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GASTROPOD DIVERSITY AS A BIO-INDICATOR OF AQUATIC POLLUTION IN SIRONJONG GADANG ISLAND PESISIR SELATAN DISTRICT

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ABSTRACT

This study aims to determine the diversity of gastropods and water conditions on Sironjong Gadang Island, Pesisir Selatan Regency. This research was conducted in August 2022 in the waters of Sironjong Gadang Island and the Marine Biology Laboratory and Marine Chemistry Laboratory of the Department of Marine Science, Universitas Riau. The method used in this research is the survey method, which is direct observation of the research area and sampling and measurement of water quality parameters in the field. The results of the study found gastropod species consisting of 4 (four) families, 4 (four) genera, and 8 (eight) species. The diversity value (H') was at a moderate level of diversity. The highest gastropod density was found at Station I, with a density value of 16.33 ind/m², and the lowest density was found at Station III, with a density value of 13.89 ind/m². The highest relative density was Monodonta labia species, with a relative density value of 27.6%, while the lowest relative density was Haustrum-scoring species, with a relative density value of 3.3%. Temperature 28-29˚C; salinity 25-27 ppt; pH 7.91-7.95; brightness 1.55-2.65 m. The sediment type at Station I was dominated by muddy gravel, Station II was dominated by sandy gravel, and Station III was defeated by sandy gravel with a total sediment organic matter content of 6.10-10.05%.

Keywords: Gastropods, Diversity, Bioindicator, Sironjong Gadang Island

1. INTRODUCTION

Mandeh tourist area is a well-known marine tourism area in South Pesisir Regency, one of which is Sironjong Gadang Island. Sironjong Gadang Island is an island with a sandy beach that has three main coastal ecosystems, namely mangrove ecosystems, seagrass ecosystems, and coral reef ecosystems, with various biota living in them, one of which is gastropods.

Diversity along the coast includes various ecosystems with unique characteristics and properties, including Pisces, crustaceans, echinodermata, and mollusks, as a very high biological resource. One of the animals included in the Mollusca phylum is gastropods.

Gastropods are marine biota found in many marine glasses of water, ranging from shallow waters to sandy coral reefs and deep seas[1]. Gastropods are commonly known as snails or conchs. One of the biological communities or organisms that feel the direct influence of pollutants and can be used as bioindicators of pollution of a body of water is the mollusk phylum because mollusks live at the bottom of the water, cannot move quickly and have a broad tolerance level to water and can show the relationship between the content of pollutants in the water and their bodies. One class of mollusk phylum is the gastropod class, which can be a bioindicator[2].

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Bioindicator comes from two words: bio and indicator. Bio means life, such as animals, plants, and microbes, and indicator means a variable that can be used to evaluate the state or status and allows measurement of changes that occur over time. Bioindicators are groups or communities of organisms whose presence and behavior in nature correlate with environmental conditions so that they can be used as clues to environmental quality. Bioindicators are also biotic indicators that indicate time and location, natural conditions (natural disasters), and environmental quality changes due to human activities[3].

2. RESEARCH METHOD

Time and Place

This research was conducted in August 2022 in the waters of Sironjong Gadang Island (Figure 1) and in the Marine Biology Laboratory and Marine Chemistry Laboratory of the Department of Marine Science, Universitas Riau.

Methods

The method used in the research is the survey method, which is direct observation of the research area and sampling and measuring water quality parameters in the field. Parameters to be measured include gastropod species, relative density, and diversity. Then, supporting data such as water temperature, salinity, pH, brightness, total organic matter, and sediment fraction. Then, the samples were identified and analyzed at the Marine Biology and Marine Chemistry Laboratory, Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Procedure

The determination of research stations was carried out by purposive sampling. Then, three observation stations were determined by considering various factors, including the condition of the research location, water characteristics, and island characteristics that were considered representative of the research location. This study divided the sampling location into three stations (Figure 2). Station I has characteristics of muddy gravel beaches and the presence of fishing boats. Station II has characteristics of sandy gravel beaches and fishing activities. Station III has characteristics of sandy gravel beaches usually used by tourists for recreation and a spot for taking pictures.

