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A Reassessment of the Flora of Gunung Ulu Kali, Genting Highlands, Malaysia—Preliminary Findings And Trends

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Abstract. The summit flora of Gunung Ulu Kali (1758m above sea level), Malaysia was reassessed following the last study 25 years previously. Employing similar methodology with necessary changes to accomodate dramatic changes in the landscape and the loss of forest areas, the study aimed to document floristic diversity in comparison with that enumerated 25 years previously. The results are largely based on data collected from two plots and from Angiosperm, Gymnosperm and Pteridophyte families found. The change in floristic diversity is discussed with additional information on the relative abundance of species.

INTRODUCTION

The mountainous regions of Malaya have been, for a long time, a lure for botanists and naturalists alike. In the colonial times, many summits were explored for their natural beauty, flora and fauna. Floristic descriptions of some of the more popular mountains such as Gunung Tahan (Ridley 1915; Strugnell and Mead 1937), Gunung Korbu (Mead and Symington 1933), Maxwell Hill (Burkill and Henderson 1925), Fraser's Hill (Burkill and Holttum1923), Kedah Peak (Ridley 1900), Gunung Benom (Strugnell and Willbourn 1931), Gunung Belumut (Holttum 1924), Gunung Mengkuang Lebah (Ridley 1914) and Gunung Tapis (Symington 1936) were already available in the first half of the twentieth century. Since then, there have been very few comprehensive accounts on the montane flora in Malaya (Null 1972; Kochummen 1982; Kiew 1991; Kiew 1998). In the attempt to compile a more recent account of the flora of Malayan mountains, the late Dr. Benjamin C. Stone initiated a study on the summit flora of Gunung Ulu Kali. The summit, situated at the southern tip of the Main Range, is located at Genting Highlands, a highland area already accessible by road.

The floristic work at Gunung Ulu Kali was carried out in the late 1960s and early 1970s and covered floristic sampling of Angiosperms, Gymnosperms, Pteridophytes and Bryophytes (Null 1972; Stone 1981). This present study aims to reassess the floristic diversity of the summit area after 25 years. Genting Highlands, an area that encompasses two other summits, Gunung Purun and Gunung Lari Tembakau, was already earmarked for development since the 1960s and the

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subsequent years saw drastic changes in its landscape. The lower slopes of Gunung Ulu Kali, especially, have undergone the most rapid development and hence the loss of forested areas. Comparisons with previous floristic accounts are likely to provide some interesting perspectives in terms of changes in floristic diversity in the face of habitat losses resulting from development pressure.

MATERIALS AND METHODS

Gunung Ulu Kali (Lat. 3° 26'N, Long. 101° 47'E) is 1758m above sea level. The physical characteristics of the summit area such as soils, climate and general vegetation have been described by Null (1972) and Stone (1981). The mean monthly air temperature during 1994–1995 was 19.7 °C with a mean annual rainfall of 3534mm and a mean relative humidity of 53.7% (Resorts World Sdn. Bhd., pers. comm.).

The methodology employed in the reassessment of the summit flora of Gunung Ulu Kali was similar to the one cited in Stone (1981). Stone (1981) established nine plots between 1576m and 1757m asl, each 30m x 10m in size. The authors discovered that at least four of the former plots could not be re-established as the forest area was no longer in existence and had been replaced with buildings. Also, Stone failed to mention the position of one plot (plot E) in the account. The present nine plots, although being of the same size and elevation range, were not sited at the original sites. The differences in grid position between the original and present plots are not critical, since what was intended in these two studies was to determine the species composition, general structure and physiognomy of the area. It must be noted that the present plots were placed as randomly as allowable by the limited forest area. The forest around the summit now covers a very small area and the fragment is completely surrounded by buildings and other structure.

Two plots were enumerated during the first half of 1997 and the remaining seven plots were enumerated later. All species encountered in the plots were vouchered and lodged at the KEP Herbarium in FRIM. For the convenience of reporting, 1972 is referred to as the year of enumeration for the original study although the actual work was carried out from the 1960s and into the early 1970s. Only the 1997 listing of species is reported in this paper. Another important component of the present study is the attempt to locate species no longer present in the plots in the surrounding forest areas. The plant search was, however, confined to the upper montane vegetation type.

