Characteristic of Microphyta Distribution of Pager River, Central Kalimantan

Inga Torang[1], Sulmin Gumiri[2], Ardianoor[2], Adi Jaya[3]

[1] Doctoral Program of Environmental Science, University of Palangka Raya, Indonesia
[2]Department of Aquatic Resources Management, Faculty of Agriculture, University of Palangka Raya, Indonesia
[3]Department of Agronomy, Faculty of Agriculture, University of Palangka Raya, Indonesia

Received: December 6, 2020. Revised: April 24, 2021. Accepted: May 13, 2021. Published: May 17, 2021.

Abstract— Environmental damage due to natural resource extraction, especially in watershed areas, seems to be of increasing concern and so far, from the aspect of aquatic and water resources, plankton is commonly used as an indicator of environmental damage. This study explores the distribution of microphyta as a parameter of environmental damage. The research was conducted in Pager watershed, Central Kalimantan and sampled at 2 (two) stations, namely station A (for the right side of the river) and station B (for the left side of the river). The study was conducted 13 sampling times, which began in the period 25 May 2019 ending until 9 November 2019. Laboratory analysis to identify the type and number of microphyta was carried out at the Palangka Raya University Laboratory. The results showed that the number of microphyta taxa at station A (right side of the river) was 12-13 species, more than station B (left side of the river). The number of microphyta taxa at Station B is 8 - 9 species, it is suspected that there is an influence from the gray water settlements around the left side, especially when the water level drops. The distribution characteristics of microphyta in the Pager river are as follows: large number of taxa/species, low abundance and low diversity index. River/peat water environments are vulnerable to change, especially human interference. This research shows the potential use of microphyta as an indicator of environmental damage.

Key words: microphyta, environmental damage, watershed.

I. INTRODUCTION

Central Kalimantan, with an area of 153564 km^2, is seen by NGOs and the international community as the lungs of the world, because it has a forest area of 12561867.57 Ha [1]. However, this forest area continues to decrease due to human activities in meeting primary and secondary needs plus changes in land use for plantation business and settlement development. For example, the area of forest area according to the 2015 Provincial Spatial Planning is 15 324 842,97 Ha according to the latest 2020 data becomes only 12561867,57 Ha, reduced by 2762975,4 Ha or 18,03%. The decline in forest area includes a decrease in the forest area of peat, covering an area of 27.827,35 hectares which is the largest peat lands and some of them are the waters [1]–[3]. One of the implications of the reduction in peat areas is a decrease in the area of swamps and peat waters, including peat rivers. A peat area that is rapidly experiencing a decrease in area is a forest area of Karangas (such as the Pager River, the location of this study), because the Karangas forest area is a thin/shallow peat area that dries quickly during the dry season [4]–[7].

Pager river is an order of rivers from the Rungan river, whose water source comes from shallow groundwater flowing over quartz sand which is covered at the top by peat (high and low level vegetation litter). The Pager river environment can still be said to be natural, because there is still forest vegetation on the left and right of its flow even though it is not a primary forest. Areas that are still vegetated are lowlands, which are often inundated by rainwater and Pager river runoff when there is a rain event. This is also the reason why the land clearing is slow, so it is different from other rivers in this area (such as: Dapur river, Tahai river, Asem river, Petuk Bukit river, and Takaras river). The Pager River is a river that supports the flow of the Rungan River, which is an important nutrient input for the aquatic biota of the Rungan River (especially the downstream part of the Pager river estuary). Viewing from the water source which is peat water (Karangas forest), Pager river water can be categorized as an oligotrophic or infertile water [8]. This can be shown by the low abundance of diversity index and uniformity index of autotrophic organisms. The autotrophic organisms in here are phytoplankton, these organisms are usually used to show the level of environmental pollution. In this study, the autotrophic organisms used as indicators were microphyta. Microphyta are autotrophic organisms that attach to the substrate, so that it can survive in waters that have current conditions [9]–[11]. This is what distinguishes it from phytoplankton, so that its growth and reproduction are determined by the organic matter that presents and formed in that area only. [12]–[14]. If phytoplankton, its existence cannot describe the conditions in which it is located, because the organic matter / materials it needs and its utilization does not describe the conditions in which it is located [12], [13].

The use of microphyta in this study is not intended to describe the level of pollution that occurs in the Pager river, because as stated above, these waters are still considered natural. Several studies have been conducted to differ the level of using Macrophytes as biological indicators of organic pollution [14]–[18].

The important problem is from a practical view of this point, regarding the waters of peatlands and heath forests that need to be preserved and maintained, especially in Central Kalimantan which was declared the lung of the world. Many discussions in the form of seminars and conferences have focused more on peat soils and heath forests, very little has touched the waters and the important commodities in them. However, this has greatly inspired the exploration of knowledge that is more focused on peat waters especialy peat swamps and rivers.

Considering that microphyta research in peat waters (swamps and peat rivers) is still rare and moreover, research in the Pager river has never done by any researchers. So the authors hope this is a new finding and more further investigation by young researchers. However, the use of microphyta as an indicator biology, as stated in the research objective, namely to describe the natural conditions of the Pager river as a peat water / river to support the existing life systems in it. The distribution characters of microphyta referred to in this study are: number of taxa / species of microphyta, abundance of microphyta, diversity index, uniformity index, and dominance index.

II MATERIAL AND METHOD

Location and Time

This research was conducted in the Pager river (the order of the Rungan river) which crosses the administrative area of Pager Jaya Urban village, Rakumpit Sub district, Palangkaraya City, Central Kalimantan Province (Figure 1). The research was only conducted at 2 (two) stations, namely: station A (for the right side of the river) consisting of 3 sub-stations (A1, A2, and A3), and station B (for the left side of the river) consisting of 3 (three) sub-stations (B1, B2, and B3). Overall there are stages in the research method:

a. Preliminary research; settled the station
b. Collecting substrate; deadwood with diameter about 10 – 15 cm that has been submerged in water, cut with length 50 cm
c. Build stations; preparing 6 poles in one station to tie substrate (A1, A2, A3 and B1, B2, B3), every pole ties up 2 substrates, put to under water about 50 cm depth.
d. Data collecting: every 2 weeks, 13 times; in situ measurement: current velocity, water brightness, Depth, water temperature, TDS, CO2, pH of Water rement; ex situ: water sampling, Microphyta sampling by sub-stations and stations and Preservation of microphyta samples.
e. Laboratory; Microphyta observation and calculating environmental constants (number of species / taxa, abundance, diversity index, uniformity index, and dominance index).

The station for the middle part of the Pager river was intentionally eliminated, because if this conducted it would disrupt community transportation activities. In addition, the construction of a special station in the middle of the river flow from previous experiences in the Jalemu river (the locus of this research which was originally set in the proposal), has always been damaged by currents when the volume of river water increases shortly after a heavy rain event. As a result, continuous data cannot be obtained, such as stations on the left and right of the river. Stations that are installed on the left and right of the river must also be strongly and firmly installed. In this study, stations A and B were installed on the former of each emergency bridge support before the current permanent bridge crossing the Pager river with a bridge span of 40 m.

