

## Alteration of Coral Reef Community Structure Caused by Anthropogenic Activity in the Coastal Area of Giliketapang Island, Probolinggo, East Java, Indonesia

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### ABSTRACT

The aim of the research was to know the effect of anthropogenic activity around the coastal area of Giliketapang Island toward community structure of coral reefs. This study used belt transect method which consisted of 18 transects in three locations (harbour, near the forest, and transitional areas) at 50-80 m from the coast, with a plot sized of 2x2m<sup>2</sup>. Abundance of coral reefs were observed based on their coverage. There were 11 families of coral reefs found. The percentage of coral damage decreased and the number of the species increased at the zones far from the coast. This also affected the coverage value of coral reefs. Coral coverage at the harbour and near the forest was 53.06 % and 65.36 % respectively, whereas in the transitional area was 38.38%. Co-domination between *Porites lobata* and *Chyphastrea microphthalma* occurred at the harbour, while *Porites mayeri* and *Acropora* spp. co-dominated in the location near the forest. Poritidae family dominated the transition area. Anthropogenic activities at transitional location caused severe damage toward coral reefs.

**Keywords:** coral reef, damage, Giliketapang Island

### INTRODUCTION

Giliketapang island is a small island located 3.8 miles from the north of Probolinggo. Giliketapang island is formed by coral rocks, so the surrounding water is filled with a variety of reef life. The majority of people living in this island are fishermen. However, most fishermen do their activities without regard to the effects of their activities toward the environment, such as the use of some explosives causing the existence of coral reefs of no more than 40% [1]. Anthropogenic activity is not only shipping, but also waste disposal, public toilets, and coral mining. One of the real impacts to the living organisms around is the decrease in fish diversity around the coral reefs; due to the fact that coral reef ecosystem is a source of living for the organisms in its surrounding areas. Therefore, the purpose of this study was to determine the effects of anthropogenic activities toward coral reefs.

### MATERIALS AND METHODS

The research used belt transect method which consisted of 18 transects in three locations (harbour, near the forest and settlement) (Fig.1) at the distance of 50-80 meters from the coast, with a plot size of 2x2 m<sup>2</sup>. The coverage of coral reefs for each location and station was observed using a visual technique [2]. The observation was done by diving in the depth of 3-7 meters, using a SCUBA equipment. Coral reef identification was done based on a book from Veron [3] and Suharsono [4].

The use of three locations was based on the reason that each location has different anthropogenic activities. Location I was harbour, located in the north of Giliketapang Island, having a substrate type of sand. There was a high anthropogenic activity found in this location and it has a depth of about 4-5 m. Location I consisted of 5 transects with 10 stations for each transect. The distance between transects was 10 meters.

Location II was near the forest and is located at a site east from Giliketapang Island and has depth about 3-4 m. This location has light slope. Based on the level of the anthropogenic activity, fishing activity was found to be rare and there

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was not any human beings' activities done in this location. This location consisted of 8 transects with 10 stations for each transect. The distance between transects was 5 meters.

Location III was near a settlement having a substrate type of sand with high shipping

activities since it has a depth of >5 m. This area is intermediate between settlements and homogeneous forests. This location consisted of 5 transects with 8 stations for each transect. The distance between transects was 5 meters.



Figure 1. Coverage area of study in Giliketapang Island

## RESULTS AND DISCUSSION

Coral reefs found in Giliketapang island were as many as 11 families; among those families were Acroporidae, Agariciidae, Astrocoeniidae,

