Journal on Biology and Instruction (JouBIns)
Vol. 4 No. 2 Tahun 2024 | 51 – 60
ISSN 2978-0863

Diversity and Conservation: Coral Reefs in Lhok Mata-IE Ujung Pancu Aceh Besar

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Article information
Article history
Received November 16, 2024
Revised December 12, 2024
Accepted December 29, 2024

Kata kunci:
Keanekaragaman
Terumbu Karang
Pelestarian
Ekosistem
Laut

ABSTRAK

Keanekaragaman terumbu karang merupakan indikator penting kesehatan ekosistem laut dan kesejahteraan masyarakat pesisir. Penelitian ini bertujuan untuk mengidentifikasi keanekaragaman spesies terumbu karang dan upaya konservasinya di Lhok Mata-Ie Ujung Pancu, Aceh Besar, dengan menggunakan metode survei transek kuadrat. Hasil penelitian menunjukkan keanekaragaman yang tinggi, didominasi oleh spesies karang keras seperti Acropora, Montipora, dan Porites. Namun, kawasan ini menghadapi ancaman serius dari penangkapan ikan ilegal, polusi, dan dampak perubahan iklim. Sebagai tanggapan, masyarakat lokal, pemerintah, dan LSM telah menerapkan berbagai langkah konservasi, termasuk pembentukan kawasan lindung dan program penanaman kembali karang. Upaya tersebut membutuhkan kolaborasi lintas sektor untuk menyeimbangkan pemanfaatan sumber daya alam dengan perlindungan ekosistem. Penelitian ini memberikan landasan yang kuat untuk pengelolaan berkelanjutan wilayah pesisir dan terumbu karang di masa depan.

Keywords:
Diversity,
Coral reefs
Marine conservation
Transect survey
Climate change

ABSTRACT

Diversity and Conservation: Coral Reefs in Lhok Mata-IE Ujung Pancu Aceh Besar. Coral reef diversity is a crucial indicator of marine ecosystems' health and coastal communities' well-being. This study aims to identify the diversity of coral reef species and their conservation efforts in Lhok Mata-Ie Ujung Pancu, Aceh Besar, using the quadratic transect survey method. The results show high diversity, dominated by hard coral species such as Acropora, Montipora, and Porites. However, the region faces serious threats from illegal fishing, pollution, and the impacts of climate change. In response, local communities, governments, and NGOs have implemented various conservation measures, including the establishment of protected areas and coral replanting programs. Such efforts require cross-sector collaboration to balance natural resource utilization with ecosystem protection. This research provides a solid foundation for the sustainable management of coastal areas and coral reefs in the future.

INTRODUCTION

Coral reef diversity is one of the important aspects of the marine ecosystem which has a vital role as a habitat for various types of marine life, as well as supporting the balance of the aquatic ecosystem. The existence of coral reefs also has high economic value, both as a marine tourist attraction and natural resources for various fishery activities. In Indonesia, one of the regions that is famous for its coral reef diversity is Lhok Mata-Ie Ujung Pancu, Aceh Besar (Rudi & Sihombing, 2020). Lhok Mata-Ie Ujung Pancu is a coastal area that has a fairly good coral reef ecosystem. However, in recent years, coral reefs in the region have been damaged due to various factors, such as climate change, human activities (especially destructive fishing), and pollution (Burke et al., 2011). This situation requires serious attention to maintain the sustainability of coral reefs as well as the biodiversity that depends on them. Efforts to preserve coral reefs in this region are crucial to prevent further damage and restore ecosystems to healthier conditions. Various initiatives have been carried out by local communities, governments, and non-governmental organizations in the context of coral reef restoration and conservation. One of the approaches used is by rehabilitating coral reefs and strengthening community capacity in sustainable natural resource management (Firdaus & Wibowo, 2019). In addition, the implementation of marine protected areas and community education have also proven to be effective in maintaining the sustainability of this ecosystem (Lubis & Putra, 2018).

Coral reefs are among the most biologically diverse ecosystems on Earth, serving as biodiversity hotspots. These reefs provide habitat and protection for approximately 25% of all marine species, including fish, mollusks, and crustaceans. They play a crucial role in marine food chains, supporting fisheries that sustain millions of people worldwide. Additionally, coral reefs contribute to coastal protection by acting as natural barriers against waves and storms, reducing the risk of coastal erosion, and safeguarding shorelines. Their ecological significance also includes their role in nutrient cycling and carbon storage, making them essential for overall ocean health..

