

Checklist of vascular plants of Klang Gates Quartz Ridge, Malaysia, a 14-km long quartz dyke

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Abstract

The Klang Gates Quartz Ridge (KGQR) is proposed for protection as National Heritage and as a UNESCO World Heritage Site because of its spectacular size, exceptional beauty and significant biodiversity. The checklist of vascular plants documents 314 species that comprise a unique combination that grows on lowland quartz and that is distinct from the surrounding lowland equatorial rain forest by the absence of orchids, palms, gingers and tree canopy families. The Rubiaceae, Gramineae, Moraceae, Apocynaceae, Melastomataceae and Polypodiaceae are the most speciose families. The summit vegetation at 200–400 m elevation is dominated by *Baeckea frutescens* (Myrtaceae) and *Rhodoleia championii* (Hamamelidaceae) and shows similarities to the plant community on rocky mountain peaks above 1500 m. About 11% of its species are endemic in Peninsular Malaysia and four are endemic to KGQR: *Aleisanthia rupestris* (Rubiaceae), *Codonoboea primulina* (Gesneriaceae), *Spermacoce pilulifera* (Rubiaceae), and *Ilex praetermissa* (Aquifoliaceae). All four are provisionally assessed as Critically Endangered. Two, *Eulalia milsumi* (Gramineae) and *Sonerila prostrata* (Melastomataceae), are endemic to KGQR and a few neighbouring smaller quartz dykes. They are assessed as Endangered. The KGQR is a fragile habitat and conservation management is urgently required to halt the spread of the aggressive alien grass, *Pennisetum polystachion* and to prevent further habitat degradation from visitors. Based on KGQR being a threatened habitat, its biodiverse flora, and endangered species, it qualifies as an Important Plant Area.

Keywords

Alien species, endangered species, endemic species, flora, Important Plant Area, quartz dyke, Selangor, UNESCO World Heritage Site

Introduction

The Klang Gates Quartz Ridge (KGQR), renamed Gombak Selangor Quartz Ridge (Mohd.-Zainuddin 2015), is a 14 km-long quartz dyke (3.12N, 101.42E to 3.15N, 101.48E) 12 km northeast of Kuala Lumpur in the state of Selangor, Malaysia. Rising to about 400 m, it dominates the skyline north of Kuala Lumpur and is believed to be the longest exposed quartz dyke in the world. Running from east to west, it is flanked to the north by the Hulu Gombak Forest Reserve Extensions and the Klang Gates Dam, a large reservoir covering 207 ha that supplies water to the capital, Kuala Lumpur. To the south, it is increasingly exposed to human disturbance.

Composed of pure quartz, the dyke was exposed as the surrounding granite material weathered away revealing sheer pale grey or white vertical cliffs rising above the surrounding vegetation. Though about 200 m wide at the base, in places the summit ridge is a knife edge only a metre or so wide with precipitous drops on either side. Jagged like a dragon's spine, it is dissected by vertical faults giving it the appearance of limestone karst, so it has been termed a pseudo-karst formation. It is pierced by three rivers that flow through narrow gullies. The pure quartz weathers to coarse sand that is very nutrient poor, has poor water retention, and has crumbled to form a steep base of colluvium with 30–35° and in places up to 60° slopes.

Adaptation to the extremely poor nutrient status and water retention has resulted in a distinctive flora with a unique assemblage of plants that includes several rare and/or endemic species restricted to the KGQR. It is markedly different from the surrounding tropical lowland rain forest not only in species composition, but also in physiognomy (with sparse stunted trees), complexity (not multi-layered and without the epiphyte flora) and lower species diversity (Saw 2010).

Its striking topography and unique flora have long attracted botanists. The first botanical collections were made by H.N. Ridley, who made three visits in 1908, 1916 and 1921 that mainly concentrated on the summit ridge flora. He wrote the first account of the flora (Ridley 1922a), describing ten new species. Henderson (1928) produced the first comprehensive listing of plants from the KGQR included in his checklist of the flowering plants of Kuala Lumpur. It was based on collections made by Forestry Department staff, in particular by Mohd Hashim in 1908, and by H.L. Hume, employed by the Federated Malay States Museum, in 1921, who discovered the new species, *Hydnocarpus humei*, that was named in his honour. Subsequently, the herbarium collection of the Federated Malay States Museum was loaned indefinitely to the Singapore Botanic Gardens Herbarium (Henderson 1928). Henderson's listing of 265 species provided the most complete inventory of the vegetation on the steep slopes that were still forested in those days. Unfortunately, Henderson did not cite specimens. Later significant collections were made by staff of the Forest Research Institute Malaysia, principally by E.J. Strugnell in 1927 and C.F. Symington in 1933, 1935 and 1939. After a long hiatus, Kiew (1978) described a new species, *Ilex praetermissa*, she had discovered and produced the third account of the flora (Kiew 1982) based on her collections made between 1977–1982 and included for the first time a checklist of ferns collected by B. Molesworth-Allen and A.G. Piggott, who recorded *Syngramma dayi*, a fern restricted to quartz habitats.

Effect of Human Activities on the Flora of KGQR

Being so close to the capital Kuala Lumpur, it has suffered disturbance from agricultural activities, urbanisation, visitor pressure, and the invasion of alien weeds. All these activities threaten the continued existence of its flora and species of conservation importance. On the Kuala Lumpur side, encroachment from housing and road building threatens. The north side is protected by the Hulu Gombak Forest Reserve Extensions and the Klang Gates Dam.

Agricultural activities were a particular problem in the 1970s and 1980s (Kiew 1982; Perumal 1992) when there was widespread clearing of sections of the steep base on the south side to plant bananas and pineapple. Clearing the land by burning the vegetation got out of control and the 5 m-tall *Baeckea frutescens* trees were burned to the ground together with thick festoons up to half a metre long of the old man's beard lichen, *Usnea* sp. Fortunately, *B. frutescens* regenerated from seed and suckers but after 30 years the old man's beard lichen has not re-established (Kiew pers. obs.). *Rhodoleia championii* (Figure 1) survived the fires with only its leaves being scorched, but in contrast the sappy *Fagraea auriculata* was totally destroyed. Due to the nutrient-poor soil, these agricultural activities failed and the area was quickly invaded by weeds of which the most damaging was the grass *Imperata cylindrica*, a fire hazard because it becomes tinder-dry in dry weather and fuelled fires on the lower slopes.

