BRYOPHYTES OF DICKSON AREA, WESTERN TAIMYR – A MODEL BRYOPHYTE FLORA FOR ASIAN ARCTIC TUNDRA
МОХООБРАЗНЫЕ ОКРЕСТНОСТЕЙ ДИКСОНА – МОДЕЛЬНОЙ БРИОФЛОРЫ АЗИАТСКИХ АРКТИЧЕСКИХ ТУНДР

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Abstract

Bryophyte flora of the Dickson village area was studied during five field seasons. The list includes 90 species and 7 infraspecific taxa of liverworts and 249 species and 2 varieties of mosses. This is the greatest number among local floras published for Asian Arctic. It exceeds previously published moss floras of the nearby areas by about hundred species. It is partly caused by application of new species concepts, which appeared as a result of revisions involving molecular phylogenetic data. However, it also demonstrates strong under-exploration, and, consequently, underestimation of bryophyte diversity and need in its conservation. The present study shows that the number of species in local floras does not decrease northward within the tundra zone. Moreover, bryophyte flora of the arctic tundra biome houses the previously neglected or only recently recognized taxonomic diversity. An annotated list of species is provided, along with comments on the problematic taxa and specimens.

INTRODUCTION

Arctic biodiversity attracts now an increasing attention as the most sensitive and endangered due to the global warming. According to the results of recent climate modeling, subpolar regions are expected to undergo stronger climatic changes than areas at lower latitudes (Weaver at al., 1998; Intergovernmental Panel on Climate Change, 2014; https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_webover.pdf).

Among the zonal biomes of the world, Arctic is regarded as the one where bryophytes play the essential role in vegetation (cf. Ogureeva et al., 2020) and this is especially true for high Arctic. In high Arctic, bryophytes in number of species exceeds that of vascular plants; moreover, the arctic tundra biomes are virtually built by bryophytes, which protect permafrost from melting and thus ensure ecosystem stability. Therefore, already first Arctic expeditions have yielded extensive bryophyte collections, which have contributed a lot to knowledge of the biodiversity of the Far North. Further, these data were supplemented by numerous collections, mostly made during phytosociological exploration of tundra commu-

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cies were recently revealed in this area (Ignatova 2020). Several previously omitted hybridogeneous species were overlooked (Hedenäs et al., 2020; Ignatov et al., 2019) recently revealed the existence of northern or high number of endemic taxa (Longton, 1988), Hedenäs et al. (2019) recently revealed the existence of northern or high mountain areas. At the same time, quite a limited number of studies dealt with Asian Arctic populations, essential centre of arctic vascular flora formation (Tolmachev & Yurtsev, 1970). However few such studies conducted with mosses resulted in revealing neglected diversity (Hedenäs et al., 2020; Ignatov et al., 2020). Several previously omitted hybridogeneous species were recently revealed in this area (Ignatova et al., 2016; Kyrkjeeide et al., 2019) indicating ongoing processes of speciation in bryophytes, which is generally regarded as an important source of endemics at high latitudes (Dynesius & Jansson, 2000). Due to global warming, arctic biomes are undergoing sufficient changes and zonal boundaries move northward. Therefore, a poorly known diversity of bryophytes is needed to evaluate its risk and develop as efficient acting plan for their conservation. In this context, the surveys of bryodiversity in Asian high Arctic based on integrative taxonomic concepts are especially important.

Dickson village in the northwest of Taimyr Peninsula is an easy to access. Since first Arctic expeditions it has been one of the most visited points of Asian sector of Arctic Ocean shore. Lundström collected here in 1875 and Kjellman in 1878. They collected 63 species that were published later by Arnell (1918). First publications on the Dickson bryophyte flora were published by Jensen (1909) and Brotherus (1910), but these lists included only few widespread species. Extensive collections of hepatics (and likely mosses as well) were made in the area in 1977–1979 by Zhukova, Zanokha and Matveyeva. Hepatics were identified by Zhukova and the list of 64 species was published by Zhukova & Matveyeva (2000). For mosses of this area, however, no sufficient data were published after Arnell (1918). The present study is based on the bryophytes collected inof 2001–2003 by Varlygina in the course of vegetation studies; in 2017 Fedosov and in 2019 Fedosov and Koltysheva conducted strictly bryofloristic exploration of the area.

**STUDY AREA**

Dickson area is situated on eastern shore of Yenisey River Gulf. Its average annual temperature is 71.4 °C, positive daily temperature during 3.5 months and average temperatures of July and August +4.6 °C and +4.8 °C correspondingly, Dickson Area is assigned to northern margin of Arctic Tundra subzone (Walker et al., 2005). Despite low annual precipitation rate of ca. 233 mm, environments are rather humid due to permafrost melting and Kara Sea influence. The area studied for bryophytes was briefly characterized by Kannuke & Matveyeva (1996) and Matveyeva & Zanokha (2017). The latter paper deals with vascular plants of Dickson village outskirts, while the former one provides the only sufficient list of mosses (159 species) published for arctic tundra of Taimyr Peninsula, explored ca. sixty kilometers eastward Dickson near Uboynaya River mouth, but since the landscape of northwestern part of Taimyr Peninsula are quite homogeneous, their description might be expanded on Dickson Area as well.

The area belongs to the western foothills of Byrranga Range. There are numerous rocky ridges up to 65 m height, stretched in latitudinal direction and emerging in the sea as capes, separated by gentle 0.5–1.5 km wide concave hollows incut in soft quaternary loamy sediments, which form bays. Upper surfaces of rocky ridges are occupied by dry rockfields (1) with scattered vascular plants (distribution of vascular plant distribution through the range of characteristic ecotopes is considered in Matveyeva & Zanokha, 2017), partly covered by saxicolous bryophytes and lichens. Although geologically rather homogeneous, these ridges somewhat differ in composition that results in different composition of saxicolous species and local abundance of calciphylous ones. Gentle southern slopes of these ridges are covered by drained Dryas dominated rocky tundra (2). These communities gradually turn into zonal arctic tundra on gentle convex loamy slopes. Hummocky or spotty zonal arctic tundra communities (3) are polydominant due to diverse nanorelief. Concave slopes and interfluvial areas are covered by boggy cotton-grass dominated communities (4), which sometimes possess polygonal structure. On sandy sediments poor in mineral nutrition vascular plants are sparse and ground cover is composed by mosses of the genera Polytrichum, Dicranum and Sphagnum. North faced slopes of rocky ridges are steep, with cliffs and lumpy screes above extensive snowfields and wet lower slopes below them (5). Overflooded due to permanent brooks, the latter ecotopes capture fine soil from snowbeds, and therefore are rather rich in mineral nutrition. Creek valleys cross the area along ridge bases or cut quaternary sediments; they have boggy or pebbly bottom and banks (6). Creeks cutting loamy hills often
form canyons with eroded solifluctional slopes and massifs of frost mounds (7) where meadow spots alternate with eroded turf and mineral ground. Diversity of nanoecotopes including moist shaded niches results in rich bryophyte representations and especially high diversity of liverworts. Along the seashore coastal retreat cause extensive soilslides where pioneer herb aggregations alternates with those, composed of pioneer mosses and bare mineral soil. Composition of the former differs on sandy, loamy including partly salty marine sediments. River deltas are covered by marshy low grass vegetation (8) which tolerate marine salt impact with sparse mosses, while along low seashores bryophytes occur mostly on drift wood. Finally, disturbed ecotopes around settlements (9) are covered by ruderal meadows and bryophyte aggregations.

