Bryophyte flora of Gayasan Mountain National Park in Korea

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(Received 1 February 2021; Revised 1 March 2021; Accepted 12 March 2021)

ABSTRACT: We investigated the bryophyte flora of the Gayasan Mountain National Park in Korea by conducting 18 field surveys in from April of 2009 to November of 2016 at various sites on the mountains. During the surveys, we discovered 204 taxa comprising 57 families, 106 genera, 199 species, 2 subspecies, and 3 varieties. Among these, 145 species were reported as new to the flora of Gayasan Mountain. A checklist based on a study of 903 specimens is provided. The most notable species recorded during the surveys were the rare bryophytes *Hattoria yakushimensis* (Horik.) R. M. Schust., *Nipponolejeunea pilifera* (Steph.) S. Hatt., *Drepanolejeunea angustifolia* (Mitt.) Grolle, *Lejeunea otiana* S. Hatt., *Cylindrocolea recurvifolia* (Steph.) Inoue and *Pogonatum contortum* (Menzies ex Brid.) Lesq.

Keywords: Bryophyte, flora, mosses, liverworts, Gayasan Mt.

The first of bryophytes on Gayasan Mountains was published by Kashimura (1939) who identified two species, *Andreaea rupestris* var. *fauriei* (Besch.) Takaki. and *Rhizomnium punctatum* (Hedw.) T. J. Kop. collected on 24 September 1938. Since that time, the bryophyte flora of the Gayasan Mountain has been surveyed and also included in inventories of mosses and liverworts of the Korean Peninsula published on 20 species by Hong (1966) and 12 species Choe (1980). However, only 38 taxa were reported in these and other old studies, and more recently, Song and Yamada (2009) have reported on 38 taxa of liverworts. In the present study, we conducted the first comprehensive survey of bryophyte species distributed in the Gayasan Mountain National Park, with the aim of providing basic data that will contribute to establishing a conservation plan for the bryophyte flora of this parks.

Gayasan Mountain, designated Korea's 9th national park in Korea in 1972, covers a total area of 77 km², and borders the Hapcheon-gun and Geochang-gun of Gyeongsangnam-do and Seongju-gun of Gyeongsangbuk-do. The mountain lies

between latitudes and longitudes 35°44'56"–35°51'19"N and 128°02'42"–128°11'10"E, the lowland area of which has a mean annual temperature of 13.4°C and precipitation of 1,276 mm per year (Korea Meteorological Administration, 2019). The highest ridges of the mountain are Sangwangbong (1,430 meters above sea level [m a.s.l.], the main peak), Chilbulbong (1,433 m a.s.l.), and Dongseongbong (1,227 m a.s.l.). The Gayasan Mountain valley's area (Hongnyudong and Baegundong valleys) comprises mainly granite and is noted for its numerous historical and scenic sites, including the Haeinsa Temple and Palmandaejanggyeong (Buddhist Scriptures) (Choi and Do, 2016). The geology of Gayasan Mountain is mainly composed of Precambrian biotite gneiss, semi-phalangeal gneiss, Ireal rock, and Haeinsa granite formed during the Cretaceous period (Lee et al., 2016). In addition, approximately 85.2% of the total area of Gayasan Mountain National Park lies at elevations higher than 600 m a.s.l., whereas 10.3% of the area exceeds 1,000 m a.s.l, and is characterized by a mixture of plants with distribution ranges

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in the southern and central regions of the Korean Peninsula (Myeong et al., 2016). The ridgeline area is also rich in rocky outcrops and there are occasional area of gravelly barren fields on the steep slopes.

Materials and Methods

Field surveys

Our collections were carried out in habitats with a high

Fig. 1. The position of Gayasan Mountain within Korean Peninsula and the surveyed routes in this study.

Fig. 2. Habitats of Gayasan Mountain. A. Sangwangbong (peak). B. Northern slope of Sangwangbong. C. Cliffs near Sangwangbong. D. Low part of Hongryudong valley. E. Middle part of Hongryudong valley. F. Baegundong valley.

Table 1. Surveyed locals and dates of Gayasan Mountain.

No.	Localities	Dates
1	Hongryudong valley	28 Apr 2009
2	Hongryudong valley–Sangwangbong (peak)	8 Sep 2009
3	Hongryudong valley–Sangwangbong (peak)	22 Jun 2010
4	Hongryudong valley, Yonggi valley	29–30 Mar 2016
5	Masu valley, Sangseonbul	18 May 2016
6	Hongryudong valley, Geumbawi valley, Gitdaebong	26–28 May 2016
7	Haeinsa temple–Hongjeam–Gwaneumgol	10 Jun 2016
8	Nakwhadam area	30 Jun 2016
9	Youngmoon waterfall area	7 Jun 2016
10	Haeinsa temple–Tosimgol	10 Aug. 2016
11	Samjeong camp, Chiin camp	16–17 Aug. 2016
12	Hongryudong valley, Yungmun waterfall	23–25 Sep 2016
13	Haeinsa temple–Sangwangbong (peak)	8–9 Oct 2016
14	Yonggigol valley	10–14 Oct 2016
15	Hongryudong valley, Sangwangbong (peak), Yonggi valley	28–30 Oct 2016
16	Seoseongjae	4–5 Nov. 2016
17	Seokgyedong valley	18–20 Nov 2016
18	Maehwasan valley	25–27 Nov 2016

diversity of bryophytes, such as wet habitats near stream beds, more or less dry rocks, bark of forest trees, and exposed stony fields and shaded cliffs near some mountain tops (Figs. 1, 2). We conducted a total of 18 field surveys from April 2009 to November 2016 at various sites in the park (Table 1).

All specimens were collected in newspaper or acid-free paper, and collection date, geographical coordinates, field herbarium numbers, collector names, preliminary species name, substrates, and habitats were recorded in the field. The collected materials were air-dried in the laboratory, and some species were cultivated in the greenhouse. All specimens were deposited in the Jeonbuk National University Herbarium (JNU) and National Institute of Biological Resources Herbarium (KB).

Latitude and longitudinal fractional composition

The treatment of latitudinal and longitudinal types basically follows to Konstantinova (2000) and Bakalin (2010). The distribution of each species was identified in a three-dimensional grid, from the Arctic to Tropical, from East Asian to Circumpolar, and its tendency to be distributed in mountainous areas. Nine latitudinal types of elements and

eleven longitudinal types of habitat (area types) were identified to classify the distribution species. For the analysis of the distribution characteristics of bryophytes, their world distribution was obtained from Noguchi (1987, 1988, 1989, 1991, 1994), Gao et al. (1999, 2003), Lawton (1999), Li et al. (2001, 2007), Wu et al. (2002, 2005, 2011), Hu et al. (2008), and Korean distribution was obtained from Choe (1980), Kim and Hwang (1991), Kim (1991), and Bakalin (2010), Park (2020).

