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POPULATION STRUCTURE OF DIPTEROCARPACEAE SPECIES IN KETAMBE RESEARCH STATION, GUNUNG LEUSER NATIONAL PARK, ACEH TENGGARA

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Abstract. Ketambe Research Station is one of the oldest and most complete stations in the world which has abundant biodiversity. The *Dipterocarpaceae* is one of the family identified as growing in the forest area of Ketambe Research Station. Ecologically, *Dipterocarpaceae* has several limiting factors for its growth and distribution and the most determining factors are soil factors and climate. *Dipterocarpaceae* is also known as nest and source of food for orangutans, namely *Shorea* spp. Therefore, it is necessary to conduct research that aims to determine the population structure of *Dipterocarpaceae* species in Ketambe Research Station. The method used Quadrat Sampling Technique. The placement of the sampling plot was randomly carried out in 25 plots with an area of 1 ha. The result showed that there were three species of *Dipterocarapaceae* found in this station i.e., *Parashorea lucida, Shorea johorensis* and *Hopea dryobalanoides*. Based on the population structure pyramid, *P. lucida* will survive and develop in the future *S. johorensis* and *H. dryobalanoides*, on the other hand, are estimated to decrease or hardly survived in the future.

Keywords:Population structure, Dipterocarpaceae, Gunung Leuser National Park, Ketambe Research Station

I.INTRODUCTION

Dipterocarpaceae is one of the major family with a number of species around the world reaching 506 species, belonging to 14 genera which predominantly (76%) plant species in the Malesia region, especially in Indonesia [1]. The diversity of Dipterocarpaceae in the Malesia region is also highest in more wet areas [2]. Geographically, the distribution of Dipterocarpaceae species is not evenly distributed throughout Indonesia, in contrast to other family species such as Myrtaceae, Euphorbiaceae, Lauraceae, Moraceae, and Annonaceae which generally have wide distribution [3]. Ecologically, Dipterocarpaceae has several limiting factors for its growth and distribution. The most determining factors are soil and climate [4]. Spesies of Dipterocarpaceae are plants which dominate lowland forests to an altitude of 1200 m above sea level [5]. One of Dipterocarpaceae subfamily is found in Ketambe Research Station. Ketambe Research Station is one of the oldest and most complete stations in the world which has abundant biodiversity. It is located in Gunung Leuser National Park, Aceh Tenggara. Currently, Gunung Leuser National Park has two global-scale status, namely as a Biosphere Reserve (1981) and World Heritage (2004). UNESCO and World Heritage Committee have set these two statuses on the proposal of the Indonesian Government after going through a stringent selection process [6]. Dipterocarpaceae is one of the family identified in Ketambe Research Station which is also known as nest tree and source of food for orangutans, namely *Shorea* sp [7]. Therefore, it is necessary to know the structure of Dipterocarpaceae species based on the level of tree growth, i.e., seedling, sapling, pole, and mature tree to examine whether these plants can survive and develop or cannot survive and more decrease. Population structure is very important to determine how the condition of plant population in habitat.

II.METHODOLOGY

This research was conducted in the Ketambe Research Station, Gunung Leuser National Park, Aceh Tenggara and the Herbarium Acehense Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, Banda Aceh. This research was conducted in February to July 2017. The research location can be seen on the map (Figure 1). The tools used in this study were GPS, compass, raffia rope, plant scissors, label paper, sacks, wet specimen storage plastic, meter (to measure plot size), stationery, hygrometer, soil thermometer, lux meter, and ground drill. While the materials used in this study was 70% alcohol. Quadratic method was used for collecting samples. Plots were randomly chosen in Ketambe Research Station area.

Survey of Dipterocarpaceae Species

The data recorded in the survey of Dipterocarpaceae species were the number of species, species abundance, and morphology of Dipterocarpaceae in each plot. Specimens were also collected in each plot. Sampling was started by determining the area to be analyzed, followed by the making and placement of the plot. Sampling of Dipterocarpaceae in each plot includes (1) seedling stage is the initial regeneration of tree with height of 1.5 m, (2) sapling stage is regeneration tree with a size higher than 1.5 m and diameter less than 10 cm, (3) pole stage is regeneration of tree with diameter of 10-20 cm, and (4) mature stage is woody plant with a stem diameter of more than 20 cm with an area of 1 ha [8]. All of Dipterocarpaceae species was collected, identified, and made Herbarium

Stand Structure

Data recorded in the stand structure survey were diameter at breast height, all the presence of Dipterocarpaceae in each growth strata including sapling, pole, and mature tree, so that tree diameter can be calculated.

Abiotic factors

Data recorded were air humidity, soil temperature, light, and soil in each plot. Soil samples used the composite method. Then the soil data was analyzed in the Soil and Plant Laboratory, Agricultural Faculty, Universitas Syiah Kuala.

