J. Appl. Environ. Biol. Sci., 5(8)112-118, 2015
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ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Orchid (Orchidaceae) Diversity in Mount of Batukau, Bali - Indonesia

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Received: April 19, 2015
Accepted: July 2, 2015

ABSTRACT

Primary forest at Mount of Batukau (Mt. Batukau) had not highly impact for land degradation. The orchid species had not yet much known and exposed. This study aimed to know the richness and correct taxonomicidentification of orchid species in this mount. The exploration conducted on August - September 2014. Both side of mount ridge Wongaya Gede village and Jatiluwih village played asexploration areas. Atotal of 81orchids species from 32 genera recorded from this area. There were 67epiphytic and16terrestrial species. *Bulbophyllum* was the most dominant genus with 12 species and accounted for 14.82% of all the species encountered. The similarity index of orchid diversity in Wongaya Gede and Pura Petali counted as much 65.57%.

KEYWORDS—Bali, Batukau, Diversity, Orchid

INTRODUCTION

Orchidsbelong to the family Orchidaceae which well known as aesthetic flower. They had variant colours and fragrances. This family was one of the largest familiest among the flowering plant and had approximately 20,000 species throughout the world [1]. It had known as tropical forest in term of orchid diversity. In Java only 731 orchids had recorded [2]. Bali as one of the Lesser Sunda part had least concern of orchid diversity. Orchid diversity in Bali based on the herbarium collections were reported 35 species [3]. Epiphyte orchid diversity in Buyan-Tamblingan lakes recorded 30 species [4]. While 173 species of Bali orchid collected in 'Eka Karya' Bali Botanical Garden [5]. Only few report and lack of taxonomic description on orchid diversity gave an important reason to explore others area in In Bali. So that Mount Batukau in Bali needed to be observed.

Itwas lie between 8°20'-8°21'S latitude and 115°5'-115°6'E longitude in Tabanan, Bali. It had known as the second highest mount in Bali and played as the highest peak in the Bedugul volcanic area. This mount had important value for local people due to a temple (*Pura Pucak Luhur*) located there. It had elevation ranging from 800 - 2,276 above sea levels (a.s.l.). Around3,270ha total area in Penebel distrcthad covered by dense primary forest with restricted view. The forest had not highly impact for land degradation. The forest vegetation comprisedof large and mossy trees, humid, and the topsoil covered with thick humus as an ideal habitat for epiphyte and terrestrial orchid. This research was deal to the orchid diversity with their latest botanical name,
habitat, place of occurance, altitudinal ranges, and colour photograhs of selected species.

METHODS

A. Study Area

The study site comprised of the Mt. Batukau on both ridges. The west part of the ridge belongs to Wongaya Gede village(Wo) and the east part belongs to Jatiluwih village (Ja). Both villages were under Penebel district (Figure 1). Elevation ranged between 800 and 2,276 asl. The vegetation at the footmount forest was dominance with *Ficus* and *Platea*. The vegetation at the top was dominance with Pteridophyte.

B. Data Collection

The orchid diversity study conducted on August and September 2014. Exploration observed using climbing trackmethod, covering 100 – 200 mbeside the area (**Figure 1.**). Orchid samplings took at the area surrounding for germplasm collection. Orchids living specimens cultivated in the 'Eka Karya' Bali Botanical Garden orchid nursery.Some of the orchids flower which found were collected as spirit collection in ethanol 70%. The relevant data from the field then transferred to the labels of live and spirit collection. Photographs of orchid species had also taken. They were identified and described at 'Eka Karya' Bali Botanical Garden. All the species arranged systematically based on their altitude wide distribution in the area with botanical names, and habitat.

C. Data Analysis

Data collected to compute the species richness,Sorensen similarity index, and the orchid zonation to the host tree. The Sorensen similarity index analyzed in accordate to [6].Orchid zonation plotdescribed by [7].

