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Distribution and Status of Endangered Plant Species Found in Aketajawe Lolobata National Park



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ABSTRACT

Taman Nasional Aketajawe Lolobata (Aketajawe Lolobata National Park) has a richness in flora and fauna diversity. This area becomes a natural museum for various kinds of trees that are highly economical. This study aimed to describe the distribution pattern and population status of endangered trees. The line transect method was employed to observe plants distribution points around the National Park, particularly those which are close by the Tayawi watershed in Tidore, North Maluku. A stub was made and transects were created on the left and right of the road, parallel with the stub. The length and the width of each transect line were 500m and 100m respectively, and the distance between transects was 20m. A 10x10m observation plot was made along the transect line. Vegetation parameters measured were the number of species and the number of each species individual. Data was analyzed to determine the distribution pattern and population status of each species. The results of the research suggest that there are five endangered species found: *Anisophtera costata* Korth, *Pterocarpus indicus* Willd., and *Hopea mengerawan* Miq. with random distribution pattern; *Agathis dammara* (Lamb.) and *Intsia bijuga* O.Kize with dispersal distribution pattern. Furthermore, findings also show that there is a possibility that some species have changed their distribution pattern and population status. *Anisophtera costata* Korth changed its status from vulnerable (Vu) into vulnerable on the area occupied. Meanwhile, *Agathis dammara* (Lamb.) changed its status from vulnerable (Vu) into critical due to its decreased population and narrowed occupied area. In addition, *Pterocarpus indicus* Willd., and *Intsia bijuga* O.Kize, changed their status from vulnerable (Vu) into critical (CR) because of their declined population. Finally, *Hopea mengerawan* Miq, has adjusted to the random distribution pattern.

INTRODUCTION

Indonesia is a country with the highest biodiversity in the world and therefore is well known as a megabiodiversity country. This richness in biodiversity is useful to support national development and maintain the world lungs Triyono [9]. The diverse plants can be found in the nature preserve areas, such as National Park (NP). One of the famous National Park that are located in the eastern part of Indonesia is Taman Nasional Aketajawe-Lolobata (Aketajawe-Lolobata National Park (ALNP) which is situated on Halmahera Island, North Maluku Province.

Based on an interview conducted with the local society, it was found that Aketajawe was derived from Tobelo language. "Ake" in Aketajawe means water or river and "Tajawe" itself comes from Tayawi word. As a result, when combined, Aketajawe can be defined as Tayawi river, one of the main rivers located in ALNP This area can be regarded as the representative of Indonesia's biodiversity in the east. According to the Decree of the Minister of Forestry No. 397/Menhut-II/2004 dated on October 18, 2004, ALNP consists of two forest blocks: 77.100 ha of Aketajawe forest block which is administratively registered in Central Halmahera Regency and Tidore Islands City and 90.200 ha of Lolobata forest block which belongs to East Halmahera Regency. ALNP Hall [1].

Referring to its flora and fauna wealth, ALNP keeps a potential which is incomparably unique. Bio-geographically, this area belongs to Wallaceae zone, a transitional region where Malesiana and Australiase flora and fauna can be found. The most prevalent species to this region is birds. Poulsen *et al.*, [7] states that the results of a global analysis on birds distribution suggest Halmahera as an endemic birds area, among 218 areas known worldwide. Therefore, North Maluku where 43 birds live with limited distribution is put on the top ten list of the prominent world endemic birds areas.

Facts show that ALNP is a home to four endemic bird genera. Twenty four unique bird species of the world, such as the angel bird (*Semioptera wallacii*), Ternate parrot (*Lorius garrulus*), Halmahera Paok (*Pitta maxima*), white cockatoo (*Cacatua alba*) can only be found in North Maluku. There are 213 bird species recorded living in this area. Other animals that make this area more magnificent include tailed butterflies (*Graphium Euphrates*), water lizard (*Hydrosaurus* sp.), monitor lizard (*Varanus* sp.), Halmahera cuscus (*Phalanger* sp.), wild boar (*Sus scrofa*), deer (*Cervus timorensis*) and a variety of interesting insects.

This region also houses many kinds of trees which grow strong and towering such as the ones which belong to genus Dipterocarpaceae (*Anisopthera thurifera*, *Hopea novoguineensis* and *Vatica rasak*), the eastern dammar (*Agathis dammara*), ironwood (*Intsia bijuga*), ranggu (*Koordersiodendron pinnatum*), Nyatoh (*Palaquium amboinensis*) and other tropical plants.