Water quality parameters measured were temperature, pH, brightness, and salinity. Each research station has three transects of three plots with a quadrat size of 1x1 m^2. Each sample found on the surface of each quadrat plot was picked up, while those in the substrate were dug ±5 cm deep.

In this study, sediment samples were also taken to measure organic matter and sediment fraction. Sediment samples were taken using a 10 cm diameter pipe that was stuck to a depth of 5 cm.

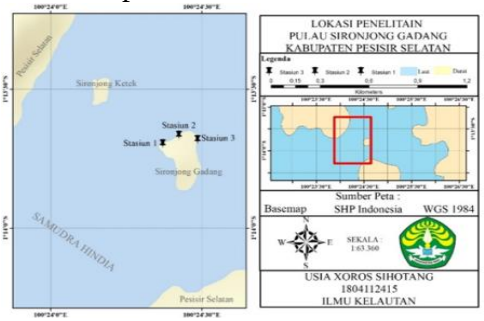

Figure 1. Research Location Map

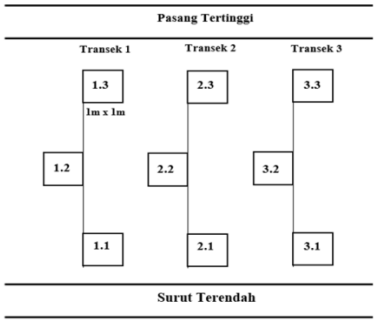

Figure 2. Quadrant Mapping Plan

Data Analysis

Samples obtained in the field were brought to the laboratory and then cleaned, grouped, and identified based on the form obtained using the Dharma identification book[4] in the Marine Biology Laboratory.

Furthermore, the number of species obtained was counted, then analyzed and calculated.

Gastropod Diversity

The diversity index can be calculated with the Shannon-wiener index according to Sudarso & Wardiatno[5] with the equation:

$$H' = - \sum_{i-1}^{s} pi \ln pi$$

Description:
H' = Diversity index
pi = ni/N
ni = number of individuals of each species
N = Total number of individuals
s = number of species

Gastropod Density

The density of gastropod individuals refers to the abundance formula according to Wulandari et al.[6], as follows:

$$\text{Density} = \frac{\text{number of individuals of a species}}{\text{Broad } (m^2)}$$

Relative Density

Relative density is calculated using the formula according to Insafitri[7] as follows:

$$KR = \frac{ni}{N} \text{x } 100\%$$

Description:
KR = Relative density (%)
ni = Total number of species (individuals)
N = The number of individuals

Sediment Fraction and Total Organic Matter

The sediment fraction analysis used the wet sieving method and the pipette method. The graded sieve method was used to obtain Ø-1 - Ø4, while the pipette method used a volumetric pipette to obtain Ø5-Ø7. Rifardi[8] was used to analyze the sediment fraction type.

The concentration of total organic matter in the sediment was measured using a formula that refers to Heiri in Mucha et al.[9] as follows:

$$\text{BOT} = \frac{(Wt - C) - (Wa - C)}{Wt - C} \text{ x } 100\%$$

Description:
Wt = The total weight (crucible + sample) before burning,
Wa = The total weight (crucible + sample) after burning
C = Weight of the empty crucible

The environmental parameters measured in this study are chemical and physical, while the physical parameters measured are temperature and salinity, and the chemical parameters measured are pH.

Data Analysis

The data obtained will be presented in tabular form using Microsoft Excel 2010 software and analyzed and discussed descriptively. The difference in density between stations was tested using One Way ANOVA and the Statistical Program for Social Science (SPSS) software application.

3. RESULT AND DISCUSSION

General Conditions of the Research Site

Sironjong Gadang Island is one of the islands in the Mandeh area located in South Coast Regency, West Sumatra Province. Setan Island borders the north of Sironjong Gadang Island, Cubadak Island borders the west, Nagari Ampang Pulai borders the east, and Sumatra Island borders the south.

Water Quality Parameters

The measured water quality parameters include physical parameters, namely temperature, brightness, and salinity, and chemical parameters, namely acidity (pH), to see the water conditions on Sironjong Gadang Island at the time of the research. The results of the measurement of water quality parameters can be seen in Table 1.

