were a debate about the coral damage that happened in Iboih from the tsunami, because colonies of corals were displaced onto the beach. This project surveyed and monitored corals recruitment and found that there were lots of new corals colony growing in area of tsunami damage, detail please see in sub title of the report “New corals recruitments after tsunami in Teluk Pelabuhan and Teupin Layeun Iboih, Sabang”.. However, this time not yet socializations due to the studies just conclusion. So, we need to continue to socialization to society especially the Iboih community that locations have been starting the existence of growth of new corals. Further monitoring data is needed to fully assess the re-growth.

- Global climate changes cause a potential threat to coral reefs in Iboih.

1.3. Coral reef education to community

This activity was conducted at Month 2 until Month 4. Public education will be essential in this project for establishing and maintaining public support for coral reef conservation, in the face of the many anthropogenic threats to corals. These efforts will succeed in the long term by if they sufficiently increase public understanding. At the local level, public education activities were conducted, such as courses for tourist guide, dive operator, fisherman, dive shop operator and

students about reef biology, the socioeconomic value of the reef and the threats to reefs, and therefore local livelihoods.
These activities were conducted by conscripting biology students who were in their final year paper (research) in Iboih. Meetings with stakeholder were conducted informally because it was easier meet them at their work place than formal meeting. The activities pleased the stakeholder that we visited because it provided them with a good opportunity to gain a broader understanding of reef ecology and biology which, previously, they did not know. The stakeholder especially teacher of basic school in study area suggest activity like this better be conducted schedulable every year, so that have strong opportunity for the encouraging local and individual commitments to altering current lifestyles toward coral conservation outreach.

2.1. Reducing anchor-related damage

This activity was start at Month 4. This activity was implemented to enhance coral recovery by ensuring optimal conditions for larval dispersal and recruitment at damaged sites. Thus, this requires reducing the damage caused from boats being anchored to the coral reef. Four mooring buoys (with sunken concrete blocks with instruction signs) were placed at the sites most frequently visited, and therefore damaged by fishing vessels. The installation of the mooring buoys in the first term of the project was warmly welcomed by the fishermen and used by the residents of Iboih. The fishermen said that when the weather was calm, they could moor their boats on the beach, without damage to the coral. However, when the weather was rough, they said that they used the mooring buoys to prevent damage to their boats. From the final project evaluation, the community requested for an addition six mooring buoys, especially in areas by the coast bungalows that are often visited by boats. However, Activity of shoreline forestation needn't be executed in Iboih village because lack of opened area for the coastal plant.

3.1. Coral biodiversity survey training

As scheduled, during Month 2, project personnel comprising eight students of Syiah Kuala University who were conducting their final year project on marine biology and three new students interested in marine studies received four weeks training in field equipment use, including water quality analysis (DO, salinity, temperature, turbidity, nitrate and phosphate analysis) and field survey methods, especially for corals and coral fishes. In this activity also equip participant by coral code material. Within This activity also, participants followed the coral code of material of produce in previously Activity 3.5. as Training manual production.

3.2. Coral biodiversity surveys

Material and Methods

Study areas

The study was carried out at Ibioh and Island Rubiah Reef (Lat. 05^{o} 52' 788" N; Long. 95^{o} 15' 499" E), Sabang NAD Indonesia (Fig. 1). Two stations were chosen for sampling area: Teluk Pelabuhan and Teluk Peneden. Teluk Pelabuhan Rubiah on the west coast of Island Rubiah which faces direct to the smaller Aroih Rubiah Strait. Along this strait, the tsunami wave passed to mainland Sumatra. Teluk Peneden, east part of Island Rubiah, experienced a lower tsunami action.

