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ABUNDANCE AND DIVERSITY OF PHYTOPLANKTON IN THE WATERS OF TELUK LECAH VILLAGE, RUPAT, BENGKALIS

Sagita Anwar[1*], Aras Mulyadi[1], Irwan Effendi[1]
[1]Department of Marine Science, Faculty of Fisheries and Marine,
Universitas Riau, Pekanbaru, 28293 Indonesia
*sagita.anwar0675@sudent.unri.ac.id

ABSTRACT

The aim of carrying out the research is to determine the abundance and diversity of phytoplankton. The method used in this research is a survey method, namely data collection, documentation, and direct observation in the field. Samples were analyzed at the Marine Biology Laboratory of Riau University. The results of the research show that there are six types of phytoplankton found in the waters of Teluk Lecah Village, Rupat District, Bengkalis Regency, namely *Synedra* sp, *Dactylococcopsis* sp, *Nitzschia* sp, *Tribonema* sp, *Cylindrotheca* sp, and *Rhizosolenia* sp. The first highest phytoplankton abundance was at station II, with an abundance of 0.1660, followed by the second highest phytoplankton abundance at station I, namely the residential area, with an abundance of 0.1494 Ind/L, while the lowest phytoplankton abundance was at station III, namely at the harbor with an abundance of 0. ,0996 Ind/L. The species diversity index at stations I and III, H' > 3, means the level of species diversity is high and the water conditions are not polluted. At station II, $1 \leq H' \leq 3$ means the level of species diversity is moderate, and the water conditions are lightly polluted. It can be concluded that the H' value still meets the criteria. The species diversity index at all stations, E > 0.5, means that the uniformity of organisms is in balance, and there is no competition for certain places or food. It can be concluded that the E value also meets the criteria. Species dominance index at all stations, D < 0.5 means no dominant species exists.

Keywords: Diversity, Phytoplankton, Teluk Lecah Village

1. INTRODUCTION

Plankton are small biota that can be found in marine and fresh waters. Plankton can be divided into two types, namely phytoplankton and zooplankton. Phyto-plankton are plankton that belong to the plant group and are the most significant primary producers of water and oxygen producers in water areas because they can carry out photosynthesis and are the basis of the food chain for marine life and river waters. Phytoplankton are also one of the parameters of the fertility level of a body of water.

The abundance of phytoplankton in a water body is high, so the water body tends to have high productivity. Primary productivity is the rate of photosynthesis and carbon binding. In addition, primary productivity is also the degree of storage of solar energy in organic form as a result of the photosynthesis and chemosynthesis of primary producers[1].

The existence of phytoplankton significantly affects life in the waters because it plays a vital role as food for various marine organisms. Changes in water function are often caused by changes in the structure and quantitative value of phytoplankton[2]. These changes can be caused by factors that come from nature or from human activities, such as a sporadic increase in nutrient concentrations, a condition where substances needed by

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organisms to grow are unevenly distributed so that they can cause an increase in the quantitative value of phytoplankton beyond the normal limits of other living organisms. This condition can have a negative impact in the form of mass death of aquatic organisms due to competition for the use of dissolved oxygen, which has occurred in various waters in the world and some Indonesian waters.

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Teluk Lecah Village, Rupat District, Bengkalis Regency, has a water tourism destination overgrown with mangrove ecosystems. The mangrove ecosystem can affect the abundance and diversity of phytoplankton. In addition, information on the abundance and diversity of phytoplankton in Teluk Lencah Village, Bengkalis Regency, has not been well documented. Seeing the various kinds of problems that occur, such as human activities, marine tourism activities, and port activities, this research is essential to determine the abundance and diversity of phytoplankton in the waters of Teluk Lecah Village, Rupat Bengkalis District.

2. RESEARCH METHOD

Time and Place

The research was conducted in February 2024 in Teluk Lecah Village, Rupat Bengkalis District (Figure 1).