**MATERIALS AND METHODS**

The field work was carried out by TV in 2001–2003 and VF & DK in 2019 in vicinity of Willem Barentz field station of Big Arctic Reserve in Meduza Bay (73.359N, 80.537E, ca. 17 km southward from Dickson) northward to Lemberova River mouth (73.405N, 80.653E), and by VF in 2017 and VF & DK in 2019 in vicinity of Dickson village northward to Kurok Cape (73.563, 80.599E) on the northern shore of Taimyr Peninsula and in the vicinity of Meduza Bay (Fig. 1). Collections of TV were identified by EI, and Valery Zolotov (Bryum), collections made by VF & DK were identified by VF, VB (Hepatics), EI and AS. NK took care of specimen processing, databasing and species list compiling. Liverwort specimen collected by VF were transferred alive (in cryo-anabiosis state) to Vladivostok and therefore were studied in the most cases with the preserved oil bodies in leaf cells. This therefore is one of a few studies of Arctic liverworts that used the information on oil bodies in the identification process and evaluation of taxonomic concept. Specimens are kept in MW, MHA, KPABG and VGBI, specimen voucher information is available in online database of Moss flora of Russia (Ivanov et al., 2017), Moscow Digital Herbarium (Seregin, 2020), Online Herbarium VBGI (liverworts, http://botsad.ru/herbarium/) and CRIS. Several specimens, collected by Matveyeva, Zanokha and Kannukene in 1970s kept in LE were also added.
Fig. 2. Various habitat types in Dikson area (## correspond ecotope numbers in text): A: Meadow near William Barents field station and rocky ridges in the opposite bay shore (## 1,3); B: Arctic tundra and low rocky ridge in the watershed (## 1,3,4); C: Watershed slope in the Meduza Creek upstream (## 3,4,5,6); D: Sedge & cotton grass dominated tundra in the flood plain of Meduza Creek (## 4, habitats of Tomentypnum nitens, Aulacomnium palustre, Drepanocladus spp.); E: Lemberova River in lower course with landslides on right bank and frost mounds along the left bank flood plain edge (## 3,6,7); F: Rocky ridge and snowfield on its north faced slope (## 1, habitats of Kiaeria blyttii, Andreaea ssp., Hymenoloma crispulum); G: Extensive snowfield and brook valley southward Dickson village (## 1,5,6); H: Extensive frost mounds in a creek valley southward Dickson village (## 7, habitat of Psilopilum cavifolium, Pogonatum spp., Hennediella heimii var arctica, Dicranella spp., Pohlia spp.).
Bryophytes of Dickson area, Western Taimyr

LIST OF SPECIES

Nomenclature of liverworts and mosses in the list of species follows Konstantinova et al. (2009) and Ignatov et al. (2006) correspondingly, with further amendments. Frequency of species is provided as follow: Com – common in at least one of widespread ecotopes (1, 3, 4) or in two or more ecotopes; Fr. – common in rare ecotopes (2, 5-9) or constantly occurs in three or more ecotopes including widespread ones; Sp. – constantly occurs in few rare ecotopes or rare in wide range of ecotopes; Rar. – few specimens (less then five) from different places or found in a single locality with low abundance; Un. – single locality with low abundance. This system largely corresponds to those accepted in Fedosov & Ignatova (2005) and Fedosov et al. (2019). Distribution within studied area, through the range of delimited ecotopes (1-9) and types of substrata are provided as well as accompanying species (for liverworts). Areas are coded as follow: D – Dickson village outskirts, i.e. from Chertova River mouth in the south to Taimyr Peninsula northern shore (Fig. 1); M – vicinity of Willem Barentz field station in Meduza Bay northward to Lemberova River mouth. Ecotopes are coded as follow: 1 – rockfields; 2 – rocky tundra, 3 – zonal Arctic tundra, 4 – wet cotton grass dominated tundra and bogs, 5 – wet lower parts of ridge slopes below snowfields, 6 – creek banks, 7 – eroded slopes and frost mounds; 8 – rural ecotopes (details are considered above). Substrata are abbreviated as follow: dr – dry or mesic rock, wr – wet or submerged rock, df – dry to moist fine soil, wf – wet fine soil, mg – other mineral ground, dh – dry to mesic humus; wh – wet humus or turf; s – peatmoss hummocks, t – wood or other substrata, not characteristic for the area natural conditions (trash). Most characteristic accompanying species are listed; presence of reproductive structures is reported. Hepatics, referred to the area by Zhukova & Matveyeva are also accounted; however, since no sufficient data about mosses of the area was published, only our data is provided in list below.

HEPATICS

Anastrophyllum sphenoloboides – This species was found by Zhukova & Matveyeva, (2000), but is absent in our collections

Aneura pinguis – Zhukova & Matveyeva (2000); Sp. D; 3,7; f, dh; with Lophozia sylvicola

Anthelia juratzkana – Zhukova & Matveyeva (2000); Sp. D; 1,3,4,5,7; f, dh; with Lophozia sylvicola

B. hatcheri – Zhukova & Matveyeva (2000); Sp. D; 1,2,3,5, f; dh; with Lophozia sylvicola

B. lycopodioides – This species was reported by Zhukova & Matveyeva, (2000), but is absent in our collections

Blepharostoma brevirete – Zhukova & Matveyeva (2000); Fr. M, D; 1,3,4,5,7; f, dh, mg; with Anthelia juratzkana, Cephalozia bicuspidata, Cephalozia cf. varians, Diplophyllum taxifolium, Lophozia ventricosa, Nardia geoscyphus, Scapania parvifolia, Sphagnum minutus, Trilophozia quinquidentata

Calcicularia laxa – Rar. D, M; 4; wh; with, Aulacomnium turgidum, Sanionia uncinata, Scorpidium revolvens, Sphagnum squarrosum.

