

Diversity of Natural Orchids and Their Habitat at the Lore Lindu National Park

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Background and Objectives: This study aimed to understand the diversity of natural orchids, their habitat in the lowlands, Sub Mountain, mountain and alpine, as well as biotic and abiotic environment factors influenced the diversity of orchids at the Lore Lindu National Park. **Methodology:** This study was conducted in several locations at the Lore Lindu National Park by selecting places that represent various type of orchids growing in the lowland with an altitude of 600 m above the sea level, sub mountain of 1,000-1,500 m above the sea level, mountain of 1,500-2,000 m above the sea level and alpine of 2,000-2,600 m above the sea level. Those places were the lowland of Bobo village, the sub mountain of Kamarora, the mountain of Danau Kalimpa'a and the alpine of Rore Katimbu. This study was conducted from November 2018 to April 2019. We employed vegetation analysis using the path-shaped method, the shape, and size of the observation path and its placement on each pioneering line if it meets the type of orchid. **Results:** Based on the identification results, we obtained 45 species of orchids with an abundance of 238 individuals and 26 orchid genera in each observation area. This results showed that variety of *Spathoglottis plicata* Bl., *Arundina bambusifolia* Lindl., *Dendrobium stratiotes* Rchb.f., *Phaius tankervilleae* (Bl.) Lindl. were dominant types. Distribution of species from 45 species were identified as a whole, lowland areas and alpine areas have the same species diversity that was as many as 22 species (48.88%), then in the mountain area as many as 16 species variations (35.55%) and the rest in the area submountain as many as 12 species variations (26.66%). **Conclusion:** The (e) orchid evenness index in the Lore Lindu National Park area is categorized as having a moderate level of uniformity. Lore Lindu National Park found several types of orchids that have the potential as a source of germplasm, this type of orchid is one type of endemic orchids and includes rare orchids namely *Grammatophyllum stapeliiflorum*, *Phaelaenopsis celebiensis* dan *Bulbophyllum echinolabium*, *Coelogyne asperata* Lindl, *Coelogyne speciosa* Lindl, *Cymbidium finlaysonianum* Lindl dan *Phaius tankervilleae* (BL) Lindl.

Key words: diversity, orchids, Lore Lindu National Park

INTRODUCTION

Public interest in protecting the world's biodiversity has increased in the past few decades. Both scientists and the general public understand that we are now living in a period of the extermination of extraordinary biodiversity. Biodiversity in the world covers various species. Biodiversity involves a complex biological community, and within each species there are also very rich genetic variations. Millions of years are needed to form the world's biological community, including humid tropical forests, coral reefs, old forests in temperate climate (temperate old-growth forest), and grasslands. However, all of them are experiencing severe damage due to human activity. Thousands or even tens of thousands of unique species and millions of populations are expected to become extinct in the next few decades. (Di Filippo, Biondi, Piovesan, & Ziaco, 2017)

Without serious efforts to restrain the rate of extinction due to human activity, the species that describe the natural environment will be lost forever from natural habitats on earth. Thousands or even millions of low-level plants, fungi, and invertebrate species are also extinct. The loss of species that are less well known to humans will also eliminate the role of these species in protecting the biological community and eventually causing damage to human habitation. (Teel et al., 2018)

Scientists realize that many threats to biodiversity are synergistic. The negative effects of a variety of different factors, such as poverty, logging, fires, and excessive hunting are combinations that increase or even multiply damage

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to biodiversity. Threats to biodiversity also almost certainly threaten populations because humans depend on the natural environment for raw materials, food, medicines, even for drinking water.(Altieri & Nicholls, 2018)

This is the potential of high value for the region to be developed. Some of this germplasm has been developed so that they have high economic value, but many of them have not been utilized at all. It is estimated that there are 40,000-45,000 species of flowering plants, most of the diversity of these plants in terms of their distribution, ecology, and taxonomy is not widely understood, especially in Sulawesi or in the 'Wallacea' bioregion, a unique region that is rich in endemic flora and fauna. Furthermore, it is estimated that 15% of natural flora in Sulawesi is endemic to Sulawesi; on the other hand, research on the flora of Sulawesi is very less compared to other islands in Indonesia. One type of flora found in the Central Sulawesi forest area is a type of natural orchid that has the potential for genetic diversity as a source of germplasm.(Subekti & Suroso, 2018)

Diversity of flora, especially species of orchids that exist must be protected and preserved. Conservation of orchids in an area that is sustainable must be protected from human damage because it can result in habitat and ecological destruction that is needed by these orchid species.(He, Si, da Silva, Li, & Duan, 2019)

Orchids are one of the riches of biodiversity that must be preserved and protected from extinction because of the beauty of the flowers and the scarcity of only certain habitats to grow. Meanwhile, the threat of finding natural orchids is getting bigger, and people's passion for orchids is increasing, which means that natural orchids are decreasing and will lead to extinction. Efforts are needed to make people aware of the importance of keeping and preserving natural orchids as a source of germplasm.(Assédé et al., 2018)

One of the natural orchid habitats in Central Sulawesi is the Lore Lindu National Park. This place is a natural forest area which is still used as a means of nature tourism with good natural conditions and beautiful natural panorama. Information about the types of natural orchids has been widely known from various studies that have been done before for the benefit of science. On the other hand information about the symbiotic relationship of natural orchids and their habitat is left unknown. Thus in-depth research needs to be done.

