

**COMPOSITION AND STRUCTURE OF MANGROVE ASSOCIATES
VEGETATION IN KWANDANG COASTAL AREA NORTH GORONTALO
REGION AND MANANGGU COASTAL AREA BOALEMO REGION**

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Abstract

Mangrove Association are plants that can adapt and tolerate in the environmental factors that are extreme ecologically in the coastal areas. That factor is salinity levels. This study described about the composition dan structure of mangrove vegetation. In order this result will support the management and utilization of mangrove associates. The method are used survey method at 2 locations, Kwandang coastal area and Managgu coastal area. Each location is made transects perpendicular from the shoreline to the land, on each transect have 6 plots, and placed on the right and left are intermittent, so the number of plots from the four stations is 24 plot. The plot size is 10 x 10 m². Environmental parameters measured are soil salinity, soil pH, soil texture and moisture. Data were analyzed by descriptive and quantitative vegetation parameter calculation and computation ordination. The results showed that in the Kwandang coastal areas and Managgu Coastal found 19 species of Mangrove Association, among others; *Derris trifoliata*, *Clerodenron inerme*, *Spinifex litoreous*, *Ipomoea pes-caprae*, *Pongamia pinnata*, *Sesuvium portulacastrum*, *Vitex ovate*, *Pluchea indica* L, *Canavalia maritime*, *Passiflora feotida*, *Cyathula prostrata* (L.), *Morinda citrifolia* L, *Terminalia catapa*, *Scaevola taccada*, *Stachytarpheta jamaicensis*, *Calotropis gigantean*, *Pinus mercusii*, *Dalbergia latifolia* Roxb, and *Thespesia populnea*. There are differences parameter values of mangrove vegetation associations and the difference in pattern formation in the Kwandang coastal area and Managgu coastal area. There are differences in the micro-environment factors, soil salinity, pH, texture and moisture of air, at both locations.

Key words: Mangrove asosiation, vegetation structure, coastal area

INTRODUCTION

A community consists of many species with a wide range of population and interactions with each other. The interaction happened in certain environment. One form community is mangrove forests . According to Noor (2006), currently in Indonesia has mangrove forests between 3.5 million hectares with 202 mangrove plant species. There are the true mangrove (exclusive mangrove) and non true mangrove (mangrove associates). According Tomlison in Setywan , et al (2008), the true mangrove is a plant which has fully habitat in tidal areas, in morphologically adapted. True mangrove, namely; *Avicennia*, *Bruguiera*, *Ceriops*, *Lumnitzera*, *Nypafruticans*, *Rhizophora*, and *Sonneratia*. Mangrove association is the other plant other than true mangrove pan that has tolerant to environmental condition factors like salinity in coastal

areas and it can interact with the true mangrove. Mangrove association include Terminalia, Hibiscus Thespesia, Calophyllum, Ficus, Casuarina, some peas and bush like Aslepiadaceae and Apocynaceae. One of the mangrove area in Indonesia, located in Gorontalo province, precisely in Kwandang coastal area in North Gorontalo district and Mananggu coastal area in Boalemo district. For mangrove in Kwandang coastal areas, based on research conducted by Katili (2009) the extent of area to 1800 ha and based on the latest data in 2011 total area decreased to 1,225 ha area. As for the mangrove areas in Mananggu coastal area, based on the report of the working group (WG) of mangrove resource management in 2010 achieve to 1005.48 ha.

Setiawan (2008), revealed that the vast mangrove areas will determine the diversity of plant species. Actually the most of researchers focus their study for the true mangrove, while the studies of mangrove mangrove associates is still relatively minimal. On the other hand, steadiness and stability of a mangrove ecosystem may occur if supported by mangrove associations and it play an important role like formed the diversity component in a mangrove ecosystem. In mangrove ecosystem, the vegetation components involved and associated with one another and it will establish the stability of the ecosystem. This argument makes the research important to studied. One form of studies is the introduction, composition and vegetations structure of mangrove associates. The aims of this study, to inventory mangrove association species, to know the composition and structure of vegetation mangrove association that exist in Kwandang coastal area and Mananggu Coastal area.