Cephalozia ambiguа – This species was reported by Zhukova & Matveyeva, (2000), but is absent in our collections

C. bicuspidata – Zhukova & Matveyeva (2000); Un. D; 3; mg; with Sphagnum minutus

Cephalozia arctogena – Zhukova & Matveyeva, (2000); Rar. D, M; 2; ?; with Lophozia sp., Dicranum cf. spadiceum, Pohlia cruda, Sanionia uncinata, Brachythecium americanum, Flexitrichum sp., Hypnum cupressiforme, Tomenonium sp., Rhytidium rugosum

C. hampeana – Un. D; 4; wh; in pure mats or with Blepharostoma brevirete, Fuscocephaloziopsis leucantha, Scapania paludosa, Schljakovianthus quadrilobus, Trilophozia quinquidentata

C. spinigera – Zhukova & Matveyeva (2000); Rar. D; 3,5; wh,f; with Odontoschisma macounii, Scapania paludicola, Trilophozia quinquidentata

C. uncinata – Rar. M; 3,4,6; wh, t; with Barbilophozia barbata, Lophoziospis excisa, Ptilidium ciliare, Sphagnum minutus, Trilophozia quinquidentata, Timmia comata, Aulacomnium turgidum, Pohlia cruda, Polytrichastrum hyperboreum, Dicranum elongatum, Sphagnum sibiricum

C. varians – Zhukova & Matveyeva (2000); Sp. D, M; 1,4,5,6; f,wh; with Anthelia juratzkana, Lophozia cf. longiflora, L. ventricosa, Lophoziospis excisa, Scapania hyperborea, Sphagnum minutus, Trilophozia quinquidentata, Bryum palens, Polytrichastrum alpinum, Oncophorus cf. wahlenbergii, Campylium stellatum, Aulacomnium turgidum, Plagiothecium denticulatum, Sanionia uncinata and other common mosses

Chiloscyphus polyanthos – Rar. D, M; 6,8; wh,t; with Ptilidium ciliare, Sanionia uncinata, Campylium stellatum, Calliergon giganteum, Tomenonium sp., Brachythecium mildeanum, Drepanoclados polygamas

Chiloscyphus polycarpus – Zhukova & Matveyeva (2000); Sp. D; 6; wh; with Aneura pinguis, Blepharostoma cf trichophyllum, Scapania paludicola, Trilophozia quinquidentata

Clevea hyalina – This species was reported by Zhukova & Matveyeva, (2000, as Athalamia hyalina), but is absent in our collections

Cryptocolea imbricata – Un. D; 1; dh; with Kiaeria blyttii, Plagiothecium cf. denticulatum, Pohlia cruda

Diplophyllum taxifolium – Zhukova & Matveyeva (2000); Sp. D; 1; dh; with Blepharostoma brevirete

Frullania subarctica – Zhukova & Matveyeva (2000), as F. nisquallensis Sull.; Rar. D; 2; f,wh; with Radula prolifera

