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STUDY OF MUDSKIPPER (*Boleophthalmus* sp.) HABITAT IN THE BRACKISH FOREST ECOTOURISM AREA, TRITIH KULON, CILACAP REGENCY BASED ON TOTAL NITRATE AND TOTAL PHOSPHATE CONTENT

Studi Habitat Ikan Gelodok (*Boleophthalmus* sp.) di Kawasan Ekowisata Hutan Payau, Tritih Kulon, Kabupaten Cilacap Berdasarkan Kandungan Total Nitrat Dan Total Fosfat

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ABSTRACK

The mangrove ecosystem in the Brackish Forest Area, Tritih Kulon, Cilacap, is affected by various human activities, which cause an increase in total nitrate and phosphate concentrations in the waters. Nitrates and phosphates are essential nutrients that support the growth and survival of organisms. This research aims to measure total nitrate and phosphate levels, and relate them to the suitability of mudskipper habitat in the area. The research was carried out using descriptive methods, using water and sediment samples from the mudskipper habitat. Water quality is measured through parameters such as temperature, salinity, and dissolved oxygen (DO). The results showed that the total nitrate concentration in water ranged from 2.35 to 3.65 mg/L with an average of 3.12 mg/L, while in sediment it ranged from 1.02 to 1.85 mg/kg with an average of average 1.4 mg/kg. The total phosphate concentration in water is in the range of 0.6 to 0.94 mg/L with an average of 0.81 mg/L, while in sediment it ranges from 0.94 to 1.45 mg/kg with an average of 1, 22 mg/kg.

Keywords: Habitat, Mudskipper, Total Phosphate, Total Nitrate

ABSTRAK

Ekosistem mangrove di Kawasan Hutan Payau, Tritih Kulon, Cilacap, terpengaruh oleh berbagai aktivitas manusia, yang menyebabkan peningkatan konsentrasi nitrat dan fosfat total di perairan. Nitrat dan fosfat adalah nutrisi penting yang mendukung pertumbuhan dan kelangsungan hidup organisme. Penelitian ini bertujuan untuk mengukur kadar nitrat dan fosfat total, serta mengaitkannya dengan kesesuaian habitat ikan gelodok di kawasan tersebut. Penelitian dilakukan dengan metode deskriptif, menggunakan sampel air dan sedimen dari

habitat ikan gelodok. Kualitas air diukur melalui parameter seperti suhu, salinitas, dan oksigen terlarut (DO). Hasil penelitian menunjukkan bahwa konsentrasi nitrat total di air berkisar antara 2,35 hingga 3,65 mg/L dengan rata-rata 3,12 mg/L, sementara di sedimen berkisar antara 1,02 hingga 1,85 mg/kg dengan rata-rata 1,4 mg/kg. Konsentrasi fosfat total di air berada dalam kisaran 0,6 hingga 0,94 mg/L dengan rata-rata 0,81 mg/L, sedangkan di sedimen berkisar antara 0,94 hingga 1,45 mg/kg dengan rata-rata 1,22 mg/kg.

Kata kunci*:* Habitat, Ikan Gelodok, Total Fosfat, Total Nitrat

INTRODUCTION

Mangrove forests are more diverse habitats compared to land forests, due to the complex interactions between the components that make up their ecosystem (Poedjirahajoe et al., 2017). The mangrove ecosystem is a transition zone between land and sea which is characterized by a diversity of characteristics, thus creating unique and distinctive ecological characteristics. (Samiyarsih et al., 2017).

Ecologically, mangroves function as spawning grounds, habitats for foraging, and growing areas utilized by various organisms. In terms of biogeochemistry, mangrove ecosystems play a role in nutrient cycling. Nutrients in the mangrove ecosystem are obtained from decomposed mangrove litter and support the lives of various living things in the ecosystem (Alamsyah et al., 2019).

The process of decomposition of mangrove litter begins with the destruction of the physical structure of mangrove plants by macrozobenthos (Destiana & Darwati, 2021). After that, bacteria and fungi as decomposers continue the destruction process by decomposing organic particles into nutrient sources for plants and food sources for fish and other biota (Sari et al., 2017). This makes the mangrove ecosystem rich in nutrients that support the lives of various organisms, including the mudskipper (Hastuti et al., 2022).

