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Water Quality of Pasuruan Juri River based on Macrozoobenthos Diversity Index

Kualitas Perairan Sungai Juri Pasuruan berdasarkan Indeks Keanekaragaman Makrozoobentos

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Abstract. Juri River is part of the Welang River unit that flows from the Arjuna mountains. Based on its location, the Juri River passes through many settlements so that a lot of garbage is disposed of in the Juri River flow, one of which is chicken slaughtering waste, which is dangerous for the environment because it contains many organic compounds that can have an impact on water quality. This research aims to determine the water quality of Juri River, which is polluted by slaughtered chicken waste from chemical, biological, and physical parameters, especially on the macrozoobenthos diversity index in Juri River. Macrozoobenthos found were identified based on morphological characters, and the diversity index was reviewed using the Shannon-Wiener formula. Data analysis used descriptive quantitative analysis. The results illustrate that the condition of the Juri Pasuruan River is included in the moderately polluted category, with a macrozoobenthos diversity index of 1.175 and a BOD value that exceeds the quality standard. This indicates the presence of pollutants in the Juri River, such as chicken slaughter waste.
Key words: aquatic environment, waste, aquatic ecosystems

Abstrak. *Sungai Juri merupakan bagian dari satuan wilayah Sungai Welang yang mengalir dari pegunungan Arjuna. Berdasarkan letaknya Sungai Juri melewati banyak pemukiman sehingga banyak sampah yang dibuang di aliran Sungai Juri, salah satunya yaitu limbah pemotongan ayam berbahaya untuk lingkungan karena mengandung banyak senyawa organik yang dapat memberikan dampak bagi kualitas air. Tujuan dari penelitian ini yaitu untuk mengetahui kualitas air Sungai Juri yang tercemar limbah ayam potong dari parameter kimia, biologi, dan fisika terutama pada indeks keanekaragaman makrozoobentos di Sungai Juri. Makrozoobentos yang ditemukan diidentifikasi berdasarkan karakter morfologinya, kemudian ditinjau indeks keanekaragaman menggunakan rumus Shannon-Wiener. Analisis data menggunakan analisis kuantitatif deskriptif. Hasil penelitian menggambarkan bahwa kondisi Sungai Juri Pasuruan termasuk dalam kategori tercemar sedang, dengan indeks keanekaragaman makrozoobentos sebesar 1,175 dengan nilai BOD yang melebihi standart baku mutu. Hal ini menunjukkan adanya bahan pencemar pada Sungai Juri seperti limbah pemotongan ayam.*
Kata kunci: *lingkungan perairan, limbah, ekosistem perairan*

INTRODUCTION

Chicken slaughtering waste is waste or residue from chicken body parts that are no longer used and cannot be sold or have no economic value. Chicken slaughtering waste can be liquid waste, such as washing residue and chicken blood, as well as solid waste, such as feathers and chicken feces in the intestines (Umroningsih, 2022). Chicken slaughtering waste disposed of in river waters directly in large quantities can affect river water quality because it contains high concentrations of organic matter; this is because there is ammonium, nitrogen, phosphorus, fat, dissolved solids, and suspended solids, which are some of the elements found in chicken slaughtering waste. Potential changes in the pH and color of the river water are a consequence of this waste discharge. Increased BOD values are caused mainly by chicken blood and carcass washing (Hendrasarie & Santosa, 2019).

The river is part of the catchment area, which is the area where water collects and flows into the river. The river system receives water supply from hydrological processes involving a long water cycle, which begins with evaporation, which will turn into clouds called the condensation process. The clouds will be carried by the wind, which will fall to the ground as rain, which then falls and enters the river (Effendi, 2003). Rivers are formed naturally and are open waterways, rivers flow from upstream to downstream end at the estuary. Rivers can also be the habitat of several animals, including macrozoobenthos. The quality of the river can influence Macrozoobenthos diversity in the river. If a river has good water quality, the diversity in the river ecosystem will experience a balance, no population dominates or decreases. Meanwhile, polluted rivers will cause a drastic decrease or increase in population (Junaidi, 2014).

