Bryophyte flora of the Magadan Province (Russia) I. Introduction and the checklist of mosses

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ABSTRACT

This paper presents the first of two parts of bryophyte flora study in the Magadan Province (Russia). It provides a review of the area’s geography, climate, vegetation history and current vegetation cover. The checklist of the mosses recorded from the province summarizes all available data on the Magadan Province moss flora, including previously published reports, our own collections and other available specimens deposited in NSK, VBGI as well as MAG and LE. It also includes data on distribution of 364 moss species, 133 of which were not included in the prior summary of the mosses by Blagodatskikh (1984). Each taxon is annotated with data on its frequency, distribution within the studied key plots, elevation and habitats. Despite the relatively large number of species recorded, the checklist is, nevertheless, preliminary. Bulk of taxa from the Magadan Province have been recorded from the western part of the province, whereas the eastern part still remains poorly investigated.

Keywords: bryophyta, Russian Far East, biodiversity, Kolyma, Okhotsk coast, Olskoye Basalt Plateau, phytogeography, North-East Asia

INTRODUCTION

The Magadan Province remains one of the poorly studied regions of Russia in regards to its moss flora. Only within the last 40 years have bryologists taken an interest in the province, and even then, only a few taxa were reported before Dr. Lidia Savelieva Blagodatskikh’s systematic attempt to document the bryophytes at the last quarter of the twentieth century. Over an approximately 15 year span, she conducted research on several local bryophyte floras, and summarized all of her collection data in the “Mosses of Kolyma Upland” (Blagodatskikh 1984). In addition to this valuable survey of the moss flora, Blagodatskikh (1988) also published the first account of the liverworts of the province.

Other roads are extremely local and very few. Due to the latter circumstance, the collecting localities visited by Blagodatskikh, as well as by us, are located mainly along the federal route, Magadan-Susuman-Ust-Nera, and its branch through Khaysn-Omchak (Fig 1). The summary published by Blagodatskikh (1984) lists 234 moss taxa and is a major contribution to the knowledge of the moss diversity both in...

Only a few new bryophyte reports from the Magadan Province have been published since Blagodatskikh’s (1984) work. Most of these were made during the course of our work, although a few were added by the collections of other researchers (Chemeris & Mochalova 2015).

The present paper is the first of two parts devoted to the description of the bryophyte flora of the Magadan Province. The main goal of part one is to provide a general overview of the province, the collecting localities and to list the recorded mosses. Part two will detail the recorded liverworts in the province as well as summarize the bryophyte flora.

**STUDY AREA**

**Climate**

Meteorological stations are very scattered across the Magadan Province and are mostly located in settlements within river valleys. Consequently, the latter provide some limitations towards an understanding of real climate in the areas under investigations. Very approximate information for the province is summarized in Table 1.

The current climate is characterized by short and relatively cool summers, although these can be locally hot and dry in ultracontinental areas. The winters are long and cold with minimum temperatures reaching -60°C and lower. Some regional variation occurs in the areas adjacent to the coastal line, with a relatively strong influence observed at the nearest 15–20 km from the sea shore (Yurtzev 1974, Berkutenko et al. 2010), however by large valleys wet air masses sometimes able to spread for 100 and even 200 km northward from the Sea of Okhotsk. Along the sea coast, the summer is foggy, wetter and much colder than in inner areas of the Kolyma Plateau. The opposite situation is characteristic of winters when coastal areas have much warmer weather than the interior of the Kolyma Upland. The average annual temperature in the Magadan region varies from -2°C in the continental districts. The thermodiary role of the sea provides a relatively long frost-free period: as a rule, on most of the coast, the temperatures below zero in Celsius scale begin in the third month of September and end in the first month of June; the duration of the frost-free period exceeds an average of 100 days. In continental areas in some years, the frost-free period (the duration of days without even morning frost exceeds 30 days) is not observed. Winter in the Magadan region lasts from 6 months in the South to 7.5 months in the North. Snow occurs on average by the middle of October (in some years to a month earlier) and disappears by May. The Magadan Province is situated completely in the land with permafrost ground distribution. Sometimes this results in additional wetting of the ground and development of swampy communities (although the mountainous relief commonly impedes these processes) and making soils poor in nutrition and acidic for plants.

**Vegetation**

The vegetation of the Magadan Province possesses a Hemiarctic nature (Fig. 2) and is completely included in the Hemiarctic (=Hypoarctic) Botanical-Geographical zone, in the sense of Yurtzev (1966). However, the vegetation and flora at its southernmost extreme is noticeably different from the remaining land and possesses a somewhat transitional character to the Boreal (taiga) zone (Yurtzev 1966). Various types of mountain tundras are widely distributed in the Magadan Province. The communities similar to the arctic
tundras are observed at the elevations exceeding 1000 and more meters a.s.l. The fundamental difference between the Hemiarctic tundras (southern and typical) from the arctic ones is in their origin. The former may be called a north taiga derivative and is somewhat similar to the vegetation ground cover developed under canopy of boreal forests (Yurtzev 1966). Other common types of vegetation are lightened larch forest and scattered larches, Pinus pumila thicketts, swamps and meadows. Below we provide a short review of the basic communities with the main attention to those bryophytes were collected.

The large river floodplains are occupied by Populus–Chose­nia forests with a light or more robust admixture of various tall willows. Kharkевич (1984) and later Khokhryakov (1989) suggested that these forests were possibly strongly transformed derivates of the so-called ‘arcto-tertiary’ (= ‘arctoboreal’) forests. Not contesting this assertion, it is worth noting that the bryophyte flora could hardly confirm this statement, due to the absence of temperate (and poor presence of bryophytes at all) taxa that result from tall grass vegetation. Therefore, it is worth noting that the latter species does not specific to them, although coastal Alneta houses some rare taxa whose distribution is limited in the Magadan Province by this type of community. For instance, Rhyti­diadelphus subpinnatus, R. triquetrus, Myriophyllum longiramea, M. mazzanowiczii and Herzeggilja adven­dens were observed along the Sea of Okhotsk only, or were mainly growing along stream banks in crooked Betula forests and Dushek­ka fruticosa thicketts. Almost the same can be said about Trachycystis flagellaris, Dieranum pycnatum and Bartramniopsis lecointei. The only locality for Mylia verrucosa in the Magadan Province is in the Dushek­ka crooked forest along small streams near Magadan city. Furthermore, it is worth noting that the latter species sporadically occurs along the western coast of the Sea of Okhotsk, but is not found in the Kamchatka Peninsula in much more southern latitudes. This may confirm the theory emphasized by Kharkевич (1984), and discussed by many other authors starting from Komarov (1950), who argued that this land was inhabited mostly from the north, but not from the south (via Kurils), thus by taxa passing through the ‘hypoarctic filter’ as in Yurtzev’s (1974) terminology.

The larch forests (Fig 2: D, G) formed by Larix cajanderii occupies large landscapes, although rarely form dense canopies and mostly presented by lighted swampy forests or larch trees scattered over shrubby vegetation or solitary crooked shrubby trees (sprawled form). The larch forests are, as usual, developed over well-drained mountain slopes,

<table>
<thead>
<tr>
<th>Floristic district (number of plot)</th>
<th>Nearest meteoestation (with Cyrillic script), coordinates, altitude</th>
<th>Mean annual temperature, °C</th>
<th>Mean January temperature, °C</th>
<th>Mean July temperature, °C</th>
<th>Average frost-free period, days</th>
<th>Average annual precipitation, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kolymsky (1)</td>
<td>Canyon (Каньон) 63°N, 152°E; 686 m alt.</td>
<td>-11</td>
<td>-30.7</td>
<td>12.2</td>
<td>48</td>
<td>484</td>
</tr>
<tr>
<td>Kolymsky (4)</td>
<td>Yugodnoye (Ягодное) 63°N, 150 E; 504 m alt.</td>
<td>-11</td>
<td>-33.3</td>
<td>14.2</td>
<td>51</td>
<td>306</td>
</tr>
<tr>
<td>~ / ~</td>
<td>Jack London Lake (оз. Джека Лондон) 62°N, 149°E; 808 m alt.</td>
<td>-11.2</td>
<td>-30.4</td>
<td>12.1</td>
<td>70</td>
<td>306</td>
</tr>
<tr>
<td>Okhotstko-Kolymsky (5)</td>
<td>Omsukchan (Омскuchen) 63°N, 156°E; 526 m alt.</td>
<td>-11.1</td>
<td>-33.4</td>
<td>13.2</td>
<td>49</td>
<td>297</td>
</tr>
<tr>
<td>Okhotstko-Kolymsky (6)</td>
<td>Madaun (Мадаун) 61°N, 151°E; 523 m alt.</td>
<td>-9.5</td>
<td>-29.8</td>
<td>13.0</td>
<td>49</td>
<td>355</td>
</tr>
<tr>
<td>Okhotstsky (8)</td>
<td>Magadan (Магадан) 60°N, 151°E; 115 m alt.</td>
<td>-3.5</td>
<td>-17</td>
<td>11.2</td>
<td>114</td>
<td>526</td>
</tr>
</tbody>
</table>
commonly with shrubs, including *Pinus pumila* in the understory, and ground cover composed by dwarf shrubs and meso- to xero-mesophitic mosses. The swampy lighted larch forests occur more rarely. The dominant ground cover is *Sphagnum* spp. and several ericoid dwarf shrubs. The larch forests are very light, decaying wood is commonly dry, and obligate epixylous taxa are rare or absent in this kind of forests. The bryophyte composition in the ground cover drastically varies from the absence of mosses (in forests with grass cover) to xero-mesophytes (like *Rhytidium rugosum*, *Barthelophyza barbata*, *Laphrozephis excisa*) or, under more wet conditions, exhibit the type of vegetation typical of mires (*Sphagnum* spp., *Anhalonium palustre*, *A. turgitum*). The epiphytes are rare in larch forests (only *Ptilidium pulcherrimum* was observed among the liverwort collections).

*Pinus pumila* thickets (Fig. 2: I) occupy large landscapes and the latter is the common edificator of communities. However the density of the canopy as well as the distribution frequency is much lower than in, e.g. the Kamchatka Peninsula. The latter is the direct consequence of poor snow cover in the winter. It is worth noting that although dwarf pine communities are commonly regarded to be tantamount to taxonomically poor floras (due to the absence of the both typical alpine and forest taxa), the situation in the Magadan Province is somewhat different. Due to the lighted character of those communities, the quantity of booreal (forest) taxa exceeds the number of boreal taxa in larch forests. Moreover, some temperate taxa (the striking example is *Bazzania trilobata*) occur here.

The forestless landscapes (Fig 2: A–C, E, F, H) are quite diverse in the Magadan Province and may be subdivided into the following types.

Alpine communities at apical part of narrow ranges along the Sea of Okhotsk. The peculiar trait of this habitat is the absence of forests that could be explained by low temperatures, but is a consequence of rather dry (well-drained) substrates, severe wind regime and very thin snow cover during the winters. The potential for altitudinal
distribution of *Pinus pumila* (or, even, ‘normal’ trees) is not maximized there, as it is in the more southerly Kurils, Sakhalin and southern Sikhote-Alin.

