Fisheries Journal, 14(2), 838-846 (2024)
http://doi.org/10.29303/jp.v14i2.892

CORAL REEFS HEALTH IN BATANGLAMPE ISLAND WATERS SINJAI REGENCY

Kesehatan Terumbu Karang di Perairan Pulau Batanglampe Kabupaten Sinjai

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(Received May 9th 2024; Accepted June 10th 2024)

ABSTRACT

Coral reefs are currently experiencing quite high pressure. Damage occurs everywhere causing ecological and economic functions to be disrupted. The impact of the damage will affect the level of health and threaten the sustainability of coral reef resources and their ecosystem. This research aims to determine the health level of coral reefs using indicators of live coral cover, algae cover, sand cover, mortality index and recovery potential. The method used is transect photos using CPCe (Coral Point Count with excel extension) software. The variables used in calculating the coral reef health index value use benthic component data. The health level of coral reefs is known by looking at live coral cover, algae cover, sand cover and the mortality index combined with the level of resilience. The results showed that the average live coral cover was 19.19% (poor). Average algae cover 29.60% (good), average sand cover 39.74% (good) and average mortality index 0.63% (high). The potential for restoration of the coral reef ecosystem on Batanglampe Island is included in the medium category. Community participation together with the Government is needed in maintaining and preserving the sustainability of the coral reef ecosystem in Sinjai Regency.

Keywords: Batanglampe Island, Coral Coverage, Coral Health, Resilience, Transect Photos

ABSTRAK

Terumbu karang saat ini mengalami tekanan yang cukup tinggi. Kerusakan terjadi dimana-mana menyebabkan fungsi ekologi dan ekonomi terganggu. Dampak kerusakan akan mempengaruhi tingkat kesehatan dan mengancam keberlanjutan sumberdaya terumbu karang dan ekosistemnya. Penelitian ini bertujuan mengetahui tingkat kesehatan terumbu karang dengan menggunakan indikator tutupan karang hidup, tutupan alga, tutupan pasir, indeks mortalitas serta potensi pemulihan. Metode yang digunakan adalah foto transek menggunakan perangkat lunak CPCe (*Coral Point Count with excel extension*). Variabel yang digunakan dalam menghitung nilai indeks kesehatan terumbu karang menggunakan data komponen bentik. Tingkat kesehatan terumbu karang diketahui dengan melihat tutupan karang hidup, tutupan alga, tutupan pasir dan indeks mortalitas dikombinasikan dengan tingkat resiliensi. Hasil penelitian menunjukkan rata-rata tutupan karang hidup 19,19% (buruk). Tutupan alga rata-rata 29,60% (baik), tutupan pasir rata-rata 39,74% (baik) dan indeks mortalitas rata-rata

0,63% (tinggi). Potensi pemulihan ekosistem terumbu karang di Pulau Batanglampe termasuk dalam kategori sedang. Peran serta masyarakat bersama Pemerintah diperlukan dalam menjaga dan melestarikan keberlanjutan ekosistem terumbu karang di Kabupaten Sinjai.

Kata Kunci: Foto Transek, Kesehatan Karang, Pulau Batanglampe, Resiliensi, Tutupan Karang

INTRODUCTION

Coral reefs are a complex aquatic ecosystem with a very high level of biodiversity. This complexity is a good habitat for millions of marine species, such as fish, molluscs, sponges and other organisms that interact with each other. Biodiversity in coral reefs not only creates natural beauty under the sea, but also supports the sustainability of the marine ecosystem as a whole. The importance of the existence of coral reefs is also to protect the coast from the onslaught of waves and storms. Fish and other marine organisms that live on coral reefs are an important food source for society. According to Gopi *et al.,* (2021) coral reefs are centers of high biological productivity, CO_2 absorbers, and rich biodiversity. They are a source of calcium carbonate deposits and help protect coastlines.

Healthy coral reefs have a major economic impact. This ecosystem supports the tourism and fisheries sectors, creates jobs, and provides various resources for local communities. However, behind the various potentials that exist, there are various serious threats that can cause degradation and extinction. Several factors contribute to the decline in the condition and health of coral reefs. Rising sea temperatures and changes in rainfall patterns due to global warming cause coral bleaching and mass death. Agricultural runoff, industrial waste, and water and plastic pollution seriously harm coral health. Destructive fishing activities reduce fish populations on coral reefs and disrupt the ecological balance. Coastal development such as beach reclamation and irresponsible tourism activities destroy coral habitat and disrupt the balance of the ecosystem (Sudiarta *et al.,* 2024).

