A taxonomic review of Korean *Leontopodium* R. Br. ex Cassini (Asteraceae)

Dong-Hyuk Lee^{1,2}, Jong-Su Park¹, and Byoung-Hee Choi^{1*}

¹Department of Biological Sciences, Inha University, 100, Inha-ro, Nam-gu, Incheon, Korea

²Division of Forest Biodiversity and Herbarium, Korea National Arboretum, 415, Gwangneungsumogwon-ro, Sohol-eup, Pocheon-si, Gyeonggi-do, Korea

(Received 22 April 2016; Revised 10 May 2016; Accepted 10 May 2016)

한국산 솜다리속의 분류학적 재검토

이동혁^{1,2} · 박종수¹ · 최병희^{1*}

¹인천시 남구 인하로 100 인하대학교 생명과학과

²경기도 포천시 소흘읍 광릉수목원로 415 국립수목원 산림생물표본관

ABSTRACT: Five species of the genus *Leontopodium* are recognized in Korea, but their taxonomic positions have been controversial. To clarify the taxonomic entity of these Korean species, we examined their morphological characters based on herbarium specimens and field observations. Valuable distinguishing characters for identification included the plant height, the basal shape of cauline leaves, the type and position of inflorescence, the types of hairs, the presence of leaves at the anthesis, and hairs on the phyllaries. Based on our observations, we were able to determine the taxonomic relationships between *L. japonicum* and its relatives, *L. coreanum* and *L. hallaisanense*. We also included the morphological characters of *L. seorakensis* in continuous variations of *L. leiolepis*, which we treated as synonyms. Consequently, we classified these Korean *Leontopodium* species into four taxa – *L. coreanum* var. *coreanum*, *L. coreanum* var. *hallaisanense*, *L. leiolepis*, and *L. leontopodioides* – with appropriate descriptions and illustrations.

Keywords: Korea, *Leontopodium*, var. *coreanum*, var. *hallaisanense*, *L. leiolepis*, *L. leontopodioides*

적 요: 한국산 솜다리속 (*Leontopodium* R. Br. ex Cassini)은 5종으로 기재되어 왔으나, 이들의 분류학적 위치에 대해서는 이견이 존재하였다. 이들의 분류학적 한계를 명확히 하고자 건조표본과 야외관찰등을 근거로 외부형태학적 형질을 재검토하였다. 식물체의 높이, 경생엽 기부의 형태, 화서의 위치 및 형태, 털의 형태, 개화기 잎의 유무, 총포편 털의 형태 등은 한국산 솜다리속 분류군을 식별하는데 유용한 형질로 확인되었다. 이러한 외부형태 형질을 바탕으로 왜솜다리 (*L. japonicum*) 및 근연분류군들 (*L. coreanum*, *L. hallaisanense*)의 분류학적 관계를 논의하였다. 또한 설악솜다리 (*L. seorakensis*)는 산솜다리 (*L. leiolepis*)의 형태적인 변이폭에 포함되므로, 이명으로 처리하였다. 본 연구에서 한국산 솜다리속은 솜다리, 한라솜다리, 산솜다리, 들떡쭈 (*L. leontopodioides*) 4분류군으로 정리하였으며, 한국산 분류군의 검색표 및 각 종의 형질 기재와 도해를 제시하였다.

주요어: 한반도산, 솜다리속, 솜다리, 한라솜다리, 산솜다리, 들떡쭈

Well-known as “edelweiss”, *Leontopodium* R. Br. ex Cassini (Asteraceae) is a small herbaceous genus comprising up to 41 species (Blösch et al., 2010). Its members are mostly distributed

in the mountains of eastern Asia. However, two exceptions are the European species *L. alpinum* Cass. and *L. nivale* (Ten.) Huét ex Hand.-Mazz., which are the most prominent

*Author for correspondence: bhchoi@inha.ac.kr

Open Access

<http://e-kjpt.org>. © 2016 the Korean Society of Plant Taxonomists. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

representatives of the genus. Originally, this genus was taxonomically reviewed in detail by two botanists, Beauverd (1912) and Handel-Mazzetti (1928). Notably, the monograph by the latter accepted 41 species that involved two subgenera (*Paragnaphalium* and *Euleontopodium*) and two sections (*Nobilis* and *Alpina*). Due to considerable variations and intermediate forms in morphology, however, the delimitation and phylogenetic relationships among species remain under dispute.

In Korea, five species (*L. coreanum* Nakai, *L. leontopodioides* Beauv., *L. leirolepis* Nakai, *L. japonicum* Miq., and *L. hallaisanense* Hand.-Mazz.) are currently recognized (Kim, 2007). However, this species delimitation is still arguable. In particular, the taxonomic entity of three endemic species (*L. coreanum*, *L. leirolepis*, and *L. hallaisanense*) has been questioned by some authors (c.f., Lee, 1996; Lee and Park, 2008; Lee et al., 2010; Lim et al., 2012). For example, *L. coreanum* was first recognized by Nakai (1917) from Mt. Keumgang in North Korea, and was thought to be similar to Japanese *L. japonicum* (Nakai, 1920). Subsequently, however, this endemic species was treated as a synonym of either *L. discolor* Beauv. which was restrictively distributed in northern Japan and Sakhalin (Handel-Mazzetti, 1928; Grubov, 1990) or *L. japonicum*, which is widely distributed in China and Japan (Lee and Park, 2008). The current taxonomic understanding for *L. coreanum* is still inadequate. Likewise, *L. hallaisanense* was originally described from Mt. Halla by Handel-Mazzetti (1928), but some authors have questioned the validity of this species (Lee, 1996; Lee et al., 2010). Another endemic species, *L. leirolepis*, was recognized by Nakai (1920), and known to be restricted to North Korea and Mt. Seolak in South Korea. Recently, however, Lim et al. (2012) have described plants from Mt. Seolak as a new species, *L. seorakensis* Lim, Hyun, Kim & Shin.

We might attribute these taxonomic arguments to a lack of knowledge about efficient diagnostic characteristics and considerable variations in morphology. Indeed, except for revisions by Lee et al. (1985), most previous work with Korean *Leontopodium* (e.g., Chung, 1956; Lee, 1980; Kim, 2007) since Nakai's declarations (1917, 1920) relied upon only simple descriptions of the regional flora. Although karyological and molecular studies have also been conducted for Korean *Leontopodium* (Lee et al., 2010, 2011; Jeon et al., 2015), its taxonomic treatment is still controversial.