The coral reef ecosystem in Lhok Mata-IE Ujung Pancu is characterized by remarkable species richness and structural complexity. The reef supports a wide variety of coral species, fish populations, and other marine organisms, forming intricate ecological interactions. The reef structure includes various formations such as fringing reefs, patch reefs, and coral bommies, which provide essential habitats for marine life. Oceanographic conditions in this region, such as water temperature and currents, influence coral growth and species distribution, making it a unique and ecologically significant site in Aceh Besar.

Despite their ecological importance, coral reefs in Aceh Besar, including those in Lhok Mata-IE Ujung Pancu, face multiple threats. Ocean warming due to climate change causes coral bleaching, which weakens reef resilience and disrupts marine ecosystems. Ocean acidification further hinders coral growth by reducing calcium carbonate availability. Human activities such as pollution from coastal development, plastic waste, and agricultural runoff degrade water quality, negatively impacting coral health. Overfishing and destructive fishing practices, including the use of explosives and cyanide, contribute to reef degradation, disrupting ecological balance and reducing fish stocks.

Several conservation initiatives have been implemented to protect and restore coral reef ecosystems in Aceh Besar. Local community involvement plays a crucial role in reef conservation through sustainable fishing practices, marine protected areas, and habitat restoration projects. Government policies and regulations aim to mitigate environmental threats by enforcing fishing restrictions and promoting sustainable tourism. Scientific approaches, such as coral transplantation and reef monitoring programs, contribute to ecosystem recovery. However, challenges remain, including limited enforcement of conservation policies, lack of funding, and the ongoing impacts of climate change, necessitating continuous efforts and innovative solutions.

This study is significant in supporting marine biodiversity conservation and sustainable coastal management in Aceh Besar. By providing valuable ecological data, it helps in understanding reef health, species diversity, and ecosystem dynamics. The research supports evidence-based policy making for marine resource management and raises awareness of the urgent need for coral reef conservation. Ultimately, these efforts ensure the long-term sustainability of coral reef ecosystems, benefiting both marine life and local communities that depend on these vital resources.

This study aims to examine the diversity of coral reefs in Lhok Mata-Ie Ujung Pancu as well as the conservation efforts that have been made to preserve the ecosystem. By knowing the level of diversity and the challenges faced, it is hoped that more effective solutions can be found in the conservation of coral reefs in the region. Given the importance of the role of coral reefs in the Lhok mata-ie coastal area, it is necessary to conduct a study entitled "Coral Reef Diversity and Conservation Efforts in Lhok Mata-Ie Ujung Pancu, Aceh Besar".

METHOD

This research was conducted in the neritic zone of Lhok Mata-Ie Ujung Pancu, Peukan Bada District, Aceh Besar Regency. The research site is 1 km² in size, consisting of 500 m long and 500 m wide. The research activity was carried out in August 2023.

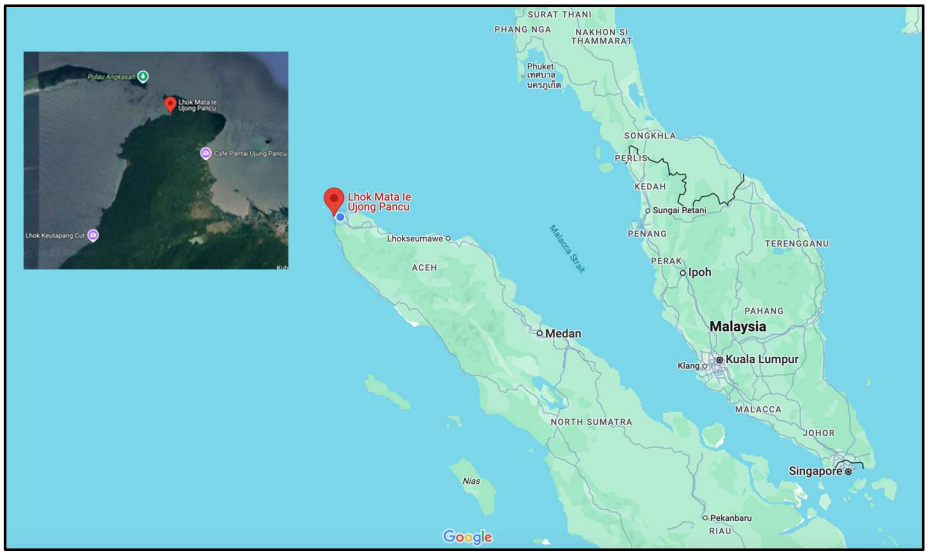

Figure 1. Research location

The tools and materials used in this study are diving goggles (mask), snorkel (water breathing aid), fins (foot swimming aid), and Canon IXUS 800 IS underwater camera (6 Mega Pixel). The material is in the form of underwater stationery (saekodive)/recording observation data and an identity guidebook (types of corals in Indonesia by Suharsono)/as a source of research.

