The composition of coral reefs in Ulee Lheue breakwater, Banda Aceh, Aceh, Indonesia

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Abstract. The present study was aimed to catalog the coral reefs that are found in Ulee Lheue breakwater, and providing a baseline data that will be valuable in Aceh marine conservation plan in the future. The research was conducted from February to October 2015. The station of observations was designed by systematic sampling. The sampling stations were located on the outer side and inner side the breakwater with a station spacing of 250 m. Furthermore, 50 m roll meter was used in each station as the reference to laying squares transects (size 100 x 100 cm) for coral reefs observation. Then, the square transects placed on 0, 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 m. The results showed the reef at the outer breakwater consists of 11 coral genus of 244 colonies. While on the inner side of the breakwater, eight genera of 46 colonies were observed. Acropora and Pocillopora were the most common genus on the outer side of the breakwater, while Chypastrea and Porites were the most common on the inner side. 0-5 cm coral colony size was the most common size found on both sides of the breakwater. This result showed that the construction of artificial structures on the coast is not only important in the development of a city but also important for marine biology and ecology study.

1. Introduction

Following the mega earthquake (9.2 M) on the coasts of Indian Ocean, the tsunami on 26 December 2004 damaged almost the entire coast of Aceh Province including its capital city Banda Aceh[1-4]. In addition, the tsunami washed away thousands of Banda Aceh's infrastructures including Ulee Lheue Port in Meuraxa sub-district. The Ulee Lheue Port is the most vital seaport in Banda Aceh. This port was used to connect Banda Aceh with some nearby islands (Weh Island, Aceh Island and etc)[5]. Ulee Lheue Port was rebuilt after the tsunami by the Rehabilitation and Reconstruction Agency (BRR) together with two km mountain rocks breakwater along its coastline.

Human-made structure in coastal areas such as the breakwater at the Ulee Lheue Port not only important for the development of engineering science but also essential for the biology and ecology science. A number of studies showed the artificial structure in coastal area might become a favorable place for marine organisms to live including the coral reefs. For example,[6] reported at least 17 coral genera were growth on the seawalls built in Singapore. This Singapore artificial coastal defense were
also reported to attract marine fish to come. [7] reported 4,943 fishes from 70 taxa were recorded, dominated by Pomacentridae (56.5%) and Labridae (17.7%). In addition, [5] reported 87 species of reef fishes in Ulee Lheue breakwater. However, the study of coral reefs in Ulee Lheue breakwater is lacking. Thus, the present study was aimed to catalog the coral reefs found in Ulee Lheue breakwater, and providing a baseline data that will be valuable in Aceh marine conservation plan in the future.

2. Materials and Method
The research was conducted from February to October 2015. The station of observations was designed by systematic sampling. The sampling stations were located on the outer side and inner side the breakwater with a station spacing of 250 m (Figure 1).

![Figure 1. Map of the studysites.](image1)

Furthermore, 50 m roll meter was used in each station as the reference to laying squares transects (size 100 x 100 cm) for coral reefs observation (Figure 2). Then, the square transects placed on 0, 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 m. The corals were identified and recorded based on [8] and [9].

![Figure 2. Coral reefs measurement and record.](image2)
3. Results and Discussion

In total, 244 colonies belonging to 11 coral genera were found in the outer side of Ulee Lheue breakwater. *Acropora digitate*(40%), *Pocillopora* (39%), *Acropora branching* (5%), and *Porites* (5%) were the dominant genus found, while, *Heliopora* and *Favia* were the lowest (Figure 3). The *Acropora* had the highest number of species compared to other genera. This type of coral usually grows in clear waters. This genus is generally has branching lifeform and classified as a fast growing coral. However, this coral very susceptible to sedimentation and fishing activities. In contrast, 46 colonies belonging to 8 coral genera were found in the inner side. The most common coral genus in this area were *Chypastrea* (48%) and *Porites* (17%) (Figure 4). According to [10], the growth of coral colonies can be different from one to another, branching colonies tend to grow faster than submassive corals and folioselifeform. Branching coral species such as *Acropora* and *Pocillopora* have 6-8 cm / year growth whereas massive coral species such as *Porites* and *Favia* have slower growths of 0.5-1 cm / year [11]. Furthermore, *Acropora* was classified as sensitive coral because they require high water brightness and open waters with free circulation of water. Such environmental characteristics are needed because this type of coral cannot clean their self because they have relatively small polyps and require waves and suitable currents to clean. [12] stated that branching coral is a type of coral that lives in shallow waters with clear water quality and is often found on beaches with wavy waters. In addition to the brightness, the temperature was also affects the survival of coral reefs. [13] stated that the optimum temperatures for coral growth ranged from 25° C - 29° C, while the maximum limit is around 36° C and the minimum ranges from 16° C - 17° C.

In addition, the size of the coral colony from 0 to 5 cm was the most commonly found on both sides of the breakwater (Figure 3-4). Alongside its function in protecting the coastal area, the mountain stone used to built the breakwater has the potential to be a suitable substrate for the recruitment and growth of coral reefs. In their study in Komodo Island, [14] found that the coral recruitment recorded in rock piles were higher than in the netting pinned to rubble and cement slabs area. In addition, the breakwater in this study generating a new habitat for coral reefs and providing shelter as well as food for reef-associated fish. This area was also had high abundance of reef-associated fish. [5] reported at least 87 species in 28 families were found in this area. Furthermore, this area also becomes a preferred fishing spot and attracted hundreds of recreational fishers in Banda Aceh.

![Figure 3](image_url)  
*Figure 3. The composition and size distribution of coral reefs found in outer side of Ulee Lheue breakwater.*

The results of the present study provide the baseline data of the coral reefs and may contribute to better management of fisheries in this area. In addition, the results of this study also can be used to promote the public awareness in saving coral reefs ecosystem in Ulee Lheue breakwater.
4. Conclusions
In total, 244 colonies belonging to 11 coral genera and 46 colonies belonging to 8 coral genera were found in the outer and inner side of Ulee Lheue breakwater, respectively. These findings indicate that the development of artificial structures on the coast is not only important in the development of a city but also important for biology and marine ecology study.

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