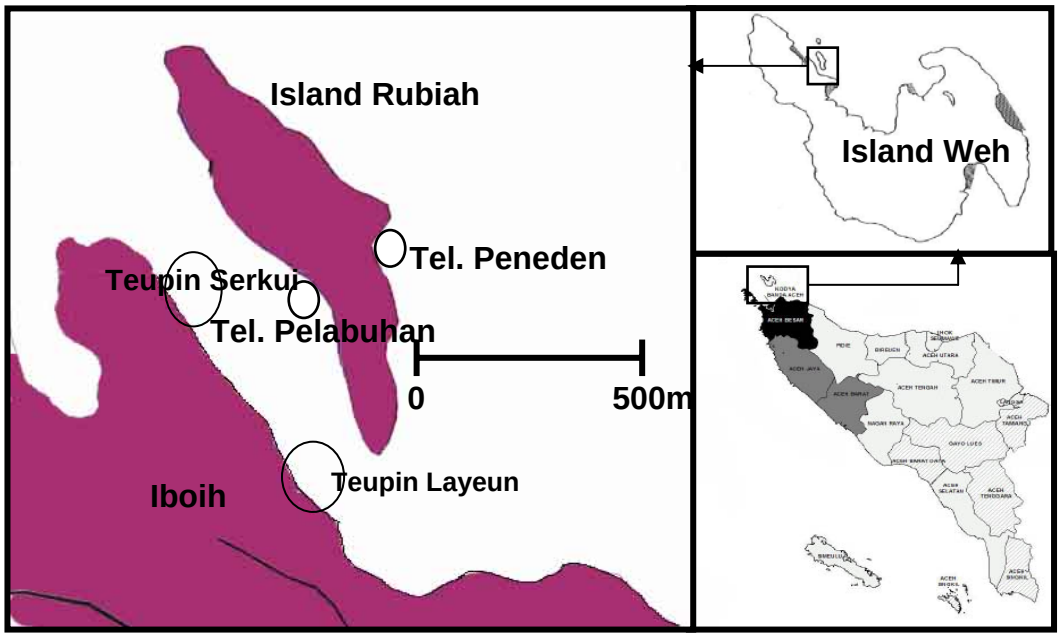


Figure 1. Map of Island Weh, showing of studies area.

Survey methods

The percentage of live and dead coral coverage and substrate (sand, rubble, stone and algae) were measured using a Line Intercepts Transect (LIT) method. Five transects line were laid parallel to the coastline at 3 m and 7 m depths for each location. Each line transects was 20 m long (English *et al.*, 1997). Physical and chemical parameters, that are known to influence coral distribution, such as temperature, salinity, pH, dissolved oxygen (DO) and nutrient (nitrate and phosphate), were measured. Number of new corals recruitment and fish distribution studies was observed at 3 m depth for Teupin Layeun and Teupin Sirkui.

The analyses provided quantitative information on the community structure of the sample sites. According to Letter of Statement (SK) of Minister of Environment of Indonesia, No. KEP-04 /MENLH/02/2001 date of 23 February 2001, the

percent cover of live coral and coral reef condition can be divided into four categories: “very good” (71-100% live coral cover); “Good” (50-74,9% live coral cover); “Fair” (25-49,9% live coral cover), and; “Bad” (0-24,9% live coral cover).

Preliminary evaluation of coral reefs condition in Island Rubiah: after one year of tsunami disaster

Teluk Pelabuhan of Island Rubiah

Physical and chemical parameters

Surface water temperature ranged between 28^0C and 30^0C; Transparency from 10 to 12 m; Dissolved oxygen content varied between 4.7 and 7 mg/L; Salinity between 32 and 33 ppt; pH was 7.5; and the variation in nutrient content was phosphate (0.001– 0.003 mg/L), nitrate (0.013-0.079 mg/L).

Nutrient potentially influences coral reef formation by effecting the growth of algae and invertebrate fouling communities which compete with corals, and by potentially inhibiting coral calcification and growth. However, the nutrient concentration in Teluk Pelabuhan (Aroih Rubiah Strait) was found to be within the normal range for coral reefs.

Coral reef condition

Five transects line were deployed in Teluk Pelabuhan at 3 and 7 m depth. Various substrate coverage coral reefs *i.e*., live coral, dead corals, sand & rubble and other substrate (rock, mud, algae, sponge and sea anemone) were recorded on transect. In Teluk Pelabuhan reef, coverage substrate may increase while live corals decrease, percentage reducing of substrate may be affected by tsunami wave action.

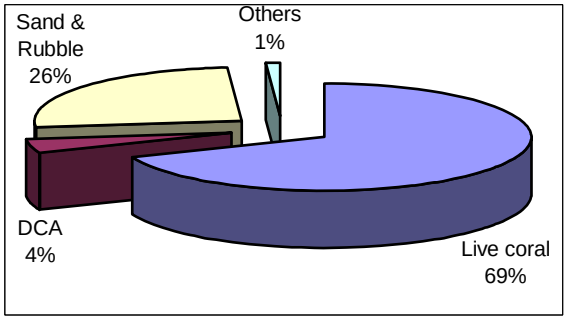
Coral reef condition in Teluk Pelabuhan was found to be in a poor condition due to the tsunami action. Comparisons between ‘before’ and ‘after’ tsunami data showed that there were decreases in live coral coverage. Average degrees of coverage of the different substrate categories before and after the tsunami are provided in Figure 2. Live coral percentage before tsunami at 3 and 7 metres water depth were 69% (good) and 63% (good), respectively. After the tsunami, live corals percentage at 3 and 7 metres water depth decreased to 32% (fair) and 29% (fair), respectively. Sand and debris deposited tended to dominate and increased on Teluk Pelabuhan reef.

