

THE MOSS FLORA OF THE NATURE PARK “KONDINSKIE OZERA”  
(KHANTY-MANSI AUTONOMOUS DISTRICT, WESTERN SIBERIA)

ФЛОРА МХОВ ПРИРОДНОГО ПАРКА “КОНДИНСКИЕ ОЗЕРА”  
(ХАНТЫ-МАНСИЙСКИЙ АВТОНОМНЫЙ ОКРУГ, ЗАПАДНАЯ СИБИРЬ)

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Abstract

The article presents the results of long-term investigation and inventory of the moss flora in the territory of the Nature Park “Kondinskie ozera” (Konda Lakes) named after L.F. Stashkevich (Khanty-Mansi Autonomous District – Yugra, West Siberia – 60°54'N, 63°30'E). Observations by the author and archive records since 2001 are summarized. In total, 114 species of mosses were identified for the study area; more than one-third of them (30 species) are *Sphagnum* mosses. 22 species are indicated for the territory of Nature Park for the first time. *Bryum cyclophyllum*, *Dichelyma capillaceum*, *Dicranum septentrionale*, *Mnium thomsonii*, *Sphagnum annulatum*, *S. mirum*, *S. subfulvum*, and *S. tenellum* are rare for the whole of West Siberia. An annotated list of mosses is compiled based on identification of ca. 2000 specimens; it includes the occurrence of species within the Nature Park as well as their ecological and phytocenotic preferences.

Резюме

В статье приведены результаты многолетних исследований по изучению и инвентаризации флоры мхов на территории природного парка “Кондинские озера” им. Л.Ф. Сташкевича (Ханты-Мансийский автономный округ – Югра). Обобщены авторские и фондовые материалы, накопленные начиная с 2001 года. Всего для территории природного парка приводится 114 видов мхов, в том числе 30 видов сфагновых и 84 вида бриевых мхов. Впервые для флоры природного парка указывается 22 вида. В парке выявлен целый ряд видов, редких для всей территории Западной Сибири: *Bryum cyclophyllum*, *Dichelyma capillaceum*, *Dicranum septentrionale*, *Mnium thomsonii*, *Sphagnum annulatum*, *S. mirum*, *S. subfulvum*, *S. tenellum*. Приведен аннотированный список мхов природного парка, в котором дана характеристика встречаемости видов, их экологическая и фитоценотическая приуроченность.

KEYWORDS: bryoflora, mosses, *Sphagnum*, ecology, protected nature territories

INTRODUCTION

Specially protected natural territories are reference areas for studying biological diversity, since the protection regime designed for them allows not only preserving, but also detailed investigating the peculiarities of composition, functioning and spatial and temporal dynamics of natural ecosystems. Identifying the biodiversity and studying of species distribution in such areas is of paramount importance to assessment of the conservation value of ecosystems and organizing monitoring of the population status of rare species. In the taiga zone of Western Siberia, mosses represent an inherent part of plant communities, playing an important phytocenotic

role, often as dominants in the ground cover vegetation or populating open surfaces of coastal outcrops, shoals, ravine slopes, areas with disturbed vegetation and pioneering overgrowth. However, compared to the flora of higher vascular plants, moss flora of the taiga zone of Western Siberia is still insufficiently studied.

The first information on the moss flora of the L.F. Stashkevich Nature Park “Kondinskie ozera” (Konda Lakes) has been presented by Lapshina & Pisarenko (2013), who listed 96 moss species for this territory. They included mainly the species identified during the geobotanical survey in the Nature Park in 2006–2007. The earlier and later moss collections remained untreated.

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The purpose of this study was to make an inventory of the moss flora and supplement the list of moss species with new data, based on the processing of all collections, to identify the main features of the bryoflora and the distribution of moss species in the study area.

#### STUDY AREA

The “Kondinskie ozera” (Konda Lakes) Nature Park is located in the western part of the Khanty-Mansi Autonomous District – Yugra in the middle taiga subzone in an area of wide occurrence of sandy soils of alluvial and fluvioglacial origin. The area of the Natural Park is 43900 ha. The territory occupies the left bank of the Konda River basin in its upper course (60–61°N, 63–63.5°E). The local climate is continental. The average annual air temperature is –0.8°C. The average temperature of the coldest month (January) is –19°C, and the temperature of the warmest month (July) is +17.1°C. The duration of the frost-free period is 97–110 days. The average annual precipitation is 533 mm, of which the main part (82%) falls in the warm period from April to October, with a maximum in July–August, when the average monthly precipitation reaches 71–94 mm.

All small rivers, lakes and mires of the Nature Park belong to the basin of the river Konda. They feed on thawed snow water, rainfall and groundwater that are poor in mineral nutrients.

The relief has a flat-riddling character, complicated by formations of fluvioglacial origin (moraine hills, ridges). The relative height difference is about 100 m.

According to the geobotanical zoning of the Tyumen region, the territory of the Natural Park falls within pine lichen, pine green moss, and spruce-pine green moss forests of the middle taiga subzone of the forest zone of Western Siberia (Voronov & Mikhailov, 1971). The vegetation cover is represented mainly by forest and mire vegetation types.

**Forests** cover about 40% of the area. The most common types of forest in the Nature Park are lichen and cowberry-lichen pine forests (Fig. 2A), which develop on sandy soils of high drained terraces, moraine hills and manes. Along with the common forest moss species, *Pleurozium schreberi* and *Dicranum polysetum*, here are found *Polytrichum piliferum*, *Pohlia nutans*, and *Ceratodon purpureus*. The total moss cover usually does not exceed 5%.

Cowberry-green moss and dwarf shrub (*Vaccinium vitis-idaea*, *Ledum palustre*) green moss pine forests are situated on moderately drained parts of gentle slopes and in flat hollows along the bog margins on sod-podzolic sandy loam and loam soils. The moss cover in such forests is completely dominated by *Pleurozium schreberi*. *Dicranum polysetum* accompanies it in small portions. *Dicranum fuscescens* and *Pohlia nutans* occur at the bases of tree trunks and on rotten wood. In conditions of poor drainage, at early stages of waterlogging, spots of *Polytrichum commune* and peat mosses *Sphagnum angusti-*

*folium*, *S. capillifolium*, and *S. russowii* appear in the moss cover.

Dark coniferous (*Picea obovata*, *Pinus sibirica*) and mixed small herb (*Maianthemum bifolium*, *Trientalis europaea*, *Linnaea borealis*, *Oxalis acetosella*, *Gymnocarpium dryopteris*)-dwarf shrub-green moss forests with admixture of aspen (*Populus tremula*), less often larch (*Larix sibirica*) in the upper layer, are found on a very limited area with loamy substrates of heavier texture. The dominant of moss layer here is *Hylocomium splendens* with a greater or lesser admixture of *Pleurozium schreberi* and *Polytrichum commune*. Such species as *Amblystegium serpens*, *Brachythecium salebrosum*, *Herzogiella turfacea*, *Rhytidiadelphys triquetrus*, *Sciuro-hypnum curtum*, and *S. reflexum* are found at bases of tree trunks and on decaying wood. Only in these types of forest in the Nature Park, rare species for the autonomous district were found: *Mnium spinulosum*, *M. thomsonii*, *Stereodon pallescens*, and *S. plicatulus*.

**Mires** occupy about 60% of the Nature Park area. Among them, oligotrophic pine-dwarf shrub-*Sphagnum fuscum* bogs – “ryams” with low (2–4 m high) pine trees (Fig. 2B), and ridge-hollow complexes predominate. In waterlogged oligotrophic hollows *Sphagnum balticum* sometimes with admixture of *S. majus* and *S. jensenii* is the most common (Fig. 2C). In the wide peripheral stripes and flat depressions of the relief, dwarf shrub-cotton grass-*Sphagnum* bogs occur; they are open or covered with sparse stunted pine. On shallow peat “tall ryams” develop; these are pine-dwarf shrub-*Sphagnum* communities with relatively high tree layer (7–8 m) and *Sphagnum angustifolium* and *S. divinum* in ground layer.

Mesooligotrophic and mesotrophic herb (*Menyanthes trifoliata*, *Comarum palustre*)-*Sphagnum* (Fig. 2E), sedge (*Carex limosa*, *C. rostrata*)-*Rhynchospora alba*-*Sphagnum* and sedge (*Carex lasiocarpa*)-*Sphagnum* homogeneous or patterned fens are situated in waterlogged areas and thalwegs of the ancient hydrographic network, in the center of which there is often a watercourse or flowing quagmire. They are characterized by a large variety of *Sphagnum* moss species. On high hummocks and ridges, *Sphagnum fuscum*, *S. angustifolium*, and *S. divinum* are found; at lower levels *S. papillosum*, *S. flexuosum*, *S. fallax*, and *S. subsecundum* occur; pure carpets are often formed of *S. riparium* and *S. obtusum*, sometimes with admixture of *Sphagnum majus* and *S. jensenii*. Findings of rare species, such as *S. annulatum*, *S. mirum*, *S. subfulvum*, and *S. teres* are precisely confined to these types of biotopes.

