Analysis of Phosphate, Nitrate and Macrozoobenthos Density in Belawan River

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Abstract: The goals of this research was to identify Phosphate and Nitrate contents and also macrozoobenthos density in Belawan River. Activities done by the community such as industries, PLTU, PDAM and aquaculture are found in Belawan River area. This action produce waste straightly discharged into water river, emerging several bad effect on water quality such as Phosphate, Nitrate, and Macrozoobenthos density. Retrieval of data with Purposive Random Sampling with five analysis the location.The method used in this research was included in the measurement of density (K), KR (relative density), and FR (frequency of attendance) of Macrozoobenthos. Identification of Macrozoobenthos results obtained in the Belawan river was amounted as nine genera. The lowest Marcozzoobenthos density was at the Station 5 (Scylla), Station 4 (Hirudo), Station 2 (Microbachiumand Melanoides) and Station 1 (Melanoides) with a density of 3.703, and the highest was instation 4 (Polymesodaerosa) with a density of 629.62. Based on phosphate concentrations, it is included as hypertrophic (0.14-0.18 mg/l,). Based on nitrate concentration, it is included as eutrophicand mesotrophic waters (1.18-7.57 mg/l).

1 INTRODUCTION

Activities done by the community such as industries, PLTU, PDAM and aquaculture are found in the Belawan River area. Waste produce from these activities is straightly released into the river, emerging in several bad effect on water qualityand the contingency of the aquatic biota. The condition of the Belawan river are based on its tributary, the condition of the land and the watersit passes through. (Yeanny, 2018).

Phosphate and nitrate are included as sources of nutrients that are needed by aquatic biota for energy sources by organisms. Organisms need nutrients in the form of phosphate and nitrates. The forms of sediment nutrients are divided into 3 forms that are on the surface of sediments,in sediments and dissolved in sedimentary pore water. Water biota that really needs nitrate and phosphate, one of them is Macrozoobenthos. Macrozoobenthos are live in sediments, under water and sediment eater, which has digging properties, in which this areas contain high as in sediments that contain lots of nutrients found in the river (Firmansyah, *et al.,* 2016)

Analysis of phosphate, nitrate, and macrozoobenthos density still has an adequate of scientific data, meanwhile this scientific data is an important issues in river management in water analysis. Therefore, it is necessary to undergo an analysis of phosphate, nitrate, and macrozoobenthos density, to obtain scientific data, results that can be used to assess the macrozoobenthos condition of in the river.

This purpose of observing the results of the analysis phosphate, nitrate countent and macrozoobenthos in the Belawan River with an approaches, that is (1) Macrozoobenthos analysis of including ; K (density), KR (relative density) and FR (frequency of attendance). (2) Describe the relation between macrozoobenthos with phosphate and nitrate.

2 RESEARCH METHODS

2.1 Materials and Methods

Sampling in March - September 2018. The stations were determined based on the community activities different. The sample was done with 3 repetition and the sampling started from upstream to downstream of Belawan river. The number of sampling site was five.

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Table 1.

Station I	Deli Serdang District, Salam Tani Village, Pancur Batu Sub-district	Control No activity/ Upstream
Station II	Deli Serdang District Sunggal kanan Village, Sunggal Sub-district	Domestic Habitation
Station III	Deli Serdang District Kampung Lalang Sunggal Sub-district	Market, Hotel
Station IV	Deli Serdang District Kelambir 5 Village, Hamparan Perak Sub-district	Paper Industries, Soy Industries
Station V	Medan Belawan City Sicanang Village, Medan Belawan Sub-district	Downstream (estuary)

2.2 Phosphates and Nitrate Sampling

Phosphates and Nitrates measurement results data can be seen in Table 2:

Table 2. Phosphates and Nitrates Parameters.

No.	Parameter	Tools	Measurment Location
1	Phosphate	Atomic Absorption Spectrofotometer (AAS)/Ascorbic Acid	Laboratory
2	Nitrate	Atomic Absorption Spectrofotometer (AAS)/Screening	Laboratory

2.3 Macrozoobenthos Sample Collection

The selected sample locations five (5) which provided Macrozoobenthos samples were based on the local community activities from upstream to downstream. The data collecting method used was Purposive random sampling. This method used to collect the macrozoobenthos samples. Afterward, Suber net was used to collect the sample on each sampling point. The collected macrozoobenthos samples were put in a bottle and preserved using 4% formalin. In the laboratory, the samples were preserved with 70% alcohol. Identification was done using identification book; Streble and Krauter (1988), Oennak (1978), Edmonson (1953).

