Arctoa (2015) **24**: *37-42*
doi: 10.15298/arctoa.24.07

TEN NEW RECORDS OF SOUTH KOREAN MOSSES

ДЕСЯТЬ НОВЫХ ТАКСОНОВ МХОВ ДЛЯ ЮЖНОЙ КОРЕИ

YOUNG-JUN YOON [1], BENITO C. TAN [2], CHUL-HWAN KIM [1] & BYUNG-YUN SUN [1]

ЁНГ-ДЖУН ЮН [1], БЕНИТО Ч. ТАН [2], ЧУЛ-ХВАН КИМ [1], БЬЁН-ЮН САН [1]

Abstract

Two moss varieties new to science, namely *Fissidens involutus* Wilson *ex* Mitt. var. *jejuensis* Y.-J. Yoon, B. C. Tan & B.-Y. Sun, *var. nov*. and *Leskeodon maibarae* var. *jejuensis* Y.-J. Yoon, B. C. Tan & B.-Y. Sun, *var. nov*., are described, and a total of eight new records of taxa of mosses of South Korea, which include *Dicranum montanum*, *Fissidens anomalus*, *Fissidens crispulus* var. *robinsonii*, *Leskeodon maibare*, *Okamuraea hakoniensis* fo. *multiflagellifera*, *Pylaisia selwynii*, *Sematophyllum phoeniceum* and *Sematophyllum subpinnatum*, are reported. Of these, seven are also new moss records for the entire Korean Peninsula, including North Korea. These noteworthy moss specimens were collected from various parts of South Korea, and the two new varieties are from Jeju-do (Jeju Island). The phytogeographical role of Jeju Island in the post-glacial migration and speciation of the cryptogamic flora of Korean Peninsula is briefly mentioned.

Резюме

Описаны две новых для науки разновидности, *Fissidens involutus* Wilson *ex* Mitt. var. *jejuensis* Y.-J. Yoon, B.C. Tan & B.-Y. Sun, *var. nov*. и *Leskeodon maibarae* var. *jejuensis* Y.-J. Yoon, B.C. Tan & B.-Y. Sun, *var. nov*.; шесть видов, одна форма и одна разновидность приводятся впервые для Южной Кореи: *Dicranum montanum*, *Fissidens anomalus*, *Fissidens crispulus* var. *robinsonii*, *Leskeodon maibare*, *Okamuraea hakoniensis* fo. *multiflagellifera*, *Pylaisia selwynii*, *Sematophyllum phoeniceum* и *Sematophyllum subpinnatum*. Семь из этих таксонов являются новыми для всего Корейского полуострова, включая Северную Корею. Образцы этих таксонов были собраны в разных частях Южной Кореи, при этом две новые для науки разновидности найдены на Чеджудо (остров Чеджу). Кратко обсуждается фитогреографическое значение этого острова в расселении и видообразовании криптогамной флоры в послеледниковый период на Корейском полуострове.

KEYWORDS: Jeju-do, South Korea, Korean Peninsula, mosses, new species, *Dicranum, Fissidens, Leskeodon, Okamuraea, Sematophyllum*

INTRODUCTION

In its early history, the moss flora of the Korean Peninsula was studied mainly by western and Japanese scholars. The first western collector of mosses on the Korean Peninsula was Father Urbain Jean Faurie (1847–1915) from France and his collections were studied by Cardot (1904). From 1930 to 1940, several Japanese scholars, namely S. Okamura, Y. Horikawa, H. Sasaoka, A. Noguchi and T. Osada, collected and studied bryophytes from the Korean Peninsula (Song & Yamada, 2001, 2003). Starting in the 1960s, the study of the moss flora of Korea was undertaken by Korean bryologists (Hong, 1960a, 1960b; Hong & Ando, 1961; Choe, 1962, 1972, 1977a, 1977b, 1978, 1979). As a result, The Illustrated Flora and Fauna of Korea, Vol. 24 (Musci, Hepaticae) prepared by Choe was published in 1980. This book contains 487 species belonging to 158 genera and 48 families. The species number corresponds to only about 4.8% of all the mosses then recognized in the world (cf. Schofield, 1985). In the past 30 years, more studies on Korean mosses have been performed jointly by local and foreign botanists who yielded new information about Korean moss biodiversity (Gao & Chang, 1983a, 1983b; Kim *et al.*, 1995; Lai *et al.*, 2007; He & Song, 2007; Yoon & Sun, 2010; Yoon *et al.*, 2011a, 2011b). In spite of these efforts, the moss flora of the Korean Peninsula remains insufficiently studied.

