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Diversity of gastropods epifauna based on substrate in littoral zone in Mesjid Raya, District of Aceh Besar, Indonesia

Nurhasballah, A Rizki and Suwarno¹

Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, Darussalam Banda Aceh, Indonesia.

E-mail: suwarno@unsyiah.ac.id

Abstract. The gastropod is one class of the Mollusca phylum using the abdomen as the leg. Generally gastropods are crawling on the bottom of the waters and submerged in the mud and are often called epifauna and infauna gastropods. Research on diversity of epifauna gastropods in the littoral zone has been done in Mesjid Raya, Aceh Besar District. This research aims to determine the diversity of gastropod species based on the substrate types (coral reef, muddy and sandy). The exploratory method by using transect line was used in this study. In each substrate, a line transect was drawn for five transects with a length of 50 m. The transects were started from the tidal line. The distance between transects were 50 m. Each transect was made in 10 sampling plots measuring 1m x 1m, and the distance between plots was 5m. The gastropods were collected directly and without damaging the substrates. The epifauna gastropods obtained was put into a sample bottle and preserved using 70% alcohol. The results showed that 23 families and 54 species of epifauna gastropods were identified. The number of species of gastropods was found in the sandy and muddy substrate more than in the sandy and coral reef substrate, but the highest diversity index was found in the sandy substrate, meanwhile the lowest diversity was found in the coral reef substrate. The highest species density was obtained on *Rhinoclavis aspera*.

1. Introduction

Coastal area is a very important habitat for a variety of marine life. Marine lives found in coastal areas are planktons, benthos and nektons. Benthos is a group of animals that live on the water or attached to the substrate (avifauna). One of the benthos group contained in the water is a Class Gastropod [1]. Gastropod is distributed on land, freshwater, to the salty waters (sea). Gastropod is generally associated with mangrove ecosystems as a place to live, shelter, spawning and food supply in order to support their life [2]. Ecologically, gastropods play an important role in the process of litter decomposition and mineralization of organic matter, especially which are herbivores and detritivore. Therefore it can be said as decomposer gastropods initiate organic material break down into smaller parts [3].

Gastropod community structure and distribution is strongly influenced by environmental factors, especially water chemical factors (such as salinity, pH, dissolved oxygen DO, BOD, COD), physical factors (such as brightness, temperature, and substrate type), and biotic factors. Therefore, gastropods can be used to predict the level of pollution to the environment, because it is very sensitive to

¹ To whom any correspondence should be addressed.



environmental changes [4]. Differences in ecosystems on coastal waters cause variations in community structure and form different patterns.

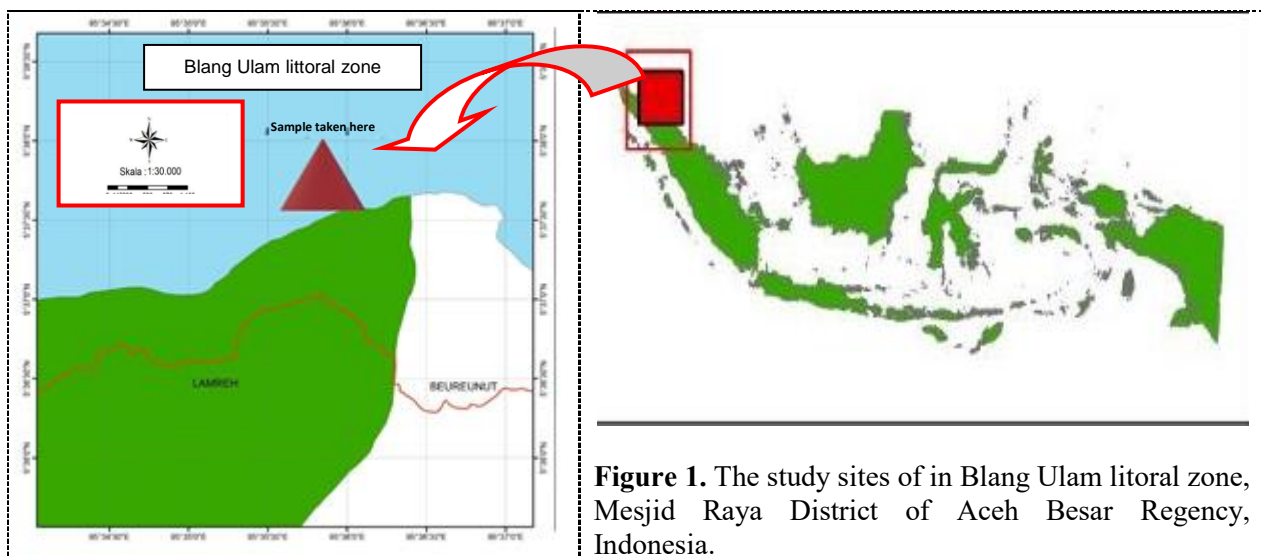
Avifauna gastropods can be found throughout the Indonesian coastal area with various substrate types of waters such as rocky, muddy, muddy sand [2]. Some gastropods epifauna research has been done on the several types of substrate of waters in various regions of Indonesia. There were five species of gastropods epifauna (*Littoria* sp., *Natica* sp., *Terebia* sp., *Nerita* sp. and *Melanoides* sp.) found on the basis of mangrove ecosystem in the muddy waters of the Sempedan River in Tallo, Makasar [5]. Furthermore, as many as 229 species of gastropods were found in four locations with a different substrate in the coastal waters of Manokwari, West Papua [6].