Mangrove associates are plants that can adapt and provide tolerance to environmental extreme factors like high salinity levels. Besides that plant communities are not found exclusively in the mangrove forest vegetation which is the transition to land or sea, but its can interact with the true mangrove. As plant which resistant to salinity, it is appropriate with the concept of tolerance Shelford which states that each organism has a limit of tolerance to factor in the environment to compete and survive Odum (1998). In this case, mangrove association plant species have the ability to adapt to extreme environments, so it can grow in the mangrove ecosystem. Examples of mangrove associates namely Terminalia, Hibiscus, Thespesia, Calophyllum, Ficus, Casuarina, some peas, and bush Aslepiadaceae and Apocynaceae (Ahmad Setiawan et al, 2002). The benefits of this study is to obtain information and data base on various of mangrove association plant species, as well as the composition and structure of its vegetation, so that it can have implications for the management and conservation of mangrove forests that will be undertaken by local governments and communities in both these areas. Other benefits academically, the results of this study may be give material in the learning activities in ecology and botany courses

RESEARCH METHOD

This study used a descriptive survey method. Data were collected by line transect method. The data obtained in quantitative descriptive analysis by describing the mangrove associations species where found, vegetation composition and structure of mangrove associations vegetation that existed at the study site in the Kwandang and mananggu coastal area.

Location of this study in the Kwandang coastal area in North Gorontalo district and Mananggu coastal area in Boalemo district. The location determination is done with tools compass and global positioning system (GPS). In each study have station for observation and sampling. Distribution of stations based on the appearance of mangrove vegetation, characteristic of each region, ease of laying transect lines, laying plots representative and based on the results of interviews between researchers and the official of local forestry department who oversee the region. Each station is considered to represent the characteristics of the region. In each station made transects perpendicular from the shoreline to landward, on each transect made 6 plot are placed on the right and left, so the number of plots to 24 plots in 4 stations.

Plots were made measuring 10 x 10 m². Environmental parameters measured include water salinity, soil salinity, soil texture, humidity, and soil pH.

The data are mangrove association plant species were analyzed descriptively by describing the characteristics of the plant species and the taxonomic hierarchy by referring to the manual book Introduction Mangroves in Indonesia By Noor et al (2006) The composition of mangrove associations vegetation conducted by calculating the number of its individuals which became members of each mangrove associations spesies. The calculation of mangrove assosiation vegetation structure conducted with calulate the vegetation structure in the form of dominance, relative dominance, density, relative density, frequency, relative frequency, and the important value index. The analysis also performed by calculating vegetation diversity index and the pattern of ordination. Calculation ordination of community data summarizing many species and many samples with measurement data pouring over charts describing patterns of species. Ordinated useful to know and recognize patterns of attendance at community data that were examined (Waite , 2000).

RESULT AND DISCUSSION

A. Classification of Mangrove Assosiation Plant Spesies

There are 19 spesies of association mangroves which found in Kwandang and Mananggu coastal area. They are; *Derris trifoliata*, *Clerodenro ninerme*, *Spinifex litoreous*, *Ipomoea pes-caprae*, *Pongamia pinnata*, *Sesuvium portulacastrum*, *Vitex ovate*, *Pluchea indica* L, *Canavalia maritime*, *Passiflora feotida*, *Cyathulapro strata* (L.), *Morinda citrifolia* L, *Terminalia catapa*, *Scaevola taccada*, *Stachytarpheta jamaicensis*, *Calatropis gigantean*, *Pinus*, *Dalbergia latifolia* Roxb, and *Thespesia populnea* . The species included in 2 division, they are Magnoliophyta and Coniferophyta; 3 class; Magnoliopsida, Liliopsida, and Pinopsida, 13 Order; Fabales, Caryophyllales, Lamiales, Solanales, Asterales, Myrtales, Gramiales, Violales, Rubiales, Asclepiadales, Goodeniales, and Pinales, 17 Family; Fabaceae, Aizoaceae, Amaranthaceae, Verbenaceae, Passifloraceae, Convolvulaceae, Asteraceae, Rubiaceae, Combretaceae, Graminae, Papilionaceae, Asclepiadaceae, Convolvulaceae, Goodeniaceae, Verbenaceae, Malvaceae, and Pinaceae. There are 9 same species in both locations. These species namely; *Derris trifoliata*, *Clerodenro ninerme*, *Spinifex litoreous*, *Ipomoea pes - caprae*, *Pongamia pinnata*, *Sesuvium portulacastrum*, *Vitex ovate*, *Pluchea indica* L, and *Canavalia maritime*.

B. Mangrove Assosiation Vegetation structure in Kwandang and Mananggu Coastal Area

Based on Table1 and Table2 can be seen the vegetation parameter values of mangrove associations and classifications of plants under the shade of a tree in Mananggu coastal areas.

