

Vaccinium (Ericaceae) in Sulawesi: a new species and a list of known taxa

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Abstract

Vaccinium sulawesiense Mustaqim & P.W.Fritsch, a newly discovered species endemic to Sulawesi, Indonesia, is described. This species is similar to *V. simulans* Sleumer but differs in having an acuminate leaf apex, larger floral organs, and an absence of trichomes in the upper half of the inner surface of corolla and disk. This species is known from two specimens, one from a mid-montane rainforest in Mamasa Regency, Sulawesi Barat Province, and the other from Poso Regency, Sulawesi Tengah Province. An updated list of the 17 known *Vaccinium* species in Sulawesi is also provided.

Introduction

The Ericaceae of Sulawesi have been treated in *Flora Malesiana* (Sleumer 1964, 1966–1967) but many new taxa have been subsequently described (e.g. Argent 2009, 2014; Craven 2014; Argent & Widjaja 2015; Argent & Mambrasar 2019; Mustaqim & Ardi 2019, 2021; Hutabarat *et al.* 2022). Five genera of Ericaceae occur in Sulawesi: *Gaultheria* Kalm ex L., *Rhododendron* L., *Rigiolepis* Hook.f., *Styphelia* Sm., and *Vaccinium* L. (Chase *et al.* 2016; Argent 2019; Kron *et al.* 2020; Mustaqim & Ardi 2021).

Sixteen species and two varieties of *Vaccinium* (tribe Vaccinieae) are currently recognized from Sulawesi and most are endemic (Sleumer 1961, 1966–1967; Argent 2019; Mustaqim & Ardi 2019). The main taxonomic reference for the genus is still the account in *Flora Malesiana* (Sleumer 1966–1967) and since that publication, no substantial taxonomic work on the *Vaccinium* of Sulawesi has been published. In the early 2000s, *Vaccinium* was included in a checklist of woody plants from Sulawesi (Kessler *et al.* 2002) but only 12 species were listed, fewer than in Sleumer (1966–1967) with several species apparently inadvertently excluded. In 2019, one

species was transferred into the recently resurrected genus *Rigiolepis*, *R. henrici* (J.J.Sm.) Argent, an endemic of South Sulawesi Province (Argent 2019). The latest taxon described from the island since *Flora Malesiana* is *Vaccinium paludicola* Sleumer var. *hirsutulum* Mustaqim (Mustaqim & Ardi 2019).

During fieldwork conducted in November and December 2019 in the mountainous regions of Mamasa Regency, Sulawesi Barat Province, the first and the fifth authors collected an unusual specimen of *Vaccinium*. Later, a morphologically similar specimen was collected by the fourth author from Mount Rorekatimbu, Sulawesi Tengah Province. After detailed examination of these specimens and in consultation with the relevant literature and type material, we concluded that the specimens represent a species new to science, which we describe herein. To facilitate taxonomic understanding of *Vaccinium* in Sulawesi, we also provide an updated checklist of the known species and varieties of *Vaccinium* from the island.

Material and Methods

Herbarium specimens were prepared as in Bridson and Forman (1992). Flowers were preserved in 70% ethanol and used for the description. Overall morphology was compared with other species in relevant literature (Sleumer 1966–1967; Vander Kloet 2005; Argent 2019; Mustaqim & Ardi 2019), herbarium material from CEB, and online images of type specimens available from Naturalis Biodiversity Center Leiden (<http://biportal.naturalis.nl>), Kew Herbarium Catalogue (<http://apps.kew.org/herbcat>), and JSTOR Global Plants (<http://plants.jstor.org>). Preliminary conservation status was evaluated in accordance with the IUCN Standards and Petitions Subcommittee (2022). The Extent of Occurrence (EOO) and Area of Occupancy (AOO) were analysed with GeoCAT (www.geocat.kew.org) (Bachman *et al.* 2011). The checklist was based on the same literature, herbarium, and online sources as above. The map used in this study was prepared with SimpleMapp (Shorthouse 2010).

Taxonomy

Vaccinium sulawesiense Mustaqim & P.W.Fritsch, *sp. nov.*

Type: Indonesia: Sulawesi Barat Province: Sulawesi Island, Mamasa Regency, trail to Talambai Village, 1890 m asl, 25 November 2019, *W.H. Ardi et al.* 583 (holo: BO; iso: FIPIA).

