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Mollusca Biodiversity as A Quality Bioindicator Waters in Central Lombok Gerupuk Bay Coastal Area

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Abstract: Various natural resource utilization activities on the coast of Gerupuk Bay can potentially affect the quality of the aquatic environment, both biotic and abiotic, one of which is mollusc biodiversity. This study aimed to determine the relationship between the existence of Mollusca biodiversity and water quality and substrate in Gerupuk Bay. This study used a quantitative descriptive method of determining stations using the purposive sampling method based on differences in community activities at each station. Sampling was conducted at three stations, including Mollusca samples and water quality measurements: salinity, pH, temperature, and substrate. Molluscs in Gerupuk Bay found 55 species of Mollusks representing three classes, namely the Gastropoda class, with as many as 44 species incorporated in 22 Families; the Bivalve class, as many as ten species contained in 6 Families; and the Scaphopoda class, with as many as one types incorporated in 1 Family. The composition of Mollusca classes found on the Gerupuk Bay Coast is Gastropoda class at 62%, Bivalve class at 35%, and Scaphopoda class at as much as 3%. Mollusca diversity is calculated using the Shannon-Wienner diversity index (H'). The diversity index results ranged from 2.890-1.998, with moderate categories at all stations. Bioindicators of water quality using the diversity index show that stations I and III categorize the Gerupuk Bay area as lightly polluted. In contrast, at station II, it is moderately polluted.

Keywords: Bioindicator; Gerupuk Bay; Index Shannon-Wienner; Molluscs.

Introduction

Coastal ecosystems in Indonesia have recently received considerable attention in various development policies and planning in Indonesia. The variety of human activities in coastal areas makes this area the most easily affected by human activities. The deterioration of coastal waters due to increased rubbish input is an additional effect [1]. The presence of environmental pressures and changes affects the total family and differences in the composition of organisms [2].

Mollusks are essential organisms for the balance of ecosystems in coastal waters. This organism plays a crucial part in the food chain and produces lime materials that help coral reefs thrive [3]. Mollusca habitat ranges are pretty comprehensive, covering tropical to subtropical seas. Molluscs can be found in coastal areas to the deep sea with a depth of 0-700 m and are also commonly found in coral reef areas, immerse themselves in sediment and can attach to marine plants [4].

The occurrence of environmental changes in existing fauna can be known through community structure and the spread of fauna. The more dangerous the pollution of waters, the less biota can continue its survival. The life of molluscs is inseparable from the influence of environmental factors, both physical and chemical, in their habitat. Molluscs are essential for the aquatic environment as bioindicators of ecological health and water quality [5].

Gerupuk Bay is one of the beaches located south of the island of Lombok, including Sengkol Village, Pujut District, and Central Lombok Regency. This region has a complex ecosystem: seagrass, mangrove and coral reef. Gerupuk Bay is also used as a Minapolitan area for seaweed development. However, people around Gerupuk Bay are starting to complain about waste pollution from hotels built around Gerupuk Bay, which causes changes in seawater colour and sediment (This was revealed during the preliminary survey). In addition, recently, the number of seaweed cultivators has continued to decline. Currently, only 20 people remain [6]. The frequent occurrence of crop failure is the cause of the community not re-pursuing the seaweed cultivation business. This is thought to be caused by the degradation of mangrove forest areas that have been converted into settlements, tourism, and space for public activities such as pond cultivation, highway construction, and park creation, so the government's development around Gerupuk Bay is also high. The high pressure on Gerupuk Bay by economic activity and environmental destruction demands a review of the quality of waters in this bay.

Research on Mollusca biodiversity as a bioindicator of water quality in the Gerupuk Bay area of Central Lombok is essential to determine the condition and quality of waters in this bay so that the development carried out by the government around Gerupuk Bay becomes more planned and following the carrying capacity of the environment.

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Research Methods

The study was conducted for three months, from February to June 2023. The research was conducted in Gerupuk Bay, Pujut District, Central Lombok Regency, West Nusa Tenggara (Figure 1) and Advanced Biology Laboratory, Faculty of Mathematics and Natural Sciences, University of Mataram.

