Mangrove Mare Island_Conference Artikel

by Rignolda Djamaluddin 19

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Assessment of mangrove condition of Mare Island, North Maluku, Indonesia

Assessment of mangrove condition of Mare Island, North Maluku, Indonesia

I Tahir [1], R C Kepel [2], and R Jamaluddin[2]

[1]Marine Science Study Program, Fisheries and Marine Science Faculty, Khairun University, Indonesia
[2]Fisheries and Marine Science Faculty, Sam Ratulangi University, Indonesia

Email: iermalitha@gmail.com

Abstract. This work aimed to determine the condition of mangroves according to the species density and mangrove canopy cover in marine conservation area of Mare Gam Village, Mare Island. The data were collected using the nested quadrat line transect method. The level of species density was calculated based on the criteria for mangrove growth, namely seedlings, saplings and trees. The results showed that there were 9 types of mangroves, based on the value of species density and canopy cover, the condition of mangroves at the observation site was in the good and dense category.

1. Introduction

North Maluku Province has an administrative area of 136,148.61 km2, with a water area of 91,078.95 km2 (66.9%), and a land area of 45,069.66 km2 (33.1%), with a total of 805 islands [1]. One of the most potential islands in North Maluku Province is Mare Island, geographically situated at 0° 33' - 0° 35' N and 127° 22' - 127° 24' E which is one of the islands included in the administrative area of South Tidore District, North Maluku Province. Mare Island closes to other potential small islands such as Moti Island, Makian Island, Maitara Island, Tidore Island, Ternate Island and Hiri Island.

Mare Island consists of two villages, namely Mare Gam Village and Mare Kofo Village, which have abundant coastal living resources including mangroves. The mangrove ecosystem in Mare Gam Village is only found in the south and north of this village. This is effected by the shape of the sloping to sloping beach topography and the substrate conditions of Mare Island which greatly determine the availability of land for mangrove ecosystems [2]. The area of mangrove in the Mare Gam Village area is 14.04 ha.

Mare Island is one of marine conservation area in North Maluku that described in provincial Zoning Plan for Coastal Zone and Small Islands and regulated in North Maluku Regional Regulation No 2 of 2018. Based on national conservation regulation, main purpose of Mare Island conservation area is for development of Marine Tourism Park with an area of 7,092.59 ha. With adjustments to the latest map of the earth, the area of Mare Island TWP becomes 7,060.87 ha. This status was determined because Mare Island has various potentials from ecological, socio-cultural, and economic point of view which are important to maintain and develop its benefits [3].

Mangrove ecosystems are essential habitats in coastal area by providing shelters, spawning grounds, nursery grounds, and feeding grounds for various types of fauna. Mangrove ecosystems can also protect coral reefs and sea grass [4]. The presence of mangrove vegetation in an area will have a

positive impact on the balance of the ecosystem on a wider scale. Vegetation plays an important role in ecosystems related to the regulation of the balance of carbon dioxide and oxygen in the air, improvement of physical, chemical, biological properties of soil and regulation of water system in the soil. In general, mangrove vegetation has a positive impact on the ecosystem, but the effect varies depending on the structure and composition of the vegetation that grows in each area. The importance of the role of mangrove vegetation in an area, it is necessary to know the ecological condition, structure and composition of the vegetation on a regular basis.

The objective of this work was to determine the condition of mangroves in the marine conservation area of Mare Gam Village. The results of this research were expected to provide information that can be used by local government ant other stakeholders as scientific base for management and development of the marine conservation area of Mare Gam Village in a sustainable manner.

2. Materials and method

This research was carried out in Mare Gam Village, Mare Island, North Maluku Province, in March 2020.

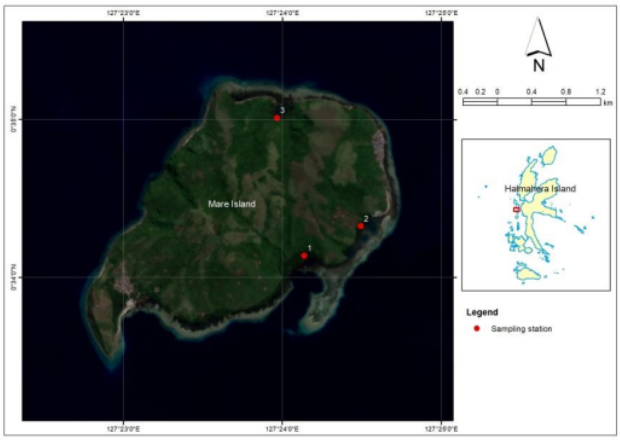

Figure 1. Study site

The devices used were the Global Positioning System (GPS), digital camera, water quality checker (Hanna Instrument HI 98194), roll meter, cutter, stationery, motor boat and the Guide and Introduction to Mangroves in Indonesia [5]. The materials used were sample bags, label paper, and samples of mangrove species.

