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MOSSES OF THE BOLSHOI ANNACHAG RANGE (MAGADAN PROVINCE, RUSSIAN FAR EAST)

МХИ ХРЕБТА БОЛЬШОЙ АННАЧАГ (МАГАДАНСКАЯ ОБЛАСТЬ, РОССИЙСКИЙ ДАЛЬНИЙ ВОСТОК)

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Abstract

Moss flora of the Bol'shoi Annachag Range is studied. The mountain range is a granitoid intrusion, forming the highest peaks in the territory of Magadan Province. A list of 192 species is provided; 37 species are new to Magadan Province, 19 are new to its continental part.

Резюме

Исследована флора мхов хребта Большой Анначаг – крупного гранитоидного образования, включающего высочайшие вершины Магаданской области. Приводится список 192 вида; из них 37 впервые выявлены в Магаданской области, еще 19 впервые указываются для ее континентальной части.

KEYWORDS: mosses, flora, Magadan, upper Kolyma upland, Cherskii mountain system, granitoids.

Introduction

Magadan Province is one of least studied regions of Russia. Until recently, the only moss studies of this area were carried out in 1970-80s by L.S. Blagodatskikh who published a monograph "Mosses of Kolyma Upland" in 1984. The Kolyma Upland is treated there in a very broad sense, including the southern part of the Cherskii Mountain System, Seymchan-Buyunda depression, the mouth of the Korkodon River, the Okhotsk coast with ridges near Okhotsk, a settlement in Khabarovsk Territory. Altogether 234 moss species are listed in this publication (Blagodatskikh, 1984a).

Additional records for Magadan Province based mainly on Blagodatskikh collections appeared in subsequent treatments of some genera: *Pohlia* (Czernyadjeva, 1999), *Hygrohypnum* (Czernyadjeva, 2003), *Grimmia* (Ignatova & Muñoz, 2004), *Stereodon* (Afonina & Blagodatskikh, 2006; Afonina & Ignatova, 2007), *Encalypta* (Fedosov, 2012, 2013) *Polytrichastrum* (Ivanova *et al.*, 2014), *Stereodon* (Afonina, 2008), *Orthotrichum* (Fedosov & Ignatova, 2011) *Sphagnum* (Maksimov & Ignatova, 2008), *Sciuro-hypnum* (Ignatov & Milyutina, 2007; Ignatov & Ignatova, 2008), *Brachythecium* (Ignatov, 2012).

In 2010-2014, V.A.Bakalin conducted a series of expeditions to study bryoflora of the province. While focusing mainly on hepatics, he collected mosses as well and published some new records (Cherdantseva & Bakalin, 2011). In 2014, I took part in the field work at the Bolshoi Annachag Range.

Study area

The Bolshoi Annachag Range is located in the central continental part of Magadan Province and is one of southern spurs of the Cherskii Mountain System. It is located on a border between Tenkinskii and Yagodinskii administrative Districts, at 149°-149°30' E and 61°51'-62°38'N (Fig. 1). The southern part of the range is one of the relatively well explored areas due to the presence of biological station "Aborigen" of the Institute of Biological Problems of the North, RAS (near Sibit-Tyellakh Settlement). In 1974-1994, the flora of the area was studied, mainly by Blagodatskikh (1981, 1984ab).

The Bolshoi Annachag Ridge is different from adjacent areas in its geological composition: like many other spurs of the Cherskii system, it represents granitoid intrusion of Late Jurassic – Early Cretaceous period in terrigenous sediments of the Verkhoyansk complex (Goryachev & Berdnikov, 2006). In general B. Annachag is characterized by relatively smooth relief forms with several levels of peneplanization and few sharp peaks. It is elevated above surrounding uplands: neighbor territories have altitudes 500-700 meters above sea level, while average altitudes of ridge surfaces are mainly 1200-1600 m, with some tops above – about 2000-2300 m. The highest peaks are Snezny (2293 m) and Aborigen (2286 m), being also he highest points of Magadan Province. During Pleistocene and Holocene, the area was several times glaciated (Glushkova, 1992; Galanin, 2012); the modern ridge relief forms are moraines, U-shaped valleys and some cirques in high

