Phytotaxa 564 (2): 139–148
https://www.mapress.com/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.564.2.1

Two new endemic species of blueberry (*Vaccinium* L., Ericaceae) from Luzon and Mindanao islands, Philippines

MAVERICK N. TAMAYO[1,3*] & PETER W. FRITSCH[2,4]

[1]*Department of Biology, College of Science and Engineering, Texas Christian University, 2800 South University Drive, Fort Worth, Texas 76129, USA*

[2]*Botanical Research Institute of Texas, 1700 University Drive, Fort Worth, Texas 76107, USA*

[3] *m.n.tamayo@tcu.edu; https://orcid.org/0000-0003-0157-5116*

[4] *pfritsch@brit.org; https://orcid.org/0000-0002-3606-663X*

**Author for correspondence*

Abstract

Two new species of *Vaccinium* from the Philippines are described and illustrated from historical herbarium collections. *Vaccinium burburan* from Luzon Island, Northern Philippines is morphologically similar to *V. tenuipes*, but is distinguished by having shorter petioles, pedicels and corolla, adaxially pubescent leaf blades with cordate base, apically pubescent corollas, and pubescent filaments throughout. It is only one of two species of *Vaccinium* in the Philippines known to have a cordate leaf blade base. *Vaccinium burburan* is considered critically endangered. *Vaccinium jubatum* from Mindanao Island, Southern Philippines, is morphologically similar to *V. sylvaticum*, but is distinguished by having a dentate leaf blade margin, shorter inflorescences and pedicels, a glabrous calyx, and shorter filaments. The dentate leaf blade margin of *V. jubatum* uniquely distinguishes it from other Philippine *Vaccinium* species. The conservation status of *V. jubatum* is considered data deficient. These discoveries further increase the current number of known *Vaccinium* species in the Philippines to 40.

Keywords: Ericales, taxonomy, Vaccinioideae, *Vaccinium* sect. *Bracteata*

Introduction

The Philippines is an archipelagic country that emerged mainly as oceanic larger island fragments, with also some fragments from mainland Asia (Heaney 1986; Hall 2002). The complex biogeographical history, wide variation in island size, substrate differences and tropical climate have synergistically resulted in exceptionally high biodiversity in the country (Mittermeier *et al*. 1998; Barthlott *et al.* 2005). At least 10,000 vascular plant species are estimated to occur in the Philippines, ca. 50% of which are endemic (Pelser *et al*. 2011 onwards).

The genus *Vaccinium* Linnaeus (1753: 349) is one of the most species-rich genera in Ericaceae, with ca. 450–500 species (Argent 2014). The Philippines is currently known to harbor 38 species of the genus (Tamayo & Fritsch 2022). Philippine *Vaccinium* are predominantly erect shrubs or trees, with some epiphytes. Most species grow in montane "mossy" forests and exposed mountain ridges and/or peaks ca. 1500–3000 m elevation (Argent 2008; Tamayo *et al*. 2021). They are rarely found in coastal vegetation at sea level, but can also thrive at elevations as high as 4400 m in New Guinea (Sleumer 1966–1967). Most of the Philippine species have tough and leathery leaves. This foliar morphology in ericaceous plants has been correlated with a low specific leaf area, low leaf nitrogen content, low photosynthetic ability, and high leaf longevity (Schwery *et al*. 2015).

As part of herbarium-based research aimed at producing a taxonomic revision of Philippine *Vaccinium*, we encountered two unusual specimens from the islands of Luzon and Mindanao, respectively. On detailed examination of these specimens, we found that they do not match the morphology of any other species of *Vaccinium*; hence we describe them as species new to science, under a morphological species concept (Cronquist 1978). Detailed descriptions and illustrations of these species are here provided, including taxonomic notes on their affinities with other Philippine and Bornean species.

Accepted by Yi-Hua Tong: 7 Sept. 2022; published: 16 Sept. 2022

Material & methods

Dried herbarium specimens of the plants were used as the basis for the description. Dried flower materials were soaked in Pohl's solution for 15 minutes and dissected under an AmScope stereomicroscope (64× magnification). Relevant taxonomic literature on Philippine and Malesian *Vaccinium* was consulted (i.e., Merrill 1908; Copeland 1930; Sleumer 1966–1967; Argent 2008, 2019; Argent and Wilkie, 2020; Co *et al*. 2002; Salares *et al*. 2018; Fritsch *et al*. 2020; Tamayo *et al*. 2021, 2022; Tamayo & Fritsch 2022), including specimens available online at JSTOR Global Plants (https://plants.jstor.org). The conservation status of the two species was assessed as per IUCN guidelines (IUCN Standards and Petitions Committee 2022). Characters in the descriptions were defined as in Beentje (2016).

Taxonomic treatment

Vaccinium burburan M.N.Tamayo & P.W.Fritsch, *sp. nov.* (Figs. 1–2).

