Arctoa (1994) **3**: *13-27*

BRYOPHYTES OF ALTAI MOUNTAINS. I. STUDY AREA AND HISTORY OF ITS BRYOLOGICAL EXPLORATION.

МОХООБРАЗНЫЕ АЛТАЯ. I. РАЙОН ИССЛЕДОВАНИЯ И ИСТОРИЯ ЕГО БРИОЛОГИЧЕСКОГО ИЗУЧЕНИЯ

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Abstract

In the introductory paper of the series the study area of Russian Altai is defined. Comments on its physiography and bryophyte composition of the main types of vegetation are provided. History of the bryological exploration of Altai is discussed. Preliminary list of Altaian mosses is given, with the altitudinal range and frequency for each species.

Резюме

Начиная с этого выпуска *Arctoa* предполагает опубликовать серию статей, в которых будут описаны и иллюстрированы мохообразные Алтая. Во вступительной части приведены сведения об истории изучения мохообразных Алтая, его природных условиях, растительном покрове и комплексах мохообразных основных типов растительности. Дан также предварительный список мхов Алтая (480 видов, 10 разновидностей), с указанием диапазона высот и частоты встречаемости для каждого вида.

INTRODUCTION

Starting with this issue of *Arctoa* I am putting forward a series of papers on bryophytes of Altai Mountains. In recent years a lots of specimens were collected in this region, including many species new to the area or poorly known in the world. Also, critical studies of previously collected materials reveal many novelties. Although a conspectus of the moss flora of Altai and Sayan Mountains has been published relatively recently by L. V. Bardunov (1974), the knowledge can now be sufficiently supplemented. Furthermore, the series will provide most of the species with description, illustration, and discussion on their distinguishing features, and in some cases, also on their nomenclature and systematic position.

STUDY AREA

There are at least two definitions of the Altai Mountain Range. In the maps of U. S. National Geographic Society (for example, *National Geographic* 181(6): 70A, 1992) and in many Atlases, this name is applied to a mountain system starting from the Russian Altai on the north-west, through the Chinese and Mongolian Altai, to Gobi Altai. Under such approach, Altai extends to about two and a half thousand kilometers, representing a huge and very heterogeneous territory. Another definition, which is commonly used in the Russian-language literature and also in some European editions, for example in *Encyclopaedia Britannica* (1902, v. 25), defines Altai to mean only the part situated within the Russia, while the other parts are named differently as Chinese Altai, Mongolian Altai, and Gobi Altai. This latter concept is accepted here (Fig. 1). Accordingly, Altai area includes the territory of (1) Republic Altai (as Gorno-Altaiskaya Autonomic Republic and Oirotskaya Oblast in earlier periods), formerly a part of Altaiskiy Territory, but became separated from the latter since 1991, and (2) the neighboring part of Altaiskiy Territory. Not included in the present consideration is the western slope of Altai in the Kazakh Republic. Delimited in such a way, the study area is about

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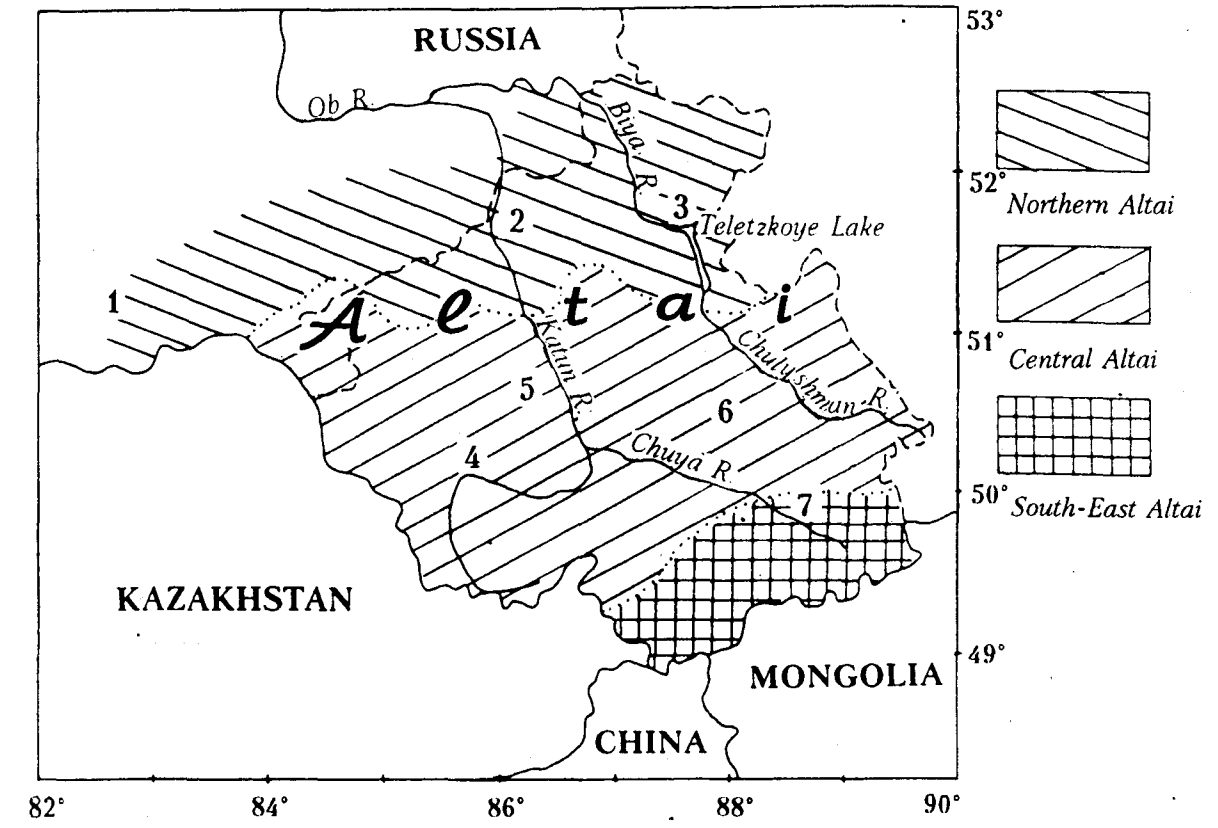

Fig. 1. Map of Altai, as it defined for present study, with bryogeographic subdivisions; numbers show places for which climatic diagrams are given on Fig. 2.

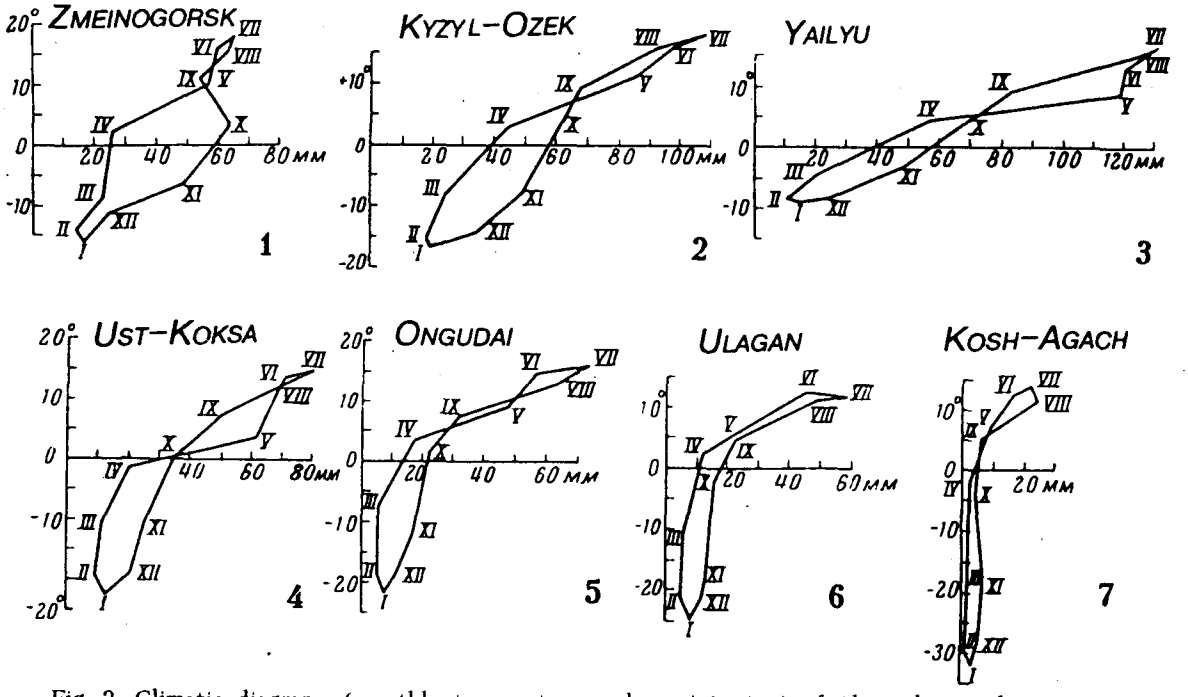

Fig. 2. Climatic diagrams (monthly temperature and precipitation) of Altai, the numbers correspond those on Fig. 1 (after Kuminova, 1960).

