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S A M P Suryani, I W Arya, N M Darmadi and I M Kawan

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Community structure, abundance and distribution of phytoplankton in Sungi River, Bali Province

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Tembusan : Arsip

Community structure, abundance and distribution of phytoplankton in Sungi river, Bali Province

Community structure, abundance and distribution of phytoplankton in Sungi river, Bali Province

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Abstract. Phytoplankton is a floating aquatic organism and as a primary producer. This study aimed to determine the community structure, abundance, and distribution of phytoplankton on the upstream, branch, midstream and downstream. The method used is a descriptive explorative method and analyzed with SPSS 20 version. The results showed that in upstream have seven genera of phytoplankton, ten genera in the branch, fourteen genera in the middle stream and sixteen genera in the downstream. Genera phytoplankton found *Anabaenopsis, Comphospaeria, Oscillatoria, Spaerocystus, Nitzchia*, and *Peridinium* in four stations. The highest of abundance at downstream is 403.590 individual/liter and the lowest in the upstream is 51.366 individual/liter. The highest diversity index in the downstream is 2.79 with a dominance index is 0.126 and 0.617 for similarity index. The results of one-way ANOVA showed that the number of phytoplankton genera is significant at different stations. The results of this study are community structure, abundance, and distribution of phytoplankton there is a difference from the upstream, branch, midstream and downstream due to the influence of water quality parameters exceed the quality standards.

1. Introduction

Phytoplankton is an important primary producer in aquatic environments such as lakes, rivers, and ponds and can be used as a sensitive biological indicator in monitoring water quality due to changes in the environment [1]. Water pollution is not only harmful to the reproduction of aquatic animals but also on human health. Physicochemical parameters used to determine the contamination is dissolved oxygen, pH, Phosphate, Nitrate, Nitrite, Ammonia, COD and BOD. Mismanagement can cause physiological changes that the growth and survival of aquatic organisms [2,3]. Excess nutrients and degradation in the water can reduce water quality [4,5].

Abundance, diversity, and dominance of plankton in aquatic species can be used as an indicator of whether the existence waters are still in good condition or contaminated. Phytoplankton abundance in waters affected by the presence of light associated with the time of acquisition. The existence of light intensity decreases at deeper depths. Specific composition and abundance of phytoplankton were instrumental as a natural food for the higher trophic level organisms and as a provider of oxygen in the waters of the river. The presence of organic material input to a river can cause increased turbidity and thus the availability of nutrients that are unevenly distributed and the penetration of light entering the waters will decrease and affect the activity of phytoplankton. This study was to determine the community structure.

2. Materials and methods

2.1. Determining the research station

This study Sungi river divides into four stations, namely upstream, branch, midstream and downstream using GPS. At the upstream at point 8° 21'4"S - 115° 10'49"E, on the branch 8° 22'25"S - 115° 11'5"E), the midstream at the point 8° 33'695"S - 115° 09'538"E and downstream at the point 8° 3'053"S - 115° 06'068"E.

2.2. Water sampling and measurement of water quality

Water sampling is done at each location 3 times in the composite. Water quality parameters were observed include temperature, pH, dissolved oxygen is measured directly at the site while the phosphate, nitrate, nitrite and ammonia analysis in a laboratory with a spectrophotometer procedure.

2.3. Sampling and measurement of phytoplankton

A sampling of phytoplankton such as water sampling done by using plankton net (Mesh size 20 micrometers), 0.5 m above the water surface. Samples preserved with 10 ml of Lugol [6]. The species were identified using a light microscope with a magnification of 10x40 [7]. Dominance index, diversity index, similarity index to determine community structure [8-10] and abundance of phytoplankton [11].

2.4. Data analysis

2.4.1. Plankton abundance. Abundance plankton in liters can be calculated using the formula APHA [11], namely:

$$N = \frac{T}{L} \times \frac{P}{p} \times \frac{V}{v} \times \frac{1}{w}$$

Where:
N = Number of phytoplankton per liter
T = area of the glass cover (mm^2)
L = area of the visual field (mm^2)
P = The number of phytoplankton
p = The number of visual fields observed
V = Volume of phytoplankton samples was filtered (ml)
v = volume of phytoplankton samples under glass cover (ml)
w = Volume of phytoplankton samples was filtered (liter)

Some of the factors of the formula is known in Sedgewick-Rafter, such as: T = 1000 mm2, v = 1 ml, and L = 0.25 mm2 μ