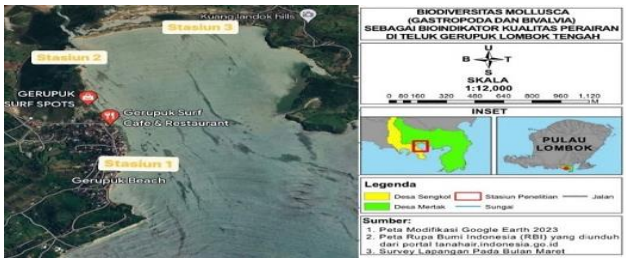

Figure 1. Map of Research Location

Stationery, identification book Compendium of Shea shells, Indonesian Snails and Shells, plot 1x1 m^2, refractometer, roll meter, pH, small shovel, thermometer, marker, 2 mm multilevel sieve, camera/cellphone, GPS, 100 m transect and gloves. At the same time, the materials used are 70% alcohol, label paper, plastic bags, zip locks, and tissue.

Research on the relationship of Mollusca biodiversity as a bioindicator of water quality was carried out using quantitative descriptive methods. The station determination method uses purposive sampling, namely, determining stations with specific considerations. At the station, 3 points are taken as repetitions with a distance of 20 m at each point. The determination of stations is based on differences in community activities in Gerupuk Bay Station I, with sandy mud substrate having rocky beach characteristics. There are seagrass ecosystems and hotel activities, fish ponds, seaweed farming, fishermen activities, and community settlements on the coast. Station II, with muddy substrates and sloping beach characteristics, has seagrass ecosystems and mangrove forests and is connected to the flow of the Gerupuk River estuary. In addition, Station II is a mangrove forest area converted into roads and parks, so the government's development in this area is relatively high. Community activities at this station are mollusk harvesting activities by the local community when the sea water recedes (madak activities). At station III, community activities are pretty low compared to other stations. That is only the activity of fishermen and settlements around the coast. Sampling at each point using quadrant transects measuring 1x1m2. The quadrant transect is divided into five observation plots. The parameters observed at each point were the diversity, distribution, and community structure of the mollusc species found and the physical and chemical conditions of the waters in Gerupuk Bay. The water quality bioindicators used are based on the Shannon-Wiener diversity index [1].

Data analysis in this study includes abundance, calculated to determine how many molluscs are in square meters (m^2). Abundance is found using the Brower and Zar, 1984 diversity index formula. A systematic picture of the population of organisms is obtained using the diversity index (H') to facilitate the analysis of information on the number of individuals of each species in an organism. The analysis of data used to calculate species diversity is a formula from the 1963 Shannon-Wiener Diversity Index [7]. The value of this diversity index can be used to determine water quality. To assess the quality of waters based on Mollusca species diversity index indicators, follow the Shanon-Winner criteria [1] uniformity index. The uniformity index is calculated to determine the uniformity of Mollusca species in the water area. The uniformity index ranges from 0-1. The uniformity index value can be found using the Shanon–Wiener uniformity index formula [8], and the dominance index is used to describe how one species can dominate in a population. The most dominating species can determine the presence of other species based on Simpson's dominance index.

Results and Discussion

The results of research on five observation transects in the coastal area of Gerupuk Bay found 55 species of Mollusks representing three classes, namely the Gastropoda class with as many as 44 types, the Bivalve class with as many as ten types and the Scaphopoda class as many as 1 type with the total number of individuals is 1.413 individuals. The class of Gastropods consists of 22 families namely *Planxidae, Collumbelidae, Costellaridae, Naticidae, Nasariidae, Conidae, Cerithiidae, Olividae, Cypraeidae, Mitridae, Assimineidae, Muricidae, Strombidae, Tegulidae, Cymatiidae, Chilodontidae, Angariidae, Turbinellidae, Pisaniidae, Trochidae, Thariadae* and *Bullidae*. The Bivalve class comprises six families: *Cyrenidae, Telinidae, Cardiidae, Arcidae, Mactridae,* and *Veneridae.* While the Scaphopoda class only found one family, namely *Dentallidae*.