Moist tundras, including communities somewhat intermediate between tundras and alpine meadows and swamps, developed due to a complexity of factors, including (each factor may play the role of various value): low temperatures, thermal inversions, and over-wetting. The floristic difference between moist mossy tundras and meso- or even oligotrophic mires are lessened. The high levels of moisture results in a sudden increase of taxonomic diversity of liverworts (with the exception of mesotrophic moss-grass meadows, where the number of bryophyte species is not so high).

Drier, flattened forestless landscapes in apical portions of smoothed hills and mountains at middle elevation and drier slopes above timberline in the interior part of the Kolyma Upland. The absence of forests in those areas is the result of low temperatures as well as dryness of substrates (due to high drainage abilities). The presence of mosses and liverworts there is largely dependent on local moisture. In areas with some amount of percolate water, small-sized communities similar to those near small streams may be observed. In other cases, the liverworts occupied relatively moist cliff crevices (a rare occasion in the Kolyma Upland) and fine soils in the crevices between stones in stony fields.

The communities forming the banks along streams contain a special complex of bryophytes (the banks of large streams and, especially rivers are commonly taxonomically poor due to regular disturbance of vegetation cover during floods or due to high coverage by grasses and shrubs). This type of habitat is the richest for both liverworts and mosses. Due to the ‘azonality’ of this habitat, it only slightly differs across altitudinal levels. Only a few taxa occurring in upper elevation levels do not occur down along the stream courses. Moreover, in some cases the absence of alpine taxa in the lower courses may be explained by changes in bedrock composition, but not in the climate change across an altitudinal gradient (it is worth mentioning that climatic changes are not as drastic as they are in more southerly latitudes, since the Magadan Province lies completely in the Hemiarctic, smoothing the difference between the stream bank floras of the lower and higher elevations). Closely connected to stream bank communities are those developed in snowbed habitats. The latter type of habitat is a relatively rare occasion in the inner part of the Kolyma Upland, due to high drainage abilities of the substrata (water from melting snow going directly underground at the place of its melting instead of spreading and forming overwetted soils). However, where the situation is different, the peculiar nival complexes can be observed, being nevertheless poorer in taxa than the sources of small streams in tundras.

The distribution of vegetation communities is closely related to the chemical composition and structure of the ground (or bedrocks). For the most part, the Kolyma Upland is open to the sun by argillaceous slates – an exceedingly loose and well-drained substrate. Then, only xeric communities relatively poor in bryophytes (although containing some specific mosses, like *Aloina rigida*) are developed. Curiously, even limestone substrates are more ‘waterproof’ than argillaceous slates. This is one of the reasons for the comparatively high diversity (both in vascular plants and bryophytes) observed in the Olskoye Basalt Plateau (regarded as a floristic ‘oasis’ by Yurtzev & Khokhryakov 1975), where basalts form firm waterproof beds and promote the development of a water-dependent flora. The granitic bedrocks are opened rarely in the Kolyma Upland. The largest outcrops are along the Sea of Okhotsk in units with a wetter climate and promote the formation of a flora with many meso- and hygrophytes.

It is worth noting that the vegetation cover in some inner areas of the Kolyma Plateau is in contrast between nominal precipitation amount and the meso-hygrophytic character of the flora in most of the localities. This may be explained by the durable foggy period when the precipitation amount is formally almost nil, but evapotranspiration also remains very low, resulting in the survival of a highly water-dependent flora.

The nominal structure of vegetation within three reviewed geobotanical districts is summarized in the Table 2 and briefly annotated below (Berkutenko et al. 2010).

**Chersko-Verkhoyansky geobotanical district** (= Kolymsk floristic district) is characterized by a lower altitudinal belt covered by lighted swampy *Larix* forests, becoming crooked and with *Pinus pumila* understory near the upper limit. The large areas are covered by mountain tundras of various composition and gravelly barrens. Some dry slopes are occupied by scattered steppe vegetation.

**Okhotsko-Magadansky geobotanical district** is characterized by the dominance of lighted *Larix* forests. The timberline occupies 600–650 m a.s.l. (considerably lower than it is inland!), below timberland, dwarf pine (*Pinus pumila*) are common, and below 400 m a.s.l. change to larch and birch-larch forests.

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**Table 2.** The structure of vegetation cover of geobotanical districts, where bryophytes were collected, coverage in percentage

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Okhotsko-Magadansky</th>
<th>Kolymsky mountainous</th>
<th>Chersko-Verkhoyansky mountainous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemiarctic tundras</td>
<td>8.8</td>
<td>5.3</td>
<td>6.5</td>
</tr>
<tr>
<td>Pinus pumila thickets</td>
<td>23.9</td>
<td>22</td>
<td>16.8</td>
</tr>
<tr>
<td>Scattered and lighted <em>Larix</em>-forests</td>
<td>39.6</td>
<td>34.2</td>
<td>47.2</td>
</tr>
<tr>
<td><em>Populus-Chosenia</em> floodplain forests</td>
<td>1.5</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Shrubby thickets</td>
<td>4</td>
<td>4.1</td>
<td>4.1</td>
</tr>
<tr>
<td>Mires</td>
<td>10</td>
<td>1.4</td>
<td>2</td>
</tr>
<tr>
<td>Meadows</td>
<td>1.8</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Alpine gravelly barrens and tundras</td>
<td>10.4</td>
<td>32.4</td>
<td>22.9</td>
</tr>
</tbody>
</table>
Kolymsky mountainous geobotanical district (= Okhotsko-Kolymsky floristic district) is somewhat superficially similar to the Chersko-Verkhoyansky mountainous geobotanical district. The lower altitudinal levels are covered by relatively low (less 15 m tall) lighted larch forests, with dense dwarf pine understorey in the upper elevations and in the dry river terraces. The alpine tundras and gravelly barrens are similarly widely distributed. The peculiar trait of this vegetation in the district are wider distributions of Pinus pumila, lower timberline and virtual absence of steppe communities, all listed are a consequence of wetter and colder summers.

General trends in flora formation in the Upper Pleistocene and the Holocene

Knowledge of the flora of the Magadan Province (largely corresponding to the Kolyma Upland), is valuable for the understanding of the origin of the flora (in a broader scale – for biota development) in North-East Asia. Magadan Province covers the South-Western part of the so-called Mega-Beringia and is, on one hand, a refuge for relics of the cryo-xeric stage of biota development, while, on the other hand – provides a link between the migration routes uniting boreal (taiga) and alpine floras of East Siberia with the Beringian sector of the Hemiarctic (Yurtzev 1966). The Kolyma Upland is also a place of origin for numerous autochthonous elements, although the latter mostly applies to the vascular plants rather than to bryophytes which have exceedingly low speed of speciation.

As Yurtzev & Khokhryakov (1975:129, translated from Russian original by VB and OP) wrote “the essential trait of Kolyma Upland geography is its position in the closest neighborhood of ultracontinental climate (North East Yakutia) and areas with oceanic climates (Sea of Okhotsk shore) that house highly contrasting floristic complexes”. The consequence of this proximity, as referenced by these authors, is the somewhat instability of the coenotic position of the taxa belonging to both the contrasting groups, as well as the somewhat dualistic nature of the North-Okhotsk Province composition.

Presently there is much paleobotanic evidence that, in general traits, supports Yurtzev’s point of view (Yurtzev 1966, 1974, etc.). To simplify, the genesis of vegetation cover in the Magadan Province may be described by the following steps. The general cooling trend became obvious at least at the end of the Miocene and is accessed as the maximum in the Upper Pleistocene and the Holocene. The consequence of this proximity, as referenced by these authors, is the somewhat instability of the coenotic position of the taxa belonging to both the contrasting groups, as well as the somewhat dualistic nature of the North-Okhotsk Province composition.

The analysis of sediments in Vodopadnoye Lake (near Magadan city, locality 8) covers the time from the Atlantic stage of the Holocene, and initially shows a larger than now distribution of grass and grass-wormwood communities. Anderson et al. (2000) explain the latter by indicating that a slight cooling occurred in the climate at that time. After the Atlantic period, the vegetation exhibits uneven, but a steady increasein Pinus pumila, Betula lanata, Larix and ‘Alnus’ (probably Duschekia).

Available data on the Sea of Okhotsk – Kolyma River mega-watershed (Chyornoye and Priaynotye Lakes surroundings, ca. 61°01’N 151°43’E, 850-900 m a.s.l., near locality 3) covers the time from the Zuryanskoye glaciation to the present (Lozhkin et al. 2000). During the Zuryanskoye glaciation, there was a dominance of Selaginita rupestris (the most common taxon of cryo-xeric epochs in the Kolyma Upland) with the dominant vegetation described as ‘tundra-grass’ and ‘grass-shrub’ communities. The palynological spectra for 11000 PB characterize this vegetation as Alnus-Betula krumholtz. In the Preboreal stage of the Holocene the strong increase of Pinus pumila notes a return to the previous Boreal distribution and the beginning of the Atlantic stages. Within the Atlantic stage, the timberline began going down and the altitudinal ‘width’ of the Pinus pumila belt became wider, the presence of Duschekia decreased, but this was compensated by the increased coverage of communities with Artemisia (cited authors describe this as wormwood communities dominance in well-exposed slopes). During the Subboreal and the Subatlantic stages, the vegetation (Lozhkin et al. 2000) may be characterized as combinations of Pinus pumila-Duschekia-Betula-Larix.
with a large percentage of ericoid dwarf shrubs and peat mosses. The latter may confirm the development of moist communities with Ericaceae (like moist hummocky tundras). The vegetation at that time exhibits features closest to the current. The data on the adjacent areas (Annachag Range: Lozhkin 1997) confirm vanishing dwarf pines at the beginning of the Sartanskoye glaciation and further development of ‘wormwood-grass’ tundra. Later, as far as 12500 BP, the grass tundra over the period less than 1000 years was replaced by Betula-Duschekia krumholtz and then lighted Larix forests. The next expansion of Pinus pumila took place about 9000 BP, when associations similar to the present were formed.

The reconstruction of vegetation changes at Smorodinovoye lake (about 100 km northward from locality 3) showed that the vegetation at 22000 BP was a mosaic of various vegetation communities such as xerophilous grasses and Selaginella in steep slopes, and wetter sedge-moss and sedge-grass communities with creeping willows. These are not the so-called uniform ‘mammoth tundra-steppe’ as it would be expected (Anderson et al. 1998: 36). The grass tundras were quickly changed for shrubby-birch tundra about 12000 BP.

