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Identification of Gastropodic Diversity in Aimere Coast Region Aimere District, Ngada Regency East Nusa Tenggara

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ABSTRACT: Aimere Beach is a beach located in the district of Ngada, Flores Nusa Tenggara East, and is a type of black sandy beach. The Aimere beach is not only used by fishermen but also as a tourist location, and there is a port as a means of transportation between the islands. There are many marine life that live in the Aimere Coast region; one of the biota found abundantly in the region is the gastropod. The degree of diversity of gastropods in an aquatic environment, especially in coastal waters, can be used as an indicator of pollution because these species have a high ability to adapt to their habitat. Therefore, this study aims to find out the diversity of gastropod species in the Aimere Coast region. Besides, to find out about the index of diversity, uniformity, and dominance of the gastropods in the Aimere Coast region. The method used is random sampling with samples taken from 3 stations, each consisting of 5 plot sizes of 1x1 m2. Data from the identification of gastropod species was analyzed using the diversity, uniformity, and dominance index formulas. The results of the research showed that the gastropod species found in the Aimere Coast region were 30 species belonging to 13 families. The index of diversity, uniformity, and dominance of the species of gastropods in the area of Aimère Coast is 2.8922, 0.8504, and 0.0738, respectively. These values indicate a high value of diversity, high uniformity, and a low value of dominance for gastropods.

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KEYWORDS: Gastropods, Identification, Aimere_Beach, Random_Sampling

INTRODUCTION

Indonesia is one of the countries that has thousands of coastal territories. The coastal region of the country extends from Sabang to Merauke, with so much fascinating coastal biodiversity. One of the islands in Indonesia that has a lot of coastal area is Flores Island. Flores Island has a variety of beaches with characteristics of both white sandy and black sandy beaches. Besides, the beaches on the island have a wide variety of marine life that is still very little known by the community because of the minimum research on the diversity of sea life on the Flores Island Coast. The beach is a sort of black sandy beach with calm sea waves, and its shoreline consists of sand and rocks as well as coral reefs with a variety of marine life.

There are many marine biota that live in the Aimere Coast region; one of the biota found abundantly in the region is the gastropod. Gastropoda is the largest class of Moluska filums, comprising 80,000 species, of which 1,500 are found in Indonesia (Ira et al., 2015). (Aba & Safrina, 2020). The gastropods have shapes and sizes that vary in shell size, with scales on the shell as well as a well-developed head equipped with eyes and tentacles. (Persulessy & Arini, 2018). The animals belonging to this class have a very wide spread from the suburbs to the waters at a depth of 8200 meters. (Andrianti & Rizal, 2020). In addition, these animals are widely found in various types of habitat substrata, both hard substrates such as rocks and sand as well as soft substrates such as mud, because they have higher adaptive abilities than other classes of animals. (Triwiyanto et al., 2015). Gastropods are one of the most important groups in the aquatic ecosystem because of their role as vital organisms or keys in the food network of aquatic regions. The degree of diversity of gastropods in an aquatic environment, especially in coastal waters, can be used as an indicator of pollution because these animals have a high ability to adapt to their habitat (Supratman et al., 2018). (Suwondo et al., 2006). These animals have good adaptability to different habitats, such as marine, freshwater, and land. Differences in substrate in each such habitat allow for differential types of gastropods that occupy a region. (Rukmana & Purnomo, 2019).

The Aimere coast also has a port used as a means of transportation for the laurel line between the islands. In addition, on this beach there are also a lot of fish-fishing activities and other marine resources that are used as a natural tourist attraction. Along with

the exploitation of potential natural resources on the coast, of course, the many activities carried out in this coastal region can be a threat to the marine life that lives in the area, especially gastropods. At the same time, data and information on the diversity of gastropods are still very small, especially in the coastal area of Flores Island. Therefore, it is necessary to do research on the identification of the diversity of gastropods in the Aimere Coast region, Aimère district of Ngada district, and East Nusa Tenggara district. This research aims to find out the diversity of gastropod species in the Aimere Coast region. Besides, to find out about the index of diversity, uniformity, and dominance of the gastropods in the Aimere Coast region.

