

# Type and Abundance of Phytoplankton in Lubuk Larangan Area, Sungai Paku Village, Kampar District, Riau

## *Jenis dan Kelimpahan Fitoplankton di Kawasan Lubuk Larangan Desa Sungai Paku, Kampar, Riau*

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### Abstract

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This study aims to determine the types and abundances of phytoplankton species in Lubuk Larangan, Desa Sungai Paku. This research was conducted in May-June 2024 in Lubuk Larangan, Sungai Paku Village, Kampar Kiri District, Kampar Regency. The method used was the survey method, and data analysis was conducted using statistical tests. Phytoplankton species found in Lubuk Larangan, Sungai Paku Village, were 33 species belonging to 5 classes: Chlorophyceae, Cyanophyceae, Diatome, Euglenophyceae, and Zygnematophyceae. The abundance of phytoplankton species ranged from 7.080 to 16.800 cells/L. The highest phytoplankton abundance was at station II (16.800 cells/L), and the lowest was at station I (7.080,8 cells/L). Diversity index values ranged from 3.2883 to 3.7419, uniformity index 0.90 to 0.95, and dominance index 0.08 to 0.11. The high abundance of phytoplankton species obtained in the lubuk larangan (Station II) compared to the area outside the lubuk larangan (Stations I and III) indicates a difference type and abundance of phytoplankton with the results of the T test obtained a significant value of 0.028 ( $p < 0.05$ ) and the value of T count is 3.374 and the value of T table is 2.77645 where T count is greater than T table.

**Keywords:** Phytoplankton, Lubuk larangan, Local wisdom

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### Abstrak

Penelitian ini bertujuan untuk mengetahui jenis dan kelimpahan fitoplankton di Lubuk Larangan Desa Sungai Paku. Penelitian ini dilaksanakan pada Bulan Mei-Juni 2024 di Lubuk Larangan Desa Sungai Paku, Kecamatan Kampar Kiri, Kabupaten Kampar. Metode yang digunakan adalah metode survei dan analisis data dilakukan dengan uji statistik. Jenis fitoplankton yang ditemukan di Lubuk Larangan Desa Sungai Paku sebanyak 33 jenis yang terdiri dari 5 kelas, yaitu Kelas Chlorophyceae, Cyanophyceae, Diatome, Euglenophyceae, dan Zygnematophyceae. Kelimpahan jenis fitoplankton yang didapatkan berkisar 7.080-16.800 sel/L. Kelimpahan fitoplankton tertinggi berada pada stasiun II (16.800 sel/L) dan yang terendah terdapat pada stasiun I (7.080,8 sel/L). Nilai indeks keanekaragaman yang diperoleh berkisar antara 3,28-3,74, nilai indeks keseragaman berkisar antara 0,90-0,95, dan nilai indeks dominansi berkisar antara 0,08-0,11. Tingginya kelimpahan jenis fitoplankton yang diperoleh pada kawasan lubuk larangan (Stasiun II) dibandingkan kawasan di luar lubuk larangan (Stasiun I dan III) menunjukkan adanya perbedaan jenis dan kelimpahan fitoplankton dengan hasil uji T diperoleh nilai signifikan 0,028 ( $p < 0,05$ ) serta nilai T hitung yaitu 3,374 dan nilai T tabel yaitu 2,77645 dimana T hitung lebih besar dari T tabel.

**Kata kunci:** Fitoplankton, Lubuk larangan, Kearifan lokal

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## 1. Introduction

Phytoplankton are autotrophic components of microorganisms in the plankton community that obtain energy through photosynthesis, similar to plants on land. Phytoplankton diversity refers to the number and variety of phytoplankton species present in an ecosystem. This diversity is very important because it determines the stability and balance of aquatic ecosystems and provides information about the water's physical and chemical conditions. Lubuk Larangan is an area off-limits because it is where fish gather. Lubuk Larangan was established by mutual agreement to form environmental wisdom (Nasution, 2020). Lubuk larangan is also a form of local wisdom that plays a role in natural resource and environmental management. One location that implements this local wisdom is Sungai Paku Village.

Lubuk Larangan in Sungai Paku Village is an important area for the conservation of water resources and biodiversity. Phytoplankton, as a fundamental component in aquatic ecosystems, plays an important role in supporting food webs and as an indicator of water ecological quality. However, several aspects need to be considered to ensure the sustainability of this ecosystem. The Larangan in Sungai Paku Village is located near residential areas. Additionally, research on the composition of phytoplankton species in the Lubuk Larangan area remains limited, particularly in the Sungai Paku region. Therefore, the author is interested in conducting this study..

