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The Diversity of Molluscs in Mangrove Ecosystem of Kendari Bay

AUTHORS INFO

La Ode Kaharudin
Universitas Muslim Buton
kaharudin.l@yahoo.com
+6281345270885

La Ode Wahidin
Universitas Bina Insan
laodewahidin@univbinainsan.ac.id
+6282344897403

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Abstract

Changes on the mangrove ecosystem, directly and indirectly, affect the living organisms associated with it, including Molluscs. This study aimed to investigating Molluscs species in mangrove ecosystem of Kendari Bay. It is descriptive research containing facts and natures of mangrove Mollusc species. This study conducted from September to November 2020. Observing and collecting the Mollusc organisms were carried out in four mangrove ecosystems like *Bruguiera, Bruguiera/Rhizophora, Rhizophora,* and *Avicenia*. The method used in this research was an exploring technique by collecting and counting the found Mollusks. Indicators of observing the Mollusks included morphological characteristics and environmental parameters. Three important environmental parameters, like salinity, acidity (pH), and temperature, were measured during field works using hand refractometer, pH tester, and thermometer, respectively. This research indicates about 279 individuals of Mollusks found in all zones consisting of 17 species representing two classes, Gastropod (14 species) and Bivalves (3 species). During this research, the Gastropod Mollusks found *Telescopium-telescopium, Terebralia palustris, T. sulcata, Cerithideopsilia cingulata, C. alata, Nerita squamulata, Cerithidea quadrata, C. obtusa, Latirus paetelianus, Cerithium kobelti*, *Chicoreus capucinus, Nassarius stolatus, N. niticusis, Siphonalia varicosus.* For the three species of Bivalves are *Polymesoda erosa, Anadora granosa,* and *Sacostrea cucullata*. The both species T. *sulcata* and S. *cucullata* positively dominated all total found Gastropods and Bivalves namely 21.86% and 3.943%, respectively. The three water quality parameters measured at research stations are still on tolerance limits for the collected molluscs.

Keywords: Molluscs, Mangrove Ecosystem, Kendari Bay

A. Introduction

The complexity and functioning as a buffering zone for vital areas of ecosystem stability, mangrove is a unique coastal vegetation (Riyandi *et al*., 2017) consisting of various types of trees up to medium height and shrubs grow along the intertidal zone of coast or estuaries in the tropical and subtropics areas (Kabir *et al*., 2014; Giri *et al*., 2011; Zhang *et al*., 2007), affected by water conditions canging at any time (Manulang *et al*., 2018) and its associated habitats support a wealth of marine resources (Htwe and Oo, 2019), as well as contributes significantly to life of organisms in the coastal and marine areas (Baderan *et al*., 2019). The structure of the

mangrove ecosystem is related to the abiotic components such as solar radiation, temperature, rainfall, nutrients and water supply (Masagca et al., 2010). Furthermore, due to bio-ecological processes, making mangrove is one of the most productive ecosystems constructing by varied interactions between biotic and abiotic components (Isnaningsih and Patria, 2018).

One of crucial living organism group in the mangrove ecosystem is Mollusc. It is the second-largest phylum with a global estimated diversity of around 0.2 million species (Chapman, 2009; Kantharajan et al., 2020). Molluscs are soft-bodied animals. This soft body condition is the basis for giving the Phylum name. Molluscs from the word Mollis which means soft. Phylum Mollusks are classified based on their differences in shell anatomy/morphology, characteristics and head, symmetry, gills and nervous system. Members of this Phylum are shellfish, squid snails, and others. At first glance, there is no similarity among those animals; however, they possess something in a common if it looked closely. One of the general characteristics is the foot. The snail it's usually used to dig the bottom of the water, and the squid has been modified to a form that functions in respiration, namely in the form of chiffon.

Various molluscs in a mangrove ecosystem indicate the richness of biodiversity within the ecosystem, referring to a good environmental condition. They usually are used to be indicators of water quality in terms of sensitivity on ecological change. Furthermore, in a food chain stage, they act as consumers at various levels in maintaining the food chain balances. Moreover, molluscs are important invertebrates for humans because of a source of food, jewellery, and even becoming pets. Certain shellfish are deliberately cultivate to produce beautiful and valuable pearls (Romimohtarto and Juwana, 2009).

