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Composition and Abundance of Periphyton Types in Artificial Habitat with Different Attractor Media in the Koto Panjang Reservoir Kampar Regency

Komposisi dan Kelimpahan Jenis Perifiton pada Artificial Habitat Apung dengan Media Isi Atraktor Horizontal Berbeda di Waduk Koto Panjang Kabupaten Kampar

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Abstract

An artificial habitat comprises a series of structures or attractor media as a habitat for aquatic biota in the waters. This study aims to determine the best attractor media viewed from the abundance of periphyton found in artificial habitats. This research was conducted in July - August 2023 using the experimental method. Periphyton sampling was done four times with an interval of one week and then identified based on the reference identification book. Water quality parameters measured were temperature, brightness, pH, Dissolved Oxygen, nitrate, and phosphate. The data obtained were statistically analyzed using a two-way ANOVA and BNt tests in MS. Excel 2020. The results showed that there were 17 species of periphyton found, consisting of 5 classes, namely Bacillariophyceae (8 species), Zygnematophyceae (4 species), Chlorophyceae (3 species), Cyanophyceae (1 species), and Trebouxiophyceae (1 species). The total abundance of periphyton obtained ranged from 13.448 – 21.406 cells/cm2, and the highest is on plastic bottle attractors ranging from 3.232 – 8.318 cells/cm2. The type of periphyton found mostly was *Navicula* sp. (6.602 cells/cm2). Based on the periphyton abundance, it can be concluded that the best attractor for periphyton media is the used plastic bottle.

Keywords: Artificial Habitat, Attractor Media, Periphyton, Plastic Bottle.

Abstrak

Artificial Habitat merupakan suatu habitat yang tersusun atas rangkaian struktur atau media atraktor sebagai habitat biota air di perairan. Penelitian ini bertujuan untuk mengetahui media atraktor terbaik dilihat dari kelimpahan perifiton yang ditemukan pada artificial habitat. Penelitian ini dilaksanakan pada bulan Juli – Agustus 2023 dengan menggunakan metode eksperimen. Pengambilan sampel perifiton dilakukan sebanyak 4 kali dengan interval satu minggu selanjutnya diidentifikasi berdasarkan acuan buku indentifikasi. Parameter kualitas air yang diukur adalah suhu, kecerahan, pH, oksigen terlarut, nitrat dan fosfat. Data yang diperoleh dianalisis secara statistik menggunakan uji *two way* anova dan uji BNt di MS. Excel 2020. Hasil penelitian menunjukkan bahwa terdapat 17 jenis perifiton ditemukan terdiri dari 5 kelas, yaitu Bacillariophyceae (8 jenis), Zygnematophyceae (4 jenis), Chlorophyceae (3 jenis), Cyanophyceae (1 jenis), dan Trebouxiophyceae (1 jenis). Kelimpahan total yang diperoleh pada penelitian ini berkisar 13.448 – 21.406 sel/cm^2 dan yang tertinggi pada atraktor bahan botol plastik berkisar 3.232 – 8.318 sel/cm^2. Jenis perifiton yang paling banyak ditemukan adalah

Navicula sp. (6.602 sel/cm^2). Berdasarkan kelimpahan perifiton tersebut, dapat disimpulkan bahwa media atraktor terbaik untuk media perifiton adalah atraktor dengan bahan botol plastik bekas.

Kata kunci: Artificial Habitat, Media Atraktor, Perifiton, Botol Plastik.

1. Introduction

One of the well-known reservoirs in Riau Province is the Koto Panjang Reservoir. This reservoir was built in 1992 and completed in 1997. It is a hydroelectric power plant reservoir (PLTA) with a dam height of about 96 m and an inundation area of about 12,400 ha, and the water depth ranges from 73.5-85 m (PLN, 2002). This reservoir is also a strategic and essential resource for the surrounding community. According to Budijono et al. (2021), the reservoir has been used for 18 years in community activities, especially in fish farming and tourism.

