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MYXOMYCETES IN THE VIRGIN BEECH AND OLD-AGED SPRUCE FORESTS OF NATIONAL NATURE PARK “BEWITCHED LAND” (UKRAINIAN CARPATHIANS)

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Mycological observations in virgin beech and old-aged spruce forests of National Nature Park (NNP) “Bewitched Land” carried out in July 2011 allowed to reveal 20 myxomycete species. *Ceratiomyxa fruticulosa* belongs to subclass *Ceratiomyxomycetidae*, other 19 species are representatives of subclass *Myxogastromycetidae*, assigned to four orders: *Trichiales* (8 species), *Physarales* (5), *Liceales* and *Stemonitales* (on 3 species each). The highest frequency of occurrence was noted for *Ceratiomyxa fruticulosa*, *Arctyria cinerea* and *Lycogala epidendrum*. *Dictydiaethalium plumbeum* was determined as the species with rather limited distribution in Ukraine and the Ukrainian Carpathians, especially. Investigation of myxomycete substrate preferences showed that the most important woody species that supported development of the majority of slime molds in NNP “Bewitched Land” were spruce (*Picea abies*) and beech (*Fagus sylvatica*). Unlike the Carpathian biosphere reserve and NNP “Skolivski Beskydy” where myxomycetes predominantly used beech wood as a substrate myxomycete biota of “Bewitched Land” showed reverse type of substrate association preferring the wood of coniferous tree – spruce.

Keywords: National Nature Park “Bewitched Land”, Myxomycetes, slime molds, virgin and old-aged forests, taxonomic diversity, substrate preferences.

INTRODUCTION

The dead wood – old stumps, trees destroyed by insects and damaged by various fungal and bacterial diseases but remain standing, fallen trunks, branches and twigs – forms one of the richest microbiotopes for biological diversity in forest ecosystems. The dead wood together with associated species diversity plays the key role in supporting of forest productivity and stable development and in maintenance of its ecological balance. This microbiotope is especially important for the organisms which are tightly connected trophically and/or topically with wood substrates: insects, fungi, lichens, mosses etc.

In spite of the tremendous meaning of the dead wood its volume in economical forests is extremely low. The dead wood in managed forests of Europe fluctuated from 0.6 m³/ha in Austria to 12 m³/ha in Switzerland [37]. Only protected virgin or old-aged natural forests guarantee securing of the dead wood volumes necessary for support of

biological diversity in forest ecosystems at the high level. In the Carpathians there are numerous protected areas which embrace the virgin beech, spruce and fir forests. The volumes of dead wood in reserves and nature parks with the virgin beech forests significantly increase in comparison with the managed ones. For example, it is known that in the virgin beech forests of the national park Semenik-Cheile-Karasului (Romania) accumulated mass of the dead wood varies in the ranges 78–121 m³/ha. In another European virgin beech forest Haveshova (nature park Poloniny, Slovakia) upon the average 121 m³/ha of dead wood remains are collected. It is considered that the highest volumes of the dead wood for Carpathians are concentrated in the Uholka virgin beech forest (Carpathian biosphere reserve, Ukraine): here the content of woody remains composes 200(–300) m³/ha [19].

This important component of reserve ecosystems provides numerous forest inhabitants with food substances and specific biotopes, creating the favorable conditions for high and stable species diversity. First of all, it concerns so called xylobiont organisms whose development and further existence are impossible without woody substrates. The representatives of xylobiont ecological group are wide-spread among the fungi and fungi-like organisms, in particular myxomycetes. According to classification of myxomycetous ecological groups based on the substrate types slime molds associated with the dead wood are treated as xylophilous ones [7]. Xylophilous slime molds form the most numerous group among phytophilous myxomycetes: the third part of its known species (more than 300 ones) are recorded on the dead wood [33]. In Ukraine 168 species belong to xylophiles, making up 60.4% of the total number of myxomycetes recorded in our country till now [7]. Another ecological group – corticuloid – includes myxomycetes connected with tree bark. A part of them adopted to the dead tree bark may be considered as a supplement to the list of myxomycetous species associated with woody forest remains.

