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# CHLOROPHYTA MICROALGA DIVERSITY IN MESAT RIVER LUBUK LINGGAU CITY, SOUTH SUMATERA PROVINCE, INDONESIA

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**Abstract:** The condition of the Mesat River in Lubuk Linggau City, Indonesia is not good, considering the large amount of waste from household activity. The purpose of this study is to analyse the diversity of microalgae in the Mesat River in Lubuklinggau City. This research paper used a survey method and was carried out between February and April 2020. Microalgae samples were collected at three stations along the Mesat River. Each station consisted of three water sampling points, to wit the left, middle, and right of the river. Water samples were taken three times, with a span of one week. Microscopic observation of the resulting microalgae for clear qualitative analysis was conducted. The results of the study found Chlorophyta microalgae which consisted of three classes, eight orders, 12 families, 15 genera and 19 species. Diversity index ranges between 0.98 and 1.27, which indicated that Chlorophyta is in the low diversity category. The evenness index value of Chlorophyta being 0.36 indicates that the community is in a depressed condition, but there is no dominance because the average value of the dominance index is 0.011. Abiotic factors measured in the Mesat River in this category is still reasonable and in accordance with second-class water quality standards. Overall, green algae diversity in the Mesat River was good, although the level of diversity was low.

Keywords: Chlorophyta, microalgae, diversity, Mesat River.

## Introduction

The Mesat River is located at Lubuk Linggau City in the South Sumatra Province of Indonesia has a length of approximately 10 kilometres with a width of between three and four metres and a depth of between one  and two metres, starting from the Mesat Jaya and Mesat Seni villages and ending at the Wirakarya Village. The flow of the Mesat River is influenced by the amount of household and industrial waste from the tofu and tempeh making process. The condition of the Mesat River will appear clear if the water flow is less, but if the water discharge is more, one will notice a lot of garbage in the river and the water is noticeably cloudy.

Lubuk Linggau City has several rivers, including the Kelingi River, Mesat River, Malus River, Kati River, and Kasie River. . Water pollution is the ingress and functioning of organisms, substances, energy, or other constituents of the air that degrades water quality and does not meet its designation (Government Regulation of the Republic of Indonesia Number 82 of 2001). Pollutants include pesticides, artificial fertilisers, garbage, oil spills and detergents (Thyagaraju, 2016; Bat *et al*., 2018). In addition to affecting water quality, it will also cause the ecosystem in these waters to be disturbed.

Microalgae can be found in fresh water and seawater, and are included in the types of photoautotroph living things (Mourelle *et al*., 2017; Coêlho *et al*., 2019). Algae acts as one of the ecological parameters that can provide an overview of water conditions and includes important biotic components in the metabolism of water bodies, because they are primary producers in the food chain of aquatic ecosystems (Prata *et al*., 2019;  Rasal *et al*., 2019). Chlorophyta has an important role in public waters as the main producers or phytoplankton. Chlorophyta converts inorganic compounds into organic compounds through photosynthesis thus becoming a food source for zooplankton and fish larvae (Kaparapu, 2018;

Lomartire *et al*., 2021). Some research has been done on Chlorophyta microalgae in the Kelingi River (Harmoko & Sepriyaningsih, 2018) and in the Kasie River (Harmoko & Sepriyaningsih, 2020). A study on microalgae in the Mesat River was carried out by (Harmoko *et al*., 2018), but is only limited to Lubuk Linggau Timur II District which found 17 Chlorophyta species. The purpose of this study was to analyze the diversity of microalgae in the Mesat River in Lubuklinggau City.

## Materials and Methods

### *Research Location and Time*

The study was conducted on the Mesat River in Lubuk Linggau Timur I District during February–April 2020. Microalgae samples were taken at three different stations depending on the river flow. The sampling location is shown in Figure 1.

