БИОЛОГИЧЕСКИЕ НАУКИ

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LICHENS OF HISTORICAL MANOR PARKS IN NORTHWEST-CENTRAL BELARUS

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Introduction. Regardless a great number of lichen collections and species occurrence records expected to be done in historical manor parks throughout Europe, little number of special scientific publications was devoted to the inventory and analysis of lichen biota in particular parks. Such data are available, e.g. for Nettlecombe Estate Park in southwest Britain (epiphytic species only) [1], some parks of Estonia (epiphytic species only) [2], parks of St. Petersburg environs [3], parks of Mikhailovskoe Memorial Reserve in Pskov region of Russia [4], Palace Park and Management Park in Białowieża, eastern Poland [5].

Manor parks were a traditional form of landscape design, widely used in estates of Belarus in the 18th and the 19th centuries. According to the survey undertaken by Fedoruk [6], 588 variously preserved manor and town parks were recorded in today Belarus. As a rule, over the 20th century their landscape complexes were significantly modified [6, 7]. The data about lichens inhabiting selected historical manor parks in Belarus were published as brief communications only in recent years [8, 9, 10]. The aim of the present research was to compare lichen biota of the parks, sampled in northwest-central part of the country, via studying species richness of lichens, proportion of their growth forms, and species distribution over substrata.

Objects and methods.

The study area. All studied parks are situated in Minsk region (oblast), northwest-central part of Belarus (Figure 1). The study area, on which six sample parks were selected, embraces approximately 10% of the all manor parks preserved in the country. The study area belongs to boreonemoral natural zone. The parks were selected to be representative in respect of various foundation times, various degree of tree stand transformation in the XX century, various relief, and anthropogenic pressure. Characteristics of the parks are given in Table 1; total area and foundation time follow the data by Fedoruk [6, 7].

Each park consists of several types of vegetation, including small-sized planted and semi-natural tree massifs and coppices, scattered trees, line plantations of shade trees along roads, bushes, and grasslands. Small-sized orchards and wetlands are present not in all parks.

Table 1 – Geographical characteristics of the studied manor parks

Name of the park	Administrative district, inhabited locality name	Geographical coordinates	Area, ha	Foundation time, century
Kamarova	Myadzel, Kamarova village	54°54'6"N, 26°23'47"E	20	mid-18th
Lahoisk	Lahoisk, Lahoisk settlement	54°12'14"N, 27°50'58"E	11	1st quarter of the 19th
Syomkava	Minsk, Syomkava village	54°1'5"N, 27°26'29"E	15	mid-18th
Pryluki	Minsk, Pryluki settlement	53°47'26"N, 27°27'13"E	6	2nd half of the 18th
Stan'kava	Dzyarzhynsk, Stan'kava village	53°37'46"N, 27°13'44"E	15	2nd half of the 19th
Dukora	Pukhavichy, Dukora village	53°40'20"N, 27°57'31"E	16	late 18th

Kamarova Park is situated on a stream terrace. The park is distinguished by the big number of various buildings (over 30). Predominant trees here are *Tilia cordata* and *Quercus robur*, 120–150 years old. There is a water system in the park, composed of several dams and two ponds. Lahoisk Park lies on a high terrace of the Haina river. The relief of the park is complicated by a rampart and a ditch around the place, earlier occupied by a medieval castle. Tree stand in the park consists mainly of *Q. robur* and *Fraxinus excelsior*, 150–200 years old. This park also has a water system with stone dykes and a fountain. Besides, Lahoisk Park is noteworthy due to several springs. Syomkava Park is characterized by complicated relief with terraces, hills, and floodplains of two watercourses. Predominant trees are *T. cordata* and *Acer platanoides*, 150–200 years old. There are ruins of the manor house and a number of comparatively recent buildings in the park. Pryluki Park is situated on the terraced slope of the Ptsich river valley and has two unsteadily watered ponds. Main species in tree stand are 100–140 years old *T. cordata* and *A. platanoides*, and about 200 years old *Populus alba*. Stan'kava Park is characterized by flat relief and the presence of large pond framed by stones. Predominant tree species here are *T. cordata* and *A. platanoides*, 130–150 years old. Dukora Park is distinguished by simple relief, slightly declined to a stream. Tree stand is composed mainly of *T. cordata* and *A. platanoides*, 80–120 years old.