Korean *Leontopodium* species are also listed as endangered species in the Rare Plant Data Book of Korea (Korea Forest Service, 2008), as follows: CR (Critically Endangered), *L. leirolepis* and *L. hallaisanense*; VU (Vulnerable), *L. japonicum*

and *L. leontopodioides*; or DD (Data Deficient), *L. coreanum*. Therefore, establishing suitable management strategies for such endangered plants means that their unclear taxonomic entities must first be resolved. Here, we examine the comprehensive morphological characters of Korean *Leontopodium* species and related taxa to clarify their taxonomic entity.

Materials and Methods

Samples of Korean *Leontopodium* species were collected from 2009 to 2012, and the voucher specimens were deposited in the herbarium of Inha University (IUI). To examine morphological characters, we also studied dry specimens in herbaria at the Chinese Academy of Sciences, Beijing (PE); Kangwon National University (KWNU); Korea National Arboretum (KH); Kyoto University (KYO); National Institute of Biological Resources (KB); Seoul National University, College of Natural Sciences (SNU); and Tokyo University (TI). Qualitative and quantitative morphological characters were observed with a microscope (Leica MZ8, Leica DC300 System) and Digimatic calipers (Mitutoyo). Several diagnostic characters were also illustrated.

Results and Discussion

Morphological characteristics of Korean *Leontopodium*

Stem: All four Korean *Leontopodium* taxa have both flowering and sterile stems. Whereas the flowering stems of *L. coreanum* var. *coreanum* and var. *hallaisanense* become lignified and firm over time, those of the two species within sect. *Alpina* (*L. leirolepis* and *L. leontopodioides*) remain herbaceous and flexible. Samples of *L. leontopodioides* can be distinguished from other species (acaulescent form) by their erect and fleecy form of sterile stems and lack of radical leaves. In addition, *L. leirolepis* is well-classified by the presence of glandular hairs on flowering stems (Table 1).

Cauline leaves: Except for *L. leirolepis*, the basal leaves of the flowering stems are generally withered at anthesis. In terms of the base shape of the cauline leaf, the two species in sect. *Alpina* – *L. leontopodioides* and *L. leirolepis* – are sheathed while those in sect. *Nobilis* are unsheathed, a difference that corresponds to the system of Handel-Mazzetti (1928). Thus, the shape of the leaf base might be valuable for interspecific delimitations as well as classifications of the genus, and has already been used for investigating the phylogenetic relationships of a related genus, *Anaphalis* DC. (Nie et al., 2013). On average,

Table 1. Comparison of morphological characters for selected Korean *Leontopodium* species.

		<i>L. coreanum</i> var. <i>coreanum</i>	<i>L. coreanum</i> var. <i>hallaisanense</i>	<i>L. leiolepis</i>	<i>L. leontopodioides</i>
Stem	Height (cm)	15.5–31.5	8.5–11.3	6.0–11.5	23.0–42.0
	Presence of glandular hair	densely pubescent	densely pubescent	densely pubescent with glandular trichomes	densely pubescent
	Lignification type	becoming ligneous basally	becoming ligneous basally	herbaceous	herbaceous
Leaf of flowering stem	Length (mm)	30.6–71.5	19.2–20.8	16.0–22.8	22.9–35.6
	Width (mm)	6.1–13.7	5.0–7.2	3.0–5.5	3.6–6.3
	Number	7–21	9–11	5–9	12–22
	Shape	lanceolate, narrowly oblong, oblong	elliptical, ovate, oblanceolate	spatulate, oblanceolate, lanceolate	linear-lanceolate, oblanceolate
	Apex	acute, acuminate	acute, acuminate	mucronate, rounded, acuminate	mucronate, acute
	Base	attenuate	attenuate	attenuate	attenuate, rounded
	Sheathing	no sheathing	no sheathing	sheathing	sheathing
	Fugacity of basal leaf	deciduous	deciduous	persistent	deciduous
Inflorescence	Number of heads	7–19	7–8	5–9	1–4
Bract	Length (mm)	11.3–18.9	13.5–16.3	11.3–17.3	12.3–21.4
	Width (mm)	3.3–6.6	4.9–5.0	2.7–4.3	3.2–6.4
	Shape	oblong-lanceolate, ovate	elliptical, oval, oblanceolate	spatulate, oblanceolate, lanceolate	linear, oblong
	Hair	both surfaces densely pubescent	both surfaces densely pubescent	more densely upper surface cobwebby	both surfaces densely pubescent
Phyllary	Hair	densely pubescent	densely pubescent	sparsely glandular	densely pubescent
Achene	Length (mm)	1.2–1.6	0.9–1.3	0.9–1.7	0.9–1.0
Pappus	Length (mm)	2.6–3.0	2.4–2.8	2.4–3.1	3.6–4.6
Flowering		Jul. to Aug.	Jul. to Aug.	May to Jun.	May to Jun.

the cauline leaves are longest for *L. coreanum* var. *coreanum*, followed in order by *L. leontopodioides*, *L. coreanum* var. *hallaisanense*, and *L. leiolepis*. The morphological characters for *L. coreanum* var. *coreanum*, such as the number of cauline leaves (12–21), leaf length (30.6–71.5 mm), and length of internode (9.6–25.0 mm) are distinguished from those of *L. japonicum* (number: 19–29; leaf length: 26.7–50.6 mm; length of internode: 5.8–11.6 mm) (Table 1, 2).

Capitula: The capitula of *L. leontopodioides*, dioecious and rarely heterogamous, are generally positioned at the top or in the axilla of flowering stems, with one to four heads. The other species feature densely or loosely solitary corymbose heads on the top of the flowering stems. The capitulum is approximately twice as large for *L. leontopodioides* than for the others (Table 1).

Phyllaries: The abaxial surfaces of phyllaries are densely pubescent for most Korean *Leontopodium* species, the exception being *L. leiolepis*, which has glabrous but sparsely

glandular hairs. This characteristic of glandular hairs on flowering stems clearly separates *L. leiolepis* from the other Korean *Leontopodium* species. Lim et al. (2012) have described plants collected from Mt. Seolak as a new species - *L. seorakensis* Lim, Hyun, Kim & Shin - that is distinct from *L. leiolepis* based on the sparsely glandular outer phyllaries that are of similar size and shape in other species. However, we found no significant difference among them in this review (Table 1).

