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# ABUNDANCE OF CORAL REEF FISHES IN THE WATERS OF GELASA ISLAND, CENTRAL BANGKA DISTRICT

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***ABSTRACT***

Gelasa Island has a coral reef ecosystem as a habitat for biota including coral reef fish, turtles, and others. The coral reef has been damaged due to anthropogenic activities. The purpose of the study was to determine the percentage of coral reef cover and the abundance of coral reef fish. The study was conducted in March 2024 in the waters of Gelasa Island. The method used was UPT (Underwater Photo Transect) for coral reefs and UVC (Underwater Visual Census) for coral reef fish, and the PAST 4.03 application to determine the diversity, uniformity, and dominance index. The results of the study showed that the percentage of coral reef cover in the waters of Gelasa Island was in the good category with an average of 52.42%. The abundance of coral reef fish was 49,114 ind/ha in the very rare category. The highest abundance of coral reef fish species was Neopomacentrus anabatoides, Pomacentrus alexanderae, and Caesio cunning. Based on the category, major fish have the highest abundance. The diversity value is in the moderate category, the uniformity value indicates an unstable community, and the dominance value is in the low category.

***Keywords :*** *Gelasa Island, coral reefs, coral reef fish*

## INTRODUCTION

Gelasa Island is located in Batu Beriga Village, Lubuk Besar District, Central Bangka Regency. The island covers an area of approximately 210 hectares, is uninhabited, and is rich in important ecosystems such as coral reefs, seagrass beds, and mangroves, along with associated biota including reef fish (Adi, 2019; Adi *et al*., 2020; Adriyansyaha *et al.,* 2023). The presence of these ecosystems is not only vital for environmental balance but also provides a natural habitat for various fish species, making the area a region with high potential for reef fish abundance (Rani *et al*., 2019; Rumkorem *et al*., 2019).

According to Regional Regulation of the Bangka Belitung Islands Province No. 3 of 2020 concerning the Zoning Plan for Coastal Areas and Small Islands (RZWP3K), the waters around Gelasa Island are included in the sub-zone for Coastal/Beach Nature Tourism and Small Islands, as well as capture fisheries. This highlights the great potential of Gelasa Island as a marine tourism destination and a sustainable fishery area. Tourist activities on the island include snorkeling and diving, which offer beautiful views of the coral reefs and underwater biodiversity. Additionally, this area serves as a habitat for species listed in the CITES Appendix and the IUCN Red List, such as sea turtles, emphasizing the importance of conservation in the region. Beyond tourism, the waters around Gelasa Island are also used for mooring boats and as fishing grounds by local fishers. These activities demonstrate that the marine ecosystem of Gelasa Island strongly supports the fisheries sector, which is the main source of livelihood for many residents in the surrounding area. The potential fish abundance largely depends on the health of the existing coral reef ecosystems, which provide shelter and food sources for fish (Ayyub *et al*., 2018; Parawansa, 2021; Vernandha *et al*., 2023).

The coral reef ecosystem in Gelasa Island currently faces serious threats due to human activities. Coral reef damage is often caused by boat anchor discharges and destructive fishing practices (Ferizal *et al*., 2024). These practices not only damage the physical structure of coral

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reefs but also disrupt the broader ecosystem, negatively impacting fish populations and marine biodiversity in the area (Sakaria, 2022; Triwibowo, 2023).

This study aims to determine the percentage of coral reef cover and the abundance of reef fish in the waters of Gelasa Island. This information is crucial for developing effective management and conservation strategies, ensuring that the potential of Gelasa Island as a marine tourism destination and sustainable fishery area can be maintained to benefit both the environment and the surrounding communities.

## RESEARCH METHOD

The research was conducted in March 2024 in the waters of Gelasa Island, Central Bangka Regency. A total of four observation stations were established, with their coordinates presented in Table 1. The observation site map is shown in Figure 1.

### Data Collection Method

The collection of water quality parameters was conducted both directly in the field and in the laboratory, and then compared against the water quality standards for marine biota, referring to Government Regulation No. 22 of 2021 concerning Guidelines for Environmental Protection and Management. The parameters are presented in Table 2.

