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Physical Chemical Factors on Gastropod Distribution Patterns in Tritih Mangrove Forest, Cilacap, Central Java

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Abstract

The mangrove area in Tritih Cilacap, Central Java is decreasing due to illegal logging. This affects the distribution pattern of gastropods. This study aims to determine the distribution pattern of gastropods and provide information related to physical chemical factors that play a role in gastropod distribution patterns. This study was conducted at five sampling points. Five sampling points from the sea to the land. The sampling method used for gastropods was collection from 1x1 m plots. Gastropods in the plot were collected by hand on the top of the sediment and in the sediment were taken 10 cm deep using a corer with 3 repetitions for each station. Environmental parameters measured were: temperature, salinity, organic matter content, pH, and substrate type. The distribution of gastropods in Tritih Cilacap mangrove forest has a clustering and random pattern. There were 11 species of gastropods found from 7 families. Gastropod species that have clustered distribution patterns are: *Ceritidhea alata, Telescopium telescopium, Neritina violacea, Neritina zigzag, Chicoreus capucinus,* and *Assimenia brevicula.* Gastropod species that have random distribution patterns are: Ceritidhea quadrata, *Neritina lineata, Cassidulla aurisfelis, Cassidulla nucleus,* and *Littoraria carinifera.*

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INTRODUCTION

Mangrove vegetation is a plant that has adaptations to different salinity gradients. Mangroves are one of the coastal ecosystems that have an important role in both ecological and economic functions (Wintah et al., 2021b). The ecological function of mangroves as a source of food for biota such as fish, crabs, shrimp, as well as a nursery area (Wintah, et al., 2022), a natural barrier that blocks storms and tsunamis (Blankespoor et al., 2017), mangroves are also a carbon stock (Wintah et al., 2017). The economic function of mangroves can be processed into food and drink ingredients (Wintah et al,, 2021a), a good mangrove ecosystem can be found with a high diversity of marine biota, such as gastropods (Ariyanto et al., 2020).

Mangroves have an important role in the survival of various species of fish, shrimp, and molluscs (gastropods) because of their role as a food chain in mangrove habitats (Dewiyanti et al., 2021). Mangroves not only act as a food chain for aquatic biota, but also contribute to the balance of biological cycles in a body of water. Tritih mangroves have been seriously degraded by illegal logging.

The existence of mangrove forests is a unique ecosystem that grows and develops influenced by terrestrial and marine environmental conditions. Environmental changes in the mangrove ecosystem will affect the presence of gastropods.

Gastropods in mangrove ecosystems are influenced by abiotic and biotic components of the environment. Abiotic variables that affect mangrove ecosystems include pH, temperature, salinity, sediment texture, and organic matter. Mangrove decomposition, organic matter, and environmental factors are some of the factors that influence the good condition of mangrove ecosystems (Wintah et al., 2023).

Tritih mangrove ecosystem in order to continue to have a sustainable ecological function, the role of biotic and abiotic factors in the ecosystem needs to be maintained in balance. Therefore, it is necessary to study the physical chemical factors on the Distribution Pattern of Gastropods in Tritih Mangrove Forest Cilacap Central Java.

METHOD

The research method used was survey. The gastropod sampling technique was random sampling. Sampling gastropods in the rainy season at five stations with three replicates at each station.

Gastropod collection method

The method used for gastropod sampling was in 1 x 1 meter plots, and each gastropod found in the plot was collected by hand and dug into the soil with a 10 cm deep corer. At each station, samples were taken three times. For each sampling, gastropod samples were cleaned and put into a five kilogram plastic container. For initial preservation, 70% alcohol solution was added. Identification of the gastropod species found refers to books by (Dharma 1988) and (Dance 1982).

Method of collecting environmental parameters

Environmental parameters were measured in situ. The physico-chemical parameters of the environment measured were: water pH, water temperature, salinity, dissolved oxygen (DO), phosphorus, nitrogen, organic matter, sediment grain size (dust, clay, and sand).

