

## **Mp3ei: Structure And Composition Of Mangrove Species In Formulating Mangrove Database In North Maluku**

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**ABSTRACT :** Coast area of North Maluku is a coastal region of the island chain strung with high potential mangrove vegetation. The structure of mangrove forest vegetation is an organization of individuals in a particular space that form a stand; the composition of the mangrove forest is the typical border, the border is due to the selective effect of land salinity duration and severity of flooding tidal currents. Until now, the populations of mangrove forests data base in the coastal area in the North Maluku are not yet recorded precisely. The acceleration and expansion of the construction can be done through the preparation of a data base mapping of mangrove and mangrove development potential as a food source. The results of this research showed that: 1) the dominant mangrove forest on the function of production forests being converted is equal to 55.33% of the total area of mangroves in the North Maluku; 2) the distribution of the largest mangrove formation is the formation of mangrove forests in South Halmahera regency; and 3) the structure and composition of mangrove species known the most are: *Rhizophora sp*, *Bruguira sp*, *Soneratia sp* and *Avicenia sp* and *Xylocarpus sp*; these mangrove types are spread almost at 9 (nine) districts / cities in the location of research, while the other mangrove species such as *Ceriops tagal*, *Nypa fruticans*, *Camptostemon sp*, and *Peuteria obovata* are found in several sites of the research and dispersed with moderate diversity.

**KEYWORDS:** structure, composition, typical mangrove in North Maluku, database

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### **I. BACKGROUND**

One of various types of coastal and marine ecosystems is a mangrove forest ecosystem. Mangrove forest is typically a tropical coastal vegetation communities, which are dominated by several species of mangrove trees that are able to grow and thrive in muddy coastal areas tidal, argillaceous or sandy (Bengen, 2001). Among the coastal forest formations that have high productivity and biodiversity are found in mangrove forests. Mangrove vegetation is also a part of the coastal and marine ecosystems that provide natural resources production, both as a source of food, minerals as well as energy mining. The other function is as the recreation or tourism areas. The Province of North Maluku is one of the provinces that has the longest coastline because the province is geographically in the form of islands. The coastal area of the North Maluku is a coastal region of the island chain strung with quite high potential mangrove vegetation. The spread of distribution of this vegetation covers coastal waters of South Halmahera, West Halmahera in North Maluku and the islands around. Potential of the coastal mangrove forests of South Halmahera region based on the survey by UNESCO in 1993 was 0.63% of the total mangrove vegetation of the 100/ha coastal area of Maluku and North Maluku (Marimoi, 2004). Until now, the population of the mangrove forests in the coastal area in North Maluku is not yet known. Based on the results of the recent study, the condition of coastal mangrove forests in North Maluku has declined both in quality and quantity from year to year.

The decline of both quality and quantity of mangrove forests has caused in such alarming impacts, such as the increase of abrasion, reduced numbers of catches coastal fisheries, further sea water intrusion and further towards the ground, and the increase incidence of malaria (Bengen, 2002). In order to accelerate and strengthen the economic development in the North Maluku, it should be in accordance with excellence and strategic potential of the islands. The acceleration and expansion of the construction can be done through the preparation of a database mapping of mangrove as well as developing the mangrove potential as food source. Based on this research, there will be a long-term goal that is to produce a master plan and potential mapping through the development of a mangrove database in the North Maluku. There are specific goals to be achieved in this study namely: to get the base model of the data preparation mangroves on the coast of North Maluku and mapping potential of mangrove fruits as an alternative food source (the use of mangrove for living resources).

As for the urgency or priority to be carried out this research are: 1) when the total population of the mangrove species in the form of a database composed and yet unknown, 2) uncharted mangrove vegetation type based on ecological and biological benefits.

## II. METHOD

This study is a first stage of three-stage study: the first stage focused on the preparation of the database of the mangrove forests in the coastal area of North Maluku, while the second stage will focus on the distribution and potential mapping of mangroves in coastal area of North Maluku, and the last stage study will aim at empowering life skills of the community through the development of new food sources from the fruits of mangroves. At this stage, the identification of the structure, composition, distribution pattern which aims to collect primary data and secondary materials in the preparation of database of mangroves in the coastal area in North Maluku. The formulation of the database employed a method used by the Census Method Engineering documents and observational studies (Concentration Count) by Kartono (1994), descriptive analysis and presentation of data of the mangroves.

