Inventory of *Dryobalanops aromatica* Gaertn. in Lae Kombih Forest Park Area, Subulussalam

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Abstract. *Dryobalanops aromatica* Gaertn. is a plant that grows in the tropical rain forests of western Indonesia which is categorized as a valuable timber tree. *Dryobalanops aromatica* Gaertn is a plant that is categorized as a valuable timber tree. *Dryobalanops aromatica* Gaertn also known as the camphor tree, lime or Sumatran camphor, this tree can grow to a height of 60 m with an average trunk diameter of 9 m. Camphor tree is a plant species belonging to the Dipterocarpaceae family which has several advantages because its tree trunk can produce a variety of high economic value commodities such as camphor, balsamic acid, resin, essential oil, beams, poles, roof construction and boards in residential buildings. The method used for the inventory of rare plants is done by using the method of vegetation analysis, the parameters in this study were the type, number, diameter and height of the *Dryobalanops aromatica* Gaertn. tree. Vegetation analysis was carried out by plotting 13 plots, each sample plot measuring 20 m x 20 m. The sample used is a total sample using a random sampling system method, the sampling chosen by exploring the area of the Tahura Lae Kombih area where the *Dryobalanops aromatica* Gaertn is located. The results show that the plant species were found starting from the seedling, sapling, pole and tree levels. The most dominant species in this area is *Dryobalanops aromatica* Gaertn that has Important Value Indeks of seedling 163%, Sapling 270%, Pole 283% and Tree 216%.

1. Introduction

Tahura Lae Kombih is a nature conservation area in Subulussalam City. Tahura Lae Kombih has an endemic plant, namely *Dryobalanops aromatica* Gaertn. which is under the supervision of the Department of Environment and Forestry with the aim of preserving *Dryobalanops aromatica* Gaertn. Aceh Singkil Regency has designated the Kedabuh area, Jontor Village, Penanggalan District as a conservation area for the *Dryobalanops aromatica* Gaertn. Nature Reserve. Since the division into an autonomous region, the city government of Subulussalam has initiated an improvement in the management of the *Dryobalanops aromatica* Gaertn. conservation area. become a new conservation area as a conservation area for the Lae Kombih Forest Park with an area of 1,482 ha in accordance with the Decree of the Minister of Environment and Forestry Number SK.510/MenLHK/Setjen/PLA.2/9/2017. Conditions in the field today show that forests are often converted into plantation areas and community settlements, especially for the people of Subulussalam City, the majority of whom own oil palm plantations.
Dryobalanops aromatica Gaertn. is a plant that grows in the tropical rain forests of western Indonesia which is categorized as a valuable timber tree. Dryobalanops aromatica Gaertn. is a plant that is categorized as a valuable timber tree. Dryobalanops aromatica Gaertn. also known as the camphor tree, lime or Sumatran camphor, this tree can grow to a height of 60 m with an average trunk diameter of 9 m. Camphor tree is a plant species in the Dipterocarpaceae family which has several advantages such as camphor, balsam, essential oils, resin, beams, poles, roof construction and boards in residential buildings [1].

Based on the International Union for Conservation of Nature (IUCN) Redlist, the camphor tree was included in the Critically Endangered or critical conservation status in 2013 and its condition improved to the Vulnerable level or vulnerable in 2017 with reforestation efforts carried out by Tahura Lae Kombih to keep the tree safe. camphor stays awake. Exploitation of the camphor tree is the main factor causing the threat of biodiversity. In order to preserve and encourage efforts to save the camphor tree, so this paper aims to see the potential existence of Dryobalanops aromatica Gaertn. and it is necessary to conduct research related to the camphor tree inventory.

2. Materials and methods

2.1. Research tools and objects
This research uses tools, namely 3 in 1 environment meter (a tool to measure light intensity, humidity and temperature), hypsometer (to measure tree height), GPS, meter, camera and stationery. The objects to be observed are the type of camphor and other types of forestry plants in the growth phase of seedlings, saplings, poles and trees in the Tahura Lae Kombih area, Subulussalam City, Aceh Province.

2.2. Data retrieval type
a. Primary data that taken were tree characteristic data including species, number, diameter and height of trees were taken using the vegetation analysis method. Environmental factors include humidity, temperature and light intensity.
b. Secondary data taken is the status of camphor plants in the Tahura Lae Kombih area of Subulussalam City and other data that supports the research.

