

Mosses of Kedrovaya Pad Nature Reserve, Primorskiy Territory, Far East Russia

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Abstract The moss flora of Kedrovaya Pad Nature Reserve, Far East Russia, was investigated in 2015. The mosses recognized comprise 26 families, 65 genera and 93 species. Three species, *Hypnum oldhamii*, *H. tristo-viride* and *Palamocladium leskeoides*, are new to Russia. The moss flora of Kedrovaya Pad Nature Reserve mainly consists of East Asian and circumboreal species. *Eocronartium muscicola*, parasitic bryophilous basidiomycete, was found on four species, *Myuroclada maximoviczii*, *Oncophorus crispifolius*, *Pylaisia stereodontoides* and *Taxiphyllum aomoriense*. For each species, locality, substrate, specimen number and element of distribution were given.

Key words: bryophytes, *Eocronartium muscicola*, Far East Russia, flora, Kedrovaya Pad Nature Reserve, mosses, Primorskiy Territory.

Introduction

This study deals with the moss flora of Kedrovaya Pad Nature Reserve, Primorskiy Territory, Far East Russia. Although the outline of the moss flora in Russia is becoming clear (cf. Ignatov *et al.*, 2006), there has never been enough knowledge on the local flora. In 2015 we made a field research and collected bryophytes mainly from Kedrovaya River basin.

Kedrovaya Pad Nature Reserve is situated at ca. 20 km west of Vladivostok, 43°01' to 43°09'N; 131°24' to 131°36'E, and located in the southernmost of Far East Russia, that is, on the Khasansky District in the southern part of Primorsky territory, and it occupies an area of ca. 180 square kilometers. The native deciduous broad-leaved and the coniferous forests are dominated by *Quercus mongolica*, *Acer mono*, etc. and *Abies holophylla*, *Pinus koraiensis*, etc.,

respectively. This area is also famous for endemic animals such as Amur tiger, Amur leopard and Asian black bear.

Materials and Methods

Field study was carried out in 2015, and a total of ca. 160 bryophyte specimens were collected. The complete set of the specimens are preserved in the herbarium of the Department of Botany, National Museum of Nature and Science (TNS) and some duplicates in the herbarium of the Botanical Garden-Institute, Far Eastern Branch, Russian Academy of Sciences (VBGI). The main sites investigated are as follows.

- A. Kedrovaya River Valley, the flood plain, broad-leaved deciduous temperate forest, 43°06'12N, 131°32'28E, ca. 45–60 m alt., July 8, 2015.
- B. Kedrovaya River system, Vtoroj Zolotoj

Stream middle course, broad-leaved deciduous temperate forest with admixture of *Abies holophylla* and *Pinus koraiensis*, 43°05'52N, 131°32'30E, ca. 150–500 m alt., July 9, 2015.

- C. Kedrovaya River system, flood plain in middle course, broad-leaved deciduous temperate forest with admixture of *Abies holophylla* and *Pinus koraiensis*, 43°06'12N, 131°32'58E, ca. 60–80 m alt., July 10, 2015.
- D. Kedrovaya River system, upper course of Pervyj Zolotoj Stream, broad-leaved *Betula-Abies holophylla-Pinus koraiensis* forest on slope, 43°05'19N, 131°32'02E, ca. 65–350 m alt., July 11, 2015.

Results and Discussion

The mosses recognized in this study comprise 26 families, 65 genera and 93 species. Three species, *Hypnum oldhamii*, *H. tristo-viride* and *Palamocladium leskeoides*, are new to Russia (cf. Ignatov *et al.*, 2006).

1. Phytogeographical analysis of the moss flora

To make clear the characteristics of the moss flora of Kedrovaya Pad Nature Reserve, the elements of distribution was studied. A total of 93 species recognized from this area include several elements of distribution. They are classified roughly into the following floristic groups: East Asian species (41 spp., 44%), circumboreal species (31 spp., 33%), cosmopolitan species (8 spp., 9%), or others (13 spp., 14%). There are no endemic species to this area. The East Asian and circumboreal species constitute about 77% of the species and represent the moss flora of Kedrovaya Pad Nature Reserve. The East Asian species occur in East Asia including China, Korea and Japan, but exceptionally extend to westwards Himalayan region and northeastwards Alaska region. Twenty one species of 41 East Asian species are known only from the “South Far East” in Russia (cf. Ignatov *et al.*, 2006). The circumboreal species, widely occurring in the Northern Hemisphere, include *Anomodon rugelii*, *Bartra-*

mia pomiformis, *Calliergonella lindbergii*, etc. The cosmopolitan species, occurring widely without relation to any continent or vegetation types, are represented by *Anoetangium thomsonii*, *Fissidens taxifolium*, *Haplocladium angustifolium*, etc. Among others, *Thuidium cymbifolium* is only species known as palaeotropical species which is distributed mainly in tropical Asia.

