Life Form Identification of Coral Reef and Genera in Pahawang Island to Support Ecosystem Rehabilitation

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Abstract. The widespread degradation of coral reef ecosystems, including on Pahawang Island, Lampung, is commonly addressed through coral transplantation activities as a means of rehabilitating the natural structure of coral reef ecosystems to once again support the life of fish and other marine biota. To support these efforts, initial data regarding the types of life forms and coral genera present on Pahawang Island are necessary. Therefore, we conducted research on the life forms and coral genera in all the sub villages of Pahawang Village. Sampling was carried out using Manta tow surveys, followed by Line Intercept Transects (LIT) representing six sites on Pahawang Island. The results of this study revealed a total of 13 life forms and 28 genera. The most frequently encountered life form was Acropora branching, and the most commonly found genus was Acropora. These findings indicate that the coral reef ecosystem on Pahawang Island, which is dominated by branching life forms from the Acropora genus, still possesses potential coral donors that can provide three-dimensional structures for fish and other biota as breeding and nursery grounds. The Acropora genus and Acropora branching life form are commonly used as seedlings in coral transplantation activities.

Keywords: *Coral Reef, Life form, LIT, Aquatic Environment, Pahawang.*

1 Introduction

The village of Pahawang consists of six sites and is located on Pahawang Island in the Punduh Pidada subdistrict, Pesawaran Regency. Pahawang is one of the tourist villages that relies on the coral reef ecosystem as its main attraction for tourism. This ecosystem attracts both local and foreign tourists to come and enjoy the beauty of its underwater world. Unfortunately, the coral reef population is facing a significant threat of damage. This damage can occur naturally or as a result of climate change and coral predators such as the crown-of-thorns starfish or Acantaster plancii. There have been numerous reports from the local community about the use of fish bombs and tiger prawn trawling in 2015 (Tribun Lampung.co.id, 2015). These illegal activities continue to occur, even though the perpetrators of the bombings come from outside Lampung Bay (Ditpolair, 2019). The traces of these illegal practices can be seen in the remnants of broken coral reefs due to bomb explosions around

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Pahawang Island. Additionally, the high demand for decorative coral reefs in the market has driven the unsustainable and unregulated mining of coral reefs. This situation is further exacerbated by the uncontrolled activities of tourists touching or stepping on the coral reefs (Burke et al. 2011). Badriawan (2019) mentioned that the potential damage caused by snorkeling activities on Pahawang Island amounts to 40.40% annually.

As a concrete step in the effort to reduce the rate of coral reef degradation, various community-based conservation efforts are actively undertaken in collaboration, aimed at addressing coral reef degradation and promoting sustainable recovery and resilience of coral reefs (Possingham et al. 2015, Boström-Einarsson et al. 2020). One of the efforts that can be undertaken is coral transplantation. However, this rehabilitation activity has not been effectively targeted due to the limited availability of references for coral species and diversity, as well as suitable locations for rehabilitation.

As a tourist village, Pahawang Village needs to maximize its natural resource potential with a spirit of sustainable utilization. Sustainable utilization should begin with the collection of initial data, which will serve as a reference for the development of community-based sustainable programs. Research conducted so far has generally focused on a few research stations that may not accurately represent the actual conditions of the coral reef ecosystem in the six sites of Pahawang Island. All of the above-mentioned issues can be addressed by conducting research that starts with a survey of coral reef populations as initial baseline data in the six sites of Pahawang Village for long-term community-based conservation programs.

The objective of this research is to explore the types and life forms of coral reefs in the waters of Pahawang Island. The data obtained will serve as initial information for the government to formulate policies related to marine conservation management and to determine the locations for coral reef transplantation.

2 Materials and Method

Observations were conducted at six research stations representing the six sites in Pahawang Village. Each station consisted of two depth points, namely three and seven meters. The research was conducted from June to August 2023. Information regarding the observation locations can be found in Table 1 and Figure 2.

The six locations of observation can be seen at Table 1.

Tabel 1. The six coordinates of each site.

