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Daily Fluctuation of Planktons Abundance in Percut Sei Tuan Waters, Deli Serdang Regency, North Sumatera

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Abstract: Plankton is an aquatic biota that lives following the currents in the water. The life of plankton is highly dependent on the water quality in those aquatic environments. The constantly changing physical and chemical conditions of water lead to fluctuations in the abundance of plankton in a water. This study aims to analyze fluctuations in plankton abundance and its correlation with water quality in Percut Sei Tuan Waters. The study was conducted in February and March 2023. Filtration method at 3 stations is the Sampling technique used in this study. The sampling period is carried out in the morning, afternoon, and evening. Data analysis to determine the relationship between variables using Pearson correlation in SPSS version 26. Based on the research results, 42 genera of phytoplankton and 16 genera of zooplankton were found. The highest abundance of phytoplankton was 4.635 Ind/L during the afternoon. The highest abundance of zooplankton was obtained at evening, which was 1.049 Ind/L. This is due to the daily vertical migration of zooplankton and their negative phototactic behavior, while phytoplankton require light for photosynthesis. The research results indicate that the abundance of phytoplankton has a very strong correlation with temperature, light intensity, salinity, TSS, pH, DO, and Nitrate. The abundance of zooplankton is highly correlated with water flow velocity, light intensity, salinity, TSS, TDS, pH, DO, Nitrate, and Phosphate.

Keywords: Correlation; Fluctuation; Percut Sei Tuan; Planktons Abundance; Water Quality

Introduction

Percut River empties into the Malacca Strait and located in Percut Village, Percut Sei Tuan Sub-district, Deli Serdang Regency. Percut River has potential aquatic resources and life support functions that are very important because of the location not far from settlements. According to Sridaryanti, et al. (2022), the presence of rivers adjacent to settlements can also affect the condition of these waters. Community activities around the Percut River produce organic waste that can reduce water quality.

Firdhausi et al. (2018) clarify that the direct or indirect input of organic waste around the riverbanks can affect the physical and chemical conditions of water. Furthermore, the presence of fishing boats also impacts water quality because the fuel entering the water can lead to pollution. Pollution that occurs in the river can affect the survival of aquatic biota in it (Sumanto, 2019). One of the aquatic biotas whose life is highly dependent on water quality is plankton. Plankton acts as food for various types of organisms that live in waters (Yulisa & Mutiara, 2016). This is the reason for the importance of the presence of plankton in a water.

Plankton is a microscopic aquatic biota whose movements are strongly influenced by water currents (Takarina et al. (2019). Plankton is divided into phytoplankton and zooplankton. Phytoplankton play a role in the food chain as primary producers and in nutrient cycle (Otero et al., 2020). Phytoplankton reflect water quality through changes in community structure,

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distribution patterns, and the proportion of specific species sensitive to environmental changes. Zooplankton acts as a primary and secondary link in the food chain (Abdulwahab & Rabee 2015). Zooplankton also play a role in regulating the abundance and distribution of marine biological resources (Ndour et al., 2014). Anggraini, et al. (2016) state that plankton are highly sensitive to environmental changes due to their tolerance limits to specific substances, making the number of species usable as indicators in a water. The quality of a water can be determined by measuring the growth, abundance, and distribution of plankton (Witariningsih et al., 2020).

Rahayu et al. (2020) point out that states that plankton distribution shows variations influenced by environmental factors such as water quality. Therefore, plankton is one of the indicators in of waters. According to Aida, et al. (2022), plankton can be used as an indicator of water quality due to its tolerance to various factors and has different responses to changes in water quality. The composition, species abundance, and distribution of phytoplankton in water bodies are closely correlated with water temperature, clarity, salinity, nitrate, and phosphate.

Fluctuations of plankton in waters can be used as a measure that the area can be used as a biota protection zone. The description above shows that the need for studies on plankton fluctuations in Percut Sei Tuan waters which are the source of life for biota in it. Therefore, research related to the fluctuations in plankton abundance in the Percut River waters is crucial and needs to be conducted.

Method

Location

This study was conducted in February and March 2023 in the Percut Sei Tuan Waters, North Sumatra (Figure 1). Samples were collected at 3 stations (Table 1).

