

MOSSES FROM THE ARCTIC TUNDRA OF THE TAIMYR PENINSULA, SIBERIA

Leiti KANNUKENE^a and Nadezhda MATVEYEVA^b

^a Ökoloogia Instituut (Institute of Ecology), Kevade 2, EE-0001 Tallinn, Eesti (Estonia)
^b Ботанический институт им. В. Л. Комарова АН России (Komarov Botanical Institute, Russian Academy of Sciences), ул. Попова 2, 197376 Санкт-Петербург, Россия (Russia)

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Abstract. The list of the mosses of the local flora of the lower reaches of the Uboynaya River (60 km east of Dickson, the northwestern coast of the Taimyr Peninsula) includes 159 species belonging to 78 genera and 28 families. Ten species new to Taimyr were recorded within the Uboynaya moss flora: *Bryum argenteum*, *Fissidens arcticus*, *Desmatodon laureri*, *Didymodon asperifolius* var. *gorodkovii*, *Hygrohypnum alpestre*, *Plagiobryum demissum*, *Pseudoleskea chilensis*, *Racomitrium panschii*, *Schistidium agassizii*, and *Seligeria diversifolia*. The proportion of the species of the arctic type is bigger in the studied area than in the southernmost regions of Taimyr. Many species, like *Distichium hagenii*, *Fissidens arcticus*, *Funaria arctica*, *Pseudoleskea chilensis*, *Racomitrium panschii*, and *Schistidium andreaeopsis*, were recorded only in the arctic subzone of the whole Taimyr tundra zone. The occurrence frequency of the moss species and the peculiarities of the species intralandscape habitat distribution are described in detail.

Key words: Arctic tundra, flora, mosses, rare species, Taimyr Peninsula, Siberia.

INTRODUCTION

The moss flora of the Taimyr Peninsula, Siberia, has been studied comparatively well for such a large and remote arctic area. At present, data on mosses are available for several locations on Taimyr. Lists of moss species have been published for three subzones of the tundra zone and for the polar desert. In the southern tundra subzone moss species lists are available for the northernmost isolated forest Ary-Mas in eastern Taimyr (Афонина, 1978) and the neighbourhood of the village of Kresty (Каннукене & Матвеева, 1986) in the Pyasina River basin in the western part of the peninsula. In the typical tundra subzone lists have been made for the vicinity of the village of Tareya (Благодатских, 1978) north of the last point mentioned, and the Mamontovaya River basin (Савич-Любицкая & Абрамова, 1954) in central Taimyr. An incomplete list is also known for the Maria Pronchishcheva Bay coast in the arctic tundra subzone (Благодатских et al., 1979a) in the eastern part of the peninsula. The polar desert is represented by a list of mosses of Cape Chelyuskin (Arnell, 1918; Благодатских et al., 1979b).

The arrangement of the studied areas along the latitudinal gradient allows us to estimate the changes in the moss floras from the south to the north. Unfortunately, the only list of moss species for the arctic tundra subzone was not complete, and its use for such comparisons is questionable. The present paper was designed to fill in this gap.

THE STUDIED AREA

The data for the present paper were collected near the mouth of the Uboynaya River ($73^{\circ}40' N$, $82^{\circ}20' W$), 60 km east of Dickson on the north-western coast of Taimyr (Fig. 1). According to the zonal subdivision of Taimyr (Чернов & Матвеева, 1979), the area under observation belongs to the arctic tundra subzone and to the northernmost part of the tundra zone as a whole. The mean air temperature of the warmest month (July) is about $5^{\circ}C$.

The area is mainly a plain dissected by several streams. The Uboynaya River has no well-developed valley. The river banks are steep and mostly eroded. There are no extensive bog depressions, yet mires often occur on the comparatively wide and flat bottoms of the stream valley. Silty soils on marine deposits predominate in the soil cover, but some rare outcrops of shale are also found. Only the top about 50-cm layer of soil becomes active during the growth period, while the depth of the underlying permafrost is hundreds of metres.

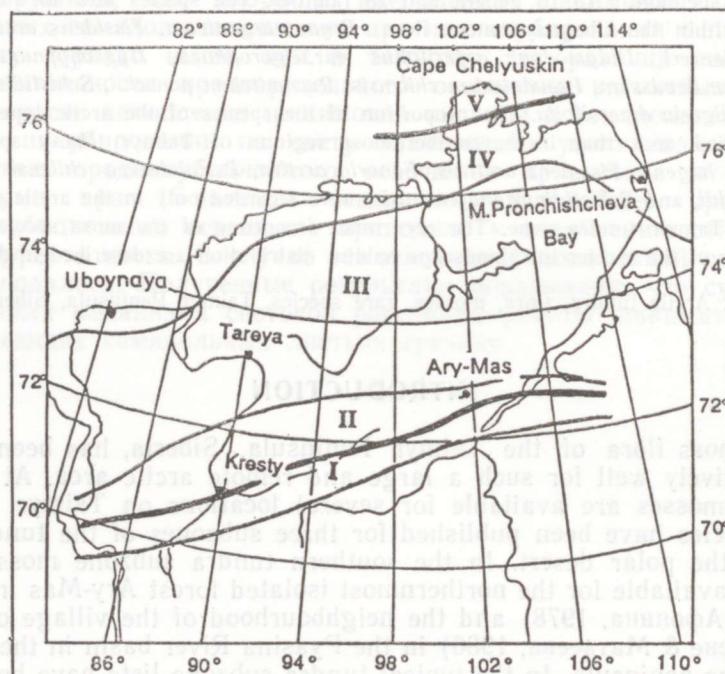


Fig. 1. Scheme of the vegetation zonation on Taimyr: I, forest-tundra zone; II—IV, tundra zone; II, southern tundra subzone; III, typical tundra subzone; IV, arctic tundra subzone; V, polar desert zone.



Fig. 2. Sedge—dwarf willow—moss polygonal tundras with a net-like vegetation cover in the fissures between the polygons.

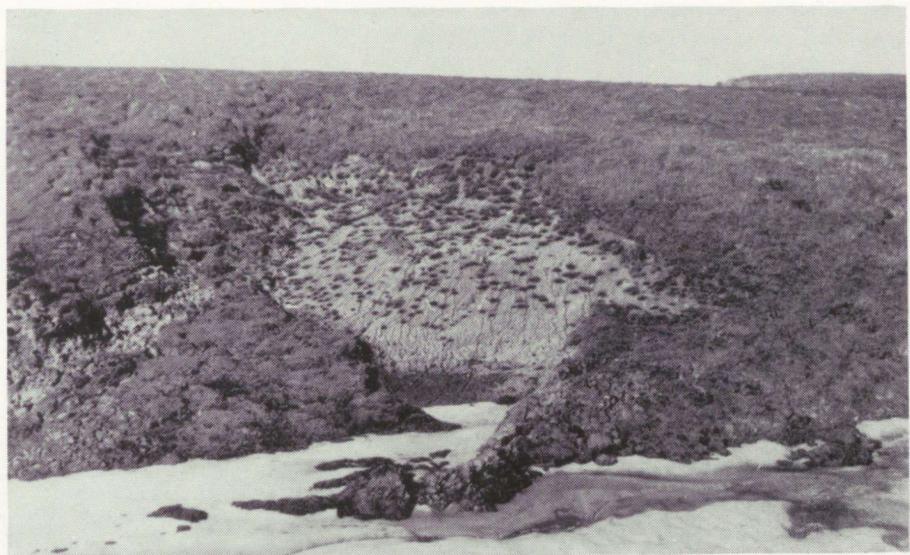


Fig. 3. Landslide on a river bank.



