JPIPA Mikroalga

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Submission date: 14-Dec-2022 09:22AM (UTC+0800)
Submission ID: 1980661719
File name: shwater_Microalgae_in_Jangkok_River,_Lombok_Indonesia_JPPIPA.pdf (461.12K)
Word count: 3038
Character count: 17544

JPPIPA 8(4) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Community Structure of Freshwater Microalgae in Jangkok River, Lombok Indonesia

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Received: June 6, 2022
Revised: September 22, 2022
Accepted: October 15, 2022
Published: October 31, 2022

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DOI: 10.29303/jppipa.v8i4.1761

Abstract: The microalgae community structure in an aquatic ecosystem is strongly influenced by environmental factors. One of the rivers in Indonesia, located in the island of Lombok, West Nusa Tenggara, is the Jangkok River. The Jangkok River is widely used by residents for activities, including industry, cultivation, waste disposal, and others. This study aimed to determine the structure of microalgae community in Jangkok River. This research was carried out with an exploration descriptive method by quantitative and qualitative approaches. Data were analyzed quantitatively by calculating the Shannon-Wiener diversity index (H'), Uniformity index (E) and Dominance index (d). The results showed that the diversity of microalgae was categorized as moderate (H'= 2.66), uniformity index (E = 0.66), and the dominance index indicate that there were no dominant species with a value (D = 0.13).

Keywords: Community Structure; Microalgae; Jangkok River

Introduction

Microalgae are microscopic organism (Astuti et al., 2017) photosynthetic, and photoautotrophic (Sepriyaningsih & Harmoko, 2020). This unicellular organism, have a size of a few hundred micrometers, have chlorophyll, and requires carbon dioxide, nutrients, and light to conduct photosynthesis. Microalgae are not the same as other plants because they do not have an organ such as roots, stems, and leaves (Hadiyanto & Azim, 2012; Winahyu et al., 2013).

Microalgae inhabit all ecosystem from cold polar regions to highly alkaline or salty water condition, from hot springs to arid lands (Masojidek & Torzillo, 2014), on the surface of the world's ocean sea and freshwater (Nugroho, 2019). In aquatic ecosystem, microalgae played a significant role as primary producer, it help other organism's live (Rosada et al., 2017; Sarifa et al., 2019) This function is related to its ability to absorb solar energy directly through the process of photosynthesis, and to convert complex compounds into simple compounds (primary productivity).

In addition to being primary producers, microalgae also function as aquatic bioindicators (Awaludin et al., 2015; Haninuna et al., 2016; Soliha et al., 2016). Changes in the water condition can disrupt the biota community structure in it. In aquatic ecosystem, the ability of microalgae is reduced if there is damage to the surrounding environment, such as waste pollution, coral reefs damaged, and others. Good and bad water quality can be seen through the level of primary productivity and diversity of microalgae (Yulianto et al., 2014).

A river is a large and elongated stream of water that flows continuously from upstream to downstream (Awal et al., 2014). One of the largest rivers in Indonesia, located on Lombok Island (West Nusa Tenggara) is the Jangkok River. Jangkok River is used as a source of raw water to meet the domestic, agricultural, and industrial needs of the community. In addition, this river is a place for household waste and industrial waste (Marganingrum et al., 2018).

The water bodies of the Jangkok River are used by residents as a place for rock and sand mining, while the riverbanks are used as places of business such as gardening. These conditions can be negative for the life of deepwater biota including microalgae (Azhari & Nofisulastri, 2018) (Azhari & Nofisulastri, 2018). In this regard, this research was conducted to reveal the microalgae community structure.

How to Cite:
Purwati, N., Jayanti, E. T., & Jannah, M. (2022). Community Structure of Freshwater Microalgae in Jangkok River, Lombok Indonesia. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2043–2047. https://doi.org/10.29303/jppipa.v8i4.1761

Method

This research was conducted in Jangkok River, Mataram Indonesia. The tools used were a plankton net (20µm), microscope, object and cover slide, coverslip, dropper, collection bottle, pH meter, thermometer, bucket, *rapia* rope, stake, and funnel. Meanwhile, the materials used were water samples, formalin (4%), and label paper.

Water sampling was carried out at 3 different stations based on differences in environmental characteristics. Each station includes 3 sampling points.. 2 liters of water were filtered using a plankton net then stored in a sample bottle and dripped with 4% formalin. Measurement of water physical factors including pH and temperature were measured on-site. Data were analyzed quantitatively by calculating the Shannon-Wiener diversity index (H'), Uniformity index, and dominance index.

