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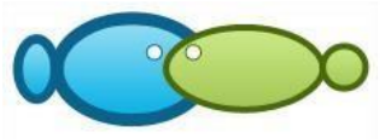

Study of plankton community in Bilah River, Labuhanbatu Regency

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Abstract. The study aimed to determine the composition and abundance of plankton in the Bilah River, Bilah Hilir District, Labuhanbatu Regency, North Sumatra. The study was carried out in May - June 2022 at 3 research stations. The following environmental variables were measured: depth, pH, dissolved oxygen, biochemical oxygen demand, nitrate, and phosphate content. The biological parameters measured included plankton composition and abundance, plankton diversity index (H'), plankton dominance index (C), and plankton similarity index between stations. 27 genera and 6 classes of phytoplankton were found, consisting of 9 genera Bacillariophyceae, 6 genera Cyanophyceae, 5 genera Chlorophyceae, 3 genera Euglenophyceae and 1 zooplankton class, namely Maxillopoda, with 2 genera. Based on the plankton diversity index in the Sungai Bilah at low tide, there is low community stability at station 2 and 3, with index values ranging from 0.69 to 1.06. Meanwhile, the diversity of plankton community was found stable in stations 1 and 3 with, Shannon's diveristy index values ranging from 1.8 to 2.11.

Key Words: Bacillariophyceae, coastal river, diversity, North Sumatra.

Introduction. One of the most important problems in a body of water is pollution. Water pollution according to Government Regulation of the Republic of Indonesia No. 82 of 2001 represents the entry or inclusion of living organisms, substances, energy, and or other components into water and or changes in the water occurring because of human activities. Because of these, water quality decreases under a certain threshold, causing problems with the role of the water (Agustiningsih et al 2012). Local monitoring in freshwaters of North Sumatra is required, since there are many unreported impacts of anthropogenic activities on the natural state of the rivers (Harahap et al 2020).

Plankton are microscopic organisms that live suspended in the waters (Gibbs et al 2020). Plankton composition can be very diverse in fresh, brackish and marine waters. Plankton are aquatic organisms that have a very important role in an aquatic ecosystem, and can also be used in determining the status of the waters by knowing the abundance and species (Rumondang 2017). The presence of plankton in the waters can be used as a bioindicator for assessing the condition of the waters (Kartika et al 2015). The variation in the presence of plankton is caused by the different adaptability of each genus to their habitat (Mirna & Makri 2011). This group of aquatic biota is generally very sensitive to environmental changes and its life cycle is relatively short. Plankton is also a major component in the food chain in waters. The abundance of plankton in the waters is highly dependent on nutrient levels and water quality conditions in the aquatic environment (Wilson et al 2018). Waters with excess of nutrients will be more abundant and have a higher variety of plankton structures and vice versa (Monteiro et al 2021).

A watershed has a dynamic biophysical diversity (Ujiti et al 2021). A river watershed is an area that topographically functions as a catchment and channel for any near water runoff (Ashari 2006). Watersheds usually present biological ecosystem

diversity, including the presence of a plankton community. Water quality parameters are important indicators of the dynamics of aquatic ecosystems (Ariadi et al 2020). Water quality and the presence of microorganisms in waters are dynamic over time (Dutta et al 2017). The dynamics of water quality are influenced by various factors, especially physical, chemical, and biological factors of water (Ariadi et al 2019).

The structure and composition of the phytoplankton community may shift as a result of the dynamic input of marine waters. The coastal are of the Bilah River may experience this during high tide and low tide. The concentrations of inorganic nutrients in the recipient waters will increase, which may encourage phytoplankton growth. As a result, the purpose of this study was to identify the species, diversity, and similarity of the plankton community in the Bilah River.

Material and Method. Negeri Lama is one of the villages in the sub-district of Bilah Hilir, Labuhanbatu Regency, North Sumatra Province, Indonesia, being the capital of the District of Bilah Hilir. This research was carried out in May 2022, when the Bilah River water conditions were receding and in June 2022, when the river water conditions were at high tide (Figure 1).

Figure 1. Research location on Bilah River (source: Google Earth).

Plankton sampling was carried out using a 10 L plastic container, by filtering 50 L of water in three sampling sites. The sampling was repeated 5 times. The water was collected and then poured through a plankton net no. 25 (30 cm diameter, 0.0535 µm).

The resulted plankton was poured into a plankton container, a 25 mL film bottle, and preserved with 4% formalin (approximately two drops using a dropper). The samples were transported to the Biology Laboratory, Faculty of Teacher Training and Education, Labuhanbatu University, and observed under a microscope. Plankton samples were identified using Mizuno (1979) and Needham (1962) references.

Plankton data were analyzed using the APHA (1980) formula to determine its abundance. To determine diversity, the Shannon-Wiener index was used. Species similarity was determined using the similarity index. Dominance was determined using the Simpson dominance index (Odum 1993).

$$N=(Ns\times Va)/(Vs\times Vc)$$

Where: N - abundance; Ns – number of individuals counted in the Sedwick rafter; Va – volume of concentrated water samples in a vial; Vs – volume of water sample in Sedwick

rafter; Vc - volume of filtered sample water (L).

