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Mangroves and Different Health Conditions of Mangrove Forests in North Lembeh Waters

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Abstract

The purpose of this study was to see the types of mangroves and the different health conditions of mangrove forests in North Lembeh Waters and around the Bitung-LIPI Marine Biota Conservation Workshop. Of the four stations, Rhizoporaapiculata is dominated by plants that grow well in areas where there is a lot of mixed sandy mud sediments and in locations that are protected from strong waves, in the estuary area which is some distance from the offshore. Based on the reference to the Decree of the Minister of Environment No. 201 in 2004, all research stations on North Lembeh Island are in good condition. The station which has a sandy and muddy substrate (LMBEM02 and LMBEM04) is dominated by Rhizoporaapiculata while the station (LMBEM 01) is dominated by AegicerasFloridum species that live on coral substrate.

The increasing density of mangroves at four stations (LMBEM01), (LMBEM02), (LMBEM03), and (LMBEM04), namely from the results of research, each number of mangroves in station at station one (LMBEM01), totaling 84 stems, station two (LMBEM02)), totaling 123 stems, station three (LMBEM03), totaling 86, and at station four (LMBEM04), there are 95 stems from the results of research on the island of Lembeh Selatan at LMBEM01 station which has the highest density value with a density value of 2500 per hectare. While the lowest density is at LMBEM04 station with a tree density value of 1500 per hectare. The decrease in the number of mangroves on North Lembeh Island when the research was carried out could be caused by the construction of fishing boat docks and community activities on North Lembeh Island which is located in Mawali.

Keywords: mangrove forest, health condition, Lembeh island, ecosystem, conservation

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INTRODUCTION

The Indonesian archipelago, as one of the countries with the longest coastline in the world, is an excellent area for the development of mangrove communities. Indonesia has the highest mangrove ecosystem in the world, around 3.2 million hectares or 22.6% of the world's mangrove area (FAO 2007; Giri et al. 2011). This shows the very high potential of mangrove communities in Indonesia ecologically as well as in direct and indirect use for coastal communities. The mangrove ecosystem in an area is very dependent on the health condition of the mangrove community. Healthy mangroves can provide maximum function for the surrounding environment. Studies on the health of mangrove ecosystems have been developed in Indonesia and have been implemented in the CTI COREMAP Program with a hemispheric photo approach and supported by community data in 30 Indonesian mangrove locations (Dharmawan and Pramudji 2014). Anthropogenic interventions will be detectable from the canopy cover in the community.The overallhealthconditionof the mangrove ecosystem can affect the condition of two other ecosystems in coastal areas, namely seagrass and coral reefs. Physically, the typical mangrove root system provides protection for seagrass and coral reefs from the dangers ofsedimentation (Dharmawan andPramudji 2014).

However, when the mangroves are damaged, the higher anthropogenic pressure will be felt by the coral reef ecosystem. For this reason, a management effort is needed that includes ecological monitoring of the condition of the mangrove community in an area (Dharmawan and Pramudji 2014). Mangrove ecosystems are coastal ecosystems that are composed of various types of vegetation that have specific biological and physiological adaptations to fairly varied environmental conditions. Mangrove ecosystems are generally dominated by several true mangrove species, including *Rhizophora sp., Avicennia sp., Bruguiera sp. and Sonneratia sp.* These mangrove species can grow well in shallow water ecosystems, because of the presence of roots that canhelpadapttotheaquaticenvironment.

According to Watson (1928), the formation of mangroves begins with the deposition of mud in coastal areas carried by rivers, mixed with sand as a result of coastal erosion. Watson also said that the first type of mangrove to grow was Avicennia, then followed by Sonneratia. The distribution of Sonneratia species is generally aided by water and develops in soils that contain lots of organic matter mixed with mud. The next vegetation to develop is the type of *Bruguiera, Rhizophora, and Casuarina*. Mangrove forest ecosystems are complex and dynamic, but unstable. It is said to be complex because in addition to the ecosystem being filled with mangrove vegetation, it is also a habitat for various animals and aquatic biota. The type of soil underneath includes young developmental soil (saline young soil) which contains clay which contains high with wet saturation value and high cation exchange capacity. The content of organic matter, total nitrogen, and ammonium is included in the medium category in the part near the sea and high in the land direction. It is dynamic because mangrove forests can grow and develop continuously and experience succession according to changes in their natural habitat. It is said to be unstable because it is easily damaged anddifficulttorecoverto normal (Kusmana, *et al.,* 2002).