III. RESULT AND DISCUSSION

There were three Dipterocarapaceae species in Ketambe Research Station i.e: *Parashorea lucida, Shorea johorensis*, and *Hopea dryobalanoides* (Table 1). *P. lucida* has a greater number than other species in each growth stratum.

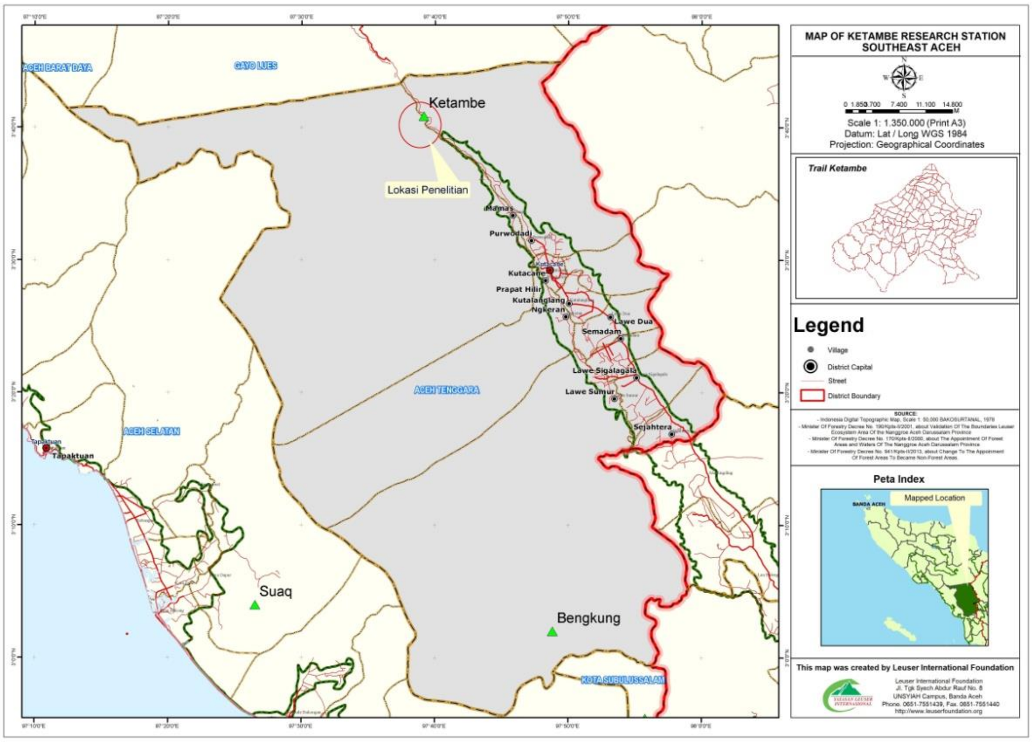

Figure 1. Map of the Ketambe Research Station

Table 1. Population Structure of Dipterocarpaceae Species

Tree Growth Stages	Dipterocarpaceae Species		
	Parashorea lucida	*Shorea johorensis*	*Hopea dryobalanoides*
	Individual	Individual	Individual
Seedling	1006	5	0
Sapling	130	13	2
pole	38	1	1
Mature tree	27	2	0

The number of *P. lucida*'s seedlings is larger than the sapling, the sapling is larger than the pole, and the pole is larger than the mature tree. It means that *P. lucida* is in a normal or developing state. While *S. johorensis* found the number of seedlings smaller than the sapling, the sapling is larger than the pole, and the pole is smaller than the mature tree. For *H. dryobalanoides*, the number of saplings is larger than the pole while the seedling and mature tree are not found. It can be predicted that *S. johorensis* and *H. dryobalanoides*are hardly survived in the future [9], if the number of seedlings is greater than the sapling, the sapling is greater than the pole, and the pole is greater than the tree, the population is in a normal or developing state. The structure of the age population in pyramids of numbers, namely *P. lucida* forms a pyramid with a broad base with a characteristic number of young *P. lucida* is larger but different to *S. johorensis* and *H. dryobalanoides*. [10], diagram shape (age pyramid) of population structure consists of three forms, i.e: (1) pyramid with a broad base is a developing population, (2) bell shape polygon is stationary and population, (3) bowl or jug shape is a declining population. Figure 2 corresponds to the existing age pyramid shape, so the researchers argue that the population structure in the figure shows that the population of *P. lucida* will survive and develop while *S. johorensis* and *H. dryobalanoides* have the age pyramid with pitcher shape so that it will not survive and the population more decreases. This is thought to be caused by environmental factors. [11], plants which survive toward environmental factors and compete against each other, they will continue to grow and for species which will not be able to perish. [12], the population structure is influenced by three factors, i.e., the environment, the way of reproduction and human activity. The status of a population is determined by the on goingreproductive status of the population, usually a rapidly developing population containing the majority of young individuals. Organisms in an environment are closely related to those around them so they will help a part of their own environment. A plant, especially the *Dipterocarpaceae* can grow successfully in a particular environment so that the environment must provide various needs to grow and be able to complete its life [11].

