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THE RELATIONSHIP BETWEEN CORAL REEFS AND COASTAL FISHERIES RESOURCES IN PANGGANG ISLAND AND SURROUNDING AREAS, SERIBU ISLANDS, JAKARTA

KETERKAITAN TERUMBU KARANG DENGAN SUMBERDAYA PERIKANAN PESISIR PULAU PANGGANG DAN SEKITARNYA, KEPULAUAN SERIBU, JAKARTA

Hera Ledy Melindo[1,2*], Rahmat Kurnia[2], Yonvitner[1,2]
[1]Center for Coastal and Marine Resources Studies, IPB University, IPB Baranangsiang Campus,
Jl. Pajajaran Raya No. 1, Bogor 16127, Indonesia
[2]Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, IPB University,
Jl. Agatis, IPB Dramaga Campus, Bogor 16680, Indonesia
*Corresponding author: ledyhera@apps.ipb.ac.id

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ABSTRACT

Panggang Island has the potential for a coral reef ecosystem covering an area of around 9 ha, but the existence of coral reefs in the waters of Panggang Island and its surroundings has decreased in area. This study aims to identify the condition of coral reefs and analyze the relationship between coral reefs and reef fish biomass in the waters of Panggang Island and its surroundings. Coral reef ecosystem data collection was carried out using the Line Intercept Transect (LIT) method, while fish data collection was carried out using the underwater visual census method. The condition of the coral reefs at the research location was classified as moderate. The highest live coral cover was recorded on Panggang Island with a value of 41% and on Air Island with a value of 31%. The coral reef growth forms (life forms) at both research locations were found to be 10 types, with the highest life forms being Coral foliose and Coral encrusting. The number of coral fish observed was 867 individuals from 106 species belonging to 27 families, dominated by the family Pomacentridae (72.81%). The abundance of fish on Air Island was 386±113 individuals/250 m², and on Panggang Island it was 406±160 individuals/250 m². The highest measurement results of coral fish biomass were at Station 4 of Panggang Island (43.05 g/m²), while the lowest one was at Station 3 of Air Island (4.98 g/m²).

Keywords: abundance, biomass, coverage, ecosystem, reefs fish

ABSTRAK

Pulau Panggang memiliki potensi ekosistem terumbu karang seluas sekitar 9 ha, namun keberadaan terumbu karang di perairan Pulau Panggang dan sekitarnya mengalami penurunan luasan. Tujuan penelitian ini adalah mengidentifikasi kondisi terumbu karang serta menganalisis hubungan terumbu karang dengan biomassa ikan terumbu di perairan Pulau Panggang dan sekitarnya. Pengambilan data ekosistem terumbu karang dilakukan menggunakan metode *Line Intercept Transect* (LIT), sedangkan pengambilan data ikan dilakukan menggunakan metode sensus visual bawah air (*underwater visual census*). Kondisi terumbu karang di lokasi penelitian tergolong kategori sedang. Tutupan karang hidup tertinggi tercatat di Pulau Panggang dengan nilai 41% dan di Pulau Air senilai 31%. Bentuk pertumbuhan terumbu karang (*life form*) di kedua lokasi penelitian ditemukan sebanyak 10 ragam, dengan *life form* tertinggi dimiliki oleh Coral foliose dan Coral Encrusting. Jumlah ikan karang yang teramati sebanyak 867 individu dari 106 spesies yang tergabung dalam 27 famili ikan karang, yang didominasi oleh famili Pomacentridae (72,81%). Kelimpahan ikan di Pulau Air sebanyak 386±113 individu/250m^2 dan di Pulau Panggang sebanyak 406±160 individu/250m^2. Hasil pengukuran nilai tertinggi biomassa ikan karang terdapat di Stasiun 4 Pulau Panggang (43,05 g/m^2), sedangkan biomassa ikan karang yang terendah di Stasiun 3 Pulau Air (4,98 g/m^2).

Kata kunci: biomassa, ekosistem, ikan terumbu, kelimpahan, tutupan

INTRODUCTION

Panggang Island has an area of approximately 9 ha and is administratively located in Panggang Island Village of North Seribu Islands District, Seribu Islands Administrative Regency, Jakarta. Panggang Island has marine potential, such as coral reef ecosystems that play an important role for aquatic biota, including as a place to find food, shelter, spawn, and a place to grow biota associated with the ecosystem, one of which is coral reef fish (Rondonuwu *et al.* 2019).