There are data on the vegetation development in the Armanskaya depression (near locality 7) from the end of the Pleistocene that cover stages from the Zyranskyoye glaciation to the present (Anderson et al. 1997). This area is of special interest because it is adjacent to the Sea of Okhotsk, and presumably should provide more moist environments due to the proximity of the sea. As it was shown (l.c.) the glaciation in the course of the Zyranskyoye glaciation was much more intense than in the inner areas of the Kolyma Upland. However, even there, within depressions, the glaciation was very thick (up to 600 m ice shield thickness), while in some upraised stations the ice cover was absent or very thin. In general, this glaciation had ‘net’ character. The areas occupied by ice during the Sartanskoye glaciation were smaller than in the Zyranskyoye one. Glaciers were up to 15 km in length in the valleys, but did not completely cover them. It is likely that possible remnants of flora survived there from the time preceding the two last glaciations. It is interesting that despite the similarity of the vegetation in the course of glaciations in maximum cooling periods (Poaceae dominance, wide distribution of Selaginella), their are nevertheless elements of mesic vegetation, including wide distribution of Sphagnum, Cyperaceae, Sanguisorba, Cardamine, etc. This is probably the result of the relative proximity of the sea coast, that although was distanced from the Armansky (Kamenny) Range for one or two hundredth kilometers southward due to shelf drainage in the course of eustatic process. The considerable changes of vegetation were noted (as in other sites of Kolyma Upland) for ca. 12300 BP. At that time, the large-scale reorganization of vegetation was common; it resulted in the replacement of the grass tundra by dwarf shrub-dwarf birch tundra (30 % of birch pollen grains belong to shrubby birches, like Betula exigilis). The Boreal period is characterized there by the largest distribution of forests (at the same time the forests reached the coast of East Siberian Sea. Lozhkin & Glushkova (1997) provided data on the vegetation changes in the lower course of the Ola River. They showed the larger than at present, distribution of forest vegetation not only in Boreal, but also in the Atlantic stages. Moreover, authors (l.c.) also evidently showed the formation of shrubby vegetation along watercourses 20000 BP (near maximum of glaciation!). The mentioned shrubby vegetation was composed by ericoid shrubs, willows and even solitary Pinus pumila (if the latter is not the result of long-distance pollen dispersal), whereas in most of the area, the meso-xerophilous communities were dominated.

There is some data on the most floristically interesting area in Kolyma Upland – the Olskoye Basalt Plateau (locality 6) and adjacent areas. The peat strata in the upper course of the Maltan River cover the interval from the end of the Sartanskoye glaciation (ca. 12000 BP) to the present (Lozhkin & Glushkova 1997b). The general traits of vegetation changes correspond to the changes in other areas of the Kolyma Upland; grass dominance and absence (or very poor presence) of woody vegetation is changed to a dominance of forest and shrubby landscapes. The presence of spore-bearing plants remained more or less stable, although several sudden increases and then decreases were observed. These fluctuations probably were the result of local fluctuations and likely weren’t connected with the general regularities of florogenesis.

It worth mentioning that some of the theoretical hypotheses by Yurtzev (1974) are partly confirmed (or at are least highly likely) as shown in the subsequent paleobotanic studies cited above:

1. The character of vegetation cover was different in various parts of Megaberingia during maximal cooling. In the middle part of Megaberingia (the usage of the tern is after Yurtzev 1974) the maximal cooling was characterized by dry a continental climate with relatively warm summers, whereas the climate in the northern extremes was strongly colder that in the interior and, in southern extremes the climate was wetter than the interior. The latter circumstance permitted the survival of many mesophytic elements including some woody taxa.

2. The basic traits of climates during the ‘entrance’ to the glaciation time were different from the climate traits at the ‘exit’ from glaciation. The ‘entrance’ time was characterized by cool and wet climate, whereas the exit – by warmer and drier climate.

The changes of water level in oceans were accompanied (in local aspect even promoted!) by climate changes when ocean coast ‘receded.’ Far northward, as far as Wrangel Island, was united with the continent, while almost the whole continental shelf was drained. Similar water level changes occurred southward the in the Sea of Okhotsk. Most of these water level changes had the glacio-eustatic nature (e.g. Zyranskyoye and Sartanskoye glaciations), however sometimes they might be associated with the increasing of capacity of oceanic depressions. The valuable consequence of this water level changes and corresponding changes in coastal line position is the fact that the search for geographic relics (meaning the taxa alien to the current vegetation that survived cooler conditions nearly in the same site where it...
occurs nowadays) is reliable in the middle part of Megaberingia, whereas: a) in northern extremities it may be under some doubts (with the exception of Wrangel Island) and b) inapplicable to mesophytic boreal elements of northern coast of the Sea of Okhotsk, that provides some warming and wetting influence not more than 20–30 km as in the present. The latter consequence, however, is likely to be doubtfull since, as Anderson et al. (1997) showed, the ‘oceanic’ influence at that time probably stretched as far as the Kamenny Range, although, certainly, to a much lesser degree than it does now.

MATERIAL AND METHODS

Between 2010 and 2014, V.A. Bakalin organized several expeditions to explore the bryoflora of the Magadan Province. A number of key areas in isolated localities could only be reached and surveyed by long distance hikes: Bolshoj Tunnakh Range, Seimchan River upper course, Zamkovaya Mr., Olskoye Basalt Plateau, Kamenny (=Armandsky) Range in Okhotsk coast and others. Bakalin’s own investigations were concentrated on hepatics, where he (by himself) collected a rather limited number of specimens, although larger collections were gathered under his supervision by E.N. Malashkina (2011) and A.V. Ermlenko (2012, 2013). The late V.Ya. Cherdantseva (1939–2013) initially identified the collections, revealing several new moss distribution records for the region (Cherdantseva & Bakalin 2011, Malashkina 2012). Later, O.Yu. Pisarenko undertook fieldwork in the Magadan Province areas of Bolshoj Annachag Ridge and Olskoye Basalt Plateau, during the summer of 2014 (Pisarenko 2015a, 2015b, 2015c). She continued processing and determining the remaining aforementioned specimens.

The current paper summarizes the results of these specimens (ca. 2000 collections). A list of collection localities is provided in Table 3, and corresponds to the map in Fig. 1. It is easy to see that the vast majority of the province remains completely unexplored.

The localities are situated within three floristic districts of the Magadan Province (Fig. 1): Kolymsky, Okhotsk-Kolymsky and Okhotsky (Kokhriakov 1985). The latter regionalization follows the recent Flora of vascular plants of Magadan Province (Berktuteno et al. 2010), although with name changes for (correspondingly): Cerska-Verkhoyansk mountainous, Kolyma mountainous and Okhotsk-Magadan geobotanic regions.

Most of the Kolyma Uplands is exposed to the sun by loose strata of argillaceous slates – a material with high drainage ability and commonly very dry and unfavorable for bryophytes. We were quite limited, therefore in finding suitable areas for study. Aside from this basic restriction, the main objectives for selecting collecting localities were 1) to find sites with more or less stable bedrock composition, 2) to cover areas along the sea shore as well as areas at a distance from it (inner part of the Upland) with drastically different climatic conditions, 3) to cover floras that develop on chemically various types of ground (limestone and basalts to granites) and 4) to cover all (or nearly so) the types of vegetation communities present in the Magadan Province. Table 1 provides a list of the main studied localities that can be divided into the following groups according to the aforementioned requirements:

- **locality 1** – dominant argillaceous slates with many bedrock outcrops composed by limestone and granites in ultracontinental climate;
- **locality 2** – dominant argillaceous slates with limestone outcrops and dominant argillaceous slates in continental climate;
- **locality 3** – Kolyma upper course lowlands with some limestone outcrops and dominant argillaceous slates in continental climate;
- **locality 4** – dominant granite outcrops in ultracontinental climate;
- **locality 5** – dominant argillaceous slates with some metamorphic limestone dikes in continental climate;
- **localities 6** – ‘alkaline’ bedrocks composed by basalt, with some dikes (?) of granites in continental climate;
- **localities 7, 8** – granitic bedrocks in merely mild subcontinental climate along the shore of the Sea of Okhotsk.

The background studies conducted by vascular plants specialists (e.g. excellent Olskoye Basalt Plateau flora analysis by Yurtzev & Khokhryakov 1975) made selecting localities easier in many cases.

Each specimen collected was annotated with the elevation, geographic coordinates, habitat (including presumable ground characteristics, shadiness, water availability, etc.) and associated taxa. Short plant community descriptions were compiled for the majority of occurring types with the practical purpose of sorting observed taxa within vegetation subunits.

LIST OF SPECIES

This list summarizes the authors’ collections (VBGI, NSK) as well as the literature data, and specimens kept in MAG and LE with the latter only partly revised. Nomenclature follows Ignatov et al. (2006) with a few recent updates. Each species is annotated by the template: its frequency – floristic districts where the species is known and author’s locality numbers in case if they are (following Fig. 1 and Table 3) – altitude range (altitude belt) – main habitats. When the abbreviation of the floristic district is given without extension by localities or references, it means that the species is known for the district only from Blagodatskikh 1984.

The frequency is given as a rough estimate: common-sporadic-rare-unique (com-sp-r-un). Abbreviations for the floristic districts is K – Kolymsky, OK – Okhotsk-Kolymsky, O – Okhotsky and GO – Gizhigsko-Omolonsky. Abbreviations for the altitude belts are: fb – forest belt, sb – shrubs belt and gb – golzi (=alpine, =forestless) belt.

The presence of sporophytes within a sample is marked “S+”. For species which were collected 1–2 times only, full labels are cited. For samples which were collected/identified not by Pisarenko, the names of the the collectors are indicated. The citations of herbarium labels are given in square brackets, and the acronym of the herbarium in curly brackets.

Publications appearing after the account by Blagodatskikh (1984) was published are cited by floristic districts, with the exception for Pisarenko’s works (2015a,b,c). Species added to the flora of the Magadan Province since the paper by Blagodatskikh (1984) are marked by an asterisk (*). The same concerns the regions for those the new records.
Table 3. Collecting localities in Magadan Region.

<table>
<thead>
<tr>
<th>No</th>
<th>Locality</th>
<th>Altitude, m</th>
<th>Latitude, N</th>
<th>Longitude, E</th>
<th>Year</th>
<th>Collector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kolyma Upland, Bolshoj Tuonnakh Ridge, Verina River basin</td>
<td>1100–2000</td>
<td>63°16’–63°18’</td>
<td>151°02’–151°06’</td>
<td>2011</td>
<td>Bakalin &amp; Malashkina</td>
</tr>
<tr>
<td>2</td>
<td>Kolyma Upland in upper course of Kolyma River, (Magadan State Nature Reserve), Zamkovaya Mt. area</td>
<td>170–530</td>
<td>63°20’</td>
<td>152°35’</td>
<td>2011</td>
<td>Bakalin &amp; Malashkina</td>
</tr>
<tr>
<td>3</td>
<td>Basin of Scimchen River ca.60 km upstream of Scimchen Settl</td>
<td>350–700</td>
<td>63°17’</td>
<td>152°10’</td>
<td>2010</td>
<td>Bakalin</td>
</tr>
<tr>
<td>4</td>
<td>Southern spurs of the Cherskii Mountain System, Bolshoy Annachag Range</td>
<td>800–1600</td>
<td>62°07’–62°13’</td>
<td>149°18’–149°30’</td>
<td>2014</td>
<td>Pisarenko</td>
</tr>
<tr>
<td>5</td>
<td>Omsukchan District, DYugadyak and Kilgana Rivers watershed</td>
<td>900–1400</td>
<td>61°11’–61°13’</td>
<td>153°54’–153°59’</td>
<td>2012</td>
<td>Bakalin &amp; Ermolenko</td>
</tr>
<tr>
<td>6</td>
<td>Omsukchan District, DYugadyak and Kilgana Rivers watershed</td>
<td>850–1460</td>
<td>60°34’–60°42’</td>
<td>151°14’–151°32’</td>
<td>2011</td>
<td>Bakalin &amp; Malashkina</td>
</tr>
<tr>
<td>7</td>
<td>Coast of the Sea of Okhotsk, Kamennyj Ridge</td>
<td>400–1060</td>
<td>59°47’–59°49’</td>
<td>149°38’–149°42’</td>
<td>2013</td>
<td>Bakalin &amp; Ermolenko</td>
</tr>
<tr>
<td>8</td>
<td>Coast of the Sea of Okhotsk, Oksa River basin</td>
<td>0–100</td>
<td>59°39’</td>
<td>150°29’</td>
<td>2011</td>
<td>Bakalin &amp; Malashkina</td>
</tr>
</tbody>
</table>

Author’s specimens are deposited in NSK and VBGI; full labels are incorporated into the Data Base Arctoa (http://arctoa.ru/Flora/basa.php).