According to the preliminary survey, it had been determined 3 observation stations, namely the southern part of Mare Gam Village consist of Mare Kofo Village (Station 1 at 127º 24' 8.413" E and 0º 34' 8.138" N), the southern part of Centre of Mare Gam Village (Station 2 at 127º 24' 29.748" E and 0º 34' 19.386" N) and the northern part of Mare Gam Village (Station 3 at 127º 23' 58.041" E and 0º 35' 0.520" N) (Figure 1). Data collection using the nested quadrat method, where at each station 3 plots are placed with a total of 9 plots at the three stations. The stratified plots were laid out at each station with a plot size of 10 x 10 meters used for tree observation, a plot size of 5 x 5 meters for observation of saplings and a plot size of 1 x 1 meter for observation of seedlings. Data collection for the tree level is individual mangroves with a diameter of 10 cm or more and a height of more than 1.5 m. For sapling level data collection, namely mangroves with a diameter of 2-10 cm with a height of 1.5 m. For the seedling level, the mangrove has a height of less than 1.5 m. The data collected were mangrove species, the number of individuals of each species for each category of growth rate (trees,

saplings, and seedlings), physico-chemical parameter data including temperature, salinity, DO, pH, substrate and tidal type were collected as well.

Mangrove cover data collection using the Hemispherical Photography method. Hemisphericchal Photography is a canopy characteristic technique using photographs to estimate solar radiation and plant characteristics through a far-view lens [6] to determine the percentage of mangrove cover.

(a) (b)

Figure 2. (a) Illustration of the hemisperichal photography method for measuring mangrove cover [7] (b) vertical shooting

The results of the measurement of mangrove vegetation data that have been collected were tabulated. Subsequently, the data was analyzed to determine the Species Density [8] and the percentage of mangrove canopy cover. The assessment of mangrove conditions was based on [9].

3. Results and discussion

3.1. Environmental parameters

Several environmental parameters were measured and observed in the form of water quality (temperature, salinity, DO, pH) and substrate conditions. The results obtained at the time of observation are presented in Table 1.

Table 1. Conditions of environmental parameters at the observation site

No	Parameter	Station		
		1	2	3
1	Water temperature (^{o}C)	32	30	30
2	Salinity ($^{o}/_{oo}$)	34	33	33
3	Dissolved Oxygen (mg/l)	8.5	7.8	8
4	pH	7.2	7.2	7
5	Substrate	Sandy mud	Muddy	Sandy mud

Table 1 shows that the water temperature at the observation site ranges from 30 – 32 ^{o}C. Daily variations in temperature can be influenced by sunlight and meteorological conditions such as wind gusts and rainfall. The measurement of salinity was carried out simultaneously with other parameters such as temperature, DO, pH, and substrate assessment. The measurement results showed that the salinity ranges from 33 – 34 $^{o}/_{oo}$. The high salinity at Mare Island was assumed to relate with low influence of fresh water and indicated that the seawater mass was influenced by high proportion of open seas mass. Ocean oxygen is a limiting factor for marine life. The optimum oxygen content for the development of marine life is above 5 mg/l. The measurement results show that dissolved oxygen is abundant, ranging from 7.8 to 8.5 mg/l. This high dissolved oxygen condition can indicate that the waters are still fertile. The dissolved oxygen content can still support the existing ecosystem. The degree of acidity (pH) is a description of the activity of hydrogen in the waters. The pH value of the marine waters of Mare Gam Village, Mare Island is between 7.0 - 7.2.

Changes in sea level occurred almost periodically with once tidal period reaching 12 hours. The tidal range ranges from 0.88 – 1.88 m. The results of tidal observations show that the tidal type in this area is a mixed tide of semi-daily dominance, i.e. tides occur twice a day with unequal tide heights [10].

3.2. Species composition

The identification of mangrove species obtained from three observation stations consisted of nine mangrove species belonging to seven genera and five families (Table 2).

Table 2. Composition of mangrove species found.

No	Family	Species	Local Name
1	Rhizoporaceae	*Rhizopora apiculata*	Soki-soki
		Rhizopora stylose	Soki-soki
		Rhizopora mucronata	Soki-soki
		Ceriops tagal	Ting
		Bruguiera gymnorrhiza	Dau
2	Acanthaceae	*Avicennia marina*	Api-api
3	Combretaceae	*Lumnitzera racemosa*	Api-api jambu
4	Meliaceae	*Xylocarpus granatum*	Kira – kira
5	Sonneraticeae	*Sonneratia alba*	Posi – posi

Table 2 shows that the Rhizophoraceae family was found to be more numerous, namely 4 species compared to other families. The number of species found in the Rhizophoraceae family is presumably to be the substrate condition at the observation location that strongly supports the growth of this family. The dominant substrate at the observation site is sandy mud, [12] stated that the influence of soil properties on mangroves is indicated by the distribution of the genus Rhizophora, among others. Environmental conditions also contribute to its presence such as tides, waves, coastal morphology and current patterns.

