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The Orchid Flora of Gunung Ledang (Mount Ophir), Malaysia - 120 Years after Ridley

Farah Alia Nordin[1], Ahmad Sofiman Othman[1]*, Nur Asyikin Zainudin[1], Nur 'Atiqah Khalil[2], Najidah Asi[1], Afifah Azmi[1], Khairul Nasirudin Abu Mangsor[1], Mohd Sukor Harun[1] and Khairul Faizee Mohd Zin[3]

[1]School of Biological Sciences, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia
[2]Medical Transfusion Unit, Hospital Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia
[3]Johor National Park Corporation, Level 1, Bangunan Dato' Mohamed Salleh Perang, Kota Iskandar, 79100 Johor Bahru, Johor, Malaysia

ABSTRACT

A comprehensive assessment on the orchid flora of Gunung Ledang, Johor, Malaysia was carried out from 2012 to 2018 with the aim to re-evaluate the presence of orchid species listed by Ridley in his "Journal of the Straits Branch of the Royal Asiatic Society 35:1–28", published in 1901, after more than 100 years. The relevant account for comparison is also listed, noting that Ridley's historical collections were for the isolated group of hills commonly known as Gunung Ledang (Mount Ophir), while the collated item in Orchidaceae is part of catalogues for the whole of Peninsular Malaysia. After Ridley, no account on the orchid flora of Gunung Ledang has been properly given, particularly from the uppermost peak of the mountain, where many interesting plants and orchids are to be found there. This study identified 26 species or 67% were the same as those recorded by Ridley (1901), and 65 species or 83% of Turner (1995) checklist of 270 species of orchids for the state of Malacca and Johor, including the common and widespread species to Peninsular Malaysia. By contribution, this paper provides an updated account on the diversity of orchids in Gunung Ledang, listing 122 species of orchids, of which eight are endemic to Peninsular Malaysia, two are hyper-endemic known only from Gunung Ledang, and 30 were recognised as new records. A comparison table of the

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E-mail addresses:
farahalianordin@usm.my (Farah Alia Nordin)
sofiman@usm.my (Ahmad Sofiman Othman)
asyikinzainuddin@gmail.com (Nur Asyikin Zainudin)
nuratiqahkhalil@usm.my (Nur 'Atiqah Khalil)
ida.asi52@yahoo.com (Najidah Asi)
afifahazmi93@gmail.com (Afifah Azmi)
khairul_nasirudin@usm.my (Khairul Nasirudin Abu Mangsor)
dvsukor@usm.my (Mohd Sukor Harun)
khairulfaizee82@gmail.com (Khairul Faizee Mohd Zin)
* Corresponding author

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current findings against Ridley (1901) and Turner (1995) is provided which shows only 16 species were the same in all three studies.

Keywords: Diversity, Gunung Ledang, H. N. Ridley, I. M. Turner, Mount Ophir, Orchidaceae

INTRODUCTION

Gunung Ledang, or historically known as the fabled Mount Ophir is an isolated mountain range consisted of several main peaks, with the highest is Puncak Gunung Ledang that stands at 1267 m above sea level. The mountain range is accessible both from Asahan to the north and from Tangkak to the east, as Gunung Ledang is located within the border of Malacca and Johor.

Knowledge on the orchids of Gunung Ledang was first published by Ridley in 1901, and his records have served as a prominent reference on orchid species diversity of that high isolated mountain. Before Ridley, Gunung Ledang has been visited and explored by Cuming and Lobb (Ridley, 1901) who have made extensive orchid collections and brought down a number of dried specimens as well, yet no account of their collections nor indeed of their expeditions appear to be ever published.

Ridley identified 39 species mostly collected from the uppermost part of the range at the elevation of about 900–1200 m, and only referring to a few of rarer species at the lower levels. Most of Ridley's account consisted of species he collected from the northwest part of the mountain, ascending to the top of the highest peak which is Puncak Gunung Ledang from Malacca *via* Bukit Besar and Lubuk Kedondong, where the mountain is accessible with safety in the early days.

Ridley explored and ascended to the main peak of Gunung Ledang from Malacca *via* two routes. The first route started from the densely wooded Bukit Besar where the ascent commences steeply towards Padang Batu at about 823 m elevation, a large sloping rock-face covered in part with thick grass and sedges, among which grow gnarled montane trees such as *Baeckia*, *Leptospermum*, and *Podocarpus*, with orchids such as *Arundina graminifolia*, *Spathoglottis aurea*, and *Paphiopedilum barbatum* heavily populated the damp spots. However, the population of *S. aurea* in Gunung Ledang seems to be rare nowadays. He then marched through Gunung Tunduk, a large bare rock area which a good view of Malacca is obtainable, before not far off descended into a damp valley, and continued by a stiff steep climb to reach the extreme peak of Gunung Ledang. The second route taken by Ridley was *via* a lower peak of the range known as Gunung Mering, where he ascended with Mr. Hervey in 1892 from Lubuk Kedondong. Ridley reported that Gunung Mering is a less visited peak which claimed by local people as inaccessible, even though the ascent proved to be just merely stiff climbs that in parts require one to cross some smooth steep rocks. About halfway up Gunung Mering, they arrived at a point across Padang Batu, a stone field with a cascading stream and were surrounded by cliffs which were covered with forest. At

present day, both Ridley's historical routes he ascended from Malacca *via* Lubuk Kedondong are now known as the 'Asahan Trail', named after a small town in Jasin that is located within the border of three states. Thus, from now onwards throughout this manuscript, Ridley's historical routes will be consistently cited as Asahan Trail, referring to the same routes taken but with new designation.

During Ridley's day, large part of Gunung Ledang was left unvisited, particularly to the east and south parts of the mountain range that lies within the state of Johor, very likely due to inaccessibility and safety reasons. Nowadays, Gunung Ledang is accessible from Tangkak in the southeast and Jementah in the northwest. The route from Tangkak *via* Sagil is popular among avid hikers, as ascending the Lagenda Trail to the top of Gunung Ledang is challenging but less arduous in comparison to Asahan. At the beginning of the trail, the route is quite treacherous with protruding tree roots, huge rocky boulders, and dense forest canopy. The ascensions commence starting from Batu Orkid towards Bukit Botak, where at some points, requiring one to scale up using ladders and ropes. From Bukit Botak towards Anjung Mahligai (1061 m above sea level), there is a clearing where intermittently covered in mist during the day, the surrounding is beautiful and the summit of Gunung Ledang is within sight. In contrast, the route from Jementah over Ulu Jementah Trail is seldom visited due to the long-winded mountain ridge and extremely steep ascent along the way through several lower peaks such as from Puncak Jementah (945 m above sea level) to Gunung Mahligai (1236 m above sea level) before summiting Gunung Ledang. Water supply is also scarce; a stream with small running water is only accessible at the first 2 km from the trail entrance, and next possible water sources will come from small creeks running through rocks. Most part of the trail is covered in dense lowland and hill forest canopy, untouched, and a best place for the botanical study of many plant groups. No account on the orchid flora from this part of Gunung Ledang has ever been published, thus the accomplishment in preparing the updates will augment the fundamental knowledge that has been firmly set up by Ridley.

