The Existence of Genetic Diversity in Maintaining Epiphytic Orchids Germplasm In Pronojiwo Conservation Area, Bromo Tengger Semeru National Park, East Java, Indonesia

L Soetopo\textsuperscript{1}, N D Saputra\textsuperscript{1}

Laboratory of Plant Breeding, Department of Agronomy, Faculty of Agriculture.
Brawijaya University

E-mail: lita.fp@ub.ac.id

Abstract. Orchids are often found naturally in tropical rainforests. Tropical rainforest destruction could decrease orchid germplasms in the natural habitat. To save their existence, it is necessary to keep them from the threat of extinction. Some efforts that could be done is by conducted periodically exploration and inventory activities. The objective of this research was to revisit the genetic diversity of epiphytic orchid germplasms in Resort Rau Darungan Pronojiwo Conservation area Bromo Tengger Semeru National Park, East Java compared to the finding in 2002. Exploration of Epiphytic Orchid Diversity at Pronojiwo Conservation Area, Bromo Tengger Semeru National Park, East Java was conducted in January to February 2018. The research method was descriptive-exploration with random sampling method. Exploration results in 2018 found 1,013 orchids population, consisted of 22 genera and 53 species. While in 2002 found 2,053 orchids population, consisted of 18 genera and 39 species. The host trees found in this research was 21, while in 2002 was found 30 host trees. The value of diversity index by Shannon – Wiener in this research was 3.03 (high) and in 2002 was 3.50 (high). Species with the highest population in 2018 was Eria monostachya with the IVI of 32.94%, while in 2002 was Bulbophyllum biflorum with the IVI of 10.84%. From this research, it is concluded that the genetic diversity of epiphytic orchids germplasm in Resort Rau Darungan is high. Besides time lapse of 16 years, the existence of epiphyte orchids biodiversity is well maintained.

1. Introduction
Indonesia has 2 of 25 biodiversity hotspots in the world; Sundaland and Wallacea [1]. Java is part of Sundaland, volcanic slopes on Java Island have high biodiversity. Indonesia is estimated to have 25% of flowering plant species in the world and is a country with a total number of 20,000 species. As for 40% of them are Indonesian endemic plants [2]. People adore orchid because of its esthetical value, various shape, and color of the flowers [3]. In Indonesia, 986 species are spread in the Java Island, 971 species are in Sumatra, 113 species grow in Maluku, and the rest can be found in Sulawesi, Irian Jaya, Kalimantan and Nusa Tenggara [4].

Orchid plants in this modern era, especially in the type of epiphytic orchids in Java, are most threatened in their natural habitat. Caused by the intensity of activities in natural forests as the effect of uncontrolled deforestation [5]. Budiharta et al [6], also stated that the extinction of orchids is most adversely affected by overexploitation and biological factors (98 and 100%, respectively).
To prevent the extinction of epiphytic orchids in their natural habitat, it is necessary to do a periodical exploration accompanied by an inventory of data. According to [7], exploration activities, especially epiphytic orchids, are very important currently because many natural orchid habitats are endangered. Exploration and research are important to do in efforts to safe the plant diversity [1]. The purpose of this research was to revisited the Pronojiwo Conservation Area Resort Ranu Darungan, Bromo Tengger Semeru National Park, East Java. and to compared the data of epiphyte orchids in 2018 to the results of exploration in 2002 in order to update data on the existence of genetic diversity in maintaining epiphytic orchids germplasms.

2. Material and Method
The survey method was descriptive-exploratory with randomize sample. The survey was conducted along 5 lines with the length was about 620 m for every line. Along the lines, there was 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 m². The number of terrestrial orchids found in the experimental plots were noted, documented, identified, and inventoried. The first step was pre-survey to determine the coordinate of the track. Based on the information from Bromo Tengger Semeru National Park staff and the villagers on the accessibility of the tracks and the presence of epiphyte orchid

Orchids of Java was used as a guide to identified epiphyte orchids found during exploration. Vegetation analyses were: density, relative density, frequency, relative frequency, important value index and Shannon-Wiener diversity index

\[
D_i = \frac{N_i}{A} \quad (1)
\]

\[
R_{di} = \frac{D_i}{D} \times 100\% \quad (2)
\]

\[
F_i = \frac{J_i}{K} \quad (3)
\]

\[
R_{fi} = \frac{F_i}{\Sigma F} \times 100\% \quad (4)
\]

