

THE BRYOPHYTE FLORA OF ERIECHKA RIVER UPPER COURSE (SE TAIMYR),  
WITH COMMENTS ON THE FIRST RECORD OF *PSEUDODITRICHUM MIRABILE* IN ASIA  
БРИОФЛОРА ВЕРХНЕГО ТЕЧЕНИЯ РЕКИ ЭРИЕЧКА (ЮГО-ВОСТОЧНЫЙ ТАЙМЫР),  
С ОБСУЖДЕНИЕМ ПЕРВОЙ НАХОДКИ *PSEUDODITRICHUM MIRABILE* В АЗИИ

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Abstract

The bryophyte flora of Eriechka River upper course includes 66 species of liverworts and 262 species of mosses. Annotated list provides data on species frequency, habitat characteristics and associated species. Species composition in different habitats is overviewed. Distribution of some rare species, as well as a taxonomic status of *Herbertus arcticus* are discussed. *Pseudoditrichum mirabile* Steere & Z.Iwats. is found in Russia for the first time. This is the second worldwide record of this unique species with ambiguous taxonomic position, described in the monotypic family Pseudoditrichaceae. Differences in moss flora between Proterozoic siliceous limestone and Cambrian dolomites poor in silica are observed. Most *Seligeria* species in the study area were found in ecotopes formed by Proterozoic siliceous limestone.

Резюме

Бриофлора верховий р. Эриечка включает 66 видов печеночников и 262 вида мхов. Приводится аннотированный список видов, содержащий данные о частоте их встречаемости, занимаемых ими биотопах и сопутствующих видах. Охарактеризованы основные группировки мохообразных района. В исследованной бриофлоре представлен ряд редких видов, обсуждаются особенности их распространения и статус *Herbertus arcticus*. *Pseudoditrichum mirabile* Steere & Iwats. приводится впервые для России. Это второе местонахождение в мире этого уникального таксона неясного родства, относимого к монотипному семейству Pseudoditrichaceae. Рассмотрены существенные различия петрофитных бриофлор, формирующихся на кремнеземистых протерозойских и малокремнеземистых кембрийских карбонатных горных породах; в частности, показано, что представители рода *Seligeria* приурочены только к первым.

KEYWORDS: Bryophyte flora, Anabar Plateau, rare species, *Pseudoditrichum mirabile*, saxicolous mosses, *Lejeunea alaskana*, *Herbertus arcticus*, bryophyte ecology.

INTRODUCTION

In a view from space Anabar Plateau (Subarctic Siberia) is notable due to an extensive area of white-colored carbonate rock outcrops. Recent results of an extensive bryofloristic study in Anabar Plateau were summarized by Fedosov *et al.* (2011). In total, 520 moss species were revealed on Anabar Plateau, making its moss flora the richest one among regional floras in the Arctic and Subarctic. In contrast, the hepatic flora of the territory is still insufficiently known. The only published data on liverworts of Anabar

Plateau were based on the collection from the lower course of Kotuy River (Andrejeva, 2009) and from Putorana Plateau. Some hepatics new for East Siberia were revealed, including *Clevea hyalina* (Sommerf.) Lindb. (*Athalamia hyalina* (Sommerf.) S. Hatt.), *Cephaloziella elachista* (J. B. Jack ex Gottsche et Rabenh.) Schiffn., *Fossombronina alaskana* Steere & Inoue, *Mannia pilosa* (Hornem.) Frye et L. Clark and *Riccia sorocarpa* Bisch.

Eriechka River basin belongs to the calcareous NW periphery of the Anabar Plateau (Fig. 1 in Fedosov *et al.*,

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2011). Siliceous Proterozoic limestones and marls are widespread throughout the Eriechka River basin, as well as along the Kotuykan River; however, epilithic moss flora on rocks of this type was still insufficiently studied, and the territory was chosen for further exploration of bryophyte flora of Anabar Plateau. The present study is based on collections made by the first author in 2013 in the upper course of Eriechka River near Nyamakit-Daldyn Creek mouth (ca. 71°14'N; 105°37'E). During the field work, the hepatic flora was a subject of special attention. In total ca. 800 moss specimens and 400 liverwort specimens were collected. Some interesting records from this area were included into previous publications, *i.e.*, liverworts *Ascidiota blepharophylla* Massal. (Potemkin *et al.*, in print) and *Frullania subarctica* Vilnet, Borovich. & Bakalin (Vilnet *et al.*, 2014), as well as some mosses were discussed by Ellis *et al.* (2014a, b).

General overview of the Anabar Plateau relief, rock composition and vegetation was given by Fedosov *et al.* (2011). Relief of the study area represents a gentle plateau. Altitudes range from ca. 165 m a.s.l. (the lowest point in the Eriechka River valley within the study area) to 535 m a.s.l. (the top of Nyamakit Mt.). At least 3 layers of calcareous rocks are exposed on gentle slopes of the plateau (Table 1, Figs. 2-9), but as they lie inclined, they occupy almost the same altitudinal range, each prevailing in several part(s) of the study area. Rock types were primarily recognized in the field using geological maps (Markov, 1979) and regarding sharp difference among them in color and solidness. Lower parts of slopes in the middle part of the territory and all altitudinal ranges in its southern part are composed of white to grey terrigenous-marine Proterozoic siliciclastic limestone with SiO<sub>2</sub> content ca. 10-18% and with CaO about 50%. Numerous rock outcrops and steep rocky slopes occur in the areas composed of limestone, alternating with relatively gentle slopes covered by forests or mountain tundra vegetation. Above the latter, the next rock layer composed of Proterozoic (in some schemes of stratigraphy this stratum is referred to the Lower Cambrian) marls is distributed. It has lower SiO<sub>2</sub> content (5-9%), about the same with limestone CaO content and higher Al<sub>2</sub>O<sub>3</sub> content. Morphologically it is realized in gentle slopes with relatively firm marl layers forming a chain of wide but low (not higher than 1-1.5 m) strongly stratified rock outcrops, occupying upper part of altitudinal range in middle part of the territory and descending almost to the bottom of river valley northward. In the northern periphery of the study area this stratum is replaced by Cambrian marine dolomites. These rocks are characterized by lack of SiO<sub>2</sub>, rather low content of CaO (ca. 30%) and rather high proportion of MgO (ca. 21%). They occupy all watersheds and represent a gentle plateau with widespread rock fields on the tops and steep creek canyons where numerous cliffs are present. Calcareous plateaus are occasionally interrupted by extensive dolerite (basic siliceous basalt-like rock with SiO<sub>2</sub> content ca. 48% and CaO Ca. 7%) intrusions 50-100 m wide and up to 2 km long,

mostly occupied by rock fields. Nyamakit Mt. is formed by isodiametric intrusion of ijolite, a plutonic ultrabasic rock with SiO<sub>2</sub> content ca. 44% and rather high, ca. 11.5%, CaO content. Rock fields and mountain tundra communities are widespread there.

Since association of bryophytes with different rock types is still insufficiently known, their distribution in the area was studied regarding this aspect. Some samples of different rocks were also collected in places of extensive bryophyte collection for the analysis of rock composition. It was performed by roentgen-fluorescent analysis in "Axios Advanced" tool (PANalytical, Netherlands), based in Institute of mineralogy, geochemistry and crystallography of rare elements, RAS, Moscow. In total, 10 rock specimens of 5 rock types previously recognized in the field were analyzed.

General overview of Anabar Plateau relief, rock composition and vegetation was given by Fedosov *et al.* (2011).

#### VEGETATION AND BRYOPHYTE COMMUNITIES

Relatively close larch forests occur only in the lower part of slope of the Eriechka River valley. *Ledum palustre* (nomenclature of vascular plants is provided according to Pospelova & Pospelov, 2007), *Vaccinium uliginosum*, or, in less drained conditions, *Betula exilis* dominate under the larch canopy. In rather dry larch forests on rocky slopes, bryophyte cover is formed by *Hylocomium splendens* var. *obtusifolium*, *Rhytidium rugosum*, *Dicranum flexicaule*, *D. majus*, *Pleurozium schreberi* with constant presence of *Sanionia uncinata*, *Brachythecium boreale*, *B. jacuticum*, *Stereodon* spp. In disturbed places, *Pohlia cruda*, *P. nutans*, *P. andrewsii*, *Isopterygiopsis pulchella*, *Eurhynchiastrum pulchellum*, *Distichium capillaceum*, *D. inclinatum*, *Ditrichum flexicaule*, *Bryoerythrophyllum recurvirostrum*, *Bryum creberrimum*, *Myurella julacea*, *Tritomaria quinquentata*, *Barbilophozia lycopodioides*, *Blepharostoma trichophyllum*, *Lophozia wenzelii* var. *groenlandica*, *L. ventricosa* var. *longiflora* and other ruderal species occur. Some of these species are also found on rotten wood, with an addition of *Orthotrichum iwatsukii*, *Plagiothecium laetum*, *Cynodontium strumiferum*, *Ceratodon purpureus*, *Tetraxis pellucida*, *Tortella fragilis*, *T. alpicola*, and *Lophozia silvicola*.

Just below the timberline, open larch stands with *Rhododendron adamsii*, *Dryas incisa*, *D. crenulata*, *Carex melanocarpa*, *C. macrogyna*, *C. trautvetteriana*, *Tofieldia coccinea*, and *Arctous erythrocarpa* are widespread, with shrub and grass cover intermingled with numerous patches of eroded ground. Among bryophytes, *Hylocomium splendens*, *Rhytidium rugosum*, *Abietinella abietina*, *Stereodon bambergeri*, *Tomentypnum nitens*, *Orthotrichum strictum*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Sphenobolus* spp., *etc.*, participate in vegetation cover, while bare ground spots are occupied by such hepatics as *Aneura pinguis*, *Arnellia fennica*, *Cryptocolea imricata*, *Blepharostoma trichophyllum* and some pioneer mosses.



Fig. 1. Collecting localities (according to Table 1).

On Eriechka River terraces and in wet hollows in the lower part of watershed slopes swampy larch stands with *Betula exilis*, *Eriophorum russeolum*, *E. vaginatum*, *Rubus chamaemorus*, *Pedicularis lapponica*, *Vaccinium minus* occur. *Dicranum elongatum*, *D. laevidens*, *Aulacomnium acuminatum*, *A. palustre*, *Oncophorus wahlenbergii*, *Sphenobolus minutus* are most common on the hummocks, while in depressions *Tomentypnum nitens*,

*Ptilidium ciliare*, *Brachythecium* spp., *Breidleria pratensis*, *Campyllum stellatum*, *Plagiomnium curvatum*, *Bryum pseudotriquetrum*, *Sanionia uncinata*, and *Calliergon giganteus* dominate.

Steep rocky slopes of the Eriechka River valley alternate with fragments of terraces occupied by polygonal bogs and open boggy larch stands. Near Nyamakit-Daldyn Creek mouth, the palsa bog is situated in the lower part of gentle slope. All bogs in the river valley have a well expressed micropattern of elevated elements composed of more or less drained and eroded peat lumps alternating with wet depressions. Calcareous bedrock composition causes almost total absence of peat mosses. Elevated forms of microrelief (swells around polygons, large hummocks and turf hillocks) are covered by more or less dense bushes of *Betula exilis* with *Salix glauca*, *S. pulchra*, *Ledum decumbens*, *Rubus chamaemorus*, *Vaccinium uliginosum* and bryophytes *Hylocomium splendens* var. *obtusifolium*, *Polytrichum strictum*, *Dicranum elongatum*, *D. laevidens*, *D. majus*, *Aulacomnium palustre*, *A. turgidum*, *Tomentypnum nitens*, *Sanionia uncinata*, *Stereodon subimponens*, *Scapania spitzbergensis*, *Sphenobolus minutus*, *Ptilidium ciliare*, etc.

On eroded turf lumps in upper part of hillocks *Dicranella cerviculata*, *Dicranum* spp., *Pohlia nutans*, *P. cruda*, *Bryum caespiticium*, *B. capillare*, *Ceratodon purpureus*, *Cynodontium strumiferum*, *Tritomaria quinque-dentata*, *Barbilophozia lycopodioides*, *B. hatcheri*, *Blepharostoma trichophyllum*, *Schljakovianthus quadrilobus* are most abundant. In the valley of Nyamakit-Daldyn Creek, an unusual palsa bog with hillocks formed by *Racomitrium lanuginosum* was revealed.

In moist and shaded niches of eroded turf lumps *Isoperlygiopsis pulchella*, *Plagiothecium berggrenianum*,

Table 1. Collection localities. Rock types: L – White Proterozoic siliceous limestones & dolomites; M – Red early Cambrian aluminous limestones and marls; Dm – White Cambrian dolomites, poor in silica; I – Plutonic ijolites; Dt – Intrusive dolerites.

N	Locality	Lat	Long	Alt., m	Rock type
1	Nyamakit Mt.	71°02'	105°07'	460-535	L, I
2	Upper course of Bezymjannyj Creek, Nyamakit-Daldyn Creek basin	71°14'	105°06'	300-360	L
3	Kamenistyj Creek Canyon	71°09'	105°22'	300-370	L, M
4	Northern slope of plateau with triangle mark 377.8 m	71°12'	105°24'	260-310	L
5	Plateau with map marks 301.5 & 316.0 m southern slope	71°15'	105°30'	220-310	L, M, Dt
6	Northern slope of plateau with map mark 327.8 m	71°11'	105°40'	220-300	L
7	Plateau with map mark 308.0 m	71°14'	105°36'	220-308	M
8	Eastern slope of plateau with map mark 252.8 m	71°15'	105°37'	220-252	L, M
9	Eriechka River valley near Nyamakit-Daldyn Creek mouth	71°15'	105°37'	190-220	L
10	Plateau with map marks 318.1 & 344.7 m	71°15'	105°42'	220-318	L, M, Dt
11	Slope of Arylach Creek valley near its mouth	71°17'	105°45'	180-250	L
12	Tyordyo Creek valley 5 km upstream its mouth and surrounding plateau	71°21'	105°34'	210-280	Dm
13	Eriechka River valley near Sare-Mas Creek mouth	71°21'	105°44'	170-180	



Figs. 2-9. 2 – red marl outcrops; 3 – Proterozoic limestones in the valley of Eriechka River upper course; 4 – red marl outcrops and Cambrian dolomites; 5 – Nyamakit Mt.; 6 – ijolite rock field on the top of Nyamakit Mt.; 7 – Cambrian dolomite outcrop; 8 – moss-dominated community below snow-field; 9 – dolerite rock-field. Photographs by I.N. Pospelov.

*P. laetum*, *Fissidens viridulus*, *F. osmundoides*, *Eurhynchiastrum pulchellum*, *Saelania glaucescens*, *Pohlia* spp., *Tritomaria quinquedentata*, *Schljakovianthus quadrilobus*, *Scapania crassiretis*, *Schistochilopsis opacifolia*, *Pseudolophozia sudetica*, etc., occur. On moist eroded turf near lake banks *Bryum bimum*, *B. neodamense*, *Polytrichum jensenii*, *Psilopilum cavifolium*, *Marchantia polymorpha* grow.

*Carex rotundata*, *C. concolor*, *C. chordorhiza*, *Eriophorum polystachion*, *Pedicularis sceptrum-carolinum* form a loose herb cover in wet depressions. Among mosses, *Cinclidium latifolium*, *Pseudocalliergon brevifolius*, *P. turgescens*, *Tomentypnum nitens*, *Catoscopium nigratum*, *Scorpidium scorpioides*, *Campylium stellatum*, *Bryum pseudotriquetrum*, *Meesia* spp., and *Mesoptychia sahlbergii* are most common, while *Calliergon* spp., *Brachythecium cirrosum*, *Scorpidium revolvens*, *Pseudocalliergon trifarium*, *Paludella squarrosa*, and *Fissidens adianthoides* occur as a tiny admixture. In small lakes with boggy turf banks *Warnstorfia tundrae*, *W. exannulata* and *Meesia triquetra* grow.