Water quality on Sironjong Gadang Island is still in the very good category to support gastropod life. The temperature at each Station can be said to help the life of gastropods. This is in line with the opinion of Rahmasari et al.[10] that gastropods can

carry out metabolic processes optimally in the temperature range between 25-35ºC; with these temperatures, the waters can be said to be suitable for gastropod survival. The measured salinity range is still ideal for gastropod survival. This is in line with the opinion of Ariska[11] that gastropods generally tolerate salinity ranging from 25-40‰.

Table 1. Average Water Quality Measurements at Sironjong Gadang Island

Station	Temperature (ºC)	Salinity (‰)	pH	Brightness (m)
I	29	25	7,91	1,55
II	28	27	7,95	2,65
III	28	25	7,93	2,50
Average	28,3	25,7	7,93	100

Gastropod Species

Based on the data obtained, several types of gastropods exist in the waters of Sironjong Gadang Island. The types of gastropods found consisted of four families, four genera, and eight species. Gastropods found at all research stations consisted of Trochidae, Muricidae, Littorinidae, and Neritidae.

According to Simbolon[12], gastropods from the Pachychilidae and Neritidae families are herbivorous gastropods that utilize plants such as algae and moss as their food (grazers). In addition to plant eaters, gastropods are filter and detritus eaters[13]. Detritus is organic particles resulting from the decomposition of various dead organisms and residual organisms[14]. The high content of organic particles will be utilized by gastropods as food. Food availability is what causes the high density of gastropods in the area.

Gastropod Diversity

The diversity values at Stations I, II, and III are 1.25, 1.71, and 1.74. From the research results, the highest gastropod diversity index is found at station III, with a value of 1.74. This is likely due to the many types of gastropods found. The lowest diversity index is at Station I, with a value of 1.25; the low index of gastropod diversity is caused by the few types of species obtained compared to Station II and Station III. The gastropod diversity index in the waters of Sironjong Gadang Island is presented in Table 2.

Table 2. Gastropod Diversity Index in Sironjong Gadang Island.

Station	Diversity Index (H')
I	1,25
II	1,71
III	1,74
Average	1,69

The high and low levels of diversity are influenced by the fertility of the habitat, which can support the life of each species that occupies the place. Overall, the value of the gastropod diversity index between stations is similar. The value obtained is quite significant compared to the results of research by Sianu[15] in Tomini Bay Waters, which ranged from 0.51-0.81 and lower than the research of Rahmasari et al.[16,] which ran between 1.62-1.43.

According to Persulessy & Arini[17], the diversity of a species is strongly influenced by the number of species and the total number of individuals of each species found; otherwise, if the number of species is small and the total number of individuals of each species is minor, then the species diversity is low.

Gastropod Density

The highest gastropod density was found at Station I, 16.33 ind/m², and the lowest at Station III, 13.89 ind/m². The high-density value at Station I is thought to be due to physical factors of water chemistry, namely the type of muddy substrate favored by gastropods, and temperature, pH, and salinity at Station I

are still in a normal state to support gastropod life. The low density of gastropods at station III is thought to be due to biological factors, namely competition in nature. The average gastropod density is presented in Table 3.

Table 3. Density of Gastropods (ind/m²) on Sironjong Gadang Island.

Station	Gastropod density (Ind/m²)	Standard deviation
I	16.33	1.08
II	14.67	0.97
III	13.89	0.78
	4.99	0.41

The density value of gastropods in the waters of Sironjong Gadang Island is high compared to the research conducted by Harif et al.[18] in Lembang Beach, Lengayang District, South Coastal Regency, West Sumatra, which amounted to 33,860 ind/ha when calculated using hectares (ha). According to Andrianna[19], gastropods have an essential role in the trophic chain of a water body. In the test of homogeneity of variances, the test results show that p = 0.649 (>0.05), so the data is said to be homogeneous, then proceed with the ANOVA test. The results of the ANOVA test obtained a significant value of 0.955, meaning that the p_{value}>0.05 indicates no difference in the density of gastropods in the waters of Sironjong Gadang Island.