Small tree, terrestrial, evergreen, to 5 m tall. Young branchlets slightly flexuous at apex, terete, sometimes slightly angular, 1.5–3.5 mm wide, with sparse minute ferruginous, simple trichomes near leaf insertion at early stage, very soon glabrous; mature branchlets lenticellate, bark not peeling. Perennating buds monomorphic, one per leaf axil, depressed-globose, up to 1.5 × 2.5 mm, with multiple overlapping scales, scales rounded at apex, glabrous. *Leaves:* spirally arranged, sparse; petiole circular, channelled above, light green tinged with red, 6.5–10.0 × 1.3–1.5 mm, glabrous; blade elliptic or slightly ovate, 65–80 × 23–30 mm, coriaceous; reddish on both surfaces when young, green adaxially, pale whitish abaxially; adaxially initially covered with reddish and curly minute ferruginous trichomes adaxially, also a few surrounding base, glabrescent, abaxially nearly glabrous, glabrescent; base attenuate, margin with 2(–3) pairs of basal glands, lower pair of marginal glands at 2–3 mm below leaf blade and petiole junction, upper pair 2–5 mm above the leaf blade and petiole junction with the distances varying among each pair, once observed right at the point of junction, distal glands appearing only as remote minute crenations, slightly recurved, apex acuminate, gland-tipped, midvein raised abaxially, slightly impressed or nearly flat adaxially, secondary veins 4 on each side of midvein, basal most vein short and close to margin with 1 or 2 usually arising from base, others from midvein, slightly raised or flat but distinct above, raised beneath, tertiary veins distinct and slightly raised abaxially, obscure adaxially. *Inflorescences:* axillary, those from uppermost node appearing terminal, racemose, 1 per leaf axil, 7–10-flowered; peduncle stout, 3–5 mm long; rachis stout and fleshy *in vivo*, angular, 20–35 mm long, glabrous; bracts not seen, presumably early caducous. *Pedicels* terete, 7–10 mm long, 1 mm wide at base, widening to c. 1.3 mm at apex, glabrous except for a few trichomes at the very tip, bracteoles absent. *Flowers:* articulated with pedicels. *Hypanthium* campanulate or turbinate, 3–4 × 5–6 mm, sparsely to sub-densely appressed-glandular-pubescent; calyx limb 2.5–3.3 mm long, glabrous, lobes broadly deltoid, 1.3–2.5 × 2.8–3.5 mm, glabrous, margin densely ciliate, without sessile marginal glands, apex obtuse to subrounded, the very tip with a minute gland. *Corolla:* in bud ovoid-cylindric, at anthesis pale red with whitish base, urceolate-elliptic, distinctly 5-angled, bluntly 5-angled at base, angles sharper distally, 13.5–15.5 × 7.0–8.8 mm, glabrous outside, pubescent on lower half inside; corolla lobes 5, becoming reflexed, ovate, c. 1.5 × 2.8 mm, apex obtuse. *Stamens:* 10, distinct, uniform in shape, 7.2–7.5 mm long; filaments 3.0–3.6 mm long, basally dilated and tapered from base to apex, pubescent except at base and apex; anthers echinulate, 2.6–3.0 mm long, cells c. 1.4–1.8 mm long, dorsally with two spurs; tubules parallel, cylindrical, subequal to slightly narrower than cells, 1.3–1.6 mm long, with several

apically stipitate-glandular trichomes, gland heads \pm globose, pore slightly larger than tubule, with glandular teeth at apex; dorsal spur oriented slightly to rather distinctly upcurved, c. 0.5 mm long. *Ovary*: glabrous, 5-locular, appearing pseudo-10-locular with false partitions extending 0.4–0.5 mm from inner wall; ovules in two columns; disk annular, c. 0.9 mm high, apex rounded, glabrous. *Style*: shorter than corolla tube, 11–12 mm long, pubescent except within upper third. *Fruit*: not seen. (Fig. 1).