Boggy terraces descend to the flood plain by relatively steep and more or less eroded slopes with open meadow vegetation of *Equisetum arvense*, *Astragalus alpinus*, *Elymus lenensis*, *Poa alpigena*, *Hedysarum arcticum*, *Elymus subfibrosus*, *Trisetum* spp., *Bistorta vivipara*, *Astragalus* spp., *Valeriana capitata*, *Pedicularis amoena*, *Taraxacum ceratophorum*, etc., where bare turf and loamy soil provide suitable ecotopes for numerous pioneer bryophytes. Among them, *Funaria hygrometrica*, *Leptobryum pyriforme*, *Aloina brevirostris*, *Dicranella cerviculata*, *D. varia*, *Distichium* spp., *Bryoerythrophyllum recurvirostrum*, *Bryum* spp., *Barbula convoluta*, *Bryobrittonia longipes*, *Tortula mucronifolia*, *Marchantia polymorpha*, *Sauteria alpina*, *Tritomaria quinquedentata*, etc., are abundant. *Funaria arctica*, *Dichodontium pellucidum*, *Bryoerythrophyllum ferruginascens*, *Ceratodon purpureus*, *Didymodon fallax*, *Encalypta rhabdocarpa*, *E. procerca*, *E. pilifera*, *E. mutica*, *Tortula leucostoma* and other pioneer mosses and hepatics are constantly present there. Bare ground alternates with turf-covered patches, where *Bryum* spp., *Brachythecium* spp., *Sanionia uncinata*, *Syntrichia ruralis*, *Ditrichum flexicaule*, *Distichium* spp., *Plagiomnium curvatulum*, *Timmia* spp., etc., occur.

Flood plain of the Eriechka River valley is occupied mostly by meadows and willow shrub communities. Willow shrubs are composed of *Salix lanata*, *S. hastata* and *S. alaxensis*, with grasses *Equisetum arvense*, *Arctagrostis arundinacea*, *Calamagrostis neglecta*, *Festuca rubra*, *F. richardsonii*, *Alopecurus alpinus*, *Saussurea parviflora*, *Carex concolor*, *C. aquatilis*, etc., in the cover. In meadows, *Sanguisorba officinalis*, *Allium schoenoprasum*, *Tanacetum bipinnatum*, *Poa alpigena*, *Galium* spp., *Aster sibiricus*, *Hedysarum* spp., *Pedicularis* spp., etc., are the most common.

Moss cover of flood plain is very mosaic. In relatively moist places, *Cinclidium*- or *Tomentypnum*- or *Catoscopium*-dominated communities occur, or these species grow intermixed. In the places with a high amount of alluvium deposits, pioneer bryophyte communities with *Dicranella varia*, *Cratoneuron curvicaule*, *Philonotis tomentella*, *Pohlia wahlenbergii*, *Bryum* sp., *Hygrohypnum luridum*, *Timmia sibirica* are formed. On boulders in flood plain *Schistidium platyphyllum* often forms pure communities. On steep slopes, drained edges of slopes of flood plain and in other permanently disturbed places with weakened competition, the polydominant bryophyte communities with small vascular plants (*Selaginella selaginoides*, *Gentiana prostrata*, *Parnassia palustris*, and *Equisetum arvense*) occur. Such taxa as *Ditrichum flexicaule*, *Distichium inclinatum*, *Brachythecium jacuticum*, *B. turgidum*, *Bryum arcticum*, *B. pseudotriquetrum*, *B. cryophyllum*, *B. altaicum*, *Calliergonella lindbergii*, *Campylium stellatum*, *Campyliadelphus chrysophyllus*, *Plagiomnium* spp., *Drepanocladus polygamus*, *D. arcticus*, *Myurella julacea*, *Cyrtomnium hymenophylloides*, *Orthothecium strictum*, *Tortula mucronifolia*, *Encalypta* spp., *Brachythecium jacuticum*, *Philonotis tomentella*, *Bryoerythrophyllum recurvirostrum*, *Timmia comata*, *T. norvegica*, *Aloina brevirostris*, *Tomentypnum nitens*, *Cinclidium* spp., *Catoscopium nigratum*, *Stereodon bambergeri*, *Blepharostoma trichophyllum*, *Sauteria alpina*, *Pellia endiviifolia*, *Preissia quadrata*, *Gymnocolea inflata*, *Tritomaria quinquedentata*, *Marchantia polymorpha* are most constant.

Willow shrub communities composed of *Salix lanata* with bryophyte cover form below snow beds. *Tomentypnum nitens*, *Catoscopium nigratum*, *Bryum pseudotriquetrum*, *B. neodamense*, *B. rutilans*, *Breidleria pratensis*, *Cinclidium arcticum*, *C. latifolium*, *Pseudocalliergon turgescens*, *Orthothecium chryseon*, *Campylium stellatum*, *Brachythecium udum*, *Bryum pseudotriquetrum*, *Cratoneuron filicinum*, *Philonotis tomentella*, *Scapania spitsbergensis*, *S. simmonsii*, *Aneura pinguis*, *Sauteria alpina*, etc., are common there.

On pebbly and sandy alluvium in the upper level of flood plain, open meadow communities with *Pentaphylloides fruticosa*, *Dryas grandis*, *Thymus reverdattoanus*, *Saxifraga oppositifolia*, *Dianthus repens*, *Chamaenerion latifolium*, *Gentianopsis barbata* are represented. Bryophytes are mostly associated with turf-covered places and patches of vascular plants. *Brachythecium jacuticum*, *Bryobrittonia longipes*, *Bryoerythrophyllum ferruginascens*, *Bryum creberrimum*, *Calliergonella lindbergii*, *Campyliadelphus chrysophyllus*, *Ceratodon purpureus*, *Didymodon fallax*, *D. validus*, *Distichium* spp., *Ditrichum flexicaule*, *Encalypta mutica*, *E. pilifera*, *E. rhabdocarpa*, *Myurella julacea*, *Orthothecium* spp., *Stereodon bambergeri*, *Syntrichia ruralis*, *Tortula leucostoma*, *T. mucronifolia* occur there.

On exposed steep rocky slopes, mostly below cliff outcrops, xeric steppe-like communities occur. Open herb

cover is composed of *Astragalus inopinatus*, *A. alpinus*, *Hedysarum dasycarpum*, *Oxytropis karga*, *Carex macrogyna*, *C. melanocarpa*, *Poa glauca*, *Elymus kronokensis*, *Festuca rubra*, and *Thymus reverdattoanus*. On bare calcareous ground spots *Abietinella abietina*, *Stereodon vaucherii*, *S. bambergeri*, *Ditrichum flexicaule*, *Bryum creberrimum*, *Bryoerythrophyllum recurvirostrum*, *Stegonia latifolia*, *Syntrichia ruralis*, and *Tortula mucronifolia* are common, and *Ceratodon purpureus*, *Encalypta rhamnoides*, *E. pilifera*, *Bryoerythrophyllum recurvirostrum*, *Bryum argenteum*, *B. kunzei*, *Trichostomum crispulum*, *Aloina brevirostris*, *Pterygoneurum ovatum*, *Didymodon validus*, *Weissia brachycarpa*, etc., are occasionally present.

Species composition of epixylic mosses on exposed and dry rotten wood in open places is different from one on rather moist rotten wood under forest canopy. On dry rotten wood, *Bryoerythrophyllum recurvirostrum*, *Tortella fragilis*, *T. alpicola*, *Orthotrichum iwatsukii* are most common, while *Orthotrichum obtusifolium*, *Amblystegium serpens*, *Pylaisia polyantha* occur among other mosses and sometimes also dominate.

Vegetation of tundra belt is represented mostly by various types of tundra, cryophyte deserts, rock fields and gravelly barrens, alpine meadows below snow beds, and minerotrophic bogs. On drained tops of rocky plateaus, cryophyte desert communities occur. In these communities, xerophyte dwarf shrubs and herbs (*Carex trautvetteriana*, *C. macrogyna*, *Kobresia simpliciuscula*, *Salix recurvigemmis*, *Saxifraga oppositifolia*, *Eremogone formosa*, and *Baeotryon uniflorum*) are common, with total cover ca. 10-15%. Bryophytes are represented by *Schistidium adreaeopsis*, *Ascidiota blepharophylla*, *Stereodon bambergerii*, *S. vaucherii*, *Abietinella abietina*, *Hylocomium splendens* var. *obtusifolium*, *Ditrichum flexicaule* being most common, with an admixture of *Trichostomum crispulum*, *Syntrichia ruralis*, *Tortella arctica*, *Encalypta rhamnoides*, *E. longicolla*, *Bryoerythrophyllum recurvirostrum*, *Bryum wrightii*, *B. creberrimum*, *Distichium* spp., *Myurella julacea*, *Orthothecium strictum*, *Odontoschisma macounii*, and *Cryptocolea imbricata*; lichens are constantly but sparsely distributed in these communities. Almost the same composition of herbs and bryophytes is characteristic for *Dryas crenulata*-dominated cryoxerophyte tundra. Total vegetation cover reaches 30-50%; *Hylocomium splendens* var. *obtusifolium* dominates among bryophytes, and *Ceratodon purpureus*, *Meesia uliginosa*, *Myurella julacea*, *Blepharostoma trichophyllum*, *Tritomaria quinqueidentata*, *Arnellia fennica*, *Lophozia perssonii*, *Plectocolea hyalina*, *Anethlia juratzkana* and other bryophytes occur on bare humous soil.

In places with dolerite outcrops on drained rocky ground, *Rhododendron adamsii* & *Dryas* spp. dominated tundra occur. Among herbs and dwarf-shrubs, *Dryas crenulata*, *D. punctata*, *Arctous erythrocarpa*, *Hedysarum*

*dasycarpum*, *Oxytropis karga*, *Potentilla nivea*, *Cardaminopsis petraea* are most common. Among bryophytes, *Hylocomium splendens* var. *obtusifolium*, *Rhytidium rugosum*, *Abietinella abietina*, *Syntrichia ruralis*, *Sanionia uncinata*, *Brachythecium cirrosum*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Orthotrichum iwatsukii*, *Stereodon bambergeri*, *Encalypta* spp., *Myurella julacea*, *Pohlia cruda*, *P. nutans*, *Ptilidium ciliare*, *Schljakovianthus quadrilobus*, *Pseudolophozia sudetica*, and *Tritomaria quinqueidentata* dominate. Boulders are covered by *Andreaea rupestris*, *Grimmia longirostris* and *Schistidium frigidum*. Niches filled with soil are inhabited by such hepatics as *Scapania obcordata*, *S. simmonsii*, *Arnellia fennica*, *Jungermannia polaris*, *Mesoptychia badensis*, *Herbertus arcticus*, *Sphenolobus saxicola*, *Lophozia excisa*, and *L. rubrigemma*.

Gentle, weakly drained slopes of plateau are occupied by willow-, sedge- and cottongrass-dominated tundra communities. Turf-covered places with *Salix recurvigemmis*, *S. saxatilis*, *Arctagrostis latifolia*, *Carex fuscicula*, *C. redowskiana*, *C. melanocarpa*, *Thalictrum alpinum*, *Tofieldia coccinea*, *Eriophorum brachyantherum*, *E. vaginatum*, etc., alternate with patches of eroded loamy ground, where various pioneer species grow. Under cottongrass canopy, *Tomentypnum nitens*, *Campylium stellatum*, *Calliargon giganteum*, *C. richardsonii*, *Brachythecium cirrosum*, *B. mildeanum*, *Plagiomnium curvatum*, *Dicranum elongatum*, *D. laevidens*, *Cinclidium latifolium*, *Aulacomnium acuminatum*, *Scorpidium cossonii*, *Oncophorus* spp., *Sanionia uncinata*, *Sphenolobus minutus* occur, with *Aulacomnium* spp., *Dicranum elongatum*, *Catoscopium nigratum* forming hummocks. In moister conditions these communities transform into minerotrophic bogs with open cottongrass canopy and bryophyte cover composed of *Tomentypnum nitens*, *Orthothecium chryseon*, *Catoscopium nigratum*, *Cinclidium arcticum*, *C. latifolium*, *Pseudocalliargon brevifolium*, *P. urgescens*, *Ditrichum flexicaule*, *Timmia sibirica*, *Didymodon giganteus*, *Ascidiota blepharophylla*, *Scapania spitzbergensis*, *S. simmonsii*, *Aneura pinguis*, *Mesoptychia sahlbergii*, etc. On spots of bare calcareous loamy ground and on gravel covered with calcareous deposits, the following species occur: *Seligeria oelandica*, *S. polaris*, *Bryum wrightii*, *Meesia uliginosa*, *Distichium inclinatum*, *Blepharostoma trichophyllum*, *Odontoschisma macounii*, *Arnellia fennica*. Wet depressions in the same habitats are occupied by colonies of cyanobacteria and such bryophytes as *Ascidiota blepharophylla*, *Frullania subarctica*, *Schistochilopsis grandiretis*, *Cephaloziella varians*, *Calypogeia sphagnicola*, *Seligeria oelandica* and *S. polaris*.

In places where siliceous limestone outcrops occur, *Didymodon asperifolius* dominates on rocky or gravelly ground. On boulders and gravel permanently moistened by water of melting snow fields, *Schistidium submuticum* and *S. abrupticostatum* are locally abundant. On

eroded and humous soil near snow fields, *Bryum pseudotriquetrum*, *B. rutilans*, *B. salinum*, *B. intermedium*, *B. cyclophyllum*, *B. calophyllum* and other *Bryum* species, *Bryoerythrophyllum recurvirostrum*, *Brachythecium turgidum*, *B. coruscum*, and *Sanionia uncinata* dominate, while on fine soil such hepatics as *Clevea hyalina*, *Sauteria alpina*, *Cephaloziella varians*, *Blepharostoma trichophyllum*, *Gymnomitrium coralloides*, *Jungermannia polaris*, *Tritomaria scitula* are common. In places where snow melts in the end of June, communities with *Trichostomum arcticum*, *Schistidium andreaeopsis* and *Ditrichum gracile* are formed. In places composed of Cambrian dolomite poor in silica, pioneer bryophyte communities below snow beds totally lack *Didymodon asperifolius*, while *Trichostomum arcticum* (on rocky ground), *Schistidium andreaeopsis* (on fine soil) or *Sanionia uncinata* and *Bryum* spp. (on humous soil) dominate here.

Near brooks running from snow fields *Hygrohypnum luridum*, *Pohlia wahlenbergii*, *Cratoneuron filicinum*, *Bryum cyclophyllum*, *Cratoneuron filicinum*, *Cinclidium stygium*, *Catoscopium nigratum*, *Orthothecium chryseon*, *Timmia sibirica* form extensive mats; such hepatics as *Sauteria alpina*, *Clevea hyalina*, *Lophoziaopsis perssonii*, *Mesoptychia badensis*, *Ascidiota blepharophylla*, *Odontoschisma macounii*, *Arnellia fennica*, *Mesoptychia heterocolpos* var. *harpanthoides*, *Tritomaria scitula*, and *Cephaloziella varians* also occur here.

