

Mollusk diversity in the intertidal zone of Menganti Beach, Kebumen, Central Java

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ARTICLE INFO	ABSTRACT
<p>Keywords: Mollusk Diversity Intertidal Zones Coastal</p> <p>DOI: 10.13170/depik.10.1.18673</p>	<p>Limited information about Mollusks in Menganti Beach, Central Java has been a strong basis for researching its diversity. This study aimed to determine the mollusks' diversity in Menganti Beach, Kebumen. The research was conducted from April to May 2020, using a survey method and purposive sampling technique. Sampling was undertaken at three stations with the belt transect method. The results revealed 37 species with 1767 individuals from the Class Bivalvia, Gastropods, and Polyplacophora. Based on the diversity index value $H' = 3.3$, station 1 with the rocky sand substrate is the best for mollusks' habitat. The H' value at station 1 shows the highest diversity that the base substrate is dominated by sand and rocks, which are very supportive of mollusks. It is supported by the evenness value (E), which indicates evenly distributed species, and dominance value (D), which does not indicate a species' dominance. The a-biotic parameters at the three stations obtained an average morning temperature of 29 °C and 30 °C in the afternoon, pH of 7, and a salinity of 30 ‰ so that these values support the Mollusk habitat at Menganti Beach, Kebumen.</p>

Introduction

The Indonesian oceans are vital in the world ecosystem that stores the potential of natural resources and high diversity. One of the popular regions with its unique and enchanting marine wealth in southern Central Java is Menganti Beach, Kebumen. Menganti Beach's habitat characteristics are suitable for the life of mollusk. Preliminary observations on the coast of Menganti Beach found a group of animals with distinctive soft-body. These animals are known as the Mollusca group, soft-bodied triploblastic coelomate animals.

After Arthropods, mollusks are the second most diverse phylum. There are around 93,000 living species and about 70,000 known fossils. There are eight Mollusks classes reported globally: Caudofoveata, Aplacophora, Monoplacophora, Polyplacophora, Scaphopoda, Cephalopods, Gastropods, and Bivalves. Among these classes, only the Gastropods and Bivalves can be found in freshwater (Brusca and Brusca, 2003).

The phylum Mollusca has two of the largest, most distributed, and scientifically famous

members, the Bivalves and the Gastropods. Both have various body shapes and shell sizes (Fontoura-da-Silva *et al.*, 2013).

Mollusks are sensitive to environmental changes. They have an ecological role as bioindicators, especially in aquatic ecosystems. Besides, mollusks can accumulate heavy metals without dying (Wahyuni *et al.*, 2017). Mollusks also acts as a connector in a food chain as detritus (organic matter). Detritus is mainly sourced from leaves, mangrove branches that fall and rot, which then mollusks use as an initial decomposer (Katukdoan *et al.*, 2018).

Mollusks, which are the primary calcareous organisms with extensive fossil records, have provided important information about past climatic events and ocean changes, thereby increasing predictions of future changes (Fortunato, 2015). Mollusks have been used for various commodities such as food products, accessories, and raw materials for medicines (Islami *et al.*, 2018).

This research focuses on coastal areas, namely the intertidal zone. Nugroho (2012) stated that the

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intertidal zone has high nutrient wealth and is rich in oxygen. This area also receives sufficient sunlight, so it is very suitable for an invertebrate breed like echinoderms and mollusks (Triacha et al., 2021).

The results of observations, data, and information regarding the mollusks diversity in the intertidal zone of Menganti Beach, Kebumen, Central Java have not revealed the issue assuredly. The limited information about mollusks in Menganti Beach is the basis for conducting research related to the diversity of mollusks to facilitate the calculation of its species diversity. Based on the description above, it is necessary to research the mollusks' diversity in the intertidal zone of Menganti Beach, Kebumen, Central Java.

Materials and Methods

Location and Time

The study was conducted from April to May 2020 in the intertidal zone of Menganti Beach, Karangduwur Village, Ayah Subdistrict, Kebumen Regency, Central Java Province. Karangduwur Village is an area of 415.2320 hectares, in which Menganti Beach is about 40 km from the center of Kebumen. The coordinates of Menganti Beach are at 07°46'12.7"S 109°24'46.7"E.