Tabel 1. Data Collected Station

Station	Geographical Location
Near the sea	3° 44'30, 95"LU and 98° 47'28,55"BT
Mangrove	3° 43'38,36" LU and 98° 47'28,65" BT
Tributary	3° 42'52,05"LU and 98° 46'21,98" BT

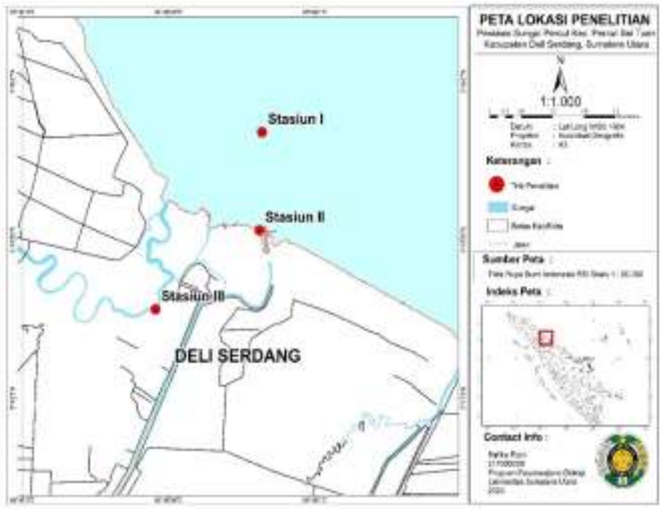

Figure 1. Map of research location Percut Sei Tuan waters

Samplings and Laboratory Observastion

Sampling was done with the pouring method. Water from the sampling point was taken as much as 50 liters and filtered using a plankton net. Water collection was repeated 3 times (morning, afternoon and evening) in a day for each station. The filtered water was collected in a 62 ml bucket bottle and then put into a sample bottle and then given 4% lugol. The sample bottles were labeled according to the stations and placed in a cool box for analysis. Samples observation and cell counting were conducted in Shafera Enviro Laboratory and identification of plankton samples refers to the identification books of Yamaji (1984) and Sterble, et al. (1985).

Physical and chemical parameters were measured as supporting data to strengthen the status of water quality which includes temperature, current speed, light intensity, pH, salinity, DO, brightness, TDS, TSS, Nitrate and Phosphate.

Data Analysis

Plankton abundance, the number of plankton found was calculated as the number of individuals per liter using a modified formula according to APHA (1992) as equation 1. Diversity Index using the Shannon-Wienner formula (1949) (Equation 2). The evenness index was calculated using the formula proposed by Magurran (1988) (Equation 3). The Species Dominance Index is calculated to solidify the interpretation of the dominance of species in a community, generally Simpson's index is used, namely the Equation 4.

$$N = \frac{Oi}{Op} x \frac{Vr}{Vo} x \frac{1}{Vs} x n \quad (1)$$

$$H' = -\sum pi \ln pi \quad (2)$$

$$E = \frac{H'}{H'Maks} \quad (3)$$

$$D = \sum(\frac{ni}{N})^2 \frac{s}{i=1} \quad (4)$$

Description:		
N	:	Plankton abundance (ind/L)
Oi	:	Cover glass area (mm^2)
Op	:	Area of one field of view (mm^2)
Vr	:	Volume of filtered sample bottle (ml)
Vs	:	Volume of filtered water(L)
Vo	:	Volume observed
n	:	number of cells observed
H	:	Shannon-Wiener diversity index
pi	:	Proportion of 1st species
ln	:	Logarithm Nature
pi	:	:∑ni/N (calculation of the number of individuals of a species with the whole species)
E	:	Evenness index
H'	:	Shannon-Wiener diversity index
H'_{maks}	:	maximum diversity index
D	:	Simpson dominance index
ni	:	Number of individual species
N	:	total number of individuals
S	:	number of genera

Simpson Index (D) is categorized as follows (Odum, 1971) where $0<D<0.5$ is No dominant species and $0.5>D>1$ is There is a dominant species. The relationship or correlation between physical and chemical factors of waters with plankton abundance using Pearson correlation analysis in the SPSS version 26 application. According to Sugiyono, (2018) the criteria for the value of the correlation level can be seen in Table 2.

