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Condition of coral cover area in the northern region of Tidung Kecil Island, Thousand Islands

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ABSTRACT

This study aims to determine the condition of the coral reef ecosystem on Tidung Kecil Island, Seribu Islands. Observational data collection was carried out in June 2022. The method used in this study was descriptive with the Line Interval Transect (LIT) technique with two repetitions, with the distance between the transect points being 10 meters. 2 repetitions aim to represent the coral cover data on the island's northern part. The data taken are the length and type of coral reef growth, which is then processed to be included in the coral cover area formula. Observational data were then analyzed using the coral cover percentage formula to calculate live coral growth and continued calculating the percentage cover for all categories of live coral lifeforms. Based on the observations, the condition of the coral cover area in the study area is classified as bad, with a percentage of coral cover area of 18.63% and a percentage of non-coral substrate of 48.7%. This is due to the high human activity (such as fishing) and tourism (such as snorkeling).

Conflict of interest: The authors declare that they have no conflicts of interest.

Introduction

As an ecosystem, coral reefs live at the bottom of the waters and are in limestone (CaCO3), which is strong enough to withstand sea waves. Coral reefs are also one of the planet's most productive and diverse ecosystems that provide ecosystem services[1,2]. Coral reef ecosystems are in tropical coastal areas and warm waters. The coral reef ecosystem is fragile, so it is classified as an ecosystem with a relatively fast extinction rate when disturbed[3], following the statement in Tonin[4] that coral reefs are a coastal resource that is very sensitive and vulnerable to damage, especially those caused by the activities of the surrounding community. Coral reefs benefit marine biota, humans, and the environment. Among the benefits of coral reefs are recreation (marine tourism), production (source of food and ornamental), conservation value, namely as a supporter of ecological processes and coastal life support, sediment sources coast, and protection of the coast from threats abrasion. Coastal protection, food sources because it is a place for fish to live and even medicines[5].

The coastal area is one of the ecosystem areas prone to degradation due to high human activities on the coast, such as fishing, tourism, and port activities. The consequences of these activities can slowly erode coral reef ecosystems, which play an essential role in coastal biodiversity[6]. On Tidung Kecil Island, high levels of human activity, especially fishing and tourism, pose a significant threat to the coral reef ecosystem. In addition to human activities on the coast, climate change and rising global temperatures are also causing the world's oceans to heat up, causing corals, especially hermatypic corals or reef-forming corals, which can provide a substrate and living space for thousands of types of invertebrates, fish and marine algae, to become stressed and release Zooxanthellae[7]. When zooxanthellae leave the coral tissue, the coral loses its primary food source, the photosynthetic product of the zooxanthellae[8,9]. This causes the coral to turn white or pale due to the color of the zooxanthellae algae, which gives the coral its color. These conditions can significantly affect the health of corals and reduce their ability to grow and survive, negatively impacting other organisms that depend on the coral reef ecosystem[10].

One area that has a coral reef ecosystem and is an island with much human activity is Tidung Island. Tidung Island is an island and a village in the South Thousand Islands Regency. Tidung Island is divided into two islands: Tidung Besar (50.13 Ha) and Tidung Kecil (17.40 Ha), with Pulau Tidung Besar being used for residential areas and Pulau Tidung Kecil being used as a conservation area. Tidung Island is one of the most popular tourist destinations in the Thousand Islands. This poses a separate threat: increasing ecosystem damage[11].

With the condition that tourism activities are quite well-known on Tidung Kecil Island, it is possible that it can affect the fertility and existence of coral reef ecosystems, so a study is needed to find out the condition of coral reefs on Tidung Island, especially Tidung Kecil, Seribu Islands.

Method

Place and Time of Research

This research was conducted on June 17-18, 2022, on Tidung Kecil Island, especially in 5 48' 0" ls and 106 31' 10" bt (Fig 1). Data was taken from 1 station, namely in the northern part of Tidung Island. The north part was chosen because it is one of the places for tourism activities such as snorkeling, banana boats, etc.