Number of bryophyte taxa and liverwort index

The liverwort index, which is based on the character that liverworts and hornworts tend to prefer more humid conditions than mosses do, was calculated as follows (Nakanishi, 2001):

$$\text{Liverwort index (\%)} = \frac{\text{Number of liverworts} + \text{number of hornworts}}{\text{The total number of bryophytes}} \times 100$$

Results and Discussion

Bryophyte flora

On the basis of an inspection of 903 herbarium specimens, we found that the bryophyte flora of the Gayasan Mountain includes 204 taxa belonging to 57 families, 106 genera, 199 species, 2 subspecies, and 3 varieties (Table 2). Among these, there were 115 taxa of Bryophyta (33 families, 67 genera, 111 species, 2 subspecies, and 2 varieties) and 89 taxa of Marchantiophyta (24 families, 39 genera, 88 species, and 1 variety). This is equivalent to 18.1% of the 1,121 taxa (346 liverworts and 775 mosses) recorded on the Korean Peninsula (Kim et al., 2020). Among the species identified, 145 taxa are newly recorded in the Gayasan Mountain (Appendix 1).

Comparison of bryophyte species richness and liverwort indices

Compared with recently studied bryophyte flora [Taebaeksan Mountain (Bum et al., 2020), Deogyusan Mountain (Yoon et al., 2011; Choi et al., 2013), Hallasan Mountain (Yim, 2012), and Sobaeksan Mountain (Choi et al., 2016)], Gayasan Mountain is characterized the lowest number of species (204 species), although the second highest number of taxa (2.67) on an area basis. The comparatively small number of species can be ascribed to the fact that although the Gayasan Mountain includes a variety of habitats, including different parent rocks (Precambrian biotite gneiss, semi-phalangeal gneiss, Ileal rock, and Cretaceous Haeinsa granite), some coniferous forests near the peaks, and small and

Table 2. Summary of Bryophyte flora of Gayasan Mountain National Park.

	Families	Genera	Species	Subsp.	Var.	Taxa
Marchantiophyta	24	39	88	-	1	89
Bryophyta	33	67	111	2	2	115
Total	57	106	199	2	3	204

Table 3. Comparison of the bryophyte species richness levels and liverwort indexes in other localities and Gayasan Mountain National Park.

	Gayasan Mt.	Taebaeksan Mt.	Hallasan Mt.	Deogyusan Mt.	Sobaeksan Mt.
Area (km ²)	76.25	70.05	153.33	231.65	322.01
No. of taxa	204	274	378	311	236
Mosses	115	167	253	184	137
Liverworts	89	107	125	127	99
Liverwort index (%)	43.6	39.0	33.1	40.8	41.9
No. of taxa/Area (km ²)	2.67	3.91	2.47	1.35	0.74

large valleys (the Hongryudong and Baegundong valleys), the area cover covered in relatively small. Furthermore, according to the liverwort index, which indicates the degree of humidity in a surveyed area, Gayasan Mountain (43.6%) was found to be the wettest among the aforementioned areas (Sobaeksan Mountain 41.9%, Deogyusan Mountain 40.8%, and Taebaeksan Mountain 39.0%) (Table 3).

The latitudinal and longitudinal distribution of floristic elements among bryophytes of the Gayasan Mountain

Analysis of floristic elements based on latitude (Table 4) revealed that 54 taxa (26.5%) are boreal temperate, 45 (22.1%) temperate, 39 (19.1%) temperate–subtropical, 20 (9.8%) multizonal, 14 (6.9%) subtropical, 11 (5.4%) subtropical–tropical, 9 (4.4%) boreal, 8 (3.9%) arctic–boreal, and 4 (1.9%) arctic species. Compared with the latitudinal distribution characteristics of the Korean Peninsula bryophyte flora, the bryophyte flora of the Gayasan Mountain is characterized by temperate–subtropical (+6.5%) and temperate (+1.4%) taxa, and the lowest numbers of boreal temperate taxa (-2.1%) and subtropical (-1.8%), boreal (-1.6%), arctic–boreal (-1.4%), subtropical–tropical (-0.5%), arctic (-0.4%), and multizonal (-0.1%) species. It is assumed that these distribution patterns are attributable to the geographical location of the Gayasan Mountain, as well as increases in the numbers of temperate–subtropical and temperate plants in the lower regions of the valleys within the Gayasan Mountain range.

Analysis of the floristic elements based on longitude (Table 5) indicated that 84 taxa (41.2%) are of Eastern Asian distribution, 48 (23.5%) circumpolar, 24 (11.8%) multi-areal,

9 (4.4%) Eastern Asia–American, 7 (3.4%) Asia–American, 4 (1.2%) Asia–Europe and Amphipacific, and 3 (1.5%) Amphiocenic, with a further single species (0.5%) showing a disjunctive distribution. Compared with the longitudinal distribution characteristics of the Korean Peninsula bryophyte flora, that of the Gayasan Mountain is characterized by Eastern Asian and Asia–American (+1.9%), Asia–European (+1.4%), Amphipacific (+0.8), Eastern Asia–American (+0.7), and Asian multi-areal (+0.6) taxa, with the lowest numbers of Circumpolar taxa (-5.3%), and disjunctive (-1.6%), Amphiocenic (-0.7%), and Southeast Asian (-0.1%) species. These findings thus clearly indicate that the flora of the Gayasan Mountain region of the Korean Peninsula is of an Eastern Asian type (Takhtajan, 1986).

Comparisons with previous studies on the bryophyte flora of the Gayasan Mountain

The Gayasan Mountain were included in the areas investigated as part of an inventory of mosses distributed in the Korean Peninsula conducted by Kashimura (1939, 1940), who published a checklist on Korean mosses, which included 15 taxa (*Andreaea rupestris* var. *fauriei*, *Pogonatum inflexum*, *Bryoxiphium norvegicum* subsp. *japonicum*, *Bryum argenteum*, *Plagiomnium acutum*, *Rhizomnium punctatum*, *Hedwigia ciliata*, *Boulaya mittenii*, *Myuroclada maximowiczii*, *Meteorium buchananii* subsp. *helminthocladium*, *Rhytidium rugosum*, *Entodon flavescens*, *Homalia trichomanoides*, *Eumyurium sinicum*, *Anomodon rugelii*) recorded in the Gayasan Mountain. Subsequently, Choe (1980) published a manual on Korean Bryophytes, which included 12 taxa (*Andreaea rupestris* var. *fauriei*, *Hedwigia ciliata*, *Eumyurium sinicum*,

Table 4. The latitude fractional composition in Gayasan Mountain with Korean Bryophyte.