Initially built, this reservoir functioned as a power plant and irrigation, but over time, it developed into a place for fisheries and tourism activities. The fishery activities are in the form of floating net cage cultivation, which can increase the reservoir's fishery potential. However, such an extensive inundation also provides potential for developing other fisheries and increasing the potential of fishing in reservoirs, such as increasing the availability of natural food needed, especially by fish in reservoir waters, using artificial habitat.

Artificial Habitat is a building composed of solid objects placed in the water for fish activities such as spawning and shelter to restore the availability of fish resources (Sunarno & Harun, 2016). The construction of artificial habitat in Koto Panjang Reservoir is planned in the form of several attractor framework components whose attractor series structure consists of different materials (artificial substrates). Attractors have properties such as fads that allow fish to come to the shelter and feed in the form of periphyton microorganisms attached to the attractor series. As is known, periphyton is an alga that lives attached to both living and inanimate objects under the surface of the water (Mills in Akbar et al., 2018) and also as a source of food for some fish and other vertebrates (Newman & McIntoch in Amaliah et al., 2020). Periphyton (phytoperiphyton) grows and attaches due to available nutrients and light and the presence of periphyton, which is influenced by using materials or materials as a substrate for periphyton attachment.

The use of materials or materials from artificial substrates has a fixed and permanent nature that facilitates the retrieval of periphyton. The attractor materials used in this artificial habitat attractor series are raffia rope, strapping rope, and plastic bottles. The three substrates have different characteristics: flat shape, elastic, easy to twist, rigid properties, not easily damaged, lightweight, and relatively affordable prices. The characteristics of the three materials or artificial substrate materials each have different properties. Despite having different properties, periphyton (phytoperiphyton) is expected to grow and adhere, but it is not yet known which attractor media has the highest abundance of periphyton found. Based on the description above, it is necessary to research to determine the best artificial substrate material or material as a growing medium for periphyton.

2. Material and Method

2.1. Time and Place

This research was conducted in July - August 2023 at the lacustrine zone of Koto Panjang Reservoir (Figure 1), and the samples were analyzed at the Waste Treatment Laboratory of the Department of Aquatic Resource Management, Faculty of Fisheries and Marine Sciences, Universitas Riau.

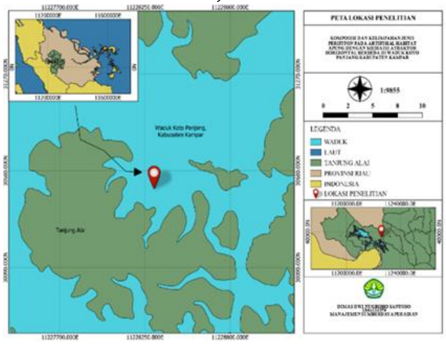

Figure 1. Research location

2.2. Methods

The method used in this research is experimental. It is carried out directly at Koto Panjang Reservoir, and the samples obtained are analyzed in the laboratory. Furthermore, the data obtained are presented in tables and graphs and discussed descriptively by referring to literature related to the research.

2.3. Procedures

The research procedure was sampling activities on three artificial habitat plots with a size of (2,7 x 2,7 m^2) arranged in a row (horizontally) with a distance of 10 m per plot. Each artificial habitat has eight attractors (fish collecting aids) sunk 2 m deep from the reservoir water surface. This artificial habitat uses several different types of materials on each plot. The artificial substrate materials used are raffia (soft), strapping (hard), and plastic bottles. Each type of material (artificial substrate) represents one artificial habitat plot. Each artificial habitat plot has eight attractors measuring 1 x 1 x 1 m that float below the water surface, and each attractor has a series of 8 substrate strands (Figure 2).