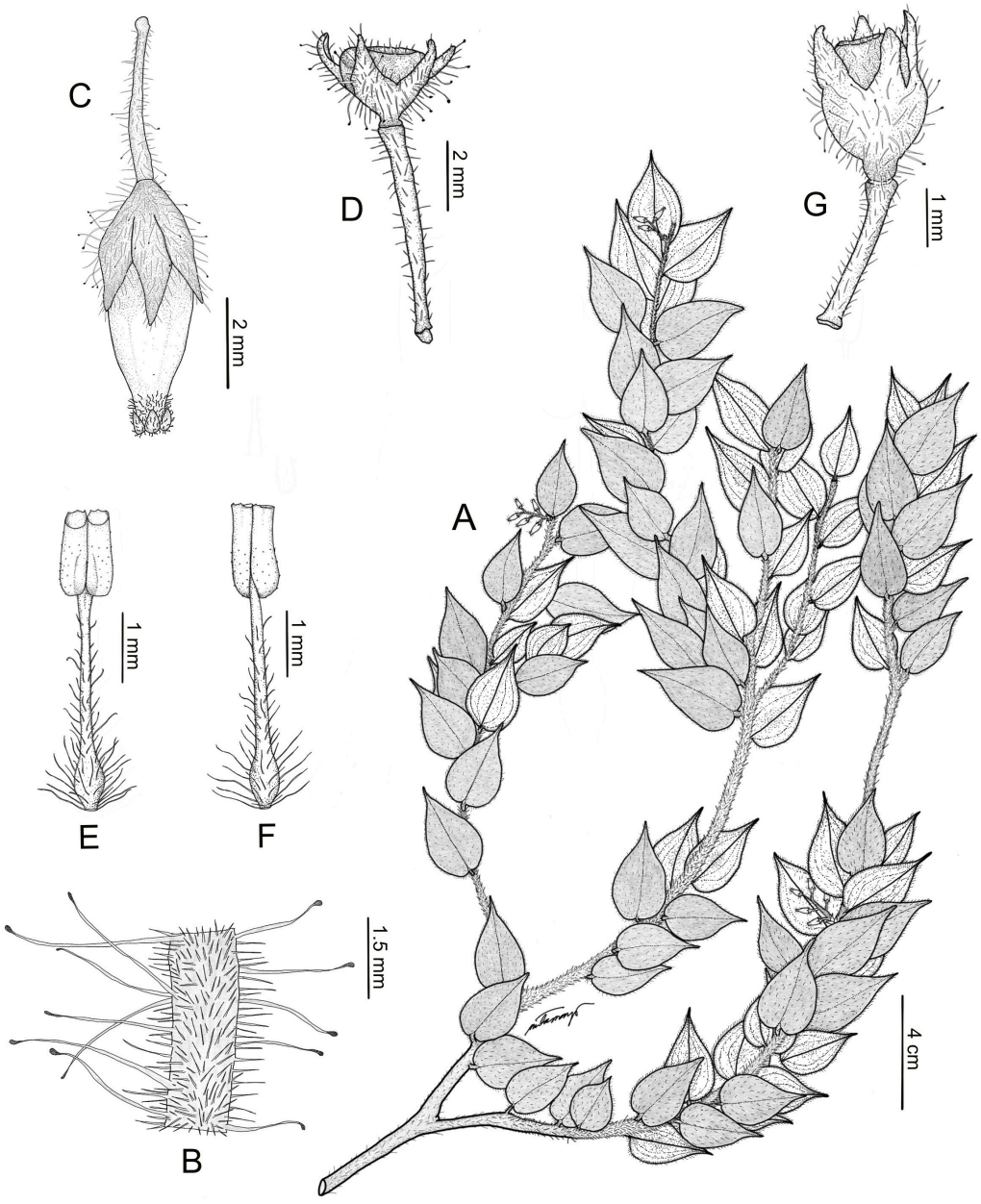

FIGURE 1. *Vaccinium burburan*. **A.** Flowering branch. **B.** Stem indumentum. **C.** Flower. **D.** Flower (corolla removed) exposing the disk. **E.** Ventral view of stamen. **F.** Dorsal view of stamen. **G.** Fruit. Illustration by Maverick N. Tamayo.