1) Species richness denoted by the number of species during observation.
2) Orchid zonation plot denoted by

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Zone 1: Tree base (first 1/3 part of tree base)
Zone 2: Upper trunk (2/3 part of tree base)
Zone 3: Inner canopy (branching base)
Zone 4: Outer canopy (first branch of tree)
Zone 5: Outher branch

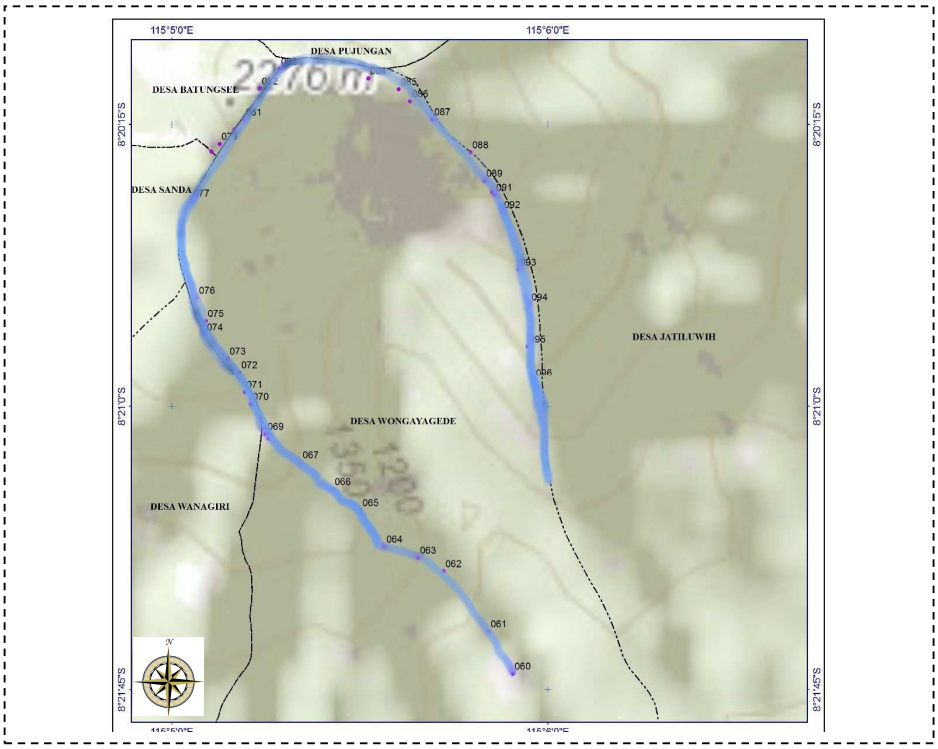

Figure. 1. The study site, blue line showing the exploration track on the ridge of Mt.

3) Sorensen similarity index (IS) denoted by

IS=2C/A+B x 100%

where IS was the Sorensen similarity index value, C was the number of orchid species were found at both Wongaya Gede and Jatiluwih track, A was the number of orchid species were found at Wo, and B was the number of orchid species were found at Ja. Sorensen similarity index value range from 0% - 100%. If IS < 25%, the orchid diversity between two ridges area were less similar. If 25% > IS < 50%, the orchid diversity hadfew similarity. If IS > 50, the orchid diversityhad high similarity.

RESULTS AND DISCUSSION

Our results had shown that epiphytic genera were significantly richer than terrestrial genera. A total of 81 orchid species from32 genera recorded from the Mt. Batukau (**Table 1**). There were 67 species with 23 epiphyticgenera, 16 species with 9 genera were terrestrial.*Bulbophyllum* was the most frequent and dominant epiphytic genus with 12 species, followed by *Dendrobium* with 8 species. Among the epiphytic orchid genera, *Bulbophyllum* was the second largest genus. *Bulbophyllum* had a pantropical distribution [8]. On terrestrial genera, *Goodyera* was the most dominant genus with 4 species as show at (**Figure 2**). This result supported by [9] that epiphytic habitat had larger niches, more resistant in dried condition, and easier reproduction than terrestrial habitat.

