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Epizoic Diatom Community Structure in Snails *Cerithidea obtusa* and *Nerita articulata* in the Mangrove Ecosystem, Dumai City, Riau Province

Struktur Komunitas Diatom Epizoik pada Siput Cerithidea obtusa dan Nerita articulata di Ekosistem Mangrove, Kota Dumai, Provinsi Riau

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Abstract

The purpose of this study was to determine the type, abundance, and community structure of epizoic diatoms attached to the shells of the snails *Cerithidea obtusa* and *Nerita articulata* in the mangrove ecosystem of Dumai City, Riau Province. This research was conducted in January 2022. A sampling of snail shells took place in the mangrove ecosystem of the city of Dumai, Riau Province, and was identified at the Marine Chemistry Laboratory, Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau. Based on the research that has been done, the results show that there are 13 genera of epizoic diatoms consisting of 5 genera centrales and 8 genera of pennales order. The highest abundance of epizoic diatoms in *C.obtusa* snail shells was at station II with a value of 29,687 ind/cm^2. While the highest abundance of epizoic diatoms in *N.articulata* shells was at station I. Based on the average values of diversity index (H'), dominance index (D), and uniformity index (E) it can be concluded that epizoic diatoms in *C.obtusa* and *N.articulata* have a moderate biota community balance value, moderate polluted water quality, no dominant species and unbalanced organism uniformity and food competition occurs.

Keywords: Dumai, Mangrove Ecosystems, Snails, Epizoic Diatoms

Abstrak

Tujuan penelitian ini yaitu untuk mengetahui jenis, kelimpahan, dan struktur komunitas dari diatom epizoik yang menempel pada cangkang siput *Cerithidea obtusa* dan *Nerita articualta* di ekosistem mangrove Kota Dumai Provinsi Riau. Penelitian ini dilaksanakan pada bulan Januari 2022. Pengambilan sampel cangkang siput bertempat di ekosistem mangrove kota Dumai Provinsi Riau dan diidentifikasi di Laboratorium Kimia Laut Jurusan Ilmu Kelautan Fakultas Perikanan dan Kelautan Universitas Riau. Berdasarkan penelitian yang telah dilakukan diperoleh hasil, yaitu terdapat 13 genus diatom epizoik yang terdiri dari centrales sebanyak 5 genus dan ordo pennales sebanyak 8 genus. Kelimpahan diatom epizoik pada cangkang siput *C.obtusa* tertinggi terdapat pada stasiun II dengan nilai 29.687 individu/cm^2. Sedangkan Kelimpahan diatom epizoik pada cangkang siput *N.articulata* tertinggi terdapat pada stasiun I. Berdasarkan nilai rata-rata indeks keanekaragaman (H'), indeks dominansi (D) dan indeks keseragaman (E) dapat disimpulkan bahwa diatom epizoik pada cangkang siput *C.obtusa* dan *N.articulata* memiliki nilai keseimbangan komunitas biota sedang, kualitas perairan tercemar sedang, tidak ada jenis yang mendominansi serta keseragaman organisme tidak seimbang dan terjadi persaingan makanan.

Kata Kunci : Dumai, Ekosistem Mangrove, Siput, Diatom Epizoik

1. Introduction

Dumai is one of the cities in Riau Province which has various ecosystems, especially mangrove ecosystems and aquatic ecosystems. The Dumai waters area has been used by the community for industrial activities, transportation of goods and oil ships, docks, to fishing activities by local fishermen. These community activities are closely related to environmental changes, both physical and chemical changes in water. Increased activity in water areas hurts organisms including diatoms.

The mangrove ecosystem is one of the ecosystems that have high productivity compared to other ecosystems with high organic matter decomposition which makes it a very important ecological link for the organisms that live in it (Imran & Effendi, 2016). The Dumai mangrove ecosystem is still quite good, where in this ecosystem organisms will adapt and make reciprocal relationships with their environment to survive. The abundance and distribution of a species in a mangrove ecosystem is determined by the availability of resources and the condition of chemical and physical factors which must be within the range that can be tolerated by the species.

