

Epiphytic Orchid Diversity in UB Forest and Opportunities for Orchid Tourism Trails Development

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Abstract

The aims of the research were to identify epiphytic orchid diversity and host tree species for the development of orchid tourism trails as a potential tourist attraction in UB Forest. A Floristic survey and questionnaires were conducted in this study. Nine epiphytic orchids were found in UB Forest, namely *Liparis viridiflora*, *Eria hyacinthoides*, *Aerides* sp., *Coelogyne* sp., *Dendrobium lineairifolium*, *Agrostophyllum* sp., *Sarcanthus* sp., *Flickingeria* sp. and *Eria monostachya*. These epiphytic orchids used Dadap (*Erythrina* sp.), Jalina (*Ficus* sp.), Kukrup (*Engelhardtia spicata*) and Cempaka wangi (*Michelia champaca*) as host species, from Gate 1 to Gunung Mujur Point in UB Forest. Analysis showed that improvement including preserving and improving the population of host tree species, establishing interpretation media for educational purposes, and improving the attractiveness of tourist attractions and facilities, could provide an opportunity to develop an eco-tourism route.

Keywords: Ecotourism, Environmental education, Orchids

INTRODUCTION

Epiphytic orchids, Orchidaceae, form one of the biggest groups of plants which are abundant in tropical countries. In tropical forests, epiphytic orchids can grow on the surface of the main stem and the branches of plants. Many tree species with a canopy provide an ideal habitat for epiphytic orchids. A hot spot of epiphytic orchids is found in cloud forest, in which epiphytic orchids are in abundance in the tree canopy. Epiphytic orchids contribute significantly to ecological processes, especially in the function of the tree canopy. Disturbance of tropical forests, therefore, influences the existence of epiphytic orchids [1;2;3].

Indonesian forests are home to numerous epiphytic orchid species. The diversity and abundance of orchids are especially relevant to tropical climatic conditions. The presence of high humidity level has obviously contributed to the high degree of diversity of orchids. The rich range of tree species and a huge canopy often provide ideal conditions for orchid growth. Orchids, especially epiphytic orchids, grow mostly on the stem and branches of trees [4].

Naturally and culturally, orchids are interesting objects and attract many visitors to a particular place to observe them. In an area with an abundance of orchids, identifying and

mapping the orchid habitat is a crucial step in developing an ecotourism attraction [5;6]. This is particularly important in UB Forest, an educational forest in Malang, East Java. In such a case, however, determining the potential for orchids is important. Trees are critical for epiphytic orchids in a wild habitat. The aims of the research are to identify the species diversity of epiphytic orchids and their host tree species and to describe the perspectives of tourists on orchids as a nature-based tourism attraction in UB Forest.

MATERIAL AND METHOD

Study Area

Fieldwork was done at UB Forest in Karangploso District, Malang Regency, in East Java Province (Figure1). In total, UB Forest covers an area of about 554 hectares; the dominant forest type is production forest. From the perspective of utilization and management, UB Forest is declared as Forest with Specific Purposes. UB forest plays an important role in biodiversity conservation and supporting local community wellbeing. It is also used as a facility for education.

Floristic survey

The survey was done along Corridor I of UB Forest, lengthwise from Gate 1 to Gunung Mujur Point. This corridor was selected for field observation because it is a potential tourist route for accessing many tourist attractions in UB Forest. The field survey was done from October

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2016 to March 2017 along 1.5 km of forest corridor.

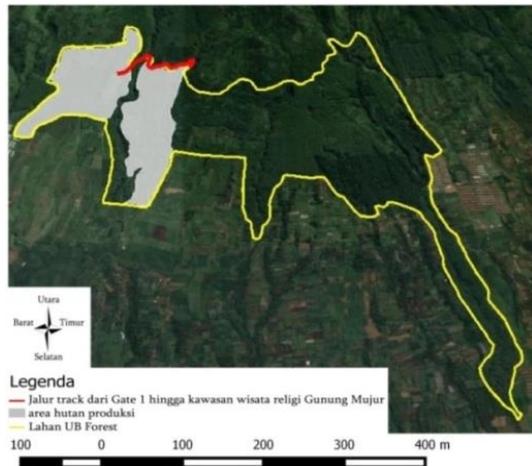


Figure 1. The position of UB Forest and the observation tract along Gate 1 to Gunung Mujur (in red line) (Google earth, 2016)