Juri River is part of the Welang River unit. Welang River is a watershed that flows from the Arjuna Mountains and Pasuruan Regency and empties into the North Coast of Java Island, Madura Strait. The Welang River has a flow length of 40.09 kilometers. The morphology of the Welang River is characterized by meandering channels, known as meanders. It belongs to the category of rivers with continuous water flow throughout the year, even during the dry season. On the other hand, the Juri River has a flow length of about 12.10 kilometers, with three different branching river courses (Irwanto, 2021). The Juri River, part of the Welang River, also serves as irrigation for rice fields and community activities such as washing, bathing, and toileting. According to regulations stipulated in Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning Environmental Protection and Management Regulations, the Juri River is categorized in class three (Rinawati, 2020). Along the Juri River are residential areas, and several residents work as broiler sellers. Three chicken traders dispose of chicken slaughtering waste directly into the river daily, and the frequency of chicken slaughtering every day can reach 20-40 chickens for each seller. The chicken slaughtering waste disposed of in the form of chicken blood, chicken feces, chicken fat, stomach stuffing, and even chicken feathers are also not often found in the river flow so that they can pollute the river.

The diversity of an area can be an indicator of the quality of a body of water. Macrozoobenthos are animals that live on the water's surface, live sedentary, and have a long life span. Macrozoobenthos can be utilized as an indicator of the quality of a river because macrozoobenthos can respond to the hydrological conditions of the river, and most animals that live in the river can adapt to river currents (Zulkifli & Setiawan, 2011). The presence and abundance of macrozoobenthos are significantly influenced by the availability of organic matter at the bottom of the aquatic substrate, so macrozoobenthos is closely related to the presence of organic matter as a source of nutrients (Musthofa et al., 2014). Macrozoobenthos can be used as a bioindicator of water pollution. The diversity index is a mathematical statement of the value of an organism's diversity in a water body for water quality. According to research by Ningrum and Kuntjoro (2020), of the five stations, the abundance of macrozoobenthos is at station 1, which contains the most oxygen or dissolved oxygen (DO). In Purba and Fitrihidajati's research (2021), there are three stations, station one is before the source of pollution or industry, station two is where pollutants are discharged, and station three is after the source of pollution or industry. Of the three stations, station one is the station that has the highest abundance of macrozoobenthos. In addition, Musthofa et al. (2014) explains the relationship between organic matter contained in waters with macrozoobenthos diversity shows a positive or directly proportional relationship; this study shows station 3, which has the highest organic matter content, also has the highest organic matter content. This proves that an environment influences the abundance of macrozoobenthos with much organic matter and a clean environment. Meanwhile, research by Rachman et al. (2016) showed that station one, which has not been polluted, has the highest macrozoobenthos index. This proves that macrozoobenthos can be a bioindicator of the water quality of a body of water.

No research has ever been done on the Juri River, especially on areas affected by chicken slaughtering waste. Therefore, the researcher conducted a study to determine the water quality of the Juri River polluted by slaughtered chicken waste based on chemical, physical, and biological parameters using the macrozoobenthos diversity index.

MATERIALS AND METHODS

This was descriptive observational research. Sampling was conducted using the purposive sampling method in the Juri River in Purwosari District from October to November 2023. The sampling procedure begins with sampling in the Juri River. The determination of sampling locations is based on three stations, namely Station 1 (before pollution from chicken slaughtering waste), station 2 (where the chicken slaughtering waste is disposed of), and Station 3 (after pollution from chicken slaughtering waste) (Figure 1).

Macrobenthos samples were taken directly by hand; this can be done because the river used as a station is shallow, so macrozoobenthos samples can be taken directly. Macrobenthos sampling was done in the morning in the river Juri. Sampling was conducted at three stations with five sampling points in the middle of the river, and it was repeated three times.