Characteristic features of the mesooligotrophic transitional fens and raised bogs of the Nature Park are the presence of groundwater discharge areas, where mesotrophic sedge-*Menyanthes*-hypnum fens and swampy sedge-moss-*Betula nana* bushes – “yerniki” develop (Fig. 2F). All the findings of wetland moss species, demanding the richness of mineral nutrition (*Bryum pseudotriquetrum*,

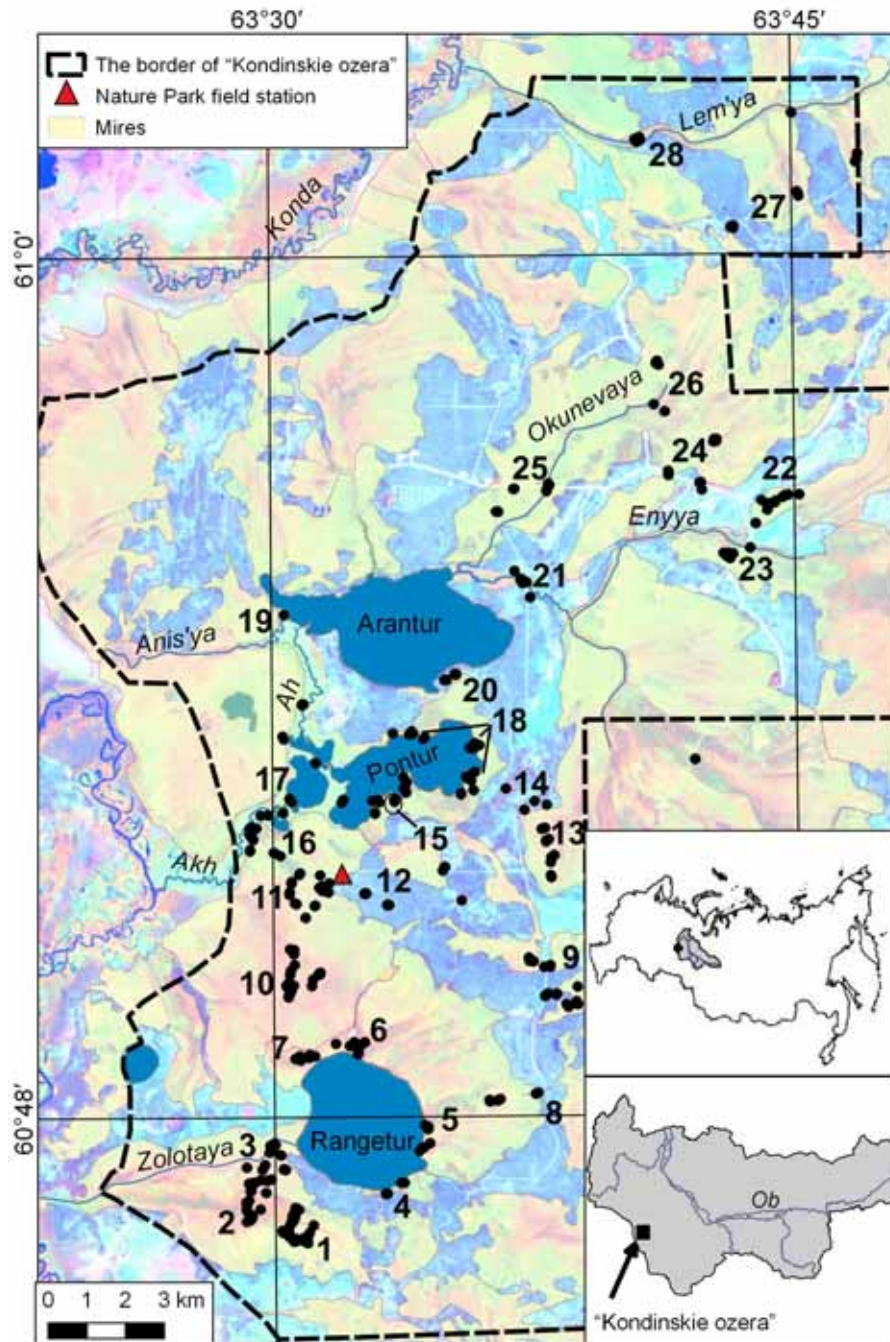


Fig. 1. Moss collection localities in the territory of the Nature Park “Kondinskie ozera”.

1 – central part of Yuzhnoe Mire with ground water discharge areas; 2 – south-west part of Yuzhnoe Mire; 3 – source of Zolotaya River; 4 – southern shore of Rangetur Lake; 5 – Priozernoe Mire on the east shore of Rangetur Lake; 6 – north shore of Rangetur Lake; 7 – ground water discharge area to the north-west from the Rangetur Lake; 8 – valley of the brook Kedrovyy; 9 – Alas Bog with adjacent raised bogs and pine forests; 10 – central part of Bazovoe Bog; 11 – northern part of Bazovoe Bog, incl. ground water discharge sites near the Nature Park field station; 12 – sandy Moraine Hill area adjoining to the field station; 13 – western periphery of the Krylatoe Mire; 14 – Murav’ynaya Gorka” (Ant Hill), limited outcrops of loamy soils among pure pine forests and raised bogs; 15 – “Elovyy Mys” (Spruce Cape) on the southern shore of the Pontur Lake; 16 – left bank of Akh River and adjacent base of moraine hill slop; 17 – flooded valley of Akh River and running-water lakes Krugloe and Lopukhove; 18 – flooded area around the Pontur Lake with adjacent raised bog; 19 – mouth part of the Anisya River valley; 20 – south shore of Arantur Lake; 21 – floodplain of Enyya River (at the bridge); 22 – Polosatoe aapa mire and adjacent dry pine forests; 23 – valley of Enyya River in upper reaches (and through flow fen Zhuravlinoe); 24 – raised bogs and mesooligotrophic fens on interfluvies of rivers Enyya and Okunevaya; 25 – valley of Okunevaya River and small raised bogs on the adjacent uplands; 26 – “Pikhtovyy Ostrov” (Fir Island) in the upper reaches of the Okunevaya River; 27 – Mesooligotrophic mires in the north-east part of the Nature Park territory; 28 – valley of Lem’ya River.

