

MOSS FLORA OF YAMAL PENINSULA (WEST SIBERIAN ARCTIC)  
ФЛОРА МХОВ ПОЛУОСТРОВА ЯМАЛ (ЗАПАДНО-СИБИРСКАЯ АРКТИКА)

IRINA V. CZERNYADJEVA<sup>1</sup>

ИРИНА В. ЧЕРНЯДЬЕВА<sup>1</sup>

Abstract

Moss flora of Yamal Peninsula (west Siberian Arctic) has been studied in 27 localities. The list includes 276 species and 12 varieties of 33 families and 98 genera, with the information about species distribution in vegetational zones, in studied localities, habitat preferences, species frequency, sporophyte production, and associated species. The biodiversity peculiarities of moss flora are discussed.

Резюме

Флора мхов на полуострове Ямал (Западно-Сибирская Арктика) изучена в настоящее время в 27 точках. Список включает 276 видов и 12 разновидностей из 33 семейств и 98 родов, для которых дана информация об их распространении по растительным зонам и по изученным точкам, об их местообитаниях, частоте встречаемости, наличии спорофитов, а также о сопутствующих видах. Обсуждаются особенности биоразнообразия флоры мхов полуострова.

INTRODUCTION

Until the last decade the knowledge on the moss flora of Yamal Peninsula was relatively poor, because no one professional bryologist conducted studies in this area. In recent years a lot of new bryological information has been obtained in Yamal, but the data were scattered in several publications, devoted mostly to floras of some particular areas. This paper is an attempt to get together all available information, both published and unpublished, about the mosses of Yamal Peninsula. It includes the data of the original research of the author, results of revision of all collections from this area in LE, and literature records. The collecting localities of mosses in Yamal are represented in the Fig. 1 and Table 1.

BRYOLOGICAL EXPLORATION

The first bryophytes from Yamal have been collected in 1875 by Lundstrom, who participated Nordensheld's Expedition to Russian Arctic along the coast of Arctic Ocean. The mosses were collected in the northernmost part of the Peninsula. In 1878 Nordqvist, a member of the same expedition, collected some specimens on the Bely Island. Their materials were identified and published by H. Arnell (1917),

who reported 25 species from the Yamal Peninsula and 14 species from the Bely Island.

In 1932 V. N. Andreev worked in the South-East of the Peninsula. His collection of mosses was identified by O. Gaze. At present, nearly 150 specimens are deposited in LE. Unfortunately, exact geographical locations of the collections of specimens were not indicated; they have been improperly labeled and because of that can not be taken into account in this paper.

Some specimens were collected in 1928 by N.N. Spizin and P.P. Korolev (the mouth of the Tiutey River), and in 1938 by N. Katz & S. Katz (in the vicinity of the Novyj Port Settlement). Specimens are deposited in LE. Ninety species were pointed for the Yamal in the summarizing monograph on the mosses of the Russian Arctic (Abramova & al., 1961).

The most important contribution to the study of the Yamal flora has been made by O.V. Rebristaya, the leader of the Yamal group of Polar Expedition of the V.L. Komarov Botanical Institute. Besides the study of vascular plants, she and her colleagues collected mosses from 1973 to 1983. These collections were partly identified, and the results were published by L.A. Volkova (Volkova & Rebristaya, 1986, 1987). They cited 70 species for

<sup>1</sup> – Komarov' Botanical Institute of Russian Academy of Sciences, Popova 2, St.-Petersburg 197376 Russia – Санкт-Петербург 197376 Попова 2, Ботанический институт РАН

Table 1. Collecting localities in the Yamal Peninsula. Number of locality correspond to that on Fig. 1. Number of specimens is the number of identified collection; however not all specimens of common species from larger collections were put in herbarium.

N	Locality	Latitude	Longitude	Source of information
<b>Arctic tundra:</b>				
1	Bely Island	73°15'N	71°30'E	Volkova, Rebristaya, 1987; specimens partly in LE
2	Bely Island	73°00'N	71°00'E	Arnell, 1917 (specimens not seen)
3	Middle Khabeiyaha River	72°25'N	72°10'E	Coll. Rebristaya, 400 specimens, LE
4	–	72°18'N	68°42'E	Arnell, 1917 (specimens not seen)
5	Upper Tambey River	71°45'N	70°30'E	Coll. Rebristaya, 70 specimens, LE
6	Tambey	71°30'N	71°50'E	Boch & al., 1971; a few specimens in LE
7	Lower Tiutey River	71°25'N	67°40'E	Coll. Spizin & Korolev, 110 specimens, LE
8	Kharasavey	71°14'N	67°00'E	Dyachenko & al., 1999 (specimens in SVER, not seen)
<b>Northern hypoarctic tundra:</b>				
9	Middle Matyuiyaha River	70°55'N	70°12'E	Volkova, Rebristaya, 1986; specimens partly in LE
10	Watershed Kharasavey and Tiutey River	70°36'N	70°12'E	Dyachenko & al., 1999 (specimens in SVER, not seen)
11	Syoyaha River	70°20'N	68°20'E	Czernyadjeva & Potemkin, 1993; 550 specimens, LE
12	Vicinity Ngaranato Lake	70°17'N	68°05'E	Czernyadjeva, 1995; 950 specimens, LE.
13	Middle Syoyaha River North of Mantyto Lake	70°05'N	72°10'E	Coll. Rebristaya, 250 specimens, LE.
14	Middle Sebayaha River	69°37'N	69°27'E	Czernyadjeva, 1993; 800 specimens, LE.
15	Lower Khakhayayaha River	69°35'N	67°35'E	Coll. Andreeva, 450 specimens, LE
<b>Southern hypoarctic tundra:</b>				
16	Lower Khutyayaha River	68°45'N	70°30'E	Coll. Andreeva, 450 specimens, LE
17	Vicinity Vajvaretto Lake	68°40'N	72°10'E	Coll. Yunak, Prokop'eva, 140 specimens, LE
18	Middle Khevesyo River	68°35'N	73°20'E	Volkova, Rebristaya, 1986; Specimens partly in LE
19	Mys Kamennyj	68°30'N	73°30'E	Coll. Yunak, Prokop'eva, 65 specimens, LE
20	Middle Yuribey River	68°25'N	72°10'E	Coll. Gribova, 55 specimens, LE
21	Lower Er'yaha River	68°10'N	72°50'E	Coll. Andreeva, 400 specimens, LE
22	Lower Erkytayaha River Tabortato Lake	68°08'N	69°05'E	Czernyadjeva, Kuzmina, 2000; 300 specimens, LE
23	Lower Erkutayaha River Yarono trading station	68°08'N	69°20'E	Czernyadjeva, Kuzmina, 2000; 500 specimens, LE
24	Novyj Port	67°42'N	72°57'E	Boch & al., 1971; a few specimens in LE; also coll. Katz, a few specimens in LE
25	Upper Khadytayaha River	67°35'N	70°25'E	Coll. Gribova, 45 specimens, LE
26	Sjunyaj-Sale	66°55'N	71°18'E	Czernyadjeva, Kuzmina, 1999, 800 specimens, LE
<b>Cis-Uralian Region:</b>				
27	Vicinity Yunto Lake	67°40'N	68°00'E	Czernyadjeva, 1998; 1100 specimens, LE

the Bely Island and 50 species for the Matyuiyaha River and the Khevesyo River. Part of the collection was determined by Czernyadjeva and was taken into consideration in this paper.

E. N. Andreeva worked on Yamal with Rebristaya in 1977-1978. She gathered a large collection and cited 35 species. However, exact locations (Andreeva, 1981) have not been indicated. This collection was examined and partly identified by Czernyadjeva and the results were included in this paper.

Geobotanist M. S. Boch investigated the mires of Yamal and cited 40 species of mosses for Tambey, Mys Kamennyj and Novyj Port in her paper (Boch et al., 1971). Geobotanists R.I.

Junak, G.I. Prokop'eva, S.A. Gribova worked in the Southern tundra zone in 1971, 1976. Their small collections of mosses were identified by Volkova and deposited in LE. In 1989 geobotanists from the Ekaterinburg University collected mosses in the vicinity of the Kharasavay Settlement. Later A.P. Dyachenko published results of identification of 70 species of this collections (Dyachenko & al., 1999).

In 1991-1996 Czernyadjeva investigated bryoflora of 6 geographical points (Ngaranato Lake, Sebayaha River, Tabortato Lake, Yarono trading station, Sjunyaj-Sale Settlement, Junto Lake) in details. The results of the study were published in a number of papers (Czernyadje-

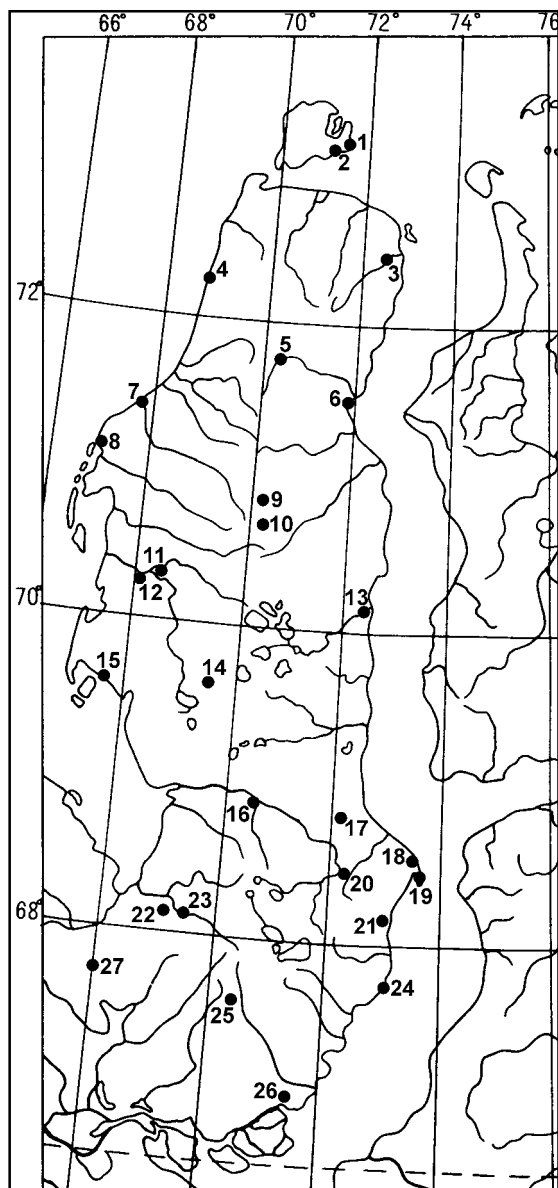


Fig. 1. Collecting localities in Yamal. Numbers correspond those in Tabl. 1

of moss flora of the Yamal Peninsula were summarized in a number of publications (Afonina, Czernyadjeva, 1995; Czernyadjeva, 2000b).

#### STUDY AREA

The Yamal Peninsula is situated in the north-western part of the West Siberian Plain and has a territory of 112,000 sq. km. The Bely Island affiliates the Yamal from the north and historically and geologically is a part of the Peninsula. During the Pleistocene the territory of Yamal has been repeatedly covered by marine transgression waters, so the Yamal terrestrial landscape has been developed starting from the Upper Pleistocene. The territory on Peninsula is an elevated part of immersed into the sea and flat graduated plain with heights not more than 90 m above sea level. Lakes are very numerous in Yamal. Quaternary clay and sand sediments of alluvial-marine genesis make a strong thick cover over the Devonian and Carboniferous limestones which come to the surface in the very limited part of SW Yamal, in the transitional area to Ural region (Dedkov, 1995a). Weakly drained and poor in humus, heavily swamped soils with high acidity (pH=3.5-5.5) and heavy deficit of nitrogen and mineral salts are typical for Yamal. The Peninsula is situated in zone where permafrost soils totally prevail. Cryogenic shapes of its relief are widespread here (Dedkov, 1995b).

Yamal is situated in the south-eastern part of Karski (Eastern) region of the Atlantic climate zone of Arctic Specific for this zone are prolonged cold winter with strong winds, short and cool summer with long daylight periods. January average temperature is  $-22$   $-27^{\circ}\text{C}$  with  $-52^{\circ}\text{C}$  as the absolute minimum recorded. July average temperature is  $+5$   $+13^{\circ}\text{C}$  reaching some times up to  $+27$   $+30^{\circ}\text{C}$ . The average annual precipitation level varies from 230 to 300 mm while evaporation does from 150 to 250 mm. The snow cover lays from September till early Yune (Shiyatov, Mazepa, 1995; see also Tabl. 2).

va, 1993, 1995, 1998; Czernyadjeva, Kuzmina, 1998, 2001). Specific features of moss cover of disturbed sites (landslides, roadbanks etc.) were studied separately (Rebristaya et al., 1993; Rebristaya et al., 1995). Czernyadjeva and A. D. Potemkin (1993) studied the collection gathered by L.I. Meltzer and A.P. Popov on Central Yamal. The preliminary results of the study

Table 2. Climate information for 3 localities in different subzones (Shiyatov & Mazepa, 1995)

Locality	mean annual $t^{\circ}\text{C}$	annual precipitation, mm	no-frost period, days	snow period, days	beginning of snow period
Tambei (Arctic tundra subzone)	-10.3	228	53	261	18. IX
Syoyaha (Northern tundra subzone)	-9.9	203	63	257	25. IX
Novyi Port (Southern tundra subzone)	-9.1	295	68	247	30. IX

## VEGETATION

The formation of Yamal vegetation started in the Upper Pleistocene, thus it is the youngest in Arctic. During the Holocene optimum tundra vegetation was replaced by spruce and birch forest.

Now the territory of Peninsula is located in tundra zone. According to Yurtsev's classification (Yurtsev & al., 1978) Yamal Peninsula belongs to the Western Siberian province of the Arctic floristic region. The Yamal territory can be subdivided into 4 regions. Three of them correspond to vegetation subzones: arctic tundra subzone (**AT**), north tundra subzone (**NT**) and south tundra subzone (**ST**). The fourth is the Cis-Uralian region (**CU**), which includes one the most south-western locality because of its sound peculiarities. Formally this territory is situated within the south tundra subzone, and this region is even not a foothills of Urals Mts. (altitudes are less than 200 m). However bedrocks are exposed at places in this area (contrary to the rest of the Yamal territory), making flora and vegetation more diverse.

Detailed description and classification of the Yamal vegetation were presented by Zhadrinskaya (1977), Boch et al. (1971), Rebristaya (1989, 2000), Magomedova, Morozova (1995), Andreyashkina, Peshkova (1995), etc.

The different variations of dwarf-shrub-sedge-herb-moss tundras are widespread on the watersheds and the flat slopes. Northern dwarf-shrubs (*Vaccinium uliginosum*<sup>1</sup>, *V. vitis-idaea*, *Empetrum nigrum*, *Arctous aplina*, *Ledum decumbens* etc.), sedges *Carex globularis* in south tundras, *C. arctisibirica* in north tundras and mosses (*Hylocomium splendens*, *Aulacomnium turgidum*, *Polytrichum juniperinum* etc.) predominate. Northwards dwarf shrubs become less significant components of vegetation, while herbs – more significant. Herb-moss and herb-sedge-moss tundras are predominant in arctic tundra subzone.

Spotty dwarf-shrub-lichen tundras with different role of mosses and grasses can be detected on the dry drainage border of watershed. *Racomitrium lanuginosum*, *Polytrichum hyperboreum*, *P. piliferum*, *Dicranum elongatum* are dominant in the moss cover.

Hummocky cottongrass-moss tundras are common on loamy ridges in southern part of

the Peninsula. *Eriophorum vaginatum*, *Ledum decumbens*, *Carex rariflora*, *Racomitrium lanuginosum*, *Polytrichum hyperboreum*, *P. piliferum*, *Dicranum elongatum* are dominant.

Bushy tundras are typical for south tundra subzone. Hilly bushy-sphagnous tundras with *Betula nana*, *Carex rariflora*, *Sphagnum lenense*, *S. balticum* are developed on weakly drained wet soils. Bushy-moss tundras with *Betula nana*, *Carex arctisibirica*, *C. globularis*, *Hylocomium splendens*, *Tomentypnum nitens*, *Ptilidium ciliare* are common on well drainage slopes. Cloud-berry (*Rubus chamaemorus*) -sphagnous tundras occur at places on peaty flat slopes.

Flat-polygonal tundra-mire complexes (PTMC) occupy weakly drainage plain watersheds. They represent alternating polygons with tundra vegetation and hollows with mire vegetation.

Hummocky dwarf-shrub-sphagnous mires with *Betula nana*, *Ledum decumbens*, *Carex rariflora*, *Sphagnum sp.* are met by patterns in wet hollows on terraces and watershed. Hummocky sedge mires with *Carex aquatilis*, *C. juncella* are situated in flood-plain rivers on the southernmost part Peninsula.

Homogeneous herb-sedge-moss mires and sedge-moss mires develop in very wet places in river flood plains and lake depressions throughout peninsula. *Carex concolor*, *C. chordorrhiza*, *Eriophorum russeolum*, *Comarum palustre*, *Equisetum fluviatile* and mosses (*Sphagnum squarrosum*, *Aulacomnium palustre*, *Limprichtia revolvens*, *Warnstorfia exannulata*, *W. sarmentosa*) are dominant. Grass minerotrophic mires with *Arctophila fulva*, *Dupontia fischeri* are rather common in northern Yamal, but very rare in more southern parts.

Flood grassy willow-shrubs are situated on banks of rivers and lakes. Flood alder-shrubs are common on south Yamal. The moss cover is developed irregularly. *Climacium dendroides*, *Pseudobryum cinclidioides*, *Plagiomnium ellipticum* are abundant. Mossy willow-shrubs and mossy alder-shrubs occur at places on slopes and in dells. *Hylocomium splendens*, *Santonina uncinata*, *Dicranum majus* prevail in moss cover.

Nival communities with different participation of dwarf-shrubs (*Rubus arcticus*, *Salix polaris*), herbs (*Lagotis minor*, *Hieracium alpinum*), grass (*Calamagrostis langsdorffii*) and mosses (*Dicranum angustum*, *Polytrichum com-*

<sup>1</sup> – Names of vascular plants are cited according to Cherepanov, 1995)

*mune*, *Calliergon stramineum*, *Sanionia uncinata*) are formed at foot slopes and on bottom of narrow dell, in nival sites.

Herb communities with *Equisetum arvense*, *E. pratense*, *Geranium albiflorum*, *Trollius asiaticus*, dwarf-srubs and mosses occupy steep south slopes. Shortgrass communities with *Festuca ovina*, *Poa alpigena*, *Vaccinium uliginosum* and mosses are situated on sandy soil on river terraces. Meadows occur at places on mesic and comparatively rich soils.

The open bare soil is rather widespread in the area, both because of natural cryogenic processes and also antropogenous disturbance.

In the south-westernmost part of the study area there are few bedrock outcrops, which becoming more common further in Arctic Ural, ca. 50-100 km to the SW.

#### LIST OF SPECIES

For each species in the list the following characters are mentioned for each of the subzones separately:

– frequency of occurrence (Un – the only record for a whole subzone; Rar – 1–4, Spar – 5–15, Com – 16–30, Wid – more than 30 records for each locality);

– sporophyte absence (S–) or presence (S+); the absence on data on sporophyte production is in case where data are taken from a publication without relevant information;

– numbers of localities within a given subzone, according to Table 1.

Habitats, growth form (cushions, mats, etc.), accompanying species, and other commens are given for the whole area. Abundance is also given for species with a pronounced role in vegetation. Peculiarities of distribution in Western Siberia, Russia or the world and taxonomic notes are also discussed where necessary. Vaucher specimens are cited for rare species.

#### SPHAGNACEAE

*Sphagnum angustifolium* (Russ.) C. Jens. – **ST** (Spar S–): 22, 24, 26; **CU** (Spar S–): 27. In bushy-sphagnous and hummocky cottongrass-moss tundras, hummocky dwarf-shrub-sphagnous mires, seldom in mossy willow-shrubs; abundant in hummocky tundras, usually mixed with other species: *S. lenense*, *S. warnstorffii* etc.

*S. aongstroemii* Hartm. – **AT** (Rar S–): 7-8; **NT** (Spar Rar S–): 9, 11-12, 14; **ST** (Rar S–): 16, 21-23, 25-26; **CU** (Spar S–): 27. In hummocky dwarf-shrub-sphagnous mires and sedge-moss mires; in hollows of

PTMC; in cloudberry-sphagnous and bushy-sphagnous tundras; less commonly in dwarf-shrub-sedge-moss tundras, homogeneous sedge mires; sometimes abundant, forming pure mats, less commonly associated with other species: *S. lenense*, *S. balticum*, etc. *S. balticum* (Russ.) Russ. ex C. Jens. – **AT** (Rar S–): 1, 6; **NT** (Spar S–): 9-10, 12, 14; **ST** (Com S–): 16, 19, 21-24, 26; **CU** (Spar S–): 27. In different mires, wet moss tundras, PTMC; less commonly in mossy willow-shrubs and nival moss communities; active in ST; forming continuous cover or associated with *S. lenense*, *S. russowii*, *S. fimbriatum*, etc. *S. capillifolium* (Ehrh.) Hedw. – **NT** (Rar S–): 11-12, 14; **ST** (Rar S–): 19, 21-22, 26; **CU** (Spar S–): 27. In wet dwarf-shrub-moss, bushy-sphagnous and hummocky cottongrass-moss tundras, PTMC; less commonly in nival moss communities, sedge-moss mires and mossy willow-shrubs. Usually mixed with *S. balticum*, *S. russowii*, *Aulacomnium palustre*, etc. In very wet conditions some specimens develop hemiisophyllous form with pores in cells of hyalodermis.

*S. centrale* H. Arnell & C. Jens. – **ST** (Rar S–): 19, 23, 26. In sedge-sphagnous mires and at lake shore; growing mixed with *S. teres*, etc. Boreal species, known by solitary localities in the Russian Arctic (Savicz-Ljubitskaya & Smirnova, 1968; Afonina, 2000).

*S. compactum* DC. – **AT** (Un S–): 6; **NT** (Spar S–): 9, 12, 14; **ST** (Spar S–): 16, 21-24, 26; **UR** (Spar S–): 27. In PTMC, dwarf-shrub-moss, dwarf-shrub-lichen, bush-sphagnous and hummocky cottongrass-moss tundras; on hummocks in dwarf-shrub-sphagnous mires; seldom in homogeneous sedge mires; sometimes abundant; growing usually in pure cushions.