Table 2. Criteria for Relationship Value Correlation Index

Coefficient Interval	Level of Relationship
0.00 – 0.20	Very low
0.20 – 0.40	Low
0.40 – 0.60	Medium
0.60 – 0.80	Strong
0.80 – 1.00	Very Strong

Result and Discussion

Based on the results of research conducted in Percut Sei Tuan Waters, 58 genera of plankton were obtained, which were included in 53 families, 40 orders, and 16 classes. Phytoplankton obtained as many as 42 genera which were included in 39 families, 32 orders, and 10 classes while Zooplankton obtained as many as 16 genus which were included in 14 families, 8 orders, and 6 classes.

Based on the results of the study, the genera of phytoplankton found in Percut Sei Tuan waters was more than zooplankton. The number of phytoplankton genus that is much more than zooplankton is a natural state in aquatic ecosystems. This happens because ecologically the phytoplankton community acts as a primary producer while the zooplankton community is in the second tropic which feeds on phytoplankton as well as a source of energy (food) for crustaceans at the third level (Japa, et al., 2013). Another factor that causes low zooplankton populations is the presence of carnivorous and omnivorous fish living in the waters. This is in accordance with the existing conditions that in the waters of Percut Sei Tuan there are carnivorous fish such as Sangor catfish and Snakehead fish, and omnivorous fish such as Tilapia fish (Susilo, et al., 2016).

The phytoplankton genera from the Bacillariophyceae class were the most commonly found, namely 10 genera consisting of Cymbella, Pleurosigma, Navicula, Pinnularia, Stauroneis, Nitzschia, Surirella, Amphora, Epithemia and Achnanthes (Figure 2). The genera Navicula and Nitzschia were found with an even number of individuals at each station and observation period. According to Triawan & Arisandi (2020), phytoplankton commonly found in estuary and coastal waters are diatoms (Bacillariophyceae). The Bacillariophyceae class is a class that able to adapt to the environment quickly (Muhtadi et al. 2020) and has a high reproductive ability even in unfavorable environmental conditions (Gurning et al., 2020). Research conducted by Witariningsih, et al. (2020), in the waters of the Lombok Strait also found the most species from the Bacillariophyceae class. This is also supported by Santos, et al. (2022) which state that many types of phytoplankton found in the Estuary Area in Sado, Portugal come from the Bacillariophyceae class. The least phytoplankton found at the study site came from the Pyramimonadophyceae class (2%) with only 1 genus, namely Halosphaera and from the Dinophyceae class (2%) also only found 1 genus, namely Peridinium.

The zooplankton commonly found belong to the classes Hexanauplia and Spirotrichea, each comprising 25% with a total of 4 genera (Figure 3). Based on the data obtained, genera from the class Hexanauplia such as Calanus, Acartia, Oithona, and Cyclops were found at the research site. The high number of zooplankton genera in the class Hexanauplia found is believed to be due to their excellent adaptive abilities, allowing them to live in various aquatic conditions. Hexanauplia is a holoplankton. If Hexanauplia widely obtained in water, it indicates the potential for natural food for meroplankton (larvae of certain marine biota) when the yolk reserves are depleted and require finding sources of food intake from outside, so that the more diverse the composition of holoplankton in a body of water can support the availability of food for meroplankton (Mulyadi et al., 2015). The dominance of the Hexanauplia class was also found by Witariningsih, et al. (2020) in the waters of the Lombok Strait, Faiqoh et al. (2015) in the waters of Pramuka Island, and Nurrachmi et al. (2021) who found 27 species of the Hexanauplia class in the Pelintung Industrial Area, Dumai.

The genera obtained from the class Spirotrichea were Epiplocylis, Eutintinnus, Favella, and Tintinnopsis. Among the genera from the class Spirotrichea found at the research site, Tintinnopsis had the highest abundance. Research conducted by Amri et al. (2020) in the Siak River Estuary also found that the genera Tintinnopsis dominated that water body. This can occur because Tintinnopsis is a zooplankton that can thrive in both freshwater and seawater due to its ability to survive in both low and high salinity conditions. This genera also has the capability to form crystals, enabling it to survive even in environmental conditions that do not support its life.