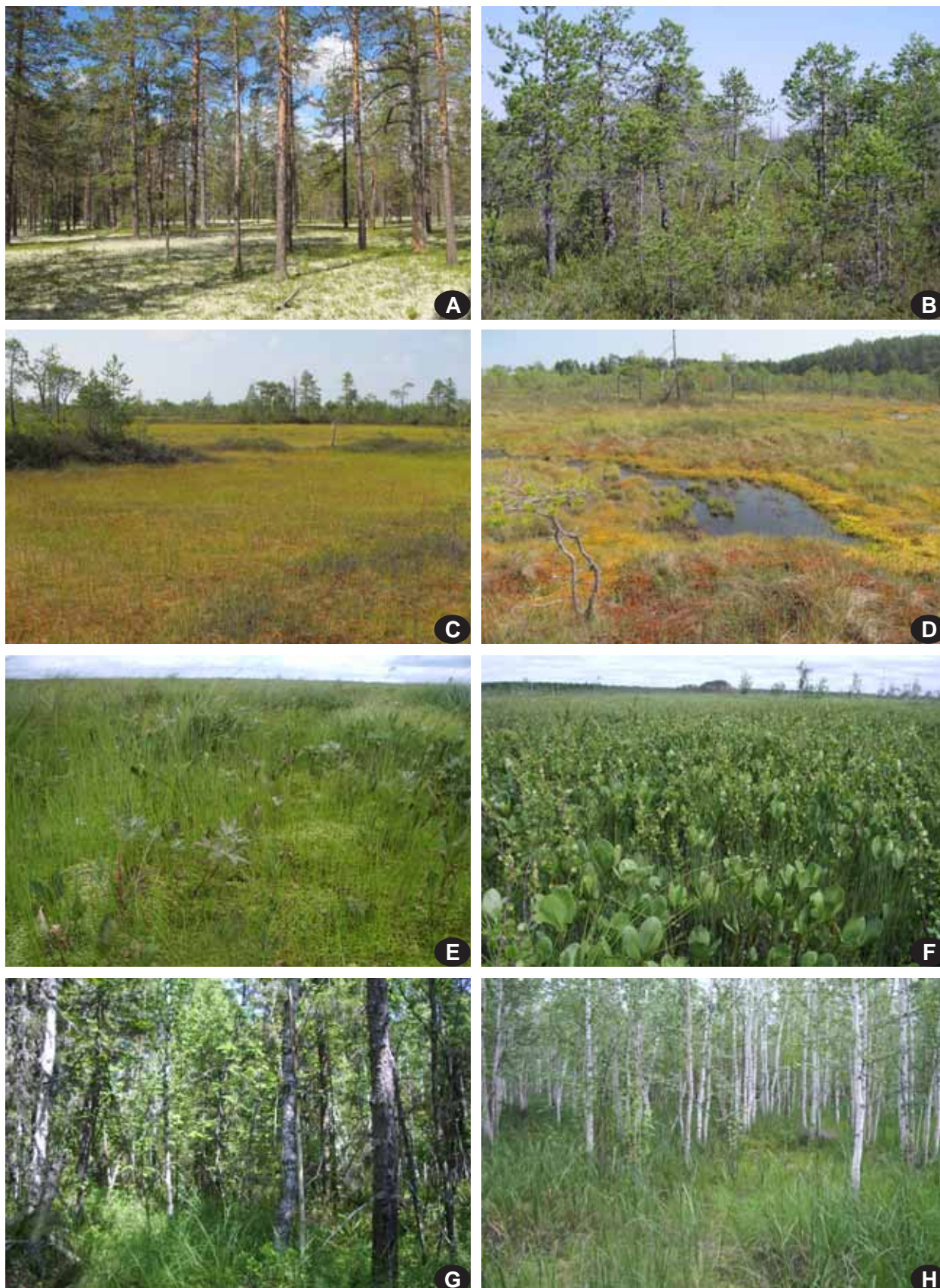


Fig. 2. Views of plant communities in the “Kondinskie ozera” Nature Park. A: dominated in the landscape cowberry-lichen pine forests; B: oligotrophic pine-dwarf shrub-*Sphagnum fuscum* bogs – “ryam”; C: ridge-hollow complex; D: pool-ridge-hollow complex, at the site of low-nutrient groundwater discharge; E: mesotrophic herb-sedge-*Sphagnum* fen; F: swampy sedge-moss-*Betula nana* bushes – “yernik”; G: birch-spruce sedge-herbs-*Sphagnum* forest swamps – “sogra”; H: swampy sedge-*Sphagnum* birch low forest.

*Campylium stellatum*, *Drepanocladus aduncus*, *Helodium blandowii*), are connected only to this type of habitat in the Park.

In the narrow valleys of small rivers and streams, periodically flooded with snowmelt waters, dark coniferous or mixed (*Pinus sibirica*, *P. sylvestris*, *Picea obovata*, *Betula pubescens*) reed-grass (*Calamagrostis purpurea*)-sedge-herbs-*Sphagnum* swampy forests and forest swamps – “sogras” – on the more or less deep peat layer are formed (Fig. 2G). They are distinguished by a high species diversity of mosses, which is associated with a variety of ecological conditions, more favorable hydrothermal regime and relatively high fertility of peaty soil. In addition, rivers are effective ways for settling of many forest, forest-bog, and meadow-bog species. Findings of many rare species of mosses, e.g., *Dicranum septentrionale*, *Eurhynchiastrium pulchellum*, *Plagiothecium latebricola*, *Pohlia cruda*, *P. prolifera*, *Schistostega pennata*, and *Sphagnum aongstroemii* are associated only with these biotopes.

In the zone of periodic flooding of the shores of large lakes and estuarine parts of the small rivers flowing into them, swampy reed grass birch forests with predominance of *Polytrichum swartzii* and sedge (*Carex aquatilis*)-*Sphagnum* low birch swamps are distributed (Fig. 2H), dominated by *Sphagnum fimbriatum* and *S. fallax* (Lapshina, 2015). These communities are enriched with a significant number of moss species, including rare ones, which probably settled here due to the hydrological connection of the habitats with the upstream valley of Konda river. *Calliergonella lindbergii*, *Calliergon cordifolium*, *Leptodictyum riparium*, *Polytrichastrum longisetum*, and *Warnstorfia fluitans* are common components of the moss cover here. Only in such habitats in the Nature Park *Bryum elegans*, *Dichelyma capillaceum*, *Serpoleskea subtilis*, and *Sphagnum platyphyllum* were revealed.

**Grass and shrub vegetation.** On the long-term flooded sites of flood plains of small rivers and low shores of lakes, a variety of specific communities is observed, i.e. bushlands of *Frangula alnus*, *Salix lapponum*, *S. cinerea*; hydrophilic sedge (*Carex aquatilis*), reed-grass (*Calamagrostis purpurea*)-sedge, and reed-grass-sedge-*Comarum palustre* community deprived of mosses.

A special type of habitat is represented by areas disturbed by human activity (embankments and roadsides, overgrown sand pits, beaches and parking grounds). According to the composition of moss species, anthropogenic habitats are similar to natural outcrops along river banks and ravines, where pioneer moss vegetation is represented by *Ceratodon purpureus*, *Dicranella humilis*, *D. subulata*, *Leptobryum pyriforme*, *Pohlia nutans*, and *Pogonatum urnigerum*.

#### MATERIAL AND METHODS

The accumulation of data was based on the identification of mosses collected during geobotanical studies, which covered all the main types of habitats and plant

communities (dark coniferous and mixed forests, pine-lichen light and boggy pine forests, swampy birch low forests and sogras, pure transitional fens and raised bogs). During the field investigations, the attention was also focused on non-cenotic biotopes: roadside ditches, outcrops, forest roads, trails, river banks and lake shores. This approach provided a fairly complete revealing of species composition of all the main types of habitats and plant communities available in the Nature Park (Fig. 1).

In total, during geobotanical survey 520 vegetation relevés were performed with full identification of the species composition of mosses, about 2 thousand moss specimens were collected and more than eight thousand determinations were made.

Moss collections of 2001–2003 were determined by A.P. Dyachenko and partly re-identified by E.D. Lapshina; 2006–2007 by E.Ya. Muldiyarov; 2008–2017 by E.D. Lapshina; 2018 by N.N. Korotkikh. Moss collections of 2001–2003, 2008 and 2018 are stored in the Herbarium of L.F. Stashkevich Nature Park “Kondinskies ozera” (Konda Lakes). All other samples are kept in the Biological Collection of the Yugra State University (YSU).

#### RESULTS

An annotated list of mosses found in the “Kondinskies ozera” (Konda Lakes) Nature Park is presented here. The names of taxa are listed in alphabetical order. The nomenclature follows the “Check-list of mosses of East Europe and North Asia” (Ignatov *et al.*, 2006), taking into account recent taxonomic studies (Tubanova, 2010; Hassel *et al.*, 2018). For each species, the frequency of occurrence on the territory of the Nature Park is indicated as follow: Un – unique (found in one site), Rar – rare (2–5 sites), Sp – sporadic (6–15 sites), Fr – frequent (more than 15 sites). The number in parentheses indicates the actual number of registered sites. Altogether about 500 points (vegetation relevés and moss collecting sites) were studied, but on the map they are combined, thus the map includes only 28 localities (Fig. 1), which are listed for each species with bold type. This is followed by brief information on the distribution and phytocenotic preferences of the species. For rare species found on the territory of the Nature Park no more than from 3 sites, labels are cited.

General locality for all specimens: Khanty-Mansi Autonomous District, Sovetsky District, “Kondinskies Ozera” Nature Park. The species that we first cited for the flora of the Nature Park are marked with an asterisk (\*), the species included in the Red Book of the Khanty-Mansi Autonomous District are marked with two asterisks (\*\*).

