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THE UNDERSTOREY FLORA

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ABSTRACT

The understorey flora of the Bau Limestone Area comprises at least 440 species in 189 genera and 74 families of flowering plants. The most speciose families are the Orchidaceae (132 species), the Rubiaceae (58 species) and the Araceae (41 species) with the Gesneriaceae, Zingiberaceae, Palmae, Moraceae and Urticaceae each with more than twenty species and for genera *Ficus* with 21 species and *Schefflera, Piper, Cyrtandra* and *Hoya* all with more than ten species. The calcifuge element is well represented with six species each for *Medinilla* and *Vaccinium*. The Bau Limestone Area shows high biodiversity associated with species restricted to limestone, most notably members of the Gesneriaceae and the Begoniaceae, many of which are endemic to the Bau or Kuching limestone. The distribution of narrow endemics confirms that the Bau Limestone Area is phytogeographically distinct from the Padawan-Serian limestone, which also falls within the Kuching Division. The limestone flora at Bau is endangered primarily by farming practices, which are widespread,as well as locally by quarrying.

Keywords: limestone flora, Sarawak, herbaceous plants, plant checklist

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Abstract. The understorey flora of the Bau Limestone Area comprises at least 440 species in 189 genera and 74 families of flowering plants. The most speciose families are the Orchidaceae (132 species), the Rubiaceae (58 species) and the Araceae (41 species) with the Gesneriaceae, Zingiberaceae, Palmae, Moraceae and Urticaceae each with more than twenty species and for genera *Ficus* with 21 species and *Schefflera*, *Piper*, *Cyrtandra* and *Hoya* all with more than ten species. The calcifuge element is well represented with six species each for *Medinilla* and *Vaccinium*. The Bau Limestone Area shows high biodiversity associated with species restricted to limestone, most notably members of the Gesneriaceae and the Begoniaceae, many of which are endemic to the Bau or Kuching limestone. The distribution of narrow endemics confirms that the Bau Limestone Area is phytogeographically distinct from the Padawan-Serian limestone, which also falls within the Kuching Division. The limestone flora at Bau is endangered primarily by farming practices, which are widespread, as well as locally by quarrying.

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INTRODUCTION

Botanical collecting started early in the Bau area with Hugh Low collecting *Rhododendron brookeanum* (now regarded as a subspecies of *R. javanicum*) from Lubang Angin in 1845. He was followed in 1849 by another commercial plant collector, Thomas Lobb, who collected at least two limestone plants (*Monophyllaea glauca* and *Chirita caliginosa*). G.D. Haviland, medical officer to the Sarawak Government, collected quite

comprehensively between 1891 and 1895 from the Bau area and also from Gunung Bra'ang, which at 729 m is the highest limestone hill in the Kuching Division. *Paraboea havilandii*, which is endemic to the Kuching limestone, is named in his honour. H.N. Ridley, Director of the Singapore Botanic Gardens, made two excursions to the Bau Limestone Area in 1893 and 1903 and the results of his collecting appeared in several publications of plants of Borneo, namely for aroids (Ridley, 1905), begonias (Ridley, 1906) and gingers (Ridley, 1906). The aroid, *Alocasia ridleyi*, is named in his honour.

After Ridley's time, plants continued to be collected from the Bau Limestone Area. C.J. Brooks, a metallurgist who prospected for gold in the Kuching Division, collected a few plants in 1908 from Bidi and in 1910 from Bau. He was followed in 1912 by J.W. Anderson, Assistant Curator of the Gardens Department, Straits Settlement; in 1929 by M.S. and J. Clemens, indefatigable professional plant collectors, who spent five days at Bidi Caves; E.P. Mjoberg, Curator of the Sarawak Museum, also collected at Bidi Cave in 1923. The name Bidi Cave does not appear on maps but is the limestone hill where the Rumoh Mines are now located (Jugah Kudi, *pers. comm.*). This is an important hill as it is the type site (the place where the type specimen was collected) for several plant species.

