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The Relationship Between Reef Fish Biodiversity and Coral Reef Health in Jepara Regency, Central Java, Indonesia

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Abstract. Coral reefs are vital habitats for numerous fish species, providing food, shelter, and breeding grounds. In Jepara Regency, Central Java, Indonesia, these ecosystems are threatened by human activities and natural disturbances. This study aimed to assess the biodiversity of reef fish in relation to coral health degradation. Researchers used the Line Intercept Transect (LIT) and Underwater Visual Census (UVC) methods to evaluate fish abundance and coral coverage across three locations with six sampling stations. 936 reef fish individuals, representing 35 species and 14 families, were recorded, with the *Pomacentridae* family being the most prevalent. The highest coral coverage, categorized as fair, was found at Location II (Blebak Beach) at Stations 3 and 4, with coverage of 27.93% and 25.61%, respectively. This coral coverage was positively correlated with reef fish abundance, with counts of 238 and 246 individuals (average ± SD: 242 ± 5.65). The biodiversity index indicated a dominance index (D) ranging from 0.05 to 0.14 (in the fair category), a high evenness index (E) between 0.75 and 1, and a low dominance index (D) between 0.05 and 0.14. A significant correlation was found between coral coverage and reef fish numbers ($P < 0.05$, $R^2 = 0.8702$), with a linear regression equation of $y=6.26+67.71$. The findings suggest that the health of coral reef ecosystems significantly affects reef fish populations. Hereafter, the healthiness of this ecosystem will support the scientific core development of Marine Sciences as well as fulfill society's needs (economically).

Keywords: Coral reefs; diversity; abundance; Line Intercept Transect (LIT); Underwater Visual Census (UVC).

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INTRODUCTION

Coral reefs are vital ecosystems that support an immense diversity of marine life(Hughes et al. , 2023). Coral reef ecosystems continue to attract interdisciplinary interest due to their indispensable ecological roles and substantial economic benefits (Eddy et al., 2021). These habitats are essential for reef fish, which play a crucial role in maintaining ecological balance by providing shelter, food, and breeding grounds (Nurdjaman et al., 2023). However, global coral reef degradation is a pressing issue, with over 25% of reefs threatened due to natural changes and human activities, such as overfishing, sedimentation, and pollution(Suryono et al., 2021;Novi & Bracco, 2022). In Indonesia, particularly in Java, rapid urbanization and pollution have led to significant declines in coral health, impacting the abundance and diversity of reef fish (Mulya et al., 2021).

The importance of Coral Triangle Initiatives in which had been spanning 6 million km2 across six countries have supports the livelihoods of nearly 400 million people (CTI, 2025). The reef check conducted by (Sukandar et al., 2022) stated that the reef ecosystem at the Gresik coastal water is still found in moderate and good condition. They still found 8 families of the reef fish, which gave a benefit to the local fishermen. In the years before, the reef ecosystem in the Philippines had already suffered from coral bleaching, where the hard-coral cover was found in only 22.8 %. In the next studies (of Coral reefs in Philippine waters), the bleaching was correlated to the thermal stress, nutrient enrichment and eutrophication, and water motion relative to the degree of embayment (Reyes et al., 2022). However, those facts data geographically different, where the two studies above were conducted in the northern hemisphere, even though Gresik (Sukandar et al., 2022) and the Jepara reef ecosystem are in similar southern hemispheres, but the geographical positions are in different longitudes.

Another study has established a correlation between coral reef conditions and the diversity and abundance of reef fish (Munasik et al., 2020). However, there remains a gap in research specifically addressing the continuous degradation of coral reefs and its effects on reef fish populations in Jepara Regency, particularly across key locations such as Bandengan Beach, Blebak Beach, and Empu Rancak Beach. This gap highlights the need for a focused investigation into how coral health influences reef fish communities in this region. The primary objectives of this research are to assess coral reef conditions using coral cover as an indicator, evaluate the abundance of reef fish at the three specified locations, and explore the correlation between coral health and reef fish diversity. This study aims to evaluate coral reef conditions by measuring coral cover percentage and assessing reef fish abundance to explore their correlation within the coral reef ecosystems of Jepara Regency. By addressing the identified research gap, this study will provide critical insights into the dynamics between coral health and reef fish populations, informing conservation strategies and management practices. Understanding these relationships is essential for preserving marine biodiversity and ensuring the sustainability of reef fisheries.

The findings from this research will contribute valuable data to the scientific community, enhancing our understanding of the ecological interplay between coral reefs and reef fish. This knowledge will be beneficial for policymakers, conservationists, and local communities, supporting initiatives aimed at preserving coral reef ecosystems and promoting sustainable marine resource management. Ultimately, the study aims to raise awareness of the importance of coral reefs in maintaining marine biodiversity and the necessity for effective conservation strategies in the face of ongoing environmental challenges.

METHODS

The research took place in June 2023 at three coral reef sites within the study location. Location I is Bandengan Beach (BA), Location II is Blebak Beach (BL), and Location III is Empu Rancak Beach (ER). Location I, known as Tirto Samodro Beach, is a popular tourist destination close to Panjang Island that serves as a shipping route between Jepara and Karimunjawa National Park. Location II experiences relatively low levels of human activity, although tourism is increasing with the development of the Sekuro Village Hotel. Location III is situated near the Tanjung Jati B National Power Plant. Sampling Location I at Station 1 (6.55° S and 110.65° E) and Station 2 (6.56° S and 110.65° E), Location II at Station 3 (6.50° S and 110.66° E) and Station 4 (6.51° S and 110.66° E), and Location III at Station 5 (6.48° S and 110.69° E) and Station 6 (6.49° S and 110.69° E) (Figure 1)

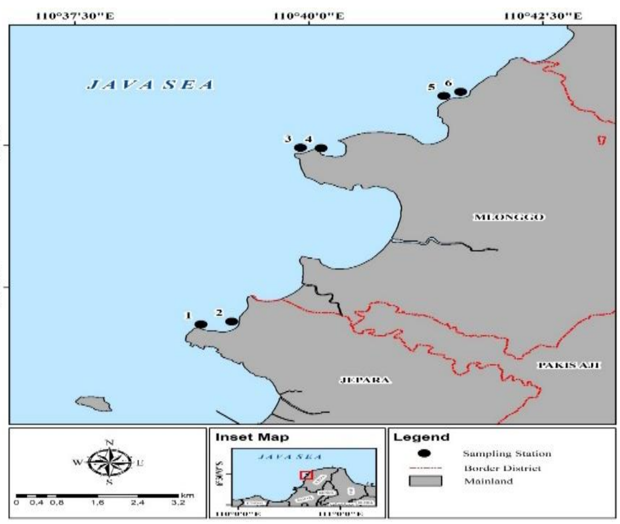

Figure 1. Research Locations I (St. 1 and 2) Bandengan, II (St. 3 and 4) Blebak, and III (St. 5 and 6) Empu Rancak of Jepara coastal waters.