The width of the Pager river, which is used as an observation station, when the water level is receding, there is still an inundated width of about 17 m. The width of the Pager river segment where this station is installed when the water level rises / floods in the rainy season can reach 60 - 80 m. The position of this research station is in the upstream part of approximately 25 m from the Pager river bridge. A condition that distinguishes between the two stations on the right side (A) and the station on the left side (B), that on the right side the flow of sewage from community settlements does not hit station A either during the dry season or the rainy season. Meanwhile, on the left side, the wastewater from the community settlements hits Station B, especially during the dry season or when the water level drops.

The time for conducting the research was from May 25th, 2019 to November 9th, 2019, with a 12-day observation / sampling interval. So that the total number of sampling is 13 times, excluding preliminary research and research station set-up.

Tool and Material

`The tools used consisted of in-situ water quality measuring instruments, the substrate on which the microphyta colonies were grown and attached, microphyta scrapers from the substrate, water sample bottles, microphyta storage bottles produced by scraping, and microscopes and sample labeling tools. The substrate to which the microphyta is attached is dead wood (in the form of logs with a diameter / circumference of 12-17 cm) that has been submerged in water at the research location. The length of the substrate is 50 cm, the total substrate installed at stations A and B is 72 pieces. While the materials used were microphyta samples and water samples for ex-situ analysis.

Identification of the type/species of microphyta

Observations about the microphyta type of this study, were micro-phyta that adhered and grew naturally on the substrate attached to the sub-station. The substrate used is dead wood that has been submerged for a long time in the Pager river, which is cut along 50 cm with an average circumference of 10-15 cm. The substrate is installed in pairs of 2 (two) substrates on a post as a support, for example for a water depth of 150 m, 3 pairs of substrates are installed. However, for more practical implementation, 5 pairs of water as deep as 2.5 m were installed. When sampling is carried out, only the substrate which is submerged in water is removed and its surface scraped.

The results of the abrasive surface of the substrate are collected in a plastic basin, put into a sample collection bottle and preserved with 2-3 ml lugol for a sample volume of 120 ml. Then the sample collection bottles were taken to the laboratory for species identification and the number of individuals was counted according to the applicable standards for micro-algae observation with calculation formulas as written in this journal, starting from: number of taxa / species, abundance, diversity index , uniformity index, and dominance index. Observation results about objects are referred to in the book of "Stream Periphyton Monitoring Manual [19].

An abundance of microphyta (N)

The microphyta identification results above are used to calculate the abundance of microphyta from each sub-station to the station. Abundance calculation uses the modified formula as follows:

$$N = (n \times Oi \times Vr)/(Op \times Vo \times Os) \times 1/A \quad \text{......(1)}$$

Where: N = an abundance of microphyta (ind/L); n = the number of microphyta observed (ind); Oi = substrate surface area (cm^2); Vr = coverglass area (3,24 cm^2); Op = luas lapang pandang/ field of vision area (2,83 cm2); Vo = the volume of the microphyta sample in the bottle; Os = the volume of pipette drops used to take microphyta samples and A= substrate area.

Diversity index (H')

The next calculation is the calculation of the microphyta diversity index for each sub-station and observation station. The calculation uses the formula from Shannon - Wiener as follows:

$$H' = \sum_{i=1}^{s} pi \log pi \qquad pi = \frac{n}{N} \quad \text{..(2)}$$

where: H' = diversity index; n = an abundance of individuals; N = total abundance; pi = the proportion of the number of individuals.

Uniformity index (E)

The basis for calculating the microphyta uniformity index in the research is continuing the calculation of the diversity index at point formula 3. above using the following formula:

$$E = H'/H \max \quad \text{.................(3)}$$

where: E = Evenness species uniformity index; H' = diversity index; and H max = ln S (for S is the number of taxa / species).

Dominance index (D)

The calculation of the microphyta dominance index in this study, using data from the calculation of individual abundance (n) and the total abundance per each sampling time for each sub-station. For station A, namely the calculation from sub-stations A1, A2, and A3; as well as the next for station B, namely the calculation from the sub-station B1, B2, and B3. The formula for the calculation is as follows:

$$D = \sum(ni/N)^2$$
or
$$D = \sum(pi.1)^2 + (pi.2)^2 + (pi.3)^2 + \dots + (pi.n)^2 \quad \text{...(4)}$$

where: D = dominance index; n = an abundance of species; N = total abundance per sampling; pi = proportion of the number of individuals per sampling.

Data analysis

To describe environmental conditions and water quality, a descriptive approach was used using MS Excel 2007. As for the relationship between physic-chemical variables in waters with microphyta distribution at and between research stations using multiple variable statistical analysis according to Principle Component Analysis (Legendre & Legendre, 1983; Ludwig & Reynolds, 1988) which is available in SPSS version 22.

III RESULTS AND DISCUSSION

The taxa of microphyta

Microphyta found in the Pager river (peat river) consist of: the phyllum of Cyanophyta, Ochrophyta, Cyanobacteria, Chlorophyta, Chrysophyta, and zooplankton groups. Phyllum of Cyanophyta consists of 7 genus, namely: Actinastrum, Anabaena, Aphanochaeta, Aphanozemenon, Lyngbya spp, Oscillatoria, and Rivularia. Phylum of Chlorophyta consists only of the genus of Ophiocytium. Phyllum of Cyanobacteria consists of 10 genus, namely: Arthospira, Beggiatoa alba, Calothrix, Crucigenia, Cylindrospermopsis, Dactyloccopsis, Planktothrix, scytonema, spirulina, and synechococcus. Phyllum of Chlorophyta consists of 24 genus, namely: Ankistrodesmus, Chaetophora, chlorella, Chlorogonium, Closterium sp., Closterium moniferum, Closteriopsis acicularis, Closteriopsis longisima, Cylindrocystis, Euronema confervicola, Gonatozygon, Hormidium, Moegeotia sp., Moegeotiopsis, Netrium, Oedocladium, Quadriqula closteriodes, Selenastrum, Sphaeroplea, Spirogyra, Stigeoclonium, Tetraedron, Tetraspora, and Olothrix. Phyllum of Chrysophyta consist of 26 genus, namely: Achnantes, Amphora, Carteria, Coconeis, Coscinodiscus, Desmidium, Diatom, Ephitemia, Eunotia, Flagillaria, Gomphonema, Gyrisigma, Melosira, Meridion circulare, Mougeotia, Navicula, Nitszchia, Pinnularia, Pleurosigma, Pleurotaeniu, Rhopalodia gibba, Spirotaenia, Stauroneis, Srirella, Synedra, and Tabellaria. As for the other groups (zooplankton) that were found attached to the substrate, there were 24 genus, namely: Amphileptus, Amphisiela, Arcella sp.,Astromoeba, Brachionus, Corythion, Cyclidium sp., Dileptus sp., Euglena deses, Euglena gracillis, Euglena oxyuris, Euglypha tuberculata, Floscularia regens, Nassula, Notholca, Ophrydium, Philodina, Pleosoma, Rhodomonas, Rotaria, Spirotonum, Tracheloraphis, Thuricola, and Uroglena sp.