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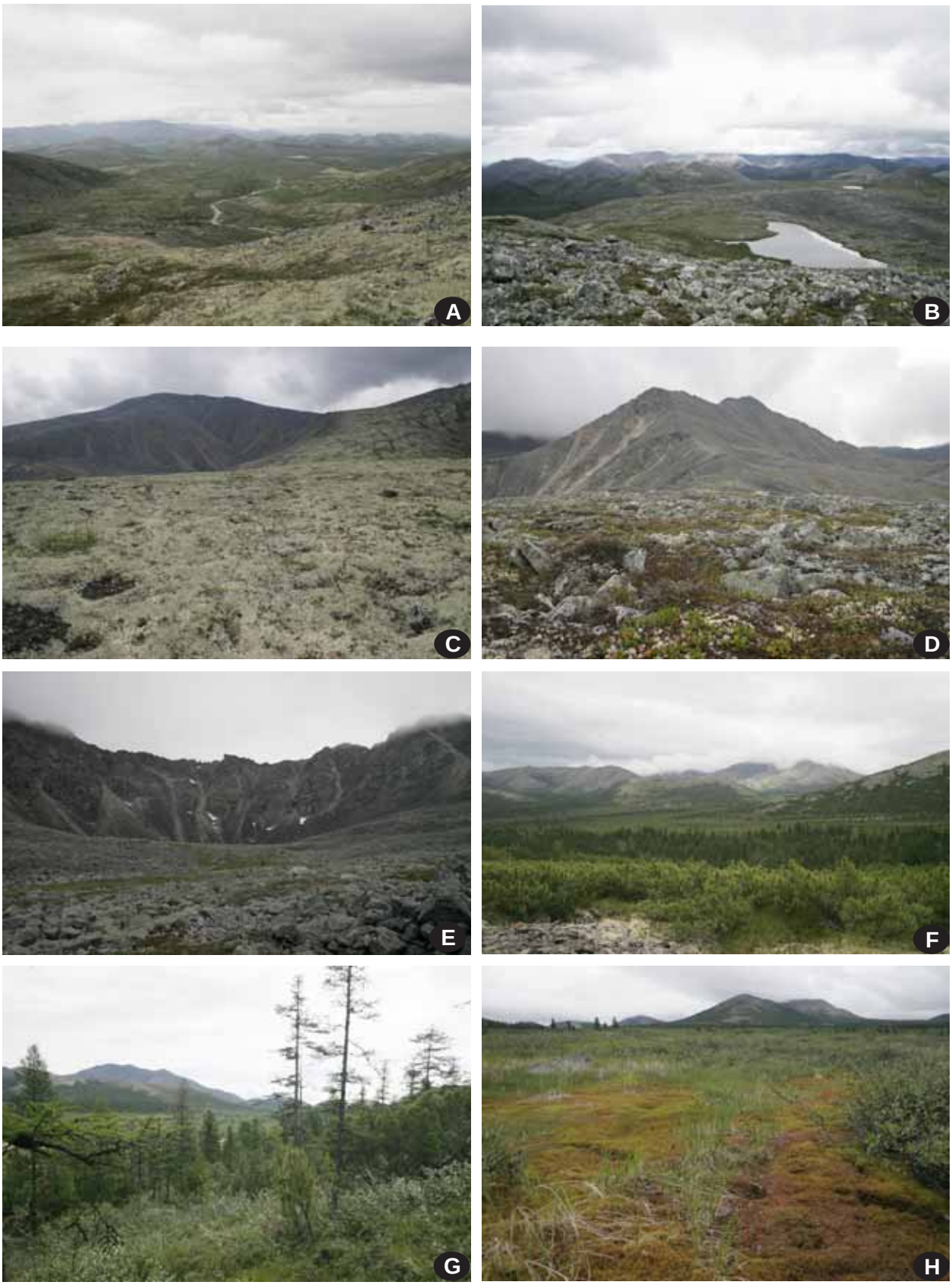

