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COMMUNITY STRUCTURE of EPIZOIC DIATOM *Pinna muricata* AT SEAGRASS ECOSISTEM IN PANDARATAN BEACH TAPANULI TENGAH REGENCY NORTH SUMATRA PROVINCE

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ABSTRACT

This research was carried out in March 2022; the location of this research is Pandaratan Beach, Tapanuli Tengah Regency, North Sumatra Province. The purpose of this study was to determine the abundance, relative abundance, diversity index, dominance index, and uniformity index of epizoic diatom species in *Pinna muricata* in the seagrass ecosystem of Pandaratan Beach. The method used is a survey method, using three sampling points to take *p.muricata*, the determination of 3 sampling points based on the density of the seagrass ecosystem. Sampling of diatoms was carried out by scraping the surface of the shells 5 cm wide, on the right and left backs of the shells. The diatom samples obtained were then analyzed in the laboratory. There were 12 types of epizoic diatoms found, consisting of *Amphora* sp, *Bacillaria* sp, *Cyclotella* sp, *Cymbella* sp, *Isthmia* sp, *Melosira* sp, *Navicula* sp, *Nitzschia* sp, *Pinnularia* sp, *Skeletonema* sp, *Surirella* sp, *Synedra* sp. the average value of epizoic diatom abundance on the shells of *Pinna muricata* ranged from 2.711,28–4.617,84 ind/cm^2, the average value of the diversity index (H') of epizoic diatoms ranged from 1.43-2.50. The mean value of the dominance index (D) is in the range of 0.26 to 0.92. The average value of the uniformity index (E) ranges from 0.40-0.70.

Keywords: Diatoms, Seagrass Ecosystem, *Pinna muricata.*

1. INTRODUCTION

Seagrass beds are important marine ecosystems that provide food, habitat, and nursery areas for several species, including shellfish, manatees, and sea turtles. One of the biota that depends on seagrass ecosystems is bivalves. Bivalves are part of a class of mollusks that have two shells or are often referred to as clams. The association of bivalves and seagrasses has a strong relationship with the food cycle. Litter on seagrasses will settle to the bottom of the water and then be decomposed by microorganisms that become food for bivalves. Bivalves or shells are the places where epizoic diatoms attach.

Pinna muricata lives in tidal areas with a muddy sand bottom at a depth of 1.5-4m. This bivalve lives by submerging part of its body. Epizoic diatoms are diatoms whose habitat is attached to invertebrates at the bottom of the water[1].

Community structure is one of the ecological studies that study an ecosystem and its relationship with environmental factors. Pandaratan Beach is a beach located in the Pondok Batu area, Sarudik District, Tapanuli Tengah Regency. Pandaratan Beach is rich in seagrass beds and mangrove ecosystems. The complexity formed from seagrass components allows potential habitat for various types of marine biota, one of which is bivalves.

In previous research conducted by Susetya[2] regarding the most found in this study, namely from the type of *P.muricata* clam. The *P.muricata* clam is the object of

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research to represent bivalves as a place to attach diatoms in the author's research.

Based on the description above, the author is interested in conducting research on the community structure of epizoic diatoms on *P.muricata* shells at Pandaratan Beach, Sarudik District, Tapanuli Tengah Regency, North Sumatra Province, with the aim of this study to determine the community structure of epizoic diatoms attached to bivalves. This community structure includes the composition of abundance, dominance, diversity, and uniformity of epizoic diatom species on bivalve shells in waters

2. RESEARCH METHOD

Time and Place

This research was conducted in February - March 2022. Sampling was carried out on the shells of *Pinna muricata* in the seagrass ecosystem of Pandaratan Beach, Tapanuli Tengah Regency, North Sumatra Province (Figure 1). Diatom identification activities were carried out at the Marine Biology Laboratory, Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Figure 1. Map of research locations

Methods

This research was conducted using a survey method, namely by making direct observations and sampling. The determination of the sampling location in this study is purposive sampling where data collection is based on specific objectives.