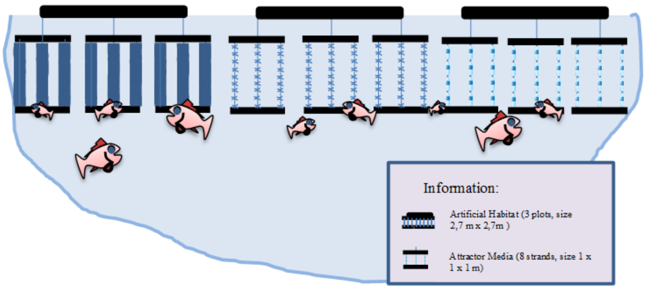

Figure 2. Sketch of artificial habitat

2.3.1. Periphyton Sampling

Sampling in the experimental design was carried out four times with an interval of 1 week by taking it directly into the water by swimming using a life jacket. Periphyton samples were taken from each artificial habitat plot where periphyton sampling by taking several parts of the attractor media material or substrate sheet (raffia rope, stripping rope, and plastic bottles) from one strand of attractor media only, which represents each artificial habitat plot. In the attractor media with raffia and strapping rope materials, six sheets were taken, namely two sheets at the top, 2 in the middle, and two at the bottom of the attractor media strands with measurements (12 x 3 cm^2) for raffia and (12 x 1 cm^2) for strapping rope. At the same time, the plastic bottle material is taken as many as three sheets, namely one at the top, 1 in the middle, and one at the bottom of the attractor media strands with a size of (8 x 8 cm^2). Part of the attractor media or artificial substrate is scraped using a fine brush on both sides slowly from top to bottom while spraying distilled water and accommodated on a tray, which is then entered into a sample bottle and given 1% lugol preservative. Then, the sample bottle is labelled on each to be further analyzed in the laboratory. Samples that have been taken are then observed under a microscope with the sweep method and identified according to the reference book Prescott (1974); Belcher & Swale (1978); Yunfang (1995); Biggs & Kilroy (2000). Furthermore, the abundance of periphyton from the samples obtained was calculated using the formula (APHA, 2012) :

$$N = \frac{n \times At \times Vt}{Ac \times Vs \times As}$$

Information:

N = Abundance of periphyton types (cell/cm^2)
n = number of periphyton found
At = Wide cover glass cover (20 x 20 mm^2)
Vt = Total volume of periphyton sample (50 mL)
Ac = Sweep area microscope (10 x 20 x 0,45 mm^2)
Vs = volume of one drop of sample on cover glass (0,05 x 10)
As = Surface area of scraped substrate (cm^2)

2.3.2. Water Quality Measurement

Water quality measurements were conducted simultaneously with periphyton sampling four times at one-week intervals. Water quality parameters measured include temperature, brightness, pH, dissolved oxygen, nitrate, and phosphate. Measurements of temperature, brightness, pH, and dissolved oxygen were carried out in situ, where the temperature was measured using a digital thermometer, brightness with a Secchi disk, pH using the pH indicator universal, and dissolved oxygen using the Winkler method. The measurement of nitrate and phosphate is carried out ex-situ, which is measured in the laboratory where for nitrate, the Cu-Cd method is used, and phosphate (orthophosphate) is measured by the SnCl method.

2.4. Data Analysis

Data from the research results were analyzed using MS. Excel 2020. Furthermore, the analyzed data were statistically tested using the two-way ANOVA test to see any differences in periphyton abundance between substrate attractor media and time. Then, the BNt test will be performed to determine the best attractor media with materials media used.

3. Result and Discussion

3.1. Periphyton Types and Abundance

Based on the results of research on artificial habitat in Koto Panjang reservoir, 17 species of periphyton (phytoperiphyton) were found, consisting of 5 classes: Bacillariophyceae class (8 species), Zygnematophyceae class (4 species), Chlorophyceae class (3 species), Cyanophyceae class (1 species), and Trebouxiophyceae class (1 species). The percentage of periphyton species found is in Table 1.

Table 1. Percentage of Periphyton Types Found in Artificial Habitat in Koto Panjang Reservoir

Class	Number of types found	% types found
Bacillariophyceae	8	47
Zygnematophyceae	4	23
Chlorophyceae	3	18
Cyanophyceae	1	6
Trebouxiophyceae	1	6
Total	17	100

