Ліхенологія

Old artificial parks as a key spot of corticolous lichen diversity in Southern Ukraine

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Old artificial parks are an important component of the cultural heritage in Southern Ukraine which represents a significant variety of specific habitats for lichen diversity. The aim of our research was to analyze the total lichen diversity in parks as well as the representation of rare and protected species. Most of the data were collected by the authors during expeditions in Southern Ukraine during 2017–2020 in Kherson and Mykolaiv regions. Overall, we identified 108 lichen species and 21 lichenicolous fungi within 17 old parks. The highest lichen diversity was recorded in parks "Labirynt" (66 species) and "Nedogirskyi Forest" (61 species). We found 18 lichen species (16.6 %) included in the Red List of Kherson and Mykolaiv regions and 25 (23.8%) rare forest-dwelling species. We concluded that old artificial parks are very important habitats for lichen diversity in the steppe zone of Ukraine as well as the unique localities for such species as *Graphis scripta*, *Hyperphyscia adglutinata*, *Sclerophora pallida* in Southern Ukraine. The total diversity of lichens did not have a significant correlation with the total number of tree species due to the dominance of several tree species (*Fraxinus excelsior*, *Quercus robur*), while most other phorophytes are young and represented singly. All old parks should become local reserves to preserve the overall biological diversity in their territories, protect against illegal logging, and regulate potential recreational activities.

Keywords: biodiversity, Graphis, Hyperphyscia, Sclerophora, Mykolaiv, Kherson, rare species

ДАРМОСТУК В.В., ХОДОСОВЦЕВ О.Є. (2021). **Старі штучні парки як осередки різноманіття епіфітних лишайників Півдня України**. *Чорноморськ. бот. ж.*, **17** (2): 148–163. doi: 10.32999/ksu1990-553X/2021-17-2-5

Старі штучні парки є важливою складовою природної та культурної спадщини півдня України, яка представляє значну різноманітність специфічних місцезростань для лишайників. Метою нашого дослідження було проаналізувати загальне різноманіття лишайників у старих парках, а також поширення рідкісних видів, та видів, що охороняються. Більшість матеріалів було зібрано під час експедиційних досліджень протягом 2017–2020 років у Херсонській та Миколаївській областях. У цілому, було виявлено 108 видів лишайників та 21 ліхенофільних грибів на території 17 старих парків. Найбільше різноманіття лишайників зафіксовано в парках «Лабіринт» (66 видів) та «Недогірський ліс» (61 видів). Ми виявили 18 видів лишайників (16,6 %), занесених до Червоного списку Херсонської та Миколаївської областей та 26 (24 %) рідкісних видів, які приурочені до штучних лісових біотопів. З огляду на це, старі парки є дуже важливими територіями для збереження різноманіття лишайників у степовій зоні України, а також унікальними місцезростаннями таких видів, як *Graphis scripta*, *Hyperphyscia adglutinata*, *Sclerophora pallida* на півдні України.

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Встановлено, що загальне різноманіття лишайників не мало статистично значущої кореляції із загальною кількістю порід дерев, що може бути пов'язано з домінуванням кількох порід дерев (*Fraxinus excelsior*, *Quercus robur*), тоді як більшість інших форофітів молоді та представлені одиничними екземплярами. Усі старі парки мають увійти до природно-заповідного фонду як ботанічні заказники для збереження загального біологічного різноманіття на своїх територіях, захисту від незаконних вирубок та регулювання потенційної рекреаційної діяльності.

Ключові слова: біорізноманіття, Graphis, Hyperphyscia, Sclerophora, Миколаїв, Херсон, рідкісні види

ДАРМОСТУК В.В., ХОДОСОВЦЕВ А.Е. (2021). **Старые искусственные парки как центры разнообразия эпифитных лишайников юга Украины**. *Черноморск. бот. ж.,* **17** (2): 148–163. doi: 10.32999/ksu1990-553X/2021-17-2-5

Старые искусственные парки являются важной составляющей природного и культурного наследия юга Украины, которая представляет значительное разнообразие специфических местообитаний для лишайников. Целью нашего исследования было проанализировать общее разнообразие лишайников в парках, а также распространение редких и охраняемых видов. Большинство материалов было собрано во время экспедиционных исследований в течение 2017–2020 годов в Херсонской и Николаевской областях. В целом, было выявлено 108 видов лишайников и 21 лихенофильных грибов на территории 17 старых парков. Наибольшее разнообразие лишайников зафиксировано в парках «Лабиринт» (66 видов) и «Недогирський лес» (61 видов). Мы обнаружили 18 видов лишайников (16,6%), занесенных в Красный список Херсонской и Николаевской областей, а также 26 редких видов (24%), которые приурочены к лесным биотопам. Принимая это во внимание старые искусственные парки следует считать важными территориями для сохранения многообразия лишайников в степной зоне Украины, а также уникальными местообитаниями таких видов, как *Graphis scripta, Hyperphyscia adglutinata, Sclerophora pallida* на юге Украины. Установлено, что общее многообразие лишайников не имело статистически значимой корреляции с общим количеством пород деревьев, что может быть связано с доминированием нескольких пород деревьев (*Fraxinus excelsior, Quercus robur*), тогда как большинство других форофитов являются молодыми и представлены единичными экземплярами. Все старые парки должны войти в природно-заповедный фонд как ботанические заказники для сохранения общего биологического разнообразия на своих территориях, защиты от незаконных вырубок и регулирования потенциальной рекреационной деятельности.