Procedure

Based on the consideration of water conditions and the distribution of *P.muricata* clams in the seagrass ecosystem of Pandaratan Beach, Tapanuli Tengah Regency, North Sumatra Province. Seagrass beds can be seen visually while at the research site, so the sampling was divided into 3 sampling points, each sampling point has different characteristics. The criteria for the distribution of sampling points at Pandaratan Beach, Sarudik District, Tapanuli Tengah Regency, North Sumatra Province are as follows:

Sampling Point I : Located in high-density seagrass habitat
Sampling Point II : Located in medium density seagrass meadow habitat
Sampling Point III : In a low-density seagrass habitat

Sampling was divided into 3 sampling points, where at each sampling point there were 3 sampling times. At one

time sampling 5 individuals of *P.muricata* clams that were still alive and ranged in size from 14-30 cm were sampled.

The surface of the clam shells was brushed approximately 5 cm to the dorsal side of the right and left sides of the clam shells. The clams taken were *P.muricata* clams that were stuck in the sand and mud which is the substrate of their life. The brushing of the shells was done slowly using a brush which was then sprayed with a sprayer filled with distilled water and collected in a sample bottle until the volume of the concentrate became 100 ml. Then the sample is labeled and preserved using 2 drops of 4% Lugol to be observed in the laboratory[3].

Observations of Epizoic Diatom Samples are in the sample bottle taken using a drop pipette after being homogenized. Then taken as much as 1 drop and then observed under a binocular microscope with a magnification of 10 x 10 using the 12 field of view method with 3 repetitions, this was done on all samples. Each diatom obtained was identified based on the plankton identification book Davis[4] and Yamaji[5] then counted the number of diatoms found.

Observations of epizoic diatoms were made under a microscope with a magnification of 10 x 10 using the 12 field of view method. Observations were made 3 times repetition for each sample bottle; Epizoic diatoms observed were identified with the help of the identification book[4]. To calculate the abundance of diatoms, a modified formula was used Lackey Drop Microtransactions Methods[6] and to calculate the area of the scrape field using the cone blanket area formula:

$$N = \frac{3Oi}{Op} \times \frac{Vr}{3Vo} \times \frac{1}{A} \times \frac{n}{3p}$$

Description:

N = Number of epizoic diatoms per unit area (individuals/cm^2)
O i= Area of cover glass (25 mm × 25 mm = 625 mm^2)
Op = Unit area of view of Olympus CX 21 microscope 100x magnification (1.306 mm^2)
Vr = The volume of sample water in the sample bottle (100 ml)
Vo = The volume of 1 drop of a sample (0.06 ml)
A = Area of the scallop field (A = π r s where $\pi = 3{,}14$) (cm)^2
N = Number of epizoic diatoms
P = Number of fields of view (12)

The relative abundance of epizoic diatoms was calculated using the formula according to Fachrul[7] as follows:

$$KR = \frac{ni}{N} \times 100\%$$

Description:

KR = Relative abundance
ni = Number of individuals of the 1st species/cell
N = Total number of individuals/cells

Species Diversity Index (H')

To see the diversity of epizoic diatom species, the Shannon-Winner formula *in* Odum[8] is used as follows:

$$H' = -\sum_{i=1}^{s} pi \; log_2 \; pi$$

Description:

Log_2 = 3.319
H' = Species diversity index
Pi = The proportion of individuals of the i-th species to total individuals of all species (pi = ni/N)
Ni = Total number of individuals of the i-th species (individuals/cm^2)
N = Total individuals of all species (individuals/cm^2)
S = Number of all individuals

Criteria: H' < 1 = Biota community is unbalanced or water quality is heavily polluted; 1 ≤ H' ≤ 3 = Moderate biota community balance, and moderately polluted water quality; H' > 3 = Biota balance in excellent condition and clean water quality

Dominance Index (D)

To calculate the dominance index of epizoic diatoms in waters, Simpson's formula[8] is used as follows:

$$D = \sum_{i=1,2,3}^{s} \left(\frac{ni}{N}\right)^2$$

Description:

ni = Total number of individuals of the i-th species (individuals/cm^2)

N = Total individuals of all species (individuals/cm^2)