Accordingto Kusmana,*et al.,* 2002, from an ecological point of view, mangrove forests are a unique form of ecosystem, because in this area four fundamental biological elements are integrated,

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namely land, water, vegetation and animals. This mangrove forest has unique ecological characteristics, which is that it can live in water with high salinityandusuallyoccursalongtidalareas.

The most importantcharacteristicsofmangroveforestappearance are:

1. Has relatively few tree species.
2. It has breath roots (*pneumatofora*) such as curved and towering anchors in mangroves Rhizophora spp., And roots sticking vertically like pencils in *Sonneratia spp*. andontheflamesof Avicennia spp.
3. Has seeds that are *viviparous* or can germinate on the tree, especially in Rhizophora which is better known as propagules.
4. Has lots of lenticels on the bark of the tree.

Based on where it lives, mangrove forests are unique habitats and have special characteristics, including:

1. The land is periodically inundated by sea water, either every day or only during the first tide.
2. The place receives an adequate supply of fresh water from land.
3. The area is protected from big waves and strong tidal currents, the water is brackish (2 - 22 0/00) to salty.

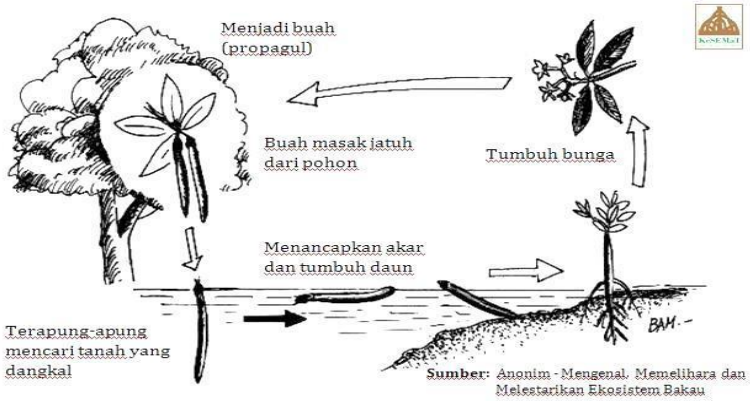

Figure 1. Mangrove Life Cycle (Kesemat, 2009)

Vegetation Structure and Mangrove Life Cycle

Mangroves are a tropical coastal vegetation community dominated by several species of distinctive trees or shrubs that can grow in salty waters. Mangroves as a tropical and sub-tropical coastal vegetation community are dominated by several types of trees that are able to grow and develop in muddy tidal coastal areas. Mangrove plants like other plants convert sunlight and nutrients into plant tissue (organic matter) through the process of photosynthesis. Mangroves are a potential food source in various forms, for all biota that live in mangrove ecosystems. Unlike other coastal ecosystems, the basic component of the food chain in the mangrove ecosystem is not the mangrove plant itself, but the litter that comes from mangrove plants (leaves, twigs, fruit, stems, etc). Some of the mangrove litter is decomposed by bacteria and fungi into dissolved nutrients which can be directly used by phytoplankton, algae or mangrove plants themselves in the process of photosynthesis, partly as litter particles (detritus) used by fish, shrimp and crabs as food (Bengen, 2004).

According to Panjaitan (2002), mangrove communities grow well on sheltered muddy beaches and bays, generally the trees have straight trunks with a height of 3.5 to 4.5 m. On sandy beaches and coral reefs, mangroves grow stunted and low with bent trunks. This type of mangrove has

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segretionary habitat (separate, isolated), depending on the height of the place from sea level, salinity, soil conditions and so on. Mangrove species are divided into three components, namely:

1. Major components, namely species that develop morphological characteristics in the form of air roots and physiological mechanisms in the form of salt glands to adapt to their environment. Types of mangroves that have salt glands include: *Rhizophora sp., Ceriops sp., Avicennia sp., Bruguiera sp., Sonneratia sp.*

2. Minor components (coastal plants), ie species that do not stand out, can grow around the habitat. Types that include minor components are Spinifex litoreus (rolls), Ipomea-pes caprae.

