



Moss flora of Zeysky State Nature Reserve (Tukuringra Range, Amur Province, Russia)

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ABSTRACT

An annotated list of the moss flora of Zeysky Nature Reserve is presented. It includes 310 species, with 140 species newly recorded for the reserve and 25 species new for Amur Province, including two species, *Hondaella caperata* and *Hyophila involuta* from the Red Data Book of Russian Federation. Other interesting records include recently described species (*Amphidium asiaticum*, *Hedwigia kuzenevae*, *Sphagnum mirum*), species on the western border of their distribution (*Cryphaea amurensis*, *Dicranum pacificum*, *Hondaella caperata*, *Leucodon coreensis* and *Stereodon calcicola*), on the southern edge of its distribution (*Psilopilum cavifolium*) and rare species with scattered localities in the southern Far East (*Hyophila involuta*, *Seligeria donniana*). A comparison with other moss floras in Asian Russia of about the same area indicates that the moss flora of Zeysky Reserve is more similar to other floras of the Amur River basin and also to Transbaikalian floras, rather than to the floras of Primorsky Territory, as the latter is much more enriched by East Asian flora elements.

Keywords: moss, phytogeography, altitude zonation, Far East, Zeysky Reserve

РЕЗЮМЕ

Дудов С.В., Кожин М.Н., Федосов В.Э., Игнатова Е.А., Игнатов М.С. Мхи Зейского заповедника (хребет Тукурингра, Амурская область, Россия). Представлен аннотированный список мхов Зейского заповедника, в котором обобщены ранее известные данные и собранные авторами материалы; он включает 310 видов, из которых 140 впервые приводятся для территории заповедника и 25 видов являются новыми для Амурской области, в числе которых *Hondaella caperata* и *Hyophila involuta*, включены в Красную книгу России. Интерес представляют находки недавно описанных видов (*Amphidium asiaticum*, *Hedwigia kuzenevae*, *Sphagnum mirum*) видов, находящихся на западной границе ареала (*Cryphaea amurensis*, *Dicranum pacificum*, *Hondaella caperata*, *Leucodon coreensis*, *Stereodon calcicola*), вида с более северным распространением, найденного в Амурской области в отрыве от основного ареала (*Psilopilum cavifolium*), редких видов с рассеянными местонахождениями на юге Российского Дальнего Востока (*Hyophila involuta*, *Seligeria donniana*). Сравнение с флорами мхов других территорий азиатской России сходного размера показывает, что флора мхов Зейского заповедника по своему составу ближе к флорам Приамурья, в том числе Верхнего (на территории Забайкальского края), нежели к флоре Приморского края, которая сильно обогащена восточноазиатскими видами.

Ключевые слова: мхи, ботаническая география, высотная поясность, Дальний Восток, Зейский заповедник

INTRODUCTION

Zeysky Nature Reserve is situated in the eastern part of the Tukuringra Range in Amur Province. Its area comprises the north-western limit of broad-leaved forests of *Quercus mongolica* Fisch. ex Ledeb. and *Tilia amurensis* Rupr., which occur here side by side with East Siberian continental taiga. Dahurian steppe species reach their eastern limit here, with the western border of Okhotian flora elements, associated with *Picea ajanensis* (Lindl. & Gordon) Fisch. & Carr. “dark taiga” vegetation, extending into the reserve. This phytogeographic hotspot contributes to an outstanding diversity of the vascular plant flora (Kuzeneva 1920, Sochava 1957, Gubanov et al. 1981).

Exploration of the moss flora of Tukuringra Range started at the beginning of the 20th century, when O.I. Kuzeneva and N.I. Prokhorov collected mosses in this area in 1909 and 1910 during the Amur expedition of the Resettlement Administration of Russian Empire. However, all collections from those years, identified by V.F. Brotherus and published by Brotherus et al. (1916), were made outside the reserve territory, mostly in the more western parts of the range. Later, in 1914 and 1915, Kuzeneva and Prokhorov collected specimens from the Zeya River along the reserve border and within the reserve territory, in the valley of Bol'shaya Erakingra Creek. These collections are mainly kept in H and LE, with some duplicates in MW and

MHA; only a few of them were published, however, mostly as a result of re-examination of specimens during later taxonomic revisions of some genera (Jamieson 1976, Ignatov & Cherdantseva 1995, Ignatova & Muñoz 2004, Ignatova et al. 2015, 2017).

Later, in 1972–1974, S.K. Gambaryan (1977, 1978a, 1978b) studied the moss flora of the newly (in 1963) organized Zeysky Reserve and listed 99 species; her collections are deposited mostly in VLA, with some duplicates in MW, MHA and IRK. Expeditions from Lomonosov Moscow State University have conducted studies of the biodiversity in Zeysky Reserve since 1976, and mosses have been collected by its participants: I.A. Gubanov (1976–1977), M.S. Ignatov (1977), D.A. Petelin (1977–1985 and in 1989 with B.F. Khasanov), K.L. Tarasov (1979) and L.I. Abramova (1980). These collections are deposited in MW, MHA and the herbarium of Zeysky Reserve. Based on them, two annotated lists were published (Abramova & Petelin 1981, Abramova et al. 1987). The latter includes 199 moss species and is still the most comprehensive source on the moss flora of the reserve; however, some records from this list are not confirmed by herbarium specimens in MW.

In 1991–1994 O.G. Barinov and M.A. Barinova studied bryophyte ecology in Zeysky Reserve, in Gilui River valley (Barinova 1997); their small collections are stored in Zeysky Reserve.

However, despite such a long history of bryofloristic exploration in the reserve territory, field work by the senior author in 2012–2016 (in 2013–2014 with K.V. Kotelnikova, in 2016 with M.N. Kozhin) has revealed many species that have not been previously recorded (collections in MW). Altogether, some 2000 specimens were studied. About half of them were gathered from the 350 vegetation relevés recorded to describe the vegetation of the reserve and its buffer zone. Some areas appeared to be more diverse in bryophytes, and mosses in such interesting sites were additionally collected; these places are shown in Fig. 1. and Table 1. The main collection is deposited in MW and label information is available in the database of the Moss Flora of Russia (Ivanov et al. 2017). Some of the more interesting records have already been published by Dudov et al. (2015a, 2015b, 2016). The aim of the present paper is to summarize all available data on the moss flora of Zeysky Nature Reserve and to discuss its phytogeographical position and species diversity.

STUDY AREA

Zeysky Nature Reserve occupies an area of 994 km² (1206 km² including its partly protected buffer zone) in the eastern part of Tukuringra Range (Fig. 1). The range is an asymmetrical horst with an elevational range of 800–1400 m. The bedrock is diverse, with a prevalence of Proterozoic rocks: biotite and hornblende gneisses, amphibolites and schist. Proterozoic formations are intersected by a belt of slightly metamorphosed Late Jurassic–Early Cretaceous conseral sandstones, siltstones and conglomerates, which are common on the southern flanks of the mountain range. Proterozoic and Mesozoic intrusions of acidic composition are also common. Outcrops of metamorphic limestone in the Izvestkovy Klyuch valley are noteworthy.

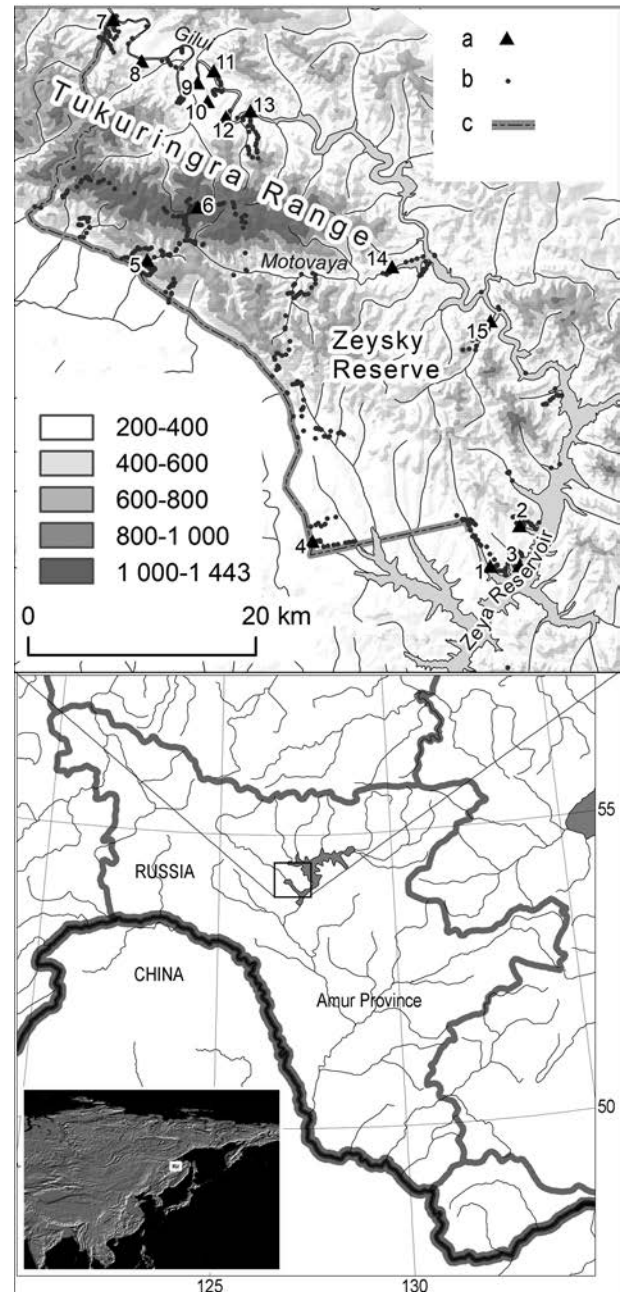


Figure 1 Collecting localities in Zeysky Nature Reserve: a – most interesting collection sites cited in checklist and in Table 1; b – other author's collection localities; c – border of Zeysky Reserve

The topography is typified by deeply incised valleys, 250–660 m in depth (Gotvanskiy 1968), often with cliffs along steep banks. Upper elevations at 1100–1442 m are usually flat, comprising mountain tundra and rock fields with some rock pillars; at lower elevations mountain watersheds are either rounded, or sharply angular. Rock fields are common on steep slopes at all elevations.

The climate of the study area is cold temperate, characterized by a combination of monsoon influences and pronounced continentality due to cold winters. The average annual temperature according to the Zeya meteorostation at the foothills of the mountains is -0.9°C , while our short term observations found it to be $+1.5^{\circ}\text{C}$ in Zeya River valley at

Table 1. Major collection sites within Zeysky State Nature Reserve.

N	Locality	Main habitats	Altitude, m a.s.l.	Coordinates, WGS84
1	vicinity of cordon "Teplyi Kluch"	larch-birch, black birch and oak forests, rock outcrops	315–400	53°51'N 127°20'E
2	valley of the Izvestkovyi Klyuch	limestone rocks and outcrops	315–350	53°53'N 127°23'E
3	bank of the Zeya reservoir between the Razvedochny and Sukhoy gulfs	birch-larch, mongolian oak forests, rock outcrops	315–380	53°51'N 127°23'E
4	vicinity of cordon "20th km"	larch-birch forest	500	53°52'N 127°06'E
5	the Bol'shaya Erakingra valley, the vicinity of the cordon "52th km"	forests in valley and at the slopes, pebbles near the streams	600–700	54°5'N 126°53'E
6	the main watershed of the ridge in the upper Motovaya River	spruce forests, <i>Pinus pumila</i> elfinwoods, sparse <i>Betula lanata</i> woodlands, subalpine meadows and bogs, tundras	1350–1440	54°08'N 126°56'E
7	vicinity of cordon "Nizhny Chimchan"	sphagnum bogs, floodplain meadows, cliffs	350–500	53°52'N 127°7'E
8	the right side of the Gilui River Valley opposite of Chapovskaya sandspit	cliffs and rock outcrops rich in calcium compounds	320–340	54°15'N 126°54'E
9	right side of the Gilui River valley below the mouth of Shirokaya River	gneiss rocks and rock outcrops, screes	320–400	54°14'N 126°56'E
10	lake on the watershed surface among Shirokaya (Stepanak) and Zolotoi valleys	sedge-sphagnum peatbog	383	54°13'N 126°57'E
11	left bank of the Gilui River upstream from the mouth of the Zolotoy spring	base-rich rock outcrops	350	54°14'N 126°57'E
12	bank of the Zeya Reservoir near the cordon «Izbriny»	meadows, degraded bogs and birch-larch forest in the underflooding zone	315–320	54°12'N 127°0'E
13	the «Chertova Pechka» cliff	gneiss rocks and outcrops	320–340	54°13'N 126°59'E
14	valley of the Motovaya River 1.5 km upstream from the modern mouth	rocky slopes with black birch forests and rock outcrops	330–400	54°5'N 127°12'E
15	the Tabuneika River valley near its mouth	valley forests, meadows in the underflooding zone of reservoir, outcrops	330–380	54°3'N 127°20'E

330 m alt. and -6.5°C at 1000 m (Dudov 2016). The coldest month is January with average temperature -24.2°C . Mean annual precipitation in the foothills is 530 mm, while in the mountains it is two to three times greater. Permafrost covers 70–80 % of the study area (Nekrasov & Klimovskiy 1978). In narrow and deep valleys, aufeis up to 4–5 m thick are formed, lasting up to July and in places even into August.

The vegetation of Tukuringra Range was subdivided into five main altitudinal belts (Golysheva et al. 1980): (1) lowermost *Quercus mongolica*–*Betula davurica* Pall. belt (only near Zeya, up to 500 m); (2) *Larix gmelinii* (Rupr.) Rupr. forest belt up to 900 m; (3) *Picea ajanensis* belt (900–1100 m); (4) *Pinus pumila* (Pall.) Regel thickets (1100–1300 m) and *Betula lanata* (Regel) V.N. Vassil. krummholz; (5) mountain tundra belt above 1100 m. However, as belts 2 & 3 and 4 & 5 can overlap spatially, both in terms of species composition and plant communities, three further subdivisions are considered:

Hemiboreal belt, 315–500 m, mainly on slopes to the Zeya River, formed by stands of broad-leaved trees, *Betula davurica* and hemiboreal larch forests enriched by temperate East Asian species.

Boreal belt, 315–1300 m, with larch forests (especially up to 1000 m), comprised of shrubby (with *Rhododendron dauricum* L.), grassy (with *Calamagrostis purpurea* (Trin.) Trin.) and cowberry (*Vaccinium vitis-idaea* L.) types, mires with *Ledum palustre* L., and moss-dominated types. In river valleys, there are poplar (*Populus suaveolens* Fisch.) and *Chose-*

nia arbutifolia (Pall.) A.K. Skvortsov stands. *Picea ajanensis* occurs throughout the boreal belt, but it forms spruce forest, usually with a continuous moss carpet, only in upper sub-belt of the boreal belt (900–1300 m).

Subalpine belt at 1100–1442.8 m with krummholz, *Pinus pumila* elfinwoods, and mountain tundras, with *Rhododendron parvifolium* Adams, *Salix sphenophylla* A.K. Skvortsov, *Diapensia obovata* (F. Schmidt) Nakai, *Vaccinium uliginosum* L., lichens (*Cladonia rangiferina* (L.) F. H. Wigg., *Cetraria laevigata* Rass., *Alectoria ochroleuca* (Hoffm.) A. Massal., *Asabineia chrysantha* (Tuck.) W. L. Culb. & C. F. Culb.) and mosses (*Aulacomnium turgidum*, *Sphagnum lenense*, *S. divinum*).

The reserve territory is surrounded on its eastern and northern borders by the Zeya Water Reservoir, filled up in 1964–1980, with the dam of the Zeya Power station 110 m high. The current level of the Zeya Water Reservoir, at 315 m elevation, is ca. 60 m above the previous level of the Zeya River, and the lower parts of small creeks, the Zeya River tributaries (called here mostly as “klyuch”) were drowned when the reservoir was filled.

