Journal of Coastal and Ocean Sciences *e-issn: 2746-4512*
Volume 5 No. 1, January 2024: 45-52 *p-issn: 2745-4355*

Gastropod Community Structure in the Mangrove Area, Kuala Batee District, Southwest Aceh District

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Received: December 18, 2023; Accepted: January 9, 2024

ABSTRACT

This research was conducted to determine the types of gastropods and the structure of the gastropod community in the Mangrove area of Kuala Batee District, Southwest Aceh Regency. The quantitative descriptive method is used to determine research stations using purposive sampling techniques. Gastropod sampling was carried out at three station locations, each station consisting of three sub-stations with a size of 10 x 10 m. In the substations, 15 transects measured 1 x 1 m, namely, two points at the corner of each transect and one point in the middle. The results of the research showed that the gastropods found were 11 species from 4 ordo, ordo Archaeogastropoda consists of *Neritina turita, N.semiconica, N.variegate, Neritodryas dubia*, and *Clithon corona*, ordo Ceanogastropoda consists of *Faunus ater* and *Bitium munitum*, ordo Mesogastropoda consists of *Cerithidea optusa, Stenomelania plicaria*, and *Thiara scabr*a, ordo Ellobiida consist of *Cassidula angulifera*. The structure of the gastropod community in the mangrove area of Kuala Batee District, Southwest Aceh Regency, has a diversity index ranging from 0.65-1.32, including the medium category, uniformity index values ranging from 0.36-0.63 including the medium category, and dominance values ranging from between 0.33-0.63 is included in the medium category. Environmental parameters in the mangrove area show an average temperature value of 28.2^{0}C, a salinity value of 5.6 ppt, and a pH value of 8.3.

Keywords: Community structure, Mangroves, Southwest Aceh

1. INTRODUCTION

The waters of Southwest Aceh have coastal habitats, including coral reefs, seagrass, and mangroves. The area of mangroves in Southwest Aceh reached 736.40 ha in 2014-2015 (BPS, 2016). The potential of Southwest Aceh is very high, so it is necessary to protect and maintain mangrove forests for the survival of various marine and river biota that have settled in these waters. The mangrove ecosystem functions as a spawning ground, nursery ground, and feeding ground for multiple types of organisms, one of which is gastropods (Randa et al., 2020; Yanti et al., 2022). One food source for gastropods is litter, which is the fall of all stems, branches, twigs, leaves, and fruit (Fiqa, 2010).

Gastropods are a class that comes from the phylum mollusca (Putra et al., 2019). Gastropods have soft bodies and generally live on the surface of muddy substrates, attached to leaves, stems, and roots of mangroves. In the mangrove ecosystem area, gastropods have an essential role in maintaining coastal ecological balance (Zulheri et al., 2014) because this biota acts as one of the initial decomposers in the process of decomposing fallen or dead leaves, stems, and mangrove trees (Ernanto et al., 2010). Composing litter and its mobility is essential in the food chain. Food sources originating from mangroves can help growth, thereby increasing diversity in gastropod communities around mangrove areas. The existence of gastropod communities is also an aquatic bioindicator, and their life tends to be influenced by environmental factors in mangrove areas.

Gastropods in mangrove areas play a role as biota in mangrove productivity and have ecological functions in waters. Their presence can be used as a bioindicator for waters in mangrove areas, Kuala Batee District, Southwest Aceh Regency. However, the structure of gastropod communities in mangrove areas can be influenced by changes in mangrove areas, such as environmental

conditions and community activities near the mangrove area. Several community activities, such as cutting down mangrove trees for building purposes, firewood, oil palm plantations, agriculture, and settlements, can cause damage to mangrove areas and have ecological impacts by reducing or disappearing various species associated with mangrove forests, especially gastropods (Hulopi et al., 2022).