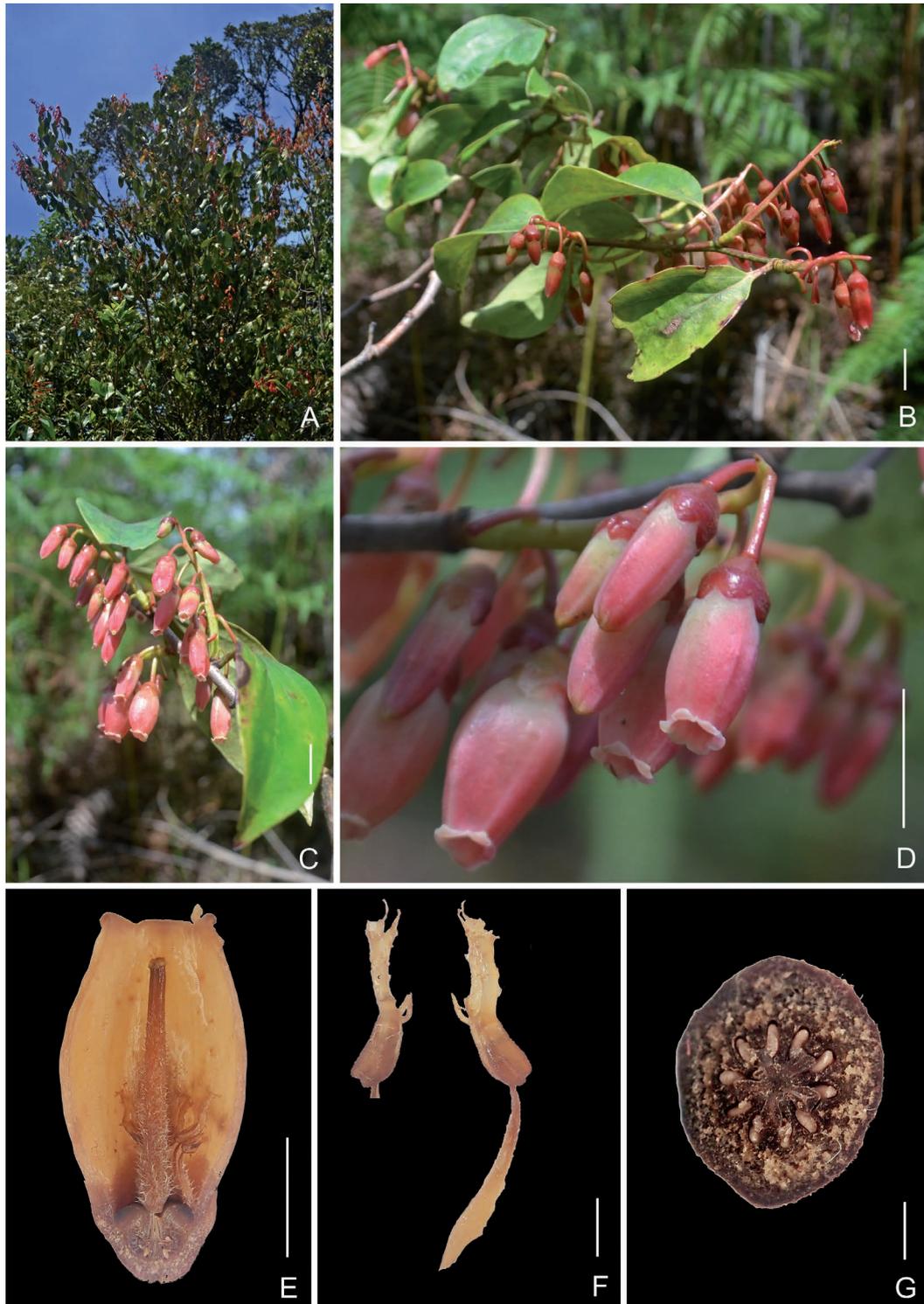


Fig. 1. Morphology of *Vaccinium sulawesiense* Mustaqim & P.W.Fritsch: A. Living plant. B. Branchlets with leaves and inflorescences. C. Inflorescence. D. Flowers. E. Longitudinal section of flower. F. Stamens. G. Cross-section of ovary. Scale bar: B–D = 10 mm; E = 5 mm; F–G = 1 mm. Photographs: A–C by Wendy A. Mustaqim, E–G by Wisnu H. Ardi. All images from W.H. Ardi *et al.* 583.

