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UDC 582.34(502.72)

**FLORA AND ECOGENOTIC ARRANGEMENT OF MOSSES
IN THE COMPLEX NATURAL CONSERVATION AREA
OF REGIONAL SIGNIFICANCE "FOREST-PARK ZATYUMENSKY"
(the Tyumen region)**

SUMMARY. This paper presents the data on the moss species diversity in the complex natural conservation area of regional significance "Forest-park Zatyumensky". The spectrum includes 26 species from 21 genera, 15 families and 3 orders belonging to the class of Bryopsida. The Hypnales have the leading role in the composition of plant communities of the forest park constituting 76,6% of the total number of species. Other dominating species are the Mniaceae, Pylaisiaceae, Brachytheciaceae, Amblystegiaceae which account to 49,6%. Among the most common species with $E_s > 0,5$ are the *Plagiomnium cuspidatum*, *Brachythecium mildeanum*, *B. salebrosum*, *Sciuro-hupnum oedipodium*, *Pylaisia polyantha*, *Sanionia uncinata*, *Stereodon pallescens*, *Amblystegium serpens*. The most diverse are the following associations: birch-plantain account for 17 species and birch-pine-bluegrass – 14 species. According to the nutrient richness of the substrate the two dominant groups are epiphytes – 26,9% and eutrophes – 19,2%, according to the degree of water saturation of substrate the dominating group is mesophytes – 53,8%.

KEY WORDS. Mosses, flora, bryology, forest-park, the Tyumen region.

Natural conservation area "Forest area of Tyumen forestry near Olovyannikov resthouse" was established by the Executive Committee of the Tyumen Region People's Deputies Council in its resolution N515 on 22/08/1968. It was later renamed under the Decree of the Tyumen Region Administration "On the Natural conservation area of Regional Significance "Forest-park Zatyumensky" of 20/08/2004 as "Complex natural conservation area of regional significance «Forest-park Zatyumensky»". This decree also adopted "Regulations on the Natural Conservation Area of Regional Significance "Forest-park Zatyumensky" and "Passport of the Natural Conservation Area of Regional Significance "Forest-park Zatyumensky". Establishing the forest-park was aimed at the preservation of natural complexes and objects including landscape, vegetation (primary pine forest, plain meadows), medicinal plants, rare and endangered animal and plant species, and protecting recreational resources.

At present “Forest-park Zatyumensky”, subsequently referred to as Forest-park, is experiencing heavy recreational load. It is visited by city-dwellers all the year round, the grass cover is trampled down and the park is littered. The territory of the Forest-park is traversed by a ski route of Tyumen State University Winter Sports Center. In the summer months Tyumen State University of Architecture and Civil Engineering conducts practical classes there.

The total area of the Forest-park amounts to 0.77193 sq km. The soils are sod-podzolic with varying degrees of podzolization. The Forest-park has flat ground, there are minor height differences. Hydrologic network is not developed.

A former arboretum with artificial plantations is situated on the territory of the Forest-park. Landscapes of the enclosed type with horizontal canopy dominate the area (they are mostly even-aged). The forest stand is mostly comprised of pine (*Pinus sylvestris*), which constitute 60% of the forest-covered area, 40% is occupied by drooping birch (*Betula pendula*). There are also species of Siberian spruce (*Picea obovata*) and small-leaved lime (*Tilia cordata*) which is listed in the Red-book of the Tyumen region (planted in 2000). The undergrowth is dominated by aspen and drooping birch. In the shrub layer one can find species of the brier, hawthorn, raspberry, willow, pea shrub, bird cherry genera. Grass cover has forbs: meadow clover, white clover, buckthorn plantain, common plantain, wild strawberry, stone bramble, great nettle, dandelion, nosebleed, cat’s foot, sagebrush, coltsfoot, awnless brome, pasqueflower and others.

Moss species diversity of the Forest-park has not been an object of study before, though mosses are an integral part of phytocenosis. They are involved in soil cover formation; they accrete tree trunks, stumps, deadfallen wood. The data on the Forest-park flora would not be comprehensive without the data on moss species. Studying moss species diversity allows us to gain a full notion of plant associations and helps to solve problems of managing and protecting natural resources.