The location selection was determined at the time of the initial survey by diving, to find out the existence of coral reefs. Coral reef data collection is carried out at high tide and low tide by taking pictures of the observed coral reefs using underwater cameras. Each coral reef species found is immediately recorded and photographed to identify it according to the literature.

The coral reef species obtained are classified and presented in the form of a table. The density of coral reef colonies found in the neritic zone of Lhok Mata-Ie Ujung Pancu Beach, Peukan Bada District, Aceh Besar Regency uses the following formula (1).

$$colony\ density = \frac{\sum \textbf{colonies for all species}}{\textbf{transect area}} \ldots\ldots \textbf{(1)}$$

To calculate the level of coral reef damage using the mortality index formula with the following formulation (2).

$$MI = \frac{\textbf{percentage of dead coral}}{\textbf{percentage of dead coral+percentage of live coral}} \text{ ..... (2)}$$

Information:

The MI value has a range between 0-1, if the MI value is close to 0, it means that the condition of the coral reef is said to have a low mortality ratio or a high level of health. An MI value close to 1 means that the condition of coral reefs is said to have a large mortality ratio or a low level of health.

RESULTS AND DISCUSSION

The results of the research that has been carried out in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency in August 2023 contain 14 species from 3 coral reef families. The composition of the species is represented by 10 species from the *Acroporidae* family, 1 species from the *Poritidae* family and 3 species from the *Pocilloporidae* family. The highest group in this observation is from the genus *Montipora* whose species is *Montipora foliosa*.

Table 1. Coral Reef Species Found in the Neritic Zone of the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency

No	Famili	No	Genus	No	Spesies
1.	Acroporidae	1	*Acropora*	1	*Acropora accuminata*
				2	*Acropora palifera*
				3	*Acropora formosa*
				4	*Acropora digitifera*
				5	*Acropora hyacinthus*
				6	*Acropora rosaria*
				7	*Acropora gemmifera*
				8	*Acropora clathrata*
				9	*Acropora humilis*
		2	*Montifora*	10	*Montifora foliosa*
2.	Poritidae	3	*Porites*	11	*Porites mayeri*
3.	Pocilloporidae	4	*pocillopora*	12	*pocillopora maendrina*
				13	*Pocillopora eydouxi*
				14	*Pocillopora woodjonesi*

Source: Research results

Research in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency, succeeded in identifying 14 coral reef species belonging to 3 families and 4 genera. From the family *Acroporidae*, 9 species were found in the genus *Acropora*, including *Acropora accuminata*, *Acropora palifera*, and *Acropora hyacinthus*, as well as one species from the genus *Montipora*, namely *Montipora foliosa*. In the family *Poritidae*, 1 species of the genus *Porites*, namely *Porites mayeri*, while in the family *Pocilloporidae*, 3 species of the genus *Pocillopora* were found, namely *Pocillopora maendrina*, *Pocillopora eydouxi*, and *Pocillopora woodjonesi*. These findings show the diversity of coral reef ecosystems in the region, with species from the *Acroporidae* family *predominating* as the most widely found coral reef group.