Diagnostic characters: *Vaccinium sulawesiense* is similar to *V. simulans* Sleumer but differs in having an acuminate leaf apex (*vs* broadly attenuate to rounded), larger corolla (13.5–15.5 × 7–8.8 mm *vs* 4–5 × 2.5 mm), a glabrous disk (*vs* pubescent), longer filaments (3–3.5 mm *vs* 1.8 mm), longer anther cells (1.3–1.8 mm *vs* 0.6 mm), longer anther tubules (1.3–1.6 mm *vs* 0.5 mm), and a longer style (11–12 mm *vs* 4 mm) bearing trichomes near the apex (*vs* restricted to the lower half).

Etymology: The specific epithet refers to the island of Sulawesi.

Distribution: Endemic to Sulawesi: known from Sulawesi Tengah and Barat Province (Fig. 2).

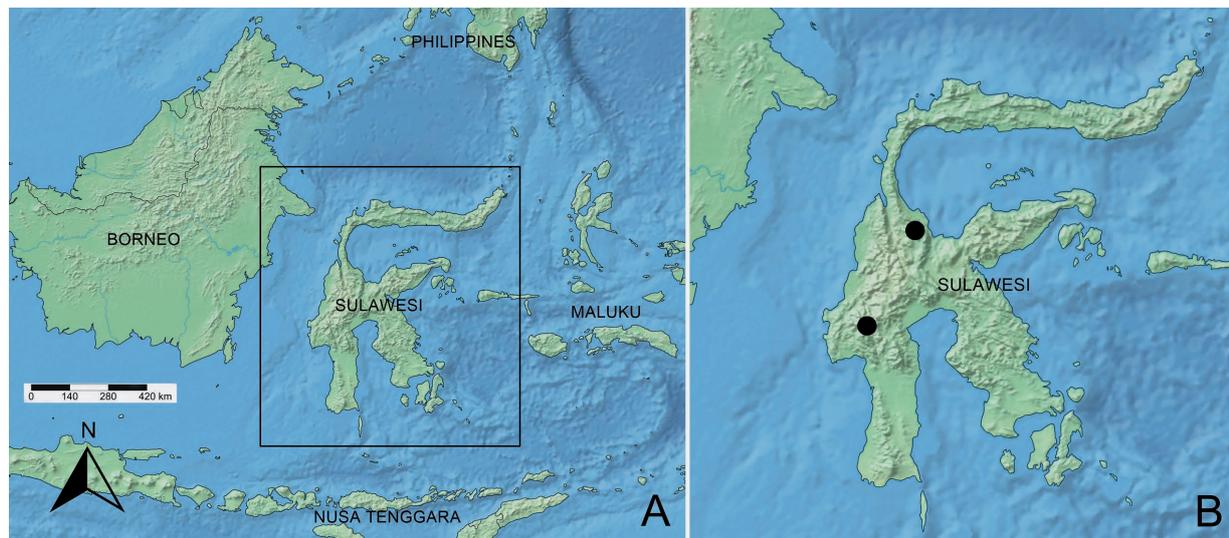


Fig. 2. Geographic distributions of *Vaccinium sulawesiense* Mustaqim & P.W.Fritsch: A. Eastern Indonesian Archipelago showing Sulawesi (box). B. The distribution of *V. sulawesiense* across Sulawesi (●).

Habitat and ecology: The species was found growing on mid- to upper montane forests at 1890 to c. 2250 m asl. In Mamasa Regency, some species recorded in its habitat are *Gaultheria retusa* (Sleumer) Kron & P.W.Fritsch, *Ficus oleifolia* King, several shrubby *Schefflera* J.R.Forst. & G.Forst., and other species of *Vaccinium* such as *V. myrtoides* (Blume) Miq.

Preliminary IUCN Red List conservation status: This species is only known from two locations. In Mamasa, our survey along trails in surrounding areas within 5–10 km yielded only one individual, whereas in Mt Rorekatimbu so far it is known only from one location; therefore, this species has an AOO of 8 km². With the currently available data, we recommend the Data Deficient (DD) category until further data become available. However, the location of the type is threatened by habitat conversion for agriculture, and once further data are available, a threatened category may be justified.

