

***Begonia* of the Matarombeo karst, Southeast Sulawesi, Indonesia, including two new species**

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ABSTRACT. Based on collections from the Matarombeo limestone mountain range in Southeast Sulawesi, Indonesia, the two new species *Begonia balgooyi* D.C.Thomas & Ardi and *B. matarombeoensis* D.C.Thomas & Ardi are described and illustrated, and an amended description and a photo plate of *B. watuwilensis* Girm. are provided. These species are restricted to limestone habitats and endemic to Southeast Sulawesi. Provisional conservation assessments indicate an Endangered (EN) status for all three species.

Keywords. *Begoniaceae*, karst flora, limestone, section *Petermannia*, stenoendemism, Sulawesi Tenggara

Introduction

Material collected on recent expeditions to the Indonesian island of Sulawesi has greatly improved our understanding of the diversity of the Sulawesi *Begonia* L. flora. There are 46 currently accepted *Begonia* species reported from the island (see Thomas et al., 2013, continuously updated), more than half of which have been described since 2005 (Tebbutt, 2005; Hughes, 2006; Thomas & Hughes, 2008; Girmansyah et al., 2009; Thomas et al., 2009a, 2009b, 2011; Wiriadinata, 2013; Ardi et al., 2014a; Lin et al., 2017).

Vast areas of Sulawesi, however, are still botanically underexplored (Cannon et al., 2007), and only four *Begonia* species, including the narrowly endemic *B. flacca* Irmsch., *B. mekonggensis* Girm. & Wiriad., *B. watuwilensis* Girm., and the more widespread *B. aptera* Blume, are known from the province of Southeast Sulawesi (Sulawesi Tenggara). An examination of herbarium material (B, BO, E, K, L, SING) and images of specimens from numerous herbaria available in the *Begonia Resource Centre* (Hughes et al., 2015, continuously updated) indicate that this is an underestimate, and that there are several new species awaiting description. This is to be expected given (i) that the mega-diverse genus *Begonia* (> 1800 species) has a centre of diversity in Southeast Asia, (ii) the large area of Sulawesi Tenggara (38,140 km²), and (iii) the presence of suitable habitats, including lowland and upland rainforest, and

suitable edaphic conditions, including extensive areas of limestone karst (Cannon et al., 2005), which frequently harbour a diverse *Begonia* flora elsewhere in Southeast Asia (e.g. Kiew, 2001; Chung et al., 2014; Kiew et al., 2015).

One example of a botanically virtually unexplored area is the limestone mountain range of Matarombeo in Southeast Sulawesi (Fig. 1). The Matarombeo mountain range comprises one of the most extensive limestone karst formations on the island extending over more than 750 km² (based on maps in Cannon et al., 2005; note that carbonated bedrock extends considerably further in the eastern part of the range). This karst is embedded in a matrix of predominantly ultramafic soils resulting in abrupt transitions of forest types and species compositions (Cannon et al., 2005). In the north, oil palm plantations and accompanying infrastructure border the Matarombeo karst, but there are no roads leading deep into the karst areas. Only some larger rivers such as the Lalindu and Lasolo, as well as roads in the oil palm plantations to the north of the range offer some access to its periphery. While there is no legal protection as a National Park, Forest Reserve, or Forest Recreational Area, the rugged terrain and the lack of infrastructure offer some natural protection for the time being.

A scientific expedition by a French team, led by the adventurer Evrard Wendenbaum and including three biologists, explored Matarombeo in 2014. This team documented the rich biodiversity of the mountain range photographically and in video (see *Lost Worlds* movie directed by Gil Kebaili, available at <http://www.lost-worlds.org/en/matarombeo>). Photographs taken during this expedition indicated that there are new species of *Begonia* in the mountain range. Following in the footsteps of this expedition, Bogor Botanical Gardens organised an expedition to Matarombeo in February and March 2017, which resulted in the collection of material of two new species of *Begonia*. These species are described below. A third species, *Begonia watuwilensis*, previously only known from a single collection on Gunung Watuwila c. 70 km southwest of the Matarombeo range, was also collected. An amended description of this species incorporating measurements of the newly available material is presented.

Taxonomy

***Begonia balgooyi* D.C.Thomas & Ardi, sp. nov.** (§ *Petermannia*).

This species has palmately compound leaves, which are rare in section *Petermannia*. Of the palmately compound-leaved species in the section (*Begonia insueta* D.C.Thomas & Ardi, *B. oligandra* Merr. & L.M.Perry, *B. polilloensis* Tebbitt and *B. rachmatii* Tebbitt) it is most similar to the Philippine *B. polilloensis*, but differs from it in its longer petioles (3.5–7.5 cm vs 0.7–2 cm), longer pedicels of the male flowers (10–34 mm vs c. 6 mm), and the different shape of the petals of the male flowers (suborbicular to broadly ovate vs elliptic). – TYPE: Indonesia, Sulawesi, Sulawesi Tenggara, Kolaka District, Mangolo Forest Reserve, 68 m, 3 February 2017, *Wisnu H. Ardi 133* (holotype BO; isotypes KRB, SING). (Fig. 1, 2)

