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Analysis of Nitrate, Phosphate, and Phytoplankton Abundance Content in Apar Waters Pariaman City West Sumatra

Analisis Kandungan Kelimpahan Nitrat, Fosfat, dan Fitoplankton di Perairan Apar Kota Pariaman Sumatera Barat

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ABSTRACT

Apar Beach is one of the tourist destinations in North Pariaman District, Pariaman City, West Sumatra. These tourism activities can affect water quality. In addition to anthropogenic activities, several factors can affect the quality of these waters, among the compounds contained in Apar waters, namely the content of nitrates, phosphates, and the abundance of phytoplankton. This study aimed to determine nitrate and phosphate content, how phytoplankton abundance, and the relationship between nitrate, phosphate, and phytoplankton abundance. The survey method was used in this study. The results of this study showed nitrate content at station I of 0.82 mg/L. Station II is 0.78 mg/L and station III is 0.90 mg/L. while the phosphate content at station I is 0.72 mg/L. station II is 0.71 mg / l and station III is 0.73 mg/L. The average phytoplankton abundance at station I was 249.99 ind/l. Station II is 288.88 ind/l, and station III is 327.77 ind/L. The relationship between nitrate and phosphate concentration with phytoplankton abundance is obtained value (R^2) 0.215, which means nitrate and phosphate affect phytoplankton abundance by 21.5%. In comparison, 78.5% is influenced by other factors, while the correlation coefficient value (r) of 0.464 means that nitrate and phosphate concentration with phytoplankton abundance has a moderate relationship.

Keywords: Phytoplankton, Abundance, Apar Beach

ABSTRAK

Pantai Apar merupakan salah satu destinasi wisata di Kecamatan Pariaman Utara, Kota Pariaman, Sumatera Barat. Kegiatan pariwisata ini dapat mempengaruhi kualitas air. Selain aktivitas antropogenik, ada juga beberapa faktor yang dapat mempengaruhi kualitas perairan tersebut, di antara senyawa yang terkandung dalam perairan Apar, yaitu kandungan nitrat, fosfat dan kelimpahan fitoplankton. Tujuan dari penelitian ini adalah untuk mengetahui berapa banyak kandungan nitrat dan fosfat, mengetahui bagaimana kelimpahan fitoplankton dan mengetahui hubungan antara kelimpahan nitrat, fosfat dan fitoplankton. Metode yang digunakan dalam penelitian ini adalah metode survei. Hasil penelitian ini menunjukkan kandungan nitrat pada stasiun I sebesar 0,82 mg/l. Stasiun II adalah 0,78 mg/L dan stasiun III adalah 0,90 mg/L. sedangkan kandungan fosfat di stasiun I adalah 0,72 mg/L. stasiun II adalah 0,71 mg/L dan stasiun III adalah 0,73 mg/L. Kelimpahan fitoplankton rata-rata di stasiun I adalah 249,99 ind/L. Stasiun II adalah 288,88 ind/L dan stasiun III adalah 327,77 ind/L. Hubungan antara konsentrasi nitrat dan fosfat dengan kelimpahan fitoplankton diperoleh nilai (R2) 0,215 yang berarti nitrat dan fosfat mempengaruhi kelimpahan fitoplankton sebesar 21,5% sedangkan 78,5% dipengaruhi oleh faktor lain, sedangkan nilai koefisien korelasi (r) sebesar 0,464 yang berarti bahwa konsentrasi nitrat, fosfat dengan kelimpahan fitoplankton memiliki hubungan sedang.

Kata Kunci: Fitoplankton, Kelimpahan, Pantai Apar

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INTRODUCTION

Apar Beach is close to the turtle conservation area located in Apar Village, North Pariaman District, Pariaman City. Geographically, Pariaman City is located between 00º 33' 00 – 00º 40' 43" LS and 100º 04' 46" – 100º 10' 55" BT. Pariaman City is one of the cities in West Sumatra province, with coastal and sea areas (Bappeda, 2010). Apar Beach has various community activities, such as fishing activities and residential areas, and is used as a beach tourist spot. These activities can potentially affect the ecosystem in the waters of Apar Beach. The nitrate and phosphate content can be found in fertilizers and household waste and can also be found in the inorganic content of liquid industrial limba (Nugroho et al., 2023).