The red-eye snail (*Ceritidea obtusa*) is a type of marine biota belonging to the Potamididae family and is a member of the gastropods found in the mangrove ecosystem and is capable of accumulating heavy metal pollutants and is cumulative. *C.obtusa* is found mainly in mud substrates associated with mangrove ecosystems and is one of the macrobenthos that has a habit of living at the bottom of the waters and is included in the benthic species that can utilize plankton and organic matter in the form of detritus in mangrove ecosystems (Eddiwan et al., 2017). *C.obtusa* generally looks for food using a deposit feeder, which collects small particles in the form of detritus along with the smallest microorganisms that settle on the bottom of the substrate.

The genus Nerita is the most prominent group of marine intertidal gastropods which are widely distributed on tropical and subtropical coasts. *Nerita articulata* is often found in intertidal areas, rocky areas, sand, mud, and mangrove forests (Frey, 2010). This gastropod has a small shell shape, has a spiral motif on its shell, larger individuals usually have a more subtle spiral motif. Relatively constant color; grayish to tan-pink with a black spiral pattern. The inner wall is yellowish-white, usually finely textured, the operculum is grayish, generally darker (Clements & Tan, 2008). One type of microalgae that is symbiotic in snails is diatoms.

Diatom is another name for the class Bacillariophyceae, a member of the Division Bacillariophyta. Diatoms are microalgae that are widely distributed in all aquatic environments and are even found in terrestrial environments, moist rock surfaces, several types of plants, and animal shells. The existence of diatoms greatly affects life in the waters because they play an important role as a food source for various marine organisms and play a role in the transfer of carbon, nitrogen, nitrate, and phosphate. Diatoms are often found in various habitats, namely marine ecosystems, fresh water, on the surface of moist soil, and even on the outer walls of ships and snail shells, which are called epizoic diatoms.

According to Mills et al. (2002), the division of diatoms based on their attached substrate is divided into six groups, namely Epipelic, Epilytic, Epidendric, Epipitic, and Epizoic. Epizoic is a group of diatoms that live attached to animals, one of which is in the shells of the snails *C.obtusa* and *N.articulata* which are commonly found in mangrove ecosystems. This species of snail has local names, namely red-eyed snail and round snail.

The structure of the diatom community can be identified by determining the composition, abundance, and diversity of genera within a community (Nybakken, 2001). Community structure examines the composition of community structure with the habitat environment and disturbances, both from physical, chemical, and biological factors as well as diversity in waters. Several parameters that are usually used to describe community structure are diversity, uniformity, and dominance indices.

The available information on research on epizoic diatoms in the shells of the snails *C.obtusa* and *N.articulata* in various places in Dumai City is still limited. Based on the above description, it is necessary to research the community structure of epizoic diatoms in the snails Cerithidea obtusa and Nerita articulata in the mangrove ecosystem of Dumai City, Riau Province.

The purpose of this study was to determine the type, abundance, and community structure of epizoic diatoms attached to the shells of the snails *C.obtusa* and *N.articulata* in the mangrove ecosystem of Dumai City, Riau Province.

2. Material and Method

2.1. Time and Place of Research

This research was conducted in January 2022. Sampling was carried out on the shells of the snails *C.obtusa* and *N.articulata* in the mangrove ecosystem of Dumai City, Riau Province. Diatom identification activities were carried out at the Marine Biology Laboratory and analysis of nitrate and phosphate content was carried out at the Marine Chemistry Laboratory, Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

2.2. Procedures

2.3.1. Snail Sampling

Snail collection was carried out in two types of habitat, namely on the surface of the sediment around the mangroves and mangrove roots by taking the snails *C.obtusa* and *N.articulata* as samples. At each sampling point, five individual snail's *C.obtusa* and *N.articulata* were taken which were considered to represent the two types of snails. The snails sampled were live snails with an average size of 3 cm. The snail shell is rinsed first so that it is clean from adhering mud.

2.2.2. Diatom Sampling

A sampling of diatoms from the snails *C.obtusa* and *N.articulata* was carried out by brushing the snail shells. The shell is brushed gently using a soft brush and then sprayed with a sprayer containing distilled water. The sample water is collected in a bottle until the concentrate volume becomes 100 ml, and then the sample is labeled and preserved using 4 drops of 4% Lugol's solution. Observations were made in the Marine Biology laboratory.

2.2.3. Observation of Epizoic Diatom Samples

The diatom sample in the sample bottle was taken using a dropper after thoroughly stirring, then 1 drop was taken and then observed under a binocular microscope using the 12 field of view method with 3 repetitions, this was done for all samples. Each diatom obtained was identified up to the species level by referring to the identification book using the identification book Davis (1955) and Yamaji (1976) and then counting the number of diatoms found.