2.3. Research methods
This study uses the method of vegetation analysis with a random sampling system [2]. Vegetation analysis was carried out by plotting 13 plots, each sample plot measuring 20 mx 20 m, the determination of the sampling plot was based on information from Tahura Lae Kombih regarding the existence of this type of Camphor.

2.4. Data analysis
Data analysis used quantitative data, vegetation data analysis in the form of significant value index (INP) data analysis, species dominance index (C) and species diversity index (H').

a. Important value index (INP)
INP is used to analyze the species that dominate an area [3].

\[
\text{INP} = \text{KR} + \text{FR} + \text{DR}
\]

\[
\text{Density (K)} = \frac{\text{number of a species (N)}}{\text{total area of plot}}
\]

\[
\text{Relative Density (KR)} = \frac{\text{density of a species (K)}}{\text{density all species}} \times 100\%
\]

\[
\text{Frequency (F)} = \frac{\text{number of plots of a species}}{\text{sum of all plots}}
\]
Relative Frequency (FR) = \frac{\text{frequency of a species (F)}}{\text{frequency of all species}} \times 100\% \\

\text{Dominance (D)} = \frac{\text{number of basic fields of a species}}{\text{total area of plot}} \\

\text{Relative Dominance (DR)} = \frac{\text{dominance of a species (D)}}{\text{dominance of all species}} \times 100\% \quad (1)

b. Species dominance index (C)

\[ C = \left( \sum_{i} \frac{n_i}{N} \right)^2 \quad (2) \]

Description:
C: Species dominance index.
\( n_i \): density of the i-th type.
\( N \): total density of all species.

If the ID value is high, then the dominance is concentrated in one species, while if the ID value is low, the dominance is concentrated in several species [3], then the ID value criteria are as follows:
- ID < 0.50 = Low dominance.
- ID 0.50 < ID < 0.75 = Moderate dominance.
- ID > 1.00 = High dominance.

c. Species diversity index (H')

\[ H' = -\sum P_i \ln (P_i) \quad (3) \]

Description:
H': Species diversity index.
P_i: \( n_i/N \).
n_i: density of the i-th type.
N: total density of all species.

According to [4], the greater the H' value, the higher the species diversity in that location. The value of H' is defined as follows:
- a. H' > 3 indicates the high diversity of species in an area.
- b. 1 < H' < 3 indicates a moderate value of species diversity in an area.
- c. H' < 1 indicates low species diversity in an area.

3. Results and discussion

3.1. Vegetation analysis
The results showed that in the Tahura Lae Kombih area of Subulussalam City were found the plant species starting from the seedling, sapling, pole and tree levels. The type of plants that found were 9 plant species with a total number of all species 409 individuals spread over 13 observation plots. Based on the results of the study, the four growth phases that were most commonly found were plants at the seedling level and 37% trees, this was because the camphor tree was a plant that was included in the tolerant plant group (the ability of trees that can grow well under shade), the sapling level 14% and pole rate 12%. Research with a similar method was also conducted by [5] in Rawa Singkil Wildlife Reserve which showed that there were 25 plant species consisting of 3 growth phases were saplings, poles and trees.
Table 1. Plant species in the Tahura Lae Kombih area, Subulussalam City.

| No. | Regional Name | Scientific Name | Family        |
|-----|---------------|-----------------|---------------|
| 1.  | Kamper        | Dryobalanops aromatica Gaertn. | Dipterocarpaceae |
| 2.  | Gaharu        | Aquilaria malaccensis | Thymelaeaceae |
| 3.  | Damar         | Agathis sp.      | Araucariaceae |
| 4.  | Akasia        | Acacia mangium   | Fabaceae      |
| 5.  | Saninten/ Rambutan hutan | Castanopsis argentea | Fagaceae |
| 6.  | Durian        | Durio zibethinus | Bombacaceae |
| 7.  | Meranti       | Shorea spp.      | Dipterocarpaceae |
| 8.  | Tongkat Ali/ Pasak Bumi | Eurycoma spp. | Simaroubaceae |
| 9.  | Jabon Putih   | Anthocephalus cadamba | Rubiaceae |