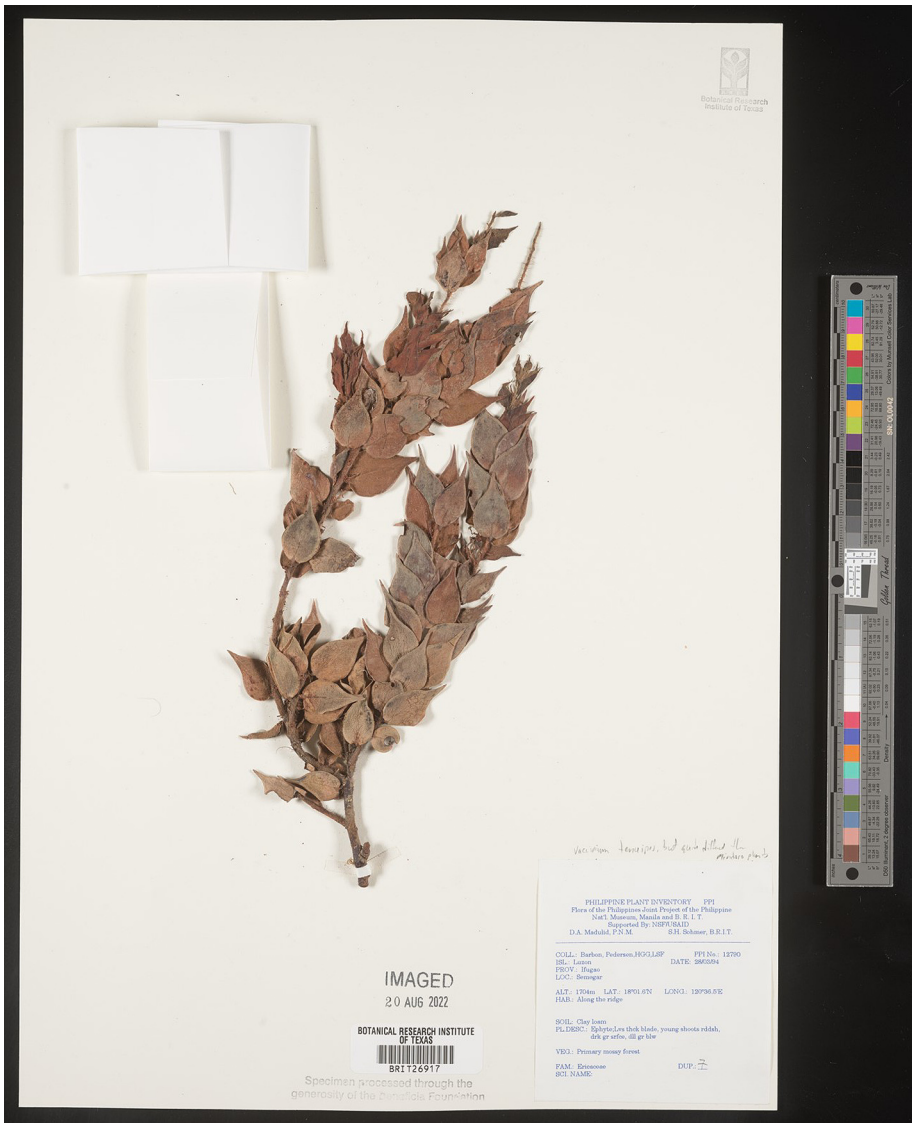

FIGURE 2. Holotype of *Vaccinium burburan* M.N.Tamayo & P.W.Fritsch (BRIT BRIT26917). Image courtesy of the Botanical Research Institute of Texas.

Type:—PHILIPPINES. Luzon Island, Ifugao Province, Municipality of Banaue, Mt. Semegar, along the ridge, 1704 m elevation, 28 March 1994, *PPI [Philippine Plant Inventory] 12790* (holotype BRIT BRIT26917!, isotype L L3786386!).

Paratypes:—PHILIPPINES. Luzon Island, Mountain Province, Mt. Polis, 2042 m elevation, March 1948, *Celestino 7974* (L L2625604!, A02006792!); Luzon Island, Ifugao and Bontoc Provinces, May 1923, *Zschokke & Laraya 29412* (UC UC237454!); Luzon Island, Banaue, Ifugao, 16 May 1967, *Mendoza 97474* (L L2625603!).

Diagnosis:—*Vaccinium burburan* resembles *V. tenuipes* Merrill (1908: 375), but differs by having shorter petioles (1.0–2.0 mm vs. 2.0–3.0 mm), pubescent adaxial leaf surface (vs. glabrous), a cordate leaf blade base (vs. rounded), shorter pedicels (5.0–6.0 mm vs. 10–20 mm), shorter corollas (5.0–6.0 mm vs. ca. 10 mm) with exterior apical pubescence (vs. glabrous), and pubescent filaments throughout (vs. pubescent only at base).

Description:—Habit shrub or vine, epiphytic, evergreen, multi-branched. ***Branchlets*** brown, lanate when young, sparsely pubescent at maturity, with a combination of simple and stipitate-glandular trichomes, 0.3–3.0 mm long, rounded in cross section, 1.5–5.0 mm wide, lenticellate; perennating buds triangular, obtuse, 1.0–1.3 mm long; bud scales non-overlapping, hirsute. ***Leaves*** persistent on older branchlets, spirally and evenly arranged, condensed, overlapping, internodes 2–10 mm long; petiole brown, in cross section abaxially and adaxially rounded, 1.0–2.0 × 0.8–1.0 mm, pubescent; leaf blade elliptic to cordate, with larger blades on each branchlet 2.2–4.0 × 2.0–2.5 cm, coriaceous, both surfaces reddish when young turning dull green abaxially and dark green adaxially, without punctae, pubescent on both surfaces, partially glabrescent adaxially when mature, hirsute, trichomes simple, abaxial surface

generally more pubescent than adaxial surface; midvein raised abaxially and adaxially, secondary veins 2 to 4 on each side of midvein with first pair arising from base and remainder along midvein, arc-ascending, abaxially raised, adaxially faintly evident or obscure, tertiary veins faintly evident or obscure, base cordate, margin entire, thinly revolute, apex acuminate, marginal glands slightly raised, ca. 1.0 mm from leaf base, one pair per leaf, 0.3–0.4 mm wide. ***Inflorescences*** pseudo-terminal or terminal, racemose, developing beyond confines of perennating bud, 1 per axil, 1.5–2.5 cm long at anthesis, 4- or 5-flowered; peduncle and rachis brown, terete, pubescent, trichomes same as on branchlets; bracts semi-persistent, reddish brown, non-foliaceous, ovate to elliptic, planar or occasionally cucullate, 1.0–1.5 × 0.5–0.8 mm, subcoriaceous, glabrous abaxially, pubescent adaxially, margin entire, occasionally with 1 or 2 glands near base. ***Pedicel*** ascending to slightly erect, 5.0–6.0 × 0.5–0.7 mm at anthesis, terete, pubescent; bracteoles borne at base of pedicel, linear or lanceolate, ca. 0.2 mm long, pubescent. ***Flowers*** articulated at junction with pedicel, 5.0–7.0 mm long. ***Hypanthium*** dark brown, triangular-obtuse, 1.0–1.2 × 0.8–1.0 mm, pubescent, trichomes same as on branchlets; calyx limb ca. 1.5 mm long; calyx lobes 5 or 6, narrowly triangular, 1.0–1.2 mm long, pubescent, trichomes same as on branchlets, margin entire, apex acuminate, without sessile terminal gland. ***Corolla*** narrowly conical-urceolate, tapering at middle toward apex, dark brown, 5.0–6.0 × 2.0–2.5 mm, glabrous outside except for apical portion including corolla lobes, inside glabrous; corolla lobes 5 or 6, pubescent, 0.5–0.7 × 0.3–0.4 mm, apex acute to obtuse. ***Stamens*** 8 to 10, monomorphic, distinct, 3.7–4.5 mm long; filaments brown, straight, dilated at base, 2.8–3.1 mm long, white-lanate especially toward base, trichomes 0.4–0.5 mm long; anthers 1.0–1.4 mm long, cells 0.6–0.9 mm long, obscurely echinulate, tubules parallel, broadly cylindrical, opening by oblique ventrally oriented apical pores, 0.4–0.5 mm long, pore apex shallowly crested, spurs absent. ***Ovary*** 5- or 6-locular but appearing pseudo-10- to 12-locular with false partitions extending ca. 0.8 mm from inner wall; ovules in two columns per locule. ***Disk*** annular, bulky, conspicuously larger than hypanthium, 0.7–1.0 × 1.5–2.0 mm, puberulent, margin obscurely ridged. ***Style*** not seen. ***Fruit*** dark brown, globose, non-ridged, 3.0–3.5 × 2.5–3.0 mm, pubescent, trichomes same as on branchlets; calyx lobes persistent, slightly recurved, disk bulged, annular, ca. 1.0 × ca. 2.0 mm; fruiting pedicels ca. 5 mm long.

