

Colorful Life on Indonesia's: Coral Reefs Reveals Fish

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Abstract. Indonesia is known as an archipelago that has one of the richest marine ecosystems in the world, especially coral reefs. Indonesia's coral reefs, which are part of the world's coral reef triangle, provide habitat for various fish species that support the balance of marine ecosystems. This research was conducted through a literature study with the aim of revealing the diversity of fish species that inhabit coral reefs in Indonesia. Data were collected from various scientific sources and journals that discuss the condition of Indonesia's coral reef biodiversity. The study results show that coral reefs in Indonesia are home to more than 2,000 species of fish, ranging from herbivorous and carnivorous fish to species that play an important role in maintaining the health of coral reefs, such as reef fish (Pomacentrida). However, pressures from human activities, climate change and marine pollution pose serious threats to this diversity. The conclusion of this study emphasizes the diversity of coral reef ecosystems to maintain fish diversity and ecological balance in Indonesian waters.

1 Introduction

The incredible diversity of fish species that inhabit coral reefs forms a close-knit, interdependent community where each species plays a vital role in maintaining ecosystem balance [1]. The unique shapes and structures of coral reefs, built from limestone formations by coral colonies, make them ideal habitats for various fish species, offering protection and abundant resources [2]. Coral reefs, composed of symbiotic relationships between coral animals and zooxanthellae algae, are complex ecosystems that play a crucial role in marine biodiversity [3]. The algae perform photosynthesis, providing essential nutrients to the corals, which in turn serve as safe havens for fish and other marine life.

One of the primary functions of coral reefs is to provide habitat and protection [4]. The intricate structures of the reef, including crevices, caves, and hidden nooks, offer shelter

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from predators, especially for small or juvenile fish. These natural refuges allow fish populations to thrive within a safe and supportive environment [5]. Additionally, coral reefs are a cornerstone of the marine food web, supporting a complex food chain. Carnivorous fish like groupers and snappers prey on smaller fish and invertebrates, while herbivorous species like parrotfish graze on algae growing on the reefs. This recycling of nutrients ensures that food sources are consistently available, supporting a wide array of marine life [6-10].

Indonesia, the world's largest archipelago, is home to some of the richest coral reef ecosystems, covering approximately 75,000 km² and contributing around 12% to 15% of the world's coral reefs. With 362 species of scleractinian corals discovered, Indonesia stands as the epicenter of global coral diversity. Its reefs not only provide critical habitats for marine species but also act as breeding grounds. Many fish species rely on coral reefs for spawning and protecting their eggs, ensuring the survival of future generations. In this regard, Indonesia's reefs play a vital role in supporting fisheries, particularly for economically valuable species such as grouper, snapper, and shrimp [11-13].

Indonesia's coral reefs are among the most diverse globally, primarily due to their location in the "Coral Triangle," the heart of marine biodiversity. The Coral Triangle is home to more than 75% of the world's coral species, creating an ideal environment to sustain a wide range of marine organisms, including fish. The interconnectedness of Indonesia's coral reefs and fish diversity is reflected in the high number of fish species, estimated between 4,000 and 6,000, making the country's waters some of the richest in marine life globally. This immense biodiversity is essential not only for the health of marine ecosystems but also for the livelihoods of coastal communities, especially in fisheries and tourism sectors.

2 Research Method

This research uses a research method in the form of a literature study. Literature study research used to review a number of articles and reading sources that are relevant to the focus of the research studied. The relevant articles were then selected to be included in the material in the discussion section of this article. In addition, a review process was also carried out by looking at the background of the problem and discussion in a number of these articles. The literature reviewed is reputable articles and related sources both nationally and internationally that have discussed this study and conducted research on similar study topics.

3 Result and Discussion

3.1 Diversity of Coral Reefs in Indonesian

Coral reef ecosystems are dominated by stony corals and calcareous algae. Coral reefs are a collection of coral animals (reefcoral), which live at the bottom of the water and produce limestone CaCO₃ [14]. Coral reefs in Indonesia can be classified into at least four types: fringing reefs, patch reefs, barrier reefs, and atolls. Coral species in Indonesia are dominated by *Acropora* spp, *Montipora* spp and *Porites* spp with the number of coral species found in Indonesia around 590 from 82 genera [15].

In general, eastern regions of Indonesia such as Sulawesi, Maluku, Halmahera, West Papua, Bali, West Nusa Tenggara, and East Nusa Tenggara are areas with the most coral genera in Indonesia. This region is known as the world coral reef triangle, which is the center of the highest biodiversity of rock corals in the world. Based on data obtained from

the 2018 Indonesian Coral Reef Status book published by the LIPI Oceanographic Research Center, from a total of 1067 coral reef sites, as many as 386 sites fall into the poor category or around 36.18 percent of the total coral reef sites, 366 sites fall into the fair category or around 34.3 percent, 245 sites fall into the good category or around 22.96 percent and as many as 70 sites or around 6.56 percent fall into the excellent category [15].

