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M. V. Yushkevich, PhD (Agriculture), assistant professor (BSTU);**L. S. Pashkevich**, PhD (Agriculture), assistant professor (BSTU)**SPECIES DIVERSITY AND SYNANTHROPIZATION OF MINSK SUBURBAN FORESTS**

The variety of the most common phytocoenosis of the suburb Minsk is established. In all are revealed 257 species. Their greatest quantity is fixed in pine forests (179) and birch groves (163). Before the unviolated phytocoenosis the greatest quantity of species is revealed before the fir groves. The level of synanthropic species before the wood and bushy tier on the average composes 50%. Before the ground cover the portion of synanthropic species before average 30% reaches maximum with 4–5 stages of recreational digression.

Introduction. Suburban forests are under considerable anthropogenic load which affects their species diversity and composition. Forest vegetation is transformed due to emerging and spreading synanthropic species which intrude into the disturbed phytocenoses and become more widespread when the man-induced load gets heavier. Synanthropization process is adapting of phytocenoses to man-affected or man-made environment. Synanthropization is adaptation of phytocenoses to man-affected or man-made environments. Synanthropic species are frequently divided into two groups: apophytes (relating to local flora) and anthropophytes (incl. adventives and introduced) [1]. The largest urban agglomeration in Belarus is a metropolitan one with more than 2 mln. people. The share of Minsk forest and parkland zone makes up 13.6% of the total republican forest and parkland area. However the share of degrading and non-sustainable Minsk park belts comprises 42.1 and 25.3% of the total republican forest and parkland area respectively. Suburban forests of Minsk are characterized by the largest degree of recreational disturbance as compared to other population centres.

Main part. The study area of Minsk park belts is inhabited by a total of 257 plant species, including 243 vascular plants with 5 ferns and 2 horsetails. The species distribution by layers is as follows: 68 trees and shrubs, 14 mosses and 175 grass and shrubs.

The greatest number of species is registered in bracken-type pine forests (179 species). This can be explained by the fact that the environment of this forest type (as well as those of cowberry pine forests, mossy pine forests and heath pine forests) is the most attractive for visitors and favourable for a large number of plants (Table 1). Bracken-type

birch forests have fewer plants (163 species). Wood sorrel spruce forests have the largest number of plants (84 species) among the phytocenoses of the 1st degradation stage (undisturbed) which have the dominant share in the green belts of forest and parkland areas of the Republic.

Further we give a detailed description of the biodiversity of bracken-type pine forests as the most widespread ones. From 179 registered plant species, the forest ground cover is inhabited by 22 trees, 35 shrubs. The most abundant plant families are – *Rosaceae*, *Asteraceae*, *Poaceae*, *Fabaceae*, *Lamiaceae*, *Apiaceae*. The most abundant plant genus are – *Agrostis*, *Carex*, *Galium*, *Poa*, *Ribes*, *Stellaria*, *Trifolium*.

Depending on recreational degradation stage, the ground cover is dominated by Schrabers moss (*Pleurozium schreberi* (Brid.) Mitt.), common blueberry (*Vaccinium myrtillus* L.), common bracken (*Pteridium aquilinum* (L.) Kuhn), glittering wood moss (*Hylocomium splendens* (Hedw.) B.S.G.), colonial bent grass (*Agrostis tenuis* Sibth.), sheep's fescue (*Festuca ovina* L.), dicranum moss (*Dicranum polysetum* Sw.), forest wild strawberry (*Fragaria vesca* L.), sweet vernal grass (*Anthoxanthum odoratum* L.), common wood sorrel (*Oxalis acetosella* L.). The understory is inhabited by alder buckthorn (*Frangula alnus* Mill.), mountain ash (*Sorbus aucuparia* L.), common hazel (*Corylus avellana* L.), common raspberry (*Rubus idaeus* L.), dwarf serviceberry (*Amelanchier spicata* (Lam.) K. Koch), the young growth is represented mainly by common spruce (*Picea abies* (L.) H. Karst.), Norway maple (*Acer platanoides* L.), silver birch (*Betula pendula* Roth), English oak (*Quercus robur* L.), littleleaf linden (*Tilia cordata* Mill.).