Ключевые слова: биоразнообразие, Graphis, Hyperphyscia, Sclerophora, Николаев, Херсон, редкие виды

Parks are an important part of urban planning as they provide space for recreation, relaxation, biodiversity conservation, and fostering awareness of the natural world [GOBSTER, 2001]. Usually, parks are managed in terms of tree composition and the practical absence of dead wood for aesthetic purposes. Despite this, parks are important refugia of diversity among agricultural landscapes. In Southern Ukraine, park construction began at the end of the 18th century and the use of parks was for both recreational and economic purposes [KHODOSOVTSEV et al., 2019a]. Most of the discovered parks are neglected except for a few well-known ones, which are actively used for recreation [KHODOSOVTSEV, KHODOSOVTSEVA, 2014; KHODOSOVTSEV et al., 2019a,b]. This gave us reason to suggest that such parks without recreational load and management have become important centers of epiphytic diversity.

Lichens are composite organisms composed of an alga and (or) a cyanobacterium with several fungi patterns [NASH, 2008; HAWKSWORTH, GRUBE, 2020]. They are mostly host-specific organisms related to particular types of rocks, soil, or tree species. Therefore, lichens are useful indicators of heterogeneity in an ecosystem, because the number of microhabitats positively correlated with the number of species. The variety of lichens that grow on trees

depends on several factors, such as the type of tree, the age of the tree, the level of humidity and lighting. The variety of these factors is well represented in the old artificial parks.

The aim of our study is to investigate lichen diversity in old artificial parks in Southern Ukraine. We hypothesized that old parks have bigger diversity of microhabitats which has a positive effect on lichen diversity and the presence of rare substrate-specific species. We also hypothesized that the total lichens diversity depends on the number of tree species and recreational activities of the park.

Materials and Methods

Survey Sites

Most of the material was collected by authors during expeditions in the Southern Ukraine during 2017–2020. We investigate 17 old artificial parks in Kherson and Mykolaiv regions (Figure 1). They are Litnii Khutir, Labirynt, Rozdolne, Sadove, Zyvkovycha Park, Dubova balka, Nedogirskyi Forest, Mostove, Novochornomorske, Tryduby, Liuboivanivka, Kyriachi lozy, Ratsynska dacha, Lisove, Maishiv sad, Ivanivskyi Forest, Katerynka. These parks meet the following criteria: a) they have accurate or approximate historical information indicating their artificial nature; b) trees more than a hundred years old are represented on their territory. We recorded the total number of tree species, park area, type of recreation activity (active recreation or abandoned), and type of plantings (deciduous or mixed).

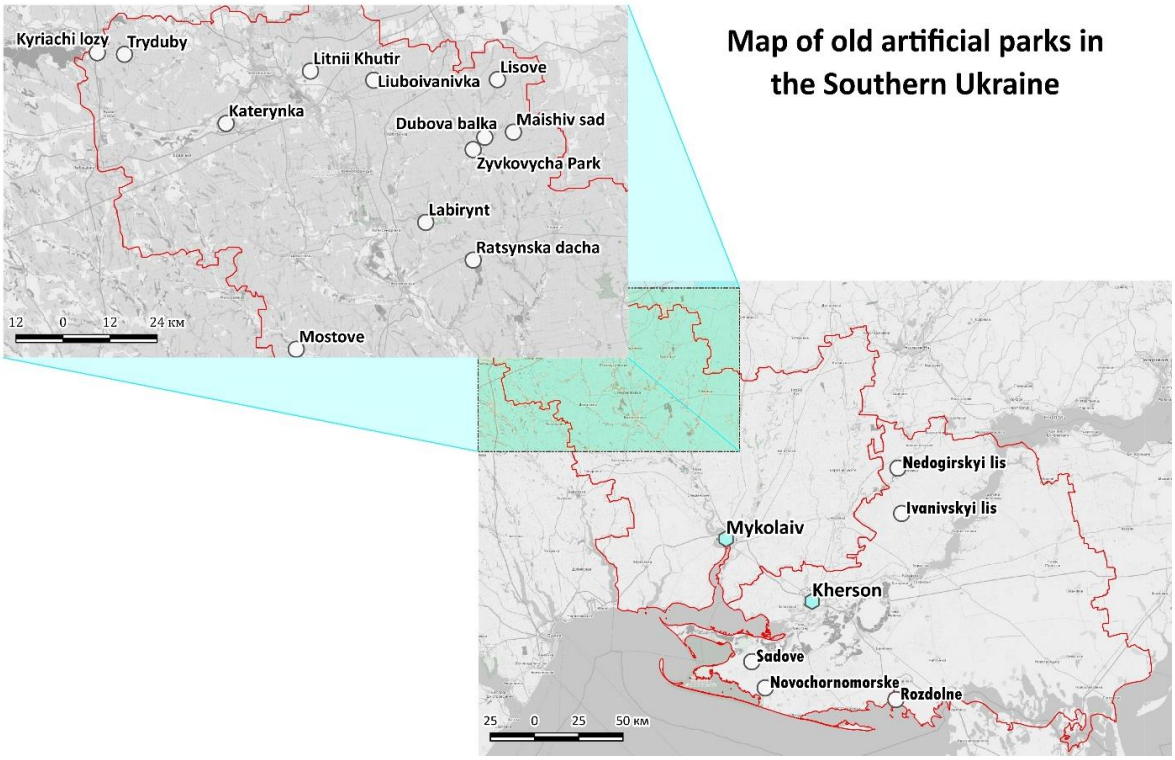


Fig. 1. Map of old artificial parks in the Southern Ukraine.

