Periphyton Diversity in Tree and Non Tree Locations in Coban Putri Tourism Area Tlekung Village, Junrejo, Batu District, East Java

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Abstrak

This study is an exploratory study that illustrates the diversity of periphyton in Coban Putri in Batu Regency dan measures the physical and chemical parameters including temperature, turbidity, light intensity, DO/BOD, nitrat, and orthophosphate. This study was conducted at 4 stations namely NPMA (non pohonmengalir/non tree-flowing), PMA (pohonmengalir/tree-flowing), NPMG (non pohonmenggenang/non tree-welled up), and PMG (pohonmenggenang/tree-welled up) by brushing epiphyte of periphyton on surfaces of stone and wood. Periphyton was identified by matching the identification book and 23 species were found. The highest periphyton abundance was found at NPMG 14395,16 n/ml. Physical parameters were pH 7,95-8,25, turbidity 5,5-18,6 NTUs, conductivity 0,13-0,14 mS/cm, temperature 20-22oC, and water brightness 5-24 cm. While chemical parameters were DO 4,80-5,30 mg/l, BOD 2,08-6,72 mg/l, nitrat 0,24-0,44 mg/l, and orthophosphate 0,01-0,06 mg/l. The species of periphyton found at 4 stations indicated the highest periphyton diversity at NPMG.

Keywords: *Periphyton; Diversity; Tourism Area; Coban Putri Waterfall;*

INTRODUCTION

Periphyton is one of biotic communities that can breed well in rivers (Rudiyanti, 2009). Periphyton usually lives on or around submerged substrates, these substrates can be rocks, wood, submerged aquatic plants, or aquatic animals (Odum, 1971). Periphyton is generally micro-sized, forming a colony, relatively sedentary, and epiphytic. Compared to plankton, the periphyton community acts as a producent on the river. It is because phytoplankton are carried by water flow, while periphyton are relatively fixed on the substrate. This makes periphyton play an important role as food for several types of invertebrates and fish (Syam, 1994).

Periphyton life in river is influenced by environmental factors such as physical, chemical, and biological factors. These factors include temperature, water flow, turbidity, nutrients (nitrates, ammonium, and orthophosphate), oxygen, pH, dissolved gases, and interactions with other organisms. Changes in river water quality affect the composition of the river ecosystem. Thus, periphyton can be an indicator of river water quality (Habib, 2009).

Periphyton abundance is also influenced by the presence of vegetation and vegetation canopy cover that can add organic material into river through the fall of leaves into the river and undergo decomposition. Vegetation canopy cover can also affect the light penetration entering the river waters. The difference in canopy cover density allows the difference of light received by the river waters below and affects the difference in the presence of periphyton in it (Ardiyansah dan Irwan, 2014).

Coban Putri is waterfall tourism located in Tlekung Village, Junrejo District, Batu Regency, Eas Java. This tourism can support the economic growth of the region, but amount of waste along with the increasing number of visits seems to potentially endanger the preservation of nature. Waste and detergents in the water flow cause changes in the aquatic ecosystem and may affect periphyton diversity. Periphyton's ecological role as a major producer and bioindicator of the quality of aquatic ecosystem makes study on the diversity of periphyton in Coban Putri necessary. This study also compare periphyton abundance in tree and non tree area.

METHODS

This study was conducted in October-November 2022 in Coban Putri, Tlekung village, Batu, East Java (7055'-7057' BT and 115017'-118019 LS). This study was conducted at 4 stations namely NPMA (non pohonmengalir), PMA (pohonmengalir), NPMG (non pohonmenggenang), and PMG (pohonmenggenang). Identification is carried out at the Ecology and Animal Diversity Laboratory, Department of Biology, Brawijaya University by using identification books in the laboratory.

Fig 1. Location of Study in Coban Putri (Google Earth, 2018)

The tools and materials used in this study are GPS, camera, sample bottles, brushes, knives, microscopes, slide glass, sedgewick rafter counting cells, pipettes, ropes, beaker glass, test tubes, plastic wrap, thermometers, turbidimeter, periphyton identification book, DO/BOD meter, CuSO4, formalin 10%, SnCl2, brucine, ammonium molybdate, whatman paper, H2SO4, and spectrophotometer.

Periphyton collection was carried out in the morning randomly (random sampling) at 4 stations by brushing epiphytes attached to rock surface and wood while spraying with distilled water. The sample was stored into a bottle and preserved with formalin 10% and CuSO4 of 3-5 drops. Then samples and chemical tests (DO/BOD, nitrate, and orthophosphate) are identified and analyzed in the laboratory. Whilw measurement of

physical parameters (temperature, conductivity, turbidity, and brightness of the water) is done at the time of sampling.