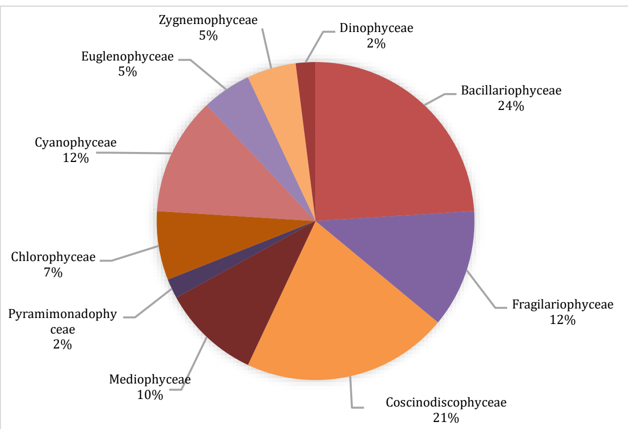

Figure 2. Percentage of Phytoplankton class in Percut Sei Tuan Waters

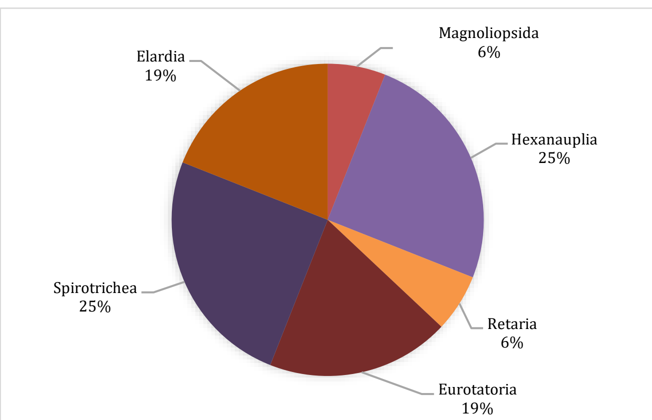

Figure 3. Percentage of Zooplankton class in Percut Sei Tuan Waters

The Magnoliopsida and Retaria classes were the classes with the least number of genera, only 1 genus in each class. The Magnoliopsida class found the genus Nauplius, and in Retaria found Globigerina. The Nauplius genus was found in every research location with an even abundance because it has good adaptability. According to Agustini & Madyowati (2017), Nauplius has an important role in the food chain in an aquatic ecosystem and most commonly found in waters. Another factor that causes Nauplius to be found at each station is thought to be because around the observation station there are submerged objects such as palm fronds and wood that become poles for floating stalls around the waters. These objects become an excellent substrate for Nauplius.

The highest phytoplankton abundance was found in station I during the afternoon at 5865 Ind/L, while the lowest was in station II during the afternoon at 2768 Ind/L. The highest zooplankton abundance was found in station I at evening as much as 1439 Ind/L, and the lowest in station II during the afternoon as much as 179 Ind/L (Table 3).

Table 3. Plankton Abundance

St	Sampling Time	Abundance (Ind/L)	
		Phytoplankton	Zooplankton
	Morning	5181	854
I	Afternoon	5865	874
	Evening	3136	1439
Average		4727	1056
	Morning	3474	269
II	Afternoon	2768	179
	Evening	2947	526
Average		3063	324
	Morning	2659	616
III	Afternoon	5231	943
	Evening	2938	1181
Average		3609	913

Based on the results of the study, the abundance of phytoplankton and zooplankton varied at each research station. During the 3 periods (morning, afternoon, evening), the abundance of phytoplankton at station I ranged from 3136-5865 Ind/L, at station II ranged from 2768-3474 Ind/L, and at station III ranged from 2659-2938 Ind/L. This indicates fluctuations in phytoplankton abundance in Percut Sei Tuan waters (Figure 4).