Floristic elements (latitudinal types)	Taxa		Percentages		
	Korea	Gayasan Mt.	Korea	Gayasan Mt.	Comparison
Arctic	24	4	2.3	1.9	-0.4
Arctic-boreal	55	8	5.3	3.9	-1.4
Boreal	62	9	6.0	4.4	-1.6
Boreal-temperate	295	54	28.6	26.5	-2.1
Temperate	214	45	20.7	22.1	1.4
Temperate-subtropical	130	39	12.6	19.1	6.5
Subtropical	90	14	8.7	6.9	-1.8
Subtropical-tropical	61	11	5.9	5.4	-0.5
Multizone	102	20	9.9	9.8	-0.1
Total	1,033	204	100	100	0

Table 5. The latitude fractional composition in Gayasan Mountain with Korean Bryophyte.

Floristic elements (longitudinal types)	Taxa		Percentages		
	Korea	Gayasan Mt.	Korea	Gayasan Mt.	Comparison
Amphioceanic	23	3	2.2	1.5	-0.7
Amphipacific	12	4	1.2	2.0	0.8
Asia	95	20	9.2	9.8	0.6
Asia-American	16	7	1.5	3.4	1.9
Asia-Europe	6	4	0.6	2.0	1.4
Circumpolar	298	48	28.8	23.5	-5.3
Disjunctive	22	1	2.1	0.5	-1.6
Eastern Asia	406	84	39.3	41.2	1.9
Eastern Asia-American	38	9	3.7	4.4	0.7
Southeastern Asia	1	0	0.1	0.0	-0.1
Multiarea	116	24	11.2	11.8	0.6
Total	1,033	204	100	100	0

Anomodon giraldii, *Anomodon rugelii*, *Boulaya mittenii*, *Trichocoleopsis sacculata*, *Jungermannia exsertifolia* subsp. *cordifolia*, *Plagiochila hakkodensis*, *Cephaloziella spinicaulis*, *Frullania diversitexta*, *Frullania inflata*) recorded in the Gayasan Mountain, whereas Hong (1966) reported 20 taxa on Gayasan Mountain as part of an inventory of the liverworts of the Korean Peninsula. The first of the surveys described herein conducted by Song and Yamada (2009) focused on liverworts, during which 38 taxa were recorded, two (*Frullania aoshimensis* and *Radula oyamensis*) of which were recorded from the Korean Peninsula for the first time. A further analysis of records in the previous literature raised the total number of taxa to 58, and on the basis of subsequent

literature and survey studies, the total number of taxa currently stands at 204 (115 mosses and 89 liverworts).

Notable species

The most noteworthy species identified during the course of surveying are *Hattoria yakushimensis* (Horik.) R. M. Schust., *Nipponolejeunea pilifera* (Steph.) S. Hatt., *Drepanolejeunea angustifolia* (Mitt.) Grolle, and *Lejeunea otiana* S. Hatt. which are rarely found in Korea, as well as *Cylindrocolea recurvifolia* (Steph.) Inoue, the population size of which on Gayasan Mountain is the largest among those recorded to date on Korean Mountains. Additionally, a further notable species is *Pogonatum contortum* (Menzies ex Brid.) Lesq., a

Fig. 3. Notable species of Gayasan Mountain in Korean flora. **A.** *Hattoria yakushimensis* (Horik.) R. M. Schust. **B.** *Nipponolejeunea pilifera* (Steph.) S. Hatt. **C.** *Drepanolejeunea angustifolia* (Mitt.) Grolle. **D.** *Lejeunea otiana* S. Hatt. **E.** *Cyindrocolea recurvifolia* (Steph.) Inoue. **F.** *Pogonatum contortum* (Menzies ex Brid.) Lesq.

rare bryophyte that grow in high-altitude areas (in excess of 1,000 m) (Fig. 3).

Hattoria yakushimensis was previously reported near the Sangwangbong Peak of Gayasan Mountain as a hitherto unrecorded species in Korea (Choi et al., 2011). This species is endemic to East Asia with a narrow distribution range (Japan and China) and is listed by the International Union for Conservation of Nature as a vulnerable (VU) species. In the present study, we also found *H. yakushimensis* on a cliff near the peak at an elevation of 1,313–1,350 m, where it grows with *Drepanolejeunea angustifolia*, *Plectocolea erecta*, and *Marsupella tubulosa*.

Nipponolejeunea pilifera, which is characterized by long cilia along the leaf dorsal lobe margin, is sparsely distributed in Japan, China, and the southernmost Russian Far East. In Korea, it has previously been recorded in Deogyusan Mountain and Jirisan Mountain (Choi et al., unpubl. data). In the present study, we found it on the edge of *Abies koreana* E. H. Wilson forest near the northern face between the peaks Sangwangbong and Chilbulbong. This species grows with *Frullania appendiculata*, *Frullania usamiensis*, and *Bazzania denudata*.

Drepanolejeunea angustifolia is mainly distributed in subtropical and tropical regions (Bhutan, Cambodia, China, India, Indonesia, Japan, New Caledonia, Papua New Guinea,

The Philippines, Sri Lanka, Thailand, and Vietnam) (Zhu and So, 2001). This bryophyte was previously reported near the Sangwangbong peak of Gayasan Mountain as an unrecorded species in Korea and has more recently been found in Jirisan Mountain, Hallasan Mountain, and Sobaeksan Mountain (Choi et al., 2012; Choi et al., unpubl. data). It is characterized by bifid underleaves, curved entire leaf margins, and 1 to 2 ocelli in the dorsal leaf lobe base, and found on shaded wet cliffs covering thin soil, along with *Plectocolea erecta*, *Marsupella tubulosa*, and *Hattoria yakushimensis*.

Lejeunea otiana has previously been collected in small caves near the Hongryudong Valley of Gayasan Mountain, at the time of which it was an unrecorded species in Korea (Choi et al., 2012). This species is distributed in Japan and the Korean islands of Jeju and Gageodo (Choi et al., unpubl. data). In the present study, we also found specimens in a small cave in the same area. This species grows on shaded wet cliffs along with *Acanthocoleus yoshinaganus*, *Conocephalum salebrosum*, and *Conocephalum japonicum*.

Cyindrocolea recurvifolia is distributed in Eastern Asian temperate regions (Japan and China), southward spreading to Indochina, and in Korea has previously been recorded in the Seolaksan, Gyeryongsan, Naejangsan, Naeyeonsan, Duryunsan, and Weolchulsan mountains and the islands of Oerarodo and Jeju. However, the patches found near the Hongryudong

Valley in the present study are, of the largest size of our knowledge, the largest that have been recorded to date. We accordingly believe that it is necessary to promote, protect, and appropriately manage the Hongryudong Valley, for example, by installing information boards in this area.

Pogonatum contortum is distributed in Eastern Asia–American temperate regions (Japan, China, India, Far East Russia, and North America) and the Keumgangsan, Seolaksan, Jirisan, and Hallasan regions of Korea at elevations greater than 1,000 m. We found it growing on slightly shaded wet soil near the northern face running from between the peaks of Sangwangbong and Chilbulbong. This species is characterized by a deep green foliage, the leaves of which are slightly curved when dried.