## III. RESULTS OF THE STUDY

The province of North Maluku as a whole has mangrove land and coastal border with buffer 100 m and the width of the area of  $\pm 55,322.61$  ha; special vast width of mangrove forest in the province of North Maluku is  $\pm 46,259.41$  ha. Of the mangrove area, the mangroves with the category of very density are  $\pm 29,848.83$  ha whereas less dense category is  $\pm 16,410.58$  ha. Based on the functions of the mangrove forests, the distribution of the forests is as follows: 1) Area of the Other Use (APL) covering an area of 13,790.01 ha; 2) Conservation Forest (HL) area of 4,999.04 ha; 3) Production Forest (HP) area of 1,324.07 ha; 4) Production Forest in Conversion (HPK) covering an area of 25,594.35 ha; and 5) Limited Production Forest (HPT) covering an area of 551.94 ha. (BP DAS Akemalamo, 2010). Based on these data, the mangrove forests for production are the dominant forest in the region that can be converted equal to 55.33% of the total area of mangroves that exist in the province of North Maluku. Potential Distribution of Mangrove Areas by Administrative Region districts / cities in the province of North Maluku in 2010 as showed on Table 1 below:

**Table 1. Potential Distribution of Mangrove Areas by Administrative Region districts / cities in the province of North Maluku in 2010**

No.	Districts / cities	Width of mangrove area (ha)	Percentage (%)
1	Ternate	0	0
2	Tidore	1,492.03	6.20
3	Halmahera Barat	1,971.88	12.20
4	Halmahera Utara	2,746	8.13
5	Halmahera Timur	5,751.51	23.73
6	Halmahera Selatan	6,337.99	26.15
7	Halmahera Tengah	1,454.14	6.00
8	Kepulauan Sula	3,489.92	14.40
9	Morotai	774.22	3.19
<b>Total</b>		<b>24,229.26</b>	<b>100.00</b>

Source: The Result of Citra Analysis BP DAS Akemalamo

By seeing the distribution of the mangroves based the administrative regions, each district / city in the province of North Maluku has mangrove forest. The distribution of mangroves for each district / city varies, and the largest mangrove forest formation in South Halmahera, which is on the SWP Bacan watershed. There are some factors that are used to measure the mangrove ecosystem based on the results of research on biophysical measurements covering the long coastline, estuaries, mangrove vegetation types, the girth, tree height and canopy, soil texture, salinity, water clarity, pH, wave height and wave types. The detail description of the biophysical / ecological respective cities / counties is described as follows.

**City of Ternate** has coastline length of 40 km and there are three types of mangrove vegetation found there such as *Rhizophora* sp, *Avicennia* sp, and *Sonneratia* sp. The salinity on mangrove habitats ranges from 26-29 ppm, dusty clay textured soils, pH 7.0, and the wave height ranges from 10-50 cm, the type of daily multiple pairs of mixture leaning with formation of the most dominant land use is for industrial, residential, and ports.

**City of Tidore Islands** has a coastline of 189 km and is the estuary of the major rivers in this area namely Ake Kolano river, Ake Oba river, Ake Lamo Tidore river, and Tayawi river. The mangrove vegetation types found there are categorized into 4 types namely *Sonneratia* sp, *Rhizophora* sp, *Avicennia* sp, and *Nypa* sp, with an average diameter of the tree of 36.72 cm and 5.26 m tall. The salinity ranges from 24-28 ppm, sandy loam soil texture and dusty, the water level of enlightenment bright and the acidity level pH 7.0 as well as wave height ranging from 15-70 cm and the ebb and flow type of daily mixture leaning.

**District of West Halmahera** has a coastline of 281 km and is the estuary of two rivers: Ake Lamo and Ake Ibu. The mangrove vegetation types found there are classified into 5 types: *Rhizophora* sp, *Avicennia* sp, and *Nypa* sp, *Xylocarpus* sp and *Bruguiera* sp with an average of tree diameter of 39.95 cm and tree height of 7.68 m, the salinity ranges from 28-30 ppm, textured sandy soil and sandy loam, pH 7.0 while the advance of the wave height ranges 10-70 cm with the tidal type of semi-diurnal tides.

**District of North Halmahera** has a coastline of 263 km and is the estuary of Tiabo Ake and Ake Kao rivers. There are four mangrove vegetation types found there namely *Rhizophora* sp, *Avicennia* sp, *Sonneratia* sp and *Nypa* sp, with an average diameter of tree of 41.02 m, tree tall of 7.88 m, the salinity ranges from 27-32 ppm, sandy loam soil and sandy-textured, bright waters with pH of 7.0, wave height ranges from 5.0 to 65 cm, while the tidal type daily inclined mixed pairs.

