Biodiversity conservation of epiphyte orchids in the natural habitat for sustainable bioeconomy

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ABSTRACT. Epiphyte orchids grow abundantly in tropical rainforests. To save the existence of epiphyte orchids, it is necessary to keep them from the threat of extinction. Some efforts that could be done is by conducted periodically exploration and conservation activities. Objective of this study was to gather information on the biodiversity of epiphyte orchids at Highway Forest Park Raden Soeryo East Java and supported by exploration data in 2006. Exploration of epiphyte orchid at Jogging Track and Coban Watu Ondo, Highway Forest Park Raden, Soeryo, East Java was conducted in May-June 2019. The research method was descriptive-exploration with random sampling method. Exploration results at South Mt Arjuno Lalijiwo in 2006 recorded epiphyte orchids 14 genus, 33 species, 343 populations; highest IVI Dendrobium nudum 32.01; lowest IVI Liparis caespitosa, Schoenorchis juncifolia and Thrixspermum aff subulantuntum 1.05. At East Mt Anjasmoro found 18 genus, 34 species, 1175 populations; highest IVI Trichostosia annulata 48.21; lowest IVI Ceratostylis andjasmoroensis 0.73. In 2019 at Jogging Track site found epiphyte orchids 14 genus, 53 species, 5545 populations. Highest IVI Appendicula elegans 35.55; lowest IVI Agrostophyllum sp, Bulbophyllum sp and Dendrobium tenellum 0.24 with Shannon-Wiener Index 2.73. At Coban Watu Ondo 14 genus, 37 species, 2352 populations. Highest IVI Eria vericulosa 20.33; lowest IVI Oberonia similis, Bulbophyllum sp, Pholidota carnea, and Appendicula sp 0.40. with Shannon-Wiener Index 2.86. It concluded that biodiversity of epiphyte orchids at Highway Forest Park R. Soeryo is moderately diverse. Its conservation also maintained well. Some epiphyte orchids have bioeconomy potential as raw material for perfume.

Keywords : biodiversity, conservation, bioeconomy, epiphyte orchids.

1. INTRODUCTION

In Java Island many forest areas has been converted into housing and plantation. Forest exploitation as logging, mining, fire, these activities could threatened the existence of epiphyte orchids germplasms. Degradation of host trees would a have negative impact on epiphyte orchids populations. Besides illegal picking of epiphyte orchids in the natural
habitat also plays role in reducing even to the state of extintion (Siregar, 2008; Sadli, 2017; Irwanda, 2018; Setiaji, 2018). Climate change also could have negative impact on orchids populations survival (Liu, et.al., 2010).

Highway Forest Park Raden Soeryo in East Java Indonesia is a nature conservation region which function as life support protection systems, preservation for flora and fauna diversity and utilization of natural resources and ecosystem. Jogging Track Cangar and Coban Watu Ondo are parts of Highway Forest Park Raden Soeryo. Previous exploration in Jogging Track Cangar has recorded 13 genus and 25 species epiphyte orchids (Abdi, et.al., 2013). In Coban Watu Ondo has recorded 18 genera and 36 species (Nusantara, et.al., 2015).

To prevent the extinction of epiphytic orchids in their natural habitat, it is necessary to do a periodically exploration accompanied by an inventory of data. According to Nasution, Patanab and Yunasfi (2014), exploration activities, especially epiphytic orchids, are very important currently because many natural orchid habitats are indangered. Exploration and research are important to do in efforts to safe the plant diversity (Puspitaningtyas, 2007). Besides orchids have prosect as germplasms, medicine and cosmetic like perfume (Lestari and Wiji, 2011).

The objective of this study was to gather information on the biodiversity of epiphyte orchids at Highway Forest Park Raden Soeryo East Java and supported by exploration data in 2006. As well as looking for its bioeconomy prospect.

2. METHODOLOGY

Exploration was carried out using a purposive sampling method at Jogging Track site and line transect at Coban Watu Ondo. From the main transect 30 plots were made in the area of each plot 20 m x 20 m with a distance between plots of 60 m at Jogging Track site and 100 m at Coban Watu Ondo, the coordinates of each plot was recorded using GPS. The first step was pre survey to determine the coordinate of the track. Based on the information from Highway Forest Park R Soeryo forest ranger on the accesbility of the tracks and the presence of epiphyte orchid host trees.