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Acknowledgments

The work was supported by the grant "Biological Diversity Survey of the Flora of Korean Bryophyta (NIBR201902104)" from the National Institute of Biological Resources of Ministry of Environment in Korea to C.W. Hyun. The work of Bakalin was partially supported by grants from the Russian Foundation for Basic researches (20-04-00278).

Conflict of Interest

The authors declare that there are no conflicts of interest.

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Appendix 1. The list of Bryophytes in Gayasan Mountain. The nomenclature and arrangement of taxa are followed the system which is proposed by Goffinet et al. (2009) for mosses and Crandall-Stotler et al. (2009) and Söderström et al. (2016) for liverworts, everywhere with the recent updates. Newly recorded species for Gayasan Mountain are marked with asterisk (*) in front of scientific names.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
Bryophyta	선류식물문			
Andereaeaceae	검정이끼과			
<i>Andereaea rupestris</i> var. <i>fauriei</i> (Besch.) Takaki.	검정이끼	Eastern Asia	Boreal	Park 16100993
Polytrichaceae	솔이끼과			
* <i>Atrichum rhystophyllum</i> (Müll. Hal.) Paris	아기주름솔이끼	Eastern Asia	Temperate	Park 16111069
* <i>Atrichum undulatum</i> (Hedw.) P. Beauv.	주름솔이끼	Circumpolar	Temperate	Park 16100948
* <i>Atrichum undulatum</i> var. <i>gracilisetum</i> Besch.	넓은주름솔이끼	Circumpolar	Boreal-temperate	Yim-GYM284
* <i>Pogonatum contortum</i> (Menzies ex Brid.) Lesq.	그늘들솔이끼	Eastern Asia-American	Temperate	Park 16101023
<i>Pogonatum inflexum</i> (Lindb.) Lac.	아기들솔이끼	Eastern Asia	Temperate-subtropical	Only literature (Kashimura 1940)
* <i>Pogonatum neesii</i> (Müll. Hal.) Doay.	들솔이끼	Eastern Asia	Temperate-subtropical	Park 16100953
* <i>Pogonatum spinulosum</i> Mitt.	침들솔이끼	Eastern Asia-American	Temperate-subtropical	Park 16100973
* <i>Pogonatum urnigerum</i> (Hedw.) P. Beauv.	산들솔이끼	Multiarea	Multizone	Park 16101021
<i>Polytrichastrum alpinum</i> (Hedw.) G. L. Sm	산솔이끼	Multiarea	Multizone	Only literature (Kashimura 1940)
* <i>Polytrichum formosum</i> Hedw.	큰솔이끼	Multiarea	Temperate	Park 16100957
Diphysciaceae	보리알이끼과			
* <i>Diphyscium fulvifolium</i> Mitt	보리알이끼	Eastern Asia	Temperate-subtropical	Park 16111064
* <i>Diphyscium lorifolium</i> (Cardot) Magombo	곰이끼	Asia	Temperate	Park 16111076
Funariaceae	표주박이끼과			
* <i>Funaria hygrometrica</i> Hedw.	표주박이끼	Multiarea	Multizone	Park 16101020
Bryoxiphiaceae	새우이끼과			
<i>Bryoxiphium norvegicum</i> subsp. <i>japonicum</i> (Berggr.) Love. & Love.	새우이끼	Circumpolar	Temperate	Yim-GYM104
Grimmiaceae	고깔바위이끼과			
* <i>Grimmia pilifera</i> P.Beauv.	흰털고깔바위이끼	Circumpolar	Boreal-temperate	Park 16111056
* <i>Racomitrium canescens</i> (Hedw.) Brid.	서리이끼	Circumpolar	Boreal-temperate	Park 16100963
* <i>Racomitrium fasciculare</i> (Hedw.) Brid.	민서리이끼	Multiarea	Multizone	Park 16100919
* <i>Racomitrium heterostichum</i> (Hedw.) Brid.	검정서리이끼	Circumpolar	Boreal-temperate	Park 1610098
* <i>Racomitrium lanuginosum</i> (Hedw.) Brid.	된서리이끼	Multiarea	Multizone	Park 1610095
* <i>Schistidium apocarpum</i> (Hedw.) Bruch. & Schimp.	고깔바위이끼	Multiarea	Multizone	Park 16100998
Ptychomitriaceae	곰솔이끼과			
* <i>Ptychomitrium dentatum</i> (Mitt.) A. Jaeger.	물가곰솔이끼	Eastern Asia	Temperate	Park 16111077
* <i>Ptychomitrium linearifolium</i> Reim. & Sakurai.	돌주름곰솔이끼	Eastern Asia	Temperate	Yim-GYM004
* <i>Ptychomitrium sinense</i> (Mitt.) A. Jaeger.	곰솔이끼	Circumpolar	Boreal-temperate	Park 16100916
Fissidentaceae	봉황이끼과			
* <i>Fissidens gymnogynus</i> Besch.	작은봉황이끼	Eastern Asia	Temperate	Park 16100922