Vegetation of cliff outcrops and rock fields is similar to xeric steppe communities described above. They are dominated by *Dryas grandis*, *D. incisa*, *D. crenulata*, *Potentilla nivea*, *Eritrichium arctisibiricum*, *Saxifraga oppositifolia*, *Arctous erythrocarpa*, etc. Surface of cliffs and boulders is often covered by lichens. Composition of saxicolous bryophyte communities changes depending on rock composition, but main species are more or less common on all studied rock types. Among most common saxicolous mosses are *Trichostomum crispulum*, *Hymenostylium recurvirostrum*, *Gymnostomum aeruginosum*, *Molendia sendtneriana*, *Grimmia teretinervis*, *Didymodon validus*, *D. icmadophilus*, *Bryoerythrophyllum recurvirostrum*, *Tortella tortuosa* var. *fragilifolia*, *Schistidium frivollianum*, *S. boreale*, *S. pulchrum*, *Syntrichia ruralis*, *Tortula mucronifolia*, *Distichium inclinatum*, *Ditrichum flexicaule*, *Orthotrichum anomalum*, *Encalypta procera*, *E. pilifera*, *E. rhaptocarpa*, *Drepanium recurvatum*, *Stereodon bambergeri*, *S. procerrimum*, *Pseudoleskeella catenulata*, *P. rupestris*, and *Timmia sibirica*. However, only *Orthotrichum anomalum*, *O. pelucidum*, *Grimmia teretinervis*, *Schistidium boreale*, *S. frivollianum*, *S. pulchrum*, and *Pseudoleskeella catenulata* settle on bare rock surface, while most species listed above require fine soil and places where it can accumulate. Differences in saxicolous bryophyte communities caused by rock composition are discussed below the list of species

## LIST OF SPECIES

**Liverworts**

The taxa are arranged in alphabetical order. The names follow N.A. Konstantinova, V.A. Bakalin & al. (2009) with some updates from recent literature (Söderström & al., 2010; Vilnet & al., 2011, 2012, 2014; Rubasinghe & al., 2011a, b; Váňa & al., 2012, 2013). Each species annotated by: 1) presence of reproductive structures: and. – androecia; gyn. – gynoecia; per. – perianths or pseudoperianths; fem. rec. – female receptacles; spor. – sporophytes; gem. – gemmae; 2) collection site numbers (1–13, cf. Fig. 1); 3) field numbers of selected specimens examined (+ indicates there are additional specimens not included into the list); 4) the frequency by the grades: not rare, sporadic, rare and unique. Species included in the Red Data Book of the Russian Federation (2008) are marked as RF, new record for the Taymyr Autonomous District marked by asterisk.

- Aneura pinguis* – 1, 4, 7, 8, 9: on fine soil and dead mosses in snow bed communities, on limestone cliffs, on eroded creek bank, on moist silt sediments at the base of rocky slope, on moist turf ditch in minerotrophic bogs, on humified soil in *Dryas*-dominated tundra (13-3-0130; 13-3-0382; 13-3-0867; 13-3-0959; 13-3-1045; +). In extensive mats in pure patches or mixed with *Blepharostoma trichophyllum*, *Cephalozia bicuspadata*, *Sauteria alpina*, *Scapania gymnostomophila*, *Schljakovianthus quadrilobus*, *Preissia quadrata*, *Tritomaria quinqueidentata*. Not rare, sometimes abundant.
- Anthelia juratzkana* (per., and., spor.) – 1, 9: on fine soil in snow bed communities, on turfs in minerotrophic bogs, on cryogenic clay spots in tundras, on bare soil along streams and on road sides (13-3-0307; 13-3-0427; 13-3-0601; +). In pure mats or mixed with *Blepharostoma trichophyllum*, *Cephaloziella varians*, *Fuscocephaloziopsis albescens*, *Nardia breidleri*, *Pseudolophozia sudetica*. Rare, but sometimes abundant.
- Arnellia fennica* – 8, 9, 10, 12: on wet fine soil among dolerite rocks along streams, in limestone cliff niche, dolerite rock field, on humified soil in calciphyte communities at the foot of slopes (13-3-0094; 13-3-0453; 13-3-0834; +). Mixed with *Blepharostoma trichophyllum*, *Odontoschisma macounii*, *Tritomaria scitula*. Sporadic.
- Ascidiota blepharophylla* – 7, 12 (Potemkin *et al.*, in press): on calcareous soil in rocky desert, and rocky tundra near late snow melt, on calcareous soil and on moist turf in minerotrophic bog and moist tundra (13-3-0120, 13-3-0237, 13-3-0893, 13-3-0918). In pure mats. Locally abundant.
- Barbilophozia hatcheri* (per., gem.) – 1, 9: on moist fine soil in moist rocky place, on turf in large hummock with *Betula exilis*, on soil under roots in open larch stand (13-3-1030; 13-3-0478; 13-3-0376). Mostly in pure patches or mixed with *Lophozia ventricosa* var. *longiflora*, *Ptilidium ciliare*. Rare.
- B. lycopodioides* – 6, 9, 11: on litter in larch forests, on wet turf in bog near small lake (13-3-0100; 13-3-0873; 13-3-1006; +). Mostly in pure patches or mixed with *Ptilidium ciliare*. Sporadic.
- \**Biantheridion undulifolium* – 9: on wet turf near small lake in bog, mixed with mosses (13-3-0873; 13-3-0874); 13: on moist turf in peat moss hillock, among *Sphagnum* (13-3-0886). Rare.

- Blepharostoma trichophyllum* (per.) – 1, 4, 6, 8, 9, 10, 12: on bare soil and fine earth on banks of streams, on cliffs, under rocks, in rocky tundras, in snow bed communities, on decaying wood, on turfs in minerotrophic bogs, in rock fields (13-3-0686; 13-3-0249; +). Sometimes in pure mats or often mixed with *Aneura pinguis*, *Cephalozia bicuspidata*, *Jungermannia polaris*, *Schljakovianthus quadrilobus*, *Scapania crassiretis*, *Sphenolobus minutus*, *Tritomaria quinquedentata*. It is the most widespread hepatic in the area studied. It occurs as admixture in most collected specimens.
- Calypogeia muelleriana* – 9, 13: on moist turf in wet depression in minerotrophic bog and in peat moss hillock in bog (13-3-0146; 13-3-0147; 13-3-0898), mixed with *Mylia anomala*, *Schistochilopsis grandiretis*. Rare.
- Cephaloziella varians* (per.) – 1, 6, 9, 12: on eroded creek bank, on fine soil in igneous boulder, in rock field below snow bed, on calcareous fine soil in bryophyte communities near brook (13-3-0387, 13-3-0519, 13-3-0615, 13-3-0920). In pure mats or mixed with *Anthelia juratzkana*, *Gymnomitrium corallioides*, *Scapania obcordata*, *Pseudolophozia sudetica*, *Tritomaria quinquedentata*. Sporadic, sometimes abundant.
- Clevea hyalina* (fem. rec., ant.) – 1: on fine soil in moist rocky habitat with late snow melting, mixed with *Sauteria alpina* (13-3-0380). Unique.
- Cryptocolea imbricata* – 1, 9: on fine soil in moist rocky place with late snow melting, on eroded creek bank (13-3-0377, 13-3-0600; +). Mixed with *Aneura pinguis*, *Radula prolifera*, *Tritomaria quinquedentata*. Sporadic.
- Frullania subarctica* – 1: on soil of bare spot border, mixed with *Herbertus arcticus*, *Tritomaria quinquedentata* (13-3-0351; 13-3-0353); 11: on soil in *Dryas*-dominated rocky tundra, mixed with *Herbertus arcticus*, *Tritomaria quinquedentata* (13-3-1072). Rare, but abundant.
- Fuscocephalozia pleniceps* (per., spor.) – 8: on humified soil in *Dryas*-dominated tundra at the base of slope (13-3-1047). Mixed with *Blepharostoma trichophyllum*, *Schistochilopsis opacifolia*, *Sphenolobus minutus*. Unique.
- Gymnocolea inflata* (per., and.) – 9: on moist fine soil in minerotrophic bog, on turf in *Sphagnum* tuft, in pure extended mats (13-3-0211). Unique.
- Gymnomitrium concinatum* (per., spor., gem.) – 1: on moist fine soil in moist place with late snow melting, mixed with *Lophozia silvicola*, *Ptilidium ciliare*, *Scapania hyperborea*, *Tritomaria quinquedentata* (13-3-0344). Unique.
- G. corallioides* – 1, 6: on fine soil among igneous boulders, on wet fine soil among rock fields below snow bed (13-3-0387; 13-3-0519; 13-3-0346; +). Usually mixed with *Cephaloziella varians*, *Scapania obcordata*. Not rare, sometimes abundant.
- \**Herbertus arcticus* – 1, 5, 9, 10, 13: on moist fine soil among boulders in rock field, on turf in large hummock with *Betula exilis* and peat moss hillocks (13-3-0275; 13-3-0586; 13-3-0829; +). In pure patches or mixed with *Cryptocolea imbricata*, *Mesoptychia sahlbergii*, *Radula prolifera*, *Sphenolobus saxicola*, *Tritomaria quinquedentata*. Not rare.
- \**Isopaches decolorans* (arch., gem.) – 9: on loamy soil at eroded slope to bank of the Eriechka River, creping and incrustated with the soil particles (13-3-0850). Unique. RF: Rare.
- Jungermannia polaris* (ant., per., spor.) – 1, 4, 5, 6, 10: on fine soil on eroded slope of watershed, on wet fine soil in rock fields, on eroded turf in larch open stand, in wet depression of minerotrophic bogs (13-3-0557; 13-3-0835; +). Usually mixed with *Blepharostoma trichophyllum*, *Mesoptychia colaris*, *M. badensis*, *Scapania obcordata*. Not rare.
- \**Lejeunea alaskana* – 9: on humified soil in *Salix lanata*-shrub community with moss cover (13-3-1018).
- Lophozia silvicola* (gem.) – 1: on fine soil in moist place with late snow melting, in more or less pure patches (13-3-0344); 9: on rotten log in larch open stand, mixed with *Gymnomitrium concinatum*, *Ptilidium ciliare*, *Scapania hyperborea*, *Tritomaria quinquedentata* (13-3-1210). Rare.
- \**L. silvicoloides* (per.) – 9: on eroded creek bank, mixed with *Aneura pinguis*, *Preissia quadrata*, *Scapania gymnostomophila* (13-3-0598). Unique.
- L. ventricosa* (Dicks.) Dumort. (gem.) – 9: on loamy ground in eroded slope of the 1st terrace, mixed with *Barbilophozia hatcheri* and *Lophozia polaris*, (13-3-0722). Unique.
- L. ventricosa* var. *longiflora* (per., gem.) – 9: on soil in shaded niche under roots in open larch stand on steep N-facing slope, in pure mats (13-3-1032). Unique.
- L. wenzelii* var. *groenlandica* (per., and, per., gem.) – 9: on soil in open larch stand on watershed slope, in pure mats (13-3-0398; 13-3-0402; 13-3-0758). Rare.
- Lophozia excisa* (ant., per., gem.) – 5, 9, 10: in shaded niche at the base of limestone cliffs (including red limestone cliffs), on eroded creek bank, in rock field at place of dolerite outcrops (13-3-0068; 13-3-0696; 13-3-0597; 13-3-0821). In more or less pure patches or mixed with *Scapania irrigua*, *S. subalpina*, *S. obcordata*, *Pseudolophozia sudetica*, *Tritomaria quinquedentata*. Not rare.
- L. polaris* (gem.) – 9: on eroded creek bank, mixed with *Cephaloziella varians*, *Schljakovianthus quadrilobus*, *Tritomaria quinquedentata* (13-3-0615); on fine soil in open larch stands on watershed slope, in mixed with *Scapania obcordata* and *Schistochilopsis opacifolia* (13-3-0410); on loamy ground in eroded slope of 1st terrace, mixed with *Barbilophozia hatcheri* and *Lophozia polaris* (13-3-0722). Rare.
- \**L. rubrigemma* (gem.) – 10: on soil in dolerite rock field, in more or less pure patches (13-3-0833).
- Mannia pilosa* (fem. rec., spor.) – 9: on fine soil on ledge of limestone cliff, in extended mats (13-3-0460). Unique.
- Marchantia polymorpha* subsp. *montivagans* (per, spor., and.) – 2, 9, 13: on moist turf and soil in irrigated lake bank, on eroded creek bank, on bottom of dry lake, moist moss community below extensive snow fields, on silt alluvium in *Equisetum*-dominated communities, on rotten log in alder shrub community near brook (13-3-0234; 13-3-0632; 13-3-0882; +). In all specimens as pure mats. Not rare.
- \**Marsupella apiculata* (per., ant.) – 1: on fine soil among igneous boulder, mixed with *Cephaloziella varians*, *Gymnomitrium corallioides* (13-3-0387). Unique.
- Mesoptychia badensis* (per.) – 7, 9, 10, 12: on fine soil on eroded slopes of watershed, on soil in dolerite rock fields, on calcareous fine soil in bryophyte communities near brooks, on calcareous fine soil in red limestone cliff base, on soil in *Salix*-shrubs communities at the bank of the river, on wet turfs in minerotrophic bogs (13-3-0116; 13-3-0171; 13-3-0678; 13-3-0835; 13-3-0917; +). Mixed with *Jungermannia polaris*, *Scapania obcordata*, *Olelophozia perssonii*. Sporadic.
- M. heterocolpos* var. *heterocolpos* (gem., per) – 1, 9: on fine soil in shaded niche at cliff base, on moist silt sediments at the base of rocky slope and in moist rocky place near snow bed communities; on soil in shaded niche under roots on steep N-facing slope in open larch stand (13-3-0933; 13-3-0378; 13-3-0154; 13-3-0230; 13-3-1029;+). Mixed with *Anthelia juratzkana*, *Blepharostoma trichophyllum*, *Radula pro-*

