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# Abundance and Diversity of Sponges in the Waters of Pasumpahan Island, West Sumatra

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**ABSTRACT**

Sponges are the most primitive multicellular animals that live in various types of waters, ranging from fresh to brackish and marine. Sponges live at the bottom of the water, usually embedding themselves in rigid substrates such as rocks or corals and competing with other attached organisms for food space. This study aimed to analyse the abundance and diversity and determine the differences in sponge abundance at different depths. This research was conducted in March 2024 in Pasumpahan Island, West Sumatra. This research used the survey method and the 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 I with a depth of 5 m, namely 1071.4 ind / ha and the lowest abundance at station II with a depth of 7 m, 714.286 ind / ha. The t-test results obtained a significant value of less than 0.05, namely 0.048, which means that the abundance of sponges at different depths is significantly different. The diversity index ranges from 1.930 to 2.013, indicating that the sponge diversity level in Pasumpahan Island waters is classified as moderate. The T-test results show a significant value of more than 0.05, namely 0.795, which means the abundance of sponges at two depths is significantly different.

**Keywords:** Sponges, Diversity, Abundance, Pasumpahan Island.

## 1. INTRODUCTION

Indonesia is located right in the center of the Coral Triangle, an area of coral reefs with the highest marine biodiversity in the world (Rinanda, 2021). Coral reefs are highly productive tropical marine ecosystems. Their complex, branched, and channelled physical structure makes them an attractive habitat for many types of marine life (Riyantini et al., 2023). Coral reefs are a group of animals belonging to the phylum *Coelenterata* (hollow), and many originate from the phylum *Cnidaria* (stinging) that can produce an external skeleton in the form of calcium carbonate ($CaCO_3$) (Azis, 2023). Coral reef ecosystems dominated by hard corals are found in almost all tropical marine waters. They are essential for organisms living in them and those associated with them. One of the families of hard corals is the Fungiidae family.

Sponges are the most primitive multicellular animals that live in various types of water, from freshwater to brackish and marine environments. Sponges live on the seabed, typically attaching themselves to rigid substrates such as rocks or coral, and compete with other sessile organisms for food space. Sponges are animals belonging to the phylum Porifera, which consists of three classes: Dexactinellida, Demospongiae, and Calcarea (Ananda et al., 2019). According to Fidayat et al. (2021), the diversity of sponge species in a habitat is generally determined by clear water conditions and the absence of strong currents. Sponges can be found at various depths with sufficient light levels for growth.

Pasumpahan Island is a coral reef ecosystem spanning 14,097 hectares from the coast to the reef edge. Coral reefs are only found at depths of 5–10 m. Several studies on coral reef conditions have been conducted on Pasumpasahan Island. The average condition of coral reefs on Pasumpahan Island falls into the category of damaged coral, with 17.14% of live coral and coral reef damage around Pasumpahan Island reaching 82.86%. Manzanaris (2018) stated that the average coral cover on Pasumpahan Island is 10.40%, with poor conditions. Noted that the coral reefs around Pasumpahan Island are classified as good

because they can still be found in the waters. However, their condition ranges from poor to moderate, with a percentage of live coral cover of 12.5–51.87%. This condition could improve if the surrounding waters are well maintained, in addition to the coral conservation efforts already implemented in this area. No research on sponges has ever been conducted in the waters around Pasumpahan Island.

Research on sponges has been conducted by Ananda et al. (2019) on Kasiak Pariaman Island, West Sumatra. These studies generally aimed to assess the diversity of sponge species. However, their locations were limited compared to the vastness and number of islands in Indonesia that remain unexplored and are estimated to harbour a wide variety of sponge species. Based on this, it is necessary to research the abundance and diversity of sponges around Pasumpahan Island, West Sumatra. The limited data on sponges in West Sumatra, particularly on Pasumpahan Island, have prompted researchers to conduct a study on sponges in Pasumpahan Island. This study aims to analyse the abundance and diversity of sponges and determine the differences in sponge abundance at different depths.