It is feared that this condition could occur in the mangrove area in Kuala Batee District, Southwest Aceh Regency, seeing that mangrove trees have been felled to make way for oil palm plantations and settlements in this area. Pressure on mangrove areas directly impacts gastropod habitat and the sustainability of these resources. Therefore, this research was conducted to determine the types of gastropods and the structure of the gastropod community in the mangrove area. The data from this research is hoped to provide information about gastropod resources in the mangrove ecosystem of Kuala Batee District, Southwest Aceh Regency.

2. RESEARCH METHOD

Time and Place

The research was carried out from November 2022 to January 2023. The research location was in the mangrove area of Kuala Batee District, Southwest Aceh Regency (Figure 1).

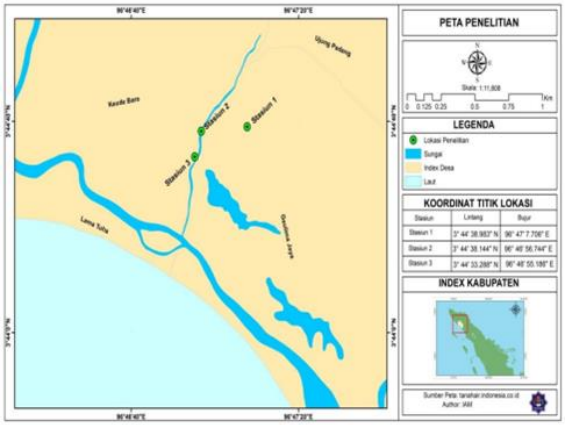

Figure 1. Research location map

Method

The method used in the research is the quantitative descriptive method. Field surveys are carried out directly to determine sampling stations. Determination of research stations using a purposive sampling technique. The community uses the mangrove area for daily activities, including looking for fish, crabs, bivalves, and gastropods. The locations used as research samples consist of three different stations considering the aquatic environment's characteristics based on community activities in the mangrove area, including station 1. Station 2 is a mangrove adjacent to an oil palm plantation, and Station 3 is a mangrove close to residential areas.

Procedures

Gastropod sampling was carried out at three station locations. Each station consists of three sub-stations of 10x10 m; within the substations, 15 transects measure 1x1 m, namely two points at the corners of each transect and one point in the middle. Transect. The gastropod samples obtained were then sieved using a sieve and sorted by hand, cleaned with distilled water, put in a plastic sample containing 70% alcohol solution, and accompanied by a paper label stating the station's location, transect, and date of sample collection. Then, the samples were identified by type using the book Marine Invertebrates of the Pacific Northwest and the Encyclopedia of SHEELS to determine diversity, uniformity, and dominance. Identification of gastropod samples is carried out by looking at the morphological form of gastropods, which can be done by identifying shell parts such as size (height and width), shell ornaments (spines, protrusions, and streaks), shell color, shell intricacies and the shape and size of the shell lid (aperture) (Bestari, 2019). Environmental parameters were measured when sampling gastropods. Sampling was carried out three times at each station. Measurement of environmental parameters includes temperature, salinity, and pH.

Data Analysis

The gastropod data obtained then calculated the diversity, uniformity, and dominance indices as follows:

Diversity Index

The Shannon Wiener species diversity index (Odum, 1996) is calculated using the formula:

$$H' = -\sum(pi)(\ln pi) \qquad (1)$$

Description:

H' = Diversity index
N = Total number of individuals
Nor = Number of individuals of the I breed

pi = ni/N is the ratio between the number of type I and the total number of types of individuals

Criteria for species diversity index values based on Shannon-Wiener (H') are as follows: H' ≤1.0 = low level of diversity, high ecological pressure; 1.0<H'<3.0= level Moderate diversity, moderate ecological pressure H'>3.0= high diversity, low ecological pressure.