The impact of urbanisation began with the building of a bungalow in 1883 on the top of the ridge above the gully through which the Klang River flows. Between 1893 and 1895



Figure 1. *Rhodoleia championii*, one of the dominant tree species on the summit.

this gully was dammed to form a reservoir (Barlow 1995). By 1926, the bungalow had become derelict and today any sign of it has almost disappeared, although a few garden plants still persist with the patch of the native *Eriachne pallescens* grass indicating where the bungalow once stood (Kiew 1982). In the 1950s a quarry was established at the western end to utilise the quartz for glass making. It had only a very local impact and was discontinued due to lack of commercial viability. The expanding population of Kuala Lumpur required a greater water supply that resulted in enlargement of the Klang Gates Dam to its present size. This caused some local damage. Housing developments continue to creep ever closer to the KGQR. The major Kuala Lumpur-Karak Highway cuts through the western end. In 2016, a major highway development, the Eastern Klang Valley Expressway, threatened its integrity but due to public protest was re-routed away from the KGQR.

The KGQR's easy accessibility and proximity to Kuala Lumpur has long encouraged rock climbers and hikers who are rewarded by a panoramic view of the Kuala Lumpur skyline in one direction and the reservoir lake and virgin rain forest in the other (Figure 2). Unfortunately, increasing visitor pressure has its negative effects including cutting down trees for camp fires (Perumal 1992). In the 1980s it was still possible to see quartz crystals 7–10 cm long, but these have long since been taken by visitors. Notable too is the disappearance from easily accessible places of *Eurycoma longifolia*, formerly a striking plant on the summit (Kiew 1982). Local Malays believe it to be a powerful aphrodisiac. The spider orchid, *Renanthera* sp., reported by Adams (1953) is also long gone. Both are the prey of opportunistic collecting by visitors. However, they may persist on inaccessible peaks.



Figure 2. View of the eastern ridge of Klang Gates Quartz Ridge from summit of western ridge, the summit (foreground) dominated by 2–3 m tall *Baeckea frutescens*.

The natural open nature of the KGQR flora makes it vulnerable to invasion by weeds. Formally, it was an island surrounded by rain forest that acted as a buffer against weed dispersal. Now this has gone from the southern side, so the KGQR is open to invasion by any weed that can withstand harsh conditions for plant growth. The agricultural activities mentioned above led to a great increase in the number of weed species recorded from the KGQR (Kiew 1982). After the initial invasion by *Imperata cylindrica*, by the 1990s Wong et al. (2010) reported that the aggressive fern *Dicranopteris linearis* covered large areas, the composite *Chromolaena odorata*, the shrub *Clidemia birta*, the secondary forest tree *Cyrtophyllum fragrans* and a variety of grasses were already established.

Legal Protection

In 1936, 130 ha of the KGQR were gazetted as the Klang Gates Wildlife Reserve to protect all wildlife and in particular the serow, *Capricornis sumatraensis*, a totally protected animal in Malaysia (Perumal 1992). Over the years, KGQR has been proposed to be designated as a National Nature Monument (in 1974 by the Malaysian Nature Society in the Blueprint for Conservation in Peninsular Malaysia) and to be included in the Selangor Heritage Park (Wong et al. 2010). The Hulu Gombak Forest Reserve Extensions were given enhanced protection when upgraded to Permanent Reserved Forest Status and from 2007 the KGQR lies within the Selangor State Park. In June 2015, the Selangor Town and Country Planning Department (JPBD) renamed the KGQR the Gombak Selangor Quartz Ridge and committed to protect it as National Heritage and to get it declared a UNESCO World Heritage Site on the grounds that it is a world-class geological phenomenon being the longest exposed quartz dyke in the world, as well as for its spectacular size, exceptional beauty, and its importance as a significant natural habitat for *in situ* conservation of biodiversity. It is currently on the Tentative List of World Heritage Sites.

In anticipation of the KGQR becoming a UNESCO World Heritage Site, this account aims to make available essential baseline data on the unique assemblage of plants that make up its flora by providing:

- a complete checklist of vascular plant species
- details of the endemic and rare species of conservation importance
- a complete bibliography for the botany of the KGQR.

Materials and methods

Accessibility and proximity to Kuala Lumpur means that many botanists have from time to time collected plants there so its flora can be said to be well-collected. This has meant that it has been possible to build the checklist using herbarium specimen data from the herbaria at KEP, KLU and SING that hold the majority of KGQR collections.

Herbarium codes follow *Index Herbariorum* at <http://sweetgum.nybg.org/ih>. Herbarium specimens provide a permanent record and, should there be questions about a species' identity, they can be verified at any time in the future by reference to the specimen. An example of the importance of making herbarium specimens is illustrated by the case of *Hoya mappigera*, a species only described in 2011 but that had been collected from the KGQR in 1962 (*Sinclair 10730*) under the name *Hoya campanulata*.

The database software Botanical Research and Herbarium Management System (BRAHMS) in the National Herbarium of Malaysia (KEP) at the Forest Research Institute Malaysia, Selangor, Malaysia, enabled records to be extracted from its extensive holding. Not included are exotic weeds, invasive species or plants from the surrounding lowland rain forest.

For cases where species are recorded from KGQR in the literature but specimens were not cited, for instance Henderson (1928), Molesworth-Allen (1963) and Piggott (Kiew 1982), the literature source is cited in the checklist.