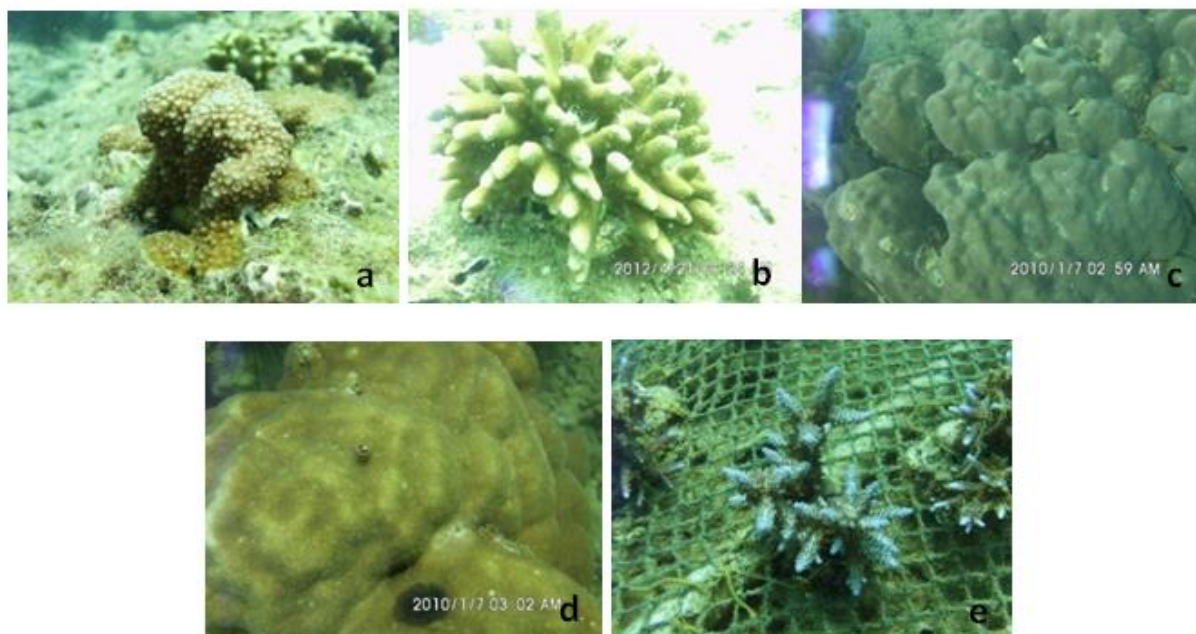
Faviidae, Fungiidae, Pocilloporidae, Poritidae, Siderastreidae, Oculinidae, Mussidae, and Merulinidae (Table 1).

Table 1. Diversity of coral reefs (filum: Coelenterata) in Giliketapang Island

No.	Family	Genus	Species	No.	Family	Genus	Species
1.	Acroporidae	<i>Acropora</i>	<i>Acropora</i> spp.	25.	Faviidae	<i>Leptastrea</i>	<i>Leptastrea</i> spp.
2.		<i>Mantipora</i>	<i>M. digitata</i>	26.			<i>L. purpurea</i>
3.			<i>M. malampaya</i>	27.		<i>Montastrea</i>	<i>Montastrea</i> spp.
4.			<i>M. porites</i>	28.		<i>Favites</i>	<i>Favites</i> spp.
5.			<i>Mantipora</i> spp.	29.		<i>Favia</i>	<i>Favias</i> spp.
6.			<i>M. turtensis</i>	30.	Fungiidae	<i>Cyloseris</i>	<i>C. costulata</i>
7.			<i>M. stellata</i>	31.		<i>Herpolitha</i>	<i>Herpolitha</i> spp.
8.	Agariciidae	<i>Coeloseris</i>	<i>Coeloseris</i> spp.	32.		<i>Diploastrea</i>	<i>D. heliophora</i>
9.		<i>Pavona</i>	<i>P. decussata</i>	33.	Pocilloporidae	<i>Pocillopora</i>	<i>P. damicornis</i>
10.			<i>P. frondifera</i>	34.	Poritidae	<i>Porites</i>	<i>P. (synarea) rus</i>
11.			<i>P. varians</i>	35.			<i>P. compressa</i>
12.	Astrocoeniidae	<i>Stylocoeniella</i>	<i>Stylocoeniella</i> sp.	36.			<i>P. cylindrica</i>
13.	Faviidae	<i>Cyphastrea</i>	<i>C. microphthalma</i>	37.			<i>P. lobata</i>
14.			<i>C. japonica</i>	38.			<i>P. mayeri</i>
15.		<i>Favites</i>	<i>F. abdita</i>	39.			<i>P. nodifera</i>
16.			<i>F. complanata</i>	40.			<i>Porites</i> spp.
17.		<i>Goniastrea</i>	<i>G. aspera</i>	41.			<i>P. stephensoni</i>
18.			<i>G. palauensis</i>	42.		<i>Alveopora</i>	<i>Alveopora</i> spp.
19.			<i>G. retiformis</i>	43.		<i>Goniopora</i>	<i>G. tenuidens</i>
20.			<i>Goniastrea</i> sp. 1	44.	Siderastreidae	<i>Psammocora</i>	<i>P. profundacella</i>
21.			<i>Goniastrea</i> sp. 2	45.	Oculinidae	<i>Galaxea</i>	<i>G. astreata</i>
22.			<i>Goniastrea</i> sp. 3	46.			<i>Galaxea</i> sp.
23.			<i>Goniastrea</i> spp. 4	47.	Mussidae	<i>Lobophyllia</i>	<i>L. flabelliformis</i>
24.			<i>Goniastrea</i> spp. 5	48.			<i>L. hemprichii</i>
				49.	Merulinidae	<i>Hydnophora</i>	<i>H. microconos</i>