Material and method

Moss samples were collected in 2007-2009 by the route-field method [1, 2] and the conventional method of geobotanical description [3, 4]. To define the frequency of occurrence we have employed the occurrence index (Ks) by analogy with colonization index suggested by A.P. Dyatchenko [5]: the number of associations and places of occurrence of a species / total number of studied associations and places of occurrence. Ks values were interpreted in the following way: 0.14 – sporadically, 0.15–0.43 – rarely, 0.44–0.70 – quite often, 0.71–0.90 – often, 0.91–1.0 – very often.

In the course of study 15 geobotanical descriptions were carried out; they were put into 7 associations: pine-raspberry-bluegrass (1), birch-pine-bluegrass (2), birch-plantain (3), birch-raspberry-forbs (4), pine- horsetail (5), maple-birch-pea shrub- forbs (6), birch-sonchus-brome (7). The numbering of associations is used in the inventory of the moss flora which was developed upon studying 116 multispecies samples. The species are listed in accordance with the system presented by M.S. Ignatyev and his co-authors [6]. The herbarium can be found at the Botany, Biotechnology and Landscape Architecture Department of Tyumen State University.

This research continues the series of works on bryoflora of natural conservation areas of the South of the Tyumen Region* [7, 8, 9, 10].

Results and Discussion

The research has shown that the flora of the territory under study includes 26 species, 21 genera, 15 families and 3 orders of the class *Bryopsida* (Table 1). The dominating role in the composition of plant associations have the mosses of the *Hypnales* order, which account for 76.6% of the total number of species. Most diverse are the families of *Mniaceae*, *Pylaisiaceae*, *Brachytheciaceae*, *Amblystegiaceae*, which account for 49.6%.

Table 1

Composition of Moss Flora

№	Order, number of families: (genera – species); share, %	Family	Number of genera – number of species	Relative share in the total number of species
1	Dicranales 1 : (1–1), 3,8%	Ditrichaceae	1 – 1	3,8
2	Bryales 3: (3–5), 19,1%	Bryaceae	1 – 1	3,8
		Mielichhoferiaceae	1 – 1	3,8
		Mniaceae	1 – 3	11,5
3	Hypnales 11 : (17–20), 76,6%	Plagioteciaceae	1 – 1	3,8
		Pylaisiadelphaceae	1 – 1	3,8
		Climaciaceae	1 – 1	3,8
		Hylocomiaceae	1 – 1	3,8
		Brachytheciaceae	2 – 4	15,4
		Calliergonaceae	1 – 1	3,8
		Scorpidiaceae	1 – 1	3,8
		Pylaisiaceae	3 – 3	11,5
		Leskeaceae	1 – 1	3,8
		Thuidiaceae	2 – 2	7,7
		Amblystegiaceae	3 – 4	15,4
Total: 15 : (21–26)		15	21 – 26	

Inventory of the Moss Flora of the Forest-park Zatyumensky

Order *Dicranales* H. Philib. Ex M.Fleish.

Family *Ditrichaceae* Lipr.

Ceratodon purpureus (Hedw.) Brid. Ks = 0.29. Occasionally. Indifferent xeromesophyte. On soil (2), on birch trunks encrustations (3).

Order *Bryales* Schwagr.

Family *Bryaceae* Schwagr.

* The author expresses deep appreciation and gratitude to Professor Alexander P. Dyatchenko, Dr. Biol. Sci., Head of Botany and its Teaching Methods Department, Ural State Pedagogical University, for his help in identifying some species.

2. *Bryum caespiticum* (Hedw.) Ks = 0.14. Sporadically. Epixilic mesoxerophyte. On fallen deadwood (3).

Family Mielichhoferiaceae Schimp.

3. *Pohlia nutans* (Hedw.) Lindb. Ks = 0.43. Rarely. Indifferent oligo-mesotrophic. On pine trunk bases, (1, 5), including scorched ones (1), on soil (1), on soil at pine pans (2).

Family Mniaceae Schwagr.

4. *Plagiomnium cuspidatum* (Hedw.) T. Kop. Ks = 1.0. Very often. Indifferent mesophyte. On soil (1, 4, 5), tree waste (1, 2, 5), bricks (1), on iron and glass debris (1), fallen deadwood (3, 4, 5, 7), tree stumps (3), birch trunks (3, 4, 5, 6), alder trunks (4), pine trunks (5), oak trunks (6).