Sampling Method

Releve of the corticolous lichen community was carried out according to the methodology of independence of the lichen communities [KHODOSOVTSEV et al., 2011, 2017]. Releve area was attached from 0.5 m to 1.5 m above ground level and projective coverage of all lichen species was recorded. We identified lichen species predominantly in the field using a 10× hand lens as well as K and C chemical spot tests. Field identifications were confirmed in the laboratory with Optica-1 and MICROMED-2 microscopes using standard microscope techniques [SMITH et al., 2009]. Lichenicolous fungi were recorded, but not included in the

analysis. All examined specimens deposited in the lichenological herbarium of Kherson State University (KHER) and the personal herbarium of the first author (herb. VD).

Statistical Analysis

Shannon Biodiversity Index was calculated for each park using the "vegan" package v.2.4-5 implemented in R v.3.6.2 [OKSANEN et al., 2017]. We used a generalized linear model (GLM) to test the effects of the park structure components on lichen diversity (Shannon Biodiversity Index), using a gamma distribution with a log link function. We used the following park structure components: total number of tree species (continuous), total area (continuous), type of recreation activity (categorical with two levels), and type of plantings (categorical with two levels). The GLM was implemented in R using the base function 'glm'.

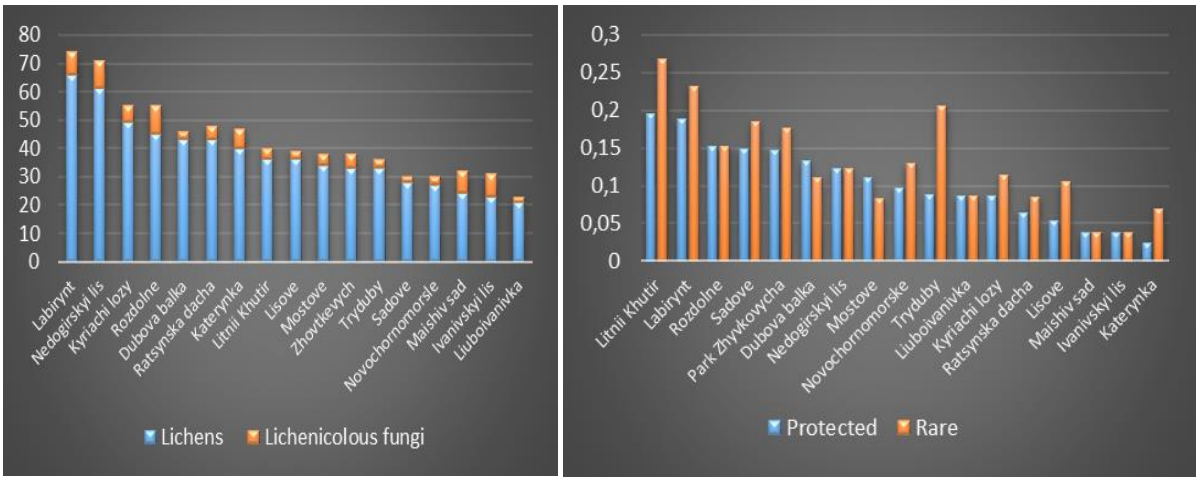
Results

Overall, we identified 108 lichen species and 21 species of lichenicolous fungi within 17 old parks in the Kherson and Mykolaiv region (Ukraine). The highest lichen diversity was observed in parks "Labirynt" (66 species) and "Nedogirskyi Forest" (61 species). The lowest lichen diversity was in parks namely "Ivanivskyi Forest" (23 species) and "Liuboivanivka" (21 species) (Fig. 2a). Shannon Biodiversity Index was calculated for each park and used for further analysis. The mean of Shannon Biodiversity Index is 3.51 with standard deviation 0.3.

Rare and protected lichens

We found 18 lichen species (16.6 % of total count) which are included in the Red List of Kherson and Mykolaiv region [CHERVONYI…, 2012]. There are *Acrocordia gemmata*, *Alyxoria varia*, *Anaptychia ciliaris*, *Bacidia fraxinea*, *B. rubella*, *Bryoria implexa*, *Caloplaca monacensis*, *Candelaria concolor*, *Chaenotheca chlorella*, *C. trichialis*, *Coenogonium pineti*, *Flavoparmelia caperata*, *Lecania fuscella*, *Opegrapha niveoatra*, *Pseudoschismatomma rufescens*, *Parmelina quercina*, *P. tiliacea*, and *Usnea hirta*. The highest diversity of protected lichens was in parks namely "Labitynt" (13 species) and "Nedogirskyi Forest" (8 species) which corresponds to the total lichen diversity in these territories. In case a ratio protected lichen diversity/total diversity "Litnii Khutir" and "Labirynt" have 0.2 and 0.19 respectively (Fig. 2b). The mean of protected species count is 4.35 which means that on average 10 % of species in parks are protected.

