Lecanorchis japonica var. *insularis* (Orchidaceae: Vanilloideae), a new variety from Jeju Island, Korea

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ABSTRACT: A new variety, *Lecanorchis japonica* var. *insularis* (Orchidaceae: Vanilloideae), a mycoheterotrophic orchid from Jeju Island, Korea, is described and illustrated. It usually grows with *L. japonica* var. *japonica*, *L. japonica* var. *hokurikuensis* and *L. kiusiana* in evergreen forests. The newly described variety is distinguished from *L. japonica* vars. *japonica*, *hokurikuensis*, and *kiiensis* by having fully opened, larger flowers and an obtuse label-lum apex.

Keywords: morphology, *Lecanorchis*, new taxon, orchid, taxonomy

Lecanorchis Bl. (Orchidaceae; Vanilloideae; Vanilleae) consists of approximately 30 species of mycoheterotrophic orchids that are widely distributed in tropical and subtropical Southeast Asia, the Pacific islands, and in certain warm temperate regions of eastern Asia, such as China, Taiwan, Korea and Japan (Hashimoto, 1990; Dressler, 1993; Pearce and Cribb, 1999; Pridgeon et al., 2003; Suetsugu and Fukunaga, 2016; Suetsugu et al., 2018). *Lecanorchis* is characterized by having leafless stems, a calyculus (i.e., a prominent cupulate structure at the base of the perianth), an elongated, slender column adnate to the labellum at the base, and polyporate pollen (Hashimoto, 1990; Dressler, 1993; Suetsugu and Fukunaga, 2016).

Two or three species with five varieties of *Lecanorchis*, typically in broadleaved evergreen forests, are in Korea (Lee, 2011). *Lecanorchis japonica* Bl., the type species of the genus, occurs on offshore islands in southern Korea and on Jeju Island. It also occurs in southeastern China, Taiwan, and Japan. The Japanese variety, *L. japonica* var. *hokurikuensis* (Masam.) T. Hashim., has been recorded in Korea (Lee, 2011). It can be distinguished from *L. japonica* var. *japonica* by having an incision on the column wings and muricate surface of the ovary and sepals. Another variety, *L. japonica* var. *kiiensis* (Murata)

T. Hashim. (Korean name *hwang-geum-mu-yeop-ran*, 황금무엽란), previously only known from the type locality in Japan (Hashimoto, 1990), is also on Jeju. Variety *kiiensis* is distinguished by having bright yellow flowers. *Lecanorchis kiusiana* Tuyama var. *kiusiana*, characterized by an erect ovary and pedicel and labellum margins with papillae (Hashimoto, 1990; Lee, 2011) and *L. kiusiana* var. *suginoana* (Tuyama) T. Hashim., distinguished from var. *kiusiana* by having yellow hairs on the labellum, are also on Jeju. Some recent authors recognized the latter as a distinct species, *L. suginoana* (Tuyama) Seriz. (Yukawa et al., 2015).

The taxonomic difficulties associated with *Lecanorchis* stem from the mycoheterotrophic habit, lack of leaves, short flowering period and limited distribution, often resulting in underestimations of species diversity (Suetsugu et al., 2018). During our fieldwork on Korean Orchidaceae, we found an unidentifiable population of a form of *Lecanorchis* growing with *L. japonica* and *L. kiusiana* on Jeju Island. After further fieldwork and an examination of the specimens, we concluded that these plants represented a new variety of *L. japonica*. Here, we provide a description, illustration, and a comparison of the diagnostic characteristics with its close relatives.

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Fig. 1. *Lecanorchis japonica* var. *insularis* S.-W. Seo, M.-S. Jung, Y.-S. Jung & S.-H. Oh. A. Habit. B. Flower, front view. C. Fruits; one of which is dehiscent. D. Dorsal sepal, abaxial view. E. Lateral sepal. F. Petal. G. Labellum, abaxial view after flattening distal part and disconnecting column at base. H. Column. Drawn from the holotype by Sang-Hun Oh.

Materials and Methods

Morphological data were obtained from liquid-preserved specimens in FAA collected during fieldwork from 2016 to 2020 and herbarium specimens deposited in KB and TUT (acronyms according to Thiers, 2018). Measurements, colors, and shapes in regard to the descriptions of the flowers were based on the liquid-preserved collection and photographs taken during the fieldwork; characteristics of the other parts of the plants, such as the root, stem, and fruits, are from herbarium specimens. The morphology of closely related species and varieties not available in the herbaria were derived from the literature (Hashimoto, 1990; Lee, 2011). The morphological characters of the flowers of the new variety, var. *insularis*, were observed under an Optinity stereomicroscope.

Taxonomic Treatment

Lecanorchis japonica Bl. var. *insularis* S.-W. Seo, M.-S. Jung, Y.-S. Jung & S.-H. Oh, var. nov. (Fig. 1).—**TYPE:** KOREA. Jeju-do, Seogwipo-si, elev. 450 m, 22 Jun 2020, S.-W. Seo 8228 (holotype: KB!, dried specimen and liquid-preserved material in a bottle, with the same label).

Korean name: young-ju-mu-yeop-nan (영주무엽란).

