First assesment of coral Mussidae in Kelagian Island waters

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First Assesment of Coral Mussidae in Kelagian Island Waters, Lampung

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Abstract. Coral reefs are marine ecosystems located in the tropics in shallow waters. Coral from the Mussidae family becomes one of the corals that are widely exploited as ornamental corals. Kelagian Island waters have a high coral cover, so the identification of the Mussidae group is needed as an assessment of this type of coral. This study aimed to analyze Mussidae coral cover in the waters of Kelagian Island. The data collection took place in December 2018 at two locations. Physical-chemical parameters of waters taken using porTABLE tools include salinity, temperature, pH, Dissolved oxygen, brightness and water current, while nitrates and phosphates were analyzed in the laboratory. Coral cover data was taken using UPT (Underwater Photo Transect) on a fifty-meter square transect. Photos were taken every one meter and then analyzed with CPCe software. Mussidae corals identified were species *L. corymbose* and *A. faviaformis*. Total coral cover in the waters of Kelagian Island were in moderate condition except at S1-7m was poor conditions. The results of measurements of aquatic parameters revealed that the environmental conditions of this area were still in good condition. All parameters were measured under normal circumstances to support the life of the coral reef ecosystem biota. However, this may indicate that the hard corals in this region are generally threatened.

Keywords: Assessment of Coral, Diversity, Hard corals, Mussidae, Water quality

INTRODUCTION

Coral reefs are a unique ecosystem that can only be found in two seasons. Coral reef ecosystems are spread in shallow ocean waters around the earth's equator, one of which is Indonesia. Coral reefs have limits to environmental conditions so that they can only live in more sTABLE climates, namely tropical areas [1]–[3]. Indonesia's coral reef cover has an area of about 2.5 million ha. However, the impact of global environmental degradation resulted in healthy coral reefs or in excellent condition only 6.39% [4]. Coral animals as inhabitants of the limestone rock cluster are very vulnerable to environmental changes [5]–[7]. Limestone rocks that are not inhabited by coral will experience coral bleaching [8]. Based on this event, it means that coral animals are the ones that make the limestone rocks colorful.

Hard corals are excellent as shelters for small biota on an ecological scale and attract interest for aesthetic value for humans [9]. Hard coral clusters can be home to small organisms as well as food source sites for predatory organisms [10], [11]. Based on its taxonomic tree, hard corals consist of several families that include Mussidae, Astraeidae, and Pectiniidae. Each group of hard corals has its own characteristics and uniqueness. One example is the coral of Mussidae. Mussidae corals are solitary but some form colonies. Coral with wide grooves and large hills. Septa with large teeth there are sharp and some are blunt. Coela and walls are very well developed [12]. However, behind the specialty there is a major threat that interferes with the sustainability of this type of coral.

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The spread of some types of coral is decreasing. Reported by Osborne [13], in Australia's great barrier reef region coral deaths are increasing as water quality declines and global climate change. Then, in the Palau region the distribution of hard coral cover is reduced due to the sedimentation effect of river discharge [14]. Changes in environmental conditions by external factors are the main cause of the loss of hard coral cover. Some physical-chemical environmental factors have changed over time away from normal circumstances. These external factors can include rising ocean temperatures due to global warming, decreased ocean pH due to increased carbon pollution intrusion, increased in polluting materials entering the oceans due to anthropogenic intrusion of land and coastal areas [15]–[17]. In addition, some human activities cause damage to coral reefs directly, including the release of ship anchors arbitrarily, the use of dangerous fishing gear around coral reefs, and the legs of divers who hit coral reefs [18]–[20].

The waters of Kelagian Island in Lampung, Indonesia are observed not too crowded. Only the activity of small fishermen that is often seen in this location indicates in this region has little impact of human activity. Based on the distribution of coral reefs, Kelagian Island has a coral cover area of about 60.85%. The cover value is the highest compared to the surrounding location in Lampung Bay [21]. Identification of hard coral communities on Kelagian Island is necessary for sustainability. One type of hard coral that gets attention globally is the coral from the Mussidae family. Therefore, this study will discuss the assessment of Mussidae corals in the waters of Kelagian Island.

MATERIALS AND METHODS

Study Site

This research was conducted in December 2018 on the southern Kelagian Island in Lampung Bay. Activity on this island was less when compared to other islands in Lampung Bay. Based on observations in the field, the island was not permanently inhabited by humans, only seen by a few buildings as a temporary stopover for tourists. The location of Kelagian Island was shown in FIGURE 1.