Notes: The new species can be placed in *Vaccinium* section *Bracteata* Nakai sensu Sleumer (1966–1967) in having many-flowered racemes, calyx lobes that are shorter than the calyx tube, a shallowly lobed corolla with an urceolate- to ellipsoid-cylindrical corolla tube, and anther tubules opening by a terminal large pore. *Vaccinium* section *Bracteata* is the only section that occurs in Sulawesi after the resurrection of the genus *Rigiolepis*, formerly known as *Vaccinium* sect. *Rigiolepis* (Hook.f.) Sleumer, with one species in Sulawesi, *R. henrici* (Sleumer) Argent (Sleumer 1966–1967; Argent 2019). *Vaccinium sulawesiense* keys out in the Flora Malesiana to *V.* section *Bracteata* (Sleumer 1966–1967) as *V. simulans* Sleumer, a species endemic to Sabah state, Malaysia in northern Borneo (Sleumer 1966–1967; POWO 2022).

In the key to Bornean *Vaccinium* in Argent (2019), this species also keys best to *V. simulans* by its erect shrub habit, young stems early glabrescent, with a few short glandular trichomes near the petiole insertion, prominent vegetative buds that are spherical, blunt and 2.5 mm wide, leaves with a petiole ≤ 10 mm long, and leaf blades > 15 mm and ≤ 30 mm wide with attenuated base and adaxial midvein flat in the proximal half. The only character that does not match is the raised abaxial lateral veins, which are instead obscure in *V. simulans*. The raised abaxial lateral nerves are found in one of the most morphologically similar species to *V. simulans*, i.e. *V. claoxylon* J.J.Sm. However, *V. claoxylon* has a raised adaxial leaf blade midvein in the proximal half, a character not present in *V. sulawesiense*. *Vaccinium claoxylon* also differs from *V. sulawesiense* by larger leaf blades (70–140 × 40–60 mm *vs* 65–80 × 23–30 mm), shorter pedicels (1–2 mm *vs* 7–10 mm long), bracteoles

present (*vs* absent), smaller corolla (6–8 × 2.5 mm *vs* 13.5–15.5 × 7–8.8 mm), and shorter stamens (c. 4 mm *vs* 6–7 mm). Like *V. simulans*, *V. claoxylon* is endemic to Borneo but has a wider geographical range from Sabah (Kinabalu) and Kalimantan (Kalimantan Barat and Kalimantan Timur Province) (Sleumer 1961).

According to Sleumer (1966–1967), the *Vaccinium* species of Sulawesi that is most similar to the new species is *V. latissimum* J.J.Sm., a species of Mamasa Regency as well as other areas in Sulawesi Tengah and Selatan Provinces. Both species have presumably small and early caducous bracts and distinct anther spurs. However, *V. latissimum* differs from *V. sulawesiense* by larger leaf blades (90–130 × 50–100 mm *vs* 65–80 × 23–30 mm) that are suborbicular or broadly elliptic (*vs* elliptic or slightly ovate) with apices mostly rounded or only short- or apiculate-acuminate (*vs* distinctly acuminate) and with more lateral nerves (6–7 *vs* 4 pairs), a deeply lobed corolla (*vs* shallowly lobed) with lobes erect or nearly so (*vs* reflexed), the absence of glandular trichomes on the anthers (*vs* present), and a glabrous style.

Sleumer (1966–1967) listed 17 species of *Vaccinium* for Sulawesi, but one of them was recently transferred to *Rigiolepis* (i.e., *R. henrici*) (Argent 2019). The discovery of *V. sulawesiense* increases the number of *Vaccinium* species known for Sulawesi to 17 species. Some unidentified Sulawesi specimens were listed by Kessler *et al.* (2002) and some of these may represent undescribed species in need of further study.

Additional specimen examined: INDONESIA: Sulawesi Tengah Province: Sulawesi Island, Poso Regency, Lore Utara, Mount Rorekatimbu, c. 2250 m, 14 Aug 2021, *F.S. Lakiu s.n.* (CEB!).