Table 2. Colony Density for All Coral Reef Species in the Research Area in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency

No	Species Name	Number of Colonies	Colony Density (∑ Colony/ Area Size)	Information
1	*Acropora accuminata*	8	1000	Good condition
2	*Acropora palifera*	3		Good condition
3	*Acropora formosa*	3		Good condition
4	*Acropora digitifera*	2		Good condition
5	*Acropora hyacinthus*	11		1 *Acropora hyacinthus* colonies bleached
6	*Acropora rosaria*	15		Good condition
7	*Acropora gemmifera*	5		Good condition
8	*Acropora clathrata*	7		Good condition
9	*Acropora humilis*	1		Good condition
10	*Montipora foliosa*	40		3 colonies of Montipora foliosa species broke
11	*Porites mayeri*	1		Good condition
12	*pocillopora maendrina*	14		Good condition
13	*Pocillopora eydouxi*	4		Good condition
14	*Pocillopora woodjonesi*	6		Good condition

Source: Research results

Research in the Lhok Mata-Ie Ujung Pancu Neritic Zone recorded the findings of various coral reef species with mostly good conditions. Among them, *Acropora accuminata* (8 colonies), *Acropora palifera* (3 colonies), *Acropora formosa* (3 colonies), and *Acropora digitifera* (2 colonies) are all in good condition, as are *Acropora rosaria* (15 colonies), *Acropora gemmifera* (5 colonies), *Acropora clathrata* (7 colonies), and *Acropora humilis* (1 colony). However, *Acropora hyacinthus*(11 colonies) experienced bleaching in one colony. The species *Montipora foliosa* has 40 colonies, with 3 colonies experiencing fractures. In addition, *Porites mayeri* (1 colony) and several species of *Pocillopora* such as *Pocillopora maendrina* (14 colonies), *Pocillopora eydouxi* (4 colonies), and *Pocillopora woodjonesi* (6 colonies) were also found in good condition. Most of the coral reef colonies in the region are in good health, although there has been some minor damage.

Coral Reef Colony Damage Rate

The results of coral reef research that have been carried out in the Neritic zone of Lhok Mata-Ie Ujung Pancu, Peukan Bada District, Aceh Besar Regency, there are several spesie of coral reefs whose body conditions are damaged due to high water temperatures so that bleaching and fractures occur due to being stepped on by humans. The results of observations in the research area, there were 1 *Acropora hyacinthus* that underwent bleaching, then there were 3 colonies of *Montipora foliosa* whose body parts were broken. The level of damage to coral reef colonies found in the research area in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada Aceh Besar District, can be seen in the following diagram.

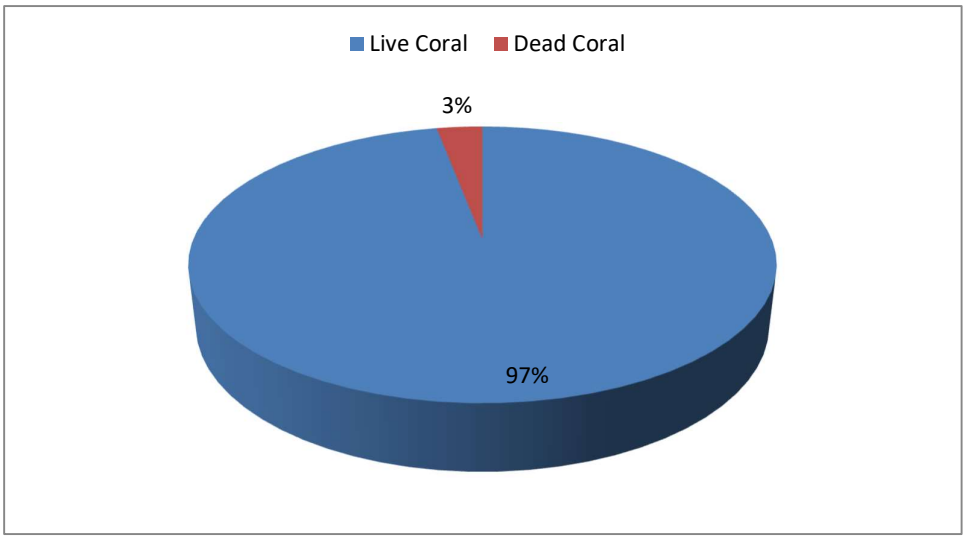

Figure 2. Diagram of Percentage Coral Reef Damage

Based on the Figure 2 shows that only 3% of coral reefs are damaged, while the other 97% of coral reefs are in good condition. Based on the percentage chart above, the level of coral reef damage in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency can be obtained as shown in Table 3.