2.4 Data Analysis

Water quality analysis using standard method APHA, (2005) and macrozoobenthos analysis as follows :

(1) Density (K)

$$K = \frac{a}{b} \quad (1)$$

K = density
a = the number of macrozoobenthos
b = area of plots

(2) Relative Density (KR)

$$KR = \frac{ni}{\sum N} x100\% \quad (2)$$

ni= the number of ind of a kind
ΣN = total of all individuals

(3) Frequency of Attendance (FK)

$$FK = \frac{\text{The number of plots is occupied by a type}}{\text{Total number of plots}} x100 \quad (3)$$

FK = 0-25 (Very Rarely)
25-50 (Rarely)
50-75 (Many)
>75 (Very much

3 RESULTS AND DISCUSSIONS

3.1 Phosphate and Nitrate Contents Analysis

Analysis of phosphate and nitrate contents on Table 3 below provided data based on Phosphate and Nitrate measurements in Belawan River:

Table 3. The Value Phosphate and Nitrate Contents in the Belawan river.

No	Parameter	Station				
		1	2	3	4	5
1	Phosphate (PO_4)	0.15	0.14	0.17	0.18	0.16
2	Nitrate (NO_3)	1.18	0.53	4.41	7.57	3.45

Belawan river phosphateis at the station IV had the highest value (0.18 mg/l) while station II resulted as the lowest one (0.14 mg/l). Stated in MENLH No. 51 of 2004 the maximum phosphate concentration of phospat for marinelife is 0.015, has exceeded the Belawan river quality standard.

T Phosphate content in the river, namely the range between > 0.13 (hypertrophic) 0.04 to 0.13 (eutrophic) 0.015 to 0.04 (mesotrophic) < 0.015 (oligotrophic) (Hakanson 2006). Furthermore, fresh water was ranged from > 0.06 (hypertrophic), 0.025 to 0.06 (eutrophic), 0.008 to 0.025 (mesotrophic) and < 0.008 (oligotrophic). Belawan river phosphate concentration was included as hypertrophic. According to Joshimura (1966) *in* Hartoko (2010) phosphate content was presented in Table 4. Belawan river phosphate content was ranged from 0.14 to 0.18 (very good fertility).

Table 4. Phosphate based on fertility levelsin water

Aquatic Fertility	Phosphate
Low	0.000 – 0.020 mg/l
Adequate	0.021 – 0.050 mg/l
Good	0.051 – 0.100 mg/l
Very Good	0.101 – 0.200 mg/l
Excellent	0.201 mg/l or more

The Belawan river nitrate concentrations was ranged from 1.18 to 7.57 (station II had the lowest value and the highest was at station IV). It has passed the enviromental quality standart (MENLH of 2004 No. 51 attachment III that nitrate 0.008). Nitrate contentis presented in Table 5 according Vollenweider (1969) *in* Effendi (2003)

Table 5. Nitrate based on fertilitylevelsin water.

Category	Nitrate Content
Oligotrophic	0-1 mg/l
Mesotrophic	1-5 mg/l
Eutrophic	5-50 mg/l

Nitrate levels based on fertility levels (Table 5) in The Belawan river, are namely 1.18-7.57 mg/l (eutrophic and mesotrophic). This was in accordance with Wetzal (2001), eutrophic waters have level ranging from 5-50 mg/l, mesotrophic (1-5 mg/l) and oligotrophic (0-1 mg/l). Belawan river is categorized aseutrophic and mesotrophic waters.

3.2 Analysis of Density (K), Relative Density (KR) and Frequency of Attendance (FK) Macrozoobenthos in Belawan River.

Analysis of Density (K), Relative Density (KR) and Frequency of Attendance (FK) Macrozoobenthos in Belawan River are presented in Table 6 and 7.

Table 6. Analysis of Density (K) (ind/m2), KR (Relative Density) (%) and FR (Frequency of Attendance) (%) Macrozoobenthos at Station I and II in Belawan River.