Determination of stations refers to the research results of (Goldyn & Kippen, 2017) while various microhabitats offer different environmental conditions. Thus, we tested the effect of different habitat types typically found within small ponds on the microalgae and zooplankton communities. We found that submerged macrophytes have the strongest impact on microalgae and zooplankton communities out of all the analysed habitats. Some epontic diatoms (e.g. Fragilaria dilatata, Cymbella affinis, which was based on differences in the environment around the river, station 1 is near a bridge which has shallow water characteristics, station 2 is near houses that has characteristics of deep water with garbage along the water flow, and station 3 is near a rubber plantation. which has a tree-covered water flow. Sampling was carried out three times.

### *Sample collection*

Sampling was carried out in the morning, one station consists of three points, namely the right bank, left bank, and the middle of the river. The water quality parameters measured consisted of temperature (stem thermometer, acidity (pH meter Risantec brand), dissolved oxygen (DO meter Lutron DO-5510), and water clarity (Secchi disk). Water samples were taken using a plankton net with a mesh size of 20, to filter 5L of river water. 10ml of stored water was then transferred to a bottle and four drops of alcohol were added.


Figure 1: Sampling Locations on the Mesat River Mesat River Lubuklinggau City, South Sumatera Province, Indonesia

***Data collection***

The observation of river water samples using an Olympus CX 22 binocular microscope with 400× magnification was done at the University PGRI Silampari Biology Laboratory. Observations were made by taking water samples with a dropper pipette (one drop of about 0.05ml) and made up to five observations. The Chlorophyta samples obtained were then photographed for further identification and analysis. Identification of Chlorophyta microalgae species was done with reference to a book by (Bellinger & Sigee, 2010; Wehr & Sheath, 2003).

***Data analysis***

The diversity index was calculated using the Shannon-Wiener formula (Odum, 1971), namely:

$$\mathrm{H'} = -\sum_{i=1}^{S} \mathrm{pi} \ln \mathrm{pi}$$

information:
H' = diversity index
pi= ni/N
ni = number of species i
N = total number of species
S = number of species in the sample

The criteria for diversity are as follows: H'≤ 2: "Small diversity", 2 < H'≤ 3: "Medium diversity", and H' > 3: "High diversity".

The dominance index is calculated according to (Odum, 1971), as follows:

$$C = \sum_{i=1}^{S} (pi)^2$$

information:
C = dominance index
pi = proportion of the ith species
S = number of species found

The dominance index values were grouped into 3 criteria, namely: 0 < C 0.5 : "Low dominance", 0.5 < C 0.75 : "Medium dominance", and 0.75 < C 1: "High dominance".

The evenness index was calculated according to (Odum, 1971), as follows:

$$E = \frac{H'}{\ln S}$$

information:
E = evenness index
H'= species diversity index
S = number of species found

Evenness index values were categorised as follows: 0 < E 0.5 : "Community is depressed", 0.5 < E 0.75 : "Community is unstable", and 0.75 < E 1 : "Community is stable".

**Results and Discussion**

Chlorophyta microalgae found in the Mesat River consisted of three classes, six orders, 11 families, 15 genera, and 19 species, Table 1.

The species of microalgae Chlorophyta are *Draparnaldia* sp., *Stigeoclonium lubricum*, *Chlamydomonas* sp., *Chlorococcum* sp., *Eudorina* sp., *Volvox* sp., *Pediastrum duplex*, *Pediastrum simplex*, *Tetraedron* sp., *Coelastrum* sp., *Scenedesmus armatus*, *Scenedesmus dimorphus*, *Scenedesmus quadricauda*, *Ankistrodesmus* sp., *Chlorella pyrenoidosa*, *Chlorella vulgaris*, *Oocystis* sp., *Rhizoclonium* sp., and *Ulothrix* sp.

Chlorophyceae has the highest number of species, namely 14 species (74%), then Trebouxiophyceae class 3 (16%) and Ulvophyceae class 2 species (10%). The percentage composition of microalgae species can be seen in Figure 2.

The composition of microalgae species based on the sampling location, namely station 1 has the highest composition with 45%, then station 2 with a value of 33% and finally station 3 with a value of 22%. The composition of microalgae by station can be seen in Figure 3.