Ovary: The Korean *Leontopodium* species, including *L. coreanum*, have hairs on the ovaries of both the disk and marginal florets, although the density of those hairs differs somewhat among species. For *L. coreanum*, we found that the ovaries of the disk florets have hairs during fruiting periods, whereas the surface of ovary is looks like glabrous initially, and is distinguished from glabrous ones of *L. japonicum* (Table 2).

Table 2. Comparison of morphological characters for *L. coreanum* and its relatives species.

	<i>L. coreanum</i> (type locality)	Populations of South Korea	<i>L. japonicum</i> (China & Japan)
Number of cauline leaves	7–16	7–21	19–29
Length of cauline leaves (mm)	32.7–55.4	30.6–71.5	26.7–50.6
Width of cauline leaves (mm)	8.7–13.6	6.1–13.7	7.2–11.3
Length of internode (mm)	11.4–19.8	9.6–25.0	5.8–11.6
Hairs on ovary of disk florets	thinly pubescent at fruiting period	thinly pubescent at fruiting period	glabrous
Base of pappus	basally connate to ring	basally connate to ring	basally connate to ring
Chromosome number	-	2n = 28	2n = 26

Taxonomic treatment

Leontopodium R. Br. ex Cassini, Bull. Sci. Soc. Philom. Paris. 144, 1819. Type. *L. alpinum* Cass.

Korean name: 솜다리속 Som-da-ri-sok

Perennial herbs. Stem pubescent, rarely glandular. Leaves alternate, sessile, tomentose to villose or cobwebby hair; margin entire. Capitula heterogamous, rarely dioecious, disciform, in dense or loose terminal corymbs. Bracteal leaves similar with upper cauline leaves, white to grayish or yellowish tomentose. Phyllaries usually 3-seriate, papery, monomorphic, brownish, transparent. Marginal florets yellow, pistillate, filiform, outnumbering the disk florets. Disk florets functionally male; corolla yellow, 5-lobes erect, sparsely glandular in apex of the lobes. Anthers ecalcarate, with short tails. Pollen gnaphalioid. Style bifid; style-branches truncate with densely hirsute stigmatic surface separated. Achenes glabrous to papillose or pubescent. Pappus basally connate to ring, barbellate, capillary bristles.

A key to the Korean species of *Leontopodium*

1. Lower part of flowering stems becoming ligneous; cauline leaves not sheathing basally; usually flowering July to August **1. *L. coreanum***
1. Lower part of flowering stems herbaceous; cauline leaves sheathing basally; usually flowering May to June
 2. Plant height usually 6.0–11.5 cm; flowering stem covered with glandular and cobwebby hairs; basal leaves of flowering stem were persisted at anthesis; outer phyllaries abaxially glabrous with sparsely glandular; pappus 2.4–3.1 mm long **2. *L. leirolepis***
 2. Plant height 23–42 cm; flowering stem covered with cobwebby hairs; basal leaves of flowering stem were generally withered at anthesis; outer phyllaries abaxially densely pubescent; pappus 3.6–4.6 mm long **3. *L. leontopodioides***

Fig. 1. Lectotype of *Leontopodium coreanum* Nakai (T. Nakai 5915, TI).

1. *Leontopodium coreanum* Nakai, Bot. Mag. Tokyo 31: 109. 1917. Type. Korea, Gangwon-do, Daejangbong, Aug. 22, 1916, *T. Nakai* 5915 (Lectotype, designated here, TI!, see Fig. 1). Remaining syntypes. Korea, Gangwon-do, Manggundae, Aug. 9, 1918, *T. Nakai* 5914 (TI); Korea, Gangwon-do, Birobong, Aug. 16, 1916, *T. Nakai* 5916 (TI!)

A key to the varieties of *L. coreanum*

1. Plant height 15.5–31.5 cm; cauline leaves of middle part 30.6–71.5 mm long, lanceolate, narrowly oblong, oblong;

densely or loosely corymbose heads; bracteal leaves oblong-lanceolate, ovate **var. *coreanum***

1. Plant height 8.5–11.3 cm; cauline leaves of middle part ca. 2 cm long, elliptical, ovate, oblanceolate; densely corymbose heads; bracteal leaves elliptical, oval, oblanceolate **var. *hallaisanense***

Var. *coreanum*

Korean name: 솜다리 Som-da-ri

Perennial herbs. Rhizome prostrate, branching, with flowering and sterile stems. Stems erect, 15.5–31.5 cm tall, internodes 9.6–25.0 mm, lower half somewhat becoming woody, pubescent. Leaves alternate, 7–21, 30.6–71.5 mm long, 6.1–13.7 mm wide, upper surface of leaves green and thinly tomentose, lower surface of leaves whitish tomentose, lanceolate, narrowly oblong, oblong, margin entire, apex acute to acuminate, base abruptly narrowed, sessile, basal leaves deciduous at flowering periods. Inflorescence solitary or

Fig. 2. Illustrations of *Leontopodium coreanum* Nakai. **A.** Habit; **B.** Capitulum; **C.** Marginal floret; **D.** Disk floret; **E.** Style of disk floret; **F.** Style of marginal floret.

branched on flowering stems. Heads 7–19, arranged in compact or sparse terminal corymbs. Bracteal leaves 11.3–18.9 mm length, 3.3–6.6 mm wide, usually smaller than cauline leaves, oblong-lanceolate, ovate, both surfaces densely pubescent. Involucre subglobose, 4–5 mm high, 3.0–4.8 mm across; phyllaries 3-seriate, acute, margin brownish scarious, densely hairy dorsally. Marginal florets female, capillary, 5-lobed with ciliolate; stigma bifid, densely hirsute; ovary densely papillose. Disk florets bisexual, corolla subtubular, 5-lobed, yellowish, sterile; stigma densely hirsute; ovary thinly hirsute apex; anther basal sagittae. Achenes 1.2–1.6 mm long, papillose. Pappus of capillary bristle, 2.6–3.0 mm length. Flowering July–August. Fruit August–September (Fig. 2).

Distribution: Endemic to Korea. Gangwon-do, Gyeonggi-do, Chungcheongbuk-do, Gyeongsangbuk-do. Growing on alpine meadow or forest on northward from central Korea.