This study aimed to understand the diversity of natural orchid species, differences in habitat in the lowlands, sub-mountain, mountain and alpine, biotic and abiotic environmental factors that affect the diversity of natural orchid species in Lore Lindu National Park.

MATERIALS AND METHODS

The study was conducted in November 2018 until April 2019 in several locations in the Lore Lindu National Park by selecting a place that could represent orchids that grow in lowlands with an altitude of 600 meters above sea level, sub-mountain areas 1,000-1,500 masl , mountain 1,500-2,000 masl and alpine with an altitude of 2,000-2,600 masl. These areas are Bobo Village which represents the lowlands, Kamarora submountain area, Lake Kalimpa'a mountain area and Katimbu Rore Path for alpine areas. This study used vegetation analysis with path-shaped methods, the shape and size of the observation path and its placement on each pioneer line if it meets the type of orchid. For each observation path, an observation plot of 1,500 m in length with a width of 10 m (5 m on the left and right sides of each path) or an observation plot area of 15,000 m² (1.5 ha) was made. The number of observation plots made for each observation path representing orchid species in lowland, sub mountain, mountain, and alpine areas was 5 observation plots. So the total number of observation plots for each observation area was 75,000 m² or 7.5 ha. The types of orchids were identified by the number of species, individuals of each type, nature of life, place of growth, and abiotic factors. Data processed in this study are as follows:

Dominance index of a type (Di)

According to Haddy and Kumiati (1996) in Djatmiko (2005):

$$Di = \frac{n_i}{N} \times 100$$

Di = Dominance index, n_i = total individual of type I, N = total individual

Relative Abundance/proportionate (KR)

Relative Abundance/proportionate of orchid presence can be calculated as follows:

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$$\% \text{ KR (a)} = \frac{\sum \text{individuals of type (a)}}{\sum \text{individuals of all type}} \times 100$$

KR = relative abundance/proportionate

Type frequency (F)

The frequency of the type of orchid referred to the number or frequency of a particular type of orchid present in each path at the research location, obtained by the following formula:

$$F(a) = \frac{\sum \text{path of orchid types (a)}}{\sum \text{total paths}} \times 100\%$$

Important Value Index (INP)

The Importance Value Index is calculated using relative (relative) values of each parameter that can be obtained by the formula, according to Curtis (1959) in Bratawinata (2001) as follows:

$$FR(\%) = \frac{\sum \text{frequency of a type}}{\sum \text{frequency of all types}} \times 100$$

$$KR(\%) = \frac{\sum \text{individual of a type}}{\sum \text{individual of all types}} \times 100$$

$$INP(\%) = FR(\%) + KR(\%)$$

FR = relative frequency KR = relative density

Species Diversity Index (H')

Species diversity index (Indeks Shannon)

$$H' = -\sum \{ (n_i/N) \log (n_i/N) \}$$

n.i = total individual per type, N = Number of individuals overall type

Evenness Index (e)

The evenness index according to Pielou (1966) in Bratawinata (1998) is:

$$e = \frac{H'}{\log S}$$

 H' = species diversity index S = Number of types present

Index of Similarity

Is calculated with evenness coefficient or index approach according to Sorensen (1948) in Bratawinata (2001) as follow:

$$ISs = \frac{2c}{A+B} \times 100 \quad \text{atau} \quad ISs = \frac{c}{\frac{1}{2}(A+B)} \times 100$$

ISs = Sorensen index, C = Number of species present in two plots, observation habitat, A= Number of species present in the first plot / habitat, B= Number of species present in the second plot / habitat

Margalef indices

To get an idea of the margalef indices of orchids at each observation location, it can be seen by the following formula:

$$Da = \frac{(S-1)}{\ln N}$$

S = Number of species observed

RESULTS AND DISCUSSION

Domination and Abundance of Orchid Types

From the observations, all types of orchids in Lore Lindu National Park were successfully identified. From the results of identification, it is known that there are 45 species of orchids with an abundance of 238 individuals. Of the 45 orchid species, most of them are species that are often found in the alpine area (Rorekatimbu pathway) with 22 species and an abundance of 100 individuals, then 22 species with an abundance of 81 individuals found in the lowlands (Bobo Village), 16 species with an abundance of 36 individuals were found in the Mountain area (Lake Kalimpa'a) and 12 species with an abundance of 26 individuals were found in the submountain area (Kamarora Village).

The abundance of orchid species was calculated based on the dominance index. The range of dominance index values used is $> 5\%$ for dominant types and $2-5\%$ for sub-dominant types (Odum, 1998 in Djatmiko 2005).

The abundance of orchids based on species dominance in the Lore Lindu National Park can be seen in Table 1.

