Phytoplacton Community In The Asahan River As A Fish Cultivation

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Abstract.

This study aims to analyze the structure of the phytoplankton community in the Asahan River. Using a descriptive survey. Determination of the location of phytoplankton sampling was carried out by purposive sampling. The results showed that overall phytoplankton were found in three divisions Crysophyta, Cyanophyta and Chlorophyta and 17 genera. The highest relative abundance (KR) was found in the genus Pediastrum of 12.7 with a diversity index of an average of 2.39, an evenness index of 0.35 and a dominance index of 0.16. The results of the physical factor measurements are an average turbidity of 3.53 NTU, an average water temperature of 32oC and an average water pH of 6. The results of the average water chemical factor measurements are water DO of 5.15 ppm, BOD = 1.85 ppm, COD = 26.45 ppm, CO2 levels = 18.29 ppm and mercury (Hg) levels measured range from 0 - 0.05 ppm. In conclusion, the abundance of phytoplankton is in the low category with a moderate diversity index and the waters are classified as stable.

Keywords: *Community; phytoplankton and Kanan River.*

I. INTRODUCTION

Phytoplankton is a primary component in aquatic ecosystems and plays an important role in supporting productivity and fish farming activities. Phytoplankton can act as one of the ecological parameters that can describe the condition of water quality and can contribute energy to advanced consumers and act as a bioindicator of water quality (Sukardi & Arisandi, 2020; Mallongi et al., 2020; Samudera et al., 2021). Phytoplankton acts as a primary producer of organic substances so that they can be consumed by zooplankton and several other organisms such as young fish larvae, while zooplankton acts as the first consumer in waters (Daniaty et al., 2021). Sukoco et al., (2020) stated that one of the important organisms in the aquatic environment is phytoplankton because it is the natural food of aquatic organisms. Phytoplankton in waters quantitatively changes throughout the year according to changes in water quality (Pagoray & Sukarti, 2020).The Asahan River is a large river and its downstream is the Malacca Strait. There are many activities around these waters, such as agriculture, plantations, sand mining, palm oil factories and other community activities. This affects the phytoplankton in the Asahan River. The Asahan River as a medium for fish cultivation needs to be considered in more depth, both in terms of water quality (physical and chemical) and natural food consisting of phytoplankton and zooplankton. A number of studies have been conducted by previous researchers regarding the composition of phytoplankton in several waters and ponds from former mining activities, such as bouxid mining waste (Apriadi & Ashari, 2018) and coal waste (Pagoray & Sukarti, 2020; Sukoco et al., 2021; Fitriadi et al., 2021).

However, so far no research has been found regarding the structure of the phytoplankton community in the Asahan River ponds which are used as a medium for fish cultivation.Physicochemical factors of water are important for phytoplankton growth, as stated by Gurning et al., (2020) that temperature is a limiting factor in phytoplankton distribution. Sunlight cannot penetrate the bottom of the water if the concentration of suspended or dissolved materials is high because it affects the photosynthesis process. The normal pH value of water is around neutral, namely 6-8, while the pH of water categorized as a limiting factor is <4 and> 11 (acid-base dead point for fish). In addition, dissolved oxygen content can also be used as an indicator of water quality (Sukoco et al., 2020).Studies to determine the condition of the Asahan River is suitable or not

for fish farming have never been conducted so far. The purpose of this study was to analyze the structure of the phytoplankton community and analyze the physical and chemical factors of the water. This study aims to provide an overview and information for the community about the quality of water both biologically, chemically and physically related to the Asahan River which is used for fish farming.

II. METHODS

The research was conducted in the Asahan River which is used for fish farming. Research activities started from March to April 2025. The type of research is Descriptive Survey. The sampling method used is purposive sampling.Phytoplankton sampling was done by filtering 100 liters of water and filtering it using plankton net no. 25, then put it into a sample bottle, then given 3-4 drops of 40% formalin. Phytoplankton samples were taken to the laboratory to identify their types, calculate their abundance, diversity index, uniformity and dominance. Sample identification was carried out under a microscope with a magnification of 10 x 40 and 10 x 100 times.

Determination of water physicochemical factor measurements were measured at each station. Measurement of physical factors includes: such as water temperature using a thermometer, and water color is determined visually. Measurement of water pH using pH paper. Measurement of water chemical factors was carried out by taking water samples when taking phytoplankton samples, then taken to the Chemistry Laboratory of Bung Hatta University to be analyzed for light penetration/brightness levels, dissolved oxygen content (DO), BOD, COD, free CO2 content and mercury content (Hg). The data analysis process was carried out by: 1) calculating phytoplankton abundance using the Lackey modification formula; 2) diversity index using the Shannon-Wiener index; 3) similarity/evenness index; 4) Simpson dominance index.