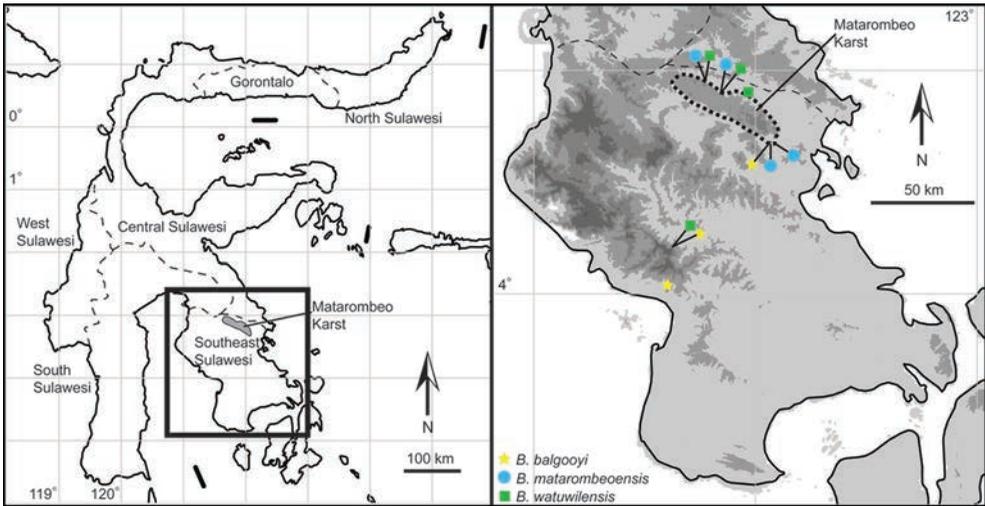


Fig. 1. Distribution map. Left: Overview of Sulawesi, provinces, and location of Matarombeo karst. Right: Species distributions in Southeast Sulawesi. Elevation is indicated by five shades of grey: 0–500 m (the lightest shade), 500–1000 m, 1000–1500 m, 1500–2000 m, and > 2000 m (the darkest shade).

Perennial, monoecious herb, up to c. 25 cm tall; stems prostrate to semi-erect, rooting at the nodes when in contact with the substrate, with microscopic glandular hairs and a sparse to moderately dense indumentum of multicellular whitish hairs, c. 0.5–1 mm long, on above-ground vegetative parts. **Stem** branched, internodes 1.5–5.5 cm long, red or reddish-greenish. **Leaves** alternate; stipules semi-persistent, 4–7 × 3–4.5 mm, ovate to elliptic, acuminate, setose, seta to 3 mm long, margin entire, translucent, reddish-greenish; petioles 3.5–7.5 cm long, adaxially shallowly channelled, concolourous with the stem; lamina basifixed, palmately compound, 5–9.5 × 3.5–7 cm, ovate to elliptic, with 3–6 leaflets, 1.5–6 × 0.8–3 cm, the smallest asymmetrical, the larger symmetric to slightly asymmetric, ovate to elliptic, margin serrate to pinnatisect (divided up to c. 80% to the midrib), teeth bristle-pointed, base cuneate or rounded, apex acuminate, adaxial surface green with reddish or greenish veins, sparsely hairy inbetween the veins or glabrous, abaxial surface pale green, sparsely to moderately hairy on the veins only, veins reddish, leaflet venation pinnate, secondary veins craspedodromus. **Inflorescences** protogynous; female flowers solitary, often one node basal to male inflorescences or separate, peduncles c. 1 mm long, green-reddish, glabrous, bracts similar to stipules, c. 3–6 × 2.5–4 mm, ovate, midrib prominent, setose, seta up to 1.5 mm long; male inflorescences monochasial cymes with 3–10 flowers, peduncles 3–19 mm long, reddish, glabrescent, bracts similar to stipules, c. 4–6 × 2–3 mm, ovate, midrib prominent, setose, seta to 1.5 mm long. **Male flowers:** pedicels 1–3.4 cm long, whitish, whitish tinged with pink, to reddish, sparsely hairy to glabrous; tepals 2, white or white tinged with pink, 7–10 × 8–13 mm, suborbicular to broadly ovate, base slightly cordate, apex rounded; androecium of c. 46–50 stamens, yellow, filaments up to c. 0.5 mm long, slightly fused at the very base, anthers up to c. 1 mm long, obovate,

dehiscing through unilaterally positioned slits c. 1/2 as long as the anthers. **Female flowers:** pedicels 3–7 mm long, green-reddish, glabrous; tepals 5, white, unequal, the four larger outer 6–9.5 × 4–7 mm, ovate to elliptic, the smaller inner one 6–8 × 3–4 mm, elliptic; ovary ellipsoid, 3–6 × 3 mm (excluding wings), red, glabrous, locules 3, placentation axile, placentae bilamellate, wings 3, subequal, pale green, base rounded or cuneate, apex truncate, style basally fused, 3-branched, each stylodium bifurcate in the stigmatic region, stigmatic surface a spirally twisted papillose band, orange. **Fruits:** peduncles c. 1–2 mm long, pedicels 3.5–9 mm long, ovary ellipsoid, 8–10 × 3.5–5 mm (excluding the wings), sparsely hairy, dehiscent, splitting along the wing attachment, wing shape as for ovary, up to 10 mm at the widest point (apically). **Seeds** barrel-shaped, c. 0.2 mm long.

