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NOTES ON *RHODODENDRON* (ERICACEAE) FROM BALI, INDONESIA, AND A NEW SUBSPECIES OF *RHODODENDRON JAVANICUM*

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In an inventory of *Rhododendron* species on the island of Bali, Indonesia, three species and two subspecies were recorded. This article presents an identification key to these taxa and brief notes on each taxon. In addition, a new subspecies of *Rhododendron javanicum* is proposed.

Keywords. Bali, key identification, *Rhododendron*, subspecies.
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Introduction

Rhododendron subg. *Vireya* Clarke in Hook.f. comprises c.326 species (Sleumer, 1966; Argent, 2015; James & Argent, 2017; Mambrasar & Hutabarat, 2018; Argent & Mambrasar, 2019). The distribution of the subgenus includes parts of China, India, Myanmar, Vietnam, Taiwan, Thailand, Peninsular Malaysia, Sumatra, Java, Borneo, Lesser Sunda Island, Sulawesi, the Moluccas, New Guinea and Australia, but with New Guinea having the highest diversity (Argent, 2015; MacKay *et al.*, 2016; Mambrasar & Arifiani, 2020). Argent (2015) stated that *Rhododendron* subg. *Vireya* is characterised by the presence of scales on the leaves, young branches, and flowers; seeds that have tails at both ends; cotyledons without scales or hairs; a tapering style–ovary junction (usually); an umbellate (or solitary-flowered) inflorescence, without rachis; leaves that are not seasonally deciduous; leaves with large idioblast; flowers without pigment spots; a calyx represented by a low disc of tissue; and plants that lack floccose (woolly), branched, glandular or lamellar (flattened) hairs. The subgenus is sometimes referred to under the terms 'Malesian *Rhododendron*' or 'tropical *Rhododendron*', as most of the species are native to tropical areas, especially the Malesian region, but often just as 'vireya rhododendrons'.

Sleumer (1966) recorded three species and one variety of *Rhododendron* from Bali, namely *R. citrinum* (Hassk.) Hassk. var. *citrinum*, *R. javanicum* (Blume) Benn. var. *javanicum*, *R. javanicum* var. *teysmanii* (Miq.) Kuntze and *R. zollingeri* Warb. Subsequently, Girmansyah *et al.* (2013) added *Rhododendron retusum* (Blume) Benn. to the list. However, Argent (2015) revised the list and included *Rhododendron citrinum* var. *citrinum*, *R. javanicum* subsp. *javanicum*, *R. javanicum* subsp. *teysmannii* and *R. zollingeri* from Bali. He

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considered the distribution of *Rhododendron retusum* to be limited to Java and Sumatra (Figure 1).

In his monograph, Argent (2015) highlighted the need to assess the taxonomy of *Rhododendron javanicum* in Bali more comprehensively. He later suggested that the Bali specimens had unique characteristics that supported treating them as a distinct subspecies (George Argent, personal communication, 2018). Unfortunately, until his death, he did not have enough material with which to conduct the necessary assessment. In 2018, a specimen of *Rhododendron javanicum* from Bali was collected and recognised as the same epiphytic *Rhododendron* found on the trunks of trees grown in Eka Karya Botanical Gardens, Bali, and previously identified as *R. javanicum* subsp. *teysmannii*. However, observation of the specimen in Herbarium Bogoriense (BO; herbarium codes follow Thiers, continuously updated) showed that although the specimen had the same characters as those plants growing in Eka Karya Botanical Gardens, Bali, it also had various morphological characters that differed from *Rhododendron javanicum* subsp. *teysmannii* and showed that this new material was sufficiently distinct to be described as a new subspecies. A detailed study of Bali's *Rhododendron* species is presented here, as is a description of the new subspecies and a key to the taxa, with remarks on their taxonomic history.

