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GAULTHERIA ROSTRATA (SECT. *DIPLYCOSIA*, ERICACEAE), A NEW WINTERGREEN SPECIES ENDEMIC TO MINDANAO ISLAND, PHILIPPINES

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Gaultheria rostrata, a new species of wintergreen endemic to Mindanao Island, Philippines, is here described and illustrated. It resembles *Gaultheria bartolomei*, endemic to Luzon Island, but differs by having a terrestrial habit, shorter petioles, longer pedicels, white or pale-pink corollas, coiled corolla lobes, longer anther tubules, and a longer style. The flowers of *Gaultheria rostrata* are unique among Asian species of *Gaultheria* on account of their coiled corolla lobes exposing the anthers and style at anthesis. This discovery raises the number of *Gaultheria* species in the Philippines to 16.

Keywords. Biodiversity, endemic, *Gaultheria* sect. *Diplycosia*, southern Philippines, taxonomy.
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Introduction

The Mindanao region of the southern Philippines is a species-rich area. It contains 63 Key Biodiversity Areas (KBAs) (The Philippine Clearing House Mechanism, 2025) critical for global biodiversity persistence, and eight ASEAN Heritage Parks (ASEAN Centre for Biodiversity, 2024). Both these types of protected area are important for advancing national and global biodiversity research and conservation efforts; they are also essential for preserving vital ecosystems and species.

The mountain ranges of Mindanao are home to the tallest peaks in the Philippines, with Mount Apo (2954 m elevation) and Mount Dulang-Dulang (2938 m elevation) ranking as the two highest mountains in the country (Heaney *et al.*, 2006). These mountains create diverse

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environmental conditions across different elevations, fostering ecological heterogeneity that supports a wide array of species, many of which are endemic to the region.

The genus *Gaultheria* L. (wintergreen) has a centre of diversity in the Malesian region, particularly on the islands of Borneo and New Guinea. On Borneo, high species diversity of *Gaultheria* is recorded in the vicinity of Mount Kinabalu, and in New Guinea, the Vogelkop Peninsula (Bird's Head Peninsula) harbours the highest diversity (Sleumer, 1967; Argent, 2002). In the Philippines, 15 species of *Gaultheria* are recorded (Pelser *et al.*, 2011–). Of these, all are endemic to the country except *Gaultheria borneensis* Stapf., *G. cumingiana* S.Vidal, *G. heterophylla* (Blume) Zoll. & Moritzi and *G. leucocarpa* Blume (Pelser *et al.*, 2011–). The species of Philippine *Gaultheria* mostly grow at elevations greater than 500 m (Argent, 2013; Fritsch & Amoroso, 2016), and some have important ethnomedicinal uses (Alfag & Napaldet, 2022).

Previous phylogenetic studies demonstrated the paraphyly of *Gaultheria* in its most widely employed circumscription (Kron *et al.*, 1999; Powell & Kron, 2001; Bush *et al.*, 2009; Fritsch *et al.*, 2011). Thus, to establish monophyly, *Gaultheria* was expanded to include *Diplycosia* Blume, *Pernettya* Gaud., *Pernettyopsis* King & Gamble and *Tepuia* Camp (Middleton & Wilcock, 1990; Kron *et al.*, 2020). Synapomorphic characters supporting *Gaultheria s.l.* include the production of methyl salicylate in damaged leaf tissues, obliquely pyramidal seeds, and possibly an accrescent, fleshy calyx at maturity (Powell & Kron, 2001; Fritsch *et al.*, 2011; Kron *et al.*, 2020).

During fieldwork in Barangay Kalabugao, Municipality of Impasugong, Bukidnon, Philippines, a collection of a terrestrial *Gaultheria* was made but could not be identified to a species. This collection clearly belonged to *Gaultheria* sect. *Diplycosia* (Blume) Kron & P.W.Fritsch based on its axillary inflorescences in fascicles of two or three flowers, cup-shaped and persistent bracteoles, and long anther tubules. However, it was unique in the section on account of its corolla lobes that are coiled at anthesis, thus exposing the anthers and style. Further comparison of the collection with other closely related species in Malesia confirmed that in addition to the unique coiling of the corolla lobes, it possesses other morphological characters that in combination do not occur in any other known species in Malesia. It is thus here described and illustrated as a species new to science. Because no molecular or phylogenetic data are available for the plants, we describe the species under a morphological species concept (Cronquist, 1978).

