Journal of Coastal and Ocean Sciences *e-issn: 2746-4512*
Volume 4 No. 1, January 2023: 20-24 *p-issn: 2745-4355*

Phytoplankton Abundance and Diversity in the Coastal Waters of Lalang Village, Siak Regency

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Received: 8 December 2022; Accepted: 31 December 2022

ABSTRACT

This research was conducted in May 2022 in the coastal waters of Lalang Village, Siak Regency. This study aims to analyze the abundance and diversity of phytoplankton. The method used is the survey method by determining the sampling location by purposive sampling. Based on the results of the study, 6 species of phytoplankton were found in the coastal waters of Lalang Village, Siak Regency, namely *Nitzschia* sp, *Isthmia* sp, *Navicula*, *Dactylococcopsis* sp, *Flagilaria* sp, and *Synedra* sp. The average value of abundant phytoplankton at station 1 ranged from 1,938.61 to 479.68; at station 2 it ranged from 3,046.40 to 479.68; at station 3 it ranged around 1,384.72 to 479.68. Based on the results, the abundance of phytoplankton at each station was significant.

Keywords: Lalang Village, Abundance, Diversity, Phytoplankton

1. INTRODUCTION

The waters of Lalang Village are located in Sungai Apit District, Siak Regency, and Riau Province. This area is astronomically located at 102'0"–106'62" North Latitude and 102010'0" –102013'35" East Longitude, with an area of 9.064 Ha. Lalang Village also has various activities such as boat transportation and fishing activities. This district is located 43 km from Siak Sri Indrapura with a travel time of about 1.5 hours by road or about 1-hour drive along the Siak River towards the estuary. This sub-district is one of the oldest sub-districts in the Siak Regency. Is a district located inestuarySiak River and on the shores of the Long Strait. The Apit River is a busy route connecting betweenBengkalis-Pekanbaru-Batamas well as being a stopover place for ships to/from Malacca Strait, thus allowing changes in water quality conditions and the life of phytoplankton in the coastal waters of Lalang Village, Siak Regency.

The existence of phytoplankton in waters is influenced by several factors, namely sunlight, availability of nutrients or organic matter in waters, water quality, and dissolved materials in waters. A high abundance of phytoplankton in water occurs when nutrient availability is high. Phytoplankton plays an important role in waters and is one of the parameters that greatly determine primary productivity in waters. The presence of phytoplankton in waters can be one of the biological indicators in determining water quality; this is related to their sensitivity to changes in aquatic environmental conditions. Phytoplankton in marine waters is found on the surface of the sea to a depth where sunlight can penetrate.

Phytoplankton is an aquatic organism that occupies a position as a primary producer in the food chain and the basis of food webs. Phytoplankton can carry out photosynthesis because it has chlorophyll so it can absorb sunlight. The results of phytoplankton photosynthesis in the form of organic matter are utilized by zooplankton, fish larvae, and other organisms as a natural food source (Andriani *et al.*, 2017). Phytoplankton is also an organism that can be used as a biological indicator in determining water quality through a species indicator approach or species diversity. This is also because phytoplankton has a short life cycle and has a very fast response to environmental changes (Lusiana *et al.*, 2021).

2. RESEARCH METHODS

Methods

The method used in this research is the survey method. Then collect quantitative data obtained from water quality measurements. Phytoplankton samples were analyzed at the

Marine Biology Laboratory, Universitas Riau. Furthermore, the data obtained are presented in the form of tables/graphs and discussed in an analytical descriptive manner.

Procedure

At each station measurements of water quality parameters were carried out. Data collection obtained from sampling are presented in the form of tables and graphs to be discussed descriptively in relation to existing water conditions. For the abundance and diversity of phytoplankton, the species diversity index (H'), species uniformity index (E), and species dominance index (D) were processed using Microsoft Excel software, while to see differences in phytoplankton abundance between stations an analytical descriptive test was carried out.