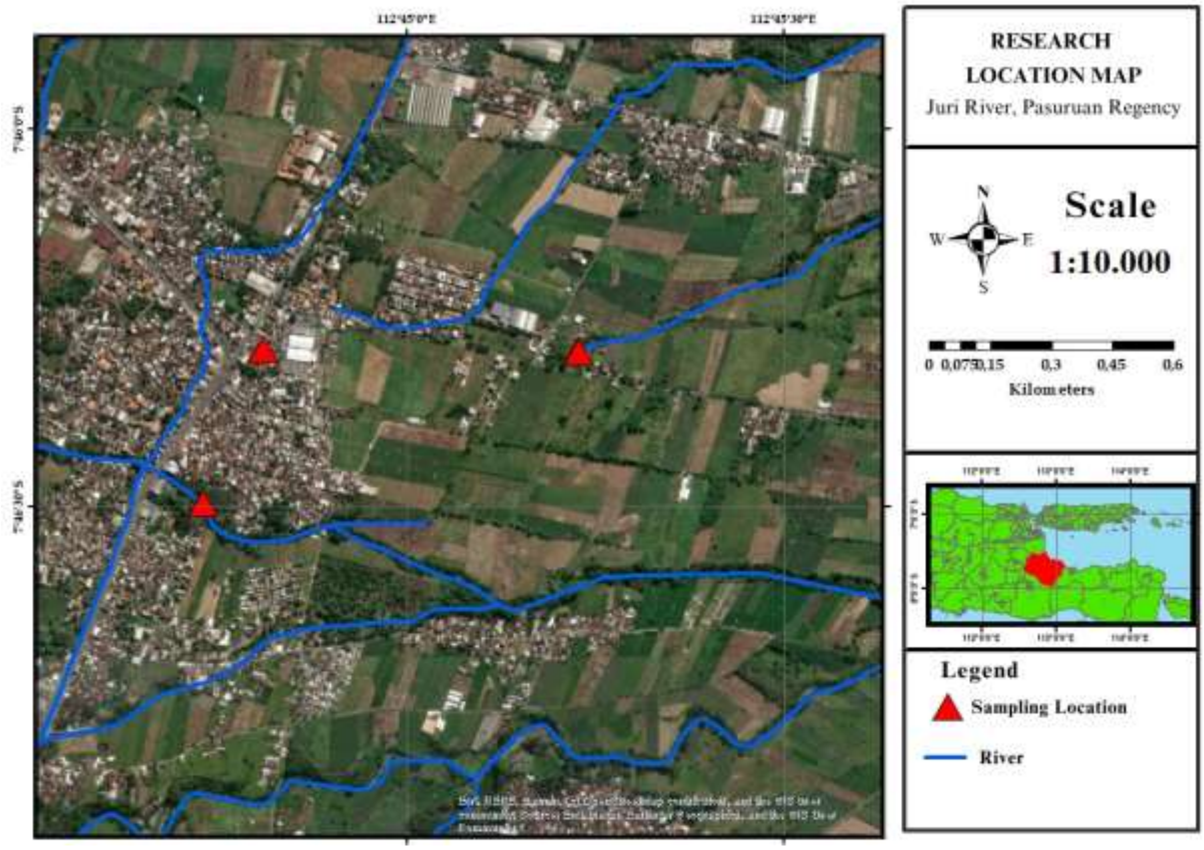

Figure 1. Map of sampling location

Water sampling was carried out to test physical parameters by measuring odor and temperature. In contrast, chemical parameters are used to measure pH, BOD, COD, and biological parameters using macrozoobenthos that live in the Juri River. Temperature and pH measurements using a pH meter tool by dipping the tool into river water and being allowed to stand until the tool shows a constant number value due to temperature and pH measurements. Odor measurements are carried out organoleptically or testing using the senses directly at the research site. Odor measurements have odor results that indicate polluted waters because they smell, and odorless results that can indicate unpolluted waters. DO measurements are made with a DO meter dipped in river water to a constant value. BOD measurements were made by checking DO on the first day of the test using a DO meter (DO_0), then incubating at 20 °C for five days. After five days, DO was checked using a DO meter (DO_5). Calculations were then made to determine the BOD content of river water at each point. The measurement of COD parameters is done by taking water samples using a bottle; the bottle is inserted into the water, then the bottle cap is still in the water. Put the sample bottle in black plastic to avoid sunlight, and the water sample is immediately taken to the DLHK laboratory in Sidoarjo Regency.