All higher plants (Angiosperms, Gymnosperms and Pteridophytes) in the plots were enumerated and their abundance noted. The diameter of trees above 5cm diameter at breast height (dbh) was measured. The presence of flowering and/or fruiting was also noted. The results reported below were based on the enumeration of selected plant families occurring in two plots. Although the remaining families in those plots and families in other plots have been enumerated, the specimens have not yet been identified to species level and are therefore not discussed here. In addition, quantitative assessments related to abundance, mean basal area and dominance are not discussed here as the project is on-going. Qualitative field

observations, such as those involving bryophytes which are not assessed in the study, are, however, briefly mentioned. Taxon names have been updated where necessary (Turner 1995; Parris and Latiff 1997).

RESULTS

Table 1 shows the diversity of families found in two plots of 0.03ha each at Gunung Ulu Kali in 1997. Appendix 1 lists the plant species that have been possible to identify so far. Of the species found in the present plots, 47.2% are endemic to Peninsular Malaysia. The high percentage of endemic species in a relatively small area of a forest fragment reflects the inherently high levels of endemicity in this vegetation type. These endemics include both tree and herbaceous species. Families listed previously by Stone (1981) as most diverse are also families presently having the highest diversity. This is perhaps not surprising as such families contain large numbers of montane species.

Table 1. List of families occurring at Gunung Ulu Kali in 1997.

Family	1997 *		
	No. genera	No. species	No. endemic spp.**
Apocynaceae	1	1	1
Aquifoliaceae	1	5	4
Araliaceae	2	2	2
Caprifoliaceae	1	1	0
Cunoniaceae	1	1	0
Cyatheaceae	1	2	na
Cyperaceae	1	1	na
Daphniphyllaceae	1	1	0
Elaeocarpaceae	1	2	1
Epacridaceae	1	1	0
Ericaceae	3	5	2
Escalloniaceae	1	1	1
Euphorbiaceae	1	1	0
Fagaceae	1	1	0
Gesneriaceae	1	1	1
Gleicheniaceae	1	1	0
Gnetaceae	1	1	0
Grammitidaceae	1	1	0
Guttiferae	2	2	2
Hymenophyllaceae	3	3	0
Lauraceae	6	10	6
Liliaceae	2	2	0
Loganiaceae	1	1	0
Matoniaceae	1	1	0

Family	1997 *		
	No. genera	No. species	No. endemic spp.**
Melastomataceae	4	5	2
Moraceae	1	1	0
Myrsinaceae	4	4	3
Myrtaceae	4	8	5
Nepenthaceae	1	3	3
Oleaceae	1	1	1
Orchidaceae	4	5	na
Palmae	2	2	2
Pandanaceae	2	2	1
Pentaphylacaceae	1	1	0
Piperaceae	1	2	na
Pittosporaceae	1	1	0
Plantaginaceae	1	1	0
Podocarpaceae	1	1	1
Polygalaceae	1	1	1
Polypodiaceae	2	3	1
Rhizophoraceae	1	2	0
Rosaceae	2	2	0
Rubiaceae	5	7	4
Rutaceae	2	2	1
Sapindaceae	1	1	na
Selaginellaceae	1	1	na
Smilacaceae	1	3	na
Symplocaceae	1	1	1
Theaceae	3	4	3
Thelypteridaceae	1	1	1
Vittariaceae	1	1	0

* based on two plots only. A few more families, mainly pteridophytes, Gramineae and Zingiberaceae are present but not reported here as their species have yet to be identified.

** does not include species whose status of endemism is doubtful; na = not available as some taxa cannot be identified to species level.

Species restricted to Gunung Ulu Kali and its neighbouring mountains, such as *Neolitsea coccinea*, *Arthrophyllum stonei*, *Garcinia cantleyana* var *grandifolia* and *Syzygium rhomboideum* have been located in both plots. The abundance of these species in the plots is given in Table 2. Only one species, *Sonerila ramosa*, previously described by Stone (1981) could not be found in the plots. This, however, does not imply that it does not exist in the study area as a thorough search has yet to be conducted. *Sonerila ramosa* can be found in abundance in neighbouring mountains such as Gunung Purun and Gunung Lari Tembakau.

