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Community Structure of the Epipelic Diatom Vertically in the Intertidal Zone, West Dumai City, Riau Province

Struktur Komunitas Diatom Epipelik Secara Vertikal di Zona Intertidal Kawasan Perairan Kota Dumai Barat, Provinsi Riau

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Abstract

The purpose of this study was to determine the community structure of epipelic diatoms vertically between stations. This research was carried out in March 2022 which is located in the waters of the City of West Dumai. The method used is the survey method. Determination of the sampling point is done by purposive sampling method and the determination of the station is based on anthropogenic input. A sampling of epipelic diatoms was carried out using a modified corer, then brought to the laboratory to identify and calculate the community structure, and the sediment samples were calculated for the content of nitrate, phosphate, organic matter, and sediment fractions. Sampling is accompanied by measurements of water quality consisting of brightness, temperature, current velocity, salinity and pH. 21 genera of epipelic diatoms were found in the waters of West Dumai City with an abundance value of 9,784 – 32,739 ind/cm2. The average value of the diversity index obtained was 2.6460 – 3.2065, the dominance index was 0.1478 – 0.2423, and the uniformity index was 0.7952 – 0.8424. The results of the one-way ANOVA test obtained an average value of 0.001, meaning that there was a significant difference in the abundance of epipelic diatoms between stations.

Keywords: Epipelic Diatom, Community Structure, Intertidal Zone, Dumai

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui struktur komunitas diatom epipelik secara vertikal antar stasiun. Penelitian ini telah dilaksanakan pada bulan Maret 2022 yang berlokasi di Perairan Kota Dumai Barat. Metode yang digunakan adalah metode survei. Penentuan titik sampling dilakukan dengan metode *purposive sampling* dan penentuan stasiun berdasarkan masukan antropogeniknya. Pengambilan sampel diatom epipelik dilakukan menggunakan *corer* modifikasi, kemudian sampel diatom dibawa ke laboratorium untuk diidentifikasi serta dihitung struktur komunitasnya, serta sampel sedimen dihitung kandungan nitrat, fosfat, bahan organik, dan fraksi sedimennya. Pengambilan sampel disertai dengan pengukuran kualitas perairan yang terdiri dari kecerahan, suhu, kecepatan arus, salinitas, dan pH. Hasil penelitian ditemukan 21 genus diatom epipelik di perairan Kota Dumai Barat dengan nilai kelimpahan 9.784 – 32.739 ind/cm^2. Nilai rata-rata indeks keanekaragaman yang didapatkan, yaitu 2,6460–3,2065, indeks dominansi 0,1478–0,2423, sedangkan indeks keseragaman 0,7952 – 0,8424. Adapun hasil uji *one way Anova* didapatkan nilai rata-rata 0,001, artinya adanya perbedaan kelimpahan diatom epipelik yang signifikan antar stasiun.

Kata Kunci: Diatom Epipelik, Struktur Komunitas, Zona Intertidal, Dumai

1. Introduction

Diatoms are microalgae that are very common in waters, are the largest primary producers in the sea, and can be found in all parts of the water. Areas with sufficient light intensity and rich in nutrients are the areas most favored by diatoms. According to Bracher *in* Nurimansyah et al. (2015), diatoms affect about 40% of primary productivity in marine waters so diatoms are used as microalgae with the highest abundance in waters.

Suprobowati & Suwarno (2009) stated that diatoms are unique and very specific organisms because their cell walls are composed of silicates so that they can be stored for a very long time in sediments. This is following the statement of Siregar et al. (2008) that diatoms can be stored for a long time because they are influenced by various factors, both water quality, and substrate, so they have a good response. Diatoms that live attached to a sedimentary substrate are called epipelic diatoms. Epipelic diatoms are commonly used as aquatic bioindicators because of their sensitivity to their habitat conditions.

The intertidal zone is a tidal area that is influenced by coastal and marine activities and is an area inhabited by many organisms. The intertidal zone is generally divided into three types of beaches, namely rocky, sandy, and muddy. As for the intertidal zone with a muddy beach type, one of them is in the waters of West Dumai City. There are various coastal areas in West Dumai City with various anthropogenic inputs from the surroundings, including the Bandar Bakau area which is a conservation area, and the Aceh Naval Base (LANAL) Bangsal area which is a water area adjacent to several industries.