120 000 square kilometers, with an altitudinal range from ca. 250 m to 4506 m of the Belukha Peak. About 1.5% of territory is above 3000 m, ca. 23% - at 2000 - 3000 m, 50% - at 1000 - 2000 m, 25% - below 1000 m. Because of the presence of late and permanent snow-fields and glaciers, only a limited number of collections were made above 3000 m.

Climate

Diversity of climatic conditions of Altai is great. Average annual temperatures range from +4 to -8°C, and colder in high mountains. The western slope, which is the main acceptor of humidity of Atlantic air masses, receives to about 1600 mm of annual precipitation. The inner or southeast slopes of Altai, however, receive only 124 mm in Kosh-Agach and Chuiskaya Steppe.The subalpine zone at about tree line receives the maximum precipitation about two-three times more than that at middle elevations (Krivonosov, 1975). Some data of local climate are given as diagrams in Fig. 2.

Vegetation

The vegetation types are described by Kuminova (1960) and Ogureeva (1980). They are classified into semi-desert, steppe, forest-steppe, forest, subalpine and alpine/tundra types. But within each of these, there are a number of contrasting variations corresponding to vegetational provinces.

Four main provinces are recognized by Ogureeva (l.c.):

(1) Western Altai - characterized by well-precipitated steppes and occurring mostly outside the study area in the Kazakh Altai. This province is peculiar in its steppe composition and is probably not so for bryophytes. Moreover, the province is rather poorly explored for bryophytes;

(2) Northern or North-Eastern Altai - a humid area without steppes, but with widespread *Abies sibirica* Ledeb. and *Pinus sibirica* De Tour forests of a rather wet type, called also czernevaya taiga. Such forests, as showed by Bardunov (1974) and Gudoshnikov (1986), exhibit a species composition that is temperate rather than boreal. There is no continuous moss carpet on forest ground where tall grasses or ferns often dominate. Because of milder and wetter climate, this area is especially rich in bryophytes and many species are known in the Altai region only from here, especially from the surroundings of Teletzkoye Lake;

(3) Central Altai - occupying most of the territory of Altai. This province comprises a mosaic of fragments of steppe, forest-steppe, forests (both wet *Abies* + *Pinus sibirica* czernevaya taiga, and boreal forest, or northern taiga dominated by *Pinus sylvestris* L., *P. sibirica*, *Picea obovata* Ledeb., *Larix sibirica* Ledeb.), and various types of subalpine and alpine vegetations; northern part of this region is more humid and classified in special subregion;

(4) South-Eastern Altai which is most unique in having semi-desert (very fragmentary inside Russian territory) and a very widespread cool steppe vegetation. The latter, in many cases, gradually changes into tundra vegetation with fragmentary *Larix* forests (rarely with *Picea obovata* and *Pinus sibirica*). General physiogeography of South-Eastern Altai is closer to that seen in Mongolia Republic. In many subdivisions of Altai this part has a higher rank such that the first subdivision of Altai would be South-Eastern Altai and the rest of Altai.

The available bryological data allow the subdivision of Altai also into three regions, corresponding somewhat to the above described regions.

(1) Northern Altai (including also Western Altai and northern part of Central Altai, in definitions of Ogureeva and Kuminova) is distinctive in having a positive specificity of species such as *Eurhynchium hians, E. angustirete, Hylocomiastrum umbratum, Heterophyllium affine, Podperaea krylovii, Buxbaumia minakatae, Thamnobryum neckeroides, Dicranella heteromalla, Orthothecium intricatum*, and *Ulota hutchinsiae*, etc. There is a great abundancy of temperate groups like *Ulota, Orthotrichum, Neckera, Homalia, Atrichum, Myuroclada*, etc., which, however, are known also from Central Altai, at least in its northern part. The transition of this region into Central Altai is gradual. In some deep canyons and wet places in Central Altai, the moss flora is fairly reminiscent that of the North-Eastern Altai;

(2) Central Altai has mostly a negative "peculiarity" (absence of species of North-East and South-East). Its positive specificity includes only a few rather rare species, *Ptychomitrium sinense, Grimmia pilifera, Physcomitrella patens, Orthotrichum pumilum*;

(3) With respect to bryophytes, South-Eastern Altai is delimited much more sharply from the rest than one would expect. Only here are found genera such as *Indusiella, Voitia, Phascum, Crossidium*, and species such as *Pterygoneurum ovatum, Plagiobryum demissum, Pseudocalliergon turgescens, Hennediella heimii, Tortula leucostoma, Syntrichia caninervis*. Very abundant here are *Tayloria froelichiana, T. acuminata, Stegonia spp.*, and *Ctenidium procerrimum*, which are rare in other parts of Altai. Striking here is the absence of common species of Central Altai like *Sarmentypnum sarmentosum, Racomitrium lanuginosum, R. microcarpon, Polytrichum piliferum*. There is no species of *Sphagnum* found here, although 50 km away they are numerous and abundant. The wet habitats are dominated by *Aulacomnium palustre*, sometimes

with *A. turgidum* and *Tomentypnum nitens*. Inside *Larix* forests are found *Hylocomium splendens* and *Rhytidium rugosum*, while *Pleurozium schreberi* is totally absent(!), although not rare 50 km apart in the taiga habitat. Many unusual combinations of species were observed in South-Eastern Altai.

VERTICAL ZONATION

Vertical zonation of forests of Northern and Central Altai is principally similar. At lower elevations, below 1000-1400 m, the forests are composed of conifers, sometimes with considerable addition of *Betula alba* L. and *Populus tremula* L. Two main complexes can be segregated: the more humid type represented by *Pinus sibirica* + *Abies sibirica* forests, usually with *Picea obovata*; and the more xeric type of *Pinus sylvestris* + *Betula alba* or *B. pendula* Roth, and also *Larix sibirica*. These two forest types differ considerably in their vascular plant composition, but their bryophyte components are more or less homogeneous. This is because bryophytes occur mostly on rock outcrops, ravines, slopes, canyons, brook banks, wet depressions and other habitats having a specific microclimate of their own. There is no constant species association present on soil in these forest types. Among the more or less frequent taxa are *Atrichum flavisetum, Eurhynchium hians, Rhytidiadelphus triquetrus, Pleurozium schreberi*. Typically on tree trunks are *Brachythecium reflexum, B. salebrosum, Amblystegium serpens, Hypnum pallescens, Entodon cladorrhizans, Plagiomnium cuspidatum, Plagiothecium laetum, Dicranum scoparium, Pohlia nutans, Frullania parvistipula, Ptilidium pulcherrimum, Pylaisiella polyantha, P. selwynii, Orthotrichum speciosum, O. sordidum, Orthodicranum spp.*, etc., most of which occur also on rotten logs. In drier areas and on fallen logs are *Orthodicranum flagellare, Oncophorus wahlenbergii, Platygyrium repens, Hypnum fertile, Bryohaplocladium microphyllum*. Under more humid condition, epiphytes, including *Neckera pennata, Orthotrichum spp. Ulota spp.*, and *Homalia trichomanoides*, become more numerous and abundant. On rotten logs here are continuous carpets of *Dicranodontium denudatum, Tetraphis pellucida, Bazzania bidentula, Lophozia incisa* and *Tritomaria exsecta*. On mesic rocks at these elevations are characteristically *Anomodon attenuatus, A. viticulosus, Leucodon sciuroides, Brachythecium populeum, B. buchananii, Tortula sinensis, Eurohypnum leptothallum, Hypnum cupressiforme, Plagiomnium confertidens, Trachycystis ussuriensis, Hedwigia ciliata, Schistidium strictum, Apometzgeria pubescens, Porella platyphylla, Frullania davurica*, etc. Also abundant are common species like *Hylocomium splendens, Abietinella abietina, Pleurozium schreberi, Rhytidium rugosum, Ptilidium crista-castrensis*. Wet cliffs are rich in rather rare species: *Bartramia pomiformis, Blindia acuta, Cirriphyllum cirrosum, Cyrtomnium hymenophylloides, Ditrichum flexicaule, Encalypta procera, Fissidens adianthoides, Hypnum hamulosum, H. callichroum, Isopterygiopsis muellerana, Mnium hornum, M. thomsonii, Myurella sibirica, Orthothecium chryseum, Plagiobryum zieri, Plagiomnium rostratum, Plagiopus oederiana, Polytrichum pallidisetum, Thamnobryum neckeroides, Timmia norvegica, Brachythecium plumosum, Hymenostylium recurvirostrum*, etc.

