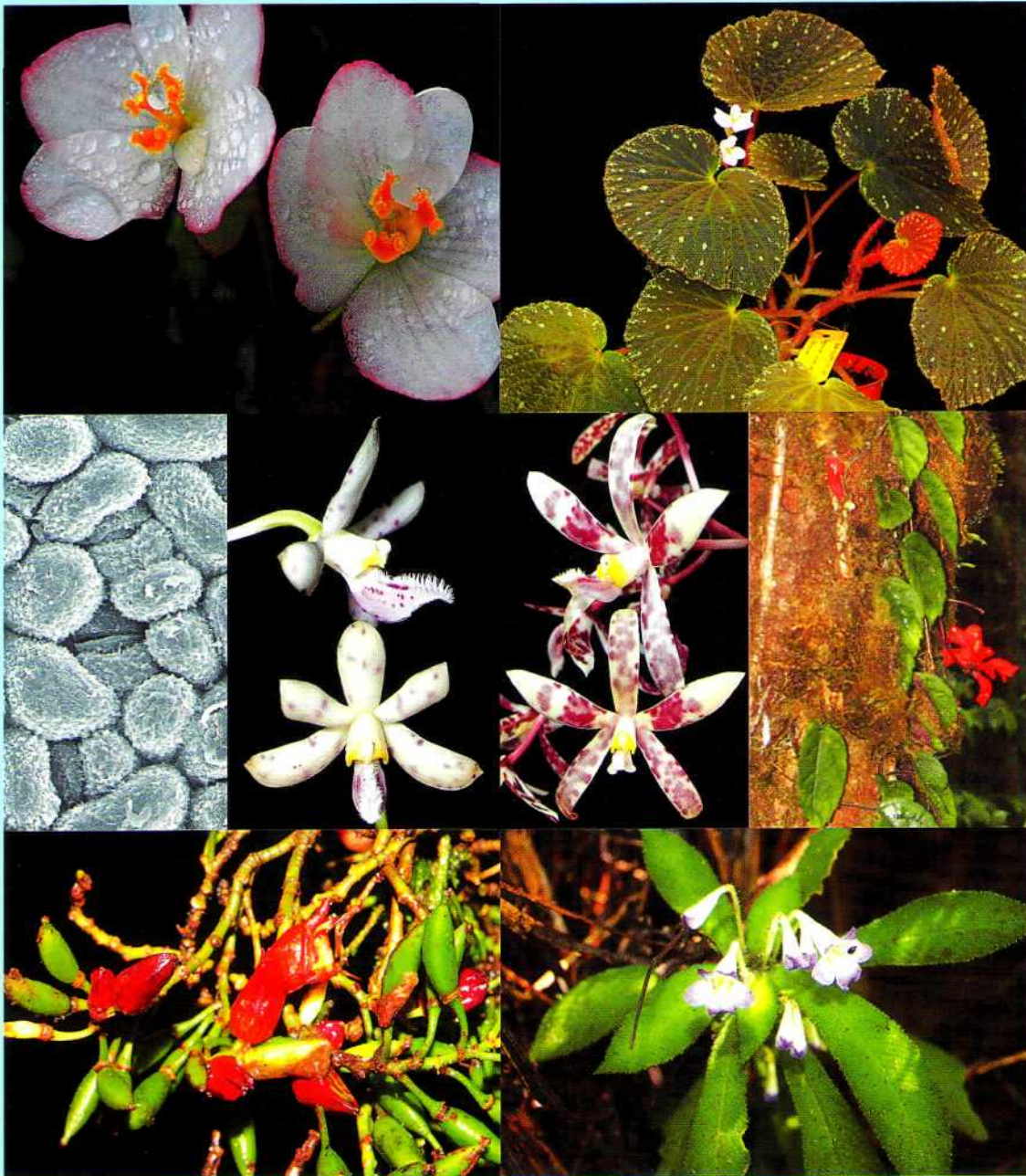




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Cover images: 1. *Begonia holosericeoides* (female flower and habit) (Begoniaceae; Ardi *et al.*); 2. Abaxial cuticles of *Alseodaphne rhododendropsis* (Lauraceae; Nishida & van der Werff); 3. *Dipodium puspitae*, *Dipodium purpureum* (Orchidaceae; O'Byrne); 4. *Agalmyla exannulata*, *Cyrtandra coccinea* var. *celebica*, *Codonoboea kjellbergii* (Gesneriaceae; Kartonegoro & Potter).