Similar to *Lecanorchis japonica* vars. *hokurikuensis* and *kiiensis* but differing by fully opened, larger flowers and obtuse labellum apex; differing from *L. japonica* var. *japonica* by having fully opened, larger flowers, obtuse labellum apex, and incised column wings.

Herbs, terrestrial, 25–50 cm tall. **Roots** horizontally elongate, wavy, more than 10 cm long. **Rhizome** horizontal at base, with numerous roots, gradually ascending or erect; ascending portion 2–9 cm long, branched, without roots; sheaths ovate-lanceolate, 0.6–1.3 cm × 5–7 mm, margin ciliate, both surfaces glabrous. **Stem** erect, slender, above-ground portion unbranched, with 4–6 sheaths, light green or yellowish brown at anthesis, black and hardened when fruiting. **Sheaths**

below middle portion of stem sessile, alternate, lanceolate to oblanceolate, base clasping stem, 1.1–1.2 cm long. **Inflorescence** terminal, raceme, loosely 4- to 6-flowered; floral bracts appressed to ovary, lanceolate, 4–5 × 3–4 mm, apex acute, glabrous. **Flowers** resupinate, bisexual, fully open, horizontally facing, yellowish brown except labellum; pedicel and ovary diverging, straight, cylindrical, 1.8–4 cm long, apex with a calyculus surrounding the flower; calyculus cupulate, ca. 1 mm tall, margin irregularly denticulate; sepals 3, free, subequal, apex cymbiform, acute, both surfaces glabrous; dorsal sepal 1, oblanceolate, 1.6–1.8 cm × 3.6–3.7 mm; lateral sepals 2, oblanceolate, weakly oblique, 1.6–1.7 cm × 3.4 mm; petals oblanceolate, spreading, 1.7–1.8 cm × 3.7 mm, glabrous, apex obtuse; labellum light purple, base adnate to column to form a tube; tube ca. 5 mm long; distal free part obovate, 1–2.5 cm × 3–7 mm when spread out, weakly 3-lobed, densely pubescent with yellow villous hairs, covering 7 × 2 mm of distal part of labellum; midlobe 3–4 mm long, apex obtuse, margin irregularly erose-undulate; lateral lobes obscure, margin entire; column 11–13 mm long, with apical wings, glabrous; wings with an incision; anther cap white, flat or slightly depressed, ca. 2 mm wide, dorsally fused with column; pollinia 2; stigma obdeltoid, ca. 1 mm wide, pubescent with short hairs. **Fruit** capsules, erect, cylindrical, 3–4 cm long, 3-locular, black, shiny.

Flowering: Late May to late June.

Distribution and habitat: *Lecanorchis japonica* var. *insularis* is distributed on the south-facing slope of Hallasan Mt. on Jeju-do Island. It occurs in moist places with a litter layer in broadleaved evergreen forests dominated by *Castanopsis cuspidata* (Thunb.) Schottky and *Camellia japonica* L. (Fig. 2). Populations of *L. japonica* var. *insularis* are at several sites on Jeju-do. We estimate that there are more than 2,000 individuals. *Lecanorchis japonica* var. *insularis* co-occurs with *L. japonica* var. *japonica*, *L. japonica* var. *hokurikuensis*, and *L. kiusiana*. *Lecanorchis japonica* var. *insularis* blooms one or two weeks earlier than other varieties of *L. japonica* on Jeju-do.

Table 1. Comparison of selected morphological characters of the varieties of *Lecanorchis japonica* in Korea.

Character	<i>L. japonica</i>			
	var. <i>insularis</i>	var. <i>japonica</i>	var. <i>hokurikuensis</i>	var. <i>kiiensis</i>
Flower diameter (cm)	2.5–3.5	2.0–3.0	2.0–3.0	2.0–3.0
Flower color	Yellowish brown	Yellowish brown	Purplish brown	Bright yellow
Ovary surface	Smooth	Smooth or lightly scabrous	Strongly scabrous	Smooth
Labellum apex	Obtuse	Truncate	Truncate	Truncate
Column wing margin	Incised at apex	Smooth	Incised at apex	Incised at apex

Fig. 2. *Lecanorchis* in Korea. **A, B.** *L. japonica* var. *insularis*. **C.** *L. japonica* var. *japonica*. **D.** *L. japonica* var. *hokurikuensis*. **E.** *L. japonica* var. *kiiensis*. **F.** *L. kiusiana*. **G.** *L. suginoana*. Scale bars: A = 4 cm, B–G = 1 cm.

Etymology: The specific epithet, *insularis*, refers to the type locality of *L. japonica* var. *insularis*.

Notes: *Lecanorchis japonica* var. *insularis* is morphologically similar to *L. japonica* vars. *hokurikuensis* and

kiiensis (Fig. 2) by having an incision at the apical portion of the column wing, forming an auricle (Fig. 1H). It is a diagnostic feature that has been used to distinguish the two varieties from *L. japonica* var. *japonica* and *L. japonica* var. *tubiformis* T.

Hashim. (Hashimoto, 1990). *Lecanorchis japonica* var. *insularis* differs from other varieties of *L. japonica* by having fully opened, larger flowers and an obtuse labellum apex.