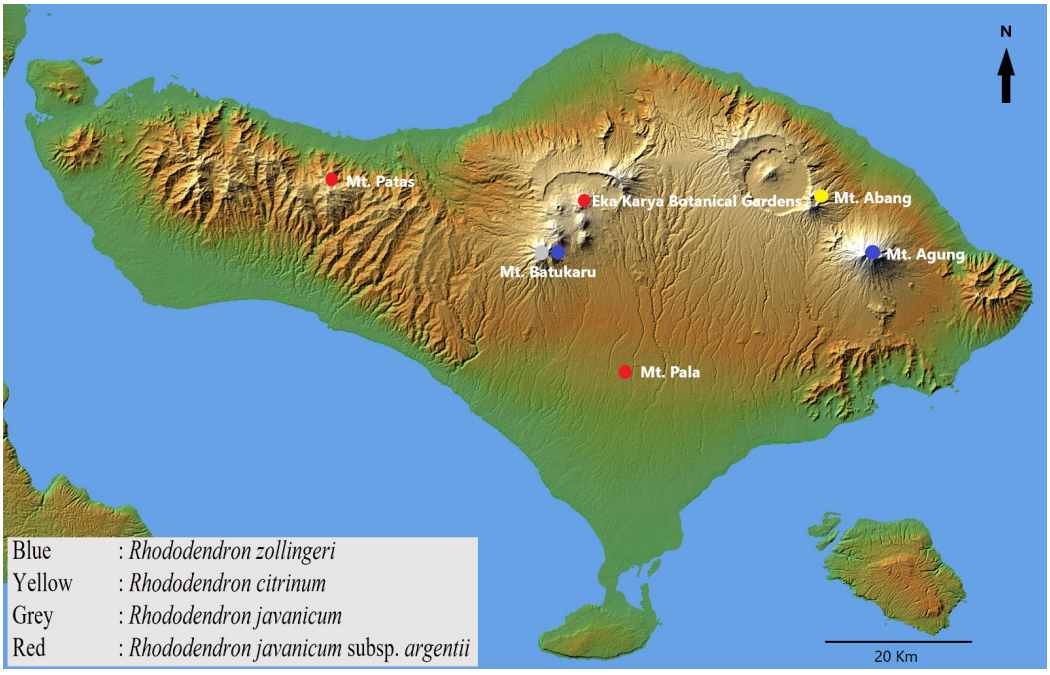

Figure 1. The distribution of *Rhododendron* in Bali. Base map from NASA's Earth Observatory.

Taxonomic treatment

Species descriptions

1. **Rhododendron citrinum** (Hassk.) Hassk., Cat. Hort. Bot. Bog. Alt., 161 (1844). – *Azalea citrina* Hassk., Flora 25(2, Beibl. 1): 30 (1842). – Type: Indonesia, Java, Mt Gede, Tjibeureum, 31 xii 1924, *Docters van Leeuwen* 8245 (neotype BO [157586] designated by Sleumer [1960]).

Rhododendron zippelii Blume, Fl. Javae, Pl. Ined.: t. 4 (1863–1883). – Type: Indonesia, Java, Megamendung, *Zippel s.n.* (holotype L).

var. *citrinum*

Shrub. *Twigs* 1–2 mm in diameter, rounded, covered by brown scales; internodes 50–80 mm. *Leaves* 5–8 in tight pseudowhorls, 17–48 × 6–18 mm, broadly elliptic, narrowly elliptic to elliptic, apex obtuse, broadly acute, margin narrowly revolute, base broadly tapering, densely scaly, quickly glabrescent above, persistently scaly beneath. Scales flat, small, subdendroid and scattered. *Petiole* 4–10 mm long, grooved, densely scaly. *Flowers* 2- to 5-clustered, half hanging. *Pedicels* 14–21 mm long, scaly. *Corolla* 10–12 mm long, 7–8 mm in diameter, campanulate, pale yellow to yellowish white, outer surface densely scaly, inner surface glabrous, stamens glabrous, c.3 × 1 mm, oblong, ovary 3 × 2 mm, laxly scaly, style glabrous. *Fruit* 10–20 × 3–4 mm, cylindrical.

Distribution. Java and Bali. In Bali only known from Mount Abang.

