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Plankton diversity in the Rowo Klampok Swamp, Malang District, East Java, Indonesia

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Abstract. *Arfiati D, Zakiyah U, Anitasari S, Inayah ZN, Orchida K, Pratiwi RK. 2024. Plankton diversity in the Rowo Klampok Swamp, Malang District, East Java, Indonesia. Biodiversitas 25: 1846-1855.* Wetlands are a productive ecosystem and have high biodiversity, including plankton. Plankton can be used to assess the health status of wetlands. This research aims to determine the diversity and abundance of phytoplankton and zooplankton and to analyze the water quality conditions of the tropical wetland (Rowo Klampok Swamp, Malang District, East Java, Indonesia). This research was conducted from May to June 2023 and it's a survey research. The research results show that the phytoplankton found in Rowo Klampok Swamp consists of 4 divisions with 13 genera, while there are 3 divisions with 3 genera in zooplankton. Phytoplankton divisions are Bacillariophyta, Chlorophyta, Cyanophyta, and Dinoflagellate, while zooplankton divisions are Arthropoda, Ciliophora, and Rotifera. The average value of total phytoplankton abundance reached 2,618,684 cells/L, while zooplankton was 10,504 Ind/L. The Chlorophyta division is the most commonly found phytoplankton, with a percentage ranging between 32.5 and 53.1%, respectively. *Dictyosphaerium* is a phytoplankton genus often found with the highest average abundance of 1,922,929 cells/L. The diversity index, uniformity index, and dominance index of phytoplankton ranged between 1.965-2.439, 0.945-1.173, and 0.125-0.213, respectively, while those of zooplankton were 0.496-0.529, 0.317-0.593 and 0.458-0.684, respectively. Rowo Klampok Swamp has a medium trophic level (mesotrophic) and shows moderate pollution. The water quality conditions are considered suitable for aquatic organisms, but we need to monitor and reduce phosphorus input into the bodies of water.

Keywords: Bioindicator, diversity, plankton, water quality, wetland

INTRODUCTION

Wetlands are an ecosystem that has high biodiversity (Kahsay et al. 2022). In general, wetlands are defined as areas of marsh, bog, peatland, or water, whether natural or artificial, permanent or temporary, with water that is still or flowing, fresh, brackish, or salty, with a depth of low tide not exceeding six meters, and providing various ecosystem services to humanity on all continents (Gopal 2015; Apriadi et al. 2018; Hasan et al. 2023). This area is one of the most productive ecosystems in the world, comparable to rainforests and coral reefs (Adebayo et al. 2021). The diversity of planktonic collections is one of the life support systems of wetland ecosystems (Prasertsin and Peerapornpisal 2018; Chen et al. 2024).

Rowo Klampok Swamp is one of the wetlands in Malang District, East Java Province, Indonesia. This wetland requires more attention to be managed because it has not been explored much. These waters provide an ideal habitat for various aquatic organisms, including plankton, which have not yet been fully discovered in Rowo Klampok Swamp. However, the area around Rowo Klampok is a residential, agricultural, and water area used for tourism (Maheta et al. 2020; Supriadin et al. 2022). The presence of anthropogenic activities around and in the wetland produces domestic waste, which can result in wetland degradation. As a result, these direct and indirect causes of wetland degradation ecosystem-function change (Ballut-Dajud et al. 2022). Even though they provide many environmental benefits, wetlands are an ecosystem vulnerable due to changes in the surrounding environment (Carabal et al. 2024).

The ecological status of a wetland ecosystem can be seen through plankton diversity. Plankton are microscopic organisms floating in water bodies (Xin et al. 2023). Plankton is the primary producer that contributes greatly to the productivity of water bodies and is one of the strong community structures supporting wetlands through the food chain (Xiao et al. 2020). Changes in environmental quality conditions can result in changes in the composition and structure of plankton communities. Plankton (phyto-plankton and zooplankton) can be used as bioindicators of water quality because they can respond quickly to environmental changes and pressures (Kostryukova et al. 2021; Muñoz-Colmenares et al. 2021). The sensitivity of plankton and changes in its composition prove a change in the ecosystem. Species diversity responds to environmental changes and can characterize various interactions that shape community structure patterns (Lomartire et al. 2021; Febriansyah et al. 2023). Plankton community structure can reflect the health status of aquatic ecosystems and serve as a guide for management (Chandran et al. 2021). Therefore, studying plankton community structure is beneficial for

protecting wetland ecological environments (Tao et al. 2023).