III. RESULTS AND DISCUSSION

Based on the identification of phytoplankton that has been carried out in the Asahan Riveras fish farming in the Asahan River, the types and abundance of phytoplankton are obtained as in the following table:

No	Division and Genus	Phytoplankton Abundance (Indv/Liter) St 1	St 2	St 3	Jumlah
Chlorophyta					
4	*Pediastrum*	3.7	3	17.9	24,8
5	*Scenedesmus*	0.5	1	8	
6	*Oocystis*	0.6	0.6	3.5	7.3
7	*Ankistrodesmus*	0.2	0.3	0.6	1.1
8	*Closterium*	1.5	1.5	9.5	12,8
9	*Desmidium*	0	0.2	0.5	0.5
10	*Spyrogira*	1.2	0.4	0.5	0,91.
11	*Oedogonium*	0	0	0.7	0.7
Chrysophyta					
12	*Meloisira*	1.3	1.5	1.8	4.3
13	*Navicula*	0.5	0.6	1	2.4
14	*Gomphonema*	0.4	0.8	0.2	0.9
15	*Fragillaria*	0.2	0.5	0.4	0.8
16	*Pleurosigma*	0	0.	0.6	0.7
17	*Cymbella*	0	0.3	0.4	0.6
Number of individuals		9.8	11.3	39.5	93
Number of types		15	19	16	

Fig 1. Types and Abundance of Phytoplankton (Indv/L) at Each Station (St) in the Kanan River Waters

Table 1 and Figure 1 show the abundance of phytoplankton species/genus found during the study in the post-gold mining pond used by the community for fish farming in the Asahan River. Phytoplankton found were 3 divisions, namely: Cyanophyta Division with 3 genera, Chlorophyta Division with 8 genera and Chrysophyta Division with 6 genera, with a total number of 17 genera found. Based on the station (St), 13 genera were found at St 1, 16 genera at St 2 and 17 genera at St 3. The abundance of phytoplankton in the Asahan River ranges between12.1 – 69.9 individuals/liter. The highest density was found at station 3, which was 69.9 individuals/liter and the lowest density was found at station 2, which was 13.5 individuals/liter. The overall phytoplankton density was found to be 93.0

individuals/liter. The abundance of phytoplankton based on the station, was seen at station 1 at 12.1 individuals/liter, station 2 at 11.4 individuals/liter and station 3 at 69.9 individuals/liter.The results of the calculation of relative density (KR), relative frequency (FR) of phytoplankton at each station in the Asahan River as a fish farm can be seen in (the following table):

Table 1. Relative Density (KR) and Relative Frequency (FR) of Phytoplankton in the Asahan River as Fish Cultivation

Genus	Relative Density	Relative Density (KR) (%)			FR (%)
		St 1	St 2	St 3	
	Cyanophyta				
	Merismopedia	21.3	11.0	11.8	100
	Microcystis	9.0	8.8	7.6	100
	Oscillatoria	4.1	5.1	4.2	100
	Jumlah	34.4	24.9	23.6	
	Chlorophyta				
	Pediastrum	22.9	17.7	16.0	100
	Scenedesmus	7.4	8.8	6.9	100
	Oocystis	1.6	2.2	2.8	100
	Ankistrodesmus	0.8	1.5	0.7	100
	Closterium	4.1	11.8	7.6	100
	Desmidium	0	2.2	1.4	0.67
	Spyrogira	1.6	2.9	2.1	100
	Oedogonium	0	0	2.8	0.33
	Jumlah	38.4	47.1	40.3	
	Chrysophyta				
	Meloisira	13.9	12.5	14.6	100
	Navicula	8.2	5.9	8.3	100
	Gomphonema	3.3	3.7	1.4	100
	Fragillaria	1.6	2.2	3.5	100
	Pleurosigma	0	1.5	4.9	0.67
	Cymbella	0	2.2	3.5	0.67
	Jumlah	27	28	36.2	

The table shows that the highest Relative Density (KR) of phytoplankton was found in the Chlorophyta Division, which ranged from 38% - 40.3% KR, while the lowest value was found in the Cyanophyta Division, which ranged from 23.6% - 34%. The highest relative density was found in the Pediatrum Genus. The Asahan River is suitable for phytoplankton development. The Relative Frequency (FR) of phytoplankton from the Chlorophyta division occupies an FR value of 100%. The highest FR value was obtained by the Desmidium, Pleurosigma, Cymbella genus, which was 0.67%, while the lowest FR was found in Oedogonium, which was 0.33%.