Plant tree species which were identified as hosts and habitats of epiphytic orchids were mapped and described. For each tree species, a survey of the epiphytic orchid species and the individual or population distribution of host tree species was made. Epiphytic orchids were identified by observing and identifying plant morphology using binoculars. An expert in orchid identification in the field from Purwodadi Botanical Garden was employed for species identification. Distribution of epiphytic orchids was classified according to zonation of epiphytic orchid distribution in host trees. There are five zones of epiphytic orchid distribution, namely Zone 1 on the basal stem of the tree, Zone 2 on the main stem of the tree, Zone 3 in a first-level branch or inner crown area, Zone 4 on a second-level branch or middle crown area, and Zone 5 on fork sites or outer crown area (Figure2).

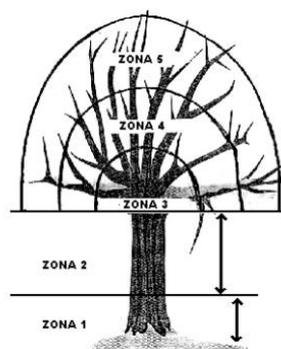


Figure 2. Zonation of epiphytes orchids distribution in host tree (Johanson, 1975)

Trees which have become a habitat for epiphytic orchids were mapped using GPS. The coordinates of trees and the elevation of sites were recorded by GPS. Data were stored in the GPS equipment, and transferred to a computer for further analysis.

Questionnaire

In order to get a vivid picture of tourist perception of epiphytic orchids as a tourist attraction along the corridor from Gate 1 to Gunung Mujur Point, a questionnaire was distributed to 70 people. The criteria for participants were: males and females in the age range 17–40, who had visited UB Forest at least once within the past few years.

Data Analysis

Epiphytic orchid species diversity was analyzed descriptively following individual morphological characters and was compared with the standard orchid identification for Java Island [2]. Host tree species were analyzed descriptively according to plant morphological characters. Questionnaire data were analyzed using the formula:

$$A_i = \frac{(a \times 5) + (b \times 4) + (c \times 3) + (d \times 2) + (e \times 1)}{a + b + c + d + e}$$

- A_i = perception score for question i
- a = number of respondents with the answer a
- b = number of respondents with answer b
- c = number of respondents with answer c
- d = number of respondents with answer d
- e = number of respondents with answer e

The result of the calculation was used to classify tourist perspectives into the following categories: $1 < x < 1.8$ (Strongly disagree), $1.81 < x < 2.6$ (Disagree), $2.6 < x < 3.4$ (Neutral), $3.41 < x < 4.2$ (Agree), $4.21 < x < 5$ (Strongly agree), or similar Likert-scale responses [7;8].

RESULT AND DISCUSSION

Epiphytic Orchid Species Diversity

Nine epiphytic orchid species were found along 1.5 km of UB Forest corridor from Gate 1 to Gunung Mujur Point.

Liparisviridiflora (Bl.) Lindl

Liparis viridiflora grows in clumps on the surface of the host tree. It is characterized by a greenish white pseudobulb stem. Leaves green, opposite and oblong, with the leaf tip retuse. The

distance between pseudobulb stem and leaf 4–5 cm. Flowers were found in some individuals with a pale yellow color, with the flower position floslateralis. This species was found in Zones 1,3,4 and 5. No population was found in Zone 2. This species is found on Java Island at an altitude of 300–1700 m asl., and in abundance at 450–1000 m asl [2].

Eria hyacinthoides (Bl.) Lindl

Pseudobulbs very close together to build dense clump; brown to dark brown, 3–4 cm long. Leaves green, alternate, oblong, with the leaf tip obliquebifidate. No flowers found during observation. Quite common in UB Forest. The species was found in Zones 3,4 and 5. Globally, this species grows in India, Peninsular Malaysia, Sumatera, Bali, Kalimantan and New Guinea [2].

Coelogyne sp.