The highest number of types found during the study came from the Bacillariophyceae class, while the lowest number of types was obtained from the Trebouxiophyceae class (Figure 3). Types from the Bacillariophyceae class were found because this type has a sticking tool in the form of a gelatinous stalk so that it can be attached to the substrate. The statement of Basmi in Tambunan et al. (2020) states that the types of Bacillariophyceae class have a cytoplasm in which mucopolysaccharide is an adhesive liquid to attach or attach to the substrate. Some factors that affect the abundance of the Bacillariophyceae class are that periphyton from the Bacillariophyceae class can live in various waters and are the primary producers. This is to the statement from Wulandari et al. in Asra et al. (2022), which stated that the Bacillariophyceae class is generally found in various waters and can adapt to the aquatic environment compared to other classes. The types of the Trebouxiophyceae class were found to be less due to several factors, including competition with other microorganisms in large numbers to obtain nutrients such as algae from different classes. Sheath & Wehr (2015) believes that the Bacillariophyceae class has the most presence in various aquatic ecosystems due to the vast number of species.

The composition of periphyton during the study showed the highest abundance of the Bacillariophyceae class ranging from 5.962 – 10.228 cells/cm^2, and the least was the Trebouxiophyceae class ranging from 630 - 956 cells/cm^2, both in the attractor media of raffia rope, strapping rope and plastic bottles (Figure 3). Periphyton is found in attractors with different media in artificial habitats in the lacustrine zone of Koto Panjang Reservoir. It shows different abundances, even though the location or position of these media is in the same area. This means that the difference in abundance is thought to be caused by different characteristics of the attractor material or materials used.

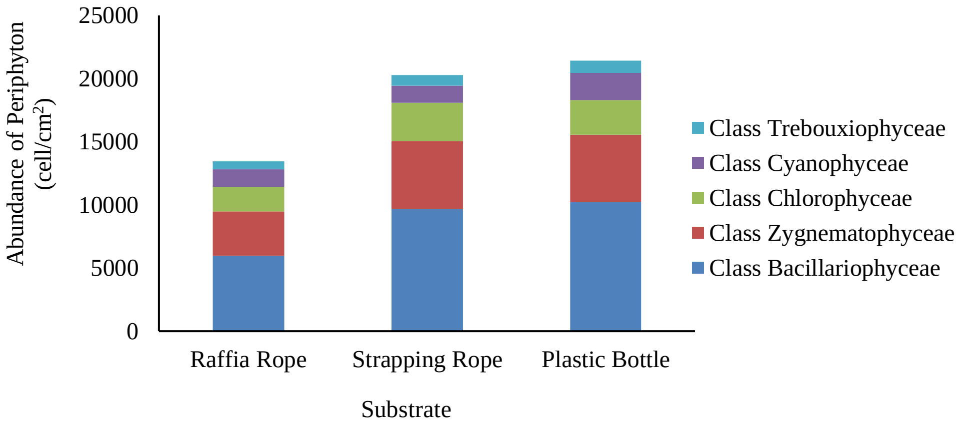

Figure 2. Sketch of artificial habitat

3.2. Total Periphyton Abundance

The abundance of phytoperiphyton each week increased between each attractor media, where the lowest abundance was found in the first week with an abundance of 1.722 – 3.232 cells/cm^2 and the highest abundance in the fourth week ranging from 5.496 – 8.318 cells/cm^2. This increase was influenced by the increased availability of nutrients during the research. The presence of nutrients and sufficient light penetration makes the photosynthesis process run well so that periphyton growth occurs optimally. The relationship between abundance and nutrient availability can be seen in Figure 4.

