Study Phytoplankton As A Bioindicator of Asahan River Water Quality

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Abstract.

This study aims to determine the types of phytoplankton, phytoplankton abundance, factors that influence phytoplankton life and the quality of the Asahan River based on phytoplankton abundance. The method used is descriptive. The results of the study in the waters of the Asahan River obtained 13 types of phytoplankton, with a species abundance of 4875 ind/L. The quality of the Asahan River is moderately polluted as seen from the species abundance value which ranges from 1,000-10,000 ind/L and environmental parameter values, namely temperature 28.66 ˚C, brightness 6.26 m and DO 7.19 mg/l is optimal for the growth and development of phytoplankton while the salinity of 31.22 ˚/₀, pH 6.7 and BOD 2.7mg/l are below the standard quality of the Asahan River for marine biota according to the Decree of the Minister of Environment and Forestry No. 51 of 2004.

Keywords: *Phytoplankton; Species Abundance and Quality Standards.*

I. INTRODUCTION

Coastal areas, besides serving as fishing grounds, are also used for aquaculture, recreation and tourism, transportation and ports, industrial development, settlements, and waste disposal (Idris, 2021). As a result of these multiple human activities, both technological and traditional, development often has negative impacts on the surrounding environment and can subsequently affect aquatic life, particularly phytoplankton, the organisms that are the first to respond to changes in environmental quality.Phytoplankton are microscopic organisms that live near the water's surface. This is based on the fact that, in general, phytoplankton play a crucial role as primary producers in waters, have a short life cycle, and many species are sensitive to environmental changes (Nontji, 2020).

The presence of phytoplankton can be used as a bioindicator of changes in the aquatic environment caused by an imbalance in an ecosystem due to pollution (Fachrul, 2008). Sachlan (1982 in Utomo et al., 2011) stated that phytoplankton is a biological parameter closely related to nutrients. According to Lancar & Krake (2022 in Utomo et al., 2019), phytoplankton can assimilate most of the nutrients from the water. The presence of phytoplankton in a body of water will be influenced by environmental parameters including water quality and physiology. The diversity and abundance of phytoplankton can change at various levels in response to changes in the physical, biological, and chemical environmental conditions of the water.Therefore, this area is highly vulnerable to human activities directly related to the water. Routine activities along the Asahan River coast include sand dredging, agriculture, and local settlements. These activities, both directly and indirectly, impact the ecosystem balance in this water area. This is because port activities contribute ballast water waste, oil from sand dredging machines, and anchor placement, which can affect phytoplankton growth.

II. METHODS

Research Procedures

1. This study used 3 stations
2. Sampling
3. Sampling, sampling was carried out by taking the Asahan River at the surface of ±0 m and a depth of ±5 m, using a 1 liter bottle at each station. The bottle (1 L) was dipped into the surface of the Asahan River to collect surface water. Next, a 7 m long rope was measured and every 1 m was marked. The rope was tied to a

weight, then lowered to a depth of 5 m. After the weight was lowered to a depth of 5 m, the researcher dived with a tightly closed bottle, after reaching a depth of 5 m, the bottle cap was opened so that water could enter, when the bottle was full, the bottle was closed again. The bottle filled with water (1 L) was brought to the surface, then the water was filtered using a plankton net to obtain 20 ml as a sample. Preserved using 4 drops of Lugol, then stored at a temperature of 13 ºC.

4. Observation and identification of samples in the laboratory

b. The water sample (20 ml) was homogenized, then 2 ml was sucked up and then dropped onto the slide and covered. Then the slide was placed on the slide table on the microscope, observed from the top left corner of the first row horizontally to the right, then the second row was observed and so on.

c. The observed phytoplankton were identified by referring to Rissik (2008), Barsanti (2006) and Sachlan (1978)

5. Measurement of environmental parameters

a. Temperature, Salinity, Brightness, pH, DO, BOD

Data analysis

Abundance phytoplankton countedbased on the formula

$$N = n \times \frac{Vr}{Vo} \times \frac{1}{Vs}$$

Information;

N = Total abundance

n = Number of Cells Observed

VR = Volume of filtered water (mL) Vo = Observed water volume (mL)Vs = Volume of filtered water (L)

III. RESULT AND DISCUSSION

Types and Classification of Phytoplankton in Tenau Sea Waters

Based on the research results, 13 types of phytoplankton were obtained and classified as in Table 1.