Fig. 3. Bol'shoi Annachag Ridge. A – high mountain landscape, B – moraine with a lake in a basin, C – lichen tundra with cryoturbation spots (left corner), D – draft-shrub tundra, E – high-mountain cirques with snow-patches (1400 m a.s.l., the peaks about 1800 m a.s.l.); F – tree line and *Pinus pumila* thickets, G – inside of open *Larix* forest. (1100 m a.s.l.); H – *Sphagnum* bog with undersized *Betula exilis* on river terrace (900 m a.s.l.).

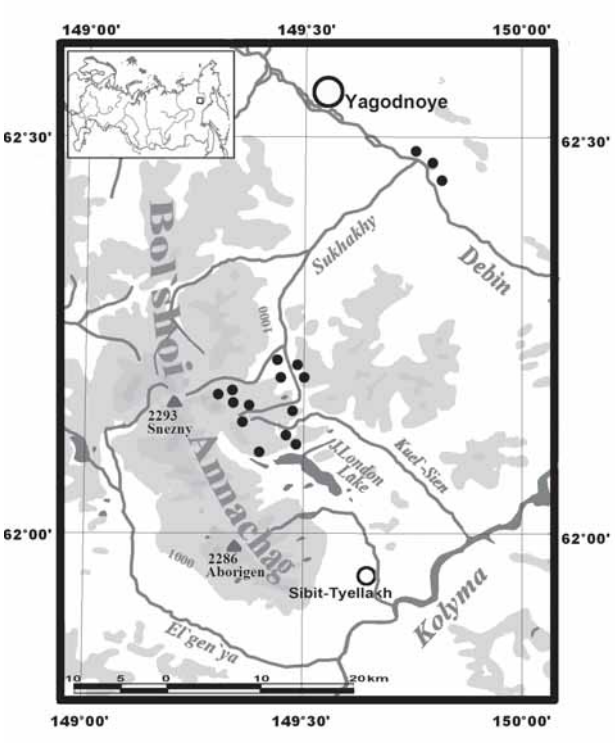

Fig. 1. Bolshoi Annachag area and collecting localities (circles).

mountains. On the moraine surfaces, there is a lot of basins of different size. Some of the basins have signs of recent drainage, while others represent lakes, among which the Jack London Lake is the biggest one.

The permafrost is ubiquitous and has 150-500 m thick with the bedrock temperature –3.5 - –7.0°C (Kalabin, 1960; Kuznetsov, 1966). Climate of the region is transitional between extracontinental climate of Eastern Yakutia and cold monsoon climate of the Okhotsk coast. The nearest meteo stations provide the parameters shown in fig. 2. For high mountains, there are only some temperature data from permanent plot "Aborigen". At the slope of Aborigen Mt at 1650 m a.s.l. mean temperature of January is –28°C; mean temperature of July is +7.9°C; the frost-free period is absent (Alfimov, 1984). It is remarkable that an amount of precipitation in the region is small and only about half of it falls as rains in summer time – 180 mm (from 390) in Yagodnoye and 169 mm (from 306) in the vicinity of the Jack London Lake. The rains have low intensity and are long-lasting; the relative air humidity in the region is about 70 % as in average per year and as in average per month (Kovel`, 1990). Depth of snow depends on wind redistribution and vary from 1-5 cm on flat plateau to 40-60 cm in depressions. Snow spots are able to persist during summer time on concave portions of northern slopes.

All rivers belong to Kolyma Basin. In winter most of them are completely frozen and have no water flow. Ice covers rivers from October to Mai. In the valleys of rivers and creeks in high-mountains aufeises (sheet-like mass of layered ice) are common. The rivers have flood period in May due to snow melting and several rain floods in warmer months. Rains also trigger melting of permafrost which causes the raising of water to several meters for a couple of days.

Bedrocks are strongly weathered. Stone fields cover huge areas but stable rock outcrops are almost absent.