The data obtained from stations I and III indicate that phytoplankton abundance increases during the afternoon and decreases at evening. A study conducted by Witariningsih et al. (2020) in the Lombok Strait also found the highest phytoplankton abundance during the afternoon. This is suspected to be because the surface water temperature is relatively warmer during the afternoon compared to the deeper layers (Witariningsih et al., 2020). Additionally, the high phytoplankton abundance during the afternoon is influenced by environmental parameters that support phytoplankton life during this period. This aligns with the statement by Dewi et al. (2023) that the presence and development of phytoplankton in a water are influenced by environmental conditions such as light, temperature, and nutrient concentration in the water.

The fluctuations in phytoplankton at station II differ from the other stations. Based on the data obtained, phytoplankton abundance at station II decreases during the daytime and increases at night. This is suspected to be due to the rainy conditions at the time of sampling in the research area. These conditions result in reduced light penetration, salinity, and temperature, and increase the turbidity of the water. According to Zainuri et al. (2023) when it rains the nutrient concentration of low light intensity will be lower so that the plankton population will also be low.

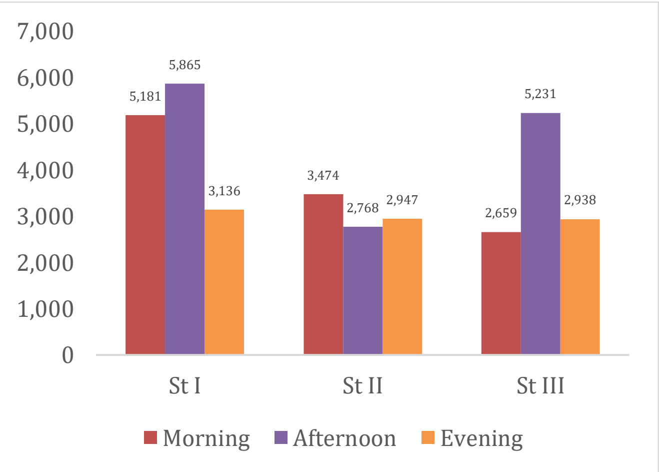

Figure 4. Phytoplankton Abundance

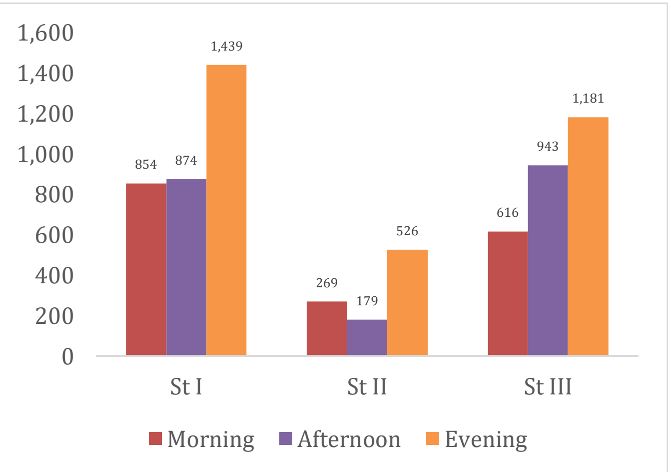

Figure 5. Zooplankton Abundance

Zooplankton abundance at each research station increased at night (Figure 5). Based on the results of the study, zooplankton abundance at station I obtained from 3 periods ranged from 854-1439 Ind/L, at station II ranged from 179-526 Ind/L and at station III ranged from 616-1181 Ind/L. Zooplankton tend to avoid light so that they will go down towards the bottom of the water during the day and will come to the surface at night. This can cause the abundance and composition of zooplankton to differ between the column and surface layers of a body of water. According to Guerra et al. (2019), this activity is called vertical migration, which is a daily migration carried out by certain zooplankton organisms towards the seabed during the day and towards the sea surface at night. Iswanto et al. (2015) point out that zooplankton are generally negative phototaxis so that during the day zooplankton will move away from the surface of the water and will rise to the surface at night.

The highest diversity index value was obtained from station I (Table 4). The high index of diversity is related to the number of genus and abundance found at station I. Water conditions at station I, both physical and chemical parameters of water also support the life of plankton such as the range of BOD levels of 3-5 mg/L, which is relatively lower than other stations and the average value of salinity 22.4 $^{0}/_{00}$ which is higher and closer to the optimum range of salinity levels than other stations. According to Nontji (2008), in general a good salinity range for plankton life is 11-40‰.