Result and Discussion

Species of Microalgae

Based on the identification results found 55 species of microalgae are included in 3 divisions, namely Bacillariophyta (39 species), Chlorophyta (12 species), and Cyanophyta (4 species). The species found are presented in Table 1. While the comparison of the number of species is shown in Figure 1.

Table 1. Species of Microalgae

Division	Species
Bacillariophyta	*Synedra ulna (Nitzsch)* Ehrenberg, *Diadesmis confervacea* Kützing, *Melosira varians* C.Agardh, *Cyclotella ocellata* Pantocsek, *Stauroneis anceps* Ehrenberg, *Nitzschia amphibia* Grunow, *Nitzschia dissipata* (Kützing) Rabenhorst , *Gomphonema* W *lanceolata* (C.Agardh) Kutzing, *Navicula gregaria* Donkin, *Nitzschia angustata* (W.Smith) Grunow, *Aulacoseira granulata* (Ehrenberg) Simonsen, *Caloneis undulata* (W.Gregory) Krammer, *Surirella biseriata* var. *bifrons* (Ehrenberg) Hustedt, *Pinnularia viridis* (Nitzsch) Ehrenberg, *Luticola mutica* (Kützing) DGMann, *Gomphonema sphaerophorum* Ehrenberg, *Rossithidium duthiei* (MRSreenivasa) JCKingston, *Achnanthes crenulata* Grunow, *Gomphon Round (Gomphon & Hel1ql) Nitzschia clausii* Hantzsch, *Pseudostaurosira brevistriata* (Grunow) DMWilliams & Round, *Planothidium apiculatum* (RMPatrick) Lange-Bertalot, Nitzschia *palea* (Kutzing) W.Smith, *Surirella biseriata* Brébisson, *Navicula salinarum* Grunowsch, *Achnanthidum K* Grunow, *Gyrosigma acuminatum* (Kützing) Rabenhorst, *Luticola olegsakharovii* Zidarova, Z.Levkov & Van de Vijver, *Achnanthidium exiguum* var. *heterovalvata* (Krasske) Czarnecki, *Craticula ambigua* (Ehrenberg) DGMann, *Eucocconeis flexella* (Kützing) Meister, *Cymatopleura elliptica* (Brébisson) W.Smith, *Nitzschia tryblionella* var. *debilis* (Arnott ex O'Meara) Hustedt, *Cymbella turgidula* Grunow, *Eunotia arcus* Ehrenberg.
Chlorophyta	*Coelastum cambricum W.* Archer, Haematococcus *lacustris (*Girod *-Chantrans*) Rostafinski, Coelastrum *microporum* Nägeli, *Coelastrum astroidum Maximum* Meyen, *Scenedesmus brasiliensis* Bohlin, *Scenedesmus obliquus* (Turpin) Kutzing, *Cosmarium botrytis* Meneghini ex Ralfs.
Cyanophyta	*Oscillatoria refringens* NLGardner, *Oscillatoria subbrevis* Schmidle, *Spirulina major* Kutzing ex Gomont, *Nostoc commune* Vaucher ex Bornet & Flahult.

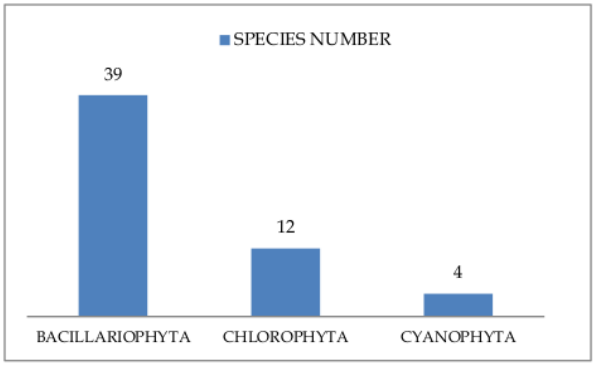

Figure 1. Comparison of Microalgae Species Number

Diversity, Uniformity and Dominance Index

The diversity index is used to calculate the diversity level of species. The uniformity index is used to show the distribution pattern of biota based on the ability of certain species in water. While the dominance index is used to see whether there are species that dominate in the aquatic ecosystem. The index values for diversity, uniformity, and dominance of the Jangkok River microalgae are presented in Table 2.