Uniformity Index

$$H' = \frac{H'}{H'max} \quad (2)$$

$$H'max = \ln S \quad (3)$$

Description:
H' = Diversity index
H'max = Maximum diversity index
S = Number of types

According to Odum (1993), the uniformity index criteria with the provision: E > 0.6-1, high type uniformity value; E <0.4-<0.6, medium type uniformity value; E 0-0.4, value of type uniformity is low

Dominant Index

$$C = \frac{1}{N2}\sum_{i-1}^{s} ni2 \quad (4)$$

Description:
C = Simpsons dominance index
ni = Number of individuals in the ith taxon
N = The total number of individuals of all taxa in a region community.

The dominance index criteria range from 0-1. An index value close to 1 indicates dominance by one species is very high, while an index approaching 0 shows that among the types determined that no one dominates (Odum, 1993).

3. RESULT AND DISCUSSION

The results of identifying gastropod species based on stations in the mangrove area of Kuala Batee District, Southwest Aceh Regency, found 11 species based on four ordos with a total of 1.348 individuals. Based on the station, the species with the highest number is Faunus ater, with a total of 611 individuals, and the lowest species are *Neritodryas dubia*, *Natina variegate*, *Cassidula angulifera*, *Cerithidea optusa*, and *Bitium munitum* with a total of 1 individual (Table 1).

Faunus ater has a high presence because this species is found in almost all observation transects. The least common types are *N.dubia*, *Natina variegate*, *Cassidula angulifera*, *Cerithidea optusa*, and *Bitium munitum*. Laily et al. (2022) explained that the high composition of gastropod species in an area can be used as a marker of whether the biota is a native species that spends its entire life in the mangrove area or gastropods that can also be found in the environment around the mangrove area. Sarong et al. (2015) state that faunus ater lives at the bottom of brackish waters in almost all mangrove ecosystems and river estuaries.

Based on station 1, 8 species were found, totaling 503 individuals, including *N.turita* with a total of 225 individuals, *Natina semiconica* with a total of 46 individuals, *Clithon corona* with a total of 8 individuals, *F.ater* totaling 2, *Cerithidea optusa* totaling 169, *Bitium munitum* totaling 45, *Stenomelania plicaria* numbered 7, and *N.dubia* numbered 1. The dominant species was the *N.turita* species. Station 2 found ten species with a total of 283 individuals, including 44 *N.turita* species, 15 *N. semiconica*, 4 *C.corona*, 176 *F.ater*, 20 *C.optusa*, 19 *B.munitum*, 2 *Stenomelania plicaria*, 2 *N.dubia* numbered 1, *N.variegate* numbered 1, and *Cassidula angulifera* numbered 1.

The dominant species was the *F.ater* species. Station 3 found six species with 562 individuals, including 8 *N.turita* species, 6 *C.corona*, 433 *F.ater*, 1 *C.optusa*, 1 *B.munitum*, and 113 *Thiara scabra*. Based on the station, the dominant gastropod species is at station 1 of the *N.turita* species because its species have the tolerance to salinity from fresh waters to brackish waters, and the condition of the mangrove area is still good to support the life of *N.turita*. According to Mujiono's (2016) statement, *N.turita* is a species with a tolerance range from freshwater to brackish water, usually found in mangrove vegetation. Meanwhile, Stations 2 and 3 are from the *F.ater* species because their species is located at the bottom of brackish waters and in almost all mangrove ecosystems and river estuaries.

The results of the identifying gastropod species based on ordo showed 11 from 4 ordos. The gastropods that dominate are gastropods from the ordo Archaeogastropoda, namely the species *N.turita*. The smallest number of gastropods, with 23 species, is in the ordo Ellobiida, namely *Cassidula aurifelis* (Table 2).

Gastropods found in the mangrove area

of Kuala Batee District, Southwest Aceh Regency, from the ordo Archaeogastro consist of 5 dominant species, namely *N.turita*, *N.dubia*, *N.variegate*, and *C.corona*. The *N.turita* species are often found because their habitat is in brackish waters influenced by tides. This condition is very supportive of *N. Turita's* life.