**Abietinella abietina** (Hedw.) M. Fleisch. – com – K: 1–4; OK: 5, 6; O: 7, 8; GO – 0–1400 m (fb, sb, gb) – wetlands, wet Larix forests, Betula euritica shrubs and tundra, wet niche among rock fields – S+.

**Aulacomnium palustre** (Hedw.) Schwägr. – com – K: 1–4; OK: 5, 6; O: 7, 8; GO – 0–1400 m (fb, sb, gb) – wetlands, wet Larix forests, Betula euritica shrubs and tundra, wet niche among rock fields – S+.

**Aulacomnium turgidum** (Wahlenb.) Schwägr. – com – K: 1–4; OK: 5, 6; O: 7, 8; GO – 300–1400 m (fb, sb, gb) – Duschekia fruticosa thickets, open Larix forest, tundra, bogs and wet rock outcrops – S+.

**Bartramia ithyphylla** Brid. – com – K: 1–4; OK: 5, 6; O: 7, 8; GO – 300–1400 m (fb, sb, gb) – crevices in rock outcrops, open grassy slopes, tundra, nival habitats – S+.

**Bartramia pomiformis** Hedw. – r – K: 1; OK: 5, 6; O: 300–1400 m (fb, sb, gb) – crevices on rock outcrops, fine soil between stones – S+.

**Bartramia subulata** Bruch et Schimp. – com – K: 1–4; OK: 5, 6; O: 7, 8; GO – 0–1400 m (fb, sb, gb) – open grassy slopes, tundra, nival habitats – S+.

**Blindia acuta** (Hedw.) Bruch et Schimp. – com – K: 1–4; OK: 5, 6; O: 7, 8; GO – 0–1400 m (fb, sb, gb) – open grassy slopes, stream banks, tundra.

**Brachytheciastrum trachypodium** (Brid.) Ignatov & Huttunen – sp – K: 1; OK: 6; O: 8 – 300–1450 m (fb, sb, gb) – open grassy slopes, stream banks, tundra.

**Brachythecium boreale** Ignatov – r – K: 4; OK: 6 – 400–1300 m (fb, sb, gb) – crevices on rock outcrops, stream banks, soil in dry gravelly tundra.

**Brachythecium cirrosum** (Schwägr.) Schimp. – r – *K: 2; OK: 6; O: 20–1450 m (fb, sb, gb) – fine soil on rock outcrops.

**Brachythecium jactuticum** Ignatov – r – K: 4; OK: 5, 6 – 340–1460 m (fb, sb, gb) – crooked Betula forests and floodplains.

**Brachythecium milleaum** (Schimp.) Schimp. – r – *K: 2; OK: 6; O: 8 – 300–1200 m (fb, sb, gb) – stream banks.

**Brachythecium rieulare** Schimp. – r – *OK: 6; O: 8 – 300–1200 m (fb, sb, gb) – stream banks.

**Brachythecium udum** I. Hagen – r – K: 4; OK: 8 – 360–1150 m (fb, sb) – Pinus pumila thickets, rock outcrops.
Brediliera pratensis (W.D.J. Koch ex Spruce) Loeske – un – OK: 6 [Olskoye Basalt Plateau, upper course of Ola River (60°41'09.3"N 151°14'03.6"E), 1170 m alt., wetlands, floodplains, wet tundra (Blagodatskikh 1984).]


Pisarenko & Bakalin

Bryeorythryphyllophyllum recurvoirnatum (Hedw.) P.C. Chen – r – K: 1; *OK: 6; O: 8 – 1000 m (fb, sb, gb) – rock outcrops, tundra, stream banks – S+.

*Bryoxiphium norvegicum (Brisl.) Mitt. – un – O: some collections in different years from the same cliffs along a stream near Magadan city, 300 m (Cherdantseva & Bakalin 2011, Pisarenko et al. 2015) – S+.

*Bryum alveolicum Sendtn. ex Müll. Hal. – un – K: 1, 1B: 400–600 m (fb) – wetland, wet tundra, rock outcrops; 1170 m alt., wetland, wet tundra with Carex, Eriophorum, Kobresia spp., in moss cover, 5.VIII.2011 [NSK].

*Bryum amblyodon Müll. Hal. – r – several specimens from the same locality collected in different years; some samples were treated by Zolotov. OK: 6 – 900–1100 m (gb) – tundra, rock outcrops.

*Bryum argenteum Hedw. – sp – K: 4; O: 6 – 500–600 m (fb) – floodplains, eroded soil.

*Bryum bimum (Schreb.) Turner – R – K: 1; OK: 6 – 500–1100 m (fb, sb, gb) – wetlands, stream banks.

*Bryum bimucronatum Hedw. – un – O (Duckha River) – floodplain, soil (Blagodatskikh 1984).

*Bryum cycrophilum (Schwär.) Bruch et Schimp. – r – K: 2; OK: 6 – 900–1100 m (sb, gb) – stream banks.


*Bryum longisetum Hedw. – sp – K: 4; O: 6 – 500–1200 m (gb) – stream banks.

*Bryum longisetum Hedw. – un – O (Duckha River) – floodplain, soil (Blagodatskikh 1984).

*Bryum pseudotrifurcatum (Hedw.) P. Gaertn. B. Mey. & Scherb. – un – K: 1, 4; OK: 6; O: 8 – 300–1300 m (fb, sb, gb) – wetlands, stream banks.

*Bryum pseudotriquetrum (Schw.) Bruch et Schimp. – com – K: 1 – 1000–1400 m (gb) – eroded soil in tundra, fine soil inbetween stones – S+.

*Bucillya aphylla Hedw. – sp – K: 4; O: 8 – 50–1100 m (fb, sb) – eroded soil along roads, naked peat on bogs – S+.

*Bucklandiella microcarpa (Hedw.) Bednarek-Ochya & Ochya – r – K: 4; O: 8 – 500–1300 m (fb, sb, gb) – stones – S+.

*Bucklandiella sudetica (Funck) Bednarek-Ochya & Ochya – sp – K: 4; O: 8 – 200–1470 m (fb, sb, gb) – rock outcrops, stones along stream banks – S+.

Buxbaumia aphylla Hedw. – r – K: 4; O: 8 – 50–1100 m (fb, sb) – eroded soil along roads, naked peat on bogs – S+.

*Calilalaria curvicaulis (Jur.) Ochya – un – K: 4 [Vicinity Yagodnoye Settlement, Debin River (62°28'04"N 149°47'40"E), 445 m alt., schist outcrops along the bank 3.VIII.2014] [NSK].

Calliergon cordifolium (Hedw.) Kindb. – sp – K; O – wetlands, floodplains (Blagodatskikh 1984).

Calliergon giganteum (Schimp.) Kindb. – r – K; O – wetlands, floodplains (Blagodatskikh 1984).

*Calliergon megalophyllum Mikut. – r – K (Chermis & Mochalova 2015); OK (Chermis & Mochalova 2015) – (fb) – wetlands, floodplains.

Calliergon richardsonii (Mitt.) Kindb. – r – K; OK: 6; O – 300–1100 m (fb, sb, gb) – wetlands, stream banks.

Calliergonella cuspidata (Hedw.) L. Ochse – un – O (River Ola close to Gadlya Settlement, floodplain, Blagodatskikh 1984).

Calliergonella lindbergii (Mitt.) Hedenäs – sp – K: 2; OK: 6; O: 8 – 1200 m (fb, sb, gb) – floodplains, stream banks.

Campylium stellatum (Hedw.) C.E.O. Jensen – sp – *K (Sinelnikova 2009): 1, 2, 4; OK: 6; O: 7 – 300–1460 m (fb, sb, gb) – wetlands, floodplains, wet tundra, wet crevices on rock outcrops, stream banks.

Campyliumys sommerfeltii (Myr.) Onchrya – r – K: 2 – 500 m (fb) – floodplains.

Catocodium nigritum (Hedw.) Brdl. – r – K: 2 – 300–600 m (fb) – wet limestone – S+.

Ceratodon purpureus (Hedw.) Brdl. – com – K (Sinelnikova 2009): 1, 2, 3, 4; OK: 5, 6; O: 7, 8; GO – 1600 m (fb, sb, gb) – wetlands, floodplains, rock outcrops, stream banks, forests and shrub thickets, eroded substrate – S+.

Cincladium arcticum (Bruch et Schimp.) Schimp. – r – K: 1, 2, 4; *OK: 5, 6 – 300–1200 m (fb, gb) – wet Kobresia tundra, wet crevices on limestone outcrops.

Cincladium latifolium Lindb. – un – O (Duckha River) – floodplain (Blagodatskikh 1984).

*Cincladium stygium Sw. – r – OK: 6 – 1000–1200 m (gb) – wetlands.

*Cincladium subrotundum Lindb. – r – *OK: 6; O: 600–1200 m (sb, gb) – wetland, wet Kobresia tundra, stream bank.

Climacium dendroides (Hedw.) F. Weber & D. Mohr – r – OK: 5; O: 10–900 m (fb) – floodplains, crooked Betula forests.


Conostomum tetragonum (Hedw.) Lindb. – sp – K: 1, 4; OK: 5, 6; O: 7, 8 – (10) 1000–1600 m (gb) – tundra, nival habitats, mege among rock fields – S+.

*Coscinnodon harttii C.E.O. Jensen – r – K: 4 – 400–600 m (fb) – boulders on open sunny slope – S+.


*Cratoneuron fildicicum (Hedw.) Spruce – r – K: 2; OK: 6 – 350–1460 m (fb, sb, gb) – streams and springs.


*Cynodontium stramineum (Hedw.) Lindb. – sp – K: 2; 4; *OK: 6; O: 7, 8 – 350–1450 m (fb, sb, gb) – fine soil between stones on rock outcrops and rock fields, eroded substrate in Larix forests and tundra – S+.

*Cynodontium tenellum (Schimp.) Limpr. – com – K: 2; 4; *OK: 6; O: 7 – 350–1450 m (fb, sb, gb) – fine soil on rock outcrops and rock fields, on spots in tundra – S+.

Cyrtomnium hymenophylloides (Huebener) T.J. Kop. – sp – K: 1, 2; *OK: 5, 6 – 350–1200 m (fb, sb, gb) – rock outcrops.

