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Original research article

### *Analysis of Coral Reef Conditions in the Waters of Panjang Island, Central Bangka Regency*

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#### ABSTRACT

*Coral reefs are organisms that live at the bottom of the water and take the form of sturdy limestone formations capable of withstanding the force of ocean waves. Ecologically, coral reefs serve as habitats where various animal and plant organisms seek food and shelter. This research aims to analyze the coral reef ecosystem conditions in the waters of Panjang Island and provide recommendations for sustainable management of marine biodiversity in the waters of Panjang Island, Central Bangka Regency. The Underwater Photo Transect (UPT) method involves underwater photography using a digital or regular digital camera equipped with a waterproof housing to withstand seawater exposure. The research results indicate that the percentage of live coral cover in the waters of Panjang Island ranges from 70.07% to 14.07%, categorizing it as fair to poor according to the Minister of Environment Decree No. 4 of 2001 on the Standard for Coral Reef Damage. Fourteen coral growth forms were identified in the waters of Panjang Island, belonging to 17 coral genera. Recommendations for managing marine resources on Panjang Island include sustainable tourism development. Environmentally based tourism development can serve as a solution for sustainably utilizing coral reefs and promoting improving coastal and fisheries management based on Marine Conservation Areas.*

#### Introduction

Pulau Panjang is a small island located in Central Bangka Regency. This island has the potential for coral reef ecosystems. According to the research by Adi et al. (2021), the coral reef area of Pulau Panjang covers an area of 475

hectares. Coral reefs are organisms that live at the bottom of the water and take the form of limestone rocks that are strong enough to withstand the force of ocean waves.

The direct benefits of coral reefs include serving as feeding grounds, nursery grounds for the growth of

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organisms, spawning grounds, marine tourism, and others. The indirect benefits provided by coral reefs include acting as a natural barrier to protect the coast from wave impact and erosion (Giyanto et al., 2017).

Despite the high benefits coral reefs provide humans, coral reefs are highly susceptible to damage, mainly due to human pressures. Coral reef decline is caused by various factors, including sedimentation, pollution originating from the land such as industrial and domestic waste disposal, coral mining for construction materials, or other physical damages like overexploitation of marine resources and environmentally harmful fishing practices such as the use of explosives and toxins.

For that reason, research on the condition of coral reef ecosystems is needed to address the threat of coral reef

damage as a basis for implementing sustainable development principles. Additionally, there has yet to be a study on the condition of the coral reef ecosystem, especially in the waters around Pulau Panjang. Therefore, it is essential to conduct a study on the condition of the coral reef ecosystem in Pulau Panjang.

### Research Methods

#### Date and Location

This research will be conducted in May 2023 in the waters of Pulau Panjang, Bangka Tengah Regency. The study focuses on the waters surrounding Pulau Panjang, characterized by coral reef ecosystems. There are four data collection stations, and sampling points will be established in four cardinal directions at each station.

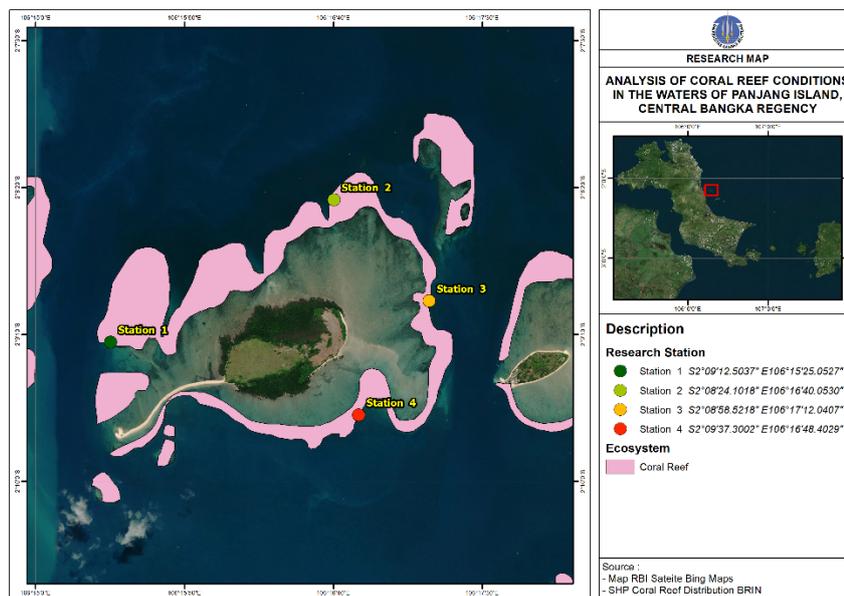


Figure 1. Location Map

Table 1. Coordinates of Research Locations

Station Code	Coordinates		Location and description
	X	Y	
1	2.15347325	106.25695910	Western Part of Pulau Panjang
2	2.14002829	106.27779250	Northern part of Pulau Panjang
3	2.14958941	106.28667798	Eastern Part of Pulau Panjang
4	2.16036117	106.280111993	Southern Part of Pulau Panjang

