Journal of Coastal and Ocean Sciences *e-issn: 2746-4512*
Volume 6 No. 1, January 2025: 23-29 *p-issn: 2745-4355*

Abundance and Diversity of Mushroom Coral of the Fungiidae in the Waters of Pasumpahan Island, West Sumatra

Farrel Pratama[1*], Thamrin[1], Irvina Nurrachmi[1]
[1]Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau, Pekanbaru 28293 Indonesia
Corresponding Author: farrel.pratama3017@student.unri.ac.id

Received: 14 November 2024; Accepted: 14 December 2024

ABSTRACT

Mushroom coral (Fungiidae) is one of the families of hard corals (scleractinian) that live off the substrate (free-living), and most of the mushroom coral habitat is found on the reef slope, which has a substrate of broken coral. This study aimed to analyze the abundance and diversity and determine the differences in abundance of mushroom corals at different depths. This research was conducted in March 2024 in Pasumpahan Island, West Sumatra. This study used the survey method and belt transect method. The sampling location was divided into three stations consisting of 3 sampling points. Station I is located in the tourist area, Station II is in the dock area, and Station III is in the area facing the open sea. The results showed that the highest abundance based on depth was found at station III with a depth of 7 m, namely 4357.14 ind/Ha and the lowest abundance at station II with a depth of 5 m, namely 1285.71 ind/Ha. The t-test results obtained a significant value of less than 0.05, namely 0.048, which means that the abundance of mushroom corals at different depths is significantly different. The diversity index ranges from 1.930 to 2.013, which shows that the level of diversity of mushroom corals in the waters of Pasumpahan Island is classified as moderate.

Keywords: Abundance, Diversity, Mushroom Corals, Pasumpahan Island

1. INTRODUCTION

Global Indonesia is located right at the center of the "coral triangle", an area of coral reefs with the highest marine biodiversity in the world (Giyanto et al., 2014). Coral reefs are a group of animals belonging to the phylum Coelenterata (hollow), and many come from the phylum Cnidaria (stingers) that can produce an exoskeleton in the form of calcium carbonate ($CaCO_3$) (Moira & Luthfi, 2020). According to Cappenberg & Akbar (2020), if a coral reef ecosystem is healthy, the biota that live in the ecosystem will be more diverse and rich. Coral reef ecosystems dominated by hard corals are found in almost all tropical marine waters, and their existence is very important for the lives of organisms that exist in them and those associated with them. One of the hard coral families is the Fungiidae family.

Mushroom corals (Fungiidae) are a family of hard corals (scleractinian) that live off the substrate (free-living), and most of the habitats of mushroom corals are found on reef slopes that have coral break substrates. This mushroom coral is a hematite coral with zooxanthella in the endodermis tissue. Mushroom coral is one of the coral species that has a unique character. This species can avoid interactions with competing organisms that can endanger its life (Hoeksema & De Voogd, 2012). Mushroom Coral is a habitat for marine organisms such as zooxanthella, fish, shrimp, crabs, barnacles, bivalves and worms (Hoeksema et al., 2012).

Research on fungal corals has been conducted, including Hermanto (2014) in Gangga Island, North Sulawesi, and Hermanto (2013) in Siladen, North Sulawesi. Hoeksema (2012) in the Spermonde Islands of South Sulawesi. These studies are generally to see the diversity of fungal coral species, but the location is still limited compared to the area and the number of islands in Indonesia that have not been reached, which is estimated to have many types of fungal corals that are quite diverse.

The abundance and diversity of mushroom corals in the waters of Pasumpahan Island have not been studied much, so the information is still lacking and not widely known. Therefore, this study was conducted to determine the abundance and diversity of mushroom corals in Pasumpahan Island with the hope that the data can complete the database of mushroom coral species in Indonesia and be

used to manage coral reef ecosystems in the region.

2. RESEARCH METHOD

Time and Place

This research was conducted in March 2024 in Pasumpahan Island, West Sumatra. Research stations will be determined using purposive sampling techniques based on water conditions representing all the research locations' waters. The sampling location was divided into three stations consisting of 3 sampling points. Station I is located in the tourist area, station II is close to the dock, and station III is in the area facing the open sea (Figure 1).