An updated list of *Vaccinium* taxa in Sulawesi

1. *Vaccinium apophysatum* Sleumer, *Blumea* 11: 82 (1961)¹
Note. Sleumer (1966–1967) indicates that this species is endemic to the ‘N. Moluccas (Talaud Is.: E. slope of Mt Piapi on Karakelang)’. The Talaud Islands are best considered a part of Sulawesi rather than the Moluccas (Cannon *et al.* 2007; Thomas *et al.* 2013–onwards); thus the species is listed here, as in Kessler *et al.* (2002).
2. *Vaccinium aucupis* Sleumer, *Bot. Jahrb. Syst.* 71: 160 (1940)¹
3. *Vaccinium centrocelebicum* Sleumer, *Blumea* 11: 45 (1961)¹
 - var. *centrocelebicum*¹
 - var. *majus* Sleumer, *Blumea* 11: 46 (1961)¹
4. *Vaccinium contractum* Sleumer, *Bot. Jahrb. Syst.* 71: 160 (1940)¹
5. *Vaccinium cuneifolium* (Blume) Miq., *Fl. Ned. Ind.* 2: 1062 (1859)¹
6. *Vaccinium dubiosum* J.J.Sm., *Bot. Jahrb. Syst.* 68: 214 (1937)¹
7. *Vaccinium kjellbergii* J.J.Sm., *Bot. Jahrb. Syst.* 68: 211 (1937)¹
8. *Vaccinium latissimum* J.J.Sm., *Bull. Jard. Bot. Buitenzorg, sér. 3, 1*: 409 (1920)¹
9. *Vaccinium lucidum* (Blume) Miq., *Fl. Ned. Ind.* 2: 1061 (1859)²
10. *Vaccinium myrtoides* (Blume) Miq., *Fl. Ned. Ind.* 2: 1062 (1859)²
11. *Vaccinium paludicola* Sleumer, *Blumea* 11: 53 (1961)¹
 - var. *paludicola*¹
 - var. *hirsutulium* Mustaqim, *Telopea* 22: 201 (2019)¹
12. *Vaccinium pilosilobum* J.J.Sm., *Bot. Jahrb. Syst.* 68: 213 (1937)^{1,2}
13. *Vaccinium sclerophyllum* Sleumer, *Blumea* 11: 96 (1961)¹
14. *Vaccinium sulawesiense* Mustaqim & P.W.Fritsch, this publication¹
15. *Vaccinium timorense* Fawc. in H.O.Forbes, *Naturalist’s Wanderings E. Archipel.*: 509 (1885)²
16. *Vaccinium tomicipes* J.J.Sm., *Bot. Jahrb. Syst.* 68: 212 (1937)¹
17. *Vaccinium warburgii* Sleumer, *Bot. Jahrb. Syst.* 71: 167 (1940).¹

¹Endemic; ²Not listed in Kessler *et al.* (2002) but documented from Sulawesi in Sleumer (1966–1967).