3. Components of association, namely species that do not grow in real mangrove communities and can grow on land (terrestrial). Types included in mangrove associations include *Terminalia cattapa(ketapang*) and *Cerbera manghas (Bintaro).* In order to survive and spread in harsh natural conditions, true mangrove species have a unique way, namely the reproductive mechanism by means of fruit, which is called viviparous. The way to propagate viviparous is to prepare the propagule from the fruit or seeds before it leaves the parent tree. Mangroves produce fruit that germinates, removes roots while still hanging on tree branches and is far above sea level. The seeds release the supporting root shoots as sprouts so that when they are ripe and fall off the stalks, they are ready to grow. This fruit will develop to its full extent, ready to be dropped into the sea so that it can grow into a new tree. Fallen trees can burrow directly into the ground and grow or drift away, far from where the parent tree is, looking for a shallower place. After ripening and falling into the water, the mangrove will float until it reaches a shallow edge. When finding a shallow place, the position of the tree will become vertically upright, then it grows roots, branches and its first leaves (Bengen, 2004). After ripening and falling into the water, the mangrove will float until it reaches a shallow edge. When finding a shallow place, the position of the tree will become vertically upright, then it grows roots, branches and its first leaves (Bengen, 2004). After ripening and falling into the water, the mangrove will float until it reaches a shallow edge. When finding a shallow place, the position of the tree will become vertically upright, then it grows roots, branches and its first leaves (Bengen, 2004).

Factors Affecting Mangrove Growth

According to Kusmana et al., 2000 several environmental factors that influence mangrove growth are as follows: coastal topography; climate; ups and down; waves and currents; salinity; dissolved oxygen; soil; nutrients and protection. Pasangsurut is a very determining factor in the zoning of mangrove flora and fauna communities. Changes in salinity levels at high tide are one of the factors that limit the distribution of mangrove species, especially the horizontal distribution. In areas that are always inundated, only *Rhizophora mucronata* grows well, while *Bruguiera spp. and Xylocarpus spp.*rarelydominatefrequentlyinundatedareas.

Mangrove ecosystems are natural resources of tropical areas that have multiple benefits both in ecological and socio-economic aspects. The magnitude of the role of mangrove ecosystems for life can be seen from the many types of animals both living in water, on land and in the canopy of mangrove treesand human dependenceontheseecosystems.

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METHODOLOGY

This research has been carried out around the Bitung-LIPI Marine Biota Conservation Workshop on Lembeh Island, Lembeh Utara District, Bitung City. This field work practice was carried out on 18 and 30 July 2019 at 08.00 to 16.30 WITA. The location and geographic position of each street vendor station is presented in Table 1.

Table 1. Geographical position, number of transects and substrate descriptive characteristics of each location of the field work practice

LOCATION	SAMPLE	CORDINAT	∑transek	SUBSTRATE
		NS		
Lirang Beach	LMBEM01	01, 54322 125, 29348	3	Coral reef
Lirang Beach	LMBEM02	01, 43783 125, 29190	3	Sandy Mud
Mawali	LMBEM03	01, 54321 125, 24503	3	Muddy sand
City Door	LMBEM04	01, 45230, 125, 22885	3	Mud

The percentage value of mangrove community canopy cover and mangrove forest health was approached using the Hemispherical Photography method (Dharmawan and Pramudji 2014). A total of 3 plots measuring 10 mx 10 m at 4 research stations were made to limit the area for taking photos. Each plot was photographed 5 times in each plot, the circumference of the tree trunk was measured parallel to the chest height and each mangrove species was identified based on the data presented by (Giesen,*et al*., 2006).

Results analysis

Photo The hemispherewasanalyzedusingImageJsoftwaretoobtainthepercentagevalueofcommunitycanopycoverbasedonthedivisionbetweenthenumberofvegetationpixelsandallpixels, thenmultipliedby 100% (Dharmawan andPramudji 2014). The circumferencevalueofeachresearchstationwasenteredintothe 100_10x10 templatetoobtaintreedensity, numberofspeciesandimportantvalueindex (IVI) values. All univariate data (percentageofcommunitycanopycoverandtreedensity) were analyzeddescriptivelytoobtainmeanvalues andstandarddeviations.