Table 2. Diversity, Uniformity, and Dominance

Index Name	Value	Criteria
Diversity index	2.66	Medium
Uniformity index	0.66	Balanced
Dominance index	0.13	There are no dominant species

Based on Table 2, it is known that the diversity index value (H') is 2.66 (H'<3) which means that the stability of the microalgae community in the Jangkok River is moderate (medium polluted water quality). The uniformity index (E) of microalgae reached a value of (0.66) so it was included in the balanced criteria. The microalgae dominance index is (0.13) which means that no microalgae species dominate the Jangkok River.

The number and types of microalgae at each station have a different distribution. The most common species

found were *Synedra ulna, Diadesmis confervacea, Melosira varians, Cyclotella ocellata, Stauroneis anceps, Coelastrum cambricum, Haematococcus lacustris.* While the few species found namely, *Luticola olegsakharovii, Achnanthidium exiguum var. heterovalvata, Craticula ambigua, Eucocconeis flexella, Cymatopleura elliptica, Nitzschia tryblionella var. debiliis, Cymbella turgidula, Eunotia arcus, Scenedesmus obliquus,* and *Nostoc commune*.

Water Physical Factor

Measurement of physical factors measured in this study includes pH and temperature. The measurement results are presented in Table 3.

Table 3. Water Physical Factor

Parameter	Station I	Station II	Station III
Water pH	7.80	7.56	7.60
Water Temperature (°C)	26.60	26.60	27.00

Referring to the microalgae species found, it is known that the Bacillariophyta division is the most common found. Species of the division Bacillariophyta can adapt to strong to slow currents. This is due to the presence of a special structure in the form of a gelatinous stalk which is useful in the attachment process to the substrate (Sepriyaningsih & Harmoko, 2020). This division is found at each observation station. When the research was conducted, the condition of the river current was not in a very strong current, so the microalgae species found were thought to be attached to rocks and objects in the river. The division Bacillariophyta is often found in water in large numbers and mostly because of its ability to adapt to the environment, its cosmopolitan nature, resistance to extreme conditions, and high reproductive power (Jayakumar et al., 2021).

Division Chlorophyta is the second largest group of microalgae found in the Jangkok River. Based on the results obtained, there were 12 species of microalgae in the Chlorophyta division, with the highest species being *Coelastrum cambricum*. This is that Chlorophyta has a wide habitat ranging from ponds, lakes, rivers, and even the sea. (Zikriah et al., 2021)stated that the Chlorophyta division is mostly found in freshwaters because it can adapt and grow quickly in waters with sufficient light intensity such as ponds, lakes, and rivers. In the absence of light, microalgae can also grow in a heterotrophic way, by using organic carbon as a source of carbon and energy (Sivaramakrishnan et al., 2022). With this capability, microalgae are suitable for treating wastewater, especially secondary waste (Cheirsilp et al., 2022). Its adaptability causes Chlorophyta called the main producer in an aquatic ecosystem.

As a primary producer of aquatic habitat, Microalga contains important macromolecules that are needed as a source of energy for certain organisms that occupy trophic on it. The content of chlorophyll causes Chlorophyta to be able to carry out photosynthesis and produce a source of food and oxygen to be used by other organisms in the waters. Some species of microalgae are reported to contain polysaccharides, protein and lipids (Jayakumar et al., 2021). It was further reported that the oil content in microalgae was 125 times higher, carbohydrates (20 times higher) and protein 17.5 times higher than soybeans and oil palm (Inuwa et al., 2022).

Cyanophyta is the division that is least found in the Jangkok River, which is as many as 4 species with different genera. Cyanophyta is prokaryotic and planktonic microalgae, generally found abundantly in intertidal and estuary areas but can be found in tropical and sub-tropical waters. Vieira et al., (2022) stated that as aquatic organisms, cyanophyta can grow well in fresh, brackish, and sea water with very high salinity.

The growth of the Cyanophyta division has tolerance to dry conditions and certain temperatures (Nirmalasari, 2018). Not so many Cyanophyta divisions were found in the Jangkok River, due to the inappropriate environmental temperature required for growth, this is as expressed by (Andriansyah et al., 2014) that the Cyanophyta Division requires temperatures higher than the temperature range required for microalgae in general. When researching the average water temperature in the Jangkok River ranges from 26°C-27 o C, while the ideal temperature for the growth of organisms including microalgae is 20-30°C. The high and low temperature of water greatly affects the life of aquatic organism (Maresi et al., 2015). Related to the effect of light on the activity of microalgae, it was reported that the excessive use of LED light could harm the microalgae cells, by disrupting the photosystem and bleaching the pigments (Cheirsilp et al., 2022).