5. *P. ellipticum* (Brid.) T. Kop. Ks = 0.29. Rarely. Eutrophic mesophyte. On tree waste (1), fallen deadwood (3).

6. *P. medium* Bruch et al. T.Kop. Ks = 0.14. Sporadically. Eutrophic mesohygrophyte. On soil (2).

Order Hypnales Dumort.

Family Plagiotheciaceae Fleisch.

7. *Plagiothecium denticulatum* (Hedw.) Bruch et al. Ks = 0.14. Sporadically. Epiphytic mesophyte. On birch trunks (3).

Family Pylaisiadelphaceae Goffinet & W.R. Buck

8. *Platygyrium repens* (Brid.) Bruch et al. Ks = 0.14. Sporadically. Epiphytic mesophyte. On birch trunks (3).

Family Climaciaceae Kindb.

9. *Climacium dendroides* (Hedw.) F. Weber & D. Mohr Ks = 0.29. Rarely. Eutrophic mesohygrophyte. On soil (2), tree stumps (3).

Family Hylacomiaceae Fleisch.

10. *Pleurozium schreberi* (Brid.) Mitt. Ks = 0.43. Rarely. Meso-eutrophic, with wide tolerance to substrate water levels. On soil (1), birch trunk base (4) pine trunk base (7).

Family Brachytheciaceae Schimp.

11. *Brachythecium mildeanum* (Schimp.) Schimp. Ks = 0.71. Quite often. Mesotrophic mesophyte. On tree waste (1, 5, 7), brick shards (3), pine trunk base, alder trunk base (5), birch trunk base (6), apple tree trunk base (7).

12. *B. salebrosum* (F. Weber & D. Mohr) Bruch et al. Ks = 1.0. Very often. Indifferent mesophyte. On the base of a scorched pine, iron and glass debris, bricks (1), birch trunk base (2, 3, 4, 5), alder trunk base (4, 6), mountain ash trunk base (4), oak trunk base (6), poplar trunk base (7), apple tree trunk base, maple trunk base (7), on soil (1, 2, 4, 5), on soil at pine pans (2) and birch pans (3), fallen deadwood (3, 4, 5, 7), tree stumps, tree waste (5).

13. *Sciuro-hupnum oedipodium* (Mitt) Ignatov & Hutten. Ks = 0.71. Quite often. Mesotrophic mesophyte. On tree waste, iron and glass debris, bricks, soil (1), birch trunk base (3), alder trunk base (4, 6), oak trunk base (6), pine trunk base (7).

14. *S. reflexum* (Sterke.) Ignatov & Huttunen. Ks = 0.29. Rarely. Mesotrophic mesophyte. On tree waste (1), oak trunk base (6).

Family Calliergonaceae (Kanda) Vanderpoorten, Hedenaes, Cox et Shaw

15. *Calliergon cordifolium* (Hedw.) Kindb. Ks = 0.14. Sporadically. Eutrophic mesophyte. On tree waste (5).

Family Scorpidiaceae Ignatov & Ignatova

16. *Sanionia uncinata* (Hedw.) Loeske Ks = 0.86. Often. Mesotrophic indifferent. On birch trunk base (3, 6), alder trunk base (4), pine trunk base (5), fallen deadwood (7), soil (2).

Family Pylaisiaceae Schimp.

17. *Callicladium haldanianum* (Grev.) H.A. Crum. Ks = 0.43. Rarely. Mesoeutrophic mesophyte. On soil at pine pans (2), birch trunk base (4), apple tree trunk base (7).

18. *Pylaisia polyantha* (Hedw.) Grout. Ks = 0.86. Often. Epiphytic epixilic xeromesophyte. On birch trunk base (2, 3, 4, 5, 6), pine trunk base (2), oak trunk base (6), maple trunk base (7), apple tree trunk base (7), on tree stumps (3), fallen deadwood (4), tree waste (5).

19. *Stereodon pallescens* (Hedw.) P. Beauv. Ks = 0.71. Quite often. oligo-mesotrophic xeromesophyte. On birch trunk base (2, 3, 4), mountain ash trunk base (4), oak trunk base (6), maple trunk base (7), apple tree trunk base (7), pine trunk base (7), on soil at pine pans (2).

Family Leskeaceae Schimp.