The interpretationofthe status ofmangrovecommunityhealthconditionsiscarriedout in thecategoriesstipulated in theDecreeoftheMinisterofEnvironment No. 201 of 2004 concerning Standard CriteriaandGuidelinesforDetermining Mangrove Damage.

RESULTS AND DISCUSSION

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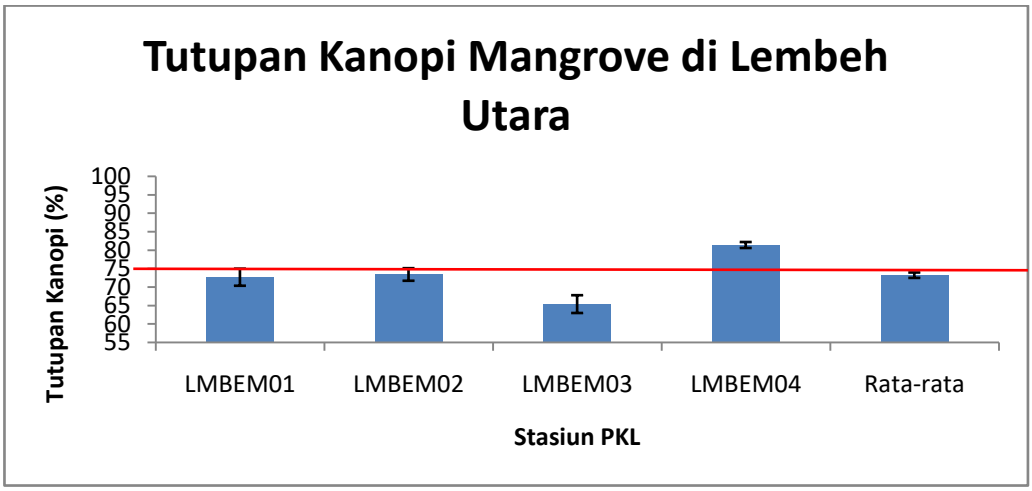

Figure 2. Percentage of mangrove canopy cover at each street vendor station and the average (Average). Note: The red line shows the boundary between medium (> 50-75%) and dense (> 75%) cover categories.

Mangrove Cover at LMBEM01

Mangrove Cover at LMBEM02

Mangrove Cover at LMBEM03

Mangrove Cover In LMBEM04

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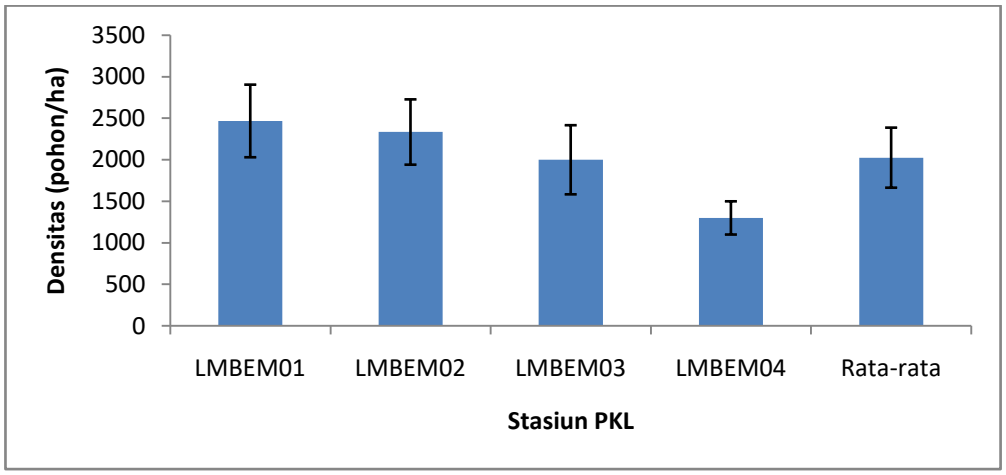

Figure 3 Tree density per hectare at each PKL station and the average value (LMBEM01-LMBEM04). as well as the average value.

