

FISH DIVERSITY AND ABUNDANCE IN CORAL REEF ECOSYSTEM IN THE WATERS OF CEMARA BESAR ISLAND, KARIMUNJAWA NATIONAL PARK

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ABSTRACT

Cemara Besar Island is one of islands in Karimunjawa National Park facing serious threat in its coral reef fish ecosystem due to tourism activities that do not pay sufficient attention to environmental aspects. Tourism visits continue to increase, reaching 31,587 visits in 2023, and 41,437 visits in 2024. Poor supervision of tourism activities, such as stepping on coral and anchoring boats, has the potential to cause significant adverse effects on coral reefs and fish populations. Damage to coral reef ecosystems causes fish to migrate to other reef areas. The presence of fish in coral ecosystems is a tourism attraction that provides economic benefits to the surrounding community. This study aims to determine the diversity and abundance of reef fish on Cemara Besar Island and will be conducted in September 2024. Field studies used the Underwater Visual Transect (UVC) method for field data collection. This study also examined coral reef conditions as fish habitats using the Line Intercept Transect (LIT) method to obtain supporting data. The survey and descriptive quantitative research methods used in this study obtained primary data on fish diversity and abundance as well as coral reef cover. The results showed that the abundance and diversity of fish were good, with a moderate level of diversity, a uniformity level classified as a stressed community, and a low level of dominance. In 2020, coral cover on Cemara Besar Island was only 54.4%, and in 2024, it ranged from 60 to 68%, indicating a significant improvement and showing that the coral reef ecosystem on Cemara Besar Island is good and well managed.

Keywords: *Abundance, Cemara Besar Island, Diversity, Fish, Reefs*

INTRODUCTION

Coral reef ecosystems serve as feeding, shelter, and breeding grounds for marine life. Reef fish are an example of marine life associated with coral reef ecosystems. The presence of reef fish can be used as a bioindicator of coral reef health. When coral reefs are damaged, reef fish will move to coral reef habitats that are still in good condition because damaged coral reefs can no longer provide sufficient food and breeding grounds (Yusuf and Ali, 2004 in Panggabean, 2012 cited in Karim *et al.*, 2020). One of the coral reef ecosystems and reef fish populations that are still well-preserved can be found in the Karimunjawa National Park (TNKJ) area.

Research conducted in TNKJ by Rahman *et al.* (2021) states that coral reef fish found in the Legon Lele area numbered 457 individuals per square meter, in the Tanjung Gelam area 316 individuals per square meter, in the Batu Lawang area 410 individuals per square meter, and in the Sintok area 654 individuals per square meter. However, the coral reef ecosystem in TNKJ is currently facing the threat of degradation. This is due to massive tourism activities, which can

reduce the diversity and abundance of reef fish. Several tourist behaviors, such as stepping on corals, touching corals, and anchoring boats on corals, have the potential to damage the habitat of reef fish. This statement is reinforced by Sahetapy *et al.* (2017), who state the negative impacts of walking and stepping on coral and anchoring boats, namely crushed, broken, and exposed coral, resulting in a decrease in coral cover and colony diameter, and an increase in dead coral cover and dead coral fragments (rubbles). Coral damage due to tourism Coral damage caused by tourism is exacerbated by the high number of tourist visits, which increases every year. In 2022, there were 20,403 visits, in 2023 there were 31,587 visits, and in 2024 there were 41,437 visits (Karimunjawa National Park Statistics, 2024). One of the islands in TNKJ that is threatened with degradation due to tourism activities is Cemara Besar Island.

Results according to statistical data from the Karimunjawa National Park Office (2024) show that the percentage of coral reef coverage on Cemara Besar Island in 2013 was 57.86%, while in 2016 it decreased to 49.89%. This coral reef degradation can have an impact on the decline in abundance and diversity of

reef fish. If this is left unchecked, the adverse ecological impact will be an imbalance in the coral reef ecosystem. Research on the diversity and abundance of reef fish as well as measurement of coral reef conditions is crucial to determine the extent of damage or decline in coral reef conditions in supporting the life of organisms within them.