METHOD

Sampling was carried out in the Aimere Beach area, located in the Aimère district of Ngada, East Nusa Tenggara. The method used is random sampling with samples taken from 3 stations, each consisting of 5 plot sizes of 1x1 m2. Station I (rock substrates), Station II (slightly sandy rock substrates), and Station III (sandy substrates). The gastropod species are identified based on the morphological characteristics of shell shape, color, and pattern. Data from the identification of gastropod species was analyzed using the diversity, uniformity, and dominance index formulas.

Diversity Index

Species diversity was calculated using the Shannon-Wiener index (Odum 1993) in (Ulum et al, 2012).

$$H' = -\Sigma\ Pi\ ln\ (Pi)$$

Description:

H' = Species diversity index

Pi = The proportion of individuals of a species to all individuals encountered, with Pi obtained from: Pi = Ni/Ntotal

Ln= Natural logarithm

Uniformity Index

Species diversity was calculated using the Shannon-Wiener index (Odum, 1993) in (Ulum et al., 2012).

$$E = \frac{H'}{lnS}$$

Description:

E = Species uniformity index

H' = Species diversity index

Ln= Natural logarithm

S = Number of species

Dominance Index

Dominance was calculated using the Simpsons Dominance index formula (1949) in (Ulum et al., 2012).

$$C = \Sigma(Pi)^2$$

Description:

C = Species dominance index

Pi = The proportion of individuals of a species to all individuals encountered, with Pi obtained from: Pi = Ni/Ntotal

RESULT AND DISCUSSION

Gastropoda species in the Aimere Coast Region

Research results suggest that there are several species of gasropods that live in the Aimere Coast region. The gastropods that were discovered consisted of 30 species belonging to 13 families, for a total of 2702 gastropodic individuals at the entire research station on the Aimere Coast. The most frequently discovered gastropod species were the *Nerita patula*, with 316 individuals at all stations. While the least known species are the *Bela nebula* with 13 individuals and the *Clithon sp*. with 13 people at the whole station, Below is a table of gastropod species in the Aimere Coast region that have been successfully identified (tabel 1).

Tabel 1. Gastropods Species in the Aimere Coast Region

No.	Family	Species	Amount Per Station			
			I	II	III	Total
1	Turbinidae	*Turbo argyrostomus*	4	24	11	38
2		*Lunella cinerea*	12	22	9	43
3	Neritidae	*Nerita patula*	178	94	44	316
4		*Nerita funiculata*	131	74	32	237
5		*Nerita incurva*	152	68	38	258
6		*Nerita exuvia*	17	8	0	25
7		*Nerita oryzarum*	27	15	7	49
8		*Nerita polita*	183	79	27	289
9		*Nerita undata*	172	65	36	273
10		*Nerita antiquata*	139	84	18	241
11		*Nerita albicilla*	156	59	25	240
12		*Nerita chamaeleon*	28	0	0	28
13		*Heminerita japonica*	12	2	0	14
14		*Clithon sp.*	4	9	0	13
15	Muricidae	*Reishia bitubercularis*	7	22	14	43
16		*Morula anaxares*	0	17	9	26
17	Nassariidae	*Nassarius reeveanus*	0	13	29	42
18		*Nassarius exilis*	0	23	6	29
19		*Nassarius pupinoides*	0	13	5	18
20	Littorinidae	*Littorina littorea*	7	16	11	34
21	Cerithiidae	*Clypeomorus inflate*	0	14	9	23
22		*Clypeomorus subbrevicula*	0	24	7	31
23	Columbellidae	*Anachis terpsichore*	0	27	17	44
24		*Pardalinops testudinaria*	6	19	10	35
25	Costellariidae	*Vexilum anthracinum*	0	8	24	32
26	Trochidae	*Trochus lineatus*	12	15	0	27
27	Mangeliidae	*Bela nebula*	13	0	0	13
28	Nacellidae	*Cellana testudinaria*	43	37	16	96
29	Cymatiidae	*Gyrineum natator*	16	21	6	43
30	Siphonariidae	*Siphonaria normalis*	59	31	12	102
		Total	**1378**	**902**	**422**	**2702**

The family Turbinidae has the characteristic of having a hard, rough shell with a rough and lengthy operculum with a white or white edge, a green shell with brown black (Saleky dkk, 2020). In this study, species of the family Turbinidae were found, including *Turbo argyrostomus* and *Lunella cinerea*. Below is a picture of the two species.

