

Niche Partitioning in Limestone Begonias in Sabah, Borneo, Including Two New Species

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Abstract

The begonia flora of limestone hills in Sabah is extremely biodiverse with several begonias being found at a single locality, the great majority of which have extremely local distributions. For example, on Bukit Dulong Lambu (better known as Gomantong Cave) four species co-exist. Two are new species, *Begonia gomantongensis* and *B. postarii* for which descriptions are provided. The former is endemic to Bk. Dulong Lambu, as is *B. malachosticta* Sands. The fourth species, *B. gueritziana* Gibbs is widespread on limestone, as well as on other rock types. Field observations show that niche partitioning occurs between these four species based on light conditions (that also relate to severity of water stress) and substrate. All four begonias are vulnerable to habitat changes – *B. gomantongensis* and *B. postarii* that grow in the damp and shaded conditions around the base of the hill are vulnerable to clearance or disturbance to the tree canopy, while all species are endangered by the periodic forest fires. Indeed, the summit vegetation of Bk. Dulong Lambu has still not recovered from the 1983 fires.

Introduction

The richness of the limestone flora in Peninsular Malaysia compared with the land area it occupies was highlighted by Chin (1977). Kiew (1991) ascribed this richness in part to the variety of microhabitats that limestone hills provide within a very confined area, from the damp dark conditions at the base of the hill, to the vertical walls that with increasing height become more exposed to sunlight, heat and water stress, to the variety of substrates - the friable soil at the base, the pocked boulders, crevices in rocks, peat-filled pockets and so on.

Begonias are one group of plants that are well represented on limestone. For example in Peninsular Malaysia, nine of the 55-odd begonia species grow on limestone and six of these are restricted to limestone. Most limestone hills support at least one species (the peltate *B. kingiana* Irmsch. is the most widespread) and frequently a second species occurs. For example on Batu Caves, *B. kingiana* grows on shaded vertical cliffs near the base of the hill while *B. phoeniogramma* Ridl. grows on steep earth slopes in gullies.

In Borneo, the genus *Begonia* is much more speciose and begonias

are well represented on limestone. Indeed, it is common for several begonias to be found on the same hill. (There is still a great deal to be learnt about Bornean begonias as there are more species undescribed than described and field collecting continues to discover novelties).

This paper examines niche partitioning of begonias on Bukit Dulong Lambu (5° 31'30"N 118° 4'15"E), a tower karst massif 229 m high in the Gomantong Virgin Jungle Reserve. This limestone hill is famous for its caves from which birds' nests are harvested. It is better known as Gomantong Cave (Lim & Kiew, 1997). Four begonias are known from this massif, two are endemic to it (*B. malachosticta* Sands and *B. gomantongensis*, described here as a new species), one (*B. postarii*, also described here as a new species) is found in another two limestone localities on the Kinabatangan River, and *B. gueritziana* Gibbs, a widespread species, is found, not only on almost every limestone outcrop, but also on other rock types too.

Populations of these four species were observed in the field to see whether differences in their habitat characteristics could be discerned to explain how they co-exist in the same locality. At the base of the hill grow *B. gomantongensis* and *B. postarii*, both confined to damp shaded conditions below intact forest canopy. Ascending the hill, these two species are replaced by *B. malachosticta* that grows in rocky crevices in the sheer cliffs or on jagged outcrops. It is not found in deep shade but occurs at a height where the tree canopy begins to open up. Unlike any begonia species in Peninsular Malaysia, it can grow on the exposed summit fully exposed to full sunlight, heat and presumably also water stress. At one time, its population must have been quite plentiful on the summit as it is reported as eaten as a vegetable by the birdnest collectors who camp on the summit of Bk. Dulong Lambu. Leaves of some begonias are pleasantly sourish, cf. Reza and Kiew (1998). However, it is no longer found on the highly disturbed summit except for the inaccessible shoulders.

Begonia gueritziana is also not found growing in the deep shade at the base of the cliff nor is it found growing in habitats exposed to full sunlight. Unlike the other three species, it produces a compact rhizome, which grows closely appressed to its substrate. (The other three species are erect begonias, *B. malachosticta* produces woody cane-like stems, while *B. gomantongensis* and *B. postarii* have rather lax stems that tend to become decumbent). *B. gueritziana* is most frequently found in soil-filled crevices and is particularly common on lightly-shaded, humus-covered ledges.