In the trophic chain, gastropods occupy the grazer and detritivore links, so the higher the density of gastropods, the more algal blooms will be reduced. Conversely, the lower the density of gastropods, the more algae lives. The high-density value is supported by the percentage of organic matter content in the waters. This is because organic matter is essential for food sources for gastropod organisms.

Relative Density

Monodonta labio species has the highest relative density of 27.6%, while *Haustrum scobina* species has the lowest relative density of 3.3%. The average relative density of gastropods is presented in Table 4.

Table 4. Relative density of gastropods on Sironjong Gadang Island.

Species	Relative density (%)
Monodonta labio	27.6
Haustrum scobina	3.3
Littoraria angulifera	21.2
Nerita polita	6.8
Nerita lineata	6.1
Nerita undata	11.4
Nerita costata	6.0
Nerita balteata	17.6
Total	100

The relative density of gastropods in the waters of Sironjong Gadang Island shows that *M.labio* has the highest relative density value compared to other species found in the study site, with a relative density value of 28%. In comparison, the species with the lowest relative density is *H.scobina*, which has a relative density value of 3%. The high relative density of Monodonta labio species is thought to be caused by physical factors of water chemistry, including temperature, salinity, pH, and substrate that support the life of *M.labio*. While *H.scobina* has the lowest relative density level, it is thought to be caused by biological factors, namely the presence of predators and natural competition. The sandy substrate type is believed to affect the availability of nutrients, affecting these gastropods' density.

According to Rahmasari et al.[16], an organism's high and low density is influenced by various factors, including physico-chemical factors of water, temperature, salinity, pH, current, and bottom substrate. Based on the relative density value in the seas of Sironjong Gadang Island, it is high compared to the waters of the South Coast of Pemekasan Madura Regency conducted by Rahmasari et al.[16], the species that has the highest relative density at the research site is

N.distortus with a relative density value of 11.21%.

Water Quality of Sironjong Gadang Island based on the Diversity Index

Station I is included in the category of moderately polluted waters because the Station is indeed a place to lean fishermen's boats. Meanwhile, station II is also included in the category of moderately polluted waters because the Station is also still included in the area used for fishing activity. Station III is also included in the category of moderately polluted waters because it is included in the area that is usually used as a tourist activity for visitors.

Table 5. Water Quality of Sironjong Gadang Island based on the Diversity Index

	Station I	Station II	Station III
Value (H')	1,25	1,71	1,74
Category	Medium	Medium	Medium
Water Quality Based on (H')	Moderately Polluted	Moderately Polluted	Moderately Polluted

4. CONCLUSION

Based on the research conducted, the types of gastropods found in the waters of Sironjong Gadang Island consist of eight species, namely, *M.labio, H.scobina, L.angulifera, N.polita, N.lineata, N. undata, N.costata,* and *N.balteata*. The density of gastropods on Sironjong Gadang Island ranged from 13.69-16.33 ind/m². Diversity Index (H') in the study site has moderate gastropod diversity. Water quality in Sironjong Gadang Island is categorized as moderately polluted.