2.2.4. Water Sampling

To find out the condition of the waters where the snails embedded with epizoic diatoms live, water quality measurements were taken when the water conditions around the mangrove ecosystem were at high tide. Measurements were carried out in 3 repetitions. Water quality parameters measured include temperature, salinity, brightness, pH, and nutrients (nitrate and phosphate).

2.3. Observation Parameters

2.3.1. Epizoic Diatom Abundance Calculations

To calculate the abundance of diatoms, a modified formula of the Lackey Drop Microtransecting Methods (APHA, 1992) was used:

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

Information :

N = Number of epizoic diatoms per unit area (individuals/cm^2)

Oi = Area of cover glass (25 mm × 25 mm = 625 mm^2)

Op = Viewing area of the Olympus CX 21 microscope 100x magnification (1.306 mm^2)

Vr = Volume of sample water in the sample bottle (100 ml)

Vo = Volume of 1 drop of the sample (0.06 ml)

A = Area of the scraping area (A =πrs / πr^2 where (cm2)$\pi = 3{,}14$)

n = Number of enumerated epizoic diatoms

p.s = Number of visual fields (12)

2.3.2. Species Diversity Index (H')

To see the diversity of types of epizoic diatoms, the Shannon-Winner formula in Odum (1998) is used as follows:

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

Information:

Log2 = 3.3219

H' = Species diversity index

pi = Proportion of individuals from the i-th species to the total individuals of all species (pi = ni/N)

ni = total number of individuals of the i type (individuals/cm^2)

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

s = Sum of all individuals

Criteria: H' < 1= Unbalanced biota community or heavily polluted water quality; 1 ≤ H' ≤ 3 = The balance of the biota community is moderate, and the water quality is moderately polluted; H' > 3 = Balance of biota in prime condition and clean water quality

2.3.3. Dominance Index (C)

To calculate the dominance index of epizoic diatoms in waters, Simpson's formula is used in Odum (1998) as follows:

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

Information :

C = Dominance Index

ni = Number of individuals of the i type (individuals/cm^2)

N = Total individual all species (individual/cm^2)

s = the number of types that were successfully retrieved

Criteria: C close to 0 (0 < C < 0.5) = neither species predominates; C is close to 1 (0.5 < C < 1) = There are types that dominate

2.3.4. Species Uniformity Index

To see the uniformity of organisms in a state of balance or not, the species uniformity index is used. The uniformity index of epizoic diatom species is calculated using Pilou's formula in Odum (1998) as follows:

$$E = \frac{H'}{\text{Log}_2\ S}$$

Information:

E = Species uniformity index

H' = Species diversity index

S = Number of species found

Criteria if the value of E: Close to 1 (0.5 < C < 1) means that the uniformity of organisms is in a state of balance and there is no competition for either a particular place or food; Approaching 0 (0 < C < 0.5) means that the uniformity of organisms in the waters is unbalanced and competition for food occurs.

2.4. Data Analysis

The data obtained from sampling will be presented in the form of tables and graphs to be discussed descriptively related to existing water conditions. Abundance, relative abundance, the diversity index (H'), dominance index (D), and uniformity index (E) of epizoic diatom species were calculated using Microsoft Excel 2010 software, while to see differences in epizoic diatom abundance between the snails *C.obtusa* and *N.articulata* with 2 stations different statistical tests were carried out with the T-test.

3. Result and Discussion

3.1. General Condition of Research Area

Dumai is a city located in Riau Province which was formed based on Law Number 16 of 1999 dated April 20, 1999, concerning the Formation of New Regencies/Cities in Riau Province as an embodiment of Law Number 22 of 1999 concerning Regional Government. Dumai has 7 (seven) Dumai Barat Districts, Dumai Timur Districts, Bukit Kapur Districts, Sungai Sembilan Districts, Medang Kampai Districts, Dumai City Districts and Dumai Selatan. The City of Dumai has a land area of 204,674 ha and a water area of 71,393 hectares. Dumai city is located between 101º0'38”-101º43'33” east longitude and 01º26'50”-02º15'40” north latitude. Administratively, Dumai City is bordered by the Rupat Strait, Rupat Island to the north, Bukit Batu District, and Bengkalis Regency to the east. District Mandau.