(Suppose a circle equals the area of the visual field microscope with r = 0.5 mm), then the formula becomes:

$$N = \frac{1000mm^2}{0{,}25x} \times \frac{P}{10} \times \frac{V}{1\ ml} \times \frac{1}{w}\ or\ N = \frac{100\ (P \times V)}{0{,}25\pi w}$$

2.4.2. Diversity index. The diversity of biota in the research area is calculated using the Shannon Diversity Index - Wiener [12] which can be formulated as follows:

$$H' = \sum_{1-1}^{s} pi\ lnpi, where\ Pi = {}^{Ni}/_{N}$$

Where:
H '= Diversity Index
Ni = Number of individuals of all types i

N = Number of individuals in total

2.4.3. Similarity index. Similarity contained in each station can be calculated using the Evenness similarity index as follows:

$$E = \frac{H'}{H'Max}$$

Where:
E = index of similarity
H '= diversity index
H' max = ln S (S = Number of species found)
Criteria used:
E <0.4: little similarity
0.4 <E <0.6: moderate similarity
E> 0.6: high similarity

2.4.4. Dominance index
The dominance of phytoplankton calculated using the dominance index [13], by the equation:

$$D = \left(\frac{Ni}{N}\right)^2$$

Where:
D = the index of dominance
Ni = Number of individuals of species i
N = the total number of individuals

2.5. Statistics analysis
Abundance types of phytoplankton in the upper branch, middle and downstream reaches of the river will be analyzed by One-way ANOVA using SPSS with a significance level of 0.05. Water quality parameters will be compared to standard quality.

3. Results and discussion

Total abundance, diversity index, index of similarity and phytoplankton dominance index (Table 1) where the highest total abundance is in downstream is 403.590 individual/l, the downstream organic ingredients highest seen in the value of 4.94 ppm, Biological Oxygen Demand (BOD) which already exceeded the quality standard for the aquatic organism that is 2 ppm [14]. The highest diversity index is on the downstream is 2.7 (Figure 3) the stability of the community approached the stable. The highest similarity index is on the downstream is 0.61, which means the similarity between species dominance index equal to 0.1 in a community where there are species that dominated. In the upstream, branch and midstream value of diversity index is close to 1 then the stability of the community is being, similarity index close to 0 means similarity among species in the community is low with dominance index close to 0 means within the community structure some species are extremely dominated other species [15]. The identification results of phytoplankton found 18 species with the abundance of phytoplankton in the upstream, branch, midstream and downstream (Table 2).

Table 1. Results of analysis of phytoplankton each station.

Analysis	Station			
	Upstream	Branch	Midstream	Downstream
Total Abundance	51366	139422	264168	403590
Diversity Index	1.04	1.21	1.96	2.79
Similarity Index	0.28	0.26	0.42	0.61
Dominance Index	0.02	0.02	0.04	0.12

Table 2. The abundance of phytoplankton.

No	Plankton	Station			
		Upstream	Branch	Midstream	Downstream
1	*Anabaenopsis*	3669	36690	11007	47697
2	*Coelosphaeria*	0	14676	0	18345
3	*Comphosphaeria*	7338	11007	0	18345
4	*Gleoetricillia*	0	0	3669	3669
5	*Microcytus*	0	0	0	11007
6	*Oscillatoria*	11007	3669	18345	36690
7	*Dimorphococcus*	0	0	11007	14676
8	*Eudorina*	0	0	18345	0
9	*Oocystus*	0	0	11007	7338
10	*Spaerocytus*	7338	3669	18345	22014
11	*Nitzchia*	7338	25683	47697	51366
12	*Synedra*	0	18345	18345	55035
13	*Peridinium*	3669	11007	18345	36690
14	*Epithemia*	0	3669	0	3669
15	*Rhopaloidea*	11007	0	18345	7338
16	*Surirella*	0	11007	33021	33021
17	*Navicula*	0	0	14676	0
18	*Bacillaria*	0	0	22014	36690

With One-Way ANOVA test between the abundance of phytoplankton species showed that the number of different types of phytoplankton significant at 0.05 level of abundance that is the p-value of 0.007. In the three visible images, Nitzchia species has an abundance of the highest compared to other species at each station.