We define rare species as typical representatives of forest-inhabiting species which are distributed within the steppe zone of Ukraine only in natural and semi-natural habitats. Some of them were also reported in the category "protected". We found 26 rare forest-dwelling species (24 % of total count). They are *Acrocordia gemmata*, *Anaptychia ciliaris*, *Bacidia fraxinea*, *B. rubella*, *Buellia griseovirens*, *Caloplaca monacensis*, *Candelaria concolor*, *Chaenotheca chlorella*, *C. chrysocephala*, *C. phaeocephala*, *C. trichialis*, *Coenogonium pineti*, *Graphis scripta*, *Flavoparmelia caperata*, *Hyperphiscia adglutinata Mycocalicium subtile*, *Pachyphiale carneola*, *Parmelina quercina*, *P. tiliacea*, *Physcia aipolia*, *Physciella chloantha*, *Piccolia ochrophora*, *Pseudosagedia aenea*, *Sclerophora pallida*, *Strangospora moriformis*, *Xanthomendoza huculica*. The highest diversity of rare lichens was in park "Labirynt" (15 species) and "Litnii Khutir" (10 species). The ratio of rare species/total species corresponded to the same data with protected lichens. "Litnii Khutir" and "Labirynt" have 0.24 and 0.21 respectively. Also, this ratio is 0.22 in park "Sadovo" (Fig. 2b). The mean of rare species count is 5.17 which means that on average 13 % of species in parks are rare.



(**a**) (**b**)

Fig. 2. Lichen diversity in old artificial parks: (a) Total diversity of lichens and lichenicolous fungi; (b) Diversity of protected and rare species (as a percentage of the total number of species).

Lichen diversity and park types

A comparison of the diversity of old artificial parks lichens did not show the statistically significant difference between deciduous and mixed park types. We found no significant effects between total number of tree species, park area, type of recreation activity and type of plantings to lichen diversity using a generalized linear model.

Discussion

Old artificial parks in the Southern Ukraine are an important habitat for the rare forest-inhabiting lichens. As a result of our research, we found that about 13% of species are rare forest-inhabiting lichens. Most of these species are confined to deciduous trees. This is due to the fact that the parks in Southern Ukraine are dominated by old plantations of *Fraxinus excelsior* and *Quercus robur* [KHODOSOVTSEV et al., 2019]. Conifer plantations are not rare in the Southern Ukraine, but not so common in parks. They are present in parks in the form of individual alleys (in the case of *Juniperus virginiana*) or individual plantations, which were planted after the establishment of the park (in the case of *Pinus* spp.). Our hypothesis was that more lichen diversity would be observed in parks with a greater diversity of tree species. This is because more tree species create more microhabitats for lichen growth. Our data did not show a statistically significant correlation between the two variables. We suggest this is due to the presence of a few old trees (*Fraxinus* and *Quercus*) in each park, which has more microhabitats (old bark, dry and wet wood, branch and twigs, etc.). Moreover, most trees were not so old and they have similar lichen diversity.

LEMAN (1906) probably is the oldest work related to lichen diversity of parks and plantations in the Southern Ukraine. The author provides the list of 23 lichen species from Ratsynska dacha. Mostly, they are a common corticolous species, but some of them are rarely reported in the Souther Ukraine. They are *Melanohalea olivacea*, *Ramalina calicaris* and *Usnea florida*. Record of the latest species looks dubious because of *U. florida* is a boreal-montan lichen with optimum in the upper montane belts.

Only in a few parks we found an old tree of not-common species for the steppe zone on which rare species of lichens were found. One of such parks is “Labirynt” which havs the biggest lichen diversity (66 species) and representation of rare species (15 species). However, *Graphis scripta* is a widespread temperate lichen mostly related to smooth bark. This species is common in forest and forest-steppe zones of Ukraine as well as in the Carpathian and Crimea mountains. However, *Graphis scripta* very rare within the steppe zone. Previously, this species was reported only from the Donetsk region [NADYEINA, 2007]. We found *Graphis*

scripta on old *Carpinus betulis* (also not-common tree species for the steppe zone) near the Arbuzynka river. These very interesting records show that parks contain not-common old trees which are required for distribution of rare species. Another interesting species is *Hyperphyscia adglutinata*. This is an occasional species in Ukraine reported from a few localities in the Carpathian and Crimea mountains [KONDRATYUK et al., 2021]. *Hyperphyscia adglutinata* is growing on coniferous trees especially on *Juniperus virginiana* in parks within the steppe zone of Ukraine [KHODOSOVTSEV et al., 2016]. This species was found in the park "Labirynt" in the old alley of *J. virginiana*.

"Litnii Khutir" (Mykolaiv region) is another park with rich lichen diversity. *Sclerophora pallida* was found only within this park on bark of old *Acer* tree. *S. pallida* is a rarely collected species in Ukraine known mainly from the Carpathians and from a few localities in the forest and forest-steppe zone [KONDRATYUK et al., 2021]. This record is the first within the steppe zone of Ukraine.