The parks Dukora, Kamarova, Lahoisk, and Stan'kava have the status of natural monuments of national importance. All six studied parks, especially Lahoisk and Stan'kava, are under significant impact of human activity, because they are used by the local communities for recreation. There are constantly functioning public buildings within the area of Dukora and Pryluki parks: school in the first park and research institute in the second. Moreover, Pryluki Park is situated in a zone of high industry and transport emissions, 6 km from the outskirts of Minsk City. The air in Dukora Park is affected by the neighbouring cattle-breeding farms.

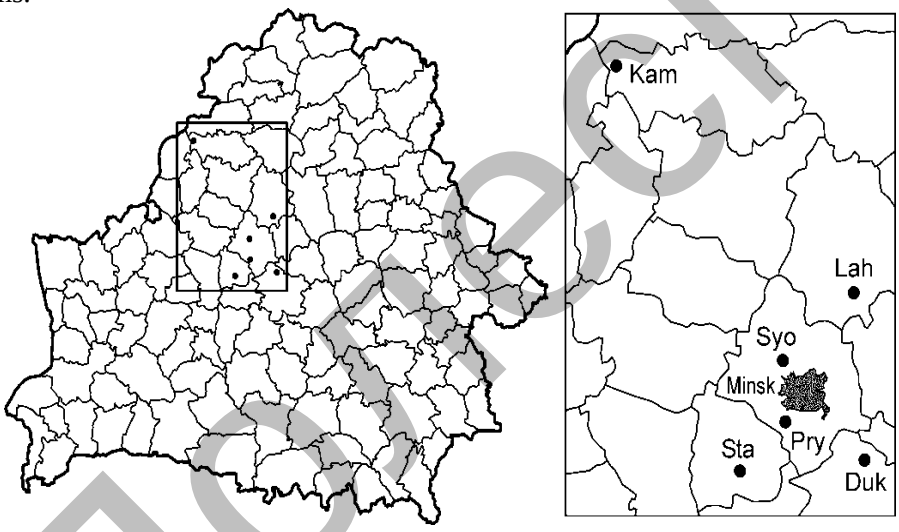

Figure 1 – Location of the studied manor parks in Belarus: Duk – Dukora, Kam – Kamarova, Lah – Lahoisk, Sta – Stan'kava, Syo – Syomkava, Pry – Pryluki

Collections and statistical analysis. Lichens were collected and recorded in 2005–2011. The all representative habitats and substrata on the whole area of each park were examined, including freshly cut trees and temporarily flooded surfaces. The bark of standing trees, walls of the buildings, and other artificial constructions were examined up to the height 2–3 m above the ground. The collected specimens (ca. 380) were deposited in herbaria: MSK-L (V.F. Kuprevich Institute of Experimental Botany) and MSKU (Belarusian State University). Species nomenclature follows *Index Fungorum* (http://www.indexfungorum.org/Names/Names.asp), except two names combined in *Melanelixia*. Relative abundance of each species within a park was assessed according to 3-grade scale: 1 (rare) – 1–2 substratum units with thalli; 2 (uncommon) – 3–10 substratum units; 3 (common) – more than 10 substratum units over the park.

Graphic comparison of lichen biotas of individual parks was done by means of cluster analysis usning STATISTICA 5.0 software (StatSoft, USA). The initial data matrix consisted of species relative abundance values. Euclidean Distance was selected as distance measure and unweighted pair-group average as the method of clusterization.

Results and discussion. Altogether 119 species of lichens (lichenized Ascomycota), were found in six studied parks (Table 2). In respect of species richness, i.e. total number of species, the parks are belonged

to the two distinct groups: with poor lichen biota (38–47 species, Pryluki and Dukora) and with rich lichen biota (65–72 species, the rest of parks; Table 3). The number of recorded species in the most species-rich park (Syomkava) was almost two times higher, than in the most species-poor one (Pryluki).