Of the other two species, *B. postarii* is a delicate begonia with soft leaves and it is not found in conditions exposed to either hot or dry conditions. It grows most profusely in sheltered, deeply shaded habitats at the base of the hill. Substrate does not seem critical as it grows both on

soil, limestone boulders and even on the base of tree trunks (semi-epiphytic).

Its distribution overlaps with that of *B. gomantongensis* and in one shaded area where the jagged limestone bedrock is exposed at soil level, both species grow together in profusion. However, *B. gomantongensis* is also found growing on vertical rock faces, but only in deep shade within 3 m of ground level where the cliff or boulder is covered by a black layer of algae. In contrast, *B. postarii* is never found on such deeply shaded vertical rock faces.

This rich biodiversity of begonias is a characteristic of the Sabah limestone flora and many other hills support at least three species, one at the base, another on the summit, as well as *B. gueritziana*. In this respect, Sabah is richer in its limestone begonia flora than Peninsular Malaysia where no begonia is found above the tree canopy, i.e. no begonia is adapted to living on the exposed summit.

The niche partitioning of these four begonias illustrates the importance of protecting Bukit Dulong Lambu from habitat disturbance in order to conserve the rich biodiversity of the limestone flora. In the past, limestone hills in Sabah have been particularly vulnerable to burning in drought periods and the summit vegetation of hills such as Bk. Dulong Lambu, Gunung Madai and Batu Batangan, for example, have still not recovered from the Great Burn of 1983 and the blackened trunks of large dead trees still stand and the summit is covered by a tangle of creepers. The flora that grows at the base of the hill is particularly vulnerable to forest clearance that opens up the canopy and would expose tender species, such as *B. gomantongensis* and *B. postarii* to the drying conditions of high light and temperature. To conserve the limestone flora of these hills, it is therefore necessary to protect a broad buffer zone of primary forest around the base of the hill to prevent fire spreading from the surrounding area. In addition, Bk. Dulong Lambu and G. Madai remain particularly vulnerable to accidental fires as birdnest collectors live on or close to these hills. It is, however, in their interest to prevent fires as smoke from the burning drives away the birdnest swiftlets.

While Bk. Dulong Lambu and G. Madai are protected within virgin jungle reserves, the majority of limestone localities are not adequately protected as they are not surrounded by protected forest (Lim and Kiew, 1997). In view of the extremely rich biodiversity of the limestone flora, a strategy needs to be implemented to protect key limestone localities of which Bk. Dulong Lambu is one (Kiew, in press).

Two New Begonia Species

Both new species belong to Section *Petermannia* in possessing an erect, branching habit; stamens produced on an elongated column; obovate anthers, which are about the same length as the filament; female flowers with five tepals, a trilocular ovary with three bifurcating styles, the stigma forming a continuous spiral papillose band; and trilocular fruits with three equal wings, bilamellate placentas and caducous styles.

Begonia gomantongensis also possesses male flowers with two tepals, which is characteristic of Section *Petermannia*. However, *B. postarii* has male flowers with four tepals. Sands (1990) has already noted that a few species of this section, such as *B. malachosticta*, are anomalous in this respect.

Begonia gomantongensis Kiew sp. nov.

Holotype: James Awing SAN 47257 (SAN, unicate).

A Begonia pryeriana Ridley *petiolis longioribus laminis latioribus et fructibus verruculosis differt.*

Erect monoecious begonia up to 60 cm tall, sparsely branched. Young stem, petioles and lower surface of veins minutely bristly. *Stems* green, purplish at nodes, up to 4–5 mm thick when dry. *Stipules* green, narrowly lanceolate, up to 2 cm long, 5 mm at base strongly tapered towards acute apex. *Leaves* alternate, distant and held horizontally. Petiole deep purplish towards apex and base, 10–16 cm long. Lamina glossy, mid-green to dark green above, pale green beneath, unpatterned, glabrous above, obliquely subrotund, 13–16(–30) by 13.5–14(–23) cm, base cordate, not overlapping, basal lobe rounded 6–8 cm long, margin minutely serrulate, apex shortly acuminate, acumen 0.5 cm long; veins slightly impressed above, conspicuously prominent beneath, main vein and 4 lateral veins radiating from the petiole with an additional 2–4 veins supporting the basal lobes, veins bifurcating three times before reaching the margin. *Inflorescence* axillary, protogynous, with 1–2 female flowers produced from the leaf axil and many male flowers on an erect monopodial rachis up to 5 cm long with short cymose branches c. 0.5 cm long. Bracts foliaceous, broadly ovate to semi-circular, up to 25 by 17 mm, diminishing in size towards the shoot apex, margin undulate, upper bracts enveloping clusters of male flowers and overlapping with bract above. *Female flowers* with pale yellow-green pedicels c. 10–12 mm long, ovary oblong tapered into pedicel, 16 by 11 mm, outer surface verruculose, wings pale yellowish green c. 4 mm wide, 3-loculate, placentas axile, bilamellate with many ovules on both surfaces, tepals 5, white, margin