Coral reef fish have a close relationship with coral reefs. The high diversity of coral species in a water location can affect the variety of types and populations of reef fish that live in it. The complex structure of coral ecosystem habitats can produce various niches or gap forms between coral reefs (Farsia and Wardah 2014). The complexity of a waterbed structure can be measured by the level of roughness (rugosity) of the waterbed (Knudby *et al.* 2007).

The effect of rugosity value on reef fish biomass in Panggang Island waters has important implications for fisheries resource management. High coral rugosity values have a positive correlation with the abundance and biomass of reef fish (Abdurrachman *et al.* 2024). In addition, Rachmawati *et al.* (2022) also found that coral reef rugosity values in Pieh Island waters were positively related to reef fish biomass.

The existence of coral reefs in the waters of Panggang Island and its surroundings has decreased from year to year, namely, experiencing worrying damage, resulting in a decrease in the quantity and quality of coral reefs. Research in 2017 showed that the condition of coral reefs on Panggang Island, based on the percentage of coral cover, ranged from 8.10% to 27.20%, including in the poor to moderate category (Prasetyo *et al.* 2018). This was added by Putra's research (2017), which found that the abundance of coral fish on Panggang Island was 13,300 individuals/ha. The greatest threat to coral reef damage comes from domestic waste, both dumped by the island's residents and waste and garbage sent from Jakarta Bay and the Seribu Islands.

The decline in the quantity of coral reef fish has a positive correlation with the decline in the quality of coral reefs. According to Ariyanti *et al.* (2022), coral reef cover and coral reef fish abundance have a correlation of 54.06%, which means they have a strong relationship. Therefore, efforts are needed to analyze the relationship between coral reef habitat conditions and associated biota in the habitat, namely coral reef fish. The purpose of this study was to identify coral reef conditions and analyze the relationship between coral reefs and reef fish biomass in the waters of Panggang Island and its surroundings.

METHODS

The research was conducted from February to April 2024 in the waters of Panggang Island and its surroundings, the Seribu Islands. The research location is a fishing ground for fishermen in the waters of Panggang Island and its surroundings. There are two observation stations divided into 16 locations, namely Station 1 waters around Panggang Island and Station 2 waters around Air Island (Figure 1).

The data used in this study were primary data, including coral cover data, coral growth form data, reef fish data, and rugosity data, as well as secondary data obtained from references, either in the form of journals or websites that support research data, such as water quality data. Coral reef ecosystem data collection was carried out using the Line Intercept Transect (LIT) method (English *et al.* 1997). Transects were made at a depth of 5-10 m with a transect length of 50 m. The life form category referred to AIMS (English *et al.* 1997).

Fish data collection was carried out using the underwater visual census method (English *et al.* 1997). Recording of reef fish data was carried out at the same depth, namely at a depth of 5-10 m (shallow). Observations were made by stretching a 50 m long line transect with a distance of 2.5 m to the left and 2.5 m to the right. Fish species were identified using a reef fish identification guidebook (Allen and Erdmann 2009; Setiawan 2010; Giyanto *et al.* 2014).

The percentage of cover for each category of coral life form using the Line Intercept Transect (LIT) method can be calculated using the following formula (English *et al.* 1997):

$$Coverage\ Percentage\ (\%) = \frac{Coverage\ length\ category\ of\ life\ form}{Transect\ line\ total\ length} \times 100$$

The assessment status of coral reef ecosystems is based on the percentage of coral cover (Table 1) (Giyanto *et al.* 2014).

The abundance of reef fish can be calculated using the following formula (Odum 1971):

$$Abudance\ (individuals/m^2) = \frac{Fish\ number\ on\ station\ at\text{-}i}{Observation\ transect\ square}$$

Biomass (B) can be calculated based on the weight of individual target fish (W) per observation area. The fish data can be converted to tons per hectare.

$$Biomass\ (g/m^2) = W \times Abudance$$

Where W = x is the weight of the target fish, while a is the species-specific index a, b is the species-specific index b, and L is the estimated total length. The values of a and b can be found through Fishbase for each target fish species (English *et al.* 1994).

The coral reef rugosity value was analyzed based on the length of the chain transect placed following the coral reef contour along 50 m and analyzed using the following equation (Hill and Wilkinson 2004; Fuad 2010).

$$R = \frac{dm}{di}$$

Where di is the length of the transect in a straight line, and dm is the length of the chain transect that follows the contour of the water bottom. The rugosity values are then grouped into rugosity categories in Table 2.