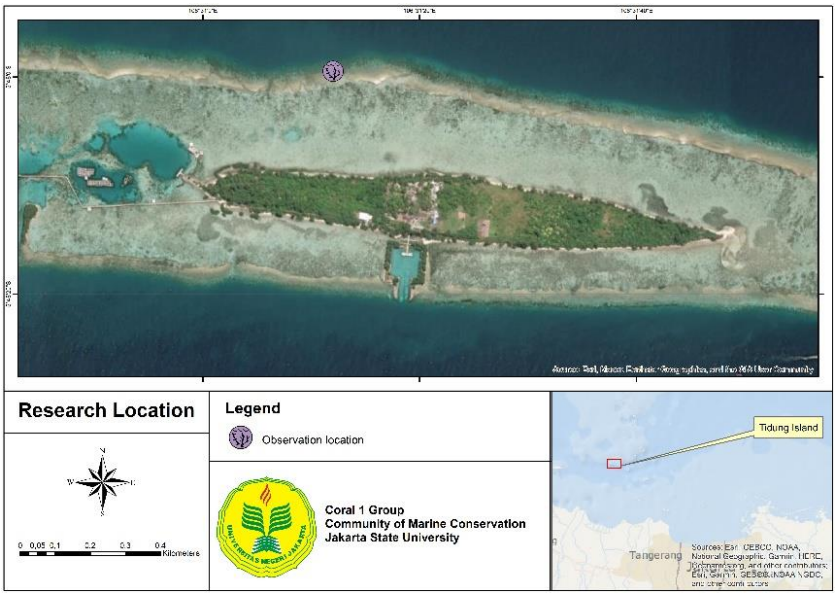


Fig 1. Research location

Tools and Materials

The tools and materials used in this study were Google mask equipment, snorkels, fins, underwater camera photos, roll meters, waterproof stationery, and GPS to determine location points.

Data Collection Techniques

The method used is descriptive with the LIT (Line Intercepts Transect) technique. Line Intercepts Transect (LIT) is a method that is used in coral reef surveys. The LIT method was developed by the Australian Institute of Marine Science (AIMS) and The Great Barrier Reef Marine Park Authority (GBRMPA)[12]. This research is a modification of AIMS and GBRMPA with a method that uses two repetitions to ensure the data can represent the northern part of this island. His method is carried out by laying a 50 m long transect parallel to the shoreline and observed as a whole. The data collection area is along the transect line. The starting point for data collection is 200 m from the shoreline perpendicular to the shoreline. The coral reefs observed were at a depth of 1.5 - 2 meters. The distance between transect points is 10 meters. The data taken is in the form of the length and type of growth of coral reefs (Fig 2).

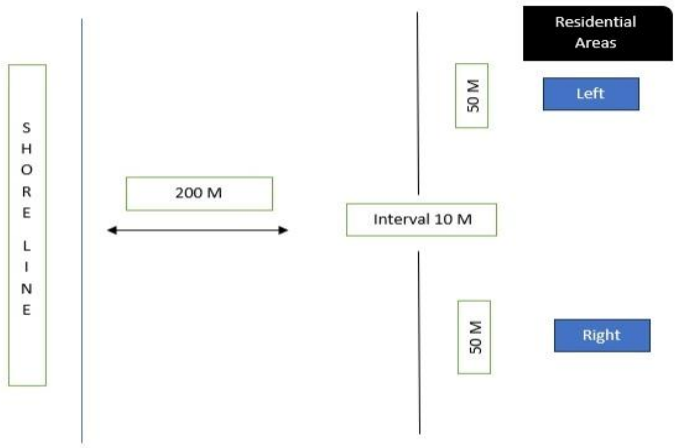


Fig 2. LIT research design

Analysis Data

Data on coral reefs will be processed using the coral cover percentage formula. The percentage of coral cover is used to calculate live coral growth. The calculations used are as follows[13]

$$Ni = Li/L \times 100\%$$

Information :
Ni: percentage cover of the i-type coral lifeform
Li: Length of the i-th type (meter)
L: Total length of the line transect (meters)

After the percentage of coral cover is found, proceed with calculating the percentage cover for all live coral lifeform categories with the following equation[13]