Diversity Index, Evenness Index and Phytoplankton Dominance Index

Results of the calculation of the Diversity Index (H), Evenness/uniformity index (E) and the dominance index (C) of phytoplankton types in the Asahan River for fish farming can be shown in the following table:

Table 2. Average Diversity Index (H), Evenness Index (E) and Dominance Index (C) Types of Phytoplankton in the Asahan River for Fish Cultivation

Parameter	St 1	St 2	St 3	Average
H	2.98	3.88	4.32	2.39
E	0.58	0.76	0.84	0.72
C	0.14	0.16	0.17	0.16

Table 2 and Figure 1 show that the phytoplankton diversity index at station 1 is 2.98, station 2 is 3.88, and station 3 is 4.32, with an average of 3.72, the evenness index of station I is 0.58, station 2 is 0.76, and station 3 is 0.88, the average of the three stations is 0.72. Dominance index phytoplankton at station 1 was 0.14, station 2 was 0.16 and station 3 of 0.17 with an average dominance index of 0.16.

The results of the measurement of the phytoplankton E index in the post-gold mining pond (Table 3) are in a stable ecosystem condition and high uniformity. If the uniformity index is between 0.75 - 1.0, it means high uniformity and the ecosystem is in a stable condition. Furthermore, the results of the calculation of the phytoplankton dominance index (Table 3) at stations 1, 2, 3 are an average of 0.16, meaning low dominance, no species dominates other species, and environmental conditions are less stable. Related to the high uniformity index, the dominance index is getting lower.

Results of Measurement of Chemical and Physical Factors of Waters

Based on the results of measurements and analysis of physical and chemical factors of water samples from the Asahan River which are used by the community for fish farming, the results obtained are (Table 4) below:

Table 3. Results of Measurement of Chemical and Physical Factors of Asahan River Water Samples for Fish Farming

No	Parameter	Unit	St 1	St 2	St 3	Average
	Chemical Factors					
1	DO	Ppm	5.62	4.95	4.88	5.15
2	BOD	Ppm	1.11	2.15	2.70	1.77
3	COD	Ppm	18.30	31.60	39.44	26.45
4	CO2	Ppm	11.45	18.30	25.13	18.29
5	Mercury (Hg)	Ppm	*)ttd	*)ttd	0.052	0.02
	Physical Factors					
6	Turbidity	NTU	2.80	3.65	4.16	3.53
7	Temperaturewater	ºC	32	33	31	3.2
8	pH of water		6	6	6	6
9	Air humidity	%	48	49	50	49
10	Water color		Cloudy	Cloudy	Cloudy	

Based on Table 4, the average results of the chemical factor measurements of several parameters for the three stations were DO ranging from 4.88 to 5.62.ppm, BOD 1.11 -2.70 ppm, COD 18.30 – 39.44 ppm, CO2 11.45 – 25.13 ppm,and Hg 0 - 0.05 ppm. Hg levels in water St 1 and 2 were not detected. Furthermore, the results of measuring the physical factors of several parameters of the three stations include: average turbidity of 3.53 NTU, water temperature of 3.20 C, average water pH of 6 and average air humidity of 6%.

Discussion

Based on the diversity index (H) or phytoplankton diversity index in the Asahan River as a fish farm at station 1 of 2.98, station 2 of 3.88 and station 3 phytoplankton diversity index 4.88. The average diversity index of the Asahan River waters of the three stations is 3.72 (Table 3) with the category of stable waters and moderate diversity. Based on the Shannon-Wiener Index, waters with a diversity index of 0 - 2.302 are included in low diversity, 2.302 - 6.907 are included in moderate diversity, and a diversity index> 6.907 indicates high diversity (Apriadi & Ashari, 2018; Dimenta et al., 2020). Based on the results of this study, the condition of the Asahan River water is in the category of stable waters with moderate diversity.The evenness/uniformity index (E) is used to see the uniformity of species in a community. The uniformity index value of the Asahan River waters as a fish farm at St 1 is 0.58, St 2 is 0.76 and St 3 is 0.84, with an average of 0.35 (Table 3). If the evenness index value is close to 1, then the uniformity index is classified as high. This indicates that the number of individuals of each type is the same or not much different. Meanwhile, if the uniformity index value is close to 0, then the uniformity index is classified as low. This means that the number of individuals of each type is not the same or different (Sukoco et al., 2021; Apriadi & Ashari, 2018).

