Coral Cover in The Sempu Strait Around Pondok Dadap Fishing Port Malang

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Abstract. The Sempu Strait is an area located in the southern coastal area of Malang Regency, precisely in Krajan Village, Sumbermanjing Wetan District. The Sempu Strait has a Pondok Dadap Fishing Port which refers to the Eco Fishing Port. This study aims to analyze the effect of fishing activities at Pondok Dadap Fishing Port on seawater quality and coral reef cover in the Sempu Strait. Data collection was carried out at 3 stations with 3 points for each station. Retrieval of data based on areas with different levels of community activity: station 1 with low activity conditions, station 2 with high activity conditions and station 3 with moderate activity. The quality of the waters in the Sempu Strait is still in accordance with seawater quality standards. The condition of coral reefs in the Sempu Strait at station 1 with coral reef cover of 69.81% is in the good category, station 2 is 0.8% is in the damaged category and station 3 is 50.7% in the good category.

1 Introduction

Coral reefs are gathering places for marine life such as fish, molluscs, and bivalves. Coral reefs provide shelter as well as a breeding ground for small fish so as not to become the target of their natural predators. According to [1], good coral reef conditions cause high diversity of reef fish species and other biota associated with coral reef ecosystems to be able to carry out their lives. Coral reefs have a role as a provider of nutrients and shelter for several aquatic biota such as reef fish and other biota [2]. According to [3] coral reef cover has an influence of approximately 42.55% on the abundance of reef fish. The statement was also conveyed by [4] that coral reef cover has a significant influence on the abundance of reef fish where a correlation of 65.4% was obtained. In addition to supporting the survival of reef fish, coral reefs also have a role in maintaining the sustainability of another biota such as megabenthos [5,6]. Such megabenthos are like echinoderms and molluscs [7]. In addition, coral reef could be potential as carbon sink [8].

Coral reefs include marine life that has a high level of sensitivity to changes in aquatic conditions both in terms of physical and chemical [9,10]. The occurrence of pollution is caused by many human activities such as fishing activities and loading and unloading activities at fishing ports [11]. Apart from port activities, community activities that directly dispose of household waste into the sea are also the cause of damage to coral [12]. Changes in water conditions due to both human and natural factors will directly affect the survival of

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coral reefs [13]. Changes in water conditions are dominated by community activities, especially fishermen, such as illegal fishing with inappropriate tools, overfishing or tourism activities [14].

The quality of seawater, crucial for the growth of coral reefs, is determined by various parameters such as temperature, dissolved oxygen (DO), pH, salinity, and water clarity. These water quality parameters are also influenced by community activities such as household waste disposal or shipping activities [15]. Fuel spills or engine lubricants can cover the surface of coral reefs which soon will cause disease and death to individual corals [12].

The diversity of marine life in the Sempu Strait itself is quite high, especially in the coral reefs but these conditions continue to decline every year due to changes in environmental conditions both caused by humans and nature [12,16]. Research activities on coral reef cover in the Sempu Strait are needed to maintain the balance of marine ecosystems.

2 Material and Methods

The research was conducted from the end of November 2021 to early December 2021. The coverage area to be studied is in the Sempu Strait, Sumbermanjing Wetan, Malang Regency, East Java with coordinates 8°25'59.34" south latitude and 112°40'54.78" east longitude with a depth of 3 to 8 meters. The study was conducted using the Underwater Photo Transect (UPT) method. The map of the research location can be seen in Figure 1.