Kendari bay is a coastal area overgrowing with mangrove forests with a sloping coastline, muddy substrate, sandy mud and sandy sand towards the sea. A mangrove ecosystem characterizes a large part of its coastal area. Some of the mangrove species found in this bay are *Avicenia* sp., *Rhizophora* sp., *Soneratia* sp., and *Xylocarpus* sp. (Wahidin et al., 2013). The mangrove ecosystem in this bay, strategically perpendicular to the coastline, is composed of *Avicennia marina* and *Avicennia lanata* facing the sea distinguishing by muddy substrates and high salinity; *Rhyzophora mucronate* and *Rhyzophora stylosa* as situating at second level characterizing by the soft muddy substrate; and *Bruguiera gyamnorriza*, at last, having hard, muddy soil substrate (Mando et al., 2019).

An observation on mangrove condition in this bay indicates that this bay's ecosystem is hugely under-fragile on coastal development like coastal dikes, fish-pond, expansion of human settlement, roads, and other infrastructure development. This condition, directly and indirectly, influences on the associating organisms living within the ecosystem, including molluscs. Fortunately, this bay's natural shape supported by a tide fluctuation cycle that bolsters marine life like molluscs. Because of sedentary life nature and slow movement, the Moluscs are vulnerable to environmental conditions changes. Some change of physical feature of mangrove ecosystem will affect eventually on the mollusc organisms associating within it. Due to this interacting situation, research regarding the diversity of Molluscs in the mangrove ecosystem at Kendari Bay is interesting to be conduct This research aimed to investigate the diversity of Molluscs living in the mangrove ecosystem at the bay and their three major environmental factors of parameters like salinity, pH, and temperature.

B. Literature Review

1. General Characteristics of Mollusks

Linneus firstly used the name of Mollusc in 1757. Mollusc is a heterogeneous group of animals with different structural shapes such as shells, octopuses and snails. Most of them are as well known by their bodies, but the shell is absent (Shanmugam and Vairamani, 2008). Their shells are functioning as an outer skeleton (Rusyana, 2011; Pakaenoni, 2019).

Phylum Mollusks gets its name from the Latin word "molluscs", which means soft. Phylum Mollusks's unique feature is the body's division, a "head-foot base" that holds the visceral mass. The head is consider to be in marked contrast to the remote sensing devices such as the eyes and tentacles. The feet are in the form of the soles or the feet wide to slither and push these animals with muscle movements. The visceral mass is surrounded by a fold covering the top called the coat (Romimohtarto and Juwana, 2009). Characteristics of molluscs ('Mollis', soft) have a non-segmented smooth body, characteristic of an anterior head, ventral muscular legs and a dorsal visceral mass. A thin, fleshy layer or mantle roughly surrounds the body, and most Mollusks have a chalky outer shell (Storer and Usinger, 2002).

Molluscs are soft-bodied animals that are protected by coats. The body of Mollusks is bilaterally symmetrical, covered in a mantle that produces a shell and has ventral legs. The shell

can be outside the body (for example in snails) or inside the body (for example, cuttlefish) (Suwignyo *et al*., 2002).

2. Systematics of Molluscs

Molluscs are grouped into two main classes Gastropod and Bivalve, distinguishing by modification of their shells (Pakaenoni, 2019).

a. Gastropods Class

Gastropod class animals are generally single-shelled twisted into a spiral. A shellless, clear head has two pairs of tentacles, wide, flat feet; gills numbering one or two, breathing with lungs, one or two housed reproductive organs, internal or external fertilization.

b. Bivalves Class

The bivalve class shells are symmetrical and consist of two pieces that can be closed and opened. On the back of the shell, there are hinge teeth and ligaments. The mantle on the right and left lobes are flattened. The bivalve siphons are present on the posterior side. Bivalve gills are plates of one or two pairs. Bivalves do not have a head and jaws (radula). The reproductive organs are bipolar. Besides, the bivalve gonads open into the mantle cavity.

3. Mangrove Ecosystem.

The mangrove ecosystem is a transition between terrestrial and marine ecosystems which have essential ecological functions. In general, Mangroves can be defined as a group of plants in the form of trees and shrubs that occupy the estuary area which is still affected by the highest tides, especially in protected areas with high mud content.