In as much as the moss floras of several countries and areas in East Asia, such as the Russian Far East, China, Taiwan and Japan, are now relatively well known, it has become more necessary today to study the less known moss flora of the Korean Peninsula in order to understand the evolution and relationship of the bryophyte floras of these countries in Northeast Asia.

While preparing a floristic study, the first author collected ten new moss records for the South Korean flora which are reported below in two groups and arranged in alphabetical order. Seven of these are also new species records for the entire Korean Peninsula.

Two of the moss collections from Jeju Island are described as new varieties. With the previous report of an

[1] – Faculty of Biological Sciences, Chonbuk National University, Jeonju 561-756, Korea; e-mail: liebejun@jbnu.ac.kr
[2] – The University and Jepson Herbaria, University of California, Berkeley, CA, USA 94720; e-mail: benctan@berkeley.edu

endemic fern genus, *Mankyua* (Sun *et al.*, 2001), and now the additional two new moss taxa, the isolated island of Jeju located at the southern end of the Korean Peninsula seems like a promising site to explore further for its little known cryptogamic plants, especially the bryophytes, in light of its established reputation as an important phytogeographical refugium and a local source of plant migration during the post glacial history of recolonization and plant speciation of the Korean Peninsula (Chung *et al.*, 2013).

TAXA NEW TO SCIENCE

1. ***Fissidens involutus*** Wilson *ex* Mitt. var. ***jejuensis*** Y.-J. Yoon, B.C. Tan & B.-Y. Sun, *var. nov*. [Fissidentaceae]. Fig. 1

Type: South Korea, on rock at Cheonjaeyeon waterfall, Jeju-do, 20 Mar 2012, *Yoon Y.-J 10175* (holotype, JNU; isotypes, NY, UC).

Plants dark green. Stems sometimes branched, 2.5–3.5 cm long, 3–4 mm wide with leaves when wet, no differentiated central strand in cross-section; axillary hyaline nodules differentiated, consisting of a cluster of small thick-walled cells. Leaves as many as 25 pairs, somewhat imbricate, lanceolate-elongate to elongate-lingulate, 2.5–3.5 mm long, about 0.5 mm wide, broadly acute and apiculate, base of dorsal lamina mostly decurrent, a few wedge-shaped; costa percurrent; margins serrulate throughout; vaginant lamina 3/5–1/3 of leaf length; lamina unistratose, cells small, quadrate to hexagonal, 5–6 μm in diameter, strongly mammillose, thin to moderately thick walled; cells of vaginant lamina larger, with indistinct papilla each at four cell corners. Setae lateral on short branch, 4–6 mm long. Capsules inclined, 1–1.5 mm long. Spores not seen.

Habitat: On humus rocks at waterfall.

Distribution: Endemic to South Korea and Japan.

Note. *Fissidens involutus* is a widespread species in E Asia and SE Asia (Li *et al.*, 2001). It is better known in Asian publications by its synonym, *F. plagiochiloides* Besch. The new var. *jejuensis* is of medium plant size for the genus, measuring to 2.5–3.5 cm long and 3–4 mm wide with leaves when wet. It differs from the typical variety by (1) the stem cross-section without a central strand; (2) leaves narrowly lanceolate-elongate to lingulate, while those of the typical variety are ovate-lanceolate to oblong-lanceolate; (3) the bases of dorsal leaves are distinctly decurrent, while those of the typical variety are mostly rounded to cuneate; and (4) several cells of basal vaginant lamina have single indistinct papilla at each corner. The obscurely round to hexagonal and mammillose cells of apical and dorsal laminae of the new variety measure 5-6 μm. The hyaline nodules on the stems and branches of the var. *jejuensis* are often seen differentiated as a group of small, thick-walled cells that are not enlarged. Like the typical variety, the new variety prefers also a wet habitat.

The illustration of the new Japanese species record of "*Fissidens bushii*" in Suzuki and Iwatsuki (2012, Fig. 24) fits well with the concept of our new variety. We confirmed the conspecific nature of these specimens after studying the duplicates of *Kimura 826* and *T. Suzuki 61200* (NICH) kindly provided by Dr. Tad. Suzuki. The descriptions and illustrations of *Fissidens bushii* (Cardot & Thér.) Cardot & Thér. from North America published by Crum & Anderson (1981) and Pursell (2007) show a small plant of about 4–7 mm high, with ovate to oblong-lanceolate, but not elongate-lingulate leaves, and without a decurrent leaf base. The habitat of *F. bushii* in North America is reported to be mainly on soil and rock in mesic woodland and disturbed road banks.

