Goodyera R. Br. (Orchidaceae) includes ca. 100 species that are distributed in southern Africa, Asia, northeastern Australia, Europe, Madagascar, North America, Mesoamerica, and the southwestern Pacific islands (Chen et al. 2009, Guan et al. 2014). Species of Goodyera are terrestrial, lithophytic or epiphytic and typically grow in the shade, on mossy rocks or along moist tracks of perennial mountain streams (Hu et al. 2016). Goodyera is characterized by creeping rhizomes and leaves that often have white or golden venation on the upper surface (Hu et al. 2016). The flowers of Goodyera usually have dissimilar sepals, a concave dorsal sepal connivent with the petals to form a hood over the column. The lateral sepals are usually connivent with a lip formed from the concave-saccate hypochile and sessile epichile (Guan et al. 2014). The flowers also have a single anther with sectile pollinia. The hairs within the concave-saccate hypochile of the lip clearly distinguish Goodyera from related genera (Chen et al. 2009). Within Goodyera, however, species are somewhat difficult to be distinguished, owing to ambiguous diagnostic characters and similar floral features (Shin et al. 2002, Guan et al. 2014, Hu et al. 2016, So & Lee 2017).

A New Variety of Goodyera schlechtendaliana (Orchidaceae) from Yakushima and Okinawa, Japan

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A new variety, Goodyera schlechtendaliana Rchb. f. var. yakushimensis Suetsugu & Hiros. Hayak. (Orchidaceae), from Yakushima and Okinawa, is described. It is distinguished from G. schlechtendaliana var. schlechtendaliana by a combination of morphological characters, such as straighter lateral sepals, straighter lip, sparsely hairy inside the concave-saccate hypochile, and slender leaves.

Key words: Goodyera schlechtendaliana var. yakushimensis, Orchidaceae, Ryukyu Islands

Goodyera R. Br. (Orchidaceae) includes ca. 100 species that are distributed in southern Africa, Asia, northeastern Australia, Europe, Madagascar, North America, Mesoamerica, and the southwestern Pacific islands (Chen et al. 2009, Guan et al. 2014). Species of Goodyera are terrestrial, lithophytic or epiphytic and typically grow in the shade, on mossy rocks or along moist tracks of perennial mountain streams (Hu et al. 2016). Goodyera is characterized by creeping rhizomes and leaves that often have white or golden venation on the upper surface (Hu et al. 2016). The flowers of Goodyera usually have dissimilar sepals, a concave dorsal sepal connivent with the petals to form a hood over the column. The lateral sepals are usually connivent with a lip formed from the concave-saccate hypochile and sessile epichile (Guan et al. 2014). The flowers also have a single anther with sectile pollinia. The hairs within the concave-saccate hypochile of the lip clearly distinguish Goodyera from related genera (Chen et al. 2009). Within Goodyera, however, species are somewhat difficult to be distinguished, owing to ambiguous diagnostic characters and similar floral features (Shin et al. 2002, Guan et al. 2014, Hu et al. 2016, So & Lee 2017).

We recently collected plants of Goodyera that we were unable to identify. They were growing along the banks of the Futamata River in a humid evergreen broadleaved forest dominated by Castanopsis sieboldii (Makino) Hatus. ex T. Yamaz. & Mashibwere. Morphologically they were similar to G. schlechtendaliana. Goodyera schlechtendaliana Rchb. f. was originally described based on specimens collected in Japan in 1849 (Göring s.n., holotype W, image!, locality and exact date unknown). Goodyera schlechtendaliana is widely distributed in Asia, occurring in India, China, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Vietnam, Taiwan, Indonesia, Korea, and Japan (Leou 2000, Chen et al. 2009, Pedersen 2011, Bhattacharjee & Chowdhery 2012). Considering that it is so widely distributed, G. schlechtendaliana is likely to exhibit regional differences that may warrant infraspecific recognition. To determine the identity of the plants we collected, we first sought to determine the morphological features of G. schlechtendaliana var. schlechtendaliana based on the type specimen. Consequently, we compared the unknown plants of Goodyera with the Japanese G. schlechtendaliana through extensive field surveys and herbarium in-
vestigations at KAG, KYO, MAK, TI, and TNS. The herbarium acronyms follow Index Herbariorum (Thiers 2018).