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STUDIES ON BEGONIA (BEGONIACEAE) OF THE MOLUCCA ISLANDS I: TWO NEW SPECIES FROM HALMAHERA, INDONESIA AND AN UPDATED DESCRIPTION OF BEGONIA HOLOSERICEA

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ABSTRACT

ARDI, W. H., KUSUMA, Y. W. C., LEWIS, C. E., RISNA, R. A., WIRIADINATA, H., ABDO, M. & THOMAS, D. C. Studies on *Begonia* (Begoniaceae) of the Molucca Islands I: two new species from Halmahera, Indonesia and an updated description of *Begonia holosericea*. *Reinwardtia* 14(1): 19 – 26. — Two new species of *Begonia*, *Begonia holosericeoides* Ardi & D. C. Thomas and *B. aketajawensis* Ardi & D. C. Thomas, are described from Aketajawe Lolobata National Park, Halmahera, Indonesia. The two species belong to *Begonia* section *Petermannia*. *Begonia holosericea*, previously only tentatively assigned to a section, is here assigned to section *Petermannia* based on the examination of newly available material. Additionally, a revised description and an illustration are provided. A key to the Moluccan species of *Begonia* is presented.

Key words: *Begonia*, new species, Halmahera.

ABSTRAK

ARDI, W. H., KUSUMA, Y. W., LEWIS, C. E., RISNA, R. A., WIRIADINATA, H., ABDO, M. & THOMAS, D. C. Studi *Begonia* (Begoniaceae) Kepulauan Maluku I: dua jenis baru dari Halmahera, Indonesia dan pertelaan terbaru *Begonia holosericea*. *Reinwardtia* 14(1): 19 – 26. — Dua jenis baru *Begonia*, *Begonia holosericeoides* Ardi & D. C. Thomas and *B. aketajawensis* Ardi & D. C. Thomas dipertelakan dari Taman Nasional Aketajawe Lolobata, Halmahera, Indonesia. Kedua jenis *Begonia* masuk kedalam seksi *Petermannia* berdasarkan pengamatan material baru yang tersedia. Sebagai tambahan, perbaikan pertelaan dan ilustrasi telah diberikan. Kunci identifikasi jenis *Begonia* dari Maluku juga disajikan dalam tulisan ini.

Kata kunci: *Begonia*, jenis baru, Halmahera.

INTRODUCTION

The *Begonia* flora of the Indonesian Islands group of the Moluccas, located west of Papua and east of Sulawesi, is poorly known. Since the description of *B. holosericea* (Teijsm. & Binn.) Teijsm. & Binn. ca. 150 years ago, only one other endemic Moluccan *Begonia* species has been described: *Begonia sageaensis* Wiriad. (Wiriadinata, 2012). Only six species of *Begonia* have been reported from the islands altogether (Hughes, 2008; Wiriadinata, 2012), but this is certainly an underestimate. Expeditions to less-explored areas of other central Malesian islands such as Sulawesi have recently brought to light numerous new species (Thomas *et al.*, 2009a; Thomas *et al.*, 2009b; Thomas *et al.*, 2011) and it has been noted that “it is evident from herbarium collections that a number of endemic species remain to be described” from the Moluccas (Hughes, 2008).

The six species previously reported from the Moluccas comprise two endemic Moluccan species, the previously poorly known *Begonia holosericea* and *B. sageaensis* as well as the more widely distributed *B. aptera* Blume, which also occurs on Sulawesi and three closely related species (*B. brachybotrys* Merr. & L. M. Perry, *B. pseudo-lateralis* Warb. and *B. rieckei* Warb.) which fall in the *Begonia rieckei* species complex, which shows a wide distribution in Malesia east of Huxley’s Line (Hughes, 2008). This paper presents an updated description of *B. holosericea* and provides descriptions of two new species of endemic Moluccan *Begonia*, raising the total number of species known from the Moluccan Islands to eight, four of which being endemic.

Begonia holosericea was previously only known from the type material and information on important characters such as placentation type was lacking. This is why Doorenbos *et al.* (1998) only tentatively assigned the species to section *Petermannia* and indicated that the placement was doubtful. Hughes (2008) emphasized that the sectional placement of the species is unknown. New material, including plants cultivated at Bogor and Bali Botanic Gardens and herbarium material deposited in BO, has recently become available as a result of expeditions to the Moluccas. Based on this material *Begonia holosericea* is here placed in section *Petermannia*, as it exhibits typical characters of the section: protogynous inflorescences, two-tepaled male flowers, anthers with unilaterally positioned slits, five-tepaled female flowers, two-flowered female inflorescences or solitary female flowers, three-

locular ovaries with axile placentation and bilamelate placentae, and fruits with equal or subequal wings. Thus all Moluccan *Begonia* species, except for *Begonia aptera* (section *Sphenanthera*), can be assigned to section *Petermannia*.