2. Infection of *Eocronartium muscicola*

Eocronartium muscicola is a parasitic bryophilous basidiomycete and is known as an obligate parasite recorded on 21 moss species of different genera and families (Boehm and McLaughlin, 1988). We found fruiting bodies of *Eocronartium muscicola* at young sporophytes of *Myuroclada maximoviczii* (Fig. 3), *Oncophorus crispifolius*, *Pylaisia stereodontoides* (Fig. 9) and *Taxiphyllum aomoriense* (Fig. 10) in different sites of this area. Although they belong to the different taxonomic groups, they could have the similar developmental stage of the sporophytes in the field.

3. Enumeration of species

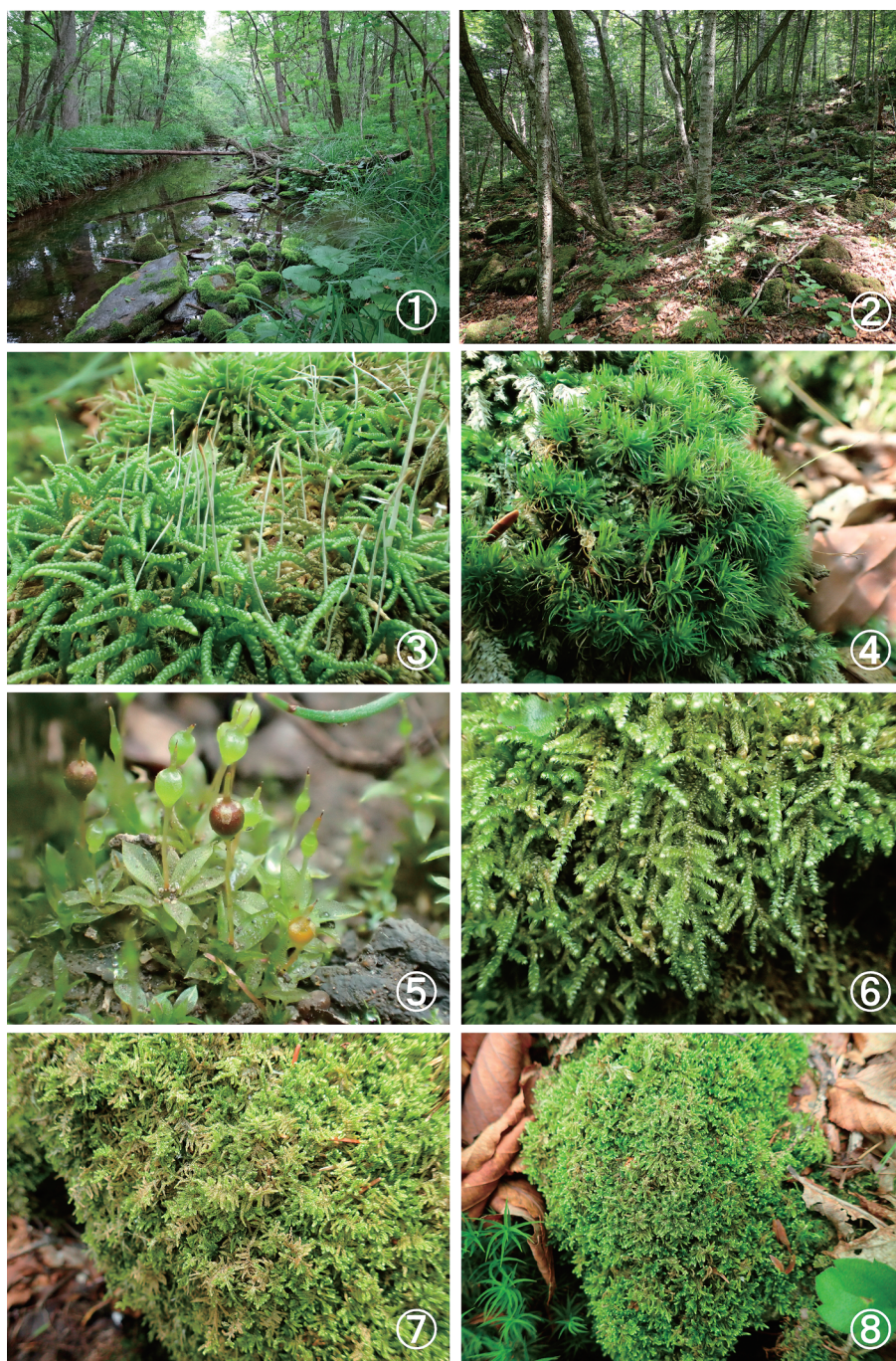
The species recognized from Kedrovaya Pad Strict Nature Reserve are listed below. The scientific names follow Iwatsuki (2004) and Goffinet *et al.* (2009). The families, genera and species are arranged alphabetically. Each species is referred by collecting sites (A–D), substrates, collector's numbers of Higuchi and distributional elements. An asterisk (*) preceding a species indicates a species to be known only from the “South Far East” in Russia (cf. Ignatov *et al.*, 2006).