So it is necessary to do research related to epipelic diatoms, by looking at the community structure based on sediment layers in the Bandar Bakau area and LANAL Bangsal Aceh

2. Material and Method

2.1. Time and Place of Research

This research was carried out in March 2022 located in the Bandar Bakau Area and LANAL Bangsal Aceh, Dumai City (Figure 1). Analysis of epipelic and sedimentary diatom samples was carried out at the Marine Biology Laboratory and Marine Chemistry Laboratory, Faculty of Fisheries and Marine, Universitas Riau.

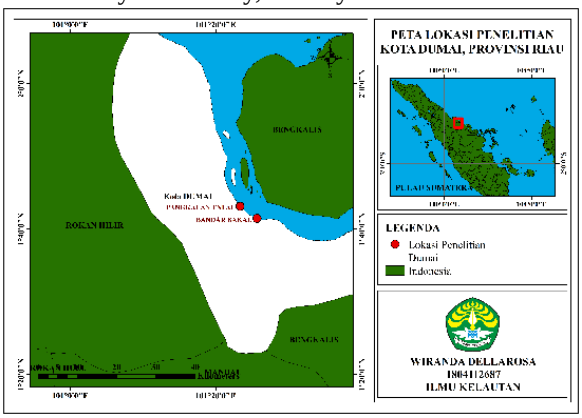

Figure 1. Map of research locations

2.2. Research Methods

The method used is the survey method, data obtained through observation and measurement in the field. Epipelic diatom and sediment samples were brought to the laboratory to be identified and to calculate the community structure and abundance. Sampling of epipelic diatoms was carried out during the day, around 10.00 WIB to 12.00 WIB. A sampling of diatoms was taken by taking sediment at depths of 0 – 1 cm, 25 cm, and 50 cm using a modified corer (Figure 2), then transferred to a sample bottle, and then given 3 – 4 drops of 4% Lugol solution.

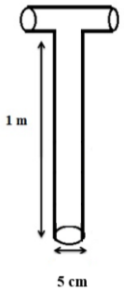

Figure 2. Corer modification

Epipelic diatom samples were brought to the laboratory for analysis. The method used to count the number of diatoms was the field of view method with a total field of view of 12, then observed using an Olympus CX 21 microscope with a magnification of 10 x 10 and identified using the identification book Yamaji (1976).

In addition to epipelic diatom samples, sediment samples were also used as samples of nitrate, phosphate, organic matter, and sediment fractions. Water quality measurements were carried out on the same day, namely at high tide. Measurements made in the form of brightness, temperature, current speed, salinity, and pH

3. Result and Discussion

3.1. Water Quality

The water quality parameters observed included physical and chemical parameters of the waters which can be seen in Table 1.

Table 1. Parameter values of aquatic physics and chemistry

Station	Time (WIB)	Physics Parameters			Chemical Parameters			
		Brightness(m)	Temperature (°C)	Current Speed (m/s)	Salinity (ppt)	pH	Nitrates (mg/L)	Phosphate (mg/L)
1	11.50	0.64	26,67	0.17	28	7,1	1.92	0.99
2	12.10	0.6	28	0.23	28	6,3	1.97	1.02

According to KLH No. 51 of 2004 concerning seawater quality standards, good water brightness is > 3 m. At the research location, the brightness value obtained was 0.60 – 0.64 m, which means that the waters are not good. The temperature directly affects organisms and indirectly affects the solubility of CO_2 used for photosynthesis and the solubility of O_2. According to Effendi *in* Supono (2008), diatoms grow well at temperatures of 20 – 30°C. In this study, the temperature values obtained ranged from 26.67 – 28°C and were classified as optimal for the growth of diatoms.

Epipelic diatoms dominate the waters with current speeds ranging from 0.2 – 1 m/s (Romimahtarto *in* Sinurat, 2019). The current velocity in the Dumai City waters ranged from 0.17 – 0.23 m/s, and the salinity at both stations is 28 ppt, but according to Nontji *in* Sinurat (2019), good salinity for plankton growth is 30-35 ppt. While the pH in the waters of Dumai City ranges from 6.3 to 7.1, this value is still in good condition for the growth of diatoms.

As for seawater nitrate concentrations that are appropriate according to KLH Decree No. 51 of 2004 is 0.008 mg/L, while the proper concentration of phosphate for marine life is 0.015 mg/L. At the research location, nitrate values were found to be in the range of 0.92 – 0.97 mg/L, this value was very high. While the phosphate values obtained range from 0.67 to 0.69 mg/L, this value is also high. According to Joshimura *in* Patty et al. (2015), these waters can be said to be very fertile. The high value of nitrate and phosphate is due to weathering from unused shipboards, various industries and estuaries, and mangrove forests.

