IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 13, Issue 4 Ver. I (Jul – Aug 2018), PP 13-17
www.iosrjournals.org

Species Diversity and Natural Seedling Availability of Mangrove Communities in Octet Mangrove Forest of Salami District Of Kupang Regency

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Abstract: *This research aims to study species diversity and availability of natural seedling of mangrove communities in the Oeteta mangrove forest, and suggested species enrichment of the communities. This research was carried out between June and Augustus 2004 in the Oeteta Village of Sulamu District of Kupang Regency. The method of this research is field observation. Samples were determined by transect line plot technique. Data were calculated by the equation of basal area, density, and dominance, and analyzed by the equation of importance value, richness, diversity, and similarity index. The results show that there are eight mangrove communities in the Oeteta Mangrove Forest. Mangrove communities which have relatively high diversity are Rhizophora mucronata, Sonneratia alba, Bruguiera gymnorrhiza, Ceriops tagal, and Bruguiera gymnorrhiza-Rhizophora mucronata community. Natural seedling availability of the mangrove communities is low. Community of Bruguiera gymnorrhiza-Avicennia marina better be enriched with species of Rhizophora mucronata whereas community of Avicennia marina-Ceriops tagal with species of Bruguiera gymnorrhiza and Sonneratia alba.*

Keyword: *mangrove, seedling, diversity*

Date of Submission: 29-06-2018 Date of acceptance: 16-07-2018

I. Introduction

Mangrove is forest vegetation dominated by several kinds of plants which are specific for tropic and subtropic regions and these plants grow in intertidal zones (Muin, *dkk.*, 2001). Mangrove ecosystems have ecological, environmental, and social-economical value for the surrounding people. Its strategy position and potential diversity, and surrounding people growth are factors that affect the sustainable function of mangrove ecosystem.

Mangrove forest area of South East Nusa in 1982 is 12.500 hectare, but in 1993, it decrease to 10.775 hectare (Wasrin, 1993). Based on field observations, several coastal areas in Timor Island, like Paradiso, Oebelo, Bipolo, and Oeteta, are faced to degradation of mangrove ecosystem function because of open-clearing mangrove forest for salt ponds and fish ponds. Therefore, in South East Nusa's space arrangement plan, mangrove ecosystems in Timor Island and surrounding islands such as Semau Island, Rote Island, and Sabu Island have been established as conservation areas (Tanggal, 1997). The establishment of these mangrove areas as conservation areas is in order to maintain and increase the function of mangrove ecosystem.

Mangrove forest conservation efforts today are still partial because there are several obstacles, one of which is the lack of data and information about the condition and potential of every mangrove forest area. In relation with it, base knowledges such as knowledge of mangrove forest structure and composition, species diversity, as well as distribution pattern of mangrove communities are indispensable for the conservation of mangrove forest.

The purpose of this study was to determine the level of species diversity and the rate of natural regeneration on mangrove communities in Oeteta Mangrove Forest of Sulamu District of Kupang Regency. The results of this study are expected to provide basic information about the current condition of mangrove forest, especially on species diversity and natural regeneration of the mangrove communities in Oeteta Mangrove Forest of Sulamu District of Kupang Regency.

II. Materaals and Method

Oeteta mangrove forest covered in Oeteta Village of Sulamu District of Kupang Regency. Oeteta Village located in the east of Sulamu District Capital and the north of Kupang Regency Capital. The distance between Oeteta Village and the capital of Sulamu District is 33 km. While, the distance between Oeteta Village

and the capital of Kupang Regency is 49 km. Oeteta Village is one of five villages covered in the Sulamu District, has 1.417 inhabitants which divided into 339 families, with a total area of 41.47 km^2, or approximately 15.35% of the total area of Sulamu District. The average density of Oeteta population is 34 inhabitants per km^2. The number of Oeteta residents whose work as farmers are 557 people and as fisherman are 17 people (Statistics Center Agency of Kupang Regency, 2002).

Behind the mangrove forest are a 5.23 ha of salt pond and several fish ponds. Approximately 1 km before entering Oeteta Village there slightly wide Nunkurus River that opens to the beach as far as approximately 500 m before the mangrove forest. During the research activities, some villagers often encountered return from the mangrove forest with a bunch of mangrove wood. In the mangrove forest are also found some mangrove trees with diameter average of approximately 70 cm that were recently cut. Based on our conversation with some locals, the mangrove woods used for firewoods, construction of houses and fences, and boat buildings.