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References

- Argent G (2009) *Rhododendron sojolense* Argent (Ericaceae), a new species of *Rhododendron* subgenus *Vireya* from Sulawesi, Indonesia. *Gardens' Bulletin Singapore* 61: 1–6. <https://www.nparks.gov.sg/sbg/research/publications/gardens'-bulletin-singapore>
- Argent G (2014) A contribution to the study of the genus *Diplycosia* (Ericaceae) in Sulawesi, Indonesia. *Edinburgh Journal of Botany* 71: 83–115. <https://doi.org/10.1017/S0960428613000309>
- Argent G (2019) *Rigiolepis* and *Vaccinium* (Ericaceae) in Borneo. *Edinburgh Journal of Botany* 76(1): 55–172. <https://doi.org/10.1017/S0960428618000276>
- Argent G, Mambrasar YM (2019) *Rhododendron widjajae* (Ericaceae, section *Schistanthe*) a new species from Sulawesi. *Reinwardtia* 18: 27–30. <https://doi.org/10.14203/reinwardtia.v18i1.3700>
- Argent G, Widjaja EA (2015) *Diplycosia mekonggaensis* (Ericaceae, Gaultherieae), a new species from Sulawesi, Indonesia. *Edinburgh Journal of Botany* 72: 239–242. <https://doi.org/10.1017/S0960428615000116>
- Bachman S, Moat J, Hill AW, de la Torre J, Scott B (2011) Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. In: Smith V and Penev L (eds) e-Infrastructures for data publishing in biodiversity science. *ZooKeys* 150: 117–126. <https://doi.org/10.3897/zookeys.150.2109>
- Bridson D, Forman L (1992) *The Herbarium Handbook*. (Kew Publishing: London)
- Cannon CH, Summers M, Harting JR, Kessler PJ (2007) Developing conservation priorities based on forest type, condition, and threats in a poorly known ecoregion: Sulawesi, Indonesia. *Biotropica* 39: 747–759. <https://doi.org/10.1111/j.1744-7429.2007.00323.x>
- Chase MW, Christenhusz MJ, Fay MF, Byng JW, Judd WS, Soltis DE, Mabberley DJ, Sennikov AN, Soltis PS, Stevens PF (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181: 1–20. <https://doi.org/10.1111/boj.12385>
- Craven LA (2014) Three new species of, and realignments in, *Rhododendron* sect. *Schistanthe* (Ericaceae). *Journal of the Adelaide Botanic Gardens* 27: 25–34. https://data.environment.sa.gov.au/Content/Publications/JABG27P025_Craven.pdf
- Hutabarat PWK, Mustaqim WA, Mambrasar YM (2022) Two new species of *Rhododendron* of subgenus *Vireya* (Ericaceae) from Sulawesi, Indonesia. *Taiwania* 67: 218–229. <https://doi.org/10.6165/tai.2022.67.119>
- IUCN Standards and Petitions Subcommittee (2022) Guidelines for using the IUCN Red List categories and criteria, version 15.1. Prepared by the Standards and Petitions Subcommittee (<http://www.iucnredlist.org/documents/RedListGuidelines.pdf>) (Accessed 16 September 2022)
- Kessler PJ, Bos MM, Sierra Daza SEC, Kop A, Willemse LPM, Pitopang R, Gradstein SR (2002). Checklist of woody plants of Sulawesi, Indonesia. *Blumea Supplement* 14: 1–160. <https://repository.naturalis.nl/pub/526385/BLUMSUP2002014001001.pdf>
- Kron KA, Fritsch PW, Lu L, Judd WS (2020) New combinations and new and resurrected names in *Gaultheria* (Ericaceae). *Gardens' Bulletin Singapore* 72: 299–317. [https://doi.org/10.26492/gbs72\(2\).2020-13](https://doi.org/10.26492/gbs72(2).2020-13)
- Mustaqim WA, Ardi WH (2019) Ericaceae of Sulawesi: a new species of *Diplycosia*, a new variety of *Vaccinium paludicolum* and one rediscovery. *Telopea* 22: 193–204. <https://dx.doi.org/10.7751/telopea13168>
- Mustaqim WA, Ardi WH (2021) *Rigiolepis argentii* (Ericaceae): a new species from Sulawesi, Indonesia. *Phytotaxa* 521: 63–69. <https://doi.org/10.11646/phytotaxa.521.1.7>
- POWO (2022) *Plants of the world online* (<http://www.plantsoftheworldonline.org>) (Accessed 13 January 2022)
- Shorthouse DP. 2010. *SimpleMappr, an online tool to produce publication-quality point maps* (<https://www.simplemappr.net>) (Accessed 15 January 2022)
- Sleumer H (1961) Florae Malesianae precursores XXVIII. The genus *Vaccinium* in Malaysia. *Blumea* 11: 9–112. <https://repository.naturalis.nl/pub/524845/BLUM1961011001002.pdf>
- Sleumer H (1964) Epacridaceae. *Flora Malesiana I* 6: 422–444. <https://repository.naturalis.nl/pub/532564/FM1S1960006001013.pdf>
- Sleumer H (1966–1967) Ericaceae. *Flora Malesiana I* 6: 669–914. <https://repository.naturalis.nl/pub/532600/FM1S1960006001016.pdf>

- Thomas DC, Ardi WH, Girmansyah D, Hughes M (2013–onwards) Sulawesi *Begonia* Data Portal (<http://portal.cybertaxonomy.org/flora-malesiana-prospective>) (Accessed 24 March 2020)
- Vander Kloet SP (2005) The taxonomy of *Vaccinium* section *Rigiolepis* (Vaccinieae, Ericaceae). *Blumea* 50: 477–497. <https://repository.naturalis.nl/pub/525327/BLUM2005050003009.pdf>

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