The only surviving tree species is *Larix cajanderi. Pinus pumila, Betula middendorffii* and *Rhododendron aureum* are often abundant in shrub layer. The ground layer is formed by Sphagna: *Sphagnum lenense* is most abundant; *S. compactum, S. fuscum, S. girgensohnii,* and *S.warnstorfii* are common; and also *Aulacomnium palustre, A. turgidum,* and *Dicranum elongatum* usually participate in the cover. Typical mire dwarf shrubs are common in small abundance in the *Sphagnum* carpet**:** *Vaccinium uliginosum, Ledum decumbens, Chamaedaphne calyculata, Oxycoccus microcarpus,* as well as *Rubus chamaemorus.*

These communities prevail in the forest belt and cover even steep slopes (15-20°). Tall shrubs – *Pinus pumila, Betula middendorffii, Duschekia fruticosa* - form closed thickets several hundred meters wide and hamper the movement; forest floor is mainly covered by litter in these thickets. Tree line is at 1100-1200 m; it is often lowered by stone fields and talus in upper parts of slopes. Gentle slopes above tree line are covered by different types of tundra. Lichen tundra with closed canopy of *Cladonia spp., Alectoria ochroleuca, A. nigricans, Cetraria cucullata* occurs in drained sites where snow is blown away in winter. In these communities, some mosses are found only on bare ground of cryoturbation spots. On flat and concave surfaces, *Betula exilis* thickets with participation of *Salix pulchra* prevail; moss cover is from 20 to 80% here, but species composition is poor: *Hylocomium splendens, Aulacomnium turgidum, A.palustre, Dicranum elongatum, etc.* In intermediate positions, tundra is formed by draft-shrubs; *Cassiope tetragona, Vaccinium vitis-ideum, Empetrum nigrum*, *Arctous alpina, Phyllodoce coerulea* prevail in these communities. *Dryas* type of tundra is absent in the region due to granitoid bedrocks.

Mire development is determined by properties of weathered granitoid rocks (good drainage and acidity). Mires are rather rare in the territory; they occur in big lake basins. Main vegetation type is oligotrophic *Sphagnum* bogs. Nival communities occupy small areas near summer-persisting snow patches.

Detailed description and syntaxonomy of the vegetation of Upper Kolyma Basin were given recently by Sinelnikova (2009).

LIST OF SPECIES

The list summarizes the data both previously published and collected by the author. Nomenclature follows Ignatov, Afonina, Ignatova *et al.* (2006). After species name, occurrence, localities and the altitude range are given for author's collections. Occurrence is roughly estimated: common-sporadically-rare (Cm-Sp-R'). The localities are numbered as follow:

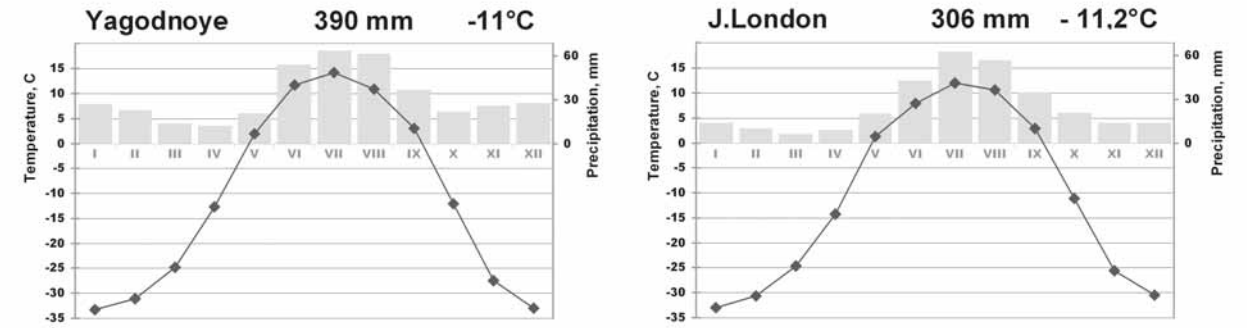

Fig. 2. Climate diagrams for study area according to data Kovel' (1990). The tops of the diagrams show the name of the climate station, its average annual temperature (C) and its average annual precipitation (mm). Locations of the stations:Yagodnoye – 62°31'N, 149°37'E, 518 m alt; Jack London Lake – 62°06'N, 149°30'E, 807 m alt.