Habitat and ecology. Epiphyte in montane forests 1600–1800 m a.s.l.

Proposed IUCN conservation category (Bali). Globally assessed as Least Concern (LC) (Argent, 2015). In Bali, it is known only from a single specimen in BO from Mount Abang, collected by van Steenis (8033) in 1936. This mountain is a popular area for climbers and as a place of worship for Balinese Hindus. The area is in danger of being damaged by the planned construction of a cable (Suyasa, 2022). Its small population size and plausible future threats from development activities suggest a provisional assessment of Vulnerable (VU) D2 (IUCN Standards and Petitions Subcommittee, 2022).

Notes. Misapplied name: *Rhododendron jasminiflorum* (auct. non Hook.) Koord., Junghuhn Gedenkb. 184 (1910); Hallier f., Med. Rijksherb. 1: 35 (1910).

Additional specimen examined. Indonesia. **Bali**: Mt Abang, 1600–1800 m, 9 iv 1936, *C.G.G.J. van Steenis* 8033 (BO).

2. **Rhododendron javanicum** (Blume) Benn., Pl. Jav. Rar. [Bennett] 85 (1838), excl. t. 19, which is *R.* var. *teysmanii* fide Sleumer (1966). *Vireya javanica* Blume, Bijdr. Fl. Ned. Ind.: 854 (1826). – Type: Mt Salak, 800–2215 m, *Blume s.n.* [leg. *Zippel*?] (holotype L, U).

Azalea javanica (Blume) Kuntze, Revis. Gen. Pl. 2: 386 (1891). – Type: Indonesia, Java, Sindanglaja. *Leg. Ign. s.n.* (BO).
subsp. *javanicum*

Shrub or tree, growing up to 5 m. *Twigs* 3–6 mm in diameter, scaly when young; internodes 20–160 mm. *Leaves* 3- to 7-clustered in tight pseudowhorls but sometimes with odd leaves along stems, 30–120 × 14–44 mm, narrowly elliptic or elliptic-ovate, apex shortly acuminate or acute, margin entire, flat, base tapering; scaly beneath leaves. Scales flat, small, dendroid and scattered. *Petiole* 5–11 × 2–4 mm, brown or red, scaly. *Flowers* 4–12 in each open umbel, semipendent. *Pedicels* 15–24 mm, scaly. *Corolla* 30–50 mm long, 70–80 mm in diameter, funnel-shaped, orange with red or rarely yellow, glabrous but occasionally scaly outside and hairy inside. *Stamens* hairy, anthers 2.5–4 × c.1.3 mm, oblong. *Ovary* 7–9 × c.3 mm, scales sparse or absent, style glabrous, 20–30 mm long. *Fruit* 30–60 × 9 mm, fusiform.

Distribution. Sumatra, Natuna Islands, Lingga Archipelago, Java and Bali (Mount Batukaru).

Habitat and ecology. Terrestrial in montane forests, c.1360 m a.s.l.

Proposed IUCN conservation category (Bali). Globally assessed as Least Concern (LC) by Argent (2015). In Bali, it is known only from Mount Batukaru, an area proposed as a nature reserve by the Indonesian Ministry of Environment and Forestry (Putri, 2012; KSDA Bali, 2019). In addition, the mountain is a popular area for climbers and as a place of worship for Balinese Hindus. The restricted, potentially small population, and plausible future threats from human activities, suggest a provisional assessment of Vulnerable (VU) D2 (IUCN Standards and Petitions Subcommittee, 2022).

Additional specimens examined. INDONESIA. **Bali**: Mt Batoe Karoe [Mt Batukaru], 1360 m, 11 x 1918, *R. Maier & Sarip* 396 (BO); Bali, Bedugul forest region, Mt Batukaru complex, 23 vi 1958, *Kostermans, Kuswata, Soegeng, Soepadmo* 84 (BO).