The relevant account for comparison by Turner (1995) is also listed, noting that Ridley's historical collections were for the isolated group of hills commonly known as Gunung Ledang, while Turner's item in Orchidaceae is part of his catalogues for the whole of Peninsular Malaysia. In 1995, Turner published his checklist "A Catalogue of the Vascular Plants of Malaya" (in The Gardens' Bulletin Singapore 47:2), an encyclopaedic compilation from his assiduous examination on the herbarium specimens holding of the Singapore Botanical Garden's Herbarium (SING), the Royal Botanic Gardens at Kew (K), and local herbaria in the Forest Research Institute of Malaysia (KEP), University of Malaya (KLU), Biology Department, Universiti Putra Malaysia (UPM), and Universiti Kebangsaan Malaysia (UKMB).

In his checklist, Turner listed 129 species of orchids specifically known from Malacca and Johor, with an additional of 141 species recognized as common and widespread throughout Peninsular Malaysia. He mentioned two hyper-endemic species known only from Gunung Ledang, *Hetaeria elegans* Ridl., which Ridley discovered from Gunung Tunduk and described it in 1908; and *Anoectochilus burmannicus* Rolfe, which is only known from one locality in the Malay Peninsula.

MATERIALS AND METHODS

Ridley's historical routes in Asahan were revisited, with two new routes accessible from Tangkak and Jementah were visited in this study (Figure 1). Seven forest trails were explored and assessed which are, (i) Asahan Trail *via* Lubuk Kedondong, (ii) Asahan Trail *via* Dataran Damai Waterfall (Gunung Mering), (iii) Lagenda Trail *via* Batu Orkid, (iv) Ayer Panas Trail *via* Kolam Gajah, (v) Ulu Jementah Trail *via* Jeram Tinggi, (vi) Gunung Mahligai, and (vii) Gunung Ledang. The collections were made based on convenient sampling method along the seven forest trails from base of the foothill ascent to the peak of Gunung Ledang and *vice versa*. Observations were also made along the tarred road starting from the Taman Hutan Lagenda Park Office towards the Telekom Tower, which is located 500 m from the main peak of Gunung Ledang.

The specimens were identified using the morphological characters described, and the identification keys prepared by Comber (2001), Go et al. (2015), Holttum (1964), Ridley (1907, 1924), Seidenfaden and Smitinand (1959) as well as Seidenfaden and

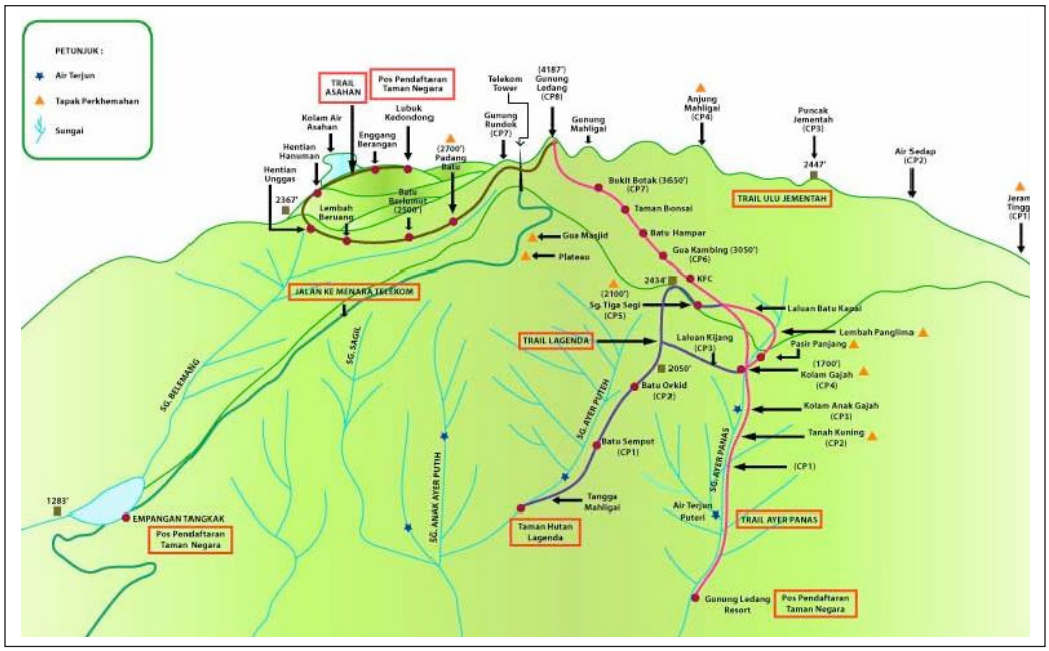

Figure 1. Trails in Gunung Ledang. Map courtesy of Johor National Park Corporation

Wood (1992). The current accepted species name will be validated through the updated online database - Kew World Checklist of Selected Plant Families (WCSP) (2020), and the checklist made available by Ong et al. (2017).

Observations on the vegetative and reproductive macromorphological characteristics of species under investigation would be conducted in the fields. The geographical, ecological, and geological attributes would also be recorded. For detail micromorphological characteristics of selected taxa, specimens would be examined under field and stereo microscopes. Most of the plant specimens would be documented in the form of photographs, and collection of living specimens was to be circumvented in any way possible, as an approach for species as well as habitat preservation and conservation. Preserved herbarium specimens and spirit materials of the taxa collected would be deposited in Herbarium of School of Biological Sciences, Universiti Sains Malaysia (USM). Living collections for germplasm studies and *exsitu* conservation purposes would be cultivated in Taman Flora, School of Biological Sciences, USM.

RESULTS

From this study, a total of 104 orchid species from 62 genera have been identified from Gunung Ledang, of which five are endemic to Peninsular Malaysia, 30 were recognised as new records to the locality, and one undetermined species. The list also serves for comparison with the works by Ridley and by Turner in Malacca and Johor (Table 1).