The distribution of the microphyta genus at each station, sub-station and between sampling times is unevenly distributed and continuously distributed. So that the number of microphyta taxa (genus and species) found in the Pager river as a peat river through this research, can be seen in Figure 2 and 3 (following graphs). The number of taxa or genus found at station A (Figure 2) ranges from 4 - 39. The smallest number of taxa, namely 4 genus, is found at sub-station A2, and the highest number, namely 39 genus, is also found at sub-station A2. Whereas in 2 (two) sub-stations, sub-station A1 there are 8-24 genus and at sub-station A3 amounted to 8-25. As a result, the average number of taxa or genus at station A (right side of the river) is 12 -13 genus for the duration of the study. The small number of taxa at station B (Figure 3) ranges from 4 - 24 genera, with an average of 8 - genus only. The smallest number of taxa, namely 4 genus, is found at sub-station B1, and the largest taxa are found in two sub-stations, namely B2 and B3, which contained 24 genus.

Abundance of Microphyta

The abundance of microphyta found in the Pager river as a peat river through this study, ranged from 24 - 1089 ind/L or an average of 129.3433 ind/L. Abundance distribution according to station and sub-station can be seen in Figures 4 and 5 (following graph).

The smallest microphyta abundance 20 ind/L found in the 3rd sampling of sub-stations A2. While the greatest abundance amounted to1089 ind/L found in the 13th sampling of sub-station B1. The average abundance of microphyta at station A (right side of the river) amounted to

Biodeversity of Microphyta

The diversity of microphyta found in the Pager river as a peat river through this study, ranged from 0.3500 - 1.8175 or an average of 0.8433. For details on the microphyta diversity index during research activities at both stations can be seen in Figure 6 and 7 (the following graph).

The smallest microphyta diversity index of 0.3500 found in this study was found at sub-station A1. However, the average microphyta diversity index at station A (right side of the river) amounted to 0.8500, higher than the average microphyta diversity index of 0.8367 at station B. Although the highest diversity index equal to 1.8175 found at sub-station B.

1. The uniformity

The microphyta uniformity index found in the Pager river through this study ranged from 0.3322 - 1.1641 or on average. For details, the microphyta uniformity index during research activities at both stations can be seen in Figure 8 and 9 (the following graph).

The smallest microphyta uniformity index of 0.3322 found in this study was found at sub-station B1 on the 13th sampling. While the largest uniformity index, namely 1.1641, was found at sub-station B2 also at the 13th sampling. The average microphyta uniformity index at station A (right side of the river) is 0.8096, smaller than the average microphyta uniformity index of 0.8112 at station B.

2. Dominance Index

The microphyta dominance index found in the Pager river through this study ranged from 0.0764 - 0.6202 or an average of 0.2131. For details on the microphyta dominance index during research activities at both stations, it can be seen in Figures 10 and 11 (following graphs).

Water quality support

Water Physics Components

The components of the physical properties of are the components of water quality as a living medium and water as a hydrological parameter. As a periphyton living medium, the estimated and measured quantities of water are: water temperature, TDS, and water transparency. Meanwhile, as hydrological parameters, are: depth and velocity of the current. The place and time of measurement, together with the sampling time at each sub-station. Thus the value or magnitude is real time and minimal efforts have been made from the effect of changes in current due to the observer

a. Water depth

The depths of the research stations (A and B) ranged from 32 - 165.3 cm with an average of 91.5 cm being the water depth at the sub-station and the water depth at the time of sampling. The difference in depth between sub-stations and stations at one sampling activity occurs due to differences in the contours of the Pager river below. Meanwhile, the difference in depth between sampling times is due to differences in the height and low of the water level from the rain event before sampling or after sampling.

b. Speed/Velocity of water flow

The water flow at research stations (A and B) ranges from 0.14 - 2.21 Km / hour or an average of 0.65 Km / hour, is the constant velocity of the Pager river flow according to the station and sub-station. The difference between sub-stations and stations is due to hydrological obstacles that exist upstream (especially those that are permanent), to the stake (the milestone where the substrate is bound from the sub-station upstream). The speed of the flow can always be different even at the same point, the cause is the flow of water masses that are trapped or fall due to mass turbulence. The flow rate between sampling times is more influenced by the amount of rainfall that occurs in the catchment area of the Pager river, as shown in Figure 13, sampling 1 - 5 during the transition.

c. Water brightness level

The results of water brightness at the research station (A and B) ranged from 10.5 - 50.5 cm or an average of 21.97 cm. As a natural river, the brightness of the Pager River can reach 50.5 cm. This indicates that there is enough light to drive the photosynthesis process, only the water is yellow-brown, the sunlight entering the water body will be diffracted to the red wave belt which has the effect of heating the water more. The affecting factor water brightness of the Pager river (sampling 4 - 13) is the community's activity of circon mining in the upstream of the research station.

d. Water temperature

The temperature of water at the research station (A and B) ranges from 26.2 - 30.7 ºC or an average of 27.3 ºC (can be classified as low temperature waters). This is thought to be closely related to the Pager river flow fact (especially at upstream), is still covered by a canopy of tall vegetation. The water temperature increased in the 7 - 9 sampling, at a time when the activity of community for circon mining was quite intensive, so that the mudy particles appeared to be saving the temperature.

e. Total dissolved solid (TDS)

Total disolved solid (TDS) water at research stations (A and B) ranged from 21 - 28.7 ppm or an average of 24.73 ppm. This shows that Pager river water is not fertile, because it contains very little essential minerals which are really needed by living things, especially low-level plants such as periphyton. Although there is an effort to circon mine which causes the water become cloudy by the ground calloid, because the soil below is sand and the mineral concentration is very insufficient.

Water Chemical Components

a. The degree of acidity of the water (pH)

The degree of acidity (pH) of water at the research station (A and B) ranges from 3.07 - 5.26 or an average of 4.31. The lowest degree of acidity (pH) of water is found at the 4th sampling of station B, and the highest water pH is at the 8th sampling of station A. For details, the pH of water during research activities at both stations can be seen in Figure 17 (the following graph).

b. Dissolved oxygen (O_2)

Dissolved oxygen (O_2) in water at the research station (A and B) ranges from 3.20 - 4.78 ppm or an average of 3.95 ppm. The lowest dissolved oxygen (O2) in water is found at the 11th sampling of station A, and the highest dissolved oxygen in water is found at the 4th sampling of station A and B. For details on the dissolved oxygen in the water during research activities at both stations can be seen in Figure 18 (the following graph).

c. Total nitrogen (N)

The solubility of Total nitrogen (N) in water at the research station (A and B) ranged from 70.35 - 196.98 ppm or an average of 118.19 ppm. The lowest solubility of total N in water is found at the 3rd sampling of station A, and the highest total N is at the 5th sampling of station B. For details on the solubility of total N in water during research activities at both stations, it can be seen in Figure 19 (the following graph).

d. Total Phosphate (P)