Amblystegiaceae

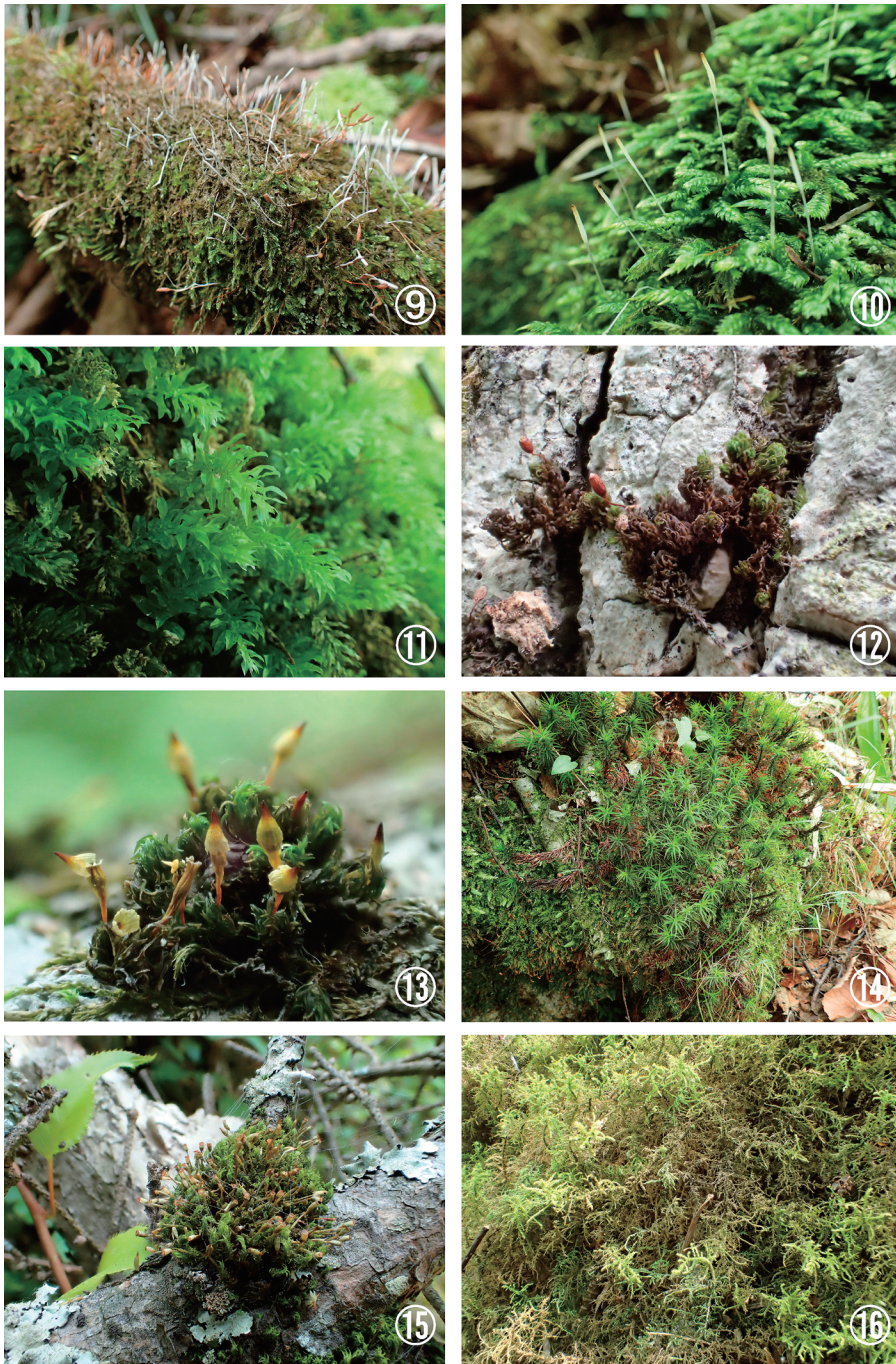
Campylium hispidulum (Brid.) Mitt. B: on basal part of rock-cliff, mh-53510 (+ *Oxystegus tenuirostris*), 53512. C: on decaying log, mh-53573. Circumboreal.

