

Community structure, phytoplankton density and physical-chemical factor of batang palangki waters of sijunjung regency, west sumatera

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Abstract. The long-term goal of this study is to provide an overview of the presence of phytoplankton in support of its functions in the waters of Batang Palangki as a conservation area of information on river water management, especially for Batang Palangki stakeholders. Specific targets to be achieved in achieving these objectives are (1) to know the density of phytoplankton, index of diversity of species, equitability index, domination index, and in Batang Palangki waters, and (2) to analyze the chemical and physical factors of the waters. The sampling method of phytoplankton is *purposive sampling*. The phytoplankton sampling is done by filtering 100 liters of water into the net plankton no 25 and filtered into the 25 cc, and then identified. The determination of water quality such as water temperature, water pH and watercolour, dissolved oxygen (DO) and BOD, and Hg content (mercury). The results showed that phytoplankton found from each of station was 370 individuals per liter with the highest density found in the station I of 155. The number of genus was 7, namely *Neidium*, *Gyrogssima*, *Synedra*, *Frustulia*, *Fragillaria*, *Nitzschia* and *Peridinium*. The diversity index averaged at 0.45, equitability index averaged at 0.54, while the dominance index averaged at 0.28. Physical and chemical factor measurement results found that water temperature averaged at 26 °C, transparency ranged from 12 - 30 cm, velocity speed ranged from 8 - 15 m/s, while chemical factors such as DO, BOD, and COD ranged from 5.25 to 5.96 mg/L, 3.28 - 3.49 mg/L, and 47.05 - 76.25 mg/L respectively. Likewise, TOM measured in this research was 9.61 - 2.10 mg/L while Hg content ranged from 0.098 - 0.208 mg/L.

Keywords: Community Structure, Phytoplankton, Waters, Physical-Chemical Factors

1. Introduction

Phytoplankton is water plants that have very small size and live floating in water. Phytoplankton can act as one of the ecological parameters that can describe the condition of water. One characteristic of phytoplankton organisms is the basis of the feed chain in the waters [1]. Therefore, its presence in a water can describe the characteristics of waters whether the water are in a fertile state or not.

The composition and abundance of phytoplankton will change at various levels in response to changes in environmental conditions both physical, chemical, and biological [2]. Diversity and abundance of phytoplankton in the waters affected by several environmental parameters and characteristics of a physiologically between factors physicochemical waters such as light intensity, dissolved oxygen, temperature stratification, and the availability of nutrients nitrogen and phosphorus,



while the biological aspect is the activity of predation by animals, mortality Natural, and decomposition.

Classes are living as Phytoplankton is Chlorophyceae, Cyanophyceae, Euglenophyceae, Chrysophyceae, and Bacillariophyceae [3]. Chlorophyceae is a green alga. Has chloroplasts containing chlorophyll a, chlorophyll b and carotenoids. As an example of the genera of each order are: 1) an example of the genera Chlorococcales, *Pediastrum* and *Clorococcum*, 2) Ulotrichales: *Ulothrix* 3) Cladoporales: *Cladopora*, 4) Volvocales: *Poliblepharides*, *Clamidomonas* and *Volvox* and 5) *Conjugates*, *Clostridium*, *Desmidium*, *Spyrogira*, *Mougeotia* and *Zygnema* [4].

Batang Palangki is one of the river located in Ampek Nagari Sub-district of Sijunjung Regency of West Sumatera, with a length of a river of approximately 30 km and width of 20 meters. People activity conducted in a long the river is the mining and processing of gold, sand quarrying, household activities such as bathing, to wash and a fish pond and farms of the population where the water comes from the river. The activity of the population causes the turbid river water conditions and the addition of material into the river, And at the same time there is a change in river ecosystem. Changes in river ecosystems lead to changes in the type and density of organisms