Fissidens gedehensis M. Fleisch., a Malesian species now reported from Japan (Suzuki & Iwatsuki, 2012), may be mistaken for this variety with similarly oblong to lingulate leaves, but the former is a smaller plant of about 8–12 mm long and with no hyaline nodules developed on the stem. The leaf cells of the vaginant lamina of *F. gedehensis* are smooth.

Fissidens teysmannianus Dozy & Molk. (see Iwatsuki & Mohamed, 1987) is another species with similar plant size and leaf shape, but it differs from the new variety of *F. involutus* in having non-decurrent leaf bases and the absence of hyaline nodules on the stem.

2. ***Leskeodon maibarae*** (Besch.) B-C. Ho & L. Pokorny var. ***jejuensis*** Y.-J. Yoon, B.C. Tan & B.-Y. Sun, *var. nov*. [Daltoniaceae]. Fig. 2.

Type: South Korea, Saryeonisup-gil, Jeju-do, 13 May 2012, *Yoon Y.-J. 1060* (holotype, JNU; isotypes, NY, UC).

Plants mat-forming, stems, when wet, measuring to 20 mm long and 3–4 mm wide including the lateral leaves, occasionally branched. Lateral leaves mostly oblong-elliptic, dorsal leaves broadly ovate to ovate-lanceolate, all with apiculate apices; marginal leaf border entire, narrow, consisting of 1–2 rows of elongate cells, not reaching the apex; costa about 2/3 of the leaf length; upper laminal cells quadrate to hexagonal, thin-walled, 8–16 μm in width; lower laminal cells larger, shortly rectangular; all leaves with 2–3 rows of smaller marginal cells throughout. Perichaetial leaves and sporophytes not seen.

Habitats: On rocks along the shaded and wet road bank in valley.

Distribution: Endemic to Jeju Island of South Korea.

Note. In South Korea, only one species of *Leskeodon*, *L. maibarae* (Besch.) B.-C. Ho & L. Pokorny, is known. The new variety differs from the typical variety in having many broadly ovate to ovate-lanceolate leaves (Plate 2a & b) with smaller apical and upper laminal cells that are quadrate-hexagonal measuring 8–16 μm in width. Also, there is a tendency to see a slight differentiation of 2–3 rows of smaller marginal cells in the upper part of the leaf near the apex (see Plate 2c). The upper laminal cells of the var. *maibarae* are homogeneous in appearance, measuring about 13–35 μm in width.

Although *L. maibarae* is a variable species in East Asia, the new variety is rather distinctive in having broad-