The word mangrove is a combination of Portuguese mangue and English grove. In English, the word mangrove is use for plant communities in the tidal range and plant communities that grow in the tidal range and individual plant species that make up the community. Meanwhile, in Portuguese, the word mangrove is used to denote particular plant species, while the word mangal refers to the mangrove plant community. It is currently the meaning of mangrove that comes from English widely used by researchers and observers of mangroves and even the general public (Kusmana, 2002: 207).

The mangrove forest is a tropical coastal vegetation community with several types of mangrove trees that can grow and develop in muddy tidal areas. The distribution and zone of mangrove forests are: (1) The area closest to the sea, with a slightly sandy substrate, is often overgrown by *Avicennia* sp. In this zone, it is common to associate Sonneratia sp., Which predominantly grows in sludge rich in organic matter. (2) more landward, mangrove forests are generally dominat by *Rhizophora* sp. In this zone also found Bruguiera sp., And Zylocarpus sp. (3) the next site is dominated by *Bruguiera* sp. (4) the transition zone between a mangrove forest and lowland forest is usually covered with nipa (*Nypa fruticans*) and several other palm species (Bengen, 2001). Mangrove has ecological functions for biotas living within and surrounding it as nursery, feeding, and spawning grounds, including for the molluscs (Idris et al., 2018).

C. Methodology

1. Research Design

This research used an adjusted design, which is morphology and identification characteristics (Adisoemarto, 2008).

2. Instruments

This study uses a plastic rope measuring meters and a filament to see the mangrove vegetation in Kendari Bay. Collecting the molluscs found during the field works was taken by a basket and jars for storing samples. Three main environmental parameters like salinity, temperature and pH were measured using Hand Refractometer, Thermometer, and pH Tester, respectively. The documentation of the research process using a camera. The molluscs found in the field were preserv using 4% formalin. Label paper is used to label the species found.

A sampling of molluscs was carried out four times. In sampling molluscs, parameters are also measured at the time of piece. Otherwise, estimating the parameters was adjusted to the sample and calculating the finding species of molluscs. This research determined three main environmental parameters, namely, temperature, salinity, and acidity. The parameter is measuring at low tide. The water temperature was determined using a thermometer submerging into a water body (a scale of ° C). The salinity of waters was quantified using a Hand

Refractometer with a unit of ‰ (per mile, gram per litre). The watering acidity was measured using a pH tester.

3. Technique of Data Analysis

This research utilized a descriptive analysis. The morphological characteristics of each molluscs species found during fieldwork at the mangrove ecosystem are described. The identification process of Molluscs species consisted of two main classes, Gastropod and Bivalve

a. Identifying class of Gastropods

The parts observed in the gastropod class were shell characteristics such as shape, the direction of rotation, operculum shape, navel, colour and decoration, and shell size (length and width).

b. *Identifying class of Bivalves*

The class of Bivalves is identify primarily based on their shell morphology. When the valves are similar, the shells are revealed to be equivalent (mussels, mussels). Whenever they are different, inequivalve (mussels). If each valve has a trace of a single-like adductor, the shell is said to be monomyarian. If two adductors are on each valve, the body is dimyarian (Shanmugam and Vairami, 2008: 373).

D. Findings and Discussion

1. Findings

a. The Composition of Molluscs Species in Mangrove Zones

All identified molluscs that had been discovert in mangrove zones at Kendari Bay are 277 individuals. Gastropod contributes 251 individuals classifying into 14 species and seven families (Table 1). Bivalve only contributes 26 individuals grouping into three species and two families (Table 2). Bruguiera is a favourable mangrove zone for all molluscs and Avicennia is found with fewer molluscs species.

Table 1. Total of individuals and species of gastropod found in each mangrove zones at Kendari Bay.

No.	Families/ Species	Zone				Total Species	Dominance (%)
		Bruguiera	*Bruguiera/ Rhizophora*	*Rhizophora*	*Avicenia*		
	Gastropods Class						
I	Potamididae						
1	*Telescopium-telescopium*	14	10	6	3	33	12.54
2	*Terebralia sulcata*	42	10	6	3	61	21.86
3	*Terebralia palustris*	24	3	2	3	32	11.47
II	Cerithidae						
4	*Cerithidea quadrata*	7	3	5	2	17	6.093
5	*Cerithidea obtuse*	4	5	3	2	14	5.018
6	*Cerithium cobelti*	1	1	2	1	5	1.792
7	*Cerithideopsilla cingulata*	8	3	1	2	14	5.018
8	*Cerithideo psillaalata*	9	1	1	1	12	4.301
II	Latiridae						
9	*Latirus capucinus*	3	2	2	1	8	2.867
IV	Murcidae						
10	*Chicoreus capucinus*	1	1	0	2	4	1.434
V	Nassaridae						
11	*Nassarius stolatus*	2	1	0	0	3	1.075
12	*Nassarius niticusis*	2	2	3	1	8	2.867
VI	Buccinidae						
13	*Siphonalia varicosus*	22	3	3	1	29	10.39
VII	Nerithidae						
14	*Nerita squamulata*	4	3	2	2	11	3.943
	Total of Individuals	143	48	36	24	251	90.68
	Total of species	14	14	12	12	14	