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
<i>*Fissidens teysmannianus</i> Dozy & Molk.	아기봉 황이끼	Asia	Subtropical-tropical	Yim-GYM147
Bruchiaceae	두루미이끼과			
<i>*Trematodon longicollis</i> Michx.	두루미이끼	Multiarea	Multizone	Park 16101020-1
Erpodiaceae	나무연지이끼과			
<i>*Venturiella sinensis</i> (Venturi) Müll. Hal.	나무연지이끼	Eastern Asia-American	Temperate	Park 1610091
Rhabdoweisiaceae	주름꼬마이끼과			
<i>*Rhabdoweisia crispata</i> (With.) Lindb.	주름꼬마이끼	Multiarea	Boreal-temperate	Park 16100994
Dicranaceae	꼬리이끼과			
<i>*Dicranella heteromalla</i> (Hedw.) Schimp.	억새이끼	Circumpolar	Boreal-temperate	Park 16111074
<i>*Dicranum flagellare</i> Hedw.	잎눈꼬리이끼	Circumpolar	Boreal-temperate	Park 16100989
<i>*Dicranum fuscescens</i> Turner.	갈색고산꼬리이끼	Circumpolar	Boreal-temperate	Park 16101019
<i>*Dicranum japonicum</i> Mitt.	꼬리이끼	Eastern Asia	Temperate	Yim-GYM070
<i>*Dicranum majus</i> Turner.	고산나무꼬리이끼	Circumpolar	Boreal-temperate	Park 16101025
Leucobryaceae	흰털이끼과			
<i>*Brothera leana</i> (Sull.) Müll. Hal.	사자이끼	Asia-American	Boreal-temperate	Park 16100966
<i>*Campylopus sinensis</i> (Müll. Hal.) J. P. Frahm	붓이끼	Amphipacific	Temperate	Park 16100907
<i>*Leucobryum juniperoideum</i> (Brid.) Müll. Hal.	가는흰털이끼	Circumpolar	Temperate	Park 16100950
Pottiaceae	침꼬마이끼과			
<i>*Bryoerythrophyllum recurvirostrum</i> (Hedw.) P. C. Chen	빨간담배잎이끼	Circumpolar	Boreal-temperate	Yim-GYM285
<i>*Weisiopsis anomala</i> Broth. & Paris	겉꼬마이끼	Eastern Asia	Temperate	Yim-GYM019
<i>*Weissia controversa</i> Hedw.	꼬마이끼	Multiarea	Multizone	Yim-GYM041
<i>*Weissia crispa</i> (Hedw.) Mitt.	흙구슬이끼	Circumpolar	Temperate	Yim-GYM061
Bryaceae	참이끼과			
<i>*Brachymenium exile</i> (Dozy & Molk.) Bosch & Sande Lac	가는참외이끼	Multiarea	Subtropical-tropical	Park 16100945
<i>*Brachymenium nepalense</i> Hook.	노란참외이끼	Asia	Temperate-subtropical	Park 16100975
<i>Bryum argenteum</i> Hedw.	은이끼	Multiarea	Multizone	Park 16111051
<i>*Bryum pseudotriquetrum</i> (Hedw.) P. Gaertn.	큰철사이끼	Multiarea	Multizone	Yim-GYM286
<i>*Rosulabryum capillare</i> (Hedw.) J. R. Spence	뱀뱀철사이끼	Multiarea	Multizone	Park 16100938
Mniaceae	초롱이끼과			
<i>*Mnium lycopodioides</i> Schwägr.	납작맥초롱이끼	Circumpolar	Boreal-temperate	Park 1610096
<i>*Mnium stellare</i> Reichard ex Hedw.	별꼴초롱이끼	Circumpolar	Boreal-temperate	Park 16111061
<i>Plagiomnium acutum</i> (Lindb.) T. J. Kop.	아기들덩굴초롱이끼	Asia	Boreal-temperate	Yim-GYM100
<i>*Plagiomnium cuspidatum</i> (Hedw.) T. J. Kop.	들덩굴초롱이끼	Circumpolar	Boreal-temperate	Park 16100941
<i>*Plagiomnium maximoviczii</i> (Lindb.) T. J. Kop.	덩굴초롱이끼	Asia	Subtropical	Park 16111060
<i>*Plagiomnium vesicatum</i> (Besch.) T. J. Kop.	큰잎덩굴초롱이끼	Asia-Europe	Temperate	Yim-GYM112
<i>*Pohlia prolifera</i> (Kindb.) Broth.	흙줄수세미이끼	Circumpolar	Boreal-temperate	Park 16100994-1
<i>*Rhizomnium punctatum</i> (Hedw.) T. J. Kop.	미선초롱이끼	Circumpolar	Boreal-temperate	Only literature (Kashimura 1939)
<i>Rhizomnium striatulum</i> (Mitt.) T. J. Kop.	줄미선초롱이끼	Asia	Boreal-temperate	Yim-GYM230

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
<i>*Trachycystis flagellaris</i> (Sull. & Lesq.) Lindb.	털아기초롱이끼	Eastern Asia-American	Boreal-temperate	Yim-GYM287
<i>*Trachycystis microphylla</i> (Dozy & Molk.) Lindb	아기초롱이끼	Eastern Asia-American	Subtropical	Park 16101030
<i>*Trachycystis ussuriensis</i> (Maack & Regel) T. J. Kop.	꼬인아기초롱이끼	Asia-Europe	Boreal-temperate	Yim-GYM288
Bartramiaceae	구슬이끼과			
<i>*Philonotis falcata</i> (Hook.) Mitt.	낫물가이끼	Multiarea	Temperate-subtropical	Park 16100933
<i>*Philonotis fontana</i> (Hedw.) Brid.	물가이끼	Multiarea	Multizone	Yim-GYM018
Hedwigiaceae	툇이끼과			
<i>Hedwigia ciliata</i> (Hedw.) P. Beauv.	툇이끼	Multiarea	Multizone	Park 16100937
Hookeriaceae	기름종이이끼과			
<i>*Hookeria acutifolia</i> Hook. & Grev.	기름종이이끼	Multiarea	Temperate-subtropical	Yim-GYM289
Amlystegiaceae	벼들이끼과			
<i>*Campyliadelphus chrysophyllus</i> (Brid.) R.S.Chopra	가는노란변덕이끼	Circumpolar	Boreal-temperate	Park 1610099
Leskeaceae	고깔검정이끼과			
<i>*Haplocladium angustifolium</i> (Hampe & Müll. Hal.) Broth.	침작은명주실이끼	Multiarea	Temperate	Yim-GYM077
<i>*Haplocladium microphyllum</i> (Hedw.) Broth.	작은명주실이끼	Circumpolar	Multizone	Yim-GYM006
<i>*Miyabea fruticella</i> (Mitt.) Broth.	꼬마나무이끼	Eastern Asia	Temperate	Park 16111084
Thuidiaceae	깃털이끼과			
<i>Boulaya mittenii</i> (Broth.) Cardot	아기방울이끼	Eastern Asia	Boreal-temperate	Only literature (Kashimura 1940)
<i>*Fauriella tenuis</i> (Mitt.) Cardot	수염이끼	Eastern Asia	Temperate-subtropical	Park 16100944
<i>*Pelekium versicolor</i> (Hornsch. ex Müll. Hal.) Touw	아기깃털이끼	Asia	Subtropical-tropical	Yim-GYM024
<i>*Thuidium kanedae</i> Sakurai	깃털이끼	Eastern Asia	Temperate-subtropical	Park 16100931
Brachytheciaceae	양털이끼과			
<i>*Brachythecium buchananii</i> (Hook.) A. Jaeger.	긴양털이끼	Eastern Asia	Temperate	Yim-GYM290
<i>*Brachythecium helminthocladum</i> Broth. & Pari	끈양털이끼	Eastern Asia	Temperate	Yim-GYM080
<i>*Brachythecium plumosum</i> (Hedw.) Schimp.	날개양털이끼	Circumpolar	Multizone	Yim-GYM101
<i>*Brachythecium populeum</i> (Hedw.) Schimp.	양털이끼	Multiarea	Temperate	Park 16101009
<i>*Brachythecium rivulare</i> Schimp.	물가양털이끼	Circumpolar	Boreal-temperate	Yim-GYM291
<i>*Bryhnia novae-angliae</i> (Sull. & Lesq.) Grout	곰솔세모양털이끼	Circumpolar	Boreal-temperate	Yim-GYM292
<i>*Eurhynchium savatieri</i> Schimp. ex Besch.	가는부리이끼	Eastern Asia	Temperate-subtropical	Yim-GYM020
<i>*Homalothecium laevisetum</i> Sande Lac.	나뭇가지이끼	Eastern Asia	Subtropical-tropical	Yim-GYM293
<i>Myuroclada maximowiczii</i> (G. G. Borshch.) Steere & W.B. Schofield	쥐꼬리이끼	Circumpolar	Boreal-temperate	Yim-GYM108
<i>*Okamuraea brachydictyon</i> (Cardot) Nog.	가는길양털이끼	Eastern Asia	Boreal-temperate	Yim-GYM294
<i>*Okamuraea hakoniensis</i> (Mitt.) Broth.	길양털이끼	Asia	Boreal-temperate	Yim-GYM295
<i>*Rhynchostegium pallidifolium</i> (Mitt.) A. Jaeger	아기양털부리이끼	Eastern Asia	Temperate-subtropical	Yim-GYM296
<i>*Rhynchostegium riparioides</i> (Hedw.) Cardot	물가부리이끼	Circumpolar	Temperate-subtropical	Park 16100924
<i>Meteorium buchananii</i> subsp. <i>helminthocladulum</i> (Cardot) Nog.	아기누운끈이끼	Asia	Temperate-subtropical	Only literature (Kashimura 1940)