Table 1. Classification of phytoplankton found in Oeba Coastal Waters

Class	Genus	Species
Snydera	*Synedra ulna*	*Nitzschia closterium*
	Thalassiasis	*Thalassiosithrix longissima*
	Triceratum	*Triceratium favus*
	Melosira	*Melosira*sp
	Snydera	*Synedra ulna*
	Eunotia	*Eunotia pectinalis*
	Nitzschia	*Nitzschia closterium*
Chlorophyceae	Lyngbia	*Lyngbia*sp
	Oscillatoria	*Oscillatoria*sp
	Cosmarium	*Cosmarium cyclidium*
Cyanophyceae	Stigonema	*Stigonema*sp
Dinophyceae	Ceratium	*Ceratium*sp
Euglenaphyceae	Euglena	*Euglena*sp

Table 1 shows 13 types of phytoplankton found in the Asahan River. The number of phytoplankton species found in this study is relatively small compared to the study by Haninuna et al. (2010) in the Asahan River, which found 37 phytoplankton species. This difference in species count is thought to be due to the decline in water quality in Tenau.

Phytoplankton Abundance in Tenau Sea Waters

The abundance of phytoplankton found in the waters of the Asahan River (table 2).

Table 2. Abundance (ind/L) of phytoplankton species in the Asahan River waters based on sampling time and water depth

Sampling Time	Depth	Station			Total
		I	II	III	
Morning (06.00)	0 m	377	412	345	1179

	5 m	147	108	175	456
Afternoon (12.00)	0 m	58	69	72	212
	5 m	276	272	316	975
Afternoon (18.00)	0 m	430	309	416	1075
	5 m	211	128	132	471
Night (00.00)	0 m	398	396	404	1286
	5 m	61	87	88	236
Total		2295	1697	1898	4875

Table 2 shows that the abundance of phytoplankton species at 6:00 a.m. (morning) at a depth of 0 meters was higher than at a depth of 5 meters. This result is supported by Gross (1988) who stated that in the morning light intensity is still low and the water surface temperature is still relatively cool so that phytoplankton are close to the surface and are more active in the process of photosynthesis. The abundance of phytoplankton species at 12:00 p.m. (noon) was higher at a depth of 5 meters than at a depth of 0 meters. This is thought to be because during the day phytoplankton avoid high intensity sunlight. Tambaru (2001) stated that the higher the light intensity, the more phytoplankton there are. enter water bodies cause growth Phytoplankton experience saturation and die, so they tend to avoid excessive light to facilitate photosynthesis. Phytoplankton abundance is higher at depths between 6:00 PM and 12:00 AM.These results align with Gross's (1988) opinion, which states that light intensity decreases in the afternoon and evening, causing phytoplankton to move closer to or even to the water's surface. Furthermore, the high abundance of phytoplankton at night is thought to be due to moonlight, which stimulates phytoplankton reproduction, causing them to double in size.

Based on Table 2, the highest abundance of phytoplankton species was at Station I, at 2,295 individuals/L. This high abundance of phytoplankton at this station is thought to be due to the lack of human activity, resulting in minimal organic and inorganic waste entering the water body. This is supported by measurements of physicochemical parameters that support phytoplankton growth and development. Meanwhile, the lowest abundance of phytoplankton was at Station II, at 1,697 individuals/L. The low abundance of phytoplankton at this station is thought to be due to frequent human activities, such as ship loading and unloading, which produce waste in the form of ballast water, anchoring, and ship cleaning, which can disrupt aquatic life. This is consistent with Elyasar (2020) who stated that waste from industrial activities, ports, and coastal residents' activities degrade the quality of the aquatic environment and affect aquatic life.Environmental Parameters that Influence Phytoplankton Abundance in Asahan River Waters The environmental parameters measured in this study include temperature, brightness, salinity, pH and dissolved oxygen.