3.2. Water Quality

The water quality parameter is an important factor for every organism to be able to carry out life processes, including in this case the intertidal waters which are in areas affected by sea tides. Physical and chemical parameters are very decisive factors for aquatic organisms because they will affect the productivity of epizoic diatoms either directly or indirectly.

Table 1 . Average value of water quality parameters at each station

Station	Physics Parameters				Chemical Parameters	
	pH	Temperature (^{o}C)	Salinity (‰)	Brightness (cm)	Nitrate (mg/L)	Phosphate (mg/L)
I	7,1	26,6	28	63,8	0.039	0.023
II	8,2	28,3	14,6	26	0.040	0.039

Based on Table 1 and Appendix 6 it can be seen that water quality measurement data has a range of average values of pH, Temperature, Nitrate, and Phosphate at each station almost the same. The pH of the waters ranges from 7.1 – 8.2, and the temperature of the waters ranges from 26.6-28.3°C where according to KMNLH (2004) the range of natural temperature values based on quality standards for marine biota ranges from 28-32°C, the salinity waters ranged from 14.6 – 28‰, waters brightness ranged from 6.8 – 7.7. As for the salinity, there is a difference where the salinity ranges from 14.6-28 ‰, with high salinity values at station I and low at station II. This is because stations I is close to the sea while station II is a bit far from the sea and is near the mouth of the river. Brightness values range from 26-63, 8 cm where the highest brightness is at station I and the lowest brightness is at station II. This is because station II is close to the mouth of the river where the water conditions in this area are more turbidity.

3.3. Types of Epizoic Diatoms

Based on the identification results carried out at the Marine Biology Laboratory, epizoic diatoms were found in snail shells of *C.obtuse* and *N.articulata* in the mangrove ecosystem of Dumai City, Riau Province, consisting of 11 genera of epizoic diatoms. The classification of the diatoms found can be seen in Table 2.

Table 2. Classification of diatoms in *C. obtusa* and *N. articulata*

Order	Family	Species
Centrales	Isthmiaceae	*Isthmia* sp.
	Melosiraceae	*Melosira* sp.
	Aulacoseiraceae	*Aulacoseira* sp.
	Skeletonemataceae	*Skeletonema* sp.
	Striatellaceae	*Striatella* sp.
Pennales	Bacillariaceae	*Nitzschia* sp.
		Bacillaria sp.
	Cymbellaceae	*Cymbella* sp.
	Thalassionemataceae	*Thalasionema* sp.
	Fragilariaceae	*Synedra* sp.
		Ulnaria sp.
	Naviculaceae	*Navicula* sp.
	Pinnulariaceae	*Pinnularia* sp.

Based on Table 2, there were 13 species of epizoic diatoms consisting of 2 orders, namely the order centrales and the order pennales

3.4. Distribution, Composition, and Abundance of Epizoic Diatoms in C.obtusa and N.articulata

The results of observations on the types of diatoms found different distributions at each research station. Diatoms in the shells of *C.obtusa* and *N.articulata* snails were found to have different distributions at each research station.

Table 3. Composition of epizoic diatom types in the Shells of *C.obtusa* and *N. articulata*

	C. obtusa		*N. articulata*		Total	
Species	I	II	I	II	*C. obtusa*	*N. articulata*
Aulacoseira sp.	2	-	3	-	2	3
Bacillaria sp.	-	-	18	5	-	23
Cymbella sp.	-	-	2	-	-	2
Isthmia sp.	11	22	54	12	33	66
Melosira sp.	22	-	-	-	22	-
Navicula sp.	5	8	11	4	13	15
Nitzschia sp.	4	5	-	-	9	-
Pinnularia sp.	18	30	12	4	48	16
Skeletonema sp.	-	-	-	60	-	60
Striatella sp.	-	4	-	-	4	-
Synedra sp.	39	46	51	21	85	72
Thalasionema sp.	-	3	-	2	3	2
Ulnaria sp.	-	17	-	19	17	19
Total Number of Species	7	8	7	8		
Total Number of individuals	101	135	151	127	236	278

Based on Table 3, it can be seen that the total number of species composition in the snail shells of *C.obtusa* and *N.articulata* at each station is the same, namely station I consists of 7 species and Station II consists of 8 species. For the total composition of individual types of diatoms in the snail shells of *C.obtusa*, the highest was at station II with a total of 135 individuals, while the highest in the snail shells of *N.articulata* was at station I. While the most abundant species were found at all stations in the shells of *C.obtusa* and *N.articulata* is a diatom of the species *Synedra* sp. with a total number of 85 and 72 individuals found.

