A Guide to Begonias at Kawag Forest, Ulu Segama-Malua Forest Reserve, Sabah, Malaysia

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ABSTRACT A study to determine *Begonia* diversity in the lowland mixed dipterocarp forest was conducted during the Kawag Forest Scientific Expedition in 2016. Five specimens of *Begonia* were collected from Kawag Forest and one species was found adjacent to the Kawag Danum Rainforest Lodge (KDRL). The collection of fertile specimens of *Begonias* was deposited at SAN (Sandakan Herbarium) and SNP (Sabah Park Herbarium). Among the species collected, five species are new records for Kawag Forest Reserve and one species is new addition to the *Begonia* flora of Borneo.

KEYWORDS: Borneo; Sabah; Kawag; Lowland mixed Dipterocarp Forest; *Begonia*.

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INTRODUCTION

Borneo is rich with *Begonia*, but its distribution was restricted and narrowly endemic. However, *Begonias* are easily found in the moist, shady location in humid lowland or highland forest. Information pertaining on the diversity of *Begonia* in Borneo is still scarce and about 200 species were described (Kiew *et al*., 2015). Many new species recently found and in the process of being described. In view of that, a study to explore and record the species diversity of *Begonias* at Kawag Forest surrounding the Kawag Danum Rainforest Lodge (KDRL) was carried out during the Kawag scientific expedition in 2016. In this study, we focus on documented the *Begonia* species and its distribution along the trails to provide floristic information, which would make them crucial for *in-situ* conservation.

METHODOLOGY

Study Site

Kawag forest is part of the Ulu Segama-Malua Forest Reserve, with an area of 126,846ha and gazetted on 24th December, 2012 as Class I Protection Forest Reserve. Kawag Danum Rainforest Lodge (KDRL) was built within the Ulu Segama-Malua Forest Reserve for tourism and recreation purposes (Figure 1). It is surrounded by lowland mixed dipterocarp forest that occurred on Mentapok basic igneous rocks. The information pertaining to flora, particularly lower plants like *Begonia* was not recorded so far in the Kawag Forest. Thus, four temporary trails, namely T1, T2, T3 and T4 were established by Yayasan Sabah to explore and survey the biodiversity of the forest surrounding the Kawag Danum Rainforest Lodge (KDRL).

Sample collection

Begonia specimens were collected from T1, T2, T3 and T4 trails as well as the surrounding KDRL covering altitudinal gradient ranged from 83 - 121 m a.s.l. All fertile species of *Begonia* that are found along the trails were collected by following the botanical collection procedures. All specimens were processed following the standard herbarium procedures, where specimens were oven-dried and

identified to species level. The first set of the herbarium specimen will be deposited at SAN Herbarium and Kinabalu Park Herbarium, followed by duplicated specimens to Kew Garden Herbarium and FRIM for future references.