The lowest diversity index value was obtained from station III. This can be caused by the dominance of species and water quality at that station. Based on the abundance data obtained, there is considerable dominance by the genus Seletonema. According to Hou, et al. (2023), the dominance of a species can affect the population balance in a community. In addition, the physical and chemical conditions of the waters are also very influential, such as the range of BOD values that are higher than other stations at 5-6 mg/L. According to Daroini & Arisandi (2020), the high BOD content indicates the lack of dissolved oxygen in the waters. The lack of DO levels in the waters will affect the survival of plankton.

The Diversity Index values for phytoplankton and zooplankton, when analyzed separately, fall into different categories. The Diversity Index for phytoplankton, with an average value of 2.74, falls into the moderate category, whereas zooplankton, with a value of 1.54, falls into the low category. This is in accordance with the data found in the study which showed that the comparison of abundance and number of genera between phytoplankton and zooplankton is very much different. The abundance value of phytoplankton at all stations was more abundant than the abundance value of zooplankton. According to

Witariningsih et al. (2020) this occurs because the reproductive cycle of zooplankton is slower than phytoplankton. Makmur et al. (2013) also states that phytoplankton populations constantly fluctuate in composition and number due to differences in water quality (especially nutrients), also due to grazing by zooplankton and herbivorous fish and accumulation of toxic metabolic wastes.

Table 4. Plankton Diversity Index

St	Sampling Time	Diversity Index (H')	
		Phytoplankton	Zooplankton
	Morning	2.55	1.68
I	Afternoon	2.63	2.11
	Evening	2.61	2.12
Average		2.60	2.60
	Morning	2.84	1.51
II	Afternoon	3.04	1.31
	Evening	2.79	1.57
Average		2.89	2.89
	Morning	2.74	0.81
III	Afternoon	2.85	0.99
	Evening	2.62	1.78
Average		2.73	2.73

The highest phytoplankton evenness index was found at station II during the afternoon, which was 0.93, and the lowest was at station I during the afternoon, which was 0.85. The highest zooplankton evenness index was recorded at station III during the evening, which was 0.99, and the lowest was also at station III during the afternoon (Table 5).

The evenness index values for phytoplankton obtained at station I in the morning, afternoon, and evening were 0.87, 0.85, and 0.87 respectively. The evenness index values in the research locations indicate uneven distribution of phytoplankton because they have evenness index values greater than 0.5. This a line with Yuliana's statement (2012) that an evenness index value greater than 0.5 indicates relatively uneven distribution of individual species within their genera, whereas an evenness index value less than 0.5 indicates relatively even distribution of individual species within their genera. The evenness index values for phytoplankton obtained at stations II and III were also quite similar to station I. Therefore, it is concluded that the evenness index at stations I, II, and III falls into the high category for each period.

The evenness values for zooplankton at station I in the morning, afternoon, and evening were 0.81, 0.92, and 0.96 respectively. The evenness values for all three periods at station I fall into the high category because they were greater than 0.5. The evenness values at station II and II also fall into the category, so it can be concluded that the value of zooplankton evennes at stations I, II, and III in each period is high, which means that there is dominance of some genus that causes the distribution of individuals to be uneven.

The highest phytoplankton dominance index also found at station II during the evening and the lowest at station II during the afternoon. The highest zooplankton dominance index observed at station III in the morning and the lowest found at station I during the evening (Table 6).