They consist of phytoplankton and zooplankton, important ecological groups in wetland ecosystems (Zhikharev et al. 2023). Phytoplankton, a significant source of organic carbon (Halsey et al. 2017), plays a role in the energy transfer process in aquatic ecosystems because it is the primary producer in the food chain (Lin et al. 2021). The community structure of the phytoplankton reflects the conditions of the aquatic environment due to its short growth cycle and the rapid response of phytoplankton to its environment (Miao et al. 2019; Ridwan et al. 2022). Phytoplankton is the main food source for zooplankton and other aquatic organisms in most freshwater habitats (Gogoi et al. 2021). Zooplankton acts as the first consumers, so they play an important role in the process of transferring energy from low to high-level organisms in aquatic ecosystems (Dorche et al. 2018) and controlling the growth of phytoplankton as primary producers (Belfiore et al. 2021). The structure of zooplankton communities is determined by the composition and abundance of phytoplankton and their predators (Liu et al. 2023). The diversity and density of zooplankton are also influenced by nutrients and aquatic abiotic variables such as dissolved oxygen (Odulate et al. 2017). Phytoplankton and zooplankton are good bioindicators for measuring water quality in aquatic systems because of their indispensable role and vulnerability to various ecological pressures (Setyono and Himawan 2018; Mohanty et al. 2023). Plankton community composition varies depending on water quality conditions, including temperature, light intensity, nutrient availability, and other limnological factors in the wetland (Ramlee et al. 2022).

Information regarding the diversity and composition of phytoplankton and zooplankton in Rowo Klampok Swamp is still limited due to a lack of attention to the management of this wetland. This research aims to identify the types, diversity, and abundance of phytoplankton and zooplankton in the Rowo Klampok Swamp wetland. Regulating the ecological conditions of Rowo Klampok Swamp due to the many activities around it is a top priority. Therefore, it is important to assess the biodiversity of phytoplankton and zooplankton in the wetland, as this will serve as a biological indicator to determine the ecological status of the research site. We predict that this research will be beneficial for the management and conservation of Rowo Klampok Swamp to protect and balance the ecosystem. The results of this research can be used as basic data to determine the environmental conditions of Rowo Klampok through the diversity and abundance of plankton found.

MATERIALS AND METHODS

The study area

This research was conducted in a tropical freshwater wetland in Rowo Klampok Swamp, Senggreng Village, Sumberpucung District, Malang District, East Java, Indonesia. This swamp location is at 112º30'30" E to 112º30'50" E and 8º9'30"S to 8º9'60"S. Rowo Klampok Swamp has a water catchment area of around 18 ha. Sampling was carried out in May-June 2023. This is survey research conducted in the field. The selection of sampling locations was based on purposive sampling. There are 4 Sampling Points (SP), which can be seen in Table 1 and Figure 1. Sampling was carried out in 3 repetitions with an interval of 7 days.

Table 1. Sampling point in Rowo Klampok Swamp, Malang District, East Java, Indonesia

Sampling point	Coordinates	Land Use
1	8°09’48” S and 112°30’35” E	Residential area
2	8°09’45” S dan 112°30’36” E	Tourist area
3	8°09’42” S dan 112°30’40” E	Forest areas and dense areas of riparian vegetation
4	8°09’39” S and 112°30’41” E	Rice field area

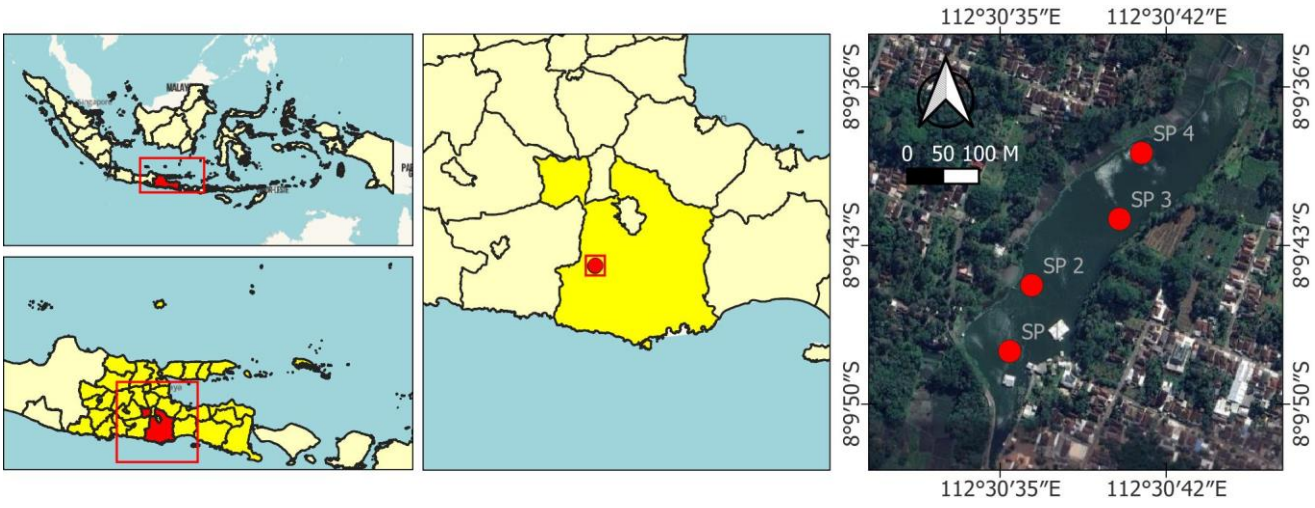

Figure 1. Research location map showing sampling points in Rowo Klampok Swamp, Malang District, East Java, Indonesia