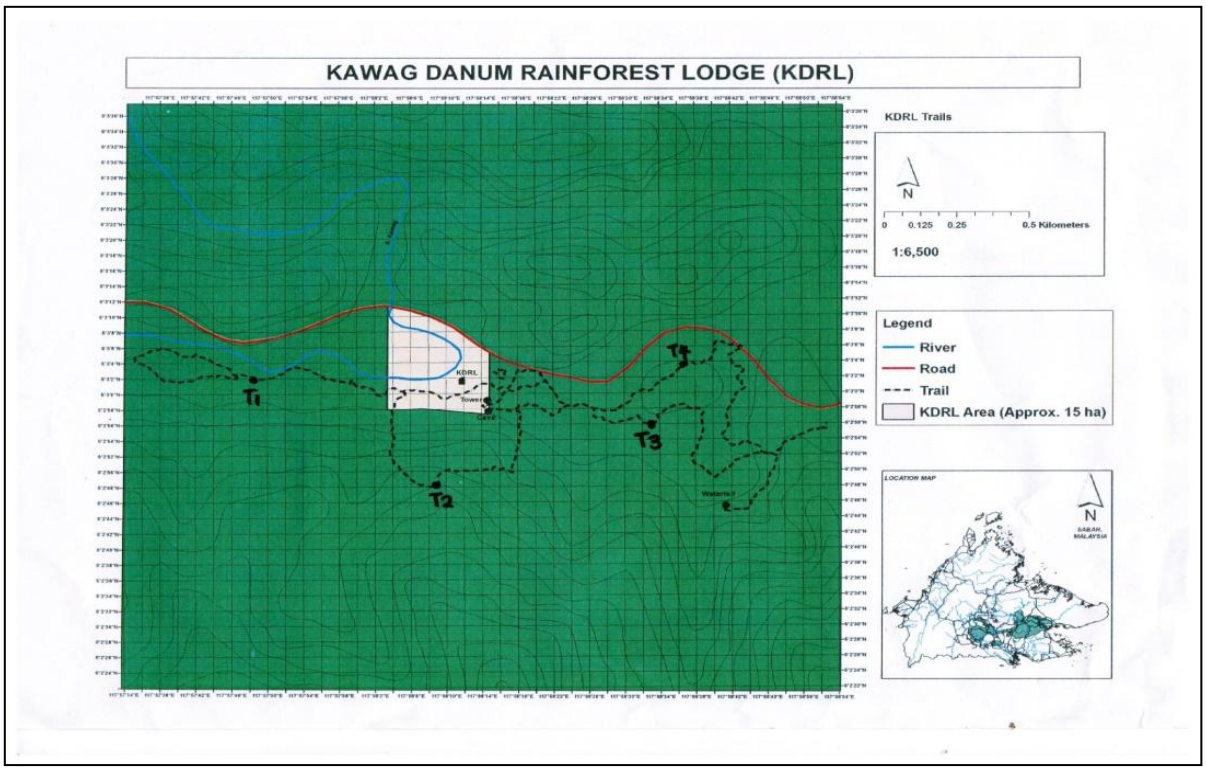

Figure 1. The four temporary trails established surrounding the Kawag Danum Rainforest Lodge (KDRL) for biodiversity survey

RESULT AND DISCUSSION

Table 1. List of *Begonia* species that found along the trails at Kawag Forest

Trail	*Begonia* species
T4	*B. postarii*
	B. prasinimarginata
	B. diwolii
	B. sp. (New)
T2	*B. danumensis*
	B. prasimarginata
	*B.*sp. (New)
KDRL	*B. ruthiae*

Begonias found in Kawag Forest area are rare and endemic to Sabah. The character of *Begonia* species found in Kawag Forest seemed to resemble the *Begonias* in Danum Valley Conservation Area except for three species (Chong, *et.al*. 2015). Most of the species are distributed near to the riverside and under shade at a low altitude of 83 m a.s.l. A total of four species of *Begonia* were found growing along the small river at trail T4 heading to waterfall. *Begonia postarii, B. prasinimarginata, B. diwolii* and one species of *Begonia* sp. that yet to be identified were recorded. *Begonia diwolii* was found to be attached to the rock surface, right adjacent to the waterfall. *Begonia danumensis, B. prasimarginata* and

Begonia sp. were found in the trail T2. *B. Ruthiae* was found next to the Kawag Danum Rainforest Lodge (KDRL) and this beautiful plant is rare and only recorded once in BSL, Danum Valley Conservation Area (Table 1). The key to identify these species is listed in Table 2.

Table 2. Keys to species of Begonia in Kawag Forest, Lahad Datu

1	Low creeping plant with round leaves	…….	*B. dewolii*
	Erect *begonia* or creeping apex is erect and leaves larger	……	3
2	Cane-like *Begonia* to 50 cm tall	……	4
	Cane-like Begonia to 100cm tall	……	*B. danumensis*
3	Leaves with silvery margin and glabrous	……	*B. prasinimarginata*
	Leaves with silvery margin and row of hairs between the veins	……	*B. ruthiea*
4	Petiole densely hairy	……	*B. postarii*
	Petiole glabrous	……	*Begonia* sp