Figure 1. Species *Turbo argyrostomus*

Figure 2. Species *Lunella cinerea*

The Neritidae family is characterized by a compact, textured, round shape and a low and large shelled tower peak. A flat-shaped columella with a half-circular operculum (Nafi, ah, 2019) and a thin tentakel (Nuha, 2015). The shell has a direction of dextral rotation. The aperture is half-circular, and a large siphon canal is rounded. (Maretta dkk, 2019). Species of the Neriridae family found at the research site include *Nerita patula*, *Nerita funiculata*, *Neritas incurva*, *Neritis exuvia*, *Neritus oryzarum*, *Nerites polita*, *Nerita undata*, *Nerita antiquata*, *Nerita albicilla*, *Nerita chamaeleon*, *Heminerita japonica*, and *Clithon sp*. Below is a picture of the 12 species.

Figure 3. Species *Nerita patula*

Figure 4. Species *Nerita funiculata*

Figure 5. Species *Nerita incurva*

Figure 6. Species *Nerita exuvia*

Figure 7. Species *Nerita oryzarum*

Figure 8. Species *Nerita polita*

Figure 9. Species *Nerita undata*

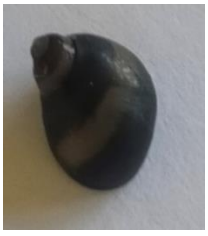
Figure 10. Species *Nerita antiquata*

Figure 11. Species *Nerita albicilla*

Figure 12. Species *Nerita chamaeleon*

Figure 13. Species *Heminerita japonica*

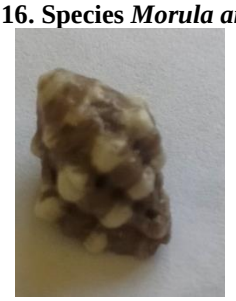
Figure 14. Species *Clithon sp.*



The Muricidae family has a characteristic shell with a variable shape with a long head with long legs and a slightly cut anterior. (Nafi,ah, 2019). Has a reinforced operculum of the inner rib. (Nuha, 2015). The gastropod species of this family that were found locally were the species *Reishia bitubercularis* and *Morula anaxares*. Below is a picture of the species.

Figure 15. Species *Reishia bitubercularis*

Figure 16. Species *Morula anaxares*



The Nassariidae are a family of gastropods that have a slightly rounded, swollen shell with a rib-to-rib surface leading to the axial. It has a short spire with a small aperture and a relatively small and narrow siphon canal, while the lips are in a smooth state without any folds. Extral shell rotation direction (Maretta dkk, 2019). The species of this family found are *Nassarius reeveanus*, *Nassaris exilis*, and *Nassaarius pupinoides*, according to the picture below.

Figure 17. Species *Nassarius reeveanus*

Figure 18. Species *Nassarius exilis*

Figure 19. Species *Nassarius pupinoides*

The family Littorinidae is characterized by a shell in the shape of eggs, a fine columella, and a thin operculum. (Nafi,ah, 2019). He has a head with a short hook and a knot-shaped tentacle. (Nuha, 2015). The species of this family found in the research area is *Littorina littorea*, according to the picture below.

Figure 20. Species *Littorina littorea*

The family Cerithiidae is a family of gastropods characterized by a crochet shell with brown and black spots, a thick and sharp elongated shell, and a large number of axial twists. The shell has a dextral rotation direction with an elongating aperture and a short siphon canal, and a columella without a strong spiral fold. (Maretta dkk, 2019). Species of this family found include *Clypeomorus inflata* and *Clybeomorus subbrevicula*, as shown below.

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Figure 21. Species *Clypeomorus inflata*

Figure 22. Species *Clypeomorus subbrevicula*

The family Columbellidae is a family of gastropods that has a small, thick shell with a surface without axial lines, a brownish shell, and white, black, and slightly yellow spots. In the direction of the dextral rotation, with an elongated spire and a long and narrow aperture, there is also a short sifon canal (Maretta dkk, 2019). The species of this family found on the Aimere Coast are the species *Anachis terpsichore* and *Pardalinops testudinaria*, according to the following picture.