Source: primary data

The recent study indicates Gastropods merely prefer to live in the mangrove zone of Bruguiera and Bivalves are discovered in all zones showing a tendency of more abundance in Avicenia zone. The highest and the lowest quantity of Gastropod species in Bruguiera zone are *Terebralia sulcata* with 42 individuals, and *C. cobelti* and *C. capucinus* with a total of individuals are one in each, respectively (Table 1).

According to the percentage of presence, Gastropod contributes almost third-quarter of all individuals, and Bivalve denotes the rest. The highest and the lowest rates are represent's by families of Potamididae (46%) and Murcidae (2%), respectively (Figure 1).

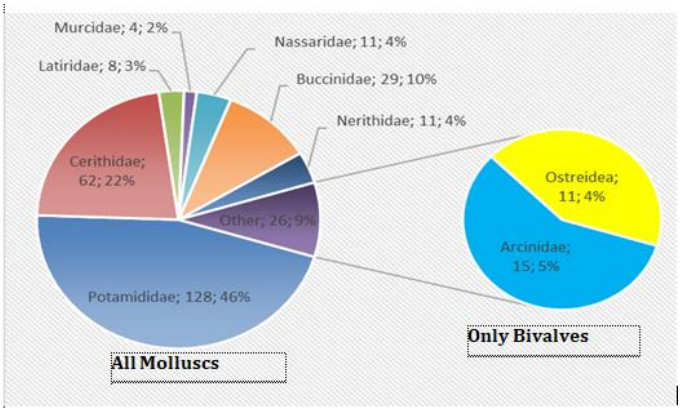

Figure 1. The presence percentage of moluscs' families in mangrove ecosystem at Kendari Bay

The highest and lowest of Bivalve species found in Avicenia zone are *S. cucullata* and *A. granosa* with a total of 4 and 2 individuals in each (Table 2).

Table 2. Total of individuals of molluscs species in class of bivalves found in the mangrove ecosystem at Kendari Bay

No.	Families/ Species	Zones				Total Species	Dominance (%)
		Bruguiera	*Bruguiera/ Rhizophora*	*Rhizophora*	*Avicenia*		
	Bivalves Class						
I	**Arcinidae**						
1	*Polymesoda erosa*	2	1	2	3	8	2.867
2	*Anadora granosa*	2	2	1	2	7	2.509
II	**Ostreidea**						
3	*Saccostrea cucullata*	2	3	2	4	11	3.943
	Number of Individuals	6	6	5	9	26	9.319
	Number of Types	3	3	3	3	3	

Source: primary data

The distribution of all individuals of molluscs at four mangrove zones is presented in Figure 2 as follows.

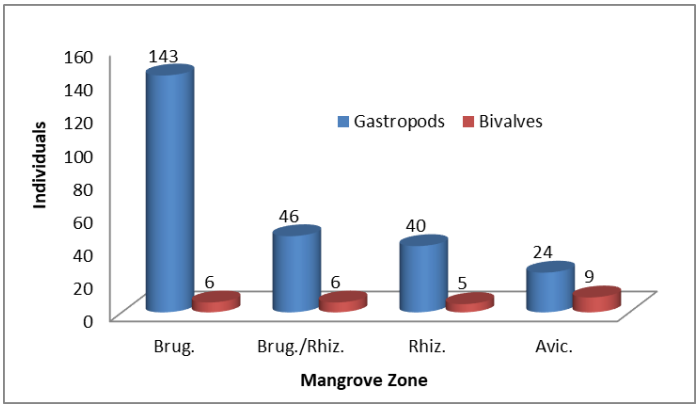

Figure 2. Percentage of types of gastropods and bivalves per zone

b. Three main environmental parameters

In general, the environmental condition of parameters affects the presence and distribution of Mollusks species. The range of environmental parameters of the water in each mangrove zone still enables to support the molluscs living in the research location. Measuring the water temperature in the mangrove zones on a low tide condition denotes a range of 26.75 – 28.310C. Two other environmental parameters, salinity and acidity, observed in the mangrove zones are in fields of 28.25-30‰, and 6.5-7.25, respectively.