## 2. RESEARCH METHOD

### Time and Place

This study was conducted in March 2024 in Pasumpahan Island, West Sumatra. Research stations were determined using purposive sampling based on water conditions considered representative of the study area. The sampling locations were divided into three stations consisting of three sampling points. Station I was located in a tourist area, Station II was near the pier, and Station III was in an area facing the open sea (Figure 1).

### Procedures

Data collection on sponge abundance and diversity was conducted using the belt transect method (Sari, 2013). This method involves stretching a tape measure 70 m along the depth contour. Observations were made from point 0 to 70 m, with a width of 2 m, at three stations (area 140 m²). Each station has two sampling depths: the first at 5 m and the second at 7 m. Data collection involves counting the number of sponges and recording their types. An underwater camera is used to assist in identifying coral types in the field.

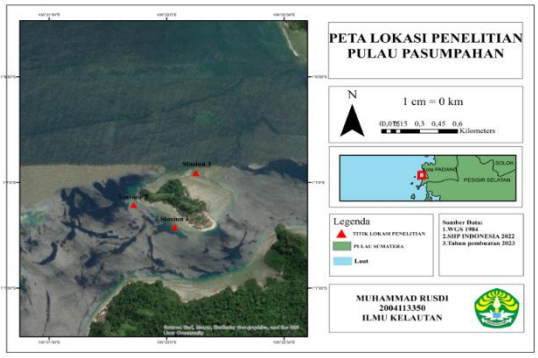


**Figure 1. Research location**

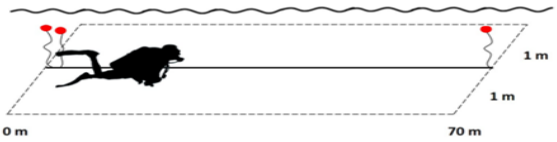


**Figure 2. Data collection scheme for abundance and diversity**

### Identifikasi Spons

Identify sponges using visual techniques, namely direct observation in nature. These visual techniques observe the body's shape (polyps), surface and structure, tentacles, colour, and habitat, and are adjusted according to guidelines. The guidelines used are from the Coral of the World website.

### Abundance of Sponges

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

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

Description:

Di : Species abundance (ind/ha)
Ini : Number of individuals of species i (ind)
A : Observation area (ha)

### Diversity Index

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

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

Description:
H': Diversity Index
Pi : ni/N (Proportion of type i)
ni : Number of individuals of type i
N : Total number of individuals of all types

The diversity index criteria are categorised and presented in Table 1.

**Table 1. Diversity index criteria**

| Diversity index (H') | Criteria |
|---|---|
| H' > 3 | High |
| 1 ≤ H' ≤ 3 | Medium |
| H' < 1 | Low |

**Water Quality Parameters**

The water quality parameters observed in this study were oceanographic parameters, including temperature, current velocity, salinity, brightness, and pH. Observations were conducted according to natural conditions in the field at each station's data collection time. Water quality parameters were measured three times.

**Testing Differences in Sponge Abundance at Different Depths**

The data obtained are presented in tables and graphs. A t-test was used to compare abundance at different depths. The purpose of this t-test is to compare the means of two unrelated populations or to determine whether the two populations have significantly different means. This is then discussed descriptively based on literature related to sponges.

## 3. RESULT AND DISCUSSION

**Water Quality**

The water quality parameters measured were temperature, brightness, current velocity, salinity, and pH. Table 2 shows the results of water quality measurements on Pasumpahan Island.