Table 2 – Species of lichens, their relative abundance and substrata in studied manor parks

Species	Parks					
	Kamarova	Lahoisk	Syomkava	Pryluki	Stan'kava	Dukora
Acarospora fuscata (Nyl.) Th. Fr.	2 (s)	2 (s)				
**Acrocordia gemmata* (Ach.) A. Massal.			2 (b)			
Alyxoria varia (Pers.) Ertz & Tehler	1 (b)	1 (b)	1 (b)	1 (b)	1 (b)	1 (b)
Amandinea punctata (Hoffm.) Coppins & Scheid.	1 (b)				1 (b)	
Anaptychia ciliaris (L.) Körb.	3 (b)	3 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Arthonia cinereopruinosa Schaer.		1 (b)				
Arthonia dispersa (Schrad.) Nyl.			2 (b)		1 (b)	
Arthonia radiata (Pers.) Ach.			1 (b)		1 (b)	
**Arthothelium ruanum* (A. Massal.) Körb.			1 (b)			
Arthrosporum populorum A. Massal.		1 (b)				
Aspicilia cinerea (L.) Körb.	1 (s)					
Bacidia biatorina (Körb.) Vain.			1 (b)			
**Bacidia laurocerasi* (Delise ex Duby) Zahlbr.		1 (b)	1 (b)			
**Bacidia rubella* (Hoffm.) A. Massal.	2 (b)	3 (b)	2 (b)	1 (b)	2 (b)	2 (b)
Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw.		1 (b)				
Buellia schaereri De Not.						1 (w)
**Calicium viride* Pers.					1 (b)	
Caloplaca cerina (Hedw.) Th. Fr.	1 (b)		1 (b)		1 (b)	
Caloplaca cerinella (Nyl.) Flagey	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Caloplaca citrina (Hoffm.) Th. Fr.	1 (c)	1 (c)				
Caloplaca decipiens (Arnold) Blomb. & Forssell	2 (c, s)	2 (c, s, me)	2 (c)	2 (c)	2 (c, s)	2 (c, s)
Caloplaca saxicola (Hoffm.) Nordin	2 (c, s)	2 (c, s)	2 (c)	2 (c)	2 (c, s)	2 (c)
***Candelaria pacifica* Westberg**					1 (b)	1 (b)
Candelariella aurella (Hoffm.) Zahlbr.	2 (b)	2 (b, s)	2 (b)	2 (b)	2 (b)	2 (b)
Candelariella vitellina (Ehrh.) Müll. Arg.	1 (s)		1 (b)		1 (b)	
Candelariella xanthostigma (Pers. ex Ach.) Lettau	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
Catinaria atropurpurea (Schaer.) Vězda & Poelt					1 (b)	
**Chaenotheca brachypoda* (Ach.) Tibell			1 (b)			
Chaenotheca ferruginea (Turner ex Sm.) Mig.		1 (b)			1 (b)	
Chaenotheca furfuracea (L.) Tibell	1 (b)	1 (b)	1 (b)		1 (b)	
Chaenotheca phaeocephala (Turner) Th. Fr.			1 (b)			
**Chaenotheca stemonea* (Ach.) Müll. Arg.			1 (b)			
Chaenotheca trichialis (Ach.) Th. Fr.	2 (b)	2 (b)	2 (b)	1 (b)	2 (b)	1 (b)
Cladonia coniocraea (Flörke) Spreng.	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Cladonia digitata (L.) Hoffm.	1 (b)					
Cladonia fimbriata (L.) Fr.	1 (w)	1 (w)	1 (w)	1 (w)	1 (w)	1 (w)
Cladonia macilenta Hoffm.	1 (w)					
Coenogonium pineti (Ach.) Lücking &		1 (b)				