Table 3. Fluctuation of three main environmental parameters in the research locations.

Parameters	Mangrove Zones				Average	Standard Deviation
	Bruguiera	***Bruguiera /Rhizophora***	***Rhizophora***	***Avicenia***		
1. Temperature (^{0}C)	26,75	28,25	29,75	28,5	28,31	0,95
2. Salinity (‰)	28,25	29,25	30	28,75	29,06	0,58
3. Acidity (pH)	6,75	7	7,25	6,5	6,88	0,25

Source: primary data.

Environmental conditions affect Molluscs species' existence in certain areas, in this case, mangrove ecosystem. Some physical and chemical parameters influencing most organisms' lives in the aquatic environment are temperature, salinity, degree of acidity (pH), organic matter, and tidal periods. The current study only focuses on three parameters such as temperature, salinity and acidity. The recorded values of those parameters in four different mangrove zones are present's in Figure 3 below.

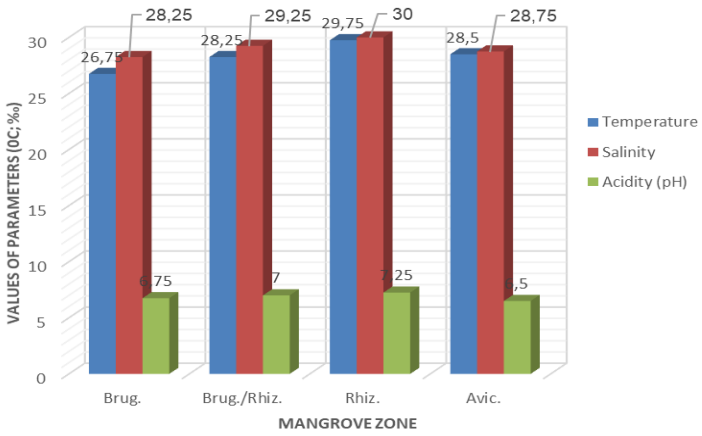

Figure 3. Distribution of three environmental parameters on four mangrove zones in Kendari Bay.

The fluctuation of three environmental parameters in this study is varied. The temperature is in a range of 26.75 – 28.310C (Table 3). Its is only 20C from the highest temperature found in Rhizopohora zone and the lowest in the Bruguiera zone (Figure 3). The parameter salinity is fluctuation only 1.25‰ overall mangrove zones, and the pH is a range of slightly to be an in normal condition (acid).

2. Discussion

a. All molluscs Species Collected in The Mangrove Ecosystem

About 279 individuals of molluscs are founded during field-works at Kendari Bay. Seventeen species are classify into Gastropod, which is consisted of 7 families. The rest three species are group into Bivalve composing of 2 families. Those Gastropod species are *Telescopium telescopium, Terebralia palustris*, *T. sulcata*, *Cerithideopsilia cingulata*, *C. alata*, *Nerita squamulata*, *Cerithidea quadrata*, *C. obtusa*, *Latirus paetelianus, Cerithium kobelti, Chicoreus capucinus, Nassarius stolatus, N. niticusis, and Siphonalia varicosus*. Furthermore, three species of Bivalve are *Polymesoda erosa, Anadara granosa, Saccostrea cucullata*. On a same bay (Kendari Bay) but in a different time of research, Muhsin and Hendra., (2016) discovered eight species of gastrophods with different density in a mangrove ecosystem of *Rhizophora apiculate* such as

Ceritidae cinggulata, Checoreus capucinus, Littorina scabra, Nerita Costata, Nerita lineata, Terebralia sulcate, and *Littoronia melanostomata*.