Distribution and Habitat:—This new species is endemic to Luzon Island, Northern Philippines. It can be found within the montane forests of the central Cordillera Mountain Range in Ifugao and Mountain Provinces.

Etymology:—The new species is notably hairy on the stem, leaves, and inflorescences. We have therefore used "*burburan*," derived from the Iloco (Ilokano) language meaning hairy, for the specific epithet. Iloco (Ilokano) is the most frequently spoken regional language in the north and central parts of Luzon Island.

Phenology:—Flowering and fruiting from March to May.

Proposed Conservation Status:—*Vaccinium burburan* is restricted to montane forests of the central Cordillera Mountain Range. It has a very narrow distribution that is confined only to the high-elevation area. Based on the available data of its distribution (EOO 48.986 km^2), we recommend that this species be categorized as critically endangered [CR:B1(i,iv)] (IUCN Standards and Petitions Committee 2022).

Discussion:—We consider *Vaccinium burburan* to be a member of *Vaccinium* sect. *Bracteata* Nakai in Nakai and Koidzumi (1927: 234) sensu Sleumer (Sleumer 1966–1967), as based on its multi-flowered racemose inflorescences, caducous bracts, absence of a membranaceous wing at the sinuses of the ampullaceous corolla, and anthers that open by short terminal pores or introrse slits (Sleumer 1966–1967; Co *et al*. 2002; Salares *et al*. 2018).

In the keys to Philippine *Vaccinium* [Merrill 1908; Copeland 1930 (the artificial key in the treatment)] and Malesian *Vaccinium* sect. *Bracteata* (Sleumer 1966–1967), *V. burburan* keys to *V. tenuipes*. *Vaccinium tenuipes* is also present in Luzon Island and is typically found as an epiphyte in high-elevation forests (1800–2800 m elevation) (Tamayo pers. obs.). In addition to the characters mentioned in the diagnosis, *V. burburan* can be distinguished from *V. tenuipes* by its fewer-flowered (4 or 5 vs. 5 to 10) and shorter [1.5–2.5 cm vs. (2–)3–5 cm] inflorescences. In the key to the Bornean species of *Vaccinium* (Argent 2019), the species best keys to *Vaccinium beamanianum* Wilbur & Luteyn (2008: 219, non *Vaccinium cordifolium* Stapf 1894: 189). However, the new species is distinct by having non-leafy bracts (vs. leafy), shorter pedicels (5.0–6.0 mm vs. 8.0–12 mm), shorter and narrower corollas (5.0–6.0 × 2.0–2.5 mm vs. 12–15 × 5.0–6.0 mm) that are narrowly conical-urceolate (vs. tubular urceolate), apically pubescent corollas (vs. glabrous), shorter filaments (2.8–3.1 mm vs. 6.0–7.0 mm), and an absence of dorsal spurs (vs. presence). Moreover, the leaves of *V. burburan* are pubescent (vs. glabrous except basally in *V. beamanianum*). The new species also bears stipitate-glandular trichomes on its stem and inflorescence, a character not present in *V. beamanianum*.

Vaccinium burburan has long been presumed to be a phenotypic variant of *V. tenuipes*. In his treatment of the Philippine *Vaccinium*, Copeland (1930) cited the specimen *Zschokke & Laraya 29412* (UC UC237454!) as *V. tenuipes*; however, he also suspected that this variant might soon result in the description of a new infraspecific taxon or even species once more material had been studied. His decision to consider the specimens as conspecific under a broad *V. tenuipes* circumscription may also be due to the absence of flowers in any of the specimens previously available.

The paratype *Celestino 7974* (L L2625604!) was annotated as *Vaccinium polisense* Merr. & Quisumb., a name that apparently was never published. This specimen clearly represents *V. burburan* as exhibited by its spirally arranged and condensed leaves that are pubescent on both surfaces, cordate leaf blade base, and the presence of stipitate glands on the stem and inflorescence. The reason that this name was not published might be because the specimen is sterile, preventing a complete description for the species or leaving some doubt as to its distinctness. The isotype (L L3786386!) was annotated by Dr. George Argent as "*Vaccinium* sp." We presume that this specimen was not confidently identified because the specimen is sterile, thus precluding confident identification.