Figure 23. Species *Anachis Terpsichore*

Figure 24. Species *Pardalinops testudinaria*

The family Costellariidae is a family of gastropods that has a circular shell shaped like an egg, no operculum, and a meruncing apex. Has a small, narrow head, a pair of tentacles, and small legs. (Nuha, 2015). One of the species in this family is *Vexilum anthracinum*.

Figure 25. Species *Vexilum anthracinum*

The family Mangeliidae is a family of gastropods with a small shell that is tall and has a fusiform to biconic shape. This family does not have an operculum with deep anal sinuses on the substructural tracks as well as a thick calus. (Nuha, 2015). One of the species of this family found on the Aimere Coast is the *Bela nebula*, as shown below.

Figure 26. Species *Bela nebula*

The family Trochidae is a family of gastropods that has a large shell in the shape of a brown-shaped white scratch with axial engraving and a spiral with a thong, as well as a flat shell base. The shell size is about 6 mm long and 5 mm wide. It has a wide and narrow syphon and a dectral direction of rotation. (Maretta dkk, 2019). One of the species of this family found on the Aimere Coast is *Trochus lineatus,* as shown below.

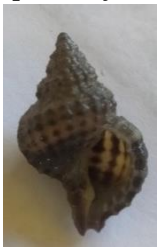
Figure 27. Species *Trochus lineatus*

The Nacellidae are a family of gastropods that have a shell that stands out in the middle of the front with colors that vary, like black, yellow, or brown. The edges of the shell have black radial lines from the inside to the outside. (Fitriani, 2020). One species of this family found on Aimere Beach is *Cellana testudinaria*, as shown below.

Figure 28. Species *Cellana testudinaria*

The Cymatiidae family is a gastropod family that has a medium- to very large size with a rough shell. The periostracum part is well developed and almost always has an outstanding shell part with a horned operculum with a large multispiral protokonch that usually disappears in adulthood. (Nuha, 2015). One species of this family found on the Aimere Coast is *Gyrineum natator*, as shown below.

Figure 29. Species *Gyrineum natator*



The Siphonariidae family is a gastropod family that has the characteristics of having a shell with a fold on the right side with a coat hole, and there is a clear lateral loop on the left side (Nuha, 2015). One species of this family found on the Aimere Coast is *Siphonaria normalis*, as shown below.

Figure 30. Species *Siphonaria normalis*

Index of Diversity, Uniformity, and Dominance of Gastropoda Species in the Aimere Coast Region

Based on the data on gastropod species that have been obtained, the index of diversity, uniformity, dominance, and abundance of the species of gastropods in the Aimere Coast region can be seen in the table below (table 2).

Table 2. Diversity Index (H'), Uniformity (E), dan Dominance (C) of Gastropod Species Found on the Aimere Coast

No.	Family	Species	Amount	H'	E	C
1	Turbinidae	*Turbo argyrostomus*	38	0,05997	0,017632	0,000198
2		*Lunella cinerea*	43	0,065893	0,019374	0,000253
3	Neritidae	*Nerita patula*	316	0,25098	0,07379	0,01368
4		*Nerita funiculata*	237	0,21347	0,06276	0,00769
5		*Nerita incurva*	258	0,22427	0,06594	0,00912
6		*Nerita exuvia*	25	0,04333	0,01274	0,00009
7		*Nerita oryzarum*	49	0,07272	0,02138	0,00033
8		*Nerita polita*	289	0,23909	0,07029	0,01144

