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Revisited the diversity of epiphyte orchids at Senduro, Bromo Tengger Semeru National Park, Indonesia

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The population of orchids in the Forest is threatened by human interferences. As in the case of Senduro Conservation II, a highway was made through the forest area in 2004. The objective of This research was to conducted revisited exploration on the diversity of epiphyte orchids in Bromo Tengger Semeru National Park, Indonesia, and compared to the finding in 2004. The exploration was executed in January to February 2018. Research method was descriptive-exploration with random sampling method. Exploration in 2018 was identified 15 genera and 39 species epiphyte orchids with total population 1245. While in 2004 was 16 genera consisted of 42 species with total population was 488. Species with highest population in 2018 was *Eria verruculosa* J.J.Sm. with the IVI of 27.46%., while in 2004 was *Coelogyne speciosa* (Bl.) Lindl. with the IVI of 24.95%. The value of diversity index by Shannon – Wiener in 2018 was 2.90 (medium - high), while in 2004 was 3.06 (high). This research proved that during 14 years gap since 2004, the diversity of epiphyte orchids in Senduro area is in good ecologically state.

Keywords: ***Epiphyte orchid, Exploration, Diversity***

INTRODUCTION

Indonesia is known as a country with high diversity of flora and fauna (Purnamasari, Yolanda, and Karno, 2016). Indonesian forests have abundant of plant species included woods, foods, medicines and ornamental plants. One kind of ornamental plants is orchid, orchid is orchidaceae family, it has 800 genera and 25.000 species (Ni'mah, Aziz, Sukma, 2014) . The beauty of orchids makes it called 'the queen of flowers' (Kasutjianingati and Irawan, 2013). Indonesia has 40 generas and 5.000 speciess of epiphyte orchid, spread in Sumatra, Borneo, Sulawesi, Java and Papua (Wulanesa, Andy, and Basuki, 2017) People adore orchid because of its esthetical value, various shape and colour of the flowers (Baker, Kaviani, Nematzadeh, and Negahdar, 2013).

Epiphyte orchids in the natural habitat is at risk of being extinct. According to Puspaningtyas (2005) in Wulanesa, Andy, and Basuki (2017), the extinction of orchid could be caused by damaged forest, such as burned forest, convertion forest to agriculture, and illegal logging.

To prevent the extinction of orchid in the the natural habitat, it is necessary to do conservation act. Ex situ and in situ conservation are important and should be done by considering the biology, ecology and the nature of threats towards the orchids (Nurfadilah, 2015). In situ conservation is an act to conserve the specimen at it's origin area. Ex situ conservation is a conservation act out side it's origin area. According to Graudal, Kjaer, Thomsen, and Larsen (1997) in Hani,

Widyaningsih, and Damayanti (2014) ex situ conservation act include : 1. Choose the priority endangered plant, 2. Maping of population spread, 3. Accumulate genetic material, 4. Preparation of planting location, 5. Develop breeding garden

Exploration and research are important to do in efforts to safe the plant diversity (Puspitaningtyas, 2017).

The importance of to gather information on orchid's occurrence in natural habitat is crucial in order to develop potential conservation strategy and policy making. Considering the fact in Java Island, there are large convertion of forest to human settlements, agricultural and plantation sites which can lead to the extinction of orchids.

The exploration was held at Senduro Conservation Area II, Ireng-Ireng Block, Bromo Tengger Semeru National Park, East Java. Bromo Tengger Semeru has been stated to be national park since October 1982 according to Agriculture ministry decree Number 736/Mentan/X/1982. This area is stated as national park because it has rich and unique potency of nature component biodiversity (Hidayat and Risna, 2007). According to the area, Senduro could be said to be main core and forest core. Main core is used to conserve the endangered species and the forest core is used for research and education purposes.

The objective of this research were to revisited conservation section Area II and compared the data of epiphyte orchids in 2004 to exploration result in 2018 in order to update the diversity of epiphyte orchids.