FIGURE 1. Data Collected Location

Sample and Data Collections

Mussidae observations were carried out at two observation points in the south of Kelagian Island as an effort to re-monitor the presence of Mussidae there as previously reported [22]. Mussidae was found at depths of 2 m to 15 m

[17]. Coral assessment in the field was carried out using the Underwater Photo Transect method at a depth of 2 m and 7 m. Corals were photographed for identification. Physical-chemical parameters of the environment measured in the field include temperature, salinity, dissolved oxygen, pH, water brightness, current velocity, while nitrates and phosphates were measured in the laboratory using spectrophotometers [23].

Data Analysis

Analysis of Coral Cover Percentage

Analysis of data to separate between total coral cover data and Mussidae coral cover data using a formula [24]. Variables of coral cover analysis included; L = percentage of coral cover (%); Li = Total area of Mussidae coral cover (m^2); N = Total area of quadratic transect (m^2), with formula:

$$L = \frac{Li}{N} \times 100\% \quad (1)$$

Mussidae coral cover area data and total coral cover area were analyzed using CPCe software. The data processed is the result of underwater photo transect [23].

Biodiversity Analysis

Analysis of coral biodivesity was conducted at the level of diversity, uniformity and dominance of species [25]–[28]. Diversity was calculated using the Shanon-Winner index, with the following formulas. With, H' was the diversity index, pi was the ratio of the number of individual species-i (ni) to the number of individual species per station (N).

$$H' = -\sum_{i=1}^{s} pi \ln pi \quad (2)$$

Uniformity of species was calculated with the following formulas. With, E was the uniformity index, H' was the diversity index, $H'max$ was the ln of the species found.

$$E = \frac{H'}{H'max} \quad (3)$$

Species dominance was calculated using the Simpson Index with the following formulas. With, C was the dominance index, ni was the number of individual species-i found and N was the number of individual species found each station.

$$C = \sum_{i=1}^{s} \left(\frac{ni}{N}\right)^2 \quad (4)$$

RESULT AND DISCUSSION

Physical-Chemical Parameters

Measurements of physical-chemical parameters on the surface of the waters at both sites included temperature, salinity, dissolved oxygen, pH, water brightness, and current speed produced values that did not differ significantly while for chemical parameters nitrates and phosphates produced varying values but remain below the standard quality of the waters. In full, the measurement results were presented in TABLE 1.

TABLE 1. Measurement of Physical-Chemical Parameters of the Waters

Parameter	Unit	Site				Measurement type
		S1-2m	S1-7m	S2-2m	S2-7m	
Temperature	°C	25	28	29	27	Field measurement
Salinity	‰	35	34	35	34	
Dissolved oxygen	mg/L	5.13	5.57	5.75	5.89	
pH	-	8.07	8.1	8.07	8.08	
Water brightness	%	100	85	100	71	
Current speed	m/s	0.07	0.05	0.08	0,06	
NO_3	mg/L	0.048	0.043	0.070	0.072	Laboratory measurement
PO_4	mg/L	0.010	0.027	0.038	0.04	

The physical-chemical parameters of the waters had an important part for the preservation of coral reefs. Deviation of parameter values that were too far from normal conditions could cause a decrease in the quality of coral reefs could be even worse until experiencing coral bleaching. As a clue to explained the health condition of the waters, a water environmental guide had been made by the government. Based on the results of measurements (TABLE 1), the temperature ranged from 25 °C – 29 °C, salinity ranged from 34 ‰ - 35 ‰, dissolved oxygen ranged from 5.13 mg/L – 5.89 mg/L, pH ranged from 8.07 – 8.1, water brightness ranged from 71% – 100%, current speed ranged from 0.05 m/s – 0.08 m/s, while parameter values measured in the laboratory, including NO_3 ranged from 0.043 mg/L – 0.072 mg/L and PO_4 ranged from 0.010 mg/L – 0.04 mg/L.

Based on TABLE 1, salinity was shown to be highest at both stations at a depth of 2 m. The salinity range was still commonly encountered, especially in Indonesian waters. The salinity value was the optimal range for coral growth. This meant that the salinity of the waters of Kelagian Island was classified as very good, especially for coral growth. Salinities for rock coral life in the range of 32 - 35 ‰ [24]. The salinity range obtained in the waters of Lampung bay which was 30.33 - 32.33 ‰ was still in the range of salinity commonly found in Indonesian waters and fell into the category of good for coral reef growth [29], [30].