3.2. Sediment Fraction

The percentage of sediment fractions and their types can be seen in Table 2.

Table 2. Sediment fraction values

Station	Layer	Sediment Fraction (%)			Sediment Type
		Gravel	Sand	Mud	
1	On	88.44	4.06	7,5	Gravel
	Middle	15,73	14.57	69,7	Pebbled mud
	Lower	54,4	13.84	31.76	Muddy gravel
2	On	7.65	13.47	78,88	Mud
	Middle	16,37	32,27	51,37	Sandy mud
	Lower	23,82	0.44	75.75	Mud

In the waters of West Dumai City, the types of sediment fractions are gravel, gravelly silt, muddy gravel, silt, and sandy silt. Overall, the condition of the bottom substrate fraction in the waters of West Dumai City contains the size of silt and gravel grains. Nugroho *in* Sinurat (2019) explains that the coarse fraction shows that the currents and waves in that area are relatively strong.

3.3. Organic Ingredients

Organic matter plays an important role in determining soil fertility (Yuningsih et al., 2014). The results of the analysis of sediment organic matter show a value of an average of 4.48 – 46.07%. According to Yuningsih et al. (2014), when the composition of organic matter ≥ 35% is classified as very high. The high content of organic matter can be suspected by the presence of mangrove vegetation at station 1, while at station 2 the source of the

organic matter content can come from the waste of several factories. The results of the analysis of organic matter can be seen in Table 3.

Table 3. Value of organic material content

Station	Layer	The calculation results		Organic Matter Value (%)
		Wo (g)	Wt (g)	
1	On	10,20	5,5	46.07
	Middle	20,37	16.09	21.02
	Lower	20	16.03	19.87
2	On	15,19	12.85	15,44
	Middle	20.02	23.08	6.06
	Lower	33,87	32,36	4.48

3.4. Classification and Distribution of Epipelic Diatoms

The classification of epipelic diatoms can be seen in Table 4 and Table 5

Table 4. Classification of Station 1 epipelic diatoms

No	Order	Family	Genus
1	Bacillariales	Bacillariaceae	*Nitzschia*
2	Biddulphiales	Biddulphiaceae	*Isthmia*
3	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus*
4	Fragilariales	Fragilariaceae	*Fragilaria*
			Synedra
			Ulnaria
5	Naviculales	Amphipleuraceae	*Amphipleura*
			Frustulia
		Naviculaceae	*Navicula*
		Pleurosigmataceae	*Gyrosigma*
			Pleurosigma
		Pinnulariaceae	*Pinnularia*
		Sellaphoraceae	*Sellaphora*
		Stauroneidaceae	*Stauroneis*
6	Rhaphoneidales	Rhaphoneidaceae	*Diplomenora*
7	Surirellales	Surirellaceae	*Surirella*
8	Thalassiosirales	Skeletonemataceae	*Skeletonema*
			Stephanodiscus
		Thalassiosiraceae	*Thalassiosira*

Table 5. Classification of Station 2 epipelic diatoms

No	Order	Family	genus
1	Bacillariales	Bacillariaceae	*Nitzschia*
2	Coscinodiscales	Heliopeltaceae	*Actinoptychus*
		Coscinodiscaceae	*Coscinodiscus*
3	Fragilariales	Fragilariaceae	*Fragilaria*
			Synedra
4	Melosirales	Melosiraceae	*Melosira*
5	Naviculales	Amphipleuraceae	*Amphipleura*
		Pleurosigmataceae	*Gyrosigma*
			Pleurosigma
		Pinnulariaceae	*Pinnularia*
		Stauroneidaceae	*Stauroneis*
6	Surirellales	Surirellaceae	*Surirella*
7	Thalassiosirales	Stephanodiscaceae	*Stephanodiscus*
		Thalassiosiraceae	*Thalassiosira*

Of the 21 diatom genera, the most genera were found at station 1 (surface), namely 15 genera, while the fewest genera were found at station 2 (middle layer), namely 9 genera. There are 4 genera of diatoms found in each sedimentary layer, namely Amphipleura, Coscinodiscus, Fragilaria, and Synedra (Table 6).