#### SPECIES LIST

*Amblystegium serpens* (Hedw.) Bruch, Schimp. & W. Gümbel – Rar (3). **14**: in an aspen-pine-birch-grass forest. 60.87331 N, 63.60988 E. 25.VIII.2010. 186-10, YSU. Lapshina; **15**: in a spruce-pine small herb-green moss forest, at the bottom of aspen trees. 60.87361 N, 63.55011 E. 24.VIII.2010. 1-10,

- YSU. Lapshina; **23**: in mixed (*Picea obovata*, *Pinus sibirica*, *Betula pubescens*) reed grass-herb-*Sphagnum* swamp forest (sogra), on decaying wood. 60.93162 N, 63.72867 E. 7.VII.2006, 250-06, YSU. Muldiarov. Two first specimens are represented by var. *juratzkanum* (Schimp.) Rau & Herv.; the third one – by type variety.
- \* *Atrichum tenellum* (Roehl.) Bruch, Schimp. & W. Gümbel – Rar (1). **20**: in the sedge-*Eliocharis palustris* community on pure sand. 60.90175 N, 63.58230 E. 25.VIII.2010. 2-10, YSU. Lapshina.
- Aulacomnium palustre* (Hedw.) Schwägr. – Fr (29). **1-4, 7-9, 13-28**: in all types of wet and boggy forests, poorly forested fens and forest swamps, as well as in ryams and on ridges of raised bog complexes.
- Brachythecium mildeanum* (Schimp.) Schimp. – Un (1). **3**: sedge-moss fen, in a soaking ryam island, submerged from the side of the lake. 60.77703 N, 63.50925 E. 2.VII.2006. 100-06, YSU. Lapshina.
- B. salebrosum* (F. Weber & D. Mohr) Bruch, Schimp. & W. Gümbel – Sp (7). **4, 14-15**: in dark coniferous grass-green moss and mixed grass forests, boggy forests and sogras along the valleys of small rivers; grows at tree bases and dead fallen wood.
- Bryum creberrimum* Taylor – Un (1). **3**: on a soaking island of ryam, which is submerged from the lake. 60.77703 N, 63.50925 E. 2.VII.2006. 100-06, YSU. Lapshina.
- \* *B. cyclophyllum* (Schwägr.) Bruch, Schimp. & W. Gümbel – Rar (2). **16**: Left bank of Akh River, on moist soil. 60.86756 N, 63.48989 E. 24.VIII.2010. #181-10, YSU. Lapshina; *ibid*, in sedge willow thickets, on moist clayish soil. 60.86722 N, 63.48894 E. 24.VIII.2010. #183-10, YSU. Lapshina.
- B. elegans* Nees – Rar (1). **18**: northern shore of the Lake Pontur, in moist reed grass-sedge-*Sphagnum* low birch forest flooded by water, on silted deadwood. 60.88906 N, 63.56720 E. 9.VII.2006. 352-06, YSU. Muldiarov.
9. \* *B. pallens* Sw. – Un (1). **16**: Left bank Akh River, on soil. 60.86756 N, 63.48989 E. 24.VIII.2010. #181-10, YSU. Lapshina.
- B. pseudotriquetrum* (Hedw.) P. Gaertn., B. Mey. & Scherb. – Un (1). **1**: *Betula nana*-*Menyanthes*-hypnum fen. 60.77122 N, 63.50950 E. 2.VII.2006. 121-06, YSU. Filippov.
- Callicladium haldanianum* (Grev.) H.A. Crum – Sp (13). **4, 15, 16, 18, 23**: in marshy birch forests and willow-birch low forests, prone to moderate flooding by the hollow waters of lakes, less common in dark coniferous sogras; grows on bark at bases of birch trunks and on decaying wood.
- Calliergon cordifolium* (Hedw.) Kindb. – Fr (32). **1-2, 7**: in dark coniferous swampy forests and herb-sedge-*Sphagnum* sogras, common in minerotrophic sedge-moss fens and yerniks.
- Calliergonella lindbergii* (Mitt.) Hedenäs – Sp (9). **4, 16-20**: along the shores of lakes, on reed grass and sedge meadows and brushwood, in periodically flooded marshy birch forests. Also noted in the mixed (*Picea obovata*, *Pinus sibirica*, *Betula pubescens*)-*Sphagnum* swamp forest in the valley of the Eenyra River.
- Campylidium sommerfeltii* (Kindb.) Ochyra – Sp (8). **4, 8, 14-15, 23, 25**: in both drained and swampy mixed dwarf shrub-grass-green moss and reed grass-moss forests, as well as in dark coniferous sogras, on decaying wood of fallen trees, at tree bases.
- Campylium stellatum* (Hedw.) C. Jens. – Rar (2). **1, 2**: in sedge (*Carex rostrata*)-moss community. 60.77707 N, 63.48898 E. 1.VII.2006. 75-06, YSU. Lapshina; *ibid* in the birch-pine-shrub-sedge (*Carex rostrata*)-*Sphagnum* low forest. 60.77235 N, 63.50622 E. 2.VII.2006. 106-06, YSU. Lapshina.
- Ceratodon purpureus* (Hedw.) Brid. – Fr (13). **12, 20-22**: in dry lichen pine forests and light forests, common in clearings and burns, less common in forest swamps on relatively dry hummocks in minor admixture among other mosses.
- Climacium dendroides* (Hedw.) F. Weber & D. Mohr – Rar (5). **18, 20**: on flooded shores around the lakes Pontur and Arantur, in the coastal pine-shrub-grass forest, in sedge communities and *Frangula alnus* thickets, in the ground cover and on bare sand.
- \* *Dichelyma capillaceum* (Dicks.) Myrin – Sp (10). **16-19**: in birch-sedge-*Sphagnum* low forests, swampy willow-birch-sedge communities in the flood zone around the lakes, in the flooded valley of the Akh River and the mouth valley part of Anisyra River. This is rare European-North American amphiatlantic species with isolated finds in the European part of Russia and Western Siberia (Czernyadjeva & Ignatova, 2013). In the Nature Park it is repeatedly encountered (Lapshina, 2015).
- Dicranella cerviculata* (Hedw.) Schimp. – Sp (6). **4, 8, 23, 25**: in swampy mixed and dark coniferous reed grass-moss forests in the valleys of small rivers and brooks, also on road side. Once found in tall ryam. Grows predominantly in disturbed areas, on peat soil, less often on mineral soil.
- \* *D. humilis* R. Ruthe – Un (1) **14**: in aspen-pine-birch-grass forest, along the edge of ravine, on loamy soil. 60.87488 N, 63.61210 E. 25.VIII.2010. #186-10, YSU. Lapshina.
- D. subulata* (Hedw.) Schimp. – Un (1) **14**: in aspen-pine-birch-grass forest, along the edge of a ravine on loamy soil. 60.87488 N, 63.61210 E. 25.VIII.2010. #186-10, YSU. Lapshina.
- Dicranum bonjeanii* De Not. – Rar (2). **14**: in birch-aspen-pine grass-green moss forest. 60.8775 N 63.611944 E. 25.VI.2002. 1, Bespalova; **26**: in dark coniferous small herbs-green moss forest. 60.963667 N, 63.689611 E. 12.VII.2002. 3 (17), Bespalova.
- D. flagellare* Hedw. – Sp (10). **4, 8, 14, 23, 25, 28**: in dark coniferous and mixed wet forests and swampy herbs-sedge-*Sphagnum* sogras along the valleys of small rivers, on decaying wood of stumps and dead fallen trees.
- D. fragilifolium* Lindb. – Fr (18). **23, 25, 28**: in dark coniferous and mixed moist forests, swampy herb-*Sphagnum* sogras along the valleys of small rivers. Grows at bases of tree trunks and on decaying wood.
- D. fuscescens* Turn. – Fr (20). **2, 8, 11, 15, 26, 28**: in pine, dark coniferous and mixed forests, in swampy forests and herb-*Sphagnum* swamps (sogras), also occurs in ryams and tall ryams. Grows at bases of tree trunks and on decaying wood.
- D. montanum* Hedw. – Sp (8). **11, 15, 26**: in dark coniferous and mixed small herb-green moss forests, swampy herb-sedge-*Sphagnum* forests and sogras along the valleys of small rivers. Grows at bases of tree trunks and on decaying stumps.
- D. polysetum* Sw. – Fr (33). **3, 8, 12, 14, 23**: in lichen and green moss forests, in ryams and on the ridges of ridge-hollow complexes of raised bogs, less often in sogras, where it settles at bases of tree trunks and mossy deadwood.
- \* *D. septentrionale* Tubanova & Ignatova – Un (1) **28**: birch-pine-herb-*Sphagnum* sogra, on decaying wood. 61.026 N, 63.677 E. 12.VII.2006. 446/5-06, YSU. Lapshina. Det. E.A. Ignatova. This species is new for the Khanty-Mansi Autonomous District. In West Siberia, it was previously known only from few localities in the north of lowland (Pisarenko *et al.*, 2017).

