

Community Structure Of Plankton In Pieh Island Aquatic Tourism Park Area, West Sumatra

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Abstract – This research was conducted from January to September 2022. This study aims to determine the community structure of plankton in the Marine Tourism Park area of Pieh Island, West Sumatra. The study used roaming methods, and sampling was determined by purposive sampling. Based on the research results, it was found that the highest density (13, 002 – 21, 405 ind/l) was on Pandan Island (13.002 Ind/l), the frequency of presence was found to be included in the category Occasionally present to always present, the diversity index was high with an even equability index and no species dominated. The physical and chemical characteristics of seawater in the area of Pieh Island are still supportive of plankton and fish life because they comply with the biota's living conditions and seawater quality standards.

Keywords – Plankton, community, structure.

I. INTRODUCTION

The Pieh Island aquatic tourism park area is the working area of the Pekanbaru National Marine Protected Area Workshop. This area is protected because it is an essential habitat for waters, namely coral reef ecosystems. Apart from coral reefs, there are also various types of turtles and marine mammals, such as whales and dolphins[1]. A large number of biota that lives in these waters is likely due to the condition of these waters, which still supports the growth of marine biota.

Plankton is small biota that can also be found in marine waters. Plankton can be divided into two groups, namely phytoplankton (plant plankton) and zooplankton, which are animal plankton [2]. Phytoplankton is included in the plant group and is the largest primary producer in the waters [3]. Meanwhile, zooplankton cannot make their food; therefore, the survival of zooplankton depends on phytoplankton [4]. The density of zooplankton depends on the density of phytoplankton because phytoplankton is food for zooplankton. Therefore the quantity or abundance of zooplankton is there if water has a high content of phytoplankton [5]. Several types of plankton have been found in the open sea, namely *Planktoniella sol* and *Rhizosolenia robusta*, which are found throughout tropical waters [6].

This study aimed to analyze the plankton community structure and water quality in the Pieh Island Aquatic Tourism Park, West Sumatra.

II. RESEARCH METHODOLOGY

This research was conducted in January – Desember 2022 in the Marine Tourism Park area of Pieh Island, West Sumatra. Plankton samples were identified at the Animal Ecology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University. Measurement of nitrate, nitrite, and phosphate levels was carried out at the Basic Chemistry

Laboratory at Bung Hatta University.

Plankton sampling was carried out using the purposive sampling method. This method using a bucket and taking as much as 100 liters of water, then filtering it with a plankton net. Each sampling location was repeated three times. Then the filtered sample is put into a sample bottle with a volume of 20 ml and given a 40% formalin solution until the formalin solution in the sample water becomes 4% then, labeled and put into a cool box.

Measurement of the physical-chemical parameters of the water was carried out before taking plankton samples. The Physico-chemical factors of water that were measured 1 liter water, temperature, water salinity, water pH, water turbidity, water nutrient concentration (nitrate, nitrite, and phosphate), DO and CO₂ content, and TSS (Total Suspended Solid) water.

2.3. Data analysis

2.3.1. The plankton data obtained is then analyzed as follows.:

a. Plankton density (K)

$$K = \frac{axc}{l}$$

Description : K = Number of plankton per 1 liter

a = average number of plankton species in 1 ml

c = Volume of sample concentrate

l = Volume of filtered water [7]

b. Frequency of attendance (FK)

$$FK = \frac{\text{the number of sample units occupied by a species}}{\text{number of units of the whole sample}} \times 100\% \quad [7]$$

c. Diversity index (H')

$$H' = - \sum_{i=1}^s p_i \ln p_i$$

Description: H' = Indeks diversitas Shanon and Winner

ln = Natural logarithm

p_i = n_i/N

s = Number of all species [7]

The criteria for the diversity index are classified as follows:

H' < 1.0 : Low diversity index

1 ≤ H' ≤ 3 : Medium diversity index

H' > 3 : High diversity index [8]

d. Equitability Index (E)

$$E = \frac{H'}{H_{maks}}$$

Description :

E = Equitability index

H' = Shanon-Wiener diversity index

H_{maks} = $\ln s$

S = Number of species [7]

e. Dominance index

$$C = \frac{\sum n_i (n_i - 1)}{N (N - 1)}$$

Description :

C = dominance index

n_i = total number of individuals of species I

N = Total number of individuals from all species.

