

STATUS OF CORAL REEFS IN THE LEMBEH STRAIT AND ADJACENT WATER, NORTH SULAWESI

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ABSTRACT

Lembah reefs and its water surrounding are among the richest and most diverse in marine biota in Indonesia. The biota and reefs in this area have an important contribution to the province's economy in the form of tourism and fishery activities. An inventory using line intercept transect and free collection on the coral diversity has been conducted in four different locations showed that live coral cover ranging from 12.2–60.7% while sand rubble ranged from 4.67 to 78.67%. Among the life form categories, sponge dominated other biota with 0.47–21.97% coverage. Macro algae and turf algae cover were low at all sites, with average less than 2.07%. A total of 193 coral species belonging to 68 genera were recognized from this area. The differences among sites may be consequences of water quality, habitat variability and condition of the land base activities. Water turbidity in the coastal area of Kema was high due to the effects of water discharge from river mouth. Further, poor land management, development of port and human settlement leading to sedimentation, water pollution and poor water quality, remain the primary causes of reefs declines. Busy harbor and local sea transportation will be the major cause of coral reef degradation in the near future. There is a need to increase awareness of local people about the importance of coral reefs and to develop management and conservation efforts involving scientists, academe and tourist operators. In addition, it is a need to strengthen the capabilities and capacities of institutions that concern reef management and enforce legislation.

Keywords: coral reef status, distribution, diversity, Lembah strait.

INTRODUCTION

Sulawesi Islands and its water surrounding are the main reef areas in Indonesia and well known as the global center of coral, species diversity. In the recent year, Sulawesi is also known as the center of Coral Triangle. The coastline of Sulawesi is bordered by an almost continuous fringing reefs while further offshore it surrounds by deep sea with clear water current of Indonesian through flow and resulting in very well reef development. Bitung Regency is located off the east coast of North Sulawesi Province, central Indonesia, with its fast growing international port. While Lembah Island is located in front of the Bitung port. The international port of Bitung is the biggest and busiest harbor in the north Sulawesi.

Coral reefs are the most important marine resources in tropical water and have the most biologically diverse of shallow marine ecosystem. Unfortunately, these reefs are being degraded very vast by human activities and climate change in the last decade. Lembah Island is located in one of the Coral Triangle, world's maximum marine species richness. Lembah Island shows habitat heterogeneity and is rich in many different species including endemic, rare and most vulnerable species (Hoeksema 2007, Wallace et al., 2001).

Lembah strait and its coastal area are one of the areas undergoing a fast increase in tourist destination especially for snorkeling and diving. For the last ten years, several numbers of dive centers operate in this areas. Diving operator uses the rare, endemic species and colorful biota for

advertisements to attract foreign tourists. This issue generates local government to protect the reefs.

Healthy reefs and richness of biota are important factors for tourist industry. On the other hand, fast growing of the international port and fishing industry are also important for local government to increase their economic development even though they bring consequences. Destructive fishing, land base pollutant and impact of harbor construction are the most serious threat to coral reefs. Whilst, unsustainable fisheries using trawl, fish traps and explosive are still operated in this area. Dive operator and tourism can also become a threat by itself. Consequently, the local government should be able to manage the use of coral reefs.

Further south of Bitung there is a river flow bringing plum and all degrading materials from land based activities. Sedimentation reduces light, smothers coral tissue and in the long term it affects the structure and function of the coral reef ecosystem by altering both physical and biological process. Effects of heavy sedimentation on coral reef structure are associated with limited coral species, slow growth rates and limited coral recruitment (West and Van Woelik 2001, James et al., 2005).

The objective of this study is to describe the conditions of coral reefs in the Lembeh Island and its water surrounding especially in the Lembeh strait in front of harbor and in the coastal area of southern part of Bitung. The information is important for the local government when management action should be made.