Materials and methods

The morphological description of the new species is based on fresh specimens, dried herbarium vouchers and *in situ* photographs. The flowers were dissected and examined with an AmScope stereomicroscope (AmScope, Irvine, California, USA) (up to × 64 magnification) and measured with a Mitutuyo CD-4"ASX digital caliper (Mitutuyo, Kawasaki, Japan). We defined characters following Beentje (2016), and relevant taxonomic literature on Malesian

species of *Gaultheria* sect. *Diplycosia* was consulted (i.e. Elmer, 1911; Copeland, 1932; Sleumer, 1957, 1967; Argent, 1982, 1989, 2002; Ferreras & Argent, 2011; Argent, 2013, 2014; Argent & Widjaja, 2015; Fritsch & Amoroso, 2016; Fritsch & Bush, 2016; Wilkie & Argent, 2016; Fritsch & Amoroso, 2017; Argent, 2018; Kron *et al.*, 2020), including digitised herbarium specimens from B, E, K, L, NY, S and U (herbarium acronyms follow Index Herbariorum, updated continuously). The conservation status of the species was assessed by following the *IUCN Red List Categories and Criteria*, version 3.1 (IUCN, 2012).

Species description

Gaultheria rostrata M.N.Tamayo, P.W.Fritsch & Medecilo, **sp. nov.**

This species resembles the Philippine endemic *Gaultheria bartolomei* (Ferreras & Argent) Kron & P.W.Fritsch but differs by having a terrestrial habit (vs epiphytic), shorter petioles (4–4.5 mm vs 5–7 mm), longer pedicels (20–35 mm vs 20–25 mm), white or pale-pink corollas (vs deep pink), corolla lobes coiled (vs reflexed), longer anther tubules (4–4.5 mm vs c.1 mm), and a longer style (10–11 mm vs c.8 mm). – Type: Philippines, Mindanao Island, Province of Bukidnon, Municipality of Impasugong, Brgy Kalabugao, 8.49490°N, 125.10293°E, 1287 m elevation, 22 viii 2024, *Maria Melanie Medecilo-Guiang* 1030 (holotype: PNH 271580!, isotype CMUH 015821!). **Figures 1, 2.**

Habit terrestrial shrub, evergreen, branches erect or flexuose, clambering, subdensely branched, 0.5–0.8 m tall. *Roots* non-swollen, densely fibrous. *Young branchlets* pale reddish green, pubescent, with reddish setose trichomes 0.8–1.5 mm long. *Mature branchlets* reddish brown, pubescent, trichomes same as young branchlets, ± glabrescent, sparsely lenticellate, flaking, 3–5 mm wide. *Leaves* persistent on older branchlets, laxly crowded, alternate, fresh leaves with mild wintergreen odour when crushed; *petiole* greenish or reddish brown at maturity, 4–4.5 × 1.8–2 mm, glabrous, occasionally with setose trichomes, in cross section abaxially rounded, adaxially flat and grooved in middle; *leaf blade* ovate or lanceolate, ± imbricate, larger leaves on each branchlet 1–5 × 1–3 cm, coriaceous, abaxial surface pale green, punctate, with sparse setose trichomes 0.5–0.6 mm long, adaxial surface glossy green, glabrous, base acute, margin entire, lined with setose trichomes 0.8–2.5 mm long, apex apiculate, gland-tipped; *midvein* raised abaxially, sunken adaxially, secondary veins 2 on each side of midvein with first pair arising from base and remainder along lower 1/3 of midvein, arc ascending, slightly raised abaxially, sunken adaxially; *tertiary veins* inconspicuous. *Inflorescences* axillary, fasciculate, 1- or 2(or 3)-flowered, 3.5–4.2 cm long; *bracts* reddish green, reddish brown *in sicco*, lanceolate, subtending pedicels, ± persistent until anthesis, 0.8–1.2 × 0.5–0.7 mm, margin entire, with glandular trichomes 0.1–0.2 mm long, apex shortly acuminate. *Pedicel* green or reddish green, slender, nodding, 20–35 × 0.2–0.3 mm at anthesis, with sparse setose trichomes 0.3–0.5 mm; bracteoles 2, green with a tinge of red, pale reddish brown *in sicco*, sub-hemispheric, 1.2–1.5 × 0.8–1 mm, margin