*S. contortum* Schultz – **NT** (Rar S–): 12, 14; **ST** (Rar S–): 16, 22, 26; **CU** (Rar S–): 27. In homogeneous cottongrass-sedge and sedge-moss mires; seldom in depressions in cloudberry-sphagnous tundra and sedge-moss tundra; growing usually as admixture to *S. lenense*, *S. warnstorffii*, etc.

*S. fimbriatum* Wilson – **AT** (Com-Spar S–): 1, 3, 6-8; **NT** (Spar-Rar S–): 9-15; **ST** (Rar S–): 21-23, 26; **CU** (Rar S–): 27. In PTMC, hummocky dwarf-shrub-sphagnous mires; in bushy-sphagnous and wet dwarf-shrub-moss tundras; less commonly in nival moss communities and mossy willow-shrubs; growing in mats, sometimes mixed with *S. balticum*, *S. lenense*, *S. warnstorffii*, *Polytrichum jense-nii*, etc.

*S. flexuosum* Dozy et Molk. – **NT** (Rar S–): 11; **ST** (Un S–): 26; **CU** (Rar S–): 27. In hollows of PTMC; seldom in sedge-moss mire, bushy-sphagnous tundra and wet dwarf-shrub-moss tundra; growing associated with *S. balticum*, *S. lenense*, etc. Some specimens are represented by hemiisophyllous plants which develop modified multifibrous stem leaves with weakly broadened border.

- S. fuscum* (Schimp.) Klinggr. – **AT**?; **ST** (Rar S–): 22, 24, 26; **CU** (Rar S–): 27. On polygons of PTMC; on hills of dwarf-shrub-sedge-moss, bushy-moss and cloudberry-moss tundras; seldom on hummock of dwarf-shrub-moss mire; forming pure mats or growing in mixture with *S. angustifolium*, *S. balticum*, *Aulacomnium palustre*, etc. *S. fuscum* is a boreal species occurring in the West Siberia mainly in forest zone. Its report (Arnell, 1917) for **AT** is doubtful.
- S. girgensohnii* Russ. – **AT** (Rar S–): 3, 8; **NT** (Com-Spar S–): 9, 11-12, 14-15; **ST** (Spar S–): 16, 20-23, 26; **CU** (Spar S–): 27. In hummocky cottongrass-moss, bushy-sphagnous, cloudberry-sphagnous and dwarf-shrub-sedge-moss tundras; on polygons of PTMC; less commonly in nival communities, mossy willow-shrubs and sedge-moss mires; dominant of wet tundras; forming continuous cover or growing mixed with *S. lenense*, *S. warnstorffii*, etc.
- S. imbricatum* Hornsch. ex Russ. – **NT** (Spar S–): 14; **ST** (Rar S–): 16, 22, 24. In hummocky sedge-sphagnous mires; seldom in homogeneous sedge mire, bushy-sphagnous tundra and in hollow of PTMC; forming mats with *S. magellanicum*, *S. warnstorffii*, etc.
- S. jensenii* H. Lindb. – **AT** (Un S–): 1. In grass-sedge mire, with *S. orientale* (Volkova, Rebristaya, 1986). Reported by literature data only.
- S. lenense* H. Lindb. ex Pohle – **AT** (Un S–): 5; **NT** (Com-Spar S–): 12, 14-15; **ST** (Com S–): 16, 19, 22-26; **CU** (Com S–): 27. In different mires and wet tundras; on polygons of PTMC; less commonly in mossy willow-shrubs and nival moss communities; one of dominants of tundras and mires, forming continuous cover and providing rusty-reddish aspect of many coenoses.
- S. lindbergii* Schimp. ex Lindb. – **ST** (Rar S–): 16, 21-22, 26; **CU** (Un S–): 27. In homogeneous sedge and sedge-sphagnous mires with stagnant water; in water and on lake shores; in hollows of PTMC, cloudberry-sphagnous and hummocky cottongrass tundras; in very wet habitats, sometimes floating. *S. lindbergii* is a boreal species occurring in ST at the northern limits of its range.
- S. magellanicum* Brid. – **ST** (Rar S–): 23, 26; **CU** (Un S–): 27. On hummocks of sedge-sphagnous mires, cloudberry-sphagnous and bushy-sphagnous tundras; forming dense mats, less commonly associated with *S. imbricatum*, *S. lenense*, etc.
- S. obtusum* Warnst. – **NT** (Rar S–): 12, 14; **ST** (Spar S–): 16, 21-23, 26; **CU** (Spar S–): 27. In hummocky dwarf-shrub-sedge-sphagnous and homogeneous sedge-moss mires; seldom in hollows of PTMC, mossy willow-shrubs and bushy-sphagnous tundra; sometimes abundant.
- S. orientale* L. Savicz – **AT** (Un S–): 1; **NT** (Un S–): 11; **CU** (Un S–): 27. In hollow of PTMC; in grass-sedge-moss tundra; in hilly dwarf-shrub-moss tundra; growing usually as admixture to *S. teres*, *S. squarrosum*, *Paludella squarrosa*, etc. Asiatic-american species occurring in Yamal near the western limits of its range.
- S. perfoliatum* L. Savicz – **ST** (Rar S–): 16, 21, 24, 26. In sedge-sphagnous mires, forming continuous covers. Taxonomic status of *S. perfoliatum* is disputable. Anderson et al. (1990) in check-list of North American *Sphagna* considered it as a synonym *S. orientale*. Distinctive characters of these species in America overlap (Afonina, 2000). However in Siberia *S. perfoliatum* and *S. orientale* appear to be well delimited species (see also Savicz-Ljubitskaya & Smirnova, 1968).
- S. platyphyllum* (Lindb. ex Breithw.) Sull. ex Warnst. – **ST** (Rar S–): 21, 26. In sedge-moss mire on lake shore and in moss mire. Boreal species occurring in ST near the northern limit of its range.
- S. riparium* Aongstr. – **NT** (Rar S–): 11, 14; **ST** (Spar-Rar S–): 22-23, 26; **CU** (Un S–): 27. In homogeneous sedge mires; in hollows in hummocky sedge-sphagnous mires; seldom in hollows of bushy-sphagnous and cloudberry-sphagnous tundras, in hollow of PTMC; in mossy willow-shrubs; forming loose mats, often associated with *S. fimbriatum*, *S. girgensohnii*, etc.
- S. rubellum* Wils. – **AT** (Un S–): 7; **NT** (Rar S–): 9-12; **ST** (Rar S–): 19, 21, 26; **CU** (Spar S–): 27. In bushy-sphagnous and dwarf-shrub-moss tundras; on polygons of PTMC; seldom on hummock of dwarf-shrub-sphagnous mire; growing mixed with *S. aongstroemii*, *S. balticum*, *S. angustifolium*, etc.
- S. russowii* Warnst. – **ST** (Spar-Rar S–): 16, 21-23, 25-26; **CU** (Spar S–): 27. In bushy-sphagnous, cloudberry-sphagnous, dwarf-shrub-moss and hummocky cottongrass tundras; on polygons of PTMC; in nival moss communities; less commonly in mossy willow-shrubs and hummocky shrub-sphagnous mires; growing mixed with *S. balticum*, *S. lenense*, *S. angustifolium*, etc.
- S. squarrosum* Crome – **AT** (Rar S–): 1-3, 6-8; **NT** (Spar S–): 9-15; **ST** (Com-Spar S–): 16, 19-23, 26; **CU** (Spar S–): 27. In different kinds of mires, in PTMC, willow-shrubs, at lake shores; less commonly in very wet hollows of bushy-sphagnous, cloudberry-sphagnous and dwarf-shrub-moss tundras; forming continuous cover and often dominating in homogeneous mires.
- S. subsecundum* Nees – **NT** (Un S–): 9; **ST** (Rar S–): 22, 26. In sedge-sphagnous mires, as admixture to *S. balticum*, *S. riparium*, *S. obtusum*, etc.
- S. teres* (Schimp.) Aongstr. ex Hartm. – **AT** (Un S–): 3; **NT** (Rar S–): 12, 14-15; **ST** (Rar S–): 17, 19-23, 26; **CU** (Spar S–): 27. In hummocky shrub-sphagnous and homogeneous sedge-moss mires; in PTMC; seldom in bushy-sphagnous tundra, cloudberry-sphagnous tundra and mossy willow-shrub; growing with *S. angustifolium*, *S. lenense*, etc.

*S. warnstorffii* Russow – **AT** (Un S–): 8; **NT** (Spar-Rar S–): 9-12, 14-15; **ST** (Com-Spar S–): 16, 21-23, 26; **CU** (Com S–): 27. In different kinds of mires and wet tundras, PTMC; less commonly in mossy willow-shrubs and nival moss communities; co-dominant in tundras and mires, growing in pure mats or with other species of *Sphagnum*.

## ANDREAEACEAE

*Andreaea rupestris* Hedw. var. *rupestris* – **NT** (Un S+): 9; **CU** (Spar S+): 27. On loamy spots in dwarf-shrub-lichen tundras; on stones among stone fields; forming small dense cushions.

*A. rupestris* Hedw. var. *papillosa* (Lindb.) Podp. – **CU** (Un S+): 27. On stone in dwarf-shrub-lichen tundra; forming small dense cushions (Czernyadjeva 2.VIII.1993, N 13).

## POLYTRICHACEAE

*Pogonatum dentatum* (Brid.) Brid. – **AT** (Spar-Rar S–): 1, 3, 6, 8; **NT** (Spar-Rar S+): 9, 12, 14-15; **ST** (Spar-Rar S+): 16, 21-23, 26; **CU** (Rar S+): 27. On bare soil bluffs, landslides, roadbanks; on peat outcrops; on spots in dwarf-shrub and herb tundras; on polygons of PTMC; in nival communities; growing as scattered plants or forming loose tufts associated with other species: *Dicranum elongatum*, *Dicranella crispa*, *Conostomum tetragonum*, etc.

*P. urnigerum* (Hedw.) P.Beauv. – **NT** (Rar S–): 9, 14; **ST** (Rar S–): 16, 22, 26; **CU** (Spar S–): 27. On bare soil bluffs; on spots in dwarf-shrub-lichen tundras; on herb slopes; in herb communities on river terraces; seldom in nival communities and grassy willow-shrub; forming loose tufts or growing with *Sanionia uncinata*, *Pohlia drummondii*, *Saetania glaucescens*, etc.

*Polytrichastrum alpinum* (Hedw.) G. L. Sm. var. *alpinum* – **AT** (Com-Rar S–): 1, 3, 8; **NT** (Com-Spar S–): 9, 11-14; **ST** (Spar-Rar S+): 16, 18-19, 22-23, 26; **CU** (Com S+): 27. In dwarf-shrub-lichen and dwarf-shrub-sedge-moss tundras; on herb slopes; on bare soil in disturbed habitats; less commonly in moss and grassy willow-shrubs and alder-shrubs, nival communities; preferring dry drainage soils, abundant in lichen tundras; forming dense tufts and cushion or growing mixed with other mosses.

*P. alpinum* (Hedw.) G. L. Sm. var. *fragile* (Bryhn) Long – **AT** (Rar S+): 1; **NT** (Rar S–): 9-10, 12, 15; **ST** (Rar S+): 16, 21. In meadows near sea coast, in grass and dwarf-shrub-sphagnous mires, sedge-moss tundra; growing in admixture to *Loeskyppnum badium*, *Pohlia bulbifera*. The status of this taxon is disputable: some bryologists consider it as a species (Savicz-Ljubitskaya, Smirnova, 1970; Afonina, 2000), while others accept it as a variety of *P. alpinum* (Anderson & al., 1990; Ignatov & Afonina, 1992).

*P. longisetum* (Sw. ex Brid.) G. L. Sm. – **AT** (Rar S–): 8; **NT** (Rar S–): 10, 12, 14-15; **ST** (Spar-Rar S+): 16, 23, 26; **CU** (Rar S–): 27. On bare wet soil of bluffs, on streams and lakes shores; in flood willow-shrubs and alder-shrubs; forming loose tufts or growing mixed with *Calliergon cordifolium*, *Sanionia uncinata*, *Brachythecium* sp., etc.

*P. norwegicum* (Hedw.) Schljakov – **NT** (Un S+): 13; **ST** (Un S–): 16. On herb slope, as admixed to *Polytrichum hyperboreum*; in dwarf-shrub-lichen tundra.

*Polytrichum commune* Hedw. – **AT** (Rar S–): 8; **NT** (Spar S+): 10, 12-15; **ST** (Com-Spar S+): 16, 18, 21-23, 26; **CU** (Spar S+): 27. In mossy willow-shrubs, nival moss communities, meadows; in bushy-moss, bushy-sphagnous and dwarf-shrub-lichen-moss tundras; active in ST, preferring humid rich soil; forming loose tufts usually mixed with *Hylocomium splendens*, *Pleurozium schreberi*, etc. There are specimens with weakly developed marginal leaf teeth and weakly notched upper lamellar cells in leaf transverse section; these specimens difficult to differentiate from *P. swartzii* Hartm.

*P. hyperboreum* R. Br. – **AT** (Spar S+): 1, 3, 7-8; **NT** (Com S+): 9, 12-15; **ST** (Spar S+): 16, 19-23, 26; **CU** (Spar S+): 27. In dwarf-shrub-lichen, herb and bushy-moss tundras; on herb slopes; in mossy willow-shrubs and alder-shrubs; on bare soil in disturbed habitats; less commonly in dwarf-shrub-sedge-moss tundras, on polygons of PTMC, on hummocks dwarf-shrub-sphagnous mires, in nival moss communities; forming dense tufts and cushion or growing mixed with *Dicranum elongatum*, *Polytrichastrum alpinum*, *Racomitrium lanuginosum*, etc. *P. hyperboreum* prefers dry drainage soil and is locally abundant.

*P. jensenii* Hag. – **AT** (Rar S–): 1, 3, 5, 7; **NT** (Com-Spar S+): 9-10, 12, 14-15; **ST** (Spar S+): 16-17, 21-24, 26; **CU** (Spar S–): 27. In different mires, nival moss community, flood willow-shrubs, on polygons of PTMC; in herb-moss aggregations on river terraces, at lake shores; less commonly in hummocky cottongrass, bushy, sedge-moss tundras; preferring wet soil and abundant in some mires; forming loose tufts associated with *Aulacomnium palustre*, *Ptilidium ciliare* (L.) Hampe, *Sphagnum* sp., etc. Taxonomic status of *P. jensenii* is not accepted by some bryologist (Nyholm, 1969; Long, 1985), who merge it with *P. commune*. Other authors (Ignatov, Afonina, 1992; Frisvoll, Elvebakk, 1996) consider it as independent species. On Yamal this species is rather well defined: it is characterized by weakly dentate to subentire fragile leaves with very deeply notched often 2-celled tips of lamella in transverse leaf section. Some specimens have marginal lamina 6-8 cells wide.

*P. juniperinum* Hedw. – **AT** (Com S–): 1,3,5-6,8; **NT** (Wid-Com S+): 9-15; **ST** (Wid-Com S+): 16, 18-19, 21-24, 26; **CU** (Com S+): 27. In different tundras, on polygons of PTMC; in moss and grassy willow-shrubs, nival moss communities, in herb-moss aggregations on river terraces, on bare soil damaged sites; less commonly on hummocks in mires; occurring in wide ecological range avoiding only very wet habitats; one of the most widespread species, dominant of tundras; forming continuous cover, dense and loose tufts or growing mixed with other mosses.

*P. piliferum* Hedw. – **AT** (Rar S–): 1, 3; **NT** (Com S+): 9, 11-12, 14; **ST** (Spar S+): 16, 21-24; **CU** (Spar S+): 27. On bare soil on disturbed habitats; in dwarf-shrub-lichen tundras, on herb slopes; less commonly mossy willow-shrubs, dwarf-shrub-sedge-moss tundras, nival communities; preferring dry drainage soil and open sites where locally abundant; forming dense cushion and tufts.

*P. strictum* Brid. – **AT** (Spar S–): 3, 5-8; **NT** (Com S+): 9-12, 14-15; **ST** (Com-Spar S+): 16, 18-24; **CU** (Spar S+): 27. In different tundras; on polygons of PTMC; on hummocks in mires; in grass and mossy willow-shrubs; less commonly in wet meadows and nival moss communities; usually on wet weakly drainage soil, often co-dominating in wet tundras; forming very dense tufts. Plants transitional to *P. juniperinum* often occur in Yamal, making sometimes difficult their differentiation. *P. strictum* may represent just an ecological form of *P. juniperinum* (cf. Abolin, 1985). Final elucidation of relationships of these species needs further investigation.

*Psilopilum cavifolium* (Wils.) Hag. – **AT** (Rar S–): 1; **NT** (Spar-Rar S+): 9, 12, 14-15; **ST** (Rar S–): 21. On bare soil of landslides, bluffs, disturbed places; on peat outcrops; seldom in herb tundras; growing as scattered plants, sometimes together with *P. laevigatum*, *Pogonatum dentatum*, *Pohlia andrewsii*, etc.

*P. laevigatum* (Wahlenb.) Lindb. – **AT** (Rar S+): 1, 3, 8; **NT** (Spar S+): 10-12, 14; **ST** (Rar S–): 19-20, 22-23, 26; **CU** (Spar S+): 27. On bare soil of landslides, bluffs, disturbed places, roadbanks; on peat outcrops; on herb slopes; less commonly on sandy and loamy spots in tundras and at early stages of succession; growing as scattered plants or forming loose tufts, often associated with *P. cavifolium*, *Ceratodon purpureus*, *Polytrichastrum alpinum*, etc.

#### BUXBAUMIACEAE

*Buxbaumia aphylla* Hedw. – **ST** (Rar S+): 16, 23, 26; **CU** (Un S+): 27. On bare soil on bluffs; on sandy spots in dwarf-shrub-moss tundra and nival herb-moss community; growing by separate stems.

#### DITRICHACEAE

*Ceratodon purpureus* (Hedw.) Brid. var. *purpureus* – **AT** (Spar S+): 1, 3, 8; **NT** (Com S+): 9-12, 14-15; **ST** (Com S+): 16, 18, 20-23, 26; **CU** (Com S+): 27.

On bare soil of disturbed places, landslides, bluffs, roadbanks; on peat outcrops; on herb slopes; in open plant aggregations; less commonly among developed tundra vegetation, on hummocks in mires, in nival communities and willow-shrubs; one of the most widespread species; growing usually mixed with other species, rarely forming loose tufts.

*C. purpureus* (Hedw.) Brid. var. *rotundifolius* Berggr. – **AT** (Rar S+): 1, 8; **NT** (Rar S–): 11-12. On bare wet soil in herb communities, on bottom of dried-up lake, on hummock in sedge-cottongrass mire; growing as admixed to *Aulacomnium palustre*, etc. The specimens from Syoyaha River have very thick stems and small almost scaly leaves with strongly thick-walled cells.

*Distichum capillaceum* (Hedw.) B.S.G. – **AT** (Spar-Rar S–): 1, 3; **NT** (Spar-Rar S+): 11-12, 14-15; **ST** (Rar S+): 22, 26; **CU** (Spar S+): 27. On bare soil of disturbed places; on sandy and loamy spots in tundras; less commonly among moss tufts in dwarf-shrub and herb tundras; on herb slopes; in nival communities; near trunk bases in willow-shrubs and alder-shrubs; forming small tufts or occurring mixed with *Ceratodon purpureus*, *Pohlia nutans*, *Ditrichum flexicaule*, etc.

*D. hagenii* Ryan ex Philib. – **AT** (Un S–): 4; **NT** (Un S+): 12; **ST** (Un S+): 22. On landslide among dwarf-willow-tussock-grass aggregation, mixed with *Sanionia uncinata*, *Bryum* sp.; in crack in bushy-sedge-moss tundra, mixed with *Leptobryum pyriforme*, *Bryoerythrophyllum recurvirostrum*. Arctic species known in West Siberia only from Yamal.

*D. inclinatum* (Hedw.) B.S.G. – **NT** (Un S+): 14; **CU** (Rar S+): 27. On loamy spots in dwarf-shrub and bushy tundras; in nival community; growing by separate stems together with *Dicranella crispa*, *Ditrichum flexicaule*, *Fissidens bryoides*.

*Ditrichum crispatisimum* (C. Muell.) Par. – **CU** (Un S–): 27. On soil over stone among rocks, forming loose tuft (Czernyadjeva, 10.VIII.1993, N 58). Systematic position of this species is not clear. Some bryologists (Nyholm, 1986; Savicz-Ljubitskaya, Smirnova, 1970) distinguish it as a variety of *D. flexicaule*, while other authors (Frisvoll, 1985; Soedestroem et al., 1996; Afonina, 2000) consider it as a species. In Yamal these species are very distinct: *D. crispatisimum* has longer leaves (5-8 mm vs. 3 mm in *D. flexicaule*), which are more gradually narrowed from basal portion into very long subula, cells of the marginal border narrower, longer and often pseudohyaline. Leaves of Yamal plants weakly denticulate in upper part.