Results

The checklist compiled in this study contains 314 species of vascular plants in 233 genera and 105 families (Table 1, Appendix I). The most speciose families are Rubiaceae (32 species), Gramineae (15), Moraceae (14), Apocynaceae (11), Melastomataceae (10) and Polypodiaceae (10). Genera with five or more species include: *Ficus* (11 species), *Hedyotis* (5) and *Ixora* (5). About 11% (36 species) are endemic in Peninsular Malaysia. Percentage endemism is lower than the national average of about 25% for tree species (Saw 2010). Four species are endemic to KGQR and a further two endemic to KGQR and several neighbouring smaller quartz dykes.

In the checklist, four species proved to be endemic to KGQR, namely *Aleisanthia rupestris*, *Codonoboea primulina*, *Ilex praetermissa* and *Spermacoce pilulifera* (Figure 3). Following the IUCN criteria and categories (2001), these four species are all provisionally assessed as Critically Endangered under criteria CR B2ab(iii,iv) on the grounds that they are endemic in Peninsular Malaysia, where they are restricted to one locality that although it lies within the Selangor State Park is threatened by habitat degradation from visitor pressure and from invasive species. A further two species, *Eulalia milsumi* and *Sonerila prostrata*, endemic to KGQR and a few nearby smaller quartz dykes in the Gombak Valley, are provisionally assessed as Critically Endangered under criteria

Table 1. Families, genera and species of vascular plants of Klang Gates Quartz Ridge.

Group	Families	Genera	Species
Lycophytes	1	1	2
Ferns	16	24	36
Gymnosperms	1	1	1
Flowering plants	87	207	275
Total	105	233	314



Figure 3. Endemic species in Klang Gates Quartz Ridge: *Eulalia milsumi* (left) and *Aleisanthia rupestris*.

EN B2ab (iii, iv) on the grounds that they are endemic species, restricted to two to four quartz dykes that, although they lie within the Selangor State Park, are vulnerable to habitat degradation. Other species of conservation importance include *Syngramma dayi*, endemic in quartz habitats in Perak and Selangor, and a few species that are extremely rare: *Hydnocarpus humei* is known from one other collection from Larut, Perak; *Hoya mappigera* is known from one other collection from Lumut, Perak, and another from Thailand. Further, the specimen of *Galearia fulva* that Ridley described as *G. lancifolia* is strikingly different from the typical form in having extremely narrow leaves and may prove to be a distinct taxon.

Discussion

Habitats

Without a doubt, it is the summit flora that is of greatest botanical interest for its unique combination of species. *Baeckea frutescens* and *Rhodoleia championii* are the dominant tree species, while shrubs include *Austrobuxus nitidus* and *Vaccinium ban-canum* and several epiphytic species, for instance *Fagraea auriculata*, *Ficus deltoidea*

var. *angustifolia* and *Rhododendron longiflorum*, that here grow directly on the quartz rocks. The ground layer is sparse with mats of the white moss *Leucobryum aduncum* covering the thin peat layer. The endemic grass *Eulalia milsumi* forms sparse tussocks in soil-filled cracks and crannies. *Aleisanthia rupestris* as its name suggests grows in crevices on the sheer cliff faces in full sun. In contrast, *Ilex praetermissa* grows in forest on steep slopes in partial shade where there is an accumulation of peat. The gorges that pierce the ridge present a completely different cool, humid, shaded environment where lush herbs, for instance *Begonia sinuata*, *Codonoboea primulina* and gingers, can thrive.

Comparison with other plant communities

Notable in the checklist is the absence or poor representation of trees typical of the canopy of lowland equatorial rain forest (Saw 2010), such as the Anacardiaceae, Burseraceae, Dipterocarpaceae, Guttiferae, Leguminosae, Myristicaceae, and Myrtaceae, and families like Orchidaceae, Palmae and Zingiberaceae. While it is obvious that the harsh exposed conditions and scanty soil act as a filter that excludes the majority of trees, shrubs and herbs that are typical of equatorial rain forest, it is notable that this lowland quartzite flora at 200–400 m elevation has much in common with the plant community of upper montane forest that grows above 1500 m on mountain peaks with peat that develops on weathered granitic soils (Reid 1951). In fact, Ridley (1922b) first drew attention to this phenomenon noting that KGQR included a “small but quite peculiar flora consisting of several endemic species with several only known from much higher altitudes in our mountains”. Species that illustrate this striking disjunct altitudinal distribution include *Austrobuxus nitidus*, *Baeckea frutescens*, *Dipteris conjugata*, *Oleandra neriiformis*, *Rhodoleia championii* and *Vaccinium bancanum*. Further, Whitmore (1984) drew attention to a few of these species, *Austrobuxus nitidus* and *Baeckea frutescens*, that also grow in lowland heath forest that also has base-poor, often sandy soil topped by a peat layer.

It might be expected that the quartzite flora would share similarities with the limestone flora that also grows on a rocky, free-draining substrate with poor soil development. However, comparison with the flora of Batu Caves with 269 species (Kiew 2014), a karst hill just 7 km from the KGQR, shows that in fact they share very little in common with just five species that grow in both localities, namely, *Alstonia scholaris* (a secondary forest species), *Pogonanthra pulverulenta* (an epiphyte that grows on trees, not on the rock substrate), *Microsorium membranifolium* (a lithophyte), and the figs, *Ficus hispida* and *F. punctata*. Even at the family level, the differences are very pronounced. At Batu Caves, Orchidaceae is the most speciose family with 23 species contrasting with just two orchid species on KGQR; while speciose families on KGQR, Rubiaceae (32 species), Gramineae (15 species), Melastomaceae (10 species), Polypodiaceae (10 species) and are represented by 13, 0, 1 and 2 species, respectively, on Batu Caves.

Changes in the flora

The repeated burning of a large section of the southern face has resulted in long-term detrimental consequences. The steep slope is still covered by secondary vegetation among which the aggressive fern *Dicranopteris linearis* smothers competing vegetation. Many of the trees recorded by Henderson (1928) have not been recollected for more than 50 years, though they might still persist on the undisturbed northern side. *Soneriella prostrata* and *Spermacoe pilulifera* have not been re-collected for more than 35 years.