MATERIALS AND METHODS

The survey method was descriptive-exploration with random sampling. The survey was conducted along 5 lines with the length was about 620 m for every lines. Along the lines, there were 6 experimental plot with the size was about 20x20 m. The interval between the experimental plot was about 100 m. Total of the experimental plots were 30 experimental plots with the width was about 12.000 m^2. The number of epiphyte orchid found in the experimental plots were noted, documented, and identified.

Orchids of Java (Comber 1990) was used as a guide to identified epiphyte orchids found during the exploration.

Vegetation analyses were: density, relative density, frecuency, relative frecuency, important value index and Shannon-Wiener diversity index:

$\frac{\Sigma Ni}{A} Di =$ (1)

Di = Density species i.
Ni = Total amount species i.
A = Field (m^2)

$Rdi = \frac{\mathrm{Di}}{\Sigma \mathrm{D}} x100\%$ (2)

Rdi = Reletive density of spesies i.
Di = Density spesies i.
D = Total of density species.

$Fi = \frac{\mathrm{Ji}}{\mathrm{K}}$ (3)

Fi = Frecuency of species i
Ji = Total plot that have i species inside
K = Total plot.

$.Rfi = \frac{\mathrm{Fi}}{\Sigma \mathrm{F}} x100\%$ (4)

RFi = Relative frecuency of species i.
Fi = Frecuency species i.
ΣF = Total of i species frecuency.

Important Value Index:
IVI= RDi + Rfi (5)

Shannon-Wiener Diversity Index (Indriyani, Alamsyah, and Erna, 2017) :

$$H = -\Sigma \{(n.i/N) \ln (n.i/N)\} \quad (6)$$

Pi = ∑ni/N
H = Shannon-Wiener Diversity Index
Ni = Important Value Index
N = Total individu

RESULTS

This research was conducted in Section Conservation Area II, Senduro, Ireng-Ireng Block. Senduro's wide is about 228,67 km², the altitude about 100-2000 meter above sea level and rainfall is about 4.176 mm a year. The average temperature at Senduro between 21- 34^0 C, with level of humidity 85%. Ireng-Ireng block is taken place at 800-1.500 meter above sea level with various topography, the average temperature at noon are between 18-20^0 C.

Exploration was conducted in January to February 2018 at the end of wet season. It has been successfully identified 15 genera and 39 species of epiphyte orchids (Figure 2) with the total individual were 1245. While the results of exploration in 2004 were 16 genera, 42 species and 488 individual plants (Figure 1.). Table 1 and Table 2 present the highest and lowest important value index of epiphyte orchids in exploration 2004 and 2018 respectively. Table 3 and Table 4 present number of genus, species and population according to the track in both exploration years.