Table 1. Mangrove Associations Vegetation Structure Under Auspices Group in Mananggu Coastal Area

No.	Species name	Sum	K	KR	F	FR
1	<i>Spinifex literus</i>	92	0.230	17.23	0.57	14.96
2	<i>Sesuvium portulacastrum</i>	85	0.031	15.92	0.71	18.64
3	<i>Ipomoea pes-caprae</i>	60	0.150	11.24	0.28	7.35
4	<i>Scaevola taccada</i>	50	0.125	9.36	0.14	3.67
5	<i>Stachytarpheta jamaicensis</i>	41	0.103	7.68	0.14	3.67
6	<i>Vitex ovata</i>	39	0.098	7.30	0.14	3.67

7	<i>Derris trifoliata</i>	26	0.125	4.87	0.14	3.67
8	<i>Clerodendrum inerme</i>	22	0.050	4.12	0.14	3.67
9	<i>Calotropis gigantea</i>	15	0.038	2.81	0.28	7.35
10	<i>Finlaysonia maritima</i>	15	0.038	2.81	0.14	3.67
11	<i>Pluchea indica Less (Beluntas)</i>	20	0.050	0.18	0.14	3.67
Total		465	1.038	83.52	2.82	73.99

In Table1, presence the first species that have a high value vegetation parameters. Mangrove associations species such as *Spinifex literus* which has a density value 0.230/m², and frequency 0.57%. The second species that have the largest vegetation parameter value is *Sesuvium portulacastrum*, which have density value 0,031/m² and frequency 0.71%. When compared with other species that are found in Mananggu coastal areas, we can say that the both species can be categorized often found.

Table 2. Mangrove Association Vegetation structure in the trees group at Mananggu Coastal Area

N o.	Species Name	Sum	K	KR	D	DR	F	FR
1	<i>Pinus merkusii</i>	39	0.098	7.30	1.98	56.97	0.28	7.35
2	<i>Pongamia pinnata</i>	20	0.050	5.75	0.5	42.33	0.43	11.29
3	<i>Dalbergia latifolia Roxb</i>	1	0.003	3.74	0.059	1.9	0.14	3.67
4	<i>Thespesia populnea</i>	9	0.023	1.69	0.56	23.73	0.14	3.67
Total		69	0.174	18.48	3.09	124.93	0.99	25.98

In Table 2, for the class of trees presence the certain species has high vegetation parameters value. Those species are *Pinus merkusii* has density value 0.098/m², frequency value 0.28%, and dominance value 1.98/m². The second species is *Pongamia pinnata*, with has density value 0.050/m², frequency value 0.43%, and dominance value 0.5/m². When compared with other species belonging to the tree we can say that both of these species can be categorized often found in this region.

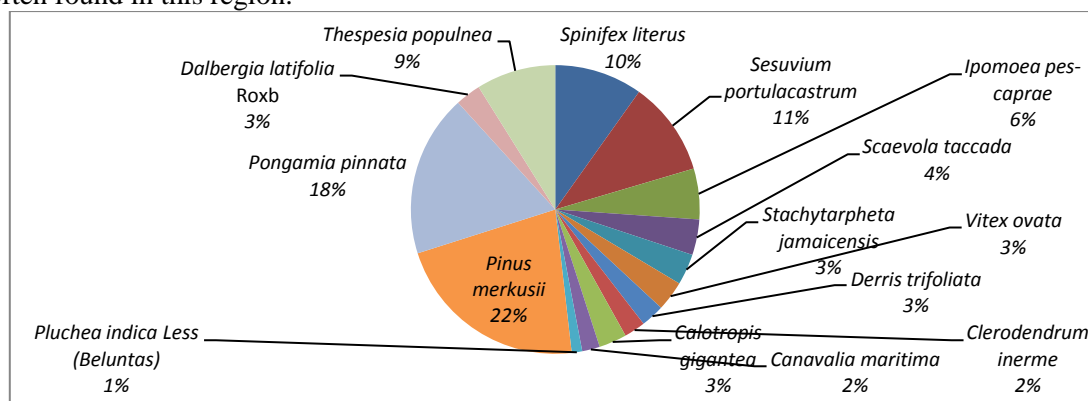


Figure1. Comparison Chart Of Importance Value Each Mangrove Associates Species In Mananggu Coastal Areas

Based on the diagram we can be seen that there are two species of mangrove association spesies under spesies plants group that dominate in this region. They are *Sesuvium portulacastrum* (11%) and *Spinifex litoreous* (10%), and the trees group that dominate are *Mercusii Pinuss* pecies (22%) and *Pongamia pinnata* (18%).