*D. cylindricum* (Hedw.) Grout – **AT** (Rar): 8; **NT** (Rar S+): 11-12, 14; **ST** (Rar S+): 16, 22-23; **CU** (Rar S+): 27. On bare soil of disturbed places; on loamy spots in hummocky cottongrass and bushy-moss tundras; seldom in herb community on river



- terrace, on sand at lake shore and in willow-shrub; growing as scattered plants or forming loose tufts or mixed with *Dicranella crispa*, *Ceratodon purpureus*, *Pohlia prolifera*, etc.
- D. flexicaule* (Schwaegr.) Hampe – **AT** (Spar-Rar S–): 1, 3, 6-7; **NT** (Rar S+): 11-12, 14; **ST** (Rar S–): 18, 21-24; **CU** (Spar S+): 27. On loamy spots in dwarf-shrub, herb and dwarf-willow-moss tundras; on hummocks in bushy and dwarf-shrub-sedge-moss tundras; in nival communities; on herb slopes; on bare soil damaged sites; seldom in willow-shrubs and alder-shrubs; growing usually mixed with other mosses: *Distichium capillaceum*, *Sanionia uncinata* etc., or rarely forming pure loose tufts.
- Saetania glaucescens* (Hedw.) Broth. – **NT** (Rar S–): 12, 14; **CU** (Rar S+): 27. On bare soil on landslide; in stone crevices; on sandy bluff; on herb slope; growing as admixed to *Distichium capillaceum*, *Myurella julacea*, *Isopterygiopsis pulchella*, etc.
- DICRANACEAE
- Aongstroemia longipes* (Somm.) B.S.G. – **ST** (Un S–): 22. In nival herbaceous willow-shrub on slope to lake, growing by separate stems among *Campylium polygamum*, *Pohlia cruda*, *Bryum* sp. (Chernyadjeva, 21.VII.1994, N 32). Rare arctic-alpine species known in Russia from a few localities in Chukotka, Wrangel Island, East Siberia (Afonina, 2000), Leningrad Province (Kurbatova & al., 1999) and Yamal.
- Cnestrum alpestre* (Wahlenb.) Nyh. ex Mogensen – **NT** (Un S+): 14; **CU** (Rar S+): 27. On loamy spot in dwarf-shrub-lichen tundra; in stone crevice in lichen tundra; in rock crevice; on herb slope; growing by separate stems with *Pohlia* sp., Hepaticae.
- Cynodontium strumiferum* (Hedw.) Lindb. – **NT** (Un S+): 12; **ST** (Un S+): 26; **CU** (Rar S+): 27. In bushy-moss and dwarf-shrub-moss tundras; in stones crevices; on bare soil on turfed bluff; growing as admixture to *Eurhynchium pulchellum*, *Pohlia prolifera*, *Bartramia ithyphylla* etc.
- Cynodontium tenellum* (B.S.G.) Limpr. – **ST** (Rar S+): 16, 26. On bare soil in dwarf-shrub tundra and in herb community; on sandy bluff; growing mixed with *Dicranum groenlandicum*, *Ditrichum flexicaule*, *Pohlia nutans*.
- Dicranella cerviculata* (Hedw.) Schimp. – **AT** (Un ): 8; **NT** (Rar S+): 12; **ST** (Spar-Rar S+): 16, 22, 26; **CU** (Un S+): 27. On bare soil of disturbed places; on peat outcrops; on sandy spots in bushy-moss and cloudberry-sphagnous tundras; forming loose tufts or growing mixed with *Psilopilum laevigatum*, *Dicranella crispa*, etc.
- D. crispa* (Hedw.) Schimp. – **AT** (Rar S+): 1, 3; **NT** (Spar S+): 10-12, 14-15; **ST** (Spar-Rar S+): 16, 22-23, 26; **CU** (Rar S+): 27. On bare soil of disturbed places; on peat outcrops; on loamy and sandy spots in different tundras; in cracks in bushy tundras; on herb slopes; in nival communities; on sand at lake shores; growing on bare soil in loose to rarely dense tufts, or mixed with *Psilopilum laevigatum*, *P. cavifolium*, *Dicranella cerviculata*, etc.
- D. grevilleana* (Brid.) Schimp. – **NT** (Rar S+): 10, 12; **CU** (Rar S+): 27. On bare loamy soil on landslide; in disturbed place; in nival grass community; on wet sand at lake shore; forming loose tufts usually associated with *D. varia*, *Funaria hygrometrica*.
- D. humilis* Ruthe – **ST** (Un S+): 26. On herb slope; growing as scattered plants, with *Pohlia prolifera* (Czernyadjeva, 8.VIII.1996, N 84). Rare Eurasian boreal species. The Yamal report is northernmost and the only locality for the Russian Arctic.
- D. riparia* (Lindb. ex H.Lindb.) Mart. et Nyh. – **ST** (Un S+): 26. On sandy spot in nival moss community, growing by separate stems mixed with *Calliergon stramineum*, *Pohlia nutans*, *Scapania hyperborea* Jorg. (Czernyadjeva 29.VII.1994). Very rare species known in Russia only from two localities in Yamal and Isthmus Karelicus of Leningrad Province (Czernyadjeva, 1999a). Outside Russia reported from few localities in Norway, Sweden and Greenland (Molinaar, 1974; Nyholm, 1986).
- D. rufescens* (Dicks.) Schimp. – **NT** (Un S+): 12. In crack in dwarf-shrub tundra, growing by separate stems as admixture to *Dicranella crispa*, *Aulacomnium turgidum* (Czernyadjeva, 3.VIII.1991). Rare species known in Russian Arctic from Yamal and Chukotka only (Afonina, Czernyadjeva, 1995).
- D. schreberiana* (Hedw.) Hilp. ex Crum & Anderson – **NT** (Rar S+): 12, 14; **ST** (Rar S+): 22. On bare soil on landslides; on loamy spots in polygonal and dwarf-shrub-moss tundras; forming loose tufts or growing with other species: *Leptobryum pyriforme*, *Pohlia andrewsii* etc.
- D. subulata* (Hedw.) Schimp. – **AT** (Un S+): 3; **NT** (Spar-Rar S+): 9, 12, 14-15; **ST** (Com-Spar S+): 16, 22-23, 26; **CU** (Rar S+): 27. On bare soil of disturbed places; on loamy and sandy spots in different tundras; in cracks in bushy tundras; on herb slopes; in nival communities; in grassy willow-shrubs; on sand on lakes banks; fastly spreading on bare soils; forming loose tufts, usually together with other species: *Pohlia andrewsii*, *P. prolifera*, *Ceratodon purpureus*, etc. In unfavorable conditions some plants form abnormal capsules: short, erect, and without striolation.
- D. varia* (Hedw.) Schimp. var. *varia* – **ST** (Rar S+): 22, 26; **CU** (Un S+): 27. On spot in herb-dwarf-willow tundra; on herb slope; in crack on bushy tundra; on bare soil of disturbed place; growing as admixture to *D. crispa*, *Ceratodon purpureus* etc.
- D. varia* (Hedw.) Schimp. var. *obtusifolia* Berggr. – **ST** (Un S+): 21. On bare soil on slope, growing by separate stems.

- Dicranoweisia crispula* (Hedw.) Lindb. – **CU** (Rar S+): 27. On stone in herb community in stream valley (Czernyadjeva, 2.VIII.1993, N 16); in nival grass-moss community (Czernyadjeva, 7.VIII.1993, N 45); forming small dense tufts.
- Dicranum acutifolium* (Lindb. et H.Arnell) C.Jens. ex Weinm. – **AT** (Spar S–): 3; **NT** (Rar S–): 12-15; **ST** (Rar S–): 16, 22; **CU** (Spar S–): 27. In different dwarf-shrub tundras; in nival communities; on herb slopes; less commonly on landslides, in stone crevices, on hummocks in cottongrass tundra; forming dense or loose tufts, often mixed with *Hylocomium splendens*, *Racomitrium lanuginosum*, *Aulacomnium turgidum*, etc. There are specimens with leaves variously keeled (from distinctly keeled to rounded) in upper half, with comparatively weakly toothed margins and areolation transitional to *D. spadiceum*; there are some difficulties to differentiate these species.
- D. angustum* Lindb. – **AT** (Com S–): 1, 3, 6-8; **NT** (Com S+): 9-14; **ST** (Com S+): 16, 18-24, 26; **CU** (Com S+): 27. In different tundras and mires, in nival communities and willow-shrubs, usually on wet soil. *D. angustum* is a widespread species in Yamal, one of dominants in tundras and mires; forming loose tufts, usually intermixed with other species. There are some specimens with strongly porose thick-walled cells similar to those of *D. laevidens* Williams; however certain identification of these plants needs further investigation. Differentiation and illustrations of *D. angustum* and *D. laevidens* are provided by Nyholm (1986).
- D. bonjeanii* De Not. – **NT** (Rar S+): 12, 14; **ST** (Rar S–): 18, 23; **CU** (Spar S–): 27. In moss and grassy willow-shrubs and alder-shrubs, in nival communities; less commonly on polygons of PTMC, on hummocks dwarf-shrub-sphagnous mires and cottongrass tundras; in dwarf-shrub tundras; preferring moderately wet and comparatively rich soils; forming loose tufts or growing mixed with *Hylocomium splendens*, *Aulacomnium palustre*, *Sanionia uncinata*, etc.
- D. brevifolium* (Lindb.) Lindb. – **NT** (Rar S–): 11-12; **ST** (Rar S–): 22-23, 26; **CU** (Spar S+): 27. On turfed damaged sites; in nival communities and bushy tundras; on herb slopes, on spots in lichen tundras; forming loose tufts intermixed with *Sanionia uncinata*, *Polytrichum hyperboreum*, *Pohlia nutans*, etc.
- D. elongatum* Schleich. ex Schwaegr. – **AT** (Wid S–): 1, 3, 5-8; **NT** (Wid S+): 9, 11-15; **ST** (Com S+): 16, 18-24, 26; **CU** (Com S+): 27. In different tundras, on herb slopes, in nival communities, in grass and mossy willow-shrubs; less commonly on hummocks in dwarf-shrub-sedge mires; usually on dry drainage soils; one of the most widespread species, dominant of tundras, forming dense cushions often intermixed with *Anastrophyllum minutum* (Schreb.) Schust., *Barbilophozia bisteadii* (Kaal.) Loeske. Yamal plants very often produce on top of stems julaceous shoots with small, blunt leaves.
- D. fuscescens* Turn. var. *fuscescens* – **ST** (Spar S+): 16, 26; **CU** (Rar S–): 27. In dwarf-shrub-lichen, bushy and dwarf-shrub-sedge-moss tundras; forming loose tufts intermixed with *Sanionia uncinata*, *Hylocomium splendens*, *Polytrichum juniperinum*, etc.
- D. fuscescens* Turn. var. *congestum* (Brid.) Husn. – **AT** (Spar S–): 1, 3, 7-8; **NT** (Com-Spar S+): 9-14; **ST** (Rar S–): 16, 18, 20, 22, 24-26; **CU** (Spar S–): 27. In dwarf-shrub-moss, sedge-moss and bushy tundras, on herb slopes, in mossy willow-shrubs; less commonly on hummocks in dwarf-shrub-sedge mires and cottongrass tundras; forming loose tufts together with other species. This taxon is sometimes considered as a species, but studied material from Yamal does not allow to differentiate them as distinct entities. Most plants have transitional characters between *D. fuscescens* and *D. congestum*, so the status of these taxa needs further investigation. Some authors distinguish them as distinct species (Schljakov, 1951; Ignatov, Afonina, 1992), while others include *D. congestum* in synonymy of *D. fuscescens* (Bellolio-Trucco, Ireland, 1990; Nyholm, 1986).
- D. groenlandicum* Brid. – **NT** (Rar S–): 14-15; **ST** (Spar S+): 16, 22, 24, 26; **CU** (Spar S+): 27. In dwarf-shrub-moss and bushy tundras, in nival communities, on polygons of PTMC, on hummocks in cottongrass tundras; seldom in moss alder-shrubs and on hummocks in mires; forming small dense tufts with admixture of *D. angustum*, *D. fuscescens*, *Aulacomnium turgidum* etc. Plants of some specimens have areolation and leaf shape transitional to *D. spadiceum* on the one hand and to *D. angustum* on the other.
- D. leioneuron* Kindb. – **ST** (Un S–): 26; **CU** (Rar S–): 27. On loamy spot in shrub tundra; in bushy-sedge-moss and bushy-sphagnous tundras; in nival moss community; forming loose tufts with *D. angustum*, *D. spadiceum*, *Aulacomnium turgidum*, etc.
- D. majus* Sm. – **AT** (Spar S–): 1; **NT** (Spar-Rar S–): 11-15; **ST** (Com S+): 16, 18, 21-23, 26; **CU** (Spar S–): 27. In different tundras, willow-shrubs, nival communities; seldom on hummocks in shrub-sedge tundras; dominant in ST; forming loose tufts or growing mixed with other species.
- D. polysetum* Sw. – **ST** (Un S–): 26. In dwarf-shrub-mossy willow-shrub, growing mixed with *Polytrichum juniperinum*, *Aulacomnium palustre* (Czernyadjeva, 31.VII.1996, N 45). This boreal species occurs in West Siberia mainly in the forest zone; in Yamal is was collected once in southeast part of Peninsula.

- D. spadiceum* Zett. – **AT** (Rar S–): 1, 3; **NT** (Rar S–): 9, 11-13; **ST** (Rar S–): 18, 21-23, 26; **CU** (Com S+): 27. In dwarf-shrub-lichen, dwarf-shrub-sedge-moss, herb and bushy tundras; on herb slopes; in nival communities, mossy willow-shrub; seldom on hummocks in cottongrass tundras; preferring dry drainage soils; forming dense pure tufts or growing associated with *Racomitrium lanuginosum*, *Polytrichum hyperboreum*, *Aulacomnium turgidum* etc.
- Kiaeria glacialis* (Beggr.) Hag. – **AT** (Spar S–): 1; **NT** (Rar S–): 9, 14; **ST** (Un S–): 16; **CU** (Spar S–): 27. In herb tundras, on polygons of PTMC, on hummocks in cottongrass tundras, in nival communities; forming loose tufts together with *Sanionia uncinata*, *Conostomum tetragonum*, *Polytrichum juniperinum* etc.
- K. starkei* (Web. Et Mohr) Hag. – **AT** (Un S–): 8; **NT** (Rar S–): 14; **ST** (Un S–): 16. In grass-dwarf-shrub tundra; on herb slope; in mossy willow-shrubs; forming small pure loose tufts.
- Oncophorus compactus* (B.S.G.) Schljak. – **AT** (Rar S–): 1, 3. **CU** (Rar S+): 27. On spots in dwarf-shrub-moss tundras; in nival herb-moss and willow-shrub-moss tundras; forming small pure dense tufts. Systematic position of this species is disputable. Nyholm (1986) consider it as a variation of *O. wahlenbergii*. However in Yamal these species are distinct from each other; *Oncophorus compactus* has shorter, more gradually narrowed into entire point leaves, slighter porose and shorter cells of leaf base.
- O. wahlenbergii* Brid. – **AT** (Com-Spar S+): 1, 3, 5-6, 8; **NT** (Com-Spar S+): 9-15; **ST** (Com-Spar S+): 16, 22-23, 25-26; **CU** (Com S+): 27. In different tundras and mires, in nival communities, in willow-shrubs, on herb slopes; widespread and abundant and having wide ecological range; forming dense cushions on dryest soil and continuous cover on very wet soils, often growing with *Sanionia incinata*, *Dicranum sp.*, *Tomentypnum nitens*, etc.
- O. virens* (Hedw.) Brid. var. *virens* – **AT** (Un S–): 1. In grass mire on bottom of ravine; growing as admixture to other species (Volkova, Rebristaya, 1987). Reported by literature data only.
- O. virens* (Hedw.) Brid. var. *serratus* (B.S.G.) Braithw. – **ST** (Un S+): 21; **CU** (Rar S+): 27. In nival moss community, mixed with *Myurella julacea* (Czernyadjeva, 14.VII.1994, N 17); in nival mossy willow-shrub, as admixture to *Pohlia nutans* (Czernyadjeva, 17.VII.1994, N 29); in moss tundra (1978, Andreeva).
- FISSIDENTACEAE
- Fissidens arcticus* Bryhn – **NT** (Un S–): 14; **ST** (Un S+): 22. On bare clay spot in polygonal tundra, separate stems among *Bryoerythrophyllum recurvirostrum* (Czernyadjeva, 28.VII.1992, N 12); on bare sandy soil in nival grass association mixed with *Lophozia perssonii* Buch et S. Arnell. (Czernyadjeva, 21.VII.1994, N 32). Rare high arctic species. Included in “Red Data Book of European Bryophytes” (1995). In Russia known from three localities – Taimyr Peninsula (Kannukene, Matveyeva, 1996) and Yamal Peninsula. There are a few reports from Alaska, Arctic Canada, Greenland and Svalbard (Steere, Brassard, 1974; Frisvoll, 1981). The taxonomic status of *F. arcticus* is discussed by Czernyadjeva (2000a).
- F. bryoides* Hedw. var. *bryoides* – **NT** (Un S+): 12; **ST** (Un S+): 26; **CU** (Rar S+): 27. On bare soil on landslide and on stream banks; on loamy spot in bushy-sedge-moss tundra; on herb meadow; growing as scattered plants or forming very loose tufts mixed with *Meesia uliginosa*, *Campylium zemlia*, *Encalypta sp.*
- F. bryoides* Hedw. var. *gymnandrus* (Buse) Ruthe – **ST** (Rar S+): 26; **CU** (Un S+): 27. On decayed wood in alder-shrub and willow-shrub; on hummock in sedge mire; on turfed bluff at lake shore; forming very loose tufts mixed with *Pohlia proligera*, *P. nutans*, *Sanionia uncinata*. The taxonomic status of this taxon is debatable. Some bryologists (Nyholm, 1986; Soedestroem et al., 1996) consider it as an independent species. The other (Ignatov, Afonina, 1992) include it in synonymy of *F. bryoides*. However this taxon can be segregated at least as a variety by sex distribution, structure of androecia and smaller size of plants.
- F. osmundoides* Hedw. – **CU** (Rar S–): 27. In bushy-sedge-moss tundra; in nival moss communities; on wet fine-grained ground in stone crevices; forming loose tufts or growing mixed with *Meesia uliginosa*, *Myurella julacea*, *Orthothecium chryseon*, *Ditrichum flexicaule*.
- F. viridulus* (Sw.) Wahlenb. – **NT** (Un S+): 12. On loamy spot in dwarf-shrub tundra (Czernyadjeva 12.VIII.1992, N 19); growing as scattered plants together with *Meesia uliginosa* and Hepaticae.
- ENCALYPTACEAE
- Encalypta affinis* Hedw. f. – **CU** (Un S+): 27. On soil over stone among rocks, forming loose tuft together with *Distichium capillaceum*, *Myurella julacea* (Czernyadjeva 12.VIII.1994, N 92).
- E. alpina* Sm. – **AT** (Un S–): 1; **CU** (Rar S+): 27. On soil over stones and in crevices among rocks; in hilly *Dryas*-sedge-moss tundra; forming loose tufts mixed with *Distichium capillaceum*, *Ditrichum flexicaule*, *Cyrtomnium hymenophylloides*.
- E. brevicollis* (B.S.G.) Bruch ex Aongstr. – **NT** (Un S+): 15; **CU** (Rar S+): 27. On soil over stones and in crevices among rocks; on turfed site among stone field; forming loose tufts mixed with *E. raphitocarpa*, *Abietinella abietina*.
- E. mutica* Hag. – **CU** (Rar S+): 27. On soil over stones among rocks (Czernyadjeva, 12.VIII.1994,

N 92); on loamy soil among stone field (Czernyadjeva, 31.VII.1993, N 6); growing as admixture to *E. rhamnoides*, *E. alpina*. Very rare species in Russia known from 5 localities: in Kola Peninsula, Yamal Peninsula, Vrangeli Island and Chukotka (Afonina, Czernyadjeva, 1998). There are a few reports from western North America (Horton, 1983), Svalbard, Fennoscandia, Estonia (Soedestroem et al., 1996) and East Greenland (Mogensen, 1988).  
*E. procera* Bruch – **CU** (Rar S+): 27. On soil over stones among rocks; growing as admixture to *Distichium capillaceum*, *Ditrichum flexicaule*.  
*E. rhamnoides* Schwaegr. – **AT** (Un S+): 3; **NT** (Rar S+): 12, 14-15; **ST** (Rar S+): 21, 26; **CU** (Spar S+): 27. On bare sand and weakly turfed soil on watershed ridges, bluffs, landslides; on spots in lichen tundras; on soil over stones and in crevices among rocks; seldom among moss turf in dwarf-shrub tundras and on herb slopes; forming loose tufts, often together with other species: *Hypnum cupressiforme*, *Ceratodon purpureus*, etc.

#### POTTIACEAE

*Aloina brevirostris* (Hook. & Grev.) Kindb. – **NT** (Un S+): 14; **ST** (Rar S+): 21-22. On loamy spots in dwarf-shrub tundras; growing as scattered plants with *Distichium capillaceum*, *Hennediella heimii* var. *arctica*, *Bryoerythrophyllum recurvirostrum*. Rare xerophytic species sporadically occurring in the Arctic.

*Bryoerythrophyllum recurvirostrum* (Hedw.) Chen – **AT** (Un S+): 1; **NT** (Rar S+): 12, 14; **ST** (Rar S+): 22, 26; **CU** (Spar S+): 27. On loamy spots in dwarf-shrub tundras; on landslides; on herb and weakly turfed slopes; on soil over stones among rocks; in cracks bushy-moss tundras; seldom in alder-shrub; growing as scattered plants or forming loose tufts together with *Fissidens bryoides*, *Ditrichum flexicaule*, *Myurella julacea*, etc.

*Didymodon rigidulus* Hedw. var. *icmadophyllus* (Schimp. ex C. Muell.) Zander – **CU** (Un S-): 27. On soil among gravel, forming loose tufts (Czernyadjeva, 20.VIII.1994 N 101).

*Hennediella heimii* (Hedw.) Mitt. var. *arctica* (Lindb.) Zander – **AT** (Rar S+): 3, 8; **NT** (Rar S+): 12, 15; **ST** (Rar S+): 21-22; **CU** (Un S+): 27. On landslides; disturbed places; on spots and in cracks in dwarf-shrub tundras; on herb slope; growing by separate stems or forming loose tufts or mixed with *Funaria hygrometrica*, *Pohlia atropurpurea*, *Leptobryum pyriforme*, etc.

*Molendia tenuinervis* Limpr. – **CU** (Un S-): 27. In rock crevices and among rocks, forming small dense tufts (Czernyadjeva 10.VIII.1993, N 58). Very rare species known from few localities in mountains of Europe, Arctic North America, Lower Kolyma River (Abramova, Stepanova, 1986; Nyholm, 1991) and Yamal Peninsula.

*Stegonia latifolia* (Schwaegr.) Venturi ex Broth. – **ST** (Un S+): 21; **CU** (Un S+): 27. On bare soil among rocks, growing as scattered plants (Czernyadjeva 20.VIII.1994, N 96); on bare soil on slope (1978, Andreeva).

*S. pilifera* (Brid.) Crum & Anderson – **CU** (Un S+): 27. On bare soil on herb slope; growing by separate stems (Czernyadjeva 7.VIII.1993).

*Syntrichia norvegica* Web. – **CU** (Un S-): 27. On bare soil in rocks crevices, growing mixed with *Rhytidium rugosum* (Czernyadjeva, 12.VII.1994, N 8).

*S. ruralis* (Hedw.) Web. & Mohr – **AT** (Un S-): 1; **NT** (Rar S+): 12, 14-15; **ST** (Rar S): 22-23; **CU** (Spar S+): 27. On herb slopes; on bare and weakly turfed soil of damaged sites; seldom on spots in dwarf-shrub tundras; forming loose pure tufts or growing mixed with *Polytrichastrum alpinum*, *Eurhynchium pulchellum*, *Ceratodon purpureus*, etc.

*Tortella fragilis* (Hook. et Wilson) Limpr. – **CU** (Spar S-): 27. On soil over stones and in rocks crevices; in cobbly lichen and bushy-lichen-moss tundras; in nival communities; on bare soil in disturbed places; forming small dense pure tufts or growing mixed with *Ditrichum flexicaule*, *Distichium capillaceum*, etc.