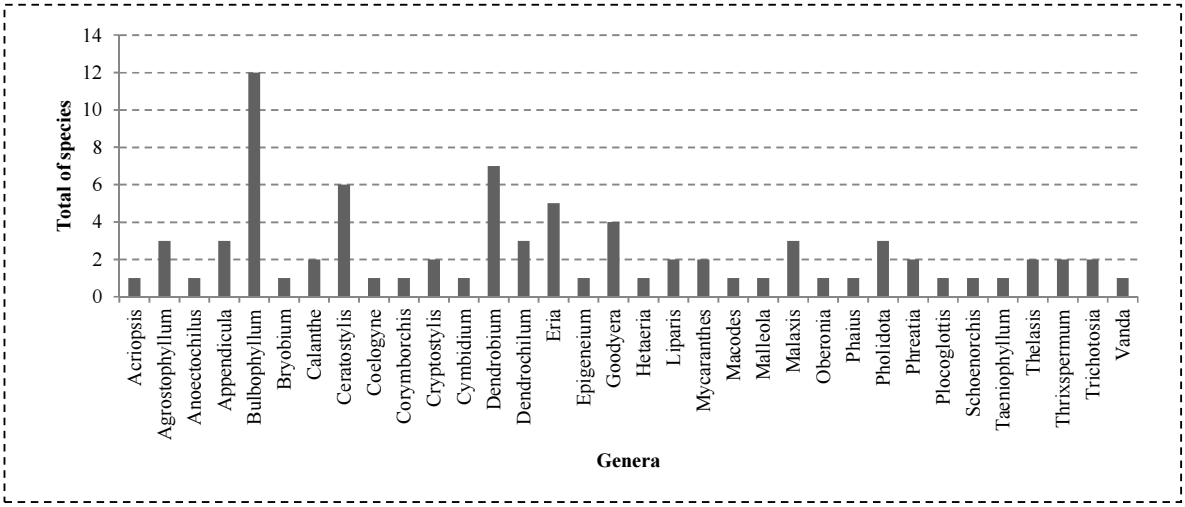

Figure. 2. Number of species in genera, *Bulbophyllum* has the highest species richness, followed by *Dendrobium*.

It informed that *Eria multiflora* had the highest frequency and wide distribution to be found at 790 – 2,173 a.s.l. *Ceratostylis* sp. (a) had the second place as the highest frequency, also had wide distribution at 848 – 2,222 a.s.l. For terrestrial habitat, *Plocoglottis acuminata*was the highest frequency and wide distribution at 790 – 1878 a.s.l. The terrestrial orchid restricted in distribution area more than the epiphytic orchid. Terrestrial orchid with restricted distribution elevation area likes *Anoectochilus reinwardtii* (**Figure 4.a.**) and *Cryptostylis arachnites* had function as bio indicator. Those two species were grow in shady situations with a lot of humus covered. Moreover *C. arachnites* mostly found at acid mountain ridges (Comber,1990). We also recorded *Thrixspermum obtusum* (**Figure 4.k.**) in the study site. *T. obtusum* was previously recorded to be found in Java only.