## 2. Material and Method

### 2.1. Time and Place

This study was conducted in May–June 2024, located in Lubuk Larangan, Sungai Paku Village, Kampar Kiri Subdistrict, Kampar Regency (Figure 1). Water quality measurements, phytoplankton sampling, and documentation were carried out at the study site. Meanwhile, water quality analysis and phytoplankton identification were carried out at the Aquatic Ecology and Management Laboratory, Faculty of Fisheries and Marine, Universitas Riau.

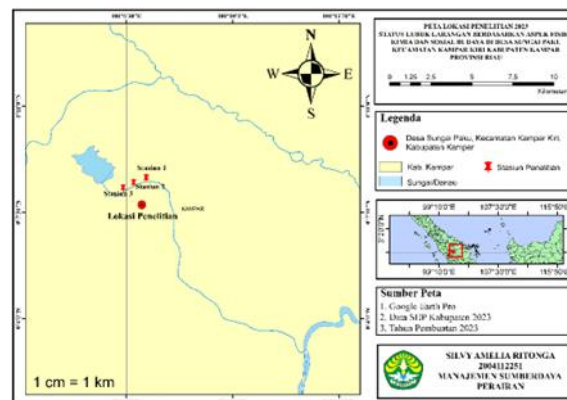


Figure 1. Location Map

### 2.2. Methods

The method used was a survey, with data types including primary and secondary data. The research stations were determined using a purposive sampling method. Water samples were taken three times at two-week intervals, with each indicator measured in accordance with applicable Indonesian National Standards (SNI), while phytoplankton was measured horizontally. The phytoplankton observation results obtained were matched with references from the identification guidebook.

### 2.3. Data Analysis

#### 2.3.1. Phytoplankton Abundance

To calculate phytoplankton abundance according to APHA in Pratiwi et al. (2017), use the following formula:

$$N = n \times \frac{A}{B} \times \frac{C}{D} \times \frac{1}{E}$$

Description:

N	= Phytoplankton abundance (sel/L)	n	= Number of organisms found
A	= area cover glass (20x20) mm <sup>2</sup>	B	= Sweeping area (10x20x0,45) mm <sup>2</sup>
C	= Filtered water volume (100 ml)	D	= Volume of water the cover glass (0,05 mL)
E	= Volume of filtered phytoplankton samples (100 L)		

According to [Raymont in Hariyati et al. \(2010\)](#), waters can be considered fertile if the abundance of phytoplankton is as follows: 0 - 2000 ind/L= Oligotrofik (Poor water fertility); 2000 - 15000 ind/L= Mesotrofik (Moderate water fertility); >15000 ind/L = Eutrofik (High water fertility).

### 2.3.2. Diversity Index

The diversity index calculation based on the Shannon and Weaver formula is

$$H' = - \sum_{i=1}^S p_i \ln n_i$$

Description:

$H'$  = Diversity index                       $n_i$  = Number of individuals of type 1  
 $N$  = Total number of individuals

The criteria for the phytoplankton diversity index in waters are:  $H' < 1$  = High ecological pressure in the waters;  $1 < H' < 3$  = Ecological pressure in moderate waters;  $H' > 3$  = Ecological pressure in low water areas.

### 2.3.3. Coefficient of Variation

The calculation of the uniformity index according to [Odum \(1993\)](#) is:  $E = \frac{H'}{\ln S}$

Description:

$E$  = Coefficient of Variation                       $H'$  = Species diversity index  
 $S$  = Number of species

The criteria for the phytoplankton uniformity index in waters are:  $0.00 < E < 0.5$  = Low uniformity;  $0.50 < E < 0.75$  = Uniformity is moderate;  $0.75 < E < 1.00$  = High uniformity

### 2.3.4. Dominance Index

The calculation of the dominance index according to [Odum in Fachrul \(2007\)](#) is as follows:

$$C = \sum_{i=1}^S \left( \frac{n_i}{N} \right)^2$$

Description:

$C$  = Dominance index                       $n_i$  = Number of individuals per species  
 $N$  = Number of all individuals per genus

[Odum \(1993\)](#) states that the criteria for the phytoplankton dominance index in water bodies are:  $C$  approaching 0 = No phytoplankton dominates;  $C$  approaching 1 = There is a dominant phytoplankton

To test the differences in phytoplankton species composition in the restricted area compared to other areas of the river, a T-test can be used to determine whether there is a significant difference in total phytoplankton abundance between the restricted area and areas outside the restricted area