Table3. Mangrove Associations Vegetation Structure Under Auspices Group in Kwandang Coastal Area

No.	Species Name	Sum	K	KR	F	FR
1	<i>Derris trifoliata</i>	185	0.460	46.150	0.670	24.910
2	<i>Clerodenron inerme</i>	98	0.250	20.600	0.500	18.590
3	<i>Spinifex litoreous</i>	80	0.200	16.480	0.600	22.300
4	<i>Ipomoea pes-caprae</i>	36	0.090	7.420	0.220	8.180
5	<i>Stachytarpheta jamaicensis</i>	41	0.103	7.68	0.14	3.67
6	<i>Sesuvium portulacastrum</i>	21	0.053	4.370	0.170	6.310
7	<i>Vitex ovata</i>	5	0.013	1.030	0.060	2.230
8	<i>Passiflora feotida</i>	3	0.008	0.620	0.060	2.230
9	<i>Pluchea indica Less</i>	20	0.050	4.120	0.110	4.090
10	<i>Cyathula prostrata (L.)</i>	10	0.025	2.060	0.060	2.230
11	<i>Finlaysonia maritima</i>	6	0.015	1.240	0.060	2.230
12	<i>Morinda citrifolia L.</i>	3	0.008	0.620	0.060	2.230
Total		482	1.2085	107.84	2.63	97.76

In Table 1, present the first species that have a high value vegetation parameters. Mangrove associations species such as *Derris trioliata* which has a density value $0.460/m^2$, and frequency 0.670% . The second species that have the largest vegetation parameter value is *Clerodenro ninerme*, which have density value $0,250/m^2$ and frequency 0.500% , the third species is *Spinifex litoreous* which have density value $0.200/m^2$ and frequency 0.600% . When compared with other species that are found in Kwandang coastal areas, we can say that three species can be categorized often found.

Table 5. Mangrove Associations Vegetation Structure Under Auspices Group in Kwandang Coastal Area

No.	Species Name	Sum	K	KR	D	DR	F	FR
1	<i>Terminalia catapa (ketapang)</i>	2	0.005	0.410	0.108	10.800	0.060	2.230
Total		2	0.005	0.410	0.108	10.800	0.060	2.230

In Table 5, for the class of trees presence only one species has high vegetation parameters value, It is *Terminalia catapathe* has density value $0.005/m^2$, frequency value 0.060% , and dominance value $10.800/m^2$. We can say this species can be considered rare in this region, although the frequency of discovery smaller when compared with gorup of mangrove association under auspices. This caused by the stature of this species is classified as tree and has dikotil roots,so its perfectly adapted to the conditions in the Kwandang coastal are as substrate

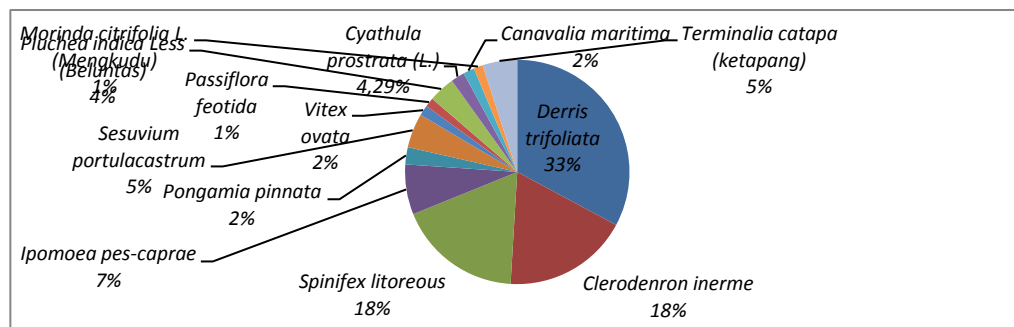
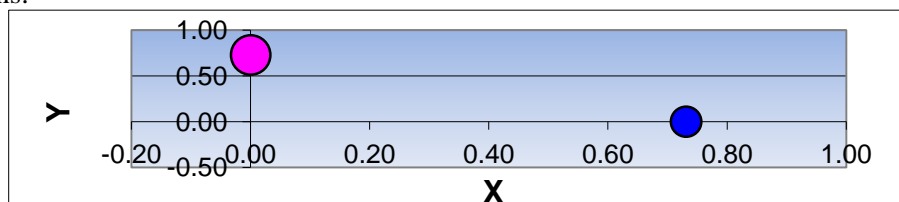