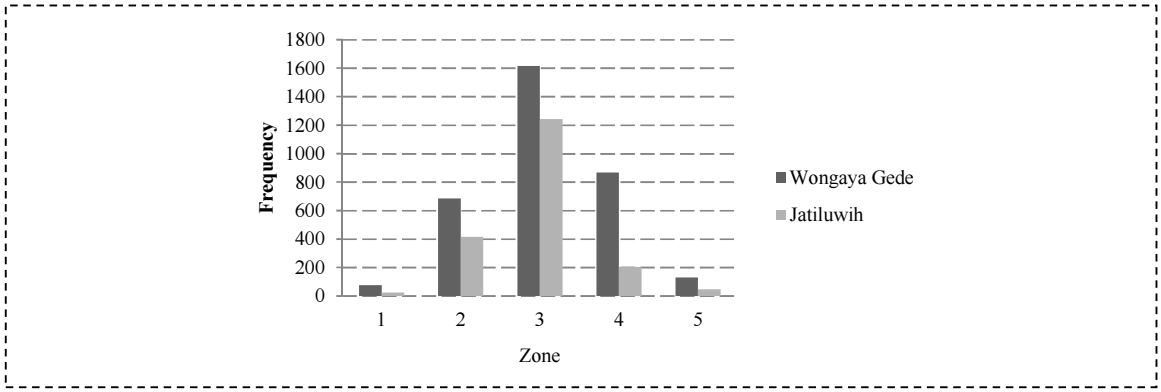

Figure. 3. Distribution of orchid species in five zones of epiphytic microhabitats in Mt. Batukau.

During observation, we were record the frequency and elevation each orchid species we found. Our results (**Table 1.**)

Table 1. List of orchids species of Mt. Batukau with habitat, frequency found, and altitudinal range

No.	Species	Habitat	Frequency	Altitude (asl)	Wo	Ja
1.	*Acriopsis liliifolia* (J.Koenig) Seidenf.	Epiphytic	1	1,000		√
2.	*Agrostophyllum majus* Hook.f.	Epiphytic	9	800-1,100	√	
3.	*A.stipulatum* subsp. *bicuspidatum* (J.J.Sm.) Schuit.	Epiphytic	1	820	√	√
4.	*A. tenue* J.J.Sm.	Epiphytic	2	1,000-1,100		√
5.	*Anoectochilus reinwardtii* Blume	Terrestrial	1	1,598		√
6.	*Appendicula cristata* Blume	Epiphytic	3	820-830	√	
7.	*App. elegans* Rchb.f.	Epiphytic	1	830	√	
8.	*App.imbricata* J.J.Sm.	Epiphytic	2	830	√	
9.	*Bulbophyllum absconditum* J.J.Sm.	Epiphytic	3	820-1,230	√	√
10.	*B. angustifolium* (Blume) Lindl.	Epiphytic	23	720-2,130	√	√
11.	*B. biflorum* Teijsm. & Binn.	Epiphytic	9	820-1,020	√	
12.	*B. comberi* J.J.Verm.	Epiphytic	5	800-930	√	
13.	*B.devium* J.B.Comber	Epiphytic	4	790-1,710	√	√
14.	*B. flavidiflorum* Carr.	Epiphytic	3	820-1,371	√	
15.	*B.gibbosum* (Blume) Lindl.	Epiphytic	22	760-1,998	√	√
16.	*B mutabile* (Blume) Lindl.	Epiphytic	5	1,073-1,772	√	
17.	*B. ovalifolium* (Blume) Lindl.	Epiphytic	10	830-1,998	√	√
18.	*Bulbophyllum* sp.	Epiphytic	2	1,600-1,772	√	
19.	*B. sulcatum* (Blume) Lindl.	Epiphytic	3	820-1,425	√	
20.	*B. triflorum* (Breda) Blume ex Miq.	Epiphytic	1	1,587	√	
21.	*Bryobiumhyacinthoides* (Blume) Y.P.Ng & P.J.Cribb	Epiphytic	17	760-1,420	√	√
22.	*Calanthececiliae* Rchb.f.	Terrestrial	1	1,371	√	
23.	*C. sylvatica* (Thouars) Lindl.	Terrestrial	11	790-1,955	√	√
24.	*Ceratostylisgraminea* Blume	Epiphytic	23	790-2,173	√	√
25.	*Ceratostylisbraccata* Rchb.f.	Epiphytic	16	790-1,600	√	√
26.	*Ceratostyliscrassifolia* J.J.Sm.	Epiphytic	17	848-2,222	√	√
27.	*Ceratostylis* sp. (a)	Epiphytic	48	848-2,222	√	√
28.	*Ceratostylis* sp. (b)	Epiphytic	2	1,797-1,841	√	√
29.	*Ceratostylis* sp. (c)	Epiphytic	4	848-1,998		√
30.	*Coelogyne miniata* (Blume) Lindl.	Epiphytic	20	1,679-2,072	√	√
31.	*Corymborchis veratrifolia* Blume	Terrestrial	6	920-1,180	√	√
32.	*Cryptostylis arachnites* (Blume) Hassk.	Terrestrial	8	1,598-1,665	√	√
33.	*Cryptostylis* sp.	Terrestrial	3	1,598-2,092		√
34.	*Cymbidiumbicolor* subsp. *pubescens* (Lindl.) Du Puy & P.J.Cribb	Epiphytic	1	1,100		√
35.	*Dendrobium acuminatissimum* (Blume) Lindl.	Epiphytic	1	1,000		√
36.	*D.aureilobum* J.J.Sm.	Epiphytic	2	820-830	√	
37.	*D.conspicuum* Bakh.f.	Epiphytic	12	790-1,711	√	√
38.	*D.linearifolium* Teijsm. & Binn.	Epiphytic	16	760-1,100	√	√
39.	*D. salaccense* (Blume) Lindl.	Epiphytic	9	760-1,020	√	√
40.	*D.subulatum* (Blume) Lindl.	Epiphytic	1	1,000		√
41.	*Dendrobium* sp.	Epiphytic	1	1,574	√	
42.	*Dendrochilumgracile* (Hook.f.) J.J.Sm.	Epiphytic	11	790-2,222	√	√