Sediment grain size and organic matter content were determined using the Walkley-Black method at the Soil Science Laboratory of Surakarta State University. For texture determination, organic matter was oxidized with H_2O_2 and dissolved salts were removed from the soil with HCl, while heating. The remaining material is mineralized and consists of sand and clay.

RESULT AND DISCUSSION

The richness of gastropods found at the research site was 11 species from 7 families. Station 1 (SA1) has high richness because gastropods have considerable adaptation to changes in environmental factors and are supported by good habitat conditions. Favorable environmental factors can support the growth of certain species. The lowest species richness was found at station 5 (SA5) where only 5 species were found. This is due to the degraded habitat conditions that have resulted in a decrease in species richness, so that only certain species are able to adapt to occupy the area.

Gastropod density at the five stations showed that station 5 (SA5) (33.36 ind/m^2) was higher than the others, followed by station 4 (SA4) (14.28 ind/m^2), station 3 (SA3) (12.83 ind/m^2), station 2 (SA2) (12.44 ind/m^2), and station 1 (SA1) (6.75 ind/m^2). The highest density was found at station 5 (SA5). Meanwhile, the lowest density was found at station 1 (SA1). This is due to the condition of mangroves at station 1 (SA1) is still good while at station 5 (SA5) the condition has been damaged. (Odum et al., 1971) states that most communities in an environment that is subjected to physical, chemical, and biological stress will have few species with a large number of individuals.

The distribution analysis of gastropods showed that of the 11 species found, most had an evenly distributed distribution at station 1 (SA1) and station 3 (SA3), while at station 2 (SA2) and station 4 (SA4) found species that had a clustered distribution, namely Assimenia brevicula, (SA2) and Cerithidea alata (SA4), while at station 5 (SA5) found two species that had a random distribution, namely Assimenia brevicula and Neritina violacea (Table 1).

Tabel 1. Distribution of Gastropods in Tritih Mangrove Cilacap

No	Family	Spesies	SA1		SA2		SA3		SA4		SA5	
			Id	Distribution	Id	Distribution	Id	Distribution	Id	Distribution	Id	Distribution
1	Assimineidae	*Assimenia brevicula*	0,12	Uniform	3,16	Aggregate	0,59	Uniform	0	-	1,0	Random
2	Eloobidae	*Cassidula nucleus*	0,01	Uniform	0,06	Uniform	0,01	Uniform	0,1	Uniform	0	-
3	Potamididae	*Cassidula aurisfelis*	0	-	0,01	Uniform	0,01	Uniform	0,1	Uniform	0	-
		Cerithidea quadrata	0,07	Uniform	0	-	0	-	0	-	0	-
		Cerithidea alata	0,01	Uniform	0,01	Uniform	0,86	Uniform	2,37	Aggregate	0,41	Uniform
4	Muricidae	*Telescopium telescopium*	0,01	Uniform	0	-	0	-	0,47	Uniform	0,41	Uniform
5	Littorinidae	*Chicoreus capucinus*	0	-	0,01	Uniform	0,59	Uniform	0,01	Uniform	0	-
6	Neritidae	*Littorina carinifera*	0,07	Uniform	0	-	0	-	0	-	0	-
		Neritina zigzag	0	-	0	-	0	-	0	-	1,0	Random
7	Assimineidae	*Neritina violacea*	0,01	Uniform	0,21	Uniforma	0,04	Uniform	0,2	Uniform	0,11	Uniform
		Neritina lineata	0,01	Uniform	0	-	0	-	0	-	0	-

Description: SA1 - station 1; SA2 - station 2; SA3 - station 3; SA4-station4; SA5-station 5; Id - Morista Index

Gastropods that show a clustered distribution pattern have a morisite index ranging from 2.37-3.16. Gastropod species that have a clustered distribution pattern are *Assimenia brevicula* and *Cerithidea alata*, these two species are often found in mangroves tend to be aggregated abundant. Aggregate distribution is caused by the presence of limiting factors on the existence of a population. Aggregate indicates that individuals gather in several favorable habitats (Wintah et al., 2022). Aggregate distribution patterns increase with the number of spawning individuals (Putra et al., 2019). Gastropods that have a morisite index < 1 have a uniform distribution pattern. Gastropods found in the study site are more dominating having a uniform scattered distribution pattern. The uniform scattered distribution pattern is having a uniform scattered distribution pattern. The uniform scattered distribution pattern is caused by competition between other individuals for food and shelter. Putra et al. (2019) added that the uniform scattered distribution pattern occurs due to competition between relatively tight individuals.