Serious pressure continues to be experienced by coral reefs today. About 50% of the world's coral reefs have been lost or seriously damaged in recent decades (Ngamal & Perajaka, 2023). Marine species loss continues to increase, highlighting failures in protecting marine biodiversity. The impact of climate change, marine pollution and human activities on the coast continues to widen the gap between ideal conditions and existing reality. A lack of resources, infrastructure and expertise for effective coral reef management is slowing recovery efforts and widening gaps. The loss of some marine and coral species has significant ecological and economic consequences. Erosion and storm surges occur, endangering infrastructure and coastal communities. The decline in fish populations threatens food security and disrupts the livelihoods of coastal communities. The loss of coral reef tourism and related revenues could have a negative impact on local and regional economies (Nursita, 2020).

The damage that occurs everywhere is an indication to immediately carry out research related to the health of coral reefs. Monitoring conditions at various locations at different times will help provide an understanding of the extent of damage and degradation trends. Identify the main factors that contribute to coral reef degradation in specific locations. Understanding the causes and risk factors allows researchers and stakeholders to develop appropriate solutions and strategies for coral reef recovery. Research data can help monitor the effectiveness of coral reef conservation programs and efforts in improving the health and resilience of coral reefs. For more than 40 years, coral reefs have been in global decline in response to global warming, acidification and disease. Additionally, fluvial runoff, hurricanes, and fishing pressure, have caused further impacts and decline of coral reefs (Kjerfve *et al.,* 2021).

Research on coral health has been carried out previously by Kjerfve *et al.,* (2021) in the Gulf of Honduras, Guatemala found that moderate fishing pressure and fluvial runoff as well as high frequency of storms have caused coral health conditions to deteriorate. The condition

of coral health in the Dominican Republic is decreasing due to four factors including: overfishing, land pollution, human activities, and coral bleaching (Eastwood *et al.,* 2017). Caribbean waters show a poor health level of 57.15%, 42.85% in critical condition, 28.5% degraded and 71.5% highly degraded (Díaz-Pérez *et al.,* 2016) . Meanwhile in Indonesia, the health status of coral reefs in the Takabonerate waters of the Selayar Islands is classified as poor with low to moderate diversity (Wulandari *et al.,* 2022). The results of the coral reef health analysis conducted by Sari *et al.,* (2021) through the coral reef health index, a score of four was obtained, which means it is in the medium category. The level of coral reef health in the waters of Tunda Island, Banten is classified as moderate to good (Mujiyanto *et al.,* 2020). Meanwhile in Sebong Bay, Bintan, based on the Coral Reef Health Index (CHRI), which consists of medium to high live coral cover, low fish biomass, and ecosystem resilience is also low (Kurniawan *et al.,* 2021).

METHODS

Coral Reef Health Research will be carried out from February to May 2024, in the waters of Batanglampe Island, Padaelo Village, Pulau Sembilan District, Sinjai Regency and the Aquatic Resources Management Laboratory of the Muhammadiyah Sinjai University. Data collection was carried out by determining the observation locations for 8 stations (based on the cardinal directions). Station I is in the waters north of Batang Lampe Island, Station II is in the Northeast, Station III is East, Station IV is Southeast, Station V is South, Station VI is Southwest, Station VII is West and Station VIII is Northwest. Coral reef photography is carried out with frames with odd numbers (1,3,5, and so on) taken on the left side of the line transect and frames with even numbers (2,4,6, and so on) taken on the right side of the line transect (Giyanto, 2013).

Field data in the form of photos for each frame is identified using CPCe (Coral Point Count with Excel extension) software. Photo analysis on the CPCe device is carried out in several stages, namely determining the photo frame, determining frame boundaries, overlaying random points, identifying the substrate at each random point , then save the data which can then be processed in an Excel spreadsheet (Giyanto, 2013). The number of random points used in one photo frame is 50 random points. The number of random points is determined based on the area of the photo frame.

The variables used in calculating coral reef health index values use benthic component data. The benthic component consists of the current condition factor which is calculated based on the variables of live coral cover, algae cover, sand cover, mortality index and resilience level factor or recovery factor which is calculated based on fleshy seaweed cover and coral rubble cover. Percentage cover of coral categories is calculated using the following equation:

$$\text{Percentage Cover Category} = \frac{\text{The number of points in that category}}{\text{Random number of points}} \text{X } 100\%$$

$$\text{Mortality Index} = \frac{\text{Percent Dead Coral Cover}}{\text{Percent Live Coral Cover} + \text{Percent Dead Coral Cover}}$$

If the mortality index value is close to 0.0, it shows that there is almost no coral death, whereas if it is close to 1.0, it shows that there has been a significant change from live coral to dead coral (Syari, 2016; Yuniar *et al.,* 2023).