Nutrients derived from land have physical properties that affect aquatic fertility. Nedi et al. (2020) state the input of nutrients needed by marine organisms, namely, the higher the nutrient content in the waters, the higher the abundance of phytoplankton in these waters. The abundance of phytoplankton can be used as a bioindicator in determining the fertility of a body of water influenced by environmental factors and the availability of nutrients (nitrates and phosphates).

MATERIALS AND METHOD

Time and place of research

This research will be carried out in January 2024 in the waters of Pariaman City, West Sumatra. Nitrate and phosphate content analysis was conducted in the Marine Chemistry Laboratory, while phytoplankton analysis was carried out at the Marine Biology Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Universitas Riau. The research site consists of 3 stations with three sampling points at each station. Station I is located near residential areas, station II is in the UPT Turtle Conservation area, and station III is in the area of the Apar River estuary.

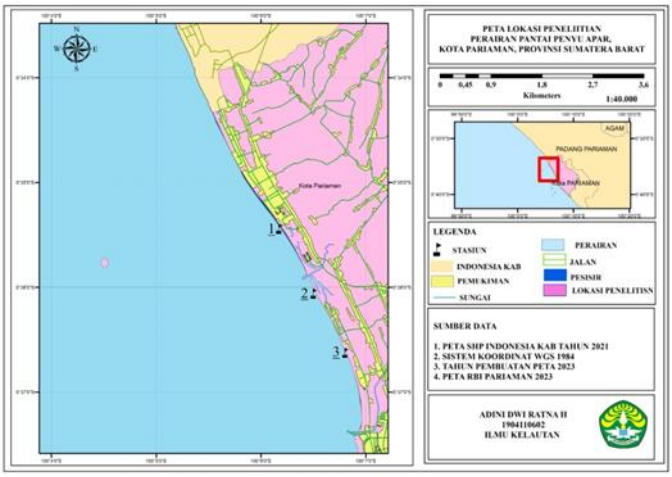

Figure 1. Research location

Analysis of phytoplankton abundance

Phytoplankton were identified using the phytoplankton identification books Davis (1955) and Yamaji (1976). The abundance of phytoplankton is calculated based on the number of individuals per liter using the APHA formula (1989).

$$N = Z\, x\, \frac{x}{y} x \frac{1}{v}$$

Description:

N = Abundance of phytoplankton individuals (ind/L)
Z = Number of individuals found
X = Volume of filtered sample water (100 mL)
Y = Volume 1 drop of water (0.06)
V = Volume of filtered water (100 L)

Relationship of nitrate, phosphate concentration, and phytoplankton abundance

Multiple linear regression tests aim to obtain the relationship between nitrate, phosphate concentration, and

phytoplankton abundance. Based on the formula referring to Sugiyono (2017) with a mathematical model is as follows;

$$y = a + bx_1 + bx_2$$

Description:
Y = Abundance of phytoplankton (ind/L)
a and b = Constants
x = Nitrate, phosphate concentration

RESULT AND DISCUSSION

Nitrate and Phosphate Content in the Apar Waters of Pariaman City

It is different based on the analysis of nitrate and phosphate content contained in the waters of Apar Kota Pariaman at each station. The average concentrations of nitrates and phosphates can be seen in Table 1.

Table 1. Average nitrate and phosphate concentrations at each station

Station	Concentration	
	Nitrate	Phosphate
I	0.82±0.064	0.72±0.07
II	0.78±0.045	0.71±0.128
III	0.90±0.126	0.73±0.102

It can be seen from the results of the analysis that nitrate has a range between 0,78 mg/L. Station I has a nitrate concentration of 0,82 mg/L and phosphate of 0,72 mg/L. Station II has a nitrate concentration of 0,78 mg/L and phosphate of 0,71 mg/L. At the same time, station III nitrate is 0,90 mg/L and phosphate 0,73 mg/L.