Table 1. Number of gastropod species by station

No	Station	Species	Individual
1.	Mangrove ecosystem	*Neritina turita*	225
		Neritina semiconica	46
		Clithon corona	8
		Faunus ater	2
		Cerithidea optusa	169
		Bitium munitum	45
		Stenomelania plicaria	7
		Neritodryas dubia	1
		Number of	503
2.	Mangroves adjacent to oil palm plantations	*Neritina turita*	44
		Neritina semiconica	15
		Clithon corona	4
		Faunus ater	176
		Cerithidea optusa	20
		Bitium munitum	19
		Stenomelania plicaria	2
		Neritodryas dubia	1
		Neritina variegata	1
		Cassidula angulifera	1
		Number of	283
3.	Mangroves adjacent to residential areas	*Neritina turita*	8
		Clithon corona	6
		Faunus ater	433
		Cerithidea optusa	1
		Bitium munitum	1
		Thiara scabra	113
		Number of	562
		Total number	1348

Table 2. Number of species by ordo

No	Ordo	Species name	Number of individuals
1.	Archaegastropoda	*Neritina turita*	277
		Neritina semiconica	61
		Neritodryas dubia	2
		Neritina variegata	1
		Clithon corona	18
2.	Ceanogastropoda	*Faunus ater*	611
		Bitium munitum	190
		Cerithidea optusa	65
3.	Mesogastropoda	*Stenomelania plicaria*	9
		Thiara scabra	113
4.	Ellobiida	*Cassidula angulifera*	1
	Total number		1348

This is to Liu and Resh's (1997) statement that *N.turita* inhabits brackish waters, influenced by sea tides near rivers and river mouths. Meanwhile, the least found ordo was the Ellobiida ordo, which had one species, *C.angulifera*. According to Ariyanto et al.

(2018), *C.angulifera* is a primitive gastropod that can live in sea and land areas and is less able to adapt to environmental changes. In the Mangrove area of Kuala Batee District, Southwest Aceh Regency, gastropods from the ordo Ceanogastropoda, which consists of 2 species, namely F.ater and B.munitum, were also found Ordo Mesogastropoda consists of 3 species: *C.obtuse, S.plicaria*, and *T.scabra*.