The forest-steppes and steppes which occupy the more xeric regions of Central Altai are poor in bryophytes. The more widespread species here are *Rhytidium rugosum, Abietinella abietina, Tortula ruralis* (these three are common practically in all the types of vegetation in Altai, including the high-alpine zone), and sometimes also *Entodon concinnus, Trachycystis ussuriensis*, and *Hypnum vaucheri*. Together, they form a somewhat pure blanket of ground moss in shrubby land consisting of *Caragana, Berberis, Rhododendron*, and on pasture land. Here on rocks are typically found *Orthotrichum anomalum, Grimmia ovalis, G. tergestina, Bryum argenteum, Tortula sinensis*, and in more xeric regions, *Jaffueliobryum latifolium* is very abundant.

From elevations of 1000-1400 m to the tree line, the conifer forests of boreal type, or taiga, appear. Though the tree composition of taiga is practically the same as that in the forests below, their structures are strikingly different. Herbs are rare but ericaceous shrublets are common in taiga. Mosses usually form continuous carpets which consist mostly of *Hylocomium splendens*, often with *Pleurozium schreberi, Rhytidiadelphus triquetrus, R. subpinnatus, Sphagnum capillifolium*, etc. Epiphytes are rare and *Dicranum fragilifolium, D. fuscescens, Plagiothecium laetum, Isopterygiopsis pulchella, Lophozia incisa, L. incisa, Tritomaria exsectiformis, Bleparostoma trichophyllum, Lepidozia reptans* are typically seen on rotten logs. Constantly present on rocks are *Ulota curvifolia* and *Cynodontium strumiferum*.

The tree line in Altai varies from 1800 in NW to 2400 m in SE. It is formed in most parts of Central and Northern Altai by *Pinus sibirica* stands. This subalpine zone combines fragments of taiga and open areas occupied mostly by shrubs of *Betula rotundifolia* Spach *(Betula nana* L. *p. p.)* that are of 0.5 - 1.5 m high. Under such shrubs, called also "yernik", in bogs in wetter places are abundant species of *Sphagnum, Aulacomnium palustre, Tomentypnum nitens, Warnstorfia exannulata* and *Campylium stellatum*. Dominants on drier sites under *Betula* shrubs are *Polytrichastrum alpinum, Rhytidium rugosum, Dicranum flexicaule (D. congestum auct.)* and lichens of the genera *Cladonia, Cladina, Stereocaulon* and *Cetraria*. As mentioned earlier, this zone is the most humid typically with precipitation everyday. It is very rich in bryophytes; here are recorded 290 species, nearly as much as in lower forest zone, where 299 species were recorded. Many alpine species are found here (*Grimmia*

incurva, G. donniana, G. funalis, Aulacomnium turgidum, Kiaeria starkei), and some alpine species restricted to this belt (*Pohlia crudoides, Psilopilum laevigatum, Hygrohypnum alpestre, Schistidium agassizii, Campylopus schimperi, C. fragilis* etc.). Some temperate forest species that are typically absent in taiga are found to penetrate occasionally into the zone of tree line. Examples are *Anomodon attenuatus, Leucodon sciudoides, Struckia argentata* ssp. *zerovii, Myuroclada maximowiczii, Atrichum flavisetum*, etc. Other species known only or predominantly from the subalpine zone are *Cnestrum alpestre, Cynodontium tenellum, Splachnum sphaericum*, and the single endemic genus of Altai and the neighbouring Western Sayan Mts., *Orthodontopsis bardunovii*. Recently descibed from one Altaian and one Sayanan localities, it is now known from 12 localities where it occurs on rotten logs within a narrow range of about 200 m of elevations between subalpine open stands and upper taiga zone. In the belt of about tree line there are very widespread also different kinds of bogs, so many *Sphagnum* species are known only from here (i.e. *S. lindbergii, S. jensenii, S. riparium*, etc.).

Tall herb vegetation (*Aconitum, Delphinium, Angelica, Heracleum, Paeonia*, etc.) sometimes is developed in upper taiga and subalpine zone. The vascular plant covers are usually too dense and dark at ground level to favor any moss growth. However, in some places are seen the common *Rhytidiadelphus triquetrus, R. subpinnatus, Dicranum majus, Brachythecium erythrorrhizon, Scleropodium ornellanum, Plagiochila porelloides*, and *Barbilophozia spp.* This assemblage of bryophytes occurs also underneath the herbaceus cover of yernik (with *Geranium, Doronicum*, etc).

The lower part of alpine zone is covered also with shrubs of *Betula rotundifolia* (sometimes intermixed with *Salix glauca* L., *S. krylovii* E. Wolf, and other willows), forming especially dense growth up to 2000-2500 m. Finally, in the upper alpine zone there are representatives of a variety of lichen and rocky tundras. Bryophytes frequently growing on soil in the alpine zone are *Dicranum spadiceum, D. congestum, Paraleucobryum enerve, Polytrichum piliferum, Polytrichastrum alpinum, Aulacomnium palustre, A. turgidum*, and on rocks or lithosoil are *G. affinis, G. donniana, G. elatior, G. funalis, G. incurva, Racomitrium microcarpon, R. canescens, Orthotrichum laevigatum* var. *japonicum, O. rupestre, Pohlia filum, Andreaea rupestris, A. alpestris, Ceratodon purpureus, Distichium capillaceum, Saelania glaucescens*, etc. Common along streams are *Hygrohypnum polare* and *Sarmentypnum sarmentosum*. Extensive *Sphagnum* bogs are not seen in this zone, and mosses such as *Meesia uliginosa, Paludella squarrosa, Limprichtia revolvens, L. cossonii, Stramigeron stramineum (=Calliergon stramineum), Sphagnum* spp., *Brachythecium turgidum* occur mostly in hummocks along streams or lake shores, or in springy bogs on mountain slopes.

South-Eastern Altai has an altitudinal range from ca. 1400 to 3500 m. Vegetations at the bottom of river valleys are semi-deserts or steppes. In most areas there is a severe disturbance caused by over-grazing of the local vegetation. *Larix* forests occupy mostly the steep slopes of northern aspect. They mostly have no continuous moss carpet or it is formed mainly of *Rhytidium rugosum*. Steppe vegetation in many places transforms directly into tundra.

Geology

Altai Mountains were formed in Late Paleozoic and had the most considerable recent uplift in Middle Oligocene-Miocene (Bogachkin, 1981).

Most of the rocks in Altai are of early Paleozoic age. They are either of magmatic origin or of marine deposits. Despite considerable differences in their chemical composition, various rocks are so strongly metamorphosed that they looks very similar. The most common type of rocks in Altai is the grayish-green chlorite-sericite schist which is difficult to classify as acidic or basic because of its complex composition and the numerous varieties of more or less basic types. Calcareous outcrops are not very common, but calcareous argillites or limestones are known here and there in relatively restricted areas. The latter typically are hard in texture, close to mramor. Acidic rocks such as granites, are very widespread, especially in high mountain areas. Sandstones are uncommon. Moraine deposits, often chemically strongly calcareous, are common in many regions.

History of vegetation

In the Paleogene on the territory of South Siberia and Kazakhstan broad leaved forests with thermophilous conifers, *Taxodium, Sequoia* and *Metasequoia*, were widespread (Dorofeev, 1964; Malyshev & Peshkova, 1984; Zhilin, 1991). However already in Oligocene the percent of *Picea* in pollen spectra was considerable (Bogachkin, 1981). Toward the Pliocene, forest composition became more and more boreal with the predominance of *Pinus* (especially *P. sibirica*), *Abies, Picea, Tsuga*, although the presence of broad-leaved trees (*Carpinus, Tilia, Corylus, Ulmus*) remained apparent up to the end of early Pleistocene (ca. 600 000 BP). A later important event is the xerophytization of vegetation and formation of steppe zone in Late Miocene and Pliocene. These changes were due to, probably, not only the planetary cooling, but also the great changes in continental Asiatic air circulation pattern. As discussed by Chang (1983), the Neogene-Quaternary uplift of Tibetan Plateau blocked the Central Asia from the wet and warm southern air currents from

Indian Ocean. This uplift resulted also in the formation of Tibetan and Siberian-Mongolian Anti-cyclones. And as a consequence, xeric territories developed in Central Asia, including the Mongolia and Inner Altai.