Table 1: Abundance of Orchid Types Based on Domination of Species in Lore Lindu National Park (Sort of Species Based on the Number of Individuals)

No	Species name	Abundance		Dominance
		Ni	Di (%)	
1	<i>Spathoglottis plicata</i> Bl	91	38,559	Dominant
2	<i>Arundina bambusifolia</i> Lindl	32	13,559	Dominant
3	<i>Dendrobium stratiotes</i> Rchb.f.	20	8,474	Dominant
4	<i>Phaius tankervillae</i> (Bl.).Lindl	15	6,355	Dominant
5	<i>Eria floribunda</i> Lindl.	6	2,542	Dominant Sub
6	<i>Eria bogorensis</i> Lind	5	2,118	Dominant Sub
7	<i>Agrotophyllum majus</i> J.J.Sm.	4	1,954	Not dominant
8	<i>Bulbophyllum fiblorum</i> Teijsm..	3	1,271	Not dominant
9	<i>Cymbidium lancifolium</i> Hook.	3	1,271	Not dominant
10	<i>Dendrobium crumenatum</i> Sw.	3	1,271	Not dominant
11	<i>Grammatophyllum stepeliiflorum</i> J.J.S.	3	1,271	Not dominant
12	<i>Coelogyne asperata</i> Lindl.	3	1,271	Not dominant
13	<i>Ancanthepphilum javanicum</i> Bl.	2	0,874	Not dominant
14	<i>Bulbophyllum echinolabium</i> J.J.S.	2	0,874	Not dominant
15	<i>Bulbophyllum lobbii</i> Lind..	2	0,874	Not dominant
16	<i>Cymbidium ensifolium</i> L.SW.	2	0,874	Not dominant
17	<i>Cymbidium finlaysonianum</i> Lindl.	2	0,874	Not dominant
18	<i>Dendrobium macrophyllum</i> A.Rich.	2	0,874	Not dominant
19	<i>Dendrobium acinaciforme</i>	2	0,874	Not dominant
20	<i>Eria retusa</i> Bl.	2	0,874	Not dominant
21	<i>Eria hyacinthoidea</i> Lind	2	0,874	Not dominant
22	<i>Eria multiflora</i>	2	0,874	Not dominant
23	<i>Goodyera oblongifolia</i>	2	0,874	Not dominant
24	<i>Liparis pallida</i> Bl.	2	0,874	Not dominant
25	<i>Liparis viridiflora</i> Bl.	2	0,874	Not dominant
26	<i>Liparis latifolia</i> Bl.	2	0,874	Not dominant
27	<i>Microstylis latifolia</i> J.J. Sm	2	0,874	Not dominant
28	<i>Rhomboda cristita</i>	1	0,423	Not dominant
29	<i>Aerides odoratum</i> Lour	1	0,423	Not dominant
30	<i>Appendiculata congenera</i> Bl.	1	0,423	Not dominant
31	<i>Calanthe veratrifolia</i> R.Br.	1	0,423	Not dominant
32	<i>Coelogyne speciosa</i> Lindl.	1	0,423	Not dominant
33	<i>Dendrobium reflexitepalum</i>	1	0,423	Not dominant
34	<i>Dendrobium platygastrium</i> Rchb.f.	1	0,423	Not dominant
35	<i>Dendrobium scundum</i>	1	0,423	Not dominant
36	<i>Dendrobium fibriatum</i>	1	0,423	Not dominant
37	<i>Dendrobium luteocilium</i>	1	0,423	Not dominant

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38	<i>Lusia Sp</i>	1	0,423	Not dominant
39	<i>Nephelaphyllum tenuiflorum</i> Bl.	1	0,423	Not dominant
40	<i>Phalaenopsis celebiensis</i> Bl.	1	0,423	Not dominant
41	<i>Dendrochillum simile</i> Bl.	1	0,423	Not dominant
42	<i>Pholidota embicata</i>	1	0,423	Not dominant
43	<i>Podochillus microphyllus</i> Lindl.	1	0,423	Not dominant
44	<i>Renanthera elongata</i>	1	0,423	Not dominant
45	<i>Trichotosia velutina</i>	1	0,423	Not dominant
Jumlah		238	100.0	

Based on the range of dominance index values, it can be seen that the types of orchids that dominate at the study site (> 5%) were *Spathoglottis plicata* Bl, *Arundina bambusifolia* Lindl, *Dendrobium stratiotes* Rchb.f.dan *Phaius tankervilleae* (Bl.). Lindl. The sub dominant types (in 2-5%) are *Eria floribunda* Lindl., *Eria bogorensis* Lindl (Table 1). To get a more extensive illustration, it can be seen from the abundance of each dominant type in each observation area in the Lore Lindu National Park as follows:

Domination of Orchids Based on Observations in Each Region

Abundance and dominance of orchids were found based on observations in the lowlands in the area of Lore Lindu National Park showing the number of individuals as many as 81 individuals consisting of 22 species which are overall shown in Table 2.