The current research is relatively rich of molluscs species than shown by Mujiono (2009). It discovers only 7 species of molluscs in the mangrove ecosystem of Ujung Kulon National Park *Telecopium-telescopium, Terebralia palustris, Cerithideopsilia cingulata, Cerithideopsilia alata, Cerithidea quadrata, Cerithidea weyersi.* The number of species in this study was also lower than in other studies. Research conducted by Budiman (1991) found 22 species in Morowali, Central Sulawesi. Heryanto (2008) found 20 species in the Mahakam delta, East Kalimantan, and Arbi (2008) found 26 species in Tambak Wedi, Madura Strait, East Java.

Potamididae is a mostly found family Gastropods in the mangrove zones in recent research. It is distributed in almost all mangrove zones even thought it getting decrease in the zone of *Avicenia*. This family is widely dispear's on different substrates. Arbi (2013) proposes this family is one of grastropods possessing strong association with mangrove ecosystem and distributes widely in tropical shallow waters around the world. Recently study regarding this family is showed by Arbi *et al*. (2019) discovering this family in all research observations on fish-pond areas at Probolinggo - East Java consisted of 8 species and 1229 inviduals collected. Furthermore, Rangan (2010) explains two species of this family (*Terebralia sulcate* and *Telescopium Telescopium*) are native organisme of mangrove forest and possess high tolerance on the environmental changes.

b. Species of Molluscs Based on Mangrove Zones

Of all molluscs, two Gastropod species, *C. capucinus* and *N. stolatus*, are not found in the zone of Rhizophora. The species *N. stolatus* also is absent in the Avicenia zone. Furthermore, the presence of Mollusks species in high density at a specific site depicts their habitat. Most gastropods lived behind the mangrove forest (mostly in open area) and close to aquaculture location (fish-ponds) and river banks. These locations provide a variety of feed ingredients from the detritus habitat from the fish-ponds. This reason is making sense why molluscs are more abundant in specific sites like Bruguera zone. This research is in line with Heryanto (2008, 143) explains that molluscs require three right conditions to have an optimum life: low temperature, high humidity, and abundant food. Wahono (1991) reveals that *Telescopium-telescopium, Cerithium quadrata,* and *Terebralia sulcata* are found everywhere in mangrove forests, because they have chewy life requirements so they can reproduce well in all places at the forest.

Bivalves prefer to stay on lush areas at most and softly emerged substrates by tides. Due to their natures of limited mobility, making them are commonly found at vegetated areas, in the current research, in Avicenia zone. This animal group's ability to increase in saline water also raises reason why Anadara granosa is slightly abundant in the research location. *Saccostrea cucullata* is species with high density in terms of Bivalve than other two species. This species attaches on mangrove roots or other hard materials in the mangrove ecosystem.

Furthermore, this Mollusc class also susceptible to environmental change, especially extreme hot in coastal areas. From an economic value perspective, Bivalves, especially *Polymesoa erosa*, target local fishers for selling. It has economic values and favourable taste for some people. Local fishers usually utilize those bivalves to feed or become ingredients for fish raring in Kendari Bay's fish-ponds. Because of massive collecting by local fishers, it is supposed to experience a degrading population besides environmental change. This kind of activity leads to a decreased number of molluscs species, for instance, on *T. telescopium*, P. erosa. This result is in line with Heryanto (2008) expresses that, in general, the mollusca population tends to continue to degrade due to the activities of the local community. Samson and Kasale (2020) express that besides habitat characteristics, a factor influencing Bivalve undergoes decrease is a human activity of collecting them for consumption. The research conducted by Tamsar et al. (2013) indicates *P. erosa* is a target mollusc for consuming by local people; however it is still under exploiting. Though, this species is detect in all mangrove zones on the recent study.

A diverse density population of molluscs in Kendari Bay is slightly related to mangrove covers. A more extensive mangrove cover, in general, has a specific diversity of organisms and it also accommodates a wider variety of Mollusks. However, the differences for micro-habitats still exist so that it can even see the zone. The recent study indicates the variation of mollusc diversity is affected by mangrove width. It's based on an assumption of micro-habitat inhabiting by molluscs which are highly depend on mangrove width. The wider a mangrove forest, the higher the number and differences in habitat types. Budiman (1991) express that mangrove forests' width can determine variations in organisms' diversity, including molluscs.