Measurement of COD parameters in the DLHK laboratory in Sidoarjo Regency was carried out using SNI 6989.2: 2009 "Water and wastewater - Part 2: How to test Chemical Oxygen Demand (COD) with spectrophotometric closed reflux". Descriptive analysis was carried out on the results of water quality measurements by comparing them with the standards set out in PP No. 22 Year. 2021 so that an understanding of the status of water quality can be obtained. In testing biological parameters using the macrozoobenthos diversity index, macrozoobenthos samples at the station were taken randomly, commonly referred to as the purposive random sampling method. Macrozoobenthos sampling is done in the morning in the river Juri. Samples that have been obtained are then put into a basin. The sample is cleaned using distilled water or running water while shaking using a sieve to remove sand particles, then preserved with 70% alcohol, then macrozoobenthos samples can be identified and documented. The types of macrozoobenthos found were then identified using the book Edmondson (1966) and articles related to macrozoobenthos identification, namely Hernawati (2019), Jeratthitikul et al. (2022), and Lentge et al., (2021).

Data analysis on macrozoobenthos samples that have been identified are then analyzed to determine the diversity index using the Shannon-Wiener formula (H') with diversity criteria. According to Shannon-Wiener criteria, the level of diversity is considered low if the diversity index is less than 1 (H'<1), moderate if it ranges from 1 to 3 (1 ≤ H' ≤ 3), and high if it exceeds 3 (H' >3).

$$H' = -\sum \text{Pi} \log \text{Pi}$$

H': Shannon-Wiener formula diversity index
Pi: n/N (ratio of the number of individuals of one genus to the whole genus)
N: Total number or total number of individuals
n: Number of individuals of the first species
Source: Modification of Lee et al., 1978 in Soegianto, 1994

RESULTS

Observations of macrozoobenthos diversity in Juri River Pasuruan were conducted at three stations with 5 points. The results of macrozoobenthos identification in the Juri Pasuruan River were found in 5 species consisting of the Thiaridae and Gecarcinucidae families. In the Thiaridae family, two genera were found, namely Tarebias, consisting of *Tarebia granifera* species. Then the Melanoides genus, consisting of *Melanoides tuberculata.* In the Gecarcinucidae family, one genus was found, namely Terrathelphusa, which consists of the species *Terrathelphusa chilensis.*

The results of identification and the number of species found in Juri River at three stations with 5 points found 2713 individuals. The overall diversity index value in Juri River amounted to 0.700, and the index of macrozoobenthos diversity in Juri River has a low diversity category. This can be seen in Table 1.

Table 1. Macrozoobenthos diversity index in Juri river

Species	Station 1	Station 2	Station 3	Total
Tarebia granifera	474	741	105	1320
Melanoides turbeculata	454	857	75	1386
Terrathelphusa chilensis	4	3	0	7
Total	932	1601	180	2713
Diversity index (H')	0.718	0.703	0.679	0.700
Criteria	Low	Low	Low	

Measurement of water quality through physico-chemical parameters is an essential aspect in evaluating the condition of the aquatic environment. Some parameters commonly used in water quality analysis include temperature, odor, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and pH. Analysis of these parameters provides a comprehensive picture of the condition of the observed aquatic environment. It can be observed in Table 2 which shows that the mean temperature at stations 1, 2, and 3 sequentially ranged from 27.5 ±0.46 ° C still meets the quality standards, the mean pH ranged from 8.2 ± 0.867 still meets the quality standards, the mean DO of 7.19 ± 0.29 mg / l still meets the quality standards, the mean BOD 7.37 ±0.39 mg / l river BOD parameters do not meet the quality standards, and the mean COD 9.26 ± 0.03 mg / l still meets the quality standards.

