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The Diversity of Molluscs (Bivalves and Gastropods) in the Intertidal Zone of Mutun Coastal, Padang Cermin, Lampung

Raden Teti Rostikawati[1], Restu Ayu Ningtias[*], Enriani Manullang, Dhia Nida Fauzia, Meilisha Putri Pertiwi
[1]Pendidikan Biologi, Universitas Pakuan, Bogor, Indonesia

*Email: restuayuningtias1@gmail.com

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Abstract

The Mutun Coast has a diversity of biota types. Biota that is often found includes the Phylum Molluscs (class of Bivalves and Gastropods). The aim of this research is to determine the diversity of Molluscs (Bivalves and Gastropods) on the Mutun Coast of Lampung. This research was carried out on 5-7 February 2021. The data collection method at both stations used the belt transect method using purposive sampling. Station I has a fine sand substrate, while station II has a coarse sand substrate. Based on the research conducted, 26 individuals were found consisting of 7 families, namely 6 families of the Gastropods (Trochidae, Strombidae, Cerithiidae, Muricidae, Potamididae and Pisaniidae) and 1 family of the Bivalves, namely the Mactridae family. The diversity value at station I is included in the medium category while at station II is included in the low category. The evenness value at station I is included in the high category, while at station II it is included in the low category. The dominance value at station I is included in the medium category, while at station II it is included in the medium category. Based on data analysis, it can be concluded that the Mutun Coast has a suitable habitat for molluscs and is also supported by abiotic parameter conditions.

Keywords: bivalves; diversity; gastropods; intertidal zone; Mutun Coastal

INTRODUCTION

Mutun Beach is a tidal area which has a large area with varied substrates. It has the same condition as the other beaches of Indonesia (Pertiwi *et al.*, 2019; Pertiwi & Lathifah, 2019; Triacha *et al.*, 2021; Mufida *et al.*, 2023). In general, coastal areas contain a wide variety of Bivalves (shellfish) and Gastropods (relatives of snails and slugs) which belong to the Phylum Molluscs (Nelwan *et al.*, 2017; Ariani *et al.*, 2019; Wijayanti *et al.*, 2020). Molluscs are soft-bodied animals, without segments, and are covered in a shell called *a shell.* Oyster, mussels, clamps, scallops are included in the Bivalves Class (part of Phylum Molluscs). The body *laterally compresses* (flattens on one side) and surrounded shell which started from the secret which own two part which called valve. Class Bivalves does not own head and radula. The Bivalves class is generally live in the intertidal zone. Class Gastropods which is a part of Phylum Molluscs usually found in beach area. Apart from that Gastropods also spread wide in peak mountains, river, lake, mainland, and coastal areas until depth certain (Baharuddin *et al.*, 2019; Samson & Kasale, 2020; Ratih *et al.*, 2021).

There are around 100,000 types of Molluscs Phylum that still survive. Meanwhile, 35,000 are inthe form of fossils. Their slow movements make molluscs relatively settled at the bottom of the water and is often used as a biological guide (indicator) of water quality (Kane *et al.*, 2016; Moraitis *et al.*, 2018;

Fadilla *et al.*, 2022). Therefore, Molluscs are one of the basic animal groups that play an important role in aquatic ecosystems, namely as primary consumers (Herbivores) and secondary consumers (Carnivores). Another important role is to help the mechanical decomposition process of organic material through its feeding activity. However, there are also Molluscs that are dangerous because they contain poison, such as the Conoidea superfamily (Olivera *et al.*, 2014; Fortunato, 2015; Casoli *et al.*, 2019).