As an ecosystem, mangrove forest is only one component of the ecosystem, there are other components such as fauna, decomposers, and abiotic environments such as soil, water, and air. All these components interact and depend on each other to form a system that can provide ecological and socioeconomic benefits (Armitage, 2002). Mangrove forest can be viewed as an exporter of organic matters for the surrounding waters, since these organic materials come from litter that fall into the form of complicated food chains (Soeroyo dan Sukardjo, 1990). Litter is a source of food for various kinds of biota living in the mangrove ecosystem (Muin dkk., 2001). Mangrove has a high productivity rate. This high productivity rate is supported by the continued supply of nutrients, and by the availability of great niches for matting, spawning, and nursering of various kinds of marine animals that live there or migrate to there (Dahdouh-Guebas, 2001).

Species diversity is a value that shows the level of species diversity within a community, which includes species richness and relatif abundance. Species richness is the total number of species in a community (Ludwig, 1988). Abundance is the number of individual organism in a population (Begon *et al*., 1996). A community is said to have a high species diversity if it is composed by many species with the same or almost the same species abundance. On the contrary, if the community is composed by very few species, and if only a few species are dominant, the species diversity is low (Soegianto, 1994). Vegetation of mangrove forests in Indonesia has a high species diversity, but there are only about 47 species of plants typical of mangrove forests. At least in the mangrove forest, there is one important or dominant species belonging to the four families, namely *Rhizophoraceae* (*Rhizophora*, *Bruguiera*, and *Ceriops*), *Sonneratiaceae* (*Sonneratia*), *Avicenniaceae* (*Avicennia*), and *Meliaceae* (*Xylocarpus*).

This study was carried out in Oeteta mangrove forest of Sulamu District of Kupang Regency from June to August 2004. The object used in this study is mangrove vegetation in Bipolo beach area of Sulamu District of Kupang Regency. The method used in this study is field survey with several stages of activity such as filed orientation, plot sampling, and data collection.

Sample plots were determined using transect line plots technique (English *et al*., 1997) and placed systematically with distance between transects are 50 m. To facilitate the observation, in each transect made plots measuring 20 m x 20 m which is put on an ongoing basis. On each plot size of 20 m x 20 m was collected vegetation data about the number of individuals and stem diameter of each mangrove plant species.

Vegetation data that has been collected processed using formulas of basal area, relative dominance, relative density, and relative frequency (English *et al*., 1997). The processed data is then used to determine the role of a plant species in plant community of the mangroves using the formula of importance value index (English et al.,1997), whatever plant communities are in Oeteta mangrove forest using the formula of similarity-Motyka index (Mueller-Dombois and Ellenberg, 1974), and species diversity of plant communities using the formula of species richness index, diversity index and evenness index (Ludwig and Reynolds, 1988).

Mangrove communities pictured in terms of spatial distribution map of the communities using interpolation method based on observational data that has been collected in each transect. To determine areas of enrichment, it is important to analyze the abundance of individuals and mean diameter of stems of trees in each plot. Plots which have individual number less than 50 and tree diameter less than 10 cm are defined as areas that need to be fortified its stand.

III. Results and Discussion

1. Species Diversity of The Mangrove Communities

The calculation results of species diversity, species richness and evenness index are shown in figure 1.A community is said to be have high diversity of species if the community consist of many species with equal or almost equal of individual abundance of species (Soegianto, 1994). Afterwards, if 1 is reduced by evenness index and the result is 0, dominance by a species in a community is low. Vice versa, if the result is 1, dominance by a species in a community is high. These two statements become the base for the determination of the plant

species diversity of the mangrove communities. To facilitate comprehension about species diversity of the mangrove communities, it is expressed through figure 1.

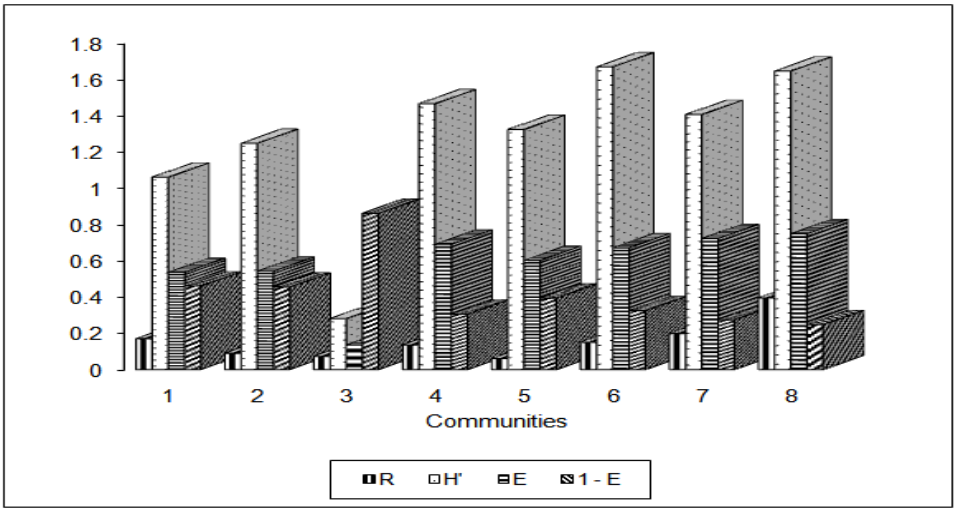

Figure 1. Species diversity of the mangrove communities.