Table 2 Measurement Results of Physico-Chemical Parameters of Juri River

Parameter	Station	Average	Quality Standard (PP No. 22/2021)
	1	26.86 ± 2.70	Dev 3
Temperatur (°C)	2	26.92 ± 0.68	(22°C – 28°C)
	3	28.84 ± 0.51	
	1	No odor	
Odor	2	Odor	No odor
	3	No odor	
	1	8.09 ± 0.03	

pH	2	8.47 ± 0.24	6-9
	3	8.30 ± 0.10	
	1	4.694 ± 0.48	
DO (mg/l)	2	10.56 ± 4.88	3 mg/l
	3	5.516 ± 0.83	
	1	6.59 ± 0.93	
BOD (mg/l)	2	9.87 ± 4.88	6 mg/l
	3	5.66 ± 2.41	
	1	11.972 ± 0.29	
COD (mg/l)	2	8.378 ± 0.26	40 mg/l
	3	7.44 ± 0.32	

DISCUSSION

The results of macrozoobenthos identification in Juri River, Pasuruan, found three species of macrozoobenthos from the families Thiaridae and Gecarcinucidae. The three species are *Tarebia granifera*, *Melanoides tuberculata*, and *Terrathelphusa chilensis*. The identification at the three research stations showed that the dominant and most frequently encountered species was *Melanoides tuberculata*, which belongs to the family Thiaridae and the genus Melanoides. The abundance of the Melanoides genus is attributed to its ability to live and thrive in polluted waters and its tolerance to low dissolved oxygen (Musayaroh & Muntalif, 2020).

Other species found from the Thiaridae family include *Tarebia granifera*. The Thiaridae family can inhabit almost all types of natural freshwater environments, such as lakes, swamps, large and small rivers, as well as artificial freshwaters like reservoirs, dams, ponds, and drainage systems. The genus Melanoides and Tarebia within this family are invasive and tend to dominate the waters they inhabit, including the waters of the Juri River (Selvianita et al., 2024).

The species *Terrathelphusa chilensis* was the least abundant across all three stations. It belongs to the Malacostraca class, and its low number may be due to the mobility of the Malacostraca class, which does not settle in one place, unlike the gastropod class that tends to remain attached to substrates. This behavior was also observed in a study by Sidik et al. (2016) in the Susoh District river estuary, where the Malacostraca class made up only 3% of the composition, the lowest among the classes. According to Cumberlidge (1999), crabs, including *Terrathelphusa chilensis*, prefer clear water, which may explain their scarcity in the Juri River, indicating possible water pollution.

The identification results and the number of species found were analyzed using the diversity index. The data show that station 1 had 932 individuals, with a diversity index of 0.718. Station 2 had 1601 individuals, with a diversity index of 0.703, while station 3 had 180 individuals, with a diversity index of 0.679. The total number of individuals found in the Juri River was 2613, with an overall diversity index of 0.700. These results indicate that all stations have low diversity based on the Shannon-Wiener index ($H < 3.00$). In terms of pollution categories, all stations are classified as severely contaminated, as the diversity index falls under 1.0. The low diversity index can be attributed to high nutrient availability and the environmental conditions at each station.

Station 1 exhibited better environmental quality than the other stations. Factors such as evenness and species composition distribution also influence diversity levels in water bodies (Arfiati et al., 2019). The presence of dissolved organic matter can serve as a nutrient source for macrozoobenthos, affecting their growth and density (Simanjuntak et al., 2018). Station 2 and stasion 3 had a particularly low diversity index, likely due to pollution from chicken slaughterhouse waste. Such waste contains significant organic matter, including carcasses and feces, which can alter species diversity. The abundance of organic matter, as well as domestic waste disposal into the river, disrupts the survival of macrozoobenthos in Station 2. Domestic waste and garbage, which contain toxic substances and organic materials, can significantly affect aquatic biota (Purba & Fitrihidajati, 2021). The high and low diversity index can be influenced by the availability of high organic matter and the environmental quality at each station. Composition distribution can also affect the level of diversity in a body of water. The evenness of a macrozoobenthos species can be influenced by the presence of organic matter dissolved in the waters organic matter can be a food source for aquatic biota, so some places experience macrozoobenthos density due to the abundance of organic matter in that place (Musayaroh & Muntalif, 2020).