Criteria: D close to 0 (<0.5) = No dominating species; D close to 1 (> 0.5) = There is a dominating species

Species Diversity Index (E)

The uniformity of organisms can be seen by using the species uniformity index. The species uniformity index of epizoic diatoms was calculated using Pilou's formula in Krebs[9] as follows:

$$E = \frac{H'}{Log_2 S}$$

Description:

E = Species uniformity index

H' = Species diversity index

S = Number of species encountered

Criteria if the value of E: Approaching 1 (>0.5) means that the uniformity of organisms is in a state of balance and there is no competition for either space or food; Approaching 0 (<0.5) means that the uniformity of organisms in the water is not balanced and there is competition for food.

3. RESULT AND DISCUSSION

General Situation of the Research Location

Tapanuli Tengah Regency is one of the areas located on the West Coast of Sumatra with an altitude between 0-1,266 m above sea level. Generally, the sub-districts in Tapanuli Tengah regency are located along the West Coast of North Sumatra with an altitude between 0-8 m above sea level, and towards the center is a hilly area that has an altitude of 100 m above sea level.

Pandaratan Beach is a beach located in Sarudik District, Tapanuli Tengah Regency, North Sumatra Province. This beach is overgrown by seagrass vegetation and there are marine biotas associated with it such as bivalves. This shows that there is a dynamic life interaction between seagrasses and bivalves that need each other in the process of growth and reproduction. Not far from Pandaratan Beach, various ship activities make the area traffic for sailing or returning to the port, as well as several residential areas. This can indirectly affect water quality and bivalve habitat in Pandaratan Beach.

Types of Epizoic Diatoms Found at the Research Site

The types of diatoms found during the study included order centrales, namely *Isthmia* sp, *Melosira* sp, *Skeletonema* sp, and *Cyclotella* sp. Diatoms belonging to order pennales are *Nitzschia* sp, *Bacillaria* sp, *Amphora* sp, *Cymbella sp*, *Synedra* sp, *Navicula* sp, *Pinnularia* sp, and *Surirella* sp. Sulaiman[10] states that order Pennales is pennatus-shaped and order Centrales has radial symmetry. The abundance of benthic diatoms in a water body is strongly influenced by light intensity, turbidity, nutrients (nitrate, phosphate, and silica), and sediment.

Abundance of Epizoic Diatoms

The mean abundance of epizoic diatoms on *P.muricata* mussel shells ranged from 2,711.28-4,617.84 individuals/cm^2 which can be seen in Figure 2.

Relative Abundance of Epizoic Diatoms

The highest relative abundance of epizoic diatoms in *Pinna muricata* clam shells at sampling point I is *Bacillaria,* which is 42% (Figure 3). The highest relative abundance of epizoic diatoms in *Pinna muricata* clam shells at sampling point II is *Synedra,* which is 38% (Figure 4).