A previous study on the Teluk Pelabuhan Island Rubiah reef characteristics during ecotourism development (Ridwan, 1998) compared after tsunami (2006) was an approximately 100% increase in the coral debris and dead coral with alga (DCA). Records from past studies indicated that the Teluk Pelabuhan reef was dominated by *Acrophora* (Ridwan, 1998). Decreased coral reef percentage from the tsunami is not yet known, because the condition of the coral reef has informed non-stoped

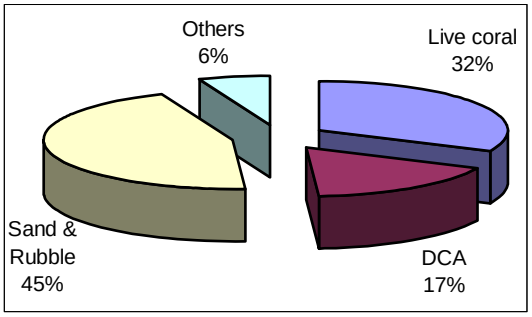
to ruining and degradation before tsunami disaster, these suggested due to fishing and tourism activity..

In Teluk Pelabuhan reef, coverage of some substrate may increase while live coral coverage decrease. There are many factors that can affect species addition and removal rates. Relative distribution among species, such as fish and corals, can change due to shifts in competitive superiority or the ability to avoid attacks by natural enemies. According to the survey data, environmental conditions can limit substrate distribution. Differences in substrate percentage between depths thus result from environmental variation.

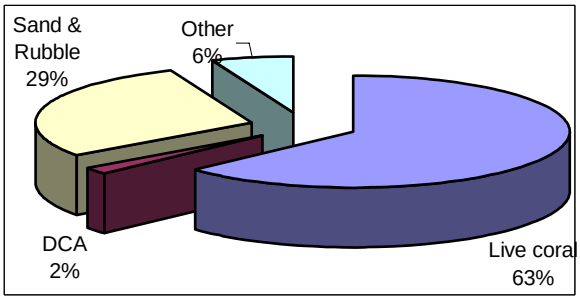
Teluk Pelabuhan coral reefs status before tsunami at depth 3m



Teluk Pelabuhan coral reefs status after tsunami at depth 3m



Teluk Pelabuhan coral reefs status before tsunami at depth 7m



Teluk Pelabuhan coral reefs status after tsunami at depth 7m

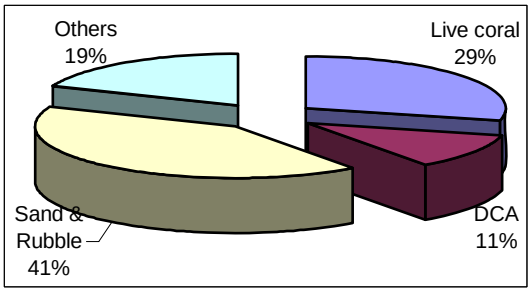


Figure 2. Percentage coverage of main categories at Teluk Pelabuhan before and after the tsunami

The amounts of coral reefs damaged in Teluk Pelabuhan Rubiah have reached 70%. From result of field observations, a lot of coral colonies were stranded by the coast and also in forest of Island Rubiah (Fig. 3). Due to strong waves during the tsunami a lot of corals were broken. Strong wave action caused more massive and sub-massive coral to be washed ashore. The transect results showed that there was 30% live corals still remaining at Teluk Pelabuhan Rubiah. The list of coral life form found in the Teluk Pelabuhan area is given in Table 2.

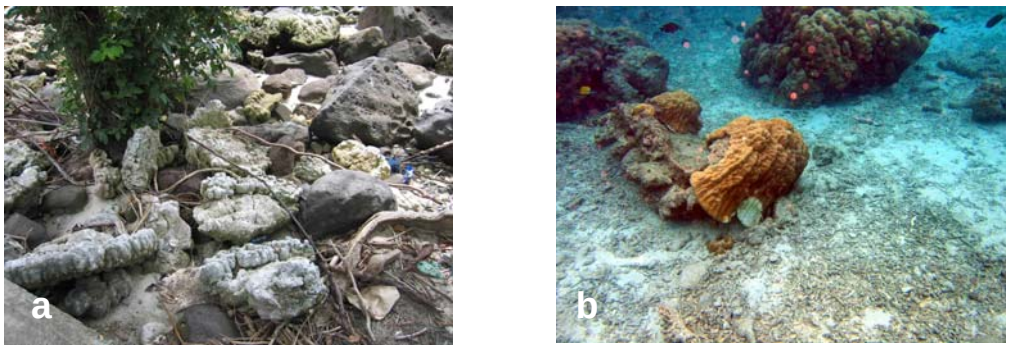


Figure 3. Teluk Pelabuhan Island Rubiah reefs condition. (a). Hard corals colony in shore area were drifted to land. (b). Coral community at 3 m depth in fall down position.