Based on measurements of environmental parameters conditions (Table 2), the air temperature at the Ketambe Research Station has shown a general standard of air temperature factor requirements of a plant so that *Dipterocarpaceae* can grow with that temperature range. [13], the daily average temperature that occurs within the Ketambe Research Station area ranges from 20-27ºC, with the minimum temperature at night being 15.5-24.2ºC with an average of 21ºC and the maximum temperature during the day ranges between 21-32ºC with an average of 27.5ºC.

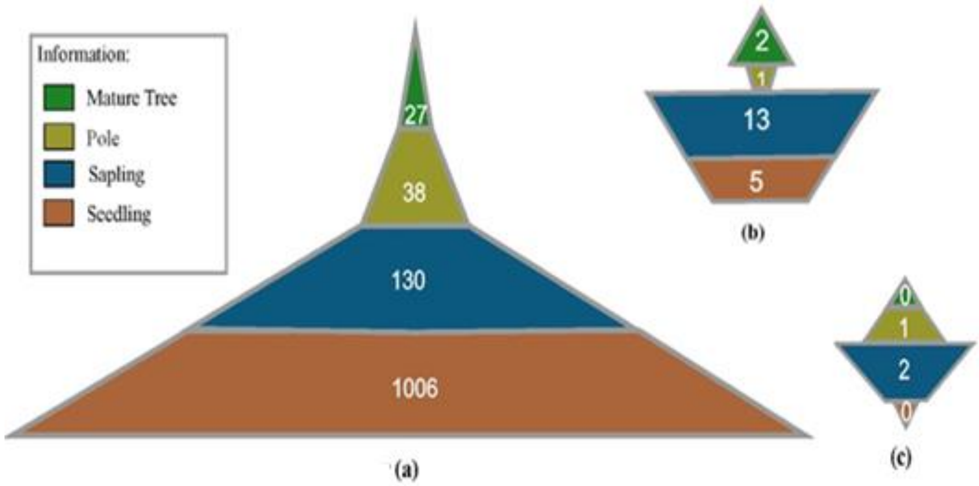

Figure 2. Pyramids of Population Structure of *Dipterocarpaceae* Species

Tabel 2 The Ranges of Environment Condition in Ketambe Research Station.

Environment Parameters	Ranges	General Standard and References
Air Temperature	23 - 28°C	24-28°C [26]
Humidity	69 - 100	80% [27]
Light Intensity	262 - 950 (13.1 – 47.5%)	Light Grade: Very low (0-20%), low (21-40%), medium (41-60%), high (61-80%) and very high (81-100%) [16]
Soil pH	4.76 – 6.96	5 – 7.5 [28]
Soil Contains		
CEC	12.80 – 24.00	Very low (<5). low (5-16), medium (17-25), high (>25)
BS	16.63 – 45.96	Low (<35), Medium (35-50), High (>50)
C	1.19 – 2.54	Low (<3), Medium (2-3), High (>3) [29]
P	0.65 – 41.5	1.56 [11]
N	0.23 – 0.39	0.20 – 0.50 [24]
K	0.05 – 0.18	0.17 – 3.30 [24]
Soil Texture		
Sand	9-62%	< 20% [30]
Silt	16-76%	37.2% [24]
Clay	5-36%	27-40 % [30]

However, for tropical rainforest areas, the temperature is not the dominant factor which determines productivity, but the length of the growing season. High and continuous productivity throughout the year will not last if only supported by high temperatures. Many other regions of the world have much higher temperatures than tropical rainforests, but they have low productivity. The interaction between high temperatures and heavy rainfall which lasts throughout the year produces moisture conditions which are ideal for tropical rainforest vegetation to increase productivity so that it causes tropical rainforests to have very high humidity (Table 2), it can be seen that moisture in the area according to plant growth [14]. The air evaporation power is the most important for plant life, because it directly affects transpiration for plants. If the humidity is low, the transpiration rate will increase so that the absorption of water and mineral substances also increases. It will increase the availability of nutrients for plant growth. If the humidity is high, the transpiration rate will low so that absorption of nutrients is also low, it will reduce the availability of nutrients for plant growth so that growth will also be hampered [15].