3.2. Type composition
Species composition is a constituent factor of an ecosystem consisting of several groups of vegetation. Based on Table 2, the dominant vegetation types were found at the seedling level of 138 individuals and the lowest was found at the pole level as many as 47 individuals. The most dominant species in this area is Dryobalanops aromatica Gaertn. with a total of 363 individuals or equivalent to 89% of the total. Dryobalanops aromatica Gaertn. has the most individuals of other species because Tahura Lae Kombih is an area that aims to preserve Dryobalanops aromatica Gaertn., in terms of level, the number of individuals of Dryobalanops aromatica Gaertn. most commonly found at the level of seedlings and trees while the least at the level of poles and saplings, this can be influenced by wind speed, humidity and temperature drops. One of the important factors that can affect the growth from seedlings to mature trees is sunlight, sunlight is the key to the ongoing metabolic processes in plants, because the camphor tree is a plant tolerant of the process of photosynthesis being less than optimal which results in slow growth of saplings and poles.

The second factor that can affect the inhibition of camphor tree growth is the spacing. The wide spacing will trigger the opportunity for greater height growth, the facts in the field show that the dense growth of seedlings makes it difficult for seedlings to grow into saplings and so on. According to the [6], the study found that sapling phase of Dryobalanops aromatica Gaertn. have a mast fruiting fertilization system causing few seedlings to be able to grow.

Based on observations in the field, Tahura Lae Kombih belongs to the secondary forest category, as evidenced at the time of the study the number of individual camphor trees was more dominant with the average condition of trees being old, burrowed and felled. Due to the age of the camphor trees which are old and grow on the edge of the crossroads, fallen trees are very common which results in the loss of the parent tree and slows down the regeneration process.

Table 2. The composition of species found in the Tahura Lae Kombih area of Subulussalam City by level.

| No. | Tree Name        | Scientific Name | Growth Phase |
|-----|------------------|-----------------|--------------|
|     |                  |                 | Seedling | Sapling | Pole | Tree | %     |
| 1.  | Kamper           | Dryobalanops aromatica Gaertn. | 138 | 55 | 47 | 123 | 89 |
| 2.  | Gaharu           | Aquilaria malaccensis | - | - | - | 2 | 0,5 |
| 3.  | Jabon Putih      | Anthocephalus cadamba | - | - | - | 3 | 0,7 |
| 4.  | Damar            | Agathis sp.      | - | - | - | 2 | 0,5 |
| 5.  | Meranti          | Shorea spp.      | 5 | - | - | 20 | 6,1 |
| 6.  | Akasia           | Acacia mangium   | 5 | - | - | 1 | 1,5 |
| 7.  | Durian           | Durio zibethinus | 2 | - | 2 | - | 0,9 |
| 8.  | Saninten         | Castanopsis argentea | - | - | 1 | - | 0,2 |
| 9.  | Pasak Bumi       | Eurycoma spp.    | 2 | 1 | - | - | 0,7 |
|     | Total            |                 | 152 | 58 | 48 | 151 | 100 |
3.3. Important value index (INP)

The index of the importance of plant species is one of the parameters that shows the role of plant species in their community.

| No. | Tree Name     | Scientific Name                     | Growth Phase |
|-----|---------------|-------------------------------------|--------------|
|     |               |                                     | Seedling (%) | Sapling (%) | Pole (%) | Tree (%) |
| 1.  | Kamper        | Dryobalanops aromatica Gaertn.      | 163          | 270         | 283      | 216      |
| 2.  | Gaharu        | Aquilaria malaccensis               | -            | -           | -        | 11       |
| 3.  | Jabon Putih   | Anthohepalus cadamba               | -            | -           | -        | 5        |
| 4.  | Damar         | Agathis sp.                        | -            | -           | -        | 9        |
| 5.  | Meranti       | Shorea spp.                        | 11           | -           | -        | 55       |
| 6.  | Akasia        | Acacia mangium                     | 14           | -           | -        | 3        |
| 7.  | Durian        | Durio zibethinus                   | 5            | 20          | -        | -        |
| 8.  | Saninten      | Castanopsis argentea               | -            | -           | 17       | -        |
| 9.  | Pasak Bumi    | Eurycoma spp.                      | 5            | 11          | -        | -        |
|     |               |                                     | Total        | 200         | 300      | 300      | 300      |