1L – literature data from permanent scientific plot "Aborigen", vicinity of Sibit-Tyellakh Settlement (~61°56`N, 149°33` E). 116 species were known for the area formerly by data of Blagodatskikh (1981, 1984ab), and a few species were published later by different authors basing on Blagodatskikh samples. In the last case citations are given.

2 – author's data from the central part of the range in the sources of the Sukhakhy and Kuel'-Sien Rivers (fig. 1: 62°07'–62°13'N, 149°18'–149°30' E, 800-1600 m a.s.l.).

3 – author's data from the Debin River valley near the Sukhakhy River mouth (fig. 1: ~ 62°26'N, 149°48' E, ~ 500 m a.s.l.). The locality does not belong to B. Annachag in a strict sense, but it is included to add to the bryological data of the area. Species new for Magadan Province are marked by **, the first record for continental part – by *.

All author's samples are in NSK (Novosibirsk). Main part of Blagodatskikh collection is in Institute of Biological problems of the north RAS (Magadan); but unfortunately specimens of rare species are missing in the herbarium, they have likely been transferred to LE.

Abietinella abietina – R: 1L, 2 – 1000-1300 m.
Andreaea blyttii – R: 2 – 1450-1600 m.**
A. obovata – R: 2 – 1270-1400 m.**
A. rupestris – Cm: 2, 3 – 500-1600 m.
A. papillosa – R: 2 – 800-1300 m.**
Arctoa fulvella – R: 1L, 2 – 1300 m.
Aulacomnium palustre – Cm: 1L, 2, 3 – 500-1100 m.
A. turgidum – Cm: 1L, 2, 3 – 500-1400 m.
Bartramia ithyphylla – Sp: 1L, 2 – 1200-1600 m.
Blindia acuta – R: 1L.
Brachytheciastrum trachypodium – R: 1L.
Brachythecium boreale – R: 2, 3 – 450-800 m.**
B. salebrosum – R: 1L.
B. udum – R: 2 – 1150 m.**
Bryoerythrophyllum recurvirostrum - R: 1L.
Bryum argenteum – R: 1L, 2 – 500 m.
B. cryophilum – R: 2 – 1250-1400 m.
B. pseudotriquetrum – Sp: 2 – 800-1200 m.
B. weigelii – R: 2 – 800 m.*
Bucklandiella microcarpa – R: 2 – 1270 m.**
B. sudetica – Sp: 2 – 1200-1600 m.**
Buxbaumia aphylla – R: 2 – 850-1100 m.*
Callailaria curvicaulis – R: 2 – 450 m.**
Campylium stellatum – R: 2 – 1300 m.*
Ceratodon purpureus – Cm: 1L, 2, 3 – 500-1400 m.
Cinclidium arcticum – R: 1L.
Cnestrum schistii – R: 1L.
Codriophorus acicularis – R: 1L.
Conostomum tetragonum – Sp: 1L, 2 – 1100-1300 m.
Coscinodon cribrosus – R: 1L.
Cynodontium strumiferum – Cm: 1L, 2, 3 – 500-1100 m.
C. tenellum – Sp: 1L, 2, 3 – 500-900 m.
Dicranella cerviculata – R: 1L.
D. crispa – R: 3 – 450 m.**
D. subulata - Sp: 1, 2 – 500-1100 m.
Dicranum angustum – Sp: 1L.
D. elongatum – Sp: 1L, 2 – 900-1400 m.
D. flexicaule – R: 1L, 2 – 900 m.
D. fuscescens – R: 2 – 850 m.**
D. groenlandicum – Sp: 1L, 2 – 1100 m.
D. laevidens – R: 2 – 850 m.**
D. leioneuron – R: 2 – 1100 m.**
D. majus – R: 1L.
D. spadiceum – Sp: 1L, 2 – 1300-1500 m.
D. undulatum – R: 1L, 2 – 850 m.
Ditrichum cylindricum – R: 3 – 500 m.**
D. flexicaule – R: 3 – 500 m.
D. pusillum – R: 3 – 500 m.**
D. zonatum – R: 2 – 1300 m.**
Drepanocladus aduncus – R: 1L.
D. sendtneri – R: 1L.
Encalypta brevicolla – R: 1L (Fedosov, 2012b), 2 – 800-1330 m.
E. ciliata – R: 1L.
E. rhaptocarpa – R: 1L.
Funaria hygrometrica – Sp: 1L, 2, 3 – 500-900 m.
Grimmia donniana – Sp: 1L (Ignatova & Muñoz, 2004), 2 800-1100 m.
G. incurva – Sp: 1L (Blagodatskikh, 1984; Ignatova & Muñoz, 2004), 2 – 1000-1300 m.
G. jacutica – R: 3 – 500 m.**
G. longirostris – Sp: 1L (Blagodatskikh, 1984; Ignatova & Muñoz, 2004), 2, 3 – 500-1200 m.
G. mollis – R: 1L, 2 – 500-1300 m.
G. reflexidens – Sp: 2 – 1200-1400 m.**
G. torquata – R: 2 – 1600 m.**
Helodium blandowii – R: 1L, 2 – 750 m.
Hygrohypnella ochracea – Sp: 1L (Czernyadjeva, 2003), 2 – 750-900 m.