*T. tortuosa* (Hedw.) Limpr. – **CU** (Rar S-): 27. In rock crevices and among rocks; on herb slope; forming loose tufts together with *Bryoerythrophyllum recurvirostrum*, etc.

*Tortula euryphylla* Zander (*Desmatodon latifolius* (Schwaegr.) Hueb.) – **ST** (Un S+): 26; **CU** (Spar S+): 27. On soil over stones and in rocks crevices; on bare soil of disturbed sites; on hill in dwarf-shrub-sedge tundra; growing by separate stems or forming loose tufts.

*T. mucronifolia* Schwaegr. – **NT** (Rar S+): 12, 14; **ST** (Un S+): 22. On bare soil on herb slope; on hill in dwarf-shrub tundra; on spot in herb-dwarf-willow tundra; growing by separate stems, with *Bryoerythrophyllum recurvirostrum*, *Myurella julacea*.

*Trichostomum crispulum* Bruch – **CU** (Un S-): 27. On stone among stone field; forming small dense pure cushions (Czernyadjeva 10.VIII.1993, N 53).

#### GRIMMIACEAE

*Grimmia affinis* Hornsch. – **CU** (Un S+): 27. On stone among stone field; forming small dense pure cushions (Czernyadjeva 12.VII.1994, N 8).

*Racomitrium canescens* (Hedw.) Brid. – **NT** (Rar S-): 10, 12-15; **ST** (Rar S-): 22-23, 26; **CU** (Spar S-): 27. On herb slopes; in lichen and dwarf-shrub tundras; on soil over stones and fine-grained ground on stone field; in herb communities on river terraces; seldom in nival communities; forming dense and loose tufts or sometimes forming continuous cover.

*R. lanuginosum* (Hedw.) Brid. – **AT** (Spar S-): 1, 3, 7-8; **NT** (Spar S-): 9-14, 17; **ST** (Spar S+): 16, 18-23, 26; **CU** (Spar S-): 27. In dwarf-shrub-lichen

- tundras; on herb slopes; on watershed ridge; less commonly in another tundras, nival communities; seldom on hummocks in dwarf-shrub-sedge mires; preferring dry drainage soils, dominating in lichen tundras; forming continuous cover or loose tufts or growing mixed with other species.
- Schistidium apocarpum* (Hedw.) B.S.G. – **CU** (Spar S+): 27. On stones among stone fields and rocks; forming small dense pure cushions.
- S. rivulare* (Brid.) Podp. var. *rivulare* – **CU** (Un S+): 27. On stone at stream bank near water; forming small pure cushions (Czernyadjeva 2.VIII.1993, N 18).
- S. rivulare* (Brid.) Podp. var. *latifolium* (Zett.) Crum et Anderson – **CU** (Rar S+): 27. On stones in water on stream banks (Czernyadjeva 10.VIII.1993, N 53; 2.VIII.1993, N 13); forming small pure cushions.
- DISCELIACEAE
- Discelium nudum* (Dicks.) Brid. – **ST** (Un S+): 26. On bare sand on herb slope; growing by separate stems, with Hepaticae (Czernyadjeva 8.VIII.1996).
- FUNARIACEAE
- Funaria arctica* (Berggr.) Kindb. – **AT** (Rar S+): 8. On bare soil on disturbed places (Dyachenko & al., 1999). Reported by literature data only.
- F. hygrometrica* Hedw. – **NT** (Spar-Rar S+): 11-12, 14; **ST** (Rar S+): 21-22; **CU** (Rar S+): 27. On bare soil of landslides, bluffs, roadbanks, damaged sites; on peat outcrops; growing as scattered plants, sometimes with *Leptobryum pyriforme*, *Ceratodon purpureus*, etc.
- SPLACHNACEAE
- Aplodon wormskjoldii* (Hornem.) Kindb. – **AT** (Un S+): 1; **NT** (Rar S+): 11-12, 14-15; **ST** (Rar S+): 16, 22-23, 26. On decaying animal material (dung, bones, etc.), in different tundras and on hummocks in mires; forming dense pure tufts, or seldom mixed with *Aulacomnium turgidum*, *A. palustre*, *Pohlia nutans*.
- Splachnum sphaericum* Hedw. – **NT** (Rar S+): 12, 15; **ST** (Rar S+): 16, 22. On decaying animal material (dung, bones, etc.) in different tundras and on hummocks in mires; forming loose tufts.
- S. vasculosum* Hedw. – **ST** (Rar S+): 23. On dung of animals in tundras; growing mixed with *Aulacomnium palustre*, *Polytrichum juniperinum*.
- Tayloria lingulata* (Dicks.) Lindb. – **NT** (Rar S+): 12, 14; **ST** (Rar S+): 26; **CU** (Rar S+): 27. On highly nitrogenous substrata in mossy willow-shrubs, sedge mires, at lake shore; growing mixed with *Plagiomnium ellipticum*, *Limprichtia revolvens*, *Aulacomnium palustre*.
- Tetraplodon angustatus* (Hedw.) B.S.G. – **ST** (Un S+): 16. On dung of animals in moss tundra (1977, Andreeva); forming loose tuft.
- T. mnioides* (Hedw.) B.S.G. – **AT** (Rar S+): 8; **NT** (Spar-Rar S+): 9, 12, 14-15; **ST** (Spar-Rar S+): 16-18, 22, 26; **CU** (Spar S+): 27. On decaying animal material (dung, bones, etc.) in different tundras, on hummocks in mires; forming very dense tufts or cushions.
- T. paradoxus* (R.Br.) Hag. – **AT** (Rar S+): 3; **NT** (Rar S+): 9, 12, 14; **ST** (Rar S+): 16, 22, 23; **CU** (Spar S+): 27. On decaying animal material (dung, bones, etc.) in tundras; forming dense tufts often mixed with *Aulacomnium turgidum*, *Polytrichum juniperinum*, *Ptilidium ciliare*.
- T. urceolatus* (Hedw.) Schimp. – **AT** (Un S+): 1; **ST** (Rar S+): 16, 23; **CU** (Un S+): 27. On decaying animal material (dung, bones, etc.) in tundras and in rock crevices; forming dense tufts often mixed with *Ceratodon purpureus*, *Pohlia nutans*, *Sanionia uncinata*.
- BRYACEAE
- Bryum* cf. *archangelicum* Bruch et Schimp. – **NT** (Rar S+): 12, 14. On bare soil on landslide, herb slope, roadbank, in dwarf-shrub tundra; on peat outcrop; in herbaceous willow-shrub on river terrace; growing by separate stems with *Polytrichum juniperinum*, *Brachythecium* sp.
- B. arcticum* (R. Br.) B.S.G. – **AT** (Rar S+): 8. On bare soil in moss tundras, herb community and disturbed places (Dyachenko & al., 1999). Reported by literature data only.
- B. argenteum* Hedw. – **NT** (Un S–): 12; **ST** (Spar S–): 21, 26; **CU** (Rar S–): 27. On bare soil in disturbed places; on herb slopes; forming small loose tufts or growing as scattered plants with *Ceratodon purpureus*.
- Bryum axel-blytii* Kaurin ex Philib. – **ST** (Un S+): 23. On sand in dwarf-shrub-herb community on river terrace (Czernyadjeva 28.IV.1994, N 69); growing by separate stems.
- B. caespiticium* Hedw. – **ST** (Rar S+): 23, 26; **CU** (Un S+): 27. On decayed wood in grassy willow-shrubs and alder-shrubs; on sand in dwarf-shrub-herb community on river terrace; growing mixed with *B. imbricatum*, *Ceratodon purpureus*, *Pohlia* sp.
- B. calophyllum* R. Br. – **AT** (Rar): 8. On sand in herb-moss tundra; on bare sand on disturbed places (Dyachenko & al., 1999). Reported by literature data only.
- B. creberrimum* Tayl. – **AT** (Spar): 8; **NT** (Un): 10. On sand in herb-moss and dwarf-willow-moss tundras; in sedge-moss mire; on bare sand on disturbed places (Dyachenko & al., 1999). Reported by literature data only.
- B. cyclophyllum* (Schwaegr.) Bruch et Schimp. – **AT** (Rar S–): 1, 4, 8; **NT** (Un S–): 12, 17; **ST** (Spar S–): 16, 26; **CU** (Spar S–): 27. At lake and streams banks; in mires; in grassy willow-shrubs and alder-shrubs; in herb-moss tundras; preferring weakly turfed very wet soils; forming loose pure tufts or growing together with *B. pseudotriquetrum*, *Calliargon cordifolium*, etc.

- B. cf. elegans* Nees ex Brid. – **ST** (Un S–): 26. On bare spot in dwarf-shrub tundra; growing by separate stems (Czernyadjeva 5.VIII.1996, N 70).
- B. funckii* Schwaegr. – **ST** (Un S+): 23. In dwarf-shrub-herb community (Czernyadjeva 27.VII.1994, N 66, det. Schljakov); forming small loose tuft.
- B. imbricatum* (Schwaegr.) B.S.G. – **AT** (Un): 8; **ST** (Rar S+): 22-23. On bare spots in dwarf-shrub-moss tundras; on dwarf-shrub-herb community on river terrace; growing mixed with *B. caespeticum*, *Aulacomnium turgidum*, *Ceratodon purpureus*.
- B. labradorensis* Philib. – **AT** (Un): 8. On sand-stony soil in grass-dwarf-willow-moss tundra (Dyachenko & al., 1999). Reported by literature data only.
- B. cf. neodamense* Itzigs. – **AT** (Un) 4; **NT** (Un S–): 15; **CU** (Rar S–): 27. In nival moss communities, in hummocky sedge-moss mire; growing mixed with *Cinclidium subrotundum*, *Limprichtia revolvens*.
- B. pallens* (Brid.) Sw. Ex Roehl. – **AT** (Rar): 8; **NT** (Un): 10. On sand on disturbed places; on gleied sand in grass community at lake shores; on clay in sedge community (Dyachenko & al., 1999). Reported by literature data only.
- B. pallescens* Schleich. ex Schwaegr. – **NT** (Un S+): 14; **ST** (Rar S+): 22. On sand in nival herb-dwarf-willow communities; on bottom of dried-up lake; forming loose tufts together with *Leptobryum pyriforme*, *Sanionia uncinata*.
- B. pseudotriquetrum* (Hedw.) Gaertn. et al. – **AT** (Rar S–): 7-8; **NT** (Rar S+): 9-10, 12-15; **ST** (Spar-Rar S+): 16, 18, 23, 26; **CU** (Spar S+): 27. On stream and lake banks, in grassy willow-shrubs, mires, hummocky cottongrass tundras; prefer very wet soils; growing usually as admixture to other species: *Calliargon cordifolium*, *Warnstorfia exannulata*, *Cinclidium subrotundum*, etc., or more rarely forming pure loose tufts.
- B. purpurascens* (R. Br.) B.S.G. – **AT** (Un): 8. On sand in grass-moss tundra in very wet depression on sea bank (Dyachenko & al., 1999). Reported by literature data only.
- B. teres* Lindb. – **AT** (Rar S–): 3-4; **NT** (Rar S+): 11-12, 14; **ST** (Un S–): 16; **CU** (Un S–): 27. On bare soil in polygonal tundras, on landslides, roadbank; on fine-grained ground in rock crevice; forming small pure tufts or growing mixed with *Leptobryum pyriforme*, *Pohlia filum*, *P. atropurpurea*.
- B. wrightii* Sull. Et Lesq. – **AT** (Rar): 8. On sand in disturbed places and grass-herb community (Dyachenko & al., 1999). Reported by literature data only.
- Leptobryum pyriforme* (Hedw.) Wils. – **AT** (Rar S+): 3-4, 8; **NT** (Spar S+): 9, 11-12, 14; **ST** (Rar S+): 17, 21-23, 26; **CU** (Spar S+): 27. On bare soil in disturbed places, landslides, bluffs, in willow-shrubs, nival moss communities, in low-grass meadows; in cracks in bushy-sedge-moss tundras; forming loose tufts or growing mixed with *Ceratodon purpureus*, *Funaria hygrometrica*, etc.
- Pohlia andrewsii* Shaw – **AT** (Un): 8; **NT** (Spar-Rar S–): 11-15; **ST** (Rar S–): 22-23, 26; **CU** (Spar S–): 27. On bare soil in disturbed places, landslides, bluffs, river banks; in cracks in dwarf-shrub-sedge-moss tundras; on peat outcrops; on herb slopes; seldom in nival moss communities; forming loose tufts or growing mixed with *Pohlia proligera*, *P. bulbifera*, *Dicranella subulata*, etc. Arctic-alpine species described recently from North America by Shaw (1981). In Russia known from most of mountain regions and Arctic (Czernyadjeva, 1999b).
- P. atropurpurea* (Wahlenb. ex Fuernr.) Lindb. – **NT** (Rar S+): 11-12; **ST** (Rar S+): 22; **CU** (Un S+): 27. On bare loamy, rarely sandy soil on landslides and road banks; seldom in cracks in bushy-sedge-moss tundra and on spot in herb-dwarf-willow tundra; growing by separate stems together with *Leptobryum pyriforme*, *Ditrichum cylindricum*, etc.
- P. beringiensis* Shaw – **AT** (Un S–): 3; **ST** (Un S–): 26. In *Dryas*-dwarf-willow tundra on polygon of PTMC (Rebristaya, 1981); on herb slope (Czernyadjeva, 3.VIII.1996); forming small loose tufts. Rare species described recently from North America by Shaw (1982). In Russia known from Altai, Severnaya Zemlya Archipelago, Chukotka (Czernyadjeva, 1999b). It seems to be an arctic-alpine asiatic-american species. Yamal locality of *P. beringiensis* is westernmost in Eurasia. Similar plants were seen from other localities in Asiatic Arctic, but the lack of propagulae does not allow the final decision on its frequency.
- P. bulbifera* (Warnst.) Warnst. – **AT** (Spar S–): 8; **NT** (Rar S–): 9-12, 14-15; **ST** (Spar-Rar S+): 21, 23, 26; **CU** (Spar S–): 27. On bare soil at river and lake banks, bluffs, roadbanks; in nival herb communities; in mossy willow-shrubs; on spots in sedge-sphagnous mires and cottongrass tundras; growing as scattered plants or forming loose tufts with *P. proligera*, *P. andrewsii*, *P. nutuns*, *Psilopilum laevigatum*, etc.
- P. cruda* (Hedw.) Lindb. – **AT** (Rar S+): 1; **NT** (Spar-Rar S+): 11-15; **ST** (Rar S+): 21, 23, 26; **CU** (Spar S+): 27. On herb slopes, in dwarf-willow-lichen and bushy tundras, nival herb communities, in grassy willow-shrubs; on bare soil in disturbed places; in cracks in moss tundras; seldom on polygons of PTMC; forming loose tufts or growing mixed with other species.
- P. crudoides* (Sull. et Lesq.) Broth. – **AT** (Un S–): 3; **NT** (Rar S+): 10, 12, 14; **ST** (Rar S–): 16, 23; **CU** (Un S–): 27. On bare soil bluffs and turfed slopes; on peat outcrops; in willow-shrub-sedge-moss tundras; on soil over stones among rocks; in nival community; forming loose tufts or growing mixed with *Amblystegiella subtilis*, *Pogonatum dentatum*, *Ditrichum flexicaule*, etc.

- P. drummondii* (C. Muell.) A. L. Andrews – **AT** (Rar S–): 4, 8; **NT** (Spar-Rar S+): 12, 14-15; **ST** (Spar S+): 16, 21-23, 26; **CU** (Rar S–): 27. On bare soil at rivers and lakes banks, landslides, bluffs; in grassy willow-shrubs; in nival communities; less commonly on spots in dwarf-shrub tundras; growing as scattered plants or forming loose tufts mixed with *P. proligera*, *P. filum*, *Dicranella subulata*, etc.
- P. elongata* var. *greenii* (Brid.) Shaw – **AT** (Un S+): 3; **NT** (Rar S+): 14. On herb slope; on loamy spot in lichen tundra; on polygon of PTMC; growing by separate stems among lichens and hepatics.
- P. filum* (Schimp.) Maort. – **AT** (Un): 8; **NT** (Rar S–): 12, 15; **ST** (Rar S–): 16, 23; **CU** (Un S–): 27. On bare sandy soil at lake shores, road bank, bluff; growing as scattered plants or in moss tufts together with *P. proligera*, *Psilopilum laevigatum*, *Dicranella subulata*, etc. This species often develops phases transitional to *P. drummondii* and/or *P. andalusica*. Their propagula are rather specific: upper half of propagula is formed by primordial lanceolate-laminate leaves whereas lower half is hemispherical. Moreover propagula are solitary or two in leaf axils. Schljakov (1984 and pers. com.) attributed these plants to *P. torrentium* (Hag.) Broth. However Shaw (pers. com.) supposed they that represent an unknown variety of *P. filum*. Earlier I (Czernyadjeva, 1997) tentatively named them nontypical *P. filum*. To solve this problem it is necessary to study extensive materials with well developed propagulae. Unfortunately all presently available material of *P. filum* have a few well developed propagula.
- P. nutans* (Hedw.) Lindb. – **AT** (Com S+): 1, 3-4, 8; **NT** (Wid-Spar S+): 9-12, 14-15; **ST** (Com S+): 16-18, 21-23, 26; **CU** (Com S+): 27. In different tundras, on hummocks in mires, in willow-shrubs and alder-shrubs, in nival communities, in disturbed places; one of the most widespread species, avoiding only very wet habitats; growing among other mosses, or forming pure tufts.
- P. proligera* (Kindb. ex Breidl.) Lindb. ex H. Arnell – **AT** (Un S–): 1; **NT** (Spar-Rar S–): 10-15; **ST** (Spar S–): 16, 21-23, 26; **CU** (Spar S–): 27. On bare soil at river and lake banks, landslides, bluffs, road banks; on peat outcrops; on herb slopes; in grassy willow-shrubs; in nival communities; less commonly on spots in dwarf-shrub tundras, on shortgrass meadow; forming loose tufts or growing mixed with *P. andrewsii*, *P. drummondii*, *Dicranella subulata*, etc.
- P. sphagnicola* (B.S.G.) Lindb. et H. Arnell – **AT** (Un): 8. On wet peat in grass-moss tundra (Dyachenko et al., 1999). Reported by literature data only.
- P. wahlenbergii* (Web. & Mohr) A.L. Andrews – **AT** (Rar): 4, 8; **NT** (Un S–): 15; **ST** (Rar S–): 22. On bare loamy soil in nival grass-moss tundra; in nival herb-moss communities; growing by separate shoots.
- MNIACEAE
- Cinclidium arcticum* B.S.G. – **AT** (Un S–): 1; **ST** (Rar S+): 17, 22; **CU** (Rar S+): 27. In homogeneous sedge-moss mires, nival moss communities; in hollows in hummocky cottongrass-moss tundras; growing mixed with *Rhizomnium andrewsianum*, *Ptilidium ciliare*, *Calliergon giganteum*, etc.
- C. latifolium* Lindb. – **NT** (Rar S–): 11-12; **ST** (Rar S–): 16-17, 26; **CU** (Un S–): 27. In homogeneous sedge-moss, grass-sedge and polygonal mires; growing mixed with *C. subrotundum*, *Limprichtia revolvens*, *Warnstorfia sarmentosa*, etc.
- C. stygium* Sw. – **NT** (Un S–): 12; **ST** (Spar S+): 16, 19, 26; **CU** (Rar S+): 27. In homogeneous sedge-moss, grass-sedge and hummocky sedge-sphagnon mires; seldom in very wet places in moss tundra; growing mixed with *C. subrotundum*, *Meesia uliginosa*, *Limprichtia revolvens*, etc.
- C. subrotundum* Lindb. – **AT** (Un, S–): 7; **NT** (Spar S+): 9, 11-14; **ST** (Spar S+): 16, 19, 21-23, 26; **CU** (Spar S+): 27. In different mires, in hollows of PTMC, in nival communities, at streams banks, less commonly in very wet sites in moss tundras; abundant or dominant in homogeneous mires; forming continuous cover or loose tufts, together with *Limprichtia revolvens*, *Warnstorfia sarmentosa*, etc.
- Cyrtomnium hymenophylloides* (Hueb.) Nyholm ex T. Kop. – **CU** (Spar S–): 27. On fine-grained ground in rocks crevices; in nival communities; preferring calcareous soils; forming loose tufts or growing together with *Campylium stellatum*, *Myurella julacea*, *Ditrichum flexicaule*, etc.
- C. hymenophyllum* (B.S.G.) Holmen – **CU** (Spar S–): 27. In fine-grained ground in rocks crevices; in nival communities, in grassy willow-shrub; preferring calcareous soils; forming loose tufts or growing together with *Campylium stellatum*, *Paludella squarrosa*, *Sanionia uncinata*, etc.
- Mnium ambiguum* H. Muell. – **AT** (Un S–): 1; **CU** (Un S–): 27. In nival dwarf-willow-grass-moss tundra mixed with *Loeskypnum badium*, *Bartramia ithyphylla* (Czernyadjeva 31.VII.1984); on gleied sand at lake shore mixed with *Pohlia nutans* and Hepaticae (Czernyadjeva 3.VIII.1993, N 27).
- M. blyttii* B.S.G. – **ST** (Un S–): 26; **CU** (Spar S–): 27. In herb communities at lake and stream banks; in grassy willow-shrubs; seldom on nival herb meadow; preferring bare and weakly turfed soils; forming loose tufts or growing mixed with other species.
- M. spinosum* (Voit) Schwaegr. – **CU** (Spar S–): 27. On meadow on slopes; in herb communities and on bare sand on streams banks; on fine-grained ground among rocks; forming loose tufts together with *Calliergonella lindbergii*, *Brachythecium sp.*, *Sanionia uncinata*, etc.
- M. thomsonii* Schimp. – **CU** (Rar S–): 27. In grassy willow-shrubs, (Czernyadjeva 2.VIII.1993); on bare

soil among rocks (Czernyadjeva 10.VIII.1993, N 58); forming loose tufts together with *Hypnum cupressiforme*, *Myurella julacea*, *Cirriphyllum cirrosum*.

*Plagiomnium ellipticum* (Brid.) T. Kop. – **AT** (Rar S–): 1, 8; **NT** (Spar-Rar S+): 9, 11-12, 14; **ST** (Com-Spar S+): 18, 21-23, 26; **CU** (Spar S+): 27. In grass and mossy willow-shrubs and alder-shrubs; in different mires; at stream and lake banks; less commonly in wet moss tundras; prefer wet comparatively rich soils; sometimes abundant; forming loose tufts together with other species: *Pseudobryum cinclidioides*, *Calliergon cordifolium*, *Sanionia uncinata*, etc.