Mudskipper is a species that inhabits mangrove swamp habitats and can adapt to two different types of habitats. This fish plays an important role in the ecosystem because it can function as a bioindicator to assess environmental cleanliness and land suitability for mangrove vegetation. (Sujono & Muzaki, 2022). In the mangrove ecosystem, mudskipper forages for phytoplankton and molluscs (Sunarni & Maturbongs, 2017).

Total nitrate and phosphate levels are crucial factors for the growth and metabolism of phytoplankton, and function as bioindicators of water quality and fertility. The main sources of nitrate and phosphate come from waters through weathering, decomposition, organism remains, and human activities (Arnando, 2022). The Brackishwater Forest area in Cilacap is utilized by humans for various activities such as ecotourism, aquaculture, and settlements, which can cause water pollution. The decline in water quality in the mangrove environment will affect the distribution of total nitrate and phosphate in the waters (Dewi et al., 2017). Based on this, the total nitrate and total phosphate content in the Cilacap Brackishwater Forest area is important. The purpose of this study was to determine the total nitrate and phosphate content in the mudskipper habitat in the Brackishwater Forest Area, Tritih Kulon, Cilacap.

RESEARCH METHOD

The research was conducted in August 2023 in the Payau Forest Ecotourism Area, Cilacap. This research was conducted using a descriptive method, namely by taking water and sediment samples and taking data on the number of gelodok fish in situ, as well as analyzing the total nitrate and total phosphate content in the Laboratory.

Water and Sediment Sample Collection Process

Water samples were taken in situ at a depth of 0-30 cm above the water surface. Samples were taken as much as 600 mL. Sediment data collection was carried out in situ at a depth of 0-30 cm above the surface of the water bed, samples were taken as much as 500 g using a core sampler.

Mudskipper Data Collection

Mudskipper fish data collection was carried out by counting the number of fish found in the same transect as the mangrove transect. This data collection was carried out 3 times at each station by considering the representation of the skiddie fish population. The number of samples taken was adjusted to the location conditions. The research location is depicted on the map in Figure 1.

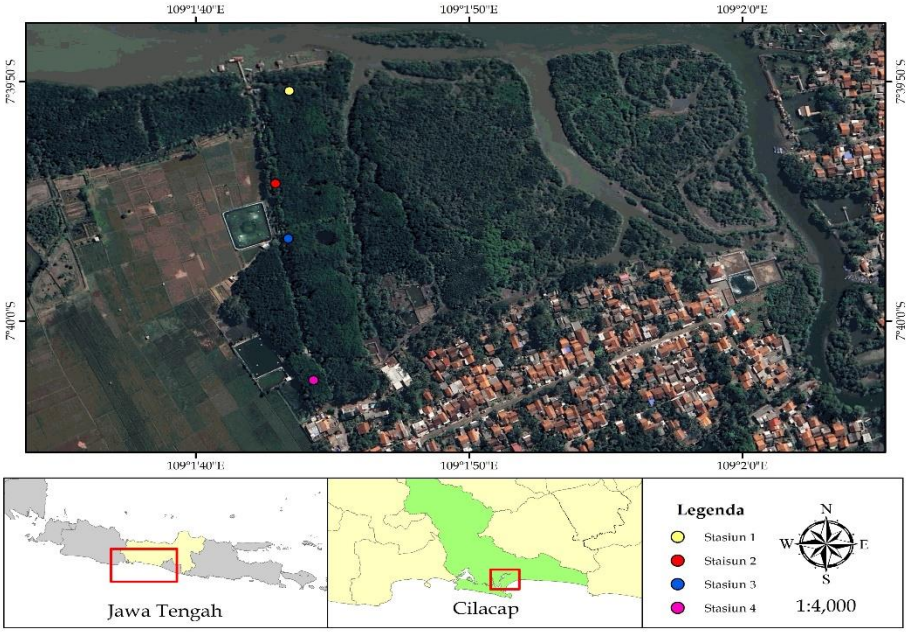

Figure 1. Research Location Map

Total Nitrate Concentration Measurement

Total nitrate testing is carried out using the phenate spectrophotometer method used in water and wastewater at levels ranging from 0.1 mg/L to 0.6 mg/L at a wavelength of 640 nm. The calculation of total nitrate levels in this method is calculated using the following formula (SNI 06-6989.30, 2005):

$$Nitrate\ levels\ = A - B$$

Information:
Nitrate levels = nitrate test results (mg NO_3-N/L)
A = NO_2-N content from reduction column
B = NO_2-N content without passing through the reduction column

Total Phosphate Concentration Measurement

Total phosphate testing using a spectrophotometer with ascorbic acid reduction is used to measure total phosphate levels in water and wastewater samples in the range of 0.001 mg P/L to 1 mg P/L with a wavelength of 880 nm. Calculation of total phosphate levels using this method is carried out with the following formula: (SNI 06-6989.31, 2005):

$$F = C \times f$$

Information:
F = total phosphate content (mg P/L)
C = levels obtained from measurement results (mg/L)
fp = Dilution factor

RESULT

Number of Mudskipper

Data on the number of mudskipper is shown in Table 1.