Fertility of Pariaman City Apar Waters based on Redfield ratio

Based on sample analysis, the Redfield nitrate and phosphate ratio was obtained in the waters of Apar Pariaman Kota Pariaman. The nitrate and phosphate analysis results and the Redfield ratio can be seen in Table 3.

Table 3. Results of nutrient nitrate and phosphate analysis and Redfield ratio

Station	Deuteronomy	Nitrate (mg/L)	Phosphate (mg/L)	Redfield ratio	Average
I	1	0,87	0,75	1,16	1,14
	2	0,85	0,77	1,10	
	3	0,75	0,64	1,17	
Average		0,82	0,72	1,14	
II	1	0.78	0.68	1.14	1,12
	2	0.74	0.86	0.86	
	3	0.83	0.61	1.36	
Average		0,78	0,71	1.12	
III	1	0,93	0,85	1,09	1,25
	2	0,77	0,69	1,11	
	3	1,02	0,66	1,54	
Average		0,90	0,73	1,25	

The Redfield nitrate ratio analysis results obtained values ranging from 1.12-1.25. At the station, I received a Redfield nitrate ratio of 1.14. Station II is 1.12. While station III is 1.25. Table 3 shows that the average nitrate concentration in the waters of Apar Kota Pariaman ranges from 0.78 to 0.90 mg/L. Nitrate is the main form of nitrogen in natural waters (Mustofa, 2015). One nutrient that can encourage the growth of marine biomass is nitrate compounds, which can directly control primary production. Therefore, high and low nitrate concentrations are closely related to aquatic fertility (Haikal et al., 2012).

The highest concentration is in station III, which is 0.90 mg/L, in the Apar River Estuary area. The area is suspected to be an estuary of the river, which can carry household waste and the rest of agricultural activities into the sea waters. Hindaryani et al. (2020) stated that nitrate concentrations on the coast are higher due to runoff from rivers, so there is a lot of material accumulation from land and sea, he also added that nitrate levels tend to be higher in estuaries and will decrease further towards the high seas. The lowest nitrate concentration is at station II in the UPT Turtle Conservation area, with a nitrate concentration value of 0.78 mg/L. The low nitrate concentration is thought to be caused by far from entering nitrates from land, such as agricultural and household waste. Nitrate

comes from ammonium that enters the river body, primarily through domestic waste; its concentration in the river will decrease farther from the disposal point (Mustofa, 2015). Low nitrate concentrations can also occur due to phytophontnones using nitrates as limiting elements for the growth and development of phytoplankton (Ainul et al., 2022).

The low concentration of nitrates in water can be affected by the temperature of the water. Yolanda et al. (2016) stated that temperature affects nitrate concentration in water because high temperatures can cause nitrates to evaporate in water. Low temperatures usually contain nutrients, so marine microorganisms also inhabit many. Based on this, it can be seen that the nitrate value is lower at 30ºC (Station I) than at 29 ºC (Station II and III). While the average phosphate concentration in the waters of Apar Kota Pariaman varies at each station, the phosphate concentration obtained from this study ranges from 0.71-0.73 mg/L. The highest phosphate concentration is at station III, which is 0.73 mg/L in the estuary area. Similar to nitrate concentrations, the highest phosphate concentration at this station is thought to be caused by the proximity of the river mouth to land that carries other inland phosphate sources, so that phosphate at the mouth of the river is higher than the surroundings.

The area near the mouth of the river also gets the highest phosphate supply compared to other zones (Rahmadani et al., 2021). Phosphate sources in sea waters close to river mouths carry garbage drift and other terrestrial phosphate sources, so phosphate sources at the mouth of the river are more significant than those in the surroundings. According to Sutamihardja et al. (2018), the increase in phosphate value is caused by the rise in various inputs of pollution load received by water bodies, which causes high phosphate concentrations.