Recent expeditions to the Moluccas, carried out through a partnership between Bogor Botanic Garden and Fairchild Tropical Botanic Garden (June-August 2011, and June-August 2012) to commemorate a historic expedition to the region led by David Fairchild in 1940, have resulted in many valuable herbarium and living specimens, a number of which may represent new species. Two of them are described below. Like the majority of Moluccan species, they are classified in *Begonia* section *Petermannia*. All available *Begonia* specimens from BO, E, K, L and SING have been consulted, and hence it must be assumed, at least until more intensive collecting may reveal otherwise, that these new species have restricted ranges and are endemic to Halmahera island (Fig. 1). Diagnostic characters of the two new species and *Begonia holosericea* are illustrated in Figs. 2–4.

Identification key to *Begonia* species in the Moluccan Islands

- 1a. Plants erect 2
- 1b. Plants creeping 3
- 2a. Female flowers with 2–5 tepals; male flowers with 2 tepals, anther connectives not projecting at apex; leaves broadly ovate *B. rieckii*
- 2b. Female flowers with 6 tepals; male flowers with 4 tepals, anther connectives projecting at apex; leaves oblong-lanceolate *B. aptera*
- 3a. Leaf apex acuminate 4
- 3b. Leaf apex rounded 5
- 4a. Adaxial leaf surface densely hirsute with red hairs; female inflorescence peduncle < 5 mm; female flowers solitary *B. sageaensis*
- 4b. Adaxial leaf surface glabrous; female inflorescence peduncle up to 3.5 cm; female flowers in two-flowered inflorescences *B. holosericeoides*
- 5a. Male flower with two tepals; female inflorescence peduncle 2–3 mm long; ovary densely hairy *B. holosericea*
- 5b. Male flowers with four tepals; female inflorescence peduncle ca. 1 mm long; ovary glabrous or glabrescent *B. aketajawensis*

SPECIES DESCRIPTIONS

Begonia aketajawensis Ardi & D. C. Thomas *spec. nov.* section *Petermannia*. Figs. 1, 2. — Type:

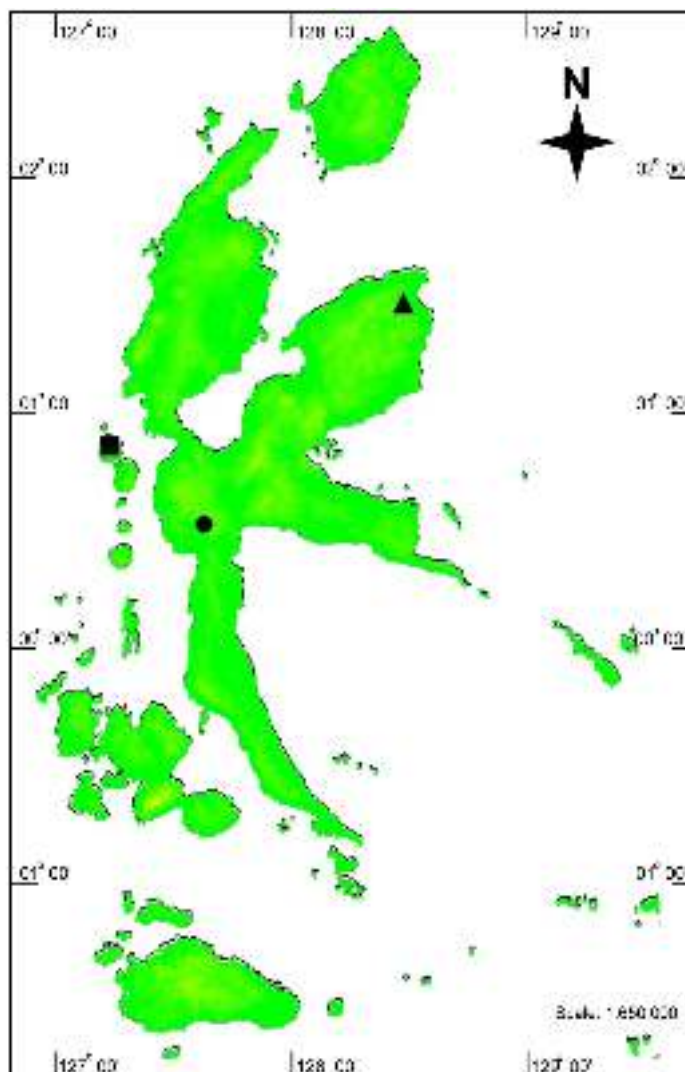


Fig. 1. Distribution of *Begonia holosericeoides* (triangle), *B. aketajawensis* (circle), *B. holosericea* (square).

Indonesia, North Halmahera, Aketajawe-Lolobata National Park, Tayawi Village, secondary lowland forest, 0°27'55.6''N, 127°44'42.3''E, 19 May 2011, *Melissa E. Abdo* 4740 (holo: BO).

Similar to *Begonia holosericea*. Differing from that species by the narrowly obovate to orbicular leaves, smaller leaf size (8.8–12 × 8.3–11 cm), male flowers with four tepals and sparsely hairy or glabrous ovaries (leaf lamina broadly ovate to suborbicular, 15–19 × 12–18 cm, male flowers with two tepals and densely hairy ovaries in *B. holosericea*).