Among the site endemic species, *Ilex praetermissa* populations are now found only on the northern side suggesting that they are unable to disperse and become established in secondary vegetation on the southern side. This species is critically endangered having an extremely small population size and, in addition, it is a dioecious species (Kiew 1983). Wong et al. (2010) counted only 20 *Ilex* plants on a 250 m transect.

The endemic grass, *Eulalia milsumi*, is also seriously threatened by disturbance. Although reasonably common in less disturbed habitats, Wong et al. (2010) discovered that its population is highly sensitive to disturbance by aggressive smothering by weeds like *Dicranopteris linearis* and that it was significantly less frequent in disturbed areas. In addition, recently it is particularly threatened by the large, tussock forming alien grass, *Pennisetum polystachion*, first reported from KGQR by Yao (2007), but is now widespread (Kiew 2009; Lim and Yao 2010).

Fortunately, *Aleisanthia rupestris* appears to be less influenced by disturbance (Wong et al. 2010) probably because it grows in such exacting conditions in full sun on vertical rock faces rooted in tiny cracks and crevices where even weeds are unable to gain a toe-hold.

The very small population of *Codonoboea primulina* of less than 150 individuals that grows in an extremely small area measuring about 50 m² (Kiew 1983), is most at risk from botanical collectors, even though there is no need for repeated collecting because it is already represented in most major herbaria in the world.

Conclusion

The proposal by the Selangor Town and Country Planning Department to protect the KGQR under the National Heritage Act 2005 (Act 645) status is long overdue. Globally, it is indeed unique for a combination of its great size, the tall exposed quartz dyke with its pseudo-karst morphology, and its unique assemblage of plant species that includes endemic and rare plants. It meets all three criteria for being designated an Important Plant Area (Anderson 2002). The quartz dyke is a fragile, threatened habitat vulnerable to visitor pressure and invasive plant species, it harbours a unique biodiverse flora quite unlike that of either lowland forest or the limestone hill flora and of its 314 species 11% are endemic to Peninsular Malaysia, among which four are provisionally assessed as Critically Endangered and two as Endangered. Management of the dyke not only needs

to control visitor access (Mohd.-Zainuddin 2015) but also to manage the invasion of aggressive weed species, most notably the *Dicranopteris linearis* thickets and to weed out *Pennisetum polystachion* by hand before it irreversibly impacts on the native flora.

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Appendix I

Checklist of vascular plant species collected from the Klang Gates Quartz Ridge, Selangor, Malaysia.

(Endemism: E – endemic in Peninsular Malaysia, EE – endemic in KGQR, E? – possibly endemic in Peninsular Malaysia).

Family classification follows the Flora of Peninsular Malaysia for ferns (Parris 2010) and flowering plants (Kiew et al. 2010).

Where details of herbarium specimens are not available, the literature source is provided, namely Henderson (1928), Molesworth-Allen (1963) and Piggott in Kiew (1982).

LYCOPHYTES

SELAGINELLACEAE

^E*Selaginella strigosa* Bedd.

Sinclair SFN 40140

Selaginella stipulata (Blume) Spring

Molesworth-Allen

FERNS

ADIANTACEAE

Haplopteris ensiformis (Sw.) E.H.Crane

Piggott

Haplopteris scolopendrina (Bory) C.Presl

Piggott

ASPLENIACEAE

Asplenium affine Sw.

Syahida FRI 55109

Asplenium nitidum Sw.

Kiew RK 1090, Parris 10968, Sinclair

SFN 40142

Asplenium pellucidum Lam.

Molesworth-Allen, Piggott

BLECHNACEAE

Blechnopsis orientalis (L.) C.Presl

Piggott

CIBOTIACEAE*Cibotium barometz* (L.) J.Sm.

Anthonysamy SA 374, Molesworth-Allen, Piggott

DAVALLIACEAE*Davallia denticulata* (Burm.f.) Mett. ex Kuhn

Molesworth-Allen

Davallia heterophylla J.Sm.

Ng FRI 22112, Molesworth-Allen, Piggott

Davallia repens (L.f.) Kuhn

Piggott

Davallia solida (G.Forst.) Sw.

Molesworth-Allen, Piggott

DENNSTAEDTIACEAE*Microlepia speluncae* (L.) T.Moore var.*hancei* (Pantl) C.Chr. & Tardieu

Piggott

Pteridium esculentum (Forst.) Cockayne

Molesworth-Allen, Piggott

DIPTERIDACEAE*Dipteris conjugata* Reinw.

Piggott

GLEICHENIACEAE*Dicranopteris linearis* (Burm.f.) Underw.

Piggott

HYMENOPHYLLACEAE*Hymenophyllum blandum* Racib.

Molesworth-Allen, Piggott

NEPHROLEPIDACEAE*Nephrolepis biserrata* (Sw.) Schott

Anthonysamy SA 373

Nephrolepis falciformis J.Sm.

Piggott

OLEANDRACEAE*Oleandra neriiformis* Cav.

Kiew RK 1080, Piggott

POLYPODIACEAE*Drynaria rigidula* (Sw.) Bedd.

Piggott

Goniophlebium percutsum (Cav.)

W.H.Wagner & Grether

Piggott

Lepisorus longifolius (Blume) Holttum

Strugnell FMS 14623

Leptochilus macrophyllus (Blume) Noot.

Piggott

Microsorium membranifolium (R.Br.) Ching

Ingram FMS 14605

Pyrrosia angustata (Sw.) Ching

Symington 39403, Piggott

Pyrrosia lanceolata (L.) Farw.

Anthonysamy SA 372, Piggott

Selliguea heterocarpa (Blume) Blume

Piggott

Selliguea lateritia (Baker) Hovenkamp

Kiew RK 1088

Selliguea stenophylla (Blume) Parris

Piggott

PTERIDACEAE*Pteris biaurita* L.