Underwater Visual Census (UVC) and Line Intercept Transect (LIT)

The biodiversity of reef fish communities in the study area was assessed using a survey method. Data on coral reefs and reef fish were collected by SCUBA diving at depths of 3 and 7 meters using the Underwater Visual Census (UVC) and Line Intercept Transect (LIT) methods. These depths were chosen because they give adequate sunshine for coral development and are thought to be ideal for shallow-water coral growth. To analyze reef fish and coral communities, the UVC technique was utilized using transects. Coral coverage was measured using both LIT and Underwater Photo Transect (UPT) techniques (Sukandar et al., 2022), resulting in accurate data collection on living and dead coral percentages, colony size, and species richness. The LIT approach is also useful for analyzing biotic communities intimately related to coral reefs. Transects measuring 100 meters in length were placed parallel to the shoreline. Following their installation, a five-minute wait period was observed to allow the fish to resume their natural behaviors before recording began. The transect was documented using an underwater camera in video mode. Fish populations were examined within a defined monitoring zone spanning 2.5 meters on either side of the transect for fish under 35 cm in length and 5 meters for those 35 cm or bigger (Arbi and Faricha,2021). Data collection for fish and coral was carried out sequentially, with a brief interval between the two operations (Winston et al.,2020). According to Allen and Walsh (2020), comprehensive guidance is offered on identifying reef fish species, emphasizing effective photographic methods and key distinguishing traits to support the documentation and classification of unfamiliar specimens in future taxonomic studies.

Data Analysis

The diversity index, denoted as H′, was calculated using the Shannon-Wiener formula (Sunardi et al., 2017) as follows:

$$H' = -\sum (ni/N) \times \ln (ni/N).$$

Where: H' represents the Shannon-Wiener Diversity Index; ni is the number of individuals of each identified species; N is the total number of species counted.

The diversity index (H') is classified as low when the value is below 1 (< 1), moderate when it ranges between 1 and 3 (1 < H' < 3), and high when it exceeds 3 (> 3).

The evenness of species distribution within the community (Mulya et al., 2021; Saputro et al., 2021), the Index of Evenness E was determined using the formula as follows:

$$E=H\hat{}'/ (\log2\ S)$$

Where: E= Homogeneity Index; Hmax = species balance in maximum balance = ln s

The dominance index was calculated based on Simpson's formula, as described by (Hariyanto et al., 2019)

$$D = \sum \left(\frac{n_i}{N}\right)^2$$

Where: D = Dominance index; n_i= number of individuals in the i-th species; N = total number of individuals

The percentage of coral cover (% cover) was calculated using the formula provided by (Gonzalez-Rivero et al., 2020)

$$ni= li/L \times 100\ \%.$$

where: ni = Percentage of live coral cover (%); Li = Length of coral colonies along the transect line (cm); L = Length of the transect line (m)

The results were classified according to the coral community coverage parameters established by the Ministry of the Environment of the Republic of Indonesia (No. 4, 2001), as illustrated in Table 1.

Table 1. Coral Reef Condition Criteria

Coral cover (%)	Category
75 - 100	Excellent
50 - 74.9	Good
25 - 49.9	Fair
0 - 24.9	Poor

Correlation of the Reef Fish and Coral Coverage

This study examines how declining coral reef conditions influence fish populations by employing statistical methods to evaluate overall ecosystem health. It highlights the effects of reef health on both fish diversity and abundance. The research adopts the framework of ecosystem health to evaluate coral reef status and its association with the abundance of reef fish. A simple linear regression model, following the approach outlined by (Meenapha, 2021), was applied to analyze the relationship between the proportion of live coral cover and the quantity of reef fish. The quantity of reef fish was regarded as the dependent variable (Y) in this model, and the percentage of live coral cover was employed as the independent variable (X).

$$Y = a \pm bX$$

where: Y is the dependent variable, which refers to the quantity of reef fish. This means that the model aims to predict or explain changes in the quantity of reef fish based on variations in the independent variable, which X represents.

RESULTS AND DISCUSSION

The study found that there were 936 individuals from 35 species of reef fish from all 3 locations of the coral reef ecosystem in Jepara Regency (Table 2). Location I Station 1 had 144 individuals, Station 2 had 107 individuals, location II Station 3 had 238 individuals, Station 4 had 246 individuals, Location III Station 5 had 121 individuals, and Station 6 had 89 individuals, respectively. These species were categorized into the following 14 families, i.e. *Pomacentridae*, *Chaetodontidae*, *Labridae*, *Nemipteridae*, *Caseonidae*, *Lutjanidae*, *Holocentridae*, *Apogonidae*, *Siganidae*, *Monacanthidae*, *Serranidae*, *Gerreidae*, *Terapontidae*, and *Mullidae*. The highest fish abundance was observed at Location II (BL) with 242±5.65 individuals, followed by Location I (BA), with a moderate abundance of 125.5±26.16, while Location III (ER) had the lowest abundance, at 105±22.62 individuals. Location II Station 4 has the highest number of individuals and species diversity among all locations and stations, with 246 individuals corresponding to 21 species. The reef fish composition showed that *Pomacentridae* was the most dominant, with 375 individuals observed, while the family *Apogonidae* was the lowest, with only 9 individuals (Table 2). Comparing to the Northern hemisphere coral reef ecosystems i.e. Philippines (Reyes et al., 2022), Gorontalo, either different longitude of Southern hemisphere i.e, Gresik (Sukandar et al., 2022), there were no *Pomacentridae* found. Data from (Fishbase, 2025) noted that *Pomacentridae* are commonly found around coral reef ecosystems and are very rarely found in brackish or freshwater. This indicates that (however) this family is categorized as an euryhaline organism. For this fact, Jepara waters are situated along the slope of Mount Muria and are traversed by two rivers, the Jethak and Mlonggo, within the study area (Figure 1). Hence, additional fresh water supply to the coastal area (study site) allegedly supplies rich nutrition and gives a good environment to the *Pomacentridae* family.