An imbalance in the coral reef ecosystem has the potential to result in a significant decline in the number of tourists, which will have a widespread adverse impact, including a decline in the economy of the surrounding community. Based on this description, research that identifies coral reef cover and coral fish abundance is considered important to conduct and analyze. Observations of coral reef cover can use the LIT (Line Intercept Transect) method. In addition, the calculation of the diversity and abundance of fish as biota associated with coral reef ecosystems can refer to the UVC (Underwater Visual Transect) method, analyzed using the book "Reef Fish Identification" (Allen *et al.*, 2003) and calculated using the ecological index formula.

MATERIAL AND METHODS

Study Site

This study was conducted in September 2024 in the waters surrounding Cemara Besar Island (Figure 1). This study was a quantitative descriptive study using purposive sampling. Fish and coral reef ecosystem samples were collected in the waters of Cemara Besar Island, Karimunjawa National Park, at four different stations, namely Station 1 (north of Cemara Besar Island), Station 2 (east of Cemara Besar Island), Station 3 (south of Cemara Besar Island), and Station 4 (west of Cemara Besar Island).

Fish data were collected in situ or directly in the field during the observation. Sampling was divided into three data collections, namely coral reef data collection, fish data collection in coral reef ecosystems, and water quality data collection.

Collecting Data

Coral reef data were collected using the Line Intercept Transect (LIT) sampling method. This method began with stretching a roll meter 50 meters to create a transect line. Observers swam from point zero to 50 meters following the transect line that had been created and recorded the types of coral in the area crossed by the transect line. The width of each coral species crossed by the transect line was measured from end to end and recorded.

Each coral species has a different category and code. These categories and codes refer to AIMS (English *et al.*, 1994). After measuring the width of the

coral species, the category and code of the coral species were recorded based on visual observation, as shown in Table 1.

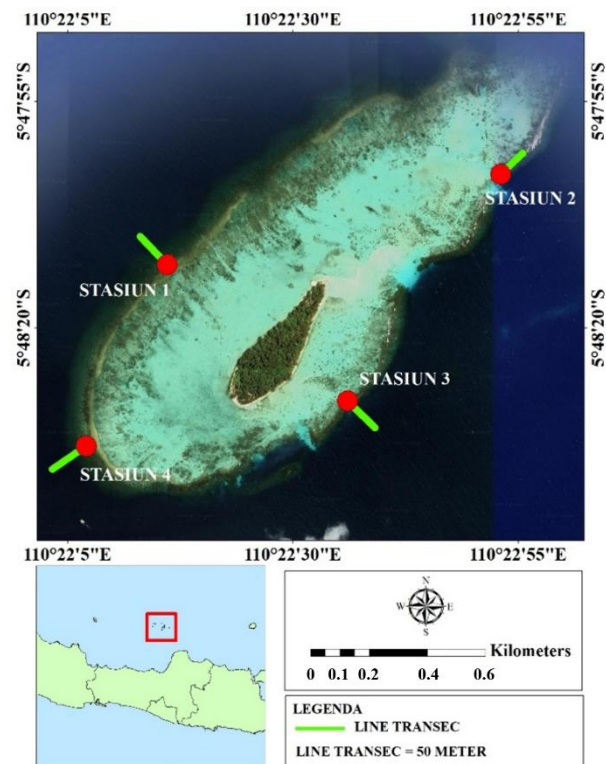


Figure 1. Map of the research location in the waters of Cemara Besar Island

Table 1. Coral type code

Category	Code	Category	Code
<i>Acropora</i>		<i>Non-Acropora</i>	
• Branching	ACB	• Branching	CB
• Encrusting	ACE	• Encrusting	CE
• Submassive	ACS	• Foliose	CF
• Tabulate	ACT	• Massive	CM
		• Submassive	CS
		• Mushroom	CMR
		• Millepora	CME
		• <i>Heliopora</i>	CHL

Source: English *et al.*, 1994 in Wiyanto, 2016

Sampling of Reef Fish

Fish data were collected in situ or directly in the field during the observation. Fish data collection in this study used the Underwater Visual Census (UVC) sampling method. This method was developed and is often used because it is fast, accurate, effective, and environmentally friendly (Akbar *et al.*, 2025). The UVC method can be carried out as illustrated in Figure 2.