Perennial, monoecious herb with creeping stems, to ca. 25 cm long, moderately to densely hairy. *Stems* few branched; *internodes* ca. 1.7–3.8 cm long, densely covered with branched hairs. *Leaves* alternate; *stipules* persistent, 8–13 × 5–6 mm, triangular, translucent glabrous except for hairs on the abaxial midrib, midrib abaxially prominent,

projecting up to ca. 3.5 mm at the apex; *petioles* 3.5–11.5 cm long, channeled, red, densely covered with branched hairs; *lamina* basifixed 8.8–12 × 8.5–11 cm, asymmetric, narrowly obovate to orbicular, base slightly rounded to cordate, lobes not or rarely slightly overlapping, apex rounded, margin fimbriate, adaxial surface green or reddish green variegated, with silvery band or spots around the margin and extending inwards between the veins, glabrous, abaxial surface paler, hairy on the veins, primary veins 7–8, actinodromous, secondary veins craspedodromous. *Inflorescences* axillary, protogynous; *bracts* ca. 7–13 × 4–6 mm, ovate, creamy tinged pink, sparsely hairy, with abaxially slightly prominent midrib projecting up to 3 mm at the apex; *female inflorescences* solitary, usually one node basal to the male inflorescences, peduncles ca. 1 mm long; *male inflorescences* usually distal to the female inflorescences, composed of 1–2 monochasial partial inflorescences with 2–4 flowers each, peduncles 2–3.5 cm long. *Male flowers*: *pedicels* 3–



Fig. 2. *Begonia aketajawensis* Ardi & D.C. Thomas. A. Plant habit in-situ (scale 10 cm); B. Juvenile plant in-situ (scale 5 cm); C. Cultivated juvenile plant (scale 2 cm); D. Male inflorescence (scale 2 cm); E. Male flowers (scale 1 cm); F. Female flower (scale 1 cm); G. Female flower (scale 1 cm); H. Inflorescence (scale 1 cm); I. Ovary cross section (scale 5 mm). (Photos: A & D-H: Made Ardhaka; B: Yayan Kusuma; C: Wisnu H. Ardi; I: Daniel C. Thomas).

5.5 cm long; *tepals* 4, white, the 2 larger 11–15.5 × 11.5–15 mm, orbicular, base slightly cordate, apex rounded, the 2 smaller 10–12.5 × 3–7 mm, elliptic or oblong-obovate; *stamens* yellow, filaments *ca.* 0.5–1 mm long, slightly fused at the very base, anthers *ca.* 1–1.5 mm long, oblong, dehiscing through unilaterally positioned slits >1/2 as long as the anthers. *Female flowers*: *pedicels* 1.7–2.5 cm long; *tepals* 5–6, white tinged with pink, unequal, the 4 larger 10.5–15 × 8–11 mm, obovate, the smallest 11–15 × 5–7 mm, elliptic; *ovary* globose 8.5–10 × 7–10 mm, locules 3, placentation axile, placentae bilamellate, wings 3, narrowly triangular, rounded at base, apex subtruncate to truncate, style basally fused, 3-branched, each styloidium bifurcate in the stigmatic region, stigmas 3, stigmatic surface a spirally twisted papillose band, yellow. *Fruiting pedicels ca.* 25 mm long. *Fruits* globose, 8.5–13 × 7

–10 mm (excluding the wings), glabrous, dehiscent, splitting along the wing attachment, wing shape as for ovary, *ca.* 5.5 mm wide at the widest point (at the apex); seeds unknown.

Distribution. Endemic to Aketajawe-Lolobata National Park, Halmahera, North Moluccas, Indonesia. Locally common.

Habitat. Found on vertical moist rock surfaces, including limestone substrates, in half to full shade, in secondary forest at 100–150 m altitude.

Other specimen examined. Cultivated at Bali Botanic Garden from vegetative material collected in the wild (Indonesia, North Maluku, Halmahera Timur, Aketajawe-Lolobata National Park), 1 September 2013, *Wisnu H. Ardi*, WI 84 (BO).