Water quality measurements were also taken at the three stations, including parameters like temperature, odor, pH, DO, BOD, and COD. The temperature ranged from 26.86°C to 28.84°C, meeting the quality standards. The highest temperature, 28.84°C, was recorded at station 3, while the lowest, 26.86°C, was at station 1. Temperature differences may be caused by weather, heat during sampling, and the presence of plants, which can absorb sunlight and increase water temperature (Fadilla, 2021). The optimum temperature for macrozoobenthos is 25-32°C (Putri et al., 2021).

Odor measurements indicated that station 1 and station 3 had no detectable odors, while station 2 emitted an odor due to chicken slaughterhouse waste and domestic waste. Odorous water is an indicator of pollution and can impact macrozoobenthos diversity. The pH values ranged from 8.1 to 8.5, with the highest at station 2 and the lowest at station 1. This pH range is within the acceptable water quality standards set by the Indonesian Government Regulation 22 of 2021. A pH range of 7.0 to 8.7 is ideal for gastropods. Extreme pH values can disrupt aquatic life, including macrozoobenthos (Deswati et al., 2022).

DO levels ranged from 3.86 mg/L to 11.21 mg/L, with station 2 having the highest value of 10.56 mg/L, while station 1 had the lowest at 4.69 mg/L. Station 2's high DO levels could be influenced by the temperature and organic waste from the slaughterhouse. High DO levels indicate good water quality for aquatic life (Ernawati & Dewi, 2016). According to PP No. 22 of 2021, the minimum DO value should be 3 mg/L, and the optimal range for macrozoobenthos is 4-6 mg/L (Gupta et al., 2017). DO levels can show the dissolved oxygen content in these waters, so DO levels can be an indicator of a body of water pollution. Organic compounds in the river can affect the DO value; the greater the amount of organic compounds present in the water, the more oxygen demand bacteria require for the decomposition process of these organic compounds (Boyd, 2019).

BOD values ranged from 5.66 mg/L to 9.87 mg/L, with the highest at station 2 and the lowest at station 3. These values do not meet the quality standards. The increase in biological oxygen demand (BOD) value can also be caused by organic pollution in the waters, where, at station 2, organic matter comes from chicken slaughtering waste and domestic waste directly discharged into the river flow. In water quality standards, the BOD parameter is essential for determining water quality. The BOD parameter utilizes oxygen to determine the content of organic substances in water (Fagbayide & Abulude, 2018). Microorganisms in water can affect BOD levels; the more microorganisms contained, the higher the BOD levels. So, the BOD parameter is tested by utilizing microorganisms when oxidizing organic matter, which then measures the amount of oxygen the bacteria uses (Cao et al., 2021). The COD values ranged from 7.44 mg/L to 11.97 mg/L, which still meet quality standards. COD measures organic substances that cannot be oxidized in the BOD test (Fardiaz, 2006). Higher COD values indicate more dissolved oxygen is required to decompose organic matter, affecting aquatic biota, particularly macrozoobenthos (Sandi et al., 2017).

CONCLUSION

Macrozoobenthos in Juri River Pasuruan consists of two families and three species, *Tarebia granifera, Melanoides tuberculate,* and *Terrathelphusa chilensis*. The overall diversity index value in Juri River is 0.7, this is classified as a low diversity category because the results indicated that all stations have low diversity based on the Shannon-Wiener index (H < 3.00). In terms of pollution categories are classified as severely contaminated, as the diversity index falls under 1.0. The results of water quality measurements in terms of physico-chemical parameters show that the parameters of temperature, odor, pH, DO, and COD still meet the established quality standards, namely the quality standards for class 3 river water according to Government Regulation no.22 of 2021, while the BOD parameter does not meet the quality standards.