The abundance of diatoms in water is influenced by environmental parameters. Several parameters that support diatom life include temperature, salinity, pH, brightness, and nutrients (nitrate and phosphate) in these waters. Heryanto et al. (2003) state that the distribution and distribution of phytoplankton is uneven in every water because it is influenced by physical and chemical factors such as wind currents and nutrient content. Salinity is one of the parameters that determine the types of diatoms present in a body of water (Nontji, 2006). Salinity in the waters of Dumai, Riau Province, ranges from 14.6 to 28‰.

Salinity variations can determine the abundance and distribution of diatoms because salinity is one of the parameters that determine the types of diatoms present in waters. Salinity in the waters serves to maintain osmotic pressure between the diatom bodies and the waters (Simanihuruk, 2012). The brightness at each station in the Dumai City Mangrove Ecosystem is around 26 – 63.8 cm. The highest water brightness is at station I with a value of 63.8 cm and the lowest is at station II with a value of 26 cm. According to Nedi (2001) the higher the brightness value, the deeper the penetration of sunlight into the waters, this will result in a higher productive layer and an increase in primary productivity.

Temperature is very influential in the amount of diatom abundance. Following the opinion of Sunarto (2008) that high temperatures facilitate the absorption of nutrients by phytoplankton, the maximum photosynthetic rate will increase at higher temperatures. Temperature acts as a regulator of metabolic processes and physiological functions of diatoms. Temperature is not a limiting factor for diatoms, but temperature greatly influences the acceleration or deceleration of growth and reproduction (Silalahi & Ngangi, 2015).

Based on the results of measurements of nitrate and phosphate concentrations, station II had the highest nitrate and phosphate concentration values compared to all stations, where the concentration values for nitrate were 0.1167 mg/L and phosphate 0.0907 mg/L. This opinion is supported by Soedibjo (2006) explaining that the input of waste from human activities on land can also cause an increase in nutrients in waters and is followed by phytoplankton biomass, growth, and production of diatoms is strongly influenced by the availability of nutrients.

Based on the results of observations, it was found that the composition of epizoic diatom species attached to the snail shells of *C.obtusa* and *N.articulata* in the mangrove ecosystem of Dumai City identified 10 species of diatoms each with a total of 13 diatoms found consisting of orders centrales as many as 5 species and order pennales as many as 8 species. The large number of Pennales diatoms found was because the diatoms of the Pennales order could survive and stick to strong currents and sea waves, while the Order Centrales was more planktonic. This is following the statement of Suthers & Rissik (2009) that the diatoms of the order centrales are planktonic and live floating in the water columns, while the diatoms of the order pennales are found mostly on the bottom or attached to the substrate.

Diatoms belonging to the order centrales are Isthmia, Melosira, and Aulacoseira. Diatoms belonging to the order pennales are Striatella, Nitzschia, Bacillaria, Cymbella, Thalasionema, Synedra, Ulnaria, Navicula, and Pinnularia. The diatoms of the order Pennales have a bilaterally symmetrical shape that looks like a taper, line, ellipse, or ovoid, while the diatoms of the order centrales have a radial symmetrical shape when viewed from above in the form of a circle, sometimes a triangle (Nontji, 2006).

3.5. Epizoic Diatom Abundance in C.obtusa and N.articulata Snail Shells

The results of observations made on the abundance of epizoic diatoms found varied abundances at each research station, more details can be seen in Figure 1 and Figure 2.