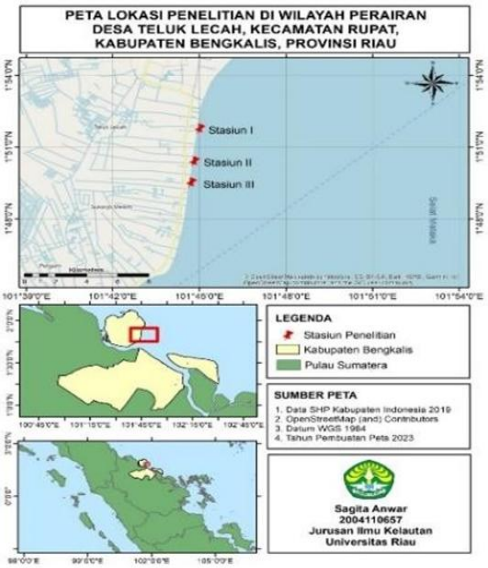

Figure 1. Maps of the locations and research stations

Methods

The method used in this research is a survey method, namely collecting data, documentation, and direct observation in the field. Then, quantitative data collection was obtained from water quality measurements. Phytoplankton samples were analyzed at the Marine Biology Laboratory, Universitas Riau. Furthermore, the data obtained are presented in tabular/graphic form and discussed descriptively analytically.

Procedures

Determination of Research Stations

Determination of station locations using purposive sampling method, namely taking several locations with consideration of the existing environmental conditions in the field with groups that represent the whole.

Based on the characteristics of the location or area around the water. Placement of station I is in an area close to residential areas (which allows the disposal of household waste), station II is in the mangrove tourism area of Teluk Lecah Village, and station III is in the ship port of Teluk Lecah Village. Pengambilan Sampel Fitoplankton

Sampling of phytoplankton in the waters of Teluk Lecah Village was carried out at 10:00-13:00 WIB. Water samples were taken as much as 100 L using a 10L bucket and done 10 times, with a depth of ± 1 meter from the water surface, then filtered using a plankton net no.25 with a mesh size of 55 µm to a volume of 100 mL. Filtered sample water is put into a sample bottle, then preserved using 4% lugol preservative, as much as 3-4 drops, then labeled with a mark to avoid confusion.

Identification and Calculation of Phytoplankton

Phytoplankton samples were identified at the Marine Biology Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Riau. The identification of phytoplankton samples was carried out at the Marine Biology Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau[3]. Using the sweep method or 12 fields of view, namely the process by looking at the preparation from the upper left end of the preparation and ending at the lower left end with a magnification of 10 x 10 for three repetitions to get representative data. Each station sample was taken 3 times, and then the sample was observed in number, and the genus was obtained. Phytoplankton samples obtained were identified using a phytoplankton identification book[4]. Phytoplankton abundance was calculated with the following formula[5] :

$$\mathbf{N = Z \times \frac{X}{Y} \times \frac{1}{V}}$$

Description :

N = Individual abundance (Ind/L)
Z = Number of phytoplankton individuals
X = Volume of filtered sample water (100 mL)
Y = Volume of 1 drop of water (0,06 mL)
V = Filtered water volume (100L)

Measurement of Water Quality Parameters

The measured water parameters that can affect the distribution of phytoplankton are temperature, acidity (pH), salinity, brightness, current speed, and nitrate phosphate.

Data Analysis

Data from the results obtained from sampling are presented in tables and graphs to be discussed descriptively associated with existing water conditions. For phytoplankton abundance and diversity, the species diversity index (H'), species uniformity index (E), and species dominance index (D) were processed using Microsoft Excel software, while to see the difference in phytoplankton abundance between stations, anova test was conducted and described descriptivelyAbundance is calculated using the following formula.

$$\mathbf{K = \frac{ni}{A}}$$

Description :

K = Species abundance (ind/m^2)
ni = Number of individuals of the i-th species obtained
A = Plot area of the i-th species found (m^2)

Species Diversity Index

To determine phytoplankton diversity, the following equation is used[6]:

$$H' = -\sum \boldsymbol{pi\ log2\ pi}$$

Description:

H’ = Species diversity index
Pi = The proportion of individuals of the I-th species to total individuals of all species (pi= ni/N)
Log2 = 3,3219

Criteria: H' < 1 = Low level of species diversity and disturbed water conditions; 1 ≤ H' ≤ 3 = Medium level of species diversity and mildly polluted water conditions; H'> 3 = High level of species diversity and water conditions are not polluted.

Species Diversity Index

This evenness index is used to determine how much the distribution of some individuals of each genus at the community level evenness index based on the equation[7], namely:

$$\mathbf{E} = \frac{H'}{Log\ 2\ S}$$

Description:
E = Species uniformity index
H’ = Species diversity index
Log2 = 3,3219
S = Number of species found

With the following criteria: If E is close to 1 (> 0.5), the uniformity of organisms is in a state of balance, and there is no competition for either place or specific food; meanwhile, if E is close to 0 (<0.5), the diversity of organisms in the waters is not balanced, and there is competition for food.