Table 2. Coral life form found at the Teluk Pelabuhan Rubiah Sabang before and after the tsunami

Corals Life form	Before tsunami (Ridwan, 1998)	After tsunami
Acropora branching	√	
Acropora tabulate	√	√
Acropora digitate	√	√
Acropora submassif	√	
Acropora encrusting	√	
Melliopora	√	
Coral foliose	√	√
Coral massive	√	√
Helliophora	√	√
Soft coral	√	

The corals that survived most in Teluk Pelabuhan Island Rubiah reef were scleratinian corals, especially *Porites*. These corals are considered to have a high tolerance to fluctuations in water quality and other environmental conditions (Nasir, 2004; Veron, 1992). The existence of coral communities in high sedimentation water can also be explained if strong currents are also present, which helps to prevent sediment build-up on coral surfaces. Most corals cannot live for long if heavily coated or buried. When corals do survive in high sedimentation water, their growth rate and the depth to which they grow will be reduced since calcification in corals is light dependent (Nasir, 2002; McClanahan & Obura, 1997).

Corals that remained in Teluk Pelabuhan Island Rubiah may be influenced by factors such as geomorphology, availability of substrates, physical, chemical, coral reef formation and biological processes. Geomorphology of certain sites of Teluk Pelabuhan has the potential to reduce the impact of the tsunami. These showed that coral reef in the region of rocky shore are protected.

Physiological tolerances of corals are part of biological processes. Physiological tolerance is important for the establishment of future coral communities. Newly recruited corals in Teluk Pelabuhan in certain area must encounter physical condition with their physiological tolerance range. Where corals are living in conditions close to their physiological limits, for example, high sedimentation rate of sand.

The availability of hard substrate should be limited. Amount of substrate available enhanced competition cover of biota, which means that corals are subject to considerable competitive pressure and may be out competed by other biota, either for settlement space or in the established community (Smith & Harriot, 1998). Variability of coral cover percentage on our transects suggested that reduced coral recruitment in future due to limitations of substrate, competition with other biota and physical disturbances (Costa *et al.,* 2000; Huston, 1985). These factors may results in low coral cover in the future.

Teluk Peneden reef of Island Rubiah

Physical and chemical parameters

Surface water temperature ranged between 29^0C and 30^0C; Transparency from 10 to 12 m; Dissolved oxygen content varied between 6 and 8 mg/L; Salinity between 32 and 33 ppt; pH was 8; and the variation in nutrient content was phosphate (0.002 –0.004 mg/L) and nitrate (0.117 – 0.155 mg/L). However, the nutrient concentration in Teluk Peneden was in the normal range for coral reefs.

Coral reef conditions

Five transects lines were surveyed in Teluk Peneden at 3 and 7 m depth. Various substrate coverage coral reef, i.e. live coral, dead coral, sand & rubble and other substrate were recorded along transects. Coral reef condition in Teluk Peneden at 7 m depth seemed to be in poor condition. Comparisons between 'before' and 'after' tsunami data showed that there was a decrease in live coral coverage. Average degrees of coverage of the different substrate categories before and after the tsunami are provided in Figure 4. Live coral percentage before the tsunami at 3 and 7 metres water depths were 71% (good) and 70% (good), respectively. After the tsunami, live coral percentage at 3 and 7 metres water depths decreased to 62% (good) and 17% (bad), respectively. Sand and debris deposits tended to dominate and increased on Teluk Peneden reef, especially at 7 m depth.