*P. curvatum* (Lindb.) Schljakov – **AT** (Un S–): 1; **NT** (Rar S–): 11-12, 14; **ST** (Rar S–): 26; **CU** (Rar S–): 27. In grass and mossy willow-shrubs; less commonly in wet moss tundras, herb community, on stream bank; forming loose tufts together with *Tomentypnum nitens*, *Ptilidium ciliare*, *Sanionia uncinata*, etc.

*P. rostratum* (Schrud.) T. Kop. – **NT** (Rar S–): 15; **CU** (Rar S+): 27. In moss tundras; on meadow on slope; on clay spot in grassy willow-shrub; growing by separate stems among *Tomentypnum nitens*, *Plagiomnium ellipticum*, *Sanionia uncinata*, etc.

*Pseudobryum cinclidioides* (Hueb.) T. Kop. – **AT** (Rar S–): 8; **NT** (Com-Spar S–): 9-12, 14; **ST** (Com-Rar S+): 16, 18, 20, 22-23, 26; **CU** (Spar S+): 27. In different mires, grassy willow-shrubs, nival communities, on stream and lake banks; less commonly in wet moss tundras; sometimes abundant or seldom dominant; forming continuous cover or loose tufts together with other species: *Aulacomnium palustre*, *Plagiomnium ellipticum*, *Calliergon cordifolium*, etc.

*Rhizomnium andrewsianum* (Steere) T. Kop. – **AT** (Un S–): 1; **NT** (Rar S–): 14; **ST** (Un S–): 18; **CU** (Rar S–): 27. On hummocks in sedge-sphagnous mire and cottongrass-moss tundra; on polygon of PTMC; in nival community; in dwarf-willow-moss and sedge-moss tundras; growing by separate stems among *Pseudobryum cinclidioides*, *Aulacomnium palustre*, *Hylocomium splendens*, etc.

*R. pseudopunctatum* (Bruch et Schimp.) T. Kop. – **AT** (Rar S–): 8; **NT** (Rar S–): 10, 12; **ST** (Spar S+): 16, 21-23, 26; **CU** (Spar S+): 27. In grassy willow-shrubs, nival communities, at stream and lake banks, on wet soil in disturbed places; less commonly in homogeneous sedge-moss mires and wet moss tundras; sometimes abundant in willow-shrubs; growing mixed with *Pseudobryum cinclidioides*, *Bryum pseudotriquetrum*, *Calliergon cordifolium*, etc.

#### AULACOMNIACEAE

*Aulacomnium acuminatum* (Lindb. et H. Arnell) Kindb. – **CU** (Spar S–): 27. In nival moss communities, dwarf-shrub-sedge-moss tundras; preferring rich calcareous moderately wet soils; forming loose tufts or growing together with *Tomentypnum nitens*,

*Climacium dendroides*, *Cirriphyllum cirrosum*, etc.  
*A. palustre* (Hedw.) Schwaegr. var. *palustre* – **AT** (Com S–): 1, 3-4, 7-8; **NT** (Wid-Com S+): 9-12, 14; **ST** (Wid-Com S+): 16, 18-20, 22-23, 26; **CU** (Wid S+): 27. In different mires, different moss tundras, grassy willow-shrubs, nival communities, on stream and lake banks; preferring wet soil; widespread dominant in boggy communities; most active in **ST**; forming continuous cover or loose tufts often mixed with other species.

*A. palustre* (Hedw.) Schwaegr. var. *imbricatum* B.S.G. – **AT** (Rar S–): 1, 3; **NT** (Un S–): 11; **ST** (Rar S–): 19-20. On peaty soil in moss tundras; on bare soil in disturbed places; on polygon of PTMC; growing mixed with other species.

*A. turgidum* (Wahlenb.) Schwaegr. – **AT** (Wid S–): 1, 3-4, 6-8; **NT** (Wid S+): 9-15; **ST** (Wid S+): 16-26; **CU** (Wid S+): 27. In different mires and tundras, willow-shrubs, alder-shrubs, on herb slopes, meadows, in nival communities, on stream and lake banks; one of the most widespread species, having very wide ecological range; dominant in tundras and mires; forming continuous cover or dense or loose tufts, or growing mixed with other mosses.

#### MEESIACEAE

*Meesia longiseta* Hedw. – **NT** (Rar S+): 12, 15; **ST** (Rar S+): 16; **CU** (Un S+): 27. On hills in sedge-moss mires; as admixture to *Plagiomnium ellipticum*, *Cinclidium subrotundum*, *Warnstorfia sarmentosa*. Some specimens of the species are transitional to *M. hexasticha* (Funck) Bruch; they have partly revolute and weakly toothed leaf margins.

*M. triquetra* (Richter) Aongstr. – **AT** (Un S–): 7; **NT** (Rar S+): 11-12, 14; **ST** (Rar S–): 16, 22, 24, 26; **CU** (Rar S–): 27. On very wet soil in homogeneous sedge-moss mires; seldom in very wet sites in moss and bushy tundras; growing mixed with *Warnstorfia sarmentosa*, *Lymprichtia revolvens*, *Paludella squarrosa*, etc.

*M. uliginosa* Hedw. – **AT** (Un S+): 1; **NT** (Rar S+): 12, 14; **ST** (Rar S+): 18, 21-22; **CU** (Spar S+): 27. On bare soil or among moss cover in dwarf-shrub-sedge-moss, bushy-moss, dwarf-shrub-lichen tundras; seldom on hummocks in cottongrass-sphagnous tundras, in nival community, grass mire; growing mixed with *M. triquetra*, *Lymprichtia revolvens*, *Aulacomnium turgidum*, etc.

*Paludella squarrosa* (Hedw.) Brid. – **NT** (Spar-Rar S–): 9-15; **ST** (Spar-Rar S–): 16, 18, 22-23, 26; **CU** (Spar S–): 27. On very wet soil in homogeneous sedge-moss mires; seldom in hummocky dwarf-shrub-sphagnous mires, moss and bushy tundras, grassy willow-shrubs, nival communities; sometimes abundant, forming continuous cover or loose tufts or growing together with *Warnstorfia sarmentosa*, *Lymprichtia revolvens*, *Meesia triquetra*, etc.



## BARTRAMIACEAE

*Bartramia ithyphylla* Brid. – **AT** (Rar S+): 1, 8; **NT** (Spar-Rar S+): 11-12, 14-15; **ST** (Spar-Rar S+): 21, 23, 26; **CU** (Spar S+): 27. On bare soil in dwarf-shrub-sedge-moss and dwarf-shrub-lichen tundras; in cracks in bushy-moss tundras; on herb and weakly turfed slopes; on bare soil on damaged sites; growing mixed with *Conostomum tetragonum*, *Brachythecium reflexum*, *Polytrichum piliferum* etc., often as admixture.

*Catascopium nigratum* (Hedw.) Brid. – **CU** (Rar S+): 27. In nival moss communities (Czernyadjeva 10.VIII.1994, N 100; 10.VIII.1993, N 57); forming dense tufts with admixture of *Ditrichum flexicaule*, *Orthothecium chryseon*.

*Conostomum tetragonum* (Hedw.) Lindb. – **AT** (Spar-Com S-): 1, 3, 4; **NT** (Spar-Com S+): 12, 14, 15; **ST** (Rar S-): 16, 23; **CU** (Spar S-): 27. In dwarf-shrub-lichen tundras, on herb and weakly turfed slopes; on bare soil in moss tundras and damaged sites; on dry hummocks on polygons of PTMC and in hummocky mires; seldom in nival communities and mossy willow-shrubs; forming dense tufts associated with *Bartramia ithyphylla*, *Ditrichum flexicaule*, *Pohlia* sp., Hepaticae, etc.

*Philonotis fontana* (Hedw.) Brid. – **AT** (Rar S-): 1, 8; **NT** (Rar S-): 12, 15; **ST** (Rar S-): 22. In mossy willow-shrubs, nival moss communities and moss tundra; growing mixed with other species. *P. fontana* is difficult to differentiate from *P. tomentella* because of numerous transitional forms. Larger plants with broad plicate leaves attributed to *P. fontana* whereas smaller plants with narrower non-plicate leaves assigned to *P. tomentella*. Some authors include *P. tomentella* in synonyms *P. fontana* or distinguish it as a variety *P. fontana* var. *pumila* (Ignatov, Afonina, 1992). In my opinion, solution of this problem needs additional study.

*P. tomentella* Mol. – **NT** (Rar S-): 12, 14; **ST** (Rar S-): 21, 26; **CU** (Spar S-): 27. In mossy willow-shrubs, nival moss communities, at stream and lake banks; seldom in sedge-moss and cottongrass-moss tundras; forming pure tufts or growing associated with *Bryum pseudotriquetrum*, *Calliergonella lindbergii*, *Calliergon cordifolium*, etc.

## TIMMIACEAE

*Timmia austriaca* Hedw. var. *austriaca* – **AT** (Rar S-): 1; **NT** (Rar S-): 12, 14; **ST** (Un S-): 21. On herb slopes; in nival moss community; on sandy spots in lichen tundra; in crack of dwarf-willow-moss tundra; growing as admixture to *Dicranum groenlandicum*, *Eurhynchium pulchellum*, *Polytrichum juniperinum*; seldom forming small pure tufts.

*T. austriaca* Hedw. var. *arctica* (Lindb.) H. Arnell. – **NT** (Rar S-): 14; **CU** (Un S-): 27. On weakly

turfed sandy slope; on loamy spot in dwarf-shrub tundra; on soil over stone among rocks; forming small loose tufts.

*T. bavarica* Hessel. – **CU** (Un S-): 27. On fine-grained ground in stones crevices, forming small loose tufts with *Ditrichum flexicaule* (Czernyadjeva 10.VIII.1993, N 58).

## ORTHOTRICHACEAE

*Orthotrichum alpestre* Hornsch. – **CU** (Rar S+): 27. On rocks faces (Czernyadjeva 10.VIII.1993, N 58; 20.VIII.1994, N 96, 101); forming small dense tufts. Rare species, occurring in Arctic only in Yamal.

*O. anomalum* Hedw. – **CU** (Un S+): 27. On rocks face, forming small dense tufts ((Czernyadjeva 12.VIII.1994, N 92). This nemoral species is known beside Yamal in the Russian Arctic from Chukotka only (Afonina, 2000).

*O. speciosum* Nees – **ST** (Un S+): 26. On decayed wood in herb community on river terrace, forming small loose tufts (Czernyadjeva 7.VIII.1996, N 75). This boreal species occurs in **ST** near the northern limits of its range.

## FONTINALIACEAE

*Dichelyma falcatum* (Hedw.) Myrin – **ST** (Rar S+): 26. On branch and decayed stems in grassy willow-shrubs and alder-shrubs; on bare soil in floodplain; forming loose mats. This boreal species occurs in **ST** near the northern limits of its range.

## CLIMACIACEAE

*Climacium dendroides* (Hedw.) Web. et Mohr. – **ST** (Spar-Rar S+): 16, 21-23, 26; **CU** (Spar S+): 27. In grassy willow-shrubs and alder-shrubs, in nival communities, bushy tundras, meadows; less commonly in cottongrass-moss tundras and hummocky mires. Usually mixed with other species: *Hylocomium splendens*, *Aulacomnium palustre*, *Calliergonella cuspidata*, etc. This boreal species is widespread in forest zone, and occurs in **ST** near the northern limits of its range.

## NECKERACEAE

*Neckera pennata* Hedw. var. *tenera* C. Muell. – **CU** (Un S-): 27. On fine-grained ground in rocks crevices; growing by separate stems (Czernyadjeva 14.07.1994, N 16).

## THELIACEAE

*Myurella julacea* (Schwaegr.) B.S.G. – **AT** (Rar, S-): 3, 7; **NT** (Un S-): 14; **ST** (Rar S-): 22; **CU** (Spar S-): 27. On soil over stones and in rocks crevices; on bare spots in moss tundras; in nival communities; growing mixed with other species: *Ditrichum flexicaule*, *Distichium capillaceum*, *Sanionia uncinata*, etc.

*M. tenerrima* (Brid.) Lindb. – **AT** (Un S-): 1; **CU** (Rar S-): 27. On bare spot in dwarf-shrub-moss and

herb-moss tundras; on fine-grained ground in rocks crevices; growing as admixture to *Ditrichum flexicaule*, *Distichium capillaceum*, *Timmia bavarica*.

## LESKEACEAE

*Leskea polycarpa* Hedw. – **ST** (Rar S+): 26. On decayed bark of willow in grassy willow-shrub; on log near water on river bank; growing as admixture to *Dichelyma falcatum*, *Sanionia uncinata*. This boreal species occurs in West Siberia mainly in forest zone and extends its range to southmost Yamal.

*Pseudoleskeella nervosa* (Brid.) Nyholm – **CU** (Un S–): 27. On soil over stones and in rock crevices; growing in loose mats (Czernyadjeva 10.VIII.1993, N 58).

*P. papillosa* (Lindb.) Kindb. – **CU** (Un S–): 27. In rock crevices, as admixture to *Abietinella abietina*, *Hypnum cupressiforme* (Czernyadjeva 14.VII.1994, N 16).

*P. tectorum* (Funck ex Brid.) Kindb. – **CU** (Un S–): 27. On stone face and in crevice among rocks, forming small loose mats (Czernyadjeva 12.VII.1994, N 92).

## THUIDIACEAE

*Abietinella abietina* (Hedw.) Fleisch. – **NT** (Rar S–): 12, 14; **ST** (Rar S–): 21-22, 26; **CU** (Spar S–): 27. In dwarf-shrub-lichen tundras, on herb slopes, in nival communities; on soil over stones and bare soil on stone fields; on spots in tundras; preferring dry drainage soils; growing as admixture to other species: *Eurhynchium pulchellum*, *Sanionia uncinata*, etc.

*Thuidium philibertii* Limpr. – **CU** (Rar S–): 27. On bare spot in dwarf-shrub-moss tundra (Czernyadjeva 1.VIII.1993, N 8); on slightly turfed place among rocks (Czernyadjeva 10.VIII.1993, N 58); forming small loose mats. This nemoral species occurs in **CU** near the northern limits of its range.

## HELODIACEAE

*Helodium blandowii* (Web. & Mohr) Warnst. – **ST** (Rar S+): 22, 26. In grassy willow-shrubs; in herb communities on river terraces; growing as admixture to *Aulaacomnium palustre*, *Plagiomnium ellipticum*, *Sanionia uncinata*, etc.

## AMBLYSTEGIACEAE

*Amblystegium serpens* (Hedw.) B.S.G. – **ST** (Rar S+): 26. On decayed woods in willow-shrub, as admixture to *Brachythecium mildeanum*, *Sanionia uncinata* (Czernyadjeva 27.VII.1996, N 14); on hummocks in sedge-moss mire, as admixture to other species (Czernyadjeva 7.VIII.1996, N 74). This boreal-nemoral species occurs in West Siberia mainly in forest zone and extends its range to southmost Yamal.

*Calliergon cordifolium* (Hedw.) Kindb. – **AT** (Rar S–): 1, 3, 7-8; **NT** (Com-Spar S+): 9, 11-12, 14-15; **ST** (Com-Spar S+): 16-18, 21-23, 26; **CU** (Spar S–): 27. In different mires, grassy willow-shrubs, at stream and lake banks, in hollows of PTMC; less

common in bushy-sphagnous and wet moss tundras. Sometimes abundant, it forming loose mats or associated with other species: *Aulaacomnium palustre*, *Sanionia uncinata*, etc.

*C. giganteum* (Schimp.) Kindb. – **AT** (Rar): 8; **NT** (Rar): 10; **ST** (Spar-Rar S+): 16-17, 22, 26; **CU** (Rar S–): 27. In wet hollows in mires; on banks and in water of streams and lakes; in wet hollow in mossy willow-shrub; in nival moss community; forming loose mats.

*C. megalophyllum* Mikut. – **NT** (Rar S–): 12, 14-15; **ST** (Rar S–): 16, 22, 26; **CU** (Rar S–): 27. In water in lakes and streams; in water of hollows in homogeneous mires; growing by separate stems or forming very loose mats.

*C. richardsonii* (Mitt.) Kindb. – **AT** (Rar S–): 1, 8; **NT** (Rar S–): 12, 14-15; **ST** (Rar S+): 16, 21-23, 26; **CU** (Spar S+): 27. In wet hollows in mires; on banks and in water of streams and lakes; growing usually mixed with *Warnstorfia exannulata*, *Lymprichtia revolvens*, *Hamatocaulus vernicosus*, etc.

*C. stramineum* (Brid.) Kindb. – **AT** (Un S–): 3; **NT** (Rar S+): 11-12, 14-15; **ST** (Rar S–): 16, 20, 22-23, 26; **CU** (Spar S–): 27. In different mires, wet moss and bushy-sphagnous tundras, in grassy willow-shrubs, nival moss communities, on lake and stream banks. It is abundant at places, forming loose mats or associated with other species: *Aulaacomnium palustre*, *Polytrichum jensenii*, *Dicranum angustum*, etc.

*Campyllum chrysophyllum* (Brid.) Lange – **NT** (Un S–): 11; **CU** (Rar S–): 27. On soil over stone in alder-shrub; on fine-grained ground in stone crevices; on sand in herb community at lake shore; in sedge willow-shrub; growing as admixture to *Calliergon cordifolium*, *Myurella julacea*, *Eurhynchium pulchellum*, etc.

*C. hispidulum* (Brid.) Mitt. – **ST** (Rar S+): 26; **CU** (Un S+): 27. On decayed wood in grassy willow-shrubs; near trunk bases of alder in alder-shrub; in wet hollow in dwarf-shrub tundra; growing as admixture to *Sanionia uncinata*, *Fissidens bryoides*, *Brachythecium* sp., etc. Widespread in forest zone, occurring in **ST** near the northern limits its range.

*C. longicuspis* (Lindb. et H. Arnell) Hedenaes – **CU** (Un S–): 27. On spot in dwarf-shrub-moss tundra; forming loose mat with admixture of *Ditrichum flexicaule*, *Ptilidium ciliare* (Czernyadjeva, 1.VIII.1993, N 9). Very rare arctic species known from the Lena and Lower Yenisey Rivers (Hedenaes, 1989), Vrangel Island, Chukotka, Arctic Canada (Afonina, 2000), Svalbard (Soedestroem & al., 1996) and Yamal Peninsula.

*C. polygamum* (B.S.G.) C. Jens. – **AT** (Rar S–): 1, 3, 8; **NT** (Rar S–): 10; **ST** (Rar S–): 22-24; **CU** (Rar S–): 27. On hummocks in cottongrass-moss tundras and dwarf-shrub-sphagnous mires; in wet

- sedge-moss tundras, nival communities, mossy willow-shrub; growing mixed with *Drepanocladus aduncus*, *Calliergon cordifolium*, *Sanionia uncinata*, etc.
- C. stellatum* (Hedw.) C. Jens. – **AT** (Rar S–): 3-4, 8; **NT** (Rar S–): 11; **ST** (Spar S+): 26; **CU** (Spar S–): 27. In dwarf-shrub-sedge-moss, dwarf-shrub-lichen and bushy-moss tundras, in nival moss communities; on hummocks in sedge mires; on decayed woods in grassy willow-shrubs and alder-shrubs; growing mixed with other species: *Brachythecium salebrosum*, *Calliergon cordifolium*, *Sanionia uncinata*, etc.; seldom forming pure loose mats.
- C. zemliae* C. Jens. – **AT** (Rar S–): 1, 3; **NT** (Spar S+): 12-13; **ST** (Un S+): 26; **CU** (Un S–): 27. In sedge-moss communities at bottom of dried-up streams; in nival communities; on bare soil on landslide and in willow-shrub; in crack in dwarf-shrub tundra; on hummocks in sedge and grass mires; growing mixed with *C. polygamum*, *Bryum pseudotriquetrum*, *Sanionia uncinata*, etc. Arctic species, probably identical with American and West European *C. arcticum* Williams (Soedstroem et al., 1996; Ireland et al., 1987).
- Drepanocladus aduncus* (Hedw.) Warnst. – **AT** (Rar S–): 1, 3; **NT** (Rar S–): 12-13, 15; **ST** (Un S–): 22; **CU** (Un S–): 27. In nival moss communities; in hollow in bushy-sphagnous tundra; on sand on stream bank; growing as admixture to *Campylium polygamum*, *Brachythecium turgidum*, *Sanionia uncinata* etc. This is exceedingly variable species. Some specimens with shorter leaf cells, large group of hyaline angular cells, shortly pointed suddenly narrowed leaves.
- D. brevifolius* (Lindb.) Warnst. – **AT** (Rar S–): 1; **ST** (Un S–): 24. In herb-dwarf-willow-moss and cottongrass-moss tundras; in hollow in mire; growing mixed with *Campylium polygamum*, *Meesia triquetra*, *Warnstorfia sarmentosa*.
- D. sendtneri* (Schimp. ex C. Muell.) Warnst. – **AT** (Rar S–): 1, 3; **NT** (Rar S–): 11, 14; **ST** (Un S–): 24. In sedge mire, in moss and sedge willow-shrubs, in nival dwarf-willow-moss tundra; forming loose mats.
- Hamatocaulis lapponicus* (Norrl.) Hedenaes – **NT** (Rar S–): 12, 14; **ST** (Rar S–): 22-24, 26. In homogeneous sedge-moss and cottongrass-sedge mires; growing as admixture to *H. vernicosus*, *Limprichtia revolvens*, *Warnstorfia sarmentosa*, etc. Some specimens are transitional to *H. vernicosus*.
- H. vernicosus* (Mitt.) Hedenaes – **AT** (Rar S–): 3; **NT** (Spar-Rar S–): 9, 11-12, 14; **ST** (Spar-Rar S–): 16, 18, 22, 26; **CU** (Spar S–): 27. In homogeneous sedge-moss and cottongrass-sedge mires; in hollows of hummocky mires and cottongrass tundras; in wet hollows in wet moss tundras. Seldom abundant; growing usually mixed with *Limprichtia revolvens*, *Warnstorfia exannulata*, *W. fluitans*, *W. sarmentosa*, etc.
- Hygrohypnum alpestre* (Hedw.) Loeske – **CU** (Rar S+): 27. On stones in water of streams, forming loose mats (Czernyadjeva, 2.VIII.1993, N 14; 10.VIII.1993, N 53).
- H. cochlearifolium* (Venturi ex De Not.) Broth. – **CU** (Un S+): 27. On stone in water of stream, as admixture to *H. duriusculum* (Czernyadjeva, 14.VII.1994, N 14).
- H. duriusculum* (De Not.) Jamieson – **CU** (Un S+): 27. On stone in water of stream, forming loose mat with admixture of *H. cochlearifolium* (Czernyadjeva 14.VII.1994, N 14).
- H. luridum* (Hedw.) Jenn. – **AT** (Un S–): 6; **CU** (Un S+): 27. On stone in water of stream, forming loose mat.
- H. ochraceum* (Turn. ex Wils.) Loeske – **CU** (Un S–): 27. On stone in water of stream, forming loose mat (Czernyadjeva 14.VII.1994, N 14).
- Leptodictyum riparium* (Schimp.) Warnst. – **ST** (Spar S+): 26. In hummocky herb-sedge and homogeneous cottongrass-sedge mires; on swampy meadow; on soil and decayed trunks in grassy willow-shrubs; growing mixed with *Dichelyma falcatum*, *Calliergonella lindbergii*, etc. This boreal species occurs in West Siberia mainly in forest zone and extends its range to southmost Yamal.
- Limprichtia cossoni* (Schimp.) Anderson et al. – **AT** (Un S–): 6; **ST** (Rar S+): 16, 24; **CU** (Rar S–): 27. In bushy-sphagnous and nival dwarf-shrub-sedge-moss tundras; at stream bank; forming loose mats with admixture of *Drepanocladus aduncus*, *Cinclidium arcticum*, *Bryum pseudotriquetrum*.
- L. revolvens* (Sw.) Loeske – **AT** (Rar S–): 1, 3, 7; **NT** (Com-Spar S–): 9, 11-12, 14; **ST** (Spar S+): 16, 18, 21-23, 26; **CU** (Spar S+): 27. In different mires, wet moss tundras, grassy willow-shrubs; preferring very wet soils, and growing often in water; sometimes abundant, growing usually mixed with other species: *Warnstorfia exannulata*, *W. sarmentosa* etc.; less commonly forming pure loose mats.
- Loeskypnum badium* (Hartm.) Paul – **AT** (Rar S–): 1, 3; **NT** (Spar-Rar S–): 9-15; **ST** (Spar-Rar S–): 16, 18, 21-22, 26; **CU** (Spar S–): 27. In different mires, on hollows PTMC, in wet moss tundras, nival communities; less commonly in grassy willow-shrubs; growing usually as admixture to other species: *Limprichtia revolvens*, *Hamatocaulis vernicosus*, *Warnstorfia sarmentosa*, etc. Some plants develop leaves with weak to obsolete, sometimes double nerve.
- Platydictya jungermannioides* (Brid.) Crum – **CU** (Rar S–): 27. On herb slope mixed with *Tortella tortuosa* (Czernyadjeva 2.VIII.1993, N 17); in stone crevices among lichen tundra (Czernyadjeva 2.VIII.1993, N 13); on stream bank as admixture to *Distichium capillaceum*, *Bryum sp.* (Czernyadjeva 20.VIII.1994).