Fig. 4. Snowbed in the bottom part of a slope.



Fig. 5. A small lake in tundra.

METHODS

The specimens of mosses for the present study (1150 specimens altogether) were collected in 1988 by L. Kannukene systematically within all the habitats of the area of about 25 km², and by N. Matveyeva and L. Zanokha (Komarov Botanical Institute) in 1981, 1988, and 1990 while making phytosociological relevés for the main syntaxa of the same area. The resulting collection is kept at the Estonian Natural History Museum.

The vascular plant nomenclature is given according to N. V. Matveyeva (Матвеева, 1979) and the lichen nomenclature according to R. Santesson (1993).

The moss nomenclature is given and the families are arranged in the list of mosses according to the system suggested for mosses of the former Soviet Union (Ignatov & Afonina, 1992). The genera and species are listed in the alphabetical order. The occurrence within the distinguished habitat types as well as the total frequencies of the species are given for each species separately. Within the habitat the frequencies are designated as follows: 1 — very rare, 1—2 specimens; 2 — rare, 3—5 specimens; 3 — sporadic, 6—10 specimens; 4 — frequent but not abundant, more than 10 specimens; 5 — common species, more than 10 specimens. The total frequency was estimated on the basis of the collection samples as well as the relevé data for the frequent and common species: very rare, 1—3 specimens; rare, 4—7 specimens; sporadic, more than 7 specimens within some habitat types; frequent, if the species occurs within several habitat types yet never appears in abundance; very frequent, if the species occurs within many habitat types and is abundant or dominant in some of them.

RESULTS AND DISCUSSION

A short description of the main vegetation and habitat types for which the bulk of the data on mosses was obtained is given below. The numbers correspond to those in the list of mosses.

I. Sedge—dwarf willow—moss polygonal tundras with a net-like vegetation cover in the fissures between polygons. This type developed either on the plain surface or on the extended gentle (less than 5°) slopes (Fig. 2). The dominant species of the plant cover were *Hylocomium splendens* var. *alaskanum*, *Carex ensifolia* subsp. *arctosibirica* (replaced by *Deschampsia borealis* on the slopes), *Salix polaris*, and sometimes *S. arctica*. Mosses inhabit the fissures between the polygons, occurring also on the surface of polygons.

II. Dwarf willow—moss polygonal tundras with a pattern similar to the previous type. These were found on relatively steep (up to 10°) slopes falling down to streams; there was a large proportion of shale detritus in the soil. The dominant plant species are *Hylocomium splendens* var. *alaskanum*, *Salix polaris*, and *S. arctica*. Moss habitats were the same as in the previous case. However, as compared to type I, the habitats were wetter during the whole growth period.

III. Outcrops of shale with a heterogenous plant cover (from almost bare ground to patchy and polygonal patterns) dominated by *Dryas punctata*. Mosses were not abundant, and they grew mainly together with a *Dryas* mat or in narrow but shallow frost cracks.

IV. Mires with a homogenous cover in stream valleys. The dominant species here were the sedge *Carex stans*, the grass *Dupontia fisheri*, the

cottongrass *Eriophorum angustifolium* β *triste*, and the mosses *Calliergon giganteum*, *Cinclidium arcticum*, *Hamatocaulis vernicosus*. This habitat is wet during the whole growth period.

V. Moss—peat hummocks in the surroundings of stream valley mires. These hummocks appeared to be of different ages. The relatively young ones were composed mainly of various *Sphagnum* species. Others were old, partly destroyed by erosion, with a thick layer of peat. In their upper parts they were dominated mostly by *Dicranum elongatum* and *Polytrichum strictum*. The active layer did not exceed 20 cm for both types of hummocks. That was a dry and cold habitat.

VI. Herb—grass mesic meadows on southern slopes, about 30° steep. Herbs predominated in the plant cover. The most abundant species were the grasses *Festuca cryophila* and *Poa alpigena*, and the forbs *Astragalus umbellatus* and *Polemonium boreale*. Mosses were suppressed under a dense herb layer and did not form a continuous cover.

VII. Landslides on steep river banks or seashore slopes (Fig. 3). Whenever these occurred, the deep layers of marine deposits that had frozen before, were exposed. They always contained great amounts of salt. Mosses grew on bare ground that was wet in spring and dry in summer.

VIII. Snowbeds at the bottom of steep slopes covered with snow up to the end of July or the beginning of August (Fig. 4). The dominant species were the moss *Sanionia uncinata*, the lichen *Cetrariella delisei*, and the grass *Phipsisia algida*.

IX. Streams and small lakes with a moss cover on their floor and stone surfaces below the water level (Fig. 5).

X. Wet river and stream banks and salt marshes with a developed moss cover and a few grasses like *Dupontia fisheri* and *Puccinellia phryganoides*.

XI. Stones (and the ground surface around them) on wet stream banks, periodically (but not constantly) under water, covered with mosses.

Systematical list of mosses

SPHAGNACEAE Dum.

Sphagnum Hedw.

- S. aongstroemii* C. Hartm., II, 1. Very rare.
- S. compactum* DC. ex Lam. et DC., V, 1. Very rare.
- S. fimbriatum* Wils. ex Wils. et Hook. f., V, 4. Rare.
- S. lenense* H. Lindb. ex Pohle, V, 2. Rare.
- S. obtusum* Warnst., V, 1; VII, 1. Very rare.
- S. russowii* Warnst., V, 1. Very rare.
- S. squarrosum* Crome, V, 4; IX, 1; X, 1. Sporadic.
- S. subsecundum* Nees ex Sturm., V, 1. Very rare.
- S. teres* (Schimp.) Aongstr. ex C. Hartm., V, 1. Very rare.
- S. warnstorffii* Russ., V, 1. Very rare.

ANDREACEAE Dum.

Andreaea Hedw.

- A. rupestris* Hedw., XI, 1. Very rare.