Besides forest products, ALNP is useful for the environment. This area serves water absorption function and also helps provide water for the society, agricultural lands, and industry nearby. There are at least 37 rivers flowing inside the national park. One of them is Tayawi river. Along the riverside, there is a traditional community who lives in harmony. The ethnic group is called Tobelo Dalam ethnic community or “Togutil”. The majority of the people are very traditional. Some of them live in a shelter which is made from a pile of young fan palms (*Livistona rotundifolia*) and some others have already used wooden beams and boards to build house pillars and walls. The community daily life still highly depends on natural resources found in the National Park they hunt wild boars and deer, go fishing, look for shrimp and even collect the megapodes eggs, dammar, and deer antlers. These hunt results are partly chartered and the rest will be used to fulfill their daily needs. Balai Taman National Aketajawe Lolobata [1].

This study aimed to collect data on the distribution and population status of endangered species which currently inhabit Tayawi watershed in the area of ALNP in North Maluku.

MATERIALS AND METHODS

The present study employed the line transect method which allows the researchers to do a survey on the distribution areas of endangered species spread in ALNP, especially those which are close by Tayawi watershed, Tidore, North Maluku province.

A stub was created (as the axis) and transects were made on the left and right of the road, parallel with the stub. The length and the width of each transect line were 500m and 100m respectively, and the distance between transects was 20m. A 10x10m observation plot was made along the transect line randomly.

Materials used in this study included: an altimeter, diameter tape, Global Positioning System) (GPS), plant scissors, herbarium labels, plastic bags, newspapers, and alcohol 70%. The survey was conducted by collecting vegetation samples at tree and sapling level. The stem diameter of vegetation at the tree level was ($\emptyset > 20$ cm) and the stem diameter of each

sapling was ($\emptyset = 10-20$ cm). The diameter was measured at a height of ± 130 cm above ground level or 20 above the floodplain starting point. Parameters of vegetation covered the number of species, the number of every species individual (density) and the diameter of the tree stem (domination). They were measured using a formula suggested by Hilton-Taylor [3]. For species determination, however, it is necessary to conduct a further identification.

Data on the vegetation parameters analyzed to investigate the distribution and population status of each species by calculating the density, domination, frequency, and important value index (in percentage) of each tree using a formula suggested by Cox; Mueller-Dombois and Ellenbrg, 1974 in Tolangara [10]. Important Value Index (IVI) of a species (IVI in %) = $RDi (\%) + Rfi (\%) + RCi (\%)$. The distribution pattern of the plants was measured using law of ranks suggested by Taylor-Philips, [6]. It combined basal area and IVI of each species and it was then checked with rules written in Hilton-Taylor [3]. The Taylor-Philips law of ranks formula used to calculate the distribution pattern is explained as follows:

$$b = \frac{a(\text{Log}x^2)(\text{log}S^2) - (\text{Log}x^2)(\text{log}S^2)}{(\text{Log}x^2) - (\text{log}X^2)}$$

Note:

n = Number of observed locations

b = Distribution pattern

x = Average number of a species

S = Variance of all species

The results of the analysis is studied in depth, re-verified, and elaborated to draw a conclusion.

RESULTS AND DISCUSSION

Research findings and the results of data analysis are recorded in Table 1 below.

Table 1. The distribution pattern, basal area, and IVI of rare plant species found near Tayawi watershed, Aketajawe Lolobata National Park

No	Indonesian Name	Scientific Name	Distribution Pattern (Id)	Basal area (m ²)	IVI (%)
1.	Kayu Marsawa	<i>Anisopthera costata</i> Korth.	0.08 (random)	2.82	16.8
2.	Kayu Damar	<i>Agathis dammara</i> (Lamb.)	2.62 (live in groups)	2.03	13.2
3.	Kayu Angsana	<i>Pterocarpus indicus</i> Wild.	0.07 (random)	0.12	1.3
4.	Kayu Besi	<i>Intsia bijuga</i> O. Kize	2.44 (live in groups)	2.24	12.2
5.	Kayu merawan	<i>Hopea mengerawan</i> Miq.	0.09 (random)	2.11	14.2

Source: Research Data, 2017.

Note: Id <0, uniformed distribution pattern, b = 1, random distribution pattern, b > 1, group distribution pattern. Basal area = area of occupancy of a species, IVI (%) = Important Value Index of a species.