The waters of Rowo Klampok Swamp are used for aquaculture, irrigating surrounding rice fields and as a tourist attraction. The area around sampling point 1 is densely populated residential. The second sampling point is a tourist area where there is the Rowo Klampok Floating Cafe, fishing spot and boat rental. Forest areas and areas of dense riverside vegetation are found in sp 4, where the waters are shaded by the surrounding vegetation. while SP 4 is located around the rice farming area. Overall, the waters of the Rowo Klampok Swamp look clear.

Sample collection

Plankton sampling was done by filtering 25 L of water using a plankton net (mesh size 25 µm). Filtered plankton samples (33 mL) were preserved directly using 1% lugol and 1-2% formalin (Guo et al. 2022).

Laboratory analysis

Laboratory analysis is carried out to identify and calculate the genus of phytoplankton and zooplankton found. Observations were carried out using an Olympus binocular microscope with an eyepiece magnification of 40 x. The phytoplankton and zooplankton found were counted based on the Lackey Drop Micro Transect Counting method (Lackey 1938) and documented. Phytoplankton genus identification uses the identification guidebooks Prescott (1954), Davis (1955), Bellinger and Sigee (2010), while zooplankton uses Suthers and Rissik (2009) and Dang et al. (2015).

Measurement of environmental parameters

Rowo Klampok water quality conditions were measured in situ and ex-situ. Temperature, water clarity, pH, and dissolved oxygen are in situ. These measurements are carried out in the morning at around 9.00 to 10.00 am. Temperature and DO were measured using a DO meter (Lutron PDO-520), water transparency (local Secchi disk), and pH using pH paper (Ref 921 10, pH-Fix 0-14, Macherey-Nagel, Düren, Germany). Meanwhile, nitrate, orthophosphate, ammonia, and total organic matter were measured ex-situ. We took 600 mL of swamp water samples. Nitrate, orthophosphate, and ammonia were measured using a spectrophotometer (Genesys 10S UV-Vis Spectrophotometer, Thermo Scientific, US), while total organic matter was measured using the $KMnO_4$ titration method. The results of water quality measurements can be used to support the plankton data obtained and determine the health condition of the water bodies in Rowo Klampok Swamp.

Data analysis

Phytoplankton and zooplankton data processing was carried out using Microsoft Excel 2016 software. The obtained data were used to calculate the abundance, diversity index, uniformity index, and dominance index.

Plankton abundance

The abundance of aquatic plankton was determined using the formula (Muhtadi et al. 2020) as follows:

$$N = \frac{T \times V \times \mathrm{P}}{L \times v \times p \times W}$$

Where: N: Plankton abundance (cell/l atau ind/L), P: Number of plankton found (cell or individual), T: Cover glass area (mm^2), V: The Volume of the water sample (mL), L: Field of View area (mm^2), v: The Observed volume of water (mL), p: Number of Field of View, W: Filtered water volume (L)

Diversity index

The Shannon-Weaver Diversity Index was used to determine the plankton diversity index (Shannon dan Weaver 1949; Odum 1971; Manickam et al. 2020). The calculation is as follows:

$$H = -\sum_{i=1}^{S} pi \; log_2 \; pi \; ; \qquad \text{Which: } pi = \frac{n_i}{N}$$

Where: *H*: Diversity index, n_i: Number of individuals-i, *N*: Total number of individuals in the sample

The diversity index criteria are as follows:

$H < 1$: low diversity
$1 < H < 3$: moderate diversity
$H > 3$: high diversity

Uniformity index

The uniformity index indicates the evenness of the species (Odum 1971; Susilowati et al. 2023). The uniformity index was calculated using the following formula:

$$e = \frac{H}{H_{max}}; \qquad \text{Which: } H_{max} = log_2 \; S$$

Where: *e*: Uniformity index, *H*: Diversity index, *S*: Number of species

The uniformity index value (*e*) ranges from 0 to 1. Values 0 to 0.4 indicate low uniformity, values 0.4 to 0.6 indicate moderate uniformity, and values 0.6 to 1.0 indicate high uniformity.