Table 1

The number of plant species by forest type

Indicator	Mossy pine f.	Bracken-type pine f.	Wood sorrel pine f.	Bracken-type spruce f.	Wood sorrel spruce f.	Bracken-type birch f.	Wood sorrel birch f.
Total number of plant species	112	179	119	94	112	163	102
Trees and shrubs	25	57	39	28	27	46	28
Mosses	7	12	8	6	11	13	7
Grasses and shrubs	80	110	72	60	74	104	67
Incl.: ferns	2	3	2	4	5	3	5
horsetails	–	1	1	–	1	1	1

The most frequent plant species (besides the listed above) of the ground cover are the following: common heath grass (*Sieglingia decumbens* (L.) Bernh.), mouse-ear hawkweed (*Pilosella officinarum* F. Schultz et. Schultz-Bip.), common cow-wheat (*Melampyrum pratense* L.), Canadian goldenrod (*Solidago canadensis* L.), spinulose woodfern (*Dryopteris carthusiana* (Vill.) H.P. Fuchs) and common male fern (*Dryopteris filix-mas* (L.) Schott), fingered sedge (*Carex digitata* L.), wood avens (*Geum urbanum* L.), stone bramble (*Rubus saxatilis* L.), blue buttons (*Knautia arvensis* (L.) Coult.), common self-heal (*Prunella vulgaris* L.), hawkweed (*Hieracium sylvularum* Jord. Ex Bo-reau), germander speedwell (*Veronica chamaedrys* L.), blue bugle (*Ajuga reptans* L.), feather reed grass (*Calamagrostis arundinacea* (L.) Roth), hairy wood-rush (*Luzula pilosa* (L.) Willd.), dog violet (*Viola canina* L.). The most common trees and shrubs are represented by: European aspen (*Populus tremula* L.), apple (*Malus domestica* Borkh.), plum (*Prunus domestica* L.), common cherry (*Cerasus vulgaris* Mill.) and sweet cherry (*Cerasus avium* (L.) Moenchy), European bird cherry (*Padus avium* Mill.), cherry plum (*Prunus cerasifera* Ehrh.), fly honeysuckle (*Lonicera xylosteum* L.), black currant (*Ribes nigrum* L.) and red currant (*Ribes rubrum* L.).

The tree-shrub layer is also characterized by the following sporadic species: Tatarian honeysuckle (*Lonicera tatarica* L.), alpine currant (*Ribes alpinum* L.) and Manchurian cherry (*Padus mackii* (Rupr.) Kom.), while the ground cover is inhabited by single species of pimpernel (*Pimpinella dissecta* Retz.), gypsywort (*Lycopus europaeus* L.), greater knapweed (*Centaurea scabiosa* L.), water pepper (*Persicaria hydropiper* (L.) Spach), Jerusalem artichoke (*Helianthus tuberosus* L.). In one forest site creeping rattlesnake plantain (*Goodyera repens* (L.) R. Br.) was found – the plant species which needs preventive protection.

From 119 plant species (22 tree species, 17 shrub species) found in wood sorrel pine forests, 80 plant species inhabit the live cover. In this forest type a plant belonging to preventive protection list was found which is meadow rue (*Thalictrum aquilegifolium* L.). 112 plant species were registered in mossy pine forests: 12 tree species, 13 shrub species, 66 plant species in the live cover. By their species composition they are similar to

wood sorrel pine forests, bracken-type pine forests and wood sorrel spruce forests. 112 plant species were registered in wood sorrel spruce forests, among them there are 12 trees, 15 shrubs and 85 plant species in the live ground cover. In this forest type some plant species belonging to preventive protection list were found which are cow vetch (*Vicia tenuifolia* Roth), lesser butterfly-orchid (*Platanthera bifolia* (L.) Rich.) and yellow foxglove (*Digitalis grandiflora* Mill.). From 102 plant species registered in wood sorrel birch forests (13 trees, 15 shrubs), 74 plant species inhabit the live ground cover. Synanthropization affects all layers of forest phytocenosis. The share of synanthropic plants in the grass-shrub layer of the study park belts of Minsk averages 50%, that of understory and young growth makes 62 and 8% respectively. The synanthropic plants are mainly represented by anthroporhytes (more frequently introduced and cultivated trees and shrubs). The share of synanthropic plants in urban forests makes up 69% according to the study of the Institute of Experimental Botany of Belarus NAS [2]. The share of synanthropic plants in the live ground cover is considerably lower (about an average of 30%) and varies by forest types. It increases with increasing stage of degradation reaching its maximum in the 4th and 5th stages. The plants are mainly of apophytic type. Synanthropization of tree-shrub layer in bracken-type pine forests is 53%, including that of understory being 60% (Table 2).