Table 2: Abundance and Domination of Orchid Types in the Lowland Region of Lore Lindu National Park Bobo Village, Palolo District, Sigi Regency (Sort of Species Based on the Number of Individuals)

No	Type	F	N	FR (%)	KR (%)	INP (%)	Dominance
1	<i>Spathoglottis plicata</i> Bl	6	25	20,689	35,211	55,9	Dominant
2	<i>Dendrobium stratiotes</i> Rchb.f.	2	20	6,896	28,169	35,065	Dominant
3	<i>Arundina bambusifolia</i> Lindl.	1	15	3,448	21,126	24,574	Dominant
4	<i>Dendrobium crumenatum</i> Sw.	2	2	6,896	2,816	9,712	Dominant Sub
5	<i>Dendrobium macrophyllum</i> A.Rich.	1	2	3,448	2,816	6,264	Dominant Sub
6	<i>Agrotophyllum majus</i> J.J.Sm.	1	1	3,448	1,408	4,856	Not Dominant
7	<i>Ancanthepphilum javanicum</i> Bl.	1	1	3,448	1,408	4,856	Not Dominant
8	<i>Appendiculata congenera</i> Bl.	1	1	3,448	1,408	4,856	Not Dominant
9	<i>Bulbophyllum lobbii</i> Lind	1	1	3,448	1,408	4,856	Not Dominant
10	<i>Coelogyne speciosa</i> Lindl.	1	1	3,448	1,408	4,856	Not Dominant
11	<i>Cymbidium ensifolium</i> (L) Sw.	1	1	3,448	1,408	4,856	Not Dominant
12	<i>Cymbidium lancifolium</i>	1	1	3,448	1,408	4,856	Not Dominant
13	<i>Dendrobium acinaciforme</i> .	1	1	3,448	1,408	4,856	Not Dominant
14	<i>Dendrobium fibriatum</i>	1	1	3,448	1,408	4,856	Not Dominant
15	<i>Dendrobium luteocilium</i> Rupp	1	1	3,448	1,408	4,856	Not Dominant
16	<i>Dendrobium reflexitepalum</i>	1	1	3,448	1,408	4,856	Not Dominant
17	<i>Dendrobium scundum</i> .	1	1	3,448	1,408	4,856	Not Dominant
18	<i>Eria retusa</i> Bl.	1	1	3,448	1,408	4,856	Not Dominant
19	<i>Grammatophyllum stapeliiflorum</i> J.J.S.	1	1	3,448	1,408	4,856	Not Dominant
20	<i>Phalaenopsis celebiensis</i> Bl.	1	1	3,448	1,408	4,856	Not Dominant
21	<i>Podochillus microphyllus</i> Lind.	1	1	3,448	1,408	4,856	Not Dominant
22	<i>Rhomboda cristata</i>	1	1	3,448	1,408	4,856	Not Dominant
		29	81	100	100	200	

Note: Calculation of Dominant Index (Di %) equals Relative Density (KR%)

From these data, it can be seen that the type of *Spathoglottis plicata* Bl. was more dominant than other types with an abundance of 25 individuals. From 7 observation plots in the lowlands, this species was found 6 times, then each type of *Dendrobium stratiotes* Rchb.f. (15 individuals), found 2 times in the observation plot and *Arundina bambusifolia* Lindl. (15 individuals) found 1 time. For the Sub-dominant species *Dendrobium crumenatum* Sw. (2 individuals) were found 2 times in the observation plot and *Dendrobium macrophyllum* A.Rich. (2 individuals) I found one observation plot.

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Given the differences in structure and composition of vegetation in forest areas, it is possible to have variations in the types of orchids in Lore Lindu National Park. Therefore the same thing was observed in orchid species in submountain areas. From 7 observations on these areas, variations of orchid species were obtained as many as 12 species with an abundance of 26 individuals. The abundance and dominance of species can be seen in Table 3.

Table 3: Abundance and Domination of Orchid Species in the Lore Lindu National Park Submountain Area Kamarora Village, Palolo District, Sigi Regency. (Data Sort Types Based on the Number of Individuals)

No	Type	F	N	FR (%)	KR (%)	INP (%)	Dominance
1	<i>Spathoglottis plicata</i> Bl.	6	15	35,294	57,692	92,986	Dominant
2	<i>Ancanthepphilum javanicum</i> Bl.	1	1	5,882	3,846	9,728	Not Dominant
3	<i>Bulbophyllum fiblorum</i> Teijsm	1	1	5,882	3,846	9,728	Not Dominant
4	<i>Coelogyne asperata</i> Lindl	1	1	5,882	3,846	9,728	Not Dominant
5	<i>Eria retusa</i> Bl.	1	1	5,882	3,846	9,728	Not Dominant
6	<i>Cymbidium finlaysonianum</i> Lindl.	1	1	5,882	3,846	9,728	Not Dominant
7	<i>Cymbidium lancifolium</i> Hook.	1	1	5,882	3,846	9,728	Not Dominant
8	<i>Dendrobium acinaciforme</i>	1	1	5,882	3,846	9,728	Not Dominant
9	<i>Dendrobium crumenatum</i> Sw.	1	1	5,882	3,846	9,728	Not Dominant
10	<i>Dendrobium platygastrium</i> Sw.	1	1	5,882	3,846	9,728	Not Dominant
11	<i>Grammatophyllum stapeliiflorum</i> Bl.	1	1	5,882	3,846	9,728	Not Dominant
12	<i>Luisia</i> sp.	1	1	5,882	3,846	9,728	Not Dominant
	Jumlah	17	26	100	100	200	

