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MOSS FLORA OF SETTE-DABAN RANGE (EAST YAKUTIA)

ФЛОРА МХОВ ХРЕБТА СЕТТЕ-ДАБАН (ВОСТОЧНАЯ ЯКУТИЯ)

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Abstract

Moss flora of the Sette-Daban Range is studied. The range is constituting the westernmost part of Verkhoyansk Mountains in its southern part, the studied area being between 62°45' and 63°14' latitude. The range is composed by limestone parts in its West, intermingling at places on its East with areas with schist rocks. The annotated list of mosses includes 294 species, which is the highest number in the Verkhoyansk area, apparently due to abundance of calcareous substrates. The large limestone areas in subalpine belt have scattered populations of *Andreaeobryum macrosporum*. Other interesting species in the area include *Hydrogonium amplexifolium, H. gregarium, Struckia enervis, Hymenostylium xerophilum, Indusiella thianschanica, Scouleria pulcherrima, Blindiadelphus diversifolius, B. sibiricus, B. subimmersus*.

Резюме

Представлены результаты изучения флоры мхов хребта Сетте-Дабан. Хребет расположен на западе Верхоянской горной системы в ее южной части; район исследования охватывает территорию между 62°45' и 63°14' с.ш. В западной части Сетте-Дабан сложен известняками, а на востоке к известнякам добавляются вкрапления сланцев. Аннотированный список включает 294 вида мхов; это наиболее богатая локальная флора мхов Верхоянья, что, очевидно, связано с хорошо представленными карбонатными субстратами. Там, где в субальпийском поясе имеются скальные выходы известняков, были обнаружены рассеянные популяции *Andreaeobryum macrosporum*. Здесь также найден ряд других редких и интересных видов, в их числе *Hydrogonium amplexifolium, H. gregarium, Struckia enervis, Hymenostylium xerophilum, Indusiella thianschanica, Scouleria pulcherrima, Blindiadelphus diversifolius, B. sibiricus, B. subimmersus*.

KEYWORDS: bryophytes, phytogeography, rare species, Siberia, Russia, Verkhoyansk Mountains

INTRODUCTION

Permafrost region in Russia covers a large area in the East Siberia, and particularly in Yakutia. The vegetation types here are diverse and often fairly different from those in most regions of boreal zone, while similar to those in Chukotka, continental Alaska and southern Taimyr (Murray, 1992; Fedosov *et al*., 2011). Although the local moss floras are not very rich, with ca. 200 species in average, each new studied locality adds new species.

Recently we studied floras of Ust-Maya District (Ignatov *et al*., 2001), Yana-Adycha Plateau (Isakova, 2010), Mus-Khaya Peak surroundings (Ignatova *et al.*, 2011), Orulgan Range (Ignatov *et al*., 2014), Suntar-Khayata Reserve (Ivanova *et al.*, 2016), and Ust-Nera area (Ivanova *et al.*, 2018). Although all of them belong to the Verkhoyansk Mountain System, their moss species composition differ considerably from one place to another and all of them have their own peculiar features.

Present publication continues this series, describing the moss flora of Sette-Daban Range. This range was mentioned before in our publications in the occasion of finding there *Andreaeobryum macrosporum* Steere & B.M. Murray in 2015 (Ignatov *et al.*, 2016), and subsequently for details of its distribution (Ignatov *et al.*, 2018). However, continuously accumulated data on its bryoflora remained unpublished.

STUDY AREA

Sette-Daban Range stretches from SWW to NEE along the western edge of big and complex mountain area, the Verkhoyansky Mountain Range, extending east on Lena River for ca. 1200 km in submeridional direction. Sette-Daban Range is treated somewhat differently, from 500 to 650 km long, and ca. 100 km wide, being itself subdivided into three ranges, from west to east: Gornostakhsky (sometimes called Okraina, meaning "Edge"), Ulakhan-Bom (in Yakutia language "Big Obstacle"), and

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Fig. 1. Collecting localities on Sette-Daban Mt. Range.

Locality	Altitude, m	Latitude, N	Longitude, E
1. Western slope of Okraina Range, between Ulaakh and Nadezhda Rivers, 35–36 km of the road to Topolinoe	350–650	63°09'–63°14'	137°03'–137°08.5'
2. Western slope of Okraina Range, Nadezhda River valley	450–790	63°05'–63°09'	137°09'–137°10.5'
3. Western slope of Okraina Range, opposite 21 km of the road to Topolinoe	4200–1400	63°05'–63°10'	137°03'–137°10'
4. Upper course of unnamed creek, right tributary of Vostochnaya Khandyga River and of a brook, right tributary of Segenyakh Creek	700–1215	63°02'–63°04'	137°55'–137°54.5'
5. Valley of Segenyakh Creek 1–2 km upstream Yakutsk – Magadan Hwy	460–700	63°01'–63°03'	137°57'–137°57.5'
6. Lower course of Segenyakh Creek and left bank of Vostochnaya Khandyga River opposite Segenyakh Creek mouth	440–680	62°47'–63°04'	136°48'–137°57'
7. Right slope of Vostochnaya Khandyga River valley	450–530	63°01.5'–63°10'	138°04.5'–138°17'
8. Brooks, right tributaries of Vostochnaya Khandyga River	490–530	63°01.5'–63°10'	137°55'–138°17'
9. Valley of Sakkyryr River and its tributaries	710–1000	62°45'–63°50.5'	130°45'–138°26'
10. Right slope of Kuraanakh River valley in its lower course	625–765	63'02'–63'02.5'	138°23'–138°23'
11. Right and leaft banks of Kuraanakh River			
12. Kuraanakh River (ca. 30 km from Yakutsk-Magadan Hwy)	695–812	62°57.5'–63°01'	138°39.5'–138°28.5'
13. Upper course of Kuraanakh River, wide valley of its left tributary	1007	62°49'02"	138°56'12"
14. Kuraanakh River in uppermost course, close to Kuraanakh-Dyby Pass	1010–1550	62°48'–62°49.5'	138°56'–139°01'
15. Valley of Dyby River and its left tributary	750–1300	62°45'–62°46'	139°04'–139°05'

Skalisty (meaning "cliffy"). Its elevations reach 1800–2102 m, although most mountains are up to 1400–1500 m, and the lowermost levels are slightly below 400 m.

The delimitation of smaller ranges is somewhat indefinite due to the complex geology (Fig. 2A). The map in Fig. 1 shows collecting localities, which cover only the middle part of the Sette-Daban range, in ca. 120 km.

In the western part of the range the bedrock is represented by Paleozoic limestone, mostly metamorphosed to quite solid rocks forming high cliffs with vertical walls (Localities 1–10 in Fig. 1). Further to the east (Localities 11–15 in Fig. 1), but still within the range, the bedrock composition changes to Mesozoic sandstones and schists (Rusanov *et al.*, 1967; Andreev, 2016).

The climate in the area is severe (Table 1) and permafrost is ca. 700 m deep. The vegetation of the forest belt is composed mostly by *Larix cajanderi*, changing above 1000 m into tickets of shrubby *Pinus pumila* and mountain tundra. Successions of vegetation in river valleys start with *Chosenia arbutifolia* and then *Populus*

Table 1. Climate data in the nearest meteostations to the Sette-Daban Range localities (based on Meteotological annuary of the Yakutsk hydrometeorological centre, 1987–1990).

Meteostation	location, elev., m	t°C annual mean	t°C July mean	t°C July max	t°C Jan mean	t°C Jan min	Precipitation annual
Zapadny	450 m	–11.3	+16.5	+30.7	–41.0	–50.1	315
Teplyj Klyuch	200 m	–11.2	+17.1	+31.1	–44.0	–54.5	363
Vostochny	1100 m	–13.2	+12.6	+26.2	–36.2	–48.3	256
Agayakan	450 m	–15.1	+15.0	+29.7	–48.2	–56.2	216
Oimyakon	450 m	–15.5	+14.9	+29.4	–52.3	–57.9	154
Allakh-Yun	600 m	–11.5	+15.6	+29.8	–44.7	–54.5	303