Figure 1. Research location at Menganti Beach, Kebumen.

Population and sample

Population in this study is all Phylum Mollusca species in the intertidal zone of Menganti Beach, Kebumen. The sample in this study is the Phylum Mollusca species found at each research station point.

Methods of data collection

This research used a survey method conducted with a descriptive exploratory approach that describes the diversity of mollusks. Data collection

with *in-situ* observation to the observation location and *hand sorting* for direct sampling in their habitat. The research location used three observation stations in the coastal area of Menganti Beach (intertidal zone).

The station is determined based on the situation and environmental conditions in the field. They are the state of vegetation, the dominating substrate, and the surrounding activities. Each station has varied substrate characteristics: station one with a rocky sand substrate; station two with a coral substrate; and station three with a seagrass bed as a substrate (Figure 1).

The technique of collecting data (Sampling)

Systematic sampling of mollusks using a purposive sampling technique. It used the belt transect method presented in Figure 2. According to Johan (2003), the belt transect method aims to describe the population of an organism, the number of individuals and colonies, and the number of species and distribution. One of the organisms' characteristics is the varied sizes with specific maximum sizes, like invertebrates.

The belt transect design applied was spread over 100 meters in a perpendicular position from the lowest tide limit to the shoreline in the intertidal zone of Menganti Beach. The transects were spread over three stations with different substrate types. Each station consisted of five plots in the shape of a 5 x 5 meters-square, separated by 15 meters between each. The determination of transects relates to the conditions of the location and substrate in the field.

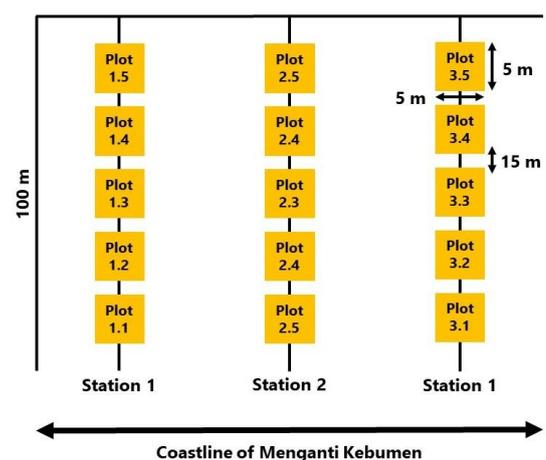


Figure 2. The design of belt transects in sampling location.

Data collection procedure

The sampling process was carried out for two days at low tide, in the morning starting at around

06.00 WIB and in the afternoon at 16.00 WIB, followed by counting the number of individuals found in each plot.

Abiotic parameter data were taken at each research station, including temperature, pH, and salinity. According to Odum (1993), the measurement of abiotic parameters aims to determine the Physico-chemical conditions of aquatic ecosystems related to environmental conditions that support aquatic-biota.

Making preserves is done outside the field to facilitate the process of identifying species. It started by storing specimens immersed in 70% alcohol solution in closed jars (Melay et al., 2015). The jars were labeled with a description containing the sample number, name of the collector, date of collection, location, habitat, and a note for the sample color.

The samples obtained were identified using relevant books and references as follows: the identification of Bivalve and Gastropod classes referring to "The Living Marine Resources of the Western Central Pacific. Volume 1", a book by Carpenter and Niem (1998) and "The Living Marine Resources of the Eastern Central Atlantic. Volume 2." by Carpenter and Nicoletta (2016); Polyplacophora class identification refers to the book "Polyplacophora" by Stebbins and Eernisse (2007); and Mollusca Identification refers to a supporting reference in the WoRMS form Word Register of Marine Species (2020).