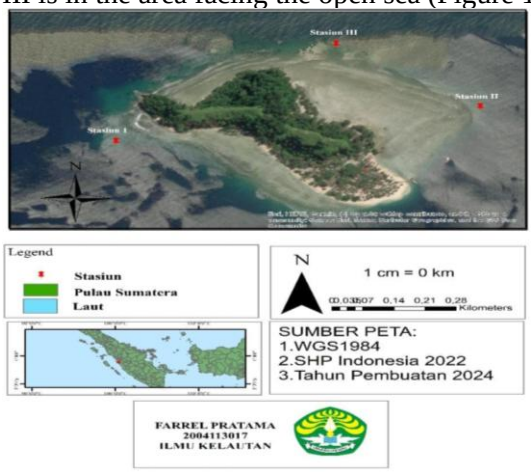

Figure 1. Research location

Procedures

Coral Data Collection

Data collection of mushroom corals using the belt transect method (Hill & Wilkinson, 2004). This method stretches a roll m as far as 70 m following the depth contour. Observations were made from points 0 to 70 m, with a width of 2 m, carried out at three stations (140 m² area). At each station, there are two points of sampling depth of observation, the first at a depth of 7 m and the second at a depth of 5 m. Data were collected by counting the number of mushroom corals. Data were collected by counting the number of fungal corals and recording their species. Underwater cameras were used to help analyze the types of corals identified in the field.

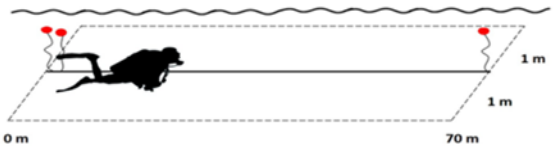

Figure 2. Coral data collection scheme

Abundance Analysis of Mushroom Corals

Abundance is the number of individuals per unit area. The abundance of species at each station was calculated using the formula (Odum, 1996) as follows:

$$Di = \frac{ni}{A} \times 10.000$$

Description:

Di : Species abundance (ind/Ha)
Ni : Number of individuals of the i-th species (ind)
A : Area of observation (Ha)

Diversity Index

This index is used to determine the diversity of fungal coral species. The equation used to calculate diversity is the Shanon-Wiener equation (Krebs, 1999).

$$H' = -\sum_{i=1}^{n} \ln Pi$$

Description:

H' : Diversity Index
Pi : ni/N (Proportion of i-th species)
Ni : Number of individuals of the i-th species
N : Total number of individuals of all species

The categorized diversity index criteria are presented in Table 1.

Table 1. Diversity index criteria

Diversity Index (H')	Criteria
H' > 3	High
1 ≤ H' ≤ 3	Medium
H' < 1	Low

3. RESULT AND DISCUSSION

Water Quality

Pasumpahan Island is an island included in the administrative area of Bungus Teluk Kabung Subdistrict in the southern part of Padang City, West Sumatra Province, with a geographical location at 01°7'5.68"N and 100°22'3.66" East. Pasumpahan Island area is a coral reef ecosystem with an area of 14,097 ha from the coast to the shore. The waters to the west-south of Pasumpahan Island have relatively calm water conditions because it is a strait that separates Pasumpahan Island from Sumatra Island with a width of ±1 km. These waters have a "reef flat" reef with a width of ±10 m, and the slope is estimated to range from 250-300. The coastal area appears to be overgrown

by mangrove vegetation. The waves and currents are quite strong in the east-north area of Pasumpahan Island. The slope ranges from 300-450. On the coast, mangrove vegetation is still found.

Table 2. Water quality

Stasiun	Temperature (ºC)	Brightness (%)	Current velocity (m/s)	Salinity(ppt)	pH
I	30	100	0,04	30	8,65
II	30,33	100	0,16	29,33	8,67
III	30,67	100	0,04	29,67	8,63

Based on the results of temperature measurements do not show significant differences. The temperature in the waters is 30-30.67ºC, which can be categorized as good for coral life. According to the Minister of Environment No. 51 Decree of 2004, the optimal temperature for coral reef growth is 20- 30°C. According to Hartoni et al. (2011), corals can still tolerate a maximum annual temperature of 36- 40°C and a minimum of 18°C. An increase in temperature of 2ºC from the optimal temperature can reduce the level of primary productivity of corals, and an increase in coral reef damage can be caused by an increase in temperature (Suharsono, 2014).