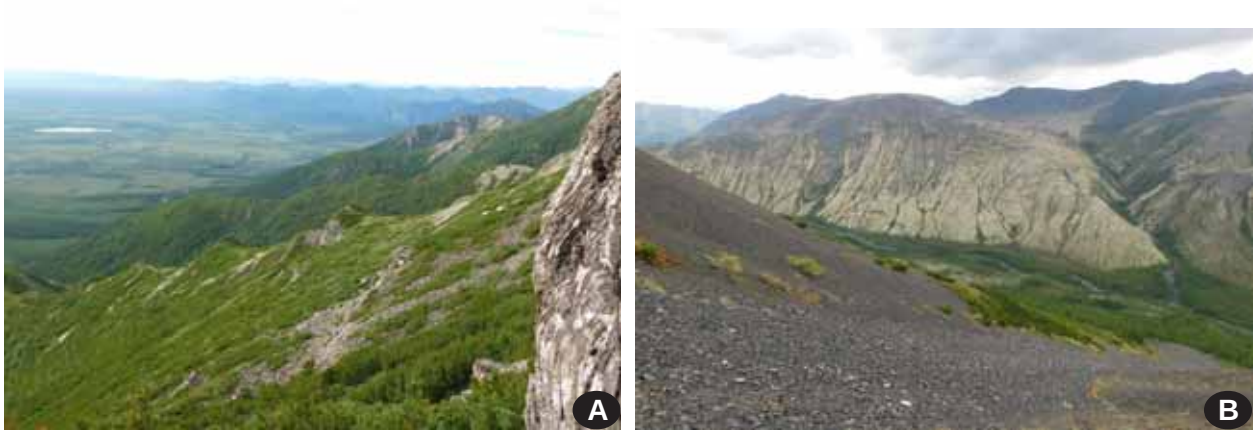

Fig. 2. A: limestome area: W-facing slope to Aldan river valley; B: schist area: slopes near pass from Kuraanakh to Dyby valley.

suaveolens, which are later substituted by *Larix*. Birch (*Betula platyphylla*) is rare, forming pure stands only on W-facing slopes to Aldan River, while it is more common on steep slopes to small streams, growing there with *Alnus fruticosa*. Spruce, *Picea obovata,* grows as scattered trees in *Larix*-dominated stands in Aldan River valley, and individual trees penetrate to Verkhoyanky Range only in Sette-Daban, up to Segenyakh Creek. Meadows, bogs, and *Betula nana* subsp. *exilis*, *B. fruticosa* and *Salix* spp. (*S. glauca* being the most common) shrubs form a mosaic in valleys and foothills. Mountain tundra and rock-fields are mostly of lichen type. Rock composition strongly affects the vegetation and some slopes totally lack forest vegetation, presumably due to high concentration of heavy metals.

Species list

Taxa are arranged alphabetically in the list; nomenclature follows Ignatov *et al*.(2006), taking into account some recent taxonomic changes. Annotation of each species includes altitudinal range (given in brackets), followed by numbers of localities (according to Fig. 1), ecological characteristics and frequency of occurrence.

Abietinella abietina – [450–1200 m], 1–6, 10, 14, 18. In open sites and larch forests, on soil, litter and rocks; common.

Aloina rigida – [460–730 m], 1, 6, 9–10, 12. In open sites on slopes, rocky soil and mineral earth, rock outcrops and ledges of cliffs covered with mineral earth, covered with soil roots of upturned tree in larch forest; sporadic.

Amblystegium serpens – [465–710 m], 1, 9. In open poplar stand in a flood valley and in stone-birch forest, on alluvium, soil under rock and rotten stump, rare.

Amphidium lapponicum – [450–1200 m], 3, 14. On wet or moist cliffs along river bank, near waterfall and in larch forest; rare.

A. mougeotii – [680–765 m], 11, 15. On wet or moist cliffs along river bank and near waterfall; rare.

Andreaea rupestris – [750–1375 m], 2, 14–15. On rocks in larch forests and in lichen tundra, on rock-fields; rare.

Andreaeobryum macrosporum – [440–1380 m], 2–4, 6, 8–9. On calcareous cliffs and rock outcrops with seeping water, wet rock faces, rarely on rocks at brook banks; sporadic in the mountain tundra belt, rarer and less abundant on cliffs along brooks and streams in the forest.

Anomobryum bavaricum – [463–700 m], 2, 6, 10–11. On steep open slope and along the road, between and under small rocks of screes, in fissures of rock outcrops; rare.

A. concinnatum – [440–1550 m], 2, 6, 9–12, 14. In forest and mountain tundra belts, on cliff ledges covered with fine earth, in niches of cliffs and rock outcrops, often along streams and brooks, on rocky soil and gravelly bars; rare.

Aulacomnium acuminatum – [420–1000 m], 2, 5–7, 9, 13. In boggy larch forests in river valleys, in wet site in mountain tundra; common.

A. palustre – [420–1000 m], 2, 6, 14. In boggy larch forests, willow and sedge swamps and wet places at slope bases; common.

A. turgidum – [440–700 m], 2, 6–7, 12, 14. In boggy larch forests, in birch forest with *Alnus fruticosa*, in mountain tundra; frequent.

Barbula convoluta – [500–700 m], 3, 6, 11. On rocky soil in disturbed sites, along roads, on the edge of low terraces in river valleys, on soil covering roots of upturned tree in spruce forest; sporadic.

B. jacutica – [460–900 m], 4–6. On rocky soil, sand and turf in disturbed sites near roads and in creek valleys, once collected in rocky mountain tundra; rare, but occasionally locally abundant,

Bartramia ithyphylla – [765 m], 15. Collected in a single locality between rocks on brook bank and in niches between rocks of a mossy rock-field near waterfall; very rare.

B. pomiformis – [490–900 m], 5–6, 11, 15. On ledges of cliffs and at cliff bases in larch forests, on rocks and between them; rare.

Blindia acuta – [700–765 m], 5–6, 11, 15. On moist cliff walls and wet rock outcrops along creek banks and near waterfalls.

Blindiadelphus diversifolius – [460–1200 m], 4–7. On rock outcrops, wet cliff walls, vertical walls of boulders, on rock surfaces in rock-fields, in forest and mountain tundra belts; locally frequent.

B. sibiricus – [470–1250 m], 5–6, 14. In niches between rocks in rock-fields on slopes to the creek valleys, on rock in mountain tundra; rare.

B. subimmersus – [460 m], 5. On slaty rock outcrops at the base of slope to the creek flood valley; very rare.

Brachytheciastrum trachypodium – [460–1200 m], 7, 14. In crevice of rock in larch forest and on rock outcrops on slope to the brook; very rare.

Brachythecium boreale – [460–1200 m], 4–7, 11–12, 14–15.

On rocks and litter in birch forests and alder thickets, cliff ledges near waterfalls, on soil banks in mountain tundra; frequent.

B. cirrosum – [460–725 m], 5–6, 12. In niches between rocks, cliff crevices and inclined walls; sporadic.

B. coruscum – [1000–1140 m], 2, 4. On cliffs near late snow bed along the brook in its upper reaches and on soil in mountain tundra; very rare.

B. dahuricum – [447 m], 6. Single collection on decaying wood in larch forest at the bank of river.

B. erythrorrhizon – [450–1010 m], 2–3, 6, 12–13. On litter, soil and rotten wood in larch and birch forests, willow stands, alder thickets, on cliffs at brook banks and near waterfall; sporadic.

B. jacuticum – [450–1200 m], 2, 5–7, 14. On rocky soil near roads and on slopes to creek flood valleys, on rocks and litter in larch and birch forests, on rocks and cliff faces near waterfalls, on soil in mountain tundra; frequent.

B. rotaeanum – [455–710 m], 2, 7, 9. At bases of birch, poplar and willow trees; rare.

B. salebrosum – [450 m], 6. Single collection on soil in poplar stand in the flood valley of Vostochnaya Khandyga River..

B. turgidum – [450–1200 m], 2, 4, 6, 15. On cliff ledges, in niches of rock-fields, on rocky soil in mountain tundra and near the road, rocks with soil layer in a bed of temporary stream; rare.

Bryobrittonia longipes – [460 m], 6. Single collection on soil in larch forest in disturbed place near the road.

Bryoerythrophyllum ferruginascens – [700–765 m], 11–12, 15. In crevices of rock outcrops on slope, on ledges and in niches of cliffs in waterfall and on stream bank; rare.

B. recurvirostrum – [415–1550 m], 1, 6, 8–9, 11–13. On rocky soil in disturbed sites, in niches of rock outcrops, on soil and litter in stone birch forests, rotten stumps, alluvium in flood valley poplar stands; frequent.

Bryum algovicum – [470–1490 m], 6, 14. In niches of rock outcrops on open steep slopes, between rocks on grassy lawn in creek flood valley; very rare.

B. amblyodon – [460–1380 m], 2, 6–7, 14. In niches and on ledges of wet cliffs in mountain tundra, on scree at brook bank, on soil along an oxbow in boggy flood valley; sporadic.

B. argenteum – [710–1550 m], 9, 14. In fissure of rock outcrop on open slope and on alluvium in flood valley poplar stand; rare.

B. bimum – [1200 m], 14. Single locality, on surfaces of rock outcrops with dense moss carpet, in niches of rock outcrop and on wet soil in flood valley of a stream.

B. caespiticium – [440–1490 m], 4, 6–7, 9, 11, 13–14. On rocky soil and litter in larch forests, in crevices of rock outcrops, on sand on gravelly bar and mossy lawn in a flood valley, between rocks in dry bed of a temporary brook, on hummock in boggy larch forest; sporadic.