Based on the results of calculations from the INP in the Tahura Lae kombih area of Subulussalam City, it proves that a plant species will be different at each level. The tree level has an INP value of 300% with 7 types of plants, for the sapling level it has an INP value of 300% with 5 types of plants, the pole level has an INP value of 300% with 3 types of plants and the seedling level has an INP value of 200% with 6 types of plants. Species that have the highest INP means that they have the most important role in an ecosystem. This species has a dominant role and influence on changes in environmental conditions and changes in other plants [4]. This is because species cover at the tree level is higher, resulting in a high INP value as well. According to field data, the camphor tree is expected to continue to dominate the research location in the future due to the high INP value.

According to [7] INP is used to see the growth of tree species in a community. The role of a species in a community is determined by the value of the INP of a species. The greater the INP value of a species, the greater the role of that species in a community and vice versa, the smaller the INP value of a species, the smaller the role of that species in a community for the stability of the forest ecosystem. According to [8], a high INP indicates that the species has the most dominant number of individuals, density and frequency. In accordance with the research conducted above, showed Dryobalanops aromatica Gaertn. as a tree that has the most dominant number of individuals with an INP value at the seedling level of 163.6%, the sapling level of 252.4%, the pole level of 239.7% and the tree level of 132.5%, this indicates that the camphor tree is capable of survive and grow well and the conditions are very suitable for growing in the place where it grows.

According to [9] that INP is an important index in the role of a type of vegetation in an ecosystem. If the INP of a vegetation type is of high value, then that species greatly affects the stability of the ecosystem, the results of the study show that Dryobalanops aromatica Gaertn. as a plant that is able to reproduce better and have much better adaptability and competence than other plants. According to [10] the results of the calculation of the INP of plant vegetation in the Gothermal le Suum area, Mesjdi Raya District, Aceh Regency are high with an INP result of 225.86%, this illustrates the effect of a type of vegetation on ecosystem stability. This study shows the influence of the environment in which it grows such as temperature, humidity and competition, such as the struggle for nutrients, light intensity and growing places with other species that affect the growth of tree trunk diameter in accordance with research conducted that the biophysics contained in the Tahura Lae Kombih area affects growth and INP reaches 200%-300%.
3.4. Species dominance index
The dominance index is a parameter that states the level of control of species in a community. Mastery or dominance of species in a community can be concentrated on one species, several species, or on many species which can be estimated from the high and low dominance index [11].

Table 4. Species dominance index.

| No. | Tree Name   | Scientific Name | Growth Phase | Seedling | Sapling | Pole | Tree  |
|-----|-------------|-----------------|--------------|----------|---------|------|-------|
| 1   | Kamper      | Dryobalanops aromatica Gaertn. |              | 0,337    | 0,134   | 0,115 | 0,301 |
| 2   | Gaharu      | Aquilaria malaccensis    |              | -        | -       | -    | 0,005 |
| 3   | Damar       | Agathis sp.          |              | -        | -       | -    | 0,005 |
| 4   | Akasia      | Acacia mangium      |              | 0,012    | -       | -    | 0,002 |
| 5   | Saninten    | Castanopsis argentea |              | -        | -       | 0,002 | -     |
| 6   | Durian      | Durio zibethinus    |              | 0,005    | 0,005   | -    | -     |
| 7   | Meranti     | Shorea spp.         |              | 0,012    | -       | -    | 0,049 |
| 8   | Pasak Bumi  | Eurycoma spp.       |              | 0,005    | 0,002   | -    | -     |
| 9   | Jabon Putih | Antochepalus cadamba |             | -        | -       | -    | 0,007 |
|     | Total       |                  |              | 0,371    | 0,141   | 0,117 | 0,363 |

Based on Table 4, the value of the species dominance index ranged from 0.1–0.4, the highest species dominance index of 0.337 was found at the seedling level with the type Dryobalanops aromatica Gaertn. and the smallest species dominance index value of 0.002 is found at the tree level with the type Castanopsis argentea. The results of the observation of the species dominance index show the plant species in the Tahura Lae Kombih area of Subulussalam City of 1. The value of the species dominance index (ID> 1.00) indicates the high species dominance in the Tahura Lae Kombih area, can be seen in Table 4. This shows the high index species dominance in the Tahura Lae Kombih area is caused by the even distribution of plant species and the distribution of individuals in that location. According to [12] the more stable an ecosystem, the higher the diversity of species, both common and rare species, so that it can be concluded that in this study there were no differences in species dominance and adaptability and plant ability to survive which were relatively the same.