The results of the analysis of the diversity, dominance, and evenness of Chlorophyta microalgae in the Mesat River are shown in Table 2.

Chlorophyta diversity in all stations was in the low category with the highest diversity index found at Station 1 of 1.27, while at Station 2 of 0.98, it was the lowest. The dominance

Table 1: Recapitulation of Microalgae Types in Mesat River Lubuklinggau City, South Sumatera Province, Indonesia

| No. | Class | Order | Family | Genera | Species |
|---|---|---|---|---|---|
| 1 | Chlorophyceae | Chaetophorales | Chaetophoraceae | Draparnaldia | *Draparnaldia* sp. |
| 2 | | | | Stigeoclonium | *Stigeoclonium lubricum* |
| 3 | | Chlamydomonadales | Chlamydomonadaceae | Chlamydomonas | *Chlamydomonas* sp. |
| 4 | | | Chlorococcaceae | Chlorococcum | *Chlorococum* sp. |
| 5 | | | Volvocaceae | Eudorina | *Eudorina* sp. |
| 6 | | | | Volvox | *Volvox* sp. |
| 7 | | Sphaeropleales | Selenastraceae | Ankistrodesmus | *Ankistrodesmus* sp. |
| 8 | | | Hydrodictyaceae | Pediastrum | *Pediastrum duplex* |
| 9 | | | | | *Pediastrum Simplex* |
| 10 | | | | Tetraedron | *Tetraedron* sp. |
| 11 | | | Scenedesmaceae | Coelastrum | *Coelastrum* sp. |
| 12 | | | | Scenedesmus | *Scenedesmus armatus* |
| 13 | | | | | *Scenedesmus dimorphus* |
| 14 | | | | | *Scenedesmus quadricauda* |
| 15 | Trebouxiophyceae | Chlorellales | Chlorellaceae | Chlorella | *Chlorella pyrenoidosa* |
| 16 | | | | | *Chlorella vulgaris* |
| 17 | | | Oocystaceae | Oocyst | *Oocystis* sp. |
| 18 | Ulvophyceae | Cladophorales | Cladophoraceae | Rhizoclonium | *Rhizoclonium* sp. |
| 19 | | Ulotrichales | Ulotrichaceae | Ulothrix | *Ulothrix* sp. |

index value at all stations was also in the low category which indicates that if the dominance index value (C) is close to zero, then there is no dominant biota in the water. The highest evenness index value at Station 1 was 0.42 and the lowest at Station 2 of 0.32 was included in the "depressed community" category. The smaller the uniformity index, the smaller the uniformity of the population, which proves that the distribution of the number of individuals of each species is not the same, so there is a tendency for one type of population to dominate. The higher the homogeneity value, the more descriptive the number of populations of the organisms in each species is either the same or not significantly different.

Measurements of temperature, dissolved oxygen, acidity, and clarity in the Mesat River are shown in Table 3.

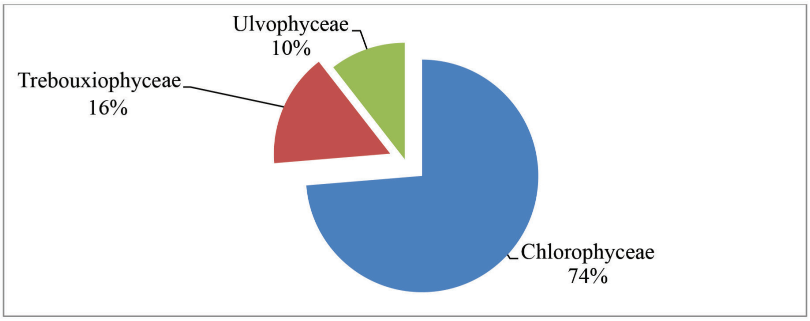


Figure 2: Percentage Composition of Microalgae Species in Mesat River Lubuklinggau City, South Sumatera Province, Indonesia