Lumbsch						
Diplotomma alboatrum (Hoffm.) Flot.			1 (b)			
Evernia prunastri (L.) Ach.	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
Flavoparmelia caperata (L.) Hale		1 (b)				
Graphis scripta (L.) Ach.	1 (b)	1 (b)	1 (b)		1 (b)	
Hypocenomyce scalaris (Ach. ex Lilj.) M. Choisy	2 (b)	2 (b)	2 (b)	1 (b)	2 (b)	1 (b)
Hypogymnia physodes (L.) Nyl.	3 (b, s)	3 (b, s)	3 (b)	3 (b)	3 (b, me)	3 (b)
Hypogymnia tubulosa (Schaer.) Hav.	1 (b)					
Imshaugia aleurites (Ach.) S.L.F. Mey.					1 (b)	
Lecania cyrtella (Ach.) Th. Fr.		1 (b)	1 (b)			
***Lecania erysibe* (Ach.) Mudd**			1 (br)			
Lecania naegelii (Hepp) Diederich & Van den Boom			1 (b)			
***Lecania sylvestris* (Arnold) Arnold**			1 (br)			
Lecanora allophana (Ach.) Nyl.	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Lecanora carpinea (L.) Vain.	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
Lecanora chlarotera Nyl.			1 (b)			
Lecanora crenulata Hook.	2 (c)	2 (c)	2 (c)	2 (c)	2 (c)	2 (c)
Lecanora muralis (Schreb.) Rabenh.	1 (s)	1 (s)			1 (s)	
Lecanora pulicaris (Pers.) Ach.		2 (b)	2 (b)			
Lecanora rugosella Zahlbr.	2 (b)		1 (b)			
Lecanora symmicta (Ach.) Ach.		1 (b)	2 (b)			
Lecidella elaeochroma (Ach.) M. Choisy	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
Lepraria incana (L.) Ach., s. l.	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
***Leptogium cyanescens* (Pers.) Körb.**			1 (b)			
**Lobaria pulmonaria* (L.) Hoffm.		1 (b)				
Melanelixia fuliginosa (Fr. ex Dudy) O. Blanco & al.	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
***Melanelixia subargentifera* (Nyl.) O. Blanco & al.**	1 (b)	2 (b)	1 (b)			
Melanelixia subaurifera (Nyl.) O. Blanco & al.		1 (b)			1 (b)	
Melanohalea exasperata (De Not.) O. Blanco & al.	1 (b)					
Melanohalea exasperatula (Nyl.) O. Blanco & al.	3 (b, s)	3 (b, me)	3 (b)	3 (b)	3 (b, me)	3 (b)
Micarea denigrata (Fr.) Hedl.					1 (w)	
Micarea prasina Fr.		1 (w)				
***Oxneria fallax* (Arnold) S.Y. Kondr. & Kärnefelt**	1 (b)	1 (b)				
Parmelia sulcata Taylor	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
***Parmelina tiliacea* (Hoffm.) Hale**	2 (b)	2 (b)	1 (b)	1 (b)	2 (b)	1 (b)
Peltigera canina (L.) Willd.					1 (g)	
Peltigera didactyla (With.) J.R. Laundon			1 (w,m)			
Peltigera malacea (Ach.) Funck	1 (g)					
Peltigera praetextata (Flörke ex Sommerf.) Zopf		1 (m, s)				
Pertusaria albescens (Huds.) M. Choisy & Werner		1 (b)	1 (b)		1 (b)	
Pertusaria amara (Ach.) Nyl.	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Phaeophyscia ciliata (Hoffm.) Moberg	1 (b)				1 (b)	
Phaeophyscia nigricans (Flörke) Moberg	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Phaeophyscia orbicularis (Neck.) Moberg	3 (b, c)	3 (b, c, s, me)	3 (b, c)	3 (b, c)	3 (b, c)	3 (b, c)
Phlyctis argena (Ach.) Flot.	2 (b)	2 (b)	2 (b)			