- lifera*, *Odontoschisma macounii*, *Scapania gymnostomophila*, *S. simmonsii*, *Schljakovianthus quadrilobus*, *Tritomaria quinquedentata*. Sporadic.
- M. heterocolpos* var. *harpanthoides* (gem.) – 12: on calcareous fine soil in bryophyte community near brook, mixed with *Arnellia fennica*, *Blepharostoma trichophyllum*, *Cephaloziella varians*, *Odontoschisma macounii*, *Tritomaria scitula* (13-3-0920). Unique.
- M. sahlbergii* – 1, 9: on fine soil in moist place with late snow melting, on wet turf in open larch stand with *Alnus* shrubs, *Betula exilis* dominated communities and wet hollow in minerotrophic bogs, on soil near cliff base (13-3-0368; 13-3-0188; 13-3-0193). In pure patches or mixed with *Blepharostoma trichophyllum*, *Sphenolobus minutus*. Not rare.
- Moerckia flotoviana* (per.) – 9: on wet soil in *Salix* shrubs at the edge of middle part of flood plane, in pure patches (13-3-1022); on fine soil in shaded niche of limestone cliff, in pure patches (13-3-0451). Rare.
- \**Myliia taylorii* – 9: on moist fine soil in creek bank, mixed with *Radula prolifera* and *Tritomaria quinquedentata* (13-3-0605); 10: on moist fine soil in shaded crevice among boulders at the base of slope, mixed with *Tritomaria quinquedentata* (13-3-0283). Rare.
- \**Nardia* aff. *japonica* (ant.) – 2: on wet organic soil in moist moss community below extensive snow fields (13-3-0610, 13-3-0611).
- Odontoschisma macounii* – 3, 9, 12: on soil in base of rocky slopes, shaded niche of limestone cliffs, bryophyte community near brook (13-3-0154; 13-3-0452; 13-3-0920). Mixed with *Blepharostoma trichophyllum*, *Mesoptychia heterocolpos*, *Scapania gymnostomophila*, *Tritomaria scitula*. Not rare.
- Oleolophozia perssonii* (gem.) – 8: on humified soil in *Dryas*-dominated tundra at the base of slope, in pure small patches (13-3-1048); 12: on calcareous fine soil in bryophyte community near brook, mixed with *Mesoptychia badensis* (13-3-0917). Rare. RF: Rare.
- \**Pellia endiviifolia* (per.) – 9: on silt alluvium in flood plane with willow shrubs on the slope of watershed, in pure mats (13-3-0420); on eroded creek bank, mixed with *Blepharostoma trichophyllum*, *Preissia quadrata* (13-3-0609). Rare.
- Peltolepis quadrata* (ant., fem.rec., spor.) – 6: on fine soil in niche under boulder of rock field, mixed with *Sauteria alpina* (13-3-0544). Unique.
- Plectocolea hyalina* (per., and.) – 1, 9: on bare spots of cryogenic origin in spotty tundra, on fine soil covered igneous boulder on loamy soil at eroded slope to the river bank (13-3-0307; 13-3-0383; 13-3-0852; +). Mixed with *Anthelia juratzkana*, *Scapania irrigua*. Sporadic.
- Preissia quadrata* (male and fem. rec., spor.) – 4, 6, 9: on fine soil in niche under boulder in rock fields, on fine soil of eroded creek bank, on moist fine soil in shaded niches of cliff base (13-3-0543; 13-3-0609; +). In pure extended mats or mixed with *Aneura pinguis*, *Blepharostoma trichophyllum*, *Pellia endiviifolia*, *Tritomaria quinquedentata*, *Sauteria alpina*. Sporadic, sometimes abundant.
- \**Pseudolophozia debiliformis* – 2: on wet organic soil in moist moss community below extensive snow fields, in pure patches (13-3-0633); on turf in dry turf hillock, mixed with *Sphenolobus minutus* (13-3-0654). Unique.
- P. sudetica* (per., spor., gem.) – 1, 4, 5, 10: on moist fine soil in rock field at place of dolerite outcrops, on limestone cliffs, on wet shaded slope to forest brook, on bare spot in tundra, on soil (13-3-0821; 13-3-0836; 13-3-0353; +). In pure patches or with numerous hepatics, more often with *Lophozia excisa*, *Ptilidium ciliare*, *Scapania obcordata*, *Solenostoma sphaerocarpum*, *Sphenolobus minutus*, *Tritomaria quinquedentata*. Not rare, sometimes abundant.
- Ptilidium ciliare* (per., spor.) – 1, 5, 6, 7, 9, 11, 12: in rocky tundra with *Rhododendron*, on hummock and litter in larch forests and dwarf shrub-lichen and lichen tundras, on wet turf in bogs, in moist places with late snow melting and near base of boulder in rock fields (13-3-0686; 13-3-0344; 13-3-0376; +). In pure mats or mixed with *Barbilophozia lycopodioides*, *Sphenolobus saxicola*, *Tritomaria quinquedentata*. Not rare, abundant.
- Radula prolifera* – 1, 9: on moist fine soil in rocky tundra with *Rhododendron* at the base of rocky slope, on moist fine soil in moist rocky place with late snow melting, on eroded creek bank on middle part of flood plane (13-3-0320; 13-3-0378; 13-3-0605; +). Mixed with *Blepharostoma trichophyllum*, *Herbertus arcticus*, *Myliia taylorii*, *Scapania simmonsii*, *Schljakovianthus quadrilobus*, *Sphenolobus minutus*, *Tritomaria quinquedentata* and *Ptilidium ciliare*. Rare.
- Sauteria alpina* (ant., fem. rec., spor.) – 1, 4, 6, 9: on moist fine soil near snow bed communities, in moist hollow with *Salix* shrubs on the slope of watershed, on cliff ledges and rocks covered by soil (13-3-0249; 13-3-0618; 13-3-0931; +). Usually in pure mats or mixed with *Aneura pinguis*, *Blepharostoma trichophyllum*, *Peltolepis quadrata*, *Preissia quadrata*, *Pseudolophozia sudetica*, etc. Not rare.
- Scapania crassiretis* (gem.) – 9: on moist turf in shaded ditch niche of large hummock in minerotrophic bogs, on moist fine soil on shaded ledge of limestone cliff and in dolerite cliffs, on fine soil in cliff niche (13-3-0870; 13-3-0712). In pure patches or mixed with *Pseudolophozia sudetica*. Rare, but locally abundant.
- S. gymnostomophila* (gem.) – 2, 7, 9: on calcareous rocks in cool brook below extensive snow fields, on calcareous fine soil in moist niche of red limestone cliff base, on eroded creek bank (13-3-0125; 13-3-0596; 13-3-0598; 13-3-0629). In pure patches or mixed with *Mesoptychia heterocolpos*, *Odontoschisma macounii*. Sporadic.
- S. irrigua* (per., gem.) – 6, 9: on banks of the river and streams (13-3-0597; 13-3-0599; 13-3-0852). Mixed with *Cephalozia bicuspidata*, *Fuscocephaloziopsis pleniceps*, *Lophozia excisa*, *Plectocolea hyalina*, *Scapania subalpina*. Rare.
- S. obcordata* (per., spor.) – 5, 6, 9: on fine soil in eroded slope of watershed, on wet fine soil in rock fields, on eroded creek bank (13-3-0601; 13-3-0821; 13-3-0519; +). Mixed with *Anthelia juratzkana*, *Cephaloziella varians*, *Jungermannia polaris*, *Lophozia excisa*, *Nardia geoscyphus*, *Pseudolophozia sudetica*, *Tritomaria quinquedentata*, *Tetralophozia setiformis*. Sporadic.
- S. simmonsii* – 1, 4, 6, 7, 9: on fine soil in moist rocky place with late snow melting, on soil in alpine meadow below snow bed, in rocky *Rhododendron*-dominated tundra, rock field at place of dolerite outcrops and on turf-covered boulders in rock fields (13-3-0378; 13-3-0928; 13-3-0683; +). Mixed with *Aneura pinguis*, *Blepharostoma trichophyllum*, *Radula prolifera*, *Schljakovianthus quadrilobus*. Not rare.
- \**S. sphaerifera* (gem.) – 9: on soil among boulders in moist crevice of limestone cliff, mixed with *Tritomaria quinquedentata* (13-3-0200). Unique. RF: Rare.
- S. spitsbergensis* (gem., ant., per.) – 6, 9: on wet rock field in niche under boulder, on fine soil near cliff base and on eroded

- creek bank (13-3-0549; 13-3-0088). In pure mats or mixed with *Aneura pinguis*, *Blepharostoma trichophyllum*. Sporadic.
- S. subalpina* (per., spor.) – 9: on soil near brooks in open larch stand with *Alnus* shrubs, on eroded creek bank (13-3-0599; 13-3-0614; +). Usually in pure mats or mixed with *Scapania irrigua*, *Lophozia excisa*. Sporadic.
- Schistochilopsis grandiretis* (gem.) – 8, 9, 13: on wet turf in depression of minerotrophic bog, mixed with *Calypogeia muelleriana* (13-3-0146; 13-3-0898; +); on humified soil in *Dryas*-dominated tundra at the base of slope, mixed with *Blepharostoma trichophyllum*, *Fuscocephalozia pleinceps*, *Sphenolobus minutus* (13-3-1047); 8: on moist turf of peat moss hillock, mixed with *Calypogeia muelleriana* (13-3-0898). Not rare.
- S. opacifolia* (per., gem.) – 1, 9: on dry turf in turf hillock, on moist fine soil in moist rocky place with late snow melting (13-3-0674; 13-3-0381; +). Usually mixed with *Blepharostoma trichophyllum*, *Pseudolophozia sudetica*. Sporadic.
- Schljakovia kunzeana* (per.) – 9: on shaded moist turf at eroded slope of flood plane, in pure patches (13-3-0486). Unique.
- Schljakovianthus quadrilobus* – 1, 6, 8, 9: on soil in *Salix* shrub community below snow bed, on eroded creek bank, on wet turf in minerotrophic bogs, on limestone boulders in xerophyte rocky slopes (13-3-0520; 13-3-0415; 13-3-0738). Sometimes in pure patches or mixed with *Cephaloziella varians*, *Ptilidium ciliare*, *Sphenolobus minutus*, *Tritomaria quinque-dentata*, etc. Not rare, sometimes abundant.
- Sphenolobus minutus* (per., gem.) – 1, 4, 8, 9: on wet turf in minerotrophic bogs, on humified soil in *Salix lanata* shrub communities and larch open stands, on moist fine soil in places with late snow melting and base of rocky slopes (13-3-0185; 13-3-0368; 13-3-0738; +). Sometimes in pure patches but more often in bryophyte turfs. Sporadic, sometimes abundant.
- S. saxicola* – 5, 10: on moist fine soil among boulders in rock fields (13-3-0275; 13-3-0824; 13-3-0829; +). Usually mixed with *Herbertus arcticus*, *Ptilidium ciliare*.
- Tetralophozia setiformis* – 1: on igneous boulder, on fine soil, without admixture of other hepatics (13-3-0359). Unique.
- Tritomaria quinque-dentata* (per.) – 1, 4, 5, 6, 9, 10: on moist fine soil in rock fields, in moist place with late snow melting, on turf depression in minerotrophic bogs, on eroded creek bank in middle part of flood plain (13-3-0283; 13-3-0382; 13-3-0600; +). In pure patches or mixed with *Barbilophozia hatcheri*, *Ptilidium ciliare*, etc. Not rare, sometimes abundant.
- T. scitula* (gem.) – 6, 9, 12: on wet fine soil in rock fields, on calcareous fine soil near brook and in shaded niche at the base of limestone cliffs in tundra belt; on soil in shaded niche under roots on steep N-facing slope in open larch stand (13-3-0515; 13-3-0698; 13-3-0920; +). In pure patches or mixed with *Arnellia fennica*, *Cephaloziella varians*, *Mesoptychia heterocolpos*, *Odontoschisma macounii*. Sporadic.

### Mosses

Moss nomenclature is cited following Ignatov *et al.*, 2006 with additions from Steere & Iwatsukii (1978) and some updates (Fedosov & Ignatova, 2008, Ignatov & Milyutina, 2010, Ignatova *et al.*, 2010, Tubanova *et al.*, 2010, Tubanova & Ignatova, 2011, Fedosov, 2012, Ivanova *et al.*, 2014). After species name collection site numbers are given (according Fig. 1), for saxicolous species

rock types are listed after semicolon according to the Table 1; a brief ecological characteristic for each species is provided.

- Abietinella abietina* – 1-13; L, M, Dm, I, Dt. Throughout the territory, in rather dry habitats, most common on rock outcrops and in dry rocky tundra, on well drained ground, both rocky and humous, on eroded turf and dry rotten wood.
- Aloina brevirostris* – 9-11; L, M. On eroded slopes of valleys, on loamy ground.
- A. rigida* – 8; L. Near base of cliff and on boulder, on calcareous ground.
- Amblyodon dealbatus* – 4; L. Alpine meadow below snow bed, on rock covered by moist fine soil.
- Amblystegium serpens* – 9, 10; L. Rocky slope covered with steppe vegetation, on shaded surface of limestone boulder; flood plain, on dry rotten log covered with silt sediments.
- Andreaea rupestris* – 1, 5, 10; I, Dt. Rock fields at places of ijolite and dolerite outcrops, on rocks.
- Aplo-don wormskioldii* – 1, 2, 4, 6, 7, 9, 12, 13. In moist tundra communities and in bogs in valleys. Most abundant near snow beds.
- Aulacomnium acuminatum* – 2-13. In larch forests, moist tundra communities, on different bogs in valleys and near snow beds.
- A. palustre* – 1, 9, 11, 13. In forests and in palsa bogs on turf hillocks.
- A. turgidum* – 9. In palsa bogs on turf hillocks in *Betula exilis* dominated communities.
- Barbula convoluta* – 9. On eroded loamy slopes of river banks and on silt alluvium in flood plane.
- B. jacutica* – 9. Single collection from eroded creek bank affected by cryogenic swelling.
- Bartramia ithyphylla* – 1, 9; I. Occasionally occurs in mountain tundra on the top of Nyamakit Mt. and in soil niches on eroded river banks and turf hillock.
- B. pomiformis* – 1; I. Single collection from slope of the Nyamakit Mt., where the species grew near a place with late snow melting.
- Blindia acuta* – 1; I. The species is abundant in the area composed of ijolite, where it grows on bare spots in rocky mountain tundra, on placer slopes and rocks.
- Brachytheciastrum trachypodium* – 10; L. Single collection from shaded cliff base.
- Brachythecium boreale* – 6, 7, 9-11. On soil in willow and alder shrub communities in flood plain, below snow beds, in *Betula exilis*-dominated communities in hollows and on eroded tops of turf hillocks on palsa bogs, rarer in niches of limestone cliffs and in larch forests.
- B. cirrosum* – 1, 4-10; L, M, I, Dt. In cliff niches, on boulders, in rocky and moist cottongrass-dominated tundra communities, in wet bryophyte communities below snow beds, in minerotrophic bogs on slopes of limestone plateau and in different bogs in valleys, in willow shrub communities in flood plain, etc.
- B. coruscum* – 6. Hollow of the right tributary of the Eriechka River below snow bed, on moist fine soil.
- B. jacuticum* – 8, 9. In larch forests with alder shrub canopy in dolerite outcrops or on rotten logs in open larch forests, in *Betula exilis* and willow shrub communities in hollows, on eroded turf hillocks, in willow shrub communities in flood plane and near places with late snow melting, on overgrown edges of pebbly banks, etc.

- B. mildeanum* – 9. On the bank of dry lake, on rotten wood.
- B. turgidum* – 1, 4, 6, 9, 10. In various tundra communities, meadows and willow shrubs below snow beds, in various types of bogs and *Betula exilis*-dominated communities, on river and creek banks, etc.
- B. udum* – 2, 9. In wet depression in minerotrophic bog; in wet cottongrass-dominated minerotrophic bog below extensive snow field.
- Breidleria pratensis* – 4, 6, 7, 9, 11. Abundant in moist hollows with *Betula exilis* and willow shrubs on slopes of watersheds, in willow shrub communities and boggy meadows below snow fields, in temporarily flooded willow shrubs and meadows in river and creek valleys. Rarely, it also grows in places with variable moisture in bogs on the Eriechka River terraces, in minerotrophic bogs and cottongrass communities on plateau slopes and in boggy forests.
- Bryobrittonia longipes* – 9-11. On eroded slopes at creek and river banks, mostly in the middle part of flood plane above annually flood level, on loamy ground and silt sediments.
- Bryoerythrophyllum alpigenum* – 9. On eroded top of dry turf hillock on palsa bog, on moist loamy ground.
- B. ferruginascens* – 9. On eroded slopes of the Eriechka River first terrace, on loamy ground.
- B. latinervium* – 7, 10; L, M. On rock field below cliff base, in cryophyte community, on fine soil; on spot in spotty tundra on red limestone, on dry calcareous ground.
- B. recurvirostrum* – 2-11, 13. On eroded loamy slopes, on silt alluvium in flood plain, on moist fine soil in cliff niches and at cliff bases, in spotty tundra, near snow beds; the species also occurs on rotten wood in various habitats throughout the forest belt. An unusual variety of the species with short eperistomate capsules and entire leaf tips occupies wet sod layer closest to late snow beds.
- Bryum algovicum* – 4, 9. In alpine meadow below snow bed near brook; on eroded slope of the Eriechka River first terrace.
- B. altaicum* – 6, 9. On rock field below snow bed; at the base of placer slope of watershed, on soil among boulders.
- B. amblyodon* – 2, 6, 9. In moist conditions below snow fields, on wet organic soil and on flood plain on silt alluvium.
- B. archangelicum* – 10; L. On cliff ledge covered by fine soil.
- B. arcticum* – 1, 5, 9. In different types of tundra and in flood plains in willow shrub communities, on bare soil.
- B. argenteum* – 5, 7-10; L, M. On open cliff faces, in dry crevices and on ledges covered by fine soil.
- B. axel-blyttii* – 9. On the bottom of dry lake, on eroded turf.
- B. bimum* – 13. On irrigated lake bank, on moist turf.
- B. caespiticium* – 9. Palsa bog, on dry turf hillock.
- B. calophyllum* – 2. Moist moss community below extensive snow fields, on reindeer dung.
- B. capillare* – 9. On loamy spot on eroded top of turf hillock, on moist loamy ground.
- B. creberrimum* – 3-5, 7-13; L, M, Dm, Dt. Widespread in well-drained rocky tundra, in disturbed places, at slope edges, in temporarily flooded places, on calcareous fine soil at rock bases and cliff ledges, on charcoal of former fireplaces, etc.
- B. cryophilum* – 9. In flood plane of the Eriechka River and the Nyamakit-Daldyn Creek, on wet silt alluvium near pools.
- B. cyclophyllum* – 2, 4, 6. In shallow brooks below snow beds, in water near banks.
- B. dichotomum* – 8; L. On fine soil on partly shaded ledge at the base of cliff.
- B. elegans* – 10; L. On cliff ledges, on calcareous fine soil.
- B. intermedium* – 9. On moist meadow near brook; on loamy spot on eroded top of turf hillock, on moist loamy ground.
- B. kunzei* – 7, 10; L, M. On cliff ledges covered with soil, on calcareous fine soil.
- B. lonchocaulon* – 8. On steep rocky slope below limestone cliffs, on mineral ground.
- B. neodamense* – 9, 13. On wet ground on banks of small lakes and on the bottom of drained pools.
- B. pallens* – 9. On eroded slope of first terrace of the Eriechka River, on loamy ground in pioneer bryophyte community.
- B. pseudotriquetrum* – 1-13. Common species throughout the territory in moist tundra, minerotrophic bogs, below snow fields, in boggy forests and *Betula exilis*-dominated communities, in bogs on river terraces and in flood plains.
- B. rutilans* – 2, 4, 6. In bryophyte communities near brooks below snow beds.
- B. salinum* – 6. On wet fine soil between boulders below snow bed.
- B. sibiricum* – 7. Single collection from eroded soil at the edge of larch forest above cliffs.
- B. teres* – 5, 7, 10; M. On marl cliff ledges, on fine soil.
- B. turbinatum* – 9. In bryophyte community on place with disturbed vegetation at the base of steep rocky slope and at the upper edge of flood plain.
- B. wrightii* – 1-12; L, M, Dm, I. Common species throughout the territory on loamy calcareous ground of eroded slopes and loamy spots in tundra, along brooks, streams and rivers, below snow beds, at cliff bases, etc.
- Calliergon cordifolium* – 11. Single collection from boggy terrace of the Arylakh Creek.
- C. giganteum* – 4, 6, 9, 11, 13. In bogs on river terraces and in flood plains, in moist hollows with *Betula exilis* and willow shrubs on slopes of watersheds. Common in forest belt, occasionally occurs near brooks below snow beds.
- C. richardsonii* – 4, 6-8. In minerotrophic bogs on plateau slopes, and in bryophyte communities below snow beds.
- Calliergonella lindbergii* – 9. Occasionally occurs in lower and middle level of flood plain, on soil, boulders and willow shrub bases.
- Campyliadelphus chrysophyllus* – 7, 9, 10. In larch forests, alder thickets, willow shrub communities and meadows; on soil, alluvium and rotten wood.
- Campylidium sommerfeltii* – 10; L. On rock field at the base of slope, on shaded surface of boulder.
- Campylium protensum* – In *Salix lanata*-dominated communities with moss cover near creeks and below snow fields, in *Betula exilis*-dominated communities in hollows on slope of watershed.
- C. stellatum* – 1, 3-13; L, M, I. Throughout the territory as an admixture in various communities in rather wet conditions: in cottongrass-dominated tundra, bryophyte communities below snow beds, in *Betula exilis* and (or) willow-dominated communities in flooding areas along streams, in bogs on river terraces, hollows on watershed slopes, etc.
- Catoscopium nigratum* – 1-13. Common species, dominates in bryophyte communities above timberline, which are formed in relatively wet conditions. Below snow beds it often forms pure mats, occupying tens of square meters. It also dominates in wet hollows, minerotrophic bogs, in wet tundra communities, etc. In forest belt the species occurs in bogs on river terraces and occupies silt alluvium in flooding areas.
- Ceratodon purpureus* – 2, 3, 8-11. Relatively rare, mostly on steep dry rocky slopes almost lacking vegetation, on cliff