The physicochemical parameters of the river determined were temperature, brightness, depth, pH, dissolved oxygen (DO), biological oxygen demand (BOD), nitrate, and phosphate content. Water samples were collected at predetermined points at each station. The physical and chemical parameters measured *in-situ* were temperature (°C) using a digital thermometer, depth, brightness using a Secchi disk, pH using a digital pH meter, and DO using the titrimetrical technique. BOD measurements were carried out at the Biology Laboratory, Faculty of Teacher Training and Education, Labuhanbatu University. Nitrate, phosphate and oil content were determined at the Labuhanbatu Industrial Research and Standardization Institute.

Results and Discussion

Plankton composition and abundance. In all water samples from 3 observation stations on the Bilah River at low and high tide, 22 species of plankton were found, consisting of 4 classes of phytoplankton, namely Bacillariophyceae (with 9 species), Cyanophyceae (5 species), Chlorophyceae (5 species), Euglenophyceae (2 species) and 1 class of zooplankton, Maxillopoda (1 species) (Table 1).

Table 1

Phytoplankton taxa found in Bilah River, Labuhanbatu District

No	*Plankton class*	*Species*
1	Bacillariophyceae	*Skeletonema* sp.
2		*Nitzschia* sp.
3		*Epithemia* sp.
4		*Rhizosolenia* sp.
5		*Melosira* sp.
6		*Noctiluca* sp.
7		*Synedra* sp.
8		*Cymbella* sp.
9		*Eudorina* sp.
10	Cyanophyceae	*Oscillatoria* sp.
11		*Nitzschia* sp.
12		*Closterium* sp.
13		*Gonatozygon* sp.
14		*Sirogonium* sp.
15	Chlorophyceae	*Zygnema* sp.
16		*Microcystis* sp.
17		*Calothrix* sp.
18		*Anabaena* sp.
19		*Micrococcus* sp.
20	Euglenophyceae	*Euglena* sp.
21		*Ulva* sp.
22	Maxillopoda	*Nauplius* sp.

Abundance of plankton. Bacillariophyceae class had the highest number of species (9 species), because it is able to better adapt to the surrounding environmental conditions compared to other classes. According to Arinardi et al (2016), Bacillariophyceae is cosmopolitan and has a high tolerance and adaptability. Class Chlorophyceae had the highest average abundance after Bacillariophyceae.

Both Cyanophyceae and Chlorophyceae had 5 species each, less than Bacillariophyceae This is in accordance with Nontji (2007) and Harahap et al (2018), who stated that Cyanophyceae are usually rare, but sometimes they will appear suddenly in a very large population explosion, and soon will disappear again quickly.

The abundance of plankton in the riverbank at low tide in May 2022 ranged from 11-15 ind L^{-1}. The abundance of plankton in the riverbank at high tide in June 2022 ranged from 22-36 ind L^{-1} (Figure 2).

Fluctuations in plankton abundance in the river is thought to be due to the influence of the tides. According to Raymont (1963), the abundance of plankton in the waters is influenced by several environmental factors, including physical factors

(temperature, brightness and depth) and chemical factors (pH, DO, BOD, nitrate, and phosphate content).

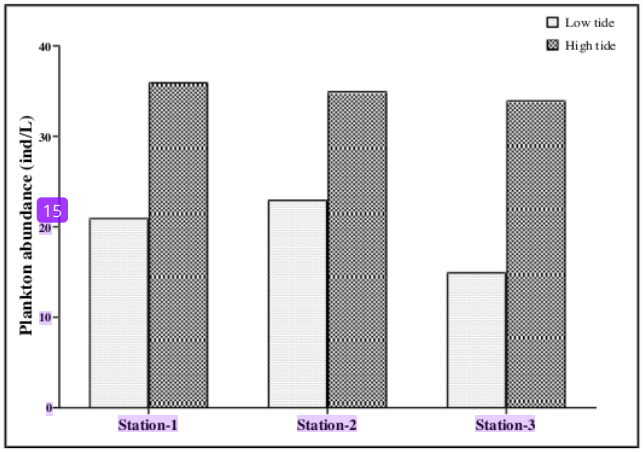

Figure 2. Plankton abundance in the Bilah River.

Diversity. The results of the analysis of the plankton species diversity can be seen in Figure 3. The diversity index in the riverbank at low tide ranges from 0.69 to 1.06. Stations 1, 3, 4 and 5, with a diversity index of 0.69, are included in the category of unstable biota community (low diversity), while station 2, with a diversity index value of 1.06, is included in the category of moderate biota community (medium diversity).

The diversity index in the river at high tide ranged from 1.8 to 2.18. Stations 1, 2 and 3 had diversity indices of 1.9, 1.8 and 2.11, respectively, being included in the category of moderate biota community (medium diversity). The highest diversity index at all research stations was located at station 3, with a diversity index value of 2.18. This was probably due to the influence of physical factors, namely high brightness at station 3 reaching a value of 81 cm, brightness being closely related to incoming solar radiation, thus greatly affecting the productivity of plankton in river waters.