Place the figure as close as possible after the point where it is first referenced in the text. If there is a large number of figures and tables, it might be necessary to place some before their text citation.
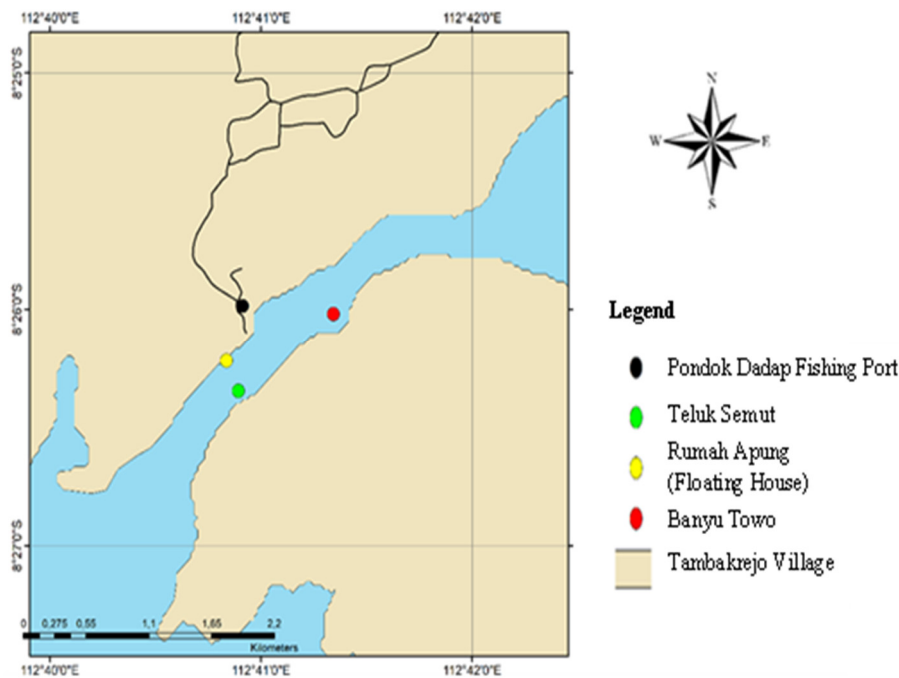
Fig. 1. Study Map in Sempu Strait, Sumber Manjing, Malang, Indonesia.

The study was conducted by quadrant transect method. Data collection using quadrant transects aims to determine the percentage of coral reef cover and the diversity of coral reef species. The placement of quadrant transects is above the roll meter which has previously

been stretched transversely as far as 50 meters at 3 different stations. The determination of observation stations is based on 3 backgrounds of environmental conditions, namely at station 1 of the Floating House where there is very little human activity, station 2 is Banyu Towo where there is a lot of human activity and station 3 is Teluk Semut where there is very few human activities. The coordinates of the observation locations at the 3 stations can be seen in Table 1.

Table 1. Coordinates of data collection location at Sempu Strait, Malang, Indonesia.

No	Station	Coordinates	
		Latitute	**Longitute**
1	Floating House (Rumah Apung)	8°26'13.84" S	112°40'49.73" E
2	Banyu Towo	8°26'0.61 S	112°41'23.95" E
3	Teluk Semut	8°26'20.85" S	112°40'53.59" E

Data collection with quadrant transects is carried out every 1 meter starting from the first point which is 1 m to the last point at 50 m. The research will produce a total of 50 points at each station and a total of 153 points that can represent the percent of coral reef cover in the Sempu Strait. Each point was photographed perpendicular to the bottom of the water with a height of 60 cm above the transect. Take photos with that distance to obtain an observation area of 2,552 cm^2. This value was obtained using a quadrant transect measuring 58 × 44 cm in full [17]

The data taken in the form of photos will then be analyzed using the CPCe 4.1 application to identify the type of coral reef. Identification of coral reef species is needed as a reference to calculate the important value index of coral reefs. Other data analysis carried out includes calculating the uniformity index, diversity index, water quality and fishermen activities. Percent coral cover indicates the percentage of live and dead corals in a predetermined area. The percent calculation of coral cover can be calculated using the Equation 1.

$$L = \frac{Li}{n} \times 100\% \qquad (1)$$

where: L is percent of coral cover (%), Li is the area of coral cover on each plot, and N is total transect areaWater parameters are analyzed using the in-situ method, where the observed data is taken directly from the field and observed in real-time to improve accuracy and suitability to field conditions when the data is taken. The parameters taken are temperature, salinity, pH, DO, and the seawater clarity. The water parameter data obtained then be compared with PPRI No. 22 of 2021 concerning seawater quality standards for marine biota. The comparison of these values showed the suitability of environmental conditions with the tolerance limit of coral reef survival.