Table 1
Species list: Comparison of orchid species found in Gunung Ledang since Ridley (1901)

No.	Species	Ridley (1901)	Turner (1995)	Current study
1	*Acriopsis liliifolia* (J.Kōenig) Ormerod var. *liliifolia*		√	√
2	*Aerides odorata* Lour.		√	√
3	*Agrostophyllum stipulatum* (Griff.) Schltr. subsp. *stipulatum*	√		√
4	*Anoectochilus albolineatus* C.S.P.Parish & Rchb.f.		√	√
5	*Anoectochilus geniculatus* Ridl.	√		
6	***Anoectochilus burmannicus* Rolfe		√	
7	*Anoectochilus* sp.			√
8	*Apostasia latifolia* Rolfe	√	√	√
9	*Apostasia nuda* R.Br. in N.Wallich	√	√	√
10	*Apostasia wallichii* R.Br. in N.Wallich			√
11	*Appendicula anceps* Blume		√	√
12	*Appendicula cornuta* Blume		√	√
13	*Appendicula reflexa* Blume		√	√
14	*Arundina graminifolia* (D.Don) Hochr.	√	√	√
15	*Bromheadia aporoides* Rchb.f.	√		
16	*Bromheadia alticola* Ridl.	√	√	
17	*Bromheadia brevifolia* Ridl.		√	
18	*Bromheadia finlaysoniana* (Lindl.) Miq.		√	√
19	**Bromheadia pungens* Ridl.	√	√	√
20	**Bromheadia rupestris* Ridl.	√	√	√
21	*Bromheadia truncata* Seidenf.		√	√
22	*Bulbophyllum clandestinum* Lindl.		√	√

Table 1 (*continue*)

No.	Species	Ridley (1901)	Turner (1995)	Current study
22	*Bulbophyllum clandestinum* Lindl.		√	√
23	*Bulbophyllum elevatopunctatum* J.J.Sm.			√
24	*Bulbophyllum fenestratum* J.J.Sm.			√
25	*Bulbophyllum gracillimum* (Rolfe) Rolfe		√	√
26	*Bulbophyllum purpurascens* Teijism. & Binn.	√	√	√
27	*Bulbophyllum pustulatum* Ridl.		√	
28	*Bulbophyllum striatellum* Ridl.		√	√
29	*Bulbophyllum uniflorum* (Blume) Hassk.		√	√
30	*Bulbophyllum vaginatum* (Lindl.) Rchb.f. in W.G.Walpers	√	√	√
31	*Campanulorchis pellipes* (Rchb.f. ex Hook.f.) Y.P.Ng & P.J.Cribb	√	√	√
32	*Ceratostylis ampullacea* Kraenzl.		√	√
33	*Ceratostylis gracilis* Blume	√		
34	*Ceratostylis subulata* Blume		√	√
35	*Calanthe angustifolia* (Blume) Lindl.	√		√
36	*Claderia viridiflora* Hook.f.	√	√	√
37	*Cleisostoma suffusum* (Ridl.) Garay		√	
38	**Coelogyne anceps* Hook.f.			√
39	*Coelogyne cumingii* Lindl.	√	√	
40	**Coelogyne kaliana* P.J.Cribb			√
41	*Coelogyne testacea* Lindl.		√	√
42	*Coelogyne tomentosa* Lindl.	√		√
43	*Corybas carinatus* (J.J.Sm.) Schltr.		√	√
44	*Corymborkis veratrifolia* (Reinw.) Blume		√	√
45	*Crepidium calophyllum* (Rchb.f.) Szlach.		√	√
46	*Cryptostylis arachnites* (Blume) Hassk. in C.L.Blume		√	√
47	*Cylindrolobus nutans* (Lindl.) J.J.Wood	√	√	√
48	*Cymbidium finlaysonianum* Lindl.			√
49	*Dendrobium angustifolium* (Blume) Lindl.		√	√
50	*Dendrobium convexum* (Blume) Lindl.		√	√
51	*Dendrobium crumenatum* Sw.		√	√
52	*Dendrobium derryi* Ridl.			√
53	*Dendrobium geminatum* (Blume) Lindl.			√
54	*Dendrobium indivisum* (Blume) Miq.		√	√
55	**Dendrobium kelsallii* Ridl.	√		
56	*Dendrobium lamellatum* (Blume) Lindl.			√
57	*Dendrobium leonis* (Lindl.) Rchb.f. in W.G.Walpers		√	√
58	*Dendrobium longipes* Hook.f.			√
59	*Dendrobium macropodum* Hook.f.			√
60	*Dendrobium mannii* Ridl.		√	
61	*Dendrobium metachilinum* Rchb.f.		√	√
62	*Dendrobium pachyglossum* E.C.Parish & Rchb.f.			√
63	*Dendrobium uniflorum* Griff.	√	√	√
64	*Dendrobium villosulum* Wall. ex Lindl.	√	√	√
65	*Dendrochilun linearifolium* Hook.f.	√		√
66	*Dendrochilum longifolium* Rchb.f.			√
67	*Dipodium conduplicatum* J.J.Sm.			√
68	*Erythrodes latifolia* Blume			√
69	*Erythrorchis altissima* (Blume) Blume			√
70	*Galeola nudifolia* Lour.		√	√
71	*Gastrodia javanica* (Blume) Lindl.			√
72	*Geodorum densiflorum* (Lam.) Schltr.		√	√
73	*Goodyera rubicunda* (Blume) Lindl.		√	√
74	*Goodyera viridiflora* (Blume) Blume			√

Table 1 (*continue*)

No.	Species	Ridley (1901)	Turner (1995)	Current study
75	*Grammatophyllum speciosum* Blume		√	√
76	*Habenaria rhodocheila* Hance			√
77	*Hetaeria elata* Hook.f.	√		√
78	***Hetaeria elegans* Ridl.	√	√	
79	*Hylophila mollis* Lindl.		√	√
80	*Lecanorchis malaccensis* Ridl.		√	√
81	*Liparis barbata* Lindl.		√	√
82	*Liparis elegans* Lindl.	√	√	√
83	*Liparis maingayi* (Hook.f.) Ridl.	√	√	
84	*Liparis viridicallus* Holttum			√
85	*Luisia* sp.			√
86	*Macodes petola* (Blume) Lindl.	√		√
87	*Neuwiedia griffithii* Rchb.f.		√	√
88	*Neuwiedia veratrifolia* Blume			√
89	**Oberonia bertoldii* King & Pantl.		√	√
90	*Paphiopedilum barbatum* (Lindl.) Pfitzer	√	√	√
91	*Peristylus maingayi* (King & Pantl.) J.J.Wood & Ormerod		√	√
92	*Peristylus monticola* (Ridl.) Seidenf.	√	√	√
93	*Phalaenopsis deliciosa* Rchb.f.			√
94	*Phalaenopsis fuscata* Rchb.f.			√
95	*Pholidota carnea* (Blume) Lindl. var. *carnea*			√
96	**Pinalia atrovinosa* (Carr) Schuit.		√	
97	*Pinalia bractescens* (Lindl.) Kuntze		√	√
98	*Platanthera angustata* (Blume) Lindl.	√		√
99	*Plocoglottis javanica* Blume		√	√
100	*Podochilus microphyllus* Lindl.	√	√	√
101	*Pomatocalpa diffusum* Breda		√	√
102	*Renanthera histrionica* Rchb.f.	√		√
103	*Rhynchostylis* sp.			√
104	*Spathoglottis aurea* Lindl.	√	√	
105	*Spathoglottis plicata* Blume		√	√
106	*Stichorkis gibbosa* (Finet) J.J.Wood		√	√
107	*Strongyleria pannea* (Lindl.) Schuit.		√	√
108	*Tainia maingayi* Hook.f.	√		
109	*Thecopus maingayi* (Hook.f.) Seidenf.		√	√
110	*Tainia speciosa* Blume	√	√	√
111	*Thrixspermum* sp.			√
112	*Trichotosia ferox* Blume		√	√
113	*Trichotosia gracilis* (Hook.f.) Kraenzl.		√	√
114	*Trichotosia pauciflora* Blume	√	√	
115	*Trichotosia poculata* (Ridl.) Kraenzl.		√	√
116	*Trichotosia velutina* (Lodd. ex Lindl.) Kraenzl.	√	√	
117	*Trichotosia vestita* (Wall. ex Lindl.) Kraenzl.	√	√	
118	*Tropidia angulosa* (Lindl.) Blume			√
119	*Tropidia curculigoides* Lindl.	√	√	√
120	*Vanilla griffithii* Rchb.f.		√	√
121	*Zeuxine affinis* (Lindl.) Benth. ex Hook.f.			√
122	*Zeuxine gracilis* (Breda) Blume			√
	Total	**39**	**78**	**104**