- D. spadiceum* J.E. Zetterest. – Rar (2). **4**: in swampy mixed (*Picea obovata*, *Pinus sibirica*, *P. sylvestris*, *Betula pubescens*) sedge-*Sphagnum* forest. 60.78464 N, 63.56129 E. 8.VII.2006. 260-06, YSU. Lapshina; **18**: in flooded *Calamagrostis*-sedge-*Sphagnum* low birch forest on the northern shore of Lake Pontur. 60.88906 N, 63.56720 E. 9.VII.2006. #352-06, YSU. Lapshina.
- D. undulatum* Schrad. ex Brid. – Sp (8). **11, 12, 15, 18, 24**: in ryams and on pine-dwarf shrub-*Sphagnum* ridges in ridge-hollow complexes of raised bogs. Once found in a dry cowberry-lichen pine forest.
- Ditrichum heteromallum* (Hedw.) E. Britton – Un (1) **14**: along the edge of the ravine, on loamy soil. 60.87488 N, 63.61210 E. 25.VIII.2010. #186, YSU. Lapshina.
- Drepanocladus aduncus* (Hedw.) Warnst. – Rar (7). **1, 2, 7, 16**: in minerotrophic fens near groundwater discharge areas in the *Menyanthes*-sedge-hypnum- and *Betula nana*-herb-sedge-moss communities as more or less noticeable admixture in ground layer. Once found in the willow-sedge community at the bottom of steep slope in Akh River valley.
- D. polygamus* (Bruch, Schimp. & W. Gümbel) Hedenäs – Sp (10). **1, 2, 7, 16-18**: in minerotrophic sedge-moss fens and yerniks, less often in birch-pine swampy low forests; it is also found on the bank and in shrub thickets in the floodplain of Akh River.
- \* *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen – Un (1) **23**: in mixed (*Picea obovata*, *Pinus sibirica*, *Betula pubescens*) sedge-herb-*Sphagnum* swampy forest. 60.93162 N, 63.72867 E. 7.VII.2006. #250-06, YSU. Muldiyarov.
- Helodium blandowii* (F. Weber & D. Mohr) Warnst. – Sp (25). **1, 2, 5, 7**: noted many times, but all the finds are almost exclusively near the groundwater discharge sites in open sedge-hypnum-, *Betula nana* herb-sedge-hypnum (“yerniks”) and sparsely wooded by birch trees minerotrophic fens.
- Herzogiella turfacea* (Lindb.) Z. Iwats. – Rar (2). **15**: in spruce-pine small herb-green moss forest, on moss-covered deadwood and at the bottom of a large aspen. 60.87361 N, 63.55011 E. 24.VIII.2010. #1-10, YSU. Lapshina; **23**: in mixed (*Picea obovata*, *Pinus sibirica*, *Betula pubescens*) sedge-herb-*Sphagnum* swampy forest. 60.93162 N, 63.72867 E. 7.VII.2006. #250-06, YSU. Muldiyarov.
- Hylocomium splendens* (Hedw.) Bruch, Schimp. & W. Gümbel – Fr (14). **4, 14-15, 23, 26, 28**: in dark coniferous and mixed, less often in pine dwarf shrub-green moss forests in the ground layer. Occurs also in swampy forests and herb-sedge-*Sphagnum* swamps (sogras), settling on mossy stumps and dead wood.
- Leptobryum pyriforme* (Hedw.) Wils. – Rar (4). **8, 16, 23**: in swampy dark coniferous and mixed reed grass-sedge-*Sphagnum* forests in the valleys of small rivers and brooks, on decaying wood and peat, as well as on bare mineral soil along the banks of the river Akh.
- Leptodictyum riparium* (Hedw.) Warnst. – Sp (5). **18, 19**: in sedge-*Sphagnum* low birch forest, willow-birch- and sedge communities in the flood zone around the Pontur Lake and the estuary part of the river valleys.
- Leskea polycarpa* Hedw. – Rar (4). **17-18, 23**: in swampy birch forests, *Frangula alnus* thickets and sedge-*Sphagnum* low birch forest in the area of flooding of the lake Pontur. Once noticed in birch-pine sedge-*Sphagnum* sogra.
- Mniun spinulosum* Bruch, Schimp. & W. Gümbel – Un (1) **15**: in a spruce-pine small herb-green moss forest, on well decomposed decaying wood covered by mosses. 60.87361 N, 63.55011 E. 24.VIII.2010. #1a-10, YSU. Lapshina.
- \* *M. thomsonii* Schimp. – Rar (2). **15**: in spruce-pine small herb-green moss forest, at the bottom of aspen, slight admixture among other mosses. 60.87361 N, 63.55011 E. 24.VIII.2010. 1-10, YSU. Lapshina. **26**: in dark coniferous (*Pinus sibirica*) small herb-green moss forest, at the bottom of tree, single plants among other mosses. 60.96350 N, 63.68861 E. 27.VII.2011. 13-11, YSU. Lapshina.
- Myrinia pulvinata* (Wahlenb.) Schimp. – Sp (8). **18, 19**: in swampy sedge-*Sphagnum* and sedge-reed grass-*Sphagnum* low birch forests at bases of tree trunks and on the willow bark. All finds are restricted to the spring flood zone around the Lake Pontur and estuarine part of the valley of river Anisya.
- Oncophorus wahlenbergii* Brid. – Fr (17). **14, 18, 23, 28**: in different types of swampy forests, low birch forests and forest swamps (sogras), on decaying wood and at bases of tree trunks.
- \* *Orthotrichum obtusifolium* Brid. – Un (1) **23**: in the middle part of the Yenya River valley, in moist birch-pine-sedge-*Sphagnum* forest, on the bark of an old aspen. 60.920359 N, 63.634682 E. 13.VII.2002. #53. Bepalova.
- Plagiomnium ellipticum* (Brid.) T.J. Kop. – Sp (8). **23, 25**: in swampy forests and sogras in the valleys of small rivers and streams, in wet micro-depressions, on slopes of hummocks.
- Plagiothecium denticulatum* (Hedw.) Bruch, Schimp. & W. Gümbel – Sp (7). **25, 28**: in dark coniferous, mixed and birch-pine reed grass-herb-*Sphagnum* sogras in the valleys of small rivers, on slopes of hummocks and in niches between roots.
- P. laetum* Bruch, Schimp. & W. Gümbel – Sp (6). **15, 23, 26**: in mixed and dark coniferous forests and reed grass-sedge-*Sphagnum* sogras, on decaying wood, in the bottom of stems, in niches between roots.
- P. latebricola* Bruch, Schimp. & W. Gümbel – Un (1) **23**: in mixed (*Picea obovata*, *Pinus sibirica*, *Betula pubescens*) herb-*Sphagnum* swampy forest (sogra), on highly decomposed wood. 60.93162 N, 63.72867 E. 7.VII.2006. #250-06, YSU. Muldiyarov.
- Pleurozium schreberi* (Brid.) Mitt. – Fr (81). **2-4, 8-28**: in all types of pine, dark coniferous and mixed forests, often as dominant of ground layer. It also occurs in swampy forests and forest swamps (sogras), in ryams and on ridges of the ridge-hollow complexes of raised *Sphagnum* bogs.
- \* *Pogonatum urnigerum* (Hedw.) P. Beauv. – Rar (2). **14**: along the side of the overgrown road and the edge of the ravine. 60.87488 N, 63.61210 E. 25.VIII.2010. #186-10, YSU. Lapshina; **15**: on the road side in dwarf shrub-green moss pine forest, on bare soil, mixed with *Ditrichum heteromallum*. 60.85800 N, 63.58178 E. 26.VII.2011. #19-11, YSU. Lapshina.
- \* *Pohlia andalusica* (Höhn.) Broth. – Un (1) **14**: on side of overgrown road and at the edge of a ravine, on loamy soil. 60.87488 N, 63.61210 E. 25.VIII.2010. #186-10, YSU. Lapshina.
- \* *P. bulbifera* (Warnst.) Warnst. – Sp (7). **16, 18, 20**: in willow-sedge thickets and on alluvial sand under sedge on the shores of lakes Pontur and Arantur, as well as on the banks of Akh River.
- P. cruda* (Hedw.) Lindb. – Un (1) **28**: in mixed (*Pinus sylvestris*, *P. sibirica*, *Picea obovata*, *Betula pubescens*) herb-*Sphagnum* sogra, on silted decaying wood and bare peat. 61.02622 N, 63.67644 E. 12.VII.2006. #452-06, YSU. Filipov.

