Analysis of the Coral Reef Ecosystem Conditions in the Zoning of the Water Conservation Area of the Banda Sea Water Tourism Park

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Abstrak
Coral reefs are natural aquatic resources that provide benefits to ecosystems and the environment. A research study was conducted to analyze the condition of coral reefs in the Banda Sea TWP. Underwater Photo Transec (UPT) was utilized to observe coral reefs, which were then processed and analyzed using CPCe software based on COREMAP CTI guidelines. The results showed that the highest live coral, specifically branching Acropora and foliose coral, dominated the average coral reef coverage with a growth rate of 81.05%. Additionally, the coral condition was found to be in the excellent category, with an average percentage of 53.71% based on the Decree of the Minister of Environment No. 4 of 2001 concerning standard criteria for coral reef damage. This was supported by a zoning system for marine conservation areas, ensuring protection and preservation of coral reefs. It is crucial to prioritize safety and conservation efforts to enhance the coral reefs' condition, benefiting all living creatures that rely on these resources.

Keywords : Coral Reff; TWP Banda Sea; Marine Protected Area; *Underwater Photo Transec* (UPT).

1. Introduction

Coral reefs are unique and highly important ecosystems found in coastal areas of tropical regions. The reefs are primarily made up of coral, which is the main component of this ecosystem. Coral are small individual organisms, also known as polyps. They belong to the animal kingdom and have a small tube-like shape with tentacles surrounding their mouth. On the other hand, a coral reef is a structure on the ocean floor made up of calcium carbonate deposits, primarily produced by coral animals. Coral polyps are part of the invertebrate animal group known as Phylum Coelenterata, or Cnidaria [1]

According to Greenpeace records, the coral reefs in Indonesia covered an area of 50,875 square kilometers in 2018. This contributed 18% of the total area of the world's coral reefs and 65% of the total area of the coral triangle. Most of the coral reef locations in the eastern region of Indonesia are part of the coral triangle. Overall, coral reefs are found in the waters of small island areas from the western region of Sumatra, the Riau Islands, Bali, Lombok, Sulawesi, Maluku to Papua. Coral reefs play a crucial role in the ecosystem of coastal areas and small islands as they serve as spawning grounds, nurseries, and feeding grounds for most fish.

The Banda Islands are home to a wealth of coral reef resources, which are spread across six islands in the Banda Island chain, from Run Island in the west to Hatta Island 50 km to the south. The Banda Sea Aquatic Tourism Park (TWP) is a national marine conservation area that was established through the Decree of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia Number Kep. 69/Men/2009, which designates the Banda Sea as a National Marine Conservation Area in Maluku Province. The Banda Sea TWP is full of potential as a conservation area, with its socio-economic and cultural value, sustainable fisheries potential, and tourism potential. This study aims to analyze the condition of the coral reef ecosystem in the Banda Sea TWP water conservation area by assessing the percentage of coral cover and growth form. The results of this analysis can be used as primary data for area management in the Banda Sea TWP.

2. Methodology

We are conducting research on the Banda Sea TWP marine conservation area in the Central Maluku district of the Maluku Province. The research will take place from February to March 2023 and will be of the quantitative nature. We will present data in the form of numbers and use statistical methods and graphs to provide an overview and draw conclusions. The research will involve two sources of data - primary and secondary. Primary data will be collected through direct observation, while secondary data will be obtained from pre-existing websites and journals.