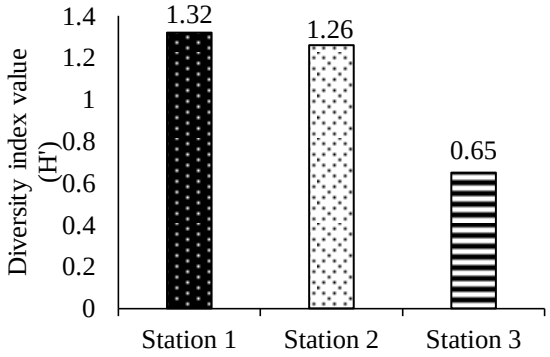

Figure 2. Diversity index value

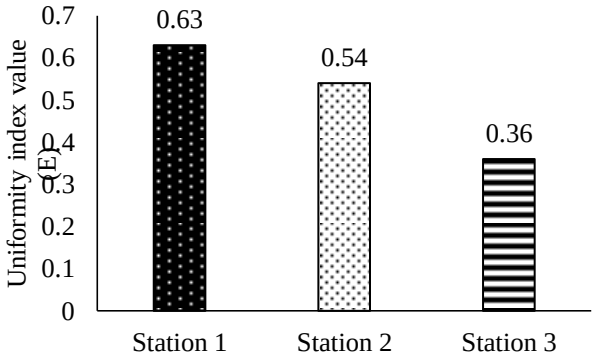

Figure 3. Uniformity index value

Gastropod Community Structure

The lowest diversity index value was found at Station 3, 0.65, and the highest at Stations 1 and 2, 1.32 and 1.26 (Figure 2). The moderate diversity at station 1 is due to the mangrove area being quite balanced for gastropod life and the sufficient productivity of mangroves in producing litter, which plays a vital role as a nutritional food source for gastropods. According to Ernawati et al. (2019), gastropods act as the initial decomposers in breaking down fallen or dead leaves, stems, and mangrove trees. Apart from that, rotting litter becomes a place for the growth of rheumatoid fungi, which are also food for gastropods (Heryanto, 2013). Gastropods carry out this behavior to survive, so the presence of gastropods in mangrove areas is greatly influenced by the area's conditions (Maturbong et al., 2017). The moderate diversity index is also influenced by unspoiled mangrove forests and suitable environmental parameters (Susiana, 2011).

Medium value diversity was also found at station 2, an oil palm plantation. Oil palm plantations can affect gastropods because they provide protection and moist palm fronds. According to Heryanto (2013), the diversity of terrestrial gastropods is highest in oil palm litter compared to other litter because it is much more stable and provides more protection. Palm frond litter is also very moist and grows microfungi because many gastropods eat microfungi. The species found at the research location can survive and adapt well in oil palm plantations. There are indications of heavy ecological pressure and an unstable ecosystem in the form of community activities, namely the residential areas at station 3 and the residential regions built close to mangroves, causing the mangrove habitat to be disturbed so that the diversity index value becomes low. Budi et al. (2012) say that diversity is the variety of species in an area. An area with a low diversity index indicates it is under pressure or degradation. This is due to household waste disposal, such as plastic and liquid waste, being dumped directly into these waters.

Budi et al. (2012) stated that many species of gastropods could not adapt and tolerate the aquatic environment, which has been heavily influenced by various human activities such as residential areas, disposal of household waste by residents, and industrial activities, thereby reducing water quality. Household wastewater flowing into the waters of mangrove areas can cause a decrease in environmental parameters and water pollution. Arbi (2012) stated that high or low diversity index values can be influenced by various factors, including the number of species obtained, the presence of species that dominate other species, and environmental conditions as a habitat for gastropods. This is because the environmental parameters are still in normal and good condition, thus supporting the life of gastropods (Gea et al., 2020).

The highest uniformity index value was found at station 1 with a value of 0.63, station 2 with a value of 0.54, and the lowest at station 3 with a value of 0.36 (Figure 3). The high uniformity index value at station 1 means that

there are more uniform species due to good ecological conditions in the mangrove ecosystem area. Mangroves have high humidity, which is suitable for gastropod life. According to Susiana (2011), uniformity is also influenced by good mangrove conditions because gastropods can survive by using mangrove litter as a food source.

Medium uniformity index values were found at station 2, located in a mangrove area adjacent to oil palm plantations. This area is still quite good for gastropod life. According to Hulopi's (2022) statement, moderate uniformity indicates that the ecology is still quite good. According to Situmorang and Afrianti (2020), mollusks (gastropods) found in oil palm plantations are influenced by high humidity. Gastropods can live in oil palm plantations because they have high humidity. The fronds are used to shelter and reproduce and make palm oil litter a food source for gastropods to survive.

The uniformity index value is low at station 3, which is located in a mangrove area close to residential areas. Low uniformity means that there is ecological pressure in the area. According to Hulopi's (2022) statement, low uniformity indicates a stressed and unstable ecology. The existence of settlements near mangrove areas can affect the ecological conditions of the area so that it is unbalanced or can affect the gastropod habitat because the area still dumps plastic waste and liquid waste into the water. According to Herawati et al. (2021), the accumulation of waste from human activities, such as waste from land (industrial waste, tourist waste, and household waste) which settles at the bottom of the waters will affect the life of macrobenthos animals because these animals have a role as decomposers.

The highest dominant index value was found at Station 3 at 0.63, at Station 2 at 0.42, and the lowest at Station 3 at 0.33 (Figure 4). The dominance index value at station 1 is in the low category, meaning there is no dominant species, so the species do not experience competitive pressure to find food and a place to live. According to Odum in Aditya and Nugraha (2020), stable environmental conditions indicate a low dominance index, and there is no ecological pressure on the biota in the area.