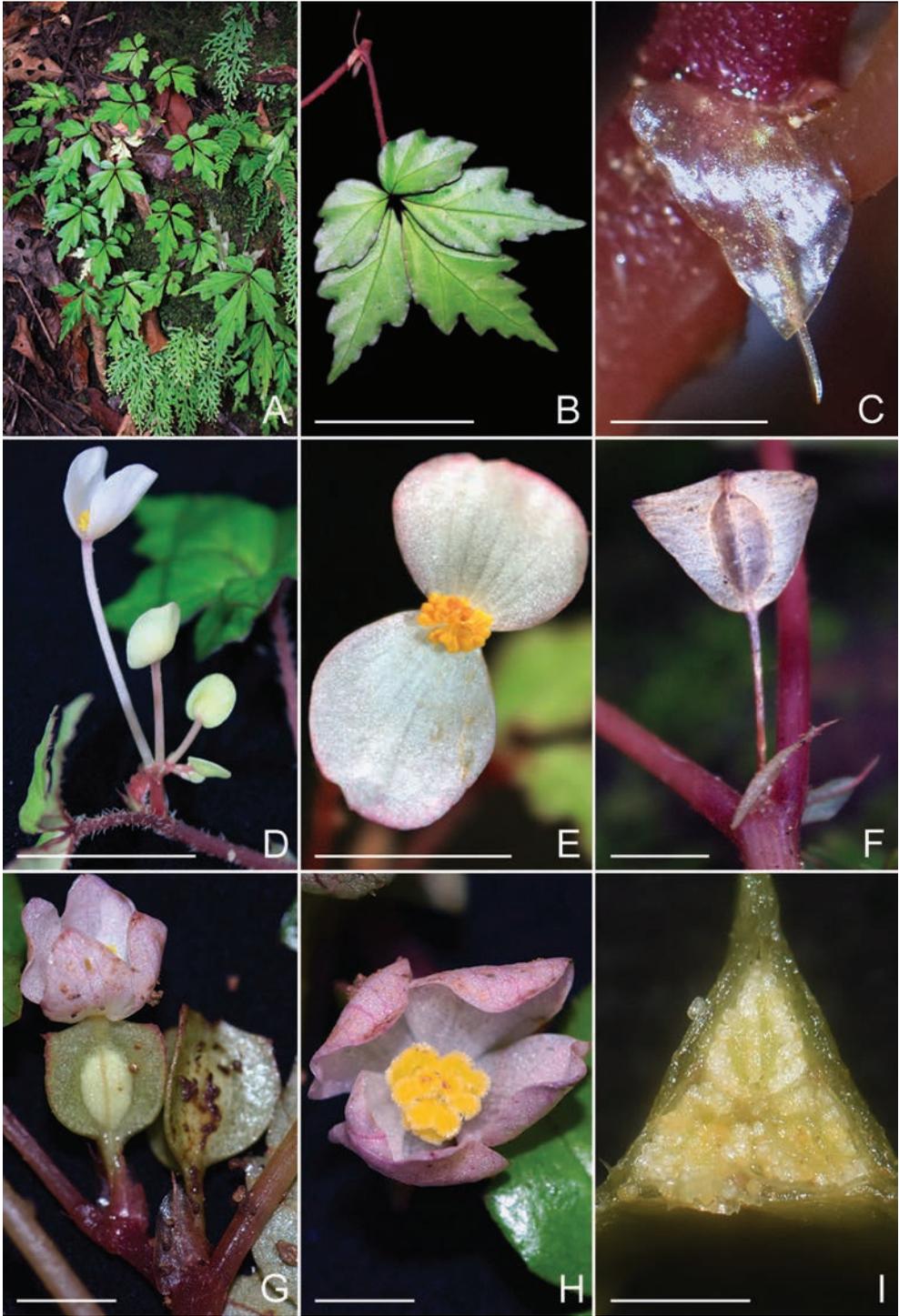
Habitat. Growing terrestrially on steep slopes or river embankments in lowland and upland rainforest, in dense shade, on limestone soils, at c. 50–1200 m altitude.

Distribution. Endemic to Southeast Sulawesi, Sulawesi, Indonesia. Known from only three localities: Mangolo Nature Recreation Park, Gunung Watuwila, and Matarombeo (Fig. 1).

Etymology. This species is named in honour of Max Michael Josephus van Balgooy; a pre-eminent expert on the Malesian flora, who extensively collected in the region and led a major Indonesian-Dutch expedition to Sulawesi in 1979 (see Baas et al., 2012).

Provisional IUCN conservation assessment. Endangered EN B1ab(iii),B2ab(iii). *Begonia balgooyi* is known from only three collections from three localities of lowland and upland rainforest on limestone: Mangolo, Gunung Watuwila and Matarombeo, only the former of which has some legal protection as a Nature Recreation Park. Only single populations were observed in Mangolo and Matarombeo, and some anthropogenic disturbance by agriculture (oil palm, cacao and clove plantations) at the periphery of the habitats were noted. The Abuki mountain range in between the three localities is botanically very poorly explored and this species is likely more widespread. However, even if it is present in suitable limestone habitats in between Mangolo, Gunung Watuwila and Matarombeo, its Extent of Occurrence (EOO) would remain < 5000 km². The small EOO and Area of Occupancy (AOO), in combination with only few collection localities and observed threats, warrant an Endangered (EN) status.

Fig. 2. *Begonia balgooyi* D.C.Thomas & Ardi. **A.** Habit. **B.** Adaxial leaf lamina and petiole (scale bar 5 cm). **C.** Stipule (scale bar 3 mm). **D.** Male inflorescence (monochasium); (scale bar 2 cm). **E.** Male flower (scale bar 9 mm). **F.** Fruit (scale bar 4 mm). **G.** Female flowers, side view; (scale bar 5 mm). **H.** Female flower, front view (scale bar 4 mm). **I.** Ovary, cross-section, axile placentation and bilamellate placentae (scale bar 3 mm). A, B, D–F from Ardi, *W.H. 133*; C, G–I from Ardi, *W.H. 157*. (Photos: W.H. Ardi)



Additional specimens examined. INDONESIA: **Sulawesi Tenggara:** Tawanga, B. Watuwila, c. 1200 m, 24 Mar 1929, *Kjellberg 1010* (BO); N of Linomoyo, Matarombeo, Anoa forest, 86 m, 15 Feb 2017, *Ardi 157* (BO, KRB, SING).