Table 2. Preliminary list of species confined to Gunung Ulu Kali and the surrounding montane forest.

Family	Species	Abundance (Average no. stems/plot*)
Araliaceae	*Arthrophyllum stonei* A.L.Lim	27.5
Guttiferae	*Garcinia cantleyana* Whitmore var *grandifolia* Whitm.	8.5
Lauraceae	*Neolitsea coccinea* B.C. Stone	32.5
Melastomataceae	*Sonerila ramosa* Ridl.	Not found
Myrtaceae	*Syzygium rhomboideum* (Ridl) I.M.Turner	1.0

* plot size is 0.03ha.

Gunung Ulu Kali also houses many other rare species endemic to Peninsular Malaysia (Table 3). *Vaccinium whitmorei, Oxyspora hispida, Phyllagathis magnifica, Syzygium tahanense* and *S. spissifolium* were recorded in the 1972 enumeration but were not located in both plots in the present study.

Table 3: Preliminary list of rare species endemic to Peninsular Malaysia, found at Gunung Ulu Kali in 1997.

Family	Species
Aquifoliaceae	*Ilex myrtillis* Ridl. (known only from Genting Highlands and Fraser's Hill) *I. patens* Ridl. (known only from Genting Highlands, Gunung Tahan and Gunung Jerai)
Araliaceae	*Schefflera singularis* B.C. Stone (known only from Genting Highlands and Fraser's Hill)
Ericaceae	*Vaccinium whitmorei* Ng (known only from Genting Highlands and Fraser's Hill)
Escalloniaceae	*Polyosma nullii* B.C. Stone (known only from Genting Highlands and Gunung Benom)
Guttiferae	*Calophyllum rotundifolium* Ridl. (known only from Genting Highlands and Gunung Mengkuang Lebah)
Lauraceae	*Lindera concinna* Ridl. var. *concinna* (known only from Genting Highlands and Gunung Tahan)
Melastomataceae	*Medinilla selangorensis* J.F. Maxwell (known only from Genting Highlands and Gunung Mengkuang Lebah) *Oxyspora hispida* Ridl. (known only from Genting Highlands, Gunung Mengkuang Lebah and Gunung Beremban) *Phyllagathis magnifica* A. Weber (known only from Genting Highlands an Gunung Bujang Melaka)
Myrtaceae	*Syzygium tahanense* (Ridl.) I.M. Turner (known only from Genting Highlands and Gunung Tahan) *Syzygium spissifolium* (Ridl.) I.M. Turner (known only from Genting Highlands)

Note: Genting Highlands is the common name for the general area including a group of summits around Gunung Ulu Kali including their ridges. The actual boundary of Genting Highlands has not been critically defined.

Table 4 provides a list of the most common species found in both plots. The most common species, the herbaceous *Argostemma yappii*, has an average of 104 stems per 0.03ha (3467 stems/ha). This and the second most common species, *Timonius oreophilus* at an average of 103 stems per 0.03ha (3433 stems/ha), places Rubiaceae as the most common family encountered. Species characteristic of the upper montane forests of Malaya such as *Ilex triflora* (Aquifoliaceae), *Dacrydium comosum* (Podocarpaceae), *Rhododendron malayanum* (Ericaceae), *Ficus deltoidea* (Moraceae) and *Pentaphylax euryoides* (Pentaphylaceae) are common in the plot area (Table 4).

Table 4. Some common species present in the two plots at the Summit of Gunung Ulu Kali in 1997.