The interpretation and conclusions of the results of this research determine the health level of coral reefs by looking at live coral cover, algae cover, sand cover and mortality index combined with the level of resilience.

Healthy coral reefs are the most ideal condition, referring to the highest coral cover and supported by a high level of resilience.

Table 1. Coral Reef Health Standard Criteria

No.	Parameter	Coral Reef Health Standard Criteria			
		Very well	Good	Currently	Bad
1.	Live Coral Cover	75 – 100%	50 – 74.9%	25 – 49.9%	0 – 24.9%
2.	Algae Cover	0 – 24.9%	25 – 49.9%	50 – 74.9%	75 – 100%
3.	Sand Cover	0 – 24.9%	25 – 49.9%	50 – 74.9%	75 – 100%
4.	Mortality Index	0.75 – 1	0.50 – 0.749	0.25 – 0.499	0.0 – 0.249

Source: (Zamani & Madduppa, 2011)

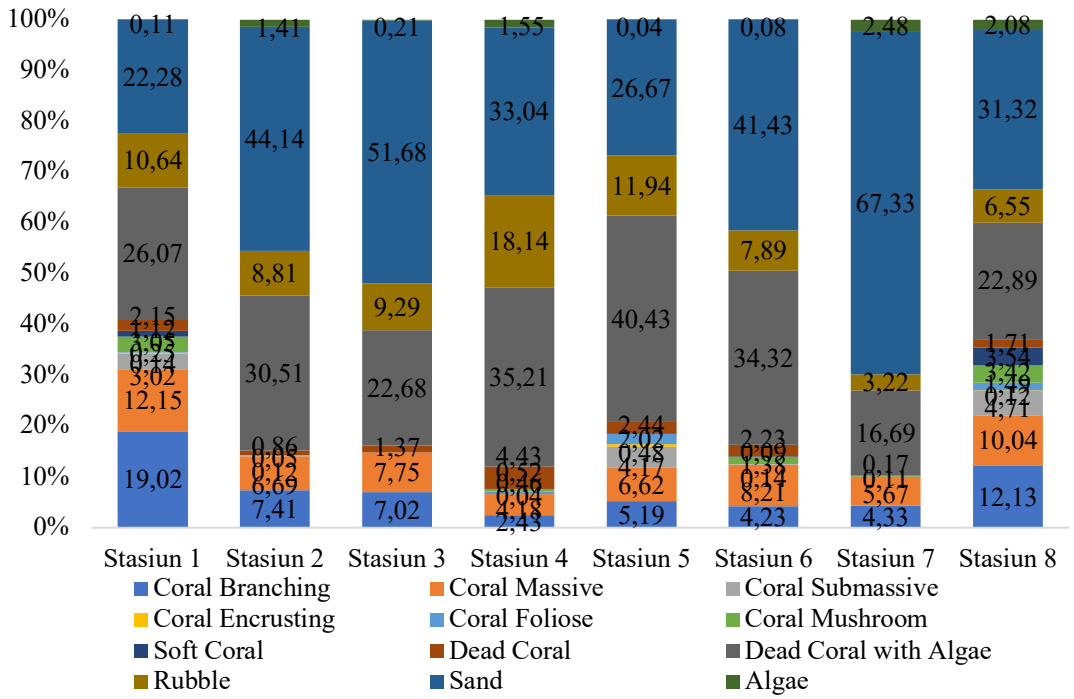
Table 2. Coral Reef Resilience Level Criteria

No.	Category	Criteria
1.	Low	(fleshy seaweed cover ≥3%) or (coral debris cover > 60% and live coral cover ≤ 5%)
2.	Currently	(cover fleshy seaweed <3%) or (coral debris cover ≤ 60% and live coral cover > 5%)

Source: (Giyanto *et al.,* 2017)

RESULT

The composition of benthic cover in the waters of Batanglampe Island consists of 12 categories: branched coral, massive coral, submassive coral, encrusting coral (spreading coral), foliose coral (flower-shaped coral), mushroom coral, soft coral, dead coral, dead coral with algae (dead coral overgrown with algae), rubble (coral fragments), sand, and algae. Sand dominates the cover by 22.28 - 67.33%. The percentage of dead coral overgrown with algae is also quite high, 16.69 - 40.43. Meanwhile, coral fragments are 3.22 – 18.14.