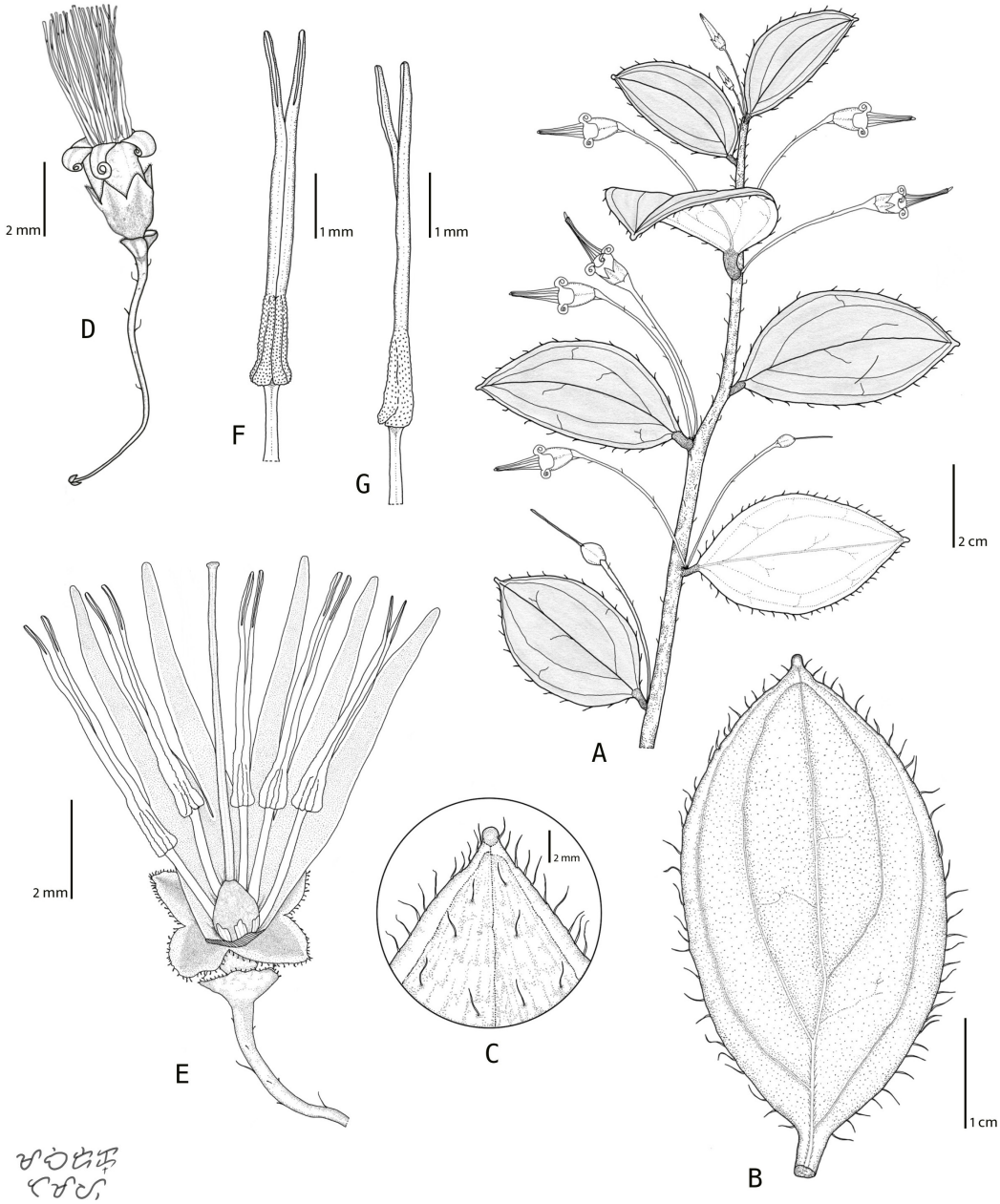

Figure 1. *Gaultheria rostrata* M.N.Tamayo, P.W.Fritsch & Medecilo, sp. nov. A, Flowering branchlet; B, leaf, adaxial surface; C, setose trichomes on leaf, abaxial surface; D, pedicel, bracteoles and flower; E, upper pedicel, bracteoles and dissected flower; F, stamen, ventral view; G, stamen, lateral view. Drawn by M. N. Tamayo from *M.M.M.-G.* 1030.