- P. subtilis* (Hedw.) Crum – **NT** (Rar S+): 12. In sedge-moss-lichen tundra as admixture to *Dicranum elongatum*, *Pohlia crudoides* (Czernyadjeva 15.VIII.1992, N 221); in dwarf-willow community on landslide as admixture to *Bryum sp.* (Czernyadjeva 12.VIII.1992, N 8).
- Pseudocalliergon trifarium* (Web. et Mohr) Loeske – **CU** (Un S–): 27. In homogeneous sedge-moss mires, growing by separate stems among *Limprichtia revolvens*, *Paludella squarrosa* (Czernyadjeva 9.VIII.1993, N 50).
- P. turgescens* (T.Jens.) Loeske – **AT** (Rar S–): 1; **CU** (Un S–): 27. In nival dwarf-willow-moss tundras, in herb mire; forming loose mats mixed with *Hamatocaulis vernicosus*, *Loeskyrium badium*.
- Sanionia uncinata* (Hedw.) Loeske – **AT** (Wid S–): 1, 3-8; **NT** (Wid S+): 9-15; **ST** (Wid S+): 16, 18-23, 26; **CU** (Wid S+): 27. In different tundras, mires, willow-shrubs, alder-shrubs, nival communities, meadows. This species have wide ecological range, avoiding only very wet habitats. One of the most widespread species; abundant, sometimes co-dominant, forming loose mats or mixed with other species. *S. uncinata* is a very variable species developing in Yamal various forms.
- Scorpidium scorpioides* (Hedw.) Limpr. – **CU** (Un S–): 27. In homogeneous sedge-moss mire, growing by separate stems among *Limprichtia revolvens*, *Paludella squarrosa*, *Warnstorfia sarmentosa* (Czernyadjeva, 9.VIII.1993, N 50).
- Warnstorfia exannulata* (B.S.G.) Loeske – **AT** (Com S–): 1, 3, 6-8; **NT** (Com-Spar S+): 10-15; **ST** (Com-Spar S+): 16, 18, 22-24, 26; **CU** (Spar S+): 27. In very wet hollow and in water in different mires; on banks and in water of streams and lakes; in very wet hollows in tundras and PTMC; in grassy willow-shrubs and nival communities. Sometimes abundant, forming pure loose mats or growing mixed with other species: *W. sarmentosa*, *Limprichtia revolvens*, *Tomentypnum nitens*, etc. This is a very variable species in Yamal.
- W. fluitans* (Hedw.) Loeske – **AT** (Rar S–): 1, 6-8; **NT** (Rar S+): 9-12, 14; **ST** (Rar S+): 16, 18, 22-26. In homogeneous sedge-moss mires; in hollows in hummocky mires and PTMC; in very wet hollows in moss tundras; forming loose mats mixed with *W. sarmentosa*, *Polytrichum jensenii*, etc.
- W. pseudostraminea* (C. Muell.) Tuom. et T. Kop. – **NT** (Rar S–): 12, 15; **ST** (Rar S–): 16, 21, 26; **CU** (Un S–): 27. In homogeneous sedge-moss and cottongrass-sedge mires; at lake shore; growing mixed with *W. exannulata*, *Calliergon stramineum*, etc. This species occurs in West Siberia in forest zone and extends its range in Yamal to **NT**. Polymorphous species often developing transitional forms to *W. exannulata* and *Calliergon stramineum*.
- W. sarmentosa* (Wahlenb.) Hedenaes – **AT** (Com-Spar S–): 1, 3-4, 6-8; **NT** (Com S+): 9-15; **ST** (Rar S+): 16, 18, 20-23, 26; **CU** (Spar S–): 27. In very wet hollows and in water in different mires; on banks and in water of streams and lakes; in very wet hollows in tundras and PTMC; in grassy willow-shrubs and nival communities; growing usually mixed with other species: *W. exannulata*, *Limprichtia revolvens*, *Tomentypnum nitens*, etc.; seldom is abundant.
- W. trichophylla* (Warnst.) Tuom. et T. Kop. – **ST** (Rar S–): 16, 23, 26. In water in homogeneous sedge-moss mires; growing by separate stems or forming loose mats. The systematical position of this species is considered according to Hedenaes (1993).
- W. tundrae* (H. Arnell) Loeske – **ST** (Un S–): 15; **CU** (Rar S–): 27. In herb-moss community at lake shore; in water on stream bank; in nival moss community; forming loose mats. The systematical position of this species is considered according to Hedenaes (1993).

## BRACHYTHECIACEAE

- Brachythecium albicans* (Hedw.) B.S.G. – **NT** (Rar S–): 10, 11, 15. On wet soil in dwarf-willow-sedge-moss tundra; in herb-mossy willow-shrub; in cottongrass-sedge-moss mire; forming loose mats.
- B. erythrorrhizon* B.S.G. var. *erythrorrhizon* – **ST** (Rar S–): 26; **CU** (Rar S–): 27. On decayed wood and near trunk bases in grassy willow-shrubs; in herb meadows; forming loose mats.
- B. erythrorrhizon* B.S.G. var. *asiaticum* Ignatov – **CU** (Un S–): 27. In meadow on slope, forming loose mat (Czernyadjeva 2.VIII.1993, N 17). Identified by Ignatov. This taxon was described recently by Ignatov (1998) from Altai. It is also known from Asian Arctic, Urals, mountains of South Siberia and Khabarovsk Territory.
- B. mildeanum* (Schimp.) Schimp. ex Milde – **AT** (Rar S–): 1, 3, 8; **NT** (Rar S+): 9-14; **ST** (Rar S–): 20, 22, 26; **CU** (Rar S–): 27. On decayed wood, near trunk bases and on soil in herbaceous and mossy willow-shrubs; on soil in nival moss communities; in wet dwarf-shrub tundras; seldom in homogeneous sedge, grass and hummocky sedge-moss mires; forming loose mats with *Plagiothecium denticulatum*, *Sanionia uncinata* etc.
- B. oedipodium* (Mitt.) Jaeg. – **ST** (Rar S–): 21, 26; **CU** (Un S–): 27. In mossy willow-shrubs; on soil among stone; growing mixed with other species.
- B. reflexum* (Starke) Schimp. – **NT** (Rar S–): 12, 14; **ST** (Rar S+): 16, 21, 22, 23, 26; **CU** (Spar S+): 27. On decayed wood, near trunk bases and on soil in herb and mossy willow-shrubs and alder-shrubs; on soil in nival moss communities, on meadows; seldom on hummock in sedge mire; forming loose mats with *B. salebrosum*, *Plagiothecium denticulatum*, *Sanionia uncinata* etc. This species is variable; plants from bare soil have weakly toothed leaves.

- B. salebrosum* (Web. et Mohr) Schimp. – **AT** (Rar S–): 4, 7; **NT** (Spar S–): 14; **ST** (Spar-Rar S+): 21-23, 26; **CU** (Spar S+): 27. On decayed woods, near trunk bases and on soil in herb and mossy willow-shrubs and alder-shrubs; on soil in moss bushy tundras, on herbaceous meadows; seldom on hummock in sedge mire and on soil over stone among rocks; forming loose mats *B. reflexum*, *Sanionia uncinata*, etc.
- B. starkei* (Brid.) Schimp. – **ST** (Rar S–): 22, 23, 26; **CU** (Un S–): 27. On trunk of willow in herbaceous willow-shrub; on soil in nival moss communities and in herb meadow; forming loose mats with *B. erythrorrhizon*, *Calliergon stramineum*, *Sanionia uncinata*, etc.
- B. turgidum* (Hartm.) Kindb. – **AT** (Rar S–): 1, 3, 7; **NT** (Spar S–): 10, 12-14; **ST** (Spar S+): 21, 22; **CU** (Spar S+): 27. On soil and branches of willow in herb and mossy willow-shrubs; on soil in nival moss tundras, dwarf-shrub-sedge-moss and bushy-sphagnous tundras; on polygons of PTMC; seldom on hummocks in dwarf-shrub-sedge-sphagnous mire; forming loose mats with other species: *Hylocomium splendens*, *Sanionia uncinata* etc.
- B. udum* (Hag.) Hag. – **AT** (Rar S–): 1; **ST** (Un S–): 23?; **CU** (Un S–): 27. On herb slope; in *Dryas*-sedge-moss and grass-moss tundras; on soil over stone among rocks; growing mixed with other species.
- Cirriphyllum cirrosum* (Schwaegr.) Grout – **AT** (Un S–): 6; **ST** (Un S–): 19; **CU** (Spar S–): 27. In dwarf-shrub-lichen and dwarf-shrub-sedge-moss tundras, nival moss communities; on soil over stones and fine-grained ground among rocks; seldom on hummocks in cottongrass-moss tundra; preferring calcareous soils; growing usually as admixture to *Rhytidium rugosum*, *Aulacomnium acuminatum*, *Orthothecium chryseon*, etc.; seldom forming loose mats.
- Eurhynchium pulchellum* (Hedw.) Jenn. – **NT** (Spar-Rar S–): 12, 14-15; **ST** (Rar S–): 16, 26; **CU** (Spar S–): 27. On herb and weakly turfed slopes; on bare spots and in cracks in dwarf-shrub-moss tundras; on soil over stones, on ground among rocks; growing usually mixed with or among *Ditrichum flexicaule*, *Dicranum spadiceum*, *Pogonatum dentatum*, etc.
- Tomentypnum nitens* (Hedw.) Loeske – **AT** (Com S–): 1, 3, 6; **NT** (Spar-Rar S–): 9-15; **ST** (Spar-Rar S+): 1-24, 26; **CU** (Wid S+): 27. In different tundras and mires, on polygons of PTMC, in mossy willow-shrubs, nival communities; preferring wet comparatively rich soils, avoids very acid soils; active in **CU** and **AT**, dominating in wet moss tundras; forming continuous cover or mixed with *Hylocomium splendens*, *Sanionia uncinata*, *Aulacomnium palustre*, *A. turgidum*, etc.
- PLAGIOTHECIACEAE
- Plagiothecium berggrenianum* Frisvoll – **AT** (Un S–): 3; **NT** (Rar S–): 11-12, 14; **ST** (Rar S–): 16, 20; **CU** (Un S–): 27. On soil and in cracks in bushy-moss and dwarf-shrub-lichen tundras; on polygon of PTMC; on soil in mossy willow-shrub; growing by separate stems among *Hypnum plicatulum*, *Sanionia uncinata*, *Aulacomnium turgidum*, etc. Arctic species described recently from Svalbard by Frisvoll (1981). Ukrainskaya (1996) found it almost throughout the Russian Arctic.
- P. cavifolium* (Brid.) Iwats. – **AT** (Rar S–): 1, 8; **NT** (Rar S–): 9; **ST** (Rar S–): 18. In dwarf-shrub-sedge-moss, dwarf-shrub-lichen, herb-moss and hummocky *Ledum*-moss tundras; in mossy willow-shrubs. Usually as admixture to *Aulacomnium turgidum*, *Hylocomium splendens*, *Pleurozium schreberi*. Reported on the basis of literature data only (Volkova, Rebristaya, 1986, 1987; Dyachenko & al., 1999). Probably some of these reports are based on material of *P. berggrenianum*.
- P. denticulatum* (Hedw.) Schimp. – **NT** (Rar S+): 12, 15; **ST** (Spar-Rar S+): 16, 22, 26; **CU** (Spar S+): 27. On decayed wood, near trunk bases and on soil in grass and mossy willow-shrubs and alder-shrubs; in nival communities; on bare soil on slopes and at lake shore; in stones crevices in stone fields; forming loose mats or growing with *Mnium blyttii*, *Sanionia incinata*, etc.
- P. laetum* Schimp. – **ST** (Un S–): 26. In recess in dwarf-shrub-lichen-moss tundra, forming loose mat with admixture of *Cynodontium tenellum*, *Ceratodon purpureus* (Czernyadjeva 5.VIII.1996, N 70). Boreal species occurs in West Siberia mainly in forest zone and extends its range to southmost Yamal.
- HYPNACEAE
- Breidleria pratensis* (Koch ex Spruce) Loeske – **NT** (Rar S–): 11-12, 14; **ST** (Rar S–): 16, 20-21, 26; **CU** (Rar S–): 27. On soil and decayed wood in mossy willow-shrubs; on hummock in cottongrass-sphagnous tundra; on soil in sedge-moss mire and nival moss community; growing mixed with *Climacium dendroides*, *Sanionia uncinata*, *Calliergon cordifolium* etc.
- Calliergonella cuspidata* (Hedw.) Loeske – **ST** (Spar S+): 26. In homogeneous sedge-moss and hummocky sedge mires; seldom in grassy willow-shrubs; growing mixed with other species: *Climacium dendroides*, *Aulacomnium palustre* etc. Boreal species occurs in West Siberia mainly in forest zone and extends its range to southmost Yamal.
- C. lindbergii* (Mitt.) Hedenaes – **NT** (Rar S–): 12-13; **ST** (Spar-Rar S–): 16, 21-23, 26; **CU** (Spar S–): 27. On alluvium on stream and lake banks; on soil, decayed woods and near trunk bases in grass and mossy willow-shrubs and alder-shrubs; in homogeneous sedge and hummocky dwarf-shrub-sphagnous mires; in cottongrass tundras; in nival communities and meadows; forming loose pure mats or growing mixed with other species: *Calliergon cordifolium*, *Cinclidium subrotundum*, etc.

- Ctenidium molluscum* (Hedw.) Mitt. – **CU** (Rar S–): 27. On soil over stones (Czernyadjeva 10.VIII.1993, N 58); in stones crevices among rocks (Czernyadjeva 10.VIII.1993); on soil in nival community, growing as admixture to *Campyllum stellatum*, *Cirriphyllum cirrosum* (Czernyadjeva 12.VIII.1994, N 93).
- C. procerrimum* (Mol.) Lindb. – **CU** (Rar S–): 27. On soil over stones and on soil among stones; on soil in nival community; growing mixed with *Ditrichum flexicaule*, *Abietinella abietina*, *Myurella julacea*.
- Hypnum bambergeri* Schimp. – **NT** (Rar S–): 12; **CU** (Rar S–): 27. In cracks in bushy-moss tundra; on herb slope; in nival moss community; on soil over stone among rocks; growing mixed with *H. subimponens*, *Abietinella abietina*, *Polytrichum juni perinum*.
- H. cupressiforme* Hedw. – **AT** (Un): 8; **NT** (Un S–): 12; **CU** (Spar S–): 27. On border of hills in dwarf-shrub-herb-moss tundras; in meadows; on soil over stone; seldom in crack in bushy-moss tundra; forming loose pure mats or growing mixed with *Campyllum stellatum*, *H. revolutum*, *Sanionia uncinata*, etc.
- H. holmeni* Ando – **AT** (Rar S–): 3; **NT** (Rar S–): 12, 14; **ST** (Rar S–): 16, 23; **CU** (Rar S–): 27. On hummocks in dwarf-shrub-moss, cloudberry-sphagnous and cottongrass-sphagnous tundras; seldom in crack in bashy-grass tundra, on soil in meadow and mossy willow-shrub; growing mixed with *Dicranum majus*, *Aulacomnium turgidum*, *Sanionia uncinata*, etc. Recently described from Canadian Arctic by Ando (1994). Afonina revised materials from Yamal and decided, that most specimens called *H. callichroum* Funck ex Brid. and some specimens of *H. plicatulum* belong in fact to this species; *H. holmeni* has circumpolar hypoarctic range and is rather widespread in the Russian Arctic (Afonina, Ando, 2000).
- H. plicatulum* (Lindb.) Jaeger – **AT** (Rar S–): 1; **NT** (Rar S–): 9, 12; **ST** (Rar S–): 18, 22-23, 26. In nival herb-moss communities and dwarf-shrub-moss tundras; forming loose mats or growing mixed with *Dicranum majus*, *Hylocomium splendens*, *Sanionia uncinata*, etc.
- H. recurvatum* (Lindb. et H. Arnell) Kindb. – **CU** (Rar S+): 27. On stones, on soil over stones and on soil among stones; in nival herb-moss community; forming loose mats with admixture of *Ditrichum flexicaule*, *Myurella julacea*.
- H. revolutum* (Mitt.) Lindb. – **NT** (Rar S–): 9, 12. On herb slope; in mossy willow-shrubs; in crack in bushy-moss tundra; growing mixed with *H. cupressiforme*, *Sanionia uncinata*.
- H. subimponens* Lesq. – **NT** (Rar S–): 9, 11-12; **CU** (Un S–): 27. In bushy-moss and dwarf-shrub-sedge-moss tundras, mossy willow-shrub, meadow; forming loose pure mats or growing mixed with *Aulacomnium turgidum*, *Tomentypnum nitens* etc.
- H. vaucheri* Lesq. – **CU** (Rar S–): 27. On stones and on soil over stones among rocks; in nival moss community; forming loose pure mats or growing mixed with *Campyllum stellatum*.
- Isopterygiopsis muelleriana* (Schimp.) Iwats. – **CU** (Rar S–): 27. In stone crevices in lichen tundra and among rocks; on hill in dwarf-shrub-moss tundra; growing as admixture to *Cirriphyllum cirrosum*, *Rhytidium rugosum*, *Pohlia cruda*.
- I. pulchella* (Hedw.) Iwats. – **AT** (Un S–): 3; **NT** (Rar S+): 11-12, 14; **ST** (Un S–): 26; **CU** (Rar S+): 27. On decayed wood and soil in mossy willow-shrubs; on loamy spots in dwarf-shrub-sedge-moss tundras; in stone crevices; on weakly turfed site on landslide; growing as admixture to *Ditrichum flexicaule*, *Distichium capillaceum*, *Campyllum hispidulum*, etc.
- Orthothecium chryseon* (Schwaegr. ex Schult.) B.S.G. – **AT** (Un S–): 1; **CU** (Spar S–): 27. In hummocky cottongrass-moss and dwarf-shrub-moss tundras; preferring calcareous soils; forming loose mats or growing mixed with other species: *Campyllum stellatum*, *Aulacomnium acuminatum*, *Meesia uliginosa*, etc.
- O. intricatum* (Hartm.) B.S.G. – **CU** (Rar S–): 27. In stone crevices among rocks, as admixture to *Cyrtomium hymenophylloides* (Czernyadjeva 10.VIII.1993, N 58); in nival moss community, forming small loose mat (Czernyadjeva 12.VIII.1994).
- O. strictum* Lorentz – **CU** (Rar S–): 27. On loamy spot in bushy-moss tundra, mixed with *Ditrichum flexicaule*, *Distichium capillaceum* (Czernyadjeva 7.VIII.1993, N 43); on soil over stones, as admixture to *Timmia austriaca* var. *arctica* (Czernyadjeva, 10.VIII.1993, N 58); in stone crevices, together with *Myurella julacea* (Czernyadjeva 10.VIII.1993).
- Ptilium crista-castrensis* (Hedw.) De Not. – **ST** (Rar S–): 20-21, 26; **CU** (Un S–): 27. On hummock in cottongrass-moss tundras; in crack in cloudberry-sphagnous tundra; on soil in grass alder-shrub; growing as admixture to *Ptilidium ciliare*, *Sanionia uncinata*, *Hylocomium splendens*, etc. This boreal-nemoral species is widespread in forest zone and extends its range in Yamal to **ST**.

## HYLOCOMIACEAE

- Hylocomiastrum pyrenaicum* (Spruce) Fleisch. – **AT** (Un S–): 8; **ST** (Rar S–): 18, 20; **CU** (Rar S–): 27. In nival herb-moss communities; in mossy willow-shrub; on stream bank; growing mixed with *Sanionia uncinata*, *Dicranum majus*, etc.
- Hylocomium splendens* (Hedw.) B.S.G. var. *splendens* – **AT** (Com S–): 2-4, 8; **NT** (Wid-Com S–): 9, 12-15; **ST** (Wid S+): 16-24, 26; **CU** (Wid S+): 27. In different tundras, mires, willow-shrubs, alder-shrubs, nival communities, meadows; one of the most widespread species having wide ecological area and avoiding only very wet places; domi-

nant of tundras, growing as continuous cover, or often mixed with other species.