Species Dominance Index

To calculate the dominance index of phytoplankton in waters, Simpson's formula is used as follows:

$$\mathbf{D} = \sum_i^s = \left(\frac{ni}{N}\right)$$

Description:
ni = Total number of individuals of the i-th species
N = Total individuals of all species

With Criteria: If the D value is close to 0 (< 0.5) = there is no dominant species. If the D value is close to 1 (≥ 0.5) = there is a dominant species.

3. RESULT AND DISCUSSION

General Conditions of Research

Rupat Sub-district is one of the sub-districts included in the administrative area of Bengkalis Regency. Geographically, the Rupat Sub-district is bordered by the Rupat Utara Sub-district to the North, Dumai City to the West, Bengkalis Sub-district to the South, and the Strait of Melaka to the East. Based on this position, most of the villages in the Rupat Sub-district are located on the coast, with only Parit Kebumen Village located inland, Pangkalan Nyirih, and Hutan Panjang Village located in the watershed[8].

Water Quality Parameters

Based on the results of water quality measurements obtained values for the parameters of average temperature 30^{o}C, average salinity 22.3 ppt, average pH 7.8, average brightness 76.8 cm, average current velocity 0.26 m/s, average nitrate 0.8 ppm and phosphate 0.9 ppm (Table 1). The quality of the coastal waters of Teluk Lecah village is classified as good for the life of living biota in these waters.

N : P ratio is good for phytoplankton growth; nitrate must be higher than phosphate. Thus, these waters' N: P ratio does not follow usual water standards. So, the N: P ratio in these waters is alarming or not in accordance with normal water standards.

Phytoplankton Classification

The following is the type and classification of phytoplankton found in Teluk Lecah Village, Rupat District waters. The results of the analysis of phytoplankton species and classification can be seen in Table 2.

In Table 2, it can be seen that there are three classes of phytoplankton found in the waters of Teluk Lecah Village, Rupat District, Bengkalis Regency, namely Bacillariophyceae, Chroococcophyceae and Xanthophyceae. Divided into six orders: Pennales, Chrococcales, Flaggilariales, Tribonematale, Bacillariales, and

Rhizosoleniales. Divided into five families, namely Diatomacceae, Synechoccaceae, Bacillariaceae, Tribonemataceae, and Rhizosoleniaceae, and six species *Synedra* sp, *Dactylococcopsis* sp, *Nitzschia* sp, *Tribonema* sp, *Cylindrotheca* sp, and *Rhizosolenia* sp.

Table 1. Water quality parameters

No	Parameter	Station			Avarage
		I	II	III	
1.	Temperature (ºC)	30	30	30	30
2.	Salinity (ppt)	25	21	21	22,3
3.	pH	7.9	7,7	7.9	7.8
4.	Brightness (cm)	80	75	75	76,6
5.	Current velocity (m/det)	0,2	0,3	0,3	0,26
6.	Nitrate (ppm)	0,9	0,7	0,8	0,8
7.	Phosphate (ppm)	0,9	0,9	1,0	0,9

Note: Station I (Resident Residential); Station II (Mangrove Tourism); Station III (Port)

Table 2. Classification of phytoplankton

No	Class	Ordo	Family	Species
1.	Bacillariophyceae	Pennales	Diatomacceae	*Synedra s*p
	Bacillariophyceae	Bacillariales	Bacillariaceae	*Cylindrotheca* sp
	Bacillariophyceae	Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia* sp
	Bacillariophyceae	Flaggilariales	Bacillariaceae	*Nitzschia* sp
2.	Chrocophyceae	Chrococcales	Synechoccaceae	*Dactylococcopsis* sp
3.	Xanthophyceae	Tribonematale	Tribonemataceae	*Tribonema* sp

Phytoplankton species *Nitzschia* sp and *Dactylococcopsis* sp are usually found in waters with mangroves that are rich in nutrients found in waters with mangroves that are rich in nutrients. Plant deposits or organic detritus derived from the mangrove serasah are a source of food for organisms such as zooplankton, shrimp, fish, crabs, mollusks, nematodes, and amphipods[9].