Blang Ulam, Mesjid Raya district of Aceh Besar, Indonesia is one of the littoral zones that have many Gastropods. This area is a potential habitat for life epifauna gastropods with the substrate is rocky, sandy and muddy sands. Preliminary study results showed that in this littoral zone there were many different species of gastropods epifauna. Gastropods that found were family *Buccinidae*, *Cerithidae*, *Cypraeidae*, *Turbinidae*, *Terrebridae*, and *Tridacnae*. Up to now there are no accurate data about the diversity of gastropods epifauna contained in this littoral zone. Based on the above issues, it is important to conduct a research on the diversity and distribution of gastropods epifauna based substrate in the littoral zone of water waters Blang Ulam, Mesjid Raya sub-district, Aceh Besar District.

2. Material and methods

2.1. Study site

The Blang Ulam littoral area is located in Mesjid Raya District, Aceh Besar Regency. The distance of this location to Krueng Raya Port is ± 8 km, and from the provincial capital of Aceh is about 30 km. Regional conditions are very beautiful and comfortable coupled with mangrove forests attracting the public to visit the location of the White Sand area, especially during the holiday season. The base of the littoral waters of Blang Ulam has a rocky, muddy and sandy one. In this region there are various marine organisms, ranging from plankton, benthos and nekton. Many benthos groups in this area are from the Gastropods class. These animals are attached to the reef, are on the surface or inside the bottom of the water. Some species have economic value for the community



2.2. Material and method

The method used in this study was an exploratory survey method using line transects in an area of ± 6 acre divided into three stations based on the substrate type, namely station I is coral substrate (ST-1),

station II substrate with sandy and muddy substrate (ST-2), station III sandy substrate (ST-3). In each of the substrate as many as five transect line with a length of ± 50 m were drawn. Setting up of the line transect begins tide, the distance between transects the next transect was ± 50 m. On each transect sampling made as many as 10 plots measuring 1m x 1 m, and the distance between the plots was 5 m. Thus for each type of marine substrate was obtained as many as 50 units of observation/sampling unit. Sampling was done when the tide was receding.

Sampling was done by non-destructive sampling (not ruin a place to stay). Sampling at stations I and II on the area sampled were taken directly by hand, whereas on a plot area of sampling at the third station, sampling was performed using Eckman Grap. Material obtained was then sieved with a sieve-rise. Physical and chemical factors of water were measured for its, temperature, pH, dissolved oxygen (DO), COD, BOD and salinity.

Gastropods epifauna obtained at each subsequent observation plots were inserted into the sample bottle and labelled (the time of collection, observation point (plot), transect number and station number) and then preserved using 70% alcohol. These samples were subsequently identified in the Zoology laboratory of the Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala.

2.3. Data analysis

Base on the data the Shannon's diversity index, Margalef's species richness, and Sorensen's evenness index were calculated to describe the gastropods epifauna in the littoral zone of Mesjid Raya.

3. Results and Discussion

There were as many as 54 species of epifauna gastropods found in this study and they belong to 23 families, as shown in Table 1. The number of most commonly found species and number of individuals were from the family *Cerithidae* (9 species and 104 individuals), *Buccinidae* (5 species and 27 individuals), *Conidae* (7 species and 18 individuals) and *Nerithidae* (7 species and 17 individualas). *Cerithidae* was the most abundant compared to other families, easy to find and common since it spreads very broad ranging from sub-tropical to tropical region. Generally, species members of the family *Cerithidae* found in the tropics region. Gastropods can be found in the coastal areas in the form of sandy substrates, muddy sand, soft corals or hard corals. Five species of *Buccinidae* obtained, generally were found in ST-2 and dominated by *Nassarius coronatus*. *Buccinidae* are medium to large marine gastropod groups, the forms vary widely and are widespread. This family has more than 1500 species [7, 8]. The true whelks (*Buccinidae*) are widespread, ranging from the tropics to the cold sea. This group can be found from the intertidal to bathypelagic zones and prefers dense and sandy substrates [9].