- POLYTRICHACEAE Schwaegr. in Willd.
- Oligotrichum* DC. ex Lam. et DC.
 - O. hercynicum* (Hedw.) DC., VII, 1; VIII, 1. Very rare.
 - Psilopilum* Brid.
 - P. cavifolium* (Wils.) Hag., VII, 3. Rare.
 - P. laevigatum* (Wahlenb.) Lindb., VII, 1. Very rare.
 - P. Pogonatum* P. Beauv.
 - P. dentatum* (Brid.) Brid., I, 1; III, 2; VII, 1; VIII, 2. Sporadic.
 - P. urnigerum* (Hedw.) P. Beauv., I, 1; III, 1. Very rare.
 - Polytrichastrum* G. L. Sm.
 - P. alpinum* (Hedw.) G. L. Sm., I, 4; II, 2; III, 4; IV, 1; V, 1; VII, 2; VIII, 4. Very frequent.
 - var. *fragile* (Bryhn) Long, VIII, 1. Very rare.
 - Polytrichum* Hedw.
 - P. hyperboreum* R. Br., VII, 2; VIII, 1. Rare.
 - P. jensenii* Hag., IV, 2. Rare.
 - P. juniperinum* Hedw., I, 4; II, 4; III, 2; VI, 1; VII, 1. Frequent.
 - P. piliferum* Hedw., III, 2; VII, 1. Rare.
 - P. strictum* Brid., I, 4; II, 4; III, 1; V, 5; VII, 2; VIII, 3. Very frequent.

FUNARIACEAE Schwaegr. in Willd.

- Funaria* Hedw.
- F. arctica* (Berrgr.) Kindb., I, 1; VII, 1. Very rare.

SPLACHNACEAE Grev. et Arnott

- Aplodon* R. Br.
- A. wormskjoldii* (Hornem.) R. Br., I, 1; II, 1; IV, 1; V, 1; VII, 1; VIII, 1. Sporadic.
- Splachnum* Hedw.
- S. sphaericum* Hedw., I, 1; III, 1; IV, 1; VIII, 1. Rare.
- S. vasculosum* Hedw., IV, 4; VIII, 1; X, 1. Sporadic.
- Tetraplodon* Bruch et Schimp. in B.S.G.
- T. mnioides* (Hedw.) Bruch et Schimp. in B.S.G., I, 1; II, 2; III, 1; V, 2; VIII, 2; XI, 1. Sporadic.

ENCALYPTACEAE Schimp.

- Encalypta* Hedw.
- E. alpina* Sm., I, 4; II, 1; III, 4; VI, 1; VII, 1; VIII, 3. Frequent.
- E. procera* Bruch, III, 1. Very rare.
- E. rhaftocarpa* Schwaegr., III, 1; VII, 1. Very rare.

POTTIACEAE Schimp.

- Aloina* Kindb.
- A. brevitostris* (Hook. et Grev.) Kindb., I, 1. Very rare.
- Bryoerythrophyllum* Chen
- B. recurvirostre* (Hedw.) Chen, I, 2; II, 1; III, 2; VII, 1; VIII, 2; XI, 1. Frequent.
- Desmatodon* Brid.
- D. heimii* var. *arctica* (Lindb.) Crum, VII, 3. Rare.
- D. laureri* (Schultz) Bruch et Schimp. in B.S.G., I, 1; VII, 1. Very rare.
- D. leucostoma* (R. Br.) Berggr., I, 1; II, 1; III, 1. Rare.
- Didymodon* Hedw.
- D. asperifolius* var. *gorodkovii* (A. Abr. et I. Abr.) Afonina, III, 1. Very rare.
- D. fallax* var. *reflexus* (Brid.) Zander, III, 1. Very rare.
- D. icmadophyllum* (Schimp. ex C. Muell.) Saito, II, 1. Very rare.

- D. rigidulus* Hedw., I, 1. Very rare.
Pterygoneurum Jur.
P. lamellatum (Lindb.) Jur., VI, 1; VII, 1. Very rare.
Stegonia Vent.
S. latifolia (Schwaegr. ex Schultes) Vent ex Broth., III, 1; VI, 1. Rare.
Tortella (Lindb.) Limpr.
T. arctica (H. Arnell) Grundw. et Nyh., III, 1; VIII, 1. Very rare.
Tortella fragilis (Hook et Wils. in Drumm.) Limpr., I, 2; II, 2; III, 2;
 VII, 1; VIII, 3. Frequent.
T. tortuosa (Hedw.) Limpr., I, 3; II, 3; III, 3; VIII, 1. Frequent.
Tortula Hedw.
T. mucronifolia Schwaegr., I, 1; VII, 1; VIII, 1; XI, 1. Sporadic.
T. norvegica (Web. f.) Wahlenb. ex Lindb., I, 1. Very rare.
T. ruralis (Hedw.) Gaertn. et al., I, 1; II, 1; III, 2; VI, 1; VII, 1. Sporadic.
Trichostomum Bruch
T. crispulum Bruch in F. Muell., I, 1; II, 1; III, 1. Rare.

GRIMMIACEAE Arnott

- Racomitrium* Brid.
R. canescens (Hedw.) Brid., I, 1; II, 3; III, 4; XI, 1. Frequent.
R. ericoides (Web. ex Brid.) Brid., III, 2; VIII, 4. Sporadic.
R. lanuginosum (Hedw.) Brid., I, 4; II, 4; III, 3; V, 3; VIII, 3. Very frequent.
R. panschii (C. Muell.) Kindb., VII, 1; VIII, 1. Very rare.
Schistidium Brid.
S. agassizii Sull. et Lesq. in Sull., IX, 1. Very rare.
S. andreaeopsis (S. Muell.) Lazar., III, 2; VII, 1. Rare.
S. apocarpum (Hedw.) Bruch et Schimp. in B.S.G., I, 1; III, 1. Very rare.
S. gracile (Schleich.) Limpr., I, 1; III, 3. Sporadic.
S. rivulare Podp., VIII, 1; IX, 2; XI, 2. Rare.

SELIGERIACEAE Schimp.

- Blindia* Bruch et Schimp. in B.S.G.
B. acuta (Hedw.) Bruch et Schimp. in B.S.G., VIII, 1; IX, 1. Very rare.
Seligeria Bruch et Schimp. in B.S.G.
S. diversifolia Lindb., VIII, 1. Very rare.
S. polaris Berggr., VIII, 1; XI, 2. Rare.

FISSIDENTACEAE Schimp.

- Fissidens* Hedw.
F. arcticus Bryhn, I, 1. Very rare.
F. viridulus (Sw.) Wahlenb., II, 1. Very rare.

ORTHOTRICHACEAE Arnott

- Orthotrichum* Hedw.
O. speciosum Nees in Sturm., III, 1. Very rare.

DITRICHACEAE Limpr. in Rabenh.