Fuscocephaloziopsis leucantha – Un. D; 5; wh; with Blepharos-
tomato trichophyllum var. brevirete, Cephaloziella hampeana, Orthocaulis quadrilobus, Trilophozia quinquedentata
F. plenceps – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
Gymnomitron concinnatum – Zhukova & Matveyeva (2000); Sp. M; D; 1,5; f
G. coralloides – Zhukova & Matveyeva (2000); Rar. D; 1; f; with Sphenolobus minitus
Jungermannia polaris – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
L. ventricosa
L. murmanica
– Rar. D; 3,5; dh, sp; with
Lophoziopsis excisa
L. ventricosa – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
J. pumila – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
Lophozia longiflora – Zhukova & Matveyeva (2000); Un. D; 5; wh; with Cephaloziella varians, Lophoziopsis excisa, Scapania hyperborea, Trilophozia quinquedentata
L. murmanica – Un. M; 1,3; df with Scapania scandica, Blepharostoma brevirete, Schistochilopsis incisa, Spagnum balticum, Polytrichum hyperboreum, Dicranum sp., Aulacomnium turgidum
L. savicziae – Zhukova & Matveyeva (2000); Un. D; 3; dh; with Diplophyllum taxifolium
L. subapiculata – Rar. D: 3,5; dh, sp; with Cephaloziella sp., Pseudotritomaria heterophylla, Schistochilopsis incisa, Lophozia ventricosa var. longiflora, Spagnum squarrosum, S. warnstorffii, Polytrichum hyperboreum, Scorpidium revolutum, Dicranum angustum [1]
L. sylvicola – Un. D; 1,2,3; dh; with Gymnomitron coralloides, Lophozia ventricosa, Sphenolobus minitus, Trilophozia quinquedentata
L. ventricosa var. ventricosa – Zhukova & Matveyeva (2000, without variety identification); Sp; D: 1,3,5,6; f, dh, wh; with Anthelia juratzkana, Blepharostoma brevirete, Cephaloziella bicuspidata, Cephaloziella spp., Diplophyllum taxifolium, Lophoziopsis polaris, Nardia geoscyphus, Scapania cf. parvifolia, Schistochilopsis opaciola, Sphenolobus minitus
L. ventricosa var. longiflora – Rar. M: 3; ?; with Ptilidium ciliare, Calycularia laxa, Blepharostoma brevirete, Tomentypnum nitens, Aulacomnium turgidum, Orthothece cf. chryseeon, Dicranum angustum, Campylium stellatum, Polytrichum hyperboreum Sanionia uncinita, Flexitricium cf. flexicaule
L. ventricosa var. rigida – Sp; D: 6; wh; with Blepharostoma trichophyllum var. brevirete, Scapania spitzbergensis, Sphenolobus minitus, Trilophozia quinquedentata [2]
L. wenzelii – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections. The record most probably based on misidentified L. murmanica.
Lophozia excisa – Zhukova & Matveyeva (2000); Rar. D; M: 5,6; wh; with Cephaloziella uncinata, Schistochilopsis incisa, Trilophozia quinquedentata, Spagnum teres Cinclidium latifolium, Dicranum cf. spadiceum, Polytrichastrum alpinum, Aulacomnium palustre, Polytrichum hyperboreum
L. pellicida var. minor – Un. D: 6; wh; with Anthelia juratzkana, Blepharostoma brevirete, Cephaloziella bicuspidata, Odontoschisma macounii, Trilophozia quinquedentata
L. polaris – Rar. D: 1,2,3; f, dh; with Anthelia juratzkana, Diplophyllum taxifolium
L. polaris var. spagnumorum – Sp; D: 1,3,5; f, mg; with Blepharostoma brevirete, Mesopychya heterocelops, Sphenolobus minitus, Trilophozia quinquedentata [3]
L. propagulifera – Un. D: 3; dh
Mannia gracilis – Zhukova & Matveyeva (2000, as Asterella gracilis), Rar. D: 3; mg
Marchantia alpestris – Zhukova & Matveyeva (2000); Rar. D: 7,9; wh,mg
Marsupella emarginata – Un. D: 1; f
Mesopychya badensis – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
M. gillmani – Un. D: 6; wh
M. heterocelops var. heterocelops – Zhukova & Matveyeva (2000, without variety identification); Sp; D, M: 2,3,5,6,8; wh,mg; with Blepharostoma brevirete, Cephaloziella varians, Trilophozia quinquedentata
M. heterocelops var. arctica – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
M. heterocelops var. harpanthoides – Un. D; 5; wh
M. rathceana – Zhukova & Matveyeva (2000); Sp; D: 5,6; wh; with Annea pinguis, Trilophozia quinquedentata
M. sahlbergii – Zhukova & Matveyeva (2000); Sp; M; D: 4,5,6; wh
Moerkia blyttii (Mfrrch) Brockm. – Un. D: 7; mg; with Schistochilopsis opaciola, Trilophozia quinquedentata
Moerkia hibernica – This species was reported by Zhukova & Matveyeva (2000), but in our opinion, this record actually bases on M. flotoviana, which for a long time has not been recognized from the previous species
Nardia geoscyphus – Zhukova & Matveyeva (2000); Un. D: 7; mg; with Moerkia blyttii, Schistochilopsis opaciola, Trilophozia quinquedentata
Neoortothecium bistensteini – Zhukova & Matveyeva (2000); Un. M; 1; df; with Neoortothecium bistensteini, Schistochilopsis incisa, Lophozia murmanica, Spagnum balticum, Polytrichum hyperboreum, species of the genera Flexitrichum, Dicranum and Tomentypnum
N. hyperboreus – Zhukova & Matveyeva (2000); Un. D: 3; dh; with Cephaloziella varians, Frullania subarctica, Lophozia excisa
Odontoschisma elongatum – Un. M: 6?; ?; with Lophoziopsis excisa, Cephaloziella uncinata, Schistochilopsis incisa, Trilophozia quinquedentata, Spagnum teres Cinclidium latifolium, Dicranum cf. spadiceum, Polytrichastrum alpinum, Aulacomnium palustre, Polytrichum hyperboreum
O. macounii – Zhukova & Matveyeva (2000); Sp; D: 3,4,5,6,7; f, wh,mg; with Annea pinguis, Blepharostoma brevirete, Nardia geoscyphus, Scapania paludicola, Schljakovianthus quadrilobus, Selenostoma subellipticum, Sphenolobus minitus, Trilophozia quinquedentata
Peltulepis quadrata – Un. D; 3; mg
Prasanthus suecicus – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
Preissia quadrata – Zhukova & Matveyeva (2000); Un. D; 7; mg; with Blepharostoma trichophyllum var. brevirete
Pseudolophozia sudetica – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
Pseudotritomaria heterocolpos – Zhukova & Matveyeva (2000); Rar. D: 3; dh; with Blepharostoma brevirete
Priligium ciliare – Zhukova & Matveyeva (2000); Com. M; D: 2,3,4; dh, wh
Radula prolifera – Zhukova & Matveyeva (2000); Un. D; 3; dh
Sauteria alpina – Zhukova & Matveyeva (2000); Rar. D; 7; mg; with Aneura pinguis
Scapania brevicaulis – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
S. crassirretis – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
S. cuspiduligera – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
S. degeni – Rar. D; 5,6; wh; with Aneura pinguis, Blepharostoma brevirete, Mesoptychia rutheana, Scapania paludicola, Schlukianthus quadrilobus, Trilophozia quinquendentata
S. gymnostromophila – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
S. irrigua – This species was reported by Zhukova & Matveyeva (2000); Un. D; 3; dh; with Lophoziosis polaris var. spagnumorum, Mesoptychia heterocolpos
S. kaurinii – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
S. lingulata – Un. M; 3; ?, with Tomentypnum sp., Stereodon hanulosus, Aulacomnium palustre, Polhia cruda, Polytrichastrum alpinum, Oncophorus cf. wahlenbergii, Isopygychiella pulchella
S. obcordata – Zhukova & Matveyeva (2000); Un. M; 6; wh; with Sphenoleboa varians, Schlukianthus quadrilobus, Sanionia uncinata, Tometypnum sp., Aulacomnium turgidum, Bryum pseudotriquetrum