The results of brightness measurements obtained at each station are 100% with a depth of 5-7 m. According to the Decree of the Minister of Environment Year 2004, the standard quality of seawater for marine biota with brightness for corals is > 5 m. Brightness is related to light penetration. This factor is closely related to the availability of light and the level of brightness of the waters. According to Sukarno in Kusuma (2013), coral reefs cannot grow and develop in more than 50 m water depths. The growth of corals and biota associated with the coral. The growth of corals and related biota is limited by the depth associated with the penetration of sunlight into the water. Coral growth is very suitable in water areas with high brightness values, considering their life is symbiotic with Zooxanthellae. The brightness value is very high because the water conditions were very calm at the time of observation, so there was no water stirring by waves.

The current velocity in the waters of Pasumpahan Island is classified as a very slow current-slow, namely 0.04 - 0.16 m/s. According to Suharsono (1991), coral life's optimum current speed value is 0.05 - 0.08 m/sec. The current factor can have a good or bad impact. It is positive if it brings nutrients and organic materials needed by corals and zooxanthellae, while it is negative if it causes sedimentation in coral reef waters and covers the surface of corals, resulting in coral death (Prasetia & Wisnawa, 2015).

The results of salinity measurements ranged from 29.33 - 30 ppt, which is less than the optimal value in the life of coral reefs. Based on the Minister of Environment Number 51 Decree of 2004, good salinity for coral reef life ranges from 33- 34‰. Zurba (2019) states that corals can grow and develop well in the salinity range of around 34 - 36‰. However, the effect of salinity on corals varies greatly depending on water conditions or natural influences. Water salinity determines the distribution of coral reefs. Coral reefs can only grow if salinity conditions fit the criteria. Although coral reefs can survive outside the salinity range, growth will be less favourable when compared to normal salinity.

The results of water pH measurements at the observation location ranged from 8.63 - 8.67. The pH range of these waters is normal and still safe for the growth of mushroom corals. Based on the KLH (2004), the quality standard of pH value or optimal acidity for coral reefs ranges from 7 to 8.5. The value of acidity (pH) for coral growth can generally grow above 7 - 8.5, which limits tolerance for living things. If the pH value is less than 7, it can cause seawater acidity, affecting phytoplankton associated with corals and other marine plants (Moira & Lutifhi, 2020).

Types of Mushroom Corals on Pasumpahan Island

Based on the observations, nine species of fungal corals were found in the waters of Pasumpahan Island, which are included in 3 different genus: Ctenactis, Cylcoseris, and Fungia. The types of fungal corals found can be seen in Table 3.

The species composition of mushroom corals found at 5 m and 7 m depth can be seen in Figure 3 and Figure 4.

Table 3. Types of mushroom corals on Pasumpahan Island

No.	Spesies	Station I		Station II		Station III		Total
		5 m	7 m	5 m	7 m	5 m	7 m	
1	*Ctenactis echinata*	4	4	2	8	4	4	26
2	*Ctenactis crassa*	3	5	5	12	5	8	38
3	*Cycloseris costulata*	5	6	2	5	6	9	33
4	*Cylcoseris vaughani*	3	3	1	1	1	1	10
5	*Fungia concinna*	2	6	3	12	6	9	38
6	*Fungia horrida*	4	-	-	4	3	4	15
7	*Fungia fungites*	7	8	1	9	8	12	45
8	*Fungia paumotensis*	2	2	3	8	2	12	29
9	*Fungia scabra*	-	-	1	-	1	2	4