Data Analysis

Calculation of Phytoplankton Abundance

Phytoplankton abundance was calculated using a modified formula of the Lackey Drop Microtransecting Methods (APHA, 1992).

Total ind/L = T/L x V0/V1x 1/P x 1/W x N

Information :

N = Number of individual plankton found in each preparation (Ind/L)
Q = Cover glass area (20 mm x 20 mm)
L = Wide field of view of the microscope (1.882 mm^2)
V0 = Volume of sample water in the sample bottle (100 mL)
V1 = volume of sample water under cover glass (0.06 mL)
P = Number of visual fields (12)
W = Volume of filtered water (100 L)

Species Diversity Index

To determine the diversity of Phytoplankton, the Shannon – Wiener index equation is used as follows (Odum, 1998)

$$H' = -\sum_{i=0}^{i} pi \log_2 pi$$

Information :

H' = Species diversity index
Pi = Proportion of individuals from the i-th species to the total individuals of all species (pi=ni/N)
log2 = 3.3219

With criteria:

H' < 1 = The level of species diversity is low and the waters are disturbed
1 ≤ H' ≤ 3 = Moderate level of species diversity and slightly polluted waters
H' > 3 = The level of species diversity is high and the waters are not polluted

Type uniformity index

This uniformity index is used to find out how large a number of individuals from each clan are spread at the community level. The uniformity index (evenness index) is based on the equation (Odum, 1998), namely:

$$E = \frac{H'}{\log_2 S}$$

Information:

E = Species uniformity index
H´ = Species diversity index
log 2 = 3.3219
S = Number of species found.

With the following criteria: If E is close to 1 (> 0.5) it means that the uniformity of organisms is in a state of balance and there is no competition for either a particular place or food. Meanwhile, if E is close to 0 (<0.5) it means that the uniformity of organisms in the waters is unbalanced and competition for food occurs.

Species Dominance Index

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

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

Information :

Ni = total number of individuals of the i type
N = Total individuals of all types

3. RESULT AND DISCUSSION

Water Quality Parameters

The results of water quality measurements at each research station can be seen in Table 1

Table 1. The average results of water quality measurements in Lalang Village, Siak Regency

Water Quality Parameters	Unit	station		
		I	II	III
Temperature	°C	29	28	30
Salinity	‰	22	22	23
Brightness	M	0.27	0.3	0.26
pH	-	6	5,5	6,5
Flow Speed	m/sec	0.2	0.3	0.3
Dissolved oxygen (5 m depth)	mg/L	6,5	5,5	6

Based on the results of field measurements, shows that the waters have a temperature range of 28–30^{o}C, a salinity of 22–23 ‰, a degree of acidity (pH) of 5.5–6.5, a current of 0.2–0.3 m/s, brightness range 0.26–0.3 and dissolved oxygen at a depth of 5 m range 5.5–6.5 mg/L. The water quality at each station shows that there are no significant differences because the study site is not too large.

Phytoplankton Classification, Distribution, and Abundance

Phytoplankton identification was obtained by 6 species of phytoplankton from all stations which can be seen in Table 2. Based on identification results, phytoplankton at each station in the coastal waters of Lalang Village can be seen in Table 3.

Table 2. Classification of Phytoplankton from all research stations in the coastal waters of Lalang Village according to Class, Order, Family, and Species

Class	Order	family	Species
Bacillariales	Flaggilariales	Bacillariaceae	*Nitzschia*
Bacillariophyta	Centrales	Biddulphiaceae	*Isthmia*
Bacillariophyceae	Naviculales	Naviculaceae	*Navicula*
Bacillariophyceae	Pennales	Diatomaceae	*Synedra*
Chroococcus phyceae	Chroococcales	Syne coccaceae	*Dactylococcopsis*
Flagilariophyceae	Pennales	Flagilariaceae	*Flagilaria*

Table 3. Distribution of phytoplankton based on each research station in the coastal waters of Lalang Village, Siak Regency