H. polare – Sp: 1L (Czernyadjeva, 2003), 2 – 1100-1600 m.
Hylocomiastrum pyrenaicum – R: 2 – 1300 m.*
Hylocomium splendens – Cm: 1L, 2, 3 – 450-1300 m.
Hymenoloma crispulum – Cm: 1L, 2, 3 – 450-1600 m.
Hypnum cupressiforme – R: 1L.
H. saitoi – R: 1L (Afonina & Blagodatskikh, 2006).
Isopterygiopsis alpicola – R: 3 – 500 m.**
I. muelleriana – R: 2 – 800-1300 m.**
I. pulchella – Sp: 2, 3 – 500-1300 m.
Iwatsukiella leucotricha – R: 1L.
Kiaeria blyttii – R: 1L.
K. glacialis – R: 1L.
Leptobryum pyriforme – Sp: 1L, 2, 3 – 450-800 m.
Loeskypnum badium – Sp: 1L, 2 – 800-1100 m.
Lyellia aspera – R: 1L.
Mielichhoferia mielichhoferiana – R: 2 – 1600 m.**
Mnium blyttii – R: 2 – 1500 m.**
M. lycopodioides – R: 1L, 2 -1100-1300 m.
Myurella tenerrima – R: 1L.
Neckera pennata – R: 1L.
Niphotrichum canescens – Sp: 1L, 2, 3 – 450-1600 m.
N. ericoides – Sp: 1L, 2 – 800 m.
Ochyraea cochlearifolia – R: 2 – 1150 m.**
O. norvegica – R: 1L (Czernyadjeva, 2003).
Oligotrichum falcatum – Sp: 2 – 800-1600 m.**
O. parallelum – R: 2 – 900-1300 m.*
Oncophorus wahlenbergii – Sp: 1L, 2 -800-1100 m.
Orthothecium chryseon – R: 1L.
Orthotrichum speciosum – R:1L, 2 – 1050 m.
Oxystegus tenuirostris – R: 1L.
Paludella squarrosa – R: 2 – 800-900 m.*
Philonotis fontana – Sp: 1L, 2 – 800-1300 m.
Plagiomnium curvatulum – R: 1L, 2 – 800 m.
P. ellipticum – R: 1L, 2, 3 – 450-800 m.
P. medium – R: 1L.
Plagiothecium denticulatum – Sp: 2 – 800-1500 m.*
P. laetum – Sp: 1L, 2, 3 – 450-900 m.
Pleurozium schreberi – Cm: 1L, 2, 3 – 450-1000 m.
Pogonatum dentatum – Cm: 1L, 2, 3 – 450-1300 m.
P. urnigerum – Sp: 1L, 2 – 1200-1600 m.
Pohlia atropurpurea – R: 2 – 1300 m.**
P. andrewsii – R: 3 – 450 m.
P. bulbifera – R: 3 – 450 m.**
P. cruda – Cm: 1L, 2, 3 – 450-1600 m.
P. crudoides – Sp: 1L, 2, 3 – 450-1500 m.
P. drummondii – Sp: 1L, 2 – 900-1600 m.
P. elongata – R: 1 – 450 m.**
P. longicollis – R: 1L.
P. nutans – Sp: 1L, 2, 3 – 450-1200 m.
P. proligera – R: 3 – 450 m.*
P. wahlenbergii – Sp: 1L, 2, 3 – 450-900 m.
Polytrichastrum alpinum – R: 1L, 2 – 1300 m.
P. fragile – R: 1L.
P. septentrionale – R: 2 – 1200-1600 m.
Polytrichum commune – Cm: 1L, 2, 3 – 450-1000 m.
P. hyperboreum – R: 1L, 2 – 1150 m.
P. jensenii – R: 1L.
P. juniperinum – Sp: 1L, 2, 3 – 450-1300 m.
P. piliferum – Sp: 1L, 2, 3 – 450-1300 m.
P. strictum – Sp: 1L, 2 – 800-900 m.