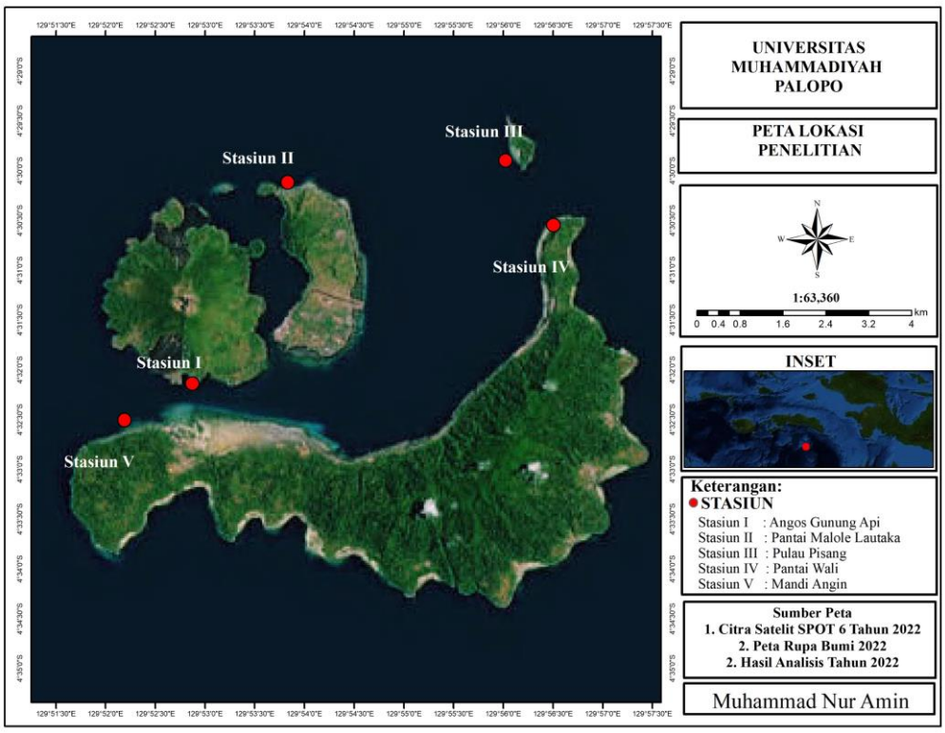

Figure 1. Research Map

This study aimed to analyze the condition of coral reef ecosystems by making observations at five different stations. The stations were categorized based on the zoning characteristics of marine conservation areas, which included core zones, utilization zones, rehabilitation zones, and sustainable fisheries zones. Station I was located in Angos Gunung Api and was classified as a Sustainable Fisheries subzone. Station II was situated at Malole Lautaka Beach, which fell under the utilization zone. Station III was on Pisang Island and was also classified as a utilization zone. Station IV was located at Wali Beach, the most protected zone known as the core, while Station V was situated in Mandi Angin Lonthoir, which was categorized as a sustainable fisheries zone.

2.1. Research Process

The research process starts by observing the location to determine the station in the study. The locations are selected based on their qualities and represent each conservation area zoning situation. The team and equipment are also prepared to make the research process more accessible and efficient. Data collection is done using the Underwater Photo Transect (UPT) method, which is based on the COREMAP CTI guidebook. According to [2], to manage the UPT method, researchers should first determine the coordinates of data collection and record the location of the observation. Then, they conduct a dive and pull a 50-meter transect. The underwater researcher takes pictures using an underwater camera at each meter, starting from the 1st meter to the 50th meter, with odd numbers being on the left and even numbers on the right of the transect line.

After capturing the images, they are processed. The pictures are separated by the observation station and placed in a dedicated folder for each station. The images are then ready for further analysis.

2.2. Data Analysis

Analysis based on photos taken from underwater photography was carried out using a computer and CPCe software [2]. The CPCe Version 4.1 (Coral Point Count With Excel Extension) application is software used to calculate the area of the basic substrate in an image observed using an underwater camera. Apart from being able to be used to calculate the percentage of basic substrate cover using the point count method, it can also be used to calculate the area of each type of basic substrate that we will analyze.

$$\text{Cover Presentage} = \frac{Totals\ Number\ of\ Point}{totals\ of\ random\ point} \text{ x } 100$$

Based on the photo analysis process carried out on each photo frame, the category coverage percentage value for each frame can be obtained, calculated based on the formula [3] as follows.