Table 6. Distribution of epipelic diatoms

No	Species	Station					
		Mangrove City			LANAL Bangsal Aceh		
		1	2	3	1	2	3
1	*Actinoptychus* sp.	-	-	-	+	-	-
2	*Amphipleura* sp.	+	+	+	+	+	+
3	*Coscinodiscus* sp.	+	+	+	+	+	+

4	*Diplomenora* sp.	-	-	+	-	-	-
5	*Fragilaria* sp.	+	+	+	+	+	+
6	*Frustulia* sp.	-	-	+	-	-	-
7	*Gyrosigma* sp.	+	+	+	-	-	+
8	*Isthmia* sp.	+	+	+	-	-	-
9	*Melosira* sp.	-	-	-	-	-	+
10	*Navicula* sp.	-	-	+	-	-	-
11	*Nitzschia* sp.	+	+	-	+	+	+
12	*Pinnulari a*sp.	-	+	-	+	+	-
13	*Pleurosigma* sp.	+	+	+	-	+	+
14	*Sellaphora* sp.	+	+	-	-	-	-
15	*Skeletonema* sp.	+	-	-	-	-	-
16	*Stauroneis* sp.	+	+	+	+	+	-
17	*Stephanodiscus* sp.	+	+	-	-	-	+
18	*Surirella* sp.	+	-	-	+	+	+
19	*Synedra* sp.	+	+	+	+	+	+
20	*Thalassiosira* sp.	+	+	+	+	-	+
21	*Ulnaria* sp.	+	+	+	-	-	-
	Total	15	4	13	10	9	11

3.5. Epipelic Diatom Abundance

Calculation of the abundance of epipelic diatoms can be seen in Table 7.

Table 7. Epipelic diatom abundance values

Station	Layer	Sampling Point	Diatoms Found	Abundance (in/cm²)	Abundance ± Std.Dev
1	On	1	82	30,482	30.105 ± 2319.7636
		2	87	32,739	
		3	72	27,095	
	Middle	1	55	20,697	20,070 ± 3256.5751
		2	63	23,708	
		3	42	15,805	
	Lower	1	46	17,311	16,307 ± 1692,2566
		2	37	13,924	
		3	47	17,687	
2	On	1	72	27,095	22,203 ± 3849.9618
		2	58	21,826	
		3	47	17,687	
	Middle	1	28	10,537	11,540 ± 773,2517
		2	33	12,418	
		3	31	11,666	
	Lower	1	23	8,655	10,286 ± 1576,7359
		2	33	12,418	
		3	36	9,784	

The abundance of epipelic diatoms can be used as an indicator of waters because of their sensitivity to environmental conditions. Based on Table 7, it can be seen that the abundance of epipelic diatoms in the waters of West Dumai City ranges from 9,784 – 32,739 ind/cm^2 with an average of 10,286 – 30,105 ind/cm^2. The highest average value of epipelic diatom abundance was found at station 1 of the upper layer with a value of 30,105 ind/cm^2 and the lowest epipelic diatom abundance value was at station 2 of the lower layer, namely with a value of 10,286 ind/cm^2. The difference in the abundance of each layer is caused by the intensity of light that is received more by the top layer (surface), while in the lower layer, it can be assumed that there is no incoming light so it is not optimal for the growth of epipelic diatoms.

Based on the results of the one-way ANOVA statistical test, it was found that there was a significant difference in the abundance of epipelic diatoms between the sediment layers.

3.6. Epipelic Diatom Community Structure

Adjusted for the fixed value of the Shannon-Winner diversity index in Odum (1998) at station 1, namely 3.2065, meaning that the level of species diversity is high and the waters are not polluted. This is because the water quality at station 1 is classified as optimum for the growth of diatoms. Whereas at station 2 the diversity value is 2.6460, meaning that the level of species diversity is moderate and the condition of the waters is lightly polluted. The waters at station 2 are classified as less than optimal and there are many sources of pollutants entering from various industries which cause the waters to become polluted.

Based on the determination of the Simpson dominance index in Odum (1998) at both stations, namely $0.01 < C \leq 0.30$, it means that the level of dominance is low or there are no dominant species. According to Amin *in*

Sinurat (2019), a D value close to 0 indicates a stable community structure and no ecological pressure on biota in these waters.