- ledges and in disturbed places, *e.g.*, eroded tops of turf hill-ocks, alluvium, former fireplaces, *etc.*
- Cinclidium arcticum* – 1-13. Widespread throughout the territory in moist tundra, various forests, on hummocks in bogs and *Betula exilis*-dominated communities, along the edge of flood plain middle part, on minerotrophic alpine bogs and in alpine meadows below snow beds and in other disturbed moist places. Sometimes dominates, mostly above timberline.
- C. latifolium* – 5-11, 13. Common species in bogs in valleys, in wet cottongrass-dominated tundra and minerotrophic bogs on gentle plateau slopes, where it occurs both on hummocks and in wet depressions. It is also not rare along river and stream banks on silt alluvium. Often dominates and forms extensive pure mats along banks of streams and brooks.
- C. stygium* – 9. Two records in minerotrophic bogs at the base of valley slope, in wet depressions.
- Cnestrum alpestre* – 9. Once collected on eroded humous slope of turf hillocks in palsa bog on river terrace.
- Cratoneuron curvicaule* – 6, 7, 9-11. Widespread in pioneer bryophyte communities along streams and the river, in willow shrub communities in flood plains and in *Betula exilis*-dominated communities in hollows on the slopes of watersheds. Also occasionally occurs on moist soil near brooks below snow beds.
- C. filicinum* – 4, 10; L. Common on moist soil near brooks in alpine meadow below snow bed, also occurs on cliff ledges near places with oozing water or beside waterfalls.
- Ctenidium molluscum* – 7, 10; L, M. Locally common in dry shaded crevices at cliff bases and on shaded boulders in forests, occasionally occurs on red limestone cliff ledges and at cliff bases, on fine soil.
- Cynodontium strumiferum* – 1, 5, 9-11; I, Dt. In larch stands on watershed slopes on humous soil and rotten logs, on eroded slopes of turf hillocks in palsa bogs on river terraces, on fine soil among boulders and in tundra in places with dolerite and ijolite outcrops.
- Cyrtomnium hymenophylloides* – 1-13; L, Dm, I, Dt. Widespread species in different disturbed places and in wide diversity of rocky habitats. Forms pure tufts in cliff crevices and on eroded turf blocks, and occurs in polydominant bryophyte communities in relatively dry disturbed places, mostly with other common weak competitors, *e.g.*, *Myurella*, *Isopterygiopsis*, *Mnium*, *Brachythecium*, *Encalypta*, *Timmia*, *Distichium*, *Ditrichum*, *Arnellia*, *Tritomaria*, *etc.*
- C. hymenophyllum* – 3-12; L. Widespread in cliff niches and crevices, and in various disturbed places, mostly in partial shade: at cliff and boulder bases in forests, in alder shrub communities, in soil niches on eroded slopes, *etc.*
- Dichodontium pellucidum* – 9. Occasionally occurs on steep eroded river banks on mineral ground in crevices between turf-covered blocks formed by cryosolic processes.
- Dicranella cerviculata* – 9. On tops of turf hillocks on palsa bogs on river terrace and on eroded river banks, both on turf and loamy ground.
- D. grevilleana* – 9, 13. On silt alluvium in lower part of flood plain and on eroded loamy strip on bank of the lake.
- D. varia* – 9-11. Common species on eroded calcareous mineral ground and on silt alluvium along creeks and the river.
- Dicranum acutifolium* – 10, 11. Two collections from mesic forests: alder shrub community under open larch canopy on dolerite outcrop and on base of rotten tree trunk in larch stand.
- D. bardunovii* – 10. Single collection from alder shrub community under open larch canopy on dolerite outcrop.
- D. elongatum* – 1-13. Common species, growing in various moist habitats. Most abundant in river and creek valleys: in boggy forests, palsa bogs, moist hollows, *etc.*, and also in cottongrass-dominated tundra communities above timberline, mostly at places with siliceous rock outcrops. The species also occurs on turf swells of polygonal bogs and in moist disturbed places.
- D. flexicaule* – 7, 9. Two collections from relatively dry larch stands and one more from *Cassiope*-dominated moist community with late snow melting at the base of steep slope.
- D. fuscescens* – 7, 9. In relatively dry open larch stands; on trunk bases, rotten wood and soil.
- D. laevidens* – 7-9, 11. On hummocks in bogs in valleys with larch stands, in boggy forests, *Betula exilis*-dominated communities in hollows, on turf swells of polygonal bogs, *etc.*, occasionally in moist cottongrass-dominated tundra.
- D. majus* Turner – 7-11. Rather common species in relatively dry forests and on dry tops of big hummocks and turf hillocks, on disturbed edges of slopes, in rocky tundra where siliceous rocks outcrop.
- D. septentrionale* – 10. Once collected on soil in open larch stand on watershed slope.
- D. spadiceum* – 1. Occasionally occurs in rocky *Dryas*- and *Cassiope*-dominated tundra in the area of ijolite outcrops.
- Didymodon asperifolius* – 3-9; L, M. Common species in rocky tundra, rock fields formed by siliceous limestone and marls, in *Cassiope*-dominated rocky tundra at slope bases where snow accumulates; especially abundant on placers just below snow beds, where it forms extensive pure tufts. Occasionally occurs on hummocks in minerotrophic bogs.
- D. fallax* – 7, 10; M. On fine soil on ledges and at bases of red limestone cliffs.
- D. ferrugineus* – 8-10; L, M. On moist calcareous fine soil and silt alluvium, on cliffs and boulders in flood plains and on ledges of white Proterozoic limestone cliffs. In calcareous rocky tundra in place with relatively late snow melting, an unusually large form of the species, transitional to *D. maximus*, was collected.
- D. giganteus* – 7 (Ellis *et al.*, 2014a). The species occasionally occurs above timberline in cottongrass-dominated minerotrophic bogs on gentle slope of plateau composed of red siliceous Proterozoic limestone, usually associated with *Cinclidium*, *Catoscopium*, *Orthothecium*, *Scapania*, *Ascidiota*, *Mesoptychia*, *Pseudocalliergon*, *etc.*
- D. icmadophilus* – 8. On steep rocky slope below cliff outcrops, on Proterozoic limestone boulder partly covered with fine soil.
- D. luridus* – 4; L (Ellis *et al.*, 2014b). Single collection from shaded cliff ledge near snow bed, where it grew on moist rock surface, forming an extensive pure mat.
- D. validus* – 3, 5, 6, 8-10, 12; L, M, Dm. On calcareous rocks and boulders, or, more often, on fine soil at their bases. The species also occurs in dry Fabaceae-dominated rocky meadows and among rocks below snow beds.
- Distichium capillaceum* – 1-13; L, M, Dm, I, Dt. Widespread and relatively common throughout the territory, occurs in most types of habitats with the exceptions of wet polygonal bogs, alder shrub communities and *Betula exilis*-dominated communities in wet hollows. It is most common in different rocky habitats, both on calcareous and siliceous rocks, but even there it mostly occurs in polydominant bryophyte communities.

- D. inclinatum* – 1-13; L, M, Dm, I, Dt. The ecology of the species in the study area does not significantly differ from the previous one, but it is less abundant in most types of bryophyte communities, excepting patches of bare ground in valleys and rocky & fine soil deposits among snow beds.
- Ditrichum flexicaule* – 1-13; L, M, Dm, I, Dt. The species occurs in rocky habitats with open vegetation cover: on cliffs and rock fields, in rocky tundra, on placers, in dry Fabaceae-dominated rocky meadows, in various places with bare soil including those below snow beds and along streams.
- D. gracile* – 4, 7, 8, 10; L, M, Dm, I, Dt. The species occupies habitats with denser vegetation cover, compared with those of *D. flexicaule*. It occurs on turf covered rocks and placers, in minerotrophic bogs, etc. It often forms extensive pure mats.
- Drepanium recurvatum* – 1-13; L, M, Dm, I. The species grows below timberline and forms pure mats in deeply shaded places at bases of boulders. It is also abundant in cliff niches and at their bases, in xeric steppe-like tundra communities, etc.
- Drepanocladus aduncus* – 13. On eroded loamy strip of small lake on the Eriechka River flood plain.
- D. arcticus* – 9. Two collections from pebbly banks, on silt alluvium.
- D. polygamus* – 9. Two collections, from willow shrub base and from rotten log in the Eriechka River flood plain.
- D. sendtneri* – 1; I. In wet depressions below places with late snow melting, several plants on fine soil.
- Encalypta affinis* – 1; I. In *Dryas*-dominated mountain tundra, on soil.
- E. alpina* – 1, 2, 4, 6, 7, 9, 10; L, M, Dm, I. Frequent species in various disturbed places and in wide diversity of rocky habitats. Sometimes it also colonizes cliff ledges and cliff bases covered by fine soil. Usually grows as an admixture in polydominant bryophyte communities in places with weakened competition.
- E. longicolla* – 1-10, 12; L, M, Dm, I. Frequent pioneer species on calcareous fine soil in spotty tundra, at cliff bases and in niches, on boulders, in various disturbed places, etc. Most common in places where Cambrian dolomites outcrop, much rarer on red marls, once collected from ijolites. Also occurs on mineral sediments forming terraces in valleys.
- E. mutica* – 2-10. Frequent pioneer species of calcareous fine soil, loamy ground and alluvium. Most abundant on Proterozoic white siliceous limestone.
- E. pilifera* – 3-5, 8, 10; L, Dt. Occasionally occurs on dry rocky slopes, in rock fields and on cliff ledges.
- E. procera* – 1-13; L, M, Dm, I, Dt. Common on rock fields, in various types of rocky tundra and meadows, at cliff bases, in flood plains and other disturbed places covered by polydominant bryophyte communities. Occasionally occupies rotten logs.
- E. rhaptocarpa* – 1, 5, 10; L, I. On ijolite rock field and at base of Proterozoic limestone cliffs.
- E. trachymitria* – 12; L. Single collection from dry rock field at the base of dolomite cliff, where it grew on calcareous soil.
- E. vulgaris* – 7, 8; L, M. On steep rocky slope, on calcareous fine soil; on ledge of red limestone cliff covered with fine soil.
- Eurhynchiastrum pulchellum* – 7-11; L, Dt. On litter, in soil niches and on rotten wood in forests, on bare humous soil on various eroded slopes and in spotty tundra, in disturbed places with weakened competition, occasionally also on fine soil on rock fields and in cliff niches.
- Fissidens adianthoides* – 9. In wet *Meesia*, *Mesoptychia* and *Pseudocalliergon*-dominated depression in polygonal bog on river terrace, as a scarce admixture.
- F. osmundoides* – 1; I. On bare spot in *Dryas*-dominated rocky tundra, on fine soil.
- F. viridulus* – 4, 7-9; L, M. In gravelly *Dryas*-dominated tundra, on side surface of small rocks submerged in wet ground, at ground level or just below, often with *Seligeria* spp.; on moist fine soil in shaded cliff niches and on ledges; on bare loamy ground in niches of eroded slopes.
- Funaria arctica* – 9. The species occasionally occurs on bare loamy ground on steep eroded slopes of terraces affected by cryogenic swelling.
- F. hygrometrica* – 6, 9-11, 13. On moist loamy ground in the forest belt; especially common on eroded slopes of river terraces, where it occurs in sites closest to the water, together with *Sauteria*, *Marchantia*, *Pellia*, etc.
- F. polaris* – 8. Locally abundant on palsa bog on river terrace, on bare, slightly humous calcareous loamy ground on eroded surfaces of hillocks.
- Grimmia anodon* – 3-10; L, M. One of the most common epilithic mosses, occupying exposed surfaces of siliceous limestone cliffs on steep slopes of Eriechka River valley. Somewhat less abundant in crevices of red marl outcrops. Common on cliffs, but almost absent on boulders both in forests and in open places.
- G. funalis* – 1, 5, 10; I, Dt. Frequent on rock fields composed of igneous rocks.
- G. longirostris* – 1, 5, 10; I, Dt. Common epilithic on igneous rocks.
- G. teretinervis* – 3-10; L, M, Dm. Common on white Proterozoic cliffs and on Cambrian dolomites, considerably rarer on red marls; inhabits mostly prominent surfaces of cliffs and occasionally grows on boulders.
- G. tergestina* – 10; L. Single collection from exposed surface of Proterozoic limestone boulder on SW slope of plateau.
- Gymnostomum aeruginosum* – 2, 4, 5, 8, 10, 12; L, M, Dm. On cliff ledges and on cliff bases, in shaded niches, and on exposed surfaces of boulders. Frequent on Cambrian dolomites, rather rare on white Proterozoic limestone, very rare on marls.
- Hygrohypnum luridum* 1-13; L, M, Dm, I. Abundant on boulders in brooks, on moist shaded cliff bases and other rock surfaces with oozing water, on creek banks and on willow shrub bases, in rock fields below snow beds, etc. Most abundant on Proterozoic white limestones, rather rare on rocks of other types.
- Hamatocaulis vernicosus* – 6, 7, 9, 11. On the periphery of polygons in polygonal bogs, in boggy strips of stream valleys, in cottongrass-dominated tundra and in minerotrophic bogs on gentle slopes of plateau.
- Hylacomium splendens* – 1-13. Main dominant in rather xeric larch stands, where it forms extensive pure carpets; also common in *Dryas*-dominated tundra, though only as an admixture to other mosses. Inhabits also other mesophyte habitats, i.e., hummocks and turf hillocks, turf-covered rocks, etc.
- Hymenoloma crispulum* – 1; I. In places with late snow melting, on ijolite boulders covered by fine soil, occasionally in rocky tundra.
- Hymenostylium recurvirostrum* – 2-5, 8, 10, 12; L, M, Dm. On cliff ledges and cliff bases, in niches and on exposed rock surfaces. Common on Cambrian dolomites, rather rare on white Proterozoic limestones and marls.
- Hypnum cupressiforme* – 8, 10; L. In forest belt, on moist shaded bases of cliffs and boulders and on rotten wood.
- Isopterygiopsis pulchella* – 1-13; L, M, Dm, I, Dt. Frequent on