The solubility of total phosphate (P) in water at the research station (A and B) ranged from 0.069 - 0.544 ppm or an average of 0.225 ppm. The lowest solubility of total P in water is at the 1st sampling of station B, and the highest total P is at the 8th sampling of station B. For details, the solubility of total P in water during research activities at both stations can be seen in Figure 20 (the following graph).

e. Potassium

The solubility of Potassium (K) in water at the research station (A and B) ranges from 55.37 - 67.57 ppm or an average of 66.6623 ppm. The lowest solubility of K in water is found at the sampling 11th of station A and the 13th sampling of station B, and the highest K is found at stations A and B in most of the sampling activities. For details on the solubility of K in water during research activities at both stations, it can be seen in Figure 21 (the following graph).

f. Chemical Oxygen Demand (COD)

The solubility of chemical oxygen demand (COD) in water at research stations (A and B) ranges from 15.5 - 18.3 ppm or an average of 16.9615 ppm. The lowest COD solubility in water was found at the 1st sampling of station B, and the highest COD was found at the 8th sampling of station B. For details on the solubility of COD in water during research activities at both stations, it can be seen in Figure 22 (the following graph).

The taxa of microphyta

Phyllum and microphyta taxa that a lot with abundance, diversity and little uniformity in the waters, actually indicating natural conditions. It is different if the dominance index is large, which states that conditions are changing, leading to pollution Research by Nasria, *et al.,* (2016) in Tinonggoli waterfall which is an area with clear water (not peat water), found 25 species with 755-1778 individuals. At least the microphyta taxa (genus/species) in the Pager river is thought to be related to several things, namely: (1) its geographic condition as a vegetated area that is quite dense and watery with peat, so that as the surface of the water where the microphyta grows and reproduces does not receive enough sunlight radiation for photosynthesis; (2) water with a low brightness level (21.97 cm) showed the thin layer of primary productivity; (3) an average water temperature of 27.3°C is considered too low to trigger the rapid photosynthesis process [20], (4). The low degree of water acidity (4.31) is only able to be adapted by microphyta to survive, but is not able to drive optimal growth [21] (5) important minerals that can encourage the growth of microphyta, especially the vegetable ones, are very deficient, as shown by the TDS value which is only around 24.73 ppm [21]. This view is supported by the fact that at station B, where the locus is slightly open from the plant canopy coupled with the indirect influence of human intervention (from household waste water/gray water), which has a small number of taxa but has a large enough abundance [12], [22].

The abundance of microphyta

Microphyta abundance is the opposite of the number of taxa/species, where station A (right side of the river) shows low abundance, namely 20 - 441 individuals/cm2 or an average of 110.87 ind/cm^2 compared to station B (left side of the river). The abundance of microphyta on the left side of the river ranges from 29 - 329 ind/L or an average of 129.34 ind/L. Overall, based on the abundance of its microphyta, which averages only 147.81 ind/L (in the range of 0 - 2000 ind/L), it is classified as poor waters or oligotrophs .

The low abundance of microphyta as an autotrophic organism (the provider of chemical energy for the trophic organisms above) is thought to be related to the ecological conditions of the Pager river, where the water reacts with acid, where in this atmosphere the nutrients that are actually needed by the microphyta are entangled [8], [23]. Although the difference is quite small, the abundance of microphyta at station B (left side of the river) has something to do with household waste disposal (gray washwater) for community settlements in Pager Urban village on the left side of the road (before the bridge) especially when the water level decreases [24], [25].

Diversity of microphyta

Diversity index is the key to balancing the distribution or evenness of individuals for each species in order to maintain species richness in a community [26]–[32]. Biodiversity is the fundamental appearance that represents the second part of an ecosystem, after physical and chemical environmental factors [33]. The diversity of microphyta in the Pager river is on average 0.81 - 0.85, lower than in fertile waters, for example 2.21 - 2.32 at Tinonggoli waterfall [32].

Based on this microphyta diversity index value, the Pager river (as a peat river) can be classified as an aquatic environment that has a low level of microphyta community stability [34]. The instability of this community is thought to be closely related to environmental conditions (namely: water depth, TDS, and brightness) which from the PCA analysis results as a component that affects the abundance and number of taxa. This physical environmental condition is thought to be related to the Karangas forest which is the source of water that watering the Pager River, which at the time of this research was not under normal watering conditions (this research period should have been in the middle of the dry season until it entered the rainy season), as a result of global climate change [32]. TDS and water brightness, especially during the implementation of the research, were influenced by the activities of the community that mining the zircon sand in the upstream part of the Pager river. This is evident in the turbidity level, which in this study uses the 6th (11.7 cm) and 8th (10.5 cm) sampling water brightness level unit approach.

Uniformity Index

Based on the microphyta uniformity index with an average of 0.8104 (in the range of 0.6 <E <1 in Meiriyani et al., 2011), then the Pager river environment has high uniformity. The microphyta uniformity index is useful in assessing or verifying an aquatic community, whether it occurs or not the competition either about space or about nutrient availability [32], [35]. The high microphyta uniformity index value of the Pager river supports the assumption that the Pager river is a natural river, so that it is able to support the life that exists in it in such a way. Even though the water quality component shows the criteria as oligotrophic waters, but all of the input materials in it are still within the limits of their carrying capacity. The conclusion from this ecological fact is that a high uniformity index does not necessarily correspond to good abundance. This finding shows that stations A and B, the factors that influence the uniformity index are current speed and depth. Microphyta live and breed at low depths, but the current velocity factor will reduce the uniformity and diversity index, a strong current will wash away the microphyta.

Dominance Index

The ecological number or constant that is important to assess the stability of an aquatic ecosystem is the dominance index [32], [36]–[38]. The microphyta dominance index in the Pager river, which ranges from 0.0764 - 0.6202 or an average of 0.2131, indicates that no genus/species dominate in this water area. This means that the condition of the Pager river is still natural, or there is no material input that has strongly polluted it. This similar thing was also found by Torang, et al., (2020) in a preliminary study which found a dominance index between 0.3380 - 0.6716 or an average of 0.3928.

IV Conclusion

The number of taxa microphyta (genus/species) in the Pager river shows that of the 5 (five) phyllum microphyta plants, all are represented by genus / species and 1 (one) animal microphyta group. However, the distribution in the water column (sub-station) was not evenly distributed and the distribution was not continuous between blasts of sampling time. This is thought to be related to many factors. Station A component 1; water depth, current velocity and dominance index; component 2; biology, diversity index, number of taxa, abundance, COD; component 3; temperature, oxygen; component 4; uniformity index, diversity index, abundance, N total; component 5; brightness, total P, TDS; and component 6; pH. Station B component 1; TDS, depth, brightness, current velocity, diversity index; component 2; water temperature, uniformity index, diversity index; component 3; Total N, dissolved oxygen, COD and TDS; component 4; pH, brightness, species dominance, uniformity index; component 5; number of taxa, uniformity index, abundance; and component 6; diversity index, total taxa. Station B is also influenced by human factors (waste). The abundance level and the Microphyta diversity index in the Pager river (as peat waters), are relatively very low; however, the uniformity index is high. The characteristics of the distribution of microphyta in peat rivers (in this case the Pager river) are: (1) the number of phyllum (genus and species) has a high probability but the frequency of finding is small), (2) the abundance is small, (3) the diversity is small, (4) the uniformity is maximum, and (5) the dominance index is small.