Physcia adscendens (Fr.) H. Olivier	3 (b, c)	3 (b, c, me)	3 (b, c, s)	3 (b, c)	3 (b, c)	3 (b, c)
Physcia aipolia (Ehrh. ex Humb.) Fürnr.	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)	2 (b)
Physcia caesia (Hoffm.) Hampe ex Fürnr.		1 (s)				1 (s)
Physcia dubia (Hoffm.) Lettau						1 (b)
Physcia stellaris (L.) Nyl.	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
Physcia tenella (Scop.) DC.	3 (b, c)	3 (b, c, me)	3 (b, c)	3 (b, c)	3 (b, c)	3 (b, c)
Physcia tribacia (Ach.) Nyl.						1 (s)
Physconia detersa (Nyl.) Poelt		2 (b)	2 (b)		2 (b)	
Physconia distorta (With.) J.R. Laundon	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)
Physconia grisea (Lam.) Poelt		1 (b)			1 (b)	1 (b)
Physconia perisidiosa (Erichsen) Moberg			1 (b)			1 (b)
***Pleurosticta acetabulum* (Neck.) Elix & Lumbsch	2 (b)	1 (b)	1 (b)	1 (b)	2 (b)	1 (b)
Pseudevernia furfuracea (L.) Zopf	1 (b)	1 (b)				
Psilolechia lucida (Ach.) M. Choisy			1 (br)			
***Pyrrhospora quernea* (Dicks.) Körb.					1 (b)	
Ramalina farinacea (L.) Ach.	3 (b)	3 (b)	3 (b)	1 (b)	3 (b)	3 (b)
Ramalina fastigiata (Pers.) Ach.	1 (b)				1 (b)	
Ramalina fraxinea (L.) Ach.	3 (b)	3 (b)	2 (b)	1 (b)	3 (b)	2 (b)
Ramalina pollinaria (Westr.) Ach.	2 (b)	2 (b)	1 (b)	1 (b)	2 (b)	1 (b)
Rhizocarpon geographicum (L.) DC.		1 (s)				
Rinodina exigua (Ach.) Gray				1 (b)		
Rinodina pyrina (Ach.) Arnold	1 (b)		1 (b)			
***Sclerophora pallida* (Pers.) Y.J. Yao & Spooner		1 (b)				
Scoliciosporum chlorococcum (Graewe ex Stenh.) Vězda					1 (b)	1 (b)
***Thelidium minutulum* Körb.**			1 (mr)			
Tuckermannopsis chlorophylla (Willd.) Hale					1 (b)	
Tuckermannopsis sepincola (Ehrh.) Hale	1 (b)					
Usnea hirta (L.) Weber ex F.H. Wigg.	1 (b)					
Verrucaria muralis Ach.	1 (s)		1 (br)		1 (s)	
Verrucaria nigrescens Pers.		1 (s)			1 (s)	
Vulpicida pinastri (Scop.) J.-E. Mattsson	1 (b)	1 (b)			1 (b)	
Xanthoparmelia conspersa (Ehrh. ex Ach.) Hale	1 (s)	1 (s)				
Xanthoparmelia pulla (Ach.) O. Blanco & al.	1 (s)				1 (s)	
Xanthoria candelaria (L.) Th. Fr.			1 (b)		1 (b)	1 (b)
Xanthoria elegans (Link) Th. Fr.		1 (c)	1 (c)		1 (c)	1 (c)
Xanthoria parietina (L.) Beltr.	3 (b, c)	3 (b, c, s, me)	3 (b, c)	3 (b, c)	3 (b, c, me)	3 (b, c)
Xanthoria polycarpa (Hoffm.) Rieber	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)	3 (b)

Remarks – In columns, out of brackets: relative abundance value according to 3-grade scale; in brackets: substrata types (b – bark, br – brick, c – concrete, g – ground, m – moss, me – metal, mr – mortar, s – stone, w – wood). The names of species published for the first time for Belarus are given in boldface. Species confined mostly to broadleaf forests are marked by one asterisk (*); species, which occur predominantly in parks, alleys and on solitary trees, are marked by two asterisks (**).

To evaluate the differences in lichen species composition between parks, as expected from their landscape differences, briefly outlined above, cluster analysis was undertaken. It demonstrates the most distant position of Syomkava Park and very close junction of Pryluki and Dukora (Figure 2).