In 2012 to 2019 there were 83 genera and more than 570 species of rock corals or 95% of the species recorded in the world's coral reef triangle or 69% of all coral reef species in the world [13] Coral reefs are also potential habitats for reef fish and other marine organisms such as algae, crabs, pearl oysters and sea cucumbers with potential fish stocks predicted to reach 80,802 tons/km² /year [1].

Various types of coral reefs in Indonesia are home to a variety of marine fish species, including some species that are commonly found in its waters. Some types of coral reefs that are home to various species of fish in Indonesia include:

1. *Acropora*.

Species such as *Acropora sukarnoi*, first described by Wallace in 1997 and found in Bali, demonstrate broad ecological flexibility, inhabiting both slopes and lagoons. This adaptability allows *A. sukarnoi* to thrive in a variety of environmental conditions, making it a vital component of the coral ecosystems across different regions in Indonesia.

The ecological roles of these corals are further illustrated by the variety of reef types they inhabit. Fringing reefs, which are closely connected to the shore, provide critical habitats for species like *Acropora russelli* and *Acropora sukarnoi*. These reefs benefit from nutrient inputs from land sources, supporting a diverse array of marine life. Barrier and patch reefs, which are more isolated from the shore, support species such as *Acropora loisetteae* and *Acropora batunai*, which are well-suited to the more protected environments these reef types provide. The nutrient-rich waters of these isolated reef systems allow these corals to flourish, forming essential components of the broader reef ecosystem [2].

2. *Pocillopora verrucosa*

Pocillopora verrucosa is a common species of stony coral belonging to the family Pocilloporidae. Known for its bushy appearance and small verrucae (wart-like growths), it forms colonies that can vary in color, ranging from pale pink to deep brown, sometimes with green hues. These corals are highly adaptable and play an essential role in the structural framework of coral reefs, contributing significantly to reef-building activities. *P. verrucosa* thrives in shallow reef environments, usually in areas with strong water movement, which helps provide the nutrients necessary for their growth. These corals are also important in maintaining biodiversity, as they provide shelter and habitat for various marine organisms, including fish and invertebrates.

Conservation efforts for coral reefs, particularly for species like *P. verrucosa*, are crucial in the face of threats such as coral bleaching, ocean acidification, and habitat destruction. The protection of these habitats is vital not only for the survival of coral species but also for the entire marine ecosystem that depends on them.

3. *Turbinaria mesenterina*,

Turbinaria mesenterina, commonly known as the scroll coral, is a significant coral species that contributes to the marine ecosystems of Indonesia. Characterized by its distinctive morphology, which resembles a series of flattened, scroll-like structures, this coral plays a crucial role in providing habitat and resources for a variety of marine organisms. Its unique

form not only adds to the aesthetic beauty of coral reefs but also enhances their structural complexity. In Indonesia, *T. mesenterina* thrives primarily in shallow waters of coral reef ecosystems, particularly in regions with moderate wave action and good water quality. This species is widely distributed throughout the archipelago, with notable populations found in locations such as Bali, West Sumatra, Lombok, the Karimunjawa Islands, the Wakatobi National Park, and the waters around Komodo National Park. The coral's adaptability to different light conditions and substrate types allows it to colonize diverse reef habitats, contributing to the overall biodiversity and resilience of these ecosystems [7,8].

4. *Favites complanata*

Favites complanata, commonly referred to as the pancake coral, is a significant coral species found in the coral reef ecosystems of Indonesia. This species is notable for its distinctive morphology, characterized by a flattened structure resembling a stack of pancakes. The coral is composed of large, rounded corallites that are densely packed, creating a robust framework that supports a diverse array of marine life [8].

In Indonesia, *Favites complanata* is primarily found in shallow reef environments, often inhabiting areas with moderate wave action and adequate light penetration. Key locations where this species thrives include the coral reefs of Bali, the Karimunjawa Islands, Wakatobi National Park, and the waters around Komodo National Park. Its adaptability to varying environmental conditions allows it to occupy diverse habitats across the Indonesian archipelago, contributing to the overall complexity and health of coral reef systems [9,10]

3.2 Fish Species that are distributed in areas with coral reef diversity in Indonesia

In Indonesia, numerous fish species thrive within coral reef ecosystems, which serve as their natural habitat. Coral reefs offer vital functions for these species, providing shelter, breeding grounds, and abundant food sources. Each region of Indonesia's coral reef waters boasts a unique array of fish species, reflecting the extraordinary diversity of the nation's marine biodiversity. The rich variety of fish found in these reefs plays a crucial role in sustaining the ecological balance of these ecosystems while also supporting local fisheries and marine tourism industries. For a detailed overview of the fish species distributed across different coral reef areas in Indonesia, refer to Table 1.