entire, apex acute, outer tepals ovate 11 by 7 mm, inner narrower 7 by 4 mm, styles c. 3–4 mm long divided to base, bifurcating, stigma papillose forming a continuous twisted band. *Male flowers* with slender pedicels 3–3.5 mm long, densely bristly, tepals 2, white, rotund, 3.5–4 by 3–3.5 mm, stamens (45–)51(–53) in an obovoid cluster 1.25 by 2 mm, torus columnar c. 0.75 mm long, filament c. 0.5 mm long, anther yellow, ovoid, c. 1 by 0.5 mm, apex emarginate. *Capsule* pendant, pedicel 1.5–2.5 cm long, oblong, 17–20 by 13–15 mm, base broadly rounded, wings 3, equal, 4–5 mm wide, drying stiffly papery (not fibrous), wing tip abruptly truncate or rounded, 3-loculate with the locule reaching to the base, outer surface of locule flat and completely verruculose, dehiscing along suture between locule and wing, placentas axile, bilamellate with numerous minute seeds on both surfaces, styles caducous. *Seeds* broadly ovoid, 0.3 by 0.2 mm, base truncate, apex rounded, testa strongly reticulate.

Distribution: Endemic to Sabah, known only from Bk. Dulong Lambu, Sandakan District.

Habitat: Base of limestone hill in deep shade on boulders or cliff faces.

Specimens examined: James Awing SAN 47257 11 Oct 1964 (SAN), S.P. Lim & Ubaldus LSP 785 6 Aug 1996 (SAN, SING), R. Kiew & S.P. Lim BDL 3 29 Oct 1996 (SAN, SING).

Notes: In its inflorescence with 1–2 female flowers at the base and an erect rachis bearing male flowers and its oblong capsules 17–19 mm long, it resembles *B. pryeriana* Ridl., which was first described from Sandakan, Sabah. However, it would not be mistaken for this species as the leaves of *B. gomantongensis* are subrotund and 13–16 cm wide (those of *B. pryeriana* are lanceolate acuminate and about 5 cm wide) and its petioles are much longer (only 2.5 cm long in *B. pryeriana*). In addition, the outer wall of the locules of the ovary and capsule are remarkable in being verruculose, those of *B. pryeriana* are smooth.

In the field, *B. gomantongensis* is a very striking species as its large subrotund leaves are held horizontally and look like tea plates. The leaves form a perfect leaf mosaic without any overlap.

Label notes on the type specimen record flower colour as yellow. All the plants I have seen have white tepals.

***Begonia postarii* Kiew sp. nov.**

Type: R. Kiew & Lim S. P. RK 4221 Bukit Panggi, Kinabatangan (holo

SAN, iso SING)

Figure 1.

A Begonia congesta Ridley *petiolis longioribus, laminis brevioribus, staminibus 23 vel 35 (non 12) et fructibus brevioribus differt.*