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CONTD

No.	Species	Habitat	Frequency	Altitude (asl)	Wo	Ja
43.	*Dendrochilum* sp.	Epiphytic	4	848-2,222	√	√
44.	*Dendrochilum* sp.	Epiphytic	2	1,587-1,380	√	√
45.	*Eria junghuhnii* J.J.Sm.	Epiphytic	13	848-2,173	√	√
46.	*E. lamonganensis* Rchb.f.	Epiphytic	5	760-1,180	√	√
47.	*E. multiflora* (Blume) Lindl.	Epiphytic	70	790-2,173	√	√
48.	*Eria* sp.	Epiphytic	2	800-820	√	
49.	*E. verruculosa* J.J.Sm.	Epiphytic	3	920-1,220	√	√
50.	*Epigeneium cymbidioides* (Blume) Summerh.	Epiphytic	1	2,130		√
51.	*Goodyeranovembrilis* (Rchb.f.) Ormerod	Terrestrial	2	920-1,000	√	√
52.	*Goodyerareticulata* (Blume) Blume	Terrestrial	7	848-1,863	√	√
53.	*Goodyera* sp.	Terrestrial	1	920	√	
54.	*Goodyeraviridiflora* (Blume) Blume	Epiphytic	1	1,863		√
55.	*Hetaeria cristata* Blume	Terrestrial	4	1,711-1,863	√	√
56.	*Liparis compressa* (Blume) Lindl.	Epiphytic	1	1,000-1,180		√
57.	*Liparis parviflora* (Blume) Lindl.	Epiphytic	2	800-802	√	
58.	*Mycarantheslatifolia* Blume	Epiphytic	3	760-1,220	√	√
59.	*Mycaranthesoblitterata* Blume	Epiphytic	11	790-1,425	√	√
60.	Macodes sp.	Terrestrial	2	1,679-1,772	√	
61.	*Malleolaligulata* (J.J.Sm.) J.J.Sm.	Epiphytic	4	820	√	
62.	*Malaxis* sp. (a)	Terrestrial	2	1,050-1,220		√
63.	*Malaxis* sp. (b)	Terrestrial	12	790-1,711	√	√
64.	*Malaxis* sp. (c)	Terrestrial	1	1,180		√
65.	*Oberonia* sp.	Epiphytic	1	1,511	√	
66.	*Phaiuspauciflorus* (Blume) Blume	Terrestrial	6	920-1,598	√	√
67.	*Pholidota carnea* (Blume) Lindl.	Epiphytic	20	790-2,222	√	√
68.	*P. globosa* (Blume) Lindl.	Epiphytic	32	848-2,173	√	√
69.	*P. imbricata* Lindl.	Epiphytic	2	820	√	
70.	*Phretia secunda* (Blume) Lindl.	Epiphytic	4	820-1,220	√	√
71.	*Phreatia* sp.	Epiphytic	1	2,072	√	
72.	*Plocoglottisacuminata* Blume	Terrestrial	6	790-1,878	√	√
73.	*Schoenorchis micrantha* Reinw. ex Blume	Epiphytic	1	1,679	√	
74.	*Taeniophyllumhirtum* Blume	Epiphytic	3	1,425-2,017	√	√
75.	*Thelasisobtusa* Blume	Epiphytic	4	820-1,890	√	√
76.	*Thelasis pygmaea (*Griff.) Lindl.	Epiphytic	1	1,000		√
77.	*Thrixspermumobtusum* (Blume) Rchb.f.	Epiphytic	4	790-1,511	√	√
78.	*Thrixspermum pensile* Schltr.	Epiphytic	9	1,031-1,425	√	√
79.	*Trichotosiapauciflora* Blume	Epiphytic	1	820	√	
80.	*Trichotosia ferox* Blume	Epiphytic	1	1,679	√	
81.	*Vanda tricolor* Lindl.	Epiphytic	2	760	√	

