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Biodiversity richness of terrestrial Orchids in Bromo Tengger Semeru National Park, Indonesia

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ABSTRACT

Terrestrial orchids live on litters and rocks on the forest floor. The natural habitat makes these orchids are at risk of being vulnerable, either by nature or human and animal interferences. Terrestrial orchids attract less people's attention because most of them are neither large nor beautiful, unlike the epiphyte orchids. But these terrestrial orchids enrich the world of orchid biodiversity. The exploration was conducted from January to February 2018. The objective of this research was to explore the biodiversity richness of terrestrial orchids atPronojiwo resort and at Senduro resort area Bromo Tengger Semeru National Park, Indonesia, and compared to the findings in 2004. The data was garnered from a exploratory descriptive survey with random sampling method. The results showed that the value of biodiversity at Pronojiwo resort was 2.52 in 2018 and 2.44 in 2004. While, at Senduro resort, the value of biodiversity was 2.48 in 2018 and 2.73 in 2005. The biodiversity richness of terrestrial orchids at Pronojiwo and Senduro resort, Bromo Tengger Semeru National Park included in moderate category. At Pronojiwo, we found 17 genera, 24 species, and 2541 individuals of terrestrial orchids in 2018. While, at Senduro, we found 16 genera, 20 species, and 563 individuals of terrestrial orchids.

Key words: *Terrestrial orchids, Biodiversity, Exploration*

Introduction

Indonesia is a country that has the largest orchid germplasm in the world. Of the approximately 26,000 orchid species in the world, Indonesia has 6000 of them. Indonesia is a tropical country that has a suitable environment as the requirements for the life of orchids (Heriswanto, 2009).

Orchid is an ornamental plant possessing high aesthetic values, i.e. the flower shape, color, and unique characteristics that attract consumers interested in ornamental plants. Orchids piqueinterest because orchids possess high economic values. The existence of the species depends on the nutrients living in the forest component. If the component is damaged, it will affect the sustainability of terrestrial orchids in the forest (Fijridiyanto and Hidayat, 2000).

Because orchids have a potential as ornamental plants, the rate of extinction of this group is quite high. Based on Puspaningtyas (2005), orchid extinction is engendered by several common causes of deforestation, i.e. forest fires, forest conversion, and intentional logging of forest trees.

Orchids in nature are very valuable asset for nation, therefore, they need to be preserved. Epiphytic and terrestrial orchids have different dispersion patterns. Hirata *et al.* (2009) posited that in the forest, the spread pattern of epiphytic orchids was influenced by two factors, i.e. dispercial (spread) and subsequent growth (establishment).

Conservation act to save terrestrial orchid

germplasm must be performed. It deals with exploration activities to obtain data of orchids, distribution and environmental state. Widhiartadi (2003) identified 36 types of terrestrial orchids at Pronojiwo area. Exploration aims to take plant samples that have important economic values and being knowledgeable (Mujahidi *et al.* 2002). From 2003 to 2017, re-exploration of the presence of the terrestrial orchids was not conducted at Pronojiwo and Senduro resort, Bromo Tengger Semeru National Park Area. Therefore, a re-exploration of the presence of terrestrial orchids in this region is indispensable.

The objective of this exploration was to identify the terrestrial orchids and the diversity of these species in Bromo Tengger Semeru National Park, Region II Conservation Section, Pronojiwo Resort; supported by data from Senduro Resort.

Materials and Methods

Exploration and inventory were conducted from January to February 2018. The exploration site was at Bromo Tengger Semeru National Park, Region II Conservation Section, Pronojiwo, East Java, Indonesia. This site was chosen based on the existence exploration of terrestrial orchids in 2004 (Fig. 1).

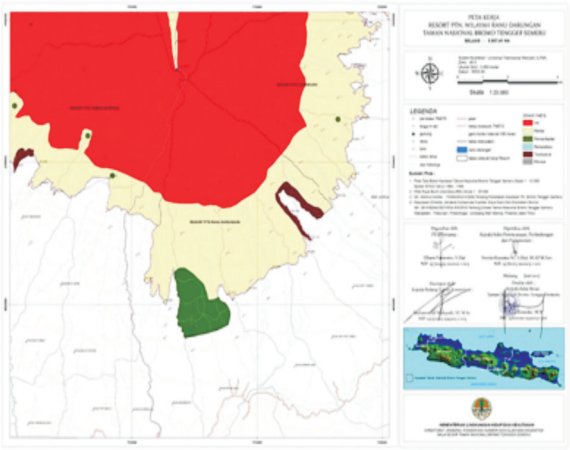

Fig. 1. Map of location at Bromo Tengger Semeru National Park East Java Indonesia

Instruments used in this research were topography maps, stationery, roll meter, camera, thermometer, pH meter, hygrometer, Orchid of Java (Comber, 1990), and GPS. Materials observed were terrestrial orchids found on the samplingplot.