Based on our comparisons, we consider the unknown plants to represent an undescribed variety of *Goodyera schlechtendaliana*, which we name *G. schlechtendaliana* var. *yakushimensis*. We also found additional specimens of *G. schlechtendaliana* var. *yakushimensis* collected from at several localities on Yakushima and on Okinawa.

**Taxonomic treatment**

*Goodyera schlechtendaliana* Rchb. f. var. *yakushimensis* Suetsugu & Hiros. Hayak., var. nov.—Fig. 1–3.

*Goodyera schlechtendaliana* var. *yakushimensis* differs from *G. schlechtendaliana* var. *schlechtendaliana* by a combination of morphological characters. Variety *yakushimensis* has straighter lateral sepals, straighter lip, the concave-saccate hypochile sparsely hairy inside, and slender leaves [length/width ratio: (1.7–)2.3–3.2]; var. *schlechtendaliana* has recurved and slightly twisted lateral sepals, strongly recurved lip, concave-saccate hypochile densely hairy inside, and broader leaves (length/width ratio: 1.5–2.1).

**Typus.** JAPAN. Kyushu. Kagoshima Pref., Yakushima Island, along the Futamata River. 6 October 2017, K. Suetsugu KS204 (holo- KYO!, dried plant on a herbarium sheet and liquid-preserved material in a bottle, labelled as the same specimen).

**Japanese name.** Yakushima-miyama-uzura, nom. nov.

Herbs, terrestrial, 5–28 cm tall. Rhizome pale green or brownish green, rooting at nodes. Roots fleshy, yellowish brown, with minute root hairs. Stem erect, 3–15 cm long, 2.5–5 mm in diam., terete, pale green, glabrous. Leaves 3–12, alternate, widely spaced or somewhat clustered toward apex, 2.3–10.9 cm long; lamina lanceolate, 1.4–8.5 × 0.7–3 cm, length/width ratio (1.7–)2.3–3.2,
Fig. 2. Flowers of Goodyera schlechtendaliana. (A) G. schlechtendaliana var. yakushimensis at the type locality. Photographed by Kenji Suetsugu. (B) G. schlechtendaliana var. schlechtendaliana in Kitakyushu City, Fukuoka Prefecture. Photographed by Koji Tanaka. (C) G. schlechtendaliana var. schlechtendaliana in Rausu Town, Hokkaido Government. Photographed by Kazuya Arai. (D) G. schlechtendaliana var. schlechtendaliana on Kozu Island, Tokyo Metropolis. Photographed by Masayuki Ishibashi.
base rounded, margin entire, apex acute, dorsally green with white or pale greenish white network; petiole-like base and tubular sheath 0.7–2.4 cm long. Inflorescence pale green, pubescent, with 2–4 sterile bracts; rachis 3–8 cm long, subdense-

Fig. 3. Goodyera schlechtendaliana var. yakushimensis (photos of the holotype). (A) Flower, front view. (B) Flower, side view. (C) Flower, bottom view. (D) Dorsal sepal, outside view. (E) Lateral sepals, inside view (left) and lateral sepals, outside view (right). (F) Lateral petals, inside view. (G) Lip and column. (H) Lip. (I) Inside concave-saccate hypochile showing hairs only basally. (J) Column. (K) Pollinarium (left) and anther cap (right). All scale bar = 3 mm. Photographed by Masayuki Ishibashi.
siform, 8–10 mm long, pale green, pubescent. Sepals 3, free, ± submilar, white tinged with pink or pale yellow, outer surface pubescent, 1-veined; dorsal sepal narrowly elliptic-lanceolate, cymbiform, 8.5–9.5 × 2.7–3.1 mm, apex subacute, forming hood with petals; lateral sepals ovate-lanceolate to narrowly triangular, 8.7–9.6 × 3.3–3.8 mm, apex acute, spreading. Petals obliquely rhombic-oblanceolate to oblong-oblanceolate, 8.2–9.2 × 3.2–3.6 mm, apex of hood recurved, white tinged with pink or pale yellow, glabrous, 1-veined. Lip ovate-lanceolate, 8.5–9.4 × 3.4–3.7