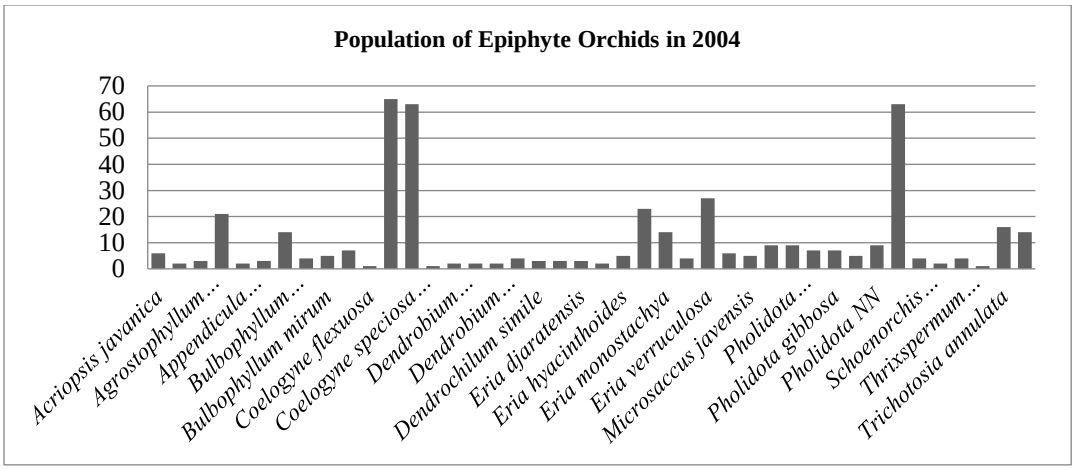


Figure 1. Population of Epiphyte Orchids in 2004

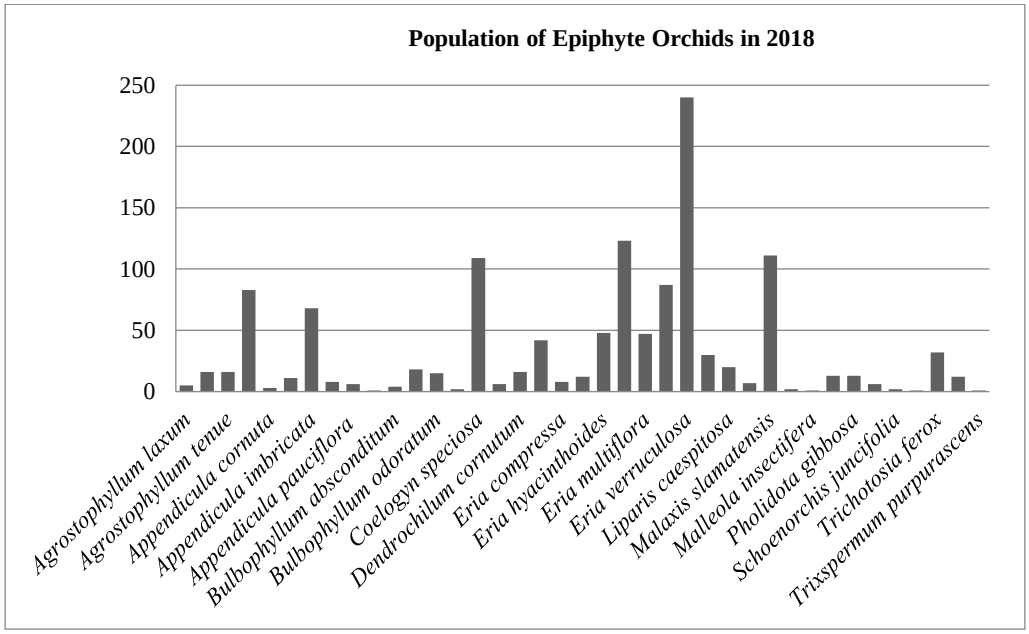


Figure 2. Population of Epiphyte Orchids in 2018

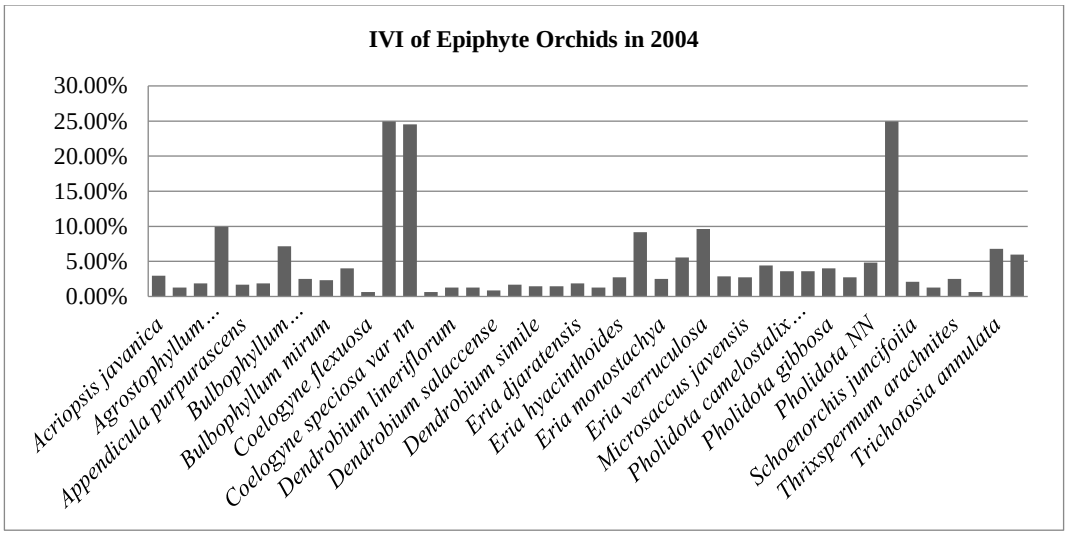


Figure 3. IVI of Epiphyte Orchids in 2004

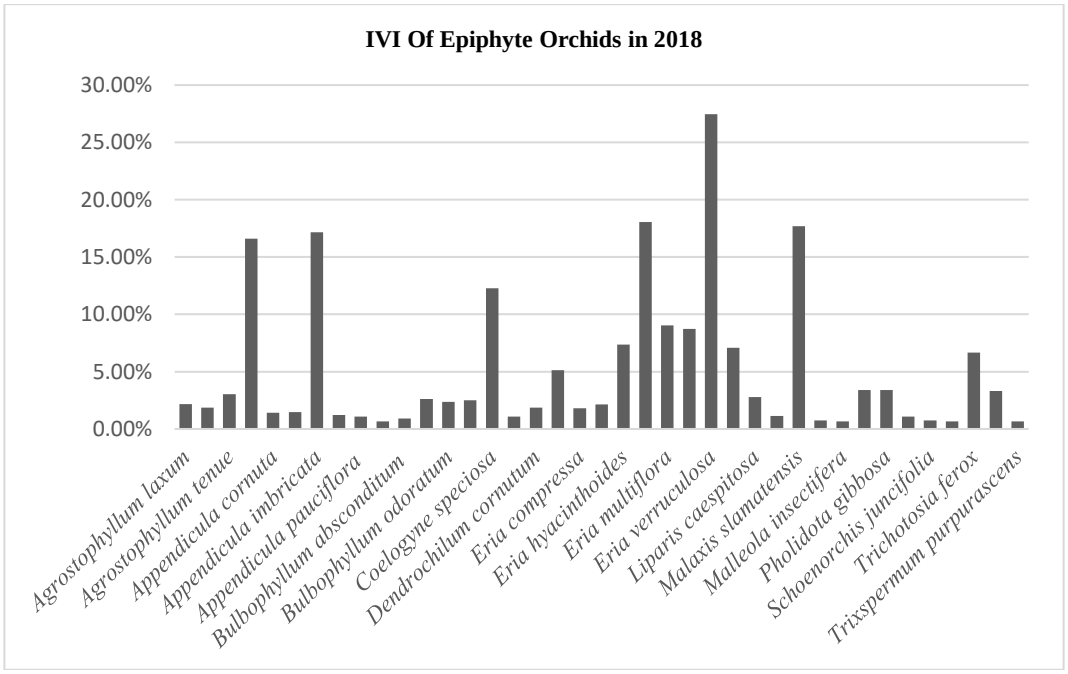


Figure 4. IVI of Epiphyte Orchids in 2018

Coordinate in 2004: 8°2'17.30" – 8°2'57.19"S and 113°0'52.33" – 113°1'39.77"E
Coordinate in 2018: 8°3'01.90" – 8°2'32.18"S and 113°1'47.27" – 113°0'56.35"E

Table 1. The Highest and Lowest IVI Value of Epiphyte Orchid During Exploration In 2004

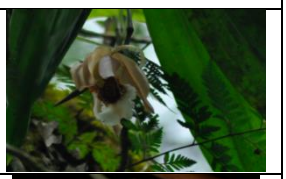
Species	IVI	Total individu	Picture
Coelogyne speciosa	24.95%	65	
Coelogyne flexuosa	0,63%	1	 (Anonymous, 2018)

Table 2. The Highest and Lowest IVI of Epiphyte Orchid During Exploration In 2018