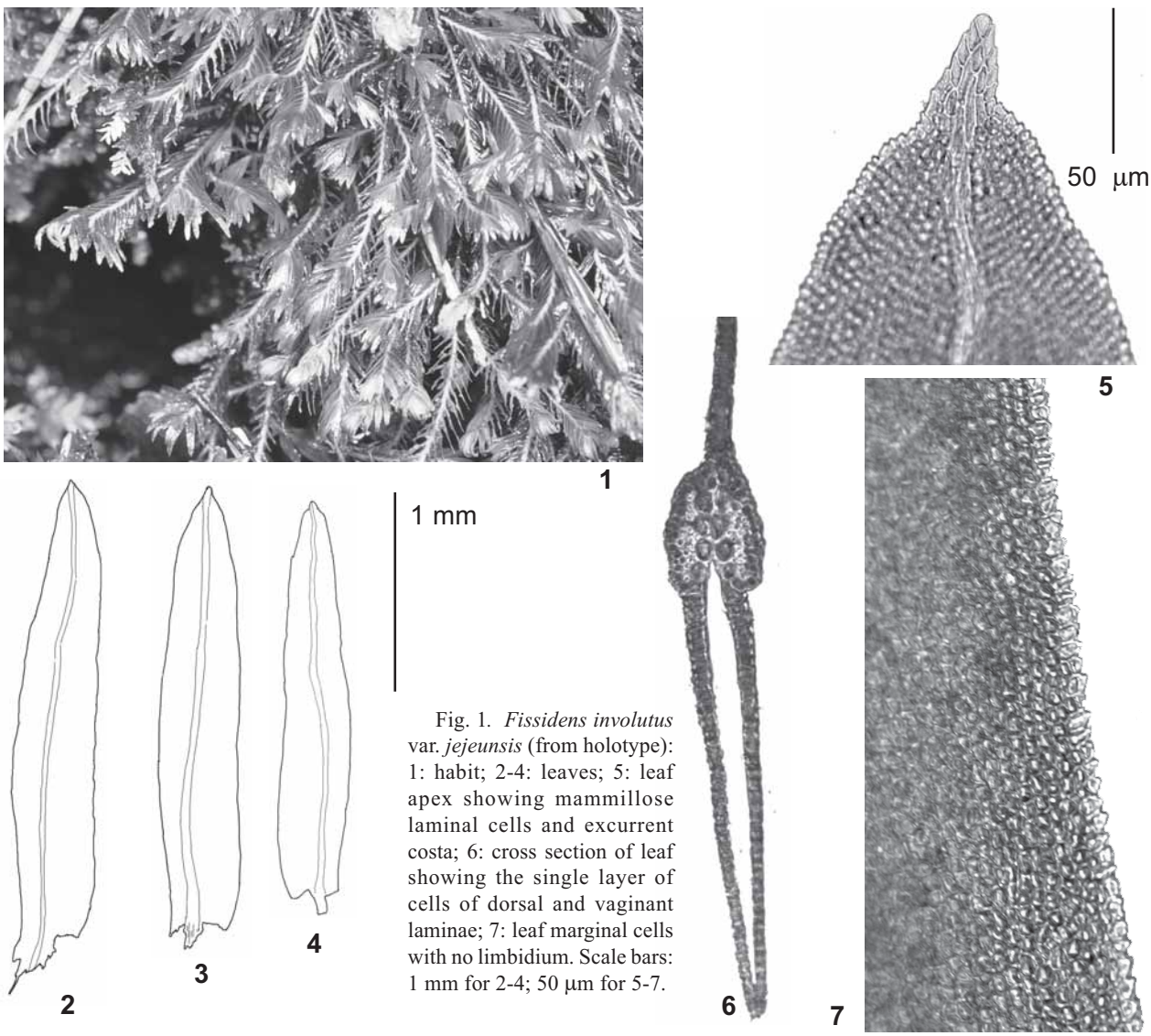

Fig. 1. *Fissidens involutus* var. *jejeunsis* (from holotype): 1: habit; 2-4: leaves; 5: leaf apex showing mammillose laminal cells and excurrent costa; 6: cross section of leaf showing the single layer of cells of dorsal and vaginant laminae; 7: leaf marginal cells with no limbidium. Scale bars: 1 mm for 2-4; 50 μm for 5-7.

ly ovate to ovate-lanceolate dorsal leaves. The dorsal leaves of typical variety of *L. maibarae* are described as oblong, oblanceolate, obovate to slightly spathulate in many floras (see Gangulee, 1977, as *Distichophyllum sinuosulum*; Noguchi, 1994; Tan & Robinson, 1990; Wu *et al*., 2002). The description of the new variety is intended for the recognition of the rather distinctive and consistent differences seen between the two varieties among the populations of *L. maibarae* on Jeju Island and peninsular South Korea.

New taxa for Korean moss flora

1. ***Dicranum montanum*** Hedw. [Dicranaceae]

Specimen examined: South Korea, Mt. Jiri, Hamyang-gun, Gyeongsangnam-do, 29 Aug 2010, *Yoon Y.-J 6013* (JNU).

Habitats: On rocks and humus soil around the peak of Mt. Jiri (alt. 1833 m).

Distribution: China, Japan, North Korea, Russia, Europe, North America (Gao *et al*., 1999). New to South Korea.

Note. *Dicranum montanum* is the smallest species of the genus in the Korean Peninsula. This species is similar in appearance to *D. flagellare* Hedw., but it can be distinguished by the following characters: (1) small plant size of 10–20 mm long; (2) strongly crisped leaves when dry; (3) upper laminal cells mammillose; and (4) without the flagelliform branchlets typically produced by plants of *D. flagellare* (Gao *et al*., 1999). Because of its somewhat erect capsule, the species has also been transferred to *Orthodicranum* as *O. montanum* (Hedw.) Loeske (Gao *et al*., 1999).