Furthermore, in the current research, the mangrove ecosystem in Kendari Bay is directly dealing with molluscs abundance. The condition of mangrove in this bay endures receiving stresses coming from anthropogenic activities of the city development as seen in a research conducted by Ido et al. (2019), such as establishing fish-ponds, roads, and human settlement in around and within mangrove ecosystem. Moreover, various polluting materials, coming from an adjacent environment that passed and flushed out through streams come into this bay, presumably rise problems for mangrove ecosystem health. Those materials, especially plastics and un-degradable materials, are trappe at mangrove roots and piled up eventually on mangrove areas and coating the natural soil and muddy substrates. This condition will cause fewer mollusc spots that graze naturally. Consequently, the molluscs population in this bay will be depleted in the future, although many studies are requir to prove this allegation. Kotte-Mapoko et al. (2017) express that habitat loss leads forcefully to the disappearance of sensitive biological communities such as macrobenthos species.

c. Environmental Conditions

Temperature is one of water quality parameters affecting the distribution of organisms in the water, including in the mangrove ecosystem. The high-temperature condition seemly in the Avicenia mangrove zone may be influenced by the bay water condition in general, which is a semi-close bay and relatively shallow water. By intensifying sunlight penetration on the bay, makes the seawater getting hotter and distributed to mangrove areas. However, this temperature level in a range of tolerable condition for molluscs, as suggested by Huctching and Saeger (2000: 154), bearable temperature for molluscs life in mangrove forests is between 25-30° C. This temperature has hugely affected the molluscs, especially Bivalve, Aji (2011) express Temperature and salinity are positively affected by Bivalve's spawning process. Setiobudiandi (1999) reveals that water temperature influences benthic animals (Mollusks) on their migration, metabolic rate, mortality and reproduction.

An interesting phenomenon is noted from the salinity condition in Kendari Bay. All mangrove zones indicate salinity in a range of 28.25 - 30‰. Even though the physical condition of Kendari Bay becoming a semi-closed shape and affecting by 13 river estuaries (Apriyanto, 2007), its water still saline up to the mangrove zone. It denotes that hydrological circulation of seawater in this still supports the bay's marine life. Nontji (2005) revealed that the salinity of seawater is ± 30 ‰. The saltiness of this water can help organisms in the sea. The water depth and salinity affect the mollusc community structure (Neves et al., 2012). Setiobudiandi (1999) explains that salinity affects the distribution of benthic animals, many species and their reproduction.

The pH of water in the mangrove zone at this study is more acid than a typical aquatic environment, as Nybakken (1992) suggested, in a range of 7.5 and 8.4. It may be affected by land materials of human activities on the surrounding areas coming down to the bay through river estuaries and drains at all the time. The current research also signifies that Gastropods still survive in a condition with slightly acid as seen they are great discovered abundantly in Bruguiera zone. Research conducted by Bula et al. (2017) in a small Island at West Seram Regency at Maluku indicates that environmental factors, which significantly affect the diversity and distribution of gastropod, are water temperatures and salinity acidity (pH). Conversely, Samsi et al., (2018) explain in their research that environmental parameters like temperature, salinity, carbon, and sediment nitrogen, do not influence the distribution of Molluscs (Gastropod and Bivalves) in both natural and rehabilitated mangrove ecosystem in two locations In Southeast Sulawesi. The distribution of molluscs is presumably affected by mangrove density, turbidity, current velocity, phosphate, nitrate, and dissolved oxygen.

E. Conclusion

Molluscs found through this research location in the mangrove ecosystem of the Kendari Bay, consisting of two main classes, namely Gastropod and Bivalve. The first class consists of 7 families covering 14 species such as *Telecopium-telescopium, Terebralia sulcata, Terebralia palustris, Cerithideopsilia cingulata, Cerithideopsilia alata, Cerithidea quadrata, Cerithidea obtusa, Latirus paetilianus, Cerithium cobelti, Chicoreus capucinus, Nassarius niticusis, Siphonalia varicosus, Nerita squamulata*. The second class comprises 2 families encompassing 3 species namely *Polymesoda erosa, Anadara granosa,* and *Saccostrea cucullata*. These molluscs distribute in four mangrove zone types namely *Bruguiera, Bruguiera/Rhizophora, Rhizophora*, and *Avicenia*. Mollusc species *T. sulcate* is the most abundance Gastropod in all zone types, and it's highly distributed in the Bruguiera mangrove zone type. Three main environmental parameters

(temperature, salinity, and pH) affect either the abundance or distribution of molluscs in the mangrove ecosystem at Kendari Bay.

F. References

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