## 3. Result and Discussion

### 3.1. Types of Phytoplankton in Lubuk Larangan, Sungai Paku Village

The types of phytoplankton found during research in Lubuk Larangan, Sungai Paku Village, numbered 33 types across 5 classes: Chlorophyceae (16 types), Cyanophyceae (10 types), Diatome (5 types), Euglenophyceae (1 type), and Zygnematophyceae (1 type). Based on these results, the Chlorophyceae class had the highest number of phytoplankton species found. This is because the Chlorophyceae class has a high capacity for adaptation to environmental changes, allowing them to live in diverse environments, including rivers. Chlorophyceae can also use various nutrient sources, such as nitrogen and phosphorus, which are abundant in rivers ([Hillebrand, 2013](#)).

Meanwhile, the fewest types of phytoplankton found in this study belonged to the Euglenophyceae and Zygnematophyceae classes. This is because these classes can only grow in optimal and stable water conditions, whereas river water dynamics often fluctuate. This is in line with [Patrick's \(1977\)](#) opinion, which states that the Euglenophyceae class tends to require specific nutritional conditions to survive and is often unable to compete with other algae groups in rivers.

### 3.2. Abundance of Phytoplankton in Lubuk Larangan, Sungai Paku Village

The abundance of phytoplankton species found during the study ranged from 7,080 to 16,800 cells/L. Based on these results, the highest phytoplankton abundance was found at station II (16,800 cells/L) and the lowest at station I (7,080.8 cells/L). This was because the availability of nutrients in the form of N and P at station II was higher than at other stations. According to [Wetzel \(2001\)](#), nutrient availability can affect the composition of

phytoplankton species because they use nutrients in the process of biomass synthesis, such as carbohydrates, proteins, and fats. Furthermore, the current velocity at station II is lower than at other stations, allowing phytoplankton to settle, grow, and persist for a longer period. The diversity index (H'), species evenness index (E), and species dominance index (C) values for phytoplankton are shown in Table 1.

Table 1. Diversity, Evenness, and Dominance Index Values

Station	Indeks H'	Indeks E	Indeks C
I	3,2883	0,9505	0,1153
II	3,7419	0,9355	0,0838
III	3,5678	0,9083	0,1009

the diversity and evenness indices are in the high category, while the dominance index is in the low category. The diversity index value obtained during the study was more than 3 (Usman, 2013). This indicates that the area experienced low ecological pressure and had a high species diversity index. Based on Odum's (1996) uniformity index, the value obtained in this study falls in the high uniformity category, indicating that the distribution of genus composition within a population is not very different or uniform. Meanwhile, the low dominance index value indicates that there is no dominant class at each station, even though several phytoplankton species were found in large numbers, such as in the Chlorophyceae class, which is good for phytoplankton growth.

The results of the T-test (Independent Sample Test) of phytoplankton abundance in the restricted area (station II) compared to areas outside the restricted area (stations I and III) are as follows. Based on the T-test results, a significant value of 0.028 ( $p < 0.05$ ) was obtained, with a calculated T value of 3.374 and a table T value of 2.77645, where the calculated T is greater than the table T. This indicates a significant difference between the abundance of phytoplankton in the restricted area and the area outside the restricted area. This significant difference is thought to be because in the restricted area (station II), there are no community activities, so that environmental conditions at this station are more stable than at other stations

### 3.3. Water Quality

The average water quality measurements in Lubuk Larangan, Sungai Paku Village, are shown in Table 2.

Table 2. Water Quality Parameter Measurement Results

Parameters	Unit	Threshold*	Station			Average
			I	II	III	
Physics						
Temperature	°C	Dev III	31,00	30,80	31,00	30,93
Brightness	Cm	1000	40,60	43,60	40,60	41,60
Flow Velocity	m/s	-	0,66	0,55	0,72	0,64
Chemical						
pH	mg/L	6 – 9	6,67	6,67	6,67	6,67
DO	mg/L	3	3,10	3,37	3,13	3,20
Nitrat	mg/L	-	0,50	0,80	0,80	0,70
Fosfat	mg/L	-	0,02	0,04	0,04	0,03

In the waters of Lubuk Larangan, Sungai Paku Village, the average water temperature is 30.8–31.00°C. The average temperature at each station does not differ significantly. The highest temperature was recorded at stations I and III, which was 31.00°C. Meanwhile, the lowest temperature was recorded at station II, which was 30.8°C. The low temperature at station II is due to the vegetation density at each station, which differs. At station II, there are still many trees along the river, so the station is quite shady and receives little sunlight. Based on the water quality standards set by Government Regulation No. 22 of 2021, the water temperature in Lubuk Larangan, Sungai Paku Village, remains good and supports phytoplankton growth.