The identification results will appear in Microsoft Excel with the closure of each category. To assess the condition of coral reefs based on the percentage of live coral cover (Hard Coral), refer to the Decree of the Minister of the Environment No. 4 of 2001 concerning standard criteria for coral reef damage. The status of coral reefs is grouped into 4 categories as follows:

a. Very Good : 75%-100%
b. Good : 50%-74,9%
c. Medium : 25%-49,9%
d. Poor : 0%-24,9%

3. Result and Discussion

The Banda Sea Marine Tourism Park is a marine conservation area managed by the Kupang National Marine Conservation Area (BKKPN). It covers an area of approximately 2500 hectares and is located southeast of Ambon, at a distance of 132 km from Ambon City. The Banda Sea TWP is situated in Banda District, Central Maluku Regency, Maluku Province. It is an archipelagic area surrounded by Naira Island, Gunung Api Island, Banda Besar Island, Syahrir Island, and Karaka Island, and is geographically surrounded by the Banda Sea.

To protect the coral reefs that exist in the area, the Banda Sea TWP plays a vital role in its management. Area zoning is used to manage the Banda Sea TWP. The area is divided into four zones: Core Zone, Utilization Zone, Sustainable Fisheries Zone, and Other Zones such as the Rehabilitation Zone and Sustainable Aquaculture Sub Zone. Each zone is regulated in accordance with the Minister of Maritime Affairs and Fisheries Regulation Number PER.30/MEN/2010 concerning Management and Zoning Plans for Marine Protected Areas.

3.1. Coral Reef Coverage Percentage

The Underwater Photo Transec method is used to monitor the percentage of coral reef cover. This method pays attention to several components to view coral reef cover on a detailed scale, providing abiotic and biotic components in coral reef ecosystems. One of the advantages of this method is that it saves time in data collection compared to the PIT and LIT methods, as it takes advantage of technological advances using cameras and software.

To determine the percentage of coral reef cover for each category, the data analysis process uses CPCe software. The results obtained are used to calculate the percentages per station.

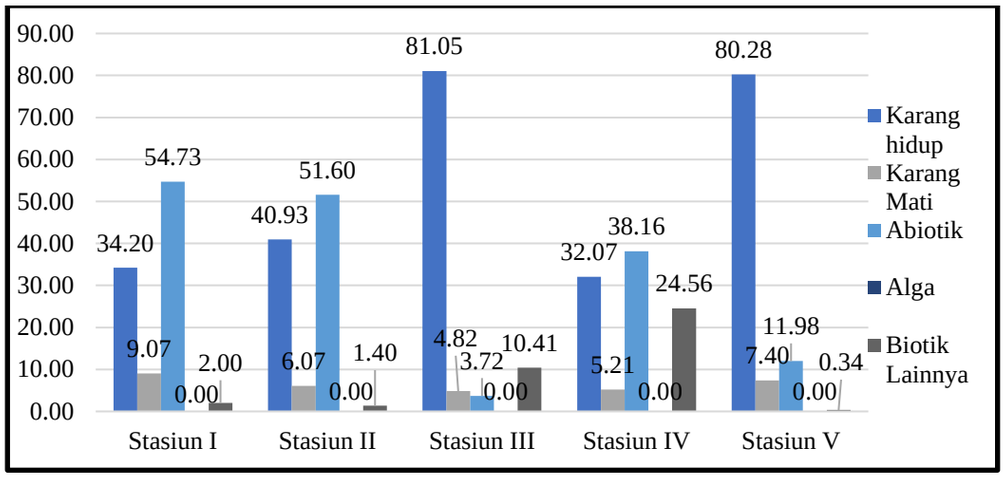

Figure 2. Coral Reef Coverage Percentage

The highest percentage was in the category of live coral cover; the highest was at Station III with 81.05%, followed by Station V with 80.28%, then Station II with 40.98%, and the lowest at Station 32.07%. At station III it is dominated by Acropora Branching and Coral Encrusting. Then, Station V is dominated by Coral Foliose and Coral Encrusting. The growth of Acropora Branching is a coral that has many types that can live in clear waters and proliferate but are challenging to deal with suspended solids [4]. As a conservation area, the Banda Sea TWP has been managing it since 2009, which allows the ecosystem within the area to be maintained. From this diagram, it can be seen that the low percentage of dead coral shows that the area is well-maintained.