B. creberrimum – [520–1070 m], 1, 4–6, 11. In on rocky soil disturbed places along roads and at the edges of low terraces in flood valleys, on soil and sand in flood valley poplar stands, on cliff ledges and rocks at brook banks; sporadic.

B. cryophilum – [1200 m], 14. Single collection on mossy lawn at brook bank.

B. cyclophyllum – [460–760 m], 7, 12. On mossy rock outcrops and in deep niche between rocks; very rare.

B. dichotomum – [625–790 m], 1, 3, 10. On a scree on slope, in a rut of winter road and on rock outcrop in open larch forest; very rare.

B. lonchocaulon – [485–900 m], 1, 4, 5–7, 10. On rocky soil on open dry slope and in larch forest, on litter and rotten wood in stone-birch forest, in mire and rocky mountain tundra; rare.

B. moravicum – [700–765 m], 11–12, 15. On wet cliff faces and in niches of rock outcrops; rare.

B. neodamense – [700 m], 11. Single collection on soil at the bank of oxbow.

B. pseudotriquetrum – [410–1400 m], 1–7, 14–15. In boggy larch forests, on ledges of wet cliffs, on moist soil and rocks in and along brooks, near snow beds, in mountain tundra, in wet niches of rock-fields; frequent.

B. sibiricum – [500 m], 8. Single collection, on vertical face of wet cliff at brook bank.

B. teres – [530 m], 1. Single collection, on rock outcrop in open larch forest.

Buckia vaucheri (*Stereodon vaucheri*) – [460–1550], 1, 3-7, 10–12, 14–15. In fissures and on rock faces of cliffs and rock outcrops along streams, on rock-fields, on rocky soil in flood valley poplar stands and on small bluffs at the edges of low terraces, on rocks in larch forests; common.

Calliergon giganteum – [460–675 m], 7, 11. In a pool in swamp, in shallow water in oxbow, in a rut of old road in boggy place; rare.

Calliergonella lindbergii – [415–750 m], 1, 6–7, 9. On vertical soil bank along an oxbow, near the pool in swamp, at the edge of low terrace and gravelly bar in a flood valley of Vostochnaya Khandyga River, in mire, on soil along brook in larch forest; sporadic.

Campyliadelphus chrysophyllus – [450–900 m], 1, 3–4, 6–7. On rocky soil along the road, on rotten wood and at on a base of larch tree in larch forest, at willow base and an sand in willow stands, in mossy mountain tundra; sporadic.

Campylophyllopsis sommerfeltii – [510–600 m], 1, 7. On rotten wood and hummocks in dry and boggy larch forests; rare.

Campylium protensum – [450 m], 3. Single collection, on soil and rocks along an oxbow in larch forest.

C. stellatum – [440–1400 m], 1–7, 9, 14–15. In boggy sites in stream flood valleys, on moist cliffs along streams and brooks, near waterfalls, on sand on a gravelly bar in stream flood valley, in a bed of a temporary brook below late snow bed' common.

Campylophyllum halleri – [840 m], 4. Single collection, on rocks of a rock-field below cliffs along a brook.

Catoscopium nigritum – [540–900 m], 3–4, 6–7, 9. In boggy mountain tundra, mires, mossy soil banks at edges of low terraces in stream flood valley, on soil and rocks along brooks, frequent.

Ceratodon purpureus – [540–900 m], 2–4, 6–9, 12–15. In disturbed sites along roads, on soil, sand and gravelly bars in flood valleys, on screes, soil and rock outcrops mountain tundra; sporadic.

Cinclidium arcticum – [450–1200 m], 5–9, 14. In wet depressions in larch forests on low terraces of streams, boggy mountain tundra, wet cliffs near waterfalls, mossy rock faces and niches of rock outcrops, on soil along brooks; common.

C. stygium – [450–1380 m], 1–7. In wet depressions in larch forests on low terraces of streams, wet rock outcrops on slopes, wet cliffs in waterfall, mires; frequent.

C. subrotundum – [460–900 m], 4, 7. On the bank of oxbow and near pool in mire, on wet soil in *Pinus pumila* thickets; rare.

Climacium dendroides – [750 m], 15. Single collection, in sedge swamp in a flood valley of Dyby River.

Cnestrum alpestre – [490 m], 5. Single collection, in a niche of mossy rock-field at the base of slope to the flood valley of stream.

C. schistii – [490 m], 5, 8. In niches between rocks on a bluff to the flood valley of stream and on soil stone-birch forest; very rare.

Coscinodon hartzii – [1375 m], 14. Single collection, on rock outcrop in mountain tundra dominated by lichens.

Cratoneuron filicinum – [460–1200 m], 4–5, 7, 9, 14–15. On wet cliffs and rock outcrops along streams and brooks, in waterfalls, on rocks and soil in and along brooks, on alluvium in flood valley poplar stands, on soil at the bank of oxbow; sporadic.

Cynodontium asperifolium – [675–1200 m], 11–12, 14–15. On litter and rocks in larch forests and alder thickets, on rocky soil along road, in fissures of cliff face, on rock outcrops at stream banks; sporadic.

C. strumiferum – [675–1376 m], 6, 11, 14–15. On rocks in larch forest, in niches of rock outcrops in mountain tundra, on rocky soil on slope to the road; sporadic.

C. tenellum – [700 m], 12. Single collection, on litter in larch forest dominated by *Vaccinium vitis-idaea*,

Cyrtomnium hymenophylloides – [450–1380 m], 2–6, 8. In niches of wet and dry cliffs and rock outcrops in forests and mountain tundra, between rocks of rock-fields, rarely on rotten wood, upturned roots of fallen trees and tree bases, on sandy alluvium in *Chosenia* stands; common.

C. hymenophyllum – [450–500 m], 3, 7. On wet soil near spring and on rock outcrops in larch forests; rare.

Dichodontium pellucidum – [700 m], 11–12. In niches of moist rock outcrops in larch forests; rare.

Dicranella schreberiana – [460–760 m], 2, 4, 6, 12. On bare turf in mire, on soil bank on lawn near road, on roadside, on soil bank in open larch forest; rare.

D. subulata – [700–750 m], 2, 4. On bare gravelly soil in open larch forest and at roadside; rare.

D. varia – [450–1000 m], 3, 6,13. On soil banks at roadsides, on covered with soil upturned roots of fallen tree in spruce forest; rare.

Dicranum angustum – [455 m], 2. Single collection on litter in birch and alder forest.

D. bardunovii – [450–1200 m], 1–3, 5–6, 8, 11–12, 14–15. On soil, litter, rotten wood and tree bases in larch and stone-birch forests, alder thickets, rarely in mountain tundra; common.

D. bonjeanii – [420 m], 1. Single collection on litter in larch and alder forest.

D. elongatum – [440–1200 m], 1–3, 5–8, 12, 14–15. On soil and rarely on rotten wood in larch forest in a flood valley of a stream and in stone-birch forest on slope, on rocky soil and rock-field in mountain tundra, in mires; common.

D. flexicaule – [440–510 m], 6–7. On rotten wood in larch forests; rare.

D. fragilifolium – [450–700 m], 3, 7,12. On rotten wood and at base of larch tree in larch forests; rare.

D. groenlandicum – [485 m], 6. Single collection at base of larch tree in larch forest along a creek.

D. majus – [765–1200 m], 14–15. On cliff ledge near waterfall and under *Pinus pumila* in mountain tundra; rare.

D. montanum – [455 m], 2. Single collection on rotten wood in birch and alder forest.

D. polysetum – [455–650 m], 1–2, 6. On soil, litter and on tree base in larch and stone-birch forests; rare.

D. schljakovii – [1000–1200 m], 14–15. On litter in larch forest on rocky slope and on soil in mountain tundra; rare.

D. scoparium – [455–515 m], 2–3. On soil in larch and stone-birch forests; rare.

D. spadiceum – [470–1200 m], 6, 14–15. On mossy rock-field and on rock outcrops at brook bank.

D. undulatum – [455–790 m], 2–3, 6–7. On litter and soil in stone-birch forest, in mires; rare.

Didymodon fallax – [460 m], 6. Single collection on rocky soil in spruce forest near the road.

D. ferrugineus – [460–1200 m], 3, 6, 9–19, 12, 14–15. In niches and crevices of rock outcrops, on cliffs with seeping water, on rocks in larch forest, on sandy alluvium in a flood valley poplar stand; sporadic.

D. gaochenii – [1070 m], 5. Single collection on vertical face of wet cliff along brook.

D. icmadophilus – [470–1215 m], 1, 3–7, 9. 12, 15. On niches and crevices of cliffs and rock outcrops, on cliff faces, on rocks covered with alluvium, on soil in larch forest, on gravel at roadside, in mountain tundra; frequent.