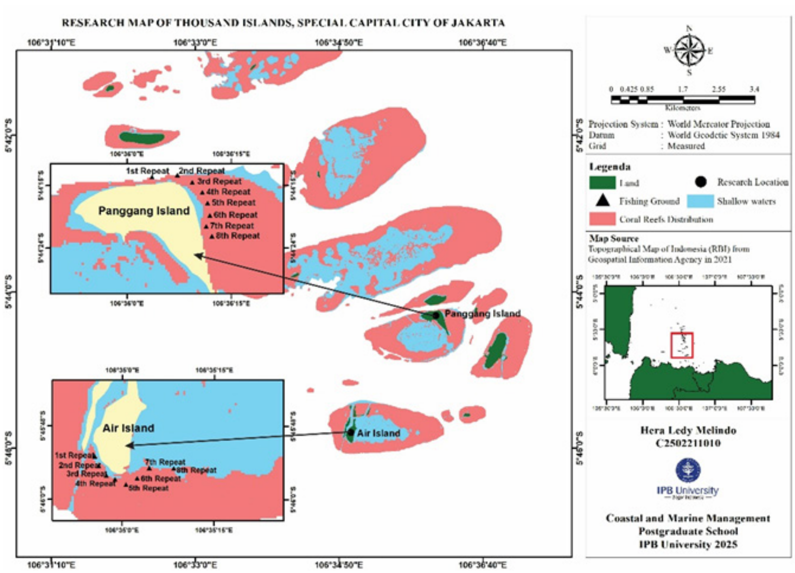

Figure 1. Location of fishing ground distribution in the research location in the waters of Panggang Island.

Table 1. Criteria for percentage of coral cover based on ecosystem conditions.

Coral Cover Percentage (%)	Category
0-24.9	Damaged
25-49.9	Medium
50-74.9	Good
75-100	Very good

Table 2. Criteria for coral reef rugosity index values.

Rugosity Indeks	Category
<0.170	Low
0.171-0.275	Medium
>0.275	High

Source: Rafly *et al.* (2020)

RESULTS AND DISCUSSION

Parameters of the aquatic environment

The condition of the aquatic environment based on secondary data sourced from journals obtained five parameters, including temperature, salinity, current speed, water clarity, and pH (Table 3).

The water quality parameter values of the coral reef ecosystem on Panggang Island and Air Island, based on secondary data, are still considered suitable for coral biota according to the seawater quality standards of Government Regulation Number 22 of 2021. However, two parameters do not meet the quality standards.

Condition of coral reefs

The composition of the basic substrate in all research locations consisted of abiotic, algae, dead coral with algae (DCA), hard coral, soft coral, and other fauna categories (Figure 2). The highest hard coral cover was recorded on Panggang Island (41%). The next highest benthic composition category was dead coral with algae (DCA), ranging from 18% to 20%. The abiotic composition at the observation location consisted of coral rubble, sand, and rock, with an average cover value of 29.96±24.02% (Pangkok Island) and 44.47±16.68% (Air Island). The highest live coral cover was recorded on Panggang Island with a value of 41% and on Air Island with a value of 31%.

Life forms found in 16 observation locations were 10 types of hard-coral lifeforms, four of which were included in the genus Acropora and six other types from non-Acropora genera (Table 4). These lifeforms include Acropora branching (ACB), Acropora digitate (ACD), Acropora tabulate (ACT), Acropora submassive (ACS), Coral branching (CB), Coral encrusting (CE), Coral foliose (CF), Coral massive (CM), Coral mushroom (CMR), and Coral submassive (CS).

Table 3. Values of coral reef ecosystem water parameters at the research location.

Location	Temperature (°C)	Salinity (ppt)	Current (m/s)	Transparency (%)	pH
Panggang Island	31[c]	34[a]	0.2[b]	100[a]	7.6[a]
Air Island	28.4[d]	32[a]	0.11[d]	100[a]	7.9[a]
Quality Standard	28-30[e]	33-34[e]	-	-	7-8.5[e]

Sources: [a]Sinatrya *et al.* (2024), [b]Wahyudin *et al.* (2023), [c]Lestari *et al.* (2021), [d]Assuyuti *et al.* (2018), [e]PP RI No 22 Year 2021