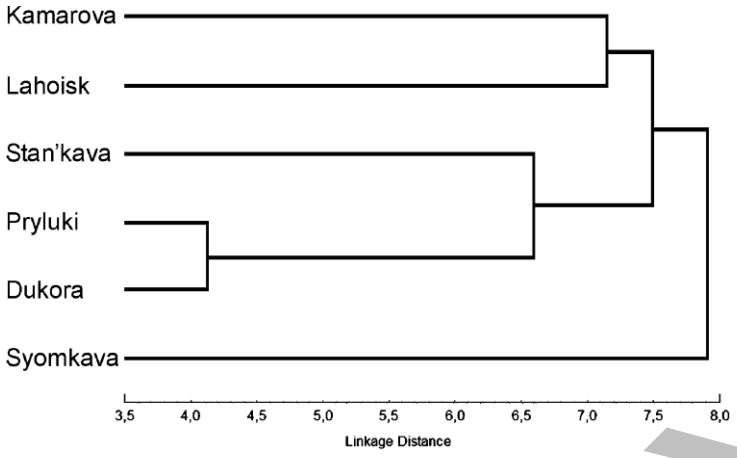

Figure 2 – Dendrogram of similarity between studied parks, based on their lichen biota

Rose and Wolseley [1] noted bark age and general humidity of the environment among the most important factors, defining the development of epiphytic lichen alliances. From this point of view, rich lichen biota of Syomkava may be explained by the presence of numerous trees about 200 years old and wetlands. Besides, we suppose the high species richness is caused by complicated relief, occupied by the park, which increases the diversity of available habitats. Among the considered parks, Syomkava has the highest number of species, found in single park only (15), of them 10 epiphytic species and 4 species found on mineral substrata (see Table 2).

Little number of species in Dukora and Pryluki is explained by less diverse landscape, intensive human activity, small area of the first park, and supposedly also higher (in comparison with other sample sites) air pollution influencing both parks. Both Pryluki and Dukora parks have little number of species that are rare or scattered over Belarus, and low number of species that are characteristic for broadleaf forests. There features apparently cause very high similarity in lichen composition of the two parks. No a correlation between the number of phorophyte species and the number of lichen species was observed: Syomkava is characterized by low species richness of trees and bushes, if to compare it with Pryluki and Dukora (Table 3).

Table 3 – Characteristics of lichen biota in the studied manor parks[1]

	Kamarova	Lahoisk	Syomkava	Pryluki	Stan'kava	Dukora
Species richness	65	70	72	38	67	47
Per cent of species, recorded in all parks	/ 57	/ 53	/ 51	/ 97	/ 55	/ 79
Species, recorded in 2 or 3 parks	18 / 28	20 / 29	17 / 24	– / –	20 / 30	5 / 11
Species, recorded in one park only	8 / 12	10 / 14	15 / 21	1 / 3	7 / 10	3 / 6
Species of major growth forms:						
crustose[2]	25 / 38.5	31 / 44	40 / 56	13 / 34	29 / 43	14 / 30
foliose[3]	28 / 43	28 / 40	25 / 35	18 / 47.5	30 / 45	26 / 55
fruticose	12 / 18.5	11 / 16	7 / 10	7 / 18.5	8 / 12	7 / 15
Species on substrata:						
bark	51 / 78	56 / 80	61 / 85	34 / 89	56 / 84	39 / 83
stone	9 / 14	13 / 19	1 / 1	–	6 / 9	3 / 6
concrete	8 / 12	9 / 13	8 / 11	7 / 18	8 / 12	8 / 17
wood	2 /	2 /	2 /	1 /	2 /	2 /

ground	1 /	–	–	–	1 /	–
moss	–	1 /	1 /	–	–	–
brick	–	–	4 /	–	–	–
mortar	–	–	1 /	–	–	–
metal	–	6 /	–	–	3 /	–
species recorded on mineral substrata[4]	16 / 25	18 / 26	13 / 18	7 / 18	12 / 18	10 / 21
species recorded on stones only	7 / 11	6 / 9	–	–	4 / 6	2 / 4
Number of phorophyte species, on which lichens were recorded	20	15	14	13	22	12
Number of species, recorded on bark and wood, per phorophyte species	2.7	3.8	4.5	2.7	2.6	3.4

[1] Except the first and the two last lines, the numbers show number of species / per cent of the total number of species in park.