Strugnell FMS 14603

Pteris longipinnula Wall. ex J.Agardh

Molesworth-Allen, Piggott

^E*Syngamma dayi* (Bedd.) Bedd.

Parris 10967, Sinclair SFN 40139

SINOPTERIDACEAE*Cheilanthes tenuifolia* (Burm.f.) Sw.

Piggott

TECTARIACEAE*Tectaria fissa* (Kunze) Holttum

Kiew RK 1089, 1091, Parris 10969,

Hume 7065

Tectaria singaporiana (Wall. ex. Hook. &

Grev.) Copel.

Molesworth-Allen

WOODSIACEAE

Diplazium polypodioides Blume
Ingram FMS 14602

GYMNOSPERMS

GNETACEAE

Gnetum gnemon L. var. *brunonianum* (Griff.) Markgr.
Henderson
Gnetum sp.
Kiew RK 991

FLOWERING PLANTS

ACANTHACEAE

Peristrophe acuminata Nees var. *acuminata*
Henderson
Pseuderanthemum graciliflorum Ridl.
Henderson
^E*Pseuderanthemum selangorensis* (C.B. Clarke)
Ridl.
Henderson
Staurogyne kingiana C.B. Clarke
Henderson

ACHARIACEAE

^E*Hydnocarpus humei* Ridl.
Hume 7256
^E*Ryparosa fasciculata* King
Henderson

ANACARDIACEAE

Buchanania sessilifolia Blume
Henderson
Semecarpus velutina King
Mohd. Hashim FMS 102
Swintonia schwenckii Teijsm. & Binn. ex
Hook.f.
Henderson

ANISOPHYLLEACEAE

Anisophyllea corneri Ding Hou
Watson 538, Kiew RK 992

ANNONACEAE

Alphonsea elliptica Hook.f. & Thomson
Syahida FRI 55106
Mitrella kentii (Blume) Miq.
Symington KEP 39393
Trivalvaria pumila (King) J. Sinclair
Sinclair SFN 40143, Kiew RK 1170

APOCYNACEAE

Alstonia scholaris (L.) R.Br.
Henderson
Chilocarpus costatus Miq.
Henderson
Dischidia bengalensis Colebr.
Kiew RK 211
Epigynum ridleyi King & Gamble
Henderson
^E*Hoya campanulata* Blume
Strugnell FMS 13033
Hoya mappigera Rodda & Simonsson
Sinclair SFN 10730
Hoya revoluta Wight
Kiew RK 1155, Strugnell FMS 55109
Kibatalia maingayi (Hook.f.) Woodson
Watson 533
Pottsia laxiflora (Blume) Kuntze
Henderson
Willughbeia edulis Roxb.
Mohd. Hashim FMS 402, Kiew FRI
65534, Symington KEP 39395

AQUIFOLIACEAE

^{EE}*Ilex praetermissa* Kiew
Kiew RK 215, RK 1255, Strugnell FMS
33213, Symington KEP 39398

ARACEAE

Aglanema nebulosum N.E.Br.
Henderson
Amydrium medium (Zoll. & Moritizi)
Nicolson
Henderson
Anadendrum microstachyum (de Vriese &
Miq.) Backer & Alderw.

Kiew RK 1150

Homalomena humilis (Jack) Hook.f.

Hay AH 2023, Kiew RK 1175, Saw FRI 34265

Homalomena pendula (Blume) Bakh.f.

Hay AH 2024

Rhaphidophora montana (Blume) Schott

Henderson

Schismatoglottis scortechinii Hook.f.

Henderson

ARALIACEAE*Arthrophyllum diversifolium* Blume

Henderson

Schefflera oxyphylla (Miq.) R.Vig.

Henderson

ARISTOLOCHIACEAE*Thottea piperiformis* (Griff.) Mabb.

Kiew RK 1139, Stone 15648

BEGONIACEAE^E*Begonia holttumii* Irmsch.

Henderson 7291

Begonia wrayi Hemsl.

Ridley 13430

Begonia sinuata Wall. ex Meisn.

Kiew RK 1084, Sinclair SFN 40132, Saw FRI 34264

CAMPANULACEAE*Lobelia zeylanica* L.

Henderson

CAPPARACEAE*Capparis versicolor* Griff.

Ridley s.n., Henderson

COMMELINACEAE*Amischotolype gracilis* (Ridl.) I.M.Turner

Ridley s.n. (1908), Kiew RK 1180

COMPOSITAE*Blumea balsamifera* (L.) DC.

Henderson

Vernonia arborea Buch.-Ham.

Henderson

CONNARACEAE^E*Rourea rugosa* Planch.

Henderson

CONVOLVULACEAE*Argyreia capitiformis* (Poir.) Ooststr.

Henderson

Neuropeltis maingayi Peter ex Ooststr. var.*maingayi*

Henderson

COSTACEAE*Cheilocostus speciosus* (J.Koenig)

C.D.Specht.

Henderson

CYPERACEAE*Cyperus compressus* L.

Henderson

Cyperus cyperoides (L.) Kuntze

Kiew RK 1142

Cyperus laxus Lam.

Kiew RK 1147A

Fimbristylis thouarsii (Kunth) Merr.

Symington KEP 33210, KEP 39410

Mapania palustris (Hassk. ex Steud.)

Fern-Vill.

Kiew RK 1144

DICHAPETALACEAE^E*Dichapetalum griffithii* (Hook.f.) Engl.

Henderson

DILLENIACEAE*Tetracera asiatica* (Lour.) Hoogl.

Julius FRI 54873

DIOSCOREACEAE*Dioscorea pyrifolia* Kunth

Anthonysamy SA 195

DIPTEROCARPACEAE*Shorea bracteolata* Dyer

Watson 741

Shorea parvifolia Dyer subsp. *parvifolia*

Watson 739

DRACAENACEAE*Dracaena elliptica* Thunb.

Kiew RK 224

^{EE}*Dracaena maingayi* Hook.f.