Note: Calculation of Dominant Index (D_i %) equals Relative Density (KR%)

In Table 3, it can be seen that based on the Domination Index (D_i) and Important Value Index (INP) there is 1 dominant orchid type (Calculation of the D_i value % is equal to KR% in the table). The dominant type was *Spathoglottis plicata* Bl with an abundance of 15 individuals and is always present in 6 observations with a dominance index of 57.692% and a Significance Index of 92.986%. Respectively followed by other types, namely *Ancanthepphilum javanicum* Bl., *Bulbophyllum fiblorum* Teijsm, *Coelogyne asperata* Lindl, *Eria retusa* Bl., *Cymbidium finlaysonianum* Lindl., *Cymbidium lancifolium* Hook., *Dendrobium acinaciforme* Sw., *Grammatophyllum stapeliiflorum* Bl. and *Luisia* sp. (not dominant).

In the mountainous region (Lake Kalimpa'a), this condition also affects the variations of the existing orchid types. Furthermore, observations of abundance and dominance of orchid species are based on observations in mountain areas (Kalimpa'a Lake). From the frequency of orchid observations of 9 times, based on the calculation of the dominance index (D_i % equal to KR%). The dominant type was *Phaius tankervillae* (Bl.), Lindl with an abundance of 15 individuals and was present in 8 observations, with a Dominance Index (D_i %) 41.666% and an Importance Value Index of 71.295%. The next type of subdominant was *Agrotophyllum majus* J.J.Sm. Domination Index (At %) 8.333% and Importance Value Index (INP%) 19.444%, *Arundina bambusifolia* Lindl. (In%) 5,555% and (INP%) 12,962% and *Eria floribunda* Lindl. (In%) 5,555% and (INP%) 12,962% and there were 12 types that are not dominant. Complete observations can be seen in Table 4. Sequence

Table 4. Abundance and Domination of Orchid Species in the Lore Lindu Lake Kalimpa'a National Mountain Mountain Area, North Lore Subdistrict, Poso District (Sort of Species Based on the Number of Individuals)

No	Type	F	N	FR (%)	KR (%)	INP (%)	Dominance
1	<i>Phaius tankervillae</i> (Bl.).Lindl	8	15	29,629	41,666	71,295	Dominant
2	<i>Agrotophyllum majus</i> J.J.Sm.	3	3	11,111	8,333	19,444	Dominant Sub
3	<i>Arundina bambusifolia</i> Lindl.	2	2	7,407	5,555	12,962	Dominant Sub
4	<i>Eria floribunda</i> Lindl	2	2	7,407	5,555	12,962	Dominant Sub
5	<i>Liparis pallida</i> (Bl.) Lindl	1	2	3,703	5,555	9,258	Not Dominant
6	<i>Aerides odoratum</i> Lour.	1	1	3,703	2,777	6,48	Not Dominant
7	<i>Bulbophyllum lobbii</i> Lindl.	1	1	3,703	2,777	6,48	Not Dominant
8	<i>Calanthe veratrifolia</i> R.Br	1	1	3,703	2,777	6,48	Not Dominant
9	<i>Coelogyne asperata</i> Lindl.	1	1	3,703	2,777	6,48	Not Dominant
10	<i>Cymbidium ensifolium</i> L.SW.	1	1	3,703	2,777	6,48	Not Dominant
11	<i>Eria hyacinthoides</i> Lind.	1	1	3,703	2,777	6,48	Not Dominant
12	<i>Goodyera oblongifolia</i>	1	1	3,703	2,777	6,48	Not Dominant
13	<i>Liparis latifolia</i> (Bl.) Lindl	1	1	3,703	2,777	6,48	Not Dominant

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14	<i>Microstylis latifolia</i> J.J.Sm	1	1	3,703	2,777	6,48	Not Dominant
15	<i>Rhomboda cristata</i> (Bl.) Omerod	1	1	3,703	2,777	6,48	Not Dominant
16	<i>Spathoglottis plicata</i>	1	1	3,703	2,777	6,48	Not Dominant
		27	36	100	100	200	

Note: Calculation of Dominant Index (Di %) equals Relative Density (KR%)

The 22 species found in the alpine area (Rorekatimbu Pathway) are enough to extend an idea of the diversity of species in the Lore Lindu National Park area, showing that the highland areas of the forest area greatly influence the presence of orchid species. The abundance and dominance of orchid species are based on observations in the alpine area (Rorekatimbu pathway), from the frequency of observations as many as 9 times found 22 species with a total of 100 individuals. Based on the Domination Index (Di %) and the Importance Value Index (INP) it is known that one dominant type was *Spathoglottis plicata* Bl., With an abundance of 50 individuals, present at 3 observations, a Dominance Index of 50,000% and an Importance Value Index of 59,677. Meanwhile, the subdominants were respectively *Arundina bambusifolia* Lindl. *Eria floribunda* Lindl. *Eria bogorensis* Lind observations which can be seen in Table 5.