The high current speed is another environmental parameter affecting the high phosphate concentration at station III. The high speed of the current can cause a resuspension. The resuspension process can cause sediments on the seabed to rise and cause chemical elements, including phosphates, to be lifted (Rahmadani et al., 2021). The lowest phosphate concentration was found at station 2, which was 0.71 mg/L in the Turtle Conservation UPT area. This is due to the observation station. The speed of the current influences the concentration of nitrate, and this is because station 2 has a calm current, and the sediment at the bottom does not rise, causing chemical elements, including phosphate, not to be lifted. In general, phosphate concentrations will decrease the farther the sea.

The abundance of phytoplankton in the Apar Waters of Pariaman City

The results of observations of phytoplankton types found in the waters of Apar Kota Pariaman can be seen in Table 4

Table 4. Types of phytoplankton found in the waters of Apar

Kelas	Ordo	Family	Species
Bacillariophyceae	Centrales	Chaetoceraceae	*Bacteriastrum* sp
	Coscinodiscales	Coscinodiscophyceae	*Coscinodiscus* sp
	Bacillariales	Bacillariaceae	*Nitzschia* sp
	Biddulphiales	Biddulphiaceae	*Isthmia* sp
	Fragilariales	Fragilariaceae	*Synedra* sp
	Centrales	Coscinodiscineae	*Thalassiosira* sp
	Centrales	Chaetoceros	*Chaetoceros* sp
Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Oscillatoria* sp
	Chroococcales	Microcystaceae	*Microcystis* sp
Dinophyceae	Amphidiniales	Amphidiniaceae	*Amphidinium* sp
	Dinophysales	Dinophysaceae	*Dinophysis caudate*
	Peridiniales	Protopediniacea	*Propedinium*
	Gonyaulacales	Ceratiaceae	*Ceratium* sp

Table 5. abundance of phytoplankton (ind/L)

Station	Sampling point	Abundance of phytoplankton (ind/L)	Average ± St.Deviation
I	1	183,33	249,99 ± 60,09
	2	266,66	
	3	300	
II	1	283,33	288,88 ± 25,45
	2	266,66	
	3	316,66	
III	1	300	327,77 ± 25,45
	2	333,33	
	3	350	

The results of phytoplankton observations in the waters of Apar Kota Pariaman during the study obtained as many as three classes, namely *Bacillariophyceae*, as many as seven species, as many as two species, and

Dinophyceae, as many as four species. The number of classes of each species varies. The results of observations on the abundance of phytoplankton found at each station in the waters of Apar Pariaman City can be seen in Table 5.

The value of phytoplankton abundance at each study station varied; the highest abundance was located at station III at 327,77 ind/L and lowest at station I at 249,99 ind/L. Based on Table 5, the average abundance of phytoplankton is found in the waters of Apar Pariaman. Factors that affect phytoplankton abundance are temperature, current, current velocity, pH, oxygen, and nutrients. The abundance of phytoplankton obtained in the study's results varied from station to station, ranging from 249.99-327.77 ind/L.

The highest phytoplankton abundance was found at station III at 327.77 ind/L and the lowest at station I at 249.99ind/l. The low abundance of phytoplankton at station I is thought to be due to the low nitrate and phosphate content concentration. This is evidenced by Aryawati et al. (2023) in their research, which states that one of the phytoplankton growth factors is caused by the presence of nutrients in the form of nitrates and phosphates and a stable improvement in water quality. High phytoplankton abundance in a body of water occurs when organic matter is available (Nurrachmi et al., 2021). The low abundance of phytoplankton at this station compared to other stations is thought to be caused by unfavorable water conditions, which affect phytoplankton photosynthesizing optimally due to low brightness.

In photosynthesis, phytoplankton requires sunlight, the main factor in phytoplankton breeding. In addition, the concentration of a body of water is highly dependent on several physico-chemical parameters, such as light intensity and nutrients, which also affect its abundance (Ridhawani et al., 2017). In other words, water quality is a benchmark for the growth and abundance of phytoplankton. Adhani et al. (2022) stated that the development of phytoplankton can be influenced by several factors in the environment, such as the intensity of light in water; light intensity has a significant influence, namely when the intensity of light can quickly shrink due to reflection and absorption, it will have an impact on primary productivity. Another factor that affects the high abundance of phytoplankton is the low current speed at station I, which is 0.12 m/s. This is because the station I has a calm current; the high speed of the current causes phytoplankton not to develop properly (Sumartini, 2013).