Temperature is measured by thermometer, water brightness is measured by secchi disk to determine the level of suspension and periphyton density, while turbidity is measured by turbidimeter (Subarijanti, 1990). DO levels are measured by a DO meter. The DO meter uses an oxygen probe consisting of a cathode and anode soaked in an electrolyte solution (Salmin, 2000).

Nitrate test was carried out by taking a 5 mL water sample filtered with wathman paper, adding 0.5 mL brucine solution and stirring. Then added 5 mL of H2SO4 solution, cooled and measured its absorbance using a spectrophotometer at 410 nm (Said and Mahmud, 2013). While the orthophosphate test was carried out by filtering a 10 mL water sample with whatman paper, added 0.4 mL of ammonium molybdate, added 0.1 mL of SnCl2 and measured its absorbance at 690 nm (Arizunadkk, 2014).

Periphyton identification is done by direct observation using a microscope and identified by matching the periphyton observed on a microscope with images in identification books.

RESULT AND DISCUSSION

Based on measurement of the physic-chemical water parameters conducted at 4 stasions (NPMA, NPMG, PMA, and PMG). The resuts are presented in table 1 below.

Table 1. The physic-chemical water parameters

Locations	pH	Turbidity (NTUs)	Conductivity (mS/cm)	DO (mg/l)	BOD (mg/l)	Nitrate (mg/l)	Ortophospate (mg/l)	Temperature (℃)	Clarity (cm)
NPMA	8,25	5,5	0,13	4,87	2,08	0,24	0,01	22	5
NPMG	8,01	18,6	0,14	4,80	5,92	0,30	0,06	22	24
PMA	7,95	15,9	0,14	5,30	3,9	0,44	0,01	21	15
PMG	7,97	14,1	0,14	5,13	6,72	0,20	0,01	20	7

The physic-chemical water parameters

- **pH**

  pH at the four stations ranges from 7.95 to 8.25. This value meets the water quality standards of class I, II, and III. It means that the pH water in this study is relatively high. The results indicate that more abundant periphyton in a location, can make more photosynthesis activity, make increase carbon dioxide in water, and pH will be higher. Periphyton biota is generally sensitive to pH changes and pH value of those stations is ranged of 7-8.5. This is in line with the statement of Effendi (2003), the higher the CO2 respiration, the higher the pH.

- **Turbidity**

Turbidity values for the four stations range from 5.5-18.6 NTUs. Turbidity is caused by organic and anorganic materials that settle and dissolve such as mud, fine sand, and water depth. The highest value of turbidity was in NPMG which was 18.6 NTUs. This is due to human activities (bathing and camping). According to Wardoyo 1975 i*n*Supratiwi (2000), high turbidity affects light penetration so that photosynthetic productivity will be reduced.

- **Conducitvity**

  Conductivity values at the four stations range from 0.13 to 0.14 mS / cm. The conductivity of the Coban Putri waters is still within the ideal limits for aquatic life because the values are below 400 mS / cm. According to Asdak (2007) the most dominant factor in influencing changes in conductivity in a waters is temperature.

- **DO**

  DO values at the four stations ranged form4.80 to 5.30 mg / l This value meets the water quality standards of class I and II. The highest DO value is in the PMA that is 5.30 mg / l, this is influenced by the brightness level of the location and the depth of the water is only 15cm (shallow) causing a high abundance of periphyton. According to Odum (1971), dissolved oxygen is one of the main elements in the process of metabolism of organisms, especially in the process of respiration.

- **BOD**

  BOD values in the four stations ranged from 2.08 to 6.72 mg /l This value meets the water quality standards of class I, II, and III. BOD indirectly describes the amount of organic material that can be deciphered biologically. The highest BOD value is on PMG (stagnant tree) which is 6.72 mg / l. This is consistent with Jeffies and Mills 1996 in Effendi (2003), BOD waters values range from 0.5 to 7.0 mg / l, so it is good for periphyton growth. This is due to the condition of the location of the PMG station being a road for citizens' vehicles to carry out activities on plantations around Coban Putri. This activity causes the station to be exposed to vehicle smoke pollutan

- **Nitrate**

  The highest nitrate value is at the pma (tree flowing) station which is 0.44 mg / l, this is due to some activity in the area around the main station, which is the activity of guava plantations carried out by local residents. the location of the pma is the location of the plantation, it is suspected that the water flowing in the area has been contaminated by synthetic fertilizers used by farmers for the purposes of guava plantations. this is consistent with effendi's (2003) presentation, the presence of nitrates in waters originating from the atmosphere, industrial exhaust, and fertilization.