2. ***Fissidens anomalus*** Mont. [Fissidentaceae]

Specimen examined: South Korea, Hyodoncheon, Jeju-do, 7 Aug 2010, *Yoon Y.-J 5488* (JNU).

Habitat: On shaded rocks.

Distribution: China, Nepal, India, Sri Lanka, Myanmar, Thailand, Vietnam, Indonesia and Philippines (Li *et al*., 2001). New to the Korean Peninsula.

Note. The Fissidentaceae are the second-largest family in the moss flora of Korea, with 16 species of *Fis-*

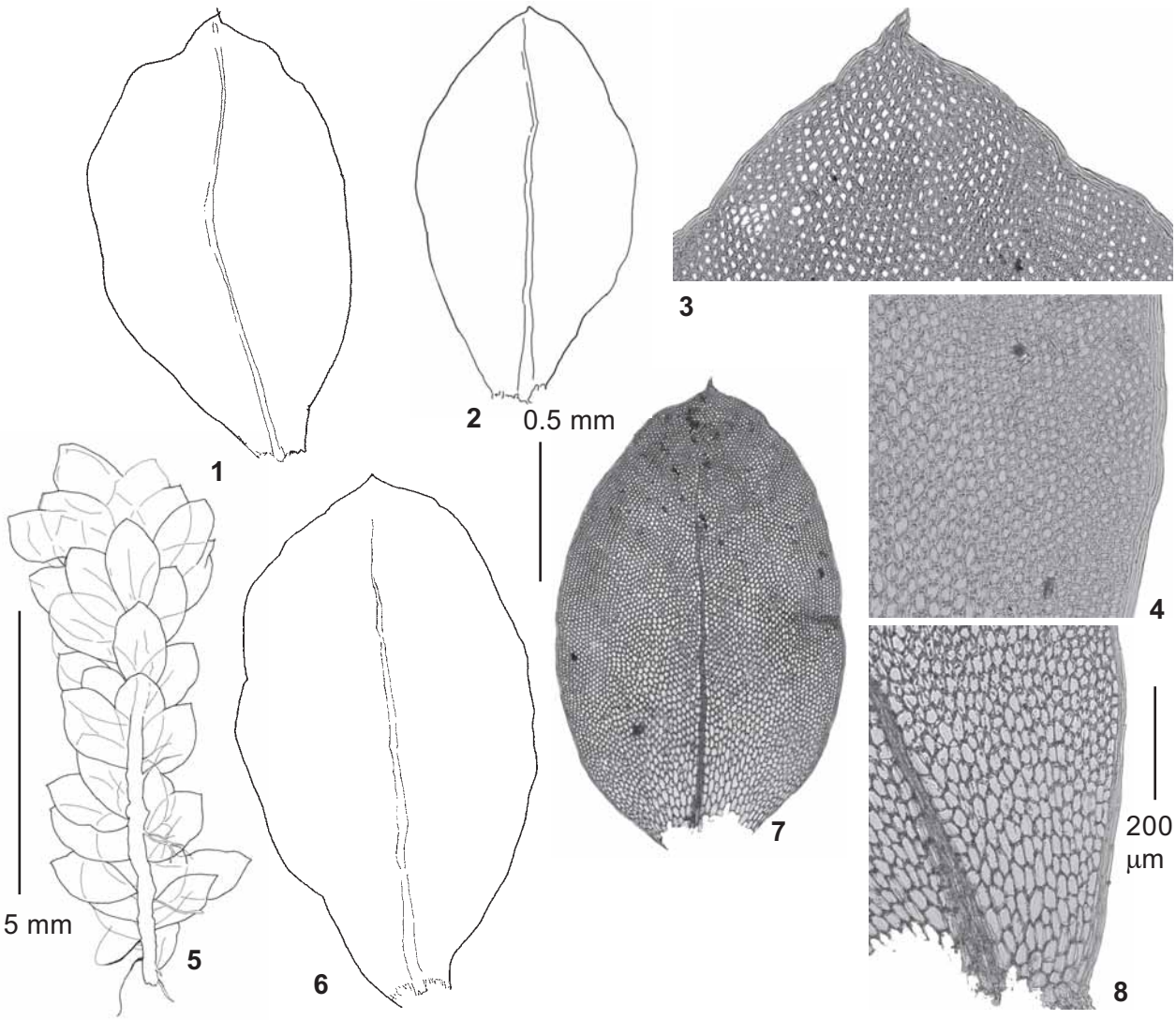

Fig. 2. *Leskeodon maibarae* var. *jejeunsis*: a & b. lateral leaves; c. median leaf cells and the slightly smaller marginal cells near the narrow leaf border; d. leaf apex. Scale bars: 5 mm for 5; 0.5 mm for 1-2, 6; 200 μm for 3-4, 8.

