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Review Article

THE CHARACTERISTICS OF GROWING SITES OF MYRISTICACEAE IN MOMIWAREN PROTECTED FOREST AREA, SOUTH MANOKWARI – WEST PAPUA, INDONESIA

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Abstract
The family of Myristicaceae is a lowland tropical forest vegetation that has a beneficial value. However, in line with the land conversion that is currently occuring, information about the characteristics of growing sites of this type of becomes important. The technique used in this study was a continuous strip sampling method for vegetation analysis at the sapling and seedling levels using the line plot systematic sampling method with nesting plots at an area of 50 Ha in the Momiwaren protected forest, as well as describing the ecophysiographic characteristics of the growing sites of Myristicaceae. The results showed that there were five types of Myristica, namely *M. Argentea* Warb, *M. Fatua* subsp fatua, *M. tubiflora.* Bl, *M. pseudoargentea* and *M. gigantea* King with the highest INV level in the tree phase for the M. Fatua subsp fatua species. This species has been included in the IUCN list. Myristicaceae live in clusters were found in flat and sloping areas, in the soil type of Inceptisol which had been formed from ultra wet metamorphic rocks, with temperatures between 10[0]C and 38[0]C.
Keywords: ecophysiographic, Myristicaceae, Momiwaren.

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INTRODUCTION

Lowland rain tropical forest is a complex type of terrestrial vegetation with a high number of species (Whitmore 1984). Papua is a lowland tropical forest with high species diversity. The height of the place and temperature are important environmental parameters that are very influencing the formation of biota therein. At different altitudes, it can cause high diversity between adjacent locations.

Tree families often found in the lowlands in New Guinea island are Podocarpaceae, Fagaceae, Moraceae, Lauraceae, Meliaceae, Euphorbiaceae, Combretaceae, Sapotaceae, Elaecarpaceae, Annonaceae, Clusiaceae, Rubiaceae and Myristicaceae (Oatham and Beehler 1997). The distribution of the Myristicaceae family is from India, the Melanesia region, Indonesia, North Australia and Fiji in the East Pacific region, where 175 species were identified (Arrijani, 2005). Heyne (1987) states that there are 9 types of Myristicaceae found in Indonesia including *Myristica argentea* Warb (Irianjaya/Papua), *M. fatua* Hoult (Maluku), *M. fragrans* Hoult (Maluku), *M. iners* Bl (Sumatra), *M. littoralis* Miq (Java/Sunda), *M. Schefferi* Warb (Maluku), *M. Speciosa* Warb (Maluku), *M. succedanea* Bl (Maluku), and *M. tesmannii* Miq (Java / Sunda). Hadad and Hamid (1990) stated that the highest genetic diversity of Myristicaceae in Indonesia was found in Papua, Banca and Siau. Furthermore, de Wilde (2000) states that 86 species of Myristicaceae have been included in various protected conservation categories.

Purseglove 1987 states that Myristicaceae family is often used as food, medicine and cosmetics by humans. Westphal and Jansen 1993 also stated that the fruit of the genus Myristica contains 33% blended oil, 4.5% essential oil, even some seeds from this family contain 23-30% butter. Furthermore Hutapea (1994) said that the seeds and fruit of Myristica contain saponins, while the leaves contain flavonoids. As such, this plant is very widely used for meeting the needs of human life.

The Momiwaren protected forest area is one of the genus distribution areas for Myristica. However, in line with population growth and regional expansion, the condition of several types of plants in this region will affect the condition and ecosystem of this plant. In addition, Myristicaceae is a plant that has been known by general public with multiple uses such as the medicine industry, food ingredients and cosmetics. It is estimated that the high level of harvesting of these plants would not be avoided. Therefore, if occurs in large numbers, it will cause degradation of the species. For this reason, information on the potential of the Myristicaceae species in the Momiwaren Protected Forest area and the characteristics of the growing sites is required as a first step for silviculture, protection and utilization of this species and reintroduction to its natural habitat.

RESEARCH METHODOLOGY

Observation of the Myristicaceae growth profile was carried out in the Momiwaren Protected Forest area, South Manokwari Regency, in West Papua – Indonesia. The coordinates of the location are between 133°59'8.1276" to 134°9'19.7712" East and 1°32'34.098" to 1°49'21.9792" South. The topography of this region is mild to steep with lowland tropical rain forest types (Figure 1).