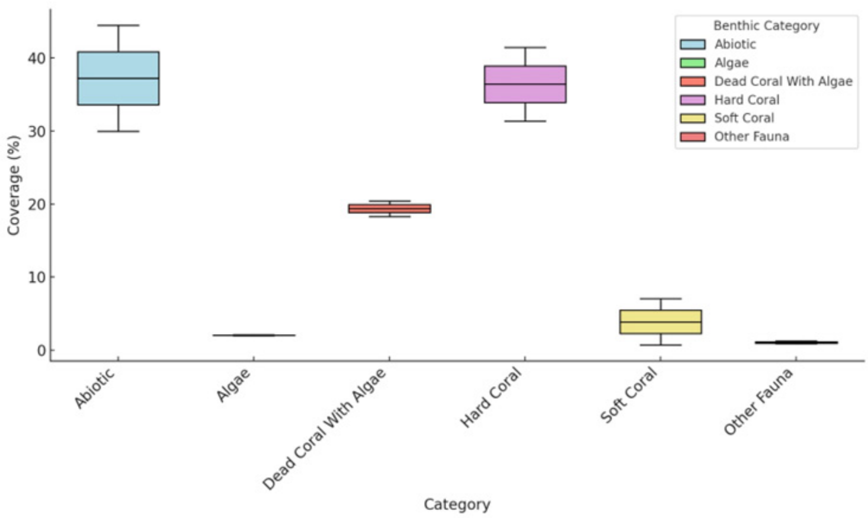

Figure 2. Percentage of benthic community coverage at the research location.

Table 4. Forms of hard coral growth in the Panggang Island and Air Island areas.

Growth Pattern	Hard Coral Growth Cover (%)	
	Panggang Island	Air Island
Acropora branching (ACB)	5.38±3.81	1.56±1.39
Acropora digitate (ACD)	0.14±0.30	0.04±0.10
Acropora submassive (ACS)	0.26±0.69	0.17±0.45
Acropora tabulate (ACT)	0	0.18±0.31
Coral branching (CB)	2.68±1.58	5.57±7.49
Coral encrusting (CE)	10.36±7.56	6.23±3.0
Coral foliose (CF)	10.48±10.89	7.19±3.24
Coral massive (CM)	7.54±6.14	3.91±2.31
Coral mushroom (CMR)	0.68±0.93	1.06±2.48
Coral submassive (CS)	3.91±2.54	5.29±3.56

Overall, CF and CE corals had the highest percentage of cover at each research station. The highest growth forms were CF (10.48% on Panggang Island and 7.19% on Air Island) and CE (10.36% on Panggang Island and 6.23% on Air Island). There were differences in the composition of branching growth forms at both research stations, with dominance on Panggang Island owned by ACB (5.38%), while on Air Island owned by CB (5.57%). CM corals were another dominant hard coral growth form found at the research stations (7.54% on Panggang Island and 3.91% on Air Island).

Coral fish abundance

Visual census observations of all types of coral fish at 16 research stations were conducted to determine the overall composition of coral fish. The results of the observations that have been carried out show that at the research location, 867 individuals from 106 species belonging to 27 coral fish families were found. The number of coral fish species found was 106 species, with 59 of them found on both islands, and the number on each island was 81 species on Panggang Island and 84 species on Air Island. The abundance of fish on Panggang Island was 406±160 individuals/250 m², and on Air Island, it was 386±113 individuals/250 m² (Figure 3).

Overall, observations of reef fish at the research station contained the five largest families (Figure 4), namely the Pomacentridae family (72.81%), Labridae (11.92%), Apogonidae (7.09%), Caesionidae (1.39%), and Chaetodontidae (1.28%), which represented 94.49% of the total observed abundance. Meanwhile, 21 other families were included in the other category, with a total of 5.51%. There were 31 species from the Pomacentridae family observed.