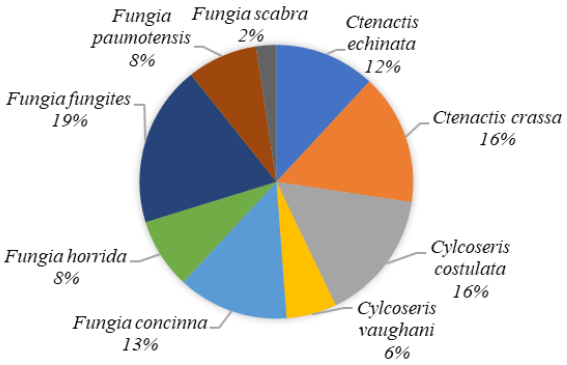

Figure 3. Fungal coral species composition at 5 m depth

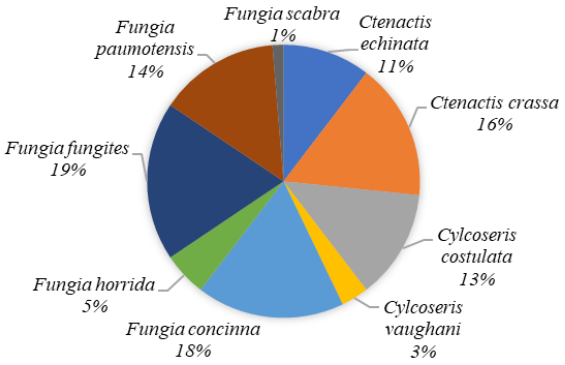

Figure 4. Fungal coral species composition at 7 m depth

Mushroom Coral Abundance

Based on observations of the abundance of mushroom corals on Pasumpahan Island, the range was from 1285.57 - 4357.14 ind/ha. The highest abundance based on depth was at station III with a depth of 7 m, namely 4357.14 ind/Ha, and the lowest abundance was at station II with a depth of 5 m, namely 1285.71 ind/ha (Figure 5).

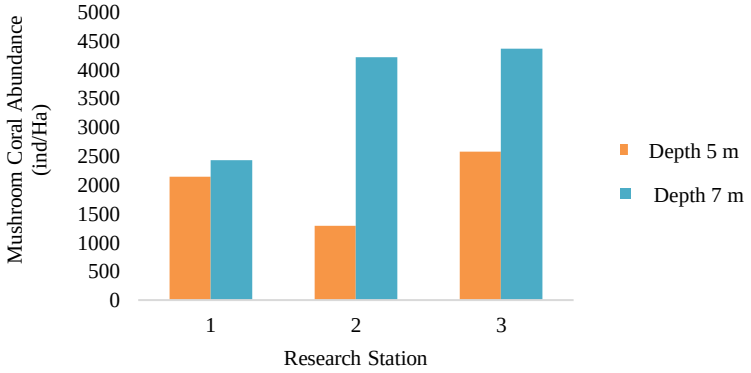

Figure 5. Total abundance of mushroom corals

The highest abundance based on depth is at station III, 7 m depth, which is 4357.14 ind/Ha. The substrate type at each station's depth is almost the same, namely broken coral (rubble). This type of substrate is a suitable habitat for mushroom coral growth. However, the fault substrate at station 3 is more dominant than other stations. Mampuk et al. (2013) stated that rubble or broken coral is a suitable substrate for corals of the Fungiidae family.

In addition, because the location is a good environment and lacks pressure from the

environment where organisms live and direct human activities, the abundance value is high (Armanto et al., 2022). Coral abundance is strongly related to the condition of the supporting environment for coral life. The more optimal the environmental carrying capacity of corals, the more optimal the growth and development of coral reef ecosystems that are known to be very vulnerable (Prasetia, 2013).

The lowest abundance is found at station II at a depth of 5 m, which is 1285.71 ind/ha. At this station, the substrate type is still broken coral (rubble), which is dominated by mud, so the growth of mushroom corals is less than optimal. In addition, other factors include anthropogenic activities such as fishing, tourism and anchor mooring on the reef. Based on research conducted by Amrullah et al. (2021), the low abundance of mushroom corals in Segajah Waters is thought to be due to the topography in these waters, categorized as steep, so that most mushroom corals fall to the deep seabed when detached from the substrate during the growth phase.

Hoeksema (2012) also revealed that in coral reef areas with steep topography (drop-off), Fungiidae corals will rarely be found in abundance, apart from the steep topography of Segajah Waters, which affects the lack of growth of Fungiidae corals in these waters because the substrate is dominated by sand. According to Gofredo & Furman (2000), some fungal corals can still be found in locations with sandy substrates, but the density is lower when compared to locations dominated by coral break substrates. Some studies reveal that fungal corals can move from one place to another. This could be one of the factors for the presence of mushroom corals in sandy substrate habitats.

Diversity Index

A diversity index can be interpreted as a systematic depiction that describes the structure of the community and can facilitate the process of analyzing information about the number of organisms. The results of the fungal coral diversity index calculation at each station are presented in Table 4.

The diversity index of mushroom corals in the waters of Pasumpahan Island ranges from 1.930 - 2.013, indicating that the diversity level is classified as moderate.

Table 4. Diversity of mushroom corals

Station	Depth (m)		Average
	5	7	
I	1,997	1,867	1,932
II	1,923	1,937	1,930
III	2,017	2,008	2,013

Based on research conducted by Amrullah et al. (2021) in Bontang City Waters, the highest diversity of Fungiidae coral species is found in Kedindingan Waters. Factors that influence the high level of diversity in Segajah Waters are the density of branching coral reefs because fungal corals live on rigid substrates such as reef slopes and coral breaks. This is influenced by the life cycle of mushroom corals attached to rigid substrates during the juvenile period. As an adult, this species will detach itself from the substrate.