9		*Nerita undata*	273	0,23160	0,06809	0,01021
10		*Nerita antiquata*	241	0,21558	0,06338	0,00796
11		*Nerita albicilla*	240	0,21505	0,06323	0,00789
12		*Nerita chamaeleon*	28	0,04735	0,01392	0,00011
13		*Heminerita japonica*	14	0,02727	0,00802	0,00003
14		*Clithon sp.*	13	0,02568	0,00755	0,00002
15	Muricidae	*Reishia bitubercularis*	43	0,06589	0,01937	0,00025
16		*Morula anaxares*	26	0,04468	0,01314	0,00009
17	Nassariidae	*Nassarius reeveanus*	42	0,06473	0,01903	0,00024
18		*Nassarius exilis*	29	0,04867	0,01431	0,00012
19		*Nassarius pupinoides*	18	0,03338	0,00982	0,00004
20	Littorinidae	*Littorina littorea*	34	0,05506	0,01619	0,00016
21	Cerithiidae	*Clypeomorus inflate*	23	0,04057	0,01193	0,00007
22		*Clypeomorus subbrevicula*	31	0,05126	0,01507	0,00013
23	Columbellidae	*Anachis terpsichore*	44	0,06705	0,01971	0,00027
24		*Pardalinops testudinaria*	35	0,05630	0,01655	0,00017
25	Costellariidae	*Vexilum anthracinum*	32	0,05254	0,01545	0,00014
26	Trochidae	*Trochus lineatus*	27	0,04603	0,01353	0,00010
27	Mangeliidae	*Bela nebula*	13	0,02568	0,00755	0,00002
28	Nacellidae	*Cellana testudinaria*	96	0,11858	0,03486	0,00126
29	Cymatiidae	*Gyrineum natator*	43	0,06589	0,01937	0,00025
30	Siphonariidae	*Siphonaria normalis*	102	0,123698	0,036369	0,001425
Total			**2702**	**2,8922**	**0,8504**	**0,0738**

The Gastropods Species Diversity Index in the Aimere Coast region is 2.8922, which indicates a high degree of diversity. On the diversity index, species *Nerita patula* has the highest diversity index value of all species at 0.25098. Species with the lowest variability index values are *Clithon sp*. and *Bela nebula* at 0.02568. If we look at the uniformity index, we get an index value of 0.8504, which indicates a high degree of uniformity. Species *Nerita patula* has the highest value of 0.07379. Species with the lowest uniformity value are *Clithon sp*. and *Bela nebula*, with 0.00755. Based on the dominance index, a value of 0.0738 was obtained, which indicates the low degree of dominance of gastropods in the Aimere Coast region. The gastropod species obtaining the highest index value is Species *Nerita patula*, which is 0.01368. Species with the lowest dominant index values are *Clithon sp*. and *Bela nebula* at 0.00002.

Based on these four indices, the distribution patterns of the gastropod are influenced by environmental factors such as the availability of feed, competition with other biota, and predators. Each species has different adaptive abilities, so certain environmental conditions and factors cause adaptation differences, which affect the spread or distribution of gastropods in their habitat (Ardiyansyah, 2018).

Gastropoda is one of the environmental indicators; the animal class is very sensitive to the changes that occur in the environment due to the contamination of inorganic materials. (Ardiyansyah, 2018). Ranjan & Babu (2016), in Wulansari & Kuntjoro (2018), add that gastropods can be used as bioindicators of coastal waters when the coastal environment is indicated to be contaminated by heavy metals. This is because the animal moves slowly, lives in the water, has a diet of detritus, and is able to accumulate or build up imia compounds in its body tissues.

CONCLUTION

On the basis of the research carried out, data on gastropod species found in the Aimere coast region of 30 species were obtained: *Turbo argyrostomus, Lunella cinerea*, *Nerita patula*, *Nerita funiculata*, *Nerita incurve*, *Nerita exuvia*, *Nerita oryzarum*, *Nerita polita*, *Nerita undata*, *Nerita antiquate*, *Nerita albicilla*, *Nerita chamaeleon*, *Heminerita japonica*, *Clithon sp.*, *Reishia bitubercularis, Morula anaxares, Nassarius reeveanus, Nassarius exilis, Nassaarius pupinoides, Littorina littorea, Clypeomorus inflate, Calypeomorpeus subbrevicula, Anachis terpsichore, Pardalinops testudinaria, Vexilum anthracinum, Trochus lineatus, Bela nebula*, *Cellana testudinaria*, *Gyrineum natator*, and *Siphonaria normalis*. Thirty species of gastropods are included in the 13 families: Turbinidae, Neritidae, Muricidae, Nassariidae, Littorinidae, Cerithiidae, Columbellidae, Costellariaceae, Trochidae, Mangeliidae, Nacellaceae, Cymatiidae, and Siphonariidae.

The index of diversity, uniformity, and dominance of gastropod species in the Aimere Coast region of 2.8922, 0.8504, and 0.0738, respectively, indicates a high degree of diversity, a high level of uniformity, and a low degree of dominance.

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