Poritidae was a family having the largest number of species compared to the other families. Poritidae is one type of coral reefs having a massive form and sheets, especially in the Porites genus. This species has the composition of coral species coralite varying in sizes without any conesteam. Walls and septa of coralite shaped its porous. The special characteristic of septa is on its erger and each genus has a typical shape of this structure. Poritidae is a family among which having the smallest polyps [4,5]. In location I (harbour), occurred co-domination between *P.lobata* and *C.microphthalma*, while *P.mayeri* and *Acropora* spp. co-domination was found in location II (near the forest). *Acropora* spp. is one type of coral reefs having a fast capability to grow and one of the

coral reefs which is extremely sensitive to environmental changes-such the changes shall happen in the environment [6]. *Acropora* spp. usually live in areas having frequent breaking waves, with sand and clear water. This kind of coral reef is classified as highly vulnerable to pollution, sedimentation, and fishing in the form of human activities [7]. If *Acropora* spp. is found in a place, then it can be said that water condition in that particular place is good and suitable for the growth of *Acropora* spp. coral species. Location III (settlement) was dominated with the existence of Poritidae family (Figure 2). If Poritidae family is found to be dominant in territorial water, it indicates that site is contaminated [8].



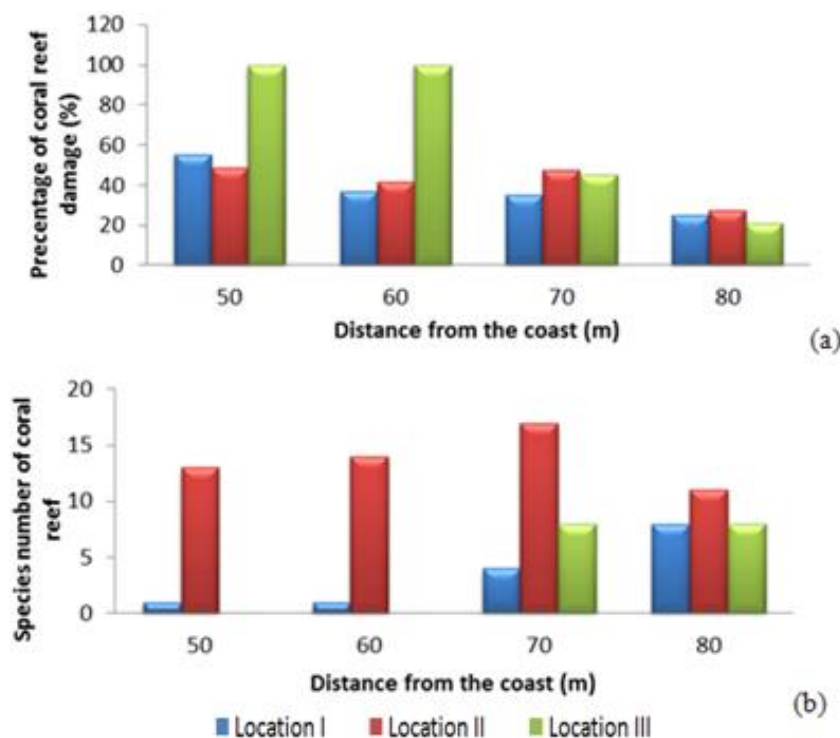
**Figure 2.** Dominant species of coral reef in Giliketapang Island; (a) *C. microphthalma*; (b) *P. compressa*; (c) *P. lobata*; (d) *P. mayeri*; (e) *Acropora* spp.