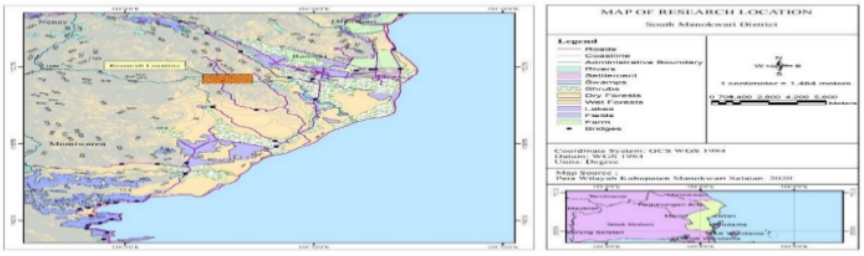

Figure 1. Map of the Myristicaceae Potential Research site in Momiwaren Forest Protected Area

Materials and Equipment used in this study are: all types of Myristicaceae trees contained in the research plot, expedition book, label, stationery, compass, meter (30 m), phiband and GPS.

Sampling

Sampling was carried out in the Momiwaren protected forest area with an area of 50 hectares, with 10 observation lines. The distance between each line was 500 meters, and in each line 25 main observation plots were made in each phase of observation. Thus, there were 250 observation plots for each phase/level. The method used was the continuous strip sampling method for the level of stakes and seedlings using the systematic plot method sampling method with nesting plot.

Data Collection

Plant species of Myristicaceae were taken in plots and every individual was identified according to the scientific name. Species identification was performed by two vegetation identifiers from technicians of Herbarium Manokwariense. Unidentified samples were set as vouchers specimens and packaged to the Manokwari Herbarium of the Forestry Research Institute and Manokwariense Herbarium for further identification.

Data Analysis

Myristicaceae composition. Data collected in the form of diameter and height. The number of individuals in each observation plot was used to calculate the density to describe the number of each species per hectare (ind ha -1). In addition, all species of plant life-forms were described using frequency. The important value index was performed only for tree level and was calculated to determine the distribution of each tree species in terms of dominance (Cox, 1985: Kusmana, 1997).

Ecological characteristics. Ecological characteristics measured were topographical factors including height, slope, slope direction. In addition, edaphic factors such as the physical and chemical properties of the soil, as well as the microclimate of the growing location were also observed.

RESULT AND DISCUSSION

Myristicaceae Composition

Distribution of stands in an area was very closely related to the condition of the supporting ecosystem. The results of this study indicated that the number of woody vegetation types in the protected forest area of Momiwaren was 296 species. Where there were 223 species in seedling phase, 211 species in sapling phase, 194 species in pole phase, and 175 species in tree phase (Figure 2). Odum (1971) states that individuals in a population would distribute based on three patterns; random, uniform and cluster. The composition of species in this forest area is very diverse and distribute randomly, where the growing environment is very diverse. Thus, the living plants within the protected forest are scattered both randomly and uniformly. Whitmore (1984) stated that wet tropical forests are the most complex type of terrestrial vegetation with the highest number of species in the world.

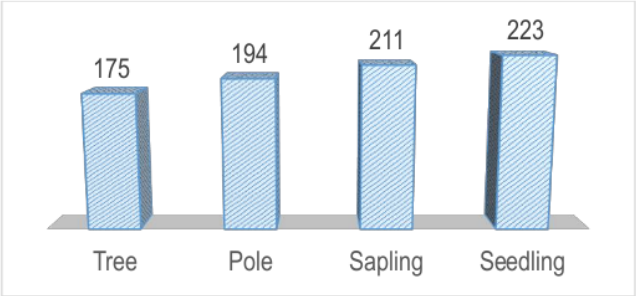

Figure 2. The composition on tree in Momiwaren Protected Forest Area

Baransano (2019) states that Papua's lowland forest-forming plants are vegetation types with a high level of diversity. Most of these plants species are endemic species with local distribution patterns, which are limited by growing sites ecological factors. Johns (1986) states that the endemic flora species found in Papua are related to ecosystem instability that is affected by earthquakes, landslides, physical damage to forests due to fallen trees/broken branches and El Nino phenomena, and very high precipitation.