Taking into account substrate preferences of myxomycetes with regard to the dead wood together with the predominance of this substrate in virgin and old-aged forests, the first mycological observations on the species diversity of myxomycetes were held in 2006 at the territory of the above-mentioned Uholka virgin beech forest [21]. As an object for the following studies of species diversity and substrate preferences of myxomycetes virgin beech and old-aged spruce forests in NNP “Bewitched Land” were chosen. NNP was founded by the Decree of President of Ukraine №343 at 21.06.2009 at the territory of Irshavski district (Zakarpatska oblast). Park with an area of 6101 ha is situated on the south-western slopes of mountain massif Great Valley, central part of Vyhorlat-Gutyn volcanic ridge. In correspondence with the geobotanical division park territory is included in Verkhovyno-Beskydski district of oak, beech, spruce and fir forests. *Fagus sylvatica* L. occupies the largest area in the park and forms monodominant climax beech forests mainly [14]. Five forest associations of “Bewitched Land” are included in the Green Book of Ukraine. Two of them – Fageta sylvaticae with predominance of *Lunaria rediviva* L. in grassy layer and Fageta sylvaticae with predominance of *Allium ursinum* L. in grassy layer – belong to the highest conservation category (1) and are characterized with the high synphytosozologic index: 11.5–12.6 for the first and 11.4–13.2 for the second one [6]. Several small plots of beech forests identified as virgin ones are preserved at the park territory [14]. One of such plot situated in the forest parcel Kamianka (Illytske forestry of NNP, near the village of Osiy) was explored for establishment of myxomycete species diversity and substrate preferences in July 2011. Except the Kamianka virgin beech forest collections of myxomycetes on the territory of “Bewitched Land” were simultaneously held in the old-aged spruce (*Picea abies* (L.) Karst.) forest near the swamp “Black Bog”

(Pidgirnianske forestry of NNP, village of Pidgirne) and in many-aged beech forest with planted spruce in the geological reserve "Bewitched Valley".

MATERIALS AND METHODS

As a result of mycological inspections of the above-mentioned territories of NNP "Bewitched Land", organized in July 2011 49 specimens of myxomycetes were collected on the various plant substrates. The collection of myxomycete specimens was fulfilled during radial routes on the park territory using generally adopted methods. Records of myxomycetes were realized by inspection of a set of plant substrates (leaf litter, fallen tree trunks, old stumps, fallen branches, dead bark, dried and living grasses etc.) with the 10-multiple magnifier. The found specimen along with the part of substrate was cut by knife and carefully transferred to plastic box (27×17 cm) divided inside on separate cells (4×17 cm). A thin layer of cork material was placed at the box bottom to fix the collected specimens with metal pins in order to avoid myxomycete sporophores destruction. In laboratory the specimens were taken out the plastic box and dried at room temperature. After that for a long storage in herbarium every myxomycete specimen was transferred to the separate match box on the drop of liquid glue at the bottom to keep it motionlessly. Installed in such way specimens are well preserved and are fit to identification for a long time.

Light microscope GS M 27257 (10×, 20×, 40×, 90× lenses) and stereomicroscope Olympus VT-II 205816 (oculars 1×, 2×, 10×) with calibrated scale were used for the studies of myxomycete micromorphological characteristics taken into consideration for their identification. The special manuals devoted to slime molds from the orders and families of Myxomycetes serve as fundamental works for the establishment of taxonomic position of the collected specimens [15, 22, 30, 31, 33–35].

Latin names of Myxomycetes given in the paper are based on the nomenclatural catalogue "Novenmyx. A Nomenclatural Taxabase of Myxomycetes" [29]. "Vascular Plants of Ukraine. A Nomenclatural Checklist" is used as a reference book for Latin names of vascular plants [32]. Abbreviations of the authors' names of myxomycete species correspond to the recommended standard forms for authors of scientific names of fungi [23].