Calicioid lichens are more or less rare species that can be used as an indicator of forest continuity. These species mostly show clear specific substrate preferences and can be found within old-growth forest sites as well as on single old trees. There are six calicioid species reported from the steppe zone of Ukraine [KHODOSOVTSEV et al., 2017, 2019]. Mostly, these species were found in old parks and only a few records are not related to them. *Chaenotheca trichialis* is the most common calicioid species in the steppe zone of Ukraine. This species was reported mostly on old acid-barked deciduous trees (*Fraxinus, Quercus*) in the natural and artificial forests as well on isolated oaks. Other species like *Chaenotheca chlorella, C. chrysocephala, C. phaeocephala, Mycocalicium subtile* are very rare and can be found only in a few parks. In this case, old artificial parks are an important site in Southern Ukraine for the conservation diversity of calicioid species.

Pachyphiale carneola is a frequent species in areas with a humid-warm climate. This is overlooked and probably rare species in Southern Ukraine that grows on bark crevices. Within our research, this species was found in five parks mostly on *Fraxinus* bark. Frequently the thalli and apothecia of *Pachyphiale carneola* are infected by *Refractohilum intermedium* and the presence of this fungus is a good hint as to the identity of the host [KHODOSOVTSEV, DARMOSTUK, 2017].

Physciella chloantha is a mild-temperate, probably submediterranean species growing on the bark of isolated trees or in light forests. This species was reported from a few localities in Central and Western Ukraine [KONDRATYUK et al., 2021]. In the study area, *Physciella chloantha* was found exclusively in old parks and plantations.

Xanthomendoza huculica is rather common species in forest zone and the western part of forest-steppe zone, but probably rare in Southern Ukraine [KONDRATYUK et al., 2021]. We found this species mostly in parks of the Mykolaiv region. *Xanthomendoza huculica* with *Candelaria concolor* dominate in lichen communities of *Quercus* and *Fraxinus* trees within those parks. We suppose that this dominance is due to the position of parks in the northwestern part of the steppe zone of Ukraine, which borders the forest-steppe zone. Future investigation of those specific communities are needed.

Most of the old parks within the steppe zone of Ukraine can be classified as forgotten because they have only a small recreational load. This is due to the remoteness of the parks from the main roads and large towns, as well as the fact that the parks were partially destroyed during the revolutionary events. This has led to new threats related to the felling of large and old trees. Therefore all the old parks should be protected by creating local reserves on their territory.

Conclusions

Overall, we identified 108 lichen species and 21 lichenicolous fungi within 17 old parks. The highest lichen diversity was in parks namely "Labirynt" (66 species) and

"Nedogirskyi Forest" (61 species). We found 18 lichen species (16.6 %) included in the Red List of Kherson and Mykolaiv regions and 26 (24 %) rare forest-dwelling species. We concluded that old artificial parks are very important habitats for lichen diversity in the steppe zone of Ukraine as well as unique localities for such species as *Graphis scripta*, *Hyperphyscia adglutinata*, *Sclerophora pallida* in Southern Ukraine. All old parks should become local reserves to preserve the overall biological diversity in their territories, protect against illegal logging and regulate potential recreational activities.

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Table 1.

Diversity of lichens and lichenicolous fungi (marked as "LF") in old parks of Southern Ukraine

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Acrocordia gemmata (Ach.) A. Massal.	*[1]Q		*F				F	F		Q			*F					KHER 10731, 10737, 11518, 13517
Alyxoria varia (Pers.) Ertz & Tehler	A	*Q		Q	*A	A	F	*F	Q				F	A	F		F	KHER 14103, 14181, 14539
Amandinea punctata (Hoffm.) Coppins & Scheid.	*A, Q, F	Q	F	F	A, Q	Q	F, Q	*F, J	Q	Q	Q	Q, P, Pi	F	Q	*Q, F, Pi	Q, F	F	KHER 8857, 10554, 11434, 14191
Anaptychia ciliaris (L.) Körb. ex A. Massal.	Q		F			Q		F			Q		F		*Q	Q		KHER 9064
Anisomeridium polypori (Ellis & Everh.) M.E. Barr	*A		F															KHER 11429
LF Arthonia apotheciorum (A. Massal.) Almq.													*F					KHER 10931
Arthonia dispersa (Schrad.) Dufour	A																	
Arthonia punctiformis Ach.	F	F														A		
Athallia pyracea (Ach.) Arup, Frödén & Søchting					A						F	P			*P	P	F	KHER 9481
LF Athelia arachnoidea (Berk.) Jülich	*F, Q	Q	F	Q	Q		Q	*F	Q	Q	*F	Q	*F	P	F, Q		A	KHER 10539, 10566, 11256, 14108, 14757, 14760
Bacidia fraxinea Lönnr.	*A, P							*F					F	*Q				KHER 10789, 11259, 11268, 11513, 11514, 12178, 14188
Bacidia rubella (Hoffm.) A. Massal.	*P				*A			*F						*Q			Q	KHER 10726, 10787, 14101, 14183, 14186
Bryoria implexa (Hoffm.) Brodo & D. Hawksw.															*Pi			KHER 10479

[1] an asterisk "*" indicates in which park the specimens were taken.