No	Site	Coordinate	
1	Suak Buah	Lat: 05^0 40' 40" S	Lon: 105 12' 23" E
2	Penggetahan	Lat: 05^0 39' 36" S	Lon: 105^0 13' 51" E
3	Jelarangan	Lat: 05^0 40' 49" S	Lon: 105^0 14' 07" E
4	Kalangan	Lat: 05^0 39' 12" S	Lon: 105^0 12' 37" E
5	Pahawang	Lat: 05^0 39' 35" S	Lon: 105^0 12' 54" E
6	Cukuh Nyai	Lat: 05^0 41' 26" S	Lon: 105^0 13' 24" E

Figure 2 The map of six observation sites in Pahawang village, Pahawang Island (Nurhasanah dkk, 2022)

Materials and Method

The equipment used in this research included a Secchi disk, refractometer, thermometer, pH meter, Manta Tow board, motorboat, SCUBA set, measuring tape, underwater camera, iron stakes, and coral identification books (Coral Identification-Indo Ocean Project, Types of Corals in Indonesia- Suharsono). The entire survey process, from measuring the physical and chemical conditions of the sea to the Manta Tow survey, Line Intercept Transect (LIT), and data processing, followed

the procedures outlined in the "Survey Manual for Tropical Marine Resources" by English et al. (1997).

The research began with the Manta Tow survey. An observer was positioned behind the boat and towed using a rope as a connection between the boat and the observer. With a constant boat speed and a 2-minute tow duration passing over the coral reefs, the objects encountered and the percentage of coral reef cover were recorded by the observer.

The main observation activities included recording the coverage of coral reef communities, counting the abundance of individual hard corals, non-coral macrobenthos, and noting the presence of rubble, both in terms of location and extent. A 50-meter transect line served as a reference or marker underwater. This transect was also used to record the coverage of coral reef communities based on the Line Intercept Transect (LIT) method (English et al., 1997).

3 Results and Discussion

4 From the observations in the six sites, a total of 13 growth forms were identified, as seen in Table 2. Acropora branching, Coral encrusting, Coral foliose, and Coral massive were found in all sites. This indicates that the area has a uniformly high variety of growth forms. Since growth forms influence the complexity of reef structure and support habitat stability, Pahawang Island has the potential for recovery (Carpenter et al., 2008). Table 3 shows the number of genera found in the six sites of Pahawang Village. Three genera were found in all sites: Acropora, Montipora, and Porites. The genus Heliopora was only found in the Jelarangan and Cukuhnyai sites. These two sites receive consistent nutrient and coral larvae-carrying currents from southern Sumatra, which allows the Heliopora genus to grow in these two sites. Blue corals rely on wave energy, a flat contour, and good circulation to thrive (Zann & Bolton, 1985).

Table 1. Salinity and temperature in six sites of observation.

Parameter	Stations					
	Suak Buah	Penggetahan	Jelarangan	Ka-langan	Pahawang	Cukuhnyai
Temperature	28^0C	28^0C	28^0C	28^0C	28^0C	28^0C
Salinity	$32^0/_{00}$	$32^0/_{00}$	$32^0/_{00}$	$32^0/_{00}$	$32^0/_{00}$	$32^0/_{00}$

Table 2. Life form found in six sites of observation in Pahawang Island.

Life Form	Dusun					
	Suak Buah	Penggetahan	Jelarangan	Kalangan	Pahawang	Cukuh Nyai
ACB	√	√	√	√	√	√
ACE	-	-	-	-	-	√
ACD	-	√	√	-	-	-
ACS	-	-	-	-	√	-
ACT	-	√	√	-	-	√
CB	-	√	√	√	√	√
CE	√	√	√	√	√	√
CF	√	√	√	√	√	√
CM	√	√	√	√	√	√
CME	-	√	√	-	-	-
CMR	√	√	√	√	√	√
CSM	√	√	√	√	√	√
CHL	-	-	√	-	-	√
Total	6	10	11	7	8	10

- : Not found, ; √: Found

ACB (*Acropora branching*, ACE (*Acropora encrusting),* ACD (*Acropora digitate), ACS (Acropora submassive), ACT (Acropora tabulate), CB (Coral branching), CE (Coral encrusting), CF (Coral foliose), CM (Coral massive), CME (Coral millepora), CMR (Coral mushroom), CSM (Coral submassive), CHL (Coral heliopore/blue coral)*

Table 3. Corals genus found in six sites of observation in Pahawang Island.