3 Results and Discussion

3.1 Coral cover at station 1 floating house (rumah apung) of Sempu Strait

The condition of coral reefs at station 1 point 1, namely in the waters of the Floating House (Rumah Apung), obtained 73.87% live corals, 11.13% dead corals and 12.73 coral fragments (rubble). Conditions at points 2 and 3 experienced a slight increase in dead corals where at point 2 had live coral cover of 66.53% and dead coral of 29.53%. Point 3 has a percentage of live coral cover of 69.03% and dead coral of 25.6%. Observations made at 3 locations showed an average live coral cover value of 69.81% and dead coral of 29.13%. This condition places the Floating House in a good coral reef condition according to KEPMENLH (2001). The

increase in the percentage of dead coral at points 2 and 3 is very likely caused by the start of community activities such as lifeboat traffic or people who carry out fishing activities in the area. According to [14] some community activities such as boat traffic, fishing or just snorkeling can directly interfere with the survival of coral reefs. These activities can have an impact because they will step on, erode or even break the coral reefs below. The dominance of coral reefs at Station 1 is the coral folio category. The high cover is because the leaf coral has a habitat in shallow waters with a depth of about 5-10 meters with strong currents [18]. The waters around station 1 have shallow characteristics with a depth of 3 to 8 meters with strong currents because they are in the area near the strait gate. The following is a graph of the average value of reef cover of station 1 can be seen in Figure 2.
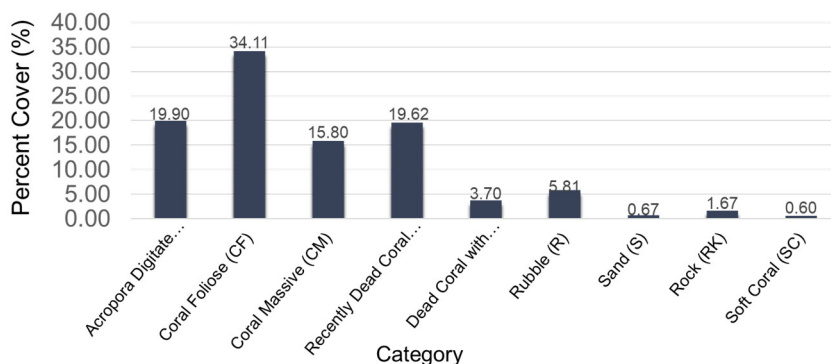
Fig. 2. Average percentage of coral reef cover at station 1 floating house (rumah apung) of Sempu Strait, Malang, Indonesia.

## 3.2 Coral cover at station 2 Banyu Towo of Sempu Strait

Conditions at station 2, namely in Banyu Towo, are dominated by macroalgae and dead coral. Point 1 has only 0.87% live corals, macroalgae by 41.05% and dead corals by 1.27%. Point 2 has 0% live corals, 24.83% macroalgae and 29.18% dead corals. Point 3 has live corals of 0%, macroalgae of 21.73% and dead corals of 41.73%. The average yield at Banyu Towo station has live coral of 0.8% and dead coral of 73.2%. The condition at Banyu Towo station 2 is classified as a bad damage category according to KEPMENLH (2001) with a category range of 0−24.5% live coral cover. This condition can occur because Banyu Towo is a place for fishing boats to lean either when not going to sea or some ship maintenance activities such as engine and hull. These activities are explained by [19] that some community activities such as waste disposal, oil disposal or other pollutants are one of the causes of damage to coral reef ecosystems in water. This condition is also exacerbated by fishing boats that randomly lower ship anchors to cause damage to coral reefs in Banyu Towo waters [20]. The high level of dead corals and macroalgae results from community activities that are carried out around the waters of Banyu Towo. Community activities such as ship repairs and mooring activities can affect the quality of waters and the survival of coral reefs [12]. The condition of the Banyu Towo is a place for fishermen to lean the ship or as a place to repair ships if needed. These activities will make water conditions unsuitable and fishing boat anchors will damage the survival of coral reefs. High macro algae conditions can occur because many coral reefs have been lost or even clean. This can happen because coral reefs and macroalgae will compete in terms of fighting for place and light so that when competitors disappear macroalgae will grow well [21]. The following is a graph of the percentage of coral reef cover at station 2 can be seen in Figure 3.
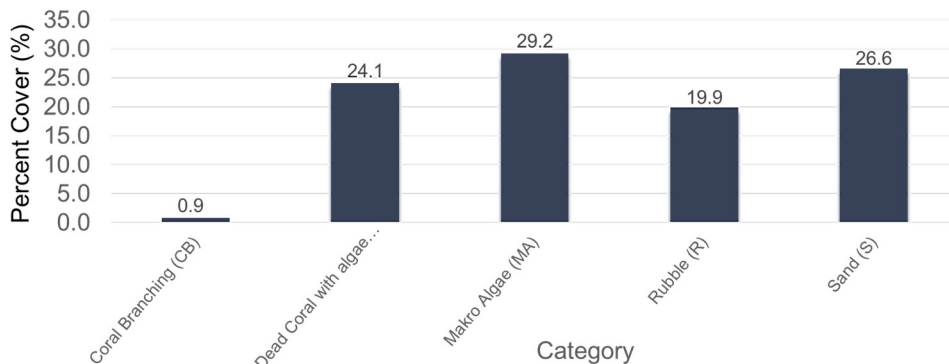
Fig. 3. Average percentage of coral reef cover at station 2 Banyu Towo of Sempu Strait, Malang, Indonesia.