MATERIAL AND METHODS

The line intercept transect was used to assess the condition of coral reef in for locations namely Serena Island, Labuhan Kompeni, Kema and Tanah Merah southern part of coastal areas (Fig. 1). The results are believed to be important for the local government when actions should be made to protect the coral reefs in the given area. A measuring tape was placed across the reefs and coral colony underlying the line transect was recorded and the projected length of living coral and other organisms on the tape was measured to the nearest centimeter. The transect was laid down in the reef slope using SCUBA diving in the depth range 3 and 10 meters. Three replicates of 50 meter long roll meter positioned parallel to shoreline were applied. Assessment was done using SCUBA diving and

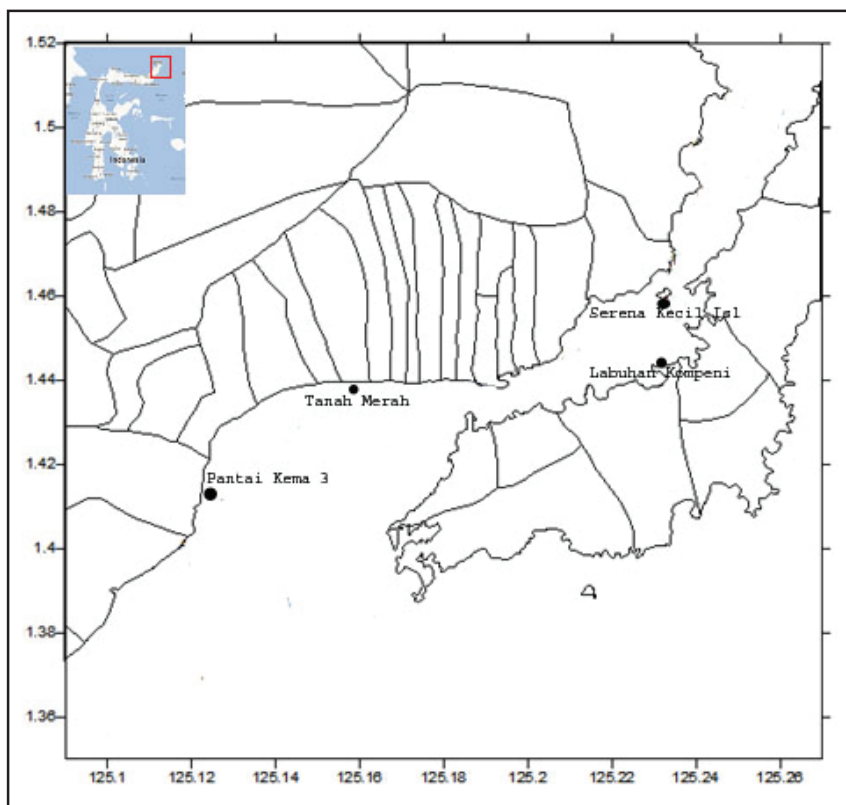


Figure 1. Location of sampling area

Table 1. Percentage cover of live coral and other life form categories of coral reefs in Lembeh Strait

	L O C A T I O N			
	Serena Kecil Island	Labuhan Kompeni	Pantai Kema 3	Tanjung Merah
Life Coral	60.70±5.37	21.80±10.31	16.30±7.59	12.20±4.67
Acropora	0.00	0.12±0.29	0.43±0.75	1.97±3.41
Non_Acropora	60.70±5.37	21.68±10.48	15.87±6.91	10.23±6.63
DC	7.23±4.58	1.23±1.92	0.00	3.57±3.30
DCA	0.00	8.43±11.47	0.00	0.00
Algae				
TA	2.07±3.58	0.93±1.51	0.00	0.00
MA	0.00	0.00	0.87±1.50	0.00
Other Fauna				
SP	14.27±9.92	20.67±18.61	1.70±0.87	0.47±0.81
ZO	0.00	0.32±0.78	0.00	0.00
Abiotic				
Sand	5.07±6.36	24.88±19.22	65.03±16.52	5.10±8.83
Rubble	10.67±16.11	21.73±22.20	16.10±12.24	78.67±14.97