TAXONOMY

Begonia diwolii Kiew

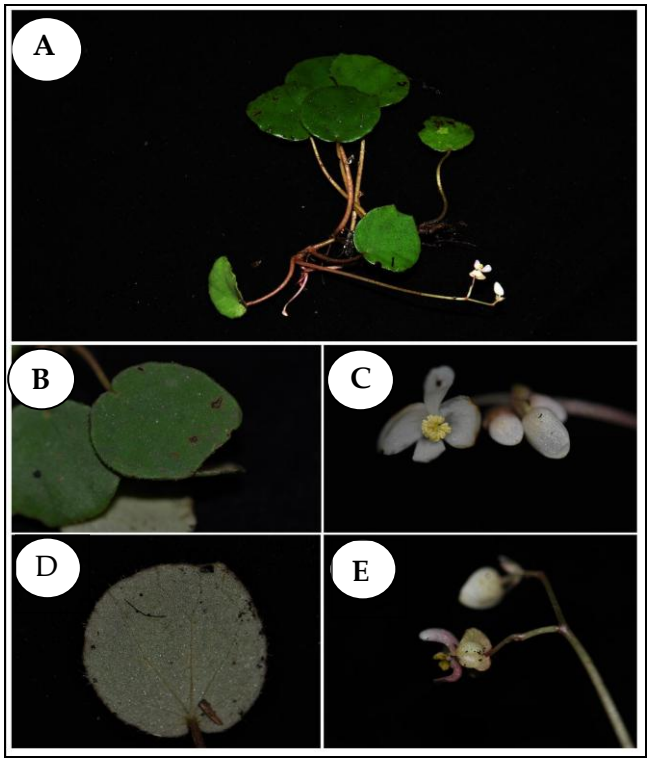

Figure 2. *Begonia diwolii* **A**. Habit; **B**. Uppersurface of lamina; **C**. Male flower; **D**. lower surface of lamina and **E**. Female flower (Incomplete). All photos (**A-E**) from *SAN156784* by Dayang Fazrinah Awg. Damit.

Scramble *Begonia, ca*. has 5cm height and clips on rock surface (Figure 2). The stem succulent and covered with short white hairs. The leaves are leathery dark green on upper surface, 3.2—4 × 2—3 cm. The margin of the leaf is minutely toothed with white hairs. Male flower has 4 tepals, the outer pairs, *ca*. 4×6cm and the inner pairs *ca.* 4×2 mm. Incomplete female flower, whitish pink, ovary 9×8 mm, wings 3, equal, light green, 4 mm wide.

Begonia danumensis F.Y.Chong

Cane-like *Begonia*, *ca*. 56 cm. Stem greenish brown, woody, hairs white (Figure 3). The leaves are matt, 14—16×5—6 cm, bristle with a short dark red hair with a white tip between the veins. The inflorescence protogynous; The male flowers, in compact clusters and have two small white tepals, 4×3 mm, and outside are deep pink with dark red hairs. The female flower, 5 pale green tepals, 11×5.7 mm. Capsule oblong, 17—18×10—11 mm, wings 3 with 4—5 mm wide that are pointed at the tip.

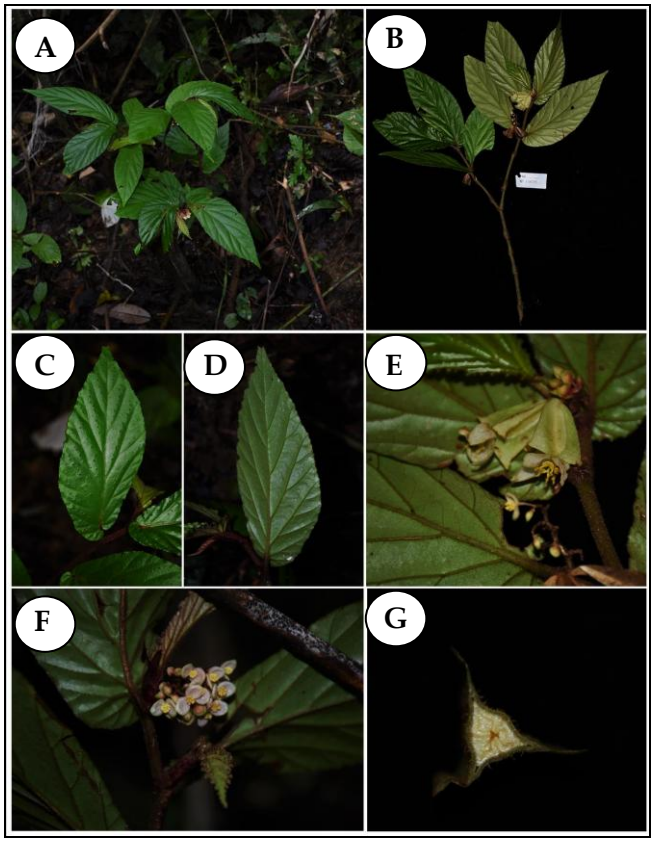

Figure 3. *Begonia danumensis* **A** & **B** Habit; **C**. Uppersurface of leaves; **D**. Lower surface of lamina and **E**. Female flower; **F**. Male flower; **G**. Cross section of the fruit. All photos (**A**-**E**) from *SAN156784* by Dayang Fazrinah Awg. Damit.