Surveys and interviews conducted by the Wali Nagari and some people Batang Palangki District of Ampek Nagari Sijunjung on December 1, 2015 that generally livelihoods of the people tend to mine gold along the Batang Palangki, but it is also the activities of mining the sand, although officially permit mining by government No local, household activities such as bathing, washing and etc. As a result the activities carried out by the community caused the addition of material into the river. The addition of materials into the waters certainly will affect the river water conditions either biological, physical or chemical means. Changes in water content determined by the content of chemical compounds and materials that go into a body of water and is an important factor in studying the development of aquatic communities, especially phytoplankton

Research on the abundance of plankton and phytoplankton in the waters of the lake from India showed that the phylum Crysophyta of types *Meloidisira* classified highest abundance was found, but the species of *Diatoma* sp, *Cymbella* sp and *Synedra* sp little find because of the type tend to live waters flow [5,6]. The Shannon-Wiener's diversity index shows the level of complexity of a community structure. Diversity also shows the pattern of distribution of a species in a community. The abundance of phytoplankton has a positive relationship with water fertility. If the abundance of phytoplankton in a water is high, then it could mean that they tend to have high productivity.

Phytoplankton can act as one of the ecological parameters that can describe the condition of water quality. Phytoplankton is the primary producer of food chain in the waters (4). Its presence in the water can describe the status of a water, whether the waters are polluted or not. Classify the fertility of the waters based on the abundance of plankton as follows. Waters with oligotrophic fertility are in abundance <2000 ind/L, Mesotrophic with abundance 2000-15000 ind/L and eutrophic> 15,000 ind /L [7].

Based on the description, we conducted a research entitled "Phytoplankton Community Structure in Batang Palangki Waters of Sijunjung Regency, West Sumatera"

This study aims to analyze: (1) phytoplankton abundance, (2), diversity index, uniformity index and phytoplankton dominance index, (3) physics and chemical factor waters of Batang Palangki, West Sumatera during research

2. Methods

The research activity was conducted on March to Mai 2016 in the waters of Batang Palangki Ampek Nagari Subdistrict, Sijunjung Regency, West Sumatra.

The location of sampling is determined by purposive sampling that is determining the sampling point, it determine from sampling point. They are the station I part of the mining and gold processing center, the upstream II station and the station III downstream part river. Phytoplankton samples were collected by taking 100 L of water and into the net plankton no. 25 The filter was put into a 25 cc sample bottle and fed 3 doses of formalin and labeled. Subsequently brought to the laboratory for identification.

Determination of water quality was measured at each station as water temperature was measured using a water thermometer, the pH of water using pH meters and watercolour was determined visually. Measurements of dissolved oxygen content (DO) and BOD were measured by DO meters, while free CO₂ content was measured with Acidimetry. The content of Hg (mercury) is measured using the AAF method.

2.1 The density of phytoplankton

Density phytoplankton in the water can be calculated using the following formula [8]:

$$N = \frac{(ax\ 1000)Xc}{L} \quad (1)$$

With:

- N = abundance of phytoplankton (number of individuals per liter)
- A = number of similar individuals per ml,
- C = volume of water taken,
- L = volume of water taken by bottle (L).

2.2 Diversity Index (H)

Diversity is the unregulated inherence of individual genera derived from a population. The variety of phytoplankton types determined using the Shannon-Wiener index:

$$H' = \sum p_i \log p_i \quad (2)$$

With:

- H' = Index of Shannon-Wiener's
- P_i = The proportion of type i within community (i = 1,2,3, ..., s)
- S = Number of types

2.3. Equitability Index (E)

$$E = \frac{H'}{H_{max}} \quad (3)$$

With:

- E = Equitability Index
- H_{max} = Maximum diversity index
- H' = Shannon-Wiener's diversity index
- S = Number of taxa

2.4. Dominance Index (D)

$$D = \sum \frac{(n_i)^2}{N} \quad (4)$$

With:

- C = Indeks dominasi Simpson
 Ni = Proportion of i in community (i=1,2,3,.....,s)
 N = Total number of individuals

3. Results and Discussion

3.1 Phytoplankton Density

Table 1. Density of phytoplankton (individual/liter) Batang Palangki the water of Sijunjung Regency of West Sumatera