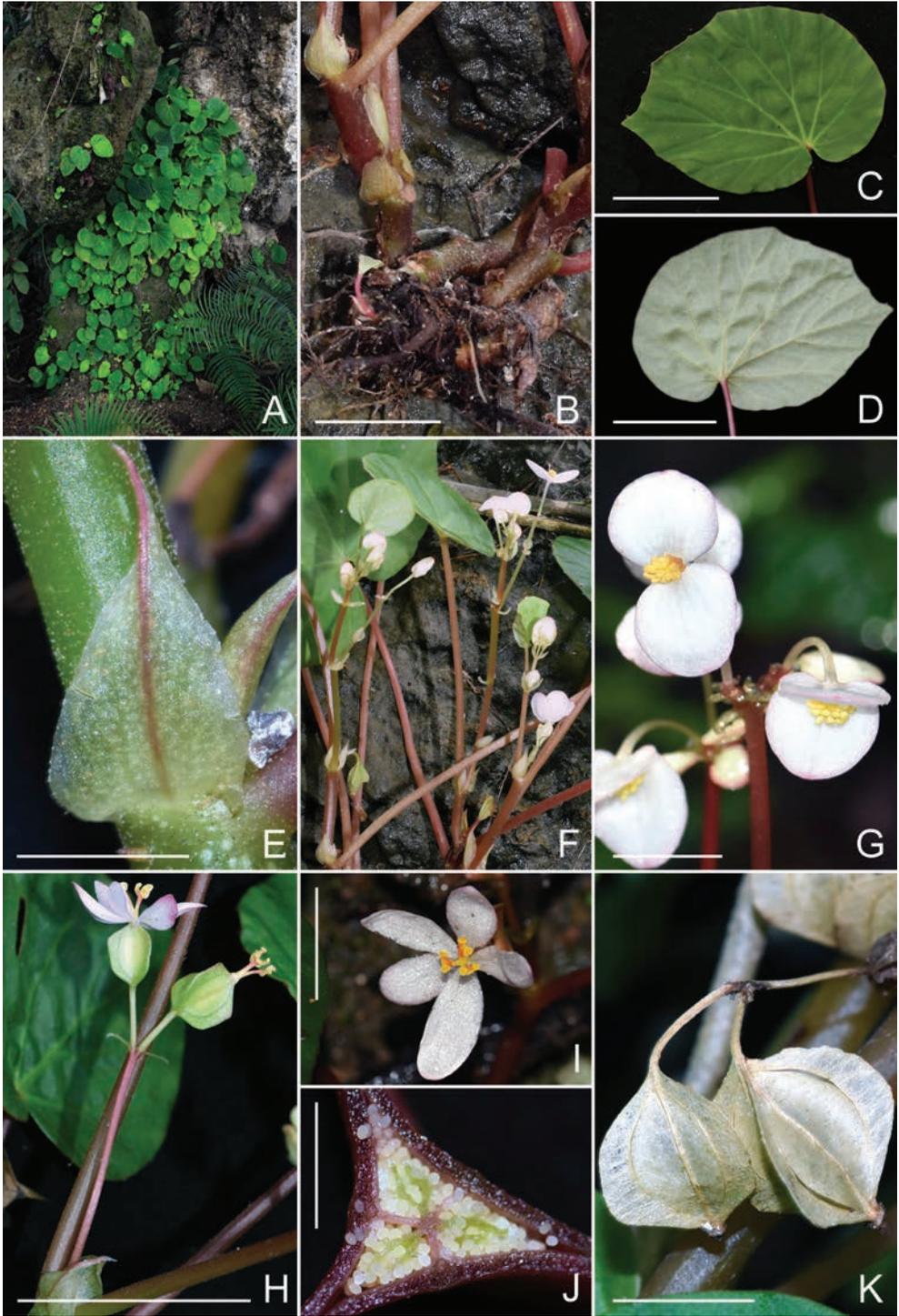
Notes. *Begonia balgooyi* is a very distinct species in *Begonia* section *Petermannia* on account of its palmately compound leaves. It can be easily differentiated from other palmately compound-leaved species in the section (*Begonia insueta* D.C.Thomas & Ardi, *B. oligandra* Merr. & L.M.Perry, *B. polilloensis* Tebbitt and *B. rachmatii* Tebbitt [see Tebbitt, 2005; Thomas et al., 2011]). *Begonia insueta* from Sulawesi and *B. oligandra* from New Guinea are morphologically dissimilar to *B. balgooyi*. They are much more robust and taller plants with unequal ovary wings. *Begonia rachmatii* from Sulawesi differs from *B. balgooyi* in having many-flowered, complex inflorescences (cymose-racemose) usually composed of multiple monochasial partial inflorescences (vs single few-flowered monochasia), fewer stamens (15–30 vs 46–50), and subsessile fruits (pedicels 1–2 mm vs 3.5–9 mm long). Differential characters of *Begonia polilloensis* are outlined in the diagnosis above.

Begonia matarombeoensis D.C.Thomas & Ardi, **sp. nov.** (§ *Petermannia*)

This species has a characteristic growth habit with the basal stem appressed to the substrate and rooting at the nodes, and distally often ascending to erect. This growth habit in combination with the complexly branching (paniculate-cymose), many-flowered male inflorescences, the relatively long peduncles of the female inflorescences (up to 4.2 cm long), and the relatively narrow wings of the fruits (up to 5 mm at the widest point), differentiate this species from other species in *Begonia* section *Petermannia*. – TYPE: Indonesia, Sulawesi, Sulawesi Tenggara, N of Linomoyo, Matarombeo, 3.32631121°S 122.08488°E, 2 m, 14 February 2017, *Wisnu H. Ardi 154* (holotype BO; isotypes KRB, SING) (Fig. 1, 3).

Perennial, monoecious herb, up to c. 30 cm tall; basal stems loosely appressed to the substrate, and rooting at the nodes, distally often ascending to erect; with microscopic glandular hairs and a sparse indumentum of whitish to reddish trichomes, c. 0.5–0.75 mm long, on above-ground vegetative parts. **Stem** branched, internodes (1.3–)2–6.5 cm long, terete, green or red. **Leaves** alternate; stipules persistent, 8–15 × 6–12 mm, ovate to broadly ovate, acuminate, setose, seta to 6 mm long, margin entire, pale green, translucent; petioles (1.5–)6.5–21 cm long, terete, reddish; lamina basifixed, 7–19 × 4.5–12.5 cm, asymmetric, elliptic, ovate, broadly elliptic or broadly obovate, base