3.3. Species density

Analysis of the density level of mangrove species was carried out based on the growth categories, namely seedlings, saplings and trees.

Seedling

There were 5 types of seedling mangroves, namely Rhizophora apiculata, Rhizophora stylosa, Rhizophora mucronata, Avicennia marina and Sonneratia alba. The value of mangrove species density for the seedling level at each station varied. Avicennia marina species showed the highest density value of 4000 stands/ha at station 2. The high density of Avicennia marina species at the seedling level is thought to be due to a pioneer plant, commonly found in tidal habitats, lives in groups, and bears fruit throughout the year [5].

Figure 3 shows that for mangrove regeneration, the seedling level was mostly found at station 2, then at stations 1 and 3. Environmental conditions at station II are suitable for the growth of Avicennia marina and Rhizophora mucronata species tend to dominate the more muddy areas [11] and are mangrove species on the part connecting to the sea.

The average value of seedling density at the observation site was 13,000 ind/ha. This indicated that the natural regeneration of the mangrove forest at the observation site was good, as in the guidelines for the brackish forest silviculture system, it has been determined that natural regeneration is good for brackish forests if the natural regeneration is 2,500 stems/ha [12]. This seedling density value was

lower than the average seedling density in the Kemujan Tracking Mangrove of 73,333 ind/ha [13]. This is presumably due to the Mangrove Tracking on Kemujan Island which was included in the Karimunjawa National Park (TKNJ) area has the most extensive mangrove forest and was a mangrove ecotourism area.

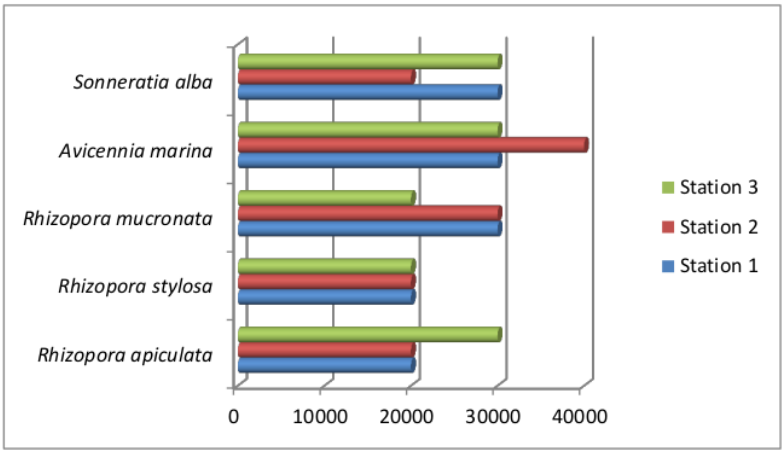

Figure 3. The value of the density of the seedling level

Sapling

The results of quantifying the density level values for the sapling level at the observation site showed that the highest species density value for the sapling level was *Sonneratia alba* at station 1 and Station 3 (Figure 4).

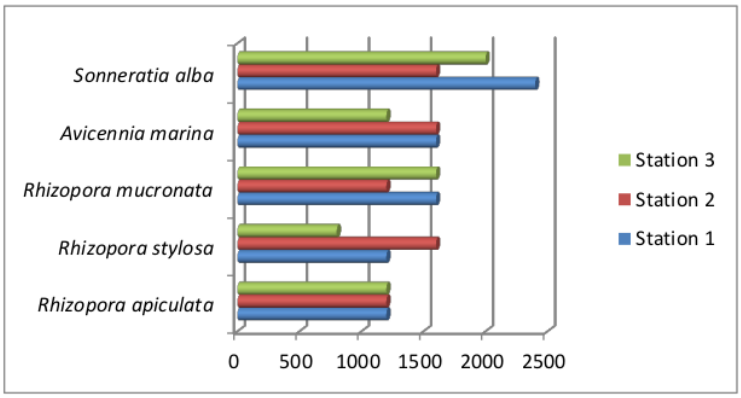

Figure 4. Sapling level density value

Overall the station that has the highest density value for the sapling level is station 1 and the lowest is station 3. This can illustrate that the highest level of mangrove regeneration for the sapling level is at station I.

Tree

The species that had the highest density value for the tree level was *Rhizophora mucronata* with a value of 600 stands/ha at station 1.