Table 3. The level of coral reef damage in the Lhok Mata-Ie Neritic Zone, Peukan Bada District, Aceh Besar Regency

No	Species Name	Damage Rate (%)	Total (%)
1	*Acropora accuminata*	0	0
2	*Acropora palifera*	0	0
3	*Acropora Formosa*	0	0
4	*Acropora digitifera*	0	0
5	*Acropora hyacinthus*	1	1
6	*Acropora rosaria*	0	0
7	*Acropora gemmifera*	0	0
8	*Acropora clathrate*	0	0
9	*Acropora humilis*	0	0
10	*Montipora foliosa*	2	2
11	*Porites mayeri*	0	0
12	*Pocillopora meandrina*	0	0
13	*Pocillopora eydouxi*	0	0
14	*Pocillopora woodjonesi*	0	0

Source: Research results

Based on the table 3, coral reef damage in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency ranges from 0-3%. The highest damage was suffered by *Montipora foliosa*.

Coral Reef Protection Status

The status of coral reef protection in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency can be observed in the following table. Table of Coral Reef Protection Status in the Neritic Zone of Lhok Mata-Ie Ujung Pancu, Peukan Bada District, Aceh Besar Regency.

Table 4. Protection status of the corals

No	Species Name	Protection Status	
		Protected	Not covered
1	*Acropora accuminata*	-	√
2	*Acropora palifera*	-	√
3	*Acropora formosa*	-	√
4	*Acropora digitifera*	-	√
5	*Acropora hyacinthus*	-	√
6	*Acropora rosaria*	-	√
7	*Acropora gemmifera*	-	√
8	*Acropora clathrata*	-	√
9	*Acropora humilis*	-	√
10	*Montipora foliosa*	-	√
11	*Porites mayeri*	-	√
12	*Pocillopora meandrina*	-	√
13	*Pocillopora eydouxi*	-	√
14	*Pocillopora woodjonesi*	-	√

Source: Research results

In the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency, all coral reef species found, including the genera *Acropora*, *Montipora, Porites*, and *Pocillopora*, are not currently protected by species protection regulations. It includes 14 species found in the study, such as *Acropora accuminata, Acropora palifera, Acropora formosa, Acropora digitifera, Acropora hyacinthus, Acropora rosaria, Acropora gemmifera, Acropora clathrata, Acropora humilis, Montipora foliosa, Porites mayeri, Pocillopora maendrina, Pocillopora eydouxi*, and *Pocillopora woodjonesi*. Although these species have an important role in coral reef ecosystems, their existence has not been covered by official protection policies. Therefore, further efforts are needed to develop and implement more effective protection policies to maintain the preservation and sustainability of coral reef ecosystems in this region.

In the Lhok Mata-Ie Ujung Pancu area, Peukan Bada District, Aceh Besar Regency, 14 species of coral reefs were found. One of the species that most dominates the waters in this area is *Acropora* spp., which grows at a depth of 3-5 meters. The existence of *Acropora* spp. ini is greatly influenced by the favorable water temperature and the appropriate depth of water as a natural habitat for the species. *Acropora* coral reefs are known to have a fast growth rate and can grow at relatively shallower depths, such as in the Lhok Mata-Ie area. According to research by Suryawan et al. (2015), *Acropora* spp. is often found in waters that have a stable temperature, ranging from 26-30°C, which supports its metabolism and growth optimally.

The existence of *Acropora* is also influenced by other environmental factors, such as depth, currents, and water brightness, all of which can be found in this region, making it an ideal location for these coral reefs to thrive. In addition to *Acropora* spp., other species such as *Pocillopora* spp., *Montipora* spp., and *Porites* spp., are also found, which are more commonly found at slightly deeper depths or in areas with stronger currents. This diversity of species shows that the coral reef area in Lhok Mata-Ie is a very important ecosystem for the survival of various coral species and other marine organisms.

Research by Wijayanti et al. (2017) shows that the diversity of coral reefs in the Aceh Besar region, especially in the coastal area of Lhok Mata-Ie, plays an important role in supporting a healthy and productive marine ecosystem. The well-growing coral reefs in the region also support the existence of various species of reef fish and other marine life, which contributes to the balance of coastal ecosystems