- Ceratodon* Brid.
C. purpureus (Hedw.) Brid., III, 1; VI, 1; VII, 1. Rare.
Distichium Bruch et Schimp. in B.S.G.
D. capillaceum (Hedw.) Bruch et Schimp. in B.S.G., I, 4; II, 4; III, 4;
 VI, 1; VII, 2; VIII, 4. Frequent.
D. hagenii Ryan ex Philib., VII, 3; VIII, 2. Rare.
D. inclinatum (Hedw.) Bruch et Schimp. in B.S.G., I, 3; II, 3; III, 2; IV, 1;
 VII, 3; VIII, 3; XI, 1. Frequent.
Ditrichum Hampe

D. flexicaule (Schwaegr.) Hampe, I, 4; II, 4; III, 4; VI, 1; VII, 3; VIII, 2.
Very frequent.

DICRANACEAE Schimp.

Dichodontium Schimp.

D. pellucidum (Hedw.) Schimp., III, 1. Very rare.

Dicranella (C. Muell.) Schimp.

D. crispa (Hedw.) Schimp., I, 1; II, 1; III, 1; VII, 3. Sporadic.

D. varia (Hedw.) Schimp., I, 1; VII, 1. Rare.

Dicranoweisia Lindb. ex Milde

D. crispula (Hedw.) Lindb. ex Milde, I, 1; III, 1; VIII, 1. Rare.

Dicranum Hedw.

D. angustum Lindb., IV, 1; V, 2; VIII, 1. Rare.

D. elongatum Schleich. ex Schwaegr., I, 4; III, 1; IV, 1; V, 5; VII, 2;
VII, 1. Frequent.

D. congestum Brid., II, 1; VII, 1. Very rare.

D. majus Sm., VI, 1. Very rare.

D. spadiceum Zett., I, 4; II, 1; VI, 1; VIII, 2. Sporadic.

Oncophorus (Brid.) Brid.

O. compactus (Bruch et Schimp. in B.S.G.) Schljak., III, 1. Very rare.

O. virens (Hedw.) Brid., VIII, 2; XI, 1. Rare.

O. wahlenbergii Brid., I, 4; II, 3; III, 1; VIII, 4; XI, 1. Frequent.

BRYACEAE Schwaegr. in Willd.

Bryum Hedw.

B. arcticum (R. Br.) Bruch et Schimp. in B.S.G., III, 1; VIII, 1. Very
rare.

B. argenteum Hedw., VII, 1. Very rare.

B. calophyllum R. Br., VII, 1. Very rare.

B. cyclophyllum (Schwaegr.) Bruch et Schimp. in B.S.G., IV, 2; VIII, 1;
X, 3; XI, 1. Sporadic.

B. teres Lindb., IV, 1; X, 3. Rare.

B. weigelii Spreng. in Biehler, IV, 1; X, 1. Very rare.

Leptobryum (Bruch et Schimp. in B.S.G.) Wils.

L. pyriforme (Hedw.) Wils., IV, 1; VII, 1. Very rare.

Plagiobryum Lindb.

P. demissum (Hook.) Lindb., I, 1; II, 1. Very rare.

Pohlia Hedw.

P. filum (Schimp.) Mårt., IV, 1. Very rare.

P. cruda (Hedw.) Lindb., II, 1; VII, 1. Very rare.

P. drummondii (C. Muell.) Andr., VII, 1; VIII, 1; XI, 1. Rare.

P. nutans (Hedw.) Lindb., V, 1. Very rare.

P. prolifera (Kindb. ex Limpr.) Lindb. ex H. Arnell, 1, 1; VII, 1. Rare.

MNIACEAE Schwaegr. in Willd.

Cinclidium Sw.

C. arcticum Bruch et Schimp. in B.S.G., IV, 5; VIII, 1; XI, 1. Frequent.

C. latifolium Lindb., IV, 3; VIII, 2. Sporadic.

C. subrotundum Lindb., IV, 1; X, 2. Rare.

Mnium Hedw.

M. blyttii Bruch et Schimp. in B.S.G., IV, 1; VII, 1; VIII, 2. Rare.

M. thomsonii Schimp., VIII, 2. Very rare.

Plagiomnium T. Kop.

P. ellipticum (Brid.) T. Kop., IV, 4; V, 3; X, 3. Sporadic.

P. medium ssp. *curvifolium* (Bruch et Schimp.) T. Kop., IV, 1. Very rare.

Rhizomnium (Broth.) T. Kop.

R. pseudopunctatum (Bruch et Schimp.) T. Kop., IV, 1. Very rare.

AULACOMNIACEAE Schimp.

- Aulacomnium* Schwaegr.
A. palustre (Hedw.) Schwaegr., I, 1; IV, 1; V, 4; VII, 1; VIII, 1. Sporadic.
A. turgidum (Wahlenb.) Schwaegr., I, 5; II, 5; III, 4; V, 5; VIII, 5; XI, 1. Very frequent.

MEESIACEAE Schimp.

- Meesia* Hedw.
M. triquetra (Richter) Aongstr., IV, 3. Rare.
M. uliginosa Hedw., II, 1; IV, 1; VIII, 2. Rare.
Paludella Brid.
P. squarrosa (Hedw.) Brid., IV, 2. Rare.

BARTRAMIACEAE Schwaegr. in Willd.

- Bartramia* Hedw.
B. ithyphylla Brid., I, 2; II, 1; III, 1; VII, 1; VIII, 3. Frequent.
Catoscopium Brid.
C. nigritum (Hedw.) Brid., I, 1. Very rare.
Conostomum Sw.
C. tetragonum (Hedw.) Lindb., I, 1; III, 1; VIII, 2. Rare.
Philonotis Brid.
P. fontana (Hedw.) Brid., II, 1; III, 1. Very rare.
var. *caespitosa* (Jur.) Schimp., X, 1. Very rare.
var. *pumila* (Turn.) Brid., I, 1; III, 1; IV, 3; VIII, 2; X, 4. Frequent.

TIMMIACEAE Schimp.

- Timmia* Hedw.
T. austriaca Hedw. (+ var. *arctica* (Lindb.) H. Arnell), I, 4; II, 3; III, 2; IV, 1; V, 1; VII, 1; VIII, 4. Very frequent.
T. norvegica var. *excurrens* Bryhn, I, 1; VII, 1. Very rare.

THELIACEAE (Broth.) Fleisch.

- Myurella* Schimp. in B.S.G.
M. julaceae (Schwaegr.) Schimp. in B.S.G., I, 2; II, 1; III, 1; VII, 1; VIII, 1. Sporadic.
M. tenerrima (Brid.) Lindb., III, 1. Very rare.

LESKEACEAE Schimp.

- Pseudoleskea* Schimp. in B.S.G.
P. chilensis (Lor.) Ochyra, X, 1; XI, 1. Very rare.

THUIDIACEAE Schimp.

- Abietinella* C. Muell.
A. abietina (Hedw.) Fleisch., I, 2; II, 2; III, 2. Sporadic.
Thuidium Schimp. in B.S.G.
T. philibertii Limpr., I, 2; II, 1; III, 1. Rare.