The survey method was exploratory descriptive 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 plots with the size of 20x20 m. The interval between the experimental plot was about 100 m. The total of the experimental plots were 30 plots. The number of terrestrial orchids found in the experimental plots were noted, documented, identified, and inventoried.

The first step was to conduct pre-survey to determine the coordinate of the track based on the accesibility of the track and the presence of terrestrial orchids. The second step was to conduct the survey according to the sampling plots marked. The third step was to observe the terrestrial orchids inside it, and then to document using DSLR camera. Orchids of Java (Comber, 1990) was used as a guide to identify terrestrial orchids found during exploration.

The data obtained from thece terrestrial orchids exploration was analyzed using vegetation analysis :

Shannon Diversity Index (Brower *et.al*, 1990)
H' = -Σ (Ni/N) ln (Ni/N)
H' : Shannon Diversity Index
Ni : The abudance of species
N : The total number of species

Important Value Index (Kusmana, 2017).
IVI = RDi + RFi
IVI : Important Value Index
RDi : Relative density species i
RFi : Relative frequency species i

Results and Discussion

Exploration of the diversity of terrestrial orchids in 2018 was conducted at Pronojiwo area within the territory II regional conservation section, Bromo Tengger Semeru National Park. The exploration identified 17 genera, 24 species with total species reaching 2541 individuals. The exploration was executed on five tracks at Pronojiwo Resort area. The coordinate of Track 1 was at altitude (930-1,234 masl), temperature (22°C-27.8 °C), and humidity (80-93%). On track 1, there were 8 genera and 11 species with total individuals reaching 140. *Phaius ambonensis* was the dominant species represented by 32 individuals.

The coordinate of track 2 was S 8011'13.3 '' E 112055'39.2 "precisely located at west side of Lake

Ranu Darungan with the altitude (803-913 masl), temperature (23 ºC-29 ºC), and humidity (61-82%). On track 2, the number of terrestrial orchids identified were 10 genera and 13 species with total individuals reaching 361. The dominant species was *Calanthe sylvatica* with 139 individuals.

The coordinate of track 3 was S 08011'21,5 'E 112055'39.2" with the altitude (871-913 masl), humidity(59% -70%) and temperature (25 ºC-28 ºC). The topography on track 3 was flat, bumpy, hilly to steep cliffs on the side of the river. We identified 15 genera and 17 species with total individual sreaching 593. The most dominant genera were Calanthe, Nervilia, Liparis and Apostasia.

The coordinate of track 4 was S 080 10'56.9 '' E 1120 55 '39.2 " with temperature (24 ºC-28.4 ºC), and the altitude (852-999 masl). The topography on track 4was bumpy. This trackhad high diversity values compared to the other tracks. We identified 18 genera and 18 species with total individualsreaching 771.The most dominantgenera were Calanthe, Corymborkis and Nervilia.

The coordinate of track 5 was S 08011'1.6 '' E 112055'44.8" temperature (25 ºC-29.4 ºC) and altitude (883-931 masl). Precisely located at east side Ranu Darungan. Here we identified 12 genera, 14 species and 791 individuals. On thia track we found *Erythroideshumilis* (BI) Ames, which was not found in the other tracks. The size of this orchid is very small and its morphology similar to Malaxis. It can be perceived from the pattern of leaf bones to distinguish between them, The most dominant gebera on this track were Calathe and Corymborkis.

The diversity of terrestrial orchids found in each track and observation plots is certainly influenced by several factors, namely altitude, temperature, humidity, intensity of sunlight and surrounding vegetation. Sadili (2013) suggested that terrestrial orchids only required a little or no light. Species dominatingthe exploration were the species with the highest number of individual, and wide spread values (Fig. 1.), i.e. *Corymborkis veratrifolia*, *Calanthe sylvatica*, and *Nervilia punctata*. While, the species with a narrow spread value were *Calanthe zollingeri, Erythrodes humilis, Malaxis kobi, Peristylus sp., and Phaius pauciflorus*. Orchids possessing a relatively high frequency (RF) value can assumedlyspread widely, thus they possibly have a good adaptability to the environment. Pasaribu *et.al* (2013) depicted that the relative frequency of a habitat type of an organism showed the frequency of the species in

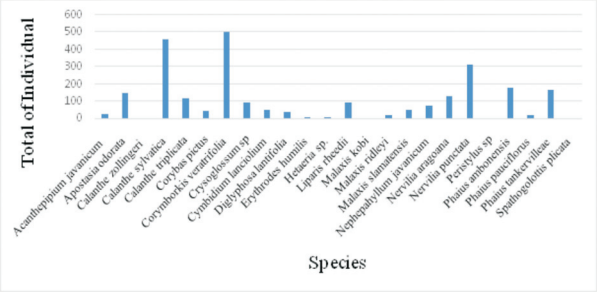

Fig. 2. Number of terrestrial orchid individual found at Pronojiwoin 2018

that habitat, while a low relative frequency (RF) value was only found in one or two plots out of 30 observation plots.