Taxonomic note: The taxonomic entity of *Leontopodium coreanum* Nakai has long been confused with its congener *L. japonicum*, which is widely distributed in East Asia. Plants of *L. coreanum* were first recognized by Nakai (1917) as endemic to Mt. Keumgang of Gangwon-do. Subsequently, Nakai (1920) described its morphology as very similar to Japanese *L. japonicum*, being distinguished by its leaf shape, minute amount of hairs on the ovaries of disk florets, and a liberal base for the pappus, when compared with plants of Japanese *L. japonicum*. Nevertheless, those two taxa have not been previously distinguished definitively due to subtle morphological differences, and the taxonomic entity of plants in South Korea also remains unclear – whether *L. coreanum* or *L. japonicum*. Accordingly, those two taxa have been recorded together in most regional floras of Korea (e.g., Lee, 1980; Lee, 1996; Kim, 2007), whereas a previous monograph by Handel-Mazzetti (1928), as well as floras for China (Chen et al., 2011) and Japan (Koyama, 1995) restricted the distribution of *L. japonicum* to those two countries.

In this study, our morphological comparisons suggested that the plants of South Korea are closely related to *L. coreanum*, and should be treated as an independent species rather than conspecific with *L. japonicum* of China and Japan, based on its diagnostic characters (Table 2). Although the character for the liberal base of the pappus, generally observed in other genera (e.g., *Anaphalis* DC. and *Pseudognaphalium* Kirp.), is not adequate for species of *Leontopodium*, the other morphological characters for populations in South Korea are similar to those of the type locality, Mt. Keumgang. In particular, the character for hairs on the ovaries of disk florets distinguishes plants of South Korea as well as *L. coreanum* from *L. japonicum* (Table 2). In contrast to a previous proposal by Lee and Park (2008), which treated *L. coreanum* as a

synonym of *L. japonicum* based on the glabrous achenes in both taxa, we determined that *L. coreanum*, which has hairs on the ovaries of the disk florets during fruiting, is distinct from the glabrous samples of *L. japonicum* that we examined here. Furthermore, the taxonomic boundary of *L. coreanum* is clearly supported by our previous cytological study (Korea: $2n = 28$; Japan: $2n = 26$; Lee et al., 2010) and by molecular data for genetic divergence (China and Japan: 0.471, Korea and China: 0.742, Korea and Japan: 0.846, unpubl. data), thereby implying differentiation of the Korean populations. Based on this evidence, we suggest that *L. coreanum*, closely related to *L. japonicum*, is in the process of differentiation (e.g., allopatric speciation due to oceanic barriers), and must be accepted as an independent species in accordance with a treatment by Nakai (1917). However, when considering the regional morphological variations (China: var. *saxatile*, var. *microcephalum*; Japan: var. *pernivium*, var. *shiroumense*, var. *spatulatum*) as well as the wide distributional ranges of *L. japonicum*, further details, e.g., molecular and micro-morphological data for their phylogenetic relationships, are

Fig. 3. Lectotype of *Leontopodium coreanum* var. *hallaisanense* (Hand.-Mazz.) D.H. Lee & B.H. Choi (U. Faurie 1964, E).

needed. Although Handel-Mazzetti (1928) treated *L. coreanum* as a synonym of *L. discolor*, without discussion, several characteristics of the former, including its oblanceolate cauline leaves and glabrous achenes, provide sufficient distinction from *L. discolor* (linear-ovate cauline leaves and pubescent achenes), as found in our morphological examination. For now, we are making provisional decisions about those South Korean plants as belonging to *L. coreanum*, due to their similarities in diagnostic characters. In the protologue, Nakai (1917) indicated

three original materials. We identified two of the original materials at TI, and selected one (*T. Nakai 5915*) having complete information in accordance with the protologue as lectotype (ICN Art. 9.2, 9.5, 9.12, McNeill et al., 2012).

Var. *hallaisanense* (Hand.-Mazz.) D.H. Lee & B.H. Choi, **comb. stat. nov.**

Leontopodium hallaisanense Hand.-Mazz. Beih. Bot. Centralbl. 44: 72. 1928. Type. Korea, Jeju Isl. Aug. 1907, U.

Fig. 4. Illustrations of *Leontopodium coreanum* var. *hallaisanense* (Hand.-Mazz.) D.H. Lee & B.H. Choi. **A.** Habit; **B.** Marginal floret; **C.** Disk floret; **D.** Style of disk floret; **E.** Style of marginal floret.

Faurie 1964 (Lectotype, designated here, E, see Fig. 3). Remaining syntype. Korea, Jeju Isl. Aug. 1907, *U. Faurie* 1967 (LE, seen as photo!; G, seen as photo!).

Korean name: 한라솜다리 Hal-la-som-da-ri

Stems erect, 8.5–11.3 cm tall, pubescent, in lower part often somewhat ligneous. Leaves alternate, 9–11, 19.2–20.8 mm long, 5.0–7.2 mm wide, elliptical to ovate, oblanceolate. Inflorescence usually solitary on flowering stems. Heads 7–8, arranged in compact terminal corymbs. Bracteal leaves 13.5–16.3 mm length, 5 mm wide, elliptical, oval, oblanceolate. Involucre subglobose, 5.0–5.5 mm high, 4.5–5.5 mm across (Fig. 4).

Distribution: Endemic to Korea. Growing on summit of Mt. Halla on Jeju Isl.

Taxonomic note: Var. *hallaisanense* is currently restricted to the upper part of Mt. Halla, where only a few individuals ($n < 30$) occur. These plants were originally described by Handel-Mazzetti (1928) as being an independent species that differed from *L. japonicum* based on plant height and shape of the bracts (Fig. 3). However, those characters are commonly found for *Leontopodium* (Ling, 1965), and some authors have questioned the validity of having a separate species (Lee, 1996; Lee et al., 2010). Indeed, such diagnostic characteristics have also been reported for several specimens from inland populations of *L. coreanum*, even though such types are rarely identified. Thus, it might not be sufficient to recognize it as an independent species. Although the number of examined specimens for *L. hallaisanense* has been limited, the results of our molecular analysis (Lee et al., unpubl. data) demonstrated that *L. hallaisanense* was nested within *L. coreanum*. Therefore, we suggest that var. *hallaisanense* be considered an ‘insular form’ of *L. coreanum*, differentiated by diagnostic characteristics as key, and should be treated as a variety of that species. Furthermore, previous reports of the distribution of *Leontopodium* species at Mt. Halla [*L. japonicum*: upper area of Mt. Halla (Nakai, 1913); *L. coreanum*: 1800–2100 m (Nakai, 1920)] may have led to a misidentification of var. *hallaisanense*. Therefore, further ecological and molecular analyses with more individuals are necessary if we are to develop a conservation strategy for the few plants ($n < 30$) that remain at the peak of Mt. Halla.