The Late Pleistocene cooling, about 45-35 thousand years BP, resulted in glaciation of about 35% of Altai territory (now glaciers occupy about 1%), and the snow line was at 1600-2100 m alt., or about 800-900 m lower than the present day position. In the valleys glaciers penetrated down to 1200-1000 m (Okishev, 1982). However, according pollen spectra, even in the most severe periods forests of *Pinus sibirica* and *Picea* survived even in close proximity to glaciers (Boyarskaya, 1978). All the present vegetational zones, probably existed during the time of maximal glaciation with just some vertical shifts, so Tertiaty temperate relicts seems had a chance to survive.

Another probable time period when the temperate flora could reach the Altai is during the Holocene climatic maximum (6000-5000 years BP). As restored by Klimanov (1989) on the basis of correlation of numerous pollen spectra throughout Eurasia, the temperature and precipitation in Altaian region and its surroundings were higher at the time. According to Belov & Belova (1986), *Tilia, Quercus* and *Ulmus* occurred in the surrounding of Baikal Lake where the same genera are absent today, being present remotely by 1-2 thousand km.

After this short optimum period, a progressive cooling process followed throughout the Holarctic. The relatively warmer and cooler periods probably alternated many times. A better documented period is the last cooling, so called the Minor Glacial Period. It started in about XIV century and had a definite climatic minumum in 1780-1850. The occurrence of a cooling period was proven by an analysis of moraine deposits and cross sectional study of *Larix* trunks (Adamenko, 1985; Okishev, 1982). According to Okishev, mean annual temperature before this period was 0.3°C higher than present, and during the period the temperature dropped 0.9°C. Thus, the main Altaian glaciers had their lower ends reaching 70 m below the present line. In term of vegetation, the more cool-resistant *Larix* forests were much more widespread in the Altai. Today no juvenile *Larix* is seen in many old *Larix* stands, where young trees of *Picea obovata* and *Pinus sibirica* became abundant. Only in South-East Altai is the survival of *Larix* forests still visible. So, one can conclude that the climate of South-East Altai (see Fig. 2) was characteristic for much wider area just two centures ago.

BRYOLOGICAL EXPLORATION

The first collections from Altai were made by Petr Shangin in 1786 (specimens at LE). However, they were identified much later, so that in Shangin's publications no bryophytes were mentioned. Such situation continued well into the XIX and the early XX century with the collections of I. Politov - 1837, F. Gebler - 1837, V. V. Sapozhnokov - 1890s, I. V. Vereshchagin - 1903-1909 & 1919, P. N. Krylov - 1903, N. I. Kusnezov -1913 and other collectors who did not mention bryophytes in their travel accounts. In spite of, these collections accumulated in several herbaria in St.-Petersburg, Tomsk and Helsinki.

The first publication on Altaian bryophytes is, probably, the list produced by A. Zass (1894) which included mostly vascular plants and 6 bryophytes without exact localities.

The first more or less comprehensive list of bryophytes of Altai appeared in the report of expedition of B. A. Keller (1914). This report contains numerous releves which include vascular plants, bryophytes and lichens, and, in addition, detailed geographical and pedological information. A list of 92 bryophytes which was presented in a special index fully referred to the releves was rich in ecological information for every species. The collection base of this report was made mostly by P. I. Kurskij (Kursky) in 1909, M. P. Tomin in 1910, and by Keller himself. All collections were identified by V. F. Brotherus and are at H.

Brotherus also received rich materials for identification from Krylov from the herbarium of Tomsk University. These include the Altaian collections of Krylov, Vereshchagin, Sapozhnikov, and to a lesser extend, those of A. I. Ivanizkaya and A. P. Vydrin. Later Krylov (1925) published the identifications of 217 species and 4 varieties in a list for the Altai area by current definition.

In 1914 Brotherus started to contribute his moss treatments to the "Flora Asiatskoj Rossii" (Flora of Asian Russia) which was edited by B. A. Fedtschenko. Three parts were published (Brotherus, 1914, 1918, 1931), covering acrocarpous species from *Andreaeaceae* to *Encalyptaceae*, in which Altaian materials were carefully cited.

B. S. Semenov (1921, 1922) published two booklets about the Sphagna and pleucarpous mosses of Altai, basing on his own collections and on the collections of Krylov determined by Brotherus. His publications contain keys, descriptions, illustrations and lists of localities, which are, however, less complete than the Krylov (1925) materials.

Since 1920s many geobotanists and floristicians of vascular plants collected bryophytes in Altai and deposited the specimens at LE after their identifications were made by L. I. Savicz-Ljubitskaya and A. L. Abramova. Among these are sufficient numbers of unusual and interesting collections made by V.I. Baranov, B. K. Schischkin, A. G. Krylov & S. P. Rechan, T. Yu. Vozzhennikova, I. A. Palamarchuk, A.G. Kalinina, and many others. In their publications, these authors mentioned, however, only the widespread

species used in the characterization of some vegetational types (Krylov & Rechan, 1967; Ogureeva, 1980).

In 1934, soon after the organization of the Altaian State Reserve in Eastern Altai which covered ca. 8800 sq. km., intensive investigations of bryophytes started. The collections of M. S. Khomutova, A. N. Goncharova, M. V. Zolotovskij and some others were identified by N. V. Samsel (Moscow) and published by Khomutova & al. (1938) with full citation of the labels for 2 hepatics and 49 mosses. However, these specimens can not be located today.

Later M. Schmidt, Volkova and G. Kreps (1930s) collected bryophytes in Altaian State Reserve and deposited the specimens at LE and H. From 1940-1967, the Reserve was abolished. After its re-establishment in 1967, collecting activity resumed. Numerous specimens were collected by N. I. Zolotukhin - 1976-1993, I. N. Zolotukhina (Lebedeva), E. F. Koroleva, and many others. Collections were sent to me for identification and were preserved in MHA.

Additional various collections are deposited in herbaria such as MHA (coll. V.V.Makarov & al. - 1972), LB (D.K.Zerov - 1940; E.I.Vysozkaya - 1977), LWS (V.M.Melnichuk - 1953). From these collections only the more interesting species were published (Abramova & Abramov, 1966; Lazarenko, 1946; Kulik, 1990; Kulik & Ulychna, 1990; Ulychna, 1990).

Inspite of the long overview above, the first professional bryological investigation of Altai mosses was undertaken by L.V.Bardunov in 1966. Working many years before in the neighboring Sayan Mountains, Bardunov was the first to collect mosses with full intent. Previous authors either could not recognize in the field what they are collecting or, like Zerov and Melnichuk, had a rather limited time for a comprehensive investigation of bryophytes. Consequently, the visits of Bardunov added more than 100 species to the Altain moss flora. In his conspectus are reported 350 species for the entire area. The conspectus contains a general or exact (for rare species) geographic distribution, altitudinal distribution, habitat preference, and also an essay on the vegetational, geographic and ecological analyses of Altaian mosses. As a whole, Bardunov (1974) provided an excellent synthesis for the bryophyte flora of Altai and Sayan Mts. His collections are mainly kept in IRK.

In 1980s S. V. Gudoshnikov worked in Northern Altai. His collections were published in a review of bryophytes of *Abies* forests in Southern Siberia (Gudoshnikov, 1986).

Thus far, no publication on the Altaian hepatic flora has been attempted.

My own studies of bryophytes of Altai started in 1988 when Zolotukhin brought to my disposal his collections made from the Altaian State Reserve and its surroundings. In 1989 and 1991-93, I also collected numerous specimens in the Altai, depositing them mainly in MHA. Some collections have already been discussed (Ignatov, 1990, 1991, 1992; Ignatov & Kurbatova, 1990; Ignatov & Tan, 1991; Tan & al., 1991; Czernyadjeva & Ignatov, 1991; Ignatov & Zander, 1993). Nevertheless, numerous additions remain unreported. Therefore, I am organizing the new information of Altaian mosses in this series in *Arctoa* journal.

The goals of the series are to report the occurrence of bryophytes in the Altai, to describe them and supply with keys to species determination, and also to illustrate them. The taxonomy of a certain groups will be discussed.

The distribution data of the Altaian mosses are stored in a database at MHA which contains the label and locality information. All information can be obtained free upon request by *Arctoa* subscribers.

Specimen citation includes name of locality, altitude, either the collector number (meaning that collector is Ignatov and specimen is in MHA), or name of collector and date and host herbarium (if herbarium acronym is not indicated - specimen is in MHA) and if present - the collection number also.