Class	Species	Station		
		I	II	III
Bacillariales	*Nitzschia*	+	–	–
Bacillariopyta	*Isthmia*	+	+	+
Bacillariophyceae	*Navicula*	+	–	–
Bacillariophyceae	*Synedra*	–	–	+
Chroococcus phyceae	*Dactylococcopsis*	+	+	–
Flagilariophyceae	*Flagillaria*	–	+	–
Amount		4	3	2

Description: + = Found; - = Not found

Based on the results of research conducted in the coastal waters of Lalang Village, 6 species were found from 4 classes (Table 4). Of the 4 classes found, the most types of phytoplankton came from the Bacillariophyceae class. This is caused by Bacillariophyceae, which is the most abundant class of phytoplankton in the waters. This is in accordance with the opinion of Aryawati & Thoha (2011), the Bacillariophyceae class is the class with the highest number of genera and abundance because it has a high reproductive capacity compared to other classes of phytoplankton. Isnaini (2011) also found that the most dominant phytoplankton in the coastal waters of Lalang Village came from the Bacillariophyceae class (Samiaji, 2013).

Based on the results of calculating the abundance of phytoplankton at each station can be seen in Figure 1.

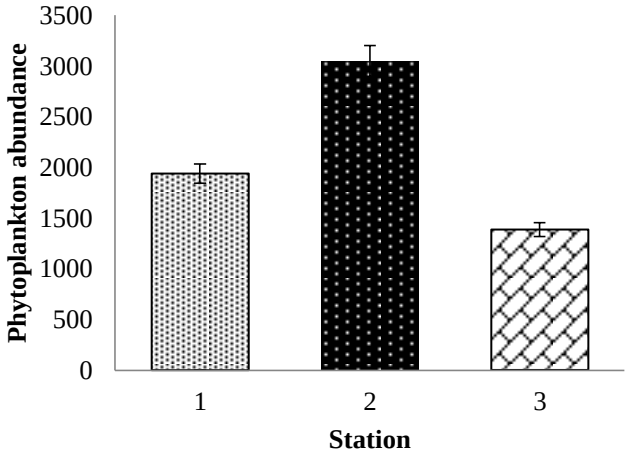

Figure 2. Average (± standard deviation) Phytoplankton abundance at each observation station in the coastal waters of Lalang Village, Siak Regency

Diversity Index, Uniformity Index, and Dominance Index

Based on the calculation results of the Diversity Index, Uniformity Index and Phytoplankton Dominance Index can be obtained in Table 4.

Table 4. Diversity Index, Species Uniformity Index, and Dominance Index for all research stations in the coastal waters of Lalang Village, Siak Regency

Station	H'	E	D
I	1.54	0.97	0.34
II	1.56	0.98	0.40
III	2.84	1.79	0.41

From the results of the calculation of the diversity index, species uniformity index, and dominance index, it can be concluded that the H' value still meets the criteria with a moderate level of species diversity and lightly polluted water conditions. The value of E still meets the criteria because E is close to 1 (> 0.5), which means that the uniformity of organisms is in a balanced state, and there is no competition either for a particular place or food. The value of D meets the criteria because at all stations the value of D is close to 0 (<0.5) so it can be concluded that there are no species that dominate from all research stations.

4. CONCLUSION

The results of observations of the abundance and diversity of phytoplankton in the coastal waters of Lalang Village, Siak Regency during the study, obtained 6 species from the three stations namely *Nitzschia, Isthmia, Navicula, Synedra, Dactylococcopsis*, and *Flagillaria*. Based on the H' value, it is almost close to three. The quality of the coastal waters of Lalang Village can be said to be stable, therefore the quality of the waters in Lalang Village are classified as good for the growth of phytoplankton.

It is necessary to carry out further research on the abundance and diversity of phytoplankton from the 6 species that have been found in the coastal waters of Lalang Village in this study. The discovery of species in the coastal waters of Lalang Village, Siak Regency.

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