S. paludicola – Rar. D, M; 5, 6; wh; with Blepharostoma brevirete, Cephalozia spinigera, Cephalozia varians, Schlukianthus kunzeana, Trilophozia quinquendentata, Bryum pseudotriquetrum, Cinclidium latifolium, Aulacomnium turgidum, Sanionia uncinata, Polytrichastrum alpinum, Scorpidium revolvens and other common march mosses
S. paludosa – Rar. D; 5, 6; wh; with Blepharostoma brevirete, Cephalozia hampeana, Fuscocephaloziopsis leucantha, Orthocaula quadrilobus, Trilophozia quinquendentata
S. parvifolia – Rar. D, M; 1, 3; f; with Cephalozia bicuspidata, Sphenoleobus minutus, Blepharostoma trichophyllum, Polytrichium hyperboreum, Dicranum angustum, Aulacomnium turgidum, Sphagnum inclinatum Mnium cf. blyttii, Encalypta alpina, Myurella ternerrina
S. parvifolia s.l. – Rar. D, M; 4, 6; wh; with Blepharostoma brevirete, Cephalozia hampeana, C. varians, Lophoziosis polaris, Mesoptychia heterocolpos var. harpantoides, Scapania paludicola, Trilophozia quinquendentata, Bryum spp., Orthothecium cf. chryson, Sanionia uncinata, Flexitrichum sp., Dicranum elongatum, Aulacomnium turgidum, Sphagnum spp., etc.
Schistochilopsis opacifolia was reported by Zhukova & Matveyeva (2000) and found in our collection; however, molecular-pylogenetic study of the genus (Bakalin et al., 2020) showed that S. opacifolia should be considered as synonym of S. incisa. Two specimens from our collection morphologically fit to S. hyperactica and even were tested using molecular phylogenetic data (see Bakalin et al., 2020), but also appeared mixed with morphologically heterogeneous specimens in S. incisa s.l. clade.
Schizkiaxia kunzeana – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections
Schizkiaxia quadrilobus – Zhukova & Matveyeva (2000); Rar. D, M; 4, 6; wh; with Blepharostoma brevirete, Cephalozia hampeana, C. varians, Lophoziosis polaris, Mesoptychia heterocolpos var. harpantoides, Scapania paludicola, Trilophozia quinquendentata, Bryum spp., Orthothecium cf. chryson, Sanionia uncinata, Flexitrichum sp., Dicranum elongatum, Aulacomnium turgidum, Sphagnum spp., etc.
Solenostoma obovatum – This species was reported by Zhukova & Matveyeva (2000), but is absent in our collections. Most likely the present record belongs to S. subellipticum before commonly not recognized as the species distinct from S. obovatum.
S. subellipticum – Rar. D; 5,6,7; wh; with Aneura pinguis, Chiloscyphus pallescens, Scapania paludicola
S. subellipticum – This species was reported by Zhukova & Matveyeva (2000); Un. M; 5, 6; wh; with Aneura pinguis, Chiloscyphus pallescens, Scapania paludicola
S. subfloratum – Rar. D; 7; 207
Blindia acuta – Sp. D; 1, 5; dr, wf
Brachythecium trachypodium – Rar. M; 1, 2; dr
Brachythecium cirrosum – Sp. M, D; 3, 4, 5, 6, 7, 8; dh, wh
B. cf. jaucuticum – Un. M; 1; dh
B. mildeanum – Rar. M, D; 3, 4, 8; wh
B. turgidum – Rar. D; 5, 6, 8; mg, wh
Bryobrittonia longipes – Rar. M, D; 7; mg
Bryophyllum terricmmasum – Rar. M, D; 3, 7; mg
B. recurvirostrum – Fr. M, D; 1, 2, 3, 7; wf, df, mg; S+
Bryum alpicum – Un. M; 3; S+
B. ambylopon – Un. M; 1; df; S+
B. archangelicum – Un. M; 3; dh; S+
B. arcticum – Sp. M; 3, 6; dh, mg; S+
B. argenteum – Sp. M, D; 9; mg; r; S+
B. cryophilum – Rar. D; 8; wf
B. cyclophylhum – Fr. M, D; 5, 6; wf, wh
B. elegans – Rar. M, D; 1; dr, dh, or
B. knowltonii – Un. M; 6; wf; S+
B. neodamense – Un. D; 4; wf
B. pallens – Un. M; 6; wf
B. pseudotrichiicum – Fr. M; 4, 5, 6, 8; wf, wh
B. purpurascens – Un. M; 2; df; S+
B. rutland – Sp. M, D; 5, 7; wh, mg
B. salinum – Un. M; 8; mg; S+
B. schleicheri – Un. M, D; 3; dh
B. wrightii – Rar. D; 3; mg; S+
Buckia vaucheri – Rar. M, D; 2; dh
Calliergon cornifolium – Un. M; 4, 6; wh
C. giganteum – Sp. M, D; 4, 5, 6, 8; wh
C. richardsonii – Rar. M, D; 4; 5; wh
Calliergonella lindbergii – Rar. M, D; 6; wh
Campyliadelphus chrysophyllum – Rar. M; 6, 8, 9; wh; t
Campylium bambergeri – Rar. M, D; 2, 3; dh
C. stellatum – Fr. M, D; 3, 4, 5, 6, 7, 8, 0; wf, mg, dh, wh, t
Ceratodon heterophyllum – Un. M; 8; mg
C. purpureum – Sp. M, D; 1, 2, 3, 6, 7, 8, 9; df, mg, dh, wh, t; S+
Cinclidium arcticum – Sp. M, D; 5; wh
C. latifolium – Sp. M, D; 4, 5; wh
C. minutifolium – Rar. M; 5; wh
C. cespitum – Un. M; 4; df
C. subrotundum – Rar. M; 4; df; S+
Cnestrum alpestre – Fr. M, D; 1, 2, 3; df, mg; S+
C. glaucescens – Un. M; 3; mg; S+
Conostomum tetragonum – Fr. M, D; 1, 2, 3, 5; df; dh; S+
Crateoenurum curvicaule – Rar. D; 4, 6, 7; mg, wh
C. filicinum – Rar. D; 3, 4, 7, 8; mg, wh
Cynodontium strumiferum – Sp. M; 1, 2; dh, or; S+
C. tenellum – Fr. M, D; 1; dh; S+
Cytomnium hymenophyllum – Rar. M; 7; mg, dh
C. schenckii – Rar. M; 3, 6, 7; mg; S+
D. schischkinii – Fr. M, D; 4, 5; wh, s
D. leioneuron – Un. D; 4; wh
D. majus – Rar. D; 2; mg, dh
D. schizakvii – Rar. M; 2; dh
D. septentrionale – Rar. D; 3; dh
D. spadiceum – Rar. M, D; 1, 2, 3; dh
Didymodon ferrugineus – Un. M; 7; mg
D. imcadophilus – Rar. D; 1; df
Distichium capillaceum – Fr. M, D; 1, 2, 3, 4, 7; wf, df, dh, mg; S+
D. hagenii – Un. M; 5; wh; S+
D. inclinatum – Sp. M, D; 2, 3; mg; S+
Drepanoclados aduncus – Rar. M, D; 6, 7; mg, wh; t
D. arcticus – Rar. M, D; 3, 6, 7; mg, wh; t
D. capillifolius – Un. D; 6; wh
D. polygamos – Rar. M, D; 6; t
D. sordidus – Rar. M; 7; wt, mg
Encalypta alpina – Fr. M; 3, 7; mg, dt, wt; S+
E. brevicolliis – Un. M; 1; df; S+[5]
E. longicolliis – Rar. M; 3; mg; S+
E. mutica – Rar. D; 7; mg; S+[6]
E. procera – Fr. M; 1, 7; wf; mg; S+
E. rhaptocarpa – Sp. M; 1, 7; df, dh; S+
E. trichiniatrix – Sp. M; D; 1, 3; df, dh; S+
Eurhynchastrum pulchellum – Rar. M, D; 7; dh
Fissidens arcticus – Sp. M, D; 7; mg; S+
F. cf. bryoides – Rar. M, D; 1; wf; S+
F. omsundoides – Rar. M; 7, 8; dh
Flexitrichium flexicaule – Fr. M; D; 1, 3, 7; df, wf, mg, wh
F. gracile – Sp. M, D; 1, 2, 4, 5; wh; S+
Funaria arctica – Sp. M, D; 7; mg; S+
F. hygrometrica – Rar. M, D; 7; 9; mg; t; S+
Grinia incisa – Fr. M; D; 1; df
Hamatocharis vernicosus – Fr. M, D; 4, 5; 6; wh
Hennediella heimii – Fr. M, D; 7, 9; mg; S+
Hygrohypnalis polaris – Fr. M; D; 1, 5, 6; wr, wf
Hygrohypnum luridum – Un. M; 6; wr, wf
Hylcomium splendens – Com. M, D; 1, 2, 3; df
Hymenoloma crispulum – Fr. M; D; 1; wf; S+
Hypnum cupressiforme – Sp. M, D; 1; df
Isopyrigetella albicaulis – Un. M; 4; wh
I. pulchella – Fr. M; D; 1, 2, 3, 5, 7; df; dh; S+
Isopyrigetella catagonioides – Rar. M; 1; df, dh
Kiaeria blyttii – Fr. M; D; 1; wr; df; S+[7]
K. glacialis – Rar. D; 5; wh
Leptobryum pyriforme – Rar. M; D; 9; S+
Lewinskya cf. ivatsukii – Rar. M; 7; dh; S+[8]
Loeskiyphyllum badium – Rar. M, D; 4; wh
Meesiag longiseta – Un. M; 5; wf; S+
M. minor – Sp. M; 2, 3, 7; mg; S+[9]
M. triquetera – Rar. M, D; 4; wh
M. uliginosa – Rar. M, D; 4; 6; wh; S+
Mnium blyttii – Rar. M; 2, 7; mg, dh [10]
M. lycopodioides – Sp. M, D; 7; mg
M. thomsonii – Un. M; 3; dh
Myurella julacea – Fr. M; D; 1, 2, 3, 7; df, mg, dh
M. tenerima – Fr. M, D; 7; mg, dh
Neckera oligocarpa – Sp. M, D; 1; dr; S+
Niphitrichium canescens – Rar. M; 6; wr
N. eucoides – Sp. D; 1, 2; df
N. panschii – Fr. M, D; 1, 2, 5, 6, 7; df, wf, mg, dh
Oncophorus elongatus – Rar. M, D; 3, 4, 6, 8; dh, wh, t; S+
COMMENTS ON REMARKABLE SPECIES