Information:

R = species richness index
H' = diversity index
E = evenness index
1 – E = species dominance
1 = *Bruguiera gymnorrhiza-Avicennia marina*
2 = *Avicennia marina-Ceriops tagal*
3 = *Ceriops tagal-Avicennia alba*
4 = *Bruguiera gymnorrhiza*
5 = *Bruguiera gymnorrhiza-Rhizophora mucronata*
6 = *Ceriops tagal*
7 = *Sonneratia alba*
8 = *Rhizophora mucronata*

Figure 1 expresses a trend that increase in evenness index is always followed by significantly decrease in dominance value of species, but increase in species diversity index is not always followed by increase in evenness index. Therefore, to determine the species diversity degree, several parameters must be measured, such as species diversity index, evenness index, dominance level by a species, and the species richness index. For example, *Ceriops tagal* community has higher species diversity index (H' = 1,68) than *Sonneratia alba* community (H' = 1,41), but *Sonneratia alba* community has an abundance distribution more even (E = 0,72), a lower dominance level by a species (1 – E = 0,28), and a higher opportunity of species occurrence (R = 0,3958) than *Ceriops tagal* community. Therefore, the level of species diversity for *Sonneratia alba* community higher than *Ceriops tagal* community.

When referring to the diagram 1, the levels of species diversity of mangrove communities in Oeteta mangrove forest are grouped into two main mangrove communities. First, the mangroves that have a high level of species diversity, including community of *Rhizophora mucronata*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, and community of *Bruguiera gymnorrhiza – Rhizophora mucronata*. Second, the mangroves that have a low level of species diversity, including community of *Avicennia marina – Ceriops tagal*, *Bruguiera gymnorrhiza – Avicennia marina*, and community of *Ceriops tagal – Avicennia alba*. According to Soegianto (1994), high species diversity indicates that these communities have a high complexity due to high interactions between species in these communities.

2. Availability of Natural Regeneration of The Mangrove Communities

The result of the average density calculation of each mangrove species can be seen in table 1.

Table 1. Species density of mangrove seedling in Oeteta mangrove forest.

No.	Species	Mean of Density/Ha
1	*Avicennia marina*	396
2	*Sonneratia alba*	43
3	*Rhizophora mucronata*	167
4	*Bruguiera gymnorrhiza*	229
5	*Rhizophora apiculata*	88
6	*Avicennia alba*	127
7	*Ceriops tagal*	229
8	*Excoecaria ovalis*	36
9	*Osbornia octodonta*	42

10	*Camptostemon schultzii*	50
11	*Aegialitis annulata*	350
12	Spesies E	48
13	Spesies G	41

Brackish forest silviculture system guidelines set amount of natural regeneration as many as 2500 stems per hectare. Table 1 shows that the average amount of natural regeneration of mangrove plant species are found insufficient or low. It can be seen from the table 1 that the highest amount of seedling is in *Avicennia marina* with an average density of only 396 seedlings per hectare or two seedlings per plot. According to Nurkin (2000), the low number of this natural regeneration is likely to be caused by the parent trees which are still young and have not been able to generate maximum propagules.

Based on observations in the field, *Avicennia marina* seedlings found in almost all the plots. Mostly *Avicenna marina* seedlings found in the area that lain between transect 2 and 14. This is because of fairly open of this area by logged. It is also happen in *Ceriops tagal* seedlings where they grow in open area of landward zone. Most of *Aegialitis annulata* seedlings found in outer edge of the mangrove forest in landward zone. Meanwhile, most of *Bruguiera gymnorrhiza* seedlings found in area that lain between transect 1 and 14 because this area is fairly open and substrated with clay soil.

Natural seedling potency hopefully can be achieved maximal in stand that come from plants through spaced of seedlings to open canopy in order to provide space for individual plant growing and path for light entering into the forest floor (Nurkin, 2000).