The temperature in the waters of Kelagian Island ranged from 25 - 29 °C. The existence of temperature differences at different depths certainly could not be separated from the influence of weather when taking data. The temperature in these waters was still classified as in good condition for the growth of coral reefs. This was in line with previous studies that coral reefs could grow optimally at temperatures of 16 – 33.5 °C [31].

The results of brightness measurements in the waters of Kelagian Island had a high percentage of brightness of 71 - 100%. The high level of brightness of the waters certainly could not be separated from the influence of the surrounding environment. The absence of input from river water so that in the waters of Kelagian Island was clean and clear, this was certainly a factor in the high percentage of brightness in these waters.

pH measurements in the waters of Kelagian Island got a pH value of 8.07 - 8.10. The pH value that could be from the measurement results was still classified as in good condition for coral growth, this was in accordance with the Minister of Environment Regulation Number 51 of 2004 stipulates that the value was 7 - 8.5 was the standard of sea water quality for coral reefs.

The content of DO could be measured at each station and with different depths ranging from 5.13 - 5.89 mg/L. the Minister of Environment Regulation Number 51 of 2004 explained that the standard quality of dissolved oxygen for biota was > 5 mg/L. So, it could be said for do content in these waters was still quite normal for biota life around it.

The measurement results of NO_3 station 1 at a depth of 2 m and 7 m respectively, namely 0.048 and 0.043 mg/L, while for station 2 at a depth of 2 m and 7 m got a value of 0.07 and 0.072 mg/L. For the results of measurement of PO_4 at station 1 at a depth of 2 m and 7 m, that was 0.01 and 0.027 mg/L, while at station 2 at a depth of 2 m and 7 m respectively obtained a value of 0.038 and 0.04 mg/L.

Nitrate results obtained from both stations were still relatively good for the life of the surrounding biota. Nitrate compounds contained in water could be done to find out the level of pollution of a water [32]. Nitrate values in the range between 0.003 - 0.008 mg/L had not been categorized as polluted this was also in accordance with the Kepmen LH Nomor 51 Tahun 2004 about the standard quality of seawater, for the maximum nitrate level in the waters was 0.008 mg/L.

The yield of phosphate values in the waters of Kelagian Island had a range between 0.01 - 0.04 mg/L, the value was still relatively good for coral reef life. Lampung Bay water had a phosphate value range of 0.042-0.057 mg/L, still relatively good, especially for coral reef life [21], [33]. The standard quality limit of phosphate concentrations that were suiTABLE for marine life was 0.015 mg/L.

Mussidae Coral Species

Based on observations in southern Kelagian Island, there were two species of Mussidae corals identified. The species found were presented in TABLE 2.

TABLE 2. Observation results of Mussidae corals in the southern Kelagian Island

Number	Family	Species	Site			
			S1-2m	S1-7m	S2-2m	S2-7m
1	Mussidae	*Lobophyllia corymbose*	+	-	-	-
2		*Acanthastrea faviaformis*	-	-	+	-

Based on TABLE 2, coral species from Mussidae were only found at one observation site, namely S1-2m at shallow depths. At three other observation sites, Mussidae corals were not found. These results indicated that the distribution of Mussidae on Kelagian Island was found in shallow waters. This also related to reports elsewhere that Mussidae corals were associated with coral reef ecosystems in shallow waters in Gulf of Kachchh, India [34].

Species of *Lobophyllia corymbose*

Mussidae corals that could be found in this study were species of *L. corymbosa.* This coral had a brown color and was shaped like half a ball for its own phaceloid-shaped colony. This reef was only found at S1-2m (station 1 with a depth of 2 m) (FIGURE 2). Coral type *L. corymbosa* its existence in nature was very rare because often overexploited [35]. In addition, this coral had a slow growth [36].

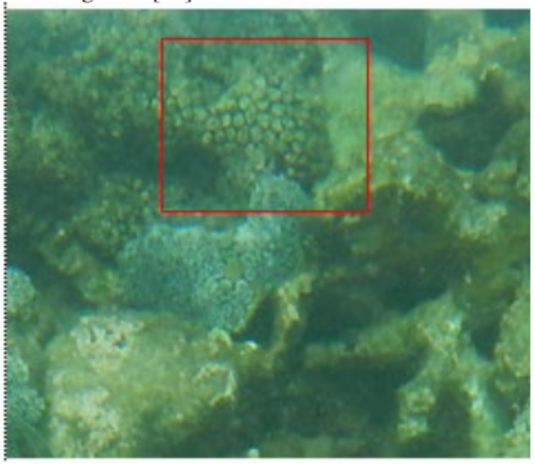

FIGURE 2. *Lobophyllia corymbose* Corals

The growth form of the coral was the shape of colonies on corals for example. The lifeform shape of this coral was shaped like a dome or half a sphere. The form of the colony was phaceloid. The form of phaceloid colonies that were corals were very prominent or form branching. There was a bulge and also branches tightly and forms like a dome or half a ball [34].