3. Rhododendron javanicum (Blume) Benn. subsp. **argentii** Mambrasar, Warseno & Kuswantoro, **subsp. nov.**
Resembles *Rhododendron javanicum* (Blume) Benn. subsp. *javanicum* in its flower shape but differs in its corolla size (25 × 15 mm vs 30–50 × 70–80 mm) and pubescent ovary (vs glabrous to sparsely scaly). It is also similar to *Rhododendron javanicum* (Blume) Benn. subsp. *teysmannii* (Miq.) Argent in its flower shape and hairy ovary but differs in its stellately scaly pedicels (vs shortly patently hairy) and leaf size (30–80 × 12–35 mm vs 80–150 × 25–50 mm). It is also close to *Rhododendron javanicum* subsp. *brookeanum* in its flower shape but differs in leaf size (30–80 × 12–35 mm vs 120–250 × 35–80 mm) and corolla size (25 × 15 mm vs 50–80 × 50–80 mm). – Type: Indonesia, Bali, Eka Karya Botanic Garden, 10 x 2018, *F. Kuswantoro* 37 (holotype BO). **Figures** 2, 3.

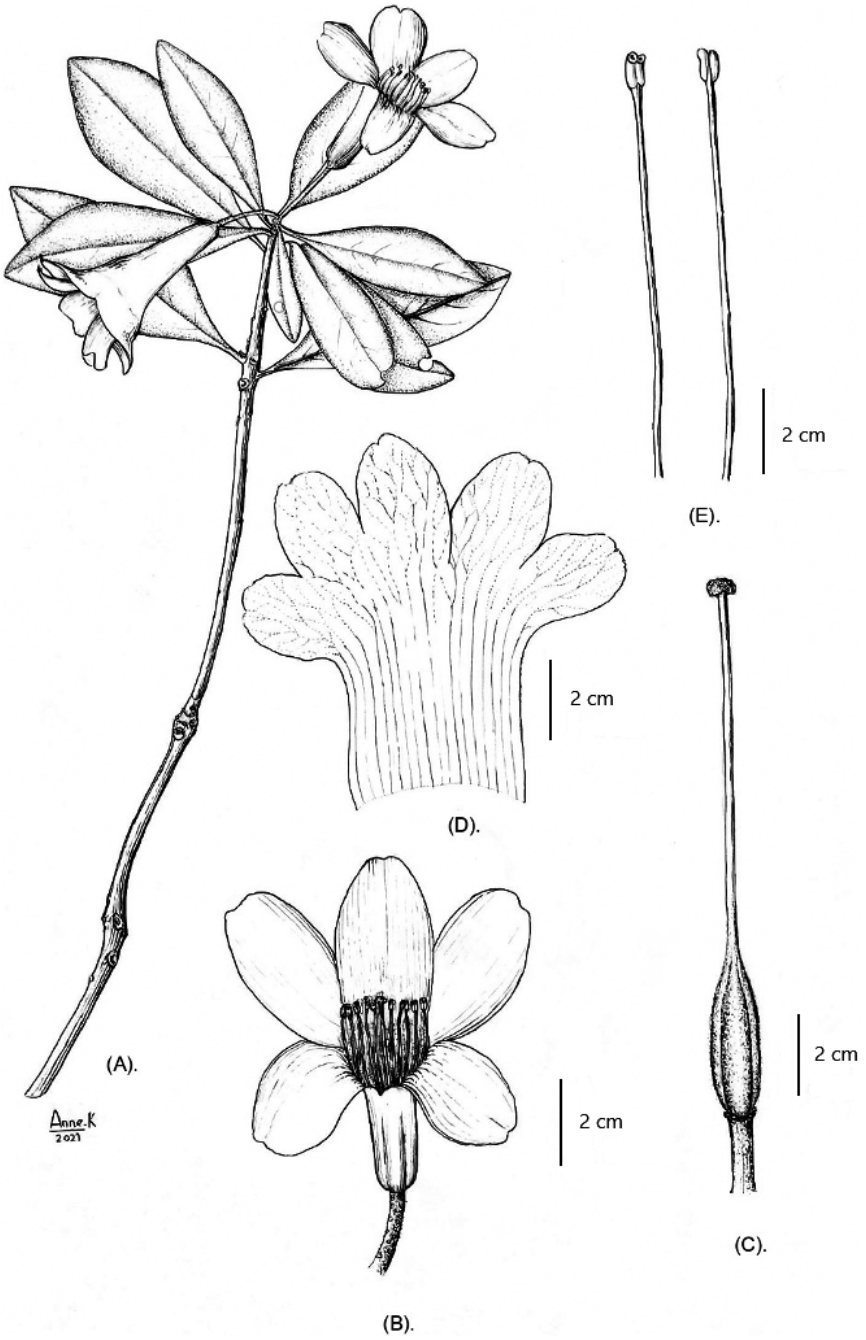

Figure 2. *Rhododendron javanicum* (Blume) Benn. subsp. *argentii* Mambrasar, Warseno & Kuswantoro, subsp. nov. A, Habit; B, flower, showing the many stamens; C, pistil; D, open corolla; E, stamens. Drawn by Anne K from the type collection, *F. Kuswantoro* 37 (BO).

Figure 3. *Rhododendron javanicum* (Blume) Benn. subsp. *argentii* Mambrasar, Warseno & Kuswantoro, subsp. nov. A, Flower; B, fruit; C, George Argent (†), after whom the subspecies is named; D, habitat. Photographs: F. Kuswantoro.

Shrub. *Twigs* laxly scaly when young, glabrescent, smooth; internodes 20–90 mm. *Leaves* 3–7 together in tight pseudowhorls, 30–80 × 12–35 mm, broadly elliptic to ovate, elliptic, apex acute, shortly acuminate or obtuse, margin entire, flat, base broadly to narrowly tapering, initially laxly scaly on both sides, early glabrescent above, laxly or more persistently scaly beneath, sometimes with short hairs above, scales small, dendroid, flat, marginal zone variously, centre brownish