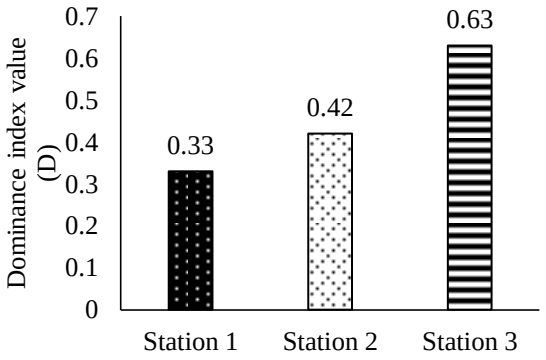

Figure 4. Dominance index value

The dominance index value at station 2 is in the low category in the mangrove area adjacent to oil palm plantations. This area is still relatively good and can still be tolerated by gastropods to survive because there is no dominant species. According to Odum's (1993) statement, low dominance shows that among the species found, there is no dominance.

The dominance index value at station 3 is in the high category, meaning there is a dominant species, indicating depressed environmental conditions and the number of species is unstable. The existence of community activities such as dumping household waste directly into waters causes species to be unable to adapt to environmental changes, so only certain species can survive these ecological changes, causing only one species to dominate. This is to Rangan's (2010) statement, which states that only certain organisms have a high tolerance for environmental changes due to physical factors outside the mangrove so that these organisms can survive and reproduce, causing these species to dominate the ecosystem.

According to Wahyuni (2016), changes in environmental factors, such as temperature, pH, and salinity, influence gastropod activity. The results of measuring ecological parameters in the mangrove area of Kuala Batee District, Southwest Aceh Regency, show an average temperature value of 28.2^{o}C, salinity value of 5.6 ppt, and pH value of 8.3 (Table 3). The temperature values at the three stations are still relatively good to support the growth of gastropods. According to the KLH (2004), a suitable temperature for aquatic organisms ranges from 28-30^{o}C. This is to the statement by Ernanto et al. (2010), which states that gastropods can adapt to suitable temperatures but can still survive in the temperature range of 12-43^{o}C. Apart from that, Maturbong et al.

(2017) also stated that the optimum temperature to support gastropod life is between 28°C and 32°C.

Table 3. Environmental parameters

Parameters	Unit	Average	Level of conformity
Temperature	°C	28,2	very suitable
Salinity	ppt	5,6	suitable
pH	-	8,3	suitable

The average salinity value is 5.6 ppt, suitable for brackish waters. According to the KLH (2004), the optimal salinity value for the gastropod survival process regarding quality standards for brackish biota in mangrove areas is a salinity range of up to 30 ppt. High or low salinity levels will not affect the presence of gastropod species because gastropods can adapt to or tolerate salinity. The average pH value is 8.3. The pH value at the research location is still suitable for the growth of gastropods. According to Rasanti (2010), a pH value between 5-9 can still support the life of gastropods; if the pH value is less than 4, it will result in the death of the gastropods, while a pH of more than 9.5 will result in the gastropods being unproductive.

4. CONCLUSION

Gastropods in the mangrove area of Kuala Batee District, Southwest Aceh Regency, were found as many as 11 species from 4 ordos, namely the ordo Archaeogastropoda, including the species *N.turita*, *N.semiconica*, *N.variegate*, *N.dubia* and *C.corona*. The ordo Ceanogastropoda is the species *F.ater* and *B.munitum*, and the ordo Mesogastropoda, namely the *C.optusa, S.plicaria*, and *T.scabra*, is found. It is also found in the ordo Ellobiida, namely the species *C.angulifera*. The structure of the gastropod community is in the moderate category, and the environmental parameters in the mangrove area are still suitable to support the life of gastropods.

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