Table 5. Plankton Evenness Index

St	Sampling Time	Diversity Index (E)	
		Phytoplankton	Zooplankton
	Morning	0.87	0.81
I	Afternoon	0.85	0.92
	Evening	0.87	0.96
Average		0.86	0.86
	Morning	0.89	0.84
II	Afternoon	0.93	0.95
	Evening	0.89	0.87
Average		0.91	0.91
	Morning	0.93	0.58
III	Afternoon	0.88	0.55
	Evening	0.89	1.00
Average		0.90	0.90

Table 6. Plankton Dominance Index

St	Sampling Time	Dominance Index (C)	
		Phytoplankton	Zooplankton
	Morning	0.10	0.24
I	Afternoon	0.10	0.14
	Evening	0.11	0.13
Average		0.10	0.10
	Morning	0.08	0.29
II	Afternoon	0.06	0.28
	Evening	0.08	0.26
Average		0.07	0.07
	Morning	0.08	0.60
III	Afternoon	0.07	0.56
	Evening	0.10	0.17
Average		0.08	0.08

The evenness values for zooplankton at station I in the morning, afternoon, and evening were 0.81, 0.92, and 0.96 respectively. The evenness values for all three periods at station I fall into the high category because they were greater than 0.5. The evenness values at station II and II also fall into the category, so it can be concluded that the value of zooplankton evennes at stations I, II, and III in each period is high, which means that there is dominance of some genus that causes the distribution of individuals to be uneven.

The highest phytoplankton dominance index also found at station II during the evening and the lowest at station II during the afternoon. The highest zooplankton dominance index observed at station III in the morning

and the lowest found at station I during the evening (Table 6).

The dominance index in phytoplankton at station I in the morning was 0.10, in the afternoon was 0.010 and at evening was 0.11. Based on this value, it can be seen that the dominance index value is in the low category and there is no dominating phytoplankton species. The value of the phytoplankton dominance index at stations II and III also shows a range that is not much different from station I so it can be concluded that the value of the phytoplankton dominance index at each station in all periods is in the low category which means there is no dominating phytoplankton species.

The dominance index in zooplankton at station III in the morning was 0.60, in the afternoon was 0.56 and at evening was 0.17. Based on these values, it can be seen that the dominance index value in the morning and afternoon is included in the high category and there are types of zooplankton that dominate while at night it is included in the low category which means that there are no dominating species. The high value of abundance in the morning and afternoon at station III occurred due to the dominance of the genus Brachionus. In contrast to station III, the value of the dominance index at stations I and II included in the low category in each period which means there is no dominating species.

Water quality data measured as support include physical and chemical parameters such as temperature, current speed, brightness, light intensity, TSS, TDS, dissolved oxygen (DO) levels, acidity (pH), salinity, BOD, and concentrations of Nitrate and Phosphate in Percut Sei Tuan waters (Table 7). Physical and chemical conditions at each research station change depending on weather factors and tidal waters. The physical - chemical characteristics of a habitat will support the structure of the biota community that lives in it, including plankton.

Table 7. Average Measurement Results of Measurements of Physical and Chemical Factors of Waters in Percut Sei Tuan Waters

Parameter	Unit	Observation Station I	Observation Station II	Observation Station III	Quality Standard*
Temperature	^oC	28-31	27-30.5	28-33.1	28-32
Current Speed	m/det	0-0.2	0.1-0.3	0-0.1	-
Turbidity	cm	0-31.3	0-17	0-37	> 6
Light Intensity	Cd	0-280	0-653	0-623	-
Salinity	$^o/_{oo}$	18-25	0	6-11	-
TSS	mg/L	0-26	0-136	0-83	80
TDS	mg/L	685.5-858.5	130-1053	571-934	2000
pH	-	7-7.8	6-7.5	7-7.5	7-8.5
DO	mg/L	0-8.8	8-9	0-8.3	>5
BOD	mg/L	0-4.5	0-4.5	0-5.7	20
Phosphate	mg/L	0-0.01	0-0.01	0-0.01	0.02
Nitrate	mg/L	0-0.04	0-0.05	0-0.04	0.06

*Government Regulation No. 22 Year 2021

The measurement results of the temperature parameters of the three stations varied. The different measurement results are thought to be influenced by measurement time factors and erratic weather forecasts. This is in accordance with Sulistiawati, et al (2019) which states that differences in the temperature range at each observation station occur due to factors such as rainfall, evaporation, humidity, wind speed and light intensity. Time differences such as morning, afternoon and evening can affect temperature differences. The highest temperature found at station III, which was an average of 31° C, then at stations I and II amounting to 29° C. According to Sulistiowati et al. (2016), the variation in temperature in a water is thought to be due to the influence of sunlight intensity that first reaches the water surface.