- litter, in soil niches and on rotten wood in forests, on bare turf and humous soil on various eroded slopes and in spotty tundra, in disturbed places with weakened competition, on fine soil in rock fields and in cliff niches, regardless of rock type.
- Leptobryum pyriforme* – 9, 11, 13. Common on vertical shaded surfaces of eroded slopes of terraces where it forms pure communities or grows intermixed with *Funaria*, *Bryum*, *Marchantia*, *Sauteria* and other pioneer bryophytes.
- Loeskypnum badium* – 1, 9, 11, 13. Occasionally occurs on high hummocks and hillocks in bogs in river valley and in fens in places where igneous rocks outcrop.
- Meesia triquetra* – 7, 9, 11, 13. Occasionally occurs in wet depressions in bogs in river valley, mainly as an admixture to *Pseudocalliergon*, *Cinclidium*, *Mesoptychia*, etc.; rather abundant along brooks in *Betula exilis*-dominated hollows on watershed slopes and in small lakes on river terraces, near boggy banks.
- M. uliginosa* – 1-13; L, M, Dm. Widespread in a great variety of habitats – in moist cliff niches and along cliff bases, in cottongrass-dominated tundra and on minerotrophic bogs, in bryophyte communities in wet meadows, bogs and willow shrub communities below snow beds. Also settles in disturbed places in flood plains, in different bogs in valleys, etc., on turf, loamy and fine soil deposits, and on moist organic remnants.
- Mnium blyttii* – 10. Two collections from soil in alder shrub-dominated communities.
- M. lycopodioides* – 1, 3-12; L. In polydominant bryophyte communities on steep rocky slopes, on shaded cliff bases, under alder shrub canopy, in rock fields, on eroded soil, etc.
- M. thomsonii* – 8. Single collection from shaded niche of limestone cliff.
- Molendoa sendtneriana* – 2, 4, 8, 10, 12; L, Dm. Sporadic on cliff ledges and in crevices; common on Cambrian dolomites and rather rare on Proterozoic siliceous limestone.
- Myurella julacea* – 1-13; L, M, Dm, I, Dt. Widespread in various, mostly rather xeric rocky habitats, forms pure covers on ledges or grows as an admixture to other mosses on turf-covered boulders, in rocky tundra, etc. It is also constantly present in polydominant bryophyte communities in various disturbed places with weakened competition in bryophyte cover, i.e., on steep rocky slopes, eroded river banks, in flood plains, etc.
- M. tenerrima* – 1, 4, 6, 9; L. In deeply shaded moist soil niches in forests and on eroded river banks, occasionally in cliff crevices.
- Oligotrichum hercynicum* – 1; I. Collected twice in *Cassiope*-dominated rocky tundra, in places with late snow melting, on spots of bare soil.
- Oncophorus virens* – 2, 5-7. In moist hummocky cottongrass-dominated tundra and near brooks below snow beds.
- O. wahlenbergii* – 1-13. T. Throughout the territory, in various tundra communities, forests, bogs, in bryophyte communities below snow beds, in flood plains, etc., mostly on hummocks. Occasionally occurs on rotten wood and on soil in disturbed places.
- Oreas martiana* – 4; L (Ellis et al., 2014b). Single collection on wet alpine meadow with close bryophyte cover below snow bed, on rock covered by moist fine soil.
- Orthothecium chryseon* – 1-13; L, M, Dm, I. Common in minerotrophic bogs above timberline, in bryophyte communities below snow beds, on moist rock bases, in various disturbed places, along brook, creek and river banks, etc.
- O. strictum* – 1-13; L, M, Dm, I, Dt. In shaded cliff niches and crevices and on various disturbed places, mainly as an admixture in polydominant bryophyte communities.
- Orthotrichum anomalum* – 2-12; L, M, Dm, I. One of the most abundant epilithic mosses on calcareous rock outcrops, especially on white Proterozoic limestone and Cambrian dolomites. Often covers almost entirely calcareous boulders under forest canopy, and rarer settles on cliffs. Much less abundant on red marls and ijolites.
- O. holmenii* – 10. On xeric SW-faced rocky slope, on dry rotten willow branch.
- O. iwatsukii* – 1, 2, 4, 6, 7, 9-13; M, Dm, I, Dt. On rocks, rotten wood, alder trunks, in open rocky tundra communities and on rocky slopes. Common on igneous rocks and Cambrian dolomites (usually at rock bases) while extremely rare on marls.
- O. obtusifolium* – 10. On xeric SW-faced rocky slope, on dry rotten willow branch and on strongly rotten wood.
- O. pellucidum* – 8, 12; L, Dm. On dry exposed surface of cliffs and boulders, rare.
- Paludella squarrosa* – 9. Sporadic on hummocks in bogs in valleys and in *Betula exilis*-dominated communities in hollows.
- Plagiobryum demissum* – 9. Single collection from palsa bog in Eriechka River valley, on eroded surface of turf hillock.
- Plagiomnium curvatulum* – 1-13. In moist turf-covered depressions among boulders and at cliff bases, in cottongrass-dominated tundra, willow and alder shrub communities, and *Betula exilis*-dominated communities, in various soil niches and in other moist and shaded disturbed microhabitats.
- P. ellipticum* – 9. Two collections from *Betula exilis*-dominated communities in hollows, dissecting terrace of river valley.
- P. medium* – 9, 11. Two collections in larch forests with alder shrubs near brooks.
- Plagiopus oederianus* – 8, 10; L. Occasionally occurs on moist shaded bases of cliffs and boulders in mesic forests and in alder shrub communities.
- Plagiothecium berggrenianum* – 9. On large hummocks and turf hillocks with *Betula exilis*, as an admixture in tufts of *Dicranum elongatum* and with various pleurocarpous mosses and hepatics in moist, shaded soil niches and crevices.
- P. laetum* – 9. In shaded niches in turf wall of a gutter; in *Betula exilis*-dominated community on large turf hummock in bog in river valley; on shaded rotten wood in forests.
- Platydictya jungermannioides* – 4, 7; L. Sporadic in shaded soil pits and in cliff niches.
- Pleurozium schreberi* – 11. Locally abundant in mesic, rather close strips of larch stands.
- Pogonatum urnigerum* – 1, 5; I, Dt. Widespread on bare ground and rocky slopes in places where igneous rocks outcrop.
- Pohlia andrewsii* – 1, 11. On slope of Nyamakit Mt., in moist place with late snow melting, on moist fine soil; in shaded soil niche under roots of fallen trunk in forest.
- P. cruda* – 1, 4-12; L, I, Dt. In shaded niches at cliff bases, in rocky tundra on igneous rocks, on shaded rocky slopes and eroded slopes at river terraces, on eroded turf hillocks, in various soil niches in forests.
- P. drummondii* – 1, 4, 6, 9. Occasionally occurs on bare ground in rocky tundra on the top plateau of Nyamakit Mt., on wet fine soil below snow beds in areas where Proterozoic rocks outcrop, on eroded tops of turf hillocks.
- P. elongata* var *greenii* – 1; I. Single collection from *Cassiope*-

- dominated rocky tundra in places with late snow melting, on spot of bare soil.
- P. nutans* – 7, 9, 10, 11. Occasionally occurs in forests on litter, rotten logs and eroded humous soil on upturned roots of fallen trees.
- P. prolifera* – 9. Single collection from eroded slope of the river terrace.
- P. wahlendbergii* – 2, 4, 6, 9, 11. Abundant along brooks running from melting snow fields, in willow shrub communities on wet ground below snow beds, occasionally occurs along stream and river banks.
- Polytrichastrum alpinum* – 1, 9; I. Common in dry rocky tundra on slopes of Nyamakit Mt. Outside it, the species was found on palsa bog in Eriechka River valley, on eroded slope of turf hillock.
- P. septentrionale* – 1; I. On moist fine soil in place with late snow melting.
- Polytrichum jensenii* – 13. On moist turf on the bank of drained small lake in Eriechka River valley.
- P. juniperinum* – 1, 9. In rocky tundra near the top of Nyamakit Mt. and on eroded tops of turf hillocks.
- P. piliferum* – 1. In dry rock field on the slope of Nyamakit Mt.
- P. strictum* – 9. On large hummocks and turf hillocks with *Betula exilis* on the edges of polygonal bogs.
- Pseudobryum cinclidioides* – 11. Single collection from boggy terrace of Arylakh Creek.
- Pseudocalliergon brevifolius* – 1-13. Common in rich fens, minerotrophic bogs and polygonal bogs on terraces, where it mostly occupies wet depressions.
- P. trifarium* – 7, 9. Sporadic in the same habitats as the former species, abundant in wet depressions in minerotrophic polygonal bogs.
- P. turgescens* – 2-13. Common in all types of bogs, often dominates in wet polygons in bogs on river terraces. Frequently occurs in wet tundra, on pebbly banks, and in bryophyte communities below snow beds.
- Pseudoditrichum mirabile* – 9. Single collection from the base of slope of Eriechka River valley, where it grew on a spot of fine soil covered by pioneer bryophytes (*Distichium* sp., *Ditrichum flexicaule*, *Myurella julacea*, *Orthoheciium chryseon*, *Blepharostoma trichophyllum*, etc.) in *Cassiope*-dominated community, indicating rather late snow melting.
- Pseudoleskeella catenulata* – 2-12; L, M, Dm. Widespread on dry exposed boulders of white Proterozoic rocks and other calcareous sedimentary rocks, on rocky slopes, on cliff bases and on dry exposed wood on these slopes.
- P. rupestris* – 7, 8, 10, 12; L, M, Dm. Occasionally occurs on shaded bases of cliffs.
- P. tectorum* – 7, 8, 10; L, M. Occasionally occurs on ledges and bases of dry cliffs. Once collected on exposed dry wood.
- Psilopilum laevigatum* – 13. Single collection from moist turf on the bank of drained small lake in Eriechka River valley.
- Pterygoneurum ovatum* – 3, 5, 8, 10; L, M. Occasionally occurs on boulders covered by calcareous fine soil, on dry exposed rocky slopes, in steppoid communities, on ledges of Proterozoic dolomite and marl cliffs.
- Ptilium crista-castrensis* – 11. Occasionally occurs in rather close mesic strips of forests.
- Pylaisia polyantha* – 8, 10. Two collections from dry rotten logs on exposed slopes of river valley.
- Racomitrium lanuginosum* – 1, 4, 5, 7, 10; L, M, 4, 5. Common in mountain tundra on ijolite and dolerite outcrops, occasionally occurs also in *Dryas*-dominated mountain tundra on Proterozoic sedimentary rocks. Dominates and forms pure covers on turf hillocks in the minerotrophic bog in creek canyon.
- Rhizomnium andrewsianum* – 1, 7. In pioneer bryophyte community near the margin of bare ground spot on rocky tundra on the top plateau of Nyamakit Mt., in minerotrophic bog on slope of calcareous plateau; as an admixture in polydominant bryophyte communities.
- R. pseudopunctatum* – 9. On turf near the bank of dried small lake.
- Rhytidium rugosum* – 1-13; L, M, Dm, I, Dt. Common on mesic rocky soil in rock fields, near cliff bases, in open forests, and *Dryas*-dominated mountain tundra, often grows as an admixture in moss cover in disturbed places, on hummocks and hillocks, in alder communities, etc.
- Saelania glaucescens* – 9. Single collection from palsa bog in Eriechka River valley, in shaded niche on slope of dry turf hillock.
- Sanionia uncinata* – 1-13; L, I, Dt. Throughout the territory, common in most types of ecotopes with disturbed vegetation, excepting well drained rocky tundra, rocky deserts and most types of bogs. Usually grows as an admixture to other bryophytes, but often dominates on disturbed soil below snow beds; on Cambrian dolomites it grows closely to the melting snow together with some *Bryum* species.
- Schistidium abrupticostatum* – 4; L. Common on placer below snow bed, forming narrow belt along its margin, where snow melts in July.
- S. andreaeopsis* – 1-8, 10, 12; L, M, Dm, I. Common and abundant on calcareous rocks in mountain rocky deserts, where sedge tufts alternate with extensive gravelly spots, on rock fields, in *Cassiope*-dominated communities in places with late snow melting. Most common on Cambrian dolomites, somewhat less abundant on white Proterozoic rocks and ijolites, and rather rare on marls.
- S. boreale* – 1-10, 12; L, M, Dm, I, Dt. Common in same habitats with previous species, and also in places where Proterozoic marls outcrop, including rocky places with late snow melting, also abundant on boulders in xeric rocky slopes, in mountain tundra and deserts, on cliffs, etc.
- S. frigidum* – 1, 5, 10; I, Dt. Common epilithe in rock fields in places where igneous rocks outcrops.
- S. frisvollianum* – 2, 4-6, 8, 10, 12; L, Dm. Widespread epilithe on white Proterozoic limestones and especially on Cambrian dolomites, on rocks and boulders.
- S. papillosum* – 1, 4, 7; L, I, Dt. Widespread in rocky tundra and in places with late snow melting, grows on fine soil and moist igneous rocks, occasionally occurs on white Proterozoic limestone.
- S. pulchrum* – 1-10, 12; L, M, Dm, I, Dt. Common epilithe on all studied types of rocks, most abundant on cliffs composed of Proterozoic limestone. Also occurs on fine soil among rocks on rocky slopes, on cliff ledges and niches, etc.
- S. sordidum* – 2, 4, 6, 7; L, M, 3. Frequently occurs on rocks, fine soil and rotten logs below snow beds, once collected also in place with late snow melting. Mostly on Proterozoic limestone.
- S. submuticum* – 2, 4, 7, 10; L, M, Dm. Occasionally occurs on cliff ledges and on boulders composed of calcareous rocks, more frequent near snow beds.
- Scorpidium cossonii* – 9. Occasionally occurs in polygonal bogs on river terrace.
- S. revolvens* – 1, 2, 4, 9, 11, 13. Widespread but not abundant