Sympodial, inflorescences at the terminal. Pseudobulb conspicuous, ovoid, with size \pm 2–3 cm, dark yellow to green. Leaves linear, dark green, oblanceolate, apex shape obtuse with blade margin entire. *Coelogyne* sp. was found in Zones 3 and 4. Flowers absent, leading to limited data to describe the proper name of species. Naturally, the distribution of *Coelogyne* includes a wide area including Thailand, Peninsular Malaysia, Java, Kalimantan, Philippines, Sulawesi and Maluku. It is commonly found at an altitude of 1500 m asl [2]

Dendrobium linearifolium Teijsm. & Binn

Dendrobium linearifolium grows in clumps on the host tree, especially in Zones 2,3,4 and 5. Roots appear at the base of the pseudobulb to absorb nutrients on the surface of the stem. Pseudobulb oval, green to dark brown, fusiform, 4–5 cm. Stem-like a needle, long, up to 15–20 cm. Leaves dark, linear. Flower sepals white, and grow at the tip of the stem.

Dendrobium linearifolium is distributed in South East Asia, Myanmar, Thailand, and Indonesia. It is often found in areas with long dry periods. It is commonly found in lowland areas < 500 m asl [2].

Eria monostachya Lindl

Grows in clumps. Stem dark brown, 5–10 cm long. Leaves green, alternate, oblong, long, leaf tip apex shape obtuse with blade margin entire. Rachis emerges and extends up to 20–30 cm, and bears many flowers. *Eria monostachya* was found in Zone 4. That this species is fairly

common in Java. It is often found in mountainous areas [2].

Agrostophyllum sp.

Stem cylindrical, 10–15 cm long, dark green. Grows creeping with branched rhizomes. Leaves in opposite position along the stem, green to dark green, ovate, with blade margin entire. Flower small, white-yellowish, appears at the tip of the stem. Orchid clumps were found in Zones 3 and 5. The distribution of *Agrostophyllum* sp. in Papua New Guinea, Peninsular Malaysia, Sumatera, Java, Borneo, and the Philippines [2].

Sarcanthus sp.

Stem cylindrical, green pile, 15–20 cm long. Leaves green, alternate. Leaves have a needle-like appearance, long, 3–5 cm with blade margin entire. This genus was found in Zones 4 and 5. It has native distribution in Burma, New Guinea, and Australia. Only two species are found on Java Island [2].

Aerides sp.

Monopodial orchid with along stem. Leaves opposite, green, oblong, with blade margin entire and the tip of leaves emarginate. This orchid was found in Zones 3 and 4. Typically, this genus is common in lowland areas to 500 m asl. *Aerides* sp. is distributed in Sumatera, Java, Borneo, Sulawesi and Papua New Guinea.

Flickingeria sp.

Pseudobulb flat, size varies, yellowish green. Leaves green, 4–8 cm long and 2–4 cm wide, oval, oblanceolate.

The second-level branch or middle crown area (Zone 4) and the outer crown area (Zone 5) were the main habitats for epiphytic orchids. The most abundant epiphytic orchid species was *Liparis viridiflora*. It accounted for 40% of all epiphytic orchids found in these zones. *Eria hyacinthoides* was abundant in Zone 4. Ninety percent of all epiphytic orchids found in Zone 4 were *Eria hyacinthoides*. *Aerides* sp. was found in Zones 3 and 4, about 50% in each, and was absent in Zones 1,2, and 5. Ninety-five percent of *Coelogyne* sp. clumps observed grew in Zone 4, and only 5% grew in Zone 3; no *Coelogyne* sp. were found in Zones 1, 2 and 5. was found in Zone 4, and represented about 50% of all epiphytic orchid species counted. *Agrostophyllum* sp. was mostly found in Zone 5.