***Pseudohygrohypnum eugyrium** (Bruch & Schimp.) Kanda. B: on boulder, mh-53540 (+ *Brachythecium rivulare*). Circumboreal.

Sanionia uncinata (Hedw.) Loeske B: on rock-



Figs. 1–8. 1. A broad-leaved deciduous forest, along a branch of Kedrovaya River, ca. 60 m alt. 2. A mixed *Betula* sp, *Abies holophylla* and *Pinus koraiensis* forest, at upper course of Pervyj Zolotoj Stream, Kedrovaya River system, ca. 350 m alt. 3. *Myuroclada maximoviczii* growing on boulder. *Eocronartium muscicola*, parasitic bryophilous basidiomycete, infected the species. 4. *Dicranum mayrii* growing on decaying log. 5. *Physcomitrium sphaericum* growing on soil. 6. *Gollania ruginosa* growing on basal part of trunk. 7. *Hypnum oldhamii* growing on boulder. 8. *Hypnum tristo-viride* growing on boulder.



Figs. 9–16. 9. *Pylaisia stereodontoides* growing on decaying log. *Eocronartium muscicola* infected the species. 10. *Taxiphyllum aomoriense* growing on boulder. *Eocronartium muscicola* infected the species. 11. *Trachycystis ussuriensis* growing on boulder. 12. *Macromitrium japonicum* growing on trunk of *Juglans* sp. 13. *Ulotia japonica* growing on tree-trunk. 14. *Pogonatum japonicum* growing on soil. 15. *Glyphomitrium humillimum* growing on decaying branch. 16. *Bryonoguchia molkenboeri* growing on boulder.

cliff, mh-53511. Circumboreal.

Anomodontaceae

***Anomodon abbreviatus** Mitt. D: on trunk of *Quercus mongolica*, mh-53579. East Asian.

Anomodon rugelii (Müll.Hal.) Keissl. D: on root, mh-53582 (+ *Rauvolfia fujisana*). Circumboreal.

Anomodon thraustus Müll.Hal. A: on trunk of *Quercus dentata*, mh-53470 (+ *Haplohymenium triste*); on tree-trunk, mh-53487. Others.

Haplohymenium triste (Ces.) Kindb. A: on tree-trunk of *Quercus dentata*, mh-53470 (+ *Anomodon thraustus*); on trunk of *Acer mono*, mh-53493 (+ *Pylaisia stereodontoides*). Circumboreal.

Herpetineuron toccoae (Sull. & Lesq.) Cardot A: on trunk of *Alnus* sp., mh-53498). Cosmopolitan.

***Schwetschkeopsis fabronia** (Schwägr.) Broth. C: on rock-cliff, mh-53565. Others.

Bartramiaceae

Bartramia pomiformis Hedw. B: on rock-cliff, mh-53529. Circumboreal.

Brachytheciaceae

Brachythecium rivulare Schimp. A: on boulder, mh-53474. B: on boulder, mh-53540 (+ *Hygrohypnum eugyrium*). D: on rock-cliff, mh-53586. Circumboreal.

Brachythecium salebrosum (F.Weber & Mohr) Schimp. D: on soil bank, mh-53589. Others.

Bryhnia hultenii E.B.Bartram A: on boulder covered with humus, mh-53479. C: on rock-cliff, mh-53570. East Asian (incl. west N. America).