- in wet conditions in alpine bogs below snow beds, in polygonal bogs on river terraces, in wet hollows in lower part of watershed slopes, in boggy forests and minerotrophic bogs on plateau slopes. Relatively abundant in moist depressions on Nyamakit Mt. top plateau. Decreases in abundance in areas where Cambrian dolomites outcrop.
- S. scorpioides* – 9, 11. In wet depressions in minerotrophic polygonal bogs and on boggy banks of lakes on river terrace.
- Seligeria brevifolia* – 3, 5, 7, 10; L, M. In spotty *Dryas*-dominated tundra at places where red Proterozoic marls outcrop, grows on shaded and moist side surfaces of gravel submerged into ground on loamy spots, often with *Fissidens viridulus*; in shaded niches of cliffs composed of marls and, rarer, of white Proterozoic limestone.
- S. campylopoda* – 10; L. Two collections from shaded crevices of limestone cliff
- S. diversifolia* – 7, 10; L, M. Two collections from shaded niches near cliff bases, several plants.
- S. donniana* – 4, 10; L. Three collections from crevices of moist shaded siliceous limestone cliffs.
- S. oelandica* – 3, 5, 7, 10; M (Ellis *et al.*, 2014a). Frequently occurs in cottongrass-dominated minerotrophic bogs on gentle slopes of plateau composed of red Proterozoic marls, grows on gravel, loamy ground and plant remnants covered by calcareous tuff crusts on spots of loamy ground, reaching a remarkable abundance.
- S. polaris* – 1, 3-5, 8-10; L, M, I. Relatively abundant on top plateau of Nyamakit Mt., grows on gravel and fine soil on barren spots. In most part of the territory composed of calcareous rocks, it grows similarly with the former species, but prefers areas where white Proterozoic limestone outcrops. It often occurs on gravel in small brooks and at bases of boulders. In some ecotopes, both *S. polaris* and *S. oelandica* occur, though these species always grow separately.
- S. pusilla* – 5; M. Single collection from shaded crevice of limestone cliff.
- S. trifaria* – 4, 10; L. In moist and shaded cliff crevices and on shaded surfaces of boulder bases, just above soil, in forests. Sometimes forms extensive pure mats in places with oozing water.
- S. tristichoides* – 4, 7, 10; L, M. At places where red Proterozoic marls outcrop, in spotty *Dryas*-dominated tundra, on loamy spots, on shaded and moist side surfaces of gravel submerged into soil, often with *Fissidens viridulus* and *Seligeria brevifolia*; in shaded niches of cliffs composed of white Proterozoic limestone, and, rarer, of marls.
- Sphagnum warnstorffii* – 9. Two collections from large hummocks under close canopy of *Betula exilis* on the edge of polygonal bog.
- S. orientale* – 9. Two collections from large hummocks under close canopy of *Betula exilis* on the edge of polygonal bog.
- Splachnum luteum* – 9. On soil slide on steep N-facing slope, on organic remnants.
- S. sphaericum* – 9. In wet depression in minerotrophic bog, on wet reindeer dung.
- S. vasculosum* – 1. In mountain tundra, on wet organic remnants.
- Stegonia latifolia* – 1, 3, 7, 8, 10; L, M, I. On calcareous ground on steep xeric rocky slopes, on boulders, covered by calcareous fine soil, on fine soil layer on cliff ledges composed mostly of red marls.
- S. pilifera* – 10. On steep xeric rocky slope between cliffs, on calcareous ground.
- Stereodon bambergeri* – 1-13; L, M, Dm, I. Common in rocky mountain tundra and deserts, in rock fields, in polydominant bryophyte communities in various disturbed places, on pebbly river banks, *etc.*, mostly grows intermixed with other bryophytes.
- S. hamulosus* – 6, 7; L. In rocky tundra, in shaded niche near boulder and on soil near cliff base.
- S. holmenii* – 11. On hummocks in larch stand.
- S. procerrimus* – 1, 3-5, 7, 8, 10; L, M, Dm, I. On cliff ledges and cliff bases, rarer in rocky tundra and on eroded hummocks in sedge and *Dryas*-dominated tundra. Abundant on red marl rock outcrops, sporadic in other habitats.
- S. subimponens* – 9. Widespread on eroded slopes of turf hilllocks and in *Betula exilis*-dominated communities along hollows.
- S. vaucheri* – 2-12; L, M, Dm. Common in open mesic to xeric larch stands, on xeric rocky slopes, and rock fields, on boulders and on cliff bases, in various disturbed places, on larch trunk bases and upturned roots, *etc.*
- Straminergon stramineum* – 9. On shaded bottom of turf ditch and on top of turf hillock in polygonal bog on river terrace.
- Syntrichia norvegica* – 7. In willow shrub community near place with late snow melting, on rocky soil.
- S. ruralis* – 1-13; L, M, Dm, I, Dt. Frequent throughout the territory, grows on exposed rocky slopes and in rock fields, at cliff bases and in rocky mountain tundra, in disturbed places, on tree trunk bases and on dry rotten logs.
- Tetraphis pellucida* – 11. In relatively close forest, on rotten stumps, locally abundant.
- Tetraplodon mnioides* – 1-13. On relatively dry organic remnants in wide diversity of habitats.
- T. pallidus* – 12. In moss-dominated community on dry calcareous gravel deposits near cliff base, on organic remnants.
- T. paradoxus* – 7, 8, 10. Four collections, each of few plants, from partly turf-covered rock fields, eroded soil and tops of turf hillocks.
- Thuidium assimile* – 9. Occasionally occurs on humous soil in willow shrub communities in flood plane and in moist hollows with *Betula exilis* and willow shrubs at the base of the watershed slope.
- T. recognitum* – 9. On disturbed humous soil in willow shrub community in place with late snow melting on steep N-facing slope of watershed; on drained edge of flood terrace slope.
- Timmia austriaca* – 12; Dm. In shaded cliff niche at the base of cliff, on fine soil.
- T. comata* – 1-13; L, M, Dm, I, Dt. Widespread in polydominant bryophyte communities in various disturbed places with weakened competition in bryophyte cover, *i.e.*, on steep rocky slopes, eroded river banks, in flood plains, *etc.*
- T. megapolitana* – 4; L. Single collection from shaded niche at the base of limestone cliff, on moist fine soil.
- T. norvegica* – 4, 8-10; L. In shaded niches below limestone cliffs and among boulders, on moist rocky slopes, in polydominant bryophyte communities in various disturbed places.
- T. sibirica* – 2, 4, 6-10, 12; L, Dm. Widespread in moist and wet conditions on calcareous ground: on wet eroded spots near snow beds, on cliff ledges with oozing water and at cliff bases, along brooks and in Eriechka River flood plain, in various disturbed places.
- Tomentypnum nitens* – 1-13. Common species, dominating in a number of various habitats: in boggy forests among hummocks, on rather dry periphery of polygons in polygonal bogs, in hollows on watershed slopes, in wet cottongrass-dominat-

- ed tundra, in minerotrophic bogs and rich fens on plateau slopes, in willow shrub communities and in wet moss-dominated alpine meadows below snow beds, in disturbed communities and in various types of vegetation associated with flood plain, *etc.* Often forms extensive pure mats. Some specimens, mostly from hollows, have slightly curved leaves and may be taken for *T. falcifolium*, but specimens kept under this name in LE have mostly much stronger falcate leaves.
- Tortella alpicola* – 3-10; L, M. Widespread and sometimes common in crevices and cavities of cliffs and boulders composed of Proterozoic rocks. Occasionally occurs on rotten logs.
- T. arctica* – 1-5, 7, 10; L, M, I, Dt. Common on ijolites in rocky mountain tundra, occasionally occurs in mountain rocky deserts, rocky tundra, rich fens and minerotrophic bogs on calcareous rocks and fine soil.
- T. densa* – 12; 3. In rock field near cliff base, in xeric bryophyte community on calcareous ground.
- T. fragilis* – 1, 3-10; L, M, Dm, I, Dt. On turf-covered rocks and in cliff crevices, on humous soil in rock fields and in various disturbed places, or eroded slopes of turf hillocks, and on rotten logs.
- T. tortuosa* – 2-8, 10, 12; L, M, Dm. On rocks and rocky soil in spotty *Dryas*-dominated mountain tundra, mostly not exceeding timberline.
- Tortula cernua* – 9. On eroded slopes of Eriechka River first terrace, on loamy ground.
- T. hoppeana* – 3. Single collection from ledge of red marl cliff covered by the fine soil.
- T. leucostoma* – 8-11; L, M. Widespread on eroded slopes of river terraces, on eroded creek banks, occasionally occurs on humous soil in cliff niches.
- T. mucronifolia* – 1, 3-10, 12; L, M, Dm, I. Common on eroded slopes and creek banks, on bare spots in mountain tundra, in cliff niches and crevices, in various disturbed places, on silt alluvium, *etc.*
- Trichostomum arcticum* – 1-8, 10, 12; L, M, Dm, I. Common in rock fields and rocky tundra in places with late snow melting, in upper parts of creek hollows, near snow beds, *etc.*, on fine soil on gravelly spots. Most common in places where Cambrian dolomites outcrop, often forms an extensive pure mats.
- T. crispulum* – 1-10, 12; L, M, Dm, I. Widespread in dry rocky habitats, *i.e.*, on cliff ledges, boulders, on rocky soil in dry tundra and in rock fields, on steep rocky slopes, on eroded calcareous ground, *etc.*
- Warnstorfia exannulata* – 9, 11, 13. Occasionally occurs along wet turf banks of drained small lakes.
- W. pseudostraminea* – 9, 11. On bottom of dry lake and on hummock in hummocky bog in river valley.
- W. tundrae* – 9. In small lakes in river valley, locally common, often forms pure mats submerged in water.
- Weissia brachycarpa* – 10; L. In rock field below cliff base, on cryophilic steppe-like community, on dry calcareous ground.

#### DISCUSSION

Eleven liverwort species are new for the Taimyr Autonomous District. The discovery of arctic (*Lophozia rubrigemma*), arctomontane (*Pseudolophozia debiliformis*), montane (*Mylia taylorii*), arctoboreomontane (*Biantheridion undulifolium*) and circumboreal (*Pellia endiviifolia*) hepatics in the studied area was quite predict-

able. It was recently shown that these species are not rare in the arctic and northern mountains of Russia (Konstantinova *et al.*, 2009).

The most impressive finding is *Lejeunea alaskana*. It was described from Alaska (Schuster & Steere, 1958), and its distribution remained insufficiently known, being mainly arctomontane Amphi-Pacific. It was recorded recently from Kolyma Upland in Magadan Province (Bakalin *et al.*, 2012) and from Kodar Mts. in Trans-Baikal Territory (Afonina & al., 2013) in Russia. The localities of *Lejeunea alaskana* in Taimyr District are probably the westernmost ones.

The distribution of *Isopaches decolorans* seems to be poorly understood. It was regarded as a rare arctomontane species and even included in the Red Data Book of Russia (Bardunov, 2008). However, the species frequency may be underestimated due to its small size which may cause it to be overlooked in the field. Furthermore, recent new records indicate a wider distribution. This species is disjunctively distributed in North Holarctic and very rarely spreads southward by mountain ranges. Within Asia it was recorded from several localities in Himalaya, including its westernmost spurs in Yunnan (Zhang *et al.*, 2013), as well as for the Caucasus (Ignatova *et al.*, 2008), Verkhoyansky Range (Sofronova, 2005), Sredinny Kamchatsky Range (Bakalin, 2009) and Yamal Peninsula (Potemkin, 1993).

The record of *Lophozia silvicoloides* is the second one from Siberia. This species is more or less common in the Russian Far East and Japan, as well as in western Alaska (Bakalin, 2005); these areas are under strong influence of Pacific Ocean wet air masses (with westernmost in Magadan Province). The species is also known in the northern Amphi-Atlantic areas (Svalbard in Norway, Murmansk Province in Russian North-West: Korableva *et al.*, 2008; Bakalin, 2005). The record from Taimyr may either reflect a slight wetting influence of the Arctic Ocean or represent the relict or late Tertiary when the coast of Arctic Ocean was ice-free. It is worthy to note that the species was also recorded by Sofronova (Sofronova & Sofronov, 2012) for the Republic of Yakutia; this finding is similarly unusual from a phytogeographic point of view. Unfortunately, in the course of the present study we were unable to restudy the specimens on which this record was based.

There is some uncertainty in the identification of *Nardia japonica* which is recorded for the first time for Taimyr Autonomous District. It can be separated from the close species, *N. lescurii* (Aust.) Underw. by oil-body structure (homogenous vs. granulate brownish). In the material from Taimyr, oil-bodies were represented by unclear residues; this precludes a doubtless identification. *Nardia lescurii* was found recently in Magadan Province (Bakalin, unpublished) as well as in Japan (Furuki, 1997), and the present collection from Taimyr may also belong to this species rather than to *N. japonica*.

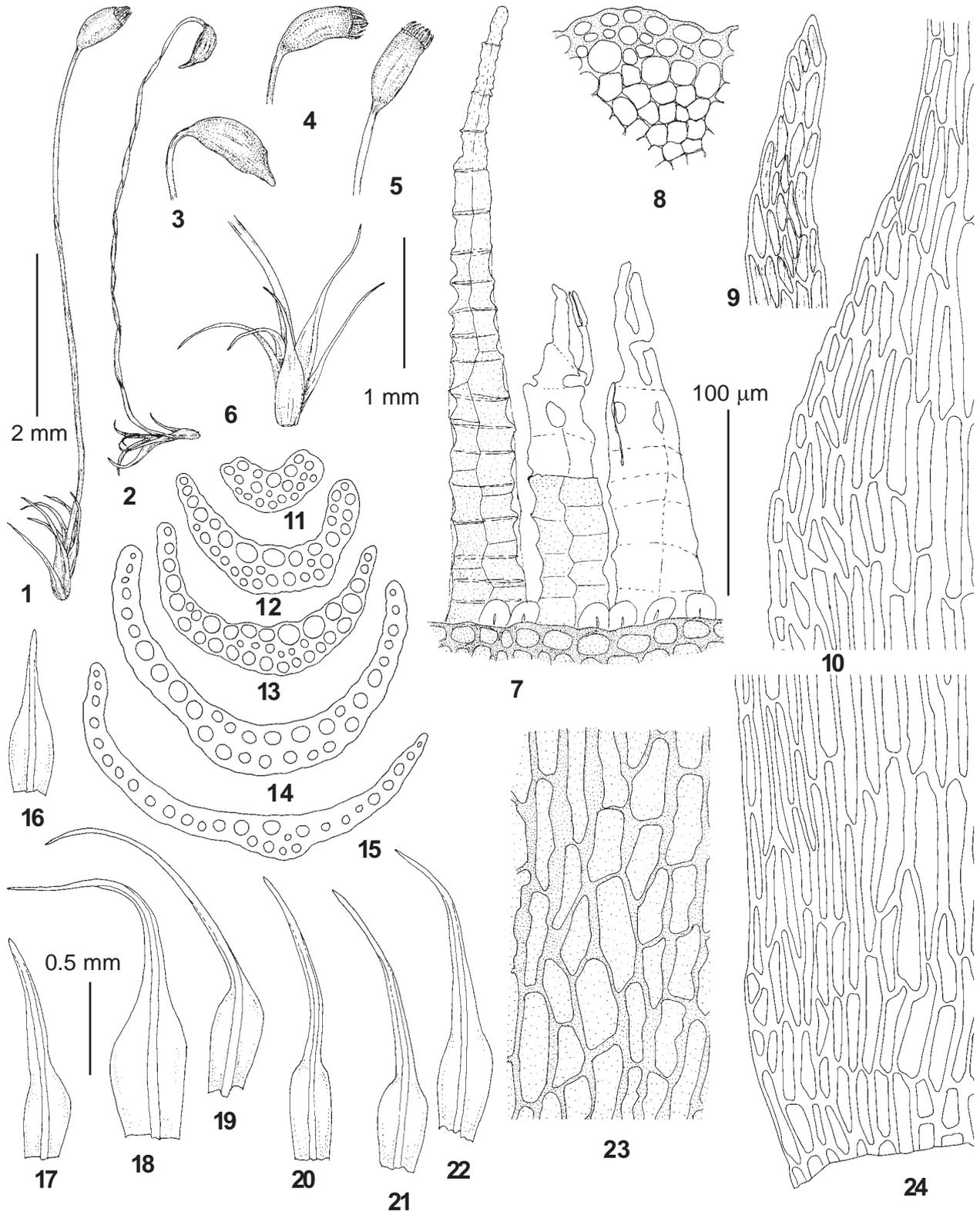


Fig. 10. *Pseudoditrichum mirabile* Steere & Z. Iwats. (from: Russia, Krasnoyarsk Territory, Taimyrsky Autonomous District, Eriehka River upper course, Fedosov 13-3-1028, MW): 1, 2 – habit, dry; 3-5 – capsules; 4 – habit, wet; 7 – peristome; 8 – stem transverse section; 9 – cells in apical part of leaf; 10 – cells at leaf shoulder; 11-15 – leaf transverse section; 16-22 – leaves; 23 – exothecium; 24 – basal laminal cells. Scale bars: 2 mm for 1-2; 1 mm for 3-6; 0.5 mm for 16-22; 100 µm for 7-15, 23-24.