RESULTS AND DISCUSSION

Collections of myxomycetes in the above enumerated localities of NNP "Bewitched Land" together with the following identification of collected specimens resulted in 20 species of myxomycetes. Their species diversity is given in Table where myxomycete species recorded in NNP "Bewitched Land" are marked with asterisks. In accordance with the modern classification [24] all species from "Bewitched Land" belong to class *Myxomycetes* (Division *Myxomycota*). Representatives of subclass *Myxogastromycetidae* (19) dominate in taxonomic structure of slime molds found in the virgin beech and old-aged spruce forests of investigated reserved territory. Only one species (*Ceratiomyxa fruticulosa*) belongs to subclass *Ceratiomyxomycetidae*. Myxogastromycetids are assigned to four orders: *Trichiales* (8 species), *Physarales* (5), *Liceales* and *Stemonitales* (on 3 species each). Among the families of myxomycetes revealed in NNP "Bewitched Land" *Trichiaceae* with 8 species was prevalent. The remaining 11 species from *Physarales*, *Liceales* and *Stemonitales* were arranged in the families: *Physaraceae* (5), *Reticulariaceae* (3) and *Stemonitidaceae* (3) correspondingly. The distribution of recorded myxomycetes between the genera was following: *Arcyria* Wigg (*Trichiaceae*) and *Physarum* Pers. (*Physaraceae*) presented in "Bewitched Land" by 4 species each

were the richest ones according to species composition in comparison with other 8 genera. *Hemitrichia* Rostaf., *Trichia* Haller (*Trichiaceae*) and *Stemonitis* Roth (*Stemonitidaceae*) embrace two species each. Only one species of every from the other genera *Dictydiaethalium* Rostaf., *Lycogala* Adans., *Tubifera* Gmel. (*Reticulariaceae*), *Fuligo* Haller (*Physaraceae*) and *Comatricha* Preuss (*Stemonitidaceae*) was found in NNP "Bewitched Land" during the expedition in July 2011.

Among the species of slime molds collected in the virgin beech and the old-aged spruce forests of NNP "Bewitched Land" rather limited number may be appreciated as a wide-spread one. The highest frequency of occurrence was noted for *Ceratiomyxa fruticulosa* (Fig. 1), *Arcyria cinerea* (Fig. 2) and *Lycogala epidendrum* (Fig. 3) the numerous specimens of which were collected in the forest parcel Kamianka (the virgin beech forest along the river Syniavka), "Bewitched Valley" (the old-aged beech forest) and near the swamp "Black Bog" (the old-aged spruce forest). In two ("Bewitched Valley" and "Black Bog") from above-named three locations *Arcyria denudata*, *Trichia affinis* and *Tubifera ferruginosa* (Fig. 4) were recorded. Rather wide-spread slime molds *Hemitrichia calyculata* (Fig. 5) and *Trichia decipiens* (Fig. 6) were found only once: the first in the beech forest of parcel Kamianka, the second in the spruce forest near swamp "Black Bog". *Physarum album* (Fig. 7, 8) is a single species observed in "Bewitched Valley", forest parcel Kamianka and in the overgrowth of *Alnus incana* (L.) Moench in the village Ilnytsia. It should be mentioned another myxomycetes whose specimens were found in this anthropogenically modified location – the meadow with old apple garden and the overgrowth of *A. incana* on the bank of stream Bagynski in the village Ilnytsia. In this location along with common species of slime molds *Fuligo septica* (Fig. 9), *Hemitrichia serpula* (Fig. 10), *Physarum album* some rather rare ones *Dictydiaethalium plumbeum* (Fig. 11) and *Physarum psittacinum* (Fig. 12) were collected namely on *A. incana*. *D. plumbeum* may be determined as a species with rather limited distribution in Ukraine and Ukrainian Carpathians especially. Fructifications of *D. plumbeum* are known as pseudoaethalia and look like plainly extended on substrate, lead-gray, gray-brown or yellowish-brown crusts with smooth shining or dull surface, in mature pseudoaethalia few right splits are arisen on the surface. At first *D. plumbeum* was collected in Ukraine on the territory of Small (Male) Polissia in vicinity of Lviv [25, 26] and three years later it was observed in Carpathian forests near Skole [27]. J. Krupa cited the species under synonymic name *Clathroptychium rugulosum* (Wallr.) Rostaf. Information about the next record of *D. plumbeum* in Ukraine appeared later 115 years after Krupa's finds. Single specimen of *D. plumbeum* was collected in Mountain Crimea at the territory of Crimea nature reserve in the alder forest along the bank of river Alma [16]. Then *D. plumbeum* was revealed in Ukraine from some locations on the territories of Left-Bank and Western Polissia, Right- and Left-Bank Forest-Steppe etc. [2–4, 8, 11, 12]. But in the Ukrainian Carpathians our record of *D. plumbeum* from NNP "Bewitched Land" is the first after Krupa's find in the forests near Skole.