D. johansenii – [1010 m], 14. In one locality on strongly weathered rock outcrops ay roadside.

D. leskeoides – [1010 m], 14. Collected once on cliff ledges in mountain tundra, locally abundant.

D. perobtusus – [440–790 m], 6, 9. On moist and dry cliff walls and in small fissures; rare.

D. validus s.l. – [445–1380 m], 2, 4, 6, 9–10, 15. On moist cliffs, rocks in brook, gravelly roadsides, rock outcrops on open slopes, in mountain tundra; sporadic.

Distichium capillaceum – [440–1550 m], 2–9, 13, 15. On ledges, in crevices and in niches of cliffs and rock outcrops, on rocks along brooks, soil banks along roads, under roots of birch in stone-birch forest on steep slope, at the edge of low terrace and gravelly bar, on soil covering upturned roots of fallen tree in spruce forest; common.

D. inclinatum – [485 m], 6. Collected once in a crevice of cliff at the base of slope.

Ditrichum heteromallum – [450 m], 7. Collected once on rocky soil at roadside.

Drepanium recurvatum – [440–1375 m], 1–2, 4–6, 10, 14. On cliff ledges, rock outcrops, between rocks of rock-fields, under rocks, on overhanging surfaces of boulders, rocky soil in mountain tundra, litter in *Pinus pumila* thickets; frequent.

Drepanocladus polygamus – [455 m], 2. Collected once on litter in stone-birch forest.

Encalypta alpina – [460–1375 m], 4–6, 13–15. In small fissures of cliff faces, in niches of cliffs and rock outcrops, on rocks near waterfall, on rocky soil in mountain tundra; sporadic.

E. brevicollis – [460–1490 m], 5, 11, 14–15. On rocky soil in larch forest on slope, in niche of rock outcrop, between rocks of a rock-field, on schist outcrops on open dry slope; sporadic.

E. ciliata – [680–725 m], 11–12. On litter in larch forest on steep slope, in niche of cliff, on hanging roots covered with soil on bluff at stream bank; rare.

E. longicollis – [890–1360 m], 2, 9. On wet cliffs along a brook on steep open slope, on cliffs in mountain tundra; rare.

E. mutica – [520–900 m], 1, 4, 6, 10, 12. In crevices and fissures of cliffs, on rock outcrops, between rocks on brook bank, on soil in mountain tundra; sporadic.

E. pilifera – [430–1050 m], 3–4, 6–8, 10, 12. On rock outcrops on open slopes, in niches between rocks, on screes, on cliff ledges and at cliff bases, on soil in mountain tundra dominated by *Dryas octopetala*; frequent.

E. procera – [450–1200 m], 3, 5–9, 11–12, 14–15. On moist and dry cliff faces at stream and brook banks and in waterfalls, on rocky soil in spruce forest, on soil and between rocks in larch forests, on rock outcrops in mountain tundra; common.

E. rhaptocarpa – [460–1490 m], 2, 4, 6, 8–9, 14–15. In crevices of rock outcrops, in niches between rocks of rock-fields, on rocks in stone-birch forest, on a scree, on soil at stream bank, on rocky soil at ridge top, on small bluffs at the edges of low terrace, on gravelly bars in river flood valleys, on covered with soil upturned roots of fallen tree in larch forest, on wet rock outcrops in mountain tundra; common.

E. trachymitria – [1550 m], 14. Single collection in niche of rock outcrop on open steep slope.

E. vulgaris – [1300 m], 15. Single collection on schist outcrops on steep open slope.

Entodon concinnus – [440–1200 m], 6, 11–14. On soil and litter in larch forests, on gravelly soil and rocks in flood valley poplar and willow stands, on mossy cliffs near waterfall, on slaty scree on slope; sporadic.

Eurhynchiastrum pulchellum – [455 m], 2. Collected once on rotten wood in stone-birch and alder forest.

Fissidens arcticus – [840 m], 4. Collected once in crevice of wet cliff in mountain tundra.

Flexitrichum flexicaule – [420–1400 m], 1–7, 9–10, 14–15. On sandy alluvium in river flood valley, on rock outcrops on open slopes, dry cliffs along brooks, on rocky slope near snow beds, at larch tree base, on litter and rotten wood in larch forests, on rocky soil at roadside, on a scree and between rocks of a rock-field, in mountain tundra dominated by *Dryas octopetala*; common.

F. gracile – [420–1400 m], 2–3, 6, 8–11, 15. In niches and fissures of wet cliffs at stream and river banks, on moist rock outcrops at slope bases, on wet cliffs in mountain tundra, in niches of rock-fields; common.

Funaria arctica – [1007 m], 13. Single collection on low bluff at roadside, in abundance.

F. hygrometrica – [450–1007 m], 6–9, 12–14. On trampled reindeer pasture, on gravelly roadside, on sandy alluvium at river bank, in fissures and on ledges of cliffs; sporadic.

Gollania turgens – [440–1200 m], 3–6, 8–9, 11, 14–15. On ledges, in niches and fissures of cliffs, on mossy rocks at the base of slope at stream bank and near waterfall, in mossy mountain tundra; sporadic.

Grimmia donniana – [1490 m], 14. Collected once on dry rock outcrops on open S-faced slope.

G. elatior – [1140 m], 2. Collected once on dry cliffs in mountain tundra.

G. jacutica – [460–1000 m], 2–3, 5–6, 15. On rocks of dry rock-fields on slopes, on cliffs in spruce forest; sporadic.

G. longirostris – [470–1010 m], 1, 3–4, 6, 10, 12, 14–15. On rocks in larch and spruce forests, in fissures of dry cliffs on stream banks, on dry rocks of rock-fields; frequent.

G. teretinervis – [400–500 m], 6, 8. On dry and moist cliff faces and in small fissures; rare.

G. tergestina – [540 m], 1. Collected once on rock face of dry cliffs.

Gymnostomum aeruginosum – [440–1090 m], 1, 3–6, 8–9, 12, 14. On cliffs along streams and near waterfalls; frequent.

Hamatocaulis vernicosus – [450 m], 7. Collected once in boggy larch forest on gentle slope,

Hedwigia czernyadjevae – [450 m], 3. Collected once at cliff base in larch forest.

H. emodica – [460–500 m], 1, 7. On rocks in larch forests, rare.

Helodium blandowii – [455 m], 2. Collected once on litter in stone-birch and alder forest

Hydrogonium amplexifolium – [445–790 m], 5–6, 9. In crevices of moderately wet to moist cliffs and rock outcrops, on gravely bars, rocky soil, sand and turf in river valleys and edges of low terraces, between rocks of rock-field at the base of slope to river valley; sporadic.

H. gregarium – [440–1380 m], 1–6, 9, 11. On rock outcrops at slope bases in stream valleys, in fissures of wet and dry cliffs on stream banks, in forests and in mountain tundra, on alluvium in a flood valley, on gravelly soil on small bluff at the edge of low terrace in a flood valley; frequent.

Hygroamblystegium varium – [710 m], 9. Single collection on alluvium in a flood valley poplar stand.

Hygrohypnella ochracea – [680–765 m], 6, 15. On moist cliff faces in waterfalls; rare.

H. polaris – [680–1200 m], 2, 11, 14. On rocks in brooks and streams; rare.

Hygrohypnum luridum – [445–1200 m], 2–4, 6, 8–9, 11–12, 14. On rocks in brooks and streams and along water courses, on cliffs near waterfalls and on stream and river banks; common.

Hylocomium splendens – [450–1010 m], 2–3, 5–8, 11, 13–14. On litter in larch forests, in mires, on wet cliff ledges, in mossy mountain tundra; common.

Hymenoloma crispulum – [1400 m], 2. Single collection on rocky soil in mountain tundra.

Hymenostylium recurvirostrum – [440–1380 m], 1–2, 4, 6, 8–12, 14. On wet and moist cliff walls along streams and near waterfalls, rock outcrops in mountain tundra; common.

H. xerophilum – [765 m], 10. Collected once in fissure of rock outcrops on open slope.

Hypnum cupressiforme – [450–900 m], 3–7, 12, 15. On ledges and fissures of cliffs at stream banks, in niches between rocks, at bases of larch and alder trees; sporadic.

Indusiella thianschanica – [440–725 m], 6, 10, 12. On dry cliff faces, on rocks at cliff base; rare.

Isopterygiopsis alpicola – [460 m], 7. Single collection, in niche between rocks in larch forest on slope.

I. muellerana – [450–765 m], 2–3, 5, 7–8, 12, 15. In niches of cliffs at stream banks, on mossy rock-fields, on rocks and rotten wood in larch forests; frequent.

I. pulchella – [485–1375 m], 1, 5–6, 8, 11–12, 14–15. On cliff ledges and in niches at stream banks, on rocky slopes, on soil and under rocks in stone-birch forests; frequent.