Note.
√ Present
* Endemic to Peninsular Malaysia as reported by Turner (1995) and Ong et al. (2017)
** Hyper-endemic species to Gunung Ledang as reported by Turner (1995)

The finding has identified 26 species or 67% were the same as those recorded by Ridley (1901), and 65 species or 83% of Turner (1995) checklist of 270 species of orchids for Johor, Malacca, and the whole of Peninsular Malaysia. Only 16 species were the same in all three studies, and 18 species which were listed before by Ridley and Turner were not recollected in this study, including the two hyper-endemics to Gunung Ledang, *Hetaeria elegans*, and *Anoectochilus burmannicus*. Checklist on the orchid species found in Gunung Ledang is provided as in Table 2.

Table 2
Checklist of Gunung Ledang orchids and the area of occurrences in Peninsular Malaysia: 122 species (from 1901-present)

No.	Species
1	*Acriopsis liliifolia* (J.Köenig) Ormerod var. *liliifolia* (Synonym: *Acriopsis javanica* Reinw. ex Blume) General Distribution: Sikkim to North West Pacific Distribution in Peninsular Malaysia: Common in lowlands throughout Lifeform: Epiphytic
2	*Aerides odorata* Lour. General Distribution: China (W. Yunnan, Guangdong) to Tropical Asia Distribution in Peninsular Malaysia: Common in lowlands throughout Lifeform: Epiphytic
3	*Agrostophyllum stipulatum* (Griff.) Schltr. subsp. s*tipulatum* General Distribution: Indo-China, Malesia to Solomon Island Distribution in Peninsular Malaysia: Johor; lowland and montane forest Lifeform: Epiphytic
4	*Anoectochilus albolineatus* C.S.P.Parish & Rchb.f. General Distribution: Indo-China Distribution in Peninsular Malaysia: Widespread; montane forest at 1000-1300 m Lifeform: Terrestrial
5	*Anoectochilus geniculatus* Ridl. General Distribution: Myanmar to West Malesia Distribution in Peninsular Malaysia: Widespread; hill and montane forest Lifeform: Terrestrial
6	*Anoectochilus burmannicus* Rolfe General Distribution: China (S. Yunnan) to Pen. Malaysia Distribution in Peninsular Malaysia: Known only from Gunung Ledang, Johor; montane forest Lifeform: Terrestrial
7	*Anoectochilus* sp. (NAJ 17) Distribution in Peninsular Malaysia: Gunung Ledang, Johor; montane forest at 1000 m Lifeform: Terrestrial
8	*Apostasia latifolia* Rolfe General Distribution: West Malesia Distribution in Peninsular Malaysia: Perak, Pahang, Melaka; hill and montane forest Lifeform: Terrestrial
9	*Apostasia nuda* R.Br. in N.Wallich General Distribution: Assam to West Malesia Distribution in Peninsular Malaysia: Widespread; lowland and hill forest to 900 m Lifeform: Terrestrial
10	*Apostasia wallichii* R.Br. in N.Wallich General Distribution: Japan (Island of Kyushu), China (South West Yunnan) to Tropical Asia and North Australia Distribution in Peninsular Malaysia: Scattered localities; lowland forest to 600 m Lifeform: Terrestrial

Table 2 (*continue*)

No.	Species
11	*Appendicula anceps* Blume General Distribution: Peninsula Thailand to Malesia Distribution in Peninsular Malaysia: Widespread and common; lowland and hill forest Lifeform: Epiphytic
12	*Appendicula cornuta* Blume General Distribution: Sikkim to China (S. Guangdong) and Malesia Distribution in Peninsular Malaysia: Common; lowland and montane forest Lifeform: Epiphytic or lithophytic
13	*Appendicula reflexa* Blume General Distribution: Taiwan, Indo-China to West Pacific Distribution in Peninsular Malaysia: Kedah, Perak, Pahang, Johor; lowlands and mountains Lifeform: Epiphytic
14	*Arundina graminifolia* (D.Don) Hochr. General Distribution: Tropical and Subtropical Asia Distribution in Peninsular Malaysia: Widespread; open sunny places in lowlands and mountains Lifeform: Terrestrial
15	*Bromheadia aporoides* Rchb.f. General Distribution: Indo-China to Borneo and Singapore Distribution in Peninsular Malaysia: South Peninsular Malaysia; lowland forest Lifeform: Epiphytic
16	*Bromheadia alticola* Ridl. General Distribution: Peninsula Thailand to Philippines (Mindanao) Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Terrestrial
17	*Bromheadia brevifolia* Ridl. General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Perak, Pahang and Selangor; hill to montane forest Lifeform: Epiphytic
18	*Bromheadia finlaysoniana* (Lindl.) Miq. General Distribution: Indo-China to New Guinea Distribution in Peninsular Malaysia: Common throughout; hill to montane forest Lifeform: Terrestrial
19	*Bromheadia pungens* Ridl. General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Gunung Tahan (Pahang) and Gunung Ledang (Melaka); montane forest Lifeform: Epiphytic
20	*Bromheadia rupestris* Ridl. General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Gunung Jerai (Kedah), Gunung Tahan (Pahang), Pulau Tioman (Johor) and Gunung Ledang (Melaka); montane forest Lifeform: Epiphytic
21	*Bromheadia truncata* Seidenf. General Distribution: Thailand to West Malesia Distribution in Peninsular Malaysia: Widespread; lowland and montane forest Lifeform: Epiphytic
22	*Bulbophyllum clandestinum* Lindl. General Distribution: Bangladesh to West Pacific Distribution in Peninsular Malaysia: Widespread; lowland forest Lifeform: Epiphytic
23	*Bulbophyllum elevatopunctatum* J.J.Sm. General Distribution: Thailand to West Malesia Distribution in Peninsular Malaysia: Johor; lowland forest Lifeform: Epiphytic
24	*Bulbophyllum fenestratum* J.J.Sm. (Synonym: *Bulbophyllum dentiferum* Ridl.) General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Kelantan, Perak, Pahang and Johor; lowland forest Lifeform: Epiphytic

