Identification of coral reef cover and invertebrate diversity in Pahawang Island Lampung Indonesia

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ABSTRACT

Pahawang Island is one of Lampung's tourist attractions known for its high organism biodiversity. The diversity of coral reefs contained in it causes Pahawang to have economic value for the audience. This study aims to determine the coverage and condition of coral reefs in the Pahawang area as a tourist attraction and identify the diversity of organisms within. This study used the Line Intercept Transect (LIT) method by dividing the plot of the observation area by six (6) identification points for data collection. Measurement data on each line transect, furthermore the closing value is calculated. The number of species was calculated by determining the value of the invertebrate diversity index. The results showed that the length of coral cover on Pahawang Island was 80.3% which lies in the "very good" category. Most of the corals have experienced bleaching which suggests that the corals are not in healthy condition. Species diversity shows that eleven (11) species reside in the Pahawang Island coral reef. The Shanon-Wiener diversity index value (H') 1.87 is categorized at the medium level. Therefore, the condition of coral cover on Pahawang Besar Island is still in the very good category.

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Introduction

Coral reefs are one of the main ecosystems of coastal and marine areas that have biodiversity, with the main constituent components of rock corals[1]. It is known that coral reefs are the most productive ecosystem in the ocean. The abundance and diversity of organisms become the main attraction for tourists which may generate economic value[2]. Coral reef becomes the identity of an area with special properties that can make a source of local wisdom for its territory. Coral reefs act as coastal protectors from strong waves and currents, habitats for marine animal species, nutrient providers, spawning and upbringing of various types of biota, and environmental services[3], especially tourism and recreation[4]. The diversity of biota on coral reefs is one of the indicators of marine pollution[3,5]. Ecosystems on coral reefs require seawater conditions with optimal salinity and water temperature (warm) as well as high levels of sunlight lighting[6,7].

One of the countries with high biodiversity of coral reefs is Indonesia[8,9]. There are 85,707 km^2 of coral reefs spread throughout the Indonesian archipelago subverting 14% of the world's

existing coral reefs[10]. Lampung is one of the provinces in Indonesia that provides the charm of the beauty of coral reefs as a tourist destination[11]. The large number of small islands surrounding the Lampung province has caused Lampung's status to become coastal and coastal ecotourism. Pahawang Island located in Ketapang Hamlet, Batumenyan Village, Lampung. Since 2010 Pahawang Island has become a popular ecotourism destination for marine life beauty and has even been visited by domestic tourists from various parts of Indonesia and even foreign tourists.

Field observations on Pahawang Island have shown changes in the current status of coral reefs and the abundance of organisms that populate them. Damage to coral reefs can result in a decrease in the production of fishery resources, accelerate coastal abrasion, and reduce the diversity of marine life[12,13] which will affect the quality of tourist areas. Therefore, monitoring of the presence of coral reefs needs to be carried out which aims to determine the length of coral reef cover, species diversity, and coral color (bleaching status) so that coral reef rehabilitation can be planned at the right location and effectively restore damaged coral reefs.

Method

This study used the Line Intercept Transect (LIT) method, which is a method to record the condition of living corals and other supporting biota in a coral reef location and to determine the condition of coral reefs in areas based on the percent of live coral cover in a fast time [14]. This observation was carried out by determining the observation plot point on Pahawang Besar Island (Fig 1) which was divided into 6 transects. The determination of area plotting is carried out based on the distance and length of the coral reef with a transect length of 100 m whose impact is straightforward and 50 m towards the right and left[15].

The observation procedure for observing marine life uses the reference literature for species identification; determined an observation plot with a length of 10 m divided into two transects each 5 m long and 1 m wide, and the distance between the plots was 20 m long. Each transect is carried out with temperature measurement using a thermometer and pH measurement using indicator paper. The final stage of the identification process is measuring coral reef cover and calculating the number of colonies and species of marine life in coral reef ecosystems. The results of the measurement data on each line transect were then calculated as the closing value based on the formula. The good and bad values of the coral condition can be seen from the percentage value of coral cover as follows very good condition = 71-100%, good condition = 51-70%, damaged condition = 26-50%, and critical condition = 0-25%[16].

$$ni = \frac{li}{L} \times 100\% \tag{I}$$

The mean of equation I, li = coral cover percentage I, ni = long of cover I, L is long of line transect. To find out the index of species diversity on Pahawang Besar Island can be calculated using the equasstion II.

$$The = - \sum pi \, In \, pi$$

$pi = \frac{ni}{N}$, number of individual species (ni) and total number of individual.

Results and Discussion

The results of the observations show that Pahawang Island has ordinates 5°40'34″S 105°13'21″E with coral reef lookout points pada ordinate 5o007'42″S 104o468'19″E. The Peta coastline of Pahawang Island is lying in Fig 1. The identification results show that the average length of coral reefs on Pahawang Island is 4.2 m from the 10 m length of the observation transect. This condition is a source of diversity of aquatic invertebrate germplasm.
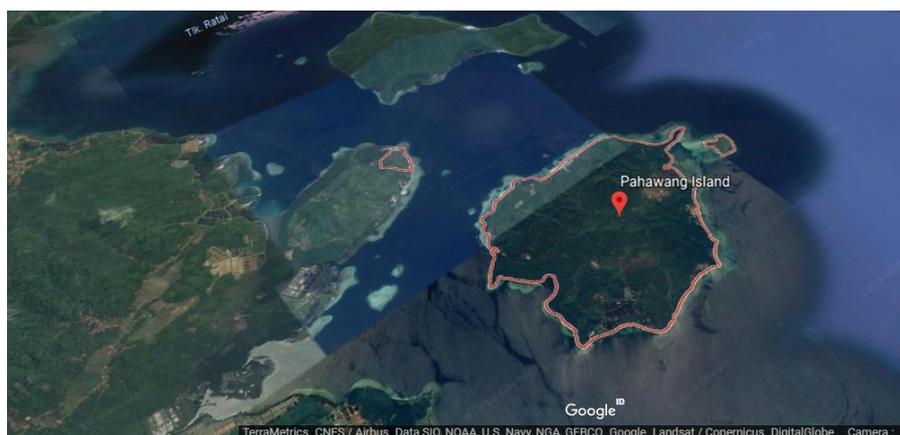
Fig 1. The location of observation.