The abundance and distribution of Molluscs in a body of water is determined by the abiotic and biotic environment and their tolerance to each of these environmental factors. The environmental factors in question include temperature, DO, pH, salinity and CO_2. Meanwhile, apart from being influenced by environmental factors, the distribution pattern of organisms is also influenced by the level of socialization of an organism in a population, interactions with other species, and the availability of resources (Martins *et al.*, 2014; Fortunato, 2015; Mainassy, 2017). Research on the diversity of molluscs in the coastal intertidal zone is also widespread. The intertidal zone is a transition zone for marine biota habitat and a source of life for marine biota. This zone is a coastal area located between the highest tide and the lowest tide. This zone is also a strategic area for observing changes in the marine environment. Therefore, monitoring the condition of organism diversity in this zone is important. This research shows that the diversity of bivalves and gastropods is low at Tanjung Rising Beach, Bangka Belitung (Fatonah *et al.*, 2023). Apart from that, Cibuaya Beach, Ujung Genteng has a moderate level of diversity in the Bivalvia class (Putri *et al.*, 2023), as well as the highest diversity of mollusks on the rocky sand substrate at Menganti Beach, Central Java (Ratih *et al.*, 2021). However, unfortunately, there is no data on the diversity of Molluscs on Mutun Beach, Lampung. Therefore, this research needs to be carried out with the aim of determining the diversity of Molluscs (Bivalves and Gastropods) in the intertidal zone of Mutun Beach, Lampung.

METHOD

This research was carried out from 5-7 February 2021 at low tide. Molluscs data collection was carried out in the intertidal zone of Mutun Beach, Padang Cermin District, Pesawaran Regency, Lampung. Mutun Beach is about 9 km from the city center of Bandar Lampung. Mutun Beach has astronomical coordinates -5.511776o South Latitude and 105.256446 East Longitude (Figure 1).

Figure 1. Research sites

In this research, the tool used is a camera cellphone, meter, *tally sheet* , refractnometer, universal indicator, thermometer, raffia rope, stationery (ruler, pencil, and paper), plastic, used plastic bottles, and an identification book that refers to the book *The Living Marine Resources of the Eastern Central Atlantic* (Carpenter & De Angelis, 2014) as well as a website in the form of WoRMS (*Word Register of Marine Species*). Meanwhile, in this research, the material used was distilled water. The systematics of mollusk sampling uses a *purposive sampling technique* using the *belt transect method* which can be seen in Figure 2.

The *belt transect* method aims to describe the population condition of an organism, the number of individuals and colonies, as well as the number of species and their distribution (Fahruddin *et al.*, 2017; Mutaqin *et al.*, 2020; Erdana *et al.*, 2022). The characteristics of these organisms are that they have various relative sizes or a certain maximum size, one of which is like invertebrates. *The belt transect* design , a combination of line and quadrant transects, is implemented extending 100 meters in a perpendicular position from the lowest tidal limit to the coastline of the intertidal zone of Mutun Beach.This transect is spread over 2 observation station locations . Substrates were found from stationI (fine sand substrate) and station II (coarse sand substrate). On each transect, a quadrant frame of 5 plots is placed, with each plot measuring 1 x 1 m^2 and the distance between plots is 3 m. So the total at the 2 observation stations is 10 sampling plots. This transect was designed using raffia rope, wooden stakes and measuring tape as in Figure 2.

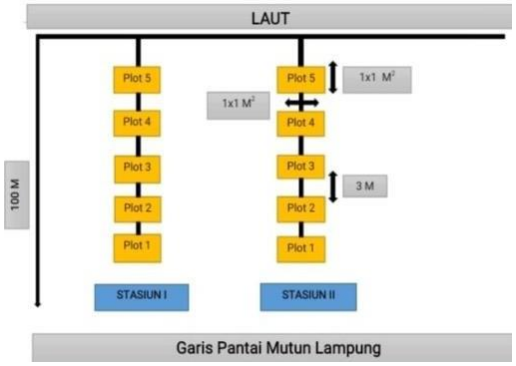

Figure 2. Research sampling design

Molluscs samples (Bivalves and Gastropods) were taken in the morning and evening. The morning starts at 09.00-11.00 WIB and the afternoon starts at 14.00-15.00 WIB simultaneously at both station I and station II. Sampling was carried out in 2 repetitions on the following day with the time period for sampling samples based on the condition of the waters at low tide with conditions from morning to evening, this was done because the water receding interval was around 4-6 hours, not only that but it was longer. The basic thing is that the risk that occurs at night is quite large. This research done during 3 days, next with calculation of the number of individuals found on each plot sampling. Apart from being recorded in the observation table, the data obtained is also documented using a camera.