The existence of microalgae in water is strongly influenced by the ability to adapt to the environment. Each type of microalgae has its ability to adapt to its environment. This is evidenced by the ability of some species from this group to grow on rocks and other surfaces with very low humidity levels. In very extreme environmental conditions, microalgae can survive for a long time even hundreds of years in dormant conditions or form cysts (Sivaramakrishnan et al., 2022; Vieira et al., 2022).

The highest number of microalgae individuals was found at station I, namely Monjok Village, which is the place of livelihood for residents, namely taking sand and gravel and other activities. The number of human activities can cause organic matter that enters the waters and others to increase. The organic matter will be converted into nutrients so that it affects aquatic biota, one of which is microalgae which make nutrients as energy.

Conclusion

The microalgae community structure in the Jangkok River includes the diversity index (H') is 2.66, the uniformity index (E) is 0.66, and the microalgae dominance index is 0.13.

References

Andriansyah, TR, S., & I, L. (2014). Kualitas Perairan Kanal Sungai Jawi dan Sungai Raya dalam Kota Pontianak ditinjau dari Struktur Komunitas Mikroalga Perifitik. *Protobiont*, *3*(1), 61–70. http://dx.doi.org/10.26418/protobiont.v3i1.4583

Astuti, W., Astuti, S. P., Suripto, & Japa, L. (2017). Komunitas Mikroalga di Perairan Sungai dan Muara Sungai Pelangan Kecamatan Sekotong Kabupaten Lombok Barat. *Jurnal Biologi Tropis*, *17*(1). https://doi.org/10.29303/jbt.v17i1.401

Awal, J., Tantu, H., & Tenriawaru, E. P. (2014). Identifikasi Alga (Algae) Sebagai Bioindikator Tingkat Pencemaran Di Sungai Lamasi Kabupaten Luwu. *Jurnal Dinamika*, *5*(2), 21–34. Retrieved from https://journal.uncp.ac.id/index.php/dinamika/article/view/36

Awaludin, A., Dewi, N., & Ngabekti, S. (2015). Koefisien Saprobik Plankton di Perairan Embung Universitas Negeri Semarang. *Jurnal MIPA*, *38*(2), 115–120. Retrieved from http://journal.unnes.ac.id/nju/index.php/JM

Azhari, N., & Nofisulastri, N. (2018). Identifikasi Jenis Annelida Pada habitat Sungai Jangkok Kota Mataram. *Bioscientist : Jurnal Ilmiah Biologi*, *6*(2), 130. https://doi.org/10.33394/bjib.v6i2.2392

Cheirsilp, B., Wantip, K., Chai-issarapap, N., Maneechote, W., Pekkoh, J., Duangjan, K., Ruangrit, K., Pumas, C., Pathom-aree, W., & Srinuanpan, S. (2022). Enhanced production of astaxanthin and co-bioproducts from microalga Haematococcus sp. integrated with valorization of industrial wastewater under two-stage LED light illumination strategy. *Environmental Technology & Innovation*, *28*, 102620. https://doi.org/10.1016/j.eti.2022.102620

Hadiyanto, O. :, & Azim, M. (2012). *Mikroalga Sumber pangan dan Energi Masa Depan* (1st ed., Vol. 1). UPT UNDIP Press.

Haninuna, E. D. N., Gimin, R., & Kaho, L. M. R. (2016). Pemanfaatan Fitoplankton Sebagai Bioindikator Berbagai Jenis Polutan di Perairan Intertidal Kota Kupang. *Jurnal Ilmu Lingkungan*, *13*(2), 72. https://doi.org/10.14710/jil.13.2.72-85

Inuwa, A. B., Zeb, I., Mahmood, Q., Irshad, U., Irshad, M., Hafeez, F., Iqbal, A., Pervez, A., & Nazir, R. (2022). Novel microalgae strains from selected lower Himalayan aquatic habitats as potential sources of green products. *PLoS ONE*, *17*(5 May). https://doi.org/10.1371/journal.pone.0267788

Jayakumar, S., Bhuyar, P., Pugazhendhi, A., Rahim, M. H. Ab., Maniam, G. P., & Govindan, N. (2021). Effects of light intensity and nutrients on the lipid content of marine microalga (diatom) Amphiprora sp. for promising biodiesel production. *Science of The Total Environment*, *768*, 145471. https://doi.org/10.1016/j.scitotenv.2021.145471