Gastropods that have a morisite index of 1 means they have a random distribution pattern. The random distribution pattern is caused by competition between individuals that encourages the division of space evenly. The random distribution pattern is related to a way of life that chooses unsuitable places. This is related to changes in abiotic environmental conditions, high availability of organic matter, good substrate types, and suitable habitats for species (Fadhil et al., 2021).

Physical chemical environmental factors can affect the presence of gastropods in mangrove ecosystems (Figure 1).

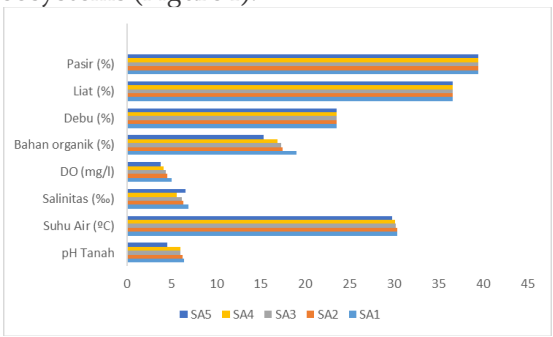

Figure 1. Physical chemistry parameters of each station

The results of the BIOENV (Biological Environment) analysis show that the environmental factors that most influence the density of gastropods are water temperature, salinity, organic matter content, and sand substrate.

Water temperature is a physical parameter that greatly affects the life patterns of aquatic biota. The temperature at the research location ranges from 28-34ºC. The temperature is normal at the research site, making it suitable for gastropod survival. According the optimum temperature for gastropod metabolism is 25-32°C (Maretta, et al., 2019), The optimal temperature for gastropod life is between 25-31°C (Marshall and McQuaid, 2020).

The salinity obtained from the study ranged from 28-34‰. The high salinity was caused by sampling during the lowest tide & high evaporation at the research site. Nevertheless, these conditions can still be tolerated for the survival of gastropods. (Mathius et al., 2018) stated that the optimum salinity to support gastropod life is 28-34‰.

The highest organic matter content was found in station 1 at 19% due to the high mangrove density indicating the high mangrove litter that can be used as a food source for gastropods. The presence of gastropods in mangrove forests has a role in the formation of organic matter. Reef et al. (2010) state that mangrove litter is an important source of organic matter in the food chain in the aquatic environment. Forest organic matter content higher than 20% indicates that an area has a very high level of fertility, because mangrove leaves that fall down will decompose into organic matter. Higher mangrove density produces more litter.

The type of substrate in the study site is dominated by a loamy sand substrate. Gastropods are organisms that have a wide range of distribution in either sandy or muddy substrates but gastropods tend to favor sand and slightly clay substrates. Nybakken (1992) states that molluscs on sandy substrates will make it easier for molluscs to get the supply of nutrients and water needed for their survival. Substrates dominated by sand and sand clay tend to be found in relatively larger numbers of gastropods. Odum et al. (1971) stated that benthos really need the type of basic substrate for their survival.

CONCLUSION

The richness of gastropods found at the research site was 11 species from 7 families. The highest density of gastropods was found in station 5 (SA5) which was 33.36 ind/m^2 while the lowest density was found in station 1 (SA1) (6.75 ind/m^2). The distribution of gastropods as a whole is evenly distributed, but there are only a few species that are distributed in clusters, namely *Assimenia brevicula* and *Cerithidea alata*. Physical chemical parameters that most influence the density of gastropods are water temperature, salinity, organic matter content, and sand substrate.

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