Water quality parameters

Water quality parameters were measured at the time in the field for each station: salinity, temperature, pH, brightness, and current speed. The results of measuring water quality parameters in apar waters can be seen in Table 6.

Table 6. Water quality parameters

Station	Temperature (°C)	Salinity ppt	pH	Current speed (m/s)	Brightness (m)
I	30 °C	30	7	0,12	3,35
II	29 °C	29	7	0,16	3,17
III	29 °C	29	7	0,24	3,49

Based on Table 6, the highest temperature is found at station I, which is 30°C, while stations II and III are 29 °C. The highest salinity is found at station I, which is 30 ppt, and stations II and III are 29 ppt. The degree of acidity (pH) at each station is the same, which is 7. The highest current speed is found at station III, which is 0.24 m/s, while the lowest is at station I, which is 0.12 m/s. The highest brightness is found at station III, which is 3.49 m, and the lowest is found at station II, which is 3.17 m.

The relationship between nitrate, phosphate concentration, and phytoplankton abundance

To determine the relationship between nitrate and phosphate concentrations with phytoplankton abundance, multiple linear regression tests can be carried out using SPSS, and the results of the regression are Y = 368.36 + 103.39X 1-229.62X_2. From the test results, the value of (R^2) is 0.215, which means nitrate and phosphate affect phytoplankton abundance by 21.5%. In comparison, other factors influence 78.5%, while the correlation coefficient (r) value is 0.464, which means that nitrate concentration with phytoplankton abundance has a moderate relationship.

The abundance of phytoplankton in waters is closely related to the concentration of nutrients such as nitrates, phosphates, and silicates, but in this study, only nitrates and phosphates play a role in phytoplankton abundance. Nutrient concentration can affect phytoplankton abundance and vice versa. Dense phytoplankton reduces the concentration of nutrients in water (Pugesehan, 2010). In addition, brightness is the primary and most

crucial factor in phytoplankton growth, especially in the smooth process of photosynthesis. The perfection of this process depends on the size of the intensity of light entering the waters. In contrast, the size of the intensity of light entering the water is influenced by the brightness and turbidity of the waters themselves.

The nutrient content of nitrates and phosphates can affect the presence of phytoplankton because phytoplankton well utilizes these nutrients for growth (Azis et al., 2020). In water, nitrates and phosphates are needed to meet the nutritional needs of phytoplankton so that phytoplankton can produce energy. Excessive nitrates and phosphates in a body of water can cause eutrophication (blooming algae).

CONCLUSION

Nitrate concentrations in Apar Pariaman waters range from 0.78-0.90 mg/L, phosphate concentrations range from 0.72-0.73 mg/L, and phytoplankton abundance ranges from 249.99-327.77 ind/L. Based on the content of nitrates, phosphates, and the abundance of phytoplankton obtained, the waters of Apar Kota Pariaman are included in the waters with low fertility levels (Oligotrophic). The relationship between nitrate and phosphate concentration with phytoplankton abundance obtained a value of (R^2) 0.215, which means nitrate and phosphate affect phytoplankton abundance by 21.5%. In comparison, 78.5% is influenced by other factors, while the value of the correlation coefficient (r) is 0.464 means that the concentration of nitrate and phosphate with phytoplankton abundance has a moderate relationship.

REFERENCES

[APHA] American Public Health Association., 1989. *Standar methods for the examination of water and wastewater.* American Public Control Federation. 20th edition, Washington DC. American Public Health Association.

Adhani, R.S., Diyana, R., Fitriyanah, H., 2022. Pengaruh efektifitas fitoplankton dalam mencegah adanya global warming. Madura: Proceeding Science Education National Conference 2022.

Ainul, F., Zainuri, M., Indriawaty, N., 2022. Perbedaan dan hubungan nitrat, fosfat dengan kelimpahan fitoplankton pada saat air pasang dan surut di muara Ujung Piring, Bangkalan. *Jurnal Kelautan*, 15(1): 60-68.