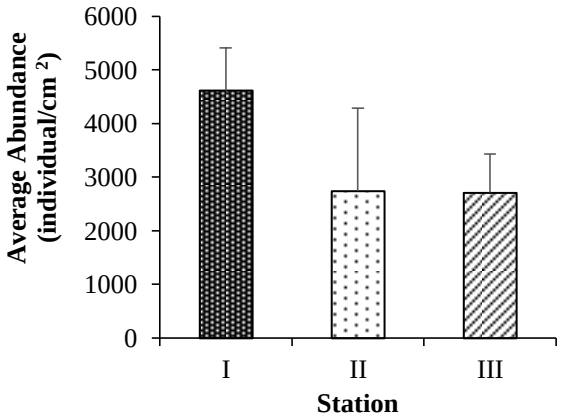

Figure 2. Abundance of epizoic Diatoms

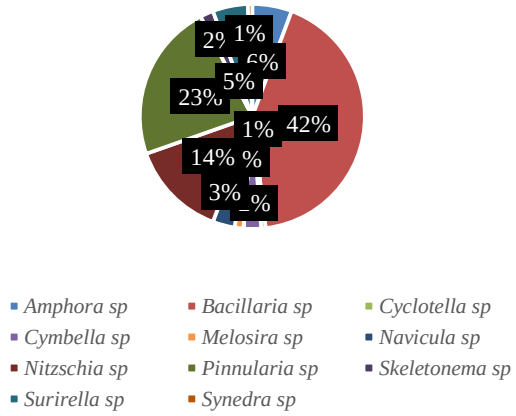

Figure 3. Relative abundance of epizoic diatoms at sampling point I

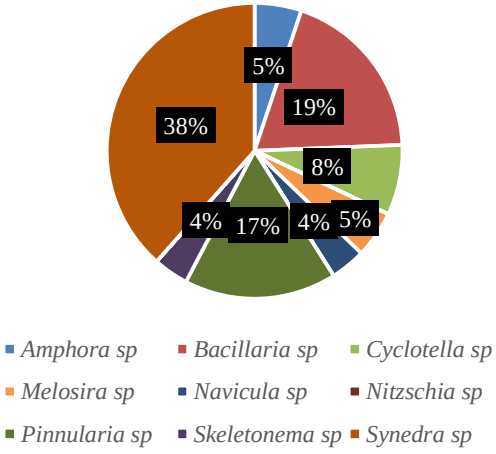

Figure 4. Relative abundance of epizoic diatoms at sampling point II

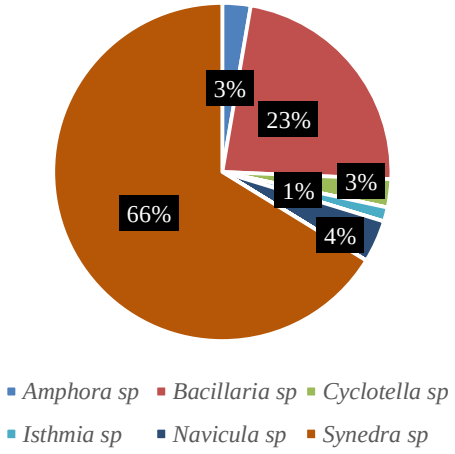

Figure 5. Relative abundance of epizoic diatoms at sampling point III

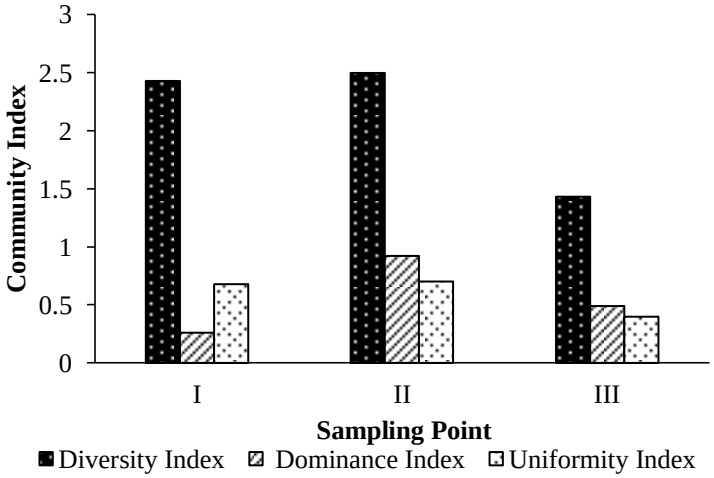

Figure 6. Values of diversity index (H'), dominance index (D), and uniformity index (E) of epizoic diatoms in *P.muricata*

Based on Figure 5, it can be seen that the highest relative abundance of epizoic diatoms in *P. muricata* clam shells at sampling point III is *Synedra*, which is 66%.

Values of Diversity Index (H'), Dominance Index (D), and Uniformity Index (E) Epizoic Diatoms in *P.muricata* Clams

The mean values of the diversity index (H`), dominance index, and uniformity index can be seen in Figure 6.

Figure 6 obtained the mean value of the diversity index (H') of epizoic diatoms ranging from 1.43-2.50. The mean value of the dominance index (D) ranged from 0.26-0.92. The mean value of the uniformity index (E) ranged from 0.40-0.70.