*Cyrtomnium hymenophylloides (Bruch et Schimp.) Holmen – r – K: 1, 2; OK: 5, 6 – 340–1200 m (fb, sb, gb) –
Dicranella cerviculata (Hedw.) Schimp. – r – K; O: 8 – 0–600 m (fb, sb) – eroded substrates in different conditions – S+.

Dicranella crispata (Hedw.) Schimp. – r – K; 2, 4 – 150–450 m (fb) – floodplains, eroded substrates along streams and routes – S+.

Dicranella grevilleana (Brid.) Schimp. – un – K (Omschak pass, stream banks, Blagodatskikh 1984).

*Dicranella schreberiana (Hedw.) Hilf. ex H.A. Crum & L.E. Anderson – un – K (Seimchan River, roadside in the basin, 513 m, Cherdantseva & Bakalin 2011) [VLA].

Dicranella subulata (Hedw.) Schimp. – sp – K; 4; O: 8 – 300–1500 m (fb, sb, gb) – eroded soil and peat in different surrounding – S+.


*Dicranum acutifolium (Lindb. & Arnell) C.E.O. Jensen – r – K: 1, 4; OK: 6 – 1000–1300 m (gb) – tundra, niche

Dicranum bardunovii (Sinelnikova 2009) – r – 900–1300 m (gb) – tundra, open slope, stream bank.

OK: 6

*Larix chamaejasme Bruch et Schimp. – 0–800 m (fb, sb) – floodplains.

Dicranum flexicaule Lindb. – sp – K: 1, 4; O: 8 – 300–1300 m (fb, sb, gb) – Larix forests, Dicranella flexicaule thickets, Pinus pumila thickets, tundra, niche among rock fields.

Dicranum fragilitifolium Lindb. – r – K: 1, 2; O: 8 – 400–900 m (fb) – Pinus pumila and Dicranella flexicaule thickets, bog.

Dicranum groenlandicum Brid. – sp – K: 1, 4; O: 6; O: 8 – 0–1100 m (fb, sb, gb) – Larix forests, crooked Betula forests, bog, wet tundra and gravelly, rock fields.

*Dicranum laevidens R.S. Williams – r – K: 3, 4 – 400–900 m (fb) – Betula exilis bushes, bogs.


*Dicranum cylindricum (Hedw.) Grout – un – K: 4 [vicinity Yagodnoye Settlement, slope to Debin River (62°28′44″E), 520 m alt., in a niche between stones on stone field in forest belt, 3.VIII.2014] [NSK] – S+.

*Dicranum asperifolium (Lindb. & Arnell) C.E.O. Jensen – sp – K: 1, 2; O: 6; O: 7 – 8 – 1400–1600 m (fb, sb, gb) – fine soil between stones on rock outcrops and rock fields, eroded substrate in Larix forests and tundra – S+.

*Distichium capillaceum (Hedw.) Bruch et Schimp. – sp – K: 1, 2; OK: 6; O: 7 – 8 – 1400–1600 m (fb, sb, gb) – fine soil between stones on rock outcrops and rock fields, eroded substrate in Larix forests and tundra – S+.


Distichium zonatum (Brid.) Kindb. – un – K: 4 [B. Anna-chag Ridge, small lake in high-mountain cirques (62°10′35″N 149°19′59″E), 1400 m alt, fine soil between stones 29.VII.2014] [NSK].

Drepanoclados aduncus (Hedw.) Warnst. – sp – K: [Che-mers & Mochalova 2015], 2, 4; *OK: 6; O: 300–1460 m – floodplains, wetlands.

Drepanoclados polygamus (Schimp.) Hedenäns – un – K (close to Nektoba Settlement, Larix forest on a slope, Blagodatskikh 1984).

Drepanoclados sendtneri (Schimp. ex Müll. Hal.) Warnst. – un – K [close to Shit-Tyehllakh Settlement, wetlands, Blagodatskikh 1984].


*Encalypta affinis R. Hedw. – un – K [cliffs in Kolyma River valley ~ 300 m, Chemers & Mochalova 2015] [IBIW].


Encalypta brevicollis Angstr. – sp – K: [Fedosov 2012], 1, 4; OK: 5, 6; O: 7 – 800–1460 m (sb, gb) – crevices on rock outcrops – S+.

*Encalypta brevipes Schljakov – r – OK: 5, 6 – 1200–1400 m (gb) – crevices on rock outcrops, soil in dry gravelly tundra – S+.

Encalypta ciliata Hedw. – sp – K; 2; *OK: 6; *O: 8 – 10–1200 m (fb, sb, gb) – rock outcrops – S+.
Eucalypta procer a Bruch – r – K: 1, 2; *OK: 6 – 530–1600 m (fb, sb, sb) – crevices on rock outcrops.

Eucalypta rhapsocarpa Schwägr. – sp – K: 1, 2, 4; *OK: 6; O: 7, 8; 10–1600 m (fb, sb, gb) – crevices on rock outcrops, soil in dry gravelly tundra – S+.


Eurhynchium striatum (Hedw.) Ignatov & Hutten – r – K: 2; OK: 6; O: 8 – 300–1300 m (fb, sb, gb) – floodplains, rock outcrops, tundra.


Grimmia incurva – 1000–1300 m (gb) – stones – S+.


Gymnostomum aeruginosum Sm. – r – K: 1, 2 – 300–1200 m (fb, sb, gb) – limestone.

Hamatocaulis lapponicus (Norrsl.) Hedenäs – un – K [Detrin River valley close to Ust-Oschug, Blagodatskikh 1984]; [Billibino Distri., Omolon River 5 km upstream Kedon mouth (~65°38'N 159°29'E), ~ 500 m alt., water of small lake between mire 2.IV.1976 Antropov] {MAG}.


Hionoziella adscendens (Lindb.) Z. Ivats. & W.B. Schofield – r – K: 4; O: 0 – 200 m (fb) – crooked Betula forests.

Hygroamblystegium humile (P. Beauv.) VandERP. GoFFner & Hedenaas – r – K: 2; O: 0 – 500 m (fb) – floodplains, wetlands, stream banks.

Hygroamblystegium varium (Hedw.) Mönk. – r – K: 0 – 300–3100 m (fb) – floodplains.

Hygrohypnum ochraceum (Turner ex Wilson) Ignatov & Ignatova – sp – K: (Czernyadevya 2004), 1, 4; *OK: 6; O: 8 – 100–500 m (fb, sb, gb) – stream.

*Hygrohypnum polare* (Lindb.) Ignatov & Ignatova – sp – K: (Czernyadevya 2004), 1, 4; *OK: 6; O: 0 – 1500 m (fb, sb, gb) – streams.

Hylocomium pyrenicum (Spruce) M. Fleisch. – r – K: 4; O: 7, 8 – 0–1470 m (fb, sb, gb) – crooked Betula forests, Duschekia fruticosa thickets, stream banks, rock outcrops.

Hylocomium splendens (Hedw.) Schimp. – com – K: 1, 2, 4; OK: 6; O: 8 – 340–1300 m (fb, sb, gb) – Betula forests, Duschekia fruticosa thickets, Betula eclos shrubs, tundra, wetlands.

Hymenoloma crispulum (Hedw.) Ochyra – com – K: 1, 4; OK: 5, 6; O: 7, 8 – 0–1500 m (fb, sb, gb) – on stones – S+.

Hymenostylium recurvirostrom (Hedw.) Dixon – un – K: 2 [Upper course of Kolyma River, Magadansky State Nature Reserve, Zamkovaya Mt. area (63°19'06"N 152°35'00"E), 350 m alt., limestone crevices 31.VII.2011 coll. Malashkina] {VBGI, NSK}.

Hypnum cupressiforme Hedw. – sp – K: (Sinelnikova 2009), 2; OK: 6; O: 5; GO: 350–1460 m (fb, sb, gb) – rock outcrops and rock fields, open grassy slopes, steppe, tundra.

*Hypnum imponens* Hedw. – un – K [ Vicinity Kulik Settlement, Blagodatskikh 1984]; [O Luzhin Bay slope, Blagodatskikh 1984]. The records are doubtful (Ignatov et al. 2006).

*Hypnum salvinii* Ando (Hedw.) Z. Iwats. & W.B. Schofield – r – K: 1, 4; OK: 5, 6; O: 3; GO: 0–1500 m (fb, sb, gb) – on stones – S+.


*Isoterigypnium alpicola* (Lindb. & Arnell) Hedennäs – un – K [ Vicinity Yagodnoye Settlement, slope to Degob River, (62°09'01"N 149°22'06"E), 520 m alt., in a niche between stones on stone field in forest belt, 3.VIII.2014] {NSK}; O: 8 [Magadan vicinity, Okhtorsk coast, Nagaya Bay (59°34'14"N 150°38'32"E), 16 m alt., in crevices of coastal rocks, 10.VIII.2014] {NSK}.

*Isoterigypnium muelleri*ana (Schnip.) Z. Ivats. – r – K: 4; O: 8 – 300–1300 m (fb, sb, gb) – on rock fields.

Isoterigypnium pulchella (Hedw.) Z. Ivats. – sp – K: 4; *OK: 6; O: 7, 8 – 250–1460 m (fb, sb, gb) – Larix forests, Duschekia fruticosa thickets, crooked Betula forests, stream banks, rock outcrops and fields, nival habitats – S+.
Lewinskya iwatsukii (Ignatov) F. Lara, Garilleti & Goffinet: (Orthothecium iwatsukii) – r – K; 4; OK: 5, 6 – 900 – 1500 m (fb, sb, gb) – on stones.

Lewinska pylatissi (Brid.) F. Lara, Garilleti & Goffinet: (Orthothecium pylatissum) – r – K; 0; OK: On stones (Blagodatskikh 1984).

Lewinska sordida (Sull. & Lesq.) F. Lara, Garilleti & Goffinet: (Orthothecium sordidum) – r – K; 6; OK: O; 8 – 0 – 1400 m (fb, sb, gb) – floodplains, crooked Betula forests, rock fields – S+.


Lyellia aspera (I. Hagen & C.E.O. Jensen) Frye – r – K (Ivanova & Ignatov 2007); OK: 0 (Pisarenko et al. 2015) – 600 – 1000 m (fb, sb, gb) – fine soil in rock crevices and ledges among open Larix forests and tundra – S+.

Meesia longiseta Hedw. – un – OK: 6; Olkhoye Basalt Plateau, upper course of Ola River (60°49′24″N 149°40′30″E), 900 m alt., cliffs on the watershed, crevices under rock 7.VII.2013 coll. & det. Bakalin [VGBJ1].

Meesia tricetata (Jolycl.) Angstr. – r – *K: 1; *OK: 6; O: 800 – 1200 m (fb, sb, gb) – wetlands.

Meesia uliginosa Hedw. – sp – K: 1, 2; *OK: 5, 6; O: 300 – 1200 m (gb) – wetlands, stream banks and and wet crevices on limestone outcrops – S+.