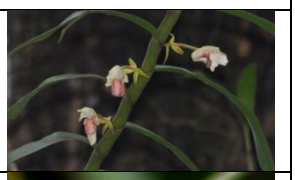
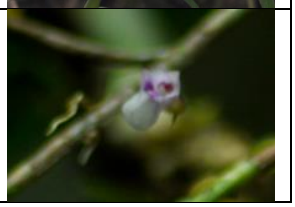
Species	IVI	Total individu	Picture
Eria verruculosa	27.46%	240	
Appendicula ramose	0,68%	1	

Table 3. Number Of Genus, Species and Populations On Tracks in 2004

Track	Altitude (asl)	Genus	Spesies	Populations
1	1200-1250	9	25	184
2	1200	9	21	84
3	1100-1200	11	18	68
4	1050-1100	7	8	40
5	1100	9	22	72
Total		45	94	448

Table 4. Number Of Genus, Species and Populations On Tracks in 2018

Track	Altitude (asl)	Genus	Spesies	Populations
1	1215	8	16	172
2	1157	11	16	219
3	1128	12	25	347
4	1112	12	19	331
5	1075	7	12	176
Total		50	88	1245

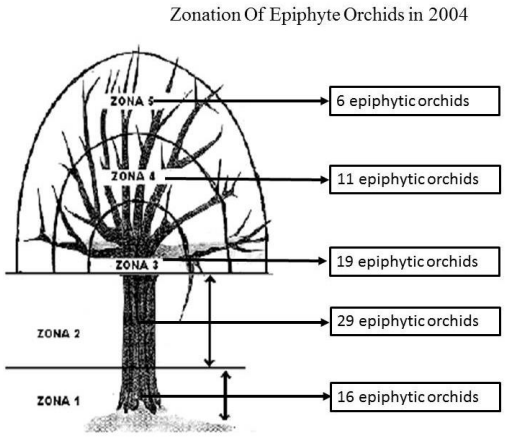


Figure 5. Zonation of Epiphyte Orchid During Exploration in 2004

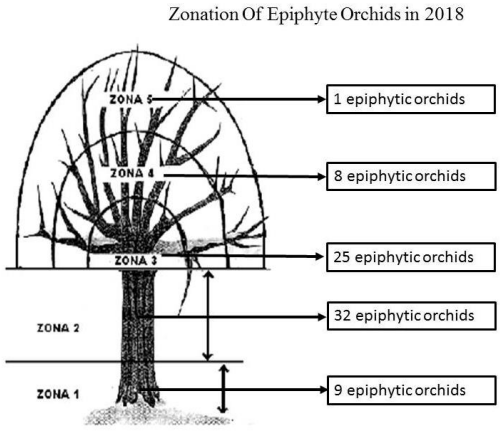


Figure 6. Zonation of Epiphyte Orchid During Exploration in 2018

The number of epiphyte orchid population in all tracks more or less was evenly distributed.

Important value index is presented in Figure 3 for exploration in 2004 and Figure 4 for exploration in 2018. The highest IVI showed that this species is abundant in number and wide spread. The lowest IVI showed that this species existed in small number and locally (Table 1 and Table 2). Species with low IVI is vulnerable and at high risk for being extinct in their natural habitat, In the exploration 2004, the highest orchids populations found was in track 1 at the altitude of 1200-1250 m above sea level. (Table 3). While in 2018, the higest orchids populations found was in track 3 at the altitude of 1128 m above sea level (Table 4).

There were 16 species of host trees found during both exploration. Those were, *Ficus viroens W. Ait., Trema orientalis (L) Bl., Ficus*

septica, Magnolia blumei Prantl, Ficus benjamina, Ficus retusa, Engelhardia spicata, Agathis dammara, Bischofia javanica, Croton sp., Ficus hispida Linn. F, Artocapus heterophyllus, Litsea sp., Quercus elegans, Quercus teymanni, Pinanga coronaria, Celtis wightii Planch, Garuga floribunda, Pinanga coronaria, Omalantus sp

Epiphyte are associated with it's host and more likely to be affected with the species and the host traits (Hietz 1999; Callaway et al. 2002; Partomihardjo et al., 2004; Hsu et al., 2014 in Timsina, et al., 2016).