2. *Leontopodium leirolepis* Nakai in Matsumura, Icon. Pl. Koisikav. 4: 75. 1920. Type. Korea, Hamgyeongnam-do, Waigalbong, 2,200 m, Jul. 11, 1914, *T. Nakai* 1542 (Holotype, TI!, see Fig. 5).

Leontopodium seorakensis Lim, Hyun, Kim & Shin, Korean J. Pl. Taxon. 42: 157. 2012. **Syn. nov.** Type. Korea,

Fig. 5. Holotype of *Leontopodium leirolepis* Nakai (*T. Nakai* 1542, TI).

Kangwon-do, Inje-gun, near the peak of Mt. Ahn (1,396 m) area in Mt. Seolak National Park, 1,360 m elev., N 38°08'10.2", E 128°20'4.2", 30 Jun. 2007, *Hyun* 20070004 (Holotype, KB; Isotype, SNU).

Korean name: 산솜다리 San-som-da-ri

Perennial herbs. Rhizome prostrate, branching, with flowering and sterile stems. Stems erect, 6.0–11.5 cm tall, woolly hair and glandular. Leaves alternate, 5–9, 16.0–22.8 mm long, 3.0–5.5 mm wide, upper surface of leaves thinly tomentose, lower surface of leaves whitish arachnoid and glandular, both sides becoming sometimes calvescent, spatulate, linear or oblanceolate, margin entire, apex mucronate, base attenuate, sheathing stems, radical and basal cauline leaves present at flowering periods. Inflorescence solitary on flowering stems. Heads 5–9, densely arranged. Bracteal leaves 11.3–17.3 mm length, 2.7–4.3 mm wide, more or less smaller than cauline leaves, linear or oblanceolate, upper surface densely floccose, lower surface thinly arachnoid. Involucre subglobose, 5.0–5.5 mm high, 3.5–4.5 mm across; phyllaries 3-seriate, 3.0–4.3 mm long, 1.1–1.4 mm wide, acute,

margin brown to reddish brown scarious, glabrous, sparsely glandular. Marginal florets female, corolla capillary, 4-lobed with sparsely ciliolate; style cylindrical; stigma bifid, densely hirsute; ovary densely papillose. Disk florets bisexual, corolla subtubular, 5-lobed, yellowish, sterile; style cylindrical; stigma clavellate, densely hirsute; ovary pubescent; stamens 5; anther basal sagittate. Achenes 0.9–1.7 mm long, papillose. Pappus of capillary bristles, 2.4–3.1 mm length. Flowering May–June. Fruit July–August (Fig. 6).

Distribution: Endemic to Korea. Hamgyeongbuk-do, Hamgyeongnam-do, Pyeonganbuk-do, Gangwon-do. Rock crevice on high mountains of northern and central Korea.

Taxonomic note: *L. leiolepis* was identified by Nakai (1920) from samples collected at Waigalbon (2,200 m) in North Korea, and was considered an endemic species distributed northward from Mt. Seolak in South Korea. Recently, however, Lim et al. (2012) have described plants from Mt. Seolak as a new species, *L. seorakensis* Lim, Hyun, Kim & Shin, separate from

Fig. 6. Illustrations of *Leontopodium leiolepis* Nakai. A. Habit; B. Capitulum; C. Marginal floret; D. Disk floret; E. Style of marginal floret; F. Style of disk floret; G. Stamen of disk floret.

L. leiolepis. In their protologue, they suggest that *L. seorakensis* is distinguished from the latter by morphological characters such as densely arachnoid hairs on the lower surface of bracteal leaves as well as sparsely glandular outer phyllaries that are of similar size and shape as the former. However, those diagnostic characteristics were already described and illustrated in the declaration for *L. leiolepis* by Nakai (1920) as “supra floccose infra aranea” and “deorso parvissime glandulosociliata”. Indeed, specimens for *L. leiolepis*, including type materials, have almost glabrous and sparsely glandular hairs on the outer phyllaries that are easily distinguished from other *Leontopodium* species. Our morphological comparison between specimens from the type locality of *L. seorakensis* [locotype: Mt. Ahn, Jun. 12, 2009, D.H. Lee & W.B. Cho 96015, 96018, 96019 (IUI!); D.H. Lee & W.B. Cho 96017, 96020 (KH!)] and those of *L. leiolepis*, including the type specimen, also indicate no clear morphological discontinuities between the two species, but further support the merging of them (Table 3). Although several specimens collected in North Korea actually exhibited somewhat glabrous bracteal leaves, such variations as density of hairs on those leaves are relatively easily recognized within the genus as intraspecific variations (Ling, 1965). Moreover, the plant materials in both the type specimen of *L. leiolepis* (Fig. 5) and the type locality of *L. seorakensis* have almost glabrous and arachnoid bracteal leaves. In fact, the glabrous bracts are mostly observed in plants during fruiting periods, and we assume that this variation in density might be influenced by the time when they were collected (i.e., flowering: arachnoid; fruiting: thinly arachnoid to almost glabrous). Another morphological character for *L. seorakensis* is also ambiguous. Lim et al. (2012) have stated that the length and shape of the outer and inner phyllaries are similar in *L. seorakensis*, but no exact quantitative values exist. In contrast, our examinations indicated that this species also has slightly narrow and longer inner phyllaries when compared with the outer ones, and the ratio of lengths between inner and outer phyllaries for *L. seorakensis* (1.06–1.28 mm) does not differ much from that for *L. leiolepis* (1.14–1.36 mm; Table 3). Hence, we assume that the above diagnostic characters for *L.*

seorakensis are not sufficient to describe it as a new species that is separate from *L. leiolepis*, despite their subtle differences. Rather, we might infer that those differences are just included in the intraspecific variations of *L. leiolepis* (Fig. 5) and, thus, we deduce here that *L. seorakensis* is a synonym of *L. leiolepis*.

Meanwhile, *L. leiolepis* has been classified within the subsection *Kurilensia* Hand.-Mazz., having glandular hairs on the stems that are similar to those of *L. kurilense* Takeda, which

Fig. 7. Holotype of *Leontopodium leontopodioides* (Willd.) Beauverd (*Willdenow s.n.*, BM).