Pseudohygrohypnum subeugyrium – R: 1L (Czernyadjeva, 2003).
Psilopilum cavifolium – R: 1L.
P. laevigatum – R: 1L.
Pterigynandrum filiforme – R: 2 – 1300 m.**
Ptilium crista-castrensis – R: 1L.
Pylaisia polyantha – R: 1L, 3 – 450 m.
Racomitrium lanuginosum – Sp:1L, 2 – 1000-1300 m.
Rhabdoweisia crispata – R: 3 – 450 m.*
Rhizomnium andrewsianum – R: 1L, 2, 3 – 450-900 m.
R. gracile – R: 2 – 800 m.**
R. pseudopunctatum – R: 2 – 800 m.*
Rhytidium rugosum – R: 1L, 2, 3 – 450-1000 m.
Saelania glaucescens – R: 1L, 2 – 1300 m.
Sanionia uncinata – Cm: 1L, 2, 3 – 450-1600 m.
Schistidium agassizii – R: 1L, 2 – 850-1100 m.
S. apocarpum – R: 1L.
S. confertum – R: 1L.
S. frigidum – R: 2 – 1300 m.**
S .cf. holmenianum - R: 2 – 1300 m.**
S. liliputanum – R: 3 – 450 m.**
S. papillosum – R: 2 – 1300 m.**
S. platyphyllum – R: 2 – 1300 m.**
S. rivulare – R: 1L.
S. sordidum – Sp: 2 – 850-1300 m.**
S. strictum – R: 1L.
Scorpidium revolvens – R: 2 – 900 m.
Seligeria campylopoda – R: 2 – 1050 m.
Sphagnum alaskense – Sp: 2, 3 – 500-1100 m.*
S. angustifolium – R: 2 – 850-1100 m.*
S. aongstroemii – Cm: 1L, 2, 3 – 450-900 m.
S. balticum – Sp: 1L, 2, 3 – 500-1100 m.
S. capillifolium – R: 2 – 850 m.*
S. compactum – Cm: 1L, 2 – 850-1300 m.
S. contortum – R: 2 – 1100 m.
S. fimbriatum – R: 1L, 2 – 850 m.
S. flexuosum – Sp: 2, 3 – 500-900 m.*
S. fuscum – Sp: 1L, 2 – 800-1100 m.
S. girgensohnii – Cm: 1L, 2, 3 – 500-900 m.
S. imbricatum – R: 1L.
S. lenense – Cm: 1L, 2, 3 – 500-1100 m.
S. lindbergii – Cm: 1L, 2 – 800-1100 m.
S. magellanicum – R: 1L.
S. orientale – R: 1L.
S. platyphyllum – R: 2 – 1100 m.**
S. riparium – R: 2 – 1100 m.*
S. rubellum – Sp: 2, 3 – 500-1100 m.*
S. russowii – R: 1L, 2 – 1100 m.
S. teres – R: 2 – 850 m.
S. warnstorfii – Sp: 1L, 2 – 800-1100 m.
Splachnum luteum - R: 1L.
S. rubrum – R: 1L.
Stereodon plicatulus – R: 1L, 2: 800 m.
S. plumaeformis – R: 1L (Afonina & Ignatova, 2007).
S. revolutus – R: 1L.
Straminergon stramineum – Sp: 1L, 2, 3 – 550-900 m.
Syntrichia ruralis – R: 1L, 2 – 1050 m.
Tetraphis pellucida – R: 1L.
Tetraplodon angustatus – R: 3 – 500 m.*
T. mnioides – R: 3 – 500 m.*
Timmia austriaca – R: 2 – 1300 m.*
Tomentypnum nitens – R: 1L, 2, 3 – 500-900 m.
Tortella tortuosa – R: 1L.
Tortula mucronifolia – R: 1L.
Ulota curvifolia – R: 1L, 3 – 500 m.
Warnstorfia exannulata – R: 1L.

