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Condition of Coral Reef in Kelagian Besar Island

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Abstract: The coral reef ecosystem plays many important roles for society. One of the its role is as a tourist attraction. Kelagian Island lies near Pahawang island which is the major attraction of marine tourism in Lampung. This position makes Kelagian Island the most potential alternative island after Pahawang Island. However, sufficient information about the coral condition and profile in Kelagian Island has yet to support this potential. For that reason, a study about coral reef conditions on Kelagian island must be conducted to provide information and support the possibility of tourism development on Kelagian island. This study was conducted in August 2022 using Point Intercept Transect (PIT) in three different sites on Kelagian Island. Coral reef condition in 3 meter depth were generally in good condition, meanwhile in 7 meters depth coral reef condition were in medium state. There were 22 genera found in Kelagian island. Acropora and Porites were found dominating three meter depth. On the other hand in seven meter of depth, Goniopora and Favia were abundantly found. Diversity index, Evenness, and Dominance Index in Kelagian Island are 2,29-2,49 (medium), 1-0,83 (stable), and 0,12-0,15 (low) respectively.

Keywords: *Point Intercept Transect, Kelagian Island, Coral Reef*

Abstrak: Ekosistem terumbu karang memainkan peranan yang sangat penting bagi manusia. Salah satu manfaat ekosistem ini sebagai daya tarik wisata. Pulau Kelagian terletak dekat dengan Pulau Pahawang dan membuat pulau ini berpotensi menjadi alternatif tujuan wisata selain Pulau Pahawang. Namun, potensi wisata di pulau ini belum didukung oleh tersedianya informasi tentang kondisi terumbu karang terkini di Pulau Kelagian. Oleh sebab itu, penelitian tentang kondisi terumbu karang di Pulau Kelagian perlu dilakukan sebagai data awal yang dapat digunakan untuk menggambarkan kondisi terumbu karang dan mendukung potensi wisata di pulau tersebut. Penelitian ini dilakukan pada Agustus 2022 dengan menggunakan teknik Point Intercept Transect pada 3 titik stasiun penelitian Pulau Kelagian. Kondisi terumbu karang di kedalaman 3 meter secara umum dalam kondisi baik, sedangkan di kedalaman 7 meter, kondisi tutupan terumbu karang dalam kondisi sedang. Sebanyak 22 genera ditemukan dengan dominansi karang dari genus Acropora dan Porites (3 meter) serta Goniopora dan Favia (7 meter). Indeks keanekaragaman, keseragaman dan dominansi di seluruh stasiun penelitian secara berurutan yaitu 2,29-2,49, 1-0,83 dan 0,12-0,15..

Kata Kunci : Point Intercept Transect, Pulau Kelagian, Terumbu Karang

Introduction

Coral reef ecosystems play important roles to coastal society. This ecosystem provides not only protection from wave action but also economic benefit. The presence of coral reefs provides the habitat for fish to breed, ensuring the sustainability of the fish stocks nationally through healthy coral reef ecosystem. Additionally, coral reefs have the potential to be sources of medicinal substances in the future. Numerous studies have focused on anti-cancer compounds derived from organic materials within coral reef organisms. Another important function is their role as tourist attraction [1]. If we were to calculate the total benefits of coral reef ecosystems in terms of valuation, the value of Indonesia's coral reefs would amount to Rp. 45 trillion. Therefore, it is crucial to raise awareness about the importance of preserving this highly valuable natural resource [2].

Nowadays, coral reefs face various threats from both natural and human activities. From an anthropological perspective, many coral reef ecosystems have been destroyed and reduced to rubble. This damage is caused by the use of bombs and toxins during illegal fishing [3]. Ship anchors and coral mining have been also contributing to the destruction of coral reef ecosystems, leading to the formation of rubble [4]. Marine tourism activities also cause to coral reef damage, particularly due to environmentally unfriendly tourist behavior [5].