Mielichhoferia mielichhoferiana (Funck) Loeske – un – K: 4; [B. Annach Ridge, upper part of E-facing macro slope (62°1′00″1″N 149°18″17″E), 1600 m alt., in a niche between granite boulders on perimeter of summer-persisting snow patch, 29.VII.2014] {NSK}.

Mnium blyttii Bruch et Schimp. – un – K: 4; [B. Annach Ridge, upper part of E-facing macro slope (62°1′26″10″N 149°18″50″E), 1470 m alt., in a niche between granite boulders on perimeter of summer-persisting snow patch, 29.VII.2014] {NSK}.

Mnium lycopodioides Schwägr. – r – K: 4; O: 100 – 1200 m (fb, sb, gb) – stream banks, crooked Betula forests, tundra.

Mnium marginatum (Dicks.) P. Beauv. – r – *K: 2; OK: O: 100 – 500 m (fb) – Larix forest, open grassly slope, limestone.

Mnium thomsonii Schimp. – r – *OK: 6; O: 100 – 1100 m (fb, sb, gb) – crooked Betula woods, Duschekia fruticosi thicketts, tundra.

Myurella julacea (Schwägr.) Schimp. – r – K: 1, 2; OK: 5, 6; O: 8 – 10 – 1500 m (fb, sb, gb) – rock outcrops.

Myurella sibirica (Müll. Hal.) Reimers – un – K: 2 [Upper course of Kolyma River, Magadansky State Nature Reserve, Zhamkovaya Mt. area (63°19′30″N 152°35′00″E), 350 m alt., limestone, admixture to Cyrtodium hymenophylloides and Philonotis tomentella 31.VII.2011 coll. Malashkina] [VGBJ1].
rest of Larix, Betula and Populus, on rotten wood. 24.VI.1982 Blagodatskhik [LE].

Plagiothecium draparnaldii (Brid.) T.J. Kop. – sp – K: 1, 2, 4; *OK: 6; O: 8 – 1200 m (fb, sb, gb) – floodplains, wetlands, stream banks, rock outcrops, niches among rock fields.

Plagiothecium elegans (Brid.) T.J. Kop. – r – K: 2; *OK: 6 – 900 m (fb, sb, gb) – open grassy slopes, stream banks.

Plagiothecium ovalatum (Brid.) T.J. Kop. – r – K: 2; *OK: 6 – 300–900 m (fb) – crevices on rock outcrops; mainly on limestone – S+.

Plagiothecium bryoides (Brid.) T.J. Kop. – *OK: 6; O: 8 – 0–900 m (fb, sb) – rock outcrops.

Plagiothecium denticulatum (Bruch & Schimp.) Z. Iwats. – O: 8; GO – 100–300 m (fb, sb) – Larix forests, Duschkia fruticosus thickets, wetlands, stream banks, rock outcrops, open grassy slopes – S+.

Plagiothecium latebricola (Cardot & Thér.) Z. Iwats. – un – K: 6; *OK: 6; O: 8 – 1200–1600 m (gb) – niche among rock fields, wetlands, stream banks, rock outcrops, rock fields, tundra, tundra habitats – S+.

Plagiothecium nutans (Hedw.) Lindb. – sp – K: 1, 4; *OK: 6; O: 8 – 500–1500 m (fb, sb, gb) – floodplains, rock outcrops, wetlands, rock outcrops, wetlands, rock outcrops, rock outcrops, rock fields, tundra, nival habitats – S+.

Plagiothecium ovatifolium (Brid.) T.J. Kop. – *OK: 6; O: 8 – 10–900 m (fb, sb, gb) – Larix forests, Duschkia fruticosus thickets, wetlands.

Plagiothecium rivulare (Brid.) T.J. Kop. – r – K: 2; *OK: 6 – 300–900 m (fb, sb, gb) – rock outcrops.

Plagiothecium rupicolae (Brid.) E.I. Ivanova – K: 4; O: 8; GO – 500–900 m (fb, sb, gb) – wetlands, Larix forests, Duschkia fruticosus thickets, crevices in rock fields, stream banks – S+.

Plagiothecium villosum (Brid.) T.J. Kop. – K: 2; *OK: 6; O: 8 – 100–1400 m (fb, sb, gb) – eroded substrates in different conditions.

Pohlia annotina (Hedw.) Lindb. – r – K: 1, 2; *OK: 6; O: 8 – 500 m (fb) – eroded substrates in different conditions.


Pohlia boryi (Bory) Hedw. – r – K: 4; *OK: 6; O: 8 – 440–1300 m (fb, sb, gb) – cryoturbation spots in tundra and eroded soil along roads.

Pohlia bulbifera (Warnst.) Warnst. – r – K: 4; *OK: 6; O: 8 – 500 m (fb) – floodplains, eroded soil along streams.

Pohlia cruda (Hedw.) Lindb. – sp – K: 2, 4; *OK: 6; O: 7, 8; GO – 300–500 m (fb, sb) – wetlands, Larix forests, Duschkia fruticosus thickets, crevices in rock fields, stream banks – S+.

Pohlia cruda (Schimp.) Martensson – un – K: 4 [B. Annach Ridge, close to Jack London Lake (62°82’3”N 149°29’59”E), 1100 m alt., fine soil between granite boulders along a stream, in admixture with Pohlia atropurpurea 26.VII.2014] [NSK].

Pohlia elongata (Hedw.) Lindb. – r – K: 4; *OK: 6; O: 8 – 300–500 m (fb) – crevices on rock outcrops – S+.

Pohlia filum (Schimp.) Martensson – un – K: 4 [B. Annach Ridge, close to Jack London Lake (62°82’3”N 149°29’59”E), 1100 m alt., fine soil between granite boulders along a stream, in admixture with Pohlia atropurpurea 26.VII.2014] [NSK].

Pohlia longicollis (Hedw.) Lindb. – r – K: 1 – 500–1600 m (fb, sb, gb) – Pinnus pumila thickets, stream banks, rock outcrops.

Pohlia nutans (Hedw.) Lindb. – sp – K: 1, 4; *OK: 6; O: 7, 8 – 100–1400 m (fb, sb, gb) – stream banks, rock outcrops, wetlands, Larix forests, tundra – S+.

Pohlia prostrata (Kindb.) Lindb. ex Broth. – r – K: 2; *OK: 6; O: 8 (Czernyadjeva 1999) – 400–550 m (fb) – eroded substrates in different conditions.


Polytrichastrum alpinum (Hedw.) G.L. Sm. – sp – K: 1, 2, 4; *OK: 6; O: 7, 8; G: 250–1600 m (fb, sb, gb) – crooked Betula forests, Duschkia fruticosus thickets, tundra, nival habitats, wetlands, rock fields – S+.

Polytrichastrum fragile (Brynn) Schjakov – r – K: 0; O (Ivanova et al. 2014) – open grassy slopes, stream banks.

Polytrichastrum saxatile (Flörke ex Brid.) G.L. Sm. – r – K: 8; *OK: 6; O: 8 – 1000 m (fb, sb, gb) – nival habitats in shaded ravine slopes.

Polytrichastrum schaeperti (Balling) J.-P. Frahm – un – O: 8 [Magadan vicinity, Nagaeva Bay coast, Vodopadnyj Stream (59°34’12.8”N 150°38’32”E), 290 m alt., in crevices of rock outcrops along the stream, 08.VIII.2014] [NSK] – S+.

Polytrichastrum commune (Brid.) T.J. Kop. – sp – K: (Sinelnikova et al. 2014) – O: 7; G: 100–1600 m (fb, sb, gb) – Duschkia fruticosus thickets, tundra, wetlands, rock fields – S+.

Polytrichastrum sphacelatum (Besch.) T.J. Kop. – sp – K: (B. Anach Ridge, upper part of E-macro slope (62°09’36”N 149°29’23”E), 1150 m alt., on granite boulders along a stream in tundra belt, 30.VIII.2014] [NSK].

Polytrichastrum squamulosum (Brid.) T.J. Kop. – sp – K: (Olskoye Basalt Plateau, Skif Mt. (59°31’42”N 150°49’05”E), 240 m alt., in moss cover in Duschkia fruticosus thickets along stream, 10.VIII.2014] [NSK].

Polytrichum commune (Brid.) T.J. Kop. – r – K: 1; 4; *OK: 6; O: 7, 8 – 100–1400 m (fb, sb, gb) – stream banks, rock outcrops, wetlands, Larix forests, tundra – S+.

Polytrichum jasminoides (Bruch & Schimp.) Z. Iwats. [Olskoye Basalt Plateau, Maltan River in upper course (59°31’13”N 150°40’17”E) 300 m alt., Okhotsk coast, Kamennyi venets Mt. (60°38’39”N 151°21’27”E), 1460 m alt., steep slope, cliffs close to the top, in crevices 7.VIII.2014] [NSK].

Polytrichum jensenii (Brid.) T.J. Kop. – sp – K: 2, 4; *OK: 6; O: 7, 8; GO – 0–1200 m (fb, sb, gb) – Larix forests, crooked Betula forests, Duschkia fruticosus thickets, wetlands, stream banks, rock outcrops, open grassy slopes – S+.

Polytrichum jutlandicum (Brid.) T.J. Kop. – un – K: 6; *OK: 6; O: 8 – 500–1500 m (fb, sb, gb) – floodplains, wetlands, stream banks.

Polytrichum macroselago (Brid.) E.I. Ivanova – sp – K: (Czernyadjeva 1999) – 400–550 m (fb) – eroded substrates in different conditions.

Polytrichum nodosum (Hedw.) Brid. – r – K: 2; *OK: 6; O: 8 – 0–900 m (fb, sb, gb) – rock outcrops.

Polytrichum novae-zealandiae (Brid.) P. Beav. – sp – K: 4; *OK: 6; O: 0–1600 m (fb, sb) – rock fields, stream banks, nival habitats – S+.
**Pseudotaxiphyllum elegans** (Brid.) Z. Iwats. – r – 1300 m alt., on granite boulders on a place of long settlement (~61°N 147°E), swampy mire, along a stream, 23.VII.1976 coll. Blagodatskikh [NSK].

**Pseudobryum cinclidioides** (Huebener) T.J. Kop. – r – OK: 1, 2, 4; OK: 6; O: 8; GÖ: 100–300 m (fb) – floodplains, limestone.


**Rhytidiadelphus subpinnatus** (Lindb.) T.J. Kop. – r – OK: 1, 4; OK: 5, 6; O: 7, 8 – 0–500 m (fb) – rocks outcrops – S+.

**Rhzomnium andrewsianum** (Steere) T.J. Kop. – sp – K: 1, 4; OK: 5, 6; O: 0–1200 m (fb, sb, gb) – Larix forests; Du schechia fruticosu thickness, thunders, rock outcrops, stream banks.

**Rhytidiadelphus triquetrus** (Hedw.) Warnst. – r – O: 8 – 0–300 m (fb) – floodplains, stream banks, **Du schechia fruticosu** thickness.

**Rhytidiadelphus nudum** (E. Britton & R.S. Williams) T.J. Kop. – r – O: 8 – 0–600 m (fb) – stream valleys, on soil in Du schechia fruticosu thickness, stream banks and at the cliffs bottom.

