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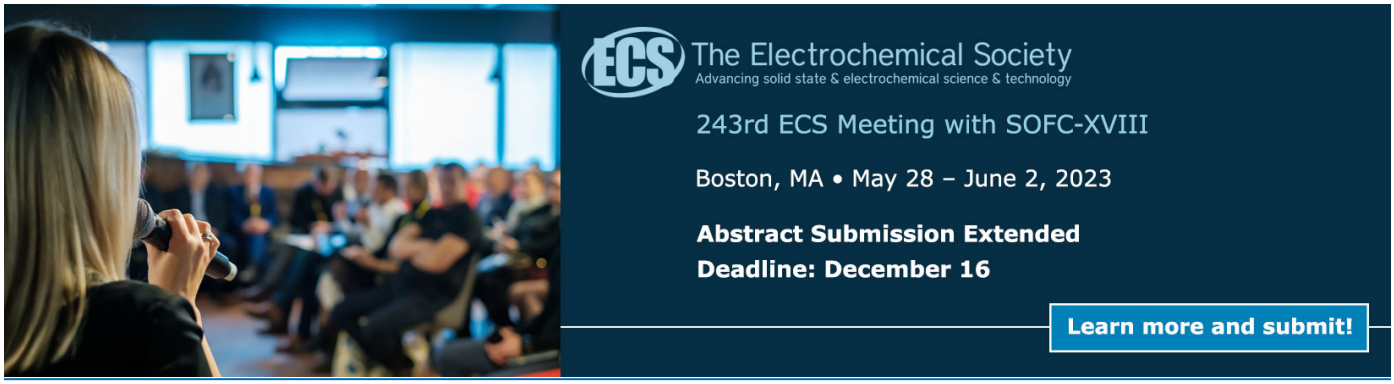

Phytoplankton diversity of Situmurun village, Toba Samosir regency, North Sumatera

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Abstract. Lake Toba is the largest lake in Indonesia located in Toba Samosir regency, North Sumatera. The lake is currently facing serious habitat exploitation due to anthropogenic activities in surrounding area. Effort to identify and assess the quality of freshwater bodies are conducted through assessment upon phytoplankton diversity. The aim of study was to identify the phytoplankton diversity at Situmurun village. The village is one of rural area in Toba Samosir regency, known as tourism spot for its Binangalom waterfall. The freshwater area of this village is still considered natural and free of human activities. List of phytoplankton taxa is presented. The study found 5 classes of phytoplankton grouped into 28 families with 33 species. Our result will be compared with overall phytoplankton diversity for assessing biological-based water quality in Lake Toba.

1. Introduction

Lake Toba is the largest lake in Indonesia, located at North Sumatera which lies about 955 m a.s.l. The lake covers an area of approximately 1,129,700 ha with an island in the middle, Samosir known as land of Toba Bataknese [1]. Lake Toba is currently utilized as Indonesia tourist spot, cultural-heritage building site, residential area and fishery management site. Water quality has changed gradually in recent years due to anthropogenic activities leading to variability of phytoplankton diversity or *vice versa* [2].

Several local and national studies have reported the gradual changes in water qualities of Lake Toba at specific sites. In 2004, a phytoplankton survey has been conducted to assess the water quality in Simanindo, an area of Lake Toba with no evidence of anthropogenic activities. The area was characterized as mildly to lightly contaminated based on physico-chemical data in accordance to its low phytoplankton diversity [3]. In contrary, human activities tend to increase number of phytoplankton species. In 2011, a phytoplankton diversity study was conducted at Parapat, a tourism site in Lake Toba resulted in abundant numbers and species of plankton collected from residential area [4]. In addition, floating net cage settlement in Lake Toba may also contribute to phytoplankton diversity due to high organic deposits into freshwater bodies [5].

Efforts to link phytoplankton diversity with water quality of Lake Toba have been reported in recent studies. In 2012, a high phytoplankton diversity was reported in relation to a very light contamination in water bodies of Ajibata and Pangaloan village located in Lake Toba [6]. In 2016, phytoplankton diversity is reported in low diversity indicating a bad quality of water bodies [7]. Phytoplankton density and diversity may be used as ecological indices to indicate water qualities in

specific locations [8]. In addition, spatial and temporal variability in phytoplankton assemblages were need to be comprehensively studied in order to reveal the overall water quality of Lake Toba [9].