The Diversity Index (H') value at Station 1 is 2.525, station 2 is 1.998, and station 3 is 2.890. The diversity index (H') values at stations 1, 2, and 3 of the study 1 <H'< 3 were categorized as "moderate". The moderate level of diversity shows that the individual distribution of each type is uneven, the number of individuals is almost uniform, and Some species are dominant. Diversity with moderate categories is due to habitats that support the existence of gastropods, such as the availability of sufficient food, pH that is still supportive, and the presence of muddy substrates that are preferred by gastropods [9]. This is following the substrate in Gerupuk Bay, which is muddy. In addition, research with a medium value diversity index was also conducted on the South Coast of East Lombok and the mangrove ecosystem of the waters of Pangkil Village, Bintan Regency [10][11]. The moderate diversity index is sufficient to describe the complexity of ecosystems [12].

The lowest Mollusca diversity value was found at station 2 at 1.998. The low value of diversity at this station is suspected because this station is a mangrove forest area converted into parks, settlements, and highways. Tourists often visit it so that it can disturb the habitat of the Mollusca. As a result, the diversity value at station 2 is lower than that of other stations.

The diversity score at station 3 is higher than the diversity value at other stations, which is 2.890. The number of individuals found at station III is thought to be because the station is a transition area and the final body of the water flow in Gerupuk Bay and the confluence of

several water flows, both water streams that have begun to look polluted with water flows that look still clean. In addition, this condition is possible because the station's location does not have many community and tourism activities that can cause environmental damage. Hence, the ecosystem at Station III is still natural.

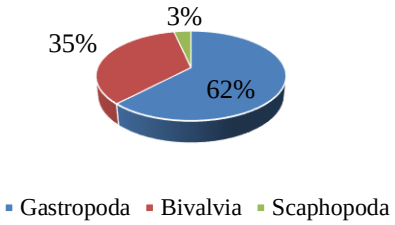

Figure 2. The Composition of The Number of Individuals of The Mollusca Class Found on The Shore of Gerupuk Bay

Based on the *pie* chart in Figure 2 shows that the presence rate of the Gastropoda class in the coastal area of Gerupuk Bay is higher at 62% compared to the presence rate of the Bivalve class at 35% and the Scaphopoda class at 3%. This is also because the Gastropoda class has a high survival at each observation station. In addition, Gastropods are animals that can live and multiply well on various types of substrates with food availability, and physico-chemical waters influence their life [13].

The result of the calculation of the distribution pattern in this study is that station III has a higher distribution pattern value than stations I and II. In this study, there is a clustered distribution pattern in the coastal area of Gerupuk Bay, as seen in the graph in Figure 3. Gastropods in mangrove forests generally have a clustered distribution pattern [14]. The pattern of clustering distribution is caused by several things, such as environmental conditions, eating habits, and how to reproduce. The distribution pattern of biota is influenced by habitat type, including the physical-chemical factors of water and the feed and adaptability of biota in an ecosystem [15]. The clustered distribution pattern will make it easier for individuals to relate to each other for various needs such as reproduction and foraging [14].

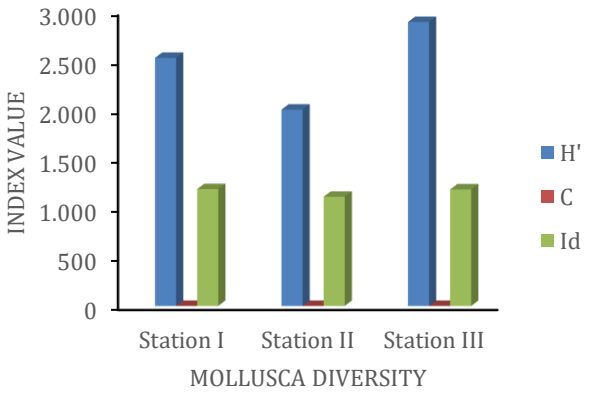

Figure 3. Mollusca Diversity Index Value

The pattern of grouping distribution is the pattern of organisms or biota in a habitat that live in groups in certain numbers [16]. Dispersal patterns are very typical in each species and habitat type. Differences in response to habitat cause the distribution pattern. The clustered distribution pattern is related to a way of life that chooses a suitable place. The grouping of individuals can be caused by the response of the same population to local conditions that are good for survival, thus affecting population density [17]. The distribution pattern of clustered types is typical in nature. This condition is caused by the accumulation of individuals in the face of changes in weather and seasons, changes in habitat, and reproductive processes, which increase competition between individuals in obtaining food and space for movement [7].