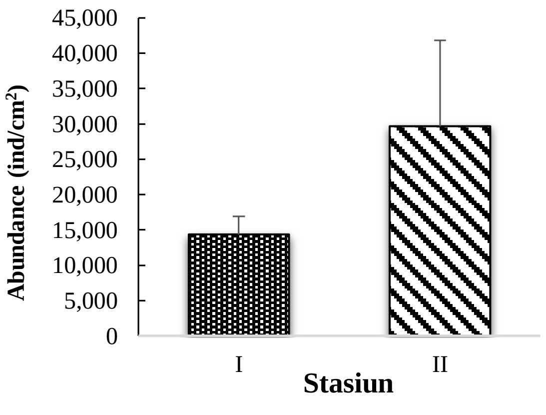

Figure 1. Average epizoic diatom abundance in *C.obtusa* Shells at each station

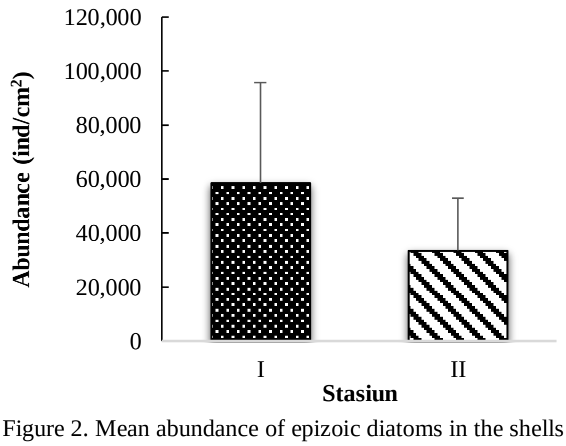

Figure 2. Mean abundance of epizoic diatoms in the shells of *N. articulata* at each station

Based on Figure 1, the highest mean epizoic diatom abundance in *C.obtusa* snail shells was at station II with a value of 29,687 individuals/cm^2, this is presumably because station II is in a mangrove forest area with brackish waters which is a potential source of nutrients through litter mangroves. While the lowest abundance average value was at station I with a value of 12,580 ind/cm^2.

Based on Figure 2, the highest mean epizoic diatom abundance in *N.articulata* snail shells was at station I with a value of 58,612 ind/cm^2, this was presumably because station I was in a mangrove forest area with seawater which is a potential source of nutrition through litter mangroves. While the lowest abundance average value was at station II with a value of 33,468 ind/cm^2.

The highest abundance of diatom species found in *C.obtusa* snail shells at each station was Synedra and Pinnularia. While the highest genus abundance of diatoms found in the snail shells of *N.articulata* at each station was Skeletonema and Isthmia. The lowest species abundance of diatoms found in *C.obtusa* snail shells at each station was Aulacoseira, Striatella, and Thalasionema. While the lowest species abundance of diatoms was found in the snail shells of *N.articulata* at each station, namely Aulacoseira, Cymbella, and Thalasionema. This is thought to be caused by the low ability of diatoms to adapt to environmental changes. Thoha & Rachman (2013) said that diatoms that are only found at one station have a low tolerant response

The existence of a population of a type of microalgae at certain times can grow and overflow so that the most abundant species appear. The appearance of these types is sometimes sudden, then disappears again and is replaced by other types (Samiaji, 2015). The difference in the composition of diatom species in each zone is thought to be caused by the presence of several genera that are tolerant to basic water conditions and tolerant to long exposure to open air. According to Mulyadi (2003) that microalgae that live in the intertidal area are microalgae that live between the tides so that periodically they experience a dry period (the lowest in the atmosphere) which at low tide causes different genera to appear.

3.6. Relative Abundance of Epizoic Diatoms in C.obtusa and N. articulata

Based on the results of the identification of epizoic diatoms in the shells of *C.obtusa* snails in the mangrove ecosystem of Dumai City, Riau Province, it was found that each station has different types of diatoms. Based on the calculation results show that the value of the relative abundance of each species varies at each research station (Figure 3 and Figure 4).

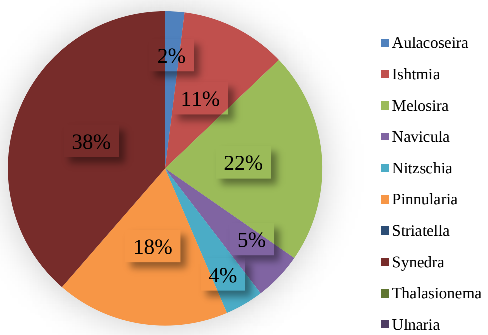

Figure 3. Relative abundance of epizoic diatoms in *C.obtusa* snail shells at the station