Physarum psittacinum belongs to those members of genus *Physarum* that can't be treated as wide-spread in Ukraine and in the world. However, in comparison with *D. plumbeum* *Ph. psittacinum* is characterized by the higher frequency of occurrence in Ukraine. The first collection of this species was carried out in Left-Bank Polissia [18]. Further on the additional finds of *Ph. psittacinum* were made in other locations of the plain part of Ukraine [1, 9, 11, 12, 17, 28]. Mycological observations fulfilled in Ukrainian Carpathians during the last decade showed significant tendency of *Ph. psittacinum* to develop not only in biotopes of plain territory but in mountain ones too. The locations of *Ph. psittacinum* are established in Carpathian biosphere reserve, nature reserve

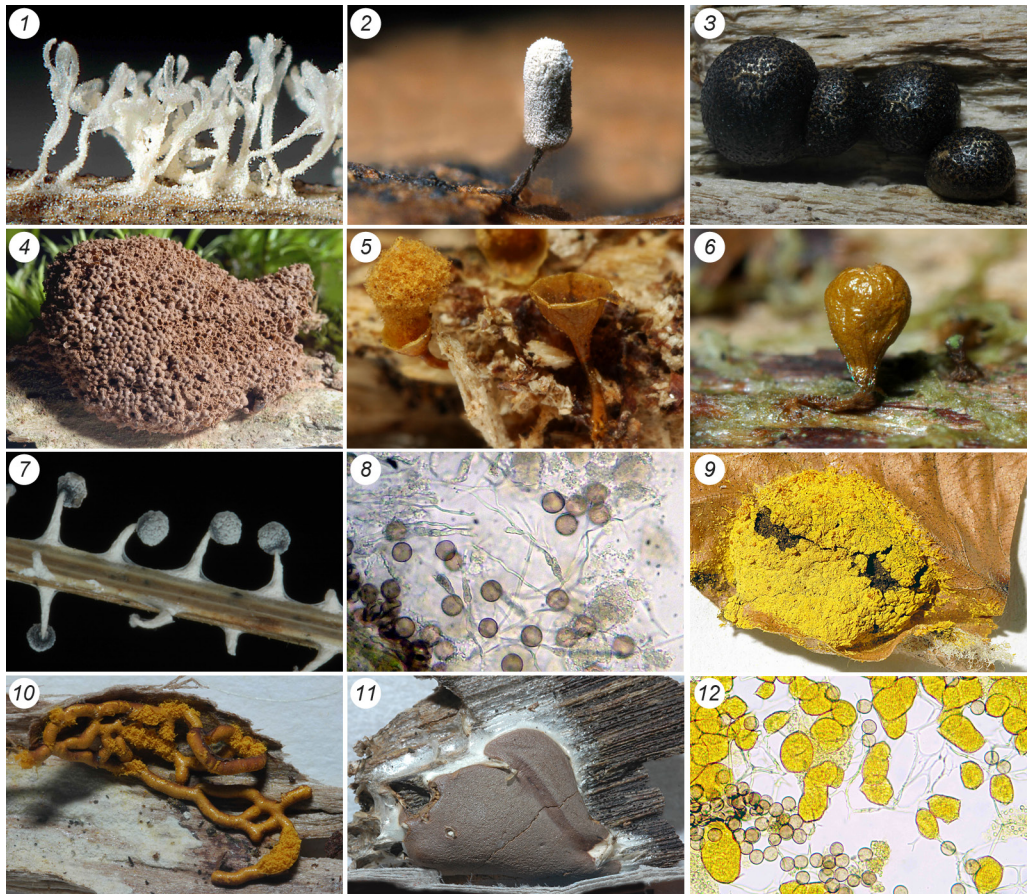


Fig. 1–12: 1 – sporocarps of *Ceratiomyxa fruticulosa*; 2 – sporocarp of *Arcyria cinerea*; 3 – aethalies of *Lycogala epidendrum*; 4 – aethalia of *Tubifera ferruginosa*; 5 – sporocarps of *Hemitrichia calyculata*; 6 – sporocarp of *Trichia decipiens*; 7 – sporocarps of *Physarum album*; 8 – spores and capillitium of *Ph. album*; 9 – aethalia of *Fuligo septica*; 10 – plasmodiocarps of *H. serpula*; 11 – aethalia of *Dictydiaethalium plumbeum*; 12 – spores and capillitium of *Physarum psittacinum*