Begonia prasinimarginata S.Julia

Low glabrous begonia, *ca*.16 cm tall (Figure 4). Stem woody and rooting at the nodes. Leaves alternate, distant and oblique, 10.5—15.5×5—6.5 cm, that are dark green on upper surface with a broad pale green margin, 2—3.5 cm wide. Its flowers are held above the leaves. The male flowers, pinkish white have 4 tepals, two outers 17×18 mm, and two inners 16×14 mm. The female flowers, reddish pink, have 5 tepals, equal sizes, 19×18 mm. The ovary, pendent, 29×27 mm, wings 3, unequal, two smaller wings, 17 mm wide and one wing, 20 mm wide.

Figure 4. *Begonia prasinimarginata* **A** & **B** Habit; **C**. Inflorescence; **D**. Stipule; **E**. Male flower; **F**. Female flower; **G**. Cross section of the fruit. All photos (**A**-**E**) from *SAN156784* by Dayang Fazrinah Awg. Damit.

Begonia postarii Kiew

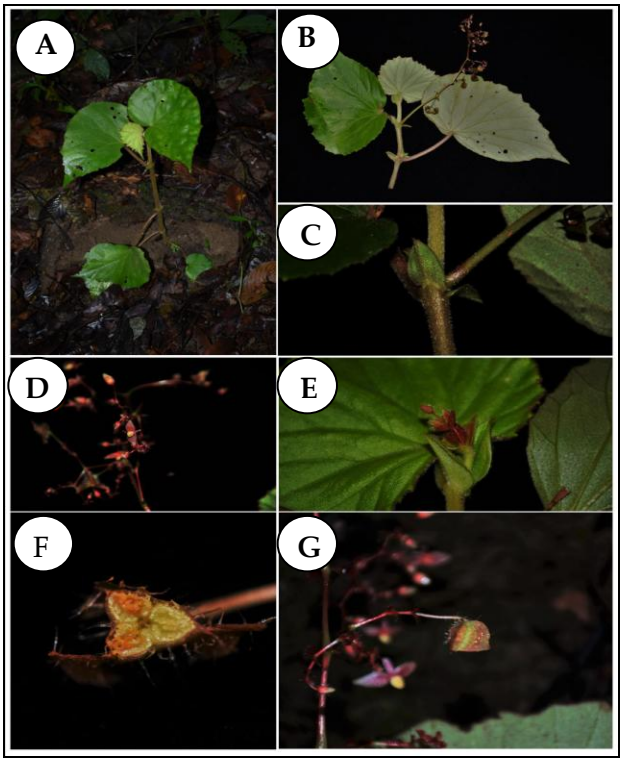

Figure 5. *Begonia postarii* **A** & **B** Habit; **C.** Stipule; **D**. Male flower; **E.** Young female flower; **F**. Cross section of the fruit; **G**. Capsule. All photos (**A**-**E**) from *SAN156784* by Dayang Fazrinah Awg. Damit.

Cane-like *Begonia, ca*. 29cm tall (Figure 5). The plant is hispid with white hairs, *ca*.2 mmlong on stem, stipule, petioles, lamina, bracts and inflorescence. Stem greenish to red, *ca.* 6.7 mm diameter.Leaves alternate, plain, green above and pale green underneath, ovate, *ca*. 18×46.5 mm. Peduncle 7 cm long. Inflorescences protogynous, racemose, erect, 2—3 male flowers on each branch, upper braches reddish. Male flower, 4 tepals, dark red, the outer pair, 6.1 — 6.2×4.1—4.13 cmand the inner pair, 3.2—1.25 cm long.Capsule, broadly ovate, 8.6—9.8×12.3—11.2cm, wings 3, equal, 3.4 — 4.1 mm wide, dehiscen, pendant. Pedicle *ca*.11.6mm long.

Begonia ruthiae S. Julia

Velvety *begonia, ca.* 6 cm tall (Figure 6). Stem succulent, and reddish. The leaves, *ca*. 13×6 cm are deep green with a bright silvery margin. Long hairs on the upper surface, white or pinkish. The leaves are deep magenta underneath. The male flowers, have 2 tepals, 8 ×7.6 mm are pinkish white. The female flowers are absent. The broadly oblong capsule, 12 × 16 mm, have 3 wings, equal, 5 mm wide, and dangles on a fine thread-like stalk, 28—36 mm long.