Conidae was also found in Blang Ulam's littoral zone in large numbers. All species from the family *Conidae* was from the genera of *Conus*. This is presumably due to the presence of food sources such as small molluscs in this area. *Conus* is a gastropod that lives in the sea and spread from the tropics to subtropics and can be found starting from the sub littoral region to a depth of 1000 m [10]. Ecologically *Conidae* is predatory gastropods that eat snails and other molluscs in the sea [11,12]. *Conidae* hunts moving and immovable prey using radular teeth containing neurotoxins. Neurotoxins produced by *Conoidea* group allegedly can be used as potential drug. Studies of biotechnology experts and pharmacists are still being conducted against the neurotoxin [13]. In addition as many as six species were found belonging to the family *Nerithidae*. Members of the *Nerithidae* family are also widespread from freshwater to salty waters. Four of the six species found were from the genera *Nerita*. *Nerita* is a member of the family of *Nerithidae* that lives in saltwater or estuary areas, while *Theodoxus* is spread in freshwater areas [14].

The data in Table 1 also show that the *Rhinoclavis aspera* and *Cerithidium kobelti* species from the *Cerithidae* family were both most commonly found, especially at ST-2. The number of these two species is found to be suspected related to the substrate type in ST-2 which is muddy sand. The

existence of *R. aspera* correlates with microbial biomass found in flat areas of waters which have a lot of organic material [15].

Table 1. The species of gastropods epifauna found in littoral zone in Mesjid Raya District of Aceh Besar, Indonesia.

	Family (1)	Species (2)	Number of individual (3)				Distribution (4)
			ST-1	ST-2	ST-3	Total	
1.	<i>Ariophantidae</i>	1. <i>Quantula striata</i>	-	-	4	4	M
2.	<i>Buccinida</i>	2. <i>Cantharus melanostomus</i>	-	1	4	5	M
		3. <i>Engina zonalis</i>	-	5	-	5	M
		4. <i>Euplica varians</i>	1	5	-	6	M
		5. <i>Euthria aracanensis</i>	-	1	-	1	A
		6. <i>Nassarius coronatus</i>	4	5	-	9	M
3.	<i>Cerithidae</i>	7. <i>Bolma guttata</i>	-	3	-	3	M
		8. <i>Cerithidea alata</i>	1	2	1	4	M
		9. <i>Cerithidea cingulata</i>	-	1	-	1	M
		10. <i>Cerithidium kobelti</i>	1	27	3	31	K
		11. <i>Cerithidium tenelum</i>	5	3	4	12	M
		12. <i>Clypeomorus petrosa</i>	2	2	2	6	M
		13. <i>Clypeomorus zonata</i>	-	3	1	4	M
		14. <i>Indocerithidium taeniatum</i>	-	1	4	5	M
		15. <i>Rhinoclavis aspera</i>	2	27	1	40	K
4.	<i>Collumbellidae</i>	16. <i>Pictocolumbella ocellata</i>	-	2	-	2	M
		17. <i>Pseudanachis duclosiana</i>	-	2	1	3	M
5.	<i>Conidae</i>	18. <i>Conus ariejoostei</i>	-	3	3	6	M
		19. <i>Conus auricomus</i>	-	1	2	3	M
		20. <i>Conus bandanus</i>	1	1	-	2	M
		21. <i>Conus harmoniconus</i>	-	1	1	2	M
		22. <i>Conus judaeus</i>	2	1	-	3	M
		23. <i>Conus nusatella</i>	-	1	-	1	A
		24. <i>Conus terebra</i>	-	1	-	1	A
6.	<i>Cypraeidae</i>	25. <i>Cyprae eovulinae</i>	-	1	-	1	A
		26. <i>Cyprae lynx</i>	-	2	-	2	M
		27. <i>Cypraea saulae</i>	-	-	2	2	M
7.	<i>Fasciolaridae</i>	28. <i>Dolicholatirus fernandesi</i>	1	2	-	3	M
		29. <i>Granulifusus bacciballus</i>	-	-	2	2	M
8.	<i>Haliotidae</i>	30. <i>Haliotis diversicolor</i>	-	-	1	1	A
9.	<i>Hipponicidae</i>	31. <i>Hipponix acuta</i>	-	-	2	2	M
10.	<i>Littorinidae</i>	32. <i>Echinolittorina conspersa</i>	-	-	1	1	A
		33. <i>Littoraria pallescens</i>	1	-	3	4	M
11.	<i>Mitridae</i>	34. <i>Mitra amaura</i>	-	2	3	5	M
		35. <i>Mitra schroeteri</i>	-	1	-	1	A
12.	<i>Muricidae</i>	36. <i>Favartia balteata</i>	2	1	2	5	M
13.	<i>Nassariidae</i>	37. <i>Nassarius bimaculosus</i>	2	1	-	3	M
		38. <i>Tritia goreensis</i>	-	1	-	1	A
14.	<i>Nerithidae</i>	39. <i>Clithon olivaceum</i>	-	1	-	1	A
		40. <i>Nerita chamaeleon</i>	1	-	4	5	M
		41. <i>Nerita neritopsoides</i>	-	1	-	1	A
		42. <i>Nerita polita</i>	1	4	1	6	M
		43. <i>Nerita undata</i>	-	1	-	1	A
		44. <i>Neritina aculeata</i>	-	-	2	2	M
		45. <i>Smaragdia feuilleti</i>	-	1	-	1	A
15.	<i>Niticideae</i>	46. <i>Polinices aurantius</i>	-	1	2	3	M
16.	<i>Neritopsidae</i>	47. <i>Neritopsis radula</i>	-	1	-	1	A
17.	<i>Olividae</i>	48. <i>Oliva trigidella</i>	-	4	1	5	M
18.	<i>Pachylidae</i>	49. <i>Faunus ater</i>	3	2	-	5	M
19.	<i>Potamididae</i>	50. <i>Cerithidea charbonnieri</i>	-	1	-	1	A
20.	<i>Strombidae</i>	51. <i>Strombus urceus</i>	-	1	-	1	A
21.	<i>Terebridae</i>	52. <i>Hastula westralica</i>	2	-	1	3	M
22.	<i>Tubinidae</i>	53. <i>Turbo marmoratus</i>	-	2	-	2	M
23.	<i>Xenophoridae</i>	54. <i>Xenophora</i> sp.	2	1	-	3	M
Number of species			18	44	27	54	
Number of individual			34	141	58	233	