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
Hypnaceae	털깃털이끼과			
* <i>Gollania ruginosa</i> (Mitt.) Broth.	주름사슴뿔이끼	Asia	Boreal-temperate	Park 16101007
* <i>Gollania varians</i> (Mitt.) Broth.	사슴뿔이끼	Eastern Asia	Temperate	Park 1610101
* <i>Hypnum oldhamii</i> (Mitt.) A. Jaeger	가느털깃털이끼	Eastern Asia	Temperate-subtropical	Park 16100940
* <i>Hypnum plumaeforme</i> Wilson	털깃털이끼	Disjunctive	Temperate-subtropical	Park 1610095
* <i>Hypnum tristo-viride</i> (Broth.) Paris	실털깃털이끼	Eastern Asia	Temperate-subtropical	Park 16100991
* <i>Pseudotaxiphyllum pohliaecarpum</i> (Sull. & Lesq.) Z. Iwats.	빨간겉주목이끼	Asia	Subtropical	Park 16111070
* <i>Taxiphyllum aomoriense</i> (Besch.) Z. Iwats.	겉친주목이끼	Eastern Asia	Boreal-temperate	Yim-GYM240
* <i>Taxiphyllum taxirameum</i> (Mitt.) M. Fleisch.	주목이끼	Asia-American	Subtropical-tropical	Yim-GYM057
Rhytidiaceae	굵은이끼과			
<i>Rhytidium rugosum</i> (Hedw.) Kindb.	굵은이끼	Circumpolar	Boreal-temperate	Only literature (Kashimura 1940)
Plagiotheciaceae	산주목이끼과			
* <i>Plagiothecium cavifolium</i> (Brid.) Z. Iwats.	둥근산주목이끼	Circumpolar	Boreal-temperate	Park 16101008
* <i>Plagiothecium euryphyllum</i> (Cardot & Thér.) Z. Iwats.	넓은잎산주목이끼	Eastern Asia	Boreal-temperate	Yim-GYM012
* <i>Plagiothecium nemorale</i> (Mitt.) A. Jaeger.	산주목이끼	Multiaerea	Multizone	Park 16101006
Entodontaceae	윤이끼과			
* <i>Entodon challengerii</i> (Paris) Cardot	넓은잎윤이끼	Circumpolar	Boreal-temperate	Park 16100918
<i>Entodon flavescens</i> (Hook.) A. Jaeger.	가지윤이끼	Asia	Boreal-temperate	Park 16100968
* <i>Entodon luridus</i> (Griff.) A. Jaeger.	물가윤이끼	Eastern Asia	Boreal-temperate	Park 16111059
* <i>Entodon sullivantii</i> (Müll. Hal.) Lindb.	가느윤이끼	Eastern Asia-American	Boreal-temperate	Yim-GYM054
Pylaisiadelphaceae	털거울이끼과			
* <i>Pylaisiadelpha tenuirostris</i> (Bruch & Schimp.) W.R. Buck	털거울이끼	Eastern Asia	Temperate-subtropical	Park 16111079
Sematophyllaceae	무성아실이끼과			
* <i>Sematophyllum subhumile</i> (Müll. Hal.) M. Fleisch.	무성아실이끼	Asia	Subtropical-tropical	Yim-GYM065
Neckeraceae	납작이끼과			
<i>Homalia trichomanoides</i> (Hedw.) Schimp.	윤납작이끼	Circumpolar	Boreal-temperate	Yim-GYM297
* <i>Neckera humilis</i> Mitt.	납작이끼	Eastern Asia	Temperate-subtropical	Yim-GYM298
* <i>Thamnobryum subseriatum</i> (Mitt. ex Sande Lac.) B.C.Tan.	대호꼬리이끼	Eastern Asia	Boreal-temperate	Yim-GYM299
Leptodontaceae	방울이끼과			
* <i>Forsstroemia trichomitria</i> (Hedw.) Lindb.	방울이끼	Eastern Asia-American	Temperate	Yim-GYM082
Myuriaceae	겉쥐꼬리이끼과			
<i>Eumyrium sinicum</i> (Mitt.) Nog.	겉쥐꼬리이끼	Eastern Asia	Subtropical-tropical	Only literature (Kashimura 1940)
Anomodontaceae	명주실이끼과			
<i>Anomodon giraldii</i> Müll. Hal.	큰명주실이끼	Eastern Asia	Boreal-temperate	Yim-GYM300
* <i>Anomodon longifolius</i> (Schleich. ex Brid.) Hartm.	명주실이끼	Asia	Boreal-temperate	Park 16111085