No	Genea	Density			Number
		Station I	Station II	Station II	
1	<i>Neidium</i>	20	0	0	20
2	<i>Gyrosigma</i>	20	10	15	45
3	<i>Synedra</i>	40	0	0	40
4	<i>Frustulia</i>	75	0	0	75
5	<i>Fragillaria</i>	0	120	30	150
6	<i>Nitzschia</i>	0	20	0	20
7	<i>Peridinium</i>	0	0	20	20
	Number of individual.	155	150	65	370
	Number of types	4	3	3	

Table 1 shows the density (individual/liter) of phytoplankton in Batang Palangki waters, with 7 genus of phytoplankton found in total, i.e *Neidium*, *Gyrosigma*, *Synedra*, *Frustulia*, *Fragillaria*, *Nitzschia*, and *Peridinium* with density 370. The highest density was found at station I of 155, and the lowest density was found at station III which was 65. The abundance of phytoplankton in Batang Palangki waters was found to be between 65 - 155, with an average of 370 stations. Classification water fertility based on plankton abundance as follows. Waters with oligotrophic fertility are in abundance <2000, Mesotrophic with abundance 2000-15000 and eutrophic > 15,000 [7].

Table 2. Relative Density (KR) and Relative Frequency (FR) Phytoplankton in Batang Palangki Waters Sijunjung Regency West Sumatra

No	Genera	Relative Density (KR) (%)			FR (%)
		Station I	Station II	Station III	
1	<i>Neidium</i>	12.9	0	0	33.3
2	<i>Gyrosigma</i>	12.9	6.72	23.1	100
3	<i>Synedra</i>	25.8	0	0	33.3
4	<i>Frustulia</i>	48.4	0	0	33.3
5	<i>Fragillaria</i>	0	80.0	50.0	66.6
6	<i>Nitzschia</i>	0	13.3	0	33.3
7	<i>Peridinium</i>	0	0	20.0	33.3

Table 2 shows the relative density (KR) and the relative frequency (FR) of phytoplankton in Batang Palangki waters of Sijunjung District. The highest relative density found in the genus *Fragillaria* is 80%. While the relative frequency of 100% found in Genus *Gyrosigma*.

3.2 Phytoplankton Type Diversity

Table 3. Average Diversity Index (H), Equitability Index (E) and Domination Index (D)

Parameter	Station I	Station II	Station III	Average
H	0.59	0.35	0.42	0.45
E	0.66	0.44	0.52	0.54
C	0.42	0.41	0.001	0.28

Table 3 shows the average value of Diversity Index (H), Equitability Index (E), and Dominance Index (D) of the phytoplankton in Batang Palangki water of Sijunjung Regency of West Sumatra at station I, II and III respectively of 0.45, 0.54 and 0.28. Overall, it can be seen that diversity index of phytoplankton in Batang Palangki water ranged from 0.35 to 0.59 with an average of 0.54 (Table 3). States that waters with diversity indexes 0 - 1 include unstable the water, 1 - 3 including almost stable and large the water of 3 including stable the water [9]. The results of this research diversity index is in the range 0-1, which means including unstable the water. The level of river pollution can be seen from the diversity or diversity and growth rate of the structure of the plankton. If the plankton diversity in the high ecosystem signifies the quality of the water is good, but if the plankton diversity is small then indicates the water is polluted [7].

The equitability index (E) of the phytoplankton in Batang Palangki ranged from 0.44 to 0.66 with an average of 0.54 (Table 3). The equitability of phytoplankton is said to spread evenly when the value reaches 1, meaning that all samples in the station have the same number of organism types based on existing criteria. The results of this study showed an average equitability index of 0.54, which means that the water of Batang Palangki have different types of phytoplankton organisms at each station.

The dominance index (D) of phytoplankton on the three research stations averaged at 0.28 (Table 3). Based on the criteria of dominance the value of index approaching the value of 1 indicated a higher dominance by certain species. The high value of existing dominance shows a low diversity with uneven distribution on each station. Also, the high value of dominance at each station indicates a change in the living environment of phytoplankton. The high dominance indicates that the place has a low type of wealth with uneven distribution, meaning within the observed community structure found species that dominate other species. Thus, these conditions can reflect the diversity of phytoplankton.