Table 2 (*continue*)

No.	Species
25	*Bulbophyllum gracillimum* (Rolfe) Rolfe General Distribution: Peninsula Thailand to Southwest Pacific Distribution in Peninsular Malaysia: Common throughout; lowland forest Lifeform: Epiphytic and lithophytic
26	*Bulbophyllum purpurascens* Teijism. & Binn. General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Common throughout; lowland forest Lifeform: Epiphytic and lithophytic
27	*Bulbophyllum pustulatum* Ridl. General Distribution: Peninsular Malaysia and Borneo Distribution in Peninsular Malaysia: Johor; lowland forest Lifeform: Epiphytic
28	*Bulbophyllum striatellum* Ridl. General Distribution: Peninsular Malaysia and Borneo (Sabah, Sarawak) Distribution in Peninsular Malaysia: Kelantan and Johor; lowland forest Lifeform: Epiphytic
29	*Bulbophyllum uniflorum* (Blume) Hassk. General Distribution: West and Central Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
30	*Bulbophyllum vaginatum* (Lindl.) Rchb.f. in W.G.Walpers General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Common and widespread; lowland forest Lifeform: Epiphytic
31	*Calanthe angustifolia* (Blume) Lindl. General Distribution: Southeast China to West Malesia Distribution in Peninsular Malaysia: North of the Peninsula; montane forest Lifeform: Terrestrial
32	*Campanulorchis pellipes* (Rchb.f. ex Hook.f.) Y. P. Ng & P. J. Cribb General Distribution: Thailand to West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
33	*Ceratostylis ampullacea* Kraenzl. General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
34	*Ceratostylis gracilis* Blume General Distribution: West Malesia Distribution in Peninsular Malaysia: Pahang, Selangor; montane forest Lifeform: Epiphytic
35	*Ceratostylis subulata* Blume General Distribution: Tropical Asia to Vanuatu Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
36	*Claderia viridiflora* Hook.f. General Distribution: Peninsula Thailand to West & Central Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
37	*Cleisostoma suffusum* (Ridl.) Garay General Distribution: Peninsular Malaysia to Sumatera, North Borneo Distribution in Peninsular Malaysia: Perak, Pahang and Malacca; hill forest Lifeform: Epiphytic
38	*Coelogyne anceps* Hook.f. General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Gunung Tahan (Perak, Pahang); montane forest Lifeform: Epiphytic

Table 2 (*continue*)

No.	Species
39	*Coelogyne cumingii* Lindl. General Distribution: Indo-China to West Malesia Distribution in Peninsular Malaysia: Widespread; lowland and hill forest Lifeform: Epiphytic
40	*Coelogyne kaliana* P.J.Cribb General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Perak, Pahang and Selangor; montane forest Lifeform: Epiphytic
41	*Coelogyne tomentosa* Lindl. General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Perak; montane forest Lifeform: Epiphytic
42	*Corybas carinatus* (J.J.Sm.) Schltr. General Distribution: West Malesia Distribution in Peninsular Malaysia: Perak, Pahang, Johor; montane forest Lifeform: Terrestrial
43	*Corymborkis veratrifolia* (Reinw.) Blume General Distribution: Tropical and Subtropical Asia to Pacific Distribution in Peninsular Malaysia: Widespread; lowland and montane forest Lifeform: Terrestrial
44	*Crepidium calophyllum* (Rchb.f.) Szlach. General Distribution: East Nepal to Hainan and Borneo Distribution in Peninsular Malaysia: Kedah, Kelantan, Pulau Pinang, Johor; hill forest Lifeform: Terrestrial
45	*Cryptostylis arachnites* (Blume) Hassk. in C.L.Blume General Distribution: Tropical & Subtropical Asia to South West Pacific Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Terrestrial
46	*Cylindrolobus nutans* (Lindl.) J.J.Wood General Distribution: Thailand to West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
47	*Cymbidium finlaysonianum* Lindl. General Distribution: Indo-China to Malesia Distribution in Peninsular Malaysia: Most abundant in the north; lowland forest Lifeform: Epiphytic
48	*Dendrobium angustifolium* (Blume) Lindl. General Distribution: Arunachal Pradesh to China and West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
49	*Dendrobium convexum* (Blume) Lindl. General Distribution: Indo-China to North Queensland Distribution in Peninsular Malaysia: Gunung Ulu Kali, Selangor; montane forest Lifeform: Epiphytic
50	*Dendrobium crumenatum* Sw. General Distribution: Taiwan to Tropical Asia Distribution in Peninsular Malaysia: Widespread and common; lowland forest Lifeform: Epiphytic
51	*Dendrobium derryi* Ridl. General Distribution: West Malesia Distribution in Peninsular Malaysia: Perak; montane forest Lifeform: Epiphytic
52	*Dendrobium geminatum* (Blume) Lindl. General Distribution: West Malesia Distribution in Peninsular Malaysia: Many localities on high exposed mountain ridges Lifeform: Epiphytic

Table 2 (*continue*)