The reef fish biodiversity index showed that the diversity index at all stations fell in the range 2.0≤ H'≥ 3.0, e.i. 2.57, 3.03, and 2.43 at locations I, II, and III, respectively, which can be classified into high diversity categories (Table 3). Instead of eutrophication, allochthonous organic matter, which was delivered from the mountain of Muria, presumably gave a food enrichment and brought an ideal environment to the reef fishes. The highest diversity is shown at location II, which this due to the longshore current from the Mlonggo River optimally enriching the area located on the tip of the peninsula (see Figure 1). Compared to location III (Empu Rancak) and I (Bandengan), location II of Blebak has more land bulge (Figure 1) for trapping the nutrient after longshore current, especially during the east seasons (April to September). Mualo et al. (2024) found that the diversity index of reef fishes in Buton is only 1.01, which suggests that little allochthonous organic matter is transported from the stony island. The evenness Index (E) is in the high category (0.75 < E ≤ 1), i.e., 1.02, 0.86, 0.87, 0.90, 0.81, and 0.80, respectively, categorized as moderate. The moderate value indicated that the reef community is facing an unstable ecosystem, as the Java Sea has a lot of waste from crowded residents. This condition increases eutrophication along the Java Sea, primarily affecting the oxygen depletion and causing disturbance to the coral reef ecosystem (Damar et al., 2021).

The dominance index (D) shows very low category i.e. 0.06 to 0.13, this is indicates that no species has dominated in this ecosystem. Location II (Blebak) has the best values (0.06), revealing that all the species were living equally. As Tony et al., (2020) studied at South Kalimantan, which is similar to the Java Sea, they also found that no dominant species of reef fishes in Halang Melingkau. However, this condition could be location-dependent. Hereafter, the Evenness Index (E) tends to be very high (Table 3). As a result, only specific fish species remain and live in these coral reefs, leading to low dominance and high diversity. However, this ecosystem still found 14 families and 35 species of fish occupying 3 locations of the Jepara reef ecosystem (Table 2).

Table 2. Reef Fish Abundance was found along the study area.

No	Family	Species	Station					
			I.1	**I.2**	**II.3**	**II.4**	**III.5**	**III.6**
1	Pomacentridae	*Pomacentrus bantunai*	9	13	7	21	9	18
2		*Pomacentrus maulocensis*	7	0	3	6	0	0
3		*Pomacentrus nagasakiensis*	8	0	3	0	0	0
4		*Pomacentrus oxyodon*	6	0	1	2	0	1
5		*Pomacentrus saksoni*	2	0	2	4	3	1
6		*Pomacentrus trifuncalus*	3	2	24	15	3	5
7		*Pomacentrus`milleri*	2	1	9	4	0	2
8		*Pomacentrus burroughi*	2	0	4	8	0	0
9		*Neoglyphidodon melas*	2	8	1	18	5	0
10		*Amphirion clarkia*	3	3	0	1	1	0
11		*Abudefduf bengalensis*	1	1	2	2	3	0
12		*Abudefduf sexfasciatus*	1	1	3	6	2	0
13		*Crysiptera cyanea*	1	1	0	1	1	3
14		*Cromis fumea*	0	1	0	16	1	3
15		*Cromis actipectoralis*	2	1	6	9	0	0
16		*Neopomacentrus azysron*	6	2	7	27	7	6
17	Chaetodontidae	*Chaetodon actafasciatus*	0	3	3	3	4	1
18		*Chelmon rastratus*	7	1	12	8	0	2
19	Labridae	*Thalasoma lunare*	2	6	0	6	1	2
20		*Halichoeres clarapterus*	16	13	26	22	9	25
21		*Halichoeres marginatus*	2	1	8	9	2	0
22	Nemipteridae	*Scolopsis bilineatus*	4	5	29	3	26	4
23		*Scolopsis lineatus*	0	0	2	3	1	0
24	Caseonidae	*Caesio terres*	5	7	25	14	0	1
25	Lutjanidae	*Lutjanus deccusatus*	9	6	23	7	11	1
26	Holocentridae	*Sargocentron coruscum*	0	1	5	5	0	8
27	Apogonidae	*Apogon semiornatus*	4	2	2	1	0	0
28	Siganidae	*Siganus canaliculatus*	1	5	2	7	0	0
29		*Siganus doliattus*	1	0	3	2	0	0
30	Monacanthidae	*Acreichthys tomentosus*	1	4	4	0	1	0
31	Serranidae	*Ephinepelus miniata*	10	7	0	0	0	1
32		*Chepalopolis Cyanostigma*	11	4	0	2	25	7
33	Gerreidae	*Gerres filamentosus.*	8	0	2	3	2	0
34	Terapontidae	*Terapon theraps*	1	6	11	5	0	0
35	Mullidae	*Upeneus sulphureus*	7	2	9	6	3	1
Total			144	107	238	246	121	89
Average±SD			125.5±26.16		242±5.65		105±22.62	

Table 3. Average of the ecological index of reef fishes in 3 locations of the Coral Reef ecosystem at Jepara waters.

Location	I	II	III
Diversity Index (H’)	2.57	3.03	2.43
The evenness Index (E)	0.43	0.92	0.81
Dominance index (D)	0.12	0.06	0.13

The results showed the highest percentage of nonliving (abiotic) components (DC, RB, RC, and SD) in comparison with living (biotic) components in the benthic community structure in the coral reef ecosystem of Jepara Regency, Central Java, Indonesia, as shown in Table 4. Hard Coral Acropora (A), Non-Acropora (NA), Macroalgae (MA), Sponges (SP), Soft Corals (SC), and other fauna (OT) were the biotic substrates that were seen at each station (Table 5). In the meantime, the abiotic substrates were rock (RC), sand (SD), rubble (RB), and dead coral (DC)

(Table 6). The occurrence of soft corals can be an indicator of reef degradation, often associated with a reduction in hard coral cover caused by factors such as coral bleaching, sediment accumulation, or nutrient enrichment (Figure 3a). The preponderance of abiotic components at all sites and stations indicates the likelihood of coral degradation (Figure 3b). At Location II, the living substrate was dominated by non-Acropora corals (25% and 19% respectively). Meanwhile, in Locations I and location III, macroalgal invasion was observed, as indicated by the high percentage of macroalgal cover (13.74% and 13.85%, respectively), suggesting damage to the coral reef ecosystem (Table 4). The abiotic substrate was primarily composed of Dead Coral (DC) and rubble (RB) (Table 5). The coral reef ecosystem at the study location is mostly dominated by three coral families: *Poritidae*, *Acroporidae*, and *Favidae*, as shown in Table 7 and Figure 2. The occurrence of *Porites* (Family *Poritidae*) in the study site reflects its status as a thermally resilient coral genus, contributing significantly to the persistence and ecological stability of reef ecosystems in Indonesia (Yusri & Siregar, 2019).