### Equipment Materials

The tools and materials used include SCUBA diving equipment, a 58 x 44 cm frame, an underwater camera, permanent stakes, a measuring tape, underwater writing tools, and a global positioning system (GPS). Other tools include a Secchi disk, stopwatch, drift flag, thermometer, refractometer, dissolved oxygen (DO) meter, pH paper, and sample bottles.

### Data Collection Method

The method employed in this

assessment is the Underwater Photo Transect (UPT) method (Giyanto et al., 2010; Giyanto, 2012a; Giyanto, 2012b). This method describes and documents the research stations, and the transect photo data are subsequently analyzed using the Coral Point Count with Excel extension (CPCe) software. An illustration of the data collection process is presented in Figure 2. Quality standards for coral reef damage based on the Minister of Environment Decision Number 4 of 2001 can be presented in Table 2.

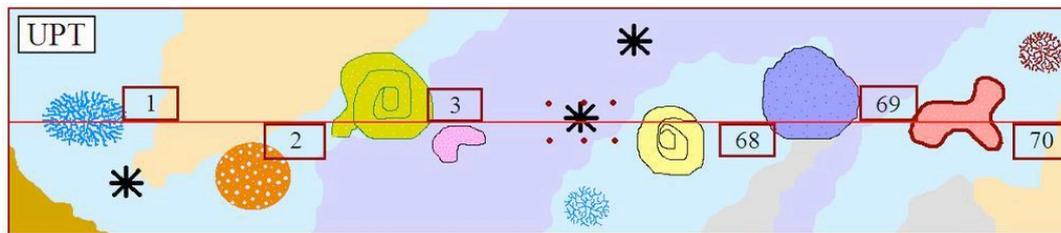


Figure 2. Coral data collection scheme (Giyanto, 2014)

Table 2. Coral Reef Quality Standards

Conditions	Coral Reef Coverage (%)
Poor	0-24,9
Moderate	25-49,9
Good	50-74,9
Excellent	75-100

## Results and Discussion

### Percentage of Coral Cover

The percentage of live coral at each station falls into the categories of good to poor. The percentage of live coral cover at Pulau Panjang station 1 is 65.20%, station 2 is 70.07%, station 3 is 47.73%, and station 4 is 14.07%. The observations conducted at four stations on Pulau Panjang indicate a percentage of live coral cover in the waters of Pulau Panjang ranging from 70.07% to 14.07%, categorized as fair to poor according to

the Minister of Environment Decree No. 4 of 2001 on the Standard of Coral Reef Damage. After analysis, two stations were classified as having good conditions, namely stations 1 and 2. The live coral cover results for station 1 were 65.20%, while station 2 obtained a live coral cover percentage of 70.07%. Station 3 received a live coral cover percentage of 47.73%, categorized as moderate, whereas station 4 had a live coral cover percentage of 14.07%, falling into the poor category. The lowest coral reef cover percentage was recorded at station

4. This station is located in the southern part of the island, close to the shipping route. One of the causes of coral reef damage is shipping lanes and ship anchors (Dahuri et al., 2001).

*Growth Forms of Coral Reefs*

Based on the observations conducted at Pulau Panjang, Bangka Tengah Regency, 14 life forms were identified. These include coral growth forms categorized as follows: Acropora branching (ACB),

Acropora Digitate (ACD), Acropora Tabulate (ACT), Coral Foliose (CF), Coral branching (CB), Coral Massive (CM), Coral Submassive (CS), Coral encrusting (CE), Coral mushroom (CMR), from the Dead Coral category, there is Dead Coral Algae (DCA), then there are Soft Corals (SC), from the Other Biota category such as Halimeda (HA), Other fauna (OT), and types from the Abiotic category such as Sand (S). The details are presented in Table 3.