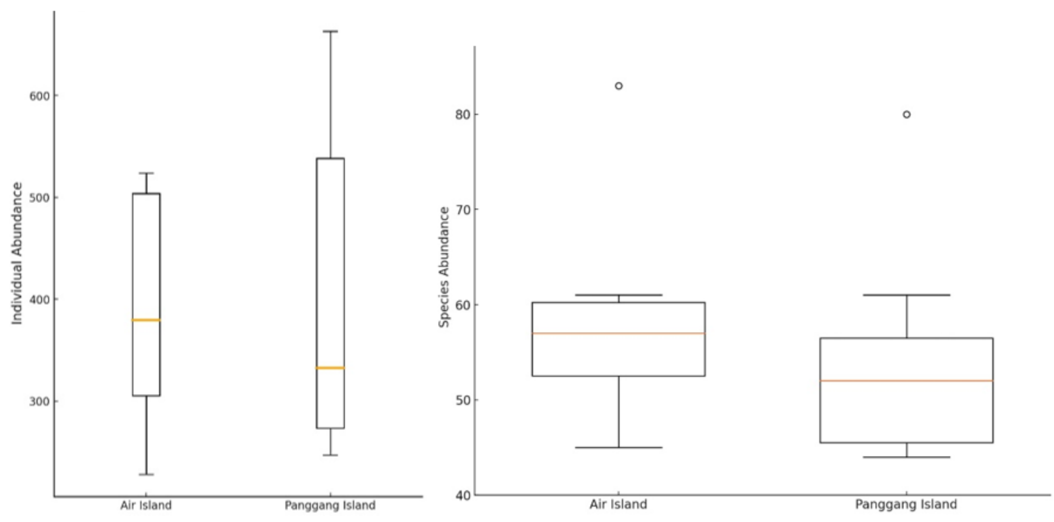

Figure 3. Boxplot of individual abundance (left) and species abundance (right) at the study site.

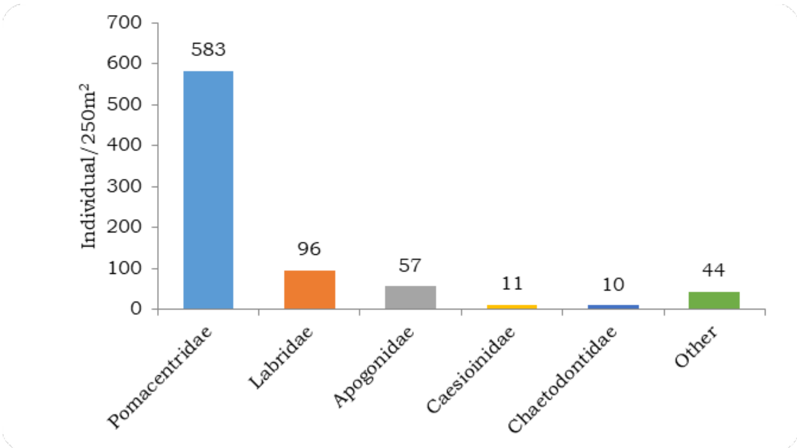

Figure 4. The abundance of coral fish families at the research location.

Observations on the abundance of coral fish were also conducted based on station points. Observations showed the highest abundance of coral fish at Station 7 of Panggang Island, followed by Station 5 of Panggang Island and Station 4 of Air Island, while several other stations had lower fish abundance, namely Station 3 of Panggang Island, Station 3 of Air Island, and Station 6 of Air Island (Table 5).

Coral reef fish biomass

The boxplot diagram depicting the distribution of fish biomass at the Panggang Island and Air Island stations (Figure 5) shows the difference in biomass values at the two research locations. Panggang Island has a median biomass value of around 15 g/m^2, and Air Island has a lower median biomass value, which is around 10 g/m^2. The variability of coral fish biomass on Panggang Island is greater than on Air Island, as indicated by a larger interquartile range. The highest measurement of coral fish biomass was at Station 4 of Panggang Island, reaching 43.05 g/m^2, while the lowest was at Station 3 of Air Island, which was only 4.98 g/m^2 (Table 5).

Coral reef rugosity

The rugosity graph (Figure 6) shows a comparison of the rugosity of the coral reef ecosystem between Panggang Island and Air Island. The rugosity value on Panggang Island is 1.56, and the rugosity on Air Island is around 1.62, which shows that Air Island has a more complex contour compared to Panggang Island.

The relationship between coral reef conditions and the abundance of reef fish

The principal component analysis (PCA) results diagram shows two principal components (Dim1 and Dim2) representing the largest variation in the data (Figure 7), with Dim1 explaining 99.5% of the variation and Dim2 explaining 0.5% of the variation. This PCA plot shows that the largest variation in the data is explained by the presence of certain fish species, especially Pomacentridae. Location and coral reef condition have a smaller influence on the total variation.

Discussion

Water parameter data obtained from secondary data show that environmental conditions do not exceed the threshold of seawater quality standards for coral biota, except for the water temperature on Panggang Island and the salinity on Air Island. The water temperature on Panggang Island is 31°C, which is above the quality standard (28-30°C), and the salinity on Air Island is 32 ppt, which is below the quality standard (33-34 ppt). However, the water temperature on Panggang Island is still within the tolerance range for coral reefs to survive (Nurrahman and Faizal 2020). The salinity on Air Island, which is below the quality standard, also allows coral reefs to survive well (Prajoko 2010). Meanwhile, the pH parameter is in the optimal pH range for coral biota according to the quality standard (7-8.5).

Table 5. Composition of coral fish communities in the research area.