20. *Leskea polycarpa* (Hedw.) Ks = 0.29. Rarely. Epiphytic mesophyte. On oak trunk base (6), apple tree trunk base (7).

Family Thuidiaceae Schimp.

21. *Abietinella abietina* (Hedw.) M. Fleisch. Ks = 0.43. Rarely. Epiphytic mesoxerophyte. On birch trunk base (2, 3), alder trunk base (4).

22. *Haplocladium microphyllum* (Hedw.) Bruch. Ks = 0.14. Sporadically. Epiphytic mesoxerophyte. On birch trunks encrustations (2).

Family Amblystegiaceae G.Roth

23. *Amblystegium serpens* (Hedw.) Bruch. Et al. Ks = 1.0. Very often. Indifferent mesophyte. On tree waste (1, 2), soil (1, 2), iron and glass debris (1), fallen deadwood (3, 5, 7), tree stumps (3, 5), birch trunk base (2, 4, 5, 6), maple trunk base (3, 7), mountain ash trunk base (4), pine trunk base (5), alder trunk base (5, 6), oak trunk base (6), poplar trunk base, apple tree trunk base (7).

24. *Campyliadelphus chrysophyllus* (Brid.) R.S. Chopra Ks = 0.29. Rarely. Mesotrophic mesophyte. On soil at a birch trunk (2), maple trunk base, apple tree trunk base (7).

25. *Drepanocladus aduncus* (Hedw.) Warnst. Ks = 0.43. Rarely. Eutrophic mesohydrophyte. On soil (2), fallen deadwood (3), alder trunk base (4).

26. *D. polygamus* (Bruch et al.) Hedenäs Ks = 0.14. Sporadically. Mesoeutrophic mesophyte. On fallen deadwood (5).

Moss species diversity is distributed into associations in the following way: birch-plantain – 17, birch-pine-bluegrass – 14, birch-sonchus-brome – 12, birch-raspberry-forbs – 11, maple-birch-pea shrub- forbs – 10, pine-raspberry-bluegrass and pine-horsetail– 9 each.

According to the type of substrate the moss species are distributed into five groups: epigeic, epiphytic, epixilic, on tree waste and debris (bricks, glass, iron). Most diverse are epigeic and epiphytic groups which include 18 and 13 species accordingly. Ten moss species were found on fallen deadwood, eight on tree waste and five on debris. The species *Plagiomnium cuspidatum*, *Brachythecium salebrosum* and *Amblystegium serpens* were found on all types of substrate. The following species proved to be only epiphytic: *Plagiothecium denticulatum*, *Platygyrium repens*, *Leskea polycarpa*, *Abietinella abietina*, *Haplocladium microphyllum*. Only soil substrate is selected by *Plagiomnium medium*, and only fallen deadwood by *Drepanocladus polygamus* and *Bryum caespiticum*.

According to the degree of substrate humidification, moss species of the Forest-park fall into five ecological groups. The species are distributed in the following way: mesophytes – 53.8%, xeromesophytes, mesoxerophytes, mesohygrophytes and indifferent – 11.5% each.

According to the nutrient quality of substrate, most dominant are epiphytic (26.9%) and eutrophic (19.2%) species, followed by mesotrophic, mesoeutrophic and indifferent species which account for the same share of 15.4%. The other groups have insignificant representation.

Conclusion

1. The flora of the reserve includes 26 species, 21 genera, 15 families, 3 orders of the class *Bryopsida*

2. The order *Hypnales* is the dominant one in the plant communities. The greatest diversity is characteristic of the families *Mniaceae*, *Pylaisiaceae*, *Brachytheciaceae*, *Amblystegiaceae*, which account for 49.6% share.

3. Most frequently found species with $K_s > 0.5$ are: *Plagiomnium cuspidatum*, *Brachythecium mildeanum*, *B. salebrosum*, *Sciuro-hupnum oedipodium*, *Pylaisia polyantha*, *Sanionia uncinata*, *Stereodon pallescens*, *Amblystegium serpens*.

4. Most diverse are birch-plantain associations (17) and birch-pine- bluegrass (14).

5. As far as the substrate is concerned, most moss species are found on tree trunks (18) and soil (13)

6. According to the ecological classification, moss flora of the reserve is composed mostly of epiphytic mesophytes.

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