Identification of epiphyte orchids was carried out by using Orchids of Java (Comber, 1990). Vegetation analyses were: density, relative density, frecuency, relative frecuency, important value index and Shannon-Wiener diversity index:

\[
\frac{D_{Ni}}{A}Di =
\]

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

\[
Rdi = \frac{Di}{D} \times 100\%
\]

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

\[
Fi = \frac{Ji}{K}
\]

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

\[
Rfi = \frac{Fi}{\Sigma F} \times 100\%
\]
RFi = Relative frequency of species i.
Fi = Frequency species i.
ΣF = Total of i species frequency.

Important Value Index (Brower, Jarrold and von Ende, 1990):

\[ IVI = RDi + Rfi \]  \hspace{1cm} (5)

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

\[ H = - \sum \{ n_i / N \} \ln \{ n_i / N \} \]  \hspace{1cm} (6)

\( P_i = \sum n_i / N \)
\( H = \) Shannon-Wiener Diversity Index
\( N_i = \) Important Value Index
\( N = \) Total of Individu

Figure. 1. Map Observation Location

3. RESULTS
Exploration was conducted in May-June 2019 at the end of wet season and the beginning of dry season in Indonesia. At Jogging Track site 1641-1785 m asl; coordinate -7° 7’ 42.70” latitude 112° 5’ 34.95 longitude to -7° 7’ 45.29” latitude 112° 5’ 35.45” longitude (Fig.1) ; temperature 17°C-24°C ; RH 79-93%. At Coban Watu Ondo 1500-1648 m asl; coordinate -7° 72’ 996” latitude 112° 52’ 276” longitude to -7° 73’969” latitude 112° 52’ 282” longitude; temperature 19.5°C-23.3°C; level of humidity RH 80-99%.

The exploration recorded in 2019 at Jogging Track site epiphyte orchids 14 genus, 53 species, 5545 populations. Highest IVI Appendixula elegans 35.55; lowest IVI Agrostophyllum sp, Bulbophyllum sp and Dendrobium tenellum 0.24 (Fig 2.; Fig 3.) with Shannon-Wiener Diversity Index 2.73. The most abundant epiphyte orchids species found on a tree host are on zone 3 and zone 4 (Fig 4.). The most preferred host trees are Engelhardia spicata and Quercus sundaica with each 32 epiphyte orchids species on them. The least preferred host tree is Syzygium racemosum with only 1 epiphyte orchid species on it (Appendix 1.). Table 1. Showed that the number of epiphyte population orchids is least on track 1 situated at elevation 1766-1785 meter above sea level.

![IVI Of Epiphyte Orchids in 2019](image-url)

Figure 2. The important value index (ivi) of epiphyte orchids found at Jogging Track site
| Species                  | IVI   | Population | Picture |
|--------------------------|-------|------------|---------|
| *Appendicula elegans* Rchb. f. | 34,63% | 1565       |         |
| *Agrostophyllum* sp 1     | 0,232% | 1          |         |

Figure 3. *Appendicula elegans* Rchb. f. and *Agrostophyllum* sp. 1 at Jogging Track site.

Figure 4. Zonation of epiphyte orchids on host trees at Jogging Track site.

Tabel 1. Number of Species and Population on Track at Jogging Track site
### Track Altitude (m asl) Light Intensity (Lux) Temperature (°C) RH (%) Species Populations

| Track | Altitude (m asl) | Light Intensity (Lux) | Temperature (°C) | RH (%) | Species | Populations |
|-------|------------------|-----------------------|------------------|--------|---------|-------------|
| 1     | 1766-1785        | 1950 – 3410           | 19.1 – 21.5      | 81 – 93| 30      | 645         |
| 2     | 1737-1765        | 1960 – 8120           | 18.7 – 22.2      | 79 – 95| 38      | 1042        |
| 3     | 1713-1735        | 1630 – 7240           | 18.4 – 22.0      | 80 – 92| 38      | 1448        |
| 4     | 1686-1711        | 1720 – 2540           | 17.6 – 21.1      | 82 – 89| 33      | 1150        |
| 5     | 1641-1681        | 1840 – 6220           | 16.9 – 24.0      | 84 – 89| 33      | 1260        |

| All Tracks | Altitude (m asl) | Light Intensity (Lux) | Temperature (°C) | RH (%) | Species | Populations |
|------------|------------------|-----------------------|------------------|--------|---------|-------------|
| All Tracks | 1641-1785        | 1630 - 8120           | 16.9 – 24.0      | 79 - 95| 53      | 5545        |