Main habitats of mosses

The main groups of habitats can be characterized by their most common species and by some species confined to respective belt as follow:

In **oak-black birch forest**, mosses grow mainly on tree trunks, e.g. *Platygyrium repens*, *Pylaisia falcata*, *P. polyantha*, *P. selwynii*, *Lewinskya sordida*, *Haplocladium angustifolium*,

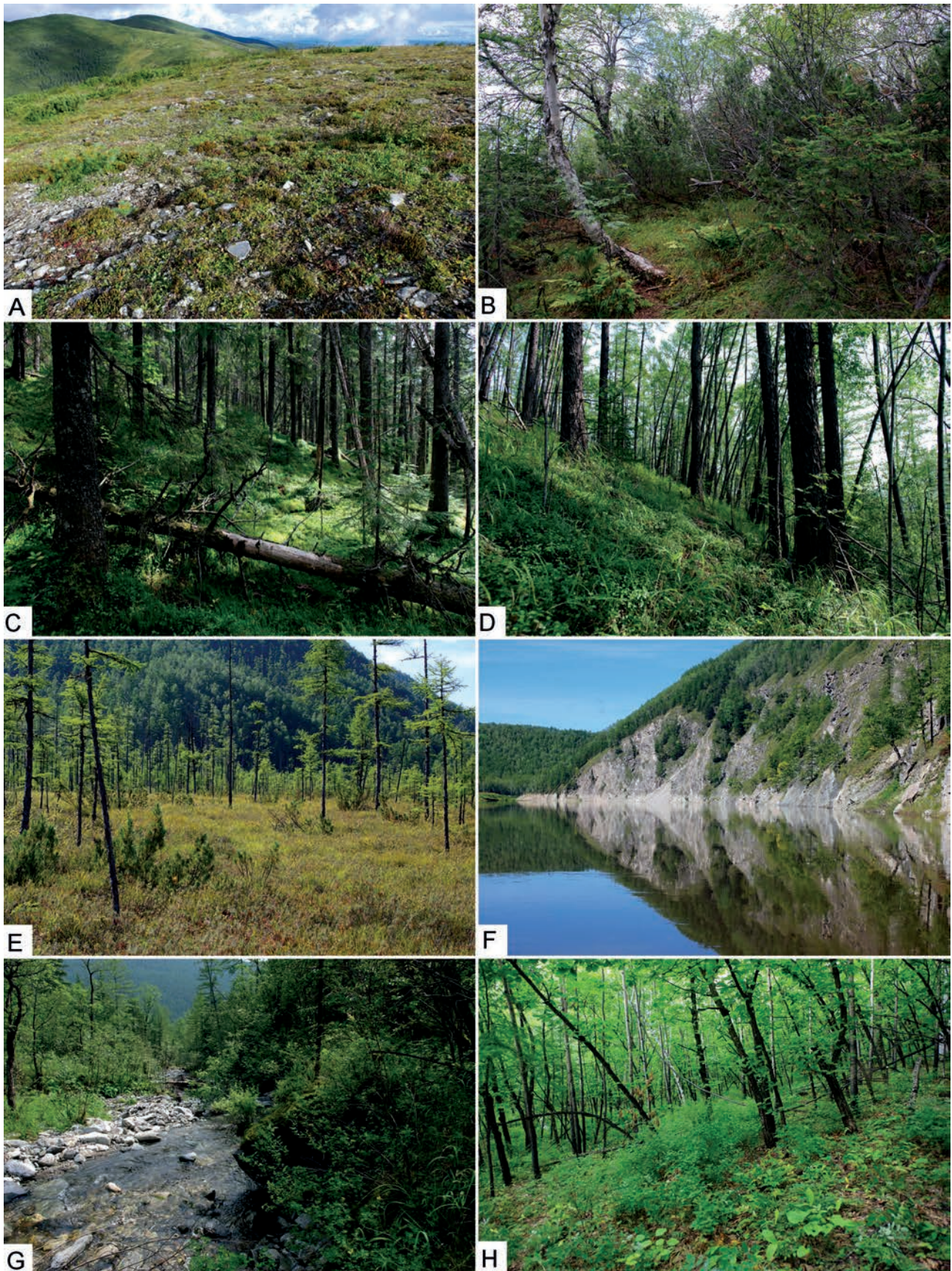


Figure 2 Major habitat types of Zeysky Reserve. A – Tundra with dwarf shrubs (*Rhododendron parvifolium*, *Salix sphenophylla*, *Vaccinium uliginosum*) at the main watershed of Tururingra Range in the upper course of Motovaya River, 1380 m a.s.l. B – Sparse *Betula lanata* woodland, 1370 m a.s.l. C – Spruce forest (*Picea ajanensis*) in the upper course of Valunnyi Klyuch, 1350 m a.s.l. D – Larch forest (*Larix gmelinii*) with well developed herb layer at the southern slope, 700 m a.s.l. E – Sparse boggy larch woodland in the Nizhnyi Chimchan River valley, 380 m a.s.l. F – Calcareous rock outcrops

Leptodontium flexifolium, while on roots and at trunk bases *Brachythecium buchananii*, *Bryoerythrophyllum recurvirostrum*, *Homomallium incurvatum* and *Myuroclada maximowiczii* occur.

Moss cover in **larch and spruce taiga** is formed by *Dicranum japonicum*, *D. polysetum*, *Eurhynchiastrum pulchellum*, *Hylocomium splendens*, *Plagiothecium laetum*, *Pleurozium schreberi*, *Polytrichum commune*, *Polytrichastrum alpinum*, *Ptilium crista-castrensis* and *Sphagnum girgensohnii*. *Rhytidium rugosum* and *Abietinella abietina* are abundant on drier and more exposed slopes. On fallen trunks, *Brotbera leana*, *Campylidium sommersfeldii*, *Dicranum fragilifolium*, *D. fuscescens*, *Oncophorus wahlenbergii*, *Plagiommium cuspidatum*, *Plagiothecium laetum*, *Pylaisiadelphus tenuirostris*, *Tetraphis pellucida*, *Sanionia uncinata*, *Sciurohypnum curtum*, *Stereodon pallescens* and *S. plicatulus* are commonly found. On trunk bases, *Abietinella abietina*, *Brachythecium buchananii*, *B. rotaezanum*, *Callicladium haldanianum*, *Thuidium assimile* and *Dicranum montanum* occur. *Pylaisiadelphus tenuirostris*, *Dicranum montanum* and *D. flagellare* usually grow on larch trunks, while *Invatsukiella leucotricha* is characteristic of spruce trunks and twigs. Wet spruce forests in valleys are rich in epiphytes: *Leucodon pendulus*, *L. sciuroides* and *Neckera pennata* often grow on spruce, while *Lewinskya imatsukii*, *L. sordida*, *L. transcasicca*, *Nybolmiella obtusifolia*, *Pylaisia falcata*, *P. polyantha*, *P. steerei*, *Ulota rehmannii* and *Zygodon sibiricus* are mostly confined to deciduous trees. *Pylaisia selwynii* and *Brachythecium daburicum* are found predominantly on aspen. After fire events, *Ceratodon purpureus*, *Dicranum montanum* and *Aulacomnium turgidum* are the first to colonise charred tree trunks, while on soil *Polytrichum juniperinum* forms extensive communities.

In the **valley forests**, *Climacium dendroides*, *Rhytidiadelphus triquetrus*, *Rhodobryum ontariense*, *Sphagnum teres*, *S. tundrae* and *S. squarrosum* are common on wet rich soil, while *Amblystegium serpens*, *Atrichum flavisetum*, *Funaria hygrometrica*, *Poblia andrewsii*, *Saelania glaucescens* and *Schistostega pennata* can be found under upturned roots of fallen trunks. On sandy and silty alluvium in floodplains, *Brachythecium rivulare*, *Bryum pseudotriquetrum*, *Dichodontium pellucidum*, *Calliargonella lindbergii*, *Niphotrichum panschii*, *Oncophorus virens*, *Philonotis fontana*, *Poblia andalusica* and *P. filum* occur. *Didymodon zanderi* is associated with tree trunks covered with silt deposits. In the temporarily exposed draw-down zone of the water reservoir and on the degraded bogs in the area of its influence, *Atrichum tenellum*, *A. undulatum*, *Poblia andalusica*, *P. andrewsii*, *P. annotina*, *P. bulbifera*, *P. prolifera* and *Trichodon cylindricus* are found.

On **rocks in brooks**, *Calliargon cordifolium*, *C. giganteum*, *Warnstorfia sarmentosa*, *Blindia acuta*, *Hygrohypnella ochracea* and *H. polaris* are most common at lower elevations. Wet cliffs near brooks are often covered by *Dichodontium pellucidum* and *Blindia acuta*.

In **open larch forests with sphagna**, *Sphagnum girgensohnii* and *S. lenense* dominate; *Helodium blandovii*, *Polytrichum strictum*, *P. swartzii* and *Tomenthypnum nitens* occur occasionally. *Sphagnum jensenii*, *S. lindbergii*, *S. obtusum*, *Warnstorfia exannulata* and *W. fluitans* grow in hollows on mires in the Gilui River valley.

On **rock fields in the highest altitudinal belt**, *Andreaea rupestris*, *Cynodontium asperifolium*, *Dicranum schljakovii*, *D. spadiceum*, *Eurhynchiastrum pulchellum* and *Niphotrichum canescens* are the most common species while on dry rock outcrops in the boreal and hemiboreal belts, *Abietinella abietina*, *Anomodon minor*, *Grimmia pilifera*, *G. longirostris*, *Hedvigia* spp. and *Schistidium pulchrum* are common.

In **shaded niches and cliff crevices**, *Amphidium mougeotii*, *Anoetangium thomsonii*, *Encalypta ciliata*, *Homomallium connexum*, *Oxystegus tenuirostris*, *Rhabdoweisia crispata*, *Mnium thomsonii*, *Homalia trichomanoides*, *Distichium capillaceum*, *Isopterygiopsis alpicola*, *Myurella julacea* and *Myuroclada maximowiczii* are found.

On **calcareous rocks** in the valley of Izvestkovyi Klyuch (the only limestone outcrops in the reserve), *Anomodon thraustus*, *Bartramia ithyphylla*, *Cyrtomnium hymenophylloides*, *Brachythecium cirrosus*, *Campyliadelphus chrysophyllus*, *Cratoneuron filicinum*, *Didymodon ferrugineus*, *Entodon concinnus*, *Gymnostomum aerginosum*, *Hymenostylium recurvirostrum*, *Molendia sendtneriana*, *Myurella julacea*, *Timmia bavarica* and *T. comata* occur.

On **soil in the subalpine belt**, taiga species such as *Ptilium crista-castrensis* and *Pleurozium schreberi*, as well as *Aulacomnium palustre*, *Dicranum bardunovii* and *Hypnum cupressiforme* grow in elfinwood thickets. In dwarf shrub tundra, *Abietinella abietina*, *Dicranum elongatum*, *Polytrichum piliferum* and *Rhytidium rugosum* are common. In moss tundras, ground cover is formed by *Aulacomnium turgidum*, *Dicranum elongatum*, *D. groenlandicum*, *D. schljakovii*, *Polytrichum strictum*, *Sphagnum balticum*, *S. compactum*, *S. lenense* and *S. divinum*; on rock outcrops at this elevation *Bucklandiella microcarpa*, *B. sudetica*, *Cynodontium strumiferum*, *Grimmia jacutica* and *G. longirostris* occur.

LIST OF SPECIES

As the most complete data on the reserve moss flora were published by Abramova et al. (1987), it is always cited for species reported in it as "[Abr 1987]". Some other publications are cited where relevant. Taxa new for Zeysky Reserve are marked with "+". Species recorded by Abramova et al. (1987), but not confirmed by specimens in MW or MHA, are included in the list with "-" before species name (these are mostly widespread species, known from neighboring areas). However, most unconfirmed species are not included in the main list of species, but enumerated and discussed after it.

Species are annotated by the altitudinal range [in brackets]; occurrence in three vegetation belts, given as abbreviations, i.e. SA: subalpine, B: boreal and HB: hemiboreal; habitats and frequency are given separately for each of these belts; frequency is abbreviated as follow: Un – unique; Rr – rare; Sp – sparse; Fr – frequent; Com – common; associated species and other comments are given where relevant.

The nomenclature follows Cherdantseva et al. (2018).

***Abietinella abietina* (Hedw.) M. Fleisch.** – [Abr 1987] [300–1351 m] SA: dwarf shrub and dwarf shrub-moss tundras, on soil among *Rhytidium rugosum*. Rr. B: in larch

on the left bank of the Gilui River upstream from the mouth of the Zolotoy Klyuch, 350 m a.s.l. G – the floodplain of small brook on the right tributary of Bol'shaya Erakingra Creek with pebble-bed, pioneer willow (*Salix udensis*, *S. cardiophylla*) communities and sparse larch forests, 650 m a.s.l. H – Oak forest with *Lespedeza bicolor* in shrub layer in the vicinity of cordon "Tepliy Klyuch", 370 m a.s.l. Photo by: S.V. Dudov 2012–2016

and small-leaved forests, rarer in spruce forests, more often on southern slopes; on soil, trunk bases, rocks. Fr. HB: in small-leaved and oak-*Betula davurica* forests; on soil, trunks and cliffs. Com.

***Amblystegium serpens* (Hedw.) Bruch, Schimp. & W. Gümbel** – [Abr 1987] [320–650 m] B: on soil under upturned roots of fallen trees, base-rich cliffs, birch trunk bases, logs and soil. Rr. For our territory, *Amblystegium serpens* var. *juratzkanum* (Schimp.) Rau & Herv is also listed.

+ ***Amphidium asiaticum* Sim-Sim, Afonina & M. Stech** – [465 m] B: cliffs at the left border of Gilui Bay, opposite Tabuneika River Bay, and on the left bank of the Gilui River opposite Nizhny Chimchan River mouth. Rr. Described from Mongolia (Sim-Sim et al. 2017), known from a few localities in Transbaikalia in Zabaikalsky Territory and the Republic of Buryatia (Afonina et al. 2017). New to Amur Province.

***Amphidium lapponicum* (Hedw.) Schimp.** – [Abr 1987] [350–645 m] B: cliffs in the upper course of the Motovaya River. HB: rock outcrops on the south-eastern slope near cordon “Teplyi klyuch”. Rr.

+ ***Amphidium mougeotii* (Bruch & Schimp.) Schimp.** – [330–450 m] B & HB: in crevices and shaded niches of schist cliffs rich in calcium. Sp.

***Andreaea rupestris* Hedw.** – [Abr 1987] [320–1376 m] SA: rock pillars, cliffs, and rock fields. Sp. B: stone fields, rocks in brooks. Rr.

+ ***Anoetangium thomsonii* Mitt.** (= *Anoetangium stracheyanum* Mitt.) – [320–450 m] B & HB: on wet gneiss, schist, and limestone cliffs. Sp. Often forms extensive pure mats.

+ ***Anomobryum concinatum* (Spruce) Lindb.** – [322–345 m] B: cliffs on the left bank of the Gilui River upstream of Zolotoy Klyuch mouth, on the “Chertova Pechka” cliff, in rock crevices with seeping water. Rr. The species was known in Amur Province from Norsky Nature Reserve (Czernyadjeva et al. 2015), it was also found on Tokinsky Stanovik (Stepanova et al. 1995).

+ ***Anomobryum nitidum* (Mitt.) A. Jaeger** – [345 m] B: on cliffs on the left bank of Gilui River upstream Zolotoy Klyuch mouth, rock crevices with seeping water. Un. New to Amur Province. Known from South-Eastern Transbaikalia, Southern Primorye, Commander and Kuril Islands (Czernyadjeva et al. 2015, Bakalin et al. in press).

***Anomodon minor* (Hedw.) Fűrnr.** – [Abr 1987] [315–690 m] B & HB: dry cliffs and rock outcrops. Fr.

***Anomodon thraustus* Müll. Hal.** – [320–470 m] B & HB: dry shaded cliffs. Sp.

***Atrichum flavisetum* Mitt.** – [Abr 1987] [320–500 m] B: on fine soil under cliff overhangs, on soil under upturned roots of fallen trunks in forests. Rr.

+ ***Atrichum tenellum* (Röhl.) Bruch, Schimp. & W. Gümbel** – [317 m] B: bank of the Gilui Bay of the Zeya Reservoir near the “Izubriny” cordon, *Calamagrostis* meadow in the draw-down zone of the water reservoir. Un. Predominantly a European species, with scattered localities east of Baikal (Afonina et al. 2017; Cherdantseva et al. 2018). New to Amur Province.