Table 4. Composition of Benthic Community Structure of Coral Reef in Jepara Regency, Central Java-Indonesia

Station	Acropora (A)	Non Acropora (NA)	Macro Algae (MA)	Sponge (SP)	Soft coral (SC)	Others (OT)	Dead coral (DC)	Ruble (RB)	Rock (RC)	Sand (SD)
I.1.	2.58	6.28	13.74	0.97	1.53	0.93	44.81	6.61	8.95	14.53
I.2.	1.47	11.78	4.77	0.43	1.24	3.15	32.74	11.82	11.86	23.89
II.3.	2.53	25.4	5.33	0.98	5.87	2.25	23.15	12.71	10.35	11.43
II.4.	6.12	19.49	1.33	0.76	7.21	3.04	30.6	3.57	13.62	14.26
III.5.	1.32	1.2	4.7	10.87	0.79	1.76	1.37	37.3	14.1	13.96
III.6.	1.32	3.14	13.85	0.92	5.16	1.49	17.98	20.9	10.14	25.1

Table 5. Living (Biotic) Lifeforms Benthic Community Structure of Coral Reef in Jepara Regency, Central Java-Indonesia

Station	Acropora (A)	Non Acropora (NA)	Macro Algae (MA)	Sponge (SP)	Soft coral (SC)	Others (OT)
I.1.	2.58	6.28	13.74	0.97	1.53	0.93
I.2.	1.47	11.78	4.77	0.43	1.24	3.15
II.3.	2.53	25.4	5.33	0.98	5.87	2.25
II.4.	6.12	19.49	1.33	0.76	7.21	3.04
III.5.	1.2	4.7	10.87	0.79	1.76	1.37
III.6.	1.32	3.14	13.85	0.92	5.16	1.49

Table 6. Non-Living (Abiotic) Lifeforms Benthic Community Structure of Coral Reef

Station	Dead Coral (DC)	Ruble (RB)	Rock (RC)	Sand (SD)
I.1.	44.81	6.61	8.95	14.53
I.2.	32.74	11.82	11.86	23.89
II.3.	23.15	12.71	10.35	11.43
II.4.	30.6	3.57	13.62	14.26
III.5.	37.3	14.1	13.95	13.96
III.6.	17.98	20.9	10.14	25.1

Table 7. Family composition of coral in Coral Reef Jepara Regency, Central Java-Indonesia

Station	*Acroporidae*	*Oculinidae*	*Agariciidae*	*Pectiniidae*	*Poritidae*	*Pocilloporidae*	*Merulinidae*	*Faviidae*
I.1.	2	1	1	1	5	1	1	3
I.2.	3	0	0	1	6	1	1	0
II.3.	8	1	2	0	7	2	1	3
II.4.	7	1	1	4	9	4	3	2
III.5.	2	3	0	0	2	2	1	2
III.6.	1	0	0	0	2	1	1	1

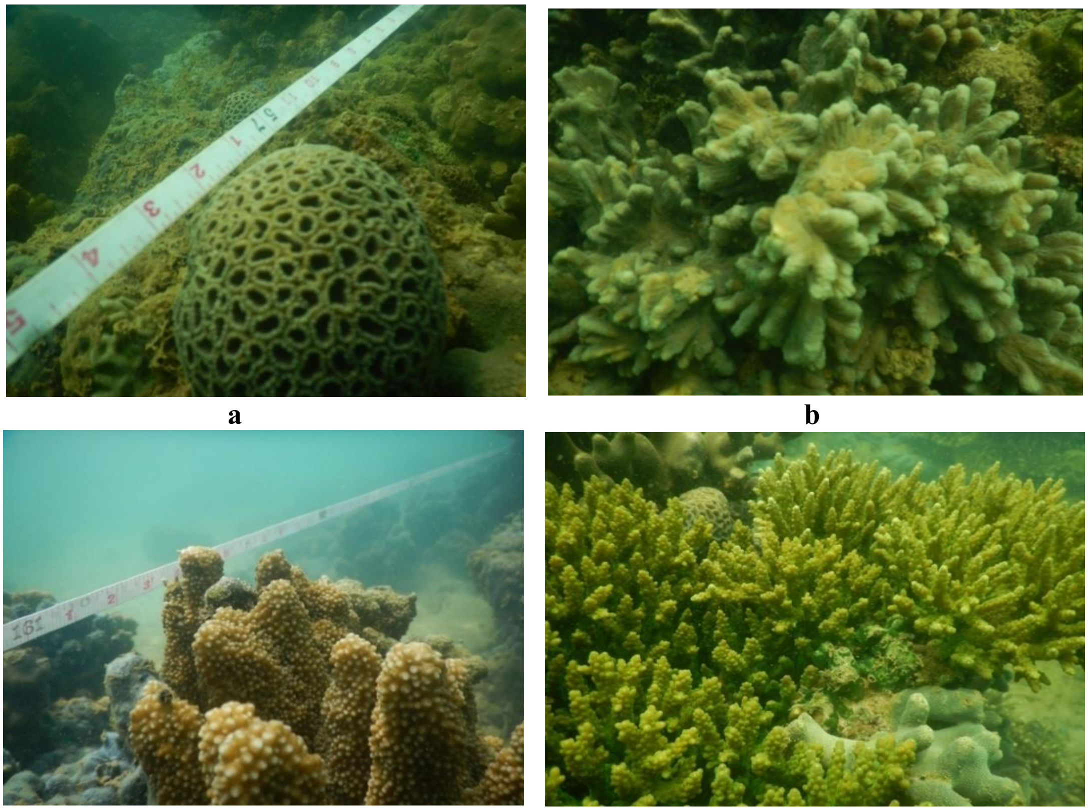

Figure 2. (a) Favia found in Location I (b) Porites (resistance genus) found in all locations and stations, (c) Pocillopora found in location I and II (d) Acropora only found in location II of the Coral Reef in Jepara Regency, Central Java, Indonesia.