**District of East Halmahera** has a coastline of 436 km and is the estuary of Sangaji and Ake Lamo rivers. There are six types of mangrove vegetation found there namely *Rhizophora* sp, *Avicennia* sp, *Bruguiera* sp, *Sonneratia* sp, and *Nypa* sp and *Comptostemon* sp. The average diameter of the tree is 49.25 m and 8.07 m tall tree. The salinity ranges from 29-33 ppm, textured sandy loam soil conditions, water condition is very bright waters and the acidity of pH 7.7. The wave height ranges 20-80 cm, whereas the tidal type of mixture daily leaning pairs.

**District of South Halmahera** has a coastline of 1,350 km and is the estuary of Ake Lamo and Halsel Sayoang rivers. There are five types of mangrove vegetation found there namely *Rhizophora* sp, *Avicennia* sp, *Comptostemon* sp, *Ceriops* sp, and *Nypa* sp, with the average diameter is 37.65 m, the tall of the tree is 7.30 m, the salinity ranges from 27-32 ppm, soil texture is sandy loam and sandy, the conditions of water belongs to the brightness of bright water with a pH of 7.8. The wave height ranges from 10-65 cm, whereas the tidal type of daily mixture leaning pairs.

**District of Central Halmahera** has a coastline of 275 km and is the estuary of Ake and Kobe Fidi rivers. There are six types of mangrove vegetation found there namely *Rhizophora* sp, *Avicennia* sp, *Sonneratia* sp, *Nypa* sp, *Bruguiera* sp, and *Ceriops* sp, with the average of tree is 47.01 m, 7.91 m tall trees, the salinity ranges from 27-32 ppm, the soil condition is sandy loam textured, water clarity conditions quite clear waters with pH of 7. The wave height ranges 10-70 cm, whereas the tidal type of mixture is daily leaning pairs.

**District of Sula Islands** has a coastline of 1,100 km and is the estuary of Way Samada, Way Kilo, Way Sataku, and Way Ipa rivers. There are seven types of mangrove vegetation found there namely *Rhizophora* sp, *Avicennia* sp, *Sonneratia* sp, *Nypa* sp, *Bruguiera* sp, *Ceriop* sp and *Xylocarpus* sp. The salinity ranges from 29-32 ppm, the soil is sandy and sandy loam texture, brightness of water conditions is relatively clear waters with a pH of 7.8. The wave height ranges 25-85 cm, whereas the tidal type of semi-diurnal tides.

**District of Morotai Islands** has a coastline of 255 km and is the river estuary of Ake Ciu and Ake Sebatai rivers. There are four types of mangrove vegetation found there namely *Rhizophora* sp, *Avicennia* sp, *Sonneratia* sp, and *Ceriops* sp, the salinity ranges from 27-31 ppm, the soil condition is textured clay, water clarity conditions are moderate water with a pH of 7.2. The wave height ranges 30-90 cm, while the pairs of mixed type daily dual skew.

The following is presented the data of the structure and composition of mangroves in the nine locations of districts / cities that has high potentials of mangrove vegetation:

#### **1. District of West Halmahera**

Based on the research data, it can be presented that the data of mangrove seeding composition in Tuada village of Sub-District of Jailolo of West Halmahera consists of 6 types namely *Rhizophora apiculata*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, *Xylocarpus moluccensis*, *Osbornia octodonta*, and *Nypa fruticans*.

Composition of mangrove vegetation in the coastal area of Payo village is found 4 types of mangrove vegetation including *Rhizophora apiculata*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, and *Avicennia alba*. All of the four of mangrove species are classified into true mangrove species.

The composition of mangrove in Gam village of Sub-District Jailolo is found 7 mangrove species including *Sonneratia alba*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Ceriops tagal*, *Bruguiera gymnorrhiza*, *Aveccenia marina* and *Xylocarpus moluccensis*.

## 2. District of South Halmahera

There are 6 types of mangrove vegetation composition in Laanda bay Sub-District of North Obi District of South Halmahera, including *Avicennia alba*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, *Rhizophora apiculata*, *Rhizophora mucronata* and *Xylocarpus granatum* and they are classified into 3 ethnics (family).

There are 5 types of mangroves are being main habitants of mangrove forest in Belang-Belang village, namely *Avicennia alba*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza* and *Xylocarpus granatum*.