Picture 1. Benthic Percentage by Station

The percentage of live coral cover ranged from 7.63-38.75%. The lowest percentage of live coral was at Station 4, while the highest percentage of live coral cover was at Station 1. Of the eight research stations, only two of them were included in the medium coral cover category. Meanwhile, the other six stations are in the bad category. Overall, the average value of the

percentage of live coral cover at all research locations is 19.19% and is included in the criteria for the poor coral cover category. The percentage of dead coral obtained ranged from 16.86-42.87%. The highest percentage was obtained at Station 5, while the lowest percentage was obtained at Station 7. A higher percentage of live coral compared to dead coral was only obtained at Stations 1 and 8, while at the other six stations the percentage of dead coral dominated.

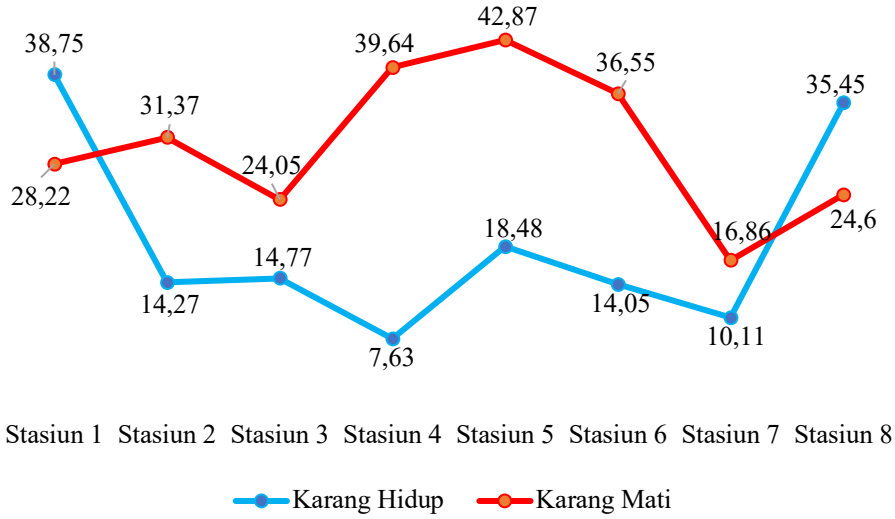


Figure 2. Percentage of Live Coral and Dead Coral by Station

The health condition of corals on Batanglampe Island based on the standard health criteria used can be seen in the following table:

Table 3. Health Condition of Batanglampe Island Coral Reefs Based on Standard Criteria

Station	Live Coral Cover		Algae Cover		Sand Cover		Mortality Index	
	%	Category	%	Category	%	Category	%	Category
1	38.75	Currently	26.18	Good	22.28	Very well	0.42	Currently
2	14.27	Bad	31.92	Good	44.14	Good	0.69	Tall
3	14.77	Bad	22.89	Very well	51.68	Currently	0.62	Tall
4	7.63	Bad	36.76	Good	33.04	Good	0.84	Lofty
5	18.48	Bad	40.47	Good	26.67	Good	0.70	Tall
6	14.05	Bad	34.4	Good	41.43	Good	0.72	Tall
7	10,11	Bad	19,17	Very well	67.33	Currently	0.63	Tall
8	35.45	Currently	24.97	Very well	31.32	Good	0.41	Currently
Average	**19,19**	**Bad**	**29.60**	**Good**	**39.74**	**Good**	**0.63**	**Tall**

DISCUSSION

Coral cover is relatively low, only ranging from 26.97 – 66.97% and is dominated by dead coral. The low distribution of coral at the observation location is caused by different environmental factors. Coral distribution is determined by the ability of coral growth in its habitat. According to Erdana *et al.,* (2022), aquatic environmental factors such as currents, food and sunlight penetration greatly influence coral growth. The corals that dominate the waters of Batanglampe Island are branching and massive corals.

The percentage of dead coral is higher than live coral. The average percentage of live coral cover is 28.36% and is included in the "medium" category (Permatasari *et al.,* 2023). Corals with branching or massive growth forms tend to prefer habitats with hard, flowing

substrates. In areas with currents, nutrients tend to be abundant, which is good for the growth of coral polyps (Kangkan *et al.,* 2023). The branching growth form is part of the adaptation to surface currents. Generally, branching corals are found in shallow water areas, namely 0-5 meters above sea level (Nayyiroh & Muhsoni, 2023). Environmental stress factors influence the health and growth form of coral reefs. These influences are light factors, hydrodynamic factors, human activity factors and sedimentation factors. (Taofiqurohman *et al.,* 2021).