Kelagian Island is located in the Pesawaran regency and is adjacent to Pulau Pahawang, which is a primary marine tourism destination in Lampung. Comprising Kelagian Besar and Kelagian Kecil, these islands are under the management of the Indonesian Navy (TNI AL) and are uninhabited. Its proximity to Pulau Pahawang makes Kelagian Island a potential alternative tourist destination alongside Pulau Pahawang [6]. However, the tourism potential of this island has not been supported by up-to-date information regarding the current condition of the coral reefs in Kelagian Island. Therefore, research on the coral reef condition in Kelagian Island is necessary as initial data to describe the coral reef condition and support the tourism potential of the island. Additionally, this data can serve as a reference for evaluating tourism activities on Kelagian Island once marine tourism becomes more prominent on the island.

Method

The research took place during June 2023 on Kelagian Island, Pesawaran Regency. A Manta tow survey [7], was conducted to determine the research station points, which were then marked using GPS. Another consideration was that these research points were locations that were starting to be frequently visited by tourists. Coral reef condition samples were taken at two depths: 3 meters and 7 meters (**Figure 1**).

This research utilized a modified Point Intercept Transect (PIT) method, adapted from the PIT method for communities by Manuputty [8]. This method was chosen because it was considered easily understood by the local community, as the research involved their participation. Furthermore, the relatively short time required for data collection was another reason for selecting this method [9]. SCUBA divers pulled out a 50-meter measuring tape. Every 0.5 meters were marked with a scale from 1 to 100. The types of data recorded can be seen in Table 1. The obtained data was separated and calculated as a percentage of coverage (%). The collected data was processed using the following formula:

$$\%\ Coverage = \frac{Number\ of\ Each\ Component}{Total\ Components}\ x\ 100\%$$

The condition of the coral reef ecosystem can be determined based on the standard set by Gomez & Yap [10] as follows:

Poor condition: 0-24.9% coverage.

Fair condition: 25-49.9% coverage.

Good condition: 50-74.9% coverage.

Excellent condition: 75-100% coverage.

Table 1. Data recording codes used in the study using the PIT method by Manuputty et al. [8].

Code	Categories
NA	Non-Acropora
AC	Acropora
DCA	Dead Coral with Algae
DC	Dead Coral
FS	Fleshy Seaweed
SC	Soft Coral
S	Sand
RK	Rock
R	Rubble
SI	Silt

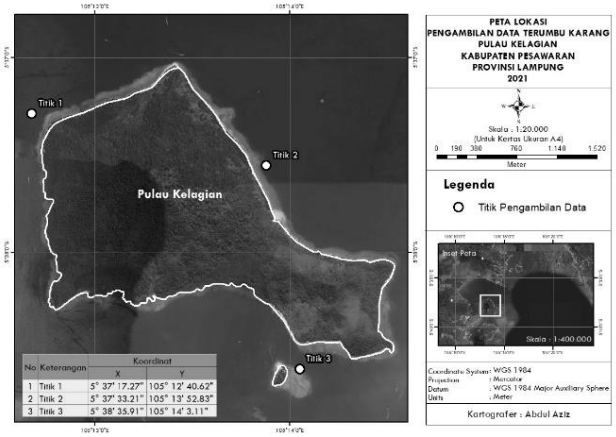

Figure 1. Research location, Kelagian Island, Pesawaran Regency, Lampung

Results And Discussion

The distribution of corals on Kelagian Island generally occurs between depths of 1 meter to 7 meters. This study identified 22 genera of corals in the waters of

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Kelagian Island (Table 2). The 3-meter depth exhibited higher abundance compared to the 7-meter depth. Almost all genera of corals in this study were found at a depth of 3 meters, while at a depth of 7 meters, only 10 genera were found, dominated by massive corals, foliose corals, and branching corals. The highest abundance was observed at the research points located on the side of Kelagian Island. Conversely, the end of the island (point 1) had the lowest abundance. The coral reefs on Kelagian Island belong to the Acroporidae family (Acropora and Montipora), Faviidae family, and Poritidae family. The genera of corals found at a depth of 3 meters include Acropora, Favites, Goniastrea, Leptoseris, Montastrea, Montipora, Pectinia, Pavona, Pocillopora, and Symphyllia. At a depth of 7 meters, only genera from the groups Cyphastrea, Goniopora, and Polyphyllia were found.