Table 5: Abundance and Domination of Orchid Species in the Alpine Region of the Lore Lindu National Park in the Rorekatimbu Line, North Lore Subdistrict, Poso District (Sort of Types Based on the Number of Individuals)

No	Jenis	F	N	FR (%)	KR (%)	INP (%)	Dominance
1	<i>Spathoglottis plicata</i> Bl.	9	50	29,032	50,000	79,023	Dominant
2	<i>Arundina bambusifolia</i> Lindl.	1	15	3,225	15,000	18,225	Dominant Sub
3	<i>Eria floribunda</i> Lindl.	2	6	6,451	6,000	12,451	Dominant Sub
4	<i>Eria bogorensis</i> Lind	3	5	5,000	5,000	10,000	Dominant Sub
5	<i>Bulbophyllum fiblorum</i> Teijsm.	2	2	6,451	2,000	8,451	Not Dominant
6	<i>Bulbophyllum echinolabium</i> J.J.S.	1	2	3,225	2,000	5,225	Not Dominant
7	<i>Eria hyacinthoides</i> Lind.	1	2	3,225	2,000	5,225	Not Dominant
8	<i>Eria multiflora</i>	2	2	6,451	2,000	8,451	Not Dominant
9	<i>Liparis latifolia</i>	2	2	6,451	2,000	8,451	Not Dominant
10	<i>Liparis viridiflora</i> Lindl.	2	2	6,451	2,000	8,451	Not Dominant
11	<i>Coelogyne asperata</i> Lindl	1	1	3,225	1,000	4,225	Not Dominant
12	<i>Cymbidium finlaysonianum</i> Lindl.	1	1	3,225	1,000	4,225	Not Dominant
13	<i>Cymbidium lancifolium</i> Hook.	1	1	3,225	1,000	4,225	Not Dominant
14	<i>Dendrobium fibriatum</i>	1	1	3,225	1,000	4,225	Not Dominant
15	<i>Goodyera oblongifolia</i>	1	1	3,225	1,000	4,225	Not Dominant
16	<i>Grammatophyllum stapeliiflorum</i> Bl.	1	1	3,225	1,000	4,225	Not Dominant
17	<i>Microstylis latifolia</i> J.J.Sm	1	1	3,225	1,000	4,225	Not Dominant
18	<i>Nephelaphyllum tenuiflorum</i> Bl	1	1	3,225	1,000	4,225	Not Dominant
19	<i>Dendrochillum simile</i> Bl.	1	1	3,225	1,000	4,225	Not Dominant
20	<i>Pholidota embricata</i>	1	1	3,225	1,000	4,225	Not Dominant
21	<i>Renanthera elongata</i>	1	1	3,225	1,000	4,225	Not Dominant
22	<i>Trichotosia velutina</i>	1	1	3,225	1,000	4,225	Not Dominant
	Jumlah	31	100	100	100	200	

Note: Calculation of Dominant Index (Di %) equals Relative Density (KR%)

The spread of Orchid Types

The types of orchids that were successfully found in each observation area in the Lore Lindu National Park area. The number of individual orchids identified was 238 individuals, distributed in each observation area. Of the 238 individuals, 81 individuals or 33.03% were found in lowland areas, 26 individuals or 10.92% were found in submountain areas, 36 individuals or 15.12% were found in mountain areas, and 22 individuals or 48.88% were found in the alpine region. Distribution of species from 45 species were identified as a whole, lowland areas and alpine areas have the same species diversity that was as many as 22 species (48.88%), then in the mountain area as many as 16 species variations (35.55%) and the rest in the area submountain as many as 12 species variations (26.66%). Distribution of species and abundance based on the observation area can be seen in Table 6.

Table 6: Distribution of Types and Abundance in Each Observation area

Location

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Plot	lowland		Sub. Mountain		Mountain		Alpine	
	Type	Indv	Type	Indv	Type	Indv	Type	Indv
1	3	20	2	6	4	5	5	12
2	5	8	2	4	2	2	2	7
3	3	7	2	3	2	2	2	7
4	3	8	3	4	4	4	3	6
5	8	14	2	4	4	6	3	6
6	2	2	2	5	5	7	4	9
7	3	2	4	4	4	4	1	5
8	-	-	-	-	3	4	3	7
9	-	-	-	-	1	1	7	32
10	-	-	-	-	-	-	6	7
11	-	-	-	-	-	-	2	2
Jumlah	22	81	12	26	16	36	22	100
Persnt (%)	48,88	33,03	26,66	10, 92	35,55	15,12	48,88	42,01

lowland, sub.mountain. mountain dan alpine.