Understandably, this series may not be completed within a few years. I am adding here therefore a preliminary list of Altaian mosses, believing that it can be used to better understanding the environmental situation. Since this list has been extracted very recently from my database, corrections and additions are certainly expected during the preparation of treatment for the various groups. Synonyms are given for names different from that in "Check-list of mosses of the the former USSR" (Ignatov & Afonina, 1992). All species names are supplemented with information on the altitudinal range and number of specimen studied.

AKNOWLEDGEMENTS

I am greatly indebted to Dr. B. C. Tan for help with the English and many useful advices and to Drs. L. V. Bardunov and S. G. Kazanovskij for loan and for duplicates of many critical collections from IRK. I am also very thankful to J. Vana for the help with identifications of hepatics. The project on moss flora of Altai was supported in part by the grant M97000 of the International Science Foundation.

PRELIMINARY LIST OF MOSSES OF THE ALTAI

SPHAGNACEAE		
Sphagnum		
angustifolium (Russ. ex Russ.) C.Jens	1200-2400	15
aongstroemii C.Hartm.	2200	2
balticum (Russ.) Russ. ex C.Jens.	1200-2550	14
capillifolium (Ehrh.) Hedw.	440-2400	34
centrale C.Jens. ex H.Arnell et C.Jens.	2050-2300	2
compactum DC.	1950-2300	3
contortum Schultz	1950	1
fallax (Klinggr.) Klinggr.	1200-2300	3
fimbriatum Wils.	2300-2350	3
flexuosum Dozy et Molk	450-2530	13
fuscum (Schimp.) Klinggr.	1620-2300	18
girgensohnii Russ.	560-2350	18
jensenii H.Lindb.	1200-1950	7
lindbergii Schimp. ex Lindb.	2050	1
magellanicum Brid.	1200-2240	6
palustre L.	1200	1
platyphyllum (Lindb. ex Braithw.) Sull. ex Warnst.	1900-2500	9
quinquefarium (Lindb. ex Braithw.) Warnst..	560-600	2
riparium Aongstr.	1950-2280	3
rubellum Wils.	2050-2400	5
russowii Warnst.	1750-2280	9
squarrosum Crome	440-1900	10
subsecundum Nees ex Sturm	520-2100	8
teres (Schimp.) Aongstr. ex Hartm.	520-2280	6
warnstorfii Russ.	450-2500	27
ANDREAEACEAE		
Andreaea		
alpestris (Thed.) Schimp.	1900-2908	10
heinemannii Hampe et C.Muell.	2300	1
obovata Thed.	2050-2850	3
rupestris Hedw.	550-2908	32
- var. *papillosa* (Lindb.) Podp.	1900-3150	7
POLYTRICHACEAE		
Atrichum		
flavisetum Mitt.	400-1900	19
tenellum (Rohl.) B.S.G.	460-480	2
undulatum (Hedw.) P.Beauv.	450-500	5
Pogonatum		
dentatum (Brid.) Brid.	470-2850	17
urnigerum (Hedw.) P.Beauv.	450-3100	11
Polytrichastrum		
alpinum (Hedw.) G.L.Sm.	440-2908	30
Polytrichum		
commune Hedw.	440-2650	19
- var. *jensenii* (Hag.) Moenk.	1600-2500	2
- var. *perigoniale* (Michx.) Hampe	1650-2100	2
formosum Hedw.	450-880	6
juniperinum Hedw.	440-2908	25
longisetum Sw. ex Brid.	470-2500	13
- var. *anomalum* (Milde) Hag.	1450	1
pallidisetum Funck	470-880	5
piliferum Hedw.	400-2965	11
sexangulare Brid.	1800-2880	9
sp.n.	2600	1
strictum Brid.	1760-2500	8
Psilopilum		
laevigatum (Wahlenb.) Lindb.	1950	1
BUXBAUMIACEAE		
Buxbaumia		
minakatae Okam.	460	1
FISSIDENTACEAE		
Fissidens		
adianthoides Hedw.	340-880	10
bryoides Hedw.	450-2550	22
osmundoides Hedw.	450-2700	22
taxifolius Hedw.	500-600	5
DITRICHACEAE		
Ceratodon		
purpureus (Hedw.) Brid.	440-2800	40
- var. *rotundifolius* Berggr.	2350	1
Distichium		
capillaceum (Hedw.) B.S.G.	440-2800	44
inclinatum (Hedw.) B.S.G.	1750-2750	6
Ditrichum		
cylindricum (Hedw.) Grout	400-1600	8
flexicaule (Schwaegr.) Hampe	340-2750	40
heteromallum (Hedw.) Britt.	440	1
pallidum (Hedw.) Hampe	440	1
pusillum (Hedw.) Hampe	450-520	2
Saelania		
glaucescens (Hedw.) Broth.	450-2900	23
SELIGERIACEAE		
Blindia		
acuta (Hedw.) B.S.G.	470-2280	7
Seligeria		
diversifolia Lindb.	440-1700	6
pusilla (Hedw.) B.S.G.	400	1
recurvata (Hedw.) B.S.G.	600	1
DICRANACEAE		
Brothera		
leana (Sull.) C.Muell.	450-550	8
Campylopus		
fragilis (Brid.) B.S.G.	2250	1
schimperi Milde	2100	2
Cnestrum		
alpestre (Wahlenb.) Nyh. ex Mogensen	1900	1
schistii (Web. et Mohr) Hag.	1000	1
Cynodontium		
fallax Limpr.	450-1950	11
polycarpon (Hedw.) Schimp.	1760	1
strumiferum (Hedw.) Lindb.	440-2200	17
tenellum (B.S.G.) Limpr.	700-2400	23
Dichodontium		
pellucidum (Hedw.) Schimp.	340-1850	28
Dicranella		
cerviculata (Hedw.) Schimp.	1950-2220	3
crispa (Hedw.) Schimp.	1000	1
heteromalla (Hedw.) Schimp.	480-1000	2
rufescens (Dicks.) Schimp.	500	1
schreberiana (Hedw.) Hilp. ex Crum et Anderson	280-1800	13
subulata (Hedw.) Schimp.	1000-2600	16
varia (Hedw.) Schimp.	450-1700	10