3.5. Species diversity index
The species diversity index in a plant community is used to determine the species diversity of a forest stand. The results of the observation of the species diversity index showed that the plant species in the Tahura Lae Kombih area of Subulussalam City were 0.28. According to [13] the high or low diversity index value is influenced by soil organic matter content, humidity, temperature and light intensity. The value of the species diversity index (H’ < 1) indicates that the species diversity in the Tahura Lae Kombih area is low, as shown in Table 9. This can occur because the intensity of light entering the forest floor is not maximal, resulting in high humidity in the canopy cover. Therefore, a silvicultural action with the Group Selection System is needed, namely logging carried out on groups of trees so that the openings are wide enough to facilitate the growth of rejuvenating tree species that require light. Based on research conducted by [14], agroforestry system applied by farmers by combining forestry and agricultural commodities in beekeeping. This method is preferred by farmers because they feel they get optimal benefits. Beekeeping system is an agroforestry system that combines forestry activities with bees. [15], states that a community has high diversity if it consists of many species and the abundance of the same species.

The value of the species diversity index in the Tahura Lae Kombih area at the tree level is 0.102 which is the highest value of the other classes. The lowest value of species diversity is pole with a value of 0.044. This indicates that the overall level of species diversity is low (H’ < 1) in accordance with the determination of the Shannon-Wiener diversity index [16], explains that species diversity is one of the
characteristics of the community level according to its biological organization. Species diversity is usually used to represent community structure.

Table 5. Species diversity index.

| No. | Tree Name       | Scientific Name                  | Growth Phase |
|-----|-----------------|----------------------------------|--------------|
|     |                 |                                  | Seedling     | Sapling | Pole | Tree |
| 1   | Kamper          | Dryobalanops aromatica Gaertn.   | 0.061        | 0.045   | 0.041 | 0.060 |
| 2   | Gaharu          | Aquilaria malaccensis            | -            | -       | -    | 0.004 |
| 3   | Damar           | Agathis sp.                      | -            | -       | -    | 0.004 |
| 4   | Akasia          | Acacia mangium                   | 0.009        | -       | -    | 0.002 |
| 5   | Saninten        | Castanopsis argentea             | -            | -       | -    | 0.002 |
| 6   | Durian          | Durio zibethinus                 | 0.004        | 0.004   | -    | -    |
| 7   | Meranti         | Shorea spp.                      | 0.009        | -       | -    | 0.025 |
| 8   | Pasak Bumi      | Eurycoma spp.                    | 0.004        | 0.002   | -    | -    |
| 9   | Jabon Putih     | Anthochepalus cadamba            | -            | -       | -    | 0.005 |
|     | Total           |                                  | 0.088        | 0.052   | 0.044 | 0.102 |

4. Conclusions
The plant species found based on research in the Tahura Lae Kombih area of Subulussalam City were 9 plant species with a total number of 559 individuals spread over 13 observation plots. The percentages of the growth stage of the species found were plants at the seedling and tree level 37%, the sapling level 14% and the pole level 12%. The results showed that in the Tahura Lae Kombih area there were 363 individuals of camphor (Dryobalanops aromatica Gaertn) in addition to other species, namely meranti (Shorea spp.), resin (Agathis sp.), acacia (Acacia mangium), gaharu (Aquilaria malaccensis), durian (Durio zibethinus), white jabon (Anthochepalus cadamba), tongkat ali/ pasak bumi (Eurycoma spp.) and saninten/ rambutan (Castanopsis argentea). Based on the results of the calculation of the Important Value Index (INP) in the Tahura Lae Kombih area of Subulussalam City, it proves that a plant species will be different at each level. The results showed that the overall INP value of the species studied was in the tree growth phase, poles and saplings had an INP value of 300% and the seedling level had an INP value of 200%. According to field data, the camphor tree is expected to continue to dominate the research location in the future due to the high INP value. The dominance index for the growth phase shows the highest value, namely the seedling growth phase of 0.37, and the diversity index for the growth phase shows the highest value, namely the tree growth phase of 0.10.

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