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
<i>*Anomodon minor</i> (Hedw.) Lindb.	푸른명주살이끼	Asia-American	Boreal-temperate	Park 16100930
<i>Anomodon rugelii</i> (Müll. Hal.) Keissl.	곱슬명주살이끼	Circumpolar	Boreal-temperate	Yim-GYM130
<i>*Haplohymenium pseudo-triste</i> (Müll. Hal.) Broth.	꼬마바위살이끼	Amphioceanic	Boreal-temperate	Park 16100984
<i>*Herpetineuron toccoeae</i> (Sull. & Lesq.) Cardot	나선이끼	Asia-American	Subtropical-tropical	Park 16111080
<i>*Schwetschkeopsis fabronia</i> (Schwagr.) Broth.	개털이끼	Eastern Asia-American	Temperate	Park 16111086
<i>*Schwetschkeopsis robustula</i> (Broth.) Ando	큰개털이끼	Eastern Asia	Temperate	Park 16100926
Marchantiophyta	태류식물문			
Aytoniaceae	삿갓우산이끼과			
<i>*Reboulia hemisphaerica</i> (L.) Raddi	삿갓우산이끼	Multiarea	Multizone	Choi 161194
Conocephalaceae	패랭이우산이끼과			
<i>Conocephalum salebrosum</i> Szweyk., Buczk. et Odrzyk.	패랭이우산이끼	Circumpolar	Boreal	Choi 161180
<i>*Conocephalum japonicum</i> (Thunb.) Grolle	아기패랭이우산이끼	Eastern Asia	Multizone	Choi 161195
Pelliaceae	물우산대이끼과			
<i>*Apopellia endiviifolia</i> (Dicks.) Nebel et D.Quandt	가는물우산대이끼	Circumpolar	Boreal	Yim-GYM301
Metzgeriaceae	리본이끼과			
<i>*Metzgeria lindbergii</i> Schiffn.	리본이끼	Multiarea	Multizone	Yim-GYM163
<i>*Metzgeria temperata</i> Kuwah.	무성아리본이끼	Amphioceanic	Temperate-subtropical	Choi 161300
Aneuraceae	초록우산대이끼과			
<i>*Aneura maxima</i> (Schiffner) Steph.	큰초록우산대이끼	Multiarea	Multizone	Choi 161181
Porellaceae	세줄이끼과			
<i>Porella caespitans</i> var. <i>cordifolia</i> (Steph.) S. Hatt. ex T. Katag. et T. Yamag.	침세줄이끼	Asia	Temperate-subtropical	Only literature (Hong 1966)
<i>Porella grandiloba</i> Lindb.	큰세줄이끼	Eastern Asia	Temperate-subtropical	Choi 161223
<i>Porella ulophylla</i> (Steph.) S. Hatt.	주름세줄이끼	Eastern Asia	Temperate-subtropical	Choi 161191
<i>Porella vernicosa</i> Lindb.	가시세줄이끼	Eastern Asia	Temperate-subtropical	Yim-GYM302
Radulaceae	부채이끼과			
<i>*Radula auriculata</i> Steph.	귀부채이끼	Amphipacific	Boreal-temperate	Choi 161267a
<i>*Radula cavifolia</i> Hampe	큰잎부채이끼	Asia	Subtropical-tropical	Choi 161242
<i>Radula constricta</i> Steph.	무성아부채이끼	Eastern Asia	Boreal-temperate	Choi 161268
<i>*Radula japonica</i> Gottsche	부채이끼	Eastern Asia	Temperate-subtropical	Choi 161198
<i>Radula oyamensis</i> Steph.	쳐너부채이끼	Eastern Asia	Temperate-subtropical	Only literature (Song & Yamada 2009)
Frullaniaceae	지네이끼과			
<i>Frullania aoshimensis</i> Horik.	가야지네이끼(신칭)	Eastern Asia	Temperate	Only literature (Song & Yamada 2009)
<i>Frullania appendiculata</i> Steph.	침지네이끼	Eastern Asia	Temperate-subtropical	Choi 161314
<i>Frullania ericoides</i> (Nees ex Mart.) Mont.	초록지네이끼	Circumpolar	Subtropical-tropical	Only literature (Song & Yamada 2009)

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
<i>Frullania davurica</i> Hampe	빨간지네이끼	Asia	Boreal-temperate	Choi 161252
<i>Frullania densiloba</i> Steph.	가느디네이끼	Eastern Asia-American	Subtropical	Choi 161205a
<i>Frullania diversitexta</i> Steph.	지네이끼	Eastern Asia	Subtropical	Only literature (Hong 1966)
<i>Frullania inflata</i> Gottsch.	물가지네이끼	Asia-American	Temperate-subtropical	Only literature (Hong 1966)
<i>Frullania muscicola</i> Steph.	참지네이끼	Asia	Temperate	Choi 161185
<i>Frullania parvistipula</i> Steph.	종지네이끼	Asia-Europe	Temperate-subtropical	Only literature (Song & Yamada 2009)
<i>*Frullania pedicellata</i> Steph.	검정지네이끼	Eastern Asia	Subtropical	Choi 4342
<i>*Frullania schensiana</i> C. Massal.	산지네이끼	Eastern Asia	Temperate-subtropical	Choi 161190
<i>Frullania taradakensis</i> Steph.	들지네이끼	Eastern Asia	Subtropical	Choi 161196
<i>Frullania usamienensis</i> Steph.	우사미지네이끼	Eastern Asia	Temperate	Choi 161262
Jubulaceae	가시지네이끼과			
<i>*Nipponolejeunea pilifera</i> (Steph.) S. Hatt.	긴털귀이끼	Eastern Asia	Boreal-temperate	Choi 161299a
Lejeuneaceae	작은귀이끼과			
<i>Acrolejeunea pusilla</i> (Steph.) Grolle & Gradst.	사슴주름이끼	Eastern Asia	Boreal-temperate	Only literature (Song & Yamada 2009)
<i>*Cheilolejeunea obtusifolia</i> (Steph.) S. Hatt.	아기사슬이끼	Eastern Asia	Temperate	Choi 161201
<i>Cololejeunea japonica</i> (Schiffn.) Mizut.	세모귀이끼	Eastern Asia	Subtropical	Only literature (Song & Yamada 2009)
<i>*Cololejeunea longifolia</i> (Mitt.) Benedix	긴귀이끼	Eastern Asia	Temperate-subtropical	Choi 161200
<i>*Dicranolejeunea yoshinagana</i> (S. Hatt.) Mizut.	검정비늘이끼	Eastern Asia	Temperate-subtropical	Choi 161183
<i>*Drepanolejeunea angustifolia</i> (Mitt.) Grolle	칼잎이끼	Eastern Asia	Subtropical	Choi 161247
<i>Lejeunea discreta</i> Lindb.	낮작은귀이끼	Eastern Asia	Subtropical	Only literature (Song & Yamada 2009)
<i>Lejeunea japonica</i> Mitt.	작은귀이끼	Eastern Asia	Temperate-subtropical	Choi 161187b
<i>*Lejeunea otiana</i> S. Hatt.	둥굴작은귀이끼	Eastern Asia	Subtropical	Choi 161182
<i>Lejeunea parva</i> (S. Hatt.) Mizut.	들작은귀이끼	Eastern Asia	Temperate-subtropical	Song & Yamada 2009
<i>Lejeunea ulicina</i> (Taylor) Gottsche	아기작은귀이끼	Asia-Europe	Subtropical	Choi 161205b
<i>Acrolejeunea sandvicensis</i> (Gottsche) Steph.	둥근귀이끼	Circumpolar	Temperate-subtropical	Choi 161186
Herbertaceae	쌍갈고리이끼과			
<i>Herbertus aduncus</i> (Dicks.) Gray	쌍갈고리이끼	Asia-American	Arctic-boreal	Choi 161299b
Lepidoziaceae	벼슬이끼과			
<i>*Bazzania denudata</i> (Torr. ex Lindenb.) Trevis.	산좁벼슬이끼	Eastern Asia	Temperate	Choi 161311
Neotrichocoleaceae	털이끼과			
<i>Trichocoleopsis sacculata</i> (Mitt.) S. Okamura	가시잎이끼	Eastern Asia	Temperate	Choe 1975