Phytoplankton Distribution and Diversity

Based on the research results conducted in Teluk Lecah Village, Rupat District, Bengkalis Regency, six species from 3 classes were found. The species found were *Nitzschia* sp at stations I, II, and III and *Dactylococcopsis* sp at stations I and II. While the least found are *Synedra* sp, *Tribonema* sp, *Cylindrotheca* sp, and *Rhizosolenia* sp (Table 3).

Table 3. Phytoplankton distribution

No	Class	Species	Station		
			I	II	III
1.	Bacillariophyceae	*Synedra* sp	+	-	-
	Bacillariophyceae	*Cylindrotheca* sp	-	-	+
	Bacillariophyceae	*Rhizosolenia* sp	-	+	-
	Bacillariophyceae	*Nitzschia* sp	+	+	+
2.	Chroococcophyceae	*Dactylococcopsis* sp	+	+	-
3.	Xanthophyceae	*Tribonema* sp	+	-	-
Amount			5	3	2

Note: +: found; -: not found

Table 4. Phytoplankton abundance

Station	Repetition	Number of Individuals	Abundance (Ind/L)	Avarage±std.dev
I	1	3	4,98	14,94 ± 1,66
	2	2	3,32	
	3	4	6,64	
II	1	3	4,98	16,60 ± 0,96
	2	3	4,98	
	3	4	6,64	
III	1	2	3,32	9,96 ± 1,66
	2	1	1,66	
	3	3	4,98	

Phytoplankton Abundance

Table 4 shows that the highest abundance was obtained at Station II, namely 0.1660 Ind/L, followed by Station I, 0.1494 Ind/L, and the lowest abundance at Station III, 0.0996 Ind L. The abundance of phytoplankton species from the Bacillariophyceae class in Teluk Lecah Village, Rupat District, Bengkalis Regency, has the most species compared to other species. The Bacillariophyceae class is one of the most important phytoplankton groups in waters. Bacillariophyceae is vital in mineralizing and recycling organic materials, so the number is abundant in waters[10].

Diversity Index, Uniformity Index, and Dominance Index

Based on the results of the calculation of the diversity index, uniformity index, and dominance index of phytoplankton can be seen in Table 5

Table 5. Diversity Index, Uniformity Index, and Dominance Index of Phytoplankton

Station	H’	E	D
I	3,07	4,14	0,26
II	3,57	1,05	0,34
III	2,61	2,57	0,5

Table 5 that the highest species diversity index is found in Station I, which is 9.09, followed by Station III, which is 4.61, and the lowest in Station III, which is 2.41. The highest uniformity index is found in station I, which is 4.14; the second highest is station III, which is 2.57; and the lowest is station III, which is 1.05. The highest Dominance Index is found at Station III, which is 0.5, followed by Station II, which is 0.34, and the lowest is Station I, which is 0.26.

The species diversity index at stations I and III, H' > 3, means high species diversity and unpolluted water conditions. At station II, $1 \leq H' \leq 3$ means the level of species diversity is moderate, and water conditions are lightly polluted[11]. It can be concluded that the value of H' still meets the criteria. The species diversity index at all stations, E >0.5, means that the uniformity of organisms is balanced, and there is no competition for a particular place or food. It can be concluded that the value of E also meets the criteria. The dominance index of species at all stations, D < 0.5, means no dominant species exists. Low dominance will lead to a stable community. The different levels of diversity index, uniformity index, and dominance index are caused by physical factors of water as well as the availability of nutrients and the utilization of nutrients in each individual. Factors that influence can come from the environment, namely the availability of nutrients such as phosphate and nitrate and the ability of each type of phytoplankton to adapt to the environment[12].

4. CONCLUSION

Phytoplankton consists of 3 classes of 6 species: *Nitzschia* sp, *Dactylococcopsis* sp, *Synedra* sp, *Tribonema* sp, *Cylindrotheca* sp, and *Rhizosolenia* sp. The abundance of phytoplankton species from the

Bacillariophyceae class in Teluk Lecah Village, Rupat District, Bengkalis Regency, has the most species compared to other species. In this study, the highest abundance was found at station II, namely in mangrove tourism, with an abundance of 0.1660 Ind/L. Then station I is a residential area with an abundance of 0.1494 Ind/L, while the lowest phytoplankton abundance is found at station III, which is in the harbor with an abundance of 0.0996 Ind/L.

The diversity index, uniformity index, and dominance index of phytoplankton at each station in the waters of Teluk Lecah Village, Rupat District, Bengkalis Regency are classified as meeting good criteria.

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