Dominance index

The dominance index is calculated to determine the type of plankton that dominates. The dominance index uses the Simpson Dominance Index formula (Simpson 1949; Magurran 1955; Margalef 1978; Odum 1971), as follows:

$$C = \sum_{i=1}^{s} pi^2 \; ; \qquad \text{Which: } pi = \frac{n_i}{N}$$

Where: *C*: Dominance index, *ni*: Number of individuals-i, *N*: Total number of individuals in the sample

The dominance index value ranges from 0 to 1. If the C value is close to 0, there are no dominant species; conversely, a C value closer to 1 means that there is a dominant species. The greater the dominance index value indicates that the diversity is low.

RESULTS AND DISCUSSION

Plankton composition

The phytoplankton in Rowo Klampok Swamp consists of 4 divisions: Bacillariophyta, Chlorophyta, Cyanophyta, and Dinoflagella. Bacillariophyta consists of 13 genera, namely *Coscinodicus*, *Cyclotella*, *Eunotia*, *Frustulia*, *Gomphonema*, *Gyrosigma*, *Leptocylindrus*, *Navicula*, *Nitzschia*, *Odontella*, *Pinnularia*, *Skeletonema*, and *Synedra*. In the Chlorophyta division, 11 genera were also found, namely *Actinastrum*, *Chlorella*, *Chlosterium*, *Dictyosphaerium*, *Haematococcus*, *Pandorina*, *Pediastrum*, *Phacus*, *Oocystis*, *Scenedesmus*, and *Straurastrum*. The Cyanophyta division comprises three genera: *Anabaena*, *Chroococcus*, and *Merismopedia*. In the Dinoflagellate division, one genus was found, namely *Peridinium*. The zooplankton found in Rowo Klampok Swamp consists of 3 divisions with 1 genus each, namely *Copepoda* (Arthropoda division), *Heliozoa* (Ciliophora division), and *Brachionus* (Rotifera division). Images of phytoplankton and zooplankton found in this research can be seen in Figure 4.

Abundance of plankton

The average value of the total abundance of phytoplankton and zooplankton can be seen in Figure 2. Phytoplankton has a higher abundance than zooplankton. The abundance and number of phytoplankton genera are higher than those of zooplankton because phytoplankton is the foundation of the aquatic food chain. Phytoplankton as primary producers must be more abundant than consumers (zooplankton) (Wahyuni et al. 2022). Phytoplankton reached an average total abundance value of 2,618,684 cells/L (SP 4), while zooplankton was 10,504 ind/L (SP 4). The highest abundance of phytoplankton and zooplankton was found at sampling point 4. We analyzed that this could happen because SP 4 is located close to the rice field area, which can contribute nutrients from fertilizer; farmers use phosphorus (P) fertilizer to increase crop yields in rice fields. The application of fertilizer can enter water bodies through runoff and leaching, which can be a limiting factor for phytoplankton growth (Zhou et al. 2022). The abundance of phytoplankton is closely related to the nutrient content in the water; the abundance of phytoplankton will increase along with the increase in nutrient content (Palupi et al. 2023). According to Kovalenko et al. (2023), phytoplankton are a food supply for zooplankton, so an increase in phytoplankton abundance can lead to an increase in zooplankton abundance.

Based on the phytoplankton division, Chlorophyta is the most commonly found phytoplankton, with a percentage ranging from 32.5 to 53.1%, followed by Bacillariophyta with a percentage from 31.4 to 43.2% (Figure 3). The Chlorophyta division was high at sampling points 1, 2, and 4, while at sampling point 3, the Bacillariophyta division was higher. Bacillariophyta, Chlorophyta, and Cyanophyta are phytoplankton communities often found in wetlands, whose community structure closely reflects environmental conditions (Li et al. 2022). Chlorophyta and Cyanophyta are phytoplankton types that reproduce quickly when there is an increase in organic matter, so the quality of the aquatic environment is unstable (Yunandar et al. 2020). Water bodies dominated by Chlorophyta and Bacillariophyta are mesotrophic, whereas those dominated by Cyanophyta are eutrophic (Pratiwi et al. 2020).

Ciliophora is a zooplankton division mostly found at sampling points 1, 3, and 4, while the lowest is at sampling point 2. This is because the relative abundance at sampling point 2 is more Arthropods and Rotifera, which have the same percentage, namely 40%. The relative abundance of zooplankton found in Rowo Klampok Swamp can be seen in Figure 5. The three zooplankton divisions we found are zooplankton commonly found in freshwater. *Heliozoa* (Ciliophora) is a zooplankton commonly found in mesotrophic water that utilizes algae such as diatoms, Chrysophyta, and Cyanophyta as food (Siver and Lott 2023). Rotifera are a group of zooplankton commonly found in tropical freshwater wetlands. The dominant presence of rotifers is generally related to pollution indicators in the aquatic environment, especially the Brachionus genus (Singh et al. 2021). The percentage of zooplankton divisions found in Rowo Klampok Swamp can be said to be balanced, thus indicating fairly good water.