Based on research that has been carried out, the value of individual abundance per m^3 was obtained from all research stations. The highest abundance value was found at station 3 (7.520 ind / m^3). In comparison, the lowest abundance value was found at station 1 (5.480 ind / m^3), and station 2 obtained the abundance value (5.820 ind / m^3). This data can be seen in Figure 4 below.

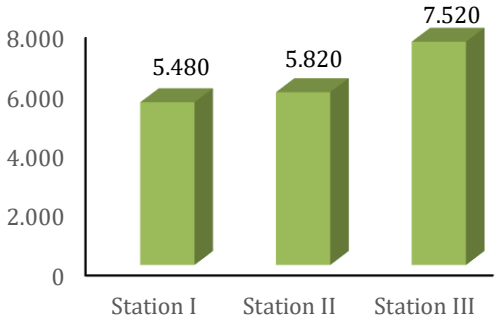

Figure 4. Number of Mollusk Abundance at Each Observation Station

The abundance of molluscs at Station 3 is likely due to Station 3, which is close to the pond's outlet and has a high primary productivity value. The factors that cause high primary productivity are the continuous addition of organic matter derived from feed residues and fish waste [18]. The high density of molluscs at station III is also related to environmental factors where temperature, salinity, depth, and pH are still ideal for mollusc life. In addition, station 3 is an area visitors and tourists rarely visit, so community activity at this station is also low; there are only fishing activities on the coast. The low abundance value found at Station 1 is thought to be caused by the many community activities and high tourist visits in this area. Starting the most popular activities in the Station 1 area are tourist surfing activities, hospitality activities on the coast, residential areas, local community madak activities, and fisherman activities. Furthermore, at station 2, the abundance value was obtained (5.820 ind/m^3).

Mollusca abundance in the mangrove area of Gerupuk Beach is classified as medium. This is because some stations have fairly dense mangrove vegetation with relatively stable station conditions. Mangrove density can affect mollusc abundance and is influenced by sediment, organic matter, and sunlight availability [19]. This aligns with the opinion that the density of mangroves contains organic matter to provide abundant food for these animals [20]. Organic matter is beneficial as nutrition for basic biota. If the organic matter exceeds the limit, then the position of the organic matter becomes a polluter [21].

At station I, 411 individuals, 41 species belonging to 28 families, were found. The high number of individuals found at station I is due to the dominance of one species whose number of individuals is huge, namely *Cerithium kobelti*. The most common mollusc species found in all observation stations is the *Cerithium kobelti* species *because it has high adaptability and* can adjust depending on where it lives. The Kobelti Cerithium species dominates because it is pretty adaptable to the environment [22]. Cerithium kobelti species have impermeable skin that serves as a barrier. Many breathe through the air and feed on plankton or organic matter. *Cerithium kobelti* species is one of the species found in various substrates. This is suspected because Cerithium kobelti species have higher adaptability than other classes in hard and soft substrates [23].

The research results on all observation stations show that Gastropoda families such as *Nasariidae, Cerithiidae,* and *Tharidae* have many individuals and are found in the Gerupuk mangrove ecosystem. This family dominates mangrove ecosystems because it likes areas affected by tides and muddy areas with mangrove tree vegetation [24]. The *Cerithiidae* family is the most widely found species because research was conducted on mangrove ecosystems, which are the original habitat of *Cerithiidae*. The substrate character favoured by this group of *Cerithiidae* is muddy [25]. When viewed in one area, the highest abundance of Gastropods found at all observation stations in the coastal area of Teluk Gerupuk is *Cerithium kobelti,* located in mangrove areas with a total of 400 individuals. The following research states that Cerithium kobelti species are found in mangrove areas overgrown with Rhizophora because Rhizophora can provide muddy substrates as habitats [26]. The type of mangrove commonly found in Gerupuk Bay, Central Lombok, is a plant of the genus Rhizopora [27]. In addition to Rhizopora, the types of mangrove plants found in the Gerupuk mangrove ecosystem include *C. dendra, Rhizophora mucronata, Sonneratia alba,* and *S. caseolaris* [28].