Genera	Station I			Station II		
	K (ind/m^2)	KR (%)	FK (%)	K (ind/m^2)	KR (%)	FK (%)
Hirudo	-	-	-	-	-	-
Baetidae	25.92	25.92	66.67	-	-	-
Polymesodaerosa						
Paguroide						
Scylla						
Macrobrachium				3.703	2.22	33.33
Fillopaludinajavanica						
Melanoides	3.703	3.70	33.33	3.703	2.22	33.33
Gerrisremigis	70.37	70.37	100	159.25	95.55	100
Total	99.993	100		166.656	100	

Table 7. Analysis of Density (K) (ind/m^2), KR (Relative Density) (%) and FR (Frequency of Attendance) (%) Macrozoobenthos at Station III, IV and V in Belawan River

Genera	Station III			`Station IV			Station V		
	K (ind/m^2)	KR (%)	FK (%)	K (ind/m^2)	KR (%)	FK (%)	K (ind/m^2)	KR (%)	FK (%)
Hirudo	-	-	-	3.703	0.57	33.33	-	-	-
Baetidae	-	-	-	-	-	-	-	-	-
Polymesodaerosa	-	-	-	629.62	98.26	100	-	-	-
Paguroide	-	-	-	-	-	-	140.74	97.43	100
Scylla	-	-	-	-	-	-	3.703	2.5	33.33
Macrobrachium	-	-	-	-	-	-	-	-	-
Fillopaludinajavanica	18.51	100	66.67	-	-	-	-	-	-
Melanoides	-	-	-	7.407	1.15	33.33	-	-	-
Gerrisremigis	-	-	-	-	-	-	-	-	-
Total	18.51	100	66.67	640.73	100		144.443	100	

Based on Table 6 and 7, The lowest Macrozoobenthos density was at the Station 5 (*Scylla)*, Station 4 (*Hirudo)*, Station 2 (*Microbachium*and *Melanoides*) and Station 1 (*Melanoides*) with a density of 3.703, and the highest was in station 4 (*Polymesodaerosa)* with a density of 629.62.

4 CONCLUSION

Analysis of phosphate (PO_4), nitrate (NO_3) contents, macrozoobenthos density, with the conclusion that phosphate was ranged from 0.14 -0.18 mg/l (hypertrophic). Nitrate was ranged from 1.18-7.57 mg/l (eutrophic and mesotrophic). Macrozoobenthos obtained amounted as 9 general. The lowest Macrozoobenthos density was at the Station 5 (*Scylla)*, Station 4 (*Hirudo)*, Station 2 (*Microbachium*and *Melanoides*) and Station 1 (*Melanoides*) with a density of 3.703, and the highest was in station 4 (*Polymesodaerosa)* with a density of 629.62.

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REFERENCES

[APHA] American Public Health Association. 2005. *Standard Methods For the Examination of Water and Wastewater.* Amer. Publ. 17th Edition. New York Health Association.

Decree of the Minister of Environment (MENLH) No. 51 of 2004.Appendix III. About *Sea Water Quality Standards for Marine Biota*

Edmonson W.T. 1963. Fresh Water Biology.Second Edition.Jhon Willey & Sons, inc., New York.pp.274-285.

*Effendi, H. 2003.Review of Water Quality for Management of Aquatic Resources and Environment.*CetakanKelima. Yogjakarta :Kanisius.

Firmansyah, N, Ihsan Y.N, Permatasari L, 2016. *Dynamics of Nutrients with Macrozoobenthos Distribution in the SegaraAnakan Laguna.Journal of Marine Fisheries Vol. VII No. 2.*

Hartoko, A. 2010.*Oceanography and Fisheries Resources - Marine in Indonesia.*Undip Press, Semarang

Håkanson, L. 2006, *A dynamic model for suspended particulate matter (SPM) in rivers.* Global Ecology and Biogeography, 15: 93–107. doi: 10.1111/j.1466-822X.2006

Pennak R.W. 1978. *Fresh-water Invertebrates of the United States.*2nd Edition. New York: John Wiley & Sons.

Streble H, and Krauter, D (1988) *Das LebenimWassertropfen: Mikroflora und Mikrofauna des Süßwassers.*EinBestimmungsbuch. Franckh-KosmosVerlag GmbH, Stuttgart.

Wetzel, R.G. 2001. *Limnology; lake and River Ecosystem* 3rd ed. Academic Press New York 1006 pp.

Yeanny, M.S. 2018. Phytoplankton community as bioindicator of fertility in belawan river. IOP Conference Series: Earth and Environmental Science 130 (1), 0120030