Coral Reef Colony Density in the Lhok Mata-Ie Neritic Zone

Based on the results of research conducted in the Lhok Mata-Ie Neritic Zone area, the density of coral reef colonies was recorded in the range of 0.12 colonies per km². This density shows that although the waters have several living coral reef species, the number of coral reef colonies in this area is relatively low when compared to other more species-rich coral reef areas. Despite this, the existence of existing coral reefs still plays an important role in supporting biodiversity. Along with the many species of coral reefs in a water, there are also more and more other species that can live in it, such as ornamental fish, shrimp, and various other marine life. This is in accordance with the opinion of Grufron (2010:74) who states that coral reef ecosystems are very important habitats for thousands of marine biota, both temporary and permanent, such as coral animals, anemones, and clams. The presence of coral reefs also creates three-dimensional structures that become shelters, forages, and breeding grounds for various marine organisms. The high density of coral reefs also provides great ecological benefits to the coastal environment. One of them is the ability of coral reefs to withstand waves and ocean currents which can reduce coastal erosion. This phenomenon has direct implications for the protection of coastlines from abrasion that can damage coastal habitats and threaten the lives of communities that depend on coastal resources. According to Supriharyono (2000:9), naturally, coral reefs can function as an effective barrier against waves and ocean currents, thus protecting the coast from the danger of abrasion caused by ocean dynamics. The importance of the role of coral reef ecosystems in supporting coastal resilience to climate change is also revealed by recent research from Harris et al. (2020), which shows that the existence of healthy coral reefs can reduce the impact of high waves and tropical storms on coastal areas, providing more effective protection for coastal communities and infrastructure along the coast. In addition to their ecological benefits, coral reefs also make a great contribution to the economy of coastal communities, especially in the tourism and fisheries sectors. The existence of dense coral reefs supports marine ecosystems rich in biodiversity, which in turn increases the potential of natural resources that can be utilized by local communities.

Damage level of Coral Reef Colonies in the Neritic Zone of Lhok Mata-Ie

The level of damage to coral reef colonies in the Lhok Mata-Ie neritic zone is relatively low, ranging from 0 to 3%. The greatest damage was recorded in the species *Montipora foliosa*, while the lowest damage occurred in *Acropora hyacinthus*. This phenomenon indicates that there is a variation in vulnerability between different coral reef species in the region. The damage experienced by *Montipora foliosa* is caused by its fragile physical nature. This species has a sheet-shaped structure that resembles a cabbage leaf, which makes it particularly susceptible to mechanical damage, especially if it is stepped on or exposed to other physical stresses. As Gilmour et al. (2021) explain, the fragmatic or sheet structure on corals often makes them more susceptible to fracture due to impact or direct contact with other organisms, potentially reducing the resilience of the coral reef. On the other hand, damage to *Acropora hyacinthus* is more related to the bleaching phenomenon caused by high seawater temperatures.

Bleaching occurs when seawater temperatures experience a significant increase, causing disruption to the symbiotic relationship between corals and zooxanthellae, microscopic algae that provide energy to corals through photosynthesis. When seawater temperatures are too high, zooxanthellae will detach from the coral polyp network, leading to a loss of coral color and a decrease in their photosynthetic ability, which in turn affects the overall health of the coral reef. This process has been discussed in depth by van Oppen et al. (2021), who revealed that coral bleaching can occur in response to environmental stress, especially abnormal temperature increases.

The drastic increase in ocean temperatures due to global climate change has become a major cause of coral reef bleaching in many parts of the world, including in the tropics. According to Hughes et al. (2017), more frequent and intensive coral bleaching can reduce the biodiversity and survival of coral reef ecosystems. If bleaching lasts for a long time, it can lead to continued coral deaths, which has an impact on the loss of habitats important for various marine species. Thus, although the damage that occurred in Lhok Mata-Ie was relatively low, the bleaching threat that occurred in *Acropora hyacinthus* shows how important sea temperature monitoring and

conservation efforts are to maintain the sustainability of coral reef ecosystems that are vulnerable to climate change.

Coral Reef Protection Status

The coral reef species found in Lhok Mata-Ie Ujung Pancu, Aceh Besar Regency, include several species that are generally not included in the protected category. These species include *Acropora accuminata, Acropora palifera, Acropora formosa, Acropora digitifera, Acropora hyacinthus, Acropora rosaria, Acropora gemmifera, Acropora clathrata, Acropora humilis, Montipora foliosa, Porites mayeri, Pocillopora meandrina, Pocillopora eydouxi*, and *Pocillopora woodjoesi*. Based on the Decree of the Minister of Forestry No. 12/KPTS-11/Um/1987, which regulates the list of protected marine life, only the Bahar root species (*Antiphates* spp), known as Black Coral, is recognized as a protected coral reef in Indonesia. However, in a study conducted in the Lhok Mata-Ie Ujung Pancu neritic zone, the presence of *Antiphates* spp was not found, which indicates that the species does not exist in the area.