- P. nutans* (Hedw.) Lindb. – Fr (62). **8, 9, 14-18, 22-25, 28**: in all types of forests, swampy forest and forested swamps, on decaying wood and at bases of tree trunks.
- P. prolifera* (Kindb.) Lindb. ex Broth. – Rar (2). **28**: in mixed (*Pinus sylvestris*, *P. sibirica*, *Betula pubescens*, *Picea obovata*) herb-*Sphagnum* swampy forest, on a peat-alluvial substrate along the river bed. 61.02661 N, 63.67809 E. 12.VII.2006. #465-06, YSU. Lapshina; *ibid*, in pine-spruce-birch herb-*Sphagnum* forest swamp (sogra). 61.02622 N, 63.67644 E. 12.VII.2006. #452-06, YSU. Filippov.
- Polytrichastrum longisetum* (Sw. ex Brid.) G.L. Sm. – Sp (13). **4, 9, 18, 21**: in moist birch forests and birch-willow low forests in the moderate flooding zone around lakes, in swampy forests along small river beds and streams.
- Polytrichum commune* Hedw. – Fr (40). **4, 9, 11, 14, 18, 25-26**: in moist and swampy forests, low birch forests, also in the moderately flooded zone around lakes; sometimes dominates in ground layer.
- \* *P. jensenii* – Rar (4). **3, 24**: in transitional sedge-*Sphagnum* and *Menyanthes*-sedge-moss fens as an insignificant admixture among *Sphagnum* mosses. Once found in the waterlogged sedge (*Carex lasiocarpa*) community close to the sandy road.
- P. juniperinum* Hedw. – Fr (16). **9, 12, 22, 25**: in pine and mixed forests, indicator of post-fire recovery stages. Rarely it grows in forest swamps on relatively dry convex elements of the microrelief.
- \* *P. piliferum* Hedw. – Sp (9). **12, 23**: in the most dry lichen, and dwarf shrub-lichen pine forests and light forests, along roadsides, on sandy soil.
- P. strictum* Brid. – Fr (85). **2-11, 13, 18, 20-28**: on the hummocks of raised bogs and transitional fens among *Sphagnum* mosses, less common in boggy forests and forest swamps.
- P. swartzii* Hartm. – Sp (10). **9, 18, 21**: in flooded sedge low birch forest in the valley of the river Enyya near the bridge, where it often dominates; also found along the periphery of the drying Alas Bog.
- Pseudobryum cinclidioides* (Hueb.) T.J. Kop. – Sp (13). **23, 25, 28**: in dark coniferous and mixed reed grass-herb-*Sphagnum* swampy forests and sogras in the valleys of small rivers, in wet hollows.
- Ptilium crista-castrensis* (Hedw.) De Not. – Rar (3). **8**: in mixed (*Pinus sylvestris*, *P. sibirica*, *Betula pubescens*) swampy reed grass-*Sphagnum* forest. 60.80517 N, 63.62454 E. 3.VII.2006. #132-06, YSU. Filippov; **18**: in a pine herb-dwarf shrub-green moss forest with a larch southeast of the lake Pontur. 60.885083 N, 63.628833 E. 17.VII.2002. #3 (37). Bepalova; **26**: in dark coniferous (*Picea obovata*, *Pinus sibirica*) small herb-green moss forest. 60.963667 N, 63.689611 E. 12.VII.2002. #2 (16), Bepalova.
- \* *Pylaisia polyantha* (Hedw.) Bruch, Schimp. & W. Gümbel – Rar (4). **14, 15**: in mixed dwarf shrub-green moss and small herb-green moss forests with aspen in the upper layer, on tree trunks.
- Rhytidiadelphus subpinnatus* (Lindb.) T.J. Kop. – Un (1). **18**: in marginal part of swampy birch-*Calamagrostis*-sedge-*Sphagnum* forest on the northern shore of the Pontur Lake, on hummocks. 60.88906 N, 63.56720 E. 1.VIII.2007. ##406-07, 407-07, YSU. Lapshina.
- \* *R. triquetrus* (Hedw.) Warnst. – Rar (2). **14**: in a young pine-birch-aspen dwarf shrub-grass-green moss forest. 60.87611 N, 63.61114 E. 25.VII.2011. #18-11, YSU. Lapshina; **15**: in mixed dwarf shrub-smal herb-green moss forest on ground layer. 60.87423 N, 63.55490 E. 24.VIII.2010. #1-10, YSU. Lapshina.
- Sanionia uncinata* (Hedw.) Loeske – Fr (27). **2-4, 7-9, 14-21, 23, 25-28**: in various types of forests and forest swamps, at bases of tree trunks, on rotten wood of stumps and fallen trees.
- \*\* (\*) *Schistostega pennata* (Hedw.) F. Weber & D. Mohr – Un (1) **23**: in the swampy mixed (*Picea obovata*, *Pinus sibirica*, *Betula pubescens*) sedge-*Sphagnum* swamp forest, on silted peat soil. 60.93162 N, 63.72867 E. 7.VII.2006. #302-06, YSU. Filippov.
- Sciuro-hypnum curtum* (Lindb.) Ignatov – Rar (3). **8**: in mixed (*Pinus sylvestris*, *P. sibirica*, *Betula pubescens*) reed grass-*Sphagnum* swamp forest. 60.80517 N, 63.62454 E. 03.VII.2006. #132-06, YSU. Filippov; **28**: noticed twice in mixed herb- and dwarf shrub-herb-*Sphagnum* sogras, at bases of tree trunks. 61.026 N, 63.677 E. 12.VII.2006. ##445-06, 465-06, YSU. Muldiyarov, Lapshina.
- \* *S. reflexum* (Starke) Ignatov & Huttunen – Rar (2). **14**: in an aspen-pine-birch-grass forest, at base of tree trunk. 60.87331 N, 63.60988 E. 25.VIII.2010. #186-10, YSU. Lapshina; **15**: in a spruce-pine small herb-green moss forest, at the bottom of a large aspen. 60.87361 N, 63.55011 E. 24.VIII.2010. #1-10, YSU. Lapshina.
- Serpoleskea subtilis* (Hedw.) Loeske – Un (1) **18**: in swampy sedge-*Sphagnum* periodically flooded low birch forest, on willow bark. 60.88554 N, 63.59516 E. 9.VII.2006. #293-06, YSU. Filippov.
- Sphagnum angustifolium* (C.E.O. Jensen ex Russow) C.E.O. Jensen – Fr (157). **1-11, 13, 18, 22-28**: in moss cover of raised bogs and transitional fens, often dominant and co-dominant in the moss layer.
- \* *S. annulatum* H. Lindb. ex Warnst. – Rar (3). **5**: in a patterned meso-oligotrophic fen, in the *Menyanthes-Scheuchzeria*-sedge-*Sphagnum* hollows, dominant of the moss cover. 60.79798 N, 63.57129 E. 25.VII.2015. #21-15, YSU. Lapshina; *ibid*, in the meso-oligotrophic *Rhynchospora*-sedge-*Sphagnum* fen. 60.79975 N, 63.57544 E. 6.VIII.2016. #5-16, YSU. Lapshina. This species has a wide distribution in northern Eurasia, being apparently rare in the most regions (Laine *et al.*, 2018). In West Siberia, it was previously known only from few localities (Lapshina *et al.*, 2019).
- S. aongstroemii* Hartm. – Rar (5). **8, 28**: in a reed grass-*Sphagnum*- and reed grass-herb-*Sphagnum* swampy forest and sogras in the valley of small river and brook.
- S. balticum* (Russow) C.E.O. Jensen – Fr (117). **1-3, 5-11, 13, 18, 22-25, 27**: in pine-cotton grass-*Sphagnum* bogs, meso-oligotrophic fens and hollows of raised bogs, where it is one of the main dominants of the moss layer.
- S. capillifolium* (Ehrh.) Hedw. – Fr (20). **3, 6, 10-11, 22, 25**: in ryams, tall ryams, on ridges of ridge-hollow complexes, less often on mesooligotrophic *Sphagnum* bogs and in birch-pine-*Sphagnum* low forests.
- S. centrale* C.E.O. Jensen – Fr (43). **2-3, 5, 7, 18, 22**: in mesotrophic sedge-*Sphagnum* fens and yerniks, in swampy sedge-birch low forests and sogras.
- S. compactum* Lam. & DC. – Sp (6). **9, 11, 18, 20**: in birch-pine forests in the coastal flood zone around lakes Pontur and Arantur, on sandy soil; in sedge-*Elyocharis palustris* community on alluvial sand; on the periphery of the drying Alas Bog, on peaty-sandy soil. It also occurs in the Bog Bazovoe at the Nature Park research station, in sedge-*Rhynchospora-Sphagnum* hollows of pool-ridge-hollow complex of raised bog.