Abiotic parameter data collection at each research station includes temperature, depth, pH, salinity and current strength. Temperature data was collected using a thermometer, depth using a meter, pH using a universal indicator, salinity using a refractometer, and current strength using a rope tied to a ping pong ball then thrown against the current and calculating the time to return to its original position, measuring abiotic parameters aims to determine the physico- chemical conditions of water ecosystems related to the environment and environmental conditions that support water biota (Nento *et al.*, 2020; Patty *et al.*, 2021; Nursanti *et al.*, 2022). The specimens obtained were placed in a jar previously filled with sea water. The jar is then labeled with a description containing the sample number, date taken, location, habitat, and notes on the color of the sample. Specimens are identified by looking at the characteristics of shell shape, shell width, shell length, shell color, apex, whorl, body whorl, siphonal canal, spire, suture, aperture, and columella. Next, it is adapted to relevant books and references as follows: "The Living Marine Resources of the Western Central Pacific. Volume 1." Carpenter, KE & Volker, HN in 1998 and "The Living Marine Resources of the Eastern Central Atlantic. Volume 2." by Carpenter, KE & Nicoletta, DA in 2016 as well as supporting references to the WoRMS Word Register of Marine Species Databasein 2020.

The data obtained after observation is analyzed to determine the species diversity index . Species diversity was analyzed using the Shannon-Wiener formula to determine the diversity of the number of species found. The diversity index is calculated using the formula (Magurran, 1988).

$$H' = -\sum Pi \ln Pi, Pi = \frac{ni}{N}$$

Information: H' indicates Diversity Index, Pi indicates Abundance of Species, ni indicates Number of Individuals of type, and N indicates total numbers of individuals. According Hidayat *et al.* (2017) the following criteria are used H' ≤ 1as Low Diversity, 1 < H' ≤ 3 as Medium Diversity and H' > 3 as High Diversity. The species evenness index in a habitat is calculated using the evenness formula (E) (Magurran, 1988).

$$E = \frac{H'}{\text{Ln}S}$$

Information: E indicates Evenness index, H' indicates Diversity index, and LnS indicates Number of species with an E value ranging from 0-1. The value of E according to Hidayat *et al.* (2017) can be concluded as follows: E ≤ 0.4 as Low population evenness, 0.4 < E ≤ 0.6 as Moderate population evenness, and E > 0.6 as High population evenness. A high dominance value indicates that there is a dominant species in the community, the dominance index value used by Simpson (Magurran, 1988). With the following formula, namely:

$$D = \sum \frac{[ni]^2 N}{N}$$

Information: D indicates Dominance index, ni indicates Number of individuals of each type, and N indicates Total number of individuals. The value of D according to Nuraina *et al.* (2018) can be concluded as follows: 0 < D ≤ 0.50 as Low dominance, 0.50 < D ≤ 0.75 as Moderate dominance, and 0.75 < D ≤ 1.0 as High dominance.

RESULT AND DISCUSSION

Based on the results of research that has been carried out, it was found that there were 7 families of molluscs, 8 species, and 26 individuals. The results of the observations are in Table 1. At station I, 6 families of the Gastropods class were found with a total of 10 individuals, namely 1 *Trochus maculatus*, 2 *Canarium erythrinum*, 3 *Rhinoclavis vertagus* , 1 *Homolopoma nana* , 1 *Cytharomorula grayi* , 1 *Claremontiella nodulosa* , 1 *Aplus dorbingyi*. The Bivalves class consists of 1 family with 11 individuals, namely *Spisula solidassima*. Meanwhile, at station II, 1 family of the Gastropods class was found with 1 individual including *Rhinoclavis vertagus* and the Bivalves class is 1 family with 4 individuals, namely *Spisula solidissima*.

Table 1. Molluscs identification results (Class of Bivalves and Gastropods)

Class	Order	Family	Species	Station		Amount
				St 1	St 2	((∑)
Gastropods	Archaeogastropod	Trochidae	*Trocus maculatus*	1	-	1
	Mesogastropoda	Cerithidae	*Rhinoclavis vertagus*	3	1	4
	Mesogastropoda	Colloniidae	*Homolopoma nana*	1	-	1
	Mesogastropoda	Strombidae	*Eritrean canary*	2	-	2
	Neogastropoda	Muricidae	*Claremontiella nodulosa*	1	-	1
	Neogastropoda	Muricidae	*Cytharomorula grayi*	1	-	1
	Neogastropods	Pisaniidae	*Aplus dorbingyi*	1	-	1
Bivalves	Eulamellibranchia	Mactridae	*Spisula solidissima*	11	4	15
Amount						**26**

Note: - (Not found)

Based on data obtained from the Bivalves and Gastropods, the calculation of the species diversity index value can be seen in Table 2.