sidens reported (Park & Choi, 2007). The present species is similar to *F. dubius* P. Beauv. mainly in having 2–4 pale colored marginal rows of cells forming the irregularly serrate leaf border. However, it can be distinguished from the latter by its more narrowly lanceolate leaves with a more or less excurrent costa (Li *et al.*, 2001).

Recently, *F. bourgaeanus* Besch., a neotropical species was found in Japan by Suzuki & Iwatsuki (2012). The species looks like *F. dubius* and *F. anomalus* in having a differentiated marginal band of cells on the leaves, but in the former, this differentiated marginal band of leaf border cells is darker in color than the inner laminal cells, while the leaf marginal band of *F. dubius* and *F. anomalous* are lighter in color than the inner laminal cells. Considering the closeness of the Korean moss flora and Japanese moss flora, *F. bourgaeanus* is likely to be present in the Korean Peninsula.

3. ***Fissidens crispulus*** Brid. var. ***robinsonii*** (Broth.) Z. Iwats. & Z.H. Li. [Fissidentaceae]

Specimen examined: South Korea, Seondol Valley, Jeju-do, 20 Jun 2011, *Yoon Y.-J 7656* (JNU).

Habitat: On rocks along valley.

Distribution: China, India, Indochina, Malesia, New Caledonia. New to the Korean Peninsula.

Note. *Fissidens robinsonii* Broth. was reduced to a synonym of *F. zippelianus* Dozy & Molk. (=*F. crispulus*) by Norris & Koponen (1987), but was made a variety of *F. zippelianus* by Iwatsuki & Suzuki (1989). The current recognition of this taxon by many muscologists is as a variety of *F. crispulus*, which is conspecific with *F. zippelianus*. The var. *robinsonii* differs from var. *crispulus* in having leaves with a narrowly acute apex and a slightly excurrent costa (Iwatsuki & Suzuki, 1982, 1989).

4. ***Leskeodon maibarae*** (Besch.) B.-C. Ho & L. Pokorny var. ***maibarae*** [Daltoniaceae]

Specimen examined: South Korea, Cheoreum Hammol-gu, Jeju-do, 19 Sept 2011, *Yoon Y.-J 8411* (JNU).

Habitat: On rocks.

Distribution: Japan, China, Taiwan, Philippines, India, Malaysia, Indo-China (Noguchi *et al.*, 1991; Wu *et al*., 2002). New to the Korean Peninsula.

Note. This is a common and widespread species found in China and Japan. Its presence in the Korean Peninsula is expected. The species is well known in Asia by its former binomial, *Distichophyllum maibare* Besch. The recent transfer of the species to *Leskeodon* is supported by molecular studies of DNA sequences reported in Ho *et al*. (2012).

The species is best distinguished by having oblong to shortly spathulate lateral and dorsal leaves that have a narrow leaf border. The apiculate leaf apex consists of a few oblong cells that are different in shape from the elongate to linear border cells. The upper leaf cell are homogeneous, measuring about 13–35 μm in width. Its habitat includes mainly wet rocks and soil, occasionally on decaying log in deeply shaded humid sites.

5. ***Okamuraea hakoniensis*** (Mitt.) Broth. fo. ***multiflagellifera*** (S. Okam.) Nog. [Brachytheciaceae]

Specimen examined: South Korea, Mt. Halla, Jeju-do, 21 Sep 2011, *Yoon Y.-J 8547* (JNU).

Habitat: On decayed wood.

Distribution: China and Japan (Wu *et al.*, 2002). New to the Korean Peninsula.

Note. *Okamuraea hakoniensis* differs from its congeners in having non-plicate leaves with long or slenderly acuminate apices. The presence of many flagelliform branchlets covered with reddish brown fasciculate rhizoids distinguishes this form from the typical *O. hakoniensis* (Wu *et al*., 2002).