Nitrate and Phosphate levels are still within the range of quality standards for sea water. According to Wiyarsih et al. (2019), environmental factors, namely the availability of nutrients such as phosphate and nitrate, greatly affect the survival of plankton in these waters. The measurement results of salinity, pH, light intensity, brightness, and DO levels are still within the range of water quality standards based on PP RI No. 22 of 2021 concerning sea water quality standards. This means that in general the water quality in Percut Sei Tuan Waters is still around conditions that can support the growth of plankton in these waters.

The correlation test was one of the tests used to see the relationship between one variable and another. The correlation stage in this study aims to see the relationship between water quality parameters and plankton abundance values. Water quality parameters are independent variables given the notation X, while the abundance of phytoplankton and zooplankton is the dependent variable given the notation Y. A correlation value close to 1 indicates that the relationship between the two variables is getting stronger (Table 8).

Tabel 8. Results of Correlation Analysis between Plankton Abundance and Physical and Chemical Factors of Water

Parameter	Phytoplankton						Zooplankton					
	Morning		Afternoon		Evening		Morning		Afternoon		Evening	
Temperature	0.99	VS	0.29	L	-0.32	L	-0.71	S	0.54	M	0.47	M
Current Speed	0.29	L	-0.75	S	-0.47	M	-0.61	S	-0.90	VS	-0.96	VS
Brightness	0.29	L	0.40	L	0.00	-	0.95	VS	0.63	S	0.00	-
Light Intensity	-0.89	VS	-0.71	S	0.00	-	-0.89	VS	-0.49	M	0.00	-
Salinity	0.71	S	0.84	VS	0.87	VS	0.99	VS	0.66	S	0.96	S
TSS	0.00	-	0.94	S	0.00	-	0.00	-	-0.81	VS	0.00	-
TDS	0.39	L	0.79	S	0.73	S	-0.98	VS	-0.93	VS	998	VS
pH	0.95	VS	-1.00	VS	0.64	S	0.81	VS	0.95	VS	999	VS
DO	0.00	-	0.82	VS	0.00	-	0.00	-	-0.95	VS	0.00	-
BOD	0.00	-	0.32	L	0.00	-	0.00	-	0.57	M	0.00	-
Phosphate	0.00	-	0.75	S	0.00	-	0.00	-	0.90	VS	0.00	-
Nitrate	0.00	-	0.98	VS	0.00	-	0.00	-	1.00	VS	0.00	-

Based on the results of the correlation analysis, it showed that the values of temperature, light intensity and pH are negatively and strongly correlated with phytoplankton abundance. This means that if the values of temperature, light intensity and pH in the waters are high, the abundance of phytoplankton will decrease. Salinity, TSS, DO, Phosphate and Nitrate values are positively and strongly correlated to phytoplankton abundance. This means that if the values of salinity, TSS, DO, Phosphate and Nitrate are high, the abundance of phytoplankton will also increase.

The results of the analysis of temperature, light intensity, current velocity, TDS, and DO were negatively and strongly correlated with zooplankton abundance. This means that if the values of temperature, light intensity, current speed, TDS and DO in the waters are high, the abundance of zooplankton will decrease. Salinity, pH, BOD, Nitrate and Phosphate values are positively and strongly correlated with phytoplankton abundance. This means that if the values of salinity, pH, BOD, Nitrate and Phosphate are high, the abundance of zooplankton will also increase.

Conclusion

Phytoplankton genus is more common than zooplankton in Percut Sei Tuan Waters. Fluctuations occur at each station. The abundance of phytoplankton increases during the day while zooplankton increases at night. Phytoplankton correlated very strongly with temperature, light intensity, salinity, TSS, pH, DO and Nitrate. Zooplankton correlated very strongly with current speed, brightness, light intensity, salinity, TSS, TDS, pH, DO, Nitrate and Phosphate.

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Author Contributions

R. R; contributed as a researcher and article writer, H. W; contributed as a research idea and article writing supervisor, and T. A. B; contributed as a supervisor in processing research data. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

In writing this article, we sincerely declare that there are no conflicts of interest that may affect the objectivity and integrity of the results.

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