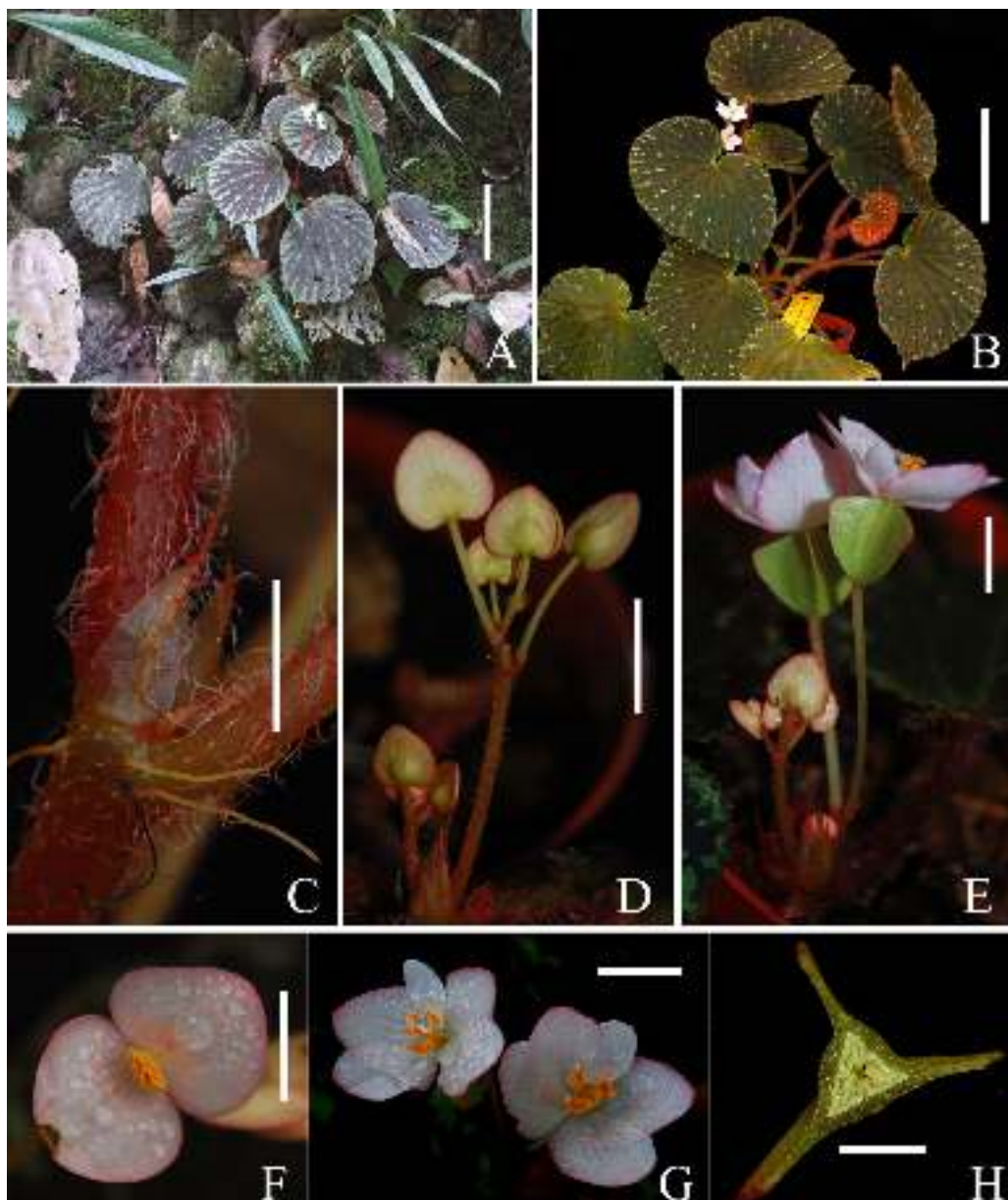


Fig. 3. *Begonia holosericeoides* Ardi & D.C. Thomas. A. Plant habit in-situ (scale 10 cm); B. Plant habit in cultivation (scale 10 cm); C. Stipule (scale 1 cm); D. Male inflorescence (scale 2 cm); E. Female inflorescence (scale 1 cm); F. Male flower (scale 1 cm); G. Female flower (scale 1 cm); H. Ovary cross section (scale 5 mm). (Photos: A: Yayan Kusuma; B-H: Wisnu H. Ardi).

Note. The specific epithet refers to the collection locality of the type material, Aketajawe-Lolobata National Park (Latin, *-ensis* – originating from). *Begonia aketajawensis* is similar to *B. holosericea*, but it can be easily distinguished by several characters such as leaf shape and size (narrowly obovate to orbicular leaves with laminas $8.8\text{--}12 \times 8.3\text{--}11$ cm, *vs.* broadly ovate to suborbicular leaves with laminas $15\text{--}19 \times 12\text{--}18$ cm), male flowers with four tepals (*vs.* male flower with two tepals) and sparsely hairy or glabrous ovaries (*vs.* densely hairy ovaries with stiff, red hairs in *B. holosericea*). *Begonia aketajawensis* shows a character combination which is unique in the large section

Petermannia (>270 species): creeping stems and four-tepaled male flowers. Four-tepaled male flowers are rare in section *Petermannia* and have only been described from a few species such as *B. georgei* Coyle, *B. grandipetala* Irmsch., *B. propinqua* Ridl. and *B. watuwilensis* Girm., none of which is morphologically close to *B. aketajawensis*. The majority of species in section *Petermannia* shows more or less erect stems, although there are some exceptions such as the rhizomatous *B. mendumae* M. Hughes and the creeping *B. gemella* Warb. ex L. B. Sm. & Wassh. In contrast to this, the *Begonia* species in section *Petermannia* endemic to the Moluccas are characterized by

creeping or rhizomatous stems. Another characteristic feature of the endemic Moluccan species are the few-flowered (2–5 flowers) male inflorescences which are arranged in simple monochasia.