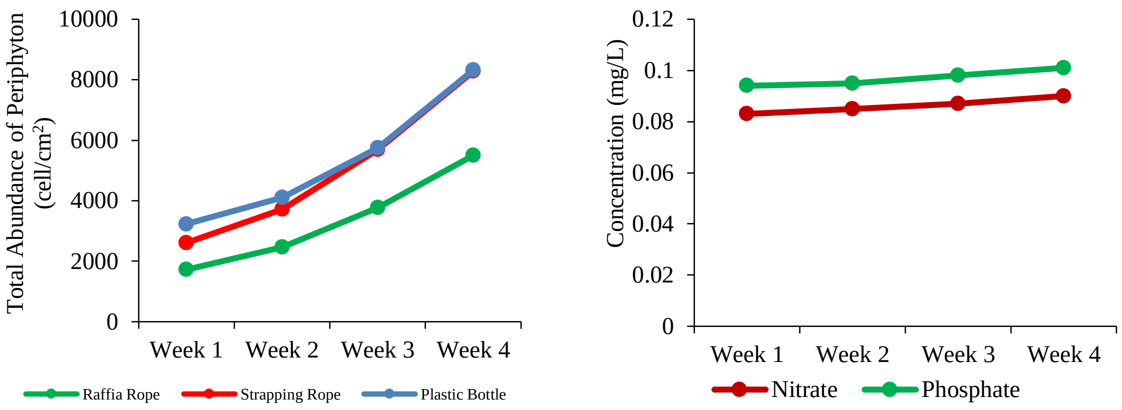

Figure 4. Relationship between total abundance of periphyton and nutrient availability during research; a**)** Total Perifiton Abundance; b**)** Nutrient (N dan P).

The lowest total abundance of periphyton (phytoperifiton) was found in the raffia attractor media, with a total abundance of 13.448 cells/cm2 (Table 2 and Figure 4). The low abundance of periphyton is due to the close distance between the rope strands attached to the attractor media strands (Figure 5). The distance between the strands of the attractor media (substrate) that are close together can affect the sticking capacity of the periphyton and the space for nutrient absorption in the water. Distance can also influence the process of photosynthesis by spreading sufficient light to the substrate to optimize periphyton growth. The statement of Pong-Masak & Sarira (2018) that the distance between different substrates can influence the abundance of periphyton, where large or long distances can provide a lot of attached periphyton due to sufficient light or nutrient absorption or a lot because they have enough space, whereas vice versa. Suppose the substrate distance is close together or too short. In that case, it can affect the periphyton's opportunity to attach. There is little space to grow due to the lack of light absorbed, so the photosynthesis process is less than optimal for periphyton growth.

The highest abundance of phytoperiphyton was found in the attractor media, namely plastic bottles, with a total abundance of 21.406 cells/cm^2 (Table 2 and Figure 4). The high abundance of periphyton is due to the attractor media material, which has an area that covers the entire area of the bottle because the mechanical properties of the material are translucent so that the attached periphyton can utilize sunlight in the photosynthesis process and is supported by the location of the attractor media from this artificial habitat in the area open, which also includes other material attractor media, making the intensity of sunlight entering the waters higher so that it can optimize the periphyton to grow and develop (Figure 5). Effendi (2003) believes that the abundance of periphyton is influenced by the intensity of light entering the waters. Conversely, the abundance will decrease due to reduced sunlight.

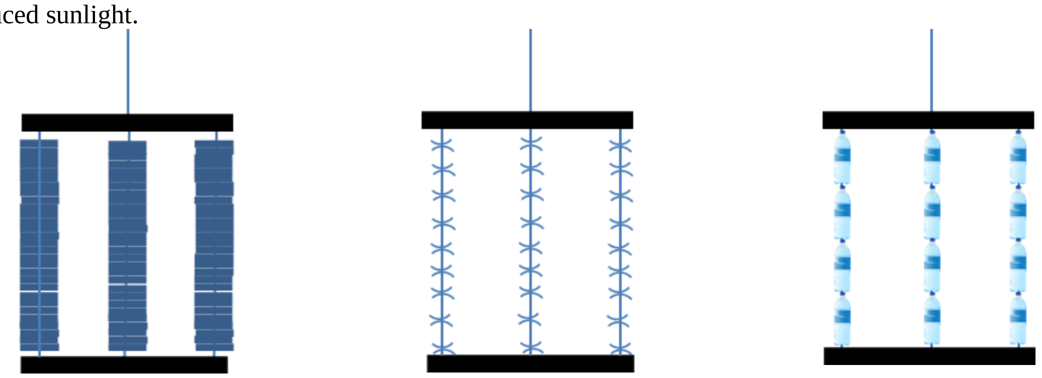

Figure 5. Sketch Attractor Media; a) Rafia Rope; b) Strapping Rope; c) Plastic Bottle

Another advantage of plastic bottle attractors is their stiff, rigid, smooth, transparent, or patterned texture. Schwoerbel in Supriyanti (2001) states celluloid, plastic, or glass is the best substrate with a smooth and transparent surface. Therefore, using several materials (artificial substrates) with different characteristics or properties can make phytoperiphyton grow or adhere tightly, even though the abundance of periphyton obtained from each artificial substrate differs. This is supported by the opinion of Simarmata et al. (2017) that artificial substrates are better used as a medium for growing periphyton because periphyton can stick tightly to the substrate. Furthermore, Nopitasari et al. (2017) stated that artificial substrates allow the growth rate of attached periphyton to be calculated, making it easier to collect data.