AMBLYSTEGIACEAE G. Roth

- Callilaria* Ochyra
C. curvicaule (Jur.) Ochyra, I, 1; II, 1; VIII, 1; X, 1; XI, 1. Sporadic.
Calliergon (Sull.) Kindb.
C. giganteum (Schimp.) Kindb., IV, 5; VIII, 3; IX, 5; X, 5. Very frequent.
C. richardsonii (Mitt.) Kindb., VIII, 1. Very rare.
C. stramineum (Brid.) Kindb., IV, 2; IX, 4; X, 1. Sporadic.
Campylium (Sull.) Mitt.
C. polygamum (B.S.G.) C. Jens., VII, 1. Very rare.
C. stellatum (Hedw.) C. Jens., I, 4; II, 3; III, 1; VII, 1; VIII, 4. Frequent.

- C. zemliae* C. Jens., IV, 4; VII, 3; VIII, 3; X, 2; XI, 1. Frequent.
Drepanocladus (C. Muell.) G. Roth
D. aduncus var. *polycarpus* (Bland. ex Voit) G. Roth, VII, 1. Very rare.
D. sendtneri (Schimp. ex H. Muell.) Warnst., X, 1. Very rare.
Hamatocaulis Hedenaes
H. vernicosus (Mitt.) Hedenaes, IV, 5; V, 1. Sporadic.
Hygrohypnum Lindb.
H. alpestre (Hedw.) Loeske, IV, 1. Very rare.
H. luridum (Hedw.) Jenn., XI, 1. Very rare.
H. polare (Lindb.) Loeske, VIII, 3; XI, 3. Sporadic.
var. *falcatum* Broth., XI, 1. Very rare.
Limprichtia Loeske
L. cossonii (Schimp.) Anderson et al., IX, 1. Very rare.
L. revolvens (Sw.) Loeske, IV, 5; VII, 1; VIII, 3; IX, 5; X, 2. Very frequent.
Pseudocalliergon (Limpr.) Loeske
P. brevifolius (Lindb.) Hedenaes, VII, 1; VIII, 3; XI, 1. Sporadic.
P. trifarium (Web. et Mohr) Loeske, IX, 1. Very rare.
Sanionia Loeske
S. uncinata (Hedw.) Warnst., I, 4; II, 4; III, 2; VI, 1; VII, 4; VIII, 5; XI, 4. Very frequent.
Sarmenthypnum Tuom. et T. Kop.
S. sarmentosum (Wahlenb.) Tuom. et T. Kop., IV, 5; V, 2; VIII, 3; IX, 5; X, 4; XI, 2. Very frequent.
Scorpidium (Schimp.) Loeske
S. turgescens (T. Jens.) Loeske, VII, 2; VIII, 1; IX, 1; XI, 1. Sporadic.
Warnstorffia Loeske
W. exannulata (Guemb. in B.S.G.) Loeske, IV, 1; IX, 2; X, 1. Sporadic.
BRACHYTHECIACEAE Schimp. in B.S.G.
Brachythecium Schimp. in B.S.G.
B. mildeanum (Schimp.) Schimp. ex Milde, I, 3; II, 1; VI, 1; VII, 1. Sporadic.
B. turgidum (Hartm.) Kindb., I, 1; II, 1; III, 1; IV, 3; V, 2; VII, 2; VIII, 2; X, 3; XI, 1. Frequent.
Brachythecium udum (Hag.) Hag., VII, 1; VIII, 1. Very rare.
Cirriphyllum Grout
C. cirrhosum (Schwaegr. ex Schultes) Grout, I, 4; II, 2; III, 1; IV, 1; VII, 1; VIII, 2; IX, 1. Frequent.
Eurhynchium Schimp. in B.S.G.
E. pulchellum (Hedw.) Jenn., I, 2; II, 2. Rare.
Tomentypnum Loeske
T. nitens (Hedw.) Loeske, I, 5; II, 5; III, 2; IV, 1; V, 4; VII, 2; VIII, 4; IX, 1; X, 2; XI, 1. Very frequent.
PLAGIOTHECIACEAE (Broth.) Fleisch.
Plagiothecium Schimp. in B.S.G.
P. laetum var. *densem* B.S.G., V, 2. Very rare.
HYPNACEAE Schimp.
Ctenidium (Schimp.) Mitt.
C. procerrimum (Mol.) Lindb., I, 1; II, 1; III, 1; VI, 1; VII, 2. Sporadic.
Hypnum Hedw.
H. bambergeri Schimp., I, 3; II, 3; III, 3; VII, 1. Sporadic.
H. callichorum Funck ex Brid., VI, 1. Very rare.
H. plicatulum (Lindb.) Jaeg., I, 1; VII, 1. Very rare.
H. pratense Koch ex Spruce, VII, 1; X, 1; XI, 1. Rare.
H. revolutum (Mitt.) Lindb., III, 2; VI, 1. Rare.
H. subimponens Lesq., I, 1. Very rare.

- H. vaucheri* Lesq., III, 1; VI, 1. Very rare.
Isopterygiopsis Iwats.
I. pulchellum (Hedw.) Iwats., I, 3; II, 3; III, 1. Sporadic.
Orthothecium Schimp.
O. chryseon (Schwaegr. ex Schultes) Schimp. in B.S.G., I, 4; II, 4; III, 1;
IV, 2; VII, 1; VIII, 4; IX, 1; X, 2; XI, 2. Very frequent.
O. rufescens (Brid.) Schimp. in B.S.G., IV, 1; VII, 1; VIII, 1. Sporadic.
O. strictum Lor., III, 1; VII, 1; VIII, 1. Rare.

HYLOCOMIACEAE (Broth.) Fleisch.

Hylocomium Schimp. in B.S.G.

- H. splendens* var. *alaskanum* (Lesq. et James) Limpr., I, 5; II, 5; III, 3;
IV, 1; V, 3; VIII, 4. Very frequent.

RHYTIDIACEAE Broth.

Rhytidium (Sull.) Kindb.

- R. rugosum* (Hedw.) Kindb., III, 2. Rare.

Taxonomical analysis

The list of mosses includes 159 species and 4 intraspecific taxa belonging to 78 genera and 28 families. Eight species supplementing the list were not included, for they have been identified only to the level of family (three species of Pottiaceae and four species of Bryaceae) or genus (one *Hypnum* species).

The 10 leading families include 118 species or about 75% of the whole moss flora (see Table 1). A similar percentage of species from the leading families was also observed for the local moss floras of the more southern regions of Taimyr both within the southern (Kresty) and the typical (Tareya) tundra subzones (Благодатских, 1978; Каннукене & Матвеева, 1986). Such a proportion is characteristic of bryophyte floras of the arctic type in general (Афонина, 1978). Other species are distributed among families as follows: Ditrichaceae, five species; Splachnaceae and Bartramiaeae, four species; Encalyptaceae, Seligeriaceae, and Meesiaceae, three species; Fissidentaceae, Aulacomniaceae, Timmiaceae, Theliaceae, and Thuidiaceae, two species; Andraeaceae, Orthotrichaceae, Leskeaceae, Plagiotheciaceae, Hylocomiaceae, and Rhytidaceae, one species.