to dark, scattered, midvein narrowly impressed above in the proximal half of the leaf, then level with the blade surface, broadly raised beneath proximally but tapering rapidly; lateral veins 5–8 per side, spreading. *Petiole* 5–15 × 1–2 mm, without groove, scaly. *Inflorescence* an open umbel of 3–8, semi-erect to horizontal. *Flower buds* and *bracts* not seen. *Bracteoles* to 10 × 0.5 mm, linear, glabrous. *Pedicels* 20–30 × 1 mm, laxly, stellately scaly, without hair. *Calyx* 3–4 mm in diameter, glabrous. *Corolla* 25 × 15 mm, funnel-shaped, orange to red, glabrous outside, and short hair inside. *Stamens* to 30 mm long, clustered on the upper side of the mouth of the corolla; filaments 29 mm, linear, densely hairy in the proximal 1/3, glabrous distally, anthers 2 × 1 mm, oblong, curved. Disc prominent, shortly hairy on the upper margin. *Ovary* 7 × 2 mm, subcylindrical-conical, densely covered with white hair, without scales; style 20 mm, glabrous; stigma c.1.5 mm in diameter placed on the upper side of the mouth. *Fruit* 45–50 × 6–8 mm, cylindrical, 5-angled.

Distribution. Known only from Bali (Mount Patas, Mount Pala and Eka Karya Botanical Gardens, Bali) and Lombok Island (Mount Rinjani).

Habitat and ecology. Found in the granitic upper montane ecosystem at an altitude of 1200–1450 m a.s.l. It is an epiphytic species, and in Eka Karya Botanical Gardens, Bali, it grows in litter-rich trees of *Bischofia javanica* Blume, *Dacrycarpus imbricatus* (Blume) de Laub., *Glochidion rubrum* Blume, *Prunus* sp. and *Syzygium polyanthum* (Wight) Walp. (Warseno *et al.*, 2020), as well as in the tree fern *Alsophila latebrosa* Wall. ex Hook.

Etymology. The epithet honours the late G. C. G. Argent of the Royal Botanic Garden Edinburgh (RBGE) for his lifetime's work on Ericaceae, especially on the genus *Rhododendron*, and is also in recognition of his mentoring of the first author.