Zonation of epiphyte orchids in both exploration are similar, where the peak number of epiphyte orchids were in zone 3 and 4 (Figure 5 and Figure 6). In general the epiphyte orchids were distributed normally throughout the host tree. The occurrence of orchids depend on the light and nutrients requirement. Zone 3 is located at the bottom of brances, this allow seeds to be trapped easily, be nourised with light, nutrients and water (Yulia and Budhiarta, 2010).

DISCUSSION

The exploration during 2004 (Figure 1) and 2018 (Figure 2) had found different numbers of epiphyte orchids. Those were differences in the number of genera, the amount of species and total population. During exploration in 2004 was found 16 genera, 42 species and 488 populations. The exploration in 2018 found 15 genera of epiphyte orchid, 39 species and 1245 populations.. The differences of numbers could be caused by several ecological and tecnical factors. The dominate species during exploration in 2004 was *Coelogyne speciosa* with IVI 24.95% (Table 1 ; Figure 3). The most dominate species during exploration in 2018 was *Eria verruculosa*, the IVI 27.46% (Table 2 ; Figure 4). Epiphyte orchid with low IVI should be taken more seriously into consideration in conservation policy because it is more vurnurable to be extinct.

Table 3 and Table 4 present the number of genus, species and population of epiphyte orchids in both exploration years according to the tracks. There were 5 tracks in each exploration. From these data it could be seen that the epiphyte orchids population could be found in all tracks. It means that the ecological condition is in good state enable to support the growth of host trees and the epiphyte orchids. Good ecological condition also contribute to the value of diversity index by Shannon – Wiener in 2018 was 2.90 (medium - high), while in 2004 was 3.06 (high). These value of diversity index can be cexplained by the weather support epiphyte orchid's growth, the temperature 19.5-21.2^{0}C similar to the ideal temperature needed by epiphytic orchid. According to Nasution, Panata, and Yunasfi (2013) orchids can live in good condition by temperature of 18-23^{0}C

Those species in 2004 that were not found during exploration in 2018 and vice versa, could be caused by the differences of the tracks and coordinate that were taken during the exploration. But also because of the season. In 2004 exploration was taken place in July-August during the end of dry season. While in 2018 in January-February during the end of wet season.

From the five of zonation where epiphyte orchid was found during exploration in 2004 (Figure 5) and 2018 (Figure 6), zone 3 has the most amount of epiphyte orchid: those were 137 in 2004 and 653 in 2018. Those are some factors that affect the distribution of epiphyte orchid in host tree such as stock of nutrient, sun light, temperature, wind velocity, water stock. A tree capable to be a host tree is tree with rough, peeled trunk with a little crack, so dust can accumulate and doused by rain causing the tree trunk become moist (Wulanesa, Andy, and Basuki, 2017). Flores-Palacios, Ortiz-Pulido (2005) in Yulia, and Budhiarta, (2010) said that epiphyte orchids prefer to attach on host trees with rough bark rather than the smooth one. The location of zone 3 is under the first branch and it become the favourite place for epiphyte orchid to grow because on the zone 3 it is easier for seed to stick in, to get sunlight, water, and nutrient. The opposite phenomenon happened on zone one. On zone 1 it is harder to get sunlight because the canopy from the higher plant block the sunlight, the wind velocity is low. *Dendrobium jacobsonii* (Figure 5) and *Trixspermum arachnites* (Figure 6) only found in zone 1. It means that these species have special ecological need to grow.

The conservation policy taken by Bromo Tengger Semeru National Park Office is quite effective in preserving the biodiversity in the national park. They are include regular patrol, night patrol, detain the illegal logger, environmental education to the villages who live next to the forest.

CONCLUSION

This research concluded that during 14 years gap since the last exploration in 2004, the diversity of epiphyte orchids in Senduro area revisited in 2018 exploration is medium-high and ecologically in good state. The conservation policy

taken by Bromo Tengger Semeru National Park is successfully in maintaining the biodiversity of epiphyte orchids.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

LTS designed the exploration, wrote and reviewed the manuscript. PDF performed the field exploration, data analysis and wrote the manuscript. All authors read and approved the final version.

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