Note : ST-1 = coral substrate; ST-2 = sandy and muddy substrate; ST-3 = sandy substrate

The number of species and the number of individual gastropods epifauna obtained at ST-2 more than the ST-1 and ST-3 (Table 1). The number of species and number of individuals at station 2 is suspected because this area has muddy sand bottom and partly borders with mangrove areas. The particle size distribution of bottom waters and correlated with epifauna gastropod populations, especially *R. asper*. Furthermore, the difference in substrate type of littoral region waters affects on the distribution and population of gastropods and bivalves in the region [15].

In the surrounding area there were a lot of mangrove litter and twigs of mangrove wood. The decomposition process conducted by gastropods is started from material derived from wood and mangrove leaves become smaller material into food for other organisms that live in the mangrove. Mangroves are an ecosystem that has high productivity. Abundant organic matter content makes the mangroves as a habitat that is suitable for many gastropods epifauna [3].

The results showed that the value of species richness (Margalef) of gastropods epifauna on all study site classified were high, diversity indexes (Shannon-Wiener) were moderate to high and with a high evenness index (Sorensen's) (Table 2). These results suggest that environmental conditions in the littoral zone of Mesjid Raya, Aceh Besar, Indonesia were support for the life of the gastropods epifauna. In a habitat, the number of species and the composition in the species affect the diversity index value correlates with the index value of species richness and the evenness index [13, 14].

Tabel 2. The species richness index (R), diversity index (H'), and evenness index (E) of the gastropods epifauna in the Mesjid Raya, Aceh Besar, Indonesia

Study Site (SS)	R	H'	E
ST-1	4.821	2.744	0.932
ST-2	8.689	2.938	0.903
ST-3	6.403	3.164	0.920
ALL AREAS	9.723	3.411	0.626

Note: ST-1 = coral substrate; ST-2 = sandy and muddy substrate; ST-3 = sandy substrate

4. Conclusion

The gastropods epifauna that found at littoral zone in Mesjid Raya consisted of 23 families and 54 species. The number of species of gastropods was found in the sandy and muddy substrate more than in the sandy and corral reef substrate, but the highest diversity index was found in the sandy substrate, meanwhile the lowest diversity was found in the coral reef substrate. The highest species density was obtained on *Rhinoclavis aspera*.

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