Proposed IUCN conservation category (Bali). Eka Karya Botanical Gardens, Bali, has more than 150 naturally occurring individuals of this species (Warseno *et al.*, 2020). No estimate of numbers of individuals or population on Mount Patas, Mount Pala or Mount Rinjani are available. Although these mountains are popular with mountaineers, there does not appear to be major impact or habitat destruction, and all areas are part of a nature reserve belonging to the Indonesian Ministry of Environment and Forestry and Eka Karya Botanic Garden, Bali. However, the areas are likely to face future challenges due to natural and anthropogenic activities such as forest fires (Undaharta & Sutomo, 2014), and floods have been reported to have happened previously. The negative impact of tourism, agriculture, and invasive alien plant species in the area has also been identified as potentially problematic (Sujarwo, 2019;

Kuswantoro *et al*., 2020). The restricted distribution, presumably small population size (fewer than 1000 mature individuals), and potential future threat suggest a provisional assessment of Vulnerable (VU) D2 (IUCN Standards and Petitions Subcommittee, 2022).

Notes. The new subspecies was initially interpreted in Sleumer (1960) as a variant of *Rhododendron javanicum* subsp. *teysmannii*, a subspecies with a hairy ovary. Two specimens from Bali, *R. Maier & Sarip* 352 and 455 (BO, L), were included as *Rhododendron javanicum* var. *teysmannii* (Sleumer 1960, 1961, 1963). Because there were no additional specimens at the time, Argent (2006, 2015) and Mambrasar *et al.* (2019) also followed Sleumer's revision. Warseno *et al.* (2002) reported a naturally epiphytic *Rhododendron* growing in Eka Karya Botanical Gardens, Bali. Because of its epiphytic habit, the plant was nearly considered a new species but was ultimately identified as *Rhododendron javanicum*. During a visit to BO in 2018, the late George Argent carried out a detailed observation of this unusual epiphytic *Rhododendron javanicum* from Bali that he thought may be a new species. Unfortunately, he passed away before his observations were finished. Our detailed observations and comparisons on additional specimens found that specimens from Bali (*F. Kuswantoro* 37, together with *R. Maier & Sarip* 352 and 455) have different characters from *Rhododendron javanicum* subsp. *teysmannii*. Therefore, these three specimens represent an undescribed new subspecies, which we describe here.

Because the two specimens from Bali (*R. Maier & Sarip* 352, 455) were excluded from *Rhododendron javanicum* subsp. *teysmannii*, the distributional range of *R. javanicum* subsp. *teysmannii* becomes limited only to Sumatra and Java, and it is absent in Bali.

Additional specimens examined. Indonesia. **Bali**: Mt Pala, 640 m a.s.l., 19 ix 1981, *R. Maier & Sarip* 352 (BO); Mt Patas, 990 m a.s.l., 20 xi 1981, *R. Maier & Sarip* 455 (BO); Mt Batukaru, Eka Karya Botanic Garden, 10 x 2018, *F. Kuswantoro* 37 (BO).

4. Rhododendron zollingeri J.J.Sm., Icon. Bogor. 4: 73, t. 322 (1910). – Type: Indonesia, Java, Besuki, Hijang [Jang] plateau, Argopuro, *Zollinger* 1684 (lectotype BO [158405]; isolectotypes BM [BM000996775], FI, L (fragment), P).

Rhododendron zollingeri J.J.Sm. var. *latifolium* J.J.Sm., Bull. Jard. Bot. Buitenzorg, ser. III, 4: 240 (1922). – Type: Indonesia, Celebes, Enrekang, Mt Sinadji, *Rachmat* (Exp. *van Vuuren*) 883 (holotype BO).