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
Lophocoleaceae	두끝벼슬이끼과			
* <i>Chiloscyphus pallescens</i> (Ehrh. ex Hoffm.) Dumort.	아기물비늘이끼	Circumpolar	Boreal	Yim-GYM303
<i>Chiloscyphus polyanthos</i> (L.) Corda	물비늘이끼	Circumpolar	Boreal	Choi 161222
<i>Heteroscyphus planus</i> (Mitt.) Schiffn.	비늘이끼	Eastern Asia	Subtropical	Yim-GYM113
<i>Lophocolea heterophylla</i> (Schrad.) Dumort.	두끝벼슬이끼	Circumpolar	Boreal	Only literature (Hong 1966)
<i>Lophocolea minor</i> Nees	아기두끝벼슬이끼	Circumpolar	Arctic-boreal	Yim-GYM304
Plagiochilaceae	날개이끼과			
<i>Pedinophyllum truncatum</i> (Steph.) Inoue	누운날개이끼	Eastern Asia	Temperate	Choi 161302
<i>Plagiochila hakkodensis</i> Steph.	빗타날개이끼	Eastern Asia	Boreal-temperate	Only literature (Choe 1975)
<i>Plagiochila ovalifolia</i> Mitt.	둥근날개이끼	Eastern Asia	Temperate-subtropical	Choi 161189
<i>Plagiochila porelloides</i> (Torrey) Lindenb.	숲날개이끼	Circumpolar	Arctic-boreal	Choi 161293
* <i>Plagiochila sciophylla</i> Nees	아기날개이끼	Asia	Subtropical	Choi 161184
<i>Xenochila integrifolia</i> (Mitt.) Inoue	세모날개이끼	Eastern Asia	Temperate	Only literature (Song & Yamada 2009)
Jamesoniellaceae	가을비늘이끼과			
<i>Szyziella autumnalis</i> (DC.) K. Feldberg, Vána, Hentschel et Heinrichs	가을비늘이끼	Circumpolar	Temperate	Choi 161296
Cephaloziaceae	게발이끼과			
* <i>Cephalozia otaruensis</i> Steph.	게발이끼	Amphipacific	Boreal	Yim-GYM305
Cephaloziellaceae	걸게발이끼과			
<i>Cephaloziella divaricata</i> (Sm.) Warnst.	들걸게발이끼	Circumpolar	Arctic	Choi 161296
* <i>Cephaloziella hampeana</i> (Nees) Schiffn. ex Leske	산걸게발이끼	Circumpolar	Boreal	Choi 161207
* <i>Cephaloziella microphylla</i> (Steph.) Douin	세모걸게발이끼	Eastern Asia	Temperate	Choi 161227
<i>Cephaloziella spinicaulis</i> Douin	가시걸게발이끼	Asia-American	Temperate	Only literature (Hong 1966)
* <i>Cylindrocolea recurvifolia</i> (Steph.) Inoue	물걸게발이끼	Eastern Asia	Temperate	Choi 161204
Scapaniaceae	엄마이끼과			
* <i>Diplophyllum albicans</i> (L.) Dumort.	흰긴엄마이끼	Amphioceanic	Arctic	Choi 161210
* <i>Scapania ampliata</i> Steph.	큰엄마이끼	Eastern Asia	Arctic-boreal	Choi 161234a
* <i>Scapania ciliata</i> Sande Lac.	털엄마이끼	Eastern Asia	Boreal	Choi 161309a
* <i>Scapania integerrima</i> Steph.	들엄마이끼	Eastern Asia	Temperate	Choi 161257a
* <i>Scapania parvitexta</i> Steph.	배루카엄마이끼	Eastern Asia	Boreal-temperate	Choi 161262b
* <i>Scapania undulata</i> (L.) Dumort.	자주엄마아끼	Circumpolar	Arctic-boreal	Choi 161319
Lophoziaceae	갈래잎이끼과			
* <i>Hattoria yakushimensis</i> (Horik.) R. M. Schust.	하늘이끼	Eastern Asia	Temperate	Choi 161230
* <i>Plicanthus birmensis</i> (Steph.) R. M. Schust.	단풍이끼	Eastern Asia	Subtropical-tropical	Choi 161202a
Calypogeiaceae	목걸이이끼과			
<i>Calypogeia arguta</i> Nees & Mont. ex Nees	아기목걸이이끼	Amphipacific	Temperate	Choi 161301b

Appendix 1. Continued.

Scientific name	Korean name	Longitudinal type	latitudinal type	Voucher No.
<i>*Calypogeia tosana</i> (Steph.) Steph.	들목걸이끼	Eastern Asia	Temperate	Choi 161322
Delavayellaceae	꼭지망울이끼과			
<i>*Liochlaena subulata</i> (A. Evans) Schljakov	꼭지망울이끼	Circumpolar	Boreal-temperate	Choi 161187a
Jungermanniaceae	망울이끼과			
<i>*Jungermannia atrovirens</i> Dumort.	암록망울이끼	Circumpolar	Arctic	Choi 4353
<i>Jungermannia exsertifolia</i> Steph.	심장형망울이끼	Circumpolar	Arctic	Only literature (Hong 1966)
Solenostomataceae	등근망울이끼과			
<i>*Nardia assamica</i> (Mitt.) Amakawa	빨간비늘이끼	Eastern Asia	Arctic-boreal	Choi 4336
<i>*Plectocolea erecta</i> Amakawa	곧은망울이끼	Eastern Asia	Temperate	Choi 161249
<i>*Plectocolea infusca</i> Mitt.	큰망울이끼	Eastern Asia	Temperate-subtropical	Choi 161267b
<i>*Plectocolea ovalifolia</i> (Amakawa) Bakalin & Vilnet	누운큰망울이끼	Eastern Asia	Boreal-temperate	Choi 7429
<i>*Plectocolea rosulans</i> (Steph.) S. Hatt.	망울이끼	Eastern Asia	Temperate-subtropical	Yim-GYM184
<i>*Plectocolea truncata</i> (Nees) Bakalin	들망울이끼	Eastern Asia	Temperate-subtropical	Choi 161258
<i>Protosolenostoma fusiforme</i> (Steph.) Vilnet & Bakalin	방추형망울이끼	Eastern Asia	Boreal-temperate	Only literature (Song & Yamada 2009)
<i>*Solenostoma pyriformum</i> Steph.	등근망울이끼	Asia	Arctic-boreal	Choi 161264a
<i>*Solenostoma rotundatum</i> Amakawa	산망울이끼	Eastern Asia	Temperate-subtropical	Choi 4355
<i>*Solenostoma sunii</i> Bakalin & Vilnet	선망울이끼	Eastern Asia	Temperate	Choi 7415
Gymnomitriaceae	은비늘이끼과			
<i>*Marsupella pseudofunkii</i> S. Hatt.	가는양끝통이끼	Eastern Asia	Temperate	Choi 161309b
<i>*Marsupella tubulosa</i> Steph.	양끝통이끼	Circumpolar	Arctic-boreal	Choi 161317
<i>*Marsupella yakushimensis</i> Steph.	산양끝통이끼	Eastern Asia	Temperate	Yim-GYM306