Species	Family	Total no. stems	Average no. stems/plot*
Argostemma yappii	Rubiaceae	208	104
Timonius oreophilus	Rubiaceae	206	103
Pentaphylax euryoides	Pentaphylaceae	202	101
Syzygium stapfianum	Myrtaceae	148	74
Ficus deltoidea var. *intermedia*	Moraceae	143	71.5
Lindera concinna	Lauraceae	140	70
Elaeocarpus nanus	Elaeocarpaceae	121	60.5
Polygala oreotrephes	Polygalaceae	110	55
Embelia myrtillus	Myrsinaceae	93	46.5
Syzygium wrayi	Myrtaceae	84	42
Rapanea perakensis	Myrsinaceae	77	38.5
Neolitsea coccinea	Lauraceae	65	32.5
Ilex triflora	Aquifoliaceae	53	26.5
Rhododendron malayanum	Ericaceae	51	25.5
Dacrydium comosum	Podocarpaceae	49	24.5

* plot size is 0.03 ha.

Table 5 provides the list of species occurring in very low numbers in the plot areas. Species characteristic of exposed areas in montane forests such as *Dipteris conjugata* (Dipteridaceae) and *Exbucklandia populnea* (Hamamelidaceae) are no longer present in the plots but are locally abundant in the surrounding forest. In the 1972 enumeration, Orchidaceae with 43 species was the top-ranking family in terms of species diversity (Stone 1981); in 1997 only six species were found in both plots. However, due to the small number of plots enumerated, we expect this number to be eventually higher. Another disappearance from the present plot areas is *Lycopodiella cernua* (L.) Pic. Serm., cited to be common in 1972 (common was defined as having between 15 to 29 stems per m^2) (Stone 1981).

Table 5. Species present in numbers less than five individuals, found in both plots* at Gunung Ulu Kali in 1997.

Species	Family	Total no. stems
Viburnum sambucinum	Caprifoliaceae	1
Cyathea lurida	Cyatheaceae	1
Styphelia malayana	Epacridaceae	1
Vaccinium scortechinii	Ericaceae	1
Mecodium exsertum	Hymenophyllaceae	1
Matonia pectinata	Matoniaceae	1
Syzygium rhomboideum	Myrtaceae	1
Tristaniopsis razakiana	Myrtaceae	1
Timonius flavescens	Rubiaceae	1
Melicope pachyphylla	Rutaceae	1
Selaginella sp.	Selaginellaceae	1
Eurya nitida	Theaceae	1
Gordonia maingayi	Theaceae	1
Vittaria angustifolia	Vittariaceae	1
Elaeocarpus mastersii	Elaeocarpaceae	2
Cinnamomum cuspidatum	Lauraceae	2
Phymatosorus nigrescens	Polypodiaceae	2
Ophiorrhiza communis	Rubiaceae	2
Ilex patens	Aquifoliaceae	3
Austrobuxus nitidus	Euphorbiaceae	3
Xiphopteris hieronymusii	Grammitidaceae	3

* plot size is 0.03ha.

DISCUSSION

During the 1997 enumeration exercise, it was noted that much of the herbaceous ground flora in both plots and their surrounding areas was represented by a few species. These species, including *Argostemma yappii* are very common where they occur. The ubiquitous components of the tropical upper montane forests, the ferns and bryophytes (Whitmore 1986; Null 1972), are, however, less conspicuous at Gunung Ulu Kali now. In his 1972 account on the phytosociology of selected Malayan mountains, Null mentioned that Ulu Kali, like many other summits in Malaya, had a typical phanero-chamaephyte phytoclimate. The abundance and diversity of terrestrial and epiphytic bryophytes and pteridophytes such as filmy hymenophylls, schizeaes, stag-horn ferns and bird-nest ferns at the summit were so great that they were the most noticeable of all life forms (Null 1972). Now, visual comparisons between Ulu Kali and other undisturbed montane forest areas around Genting Highlands show a lack of such groups of plants at the summit area.