Location	Station	Abundance (Individuals/250m^2)	Species Richness	Biomass (g/m^2)
Air Island	1	350	83	14.32
Air Island	2	330	60	5.44
Air Island	3	232	51	4.98
Air Island	4	524	61	18.03
Air Island	5	516	57	12.32
Air Island	6	228	45	5.93
Air Island	7	500	57	13.69
Air Island	8	409	53	11.57
Panggang Island	1	257	53	9.00
Panggang Island	2	279	44	8.90
Panggang Island	3	247	61	6.07
Panggang Island	4	362	46	43.05
Panggang Island	5	632	51	12.05
Panggang Island	6	507	55	20.42
Panggang Island	7	663	80	18.64
Panggang Island	8	303	44	17.27

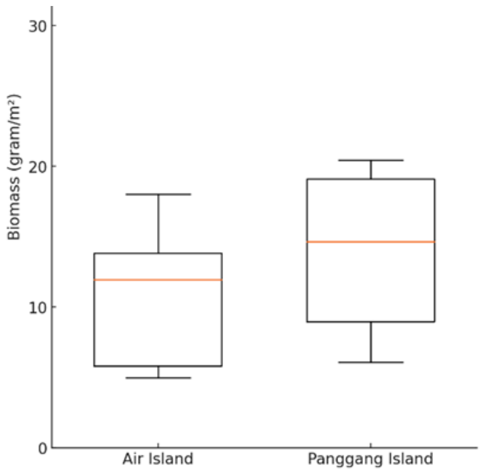

Figure 5. Boxplot of reef fish biomass at the research location.

Figure 6. Comparison of rugosity of coral reef ecosystems in the research area.

The condition of coral reefs based on observations at the research location shows the type of fringing reef. This type of coral reef can grow upwards in the waters and towards the sea (Muniaha *et al.* 2017). Based on the percentage of live coral cover at the research location, the condition of coral reefs on Panggang Island and Air Island is categorized as moderate according to the Decree of the Minister of Environment

Number 4 of 2001. Conditions that are categorized as moderate can be caused by several factors, including physical and chemical parameters of water, water quality in water areas, and anthropogenic activities (Sinatrya *et al.* 2024).

The hard coral cover value on Panggang Island is greater than on Air Island. The large value of live coral cover on Panggang Island can occur because the water quality on Panggang Island supports good coral reef growth, such as brightness and current (Assuyuti *et al.* 2018). Oceanographic conditions, such as currents, play a role in the movement of particles in the water column (Nurrahman and Faizal 2020). On the other hand, the causes of poor coral reef conditions due to human activities can be destructive fishing with explosives, coral gouging, and toxic materials that cause physical damage (Nurrahman and Faizal 2020). Coral reef ecosystems that are indirectly damaged by human activities cause a decline in water quality. A decline in water quality can occur due to several things, such as industrial waste, household waste, and forest clearing (Prajoko 2010). Coral reefs are inherently sensitive to environmental changes and are among the most vulnerable marine ecosystems. Natural factors do not solely drive the decline in the Seribu Islands' coral cover, but are also significantly influenced by increasing anthropogenic pressures.

According to Assyifa *et al.* (2023), the reduction in coral cover in the Seribu Islands is attributed to several key factors, including domestic wastewater discharge, the use of destructive fishing gear, and intensive human activities in coastal areas. Domestic waste entering the marine environment contributes to eutrophication and decreases water clarity, which inhibits the photosynthetic processes of zooxanthellae, the symbiotic algae living within coral tissues. Furthermore, destructive fishing practices, such as blast fishing or the use of non-selective gear that damages the seabed, contribute to the physical destruction of coral reef habitats.

Coral reef growth forms (life forms) are individual forms or coral colonies with the same species that grow to adapt to the environmental conditions where the coral grows (Sinatrya *et al.* 2024). Corals with encrusting and foliose life forms dominate the waters of Panggang Island and Air Island. Encrusting life forms grow in colonies spread along the bottom of the waters with sufficient sunlight intensity (Nurma *et al.* 2022). The crust-like growth form of Encrusting makes this coral able to adapt to the slope of the substrate (Reskiwati *et al.* 2022). Thovyan *et al.* (2017) stated that the encrusting growth form is an effort by coral to adapt to decreasing light intensity with increasing depth. Low light intensity triggers corals to increase their surface area to support photosynthesis. Encrusting life forms are also able to adapt to extreme aquatic environmental conditions, such as strong currents, high temperatures, and sedimentation (Reskiwati *et al.* 2022).