Leptobryum pyriforme – [460–1380 m], 2, 4, 6, 8, 12, 14. On trampled soil on pasture, on bare turf in mire, on soil in alder stand, on rotten wood in birch forest, on soil in mountain tundra; sporadic,

Leptodictyum riparium – [710 m], 9. Single collection on rotten wood in flood valley poplar stand.

Lewinskya elegans – [455–790 m], 2. On birch trunk in stone-birch forest and on dead branch of *Pinus pumila* at stream bank; rare.

L. iwatsukii – [450–750 m], 1, 6–7, 9, 11–12. On rocks in larch forests, along the road, on rock-field, on dry cliff face and rock outcrop; sporadic.

L. sordida – [450–750 m], 3, 6–9, 11, 15. On trunks of poplar, aspen, stone-birch, and alder trees, rarely on rock outcrops; sporadic.

Loeskypnum badium – [460 m], 7. Single collection in wet depression at the edge of mire in river flood valley.

Lyellia aspera – [700–1380 m], 2, 4, 14. In moss carpet on steep slope to a stream valley, in open larch forest and in wet mountain tundra; rare.

Meesia triquetra – [460 m], 7. Single collection in wet depression at the edge of mire in river flood valley.

M. uliginosa – [460–1000 m], 2–9. In wet mountain tundra, mires, wet rock outcrops with seeping water; common.

Mielichhoferia asiatica – [480–810 m], 11–12. On slaty cliffs and rock outcrops at brook banks; rare.

Mnium blyttii – [450–490 m], 5, 7. In deep crevice of a cliff at stream bank and on bare soil along the brook; rare.

M. lycopodioides – [450–1400 m], 1–6, 11, 14–15. On cliff ledges at stream banks and near waterfalls, in niches between rocks of rock-fields, on soil in flood valley poplar stand, on litter in stone-birch forest, on rotten wood in spruce forest, in mountain tundra; common.

M. marginatum – [700 m], 11. Single collection on rock outcrops in larch forest on steep slope to a brook.

M. spinosum – [440–455 m], 2–3, 6. On soil, litter and rotten stump in larch, stone-birch and spruce forests; rare.

M. stellare – [520 m], 5. Single collection between rocks on brook bank.

M. thomsonii – [470–1490 m], 3–4, 6, 8, 11, 14. On ledges and in niches of cliffs at stream banks, between rocks of rock-fields, on rock outcrops in mountain tundra, at base of spruce in spruce forest; sporadic.

Molendoa hornschuhiana – [460–1000 m], 1, 3–4, 6–8, 11–12. On rock faces and in small fissures of dry and wet cliffs at stream banks, on rock outcrops in larch forests and in mountain tundra; common.

Myurella julacea – [450–1550 m], 1–4, 6–12, 14. In niches and fissures of cliffs and rock outcrops in stream and river valleys and in mountain tundra, on rocky soil on small bluffs at river banks, on soil under rock in stone-birch forest; common.

M. sibirica – [450–500 m], 5–6, 8. In niches of rock outcrops and cliffs at stream banks, on rocks of a rock-fields, on gravelly soil of small bluffs at the edge of low terraces in river valleys, on soil covering upturned roots of fallen trunk in larch forest; sporadic.

M. tenerrima – [460–725 m], 1, 3, 6, 12. In niches of cliffs at stream banks, on rocky soil on small bluff to the gravelly bar, between rocks of a rock-fields; sporadic.

Neckera oligocarpa – [460–1000 m], 5–7, 15. On rocks in larch forests, in crevices of rock outcrops at stream banks, rarely at bases of alder trunks; sporadic.

Niphotrichum canescens – [470–1100 m], 6, 14. On cliffs in mountain tundra and on rocks in stone-birch forest on slope; rare.

N. panschii – [460–1375 m], 5–6, 13–14. On rocks of rock outcrops on slopes and along brooks, on rocks in larch forests; frequent.

Nyholmiella obtusifolia – [440–750 m], 3, 6, 9, 15. On poplar and rowan trunks in flood valley poplar stands and mixed larch and poplar forests, rarely in fissures of cliffs; sporadic.

Oligotrichum falcatum – [810 m], 12. Collected once on inclined cliff face on slope to a brook,

Oncophorus elongatus – [440–710 m], 5–6, 8–9. On rotten wood in larch forests and flood valley poplar stands; rare.

O. virens – [725–1010 m], 9, 12, 14. On rock outcrops near the road, on small bluff at the edge of low terrace, in fissures of cliff at stream bank.

O. wahlenbergii – [755–1375 m], 2–3, 6–7, 11, 14. On rotten wood and soil in larch, stone-birch and spruce forests, on rocky soil in mountain tundra; sporadic.

Orthothecium chryseon – [760–1000 m], 2–6, 7–9. On soil and rocks in wet depressions at the bases of slopes to stream flood valleys, on mossy rocks along brook banks, in wet niches of rock-fields, in wet depression in a mire, in wet niches and on ledges of cliffs; common.

O. strictum – [450–1100 m], 4–6, 8–9,12, 14–15. On overhanging walls of wet cliffs, on rock outcrops in mountain tundra and along streams and rivers, on moist cliffs in waterfalls, on mossy rock-fields near streams; frequent.

Oxystegus tenuirostris – [520–1090 m], 7, 11–12, 14–15. On ledges and in niches of cliffs along streams, on rotten wood and litter in larch forests; sporadic.

Paludella squarrosa – [760 m], 2. Single collection, in wet depression in mire at the base of gentle slope.

Philonotis tomentella – [460–510 m], 3, 5–7, 11. On soil and rocks in larch forests, on ledges of cliffs along streams, on soil at the bank of oxbow; sporadic.

Plagiomnium confertidens – [750 m], 3, 5–7, 11. Collected once at base of poplar tree in a flood valley poplar stand.

P. curvatulum – [440–1090 m], 2, 5–9, 11–12, 14–15. On soil and litter in larch and stone-birch forests, on rotten wood in flood valley poplar stands, on soil and rocks at bases of cliffs, in niches of rock-fields, on inclined surface of wet cliff; frequent.

P. cuspidatum – [710 m], 9. Single collection on rotten log in a flood valley poplar stand.

P. ellipticum – [450–710 m], 7, 9. On alluvium in a flood valley poplar stand and on bare soil along a brook in boggy larch forest on gentle slope.

Plagiopus oederianus – [460–900 m], 3–9,11–12, 15. In niches, on ledges and inclined walls of cliffs, niches between rocks, dry bed of a temporary brook, on soil in larch forests, at brook banks, cliffs near waterfall; frequent.

Plagiothecium berggrenianum – [1200 m], 14. Single collection, on a steep mossy slope to a brook.

P. cavifolium – [680–810 m], 11–12. On cliffs along brooks and streams, in niche under roots of alder; rare.

P. denticulatum – [765–1090 m], 14–15. On mossy rock-field and low cliff wall at brook bank; rare.

P. laetum – [455–1100 m], 2, 7, 9, 11, 15. On soil, rotten wood and under rocks in larch and stone-birch forests, in niches of mossy rock-fields, on small bluff at the edge of low terrace in flood valley; sporadic.

Platydictya acuminata – [510–650 m], 1, 7. On rotten wood in larch forest and in niche under large flat rock in stone-birch forest; rare.

P. jungermannioides – [460–650 m], 1, 7. On rotten wood in larch and stone-birch forests, in deep niche between rocks on larch forest; rare.

Platyhypnum alpestre – [1200–1250 m], 14. On rocks in streams; rare.

P. cochlearifolium – [1140 m], 2. Single collection, on rocks in a brook in mountain tundra.

P. duriusculum – [1200 m], 14. Single collection, on rocks in a brook.

P. norvegicum – [1120 m], 4. Single collection, on moist rocks below melting snow bed.

Platygyrium repens – [455 m], 2. Collected once at base of alder trunk in stone-birch forest with alder.

Pleurozium schreberi – [430–1390 m], 2, 6, 14. On litter in larch forest, in *Pinus pumila* thickets, in mountain tundra; sporadic.

Pogonatum dentatum – [675–1070 m], 11, 15. Between rocks at brook bank, on slaty rock outcrops with seeping water, on rocky soil on small bluff near the road, on a scree; sporadic.

P. urnigerum – [765–1010 m], 13, 15. On soil on a pasture and on cliff ledge near waterfall; rare.

Pohlia cruda – [460–1490 m], 1, 3–8, 11, 13–15. In niches and crevices of cliffs and rock outcrops, on soil banks at roadsides, between rocks in larch forest and rock-fields, under roots of birch in stone-birch forest on steep slope, on covered with soil upturned roots of fallen tree; frequent.