The family *Nasariidae* had the most species after *Cerhitiidae* in this study. There are five species: *Nassarius coronatus, Nassarius pullus, Nassarius reevanus, Nassarius olivaceus* and *Nassarius gaudiosus.* These Gastropods have shell sizes ranging between 1.1-1.3 cm, brown-white stripes and are very fond of sandy substrates. Research obtained the Family Nassariidae's highest density in Ambon Bay, Maluku [29]. The family *Nassariidae* is found in almost all habitat strata in the littoral zone with sandy, mud, and rock substrates. The family *Nasariidae* is a facultative Gastropod because many individuals and species are found inside and outside the mangrove ecosystem [30]. The family *Nasariidae* lives on the trunks, branches, roots, and leaves of mangrove trees. The distribution of this type is determined by several factors, such as the function of an area as a shelter for gastropods and the type of mangrove tree vegetation [31].

Most of the Bivalves found at station II numbered 74 individuals, and they were obtained in unspoiled mangrove forest areas without any local community activities. The least number of Bivalves was found at station I, with 16 individuals, in coastal and hospitality areas close to residential areas. The high population at station II is likely because this area is still natural and not influenced by community activities compared to other stations, so this area contains a lot of litter from mangrove plants and organic matter needed by Bivalves as a food source. The species and density of mangroves will affect the existence and density of Bivalves [32]. Due to the high density of mangroves, many macrozoobenthos species and Bivalve populations are found in this area.

Based on research conducted in the coastal area of Gerupuk Bay, a family of Bivalves was found in this area, namely from the *Cyrenidae* family with *Geloina coaxans* species. Species *Gelonia coaxans* can be found in mangrove forest areas because they are suitable for organismal life and source several nutrients [33]. *Gelonia coaxans* can be found in almost all coastal regions that are still overgrown by mangroves because it is a suitable habitat for kapah clams or *Gelonia coaxans,* which are influenced by muddy substrates and are still affected by tidal currents.

The low population at Station I is likely due to the coastal area being close to residential areas, hotels, and pond outlets. In addition, this area has been used as a tourism area by local communities and migrants. Land use in the form of ponds can trigger significant abrasion and sedimentation, thus causing pollution to biota on the land, especially benthos [34].

Station II is an area of mollusk harvesting activities (*madak activities*) by the community and local fishermen. However, the condition of mangrove vegetation is good enough for no significant extinction. The community also uses traditional methods such as simple tools in the form of knives /machetes or both hands so that the existence of mollusks in the mangrove ecosystem of Gerupuk Bay does not experience significant extinction or decline.

Research conducted by phylum Mollusca, which is only found at station II and not found at other stations, is the phylum Scaphopoda, namely the species *Dentalium aprinum,* and found a total number of only one individual from all observation stations in the coastal area of Teluk Gerupuk. This is consistent with the statement that Scaphopods are a small class of marine molluscs and are rarely found. Most scaphopods cannot be collected easily because they live in the deep sea, and their abundance is always limited [36][37]. *Dentalium aprinum* species found in this study are at station II with muddy substrates in mangrove ecosystems with environmental conditions of pH 7, salinity 30%, and environmental temperature 30 °. All Scaphopods are benthic micro carnivores of euhaline inhabiting all soft bottom aquatic environments [35]. Scaphopods are buried beneath the surface in sand or mud [36]. Based on the Scaphopoda samples in this study, environmental conditions at the study site are considered optimal for Scaphopods to survive and reproduce at temperatures ranging from 29-31 °C. pH conditions at the study site were recorded in the range of 7-8. Mollusc life-supporting pH ranges from 5.7 to 8.4. The pH at the study site supports Scaphopod life [38]. Waters and soils with a pH of 6-9 are waters and soils with a high level of fertility [8]. The salinity level at all three research stations was 30 ppt. Salinity that belongs to the good category for macrozoobenthos growth ranges from 25-40‰ [34]. Thus, it can be known that this species of *Dentalium aprinum* can be found at the study site because the environment's carrying capacity qualifies to support the species' life.