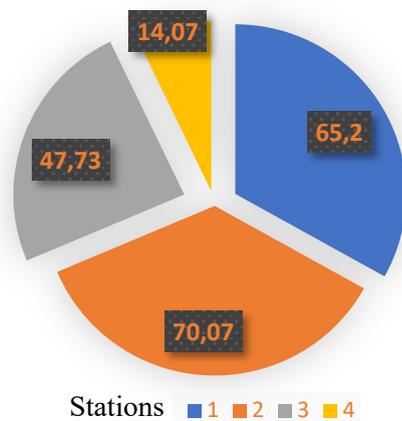


Figure 3. The percentage of coral reef cover at Pulau Panjang

Table 3. Growth Forms of Coral Reefs

CATEGORIES LIFEFORM	STATIONS (%)			
	1	2	3	4
<i>CORAL (HC)</i>				
<i>Acropora Branching (ACB)</i>	4,27	13,40	0,00	0,00
<i>Acropora Digitate (ACD)</i>	8,20	14,40	0,67	0,73
<i>Acropora Tabulate (ACT)</i>	0,27	9,53	0,40	0,00
<i>Coral Branching (CB)</i>	0,27	0,00	0,67	0,60
<i>Coral Encrusting (CE)</i>	7,87	5,20	5,20	2,33
<i>Coral Foliose (CF)</i>	7,93	7,13	20,93	5,20
<i>Coral Massive (CM)</i>	28,47	16,27	19,33	5,13
<i>Coral Mushroom (CMR)</i>	3,93	0,73	0,47	0,00
<i>Coral Submassive (CS)</i>	4,00	3,40	0,07	0,07
<i>DEAD CORAL WITH ALGAE (DCA)</i>				
Dead Coral with algae (DCA)	27,80	27,73	51,00	66,73
<i>SOFT CORAL (SC)</i>				
Soft Coral (SC)	0,07	0,00	0,00	0,00
<i>OTHER BIOTA (OT)/BIOTIK</i>				
Halimeda (HA)	0,00	0,33	0,00	0,00

CATEGORIES LIFEFORM	STATIONS (%)			
	1	2	3	4
Other (Fauna) (OT)	2,27	1,87	0,87	0,00
<i>ABIOTIK</i>				
Sand (S)	4,67	0,00	0,40	19,20
Total (%)	100,00	100,00	100,00	100,00

The dominant growth forms of coral reefs in all four research stations are non-acropora, including Coral Encrusting, Coral Foliose, and Coral Massive. A similar study by Muftiadi et al. (2021) in Ketawai Island, Central Bangka Regency, mentioned 20 types of lifeform growth dominated by Coral Foliose. Adi et al.'s research (2020) on Gelasa Island, Central Bangka Regency, indicated 20 types of lifeform growth dominated by Coral Massive and Coral Submassive. It suggests that the growth forms of coral reefs in the waters of Pulau Panjang, Central Bangka Regency, are relatively similar to those of other small islands in the region, as supported by the statement from Siringoringo and Hadi

(2013), stating that Coral Massive dominates the waters of Bangka Island.

#### *Coral Genus Composition*

Based on observations conducted at Pulau Panjang, Central Bangka Regency, 17 coral reef genera compositions are found in Pulau Panjang waters. These include the genera Acropora, Caulastrea, Coeloseres, Echinopora, Euphyllia, Favites, Fungia, Goniastrea, Goniopora, Lobophyllia, Merulina, Pavona, Platygyra, Porites, Psammocora, Symphyllia, and Turbinaria, as presented in Table 4.

Table 4. Coral Reef Genus

No	GENUS	STATIONS			
		1	2	3	4
1	Acropora	+	+	+	+
2	Caulastrea	+	+	-	-
3	Coeloseres	+	+	-	-
4	Echinopora	+	+	+	+
5	Euphyllia	+	+	-	-
6	Favites	+	+	-	-
7	Fungia	+	+	+	+
8	Goniastrea	+	+	+	-
9	Goniopora	+	+	+	-
10	Lobophyllia	+	+	+	-
11	Merulina	+	+	+	+
12	Pavona	+	+	+	+
13	Platygyra	+	+	+	-
14	Porites	+	+	+	+
15	Psammocora	+	-	-	-
16	Symphyllia	+	+	+	-

No	GENUS	STATIONS			
		1	2	3	4
17	Turbinaria	+	+	+	-

The genera frequently found at the observation stations are Acropora, Pavona, and Porites. Similar research conducted by Adi et al. (2020) on Gelasa Island, Central Bangka Regency, mentioned the discovery of 20 coral genera, with Acropora, Porites, and several families of Faviidae being the most frequently encountered coral genera. Another study by Adibrata et al. (2023) in the waters of Central Bangka reported 32 genera, including Galaxea, Goniastrea, Merulina, Pectinia, and Porites sp., which were dominant at each station. It indicates that the coral genera in Pulau Panjang, Central Bangka, are relatively similar to those on Gelasa Island and in the waters of Central Bangka. Siringiringo and Hadi (2013)

stated in their research that they found 89 types of stony corals divided into 13 families in the waters of Bangka, including South Bangka and West Bangka waters.