No.	Species
53	*Dendrobium indivisum* (Blume) Miq. General Distribution: Bangladesh to Malesia Distribution in Peninsular Malaysia: Widespread; lowland forest Lifeform: Epiphytic
54	*Dendrobium kelsallii* Ridl. General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Johor; lowland forest Lifeform: Epiphytic
55	*Dendrobium lamellatum* (Blume) Lindl. General Distribution: Java and Peninsular Malaysia Distribution in Peninsular Malaysia: Widespread but uncommon; lowland forest Lifeform: Epiphytic
56	*Dendrobium leonis* (Lindl.) Rchb.f. in W.G.Walpers General Distribution: Indo-China to West Malesia Distribution in Peninsular Malaysia: Widespread and common; lowland forest Lifeform: Epiphytic and lithophytic
57	*Dendrobium longipes* Hook.f. General Distribution: Peninsular Malaysia to West Sumatra Distribution in Peninsular Malaysia: Many localities on high exposed mountain ridges Lifeform: Epiphytic
58	*Dendrobium macropodum* Hook.f. General Distribution: West Malesia Distribution in Peninsular Malaysia: Many localities on high exposed mountain ridges Lifeform: Epiphytic
59	*Dendrobium mannii* Ridl. General Distribution: Arunachal Pradesh to Peninsular Malaysia Distribution in Peninsular Malaysia: Malacca and Johor; lowland and hill forest Lifeform: Epiphytic
60	*Dendrobium metachilinum* Rchb.f. General Distribution: Peninsula Thailand to West Malesia, Maluku (Ambon) Distribution in Peninsular Malaysia: Common in south of Peninsular Malaysia; lowland forest Lifeform: Epiphytic
61	*Dendrobium pachyglossum* E.C.Parish & Rchb.f. General Distribution: Indo-China to Peninsular Malaysia, Borneo (Sarawak) Distribution in Peninsular Malaysia: Several localities; montane forest Lifeform: Epiphytic
62	*Dendrobium uniflorum* Griff. General Distribution: Indo-China to West and Central Malesia Distribution in Peninsular Malaysia: Widespread; lowland forest Lifeform: Epiphytic
63	*Dendrobium villosulum* Wall. ex Lindl. General Distribution: Thailand, Peninsular Malaysia (P. Pinang), Borneo Distribution in Peninsular Malaysia: Widespread; lowland and montane forest Lifeform: Epiphytic
64	*Dendrochilun linearifolium* Hook.f. General Distribution: Peninsular Malaysia to Sumatra Distribution in Peninsular Malaysia: Quite widespread; montane forest Lifeform: Epiphytic
65	*Dendrochilum longifolium* Rchb.f. General Distribution: Indo-China to Papuasia Distribution in Peninsular Malaysia: Pahang southward; lowland forest Lifeform: Epiphytic
66	*Dipodium conduplicatum* J.J.Sm. General Distribution: Peninsular Malaysia to North and West Sumatra Distribution in Peninsular Malaysia: Pahang, Johor; montane forest Lifeform: Terrestrial, sometimes climbing

Table 2 (*continue*)

No.	Species
67	*Erythrodes latifolia* Blume General Distribution: West Malesia Distribution in Peninsular Malaysia: Perak, Pahang, Selangor; montane forest Lifeform: Terrestrial
68	*Erythrorchis altissima* (Blume) Blume General Distribution: Assam to Japan and Malesia Distribution in Peninsular Malaysia: Several localities; lowland forest Lifeform: Climbing holomycotroph
69	*Galeola nudifolia* Lour. General Distribution: South Hainan to Tropical Asia Distribution in Peninsular Malaysia: Widespread; lowland and hill forest Lifeform: Terrestrial holomycotroph
70	*Gastrodia javanica* (Blume) Lindl. General Distribution: Peninsula Thailand to Malesia Distribution in Peninsular Malaysia: Several localities; lowland forest Lifeform: Terrestrial holomycotroph
71	*Geodorum densiflorum* (Lam.) Schltr. General Distribution: Tropical and Subtropical Asia to West Pacific Distribution in Peninsular Malaysia: Melaka northward; open grassy places in the lowlands Lifeform: Terrestrial
72	*Goodyera rubicunda* (Blume) Lindl. General Distribution: Sikkim to Malesia to Southwest Pacific Distribution in Peninsular Malaysia: Perak, Pahang and Johor; montane forest Lifeform: Terrestrial
73	*Goodyera viridiflora* (Blume) Blume General Distribution: Tropical amd Subtropical Asia to South West Pacific Distribution in Peninsular Malaysia: Gunung Jerai (Kedah), Penang Hill, Bukit Fraser (Pahang); montane forest Lifeform: Terrestrial
74	*Grammatophyllum speciosum* Blume General Distribution: Indo-China to West Malesia Distribution in Peninsular Malaysia: Widespread; lowland and hill forest Lifeform: Epiphytic
75	*Habenaria rhodocheila* Hance General Distribution: South China to Peninsular Malaysia, Philippines Distribution in Peninsular Malaysia: Kedah, Pulau Pinang; lowland forest Lifeform: Terrestrial
76	*Hetaeria elata* Hook.f. General Distribution: Peninsular Malaysia to Philippines Distribution in Peninsular Malaysia: Pahang (Cameron Highlands); montane forest Lifeform: Terrestrial
77	*Hetaeria elegans* Ridl. (Synonym: *Hetaeria ophirensis* Ridl.) General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Hyper endemic in Gunung Tunduk, Malacca; montane forest Lifeform: Terrestrial
78	*Hylophila mollis* Lindl. General Distribution: Peninsula Thailand to West Malesia and Papuasia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Terrestrial
79	*Lecanorchis malaccensis* Ridl. General Distribution: Indo-China to West Malesia Distribution in Peninsular Malaysia: Quite widespread; lowland and montane forest Lifeform: Terrestrial holomycotroph
80	*Liparis barbata* Lindl. General Distribution: Hainan to Taiwan, Tropical Asia to South West Pacific Distribution in Peninsular Malaysia: Perak, Pahang, Johor; lowland forest Lifeform: Terrestrial

Table 2 (*continue*)

No.	Species
81	*Liparis elegans* Lindl. (Synonym: *Stichorkis elegans* (Lindl.) Marg., Szlach. & Kulak) General Distribution: Nicobar Island to Hainan and South West Pacific Distribution in Peninsular Malaysia: Widespread; lowland and hills to 1000 m Lifeform: Epiphytic or lithophytic
82	*Liparis maingayi* (Hook.f.) Ridl. General Distribution: Peninsular Malaysia to West Sumatera Distribution in Peninsular Malaysia: Kedah, Pulau Pinang, Perak, Johor; hill forest Lifeform: Epiphytic
83	*Liparis viridicallus* Holttum General Distribution: West Malesia to Philippines Distribution in Peninsular Malaysia: Pahang (Fraser's Hill and Gunung Ulu Kali); montane forest Lifeform: Terrestrial or lithophytic
84	*Luisia* sp. Distribution in Peninsular Malaysia: Gunung Ledang; hill forest Lifeform: Epiphytic
85	*Macodes petola* (Blume) Lindl. General Distribution: South Japan, Peninsula Thailand to West and Central Malesia Distribution in Peninsular Malaysia: Pulau Pinang southward; damp lowland and hill forest Lifeform: Terrestrial
86	*Neuwiedia griffithii* Rchb.f. General Distribution: Vietnam, Malaya to North Sumatra Distribution in Peninsular Malaysia: Pahang, Selangor, Negeri Sembilan, Malacca, and Johor; damp lowland forest Lifeform: Terrestrial
87	*Neuwiedia veratrifolia* Blume General Distribution: Malesia to Vanuatu Distribution in Peninsular Malaysia: Pulau Pinang southward; hill and montane forest Lifeform: Terrestrial
88	*Oberonia bertoldii* King & Pantl. General Distribution: Endemic in Peninsular Malaysia Distribution in Peninsular Malaysia: Perak, Pahang, Selangor and Johor; lowland forest Lifeform: Epiphytic
89	*Paphiopedilum barbatum* (Lindl.) Pfitzer General Distribution: Peninsula Thailand to North Sumatra Distribution in Peninsular Malaysia: Widespread; open grassy or rocky places in the mountains Lifeform: Terrestrial
90	*Peristylus maingayi* (King & Pantl.) J.J.Wood & Ormerod (Synonym: *Peristylus candidus* J.J.Sm.) General Distribution: South Indo-China to North Queensland Distribution in Peninsular Malaysia: Commoner in the south of Peninsular Malaysia; montane forest Lifeform: Terrestrial
91	*Peristylus monticola* (Ridl.) Seidenf. General Distribution: Andaman Island, Malesia to New Guinea Distribution in Peninsular Malaysia: Gunung Jerai (Kedah), Gunung Ledang (Johor); montane forest Lifeform: Terrestrial
92	*Phalaenopsis deliciosa* Rchb.f. (Synonym: *Kingidium deliciosum* (Rchb.f.) H.R.Sweet) General Distribution: India to China to Malesia Distribution in Peninsular Malaysia: Widespread but not common; lowland and hill forest Lifeform: Epiphytic
93	*Phalaenopsis fuscata* Rchb.f. General Distribution: Peninsular Malaysia to Philippines Distribution in Peninsular Malaysia: Pahang and Johor; lowland forest Lifeform: Epiphytic