W. fluitans – R: 1L, 2 – 1100 m.
W. sarmentosa – Sp: 1L, 2, 3 – 500-1100 m.
W. trichophylla – R: 2 – 1100 m.**

The list does not qualify to be a complete bryoflora of B.Annachag. In the field works, we were unlucky with the weather. Only 1.5 of 5 working days were without rain, so most time it was impossible to use a hand-loupe for species collection… But even so, many of the data proved to be new to the region.

The present list includes 192 species. 124 species have been published previously for surroundings Aborigen Mt; some literature records in the list evidently doubtful and were based on obsolete concepts of the species, these include *Brachythecium salebrosum, Schistidium apocarpum, S. strictum.*

144 species were revealed in ca. 500 author‘s samples. From them 131 species were found in central part of the B. Annachag Range, but 13 were recorded only in Debin River valley, were bedrocks are mainly schists unlikely granitoids of the ridge itself.

The nearest well-investigated and comparable in size area is Mus-Khaya Mountain (Ignatova & al., 2011). Mus-Khaya Mt. is situated on almost the same latitude but 440 km West of B.Annachag; the territories are more or less similar in relief and climate. They also similar in a number of moss species (180 in Mus-Khaya, 177 in B.Annachag in strict sense without doubtful records). But in species composition the territories are strongly different and only some more than a half of species (108) were recorded in both mountain systems. That is obviously due to geology of the territories. So, calciphytes almost absolutely absent on granitoid B.Annachag; I failed to find even so widespread species as *Distichium capillaceum;* even *Abietinella abietina* and *Rhytidium rugosum* are rare here and were recorded only few times. *Seligeria campylopoda, Saelania glaucescens, Encalypta spp.* were found 1-2 times and the habitats look like are outliers in between the intrusion. Xerophytes are also almost absent and even *Syntrichia ruralis* is very rare. Epiphytic and epixilic mosses are absent too due to specificity of *Larix* bark; only *Pylaisia polyantha* was recorded in outskirts of the ridge in rivers floodplains on *Chosenia* (which are rare here). *Orthotrichum speciosum* is rare and grows only on stones. *Sphagnum* species are absolutely dominate on the areas especially in forest belt and cover even rather steep sites in footstool of slopes. Oligotrophic and acidophitic species prevail in hygrophytes too; for example, I failed to find *Scorpidium scorpioides* or any *Drepanocladus*; *Campylium stellatum* and *Tomentypnum nitens* are rare.

So, in Bolshoi Annachag Range we have a sample of poor northern bryoflora on granitoid bedrocks in conditions of cold and moderately dry climate with permafrost.

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