The data analysis

The data obtained after observations were then processed to determine the biological index. The species diversity was analyzed using the Shannon-Wiener Index (H') formula (Wilhm and Troy, 1968).

$$H' = -\sum pi \ln pi \quad \text{with} \quad pi = \frac{ni}{N}$$

Where:

H' = diversity index

pi = relative abundance of species

ni = number of individuals of a species

N = total number of individuals

The evenness index is analyzed using the Evenness (E) formula (Magurran, 1988):

$$E = \frac{H'}{\ln S}$$

Information:

E = evenness index

H' = diversity index

In S = number of species with E values ranging from 0-1

The Dominance Index is analyzed using the Dominance of Simpson formula (Magurran, 1988):

$$D = \frac{1}{\sum Pi^2} \quad \text{with} \quad Pi = \frac{ni}{N}$$

Information:

D = dominance index

ni = number of individuals per species

N = total number of individuals

Results

There were 37 species of mollusks obtained with 1767 individuals, including the classes of Bivalve, Gastropod, and Polyplacophora. The results of observations of mollusks species are presented in Table 1.

Based on the data obtained from Mollusks, calculations were made to find the values of diversity index (H'), evenness index (E), and dominance index (D). The index values found at station 1 (rocky sand), station 2 (coral), and station 3 (seagrass beds) can be seen in Table 2. The average results of measuring abiotic parameters at the study location for two days in the morning and afternoon, can be seen in Table 3.

Discussion

Station 1

The mollusk diversity index at station 1 is 3.3, with H' is 3.0. So, it belongs to the high category of diversity. One of the factors is the base substrate's characteristics dominated by sand and rocks, which are very supportive for their living. It is in line with Shalihah et al. (2017) that mollusks can grow and develop on substrates such as sand because mollusks have special physiological tools to adapt to aquatic environments having a sandy substrate type. Also, the sandy substrate contains organic material, which is a source of nutrition for Mollusks.

The high evenness value (E), which is 1.0, indicates that the Mollusca species at the station have evenly distributed, supported by a high population evenness index value of E > 0.6. Besides, the dominance index (D) is in a low category, namely 0.04. The diversity at station 1 is correct because the number of individuals is found with various species, reinforced by the low dominance of species in this habitat. This finding is in line with Magurran (1988) that the value of E = 1 indicates that the evenness between species is relatively even and that no one dominated in the habitat.

Mollusca species occupying Station 1 generally have a smooth shell surface. One of which is the *Nerita polita* species which is the most found (96).

The shell characteristics facilitate a species penetrating deeper sand substrate to obtain a great source of nutrients as a going concern, so the species is the most commonly found in Station 1.

Acanthopleura gemmata species is the least found at this station (only 3). The species belonging to the

Polyplacophora class tends to be found attached to rocks by forming holes in the rock surface. This finding is in line with Nugroho (2012) that other adaptations are found in Molluscs that stick to rocks, corals, or bury themselves, which tend to have slippery and heavy shells.

Table 1. The results of mollusks sampling.

No.	Class	Species Name	Number of Individuals			Total (Σ)
			St. 1	St. 2	St. 3	
1.	Bivalve	<i>Barbatia foliata</i>	29	23		52
		<i>Barbatia trapezina</i>	22	27		49
		<i>Barbatia amygdalumtostum</i>	20	31	5	66
		<i>Asaphis violascens</i>	19		1	32
		<i>Cardita variegata</i>	26	40		66
		<i>Perna perna</i>	33	57		90
		<i>Periglypta reticulata</i>	17		4	40
2.	Gastropod	<i>Nerita albicilla</i>	37	35		72
		<i>Nerita polita</i>	96	56		111
		<i>Haliotis tuberculata coccinea</i>	29			29
		<i>Phalium areola</i>	24		3	57
		<i>Monetaria annulusg</i>	23	26	194	84
		<i>Monetaria caputserpentis</i>	25	12		37
		<i>Maurita arabica</i>	20	3		30
		<i>Lyncina leviathan</i>	27			27
		<i>Ranella olearium</i>			31	39
		<i>Conus gladiator</i>		30		30
		<i>Conus biliosus</i>		24	9	41
		<i>Conus hybridus</i>			11	31
		<i>Purpura bufo</i>	36		1	46
		<i>Mancinella alouina</i>	27	2		40
		<i>Stramonita rustica</i>	28			28
		<i>Tylothais virgata</i>	9		3	45
		<i>Agaronia lutaria</i>	30		2	58
		<i>Trochus radiatus</i>	23	34		57
		<i>Lunella cinerea</i>	46		22	69
		<i>Lunella jungi</i>	34		10	59
<i>Turbo bruneus</i>	41	30		71		
<i>Turbo crassus</i>		45		38		
<i>Patelloida saccharina</i>	23	13		36		
<i>Patelloida striata</i>	36	21		57		
<i>Cellana cylindrica</i>		23		23		
<i>Cellana rota</i>	32	24		56		
3.	Polyplacophora	<i>Acanthopleura gemmata</i>	3	21		24
		<i>Chiton tuberculatus</i>	25	11		36
		<i>Lepidozona cooperi</i>	20	9		29
		<i>Tonicella lineata</i>	14			14
Total		37	874	597	296	1767