Fig. 3. *Begonia matarombeoensis* D.C.Thomas & Ardi. **A.** Habit and limestone habitat. **B.** Basal stem and roots (scale bar 2.4 cm). **C.** Adaxial leaf lamina (scale bar 5 cm). **D.** Abaxial leaf lamina (scale bar 5 cm). **E.** Stipule (scale bar 6 mm). **F.** Inflorescence. **G.** Male partial inflorescence (scale bar 8 mm). **H.** Female inflorescence (scale bar 4 cm). **I.** Female flower, front view (scale bar 12 mm). **J.** Ovary, cross-section; axile placentation and bilamellate placentae (scale bar 4 mm). **K.** Infructescence (scale bar 1 cm). A–G, J from *Ardi, W.H. 154*; H, I from *Ardi, W.H. 155*. (Photos: W.H. Ardi)



cordate and lobes not or sometimes slightly overlapping, apex shortly acuminate, margin subentire to distantly dentate or serrate, and denticulate between the larger teeth, the teeth bristle-pointed, adaxial surface dark green or green-maroonish, sometimes with small white dots, abaxial surface pale green or maroon, very sparsely hairy on the veins to glabrescent, primary veins 5–7, actinodromous, secondary veins craspedodromous. **Inflorescences** protogynous; female partial inflorescences 1–2-flowered, usually one node basal to male inflorescences, peduncles up to 4.2 cm long, bracts 4–5 × 2 mm, elliptic. Male inflorescences paniculate-cymose, composed of several monochasial partial inflorescences, monochasia on up to 6 cm long peduncles in the basal part of inflorescence, but sessile in the most distal part, each monochasium with 3–9 flowers, subumbellate or internodes distinct, bracts elliptic, 4–7 × 2.5–4.5 mm, pale green, translucent. **Male flowers:** pedicels 11–20 mm long, whitish-greenish, glabrous; tepals 2, broadly ovate to suborbiculate, 8–13 × 9–12 mm, base slightly cordate, margin entire, apex rounded, white or white tinged with pink, glabrous; androecium of (13–)25–39 stamens, yellow, filaments c. 1–1.5 mm long, slightly fused at the very base, anthers c. 0.5–1.5 mm long, obovate, dehiscing through unilaterally positioned slits c. 1/2 as long as the anthers. **Female flowers:** pedicels 9–11 mm long, glabrous, greenish or green–reddish; tepals (4–)5, white tinged with pink, subequal to unequal and the four outer larger, 11–15 × 5.5–8 mm, elliptic, the inner smaller, 9.5–11 × 4–5 mm, elliptic, glabrous; ovary ellipsoid, 9–15 × 4–10 mm (excluding the wings), pale green, glabrous, locules 3, placentation axile, placentae bilamellate, wings 3, base rounded or cuneate, apex cuneate to subtruncate, style basally fused, 3-branched, each stylodium bifurcate in the stigmatic region, yellow to orange and tinged with pink, stigmatic surface a spirally twisted papillose band, yellow to orange. **Fruits:** pedicels up to 1.5 cm long, curved downwards at apex, seed bearing part ellipsoid to obovoid, 8–16 × 7–11 mm (excluding the wings), glabrous, dehiscent, splitting along the wing attachment, wing shape as for ovary, up to 5 mm at the widest point (middle part to subapically). **Seeds** barrel-shaped, c. 0.2–0.3 mm long.

Distribution. Endemic to Matarombeo, Southeast Sulawesi, Sulawesi, Indonesia (Fig. 1). Locally common.

Habitat. Growing on rock walls at the base of limestone cliffs and limestone boulders, in dense to light shade, at c. 2–200 m altitude.

Etymology. The species epithet refers to the limestone mountain range of Matarombeo in Sulawesi Tenggara, where the type material was collected.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii), B2ab(iii). *Begonia matarombeoensis* is known from only four collections and several observations from the SE and N of the Matarombeo mountain range, where this species is locally common. Matarombeo is not legally protected, and the species' currently known EOO and AOO coupled with the detrimental impact of land use (particularly oil palm

plantations, but also other threats such as nickel mining) on the habitats at the periphery of the limestone karst, warrants an Endangered (EN) status. As Matarombeo is very poorly explored, this species is likely more widespread within the mountain range than currently known and may also occur in suitable karst habitats in Morowali Regency in Central Sulawesi north of Matarombeo. However, even if this is the case, the extent of suitable karst habitats is still limited, and its EOO and AOO would still fall well in the range for an Endangered (EN) status.

Additional specimens examined. INDONESIA: **Sulawesi Tenggara:** N of Linomoyo, Matarombeo, Anoa forest camp, 30 m, 14 Feb 2017, *Ardi 155* (BO, KRB, SING); Matarombeo, Telaga biru, c. 14 km west of Mataraki bridge, 115 m, 19 Feb 2017, *Ardi 172* (BO, KRB, SING); Matarombeo, c. 20 km west of Mataraki bridge, 194 m, 19 Feb 2017, *Ardi 178* (BO, KRB, SING).

Notes. *Begonia matarombeoensis* is a low growing species and larger plants can form mats almost continuously covering the limestone substrate (Fig. 3A). The basal stems have relatively thick internodes, are appressed to the substrate and root at the nodes (Fig. 3B). The plants die back during drier periods and have leafless stems or only a few short-petioled, small leaves (Aurélien Bour, pers. obs.). This ecology is similar to the Sulawesian endemic *Begonia siccacaudata* J.Door., which is adapted to coralline limestone habitats in South Sulawesi and perennates in drier periods with leafless tuberous-rhizomatous stems. The low growth habit and ecology of *Begonia matarombeoensis* are unusual in the huge section *Petermannia* (> 400 species), but there is already known to be a considerable variety of growth habits, including several low growing prostrate-creeping species (e.g. the Sulawesian *B. flacca*, *B. gemella* Warb. ex L.B.Sm. & Wassh., *B. heteroclinis* Miq. ex Koord., and several Moluccan *Begonia* species [see Ardi et al., 2014b; Ardi & Thomas, 2015]). However, the complexly branching (paniculate-cymose), many-flowered male inflorescences, the relatively long peduncles of the female inflorescences (up to 4.2 cm long), and the relatively narrow wings (up to 5 mm at the widest point) differentiate *Begonia matarombeoensis* from species with a similarly low growth habit.