Bryhnia novae-angliae (Sull. & Lesq.) Grout A: on humus, mh-53500 (+ *Plagiomnium acutum*). C: on boulder covered with thin layer of soil, mh-53576. Circumboreal.

Myuroclada maximoviczii (Borcz.) Steere & W. B.Schofield A: on boulder, mh-53491. East

Asian (incl. west N. America). (Fig. 3)

***Okamuraea hakoniensis** (Mitt.) Broth. C: on decaying log, mh-53572. East Asian.

Palamocladium leskeoides (Hook.) E.G.Britton D: on rock-cliff, mh-53603 (+ *Thamnobryum plicatulum*). East Asian.

Notes. This species is new to Russia.

Rhynchostegium riparioides (Hedw.) Cardot C: on boulder, mh-53563. Circumboreal.

Bryaceae

Bryum cyclophyllum (Schwägr.) Bruch & Schimp. B: on boulder, mh-53546. Circumboreal.

Climaciaceae

Climacium dendroides (Hedw.) F.Weber & Mohr A: on boulder covered with humus, mh-53482. Others.

Dicranaceae

Dicranella heteromalla (Hedw.) Schimp. B: on rock-cliff, mh-53535 (+ *Rhabdoweisia crispata*). D: on rock-cliff, mh-53590, 53593. East Asian.

Dicranum flagellare Hedw. B: on decaying log, mh-53549. Others.

Dicranum japonicum Mitt. B: on boulder, mh-53561. D: on boulder, mh-53606, 53626 (+ *Polytrichum formosum*), 53627. East Asian.

***Dicranum mayrii** Broth. A: on decaying log, mh-53477 (+ *Haplocladium microphyllum*), 53489, 53497 (+ *Haplocladium microphyllum*). East Asian.

***Dicranum nipponense** Besch. B: on decaying log, mh-53517 (+ *Rhizomnium parvulum*). East Asian.

Entodontaceae

Entodon flavescens (Hook.) A.Jaeger A: on decaying log, mh-53478. East Asian (incl. S. India).

Entodon scabridens Lindb. C: on tree-trunk, mh-53578. East Asian.

***Entodon sullivantii** (Müll.Hal.) Lindb. C: on boulder, mh-53562 (+ *Haplocladium angustifolium*), 53566. East Asian.

Fissidentaceae

Fissidens dubius P.Beauv. D: on rock-cliff, mh-53602. Circumboreal.

***Fissidens gymnogynus** Besch. A: on base of tree-trunk, mh-53472. East Asian.

Fissidens taxifolius Hedw. D: on soil at crevice of rock-cliff, mh-53584. Cosmopolitan.

Funariaceae

Physcomitrium sphaericum (Ludw.) Fuernr. A: on soil, mh-53469. Others.

Grimmiaceae

Grimmia pilifera P.Beauv. B: on boulder, mh-53548. Others.

Hylocomiaceae

Hylocomiastrum pyrenaicum (Spruce) Broth. D: on boulder, mh-53614 (+ *Thuidium cymbifolium*). Circumboreal.

Hylocomium splendens (Hedw.) Schimp. D: on boulder covered with humus, mh-53617, 53629. Circumboreal (incl. New Zealand).

Pleurozium schreberi (Brid.) Mitt. D: on boulder, mh-53625, 53631. Circumboreal.

***Rhytidiadelphus japonicus** (Reimers) T.J. Kop. B: on humus, mh-53530. D: on boulder, mh-53615. East Asian.

Rhytidiadelphus triquetrus (Hedw.) Warnst. B: on boulder, mh-53554. D: on boulder, mh-53623. Circumboreal.

Hypnaceae

Callicladium haldanianum (Grev.) H.A.Crum A: on decaying log, mh-53496. Circumboreal.

Calliergonella lindbergii (Mitt.) Hedenäs B: on boulder, mh-53528. C: on decaying log, mh-53571; on boulder, mh-53580. Circumboreal.

Gollania ruginosa (Mitt.) Broth. A: growing on basal part of trunk, mh-53483. B: on decaying log, mh-Higuchi 53526. East Asian.

Note. Higuchi (2016) reported this species from Kedrovaya Pad' Strict Nature Reserve.

Herzogiella turfacea (Lindb.) Z.Iwats. C: on decaying log, mh-53568. Circumboreal.