The high percentage of dead coral indicates the level of coral reef damage occurring in the waters of Batanglampe Island. The damage to coral reefs that occurs is thought to be influenced by natural disturbances and pressure from human activities (Lasagna *et al.,* 2014; Munasik *et al.,* 2020; Suryono *et al.,* 2018). Some of the causes of damage to coral reefs are the sedimentation process due to land run-off events through river flows, exposure to fishing nets and boat anchors, the influence of coral disease and tourism activities or human activities (anthropogenic) (Hapsari *et al.,* 2017). Furthermore, according to Yusuf (2013), damage to coral reefs in Indonesia is mostly caused by various human activities in exploiting marine resources. In addition, underwater tourism activities can have a negative impact on the condition of coral reefs if not managed properly. The relatively high level of turbidity in Batanglampe waters adds to the bad conditions because it can cause death of coral polyps. Branching corals are characterized by low tolerance to sedimentation. Meanwhile, massive corals, although their growth rate is not as fast as branching corals, have a higher tolerance for water conditions that are not ideal for coral reef growth (McLeod *et al.,* 2019).

Another cause of the destruction of hard corals, especially in the Sembilan Island group, Sinjai Regency, is the widespread fishing activities that use bombs and anesthesia (Uspar *et al.,* 2020). Seaweed cultivation activities on coral are also one of the triggers for damage to the coral ecosystem. Ship anchors impact coral damage, hard coral size and density (Forrester, 2020). Careless throwing of anchors also results in coral being destroyed, broken and exposed (Kangkan *et al.,* 2023). A high percent of hard coral cover in a location indicates that the location is in very good or good health (Edrus *et al.,* 2010).

The condition of live coral is in the poor to moderate category but is dominated by poor conditions. Algal cover can still be tolerated in the good to excellent category. The distribution of sand is still dominant throughout the station even though the category is still good to very good. The mortality index is quite high and Station 4 is in the very high mortality category. Coral reef health indicators consider the total live coral cover (Díaz-Pérez *et al.,* 2016). Ecological functions are disrupted so that the health condition of coral reefs on Batanglampe Island is quite worrying. The percentage of live coral is low and dominated by dead coral overgrown with algae and coral fragments. This condition triggers a decline in the ecological function of coral reefs as indicated by the high percentage cover value of coral fragments (Adrian *et al.,*, 2020). Coral health is used to estimate the current status of coral reef ecosystems and as a tool for management or conservation strategies (Kaufman *et al.,* 2011).

The combination of the four coral health parameters used can provide an overview of the health and beauty of the coral. The combination of the percentage of live coral cover and the death index can provide an overview of coral conditions in the past (Zamani & Madduppa, 2011). The level of resilience and potential for restoration of the coral reef ecosystem on Batanglampe Island is included in the medium category where fleshy seaweed is less than 2.48%, coral fragments are less than 18% and live coral cover is more than 7.63%. Thus, the potential for improving the coral reef ecosystem, especially on Sembilan Island, Sinjai Regency, is quite good. The participation of all stakeholders, especially the government, is needed in paying attention to the sustainability of coral reef ecosystems and increasing the role of society in protecting and not destroying existing corals. Data and information about coral reefs in an area is very important in long-term management efforts (Alamsyah *et al.,* 2023; Permatasari *et al.,* 2023).

CONCLUSION

The criteria for assessing the health of coral reefs in the waters of Batanglampe Island, Sinjai Regency use the indicators: Live coral cover, algae cover, sand cover, and mortality index. Adding the level of resilience as an indicator to determine the potential for recovery from damage to coral reefs that has occurred. Live coral cover is indicated to be poor with an average cover percentage of 19.19%. The average algae cover is 29.60% in good conditions, the average sand cover is 39.74% in good conditions and the average mortality index is 0.63%, which is in the high category. The potential for restoration of the coral reef ecosystem on Batanglampe Island is included in the medium category.

ACKNOWLEDGEMENT

Special thanks go to the Dean of the Faculty of Agriculture, Muhammadiyah University of Sinjai and the Head of the Aquatic Resources Management Study Program for their assistance with research facilities and infrastructure so that this research was carried out and completed in accordance with the stipulated time.

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