+ ***Atrichum undulatum* (Hedw.) P. Beauv.** – [317–320 m] B: on soil in degraded forests in the area of water reservoir influence, on fine soil in temporary stream beds. All findings in vicinity of cordon “Izubriny”. Rr.

***Aulacomnium palustre* (Hedw.) Schwägr.** – [Abr 1987] [320–1435 m] SA: on soil in moss and dwarf shrub-moss tundras, in elfinwood communities. Fr. B: in *Sphagnum* bogs and boggy larch forests; in shrub communities along brooks; on soil, trunk bases, and on fallen logs in larch and secondary forests, often in burnt areas. Fr. We also collected *Aulacomnium palustre* var. *imbricatum* Bruch & Schimp.: near cordon “20th km”, on soil in birch and larch forest with *Calamagrostis* and *Vaccinium vitis-idaea*.

***Aulacomnium turgidum* (Wahlenb.) Schwägr.** – [Abr 1987] [320–1400 m] SA: in moss and dwarf shrub-moss tundras where it dominates, in elfinwood communities. Com. B: in sparse larch forests with *Sphagnum*, in *Sphagnum* bogs. The species grows as a pioneer on charred trunks and stumps in burnt forest areas. Sp.

+ ***Bartramia ithyphylla* Brid.** – [320–340 m] B: gneiss outcrops on the right slope of the Gilui River valley opposite Chapovskaya sandspit, marble outcrops on the right bank of the Gilui Bay of the Zeya Reservoir above the mouth of Mrachnyi Klyuch. Rr.

***Bartramia pomiformis* Hedw.** – [Abr 1987] [326–670 m] B: on soil, rock outcrops, logs in larch and birch forests, on rocks in stone fields. Sp.

***Blindia acuta* (Hedw.) Bruch, Schimp. & W. Gümbel** – [Abr 1987] [326–768 m] B: on cliffs near watercourses, on rocks in temporary stream beds and oxbows in floodplains. Sp.

+ ***Brachytheciastrum trachypodium* (Brid.) Ignatov & Huttunen** – [350 m] B: between rocks in stone rivers at the right slope of the Gilui River valley below the mouth of Shirokaya River. Un.

+ ***Brachythecium buchananii* (Hook.) A. Jaeger** – [320–500 m] B & HB: on tree trunks, fallen logs and rocks in larch and deciduous forests. Sp.

+ ***Brachythecium cirrosum* (Schwägr.) Schimp.** – [320–400 m] B & HB: on gneiss cliffs opposite Nizhny Chimchan River mouth, on cliffs of metamorphosed limestone in the valley of Izvestkovyi Klyuch. Rr.

+ ***Brachythecium daburicum* Ignatov** – [370–860 m] B & HB: on soil, fallen logs, and trunks of aspen and willow trees on exposed slopes and floodplains. Rr.

+ ***Brachythecium erythrorrhizon* Bruch, Schimp. & W. Gümbel** – [1350 m] SA: on soil on sedge-reed grass meadow with *Rhododendron aureum* at the main watershed of the ridge in the upper reaches of the Motovaya River. Un.

***Brachythecium mildeanum* (Schimp.) Schimp.** – [Abr 1987] [320–550 m] B: on fine alluvium in narrow valley with constant brook within a cliff depression in larch forest, on soil in bird-berry thickets in floodplain of Bol’shaya Erakingra River. Rr.

+ ***Brachythecium rivulare* Bruch, Schimp. & W. Gümbel** – [320–1300 m] B: in a microdepression in dry bed of a brook in spruce forest; on rock outcrops and soil, shaded cliff walls near watercourses, on moss-covered rock fields at bases of slopes. Rr.

+ ***Brachythecium rotaceum* De Not.** – [320–700 m] B: on soil, fallen logs, trunk bases of birch, aspen and poplar in mixed aspen and birch-larch forests, poplar and *Chosenia* forests. Fr. Apparently, the most frequent species of the genus in the nature reserve.

***Brachythecium salebrosum* (F. Weber & D. Mohr) Bruch, Schimp. & W. Gümbel** – [Abr 1987] [320–390 m] B: on fallen logs in floodplain spruce and mossy larch forests. Rr.

***Brothera leana* (Sull.) Müll. Hal.** – [Abr 1987] [320–820 m] B: on fallen logs, rarer on trunk bases of trees in forests of different types. Fr.

+ ***Bryoerythrophyllum cf. ferruginascens* (Stirt.) Giacomo.** – [330 m] B: on “Chertova Pechka” cliffs in vicinity of cordon “Izubriny”, with *B. recurvirostrum*. Un. New to Amur Province (Fedosov & Ignatova 2011).

***Bryoerythrophyllum recurvirostrum* (Hedw.) P.C. Chen** – [Abr 1987] [320–650 m] B & HB: on cliffs, large rocks, where it grows together with *Myurella julacea*, *Encalypta ciliata*, *Dicobodontium pellucidum*, *Distichium capillaceum*, *Fissidens* cf. *bryoides*; as well as on bark of deciduous trees: poplar and *Betula davurica*, predominantly in floodplain forests. Sp.

+ ***Bryum argenteum* Hedw.** – [315–500 m] HB: on exposed cliffs in valleys of Zeya and Gilui Rivers. Rr.

Bryum creberrimum Taylor – [Abr 1987] [330–1300 m] B & HB: on cliffs, river alluvium, exposed soil in spruce forest. Sp.

+ *Bryum cyclophyllum* (Schwägr.) Bruch & Schimp. – [320 m] B: narrow valley with constant brook within a cliff depression in larch forest in the vicinity of cordon “Izubriny”. Un.

+ *Bryum elegans* Nees – [780 m] B: on alluvium along Motovaya River in its upper course. Un.

Bryum pseudotriquetrum (Hedw.) G. Gaertn., B. Mey. & Scherb. – [Abr 1987] [320–700 m] B & HB: in various wet habitats in valleys: on fine soil in temporary watercourses, gravel bars, rocks and cliffs near watercourses, aufeis glades; on mire near eutrophic lake in the Gilui River valley, in *Betula davurica*-oak forest. Fr.

+ *Bucklandiella microcarpa* (Hedw.) Bedn.-Ochyra & Ochyra – [1343–1430 m] SA: on rock pillars within dwarf shrub tundras. Rr.

+ *Bucklandiella nitidula* (Cardot) Bedn.-Ochyra & Ochyra – [1370 m] SA: rock within *Pinus pumila* elfinwoods. Rr. The closest known population is in Transbaikalian region, in Stanovoe Upland (Afonina et al. 2017), also known from Buryatia, Kamchatka and Kuril Islands. New for Amur Province (Ignatova 2017b).

Bucklandiella sudetica (Funck) Bedn.-Ochyra & Ochyra – [Abr 1987] [1370–1390 m] SA: on rocks within dwarf shrub tundras and *Pinus pumila* thickets. Rr.

Buxbaumia aphylla Hedw. – [≈1370 m] SA: on exposed soil of a cut soil profile. (Barinov 15.IX.1991, MW and Zeysky Reserve herbarium). Un.

Callicladium baldanianum (Grev.) H.A. Crum – [Abr 1987] [350–700 m] B: on trunk bases, fallen logs and soil in larch and secondary forests. Rr.

Calliergon cordifolium (Hedw.) Kindb. – [Abr 1987] [320–360 m] B: on soil in valley forests, in the meadow on low floodplain of the Gilui River, in water between rocks in the Motovaya River bed. Sp.

Calliergon giganteum (Schimp.) Kindb. – [Abr 1987] [320–650 m] B: on rocks along banks of streams and brooks. Sp.

Calliergon richardsonii (Mitt.) Kindb. – [Abr 1987] [700 m] B: on fine soil on the bank of stream – right tributary of Bol’shaya Erakingra River. Un. Reported by Abramova et al. (1987) as Sp.

+ *Calliergonella cuspidata* (Hedw.) Loeske – [320 m] B: iris-sedge-reed grass mire near eutrophic lake on the Gilui River terrace at the left bank of the Gilyui Bay of the Zeya Reservoir opposite Zolotoi Klyuch. Un.

Calliergonella lindbergii (Mitt.) Hedenäs – [Abr 1987] [320–650 m] B: on gravel and sandy alluvium, on soil in valley forests. Sp.

Campyliadelphus chrysophyllus (Brid.) Kanda – [Abr 1987] [320–400 m] B & HB: on cliffs of gneiss, marble and limestone, on wet soil. Sp.

Campylophyllopsis sommerfeltii (Myrin) Ochyra – [Abr 1987] [320–760 m] B: on fallen logs, rarer on soil in forests of different types. Sp. Reported by Abramova (1987) as *C. hispidulum*.

+ *Campylium stellatum* (Hedw.) C.E.O. Jensen – [350 m] B: on soil in valley in larch forest with *Sphagnum*, in Teplyi Klyuch valley. Rr.

Ceratodon purpureus (Hedw.) Brid. – [Abr 1987] [320–1380 m] SA: on exposed soil and rock debris in tundras, reed grass meadows in late snow patches. Rr. B & HB: on soil, fallen logs, rocks, burnt wood and cliffs of various composition. Sp.

+ *Claopodium pellucinerve* (Mitt.) Best – [320–1265 m] B: on fallen logs, rocks in forests of different types and basic cliffs. Rr.

Climacium dendroides (Hedw.) F. Weber & D. Mohr – [Abr 1987] [330–650 m] B: on gravel bars, soil, mounds at tree trunk bases, and fallen logs in poplar, *Chosenia*, alder, spruce and larch forests in river valleys. Sp.

Cnestrum schisti (F. Weber & D. Mohr) I. Hagen – [Abr 1987] [360 m] B: on cliffs on right slope of the Gilui River valley below the mouth of Shirokaya River; on rock field near the mouth of Kamrai River (Abramova et al. 1987). Rr.

+ *Coscinodon cribrosus* (Hedw.) Spruce – [330 m] B: on walls on “Chertova Pechka” cliffs in vicinity of cordon “Izubriny”. In pure mats. Un. New for Amur Province. Closest localities of the species are known from the Republic of Buryatia and Kamchatka (Ignatova 2017a).

Cratoneuron filicinum (Hedw.) Spruce – [Abr 1987] [320–400 m] B & HB: in places with seeping water on cliffs on the left bank of Gilui River opposite Zolotoy Klyuch; on limestone outcrops, soil in valley willow-alder forest in Izvestkovyi Klyuch, and fine soil on the bank of Teplyi Klyuch. Rr.

Cryphaea amurensis Ignatov – [380–600 m] B: on spruce twigs in valley spruce forests in floodplains of the Kamenushka River and Teplyi Klyuch, on willow branches in the forest in the valley of an unnamed brook – left tributary of the Gilui River 1.5 km downstream from the mouth of Nizhny Chimchan River. Rr. Previously reported by Abramova et al. (1987) as *Forstroemia trichomitria* based a single specimen from Zeysky Nature Reserve and Amur Province: “Teplyi klyuch, dwarf shrub-grass spruce forest with birch. On bark of a living old elm. VIII.1979. D.A. Petelin”; this locality was subsequently flooded by Zeya Water Reservoir. Our records demonstrate that this species is significantly more widely distributed in Tukuringra Ridge. Included into the Red Data Book of Russian Federation (Ignatov 2008) under category 2.

Cynodontium asperifolium (Lindb. & Arnell) Paris – [Abr 1987] [350–1350 m] SA: on soil in dwarf shrub tundra. Un. B: on rocks on moss-covered rock fields; on soil, rocks and fallen logs in larch forests. Sp. Grows in scattered small turfs.

Cynodontium strumiferum (Hedw.) Lindb. – [Abr 1987] [420–1400 m] SA: on rock pillars, outcrops, and soil in dwarf shrub tundras. Sp. B: on rocks on large block deposit in the upper course of the Motovaya River, in larch forest in Razvedochny Klyuch valley (tributary of Gilui River). Rr.

Cynodontium tenellum (Schimp.) Limpr. – [Abr 1987] [610–1400 m] SA: on barren soil, on vertical wall of micro-depression among elfinwood thicket near peak with 1442 m height mark (L.I. Abramova, 11.VIII.1980; MW). Un. B: on large block deposit at the right side of Izubriny Klyuch valley. Un.

+ *Cyrtomnium hymenophylloides* (Huebener) T.J. Kop. – [330–350 m] B & HB: on rocks rich in calcium compounds (marble, limestone) at the right side of the Gilui River Valley opposite of Chapovskaya sandspit and in Izvestkovyi Klyuch valley. Rr.

Dichodontium pellucidum (Hedw.) Schimp. – [Abr 1987] [315–340 m] B & HB: on cliffs, predominantly in niches on fine soils, on sandy alluvium. Sp.

Dicranella cerviculata (Hedw.) Schimp. – [Abr 1987] [600–650 m] B: on soil and roots of fallen trees, along the lake bank. Rr.

Dicranella curvipes (Lindb.) Ignatov (*D. heteromalla* var. *curvipes* Lindb.) – [434–810 m] B: on soil and fallen logs in larch forests. Rr.

– *Dicranella schreberiana* (Hedw.) Hilf. ex H.A. Crum & L.E. Anderson – [Abr 1987] in forest in Teplyi Klyuch valley. Un.

– *Dicranella subulata* (Hedw.) Schimp. – [Gambaryan 1977] [Abr 1987] B: on bare soil in forest belts. Rr.

Dicranum acutifolium (Lindb. & Arnell) C.E.O. Jensen – [Abr 1987] [350–630 m] B: on soil and rocks in birch and

larch forests. Rr. HB: on wet rotten logs in birch forest with oak. Un.

+ *Dicranum bardunovii* Tubanova & Ignatova – [Abr 1987] [1320–1360 m] SA: on soil in *Pinus pumila* and *Duschekia fruticosa* thickets. Rr.

Dicranum bonjeanii De Not. – [Abr 1987] [350–1300 m] B: on soil in spruce, larch and birch-larch forests. Rr.

+ *Dicranum drummondii* Müll. Hal. – [955 m] B: on soil in birch-larch forest on southern slope in vicinity of the cordon “52nd km”.

Dicranum elongatum Schleich. ex Schwägr. – [Abr 1987] [330–1420 m] SA: on soil in dwarf shrub and moss tundras, in *Pinus pumila* communities. Fr. B: on soil and fallen logs in larch forests. Sp.

Dicranum flagellare Hedw. – [Abr 1987] [330–1310 m] B: on rocks, rock outcrops, fallen logs, rarer on tree trunks in forests of various types. Fr.

Dicranum flexicaule Brid. – [Abr 1987] [380–1380 m] SA: on soil in *Pinus sibirica* thickets and in *Betula lanata* forests. Rr. B: on soil, rarer on fallen logs in spruce, larch and small-leaved forests. Sp.

Dicranum fragilifolium Lindb. – [Abr 1987] [370–950 m] B: on rotten wood, tree trunks and trunk bases, rarely on soil in larch, small-leaved and spruce forests. Fr.

Dicranum fuscescens Turner – [Abr 1987] [320–1350 m] SA: on soil in *Pinus pumila* thickets. Rr. B: on soil, fallen logs, trunk bases of trees in forests of different types, on rock fields. Com. One of the most common species of the genus in Zeysky Nature Reserve.

+ *Dicranum groenlandicum* Brid. – [1280–1340 m] SA: on soil in dwarf shrub moss tundra and sparse *Betula lanata* forest. Rr.

+ *Dicranum japonicum* Mitt. – [320–1350 m] SA: on soil in *Betula lanata* crooked forest, *Rhododendron aureum* shrubs and *Calamagrostis* meadow. Rr. B: on soil, at the trunk bases and fallen logs in spruce, larch and small-leaved forests of different types, more commonly on south-facing slopes. Fr. New for Amur Province.

Dicranum majus Turner – [Abr 1987] [400–1320 m] SA: on soil in *Pinus pumila* and *Salix divaricata* thickets in the upper course of Verevochkin Klyuch. Un. B: on soil in spruce and larch forests, mossy rock fields. Rr.

Dicranum montanum Hedw. – [Abr 1987] [330–1350 m] SA: on soil in *Pinus pumila* thickets, on trunk bases of birch in crooked *Betula lanata* forest. Rr. B: on rotten wood, tree trunks, including burnt ones. Com.

+ *Dicranum nipponense* Besch. – [550–1376 m] SA: in *Rhododendron aureum*-juniper reed grass meadow in the upper reaches of the Motovaya River. Un. B: on soil in larch and small-leaved forests on southern macroslope near cordons “52nd” and “34th”. Rr.