Vaccinium burburan is only one of two species in the Philippines that possesses a cordate leaf blade base, the other being *V. oscarlopezianum* Co (2002: 373) (Co *et al.* 2002). However, *V. burburan* is distinct from *V. oscarlopezianum* by the presence of stipitate-glandular trichomes (vs. absence), smaller leaf blades (2.2–4.0 × 2.0–2.5 cm vs. 4.0–8.0 × 2.0–4.2 cm), shorter inflorescences (1.5–2.5 cm vs. 8.0–15 cm), non-foliaceous bracts (vs. foliaceous), apically pubescent corollas (vs. non-apically pubescent), and shorter stamens (3.7–4.5 mm vs. 5.0–7.0 mm). Moreover, the widespread *Vaccinium myrtoides* (Blume 1826: 861) Miquel (1859: 1062) on occasion may exhibit a cordate leaf blade base. However, *V. burburan* can be distinguished from this species by the presence of stipitate-glandular trichomes on its branches, leaves, and hypanthium (vs. absence), and a narrowly conical corolla (vs. urceolate) that is apically pubescent (vs. glabrous).

Vaccinium jubatum M.N.Tamayo & P.W.Fritsch, *sp. nov.* (Figs. 3–4).

Type:—PHILIPPINES. Mindanao Island, Bukidnon Province, Municipality of Impasug-ong, Sitio Intavas, Mt. Kitanglad, 18 July 1991, *PPI [Philippine Plant Inventory] 3256* (holotype BRIT BRIT26945!, isotype L L3786394!).

Paratypes:—PHILIPPINES. Mindanao Island, Bukidnon Province, Mt. Kitanglad (southern slope), 2200 m elevation, 16 March 1949, *Sulit 3390* (A 00016194!, L L0008222!).

Diagnosis:—*Vaccinium jubatum* resembles *V. sylvaticum* Elmer (1911: 1095) but differs by having dentate leaf margins (vs. entire), shorter inflorescences (2–5 cm vs. 5–8 cm), shorter pedicels (3.0–5.0 mm vs. ca. 7.5 mm), a glabrous calyx (vs. puberulent), and shorter filaments (2.5–2.8 mm vs. ca. 3.5 mm).

Description:—Habit shrub or vine, epiphytic, evergreen, multi-branched. ***Branchlets*** brown, terete, 2–5 mm wide, glabrous, lenticellate; perennating buds broadly triangular, 1.5–2.0 mm long; bud scales overlapping, margins ciliolate. ***Leaves*** persistent on older branchlets, spirally and evenly arranged, glossy and dark green adaxially, light green abaxially, slightly overlapping, internodes 5–10 mm long; petiole dark brown, in cross-section rounded abaxially and flattened adaxially, 3.0–7.0 × 1.5–3.0 mm, glabrous; leaf blade elliptic, with larger blades on each branchlet 4.0–7.5 × 1.2–2.0 cm, coriaceous, both surfaces glabrous, brown, abaxially with scattered minute punctae; midvein strongly raised abaxially, slightly raised adaxially, secondary veins 3 or 4 on each side of midvein with first pair arising from base and remainder along midvein, arc-ascending, abaxially and adaxially raised, tertiary veins faintly evident or obscure, base cuneate, margin dentate, non-revolute, teeth tipped by a prominent gland, 8 to 12 per side, scattered along length of margin but more concentrated toward apex, 0.5–0.8 mm wide, apex acuminate. ***Inflorescences*** pseudo-terminal or terminal, racemose, developing beyond confines of perennating bud, 1 per axil, 2–5 cm long at anthesis, densely 10- to 14-flowered; peduncle and rachis dark brown, slightly ridged, terete, glabrous; bracts early caducous. ***Pedicel*** nodding, 3–5 × 0.4–0.5 mm at anthesis, terete, spreading, glabrous, occasionally with 1 or 2 globose glands near base; ebracteolate. ***Flowers*** articulated at junction with pedicel, 2.5–6.0 mm long. ***Hypanthium*** dark brown, 1.2–1.4 × 1.2–1.5 mm, glabrous; calyx limb 0.9–1.1 mm long, glabrous; calyx lobes 5 or 6, crescent-shaped, 0.7–0.8 mm long, glabrous, margin entire, ciliolate, rounded, with a sessile terminal gland. ***Corolla*** ampullaceous, white in upper 1/3 portion, pink at base, 4–5 × 1.3–2.2 mm, both sides glabrous; corolla lobes 5 or 6, 0.5–0.8 × 0.4–0.5 mm, apex obtuse to rounded. ***Stamens*** 8–10, monomorphic, 3.5–4.0 mm long; filaments light brown, straight, bulged at base, 2.5–2.8 mm long, white-lanate especially toward base, trichomes 0.2–0.4 mm long; anthers 1.0–1.2 mm long, cells 0.7–0.8 mm long, minutely echinulate, tubules parallel, broadly cylindrical, opening by oblique ventrally oriented apical pores, 0.3–0.4 mm long, pore apex rounded or truncate, spurs absent. ***Ovary*** 5- or 6-locular but appearing pseudo-10- to 12-locular with false partitions extending ca. 0.5 mm from inner wall; ovules in two columns per locule. ***Disk*** annular, slightly bulky, ca. 0.7 mm × ca. 1.5 mm, glabrous, margin obscurely ridged. ***Style*** brown, not exserted from corolla, 4–6 mm long, glabrous. ***Fruit*** dark brown, globose, smooth, non-ridged, 4–5 × 4–5 mm, glabrous, slightly recurved; fruiting pedicels ca. 5 mm long.