Table 2. Molluscs species diversity index (Class of Bivalves and Gastropods)

Station	Biology Index					
	H'	Category	E	Category	D	Category
I	1.44	Currently	0.72	Tall	0.57	Currently
II	0.86	Low	0.10	Low	0.35	Currently

Information: H' indicates Diversity Index, E indicates Evenness Index, and D indicates Dominance Index

From the results of Phylum's research Molluscs found at station I with fine sandy substrates, Class Gastropods include *Trochus maculatus*, *Canarium erythrinum*, *Rhinoclavis vertagus*. *Homolopoma nana*, *Cytharomorula grayi*, *Claremontiella nodulosa*, and *Aplus dorbingyi* and the Class Bivalves found is the Mactridae family, namely *Spisula solidissima*. The results of research at station I showed that species from the Bivalves, namely the Mactridae Family, were more commonly found (11 individuals) than Gastropods (10 individuals). The Bivalves can grow and develop in habitats with substrates such as sand, because they have special physiological tools to adapt to sandy bottom water environments. This is also related to the ability of the substrate to capture organic material needed by species from the Bivalves as a food source. These specimens in the research area were found mostly buried in sand or mud. The Bivalves is generally found in waters with fine sand and muddy substrates and immerses itself in the substrate (Casoli *et al.*, 2019; Samson & Kasale, 2020; Ratih *et al.*, 2021).

From the research results of the Molluscs Phylum found at station II, the Gastropods contain the Cerithiidae Family and the Bivalves contain the Mactridae Family. The results of research at station II showed that only a small number of Molluscs were found. The Cerithiidae family has 1 individual and the Mactridae family has 4 individuals. The number of Molluscs found at station II was less in species compared to the number of mollusks found at station I. The family that dominated at station II was of the Mactridae family, namely the species *Spisula solidissima*, this is influenced by the aquatic environment and substrate. *Spisula solidissima* prefers habitats with fine sandy bottom substrates to muddy sediments on the bottom surface of the substrate, this is related to the behavior of the biota, whether it is to obtain food with a *filter feeder*, which is obtained by pumping water through the mantle cavity so that it obtains the necessary particles is in the water (Aranda-Burgos *et al.*, 2014; Carpenter & De Angelis, 2014; Afriyansyah *et al.*, 2023).

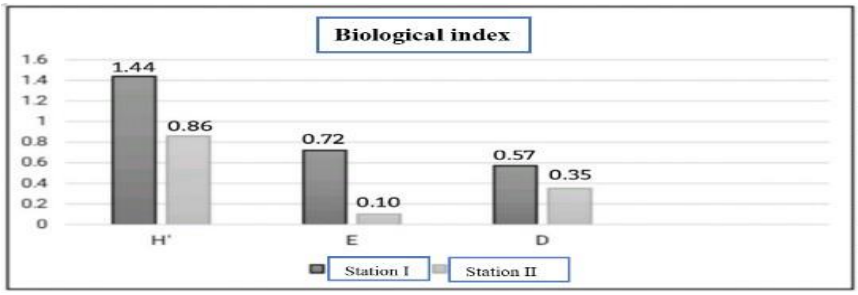

Figure 3. Molluscs species diversity index (Class of Bivalves and Gastropods)

The Molluscs diversity index at station I is 1.44 which is included in the medium category, while at station II it is 0.86 which is included in the low category. The diversity index at station II is lower than station I due to differences in the substrate of the two stations. Food quality is very low in many coarse sand habitats, so it can inhibit the growth of Molluscs and can also cause the number of Molluscs in coarse sand habitats to be lower than the number of molluscs in fine sand substrates. Molluscs can grow and develop on substrates such as fine sand, because Molluscs have special physiological tools to

adapt to aquatic environments with fine sandy substrates and sandy substrates containing organic material which is a source of nutrition for Molluscs (Mainassy, 2017; Shalihah *et al.*, 2017; Fatonah *et al.*, 2023). This condition has the same intercorrelation between living things and environment. This thing will be beneficial to human (Istiana *et al.*, 2019; Saputri *et al.*, 2020; Pertiwi & Saputri, 2020; Saputri & Pertiwi, 2021).