The composition of mangrove vegetation in the coastal village of Mangga Air is found that there are 9 types, comprising *Avicennia alba*, *Sonneratia alba*, *Sonneratia caseolaris*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Xylocarpus granatum*, *Ceriops tagal*, *Bruguiera gymnorrhiza*, *Peuteria obovata*.

Diversity of mangrove vegetation types that are being main habitants (composition) found mangrove coastal area of Doro village Sub-District Ganebarat District of Central South Halmahera, there are 7 types of vegetation including *Sonneratia alba*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, and *Nypa fruticans*. Diversity of mangrove vegetation in Doro village  $H' = 1.6265 (< 3)$ , then the species diversity is categorized as moderate.

## 3. Tidore Islands

Based on the research on mangrove density from the tree until the seedlings on Raja District Gita Island, it is found that there are 6 mangrove species, namely *Avicennia alba*, *Sonneratia alba*, *Rhizophora apiculata*, *Bruguiera cylindrica*, *Bruguiera gymnorrhiza*, *Xylocarpus granatum* and all of those six types are categorized into the tree level. Based on the result of the study on composition of mangrove vegetation in Lola village, there are 5 types of mangrove species in this village namely *Rhizophora apiculata*, *Avicennia alba*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, and *Xylocarpus granatum*. The composition of mangrove species as the result of identification in the coastal waters of District of Guraping Oba Tidore Islands can be found 12 species of mangroves stated follows: 1) *Rhizophora apiculata*, local name Soki-Soki; 2) *Rhizophora mucronata*, local name Soki-Soki; 3) *Sonneratia alba*, local name Posi-Posi; 4) *Sonneratia ovata*, local name Posi-Posi; 5) *Avicennia lanata*, local name Fika-Fika; 6), 7) *Avicennia alba*, local name Fiko-Fiko; 8) *Sonneratia caseolaris*, local name Posi-Posi; 9) *Bruguiera gymnorrhiza*, local name Dao; 10) *Bruguiera cylindrica*, local name Dao; 11) *Ceriops tagal*, local name Ting; 12) *Aegiceras floridum*, local name Bido-Bido; and 13) *Xylocarpus granatum*, local name Kira-Kira. There are six types of composition of mangrove vegetation found in the Guruatu Island, namely *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, and *Xylocarpus granatum*. Of the six mangrove vegetation types, there are four types that are classified into ethnic (family) Rhizophoraceae including *Rhizophora apiculata*, *R. stylosa*, and *Bruguiera gymnorrhiza*. The other two types are grouped into the ethnic (family) Sonneratiaceae, including *Sonneratia alba*, and the ethnic (family) Meliaceae, covering *Xylocarpus granatum*.

## 4. District of Central Halmahera

There are five types of mangrove vegetation composition in Sub-District Weda village Central Halmahera, namely *Rhizophora apiculata*, *Avicennia alba*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, and *Xylocarpus granatum*. Composition of mangrove forests that grows in the village of Messa, there are five types namely *Rhizophora apiculata*, *Avicennia alba*, *Sonneratia caseolaris*, *Bruguiera cylindrica*, and *Bruguiera gymnorrhiza*. Mangrove species diversity in Messa village is 1,326 (<3), then it is categorized in the moderate diversity.

## 5. District of Morotai

Based on the research result in the village of Bere-Bere Sub-District Morotai, District North Morotai Island, it is found four types of mangrove seedlings comprising *Bruguiera gymnorrhiza*, *Rhizophora apiculata*, *Sonneratia alba*, and *Rhizophora mucronata*. The diversity of mangrove seedlings in the village of Bere-Bere Sub-District of North Morotai, District of Morotai Island is ( $H' < 1$ ), then it is categorized into low species diversity.

#### **6. District of North Halmahera**

There are 5 types of mangrove vegetation based on the study result in 25 plots on 5 line transects, the five mangrove species are: *Rhizophora apiculata*, *Bruguiera gymnorrhiza*, *Avicennia caseolaris*, *Sonneratia alba*, and *Sonneratia ovata*. All five types above are classified into 3 families.

#### **7. District of East Halmahera**

The structure and composition of mangrove in the coastal village of Woisumo Geltoli Sub-District of Maba District of East Halmahera, there are eight species of mangroves comprising *Rhizophora apiculata*, *Rhizophora mucronata*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, *Bruguiera parviflora*, *Ceriop tagal*, *Xylocarpus moluccensis*, and *Nypa fruticans*.