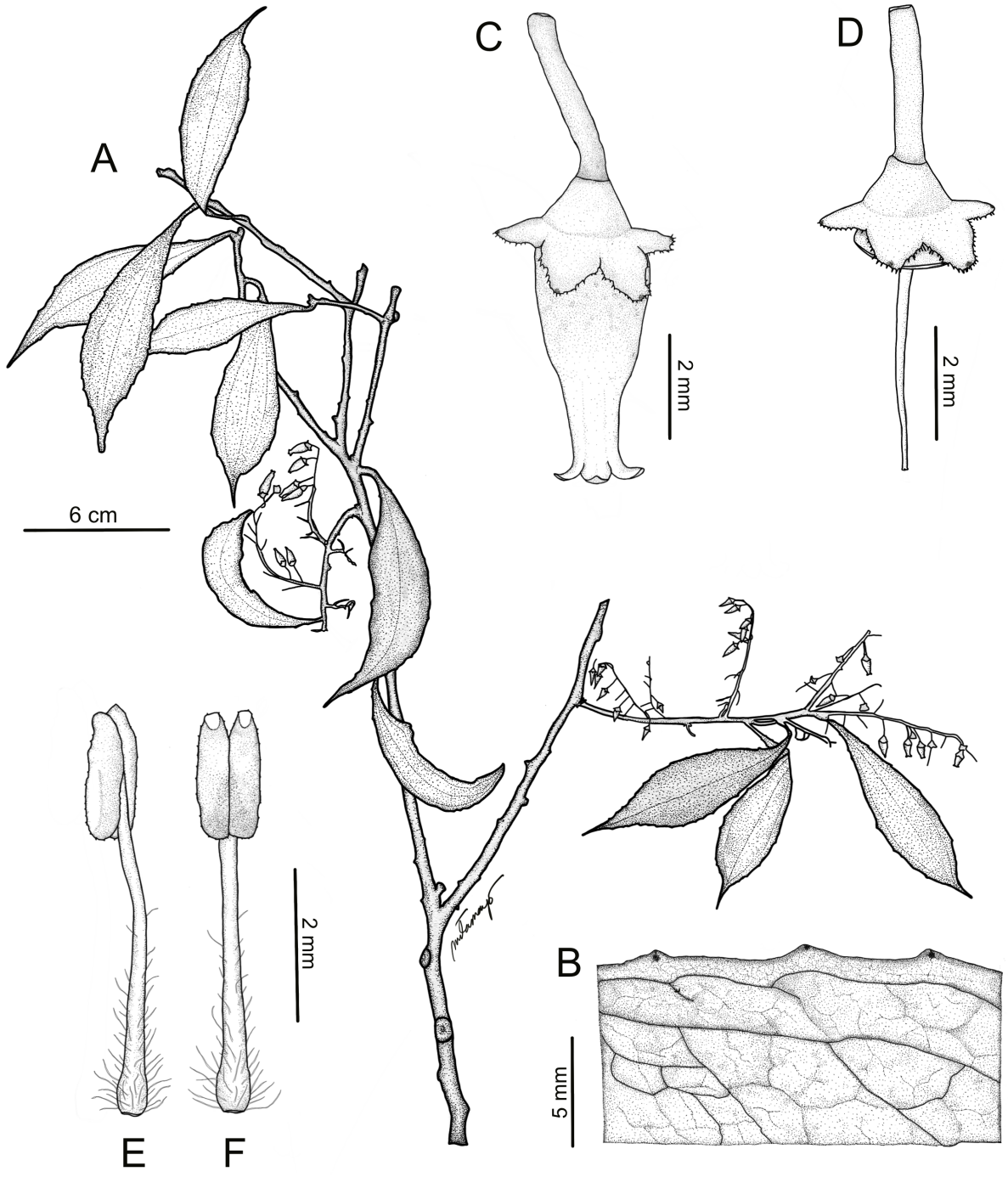

FIGURE 3. *Vaccinium jubatum*. **A.** Flowering branch. **B.** Adaxial view of part of a leaf showing the marginal glands. **C.** Flower. **D.** Flower (corolla removed) exposing the style and disk. **E.** Lateral view of stamen. **F.** Ventral view of stamen. Illustration by Maverick N. Tamayo.

Distribution and Habitat:—This new species is endemic to Mindanao Island, Southern Philippines. It occurs on the northeastern and southern slopes of Mt. Kitanglad Range. Paratypes of *V. jubatum* were collected near the vicinity of the summit at 2200 m elevation.

Etymology:—The specific epithet "*jubatum*" is derived from the Latin word "jubatus" meaning "crested." This is in reference to the dentate leaf margin of the new species that is tipped by a prominent gland.

Phenology:—Flowering in March and July.

Proposed Conservation Status:—*Vaccinium jubatum* is currently only known from its type locality. We know of no other collections of this species. Although Mt. Kitanglad Range is a protected area, the lack of population data precludes assessment with IUCN guidelines. Thus, we recommend a Data Deficient (DD) status for this species (IUCN Standards and Petitions Committee 2022).

FIGURE 4. Holotype of *Vaccinium jubatum* M.N.Tamayo & P.W.Fritsch (BRIT BRIT26945). Image courtesy of the Botanical Research Institute of Texas.

Discussion:—*Vaccinium jubatum* is a member of *Vaccinium* sect. *Bracteata* Nakai in Nakai and Koidzumi (1927: 234) sensu Sleumer (1966–1967) as per its multi-flowered racemose inflorescences, (minute) caducous bracts, absence of a membranaceous wing at the sinuses of the corolla, and anthers that open by short terminal pores or introrse slits (Sleumer 1966–1967; Co *et al*. 2002; Salares *et al*. 2018).