The finding of *Scapania sphaerifera* could be expected in Taimyr, if its general distribution patterns is taken into account. It was described from Murmansk Province in 1936 and for a long time considered as an endemic of that territory. However, since its first finding it was not collected again either in the *locus classicus* or elsewhere in the region despite a special search (Konstantinova, pers. com.) and might be regarded as extinct in this area. The species is included in the Red-list of Russia (Bardunov, 2008). At the same time, *Scapania sphaerifera* was revealed recently in a number of localities in Asian Russia: Altai Republic, Teletskoe Lake (Schuster & Konstantinova, 1996), Krasnoyarsk Territory, Western Sayan Mts. (Konstantinova & Vasiljev, 1994), Tuva Republic, Eastern Sayan Mts (Váňa & Soldán, 1985), Trans-Baikal Territory (Afonina & al., 2012), Irkutsk Province and Buryatia Republic, Khamar-Daban Range (Kazanovsky & Potemkin, 1995; Konstantinova & Savchenko, 2008), Yakutia, Verkhoyansky Mt. Range and Udokan Range (Sofronova, 2005), Chukotsky Autonomous District, Kamchatsky and Khabarovsk Territories, Magadan and Sakhalinskaya Provinces, Primorsky Territory (Choi & al., 2012a); it was found also in South Korea (Choi & al., 2012b). The new locality in Taimyr District is probably the northernmost one.

*Herbertus arcticus* (Inoue et Steere) Schljakov was described from Arctic Alaska by Steere and Inoue (1978) as *Herbertus sakuraii* ssp. *arcticus* Inoue et Steere, and then elevated to species rank by Schljakov (1982). Later Konstantinova et al. (1992) regarded it as a form of *H. sakuraii* (= *H. dicranus*), and then the same point of view was repeated by Konstantinova, Bakalin et al. (2009). Juslen (2006) did not mention this name in the revision of Asian *Herbertus* (Juslen, 2006). However, we suppose that this taxon deserves recognition at species rank due to: 1) strong geographic isolation of its localities (Arctic Alaska, Chukotka, Magadan Province and Taimyr) from more southern area of *H. dicranus* (its closest localities are in Amurskaya Province and Primorsky Territory), 2) sinus descending to 1/2-3/5 of leaf length (versus sinus up 3/4-4/5 of leaf length), 3) ill-defined vitta that is commonly interrupted in lower fourth of the lobe (versus vitta reaching upper third of the lobe), and 4) slightly inflated undivided part of leaves (versus lamina almost flat).

Some moss records are new for the territory, including *Seligeria oelandica*, *Plagiothecium svalbardense* with closest known locality on Chukotka Peninsula, highly disjunctive *Didymodon giganteus*, *Oreas martiana* and xeric, mostly Mediterranean *Didymodon luridus*. For these species (excepting *Oreas*) new localities are second or third known in Russia. These records are discussed by Ellis et al., 2014a, b. Other interesting species, e.g. *Bryoerythrophyllum latinervium*, *Funaria polaris*, *Seligeria* spp., etc. were discussed by Fedosov et al., 2011. The record of *Pseudoditrichum mirabile* is, without doubt, the most interesting one among mosses in the studied area. This small

moss was hitherto known only from type locality in Great Bear Lake region, NWT, Canada (Steere & Iwatsukii, 1974). In the field it was taken for *Dicranella*, but the study of specimen under stereomicroscope revealed unusual for *Dicranella* whitish exostome color and scarious translucent endostome in most mature capsules. We provide the description of species based on Siberian plants.

***Pseudoditrichum mirabile*** Steere & Z. Iwats., Canadian Journal of Botany 52(4): 701–706, f. 1–46. 1974. Figs. 10, 12–14.

Plants forming loose tufts or growing by separate plants among other mosses yellowish in upper part (distal parts of leaves), brownish below. Stems erect or ascending, short, 0.1–0.2 (–0.3) cm, not branching, ± fragile, without hyalodermis and central strand, cortical cells in (1–) 2 layers thick-walled, brown, medullar cells thin-walled. Leaves loosely appressed and slightly incurved or somewhat flexuose when dry, occasionally one-sidedly turned, erect-spreading when wet, concave proximally, (1.25–)1.4–2.0(–2.2)×0.22–0.42 mm, becoming longer in distal part of shoot, broadest at proximal 1/4–1/3, from ovate to obovate base ± abruptly narrowed into long triangular-lanceolate to subulate apical part, acuminate at apex, mucronate; costa ± clearly delimited from lamina, 40–85 µm wide at base, of equal width throughout the leaf, slightly narrowed or widened toward the apex, percurrent or shortly to ±longly excurrent, filling the apices of upper leaves, in transverse section weakly differentiated, slightly concave on ventral surface, mostly with larger ventral cells, or with small dorsal stereid band in middle part of leaf, smooth on both sides; lamina unistratose proximally, mostly 2-stratose distally; margins plane, unistratose proximally, entire or slightly uneven proximally and distally, serrulate due to protruding cell angles at constriction (like in *Seligeria donniana*); laminal cells thick-walled, yellow to brownish at leaf base, long rectangular, (40–)50–80(–85)×7–12 µm throughout the leaf, basal marginal cells somewhat shorter and narrower, 25–35×5–7 µm, along margin at constriction rhombic, 12–20×7–10 µm, smooth. Specialized asexual reproduction not seen. Dioicous. Seta red or pale reddish-yellow, twisted when dry, 5–7 mm. Capsule 0.7–0.8 mm, shortly ovoid, inclined, horizontal to slightly turned downward, curved-asymmetric, slightly longitudinally furrowed, contracted below the mouth, pale brown; annulus of 1 row of inflated cells; operculum 0.2–0.3 mm, rostrate; peristome double, with 16 exostome teeth situated opposite 16 endostome segments; exostome teeth ca. 300–340 µm long, white, prostrate and curved when dry, triangular, composed of two cell rows on outer surface, reticulate proximally, finely papillose distally, with strong trabeculae on inner side; endostome segments ca 180 µm long, wider than exostome teeth, forming low basal membrane, filmy, translucent, in upper part irregularly perforated or splitted, smooth on both sides. Spores 13–16 µm, smooth or finely papillose.

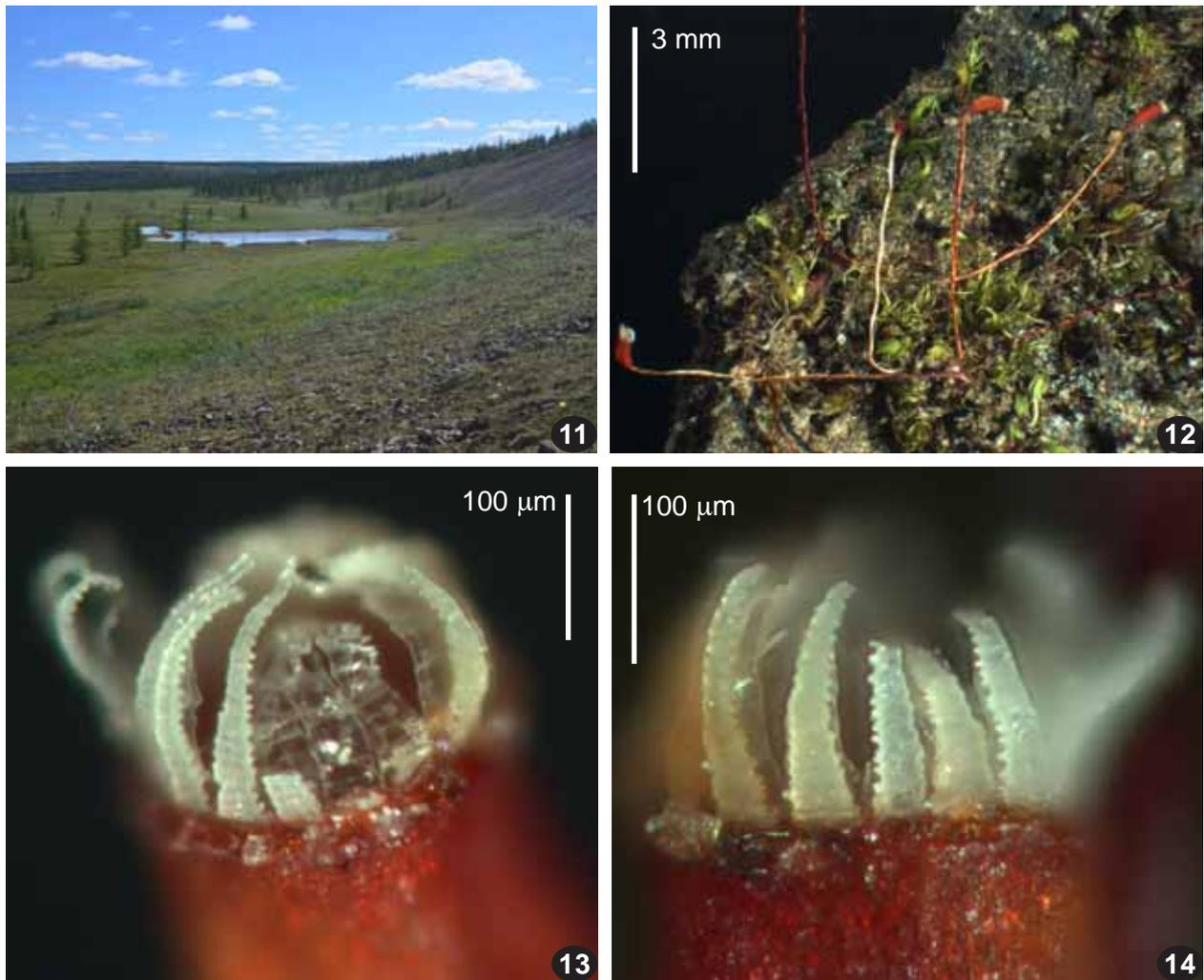


Fig. 11– habitat of *Pseudoditrichum mirabile*. Figs.12-14. *Pseudoditrichum mirabile* Steere & Z. Iwats. (from: Russia, Krasnoyarsk Territory, Taimyrsky Autonomous District, Eriechka River upper course, Fedosov 13-3-1028, MW): 12 – habit, dry; 13-14 – peristome.

Generally, *Pseudoditrichum mirabile* can be characterized as an extremely rare Hypoarctic pioneer calciphilous species with broadly Beringian distribution. Its taxonomic position is ambiguous due to a peculiar combination of gametophyte similar to *Ditrichum* or *Dicranella* and double peristome looking opposite. It will be discussed separately (Fedosov *et al.*, in progress). The strongly disjunctive distribution and an occurrence in ecotopes with weakened competition suggest its relic condition.

#### DIFFERENCE IN EPILITHIC MOSS FLORA REGARDING ROCK TYPES

The remarkable difference between bryophyte floras and composition of bryophyte communities on different types of rocks was observed in the upper course of Eriechka River. Igneous rocks have a limited distribution within the studied area. Four hepatic species (*Clevea hyalina*, *Gymnomitrium concinnatum*, *Marsupella apiculata*, and *Tetralophozia setiformis*) and 13 mosses (*Andreaea rupestris*, *Bartramia pomiformis*, *Blindia acuta*, *Drepanocladus sendtneri*, *Encalypta affinis*, *Fissidens osmun-*

*doides*, *Grimmia funalis*, *G. longirostris*, *Hymenoloma crispulum*, *Oligotrichum hercynicum*, *Pohlia elongata* var. *greenii*, *Polytrichastrum septentrionale*, and *Schistidium frigidum*) were found only on ijolites and dolerites. Some of these species are known from the study area from a single collection, but they have similar distribution in terms of rock types in Anabar Plateau as a whole.

Differences among various calcareous rocks were found to be rather sharp. Since hepatics were not recognized when collecting and data on their distribution may be incomplete, only saxicolous moss flora is discussed below, taking into account some additional data from other localities of the Anabar Plateau (Fedosov *et al.*, 2011). These additional data include saxicolous moss flora of Afanas'evskie Lakes (ca. 70 km northward of the study area), where Cambrian dolomites are widespread, as well as less thoroughly studied epilites of Kotuykan and Kotuy River valleys southward of the study area (see Fedosov *et al.*, 2011), where both white Proterozoic limestone and Cambrian dolomites are common.

Proterozoic siliceous terrigenous-marine limestone and Cambrian marine dolomites show the most contrast in saxicolous moss composition. For example, rocky ecotopes in areas of Cambrian dolomite outcrops almost lack *Seligeria* species. Only *Seligeria polaris* grows there along brooks on gravel covered by calcareous crusts. Even *Seligeria campylopoda* which is rather frequent in Anabar Plateau and inhabits ijolites, pyroxenites, calcareous sandstones, basalts and melilite gneisses, does not settle on Cambrian dolomites.

Contrary to Cambrian dolomites, Proterozoic limestone houses 12 *Seligeria* species. Most of them are not rare in suitable ecotopes (*S. brevifolia*, *S. pusilla*, *S. donniana*, *S. trifaria*, *S. oelandica*, *S. polaris*, and *S. campylopoda*). On siliceous Proterozoic limestone, such species as *Grimmia anodon*, *Tortella alpicola*, *Stegonia latifolia*, *Ctenidium molluscum*, *Bryum teres*, *Didymodon asperifolius*, *D. fallax*, and *Racomitrium lanuginosum* are not rare; some of them dominate on cliffs, rock fields and in xeric steppe-like communities. Most of these species are totally absent on Cambrian dolomites. At the same time, on the latter rock type, such species as *Hymenostylium recurvirostrum*, *Gymnostomum aeruginosum*, *Molendoa sendtneriana*, *Orthotrichum iwatsukii*, and *Encalypta longicolla* are much more common than on Proterozoic rocks.

Rare xeric species, e.g., *Didymodon johansenii*, *Pseudocrossidium obtusulum*, *Tortula cuneifolia*, etc. and also rather frequent in the study area *Conardia compacta*, *Tortella densa* and *Tortula obtusifolia* were also revealed on Cambrian dolomites. Composition of xeric mosses on Proterozoic limestone is quite different: *Grimmia tergestina*, *Indusiella thianschanica*, *Jaffuelobryum latifolium*, *Microbryum starckeanum*, *Pterygoneurum ovatum* (including var. *humile* (Amann) Podp.), *Syntrichia caninervis*, and *Weissia brachycarpa* occur there. Absence of some of these species on the Orulgan Range in Yakutia discussed by Ignatov *et al.* (2014) is obviously caused by a lack of calcareous rock outcrops in that area.

The difference between saxicolous bryophyte floras is apparently caused by rock composition. Calcium oxide content in limestone is much higher (about 50%), while in dolomites it does not exceed 30%. Notable silica admixture can affect bryophyte composition as well.

Proterozoic marls and Proterozoic limestone were found to be rather similar in moss species composition, and several chemical analyses have also shown that their oxide spectrum is similar. Since marl is less solid, it does not form extensive rock outcrops with vertical cliffs, therefore not providing a variety of microhabitats for bryophytes. Apparently due to the same reason bare rock surfaces of marl almost lack epilithic bryophytes. However, pioneer bryophyte composition on cliff ledges and in shaded niches of marl outcrops, as well as on rock fields composed of this rock type, does not differ significantly from these on white limestone.

Only few species, i.e., *Bryum teres*, *Didymodon fallax* and *Seligeria pusilla* were found only on marls in the study area, but they also occur on Proterozoic limestone in other localities of the Anabar Plateau. Interestingly, two rare species, *Seligeria oelandica* and *Didymodon giganteus* occur only in fens developed on marls.

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