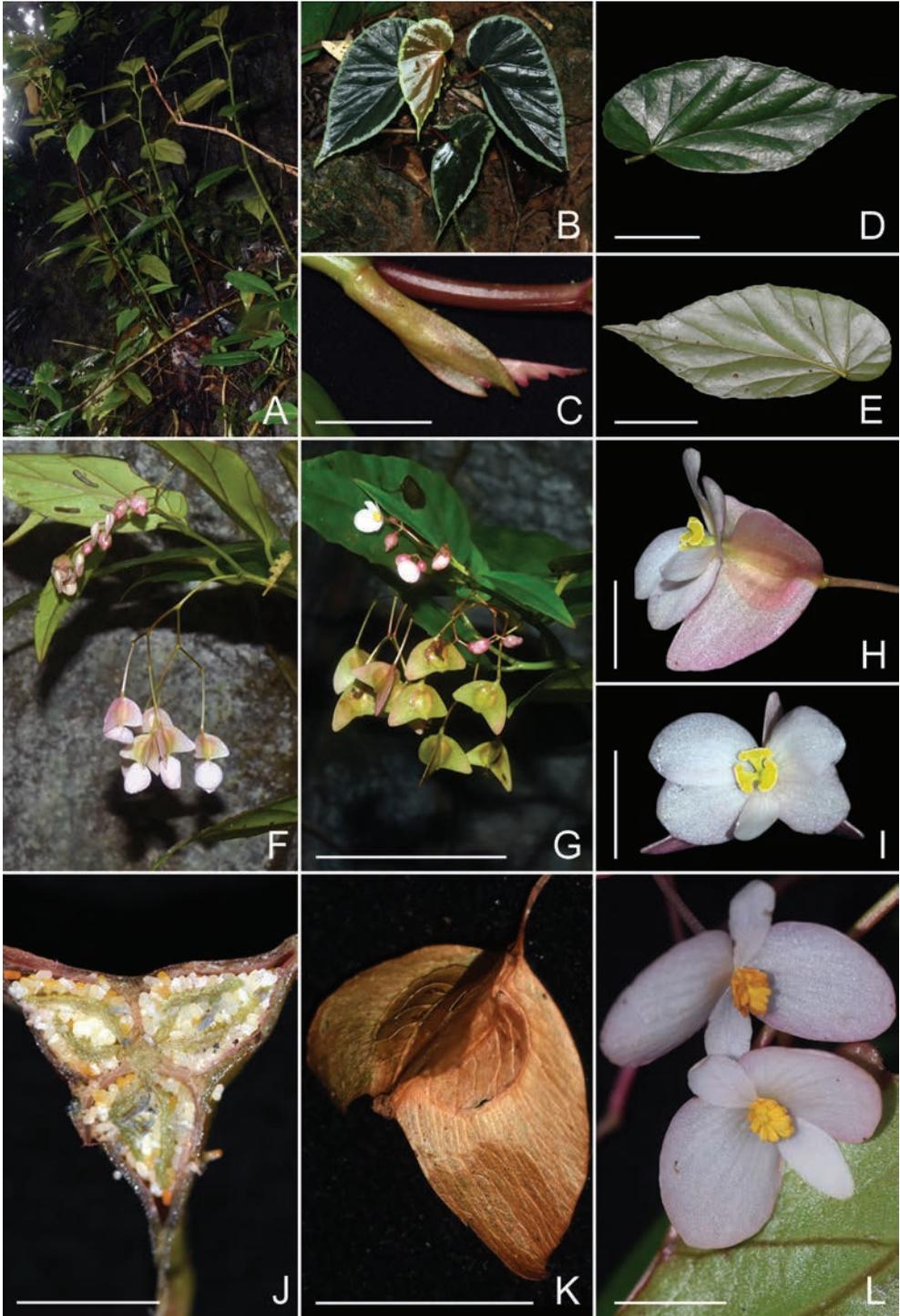
The inflorescence architecture of *Begonia matarombeoensis* and the long peduncles of the female inflorescences are similar to those of *B. siregarii* Ardi & D.C.Thomas, a species growing on limestone cliffs in Southwest Sulawesi. *Begonia siregarii* is an erect species up to about 1 m tall, however, and also otherwise morphologically dissimilar (see Ardi et al., 2014a).

Begonia watuwilensis Girm., Reinwardtia 13(1): 70 (2009) (§ *Petermannia*); Girmansyah, Berita Biol. 10(1): 36 (2010). – TYPE: Indonesia, Sulawesi, Sulawesi Tenggara, Kabupaten Kolaka Utara, Kecamatan Uluiwoi, Desa Sanggona, Mt Watuwila, 14 May 2008, *Deden Girmansyah 914* (holotype BO; isotypes E, K, L, US). (Fig. 1, 4)