Kiew RK 1124, RK 1140

Dracaena umbratica Ridl.

Kiew RK 1194

EBENACEAE*Diospyros sumatrana* Miq.

Henderson

ELAEOCARPACEAE*Elaeocarpus mastersii* KingKiew RK 77, Symington 33207, Burkill
SFN 10028*Elaeocarpus nitidus* Jack var. *nitidus*

Phoon 108, 110

Elaeocarpus stipularis Blume var. *stipularis*

Phoon 107

ERICACEAE*Rhododendron longiflorum* Lindl.

Ridley s.n., Symington KEP 33215

Vaccinium bancanum Miq. var. *tenuinervium* J.J.Sm.

Symington KEP 33206, 39404

EUPHORBIACEAE*Croton oblongus* Burm.f.

Henderson

Epiprinus malayanus Griff.

Henderson

Euphorbia ridleyi Croizat.

Wong FRI 35270

Macaranga gigantea (Rchb.f. & Zoll.)

Müll.Arg.

Henderson

Macaranga bullettii King ex Hook.

Henderson

Macaranga hypoleuca (Rchb.f. & Zoll.)

Müll.Arg.

Henderson.

Mallotus macrostachyus (Miq.) Müll.Arg.

Henderson

Pimelodendron griffithianum (Müll.Arg.)

Benth.

Henderson

FAGACEAE*Castanopsis inermis* (Lindl. ex Wall.) Benth.
& Hook.f.

Mohd Hashim FMS 305

Castanopsis megacarpa Gamble

Henderson

Lithocarpus ewyckii (Korth.) Rehder

Henderson

Lithocarpus sundaicus (Blume) Rehder

Mohd Hashim FMS 29

GENTIANACEAE*Fagraea auriculata* Jack

Henderson

GESNERIACEAE*Aeschynanthus pulcher* (Blume) G.Don

Kiew RK 1081, Syahida FRI 55108

^{EE}*Codonoboea primulina* (Ridl.) KiewRidley s.n., Kiew RK 1182, Soh FRI
471218, Syahida FRI 55105*Codonoboea quinquevulnera* (Ridl.)

C.L.Lim

Kiew RK 1077, Symington KEP 39407,

Syahida FRI 55107

GRAMINEAE*Acroceras tonkinense* (Balansa) C.E.Hubb.

Chew FRI 51872

Axonopus compressus (Sw.) P.Beauv.

Chew FRI 51866

Centotheca lappacea (L.) Desv.

Chew FRI 51873

Chrysopogon aciculatus (Retz.) Trin.

Chew FRI 51868

Cyrtococcum patens (L.) A.Camus

Chew FRI 51875

Digitaria fuscescens (J.Presl) Henrard

Chew FRI 51864

Eragrostis brownii (Kunth) Nees

Chew FRI 51863

Eriachne pallescens R.Br.

Chew FRI 51862, Kiew RK 1126, Symington KEP 47125

^{EE}*Eulalia milsumi* Ridl.

Symington KEP 39405, Chew FRI 51879

Lophatherum gracile Brongn.

Chew FRI 51871

Melinis repens (Willd.) Zizka

Chew FRI 51867

Ottochloa nodosa (Kunth) Dandy

Chew FRI 51874

Panicum brevifolium L.

Chew FRI 51876

Paspalum conjugatum P.J.Bergius

Chew FRI 51880

Pennisetum polystachion (L.) Schult.

Chew FRI 51865

GUTTIFERAE

^E*Calophyllum ferrugineum* Ridl. var. *oblongifolium* (T.Anderson) P.F.Stevens
Wyatt-Smith 66609

^E*Mesua elegans* (King) Kosterm.

Ridley 13527

^E*Mesua kunstleri* (King) Kosterm. var. *kunstleri*

Symington KEP 47132

HAMAMELIDACEAE

Rhodoleia championii Hook.f.

Foxworthy KEP 10031, Strugnell KEP 10991, Kiew RK 210

HUGONIACEAE

Indorouchera griffithiana Planch. Hallier f.
Henderson

ICACINACEAE

Gomphandra quadrifida (Blume) Sleumer
Henderson

IXONANTHACEAE

Ixonanthes icosandra Jack

Henderson

Ixonanthes reticulata Jack

Symington KEP 33220, 37450

LABIATAE

Callicarpa longifolia Lam.

Henderson

Callicarpa pentandra Roxb.

Henderson

Clerodendrum deflexum Wall.

Henderson

Rothea serrata (L.) Steane & Mabb.

Kiew RK 209, Anthonsamy SA 163

^E*Vitex longisepala* King & Gamble

Henderson

LAURACEAE

Alseodaphne nigrescens (Gamble) Kosterm.

Henderson

Litsea umbellata (Lour.) Merr.

Mohd Hashim FMS 198

Litsea costalis (Nees) Kosterm.

Mohd Hashim FMS 277

LECYTHIDACEAE

Barringtonia macrostachya (Jack) Kurz

Kiew RK 1107

Barringtonia scortechinii King

Kiew RK 1179

LEGUMINOSAE

Archidendron contortum (Mart.)

I.C.Nielsen

Henderson

Archidendron jiringa (Jack) I.C. Nielsen

Henderson

Derris elegans Grah. ex Benth.

Strugnell FMS13389

Bauhinia bidentata Jack

Mead FMS 30765

Flemingia strobilifera (L.) W.T.Aiton

Strugnell FMS 13387

^E*Fordia albiflora* (Prain) Dasuki & Schot

Henderson

LOGANIACEAE

Norrisia malaccensis Gardner

Symington KEP 37448

LORANTHACEAE

Macrosolen cochinchinensis (Lour.) Tiegh.

Symington KEP 37446, Stone 15641

Scurrula ferruginea (Jack) Danser

Kiew RK 1125

LOWIACEAE

^E*Orchidantha longiflora* (Scort.) Ridl.

Henderson

MALVACEAE

Durio griffithii (Mast.) Bakh.