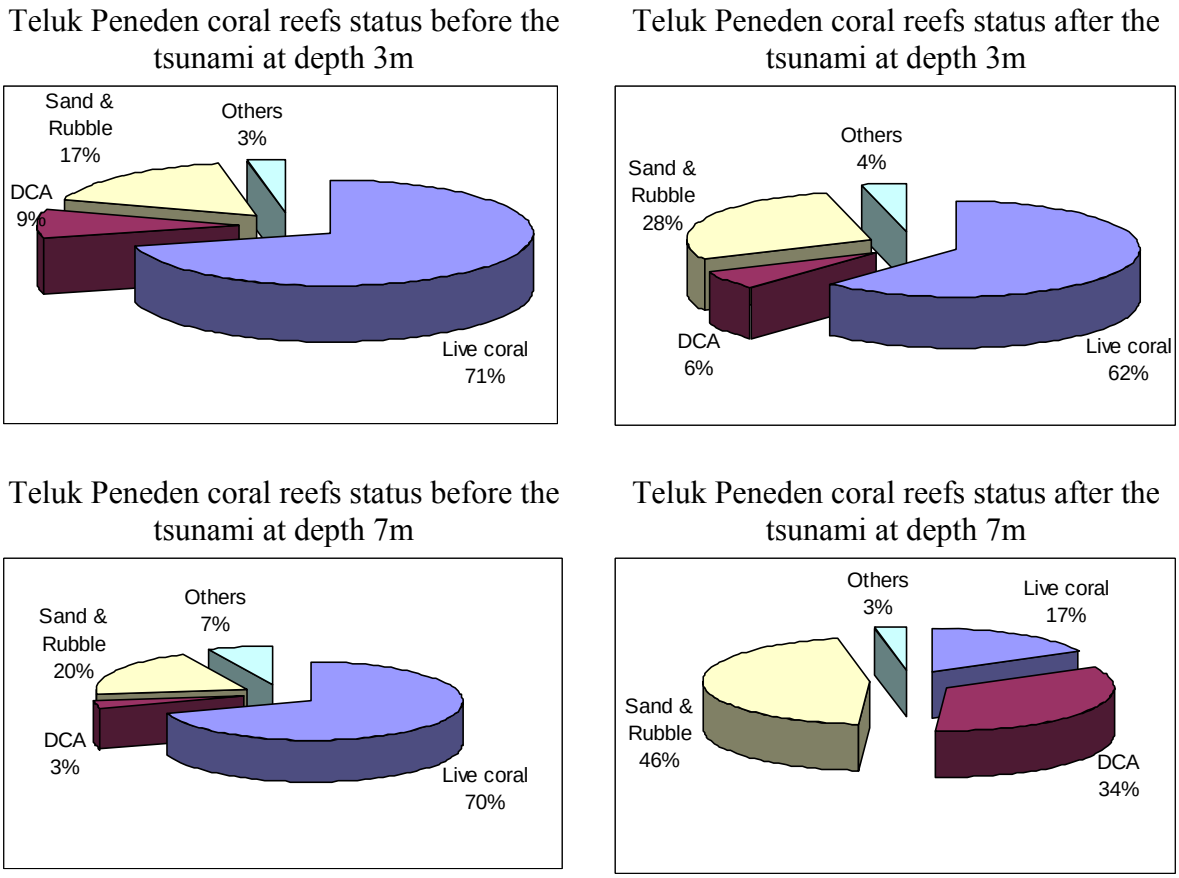


Figure 4. Percentage coverage of main categories at Teluk Peneden before and after the tsunami

Figure 5. Coral reef condition at Teluk Peneden Island Rubiah. (a). Coral community at 3 m depth dominated by ACT. (b) Coral community at 7 m depth dominated by DCA.

A previous study on the Teluk Peneden Island Rubiah reef characteristics during ecotourism development (Ridwan, 1998) that was compared to after the tsunami (2005) showed an increase in the coral debris and dead coral with alga (DCA). Live coral percentage at 3 m depth did not suggest a tsunami effect. In sections at 7 m, a drastic degradation was found of live coral percentage from 70% (good) to 17% (bad). However, in general, coral reef condition at 7 m depth was shown to be buried by sand and rubble (Fig. 5.). These condition occurred possibility because of sediment that accumulated after the tsunami. The list of coral life form found in the Teluk Peneden area is given in Table 3.