The average uniformity index value obtained ranges from 0.7952 to 0.8424. Based on the uniformity index of Pilou *in* Saribu (2017) with a uniformity index value of > 0.6 which indicates that the population uniformity value at each research station is high. This means that the uniformity of organisms in these waters is in a state of balance and there is no competition for either a particular place or food. Epipelic diatom community structure at the study site can be seen in Table 8.

Table 8. Community structure value of epipelic diatoms

Station	Layer	Biological Index					
		H'	H' Average	D	D average	E	E average
1	On	3.3850	3.2065	0.1153	0.1478	0.8664	0.8424
	Middle	3.1647		0.1557		0.8312	
	Lower	3.0697		0.1725		0.8295	
2	On	2.6645	2.6460	0.2229	0.2423	0.8021	0.7952
	Middle	2.2321		0.3489		0.7042	
	Lower	3.0414		0.1550		0.8792	

4. Conclusions

Environmental water quality in the waters of West Dumai City has optimum characteristics for the growth of epipelic diatoms. The community structure of epipelic diatoms found in the waters of Dumai City based on their composition obtained 21 genera of diatoms. 4 genera are found in each station and sedimentary layer. The highest average abundance value was found at station 1 of the upper layer with a value of 30,105 ind/cm^2, while the lowest average abundance value was found at station 2 of the lower layer with a value of 10,286 ind/cm^2. The species diversity index value at station 1 is high and the waters are not polluted, while at station 2 it is moderate and the waters are lightly polluted. Dominance index values at both stations were low or there were no dominant species. While the value of the type uniformity index at both stations is high. Based on the one-way ANOVA test, there is a significant difference in the abundance of epipelic diatoms between the sediment layers.

5. Suggestion

Further research is needed by adding an analysis of the epipelic silica content of diatoms vertically. It is also recommended to the government and the local community to maintain the aquatic environment from various marine pollution.

6. References

Nurimansyah, E., Soeprobowati, T.R., Murningsih. (2015). Distribusi Vertikal Diatom Epipelik di Muara Sungai Banjir Kanal Timur Semarang. *Jurnal Biologi*, 4(4):1-7.

Odum, E.P. (1998). *Dasar-dasar Ekologi*. Diterjemahkan oleh T. Samingan. Edisi Ketiga. Gadjah Mada University Press. Yogyakarta.

Patty, S.I., Arfah, H., Abdul, M.S. (2015). Zat Hara (Fosfat, Nitrat), Oksigen Terlarut dan pH Kaitannya dengan Kesuburan di Perairan Jikumerasa, Pulau Buru. *Jurnal Pesisir dan Laut Tropis*, 1(1):44-50.

Saribu, M.H.D. (2017). *Studi Kelimpahan Diatom (Bacillariophyta) Planktonik dengan Konsentrasi Nitrat dan Fosfat di Perairan Belawan Provinsi Sumatera Utara*. Fakultas Perikanan dan Ilmu Kelautan. Universitas Riau. Pekanbaru.

Sinurat, N.M. (2019). *Struktur Komunitas Diatom Epipelik Secara Vertikal pada Lapisan Sedimen di Kawasan Konservasi Lamun Trikora, Kabupaten Bintan Kepulauan Riau.* Fakultas Perikanan dan Kelautan. Universitas Riau. Pekanbaru.

Siregar, S.H., Mulyadi, A., Hasibuan, O.J. (2008). Struktur Komunitas Diatom Epilitik (Bacillariophyceae) pada Lambung Kapal di Perairan Dumai Provinsi Riau. *Jurnal Ilmu Lingkungan*, 2(2):33-47.

Soeprobowati, T.R., & Hadisusanto, S. (2009). Diatom dan Paleolimnologi: Studi Koperasi Perjalanan Sejarah Danau Lac Saint-Augustine Quebeq-city, Canada dan Danau Rawa Pening Indonesia. *Biota*, 14(1):60-68.

Supono. (2008). *Analisis Diatom Epipelik sebagai Indikator Kualitas Lingkungan Tambak untuk Budidaya Udang.* Program Studi Magister Manajemen Sumberdaya Pantai. Universitas Diponegoro. Semarang.

Yuningsih, H.D., Soedarsono, P., Anggoro, S. (2014). Hubungan Bahan Organik dengan Produktivitas Perairan pada Kawasan Tutupan Eceng Gondok, Perairan Terbuka dan Keramba Jaring Apung di Rawa Pening Kabupaten Semarang Jawa Tengah Diponegoro. *Journal of Maquares.* 3(1):37-43.