Table 1. Number of Mudskipper in the Brackish Water Forest Area, Cilacap

Number of Mudskipper	**Station**			
	1	2	3	4
amount	62	40	28	29

Total Nitrate and Total Phosphate Concentration

Based on the results of observations and analysis of the total nitrate and total phosphate content, the data are presented in Table 2 below:

Table 2. Total Nitrate and Total Phosphate Concentration

No.	Station	Concentration			
		Total Nitrate		Total Phospate	
		Water Sample (mg/L)	Sediment Samples (mg/kg)	Water Sample (mg/L)	Sediment Samples (mg/kg)
1	ST 1	2,35	1,63	0,94	1,45
2	ST 2	2,95	1,02	0,87	0,94
3	ST 3	3,65	1,1	0,83	1,07
4	ST 4	3,55	1,85	0,6	1,42
Rata - rata		3,125	1,4	0,81	1,22

DISCUSSION

The total nitrate concentration in the estuary waters of the Payau Forest Ecotourism Area ranges from 2.35 to 3.65 mg/L with an average of 3.125 mg/L. Based on the quality standards stipulated in the Decree of the Minister of State for the Environment No. 51 of 2004, which sets the maximum limit for nitrate in waters at 0.008 mg/L, the nitrate levels in the Payau Forest Ecotourism Area have exceeded the threshold. Meanwhile, the total nitrate concentration in mangrove sediments in the area ranges from 1.02 to 1.85 mg/kg. According to the classification which is divided into three categories, namely -<3 ppm = low, 3-10 ppm = moderate, and> 10 ppm = high (Moarfa, 1992 in Fahruddin et al., 2017) the nitrate content in sediments in the Payau Forest Ecotourism Area is included in the low category. The total nitrate content in the Cilacap Payau Forest Area varies at each observation station. Station 1, which is located at the end of the estuary, has characteristics that are influenced by sea waters. The total nitrate concentration at this location is partly due to marine factors, such as tides and sedimentation processes that cause nitrate accumulation (Yogaswara, 2020).

Station 3 is located near shrimp ponds and not far from residential areas. Station 4, which is located at the end of the brackish water forest area, is the station closest to the settlement. The high total nitrate concentration at this location is influenced by natural factors such as tides and sedimentation, as well as by human activities that cause the entry of particles. This is in line with research by Yulma et al. (2018), which states that the organic matter content

in river estuary sediments is generally higher due to the entry of materials from upstream, such as domestic waste and garbage, which increase the levels of organic matter.

Total nitrate concentration is closely related to dissolved oxygen (DO) content. DO levels in brackish water forest areas range from 4.6 to 10 mg/L. Dissolved oxygen plays a direct role in the nitrification process, where ammonia reacts with oxygen to produce nitrite, which is then converted into nitrate through interaction with other types of bacteria (Hastuti, 2011). The nitrification process in the brackish water forest area can run well because it is supported by adequate environmental conditions and minimal anthropogenic activity in the mangrove area. According to Sawner and McCarty (1978) in Effendi (2000), the nitrate levels that can be tolerated by aquatic biota and organisms are less than 1 mg/L. Mudskippers in this brackish water forest area are able to survive and can still be found because these fish are able to utilize excessive nitrate as a food source so that they can increase the population of mudskippers in the brackish water forest area, Cilacap (Mishbach et al., 2021).

Natural production of total nitrate through the nitrification process occurs with the level of decomposition of organic matter originating from the environment, such as litter and dead organisms, as well as external inputs carried to deeper zones. Humid conditions and low exploitation also contribute to the high level of decomposition in this area. Litter quality also affects the rate of decomposition and mineralization of the litter (Qifli et al., 2014).

The total phosphate concentration in brackish waters ranges from 0.6 to 0.94 mg/L with an average of 0.81 mg/L. Based on water quality standards, the total phosphate content in brackish waters exceeds the established threshold, where the total phosphate quality standard that is safe for biota is 0.015 mg/L (Ministry of Environment, 2004).