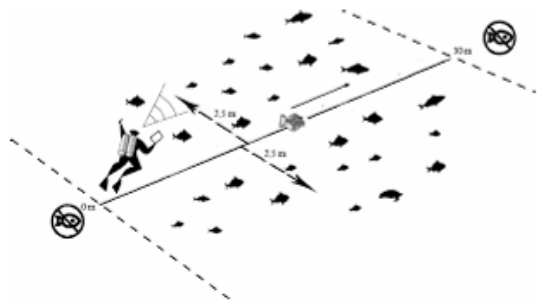


Figure 2. Underwater Visual Transect (UVC) method. Source : Wijaya *et al.*, 2022

This method begins with diving and laying out a 50-meter measuring tape. Then wait 5 to 15 minutes for the fish to return to their original location, and dive along the measuring tape line with observation areas 2.5 meters to the left and right. An underwater camera is used to take videos for coral fish identification.

Water Quality Data Collection

The water quality parameters observed in this study included depth, brightness, pH, temperature, dissolved oxygen (DO), salinity, nitrate, and phosphate. Each water quality data was listed according to the quality standards specified in Decree of the Minister of Environment of the Republic of Indonesia No. 51 of 2004.

Data Analysis

Coral cover can be determined by calculating the percentage of coral cover using the formula (English *et al.*, 1994):

$$\text{cover} = \frac{\text{total length of living coral reefs}}{\text{total length of transect}} \times 100\% \quad (1)$$

Fish abundance in coral reef ecosystems is the number of fish that can be found at an observation site per unit area of observation transect. Coral fish abundance can be calculated using the following formula (Labrosse, 2002):

$$D = \frac{n_i}{A} \quad (2)$$

D = Abundance of fish individuals (ind/250m²);
n_i = Individuals of each species (ind); A = Observation area size (250m²)

Coral reef fish diversity is the number of fish species that can be found at an observation site per unit area of observation transect. Diversity can be calculated using the following formula (Labrosse, 2002):

$$H' = - \sum_{n=1}^s P_i \ln P_i \quad (3)$$

H' = Species diversity index; n_i = Individuals of each species; N = Total number of individuals of all types. Coral reef fish uniformity is the number of fish species that can be found at an observation site per unit area of observation transect. Diversity can be calculated using the following formula (Labrosse, 2002):

$$E = \frac{H'}{\ln S} \quad (3)$$

E = Species uniformity index; H' = Species diversity index; S = Total species. The coral fish dominance index is used to determine the presence of dominant species/genera in the waters. A high degree of dominance will disrupt the balance of the ecosystem. Diversity can be calculated using the following formula (Chot and Bellwood, 1991):

$$C = \sum \left(\frac{n_i}{N} \right)^2 \quad (4)$$

C = Dominance index; N_i = Individuals of each species; N = Total individuals of all types

RESULTS AND DISCUSSION

Results

Abundance of reef fish

Based on the identification results, the abundance of fish families in the waters of Cemara Besar Island was found to be 7 families, including Chaetodon, Blenniidae, Caesionidae, Labridae, Pomacentridae, Scaridae, and Nemipteridae. The abundance of fish in the waters of Cemara Besar Island ranged from 93 to 197 ind/250m². The highest fish abundance in the waters of Cemara Besar Island was found at station 2 with 197 fish/250m². Meanwhile, at other stations, such as station 3, there were 123 fish/250m² and at station 4 there were 106 fish/250m². Meanwhile, the lowest fish abundance in the waters of Cemara Besar Island was found at station 1 with 93 fish/250m². Fish abundance during the observation of 4 stations in the waters of Cemara Besar Island is presented in Figure 3.

The highest abundance of indicator fish at all Cemara Besar water stations was found at station 1 with 13 ind/250m². Meanwhile, indicator fish at stations 2, 3, and 4 were only found at 1 ind/250m² at each station. The highest abundance of major fish was found at station 3 with 106 ind/250m², while the lowest abundance of major fish was found at station 1 with 71 ind/250m². The highest abundance of target fish was found at station 2 with 106 ind/250m², while the lowest abundance of target fish was found at station 4 with only 1 ind/250m². Significant differences in fish groups at observation stations may be due to differences in fish habitat diversity.