Table 3. Average results of environmental parameter measurements in Tenau sea waters

Environmental parameters measured	Measurement results	Seawater Quality Standard*
Temperature (˚C)	28.66 ˚C	28-32˚C
Brightness (m)	6.26 m	>5 m
salinity (˚/₀₀)	31.22 ˚/₀₀	31-33 ˚/₀₀
Ph	7.12	7 – 8.5
Dissolved oxygen (mg/l)	7.19 mg/L	>5 mg/l
BOD	2.7 mg/L	20 mg/l.

** Asahan River Quality Standards for Marine Biota Decree of the Minister of Environment Number 51 of 2004*

The average temperature of the Asahan River waters is around 28.66 ˚C. Generally, Indonesian water temperatures range between 28-31˚C (Nontji, 2005). The tolerance range for phytoplankton in the waters is 20-30˚C (Effendi, 2003). This means that the temperature of the Asahan River waters is still within the tolerable range for phytoplankton growth and development.Based on the research results, the water clarity of the Asahan River is generally considered good, with an average sea clarity of 6.26 meters. This measurement result is still above the Asahan River quality standard for marine biota as stipulated in the Decree of the Minister of Environment No.51 of 2004. Except at station 2 (Cargo Port) with a clarity level of 3.25 meters. The low clarity level at this station is thought to be due to the high port activity resulting in a lot of waste from ballast water, oil from ships, anchoring and ship cleaning entering the water body, causing the water to

become cloudy.The average salinity value of the waters is 31.22 ˚/₀₀. When compared to the quality standards of the Asahan River for marine biota as stipulated in the Decree of the Minister of Environment No. 51 of 2004, namely 31-33 ˚/₀ the salinity value in the waters of the Asahan River is considered low. The low salinity in the waters of the Asahan River is caused by the supply of fresh water that flows into sea waters.

The average pH value measurement result of the Asahan River waters is 7.63. This measurement result is below the standard quality limit of the Asahan River according to the Decree of the Minister of Environment No. 51 of 2004 for marine biota. The low pH content is suspected to be due to the presence of waste from aquatic organisms and waste from settlements and ports around the riverbank. The average DO measurement result in the Asahan River waters is 6.3 mg/l. The DO value obtained indicates that the waters are in very good condition, and still meet the standard quality standards of the Asahan River in the Decree of the Minister of State for the Environment No. 51 of 2004 for marine biota life with a DO value of >5 mg/l, so the DO concentration in the Tenau waters is still considered good for marine biota. The average BOD5 measurement result in the Asahan River waters is 2.7 mg/l. The BOD5 value obtained does not meet the standard quality standards of the Asahan River in the Decree of the Minister of State for the Environment No. 51 of 2004 for marine biota life with a maximum value of 20 mg/l. The low BOD5 value reflects the high organic material from domestic and industrial waste due to the low oxygen required by microorganisms to degrade organic waste in the water.

IV. CONCLUSION

The types of phytoplankton found in the waters of the Asahan River are Euglena sp. Coscinodiscus sp. Melosira sp. Eunotia pectinalis. Rhizosolenia alata. Cosmarium cyclidium. Triceratium favus. Nitzschia closterium. Ceratium sp. Lyngbia sp. Synedra ulna. Bacillaria sp. Oscillatoria sp. Thalassiothrix longissima. Stigonema sp. The abundance value of phytoplankton types in the waters of the Asahan River is 4875 ind/L The results of environmental parameter measurements show that the average temperature is 28.11˚C, the average brightness is 5.82 meters, the average salinity is 31.22, the average pH is 7.12, the average DO is 7.19 mg/l and BOD is 2.7mg/L. The quality of the Asahan Tenau River is classified as moderately polluted based on the abundance value of phytoplankton species of 1,000-10,000 ind/L, meaning moderate abundance of species, moderate stability of the phytoplankton community or moderately polluted water quality.

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