- S. cuspidatum* Ehrh. ex Hoffm. – Rar (2). **9**: in the drying peripheral lagg zone of Alas Bog, in sparse sedge (*Carex lasiocarpa*) community, on a peaty-sandy soil. 60.82840 N, 63.63027 E. 25.VII.2015. #25-15, YSU. Lapshina; *ibid*, in the sedge-cotton grass (*Eriophorum polystachyon*) community. 60.82777 N, 63.63283 E. 6.VIII.2016. #10-16, YSU. Lapshina. It is rare species in Western Siberia despite its suitable habitats are widespread. Numerous references to this species as a dominant of plant communities on West Siberian mires are incorrect.
- S. divinum* Flatberg & Hassel (*S. magellanicum* auct.) – Fr (188), a widespread Eurasian species recently separated from the *Sphagnum magellanicum* Brid. complex (Hassel *et al.*, 2018). **1-11, 13, 20-25, 27-28**: grows in tall ryams, ryams, open and wooded raised *Sphagnum* bogs, and in mesooligotrophic bog complexes, less often in mesotrophic boggy forests, forested swamps and sogras.
- S. fallax* (H. Klinggr.) H. Klinggr. – Fr (63). **2-3, 5-7, 9-10, 18, 25, 27**: most common in swampy sedge-*Sphagnum* low birch forests in the area of flooding around the Lake Pontur, where often dominates. It is also occurs in meso-oligotrophic sedge-*Sphagnum* bogs and transitional fens.
- S. fimbriatum* Wilson – Fr (51). **1, 8, 17-19, 23, 25**: in swampy sedge-*Sphagnum* low birch forests in the flooded zone around the Pontur Lake, in the floodplains of the rivers Akh and Anisya, in sogras along the river beds and streams. Also noted in the Yuzhnoe Mire in the open transitional fen communities and yerniks.
- S. flexuosum* Dozy & Molk. – Fr (17). **2, 5, 9, 27**: in meso-oligotrophic sedge-*Menyanthes-Sphagnum* fens, more often along the eastern shore of the lake Rangetur, where it grows on slopes of hummocks and ridges mixed with other *Sphagnum* species.
- S. fuscum* (Schimp.) Klinggr – Fr (111). **2-4, 5-6, 9-11, 13, 22, 24, 27-28**: in ryams, on ridges and hummocks of oligotrophic and meso-oligotrophic raised bog complexes, the most common dominant of the moss layer.
- S. girgensohnii* Russow – Fr (31). **1-3, 7-9, 18, 25**: in moist forests, where it sometimes dominates, and in swampy dark coniferous reed grass-herb-*Sphagnum* forests along river valleys and streams. It is also recorded in the open mesotrophic sedge-*Menyanthes*-hypnum fen communities.
- S. jensenii* H. Lindb. – Fr (53). **1-3, 5-7, 9-11, 13, 18, 22, 24, 27**: in oligotrophic fens, in hollows and waterlogged lawns of raised *Sphagnum* bogs, where it is often the dominant of the moss cover. Also recorded in the meso-oligotrophic *Menyanthes*-sedge-*Sphagnum* transitional fens.
- S. lindbergii* Schimp. – Fr (17). **6, 10-11, 27**: in extensive oligotrophic fens and in waterlogged hollows of complex raised *Sphagnum* bogs, the most common in the central part of the Bog Bazovoe.
- S. majus* (Russow) C.E.O. Jensen – Fr (62). **2-3, 5-6, 9-11, 24, 27**: in terms of its distribution and habitats in the Park this species is similar to *Sphagnum jensenii*.
- S. mirum* Flatberg & Thinggaard – Un (1) **7**: in mesotrophic *Betula nana*-*Menyanthes*-sedge-*Sphagnum* fen to the north-west of the lake Rangetur. 60.81145 N, 63.54692 E. 31.VIII.2007. #8-07, YSU. Lapshina. In West Siberia, this species is known only from few localities (Ellis *et al.*, 2018; Lapshina *et al.*, 2018).
- S. obtusum* Warnst. – Fr (103). **1-3, 5-7**: in vast mesotrophic *Menyanthes*-sedge-*Sphagnum* and sedge-hypnum fens around the lake Rangetur and in the mire Yuzhnoe, where it occupies a vast area and often dominates in the moss cover.
- S. papillosum* Lindb. – Fr (74). **2, 5, 9, 10, 11, 22, 27**: in oligotrophic and meso-oligotrophic fens and in vast hollows of raised bogs, forming flat carpets and low hummocks. The most common in the bogs Bazovoe, Polosatoye, and on the eastern shore of the lake Rangetur.
- S. platyphyllum* (Lindb. ex Braithw.) Warnst. – Rar (5). **17, 18, 21**: in periodically flooded birch low forests and sedge-shrub thickets on the eastern and northern shores of the lake Pontur, as single plants in ground layer.
- S. riparium* Ångstr. – Fr (48). **1-7, 23, 25**: in the meso-oligotrophic sedge-*Menyanthes-Sphagnum* flowing fens of thalwegs of the former hydrographic network. It occupies a vast area in the Yuzhnoe Mire and around the Lake Rangetur. It was also recorded in the muddy hollows in dark coniferous reed grass-herb sogras in the small river valleys.
- S. russowii* Warnst. – Sp (6). **3, 6-7, 11**: in ryams, tall ryams and boggy green moss-*Sphagnum* pine forest, less common on the hammock and ridges in the meso-oligotrophic sedge-*Menyanthes-Sphagnum* fens.
- S. squarrosum* Crome – Fr (35). **1-2, 7, 18-19, 23**: in swampy forests and sogras along the valleys of small rivers, in sedge-*Sphagnum* birch low forests with regular moderate flooding by hollow waters; also noticed in areas of groundwater discharge in the Yuzhnoe Mire and to the north-west of the lake Rangetur.
- \*\* *S. subfulvum* Sjörs – Rare (5). **22**: found only in the Polosatoye aapa mire, where it grows in string-flark complex along the edge of the *Sphagnum papillosum* low ridges and carpets, in contact with watered hollows. 60.94207 N, 63.74067 E. 26.VII.2015. #30-15, YSU. Lapshina. In West Siberia, this species is known only from few localities (Yurkovskaya & Maksimov, 2009; Vasin & Vasina, 2013).
- S. subsecundum* Nees – Fr (29). **1, 5-6, 21-22**: in mesotrophic *Rhynchospora*-sedge, sedge-*Sphagnum* fens, yernicks and swampy birch-pine light low forests. It was also recorded in the regularly flooded willow-sedge birch low forests and willow thickets (*Salix lapponum*).
- \*\* *S. tenellum* (Brid.) Brid. – Rar (3). **11**: in the Bog Bazovoye, where it grows along the edge of ridges and oligotrophic hollows in the pool-ridge-hollow complex, at the site of low-nutrient groundwater discharge (Fig. 2D). 60.85267 N, 63.52336 E. 29.VII.2011. #28-11, YSU. Lapshina; *ibid*, along the watercourse on the border of the ridge. 60.85628 N, 63.52238 E. 25.VII.2015. #4-15, YSU. Lapshina. This is only location of this species in the autonomous district and in Western Siberia as a whole (Lapshina & Maksimov, 2014).
- S. teres* (Schimp.) Ångstr. – Rar (6). **1-2 7**: all finds are limited to groundwater discharge sites. In *Menyanthes*-sedge-moss fens and yerniks in the central part of the Yuzhnoje Mire and sedge-hypnum low birch community to the north-west of the lake Rangetur.
- S. warnstorffii* Russow – Sp (8). **8, 21-23, 25**: in swampy dark coniferous and mixed swampy forests and sogras in small river and brook valleys, in minerotrophic and transitional fens. Also noted in the mouth of the valley of the river Enyya in the area of flooding at the lake Arantur.
- S. wulfianum* Girg. – Rar (3). **11**: in a boggy *Pinus sibirica* dwarf shrub-green moss-*Sphagnum* forest at the edge of a mineral island. 60.84298 N, 63.51041 E. 2006. Lapshina; **21**: in a sedge-*Calamagrostis* community with sparse low