In the case of *Prescottiastachyodes*, Whitman and Ackerman (2015) concluded that habitat characteristics affecting species abundance can differ from conditions that influence plant size or reproductive effort. Nomura *et al.* (2013) found that the existence of a rare terrestrial orchid, *Nervilianipponica,* consistently associated with a single group of mycobionts. In our exploration, we found *Nerviliapunctata*, *Nerviliaaragoana* and *Nervilia discolor*. Terrestrial orchids take nutrition from soil or humus (Sadili and Sundari, 2013. *Nerviliapunctata* live in tropical and subtropical regions, green forest with heavy covering and high humidity. It grow on organic soil, humid hills as well as on lime forest (Gale and Phaxasysombath, 2017).

Important value indexwas obtained by summing the relative density values of species (Rdi) with the relative frequency values of species (Rfi). INP can be seen as a species dominating in 30 observation plots that have been distributed throughout the track. Terrestrial orchid species found were *Corymborkis veratrivolia* (31.15%), *Calanthe sylvatica* (30.60%) and *Nervilia punctata* (19, 18%) of 2541 individuals found in total. The high value of IVI can be assumed that almost all of the epiphytic orchid species mentioned above have been foundin each observation plot. Astuti and Darma (2010) corroborated that *Corymborkis veratrifolia* could grow well in shaded and wet areas, even in a rather dry place it can still grow and reproduce well. While, *Calanthe sylvativa,* according to Pasaribu *et al.* (2013), could grow in a fairly humid location, and from low / medium sunlight due to liana cover and low tree vegetation. The smallest IVI valueswere orchid species from the genus *Malaxis kobi, Calanthe zollingeri*, *Peristylus* sp., and *Erytrhodes humilis*. This smallest IVI value is

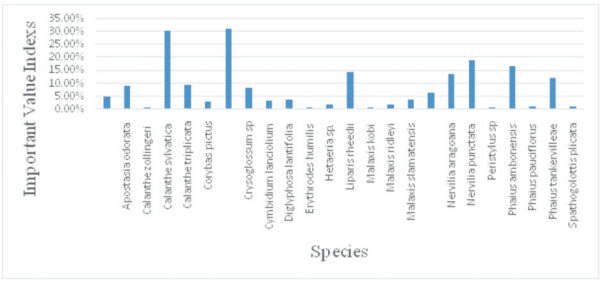

Fig. 3. Important value index (IVI) of terrestrial orchids found atPronojiwoin 2018

obtained fromonly 1 species and 1 individualfound in one plot or two observation plotout of 30 plots during exploration activities (Fig. 3).

Shannon-Wiener Diversity Index of terrestrial orchids at Pronojiwo Resort was 2.52 which was categorized moderate. In 2003, Shannon-Wiener Diversity Index of terrestrial orchids at Pronojiwo Resort was 2.83. While at Senduro resort, Shannon-Wiener Diversity Index of terrestrial orchids in 2018 was 2.48 (Soetopo and Figianti, 2018) and 2.73 (Zunaidi, 2005) which was also categorized moderate.

The terrestrial orchid germplasms found in this exploration hadvarious morphological characters in terms of shape, size, color of flowers and labellum on orchid flowers. The diversity of germplasm can be used for basic plant breeding material, therefore its genetic resources need to be maintained. During exploration, many terrestrial orchids were found at flowering state and had seeds;with the abundance of these seeds can be used to multiply and maintain the sustainability of terrestrial orchids.

Efforts to maintain the sustainability of terrestrial orchids can be carried out *ex-situ* and *in-situ* conservation activities. Conservation efforts can be done *ex-situ* in the form of collection gardens, while Radji (2005) statedthat the biotechnology such as tissue culture techniques, *in-vitro* propagation, genetical engineering played a role especially in the context of developing and utilizing types of medicinal plants and orchids.