Symington KEP 47126

Grewia laevigata Vahl

Henderson

Microcos tomentosa Sm.

Henderson

Pterospermum javanicum Jungh.

Watson 531

MARANTACEAE

Donax canniformis (G.Forst.) K.Schum.

Henderson

MELASTOMATACEAE

^E*Anerincleistus pauciflorus* Ridl.

Sinclair SFN 40137

Diplectria divaricata Kuntze

Henderson

Medinilla crassifolia (Reinw. ex Blume)

Blume

Poore 1086

Melastoma malabathricum L.

Omar FMS 9936

Oxyspora bullata (Griff.) J.F.Maxwell

Kiew RK 1178

Oxyspora exigua (Jack) J.F.Maxwell

Henderson

Pogonanthera pulverulenta (Jack) Blume

Kiew RK 993, Putz FRI 21901, Wyatt-

Smith KEP 66610

Pternandra echinata Jack

Henderson

Sonerila obliqua Korth.

Kiew RK 1086, Sinclair SFN 40133

^E*Sonerila prostrata* Ridl.

Ridley s.n., Foxworthy KEP 10039, Sym-

ington KEP 47134

MELIACEAE

Chisocheton pentandrus (Blanco) Merr.

subsp. *paucijugus* (Miq.) Mabb.

Henderson

Dysoxylum arborescens (Blume) Miq.

Mohd Hashim FMS 1310

MELIOSMACEAE

Meliosma sumatrana (Jack) Walp.

Henderson

MEMECYLACEAE

Memecylon dichotomum (C.B.Clarke) King

var. *dichotomum*

Henderson

MENISPERMACEAE

Pericampylus glaucus (Lam.) Merr.

Henderson

MORACEAE

Artocarpus gomezianus Wall. ex Trécul

Henderson

Ficus chartacea (Wall. ex Kurz) King

Henderson

Ficus deltoidea Jack var. *angustifolia* (Miq.)

Corner

Mohd Hashim FMS 1103, Kiew RK 214, *Knema malayana* Warb.

Strugnell FMS 13029

Ficus deltoidea Jack var. *kunstleri* (King) ^E*Knema plumulosa* J.Sinclair

Corner

Kiew RK 93, Mead FMS 30761, Symington

KEP 39390

Ficus fulva Reinw. ex Blume

Henderson

Ficus hispida L.f.

Anthonyamy SA 167

Ficus obscura Blume var. *borneensis* (Miq.) *Ardisia colorata* Roxb.

Corner

Henderson

Ficus pellucidopunctata Griff.

Henderson

Ficus punctata Thunb.

Davies 2837

Ficus sagittata Vahl

Henderson

Ficus sumatrana Miq.

Symington KEP 39394

Ficus trichocarpa Blume

Henderson

Ficus villosa Blume var. *villosa*

Henderson

Hullettia dumosa King

Kiew RK 1171

MYRISTICACEAE

Gymnacranthera forbesii (King) Warb.

Henderson

Horsfieldia majuscula (King) Warb.

Henderson

Horsfieldia polyspherula (Hook.f. ex King) *Syzygium gratum* (Wight) S.N.Mitra

J.Sinclair var. *sumatrana* (Miq.) W.J.de

Wilde

Watson FMS 537

Knema furfuracea (Hook.f. & Thomson) Kiew RK 213, Symington KEP 47123

Warb.

Henderson

Knema hookeriana (Wall. ex Hook.f. & *Campylospermum serratum* (Gaertn.)

Thomson) Warb.

Henderson

Henderson

^E*Knema plumulosa* J.Sinclair

Mohd Hashim FMS 279

Myristica cinnamomea King

Kiew RK 222

MYRSINACEAE

^E*Antistrophe caudata* King & Gamble

Kiew RK 1181, Sinclair SFN 40132

Ardisia colorata Roxb.

Henderson

Ardisia lanceolata Roxb.

Henderson

Ardisia villosa Roxb.

Henderson

Grenacheria amentacea Mez

Henderson

Grenacheria lampani Mez

Henderson

Labisia pumila (Blume) Fern.-Vill.

Kiew RK 1148

MYRTACEAE

Baeckea frutescens L.

Symington KEP 37441

Syzygium attenuatum (Miq.) Merr. &

L.M.Perry

Strugnell FMS 13036, Symington KEP

33202

Syzygium chloranthum (Duthie) Merr. &

L.M.Perry

Mead FMS 30764

Syzygium gratum (Wight) S.N.Mitra

Kiew RK 850

Syzygium subdecussatum (Wall. ex Duthie)

I.M.Turner var. *subdecussatum*

Kiew RK 213, Symington KEP 47123

OCHNACEAE

Campylospermum serratum (Gaertn.)

Bittrich & M.C.E.Amaral

Henderson

OLEACEAE

Jasminum elongatum (P.J.Bergius) Willd.
Kiew RK 1154

OPILIACEAE

Champereia manillana (Blume) Merr.
Henderson
Lepionurus sylvestris Blume
Henderson

ORCHIDACEAE

Renanthera sp. (Spider orchid)
Adam obs.
Dendrobium acerosum Lindl.
Strugnell FMS 13398

PALMAE

Calamus javensis Blume
Henderson
Eugeissona tristis Griff.
Adams obs., Kiew obs.
Licuala triphylla Griff.
Kiew RK 1079, RK 1172
Pinanga disticha (Roxb.) Blume ex
H. Wendl.
Kiew RK 1173

PANDACEAE

Galearia fulva (Tul.) Miq.
Hume 7146

PANDANACEAE

Benstonea ornata (Solms.) Callm. & Buerki
Kiew RK 1145, Rk 1810

PENTAPHRAGMATACEAE

Pentaphragma horsfieldii (Miq.) Airy Shaw
Henderson

PENTAPHYLACACEAE

Eurya acuminata DC.
Henderson

PHRYMACEAE

Cyrtandromoea grandis Ridl.
Kiew RK 1146

PHYLLANTHACEAE

Antidesma salicinum Ridl.
Henderson
Aporosa benthamiana Hook.f.
Henderson
Baccaurea brevipes Hook.f.
Henderson
Breynia discigera Müll.Arg.
Henderson
Bridelia tomentosa Blume
Burkill SFN 10033, Julius FRI 54866
Glochidion superbum Baill.
Henderson
Phyllanthus pulcher Wall.
Henderson
Sauropus androgynus (L.) Merr.
Henderson