REFERENCES

Arfiati D, Herawati EY, Buwono NR, Firdaus A, Winarno MS, and Puspitasari AW, 2019. Struktur Komunitas Makrozoobentos pada Ekosistem Lamun di Paciran, Kabupaten Lamongan, Jawa Timur. *JFMR (Journal of Fisheries and Marine Research);* 3(1): 1-7.

Boyd CE, 2019. *Water quality: an introduction*. Springer Nature. Berlin.

Cao L, Zhang D, Guo Q, and Zhan J, 2021. Inversion of Water Quality Parameter BOD5 Based on Hyperspectral Remotely Sensed Data in Qinghai *Lake*. In *2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS* (pp. 5036-5039). IEEE.

Cumberlidge N, 1999. *The freshwater crabs of West Africa: family Potamonautidae* (Vol. 36). IRD editions.

Deswati D, Safni S, Khairiyah K, Yani E, Yusuf Y, and Pardi H, 2022. Biofloc Technology: Water Quality (pH, temperature, DO, COD, BOD) in a Flood & Drain Aquaponic System. *International Journal of Environmental Analytical Chemistry*; 102(18): 6835-6844.
Edmondson WT (Ed.), 1959. *Fresh-water biology. John Willey and Sons*. New York.
Effendi H, 2003. *Telaah Kualitas Air bagi Pengelolaan Sumberdaya dan Lingkungan Perairan*. Yogyakarta: Penerbit Kanisius.
Ernawati NM, and Dewi APWK, 2016. Kajian Kesesuaian Kualitas Air Untuk Pengembangan Keramba Jaring Apung di Pulau Serangan, Bali. *Ecotrophic*; 10(1): 75-80.
Fadilla RN, Melani WR, and Apriadi T, 2021. Makrozoobentos sebagai Bioindikator Kualitas Perairan di Desa Pengujan Kabupaten Bintan. *Habitus Aquatica*; 2(2): 83-94.
Fagbayide SD, and Francis OA, 2017. Effects of Human Activities on Water Quality Assessment of Ala River in Akure, Ondo State, Nigeria. *World Journal of Environmental Research*; 8(1): 37- 44.
Fardiaz S, 2006. *Polusi Air dan Udara.* Yogyakarta: Penerbit Kanisius.
Gupta N, Pandey P, and Hussain J, 2017. Effect of Physicochemical and Biological Parameters on the Quality of River Water of Narmada, Madhya Pradesh, India. *Water Science*; 31(1): 11-23.
Hendrasarie N, and Santosa BA, 2019. Pengolahan Limbah Cair Rumah Potong Hewan Menggunakan *Rotating Biological Contactor* Modifikasi *Sludge Zone*. *Journal of Research and Technology*; 5(2): 168-177.
Hernawati RT, 2021. Kepiting Air Tawar (*Decapoda: Brachyura*) Dari Lereng Selatan Gunung Slamet, Kabupaten Banyumas, Provinsi Jawa Tengah. *Zoo Indonesia*; 28(2): 97-111.
Jeratthitikul E, Paphatmethin S, Sutcharit C, Ngor PB, Inkhavilay K, and Prasankok P, 2022. Phylogeny and Biogeography of Indochinese Freshwater Mussels in the Genus *Pilsbryoconcha Simpson*, 1900 (Bivalvia: Unionidae) with Descriptions of Four New Species. *Scientific Reports*; 12(20458): 1-12.
Junaidi FF, 2014. Analisis Distribusi Kecepatan Aliran Sungai Musi (Ruas Jembatan Ampera sampai dengan Pulau Kemaro). *Jurnal Teknik Sipil dan Lingkungan*; 2(3): 542-552.
Lee CD, Wang SB, and Kuo CL, 1978. Benthic Macroinvertebrate and Fish as Biological Indicators of Water Quality, with Reference to Community Diversity Index. Bangkok. Thailand. *International Conference on Water Pollution Control in Development Countries.*