The method used for coral reef data collection was the *Underwater Photo Transect* (UPT) based on Giyanto *et al*. (2017). A 50-meter roll meter was laid along the study site. Photographs were taken within 58 x 44 cm quadrats in a zigzag pattern, starting from the left side of the transect line from the first to the last meter. In this study, coral reef components and lifeforms were analyzed to assess reef conditions. The tools and materials used are presented in Tables 3 and 4

**Tabel 1.** Coordinates of data collection points

| Station Name | Latitude | Longitude |
|---|---|---|
| Station 1 | -2.419978 | 107.086203 |
| Station 2 | -2.422500 | 107.073307 |
| Station 3 | -2.411930 | 107.084105 |
| Station 4 | -2.407535 | 107.063302 |

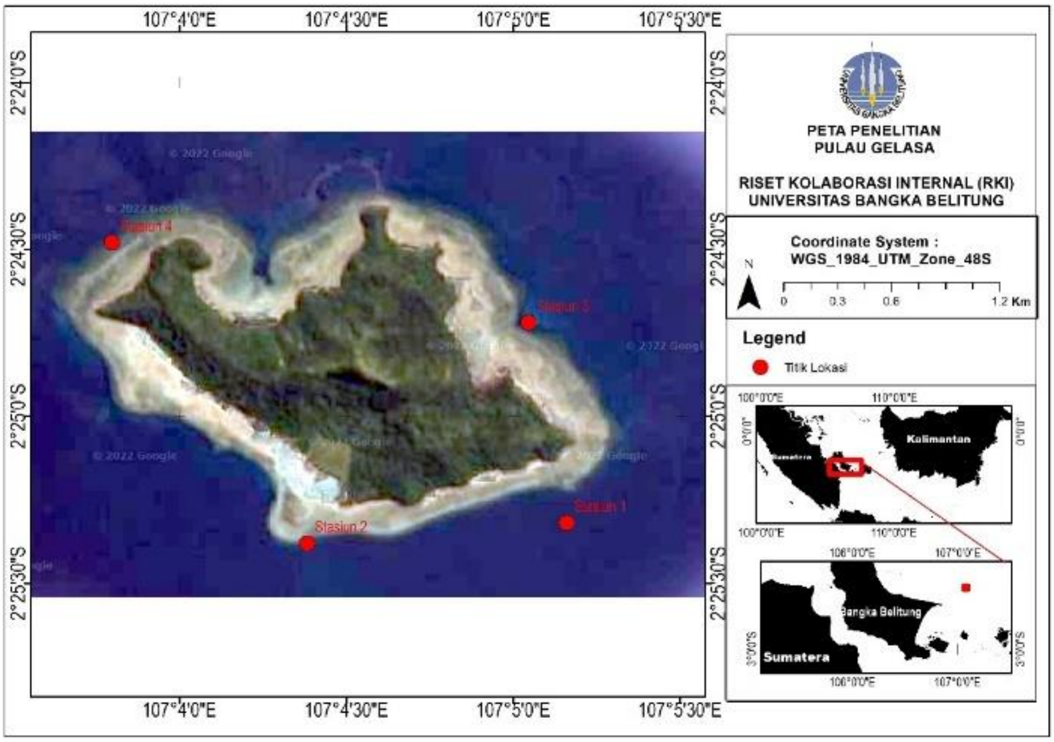


**Figure 1.** Research Map

**Table 2.** Water Quality Parameters

| Parameter | Equipment/Method | Description |
|---|---|---|
| Water pH | pH Meter | Insitu |
| DO (*Dissolved Oxygen*) | DO Meter | Insitu |
| Current | *Current Meter* | Insitu |
| Salinity | Refractometer | Insitu |
| TSS | Gravimetry | Laboratory |
| Depth | Roll Meter | Insitu |
| Temperature | Thermometer | Insitu |

**Table 3.** Equipment for Coral Reef Data Collection

| Tool/Material | Function |
|---|---|
| Set Scuba | Diving |
| Roll 100 meter | Transect Line |
| frame 48 x 58 | Photo Area |
| TG 6 Camera | Transect photography and documentation |