Weak erect but rather straggling branched monoecious begonia to 50 cm tall becoming decumbent and rooting at nodes. Plant hispid with uniseriate, glandular, white (sometimes red) trichomes 1–3 mm long on the stem, stipules, petioles and lamina, bracts, inflorescence, outside of male and female tepals and the ovary, particularly dense and brownish on young stems, petioles and lower surface of veins, on upper lamina surface trichomes have raised bases. *Stem* reddish, c. 8 mm thick when dry. Stipules foliaceous, broadly elliptic with a distinct dorsal midrib, up to 2.5 by 1.5 cm, margin entire with dense fringe of hairs, apex rounded or slightly acute, persistent. *Leaves* alternate and distant. Petiole reddish, (4–)6–8 cm long. Lamina plain pale green above and beneath, soft and thin in life, drying thinly papery, obliquely ovate, (8.5–)10–11(–14) by 7–9(–12) cm, base cordate (not overlapping), basal lobe rounded, (3.5–)6–8 cm long, margin minutely dentate, apex cuspidate, acumen to 1.25–1.5 cm long, main veins 5, of almost equal length radiating from the petiole and bifurcating twice before reaching the margin, with 2 minor veins running into basal lobes, slightly impressed above and raised beneath. *Inflorescence* erect and projecting above leaves, paniculate, 13.5–18 cm long, peduncle 5.5–7 cm long, lowest 1–2 branches 1.5–3.5 cm long, each producing 2–3 female flowers, upper branches branching three times, ultimate branch 1.5–3 cm long with many male flowers. Bracts, peduncle and rachis pale green and fleshy, upper bracts tipped red and ultimate branches of rachis reddish. Lower bracts broadly oval up to 1.5 by 1 cm, margin minutely toothed; ultimate bracteoles broadly ovate, c. 3 by 4 mm with dentate margin each tooth tipped by long trichome. *Female flowers* with reddish pedicels c. 7–10 mm long, ovary broadly ovate, 8 by 9.5–10 mm, wings crimson, c. 2 mm wide, 3-loculate, placentas axile, bilamellate with many ovules on both surfaces, outer surface smooth, tepals 5, pink, margin entire, apex rounded, outer broadly ovate 8 by 4 mm, inner narrower 4.5 by 2.5 mm, slightly tapered to base, styles 3 mm long divided to base, bifurcating, stigma papillose forming a continuous twisted band. *Male flowers* with pedicels up to 8 mm long, tepals 4, outer 2 white tinged pink merging to cerise towards centre, elliptic 7–8 by 4.5–5 mm, apex rounded, conspicuously hirsute outside, inner pair glabrous, narrowly lanceolate, 7 by 1.3–2 mm, stamens 23–35 in a conical cluster c. 3 by 1.7 mm, torus columnar c. 2 mm long, filament c. 0.5 mm long, anthers yellow, 1 by 0.5 mm, apex emarginate. *Capsule* pendulous on