Dicranodontium		
denudatum (Brid.) Britt.	440-1850	25
Dicranoweisia		
crispula (Hedw.) Lindb.	550-2650	33
intermedia Amman	2300-2600	3
Dicranum		
acutifolium (Lindb. et H.Arnell) C.Jens. ex Weinm.	1760-2600	9
angustum Lindb.	2050-2530	3
bergeri Bland. in Starke	440-2400	17
bonjeanii De Not.	760-2500	20
brevifolium (Lindb.) Lindb.	1920-2800	3
congestum Brid.	440-2600	43
drummondii C.Muell.	1850	1
elongatum Schleich. ex Schwaegr.	1760-2908	25
fragilifolium Lindb.	480-2000	25
fuscescens Turn.	450-2908	23
majus Sm.	1920-2250	4
muehlenbeckii B.S.G.	450-2300	6
polysetum Sw.	450-2250	11
scoparium Hedw.	450-2650	15
spadiceum Zett.	1750-3010	49
Kiaeria		
falcata (Hedw.) Hag.	1900	1
starkei (Web. et Mohr) Hag.	1900-2700	8
Oncophorus		
virens (Hedw.) Brid.	1750-2650	21
wahlenbergii Brid.	400-2400	35
Orthodicranum		
flagellare (Hedw.) Loeske	440-1000	21
montanum (Hedw.) Loeske	55-1800	17
Paraleucobryum		
enerve (Thed.) Loeske	1900-2800	16
longifolium (Hedw.) Loeske	440-2260	16
Rhabdoweisia		
crispata (Dicks.) Lindb.	380-2100	14
ENCALYPTACEAE		
Bryobrittonia		
longipes (Mitt.) Horton	440-1400	10
Encalypta		
alpina Sm.	1900-2700	5
brevicollis (B.S.G.) Bruch ex Aongstr.	900-2300	12
ciliata Hedw.	370-2400	46
procera Bruch	350-2750	12
rhaptocarpa Schwaegr.	340-2900	53
vulgaris Hedw.	1700-2400	4
POTTIACEAE		
Aloina		
brevirostris (Hook. et Grev.) Kindb.	870-2700	9
rigida (Hedw.) Limpr.	440-2300	12
Barbula		
amplexifolia (Mitt.) Jaeg.	400-550	5
convoluta Hedw.	310-1800	15
unguiculata Hedw.	450-900	7
Bryoerythrophyllum		
alpigenum (Vent.) Chen	450-2100	8
inaequalifolium (Tayl.) Zander	600	1
recurvirostrum (Hedw.) Chen	340-2750	49
Crossidium		
squamiferum (Viv.) Jur.	2200-2400	5
Didymodon		
asperifolius (Mitt.) Crum et al.	500-2800	5
cordatus Jur.	2000	1
fallax (Hedw.) Zander	400-800	6
icmadophilus (Schimp. ex C.Muell.) Saito	340-2700	34
johansenii (Williams) Crum	340-2400	11
perobtusus Broth.	1100-2500	2
rigidulus Hedw.	400-2400	22
vinealis (Brid.) Zander	450-2250	3
Eucladium		
verticillatum (Brid.) B.S.G.	350-350	2
Gymnostomum		
aeruginosum Sm.	2100	1
calcareum Nees et Hornsch.	600	1
Hennediella		
heimii (Hedw.) Zander (= *Pottia heimii*)	1980-2150	4
Hymenostylium		
recurvirostrum (Hedw.) Dix.	400-2750	21
Molendoa		
schliephakei (Limpr.) Zander (= *Pleuroweisia schliephakei*)	2050-2450	4
sendtneriana (B.S.G.) Limpr.	2450	1
Phascum		
cuspidatum Hedw.	2150-2150	2
Pterygoneurum		
ovatum (Hedw.) Dix.	2150-2550	9
subsessile (Brid.) Jur.	800-2200	5
Stegonia		
latifolia (Schwaegr.)Vent. ex Broth.	1900-2800	13
pilifera (Brid.) Crum et Anderson	2200-2700	4
Syntrichia (= *Tortula p.p.*)		
caninervis (Mitt.) Broth.	1800-2500	11
laevipila Brid.	1950-2350	6
norvegica Web.f.	1800-2900	5
pagorum (Milde) Amann	1700-1800	2
ruralis (Hedw.) Web. et Mohr	440-2800	25
sinensis (C.Muell.) Ochyra	340-1700	38
Timmiella		
anomala (B.S.G.) Limpr.	400-800	8
Tortella		
fragilis (Hook. et Wils.) Limpr.	440-2750	34
inclinata (Hedw.f.) Limpr.	2300-2700	2
tortuosa (Hedw.) Limpr.	350-2800	30
Tortula		
cernua (Hueb.) Lindb. (= *Desmatodon cernuus*)	1220-2750	6
euryphylla Zander (= *Desmatodon latifolius*)	1950-2500	21
laureri (Schultz) Lindb. (= *Desmatodon laureri*)	2450	1
leucostoma (R.Br.) Hook. et Grev. (= *Desmatodon leucostomus*)	2000-2500	7
modica Zander (= *Pottia intermedia*)	1800	1
mucronifolia Schwaegr.	500-2500	23
obtusifolia (Schwaegr.) Math. (= *Desmatodon obtusifolius*)	440-550	2
systylia (Schimp.) Lindb. (= *Desmatodon systilius*)	1800-2700	8
Trichostomum		
arcticum Kaal.	1650	1
crispulum Bruch in F.Muell.	340-2050	5
tenuirostre (Hook. et Tayl.) Lindb. (= *Oxystegus tenuirostris*)	350-1400	15
Tuerkheimia		
svihlae (Bartr.) Zander	400-2500	13

Weissia		
brachycarpa (Nees et Hornsch.) Jur.	1100-2250	7
condensa (Voit) Lindb.	440-900	6
controversa Hedw.	450-2400	10
exserta (Broth.) Chen	2000	1
CINCLIDOTACEAE		
Cinclidotus		
riparius (Brid.) Arnott	340-400	4
GRIMMIACEAE		
Coscinodon		
cribrosus (Hedw.) Spruce	2050-2100	2
Grimmia		
affinis Hoppe et Hornsch.	400-2966	118
alpestris (Web. et Mohr)Schleich. ex Nees	2000-2200	2
anodon B.S.G.	1600-2600	44
caespiticia (Brid.) Jur.	1600-2400	13
donniana Sm.	1930-3150	28
elatior Bruch ex Bals. et De Not.	400-2908	50
funalis (Schwaegr.) B.S.G.	1750-2750	36
incurva Schwaegr.	1900-3151	42
laevigata (Brid.) Brid.	340-1400	10
montana B.S.G.	800-2100	2
ovalis (Hedw.) Lindb.	340-2700	44
pilifera P.Beauv.	450-2300	7
plagiopodia Hedw.	2200-2250	2
tergestina Tomm. ex B.S.G.	440-2300	20
unicolor Hook.	450-2700	18
Hydrogrimmia		
mollis (B.S.G.) Loeske	2400-2600	3
Indusiella		
thianschanica Broth. et C.Muell.	2100	1
Jaffueliobryum		
latifolium Lindb. et H.Arnell ex Ther.	450-2500	15
Racomitrium		
canescens (Hedw.) Brid.	450-2890	13
lanuginosum (Hedw.) Brid.	1920-3100	15
microcarpon (Hedw.) Brid.	880-2600	13
panschii (C.Muell.) Kindb.	1665-3150	5
sudeticum (Funck) B.S.G.	1860-2500	14
Schistidium		
agassizii Sull. et Lesq.	1750-2050	5
apocarpum (Hedw.) B.S.G.	400-2750	14
helveticum (Schkuhr) Deguchi	1950	1
liliputanum (C.Muell.) Deguchi	1100-2100	6
rivulare (Brid.) Podp.	440-2650	16
strictum (Turn.) Maort.	400-2800	74
FUNARIACEAE		
Funaria		
hygrometrica Hedw.	450-2350	15
muehlenbergii Turn.	440-900	5
Physcomitrella		
patens (Hedw.) B.S.G.	450	1
SPLACHNACEAE		
Splachnum		
luteum Hedw.	1250-2050	4
rubrum Hedw.	1660-2050	2
sphaericum Hedw.	1655-2400	4
Tayloria		
acuminata Hornsch.	1400-2400	6
froelichiana (Hedw.) Mitt. ex Broth.	2300-2800	11
lingulata (Dicks.) Lindb.	2100-2400	3
Tetraplodon		
angustatus (Hedw.) B.S.G.	1500-2100	8
mnioides (Hedw.) B.S.G.	1600-2250	12
urceolatus (Hedw.) Bruch et Schimp.	2070-2750	9
Voitia		
nivalis Hornsch.	2150-2200	3
SCHISTOSTEGACEAE		
Schistostega		
pennata Hedw.	485-1900	4
TETRAPHIDACEAE		
Tetraphis		
pellucida Hedw.	440-2250	16
Tetrodontium		
brownianum (Dicks.) Schwaegr.	470-2000	2
BRYACEAE		
Anomobryum		
julaceum (Gaertn. et al.) Schimp.	350-2800	28
Bryum		
algovicum Sendtn. ex C.Muell.	2150-2550	2
alpinum Huds. ex With.	900-2050	3
argenteum Hedw.	440-2500	22
caespiticium Hedw.	450-2150	8
capillare Hedw.	440-2100	6
creberrimum Tayl.	350-2500	11
cryophilum Maort.	1900-2720	16
elegans Nees ex Brid.	440-1900	2
funckii Schwaegr.	1950	1
imbricatum (Schwaegr.) B.S.G.	1400-2300	2
neodamense Itzigs.	2350	1
pallens (Brid.) Sw. ex Roehl.	450-2300	3
pallescens Schleich. ex Schwaegr.	2500	1
pseudotriquetrum (Hedw.) Gaertn. et al.	400-2750	29
recurvulum Mitt.	950	1
schleicheri Schwaegr.	1665-2100	4
subelegans Kindb.	400-1000	6
uliginosum (Brid.) B.S.G.	2050-2400	3
warneum (Roehl.) Bland. ex Brid.	2800	1
weigelii Spreng.	1665-2380	4
Leptobryum		
pyriforme (Hedw.) Wils.	400-2050	10
Orthodontopsis		
bardunovii Ignatov et Tan	1600-2100	11
Plagiobryum		
demissum (Hook.) Lindb.	2450-2700	2
zieri (Hedw.) Lindb.	440-2600	14
Pohlia		
andalusica (Hoehnel) Broth.	1800	1
andrewsii Shaw	440-3150	29
atropurpurea (Wahlenb. ex Fuernr.) Lindb.	900-2300	4
bulbifera (Warnst.) Warnst.	1760-2530	3
cruda (Hedw.) Lindb.	440-3150	39
crudoides (Sull. et Lesq.) Broth.	1930-2220	2
drummondii (C.Muell.) Andrews	1800-2900	11
elongata Hedw.	440-2800	34
filum (Schimp.) Maort.	1930-2850	10
longicollis (Hedw.) Lindb.	470-2700	22
melanodon (Brid.) Shaw	450-1800	5
nutans (Hedw.) Lindb.	440-3150	36
proligera (Kindb. ex Breidl.) Lindb. ex H.Arnell	470-2150	4
vexans (Limpr.) H.Lindb.	1400-1760	2