Table 3. Coral life form found at the Teluk Peneden Rubiah Sabang before and after the tsunami

Corals Life form	Before tsunami (Ridwan, 1998)	After tsunami 3m	After tsunami 7m
Acropora branching	√	√	√
Acropora tabulate	√	√	√
Acropora digitate	√	√	√
Acropora submassif	√	√	
Acropora encrusting	√	√	
Melliopora	√	√	√
Coral foliose	√		
Coral massive	√	√	√
Helliophora	√	√	
Soft coral	√		

Coral reef condition in Teluk Pelabuhan seems in poor condition due to the tsunami action. Live corals percentage at 3 and 7 metres water depth before the tsunami were 69% (good) and 63% (good), respectively. After the tsunami, live corals percentage at 3 and 7 metres water depth decreased to 32% (fair) and 29% (fair), respectively. Sand and debris deposits tend to dominate and increased on Teluk Pelabuhan reef. Live coral percentage in Teluk Peneden before the tsunami at 3 and 7 metres water depth were 71% (good) and 70% (good), respectively. After the tsunami, live corals percentage at 3 and 7 metres water depth have decreased to 62% (good) and 17% (bad), respectively. Sand and debris deposits tend to dominate and increased on Teluk Peneden reef especially at 7 m depth. These conditions possibility occurred because of sediment that accumulated after the tsunami.

New Coral Recruitment after Tsunami in Teluk Pelabuhan and Teupin Layeun Iboih, Sabang

Teupin Layeun is a human settlement occupied by resident in the coastal area of Iboih. These residents use the area's natural resources for subsistence and commercial purposes by building tourist bungalows. There is also activities from the rental of boats, diving and snorkeling equipment for tourists. Five transect lines were deployed in Teluk Pelabuhan at 1-3 m depth. Various substrate

coverage coral reef and number of juvenile coral were recorded on transects. In Teluk Pelabuhan reef, number o corals juvenile showing in index shown in Table 4.

Diversity index of new corals recruitment

Composition of new corals recruitment in natural substrate in Teupin Layeun and Teluk Pelabuhan reefs consist of seven genera that are *Acropora, Posilopora, Porites, Montipora, Siriatopora, Goniastrea* and *Peudosiderastrea* (Table 4). The genera *Acropora*, *Posilopora* and *Porites* each consisted of three species, *Montipora* (two species) and *Geniastera, Siriatopora* and *Pseudosiderstrea* (one species). The diversity index (H') of new coral recruitment at Teupin Layeun, Iboih, ranged from 0,02-0,51 (Table 4). Overall, diversity index at Teupin Layeun was lower (3,21) than at Teluk Pelabuhan (3,78).

The tsunami caused damage at coral reefs so that many solid substrate that are good for providing a place to stick new coral recruitment have moved, so that the existence of new corals are influenced by substrate availability. A study by Oktarina (2007), explain coral reefs and natural substrate in Teupin Layeun have damage up to 63%.

Result indicate that most dominant genera were *Acropora, Posilopora* and *Porites*, while recruiting from other species at natural substrate was rarely recorded. This matter such as those which perceived by Rudi (2006) that new recruitment composes domination by coral *Acroporidae, Posiloporidae* and *Poritidae* because of substrate existing, fish composition and human activities.

New corals stick at substrate become juvenile influenced by deepness of water this relates to light for photosynthesis. Results of research at 1-3 meter depth recorded a mean density index of new coral recruit per transect ranging from 3,6-5,6 colonies /m^2.

Table 4. Diversity Index (H') of new corals recruitment at Teluk Pelabuhan and Teupin Layeun, Sabang

Ordo	Familia	Genus	Species	Teluk Pelabuhan			Teupin Layeun		
				Amount	Avarage	(H')	Amount	Average	(H')
Scleractinia	Acroporidae	Acropora	*Acropora polifera*	2,6	0,26	0,24	7,8	0,78	0,5
			Acropora tenuis	4,0	0,4	0,31	-	-	-
			Acropora millepora	3,3	0,33	0,26	-	-	-
			Acropora digitifera	4,7	0,47	0,35	8,0	0,8	0,50
			Acropora humilis	2,0	0,2	0,21	-	-	-
			Acropora bushyhensis	2,2	0,22	0,21	-	-	-
			Acropora danai	2,4	0,24	0,21	-	-	-
			Acropora sp.	8,4	0,84	0,45	-	-	-
			Acropora Hyachinthus	-	-	-	0,5	0,05	0,06
		Montipora	*Montipora venosa*	1,1	0,12	0,15	0,3	0,03	0,06
			Montipora digitata	0,7	0,07	0,11	-	-	-
			Montopora sp.	1,2	0,12	0,15	-	-	-
			Montipora spongodes	-	-	-	0,9	0,09	0,11
	Pocilloporidae	Pocillopora	*Pocillopora demicornis*	0,9	0,09	0,11	2,1	0,21	0,24
			Pocillopora verucosa	-	-	-	0,3	0,03	0,06
			Pocillopora eudoxy	-	-	-	0,2	0,02	0,04
		Seriatopora	*Seriatopora hystrix*	0,4	0,04	0,06	0,1	0,01	0,02
	Siaderastreidae	Pseudosiderastrea	*Psodociderastrea tayami*	-	-	-	0,2	0,02	0,04
	Favidae	Goniastrea	*Goniastrea* sp.	0,8	0,08	0,11	-	-	-
			Goniastrea retiformis	-	-	-	0,2	0.02	0,04
	Poritidae	Porites	*Porites lutea*	2,03	0,2	0,21	9,0	0,9	0,51
			Porites annae	1,3	0,13	0,15	0,2	0,02	0,04
			Porites lichen	-	-	-	0,4	0,04	0,08
			Porites sp.	4,0	0,4	0,31	-	-	-
	Pectinidae	Pectinia	*Pectinia lactuta*	1,9	0,19	0,18	-	-	-
				43,93		**3,78**	30,2		**3,21**