Рис. 1–12: 1 – спорокарпи *Ceratiomyxa fruticulosа*; 2 – спорокарпи *Arcyria cinerea*; 3 – етаїї *Lycogala epidendrum*; 4 – етаїї *Tubifera ferruginosa*; 5 – спорокарпи *Hemitrichia calyculata*; 6 – спорокарп *Trichia decipiens*; 7 – спорокарпи *Physarum album*; 8 – спори і капіліції *Ph. album*; 9 – етаїї *Fuligo septica*; 10 – плазмодіокарп *H. serpula*; 11 – етаїї *Dictydiaethalium plumbeum*; 12 – спори і капіліції *Physarum psittacinum*

“Gorgany”, NNP “Synevyr” [10, 13]. Our find of *Ph. psittacinum* completed the list of its locations in Ukrainian Carpathians with NNP “Bewitched Land”.

Comparison of myxomycete species diversities in NNP “Bewitched Land” and in two other protected nature objects with the virgin beech and the old-aged spruce-fir forests (Carpathian biosphere reserve and NNP “Skolivski Beskydy”), where we studied slime molds earlier [5, 21], showed rather noticeable difference between the species richness of myxomycetes. In NNP “Bewitched Land” 20 myxomycete species were recorded against 18 species in Carpathian biosphere reserve and 27 species in NNP “Skolivski Beskydy”. The main reason of such discrepancy between wealth of myxomycete biota in NNP “Bewitched Land” and biosphere reserve, from the one side, and NNP “Skolivski

Beskydy”, from the other side, consists in the different terms for collection of slime molds specimens. It was noted above that mycological inspection of NNP “Bewitched Land” for revealing of myxomycetes was held in summer 2011. The observations on myxomycetes in Carpathian biosphere reserve were predominantly undertaken in spring and summer 2006. Only in NNP “Skolivski Beskydy” autumn 2010 was chosen for collection of these protozoan fungal analogues. The autumn is considered the most suitable time for myxomycete collection as a period when the best correlation between substrate moisture and air temperature is established producing the favorable conditions for slime molds development [35]. Thus the highest level of myxomycete species diversity in NNP “Skolivski Beskydy” is directly connected with the term of its collection.

At the same time, in spite of the difference in quantitative presentation of myxomycetes found at the investigated territories the taxonomic structures of slime molds in three comparable protected nature objects are similar. The family *Trichiaceae* takes the dominant positions in NNP “Skolivski Beskydy” (15 species from 5 genera) and in Carpathian biosphere reserve (7 species and two varieties from 3 genera) the same as in NNP “Bewitched Land” (8 species of 3 genera). The second place in these comparable territories belongs to the family *Physaraceae* presented in studied national parks with 5 species in each and in biosphere reserve with 4 species. Among the genera *Trichia* Haller becomes the dominant in “Skolivski Beskydy” (6 species) and biosphere reserve (4 species and two varieties) instead of *Arcyria* Wigg in “Bewitched Land” (4 species). However, *Arcyria* yields to *Trichia* not so much: in “Skolivski Beskydy” *Arcyria* is presented with 5 species against *Trichia* with 6 species.