*H. splendens* (Hedw.) B.S.G. var. *obtusifolium* (Geh.) Par. – **AT** (Wid-Com S–): 1, 3, 6, 8; **NT** (Spar-Rar S–): 9, 11-15; **ST** (Rar S–): 16-21, 25; **CU** (Rar S–): 27. Range in Yamal is identical to the type variety of the species. However, in arctic tundra var. *obtusifolium* replaces var. *splendens*. In Yamal I distinguish only well defined phases of this variety. Other forms attributed to the type variety of the species. It is possible that previous reports of var. *splendens* from Yamal are based partly on materials of var. *obtusifolium*. Steere (1978) considers var. *obtusifolium* as an ecological form of *H. splendens*. I think that this problem needs further investigation.

*Pleurozium schreberi* (Brid.) Mitt. – **AT** (Rar S–): 3, 8; **NT** (Com-Spar S–): 9, 11-14; **ST** (Com-Spar S–): 16-18, 20-24, 26; **CU** (Wid S–): 27. In different tundras, on hummocks in mires, willow-shrubs, alder-shrubs, nival communities, meadows; preferring mesic soils; widespread in **ST**, dominating in bushy-moss tundras; growing mixed with other species: *Hylocomium splendens*, *Sanionia uncinata*, *Polytrichum juniperinum*, etc.

*Rhytidiadelphus triquetrus* (Hedw.) Warnst. – **ST** (Rar S–): 26; **CU** (Rar S–): 27. In nival herb-moss communities; seldom in bushy-moss tundra; growing mixed with *Hylocomium splendens*, *Dicranum majus*, *Tomentypnum nitens* etc. This boreal-nemoral species is widespread in forest zone, occurring in **ST** near the northern limits of its range.

#### RHYTIDIACEAE

*Rhytidium rugosum* (Hedw.) Kindb. – **AT** (Un): 8; **NT** (Spar S–): 9, 12, 14-15; **ST** (Spar-Rar S–): 16-17, 19-20, 22-23, 26; **CU** (Com S–): 27. In different tundras, willow-shrubs, alder-shrubs, meadows; on herb and weakly turfed slopes; on soil over stones and on soil among stones; prefer dry drainage soils; it is active in **CU**; forming loose mats or growing mixed with other species: *Hylocomium splendens*, *Saniunia uncinata*, *Pleurozium schreberi*, etc.

#### EXCLUDED TAXA

*Brachythecium campestre* (C. Muell.) B.S.G. (Czernyadjeva, Potemkin, 1993) – report is doubtful.  
*Campylium sommerfeltii* (Myrin) Lange (Czernyadjeva, 1998) – reconsidered as *C. hispidulum*.  
*Dicranum bergeri* Blandow (Czernyadjeva, Kusmina, 1998) – absent in herbarium.  
*Hypnum callichroum* Funck ex Brid. (Czernyadjeva, 1993, 1995, 1998; Czernyadjeva, Kusmina, 1998; Czernyadjeva, Potemkin, 1993) – partly reidentified as *H. holmenii*, partly – as *H. plicatulum*.  
*Mnium stellare* Hedw. (Czernyadjeva, 1995) – reidentified as *M. blyttii*.

*Plagiomnium affine* (Blandow ex Funck) T. Kop. report of Arnell (1917, as *Astrophyllum cuspidatum*) is doubtful. No one specimen of this species was seen from the Russian Arctic.

*Polytrichum sexangulare* Floerke ex Brid. (Czernyadjeva, 1993) – absent in herbarium.

*P. swartzii* Hartm. (Boch et al., 1971) – report is very doubtful; most of material reidentified as *P. commune*.

*Spagnum fallax* (Klinggr.) Klinggr. (Boch & al., 1971, as *S. apiculatum*) – report is very doubtful, most probably this material is *S. flexuosum*.

*S. majus* (Russ.) C. Jens. (Boch & al., 1971, as *S. dusenii*) – report is very doubtful, most probably this material is *S. jensenii*.

#### DISCUSSION

At present, 276 species and 12 varieties of mosses are known from the Yamal Peninsula, combining with the Bely Island. This comprises 55% of the moss flora of the whole Russian Arctic (Afonina, Czernyadjeva, 1995). Two other territories with the similar physiography and level of exploration are Taymyr Peninsula and the Kanin-Pechora region (including Bolshezemelskaya and Malozemelskaya tundras); they have moss richness 292 and 242 species respectively (Afonina, Czernyadjeva, 1995). Species richness of regional moss floras of tundra plain areas seems to account for 250–300 species.

Rebristaya (2000) emphasizes the species richness of vascular plants of the Yamal flora is lower than those of other areas of tundra plains. According to our results, the richness of mosses does not exhibit this patterns. This can be explained by: (1) broader geographical ranges of mosses; (2) ability to survive in micronishes; (3) broader ecological amplitude of many mosses.

Species diversity of vascular plants, mosses and liverworts of the whole Yamal Peninsula and its subzones are shown in Table 3. The species numbers of vascular plants are given according to Rebristaya (2000 and pers. comm.), of liverworts – according to Potemkin (1993). 410 vascular species were found in Yamal, so the moss/vascular species ratio is equal to 1:1.5 which is typical for the Arctic (cf. 1:1.6 in Taymyr, Matveyeva, 1998). The role of mosses in the plant cover increases to the north, and the moss/vascular species ratio decreases to 1.3:1 in the Severnaya Zemlya Archipelago (Afonina, 1999) and 1.8:1 in the Franz-Jozeph

Table 3. Number of species of vascular plants, mosses, liverworts and their rates in Yamal Peninsula and its parts

	Yamal	AT	NT	ST
Vascular plants	410	149	250	282
Mosses	276	133	163	194
Liverworts	121	76	99	102
Rate mosses/vascular plants	1:1.5	1:1.1	1:1.5	1:1.5
Rate liverworts/mosses	1:2.3	1:1.8	1:1.6	1:1.9

Land (Afonina, Czernyadjeva, 1995; Safronova, 1983). This rule is also seen in Yamal, where this ratio is 1:1.5 in the southern (ST) and the northern subarctic (NT) tundras, dropping to 1:1.1 in the arctic tundras (AT).

The ratio liverwort/moss species in Yamal is 1:2.3, which is similar to 1:2.0 in Taimyr (Afonina, Czernyadjeva, 1995; Konstantinova, Potemkin, 1996), 1:2.5 in Chukotka (Afonina, 2000), Kola Peninsula (Schljakov, Konstantinova, 1982) and Ellesmere Island in Arctic Canada (Schuster & al., 1959). So, this ratio is varying in regions of Arctic from 1:2.0 to 1:2.5.

The "leading" (i. e. most rich in species) moss families of both the whole Yamal Peninsula and its subzones are listed in Table 4. The ranked familiar-specific spectrum is generally typical for the north regions of the Holarctic. The first ranks in the spectra of the moss floras of Yamal and the subzones within it belong to families Amblystegiaceae, Bryaceae, Dicranaceae, Sphagnaceae. The families Hypnaceae and Pottiaceae hold the 5<sup>th</sup> the 7<sup>th</sup> positions in the flora of both the whole Yamal and the CU, respectively. But in the AT, NT, and ST spectra their ranks are the last among all the "leading" families because many of the representatives of Hypnaceae and Pottiaceae are restricted to rock or detritus substrata. On the contrary, the family Polytrichace-

ae is not rich in species in the Yamal and the CU floras (the 8<sup>th</sup> rank) but plays an important role in the floras of AT, NT, and ST (the 5<sup>th</sup> rank). The family Brachytheciaceae is represented by boreal species mostly and hence is most sound in the ST spectrum (the 6<sup>th</sup> rank). The role of the 10 "leading" families in the moss flora increases from the south northwards. This fact was already stated by Bardunov (1992): according to his data, the 10 "leading" families constitute 75.3% of the moss flora in Arctic Siberia but only 67.9% in Boreal Siberia. For the Yamal moss flora the same parameter is 76%. This trend can be easily followed in the floras of different subzones of Yamal. For instance, the 10 "leading" families constitute 77% and 80% of the moss floras of ST and AT, respectively.

The moss flora of Yamal includes 97 genera, the most rich in species among them in both the whole Yamal and the subzones are *Sphagnum*, *Bryum*, *Pohlia*, *Dicranum*. It's also interesting to note the rather high diversity in *Dicranella*.

As it was shown several times (Matveyeva, 1998; Afonina, 2000), the role of monospecific genera increases in the arctic floras. But it is not the same for the moss flora of Yamal. On the contrary, the AT moss flora represents the lowest percent of the monospecific genera (53.5%) whereas the ST flora displays the highest one (55.1%).

Table 4. Ten leading families in the Yamal moss flora: ranks in spectra and number of species (in parenthesis)

Family	Yamal	AT	NT	ST	CU
Amblystegiaceae	1 (38)	2 (20)	1-2 (21)	1 (26)	1 (30)
Bryaceae	2 (33)	1 (25)	1-2 (21)	4 (21)	4-6 (16)
Dicranaceae	3 (30)	3 (14)	3 (20)	3 (24)	2 (22)
Sphagnaceae	4 (27)	4 (12)	4 (18)	2 (25)	3 (21)
Hypnaceae	5 (19)	8-10 (4)	6-7 (9)	8-10(7)	4-6 (16)
Mniaceae	6 (16)	6 (8)	6-7 (9)	7 (10)	4-6 (16)
Pottiaceae	7 (14)	–	10 (5)	8-10 (7)	7 (12)
Polytrichaceae	8 (13)	5 (10)	5 (13)	5 (13)	8-9 (11)
Brachytheciaceae	9 (12)	7 (6)	8-9 (7)	6 (11)	8-9 (11)
Ditrichaceae	10 (8)	8-10 (4)	8-9 (7)	–	10 (7)
Splachnaceae	–	8-10 (4)	–	8-10 (7)	–
Total number of species in 10 leading families (% of flora of whole Yamal)	210 (76%)	107 (80%)	130 (79%)	151 (77%)	162 (76%)



Table 5. Floristic diversity of moss flora of the Yamal Peninsula

	Yamal	AT	NT	ST	CU
Number of species	276	133	163	194	213
Number of families	33	22	24	31	30
Number of genera	97	56	65	78	89
Number of genera with one species	45(46.4%)	30(53.5%)	35(53.8%)	43(55.1%)	46(51.7%)
Number of species, known from only this subzone	–	8	4	22	45
Number of species, known with sporophytes	145(53%)	22(16%)	75(46%)	96(50%)	93(44%)

Species richness and diversity structure of the moss floras of different subzones of Yamal is shown in Table 5. The CU flora appears most rich and peculiar due to presence of rock outcrops in this area. 213 species, or 77% of the Yamal moss flora were collected here, and 45 species (16% of the Yamal moss flora) were found only here. Among these are obligate saxicolous species (*Grimmia affinis*, *Schistidium apocarpum*, *S. rivulare*, *Didymodon rigidulus* var. *icmadophilus*, *Neckera pennata* var. *tenerima*, *Orthotrichum anomalum*, etc.), species growing on gravelly soil, usually calcareous (*Orthothecium intricatum*, *O. strictum*, *Cyrtomnium hymenophyllum*, *C. hymenophylloides*, *Encalypta procera*, *E. affinis*, *Ctenidium procerimum*, *C. molluscum*, etc.), species of rich fens (*Scorpidium scorpioides*, *Pseudocalliergon trifarium*), hygro- and hydrophytic epilits (*Hygrohypnum alpestre*, *H. cochlearifolium*, *H. duriusculum*), species of rich soils in nival communities in this area (*Catascopium nigratum*, *Aulacomnium acuminatum*).

194 species (70% of the Yamal moss flora) were found in ST, and 23 of them were found only in this subzone. Among the latter are forest species (*Leskea polycarpa*, *Orthotrichum speciosum*, *Amblystegium serpens*), which grow mostly on trunks and rotten wood in willow shrubs along rivers; species of *Sphagnum* mires (*Sphagnum platyphyllum*, *S. perfoliatum*, *S. centrale*), of rich fens (*Calliergonella cuspidata*, *Helodium blandowii*), and many rare species of eroded substrates (*Dicranella humilis*, *D. riparia*, *Aongstroemia*, *longipes*, *Discelium nudum*, *Bryum axel-blyttii*).

163 species (59%) were recorded for the NT, and only 6 among them are exclusive for the subzone. All of them are rare species: *Dicranella rufescens*, *Fissidens viridulus*, *Hypnum revolutum*.

The AT moss flora is least rich one (133 species, 48%) due to its northernmost location and poorest knowledge. 8 exclusive species were registered here, including 5 species of *Bryum* known only from literature.

It is very demonstrative to compare the values of moss species richness for different local floras (i.e. floristic samples from sufficient areas; Yurtsev, Kamelin, 1991) in different subzones of Yamal. In CU the only local moss flora has been studied, and 213 species were revealed here; seems this is the the richest local moss flora in the Russian Arctic and Subarctic (Matveyeva, 1998; Afonina, 2000, etc.). Such a high level of richness may be caused by the location of this flora in the ecotone between the mountains of the Polar Urals and the plains of Yamal. The richest local moss flora in ST lists 135 species (72.6% of the moss flora of the subzone), in NT – 125 species (81.7%) and in AT – only 70 (52.2%; note, however, that no professional bryologists worked there). So species richness of the Yamal local moss floras increases in the southward direction.

The next to discuss is that of moss distribution through plant communities and their role in the latter. 90 species (32% of the whole moss flora) are common for all the subzones. 64 of them constitute the “bulk” of the flora, i. e. are widespread and often play an important role in vegetation formation. These species, together with their activeness in different subzones of Yamal, are listed in Table 6. The activeness is given on the 3-grade scale of Yurtsev, Petrovskii (1994). 8 species are highly active throughout Yamal Peninsula, namely *Aulacomnium palustre*, *A. turgidum*, *Dicranum angustum*, *D. elongatum*, *Polytrichum juniperinum*, *Sanionia uncinata*, *Warnstorfia exannulata*, *Hylocomium splendens* (the latter is represented by var. *obtusifolium* in the arctic tundras). While moving northwards, the

Table 6. Activity of widespread species of mosses in subzones of the Yamal Peninsula (I – lowly active, II – middle active, III – highly active (Yurtsev &amp; Petrovskii, 1994)).

Species	AT	NT	ST	CU
<i>Aulacomnium palustre</i>	III	III	III	III
<i>A. turgidum</i>	III	III	III	III
<i>Bartramia ithyphylla</i>	I	I	I	I
<i>Brachythecium salebrosus</i>	I	I	I	I
<i>B. turgidum</i>	I	I	I	I
<i>Bryum cyclophyllum</i>	I	I	I	I
<i>B. pseudotriquetrum</i>	I	I	I	I
<i>Calliergon cordifolium</i>	II	II	II	II
<i>C. stramineum</i>	I	II	II	I
<i>Campylium stellatum</i>	I	I	I	I
<i>Ceratodon purpureus</i>	III	II	I	I
<i>Cinclidium subrotundum</i>	III	III	II	II
<i>Conostomum tetragonum</i>	III	II	I	I
<i>Dicranella crispa</i>	I	I	I	I
<i>D. subulata</i>	I	I	I	I
<i>Dicranum acutifolium</i>	I	I	I	I
<i>D. angustum</i>	III	III	III	III
<i>D. elongatum</i>	III	III	III	III
<i>D. fuscescens</i> var. <i>congestum</i>	I	II	I	I
<i>D. majus</i>	I	II	III	III
<i>D. spadiceum</i>	I	I	I	I
<i>Distichium capillaceum</i>	I	I	I	I
<i>Ditrichum flexicaule</i>	I	I	I	I
<i>Hamatocaulis vernicosus</i>	I	I	I	I
<i>Hylocomium splendens</i>	III	III	III	III
<i>Kiaeria glacialis</i>	I	I	I	I
<i>Leptobryum pyriforme</i>	I	I	I	I
<i>Limprichtia revolvens</i>	I	II	II	I
<i>Loeskygnum badium</i>	I	I	I	I
<i>Meesia triquetra</i>	I	I	I	I
<i>M. uliginosa</i>	I	I	I	I
<i>Oncophorus wahlenbergii</i>	III	III	II	II
<i>Plagiomnium ellipticum</i>	I	I	I	I
<i>Pleurozium schreberi</i>	I	I	II	III
<i>Pogonatum dentatum</i>	I	I	I	I
<i>Pohlia andrewsii</i>	I	I	I	I
<i>P. bulbifera</i>	I	I	I	I
<i>P. nutans</i>	I	II	I	II
<i>P. proligera</i>	I	I	I	I
<i>Polytrichastrum alpinum</i>	III	II	I	I
<i>Polytrichum commune</i>	I	I	II	II
<i>P. hyperboreum</i>	III	III	II	II
<i>P. jensenii</i>	III	II	II	II
<i>P. juniperinum</i>	III	III	III	III
<i>P. piliferum</i>	I	II	II	II
<i>P. strictum</i>	III	III	II	II
<i>Pseudobryum cinclidioides</i>	II	II	II	I
<i>Psilopilum laevigatum</i>	I	I	I	I
<i>Racomitrium lanuginosum</i>	III	II	II	II
<i>Rhizomnium pseudopunctatum</i>	I	I	II	I
<i>Rhytidium rugosum</i>	I	I	I	III
<i>Sanionia uncinata</i>	III	III	III	III
<i>Sphagnum aongstroemii</i>	I	III	II	III
<i>S. balticum</i>	I	I	III	III
<i>S. compactum</i>	I	II	II	I
<i>S. fimbriatum</i>	II	I	I	I
<i>S. girgensohnii</i>	I	II	II	II
<i>S. lenense</i>	I	III	III	III
<i>S. squarrosum</i>	I	III	III	III
<i>S. warnstorffii</i>	I	II	II	III
<i>Tetraplodon mnioides</i>	I	I	I	I
<i>Tomentypnum nitens</i>	III	II	I	III
<i>Warnstorfia exannulata</i>	III	III	III	III
<i>W. sarmentosa</i>	I	II	II	I

activeness of boreal species, *Dicranum majus* and *Pleurozium schreberi*, decrease. The same is true for the group of *Sphagnum* species, playing a landscape-forming role in the south of Yamal. Among the most active are *S. lenense*, which gives a rusty-reddish aspect to a many tundra communities, and also *S. balticum* and *S. squarrosium*. On the other hand, the activeness of the arctic and arctic-alpine species like *Cinclidium subrotundum*, etc. increases to the north of the Peninsula. It is interesting to trace the behavior of *Tomentypnum nitens* which is lowly to moderately active in the southern and typical tundras, but becomes highly active in the arctic tundras and the CU; such a pattern is caused by the ecology of this species which avoids hyperacid soils poor in mineral nutrition. The CU is the only area with a high degree of activeness of *Rhytidium rugosum* which is affiliated with detritus substrata.

More than a third of the Yamal moss flora species (94 species, 34%) find the northern limits of their distribution within the **ST** subzone. They are mostly boreal species, such as typical forest moss *Climacium dendroides*, *Ptilium crista-castrensis*, *Rhytidiadelphus triquetrus*, etc. 9 of these species enter the only southernmost part of Yamal adjacent to a forest-tundra zone. Such species are usually widespread in the forest zone, like *Dicranum polysetum*, *Leskea polycarpa*, *Amblystegium serpens*, *Calliergonella cuspidata*, etc. The species restricted in their distribution on Yamal to the ST belong to 8 families. Among these 8 are families restricted mostly to forests, namely *Climaciaceae*, *Neckeraceae*, *Leskeaceae*, *Helodiaceae*, and also the families *Fontinaliaceae* (represented by hydrophytes), *Orthotrichaceae* (including mostly the epiphytic and epilithic species), *Buxbaumiaceae*, *Discealiaceae*. Alternatively, 16 species are restricted to the AT and/or NT but absent in the south of the peninsula. Among them *Funaria arctica*, the arctic species found nowhere in Western Siberia outside arctic tundras. The other 15 species are

known in the Urals; most of them are extremely rare species, collected only once or twice. A group of 9 species which are exclusive for both the AT and the CU together is of a special interest. These species are mostly avoiding acid soils, like *Encalypta alpina*, *Myurella tenerrima*, *Orthothecium chryseon*, etc.

145 (53%) moss species of Yamal are known with sporophytes. The percent of species with sporophytes is decreasing from ST (50%) and NT (46%) to only 16% in AT subzone. This is a good illustration of the rule, that in high Arctic the sexual process in mosses is suppressed, and vegetative reproduction prevails.

Species with circumpolar distribution constitute more than 90% of the Yamal moss flora. Three species have the Asian-American type of distribution, and grow here on or near their western limits: *Aulacomnium acuminatum*, *Pohlia beringiensis*, *Sphagnum orientale*. Several species of extremely rare occurrence and disjunctive areas, with unique findings in Russia were found in Yamal, such as *Campylium longicuspis*, *Dicranella riparia*, *Encalypta mutica*, *Fissidens arcticus*, *Molendoo tenuinervis*, etc.

Thus, in spite of the monotonous character and poverty of the Yamal natural conditions, as well as the "young ages" of its natural complexes, its moss flora is rich and diverse.

#### ACKNOWLEDGEMENTS

I express my sincere thanks to Dr. O.M. Afonina and Dr. O.V. Rebristaya for constant help in my work. I am very thankful to Dr. A.D. Potemkin and Dr. I. Kucherov for their help in English translation. I am very grateful to Dr. M.S. Ignatov, Dr. R.N. Schljakov, E.Yu. Kuzmina and G.Ya. Ukraynskaya for determination of the some specimens. I am indebted to O.V. Khitun for the organisation of field investigations and Dr. E. N. Andreeva, who brought to my disposal their collections of Yamal mosses. The researches was supported by the RFFI, grants 98-04-49827.