The live ground cover is characterized by a greater share of synanthropic plants as compared to their average share in park belts of Minsk (37%). The share of synanthropic plants varies according to the stage of recreational degradation. It comprises 32% in the tree-shrub layer of undisturbed bracken-type pine forests. Higher recreational load results in a higher share with 62%. Individual forest sites are characterized by denser synanthropic plantations as compared to typical forest plants. Further increase of recreational load and competition with spreading grasses causes reduced density of understory and lower share of synanthropic plants. The 5th stage of degradation is characterized by disappearing understory. Synanthropization of the live ground cover shows increasing share of apophytes (more rarely anthropophytes) due to increasing recreational load. Undisturbed forest stands have 8% of apophytes in their species composition.

Table 2

Synanthropization of bracken-type pine forests

Storey	Share of synanthropic plants by stages of recreational degradation, %				
	1 st stage	2 nd stage	3 rd stage	4 th stage	5 th stage
Trees and shrubs	32	50	41	35	–
Understory	43	62	55	44	–
Live ground cover	8	39	42	57	89

Synanthropic plants dominate typical forest plants both by the number of species (57%) and the projective cover in stands of the 3rd and 4th degradation stages. Degrading stands have 89% of plant species which are not typical of natural undisturbed phytocenoses.

The share of synanthropic plants in the tree-shrub layer of mossy pine forests is 48%, including 60% in their understory. Bracken-type pine forests also have a greater share of synanthropic plants (44%) as compared to their average share in park belts of Minsk. This share makes up 36% in the tree-shrub layer of wood sorrel pine forests, including 45% in the understory, 10% in the young growth and 24% in the live ground cover.

The share of synanthropic plants is considerably lower in the tree-shrub layer of bracken-type spruce forests (18%), including 26% in their understory. It is also low in their live ground cover (17%). This share is slightly higher in the tree-shrub layer of wood sorrel spruce forests (22%), including 32% in their understory. No synanthropic plants were registered in the young growth layer however they can be found in other forested areas of Belarus. The share of synanthropic plants in the live ground cover is 22%.

Lower synanthropization of spruce forests can be explained by their lower visitation and certain peculiarity of transformation of the live ground cover. The share of synanthropic plants in the tree-shrub layer of bracken-type birch forests is 48%, including 58% in their understory. It is rather low in their live ground cover with 27%. Synanthropization of the tree-shrub layer in wood sorrel birch forests is 18%, including 26% in their understory. Their live ground cover is characterized by the lowest synanthropization with 14%.

Conclusion. The study area of Minsk park belts is characterized by a rich species diversity resulting from considerable anthropogenic load. The highest number of species is registered in bracken-type pine forests (179 species) and birch forests (163 species) as they are subject to maximum transformation caused by their recreational use. Other forest types under study contain species diversity ranging from 119 to 94 species. Wood sorrel spruce forests have the greatest species diversity among undisturbed forest phytocenoses.

Suburban forests of Minsk are characterized by a high average share of synanthropic plants in their tree-shrub layer (50%). Considerable variations of this indicator in the live ground cover can be explained by varying stages of recreational degradation.

Bracken-type pine forests have the highest share of synanthropic plants in their tree-shrub layer (53%). Mossy pine forests have the highest share of synanthropization in their live ground cover (44%).

Wood sorrel forests are characterized by the lowest synanthropization, especially in their live ground cover. Spruce forests are little affected by synanthropization as well.

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