wahlenbergii (Web. et Mohr) Andrews	400-2500	11
Rhodobryum		
ontariense (Kindb.) Kindb.	400-1900	14
roseum (Hedw.) Limpr.	460-1600	8
MNIACEAE		
Cinclidium		
stygium Sw.	1760-2700	9
Cyrtomnium		
hymenophylloides (Hueb.) Nyh. ex T.Kop.	440-2800	19
hymenophyllum (B.S.G.) Holmen	470	1
Mnium		
hornum Hedw.	440-2500	30
marginatum (Dicks.) Beauv.	450-1930	8
spinosum (Voit) Schwaegr.	470-2600	18
spinulosum B.S.G.	480-1850	9
stellare Hedw.	440-1850	9
thomsonii Schimp.	530-2450	18
Plagiomnium		
acutum (Lindb.) T.Kop.	450-600	4
confertidens (Lindb. et H.Arnell) T.Kop.	280-1800	34
cuspidatum (Hedw.) T.Kop.	440-2050	37
drummondii (Bruch et Schimp.) T.Kop.	440-1000	8
ellipticum (Brid.) T.Kop.	400-2400	23
medium (B.S.G.) T.Kop.	450-2800	9
- ssp. *curvatulum* (B.S.G.) T.Kop.	2350	1
rostratum (Schrad.) T.Kop.	400-1300	8
Pseudobryum		
cinclidioides (Hueb.) T.Kop.	1300-1750	3
Rhizomnium		
andrewsianum (Steere) T.Kop.	2000-2350	2
magnifolium (Horik.) T.Kop.	460-1400	11
pseudopunctatum (Bruch et Schimp.) T.Kop.	880-2400	16
punctatum (Hedw.) T.Kop.	440-1400	12
Trachycystis		
ussuriensis (Maack et Regel) T.Kop.	350-1100	38
AULACOMNIACEAE		
Aulacomnium		
palustre (Hedw.) Schwaegr.	450-2800	21
turgidum (Wahlenb.) Schwaegr.	1150-2850	24
MEESIACEAE		
Amblyodon		
dealbatus (Hedw.) B.S.G.	2300	1
Meesia		
triquetra (Richter) Aongstr.	2350-2700	3
uliginosa Hedw.	1700-2800	19
Paludella		
squarrosa (Hedw.) Brid.	1000-2600	25
BARTRAMIACEAE		
Bartramia		
ithyphylla Brid.	1750-2908	20
pomiformis Hedw.	400-1900	14
Conostomum		
tetragonum (Hedw.) Lindb.	1930-2908	4
Philonotis		
fontana (Hedw.) Brid.	450-2400	12
- var. *caespitosa* (Jur.) Schimp.	550-2500	3
- var. *pumila* (Turn.) Brid.	1000-2800	31
- var. *seriata* (Mitt.) Kindb.	440-2300	2
mollis (Dozy et Molk.) Mitt.	400-450	2
Plagiopus		
oederiana (Sw.) Crum et Anderson	440-2500	21
TIMMIACEAE		
Timmia		
austriaca Hedw.	2300	1
bavarica Hessl.	340-2700	20
norvegica Zett.	440-2800	12
PTYCHOMITRIACEAE		
Ptychomitrium		
sinense (Mitt.) Jaeg.	420-450	6
ORTHOTRICHACEAE		
Amphidium		
lapponicum (Hedw.) Schimp.	1900-2370	5
mougeotii (B.S.G.) Schimp.	470-2400	8
Orthotrichum		
alpestre Hornsch.	1850-2300	8
anomalum Hedw.	310-2450	35
cupulatum Brid.	2450	1
dasymitrium Lewinsky	750	1
laevigatum Zett.		
- ssp. *japonicum* (Iwats.) Lewinsky	780-2780	19
obtusifolium Brid.	400-1100	14
pallens Bruch ex Brid.	550-2100	2
pellucidum Lindb.	1850-2750	3
pumilum Sw.	800	1
rogeri Brid.	450	3
rupestre Schleich. ex Schwaegr.	880-2400	15
sordidum Sull. et Lesq.	440-1100	18
speciosum Nees	450-1600	28
striatum Hedw.	440-470	9
vladikavkanum Vent.	440-1100	7
Ulota		
crispa (Hedw.) Brid.	450-1000	24
curvifolia (Wahlenb.) Lilj.	1400-2250	10
hutchinsiae (Sm.) Hammar	430	1
rehmannii Jur.	380-1000	12
Zygodon		
rupestris Lor.		
(= *Z. viridissimus var. rupestris*)	450	1
FONTINALIACEAE		
Dichelyma		
falcatum (Hedw.) Myr.	1760-2700	5
Fontinalis		
antipyretica Hedw.	400-1665	14
hypnoides Hartm.	440-1900	5
squamosa Hedw.	?	1
CLIMACIACEAE		
Climacium		
dendroides (Hedw.) Web. et Mohr	440-2600	19
HEDWIGIACEAE		
Hedwigia		
ciliata (Hedw.) Beauv.	440-2750	34
LEUCODONTACEAE		
Leucodon		
sciuroides (Hedw.) Schwaegr.	440-2100	29
NECKERACEAE		
Homalia		
besseri Lob.	440-550	2
trichomanoides (Hedw.) B.S.G.	400-1300	31

Neckera		
pennata Hedw.	440-2300	29
THAMNOBRYACEAE		
Thamnobryum		
neckeroides (Hook.) Lawt.	450-1030	16
THELIACEAE		
Myurella		
julacea (Schwaegr.) B.S.G.	350-2800	37
sibirica (C.Muell.) Reim.	440-2100	17
tenerrima (Brid.) Lindb.	440-1900	6
PTERIGYNANDRACEAE		
Pterigynandrum		
filiforme Hedw.	440-2908	49
FABRONIACEAE		
Anacamptodon		
latidens (Besch.) Broth.	280-450	8
Fabronia		
ciliaris (Brid.) Brid.	340-1950	34
MYRINIACEAE		
Myrinia		
pulvinata (Wahlenb.) Schimp.	1000	3
LESKEACEAE		
Iwatsukiella		
leucotricha (Mitt.) Buck et Crum	500-2300	17
Leptopterigynandrum		
austro-alpinum C.Muell.	960-2700	37
Lescuraea		
saxicola (B.S.G.) Milde	1800-2600	21
Leskea		
polycarpa Hedw.	280-1000	9
Leskeella		
nervosa (Brid.) Loeske	340-2750	69
Pseudoleskea		
incurvata (Hedw.) Loeske	2100-2400	2
radicosa (Mitt.) Kindb.	1800-2500	3
Pseudoleskeella		
catenulata (Brid. ex Schrad.) Kindb.	2050-2700	2
papillosa (Lindb.) Kindb.	850-2400	20
tectorum (Funck ex Brid.) Kindb.	410-2750	17
ANOMODONTACEAE		
Anomodon		
attenuatus (Hedw.) Hueb.	440-1850	36
longifolius (Brid.) Hartm.	450-800	6
viticulosus (Hedw.) Hook. et Tayl.	340-1100	30
THUIDIACEAE		
Abietinella		
abietina (Hedw.) Fleisch.	440-2800	22
- var. *hystricosa* (Mitt.) Sak.	450	1
Bryohaplocladium		
angustifolium (Hampe et C.Muell.) Wat. et Iwats.	450-530	3
microphyllum (Hedw.) Wat. et Iwats.	450-800	6
Claopodium		
pellucinerve (Mitt.) Besch.	400-1000	9
Heterocladium		
dimorphum (Brid.) B.S.G.	450	1
Thuidium		
delicatulum (Hedw.) B.S.G.	1000	1
philibertii Limpr.	400-2250	52
recognitum (Hedw.) Lindb.	1000-2350	3
HELODIACEAE		
Helodium		
blandowii (Web. et Mohr) Warnst.	370-1000	5
Palustriella		
commutata (Hedw.) Ochyra	440-2150	17
decipiens (De Not.) Ochyra	1850	1
CRATONEURACEAE		
Cratoneuron		
filicinum (Hedw.) Spruce	400-2700	45
AMBLYSTEGIACEAE		
Amblystegium		
serpens (Hedw.) B.S.G.	280-2400	38
- var. *juratzkanum* (Schimp.) Rau et Herv.	400-450	2
varium (Hedw.) Lindb.	620	1
Callialaria		
curvicaulis (Jur.) Ochyra	2450	1
Calliergon		
cordifolium (Hedw.) Kindb.	480-1950	5
giganteum (Schimp.) Kindb.	1220-1980	7
richardsonii (Mitt.) Kindb.	1700-2300	4
Calliergonella		
cuspidata (Hedw.) Loeske	440-1000	7
lindbergii (Mitt.) Hedenaes (= *Hypnum lindbergii*)	440-2400	25
Campylium		
calcareum Crundw. et Nyh.	2300-2400	2
chrysophyllum (Brid.) J.Lange	350-620	4
halleri (Hedw.) Lindb.	1700-2100	4
hispidulum (Brid.) Mitt.	470	1
longicuspis (Lindb. et H.Arnell) Hedenaes	2550	1
protensum (Brid.) Kindb.	1750-2500	3
sommerfeltii (Myr.) J.Lange	450-1000	7
stellatum (Hedw.) C.Jens.	440-2500	19
Conardia		
compacta (C.Muell.) Robins.	1220-1800	2
Drepanocladus		
aduncus (Hedw.) Warnst.	1600-2700	12
sendtneri (Schimp. ex C.Muell.)Warnst.	1800-2600	6
Hamatocaulis		
vernicosus (Mitt.) Hedenaes	1950-2400	3
Hygrohypnum		
alpestre (Hedw.) Loeske	2050-2300	4
cochlearifolium (Vent. ex De Not.) Broth.	1900-2800	4
duriusculum (De Not.) Jamieson	400-2400	11
luridum (Hedw.) Jenn.	340-2650	23
ochraceum (Turn. ex Wils.) Loeske	450-2150	7
polare (Lindb.) Loeske	1600-2450	10
Leptodictyum		
riparium (Hedw.) Warnst.	1000-1750	3
Limprichtia		
cossonii (Schimp.) Anderson et al.	1700-2800	17
revolvens (Sw.) Loeske	1600-2700	33
Loeskypnum		
badium (Hartm.) Paul	1760-2900	13
Pseudocalliergon		
trifarium (Web. et Mohr) Loeske	1760-2400	6
turgescens (T.Jens.) Loeske	2300-2550	7