Table 2. Total abundance of periphyton during research on artificial habitat in Koto Panjang Reservoir

No	Types	Total abundance of periphyton (cell/cm²)											
		Raffia Rope				Strapping Rope				Plastic Bottle			
		W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
	Bacillariophyceae												
1	*Cyclotella* sp.	40	82	166	266	51	111	228	393	84	122	234	358
2	*Cymbella* sp.	28	70	150	254	57	120	231	390	98	142	238	366
3	*Gomphonema* sp.	264	300	380	480	414	486	624	765	384	452	584	772
4	*Gyrosigma* sp.	14	46	94	196	24	84	201	384	34	70	168	280
5	*Melosira* sp.	60	100	180	284	105	168	288	459	244	280	370	532
6	*Navicula* sp.	282	324	404	508	504	570	693	831	386	464	642	994
7	*Pinnularia* sp.	30	72	150	252	57	120	240	366	150	188	262	406
8	*Surirella sp.*	24	66	146	250	54	120	216	351	126	172	248	378
	Sub Total	742	1060	1670	2490	1266	1779	2721	3939	1506	1890	2746	4086
	Zygnematophyceae												
9	*Cosmarium* sp.	280	336	408	504	282	354	480	636	320	380	460	624
10	*Mougeotia* sp.	66	108	188	288	270	345	477	603	304	372	448	574
11	*Spyrogyra* sp.	54	96	172	278	75	138	249	396	48	90	198	316
12	*Staurastrum* sp.	92	132	208	310	108	168	288	453	176	242	320	454
	Sub Total	492	672	976	1380	735	1005	1494	2088	848	1084	1426	1968
	Chlorophyceae												
13	*Ankistrodesmus* sp.	22	64	146	248	36	99	201	378	120	160	238	358
14	*Bulbochaete* sp.	64	108	188	292	123	180	309	456	100	164	242	368
15	*Coelastrum* sp.	104	154	234	334	180	246	339	498	150	190	260	410
	Sub Total	190	326	568	874	339	525	849	1332	370	514	740	1136
	Cyanophyceae												
16	*Oscillatoria* sp.	238	296	372	472	201	264	384	513	376	440	582	738
	Sub Total	238	296	372	472	201	264	384	513	376	440	582	738
	Trebouxiophyceae												
17	*Oocystis* sp.	60	104	186	280	69	138	249	405	132	178	256	390
	Sub Total	60	104	186	280	69	138	249	405	132	178	256	390
	Total	1722	2458	3772	5496	2610	3711	5697	8277	3232	4106	5750	8318

The most common type of phytooperiphyton found during the research was *Navicula* sp. (6.602 cells/cm²). Navicula sp. is yellowish brown, elliptical (oval), and has siliceous cell walls (Wiadnyana & Wagey in Kurnia & Panjaitan, 2020). *Navicula* sp also has a gelatin-like substance, which allows it to stick to an object or substrate. Usually, this type is found in pelagic and benthic (Padang et al., 2013). This makes the *Navicula* sp's abundance high and can be found in every attractor medium in artificial habitats.

The least common type of periphyton found is *Gyrosigma* sp. (1.595 cells/cm²). *Gyrosigma* sp is a diatom with siliceous cell walls and beautiful ornamentation called frustules that allow this type to move. In addition, *Gyrosigma* sp is one of the species commonly found attached to sediments and bottom-water substrates (Dionfriski et al., 2021). Therefore, this type of periphyton has a low abundance because it usually lives connected to the substrate at the bottom of the water. It is also often found in marine waters. However, there are some in freshwaters.