The brightness during the study ranged from 40.60 to 43.60 cm. The lowest brightness was observed at station II, while the highest was observed at stations I and III. The low brightness at station II was due to the deeper water at this station compared to stations I and III. The low brightness at stations I and III caused a reduction in phytoplankton abundance at these stations because phytoplankton cannot carry out photosynthesis. Meanwhile, high water brightness allows sufficient light penetration, thereby supporting photosynthesis. According to Dodds (2002), the optimum water brightness value for phytoplankton photosynthesis is around 40–60 cm from the water surface. Thus, the brightness obtained at Lubuk Larangan in Sungai Paku Village is suitable for phytoplankton life.

The current velocities measured during the study ranged from 0.55 to 0.72 m/s. The highest current velocity was found at Station III (0.72 m/s), and the lowest current velocity was found at Station II (0.55 m/s). Current velocity can affect phytoplankton abundance in the water. At low current speeds (0.1–0.5 m/second), phytoplankton can grow and develop well due to sufficient nutrient availability and minimal sedimentation effects. However, at high current speeds (1–2 m/s), phytoplankton can experience stress and die due to strong turbulence

and friction (Nugroho, 2019). Weak current speeds indicate calm waters, leading to an increase in phytoplankton and its accumulation in the water (Samudera et al., 2021).

The pH measurement results during the study were 6.67. Based on the quality criteria of PP RI No. 22 of 2021 (Class III), the pH value obtained is suitable for phytoplankton growth. This is in line with the opinion of Soliha & Rahayu (2016), who stated that the optimal pH range for phytoplankton growth is 6.0-8.0, while for zooplankton it is 5.0-8.0. The optimal pH value can affect the availability of nutrients such as nitrogen and phosphorus, which are important factors for phytoplankton growth. This is because at the optimal pH, nutrients are more readily available to phytoplankton, thereby increasing phytoplankton abundance in a water body.

Based on the study results, dissolved oxygen levels ranged from 3.10 to 3.37 mg/L. The highest dissolved oxygen level was observed at station II (3.37 mg/L), while the lowest was at station III (3.10 mg/L). The high dissolved oxygen level at station II is thought to be due to the lower temperature at that station compared to the other stations. This is in line with the statement by Hamzah & Trenggono (2014) that the lower the temperature, the higher the dissolved oxygen value; conversely, the higher the temperature, the lower the dissolved oxygen value. In addition to temperature, another factor that affects the high dissolved oxygen levels at station II is the high abundance of phytoplankton at that station compared to other stations. This is in line with Yulita's (2014) opinion, which states that phytoplankton can produce dissolved oxygen in water. This is because phytoplankton plays an active role in photosynthesis and converts CO<sub>2</sub> into oxygen, thereby increasing oxygen productivity.

Based on the research results, nitrate concentrations ranged from 0.5 to 0.8 mg/L, and phosphate concentrations ranged from 0.07 to 0.08 mg/L, with the highest concentrations at stations II and III and the lowest at station I. This is because stations II and III receive nitrate and phosphate contributions from river water carried by the current and are located close to densely populated residential areas. This is in line with Patty et al. (2015), who explained that nitrate and phosphate depend on the water's surrounding conditions, including contributions from land through river flows that contain various industrial and domestic wastes containing organic compounds. The abundance of phytoplankton is closely related to the high and low concentrations of nitrate and phosphate, where the highest abundance of phytoplankton is found at stations II and III. According to Ruminanti et al. (2014), the optimum nitrate value for phytoplankton growth in rivers is 0.5-2.5 mg/L, while the optimum phosphate value is 0.01-0.05 mg/L. Thus, the waters in Lubuk Larangan in Sungai Paku Village are still suitable for phytoplankton.

## 4. Conclusions

Based on the results of the study, 33 species of phytoplankton were found, consisting of 5 classes, namely the Chlorophyceae class (16 species), the Cyanophyceae class (10 species), the diatom class (5 species), the Euglenophyceae class (1 species), and the Zygnematophyceae class (1 species). The abundance of phytoplankton species found in the Lubuk Larangan area during the study was classified as eutrophic, while that in areas outside Lubuk Larangan was classified as mesotrophic. After conducting a statistical test using the T-test, there was a significant difference between the abundance of phytoplankton in the Lubuk Larangan area and that in areas outside Lubuk Larangan.

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