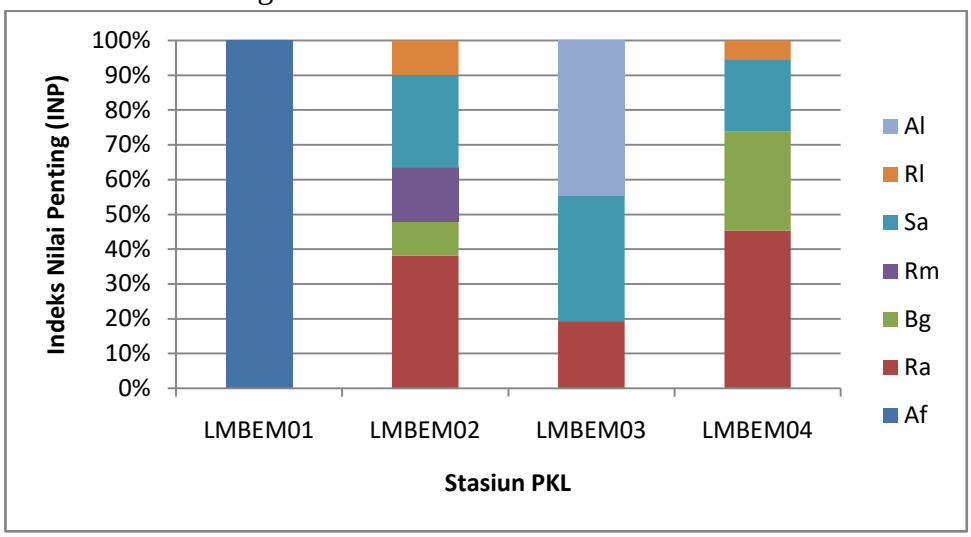

Figure 4. Importance value index (IVI) of each species at each street vendor station (SA sg = Sonneratia alba; AL = Avicennia lanata; RA = Rhizophora apiculata; RM = R. mucronata; BG= Bruguieragymnorrhiza; RL = Rhizopora Lanata)

Based on the Decree of the Minister of Environment No. 201 of 2004 concerning Book Criteria and Guidelines for Determination of Mangrove Damage, the value of the canopy cover of the mangrove community on North Lembeh Island indicates that the condition of the mangrove community is still in quite good condition.Based on Reference to the Decree of the Minister of Environment No. 201 year 2004, mangrove conditions on the island of Lembeh Utara are in good condition with the percentage of canopy cover showing the boundary between moderate (> 50-75%) and dense (> 75%) cover categories. However, the diversity of species is very low and only dominated by Rhizophora apiculata. the muddy substrate supports the growth of this species well. This plant grows best in areas of sand, mud, clay, and a combination of these (Duke, 2006). The mangrove condition is classified as good in the research location because it is close to the natural tourism area, and the low activity of residents towards mangrove forest destruction.

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Based on the 2015-2035 RZWP3K document of North Sulawesi Province, the area of mangroves spread across North Sulawesi is 11,691.41 ha with a relatively good condition even though there is still land clearing for ponds and logs. The highest area of the mangrove ecosystem is in North Minahasa Regency with an area of 4,707.87 ha. While the lowest mangrove ecosystem area is in Bitung City including Lembeh Island with an area of 47.13 ha (Pratiwi et al. 2013).

Based on the Ministry of Environment Decree No. 201 of 2004, stations that have substrate mixed with sediment are LMBEM02, LMBEM03 and LMBEM04 stations dominated by rhizoporaapiculata and Avicennialanata prefer to grow on a slightly sandy and hard muddy substrate (Lee et al. 2015). At station LMBEM01 is dominated by AegicerasFloridum because at station LMBEM01 has a rocky substrate, the AegicerasFloridum Mangrove grows well on a corroded substrate (Noor YusRusila et al, 2006).