Fig. 4. Goodyera schlechtendaliana var. schlechtendaliana collected by Masayuki Ishibashi in Kozu Island, Tokyo Metropolis on 30 August 2017 (Masayuki Ishibashi KS205, TNS). (A) Flower, front view. (B) Flower, side view. (C) Flower, bottom view. (D) Dorsal sepal, outside view. (E) Lateral sepals, inside view (left) and lateral sepals, outside view (right). (F) Lateral petals, inside view. (G) Lip and column. (H) Lip. (I) Hairs entirely covering inside of concave-saccate hypochile. (J) Column. (K) Pollinarium (left) and anther cap (right). All scale bars = 3 mm. Photographed by Masayuki Ishibashi.
mm; hypochile concave-saccate, inside base papillose; epichile ligulate, apex subacute, with 2 keels along midrib. Column 4.9–5.1 mm long; stigma orbicular, slightly protruding; rostellar arms slender, acute; anther ovoid, 2.5–2.8 mm long; pollinia clavate, ca 3.5 mm long; viscidium ellipsoid, ca. 1.2 mm long. Fruit cylindrical-fusiform, 9–12 mm long.


Distribution. JAPAN. (Kagoshima Pref., Yakushima Island and Okinawa Pref., Okinawa Island).

We discovered Goodyera schlechtendalianavar. yakushimensis along the banks of the Futamata River, in a humid evergreen broadleaved forest dominated by Castanopsis sieboldii. The population contained dozens of flowering plants of G. schlechtendalianavar. yakushimensis, but no plants of var. schlechtendaliana. Through additional field surveys and herbarium investigations we found additional plants and specimens of G. schlechtendalianavar. yakushimensis in other localities in lowland evergreen broadleaved forests on Yakushima. We also found a specimen of G. schlechtendalianavar. yakushimensis collected on Okinawa Island.

Taxonomic note. Goodyera schlechtendalianavar. yakushimensis can be distinguished from var. schlechtendaliana by the shape of the lateral sepals (nearly straight vs. recurved and slightly twisted), shape of the epichile (slightly recurved vs. strongly recurved), and distribution of hairs inside the concave-saccate hypochile (basally vs. entirely. Additionally, the leaves of var. yakushimensis tend to be more elongate (typically length/width ratio: 2.3–3.2 vs. 1.5–2.1, based on herbarium specimens, Nakajima 2012 and Yokota 2016). Despite an extensive search of herbarium specimens collected in Hokkaido, Honshu, Shikoku and Kyushu, we did not find var. yakushimensis. It should be noted that we could not positively identify some specimens in KAG, KYO, MAK, TI, and TNS because they were vegetative or the flowers were in poor condition. Extensive surveys during the flowering season are needed to elucidate the distribution of both varieties.

Our literature survey also indicated that specimens identified as G. schlechtendaliana other than from Japan may include additional undescribed infraspecific taxa. For example, from the line drawing in Chen et al. (2009), at least some specimens of G. schlechtendaliana from China have straighter lateral sepals and a straighter lip than G. schlechtendalianavar. schlechtendaliana, but the leaves and hairs of lip do not differ greatly from G. schlechtendalianavar. schlechtendaliana. Additionally, the Thai plants of G. schlechtendaliana appear to differ from G. schlechtendalianavar. schlechtendaliana in having more densely hairy green sepals and reddish orange rostellar arms, judging from the line drawing and picture in Pedersen (2011). Therefore, further detailed morphological investigations may reveal additional infraspecific taxa in G. schlechtendaliana from various Asian countries besides Japan.
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References


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