Ecological analysis of myxomycetes consists in the clarification of its substrate distribution that allows to determine relation of certain species to the concrete ecological group. The results on association of myxomycetes from NNP “Bewitched Land” with the different substrate types (Table) support thesis about the wood as a preferable substrate for slime molds in the forest communities. Representatives of xylophilous ecological group prevailed in the myxomycete biota: 18 from 20 recorded species were found on decaying stumps, trunks, logs, fallen branches and twigs of 6 tree’s species (*Alnus glutinosa* (L.) Gaertn., *A. incana*, *Betula pendula* Roth, *Fagus sylvatica*, *Malus domestica* Borkh and *Picea abies*) at various stages of decomposition. It should be noted that 3 (*Arcyria denudata*, *Ceratiomyxa fruticulosa*, *Fuligo septica*) from those 18 lignicolous slime molds were marked on bark of trees too. It means they may be considered as members of corticuloid ecological group but in view of their ability at the same time to occupy wood we include them in xylophilous ecological group. *Hemitrichia serpula* was the single slime mold collected in “Bewitched Land” on the bark only; so this species may be included in corticuloid group. *Picea abies* and *Fagus sylvatica* are the two main woody species that were used as a substrate with the greatest numbers of myxomycetes. Altogether 16 taxa were found on their decaying wood; 13 taxa on the wood of *Picea* and 8 on the wood of *Fagus*. It is necessary to attract attention to the numbers of multisubstrate slime molds in NNP “Bewitched Land”. Development of fructifications of *Arcyria cinerea*, *A. denudata*, *Ceratiomyxa fruticulosa*, *Comatricha nigra*, *Fuligo septica*, *Lycogala epidendrum*, *Physarum album*, *Ph. viride* was observed on 2–3 and even on 5 various substrates. For example, *C. fruticulosa* was collected on the wood and bark of beech, the wood of spruce and birch and on the basidioma of wood-destroyed fungus; *Fuligo septica* was found on the wood of living apple tree, the bark of spruce and on living herbal plants. In “Bewitched Land” several species of slime molds (*Arcyria affinis*, *A. incarnata*, *Stemonitis fusca*, *S. splendens*, *Trichia affinis*, *T. decipiens*, *Tubifera ferruginosa*) were revealed on the wood of

**Comparison of species diversity and substrate preferences of myxomycetes
from three protected nature objects of the Ukrainian Carpathians**

**Порівняння видового різноманіття і субстратних уподобань міксоміцетів
із трьох природоохоронних об'єктів Українських Карпат**

Nr	Species	Location		
		National Nature Park "Bewitched Land"	Carpathian Biosphere Reserve	Natural Nature Park "Skolivski Beskydy"
			[21]	[5]
1	<i>*Arcyria affinis</i> Rostaf.	PAw+		Fsw+
2	<i>*A. cinerea</i> (Bull.) Pers.	6Fsw+; PAw+		AAw+
3	<i>*A. denudata</i> (L.) Wettst.	Fsw+; FSb+; b+		AAw+; 2Fsw+; 2FSbw+
4	<i>A. ferruginea</i> Saut.			AAw+; PAw+
5	<i>*A. incarnata</i> (Pers. ex J.F. Gmel.) Pers.	PAw+		Fsw+; PTw+
6	<i>*Ceratiomyxa fruticulosa</i> (O.F. Müll.) T. Macbr.	BPw+; 3Fsw+; FSb+; 2PAw+; f	Fsw+; PAw+	
7	<i>*Comatricha nigra</i> (Pers. ex J.F. Gmel.) J. Schröt.	Fsw+; PAw+		
8	<i>Craterium minutum</i> (Leers) Fr.		g+	l+
9	<i>Cribraria aurantiaca</i> Schrad.			3AAw+
10	<i>C. purpurea</i> Schrad.			3AAw+
11	<i>Diachea leucopodia</i> (Bull.) Rostaf.		FSI+	
12	<i>*Dictydiaethalium plumbeum</i> (Schumach.) Rostaf.	Alw+		
13	<i>Didymium difforme</i> (Pers.) Gray			HI
14	<i>D. squamulosum</i> (Alb. & Schwein.) Fr.			HI
15	<i>Fuligo intermedia</i> T. Macbr.		Fsw+	
16	<i>F. leviderma</i> H. Neubert, Nowotny & K. Baumann			Fsw+
17	<i>*F. septica</i> (L.) F.H. Wigg.	MDw*; PAb+; 2g*	Fsw+	5AAw+; Alw+; PAw*; 2PAw+
18	<i>*Hemitrichia calyculata</i> (Speg.) M.L. Farr	Fsw+		2Fsw+
19	<i>H. clavata</i> (Pers.) Rostaf.		Fsw+	
20	<i>*H. serpula</i> (Scop.) Rostaf. ex Lister	Alb+		Sb+
21	<i>Licea minima</i> Fr.		PAw+	
22	<i>*Lycogala epidendrum</i> (L.) Fr.	AGw+; 2Fsw+; PAw+	Fsw+	AAw+; AGw+; BPw+; CBw+; 4Fsw+; PTw+; Sw+
23	<i>L. terrestre</i> Fr.		Fsw+	
24	<i>Metatrichia floriformis</i> (Schwein.) Nann.-Bremek.		Fsw+	