+ *Dicranum pacificum* Ignatova & Fedosov – [1393 m] SA: on soil in dwarf shrub lichen tundra. Un.

Dicranum polysetum Sw. – [Abr 1987] [340–1349 m] SA: on soil in sparse *Betula lanata* woodlands, in *Pinus pumila* thickets. Rr. B: on soil and rotten wood in forests of various types. Fr.

+ *Dicranum schljakovii* Ignatova & Tubanova – [400–1434 m] SA: on soil and rocks in dwarf shrub, moss tundras, in elfinwood communities, sparse *Betula lanata* forests. Sp. B: on rock outcrops, rock fields and on peat in *Sphagnum* bog. Rr.

Dicranum scoparium Hedw. – [Abr 1987] [340–1350 m] B: on soil, fallen logs and tree trunks in forests of various types. Fr. Apparently less common in the study area than a related species *D. japonicum*. Unlike the latter, it is typical for taiga forests on north-facing slopes and moss-covered rock fields. Differences in ecology between these two species need further studies.

Dicranum spadiceum J.E. Zetterst. – [Abr 1987] [340–1390 m] SA: on soil, rock outcrops and rock pillars in dwarf shrub mountain tundras, *Pinus pumila* thickets and subalpine meadows. Sp. B: on rocks on rock fields, in larch forests. Sp.

Dicranum undulatum Schrad. ex Brid. – [Abr 1987] [350–1220 m] B: on soil in forests of various types. Sp.

+ *Didymodon ferrugineus* (Schimp. ex Besch.) M.O. Hill – [330–420 m] B & HB: on basic rock outcrops. Sp.

+ *Didymodon bedysariformis* Otnyukova – [320–410 m] B & HB: on cliffs, rock outcrops, and tree trunks in larch, oak and *Betula davurica* forests. Sp. Known from Yakutia (Ivanova et al. 2005), Republic of Buryatia, Zabaikalsky Territory (Afonina et al. 2017), Altai Mts. (Ignatov & Ignatova, unpubl.) and Kamchatka (Czernyadjeva 2012). New to Amur Province.

+ *Didymodon icmadophilus* (Schimp. ex Müll. Hal.) R.H. Zander – [420 m] HB: on cliff of metamorphosed limestone in Izvestkovyi Klyuch valley. Un.

+ *Didymodon cf. validus* Limpr. – [Abr 1987] [330–360 m] B & HB: on cliffs (schists and gneiss rich in calcium) in Izvestkovyi Klyuch valley, on northern bank of Motovaya River bay, right slope of the Gilui River valley, below the mouth of the Shirokaya River. Rr. The taxonomy of this group remains dubious and records of *D. rigidulus* by Abramova et al. (1987) are referred to this name.

+ *Didymodon zanderi* Afonina & Ignatova – [330–770 m] B: on cliffs, predominantly near streams, on soil on aufeis glade, on bark of *Salix cardiophylla* and poplar in valley forest. Sp. Often forms extensive pure patches or carpets. Known in Altai Mts., Baikal Lake area and Transbaikalia, Anabar Plateau, Primorsky Territory (Afonina & Ignatova 2007a) and Kamchatka (Czernyadjeva 2012). New to Amur Province.

Distichium capillaceum (Hedw.) Bruch, Schimp. & W. Gümbel – [Abr 1987] [330–700 m] B & HB: in crevices and niches of cliffs, on fine soil at cliff bases, between rocks in rock fields. Fr.

+ *Ditrichum heteromallum* (Hedw.) E. Britton – [320–1376 m] SA: on bare soil in *Rhododendron aureum*-juniper reed grass meadow. Un. B: on silt deposit in degraded birch-larch forest on the bank of the water reservoir. Un.

+ *Ditrichum cf. rhynchosstegium* Kindb. – [1340 m] SA: on reed grass meadow with scattered birches, on fine soil in chipmunk burrow destroyed by a bear. Un.

+ *Ditrichum pusillum* (Hedw.) Hampe – [320 m] B: in communities of temporal draw-down zone of the water reservoir and in degraded birch-larch forests on the banks of water reservoir. Rr.

Drepanocladus aduncus (Hedw.) Warnst. – [Abr 1987] [320 m] B: mire near the lake on the low terrace of Gilui River. Rr.

+ *Drummondia sinensis* Müll. Hal. – [320–380 m] HB: cliffs on the left slope of Motovaya River bay, on fallen logs in larch forest at the right slope of the Zimoveiskiy Klyuch valley. Rr.

Encalypta ciliata Hedw. – [Abr 1987] [320–700 m] B & HB: on cliffs, between rocks on steep rocky slopes. Sp.

+ *Encalypta pilifera* Funck – [370 m] HB: on cliffs in *Betula davurica* forest on a steep slope at the left side of the Motovaya River valley in its lower course. Un.

+ *Encalypta trachymitria* Ripart – [320 m] HB: on limestone at the mouth of Izvestkovyi Klyuch (Petelin 24.VII.1989, MHA). Un.

Entodon concinnus (De Not.) Paris – [Abr 1987] [320–360 m] B & HB: on cliffs rich in calcium in Gilui Bay and in Izvestkovyi Klyuch bay. Rr.

+ *Entodon giraldii* Müll. Hal. – [420 m] HB: on limestone cliffs on a south-facing slope at the right slope of Izvestkovyi Bay. Un.

Entodon schleicheri (Bruch, Schimp. & W. Gümbel) Demet. – [Abr 1987] [600 m] B: on steep south-facing rocky slope of Bol'shaya Erakingra River valley. Un.

Entosthodon pulchellus (H. Philib.) Brugués – [350–630 m] B & HB: on cliffs rich in calcium compounds in Gilui River valley. Rr.

Eurhynchiadelphus eustegia (Besch.) Ignatov & Huttunen – [330 m] HB: on limestone cliffs on south-facing slope on the right slope of Izvestkovyi Bay. Un. This species was also reported by Gambaryan (1977).

Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen – [Abr 1987] [330–1350 m] SA: on rock in sparse *Pinus pumila* thicket. Un. B: on soil, rocks, rotten wood, tree trunk bases in forests and rock fields. Com.

+ *Eurohypnum leptothallum* (Müll. Hal.) Ando – [320–630 m] B & HB: on cliffs, rocks on steep slopes. Rr.

+ *Fabronia ciliaris* (Brid.) Brid. – [320–700 m] B & HB: on vertical cliff walls, in valleys of Zeya and Gilui Rivers. Sp.

+ *Fabronia rostrata* Broth. – [420–630 m] HB: on linden bark on steep southern slope in Izvestkovyi Bay, on cliffs on steep slope towards Zeya Reservoir at the mouth of Gilui Bay. Rr.

Fissidens bryoides Hedw. – [Abr 1987] [320–630 m] B & HB: on cliffs, rocks, rock outcrops, fallen logs and trunk bases of *Betula davurica*. Sp.

– *Fontinalis dalecarlica* Bruch, Schimp. & W. Gümbel – [Gambaryan 1978a] [Abr 1987] B: on rocks in rapidly flowing water of streams. Sp.

Funaria hygrometrica Hedw. – [Abr 1987] [320–650 m] B: on soil and upturned roots of fallen trees in valley forests, in burnt forest areas. Rr.

+ *Glyphomitrium* cf. *humillimum* (Mitt.) Cardot – [350 m] B: on vertical walls in “Chertova Pechka” cliffs near the cordon “Izubriny”. Un.

Grimmia elatior Bruch ex Bals.-Criv. & De Not. – [Gambaryan 1978b] [Abr 1987]: B: on rocks. Sp. There is a specimen in MHA collected by Gambaryan from Zhurban (at Zeya River bank, now drowned by the reservoir).

Grimmia jacutica Ignatova, Bednarek-Ochyra, Afonina & J. Muñoz – [Ignatova et al., 2003] [320–1355 m] SA: on rock outcrops and rock pillars in elfinwood thickets. Sp. B: on rocks in rock fields. Sp.

Grimmia longirostris Hook. – [Abr 1987] [320–1355 m] SA: on rocks, rock outcrops, rock pillars within elfinwood thickets. Fr. B & HB: on rocks in forests, in cliffs of various composition. Com.

Grimmia pilifera P. Beauv. – [Abr 1987] [320–700 m] B & HB: on cliffs and rock outcrops. Fr. Often abundant.

+ *Gymnostomum aeruginosum* Sm. – [320–420 m] B & HB: on cliffs rich in calcium in Zeya and Gilui River valleys. Sp. Forms thick tufts.

+ *Haplocladium angustifloium* (Hampe & Müll. Hal.) Broth. – [Abr 1987] [320–820 m] B & HB: on trunk bases, fallen logs, rocks, rock outcrops in forests, predominantly on south-facing slopes. Fr.

+ *Hedwigia emodica* Hampe ex Müll. Hal. – [320–1350 m] B: on rock outcrops, rocks, bare soil, trunk bases in forests, predominantly on south-facing slopes. Fr.

+ *Hedwigia kuzenevae* Ignatova & Ignatov – [350–579 m] Ecological preferences apparently similar to the previous species.

Helodium blandowii (F. Weber & D. Mohr) Warnst. – [Abr 1987] [340–700 m] B: on soil in floodplain larch and spruce forests, in larch forest on a north-facing slope. Rr. Small turfs among *Sphagnum girgensohnii*, *Pleurozium schreberi*, *Hylacomium splendens* and other species.

– *Helodium paludosum* (Austin) Austin ex Broth. – [Abr 1987] B: in open larch stand, on soil. Rr. Gambaryan (1978b) reported this species from Boyarkinsky Klyuch and from Zhurban settlement (at Zeya River bank, now drowned by the reservoir).

Herpetineuron tocoae (Sull. & Lesq.) Cardot – [Abr 1987] [320–330 m] B & HB: on rock outcrops, rocks, “Chertova Pechka” cliffs; on steep cliffy left bank of Gilui Bay opposite Motovaya River Bay; in Teplyi Klyuch valley (Abramova et al. 1987). Rr.

Herzogiella turphacea (Lindb.) Z. Iwats. – [Abr 1987] [320–700 m] B: on rotten wood and trunk bases in wet forests. Rr.

+ *Heterophyllum affine* (Hook.) M. Fleisch. – [430–1260 m] B: on fallen logs, spruce trunk bases in spruce and spruce-larch green moss forests. Rr.

Homalia trichomanoides (Hedw.) Bruch, Schimp. & W. Gümbel – [Abr 1987] [320–450 m] B & HB: in shaded niches and crevices of cliffs, under rocks in rock fields. Sp.

+ *Homomallium connexum* (Cardot) Broth. – [320–400 m] B & HB: on rock outcrops and boulders. Rr.

Homomallium incurvatum (Schrad. ex Brid.) Loeske – [Abr 1987] [320–860 m] B & HB: on rock outcrops, boulders, trunk bases of trees in forests on south-facing slopes. Rr.

+ *Hondaella caperata* (Mitt.) Ando, B.C. Tan & Z. Iwats. – [330 m] HB: on shaded limestone outcrops in Izvestkovyi Klyuch valley. Un. This species is known in Russia from only a few localities in southern Russian Far East, in Bastak Nature Reserve in Jewish Autonomous Region, in Bolshekhkheksirsky Nature Reserve in Khabarovsk Territory, at Zmeinaya River (tributary of Bikin River), and in Kedrovaya Pad Nature Reserve in Primorsky Territory. New to Amur Province. Included in the Red Data Book of Russian Federation (Cherdantseva 2008), category 2.

+ *Hydrogonium amplexifolium* (Mitt.) P.C. Chen – [326–649 m] B & HB: on basic rock outcrops (Izvestkovyi Klyuch; cliffs on the left slope of the Gilui River valley upstream Zolotoy Klyuch), on rocks in the valley of a stream – right tributary of Bol'shaya Erakingra River. Rr. In Russia, this species is known from scattered localities in Stanovoy Upland in Transbaikalia (Afonina et al. 2017), Eastern Yakutia (Ivanova et al. 2005), south-eastern part of Taimyrsky Region (Fedosov & Zolotov 2008) and Altai Mts. (Ignatov & Zander 1993). New to Amur Province.

Hydrohypnella ochracea (Turner ex Wilson) Ignatov & Ignatova – [Abr 1987] [320–1300 m] SA: on rocks in water at the mouth of Verevochkin Klyuch. Un. B: on river banks and rocks in river and brook beds. Rr.

Hydrohypnella polaris (Lindb.) Ignatov & Ignatova – [Abr 1987] [320–770 m] B: on banks of rivers and brooks, on rocks in river beds. Rr.

+ *Hydrohypnum luridum* (Hedw.) Jenn. – [650 m] B: on rocks in a brook in the uppermost course of Shaman River. Un.

Hylacomium splendens (Hedw.) Bruch, Schimp. & W. Gümbel – [Abr 1987] [320–1350 m] SA: on soil in *Pinus pumila* thickets. Rr. B: on soil, tree trunks and fallen logs in forests. More frequent on shaded slopes and in valleys. This species forms extensive moss cover in taiga forests. Com.

+ *Hymenostylium recurvirostrum* (Hedw.) Dixon – [330–350 m] B & HB: on cliffs rich in calcium (left and right slopes of the Gilui River valley, below the mouth of the Shirokaya River, in Izvestkovyi Klyuch valley). Rr. New for Amur Province.

+ *Hyophila involuta* (Hook.) A. Jaeger – [330 m] HB: on shaded limestone outcrops in the Izvestkovyi Klyuch valley. Un. In Russia, known from Southern Primorye (Bardunov 2008) and several localities in South-Eastern Zabaikalsky Territory (Afonina et al. 2017). New to Amur Province. Included in the Red Data Book of Russian Federation (Bardunov 2008), category 3.

Hypnum cupressiforme Hedw. – [Abr 1987] [320–1350 m] SA: on rock pillars, rocks in *Pinus pumila* thickets, on trunk bases of *Betula lanata*. Sp. B: on soil, trunk bases of trees in forests of various types. Sp. One specimen collected from the base of *Larix gmelinii* trunk near the cordon “20th km” was determined as *Hypnum cupressiforme* var. *subjulaceum* Molendo.

Hypnum saitoi Ando – [Abr 1987] [≈1200 m] B: on soil and rocks in subalpine spruce forest (Gambaryan 6.VII.1974, MW). Un. Reported by Gambaryan (1978a) as Rr.

+ *Isopterygiopsis alpicola* (Lindb. & Arnell) Hedenäs – [380–670 m] B & HB: in crevices and niches of cliffs of various composition, on rocks with fine soil sediments. Sp. Together with *Poblia cruda*, *Fissidens bryoides*, *Oxystegus tenuirostris*.

+ *Isopterygiopsis muelleriana* (Schimp.) Z. Iwats. – [340–1355 m] SA: on outcrops and soil between rocks in mountain tundra and in *Pinus pumila* thickets. Rr. B & HB: on cliffs, on rocks on forested screes. Rr.

Isopterygiopsis pulchella (Hedw.) Z. Iwats. – [Abr 1987] [330–370 m] B & HB: on rocks and tree trunk bases. Rr.

Iwatsukiella leucotricha (Mitt.) W.R. Buck & H.A. Crum – [Abr 1987] [330–1350 m] SA: on trunk of *Pinus pumila*. Rr. B: on bark of tree branches and trunks, more frequently on spruce. Sp.

Leptobryum pyriforme (Hedw.) Wilson – [Abr 1987] [390–410 m] B: on cliffs, silt deposit near brooks and in the temporarily exposed draw-down zone of the water reservoir. Rr.

+ *Leptodontium flexifolium* (Dicks.) Hampe – [330–630 m] B & HB: on bark of *Betula davurica* and aspen, on fallen logs. Rr.

+ *Leucodon corensis* Cardot – [360 m] B: on a cliff on the right slope of the Gilui River valley, below the mouth of the Shirokaya River. Un.

Leucodon pendulus Lindb. – [Abr 1987] [330–1265 m] B: on branches and trunks of spruce, poplar and birch trees in valley forests, in subalpine spruce forests. Sp.

Leucodon sciuroides (Hedw.) Schwägr. – [Abr 1987] [330–380 m] B: on trunks of spruce and birch trees in valleys. Rr.