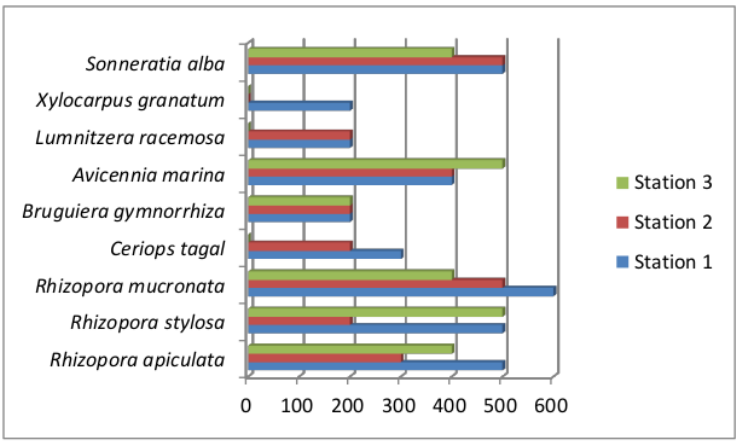

Figure 5. Tree-level Density Value (stand/ha)

Density for the tree level can be used as a basis for determining the damage level of mangrove forests. Based on the Decree of the Minister of Environment Number 201 of 2004 concerning the standard criteria and guidelines for determining mangrove damage, then based on the calculation of the total species density value of 2,767 ind/ha, it can be stated that the condition of mangroves at each station is still in the good and dense category. The condition of dense mangroves was also marked when data collection experienced difficulties in exploring, laying transects and observing plots.

Percentage of mangrove cover

The condition of the mangrove forest at Mare Gam Island is based on the results of the analysis using the Hemispherical Photography method that the mangrove canopy cover of the three observation stations is based on the Standard Criteria for Mangrove Damage, [8] it can be stated that the condition of mangroves at each station was in the good category (> 75%).

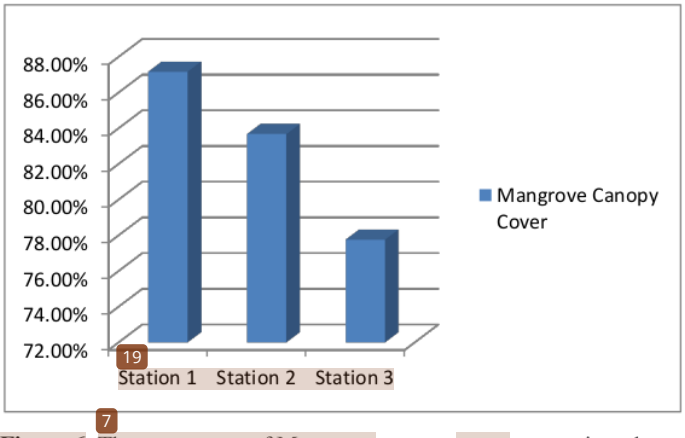

Figure 6. The percentage of Mangrove canopy cover on station observations

The results of the hemisperichal photography then inputted those values into the following table:

Table 3. Mangrove Cover Analysis Results

No	Picture	P255	P	Canopy Cover	Criteria	
1	PLOT 1	4167875	5018112	89.49%	Well	Heavy
2	PLOT 2	4530780	5018112	86.50%	Well	Heavy
3	PLOT 3	4294613	5018112	85.56%	Well	Heavy
4	PLOT 4	4233341	5018112	84.36%	Well	Heavy
5	PLOT 5	4156575	5018112	82.83%	Well	Heavy
6	PLOT 6	4206424	5018112	83.82%	Well	Heavy
7	PLOT 7	3923612	5018112	78.19%	Well	Heavy
8	PLOT 8	3846712	5018112	76.66%	Well	Heavy
9	PLOT 9	3935992	5018112	78.44%	Well	Heavy
			Average:	82.87%	Well	Heavy

In general, percentage values of mangrove canopy cover using the hemispherical photography method were included in the dense category at each station. These values showed that there was a relationship between the presence of Rhizoporaceae mangrove species at each station and the high value of mangrove canopy cover. Canopy cover high percentages indicated condition of a dense community. On other words, high value of canopy cover assumed that a mangrove community was in good condition.

4. Conclusion

There were 9 species of mangroves found at three observation stations at Mare Island, namely *Rhizopora apiculata, Rhizopora stylosa, Rhizopora mucronata, Ceriops tagal, Bruguiera gymnorrhiza, Avicennia marina, Lumnitzera racemosa, Xylocarpus granatum*, and *Sonneratia alba*. According to calculated values of species density and canopy cover, condition of the mangroves at Mare Gam Village was categorized as good and dense.

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