### 3.3 Coral cover at station 3 Teluk Semut of Sempu Strait

The condition of coral reefs at station 3 is classified as good in the range of 50-74.5% according to KEPMENLH (2001) at point 1 with live coral cover of 53.46% and point 3 with live coral cover of 50.4%. While at point 2 classified as moderately damaged in the range of 25-49.5% according to KEPMENLH (2001) where at point 2 the percentage of live coral was obtained at 48.73%. The average coral reef cover value at station 3 of the Teluk Semut obtained live corals by 50.7% and dead corals by 48.4%. This condition shows that Teluk Semut has coral reefs with good conditions according to KEPMENLH (2001). This condition can be obtained because many people carry out fishing activities using fishing rods or gill nets. Fishing using gill nets has the potential to break [22]. The high number of dead coral reefs in the waters of Teluk Semut can potentially be a medium for new coral reefs to grow. Coral reefs resulting from sexual reproduction in the form of polyps will attach to the surface of dead coral reefs which will then form a new individual coral reef in the area [23]. The geographical condition of the waters of Teluk Semut is in the strait gate area so it has a strong current with shallow waters of about 3 to 7 meters. This condition makes the dominant coral reef living in the waters of Teluk Semut is coral foliose [18]. The following is a graph of the percentage of coral reef cover at station 3 can be seen in Figure 4.
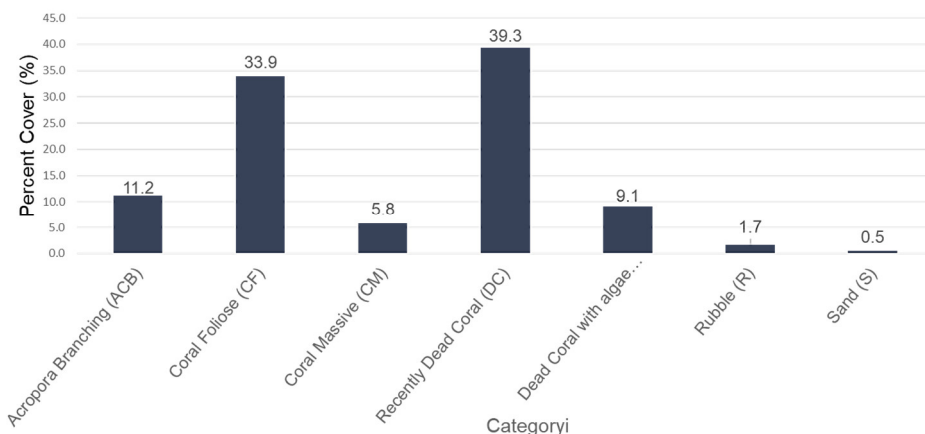
Fig. 4. Average percentage of coral reef cover at station 3 Teluk Semut of Sempu Strait, Malang, Indonesia.