Begonia holosericeoides Ardi & D. C. Thomas *spec. nov.* section *Petermannia*. Figs. 1, 3. — Type: Cultivated at Bogor Botanic Garden from vegetative material collected in the wild (Indonesia, North Maluku, Halmahera Timur, Aketajawe-Lolobata National Park, SP2 Village, primary lowland forest, 1° 26'05.6"N 128° 37'30.20"E, 1 September 2013, Wisnu H. Ardi, WI 83 (holo: BO, iso: KRB).

Similar to *Begonia holosericea* (Teijsm. & Binn.) Teijsm. & Binn. Differs from this species by the longer peduncles of the female inflorescences (1.1–3.5 cm), sparsely hairy or glabrous ovaries and ovate leaves with acuminate apex (peduncle of the female inflorescence 2–3 mm long, ovary densely hairy and leaves suborbicular with rounded apex in *B. holosericea*).

Perennial, monoecious herb with creeping stems, to ca. 15 cm long. *Stems* few branched; *internodes* ca. 10–12 mm long, dark green or green tinged red, densely covered with branched hairs. *Leaves* alternate; *stipules* persistent, ca. 7–12 × 9–12.5 mm, triangular, glabrous except for hairs on the abaxial midrib, midrib abaxially prominent, projecting up to ca. 4 mm at the apex; *petioles* 3–4 cm long, red, densely covered with hairs; *lamina* basifixed, 15–15.5 × 10.5–11 cm, asymmetric, ovate, base cordate and lobes not or slightly overlapping, apex acuminate, margin fimbriate, adaxial surface glabrous, dark green reddish, variegated with silver bands or spots between the veins sometimes fused forming a band along the margin, abaxial surface pale green, with red hairs on the veins, coriaceous, primary veins 7–8, actinodromous, secondary veins craspedodromous. *Inflorescences* axillary, protogynous; *bracts* 8–14 × 4–8 mm, oblong, reddish, sparsely hairy, with abaxially slightly prominent midrib projecting up to 2 mm at the apex; *female inflorescences* two-flowered, usually one node basal to the male inflorescences, peduncles ca. 1.1–3.5 cm long; *male inflorescences* usually distal to the female inflorescences, composed of 1–3 partial inflorescences, each consisting of 2 monochasia with 2–4 flowers each, peduncles ca. 5–8 cm long, hairy. *Male flowers*: *pedicels* 1.5–4 cm long, hairy; *tepals* 2, white tinged with pink, 13–15 × 11–13 mm, broadly ovate, base slightly cordate and becoming rounded at anthesis, apex rounded, abaxially glabrescent; stamens yellow, filaments ca. 1–2 mm long, slightly fused at the very base, anthers ca. 1.5

–2 mm long, oblong, dehiscing through unilaterally positioned slits >1/2 as long as the anthers. *Female flowers*: *pedicels* 2.2–3.1 cm long, sparsely hairy, red; *tepals* 5, white tinged with pink at the margin, unequal, the four larger broadly ovate, 14 × 11–12 mm, one smaller, elliptic, 11 × 5 mm, margin fimbriate; *ovary* ellipsoid, 12.5 × 4.5 mm (excluding the wings), locules 3, placentation axile, placentae bilamellate, wings 3, subequal, cuneate to rounded at base, subtruncate at apex, widest point apically, style basally fused, 3-branched, each styloidium bifurcate in the stigmatic region, stigmas 3, stigmatic surface a spirally twisted papillose band, yellow. *Fruiting pedicels* ca. 2.2–3.1 cm long. *Fruits* ellipsoid, 10–13 × 4.5–5.5 mm (excluding the wing), sparsely hairy or sometimes glabrous, dehiscent, splitting along the wing attachment, wing shape as for ovary, ca. 9 mm wide at the widest point (at the apex); seeds unknown.

Distribution. Endemic to the Aketajawe-Lolobata National Park, Halmahera, North Mollucas, Indonesia.

Habitat. Found on vertical moist rock surfaces, including limestone substrates, in full shade, in primary rain forest at ca. 145 m asl.