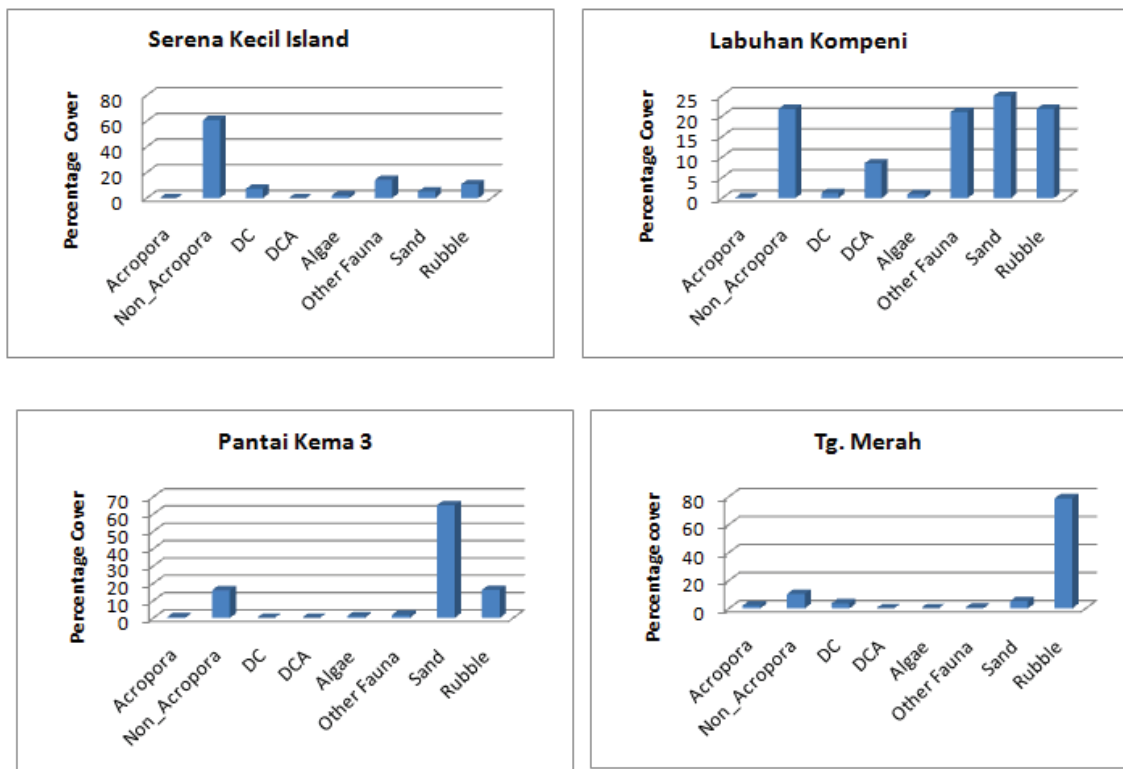


Figure 2. Percentage cover of live form categories of coral communities in the Lembeh Strait. DC: Dead corals, DCA: Dead Coral with Algae.

the data were recorded on the waterproof data sheet. All the benthic organism underlying the line transect were classified at the level of life-form (De Vantier 1986, English et al., 1994). The field data were entered into a dBase program for storage,

checking and analysis. Free collection of corals was also done to assess the species richness and diversity. The free collection was started from the upper reef slope down to the depth 20–30 meters depending on the occurrence of coral colonies.

RESULTS AND DISCUSSION

The Lembeh Island and its water surround are known as one of the central mega-biodiversity (Hoeksema 2007, Wallace 2003). A total of 193 species of scleractinian corals belonging to 68 genera has been recorded including 7 species of non scleractinian coral such as Tubipora, Heliopora, Millepora, Distichopora and Stylaster. In order to show the species richness of coral in this area, we focused on fungia species found during this study. There were 30 species of Fungia belonging to 12 genera found. So far, TIU-LIPI Bitung has recorded 37 Fungia species (Bambang, press.com) among 41 species known from Indonesia. Meanwhile, there are 43 species distributed throughout the world (Hoeksema, 2007). The complexity of habitat types in the Lembeh Island and its surrounding waters resulted in high species diversity. This study also showed that the highest live coral coverage and species numbers were recorded in Serene Kecil Island with 130 species. In the other hand, the lowest average percentage cover was found in Tanjung Merah and the smallest species number was in Kema (34 species) (Table 1).