The highest foliose lifeform cover was found on Panggang Island, with a percentage value reaching 10% on Panggang Island and 7% on Air Island. Foliose coral has a thin morphology in the form of circular sheets. This coral can live in colonies and form prominent folds on the reef base (Insafitri *et al.* 2021; Nurma *et al.* 2022). Foliose coral has fast growth, although not as fast as Acropora (Podung *et al.* 2022). Foliose coral grows well in environments that are protected by currents, thus supporting the ability of foliose coral to dominate a body of water (Barus *et al.* 2018). Insafitri *et al.* (2021) and Irsyad *et al.* (2022) stated that waters with sandy substrate types and low turbidity levels are suitable conditions for the growth of foliose coral.

The highest abundance of reef fish is dominated by reef fish from the Pomacentridae family. The Pomacentridae family is also found in high abundance and dominates in Karangasem Regency, Bali (Dhananjaya *et al.* 2017), the southern coast of Kupang Bay, East Nusa Tenggara (Prajoko 2010), and on Karimunjawa Island and Kemujan Island, Central Java (Rahman *et al.* 2021). Reef fish from the Pomacentridae family are generally relatively small in size and high in abundance so that they can dominate the species' composition in a body of water. The abundance of the Pomacentridae family can also be caused by the area where the fish live having dense coral reef cover. Most small reef fish tend to live close to coral, especially with branching growth forms that are used as shelters (Dhananjaya *et al.* 2017).

Rahman *et al.* (2021) stated that coral reefs are used as feeding grounds for the Pomacentridae family. Reef fish of the Pomacentridae family are also included in the category of herbivorous fish that consume algae and phytoplankton around coral reef areas. Most fish from the Pomacentridae family are also diurnal fish (active during the day). This activity pattern is supported by the vertical distribution of phytoplankton during the day for photosynthesis. This then encourages the high abundance of Pomacentridae fish, considering that phytoplankton is the main food for fish from the Pomacentridae family (Rahman *et al.* 2021).

The abundance of coral fish on Panggang Island is the highest compared to Air Island, presumably because the condition of live coral cover on Panggang Island (41.43±19.48%) is better than on Air Island. The presence of coral fish is an indicator of the health of coral reefs, as shown by the percentage of live coral cover (Rahman *et al.* 2021; Prajoko 2010). Live coral cover is a positive factor in the abundance of coral fish. Several other factors that influence the abundance of coral fish are reef complexity, water clarity, and the diversity of other biota (Erdana *et al.* 2022).

Fish biomass is the value of the relationship between fish length and weight. Biomass value is key in determining the potential of fishery resources in waters, as well as a reference for determining future fisheries management efforts (Mamun *et al.* 2018). The coral fish biomass boxplot at the research location showed different interquartile values during the same period. All data collection locations showed a clear relationship between fish biomass values and the percentage of hard coral cover. Research by Wismer *et al.* (2019) stated that Acropora is usually preferred by damselfish or a group of small fish belonging to the Pomacentridae family. Other factors, such as the category of fish as obligate fish and facultative fish, also affect coral fish biomass. Non-coral habitats adjacent to reef ecosystems also provide the same relationship for fish biomass, especially the Labridae family (Sievers *et al.* 2020).

The high biomass value at Station 7 of Panggang Island is due to the high abundance of individual coral fish and the high percentage of live coral cover. Meanwhile, the low biomass value of coral fish on Air Island, especially at Station 6, is due to the low abundance of coral fish. Factors that influence the increase in coral fish biomass, such as food sources, fish abundance, and substrate conditions, indicate the role of coral reef ecosystems as service providers and supporters of coral fish life (Hapsari *et al.* 2024; Faricha *et al.* 2020).