The species diversity index value (H') of epizoic diatoms in *P.muricata* clam shells has an average value ranging from 1.43 - 2.50, if adjusted to the value of the Shannon Winner diversity index determination in Odum[8], it is included in the range of diversity index values $1 \leq H' \leq 3$ where the balance of the biota community is moderate and the water quality is moderately polluted. The species diversity index (H') is used to see how much the level of balance of the observed community structure with habitat characteristics inhabited by this biota[11]. The balance of an ecosystem can be seen in the high value of the uniformity index in microalgae habitat. This is following Ruswahyuni[12] statement that species diversity shows the balance of the ecosystem. The higher the species diversity, the more balanced the ecosystem. Conversely, the lower the species diversity, it indicates that the aquatic ecosystem is under pressure and its condition is declining.

Rudiyanti[13] explains that the value of diversity in the range of 1-2 indicates waters in moderately polluted conditions. According to Thoha and Rachman (2013), diatom diversity is strongly related to environmental stability. The more stable an environment, the higher the species diversity.

The dominance index of sampling points I and III has a value of 0.26 - 0.49, the dominance index of sampling points I and III is close to 0 (<0.5) there is no dominating species. The dominance index value is close to zero which means there is no dominating species. This shows that the microalgae habitat can support its life so that no competition causes dominance in certain species. While sampling point II has a value of 0.92, based on the determination of Simpson's dominance index *in* Odum[8] the dominance index value of all sampling points is included in the D criteria close to 1 (>0.5) which means there is a dominating species. As well as the statement Waty & Imanto[14] states that the microalgae habitat is still able to support its life so that there is no competition and extreme conditions that cause dominance in certain species.

The uniformity index (E) at sampling points I and II ranged from 0.68 to 0.70 when viewed from the criteria for the value of E according to Pilou in Krebs[9] including the criteria for the value of E close to 1 (>0.5) which means the uniformity of organisms in balanced waters, where there is no competition for both place and certain food. Siagian[15] states that the occurrence of differences in the uniformity index value in each observation can occur because the number of species and density of each type of microalgae is different so it will affect the microalgae uniformity index.

Water Quality Parameters

Water quality measurements that the range of average values of pH, temperature, salinity, nitrate, and phosphate at each sampling point is almost the same. While the brightness at each sampling point shows a value of 100% so that seagrass can still grow on Pandarat Beach. A good seagrass ecosystem supports the life of *P.muricata* clams to which epizoic diatoms are attached. According to Pakpahan[16], it is stated that differences in diatom abundance are caused by differences in the influence of activities around the waters and conditions at each sampling point, where each location of the observation sampling point has different anthropogenic influences and the supply of nutrients affects the growth of diatoms in the waters. The average value of

water quality parameters at each sampling point can be seen in Table 1.

Table 1. The average value of water quality parameters

Sampling Point	pH	Temperature (ºC)	Salinity (ppt)	Brightness (%)	Nitrate (mg/L)	Phosphate (mg/L)
I	8,0	34	30	100	0,69	0,77
II	8,0	33	32	100	0,84	0,74
III	8,0	34	32	100	0,82	0,95

The nitrate and phosphate content at sampling point III is higher when compared to other sampling points. The high nitrate content certainly influences the abundance of diatoms. According to the opinion of Constina et al.[17], the concentration of nitrate and phosphate increases, the abundance of diatoms will also increase and vice versa, if the concentration of nitrate and phosphate decreases, the abundance of diatoms will decrease, although the effect given is only slightly on the abundance of diatoms. The same thing is also explained by Rudiyanti[13] which states that the abundance of diatoms in waters is also influenced by the availability of nutrients in the environment.

4. CONCLUSION

The highest species abundance of all diatom species found was *Bacillaria* and *Synedra*. While the total number of individuals most commonly found at sampling point I is 151 individuals. Based on the average value of the diversity index (H'), dominance index (D), and uniformity index (E), it can be concluded that epizoic diatoms on *P.muricata* clam shells have a moderate biota community balance value and there is a disturbance in the waters, there are dominating species, and the uniformity of organisms in balanced waters.

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