Figure 2. *Gaultheria rostrata* M.N.Tamayo, P.W.Fritsch & Medecilo, sp. nov. A, Habit *in situ*; B, leafy branchlets; C, leaf, abaxial surface; D, leaf, adaxial surface; E and F, flowering branchlets; G, flower bud; H, I and J, upper pedicel, bracteoles and flower; K, stamens, ventral view. Photographs: A–E and H, M. M. Medecilo-Guiang from *M.M.M.-G.* 1030; F, G, I and J, D.N. Tandang; K, M. N. Tamayo from *M.M.M.-G.* 1030.

entire, ciliolate, with simple trichomes 0.1–0.2 mm long and clavate glands 0.1–0.2 mm long, apex obtuse. *Calyx* reddish green, cupuliform, 2.5–3 × 2–2.5 mm, glabrous; *calyx lobes* broadly triangular, 1.2–1.5 × 1.5–1.7 mm, glabrous, margin entire, with trichomes and glands same as bracts, apex shortly acuminate. *Corolla* white or pale pink, narrowly ampullaceous (unopened), becoming urceolate at anthesis, [8–12 (unopened), 4–5 (opened)] × 3–4 mm, glabrous on both surfaces; *corolla lobes* 5, coiling downwards to c.1/2 of corolla length exposing the anthers and c.1/3 length of style at anthesis, 6–8 × 0.3–0.5 mm, apex obtuse or acute. *Stamens* 10, monomorphic, 9–10 mm long, exserted at c.1/2 length at anthesis; *filaments* straight, slightly dilated at base, 3.5–4 mm long, glabrous; *anthers* 6–7 mm long; *thecae* 1.5–2 mm long, minutely echinulate, the base slightly dilated; *tubules* parallel, erect, cylindrical, 4–4.5 mm long, slightly narrowing towards apex, opening by oblique ventrally oriented apical slits. *Nectar glands* deltoid, 0.2–0.3 mm long. *Ovary* broadly spherical or oblong, glabrous, 1.2–1.5 × 0.8–1 mm; *style* tubular, exserted c.1/2 length from corolla at anthesis, 10–11 mm long, glabrous, stigma rounded or truncate. *Fruits* not seen.

Distribution. Found within upper montane rain forests of north-central Mindanao Island, Philippines.

Habitat and ecology. A terrestrial and scrambling shrub found on exposed to partly shaded areas. It grows well alongside thickets of fern. Flowering in August.

Etymology. The specific epithet rostrata alludes to the morphological resemblance of the flowers of the new species to avian beaks or proboscides.

Proposed IUCN conservation category. In addition to the population at the type locality, plants that match the morphology of *Gaultheria rostrata* were also observed in Mount Bungkasan in the Pantaron Range (c.30 km from the type locality) during separate fieldwork by D.N.T. and N.E.L., although a specimen was not vouchered. Both the Kitanglad and Pantaron Mountain Ranges have multiple peaks composed of high-elevation zones with habitats that most likely support the species. We classify the conservation status of *Gaultheria rostrata* as Data Deficient (DD) (IUCN, 2012) pending further data on its population and distribution.

Notes. In the key to the Malesian species of *Diplycosia* (Sleumer, 1967; ≡ *Gaultheria* sect. *Diplycosia*), *G. rostrata* best keys to *D. rufescens* Schltr. (≡ *G. sepikensis* Kron & P.W.Fritsch), endemic to New Guinea, and *D. gracilipes* J.J.Sm. [≡ *G. gracilipes* (J.J.Sm.) Kron & P.W.Fritsch], endemic to Sulawesi. However, *Gaultheria rostrata* differs from *Diplycosia rufescens* by having a terrestrial habit (vs epiphytic), glabrous petioles (vs setulose), longer pedicels (20–35 mm vs 5–10 mm), an urceolate corolla (vs subglobose urceolate), and longer anther tubules (4–4.5 mm vs c.2 mm), and from *D. gracilipes* by having an ovate or lanceolate leaf blade (vs subspathulate-obovate), an apiculate leaf apex (vs rounded or retuse), longer pedicels (20–35 mm vs 12–26 mm), glabrous bracteoles (vs puberulous and glandular-muriculate), and longer corolla lobes (6–8 mm vs c.3 mm).