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Buellia griseovirens (Turner & Borrer ex Sm.) Almb.										Q	Q	Q			*Q			KHER 8858, 11399
Calogaya lobulata (Flörke) Arup, Frödén & Søchting										P		P			P			
Caloplaca obscurella (J. Lahm ex Körb.) Th. Fr.						*Ca	*F				*Q		*F	Q	*Q			KHER 10736, 10740, 10745, 10831, 14105, 14198, 14754
Caloplaca monacensis (Leder.) Lettau	*Q				*A													KHER 11511, 14099
Caloplaca substerilis Vondrák, Palice & van den Boom	*F		*Q										*F				F	KHER 10552, 11275, 11537
Candelaria concolor (Dicks.) Arnold	A, F	Q			F		F	F	Q		F		F		Q			KHER 14537
Candelariella aurella (Hoffm.) Zahlbr.	F														*P			KHER 9482
Candelariella efflorescens R.C. Harris & W.R. Buck	*F	Q	F		F	Q	F	F	F	Q	*F	Q	F	Q	*F	F		KHER 10571, 10837, 14756
Candelariella xanthostigma (Pers. ex Ach.) Lettau	*A, F, Q	Q	F		*F	Q	Q	*J			1		F	*Q	*F, Q		F	KHER 4372, 9349, 9476, 10561, 14179, 14196, VD 894, 903
Catillaria nigroclavata (Nyl.) J. Steiner	*F		F								1				P			KHER 14192, 14719
Chaenotheca chlorella (Ach.) Müll. Arg.	*Q																	KHER 11428, 11515
Chaenotheca chrysocephala (Ach.) Th. Fr.										Q								
Chaenotheca phaeocephala (Turner) Th. Fr.														*Q				KHER 11608
Chaenotheca trichialis (Ach.) Hellb.	*Q	Q	Q		Q		Q	Q		Q		Q		Q	*Q		Q	KHER 10838, 11430, 14194
Cladonia coniocraea (Flörke) Spreng.	Q	Q	*Q	F		Q	Q			Q	1	Q			F, Q			KHER 13525

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Cladonia ochrochlora Flörke											*w							KHER 14768
[LF]*Cladosporium licheniphilum* Heuchert & U. Braun					*A			F				*P	F		*P	F		KHER 14781, VD 751, 939
Coenogonium pineti (Ach.) Lücking & Lumbsch	*Q																	KHER 10721
Diplotomma alboatrum (Hoffm.) Flot.	*F												F					VD 890
[LF]*Erythricium aurantiacum* (Lasch) D. Hawksw. & A. Henrici	F, Q	Q		F	*A	A	F			Q	F	Q			F, Q	F, Q		VD 904
Evernia prunastri (L.) Ach.	A, F, Q		F, Q	F	F, Q	Q	F, Q	F	Q	Q	F, Q	Q, P	F	Q	F, Q	F, Q	F, Q	
Graphis scripta (L.) Ach.	*Cb																	VD 889
Flavoparmelia caperata (L.) Hale															A			
Hyperphyscia adglutinata (Flörke) H. Mayrhofer & Poelt	*J																	KHER 14195
Hypogymnia physodes (L.) Nyl.	A	Q		F	F				Q	Q	F	Pi			F, Pi			
Hypogymnia tubulosa (Schaer.) Hav.	A	Q			F						Q				Pi			
Hypocenomyce scalaris (Ach.) M. Choisy											*w	Pi			Pi			KHER 14767
[LF]*Illosporiopsis christiansenii* (B.L. Brady & D. Hawksw.) D. Hawksw.	*F, Q			Q	A	Q		F							Q	Q		KHER 10319, 10576
[LF]*Laetisaria lichenicola* Diederich, Lawrey & Van den Broeck		F		Q	A			F					*F		F	Cr		KHER 10741
Lecania cyrtella (Ach.) Th. Fr.			P	F		A				F	P	P	F		P		A	

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Lecania fuscella (Schaer.) A. Massal.													*F					KHER 11270
Lecania naegelii (Hepp) Diederich & van den Boom	F				A			F				P	F		P		A	
Lecanora allophana (Ach.) Nyl.	A, F		Q		F			*F										KHER 14184
Lecanora argentata (Ach.) Röhl.	*F				F		F	F					F		Q, Pi			VD 888
Lecanora carpinea (L.) Vain.	A, F, Q	Q	F	Q	A, F, Q	Q	F	F	Q	Q	F, Q	Q, P, Pi	F	Q	F, Q, P, Pi	F, Q, P	A, Q, F	
Lecanora chlarotera Nyl.					A					F								
Lecanora expallens Ach.	*F	Q	Q		Q		Q				Q	Q			Q			KHER 11425
Lecanora saligna (Schrad.) Zahlbr.	F		Q	Q	*Q	Q	Q	Q		Q	Q	Pi	F	Q	Pi			VD 901
Lecanora strobilina (Spreng.) Kieff.															*Pi			KHER 1111
Lecanora symmicta (Ach.) Ach.												Pi			Pi			
Lecidella elaeochroma (Ach.) M. Choisy	A, F	Q	F, Q	F	A	Q	F	F	Q	Q	*Pr	Q, P	F	Q	F, Q	F, P	F	KHER 14763
Lepraria finkii (B. de Lesd.) R.C. Harris			Q			*Ca					*Q							KHER 14104, 14770
Lepraria incana (L.) Ach.										Q	Q	Q						
[LF]*Lichenochora obscuroides* (Linds.) Triebel & Rambold			*F		*A													KHER 13518, 14100, VD 902
[LF]*Lichenochora weillii* (Werner) Hafellner & R. Sant.	*F		*F				*Q			*F		Q						KHER 11633, 11640, 14197, VD 730, 892
[LF]*Lichenoconium erodens* M.S. Christ. & D. Hawksw.				F								*Q			Pi		F	VD 691
[LF]*Lichenoconium lecanorae* (Jaap) D. Hawksw.	A			F	*F			F			F					Q		VD 896