+ *Lewinskya cf. affinis* (Brid.) F. Lara, Garilleti & Goffinet (= *Ortotrichum affine* Brid.) – [660 m] B: on trunk of a willow tree in Bol'shaya Erakingra River valley. Rr. Newly recorded for Amur Province; however, further studies are needed for clarifying taxonomy in this group.

+ *Lewinskya elegans* (Schwägr. ex Hook. & Grev.) F. Lara, Garilleti & Goffinet (= *Ortotrichum elegans* Schwägr. ex Hook. & Grev.) – [Abr 1987] [340–850 m] B: on bark of aspen, birch, poplar and willows in forests of various types. Sp. Previously not listed for the region; however, the recent revision of the family Orthotrichaceae in Russia (Fedosov & Doroshina 2018) demonstrated that all specimens from the Zeysky Nature Reserve identified as *Ortotrichum speciosum* Nees actually belong to *L. elegans*.

+ *Lewinskya iwatsukii* (Ignatov) F. Lara, Garilleti & Goffinet (= *Ortotrichum iwatsukii* Ignatov) – [360–820 m] B: on branches and trunks of aspen, birch and spruce in forests of various types. Sp.

Lewinskya sordida (Sull. & Lesq.) F. Lara, Garilleti & Goffinet (= *Ortotrichum sordidum* Sull. & Lesq.) – [Abr 1987] [320–1280 m] SA: on bark of *Betula lanata* in sparse birch woodland. Rr. B & HB: on trunks and branches of birch, willows, aspen, spruce, and oak trees in forests of various types. Fr.

+ *Lewinskya transcaucasica* Eckstein, Garilleti & F. Lara – [380–1282 m] B: on bark of birch, aspen and willow in valley and slope forests. Rr. This species has been recently discovered in Russia (Fedosov et al. 2017) and is comparatively common in southern Russian Far East. All specimens from Zeysky Nature Reserve previously identified as *Ortotrichum striatum* Hedw. actually belong to *L. transcaucasica*.

Mnium lycopodioides Schwägr. – [Abr 1987] [320–650 m] B & HB: in crevices, shaded niches of cliffs, between rocks of rock fields. Rr.

Mnium marginatum (Dicks.) P. Beauv – [Abr 1987] [320–350 m] B: in spruce forest in Kamrai Klyuch (Petelin 5.IX.1979, MW), on birch hanging over water in the Teplyi Klyuch valley (L.I. Abramova 16.VIII.1980, MW). Rr. These localities were likely flooded by Zeya Reservoir.

Mnium spinulosum Bruch, Schimp. & W. Gümbel – [Abr 1987] [640–1310 m] B: on soil, fallen logs, mounds at the trunks of trees in spruce forests. Sp.

Mnium thomsonii Schimp. – [Abr 1987] [320–600 m] B & HB: in crevices, shaded niches of cliffs, on trunk bases of trees, fallen logs and rocks in valley forests. Sp.

+ *Molendoa sendtneriana* (Bruch, Schimp. & W. Gümbel) Limpr. – [320–420 m] B & HB: on base-rich cliffs in Zeya and Gilui River valleys. Sp. Generally in pure mats.

Myurella julacea (Schwägr.) Bruch, Schimp. & W. Gümbel – [Abr 1987] [330–650 m] B: on vertical walls of bare soil, rocks, fallen logs, trunk bases of trees in valley forests, in crevices of cliffs. Sp.

+ *Myurella sibirica* (Müll. Hal.) Reimers – [330–360 m] B & HB: on wet calcareous cliffs in Zeya and Gilui River valleys. Rr. Often with *Abietinella abietina*, *Bryoerythrophyllum recurvirostrum*, *Distichium capillaceum*, *Brachythecium daburicum*. New for Amur Province.

+ *Myuroclada longiramea* (Müll. Hal.) Min Li, Y.F. Wang, Ignatov & Huttunen – [320–570 m] B: on soil in valley forests, communities in the temporarily exposed draw-down zone of the water reservoir. Rr.

Myuroclada maximowiczii (G.G. Borshch.) Steere & W.B. Schofield – [Abr 1987] [320–410 m] B: on fine soil in shaded niches of cliffs, on soil, trunk bases of trees in valley forests. Sp. HB: on cliffs, soil, trunk bases of *Quercus mongolica* in forests on exposed slopes. Sp.

Neckera pennata Hedw. – [Abr 1987] [330–1150 m] B: on trunks of spruce and poplar, on fallen logs in spruce forests; between rocks on forested block screes, in crevices and niches of cliffs. Sp.

Niphotrichum canescens (Hedw.) Bedn.-Ochyra & Ochyra – [Abr 1987] [350–1380 m] SA: on soil and rocks in mountain tundras. Rr. B: on alluvium in river valleys, on rocks of rock fields. Rr.

+ *Niphotrichum panschii* (Müll. Hal.) Bedn.-Ochyra & Ochyra – [320–350 m] B: on rocks of rock fields, on gravel and sandy alluvium in valleys of rivers. Sp.

Nyholmia obtusifolia (Brid.) Holmen & E. Warncke (= *Ortotrichum obtusifolium* Brid.) – [Abr 1987] [320–820 m] B & HB: on bark of deciduous trees. Sp.

+ *Oncophorus elongatus* (I. Hagen) Hedenäs – [320–420 m] B: on fallen logs in birch-larch forests. Rr. This species was recently re-instated (Hedenäs 2017). Its ecological preferences and frequency of occurrence in the territory need further studies.

Oncophorus virens (Hedw.) Brid. – [Abr 1987] [320–700 m] B: on gravel and sandy alluvium, cliffs and rocks near watercourses, on soil in valley forests and on aufeis glades. Sp.

Oncophorus wahlenbergii Brid. – [Abr 1987] [330–1350 m] B: on fallen logs, tree stumps and trunk bases in forests. Fr. Herbarium specimens previously identified as *O. wahlenbergii* need to be revised as some of them may belong to *O. elongatus*.

+ *Oxystegus tenuirostris* (Hook. & Taylor) A.J.E. Sm. – [320–820 m] B & HB: in cliff crevices, on fallen logs, bark of spruce, aspen, *Quercus mongolica* and *Betula davurica*. Sp. Often with *Haplocladium angustifolium*, *Poblia cruda*, *Isopterygiopsis alpicola*.

Paludella squarrosa (Hedw.) Brid. – [350–670 m] B: on wet soil in valley forests (sphagnum larch forests, poplar forests), on gravel near watercourses. Rr.

- + *Paraleucobryum longifolium* (Hedw.) Loeske – [1380–1400 m] SA: on soil in willow-*Rhododendron* tundra and *Rhododendron aureum*-juniper reed grass meadow. Rr.
- + *Philonotis* cf. *capillaris* Lindb. – [320–490 m] B: on fine soil alluvium. Rr. Possibly widespread on alluvium along rivers and brooks, but easily overlooked and lacking in collections.
- + *Philonotis fontana* (Hedw.) Brid. – [350–700 m] B: on gravel, rocks in slow watercourses in floodplains of rivers. Sp.
- + *Philonotis tomentella* Molendo – [500 m] B: on gravel in reed grass-variegated horsetail willow forest in valley of the Garmakan River. Rr.
- + *Plagiomnium acutum* (Lindb.) T.J. Kop. – [400 m] HB: on soil in willow-alder community of floodplain of Izvestkovyi Klyuch. Un.
- Plagiomnium confertidens* (Lindb. & Arnell) T.J. Kop. – [Abr 1987] [330–700 m] B: on bases of tree trunks, fallen logs in valley forests, predominantly in spruce forests, on cliffs. Rr. HB: on wet cliffs. Sp.
- Plagiomnium cuspidatum* (Hedw.) T.J. Kop. – [Abr 1987] [320–770 m] B: on soil, fallen logs, trunk bases of trees in forests, more often in valley forests; on fine soil in niches on rock outcrops. Com.
- + *Plagiomnium drummondii* (Bruch & Schimp.) T.J. Kop. – [640 m] B: on soil in aspen forest on the right slope of Malaya Erakingra River valley. Un.
- Plagiomnium ellipticum* (Brid.) T.J. Kop. – [Abr 1987] [320–550 m] B: on soil, trunk bases, fallen logs in valley forests; in mires. Sp.
- Plagiomnium rostratum* (Schrad.) T.J. Kop. – [Abr 1987] [317 m] B: on soil of reed grass meadow in the temporarily exposed draw-down zone of the water reservoir; in birch forests (Abramova et al. 1987). Rr.
- + *Plagiopus oederianus* (Sw.) H.A. Crum & L.E. Anderson – [330 m] HB: on shaded limestone outcrops in the Izvestkovyi Klyuch. Un. Together with *Distichium capillaceum*, *Myurella sibirica*, *Campyladelphus chrysophyllus*, *Mnium thomsonii*, *Didymodon ferrugineus*.
- + *Plagiothecium cavifolium* (Brid.) Z. Iwats. – [320–130 m] B: on shaded wet cliffs, on soil near streams, on mounds at the trunk bases in subalpine spruce forest. Rr.
- *Plagiothecium curvifolium* Schlieph. ex Limpr. – [Abr 1987] HB: Teplyi Klyuch, on rotten log. Un.
- Plagiothecium denticulatum* (Hedw.) Bruch, Schimp. & W. Gumbel – [Abr 1987] [360–1320 m] B: on fine soil along brooks, on rocks and fallen logs in spruce and larch forests. Rr.
- Plagiothecium laetum* Bruch, Schimp. & W. Gumbel – [Abr 1987] [320–1270 m] B: on soil, on fallen logs in wet forests, between rocks of rock fields. Rr.
- *Plagiothecium latebricola* Bruch, Schimp. & W. Gumbel – [Abr 1987] B: near the mouth of Pryamoi Klyuch. Un.
- *Plagiothecium nemorale* (Mitt.) A. Jaeger – [Abr 1987] HB: Teplyi Klyuch, on rotten log. Un.
- Platydictya jungermannioides* (Brid.) H.A. Crum – [Abr 1987] [350 m] B: on a cliff on the left bank of Gilui River opposite Zolotoy Klyuch. Un. Also reported by Abramova et al. (1987) as Rr.
- Platygyrium repens* (Brid.) Bruch, Schimp. & W. Gumbel – [Abr 1987] [320–800 m] B & HB: on bark of birch, aspen, spruce and larch, on rocks, on fallen logs in forests of various types. Fr.
- Pleurozium schreberi* (Brid.) Mitt. – [Abr 1987] [320–1440 m] SA: on soil in elfinwoods and dwarf shrub thickets in tundras, in *Pinus pumila* and crooked birch communities. Fr. B: on soil, rarer on fallen logs, trunk bases, rocks in coniferous and small-leaved forests. Com.
- Podperaea krylovii* (Podp.) Z. Iwats. & Glime – [Abr 1987] [320–370 m] HB: on cliffs, rocks, trunk base of an oak. Rr. Grows with *Weissia brachycarpa* and *Fissidens bryoides*.
- + *Pogonatum dentatum* (Brid.) Brid. – [350–650 m] B: on barren soil, cliffs covered by fine soils in river floodplains and on tree roots in larch forest. Sp.
- Pogonatum urnigerum* (Hedw.) P. Beauv. – [Abr 1987] [330–1300 m] B: on fine soil on cliffs, weakly turfed areas on river and brook banks, and on upturned roots of fallen trees. Sp.
- + *Poblia andalusica* (Höhn.) Broth. – [320–360 m] B: on silt deposit of a temporary brook in floodplain of the Gilui River and in the temporarily exposed draw-down zone of the water reservoir. Rr. Grows with *Poblia andrewsii*, *Philonotis capillaris*, *Trichodon cylindricus*.
- + *Poblia andrewsii* A.J. Shaw – [320–1300 m] B: on silt deposit in degraded birch-larch forest in the temporarily exposed draw-down zone of the water reservoir; on soil in valley poplar forest; on soil along brooks, on upturned roots of fallen spruce trees. Rr. This species is absent from the list of mosses of Zeya Reserve (Abramova et al. 1987); however, several specimens collected in subalpine spruce forest near the peak with 1442 m height mark by D.A. Petelin and L.I. Abramova in 1979–1980 are stored in MW.
- + *Poblia annotina* (Hedw.) Lindb. – [320 m] B: on soil in narrow valley with a permanent brook near cordon “Izubriny”. Un.
- + *Poblia bulbifera* (Warnst.) Warnst. – [320–340 m] B: on silt deposit of a temporary brook in floodplain of the Gilui River and in the temporarily exposed draw-down zone of the water reservoir. Rr. Together with *Ceratodon purpureus*, *Trichodon cylindricus*, *Calliergonella lindbergii*, *Poblia bulbifera*, *P. andrewsii*.
- Poblia cruda* (Hedw.) Lindb. – [Abr 1987] [340–1390 m] SA: on fine soil in willow-*Rhododendron* tundras. Un. B: on cliffs, walls composed of fine soil, upturned roots of fallen trees, soil under roots and between rocks in forests. Sp. HB: in shaded wet niches of rock outcrops. Sp.
- Poblia elongata* Hedw. – [Abr 1987] [390–1310 m] SA: in crevices of rock outcrops in the upper course of Verevochkin Klyuch. Un. B: in crevices on cliffs, rarer on fallen logs in forests. Rr. *Poblia elongata* var. *greenii* (Brid.) A.J. Shaw was collected on cliffs on the right slope of Razvedochny Klyuch valley (tributary of Gilui River).
- + *Poblia filum* (Schimp.) Mårtensson – [320–360 m] B: on sandy alluvium in the low floodplain of the Gilui River, on silt deposit in the temporarily exposed draw-down zone of the water reservoir. Rr.
- + *Poblia lescuriana* (Sull.) Ochi – [1380 m] SA: on soil within grass-reed grass meadow on the main watershed of the ridge in the upper reaches of the Motovaya River. Un.
- + *Poblia longicollis* (Hedw.) Lindb. – [340–1390 m] SA: in crevices of granite buttes, on soil in willow-*Rhododendron* tundra. Rr. B: on rock outcrops, rocky soil on steep slopes. Rr.
- Poblia nutans* (Hedw.) Lindb. – [Abr 1987] [340–1380 m] SA: on soil in grass-reed grass meadow, on fine soil in chipmunk burrow destroyed by a bear, on trunk bases of birch within sparse birch forest. Sp. B: on fallen logs, trunk bases, soil and rocks in forests. Fr.
- + *Poblia prolifera* (Kindb.) Lindb. ex Broth. – [320 m] B: on silt deposit in birch-larch forest in the temporarily exposed draw-down zone of the water reservoir. Un.
- + *Poblia tundrae* A.J. Shaw – [360 m] B: between rock blocks in fire-disturbed birch-larch forest on northern slope of the Tabuneika River valley, together with *Eurhynchiastrum pulchellum*, *Trichodon cylindricus*, *Poblia cruda*. Un. New to Amur Province.
- Polytrichastrum alpinum* (Hedw.) G.L. Sm. – [Abr 1987] [350–1400 m] SA: on soil, rocks covered by fine soil in tundras and elfinwood communities. Sp. B: on bare soil, fallen logs and rock outcrops in forests. Sp.

Polytrichum commune Hedw. – [Abr 1987] [320–1370 m] SA: on soil in tundras, in communities of elfinwood, birch krummholtz. Fr. B: on soil, fallen logs, trunk bases of trees in forests. Com.

+ *Polytrichum hyperboreum* R. Br. – [610 m] B: On soil in poplar-alder forest in floodplain of Bol'shaya Erakingra Creek. Un.

Polytrichum jensenii I. Hagen – [Abr 1987] [380 m] SA: Gambaryan (1978b) reported one collection from mountain tundra. B: on a mire near a lake on the watershed of Shirokaya and Zolotaya Rivers (Petelin 11.IX.1979, MW). Un.

Polytrichum juniperinum Hedw. – [Abr 1987] [320–1440 m] SA: on soil in mountain tundra, reed grass meadow. Rr. B: on soil, trunk bases of trees, fallen logs in forests and in bogs. Common in burnt forest areas. Fr.

Polytrichum longisetum Sw. ex Brid. – [Abr 1987] [360–1300 m] B: on upturned roots of fallen trees in subalpine spruce forest near 1442 m peak, on soil and on trunk of fallen larch near lake on the watershed of Shirokaya and Zolotaya Rivers, on alluvium in low floodplain of the Gilui River. Rr.