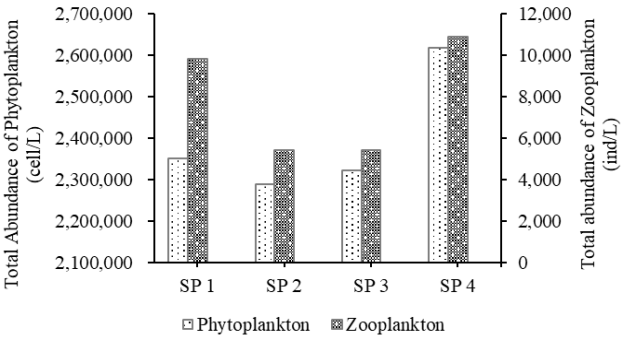

Figure 2. Total abundance of phyto-and zooplankton in freshwater wetland tropical area of Rowo Klampok Swamp, Malang District, East Java, Indonesia

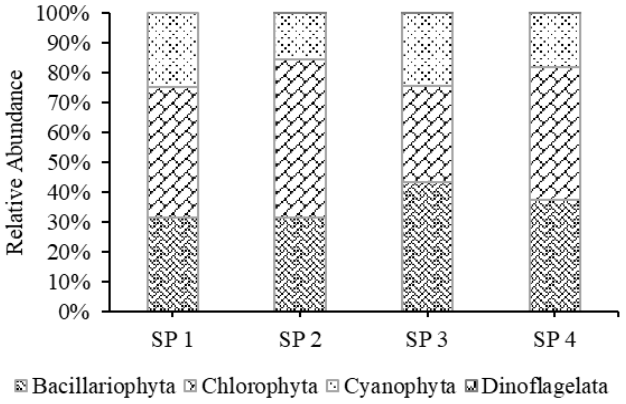

Figure 3. Mean relative abundance of phytoplankton based on division in freshwater wetland tropical area of Rowo Klampok Swamp, Malang District, East Java, Indonesia