Sanionia		
uncinata (Hedw.) Loeske	400-3150	67
Sarmentypnum		
sarmentosum (Wahlenb.)Tuom. et T.Kop.	1300-2900	26
Scorpidium		
scorpioides (Hedw.) Limpr.	1850-2104	3
Serpoleskea		
subtilis (Hedw.) Hampe	600-880	4
Stramigeron		
stramineum (Brid.) Hedenaes		
(= *Calliergon stramineum*)	520-2450	22
Warnstorfia		
exannulata (Guemb. in B.S.G.)Loeske	520-2700	59
fluitans (Hedw.) Loeske	450-2300	5
pseudostraminea (C.Muell.)Tuom. et T.Kop.	2250-2300	2
BRACHYTHECIACEAE		
Brachythecium		
albicans (Hedw.) B.S.G.	1000	1
buchananii (Hook.) Jaeg.	330-1000	32
collinum (Schleich. ex C.Muell.) B.S.G.	2200-2850	4
dovrense (Limpr.) Schljak.	2050	1
erythrorrhizon B.S.G.	1700-2600	19
kuroishicum Besch.	350-1000	19
latifolium Kindb.	2300	1
mildeanum (Schimp.)		
Schimp. ex Milde	440-2850	26
oedipodium (Mitt.) Jaeg.	450-2050	12
plumosum (Hedw.) B.S.G.	350-2100	18
populeum (Hedw.) B.S.G.	350-2400	35
reflexum (Starke) B.S.G.	440-1900	9
rivulare B.S.G.	280-2150	27
rutabulum (Hedw.) B.S.G.	450-1000	2
salebrosum (Web. et Mohr) B.S.G.	400-2300	31
starkei (Brid.) B.S.G.	500-2050	15
turgidum (Hartm.) Kindb.	1760-3000	20
velutinum (Hedw.) B.S.G.	450-2700	50
wichurae (Broth.) Par.	330-700	11
Bryhnia		
novae-angliae (Sull. et Lesq.) Grout	280	1
Cirriphyllum		
cirrosum (Schwaegr. in Schultes) Grout	340-2750	39
piliferum (Hedw.) Grout	280-1500	12
Eurhynchium		
angustirete (Broth.) T.Kop.	280-800	10
hians (Hedw.) Sande Lac.	400-600	5
pulchellum (Hedw.) Jenn.	450-2700	28
- var. *praecox* (Hedw.) Dix.	2900-2900	3
sp. n.	280-900	14
Homalothecium		
philippeanum (Spruce) B.S.G.	440	1
Myuroclada		
maximoviczii (Borszcz.) Steere et Schof.	280-2000	30
Rhynchostegium		
riparioides (Hedw.) C.Jens.	400-470	10
Scleropodium		
ornellanum (Mol.) Lor.	850-2050	7
Tomentypnum		
nitens (Hedw.) Loeske	1000-2800	23
ENTODONTACEAE		
Entodon		
cladorrhizans (Hedw.) C.Muell.		
(incl. *E. scleicheri*)	280-1500	24
compressus (Hedw.) C.Muell.	280-470	11
concinnus (De Not.) Par.	350-2750	26
PLAGIOTHECIACEAE		
Plagiothecium		
cavifolium (Brid.) Iwats.	440-2400	29
denticulatum (Hedw.) B.S.G.	440-2850	24
laetum B.S.G.	440-2250	24
latebricola B.S.G.	470	2
SEMATOPHYLLACEAE		
Heterophyllium		
affine (Hook. ex Kunth) Fleisch.	450-850	8
HYPNACEAE		
Breidleria		
pratense (Koch ex Spruce) Loeske		
(= *Hypnum pratense*)	400	1
Callicladium		
haldanianum (Grev.) Crum	450-700	9
Ctenidium		
procerrimum (Mol.) Lindb.	2350-2600	7
Eurohypnum		
leptothallum (C.Muell.) Ando	280-950	31
Gollania		
turgens (C.Muell.) Ando	1000	1
Herzogiella		
turfacea (Lindb.) Iwats.	440-700	2
Homomallium		
incurvatum (Brid.) Loeske	400-1100	19
Hypnum		
bambergeri Schimp.	1900-2800	5
callichroum Funck ex Brid.	440-2150	6
cupressiforme Hedw.	400-2908	88
- var. *subjulaceum* Mol.	560-2150	8
fertile Sendtn.	440-1950	10
hamulosum B.S.G.	440-2850	20
pallescens (Hedw.) P.Beauv.	400-1950	19
plicatulum (Lindb.) Jaeg.	440-2100	4
recurvatum (Lindb. et H.Arnell) Kindb.	1000-1900	4
revolutum (Mitt.) Lindb.	2000-2750	9
vaucheri Lesq.	350-2500	33
Isopterygiopsis		
alpicola (Lindb. et H.Arnell)		
Hedenaes	1900-2300	2
muelleriana (Schimp.) Iwats.	450-2180	15
pulchella (Hedw.) Iwats.	450-2800	47
Orthothecium		
chryseon (Schwaegr. ex Schultes) B.S.G.	470-2800	21
intricatum (C.Hartm.) B.S.G.	440-1950	3
strictum Lor.	1800-2800	8
Platydictya		
jungermannioides (Brid.) Crum	1220-2750	9
Platygyrium		
repens (Brid.) B.S.G.	360-1200	17
Podperaea		
krylovii (Podp.) Iwats. et Glime	450-530	6
Ptilium		
crista-castrensis (Hedw.) De Not.	440-2240	15
Pylaisiella		
cf. *intricata* (Hedw.) Grout	400-1600	2
polyantha (Hedw.) Grout	280-1940	30
selwynii (Kindb.) Crum et al.	400-600	14
Struckia		
argentata C.Muell.		
- ssp. *zerovii* (Lazar.) Tan et al.	440-1850	22

Taxiphyllum		
wissgrillii (Garov.) Wijk et Marg.	350-1300	22
RHYTIDIACEAE		
Rhytidium		
rugosum (Hedw.) Kindb.	440-2800	22
HYLOCOMIACEAE		
Hylocomiastrum		
pyrenaicum (Spruce) Fleisch.	600-2600	23
umbratum (Hedw.) Fleisch.	470-1030	5
Hylocomium		
splendens (Hedw.) B.S.G.	440-2908	16
- var. *obtusifolium* (Geh.) Par.	1950	1
Pleurozium		
schreberi (Brid.) Mitt.	450-2908	16
Rhytidiadelphus		
subpinnatus (Lindb.) T.Kop.	400-2050	11
triquetrus (Hedw.) Warnst.	440-2100	20

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