– *Polytrichum pallidisetum* Funck (*P. obioense* auct.) – [Gambaryan 1978a] [Abr 1987] SA: *Pinus pumila* thickets. Rr.

Polytrichum piliferum Hedw. – [Abr 1987] [320–1400 m] SA: on soil in dwarf shrub tundras, in elfinwood communities, reed grass meadows. Fr. B: on soil in open forests, in burnt forest areas; on bogs; on fine soil and screes. Sp.

Polytrichum strictum Brid. – [Abr 1987] [320–1400 m] SA: on soil in mountain tundras, predominantly of dwarf shrub-moss type, in elfinwood communities. Fr. B: on peat in mires. Sp.

+ *Polytrichum swartzii* Hartm. – [320–370 m] B: on peat in mires along Gilui River. Rr.

Pseudobryum cinclidioides (Huebener) T.J. Kop. – [Abr 1987] [350–670 m] B: on wet soil in valley forests, along oxbows, brook banks and mires. Sp.

+ *Pseudoleskeella papillosa* (Lindb.) Kindb. – [650 m] B: on rock on large-block rock field in the upper course of Motovaya River. Un.

+ *Psilopilum cavifolium* (Wilson) I. Hagen – [350 m] B: on rocky bank of the Gilui River opposite Chapovskaya sandspit (Barinov 15.IX.1991, MW and herbarium of Zeysky Reserve). Un. The nearest known localities of this species, which is rare in boreal regions, are from Stanovoe Upland (Zabaikalsky Territory) (Afonina et al. 2017). New for Amur Province and Southern Far East (Ivanova & Ignatov 2017).

Ptilium crista-castrensis (Hedw.) De Not. – [Abr 1987] [330–1440 m] SA: on soil under tree trunks and between rocks, in elfinwoods and yerniks, in sparse birch forests. Sp. B: on soil, fallen logs, trunk bases of trees in forests, bogs and block screes. Com.

+ *Ptychomitrium sinense* (Mitt.) A. Jaeger – [320–340 m] HB: on exposed cliffs at the bank of Zeya Reservoir. Rr.

+ *Pylaisia* cf. *curviramea* Dixon – [420–580 m] B: on bark of aspen and birch in birch- and aspen-larch forests. Rr.

+ *Pylaisia falcata* Bruch, Schimp. & W. Gumbel – [320–820 m] B & HB: on bark of birch, aspen and poplar in forests of various types. Sp. In pure turfs or together with *Calli cladium baldanianum*, *Haplocladium angustifolium*, *Herzogiella turfacea*, *Homomallium connexum*, *Platygyrium repens*, *Pylaisiadelphus tenuirostris*.

Pylaisia polyantha (Hedw.) Bruch, Schimp. & W. Gumbel – [Abr 1987] [320–950 m] B & HB: on bark of birch, aspen, spruce, poplar, *Salix cardiophylla*, on fallen logs in forests of various types. Sp. In pure turfs or mixed with *Campylidium sommerfeltii*, *Dicranum flagellare*, *Haplocladium angustifolium*, *Oncophorus nahlenbergii*, *Oxystegus tenuirostris*, *Platygyrium repens*, *Poblia nutans*, *Sanionia uncinata*, *Zygodon sibiricus*.

+ *Pylaisia selwynii* Kindb. – [315–160 m] B & HB: on bark of aspen, poplar and *Betula davurica*, on cliffs. Sp. Commonly in pure turfs.

+ *Pylaisia steerei* (Ando & Higuchi) Ignatov – [370–760 m] B & HB: on fallen logs, rock and trunks of aspen in birch-larch and *Betula davurica* forests. Rr.

Pylaisiadelphus tenuirostris (Bruch & Schimp. ex Sull.) W.R. Buck – [Abr 1987] [320–820 m] B: on bark of birch, aspen and larch, on fallen logs in birch- and aspen-larch forests. Fr. One of the most common epiphytic mosses. In pure turfs or together with *Abietinella abietina*, *Brothera leana*, *Ceratodon purpureus*, *Dicranum montanum*, *Fissidens* cf. *bryoides*, *Invatsukiella leucotricha*, *Platygyrium repens*, *Poblia cruda*, *Pylaisia polyantha*, *Stereodon pallescens*. Reported by Abramova et al. (1987) as *Clastobryella kusatsuenensis*.

Rhabdoweisia crispata (Dicks. ex With.) Lindb. (= *Rhabdoweisia kuszenovae* Broth.) – [Abr 1987] [340–1220 m] SA: on soil in mountain tundra. (Abramova et al. 1987). B: in cliff niches and crevices, on rocks. Sp.

+ *Rhodobryum ontariense* (Kindb.) Kindb. – [330–370 m] B: on fallen logs, trunk bases of spruce and poplar, on soil in valley forests. Rr. Apparently, previous records of *Rhodobryum roseum* (Hedw.) Limpr. in Zeysky Nature Reserve (Abramova et al. 1987) should be referred to *R. ontariense*.

Rhytidiadelphus triquetrus (Hedw.) Warnst. – [Abr 1987] [320–1350 m] SA: on soil between rocks in elfinwood communities. Rr. B: on soil, tree trunk bases in valley forests and rocks near watercourses in narrow valleys. Sp.

Rhytidium rugosum (Hedw.) Kindb. – [Abr 1987] [320–1440 m] SA: on soils, on rocks in dwarf shrub tundras, often in abundance. Fr. B & HB: on soil, among rocks, on tree trunk bases of trees in forests, commonly on south-facing slopes, rocky deposits, and cliffs. Com.

Saelania glaucescens (Hedw.) Broth. – [Abr 1987] [340–720 m] B: on upturned roots of fallen trees, bare soil between rocks, fallen logs and in shaded niches of cliffs. Sp.

Sanionia uncinata (Hedw.) Loeske – [Abr 1987] [320–1380 m] SA: on soil in elfinwood communities, reed grass meadows in areas with snow accumulation. Sp. B: on soil, fallen logs, trunk bases of trees and rocks in forests of various types. Com.

+ *Schistidium austrosibiricum* Ignatova & H.H. Blom – [420–650 m] B: on rocks in rock fields. Rr.

+ *Schistidium lancifolium* (Kindb.) H.H. Blom – [320–520 m] B: on rock outcrops. Rr.

+ *Schistidium liliputanum* (Müll. Hal.) Deguchi – [340–520 m] B: on vertical surfaces of rock outcrops, on rocks in rock fields. Sp. New to Amur Province (Ignatova & Blom 2017).

+ *Schistidium marginale* H.H. Blom, Bedn.-Ochyr & Ochyr – [370 m] HB: on rock outcrop on the left bank of Gilui Bay opposite Motovaya River mouth. Un. New to Amur Province (Ignatova & Blom 2017).

+ *Schistidium papillosum* Culm. – [340–700 m] B & HB: on rock outcrops and rocks in forests. Rr.

+ *Schistidium platyphyllum* (Mitt.) Perss. – [330 m] B: on rocks in floodplain of the Gilui River. Un.

+ *Schistidium pulchrum* H.H. Blom – [320–430 m] B & HB: on vertical walls of rock outcrops, on rocks. Fr.

+ *Schistidium sibiricum* Ignatova & H.H. Blom – [340–770 m] B: on rocks in valley forests, meadows in the low floodplain of the Gilui River, on cliffs near watercourses. Sp.

+ *Schistidium subjulaceum* H.H. Blom – [650 m] B: cliffs near water in the upper course of Motovaya River. Un. New to Amur Province (Ignatova & Blom 2017).

Schistostega pennata (Hedw.) F. Weber & D. Mohr – [Abr 1987] [440–1320 m] B: between rocks on forested screes, on upturned roots of fallen trees in spruce forests. Rr.

+ *Sciuro-hypnum curtum* (Lindb.) Ignatov – [430–1270 m] B: on soil, fallen logs in mossy spruce and larch-spruce forests. Sp.

Sciuro-hypnum plumosum (Hedw.) Ignatov & Huttunen – [Abr 1987] [330–860 m] B: on soil, rocks, on fallen logs in floodplain forests and meadows in low floodplain of the Gilui River. Sp.

Sciuro-hypnum cf. reflexum (Starke) Ignatov & Huttunen – [Abr 1987] [1380 m] SA: on soil in *Rhododendron aureum*-juniper reed grass meadow in lately melted snowbed area. Un. Another locality at the mouth of Promyslowy Klyuch is reported by Abramova et al. (1987).

– *Scorpidium revolvens* (Sw. ex anon.) Rubers – [Abr 1987] SA & B: mountain tundras and mires. Rr.

+ *Scouleria pulcherrima* Broth. [330 m] B: on boulders on the Gilui River floodplain (Barinov 20.VIII.1992, MW and Zeyisky Reserve herbarium). Rr. Brotherus (1916) and Ignatova et al. (2015) include references to finding this species in many places along Gilyi and Zeya Rivers; one record was from Zeya River where it crosses the Tukuringra Range.

+ *Seligeria donniana* (Sm.) Müll. Hal. – [330 m] HB: in shaded crevice of limestone cliff in the Izvestkovyi Klyuch valley. Un.

+ *Seligeria tristichoides* Kindb. – [330 m] HB: in shaded crevice of limestone cliffs in the Izvestkovyi Klyuch valley. Un.

+ *Sphagnum alaskense* R.E. Andrus – [320 m] B: *Sphagnum lindbergii* bog with *Carex limosa* in waterlogged lowland on terrace of Gilui River, 1 km upstream from cordon “Izubriny”. Un.

Sphagnum angustifolium (C.E.O. Jensen ex Russow) C.E.O. Jensen – [Abr 1987] [320–1420 m] SA: in mountain tundra. Rr. B: in boggy forests. Sp.

Sphagnum aongstroemii Hartm. – [Abr 1987] [350–1370 m] SA: at edges of hollows in mossy tundras and subalpine bogs. Sp. B: along the brook in subalpine spruce forest, in spruce forest in the Malyi Garmakan River valley, in boggy larch forest along the brook in the Beloborodovskiy Klyuch valley. Rr.

Sphagnum balticum (Russow) C.E.O. Jensen – [Abr 1987] [340–1440 m] SA: in moss-lichen and mossy tundras. Sp. B: *Sphagnum* bogs, boggy larch forests. Sp. Often with *Sphagnum lenense* and *S. divinum*.

+ *Sphagnum beringiense* A.J. Shaw, R.E. Andrus & B. Shaw – [320 m] B: in eutrophic lake on the terrace of the Gilui River near the mouth Zolotoy Klyuch; on boggy clearing for power transmission-line (Petelin 25.IX.1979, MW). Rr. With *Sphagnum flexuosum*.

+ *Sphagnum capillifolium* (Ehrh.) Hedw. – [320–870 m] B: in *Sphagnum* bogs and boggy larch forests. Rr.

– *Sphagnum centrale* C.E.O. Jensen – [Abr 1987] B: coniferous forests. Rr.

Sphagnum compactum Lam. & DC. – [Gambaryan 1978a] [Abr 1987] [390–1440 m] SA: in lichen-moss tundras, along brooks and areas of solifluction disturbance in mossy tundras. Sp. B: single record in *Sphagnum* bog with scattered larch trees in the valley of the Nizhny Chimchan River. Un.

Sphagnum divinum Flatberg & Hassel (*S. magellanicum* auct.) – [Abr 1987] [320–1400 m] SA: in mossy tundras. Fr. B: in boggy larch forests and *Sphagnum* bogs. Fr.

Sphagnum fallax (H. Klinggr.) H. Klinggr. – [Abr 1987] [1342 m] SA: in hollow of cotton-grass lichen-moss bog in the watershed in the upper reaches of the Motovaya River. Un. Abramova et al. (1987) reported it as sporadic in forests: Sp.

+ *Sphagnum flexuosum* Dozy & Molk. – [320–380 m] B: in the *Warnstorfia* & *Sphagnum* mire with sedges on the terrace of the Gilui River opposite Zolotoy Klyuch, on the bank of lake in the watershed of Shirokaya and Zolotaya Rivers. Rr.

Sphagnum fimbriatum C.E.O. Jensen – [Gambaryan 1978a] [Abr 1987]: B: spruce forest. Rr. There is a specimen in MHA collected by Gambaryan from Zhurban (at Zeya

River bank, now drowned by the reservoir).

Sphagnum fuscum (Schimp.) H. Klinggr. – [Abr 1987] [370–1300 m] B: in boggy larch forests, in spruce forests. Sp. Abramova et al. (1987) considered it as a common species.

Sphagnum girgensohnii Russow – [Abr 1987] [330–1350 m] SA: in elfinwood and dwarf birch communities. Rr. B: in bogs, spruce and larch forests. Com. One of the main dominant species of the moss layer.

+ *Sphagnum imbricatum* Hornsch. ex Russow s. str. – [1340 m] SA: moss tundra in the lower part of eastern slope on the main watershed ridge in the upper reaches of the Motovaya River and Burlivy Klyuch Creek. Un.

+ *Sphagnum jensenii* H. Lindb. – [340–1370 m] SA: in small brook in mossy tundra on the main watershed of Tukuringra Ridge in the upper reaches of the Motovaya River and Burlivy Klyuch Creek. Un. B: hollows in mire on terrace of Gilui River. Rr.

Sphagnum lenense H. Lindb. ex L.I. Savicz – [Abr 1987] [330–1400 m] SA: in mossy mountain tundras. Fr. B: in boggy larch forests and *Sphagnum* bogs. Fr.

+ *Sphagnum lindbergii* Schimp. – [320 m] B: *Sphagnum lindbergii* bog with *Carex limosa* in waterlogged lowland on terrace of the Gilui River, 1 km upstream from cordon “Izubriny”. Un.

+ *Sphagnum mirum* Flatberg & Thingsgaard – [380 m] B: sedge-*Sphagnum* bog near the lake in the watershed between Shirokaya (Stepanak) River and Zolotoy Klyuch Creek. Un. In Russia, it is currently known from Kodar Mt. Range in the north of Zabaikalsky Territory, Taimyr and Chukotka (Flatberg et al. 2016). New to the southern Russian Far East and Amur Province.

Sphagnum obtusum Warnst. – [Abr 1987] [320–380 m] B: on mire on the Gilui terrace opposite of the Zolotoy spring, along the lake bank on the watershed of Shirokaya and Zolotaya Rivers. Rr.

– *Sphagnum orientale* L. Savicz – [Gambaryan 1978a] [Abr 1987] SA & B: mountain tundra and forests. Rr. There are correctly identified specimens collected by Gambaryan in MHA, from areas neighbouring to reserve.

Sphagnum rubellum Wilson – [Abr 1987] [650–1000 ? m] B: mires and boggy spruce forests. Rr.

Sphagnum russowii Warnst. – [Abr 1987] [1320 m] B: in spruce mossy forest in the upper course of Valunnyi Klyuch. Un. Abramova et al. (1987) considered it as a sporadically occurring in the boreal belt as well.

Sphagnum squarrosus Crome – [Abr 1987] [380–1180 m] B: on wet banks of brooks, in hollows of lake floating mats, in boggy clearing for power transmission-line. Sp.

+ *Sphagnum tenellum* (Brid.) Pers. ex Brid. – [390 m] B: in *Sphagnum* bog on the terrace of the Nizhny Chimchan River. Un.

Sphagnum teres (Schimp.) Ångstr. – [Abr 1987] [380–1442 m] SA: several collections from mountain tundra. Rr. B: along temporary courses in river valleys, on aufeis glades, in mires and on soil in subalpine spruce forest. Sp.

+ *Sphagnum tundrae* Flatberg – [320–700 m] B: on alluvium along brooks, on soil in spruce, alder and poplar valley forests. Sp.

– *Sphagnum wulfianum* Girg. – [Abr 1987] B: in spruce forest in Bol'shaya Erakingra Creek valley. Un.

– *Splachnum rubrum* Hedw. – [Abr 1987] B: Motovaya River mouth, in forest. Un.

+ *Stereodon calcicola* (Ando) Afonina & Cherd. – [330 m] HB: on horizontal ledges of limestone cliffs in the Izvestkovyi Klyuch valley. Un. An East-Asian species, known from Japan and two localities in Russia in Southern Primorye (Afonina & Ignatova 2007 b), where it also occurs on limestone outcrops.

New to Amur Province.