Table 3. Comparison of morphological characters between *L. leiolepis* and *L. seorakensis*.

	<i>L. leiolepis</i>	<i>L. seorakensis</i>
Shapes of cauline leaves	spatulate, linear or oblanceolate	spatulate, oblanceolate
Ratio of lengths between inner and outer phyllaries	1.14–1.36	1.06–1.28
Hairs on lower surface of bract	thinly arachnoid	thinly arachnoid
Hairs on outer phyllaries	sparsely glandular	sparsely glandular

is endemic to Japan (Handel-Mazzetti, 1928). Furthermore, several varieties (i.e., var. *curvicolium* and var. *crinulosum*) have been proposed for populations in North Korea (Im, 1999). However, its distribution and taxonomic relationships had not previously been evaluated. In addition, the isolated habitats of Mt. Seolak represent the South limit of its distribution range. Therefore, further molecular and population analyses are necessary if we are to gain broad knowledge about the phylogenetic relationships and conservation of this species.

3. *Leontopodium leontopodioides* (Willdenow) Beauverd in Bull. Soc. Bot. Geneve, Ser. 2, 1: 371. 1909. Type. Russia, Siberia, s.d. *Willdenow* s.n. (Holotype, BM, seen as photo!, Fig. 7)

Filago leontopodioides Willdenow, Phytogr. 12. 1794. *Gnaphalium leontopodioides* (Willdenow) Willdenow, Sp. Pl. 3: 1893. 1804. *Antennaria leontopodioides* (Willdenow) Nakai in Bull. Nat. Sci. Mus. Tokyo 31: 112. 1952.

Korean name: 들떡쭈 Deul-tteok-ssuk

Fig. 8. Illustrations of *Leontopodium leontopodioides* (Willd.) Beauverd. **A.** Habit; **B.** Capitulum; **C.** Marginal floret; **D.** Disk floret; **E.** Style of marginal floret; **F.** Style of disk floret; **G.** Stamen of disk floret.

Perennial herbs. Rhizome short, lignose, multicapital, with flowering and sterile stems, not radical leaves. Stems slender or erect, somewhat flexuous, 23–42 cm tall, covered with woolly hair, then becoming peeled. Leaves sparsely alternate, 12–22, similar in size and shape, 22.9–35.6 mm long, 3.6–6.3 mm wide, linear to lanceolate, apex rounded to mucronate, margin entire, base gradually narrowed, half-sheathing stem, upper surface greenish and thinly pubescent, lower surface densely pubescent. Inflorescence depauperate, top or axilla on flowering stems. Heads 1–4, dioecious. Bracteal leaves 1–4 per heads, smaller than cauline leaves, 12.3–21.4 mm long, 3.2–6.4 mm wide, linear to lanceolate, inner phyllaries more narrowed, colorless or brownish scarious, densely hairy dorsally. Achenes 0.9–1.0 mm length. Pappus uniseriate, 3.6–4.6 mm long, grayish white. Flowering May–June. Fruit July–August (Fig. 8).

Distribution: China, Korea, Mongolia, Russia.

Korea: Hamgyeongnam-do, Chungcheongbuk-do, Gyeong-sangbuk-do, Gyeongsangnam-do. Sunny grassland on central Korea.

Taxonomic note: This species was first recorded as *Filago leontopodioides* Willdenow from Siberia before being transferred to the genus *Leontopodium*, i.e., *L. leontopodioides* (Willdenow) Beauverd. This treatment is now broadly accepted for plants in their distribution range of China, Mongolia, Russia, and Korea (Grubov, 1990; Kim, 2007; Chen et al., 2011). A Korean distribution was first recorded in Seoul by Palibin (1898) and assigned the name *Gnaphalium leontopodioides*. It has been also collected from Chinampo in the northern region of Korea (Beauverd, 1912; Handel-Mazzetti, 1928). Compared with other species in that genus, *L. leontopodioides* grows at relatively lower elevations (300–700 m) and has a wider distribution range. This taxon, being dioecious, is well-distinguished by inflorescences positioned at the top or axillary to the flowering stems. It lacks a pedicel and pappus and its flower heads are 1.5 times longer than those of other *Leontopodium* species.

Acknowledgments

The authors express our sincere thanks to curators of the following herbaria for assisting in our examination of the specimens used in this study: KB, KH, KGNU, KYO, PE, SNU, and TI. We are also grateful to our colleagues W.B. Cho, I.S. Choi, and D.P. Jin at the Plant Systematics Laboratory of Inha University for help in collecting the plant materials and making comments on this manuscript.

Literature Cited

- Beauverd, G. 1912. Contribution à l'étude des Composées. Suite VI. Nouveaux *Leontopodium* et *Raoulia*. Bulletin de la Société botanique de Genève 5: 12–55. (in French)
- Blösch, C., W. B. Dickoré, R. Samuel and T. F. Stuessy. 2010. Molecular phylogeny of the edelweiss (*Leontopodium*, Asteraceae: Gnaphalieae). Edinburgh Journal of Botany 67: 235–264.
- Chen, Y. S., S. X. Zhu and R. A. Bayer. 2011. Gnaphalieae. In Flora of China Vol. 20–21 (Asteraceae). Wu, X.Y., P.H. Raven and D.Y. Hong (eds.), Science Press (Beijing) & Missouri Botanical Garden Press (St. Louis). Pp. 774–818.
- Chung, T. H. 1956. Korean Flora. Sinjisa, Seoul. Pp. 712–713. (in Korean)
- Grubov, V. I. 1990. *Leontopodium* R. Br. ex Cass. In Flora of the U.S.S.R. Vol. 25. Shishkin B.K. (ed.), Koeltz Scientific Books, Dehra Dun. Pp. 367–387.
- Handel-Mazzetti, H. 1928. Systematische monographie der gattung *Leontopodium*. Beihefte zum Botanischen Centralblatt 44: 1–178. (in German)
- Im, R. J. 1999. Flora of Coreana 7. Science and Technology Publishing House, Pyongyang. Pp. 250–253. (in Korean)
- Jeon, M. G., K. J. Choi and J. Y. Kim. 2015. Discrimination of the genus *Leontopodium* species (Gentianales: Asteraceae) based on RAPD. Journal of Forest and Environmental Science 31: 68–71.
- Kim, K. J. 2007. *Leontopodium*. In The Genera of Vascular Plants of Korea. Park, C.-W. (ed.), Academy Publishing Co., Seoul. Pp. 1003–1005.
- Korea Forest Service. 2008. Rare Plants Data Book in Korea. Korea National Arboretum. Pocheon. (in Korean)
- Koyama, H. 1995. *Leontopodium*. In Flora of Japan Vol. IIIb. Iwatsuki, K., T. Yamazaki, D. E. Boufford and H. Ohba (eds.), KodanSha, Tokyo. Pp. 106–108.
- Lee, C. and K. W. Park. 2008. Taxonomic reconsideration of the *Leontopodium coreanum* Nakai (Asteraceae). P. 196 (Abstract in Botany 2008).
- Lee, D. H., G. Y. Chung and B. H. Choi. 2010. Chromosome number of four Korean species of *Leontopodium* (Asteraceae). Korean Journal of Plant Taxonomy 40: 153–156. (in Korean)
- Lee, D. H., J. H. Lee and B. H. Choi. 2011. Isolation and characterization of 10 microsatellite loci from Korean *Leontopodium japonicum* (Asteraceae). American Journal of Botany 98: e183–e184.
- Lee, K. E., W. C. Lee and C. H. Lim. 1985. Studies on certain growing aspects of wild genus *Leontopodium* distributed in Korea. Korean Journal of Horticultural Science and Technology 26: 59–65. (in Korean)