The increasing percentage of coral reefs damage caused the decrease in the number of species in each location. Coral reefs damage (bleaching) would decrease in the location far from the coast. At the distance of 70 meters from the coast, the damage began to decline which was characterized by the non-existence of coral bleaching (Figure 3a and 3b). It was caused by the decrease of the anthropogenic activities and as such the varieties of species increased. Activities causing the damage to coral reefs include waste disposal, public toilets activities, coral mining, and shipping activities. The decrease of coral reefs can occur because of disruption caused by the activities of public and environmental conditions. Interference can cause

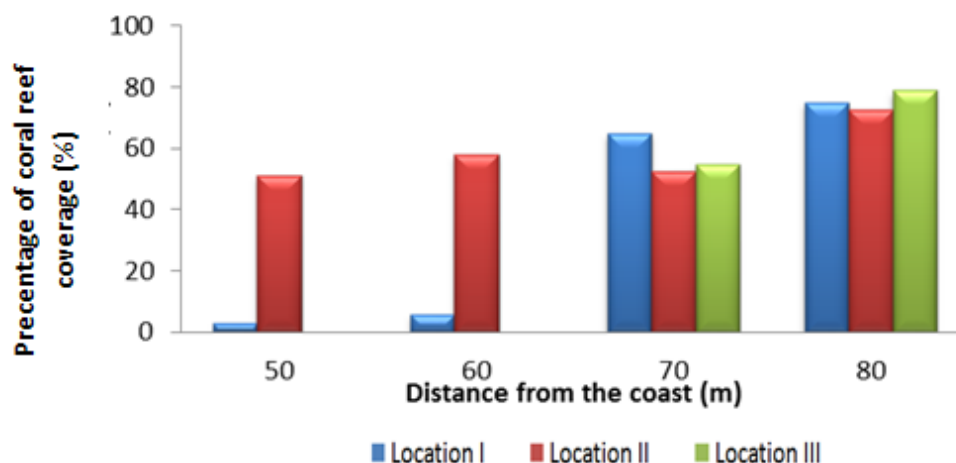
stress to the organisms and that can cause changes toward the qualitative and quantitative structures and functions of a community. Stress on coral reefs can occur due to sedimentation, the influx of fresh water, changes in temperature, and light penetration [9]. Meanwhile, according to Leksono [10], environmental disorders not only cause changes in a community structure, but can also cause changes in the physical environment around it. In marine ecosystems, cyclone disturbance affects the coverage area of coral reef ecosystems. Coral reefs unprotected by the island are more vulnerable to damage than those which are protected by the island. The more number of coral reef species, the greater their coverage will be.

At a distance of 80 meter from the coast, the number of coral reef species increases. It may be reasonable to assume that the farther the distance then the higher the carrying capacity of the corals reduced. However, based on (Fig. 4), the closing value at a distance of 80 meter from the coast was found to be the highest value compared to the closing value without distances. At distances of 50 and 60 m from the coast, at location III, the coral reef coverage was 0 %; in both of these distances sand dominated the environment, so there were not any coral reefs found.

The number of coral reef species will affect the percentage of coral reefs in covering each location. The more number of coral reef species, the greater the value of its coverage. The magnitude of the coverage of living and dead coral reefs was shown by the value of their coverage in each location and each transect in each location. Based on the criteria from Kreb [11], coral reefs coverage in location I and II was in good condition (53.06 % and 65.36), while in location III was not (38.38 %).



**Figure 3.** Comparison of the percentage of coral reef damage (a) and number of coral reef species (b) based on the distance from each location in Giliketapang island (Location I= harbour; Location II= near the forest; Location III= settlement).



**Figure 5.** Percentage of coral reefs coverage based on the distance from each location in Giliketapang island (Location I= harbour; Location II= near the forest; Location III= settlement).

## CONCLUSION

Anthropogenic activities especially the ones found in the settlement area can influence the community structure of coral reefs. The effect of anthropogenic activities in harbour and near the forest were less damaging than the ones in the settlement area. Activities causing damage to coral reef include waste disposal activities, public toilets activities, coral mining activities, and shipping activities. Coral reefs coverage in location I and II was in good condition (53.06 % and 65.36), while in location III was not (38.38 %). Co-domination between *P. lobata* and *C. microphthalma* occurred in location I, *P. mayeri* and *Acropora* spp. co-domination was found in location I, and the existence of Poritidae family dominated location III.

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