Figure 3. (a) soft coral only found in location II (b) abiotic seabeds of Coral Reef in Jepara Regency, Central Java-Indonesia

Table 4 depicts the destruction of the coral reef in Jepara Regency, Central Java, Indonesia, as evidenced by the dominance of the non-living (abiotic) component of the benthic community structure (Spring & Williams, 2023). The presence of abiotic components in all sites and stations indicates a danger of coral degradation, as evidenced by macroalgal invasion, with high macroalgal cover percentages indicating possible damage to coral reef ecosystems (Chen et al., 2023; Huang et al., 2024). Intensive and long-term anthropogenic activities, such as tourism, at Location I have degraded coral reef ecosystems (Suryono et al., 2021, 2022). Location III is next to the national strategic project, Tanjung Jati B coal-fired power station, with a capacity of 4 × 660 MW Power plants of this scale or smaller generate thermal waste at temperatures ranging from 31°C to 42°C, which harms the coral reef ecology and reef fish (Chen et al., 2023). According to Saptarini et al., (2017), thermal waste from power plants has a considerable impact on the diversity and composition of coral life forms. Certain coral species may be unable to survive in the increasing water temperature induced by this garbage (Chen et al., 2023). Increased sea temperatures are a significant contributor to coral community stress, resulting in bleaching events and, eventually, coral death (Nurdjaman et al., 2023).

The distribution and abundance of reef fish varied between species and families across locations and stations (Table 4). These variances were caused by differences in coral reef conditions between the three locations. In all three places, the reef fish genus Pomacentridae was the most common (Figure 4). Shalihah et al. (2024) stated that *Pomacentridae* dominates reef fish populations because this family is commonly found in temperate and tropical reef regions. It was found 16 species of the family *Pomacentridae* i.e *Pomacentrus bantunai, Pomacentrus maulocensis, Pomacentrus nagasakiensis, Pomacentrus oxyodon, Pomacentrus saksoni, Pomacentrus trifuncalus, Pomacentrus`milleri, Pomacentrus burroughi, Neoglyphidodon melas, Amphirion clarkia, Abudefduf bengalensis, Abudefduf sexfasciatus, Crysiptera cyanea, Cromis fumea, Cromis actipectoralis, Neopomacentrus azysron.* The great prevalence of the *Pomacentridae* family in coral reef ecosystems is linked to their feeding behavior and habits. These fish predominantly eat plankton and algae found in the coral reef habitat. *Pomacentridae* is the most widely known coral reef fish family, and it is widely spread in coral reef ecosystems around the world, which accounts for its supremacy. As a result, reef fish serve as bioindicators of biodiversity in coral reef ecosystems (Isdianto et al., 2024). The Shannon-Wiener diversity index of reef fish shows that the diversity index in the range >2.0<H'≤ 3.0, (fair category). The evenness index (E) is high (0.75<E≤1) while the dominance index (D) is low (0<E≤0.50), ranging from 0.05-0.14. According to (Tony et al., 2020), coral reef ecosystem deterioration impacts reef fish ecology. A low dominance index in an ecosystem correlates with a higher diversity index at that site. Due to little coral cover, the reef fish diversity index remains low, allowing only a few fish species to thrive. Human activities in Jepara Regency, Central Java, Indonesia, have deleteriously impacted reef fish populations (Suryono et al., 2021). The prominent corals in Jepara Regency, Central Java, Indonesia, belong to the *Poritidae*, *Acroporidae*, and *Favidae* families. Thus, three coral families are recognized as the most common groupings in coral reef ecosystems and are widely distributed worldwide across diverse reefs (Mualo et al., 2024). The coral reef in the Java Sea is classified as an urban coral reef, making it significantly less diversified. Low diversities are heavily influenced by poor water quality factors such as high turbidity, fluctuating temperature, pH levels, dissolved oxygen, and chlorophyll-a concentrations, whereas salinity tends to be lower. When *Poritidae*, particularly the *Porites* genus, are widespread in a specific coral reef, it generally indicates that the site is undergoing some level of contamination, which promotes coral reef degradation therefore, seabeds dominated by nonliving (abiotic) seabeds (Murdani et al., 2025).

The results suggested coral coverage location II (BL) had the highest live coral cover with 27.93 % (Station 3) and 25.61% (Station 4), classified in the fair category. Location I (BA), with 8.86 % (Station 1) and 13.25% (Station 2) falls within the poor category. Location III (ER) with 90% (Station 5) and 4.46 % (Station 6), classified as the poor category (Table 5). A substantial association was established between the percentage of coral cover and the number of reef fish ($P < 0.05$, $R^2 = 0.8702$).Data show that as coral cover grows, so does the abundance of reef fish. This link is represented by the linear regression equation $y = 6.26 + 67.71$, with an R-value of 0.87. Location II has modest coral cover (Table 5). This suggests that the coral reef ecosystem has degraded because of tourism development. Increased tourism development may cause coral reef degradation (Aldyan et al., 2023; Satya et al., 2023). Similar studies demonstrate that the bioecological damage to coral reefs induced by growing human activities (anthropogenic) is visible in tourism activities (Suryono et al., 2021, 2022). Significant damage to coral reefs can change the composition of reef fish and reduce their abundance. Continuous losses in coral cover can result in fewer reef fish in the ecosystem (Huang et al., 2023). The degradation of coral reef habitats alters the community structure, biodiversity, and dominant species group size, resulting in smaller group sizes, shifts in species composition, and a decline in both the abundance and diversity of reef-associated fish (Huang et al., 2024). The result showed domination of reef fish communities from the *Pomacentridae* and *Labridae* families because these families are most resilient to coral habitat loss (Tony et al.,2020, and Arias-Godinez et al.,2021).