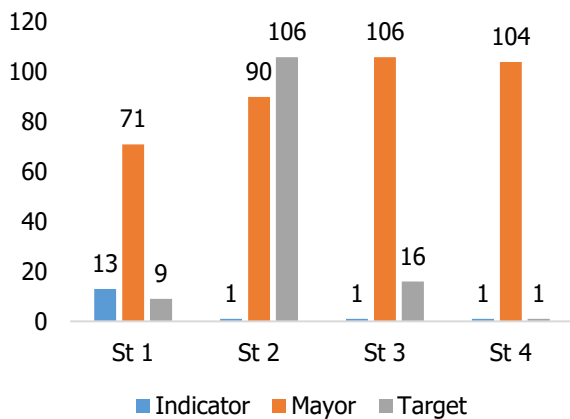


Figure 3. Abundance of reef fish in the waters around Cemara Besar Island

Diversity index (H), uniformity (E), and dominance (D)

The highest diversity index value was obtained at station 1 at 2.89, while the lowest was obtained at station 4 at 1.38. The highest uniformity index value was obtained at station 1 at 0.18, while the lowest was obtained at station 3 at 0.14. The highest dominance index value was obtained at station 2 at 0.33, while the lowest was obtained at station 1 at 0.12. The diversity, evenness, and dominance index values in the waters of Cemara Besar Island are presented in Table 2.

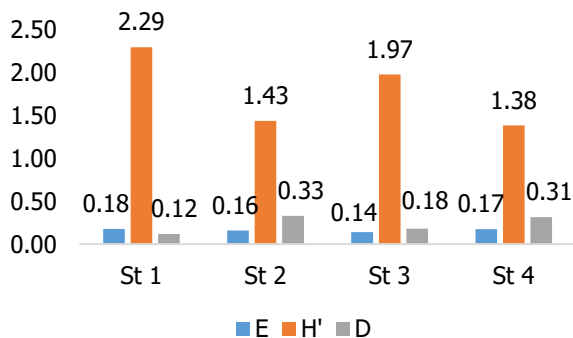


Figure 4. Coral reef fish ecological index chart

The diversity index values at all the observation stations within the criteria of $1 \leq H' \leq 3$, indicating a moderate level of diversity. The evenness index values at all observation stations fall within the criteria of $0 < E \leq 0.4$, indicating a low level of evenness. The dominance index value at all observation stations falls within the criteria of $0.00 < C \leq 0.50$, indicating a low level of dominance.

Unlike fish, the highest diversity index value was obtained at station 1 at 2.89, while the lowest was obtained at station 4 at 1.38. The highest uniformity index value was obtained at station 1 at 0.18, while

the lowest was obtained at station 4 at 0.14. The highest dominance index value was obtained at station 2 at 0.33, while the lowest was obtained at station 1 at 0.12. The diversity, evenness, and dominance index values in the waters of Karimunjawa National Park are presented in Table 2.

Table 2. Coral reef ecological index

Ecological Index	St 1	St 2	St 3	St 4
Coral Cover (%)	68%	60%	64%	65%
Diversity (H')	2.65	1.64	2.14	2.55
Uniformity (E)	0.09	0.11	0.13	0.11
Dominance (D)	0.10	0.34	0.16	0.11

The diversity index values at all stations fall within the criteria of $1 \leq H' \leq 3$, indicating a moderate level of diversity. The evenness index values at all stations fall within the criteria of $0 < E \leq 0.4$, indicating a low level of evenness, classified as a suppressed community. The dominance index value at all stations falls within the criteria of $0.00 < C \leq 0.50$, indicating a low level of dominance.

Water environment quality

The life of reef fish has limiting factors. These limiting factors exist naturally, one of which is water quality parameters. Water quality parameters are very important to know because they directly or indirectly affect the survival of reef fish in an ecosystem. Water quality parameters that can be limiting factors for reef fish life are depth, brightness, pH, temperature, salinity, DO, nitrate, and phosphate. Based on the results measurements of eight water quality parameters found two parameters exceeding normal coastal marine conditions, namely pH and DO.

