The Community Structure of Microalgae and Exploring its Potentially to Biofuel Producing in Ranu Grati, East Java Indonesia

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Abstract. Microalgae are microscopic autotrophic organisms which act as one of the biofuel-producing organisms. Ranu Grati is one of the volcanic lakes located in Pasuruan, East Java. Human activities around the waters are responsible for eutrophication of the water quality. The aim of this study was (1) described the profile of water quality and microalgae community structure, and (2) investigated microalgae potential as a producer of biofuels based on lipid content. Explorative research was carried out by taking a sample of water at a depth of 50 cm at 5 stations. Water quality parameters measured were DO, pH, BOD, TP, and TKN. Microalgae samples were taken by filtering 3 L of water using Plankton Nets. Plankton samples were identified and calculated using Haemocytometer. Furthermore, microalgae abundance, Important Value Index (IVI), diversity index, richness taxa, Evenness, and Richness index were determined. Species with the two highest IVI was determined the lipid levels use literature. The results showed that the waters of Ranu Grati had been contaminated with high organic matter (BOD levels 8.30-8.72 mg/L) with trophic status classified as mesotrophic to hypertrophic (TP 0.05-0.08 mg/L and TKN 0.23-0.32 mg/L). DO levels was high and have a range value 7.47-9.87 mg / L, while range of pH value 8.73-9.07. There were found 18 species of microalgae with varied 10-18 species in each station. Pollution status of Ranu Grati based on Shannon Wiener diversity index categorized as moderately polluted with range values 1.95-2.34. Value of microalgae evenness 0.77-0.86 indicated high uniformity with equally even distribution of species. Chlorella sp. and Scenedesmus sp. have the highest IVI and have a potential to produce biofuel with lipid levels 28 - 32% (dry weight) and 12-14% (dry weight) respectively.

1. Introduction
Lakes are ecosystems that has complex interactions, [1] for example between bacteria and microalgae [2].
The study of the structure of microalgae communities in Ranu Grati becomes important, because microalgae have various potentials and their lives are influenced by abiotic factors [2]. However, the profiles of the community structure microalgae in Ranu Grati lake remained unknown. In this study, the community structure microalgae was investigated in February, 2019.

Ranu Grati, a lake with an area of 198 H, is located in Pasuruan, East Java. In this study, physical and chemical factors are observed and the structure of the microalgae community is studied.

2. **Eksperimental Methods**

2.1. **Study site and sampling station**

Ranu Grati with various human activities around and on the lake, causing abundant microalgae. Sampling with “purposive random sampling”, with 5 stations, at a depth of 0.5 m (Figure 1.).

![Figure 1. Ranu Grati with five sampling station.](image)

2.2. **Microalgal samples collection**

Microalgal samples were collected from water at 5 stations in the lakes. Microalgae sampling using plankton nets. Precipitated in a centrifuge and then observed with a haemocytometer. The microalgal samples were calculated and identified.

2.3. **Analysis of physicochemical parameters of water**

The Kjeldahl method is used to calculate concentration the total N. The phosphorus molybdenum blue colorimetric method was used to determined the content of Dissolved Inorganic Phosphorus (DIP)[5][6]. Water transparency was determined in situ using the Disc method. The salinity measured using Refractometer ATAGO S-28E. Concentrations of DO (dissolved oxygen), temperature, and pH were measured using DO meter Lutron 5510 and pHmeter Lutron 5509 respectively[4].

2.4. **Data analysis**

The data obtained include phytoplankton abundance data, diversity index and uniformity index. Data is displayed and analyzed descriptively and presented in tables and graphs. Phytoplankton abundance is calculated in individual units per liter based on the equation according to APHA. Calculation of species diversity was carried out using the Shannon-Wiener formula at Parsons et al. 1977, Evenness Index (E) is a number that shows the level of uniformity of organisms in an ecosystem that is related to the number of individuals of each type and is related to the stability of environmental conditions in Odum, 1996[4].

3. **Results and Discussion**
The Biological Oxygen Demand (BOD) were around 8.30–8.72 mg/L and the pH was around 8.73 – 9.07. Light intensity was around 292-764 (x100 lux) (Table 1).

Table 1. Physicochemical Water Parameters of Ranu Grati Lake

| Station | DO (mg/L) | pH  | BOD mg/L | P mg/L | N mg/L | Light intensity (x100 lux) | Transparency (cm) |
|---------|-----------|-----|----------|--------|--------|---------------------------|------------------|
| 1       | 7.70      | 8.83| 8.34     | 0.08   | 0.32   | 292                       | 81               |
| 2       | 8.30      | 8.97| 8.30     | 0.07   | 0.25   | 457                       | 82               |
| 3       | 8.13      | 8.99| 8.43     | 0.07   | 0.23   | 764                       | 92               |
| 4       | 7.47      | 8.73| 8.58     | 0.05   | 0.26   | 626                       | 97               |
| 5       | 9.87      | 9.07| 8.72     | 0.06   | 0.31   | 333                       | 87               |

Some environmental factors were not significantly different in all stations, namely light intensity, temperature, and conductivity. While the brightness, pH and DO appear to differ markedly at several stations (Figure 2). This difference will affect the type and number of microalgae that grow in each station.

It revealed that pH, brightness and dissolve oxygen were responsible for most of the variation in station in the phytoplankton community. These environmental parameters play an essential role in the community structure variation of phytoplankton in the lakes. The strong association between phytoplankton community structure and ecological factors is varied in lakes[7].

Tabel 2. Diversity indexs, Evennes indexs and Taxa Richness

| Station | S  | R       | E        | H       |
|---------|----|---------|----------|---------|
| 1       | 10 | 0.696368| 0.907317 | 1.765558|
| 2       | 14 | 0.996808| 0.881597 | 2.029952|
| 3       | 12 | 0.925422| 0.84466  | 1.855908|
| 4       | 16 | 0.709256| 0.915933 | 1.782324|
| 5       | 18 | 0.934971| 0.854753 | 1.878084|

S = species, R=taxa richness, E=evennes indexs, H=diversity indexs

There were found 18 species of microalgae with varied 10-18 species in each station. Pollution status of Ranu Grati based on Shannon Wiener diversity index categorized as moderately polluted with range values 1.95-2.34. Value of microalgae evenness 0.77-0.86 indicated high uniformity with equally even distribution of species. (Figure 4)
Important value analysis (IVI) shows that predominant phytoplankton genera have high IVI, such as *Chlorella* sp. 41.2%, *Scenedesmus* sp. 32.2% (Figure 5). This value indicates that the five genera of phytoplankton have the most important role in their community. Thus, changes in the abundance of the five genera can affect all phytoplankton community structures in the waters.

**Conclusion**

The results showed that the waters of Ranu Grati had been contaminated with high organic matter with trophic status classified as mesotrophic to hypertrophic. Pollution status of Ranu Grati based on Shannon Wiener diversity index categorized as moderately polluted.
Value of microalgae evenness indicated high uniformity with equally even distribution of species. *Chlorella* sp. and *Scenedesmus* sp. have the highest IVI and have a potential to produce biofuel with lipid levels 28 - 32% (dry weight) and 12-14% (dry weight) respectively.

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