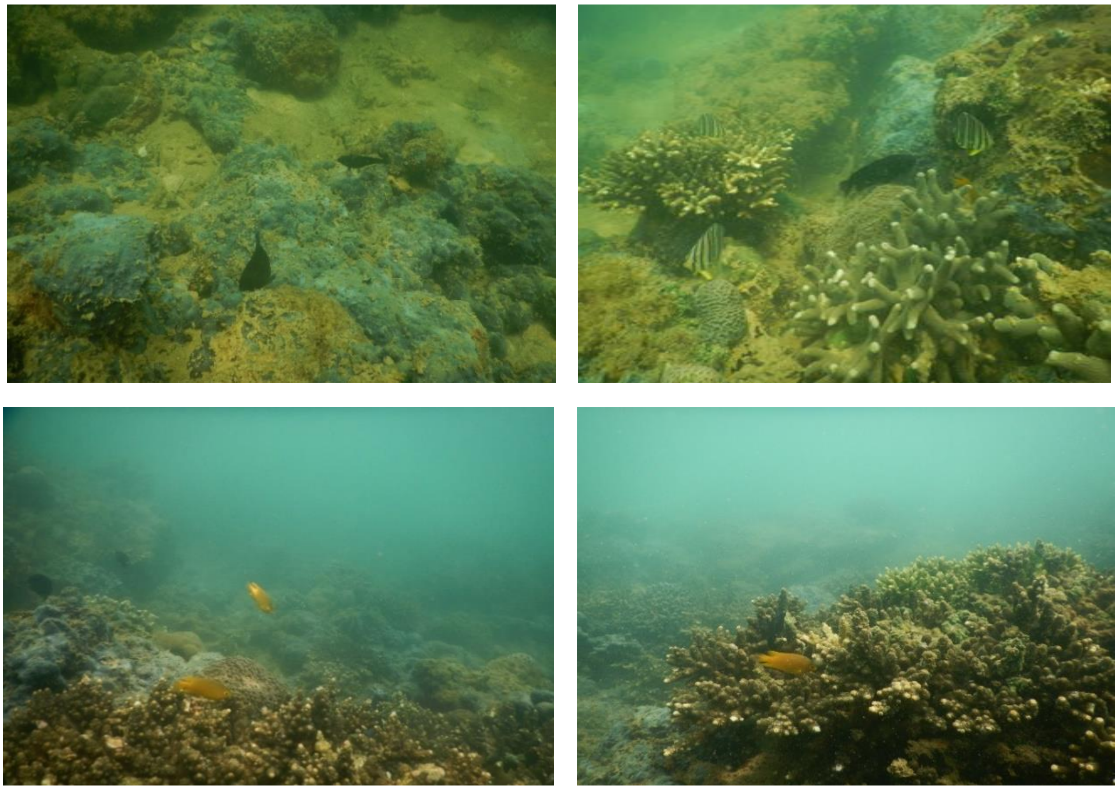

Figure 4. Reef fish of the Coral Reef found in Coral Reef Jepara Regency, Central Java-Indonesia

Figure 5. shows a favorable link between reef fish numbers and coral cover. This study's findings, like those of, demonstrate a linear positive association between fish abundance and coral cover % (Rizal et al., 2022). Different results were found, with coral cover negatively correlated with species diversity and fish abundance (Suryono et al., 2021; Ernaningsih et al., 2022). Damage to the coral reef ecosystem components reduces the population of reef fish. A low coral cover affects the physiological and reproductive activity of reef fish (Pratchett et al., 2023). Long-term alterations to reef fish physiological and reproductive systems reduce fish diversity and abundance. Furthermore, research may have investigated how coral conditions affect fish populations within coral reef ecosystems by counting fish. These findings highlight reef fish's dependency on coral ecosystems and provide useful information for conservation efforts focused on protecting and rebuilding these critical marine environments (Isdianto et al., 2024; Muruga et al., 2024).

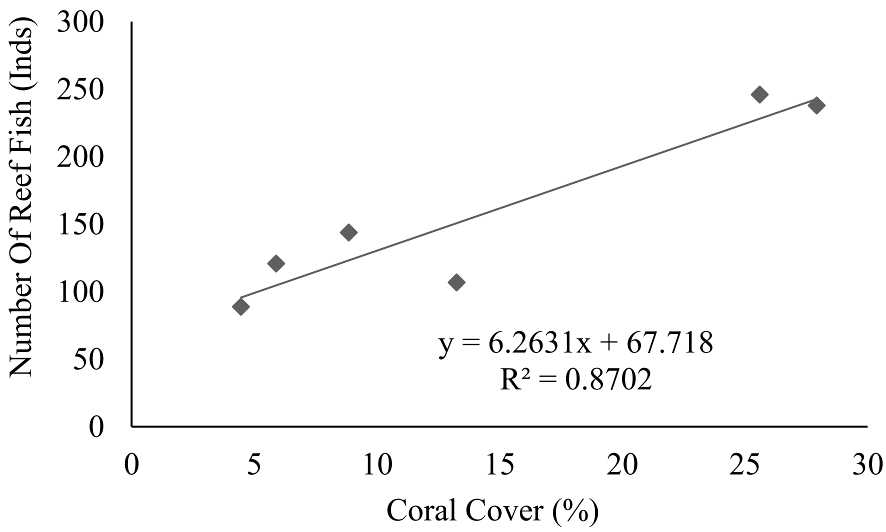

Figure 5. The Relationship Between Reef Fish Numbers and Coral Coverage in coral reef Jepara Regency, Central Java-Indonesia

The novelty of the research presents new perspectives on the connection between coral reef health and reef fish diversity in Jepara Regency, a coastal area in Central Java that has not been extensively examined in comparison to Indonesia's more prominent reef ecosystems. This research contributed foundational information on coral reef condition and reef fish diversity in Jepara Regency, a coastal area that has received limited scientific exploration, offering meaningful contributions to the understanding of marine ecological dynamics.

CONCLUSION

The study found that a total of 936 individuals representing 35 species from 14 families were collected from all sampling sites and stations in coral reef ecosystems, in Jepara Regency, Central Java, Indonesia. The biodiversity of reef Fish was moderate in the location, with coverage in the moderate category, and low in the bad category. There was a direct correlation between Reef Fish Biodiversity and Coral Reef Health, with a linear regression equation of y=6.26 + 67.71. The study confirms that the healthiness of coral reefs will support the development of Marine Sciences, especially in Adaptive Conservation of coastal ecosystems and fulfill society's need (economically). Although this study has established important baseline information on the connection between reef fish diversity and coral reef condition in Jepara Regency, there are still unexplored aspects that present opportunities for deeper analysis. Upcoming research is encouraged to examine seasonal differences related to coral coverage and fish community composition.