In undisturbed tropical montane forests, most of the chamaephytes inhabit damp places with low light levels. These plant forms have evolved and adapted to this environment. Drifts in the composition of chamaephytes signal some form of change in the physical environment. The authors suspect that this has taken place at Gunung Ulu Kali, judging by their poor representation. The authors further suspect that among the many environmental components, microclimate is likely a component that has undergone significant changes. This is simply because the forest area has been severely fragmented into small pieces. The understorey microclimate near a forest edge has been shown to be hotter and drier than that in a continuous forest (Kapos 1989; Ranney et al.1981; Williams-Linera 1990; Camargo and Kapos 1995). Although the extent of edge influences into the forest is difficult to determine because of complications from other factors (Camargo and Kapos 1995), hygromorphic or semi-hygromorphic plant species which had previously been living in deep shade but now forced to live close to forest edges, would be severely affected (Kiew 1991). That is why hygromorphic plants such as the tiny, delicate filmy ferns of Hymenophyllaceae, are no longer found along forest edges. Prolonged loss of moisture retention capacity in the forest would affect other less sensitive plants such as the terrestrial herbaceous species. This perhaps explains why some of the species that no longer occur at the summit area of Ulu Kali are found in larger forest fragments close by. The changes in species composition clearly indicate that there have been immense environmental changes at Gunung Ulu Kali.

Although species composition at the summit area is changing, it is difficult to determine at this point in time, the actual loss, recruitment or persistence of species. In the case of species confined to Gunung Ulu Kali, the relative abundance of *Neolitsea coccinea* and *Garcinia cantleyana* var *grandifolia* compared to a small number of *Syzygium rhomboideum* and the absence of *Sonerila ramosa* may indicate differing biological responses and reproduction capacity to long-term physical changes in the microhabitat. The preliminary results suggest that while physical changes arising from forest fragmentation may have some negative influences on the populations of certain plant species, others can still continue to grow and reproduce.

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APPENDIX I

Listing of species in two plots at Gunung Ulu Kali in 1997

	Family	Species
Ferns and fern allies	Selaginellaceae	*Selaginella* sp.
	Cyatheaceae	*Cyathea* sp.
		C. lurida (Blume) Copel.
	Gleicheniaceae	*Sticherus hirtus* (Blume) Ching
	Grammitidaceae	*Xiphopteris hieronymusii* (C.Chr.) Holttum
	Hymenophyllaceae	*Macroglena meifolia* (Bory *ex* Willd.) Copel.
		Mecodium exsertum (Wall. *ex* Hook.) Copel.
		Meringium bakeri (Copel.) Copel.
	Matoniaceae	*Matonia pectinata* R.Br.
	Polypodiaceae	*Phymatosorus nigrescens* (Bl.) Pic. Serm.
		Selliguea stenophylla (Blume) Parris
		S. wrayi (Baker) Parris comb. nov.
	Thelypteridaceae	*Coryphopteris pectiniformis* (C. Chr.) Holttum
	Vittariaceae	*Vittaria angustifolia* Blume
Gymnosperms	Gnetaceae	*Gnetum gnemon* L.
	Podocarpaceae	*Dacrydium comosum* Corner
Monocotyledons	Cyperaceae	*Gahnia baniensis* Benl
	Hypoxidaceae	*Molineria latifolia* (Dryand.) Herb. *ex* Kurz
	Liliaceae	*Dianella javanica* (Blume) Kunth
	Orchidaceae	*Apostasia* sp.
		Coelogyne sp.
		Dendrochilum linearifolium Hook.*f.*
		Liparis sp 1
		Liparis sp 2
	Palmae	*Pinanga polymorpha* Becc.
		Calamus viridispinus Becc.
	Pandanaceae	*Freycinetia sumatrana* Hemsl.
		Pandanus klossii Ridl.
	Smilacaceae	*Smilax* sp.
		S. calophylla Wall. *ex* A. DC.
		S. lanceifolia Roxb.
	Zingiberaceae	*Camptandra ovata*
Dicotyledons	Apocynaceae	*Alyxia oleifolia* King & Gamble var. *oleifolia*
	Aquifoliaceae	*Ilex epiphytica* King
		I. illustris Ridl.
		I. myrtillis Ridl.
		I. patens Ridl.
		I. triflora Blume
	Araliaceae	*Arthrophyllum stonei* Lim
		Schefflera singularis B.C. Stone
	Caprifoliaceae	*Vibrunum sambucinum* Blume
	Cunoniaceae	*Weinmannia fraxinea* (D. Don) Miq.