In the artificial key to Philippine *Vaccinium* (Copeland 1930) and the key to the Malesian *Vaccinium* (Sleumer 1966–1967), *V. jubatum* keys to *V. sylvaticum*, a species endemic to Mindanao Island. It is distinguished from this species by having longer petioles (3–7 mm vs. ca. 5 mm), shorter corollas (4–5 mm vs. ca. 8 mm), shorter anthers (1.0–1.2 mm vs. ca. 1.5 mm), and a shorter style (4–6 mm vs. ca. 8 mm) (Elmer 1911; Sleumer 1966–1967). In the key to Bornean *Vaccinium* (Argent 2019), *V. jubatum* keys to *V. phillyreoides* Sleumer (1940: 163). However, the new species is distinct from *V. phillyreoides* by having glabrous branchlets (vs. puberulent), larger leaf blades (4.0–7.5 × 1.2–2.0 cm vs. 2.2–3.0 × 0.5–1.0 cm) with dentate leaf margins (vs. entire), glabrous inflorescences (vs. pubescent), shorter pedicels (3–5 mm vs. 5–7 mm), shorter corollas (4–5 mm vs. 8–9 mm), shorter stamens (3.5–4.0 mm vs. 6.0–7.0 mm), and a glabrous disk (vs. densely pubescent). Moreover, the dentate leaf margins with large and raised marginal glands are unique to *V. jubatum* among the species of Philippine *Vaccinium*.

The specimens *Sulit 3390* (A 00016194!; L L0008222!) were annotated as *Vaccinium sulitii* P.F.Stevens, a name that apparently was never published. These specimens clearly belong to *V. jubatum* as exhibited by the dentate leaf blade margins. The reason that this name was not published might be because the specimens are merely in flower bud, thus making it difficult to dissect and examine the flower characters within the corolla.

Acknowledgments

We thank the curators of A and UC for their assistance in processing and loaning *Vaccinium* specimens, Nila O. Camiguin (Balaoan Central School, Philippines) for help with the etymology of *V. burburan*, and Tiana Rehman and Jerrod Stone of BRIT for their assistance in digitizing the specimens. We acknowledge the financial support of U.S. National Science Foundation grant DEB-1754697 to PWF. MNT thanks the Department of Biology, College of Science and Engineering at Texas Christian University, the U.S. National Science Foundation, and Botanical Research Institute of Texas for additional financial support. We also thank the anonymous reviewers and Dr. Yi-Hua Tong for their constructive comments that improved the paper.

References

Argent, G. (2008) A checklist of Philippine Ericaceae. *Philippine Journal of Systematic Biology* 2 (1): 40–46.

Argent, G. (2014) *Vaccinium utteridgei* (Ericaceae), a new species (sect. *Bracteata*) from Indonesian New Guinea. *Edinburgh Journal of Botany* 71: 189–192.
https://doi.org/10.1017/S0960428614000080

Argent, G. (2019) *Rigiolepis* and *Vaccinium* (Ericaceae) in Borneo. *Edinburgh Journal of Botany* 76: 55–172.
https://doi.org/10.1017/S0960428618000276

Argent, G. & Wilkie, P. (2020) Six new species of *Vaccinium* (Ericaceae) from New Guinea. *Edinburgh Journal of Botany* 77: 439–453.
https://doi.org/10.1017/S0960428620000104

Barthlott, W., Mutke, J., Rafiqpoor, D., Kier, G. & Kreft, H. (2005) Global centers of plant diversity. *Nova Acta Leopoldina* 92: 61–83.

Beentje, H. (2016) *The Kew plant glossary*, Second Ed. Kew Publishing, 200 pp.

Blume, C.L. (1826) *Bijdragen tot de Flora van Nederlandsch Indië*. Lands Drukkerij, Batavia, 1169 pp.

Co, L.L., Madulid, D. & Argent, G. (2002) A new species of *Vaccinium* (Ericaceae) from the Philippines. *Edinburgh Journal of Botany* 59 (3): 373–376.
https://doi.org/10.1017/S0960428602000227

Copeland, H.F. (1930) Philippine Ericaceae, II: the species of *Vaccinium*. *Philippine Journal of Science* 42: 537–607.

Cronquist, A. (1978) Once again, what is a species? *In*: Knutson, L.V. (Ed.) *Biosystematics in agriculture*. Allenheld Osmin, Montclair, New Jersey, pp. 3–20.

Elmer, A.D.E. (1911) The Ericaceae of Mt. Apo. *Leaflets of Philippine Botany* 3: 1089–1107.

Fritsch, P.W., Amoroso, V.B., Coritico, F.P. & Penneys, D.S. (2020) *Vaccinium hamiguitanense* (Ericaceae), a new species from the Philippines. *Journal of the Botanical Research Institute of Texas* 14: 281–287.
https://doi.org/10.17348/jbrit.v14.i2.1009

Hall, R. (2002) Cenozoic geological and plate tectonic evolution of SE Asia and the SW Pacific: computer-based reconstructions, model, and animations. *Journal of Asian Earth Sciences* 20: 353–431.
https://doi.org/10.1016/S1367-9120(01)00069-4

Heaney, L.R. (1986) Biogeography of mammals in SE Asia: estimates of rates of colonization, extinction, and speciation. *Biological Journal of the Linnean Society* 28: 127–165.
https://doi.org/10.1111/j.1095-8312.1986.tb01752.x

IUCN Standards and Petitions Committee. (2022) *Guidelines for using the IUCN Red List Categories and Criteria. Version 15.1*. Prepared by the Standards and Petitions Committee. Available from: https://www.iucnredlist.org/resources/redlistguidelines (accessed 10 September 2022).