#### *Physical and Chemical Parameters of Water*

Water quality data is a set of physical and chemical parameters collected during coral reef data collection, including temperature, pH, dissolved oxygen (DO), salinity, clarity, water depth, current velocity, and Total Suspended Solids (TSS). The processed results are presented in Table 5.

Table 5. Physical and Chemical Water Data

Parameter	STATIONS			
	1	2	3	4
Temperature	29°C	30°C	31°C	31°C
Salinity	33‰	31‰	32 ‰	30 ‰
Current Velocity	0,076 m/s	0,083 m/s	0,41 m/s	0,14 m/s
Dissolved Oxygen (DO)	6,3 mg/L	5,3 mg/L	5,5 mg/L	5,6 mg/L
Brightness	7	7	8	8
Depth	75 %	77,70 %	61,10 %	58,30 %
Total Suspended Solids (TSS)	3 m	4,5 m	5 m	3 m
Temperature	19,2	17,9	14,5	31

The research results in the waters of Pulau Panjang indicate that the coral conditions range from good to poor. It is influenced by environmental conditions supporting coral reef survival, with good physical and chemical water parameter values. The water temperature obtained

from the data collection ranges from 29°C to 31°C, which is still tolerable for coral reefs. The values obtained are within the normal temperature range for marine life. According to the Regulation of the Republic of Indonesia number 22 of 2021 concerning the implementation of

environmental protection and management, the temperature for marine life is between 28°C and 30°C. It is allowed to change up to 2°C from its natural temperature. It is supported by Suharsono (2000), who states that coral reefs living in Indonesian waters range from 26°C to 34°C. The salinity value is 30-33 ppt, indicating that the salinity of the waters around Pulau Panjang is considered normal. According to the Regulation of the Republic of Indonesia number 22 of 2021 concerning the implementation of environmental protection and management, the waters around Pulau Panjang are still suitable to support coral reef life. The current velocity ranges from 0.14 to 0.083 m/second, falling into the slow category.

The dissolved oxygen (DO) levels in the waters of Pulau Panjang range from 5.3 mg/L to 6.3 mg/L. According to the (Minister of Environment Decree, 2004), this DO content is suitable for coral growth as it exceeds the recommended DO level of 5 mg/L for the survival of marine organisms. Therefore, the relatively good DO content in the waters of Pulau Panjang allows for favorable coral growth. The measured pH values at the observation stations range from 7 to 8. Consequently, the pH values in the waters of Pulau Panjang are suitable for coral reef growth, aligning with Susana's (2005) suggestion that the optimal pH for marine life ranges from 6.5 to 8.5. The water clarity data obtained shows a range of 50.30% to 77.70%, with water depths at each station ranging from 3 to 5 meters during data collection. The suspended solids (TSS) levels vary from 14.5 to 31 mg/liter, indicating relatively low to moderate TSS concentrations in the waters of Pulau Panjang. It complies with the water quality standards set by the Minister of Environment (2004), where the TSS threshold is 20 mg/L. High concentrations of TSS in water can lead to increased sedimentation, impacting water quality over time and potentially

reducing photosynthesis activity in zooxanthellae by obstructing incoming light (Siswanto, 2009).

#### *Recommendations for Sustainable Management*

The study's results indicate that the condition of coral reefs in the waters of Pulau Panjang can be characterized as ranging from good to poor. Recommendations for managing coastal and marine ecosystems (coral reefs) include maintaining the environmental conditions conducive to coral reef development, particularly at stations 1 and 2, as these stations exhibit favorable coral reef conditions. This recommendation aligns with the Regional Regulation of Bangka Belitung Islands Number 3 of 2020 concerning the Spatial Planning for Coastal and Small Island Areas (RZWP3K) of Bangka Belitung, which designates Pulau Panjang as part of the sub-zone for natural coastal/island tourism. Therefore, it can be utilized as a snorkeling or diving destination to support the local coastal community's economy. Conversely, for station 4, where the coral reef condition is known to be damaged, efforts can be directed toward declaring the waters around Pulau Panjang as a Marine Conservation Area (KKL). This designation could serve as a solution to mitigate excessive exploitation of coral reefs in the area.

#### **Conclusion**

In general, the results of the percentage of live coral cover in the waters of Pulau Panjang, ranging from 70.07% to 14.07%, are categorized as ranging from good to poor according to the Minister of Environment and Forestry Decree No. 4 of 2001 concerning the Standard of Coral Reef Damage. The growth forms of coral reefs found in the waters of Pulau Panjang include 14 life forms. There are 17 genera of coral reefs found in the waters of Pulau Panjang.

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