Lecanorchis japonica var. *insularis* occurs in sympatric populations of all of the Korean taxa of *Lecanorchis* except *L. suginoana*. Dependence on the fungal associates of mycoheterotrophic orchids may play an important role in the sympatry in *Lecanorchis*. The sympatric occurrence of various taxa of *Lecanorchis* suggests that the fungal associations of these species may not be species specific between *Lecanorchis* and fungi. Okayama et al. (2012) found that *L. japonica* and *L. kiusiana* have specific relationships with the fungal genus *Lactarius* and that no significant differences in fungal relationships between *L. japonica* and *L. kiusiana* due to geographic bias could be found in their survey. Further study is necessary to determine the relationships between the species of *Lecanorchis* and fungal diversity and specificity. Conservation of mycoheterotrophic orchids such as *Lecanorchis* require preservation of ecosystems where the ecological interactions among species maintain species diversity.

Conservation status: Based on our field study and examination of herbarium specimens, *L. japonica* var. *insularis* is restricted to Jejudo Island. Owing to the limited distribution, we consider its conservation status as Vulnerable (VU) according to IUCN criteria (IUCN 2019).

Additional specimens examined: Korea. Jeju-do: Seogwipo-si, Sanghyo-dong, Seondol, elev. 503 m, 23 Jun 2010, Kim 29862 (KB [3 sheets]); Seogwipo-si, elev. 450 m, 18 Sep 2020, Oh 20200918-01 (TUT).

Key to the species and variety of *Lecanorchis* in Korea

1. Plants usually more than 20 cm tall; flowers yellow, yellowish brown, or purplish brown; ovary and pedicel ascending or deflexed when flowers are open; margin of the distal portion of labellum without papillae.
2. Flowers bright yellow *L. japonica* var. *kiiensis*
2. Flowers yellowish brown or purplish brown.
3. Column wings smooth *L. japonica* var. *japonica*
3. Column wings with an incision near apex.
4. Flowers purplish brown; ovary and pedicel spreading to reclining at anthesis; labellum apex truncate *L. japonica* var. *hokurikuensis*
4. Flowers yellowish brown; ovary and pedicel diverging and straight; labellum apex obtuse
..... *L. japonica* var. *insularis*

1. Plants 10–30 cm tall; flowers yellow, whitish brown, yellowish brown, or light blue; ovary and pedicel erect when flowers are open; margin of distal portion of labellum with papillae.

5. Flowers whitish brown, yellowish brown or light blue; midlobe of labellum with purple or reddish hairs
..... *L. kiusiana*
5. Flowers yellowish brown; midlobe of labellum with yellow hairs *L. suginoana*

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Conflict of Interest

The authors declare that there are no conflicts of interest.

Literature Cited

- Dressler, R. L. 1993. Phylogeny and Classification of the Orchid Family. Dioscorides Press, Portland, OR, 312 pp.
- Hashimoto, T. 1990. A taxonomic review of the Japanese *Lecanorchis* (Orchidaceae). Annals of the Tsukuba Botanical Garden 9: 1–40.
- IUCN. 2019. Guidelines for using the IUCN red list categories and criteria, version 14. Retrieved Jul. 30, 2020, available from <https://www.iucnredlist.org/resources/redlistguidelines>.
- Lee, N. S. 2011. Illustrated Flora of Korean Orchids. Ewha Womans University Press, Seoul, 345 pp. (in Korean)
- Okayama, M., M. Yamato, T. Yagame, and K. Iwase. 2012. Mycorrhizal diversity and specificity in *Lecanorchis* (Orchidaceae). Mycorrhiza 22: 545–553.
- Pearce, N. and P. Cribb. 1999. Notes relating to the flora of Bh-

- tan: XXXVII. New species and records of Orchidaceae from Bhutan and India (Sikkim). *Edinburgh Journal of Botany* 56: 273–284.
- Pridgeon, A. M., P. J. Cribb, M. W. Chase and F. N. Rasmussen. 2003. *Genera Orchidacearum*, Vol. 3. Oxford University Press, New York, 360 pp.
- Suetsugu, K. and H. Fukunaga. 2016. *Lecanorchis tabugawaensis* (Orchidaceae, Vanilloideae), a new mycoheterotrophic plant from Yakushima Island, Japan. *PhytoKeys* 73: 125–135.
- Suetsugu, K., C. Shimaoka, H. Fukunaga and S. Sawa. 2018. The taxonomic identity of three varieties of *Lecanorchis nigricans* (Vanilleae, Vanilloideae, Orchidaceae) in Japan. *PhytoKeys* 92: 17–35.
- Thiers, B. 2018. [continuously updated] *Index Herbariorum: A Global Directory of Public Herbaria and Associated Staff*. Retrieved Jul. 30, 2020, available from <http://sweetgum.nybg.org/science/ih/>.
- Yukawa, T., H. Nakayama, M. Takano, H. Matsuoka and H. Yamashita. 2015. *The Handbook of Japanese Wild Orchids*, Vol. 1. Warm-temperate Regions. Bun-ichi, Tokyo, 135 pp. (in Japanese)