Table 2 (*continue*)

No.	Species
94	*Pholidota carnea* (Blume) Lindl. var. *carnea* General Distribution: Peninsular Thailand to New Guinea Distribution in Peninsular Malaysia: Perak, Pahang; montane forest Lifeform: Epiphytic
95	*Pinalia atrovinosa* (Carr) Schuit. General Distribution: Peninsular Malaysia to Borneo Distribution in Peninsular Malaysia: Pahang, Selangor and Malacca; montane forest Lifeform: Epiphytic
96	*Pinalia bractescens* (Lindl.) Kuntze General Distribution: Tropical Asia Distribution in Peninsular Malaysia: Widespread and more frequent in the south; montane forest Lifeform: Epiphytic
97	*Platanthera angustata* (Blume) Lindl. General Distribution: Hainan to West Java and Philippines Distribution in Peninsular Malaysia: Many localities; montane forest Lifeform: Terrestrial
98	*Plocoglottis javanica* Blume General Distribution: South Indo-China to West Malesia Distribution in Peninsular Malaysia: Widespread; lowland and montane forest Lifeform: Terrestrial
99	*Podochilus microphyllus* Lindl. General Distribution: Indo-China to West Malesia Distribution in Peninsular Malaysia: Widespread and common; lowland and hill forest Lifeform: terrestrial or lithophytic
100	*Pomatocalpa diffusum* Breda (Synonym: *Pomatocalpa latifolium* (Lindl.) J.J.Sm.) General Distribution: Peninsula Thailand and Malesia Distribution in Peninsular Malaysia: Widespread; lowland forest Lifeform: Epiphytic
101	*Renanthera histrionica* Rchb.f. (Synonym: *Renantherella histrionica* (Rchb.f.) Ridl.) General Distribution: Peninsula Thailand to Peninsular Malaysia Distribution in Peninsular Malaysia: Quite widespread; lowland and hill forest Lifeform: Epiphytic
102	*Rhynchostylis* sp. Distribution in Peninsular Malaysia: Gunung Ledang; hill forest Lifeform: Epiphytic
103	*Spathoglottis aurea* Lindl. General Distribution: Southeast Indo-China to West New Guinea Distribution in Peninsular Malaysia: Widespread; grassy places in the mountains at 900-1300 m Lifeform: Terrestrial
104	*Spathoglottis plicata* Blume General Distribution: Tropical and Subtropical Asia to Pacific Distribution in Peninsular Malaysia: Widespread and common; grassy places to 700 m Lifeform: Terrestrial or lithophytic
105	*Stichorkis gibbosa* (Finet) J.J.Wood General Distribution: Tropical Asia to Southwest Pacific Distribution in Peninsular Malaysia: Widespread; lowland forest Lifeform: Epiphytic
106	*Strongyleria pannea* (Lindl.) Schuit. General Distribution: East Himalaya to South China and West Malesia Distribution in Peninsular Malaysia: Common in the south; montane forest Lifeform: Epiphytic
107	*Tainia maingayi* Hook.f. General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: North of peninsula; montane forest Lifeform: Terrestrial

Table 2 (*continue*)

No.	Species
108	*Thecopus maingayi* (Hook.f.) Seidenf. General Distribution: South Indo-China to West Malesia Distribution in Peninsular Malaysia: Malacca; lowland forest Lifeform: Epiphytic
109	*Tainia speciosa* Blume General Distribution: Thailand to West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Terrestrial
110	*Thrixspermum* sp. Distribution in Peninsular Malaysia: Gunung Ledang; montane forest Lifeform: Epiphytic
111	*Trichotosia ferox* Blume General Distribution: Thailand to West and South Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
112	*Trichotosia gracilis* (Hook.f.) Kraenzl. General Distribution: Indo-China to West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
113	*Trichotosia pauciflora* Blume General Distribution: Thailand to West Malesia and Lesser Sunda Island (Bali) Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
114	*Trichotosia poculata* (Ridl.) Kraenzl. General Distribution: West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
115	*Trichotosia velutina* (Lodd. ex Lindl.) Kraenzl. General Distribution: Arunachal Pradesh to West Malesia Distribution in Peninsular Malaysia: Widespread and common; montane forest Lifeform: Epiphytic
116	*Trichotosia vestita* (Wall. ex Lindl.) Kraenzl. General Distribution: West Malesia Distribution in Peninsular Malaysia: Widespread; montane forest Lifeform: Epiphytic
117	*Tropidia angulosa* (Lindl.) Blume General Distribution: Bhutan to South China and Lesser Sunda Island (Bali) Distribution in Peninsular Malaysia: Perak; lowland and montane forest Lifeform: Terrestrial
118	*Tropidia curculigoides* Lindl. General Distribution: East Himalaya to South China and West and Central Malesia Distribution in Peninsular Malaysia: Widespread; lowland and montane forest Lifeform: Terrestrial
119	*Vanilla griffithii* Rchb.f. General Distribution: Peninsula Thailand to West Malesia Distribution in Peninsular Malaysia: Widespread and common; lowland and montane forest Lifeform: Climber
120	*Zeuxine affinis* (Lindl.) Benth. ex Hook.f. General Distribution: Indian Subcontinent to Nansei-shoto and Peninsular Malaysia Distribution in Peninsular Malaysia: Gunung Jerai (Kedah), Penang Hill; montane forest Lifeform: Terrestrial
121	*Zeuxine gracilis* (Breda) Blume General Distribution: India to West Malesia Distribution in Peninsular Malaysia: Kedah, Penang, Pahang; montane forest Lifeform: Terrestrial