Serena Kecil Island

Serena Kecil Island is a small island covered by vegetation and located in the middle of Lembeh strait. The reef flat is narrow with the reef sloping $\pm 60^\circ$ and grown by corals to the depth of 20–30 meters. Corals were in a good condition with coral foliaceous was the most dominant species among the live form categories. The foliaceous corals included *Echinopora lamellose*, *Echinophyllia elaphanthotus* and *Pachyseris speciosa* which grew in the depth of 5–10 meters and took up 60.70% of the area. Live form such as mushroom, sub massive and coral massive was common in this area. A part from featuring the most diverse assemblage of foliaceous live form categories, this region contained flourishing sponge populations (14.27%).

Labuhan Kompeni

Labuhan Kompeni is located in the Lembeh Island in front of the Bitung Harbor. The reef flat is narrow with reef slope 60° down to 30 meters

depth. The average of live coral cover was very low 18.7% and overall dead coral, sand and rubble were 56.84%. Sponges were presently conspicuous in this area with percentage cover of 21.97%. Reef slope substrate was mostly sand and mud, and corals in the reef flat and upper reef slope were significantly damaged. Coral degradation in this area was profound due to the construction of the shipyard and harbor facilities. Harbor facility is about to build when we visited the area for field work.

Tanjung Merah

Tanjung Merah is located in the southern part of Bitung Harbor. The reef flat is wide with gently reef slope. The substrate in this area was dominated by coral rubble or fragments of dead corals overgrown with algae. The coral conditions were in bad category with average percentage of live coral cover less than 12.2%. It was found that among all live form categories, rubble corals were dominant in this area (78.67%). The destructive fishing practice might be the driving force for the degradation of reef habitat. The small craters of blasted area were easily found with the outer of the craters cover with lots of rubble or broken colonies of *Acropora* and *Montipora*.

Kema

The reef flats of Kema are very wide with very gently slope down to 5–10 meters. The present study showed that the average of live coral coverage only 16.3% with an overall average non acropora cover of 15.87% consisting of massive and sub massive corals. Habitat types between Kema and Serene kecil were very different. The Serene Kecil was characterized by very short reef flat with very sharp reef slope while Kema was in contrast. This differences in the reef structure brought differences in species composition, colony size and species abundance. It may indicate that coral reefs in Kema have been affected by heavy sediment load and shallow reef flats showed the worst condition.

Sedimentation could be the major cause of very low live coral cover in Kema and Tanah Merah. Accumulation of sand and mud did not give support to reef development. Wave and water

turbulence may cause sediment resuspension in the water which was unfavorable for reef coral recruitment and growth (Montaggioni, 2005; Xiubao et al. 2012). Direct effects of sedimentation from river mouth nearby Kema could be smothering and shading. The most severed inhabitants are the early stage settlements. The study of sedimentation in Berau river of east Kalimantan showed that the movement of sediment can reach as far 30 km from the river mouth and higher turbidity occur during wet season due to high runoffs and heavy rain (Susanto, 2010).

It is not easy for local government of Bitung city to develop fishing industry, international harbor facilities and tourist industry without any impact on the surrounding environment. Meanwhile, the developments are very important economic growth and for the welfare of the Bitung residents. In this regard we suggested that the Lembeh strait is only for the development of tourist industries. The fishing industries can't operate in the strait and it is important to locate certain industry in particular location for instance only subsistence fishers are allowed to fishing in this areas using environment friendly fishing gear. In addition, tourist operators in this area should give the opportunities for the local people to become a part of tourist industries. Any infrastructure and harbor facilities should not be built in the Lembeh Island and any fishing boats or vessels bigger than 10 gross ton are prohibited passing through the Lembeh strait. Further, Harbor authority has to make sure that Lembeh is free from any kind of wastes.

In conclusion, the reef in Lembeh Island contains a variety of habitat related to geological setting and exposure to prevailing currents, wave, as well as any pollutants including land base activities sediment industrial domestic works runoff, siltation and turbidity. The high species diversity in the Lembeh straits but lack of comprehensive management as a whole makes the entire coral communities vulnerable to degradation.

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