**Table 4.** Equipment for Reef Fish Data Collection

| Tool/ Material | Function |
|---|---|
| Set Scuba | Diving |
| Roll 100 meter | Transect Line |
| Slate and pencil | Recording Fish |
| TG 6 Camera | Dokumentation |
| Fish ID sheets | Assist underwater identification |

The method used for reef fish observation was the *Underwater Visual Census* (UVC), based on Suharti *et al*. (2017) and the Ministry of Manpower Decree No. 154 of 2019. A 70-meter roll meter was deployed, and reef fish were observed within 2.5 meters on both the left and right sides, resulting in a total observation area of 350 m². Fish identification referred to Kuiter & Tonozuka, 1991a, 1991b, (2001); Froese & Pauly (2022); Ahyong *et al*. (2023); Allen *et al*. (2003). Identification of target fish species was carried out through interviews with local fishers. Major and indicator fish groups followed the references by English *et al*. (1997) and Suharti *et al*. (2017).

**Data Analysis**

Coral reef photo data were analyzed using the CPCe (Coral Point Count with Excel extension) software based on Kohler & Gill (2006). This software allows for identification of lifeforms, coral genera, and other aspects using random points on 50 photos per station. The results of the analysis include percentage cover and coral lifeform data, exported as Excel spreadsheets. The percentage cover was calculated using the following formula:

$$\frac{\text{Number of points for a specific category}}{\text{Total random points}} x\ 100$$

The analysis results were then matched with coral reef cover categories according to the Decree of the Minister of Environment No. 4 of 2001 concerning Standard Criteria for Coral Reef Damage, presented in Table 5.

The analysis of coral reef fish abundance refers to Odum (1959), using the following formula:

$$Xi\,\frac{N_i}{A}$$

Note: Xi = Fish abundance per square meter n/m$^2$; Ni = Number of individual fish observed; A = Observation area 350 m$^2$. The calculated abundance is then converted to individuals per hectare and categorized based on the criteria by Djamali & Darsono (2005) as follows : 1-50.000 = Very Rare; 50.000–100.000 = Rare; 100.000–200.000 = Moderately Abundant; 200.000–500.000 = Abundant; >500.000 = Very Abundant.

Fish species composition refers to Setyobudiandi *et al*. (2009), where species composition is defined as the number of species recorded in the observation area.

**Indices of Diversity, Evenness, and Dominance**

Indices of coral reef fish community structure refer to Magurran (2004) and are analyzed using the software PAST version 4.03. The analysis includes the Shannon-Wiener Diversity Index, calculated using the following formula:

$$H' = -\Sigma\ Pi\ Ln\ Pi\ where\ Pi = \frac{n_i}{N}$$

Note: H’ = Diversity index; Pi = Proportion of individuals in species *i*; ni = Number of individuals of species *i*; N = Total number of individuals

$$E = \frac{H'}{H_{maks}}\ where\ H_{maks} = \mathrm{Ln}\,S$$

Note: E = Evenness index; H’= Diversity index; Hmaks = Maximum possible diversity; S = Total number of species

$$\mathrm{C} = \Sigma\ {P_i}^2\ where\ Pi = \frac{ni}{N}$$

Explanation: C = Dominance index; Pi = Proportion of individuals in species *i*. The community structure criteria refer to Rumkorem *et al*. (2019) and are presented in Table 6.

**RESULTS AND DISCUSSION**

**Water Quality Parameters**

The measurement results of 7 water quality parameters in the waters of Gelasa Island generally indicate that the values comply with the standards set for marine biota in Government Regulation No. 22 of 2021. Therefore, they fall within the safe limits to support the life and growth of marine organisms, particularly coral reefs and reef fish. The water quality parameters of Gelasa Island are presented in Table 7.