The results of the measurement of light intensity (Table 2) show that the light intensity at the Ketambe Research Station is classified as low to medium while the light requirements for the growth of *Dipterocarpaceae* in a young tree have a range from 50 - 85% of total light (medium to high) [16]. It is because the canopy cover in the upper layer is quite tight. Therefore, low sunlight intensity entering both the middle and the lower strata. It is thought to cause a lack of seedling strata in *S. johorensis* species and even there was no seedling strata in *H. dryobalanoides* in all of plots [17]. Due to the close closure of the canopy, it generally causes the intensity of sunlight entering the area of *S. johorensis* regeneration to be around 30%. Among the regeneration of seedlings, sapling, and pole, the incoming light intensity is almost equal, which are 22 - 30% at the seedling, 22 - 31% at the sapling, and 29 - 36% at the pole. This is in accordance with the results of the study in Table 2. In general, *Dipterocarpaceae* grow in fertile places [17]. The results showed that *P. lucida*, *S. johorensis* and *H. dryobalanoides* can grow under pH conditions in the study area. The existence of mutualism symbiosis between *mycorrhizae* in the *Dipterocarpacea*e root system is thought to be very instrumental in helping the absorption of nutrient P from the soil so that the problem of infertile growing conditions can be overcome. [17], states *S. johorensis* can grow in very acidic pH conditions.

Sunlight can limit when high intensity, as well as low intensity. Sunlight is a very important factor in plant life as a source of energy, therefore changes in light intensity greatly affect plant life [18]. The higher of the light intensity, the higher photosynthesis rate which carried out by plants if supported by other environmental factors such as moisture, water, and mineral elements. Every plant or tree species has a different tolerance to sunlight. There are plants which grow well in an open place while others prefer growing in or require different light intensities throughout their lifetime [19]. Most of the *Dipterocarpaceae* species are tolerant of light intensity during seedling and intolerance after reaching the sapling and pole stage [20].

Some of the *Dipterocarpaceae* which are tolerant, especially those which have a high density (sinking), for example, *Dipterocarpus* spp and some are classified as semi-tolerant, namely species which have low density (floating) wood, for example *Shorea* sp. and *Hopea* sp. In general, the soils which are under conditions of forest vegetation will tend to be more acidic than those that develop under grasslands [21]. pH is one of the important parameters of a plant can grow or not. [22], the pH soil value has an effect toward stored carbon, but not directly. The size of the pH value will affect the availability of nutrients in the soil. The availability of these nutrients will affect plant physiology. One of the plant's physiological processes which will influence is the absorption of carbon through photosynthesis. Therefore, the pH value at a certain level will ensure the availability of nutrients so that it can increase carbon stored in tropical rainforests, especially in the Ketambe Research Station area.

Nutrients in soil (Table 2) show elements of CEC, base saturation (BS), and carbon elements (C) in low to medium condition, N element is medium, P and K are low. Based on this, it can be assumed that soil fertility in the study area is not fertile. This is according to the author's observation that there has been forest destruction by natural factors or due to human activities, resulting in degradation or impoverishment of land under forest stands. Ref [23] states that the soil function as a medium of vegetable life, carries out four functions, i.e., soil as a place for anchoring of vegetable roots, provides vegetable drink, provides air for root breathing, and provides nutrients for plant foods. But *Dipterocarpaceae* can grow in infertile environments.

Based on soil analysis taken at a depth of 0-20 cm from all plots in Ketambe Research Station area, the sand fraction can range from 9-62%, silt fraction ranges from 16-76%, and clay fractions with a range between 5- 36% so that the soil texture class can be obtained, i.e.: salty clay loam, sandy clay loam, loam, and salty loam. The soil texture in the research plot represented by 12 sample plots was dominated by salty loam (Table 2). In general, *Dipterocarpaceae* species grow in fertile places with clay loam texture [17]. Due to the texture of clay loam has a high porosity. [24], said that the rather coarse soil texture such as loam which has nearly balanced sand, silt, and clay fraction, will be more porous than soil with smooth and high content. It means that this type of soil is generally the ideal soil type because it will be easily penetrated by plant roots, the amount of water and air held in the soil will be balanced for plant growth. Indirectly, the soil texture also determines the soil structure which is important for the movement of air, water, nutrients, and activities of macro and microorganisms in the soil. The texture of forest soil is more developed than agricultural soil. One of the causes is the influence of soil organic matter. In the process of decomposition of organic matter will produce organic acids which are effective solvents for rocks and primary minerals (sand and silt) so that they break more easily into smaller sizes such as clay. In addition, the higher amounts and densities of roots in the forest will accelerate physical destruction so that smoother fractions will be formed faster [25].

CONCLUSION

The results showed that there were three of *Dipterocarapaceae* species found in this station, i.e., *Parashorea lucida*, *Shorea johorensis,* and *Hopea dryobalanoides*. Based on the population structure pyramid, *P. lucida* will survive and develop in the future, while *S. johorensis* and *H. dryobalanoides* population are estimated to decrease or hardly survived in the future.

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