1. Lophozia subapiculata was neglected from the time of its description: it is regarded as the synonym of *L. ventricosa* in the revision of *Lophozia* worldwide (Bakalin, 2005) and regarded as doubtful (one asterisk) in the World checklist of liverworts (Söderström et al., 2016). We cannot evaluate the true status for this taxon prior to integrative revision of the genus and include it here provisionally, rather with the purpose to attract attention to this poorly known taxon. Due to data in hand this is the first record of the species in Asia if even the plants in type (arisen from West Greenland) actually represent in molecular-genetic sense the same taxon with the present record. One specimen collected in zonal tundra has smaller leaf cells and not so prominently acute lobe apices.

2. World liverwort checklist (Söderström et al., 2016) does not include infraspecific taxa within *L. ventricosa* treating most of them as the independent taxa of species rank. *Var. rigida* is one of the taxa within ‘*Lophozia ventricosa s.l.*’ whose status is not definitively known and the taxon is neglected in the recent literature. This may be high-Arctic derivative of *L. ventricosa* or even a taxon that needs to be evaluated in the species rank.

3. The undoubtful segregation of *Lophoziopsis polaris* var. *sphagnorum* from *L. polaris* is only possible in the presence of botryoidal oil bodies in leaf cells those were present in alive material of the taxon.

4. The specimen referred here to *Arctoa hyperborea* was sterile and its identification is based on DNA sequence data. Nuclear ITS as well as plastid markers rps4 and trnl and mitochondrial Nad5 from this specimen were nearly identical to specimens of *A. hyperborea* from Novaya Zemlya Archipelago (see Fedosov et al., 2020). Gametophyte morphology meets this species as well, therefore we refer our specimen to *A. hyperborea*. This rare species and its differences from *A. fulvella* are likely misunderstood. Partial revision of the genus *Arctoa* in LE revealed several specimens from Kola Peninsula and one specimen from Chukotka, which morphologically fit *A. hyperborea* rather than *A. fulvella*. On the other hand, in phylogenetic tree in Fedosov et al. (2020), *A. hyperborea* forms a clade nested within *A. fulvella*. Additional sequencing and revision is needed to confirm the status and clarify distribution of this critical taxon.

5. *Encalypta brevicollis* is widespread in inland part of Taimyr but here it is reported for peninsular one for the first time.

6. *Encalypta mutica* is widespread in inland part of Taimyr but here it s reported for peninsular one for the first time.

7. *Kiæria blytii* is very abundant within the studied area and very diverse morphologically: along with the plants with short mamillloose upper leaf cells (which are rather rare), plants with falcate leaves and elongate upper leaf cells occur and are especially abundant. Morphologically these plants rather resemble *K. starkei*, and based on such plants *Kiæria starkei* was listed for Anabar Plateau (Fedosov et al., 2011) and likely also for Novaya Zemlya Archipelago (Vekhov & Kuliev, 1998). However, two DNA-barcoded specimens are identical to one of haplotypes of *K. blytii*.

8. The identity of large Arctic plants of *Lewinskya* needs in further study. Unpublished results of the first author show that plants recently assigned to *L. iwatsukii* actually are not homogeneous, and several different haplotypes, which do not form a separate clade, occur in Arctic. At the same time, high Arctic plants have a unique haplotype. However, this regularity, as well as morphological identity of high Arctic plants should be checked with broader selection of samples.

9. *Meesiæ minor* for a long time has been considered as a synonym of *M. uliginosa* until Hedenäss (2020) resurrected it based on the results of molecular phylogenetic analysis; it was consequently found to be rather common in Russia. In studied area these two species differ in ecology: *M. minor* colonizes spots of bare loamy soil in spotty tundra, while *M. uliginosa* occurs in closer bryophyte communities in tundra bogs or along brooks.

10. Several specimens from vicinity of Meduza Bay and from Dickson are referred herein to *Mnium blytii* were originally identified as *M. stellare* due to lack of any cell differentiation along leaf margin. At the same time, according to Ignatov et al. (2018), the latter species does not occur in Taimyr, so these strange plants nevertheless represent a marginal phenotype of *M. blytii*. Additional study is needed to check its identity.

11. Arctic plants of *Plagiothecium denticulatum* from the vicinity of Meduza Bay resemble other saxicolous collections of this species from Taimyr in having broadly acute to obtuse, rarely hook like pointed leaves with recurved margins. Status of this taxon needs in further study.

12. According to the key to the genus *Pseudocalliergon* in Flora of North America (Hedenäss & Miller, 2014), *P. brevifolium* should have acute to short acuminate leaves, while most of our plants have longer acuminate ones, unlike plants from vicinity of Ledyanaya Bay of from Anabar Plateau. At the same time, according to this key, *P. angustifolium* usually has prorate laminal cells, while in our plants cells are not prorate. According to Hedenäss & Miller (2014), these species differ in ecology: *P. brevifolium* usually occurs in rich arctic fens, while *P. angustifolium* grows in medium rich fens. Despite of northern locality, in the studied area rich arctic fens are very rare (and short-leaved plants occur there), while in other mire ecotopes *Pseudocalliergon* species with falcate leaves either absent or are represented by longer leaf form, thus attributed to *P. angustifolium*.