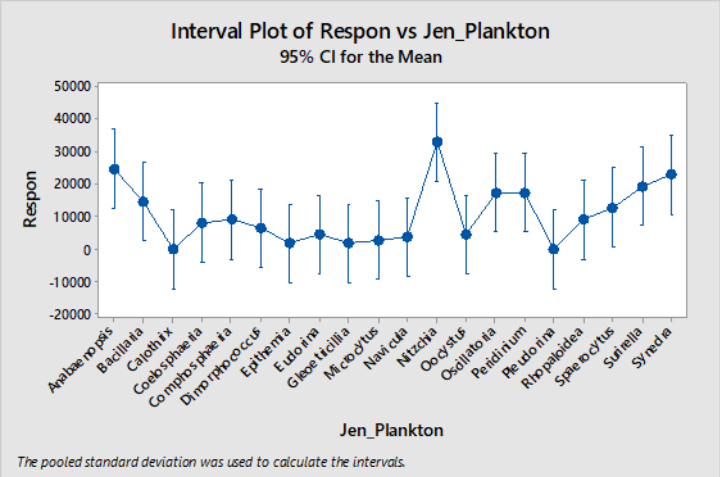

Figure 1. The plot of response interval species phytoplankton.

Abundance total upstream, branch, middle and downstream of the river can be seen in Figure 2. The lowest abundance is on the upstream due to low nutrients and low light entering the water because it was blocked by large vegetation and lush around the river, on a branch of an increase and continued to rise in the middle and downstream because of the increased parameter Phosphate, TSS and TDS in the river.

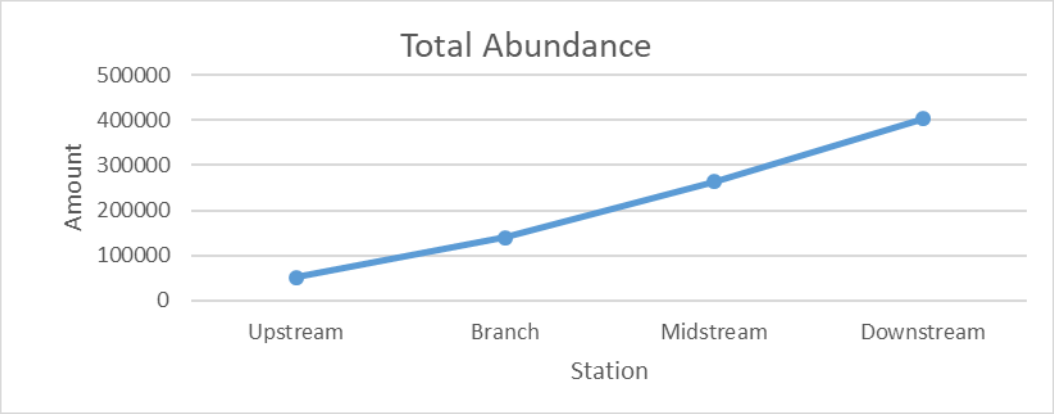

Figure 2. Graph of total abundance phytoplankton.

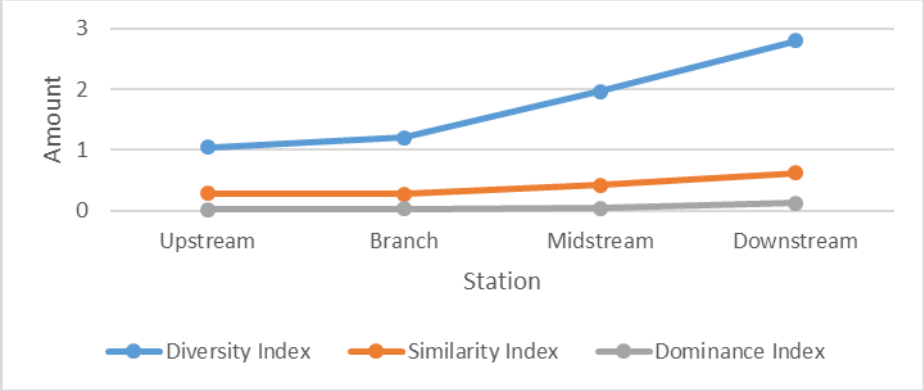

Figure 3. Graph of diversity index, similarity index and dominance index.

4. Conclusion

Phytoplankton community structure in Sungi rivers polluted was classified as having moderate stability to the similarity of species classified as uneven and there are no extreme species dominated other species. Abundance total from upstream to downstream and the highest increase was in the downstream. Distribution of phytoplankton from the upstream, branch, middle and downstream increased in upstream consists of 7 species, branch 10 species, 14 species of midstream and downstream reaches 16 species. Differences in the distribution of phytoplankton are affected by water quality parameters at each location such as BOD, Phosphate, TSS and the temperature increases from upstream to downstream and exceed the quality standards for the river.

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