The greater the value of the dominance index, the greater the tendency for species to dominate [7]

2.3.2 Analysis of water Physico-chemical parameters

a. Dissolved oxygen content (O_2)

$$\text{ppm } O_2 = \frac{\text{ml titrant} \times N \text{ titrant} \times 8 \times 1000}{\text{ml sample (bottle volume - 2)}} \times \frac{1}{\text{bottle volume}} \quad [7]$$

b. Free CO_2 measurement

$$\text{ppm} = \frac{\text{ml titrant} \times N \text{ titrant} \times 44000}{\text{ml sample}} \quad [7]$$

c. TSS measurement (*Total Suspended Solid*)

$$\text{TSS} = \frac{W_2 - W_1}{V}$$

Description :

W_1 : Weight of filter paper before filtering (mg)

W_2 : Weight of filter paper after filtering (mg)

V : Volume of filtered water (l) [7]

Analysis of the data used for environmental physics-chemical parameters is descriptive and presented in tabular form. The analysis includes comparing the measured water quality characteristic values with quality standards. The quality standard of Decree of State Minister of Environment Year 2004 (Seawater quality standard for marine biota)

III. RESULTS AND DISCUSSION

3.1 Plankton Density (K)

The highest density was found on Pandan Island (13.002 Ind/l) and the lowest on Toran Island (21.405 Ind/l) (Figure 1).

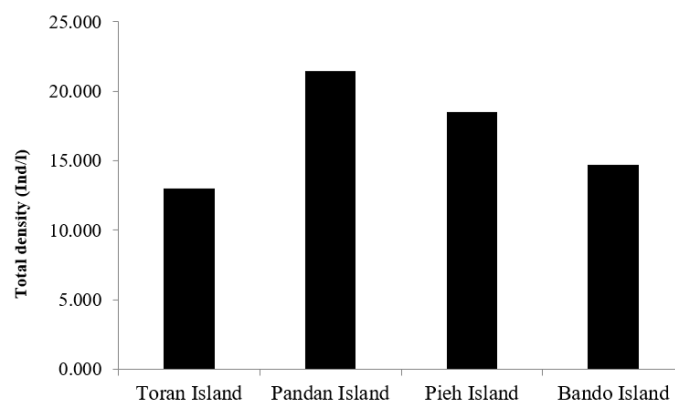


Figure 1. Plankton density in Pieh Island aquatic tourism park area, West Sumatra

The high density on Pandan Island is due to the high density of the *Trichodesmium erythraeum*. *Trichodesmium* sp is a species from the Cyanophyceae family with a high density and rapid growth in Indian coastal waters [9]. In addition, the high plankton density of the *T. erythraeum* species is also supported by the water conditions themselves. A warm surface's temperature can support *Trichodesmium* sp growth [10]. This statement follows research results, namely 27.6°C – 29.3°C (Table 2). *Trichodesmium* sp can grow at temperatures ranging from 20 - 34°C with an optimal temperature of 28°C [11].

T.erythraeum was dominant in each location because this type is most often found in clean and clear high seas. The type *T.erythraeum* is a likes to live in the open sea far from the influence of land and clear and clean waters [12]. All islands in the Pieh Island Aquatic Tourism Park are uninhabited and protected islands, so there is no human activity that can cause the entry of excess nutrients into the waters. The flow of urban waste that flows into the river and the waters will cause an increase in chemical nutrients in the waters and will impact the quality of the environment and waters [13].