Of the four stations, Rhizopora apiculata is dominated by plants that grow well in areas where there is a lot of mixed sandy mud sediments and in locations that are protected from strong waves, as well as in estuary areas which are quite far from the offshore (Lee et al., 2015). Based on the reference to the Decree of the Minister of Environment No. 201 in 2004, all research stations on North Lembeh Island are in good condition. The station which has a sandy and muddy substrate (LMBEM02 and LMBEM04) is dominated by Rhizopora apiculata while the station (LMBEM 01) is dominated by Aegiceras Floridum species that live on coral substrate.

The increasing density of mangroves at four stations (LMBEM01), (LMBEM02), (LMBEM03), and (LMBEM04), namely from the results of research, each number of mangroves in station at station one (LMBEM01), totaling 84 stems, station two (LMBEM02)), totaling 123 stems, station three (LMBEM03), totaling 86, and at station four (LMBEM04), there are 95 stems from the results of research on the island of Lembeh Selatan at LMBEM01 station which has the highest density value with a density value of 2500 per hectare. While the lowest density is at LMBEM04 station with a tree density value of 1500 per hectare. The decrease in the number of mangroves on North Lembeh Island when the research was carried out could be caused by the construction of fishing boat docks and community activities on North Lembeh Island which is located in Mawali.

The four mangrove forest monitoring stations in the North Lembeh area have different conditions. Based on the reference to the Decree of the Minister of Environment No. 201 of 2004 the research station for the coastal area of Lembeh Island, has very good mangrove conditions. At this station (LMBEM04), it has a canopy cover value (> 80%) and the station (LMBEM02), (LMBEM01) has a canopy cover percentage (> 75%) while at the station (LMBEM03) it has a canopy cover percentage (> 65%) Researchers The 2019 Bitung-lipi Marine Biota Conservation Workshop in the Lembeh Strait Island and its surroundings, for the opportunity and guidance in conducting street vendors. Tomlinson (1994) added that the species Rhizophora apiculata, Rhizophora sylosa, and Rhizophora mucronata are scattered in several islands in Indonesia. At the station (LMBEM02), they have the highest species diversity,

Based on the results of research on mangrove ecosystems found in North Lembeh, it has an average value from the stations (LMBEM01), (LMBEM02), (LMBEM03) and (LMBEM04) with a percentage of cover (> 75%) this shows that mangrove forests on the island of North Lembeh classified as forest conditions in the good category. The condition of the mangrove forest which is

located on Lembeh Island, especially in North Lembeh, is classified as healthy because human activities are still very rare. The local government needs to carry out a sustainable spatial plan for mangrove forests on Lembeh Island, especially in North Lembeh.

CONCLUSION

The condition of the mangrove community in the waters of Lembeh Island, especially in North Lembeh, is in the good category with a large average percentage of canopy cover (> 50-75%) and dense (> 75%). Overall, Rhizophora apiculata was the most dominant species in the area, followed by Sonneratia alba of the seven species found in the study site. The substrate condition is very