Acropora and Porites are genera found in all research stations at a depth of 3 meters, while Goniopora and Favia are the genera present at each research station at a depth of 7 meters. This is possible because Acropora and Porites are the primary reef builders and dominant coral genera in the coral reef ecosystem in Indonesia [11]. Meanwhile, Goniopora is a genus that is tolerant to sedimentation and can thrive in areas with mixed muddy sediment [12]. The abundance of corals on Kelagian Island is influenced by depth differences. The variation in depth results in different sunlight absorption. This can be observed from the difference in coral composition between depths of 3 and 7 meters, as the photosynthetic activity of coral animals depends on the penetration of sunlight [13]. The difference in light intensity capable of penetrating the water column is believed to be the cause of this compositional difference. The presence of surrounding islands, including the Sumatran mainland, influences the environmental conditions of the waters around Kelagian Island. During the rainy season, runoff from the mainland in the form of sediment carried by river currents will end up in the waters surrounding Kelagian Island. This sediment increases turbidity, decreases water clarity, and eventually accumulates on the seafloor. High sedimentation can disrupt coral growth [14].

Table 2. Coral genus found in Kelagian Island, Pesawaran Regency.

Coral Genus	Depth (3m)			Depth (7m)		
	St1	St2	St3	St1	St2	St3
Acropora	v	v	v	v	-	-
Chypastrea	-	-	-	-	v	v
Ctenactis	-	-	-	-	v	v
Favia	-	v	v	v	v	v
Favites	v	v	v	v	-	-
Fungia	-	-	v	-	v	v
Galaxea	-	v	v	-	-	-
Goniastrea	v	v	v	v	v	v
Goniopora	-	-	-	-	v	v
Hydnopora	v	v	v	-	v	v
Leptoseris	v	v	v	v	-	-
Lobophilla	-	v	v	-	-	-
Montastrea	v	v	v	v	v	-
Montipora	v	v	v	v	v	v
Pavona	v	v	v	v	-	v
Pectinia	v	v	v	-	v	-
Platygyra	v	v	-	-	-	-
Polyphylia	-	-	-	-	v	v
Porites	v	v	v	v	v	v
Stylophora	v	v	-	-	-	-
Symphillia	v	v	v	-	-	-

v: found
-: not found

Percentage of Coral Cover

The percentage of live coral cover on Kelagian Island ranges from 40% to 70% (Table 2). The highest coral cover percentage is found at a depth of 3 meters, while the lowest cover is observed at a depth of 7 meters. The 3-meter depth has the highest cover at station 2, followed by station 3. In contrast, station 1 has the lowest cover with the highest rubble value among the three research stations. Stations 2 and 3 are located on the side of the island that receives good water circulation. Water circulation is necessary for the distribution of larvae, microplankton, and serves to clean sediments [15]. However, at point 1, located at the end of the island, this area experiences the greatest sediment accumulation, which limits the diversity of corals. At a depth of 7 meters, the lowest cover is also found at point 1, with a coverage of 42%. The coral reefs on Kelagian Island are in good and fair conditions. The good condition is observed at all research stations at a depth of 3 meters, while the fair condition is observed at all stations at a depth of 7 meters.

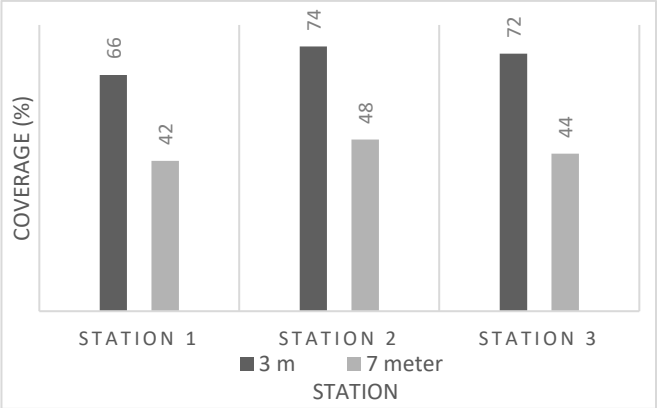

Figure 2. Percentage of coral cover in Kelagian Island, Kabupaten Pesawaran Regency