Aryawati, R., Melki, M., Azhara, I., Ulqodry, T.Z., Hendri, M., 2023. Keragaman fitoplankton dan potensi Harmfull Algal Blooms (HABs) di Perairan Sungai Musi bagian hilir Provinsi Sumatera Selatan. *Buletin Oseanografi Marina*, 12(1): 27–35.

Azis, A., Nurgayah, W., Salwiyah, S., 2020. hubungan kualitas perairan perairan dengan kelimpahan fitoplankton di Perairan Koeno, Kecamatan Palangga Selatan, Kabupaten Konawe Selatan. *Jurnal Sapa Laut,* 5(3): 221−234.

Haikal, M.V., Taofiqurohman, A., Riyantini, I., 2012. Analisis massa air di Perairan Maluku Utara. *Jurnal Perikanan dan Kelautan*, 3(1): 1–9.

Hindaryani, I.P., Zainuri, M., Rochaddi, B., Wulandari, S.Y., Maslukah, L., Purwanto, P., Rifai, A., 2020. Pola arus terhadap sebaran konsentrasi nitrat dan fosfat di Perairan Pantai Mangunharjo, Semarang. *Indonesian Journal of Oceanography*, 2(4): 313-323.

Mustofa, A., 2015. Kandungan nitrat dan pospat sebagai faktor tingkat kesuburan perairan pantai. *Disprotek*, 6(1): 1-7.

Nedi, S., Effendi, I., Elizal, E., 2020. Status tingkat tropik muara Sungai Dumai berdasarkan kandungan klorofil. *Jurnal IOP Ilmu Bumi dan Lingkungan*, 496(1): 1-6.

Nugroho, S.D., 2023. Studi pengaruh tata guna lahan daerah urban sungai brantas ruas kota malang terhadap nitrat dan fosfat. *Jurnal Teknologi dan Rekayasa Sumber Daya Air*, 3(2): 231-240.

Nurrachmi, I., Nedi, S., Khaironisa, R., 2021. Analysis of total oil concentration and phytoplankton community structure in the waters of Pelintung Industrial Area. *Journal of Coastal and Ocean Sciences*, 2(1): 7-14.

Pemerintah Kota Pariaman., 2010. *Rencana tata ruang wilayah Kota Pariaman 2010-1030*. Pariaman: Badan Perencanaan Pembangunan Daerah (Bappeda) Kota Pariaman. 183 pp.

Pugesehan, D.J., 2010. Asesmen eutrofikasi perairan pesisir menggunakan metode indeks trofik (TRIX). *Oseana*, 42(2): 23-33.

Rahmadani, P.A., 2021. Analisa konsentrasi fosfat sebagai parameter cemaran bahan baku garam pada badan sungai, muara, dan pantai di Desa Padelagan Kabupaten Pamekasan. *Juvenil*, 2(4): 318-323.

Ridhawani, F., Ghalib, M., Nurrachmi, I., 2017. Tingkat kesuburan perairan berdasarkan kelimpahan fitoplankton dan nitrat-fosfat terhadap tingkat kekeruhan muara Sungai Rokan Kabupaten Rokan Hilir. *Jurnal Perikanan dan Kelautan*, 22(2): 10-17.

Sugiyono, S., 2017. *Metode penelitian kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta, CV.

Sumartini, S., Rudiyanti, S., 2013. Kualitas perairan Sungai Seketak Semarang berdasarkan komposisi dan kelimpahan fitoplankton. *Management of Aquatic Resources Journal (MAQUARES)*, 2(2): 38-45.

Sutamihardja, R., Azizah, M., Hardini, Y., 2018. Studi dinamika senyawa fosfat dalam kualitas air sungai Ciliwung Hulu Kota Bogor. *Jurnal Sains Natural Universitas Nusa Bangsa*, 8(1): 43-49.

Yolanda, D.S., Muhsoni, F.F., Siswanto, A.D., 2016. Distribusi nitrat, oksigen terlarut, dan suhu di perairan Socah-Kamal Kabupaten Bangkalan. *Jurnal Kelautan*, 9(2): 93-98