Hypnum cupressiforme Hedw. B: on rock-cliff, mh-53536. Cosmopolitan.

Hypnum oldhamii (Mitt.) A.Jaeger & Sauerb. D: on boulder, mh-53633. East Asian.

Note. This species is new to Russia.

Hypnum plicatum (Lindb.) A.Jaeger & Sauerb. D: on boulder, mh-53619. Circumboreal.

Hypnum tristo-viride (Broth.) Paris D: on boulder, mh-53636. East Asian.

Note. This species is new to Russia.

Isopterygiopsis muelleriana (Schimp.) Z.Iwats. B: on rock-cliff, mh-53508 (+ *Taxiphyllum taxirameum*). D: on soil at crevice of rock-cliff, mh-53604; on boulder, mh-53632. Circumboreal.

***Pylaisia brotheri** Besch. A: on trunk of *Alnus* sp., mh-53495. East Asian.

***Pylaisia stereodontoides** Broth. & Yasuda ex Iisiba A: on decaying log, mh-53480; on fallen tree-trunk, mh-53481; on trunk of *Acer mono*, mh-53493 (+ *Haplohymenium triste*). B: on dead tree-trunk, mh-53560. C: on decaying log, mh-53574; on trunk of *Acer mono*, mh-53577; on fallen tree-trunk, mh-53601. East Asian.

***Taxiphyllum aomoriense** (Besch.) Z.Iwats. A: on base of tree-trunk, mh-53471; on boulder, mh-53476. C: on rock-cliff, mh-53564. East Asian.

***Taxiphyllum taxirameum** (Mitt.) M.Fleisch. B: on rock-cliff, mh-53508 (+ *Isopterygiopsis muelleriana*). Others.

Lembophyllaceae

Dolichomitriopsis diversiformis (Mitt.) Nog. B:

on base of tree-trunk, mh-53552. East Asian.

Leptodontaceae

Forsstroemia japonica (Besch.) Paris B: on tree-trunk, mh-53544 (+ *Forsstroemia trichomitria*). East Asian.

***Forsstroemia trichomitria** (Hedw.) Lindb. B: on tree-trunk, mh-53544 (+ *Forsstroemia japonica*). Others.

Leskeaceae

Haplocladium angstifolium (Hampe & Müll. Hal.) Broth. C: on boulder, mh-53562 (+ *Entodon sullivantii*). Cosmopolitan.

Haplocladium microphyllum (Hedw.) Broth. A: on decaying log, mh-53477 (+ *Dicranum mayrii*), 53492, 53497 (+ *Dicranum mayrii*). Cosmopolitan.

***Hylocomiopsis ovicarpa** (Besch.) Cardot D: on boulder, mh-53620. East Asian.

***Miyabea fruticella** (Mitt.) Broth. B: on trunk of *Acer mono*, mh-53547. East Asian.

Leucobryaceae

Brothera leana (Sull.) Müll.Hal. B: on basal part of tree, mh-53555; on decaying stump, mh-53556. Others.

Mniaceae

Mnium lycopodioides (Hook.) Schwägr. B: on rock-cliff, mh-53507; on boulder, mh-53545. Circumboreal.

Plagiomnium acutum (Lindb.) T.J.Kop. A: on base of tree-trunk, mh-53485. B: on boulder, mh-53515. D: on boulder, mh-53596. East Asian.

Plagiomnium medium (Bruch & Schimp.) T.J. Kop. A: on humus, mh-53499. C: on humus, mh-53567. Circumboreal.

Pohlia wahlenbergii (F.Weber & Mohr) A.L. Andrews B: on rock-cliff, mh-53537. Cosmopolitan.

***Rhizomnium parvulum** (Mitt.) T.J.Kop. B: on decaying log, mh-53516, 53517 (+ *Dicranum nipponense*); on humus, mh-53531. D: on soil at crevice of rock-cliff, mh-53591. East Asian.

Trachycystis flagellaris (Sull. & Lesq.) Lindb. B: on humus, mh-53532. D: on boulder, mh-53611. East Asian (incl. west N. America).

Trachycystis ussuriensis (Maack & Regel) T.J. Kop. B: on boulder, mh-53524. D: on boulder, mh-53608. East Asian.

Neckeraceae

Homalia trichomanoides (Hedw.) Schimp. B: on rock-cliff, mh-53509; on root, mh-53543. Circumboreal.