Based on the composition of tree species in the Momiwaren protected forest area in 250 observation plots, 5 species of the Myristicaceae family were found, namely *M. Argentea* Warb, *M.fatua subsp fatua, M. tubiflora.* Bl, *M. pseudoargentea* and *M.gigantea* King, with relative density values (Figure 3).

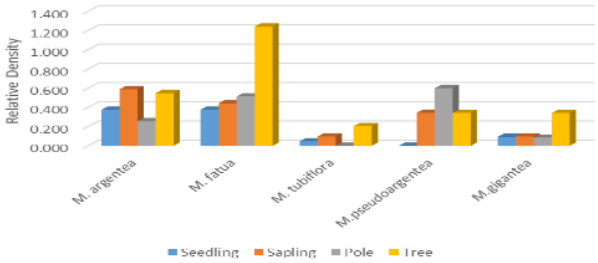

Figure 3. The relative density Miristycaceae in the Momiwaren Protected Forest area.

The value of relative density is the value of the amount of a type of vegetation found at a certain observation area. Figure 3 showed that *M. fatua* species at the study site had a high relative density value at the tree level compared to several other levels. But the potential for youthfulness, will determine the existence of this type in the future. The rejuvenation types *M. argentea* and *M. fatua* have higher values than the other two types of

Myristicaceae. This is strongly influenced by the suitability of plants with the conditions of the sites to grow.

The role of a type in a community would be observed from the importance value index (IVI). At the *M.fatua* study site, the tree level had a higher IVI level compared to other Myristicaceae species (Figure 4). The diversity of IVI values at the study site was strongly influenced by the growing environment.

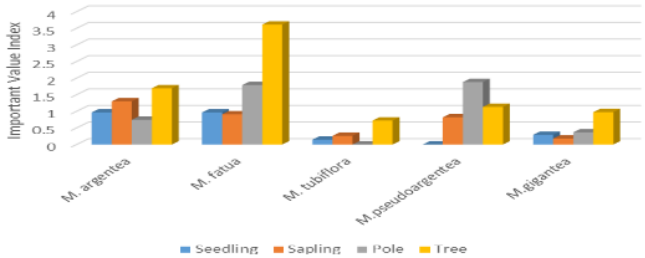

Figure 4. The Important value index (IVI) of Myristica in the Momiwaren Protected Forest Area

Characteristics of growing place Myristicaceae

The level of density of Myristica species found in Momiwaren protected forest areas is strongly influenced by internal and external factors of individual plants. Internal factors that affect growth according to Siburian et al (2017) are the composition of genes and the biological and physiological processes of individual species towards external factors tolerable by plants. While plant external factors include temperature, humidity, and slope. The presence of Myristicaceae in the Momiwaren protected forest area in 250 observational plots showed variations in the characters of the diverse sites of growth, mainly influenced by physiographic factors in the area.

The number of individuals Myristica found in observation plots in the area are generally grouped and in areas with a slope between 0 and 8% in the slope direction to Southeast. In addition, Myristicaceae was also found in an area with moderate to rather steep slopes (between 30 and 40%) which eventually formed Massart's architectural model. Where the plant stems are monopodial and orthotropic with multilevel branching originating from the lateral branching stem meristem which is plagiotropic (Halle et al 1978). This condition is strongly supported by the surface layer of the soil that supports the plant to grow. Hardjowigeno (1992) states that in areas with moderate to steep slopes, it generally has a thin soil nutrient content. Therefore, the type of roots is strongly influenced by the structure of its constituent rocks. The more oblique the location where Myristicaceae grows, the bigger the buttress formed. In locations that tend to be flat, these plants would grow to reach 30 meters high, but when it is found in areas with moderate to steep slope, these plants tend to be shorter.

Paijmans (1976) states that the composition of flora in lowland forests is more open and has many gaps that are dominated by trees with lower canopy. Species of trees that are generally located in the upper layers of Papua's tropical rain forest areas according to Kartika et al (2012) are *Pometia pinnata*, *Ficus* spp, *Alstonia scholaris* and Terminalia spp. While the type of Myristica is generally found in the layer below and generally in the area close to the river flow (Figure 1).