Scaphopods of the genus *Dentalium* live in slightly coarser sediments with a mixture of sandy fractions and shell detritus. Well-oxygenated sediments associated with the presence of Scaphopods. It is suspected that a thin oxygenated sediment layer became a place for Scaphopods living on the seafloor [39]. Scaphopoda abundance decreases dramatically in organic-rich areas, indicating low tolerance to oxygen depletion [40].

The values of the species dominance index from the highest to the lowest are station III, station II, and then station I, with successive values of 0.092, 0.144, and 0.252. The dominance index value obtained from the study location ranged from 0.092-0.252, with a low dominance category. The value of the dominance index category classified as low is < 0.5, meaning that at each research station, several types of Mollusca dominate [7]. Dominance values determine whether a particular species dominates an ecosystem [8]. Thus, in this study, it can be known that the Gastropod species that dominate at all research stations are from the phylum Cheritiidae, namely the Cheritium kobelti and the class Bivalves, namely *Gelonia coaxans.* This species is found in all research stations because it has a native habitat in the mangrove ecosystem and is highly adaptable to changes in the environment in which it lives.

The results of research conducted by Mollusca in the Bivalve class are found at station II compared to other stations. This is suspected because, at station II's location, two streams originate from land from the Gerupuk River flow in the mangrove ecosystem. It is these streams that carry low-salinity water into the ocean. In this stream, the species Tellina essingtonensis comes from the class Bivalves, which is found in coastal areas [41]. In addition, in the Bivalve class, *Tellina essingtonensis* and *Anadara granosa* are two species found at all research stations. These two species are commonly found in mangrove areas and can spread widely vertically and horizontally [42].

Some species of mollusks are found in almost all stations, such as *Nassarius gaudiosus, Melanoides torulosa, Cerithium kobelti,* and *Chicoreus capucinus* which are found in three stations. These species have habitats or live in mangrove areas with muddy substrate types. This species' mobility level is relatively high compared to other species, so this species can be found at almost all stations [43]. Family *Thiaridae* is a group of macrozoobenthos most commonly found in the waters of Gerupuk Bay. The presence of macrozoobenthos species *Melanoides turulose, Tarebia granifera, Melanoides tuberculata*, and *Thiara scabra* from the *Thiaridae* family indicates organic pollution so that the quality of the waters is polluted [44]. These species have a tolerance value of 6, which means they are at moderate levels or resistant to changes in environmental conditions. Species of the Gastropod class, especially the family *Thiaridae*, have excellent adaptability in various substrates and a very high ability to accumulate contaminated materials without being killed by hiding themselves in their shells [45]. Several species of mollusks, such as Angaria delphinus, Vasum turbinellus, and Drupa morum, are only found at one research station. These species are found only at station I, i.e., in habitats in shallow intertidal waters, usually on rocky shores and reef flats.

Table 2. Uniformity Index and Water Quality Index at Each Station in Bay Gerupuk

Station	Uniformity Index	Category	Aquatic Quality Index	Category
1	0.680	High uniformity	2.525	Lightly polluted
2	0.613	High uniformity	1.998	Moderately polluted
3	0.773	High uniformity	2.890	Lightly polluted

Species uniformity ranges from 0.559-0.756, which means uniformity indicates that the waters are in a balanced condition, as Mollusca uniformity is close to 1 (>0.5) [46]. The uniformity index value is close to 1. This shows that the number of individuals in each species is almost the same and indicates the stability of the ecosystem [12][47]. Conversely, if the uniformity index is close to 0, a particular species dominates that ecosystem. The uniformity value obtained is close to 1, indicating that the individual composition of each species contained in a community is in relatively good condition, and the distribution of each type is relatively equal or uniform. However, some types of Gastropods are found in more significant numbers than others [49]. Research with a reasonably even uniformity index was also found with an E > 0.6. The high value of uniformity is thought to be due to temperature, pH, and DO conditions that are not significantly different at each station and do not exceed the threshold value of Gastropod growth [48]. Relatively homogeneous physical-chemical factors cause the high evenness of benthos [50]. This shows that the distribution of Mollusca populations in the waters of Gerupuk Bay is quite good. Many Mollusca species are found at each station, although certain species predominate. This may be related to the state of waters whose habitat conditions vary [51].