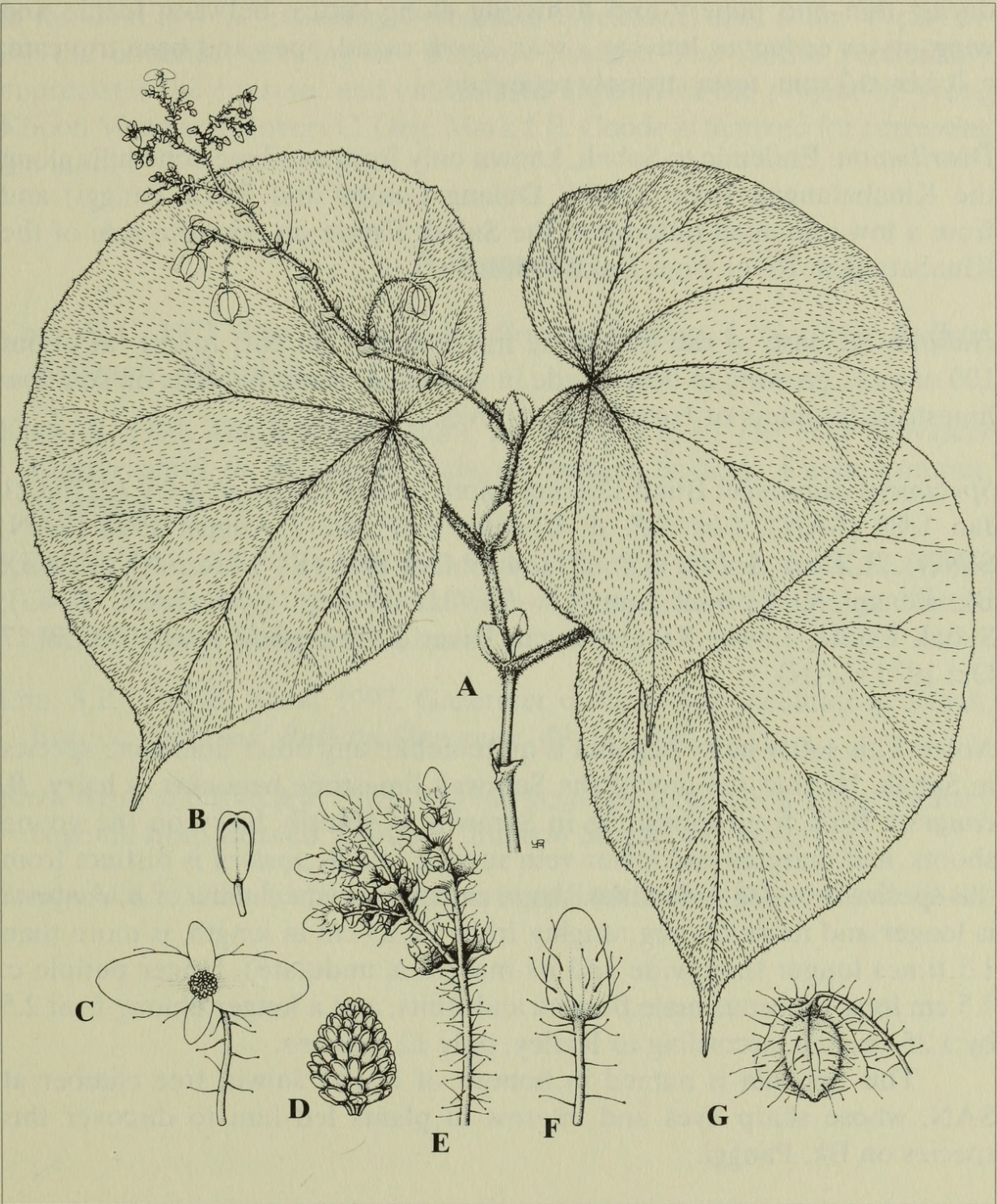


Figure 1. *Begonia postarii*
A Habit (x 0.4), B Anther (x 8), C Male flower (x 2), D Androecium (x 4.8), E Branchlet with male flowers (x 1.6), F Male bud (x 2.8), G Capsule (x 1.2).

a thin thread-like stalk c. 1.5–2 cm long, broadly ovate, (8–)10 by (9–)13 mm, hirsute outside, 3-loculate, locules bulging, wings 3 equal, narrow 3 mm wide, distinctly rounded at base, truncate distally, tip sometimes acute, drying thin and papery and dehiscing along suture between locule and wing, styles caducous leaving a scar. *Seeds* ovoid, apex and base truncate, c. 0.4 by 0.3 mm, testa strongly reticulate.

Distribution: Endemic to Sabah, known only from two limestone hills along the Kinabatangan River (Bukit Dulang Lambu and Bukit Panggi) and from a low unnamed outcrop in the Subak Estate on opposite side of the Kinabatangan River from Bukit Garam.

Habitat: At base of the limestone hill (but not on cliff faces) at about 100 m a.s.l., growing in deep shade in sheltered, damp habitats on soil, low limestone boulders or base of tree trunks.

Specimens examined: Bukit Dulong Lambu Joseph B. et al. SAN 122763 21 Jan 1988 (SAN), Lim S.P. & Ubaldus LSP 802 7 August 1996 (SAN, SING), R. Kiew & Lim S.P. BDL4 29 Oct 1996 (K, SAR, SAN, SING); Bk. Panggi R. Kiew & Lim S.P. RK4221 19 Sept 1996 (SAN, SING); Subak Estate, Lower Kinabatangan River J. Dransfield et al. JD5770 17 Oct 1979 (SAN).

Notes: This softly hairy begonia is quite unlike any other limestone species in Sabah. Neither are any of the Sarawak limestone begonias as hairy. *B. congesta* Ridl. from limestone in Sarawak is scantily hairy on the young shoots, leaf margins and lower vein surface but *B. postarii* is distinct from this species in leaf indumentum, shape and margin (the lamina of *B. congesta* is longer and more oblong ranging from 15–23 cm in length, is more than 1.5 times longer than wide and its margin is undulate), longer petiole c. 7.5 cm long, glabrous male flowers and fruits, and a longer oblong fruit 2.5 by 1.25 cm and, according to Ridley, only 12 stamens.

This begonia is named in honour of Postar Jaiwit, tree climber at SAN, whose sharp eyes and interest in plants led him to discover this species on Bk. Panggi.

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