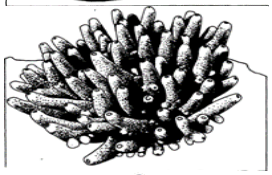
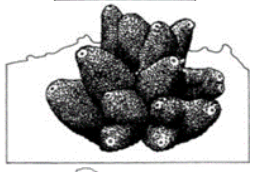
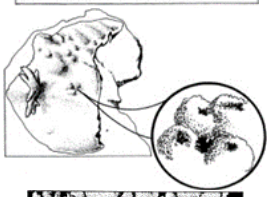
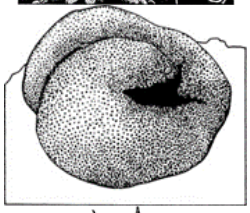
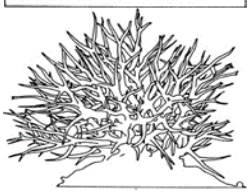
$$\text{Percentage of total cover} = (\text{Total length of live coral reef})/(\text{Total length of transect}) \times 100\%$$

After the standard criteria for coral reef health were obtained, a conclusion was made regarding the latest condition of the coral cover area of Tidung Kecil Island, Thousand Islands, Jakarta.

Results and Discussion

Based on observations made on June 17-18, 2022, in the northern part of Tidung Island, data for ten types of life forms were divided into Acropora and Non-Acropora. The species found are listed in Table 1.

Table 1. Coral types on the Northern Tidung Kecil Island

Lifeform	Picture	Information
Acropora branching		The branching shape is like a tree branch. Example: *Acropora palmat, A. formosa*
Acropora tabulate		The shape is branched horizontally, flat like a table. Example**:** *A. hyacinthus*
Acropora digitate		Branching forms straight and separated like fingers. Example: *A. humilis*
Acropora submassive	 	Sturdy branch. Example: *A. paljfera*
Acropora encrusting		Creeping form. Example: *A. paljfera, A. cuneata*
Coral foliose		The shape resembles a sheet/leaf. Example: *Turbinaria* sp.
Coral massive		Massive shape, like a rock. Example: *Leptoria phrygia*
Coral branching		Branched shape like tree branches. Example: *Seriatopora hystrix*

Coral encrusting		Creeping form. Example: *Leptoseris incrustans*
Soft coral		All types of soft corals (ahermatypic). Example: *Tubipora musica*
Sand	-	Sinks if lifted
Rock	-	Rocks that come from coral
Dead coral	-	Newly dead coral had a white color.
Rubber		Coral fragments measure around 0.5 cm – 15 cm.

There are five types of Acropora: Acropora *Branching*, *Acropora Digitate*, *Acropora Encrusting*, *Acropora Tabulate*, and *Acropora Submassive*. At the same time, non-Acropora found as many as five types of *Coral Foliose*, *Coral Massive*, *Coral Branching*, *Coral Encrusting*, and Soft Coral. Covers of sand, rocks, and dead coral fragments were also found. The highest number of individuals was *Acropora Branching*, with 19 individuals, while the least was Soft Coral, with only one individual. The most dominating percentage of coral cover, namely 4.03%, is owned by *Acropora Branching*, while Soft Coral owns the lowest rate at 0.1% (Fig 3).