P. crudoides – [1010 m], 13. Collected once on soil bank at roadside.

P. elongata – [675 m], 11. Collected once on rocky soil of a small bluff at the roadside.

P. longicollis – [450–1300 m], 3, 5, 8, 11–12, 14–15. On soil, litter and under rocks in larch forests and alder thickets, at base of cliff walls, on ledges and in niches of rock outcrops at stream bank; frequent.

P. nutans – [450–790 m], 2–3, 7–8, 11, 15. On rotten wood, litter and tree bases in larch, stone-birch and spruce forests, in a rut of winter road; sporadic.

P. wahlenbergii – [460–710 m], 7, 9. On alluvium in a flood valley poplar stand and on soil at the bank of oxbow; rare.

Polytrichastrum alpinum – [470–1400 m], 2–3, 5–6, 11–15. On rocks and in niches of mossy rock-fields at the base of slopes to stream flood valleys, in niches of cliffs, on litter and soil in larch forests, in mountain tundra; common.

Polytrichum hyperboreum – [1010 m], 13. Single collection on trampled soil on reindeer pasture.

P. juniperinum – [455–1050 m], 2, 4, 14. On soil and litter in burnt larch forest and in stone-birch forest, on ledge of dry cliff; rare.

P. longisetum var. *anomalum* – [1010–1200 m], 13–14. On soil in a willow stand and on mossy slope to a stream.

P. piliferum – [680 m], 6. Collected once on soil in open larch forest on dry slope.

P. schwartzii – [1010 m], 14. Collected once in small mire near the road.

P. strictum – [440–1200 m], 2, 6, 14. In boggy birch forest and in mountain tundra; rare.

Pseudoleskeella catenulata – [765–1300 m], 4, 15. In a fissure of cliff wall, on schist outcrops on open slope, on rock at brook bank; rare.

P. rupestris – [500–600 m], 1. On rocks in larch forest; rare.

P. tectorum – [1490–1550 m], 14. In niche and on surface of rock outcrops on open S-faced slope; rare.

Pseudostereodon procerrimus – [795–1050], 4, 15. On wet cliffs near waterfall and on rock outcrops on slope with larch forest; rare.

Psilopilum cavifolium – [1010 m], 13. On trampled soil on reindeer pasture and on soil bank at roadside; rare.

P. laevigatum – [1070 m], 15. Collected once on a mudslide on steep slope.

Pterygoneurum ovatum – [625 m], 10. Collected once on gravelly scree on a steep open slope.

Ptilium crista-castrensis – [440–765 m], 3, 5, 8, 14–15. On mossy rock-fields and bluffs on slopes to stream flood valleys, on rotten log in larch forest; sporadic.

Pylaisia polyantha – [415–790 m], 1–3, 7–9, 11, 15. On trunks of poplar and rotten wood in flood valley poplar stands, rocks in larch forest, base of spruce in spruce forest, birch, aspen and rowan trunks and rotten wood in stone-birch forests; frequent.

P. selwynii – [450–1200 m], 3, 14. On trunks of poplar and aspen trees in mixed larch and spruce forests, on rocks of a rock-field; rare.

P. steerei – [440–750 m], 6, 9, 12. On mossy rock-field and on rock outcrops at slope base; rare.

Racomitrium lanuginosum – [465–1375 m], 2, 5, 8–9, 11, 13. On rocks and soil in mountain tundra, on rock-fields, on in mire; sporadic.

Rhabdoweisia crispata – [700–765 m], 11, 15. On cliff ledges at stream bank and on rotten wood in larch forest on steep slope; rare.

Rhizomnium andrewsianum – [700–1200 m], 2, 5, 11, 14. On soil in larch forest, on moist rock outcrops at stream banks, in minerotrophic mire; rare.

R. nudum – [1200 m], 14. Single collection on soil in open larch forest.

Rhytidiadelphus triquetrus – [450–760 m], 2–3. On soil in larch forest and in mire; rare.

Rhytidium rugosum – [440–1215 m], 4–6, 8, 11–12, 14. On litter and soil in larch forests, on gravelly soil, on rocky slope base covered with moss carpet, in mountain tundra; frequent.

Roaldia revoluta (*Stereodon revolutus*) – [1050], 4. On rocky soil and between rocks of a rock-field in below snow bed in the upper course of a brook; rare.

Saelania glaucescens – [450–1000 m], 3, 7–8, 15. On rocks on soil in larch and stone-birch forests, in niches of cliffs, between rocks, on small gravelly bluff at the edge of low terrace; sporadic.

Sanionia uncinata – [450–1200 m], 2–3, 6–7, 11–12, 14–15. On rocks and soil along brooks, on cliffs near waterfalls, on rocky soil at roadside, on litter in larch forest, on gravelly soil in flood valley poplar stand, at bases of birch and aspen trees in mixed stone-birch forest, in mountain tundra; common.

Schistidium boreale – [465–1370 m], 1–6, 8–9. On rocks and rock outcrops in mountain tundra, on wet cliffs, on rocks of a rock-field covered with alluvium, on rocks and bases of cliff walls at stream banks; frequent.

S. dupretii – [1350 m], 2. Collected once on cliffs in mountain tundra.

S. frigidum – [465–1200 m], 5, 14. On rocks near waterfall and in larch forest in stream flood valley; rare.

S. obscurum – [500–1490 m], 3, 14–15. In fissures and rock faces of dry rock outcrops on open S-faced slope and on vertical cliff walls on stream bank; rare.

S. papillosum – [415–1200 m], 1, 3, 5, 7, 11, 14–15. On dry rocks in larch and spruce forests and in flood valley poplar stands, on mossy rock-fields at slope bases, on cliffs near waterfall, in dry bed of temporary brook; frequent.

S. platyphyllum – [445–1200 m], 2, 4, 6, 8, 11–12, 14–15. On rocks in brooks and near waterfalls, wet rock outcrops at roadside, on temporarily flooded cliffs at river bank; frequent.

S. pulchrum – [445–1550 m], 5–9, 11–12, 14–15. On rocks in larch and stone-birch forests, on schist mudslide on steep slope, in fissures of cliff walls at stream banks, on dry rock outcrops on open S-faced slope, on cliffs near waterfall, on strongly weathered cliffs at roadside; common.

S. relictum – [440–1380 m], 2–6, 8–9, 14. On rocks covered with sand and silt at bases of slopes to stream flood valleys, on rocks in brooks, on rock outcrops and cliffs along creeks, on moist cliffs in waterfalls, cliff walls with seeping water (same habitat with *Andreaeobryum macrosporum*), cliffs and rock outcrops in mountain tundra; common.

S. scabripilum – [440–1450 m], 6, 9, 11, 14–15. On rocks in larch forests on slopes, on overhanging dry cliff wall near waterfall, on a scree at roadside, in fissures of dry rock out-

crops on open steep slope, on rock-fields and rocks in stream valleys, on dry and wet cliff faces; sporadic.

S. subjulaceum – [790 m], 9. Single collection in dry bed of temporary brook.

S. submuticum subsp. arcticum – [440–1140 m], 2, 6. On temporarily flooded cliffs on river bank, on cliff at brook bank and in depression of S-faced cliff wall on slope; rare.

S. tenuinerve – [1490 m], 14. Single collection in fissures of dry rock outcrops on S-faced open steep slope.

Sciuro-hypnum plumosum – [490 m], 5. Single collection on rocks at stream bank.

Scorpidium cossonii – [420–1000 m], 1–9, 15. In sedge, dwarf-shrub and willow mires, boggy mountain tundra, wet cliffs, pools in mires, moist soil in depressions; common.

S. revolvens – [450–680 m], 7–6, 11. In wet larch forests and mires; sporadic.

S. scorpioides – [480 m], 5. In a pool in mire and in wet depression in larch forest near the road; rare.

Scouleria pulcherrima – [447 m], 6. In single locality on walls of temporarily flooded cliffs at the bank of Vostochnaya Khandyga River, in abundance.

Seligeria brevifolia – [460 m], 7. Single collection in a crevice of rock in larch forest at the edge of mire.

S. tristichoides – [450–1380 m], 1–4, 8–9. On vertical cliff faces at stream and brook banks, on wet cliffs and rocks in mountain tundra; sporadic.

Sphagnum angustifolium – [680–1150 m], 11, 15. In larch forest on gentle slope and in dwarf-shrub mire; rare.

S. aongstroemii – [1050 m], 15. Single collection in dwarf-shrub mire on slope to river valley.

S. balticum – [1230 m], 14. Single collection in mire on slope to a creek valley.

S. capillifolium – [625–1200 m], 2, 10–12, 14. In larch forest on gentle slope, in mires, on mossy slopes to a stream valley; sporadic.

S. fuscum – [440–1200 m], 2, 6–8, 12, 14. In mires and wet larch forests; sporadic.

S. girgensohnii – [440–1200 m], 3, 5–6, 11–12, 14–15. In larch and spruce forests on slopes, mires, on slopes to stream flood valleys; common.