Figure 2. Comparison Chart Of ImportanceValue Each Mangrove Associates Species In Kwandang Coastal Areas

Based on the diagram we can be seen that there are three species of mangrove association species that has dominate in this region, they are *Derris trifoliata* (33%), *Spinifex litoreous* and *Clorodendon Inerme* (10%). If comparated with Mananggu coastal, it can seen there has one spesies which same and dominated in both area, it is *Spinifex litoreous*. It is a shrub plant and founded in mound of ground or sand. This fact related with morphologic traits that has needle-shaped leaves structure, so this spesies vulnerable to live in submerged water habitat for long time. *Sesuvium portulacastrum* also has individual distribution abundant with physique shape like herbs and has small leaves structures, so it can adapt in a dry or sandy soil. Both of these spesies are the most dominant and has the most extensive distribution compared to other spesies in along the edge of the mangrove land. Its growing on stretch of mud and sand. Generaly its mostly growing in sand substrate and silt. Its caused this spesies has the ability to bind the sand.

C. Vegetation ordination of Maangrove Association in Mananggu dan Kwandang Coastal Area

Two-dimensional ordination of mangrove associations vegetation used to shows a grouping based on the density and frequency of each species and vegetation pattern of the two observation sites. In calculating the ordinated obtained the PV (prominance Values) or a value to indicate the habitat suitability of the community. The following chart ordinated observed at both locations.



Information :

- Kwandang
- Managgu

Figure 3. Ordinated Chart of Mangrove Association Vegetation in Mananggu and Kwandang Coastal Area

Based on the ordination chart that the pattern of mangrove association vegetation It can also be said that in both area have different formations. This difference may be due by different characteristics the of both region. In Kwandang coastal areas has characteristic substrate composed mostly of mud, while Mananggu coastal area has largely sand and mud substrate. In both area, indicate the prominace Values are different. Besides that, the differences of tidal in both of area causes differences fluctuations salinity level in both area.

Based on the results of research can be described, in Kwandang coastal area obtained 13 species of mangrove associates plant which have varying tolerance to environmental factors. Environmental factors greatly affect to the existence of a species especially for growing and thrive. Just as proposed by Katili (2009), to grow and develop properly, each species requires different growing requirements so it is to enable the efficient allocation of energy to growth. *Derris trifoliata* is one of the plant species that dominates the entire mangrove associations plant area in Kwandangcoastal area. It cause the number of individuals of this spesies are found much more than other spesies. This is due to the ability of these spesies are well adapted to salinity and soil texture. As known that the is spesies classified in the euryhaline plants. Euryhaline plants is a plant that able to adapt well in different salinity levels. This spesies has founded in every sampling point and is able to live with the condition of the soil is sandy, muddy sand and muddy, but these spesies are more often found in muddy soil with a pH range

from 5 until 7.2 and humidity levels ranging from 68 % until 88 %.

Derris trifoliata often found associated with true mangroves such as *Rhizophora* and *Avecennia*. The tolerance ability of this species in environmental factors affecting the distribution of species. According Wirakusumah (2003), the existence of a broad distribution of species indicates that the species has the ability to take advantage of environmental factors as well as possible so it is very influential in the community. The Other species like *Clerodendro ninerme* also one species of mangrove associates that has a good physiological adaptation to the environment. Its cause the spesies able to tolerate the sandy soils at low tide area, the edge of mangrove forest land that has sandy mud with the tolerance range of pH 5-7 , 2, the humidity ranged between 68 % - 88 %, and the salinity level 3.50 mmhos/cm until 11.90 mmhos/cm. This spesies Often found in association with a true mangrove *Bruguiera* species. Other mangrove species association that *Passiflora feotida*, *Pongamia pinnata* and *Vitex ovata* are not quite tolerant of coastal environmental factors, this can be seen in the number of species that found very little. *Passiflora feotida* encountered in open areas with sandy soil conditions, the range of pH 5, humidity 80 %, and salinity of 8.27 mmhos/cm. Similarly with *Pongamia Pinnata*, this plant is found only on sandy soils in the area of lowest tide, with salinity levels are very low at 2.5 mmhos /cm , pH at 4 and humidity at 70 %. While *Vitexovata* found on muddy soil with pH level at 6.6, humidity level at 88 %, and salinity level at 12.6 mmhos/cm. The unique this species is can be tolerance to high salinity levels. Furthermore *Sesuvium portulacastrum* and *Ipomoea pes-CaPre* an herbaceous plant found in coastal Kwandang, both of plant grow in sandy areas because this these spesies can bind the sand. Setiawan (2008) stated that both of these plants contribute as a soil stabilizer sand thus facilitating the presence of other plants to grow. This is evident in the location, there are other species such as *Spinifex litoreous* and other true mangrove species that grow around this of plant.