Based on the quality standard nitrate values at the four stations ranged from 0.20 to 0.44 mg / l. this value meets the standard of water quality class I. meaning that the water can be used for drinking. however, if we look again at the sightings and several other activities carried out by visitors and local residents around Coban Putri, such as bathing at the NPMG (non-puddled) station, the NPMG location is a location close to Waterfall, and is often used as visitor's bathing pool, water flowing from here will go down and affect the quality of the water below. So , from this explaining it can be concluded that the water in cobanputri cannot be used as drinking wate.

- **Orthophosphate**

Ortophosphate values at the four stations ranged from 0.01 to 0.06 mg / l. This is due to the large number of leaf litter around the site, both naturally and severely cut off due to high human activity on the coban (swimming and camping). This is in accordance with Ulqodry et. Al., (2010) that the high orthophosphate content is derived from dead flora and fauna of the biota, the use of detergents, fertilizers, and domestic. Effendi (2003) states that the orthophosphate element is the main nutrient for periphyton growth. So that if these nutrients are available, the abundance of periphyton will increase.

- **Temperature**

The temperature at the four stasions ranges from 20-22^{o}C. Temperature as a regulator of metabolism and physiological functions of organisms. According to Welch (1980), Halsen (1995) in Effendi (2003) that auqiatic organism have a certain range that is good for growth such as periphyton groups will grow well in temperature range of 20-30^{o}C. The result of temperature measurement show those stations has optimum temperature for periphyton growth.

- **Clarity water**

The clarity of all four stations range from 5-24 cm. Periphyton can be divided into several types based on substrate on they are attached, namely epilithic (attached to stone), epiphytic (attached to plants), epizoic (attached to animals), and epipelic (attached to sediments) (Cole, 1988). Apart form being a place to grow, the substrate is also a determining facotr for developing periphyton. Permanent in animate substrate compared to living matter substrate that experiences growth anda death (Pratiwi*et al*, 2017)

Table 2. Species identification at four stations

Species	NPMA		NPMG		PMA		PMG	
	Stone	Wood	Stone	Wood	Stone	Wood	Stone	Wood
Actinastrumhantzchii				+				
Anabaena helicoidal						+		
Chroococcus turgidus				+				
Closterium canceolatum			+	+	+			
Diploneis elliptica				+				

Eucocconeisflexella			+							
Euglena agusta						+				
Fridaeatorrenticola					+					
Gonatozygon spp.			+	+		+				
Gymnozyga spp.			+	+	+	+			+	
Hyalothecadissilliens			+							
Mastogloiadanseii				+						
Mesotaeniumaplosporum			+							
Mycrocistis maxima					+					
Peniumnavicula						+				
Phacusacutissimus			+							
Phaluspleuronectes				+						
Pleurodiscusborinquenae					+					
Pleurotaenium spp.			+	+	+					
Schenedemuxhystrix	+	+								
Spaerocystisschrosteri				+						
Ulothrix zonata	+									
Uronemaelongatum								+		

Table 3. Density

Stasiun	Taxa Richness	Kerapatan Total (n/ml)
NPMA	2	5000
NPMG	14	14395,16
PMA	10	3714,29
PMG	2	1333,33

The density at each station looks different. At a non tree station, the density is higher than station with tree. This is caused by the cover of the tree canopy which can reduce sunlight penetration. As Weitzel (1979) states that periphyton needs sunlight for photosynthesis. At the PMA station, there are bamboo groves that cover the waters. While at the PMG station, there are a jackfruit tree that cover the waters. Besides, physical and chemical parameters also affect the difference in density values.

Higley (2001) stated that water currents also affect the presence of periphyton. The more rapid the flow of water, the lower the density is likely. However, the density value at the PMA station is high, because this station is water drainage with a depth of only 15 cm and its location is close to guava plantations which are routinely fertilized and given NPK pesticides.