The presence of coral reefs and reef fish is highly dependent on good water quality, as coral reefs require stable and low-pollution environments to grow and develop optimally. Gelasa Island meets these parameters, indicating that the seawater surrounding the island has good quality to support coral reef ecosystems. This is supported by Riyantini *et al*. (2023), who stated that environmental factors such as temperature, habitat depth, predators, and food availability greatly influence the presence of reef fish in an area. Water quality parameters such as temperature, salinity, dissolved oxygen (DO), pH, water clarity, and currents play a crucial role in supporting the coral reef ecosystem and the abundance of reef fish (Rusli *et al*., 2021; Lalang *et al*., 2022).

**Coral Reefs**

Research conducted by Adi *et al*. (2020), Adriyansyah *et al*. (2023), and the most recent data collection in 2024 show that the percentage of coral reef cover in the waters of Gelasa Island consistently falls within the "good" category, with an average of 52.42%. In 2020, the results indicated that the average coral reef cover was 51.53%. In 2023, it was

**Table 5.** Live Coral Cover Criteria

| Cover Value | Category |
|---|---|
| 0 -24,99 | Poor (Damaged) |
| 25 -49.99 | Moderate (Damaged) |
| 50 -74.99 | Good |
| 75-100.00 | Very Good |

Note : Based on the Decree of the Minister of Environment No. 4 of 2001 on Coral Reef Damage Criteria

**Table 6.** Coral Reef Fish Community Structure Criteria

| Indeks | Range | Category |
|---|---|---|
| | H'≤2 | Low |
| (H’) | 2,0<H≤3 | Medium |
| | H'≥3,0 | High |
| | 0,00<E≤0,50 | Stressed Community |
| (E) | 0,50<E≤0,75 | Unstable Community |
| | 0,75<E≤1,00 | Stable Community |
| | 0,00<C≤0,50 | Low |
| (C) | 0,50<C≤0,75 | Medium |
| | 0,75<C≤1,00 | High |

Note : Community structure criteria refer to Rumkorem *et al*. (2019)

50.83%, and in 2024, the data showed a stable and slightly increased value of 54.9%.

Other major components recorded include Dead Coral with Algae (DCA) at 20.6% and Rubble (R) at 20.2%. The composition of coral reef components is illustrated in Figure 2.

The "good" category indicates that the coral reef ecosystem around Gelasa Island is in healthy condition and has the potential to continue developing well due to favorable marine conditions that support coral growth. Contributing factors include good water clarity, stable water temperature, dissolved oxygen, and moderate currents, all of which influence the health of coral reef ecosystems in the waters of Gelasa Island.

Water quality parameters such as dissolved oxygen, clarity, temperature, and current play essential roles in supporting coral reef growth by facilitating the exchange of nutrients and oxygen between the reef and its surrounding environment. These factors also contribute to the nutrient cycles and signaling processes that sustain coral reef ecosystems (Wijgerde *et al*., 2014; Hebbeln *et al*., 2020).

However, there is evidence of coral reef degradation in Gelasa Island's waters, caused by anthropogenic activities such as the disposal of fishing boat anchors and the use of destructive fishing gear. During field observations, many instances of broken corals, algae-covered dead corals, and discarded fishing gear—especially nets—were encountered. This is consistent with the findings of Veronika & Tajidan (2022) and Sari & Liliani (2023), who noted that coral reef damage can result from human activities such as increased coastal population pressure, climate change accelerating limestone dynamics, global warming, ocean acidification, rising sea temperatures, pollution, overfishing, anchor drops, and the use of destructive fishing methods.

**Table 7.** Measurement Results of Water Quality Parameters

| Paramater | Value | Quality Standard |
|---|---|---|
| pH | 7.12 | Compliant* |
| DO | 7.14 (mg/L) | Compliant* |
| Current | 0.134 (m/s) | Compliant** |
| Salinity | 32 (ppt) | Compliant* |
| TSS | 0.11 (mg/L) | Compliant* |
| Depth | 4 – 5 (m) | Compliant* |
| Temperature | $30^0$C | Compliant* |

Keterangan : * = Government Regulation No. 22 of 2021 (Appendix VIII - Marine Water Quality Standards)
** = Introduction to Coral Reefs as the Foundation of Our Oceans (Zurba, 2019)