**Table 2. Water quality**

| Station | Temperature (ºC) | Brightness (%) | Current speed (m/sec) | 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 water quality parameter measurements, there were no significant differences. The water temperature ranged from 30–30.67ºC, suitable for coral life. According to the Minister of Environment Regulation No. 51 of 2004, the optimal temperature for coral reef growth is 20–30°C. According to Ompi et al. (2019), corals can tolerate maximum annual temperatures of 36–40°C and minimum temperatures of 18°C. The light transparency measurements obtained at each station were 100% at depths of 5 m and 7 m. According to the 2004 Ministerial Decree on water quality standards for marine life, light transparency for coral must be > 5 m. Light transparency is related to light penetration. This factor is closely associated with light availability and water clarity. According to Arisandi et al. (2018), coral reefs cannot grow and develop in depths exceeding 50 m. The current speed in the waters around Pasumpahan Island is classified as very slow to slow, ranging from 0.04–0.16 m/ m/second. According to Adamimawar et a. (2022), the optimal current speed for coral life is 0.05–0.08 m/m/ m/second. Current factors can have both positive and negative effects. They are positive when they carry nutrients and organic materials needed by corals and zooxanthellae. At the same time, they are negative when they cause sedimentation in coral reef waters and cover the coral surface, leading to coral death (As-Syakur et al. 2016). Salinity measurements ranged from 29.33 to 30 ppt, below the optimal value for coral reef life. According to Ministerial Decree No. 51 of 2004, the optimal salinity for coral reef life ranges from 33–34‰. Nayyiroh (2022) states that corals can grow and develop well within a salinity range of approximately 34–36‰. However, the effect of salinity on corals varies significantly depending on water conditions or natural influences. pH measurements of the water at the observation site ranged from 8.63 to 8.67. This pH range is normal and still safe for the growth of sponges. According to the Minister of Environment's Decision (2004), the optimal pH standard for coral reefs ranges between 7 and 8.5. Thus, water quality parameters do not influence sponge abundance in the waters around Pasumpahan Island.

Based on observations, six species of sponges were found in the waters of Pasumpahan Island. The types of sponges found are listed in Table 3.

**Tabel 3. Spons in Pasumpahan Island**

| No | Species | Station | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | I | | II | | III | | |
| | | Depth (m) | | | | | | |
| | | 5 | 7 | 5 | 7 | 5 | 7 | |
| 1 | *Plakotris sp.* | 3 | | - | - | - | 3 | 6 |
| 2 | *Cymbastela sp.* | 3 | 1 | - | - | - | 1 | 4 |
| 3 | *Petrosia sp.* | 1 | | 3 | | 1 | | 5 |
| 4 | *Jaspis sp.* | 2 | 2 | 4 | 2 | 5 | 2 | 17 |
| 5 | *Clathrina sp.* | 6 | 10 | 5 | 7 | 7 | 6 | 41 |
| 6 | *Dysidea sp.* | - | - | 2 | 1 | - | - | 3 |

**Abundance of Sponges on Pasumpahan Island**

The results of sponge abundance calculations at each station on Pasumpahan Island can be seen in Table 4.

**Table 4. The abundance of sponges at each station on Pasumpahan Island**

| No | Species | Stasion | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | | II | | III | |
| | | Depth (m) | | | | | |
| | | 5 | 7 | 5 | 7 | 5 | 7 |
| 1 | *Plakotris* | 214,2 | 0 | 0 | 0 | 0 | 214,28 |
| 2 | *Cymbastela* | 214,2 | 71,42 | 0 | 0 | 0 | 71,428 |
| 3 | *Petrosia* | 71,42 | 0 | 214,28 | 0 | 71,42 | 0 |
| 4 | *Jaspis* | 142,8 | 142,85 | 285,71 | 142,85 | 357,14 | 142,85 |
| 5 | *Clathrina* | 428,5 | 714,28 | 357,14 | 500 | 500 | 428,57 |
| 6 | *Dysidea* | 0 | 0 | 142,85 | 71,428 | 0 | 0 |
| Total | | 1071,4 | 928,571 | 1000 | 714,286 | 928,571 | 857,143 |

Based on Table 4, it can be seen that the highest abundance based on depth was found at station I at a depth of 5 m, namely 1071.4 ind/Ha, and the lowest abundance was found at station II at a depth of 7 m, namely 714.286 ind/ha.

Based on the results of observations, the highest abundance of sponges was found at station I at a depth of 5 m, namely 1071.4 ind/ha, and the lowest abundance was found at station II at a depth of 7 m, 714.286 ind/ha. The substrate type at each station was almost the same, namely coral rubble (rubble). This type of substrate is a suitable habitat for sponge growth. The high density of sponges at Station 1 is likely influenced by water quality parameters that support sponge growth, including temperature (30°C), salinity (33 ppt), transparency (100%), pH (6.4), and current (0.33 m/s). According to Ananda et al. (2019), the growth of young sponges into mature individuals is influenced by temperature, salinity, sedimentation, pH, and spatial competition.