Note. The specific epithet is a compound of *holosericea* (the species epithet of *B. holosericea*), and *-oides* (in Greek compounds: resembling). It refers to the creeping habit and adaxial leaf pattern, which are similar to the conditions found in *B. holosericea*. Although similar on first sight, *B. holosericeoides* can be easily distinguished by several characters such as the acuminate leaf apex (rounded in *B. holosericea*) and the sparsely hairy to glabrous ovary (densely hairy with stiff, red hairs in *B. holosericea*) and the length of the peduncles of the female inflorescences (0.2–0.3 cm in *B. holosericea*, vs. 1.1–3.5 cm in *B. holosericeoides*).

BEGONIA HOLOSERICEA (Teijsm. & Binn.) Teijsm. & Binn., *Epim. Ludg. Bat.*: 5(1863). Section *Petermannia*. — *Diploclinium holosericeum* Teijsm. & Binn., *Tijdschr. Ned.-Indie* 25:421 (1863). — Type: Ternate Island, J.E. Teijsmann sn. (holo: BM), Figs. 1, 4.

Perennial, monoecious herb with creeping stems, to ca. 25 cm long. *Stems* few branched; *internodes* ca. 2–4.5 cm long, reddish, densely covered with branched hairs, which are red at base, and white at the apex. *Leaves* alternate; *stipules* persistent, 13–16 × 9–12 mm, triangular, glabrous except for hairs on the abaxial midrib, midrib abaxially prominent,