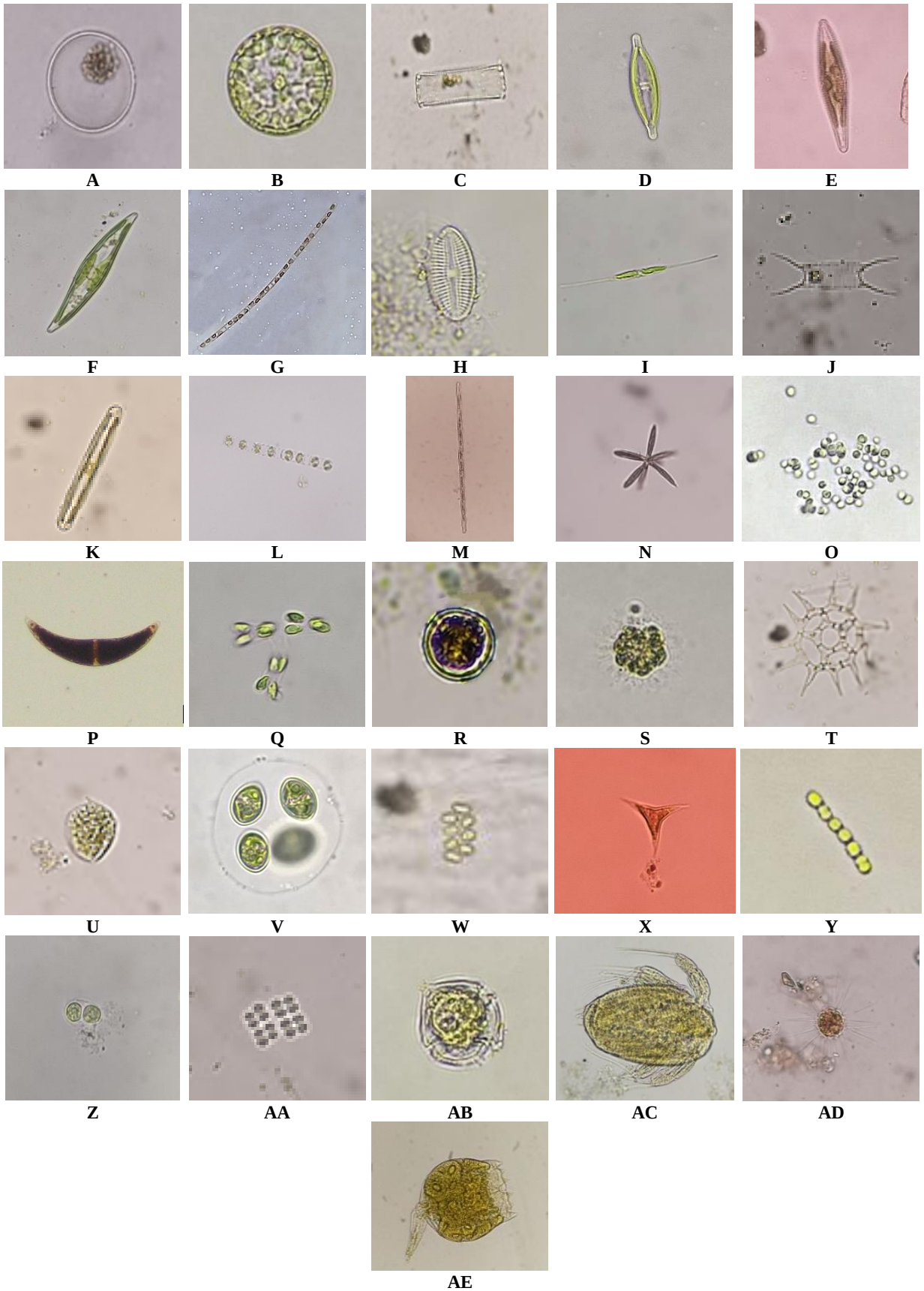

Figure 4. A genus of plankton found in the water body of Rowo Klampok Swamp, Malang District, East Java, Indonesia; Phytoplankton, A. *Coscinodicus*, B. *Cyclotella*, C. *Eunotia*, D. *Frustulia*, E. *Gomphonema*, F. *Gyrosigma*, G. *Leptocylindrus*, H. *Navicula*, I. *Nitzschia*, J. *Odontella*, K. *Pinnularia*, L. *Skeletonema*, M. *Synedra*, N. *Actinastrum*, O. *Chlorella*, P. *Chlosterium*, Q. *Dictyosphaerium*, R. *Haematococcus*, S. *Pandorina*, T. *Pediastrum*, U. *Phacus*, V. *Oocystis*, W. *Scenedesmus* X. *Straurastrum*, Y. *Anabaena*, Z. *Chroococcus*, AA. *Merismopedia*. AB. *Peridinium*; Zooplankton, AC. *Copepoda*, AD. *Heliozoa*, and AE. *Brachionus*

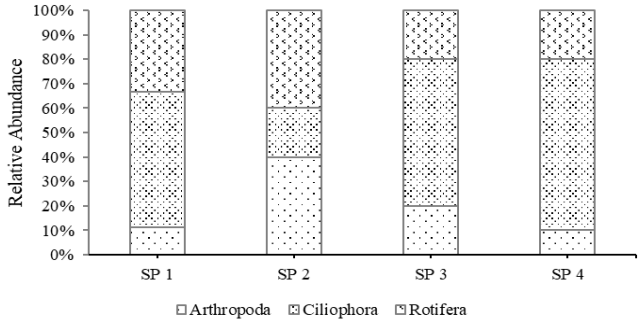

Figure 5. Mean relative abundance of zooplankton based on the division in freshwater wetland tropical area of Rowo Klampok Swamp, Malang District, East Java, Indonesia

Based on the genus, the phytoplankton with the highest abundance is *Merismopedia* (Cyanophyta) in SP 1 and 3, with an abundance of 1,610,882 cells/L and 1,509,589 cells/L. *Chlorella* is a genus from the Chlorophyta division, which has the highest abundance in SP 2, reaching 1,339,679 cells/L, while in SP 4, *Dictyosphaerium* (Chlorophyta) has the highest abundance, reaching 1,922,929 cells/L. *Cyclotella* is a genus of Bacillariophyta with a high abundance of 712,317 cells/L at SP 1, and at this sampling point, no *Peridinium* (Dinoflagellates) were found. The abundance of each genus at each sampling point in this study can be seen in Figure 6.

Dictyosphaerium is a phytoplankton often found in swamps. It is cosmopolitan and can tolerate various environmental conditions such as light, temperature, pH, and trophic (Irfanullah and Moss 2006). *Cyclotella* is a good water indicator, while the high presence of dinoflagellates such as *Ceratium*, *Glenodinium*, and *Peridinium* indicates eutrophic water conditions (Dorche et al. 2018). *Merismopedia* indicates a higher concentration of phosphorus, which is the inorganic nutrient required for algal growth. *Pediastrum* shows high DO and pH, which supports good water quality (Joseph and Subramani 2021), but its abundance is only in SP 1. We analyze that the condition of the Klampok Rawa swamps is still quite good (no eutrophication occurs), even though it shows phosphorus contamination.

Phytoplankton community composition is considered a good bioindicator due to its rapid response to environmental fluctuations (Zhang et al. 2021). Changes in the composition and quantitative structure of plankton communities in aquatic environments are influenced by various environmental factors, such as physical, chemical, and biological factors. Environmental factors play a significant role in plankton composition, which demonstrates good aquatic health when many factors interact with plankton (Xiao et al. 2020).