In the key to species of *Diplycosia* from Sulawesi (Argent, 2014), *Gaultheria rostrata* best keys to *D. aperta* J.J.Sm. [≡ *G. aperta* (J.J.Sm.) Kron & P.W.Fritsch]. However, *Gaultheria rostrata* differs by having larger leaves (1–5 × 1–3 cm vs 1–4 × 0.7–2.5 cm), an entire leaf blade margin (vs minutely denticulate), a longer petiole (4–4.5 mm vs 2–4 mm), longer corolla lobes (6–8 mm vs c.1.5 mm), and a glabrous style (vs patently pubescent). In the key to *Diplycosia* and allies in Borneo (Argent, 1989), *Gaultheria rostrata* best keys to *D. pseudorufescens* Sleumer [≡ *G. pseudorufescens* (Sleumer) Kron & P.W.Fritsch)], an endemic to Borneo; however, *G. rostrata* differs by having setose trichomes on branches (vs rufous-setulose), an acute leaf blade base (vs rounded to broad-attenuate), longer pedicels (20–35 mm vs 2–3 mm), an urceolate corolla (vs tubular subcampanulate), longer anther tubules (4–4.5 mm vs c.1 mm) and a longer style (10–11 mm vs c.3 mm).

In the key to Philippine species of *Diplycosia* (Argent, 2013), *Gaultheria rostrata* best keys to *D. bartolomei* Ferreras & Argent [≡ *G. bartolomei* (Ferreras & Argent) Kron & P.W.Fritsch]. Aside from the divergent characters mentioned in the diagnosis, *Gaultheria rostrata* can be further distinguished from *G. bartolomei* by having shorter leaves (1–5 cm vs 3.5–6.5 cm), a gland-tipped leaf blade apex (vs glandless), pedicels covered with sparse setose trichomes (vs densely covered with loosely appressed bristles), longer corolla lobes (6–8 mm vs c.2.5 mm) and an oblique anther tubule apex (vs hooked). Furthermore, *Gaultheria bartolomei* is endemic to Luzon Island, whereas *G. rostrata* is endemic to Mindanao Island.

The vegetative morphology of *Gaultheria rostrata* resembles that of *Diplycosia kitangladensis* P.W.Fritsch [≡ *G. kitangladensis* (P.W.Fritsch) Kron & P.W.Fritsch] and *D. trinervia* Elmer [≡ *G. trinervia* (Elmer) Kron & P.W.Fritsch]. In sterile or fruiting state, we are unable to distinguish these three species. A fruiting *Gaultheria* specimen at BRIT (BRIT490417!) from Mount Limbawon in the Tago Range could be any of the three species. However, if flowers are available, *Gaultheria rostrata* can be easily distinguished from the two species by its long flower buds (**Figure 2G**) and its corolla lobes coiling at anthesis exposing the anther tubules and style (**Figure 2H–J**).

The flowers of *Gaultheria rostrata* are unique on account of their corolla lobes coiling at anthesis, revealing the anther tubules and style. This flower form has never been recorded in Asia (and probably elsewhere), as typically *Gaultheria* flowers exhibit a globose, campanulate or tubular shape, with the corolla lobes usually reflexed but never coiling at anthesis (Sleumer, 1967). It is reminiscent of the flowers of several species of *Agapetes* (Vaccinieae) in mainland Asia (e.g. *A. bracteata* Hook.f. ex C.B.Clarke, *A. lobbii* C.B.Clarke, *A. parishii* C.B.Clarke and *A. saxicola* Craib.), as well as the circumboreal species *Vaccinium oxycoccos* L. in *Vaccinium* sect. *Oxycoccus* (Pers.) W.D.J.Koch.

The evolution of this flower form and how it may function for pollination remain unknown. Thus, we advocate for a more thorough investigation into the floral evolution of this species and the Asian members of tribe Gaultherieae in general. Additionally, in the absence of a well-sampled phylogenetic hypothesis for the Philippine and the more inclusive Malesian

Gaultheria, it is difficult to infer patterns of diversification and biogeographical relationships within this group (Powell & Kron, 2001; Kron *et al.*, 2020). A phylogenetic study incorporating a robust sampling across major regions is therefore warranted.

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