Hoeksema & Benzoni (2013) stated that when juveniles, mushroom corals will be attached to hard substrates using coral stalks. Mushroom corals that have just detached themselves from the hard substrate will have fracture marks on the underside of the polyp (Vizel et al., 2009). So, it can be said that most mushroom corals can be found in areas that have coral break substrates.

In Segajah Waters, the diversity of Fungiidae corals tends to be lower than that of other waters. The low abundance of fungal corals in Segajah Waters is thought to be due to the topography in these waters being categorized as steep, so most fungal corals fall to the deep seabed when detached from the substrate during the growth phase. This is supported by the theory expressed by Hoeksema & Voogd (2012) that in areas with steep topography (drop off), the presence of mushroom corals decreases with increasing depth, and the intensity of light available decreases. The intensity of sunlight also supports the intensity of light entering the water due to coral growth factors. So, steep topographic conditions (drop-off) are less suitable for the growth of mushroom corals.

Based on research conducted by Nadiansyah et al. (2022) in the southern part of Kabung Island, the diversity index value obtained in the tourist area at a depth of 3-4 m is 3.32, and at a depth of 6-7 m is 3.13 which is included in the category of high diversity, high distribution and high community stability. The dock area at a depth of 3 - 4 m of 2.29 and at a depth of 6 - 7 m of 1.55 is categorized as

moderate diversity, moderate distribution and moderate community stability.

In areas with little human activity at a depth of 3 - 4 m, it amounted to 2.69 and at a depth of 6 - 7 m, it amounted to 2.19, included in the category of moderate diversity, distribution, and moderate community stability. The value of the coral diversity index at each research station is in the medium category until physicochemical factors also influence the high diversity. The results of research conducted by Utomo et al. (2013) show that the physicochemical characteristics of good water will also make up the diversity index of a good community.

4. CONCLUSION

Based on the research conducted in the waters of Pasumpahan Island, it can be concluded that the number of fungal coral species found is as many as nine species that belong to 3 different genera. The highest abundance of fungal corals is found at a depth of 7 m, and the lowest is at a depth of 5 m. The abundance of fungal corals at different depths shows a real difference. The abundance of fungal corals at different depths showed significant differences. The diversity index (H') of fungal corals in the waters of Pasumpahan Island is in the medium category.

REFERENCES

[KLH] Kementrian Lingkungan Hidup, (2004), Keputusan Menteri Lingkungan Hidup No. 51/MenLH/2004 Tentang Baku Mutu Air Laut untuk Biota Laut. Jakarta.

Amrullah, A., Eryati, R., & Rafi'i, A. (2021). Distribusi Karang Keras Famili Fungiidae (*Mushroom Coral*) di Perairan Kota Bontang. *Jurnal Aquarine*, 6(1): 37.

Armanto, A., Nurrahman, Y.A., & Helena, S. (2022). Kelimpahan dan Keanekaragaman Ikan Karang di Perairan Selatan Pulau Kabung Kabupaten Bengkayang, Kalimantan Barat. *Jurnal Laut Khatulistiwa*, 5(2): 62-70.

Cappenberg, H.A.W., & Akbar, N. (2020). Kondisi Megabentos di Perairan Kabupaten Sumba Timur, Provinsi Nusa Tenggara Timur. *Jurnal Ilmu Kelautan Kepulauan*, 3(2):130–146.

Giyanto, G., Manuputty, A.E.W., Abrar, M., Siringoringo, R.M., Suharti, S.R., Wibowo, K., Edrus, I.N., Arbi, U.Y., Cappenberg, H.A.W., Sihaloho, H.F., Tuti, Y., & Zulfianita, D. (2014). *Panduan Monitoring Kesehatan Terumbu Karang: Terumbu Karang, Ikan Karang, Megabenthos dan Penulisan Laporan*. Coremap CTI LIPI. Jakarta.

Gofredo, S. & Chadwick-Furman, N.E. (2000). Abundance and Distribution of Mushroom Corals (Scleractinia: Fungiidae) on a Coral Reef at Eilat, Northern Red Sea. *Bulletin of Marine Science*, 6(1): 241–254.