Maresi, S. R. P., Priyanti, & Yunita, E. (2015). Fitoplankton Sebagai Bioindikator Saprobitas Perairan Di Situ Bulakan Kota Tangerang. *Al-Kauniyah Jurnal Biologi*, *8*(2), 113–122. https://doi.org/10.15408/kauniyah.v8i2.2697

Marganingrum, D., Djuwansah, M. R., & Mulyono, A. (2018). Penilaian Daya Tampung Sungai Jangkok Dan Sungai Ancar Terhadap Polutan Organik. *Jurnal Teknologi Lingkungan*, *19*(1). https://doi.org/10.29122/jtl.v19i1.1789

Masojidek, & Torzillo, G. (2014). *Mass Cultivation of Freshwater Microalgae*. Encyclopedia of Ecology (pp.2226-2235). http://dx.doi.org/10.1016/B978-008045405-4.00830-2

Nirmalasari, R. (2018). Analysis of Water Quality In Sebangau River Kereng Bengkiray Port Based On Phytoplanktons Diversity and Composition. *Jurnal Ilmu Alam Dan Lingkungan*, *9*(17), 48–58. https://doi.org/10.20956/jal.v9i17.4008

Nugroho, S. H. (2019). Karakteristik Umum Diatom dan Aplikasinya Pada Bidang Geosains. *OSEANA*, *44*(1), 70–87. https://doi.org/10.14203/oseana.2019.Vol.44No.1.32

Rosada, K. K., Pribadi, T. D. K., & Putri, S. A. (2017). Struktur Komunitas Fitoplankton pada Berbagai Kedalaman di Pantai Timur Pananjung Pangandaran. *Jurnal Biodjati*, *2*(1), 30. https://doi.org/10.15575/biodjati.v2i1.1290

Sarifa, Kasim, M., & Nur, A. I. (2019). Struktur Komunitas Miroalga pada Terumbu karang Buatan di Perairan Desa Tanjung Tiram Kecamatan Moramo Utara Kabupaten Konawe Selatan. *Jurnal Manajemen Sumber Daya Perairan*, *4*(1), 93–102. Retrieved from http://ojs.uho.ac.id/index.php/JMSP/article/view/5588

Sepriyaningsih, & Harmoko. (2020). Keanekaragaman Mikroalga Bacillariophyta di Sungai Mesat Kota Lubuk Linggau. *Quangga: Jurnal Pendidikan Dan Biologi*, *11*(2). https://doi.org/10.25134/quagga.v12i2.2768

Sivaramakrishnan, R., Suresh, S., Kanwal, S., Ramadoss, G., Ramprakash, B., & Incharoensakdi, A. (2022). Microalgal Biorefinery Concepts' Developments for Biofuel and Bioproducts: Current Perspective and Bottlenecks. In *International Journal of Molecular*

Sciences (Vol. 23, Issue 5). MDPI. https://doi.org/10.3390/ijms23052623

Soliha, E., Rahayu, S. Y. S., & Triastrinurmiatningsih. (2016). Kualitas Air dan Keanekaragaman Fitoplankton di Danau Cikaret, Cibinong, Bogor. *Ekologia*, *16*(2), 1–10. https://doi.org/10.33751/ekol.v16i2.744

Vieira, V. V., Cadoret, J. P., Acien, F. G., & Benemann, J. (2022). Clarification of Most Relevant Concepts Related to the Microalgae Production Sector. *Processes*, *10*(1). https://doi.org/10.3390/pr10010175

Winahyu, D. A., Anggraini, Y., Rustiati, E. L., Master, J., & Setiawan, A. (2013). Prosiding Semirata FMIPA Universitas Lampung, 2013 Semirata 2013 FMIPA Unila |93. *Prosiding Semirata FMIPA Universitas Lampung*, 93–98.

Yulianto, D., Muskananfola, M. R., & Purnomo, P. W. (2014). Tingkat Produktivitas Primer Fitoplankton Berdasarkan Waktu yang Berbeda di Perairan Pulau Panjang Jepara. *Iponegoro Journal of Maquares*, *3*(4), 195–200. https://doi.org/10.14710/marj.v3i4.7099

Zikriah, Z., Bachtiar, I., & Japa, L. (2021). The Community of Chlorophyta as Bioindicator of Water Pollution in Pandanduri Dam District of Terara East Lombok. *Jurnal Biologi Tropis*, *20*(3), 546–555. https://doi.org/10.29303/jbt.v20i3.2344

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