Table 2. Biology index of Molluscs at each station.

Station	Biology Index					
	H	Category	E	Category	D	Kategori
1	3.3	High	1.0	High	0.04	Low
2	3.0	Medium	1.0	High	0.06	Low
3	1.3	Low	0.5	Medium	0.5	Medium

Station 2

The Mollusca diversity index at station 2 is 3.0, $H' \geq 3.0$, so it fits the medium diversity category. The value of H' shows has a slight difference to station 1's, which is 0.3. The diversity index at Station 2 is lower than Station 1 because of the substrate difference factor. It is in line with [Jurkiewicz-Karnkowska \(2011\)](#) that low food quality, especially in many semi-permanent habitats such as corals, can inhibit the development of Mollusks. It makes the number of Mollusks in coral habitats tend to be less than Mollusks on sandy substrates.

Table 3. Abiotic parameters at each station.

No	Parameters	Research Station			Average
		1	2	3	
1.	Temperature (°C)	Morning	29.1	30	29
		Afternoon	30	31.3	29.5
2.	pH	7	7	7	7
3.	Salinity (S ‰)	29	30	30	30

The evenness value (E) is high, namely 1.0, indicating that the Mollusca species at Station 2 are evenly distributed, with a population evenness index value of $E > 0.6$. Meanwhile, the dominance index (D) is in a low category, namely 0.04, so the evenness at station 2 is correct. It supports the low dominance of species in this habitat. This finding is in line with [Magurran \(1988\)](#) that the value of $E = 1$ indicates that the evenness between species is relatively even that none dominated in the habitat.

At Station 2, there were *Perna* species found (57 individuals). The environmental conditions at station 2 are very supportive of life, supported by a stable temperature and salinity range at this station (Table 1). This finding is in line with [Carpenter and Niem \(1998\)](#) that *Perna* species live in the intertidal zone to a depth of about 5 meters and cannot tolerate low salinity or high temperatures (permanent tropical).

Perna species live by attaching themselves to a solid substrate such as coral. It supports to [Widayat \(2016\)](#) statement that Menganti Beach's coast has large and small coral stretches. The coral has a basin full of tiny snails, which is none other than a mollusk. In line with [Suharsono \(2011\)](#), the coral substrate has a collection of symbiotic aquatic biota. Aquatic biota that inhabits coral substrates includes fish and invertebrates such as mollusks.

Alouina Mancinella species is a species found in the station at least this amount to 2 individuals. It is because these species, besides living in coral substrates, also live in rocky substrates. Field

observations, these species are found at station 1 with the characteristics of the rocky sand substrate.

Station 3

The Mollusca diversity index at station 3 is 1.3, which is distinctive from Stations 1 and 2, where the value of $H' \leq 2.0$, included in the low diversity category. The evenness value (E) at station 3 is 0.5, which is in the medium category. The dominance index (D) is 0.5, included in the medium dominance category.

The low diversity index at station 3, evidenced by the small number of individuals found, and presumably due to natural pressure and disturbance. Meanwhile, the evenness and dominance values classified as moderate are affected by environmental factors that are very influential for the life of Mollusks in the substrate. It is in line with [Sharma et al. \(2013\)](#) that the aquatic environment's physicochemical factors significantly influence the Mollusks' diversity and distribution in their habitat.