Distribution of species in each observation path of 45 species identified, the same types were found in four areas, namely the observation areas of the lowlands, submountain, mountain, and alpine. Lowland areas and submountain areas are found in 7 of the same types that were *Ancanthepphilum javanicum* Bl., *Cymbidium lancifolium* Hook., *Dendrobium crumenatum*, *Dendrobium acinaciforme*, *Eria etusa*, *Grammaphyllum stapelliiflorum* J.J.S., and *Spathoglottis plicata* Bl. Lowland and mountain areas were found in the same 6 types, namely *Agrostophyllum majus* J.J.S., *Arundina bambusifolia* Lindl., *Bulbophyllum lobi* Lindl., *Cymbidium ensifolium* LSW., *Rhomboda cristata* (Bl) Omerod., And *Spathoglottis plicata* Bl. 5 species were found in the alpine , namely *Arundina bambusifolia* Lindl., *Cymbidium lancifolium* Hook. *Dendrobium fibriatum*, *Grammaphyllum stapelliiflorum* J.J.S., and *Spathoglottis plicata* Bl. The similarity of this type is possible in the similarity of environmental conditions such as temperature, humidity, and light intensity. For this type of orchid *Dendrobium* the need for light ranges from 40-50% and protected. This type of orchid needed 10-30% light and was protected. *Spathoglottis plicata* is a type of orchid whose habitat grows in favor of open spaces between weeds and is a type of orchid that is able to spread widely or cosmopolitan orchids.(Muthukumar & Shenbagam, 2018)

Type Similarities

By comparing the composition of type and individuals in each observation area, we can calculate the index of similarity. The index of similarity in 4 observation areas (lowlands, submountain areas, mountain areas, and alpine areas) at the Lore Lindu Natioal Park can be seen in Table 7.

Table 7: Odum Index of Similarity (in%) on Each Observation Path in Lore Lindu National Park

Location	Lowland	Sub Mountain	Mountain	Alpine
Lowland		82,35	63,15	45,45
Sub Mountain	82,35	-	-	-
Mountain	63,15	-	-	-
Alpine	45,45	-	-	-

As shown in Table 7 that there were 7 species existed in the in the lowland and submountain areas simultaneously. Thus type variation of these two paths numbered to 38 types from 45 types identified with an index of similarity of 82.35%. It is assumed that condition of these 2 observation areas is relatively the same.

The same habitat condition was also found for the lowland and mountain areas. Of these type variations, 6 types were similar, and therefore, these two habitats had variations of 39 types from 45 types identified. Consequently, the index of similarity was 63.15%. Meanwhile, in the lowland and alpine areas, 5 types were similar, and these two habitats had variations of 40 types from 45 types identified. Therefore the index of similarity was 45.45%.

Type Diversity and Evenness

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To get a general picture of the diversity and evenness of orchid species in each observation area, by combining the data obtained in each observation plot in each observation area. For more details, see Table 8.

Table 8: Indeks Kekayaan Jenis (D_a), Keanekaragaman Jenis (H') dan Kemerataan Jenis (e) Anggrek pada Masing-masing Jalur Pengamatan

Indeks	Location			
	Lowland	Sub Mountain	Mountain	Alpine
Wealth type (D_a)	11,006	7,773	9,640	14,084
Species diversity (H')	0,908	0,731	0,855	0,849
Evenness of types (e)	0,676	0,677	0,710	0,632
Similarity type (%)	82,35			
	63,15			
	45,45			

Based on the study results, it is known that at each observation site the diversity of orchid species was different in each observation area. This shows that the range of species wealth index (D_a) values distributed by the types of individuals were more evenly distributed and did not differ much between lowland areas with a value of species wealth index of 11,006 and alpine areas of 14,084. The mountain value of the 9,640 species richness index did not differ much from the 7,773 submountain area.

The difference in species richness index (margalef) in the two regions, namely mountain, submountain with lowland areas and alpine areas, is caused by the condition of open vegetation, especially tree stands which are decreasing due to deforestation for cocoa plantations occurring in submountain areas (Kamarora). Type of orchid that was found and dominant was *Spathoglottis plicata* Bl that is a cosmopolitan soil orchid. The types of orchids that live in epiphytes are found in only one individual, and most of them are orchids which like the open space. (Jaffe, Pavis, Vansuyt, & Kermarrec, 2006)

For mountain areas (Kalimpa Lake ') the low species richness index is not caused by the reduction in tree stands, but the number of individual orchids was dominated by terrestrial orchids from the species of *Phaius tankervilleae* (Bl.). Lindl, *Arundina bambusifolia* Lindl including subdominant and orchid species Other terrestrial *Calanthe veratrifolia* R.Br, *Goodyera oblongifolia*, *Microstylis latifolia* JJSm, *Rhomboda cristata* (Bl.) Omerod and *Spathoglottis plicata* were one for each type (not dominant). Epiphytic orchid species were one in each lane (not dominant). The low value of this in the mountainous area (Kalimpaa Lake) is due to the swampy soil conditions, high humidity, tree stand density and the type of orchid epiphytes found were orchid species that live in places with high humidity with low air temperatures namely *Agrotophyllum majus* JJSm., *Eria floribunda* Lindl, *Liparis pallida* (Bl.) Lindl, *Aerides odoratum* Lour., *Bulbophyllum lobbii* Lindl., *Coelogyne asperata* Lindl., and *Eria hyacinthoides* Lind. cosmopolitan soil orchids that can live and thrive in various conditions. *Phaius tankervilleae* (Bl.). Lindl which dominates the area was a type of orchid whose habitat grows only in humid soil conditions with rich humus.