This study is one part of comprehensive study in linking phytoplankton parameters (density, diversity and chlorophyll-a content) as biological indicators to physico-chemical characteristics of waters in Lake Toba sampled through spatial and temporal aspects. Here, we reported a list of phytoplankton taxa sampled from Situmurun village in Toba Samosir regency. Based on recent information and condition, the water bodies in the village is still considered natural with no human activities recorded.

2. Materials and Methods

2.1. Sampling site

Situmurun village is located in Simanindo district, Toba Samosir regency, North Sumatera province, Indonesia. Sampling points were representatively chosen randomly by plotting four points as stations around area. The sampling site coordinates were: Station 1 (N2^{0}32'52,6452" E 98^{0}58'21,8928"), Station 2 (N2^{0}32'52,6452" E 98^{0}58'21,8928"), Station 3 (N2^{0}32'52,6452" E 98^{0}58'21,8928"), and Station 4 (N2^{0}32'52,6452" E 98^{0}58'21,8928").

2.2. Phytoplankton sampling

Phytoplankton sampling was conducted using plankton net during the day on April 2018. Twenty-five litres of surface freshwater were sampled using 5 L bucket and filled into plankton net. Five replications of sampling were pooled into a 100 mL composite of freshwater samples. Lugol's iodine (1% w/v) was added into samples and stored in cold condition prior laboratory works.

2.3. Data analysis

Samples were carried to Laboratory of Ecology, Faculty of Mathematics and Natural Sciences for identification. Identification of phytoplankton were based on morphological images from available sources [10,11]. The phytoplankton taxa is listed in the order of Class, Family and Genera.

3. Results and discussion

The phytoplankton composition consists of 33 genera from five classes: Chlorophyceae, Cyanophyceae, Desmidiaceae, Diatomae and Xanthophyceae. A list of taxa is presented in Table 1. The resulting taxa is a compilation of four sampling stations in this study. Chlorophyceae is a dominant phytoplankton groups based on species composition (12 species) covering 36% of community followed by Diatomae with 11 species, Cyanophyceae with 7 species, Desmidiaceae with 2 species and Xanthophyceae with 1 species (Figure 1).

Table 1. List of phytoplankton taxa of Situmurun

Class	Family	Genera
Diatomae	Bacillariaceae	*Bacillaria*
		Denticula
	Coscinodiscaceae	*Coscinodiscus*
		Melosira
	Fragillariaceae	*Diatom*
		Tabellaria
		Fragilaria
		Synedra
	Nitzschiaceae	*Nitzschia*
	Naviculaceae	*Navicula*
	Pinnulariaceae	*Pinnularia*
Chlorophyceae	Haematococcaceae	*Chlorogonium*

	Mesotaeniaceae	*Gonatozygon*
	Chlorellaceae	*Gloeotila*
	Oocystaceae	*Closteriopsis*
	Ulotrichaceae	*Ulothrix*
	Zygnemataceae	*Zygnema*
	Volvocaceae	*Volvox*
	Oedogoniaceae	*Oedogonium*
	Chaetophoraceae	*Stigeoclonium*
	Palmellaceae	*Sphaerocystis*
	Chlorococcaceae	*Chlorococcum*
	Zygnemataceae	*Spirogyra*
Xanthophyceae	Tribonemataceae	*Tribonema*
Cyanophyceae	Chroococcaceae	*Chroococcus*
	Oscilatoriaceae	*Oscilatoria*
		Spirulina
	Nostocaceae	*Anabaena*
		Aphanizomenon
	Scytonemataceae	*Plectonema*
	Mycrocystaceae	*Microcystis*
Desmidiaceae	Peniaceae	*Closterium*
	Desmidiaceae	*Staurastrum*