PICRODENDRACEAE

Austrobuxus nitidus Miq.
Kiew RK 848, Symington KEP 37444,
Wyatt-Smith KEP 6612

PIPERACEAE

^{E2}*Piper porphyrophyllum* N.E.Br.
Henderson
Piper stylosum Miq.
Kiew RK 1176

POLYGALACEAE

Salomonina cantoniensis Lour.
Kiew RK 208
Xanthophyllum griffithii Hook.f. ex
A.W.Benn.
Watson 529
Xanthophyllum wrayi King
Henderson

PRIMULACEAE

Maesa ramentacea (Roxb.) A.DC.
Henderson

PROTEACEAE

Helicia attenuata (Jack) Blume
Hume FMS 7251

RHIZOPHORACEAE

Carallia eugenoidea King
Ridley s.n. (1921), Strugnell FMS 33208,
Symington KEP 39396
Carallia suffruticosa Ridl.
Sinclair SFN 40136

ROSACEAE

Prunus grisea (Blume) Kalkman var.
tomentosa
Henderson

RUBIACEAE

^{EE}*Aleisanthia rupestris* (Ridl.) Ridl.
Ridley s.n., Symington KEP 33201, Kiew
RK 216
Argostemma pictum Wall.
Kiew RK 1185
Chassalia curviflora (Wall.) Thwaites
Henderson
Greenea corymbosa (Jack) K.Schum.
Kiew RK 1153
Hedyotis auricularia L.
Henderson
Hedyotis capitellata Wall. ex G.Don
Henderson
Hedyotis corymbosa (L.) Lam.
Henderson
Hedyotis dichotoma J.Koenig ex Roth
Kiew RK 207
Hedyotis vestita R.Br. ex G.Don
Henderson
Ixora concinna R.Br. ex Hook.f.
Kiew RK 1143
Ixora congesta Roxb.
Kiew RK 1152

Ixora javanica (Blume) DC. var. *javanica*
Henderson
Ixora lobbii Loudon
Henderson
Ixora pendula Jack var. *pendula*
Kiew RK 1151
Lasianthus densifolius Miq.
Henderson
Lasianthus maingayi Hook.f.
Henderson
^{EE}*Lasianthus oblongus* King & Gamble
Henderson
Mitragyna speciosa (Korth.) Havil.
Henderson
Mussaenda villosa Wall. ex G.Don
Henderson
Nauclea subdita (Korth.) Steud.
Henderson
Neonauclea pallida (Reinwa. ex Havil.)
Bakh.f.
Henderson
Ophiorrhiza communis Ridl.
Henderson
Ophiorrhiza discolor R.Br.
Henderson
Pavetta graciliflora Wall. ex Ridl.
Henderson
Porterandia anisophylla (Jack ex Roxb.)
Ridl.
Henderson
^{E2}*Psychotria maingayi* Hook.f.
Henderson
Psydrax sp.
Kiew RK 213
Rothmannia macrophylla (R.Br.) Bremek.
Kiew RK 1149
^{EE}*Spermacoce pilulifera* (Ridl.) I.M.Turner
Henderson
Timonius wallichianus (Korth.) Valetton
Kiew RK 989
Uncaria lanosa Wall. var. *glabra* (Blume)
Ridsdale
Henderson
Urophyllum hirstum (Wight) Hook.f.

Henderson

RUTACEAE*Glycosmis chlorosperma* Spreng. var. *chlorosperma*

Henderson

SALICACEAE*Homalium caryophyllaceum* Benth.

Henderson

Osmelia maingayi King

Henderson

SAPINDACEAE*Guioa diplopetala* (Hassk.) Radlk.

Symington KEP 37447

Lepisanthes tetraphylla Radlk.

Kiew RK 1141, Symington Keo 37449

Pometia pinnata J.Forst. & G.Forst.

Henderson

SAPOTACEAE*Payena lucida* DC.

Henderson, Mohd Hashim FMS 37449

SIMAROUBACEAE*Eurycoma longifolia* Jack

Kiew RK 990, RK 1073

SMILACACEAE*Smilax myosotiflora* A.DC.

Kiew RK 1147B

STYRACACEAE*Styrax benzoin* Dryand.

Henderson

THYMELAEACEAE*Gonystylus maingayi* Hook.f.

Henderson

TORRICELLIACEAE*Aralidium pinnatifidum* (Jungh. & de Vre-ise) Miq.

Henderson

URTICACEAE*Nothocnide mollissima* (Blume) Chew

Henderson

Poikilospermum suaveolens (Blume) Merr.

Henderson

VIOLACEAE*Rinorea anguifera* (Lour.) Kuntze

Henderson

Rinorea horneri (Korth.) Kuntze

Henderson

VITACEAE*Ampelocissus cinnamomea* (Wall.) Planch.

Henderson

Cayratia mollissima (Wall.) Gagnep.

Henderson

Cayratia japonica (Thunb.) Gagnep.

Kiew RK 223

Cissus hastata Miq.

Henderson

Leea indica (Burm.f.) Merr.

Henderson

ZINGIBERACEAE*Camptandra parvula* (King ex Baker) Ridl.

Kiew RK 1177, Saw FRI 34267

Etlingera littoralis (J.Koenig) Giseke

Henderson

Globba patens Miq. var. *costulata* S.N.Lim

Kiew RK 1082

Globba pendula Roxb. var. *pendula*

Henderson

^E*Globba variabilis* Ridl. var. *variabilis*

Henderson

Zingiber gracile Jack

Kiew RK 1174