Species of *Acanthastrea faviaformis*

This coral had a massive shape, and was brownish yellow with brown patches. Coral found in the waters of Kelagian Island had a small size. However, some of these coral species could reach sizes of less than 0.2 m.

Corals found include the family Mussidae. Genus was *Acanthastre* and species was *A. faviaformis.* Based on observations in this study, this species was only found at the location S1-2m (station 1 with a depth of 2 m). This type of coral had a massive lifeform form. The massive shape was around coral like a solid ball and also usually lived solitary. The shape of this colonies coral was form of encrusting or creeping up to massive shape [37]. The coral shape is plocoid. The shape of the plocoid was a short tube-shaped coralite, slightly long thickened from the conestum so that there was a distance between the cornestites called the confectionum.

FIGURE 3. *Acanthastrea faviaformis* Coral

Coral Cover Conditions

The percentage of coral cover data for all observation sites was presented in FIGURE 4.

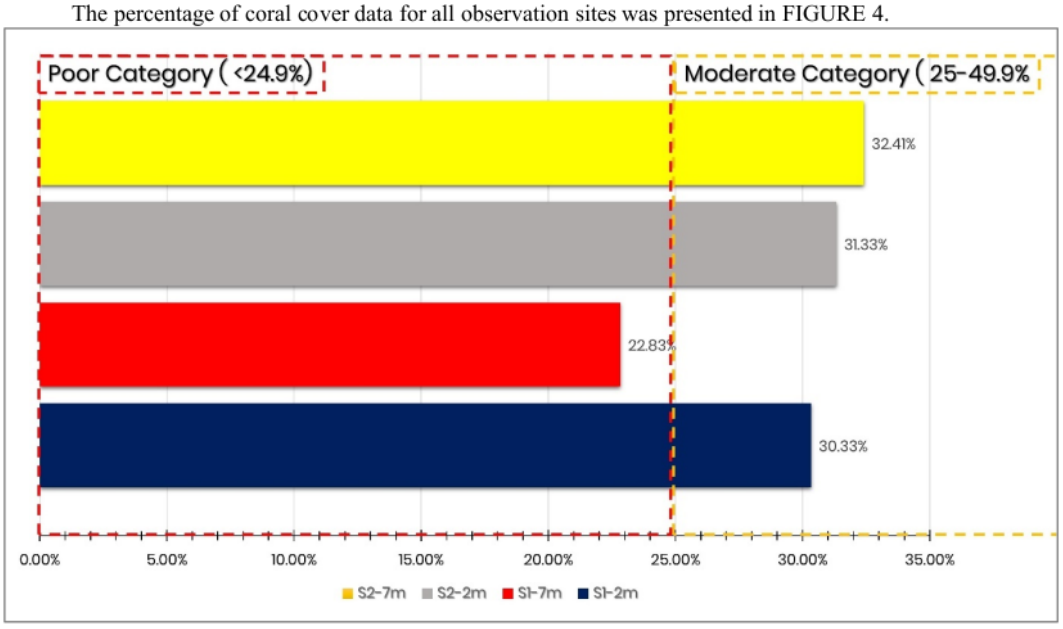

FIGURE 4. The percentage of coral cover at all observation sites in Kelagian Island

Based on FIGURE 4, S1-2m had 30.3[illegible]%, S2-2m had 31.33%, S1-7m 22.83%, and S2-7m had 32.41%. The percentage of coral cover could be assessed based on the Decree of the Environment Minister of Indonesia N[illegible]mber 4 of 2001 concerning criteria for hard coral cover which were divided into 4 categories, namely poor (< 24.9%), moderate (25 – 49.9%), good (50 – 74.9%) and very good (75 – 100%). Based on these data, only S1-7m was in the poor category while the other points were in the moderate category. The percentage of coral species found on Kelagian Island was presented in FIGURE 5.