J.A.R. Anderson, of the Sarawak Forest Department, collected extensively between 1951 and 1970, as the limestone flora was one of his special interests (Anderson, 1965). He covered not only the Bau Limestone Area but also other hills in the Kuching Division, such as in the Padawan-Serian areas. B.L. Burtt, taxonomist with the Royal Botanic Garden Edinburgh made intensive collections of the groups he studied from the Kuching limestone in 1962 and 1967, which contributed to monographs on two limestone genera of the Gesneriaceae, *Monophyllaea* (Burtt, 1978) and *Paraboea* (Burtt, 1984).

Subsequently, many collections have been amassed over the years by the staff of the Sarawak Forest Department Herbarium (SAR).

The aim of our study was to make a comprehensive collection of specimens from the Bau Limestone Area and to provide a checklist based not only on these specimens, but also records from the literature and specimens from other herbaria. The field survey enabled us to assess the conservation status of the rare and endangered species and also to assess the level of disturbance to the flora on individual hills.

METHODOLOGY

The Bau limestone hills range in height from 110 m to 510 m asl. Twenty hills were visited during the course of 30 months (2001-2003). In the

preliminary survey, all hills were visited with one or two day trips to Gunung Batu, Gunung Batu Payong, Gunung Jebong, Gunung Juita, Gunung Krian, Gunung Lanyang, Gunung Pambor, Gunung Tai Ton, Gunung Tongga and Gunung Umbut, while hills that had high biodiversity, diversity of topography and were accessible and undisturbed, namely Gunung Apin, Gunung Aup, Gunung Doya, Gunung Kawa, Gunung Meraja, Gunung Poing, Gunung Ropih, Gunung Stulang, Gunung Tabai and Gunung Umbut, were the subject of a more detailed survey spanning four to six days. Trips were made in different months to maximise the number of fertile specimens collected. Care was taken to collect from all the microhabitats from each hill (Kiew, 2004).

The survey concentrated on understorey plants (herbs, shrubs, treelets to 3m tall, understorey climbers and epiphytes) but excluded groups in which other members of the team specialised, namely Orchidaceae (Meekiong, 2004a), Marantaceae and Zingiberaceae (Poulsen *et al*., 2004) and ferns and fern-allies (Meekiong, 2004b). The figs, many of which exceed 3m in height, are included in the checklist because of their importance as a food source for birds and mammals.

Identification was by personal knowledge, matching with specimens at the Forest Research Centre, Kuching, and by consulting the literature. Specimens are deposited at the herbarium of the Sarawak Biodiversity Centre, SAR and the Singapore Herbarium.

THE UNDERSTOREY FLORA

The limestone flora is one of the richest habitats for herbaceous plants, the other being montane forest (Kiew, 1991a). The largest family by far is the Orchidaceae (Table 1), compared with the total non-orchid flora, which comprised 74 families, 189 genera and 440 species (Appendix). Table 1 shows the size of the most speciose families on the Bau Limestone Area.

At the generic level, the most biodiverse genus is the figs, *Ficus* (Moraceae), with 21 species, followed by *Schefflera* (Araliaceae) with 13, *Piper* (Piperaceae) with 12 species, *Cyrtandra* (Gesneriaceae) with 11, *Hoya* (Asclepiadaceae) with 10 species, *Ardisia* (Myrsinaceae) and *Schismatoglottis* (Araceae) with 9; *Alocasia* (Araceae), *Elatostema* (Urticaceae), *Psychotria* (Rubiaceae) and *Rhaphidophora* (Araceae) with 7 species, and *Aeschynanthus* (Gesneriaceae), *Begonia* (Begoniaceae) *Dischidia* (Asclepiadaceae), *Medinilla* (Melatomataceae) and *Vaccinium* (Ericaceae) each with 6 species. *Monophyllaea glauca* (Gesneriaceae) is represented by five varieties on the Bau Limestone Area.

Table 1: The largest families on the Bau Limestone Area.