S. lenense – [680–1200 m], 11, 14. In larch forests on slopes; rare.

S. majus – [680], 11. Single collection in a pool in mire in a river flood valley.

S. teres – [1200], 14. Single collection in open larch forest on gentle slope.

S. tundrae – [440], 6. Single collection in open larch forest.

S. warnstorfii – [492], 5. Single collection at base of slope to stream flood valley.

Splachnum luteum – [450], 7. Single collection in mire in a flood valley of Vostochnaya Khandyga River.

Stegonia latifolia – [520–1050], 1, 4. On rock outcrops in larch forests on slopes and at stream bank, in rocky mountain tundra dominated by *Dryas octopetala*; rare.

Stereodon bambergeri – [530–1070], 4, 6. 8–9. In boggy mountain tundra, on cliffs along a brook and near snow beds, rock-fields, on rocky soil at the border between mire and gravelly scree; sporadic.

S. hamulosus – [680–1200], 11, 14. In niches of rock outcrops and cliffs on stream banks, on small bluff near brook; rare.

S. plicatulus – [455–790], 2. 9. On rock outcrops in alder thicket and at larch base in mixed stone-birch and alder forest; rare.

Struckia enervis – [520], 5. Single collection in shady niche between rocks at base of slope to a brook.

Syntrichia norvegica – [1100–1140], 2, 4. On soil in grassy and *Dryas octopetala*-dominated mountain tundra; rare.

Syntrichia ruralis – [460–1370], 1, 2, 5, 10–11, 14–15. On soil and rocks in larch forests, on schist mudslide on steep slope, on small bluffs at edges of low terraces, on rock outcrops at stream banks, on wet cliff faces in mountain tundra, on rotten wood in larch forest; common.

Tetraphis pellucida – [455–510], 2, 7. On rotten wood in larch and stone-birch forests; rare.

Tetraplodon angustatus – [490], 8. Single collection on strongly decayed organic substrate in stone-birch forest on slope.

T. mnioides – [430–1200], 6, 12, 14. On decaying dung and animal remnants in larch forests, in niches of rock-fields, on stream banks; sporadic.

T. pallidus – [1375], 14. Single collection in mountain tundra dominated by lichens.

Thuidium assimile – [440–540], 2, 6–7, 9, 11, 15. On soil, litter and rocks in larch forests, on soil and bases of poplar trunks in flood valley poplar stands, at base of willow trunk in flood valley willow stand, in deep niches of rock-fields; frequent.

T. recognitum – [440], 6. Single collection on soil in a narrow strip of larch forest between road and cliffs.

Timmia austriaca – [795–1200], 14,15. At base of cliff wall, in niche of rock outcrops and on small bluff to a stream; rare.

T. bavarica – [710], 9. Single collection on alluvium in a flood valley poplar stand,

T. comata – [415–1030], 1, 4, 6–9, 12. In niches of cliffs and on rock outcrops at stream and brook banks, on temporary flooded cliffs at the banks of Vostochnaya Khandyga River, on rocky soil of small bluffs at the edges of low terraces, in niches of rock-fields, on soil covering upturned roots of fallen trunk, on wet soil near springs, on cliffs near waterfalls, in mountain tundra; common.

T. norvegica – [440–460], 5–7. Between hummocks at the edge of a mire in flood valley of river and on rock outcrop in larch forest; rare.

T. sibirica – [450–1200], 2, 5–7, 9, 11, 14–15. In crevices of wet cliff faces at stream and river banks, near waterfalls, in niches of mossy rock-fields, on soil on brook banks and in beds of temporary brooks, on rock outcrops in larch forest; frequent.

Tomentypnum nitens – [450–1010], 1–2, 5–9, 12, 14. In wet larch forests and mires of various types; common.

Tortella alpicola – [500–1300], 3, 15. In cliff crevices in spruce forest, on a scree and on schist outcrops on open slope; rare.

T. densa – [625–880], 9–10. In rocky mountain tundra, on *Dryas octopetala*-dominated community and on soil at cliff base; rare.

T. fragilis – [460–1400], 1–15. In mountain tundra of various types, on rocky slopes, on rock outcrops along streams, occasionally on soil in larch and stone-birch forests; common.

T. inclinata – [440–1000], 1, 4–6, 9. On gravelly soil in flood valley poplar stands, on small bluffs at the edges of low terraces, on rock-fields, rock outcrops at stream banks; frequent.

T. spitzbergensis – [465–470], 5–6. On grass-forb meadow on a terrace of stream valley and at base of larch tree in larch forest on a terrace of stream; rare.

T. tortuosa – [485–1215], 1–6, 9–10. On cliffs and rock outcrops along streams, in mountain tundra, on screes; frequent.

Tortula mucronifolia – [520–1200], 1, 6, 9, 11–12, 14–15. In

fissures and on ledges of dry and wet cliffs along streams and in larch forests, in niches of rock-fields; sporadic.

Trichodon cylindricus – [1010], 13. Collected once on soil bank at roadside.

Trichostomum crispulum – [445–900], 4, 6, 9. On ledges and in fissures of cliffs along streams and rivers, on rocks at brook banks, on rock-fields covered with alluvium at slope bases; sporadic.

Ulota curvifolia – [500–1090], 3, 5, 11, 14–15. On walls of cliffs along streams, on rocks in larch forests; sporadic.

Warnstorfia exannulata – [1200], 14. Single collection in a brook in mountain tundra.

W. sarmentosa – [675], 11. Single collection in an oxbow near the main water course of a river.

Zygodon sibiricus – [445–750], 3, 5–6, 15. On trunks of poplar and aspen in flood valley mixed forests and poplar stands.

DISCUSSION

The total number of species in the Sette-Daban is 294, which is the highest number among the studied local floras in the Central and Eastern parts of Yakutia (Table 1). The published flora of Ust-Maya District (Ignatov *et al.*, 2000) with 253 species, included in fact floras of three areas with more than 200 km between them, thus we included from that publication only species found around Allakh-Yun settlement and Tarbagannakh Peak.

When these studied regions are arranged according to their species richness (Table 2), it becomes clear that their higher diversity correlates with the presence of calcareous rocks, while the regions with acid bedrocks are the least in number of species. To visualize this rule, we included in Table 2 indicators of acid / basic substrates, such as *Seligeria* s.l.

At the same time, high diversity of the moss flora of Sette-Daban Range can be explained by the presence of two contrastively different parts with calcareous bedrocks and with schists (Fig. 2C, D). Only about a half of species was found in both areas, whereas 87 species were not found in the schist area, and 51 not found in limestone area (Table 3). Such strong difference appeared unexpectedly, thus some species (e.g., widespread *Pohlia wahlenbergii*) seems were simply undercollected. Nevertheless, we provide in Table 3 the complete lists of species from these two areas, as the limited habitat preference can be characteristic for this part of Yakutia. Naturally, it is expected that *Andreaeobryum* occurs in calcareous areas, and *Andreaea* in non-calcareous, but the fact that in calcareous area were found two species of *Hedwigia*, while in schist area no one, is unexpected and call for further observations, as well as on similarly "calciphilous" *Grimmia elatior*. The absence in calcareous part, and at the same time presence in schist part of *Dichodontium pellucidum* and *Timmia austriaca* are also noteworthy, as in other parts of Russia these two species are associated mostly with calcium-rich substrates.

In addition, the "calcareous part" has also patches of stone-birch forests in places with milder climate. They are peculiar as being enriched by epixylous species, and Sofronova (2014) mentioned for this habitat a number of boreal epixylous hepatics. Among mosses, we found *Tetraphis pellucida* in such birch forests (two places), and one of them was the only place where *Dicranum montanum* and *D. angustum* were found, as well as one of two findings of *D. scoparium* was made there. Interestingly, *D. undulatum*, a species usually occurring in bogs, also occurs there on rotten logs with one more fen species, *Helodium blandowii,* the latter being the only collection in the studied region.

Among other calcareous species, it is interesting to mention an exceeding abundance of *Catoscopium nigritum*, which grows not only in wet habitats, but also on dry soil banks in flood valleys. Some species which were considered to be rare elsewhere, i.e. *Schistidium relictum, Barbula amplexifolia,* and *Hydrogonium gregarium,* were found in many places in Sette-Daban; the latter species was only recently discovered in Russia, in lowland west of Sette-Daban (Ignatova *et al.*, 2013), and now it became clear that it was just flushed down from the range.

Four species of the former *Seligeria*, such as *Blindiadelphus diversifolius, B. sibiricus, B. subimmersus* and *Seligeria tristichoides* grow on rocks along the Segenyakh Creek, where a single locality of *Struckia enervis* was also discovered. Two large populations of *Barbula jacutica* were located in the valley of this creek as well. Banks of Vostochnaya Khandyga River appeared to have a large population of *Scouleria pulcherrima*: this species usually grows in Siberia along larger rivers.