1. Distribution Pattern

The results of Taylor’s rank calculation of rare plants found in ALNP are presented in Table 1. The distribution pattern is associated with areas occupied by each rare plant: 3 of 5 trees indicate a random distribution pattern while two others live in groups. This is in line with Hilton-Taylor [3] who assume that changes brought to the environment may result in scarcity of a plant species. It happens because most of the individuals live in small groups which are separated or relatively isolated from their environment. These small groups become scarce due to lack of opportunity to live together with other groups.

The five rare plant species found were examined to determine their conservation status of population status. The analysis was conducted by referring to the criteria suggested by *IUCN Red List* [4]. The results of the analysis are presented in Table 2.

Table 2. List of Five Rare Plants found near Tayawi watershed, Aketajawe Lolobata National Park

No	Indonesian Name	Scientific Name	Conservation Status	Source
1.	Kayu Marsawa	<i>Anisopthera costata</i> Korth.	Endangered (EN:A1cd+2cd)	IUCN
2.	Kayu Damar	<i>Agathis dammara</i> (Lamb.)	Vulnerable (Vu,A1cd)	IUCN
3.	Kayu Angsana	<i>Pterocarpus indicus</i> Wild.	Vulnerable(Vu,A1d)	IUCN
4.	Kayu Besi	<i>Intsia bijuga</i> O. Kize	Endangered(A1cd)	IUCN
5.	Kayu merawan	<i>Hopea mengerawan</i> Miq.	Critical(A1cd,B1+2c)	IUCN

Note: List of endangered plant species according to *IUCN Red List* [4].

Biodiversity in Indonesia covers plants, animals, and microorganisms. Sakura [8], explains that millions of plants, animals, and microorganisms live in various communities and ecosystems by nature. Within the communities, rare plants and animals can be found. Many scarce plant species live in Indonesia. They are native to the country. Unfortunately, the number of the individuals and the genetic diversity of the plants start to diminish. Therefore, conservation efforts are urgently required to save the endangered species Mogeia [5].

The explanation above, if associated with the research findings, indicates that some endemic plant taxa found near Tayawi watershed, ALNP are threatened to extinction. This assumption is supported by the figure showing the distribution pattern, basal area, and Important Value Index (IVI) of the plants.

In addition to that, the real condition near Tayawi watershed, ALNP also suggests that the area is more dominated by the secondary vegetation which at first lived on the PT. Djayanti Group logged-over regions. These plants include *Piper aduncum*, *Anthocephalus macrophyllus*, *Ficus spp.*, *Pipturus sp.*, *Duabanga moluccana*, *Timonius sp.* and *Pertusadina sp.* In some places, reed grass (*Imperata cylindrica*) which makes up distinct vegetation in open spaces is easy to find. Vines such as *Nephrolepis biserrata*, and *Merremia peltata* also live here.

The facts shown above obviously indicate that there are habitat changes brought to the area near Tayawi watershed due to Forest Concession Rights activities. As a result, rare plants found in this region start to diminish, and therefore it is necessary to determine the recent population status of the plant species.

2. Population Status

Research findings show that five plant species that can be categorized as rare plants are *Anisopther costata* Korth., *Agathis dammara* (Lamb.), *Pterocarpus indicus* Willd., *Intsia bijuga* O.Kize., and *Hopea mengerawan* Miq. The assignment of the rare status refers to Groombridge and Jenkins [2], and Hilton-Taylor [3] (Table 1.).

Anisopthera costata Korth., or Kayu mersawa (Indonesian name) live with random pattern near the Tayawi watershed. This plant can be found on 128° 12'3''-129°40'49''E and

00°27'34''-00°58'47''S. Referring to the IUCN criteria [4], this species can be categorized as endangered (EN: A1cd+2cd). However, if it is related to the number of its individuals (15 in 10.000 m²), the conversion results of the area of ALNP (100.000 in 90.200 Ha) with basal area 2.82 m², the (IVI) of the plant is so small (16,8% in 3.126 m²). Thus, according to the characteristics of endangered species suggested by *IUCN Red List* in Hilton-Taylor [3], *Anisopthera costata* Korth. is categorized into *Critically Endangered* (CR) because there is a high possibility of the taxon to extinct in the near future and the extent of occurrence of the plant is estimated less than 5000 km².