The evenness index (E) value at station I is 0.72 which is included in the high category, indicating that the Molluscs species at station I are evenly distributed, while at station II the value is 0.1 which indicates low evenness. Meanwhile, the dominance index (D) value which is classified as moderate at both stations is 0.57 at station I and 0.35 at station II. This shows that the evenness between species is relatively the same and some dominate in that habitat (Samson & Kasale, 2020; Marinho & Arruda, 2021; Afriyansyah *et al.*, 2023). This is in accordancewith the theory, the dominance of certain species, namely the low diversity value is caused by many species being found in one community, but their distribution is uneven (Fatonah *et al.*, 2023; Nento *et al.*, 2020; Ratih *et al.*, 2021). The results of measuring abiotic parameters at the research location, namely temperature, pH, salinity and current strength, can be seen in Table 3.

Table 3. Results of measuring abiotic parameters at the research location

No	Parameter	Time	Station		Average
			I	II	
1.	Temperature (^{o}C)	Morning	27	27.2	27
		Afternoon	26	26.5	
2.	pH	Morning	6	6.3	6
		Afternoon	6	6.3	
3.	Salinity ($^{o}/_{oo}$)	Morning	28.5	30.2	29
		Afternoon	28.5	30.2	
4.	Current strength(cm/sec)	Morning	0.0580	0.0595	0.074
		Afternoon	0.0820	0.0822	
5.	Depth (cm)	Morning	48	34.5	50
		Afternoon	60	55.3	

As for the calculation of abiotic parameters, the results of temperature measurements in both stations are 26 - 27 ^{o} C. Meanwhile temperature which in accordance for life Phylum Molluscs range between 28-31°C (Casoli *et al.*, 2019; Kisman *et al.*, 2016; Patty *et al.*, 2021). Limit temperature highest which still can tolerated by animalsea is 35°C and if the temperature pass limit 35°C, those animal in the sea can feel stress (Carpenter & De Angelis, 2014; Kisman *et al.*, 2016; Supratman *et al.*, 2019). Meanwhile, the pH value obtained at the research location shows the optimal value, namely 6. According to the Decree of the Minister of Environment No. 51 of 2004 that a good pH value for marine biota ranges from 6.5 - 8.5, if the value obtained is close to 5 then it is not good for marine biota (Marpaung *et al.*, 2014; Shalihah *et al.*, 2017; Afriyansyah *et al.*, 2023) . Then the second measurement of salinity. The observation location is around 28.5 – 30.2 $^{0}/_{00}$ which is still included in salinity worthy. Mark salinity for macrozoobenthos life that is range 15-35‰. The current speed at both stations is 0.0590 m/s. Speedcurrent for mollusk life ranges from 0.3 -0.39 m/s. Macrobenthos will difficult for grow and reproduce when the current speed is high (Carpenter & De Angelis, 2014; Marpaung *et al.*, 2014; Marinho & Arruda, 2021). Apart from the dynamics of biotic and abiotic conditions at the station, the low number of Molluscs found can also be caused by several factors, including the impact of disturbance caused by humans, because the location is used for marine tourism such as *banana boats*, *swimming*, *diving* and other activities. High levels of anthropogenic pollutants can cause loss of biodiversity, especially Molluscs species found in the coastal waters of Mutun Beach (Kisman *et al.*, 2016; Supratman *et al.*, 2019; Wibowo *et al.*, 2019).

CONCLUSION

From the results of the research that has been carried out, it can be concluded that the Station I area has a medium level of mollusk diversity, a high level of evenness, and a medium level of dominance. Then at station II the level of mollusk diversity was low, the level of evenness was low and the level of dominance was medium. Abiotic parameters have good values for both Bivalvia and Gastropod habitats. Therefore, Mutun Padang Cermin Lampung Beach still has an environment that supports its marine ecosystem. . This research is useful for the nation, especially researchers, because this research can be an initial input or reference for agencies related to marine ecosystem conservation for its preservation and sustainability in the future. Apart from that, the results of this research are useful for teachers because the data can be used as material for learning resources.

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