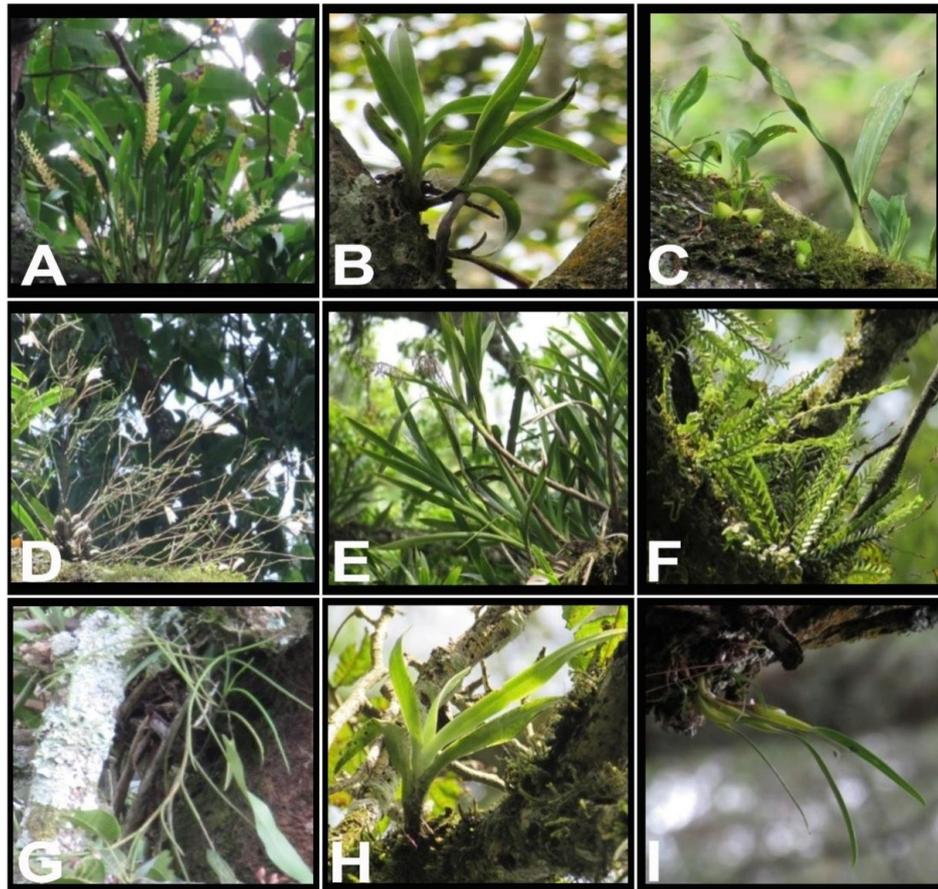


Figure 3. *Liparis viridiflora* (A), *Eria hyacinthoides* (B), *Coelogyne* sp. (C), *Dendrobium linearifolium* (D), *Eriamnostachya* (E), *Agrostophyllum* sp. (F), *Sarchanthus* sp. (G), *Aerides* sp. (H), *Flickingeria* sp. (I)

The distribution of epiphytes orchids in host tree species was given in Fig. 4.

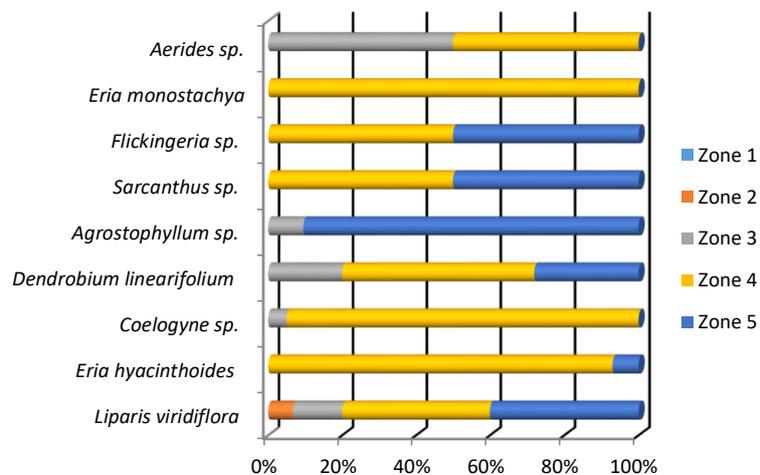


Figure 4. The total distribution of orchids following zones

About 90% of orchids in Zone 5 were *Agrostophyllum* sp. This taxon was also found in Zone 3 (10% of all counted species). *Sarchanthus*

sp. was found in Zones 4 and 5, 50% in each zone. This species not found in Zones 1, 2 and 3. *Flickingeria* sp. was found in Zones 4 and 5, about

50% in each zone. This taxon was absent in Zones 1,2 and 3. *Eria monostachyawa* was only found in Zone 4.

Zone 4 has been identified as the main habitat for epiphytic orchids. This zone provides a potential habitat for orchids, since there is an abundance of organic debris, and it often has relatively high humidity to support epiphytic growth. Zones 1, 2 and 3 have a limited number of epiphytic orchids. The perpendicular position of the zone seems to be a physical limitation factor for epiphytic growth [9;10].