Furthermore, Ananda et al. (2019) mention that sponges prefer fairly clear waters. In addition, the location has a good environment and slight pressure from both the organisms' habitat and direct human activity, resulting in high abundance values (Sofarini et al., 2021). Coral abundance is closely related to the environmental conditions supporting coral life. The more optimal the ecological support for corals, the more optimal the growth and development of coral reef ecosystems, which are known to be highly vulnerable (Prasetia, 2012).

**Sponge Diversity on Pasumpahan Island**

Diversity indices can be interpreted as a systematic representation of community structure, facilitating information analysis regarding the number of organisms. Table 5 presents the results of diversity index calculations for sponges at each station.

**Table 5. Diversity of sponges**

| Stasion | Depth (m) | | average |
|---|---|---|---|
| | 5 | 7 | |
| I | 1,459 | 0,687 | 1,073 |
| II | 1,333 | 0,801 | 1,067 |
| III | 0,898 | 1,198 | 1,048 |

The sponge diversity index in the waters of Pasumpahan Island ranges from 1.048 to 1.073, indicating a moderate level of diversity. The highest sponge diversity index (H') based on depth was found at Station I at a depth of 5 m, with a value of 1.459, while the lowest diversity index was recorded at Station I at a depth of 7 m, with a value of 0.687.

The diversity index can be interpreted as a systematic representation that describes the structure of a community and facilitates the analysis of information regarding the number of organisms. The diversity index of sponges in the waters of Pasumpahan Island ranges from 1.048 to 1.073, indicating a moderate level of diversity. The highest diversity index (H') of sponges based on depth was found at station I at a depth of 5 m, which was 1.459, while the lowest diversity index was found at station I at 7 m, which was 0.687.

Muqsit (2016) stated that the coral distribution west of Sumatra is a coral reef of the Indian Ocean type, characterised by relatively low to moderate diversity. They are scattered from Weh Island at the northern tip of Sumatra Island along the west coast of Sumatra. The species richness and individual abundance of a community influence the diversity index. The higher the species richness, the higher the diversity index. Conversely, the lower the species richness, the lower the diversity index (Purnama, 2013). The moderate diversity index value or relatively good condition in the waters of Pasumpahan Island indicates that the local community and tourists still preserve and protect the marine biodiversity, especially the coral reef ecosystem.

## 4. CONCLUSION

The highest abundance based on depth was found at Station I at 5 m, with 1,071.4 ind/Ha, while the lowest abundance was found at Station II at 7 m, with 714.286 ind/Ha. The T-test results showed a significant value greater than 0.05 (0.795), indicating no significant difference in sponge abundance between the two depths. Thus, hypothesis H0 is accepted and hypothesis H1 is rejected, indicating no sponge abundance difference between depths. The sponge diversity index in the waters around Pasumpahan Island ranges from 1.048 to 1.073, indicating moderate diversity. The highest sponge diversity index (H') based on depth was found at station I at a depth of 5 m, which was 1.459, while the lowest diversity index was found at station I at a depth of 7 m, which was 0.687.

## REFERENCES

[KLH] Kementerian Negara Lingkungan Hidup. (2004). Keputusan Menteri Lingkungan Hidup Nomor 51 Tahun 2004 Tentang Baku Mutu Air Laut. Jakarta. 10 p. Retrieved April 17, 2025

Adamimawar, C.N.I., Jailani, A.Q., & Aji, M.T. (2022). Study on Potential Feasibility of Aquaculture Land Using Geographic Information System (GIS) in North Semarang Sea. *Asian Journal of Aquatic Sciences*, *5*(2): 249-256.

Alfiah, A. (2023). *Kontribusi Pengembangan Wisata Bahari Dalam Peningkatan Pendapatan Masyarakat Sekitar Pulau Karampuang Kabupaten Mamuju*. IAIN Parepare. 104 p.

Ananda, N.N., Efriyeldi, E., & Thamrin, T. (2019). Species Diversity and Distribution of Sponges in the Coastal Area of Kasiak Island, Pariaman Regency, Sumatera Barat Province. *Asian Journal of Aquatic Sciences*, 2(2): 162-169.