DISCUSSION

One of the interesting findings from this study is the discovery of a peculiar jewel orchid species from the genus *Anoectochilus* (*Anoectochilus* sp., NAJ17). Few individuals were observed to dwell dispersedly on the dampened ground rich in humus, in between the steep and narrow route from Gunung Tunduk towards the misty valley commencing the peak of Gunung Ledang (Figure 2). The population is very small and rare, growing among the more common dark-burgundy *Anoectochilus albolineatus*. The leaf is lime-green with interconnecting golden veins, which immediately can be easily mistaken with the velvety *Macodes petola*. However, during the visit, this unknown species of *Anoectochilus* is not in its flowering state that to proceed with taxonomic determination is a challenge. Vegetatively, the species closely resembles *Anoectochilus roxburghii* which is native to Indo-China. However, any detail on this discovery is put on hold until new information comes into light.

Figure 2. The undetermined orchid species from Gunung Ledang (*Anoectochilus* sp., NJ17). Photo by Nordin, F. A.

None of the two hyper-endemic species which have been listed previously by Turner (1995) were encountered in this study, proven by their narrow distribution and rarity. *Hetaeria elegans*, previously known as *H. ophirensis*, was discovered, and described by Ridley from Gunung Tunduk in 1908. Seidenfaden and Wood (1992) stated that *H. elegans* may be conspecific with *H. elata*, the sister species that was found to grow quite abundantly on the rich humus along the route to the bare rocky area in Gunung Tunduk at about 1200 m above sea level. Thus, more research needs to be done to resolve the taxonomic questions between the two species.

In a nutshell, Gunung Ledang was proven to be rich and diverse with its orchid flora, with Ridley's historical routes *via* Gunung Tunduk, the Lagenda Trail *via* Batu Orkid, and the peak of Gunung Ledang offer myriads of interesting discoveries. Some of the enchanting beauties are shown in Figure 3A-L. The higher peaks of Gunung Ledang were occasionally clouded in mist during the day, making them as desirable habitats for the montane orchid species. Meanwhile, the Ulu Jementah Trail *via* Jeram Tinggi worth the exploration, however fewer orchid species were counted at the lower levels of the forest. The route begins to be consistently rich with orchid species as the ascent commences Gunung Mahligai towards the peak of Gunung Ledang.

By contribution, this paper provides an updated account on the diversity of orchids in Gunung Ledang, listing 122 species of orchids, of which eight are endemic to

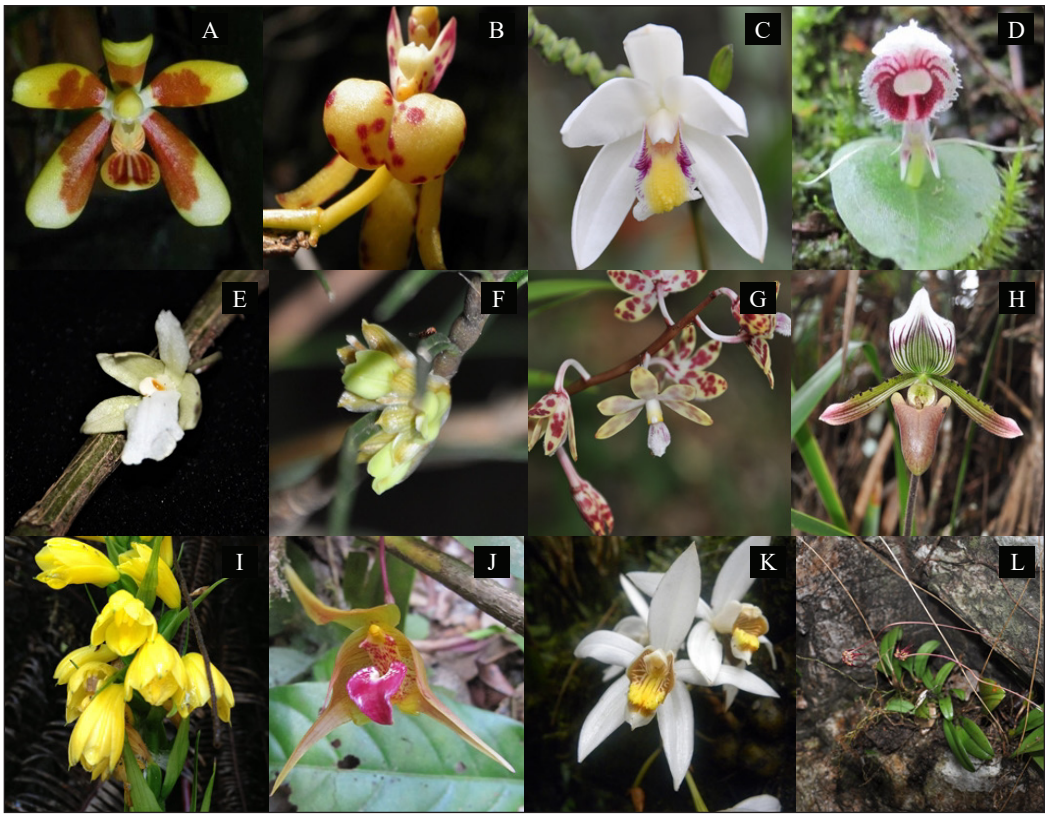

Figure 3. Myriads of orchid species from Gunung Ledang, (A) *Phalaenopsis fuscata*, (B) *Renanthera histrionica*, (C) *Bromheadia finlaysoniana*, (D) *Corybas carinatus*, (E) *Dendrobium derryi*, (F) *Dendrobium villosulum*, (G) *Dipodium conduplicatum*, (H) *Paphiopedilum barbatum*, (I) *Neuwiedia veratrifolia*, (J) *Bulbophyllum uniflorum*, (K) *Coelogyne kaliana*, and (L) *Bulbophyllum gracillimum*. Photos by Nordin, F. A.

Peninsular Malaysia, two are hyper-endemic known only from Gunung Ledang, 30 were recognised as new records, and one species needs further taxonomic clarification.

CONCLUSION

Gunung Ledang exhibits a great diversity of orchids with Ridley's historical routes were revisited and new captivating routes were explored. The 122 species in 62 genera portrayed the exceptionally rich orchid flora found on the mountain region. The decision to gazette the forests of Gunung Ledang as a national park has ensured the conservation of the rich and unique biodiversity represented in these still pristine forest areas, and especially the survival of the notable orchids as floristic heritage.

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