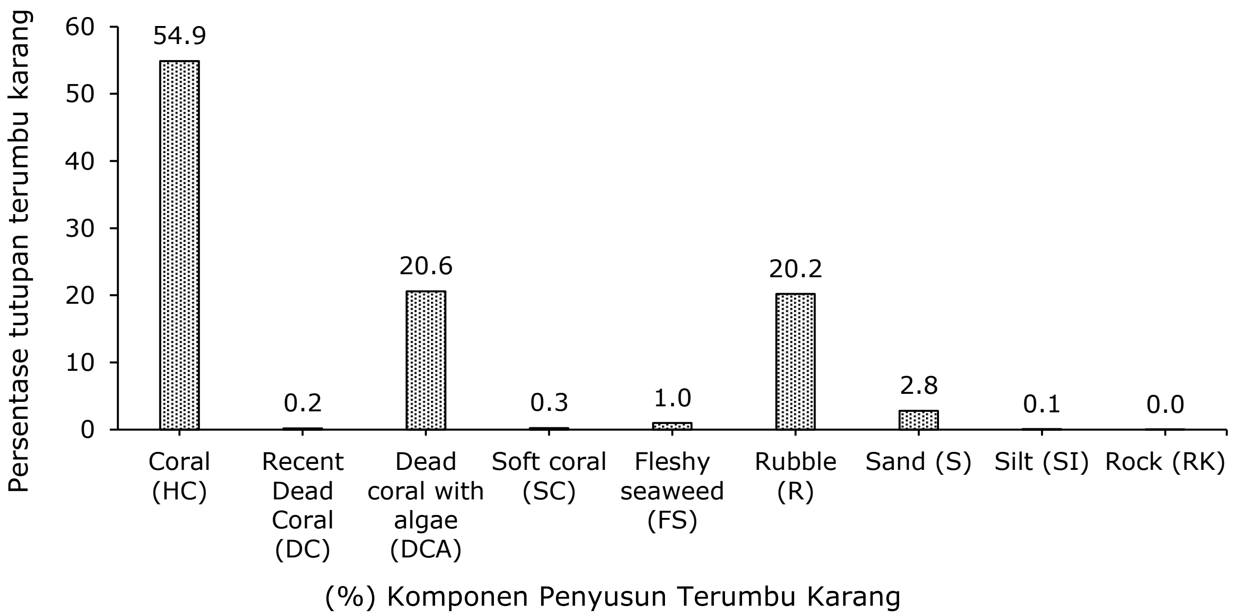


**Figure 2.** Coral Reef Composition Components

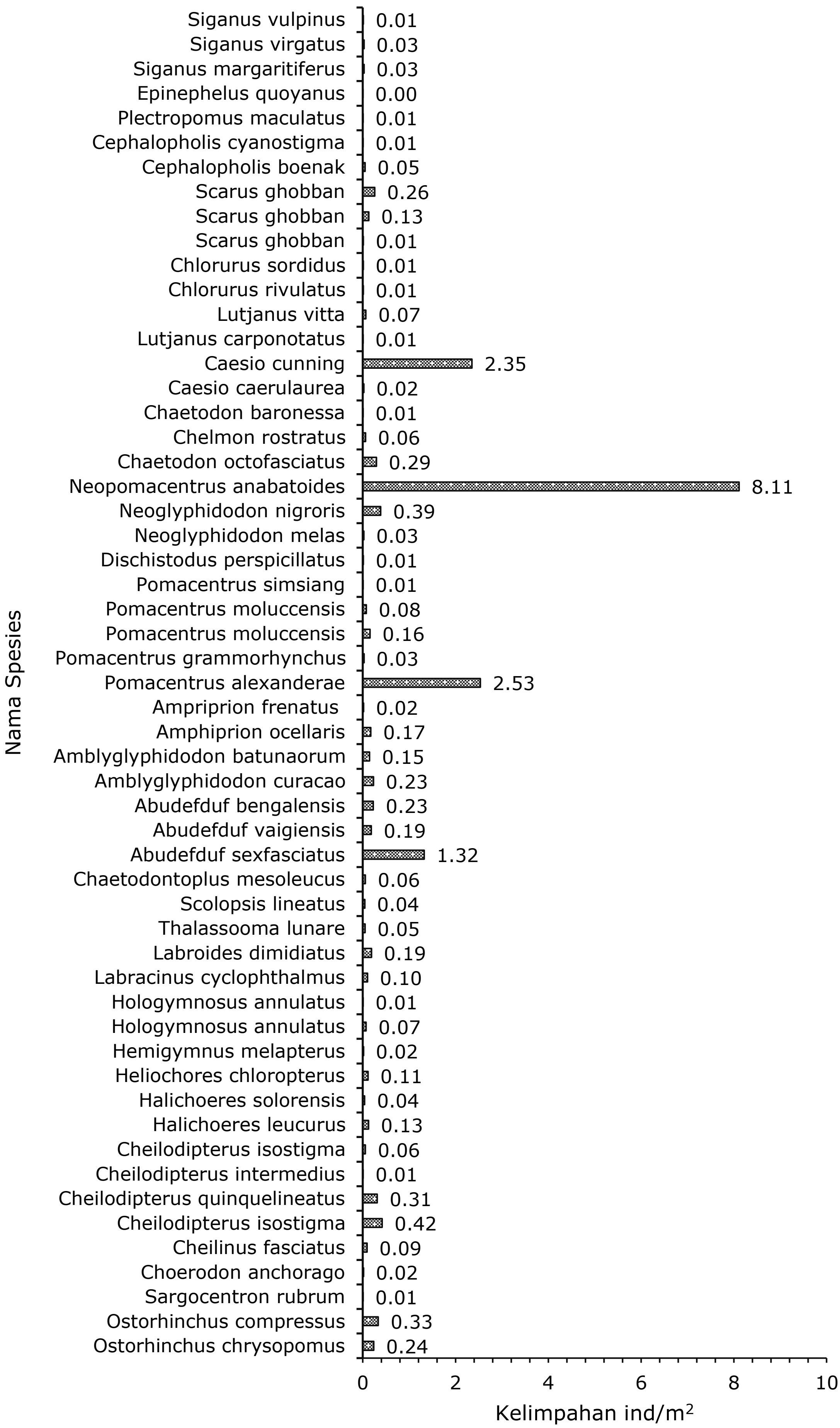


**Figure 3.** Fish abundance per spesies

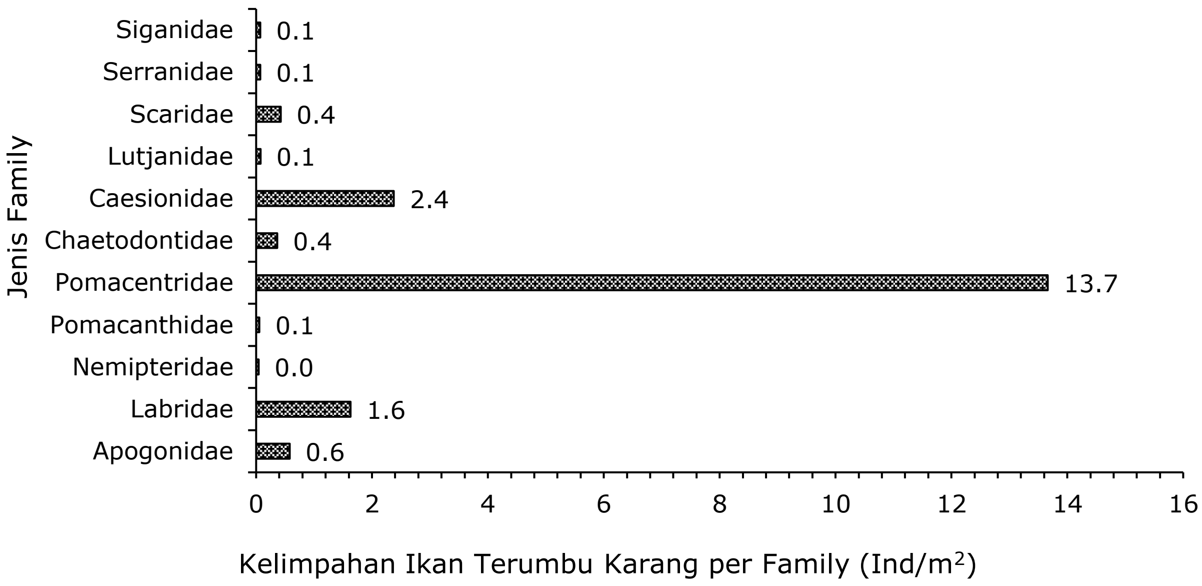


**Figure 4.** Fish abundance perfamily

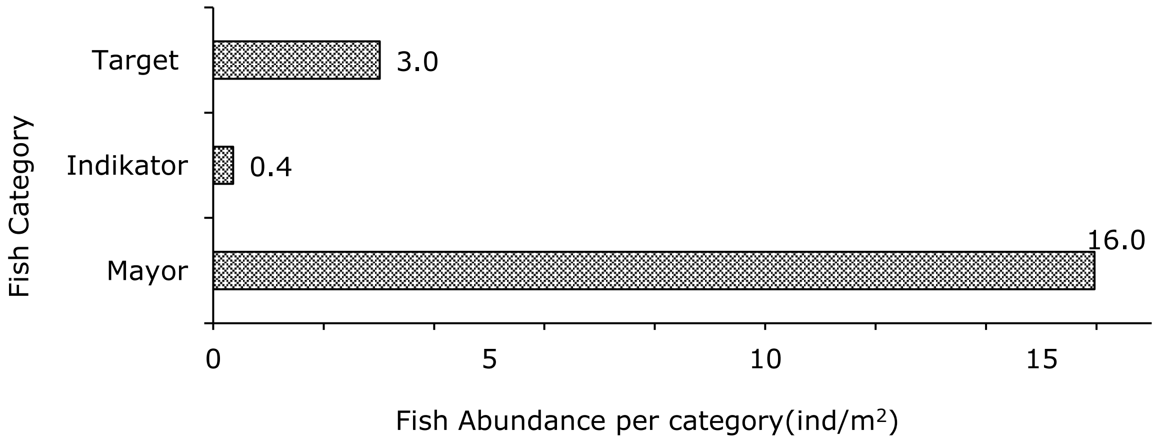


**Figure 4.** Fish Abundance per category

**Reef Fish**

In general, the reef fish abundance recorded in the waters of Gelasa Island is 49,114 individuals/ha, which falls into the "very rare" category. However, this abundance is relatively higher than that reported in several other studies in the waters of Bangka Island. For example, Ferizal *et al*. (2024) reported only 23,114 individuals/ha at four