In Mananggu coastal areas, obtained 15 species of mangrove associates. Most of these plants are shrubs plant, the second are trees plant, and the least is liana sand herbaceous. The most dominating species are *Spinifex literus* and also *Sesuvium portulacastrum* and *Ipomea pes-caprae*. All three of these species can be found living and interacting together in a particular area. The third the most dominant species, its caused the they are cosmopolitan species and have a great range tolerance on physical environmental factors changes (Kusmana,1997). This is evidenced by the ability of these spesies to survive in high salinity conditions. *Sesuvium portulacastrum* has salinity environmental level at 9.9mmhos/cm, *Spinifex literus* at 10.5, and *Ipomeapes-caprae* at 5.01 mmhos/cm, while for pH *Sesuvium portulacastrum* at 5.9, *Spinifex literus* at 5.1, and *Ipomeapes-caprae* 6.1. The humidity factor of these spesies ranged between 50-65%.

Other species present in the study site is *Scaevola taccada* with salinity levels at 10.3 mmhos /cm, *Pinus mecusii* 9.7 mmhos/cm ,*Stachytar phetajamaicensis* 8.7 mmhos/cm, and *Vitex ovata* 8.6 mmhos/cm. these spesies have a high tolerance to salinity and can be classified as a species tolerant to environmental factors and a pioneer plants in sheltered beach land, as well as have the ability to occupy and grow at different tidal habitats (Haroen, 2002). This can be evidenced by the high number of each species distribution. Its cause that these plant can adapt and grow on various substrates namely sandy substrate, sandy mud, and mud hard, that has pH level from 4.2 until 7.3, and the humidity lever 50-65%. *Thespesia populnea* is a plant looks like a tree, growing on sandy substrate with low of individual distribution, but its has a high tolerance to environmental factors with low salinity levels at 2.6 mmhos/cm , as well as with *Derris trifoliata* that has salinity levels at 2.6 mmhos/cm. Compared with other species, both of species are relatively tolerant at low salinity level. According Setiawan (2008) that the mangrove associates species were able to grow in environments with low-to- high salinity level

and grow in the transition area with the mangrove plant is generally coastal vegetation. *Derris trifoliata* multiply vegetatively and form a dense mass or thickness and can inhibits the growth of other species.

In open areas, *Derris trifoliata* can grow dense and dominate. This is an initial step process of secondary succession. Others species *Thespesia populnea* and *Derris trifoliata* that have pH level at 7.1 and 7.3, humidity level at 50-60 %. *Calatropis gigantea* have low salinity levels at 4.9 mmhos/cm and *Finlaysonia maritima* is the same. pH level both these plant, do not have significant differences, at level 6.5 and 6.8 and the humidity level at 45-50 %. *Calatropis gigantea* is a dry plains with high distribution. Its ability to adapt to salinity and drought caused the plant grow as a mangrove associate. *Pongamia pinnata* and *Clerodendru minerme* are species with pH levels 6.8 and 7.3, and generally grow on sandy mud substrate. Both of these species are tolerant on salinity levels at 5.8 and 5.6, and humidity level at 50 % and 65 %.

CONCLUSION AND SUGGESTION

The conclusion are; in the Kwandang and Managgu coastal area found 19 species of Mangrove associates, they are; *Derristrifoliata*, *Clerodenroninerme*, *Spinifexlitoreous*, *Ipomoeapes-caprae*, *Pongamia pinnata*, *Sesuvium portulacastrum*, *Vitex ovate*, *Pluchea indica* L, *Canavalia maritime*, *Passiflora feotida*, *Cyathula prostrata* (L.), *Morinda citrifolia* L, *Terminalia catapa*, *Scaevola taccada*, *Stachytarpheta jamaicensis*, *Calatropis gigantean*, *Pinus mercusii*, *Dalbergia latifolia* Roxb, and *Thespesia populnea*. There are a difference in the values of the parameters of mangrove associates vegetation, pattern formation, and micro environmental factors at both locations. Need to do a further research about of mangrove association species that used as bioindikator damage of coastal areas and the relationship between mangrove associates vegetation species and fauna diversity in coastal areas.

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