Diversity, uniformity, and dominance index

Rowo Klampok Swamp phytoplankton at four sampling points for three weeks had a diversity index ranging from 1.965 to 2.439 (medium, H' 1-3), a uniformity index of 0.945-1.173 (high, e > 6), and a dominance index ranging from 0.125 to 0.213 (low, D is close to 0). Meanwhile, zooplankton has a diversity index ranging from 0.496 to 0.529 (low, H' < 1), a uniformity index from 0.317 to 0.593 (low to medium, e < 0.4 (low), e = 4-0.6 (medium)) and a zooplankton dominance index ranging from 0.458 to 0.684 (high, D is close to 1). The diversity, uniformity, and plankton dominance index in Rawa Rowo Klampok can be seen in Table 2.

The diversity and uniformity index of phytoplankton in the Klampok Swamp is higher than that of zooplankton. This index shows that the types of phytoplankton found are more diverse and evenly distributed, while the zooplankton found are not as numerous as phytoplankton. The dominance index value is inversely proportional to the diversity and uniformity indexes. The dominance index value for zooplankton is lower than that for phytoplankton, as evidenced by less phytoplankton found, while certain types are found in greater quantities.

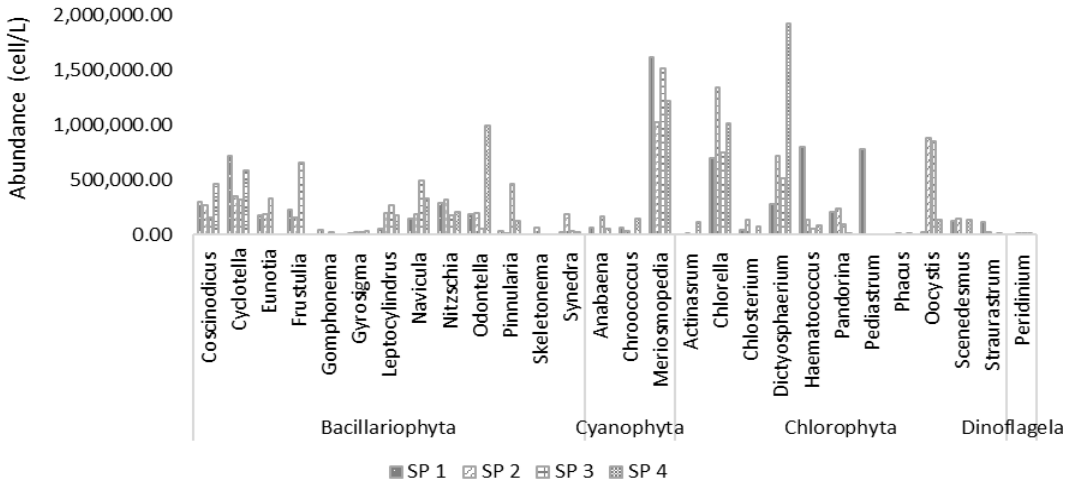

Figure 6. Average abundance of phytoplankton genera in freshwater wetland tropical area of Rowo Klampok Swamp, Malang District, East Java, Indonesia

Table 2. Diversity, uniformity, and dominance index of plankton in Rowo Klampok Swamp, Malang District, East Java, Indonesia

Sampling point	Diversity index		Uniformity index		Dominance index	
	Phytoplankton	Zooplankton	Phytoplankton	Zooplankton	Phytoplankton	Zooplankton
1	2.209	0.529	0.733	0.593	0.179	0.665
2	2.439	0.347	0.803	0.317	0.125	0.458
3	2.332	0.347	0.790	0.317	0.135	0.458
4	1.965	0.496	0.780	0.350	0.213	0.684

Table 3. Environmental conditions of Rowo Klampok Swamp, Malang District, East Java, Indonesia

Water quality parameters	Stations			
	SP 1	SP 2	SP 3	SP 4
Temperature (°C)	27.2 ± 0.2	27.5 ± 1.3	27.2 ± 0.9	27.3 ± 0.6
Water transparency (cm)	70.0 ± 0.9	63.4 ± 7.8	58.0 ± 10.6	68.6 ± 5.9
pH	7.0 ± 0.00	7 ± 0.00	7 ± 0.00	7 ± 0.00
Dissolved oxygen (mg/L)	7.7 ± 9.0	6.7 ± 1.1	6.9 ± 1.2	8.1 ± 1.4
Nitrate (mg/L)	0.07 ± 0.02	0.09 ± 0.02	0.10 ± 0.02	0.09 ± 0.04
Orthophosphate (mg/L)	0.026 ± 0.003	0.020 ± 0.013	0.020 ± 0.003	0.025 ± 0.004
Ammonia (mg/L)	0.24 ± 0.16	0.16 ± 0.05	0.20 ± 0.07	0.17 ± 0.07
Total organic matter (mg/L)	24.01 ± 5.48	41.89 ± 19.23	25.60 ± 4.75	20.68 ± 14.85