Acknowledgment

I would like to thank my supervisor for the much needed guidance and support in completing this research work.

References

[1] S. K. Uda, L. Hein, and D. Atmoko, "Assessing the health impacts of peatland fires: a case study for Central Kalimantan, Indonesia," *Environmental Science and Pollution Research*, vol. 26, no. 30, pp. 31315–31327, 2019.

[2] Y. Suwarno, N. Purwono, A. Suriadi, and I. Nahib, "Kajian kesatuan hidrologis gambut wilayah Kalimantan Tengah," 2016, pp. 233–242.

[3] E. Tjahjono, "Kajian potensi endapan gambut Indonesia berdasarkan aspek lingkungan," *Jakarta: Pusat Sumber Daya Geologi*, vol. 4, 2006.

[4] S. A. Azizah, K. Kissinger, Y. Nugroho, and H. Fauzi, "Analisis Vegetasi Hutan Kerangas Di Arboterum

Nyaru Menteng Kalimantan Tengah," *Jurnal Serambi Engineering*, vol. 5, no. 1, 2020.

[5] O. ONRIZAL, C. KUSMANA, B. H. SAHARJO, I. P. HANDAYANI, and T. KATO, "Species composition and structure of ex-burned heath forest in Danau Sentarum National Park, West Kalimantan," *Biodiversitas Journal of Biological Diversity*, vol. 6, no. 4, 2005.

[6] I. Hilwan, "Ekologi dan Diversity Ekosistem Hutan Tropika Indonesia," *Bogor: Pusat Pengkajian Keanekaragaman Hayati, Institut Pertanian Bogor*, 1996.

[7] C. Kusmana, "Habitat Hutan Mangrove Dan Biota," *Laboratorim Ekologi Hutan Fakultas Kehutanan Institut Pertanian Bogor. Bogor*, 1995.

[8] I. Torang, S. Gumiri, and A. J. Ardianor, "DISTRIBUSI PERIFITON PADA SUNGAI GAMBUT," 2020, vol. 5, no. 2, pp. 42–50.

[9] T. R. Dos Santos, C. Ferragut, and C. E. de Mattos Bicudo, "Does macrophyte architecture influence periphyton? Relationships among Utricularia foliosa, periphyton assemblage structure and its nutrient (C, N, P) status," *Hydrobiologia*, vol. 714, no. 1, pp. 71–83, 2013.

[10] L. K. Graham and L. W. Wilcox, "The origin of alternation of generations in land plants: a focus on matrotrophy and hexose transport," *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, vol. 355, no. 1398, pp. 757–767, 2000.

[11] B. Hill, A. Herlihy, P. Kaufmann, R. Stevenson, F. McCormick, and C. B. Johnson, "Use of periphyton assemblage data as an index of biotic integrity," *Journal of the North American Benthological Society*, vol. 19, no. 1, pp. 50–67, 2000.

[12] N. T. Pratiwi, S. Hariyadi, and D. I. Kiswari, "Struktur Komunitas Perifiton Dibagian Hulu Sungai Cisadane, Kawasan Taman Nasional Gunung Halimun Salak, Jawa Barat," *Jurnal Biologi Indonesia*, vol. 13, no. 2, 2017.

[13] E. Bondar-Kunze, S. Maier, D. Schönauer, N. Bahl, and T. Hein, "Antagonistic and synergistic effects on a stream periphyton community under the influence of pulsed flow velocity increase and nutrient enrichment," *Science of the Total Environment*, vol. 573, pp. 594–602, 2016.

[14] P. Bytyqi *et al.*, "Macrophytes as biological indicators of organic pollution in the Lepenci River Basin in Kosovo," *Journal of Freshwater Ecology*, vol. 35, no. 1, pp. 105–121, 2020.

[15] M. Onaindia, I. Amezaga, C. Garbisu, and B. García-Bikuña, "Aquatic macrophytes as biological indicators of environmental conditions of rivers in north-eastern Spain," 2005, vol. 41, no. 3, pp. 175–182.

[16] A. Melzer, "Aquatic macrophytes as tools for lake management," in *The Ecological Bases for Lake and Reservoir Management*, Springer, 1999, pp. 181–190.

[17] D. Farias, C. Hurd, R. Eriksen, and C. Macleod, "Macrophytes as bioindicators of heavy metal pollution in estuarine and coastal environments," *Marine Pollution Bulletin*, vol. 128, pp. 175–184, 2018.

[18] J. Caffrey, "Macrophytes as biological indicators of organic pollution in Irish rivers," *Biological indicators of pollution. Royal Irish Academy, Dublin*, pp. 77–87, 1987.

[19] B. J. Biggs, "New Zealand periphyton guideline," *Detecting, Monitoring and Managing Enrichment of Streams. NIWA, Christchurch*, 2000.

[20] M. Junda and Y. H. Hijriah, "Identification of Periphyton As Water Quality Indicator in Nile Pond (Oreochromus niloticus)," *Jurnal Kajian, Penelitian, dan Pengajaran Biologi*, vol. 14, no. 1, pp. 16–24, 2013.

[21] H. Effendi, *Telaah kualitas air, bagi pengelolaan sumber daya dan lingkungan perairan*. Kanisius, 2003.

[22] R. Glasaitė and I. Šatkauskienė, "Periphyton composition and diversity in the Kaunas Lagoon and the Nemunas River," *Biologija*, vol. 59, no. 2, 2013.

[23] M. Kevin and M. Lancar, "Aquatic weeds and their management," *International Commission on Irrigation and drainage. Australia*, vol. 12, no. 1–2, pp. 15–64, 2002.

[24] P. D. Susanti and A. Miardini, "The impact of Land use Change on Water Pollution Index of Kali Madiun Sub-watershed," 2017, vol. 31, no. 1, pp. 128–137.

[25] E. Nilasari, M. F. M. Faizal, and S. Suheryanto, "Pengolahan Air Limbah Rumah Tangga dengan Menggunakan Proses Gabungan Saringan Bertingkat dan Bioremediasi Eceng Gondok (Eichornia crassipes),(Studi Kasus di perumahan Griya Mitra 2, Palembang)," *Jurnal Penelitian Sains*, vol. 18, no. 1, pp. 8–13, 2016.

[26] M. Nyström and C. Folke, "Spatial resilience of coral reefs," *Ecosystems*, vol. 4, no. 5, pp. 406–417, 2001.

[27] J. P. Grime, "Biodiversity and ecosystem function: the debate deepens," *Science*, vol. 277, no. 5330, pp. 1260–1261, 1997.

[28] J. Hodgson, K. Thompson, P. Wilson, and A. Bogaard, "Does biodiversity determine ecosystem function? The Ecotron experiment reconsidered," 1998.