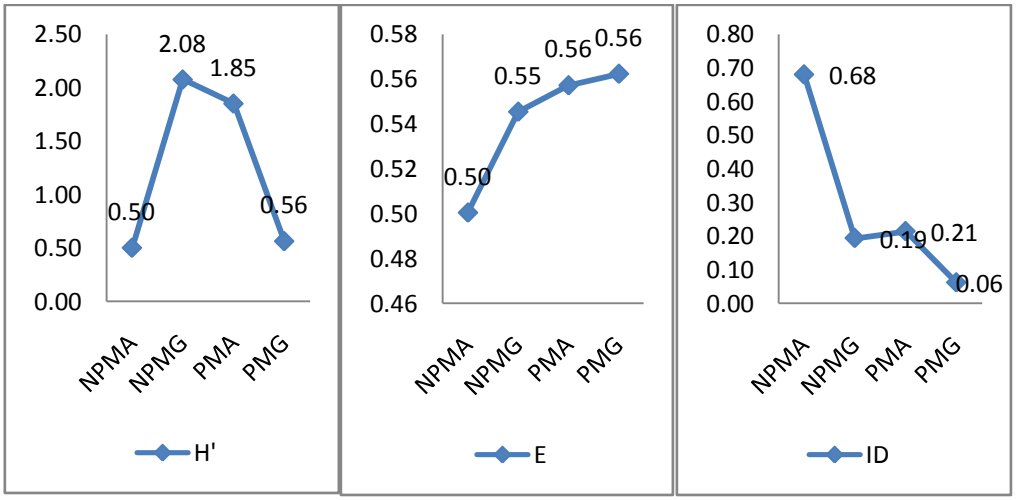

Fig. 2. (1) Diversity (2) Evennes (3) Dominance

The correlation between variables in this study is presented in the following PCA analysis:

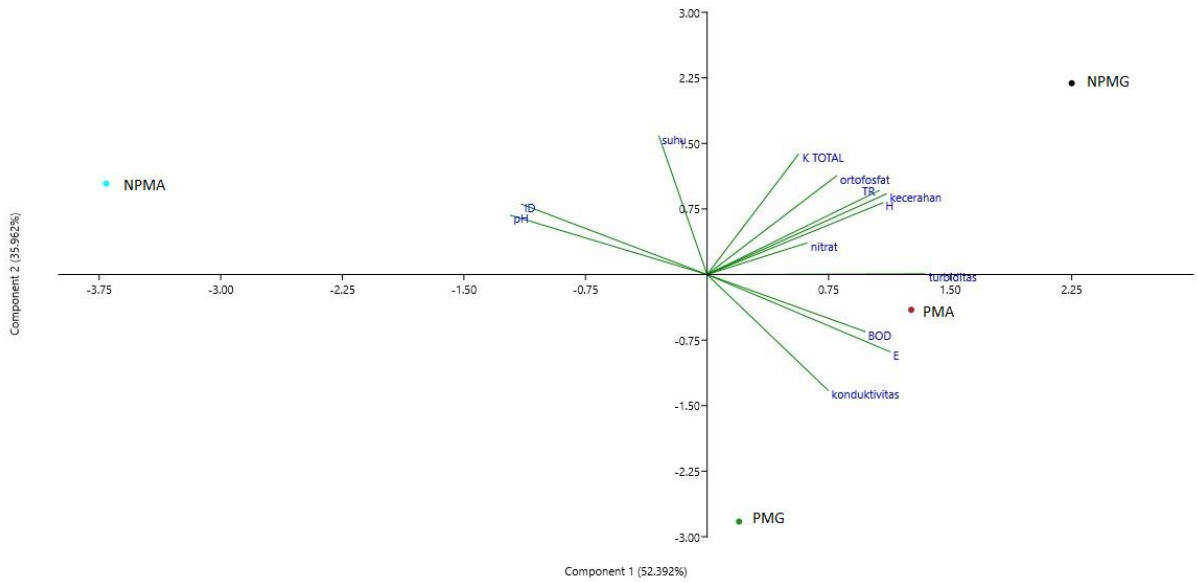

Fig. 3. PCA analysis between variables

NPMG Station has the highest diversity value compared to 3 other stations. Based on the PCA analysis above, the most influencing diversity is the physics-chemical parameters in the form of nitrate, brightness, and orthophosphate levels. While other parameters that affect diversity are total density and taxa richness. Nitrate and orthophosphate levels directly affect the presence of periphyton, as well as the brightness that determines the level of sunlight penetration. While the density of the individual periphyton and the number of species found in each substrate play a role in forming periphyton diversity at each station.

CONCLUSION

Based on research results, periphyton found in Coban Putri is 23 species. The measured water quality includes physical and chemical parameters indicating conditions that support the survival of periphyton life.

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