Vink (1998) states that the Myristica distribution area in the Momiwaren protected forest area is in lowland wet forest which is formed from ultrawet metamorphic rocks. Bowles (1984) further explains that these rocks are formed through sedimentation with high temperatures and pressures that change the texture and composition of minerals and their chemical substances. Generally, the soil type found in the Momiwaren Manokwari Selatan protected forest area is inceptisol which has a low clay content (<8%). Resman *et al* (2006) added that the physical and chemical properties of inceptisol include specific gravity of 1.0 g/cm3, calcium carbonate < 40%, wet saturation < 50% at 1.8 m depth, COLE (Coefficient of Linear Extensibility) between 0.07 and 0.09, and porosity values between 68% and 85%. In addition, Nuryani *et al* 2003 stated that the soil solumn was rather thick (ie 1-2 meters), the texture of sand: dust and clay, the pH ranged from 5.0 to 7.0, with 10-31% organic matter content, with soil productivity moderate to high. But on the other hand, high rainfall would have an impact on the surface movement of water especially on the slope area which results in the drift of soil particles, nutrients and other soil particles.

The temperature and humidity in the region also plays an important role in supporting the growth process and the presence of Myristica species. The activity of enzymes and metabolic processes in plant bodies would take place well if they live in the optimum temperature. Plants are generally able to grow in the temperature range between 10^0C and 38^0C. When examined physically, temperature is affected by sunlight radiation. Whitmore (1984) states that the level of soil fertility changes based on its height, where the higher the location of a site, the level of humidity increases, so that anaerobic conditions inhibit the decay of organic matter which may impact on soil nutrient content.

Conservation status of Myristicaceae species

Papua's lowland tropical rain forests are the most complex type of vegetation (Whitmore, 1984). One family of woody plants that exists in this forest type is Myristicaceae family. Heyne (1987) states that *M. argentea* Warb from the Myristicaceae family is only found on New Guinea Island, in which part of Papua Indonesia is included.

The types of Myristica found in this study were five types. Two types have entered the global conservation 21 us which see the risk of extinction status based on data from International Union for Conservation of Nature (IUCN). The first type of *M. gigantean*. This type according to the World Conservation Monitoring Center (1998), is in the status of Near threatened (NT), while the type of *M. fatua* ssp. Fatua according to de Wilde (1998) is in status of Least Concern (LC). The cause of scarcity of species in an area would occur by biological or ecological characteristics of species such as the nature of species and the nature of the ecosystem. Besides anthropogenic factors such as land conversion, biotic mixing due to introduction of exotic species, even pollution that would change the biochemical cycle or introduction of synthetic organic chemical compounds.

The other three types of Myristicaceae, namely *M. argentea, M. pseudoargentea* and *M. tubiflora*, currently are not listed on the IUCN Redlist. However, it is predicted that the status of these three species may be included in the list of global conservation status if the natural conditions under which these plants grow, are not maintained. In addition, when it is viewed from the species potential data in Diagrams 3 and 4, the relative density values for *M. tubiflora* species at the level of seedling, sapling and pole have lower density values compared to other Myristica species at this location. For this reason, species conservation

activities need to be implemented both in the area where the species was found and in conservation initiatives by taking a collection of plants from nature to be developed in the existing conservation areas.

The hindrance often faced in the development of the Myristica group according to Arrijani (2005) is that this nutmeg plant or arillus flower is very thick. This may cause the seeds are shrinking that may have an impact on germination restrictions. Asexual development greatly helps conservation efforts in increasing the number of individuals of this type. Another obstacle is the period of dormancy or germination of seeds of the type of Myristica would reach three months. Therefore, the scarification or chemical treatment needs to be applied to elevate the germination period.

CONCLUSION

The highest INV value for the Myristicaceae family in the Momiwaren Protected Forest area is *M. fatua* species, found at the tree level. Where two types of them have entered the status of global conservation that see the risk of extinction status. Myristicaceae were found living in clusters on flat topography (0-8%) with ultrawet metamorphic rocks, and temperatures between 10^{0}C and 38^{0}C.

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