[29] J. Lawton, S. Naeem, L. Thompson, A. Hector, and M. Crawley, "Biodiversity and ecosystem function: getting the Ecotron experiment in its correct context," 1998.

[30] P. Diaz, S. C. Jeong, S. Lee, C. Khoo, and S. R. Koyyalamudi, "Antioxidant and anti-inflammatory activities of selected medicinal plants and fungi containing phenolic and flavonoid compounds," *Chinese medicine*, vol. 7, no. 1, pp. 1–9, 2012.

[31] N. W. Mason, K. MacGillivray, J. B. Steel, and J. B. Wilson, "An index of functional diversity," *Journal of Vegetation Science*, vol. 14, no. 4, pp. 571–578, 2003.

[32] R. Nasria and N. Irawati, "Perbandingan kepadatan dan keanekaragaman perifiton pada subtrat buatan yang berbeda di Perairan Air Terjun Tinonggoli (Nanga-Nanga) Kota Kendari Sulawesi Tenggara," *Jurnal Manajemen Sumber Daya Perairan*, vol. 2, no. 1.

[33] A. Protasov, S. Barinova, T. Novoselova, and A. Sylaieva, "The aquatic organisms diversity, community

structure, and environmental conditions," *Diversity*, vol. 11, no. 10, p. 190, 2019.

[34] J. E. Brower, J. H. Zar, and C. Von Ende, "Field and laboratory methods for general ecology. Wm. C," *Brown Co. Pub. Dubuque. Iowa*, 1990.

[35] F. Meiriyani, T. Z. Ulqodry, and W. A. E. Putri, "Komposisi dan sebaran fitoplankton di perairan Muara Sungai Way Belau, Bandar Lampung," *Maspari Journal*, vol. 3, no. 2, pp. 69–77, 2011.

[36] F. J. Burdon *et al.*, "Assessing the benefits of forested riparian zones: A qualitative index of riparian integrity is positively associated with ecological status in European streams," *Water*, vol. 12, no. 4, p. 1178, 2020.

[37] T. Yang, Q. Zhang, X. Wan, X. Li, Y. Wang, and W. Wang, "Comprehensive ecological risk assessment for semi-arid basin based on conceptual model of risk response and improved TOPSIS model-a case study of Wei River Basin, China," *Science of The Total Environment*, vol. 719, p. 137502, 2020.

[38] A. W. Tranmer *et al.*, "Coupled reservoir-river systems: Lessons from an integrated aquatic ecosystem assessment," *Journal of environmental management*, vol. 260, p. 110107, 2020.

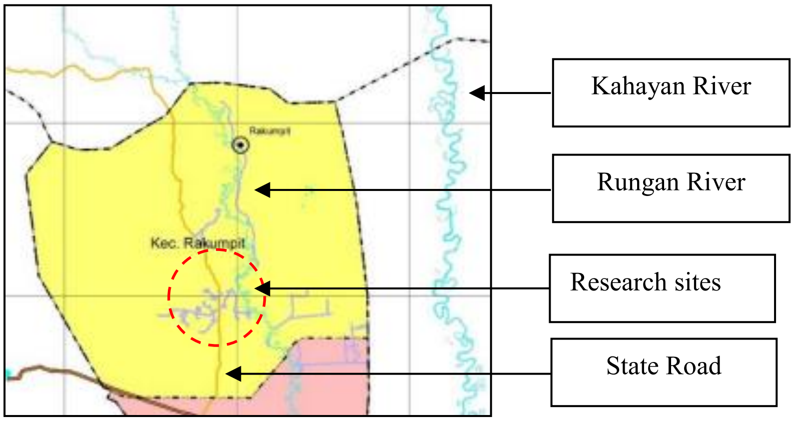

Figure 1. : Map of Research Location Points

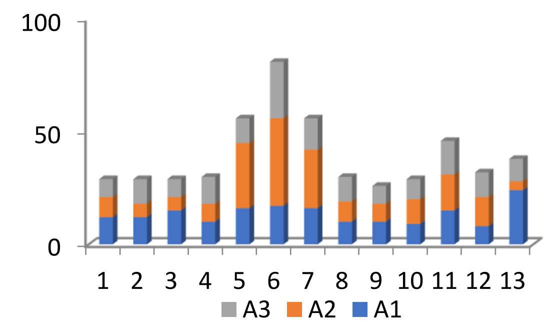

Figure 2. : Graph of the number of taxa at station A (right side of the river)

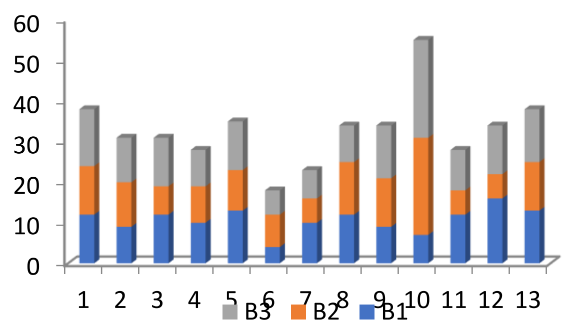

Figure 3. : Graph of the number of taxa at station B (left side of the river)

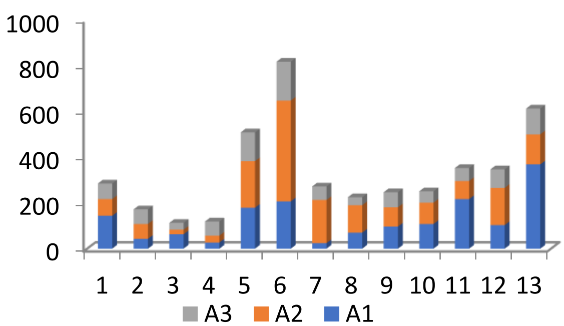

Figure 4. : Abundance at Station A (right side of the river)

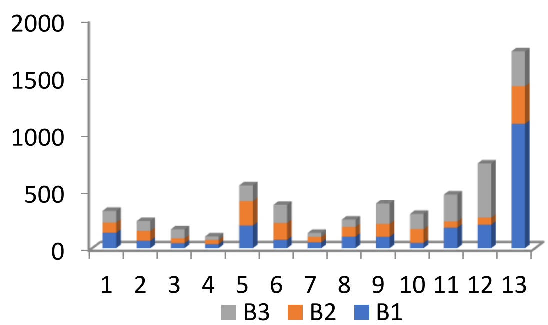

Figure 5. : Abundance at Station B (left side of the river)

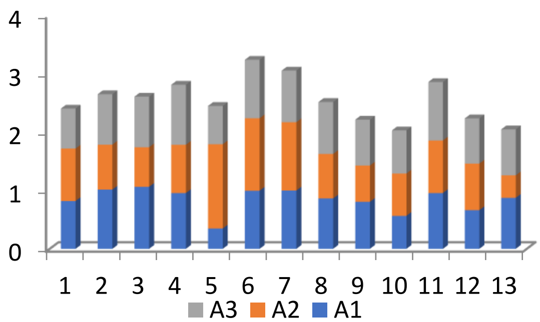

Figure 6. : Biodiversity of Microphyta at Station A (the right side of the river)