At Coban Watu Ondo it was recorded 14 genus, 37 species, 2352 populations. Highest IVI was *Eria vericulosa* 20.33; lowest IVI were *Oberonia similis, Bulbophyllum sp, Pholidota carnea*, and *Appendicula sp* 0.40.(Fig 5; Fig 6.) with Shannon-Wiener Diversity Index 2.86. The most abundant epiphyte orchids species found on a tree host are on zone 3 and zone 4 (Fig 7.). The most preferred host trees are *Engelhardia spicata* with 34 epiphyte orchids species and *Quercus sudaica* with 27 epiphyte orchids species on them. The least preferred host tree is *Casuarina junghuniana* with 2 epiphyte orchid species on it (Appendix 2.). Table 2. showed that the number of epiphyte population orchids is least on track 1 situated at elevation 1598 – 1648 meter above sea level.

![IVI Of Epiphyte Orchids in 2019](image)

Figure 5. The important value index (ivi) of epiphyte orchids found at Coban Watu Ondo site.
| Species                  | IVI | Total Population |
|--------------------------|-----|------------------|
| *Appendicula elegans* Rchb.f. | 17.2% | 288              |

1. *Bulbophyllum* sp. 1
   
2. *Oberonia similis* (Bl.) Lindl.
   
3. *Pholidota* sp.

Figure 6. *Appendicula elegans* Rchb.f., *Bulbophyllum* sp. 1, *Oberonia similis* (Bl.) Lindl. and *Pholidota* sp. 1 at Coban Watu Ondo site.
Figure 7. Zonation of epiphyte orchids on host trees at Coban Watu Ondo site

Table 2. Number of Species and Population On Tracks at Coban Watu Ondo site

| Track | Altitude (Asl) | Light Intensity (Lux) | Temperature (°C) | RH (%) | ∑ Species | ∑ Populations |
|-------|----------------|-----------------------|------------------|--------|-----------|--------------|
| 1     | 1548 – 1648    | 2150 – 4560           | 21.1 – 21.3      | 81 – 92| 21        | 343          |
| 4     | 1540 – 1598    | 1000 – 3250           | 20.2 – 21.2      | 89 – 98| 27        | 862          |
| 3     | 1540 – 1580    | 2550 – 3530           | 19.5 – 21.0      | 90 – 98| 23        | 477          |
| 5     | 1532 – 1561    | 2750 – 3520           | 19.9 – 21.0      | 92 – 97| 27        | 412          |
| 2     | 1501 – 1530    | 3370 – 3550           | 19.5 – 23.3      | 80 – 98| 22        | 510          |
| All   | 1501 - 1648    | 1000 – 4560           | 19.5 – 23.3      | 80 – 98| 36        | 2.604        |

Table 3. Orchids Species and its uses

| No. | Species             | Parts of plant | Uses                   | Reference                        |
|-----|---------------------|----------------|------------------------|----------------------------------|
| 1   | *Bulbophyllum odoratum* | Flower        | Perfume               | Soetopo *et.al.*, (2019)         |
| 2   | *Bulbophyllum sp.*  | Whole plant   | Cough, wound and lungs| Shengji and Zhiwei (2018)        |
| 3   | *Dendrobium salaccense* | Leaf         | Stomach pain          | Silalahi dan Nisyawati (2015)    |
| 4   | *Pholidota imbricata* | Pseudobulb    | Stomach pain and rheumatism | Bone fracture | Hosain, 2011 |
4. DISCUSSION

Exploration was conducted in May-June 2019 at the end of wet season and beginning of dry season. At Jogging Track site epiphyte orchids 14 genus, 53 species, 5545 populations. Highest IVI Appendicula elegans 35.55; lowest IVI Agrostophyllum sp, Bulbophyllum sp and Dendrobium tenellum 0.24 (Fig 2.; Fig 3.). 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. The Shannon-Wiener Diversity Index 2.73 is categorize medium. The most abundant epiphyte orchids species found on a tree host are on zone 3 and zone 4 (Fig 4.). The most preferred host trees are Engelhardia spicata and Quercus sundaica with each 32 epiphyte orchids species on them. The least preferred host tree is Syzygium racemosum with only 1 epiphyte orchid species on it (Appendix 1.).