sampling stations in the waters of Tanjung Labu, while Adibrata *et al*. (2024) found 31,850 individuals/ha in Central Bangka at six sampling stations.

Based on reef fish abundance, the most abundant species is *Neopomacentrus anabatoides*, with 8.11 individuals/m², followed by *Pomacentrus alexanderae* with 2.53 individuals/m², and in third place *Caesio cunning* with 2.35 individuals/m².

From the species composition perspective, there are 56 species from 11 families of reef fish. The highest total abundance per family is Pomacentridae with 14 individuals/m², followed by Caesionidae with 2.4 individuals/m², and Labridae with 1.6 individuals/m². In terms of functional categories, major reef fish dominate in abundance with 16 individuals/m². The abundance and species composition of reef fish are illustrated in Figures 3, 4, and 5.

The high abundance of coral reef fish in the waters around Gelasa Island is attributed to the good water quality and healthy coral substrates. Coral reefs serve as habitats for fish to feed, hide from predators, play, and spawn. Species such as *Neopomacentrus anabatoides*, *Pomacentrus alexanderae*, *Abudefduf sexfasciatus*, and *Caesio cunning* were observed in large schools ranging from 10 to 500 individuals during surveys. This schooling behavior suggests that these species tend to live in groups, which helps them in food acquisition and protection against predators.