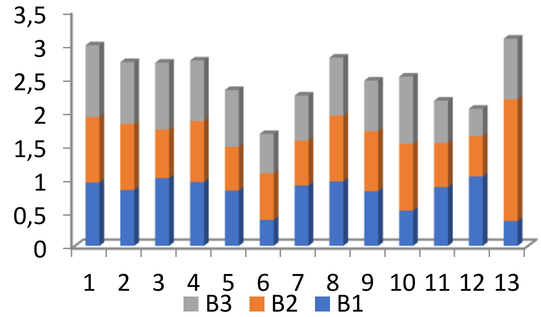

Figure 7. : Biodiversity of Microphyta at Station B (the left side of the river)

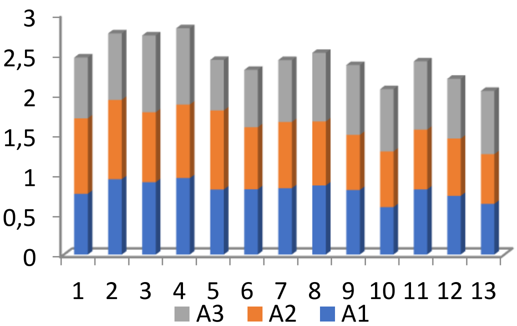

Figure 8. : Microphya Uniformity at Station A (the right side of the river)

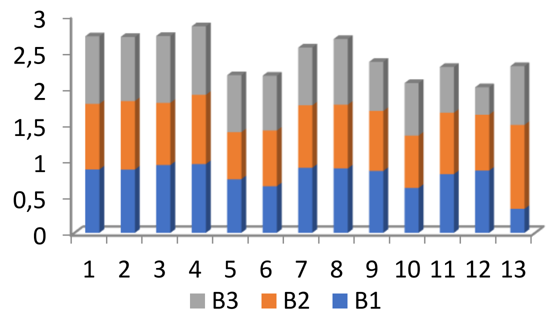

Figure 9. : Microphya Uniformity at Station B (the left side of the river)

stations, it can be seen in Figures 10 and 11 (following graphs).

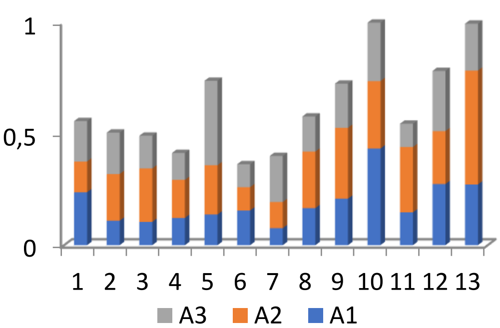

Figure 10. : Dominance Index at Station A (the right side of the river)

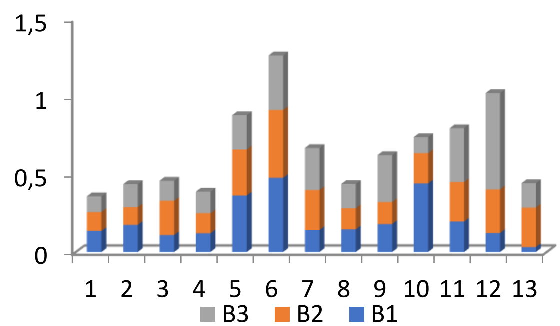

Figure 11. : Dominance Index at Station B (the left side of the river)

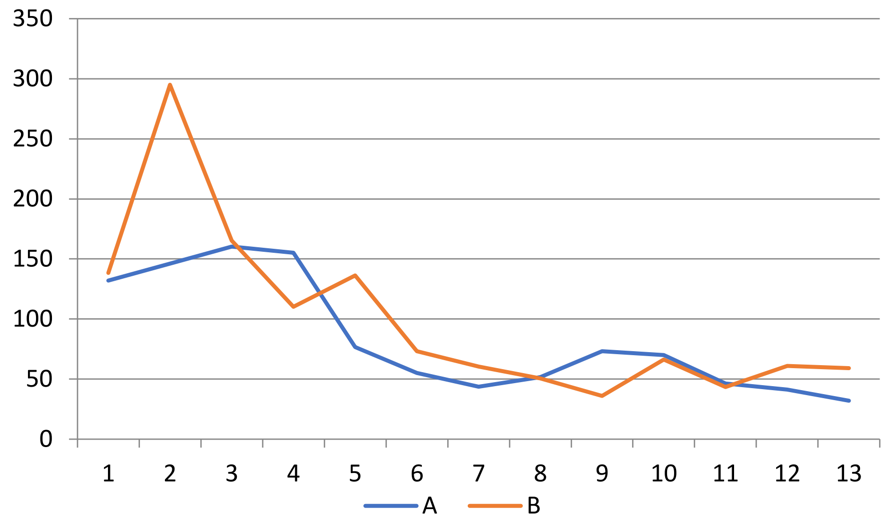

Figure 12. : Water Depth Level During Research Activities

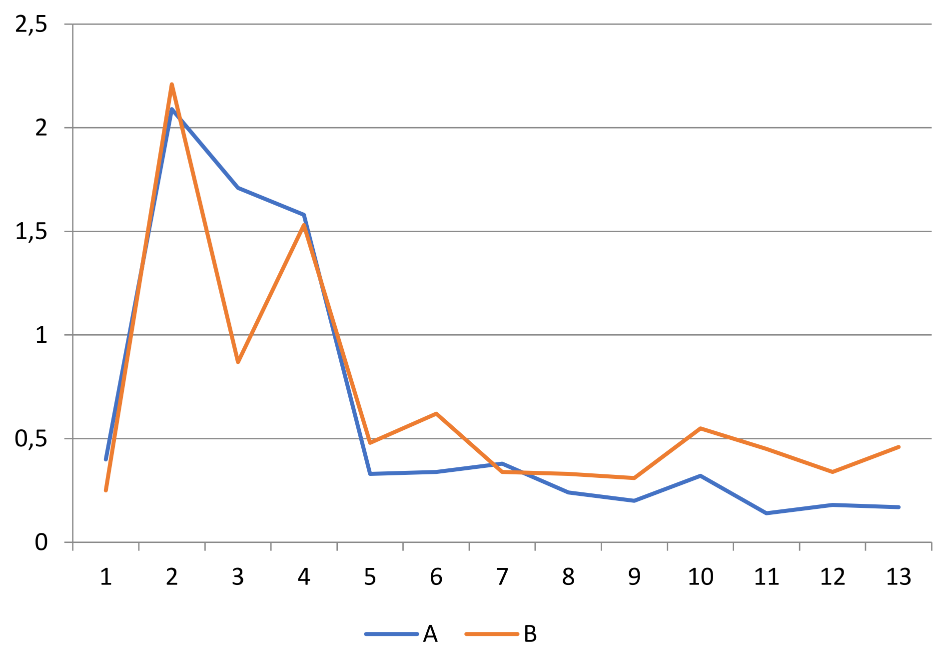

Figure 13. : Water Flow Velocity During Research Activities

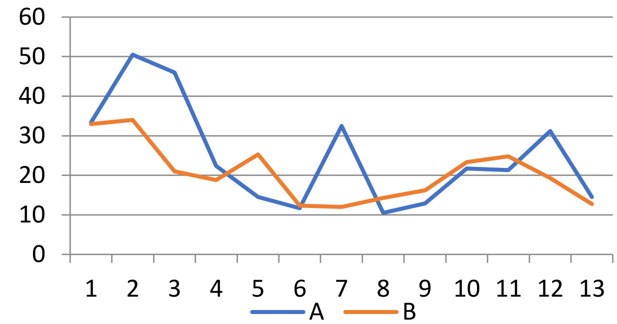

Figure 14. : Water Brightness Level During Research Activities

).