REFERENCES

1. Laily, N., Isnaningsih, N.R., Ambarwati, R. Struktur Komunitas Gastropoda di Kawasan Mangrove Pesisir Suramadu, Surabaya. *Oseanologi dan Limnologi di Indonesia*, 2022; 7(1): 33-41.
2. Wulansari, D.F., Kuntjoro, S. Keanekaragaman Gastropoda dan Peranannya sebagai Bioindikator Logam Berat Timbal (Pb) di Pantai Kenjeran, Kecamatan Bulak, Kota Surabaya. *Lentera Bio*, 2018; 7(3): 241-247.
3. Pratiwi, A. *Bioindikator Kualitas Perairan Sungai. Fakultas Arsitektur Lanskap dan Teknologi Lingkungan*. Universitas Trisakti. Jakarta, 2019.
4. Dharma, R., Wibowo, N., Raranta, H.P. Disfungsi endotel pada preeklampsia. *Makara Kesehatan*, 2005; 9(2): 63-69.
5. Sudarso, J., Wardiatno, Y. *Penilaian Status Mutu Sungai dengan Indikator Makrozoobentos*. Pena Nusantara, 2015.
6. Wulandari, E.T., Ramadhan, A., Masrianih, M. Keanekaragaman Jenis Gastropoda di Pantai Desa Tumbu, Kecamatan Topoyo Kabupaten Mamuju Tengah dan Pengembanganya Sebagai Media Pembelajaran. *E-Jip Biol*, 2017; 5(2): 30-40.
7. Insafitri, I. Keanekaragaman, Keseragaman, dan Dominansi Bivalvia di Area Buangan Lumpur Lapindo Muara Sungai Porong. *Jurnal Kelautan: Indonesian Journal of Marine Science and Technology*, 2010; *3*(1): 54-59.
8. Rifardi. Deposisi Sedimen di Perairan Laut Dangkal. *Journal of Marine Sciences,* 2008; 13(3): 147-152.
9. Mucha, A.P., Mazidah, M.T.S.D.N, Nugroho, F., Bathara, L. The Multiplier Effect of the Gandoriah Beach Marine Tourism to the Coastal Community of Kelurahan Pasir, Central Pariaman District, Pariaman City West Sumatra Province. *Jurnal Online Mahasiswa Fakultas Perikanan dan Ilmu Kelautan Universitas Riau*, 2016; 3(2): 1-12.

10. Rahmasari, T., Purnomo, T., Ambarwati, R. Keanekaragaman dan Kelimpahan Gastropoda di Pantai Selatan Kabupaten Pamekasan, Madura. *Biosaintifika: Journal of Biology & Biology Education*, 2015; 7(1): 48-54.
11. Ariska. *Keanekaragaman dan Distribusi Gastropoda dan Bivalvia (Moluska) di Muara Karang Tirta Pangandaran.* Institut Pertanian Bogor. Bogor, 2012.
12. Simbolon, A.R., Pencemaran Bahan Organik dan Eutrofikasi di Perairan Cituis Pesisir Tangerang, *Jurnal Pro-Life*, 2016; 3(2), 109-118.
13. Nurmiati, N., Sirih, H.M., Parakkasi, P. Identifikasi Jenis-Jenis Gastropoda dan Bivalvia di Pantai Lowu-Lowu Kecamatan Lea-Lea Kota BauBau, *Jurnal Ampibi*, 2016; 1(3): 56-60.
14. Tang, M., Nur, A.I., Ramli, M. Studi Kondisi Ekosistem Mangrove dan Produksi Detritus di Pesisir Kelurahan Lalowaru Kecamatan Moramo Utara Kabupaten Konawe Selatan, *Jurnal Manajemen Sumber Daya Perairan*, 2016; 1(4): 439-450.
15. Sianu, N.E. Keanekaragaman dan Asosiasi Gastropoda dengan Ekosistem Lamun di Perairan Teluk Tomini Sekitar Desa Tabulo Selatan Kecamatan Mananggu Provinsi Gorontalo. Nikè: *Jurnal Ilmiah Perikanan dan Kelautan*, 2014; 2(4):156 - 163.
16. Rahmasari, T., Purnomo, T., Ambarwati, R. Keanekaragaman dan Kelimpahan Gastropoda di Pantai Selatan Kabupaten Pamekasan Madura. *Journal of Biology & Biology Education*, 2015; 7(1): 48-54.
17. Persulessy, M., Arini, I. Keanekaragaman Jenis dan Kepadatan Gastropoda di Berbagai Substrat Berkarang di Perairan Pantai Tihunitu Kecamatan Pulau Haruku Kabupaten Maluku Tengah. *Biopendix*, 2018; 5(1): 45-52.
18. Harif, I., Tanjung, A., Elizal, E. Pola Kelimpahan dan Distribusi Gastropoda di Pantai Kambang Kecamatan Lengayang Kabupaten Pesisir Selatan Sumatera Barat. *Jurnal Natur Indonesia*, 2021; 19(2): 37-42.
19. Andrianna. *Kelimpahan dan Keanekaragaman Gastropoda di Pantai Sindangkerta Kecamatan Cipatujah Kabupaten Tasikmalaya*. Program Studi Pendidikan Biologi Fakultas Keguruan dan Ilmu Pendidikan. Universitas Pasundan, 2016.