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
[LF]*Lichenoconium xanthoriae* M.S. Christ.				F	*A								*F				F	KHER 10933, VD 905
[LF]*Lichenodiplis lecanorae* (Vouaux) Dyko & D. Hawksw.								*F							Pi			KHER 14189,
Massjukiella polycarpa (Hoffm.) S.Y. Kondr., Fedorenko, S. Stenroos, Kärnefelt, Elix, Hur & A. Thell	A, F	Q		F	A, F, Q	A, Q	0	F	Q	F, Q	F, Q	Q, P	F	Q	F, Q, Pi	F, Q, P	F, Q	
[LF]*Marchandiomyces corallinus* (Roberge) Diederich & D. Hawksw.	F														*Q	*F		KHER 10829, 10832, 11621, 11741, 12179, 14782, VD 410
Melanelixia glabra (Schaer.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch						*Q							F			Q		VD 907
Melanelixia subargentifera (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch	F	F	F	F	F	Q	F	Q	F	F	F	Q	F	Q	F		F	
Melanelixia subaurifera (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch	A		*F		F	Q		F	F	F	F	Pi			Pi			KHER 13523
Melanohalea exasperatula (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch	A					Q				F	F	Q						
Micarea denigrata (Fr.) Hedl.											*Q	Pi			Pi			KHER 14756
Micarea misella (Nyl.) Hedl.															Pi			
Mycocalicium subtile (Pers.) Szatala	w						w											

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Myriolecis hagenii (Ach.) Śliwa, Zhao Xin & Lumbsch	A		P		A								F		P			
Myriolecis persimilis (Th. Fr.) Śliwa, Zhao Xin & Lumbsch															F			
Myriolecis sambuci (Pers.) Clem.				P								*P						VD 729
Opegrapha niveoatra (Borrer) J.R. Laundon	*A												*F					KHER 11510, 10744
Pachyphiale carneola (Ach.) Arnold						F							*F	F			F	KHER 10746, 11251,
Parmelia sulcata Taylor	A, F, Q	Q	F, Q	Q	F, Q	Q	F	F	F	F, Q	F, Q	Q, P	F	Q	F, Q, Pi	F, P	F, Q	
Parmelina quercina (Willd.) Hale											Q							
Parmelina tiliacea (Hoffm.) Hale	F				Q			Q		Q	Q				F			
Phaeophyscia nigricans (Flörke) Moberg	A	P	P		F	Q	F	P		F	Q	P	F	A	P	P		
Phaeophyscia orbicularis (Neck.) Moberg	*A, F, Q	Q	F, Q	Q	F, Q	Q	Q	F	F	F, Q	F, Q	Q, P	F	Q	F, Q, Pi	F, Q, P	F, Q	KHER 14718
[LF]*Phacothecium varium* (Tul.) Trevis.													*F					KHER 11254
Phlyctis argena (Ach.) Flot.	F	Q	F, Q		Q	Q			Q		Q	Q			F, Q		F	
Physcia adscendens H. Olivier	A, F, Q		F, Q	Q	A, F, Q	Q	Q	F	Q	Q	Q	Q, P	F	F, Q	F, Q, Pi	F, Q, P	F, Q	
Physcia aipolia (Ehrh. ex Humb.) Fürnr.	*Q						F	F					F					KHER 14715, VD 887
Physcia dubia (Hoffm.) Lettau											*Q							KHER 14759
Physcia stellaris (L.) Nyl.	A, F	Q	Q	Q	A	Q	F	F			Q	Q, P			F, Q	Q		
Physcia tenella (Scop.) DC.	A	Q	Q		Q	Q		F	Q	Q	*Q	P	F		F	F, Q	F	KHER 14755, 14761

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Physciella chloantha (Ach.) Essl.	*Q		Q		*F	F		F	Q									VD 886, 898
Physconia detersa (Nyl.) Poelt											*Q							KHER 14735
Physconia distorta (With.) J.R. Laundon	F		F		A	F		P		F						F		
Physconia enteroxantha (Nyl.) Poelt	Q	Q	F, Q		Q		F				*Q		F	Q	F	F		KHER 14754
Physconia grisea (Lam.) Poelt	A, F	Q	F, Q	Q	F, Q	F	Q	F	Q	F	Q	Q	F	Q	F		Q	
Physconia perisidiosa (Erichsen) Moberg	F		F	Q	F	Q	F	F			F	Q	F		F		*F	KHER 11248
Piccolia ochrophora (Nyl.) Hafellner				*P														KHER 14106
Placynthiella icmalea (Ach.) Coppins & P. James	w		w								w	w			*w			KHER 12289
Platismatia glauca (L.) W.L. Culb. & C.F. Culb.															*Pi			KHER 9478
Pleurosticta acetabulum (Neck.) Elix & Lumbsch	Q	Q	Q		Q	Q	Q	F		Q	Q	Q	F	Q	F, Q	Q		
Pseudevernia furfuracea (L.) Zopf															Pi			
Pseudoschismatomma rufescens (Pers.) Ertz & Tehler	*A	*Q					F						F					KHER 14536, 14716
Pseudosagedia aenea (Körb.) Hafellner & Kalb													*F	F				KHER 10729, 10730
LF*Pronectria leptaleae* (J. Steiner) Lowen	*F				*A													KHER 10322, VD 940
Protoparmeliopsis muralis (Schreb.) M. Choisy							F											
LF*Pyrenochaeta xanthoriae* Diederich															*F	*Cr		KHER 10825, 11740