Host Tree Species

Along the corridor from Gate 1 to Gunung Mujur Point, four species, namely Dadap (*Erythrina* sp., Fabaceae), Jalina or Beringin (*Ficus* sp., Moraceae), Kukrup (*Engelhardtiaspicata*, Juglandaceae) and Cempaka wangi (*Michelia champaca*, Magnoliaceae), were identified as habitats for epiphytic orchids. These plants were distributed at an altitude of 1224–1316 m asl. The species with the highest number of host trees were *Engelhardtia spicata* (42%), followed by *Michelia champaca* (33%), *Erythrina* sp. (17%) and *Ficus* sp. (8%).

Engelhardtia spicata is one of the crucial species components in a mountain forest plant community [11]. The geographic position of host trees and their habitus as host species are given in Table 1. A rough and cracked stem surface provides ideal sites for organic debris and water to collect, providing sustenance for epiphytic orchid growth.

The existence of few epiphytic orchid host tree species (Table 1) indicates past lowland forest disturbance in UB Forest. Recent dominant vegetation, *Pinus*, is unable to support epiphytic growth. These data indicate that efforts to introduce seedlings and new individuals and populations of native plant trees species are important to enhance epiphytic orchid conservation in UB Forest. This program will also potentially support the attractiveness of the forest road from Gate 1 to Gunung Mujur as an ecotourism route.

Tourist Perception of Orchids as A Tourist Attraction

Respondents were predominantly tourists in the range 20–22 years old (64.8%), followed by tourists 17–18 years old (16.3%), and those who were 22–23 years old (9.51%).

Table 1. Coordinates position of tree species as host of epiphytes orchids and stem morphological feature which are important to support epiphytes grows.

No.	Host Tree Species	Geographic Position		Plant Height (m)	Plant and Stem	
		Coordinate	Alt. (m asl)		Stem Circumference	Stem Surface/Bark Type
1.	<i>Michelia champaca</i>	S:7°49'28,3" E:112°34'45,3"	1224	35	340	Rough, cracked
2.	<i>Engelhardtia spicata</i>	S:7°49'29,6" E:112°34'48,1"	1239	33	300	Cracked
3.	<i>Michelia champaca</i>	S:7°49'25,9" E:112°34'43"	1256	22	220	Rough, cracked
4.	<i>Michelia champaca</i>	S:7°49'25,9" E:112°34'48"	1247	23	220	Rough, cracked
5.	<i>Michelia champaca</i>	S:7°49'24,8" E:112°34'49,3"	1241	36	500	Rough, cracked
6.	<i>Engelhardtia spicata</i>	S:7°49'22" E:112°34'51,1"	1288	32	280	Cracked
7.	<i>Engelhardtia spicata</i>	S:7°49'25,3" E:112°34'51,9"	1316	35	300	Cracked
8.	<i>Engelhardtia spicata</i>	S:7°49'25,3" E:112°34'51,9"	1237	33	250	Cracked
9.	<i>Engelhardtia spicata</i>	S:7°49'30" E:112°34'43,7"	1268	37	400	Cracked
10.	<i>Ficus</i> sp.	S:7°49'26,3" E:112°35'6"	1251	40	300	Scaly
11.	<i>Erythrina</i> sp.	S:7°49'27,7" E:112°35'6,6"	1262	30	150	Peeling to smooth, cracked
12.	<i>Erythrina</i> sp.	S:7°49'27,6" E:112°35'6,5"	1277	25	175	Peeling to smooth, cracked
13.	<i>Michelia champaca</i>	S:7°49'33,2" E:112°35'25,8"	1262	20	180	Rough, cracked

Only 2.8% of respondents were aged 24; 14% of respondents were 17 years old. About 5.19% did not mention their age; 39.2% of respondents were male and 60.8% were female. Respondents' perception of orchids as a tourist attraction and tourism-supporting system is given in Table 2.

Knowledge of Wild Orchids

Questionnaire data analysis indicates that respondent's have limited knowledge about wild orchids. Mostly, respondent's have too little knowledge to recognize the morphological characteristics of orchids, leading to poor ability to identify the proper name of orchids (Table 1). There is an opportunity for UB Forest management to improve the education facility, to facilitate tourists' active learning in the field.

Attractiveness of Orchids

Orchids are attractive to the respondents (Table 1). The morphological aspects of orchids and their population in a wild habitat are significant potential factors to attract visitors to UB Forest. The interest of respondents to explore orchids in the wild is principally similar to that reported for other areas [12;5]. In order to increase the attractiveness of orchids in a wild habitat, some aspects should be improved.