Family	Species
Daphniphyllaceae	*Daphniphyllum glaucescens* Blume ssp. *lancifolium*
	D. glaucescens Blume ssp. *scortechinii*
Elaeocarpaceae	*Elaeocarpus mastersii* King
	E. nanus Corner
Epacridaceae	*Styphelia malayana* (Jack) Spr.
Ericaceae	*Diplycosia pseudorufescens* Sleumer
	Rhododendron malayanum Jack
	R. scortechinii King & Gamble
	Vaccinium scortechinii King & Gamble
	V. viscifolium King & Gamble
Escalloniaceae	*Polyosma nullii* Stone
Euphorbiaceae	*Austrobuxus nitidus* Miq.
Fagaceae	*Lithocarpus lampadarius* (Gamble) A. Camus
Gesneriaceae	*Henckelia hispida* (Ridl.) A. Weber
Guttiferae	*Calophyllum rotundifolium* Ridl.
	Garcinia cantleyana Whitm. var *grandifolia* Whitm.
Lauraceae	*Actinodaphne* sp.
	Alseodaphne sp.
	Cinnamomum aureofulvum Gamble
	C. cordatum Kosterm.
	C. cuspidatum Miq.
	Lindera caesia Blume
	L. concinna Ridl.
	L. montana Ridl.
	Litsea acrantha Ridl.
	Neolitsea coccinea B.C. Stone
Loganiaceae	*Fagraea gardenioides* Ridl.
Melastomataceae	*Dissochaeta spectabilis* J.F. Maxwell
	Medinilla clarkei King
	M. selangorensis J.F. Maxwell
	Melastoma malabathricum L.
	Anerincleistus grandiflorus Ridl.
Moraceae	*Ficus deltoidea* Jack var. *intermedia* Corner
Myrsinaceae	*Ardisia rosea* King & Gamble
	Embelia myrtillus Kurz
	Labisia paucifolia King & Gamble
	Rapanea perakensis (King & Gamble) B.C. Stone
Myrtaceae	*Leptospermum amboinense* Blume
	Rhodamnia cinerea Jack
	Syzygium napiforme (Koord. & Valeton) Merr. & L.M. Perry
	S. spissifolium (Ridl.) I.M. Turner
	S. stapfianum (King) I.M. Turner
	S. wrayi (King) I.M. Turner
	S. rhomboideum (Ridl) I.M.Turner
	Tristaniopsis razakiana (Kochummen) Peter G. Wilson & J.T. Waterh.

Family	Species
Nepenthaceae	*Nepenthes gracillima* Ridl.
	N. macfarlanei Hemsl.
	N. sanguinea Lindl.
Oleaceae	*Chionanthus caudifolius* (Ridl.) Kiew
Pentaphylacaceae	*Pentaphylax euryoides* Gardner & Champ.
Piperaceae	*Piper* sp 1
	Piper sp 2
Pittosporaceae	*Pittosporum reticosum* Ridl.
Plantaginaceae	*Plantago major* L.
Polygalaceae	*Polygala oreotrephes* B.L. Burtt
Rhizophoraceae	*Carallia eugenioidea* King
	C. brachiata (Lour.) Merr.
Rosaceae	*Prunus arborea* (Blume) Kalkman
	Rubus moluccanus L.
Rubiaceae	*Argostemma yappii* King
	Psychotria tahanica I.M. Turner
	Ophiorrhiza communis Ridl.
	Psychotria condensa King & Gamble
	P. sarmentosa Blume
	Timonius flavescens (Jack) Baker
	T. oreophilus Ridl.
Rutaceae	*Melicope pachyphylla* (Blume) T.G. Hartley
	Melicope lunu-ankenda (Gaertn.) T.G. Hartley
Sapindaceae	*Guioa* sp. 1
Symplocaceae	*Symplocos ophirensis* C.B. Clarke ssp *ophirensis*
Theaceae	*Eurya nitida* Korth.
	Gordonia maingayi Dyer
	Ternstroemia maclellandiana Ridl.
	T. penangiana Choisy