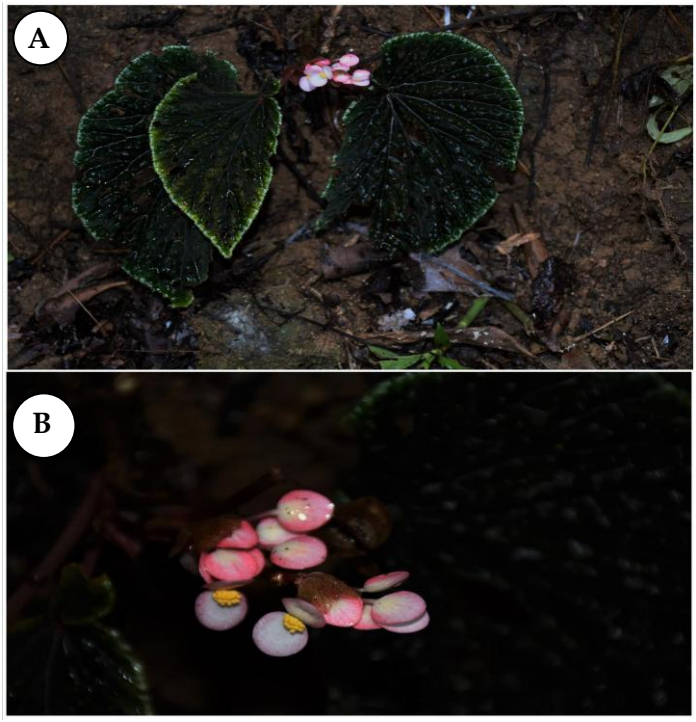

Figure 6. *Begonia ruthiea* **A** Habit; B**.** Male flower. Photo **A&B** by Dayang Fazrinah Awg. Damit.

Begonia sp.

Cane-like *Begonia, ca.* 16 cm tall (Figure 7). Stem succulent, brown. Leaves are glabrous, 12—21×4—6 cm, lanceolate, margin minutely toothed. Inflorescence racemose, 9 flowers on each branch. The male flowers, light pink have 4 tepals with 2 outer and 2 inner. Outer tepal, ovate, 19×19 mm and inner tepal16×13 mm. Female flower have 5 tepals, pinkish, with 4 outer tepals, 7×4 mm, one inner tepals, 6×2 mm.

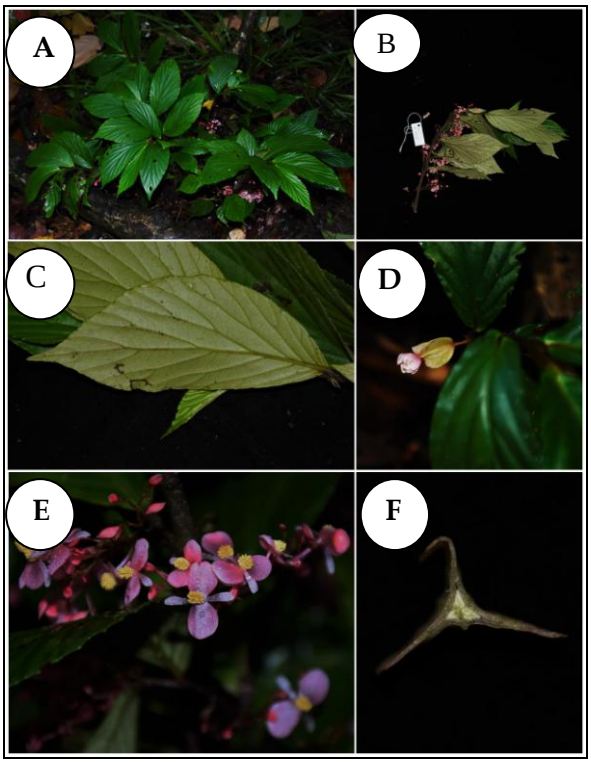

Figure 7. *Begonia* sp. **A & B**. Habit; **C.** Lower surface of lamina**; D.** Female flower; **E**. Male flower; **F**. Cross-section of fruit. All photos (**A-E**) from *SAN156784* by Dayang Fazrinah Awg. Damit.

Begonia Diversity in Promoting Kawag Danum Rainforest Lodge (KDRL)

The study on *Begonia* plant surrounding KDRL is just the beginning of a detailed study of the *Begonias* of Kawag Forest, Ulu Segama Forest Reserve as it covers a large area. As this species has limited distribution, the *Begonias* are rare and prominent to the habitat at Kawag Forest. The stunning and lovely *Begonias,* with the guide of identify *Begonia* can become part of nature tourism product to promote KDRL.

CONCLUSION

From this study, the number of *Begonia* species at Kawag Danum Rainforest Lodge is higher compared to Danum Valley Conservation Area. However, most of *Begonias* found in this study are rare and endemic to Borneo. This information will serve as the baseline data for future research work. These endemic *Begonia* species that have been recorded and the availability of key to identify these plants will help in promoting the nature tourism in the site.

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