A high diversity index value indicates high water quality, but this does not mean a low diversity value indicates poor water quality (Setyono and Himawan 2018). Diversity, similarity, and dominance indices assess the distribution and diversity of certain organisms at a sampling location. The Shannon-Weaver Diversity Index (H′) is an index that shows indications of being sensitivity to pollution; its value does not fluctuate too much and is commonly used to determine the abundance and evenness of species in a community (Farukuzzaman et al. 2023). The value increases as the number of plankton taxa in the ecosystem increases, with a uniform value. This diversity index is related to the uniformity and dominance index (Ghosh and Biswas 2015; France et al. 2021). This index ranges from 0-5, which shows a correlation between species diversity and pollution status; if the value is > 3.0, indicating clean water; 1.0-3.0, indicating moderate pollution; and < 1.0, indicating heavy pollution (Zhu et al. 2021). Based on the diversity index, the Rowo Klampok swamp has moderate pollution. We suspect that the pollution comes from the environment around the swamp in the form of agricultural land, residential areas, and tourism.

The Rowo Klampok Swamp has a diversity value that tends to be medium to low because the condition of the swamp is quite shallow. Shallow swamps and low currents generally result in increased nutrient concentrations, so diversity, evenness, and species richness levels tend to be low (Ramlee et al. 2022). Differences in diversity indices across sampling points may also be caused by interactions between zooplankton and phytoplankton, thereby influencing zooplankton abundance across sampling points (Geng et al. 2022). Fluctuations in a body of water's diversity index are closely related to that water's physical and chemical parameters (Arsad et al. 2021).

A high Uniformity Index value indicates each type of biota in the waters in even conditions (Inayah et al. 2023). A uniformity index that is small or close to zero tends to indicate an unstable community, meaning that the distribution of the number of individuals for each species is not the same, and a particular species tends to dominate the population (Florescu et al. 2022). The high dominance index value is due to the low number of species obtained, so the abundance value obtained for one species tends to be high and dominates (Meisaroh et al. 2019). Environmental factors can influence the dominance of a species because each phytoplankton species has different requirements for the environmental conditions in which it lives (Abida 2010).

Environmental condition

The water quality conditions of Rowo Klampok Swamp can be seen in Table 3. The results of temperature measurements between sampling points are almost the same, namely around 27.2-27.5°C. This is a normal value in swamps and supports plankton growth. Temperature can affect phytoplankton photosynthesis; very high temperatures > 30°C can stop photosynthesis. A good temperature for plankton growth is around 20-30 °C (Yuliana and Irfan 2018; Rugebregt et al. 2020). The brightness of the water obtained ranges from 58.0 to 70.0 cm. The brightness at SP 3 is lower than at other points because this point has shade from surrounding vegetation, which prevents sunlight from entering. Water brightness indicates the intensity of light entering the water body and is needed by phytoplankton for photosynthesis (Geng et al. 2022; Piranti et al. 2024). The temperature and brightness results of the Rowo Klampok Swamp are classified as suitable for the aquatic biota within it.

The acidity value for Rowo Klampok at all sampling points is the same, namely 7. This value indicates that the waters are in normal condition. A good pH for the growth of aquatic organisms, including plankton, is 6.5-8 (Febriansyah et al. 2023). Dissolved oxygen in the water

body of Rowo Klampok Swamp is quite high, around 6.7-8.1 mg/L. Sampling point 4 has a higher dissolved oxygen value than the other sampling points. We suspect this is related to the high abundance of plankton, which can produce oxygen from photosynthesis. The photosynthesis process carried out by phytoplankton produces oxygen, so dissolved oxygen in the water increases (Baxa et al. 2021).

Nutrients of nitrate and phosphate are necessary for plankton (phytoplankton) growth (Susilowati et al. 2023.). The nitrate results obtained ranged from 0.09-0.1 mg/L, while those for orthophosphate ranged from 0.020-0.026 mg/L. These nutrient values indicate the trophic status of waters in the mesotrophic category. This confirms that the type of phytoplankton that grows in these swamps is plankton, which indicates quite high levels of phosphate, namely, *Merismopedia*. The high content of nitrates and phosphates in water body indicates organic material contamination and eutrophication (Astuti et al. 2022).

The ammonia contained in the waters of Rowo Klampok Swamp ranges from 0.16 to 0.24 mg/L. Ammonia is a compound resulting from the metabolism of aquatic organisms and is used by phytoplankton as a nitrogen source. Therefore, ammonia is a key driver of zooplankton assemblages (Du et al. 2023). The Total Organic Matter (TOM) obtained ranged from 20.68 to 41.89 mg/L. TOM describes water's total organic material content in particles and dissolved organic materials. This organic material can affect plankton and cause eutrophication (Reinl et al. 2022).

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