- Lee, T. B. 1980. Illustrated Flora of Korea. Hyangmunsa, Seoul. Pp. 727–728. (in Korean)
- Lee, W. T. 1996. Lineamenta Florae Koreae. Academy Publishing Co., Seoul. Pp. 1169–1171. (in Korean)
- Lim, Y. S., J. -O. Hyun, Y. -D. Kim and H. C. Shin. 2012. *Leontopodium seorakensis*, a new species of Asteraceae from Korea. Korean Journal of Plant Taxonomy 42: 157–160.
- Ling, Y. 1965. Notulae de nonnullis generibus tribus Inulearum familiae Compositarum florum Sinicae. Acta Phytotaxonomica Sinica 10: 167–181. (in Chinese)
- McNeill, J., F. R. Barrie, W. R. Buck, V. Demoulin, W. Greuter, D. L. Hawksworth, P. S. Herendeen, S. Knapp, K. Marhold, J. Prado, W. F. Prud'homme van Reine, G. F. Smith, J. H. Wiersema and N. J. Turland. 2012. International Code of Nomenclature for Algae, Fungi, and Plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress, Melbourne, Australia, 2011. Regnum Vegetabile Vol. 154. Koeltz Scientific Books, Knigstein.
- Nakai, T. 1913. Flora of Quelpart and Wangto Island. Government General of Chosen, Seoul. (in Japanese)
- Nakai, T. 1917. Notulae ad plantas Japoniae et Koreae. XIV. Botanical Magazine (Tokyo) 31: 97–11.
- Nakai, T. 1920. Icones Plantarum Koisikavenses or Figures with Brief Descriptive Characters of New and Rare Plants, Selected from the University Herbarium 4: 72–76. (in Japanese)
- Nie, Z. L., V. Funk, H. Sun, T. Deng, Y. Meng, J. Wen. 2013. Molecular phylogeny of *Anaphalis* (Asteraceae, Gnaphalieae) with biogeographic implications in the Northern Hemisphere. Journal of Plant Research 126: 17–32.
- Palibin, J. 1898. Conspectus Florae Koreae 1. Acta Horti Petropolitani 17: 1–5135.

Appendix. Specimens examined for Korean *Leontopodium* species and its relatives.

***Leontopodium coreanum* Nakai var. *coreanum* KOREA.** Gyeonggi-do: Gapyeong-gun, Mt. Unak, 17 Aug. 2009, *D.H. Lee* 98001 – 98004 (IUI); Gapyeong-gun, Mt. Unak, 6 Sept. 1992, *J.H. Mun* 389, 390 (SNU); Gangwon-do: Mt. Keumgang, Birobong, 30 Jul. 1928, *K. Kondo* 9384 (PE); Mt. Keumgang, 13 Aug. 1932, *S. Kitamura* s.n. (KYO); Mt. Keumgang, 27 Jul. 1933, *B.S. Toh & H.J. Sim* 14269 (SNU); Mt. Keumgang, 11 Aug. 1943, *B.S. Toh* 14264, 14268 (SNU); Mt. Keumgang, 5 Aug. 1932, ? 14270 (SNU); Gosung-gun, Mt. Hyangro-bong, 29 Aug. 1990, ? (IUI); Gosung-gun, Mt. Hyangro-bong, 1 Aug. 2008, *J.O. Hyun & H.J. Kwon* NAPI-0337 (KH); Inje-gun, Mt. Seolak, 25 Aug. 2009, *D.H. Lee & W.B. Cho* 98301 – 98316 (IUI); Inje-gun, Mt. Seolak, 24 Oct. 2004, *J.O. Hyun & H.K. Park* 2004192 (KH); Inje-gun, Mt. Seolak, 15 Jul. 2005, *E.S. Jeon* ESJeon52257; Hongcheon-gun, Mt. Gachil, 23 Jul. 1999, *G.Y. Chung et al.* ANH990723-001; Pyeongchang-gun, Mt. Gariwang, 2 Jul. 2010, *J.Y. Lee & J.H. Lee* 107901 – 107914 (IUI); Wonju-si, Mt. Chiak, Sept. 1973, *B.S. Toh & H.J. Sim* 47992 (SNU); Chungcheongbuk-do: Danyang-gun, Mt. Sobaek, 22 Jul. 2009, *D.H. Lee & W.B. Cho* 97201 – 97210 (IUI); Danyang-gun, Mt. Sobaek, 6 Aug. 1999, *C.W. Park, H.W. Lee & J. Koh* 10679 (SNU); Danyang-gun, Mt. Sobaek, 17 Jul. 1999, *C.W. Park, H.W. Lee & J. Koh* 10619 (SNU); Danyang-gun, Mt. Sobaek, 18 Aug. 2001, *E.S. Jeon, S.H. Park & S.G. Gwon* s.n. (KH); Danyang-gun, Mt. Sobaek, 7 Aug. 1995, *W.Y. Lee, S.S. Kim & H.Y. Park* s.n. (KH); Danyang-gun, Mt. Sobaek, 16 Sep. 2006, *G.Y. Chung* ANH060916-003 (KH); Mt. Dosol, 25 Jul. 1996, *G.Y. Chung et al.* ANH960725 – 001 (KH); Gyeongsangbuk-do: Mungyeong-si, Mt. Daeya, 3 Sep. 2009, *D.H. Lee & W.B. Cho* 99001 – 99011 (IUI); Mungyeong-si, Mt. Daeya, 27 Jul. 2010, *D.H. Lee* 107801 – 107806 (IUI).