#### LITERATURE CITED

- [ABOLIN, A.A.] АБОЛИНЬ, А.А. 1985. *Polytrichum strictum* (Polytrichaceae) – самостоятельный вид или модификант *P. juniperinum*? – [Polytrichum strictum (Polytrichaceae) – an original species or a modificant *P. juniperinum*?] *Бот. журн.* [Bot. Zhurn.] **70**(11): 1503-1512.
- [ABRAMOVA, A.L., L.I. SAVICZ-LYUBITSKAYA & Z.N. SMIRNOVA] АБРАМОВА, А.Л., Л.И. САВИЧ-ЛЮБИЦКАЯ, З.Н. СМІРНОВА 1961. Определитель листостебельных мхов Арктики СССР. – [Handbook of mosses of Arctic of the USSR] *М.-Л., Изд. АН СССР [Moscow-Leningrad, Isd. Akad. Nauk SSSR], 716 pp.*

- [ABRAMOVA, A.L. & N.A. STEPANOVA] АБРАМОВА, А.Л., Н.А. СТЕПАНОВА 1986. К флоре мхов нижнего течения р. Колымы. – [On the moss flora of lower course of Kolyma River] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **23**: 208-214.
- AFONINA O.M. [АФОНИНА О.М.] 1995. Интересные находки листостебельных мхов на Чукотке. – [Interesting findings of mosses in Chukotka] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **30**: 93-97.
- AFONINA O.M. [АФОНИНА О.М.] 1999. К флоре листостебельных мхов острова Большевик (архипелаг Северная Земля). – [To moss flora of Bol'shevik Island (Archipelago Severnaya Zemlya)] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **33**: 171-179.
- [AFONINA O.M.] АФОНИНА О.М. 2000. Бриофлора Чукотки. – [Moss flora of Chukotka] *Дисс. докт. б.н., БИН РАН, СПб* [Ph. D. Thesis, Bot. Inst. of Ross. Akad. Nauk, Sankt-Petersburg], 385 pp.
- [AFONINA O.M. & H. ANDO] АФОНИНА, О.М., Х. АНДО 2000. *Hypnum holmenii* (Musci, Нурпнаеae) в бриофлоре России. – [Hypnum holmenii (Musci, Нурпнаеae) in the moss flora of Russia] *Бот. журн.* [Bot. Zhurn.] **85**(3): 40-46.
- AFONINA O.M. & I.V. CZERNYADJEVA. 1995. Mosses of the Russian Arctic: check-list and bibliography. – *Arctoa*. **5**: 99-142.
- AFONINA O.M. & I.V. CZERNYADJEVA. 1998. New records of *Encalypta mutica* Nag. (Encalyptaceae, Musci) in Russia. – *Lindbergia* **23**(2): 107-109.
- ANDERSON, L.E., H.A. CRUM & W.R. BUCK. 1990. List of the Mosses of North America North of Mexico. – *Bryologist* **93**(4): 448-499.
- ANDO, H. 1994. A revision of *Hypnum aemulans* Limpr., with records of a new species, *H. holmenii* (Sect. Hamulosa) from northern North America, Greenland and Finland. – *Hikobia*. **11**: 363-370.
- [ANDREEVA, E.N.] АНДРЕЕВА, Е.Н. 1981. О некоторых основных типах местообитаний мохообразных в южных гипоарктических тундрах Ямала. – [On some main types of habitats of bryophytes in southern hypoarctic tundras of Yamal] *В кн.: Брио-лихенологические исследования высокогорных районов и Севера СССР (ред. Шляков, Р.Н.) Апатиты, ПАБС* [In: *Schljakov, R.N. (ed.) Briolichenologicheskie issledovaniya vysokogornyh raionov i Severa SSSR. Apatity, Polarno-Alp. Bot. Sad*]: 18-19.
- [ANDREYASHKINA, N.I. & N.V. PESHKOVA] АНДРЕЯШКИНА, Н.И., Н.В. ПЕШКОВА 1995. Субарктические тундры. – [Subarctic tundra] *В кн.: Природа Ямала (ред. Ю.И. Чернов). Екатеринбург, УИФ Наука* [In: *Chernov, Yu.I. (ed.) Priroda Yamala. Ekaterinburg, UIF Nauka*]: 188-200.
- ARNELL, H. W. 1917. Die Moose der Vega Expedition. – *Ark. Bot.* **15**(5): 1-111.
- [BARDUNOV, L.V.] БАРДУНОВ, Л.В. 1992. Очерк бриофлоры Сибири. – [Sketch of bryoflora of Siberia] *Новосибирск, Наука* [Novosibirsk: Nauka]: 1-96.
- BELLOLIO-TRUCCO, G. & R.R. IRELAND. 1990. A taxonomic study of moss genus *Dicranum* (Dicranaceae) in Ontario and Quebec. – *Can. J. Bot.* **68**(4): 867-909.
- [BOCH, M.S., T.V. GERASIMENKO & Yu.S. TOLCHELNIKOV] БОЧ, М.С., Т.В. ГЕРАСИМЕНКО, Ю.С. ТОЛЧЕЛЬНИКОВ. 1971. Болота Ямала. – [Mires of Yamal Peninsula] *Бот. журн.* [Bot. Zhurn.] **56**(10): 1421-1435.
- [CHEREPANOV, S.K.] ЧЕРЕПАНОВ, С. К. 1995. Сосудистые растения России и сопредельных государств. – [Vascular plants of Russia and adjacent states] *СПб, Мир и семья-95* [Sankt-Petersburg, Mir i sem'ya-95]: 990 pp.
- [CZERNYADJEVA, I.V.] ЧЕРНЯДЬЕВА, И.В. 1993. Листостебельные мхи среднего течения реки Сэбаяхи (Центральный Ямал). – [Leafy mosses in middle current of Sebayakha River (Central Yamal)] *Бот. журн.* [Bot. Zhurn.] **78**(11): 58-72.
- [CZERNYADJEVA, I.V.] ЧЕРНЯДЬЕВА, И.В. 1995. Материалы к флоре листостебельных мхов окрестностей оз. Нгаранато (Центральный Ямал). – [Materials to the moss flora of surroundings of the Ngaranato Lake (Central Yamal)] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **30**: 136-139.
- [CZERNYADJEVA, I.V.] ЧЕРНЯДЬЕВА, И.В. 1997. Виды рода *Pohlia* (Musci) с выводковыми почками. – [The species of the genus *Pohlia* (Musci) with propagula] *Бот. журн.* [Bot. Zhurn.] **82**(7): 102-122.
- [CZERNYADJEVA, I.V.] ЧЕРНЯДЬЕВА, И.В. 1998. Листостебельные мхи окрестностей оз. Юнто (Западно-Сибирская Арктика). – [Mosses of the vicinity of Yunto Lake (West Siberian Arctic)] *Arctoa* **7**: 1-8.
- CZERNYADJEVA, I.V. 1999a. New record of *Dicranella riparia* (H.Lindb.) Maort. et Nyh. (Dicranaceae, Musci) in Russia. – *Arctoa*. **8**: 71-72.
- CZERNYADJEVA, I.V. 1999b. On the distribution of propaguliferous species of *Pohlia* (Bryaceae, Musci) in Russia. – *Arctoa*. **8**: 51-56.
- CZERNYADJEVA, I.V. 2000a. *Fissidens arcticus* Bryhn in Russia. – *Arctoa*. **9**: 25-28.
- [CZERNYADJEVA, I.V.] ЧЕРНЯДЬЕВА, И.В. 2000b. Итоги изучения флоры листостебельных мхов полуострова Ямал. – [Results of study of moss flora of the Yamal Peninsula] *В кн.: Микология и криптогамная ботаника в России: традиции и современность. СПб., Изд. Санкт-Петербургской государственной химико-фармацевтической академии*. [In: *Mikologiya i kriptogamnaya botanika v Rossii: traditii i sovremennost'. Petersburg, Izd. Sankt-Petersburg Gos.Himiko-Farmazevticheskoi Akademii*]: 541-544.
- [CZERNYADJEVA, I.V. & A.D. POTECHKIN] ЧЕРНЯДЬЕВА, И.В., А.Д. ПОТЕМКИН. 1993. К флоре мохообразных Центрального Ямала. – [On the bryoflora of Central Jamal] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **29**: 165-171.
- [CZERNYADJEVA, I.V. & E.Yu. KUZMINA] ЧЕРНЯДЬЕВА, И.В., Е.Ю. КУЗЬМИНА 1998. Листостебельные мхи окрестностей пос. Сюняй-Сале (полуостров Ямал, Западно-Сибирская Арктика). – [Mosses of the vicinity of Sjunyay-Sale Settlement (Yamal Peninsula, West Siberian Arctic)] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **32**: 171-179.

- [CZERNYADJEVA, I.V. & E.Yu. KUZMINA] ЧЕРНЯДЬЕВА, И.В., Е.Ю.КУЗЬМИНА 2001. Листостебельные мхи нижнего течения реки Еркутаяха (южный Ямал, Западно-Сибирская Арктика). – [Mosses of the lower Erkutayaha River ( Southern Yamal, West Siberian Arctic)] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **34**: 247-262.
- [DEDKOV, V.S.] ДЕДКОВ, В.С. 1995а. Генезис и условия формирования ландшафтов. – [Genesis and conditions of formation of landscapes at the Yamal Peninsula] В кн.: *Природа Ямала (ред. Ю.И. Чернов). Екатеринбург, УИФ Наука.* [In: Chernov, Yu.I. (ed.) *Priroda Yamala. Ekaterinburg, UIF Nauka*]: 92-102.
- [DEDKOV, V.S.] ДЕДКОВ, В.С. 1995б. Почвенный покров. – [Soil cover] В кн.: *Природа Ямала (ред. Ю.И. Чернов). Екатеринбург, УИФ Наука.* [In: Chernov, Yu.I. (ed.) *Priroda Yamala. Ekaterinburg, UIF Nauka*]: 103-127.
- DYACHENKO, A.P., L.M. MOROZOVA, A.V. STEPANOVA & M.A. MAGOMEDOVA 1999. Contributions to the moss flora of the Yamal Peninsula (Siberian Arctic). – *Arctoa* **8**: 73-78.
- FRISVOLL, A.A. 1981. Fifteen bryophytes new to Svalbard, including notes on some rare or interesting species. – *Lindbergia* **7**: 91-102.
- FRISVOLL, A.A. 1985. Lectotypifications Including Nomenclatural and Taxonomical Notes on *Ditrichum flexicaule* sensu lato. – *Bryologist* **88**(1): 31-40.
- FRISVOLL, A.A. & A. ELVEBAKK 1996. Bryophytes. – A catalog of Svalbard plants, fungi, algae and cyanobacteria. 57-172.
- HEDENAES, L. 1989. *Amblystegium longicuspis* Lindb. & H. Arn., its status and taxonomic position. – *Lindbergia* **14**: 142-146.
- HEDENAES, L. 1993. A generic revision of the Warnstorfia – Calliargon group. – *J. Bryol.* **17**: 447-479.
- HEDENAES, L. 1997. A Partial Generic Revision of *Campyllum* (Musci). – *Bryologist* **100**(1): 65-88.
- HORTON, D.G. 1983. Revision of the Encalyptaceae (Musci), with particular reference to the North American taxa. 2. – *J. Hattori Bot. Lab.* **54**: 353-532.
- IGNATOV, M.S. 1998. Bryophyte flora of Altai Mountains. VIII. Brachytheciaceae (Musci). – *Arctoa* **7**: 85-152.
- IGNATOV, M.S. & O.M. AFONINA. 1992. Check-list of mosses of the former URRS. – *Arctoa* **1**: 1-85.
- IRELAND, R.R., G.R. BRASSARD, W.B. SCHOFIELD & D.H. VITT. 1987. Checklist of the mosses of Canada. II. – *Lindbergia* **13**: 1-62.
- KANNUKENE, L. & N. MATVEYEVA. 1996. Mosses from the Arctic tundra of the Taimyr Peninsula, Siberia. – *Proc. Estonian Acad. Biol.* **45**(1/2): 51-67.
- KONSTANTINOVA, N.A. & A.D. ПОТЕМКИН. 1996. Liverworts of the Russian Arctic: annotated check-list and bibliography. – *Arctoa* **6**: 125-150.
- [KURBATOVA, L.E., G.Ya. DOROSHINA-UKRAINSKAYA & E.O. KUZMINA] КУРБАТОВА, Л.Е., Г.Я. ДОРОШИНА-УКРАИНСКАЯ, Е.О. КУЗЬМИНА. 1999. Листостебельные мхи Ленинградской области. – [Mosses of the Leningrad region] В кн.: *Биоразнообразие Ленинградской области (ред. Балашова, Н.Б., А.А. Заварзин). С.-Петербург, Изд-во С.-Петербургского университета.* [In: Balashova, N.B. & A.A. Zavarzin (edd.) *Biodiversity of the Leningrad region. St. Petersburg University Press*]: 271-302.
- LONG, D.G. 1985. Polytrichaceae. – In: *Mogensen, G.S. (ed.) Illustrated moss flora of arctic North America and Greenland. I. Medd. Groenland, Biosci.* **17**: 9-57.
- [MAGOMEDOVA, M.A. & L.M. MOROZOVA] МАГОМЕДОВА, М.А., Л.М. МОРОЗОВА. 1995. Арктические тундры. – [Arctic tundra] В кн.: *Природа Ямала (ред. Ю.И. Чернов). Екатеринбург, УИФ Наука.* [In: Chernov, Yu.I. (ed.) *Priroda Yamala. Ekaterinburg, UIF Nauka*]: 177-187.
- [MATVEYEVA, N.V.] МАТВЕЕВА, Н.В. 1998. Зональность в растительном покрове Арктики. – [Zonation in plant cover of the Arctic] СПб., РАН [Sankt-Petersburg, RAN]: 1-219.
- MOGENSEN, G.S. 1988. Taxonomy and Distribution of Greenland Mosses. I. Encalypta brevipipes, E. mutica, E. longicolla and Amblyodon dealbatus. – *Nova Hedwigia* **90**: 387-397.
- De MOLINAAR, J.G. 1974. *Dicranella riparia* new to Greenland. – *Bryologist* **77**: 236-238.
- NYHOLM, E. 1969. Illustrated Flora of Fennoscandia. II. Musci. Fasc. 6. – *Stockholm, Natural Science Research Council*: 647-799.
- NYHOLM, E. 1986. Illustrated Flora of Nordic Mosses. Fasc. 1. – *Copenhagen & Lund, Nordic Bryol. Soc.*: 1-72.
- NYHOLM, E. 1991. Illustrated Flora of Nordic Mosses. Fasc. 2. – *Copenhagen & Lund, Nordic Bryol. Soc.*: 76-141.
- ПОТЕМКИН, А.Д. 1993. The Hepaticae of the Yamal Peninsula, West Siberian Arctic. – *Arctoa* **2**: 57-101.
- [REBRISTAYA, O.V.] РЕБРИСТАЯ, О.В. 1989. Особенности растительного покрова полуострова Ямал. – [Peculiarities of plant cover of the Yamal Peninsula] В кн.: *Характеристика геологических и почвенно-растительных особенностей территорий газоконденсатных месторождений севера Тюменской области (ред. Шилов, В.Н.), М.* [In: Shilov, V.N. (ed.) *Kharakteristika geologicheskikh i pochvenno-rastitel'nykh osobennostej terrotorij gazokondensatnykh mestorozdenij severe Tyumenskoj oblasti. Moscow.*]: 40-47.
- [REBRISTAYA, O.V.] РЕБРИСТАЯ, О.В. 2000. Подзональное деление Западносибирской Арктики. – [Subzone division of West Siberian Arctic] В кн.: *Структура, динамика, экология степной и пустынной растительности. К 100-летию акад. Е.М. Лавренко СПб* [In: *Struktura, dinamika, ekologiya stepnoj i pustynnoj rastitel'nosti. K 100-letiyu akad. Lavrenko. Sankt-Petersburg*]: 4-7.
- [REBRISTAYA, O.V. & O.V. KHITUN & I.V. CZERNYADJEVA] РЕБРИСТАЯ, О.В., О.В. ХИТУН, И.В. ЧЕРНЯДЬЕВА 1993. Техногенные нарушения и естественное восстановление растительности в подзоне северных гнипоарктических тундр полуострова Ямал. – [Technogenous disturbances and natural reestablishment of vegetation in the subzone of the Yamal Peninsula] *Бот. Журн.* [Bot. Zhurn.] **78**(3): 122-135.

- [REBRISTAYA, O.V. & O.V. KHITUN & I.V. CZERNYADJEVA & M.O. LEIBMAN] РЕБРИСТАЯ, О.В., О.В. ХИТУН, И.В. ЧЕРНЯДЬЕВА, М.О. ЛЕЙБМАН 1995. Динамика растительности на криогенных оползнях в центральной части полуострова Ямал. – [Dynamics of vegetation on the cryogenic landslides in the central part of the Yamal Peninsula] *Бот. Журн.* [Bot. Zhurn.] **80**(4): 31-48.
- RED DATA BOOK of European Bryophytes. 1995. *ECCB, Trondheim*. 291 p.
- [SAFRONOVA, I.N.] САФРОНОВА, И.Н. 1983. Материалы к флоре островов Мейбел и Гукера (Архипелаг Земля Франца-Иосифа). – [Materials to the flora of the Mebel and Hooker Island (Franz Joseph Land)] *Бот. журн.* [Bot. Zhurn.] **68**(4): 513-519.
- [SAVICZ-LYUBITSKAYA, L.I. & Z.N. SMIRNOVA] САВИЧ-ЛЮБИЦКАЯ, Л.И., З.Н. СМИРНОВА. 1968. Определитель сфагновых мхов СССР. – [The Handbook of Sphagnaceae of the USSR] *Л., Наука [Leningrad, Nauka]*: 1-112.
- [SAVICZ-LYUBITSKAYA, L.I. & Z.N. SMIRNOVA] САВИЧ-ЛЮБИЦКАЯ, Л.И., З.Н. СМИРНОВА. 1970. Определитель листостебельных мхов СССР. Верхнеплодные мхи. – [The Handbook of mosses of the USSR. The mosses acrocarpous] *Л., Наука [Leningrad, Nauka]*: 1-824.
- SHAW, A.J. 1981. *Pohlia andrewsii* and *P. tundrae*, two new arctic-alpine propaguliferous species from North America. – *Bryologist* **84**(1): 65-74.
- SHAW, A.J. 1982. *Pohlia Hedw.* (Musci) in North and Central America and the West Indies. – *Contr. Univ. Michigan Herb.* **15**: 219-295.
- [SCHLJAKOV, R.N.] ШЛЯКОВ, Р.Н. 1951. К пониманию некоторых видов рода *Dicranum*. – [To understanding of some *Dicranum* species] *Бот. матер. Отд. спор. раст. Бот. ин-та АН СССР [Bot. Mat. Otd. Spor. Rast. Bot. Inst. Akad. Nauk SSSR]* **7**: 234-247.
- [SCHLJAKOV, R.N.] ШЛЯКОВ, Р.Н. 1984. О виде *Pohlia torrentium* (I.Hag.) Broth. – [On the identity of *Pohlia torrentium* (I.Hag.) Broth.] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **21**: 211-213.
- [SCHLJAKOV, R.N. & N.A. KONSTANTINOVA] ШЛЯКОВ, Р.Н., Н.А. КОНСТАНТИНОВА. 1982. Конспект флоры мохообразных Мурманской области. – [The synopsis of bryophytes of the Murmansk Province] *Апатиты, Колск. Фил. АН СССР [Apatity, Kolsk. Fil. Akad. Nauk SSSR]*, 227.
- SCHUSTER, R.M., W.C. STEERE & J.W. THOMSON. 1959. The terrestrial Cryptogams of Northern Ellesmere Island. – *Natl. Mus. Canada Bull.* **164**: 1-132.
- [SHIYATOV, S.G. & V.S. MAZERA] ШИЯТОВ, С.Г., В.С. МАЗЕПА. 1995. Климат. – [Climate] *В кн.: Природа Ямала (ред. Ю.И. Чернов). Екатеринбург, УИФ Наука. [In: Chernov, Yu.I. (ed.) Priroda Yamala. Ekaterinburg, UIF Nauka]*: 32-68.
- SOEDERSTROEM, L. (ed.). 1996. Preliminary distribution maps of bryophytes in Northwestern Europe. Vol. 2. – *Mossornas Vanner, Trondheim*: 1-72.
- STEERE, W.S. 1978. The Mosses of Arctic Alaska. – *J. Cramer. FL-9490 Vaduz*. 507.
- STEERE, W.S. & G.R. BRASSARD. 1974. The systematic position and geographical distribution of *Fissidens arcticus*. – *Bryologist* **77**(2): 195-202.
- [UKRAINSKAYA, G.Ya.] УКРАИНСКАЯ, Г.Я. 1996. *Plagiothecium berggrenianum* (Plagiotheciaceae, Musci) в России. – [Plagiothecium berggrenianum (Plagiotheciaceae, Musci) in Russia] *Бот. журн.* [Bot. Zhurn.] **81**(2): 87-91.
- [VOLKOVA L. A. & O.V. REBRISTAYA] ВОЛКОВА, Л.А., О.В. РЕБРИСТАЯ. 1986. К бриофлоре полуострова Ямал. – [To the moss flora of Yamal Peninsula] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **23**: 230-234.
- [VOLKOVA L. A. & O.V. REBRISTAYA] ВОЛКОВА, Л.А., О.В. РЕБРИСТАЯ. 1987. Дополнения к бриофлоре Ямала. – [Additions to the moss flora of Yamal Peninsula] *Новости сист. низш. раст.* [Novosti Sist. Nizsh. Rast.] **24**: 199-203.
- [YURTSEV, V.A., A.I. TOLMACHEV & O.V. REBRISTAYA] ЮРЦЕВ, В.А., Ф.И. ТОЛМАЧЕВ, О.В. РЕБРИСТАЯ. 1978. Флористическое ограничение и разделение Арктики. – [The floristic delimitation and subdivision of the Arctic] *В кн.: Арктическая флористическая область (Ред. Юрцев В.А.), Л.: Наука [In: Yurtsev, V.A. (ed.) Arctic floristic province. Leningrad, Nauka]*: 9-67.
- [YURTSEV, V.A. & R.V. KAMELIN] ЮРЦЕВ, В.А., Р.В. КАМЕЛИН. 1991. Основные понятия и термины флористики. – [The main concept and terms of florology] *Перм [Perm]*: 80.
- [YURTSEV, V.A. & V.V. PETROVSKII] ЮРЦЕВ, В.А., В.В. ПЕТРОВСКИЙ. 1994. Флора окрестностей бухты Сомнительной: сосудистые растения. – [Flora of vicinity of Somnitel'naya Bay: vascular plants] *В кн.: Арктические тундры острова Врангеля. СПб. [In: Arctic tundras of Vrangell Island. Sankt-Petersburg]*: 9-67.
- [ZHADRINSKAYA, N.G.] ЖАДРИНСКАЯ, Н.Г. 1977. Растительный покров. – [Plant cover] *Ямало-Гыданская область, Л. [Yamalo-Gudanskaya oblast', Leningrad]*: 168-172.