One of the species commonly found in Indonesian waters is *Lutjanus argentimaculatus*, a type of red snapper that inhabits the waters of Karimunjawa National Park, Jepara Regency. This species is highly valued both for its ecological role as a predator in reef systems and its importance in local fisheries. Its presence in this protected area highlights the significance of preserving marine habitats for both biodiversity and sustainable fishing practices. Another notable species is *Pomacentrus bankanensis*, a damselfish that thrives in the Sidodadi and Tegal Island Waters of Lampung Province. As a territorial species, *Pomacentrus bankanensis* often inhabits coral-rich areas where it helps maintain the balance of algae on the reefs. Its colorful appearance and ecological role make it a prominent feature of these reef environments.

Caesio cuning, a fusilier species, inhabits the Northern Waters of Bangkalan, where it plays an essential role in nutrient cycling within coral reefs. These fish are often found in schools and contribute to the resilience of coral reef ecosystems by promoting algal control and recycling nutrients through their feeding habits. The *Carangoides plagiotaenia*, or barcheek trevally, is another important species distributed in the Maba Sub-district of East Halmahera Regency, North Maluku Province. As a fast-swimming predator, this species is

integral to maintaining the food web dynamics in coral reef ecosystems, preying on smaller fish and invertebrates.

Table 1. Fish species names and locations

Name of Species	Location of Indonesia's Coral Reef Waters
<i>Lutjanus argentimaculatus</i>	Waters of Karimunjawa National Park, Jepara Regency
<i>Pomacentrus bankanensis</i>	Sidodadi and Tegal Island Waters, Lampung Province
<i>Chaetodon trifasciatus</i>	Sambangan Island, Karimun Jawa Islands, Jepara, Central Java
<i>Chaetodontidae collare</i>	Mouse Island Waters
<i>Caesio cuning</i>	Northern Waters of Bangkalan
<i>Carangoides plagiotaenia</i>	Maba Sub-district, East Halmahera Regency, North Maluku Province
<i>Lutjanidae</i> Sp.	Gili Matra waters, West Nusa Tenggara
<i>Tylosurus crocodiles</i>	Pulau Sibu, Kecamatan Oba Utara, Kota Tidore Kepulauan
<i>Pomacentridae</i> Sp.	Waters of Waigoiyofa Village, Sula Islands Regency
<i>Chlorurus microrhinos</i>	Sub-district Pulau Tiga Natuna Regency
<i>Haemulidae</i> Sp.	The waters of Maitara Island
<i>Neoglyphidodon nigroris</i>	Ketawai Island and Gusung Asam Island, Central Bangka Regency

In the Gili Matra waters of West Nusa Tenggara, species from the Lutjanidae family are commonly found. These snappers are crucial for reef ecosystems as they occupy various trophic levels, contributing to both predation and nutrient cycling, which helps sustain the health and balance of coral reefs. Another unique species is the *Tylosurus crocodiles*, commonly known as crocodile needlefish, found in the waters around Pulau Sibu, North Tidore. Its slender, elongated body and predatory habits make it a distinctive feature of the region's coral reefs, playing a crucial role in the local marine food chain.

Finally, the *Neoglyphidodon nigroris*, a damselfish species, inhabits Ketawai Island and Gusung Asam Island, Central Bangka Regency. This species is highly territorial and often resides in branching corals, providing both protection and food for itself. It plays a vital role in maintaining the health of coral ecosystems by managing algal growth and providing shelter for smaller marine organisms.

The incredible variety of fish species found throughout Indonesia's coral reef ecosystems reflects the region's marine richness. The health of these coral reefs is vital not only for the biodiversity they support but also for the livelihoods of coastal communities who depend on them for fishing and ecotourism. With proper conservation and management efforts, Indonesia's coral reefs can continue to sustain their vibrant marine life for future generations.

4 Conclusion

The conclusion of this discussion is that Indonesia, as an archipelago with one of the richest marine ecosystems in the world, has very diverse coral reefs and is an important habitat for various types of fish. Indonesia's coral reefs, which are part of the Coral Triangle, support more than 2,000 species of fish that play an important role in maintaining the balance of the marine ecosystem. Various fish species utilize coral reef structures for shelter, foraging, and breeding. For example, fish species such as *Lutjanus argentimaculatus*, *Chaetodon trifasciatus*, and *Carangoides plagiotaenia* are found in many coral reefs in Indonesia. Therefore, the conservation of coral reefs is very important to maintain the survival of fish and marine ecosystems.

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