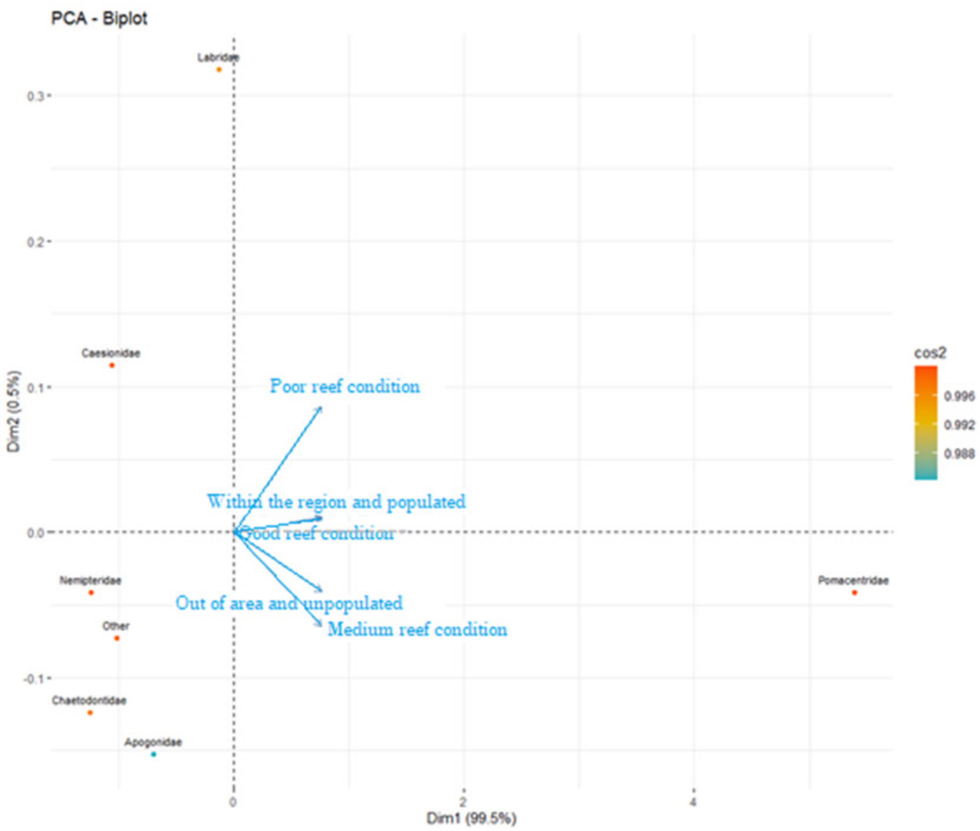

Figure 7. Diagram of the results of the principal component analysis on Panggang Island and Air Island.

Rugosity is a measure of coral reef surface diversity that affects habitat complexity. The level of rugosity can be an indicator of coral reef health. Reefs with higher rugosity usually indicate healthy and non-degraded coral growth (Abdurrachman *et al.* 2024). This difference in rugosity can be caused by differences in coral development and growth, external disturbances due to human activities, and oceanographic conditions (Abdurrachman *et al.* 2024). Higher rugosity in Pulau Air supports the presence of a higher abundance of reef fish because the complexity of coral reefs in Pulau Air can provide more microhabitats that support many fish species. This can be seen in that the rugosity of coral reefs in both research locations is included in the high category (Rafly *et al.* 2020).

Principal component analysis was used to understand the relationships between reef conditions (good and bad), location categories (populated and unpopulated), and different reef fish groups. Dim1 explained most of the variation in the data, such as good and poor reef condition variables located close to the center, indicating that reef condition had a smaller influence than specific reef fish families. The location variables within the populated and unpopulated areas were located close to the center and contributed little to the total variation, indicating that reef conditions did not differ much within populated and unpopulated areas.

This means that the physical condition of coral reefs may be more homogeneous, or other variables such as habitat type and external influences are more dominant in influencing the abundance and diversity of coral fish. This statement is supported by Karim *et al.* (2020) and Putra and Widyorini (2015), who state that the abundance of coral fish is related to limiting factors, especially with water depth and brightness, temperature, and salinity, with a strong relationship.

This PCA plot shows that the largest variation in the data is explained by the presence of certain fish species, especially Pomacentridae. The Pomacentridae reef fish family may have more significant variation from the center of the biplot, indicating that the distribution and abundance of the Pomacentridae reef fish family have a greater impact on the main variation in the data. This condition indicates a more complex biological interaction between fish species and coral reefs and depends on other aspects, such as coral reef structure, food availability, and predator-prey interactions. The complexity of coral reef ecosystems is caused by the high diversity of habitats accompanied by varying niche specificity (Atjo and Fitriah 2020).

The location and condition of coral reefs also have a smaller influence on total variation. Species such as Labridae and Caesionidae show unique distribution patterns and may be influenced by other environmental factors. The unique distribution patterns of the Labridae and Caesionidae families may be due to these species being target fish for fishermen (Edrus and Hadi 2020). The Caesionidae family is also a type of fish with a very wide range (Adiyoga *et al.* 2020).

CONCLUSION

The condition of coral reefs in the waters of Panggang Island and Air Island is classified as moderate. The percentage value of hard coral cover and abiotic cover at both observation locations dominates the other four categories. The highest abundance of coral fish is dominated by the Pomacentridae family. This is related to the high rugosity of the reef, which provides microhabitats for various fish species.

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