Linnaeus, C. (1753) *Species plantarum*, Vol. 1. Salvius, Stockholm, 1200 pp.

Merrill, E.D. (1908) Philippine Ericaceae. *The Philippine Journal of Science,* vol. 3, section C (Botany): 369–382.

Miquel, F.A.W. (1859) *Flora van Nederlandsch Indië*, Vol 2. C.G. van der Post, Amsterdam, 1103 pp.

Mittermeier, R.A., Myers, N., Thomsen, J.B., Da Fonesca, G.A.B. & Olivieri, S. (1998) Biodiversity hotspots and major tropical wilderness areas: approaches to setting conservation priorities. *Conservation Biology* 12: 516–520.
https://doi.org/10.1046/j.1523-1739.1998.012003516.x

Nakai, T. & Koidzumi, G. (1927) *Trees and shrubs indigenous in Japan proper* (revised Ed.), Vol. 1. Seibido Shoten, Tokyo, 714 pp.

Pelser, P.B., Barcelona, J.F. & Nickrent, D.L. (Eds.) (2011 onwards) *Co's digital flora of the Philippines*. Available from: www.philippineplants.org (accessed 9 October 2021).

Salares, V.B., Obico, J.J.A., Ormerod, P., Barcelona, J.F. & Pelser, P.B. (2018) Taxonomic novelties from Cebu: a new species of *Vaccinium*

(Ericaceae) and a new record of *Phaius* (Orchidaceae) for the Philippines. *Phytotaxa* 360 (3): 255–262. https://doi.org/10.11646/phytotaxa.360.3.5

Schwery, O., Onstein, R.E., Bouchenak-Khelladi, Y., Xing, Y., Carter, R.J. & Linder, H.P. (2015) As old as the mountains: the radiations of the Ericaceae. *New Phytologist* 207: 355–367. https://doi.org/10.1111/nph.13234

Sleumer, H. (1940) Neue Ericaceen aus Malesien. *Botanische Jahrbücher* 71: 138–168.

Sleumer, H. (1966–1967) Ericaceae. *In*: van Steenis, C.G.G.J. (Ed.) *Flora Malesiana.* Ser. 1, Vol. 6, Parts 4, 5. Wolters-Noordhoff, Groningen, pp. 469–914.

Stapf, O. (1894) On the flora of Mt. Kinabalu in north Borneo. *Transactions of the Linnean Society of London* 4: 69–263.

Tamayo, M.N., Bustamante, R.A.A. & Fritsch, P.W. (2021) *Vaccinium exiguum* (Ericaceae, Vaccinieae), a new species from the ultramafic summit of Mt. Victoria, Palawan Island, Philippines. *PhytoKeys* 179: 145–154. https://doi.org/10.3897/phytokeys.179.68323

Tamayo, M.N., Coritico, F.P., Amoroso, V.B., Penneys, D.S., Tandang, D.N. & Fritsch, P.W. (2022) *Vaccinium carmesinum* (Ericaceae), a new species of blueberry from Mt. Tago range, Mindanao Island, Philippines. *Phytotaxa* 533 (3): 173–180. https://doi.org/10.11646/phytotaxa.533.3.3

Tamayo, M.N. & Fritsch, P.W. (2022) *Vaccinium paradoxum* (Vaccinieae, Ericaceae), an unusual new species from sea cliffs on ultrabasic forest of Luzon Island, Philippines. *Taiwania* 67 (3): 408–412. https://doi.org/10.6165/tai.2022.67.408

Wilbur, R.L. & Luteyn, J.L. (2008) A synopsis of the Mexican and Central American species of *Vaccinium* (Ericaceae). *Journal of the Botanical Research Institute of Texas* 2: 207–241.

APPENDIX 1. Additional *Vaccinium* specimens examined for morphological comparison.

Vaccinium beamanianum Wilbur & Luteyn. MALAYSIA. Sabah: Mt. Kinabalu, August 1892, *G. Haviland 1148* (K K000780722!).

Vaccinium oscarlopezianum Co. PHILIPPINES. Luzon Island: Municipality of San Mariano, Barangay Disulap, Dappig Creek, Isabela Province, 25 February 1991, *L. Co 3326* (A 00106671!).

Vaccinium phillyreoides Sleumer. MALAYSIA. Sarawak: Ulu Koyan, near Long Kapa (Mt. Dulit), ca. 950 m elevation, 08 November 1932, *Richards 2510* (K K000780791!).

Vaccinium sylvaticum Elmer. PHILIPPINES. Mindanao Island: Todaya (Mt. Apo), District of Davao, 11 April 1911, *A.D.E. Elmer 11819* (K K000780735!).

Vaccinium tenuipes Merrill. PHILIPPINES. Luzon Island: Benguet Province (Mt. Pulogloco), September 1921, *M. Ramos & G. Edaño 40404* (A 02006789!); Anilog, Rizal Province, March 1914, *A. Loher 14173* (UC 242975!).

Vaccinium tenuipes Merrill. PHILIPPINES. Mindoro Island: Barangay Lantuyan (Mt. Halcon), Oriental Mindoro Province, ca. 1200 m elevation, 13 March 1997, *PPI 20045* (BRIT BRIT26879!; BRIT BRIT26909!).

Vaccinium tenuipes Merrill. PHILIPPINES. Negros Island: Dumaguete (Cuernos Mountains), Negros Oriental Province, May 1908, *A.D.E. Elmer 10108* (U 0111118!); Sibulan, Kabalinan (Lake Balinsasayao), Negros Oriental Province, 18 May 1991, *PPI 935* (BRIT BRIT26883!).