Table 3. Results of Physical and Chemical Water Parameter Measurements

Parameters	Location				Quality Standards
	St 1	St 2	St 3	St 4	
Depth (m)	2.78	2.58	2.62	3.17	-
Brightness (m)	2	1.6	2.23	3.15	>5
pH	8.8	9.73	8.1	8.4	7 – 8.5
Temperature (°C)	29.7	28.9	26.3	28.8	28 - 30
Salinity (‰)	27	30	30	30	33 - 34
DO (mg/l)	7.13	7.78	7.67	7,0	4-8
Nitrate (mg/l)	0.4	0.5	0.3	0.3	0.008
Phosphate (mg/l)	0.06	0.06	0.18	0.18	0.015

Source: (Research, 2024), (Decree of the Minister of Environment of the Republic of Indonesia No. 51 of 2004)

The pH level increased at station 2 due to the station's relatively remote location from the island and

the presence of more dynamic currents and waves compared to other stations. Additionally, the abundance of algae, both microalgae and macroalgae, contributed to increased CO₂ absorption. The DO value exceeding normal conditions was caused by a malfunction of the DO meter due to insufficient calibration with standard solution. To address this issue, the DO value was reduced by 10 so the resulting value is approximately 7.

Discussion

Abundance and diversity of reef fish

The results of coral reef fish identification in the waters of Cemara Besar Island found that they belong to seven families, namely Pomacentridae, Chaetodontidae, Caesionidae, Labridae, Scaridae, and Nemipteridae. The most abundant family found in the waters of Cemara Besar Island is Pomacentridae, which dominates stations 1, 3, and 4. The dominance of Pomacentridae may be due to their habit of living in groups on reef flats. According to Hamid *et al.* (2020), fish of the Pomacentridae family are resident species and do not forage or wander far from their shelter (coral reefs). Additionally, the Pomacentridae family is one of the ornamental fish families prohibited from being caught in Karimunjawa National Park (Yuliana *et al.*, 2017).

The presence of fish in coral reefs can be used as a bioindicator of coral reef habitat quality by determining the abundance and diversity of indicator fish, major fish, and target fish. The results show that major fish dominate stations 1, 2, and 4, originating from the families Pomacentridae, Blenniidae, and Labridae. The dominance of this major fish group stems from the frequent occurrence of the Pomacentridae family at all observation stations. The high abundance of major fish is understandable because this type of fish is generally ornamental fish found on coral reefs and is not targeted by fishermen (Hukom and Syaihailatua, 2010 in Rani *et al.*, 2019). Meanwhile, the target fish groups found belong to the Caesionidae, Nemipteridae, and Scaridae families. The target fish groups only dominate at station 2, where the Caesionidae family dominates by living in groups at that station. According to Rani *et al.* (2019), the high abundance of target fish is a bioindicator of high fish exploitation in coral reef areas. The lowest fish group can be found at all stations, namely indicator fish, where there are 13 ind/250m² at station 1 and only 1 ind/250m² at stations 2, 3, and 4. According to Mujiyanto (2014) in Yudha *et al.* (2025), the abundance of indicator fish can be influenced by the health of coral reefs and the condition of the aquatic environment as the habitat of indicator fish. Therefore, the low abundance of indicator fish groups may indicate that the health of coral reefs in the waters

around Cemara Besar Island is in poor condition.

Diversity index (H), uniformity (E), and dominance (D) reef fish

Water conditions can be categorized as good if high diversity and evenness indices and low dominance indices are obtained (Basmi, 2020 in Mariyati *et al.*, 2020). The criteria for the diversity index are as follows: if $H' \leq 1$, diversity is low; $1 < H' \leq 3$, diversity is moderate; and $H' > 3$, diversity is high (Fachrul, 2007 in Armanto *et al.*, 2022). The criteria for the evenness index are $0 < E \leq 0.4$ for a suppressed community, $0.4 < E \leq 0.6$ for an unstable community, and $0.6 < E \leq 1$ for a stable community (Odum, 1971 in Zamdial *et al.*, 2020). The criteria for the dominance index are $0 < C < 0.5$ for low dominance, $0.5 < C < 0.75$ for moderate dominance, and $0.75 < C < 1$ for high dominance (Labrosse, 2002 in Armanto *et al.*, 2022).

The diversity index values obtained based on calculations at each observation station showed different results. The range of diversity index (H') values was 1.38–2.29, which is classified as moderate diversity. Moderate diversity is caused by several factors, such as adequate coral cover supported by the availability of food for reef fish. This statement is supported by Sirait (2018) in Mokodompit *et al.* (2022), who states that moderate diversity in an area describes a stable ecosystem balance. According to Irni (2021), the general principle in a high diversity index is that the number of individuals is distributed proportionally across each species, and diversity will decrease if a certain species is dominant.