Uniformity index $0.5 \leq E \leq 0.75$ the ecosystem is in a less stable condition and moderate uniformity (Sukardi & Arisandi, 2020). The results of this study, the phytoplankton uniformity index in the Asahan River averaged 0.72, meaning that the water conditions of the Asahan River were less stable with a moderate evenness/uniformity category.The dominance index (C) of phytoplankton in the Asahan River waters as fish farming at St 1 was 0.14, St 2, 0.16 and St 3 was 0.17, with an overall average of 0.16. The dominance index value ranges from 0 to 1. If the dominance index value is close to 1, then the dominance index is classified as high. This indicates that there are species that have more individuals than other species. Meanwhile, if the dominance index value is close to 0, then the dominance index is classified as low and indicates that no species dominates and there is no ecological pressure on aquatic biota (Sukardi & Arisandi, 2020). The results of this study showed that the phytoplankton dominance index in the Asahan River averaged 0.16, meaning it is in the low category.

The abundance of phytoplankton in the Asahan River at the three stations ranged from 11.4 - 69.9 individuals/L, the highest abundance was found at station 3 at 69.9 (Table 1). According to Asiddiqi et al., (2019) the abundance of phytoplankton <1,000 cells/L is low, the abundance between 1,000-40,000 cells/L is moderate and the abundance> 40,000 cells/L is high. The abundance of phytoplankton is influenced by the number of individuals found, the more individuals found, the higher the abundance (Nirmalasari, 2018). The results of this study indicate that the abundance of phytoplankton ranges from 11.4 - 69.9 individuals/L, including the low category.

Chemical and Physical Factors of Water

Physicochemical factors of water for phytoplankton growth such as that the optimum temperature ranges from 28.4ºC - 31.1ºC. The normal pH value of water is around neutral, which is 6-8, while the pH of polluted water. degrees can be categorized as a limiting factor, if pH <4 and pH> 11 is the acid-base dead point for fish. Physicochemical factors of water are important for phytoplankton growth as stated in (Sukoco et al., 2020; Gurning et al., 2020).Dissolved oxygen content can be used as an indicator of water quality, its value is > 6.5 mg/l very lightly polluted, 4.5 - 6.4 mg/l lightly polluted, 2.0 - 4.4 mg/l moderately polluted and < 2.0 mg/l heavily polluted (Sukoco et al., 2021). Nutrient content such as nitrate and phosphate are the main needs of phytoplankton to grow and reproduce. Based on the results of dissolved oxygen (DO) measurements in the Asahan River, it is in the range of 4.88 - 5.62 with an average of 5.15 Dissolved oxygen is influenced by the rate of photosynthesis in waters. The dissolved oxygen in the Asahan River is still suitable for the growth and development of phytoplankton. This is in accordance with the quality standards of the Minister of Environment Decree number 51 (2004) which stipulates the standard value of dissolved oxygen quality to support the life of aquatic biota of > 5 mg/L (Samudera et al., 2021).Turbidity can be caused by the presence of organic or inorganic materials, both suspended and dissolved, such as debris, fine particles, soil, plankton, etc.

This can come from the results of rock weathering activities, runoff from the land (erosion), and anthropogenic influences (garbage, domestic waste, industry or swamp water rich in organic materials). The level of water turbidity in the Asahan River ranges from 2.80 NTU - 4.16 NTU. This range is considered to be able to affect the supply of dissolved oxygen from photosynthesis because turbidity is considered to reduce the penetration of sunlight into the water column, thereby affecting the photosynthesis process (Pagoray & Ghitarina, 2016).The results of measuring the pH of the water in the post-gold mining pond were slightly acidic pH 6. In waters, it can be used as an indicator of the balance of chemical elements and nutrients that are very beneficial for the life of aquatic biota. In waters with low pH, ionizable ammonium compounds are found in abundance (ammonium is not toxic). In alkaline conditions (high pH), more non-ionized ammonia is found and is toxic. The pH suitable for plankton growth ranges from 7-8.5 (Daniaty et al., 2021; Gurning et al., 2020), meaning that the pH of the Asahan River waters is in normal conditions. Dissolved oxygen is influenced by the rate of photosynthesis in waters. The main source of dissolved oxygen in waters is produced by phytoplankton.

V. CONCLUSION

The abundance of phytoplankton in the Asahan River is in the low category. The phytoplankton diversity index in the pond is in the medium category and the pond is classified as having stable waters. However, based on the evenness index, the pond waters are less stable, and the dominance index is in the low category. In addition, the results of the physical-chemical factor measurements showed that the DO in the pond was suitable for phytoplankton growth. The concentration of mercury (Hg) at stations 1 and 2 was not detected, while at station 3 it was detected at 0.05 ppm, meaning it was still within normal limits. The pH of the water is classified as normal, the turbidity level and water temperature of the Asahan River are still within tolerance limits.

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