Table 2. Diversity comparison between Wongaya gede and Jatiluwih

	Species richness	Sorensen Similarity Index
		IS
Wongaya Gede	67	65.57%
Jatiluwih	55	

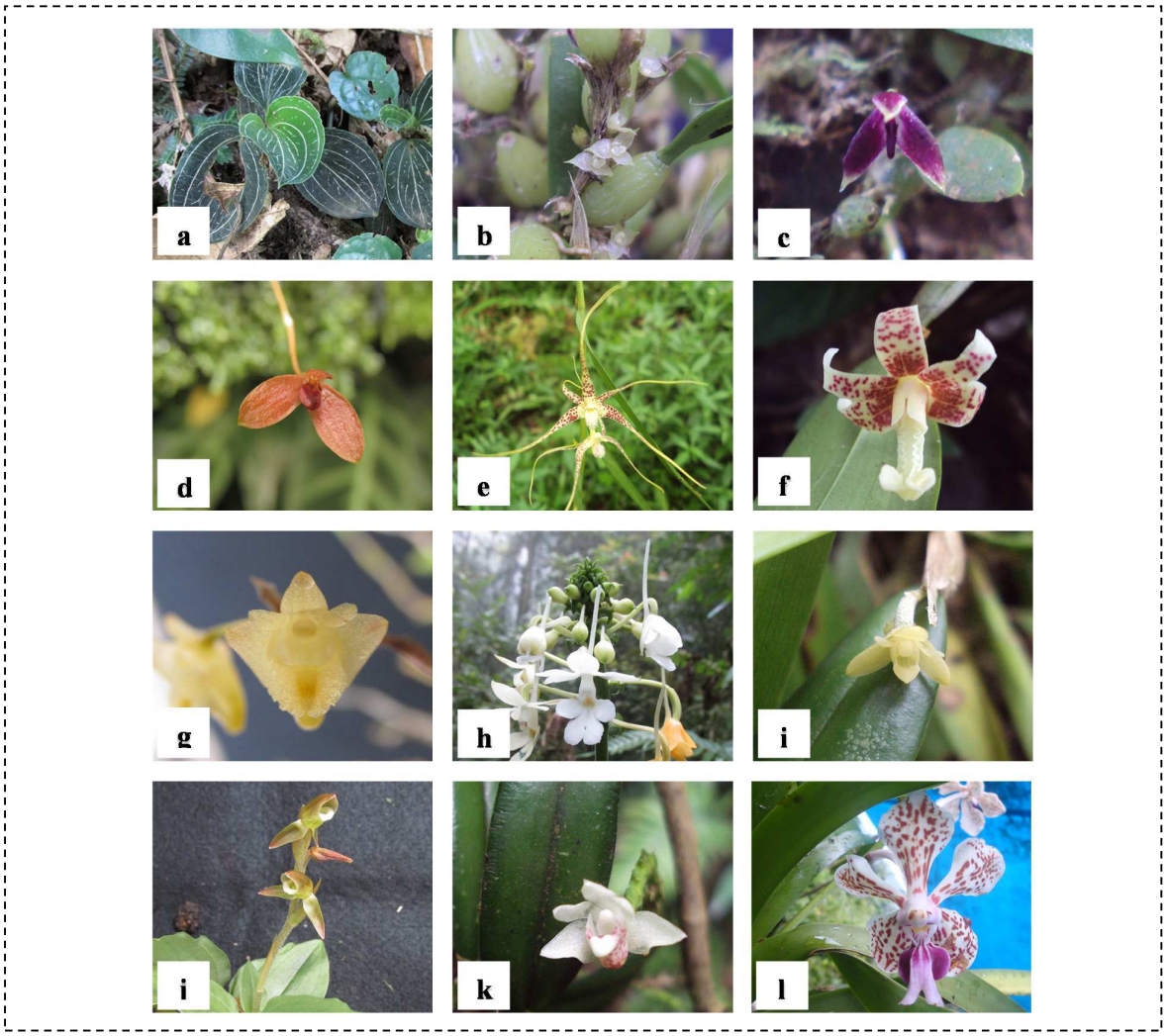

Figure. 4. Orchids in Mt. Batukau, a) *Anoectochylus reinwardtii*, b) *Bulbophyllum absconditum,* c) *Bulbophyllum comberi,* d) *Bulbophyllum ovalifolium,* e) *Dendrobium acuminatissimum,* f) *Dendrobium aureilobum,* g) *Dendrobium subulatum,* h) *Calanthe ceciliae,*i) *Ceratostylis graminea,* j) *Goodyera viridiflora,* k) *Thrixspermum obtusum,* l) *Vanda tricolor*.

From the study, Wo area had more diverse orchid species than Ja area. Orchid diversity on Wo and Ja denoted by Sorensen similarity index. The mean Sorensen similarity index in the study site was 65.57% (**Table 2.**). Sorensen similarity index was show the orchid diversity in Wo and Ja which had high similarity. It was indicate that vegetation and microclimate of two ridge area were the same. Forest vegetation and microclimate had important role for orchid niches. Epiphytic orchid niches was first proposed by [7] with 5 zonation. From our observation, most of epiphytic orchid were found in zone 3 (**Figure 3.**). Microhabitat from this zone had assemblage environment from the outer and inner canopy [10]. The branches in this zone mostly got shade from canopy and covered by moss, so epiphytic orchid could endure during dry season.

CONCLUSION

Mount Batukau forest area exhibited a high diversity of orchids with 81 species were recorded from the study. Orchid diversity in Wongaya Gede and Jatiluwih had a high similarity with IS 65.57%.*Bulbophyllum* was the dominant genus with high diverse of species. *Thrixspermum obtusum* (Blume) Rchb.f. recorded as new distribution, while *Anoectochilus reinwardtii* Blume and *Cryptostylis arachnites* (Blume) Hassk. had recorded as bioindicator. Mt. Batukau had primary forest that needed more attention to preserved.

ACKNOWLEDGEMENTS

Authors would like to thank to 'Eka Karya' Bali Botanical Garden – Indonesian Institute of Sciences for funding and permission in this research. We would like to express our gratitude to BKSDA Bali for allowing us into the study site. Also we would like to thank Rajif Iryadi for helping us provide the study site map.

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