This observation aligns with studies by Edrus & Hadi (2020), Karim & Rifa (2020), Maisaroh *et al*. (2022), and Mujiyanto *et al*. (2021), which state that schooling fish habitats are typically found in lagoons, shallow coral areas, and near large branching coral colonies. The dominance of major fish groups in Gelasa waters also indicates lower exploitation of these species for ornamental purposes compared to target fish caught for consumption. Major fish tend to school and are less elusive compared to some target species, which are harder to find. This is supported by Coloay *et al*. (2022) and Titaheluw *et al*. (2021), who report that dominance of major species groups in coral reefs often correlates with higher fishing pressure on target consumptive species.

**Diversity, Evenness, and Dominance Indices**

The indices of diversity, evenness, and dominance reflect the balance of individual distribution among species and indicate the richness of reef fish species (Odum, 1959). The diversity index (H') of coral reef fish was 2.34, categorized as moderate The evenness index (E) was 0.58, indicating a labile (unstable) community. The dominance index (C) was 0.21, categorized as low dominance.
The moderate diversity index suggests a fairly diverse fish community, which is important for maintaining ecosystem balance, enabling complex species interactions, and providing stability against environmental changes. This is consistent with Nybakken (1993) who noted

*Caesio cunning*

*Pomacentrus alexanderae*

*Neopomacentrus anabatoides*

*Eretmochelys imbricata* (Appendix I)

*Tridacna squamosa* (Appendix II)

Cangkang Nautilus (Appendix II)

**Figure 6.** Protected species in the waters of Gelasa Island

that high diversity indicates a stable, comfortable environment, while low diversity signals an unstable, harsh environment.

The low evenness value indicates an uneven distribution of individuals among species, with some species nearly dominant and others less common. This suggests possible ecosystem stress or disturbances, likely due to factors such as climate change, overfishing, and pollution. Labile communities require special attention to understand the causes of uneven distribution and to implement measures for ecosystem balance. Nolan *et al*. (2019) highlighted that low evenness can indicate instability in community composition and serves as an important indicator of ecosystem health.

Low dominance implies that no single species overwhelmingly dominates the reef ecosystem, which is a positive sign of balanced species distribution. Balanced dominance reduces the risk of resource monopolization by one species, supporting ecosystem stability and resilience. Coral reefs with low dominance tend to be more resistant to disturbances and better able to adapt. This finding aligns with Yustiati *et al*. (2023), who stated that balanced species distribution enhances ecosystem stability by minimizing dominance by any single species.

Gelasa Island also hosts several species listed in the CITES Appendices, the list of species protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which can be accessed at https://checklist.cites.org/#/en. These species were found outside the observation transects, including the hawksbill turtle (*Eretmochelys imbricata*), Nautilus shells, and *Tridacna* clams. This finding is supported by the study of Adriyansyaha *et al*. (2023), which reported *Tridacna squamosa* and *Tridacna crocea* in the waters of Gelasa Island, as well as the research by Aisyah *et al*. (2021), which documented the presence of Nautilus in the waters of Bangka Belitung. Meanwhile, the Napoleon wrasse (*Cheilinus undulatus*) was not documented. However, this species' distribution is supported by Froese & Pauly (2022) at https://www.fishbase.se/summary/5604 and by the Mongabay electronic media edition dated May 11, 2022, regarding the waters of Gelasa Island at https://www.mongabay.co.id/2022/05/11/perairan-pulau-gelasa-sudah-semestinyadilindungi/. Further comprehensive studies are needed regarding the protected species in the waters of Gelasa Island. Field documentation is presented in Figure 6.

## CONCLUSION

The percentage of coral reef cover in the waters of Gelasa Island falls into the good category, with an average cover of 52.42%. The abundance of coral reef fish in the waters of Gelasa Island is 49,114 individuals per hectare. The composition of coral reef fish species found includes 56 species from 11 families. Based on species abundance, *Neopomacentrus anabatoides* has the highest abundance, followed by *Pomacentrus alexanderae* as the second highest, and *Caesio cunning* as the third. Based on categories, major fish species have the highest abundance. The diversity index falls into the moderate category, the evenness index indicates a labile (unstable) community, and the dominance index is in the low category.

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