The abiotic component also has high cover after live coral, with the highest percentage of 54.73% at Station I and the lowest at Station III with 3.72%. Then, the Abiotic Percentage is 24.56% at Station IV, the highest, and 0.34% at Station V, the lowest. The lowest percentage is in the Algae category, with none found at all stations. According to Prasetia and Wisnawan [5], algae are living competitors for coral reefs and will find it challenging to grow on live coral that grows well. Coral reefs will grow more quickly because they no longer need to compete with algae.

3.2. Coral Reef

The condition of coral reefs at stations in the Banda Sea TWP area is carried out by conducting an assessment based on the results of the CPCe. This assessment is based on the coral reef closure category and is assessed based on the provisions of Minister of Environment Decree No. 4 of 2001 which have been stipulated.

Table 1 Corals reef Presentage

Station	Coral Life	
	Percen	Cover
Station I	34,20	Medium
Station II	40,93	Medium
Station III	81,05	Very Good
Station IV	32,07	Medium
Station V	80,28	Very Good
	53,71	Good

The highest percentage of hard coral cover was found at station III, which had perfect conditions, with a percentage of 81.05. Station V had a very good percentage, indicating that the coral reefs in the area are well maintained. Station V is permitted for fishing, but uses environmentally and tourism-friendly fishing gear, while station III is intended for research, protection and habitat preservation, not for fishing.

Stations I, II, and IV are in moderate condition. Although activities are permitted in these sustainable fisheries subzones, the mild conditions must be improved. Station II, as a utilization zone, also needs to be preserved to achieve good condition, whereas Station IV, as a core zone, should continue to be used to improve the condition of coral reefs in the area and protect it as a habitat without human interference. Overall, the conditions obtained from each station show that the entire area is in good condition with a value of 53.71%. This indicates that the coral reefs in the Banda Sea TWP area are still alive and well. Therefore, it is essential to protect and preserve them to support the life of fish and other animals in the coral reef ecosystem. Moreover, the existence of coral reef ecosystems will benefit future generations. According to the 2019 book [6], "The Heart of Banda Sea," the coral reefs in the Banda Sea TWP area are in good condition and improving yearly [7].

This illustrates that zoning marine conservation areas is an effective solution for protecting and preserving coral reef ecosystems. Coral reef restoration can be done if we eliminate all direct impacts from humans that can cause damage to the coral reef ecosystem [8]. The suitability of water quality is a limiting factor for coral reefs and will accelerate their recovery. The water temperature of 29.4-29.6℃, pH acidity of 7.38-7.55, and current speed of 0.12-0.30 m/s are already in ideal conditions for coral reef growth. However, the salinity of 27.2-28‰ is not ideal. Nevertheless, coral reefs can still survive because the influence of salinity on coral animal life varies greatly depending on the conditions of local sea waters, as explained by Nabil Zubra in 2019 [1] and Giyanto [9] in their book.

Conclusion

The Banda Sea TWP is dominated by live coral reefs, with the highest percentage at Station III, measuring at 81.05%. Algae was not found at any of the stations. The hard coral structures are primarily composed of branching and foliose corals belonging to the Acropora family. Based on observations, the coral reefs in the Banda Sea TWP area are in relatively good condition, with a rating of 53.71%. Stations III and V are in good condition, while stations I, II, and IV have a fair rating. The area is also designated as a marine conservation zone to ensure the protection and preservation of the coral reef ecosystem. Recent studies also confirm that the condition of the coral reefs remains in good shape.

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