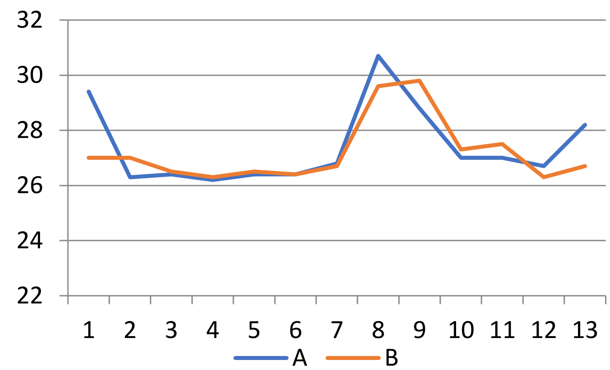

Figure 15. : Water Temperature During Research Activities

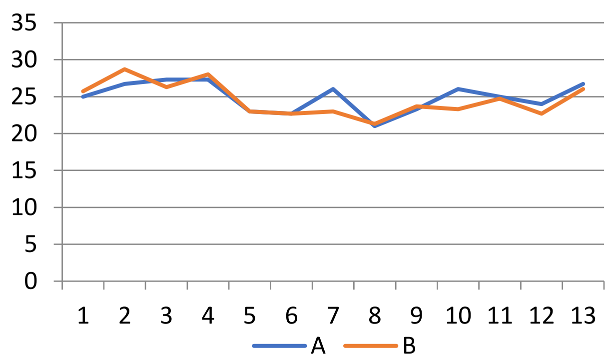

Figure 16. : Total Dissolved Solid of Water During Research Activities

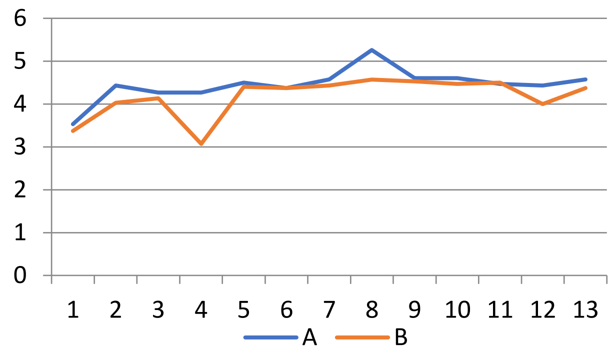

Figure 17. : Degree of Water Acidity During Research Activities

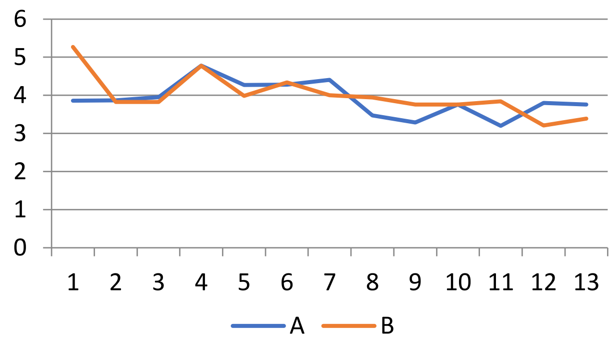

Figure 18. : Dissolved Oxygen (O2) in Water During Research Activities

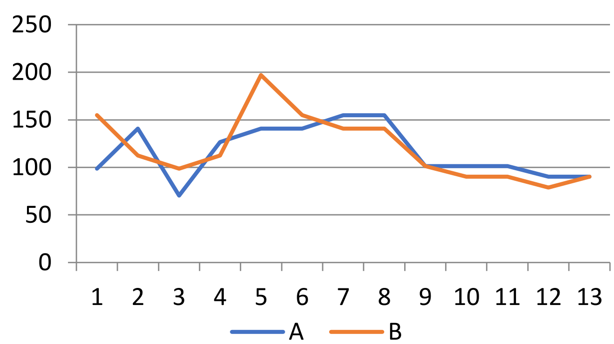

Figure 19. : The Solubility of Total N in the Water During Research Activities

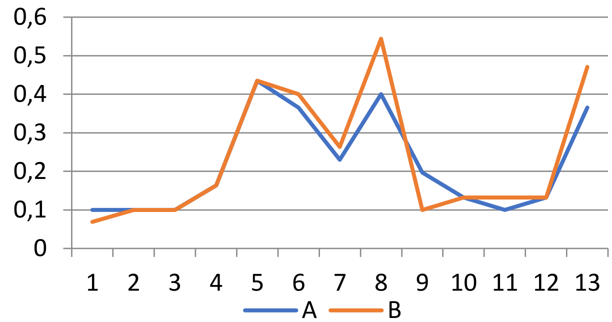

Figure 20. : The Solubility of Total P in the Water During Research Activities

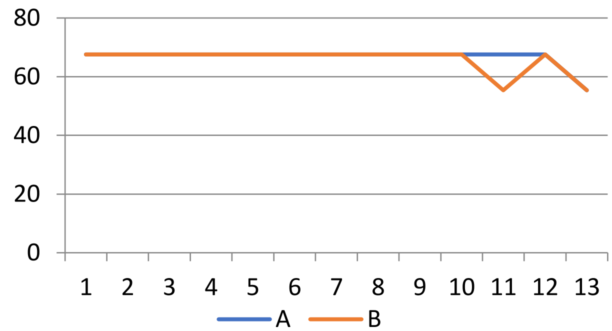

Figure 21. : The Solubility of Total K in the Water During Research Activities

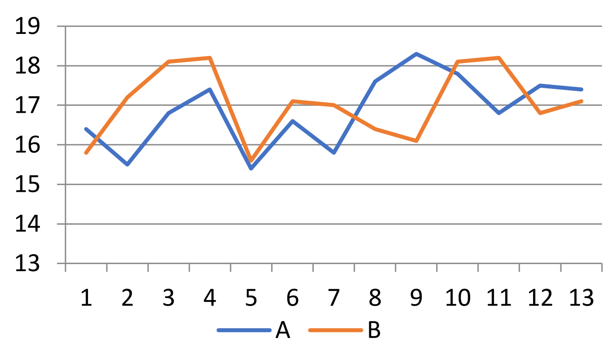

Figure 22. : The Solubility of COD in the Water During Research Activities