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Dubova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
Ramalina europaea Gasparyan, Sipman & Lücking		Q	*F		Q	Q		F				*Q	F		F			KHER 13520, VD 685
Ramalina fastigiata (Pers.) Ach.		Q	F		Q								F		U	F		
Ramalina farinacea (L.) Ach.	A, F	Q	*F		Q	Q		F	F		F	Q	F	Q	Q			KHER 13516, 13522
Ramalina fraxinea (L.) Ach.	F		*F		Q	Q							F			Q		KHER 13251
Ramalina pollinaria (Westr.) Ach. s.str.			*Q, F															KHER 13254
[LF]Refractohilum intermedium Cl. Roux & Etayo						F				*F			F	F				VD 717
Rinodina pityrea Ropin & H. Mayrhofer		Q		*P							*Q						F	KHER 14107, VD 728
Rinodina pyrina (Ach.) Arnold	Cr	Q		Q	Q	Q	F	Q	Q	Q		P	F	Q	P			
Sclerophora pallida (Pers.) Y.J. Yao & Spooner								*A										KHER 14187
Scoliciosporum chlorococcum (Graewe ex Stenh.) Vězda	A			Q	Q		Q			Q	Q	Q, P		Q	Q			
Scoliciosporum gallurae Vězda & Poelt	A	Q	Q								*Pr							KHER 14762
Scoliciosporum sarothamni (Vain.) Vězda	A, F	Q									*Q	Pi	F		Q, Pi	Q	Q	KHER 14758
Scythioria phlogina (Ach.) S.Y. Kondr., Kärnefelt, Elix, A. Thell & Hur													*F					KHER 11275, 11279, 11253, 11261
Strangospora pinicola (A. Massal.) Körb.								P							Pi			
Strangospora moriformis (Ach.) Stein																	A	

Park	Labirynt	Mostove	Ratsynska dacha	Maishiv sad	Duhova balka	Lisove	Park Zhyvkovycha	Litnii Khutir	Liuboivanivka	Tryduby	Kyriachi lozy	Katerynka	Rozdolne	Sadove	Nedogirskyi lis	Ivanivskyi lis	Novochornomorske	Vouchers
[LF]*Taeniolella phaeophysciae* D. Hawksw.	*F												*F		*Q			KHER 10747, 10828, 14717
Thelenella modesta (Nyl.) Nyl.																	*F	KHER 11242
Trapeliopsis flexuosa (Fr.) Coppins & P. James			w	w							w	Pi						
[LF]*Tremella phaeophysciae* Diederich & M.S. Christ.	*Q												F					KHER 10310, 11624, 12180
[LF]*Trichothecium roseum* (Pers.) Link							*F											VD 893
Usnea hirta (L.) F.H. Wigg.															Pi			
Vulpicida pinastri (Scop.) J.-E. Mattsson & M.J. Lai															*Pi			KHER 9000
Xanthomendoza huculica (S.Y. Kondr.) Diederich	A, Cb	*Q					F	*F		*F		Q						KHER 14178, 14182, 14535, VD 753
Xanthoria parietina (L.) Th. Fr.	A, F, Q	Q	*F, Q	Q	Q	Q	F, Q	F	Q	F, Q	F, Q	Q, P	F	F, Q	*F, Q, P	Cr, F, Q, P	A, F, Q	KHER 13099, 13519
[LF]*Xanthoriicola physciae* (Kalchbr.) D. Hawksw.	*A, F	Q		Q	Q	Q	Q	F	Q			Q	*F		F, Q	Cr, F		KHER 9737, 11276
Shannon Biodiversity Index	**4.12**	**3.47**	**3.73**	**3.18**	**3.69**	**3.51**	**3.41**	**3.59**	**3.04**	**3.40**	**3.43**	**3.63**	**3.71**	**3.18**	**4.06**	**3.16**	**3.31**	
Total count of lichen	**66**	**34**	**43**	**24**	**45**	**36**	**33**	**40**	**21**	**33**	**36**	**43**	**49**	**28**	**61**	**23**	**27**	
Total count of lichenicolous fungi	**8**	**4**	**3**	**8**	**10**	**4**	**5**	**7**	**2**	**3**	**3**	**5**	**6**	**2**	**10**	**8**	**3**	

Notes: A – *Acer* spp., Ca – *Corylus avellana*, Cb – *Carpinus betulus*, Cr – *Crataegus monogyna*, F – *Fraxinus* spp., J – *Juniperus virginiana* Q – *Quercus robur*, P – *Populus* spp., Pi – *Pinus* spp., Pr – *Prunus avium*, U – *Ulmus* spp., w – wood.