The evenness index (E) is used to determine the similarity in the distribution of individuals of each species found in a community. The results show that the evenness index (E) ranges from 0.14 to 0.18, which is considered low evenness or indicates a stressed community. Low evenness means that the number of individuals of each species is uneven and tends to be dominated by certain genera. Low evenness values can be caused by several factors, such as environmental changes and differences in fish adaptation levels, which are reinforced by the statement by Wiyarsih *et al.* (2019), who stated that differences in evenness values can originate from environmental factors, namely the availability of phosphate and nitrate, as well as the ability of each species to adapt to the existing environment.

The dominance index (C) is used to determine whether or not a particular species dominates an ecosystem. The dominance index (C) value for reef fish ranges from 0.12 to 0.33, which is considered low dominance. According to Riyantini *et al.* (2023), a smaller dominance value indicates that no species dominates. The smaller the dominance value, the better the ecosystem balance in the waters.

Coral reef ecosystem

Coral reef ecosystems play an important role in maintaining fish abundance, where there is a positive correlation between coral reef ecosystems and fish living in coral reef ecosystems. Based on observations, coral cover in the waters around Cemara Besar Island ranges from 60 to 68%. The highest coral cover on Cemara Besar Island was found at station 1, which is dominated by *Acropora* branching coral. *Acropora* has a faster growth rate compared to other types of coral (Zakaria *et al.*, 2019 in Hanafi *et al.*, 2024). Although the observation results obtained vary, the condition of the coral reef ecosystem is still considered good with a moderate level of coral reef diversity. The lowest coral cover was found at Station 2. Although this station with the lowest cover has the same dominant coral species, *Acropora* branching, other dominant coral species are of the Non-*Acropora* Massive type. This difference is very influential because massive types only have an area growth type. This type will affect the acceleration of growth because growth tends to be focused on area growth only (Hanafi *et al.*, 2024).

Characteristics of the aquatic environment

Environmental quality at observation stations can be determined, among other things, by knowing the physical and chemical parameters. Measurements of depth, brightness, pH, DO, temperature, salinity, nitrate, and phosphate are the parameters measured. Supporting parameter data can be seen in Table 4.1. The depth obtained at each observation station in the waters of Cemara Besar Island ranges from 2 to 3 meters. This depth is dominated by fish of the Pomacentridae family, which are found in the greatest numbers at all observation stations. Pomacentridae are easily recognizable and are often found in abundance in coastal areas, especially in reef flats (Aziz, 2004 in Ati *et al.*, 2022). Pomacentridae are mostly diurnal fish (active during the day), where this activity pattern is caused by the availability of phytoplankton food that is widely distributed during the day due to photosynthetic activity (Putra *et al.*, 2015). This photosynthetic activity is also supported by brightness values ranging from 1.6 to 3.15 m. Although the values obtained are still relatively below the standard quality standard of >5 m, the brightness values obtained are still considered good when adjusted to the water depth conditions of the study site, which is only 2 to 3 meters deep.

The pH value at the observation station in the waters of Cemara Besar Island was found to be between 8.1 and 9.73. The pH obtained was within the optimal to relatively high quality standards. The high and low pH levels were influenced by fluctuations in oxygen and carbon dioxide content (Sahrijanna and

Septiningsih, 2017). The oxygen content or DO obtained in this study ranged from 7 to 7.8 mg/l, which is relatively high compared to the quality standard. High DO levels can be caused by weather conditions and the time of research during the day. During the day, photosynthetic activity in the water causes the concentration of DO in the water to often rise above saturation or supersaturation (Nurchayati *et al.*, 2021).

Water temperature is an important factor for marine organisms because it affects their metabolic activity and reproduction. Based on the results of environmental parameter measurements, the temperature in the waters of Cemara Besar Island ranged from 26.3 to 29.7 °C, which is considered optimal. The temperature range that marine biota can tolerate ranges from 26 to 34°C (Tony *et al.*, 2020 in Handayani and Dewi. 2020).