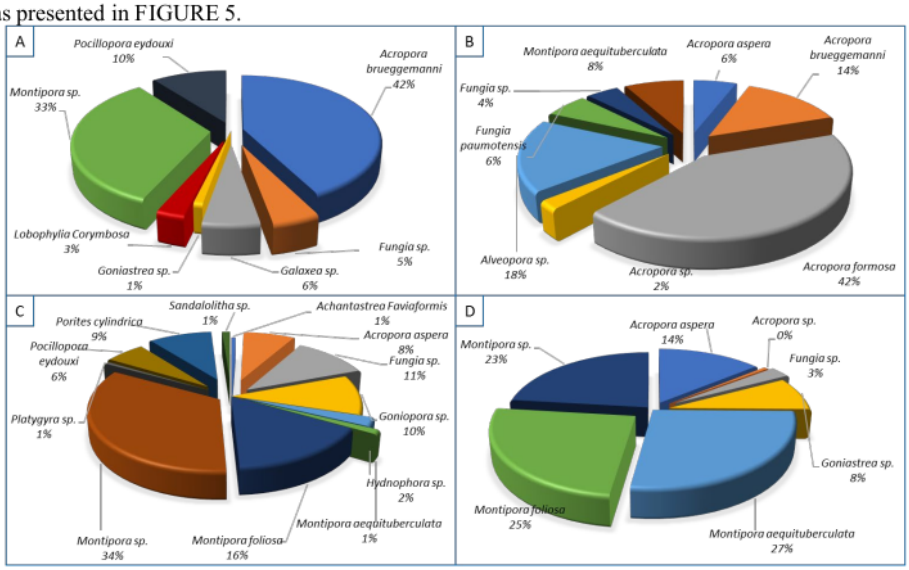

FIGURE 5. Percentage of Coral Species, A) S1-2m; B) S1-7m; C) S2-2m; D) S2-7m

Based on FIGURE 5, S1-2m found a total of seven coral species with one of them from *L. Corymbose* species from the Mussidae family, S1-7m found eight hard coral species, S2-2m found twelve hard coral species with one of them from *A. faviaformis* species from the family Mussidae, S2-7m found seven hard coral species.

Mussidae corals in addition to their existence were rare and had very slow growth compared to other types of corals, this allowed a low percentage of Mussidae corals in the waters of Kelagian Island. This type of coral had been widely used as an ornamental coral had been going on since 2001 and also carried out monitoring for the condition of this type of ornamental coral stock [36].

Mussidae Coral Community Structure

The structure of the Mussidae family coral community consisted of the calculation of the value of the diversity index (H'), uniformity index (E) and dominance index (C). The index calculation values obtained from each station were available in FIGUR[illegible]5.

Diversity criteria was low (H' ≤ 2), medium (2 > H' < 3) and High (H' > 3) [28]. So when referring to the existing criteria, the value of Mussidae coral diversity in the waters of Kelagian Island was very low. Because the value of diversity in these waters was categorized as less than 2.

The value of uniformity or generality was divided into 3 criteria, namely low uniformity (E > 0; E < 0.5), moderate uniformity (E > 0.5; E < 0.75) and high uniformity (E > 0.75: E = 1) [38]. When referring to the criteria that had been mentioned, the uniformity index value was categorized as small, because it was in the range of E > 0; E < 0.5.

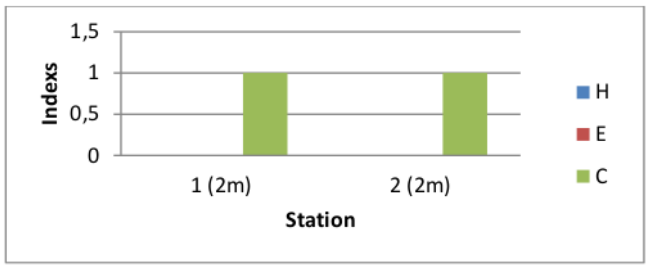

FIGURE 6. Community Structure of Mussidae Coral

The Dominance index aimed to look at the most dominating types of waters. Category to determine the dominant value i.e. for low dominance ($C > 0$; $C < 0.5$), moderate dominance ($C > 0.5$; $C < 0.75$) and high dominance ($C > 0.75$; $D = 1$) [38]. For the value of the dominance index in these waters at both stations at 2 m deep had a value of 1. When referring to these criteria it could be said that this water had a "high" dominance index value because it was in the range $C > 0.75$; $C = 1$.

CONCLUSION

Coral cover on Kelagian Island was in the moderate category for three points, while one was in the poor category. The cover condition of coral species from the Mussidae family had a low percentage value, *L. corymose* at S1-2m locations was 3% and *A. faviaformis* at S2-2m locations was 1%. There are only two species of Mussidae corals. Based on these data, the Mussidae corals on Kelagian Island have decreased compared to the population of other species.

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