The low coral cover at a depth of 7 meters is likely due to the substrate condition, which consists mostly of sand and mud. Such substrate is not suitable for coral settlement as corals require hard and stable substrates for larval attachment. Additionally, larval recruitment of corals depends on water circulation driven by currents [16]. Sedimentation and resuspension of sediments also affect coral resilience. Coral colonies will experience mortality or tissue damage when sediment loads exceed their cleaning capacity. Excessive sediments can also cause anoxic conditions on the colony surface, leading to tissue death [17]. Smaller sediment particles can enter coral cavities and hinder mucus production. Fine sediments will mix with mucus, forming sticky clumps that cover the polyp surface. Once sediment clumps form, they become increasingly difficult to be removed by coral tentacles or cilia.

Based on the growth forms, the coral reef in Kelagian Island consists of branching Acropora corals, massive corals, and foliose corals. At a depth of 3 meters, branching corals dominate, while at a depth of 7 meters, the dominant forms are massive corals and foliose corals (**Table 3**). Branching corals from the Acropora genus indicate high light availability and good water circulation. The presence of Acropora suggests that the area has favorable wave action [18]. At a depth of 7 meters, besides the dominance of massive corals, other growth forms such as foliose corals, encrusting corals, submassive corals, and mushroom corals (CMR) are also found. Mushroom corals (CMR) are commonly found on sandy substrates with low coral cover. These corals live freely or solitarily and do not attach to substrates [19]. They usually occupy spaces not occupied by other coral species [20].

Table 3. Coral cover percentage in Kelagian Island based on Life Form

Depth	Station	Cover percentage						
		ACB	CB	CE	CM	CS	CF	CMR
3 m	1	30,2	3,03	12,1	30,3	6,06	18,1	0
	2	29,7	5,40	5,40	27,02	8,10	18,9	2,70
	3	25	0	5,55	27,7	16,6	22,2	2,77
7 m	1	0	9,52	9,52	42,85	4,76	28,57	0
	2	0	0	12,5	58,33	4,16	8,33	16,6
	3	0	0	13,6	59,09	0	9,09	18,18

ACB : Acropora branching
CB : Non Acropora branching
CE : Coral encrusting
CM : Coral massive
CS : Coral submassive
CF : Coral foliose
CMR : Coral mushrom

Coral diversity index in Kelagian Island ranges from 2.29 to 2.49 (Table 4). The diversity index is considered moderate. Within this range, Station 1 exhibits low abundance, which is believed to be due to higher ecological pressures compared to other stations. On the other hand, the evenness index ranges from 0.83 to 1, indicating overall stability. All index fall within the stable range. Generally, the dominance index of corals in Kelagian Island ranges from 0.15 to 0.12. The lowest index is found at Station 1, suggesting the presence of specific dominant coral species in the area.

Table 4. Diversity, Dominance, and Evenness Index of Coral Reefs at Research Stations in Kelagian Island, Pesawaran Regency.

Depth	Station	H' Index	E Index	C Index
3 meter	1	2,29	0,85	0,15
	2	2,49	0,86	0,13
	3	2,46	0,83	0,12
7 meter	1	2,47	0,96	0,12
	2	2,28	0,92	0,13
	3	2,29	1	0,14

H' : Shanon-Weiner Index
E : Evennes Index
C : Dominance Index

Conclusions

Twenty-two (22) hermatypic genera were found in Kelagian Island. The abundance is higher at a depth of 3 meters compared to 7 meters at all research stations. Acropora and Porites dominate at a depth of 3 meters, while Goniopora and Favia dominate at a depth of 7 meters. The condition of the coral reef ecosystem in the waters of Kelagian Island is classified as good and moderate. All stations at a depth of 3 meters are classified as good, while at a depth of 7 meters, all research stations are classified as moderate. The coral diversity index in Kelagian Island is classified as moderate, ranging from 2.29 to 2.49. The evenness

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index is stable, ranging from 0.83 to 1, and the dominance index ranges from 0.15 to 0.12.

Conflicts of interest

Hereby the authors state that there are no conflicts to declare.

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