The results of statistical tests using the two-way ANOVA test show that there are differences in abundance between substrate attractor media with a value of $p = 0.0012$ ($p < 0.05$) and between times with $p = 0.0004$ ($p < 0.05$), which means they are different authentic. Furthermore, the BNt test analysis was carried out. It was found that the attractor media made from plastic bottles was the best attractor media as a periphyton medium with a BNt value of 6.098,636 and an average abundance value of 5351,50 cells/cm², which was higher than the BNt value and the average abundance of periphyton. Compared to other material media.

3.3. Water Quality

The results of measurements of water quality parameters carried out during the research can be seen in Table 3.

Table 3. Results of water quality measurements in artificial habitat at Koto Panjang Reservoir

No	Parameters	Week			
		I	II	III	IV
1.	Temperature (°C)	29	30	31	31
2.	Brightness (cm)	135	138	137	140
3.	pH	6	6	6	6
4.	Dissolved oxygen (mg/L)	7,42	7,68	7,82	8,14
5.	Nitrate (mg/L)	0,083	0,085	0,087	0,09
6.	Phosphate (mg/L)	0,094	0,095	0,098	0,101

Temperature is a vital physical factor, especially in microalgae's metabolic processes and physiological functions. The results of temperature measurements during research in the artificial habitat in the Koto Panjang Reservoir ranged from 29 - 31ºC. The temperature range obtained is still suitable or fulfils the life of periphyton in the water. According to Nontji in Tambunan et al. (2020), the optimal temperature for periphyton growth in tropical waters ranges from 25 – 32ºC.

The brightness of a body of water can influence the photosynthesis process in algal microorganisms. The brightness value obtained is 135 – 140 cm. The high brightness value is due to the artificial habitat in an open area, which increases the light intensity, thus helping the optimal process of photosynthesis by algae. Therefore, the brightness obtained is high and quite good for the life of aquatic organisms, especially periphyton, which is supported by the opinion of Suhadi et al. in Siagian (2018) that the minimum brightness for aquatic organisms is 45 cm. The pH value obtained during the research was the same every week, namely six or acidic. This value still supports the life of aquatic organisms, especially periphyton. According to Wardoyo in Tambunan et al. (2020), the degree of acidity of waters that support the life of aquatic organisms is 5 – 9.

Dissolved oxygen is the amount of oxygen dissolved in water. The source of dissolved oxygen is obtained through one of the results of the photosynthesis process of microalgae, which is caused by an increase in the abundance of microalgae or periphyton in the waters. The DO value from the measurements ranges from 7,42 – 8,14 mg/L. According to Wardoyo in Tambunan et al. (2020), the range of dissolved oxygen that can support the life of aquatic organisms is typically not less than 2 mg/L.

Furthermore, nitrate and phosphate (orthophosphate), which are periphyton nutrients, were also measured during the research. The nitrate obtained ranged from 0,083 – 0,09 mg/L, and phosphate (orthophosphate) ranged from 0,094 – 0,101 mg/L. A good nitrate concentration level for periphyton growth in water is around 0,01 – 5 mg/L (Novonty & Olem in Sibarani et al., 2020). In connection with the phosphate or orthophosphate content, according to Rizqina et al. (2017), if the phosphate level is less than 0,004 mg/L, it causes a limiting factor for microalgae, while levels of more than one mg/L can cause an explosion of the algae population or what is usually called blooming algae

4. Conclusions

Based on the research results, the type of phytoperiphyton obtained in each artificial substrate attractor media is the same; namely, there are 17 types of species consisting of 5 classes, namely the Bacillariohyceae class (8 types), the Zygnematophyceae class (4 types), the Chlorophyceae class (3 types), the Cyanophyceae class (1 type), and class Trebouxiophyceae (1 type). The most common type of periphyton (phytoperifiton) is *Navicula* sp. (6.602 cells/cm^2) and the least *Gyrosigma* sp. (1.595 cells/cm^2). The abundance of periphyton in artificial habitats with attractor media ranged from 13.448 – 21.406 cells/cm^2, with the best attractor being plastic bottle media. The abundance of periphyton between attractor media and between times was significantly different.

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