Important Value Index [8]:

\[
IVI = R_{Di} + R_{fi} \quad (5)
\]

Shannon-Wiener Diversity Index (Sarma and Das, 2015; Indriyani, Flamin and Erna, 2017):

\[
H = -\sum \left\{\frac{n_i}{N} \ln \left(\frac{n_i}{N}\right)\right\} \quad (6)
\]

\[
Pi = \sum n_i/N
\]

\[
H = \text{Shannon-Wiener Diversity Index}
\]
3. Material and Method

This research was conducted in Pronojiwo Conservation Area. Resort Pronojiwo is about 3,425.72 ha [9], the altitude about 800-3,600 above sea level and rainfall is about 6,200 mm a year. The average temperature at Pronowijo between 22 - 26°C, with the level of humidity 80%. This Research is taken place at 860-1,234 meter above sea level with various topography, the average temperature at noon is between 22-29°C, with the level of humidity 59-93%.

Exploration was conducted in January to February 2018 at the end of wet season. It has been successfully identified 1,013 orchids population, consisted of 22 genera and 53 species (Figure 1 and 2). While in 2002 found 2,053 orchids population, consisted of 18 genera and 39 species (Figure 3 and 4). Table 3 presented number of genus, species, and population according to the track in exploration 2018. The number of epiphyte orchid population in all tracks more or less was evenly distributed.

Important value index was presented in Figure 5 dan 6 for exploration in 2018 and Figure 7 dan 8 for exploration in 2002. The highest IVI showed that this species is abundant in number and widespread. 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. Some genus, species, and population on tracks in 2018 is presented in Table 3.

The most population of epiphytic orchids are found in zone 3 but the most general and species in zone 2 (Figure 9). In general, the epiphyte orchids were distributed normally throughout the host trees. According to [10] the spread of epiphytic orchids in each zone due to the characteristics of the host tree trunk, as well as the need for orchids for different sunlight in each species. Host Trees and Number Of Epiphytic Orchid Species are presented in Table 4.

![Figure 1. The population of Epiphytic Orchids in 2018](image-url)
Figure 2. The population of Epiphytic Orchids in 2018

Figure 3. The population of Epiphytic Orchids in 2002

Figure 4. The population of Epiphytic Orchids in 2002
Figure 5. IVI of Epiphytic Orchids in 2018

Figure 6. IVI of Epiphytic Orchids in 2018

Figure 7. IVI of Epiphytic Orchids in 2002
Figure 8. IVI of Epiphytic Orchids in 2002

Table 1. The Highest and Lowest IVI Value of Epiphyte Orchid During Exploration In 2002

| Species               | IVI     | Total Population |
|-----------------------|---------|------------------|
| *Bulbophyllum biflorum* | 10.84%  | 147              |
| *Taeniophyllum hasseltii* | 0.59%  | 4                |

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

| Species               | IVI     | Total Population |
|-----------------------|---------|------------------|
| *Eria monostachya*    | 32.94%  | 244              |
| *Agrostophyllum bicuspidatum* | 0.47%  | 1                |
Table 3. Number Of Genus, Species, and Population On Tracks in 2018

| Track | Altitude (asl) | Genus     | Species | Population |
|-------|----------------|-----------|---------|------------|
| 1     | 930 – 1,234    | 13        | 26      | 105        |
| 2     | 871 – 913      | 12        | 18      | 128        |
| 3     | 860 – 982      | 17        | 35      | 322        |
| 4     | 852 – 999      | 14        | 29      | 252        |
| 5     | 883 – 931      | 15        | 31      | 206        |
| Total | 860 – 1,234    | 22        | 53      | 1013       |
The exploration during 2018 (Figure 1 and 2) and 2002 (Figure 3 and 4) have found different numbers of epiphyte orchids. Those were differences in the number of genera, the number of species and total population. During exploration in 2018 found 1.013 orchids population, consisted of 22 genera and 53 species. The exploration in 2002 found 2.053 orchids population, consisted of 18 genera and 39 species. The differences in numbers can be caused by several ecological and technical factors. [11] states that the identification of epiphytic orchids in the field is not easy because generally from the diversity of

![Zonation of Epiphyte Orchid During Exploration in 2018](image)