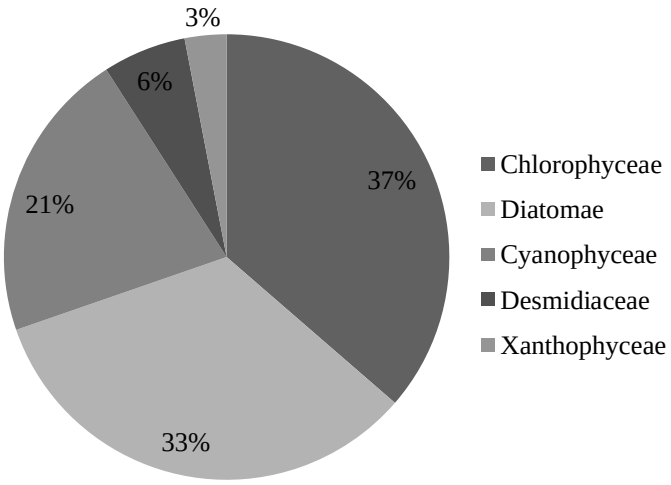

Figure 1. Percentage of species composition among phytoplankton groups

In lentic ecosystem such as lake and reservoir, two phytoplankton groups are commonly found i.e. Chlorophyceae and Cyanophyceae.[12]. Chlorophyceae or green algae is reported to numerous in high nutrients habitat leading to eutrophication. Diatomae presence in Lake Toba may be due to geohistorical phenomenon leading to the formation of diatomite deposits [13]. Other study also reported the dominance of species composition in Chlorophyceae in water reservoir of Cruzeta, Brazil that predominantly came from rainfall and natural nutrient cycle [14]. Compared to previous study, variability in species composition and group of phytoplankton was obvious in surrounding water bodies of Lake Toba. Seventy-nine species of phytoplankton were reported during a survey in 2004

which was also dominated by Chlorophyceae (32 species) [3]. However, we only found 12 species of Chlorophyceae which is lower than reported.

Two groups, i.e. Bacillariophyceae and Chlorophyceae are reported to harbor water bodies around Parapat, Lake Toba. Genus *Ulothrix* was reported to be a dominant species during the study [4]. Although we also found *Ulothrix* in this study, we were not able to present the density of each species. Density and diversity of phytoplankton will be further investigated to show the species-specific dominance within community.

Other study also reported four groups of phytoplankton, i.e. Cyanophyceae, Chlorophyceae, Desmidiaceae and Diatomae in other water bodies of Lake Toba (Ajibata and Pangaloan). The richest species composition is Diatomae with 18 species followed by Chlorophyceae with 15 species. In comparison, our results may be considered as less diverse than previously reported. A phytoplankton diversity study was also conducted around water bodies in Samosir island, Lake Toba. The study reported 35 genera from four classes, i.e. Cyanophyceae, Chlorophyceae, Bacillariophyceae and Dinophyceae [7]. Different from our results, we reported a new group, Xanthophyceae instead of Dinophyceae.

Lake Toba is officially reported to be inhabited by 8 phytoplankton groups, i.e. Bacillariophyceae, Chlorophyceae, Chrysophyceae, Dinophyceae, Euglenaphyceae, Myxophyceae, Rhodophyceae and Xanthophyceae [15]. To our understanding, the phytoplankton groups were only reported from four districts (Balige, Tambunan, Laguboti and Porsea) and further sampling efforts are needed as data improvement in the future. In general, certain species is found only in our study explaining the temporal and spatial differences of phytoplankton assemblages in Lake Toba. Other parameters like physico-chemical characteristics or abiotic factors are to be measured in relation to their presence in Situmurun as control area of our comprehensive study.

4. Conclusion

Five phytoplankton groups namely Chlorophyceae, Cyanophyceae, Bacillariophyceae, Desmidiaceae, and Xanthophyceae are found during a survey in Situmurun village, Lake Toba, North Sumatera. Chlorophyceae is the most speciose group followed by Diatomae in this study. Different results in terms of species composition and groups have been reported so far. A list of taxa presented from our results will be used as comparison in future study to evaluate the water quality based of phytoplankton communities in Lake Toba.

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