[2] including leprose, granulose, endosubstratal

[3] including placodioid, squamulose, subfruticose.

[4] stone, concrete, brick, mortar.

The joining of Kamarova and Lahoisk in a separate cluster (Figure 2) can be explained by the presence of abundant stony substrata, associated with water bodies and watercourses. Near 10% of species in both parks were found on stones only. Five species from the general list were recorded in Kamarova and Lahoisk only: *Acarospora fuscata*, *Xanthoparmelia conspersa* (on stones), *Caloplaca citrina* (on concrete), *Oxneria fallax*, and *Pseudevernia furfuracea* (on bark). Both parks are distinguished by the presence of beard growth form: the genus *Usnea* was recorded in Kamarova and *Bryoria* in Lahoisk.

The shares of constant and inconstant species in a range of similar ecosystems are the important characteristics of their biota. The group of lichens recorded in all studied parks (constant species) includes 37 taxa, or 31% of the total list. All these species have common distribution over Belarus. Within this group, 17 species (14%) were the most abundant in all parks, with the abundance value 3 at least in five parks. The share of constant species in the parks with rich lichen biota was remarkably similar, namely 51–57% (Table 3). Parks with poor lichen lists were prominent in this characteristic: near 80% of species in Dukora and near 100% in Pryluki belong to constant species. The share of species, recorded in 2–3 of 6 studied parks, was also notably similar between parks: 28–30% for Kamarova, Lahoisk, and Stan'kava (Table 3). Similar share was observed also for the species, recorded in one of six parks only: they constitute 10–14% of lichens in Kamarova, Lahoisk, and Stan'kava.

Growth forms in lichens generally reflect the adaptation of a species to particular environmental conditions, and thus the number of species belonged to various growth forms can be considered as an additional characteristic of local biota. Such kind of analysis (Table 3) showed that the proportion of three main morphological types of thallus was highly variable between parks. Foliose forms constituted 35–55%, fruticose 10–18.5%, and crustose 30–56%. In the same time, the number of species with foliose thallus was remarkably similar between parks (25–30, except Pryluki), independently of the total species number in a park. The number of fruticose species was comparatively little variable between parks (7–12), whereas the number of crustose forms varied greatly (13–40). Species richness of crustose forms partly correlates with the average tree age.

Additional analysis, which was done to compare lichen biota in studied parks, was the distribution of species over the main kinds of substrata (Table 2, 3). Corticolous species, growing on bark of living trunks and branches, was the main group in parks, and in the studied biotas they constituted similar shares (78–89%). The number of epiphytic species varied from 34 to 61. This characteristic occurred to be similar with parks in Estonia, where 44–62 epiphytic species were recorded [2], and parks in Pskov oblast, where 32–78 epiphytic species were counted [4]. The ratio {number of epiphytic species/number of phorophyte species, on which they were recorded} was found to be highly variable between parks, independently of their landscape characteristics (Table 3).

The number of species on mineral substrata was higher in parks with stone dams, and reached roundly 25% in Kamarova and Lahoisk. This characteristic was very similar (18–21%) in the rest of parks. Most of saxicolous species belong to widespread and ecologically plastic taxa. The number of species on con-

crete was surprisingly similar in all parks (7–9). The same figure (1–2 species per park) was observed for lichens recorded on decaying wood (fallen trunks, differently decayed stumps, and timbers). Species on ground, mosses, mortar, and brick were scarce or occasional in all parks. The finds of lichens on metal may be classified as ephemeral ones because of metal constructions are periodically treated to prevent corrosion. During this research, four species were found for the first time in Belarus (Table 2), three of them in Syomkava Park. *Lecania erysibe* is known in Europe as saxicolous species, preferring nutrient-enriched substrata such as mortar, concrete, and brick. The species was known from the neighbouring countries: Latvia [11], Lithuania [12], Ukraine [13], and Poland [14]. *Lecania sylvestris* develops on calcareous rocks, limestone, and concrete, often in shaded conditions. It was recorded also in Lithuania [15] and Poland [14]. *Thelidium minutulum* occurs in shady, humid habitats, on bricks and basic silicate rocks [16]. This lichen was known from the adjacent countries: Ukraine [13], Lithuania [15], and Poland [14]. *Candelaria pacifica* is a common species in Belarus, as it was shown by recent field observations. It was found on many phorophytes, but usually this species prefers deciduous trees in open habitats or in old parks. Three species, confirmed by collections in this study (*Diplotomma alboatrum, Leptogium cyanescens, Pyrrhospora quernea*), earlier were known for Belarus from publications only [17].