Amblystegiaceae and Pottiaceae are the richest families in species within the Uboynaya moss flora. The family Amblystegiaceae occupies the same position in all the other local floras within the tundra zone on Taimyr (Table 2). The role of Pottiaceae in the floristic composition seems to increase northwards from the southern to the arctic tundra subzone. The same tendencies were shown by Grimmiaceae and Hypnaceae. Among the 29 moss families now known for Taimyr only the Climaciaceae were absent in the Uboynaya local flora. However, in the polar deserts on Cape Chelyuskin, the following 11 families represented in the Uboynaya flora were absent: Sphagnaceae*, Funariaceae*, Splachnaceae, Orthotrichaceae, Mniacaceae, Fissidentaceae*, Meesiaceae*, Leskeaceae, Thuidiaceae, Plagiotheciaceae*, and Rhytidaceae. Families marked with an asterisk were also absent in the flora of the Severnaya Zemlya Archipelago (Андреев et al., 1993).

The leading nine genera (with more than three species) of the Uboynaya flora include 50 species or over 30% of the whole flora list (Table 3).

The position of leading families in the moss flora of the Uboynaya River basin

Family	Number of species, abs./%	Position in flora	Family	Number of species, abs./%	Position in flora
Amblystegiaceae	21/12.5	I-II	Polytrichaceae	11/6.5	VI
Pottiaceae	21*/12.5	I-II	Splachnaceae	10/5.9	VII
Bryaceae	17*/10.1	III	Grimmiaceae	9/5.4	VIII
Hypnaceae	13*/7.8	IV	Mniaceae	7/4.2	IX
Dicranaceae	12/7.1	V	Brachytheciaceae	6/3.5	X

Table 2

The number of species (S) and genera (G) within the families for some Taimyr local floras

Family	Tundra						Polar desert (Chelyuskin)	
	Southern (Kresty)		Typical (Tareya)		Arctic (Uboynaya)			
	G	S	G	S	G	S	G	S
Amblystegiaceae	11	20	13	25	12	21	8	0
Andreaceae	—	—	—	—	1	1	1	2
Aulacomniaceae	1	2	1	3	1	2	—	—
Bartramiaceae	4	4	3	5	4	4	3	3
Brachytheciaceae	4	8*	4	6	4	6	3	3
Bryaceae	4	18*	3	8	4	17*	2	5
Climaciaceae	1	1	—	—	—	—	—	—
Dicranaceae	5	12	4	11	5	12	6	11
Ditrichaceae	4	5	4	5	3	5	4	5
Encalyptaceae	1	4	2	5	1	3	1	3
Fissidentaceae	1	2	1	3	1	2	—	—
Funariaceae	1	1	—	—	1	1	—	—
Grimmiaceae	2	3*	2	5	2	9	2	6
Hylocomiaceae	2	2	1	1	1	1	1	1
Hypnaceae	2	7	3	9	4	13	3	6
Leskeaceae	—	—	1	1	1	1	—	—
Meesiaceae	2	4	2	4	2	3	—	—
Mniaceae	5	9	4	12	3	8	—	—
Oligotrichaceae	1	1	1	1	1	1	—	—
Plagiotheciaceae	1	3	—	—	1	1	—	—
Polytrichaceae	6	13	3	9	5	11	1	3
Pottiaceae	7	12*	12	16	9	21*	6	7
Rhytidaceae	2	2	1	1	1	1	—	—
Seligeriaceae	—	—	1	1	2	3	2	2
Sphagnaceae	1	14	1	17	1	10	—	—
Splachnaceae	3	3	3	4	3	4	—	—
Theliaceae	1	2	1	2	1	2	1	2
Thuidiaceae	2	3	2	2	2	2	—	—
Timmiaceae	—	—	1	3	1	2	1	2
TOTAL	74	159	74	162	79	167	46	71

* including samples identified only to the genus or family level.

The position of leading genera in the moss flora of the Uboynaya River basin

Genera	Number of species, abs./%	Position in flora	Genera	Number of species, abs./%	Position in flora
<i>Sphagnum</i>	10/6.2	I	<i>Pohlia</i>	5/3.1	IV—VII
<i>Hypnum</i>	7/4.4	II	<i>Polytrichum</i>	5/3.1	IV—VII
<i>Bryum</i>	6/3.7	III	<i>Schistidium</i>	5/3.1	IV—VII
<i>Dicranum</i>	5/3.1	IV—VII	<i>Didymodon</i>	4/2.5	VIII—IX

Ten species new to Taimyr were recorded in the Uboynaya moss flora, viz. *Bryum argenteum*, *Fissidens arcticus*, *Desmatodon laureri*, *Didymodon asperifolius* var. *gorodkovii*, *Hygrohypnum alpestre*, *Plagiobryum demissum*, *Pseudoleskeia chilensis*, *Racomitrium panschii*, *Schistidium agassizii*, and *Seligeria diversifolia*.

Geographical analysis

The species of the arctic alpine distribution area type were the most abundant and frequent within the Uboynaya moss flora. These were *Aulacomnium turgidum*, *Bartramia ithyphylla*, *Brachythecium turgidum*, *Cirriphyllum cirrhosum*, *Dicranum elongatum*, *D. spadiceum*, *Distichium capillaceum*, *D. inclinatum*, *Ditrichum flexicaule*, *Encalypta alpina*, *Hypnum bambergeri*, *Limprichtia revolvens*, *Oncophorus wahlenbergii*, *Orthothecium chrysaeum*, *Philonotis fontana* var. *pumila*, *Racomitrium lanuginosum*, *Sarmentypnum sarmentosum*, and some others. Species with a hypoartic distribution were also well represented, including such as *Calliergon giganteum*, *Campylium stellatum*, *Polytrichastrum alpinum*, *Tetraplodon mnioides*, *Timmia austriaca*, *Tomentypnum nitens*, *Tortella fragilis*, and some others. All the mentioned species with either arctic-alpine or hypoartic distribution were common and they occurred quite frequently within the local floras of Taimyr both in the southern and the typical tundras (Ary-Mas, Kresty, and Tareya).