Hartoni, R., Damar, D., & Wardiatno, Y. (2011). Kondisi Terumbu Karang di Perairan Pulau Tegal dan Sidodadi Kecamatan Adang Cermin Kabupaten Pasarawan Provinsi Lampung. *Jurnal Maspari*. 4(1): 46 – 47.

Hermanto, B. (2013). Keanekaragaman Karang Jamur (Fungiidae) di Perairan Pulau Siladen, Minahasa Utara. *Jurnal Ilmiah Platax*, 1(4): 20–31.

Hermanto, B. (2014). Struktur Komunitas Karang Jamur (Fungiidae) di Perairan Pulau Gangga, Sulawesi Utara. *Oseanologi dan Limnologi di Indonesia*, 40(2): 169–179.

Hill, J., & Wilkinson, C.L.I.V.E. (2004). *Methods for Ecological Monitoring of Coral Reefs*. Australian Institute of Marine Science, Townsville, 117 p.

Hoeksema, B.W. (2012). Distribution Patterns of Mushroom Corals (scleractinia: fungiidae) Across the Spermonde Shelf, South Sulawesi. *The Raffles Bulletin of Zoology*, 60(1): 183–212.

Hoeksema, B.W., & Benzoni, F. (2013). Multispecies Aggregation of Mushroom Corals in the Gambier Islan, French Polynesia. *Coral reefs*, 32: 1041.

Hoeksema, B.W., & Voogd, N.J. (2012). On the Run: Free-Living Mushroom Corals Avoiding Interaction with Sponges. *Coral Reefs*, 31: 455– 459.

Krebs, C.J. (1999). *Ecological Methodology*. New York: Harper & Row Inc Publisher.

Kusuma, R.C. (2013). Kelimpahan Nudibranchia pada Karang Bercabang dan Karang Batu di Pantai

Pancuran Belakang Pulau Karimunjawa Jepara. *Management of Aquatic Resources Journal (MAQUARES)*, 2(3): 273-281.

Mampuk, F., Tioho, H., & Kusen, J.D. (2013). Distribusi Vertikal dan Kepadatan Karang Fungiidae di Perairan Malalayang. *Jurnal Pesisir dan Laut Tropis*, 1(1):42-47.

Moira, V. S., & Luthfi, O. M. (2020). Organisme Kriptik Crustacea pada Karang Mati (Dead Coral) Pocillopora di Perairan NCF Putri Menjangan, Buleleng, Bali Barat. *Journal of Tropical Marine Science*, *3*(1), 47-52.

Nadiansyah, N., Idiawati, N., & Nurrahman, Y.A. (2022). Struktur Komunitas Terumbu Karang di Bagian Selatan Pulau Kabung, Kabupaten Bengkayang, Kalimantan Barat. *Jurnal Laut Khatulistiwa*, 5(3): 116-124.

Odum, E.P. (1996). *Dasar-dasar Ekologi*. Gadjah Mada University Press. Jogyakarta.

Prasetia, I.N.D. (2013). Kajian Jenis dan Kelimpahan Rekrutmen Karang di Pesisir Desa Kalibukbuk, Singaraja, Bali. *Bumi Lestari*, 13(1): 69-78.

Prasetia, I.N.D., & Wisnawa, G.Y. (2015). Struktur Komunitas Terumbu Karang di Pesisir Kecamatan Buleleng Singaraja. *Jurnal Sains dan Teknologi*, 4: 2303-3142.

Suharsono, S. (1991). Bulu Seribu (*Acanthaster planci*), Balai Penelitian dan Pengembangan Biologi Laut. *Jurnal Oseanologi.* 16(3):17.

Suharsono, S. (2014). *Biodiversitas Biota Laut Indonesia*.: Puslit Oseanografi – LIPI, Jakarta 418 hlm.

Utomo, S.P.R., Ain, C., & Supriharyono. (2013). Keanekaragaman Jenis Ikan Karang di Daerah Rataan dan Tubir pada Ekosistem Terumbu Karang di Legon Boyo, Taman Nasional Karimunjawa, Jepara. *JurnalMaquares*, 2(4): 81-90.

Vizel, M., Kramarsky-Winter, E., & Loya, Y. (2009). Mushroom Coral Regeneration from a Detached Stalk. *Coral Reefs*, 28:939-939.

Zurba, N. (2019). *Pengenalan Terumbu Karang sebagai Pondasi Utama Laut Kita*. Unimal Press. 116p.