Family	Genera	Species
Orchidaceae[1]	52	132
Rubiaceae	26	56
Araceae	11	41
Gesneriaceae	7	27
Zingiberaceae[2]	10	25
Palmae	10	21
Moraceae	1	21
Urticaceae	4	20
Asclepiadaceae	3	19
Annonaceae	9	15
Euphorbiaceae	13	16
Araliaceae	2	14
Acanthaceae	6	12
Melastomataceae	3	12
Myrsinaceae	3	12
Piperaceae	1	12

([1]Meekiong, 2004a; [2]Poulsen *et al.*, 2004)

The limestone flora at Bau shows several similarities with that of Sabah (Kiew, 2001) with, at the family level, the Orchidaceae, Araceae, Urticaceae and Begoniaceae being among the most speciose as are *Ficus*, *Cyrtandra*, *Begonia*, *Elatostema* and *Alocasia* among the genera. While, on the one hand, the Rubiaceae, Zingiberaceae, Palmae, Gesneriaceae, Melastomataceae and Asclepiadaceae and *Ardisia*, *Hoya* and *Discidia*, *Piper* and *Schefflera* are better represented at Bau. On the other hand, the Acanthaceae and *Dracaena* are better represented in Sabah. This difference may be ascribed to climate: the Kuching Division is wetter and has less seasonal rainfall, while many areas in Sabah experience periods of drought. In Kuching, wetter conditions enable the peat layer to develop on the summit of even quite low hills and this supports the acid-loving flora that includes the melastomes, particularly *Medinilla*, and the ericaceous rhododendrons and vacciniums, which are rare or absent in Sabah (Kiew, 2004). This is also borne out by the presence of several saprophytic species (*Sciaphila* and *Thismia*) and the parasite, *Rhizanthes lowii*, that have not been found on Sabah limestone.

Much still remains to be known about the limestone flora in Sarawak, even in a relatively well-collected area such as the Bau Limestone. Several interesting species were encountered during this study, such as the new begonia species, *Begonia lailana* (Kiew and Geri, 2003) and possibly new taxa of *Aeschynanthus* (Gesneriaceae), *Labisia* (Myrsinaceae), *Homalomena* and *Schismatoglottis* (Araceae) and *Symplocos* (Symplocaceae). Field

studies also indicate that *Tacca borneenis* (Taccaceae) and *Monophyllaea glauca* var. *boraginea* (Gesneriaceae) are distinct at the species level.

In several speciose genera, most notably *Cyrtandra*, *Elatostema*, *Hoya*, *Piper* and *Schefflera*, many specimens could not be identified because their species are so poorly known.

A characteristic feature of the limestone flora is the relatively high number of species restricted to limestone hills, the high biodiversity in comparison to the small area the limestone hills occupy and high endemism often associated with extremely local distributions (Kiew, 2004).

Species restricted to limestone

Several groups of plants are restricted to limestone, as, for example, are the great majority of species belonging to *Chirita*, *Epithema, Monophyllaea* and *Paraboea* in the Gesneriaceae. However, none can be considered obligate limestone species, e.g. *Chirita* and *Paraboea* in cultivation can grow on a variety of substrates as long as they are free-draining. Species of *Epithema* and *Monophyllaea* that grow off limestone are found on a range of rock types, such as granite or shale, i.e., they are lithophilous. Therefore, Chin's 1977 terminology of exclusives (species always found on limestone) and preferents (species usually found on limestone or that are more abundant on limestone) is more suitable than the term obligate.

Very few species show any adaptations to coping with high pH or calcium ions (Burtt and Tan, 1984). A few species of the Gesneriaceae, *Cyrtandra farinosa*, *C. incrustata*, *Paraboea effusa* and *P. meiphylla* from Sarawak and *P. caerulescens* and *P. verticillata* from Peninsular Malaysia deposit calcium salts in groups of cells in the external layers of their leaves, which appear as white spots on the leaf surface. Only *Paraboea acutifolia* from Peninsular Malaysia has glands that excrete calcium.

Plants on the summit that grow in shallow pockets of soil in crevices in the jagged limestone are susceptible, not only to drought, but also to high temperatures reflected from the rock surface. Many of the *Paraboea* species have a dense covering of hair that helps to reduce water loss but even so on hot days and in dry periods their leaves wilt and roll up but they are able to revive when water is available. Other species, like *Begonia rubida* from Bau, have succulent leaves that are held vertically and so reduce the leaf surface directly exposed to sunlight (Kiew and Geri, 2003).

Many of the exclusive species are probably confined to limestone, not because they are particularly adapted to it, but because they can escape from the intense competition and deep shade of the rainforest understorey.