pH and temperature measurement data obtained mean values respectively are 6.9 and 35.96 °C as stated in Table 1. The results of pH and temperature measurements on each coral reef observation sample transect indicate that seawater conditions are within normal (good) thresholds. The Ministry of Environment on 2004 revealed that the threshold range of pH (acidity) thresholds that are good for marine life ranges from 6-9[17]. The seawater temperature is 36 °C, this is also included in the good condition because according to the Minister of Environment (2004), the most optimal temperature for coral growth ranges from 23 0-32⁰C[18].

Table 1. Results of pH and temperature measurements on the coral reefs of Pahawang Island

Plot transect	pH	Temperature (c)
1A	6.8	36.1
1B	7.0	36.0
2A	6.9	36.1
2B	7.1	35.5
3A	6.8	36.2
3B	6.9	36.0
Average	6.9	35.96

The percentage of coral cover based on calculations is 80.3% (Table 2), so the coverage of coral reefs on Pahawang Island is in the very good category, this is because every year efforts are made to conserve coral reefs using transplantation. Transplantation techniques are increasingly being developed for use in conservation[19].

Some efforts can be implemented to prevent the further destruction of coral reefs. For example, minimizing physical contact of tourists with coral reefs either intentionally or unintentionally. These physical contacts include kicking corals, holding corals/another biota, stepping on corals, picking up corals/another biota, diving tour equipment that touches corals, and anchoring ships on corals[20].

Table 2. Length of coral cover

Transect	Cover long (m)
1	5
2	5
3	2.5
4	3
5	3.6
6	5

Identifying the diversity of fauna on Pahawang Island, there are 11 species of invertebrate animals in it, namely *Acrophora*, anemone, starfish, sea snake stars, *Favites*, *Fungia*, *Goniastrea Leucolonia*, sea lilies, blue sea stars, and Porifera. The distribution of the abundance of numbers in each species is shown in Fig 2. This showed the value of the diversity index H'=1.87 with the biodiversity index category being moderate.
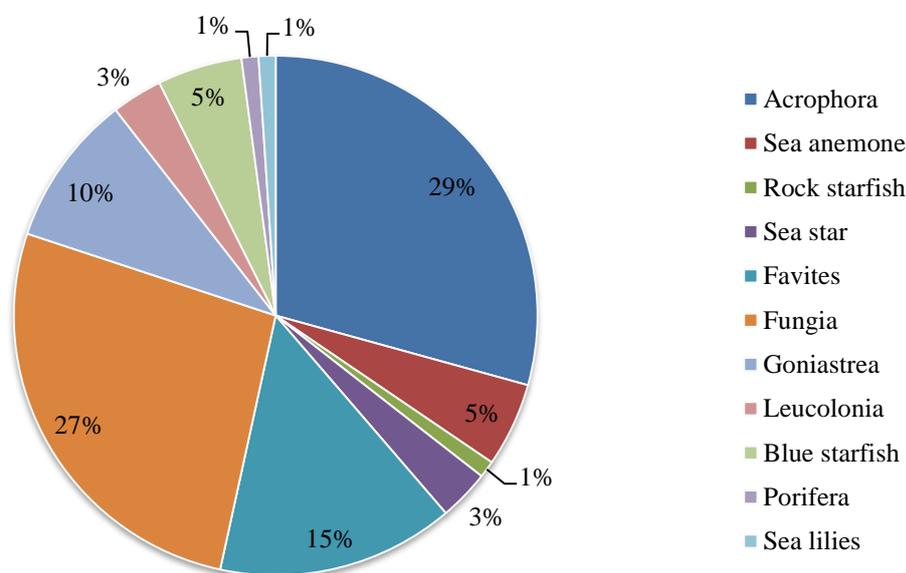

Fig 2. Identify species diversity on coral reefs on Pahawang Island

Assessment of the diversity index in all species found, there are dominant faunal species that are classified in the class fauna of Anthozoa. The large value of the evenness of fauna species at the location of Pahawang Island shows that the distribution of fauna spreads evenly in the waters and can be found in almost all locations, especially in areas that are slightly turbid and not too choppy and have a bottom substrate in the form of dead corals. Jones and Endean states that rock corals of many faunas of the Anthozoan class generally dominate waters that have a small water movement[21]. There is a positive relationship between the percentage of coral cover and the diversity index of organism species that depend on aquatic physical factors and biological factors[22,23].

A high percentage of *coral reef* cover does not determine a high level of faunal diversity, but the value of species diversity is more likely to be the number of species. Supporting factors such as environmental parameters in the form of physical factors such as salinity, temperature, water depth, wave action, light, sediment, and ocean circulation patterns are things that play a very important role in the development of *coral reefs*[1]. Biologically, the ability of *coral reefs* to meet nutritional needs as an ongoing effort in breeding and growth and aggression of the colony's growth space is larger and faster than other types.

Conclusion

The condition of coral cover on Pahawang Besar Island is still in the very good category but shows an unhealthy condition that has an impact on the diversity of existing species. Species diversity on Pahawang Besar Island is in the moderate category, conservation efforts need to be increased again to protect the existing species diversity.

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Author contributions

All authors contributed to the study's conception and design. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.