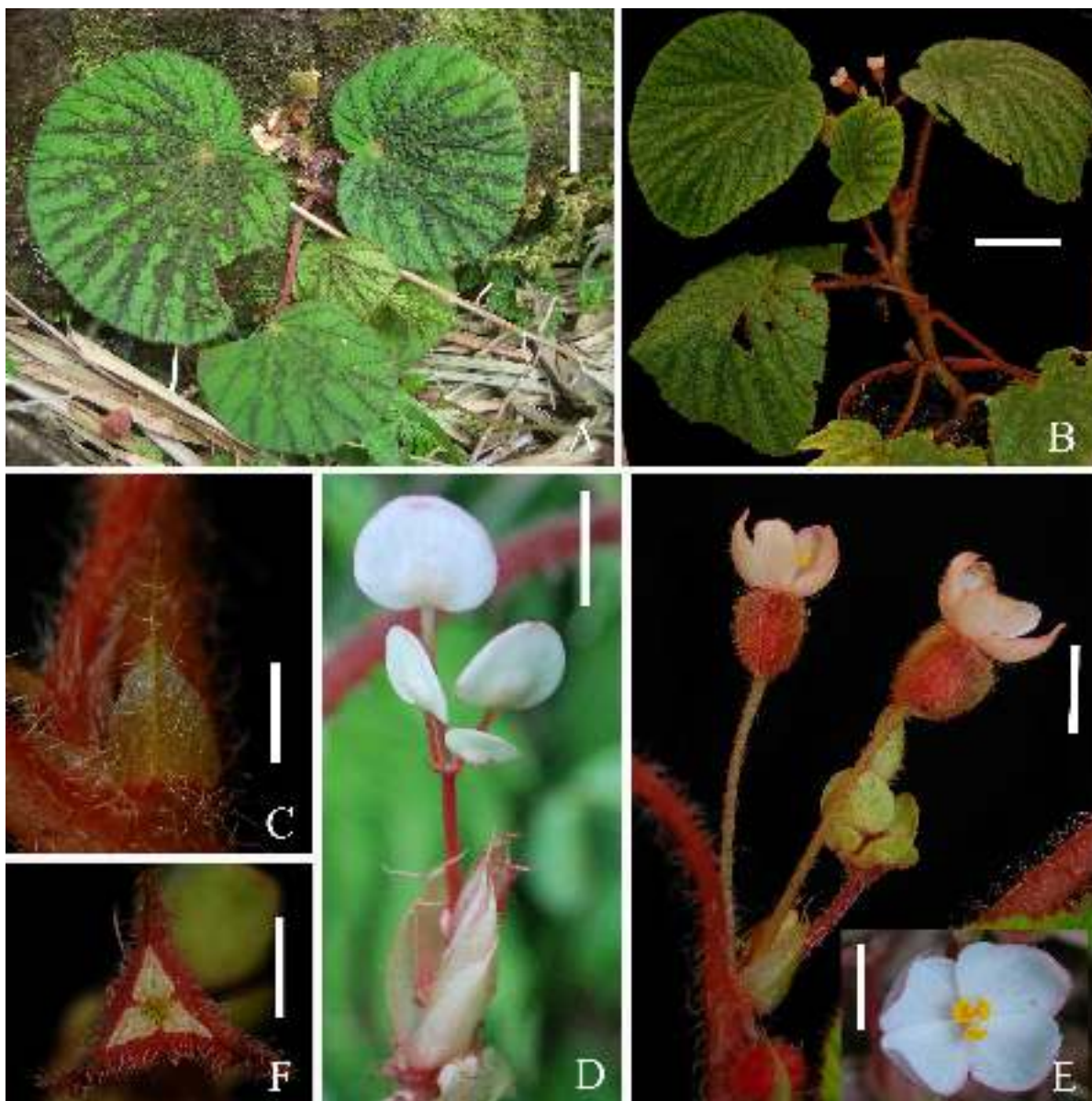


Fig. 4. *Begonia holosericea* (Teijsm. & Binn.) Teijsm. & Binn. A. Plant habit in-situ (scale 5 cm); B. Plant habit in cultivation (scale 5 cm); C. Stipule (scale 1 cm); D. Male inflorescence (scale 1 cm); E. Female inflorescence and flower (scale 1 cm); F. Ovary cross section (scale 5 mm). (Photos: A & D: Izu A. Fijridiyanto.; B, C, E, F: Wisnu H. Ardi).

projecting up to *ca.* 12 mm at the apex; *petioles* 7–11.5 cm long, red, densely covered with branched hairs; *lamina* basifixed, 15–19 × 12–18 cm, asymmetric, broadly ovate to suborbicular, base cordate and lobes overlapping, apex rounded, margin fimbriate, adaxial surface glabrous, bullate, variegated, green with silvery green blotchs or spots between the veins and forming bands, abaxial surface pale green, hairy on the veins, primary veins 7–8, actinodromous, secondary veins craspedodromous. *Inflorescences* axillary, protogynous; *bracts ca.* 15 × 8 mm, ovate, creamy tinged pink, sparsely to moderately hairy, with abaxially slightly prominent midrib projecting up to 6 mm at the apex; *female inflorescences* one- or two-flowered, usually one node basal to the male inflorescences,

peduncles 2–3 mm long; *male inflorescences* usually distal to the female inflorescences, composed of 1–3(–5) partial inflorescences, each consisting 1–2 monochasia with 2–4 flowers each, peduncles *ca.* 3–5 cm long, hairy. *Male flowers*: *pedicels* 3–4 cm long, hairy; *tepals* 2, white tinged with pink, 10–17 × 10–13 mm, broadly ovate, base slightly cordate and becoming rounded at anthesis, apex rounded; abaxially hairy, stamens yellow, filaments *ca.* 1 mm, slightly fused at the very base, anthers *ca.* 1–1.5 mm long, oblong, dehiscing through unilaterally positioned slits >1/2 as long as the anthers. *Female flowers*: *pedicels* 3–4.2 cm, hairy, red; *tepals* 5, white tinged with pink at the margin, unequal, the four larger broadly ovate and adaxially concave (+/- bowl-shaped), 10–14 × 10–

12 mm, one smaller, elliptic, 10–13 × 5–6 mm, margin fimbriate; *ovary* ellipsoid, 9–11 × 5–7 mm, red, densely hairy, locules 3, placentation axile, placentae bilamellate, wings 3, subequal, rounded to cuneate at base, truncate to rounded at apex, widest point apically, style basally fused, 3-branched, each stylodium bifurcate in the stigmatic region, stigmas 3, stigmatic surface a spirally twisted papillose band, yellow. *Fruiting pedicels* 3.5–4.2 cm long. *Fruits* ellipsoid, 11–18 × 10–11 mm (excluding the wing), densely hairy, dehiscent, splitting along the wing attachment, wing shape as for ovary, reddish, *ca.* 12 mm wide at the widest point (at the apex); seeds unknown.

Distribution. Endemic to Mt. Gamalama, Ternate Island, North Moluccas, Indonesia.

Habitat. This species can be found growing in shady places on vertical moist rock surfaces, in secondary forest at *ca.* 600 m altitude.

Other specimen examined. Cultivated at Bogor Botanic Garden from vegetative material collected in the wild (Indonesia, North Moluccas, Ternate Island, Mt. Gamalama), 6 January 2014, *Wisnu H. Ardi*, WI 95 (BO).

Note. *Begonia holosericea* is the first endemic species described from Ternate island on the basis of a specimen collected by Teijsmann. The species was initially described as *Diploclinium holosericeum*, but later referred to *Begonia*. Sectional placement was problematic for this species as information about its placentation was lacking, and Doorenbos (1998) and Hughes (2008) only tentatively assigned it to section *Petermannia*. Based on recent observations of plants cultivated in Bogor Botanic Garden, which were collected from the type locality in 2009, *B. holosericea* can be confidently assigned to section *Petermannia* 150 years after it was first described. It exhibits several typical characters of the section: protogynous inflorescences, two-tepaled male flowers, anthers with unilaterally positioned slits, five-tepaled female flowers, two-flowered female inflorescences or solitary female flowers which are born basal to

the male, three-locular ovaries with axile placentation and bilamellate placentae, and fruits with equal or subequal wings.

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