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AUTHOR CONTRIBUTION STATEMENT

All authors contributed significantly to the work reported in this manuscript. S conceived and designed the study, coordinated the field research, and led the manuscript writing. NTS conducted the data collection and species identification, contributed to the analysis, and reviewed the manuscript critically for important intellectual content. DPW was responsible for the literature review, assisted in data visualization, and supported the drafting of the manuscript. IP contributed to the interpretation of ecological data, provided methodological insights, and reviewed the manuscript for clarity and accuracy. HN assisted in statistical analysis, ensured data integrity, and provided substantial feedback during manuscript revisions. All authors read and approved the final manuscript and agreed to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript.

REFERENCES

Aldyan, R. A., Budiastuti, M. T. S. S., Warto, W., & Wiwik, W. (2023). Impact of coral reef damage due to tourism activities in Karimunjawa National Park. *E3S Web of Conferences*, *448*, 03063.

Arbi, U. Y & Faricha, A. (2021). New host record of microhabitat preferences of the Banggai cardinalfish (Pterapogon kauderni) in the introduced habitat in Luwuk waters, Sulawesi. IOP Conf. Series: Earth and Environmental Science 944 (2021), 012018. doi:10.1088/1755-1315/944/1/012018

Arias-Godínez, G., Jiménez, C., Gamboa, C., Cortés, J., Espinoza, M., Beita-Jiménez, A., & Alvarado, J. J. (2021). The effect of coral reef degradation on the trophic structure of reef fishes from Bahía Culebra, North Pacific coast of Costa Rica. *Journal of Coastal Conservation*, *25*(1), 8.

Chen, C.-T., Jan, S., Chen, M.-H., Liu, L.-L., Huang, J.-F., & Yang, Y.-J. (2023). Far-Field Influences Shadow the Effects of a Nuclear Power Plant's Discharges in a Semi-Enclosed Bay. *Sustainability*, *15*(11), 9092.

CTI. (2025). *The Coral Triangle Initiatives*.

https://www.conservation.org/projects/coral-triangle-initiative

Damar, A., Ervinia, A., Kurniawan, F., & Rudianto, B. Y. (2021). Eutrophication in a tropical estuary: Is it good or bad? *IOP Conference Series: Earth and Environmental Science*, *744*(1), 12010.

Eddy, T. D., Lam, V. W. Y, Reygondeau, G., Cisneros-Montemayor, A. M., Greer, K., Palomares, M. L. D., Bruno, J.F., Ota, Y., & Cheung, W.W.L. 2021. Global decline in capacity of coral reefs to provide ecosystem services. *One Earth, 4,* 1278-1285. https://doi.org/10.1016/j.oneear.2021.08.016

Ernaningsih, E. (2022). The correlation of coral cover and reef fish density in the biggest archipelagos located in the centre of Indonesia. *Iran. J. Ichthyol*, *9*(2), 111–123.

Fishbase. (2025). *Family Pomacentridae – Damselfishes*. https://www.fishbase.se/summary/FamilySummary.php?ID=350

Gonzalez-Rivero, M., Beijbom, O., Rodriguez-Ramirez, A., Bryant, D. E. P., Ganase, A., Gonzalez-Marrero, Y., Herrera-Reveles, A., Kennedy, E. V, Kim, C. J. S., & Lopez-Marcano, S. (2020). Monitoring of coral reefs using artificial intelligence: A feasible and cost-effective approach. *Remote Sensing*, *12*(3), 489.

Hamzah, S. N., Paruntu, C. P., Mingkid, W. M., Rembet, U. N. W. J., Tumbol, R. A., & Lasabuda, R. (2020). Reef fishes community performances in Olele marine tourism area, Bone Bolango Regency, Indonesia. *AACL Bioflux*, *13*(2), 597–604.

Hariyanto, S., Fahmi, A. K., Soedarti, T., & Suwarni, E. E. (2019). Vegetation and community structure of mangrove in Bama Resort Baluran National Park Situbondo East Java. *Biosaintifika*, *11*(1), 132–138.

Huang, M., Wei, S., Li, Q., Gao, K., Peng, Z., Chen, Y., Zhou, W., & Wei, F. (2023). Degradation of coral reefs altered the community trophic structure and reduced the shoaling size of fish. *Frontiers in Conservation Science*, *4*, 1229513.

Huang, R., He, Z., Yu, K., Yao, Z., Zou, B., & Xiao, J. (2024). Development of a coral and competitive alga-related index using historical multi-spectral satellite imagery to assess ecological status of coral reefs. *International Journal of Applied Earth Observation and Geoinformation*, *134*, 104194.

Hughes, T. P., Andrew H. Baird, Tiffany H. Morrison, & Gergely, T., (2023). Perspective Principles for coral reef restoration in the anthropocene. *One Earth,* 6, 656-665. https://doi.org/10.1016/j.oneear.2023.04.008

Hutomo, F. S., Ismanto, A., Setiyono, H., Maslukah, L., & Widiaratih, R. (2021). Thermal Waste Dispersion Model at Tanjung Jati B Power Plant, Jepara[IND]. *Indonesian Journal of Oceanography*, *3*(1), 76–88.

Isdianto, A., Ariefandi, M. F., Asadi, M. A., Yamindago, A. D. E., Setyawan, F. O., Bintoro, G., Setyanto, A., Lelono, T. R. I. D., Tumulyadi, A., & Adhihapsari, W. (2024). Community structure and biomass of reef fish concerning coral cover in Sempu Strait, East Java, Indonesia. *Biodiversitas Journal of Biological Diversity*, *25*(8), 3376–3385. https://doi.org/https://doi.org/10.13057/biodiv/d250808

Licuanan, W. Y., Robles, R., & Reyes, M. (2019). Status and recent trends in coral reefs of the Philippines. *Marine Pollution Bulletin*, *142*, 544–550.

Meenapha, A. (2021). The relationship between Coral reef fish and habitat structure on coral reefs at Kut Islands, Trat province. *NU. International Journal of Science*, *18*(2), 50–57.