The most dominant species at this station is the *Monetaria annulus* (194 individuals). This finding is in line with [Aji et al. \(2018\)](#) that *the Monetaria annulus* is often found in intertidal areas and inhabits coastal areas (sandy and muddy), and reef flats seagrass and coral fragments are present. Meanwhile, the species with the lowest dominance were *Asaphis violascens* and *Purpura bufo*, each with one individual. It is in line with the statement of [Athifah et al. \(2018\)](#) that high predation or competition between individuals and an unsuitable aquatic Physico-chemical environment can cause differences in the density and number of Molluscs in a habitat.

The diversity of mollusks based on the habitat in the three research stations can be said to be diverse and abundant, seen from the types and numbers of mollusks found. It is supported by abiotic conditions in the intertidal zone of Menganti Beach, Kebumen, which is ideal for the life of mollusks. Based on the abiotic parameters, biological index, and the number of species, Station 1 can be said to have the ideal conditions for the life of mollusks. This finding is in line with [Sharma et al. \(2013\)](#) that the aquatic-environment physicochemical-factors have a significant influence on the diversity and distribution of mollusks in their habitat.

Mollusks that have an even distribution are at station 1 (rocky sand), station 2 (coral), and station 3 (seagrass bed), namely *Monetaria annulus*. Mollusks with uneven distribution, such as *Haliotis tuberculata coccinea*, *Lyncina leviathan*, *Ranella olearium*, *Conus gladiator*, *Conus hybridus*, *Stramonita rustica*, *Turbo*

crassus, *Cellana cylindrica*, and *Tonicella lineata* are only at one of the three stations.

Mollusks found in Menganti Beach, Kebumen, apart from their various types, also have an ecological role as living organisms sensitive to environmental changes capable of accumulating heavy metals without dying. It is in line with Wahyuni *et al.* (2017) that mollusks like *Perna* can act as environmental bioindicators in aquatic ecosystems because of their sedentary nature and *feeder filter*. They can accumulate pollutants such as bacteria and heavy metals. It supports Katukdoan *et al.* (2018) that mollusks also act as connectors (early decomposers) in a food chain.

Regarding this ecological role, mollusks have benefited the community, especially around Menganti Beach, Kebumen, including as a source of protein, animal feed ingredients, industrial materials, fertilizer materials, and medicines. Bivalve and Gastropod shells can be used as accessories or jewelry. This finding is in line with Islami *et al.* (2018) that mollusks can be used as various commodities such as food products, accessories, jewelry, and raw materials for medicines.

The community, especially around the Menganti Beach, Kebumen, generally uses mollusks from the Bivalvian Class and Cephalopods as a source of food for consumption. It supports Hamli *et al.* (2012) that gastropods and seashells consist of various species widely used for varied purposes, one of which is a source of nutrition traded in many countries. According to Meloni (2015), economically, mollusks are used for regional and export markets as a source of nutritious food.

Abiotic Parameters for each Station

Abiotic parameters at station 1 with morning temperatures range from 29.1 C and evening 30°C. At Station 2, morning temperatures ranging from 30°C and in the afternoon 31.3°C. At station 3, morning temperatures are around 29 °C and 29.5 C in the afternoon. This finding is in line Hicks and McMohan (2002) and Pertiwi and Lathifah (2018) stated that an organism's optimum growth temperature for specific mollusks generally ranges from 20°C-30°C.

Water conditions at stations 1, 2, and 3 have a pH of 7 (neutral). This value shows that the pH of the waters at the three stations is supportive for the growth and development of mollusks. It supports Shalihah *et al.* (2017) that the optimum pH preserving mollusks' life ranges from 6.5 - 7.5.

The salinity of the waters at station 1 was around 29 ‰, while the water salinities at Station 2 and 3

were around 30 ‰. This value indicates that the water conditions at the three stations are very supportive for the life of mollusks. Supported by the statement of Vonk *et al.* (2008) stated that the salinity range for macrozoobenthic life is mollusks, which is around 25 - 40 ‰.

Conclusion

There found a high diversity at Station 1 with the rocky sand substrate is 3.3. Station 2 with a coral substrate (3.0) is moderate, and station 3 with seagrass substrate, which is 1.3 is low. Habitat with a rocky sand substrate is the most suitable for Mollusca habitat. It is supported by the evenness value, indicating evenly distributed species, and the dominance value, which does not indicate species dominance.

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