3.2. Presence Frequency

The frequency of presence is divided into five categories, namely rarely (1-20%), sometimes (21-40%), often (41-60%), often (61-80%), and always (80- 100%) [14]. Plankton in the Pieh Island area falls into the category of Occasionally present until always present.

Table. 1 Frequency of plankton presence in Pieh Island Aquatic Tourism Park, West Sumatra

Category	Presence Range (%)	Number of Species
Seldom	0-20	-
Sometimes there	21-40	20
Often there	41-60	25
Often	61-80	39
There always is	81-100	30

A species with a high frequency of presence indicates that it is often found in that area or habitat [15]. In this study, the frequency of presence with the highest 100% value was in the Bacillariophyceae class, namely 30 species. The number of genera in the Bacillariophyceae class is quite a lot, has a wide distribution, and can live in various habitats and under different circumstances [16].

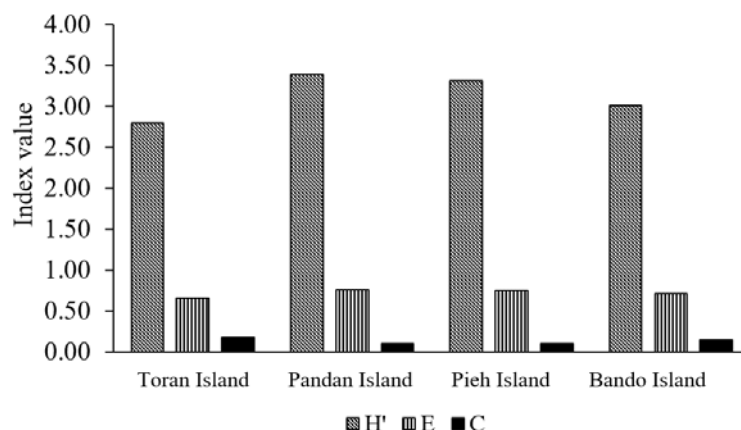
3.1.3. Diversity Index (H'), Equitability Index (E) and Dominance Index (C)

Figure 2. Diversity Index (H'), Evenness Index (E) and Dominance Index (C) of plankton for each location in Pieh Island Aquatic Tourism Park, West Sumatra.

The highest diversity index was on Pandan Island at 3.38, which was included in the high category, and the lowest was found at Toran Island (2.80), which was included in the medium diversity index. The high value of the diversity index on Pandan Island is due to the number of species found, namely 86. The H' index value is in line with the Equitability index for each location ranging from 0.671 – 0.761 (Figure 2), indicating that the individual components of each species in each location are even because the E value is close to one [17]. The dominance index (C) in the Pieh Island Aquatic Tourism Park, is close to zero (0.104 – 0.186); this indicates that there are no dominating species. The dominance index (C) in Pieh Island Aquatic Tourism Park, is close to zero. The smaller the dominance index value indicates no species dominates, and vice versa [18].

3.2. Physical-Chemical Parameters of Waters in the Pieh Island Aquatic Tourism Park, West Sumatra

The temperature parameters at each station range from 27.6 – 29.3°C (Table 2). This temperature range is still possible for plankton and fish to live because it does not exceed the range of marine biota quality standards, namely 28 – 30°C [19]. The optimum temperature for plankton growth ranges from 22°C – 30°C [20].

Table 2. Water Quality in Pieh Island Aquatic Tourism Park, West Sumatra

No	Parameters	Lokasi				Quality standard for marine biota *
		I Toran Island	II Pandan Island	III Pieh Island	IV Bando Island	
1	Temperature (°C)	28	29	27.6	29.3	28-30
2	Salinity (ppm)	31.5	33.5	33.6	33.6	33-34
3	CO ₂ (ppm)	1.84	0.86	0.67	0.47	-
4	pH	7	7.05	7.06	7.12	7-8,5
5	Water brightness (m)	14.6	20	25	22.6	> 5
6	DO (ppm)	9.36	8.17	8.37	9.02	>5
7	TSS (mg/l)	0.09	0.14	0.07	0.11	20
8	Phosphate (PO ₄) (mg/l)	0.067	0.028	0.06	0.02	0,015
9	Nitrate (NO ₃) (mg/l)	0.27	0.26	0.16	0.28	0,008
10	Nitrite (NO ₂) (mg/l)	0.02	0.02	0.18	0.02	1