6. ***Pylaisia selwynii*** Kindb. [Hypnaceae]

Specimen examined: South Korea, Seonunsa, Gochang-gun, Jeollabuk-do, 6 Feb 2009, *Yoon Y.-J 2222* (JNU).

Habitat: On base of tree.

Distribution: China, Japan, Russian Asia, North Europe, North America (Wu et al., 2005; Noguchi, 1994). New to the Korean Peninsula.

Note. This species is reported here new to the Korean Peninsula. The generic name, *Pylaisia* Schimp., is a conserved name against *Pylaisiella* Grout. The genus was revised recently by Arikawa (2004) who reported three species from the Korean Peninsula, namely, *P. polyantha* (Hedw.) Schimp., *P. brotheri* Besch. and *P. stereodontoides* Broth. Among its congeners in the Korean Peninsula, *P. selwynii* is closest to *P. brotheri*. The latter differs from *P. selwynii* in having (1) broadly ovate-lanceolate leaves with a gradually narrowed long-acuminate apex; (2) numerous alar cells (25–35); and (3) an ovoid capsule. *P. selwynii* has ovate-lanceolate leaves with somewhat constricted short-acuminate apices, about 20–25 alar cells along the leaf basal margin, and an ovoid-oblong capsule. From *P. polyantha*, *P. selwynii* is distinguished in having the endostome partly adhered to the exostome. The illustration of a free endostome in the peristomial structure of *P. selwynii* in Wu *et al.* (2005, Plate 209) is misleading. *Pylaisia stereodontoides* has lanceolate leaves with few alar cells and an oblong-elongate capsule (Arikawa, 2004; Wu et al., 2005).

7. ***Sematophyllum phoeniceum*** (Müll. Hal.) M. Fleisch. [Sematophyllaceae]

Specimen examined: South Korea, Daeheungsa, Haenam-gun, Jeollanam-do, 4 Feb 2009, *Yoon Y.-J 2037* (JNU).

Habitat: On base of tree.

Distribution: China, India, Sri Lanka, Kampuchea, Laos, Vietnam, Africa (Tan & Jia, 1999; Wu *et al*., 2005). New to the Korean Peninsula.

Note. This is the second species of the genus found in Korea after the report of *S. subhumile* (Müll. Hal.) M. Fleisch. (Park & Choi, 2007). Its morphological differences from *S. subhumile* (Müll. Hal.) M. Fleisch. and *S. subpinnatum* (Brid.) Britt. are outlined in Tan and Jia (1999). *Sematophyllum phoeniceum* is best identified by its long acuminate and pointed leaf apices with elongate upper leaf cells (Tan & Jia, 1999; Wu *et al*. 2005).

8. ***Sematophyllum subpinnatum*** (Brid.) E. Britton [Sematophyllaceae]

Specimen examined: South Korea, Bogil-do, Wando-gun, Jeollanam-do, 8 Mar 2011, *Yoon Y. J 7002* (JNU).

Habitat: On rocks.

Distribution: Nearly pantropical, also in China, Japan, Russia Far East, Asia Minor, Europe (Noguchi, 1994; Wu *et al.*, 2005). New to the Korean Peninsula.

Note. This is a new record and the third species of *Sematophyllum* found in Korea. Our species concept of this taxon includes *S. caespitosum* (Sw.) Mitt. and *S. demissum* (Wils.) Mitt. for its heterotypic synonyms. *Sematophyllum subpinnatum* can be identified from other congeneric species in Korean Peninsula by its leaves that are mostly ovate to broadly lanceolate with short-acuminate, acute to, at times, obtuse apices, and oval to rhomboidal upper leaf cells (see also Tan & Jia, 1999; Wu *et al*., 2005).

ACKNOWLEDGEMENTS

We extend our best wishes to the honoree of this Festschrift issue of Arctoa, Dr. O.M. Afonina at Komarov Botanical Institute at St. Petersburg in Russia, on the occasion of her birthday in 2015 and in recognition of her great contributions to the Russian bryology over the decades. The work was supported by the grant "Survey of Korean indigenous Species (NIBR No. 2013-02-001)" from the National Institute of Biological Resources of Ministry of Environment in Korea. The third author (BCT) acknowledges also the technical assistance provided by his colleagues at UC Herbarium at Berkeley. Additionally, the positive re-

viewing comments provided by W. Buck, H. Akiyama and J. Shevock are deeply appreciated. Dr. T. Suzuki is thanked for providing the alleged Japanese specimens of *F. bushii* for our study.

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