Perennial, monoecious herb, up to c. 150 cm tall; stems erect or semi-erect, slightly woody at base, all above-ground vegetative parts with microscopic glandular hairs, otherwise glabrous or with a sparse indumentum of white trichomes, c. 0.5–1.5 mm long. **Stem** branched; internodes 2.5–16 cm long, terete, green, red or brownish. **Leaves** alternate; stipules caducous, 12–29 × 6–12 mm, oblong, ovate or elliptic, acuminate, setose, seta to 3 mm long, margin entire, green, translucent at margin; petioles c. 1–8.2 cm long, terete, red; lamina basifixed, 8.5–29.5 × 3–16.5 cm, very asymmetric, ovate, elliptic, or sometimes oblong, base obliquely cuneate to cordate, lobes not overlapping, apex acute, margin distantly dentate to serrate, the teeth bristle-pointed, adaxial surface dark green, sometimes with a whitish to pale greenish band running along the margin, abaxial surface pale green or reddish, venation pinnate to palmately-pinnate, secondary veins craspedodromous. **Inflorescences** pendent, racemose-cymose with several protandrous, dichasial partial inflorescences, each many-flowered, peduncles 2.2–4 cm long, bracts obovate or suborbicular, 6–14 × 6–13 mm, pale greenish to pinkish. **Male flowers**: pedicels (3–)7–22 mm long, white, glabrous; tepals 4, unequal, the outer larger 8–14 × 4–15, suborbicular to broadly ovate, the inner smaller 6–12 × 2–4 mm, oblong, narrowly elliptic or narrowly obovate, margin entire, apex rounded, white, white tinged with pink, or pink, sometimes with the outer tepals white and the inner pink, glabrous; androecium of 15–23 stamens, yellow, filaments c. 0.5–1 mm long, slightly fused at the very base, anthers c. 1–1.5 mm long, obovate, dehiscing through unilaterally positioned slits c. 1/2 as long as the anthers. **Female flowers**: pedicels (7–)11–24 mm long, glabrous, green-reddish; tepals 5, unequal, white, white tinged with pink, or pale pink, unequal and the four outer larger, 10–18 × 7–12 mm, elliptic to obovate, the inner smaller, 8–17 × 3–6 mm, elliptic, glabrous; ovary subglobose, 8.5–10 × 6–8 mm (excluding the wings), pinkish, glabrous, locules 3, placentation axile, placentae bilamellate, wings 3, subequal to unequal, usually one larger and two smaller, or sometimes two larger and one smaller, base rounded, apex truncate, widest at the apex (larger wings up to 13 mm), style basally fused, 3-branched, each stylodium bifurcate in the stigmatic region, stigmatic surface a spirally twisted papillose band, yellow to orange. **Fruits**: pedicels thin and hanging, up to 2.9 cm long, seed bearing part subglobose, 8–15 × 5–9 mm (excluding the wings), glabrous, dehiscent, splitting along the wing attachment, wing shape as for ovary, larger wing up to 14 mm wide (widest point at apex). **Seeds** barrel-shaped, c. 0.3 mm long.

Distribution. Endemic to Southeast Sulawesi, Sulawesi, Indonesia. Known from only two localities: Gunung Watuwila and Matarombeo (Fig. 1).

Fig. 4. *Begonia watuwilensis* Girm. **A.** Habit. **B.** Plant with a pale greenish band running in parallel with the leaf lamina margin. **C.** Stipule (scale bar 1 cm). **D.** Adaxial leaf lamina (scale bar 5 cm). **E.** Abaxial leaf lamina (scale bar 5 cm). **F.** Inflorescence with dichasial partial inflorescences. **G.** Inflorescence with male flowers and infructescence. **H.** Female flower, side view (scale bar 9 mm). **I.** Female flower, front view (scale bar 1.5 cm). **J.** Ovary, cross-section; placentation axile, placentae bilamellate (scale bar 4 mm). **K.** Fruit (scale bar 12 mm). **L.** Male flowers (scale bar 1 cm). A, D–J from *Ardi, W.H. 171*; C, K, L from *Ardi, W.H. 169*. (Photos: W.H. Ardi)



Habitat. Growing in primary lowland and upland rainforest, in light to dense shade, on limestone rock or steep slopes on limestone soils, at c. 100–1200 m altitude.

Etymology. The species epithet refers to Gunung Watuwila; the type locality of this species.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii),B2ab(iii). *Begonia watuwilensis* is known from only two localities: lowland karst rainforest in Matarombeo and upland rainforest on Gunung Watuwila, which lie about 100 km apart. None of the collection localities are in legally protected areas, and some anthropogenic disturbance by agriculture (oil palm plantations) was observed in Matarombeo at the periphery of the habitats. The small EOO and AOO in combination with only few collection localities and observed threats warrant an Endangered (EN) status. The Abuki mountain range in between the two localities is botanically very poorly explored, and this species is likely more widespread, but even if it is present in suitable limestone habitats in between Matarombeo and Gunung Watuwila, its EOO would remain < 5000 km².

Additional specimens examined. INDONESIA: **Sulawesi Tenggara:** Matarombeo, close to Mataraki bridge, 117 m, 18 Feb 2017, *Ardi 169* (BO, KRB, SING); Matarombeo, Telaga biru, c. 14 km west of Mataraki bridge, 115 m, 19 Feb 2017, *Ardi 171* (BO, KRB, SING); Matarombeo, c. 20 km W of Mataraki bridge, 194 m, 19 Feb 2017, *Ardi 177* (BO, KRB, SING); cultivated at Bali Botanic Garden from material collected on Gunung Watuwila, 4 Apr 2009, *Thomas & Ardi 09-55* (BO, E).

Notes. *Begonia watuwilensis* does not have separate female and male inflorescences or partial inflorescences, which differentiates it from the vast majority of species in the large section *Petermannia* (but see *B. divariacta* Irmsch. (Irmscher, 1953), and possibly also *B. gracilicyma* Irmsch. ex M.Hughes (Hughes et al., 2009)). Its partial inflorescences are protandrous dichasia with basal male and distal female flowers. However, some morphological features (the lack of specialised underground organs such as rhizomes and tubers, unilaterally opening anthers, and 3-loculed capsules with bilamellate, axile placentation) as well as cpDNA sequence data (see Thomas et al., 2012) allow placement of this species in section *Petermannia*.