#### **8. District of Sula Islands**

The structure and composition of mangrove in the coastal village of Balohang Sub-District Lede District of Sula Islands, there are eight mangrove species comprising *Rhizophora apiculata*, *Rhizophora mucronata*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, *Bruguiera parviflora*, *Ceriops tagal*, *Xylocarpus moluccensis* and *Nypa fruticans*.

#### **9. Moti Island Ternate**

The structure and composition of mangrove in the coastal town of Moti District Ternate Island, there are three types of mangroves as follows *Rhizophora*, *Avicennia*, *Sonneratia*.

### **IV. DISCUSSION**

Based on the exposure data from this study, it can be seen that the preparation of a database of mangroves in North Maluku which has a long-term goal that is to produce a master plan and mapping potential of mangrove supported by data on the composition and structure of mangrove species in each of the district / city. Mangrove forest is a typical formation of the tropical regions and some of subtropical regions, located in a low and quiet beaches, muddy, slightly sandy, and influenced by the sea water tidal. Mangrove is also an essential link in the sustainability of balance in a biological aquatic cycle. Mangrove has various functions including physical function, chemical function, biological function and economical function. Based on the notes of the research data, mangrove forests dominantly function as production forest that can be converted is equal to 55.33 % of the total area of mangrove forests that exist in the province of North Maluku. Regarding the distribution of mangroves based on the administrative regions, each district / city in the province of North Maluku has mangrove vegetation. The distribution of mangrove forest for each district / city varies, where the largest mangrove forest formation is in South Halmahera, which is on the SWP Bacan watershed.

Database of composition and structure of mangroves in North Maluku in general consists of mangrove species mostly are: *Rhizophora sp*, *Bruguiera sp*, *Sonneratia sp*, *Avicennia sp* and *Xylocarpus sp*. These types of mangroves are spread almost in nine districts / cities in the location of this research, while there are some other types of mangrove such as *Ceriops tagal*, *Nypa fruticans*, *Camptostemon sp*, and *Peuteria obovata* also found in several study sites and the spread is categorized into moderate diversity. It is influenced by the natural conditions in the province of North Maluku which is a Biophysical factor of mangrove vegetation in North Maluku, in this study, it consists of coastline, salinity, soil texture, pH or acidity, wave height; the data derived from these factors support the structure and composition of mangrove in the province of North Maluku. The data on the biophysical factors such as the location of the study follows: the lowest coastline in in Ternate (40 km) and the longest in South Halmahera (1,350 km), the salinity between 24-32 ppm, generally sandy soil texture, acidity or pH ranges from 7 to 7.8, wave height between 10-90 cm and tidal types in general tend to be daily. Various forms of coastal landscapes, including mangrove forest type that grows along the coast or river water mix tidally, they are influenced by combination of river and sea water that contains salt. Basically coastal region is a region of transition between the land and sea area. Physiographic in this area is defined as the area between the coastline to inland are still influenced by tidal sea water with a width determined by the gradient (% slope) and the coastal sea floor, and is formed by clay sedimentation until the sand is loose, and sometimes mixed with gravel (BP DAS Akemalamo, 2010). In general it can be concluded that the shape / type of coastal areas, types of vegetation, extensive mangrove forests as well as the spread of the mangroves depend on the characteristics of the biogeography and local hydrodynamics. Various coastal areas in Indonesia have both similarities and differences in the climatic factors, water temperature, sedimentation rate, tidal water levels, relief, protection from waves and wind erosion, salinity of water and geological history. Therefore, there is a wide range of capabilities and suitability of land use.

## V. CONCLUSION

Based on the discussion above, there are some conclusions that can be derived as follows:

1. The formation of the database is supported by data on the composition and structure of the species in each district / city, based on biophysical conditions of mangrove Ecosystem in the province of North Maluku.
2. The structure and composition database of mangroves reveals that most mangrove species are comprising: *Rhizophora* sp, *Bruguiera* sp, *Sonneratia* sp, *Avicennia* sp and *Xylocarpus* sp, the distribution of the mangroves is almost in nine districts / cities in the location of research, while the other mangrove species such as *Ceriops tagal*, *Nypa fruticans*, *Camptostemon* sp, and *Peuteria obovata* are also found in several study sites and the distribution is categorized into moderate diversity.
3. Biophysical factors database of mangrove vegetation in the province of North Maluku in this study consist of lowest coastline in Ternate (40 km) and the longest in the province of North Halmahera (1,350 km), the salinity between 24-32 ppm, generally sandy soil texture, pH or acidity ranges 7-7.8, wave height between 10-90 cm and tidal types in general tend to be daily.

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