Shrub or tree to 4 m. *Twigs* slender, rounded and covered with scales when young; internodes 1.5–3 cm. *Leaves* 4–7, clustered in tight pseudowhorls but sometimes with odd leaves in other parts, 25–50 × 6–16 mm, elliptic, sometimes obovate, apex acuminate or acute, sometimes obtuse, margin flat and entire, base tapering, scales on lower leaf surface deeply lobed, densely arranged. *Petiole* 3–10 × 1–2 mm, scaly. *Flowers* 3–8, open umbel, horizontal to half hanging. *Pedicels* 15–23 mm, scaly. *Corolla* 14–15 × 9 mm, tubular, red or orange, scaly outside. *Stamens* glabrous; anthers c.1 × 1 mm, obovate. *Ovary*

30–40 × 20–25 mm, brown-scaly; style 4 mm, glabrous. *Fruit* 10–15 × 5 mm, fusiform or subcylindrical; style persistent.

Distribution. Java and Lesser Sunda Islands (Bali and Lombok), Sulawesi and Philippines. In Bali, known from both Mount Agung and Mount Batukaru.

Habitat and ecology. Montane forest, 1360–3150 m a.s.l.

Proposed IUCN conservation category (Bali). Globally assessed as Least Concern (LC) by Argent (2015). In Bali known from both Mount Batukaru and Mount Agung (area of occupancy c.12 km^2). *Rhododendron zollingeri* is under natural threat from the active volcano Mount Agung, which exploded a few years ago. It is known from only two locations, which suggests that *Rhododendron zollingeri* in Bali has a small population size. Therefore, a provisional assessment of Vulnerable (VU) D2 is suggested (IUCN Standards and Petitions Subcommittee, 2022).

Notes. Misapplied names: *Rhododendron tubiflorum* auct.non (Blume) DC.: Moritzi, Syst. Verz. 42 (1846). *Rhododendron album* auct.non Blume: Zollinger, Syst. Verz. 2: 137 (1854).

Additional specimens examined. INDONESIA. **Bali**: S. shore and summit of Mt Agoeng [Mt Agung], 7 iv 1936, *C.G.G.J. van Steenis* 7921 (BO, L); Mt Agoeng [Mt Agung], 2000–3150 m, 4 vii 1933, *Voogd de* 1941 (BO, L); Mt Batoe karoe [Mt Batukaru], 1360 m, 11 x 1918, *R. Maier & Sarip* 397 (BO, L); Mt Batukaru, North of Tabanan, 1900 m, Nengah Irawan 499 (BO).

Key to the native Rhododendron *taxa of Bali*

1a. Scales on lower leaf surface with a small centre, occasionally subdendroid or dendroid, scattered _____ 2
1b. Scales on lower leaf surface deeply lobed, densely arranged _____ 4. *R. zollingeri*

2a. Corolla ≥ 25 mm long, funnel-shaped, orange or bright red, rarely yellow _____ 3
2b. Corolla 10–12 mm long, campanulate, shape pale yellow or yellowish white 1. *R. citrinum*

3a. Ovary glabrous; scales sparse or absent _____ 2. *R. javanicum* subsp. *javanicum*
3b. Ovary densely covered with white hairs; scales absent __ 3. **R. javanicum** subsp. **argentii**

Unconfirmed Rhododendron *species from Bali*

While carrying out a literature review for *Rhododendron* in Bali, we found two unconfirmed *Rhododendron* species supposedly present in Bali, namely *R. retusum* and *R. renschianum*.

1. Rhododendron retusum (Blume) Benn.
This species was reported by Girmansyah *et al.* (2013) in an annotated checklist of Bali. However, no specimens have been found to corroborate its inclusion here. Moreover, the *Vireya*

Rhododendron revision by Sleumer (1966) and Argent (2015) mentioned that the distribution of *R. retusum* is restricted to Sumatra and Java, and does not extend to Bali Island.

2. Rhododendron renschianum Sleumer
A specimen in BO from Bali (*Nengah Irawan* 499) was identified as *Rhododendron renschianum*. Argent (2015) noted there were "unconfirmed reports of this species from Bali", but it is not clear if he had seen this specimen. Our research has identified this sterile specimen as *Rhododendron zollingeri* based on leaf and scale shape and the fact that no report of *R. renschianum* has been made in the past 10 years from flora explorations conducted across Bali.

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