Mollusca is one of the biota that can be used as a biological parameter in determining the condition of a body of water [52]. If polluted material enters the body of the species, then the body of the intolerant species cannot survive; thus, its presence can be used as a bioindicator. Mollusks that are abundant in coastal ecosystem areas are usually dominated by classes of Gastropoda and Bivalves digging on the surface of the coast [22].

Table 4 shows that the Gerupuk Bay Coastal area is included in the 'Lightly Polluted' category at Station I and Station III. In contrast, Station II is included in the "Moderately Polluted" category. These results refer to the Mollusca diversity index value ranging from 2.890 – 2.525, provided that the area is lightly polluted if the diversity index value (H') is 3.0-4.0 [53]. The low water quality index value at station II is thought to be because it is a mangrove forest area converted into parks, settlements, and highways. Tourists often visit it so that it can disturb the habitat of the Mollusca. As a result, the value of the water quality index at station 2 is lower than that of other stations. The result corresponds to the calculation based on the diversity index.

Changes influence mollusc activity regarding environmental factors such as temperature, pH, salinity, and base surface substrate type. Temperature affects the metabolic activity of molluscs in coastal areas [54]. Based

on the Mollusca samples in this study, environmental conditions at the study site are considered optimal for Mollusks to survive and reproduce at temperatures ranging from 29- 31 °C. This result is close to temperature measurements in the mangrove area of the Musi River estuary, South Sumatra, Indonesia, which ranges from 28-31.5°C [55]. The optimum temperature for Gastropod metabolism ranges from 25-32°C [49]. The increase in temperature is more influenced by the sampling time and density of mangroves [56]. The degree of acidity (pH) is significant in supporting the survival of Gastropod organisms. This is because pH can affect the type and availability of nutrients as well as the toxicity of trace elements. pH conditions at the study site were recorded in the range of 7-8. The pH that supports the life of Gastropods ranges from 5.7 to 8.4, and the pH at the study site supports macrozoobenthos life [38]. Waters and soils with a pH of 6-9 have high fertility levels [8]. This is following the quality standards for the growth of macrozoobenthos. Photosynthetic and respiration activities in ecosystems determine pH changes. The higher the concentration of carbon dioxide, the lower the pH of the water. In this case, carbon dioxide in the ecosystem is obtained through the process of respiration by all organisms [57]. The increased temperature change can be due to the sparse density of vegetation or the time sampling is carried out [57]. Several other factors, such as encroachment of organic and inorganic matter by bacteria or the processes of photosynthesis and respiration, can cause changes in pH.

The salinity level at all three research stations was 30 ppt. Gastropods had relatively even abundance in this study, and salinity affected growth rate, amount of food consumed, and survival of aquatic biota [58]. The salinity range suitable for macrozoobenthos life is 15–45 ppt [59]. The optimal salinity for supporting the life of gastropods ranges from 28-34 ppt [60]. Salinity included in the excellent category for the growth of macrozoobenthos ranges from 25-40‰ [34]. Based on this information, the measurement results at the three stations are considered ideal for developing Gastropoda.

The most dominant substrate types at the three study sites were muddy and sand substrate types with varying percentages. This type of substrate is suitable for mollusc life because substrates with fine fractions, such as mud and sand, contain many nutrients or organic matter that can benefit macrozoobenthos life [61]. Sedimentary conditions greatly influenced the development of Gastropod communities, where mud and sand sediments were suitable for Gastropod life [62]. The organic matter content contained in this type of substrate (sand and mud) is used by Gastropods as food ingredients through filters *(filter feeders*) [63].

Conclusion

The results of diversity calculations obtained that the diversity (H') of Mollusca in the coastal area of Gerupuk Bay ranged from 2.890-1.998. The lowest diversity was found at station 2 at 1.998, and the highest diversity was found at station 3 at 2.890. Mollusca diversity in the coastal area of Gerupuk Bay is included in the medium category. For Water Quality Bioindicators using the diversity index, the coastal area of Gerupuk Bay is included in the lightly polluted category at stations I and III. In contrast, station II is included in the moderately polluted category because the Mollusca diversity index value in the station area is 1.998.

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