Salinity plays an important role in the life of aquatic organisms, including fish. Reef fish have a limited ability to tolerate changes in salinity in the range of 25 to 40‰. Changes in salinity are related to the ability of fish to adapt to their habitat. The further away from the quality standard or tolerance threshold, the more threatened the life of fish in that environment becomes. The salinity of the water in this study ranged from 27 to 30 ppt and was still tolerable for reef fish. The effect of salinity on the life of reef-associated biota varies greatly depending on local sea water conditions.

The nitrate level in the waters of Cemara Besar Island ranged from 0.3 to 0.5 ppm. The nitrate level at the study site was higher than the seawater quality standard for marine biota, which according to MENLH (2004) is 0.008 ppm. Nitrate levels can be caused by the decomposition of organic matter originating from tourist activities and natural activities on Cemara Besar Island. Organic waste from tourist activities can come from food scraps brought directly by visitors or purchased directly from vendors on Cemara Besar Island. These food scraps decompose into organic matter and become a source of nitrate in the waters surrounding Cemara Besar Island. Meanwhile, organic waste from natural activities comes from the lush trees on Cemara Besar Island. Leaves from these lush trees fall into the water and decompose into organic matter, becoming a high source of nitrate for the waters of Cemara Besar Island. High nitrate levels can lead to eutrophication, a condition in which phytoplankton and algae grow excessively, which can threaten the survival of reef fish.

The optimal phosphate level according to seawater quality standards is in the range of 0.008 ppm. The phosphate level in the waters of Cemara Besar Island is in the range of 0.6 to 0.18 ppm. The phosphate level at stations 1 and 4 was 0.6 ppm, which is lower than the seawater quality standard. Low phosphate levels are a limiting factor for the growth of phytoplankton, which is the main food source for

herbivorous reef fish. This shows that low phosphate levels in the water can affect the abundance and diversity of reef fish. Meanwhile, phosphate levels at stations 2 and 3 were measured at 0.18 ppm, which is higher than the seawater quality standard. The high phosphate levels at stations 2 and 3 may be caused by natural activities and tourism activities. Natural activities that can affect water phosphate levels also originate from the falling leaves of trees on Cemara Besar Island. These fallen leaves will decompose through bacterial decomposition and become a source of phosphate for the surrounding waters. Meanwhile, one of the tourism activities that can increase the phosphate content of the water is the use of detergent to clean tableware and wash hands for tourists. This use of detergent is carried out in the area around the ship's berth because there is usually a group meal on the ship for tourists before they go on a recreational trip to Cemara Besar Island. The higher the phosphate levels, the higher the growth of phytoplankton and algae. High algae growth will cover the surface of the coral, causing the coral, which is a habitat for fish, to die. The abundance of algae and dead coral will result in changes in the fish community, where the environment will be dominated by herbivorous fish that eat algae.

CONCLUSION

The diversity and abundance of coral reefs on Cemara Besar Island are still quite good, with coral cover ranging from 60 to 68%. The level of diversity was moderate, the level of uniformity was classified as a stressed community, and the level of dominance was classified as low. The dominant coral species is *Acropora* branching coral. Meanwhile, the condition of reef fish on Cemara Besar Island is still relatively good, with an abundance ranging from 93 to 197 ind/250m². The level of diversity is moderate, the level of uniformity is classified as a stressed community, and the level of dominance is classified as low. In addition, the water quality conditions of Cemara Besar Island show that fish of the Pomacentridae family dominate at a depth of 2 to 3 m. The brightness values obtained ranged from 1.6 to 3.15 m. Although the values obtained are still relatively below the standard quality value of >5 m, the brightness values obtained are still considered good when adjusted to the water depth conditions. The pH values at the observation station in the waters surrounding Cemara Besar Island ranged from 8.1 to 9.73. The pH values obtained compared to the general water pH and quality standards are considered optimal or relatively high. The DO content obtained in this study ranged from 7 to 7.8 mg/l, which is relatively high compared to the quality standards. The temperature in the waters of Cemara Besar Island ranged from 26.3 to 29.7 °C, which is considered optimal. The salinity of the water in this study ranged

from 27 to 30 ppt, which is still tolerable for reef fish. These water quality conditions indicate that the coral reef ecosystem at the observation station is in good and stable condition, thus supporting the abundance of reef fish in the waters around Cemara Besar Island.

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