Compared to the results of exploration carried out by Widhiartadi in 2004at Pronojiwo area, addition and reduction of terrestrial orchid species were found (Table 1). Addition and reduction of genera and orchid species can becaused by the differences

Table 1. Number of Individual and Important Value Index of Terrestrial Orchids in Bromo Tengger Semeru National Parkin 2018

NO.	Species	Total	Di	Rdi	Fi	Rfi	IVI
1	*Acanthepipium javanicum* *)	28	0.0038	1.10%	0.23	4.00%	5.10%
2	*Apostasia odorata* **)	147	0.0204	5.79%	0.2	3.43%	9.21%
3	*Calanthe zollingeri* **)	2	0.0002	0.08%	0.03	0.57%	0.65%
4	*Calanthe sylvatica* **)	458	0.0636	18.02%	0.73	12.57%	30.60%
5	*Calanthe triplicata*)	115	0.0159	4.53%	0.3	5.14%	9.67%
6	*Corybas pictus*)	46	0.0063	1.81%	0.06	1.14%	2.95%
7	*Corymborkis veratrifolia* *)	501	0.0695	19.72%	0.66	11.43%	31.15%
8	*Crysoglossum* sp.**)	93	0.0129	3.66%	0.26	4.57%	8.23%
9	*Cymbidium lanciolium* *)	48	0.0066	1.89%	0.10	1.71%	3.60%
10	*Diglyphosa lantifolia* *)	35	0.0048	1.38%	0.13	2.29%	3.66%
11	*Erythrodes humilis* **)	5	0.0006	0.20%	0.03	0.57%	0.77%
12	*Hetaeria* sp. **)	8	0.0011	0.31%	0.10	1.71%	2.03%
13	*Liparis rheedii* *)	91	0.0126	3.58%	0.63	10.86%	14.44%
14	*Malaxis kobi* *)	1	0.0001	0.04%	0.03	0.57%	0.61%
15	*Malaxis ridleyi* **)	22	0.0030	0.87%	0.06	1.14%	2.01%
16	*Malaxis slamatensis* **)	49	0.0068	1.93%	0.1	1.71%	3.64%
17	*Nephepahyllum javanicum* *)	77	0.0106	3.03%	0.2	3.43%	6.46%
18	*Nervilia aragoana* *)	131	0.0181	5.16%	0.5	8.57%	13.73%
19	*Nervilia punctata* *)	313	0.0434	12.32%	0.4	6.86%	19.18%
20	*Peristylus* sp. **)	2	0.0002	0.08%	0.03	0.57%	0.65%
21	*Phaius ambonensis* *)	180	0.0250	7.08%	0.56	9.71%	16.80%
22	*Phaius pauciflorus* *)	19	0.0026	0.75%	0.03	0.57%	1.32%
23	*Phaius tankervilleae* *)	167	0.0231	6.57%	0.33	5.71%	12.29%
24	*Spathogolottis plicata* *)	3	0.0004	0.12%	0.06	1.14%	1.26%

Notes : *): terrestrial orchid species found in 2003 and 2018

**)terrestrial: orchid species that were not found in 2003, but found in 2018.

in the coordinates of the observation sites, and time of exploration.

Ornamental potentials of terrestrial orchid germplasms at Pronojiwo in 2018 are shown in Table 2. While, at Pronojiwo in 2003 and Senduro in 2018 is shown in Appendix 1. Terrestrial orchids have ornamental potentials both in the flowers (colour and shape) and the leaves (colour, pattern, and shape).

Conclusion

This research conducted at Pronojiwo Resort identifies 17 genera and 24 species with 2541 individuals in total. The dominant species are *Corymborkis veratrifolia* (RD = 20%) and *Calanthe sylvatica* (RF = 13%). The highest IVI are *Corymborkis veratrifolia, Calanthe sylvatica* and *Nervilia punctata*. While, the lowest IVI are*Malaxis kobi, Calanthe zollingeri, Peristylus sp*. and *Erythrodes humilis*. The diversity of terrestrial orchids at Pronojiwo Resort is categorized moderate, with Shannon-Wienner Diversity Index of 2.52. In 2003, Shannon-Wiener Diversity Index of terrestrial orchids at Pronojiwo Resort was 2.83 (Widhiartadi, 2003). While at Senduro resort, Shannon-Wiener Diversity Index of terrestrial orchids in 2018 was 2.48 (Soetopo and Figianti, 2018) and in 2006 was 2.73 (Zunaidi, 2005) which is also categorized moderate.

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Appendix 1. Ornamental Potentials of Terrestrial Orchid in Pronojiwo Resort in 2018

Species	Ornamental potentials	Picture
Acanthepipium javanicum Blume	Flower	 (Pesonal documentation, 2018)
Nervilia aragoana Common ex Gaudich	Leaf	 (Personal documentation 2018)
Nerviliapunctata (Bl.) Makino, in Bot	Leaf	 (Personal documentation, 2018)

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