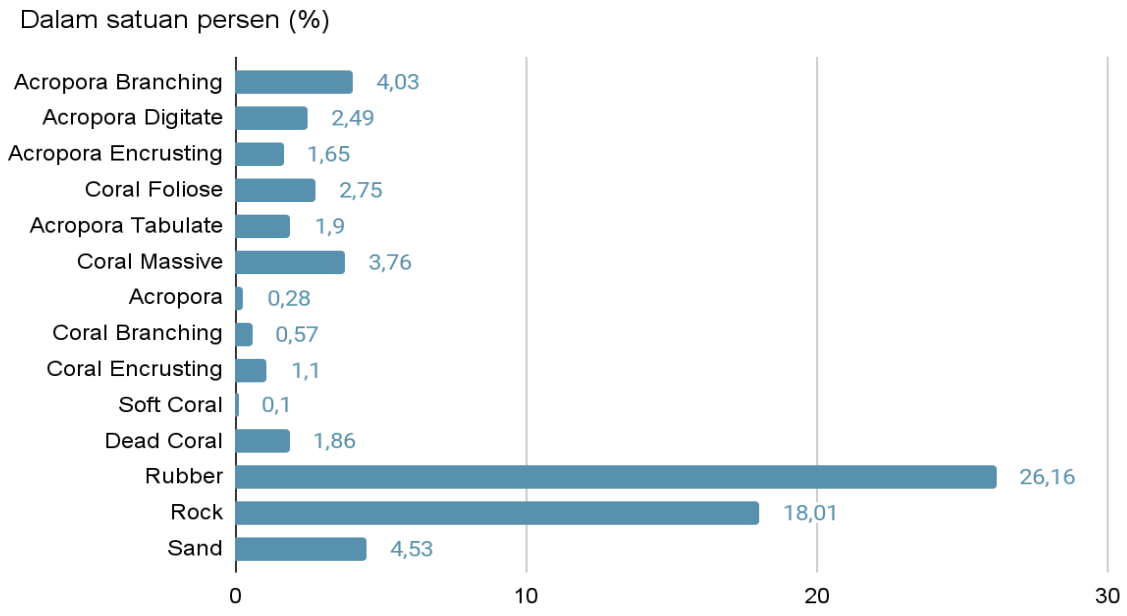


Fig 3. Percentage Cover of Coral Lifeforms With The Ni Formula

The percentage of the coral cover area obtained in this study was 18.63%, and the rate of the non-coral substrate was 48.7%. The data indicates that the percentage of coral cover in the Northern Territory, Tidung Kecil Island, Seribu Islands is classified as bad. The classification is based on Table 2.

Table 2. Coral reef health standard criteria

Parameter	Category (%)			
	Great	Good	Medium	Bad
Coral cover	75 – 100	50 - 74.9	25 – 49.9	0 - 24.9
Algae cover	0 – 24.9	25 – 49.9	50 – 74.9	75 – 100
Sand cover	0 – 24.9	25 – 49.9	50 – 74.9	75 – 100
Coral death index	0.075 - 1	0.50 – 0.749	0.25 – 0.49	0 – 0.24

The transects in this study were drawn from the right to the left, approaching the part of Tidung Besar Island where residents live, with a distance of approximately 700 meters from the residential area to the data collection site. The coral cover was found to be 12.76% in transect 1 and 5.87% in transect 2, indicating a decrease in coral cover towards the section of Tidung Besar Island. This observation aligns with existing research that identifies terrestrial human activities, such as fishing, tourism-related boat transportation, indiscriminate waste disposal, and snorkeling, as causes of coral reef degradation[14-16]. Human activities, including snorkeling, were observed to cause damage to coral reefs, with visitors trampling on corals in prohibited areas[15,17]. Based on observation, coral fractures were also found due to snorkeling activities. Tourists trample on corals where they are not supposed to. Additionally, the detrimental effects of oil pollution on reef corals have been documented, including decreased colony viability and damage to the reproductive system of corals. Furthermore, studies have shown a negative correlation between coastal pressures, such as overfishing and coastal eutrophication, and coral health[18]. The impact of tourism on coral reef cover has also been investigated, with findings indicating a relationship between tourist visits and coral reef degradation[19]. Moreover, the damaging effects of plastic waste on coral reefs have been highlighted, particularly on structurally complex corals[20].

Conclusion

The condition of the coral cover area in the Northern Territory, Tidung Kecil Island, Seribu Islands is classified as bad, with a percentage of coral cover area of 18.63% and a percentage of non-coral substrate of 48.7%. The percentage of coral cover area on transect 1 is 12.76%. While on transect two, it was 5.87%. Data shows that the extent of coral cover in the northern part is in a bad category; where if you look at the condition of coral cover, it gets worse if you go to the nearest part of Tidung Besar Island, which is a place with a lot of human activity such as tourism activity and fishing.

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Author contributions

All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was written by [**Nada Qitriyyah Suhaika**] and [**Renata Martanto**]. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.