**Rhytidium rugosum** (Hedw.) Lindb. – sp – K: 1, 2, 4; OK: 6; O: 7 – 8–1600 m (fb, sb, gb) – floodplains, dry Larix forests, open grassy slopes and steppe, rock outcrops and rock fields, thunders.

**Saelania glaucescens** (Hedw.) Broth. – r – K: 1, 4; OK: 5, 6; O: 900–1300 m (sb, gb) – crevices on rock outcrops.

**Sanionia uncinata** (Hedw.) Loeske – com – K: 1, 2, 4; OK: 6; O: 7, 8; GO: 800–1600 m (fb, sb, gb) – floodplains, wetlands Larix forests, Du schechia fruticosu thickness, Pinus pumila thickness, thunders, rock outcrops.

**Schistidium agassizii** Sull. & Lesq. – r – K: (Chemeris & Mochalova 2015), 4; *O (Chemeris & Mochalova 2015) – 500–1100 m (fb, sb, gb) – stones in and along streams – S+.


**Schistidium platyphyllum** (Mitt.) Perss. – sp – K: 1, 2, 4; OK: 6 – 900–1400 m (sb, gb) – streams – S+.


**Schistidium spiciligenous** (Lindb.) Podp. – sp – K: 1, 2, 4; OK: 6 – 300–1400 m (fb, sb, gb) – streams – S+.

**Schistidium vulgare** (Bruch et Schimp.) T.J. Kop. – r – K: 4; OK: 6; O: 7, 8 – 0–1200 m (fb, sb, gb) – floodplains, stream banks, **Du schechia fruticosu** thickness.
B. Haya (60°38′40″N 151°26′34″E), 1220 m alt., wet tundra near snowbed 6.VIII.2014 coll. Pisarenko, det. Ignatova] [NSK, MW] – S+.

*Schistostega pennata* (Hedw.) F. Weber & D. Mohr – r – OK; O – in floodplains on fine soil along stream, near *Larix* roots and in rock crevices.

*Sciuro-bypnum latifolium* (Kindb.) Ignatov & Huttunen – r – *K*: 2; *OK*: 6; O (Ignatov & Mel’inya 2007) – 8 – 100–1100 m (fb, sb) – *Duscheckia frustiosa* thickets, stream banks.

*Sciuro-bypnum pluustom* (Hedw.) Ignatov & Huttunen – un – O: 8 [Magadan city surroundings, Okhotsk coast, Nagaev Bay (59°34′13.8″N 150°38′31.6″E), 290 m alt., *Sphagnum* bog on a watershed, on peat 10.VIII.2014] [NSK].

*Sciuro-bypnum reflexum* (Starke) Ignatov & Huttunen – sp – *OK*: 6; O – 300–1100 m (fb, sb, gb) – *Betula* forests, *Duscheckia frustiosa* and *Pinus pumila* thickets, floodplains, stream banks and wetlands – S+.

*Sciuro-bypnum starkei* (Brid.) Ignatov & Huttunen – un – O: 8 [Magadan vicinity, Marchekanskaya hill, N-faced slope in lower part (59°31′42″N 150°49′05″E), 240 m alt., *Duscheckia frustiosa* thickets along stream, on soil 10.VIII.2014] [NSK].

*Scorpidium cossonii* (Schimp.) Hedénäs – r – *K*: OK; O – 900–1100 m (fb, sb, gb) – wetlands.

*Scorpidium revolvea* (Sw. ex anon.) Rubers – r – K 4; OK 6; O – 900–1400 m (fb, sb, gb) – wetlands.

*Scorpioides scorpioides* (Hedw.) Limpr. – r – *K* (Sinelnikova 2009, Chemeris & Mochalova 2015); O: 0–800 m – in lakes and wetland.

*Scouleria pulcherrima* Broth. – r – K: (Chemeris & Mochalova 2015), 2 – 300–500 m – in streams and rivers.


*Sphagnum alaskense* (Schimp.) Hedenäs – r – *K*: OK 6; O – 900–1100 m (fb, sb, gb) – wetlands.

*Sphagnum capillifolium* (Schimp.) Hedenäs – r – *K*: OK; O (Ignatov & Mel’inya 2007) – 8 – 100–1100 m (fb, sb) – *Duscheckia frustiosa* thickets, stream banks.


*Sphagnum flexuosum* (Chimp.) H. Klinggr. – sp – *K*: (Sinelnikova 2009), 1, 4; O – 300–1100 m (fb, sb, gb) – *Larix* forests and tundra.

*Sphagnum gigrosohnum* Russow – com – *K*: (Sinelnikova 2009), 1, 4; OK: 6; O – 8 – 1200 m (fb, sb, gb) – wetlands, wet *Larix* forests and tundra, *Duscheckia frustiosa* thickets, stream banks.

*Sphagnum lenense* H. Lindb. ex L.I. Savicz – com – *K*: (Sinelnikova 2009), 1, 4; OK: 8 – 100–1300 m (fb, db, gh) – wet *Larix* forests and tundra, wet niche among rock fields.

*Sphagnum lindbergii* Schimp. ex Lindb. – com – *K*: (Sinelnikova 2009), 4; OK: 8 – 300–1100 m (fb, sb, gh) – *Larix* forests and tundra.


*Sphagnum papillosum* Lindb. – un – O: 8 [Magadan city surroundings, Okhotsk coast, Nagaev Bay (59°34′13.8″N 150°38′31.6″E), 330 m alt., *Sphagnum* bog on watershed, 10.VIII.2014] [NSK].

*Sphagnum perfoliatum* L. – un – K: (Kulu vicinity, wet tundra, Blagodatskikh 1984); O: 8 [Magadan city surroundings, Okhotsk coast, Nagaev Bay (59°34′13.8″N 150°38′31.6″E), 330 m alt., *Sphagnum* bog on watershed, 10.VIII.2014] [NSK].


*Sphagnum quinquefarium* (Lindb. ex Bratihw) Warnst. – un – K: 4 [B. Annachag Ridge, the foot of E-faced slope (62°12′04″N 149°28′26″E), 860 m alt., in moss cover allogrostaphic *Sphagnum* bog with well-developed shrub layer (*Vaccinium uliginosum*, Ledum palustre, *Andromeda polifolia*) 25.VII.2014] [NSK].

*Sphagnum riparium* Angstr. – sp – *K*: 4; O – 0–1100 m (fb, sb, gb) – wetlands, stream banks.


*Sphagnum russowii* Warnst. – r – K: 1, 4; OK: 6; O – 0–1300 m (fb, sb, gh) – *Larix* forests and tundra.

*Sphagnum squarrosum* Crome – sp – K (Sinelnikova 2009); 4; OK: 6 – 400–1200 m (fb, sb, gh) – wetlands, streams and springs under canopy in *Larix* forests, crooked *Betula* forests, *Duscheckia frustiosa* thickets.

*Sphagnum steerei* R.E. Andrus – r – K: (Maksimov 2007); OK: (Maksimov 2007) – 8 – 1–600 m (fb) – wetlands.


*Sphagnum subsecundum* Nees – un – K: 6 [Olskoye Basalt Plateau, watershed of rivers Ola and B. Haya (60°38′33″N 151°25′44″E) 1200 m alt., small stream on meadow slope, between stones 6.VIII.2014] [NSK].

*Sphagnum terses* (Schimp.) Ångstr. – sp – K: 1, 4; OK: 6; O – 800–1300 m (fb, sb, gh) – wetlands, stream banks.

*Sphagnum tundrae* Flatberg – r – K: 4; OK: 6 – 900–1300 m (fb, sb, gh) – *Larix* forests with *Sphagnum* cover and wet tundra.

*Sphagnum warnstorffii* Russow – com – *K*: (Sinelnikova 2009), 1, 2, 4; OK: 6; O – 300–1300 m (fb, sb, gh) – *Larix* forests and tundra.

*Splachnum ambulaceum* Hedw. – r – O (on soil in *Betula* forests, Blagodatskikh 1984).

*Splachnum luteum* Hedw. – r – K; OK: O (decomposed dung in *Larix* forests and crooked forests, Blagodatskikh 1984).

*Splachnum rubrum* Hedw. – r – K; OK: O (decomposed dung in *Larix* forests and crooked forests, Blagodatskikh 1984).
**Stereodon bambergeri** (Schimp.) Lindb. – un – K (Omol'evka River, limestone, Blagodatskikh 1984); *OK: 6 (Olskoye Basalt Plateau, watershed of rivers Ola and B. Belaya (60°38′24″N 151°29′15″E), 1090 m alt., saddle between tops, boggy Koloniea-Eriophorum tundra 5.VIII.2014 [NSK]).


**Hedw.** – r – along streams, shades rocks.

**Tetraphis pellucida** (Hedw.) Loeske – com – K; *OK: 6 – 1200–1460 m (gb) – tundra, rock fields.

**Stereodon subinmenus** (Lesq.) Broth. – sp – K; *OK: open Larix forests, Blagodatskikh 1984).

**Stereodon vaucheri** (Lesq.) Broth. – sp – K; *OK: 1200–1460 m (gb) – wetlands, wet tundra.

**Straminergon stramineum** (Dicks. ex Brid.) Hedenäs – r – 0–1100 m (fb, sb, gb) – rock outcrops.

**Tortella tortuosa** (Hedw.) Limpr. – r – K; *OK: 6 – 300–1200 m (fb, sb, gb) – rock outcrops.

**Tortella hoppeana** (Schultz) Ochyra – r – *OK: 6; O: 7, 8 – 1000–1300 m (gb) – crevices on rock outcrops, ersed soil – S+.

**Tortella lauernii** (Schultz) Lindb. – un – K; *OK: 6 (Olskoye Basalt Plateau, Skift. Mt. (60°38′40″N 151°22′15″E), 1460 m alt, steep slope close to the top, rock outcrops, in crevices 7.VIII.2014 [NSK]).

**Trachycystis flagellaris** (Sull. & Lesq.) Lindb. – r – K: 1, 2; *OK: 6; O: 7 – 500–1460 m (fb, sb, gb) – crevices on rock outcrops, eroded substrates – S+.


**Warnstorfia alpina** (Hedw.) Lilj. – r – K: 4 – 300–500 m (fb) – rock outcrops.

**Warnstorfia exannulata** (Schimp.) Loeske – cm – K: 4; *OK: 6; O: 8 – 0–1200 m (fb, sb, gb) – wetlands.

**Warnstorfia fluitans** (Hedw.) Loeske – sp – K: 1, 2, 4; *OK: 6 – 300–1460 m (fb, sb, gb) – open grassy slopes, rock outcrops and rock fields, dry tundra – S+.

**Typhus annulatus** (Hedw.) Bruch et Schimp. – un – K: 4 (Victory Yagodnoye Settlement, Debin River valley (62°28′04″N 149°47′40″E), 520 m alt., stone field among wetlands, stream banks).

**Trachycystis flagellaris** (Sull. & Lesq.) Lindb. – r – K: 1, 2; *OK: 6; O: 7 – 300–500 m (fb, sb, gb) – rock outcrops, eroded substrates – S+.

**Thuidium damianum** (Mitt.) A. Jaeger – r – *OK: 6; O: 300–1200 m (fb, sb, gb) – crooked Betula forests, thickets along streams, shaded rocks.