As distinct from the above-mentioned floras, species with the arctic distribution were represented more significantly in the Uboynaya moss flora. Many arctic species, viz. *Distichium hagenii*, *Fissidens arcticus*, *Funaria arctica*, *Pseudoleskeia chilensis*, *Racomitrium panschii*, and *Schistidium andraeaopsis* have been recorded of late only there in the whole Taimyr tundra zone. Some species of the arctic distribution, such as *Campylium zemliae*, *Cinclidium arcticum*, *C. latifolium*, and *Pseudocalliergon brevifolius*, were very frequent within the mentioned flora and sometimes also demonstrated a high abundance. This can be well explained by the high latitudinal position of the studied area. For the same reason some boreal species present in the Kresty local flora, like *Climaciumpendroides*, *Pleurozium schreberi*, *Rhytidadelphus triquetrus*, and some *Sphagnum* species, seem to be absent in the Uboynaya local flora.

Species of the main distribution within the arid regions, such as *Abietinella abietina* and *Tortula ruralis* as well as the group of cosmopolitan mosses like *Ceratodon purpureus*, *Leptobryum pyriforme*, and *Pohlia nutans*, were comparatively rare and not numerous in the studied area.

Intralandscape distribution of mosses

The distribution of moss species according to their occurrence frequencies was close to the normal type (Fig. 6). This means that the very rare species are the most numerous and the common species the least numerous in the flora list.

Only less than 20% of the species belong to the groups of frequent (16) and very frequent (13) occurrences. Very common species in quite different environments are *Aulacomnium turgidum*, *Brachythecium turgidum*, *Dicranum elongatum*, *Ditrichum flexicaule*, *Hylocomium splendens* var. *alaskanum*, *Orthothecium chryseum*, *Polytrichastrum alpinum*, *Sanionia uncinata*, and *Tomentypnum nitens*.

The most common and dominant species of mesic habitats on the plain surfaces and also on very gentle slopes were *Aulacomnium turgidum*, *Hylocomium splendens* var. *alaskanum*, and *Tomentypnum nitens*. *Distichium capillaceum*, *D. inclinatum*, *Ditrichum flexicaule*, *Oncophorus wahlenbergii*, *Polytrichastrum alpinum*, *Polytrichum strictum*, *Racomitrium lanuginosum*, *Timmia austriaca*, *Tortella fragilis*, and *T. tortuosa* were also frequent enough, but less abundant in the same environments.

Calliergon giganteum, *Cinclidium arcticum*, *Limprechtia revolvens*, *Campylium zemliae*, and *Sarmentypnum sarmentosum* were common and abundant in the mire habitats. *Philonotis fontana* var. *pumila* and *Brachythecium turgidum* usually occurred on the moderately wet slopes.

On landslides, *Bryoerythrophyllum recurvirostre* appeared constant and abundant. On sandy soils *Racomitrium canescens* was frequent but never abundant.

Bartramia ithyphylla, *Cirriphyllum cirrhosum*, *Campylium stellatum*, and *Encalypta alpina* occurred constantly in small fissures on the surface of the patches of the cryogenous bare ground in the polygonal tundras.

Young moss hummocks in the mires consisted of *Sphagnum* species, coupled with a high proportion of *Aulacomnium turgidum*. Old moss—peat hummocks had *Sphagnum* peat in their bottom part but were mostly made up of *Dicranum elongatum* and *Polytrichum strictum* in the top part.

The most common species of the snowbed communities were *Aulacomnium turgidum*, *Oncophorus wahlenbergii*, *Polytrichastrum alpinum*, *Racomitrium ericoides*, and *Sanionia uncinata*.

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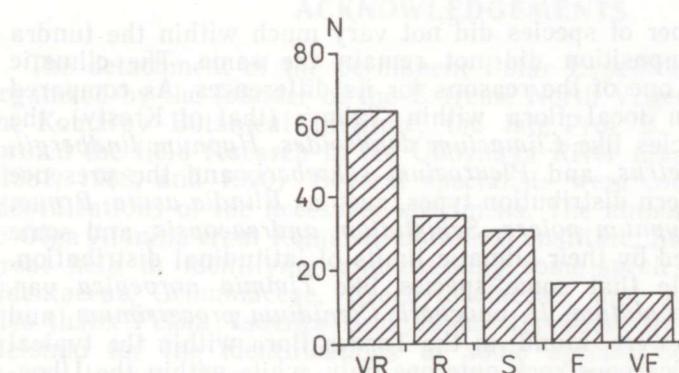


Fig. 6. Histogram of the total frequencies of moss species occurrence. N, number of species; the frequency ranks: VR, very rare; R, rare; S, sporadic; F, frequent; VF, very frequent (see also the "Methods" section above).

About 20% (31) of the moss species occurred sporadically. Only a few of them were relatively abundant: *Aulacomnium palustre* and *Sphagnum squarrosum* on young moss—peat hummocks; *Cinclidium latifolium*, *Hamatocaulis vernicosus*, and *Plagiomnium ellipticum* in mires; *Bryum cyclophyllum* on wet stream banks; and *Hypnum bambergeri* on patches of the cryogenous bare ground.

The groups of very rare (64 species) or rare (35) species, which are not significantly important in the plant cover performance, include 62% of the mosses. Nine out of the ten *Sphagnum* and eleven out of the thirteen Bryaceae species belong to these groups. More than half of the species in the families which are among those prevailing in the composition of the local moss flora, such as Dicranaceae, Hypnaceae, Polytrichaceae, and Pottiaceae, were also rare or very rare. Only within the Amblystegiaceae the frequent and common species together amounted to about 60% of the family. The most common species *Hylocomium splendens* var. *alaskanum*, which was dominant in large areas not only in the lower reaches of the Uboynaya River but throughout the whole Taimyr Peninsula, belonged to a family represented by a single species.

Number of species

The number of species in the Uboyanaya moss flora (Table 2) was similar to that of the other regions of Taimyr within the tundra zone (159 species in the Kresty moss flora, 162 in the Tareya flora, and 167 in the Uboynaya flora) but was more than twice bigger than that of the flora of the polar deserts of Cape Chelyuskin (71 species; Arnell, 1918; Благодатских et al., 1979b) and of the Severnaya Zemlya Archipelago (83 species; Андреев et al., 1993). The species abundance of the Uboynaya moss flora was similar to that of the floras known within the corresponding zonal subdivisions in the Canadian Arctic. For instance, 172 species are known for Banks Island (Steere & Scotter, 1979), 147 species for the northern part of Baffin Island (Brassard et al., 1979), and 166 species for the northern part of Ellesmere Island (Brassard, 1971). The characteristic number of species in the local moss flora within the tundra zone seems to be 150—170.

Changes in the species composition

Although the number of species did not vary much within the tundra zone, the species composition did not remain the same. The climatic variation seems to be one of the reasons for its differences. As compared to the more southern local flora within Taimyr (that of Kresty), the absence of boreal species like *Climaciun dendroides*, *Hypnum lindbergii*, *Rhytidadelphus triquetrus*, and *Pleurozium schreberi*, and the presence of species of the northern distribution types, such as *Blindia acuta*, *Bryum cyclophyllum*, *Hygrohypnum polare*, *Schistidium andreaeopsis*, and some others can be explained by their climatic limits of latitudinal distribution. It is interesting to note that some species like *Timmia norvegica* var. *excurrens*, *Hypnum revolutum*, *H. vaucheri*, *Ctenidium procerrimum*, and *Tortula mucronifolia* were found in the Tareya flora within the typical tundra subzone on calcareous rock outcrops only, while within the Uboynaya flora these species grew in various habitats with no sign of a significant presence of calcium in the soil.