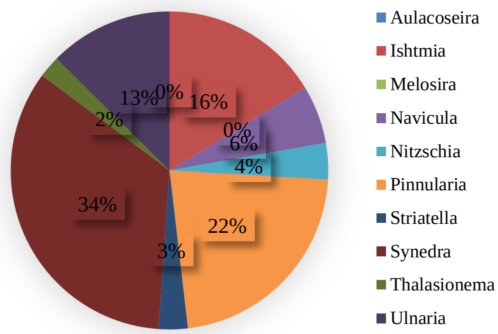

Figure 4. Relative abundance of epizoic diatoms in *C.obtusa* snail shells at station II

Based on Figure 3, it can be seen that the highest relative abundance of epizoic diatoms in the *C.obtusa* snail shell at the station I was Synedra, namely 38. Based on Figure 4, it can be seen that the highest relative abundance of epizoic diatoms in the *C.obtusa* snail shell at the station I was Synedra, namely 34%.

Based on the results of the identification of epizoic diatoms in the shells of the snail *N.articulata* in the waters of Dumai City, Riau Province, it was found that each station has different types of diatoms. Based on the calculation results, it shows that the value of the relative abundance of each species varies at each research station. For more details, the value of the relative abundance of epizoic diatoms at station 1 can be seen in Figure 5 and station II in Figure 6

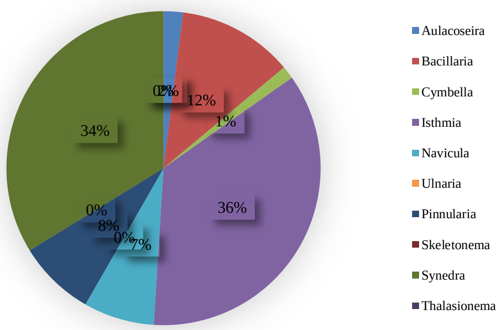

Figure 5. Relative abundance of epizoic diatoms in *N.articulata* snail shells at station I

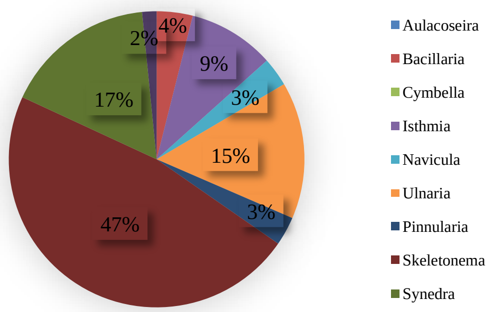

Figure 6. Relative abundance of epizoic diatoms in *N.articulata* snail shells at station II

The abundance of diatoms in the waters is also directly influenced by physiological processes such as respiration and photosynthesis such as light, temperature, salinity, and nutrients. The same thing was explained by Rudiyanti (2011), stating that the abundance of diatoms in water is also influenced by the availability of nutrients found in the environment. Influential factors include temperature, pH, and light intensity and a very important factor is the salinity factor.

3.7. Diversity Index (H'), Dominance Index (C), and Uniformity Index (E) of Epizoic in C.obtusa and N.articulata

Based on the results of observations, different diatoms were found at each research station, from the types of diatoms found at each station, calculations were carried out to obtain the values of the Diversity Index (H'), Dominance Index (D), and Uniformity Index (E) which can be seen in Table 4.

Table 4. Diversity Index (H'), Dominance Index (D), and Uniformity Index (E) Epizoic Diatoms in *C. obtusa* Snail Shells

Station	Point sampling	Diversity Index (H')	Dominance Index (D)	Uniformity Index (E)
	1.1	1.8933	0.3388	0.1140
I	1.2	1.3128	0.4465	0.1317
	1.3	1.9194	0.1110	0.1156
Average		1.7085	0.2988	0.1204
	2.1	2.0396	0.2404	0.1056
II	2.2	1.3623	0.4941	0.1025
	2.3	1.7680	0.3517	0.1064
Average		1.7233	0.3620	0.1048

From Table 4, the average value of diversity index (H') for epizoic diatoms ranges from 1.7085 to 1.7233. The average value of the dominance index (D) ranges from 0.2988 to 0.3620. The average value of the uniformity index ranges from 0.1048-0.1240. Based on the results of observations, different diatoms were found at each research station. From the types of diatoms found at each station, calculations were made to obtain the values of the Diversity Index (H'), Dominance Index (D), and Uniformity Index (E) which can be seen in Table 5.