***Leontopodium coreanum* var. *hallaisanense* (Hand.-Mazz.) D.H.Lee & B.H.Choi KOREA.** Jeju-do: Jeju-si, Mt. Halla, 29 Aug. 2009, *D.H. Lee & W.B. Cho* 98501, 98502 (IUI); Jeju-si, Mt. Halla, 18 Jul. 1935, *B.S. Toh* 14265 (SNU); Jeju-si, Mt. Halla, 12 Jul. 2007, *J.H. Lee* S0124 (KH).

***Leontopodium leirolepis* Nakai KOREA.** Hamgyungbuk-do: Buyong, 20 Jul. 1939, *T. Nakai* s.n. (TI); Hamgyungnam-do: Mt. Nobong, 17 Aug. 1935, *T. Nakai* 15774 (TI); Pyeonganbuk-do: Mt. Myohyang, 20 Jul. 1938, *B.S. Toh & H.J. Sim* 15228 (SNU); Gangwon-do: Inje-gun, Mt. Seolak, 21 May 1997, *S.S. Kim & D.N. Sin* s.n. (KH); Inje-gun, Mt. Seolak, 27 May 2009, *D.H. Lee & W.B. Cho* 95001, 95002 (IUI); Inje-gun, Mt. Seolak, 11 Jun. 2009, *D.H. Lee & W.B. Cho* 96001 – 96014 (IUI); Inje-gun, Mt. Ahn, Mt. Seolak, 12 Jun. 2009, *D.H. Lee & W.B. Cho* 96015, 96017, 96018, 96019, 96020 (IUI); Inje-gun, Mt. Seolak, 5 Jul. 2009, *D.H. Lee* 97001 – 97004 (IUI); Inje-gun, Mt. Seolak, 25 Aug. 2009, *D.H. Lee & W.B. Cho* 98317 – 98319 (IUI).

***Leontopodium leontopodioides* (Willd.) Beauverd KOREA.** Hamgyeongnam-do: ? 1938, *S. Tsuya* 4522 (TI); Chungcheongbuk-do: Danyang-gun, Mt. Sobaek, 22 Jul. 2009, *D.H. Lee & W.B. Cho* 97220 (IUI); Gyeongsangbuk-do: Cheongsong-gun, Mt. Mupo, 23 Jun. 2000, *G.Y. Chung et al.* ANH000623-001 (KH); Uiseong-gun, Mt. Bibong, 23 Jul. 2009, *D.H. Lee & W.B. Cho* 97230 – 97245 (IUI); Sangju-si, Mt. Deokam, 14 Jun. 2010, *D.H. Lee* 106518 – 106530 (IUI); Gyeongsangnam-do: Hapcheon-gun, Mt. Hwangmae, 5 Sep. 2009, *D.H. Lee & W.B. Cho* 99051 – 99054 (IUI); Daegu-si: Dalseo-gu, Mt. Daeduk, 4 Jun. 2006, *C.Y. Yoon* Yoon224 (KH). MONGOLIA. Selenge Aimag, 19 Jul. 2004, *S. Y. Woo* s.n. (KH); TUV Aimag, 21 Aug. 2001, *Y.D. Ro & J.O. Hyun* 2001067 (KH). RUSSIA. Primorye, Kievskaya River bank, 19 Jul. 2002, *B.Y. Sun et al.* 2009 (KH); Primorsky Territory, Lazovsky, 7 Jul. 2001, *K.A. Gozobets & R.V. Doudkin* s.n. (KH).

***Leontopodium japonicum* Miq. JAPAN.** Iwate: Mt. Iwate, 10 Aug. 1909, *S. Yajima* 6006 (KH); Oshu, Mt. Yakeishi, 24 Aug. 1962, *H. Koyama* 1393 (KYO); 24 Aug. 1973, *M. Takahashi* s.n. (TI); Nagano: Utukushigabara, 9 Aug. 1992, *G. Murata* 70904 (KYO); Ohshika-mura, Tsubakuroiwa, 21 Aug. 1965, *T. Yamazaki* 9924 (TI); Komoro-shi, Takamine, 22 Aug. 1985, *Z. Sato* s.n. (TI); Shinoina-gun, 4 Aug. 1966, *M. Furuse* 44354 (PE); Gunma: Minakami, Mt. Tanigawa, 16-17 Jul. 1973, *S. Kurata & T. Nakaike* 10050 (KYO); Annaka-shi, Mt. Myogi, *G. Murata* 27489 (TI); Mt. Akagi, 13 Jul. 2010, *D.H. Lee* 107501 – 107510 (IUI); Miyagi: Sendai, Mt. Funagata, 8 Jun. 1961, *H. Ohashi* 610734 (KYO); Shiroy-shi, Mt. Zao, 14 Aug. 1931, *S. Saito* s.n. (TI); Mt. Fubo, 28 Jul. 1985, *B.H. Choi* s.n. (IUI); Saitama: Chichibu-gun, Mt. Futagoyama, 16 Aug. 1986, *J. Murata, H.T. Im & C.S. Chang* 21559 (TI). CHINA. Hupeh: Shenlungkai, ?, *K.S. Chow* 76028 (TI); Shaanxi: ?, *C.H. Wang* 552 (PE); ?, *T.S. Wang* 16420 (PE); ?, 3 Sep. 1952, *F. Kun-Tsun* 5662 (PE); ?, 16 Aug. 1952, *W. Si-Tchou* 16148 (PE); Anhui: ?, 12 Aug. 1935, *T.N. Liou & P.C. Tsoong* 2577 (PE); ?, 14 Jul. 1975, ? 550 (PE); Mt. Huangshan, 22 Jul. 2010, *B.H. Choi & D.H. Lee* 107301 – 107315 (IUI).

***Leontopodium discolor* Beauverd JAPAN.** Hokkaido: Is. Rebun, Uennai, 13 Jul. 1983, *T. Yamazaki* 4658 (TI); Is. Rebun, Mt. Sankaku-yama, 14 Aug. 1984, *K. Tatsumi & S. Satoki* 4119 (KYO).