Facilities

Respondents think that the facilities should be improved. The accessibility of UB Forest and its safety should become crucial aspects in the improvement of the tourist facilities. Improvement of the tourist facilities is required to enhance tourist satisfaction, and in the context of ecotourism to increase the success of educational programs through field trips. It is important for the management of UB Forest to provide interpretation material along the tourist route. Interestingly, respondents argue that local community participation is important. This is important in ecotourism programs [5].

The recent status of orchids and their host tree species opens opportunities for further orchid tourism trails development for ecotourism programs. Orchid tourism trails are corridors in which the education process can be facilitated by showing and explaining the epiphytic orchid diversity, both in their individual and ecosystem aspects.

In such a case, the introduction of new native forest tree species to act as future host species for epiphytic orchids is crucial. The number of new individuals of *Erythrina* sp., *Ficus* sp., *Engelhardtia spicata* and *Michelia champaca* could be increased.

Table 2. Knowledge, attractiveness and tourist perception of tourist facilities in UB Forest

No.	Variables	X	Category
A. Knowledge			
1.	Information regarding epiphytic orchids	2.89	Fair
2.	Ability to recognize orchids' morphological characteristics	2.81	Fair
3.	Ability to recognize and identify orchids from other epiphytes	2.78	Fair
4.	Know epiphytic orchids' habitat	2.81	Fair
5.	Know the benefits of epiphytic orchids	2.66	Fair
6.	Frequency of observing orchids in UB Forest	1.94	Very Rare
B. Attractiveness			
1.	Have the interest to observe epiphytic orchids	4.10	Agree
2.	Orchids are beautiful flowers	4.01	Agree
3.	Orchids have potential value as a tourist attraction	4.14	Agree
4.	The interesting part of orchids is individual structure, including stem, leaf, and flower	4.06	Agree
C. Tourist Facilities			
1.	Conformability of transportation to UB Forest area	3.13	Moderately satisfied
2.	Quality of corridors/forest road in UB Forest	2.91	Moderately satisfied
3.	Accessibility of UB Forest as a recreation site	2.97	Satisfactory
4.	Attractiveness of tourist facilities	2.61	Good
5.	Improvement and establishment of new tourist attraction	3.60	Neither agree nor disagree
6.	Outdoor accommodation	3.81	Agree
7.	Homestay managed by local community	2.89	Neither agree nor disagree
8.	Festival and exhibition related to orchid diversity and conservation	4.06	Agree
9.	Improvement of UB Forest	4.24	Strongly agree
10.	Conformability of orchid observation point	3.32	Moderately satisfied
11.	Safety of orchid observation point	3.39	Somewhat concerned

Other potential species to introduce include *Lithocarpus sundaicus*, *Trema orientalis*, *Macropanax dispermus*, *Actinodaphne procera*, *Castanopsis javanica*, *Syzygium* sp. and *Litsea* sp. These species were found in a similar type of forest, Bromo Tengger Semeru Forest, as a habitat of epiphytic orchids [2;11;13].

Further exploration of the orchid species in the UB Forest area and the surrounding forest on Mt. Arjuno and Mt. Welirang is important to identify orchid species other than those reported in this study. These orchids should be introduced and integrated along the established ecotourism route from Gate 1 to Gunung Mujur.

CONCLUSION

Nine species of epiphytic orchids were found in UB Forest: *Liparis viridiflora*, *Eria hyacinthoides*, *Aerides* sp., *Coelogyne* sp., *Dendrobium linearifolium*, *Agrostophyllum* sp., *Sarcanthus* sp., *Flickingeria* sp. and *Eria monostachya*. Dadap (*Erythrina* sp.), Jalina (*Ficus* sp.), Kukrup (*Engelhardtia spicata*) and Cempaka wangi (*Michelia champaca*) are the hosts of the epiphytic orchid species. Orchids diversity and their host tree species open opportunities for further orchid tourism trail development for ecotourism programs. Improvements programs should be implemented, including preserving and improving the population of host tree species, establishing interpretation media for educational purposes, and improving the attractiveness of tourist attractions and facilities

ACKNOWLEDGEMENT

The authors thank to the Brawijaya University for facilitating this research.

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