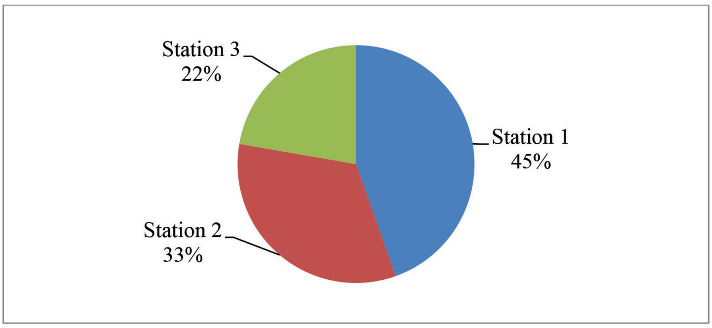


Figure 3: Percentage of Microalgae Composition By Station in Mesat River Lubuklinggau City, South Sumatera Province, Indonesia

Table 2: Diversity, Dominance and Eveness Of Microalgae Species in Mesat River Lubuklinggau City, South Sumatera Province, Indonesia

| No. | Component | Station 1 | Station 2 | Station 3 | Mean | Std. deviation |
|---|---|---|---|---|---|---|
| 1 | Diversity | 1.27 | 0.98 | 1.04 | 2.35 | 0.22 |
| 2 | Dominance | 0.01 | 0.008 | 0.006 | 0.11 | 0.01 |
| 3 | Eveness | 0.42 | 0.32 | 0.34 | 0.79 | 0.07 |

Table 3: Abiotic Factors in Mesat River Lubuklinggau City, South Sumatera Province, Indonesia

| No. | Component | Station 1 | Station 2 | Station 3 | Mean | Std. deviation |
|---|---|---|---|---|---|---|
| 1 | Temperature (°C) | 27.2 | 26.5 | 26.8 | 26.83 | 0.35 |
| 2 | Dissolved Oxygen (mg/L) | 4.6 | 4.2 | 4.5 | 4.43 | 0.20 |
| 3 | Acidity | 6.7 | 6.6 | 6.6 | 6.63 | 0.05 |
| 4 | Clarity (cm) | 16.3 | 22 | 17.5 | 18.60 | 3.00 |

Dissolved oxygen levels and pH still meet water quality standards in accordance with Government Regulation No. 82 of 2001. Dissolved oxygen belongs to class II, namely with a value of 4 mg/L, acidity or pH is included in all classes, both classes I–IV with values between 6 and 9. The clarity as measured by the Secchi disk and the water temperature as measured by the thermometer in the regulations are not clearly written as to what the standard numbers should be.

The number of species of Chlorophyta microalgae found in the Mesat River was 19 species. Based on Table 1, the highest diversity index is at Station 1 with a value of 1.27 and the lowest is at Station 2 with a value of 0.98. The diversity index, which ranged from 0.98–1.27 is considered low, because according to (Odum, 1971) the criteria for diversity is as follows: H'≤ 2: "Small diversity", 2 < H'≤ 3: "Medium diversity", and H' > 3: "High diversity".

Species diversity in a waters can provide information about the level of pollution of the water (Chen *et al*., 2019; Nabi *et al*., 2019). The diversity index value (H') ranged from 0–3. The level of diversity will be high if the value of H' is close to 3, which indicates good water conditions. Conversely, if the value of H' is close to 0 then the diversity is low and the water conditions are not good (Odum, 1971).

The highest dominance index is Station 1 with a value of 0.019 and the lowest was at Station 3 with a value of 0.006. The dominance index is used to see the most common species found in a habitat and describes the presence of the dominant species (Li *et al*., 2021; Lin *et al*., 2021). The dominance of Chlorophyta microalgae is included in the criteria for low dominance 0 < C 0.5 (Krebs, 2001). Based on this, in general in the Mesat River during the study there was no dominant species in the Chlorophyta microalgae community. However, there are species that are often found, namely from the Genera Chlorella.