3.3 Physical Factor of Batang Palangki

Table 4. The result of Physics factor measurement of Batang Palangki the water

Station	Water temperature (°C)	Transparency (Cm)	Humidity (Atm)	Water colour	Water velocity (m/sec)
I	25	12	66	Murky	12
II	25	28	65	Murky	12
III	26	12	65	Murky	8

Based on table 4 shows the results of the measurement of the physics parameters of Batang Palangki waters of Sijunjung Regency, West Sumatra. The measurement result of the three stations for water temperature ranges from 25 – 26 0C, transparency ranges from 12 - 28 cm, the highest transparency is at station II (upstream), with watercolour of each cloudy station. Strong current parameters at station I of 12 m/sec, station II of 12 m/sec and station to III 8 m/sec. The movement of phytoplankton is strongly influenced by currents. Current velocities in streams are grouped into three categories, ie fast, when current velocities range from 0.5-1 m/sec, while current velocity ranges from

0.25-0.49 m/sec and slow when current velocity ranges from 0.1-24 m/sec [10].

3.4 Chemical Factor of Batang Palangki

Table 5. The result of the measurement of the water chemical factor of Batang Palangki water

Parameter Station	DO (mg/L)	BOD (mg/L)	COD (mg/L)	TOM (mg/L)	(Hg) (mg/L)	The water pH
I	5.41	3.40	60.33	11.07	0.174	6.00
II	5.25	3.49	76.25	12.10	0.098	7.00
III	5.96	2.80	47.05	9.61	0.208	7.60
Average	5.54	3.23	61.21	10.93	0.16	6.86

Table 5 shows the result of measurement of chemical factors (milligram per liter) of Batang Palangki the water of Sijunjung Regency, West Sumatera that the results of measurement of each parameter for all three stations are as follows: dissolved oxygen content (DO) averaged at 5.54, BOD at 3.23, and COD at 61.2. The total organic content (TOM) averaged 10.93. Furthermore mercury (Hg) averaged 0.16, the highest Hg levels were found in station III (downstream) that is equal to 0.208

Dissolved carbon dioxide (COD) ranges from 47.05 - 76.25. Carbon dioxide is produced from the respiratory processes of both animal and plant organisms. Waters undergoing rapid decomposition process will produce high CO₂ content and lack of oxygen. High carbon dioxide content in the waters causes death for animals [11].

The degree of acidity shows the concentration of H⁺ ions in the solution. The pH of water qualified for organism life ranges from 6.0-7.6. Changes in pH of water bodies can greatly disturb the life of plants, animals and decomposing organisms that live in these water bodies [2]. Furthermore, the optimum pH for plankton life ranged from 5.5 to 8.5 [10].

Dissolved oxygen content of Batang Palangki waters averages 5.4 mg/l According to [12], that the minimum dissolved oxygen required to support the aquatic organism's life normally is 2 ppm with no record in the water Toxic.

4. Conclusion

From the results and discussions that have been described, it can be taken some conclusions as follows:

1. The abundance of phytoplankton (individual/liter) ranges from 65 to 155 consisting of 7 Genus phytoplankton: Genus Neidium, Gyrogsima, Synedra, Frustulia, Fragillaria, Nitzschia, and Peridinium
2. Diversity Index (H), Uniformity Index (E) and Domination Index (C) were 0.45, 0.54 and 0.28, respectively
3. Chemical factors including dissolved oxygen (DO) averaged 5.54 mg/L, BOD 3.23 mg/L. COD averaged 61.21 mg/L. The total organic content (TOM) averaged 10.93 mg/L. Mercury content (Hg) averaged 0.16, the highest Hg levels were found in station III (downstream) that is equal to 0.208 mg /L
4. The above results: Batang Palangki waters are at oligotrophic and unstable levels of fertility

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