3.4 Mean Coral Cover of Sempu Strait

Research activities conducted in the Sempu Strait at 3 observation stations provided results in the form of a percentage of coral reef cover that describes the condition of the waters in the Sempu Strait. The observation results obtained that Floating House (Rumah Apung) has the highest level of coral reef cover and Banyu Towo has the lowest in coral reef cover. This condition can occur due to the influence of human activities and physical conditions of the waters which will directly have a major impact on the survival of marine life. Physical factors that generally have influences such as temperature, salinity, pH, brightness, and acidity of seawater are considerable contributors to the survival of coral reefs [24]. The physical condition of the waters in the Sempu Strait almost has a value that is not much different at each observation station so the influence of the physical components of the waters can be said to be the same. The striking difference from each observation station lies in the different level of activity of the community around the research site. High human activities will increase the possibility of damage to aquatic ecosystems such as what happened in Banyu Towo due to the large number of ships docking and ship maintenance activities [25]. This contrasts with the Floating House where there is very little human activity so the possibility of damage to the marine ecosystem becomes less. The following is the percentage of coral reef cover in the Sempu Strait can be seen in Figure 5.
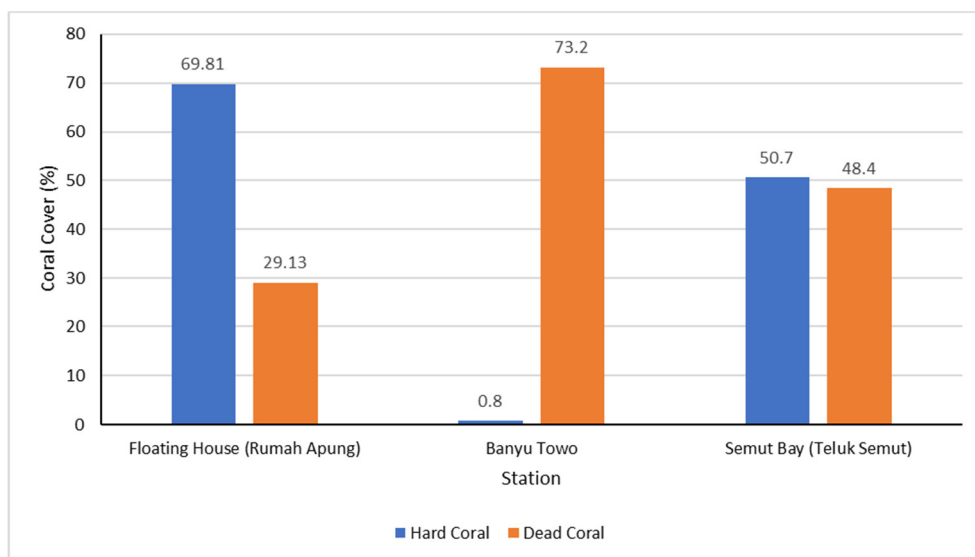
Fig. 5. Average percentage of coral reef cover at Sempu Strait, Malang, Indonesia.

3.5 Water Quality Parameters of Sempu Strait, Malang, Indonesia

The condition of the waters in the Sempu Strait area is classified as a condition that is quite suitable to support the survival of marine life, especially coral reefs. Temperature conditions in the Sempu Strait area are still very supportive to maintaining the ability of coral reefs at their optimal temperature, while in certain periods of time temperature changes of $1-2°C$ will be able to disrupt the growth rate of coral reefs [26]. The condition of the waters in the Sempu Strait has a good salinity value to be able to support coral reef life (Table 2).

Table 2. Coordinates of data collection location at Sempu Strait, Malang, Indonesia.

No	Parameter	Station			Quality Standard
		Station 1 (Floating House)	Site 2 (Banyu Towo)	Site 3 (Teluk Semut)	
1	Water Temperature	30ºC	31ºC	29.7ºC	28º−30ºC
2	Salinity	34‰	35‰	34‰	33‰−34‰
3	Dissolve Oxygen	7.97 mg/l	7.12 mg/l	7.97 mg/l	>5 mg/l
4	Water Clarity	7.9 m	6.5 m	7.5 m	>5 m

4 Conclusion

The condition of coral reef cover at station 1 (Floating House) is included in good condition, station 2 Banyu Towo is included in a condition of heavy damage and station 3 (Teluk Semut) is included in good condition. Meanwhile, average condition of coral reef in Sempu Strait is in moderate condition. Water quality in Sempu Strait is suitable for marine life.

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