13. Identity of this arctic *Pterygoneurum* species remains unclear. This plant is rather frequent in salty sediments throughout Taimyr; it was first considered by Abramova et al. (1973), and due to unknown reason re-
ferred to *P. lamellatum*. At the same time, this European species differs from most congeneric ones in having peristome capsules, while capsules in plants from Arctic Taimyr are eperistome. From widespread *P. ovatum*, which occurs in southern part of Taimyr Area and often grows together with “*Arcte P. cf. lamellatum*”, the latter species differs in having larger plants with longer sporophytes, short to nearly absent hyaline hair points and shape of leaf cells. Unpublished molecular data by Jan Kučera and VF suggest that this plant differs from other Eurasian species of the genus *Pterygoneurum*, but several older names are to be checked before describing it as a new species.

14. Large *Sanionia* morphotype with strongly plicate leaves, which occur along a seashore is morphologically nearly identical to the plants from Kola Peninsula referred to *S. orthothecioides*. At the same time, leaves are somewhat longer acuminate in plants from Dixon area, therefore we are uncertain if they belong to *S. orthothecioides*.

15. One *Sphagnum* specimen represented by green plants, which superficially resembled *S. fimбриatum*, had less conspicuous tin bud, and its stem leaves have lower width/length ratio than *S. fimбриatum* usually has; it also demonstrate strong border at the base, apex lacerated rather to 1/3 – 1/2 of leaf length that is characteristic for *S. concinnum*.

16. Two specimens of *Sphagnum cf. girgensohni* combine characters of *S. girgensohni* and *S. russowii* and therefore could be determined as *S. russowii*. These plants have rather long stem leaves and external cells of hyalodermis with only one medium-sized pore, which is characteristic for the latter species. However, these plants have more lacerate stem leaf apex (from 1/2 to whole leaf width) and less abundant pores on concave surface of branch leaf, which better fit *S. tescorum* or some morphs of *S. girgensohni*.

17. Specimens referred to *Sphagnum warnstorffii* differ from typical populations of this species which grow in taiga zone in having more ovate branch leaves with larger free ringed pores on the first quarter of convex side of leaf as it was pointed for “high arctic *S. warnstorffii*” by Yousefi *et al.* (2019).

18. Although morphologically plants referred to *T. cernua* fit this species well, unpublished data by Jan Kučera and VF suggest that it is slightly different genetically and may represent a separate arctic (?) species.

19. Although, formally plants from vicinity of Dickson village fit *T. laureri*, position of capsule is a variable trait, while gametophytically plants referred to *T. laureri* do not differ from the previous species.

20. The specimen is represented by plants without capsules; it is identical to one from the vicinity of Ladyanaya Bay (Fedosov & Ignatova, 2005), referred to *W. brachycarpa* due to lack of reddish coloration, which is characteristic to *Trichostomum crispulum*. In addition, the latter usually grows in the areas with limestone outcrops, which are absent in studied area.

**DISCUSSION**

With its limited area of exploration (in general ca. 100-150 sq. km), uniform relief, homogeneous bedrock composition and climate, ease to access and long history of the bryophyte flora exploration, Dickson area deserves to be considered as kind of a model object of a - diversity study according to Tolmachov (1974) approach. Therefore we present the studied flora as a reference for comparison with other high Arctic bryophyte moss floras. In studied collections we revealed 69 liverwort and ca. 249 moss species; combined with the previously published data by Zhukova and Matveeva (2000), list of Hepatics includes 90 species and 7 infraspecific taxa, 339 species of bryophytes are referred to the area – nearly 2.5 times more than flora of vascular plants, know from this area (Kuvaev & Vaschenkova, 1994 with further additions; Matveeva & Zanokha, 2017). Although only 88 species of hepatics were hitherto known from arctic tundra subzone of Taimyr, each third liverwort species collected by non-hepaticologist (VF) was new for the area; therefore, our data about their diversity cannot be considered as complete. Therefore, the comparative account below is mostly concentrated on mosses. The bryophyte flora of the vicinity of Uboynaya River mouth comprises 159 species of mosses (Kannukene & Matveeva, 1996) and nearly the same number of moss species were published for the local moss floras of Chukotka Peninsula (Afonina, 1974).

Although the studied area and Uboynaya River lower course represent the same biome and nearly the same landscape, the difference in revealed species is unexpectedly high. Several species of mosses found in vicinity of Uboynaya River mouth are absent in our list. Among them, eleven species, *Aretoa fulvella, Brachythecium udmum, Catascopium nigritum, Didymodon rigidulus, Pohlia filum, Pseudocaliciphyllum trifarium, Sphagnum compactum, S. obtusum, S. russowii, Splachnum sphaericum*, and *Thuidium assimile* occur in similar landscapes in Arctic and Hypoarctic zones and may occur in the studied area, but have not been found. Five species, *Bryum teres, Didymodon asperifolius var. gorkovskii, Blindiadelphus polaris, B. subimmersus*, (originally reported as *Seligeria diversifolia*, but further this specimen was reidentified) and *Trichostomum crispulum* are calcicolous species, which are absent due to lack of suitable substrates.

Circumscription of several species have changed since 1996: *Orthothecium rufescens*, reported for the lower course of Uboynaya River, according to Ignatov *et al.* (2020) does not occur in Arctic; all specimens, previously referred to this species they transferred to *O. chryseon*, while many specimens identified as *O. chryseon* were referred to the newly described *O. retroflexum*. Likewise, specimens from Uboynaya River identified as *Hypnum callichum*, actually belong to *Sedoreon holmenii* (for details see Afonina, 2004); *Plagiothecium laetum*. However, 31 moss taxa from our list have started been recognized after 1996 and therefore could not be reported by Kannukene and Matveeva, but several species appeared in their paper under other names and ca. 80 moss species from our list could appear in their paper, but either do not occur in the vicinity of Uboynaya River mouth or were omitted.
Only three species of Splachnaceae were revealed in the studied flora; this might be explained by low abundance a reindeer due to high human population. At the same time, two of three species, Tetraplodon mnnooides and Aploodon wormskjoldii, are quite frequent in the area, which could be explained by their ability to colonize different types of organic remnants. In addition to a list of “not found species”, Grimmia elatior, G. longirostris, G. funalis, G. jactatica, Pseudohygrohypnum subangyrum, and Encalypta brevipes in central Byrranga (Ledyanaya Bay) occur exactly in the same environments which are widespread in Dickson area, but have not been found in the latter despite of special search and also despite the fact that in Central Byrranga at least three of them are frequent. Lewinskya cf. iwatsuki is common in Central Byrranga, but was found only in one place in Dickson area. Instead, Kiaeria blyttii is common on rock outcrops throughout studied area; this species was referred for vicinity of Ledyanaya Bay (Fedosov & Ignatova, 2005), but this record based on misidentification. Since Kiaeria blyttii generally occurs in more humid environments than other above mentioned species (which usually grow together), this difference in composition of saxicolous moss communities might be caused by mesoclimatic conditions, which are more humid in studied area due to seashore influence appearing as a misty summer weather. The same reason could explain uneven distribution of several other species. In particular, within studied area, Amphidium mougeottii is common along northern seashore of Taimyr Peninsula. On the opposite, both species of Cynodontium are rather frequent in vicinity of Meduza Bay, but do not occur in Dickson village outskirts.