The highest evenness index value (0.42) is at Station 1 which is included in the medium criteria and the lowest (0.32) is at Station 2 is included in the low criteria. The level of evenness of species is a description of the distribution of individuals in the community (Engel *et al.,* 2020). Most Chlorophyta are autotrophs meaning they can synthesize food directly from inorganic compounds (Calbet *et al*., 2014; Khalili *et al*., 2020). If environmental conditions are favourable, Chlorophyta will grow rapidly which can fill water bodies and cause an algae population explosion (Odufuwa & Ajaba, 2019; Chaffai *et al.,* 2022).

The average temperature in the Mesat River is 26.9°C, dissolved oxygen content is 4 mg/L, water pH is 6.7 and clarity is 18.63 cm (Table 3). The presence of Chlorophyta in waters will vary depending on water quality conditions which are grouped into physical and chemical factors (Gil-Guarín *et al*., 2020; Pala *et al*., 2021). Temperature is one of the environmental factors that greatly affects the life of aquatic organisms, including microalgae (Harmoko & Krisnawati, 2018). The Mesat River temperature range is ideal for microalgae growth, the optimum temperature limit for microalgae growth as found in several previous studies, is around 20–30°C (Singh & Singh, 2015; Corredor *et al*., 2021; Soriano *et al*., 2021).

The highest dissolved oxygen level in the Mesat River is at Station 1 was 4.59 mg/L and the lowest is at Station 2 with a value of 4 mg/L. The average dissolved oxygen level in the Mesat River was 4.46 mg/L, when adjusted for the dissolved oxygen criteria by (Young *et al*., 2014), indicating the criteria for not being considered polluted. This can be seen from the condition of the Mesat River which is still clean, but during the rainy season there is a lot of garbage and it gets cloudy. Based on PP No. 82 of 2001 for the DO and pH parameters of water in the Mesat River it is classified as class II. Water in class II criteria is water that can be used for water recreation facilities/infrastructure, freshwater fish farming, agriculture, animal husbandry, and other uses requiring water quality equivalent to those specified.

The pH value in the Mesat River ranged from 6.6 to 6.7. Organisms have different tolerance limits to acidity, most natural waters have acidity ranging from 6-9 (Ying *et al*., 2014; Furuhashi *et al*., 2019). Based on this, the Mesat River has a pH that is within the normal range, so that microalgae can grow well.

Clarity with a value of 18.63 cm is included in the cloudy category. This is in accordance with (Arthington *et al*., 2006), namely cloudy waters if the clarity value is between 0.25 and 1 m. If the water clarity is less than 25 cm, it can endanger the life of plankton because photosynthesis is inhibited (Buchanan, 2020) taxonomic composition, biomass. High turbidity inhibits the penetration of sunlight in the photosynthesis process of phytoplankton and can cause siltation. Penetration of light into the water is influenced by the intensity and angle of incidence of light, water surface conditions, and dissolved and suspended materials in the water (Atta *et al*., 2013).

Chlorophyta microalgae found in the Mesat River in Lubuklinggau City found 19 species and included many categories when compared to previous studies. In the Kelingi River, Lubuklinggau City, 15 species of chlorophytic microalgae were found (Harmoko & Sepriyaningsih, 2018) while in the Kasie River, 9 types of chlorophyta were found (Harmoko & Sepriyaningsih, 2020). This difference is caused by different river conditions, the Mesat River is a river that is polluted with organic waste, causing the presence of quite a lot of chlorophyta.

## Conclusion

Microalgae Chlorophyta found in the Mesat River includes 3 classes, 6 orders, 11 families, 15 genera and 19 species. The Mesat River has a diversity of Cholophyta microalgae in a small category with a low level of dominance and the Genera that is often found in the Mesat River is Chlorella. This research can be used as data for related services, management and protecting the environment in the Mesat river in Lubuklinggau city, considering that Chlorophyta is one the reasons that algae blooms in the water.

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