*The quality standard for marine biota is based on the Decree of the State Minister for the Environment (2004)

The highest salinity values were on Pieh Island and Bando Island, while the lowest salinity was found on Toran Island. The high value of salinity in water can be caused by the entry of organic compounds from living organisms into the area. The low

value of the salinity of the water is caused because the water's waters are still natural [21]. A good value for plankton growth in the sea is 30 - 35 ‰ [22]. The measurement results follow marine biota quality standards [19].

The CO₂ content is related to the pH conditions in the waters. The higher the pH, the lower the carbon dioxide level, the free carbon dioxide released will react with water and form carbonic acid, which will then be reduced to bicarbonate and carbonate, lowering the pH [23]. The lowest CO₂ content, namely 0.49 ppm, is on Bando Island, which has a pH value of 7.12; this value is higher when compared to the other three islands. The standard pH value for water ranges from 6-8 [24].

High brightness indicates the ability of sunlight to penetrate deep into the waters and vice versa [25]. Brightness is highly dependent on light intensity. Low light intensity will lead to a high abundance of phytoplankton in the waters because optimal chlorophyll synthesis requires high light intensity. Relatively low [26]. A good brightness value for marine biota is > 5 m [19], the results obtained in this study are by predetermined quality standards because not less than 5 m.

The DO (Dissolved Oxygen) value in the waters of Pieh Island Aquatic Tourism Park ranges from 8.17 – 9.36 ppm; the high value of dissolved oxygen in water is due to the high rate of photosynthesis in these waters [27]. The life of aquatic organisms will go well if the dissolved oxygen content is at least five ppm [28], which states that DO is suitable for marine biota, namely > 5 ppm [19].

The TSS value in the Pieh Island Aquatic Tourism Park area ranges from 0.07 – 0.15 mg/l. The TSS content obtained in this study was shallow compared to seawater quality standards, namely 20 mg/l. The low TSS value is because the condition of the waters in the area is still very natural, and there is still little pollutant waste that enters the area [29]. The low TSS value is directly proportional to the results of the abundance of plankton obtained. Research results Wishu in 2016 [30] show a link between the low level of TSS concentration and the abundance of phytoplankton because if water is turbid, then the process of photosynthesis will be hampered.

The phosphate value obtained is good enough for plankton growth in the waters. The concentration value needed for optimal plankton growth is in the range of 0.27 - 5.51 mg/l and will be a limiting factor if the concentration value is less than 0.02 mg/l [31]. The value of the concentration of phosphate in seawater is 0.015 mg/l [19].

Table 1 shows the value of nitrate in the Pieh Island Aquatic Tourism Park, which ranges from 0.16 – 0.28 mg/l. The nitrate content in the research location exceeded the quality standard limit in the Decree of the State Minister for the Environment (2004), namely 0.008 mg/l. If water has excess nitrate levels, this indicates that human activities have caused pollution [32]. Meanwhile, the nitrite levels obtained in the Pieh Island Aquatic Tourism Park ranged from 0.02 – 0.18 mg/l [27]. If the nitrite content is still below one mg/l, it is still in the normal category [19].

IV. CONCLUSION

Plankton density ranges from 13.002 – 21.405 (Ind/l) with a high Relative Density at each location, namely the type of *Trichodesmium erythraeum*. The diversity index (H') in the Pieh Island Aquatic Tourism Park, is relatively high with an Equitability Index (E) evenly distributed in each location, and there are no dominant species. The physical and chemical characteristics of seawater in the Pieh Island Aquatic Tourism Park, in general, are still supportive of plankton and fish life because they comply with the living conditions of biota and seawater quality standards.

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