+ *Stereodon fauriei* (Cardot) Ignatov & Ignatova – [350–700 m] B: on fallen logs in larch and small-leaved forests. Rr.

Stereodon pallescens (Hedw.) Mitt. – [Abr 1987] [340–1200 m] B: on fallen logs, rocks and trunk bases of trees in forests of various types. Fr. Often found with *Stereodon plicatulus*, *Pylaisiadelphina tenuirostris*, *Sanionia uncinata*.

+ *Stereodon plicatulus* Lindb. – [320–1400 m] SA: on soil in mountain tundras, on bark of *Duscheckia fruticosa* in elfinwood communities. Sp. B: on fallen logs, trunks of deciduous and coniferous trees. Fr.

+ *Stereodon cf. subimponens* (Lesq.) Broth. – [500 m] B: on carbonate outcrops on the right slope of the Gilui River valley, 3 km upstream from the mouth of Razvedochnyi Klyuch. Un.

+ *Stereodon vaucheri* (Lesq.) Lindb. ex Broth. – [630 m] B: on rock in aspen forest at the mouth of Gilui Bay. Un.

Straminergon stramineum (Dicks. ex Brid.) Hedenäs – [Abr 1987] [320–390 m] B: on soil on river and brook banks, in *Sphagnum* bogs. Sp.

+ *Syntrichia pagorum* (Milde) J.J. Amann – [320 m] HB: on schist outcrops at the shore of Zeya Reservoir between Razvedochny and Sukhoy Klyuch Creeks. Un. With *Didymodon* spp. and *Ptychomitrium sinense*.

+ *Syntrichia sinensis* (Müll. Hal.) Ochyra – [320–700 m] B & HB: on rocks, rock outcrops on southern slopes and exposed cliff walls. Sp.

Tetraphis pellucida Hedw. – [Abr 1987] [330–1270 m] B: on rotten wood in forests of various types. Fr.

Tetraplodon angustatus (Hedw.) Bruch, Schimp. & W. Gümbel – [Gambaryan 1977, 1978a] [Abr 1987] [350–1300 m] SA: on cliffs in *Pinus pumila* thickets (Abramova et al. 1987). B: on soil at the mouth of Kamrai River and near the cordon “Ludoed”; on scree along the right slope of the Shirokaya River valley. Rr.

Tetraplodon mnioides (Hedw.) Bruch, Schimp. & W. Gümbel – [350 m] B: on soil near the cordon “Ludoed” (Barinov 10.IX.1991, MW and Zeysky Reserve herbarium). Un.

Thuidium assimile (Mitt.) A. Jaeger – [Abr 1987] [320–700 m] B & HB: on rocks, fallen logs, trunk bases of deciduous trees in forests of various types and calcareous cliffs. Fr.

Timmia bavarica Hessel. – [Abr 1987] [330 m] B & HB: on horizontal ledges of limestone cliffs in the Izvestkovyi Klyuch valley. Rr.

+ *Timmia comata* Lindb. & Arnell – [320–340 m] B & HB: on calcareous rock outcrops in the Gilui River and Izvestkovyi Klyuch valleys. Rr. New for Amur Province (Ignatov & Ignatova 2017).

+ *Timmia megapolitana* Hedw. – [330 m] B: on soil in floodplain forest at the mouth of Shirokaya River (Petelin 11.IX.1979, MW). Rr. New for Amur Province (Ignatov & Ignatova 2017).

+ *Timmia anomala* (Bruch & Schimp.) Limpr. – [320 m] HB: on dry schist outcrops on the shore of Zeya Reservoir between Razvedochny and Sukhoy Klyuch Creeks. Un.

Tomentypnum nitens (Hedw.) Loeske – [Abr 1987] [320–370 m] B: in boggy sparse larch forests in river valleys. Rr. Abramova et al (1987) reported it as Fr.

Tortella fragilis (Hook. & Wilson) Limpr. – [Abr 1987] [330–650 m] B: on cliffs, trunks of alder (*Alnus hirsuta*) trees and on soil in valley forests. Rr.

Tortella tortuosa (Hedw.) Limpr. – [Abr 1987] [340 m] B: on calcareous rock outcrops in the narrow valley of Gilui River. Rr.

Trachycystis ussuriensis (Maack & Regel) T.J. Kop. – [Abr 1987] [320–360 m] B & HB: in crevices and shaded

niches of calcareous rocks; on fallen logs in valley forests. Rr.

+ *Trichodon cylindricus* (Hedw.) Schimp. – [Abr 1987] [315–1320 m] B: in meadow communities in the draw-down zone of the water reservoir, on sandy alluvium on the bank of the Gilui River and of brooks with slow current, on upturned roots of fallen trees in forests. Rr.

Trichostomum crispulum Bruch – [Abr 1987] [340 m] B: on calcareous rock outcrops on the right slope of Gilui River valley, 3 km upstream from the mouth of Razvedochnyi Klyuch Creek. Un.

Ulota curvifolia (Wahlenb.) Sw. – [Abr 1987] [350 m] B: rock crevices in larch forest on north-western slope near the Tabuneika River backwater area (L.I. Abramova, 11.VIII.1980, MW). Un.

+ *Ulota rehmannii* Jur. – [330–1270 m] B: on trunks of mountain ash, birch, aspen and spruce in forests of various types. Fr. Often mixed with *Lewinskya elegans*, *L. iwatsukii*, *L. sordida*, and *Iwatsukiella leucotricha*.

+ *Ulota reptans* Mitt. – [500 m] B: on birch in birch-larch forest in vicinity of cordon “20th km”. Un.

Warnstorfia exannulata (Bruch, Schimp. & W. Gümbel) Loeske – [Abr 1987] [320–1370 m] SA: in hollows in moss tundras. Sp. B: in temporary watercourses in floodplains of rivers, in small lakes on terrace of the Gilui River. Rr.

+ *Warnstorfia fluitans* (Hedw.) Loeske – [320–650 m] B: in bog near small overgrowing lake on left bank of Gilui Bay on the Zeya Reservoir opposite Zolotoy Klyuch mouth; in a depression in sparse larch forest with *Alnus hirsuta* in the valley of Malaya Erakingra River. Rr.

Warnstorfia sarmentosa (Wahlenb.) Hedenäs – [Abr 1987] [640–660 m] B: on gravel and rocks in the valleys of Bol’shaya Erakingra River and Motovaya River. Rr.

+ *Weissia brachycarpa* (Nees & Hornsch.) Jur. – [320–410 m] B & HB: in cliff crevices and niches. Sp.

Zygodon sibiricus Ignatov, Ignatova, Z. Iwats. & B.C. Tan (cited by Abramova et al. 1987 as *Z. conoides*) – [Abr 1987] [330–800 m] B: on trunks of poplar, willow and aspen in forests, more often in valley forests. Sp.

Species excluded

Three groups of species previously reported from Zeysky Reserve are not included in the present check-list for the following reasons:

1. Some moss genera were revised, resulting in considerably narrower species concepts, which made it impossible to interpret unconfirmed literature data. For this reason, the records of *Hedwigia ciliata*, *Racomitrium heterostichum*, *Schistidium alpicola*, *S. apocarpum*, *S. strictum*, and *Ulota crispa* have been excluded and, moreover, they cannot be attributed to any single accepted species, but only to the species group. All available specimens of these genera were re-identified and included in the present paper, but without correspondence with any names used before. It is important to distinguish these cases from those when, despite the species splitting, all plants from the study area can be named with certainty. For example, all plants formerly referred to as *S. magellanicum* are now classified as *S. divinum*, or all *Zygodon* records in Siberia now are considered as *Z. sibiricus* (previously called as *Z. conoides*, *Z. rupestris*, or *Z. viridissimus*). In such cases we indicate changes in text without listing them among the species excluded.

2. A number of species reported by Abramova et al. (1987) but not confirmed by herbarium specimens, are referred to as doubtful for at least one of the following rea-

sons: (a) recent changes in taxonomy make the record highly unlikely; (b) species range has been re-appraised and there are no records currently known from any neighbouring areas; (c) species ecology as described by Abramova et al. (1987) raises doubts as to the veracity of the identification; (d) species localities proved to be outside the reserve area. These species are: *Bryhnia novae-angliae*, *Brachythecium glareosum*, *Bryum lonchocaulon*, *Cirriphyllum piliferum*, *Cnestrum glaucescens*, *Cynodontium polycarpon*, *Dicranum angustum*, *D. fulvum*, *D. muehlenbeckii*, *Didymodon rigidulus*, *Distichium inclinatum*, *Drepanocladus polygamus*, *D. sendtneri*, *Grimmia ovalis*, *G. elongata*, *Hymenoloma crispulum*, *Leptodictyum riparium*, *Meesia triquetra*, *Oxyrrhynchium hians*, *O. schleicheri*, *Palustriella commutata*, *Paraleucobryum enerve*, *Pseudoleskeella tectorum*, *Serpoleskea subtilis*, *Stereodon callichrous*, *Sphagnum warnstorffii* and *Thuidium delicatulum*.

3. The catalogue of mosses of Russian reserves (Ignatov et al. 2004) lists a number of species for the Zeya Reserve that are absent in Abramova et al. (1987), without citing additional sources of information. Therefore, reports of the following species are considered to be technical errors: *Bryum caespiticium*, *B. pallens*, *Codriophorus acicularis*, *Fontinalis antipyretica*, *Hygroamblystegium tenax*, *Plagiomnium japonicum* and *Rhizomnium punctatum*. Species found in the course of present study which were listed by Ignatov et al. (2004) but not listed by Abramova et al. (1987) are considered here as new for the reserve (given with + in the list).

FLORA ANALYSIS

Taxonomic diversity

The moss flora of Zeysky Reserve currently includes 310 species (including 13 previously recorded species not supported by herbarium specimens) of 138 genera and 55 families. As many as 140 species are newly recorded for the reserve, and 25 species are also new for Amur Province. Thus, Zeysky Reserve has the most diverse moss flora of all the Nature Reserves of Transbaikalia and continental southern Russian Far East (Table 2).

In Zeysky Reserve, the family Sphagnaceae is the largest one, with 28 species. This is explained by the great diversity of both eutrophic and oligotrophic waterlogged habitats. The second richest family is the Pottiaceae, with 22 species, which reflects the abundance of calcareous and base-rich substrates. Then follow the Dicranaceae, in the narrow sense, which includes 21 species, and the Grimmiaceae, with 30 species, which reflect mountain specificity of the flora. Fifth and sixth are the Pylaisiaceae and

Brachytheciaceae, with 17 and 16 species respectively, mainly epiphytic and epixylic mosses. The ratio Pottiaceae / Dicranaceae s.l. in the flora of Zeysky Reserve is lower than 1 (0.71), which is typical for moss floras of humid areas (Ignatov 2001).

Among genera, the first three places in the flora are occupied by *Sphagnum*, with 28 species, *Dicranum* with 20, and *Pohlia* with 12. This ratio is typical for humid boreal mountain bryofloras; this has been shown for Bureinsky, Norsky and Botchinsky Reserves, as well as for the Udokan Ridge. The genus *Schistidium* is rather diverse in Zeysky Reserve, including 9 species. Among the other comparable floras, only Sokhondinsky Reserve has a richer number of species for this genus (with 10 species).

Altitudinal distribution of mosses

Distribution of mosses in six altitudinal intervals, based on herbarium specimens and vegetation relevés, is shown in Table 3. Only 18 species were found in all altitudinal intervals; they are the most common and abundant in the widespread plant communities: *Aulacomnium palustre*, *A. turgidum*, *Ceratodon purpureus*, *Dicranum fuscescens*, *D. japonicum*, *Grimmia longirostris*, *Hylocomium splendens*, *Hypnum cupressiforme*, *Pleurozium schreberi*, *Polytrichum commune*, *P. juniperinum*, *P. piliferum*, *P. strictum*, *Rhytidiadelphus triquetrus*, *Rhytidium rugosum*, *Sanionia uncinata*, *Sphagnum angustifolium* and *Stereodon plicatulus*. In total, 85 species were found above 1300 m, and only 14 species are specific to this altitudinal belt. With decrease in altitude, the level of species richness increases; however, only 5 species are known exclusively at 700–1300 m. The largest number of moss species, 257, was registered at 350–499 m. In general, 276 species (89 % of the flora) occur below 700 m and 262 species (85 %) occur below 500 m. As many as 166 species were found exclusively below 700 m altitude and 104 species below 500 m. The most diverse moss flora is confined to the elevation from 350 to 499 m, where 219 species (71 % of the flora) grow and 60 of them are found only in this interval. It is remarkable that 195 species occur in the lowest altitudinal interval, 315–350 m, starting from the upper level of Zeysky Water Reservoir, with 38 species registered in the reserve and only found here.

The analysis of species distribution among the three altitudinal vegetation belts (Table 4) shows an even stronger altitudinal differentiation: there are only 9 species common to all hemiboreal, boreal and subalpine belts. These species are *Abietinella abietina* and *Rhytidium rugosum*, from predo-

Table 2. Bryophyte diversity in Zeysky State Nature reserve in comparison with other East Siberian and Far Eastern nature reserves (sources: Ignatov et al. 2004, Afonina et al. 2012, Bezgodov et al. 2013, Ignatova et al. 2013)

Reserve	Total area, sq. km	Coordinates	Altitudinal range, m a.s.l.	Species number
Zeysky Reserve	1206	53°51'–54°17'N 126°43'–127°27'E	315–1443	310
Botchinsky Reserve	2670	48°17'–48°18.5'N 139°33'–139°42'E	30–1409	239
Bureinsky Reserve	3570	51°40'–52°30'N 134°20'–135°10'E	550–2241	278
Lazovsky Reserve	1209	42°48'–43°22'N 133°41'–134°12'E	0–1395	203
Norsky Reserve	2111	52°3'–52°8'N 129°8'–130°4'E	200–371	251
Sokhondinsky Reserve	2000	49°25'–49°59'N 110°28'–110°34'E	600–2508	276
Olyokminsky Reserve	8451	58°04'–59°20'N 58°45'–58°53'E	220–1206	212

minantly dry habitats, the petrophytes *Grimmia longirostris*, *Isopterygiopsis muelleriana* and *Poblia cruda*, the widespread epiphyte *Lewinskya sordida*, the forest floor species *Pleurozium schreberi* and *Sanionia uncinata*, and *Ceratodon purpureus* growing on disturbed substrates and on coarse woody debris.

The greatest number of species, 271, is associated with the boreal belt, which has the greatest area and variety of habitats in the study area, including forest, rock and wetland habitats. 50 % of the total number of species (155) occurs only within this belt. Among them, the most numerous are the species of forest habitats (*Atrichum flavisetum*, *Brothera leana*, *Dicranum fragilifolium*, *Leucodon pendulus* and *Plagiomnium cuspidatum*); bog mosses (*Helodium blandovii*, *Polytrichum swartzii*, *Sphagnum capillifolium* and *S. flexuosum*) and the alluvial species (*Blindia acuta*, *Calliergonella lindbergii*, *Hygrohypnella polaris* and *Philonotis* spp.).

In Zeysky Reserve, subalpine and hemiboreal belts occupy quite small areas and have a low diversity of habitats. There are almost no permanent watercourses and lakes. Only 73 species were found in the subalpine belt, of which only 14 are specific for this altitudinal level: *Brachythecium erythrorrhizon*, *Bucklandiella microcarpa*, *B. nitidula*, *B. sudetica*, *Buxbaumia aphylla*, *Dicranum bardunovii*, *D. groenlandicum*, *D. pacificum*, *Paraleucobryum longifolium*, *Poblia lescuriana*, *Sphagnum imbricatum* and *S. perfoliatum*.

A total of 90 species were found in the hemiboreal belt, among which 29 species are exclusively confined to it, growing mostly on cliffs rich in calcium compounds: *Bryum argenteum*, *Encalypta pilifera*, *Entodon giraldii*, *Fabronia rostrata*, *Hondaella caperata*, *Plagiomnium acutum*, *Plagiopus oederianus*, *Podperaea krylovii*, *Ptychomitrium sinense*, *Seligeria tristichoides*, *Stereodon calcicola*, *Timmiella anomala*, etc.

Table 3. Moss diversity from different altitudinal ranges.