**Timmia atrinsula** (Hedw.) Loeske – sp – K: (Sinelnikova 2009), 1, 2, 4; *OK: 6; O: 7, 8 – 300–1600 m (fb, sb, gb) – wetlands Larix forests, tundra.

**Tortella alpicala** Dixon – un – O: 7 [Kamennyy Khrabret Range, central part (59°48′10″N 149°39′45″), 1062 m alt., crevices on rock outcrops 8.VIII.2013 coll. Ermolenko] [VGBI].

**Tortella arctica** (Arnell) Grundw. & Nyholm – r – K: 6 [Olskoye Basalt Plateau, watershed of rivers Ola and B. Belaya (60°38′24″N 151°29′17″E), 1090 m alt., between stones in wet Koloniea-Eriophorum tundra 5.VIII.2014 [NSK]; (Kop.); *OK: 6 (Olskoye Basalt Plateau, watershed of rivers Ola and B. Belaya (60°38′40″N 151°26′34″E), 1220 m alt, wet tundra near snowbed close to saddle, 6.VIII.2014 [NSK]).

**Tortella fragilis** (Hook. & Wils.) Limpr. – r – K: 1, O: 6 – 300–1200 m (fb, sb, gb) – rock outcrops.

**Trachycystis flagellaris** (Sull. & Lesq.) Lindb. – r – K: 7, 8 – 500–1460 m (fb, sb, gb) – crevices on rock outcrops, eroded soil – S+.

**Trachycystis flagellaris** (Sull. & Lesq.) Lindb. – r – K: 7, 8 – 500–1460 m (fb, sb, gb) – crevices on rock outcrops, eroded soil – S+.

**Warnstorfia pseudosarmentosa** (Cardot & Thér.) Tuom. & T.J. Kop. – r – K: 4; O: 8 – 300–1000 m (fb, sb, gb) – wetlands, stream banks.

**Warnstorfia pseudostremaniae** (Müll. Hal.) Tuom. & T.J. Kop. – r – K: 2, 4 – 500 m (fb) – floodplains.

**Warnstorfia sarmentosa** (Wahlenb. Hedenäs – com – K: (Sinelnikova 2009), 1, 2, 4; *OK: 5, 6; O: 500–1460 m (fb, sb, gb) – wetlands, wet tundra, stream banks, nival habitats.


**Species excluded**

*Albina brevitrichia* (Hook. & Grev.) Kindlb. – the only record (Blagodatskikh 1984) based on misidentification of *A. rigida* [LE]

*Brachythecium salebrosum* (Wahlenb.) Lilj. – r – K: 2; *OK: 6 (Olskoye Basalt Plateau, Skift. Mt. (60°38′40″N 151°22′15″E), 1460 m alt, steep slope close to the top, rock outcrops, in crevices 7.VIII.2014 [NSK]).

**Warnstorfia alpina** (Hedw.) Lilj. – r – K: 4 – 300–500 m (fb) – rock outcrops.

**Warnstorfia exannulata** (Schimp.) Loeske – cm – K: 4; *OK: 6; O: 8 – 0–1200 m (fb, sb, gb) – wetlands.

**Warnstorfia fluitans** (Hedw.) Loeske – sp – K: 1, 2, 4; *OK: 6 – 300–1460 m (fb, sb, gb) – open grassy slopes, rock outcrops and rock fields, dry tundra – S+.

**Typhus annulatus** (Hedw.) Bruch et Schimp. – un – K: 4 (Victory Yagodnoye Settlement, Debin River valley (62°28′04″N 149°47′40″E), 520 m alt., stone field among wetlands, stream banks).

**Trachycystis flagellaris** (Sull. & Lesq.) Lindb. – r – K: 7, 8 – 500–1460 m (fb, sb, gb) – crevices on rock outcrops, eroded soil – S+.

**Trachycystis flagellaris** (Sull. & Lesq.) Lindb. – r – K: 7, 8 – 500–1460 m (fb, sb, gb) – crevices on rock outcrops, eroded soil – S+.

**Warnstorfia pseudosarmentosa** (Cardot & Thér.) Tuom. & T.J. Kop. – r – K: 4; O: 8 – 300–1000 m (fb, sb, gb) – wetlands, stream banks.

**Warnstorfia pseudostremaniae** (Müll. Hal.) Tuom. & T.J. Kop. – r – K: 2, 4 – 500 m (fb) – floodplains.

**Warnstorfia sarmentosa** (Wahlenb. Hedenäs – com – K: (Sinelnikova 2009), 1, 2, 4; *OK: 5, 6; O: 500–1460 m (fb, sb, gb) – wetlands, wet tundra, stream banks, nival habitats.

(Ignatova 2005) the species is rare in Russia and was not revealed in Northern Far East, most so-identified samples belong to D. laevifrons.

Lecanora mutabilis (Brid.) Lindb. – according Ignatov & al. (2006) the records of the species eastward of the Urals are doubtful.


Orthotrichum speciosum (Nees (Orthotrichum speciosum (Nees) F. Lara, Garilleti & Goffinet) according recent revision (Fedosev & Doroshina 2018) does not occur in Asian Russia. All checked specimens belong to L. inulisukii.

Schistidium aponzum (Hedw.) Bruch et Schimp. – all so-named Russian Far East specimens belong to other taxa (Ignatov, Afonina, Ignatova et al. 2006).

Schistidium confertum (Funke) Bruch et Schimp. – excluded from the flora of the Russian Far East; all so-named specimens belong to other species (Ignatova & Blom 2017).

Schistidium strictum (Turner) Loeske ex Martensson – excluded from moss flora of Russia (Ignatov & al. 2006).

Sphagnum imbricatum Hornsch. ex Russow – it was reported for the Kolyma floristic district: vicinity Sibit (Blagodatskikh 1984), however, the cited specimens belong to S. steeri (Maksimov 2007).

Triechostomum articum Kaal. – it was reported for the Okhotsk floristic district: Atargan and Kolymys floristic district: Omulevka River (Blagodatskikh 1984). The first sample is checked, it is Oxystegium tenerostra (LE.). The second report is doubtful (specimen was not found), therefore the occurrence of the species in Magadan needs additional confirmation.

CONCLUDING REMARKS

It is worth noting that we regard the present checklist to be preliminary only, since most of the Magadan Province remains poorly investigated, specifically in the eastern part of the province. Data on the Omolonsky and the Gihigysk floristic districts are completely absent, while data on Gihigysko-Omolonsky district is poor. However, in comparison with the previous checklist by Blagodatskikh (1984), the number of recorded taxa has increased by some 30 %. Currently we list 364 moss taxa.

For many genera, the increase in known taxa is the result of taxonomic revisions. For instance, the known diversity of Bryum was increased from 4 to 16 species due to Zolotov’s (2018) revision, of which 11 taxa were treated by the monographer (B. algovium, B. amblyodons, B. archangelicum, B. binum, B. crenatum, B. cyclophyllum, B. intermediurn, B. kwonlonius, B. longisutum, B. pseudotriquetrum and B. salinum). Bryum argentum, B. caespiticium, B. cyclophyllum, B. parvanscens and B. weilgieli were previously known from the area. Another example is in the Grimmiaeae where the efforts by Ignatova (Ignatova & Blom 2017, Ignatova & Muñoz 2004) increased the diversity of Schistidium with the addition of S. frigidum, S. bolmenianum, S. filipatum, S. pappiscum, S. pulchrum, S. platphyllum and S. sordidum; as well as the diversity of Grimmia from 3 to 8 species (G. donniana, G. jucunda, G. pilifera, G. reflexuens and G. torqueta added). Due to recent taxonomic revisions of herbarium specimens (Ignatova 2005, Tubanova et al. 2010, Tubanova & Ignatova 2011) Diazunum is expanded with the addition of D. acutidum, D. bardonnii, D. laevindus and D. leuconeur. A similar situation occurs in Sphagnum with the addition of new taxonomic concepts (Flatberg & Thingegaard 2003, Maksimov 2007, Maksimov & Ignatova 2008) that have increased the number of species from 24 to 32. S. alaskense, S. platphyllum, S. quinquesperium, S. ruhiginoeum, S. steeri, S. subclavum and S. tundren are added.

On the other hand, some habitats had not been carefully investigated in previous work. After these were thoroughly studied, a large number of taxa were newly recorded for the province, with the status on their rarity considerably changed. The study of snowbed habitats added Andreaea blytta, A. nivalis, A. obovata, A. papillosa (only Andreaea rapestriss was known in the province), Oligotrichum falcatum, Braehlyctheium turdigu, Polystichastrum septentrionale and P. sphaerothecium to the moss flora. Taxa such as Arctos fulvella, Pohlia drummondii and Catosciadium nigritum can no longer be regarded as ‘very rare’ and sparsely occurring in the province. Similarly, the moss flora on limestone habitats and otherwise similar habitats with presumably slightly alkaline reaction, - the diversity of Encalypta increased from 3 to 8 taxa (E. affinis, E. alpina, E. breviscula, E. brevipes, E. trachymitra were added), newly recorded are Amphiumidum lataponicum, Gymnostomum aeruginosum, Hymenostylium recurvirostrum, Myurrella julacea, M. tenerrma, Plagiopus sederianus. Many taxa that were previously regarded as rare are found in this series of new localities, and where sometimes even locally abundant: Aulacomnium acuminatum, Braehlyctheium cirusum, Buxbaumia aphylla, Campylidium stellatum, Cyrtomium hynemophylodes, Distichium capillaceum, Grimmia incurva, Hamatocaulis lapponicus, Myuroclada macizonwiczii, Neckera pennata, Orthothecium strictum, Timmia austriaca, Tortula hoppaena, etc.

Despite relatively low landscape diversity, the territory of the Magadan Province was found to be very interesting taxonomically. The history of the biota development and current climatic situation provides the ‘neighborhood’ of some contrasting floristic complexes. The taxa of mostly hemiarctic and arctic-alpine distribution are quite abundant here: Aulacomnium turgidum, Bartramia tibphylla, Cinclidiun articum, Conostomum tetragumnum, Diazunum elogatum, Hygrohypnella polaris, Mesia uliginosa, Oligotrichum falcatum, Paludela squarrosa, Pohlia crudaides, Pseudocalicirion brevifolium, Racomitroneum lanuginosum, Warstorffia sarmentosa, etc. Along with some expected boreal taxa (Aulacomnium palustre, Climacium dendroides, Hygrohypnella oxiacea, Niphatherium canescens, Onchorhiza wahlenbergii, Plagiomnium elipticum, P. medium, etc), some hemiboreal and even temperate ones also occur (Myuroclada longirama, M. maximoviczii, Pylaia fynathya, Rhizomnium magnifolium, Thuidium assimile, etc.). The additional point is provided by taxa having an amphili-oceanic and amphi-Paciﬁc distribution: Bryodoxiophium norvegicum, Herzogella adscendent, Oligotrichum paralelum, Sphagnum alaskense, Trachyphyllum flagellastrum, Trematodon ambigus. One of the most interesting records is Oedipodium grifithianum. This taxa is highly disjunct. In Russia this is the fourth and the northernmost location.

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