REFERENCES

1. Aslianti, T.(2010). Reproductive Biological Studies of Sunu Grouper (Plectropomusareolatus) in the Fishing Season. Journal, Aquatic Resources Management Study Program. Haluoleo University. TridharmaAnduonohu Kendari Campus.
2. Asri, RS.(2001). Quality Control System for Live Lobster (Panulirus sp) Handling for Export Purposes. Thesis, Fishery Resources Utilization Study Program. Faculty of Fisheries and Marine Sciences, Bogor Agricultural Institute.
3. Hana. (2011).Evaluation of Sea Cucumber Stock Tracing in the Seagrass Conservation Habitat of Pramuka Island, Seribu Islands, Jakarta. Thesis, Department of Aquatic Resources Management. Faculty of Fisheries and Marine Science. Bogor Agricultural Institute.
4. Manurung DM.(2009). Chemical Composition, Fatty Acids and Cholesterol of Ronggeng Shrimp (Harpiosquillaraphidea). Thesis, Due to Boiling. Department of Aquatic Product Technology. Faculty of Fisheries and Marine Sciences. Bogor Agricultural Institute.
5. Hamidun, M.S, *et al*. (2021). The Land Suitability Analysis for Ecotourism Development around Lake Tondano. *Annals of the Romanian Society for Cell Biology*, 3997–4001. Retrieved from http://annalsofrscb.ro/index.php/journal/article/view/5066
6. Marzuqi M, *et al*. (2010). Utilization of Single Cell Protein as Feed Material for Sand Crab Fish (Epinepheluscorallicola). JournalJl. Br. Gondol, Gerokgak District, Buleleng Regency, Postal Box 140 Singaraja, Bali 81101.
7. Boalemo Regency Government.(2008). Annual Fisheries Report Statistics for Boalemo Regency.
8. DHARMAWAN, I Wayan Eka.*Panduan Monitoring Status Kesehatan Komunitas Mangrove / I Wayan Eka Dharmawan; Editor. Pramudji* .2014
9. RPJM Bajo Village, Tilamuta District, Boalemo Regency, Gorontalo Province 2015.
10. Pratiwi, dkk. (2015). DayahambatekstrakdaunpepayaterhadapadhesibakteriPorphyromonasgingivalis pada neutrofil. J Pustaka Kesehatan. 3(2):194- 197.
11. Rusmadi., H Irawan., F Yandri. (2009).Biology Study of Crab in Inner Bay Waters, Malang Village Meeting in Bintan Regency, Riau Islands Province. Journal, Department of Marine Science. Faculty of Marine and Fisheries Sciences. King Ali Hajj Maritime University.
12. Husain,R., Yapanto,L.M., Pasilia, G.J. (2021). Analysis of Organoleptic and Chemical Quality of Dodol Ketan with the Addition of CarabanxLeptolepis Flour. *Annals of the Romanian Society for Cell Biology*, 2927–2937. Retrieved from http://annalsofrscb.ro/index.php/journal/article/view/1758
13. Siregar, YI. (2015). Exploring the Potential of Indonesia's Marine Resources. Paper, Marine Science Program. Faculty of Fisheries, UR. Bina Widya Panam Campus. Pekanbaru Riau.

14. Stanis, S. (2005). ManagementofCoastaland Marine Resources throughEmpowermentofLocal Wisdom in Lembata Regency, East Nusa Tenggara Province. Thesis, Master Program in Coastal Resource Management. DiponerogoUniversity Semarang.
15. Susilowati, I. (2012). Towards Sustainable Fisheries Resources Management Based on Ecosystems. Thesis, Diponerogo University. Karimunjawa, Central Java.
16. Suprapto D, *et al*.(2014).Growth of Scylla serrata Mud Crab Given Various Types of Feed. Journal, Department of Fisheries. Faculty of Fisheries and Marine Sciences. Diponerogo University.
17. Sylvia Y.(2011). Study of Potential Development of Sea Cucumber Protein Functional Characteristics as Indonesian Local Marine Resources to Increase National Competitiveness. Journal, Bogor Agricultural University.
18. Syamsuddin., A. Mallawa., A. Salam., Y. Koniyo. (2014).Sustainable and Environmentally Friendly Capture Fisheries Development Strategy in Gorontalo Province. Journal, Gorontalo State University
19. Tumengkol, S.(2013). PotentialsandProblems in the Development ofCoastalAreasandOceans. Journal, Sam Ratulangi University. FacultyofSocialandPoliticalSciences. Manado.
20. Kankaew, K., Yapanto, L. M., Waramontri, R., &Arief, S. (2021). *Uncertain Supply Chain Management Supply chain management and logistic presentation : Mediation effect of competitive advantage*. *9*, 255–264. https://doi.org/10.5267/j.uscm.2021.3.007
21. Kusmana, C., S. Wilarso, I. Hilwan, P. Pamoengkas, C. Wibowo, T Tiryana, A. Triswanto, Yunasfi, & Hamzah. (2003). Teknik Rehabilitasi Mangrove. Bogor: FakultasKehutanan IPB.
22. Yapanto, ML, &Modjo, ML. (2018). Assessingpublicawareness level onthepreservationofcoralreefs (The case study in Biak Numfor, Papua, Indonesia). In Copyright @ EM International.*Ecology, Environment and Conservation* (ISSN: 0971765X). Vol 24:4 Page 1931-1939
23. Watson, J. B. (1928). *Psychological care of infant and child.* W W Norton & Co.