25	<i>M. vesparia</i> (Batsch) Nann.-Bremek. ex G.W. Martin & Alexop.		2FSw+	2AAw+
26	<i>Perichaena corticalis</i> (Batsch) Rostaf.			AGw+
27	* <i>Physarum album</i> (Bull.) Chevall.	2FSw+; FVg*; w+		
28	<i>Ph. cinereum</i> (Batsch) Pers.			Sw+
29	<i>Ph. leucophaeum</i> Fr.			2FSw+
30	* <i>Ph. psittacinum</i> Ditmar	Alw+		
31	<i>Ph. robustum</i> (Lister) Nann.-Bremek.		PAw+	
32	* <i>Ph. viride</i> (Bull.) Pers.	FSw+; PAw+		
33	* <i>Physarum</i> sp.(9)	g*		
34	* <i>Stemonitis fusca</i> Roth	PAw+		Alw+
35	* <i>S. splendens</i> Rostaf.	PAw+		
36	<i>Stemonitopsis typhina</i> (F.H. Wigg.) Nann.-Bremek.		FSw+	
37	<i>Symphytocarpus impexus</i> Ing & Nann.-Bremek.			FSw+
38	* <i>Trichia affinis</i> de Bary	2PAw+	2FSw+	
39	* <i>T. decipiens</i> (Pers.) T. Macbr.	PAw+	FSw+; PAw+	2AAw+; 4FSw+
40	<i>T. lutescens</i> (Lister) Lister			FSw+
41	<i>T. persimilis</i> P. Karst.		FSw+	AGw+
42	<i>T. scabra</i> Rostaf.			2AGw+
43	<i>T. subfusca</i> Rex			FSw+
44	<i>T. varia</i> (Pers. ex J.F. Gmel.) Pers.		FSw+; PAw+	3AAw+; 2FSw+; Sw*
45	* <i>Tubifera ferruginosa</i> (Batsch) J.F. Gmel.	3PAw+	FSw+	

Legend: AAw+ – dead wood of *Abies alba*; AGw+ – dead wood of *Alnus glutinosa*; Alw+ – dead wood of *Alnus incana*; BPw+ – dead wood of *Betula pendula*; CBw+ – dead wood of *Carpinus betulus*; FSb+ – dead bark of *F. sylvatica*; FSbw+ – dead bark and wood of *F. sylvatica*; FSI+ – dead leaves of *F. sylvatica*; FSw+ – dead wood of *Fagus sylvatica*; FVg* – stem of living *Fragaria vesca*; HI – leaves of *Heracleum* sp.; MDw* – wood of living tree *Malus domestica*; PAb+ – dead bark of *Picea abies*; PAw+ – dead wood of *P. abies*; PAw* – wood of living tree *P. abies*; PTw+ – dead wood of *Populus tremula*; Sw+ – dead wood of *Salix* sp.; Sw* – wood of living tree *Salix* sp.; f – fruit body of wood-destroyed fungus; g+ – dead herbal plants; g* – living herbal plants; l+ – dead tree leaves; w+ – dead wood; figure before substrate symbols means the numbers of collected specimens.

Скорочення: AAw+ – мертва деревина *Abies alba*, AGw+ – мертва деревина *Alnus glutinosa*, Alw+ – мертва деревина *Alnus incana*, BPw+ – мертва деревина *Betula pendula*, CBw+ – мертва деревина *Carpinus betulus*, FSb+ – мертва кора *Fagus sylvatica*, FSbw+ – мертва кора і деревина *F. sylvatica*, FSI+ – мертві листки *F. sylvatica*, FSw+ – мертва деревина *F. sylvatica*, FVg* – стебло живої рослини *Fragaria vesca*, HI – листки *Heracleum* sp., MDw* – деревина живого дерева *Malus domestica*, PAb+ – мертва кора *Picea abies*, PAw+ – мертва деревина *P. abies*, PAw* – деревина живого дерева *P. abies*, PTw+ – мертва деревина *Populus tremula*, Sw+ – мертва деревина *Salix* sp., Sw* – деревина живого дерева *Salix* sp., f – плодове тіло дереворуйнівного гриба, g+ – мертві трав'янисті рослини, g* – живі трав'янисті рослини, l+ – мертві листки дерев, w+ – мертва деревина; цифри перед символами субстратів відповідають кількості зібраних зразків.