The new collections of *Begonia watuwilensis* from Matarombeo indicate that this species is more widespread and has a wider ecological amplitude than previously thought. It was previously known from only a single collection from Gunung Watuwila, where it was collected from slopes in upland forest (at c. 1000 to 1200 m altitude). The new collection localities in Matarombeo lie c. 80 km northeast of Gunung Watuwila, and the species occurs here in lowland rainforest on limestone at c. 100 to 200 m altitude. The material of some individuals from Matarombeo also has some quantitative (e.g. larger leaves, longer pedicels of male and female flowers) and qualitative morphological characters (fruits with unequal wings, leaf laminae with a white band running in parallel to the margin) which deviate from the

original description. The amended description above is based on measurements of living material from the type locality cultivated at Bali Botanic Gardens, as well as measurements of the newly available material from Matarombeo. It also incorporates measurements from the original description by Girmansyah et al. (2009), except for the androecium. The androecium was described as consisting of ‘c. 80–95 stamens’ with ‘2.5–3 mm long’ anthers, which open by ‘slits along sides’ (Girmansyah et al., 2009), but this is inconsistent with our observations from the holotype, cultivated material from the type locality (vouchered as *Thomas & Ardi 09-55*), and the material from Matarombeo, which has flowers with 15–23 stamens, and c. 1 to 1.5 mm long anthers dehiscing through unilaterally positioned slits.

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References

- Ardi, W.H. & Thomas, D.C. (2015). Studies on *Begonia* (Begoniaceae) of the Moluccas II: a new species from Seram, Indonesia. *Gard. Bull. Singapore* 67(2): 297–303.
- Ardi, W.H., Ardaka, I.M., Hartutiningsih, Lugrayasa, I.N. & Thomas, D.C. (2014a). Two new species of *Begonia* (Begoniaceae) from Sulawesi, Indonesia. *Edinburgh J. Bot.* 71: 259–268.
- Ardi, W.H., Kusuma, Y.W.C., Lewis, C.E., Risna, R.R., Wiriadinata, H., Abdo, M.E. & Thomas, D.C. (2014b). 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.
- Baas, P., Roos, M.C. & van Welzen, P.C. (2012). On Max van Balgooy’s 80th birthday. *Blumea* 57: 103–104.
- Cannon, C.H., Harting, J., Salim, A. & Summers, M. (2005). *The vegetation of Sulawesi: Coarse filter analysis*. Report. Bogor: The Nature Conservancy.
- Cannon, C.H., Summers, M., Harting, J.R. & Kessler, P.J.A. (2007). Developing conservation priorities based on forest type, condition, and threats in a poorly known ecoregion: Sulawesi, Indonesia. *Biotropica* 39: 747–759.
- Chung, K.F., Leong, W.C., Rubite, R.R., Repin, R., Kiew, R., Liu, Y. & Peng, C.-I (2014). Phylogenetic analyses of *Begonia* sect. *Coelocentrum* and allied limestone species of China shed light on the evolution of Sino-Vietnamese karst flora. *Bot. Stud.* 55(1): 1.
- Girmansyah, D., Wiriadinata, H., Thomas, D.C. & Hoover, W.S. (2009). Two new species and one new subspecies of *Begonia* (Begoniaceae) from Southeast Sulawesi, Indonesia. *Reinwardtia* 13: 69–74.
- Hughes, M. (2006). Four new species of *Begonia* (Begoniaceae) from Sulawesi. *Edinburgh J. Bot.* 63: 191–199.
- Hughes, M., Girmansyah, D., Ardi, W.H. & Nurainas (2009). Seven new species of *Begonia* from Sumatra. *Gard. Bull. Singapore* 61(1): 29–44.

- Hughes, M., Moonlight, P., Jara, A., Tebbitt, M. & Pullan, M. (2015, continuously updated). *Begonia Resource Centre*. <http://elmer.rbge.org.uk/begonia/>. Accessed 18 Sep. 2017.
- Irmscher, E. (1953). Neue Begoniaceen, von O. Beccari in Malesien gesammelt. *Webbia* 9(2): 469–509.
- Kiew, R. (2001). The limestone begonias of Sabah, Borneo – Flagship species for Conservation. *Gard. Bull. Singapore* 53: 241–286.
- Kiew, R., Julia, S., Rimi, R. & Joffre, A.A. (2015). *A Guide to Begonias of Borneo*. Kota Kinabalu: Natural History Publications (Borneo).
- Lin, C.W., Thomas, D.C., Ardi, W.H. & Peng, C.-I. (2017). *Begonia ignita* (sect. *Petermannia*, Begoniaceae), a new species with orange flowers from Sulawesi, Indonesia. *Gard. Bull. Singapore* 69(1): 89–95.
- Tebbitt, M.C. (2005). Three new species and a new subspecies of *Begonia* (Begoniaceae) from Asia. *Edinburgh J. Bot.* 61: 97–107.
- Thomas, D.C. & Hughes, M. (2008). *Begonia varipeltata* (Begoniaceae): A new peltate species from Sulawesi, Indonesia. *Edinburgh J. Bot.* 65: 369–374.
- Thomas, D.C., Ardi, W.H. & Hughes, M. (2009a). Two new species of *Begonia* (Begoniaceae) from Central Sulawesi, Indonesia. *Edinburgh J. Bot.* 66: 103–114.
- Thomas, D.C., Ardi, W.H., Hartutiningsih & Hughes, M. (2009b). Two new species of *Begonia* (Begoniaceae) from South Sulawesi, Indonesia. *Edinburgh J. Bot.* 66: 229–238.
- Thomas, D.C., Ardi, W.H. & Hughes, M. (2011). Nine new species of *Begonia* (Begoniaceae) from South and West Sulawesi, Indonesia. *Edinburgh J. Bot.* 68: 225–255.
- Thomas, D.C., Hughes, M., Phutthai, T., Ardi, W.H., Rajbhandary, S., Rubite, R., Twyford, A.D. & Richardson, J.E. (2012). West to east dispersal and subsequent rapid diversification of the mega-diverse genus *Begonia* (Begoniaceae) in the Malesian archipelago. *J. Biogeogr.* 39(1): 98–113.
- Thomas, D.C., Ardi, W.H., Girmansyah, D. & Hughes, M. (2013, continuously updated). *Sulawesi Begonia Data Portal*. <http://portal.cybertaxonomy.org/flora-malesiana-prospective/>. Accessed 18 Sep. 2017.
- Wiriadinata, H. (2013). A new species of *Begonia* (Begoniaceae) from South Sulawesi, Indonesia. *Reinwardtia* 13: 445–448.