- birch layer. 60.92464 N, 63.61892 E. 22.VII.2011. #3-11, YSU. Lapshina; **28**: in a *Pinus sibirica*-birch-pine herbs-*Sphagnum* sagra. 61.02622 N, 63.67644 E. 12.VII.2006. #445-06, YSU. Muldiarov.
- \* *Splachnum rubrum* Hedw. – Un (1). **22**: in a pine-birch dwarf shrub-herbs-*Calamagrostis*-*Sphagnum* sagra on elk's decomposed dung. 60.94875 N, 63.748111 E. 13.VII.2008. Bespalova.
- \* *S. luteum* Hedw. – Un (1). **22**: Ibid, in the same mat with *Splachnum rubrum*. 13.VII.2008. Bespalova.
- \* *Stereodon pallescens* (Hedw.) Mitt. – Un (1) **26**: in the upper reaches of the river Okunevaya, in a dark coniferous (*Picea obovata*, *Pinus sibirica*) forest with birch, small herbs and green mosses, at the base of a spruce trunk. 60.963667 N, 63.689611 E. 2.VII.2002. Bespalova.
- \* *S. plicatulus* Lindb. – Rar (2). **15**: in a spruce-pine small herb-green moss forest, at the base of old aspen. 60.87361 N, 63.55011 E. 24.VIII.2010. 1-10, YSU. Lapshina; **26**: in a dark coniferous (*Pinus sibirica*, *P. sylvestris*) small herb-cowberry-green moss forest, at the base of tree. 60.96350 N, 63.68861 E. 27.VII.2011. #13-11. YSU. Lapshina.
- Straminergon stramineum* (Dicks. ex Brid.) Hedenäs – Fr (47). **1-3, 4-7, 11**: in meso-oligotrophic and mesotrophic fens and mire complexes of various types. It is most often found in bogbean (*Menyanthes*)-sedge-moss fens and yerniks in the Mire Yuzhnoje.
- Tetraphis pellucida* Hedw. – Fr (26). **8, 25, 28**: in dark coniferous and mixed swampy grass-*Sphagnum* forests and forest swamps (sogras) in the valleys of small rivers and streams. It is also found in dark coniferous forests and tall ryams, everywhere on decaying wood.
- \* *Tetraplodon angustatus* (Hedw.) Bruch, Schimp. & W. Gumbel – Rar (2). **12**: in a lichen pine forest on moraine hill, 1.5 km east of the field station. 60.85311 N, 63.54247 E. 12.IX.2015. #2-15, YSU. Lapshina; **24**: pine cowberry-lichen forest recovering after a fire. 60.942271 N, 63.687362 E. 29.VII.2001. Bespalova.
- T. mnioides* (Hedw.) Bruch, Schimp. & W. Gumbel – Rar (3). **12**: in lichen pine forest on moraine hill at the field station. 60.85401 N, 63.52637 E. 11.IX.2015. 1-15, YSU. Lapshina; **ibid**, in cowberry-lichen pine forest, on the road 2 km from field station to the lake Rangetur. 60.84850 N, 63.55565 E. 11.IX.2015. #1a-15, YSU. Lapshina; **20**: on the side of the forest road, on the sand. 60.899410 N, 63.582360 E. 19.VI.2018. Korotkikh.
- Warnstorfia exannulata* (Bruch, Schimp. & Gumbel) Loeske – Fr (27). **1-2, 5-6, 11**: in herbs-moss and *Menyanthes*-sedge-hypnum fens and yernicks, the most common is the Mire Yuzhnoje. Once collected in the oligotrophic ridge-hollow-pools complex in the Bog Bazovoe at a groundwater discharge.
- W. fluitans* (Hedw.) Loeske – Fr (52). **1-3, 5-7, 10-11, 22**: in meso-oligotrophic sedge-moss- and sedge-*Sphagnum* fens, as well as in flooded sedge-*Sphagnum* low birch forest.
- W. pseudostraminea* (Müll. Hal.) Tuom. & T.J. Kop. – Fr (19). **16-19, 25, 28**: in the periodically flooded zone around the lake Pontur and the flooded valley of the Akh River, less common in swampy forests and in forest swamps (sogras) in valleys of small rivers and streams.

## UNCONFIRMED AND ERRONEOUS RECORDS

Specimens of *Aulaacomnium turgidum* (Wahlenb.) Schlagr., *Bryum algovicum* Sendtn. ex Müll. Hal., and

*Sphagnum contortum* Schultz cited earlier for the territory of the Nature Park “Kondinskie ozera” (Konda Lakes) (Lapshina & Pisarenko, 2013) are lost, and it is impossible to clarify their identity. The presence of *Sphagnum palustre* L. in the Nature Park has not been confirmed either. The species was registered in 2007 in the peripheral lagg area of the Bog Alas, but the specimen was not preserved. In subsequent years, the species disappeared in this habitat due to the drying of the bog, but its new finds in the Park are possible in future.

The records of two other moss species are erroneous. Specimens of *Dicranella varia* (Hedw.) Schimp. were re-identified as *D. humilis*. All specimens referred to *Calliergon giganteum* (Schimp.) Kindb. belong to *Calliergon cordifolium*.

## DISCUSSION

As a result of this study conducted on the territory of the Nature Park “Kondinskie ozera” (Konda Lakes) 114 moss species were identified, which is 47.9% (238 species) of the moss flora of plain part of the Khanty-Mansi Autonomous District – Yugra as a whole. The previous list of moss flora for this territory counted 236 species (Lapshina & Pisarenko, 2013). Earlier reference to *Sphagnum pulchrum* was incorrect and excluded. At the same time three new species, i.e., *Sphagnum inexpectatum*, *S. mirum*, and *S. perfoliatum* were recently reported from this region (Ellis *et al.*, 2018; Lapshina *et al.*, 2018; Czernyadjeva *et al.*, 2019).

From the present list of studied moss flora, 22 species are first recorded for the territory of the Nature Park. Two species, *Dicranum septentrionale* and *Sphagnum tenellum* are currently known in of the Autonomous District only from the territory of this Nature Park.

The moss flora of Nature Park is comparable in its diversity with the moss flora of the “Malaya Sosva” State Nature Reserve (110 species) (Dyachenko *et al.*, 1995) and the Nature Park “Numto” (114 species) (Lapshina *et al.*, 2018), and significantly exceeds the moss flora of the Nature Park “Sibirskie Uvaly” (79 species) (Kuzmina & Kukurichkin, 2012). The relatively low level of species richness of the studied bryoflora is explained, first of all, by the environmental conditions of the territory. The absolute dominance of pine forests on poor sandy soils and rain feeding raised bogs that have a low phytocenotic diversity, only very limited areas of dark coniferous and mixed forests, the absence of large river valleys and fed by groundwater minerotrophic rich fens, the lack of river bank outcrops and, moreover, outcroppings of bedrock are not favourable for a high bryofloristic diversity.

The majority of the Nature Park bryoflora combines typical boreal forest and mire species with wide circum-polar ranges. At the same time, a significant part is composed of species, the phytocenotic optimum of which is located much further to the south, within the southern taiga and sub-taiga (zone of small-leaved birch and aspen forests); these are *Campylidium sommerfeltii*, *Leskea*

*polycarpa*, *Myrinia pulvinata*, *Orthotrichum obtusifolium*, *Plagiothecium latebricola*, *Rhytidiadelphus subpinatus*, *Sciuro-hypnum curtum*, *Serpoleskea subtilis*, and *Stereodon pallescens*. Appreciably small quantity of hypoarctic species are represented: *Bryum cyclophyllum*, *Polytrichum jensenii*, *Sphagnum aongstroemii*; these species are located at the southern border of their distribution.

One of an interesting special feature of the bryoflora of the Nature Park is the high species diversity of *Sphagnum* mosses (30 species). For comparison, in the “Malaya Sosva” State Nature Reserve, whose area is twice as large, 24 species of *Sphagnum* mosses were identified; in the “Numto” Nature Park 28 species; in the “Sibirskie Uvaly” Nature Park 21 species. Almost all species of this genus reliably known for the Khanty-Mansiysk Autonomous District were found in the Park, with exception of the recently discovered extremely rare hypo-arctic species *Sphagnum inexpectatum* Flatberg (Ellis *et al.*, 2018), *S. perfoliatum* L.I. Savicz (Czernyadjeva *et al.*, 2019), predominantly oceanic and sub-oceanic *S. rubellum* Wilson, and *S. contortum* Schultz., for which only one location in autonomous district is known in the vicinity of Surgut (Chernyadjeva & Kuzmina, 2002). It can be also explained mainly by the environmental conditions and landscape features of the Nature Park, which presents the entire diversity of mire types in relation to mineral water supply from extremely poor to moderately rich in nutrients, which account for the phytocenotic optimum of the majority of *Sphagnum* species. Not the least of the reasons is the fact that moss collections were carried out mainly in mires (swamps), so the peatland flora is the best studied.

Fore species, *Dichelyma capillaceum*, *Schistostega pennata*, *Sphagnum subfulvum*, and *S. tenellum*, which a red-listed in Khanty-Mansi Autonomous District (Vasin & Vasina, 2013) were found in “Kondinskie ozera” (Konda Lakes) Nature Park. Two species, *Dichelyma capillaceum* and *Pohlia bulbifera*, were also included in the Red Book of the Tyumen Region (Petrova, 2004).

The new finds of mosses rare for the region, on the background of the general low species diversity, suggest that the moss flora of the whole territory and particularly of the “Kondinskie ozera” Nature Park has not yet been fully revealed and requires further investigations. Special attention should be paid to forest-swamp valley complexes of small rivers, steep sparsely sodded slopes and natural outcrops.

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