(H') = Diversity index

Fish Densities at Pantai Sirkui, Teupin Layeun and Teluk Pelabuhan, Iboih and Sabang

Visual census surveys were used to study the distribution of coral reef fishes that are associated with various corals reefs substrate along the Iboih coast, Sabang, Island Weh. In the present study, 94 species of reef fish were observed in transect of the reefs (5 transects x 30 m length x 5 m wide). Fish densities in Pantai Sirkui, Teupin Layeun and Teluk Pelabuhan reef are shown in Table 5.

Table 5. Fish densities (individuals/750 m^2) at Patai Sirkui, Teupin Layeu and Teluk Pelabuhan.

No	Familia	Species	Number of Fish		
			Pantai sirkui	Teupin layeun	Teluk pelabuhan
1	Acanthuridae	*Acanthurus triotegas*	18	11	12
2		*Acanthurus lineatus*	19	13	9
3		*Acanthurus leucosternon*	33	21	22
4		*Acanthurus nigricauda*	8	9	6
5		*Acanthurus grammoptilus*	23	11	24
6		*Achantaurus mata*	4	6	-
7		*Aethaloperca rogaa*	-	14	-
8		*Acanthurus lecocheilus*	6	9	11
9		*Ctenochaetus Striatus*	7	-	19
10		*Zebrasoma scopas*	10	7	-
11		*Acanthurus auranticavus*	-	-	4
12	Chaetodontidae	*Chaetodon vagabundus*	14	9	34
13		*Chaetodon collare*	15	12	29
14		*Chaetodon interuptus*	14	19	-
15		*Chaetodon octofasciatus*	-	-	28
16		*Chaetodon melanotus*	-	10	-
17		*Chaetodon meyeri*	19	8	17
18		*Chaetodon trifasciatus*	-	-	18
19		*Chaetodon benneti*	-	12	19
20		*Chaetodon ornatissimus*	-	11	-
21		*Chaetodon flavirostris*	-	15	-
22		*Chaetodon ocelicaudus*	-	3	-
23		*Chaetodon semion*	-	7	-
24		*Chaetodon rafflesi*	11	12	7
25		*Chaetodon ocelicaudus*	-	3	-
26		*Chaetodon guentheri*	5	3	13
27		*Chaetodon auriga*	10	3	13
28		*Heniochus varius*	9	7	-
29		*Heniochus acuminatus*	12	2	-

30		*Hemytaurichthys zooster*	6	18	-
31		*Chelmon rostratus*	9	4	-
32		*Forcipiger flavissiamus*	4	-	-
33		*Chaetodon melanotus*	8	-	14
34	Pomachanthidae	*Centropyge eibli*	11	12	21
35		*Centropyge flavissianus*	-	-	21
36		*Centropyge multifasciatus*	-	-	37
37		*Pomacanthus annularis*	7	4	-
38		*P. xanthomometopon*	-	-	36
39	Pomacentridae	*Abudefduf vaigiensis*	28	13	37
40		*Abudefduf notatus*	7	14	-
41		*Dascylus trimaculatus*	13	7	-
42		*Dascylus reticulatus*	16	19	-
43		*Dascylus aruanus*	9	9	-
44		*Pomacentrus adelus*	6	5	-
45		*Neoglyphidodon melas*	-	-	44
46		*A. polyacanthus*	-	-	55
47		*N. cyanomos*	-	-	45
48		*Chormis Canthochira*	-	4	-
49		*Cromis iomelas*	-	-	60
50		*Forcipiger flavisssiamus*	-	8	-
51		*Dishistotus fasciatus*	-	-	13
52	Labridae	*C. undulatus*	-	-	13
53		*T. purpereum*	-	-	17
54		*Hemigymus fasciatus*	4	15	-
55		*A. caeruleopunctus*	-	-	18
56		*Stethojulis bandanensis*	-	-	15
57		*Pseudocoris heteroptera*	-	-	25
58		*Halichoeres schartzi*	-	-	18
59	Lutjanidae	*Lutjanus corponotacus*	-	5	26
60		*Lutjanus decussatus*	7	6	-
61		*Lutjanus vitta*	-	3	26
62	Mulidae	*Parupeneus barberinus*	32	5	-
63		*Parupeneus bifasciatus*	25	8	-
64		*Parupeneus indicus*	27	8	-
65		*Parupeneus pleurostigma*	18	7	-
66		*Upeneus tragula*	15	-	-
67	Scaridae	*Scarus hypselopterus*	-	-	21
68		*Ctenochaetus Striatus*	-	4	-
69		*Scarus prasiognathus*	-	-	28
70		*B. muricatum*	-	-	40
71		*Chlorurus Sordidus*	9	3	-
72		*Scarus niger*	5	9	-