Although the area of á - diversity inventory should be rather homogeneous and species are supposed to be distributed rather homogeneously in all suitable habitats within it, in the studied area this is not always true. An impact of ground/bedrock composition likely supplies probable differences in mesoclimatic conditions between seashore and inland localities, especially ones associated with S-faced slopes resulting in mosaic pattern of bryodiversity on a local scale. In particular, Amphidium mougeottii is common on dolerite rocks near northern seashore, but has not been found in other places, although rock outcrops of similar composition are widespread throughout the area. Buckia vaucheri, Pseudostereodon procerrimus, Schistidium andreaeopsis and Frullania subarctica occur in small patch in rocky tundra near the top of one rocky ridge; apparently, here composition of dolerite rock is somewhat different, with higher calcium content. Although high Arctic environments are usually considered as eutrophic and base rich, rich fens are rather rare in studied area and cover quite limited places, therefore species of the genera Pseudocalliergon, Cinclidium, and Meesia are rather rare (and likely also occur in places with more basic rocks). Instead, Scorpidium cossinii, S. revolvens, Warnstorffia sarmentosa, Bryum pseudotriquetrum, Hamatocaulis vernicosus, species of the genera Calliergon and Sphagnum are common. Composition of pioneer mosses is also uneven. Most interesting species such as Aloina brevirostris, Steggonia latifolia, Pohlia atropurpurea, and Pterygoneurum sp. are mostly concentrated on eroded slope of seashore terrace southward the mouth of Lemberova River. Only here Cnestrum glaucescens and Lewinskya cf. iwatsuki were found, as well as several vascular plant species.

The same factor (i.e. ground or bedrock composition) works in larger scales as well. For instance, moss flora of sandy Siberiyakova Island situated nearby includes only 74 species (Kuvaev et al., 1994). Similar plain landscapes of Arctic Yamal and Gydan largely formed by sandy sediments house even poorer floras, which, according to the available data, include: Belyi Island – 73 species (Czernyadjava, 2001); whole arctic tundra zone of Yamal Peninsula – 133 species (Czernyadjava, 2001), Shokalskogo Island – 79 species (Beldiman et al., 2020).

On the other hand, large scale latitudinal gradient seemingly has a little impact on the bryophyte flora composition within tundra zone. With outstanding latitudinal extension of the area northward timberline and isolation from influence of both Atlantic and Pacific oceans, Taimyr Peninsula is considered as a useful area for studies of zonal trends in composition of arctic flora and vegetation (Matveeva, 1998). Although with insufficient data available to that time, Matveeva (l.c.) concluded that bryophyte diversity decreases northward. According to amended data, ca. 210 species of mosses occur in the vicinity of Ary-Mas area, situated in south tundra subzone of Taimyr Peninsula (Afonina, 1978, Fedosov & Afonina, 2009 with further additions). Ca. 233 species were found in the vicinity of Ledyanaya Bay in the typical tundra subzone, among which numerous saxicolous species could not occur in Ary-Mas Area due to lack of rock outcrops. Formally, comparing moss flora of Ary-Mas area (48 species of liverworts, 210 species of mosses), vicinity of Ledyanaya Bay (52 liverworts and 233 mosses) and present flora (97 liverworts and 251 mosses) one could suggest that the bryophyte diversity increases northward, while in fact other factors, including taxonomic concepts used for specimen identification, recall ratio etc. matter rather than a temperature gradient.

Recent concepts, often improved by use integrative taxonomic approach, managed to reveal high arctic element in moss flora, which was neglected before. Among high arctic taxa, Sphagnum concinnum, “arctic S. warnstorfi”, Orthothecium remotifolium and several other distinct, though weakly delimited taxa worth mentioning, while the identity of several species from our list need further studies. Among predominantly Arctic species, Aploidon wormskjoldii, Bryum purpurascens, Ceratodon heterophyllus, Drepanocladus arcticus, Funaria arctica, Plagiothecium berggrenianum, Pterygoneurum sp., Schistidium andreaeopsis, S. holmenianum, and
Tortula cf. cernua might be listed. One more recently revealed phytogeographically interesting element, neglected before, includes species largely associated with Asian cryolithozone and widespread in Arctic: Lewinskya cf. iwatsukii, Orthothecium remotolobulatum, Plagiothecium svalbardense, and Tomentypnum involutum.

Since Arctic biomes have appeared rather recently, i.e. in early Pleistocene (Yurtsev & Tolmachev, 1970), quite a limited number of vascular plants might be considered as high Arctic endemics, and slowly evolving bryophytes unlikely could form well morphologically distinctive arctic species. In large scale retrospective trend to high extinction rate in higher latitudes is shown by e.g. Dynesius & Jansson (2000) and formulated as the Rapoport’s rule (Rapoport, 1982). Due to a shift of the vegetation latitudinal boundaries northward with increasing temperatures, strong decrease of the areas covered by high Arctic biome in continental areas is predicted (Lijiedahel et al., 2016, Hobbie et al., 2017), associated with quick loss of biodiversity due to the high Arctic taxa extinction. Moreover, a sufficient change in landscape of Dickson area over last 30 years has already been noticed (Matveyeva & Zanokha, 2017). Likely, high arctic bryophytes may survive in Arctic Islands, if they manage to colonize them. Recently Zanatta et al. (2020) highlighted a role of dispersal ability in survival of bryophytes behind the climate change, and in case of Arctic bryophytes, this would be of especial importance, since they are generally known to produce sporophytes seldom (Longton, 1988) and in several groups where high arctic taxa were recently revealed sporophytes occur especially rarely. Obviously, a sufficient portion of high arctic bryophyte diversity can disappear before being discovered and described, therefore the aim of the present account is to encourage bryologist to pay special attention to this very interesting phytogeographical group.

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