***Thamnobryum coreanum** (Cardot) Nog. & Z. Iwats. B: on boulder, mh-53520, 53541. East Asian.

***Thamnobryum plicatum** (Sande Lac.) Z. Iwats. B: on rock-cliff, mh-53519. D: on rock-cliff, mh-53603 (+ *Palamocladium leskeoides*). East Asian.

Orthotrichaceae

***Macromitrium japonicum** Dozy & Molke. A: on trunk of *Juglans* sp., mh-53486. East Asian.

***Orthotrichum consobrinum** Cardot D: on tree-trunk, mh-53598. East Asian.

Ulota crispa (Hedw.) Brid. B: on decaying log, mh-53550 (+ *Glyphomitrium humillimum*). D: on branch, mh-53610. Circumpolar.

***Ulota japonica** (Sull. & Lesq.) Mitt. D: on tree-trunk, mh-53609. East Asian (incl. west N. America).

Plagiotheciaceae

Plagiothecium cavifolium (Brid.) Z.Iwats. D: on rock-cliff, mh-53592. Circumboreal.

Plagiothecium laetum Schimp. B: on rock-cliff, mh-53514. C: on boulder, mh-53569. D: on rock-cliff, mh-53583. Circumboreal.

Plagiothecium nemorale (Mitt.) A.Jaeger B: on rock-cliff, mh-53533. D: on rock-cliff,

mh-53600. Circumboreal.

Polytrichaceae

***Atrichum rhystophyllum** (Müll.Hal.) Paris A: on soil, mh-53494. Circumboreal.

Pogonatum contortum (Brid.) Lesq. D: on soil, mh-53634. East Asian (incl. west N. America).

Pogonatum japonicum Sull. & Lesq. D: on soil, mh-53622, 53635. East Asian.

Polytrichastrum alpinum (Hedw.) G.L.Sm. D: on boulder, mh-53612. Circumboreal.

Polytrichastrum formosum (Hedw.) G.L.Sm. D: on boulder, mh-53624, 53626 (+ *Dicranum japonicum*). Cosmopolitan.

Pottiaceae

Anoetangium thomsonii Mitt. B: on rock-cliff, mh-53506. Cosmopolitan.

Oxystegus tenuirostris (Hook. & Taylor) A.J.E.Smith A: on boulder, mh-53490. B: on basal part of rock-cliff, mh-53510 (+ *Campylium hispidulum*); on boulder, mh-53523. D: on boulder, mh-53597. Circumboreal.

Pylaisiadelphaceae

Platygyrium repens (Brid.) Bruch & Schimp. B: on decaying log, mh-53502; on decaying branch, mh-53504. Circumboreal.

Pylaisiadelpha tenuirostris (Bruch & Schimp.) W.R.Buck A: on fallen tree-trunk, mh-53475; on decaying log, mh-53501. B: on decaying log, mh-53505; on trunk of *Quercus mongolica*, mh-53559. D: on trunk of *Betula* sp., mh-53628. East Asian.

Rhabdoweisiaceae

***Glyphomitrium humillimum** (Mitt.) Cardot B: on decaying branch, mh-53539, 53550 (+ *Ulota crispa*); on trunk of *Quercus mongolica*, mh-53558. D: on fallen branch, mh-53581. East Asian.

Oncophorus crispifolium (Mitt.) Lindb. D: on

rock-cliff, mh-53595. East Asian.

Rhabdoweisia crispata (With.) Lindb. B: on rock-cliff, mh-53534, 53535 (+ *Dicranella heteromalla*). D: on rock-cliff, mh-53594. Others.

Thuidiaceae

***Boulaya mittenii** (Broth.) Cardot B: on trunk of *Quercus mongolica*, mh-53557. East Asian.

***Bryonoguchia molkenboeri** (Sande Lac.) Z. Iwats. & Inoue D: on boulder, mh-53621. East Asian.

Raiiella fujisana (Paris) Reimers D: on root, mh-53582 (+ *Anomodon rugelii*). East Asian.

***Thuidium cymbifolium** (Dozy & Molk.) Broth. B: on boulder, mh-53542. D: on boulder, mh-53614 (+ *Hylocomiastrum pyrenaicum*). Others.

***Thuidium subglaucinum** Cardot B: on rock-cliff, mh-53538. East Asian.

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