Agathis dammara (Lamb.), or Kayu damar (Indonesian name) can be found on 128° 12'3''-129°40'49''E and 00°27'34''-00°58'47''S. Previous research findings suggested that this species belonged to the vulnerable plant category (Vu: A1cd) (referring to IUCN) [4] since the number of individuals was only 62 in 10.000 m². If it is compared to the area of ALNP, then there will be only 100.000 individuals found in 90.200 Ha with 2.03 m² basal area. Important Value Area (IVI) of the species was 13.2%. This figure shows that the plant has little importance because the number of the individuals has decreased by 80%. Based on IUCN Red List in Hilton-Taylor [2], one of the characteristics of vulnerable (Vu) plants is that if the taxon does not belong to CR (critical) or EN (endangered), but it is likely to disappear in the distant future. The extent of occurrence of the species is estimated less than 5000 km². After a careful observation, it can be concluded that the species experiences a continuously decreased population rate on the occupied area with group distribution pattern.

Pterocarpus indicus Willd., or Angsana (Indonesian name) live on the coordinate 128° 12'3''-129°40'49''E and 00°27'34''-00°58'47''S. Based on the results of the previous research, this plant species was considered vulnerable (Vu: A1cd). Referring to the IUCN criteria [4], it means that there are only 3 individuals in 10.000 m² or 100.000 individuals in 90.200 Ha (Tayawi sub sector area) of which basal area is 0.12 m². The IVI of this species was 1.3%. This is in line with the characteristics of endangered species suggested by IUCN Red List in Hilton-Taylor [3] which mentions that a taxonomic group can be categorized endangered if the taxon has a strong tendency to extinct shortly and if it is assumed that the population decreases significantly by 80%. This kind of plant will be likely to be found in the next 10 years with random distribution pattern.

Intsia bijuga O. Kize., or kayu besi (Indonesian name) can be found on 128° 12'3''-129°40'49''E and 00°27'34''-00°58'47''S. Previous research findings suggested that this

species belonged to the vulnerable plant category (Vu:A1cd) if it referred to IUCN criteria [4]. The number of the individuals are estimated around 23 in 10.000m². If it is compared to the ALNP area, then there will be only 100.000 individuals in 90.200 Ha(basal area = 2.24 m²). In 2.483 m², the IVI of the species is 12.2%. which shows its little importance. According to *IUCN Red List* in Hilton-Taylor [3], a taxonomic group can be categorized vulnerable (Vu) if it does not belong to CR (critical) nor endangered (EN), but it will probably vanish soon. The extent of occurrence of this species is estimated less than 5000 km²because the species population keeps declining and the habitat where they live in groups keep growing smaller.

Hopea mengerawan Miq., or Kayu merawan (Indonesian name) live with random distribution pattern on 128° 12'3''-129°40'49''E and 00°27'34''-00°58'47''S. Previous research findings suggested that this species belonged to the Critically Endangered (CR) category or critical (A1cd,B1+2cd) if it referred to IUCN criteria [4]. The number of the individuals are estimated around 6 in 10.000m². If it is compared to the Aketajawe Lolobata National Park area, then there will be only 100.000 individuals in 90.200 Ha (basal area = 2.11 m²). In 2.339 m², the IVI of the species is small (14,2%). According to *IUCN Red List* in Hilton-Taylor [3], a taxon can be considered to be critical (CR) if it is going to extinct in the near future. The observation results indicate that the extent of occurrence of this area is less than 5000 km²; therefore, it can be concluded that the species experiences a continuously decreased population on the occupied area and that it has random distribution pattern.

CONCLUSION

The results of the research suggest that:

1. There are five plant species that can be categorized as rare. They are *Anisopthera costata* Korth, *Pterocarpus indicus* Willd, and *Hopea mengerawan* Miq. with random distribution pattern, and *Agathis dammara* (Lamb.) and *Intsia bijuga* O.Kize with group distribution pattern.
2. There is a possibility that the population status of the plants has been changed accordingly. *Anisopthera costata* Korth. changed its status from vulnerable (Vu) into vulnerable on the area occupied. Meanwhile, *Agathis dammara* (Lamb.) changed its status from vulnerable (Vu) into critical due to its decreased population and narrowed occupied area. In addition, *Pterocarpus indicus* Willd. and *Intsia bijuga* O.Kize. changed their status

from vulnerable (Vu) into critical (CR) because of their declined population. Finally, *Hopea mengerawan* Miq. has adjusted to the random distribution pattern.

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