Altitudes, m	Species number / % from total number	Incl. collected only on these range
1300–1442	85 / 27	14 / 5
1000–1299	85 / 27	1 / 0.3
700–999	130 / 42	4 / 1
500–699	175 / 56	13 / 4
350–499	219 / 71	60 / 19
<350	194 / 63	38 / 12

Table 4. Species diversity of Zeysky State Nature reserve from mountain altitudinal belts.

Mountain altitudinal belts	Altitudinal range m a.s.l.	Area, sq. km	Moss species number	% altitudinal belt moss species number	% total moss species number in Reserve
Subalpine: dwarf shrub tundra, <i>Pinus pumila</i> thickets and <i>Betula lanata</i> krummholtz	1100–1400	53	Total:	73	100
			Only in belt:	16	22
Boreal: larch (<i>Larix gmelinii</i>) and spruce (<i>Picea ajanensis</i>) taiga	315–1300	1128	Total:	271	100
			Only in belt:	155	57
Hemiboreal: hemiboreal larch and <i>Quercus mongolica</i> and <i>Betula davurica</i> forests	315–500	25	Total:	90	100
			Only in belt:	22	24
Total:				310	100

Phytogeographic relation

Phytogeographic features of the flora are shown in Table 5. Three phytogeographic elements predominate the flora of Zeysky Reserve: multizonal (90 species, or 30 %), boreal-temperate (60 species, 19 %) and mountain (53 species, 17.1 %). They are followed by the boreal and arcto-montane elements, hyperarctic, hyperarctomontane, temperate, suboceanic and xeric. Altitudinal belts mostly do not differ in spectra of such elements, except for boreal-temperate and temperate species. Boreal-temperate species (*Callicladium baldanianum*, *Cladopodium pellucinerve*, *Plagiomnium cuspidatum*, *Pylaisia selwynii*) mainly associated with humid forests habitats comprise 12.3 % in the subalpine belt and 13.7 % in the boreal belt, but they are nearly absent in the hemiboreal belt. Temperate (*Herpetineuron tocoae*, *Hondaella caperata*, *Leucodon coreensis*, *Ptychomitrium sinense*) and xeric (*Entosthodon pulchellus*, *Fabronia ciliaris*, *Syntrichia pagorum*, *S. sinensis*) species are relatively more abundant in the hemiboreal belt (5.6 % in both cases) and absent from the subalpine belt.

The longitudinal spectra indicate a progressive decrease of circumpolar species from the subalpine to boreal and then hemiboreal belts from 79.5 to 76.0 and 65.4 %, respectively, and a concomitant increase of the number of Asian and Eurasian species. A similar pattern was found for mosses of the Northern and Western Palearctic (Ignatov 2001), as well as for vascular plants across altitudinal zonation in Zeysky Reserve (Dudov 2016); in the latter case, the percentage of East Asian species also significantly increased in the hemiboreal belt.

The fact that, in general, temperate mosses have less extensive ranges than boreal taxa can be shown in the following grouping of temperate species from Zeysky Reserve:

Circum-temperate: *Haplocladium angustifolium*, *Entodon schleicheri*, *Heterophyllum affine*, *Homalia trichomanoides*, *Homomallium incurvatum*, *Hyophila involuta*, *Neckera pennata*.

East Asian, disjunctive to eastern North America, some of them having localities in the tropics: *Anomodon minor*, *Brothera leana*, *Grimmia pilifera*, *Helodium paludosum*, *Herpetineuron tocoae*, *Hyophila involuta*, *Pylaisia falcata*, *Pylaisiadelphina tenuirostris*, *Stereodon fauriei*.

East Asian: *Anomobryum nitidum*, *Anomodon thraustus*, *Brachythecium buchananii*, *Bucklandiella nitidula*, *Cryphaea amurensis*, *Dicranum japonicum*, *D. nipponense*, *D. pacificum*, *Drummondia*

Table 5. Distribution moss species of Zeysky State Nature Reserve by geographic elements proposed by M.S. Ignatov (1993)

Phytogeographic category	Total in Reserve		Subalpine belt		Boreal belt		Hemiboreal belt	
	Number of species	Percent of flora*	Number of species	Percent of flora**	Number of species	Percent of flora**	Number of species	Percent of flora**
Zonal and altitudinal elements								
Multizonal	93	30.0	17	23.3	85	31.4	30	33.3
Arctomontane	38	12.3	8	11.0	36	13.3	8	8.9
Montane	53	17.1	16	21.9	45	16.6	18	20.0
Hyparctomontane	3	1.0	2	2.7	2	0.7	1	1.1
Hyparctic	6	1.9	3	4.1	6	2.2	–	–
Boreal	40	12.9	16	21.9	49	18.1	22	24.4
Boreal-temperate	60	19.4	9	12.3	37	13.7	1	1.1
Temperate	6	1.9	–	–	4	1.5	5	5.6
Suboceanic	6	1.9	2	2.7	4	1.5	–	–
Arid	5	1.6	–	–	3	1.1	5	5.6
Longitudinal elements								
Circumpolar	227	73.2	58	79.5	206	76.0	59	65.6
Asian	32	10.3	4	5.5	24	8.9	13	14.4
Asian-American	27	8.7	8	11.0	22	8.1	10	11.1
Eurasian- American	15	4.8	2	2.7	14	5.2	3	3.3
Eurasian	9	2.9	1	1.4	5	1.8	5	5.6
Total	310	100	73	100	271	100	90	100

* Total species number in the Reserve

** Species number in altitudinal belt

sinensis, *Entodon giraldii*, *Eurhynchia delphus eustegia*, *Eurohypnum leptothallum*, *Fabronia rostrata*, *Glyphomitrium* cf. *humillimum*, *Homomallium connexum*, *Hondaella caperata*, *Hypnum saitoi*, *Leucodon coreensis*, *L. pendulus*, *Myuroclada longiramea*, *Plagiomnium acutum*, *P. confertidens*, *Podperaea krylovii*, *Ptychomitrium sinense*, *Stereodon calcicola*, *Trachycystis ussuriensis*, *Ulota reptans*, *Zygodon sibiricus*.

East Asian & Western North American (Beringian *sensu lato*): *Claopodium pellucinerve*, *Didymodon hedysarififormis*, *Grimmia jacutica*, *Imwatsukiella leucotricha*, *Myuroclada maximowiczii*.

This enumeration shows that temperate moss species in Zeysky Reserve are mostly of East Asian origin. Nevertheless, these elements here are much poorer represented than in Primorsky Territory, as can be seen from comparison shown in Fig. 3. Cluster analysis (Ward's method, Euclidean distance) of 15 moss floras from eastern part of Asian Russia provides the following results:

Cluster 1 includes Manchurian bryofloras of Sikhote-Alin Mts (floras SIK, LAZ) and Lesser Khingan Mts (KHI). There are 85–125 species in common with the flora of Zeysky Reserve (Fig. 4), and measures of inclusion of these bryofloras into the flora of Zeysky Reserve are 0.54–0.64 for the Sikhote-Alin flora and 0.75 for the Lesser Khingan, whereas measures of reverse inclusion are no more than 0.40.

Cluster 2 encompasses the flora of Zeysky Reserve together with Norsky, Botchinsky, Bureinsky and Sokhondinsky reserves. There are 146–194 species in common, the measures of inclusion of the floras included into the analysis into the Zeysky Reserve flora were 0.69–0.73, and 0.48–0.63 for reverse inclusion.

Cluster 3 includes the floras of mountains of South and Eastern Yakutia (TS, UMA, MUS, ORU) and Stanovoe Upland (UDO). For these floras, 100–157 species are in common with the flora of Zeysky Reserve. At the same time,

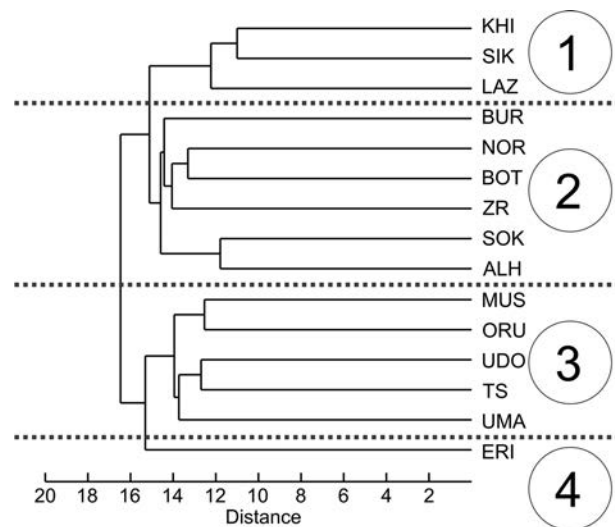


Figure 3 The results of cluster analysis (Ward's method, Euclidean distance) of East Siberian moss floras. The following data was used: – Zabaikalsky Territory: ALK – Alkhanay National Park (Afonina et al. 2017); SOK – Sokhondinsky State Reserve (Afonina et al. 2012); UDO – Udokan Range, Stanovoe Upland (Filin et al. 2015).

– Amur Province: KHI – Khingansky State Nature Reserve (Ignatov et al. 2004); NOR – Norsky State Nature Reserve (Bezgodov et al. 2013).

– Khabarovsk Territory: BOT – Botchinsky State Nature Reserve (Ignatova et al. 2013), BUR – Bureinsky State Nature Reserve (Ignatov et al. 2004).

– Primorie Territory: LAZ – Lazovsky State Nature Reserve; SIK Sikhote-Alin Biosphere Reserve (Ignatov et al. 2004).

– Yakutia: MUS – Mus-Khaya Mt., Suntar-Khayata Range (Ignatova et al. 2011); ORU – Orulgan Range (Ignatov et al. 2014), TS – Tokinsky Stanovik Range, Algama River basin (Stepanova et al. 1995); UMA – Yudomo-Mayskoe Upland, Ust-Maya District (Ignatov et al. 2001).

– Krasnoyarsk Territory: ERI – Eriechka River upper course, SE Taimyr (Fedosov et al. 2015)

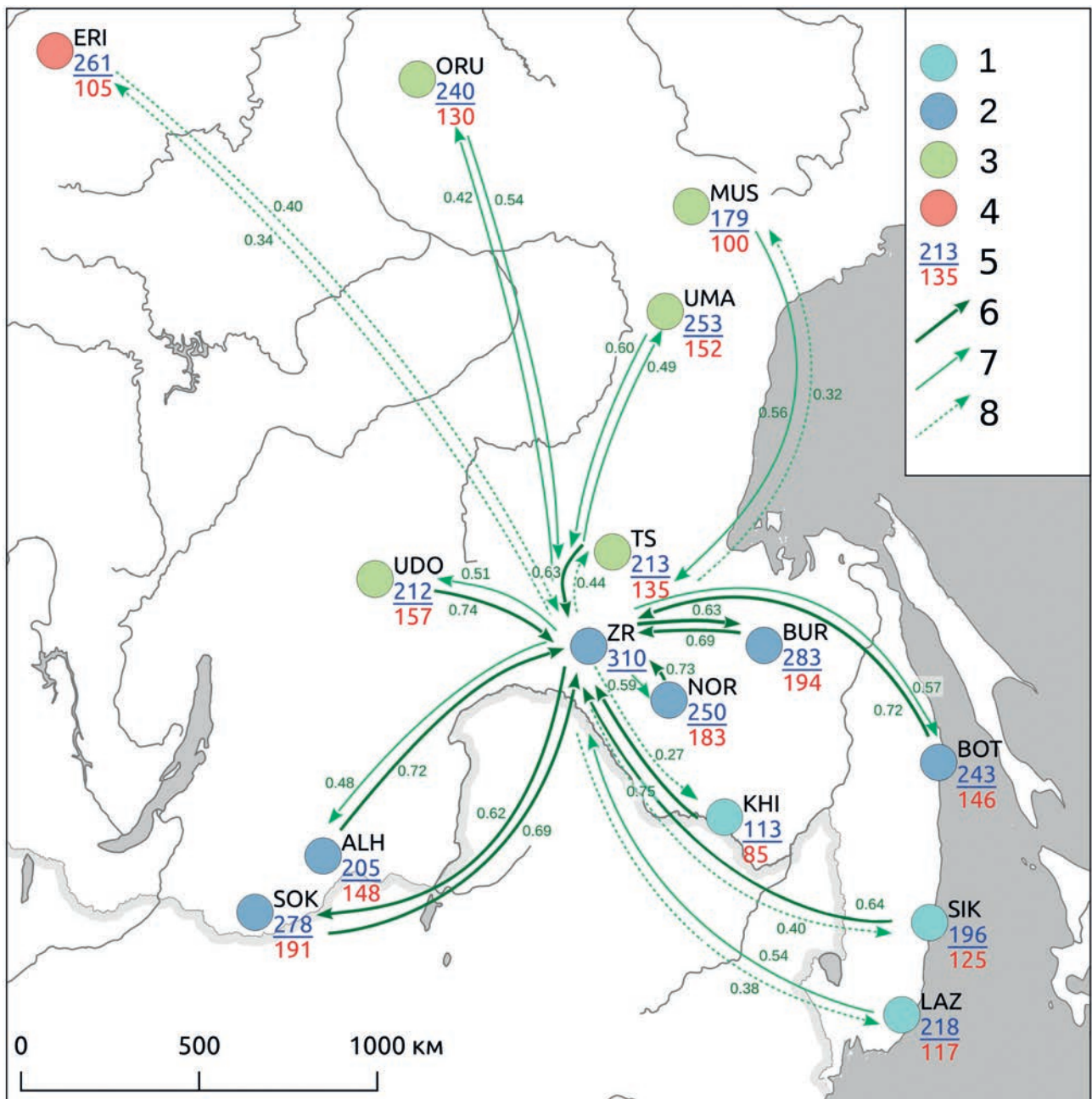


Figure 4 Similarity of the Zeysky Nature Reserve moss flora with Eastern Siberian and Far Eastern floras. 1–4 – Ward’s clusters (see fig. 3). 5–6 – number of species in floras (blue type) and common ones. 7–8 – degree of similarity estimated using measures of inclusion (Yurtsev & Semkin 1980): more 0.6, more 0.4 and less 0.6, less 0.4. For abbreviation of bryofloras see at fig. 3

63 % of species of the Tokinsky Stanovik Range and 74 % of Udokan Range occur on Tukuringra Range as well. The Subarctic flora of Upper Course of Eriechka River, South-East Taimyr is found in cluster 4. There are 105 species in common with the flora of Zeysky Reserve (Fig. 4); less than 40 % of species of the upper reaches of Eriechka River are present in the Zeysky Reserve flora. Phytogeographical differences between clusters 1 (South Primorsky Territory cluster) and 2 (Amur Province, south of Khabarovsk Territory & north of Primorsky Territory cluster) were also discussed by Pisarenko & Bakalin (2017). However, South-Eastern Transbaikalian bryofloras seem to be similar with the second cluster.

Therefore, the moss flora of Zeysky Reserve demonstrates a similarity to the moss floras along the border of the East-Asian and the Circum-Boreal floristic regions. Likewise the moss floras of Stanovoe and Bureinskoe Uplands and South-Eastern Transbaikalia, it is enriched by East-Asian elements, being in general of boreal type.

Rare species

Three species of mosses occurring in Zeysky Reserve are included in the Red Data Book of Russian Federation. All these species are associated with specific and rare habitats: metamorphic limestone cliffs (*Hondaella caperata*, *Hyophila involuta*) and spruce twigs in wet shaded parts of

the mountain valleys (*Cryphaea amurensis*). It is important that the remaining population of the latter species remains stable, given the partial destruction of its habitat by the construction of Zeysky Water Reservoir.

CONCLUSION

High moss diversity in Zeysky Nature Reserve obviously corresponds to the presence of an apparent altitudinal zonation, rock diversity and its position at the junction between large phytogeographical districts. The species found only in the hemiboreal part of the reserve are largely of East Asian distribution, including three species from the Red Data Book of Russian Federation.

Stereodon calcicola has its westernmost localities in Zeysky Reserve, while some other East Asian flora elements are penetrating further to South Siberia, up to Baikal area (e.g. *Entodon giraldii*, *Plagiomnium acutum*) or even Altai (e.g. *Brothera leana*, *Podperaea krylovii* and *Ptychomitrium sinense*). It proves the role of Tukuringra Range as an important phytogeographical border not only for vascular plants but also for mosses. It also highlights the conservation value of the reserve as a hotspot of the bryophyte diversity.

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