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 (Priandana, 2007). The number of epiphyte orchid population is least on track 1 situated at elevation 1766-1785 meter above sea level (Table 1). At Coban Watu Ondo it was recorded 14 genus, 37 species, 2352 populations. Highest IVI was Eria vericusula 20.33; lowest IVI were Oberonia similis, Bulbophyllum sp, Pholidota carnea, and Appendicula sp 0.40.(Fig 5; Fig 6.) with Shannon-Wiener Diversity Index 2.86. The most abundant epiphyte orchids species found on a tree host are on zone 3 and zone 4 (Fig 7.). The most preferred host trees are Engelhardia spicata with 34 epiphyte orchids species and Quercus sundaica with 27 epiphyte orchids species on them. The least preferred host tree is Casuarina junghuniana with 2 epiphyte orchid species on it (Appendix 2.). Table 2. showed that the number of epiphyte population orchids is least on track 1 situated at elevation 1598–1648 meter above sea level. It could be explained by the ecological situation in that elevation, the situation are similar at both sites. On track 1 at both sites the host trees are small and infrequently. Less suitable host, too much light and strong wind could be the reasons. The peak of orchids species richness at Jogging track site appeared at elevation of 1713-1735 meter asl and at Coban Watu Ondo at elevation 1580-1598 meter asl. Acharya et.al (2011) observed in Bhutan and Nepal maximum orchid species richness at 1600 meter asl

Exploration results at South Mt Arjuno Lalijiwo in 2006 recorded epiphyte orchids 14 genus, 33 species, 343 populations; highest IVI Dendrobium nudum 32.01; lowest IVI Liparis caespitosa, Schoenorchis juncifolia and Thrisspermum aff subulantum 1.05. The index diversity was 2.95 (Rama, 2006). At East Mt Anjasmoro found 18 genus, 34 species, 1175 populations; highest IVI Trichostosia annulata 48.21; lowest IVI Ceratostylis andramoronsensis 0.73 with idex diversity was 2.50 (Priandana, 2007). Previous exploration in Jogging Track Cangar has recorded 13 genus and 25 species epiphyte orchids (Abdi et.al, 2013). In Coban Watu Ondo has recorded 18 genera and 36 species (Nusantara et.al., 2015).

In 2019 the results of exploration on epiphyte orchids are more abundant compared to 2006, 2013 and 2015. It showed that the conservation policy in the Highway Forest Park Raden Soeryo from 2006 to 2019 is well managed. This finding supported by the results at Senduro Bromo Tengger Semeru National Parks that management of conservation East Java National Park is good (Soetopo and Febriandito, 2019). In some area in Indonesia like South Papua, some orchids species with high value are high sought by dealers and collectors (Agustini, et.al.,2013). Such activities have placed these species in an endangered situation.

In Lamedai Nature Reserve, Kolaka, Southeast Sulawesi Indonesia, the host preference for epiphytic orchids is in the group of Myrtaceae family (Lestari and Wiji, 2011). (Zhao, et.al. (2015) reported that epiphyte diversity was strongly correlated with host size. The species composition of orchid communities is strongly associated with various host characteristics, species and family (Timsina, et.al., 2016).

In Northwestern Himalaya, Dactylorhiza hatagirea and Malaxis muscifera are used as medicine and food (Sharma and Samant, 2017). From this research Bulbophyllum odoratum might has bioeconomic value. We need to explore further more for its prospect as perfume material.
Dendrochilum salaccanense for stomach pain, Dendrochilum aurantiacum for diabetic, Pholidota imbricata for stomach pain, bone fracture and rheumatism (Table 3).

5. CONCLUSION

It concluded that biodiversity of epyphyte orchids at Highway Forest Park Raden. Soeryo is moderately diverse. Its conservations well maintained. Some epyphyte orchids have bioeconomy potential as raw material for perfume, stomach pain, cough, wound, bone fracture and rheumatism.

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