Lentge-Maaß N, Neiber MT, Gimnich F, and Glaubrecht M, 2021. Evolutionary Systematics of The Viviparous Gastropod Sermyla (Gastropoda: Cerithioidea: Thiaridae), with The Description of A New Species. *Zoological journal of the linnean society*; 192(3): 736-762.
Musayaroh S, and Muntalif BS, 2020. Determination of Surface Water Quality based on Macrozoobenthos Biodiversity and The Prevalence of *Trematodes cercariae* in Freshwater Molluscs. *Malaysian Applied Biology*; 49(2): 19-25.
Mushthofa A, Rudiyanti S, and Muskanonfola MR, 2014. Analisis Struktur Komunitas Makrozoobenthos sebagai Bioindikator Kualitas Perairan Sungai Wedung Kabupaten Demak. *Management of Aquatic Resources Journal (MAQUARES)*; 3(1): 81-88.
Ningrum NC, and Kuntjoro S, 2022. Kualitas Perairan Sungai Brangkal Mojokerto berdasarkan Indeks Keanekaragaman Makrozoobentos. *LenteraBio: Berkala Ilmiah Biologi*; 11(1): 71-79.
Peraturan Pemerintah, 2021. *Peraturan Pemerintah (PP) tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup.* Web publication https://peraturan.bpk.go.id/Home/Details/161852/pp-no-22-tahun-2021. Accessed 15 October 2023
Purba NC, and Fitrihidajati H, 2021. Kualitas Perairan Sungai Sadar Berdasarkan Indeks Keanekaragaman Makrozoobentos dan Kadar Logam Berat (Pb) di Kabupaten Mojokerto. *LenteraBio: Berkala Ilmiah Biologi*; 10(3): 292-301.
Putri VT, Kartini N, Yudha IG, and Damai AA, 2021. The Performance Of Macrozoobentos As A Bioindicator Of Water Quality In The Lower Parts Of The Hurun Lampung River. *Journal of Aquatropica Asia*; 6(2): 72-82.
Rachman H, Priyono A, and Mardianto Y, 2016. Makrozoobenthos sebagai Bioindikator Kualitas Air Sungai di Sub Das Ciliwung Hulu. *Media Konservasi*; 21(3): 261-269.
Sandi MA, Arthana IW, and Sari AHW, 2017. Bioassessment dan Kualitas Air Daerah Aliran Sungai Legundi Probolinggo Jawa Timur. *Journal of Marine and Aquatic Sciences*; 3(2): 233- 241.
Selvianita S, Zainal S, and Bustamim B, 2024. Macrozoobentos Diversity as A Bioindicator of Water Quality in Poso Lake, South Pamona District, Poso Regency and Its Utilization as A Learning Media. *Equator Science Journal*; 2(2): 27-42.
Sidik RY, Dewiyanti I, and Octavina C, 2016. Struktur Komunitas Makrozoobentos dibeberapa Muara Sungai Kecamatan Susoh Kabupaten Aceh Barat Daya. *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah*; 1(2): 287-296.
Simanjuntak SL, Muskananfola MR, and Taufani WT, 2018. Analisis Tekstur Sedimen dan Bahan Organik Terhadap Kelimpahan Makrozoobenthos di Muara Sungai Jajar, Demak. *Management of Aquatic Resources Journal (MAQUARES)*; 7(4): 423-430.

Standar Nasional Indonesia, 2009. Cara Uji Kebutuhan Oksigen Kimiawi (Chemical Oxygen Demand/COD) dengan Refluks Tertutup secara Spektrofotometri. Jakarta: Badan Standarisasi Nasional.

Umroningsih U, 2022. Limbah Cair Menyebabkan Pencemaran Lingkungan. *Jisos: Jurnal Ilmu Sosial*; 1(7): 647-666.

Zulkifli H, and Setiawan D, 2011. Struktur Komunitas Makrozoobentos di Perairan Sungai Musi Kawasan Pulokerto sebagai Instrumen Biomonitoring. *Jurnal Natur Indonesia*; 14(1): 95-99.

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