Genus	Dusun					
	Suak Buah	Penggetahan	Jelarangan	Kalangan	Pahawang	Cukuh Nyai
Acropora	√	√	√	√	√	√
Astreopora	-	√	√	-	-	√
Caulastrea	-	-	√	-	-	√
Coelastrea	-	√	-	-	√	-
Coeloseris	-	√	√	-	-	√
Ctenactis	√	-	√	-	-	-
Cyphastrea	√	√	-	√	√	√
Echinopora	-	√	-	√	√	-
Favites	√	√	√	√	-	√
Fungia	√	√	√	√	√	√
Galaxea	-	-	√	-	√	√
Goniastrea	√	√	√	√	-	-
Halomitra	√	√	-	√	-	√
Heliopora	-	-	√	-	-	√
Isopora	√	√	-	√	-	√
Leptoseris	-	√	√	-	-	√
Lobophyllia	-	√	-	√	√	-
Merulina	-	-	√	-	√	-
Montipora	√	√	√	√	√	√
Pachyseris	√	-	√	√	-	√
Pavona	√	√	√	√	-	√
Pocillopora	-	√	-	-	√	-
Porites	√	√	√	√	√	√
Psammocora	-	√	-	√	-	-
Sandalolitha	-	-	√	-	-	√
Seriatopora	√	-	√	√	√	√
Stylopohora	-	√	√	√	-	-
Tubipora	√	-	√	-	√	√
Total	14	19	20	16	13	19

- : Not found, ; √: Found

Genus Acropora generally exhibits a branching growth form, which provides them with high reproductive and adaptive capabilities. Branching corals can reproduce asexually through fragmentation, with their branches being particularly vulnerable to wave action. When coral branches break, they can fragment and form new colonies of branching coral (Jackson, 1992). This is why branching corals can be found in all sites. In contrast, the genera Montipora and Porites typically have plate-like and massive globe-shaped growth forms (Raymundo, 2007). These growth forms have a high level of adaptation, as they increase the colony's surface area to maximize contact with sunlight, supporting photosynthesis by zooxanthellae algae. Both of these genera are commonly found in deeper areas to avoid strong currents (Guan et al., 2015).

From this study, a total of 29 genera were identified (Table 3). All of these genera were distributed according to the characteristics of each site. Despite nearly uniform temperature and salinity across all sites, the water characteristics in each site were different, especially in Jelarangan site. Jelarangan site and Cukuhnyai site receive currents from the south of the

island, which transport organic materials and coral larvae to this area earlier than in other sites. Exposure to currents in an area is crucial for maintaining oxygen and nutrient circulation, the removal of suspended matter, and plankton distribution. This resulted in the highest number of genera being found in Jelarangan and Cukuhnyai sites.

However, the coral reef cover in this area is relatively lower compared to other sites. We suspect that this is due to anthropogenic disturbances such as the use of fish bombs and natural disturbances such as strong currents and the predator Acantaster plancii. These disturbances are evident in the coral reef ecosystem profile in this area, which is dominated by covered coral fragments. These fragments are referred to as rubble and are difficult to serve as substrates for new coral colonies. Coral larvae require a stable substrate to attach to and form colonies (Burke, 2011). Based on this, we believe that Pahawang Island, especially Jelarangan and Cukuhnyai sites, has the potential to become an area with high species diversity.

Based on the results of this research, we conclude that the marine conditions in Pahawang support the sustainability of coral reef ecosystems, although some areas are damaged due to destructive fishing activities. Coral reefs can play a significant role for humans both directly and indirectly. They provide direct benefits such as tourism attractions, cultural significance, and a source of protein from fish. Indirect benefits include coastal protection from erosion, carbon sequestration, and wave attenuation (Fox, 2003). As a suggestion for future research, it is necessary to analyze coral reef cover and calculate coral and macrobenthos diversity. These steps are crucial to make coral reef ecosystem research more comprehensive.

5 Conclusion

The six sites in Pahawang Village are predominantly characterized by coral reefs with life forms including branching Acropora corals, encrusting corals, foliose corals, and massive corals. Genera that were found in all sites include Acropora, Montipora, and Porites. It can be concluded that Pahawang Island has the potential for recovery. Jelarangan and Cukuhnyai sites, in particular, have the potential to become areas with high species diversity.

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