3. Mangrove Stand Enrichment

Species enrichment of mangrove in the areas that need to be enriched must consider species founded in the communities. It is better that species enrichment involves species which have a lower of important value. Such consideration is needed in order to increase the role of the species proportionately. It then gives balance and stabilization for the communities and the mangrove ecosystem.

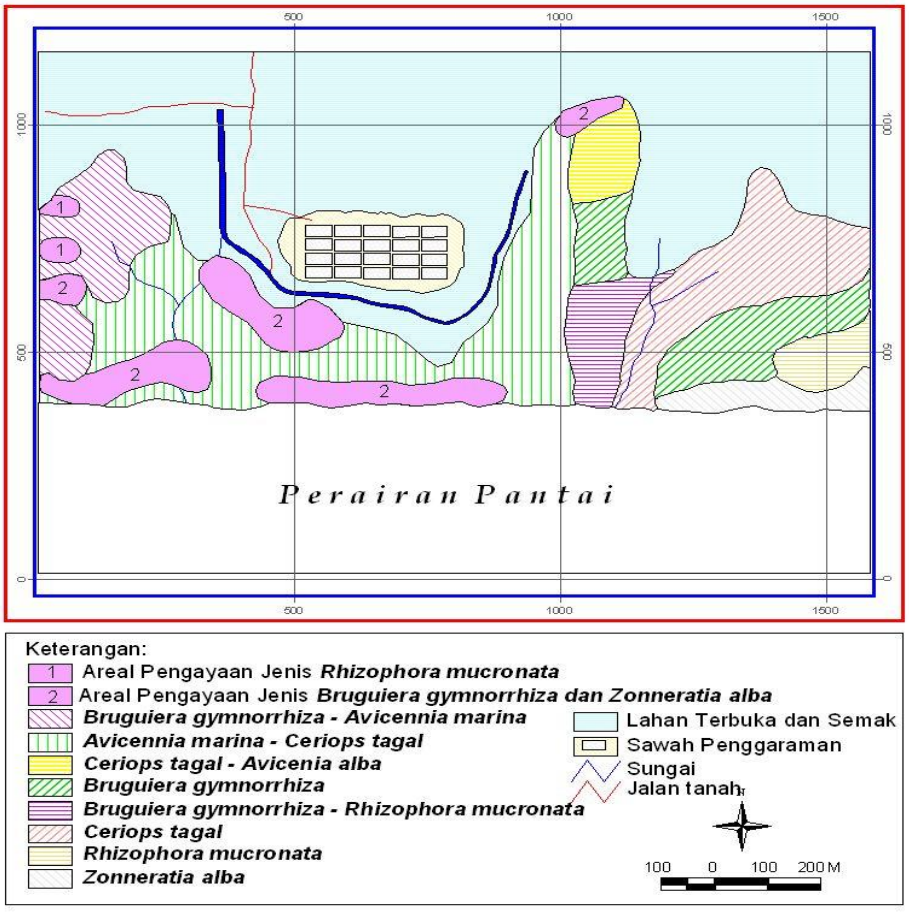

Figure 2. Map of Mangrove Species Enrichment Areas.

Figure 2 shows that there are two mangrove communities that need to be enriched include the community of *Bruguiera gymnorrhiza-Avicennia marina* with areas of 1 ha and the community of *Avicennia marina-Ceriops tagal* with areas of 8.5 ha. *Bruguiera gymnorrhiza-Avicennia marina* community better be enriched with species of *Rhizophora mucronata*. While, *Avicennia marina-Ceriops tagal* community better be enriched with species of *Bruguiera gymnorrhiza* and *Sonneratia alba*.

IV. Conclusions

In Oeteta mangrove forest, there are eight of mangrove plant communities that can be grouped into two main mangrove communities based on the level of species diversity, including mangroves communities that have a high level of species diversity, such as community of *Rhizophora mucronata*, *Sonneratia alba*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Bruguiera gymnorrhiza – Rhizophora mucronata*, and mangrove communities that have a low level of species diversity, such as community of *Avicennia marina – Ceriops tagal*, *Bruguiera gymnorrhiza – Avicennia marina*, and *Ceriops tagal – Avicennia alba*. Natural seedling availability is low according to the brackish forest silviculture system guidelines.

V. Acknowledgements

The author extends gratitude to the supervisors on the master program of Hasanuddin University for their patience and thought contribution so that this paper can be resolved.

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IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) is UGC approved Journal with Sl. No. 5012, Journal no. 49063.

Mario Justinianus Santrum "Species Diversity and Natural Seedling Availability of Mangrove Communities in Octet Mangrove Forest of Salami District Of Kupang Regency." IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) 13.4 (2018): 13-17.