Based on the data on the lichens occurrence in Belarus and their ecological preferences, we distinguished in the present list three species, having scattered distribution and in the same time restricted to park ecosystems: *Oxneria fallax, Parmelina tiliacea, Pleurosticta acetabulum*. We believe these taxa deserve preventive conservation measures in Belarus due to their particular eco-geographical patterns. Besides, according to the present state of knowledge about lichen biota of Belarus, four more species display the preference to park ecosystems (see Table 2). The significance of historical manor parks as potential objects for biodiversity conservation is stressed by the occurrence of *Lobaria pulmonaria, Rhizocarpon geographicum* (both in Lahoisk), and *Leptogium cyanescens* (in Syomkava). In the scale of Belarus, the first species is belonged to vulnerable; the two latter species are listed in the category ‘requiring preventive conservation measures’ [18]. *Lobaria pulmonaria* was recorded earlier in three more historical manor parks of Belarus: Nyasvizh, Al'ba, and Byal'mont [19].

Conclusions. The composition of lichens in historical manor parks varies greatly depending on average tree age, presence of water bodies, wetlands, stone aggregations, ruins, actual human activity, and the proximity of air pollution sources. The main characteristics in which the parks were different are species richness of lichens, number of rare species, number of species belonged to crustose growth form, number of species inhabiting mineral substrata. In the same time such characteristics as number of foliose species, per cent of epiphytic species, number of species on concrete and wood, were similar for sampled parks. The per cent of constant species (found in all sampled parks) was similar for parks with rich lichen biota. A correlation between species richness of lichens and the number of phorophyte species in parks was not observed. Three main anthropogenic factors: landscape alterations (especially land drainage), excessive human recreation activity, and air pollution, in our opinion reduce species richness of lichens in parks. The common features of lichen biota stated for species-poor parks were species richness lower than 50, the share of constant species more than 75%, the share of rare and occasional species lower than 10%, the share of crustose species lower than 35%, and the absence of beard growth form (*Bryoria* and *Usnea*). In modern situation, when the area of old, in particular broadleaf forests is small or reducing in agriculturallydeveloped, industrial, and densely populated regions, historical parks with rich lichen biota can serve as additional harbours for epiphytic species with restricted ecological preferences.

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LICHENS OF HISTORICAL MANOR PARKS IN NORTHWEST-CENTRAL BELARUS

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Summary

As a result of the study of lichenized Ascomycota in six sample manor parks, situated in Minsk region, 119 species were identified. The parks belong to the two categories: species-rich (with 65–72 lichen species) and species-poor (with 38–47 species). Cluster analysis based on relative abundance of the species showed small differences between species-poor parks and significant differences between species-rich parks. The presence of numerous old-aged trees, wetlands, stone aggregations, ruins, and complicated relief are considered. as the factors, rising species richness in parks. The main characteristics making differences in lichen biota of the parks were number of rare species, number of species belonging to crustose growth form, and number of species inhabiting mineral substrata. In the same time number of foliose species, per cent of epiphytic species, number of species on concrete and wood were similar in the parks studied. Seven taxa, especially *Oxneria fallax*, *Parmelina tiliacea*, and *Pleurosticta acetabulum*, were distinguished as confined mostly to park ecosystems. *Candelaria pacifica*, *Lecania erysibe*, *L. sylvestris*, and *Thelidium minutulum* were recorded for the first time in Belarus. *Diplotomma alboatrum*, *Leptogium cyanescens*, and *Pyrrhospora quernea* were confirmed for lichen biota of Belarus by recent collections.

Key words: epilithes, epiphytes, phorophyte, substratum type, thallus morphotype

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