The total phosphate concentration in sediment in the brackish forest area ranges from 0.94 to 1.45 mg/kg with an average of 1.22 mg/kg. The total phosphate content of sediment in this brackish forest is classified as very low because its concentration is below 3 mg/kg. Total phosphate in soil is categorized into four levels: very low (<3 mg/kg), low (3-7 mg/kg), moderate (7-20 mg/kg), and high (>20 mg/kg) (Permatasari et al., 2016).

Total phosphate compounds in waters can come from natural sources such as soil erosion, animal waste, plant decay, and decomposition of organic matter and phosphate minerals. In addition, total phosphate can also come from human activities, such as domestic waste disposal, agricultural practices, and pond activities that contain phosphate and last for a long time. (Hamuna et al., 2018).

The concentration of total phosphate in sediment tends to be higher than the concentration of total phosphate in waters. This is due to the nature of the dissolved nutrients so that they are easily carried away by currents and tides, while phosphate in the substrate settles and is not easily carried away by tidal currents, so that sedimentation is formed (Arnando, 2022).

Sediment functions as the main storage of phosphorus in the marine cycle. Phosphorus bound in sediment can be degraded by bacteria or through abiotic processes, producing dissolved phosphate compounds that can redistribute into the water column (Patty et al., 2015). Therefore, the high sedimentation rate is proportional to the total amount of phosphate contained in it. The finer the sediment particles, the easier it is for the particles to bind water suspended in the sediment. Research conducted by Pauwah et al. (2020), states that mudskippers are able to live in waters with fairly high phosphate levels, ranging from 0.017 - 0.027 mg / L. This is because the high phosphate content causes the food sources in a water to also increase, which are used for the growth of mudskippers (Romadhony et al., 2023).

Mudskipper is a member of the Gobiidae family that has a unique ability to adapt and is often found in mangrove areas, including in the Cilacap brackish water forest. This fish can adapt to two different habitats and has the ability to jump like an amphibian, so it is often referred to as an amphibious fish (Umami, 2022). According to the research results shown in

Table 1, the variation in the number of mudskippers at each station is influenced by environmental conditions. The high and low diversity of fish species is influenced by various factors, including environmental conditions (Destiana & Darwati, 2021).

The results of the regression analysis of the mudskipper with a total nitrate of 0.037 indicate that total nitrate affects the mudskipper by 0.37%. The results of the regression analysis of the mudskipper with total phosphate have a value of 0.149, meaning that total phosphate affects the mudskipper by 14.9%. The rest is influenced by other factors such as environmental factors, availability of food and nutrients.

The mudskipper, which is often found in muddy habitats with mangrove vegetation, is an indicator of the quality of coastal ecosystems. According to research by Polgar & Crosa (2009), the mudskipper population is greatly influenced by the availability of food, sediment texture, and water quality, including nutrient levels such as nitrate and phosphate.

The presence of mudskipper in mangroves is influenced by the availability of food, most of which comes from organisms that live in the sediment. The nitrate and phosphate content in the sediment plays an important role in supporting the growth and development of these organisms. Increasing the nitrate and phosphate content in the sediment can increase primary productivity, namely the number of plants and algae that grow in the area. Increasing primary productivity will increase the availability of nutrients for organisms living in the sediment, such as crabs, shrimp, and worms. The abundant availability of food will attract mudskippers to forage in the area (Romadhony et al., 2023).

CONCLUSION

1. The total nitrate concentration in water ranges from 2.35-3.65 mg/L with an average of 3.12 mg/L, which exceeds the standard quality limit for total nitrate in waters, which is 0.5 mg/L. In contrast, the total nitrate in sediment is in the range of 1.02-1.85 mg/kg with an average of 1.4 mg/kg, which is included in the low category (<3 ppm). The total phosphate concentration in water ranges from 0.6-0.94 mg/L with an average of 0.81 mg/L, also exceeding the set standard quality limit, which is 0.015 mg/L for optimal conditions for biota. Meanwhile, the total phosphate concentration in sediment in the brackish water forest area is in the range of 0.94-1.45 mg/kg with an average of 1.22 mg/kg, which is very low because it is below 3 mg/kg.
2. The relationship between mudskipper and total nitrate is 0.037, which shows that total nitrate affects mudskipper by 0.37%. While the relationship between mudskipper and total phosphate has a value of 0.149, which means that total phosphate affects mudskipper by 14.9%.

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