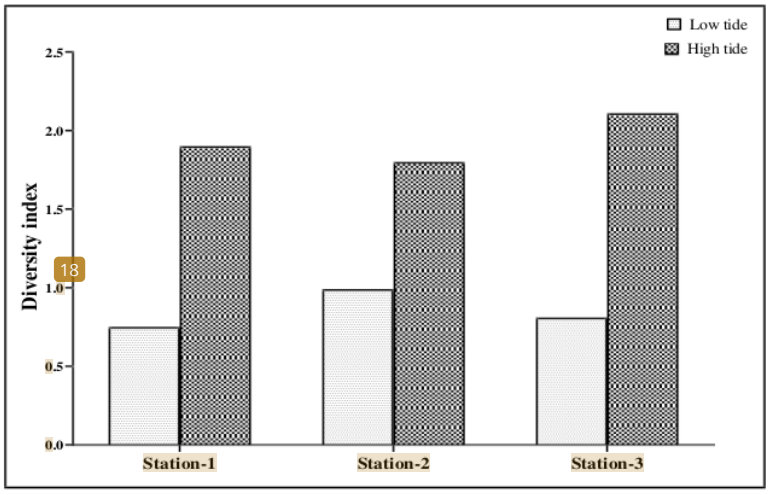

Figure 3. Plankton diversity index in the Bilah River.

Dominance. The dominance index of the Bilah river at low tide was between 0.36 and 0.50, while at high tide it was between 0.12 and 1.17 (Figure 4). Based on the criteria, if dominance (D) is close to 0 (<0.5), there is no dominant species and, if D is close to 1 (>0.5), there is a dominant species (Fauziyah et al 2019). Based on the dominance index in Sungai Bilah at low tide and high tide at all stations, there is no the predominant species of plankton.

According to Odum (2015), the loss of the dominant species will cause important changes not only in the biotic community itself, but also in the physical environment. The existence of a dominant plankton species can indicate that the waters are polluted or less fertile, so that only a certain species is able to adapt. The dominance of a species is one of the indicators used in assessing the quality of an environment.

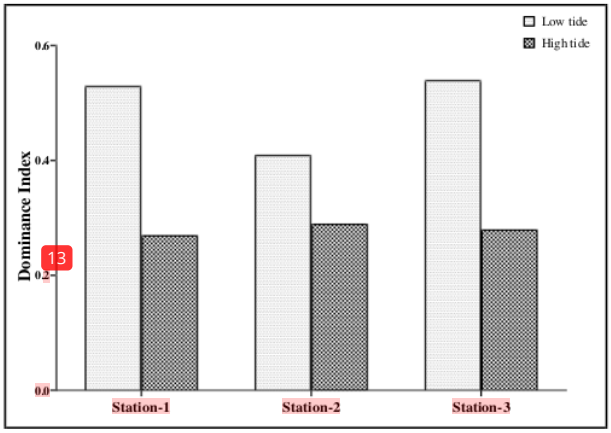

Figure 4. Plankton Dominance Index in Bilah River.

Similarity. The results of the analysis of the similarity of plankton in the riverbank at low tide had a low similarity value of 0-0.5 (Table 2), while at high tide, the similarity value was moderate, from 0.1-0.8 (Fauziyah et al 2019) (Table 3).

Table 2

The similarity index of the plankton community in the river bar at low tide

Station	*I*	*II*	*III*
I	1	0.2	0
II	-	1	0.2
III	-	-	1

Table 3

Index of plankton community similarity in the river bar at high tide

Station	*I*	*II*	*III*
I	1	0.7	0.2
II	-	1	0.2
III	-	-	1

Satrioajie et al (2012) stated that the similarity index (IS) value that falls between 0 and 0.5 indicate that the community is in a depressed condition, while values between 0.5 and 0.75 indicate unstable condition. IS between 0.75 and 1 indicates a stable community. Based on the data above, it can be seen that the condition of the waters of the Bilah river, depending on the station, can be categorized in the unstable, but also in the stable category.

Water parameters. The water parameters determined at each site are presented in Table 4. Based on the results, the water quality parameters obtained at stations 1 and 2 are classified as having "good quality", while the research station 3, the quality is medium.

Table 4

Physico-chemical parameters of water at each sampling site

Parameters	*Unit*	*Station 1*	*Station 2*	*Station 3*
Temperature	°C	25.06	25.04	25.36
DO	mg L^{-1}	7.5	7.21	7.01
pH	-	7.46	7.63	7.65
Brightness	cm	46	37.8	34.8
BOD_5	mg L^{-1}	5	4.5	4.2
NO_3	mg L^{-1}	2.321	1.362	1.276
PO_4	mg L^{-1}	0.623	0.544	0.487

Conclusions. The composition and diversity of plankton in the riverbank is in low to moderate conditions. This indicates that the river water is in moderate condition. The value of the similarity index at the 3 stations as a whole is >0.1, including the waters in the unstable, but also stable conditions, depending on the station. In general, the 3 research stations do not have dominant plankton species. Thus, the balance of the plankton community in the riverbank shows a relatively good condition.

Conflict of Interest. The authors declare that there is no conflict of interest.

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