73	Scorpaenidae	*Pterois antena*	-	-	3
74		*Pterois volitans*	2	6	5
75	Zanclidae	*Zanclus cornutus*	10	6	19
76	Holocentridae	*S. caudimaculatum*	-	-	14
77		*Myriptistis adusta*	-	-	7
78		*S. spiniferum*	-	-	14
79	Serranidae	*Psedanthias squamipinnis*	-	-	15
80		*Centrogenys valginensis*	-	-	19
81		*Cephalopolis leopardus*	-	-	20
82		*Selehanthias analis*	-	-	29
83		*Ephinephelus fasciatus*	-	-	22
84		*P. Rubrizonatus*	-	-	23
85		*Psedanthias dispar*	-	-	57
86	Nemipteridae	*Scolopsis monogramma*	-	-	38
87		*Scolopsis bilineatus*	-	-	43
88		*Upeneus moluccensis*	-	-	43
89		*Parupeneus pleurostigma*	-	-	25
90		*Parupeneus barberinus*	-	-	23
91		*Parupeneus bifasciatus*	-	-	32
92		*Parupeneus indicus*	-	-	28
93	Centridae	*Acoliscus strigatus*	-	-	38
94	Murainidae	*Echidna nebulosa*	-	-	9
	Total		515	439	1441
	Diverisity index (H')		3,54	3,86	3,96

Pantai Sirkui has a diversity index lower (3,54) than Teupin Layeu (3,86) and Teluk Pelabuhan (3,96). This suggests that reef condition is an influential factor. Pantai Sirkui has a lower percentage of coral coverage than other sites. Teluk Pelabuhan has the greatest amount of individual which compared to any other location. These matters relate to the condition of many corals safe and new corals grow more in Teluk Pelabuhan compared to other place. The similarity indices at the three locations of Pantai Sirkui, Teupin Layeu and Teluk Pelabuhan were relatively high, meaning that fish type composition at this location was well-balanced.

4.1. Project review

The project was reviewed during Month 6 by the University of Kent. The first term activities that were not completed on time (namely 'coral code of conduct production' and 'shoreline reforestation') were discussed and their delayed implementation for the second term agreed upon. The project manager and field team leader then discussed the second term timetable implementation, as well as staff appraisals and future developments. The project has made progress over the course of PY1. Numerous additional activities have been completed, such as the mooring buoys installation, and these have been important for Iboih reef conservation.

Additional activity

Presentation to Leuser International Foundation and Fauna & Flora International

During Month 9, project staff gave a joint presentation to a local and an international NGO working in Banda Aceh. During this time project progress and research opportunities were presented and discussed to maintain on-going collaboration between the project and these NGOs.

Future activities identified

1) Coral and fishery management plan needed for Iboih and Sabang area with fishing zones, snorkelling zones and diving zones.
2) We have been having taken of survey and monitoring to new corals recruitment, the result shown that there are a lot of new corals colony growing in area of tsunami damage. But, this time not yet informing stakeholders of the locations that have been growing new corals. So that we indeed need the existence of continues this project to conservation of reefs.
3) Marine law enforcement patrols being conducted to protect the coral reefs.
4) Recycling of rubbish - establish 8-10 ‘recycling’ stations (i.e. metal drums where rubbish can be burnt and vegetable waste used for compost).
5) Add six additional mooring buoys in areas close to coastal bungalows with high boat visitations.
6) School field trips – bring school children to the beach in Iboih. Need interesting/fun coral activities to help the children learn. Teachers to design a follow up classroom activity/homework, small project etc. which reinforces what they have learnt.

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