Arisandi, A., Badrud, T., & Fauzan, A. (2018). Coral Reef Profile of Kangean Island, Sumenep District, Indonesia. *Jurnal Ilmiah Perikanan dan Kelautan*, 10(2): 76-83.

As-Syakur, A.R., & Wiyanto, D.B. (2016). Studi Kondisi Hidrologis sebagai Lokasi Penempatan Terumbu Buatan di Perairan Tanjung Benoa Bali. *Jurnal Kelautan: Indonesian Journal of Marine Science and Technology*, *9*(1): 85-92.

Azis, R. (2023). *Struktur Komunitas Makrozoobentos Epifauna pada Ekosistem Mangrove di Desa Bulu Cindea, Kecamatan Bungoro, Kabupaten Pangkep*. Universitas Hasanuddin. 38 hlm.

Fidayat, F., Lestari, F., & Nugraha, A.H. (2021). Keanekaragaman Spons pada Ekosistem Padang Lamun di Perairan Malang Rapat, Kabupaten Bintan. *Jurnal Akuatiklestari*, *4*(2): 71-83.

Krebs, C.J. (1989). *Ecological Methodology*. Second Edition. New York: An Imprint of the Addition Wesley Longman. 237 p.

Manzanaris, M.R., Rondonuwu, A.B., & Pratasik, S.B. (2018). Struktur Komunitas dan Kondisi Terumbu Karang di Perairan Desa Poopoh Kecamatan Tombariri Kabupaten Minahasa. *J. Ilmiah Platax, 7*(1): 9-19.

Muqsit, A., Purnama, D., & Ta'alidin, Z. (2016). Struktur Komunitas Terumbu Karang di Pulau Dua Kecamatan Enggano Kabupaten Bengkulu Utara. *Jurnal Enggano*, 1(1): 75-87.

Nayyiroh, D.Z., & Muhsoni, F.F. (2022). Evaluasi Kondisi Terumbu Karang di Pulau Gili Labak Kabupaten Sumenep. *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*, *3*(4): 125-133.

Odum, E.P. (1996). *Dasar-dasar Ekologi; Edisi Ketiga*.Yogyakarta. Gadjah Mada University Press, Penerjemah Samingan, Tjahjono.

Ompi, B.N., Rembet, U.N., & Rondonuwu, A.B. (2019). Coral Reef Conditions of Hogow and Dakokayu Islands, Southeast Minahasa Regency. *Jurnal Ilmiah Platax, 7*(1): 186-192.

Prasetia, I.N.D. (2012). Rekrutmen Karang di Kawasan Wisata Lovina. *JST (Jurnal Sains dan Teknologi)*, *1*(2): 61-72.

Purnama, A.A. (2013). Struktur Komunitas Karang di Perairan Pulau Pasumpahan. *Edu Research*, *2*(2): 103-110.

Rinanda, R. (2021). *Analisis Aktivitas Radionuklida 14c Pada Karang Favia Stelligira di Pulau Satando Kepulauan Spermonde Menggunakan Metode Lsc (Liquid Scintillation Counting)*. Universitas Hasanuddin. 31 p.

Riyantini, I., Harahap, S.A., Kostaman, A.N., Aufaadhiyaa, P.A., Yuniarti, M.S., Zallesa, S., & Faizal, I. (2023). Kelimpahan, Keanekaragaman dan Distribusi Ikan Karang dan Megabentos Serta Hubungannya dengan Kondisi Terumbu Karang dan Kualitas Perairan di Gosong Pramuka, Taman Nasional Kepulauan Seribu. *Buletin Oseanografi Marina*, 12(2): 179-191.

Sari, L. N., & Aunurohim, A. (2013). Korelasi Komunitas Nudibranchia dengan Komunitas Porifera di Perairan Pasir Putih, Situbondo. *Jurnal Sains dan Seni ITS*, *2*(2): 224-229.

Sofarini, D., Aminah, S., Hidayah, R.N., & Hanifa, M.S. (2021). Keterkaitan Kualitas Air dengan Keanekaragaman Zooplankton di Sungai Barito Kecamatan Marabahan Kabupaten Barito Kuala. *Rekayasa*, 14(3): 421-430