**Figure 9.** Zonation of Epiphyte Orchid During Exploration in 2018

| No | Host trees                     | Number of Epiphytic orchid species |
|----|--------------------------------|------------------------------------|
| 1  | *Alstonia scholaris*           | 5                                  |
| 2  | *Garuga floribunda*            | 3                                  |
| 3  | *Trema orientalis*             | 4                                  |
| 4  | *Elaeocarpus pierrei*          | 3                                  |
| 5  | *Sloanea sigun*                | 2                                  |
| 6  | *Bischofia javanica* Blume     | 14                                 |
| 7  | *Wetria insignis*              | 3                                  |
| 8  | *Lithocarpus elegant and sundaicus* | 28                         |
| 9  | *Engelhardtia spicata*         | 4                                  |
| 10 | *Litsea glutinosa and Noronha* | 5                                  |
| 11 | *Erythrina lithosperma*        | 1                                  |
| 12 | *Toona sureni*                 | 7                                  |
| 13 | *Ficus ampelais*               | 6                                  |
| 14 | *Myrica javanica*              | 14                                 |
| 15 | *Eugenis operculata*           | 3                                  |
| 16 | *Dachyrarpus imbricatus*       | 15                                 |
| 17 | *Psydrax dicocco*              | 7                                  |
| 18 | *Facourtia rukam*              | 4                                  |
| 19 | *Laportea stimulans*           | 1                                  |

**Table 4.** Host Trees and Number Of Epiphytic Orchid Species
species that exist, only 10% are found in flowering conditions, thus it is very difficult to be able to identify to the species level of all species found in nature. The dominant species during exploration in 2018 was *Eria monostachya* with IVI 32.94%. The most dominant species during exploration in 2002 was *Bulbophyllum biflorum*, the IVI 10.84%. Epiphyte orchid with low IVI should be taken more seriously into consideration in conservation policy because it is more vulnerable to be extinct.

Table 3 presented the number of genus, species, and population of epiphyte orchids in exploration 2018, according to the tracks. There were 5 tracks in exploration 2018. 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. The good ecological condition also contribute to the value of diversity index by Shannon – Wiener in 2018 was 3.03 (high), while in 2004 was 3.50 (high). These values of diversity index can be explained by the weather support epiphytic orchid’s growth, the temperature 22-29°C similar to the ideal temperature needed by the epiphytic orchid.

Those species in 2002 that were not found during exploration in 2018 and vice versa could be caused by the differences of the tracks and coordinate that was taken during the exploration. But also because of the season. In 2002 exploration was taken place in June-November during the dry season and early wet 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 2018, zone 3 has the most amount of epiphyte orchid. Those are some factors that affect the distribution of epiphyte orchid in host tree such as stock of nutrient, sunlight, temperature, wind velocity, water stock. The location of zone 3 is under the first branch, and it becomes the favorite place for epiphyte orchid to grow because on the zone 3 it is easier for the seed to stick in, to get sunlight, water, and nutrient. The relationship between host trees and orchid species is not always specific, and more acts as a microclimate supporting factor and habitat for the survival of the orchid species that stay [1].

Table 4 presented the host trees and number of epiphytic orchid species in exploration 2018. A tree capable of being a host tree is a tree with rough, peeled trunk with a little crack, so dust can accumulate and douse by rain causing the tree trunk to become moist [12]. Based on Table 4, epiphytic orchids are most commonly found on the pasang tree (*Lithocarpus* sp), Because Pasang tree has bark that is rough textured. Thus, epiphytic orchids are more easy to stick on the host tree.

Among the main points in establishing genetic reserves are their location, size and number. In identifying and designing conservation areas, management policies or actions should always recognize that each and every individual of a species in nature is genetically unique, for example in Education Forest, National Park etc. Conservation of genetic material is being achieved through active management of a reserve and sustainable germ-plasm utilization [13,14].

### 4. Conclusion

Exploration results in 2018 found 1,013 orchids population, consisted of 22 genera and 53 species. While in 2002 found 2,053 orchids population, consisted of 18 genera and 39 species. The host trees found in this research was 21, while in 2002 was found 30 host trees. The value of diversity index by Shannon – Wiener in this research was 3.03 (high) and in 2002 was 3.50 (high). Species with the highest population in 2018 was *Eria monostachya* with the IVI of 32.94%, while in 2002 was *Bulbophyllum biflorum* with the IVI of 10.84%. From this research, it is concluded that the genetic diversity of epiphytic orchids germplasm in Resort Ranu Darungan is high. Besides time lapse of 16 years, the existence of epiphytic orchids biodiversity is well maintained.

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