High species richness index in two regions, namely lowland areas (Bobo Village) and alpine (Rorekatimbu Pathway) due to stable habitat conditions and each observation area where orchid species are found. Although the two regions have different heights, 5 species of similarities were still found, namely *Arundina bambusifolia* Lindl., *Cymbidium lancifolium* Hook. *Dendrobium fibriatum*, *Grammaphyllum stapelliiflorum* J.J.S., and *Spathoglottis plicata* Bl. The five orchid species found in both regions are orchid species that need a shady and open place. This condition is also found in the alpine area at an altitude of 2100 to 2300 meters above sea level is an open area; the type of vegetation is Imperata. (Pornarong SIRIPIYASING, 2012; Stern & Carlsward, 2009; Suetsugu, 2014)

Diversity is the number of species live in a community; its size is often referred to as species richness or describes the rate of change in species composition, across a large area. (Motomura, Selosse, Martos, Kagawa, & Yukawa, 2010)

The range of biodiversity index (H') of each observation, which had the highest diversity index was orchids lived in the lowland namely 0.908. However this value was not highly different with diversity index in the submountain, mountain, and alpine area which were 0.731, 0.855, and 0.849 respectively. The diversity index can be influenced by the number of type and individual found was less and dominated by certain types.

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Types of orchids found in Lore Lindu National Park has good spread and stabilization levels by observing habitats of each orchid. High stabilization also shows high complexity level due to high interaction, and thus they have high capability to encounter potential threat. The biodiversity level shows stabilization level of a forest community.(O'hanlon, Holwell, & Herberstein, 2014; Sánchez, Armenteras, & Retana, 2016) The higher the diversity level, the higher the stabilization level in a community. (Su et al., 2013) With respected to evenness index (e), from observation it is known that the highest evenness level found in the mountain areas is not highly different with lowland, submountain and alpine areas. Overall, the evenness index of each type is equal for all locations. The range of evenness index value (e) was 0.677 to 0.710 showing that the higher the index value (close to 1), the higher the population homogeneity means the individual spread is equal and no tendency to certain type domination.(Lin et al., 2016; Wu, Chang, & Huang, 2011) The evenness index type ranges from values 0-1 which are then classified into:

e < 1 : High evenness index
0,4 < e < 0,6 : Moderate evenness index
e < 0,4 : Low evenness index

The condition of the community is said to be good / stable if it has a value of evenness of type approaching 1 or vice versa, where the smaller the value of "e" indicates the uneven distribution of species, while the greater the value of "e" then the distribution of species is relatively evenly distributed. By looking at the evenness index of species (e) in the Lore Lindu National Park area, it can be assumed that the types of orchids are categorized as having a moderate level of evenness / uniformity.

CONCLUSION AND RECOMMENDATIONS

The results of the identification of orchids in each observation area in the Lore Lindu National Park are known to have 45 species out of 238 individuals and 28 genera of orchids. The dominant types are *Spathoglottis plicata* Bl., *Arundina bambusifolia* Lindl., *Dendrobium stratiotes* Rchb.f., and *Phaius tankervillae* (Bl.) Lindl. The distribution of orchids from 45 species were identified as a whole, lowland areas and alpine areas have the same species diversity that is as many as 22 species (48.88%), then in the mountain area as many as 16 species variations (35.55%) and the rest in the area submountain as many as 12 species variations (26.66%). In the lowland and submountain areas, there are 7 same types of orchids found, namely, *Ancanthepphilum javanicum* Bl., *Cymbidium lancifolium* Hook., *Dendrobium crumenatum*, *Dendrobium acinaciforme*, *Eria etusa*, *Grammaphyllum stapelliiflorum* J.J.S., and *Spathoglottis plicata* Bl. Meanwhile, in the lowland and mountain areas , there are 6 same types of orchids found, namely *Agrostophyllum majus*J.J.S., *Arundina bambusifolia* Lindl., *Bulbophyllum lobi* Lindl., *Cymbidium ensifolium* LSW., *Rhomboda cristita* (Bl) Omerod., And *Spathoglottis plicata* Bl. in the alpine lowland area, there are 5 of the same orchid species found, *Arundina bambusifolia* Lindl., *Cymbidium lancifolium* Hook. *Dendrobium fibriatum*, *Grammaphyllum stapelliiflorum* J.J.S., and *Spathoglottis plicata* Bl. The species richness index (Da) of orchids, distributed by individual species, is more evenly distributed and does not differ much between lowland areas with a species richness index value of 11,006 and alpine areas of 14,084. The mountain value of the 9,640 species richness index does not differ much from the 7,773 submountain area. Species diversity index (H ') of orchids, from each observation area that has the highest diversity index is the orchid species in the lowland area of 0.908, but the diversity index is not significantly different from the submountain, mountain, and alpine areas, 0.731, 0.855 0.849 respectively. The evenness index (e) of orchids in Lore Lindu National Park has a moderate level of uniformity. The Lore Lindu National Park area has the potential for the development, preservation, and protection of orchid species. the need for handling, oversight, and cultivation as a data information center and make a place of orchid research and ecotourism.

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