Mualo, A., Tuhumena, L., Hisyam, M., Rumahorbo, B. T., Hamzah, H., Wambrauw, D. Z. K., & Manalu, K. A. A. (2024). Diversity of coral reef and reef fish in Isau Island, Central Maluku, Indonesia. *Aquaculture, Aquarium, Conservation & Legislation*, *17*(5), 1814–1824.

Mulya, H., Santosa, Y., & Hilwan, I. (2021). Comparison of four species diversity indices in mangrove community. *Biodiversitas Journal of Biological Diversity*, *22*(9), 3648–3655. https://doi.org/10.13057/biodiv/d220906.

Munasik, M., Nugroho, A. A., Hartati, R., Sabdono, A., Sugiyanto, S., & Sugianto, D. N. (2020). Reef Fish Community Structure and Coral Cover on an Artificial Patch Reef (APR). *Journal of Tropical Marine Science.[IND] 23*(3), 333- 340. https://doi.org/10.14710/jebt.%Y.9171

Murdani, M. T. Z., Candri, D. A., & Ahyadi, H. (2025). Condition of Coral Reefs at Mentigi Beach, North Lombok Regency. *Jurnal Pijar Mipa*, *20*(3), 421–429.

Muruga, P., Siqueira, A. C., & Bellwood, D. R. (2024). Meta-analysis reveals weak associations between reef fishes and corals. *Nature Ecology & Evolution*, *8*(4), 676–685.

Novi, L., & Bracco, A. (2022). Machine learning prediction of connectivity, biodiversity and resilience in the Coral Triangle. *Communications Biology*, *5*(1), 1359.

Nurdjaman, S., Nasution, M. I., Johan, O., Napitupulu, G., & Saleh, E. (2023). Impact of climate change on coral reefs degradation at West Lombok, Indonesia. *Tropical Marine Science.[IND]*, *26*(3), 451–463.

Pratchett, M. S., Caballes, C. F., Hobbs, J.-P. A., DiBattista, J. D., Bergseth, B., Waldie, P., Champion, C., Mc Cormack, S. P., & Hoey, A. S. (2023). Variation in the Physiological Condition of Common Coral Trout (*Plectropomus leopardus*) Unrelated to Coral Cover on the Great Barrier Reef, Australia. *Fishes*, *8*(10), 497.

Pratchett, M. S., Wilson, S. K., Berumen, M. L., & McCormick, M. I. (2004). Sublethal effects of coral bleaching on an obligate coral feeding butterflyfish. *Coral Reefs*, *23*, 352–356.

Reyes, M., Robles, R., & Licuanan, W. Y. (2022). Multi-scale variation in coral reef metrics on four Philippine reef systems. *Regional Studies in Marine Science*, *52*, 102310.

Rizal, A., Nugraha, R. B. A., Farhan, A. R., Triwibowo, H., Widjanarko, E., Secasari, Y., Mbay, L. N., Naibaho, N., Borneo, B. B., & Farahdita, W. L. (2022). Analysis of coral reef diversity and its correlation to fish abundance in Biawak Island cluster areas. *IOP Conference Series: Earth and Environmental Science*, *1033*(1), 012002.

Saptarini, D., Mukhtasor, M., & Rumengan, I. F. M. (2017). Coral reef lifeform variation around power plant activity: Case study on coastal area of Paiton Power Plant, East Java, Indonesia. *Biodiversitas Journal of Biological Diversity*, *18*(1), 116–120. https://doi.org/https://doi.org/10.13057/biodiv/d180116

Saputro, R. W., Utami, S., & Khotimperwati, L. (2021). Species diversity of epiphyte Fern plants in Curug Lawe waterfall region, Semarang District. *Biosaintifika: Journal of Biology & Biology Education*, *13*(3), 379–385.

Satya, E. D., Sabdono, A., Wijayanti, D. P., Helmi, M., Widiaratih, R., Suryoputra, A. A. D. W. I., Handoyo, G., & Puryajati, A. D. (2023). Mapping coral cover using Sentinel-2A in Karimunjawa, Indonesia. *Biodiversitas Journal of Biological Diversity*, *24*(2), 827–836. https://doi.org/10.13057/biodiv/d240219

Shalihah, M., Srimariana, E. S., Subhan, B., Arafat, D., Palisu, V. H., Budiarto, H., Santoso, P., & Karissa, P. T. (2024). The abundance of reef fish based on ecological role and trophic level on Kaliage Island, Seribu Archipelago, DKI Jakarta. *BIO Web of Conferences*, *106*, 02014.

Spring, D. L., & Williams, G. J. (2023). Influence of upwelling on coral reef benthic communities: a systematic review and meta-analysis. *Proceedings of the Royal Society B*, *290*(1995), 20230023.

Sukandar, Samuel, P. D., Dewi, C. S. U., Pratiwi, I. D., Anam, M. C., Beno, J. E., & Fatmawati, R. (2022). Current status of the coral reef ecosystem in Gresik Regency, East Java. *AACL Bioflux*, *15*(4), 1692–1702.

Sunardi, S., Febriani, R., Irawan, B., & Saputri, M. S. (2017). The dynamic of phytoplankton community structure in face of warming climate in a tropical Man-Made Lake. *Biosaintifika: Journal of Biology & Biology Education*, *9*(1), 140–147.

Suryono, S., Ambariyanto, A., Munasik, M., & Wijayanti, D. P. (2022). *Socio-ecological resilience of marginal coral reefs in java sea indonesia*. Research Square, 19 Dec 2022 https://doi.org/10.21203/rs.3.rs-2297906/v1 PPR: PPR586338 Preprint v1.

Suryono, S., Ambariyanto, A., Munasik, M., Wijayanti, D. P., Ario, R., Pratikto, I., Taufiq-Spj, N., Canavaro, S. V, Anggita, T., & Sumarto, B. K. A. (2021). Bioecology of coral reef in Panjang Island of Central Java Indonesia. *ILMU KELAUTAN: Indonesian Journal of Marine Sciences*, *26*(2), 125–134.

Tony, F., Soemarno, Wiadnya, D. G. R., & Hakim, L. (2020). Diversity of reef fish in halang melingkau island, South Kalimantan, Indonesia. *Biodiversitas*, *21*(10), 4804–4812. https://doi.org/10.13057/biodiv/d211046

Yusri, S., & Siregar, V. P. (2019). Distribution Modelling of Porites (Poritidae) in Indonesia. *IOP Conference Series: Earth and Environmental Science*, *363*(1), 12025.