Table 5. Diversity Index (H'), Dominance Index (D), and Uniformity Index (E) values of epizoic diatoms in *N.articulata* snail shells

Station	Point sampling	Diversity Index (H')	Dominance Index (D)	Uniformity Index (E)
	1.1	1.9851	0.3448	0.0996
I	1.2	1.6364	0.4465	0.1642
	1.3	1.9191	0.3088	0.1155
Average		1.8469	0.3667	0.1264
	2.1	1.4610	0.4394	0.1010
II	2.2	1.1971	0.5980	0.0721
	2.3	1.5308	0.4374	0.1152
Average		1.3963	0.4916	0.0961

Table 5 shows that the average diversity index (H') of epizoic diatoms ranges from 1.3963 to 1.8469. The average value of the dominance index (D) ranges from 0.3667 to 1.4916. The average value of the uniformity index ranges from 0.0961-0.1264. The species diversity index (H') is used to see how much the level of balance of the observed community structure with the characteristics of the habitat inhabited by this biota (Supono, 2008).

The species diversity index (H') value of epizoic diatoms in *C.obtusa* snail shells has an average value of around 1.7085 – 1.7233. Meanwhile, the snail *N.articulata* has an average value ranging from 1.3963 – 1.8469. This is adjusted to the value of the diversity index determination Shannon Winner in Odum (1998) 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 quality of polluted waters is moderate. Judging from the measurement of pH concentrations in the waters, it ranges from 7.1 to 8.2. According to Effendi (2003), a pH range of 6 - 6.5 will cause diatom diversity to decrease, and a pH range of 7 - 8.5 high diatom diversity, so the pH at this research station still supports diatom life.

Rudiyanti (2009) explained that diversity values with a range of 1-2 indicate waters in moderately polluted conditions. According to Thoha & Rachman (2013), the diversity of diatoms is closely related to environmental stability. The more stable an environment, the higher the diversity of species, the average value of the dominance index in *C.obtusa* snails ranged from 0.2988 – 0.3620. While *N.articulata* has an average value of 0.3667 – 0.4916. Based on the determination of Simpson's dominance index in Odum (1998) the dominance index values of all stations included in criterion D are close to 0 (<0.5) which means that no species dominates.

Amin et al. (2012) explained that the dominance index in waters close to 0 indicates that in general the community structure is stable and there is no ecological pressure on microalgae in these waters.

The uniformity index (E) found in *C.obtusa* snails ranged from 0.1048 to 0.1204. Meanwhile, the snail *N.articulata* has an average value of 0.0961 – 0.1264. When viewed from the criteria for the E value according to Pilou in Odum (1998) it is included in the criteria for an E value close to 0 (<0.5), which means that the uniformity of organisms in the waters is unbalanced, where there is competition for place and food. Pirzan et al. (2005) stated that if the uniformity is close to 0, it means that the uniformity between species in the community is low and if the uniformity is close to 1, it can be said that the uniformity is even or equal. Telambanua & Siregar (2007) explained that several species of microalgae that live attached can dominate waters with strong currents and reduced current velocity will increase the species uniformity of the organisms attached.

4. Conclusions

Based on the results of the study, it can be concluded that epizoic diatoms in the shells of *C.obtusa* and *N.articulata* snails were found in 13 genera, consisting of 5 genera of the centrales order and 8 genera of the pennales order. The epizoic diatom that has the highest species abundance value is Navicula. The highest abundance of epizoic diatoms in *C.obtusa* snail shells was at station II with a value of 29,687 ind/cm^2. While the highest abundance of epizoic diatoms in *N.articulata* snail shells was at station I. Based on the average values of diversity index (H'), dominance index (D), and uniformity index (E) it can be concluded that epizoic diatoms in the shells of *C.obtusa* and *N.articulata* snails have moderate biota community balance values, moderate polluted water quality, there is no dominant type and the uniformity of organisms is unbalanced and competition for food occurs.

5. Suggestion

It is hoped that the surrounding community and local government will continue to maintain the mangrove ecosystem area so that the mangrove ecosystem is preserved so that one of the gastropod organisms such as the snails *C.obtusa* and *N.articulata* that live in the mangrove ecosystem area are biota that can provide benefits in the economic field as well, and it is hoped that further research was carried out regarding the structure of the epizoic diatom community on different types of substrates so that a wider diatom community could be identified and could provide information for related parties.

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