Schist area is interesting especially in lacking species so common only few kilometer apart (Table 3). Among species revealed in the schist area and not found in the calcareous one, are seven species of the Polytrichaceae and six of *Sphagnum*.

Schist slopes which almost lack vegetation are interesting in first record of *Hymenostylium xerophylum* and

Table 2. Number of species of families and genera in some floras of Yakutia (SD: Sette-Daban, KH: Khangalassky District; SKH: Suntar-Khayata Range; AY: Allakh-Yun; OR: Orulgan Range; MKH, Mus-Khaya Peak; UN: Ust-Nera; YA: Yano-Adycha Plateau. Families and genera are chosen to highlight the decreasing of calciphilous species from left to right. The publication on AY (Ignatov *et al.*, 2000) used old approch to *Schistidium* taxonomy and cannot be taken for the present comparison.

	SD	KH	SKH	AY	OR	MKH	UN	YA
Seligeria and *Blindiadelphus*	5	4	1	2	0	1	0	0
Sphagnum	9	13	12	14	17	13	15	14
Pottiaceae	32	30	26	15	26	12	17	13
Grimmia/Schistidium	6/12	4/7	5/8	---	8/4	6/8	8/4	4/4
Total N species	294	232	208	202	241	180	162	173

Species found: only in calcareous areas of Sette-Daban (locs. 1–9);		only in schist areas of Sette-Daban (locs. 10–15)
Andreaeobryum macrosporum	*Loeskypnum badium*	*Amphidium mougeotii*
Barbula amplexifolia	*Meesia triquetra*	*Andreaea rupestris*
Barbula jacutica	*M. uliginosa*	*Bartramia ithyphylla*
Blindiadelphus diversifolius	*Mnium blyttii*	*Bryoerythrophyllum ferruginascens*
B. subimmersus	*M. spinosum*	*Bryum bimum*
Brachythecium coruscum	*M. stellare*	*B. cryophilum*
B. dahuricum	*Myurella sibirica*	*B. moravicum*
B. rotaeanum	*Oncophorus elongatus*	*B. neodamense*
Bryobrittonia longipes	*Orthothecium chryseon*	*Climacium dendroides*
Bryum sibiricum	*Paludella squarrosa*	*Coscinodon hartzii*
Calliergonella lindbergii	*Plagiomnium cuspidatum*	*Cynodontium asperifolium*
Campyliadelphus chrysophyllus	*P. ellipticum*	*C. strumiferum*
Campylidium sommerfeltii	*Platydictya acuminata*	*C. tenellum*
Campylium protensum	*P. jungermannioides*	*Dichodontium pellucidum*
Campylophyllum halleri	*Platygyrium repens*	*Didymodon johansenii*
Catoscopium nigritum	*Platyhypnum norvegicum*	*D. leskeoides*
Cinclidium stygium	*Pohlia wahlenbergii*	*Encalypta ciliata*
C. subrotundum	*Roaldia revoluta*	*E. trachymitria*
Cnestrum alpestre	*Schistidium boreale*	*Grimmia donniana*
C. schistii	*S. dupretii*	*Hymenoloma crispulum*
Cyrtomnium hymenophylloides	*S. relictum*	*Hymenostylium xerophilum*
C. hymenophyllum	*S. subjulaceum*	*Mielichhoferia asiatica*
Dicranella subulata	*S. submuticum subsp. arcticum*	*Mnium marginatum*
Dicranum angustum	*Sciuro-hypnum plumosum*	*Oligotrichum falcatum*
D. montanum	*Scorpidium scorpioides*	*Oxystegus tenuirostris*
D. polysetum	*Scouleria pulcherrima*	*Plagiothecium berggrenianum*
D. scoparium	*Seligeria brevifolia*	*P. cavifolium*
D. undulatum	*S. tristichoides*	*P. denticulatum*
Didymodon fallax	*Sphagnum warnstorfii*	*Pogonatum dentatum*
D. gaochenii	*Splachnum luteum*	*P. urnigerum*
D. perobtusus	*Stegonia latifolia*	*Pohlia crudoides*
Distichium inclinatum	*Stereodon bambergeri*	*P. elongata*
Encalypta longicollis	*S. plicatulus*	*Polytrichum hyperboreum*
Eurhynchiastrum pulchellum	*Struckia enervis*	*P. schwartzii*
Fissidens arcticus	*Syntrichia norvegica*	*Psilopilum cavifolium*
Grimmia elatior	*Tetraphis pellucida*	*P. laevigatum*
G. teretinervis	*Tetraplodon angustatus*	*Pterygoneurum ovatum*
G. tergestina	*Thuidium recognitum*	*Rhabdoweisia crispata*
Hamatocaulis vernicosus	*Timmia bavarica*	*Schistidium tenuinerve*
Hedwigia czernyadjevae	*T. norvegica*	*Sphagnum angustifolium*
H. emodica	*Tortella inclinata*	*S. aongstroemii*
Helodium blandowii	*T. spitzbergensis*	*S. balticum*
Hydrogonium gregarium	*Trichostomum crispulum*	*S. lenense*
Isopterygiopsis alpicola		*S. majus*
		S. teres
		Stereodon hamulosus
		Tetraplodon pallidus
		Timmia austriaca
		Warnstorfia exannulata
		W. sarmentosa

Table 3. Species occurring in Sette-Daban only in one area with either calcareous, or schistose bedrocks.

fairly common here *Anomobryum bavaricum*. In south-facing parts of such slopes in schist area (Fig. 2 B, D), xerophytic species *Pterygoneurum ovatum, Didymodon johansenii, Grimmia tergestina,* and *Tortella densa* were found, as well as the "flag of xerophytes" *Indusiella thianschanica.* The latter species however is not among those differentiating two parts, as it was once found also in calcareous area, where it grows in small quantity, surprisingly, of calcareous rocks nearby *Andreaeaobryum*, the latter adjusted to a seepage on the other side of the same cliff.

Metallophytic *Coscinodon hartzii* and *Mielichhoferia mielichhoferiana,* more common in more eastern parts of Yakutia, are rare in Sette-Daban, collected in one place each, not together.

* * *

Compared with the other parts of Yakutia, especially with lowlands of Central Yakutia (near Yakutsk and in Khangalassky District), the Verkhoyansky Mountain System differs in the absence of widespread East Asian (*Anomodon minor, Plagiomnium acutum, Claopodium pellucinerve, Trachycystis ussuriensis, Myuroclada maximowiczii, Brachythecium buchananii, Plagiomnium confertidens*), or pan-temperate species (*Homalia trichomanoides*, *Fabronia ciliaris, Leucodon sciuroides*) that penetrate to the core of permafrost zone along the Lena River. Here, the "southern element" is represented by montane species with scattered distribution in southern mountains. These two patterns, shown in Fig. 3, were described and discussed by Iwatsuki (1972) in his inter-

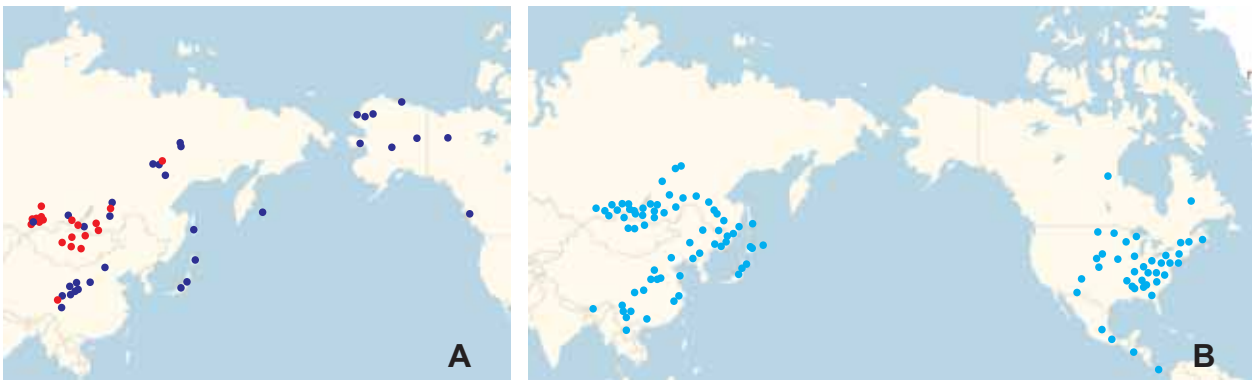

Fig. 3. A comparison of distribution of two species found in Sette-Daban, *Struckia enervis* (A: red) and *Gollania turgens* (A: blue), and *Anomodon minor*, still not found there, but reaching central Yakutia (B), illustrating different types of distribution of the southern elements. Data mainly from http://www.tropicos.org/namesearch.aspx and http://arctoa.ru/Flora/basa.php.

esting comparison of East Asian and North American disjunct mosses.

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