All the ten species new to Taimyr are rare species, and they might be absent in the more southern floras. The same explanation is perhaps

suitable for some rare species recorded in Tareya but absent in the Uboynaya flora: *Briobrittonia pellucida*, *Cyrtomnium hymenophyllum*, and *Oxystegus cylindricus*. At the same time some species were recorded in the Kresty and Uboynaya floras but not in Tareya: *Cinclidium latifolium*, *Dicranum majus*, *Hypnum pratense*, and *Pogonatum urnigerum*.

Changes in the species frequency and abundance

There are some species that occur both in the south (the Kresty area) and in the north (the present investigation area) of Taimyr, yet their abundance and frequency of occurrence vary there. One such group includes species with numbers decreasing towards the north. This group includes *Dicranum angustum*, *D. congestum*, *Meesia triquetra*, and *Rhytidium rugosum*. Almost all the *Sphagnum* species (with the exception of *S. squarrosum*) also become rare or very rare in the north of Taimyr. Another group includes species that, on the contrary, become more abundant northwards: *Cirriphyllum cirrhosum*, *Cinclidium arcticum*, *Bartramia ithyphylla*, *Encalypta alpina*, *Bryoerythrophyllum recurvirostre*, *Timmia austriaca*, *Tortella fragilis*, and *T. tortuosa*. On the other hand, such species as *Sanionia uncinata* and *Orthothecium chryseum* are frequent and abundant all over the area; they also seem to widen their ecological amplitudes in the north of Taimyr.

For a large group of species that includes some of the main dominants of the tundra plant cover (here marked by an asterisk), the positions of its members remained unchanged throughout the whole tundra zone of Taimyr. These were *Aulacomnium turgidum**, *Dicranum spadiceum*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Hylocomium splendens* var. *alaskanum**, *Tomenthypnum nitens**, *Racomitrium lanuginosum*, and *Oncophorus wahlenbergii* within the main tundra types on the plain surfaces and on very gentle slopes; *Calliergon giganteum*, *Sarmenthypnum sarmenosum*, *Hamatocaulis vernicosus*, and *Limpriichtia revolvens* in the mires; *Dicranum elongatum* and *Polytrichum strictum* on the moss—peat hummocks; *Racomitrium canescens* on sandy soils.

A more detailed analysis of changes in the species distribution and their role in the organization of the vegetation cover remains to be done when more data are available.

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LEHTSAMBLAD SIBERIS TAIMÖRI POOLSAARE ARKTILISES TUNDRAS

Leiti KANNUKENE, Nadežda MATVEJEVA

Taimöri poolsaare idaosas, Diksonist ca 60 km ida pool asuvast Uboinaja jõe suudmealal levinud arktilisest tundrast leiti 159 liiki lehtsamblaid, mis kuuluvad 78 perekonda ja 28 sugukonda. 10 liiki — *Bryum argenteum*, *Fissidens arcticus*, *Desmatodon laureri*, *Didymodon asperifolius* var. *korolkovii*, *Hygrohypnum alpestre*, *Plagiobryum demissum*, *Pseudoleskeia*

chilensis, *Racomitrium panschii*, *Schistidium agassizii* ja *Seligeria diversifolia* — olid uued poolsaare tundravööndis. Kogu uuritud alal olid tavali sed ja sageli massiliselt esinevad liigid *Aulacomnium turgidum*, *Brachythecium turgidum*, *Dicranum elongatum*, *Ditrichum flexicaule*, *Hylocomium splendens* var. *alaskanum*, *Orthothecium chryseum*, *Polytrichastrum alpinum*, *Sanionia uncinata* ja *Tomenthypnum nitens*. Polügonaaltundrates kasvasid samblad peamiselt polügoone ümbritsevates lõchedes, siin domineerisid *Hylocomium splendens* var. *alaskanum*, *Racomitrium lanuginosum* ja *Tomenthypnum nitens*. Soodes olid tavalised *Calliergon giganteum*, *Campylium zemliae*, *Cinclidium arcticum*, *Limpriichtia revolvens* ja *Sarmenthypnum sarmentosum*. Kasvukohtadena olid polügonaaltundrate kõrval (63–65 liiki) väga liigirikkad ka maalihked ja nivaalsed nõlvad igilume piirkonnas. Seal esinesid sagedamini *Bartramia ithyphylla*, *Bryoerythrophyllum recurvirostre*, *Campylium stellatum*, *Cirriphyllum cirrhosum*, *Encalypta alpina* ja *Polytrichastrum alpinum*.

ЛИСТОСТЕБЕЛЬНЫЕ МХИ В АРКТИЧЕСКОЙ ТУНДРЕ НА ПОЛУОСТРОВЕ ТАЙМЫР (СИБИРЬ)

Лейти КАННУКЕНЕ, Надежда МАТВЕЕВА

На п-ве Таймыр, в бассейне р. Убоиная (60 км от Диксона на восток), в арктической тундре было обнаружено 159 видов листостебельных мхов, относящихся к 78 родам и 28 семействам. 10 видов (*Bryum argenteum*, *Fissidens arcticus*, *Desmalodon laureri*, *Didymodon asperifolius* var. *korolkovii*, *Hygrohypnum alpestre*, *Plagiobryum demissum*, *Pseudoleskeia chilensis*, *Racomitrium panschii*, *Schistidium agassizii* и *Seligeria diversifolia*) являются новыми для тундровой зоны Таймыра. Самыми распространенными и массовыми видами в различных местообитаниях были *Aulacomnium turgidum*, *Brachythecium turgidum*, *Dicranum elongatum*, *Ditrichum flexicaule*, *Hylocomium splendens* var. *alaskanum*, *Orthothecium chryseum*, *Polytrichastrum alpinum*, *Sanionia uncinata* и *Tomenthypnum nitens*. В сообществах полугональных тундр доминировали *Hylocomium splendens* var. *alaskanum*, *Racomitrium lanuginosum* и *Tomenthypnum nitens*, в болотах — *Calliergon giganteum*, *Campylium zemliae*, *Cinclidium arcticum*, *Limpriichtia revolvens* и *Sarmenthypnum sarmentosum*. Кроме полугональных тундр богатыми видами листостебельных мхов были и опалзники и нивальные склоны вблизи снегников, где обычными являлись *Bartramia ithyphylla*, *Bryoerythrophyllum recurvirostre*, *Campylium stellatum*, *Cirriphyllum cirrhosum*, *Encalypta alpina*, *Polytrichastrum alpinum* и др.