However, the community around Lhok Mata-Ie Ujung Pancu Beach has made efforts to protect the coral reef ecosystem and its habitat. This is in line with the provisions stipulated in Law of the Republic of Indonesia No. 27 of 2007, especially in Article 28 paragraph (3), which mandates that conservation areas that have characteristics as a single ecosystem must be protected for the purpose of maintaining: a) Fish resources; b) Stopover places and/or other migration channels of marine life; c) Territories regulated by certain customs, such as sasi, mane'e, panglima laot, awig-awig, and/or other terms of certain customs; and d) Coastal ecosystems that are unique and/or vulnerable to change. This community-based management practice contributes to the preservation of coral reefs and supports the preservation of coastal ecosystems that are vulnerable to the threat of environmental change.

The community's efforts to protect the coral reef ecosystem at Lhok Mata-Ie Ujung Pancu have significant implications for marine life and align with the Sustainable Development Goals (SDGs). These conservation initiatives support SDG 14 (Life Below Water) by ensuring the survival of marine species that depend on coral reefs for shelter, breeding, and food. Healthy coral ecosystems also sustain fish populations, benefiting fisheries and food security for coastal communities. Additionally, these efforts contribute to SDG 13 (Climate Action) by preserving coral reefs, which act as carbon sinks and natural barriers against coastal erosion, helping to mitigate the effects of climate change. From a socioeconomic perspective, protecting coral reefs aligns with SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth) by supporting sustainable fisheries and ecotourism, creating economic opportunities, and empowering local communities through traditional resource management practices such as sasi and panglima laot. Moreover, coral reef conservation plays a vital role in maintaining water quality and biodiversity, contributing to SDG 6 (Clean Water and Sanitation) and SDG 15 (Life on Land) by preventing pollution and ensuring ecosystem stability. Overall, these efforts help sustain marine biodiversity, enhance climate resilience, and promote sustainable coastal livelihoods, reinforcing the importance of community-led conservation in achieving global sustainability goals.

Based on the latest research and findings, community-based conservation has proven to be effective in strengthening the resilience of coral reef ecosystems to damage caused by human activities and climate change. For example, communities living around coral reef areas in Lhok Mata-Ie often implement customary-based management systems governed by local laws, which support coastal ecosystem protection efforts (Badruddin et al., 2020).

The success of coral reef ecosystem management through this community-based conservation approach is also evidenced by research by Wibowo et al. (2021), which shows that the implementation of custom-based management systems has the potential to improve the sustainability of coastal resources, including coral reefs, by minimizing damage due to unsustainable exploitation. This approach is in line with the Indonesian government's efforts to implement more inclusive policies to protect coral reefs and coastal ecosystems.

CONCLUSION

Based on the results of the research conducted in the Lhok Mata-Ie Ujung Pancu Neritic Zone, Peukan Bada District, Aceh Besar Regency, it can be concluded that this area has a fairly high potential for coral reef diversity even though it is in a vulnerable condition. This study recorded 14 coral reef species the accros 4 genera, and 3 families. The diversity of these coral reef species shows that the area has a diverse coral reef ecosystem, although it has not yet reached a very high level of diversity. The density of coral reef colonies in this area was recorded at 0.12 colonies per km², indicating a relatively low level of density. This can be caused by a variety of factors, including the physical condition of the waters, depth, and other environmental factors that affect the distribution and growth of coral reef colonies. Although the density of coral reef colonies tends to be low, the level of damage to coral reefs in the Lhok Mata-Ie Ujung Pancu Neritic Zone is relatively low. Damage is mainly observed in some species, such as *Acropora hyacinthus* and *Montipora foliosa*, but the impact of the damage has not reached a significant level to threaten the survival of the coral reef ecosystem as a whole. In terms of protection, coral reef species found in the region are not yet included in the list of protected species, indicating the need for stricter policies and regulations in efforts to conserve and protect coral reef ecosystems in the region. Overall, although the Lhok Mata-Ie Ujung Pancu Neritic Zone still has good coral reef ecosystem potential, the existing density and colony damage conditions show that there are challenges in maintaining the sustainability of this ecosystem. Therefore, more intensive conservation efforts, such as coral reef rehabilitation and protection of vulnerable coral reef species, are needed to maintain the sustainability of this ecosystem in the future.

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