Picea abies only. However, some of these species were also found on other types of wood outside the study area. It is distinctly shown by our data on myxomycetes of NNP "Skolivski Beskydy" and Carpathian biosphere reserve (Table) where the same species were collected on the wood of beech (*Arcyria affinis*, *Trichia affinis*, *Tubifera ferruginosa*), the wood of beech and aspen (*Arcyria incarnata*), the wood of speckled alder (*Stemonitis fusca*), the wood of beech and silver fir (*Trichia decipiens*). There are many literature data that demonstrate significantly wider range of substrates suitable for colonization with the mentioned myxomycete species [20, 36].

More limited woody substrates than the beech and spruce ones are presented in NNP "Bewitched Land" by the speckled alder (*Alnus incana*), areal of which in Ukraine is connected with Carpathian region. Only three myxomycete species were found on the substrates produced by *A. incana*. *Dictydiaethalium plumbeum* and *Physarum psittacinum* are associated with the wood and *Hemitrichia serpula* – with the bark of speckled alder. It should be noted the first record of *D. plumbeum* in Ukraine was made in XIX century at the same substrate: stumps of *A. incana* [26]. But narrow adaptation of this species to *A. incana* is doubtful: at the same time with the finds on speckled alder wood *D. plumbeum* was collected on the wood of black alder (*Alnus glutinosa*) [26]. Later the list of *D. plumbeum* substrates enlarged: it was revealed on bark and wood of *Betula pendula*, wood of *Fraxinus excelsior* L., *Carpinus betulus* L. and *Quercus robur* L., wood of unidentified tree [2, 4, 11, 12, 16]. The numbers of substrates on which *Ph. psittacinum* fructifications were observed in Ukraine are much more numerous and include not only the bark, wood and leaf litter of deciduous trees (lime, oak, aspen, hornbeam) [9, 11, 12] but the wood of coniferous ones (spruce and fir), mosses, fruit bodies of wood-destroyed fungi too [1, 10, 13].

CONCLUSION

Ecological analysis of myxomycete substrate preferences showed that the most important woody species that supported the development of the majority of slime molds in NNP "Bewitched Land" were spruce (*Picea abies*) and beech (*Fagus sylvatica*). At previous studies of myxomycetes in the forest communities of Ukrainian Carpathians [5, 10, 13, 21] it was established that usually myxomycetes occurred, first of all, on dead wood of deciduous trees; coniferous wood is used as a substrate with a smaller number of the specialized slime molds. As an example of such association with the wood of deciduous trees myxomycetes of Carpathian biosphere reserve that clearly demonstrate preference in relation of the beech wood are given in Table. Myxomycete biota of "Bewitched Land" shows reverse type of substrate association using as preferable the wood of coniferous tree – spruce. Possibly prevail of slime molds on the wood of spruce in the study area may be connected with the stage of its decomposition which was more suitable for myxomycete development than the stage of beech wood destruction. The slime molds which develop in NNP "Bewitched Land" only on such limited substrate as the speckled alder wood are known as colonizers of the different woody substrates in various regions of Ukraine.

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МІКСОМІЦЕТИ БУКОВИХ ПРАЛІСІВ І СТАРОВОКОВИХ ЯЛИНОВИХ ЛІСІВ НАЦІОНАЛЬНОГО ПРИРОДНОГО ПАРКУ „ЗАЧАРОВАНИЙ КРАЙ” (УКРАЇНСЬКІ КАРПАТИ)

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Мікологічні спостереження, проведені у липні 2011 р. у букових пралісах і старовікових ялинових лісах Національного природного парку (далі НПП) „Зачарований край”, дали змогу виявити 20 видів міксоміцетів. *Ceratiomyxa fruticulosa* – єдиний вид, що належить до підкласу *Ceratiomyxomycetidae*, інші 19 видів є представниками підкласу *Muxogastromycetidae*, у складі якого розподіляються за чотирма порядками: *Trichiales* (8 видів), *Physarales* (5), *Liceales* та *Stemonitales* (по 3 види в кожному). Найбільшою частотою трапляння відзначаються *Ceratiomyxa fruticulosa*, *Arcyria cinerea* та *Lycogala epidendrum*. *Dictydiaethalium plumbeum* є видом із доволі обмеженим поширенням в Україні і особливо в Українських Карпатах. Вивчення субстратних уподобань міксоміцетів показало, що найбільш важливими деревними породами, які утворюють субстрати для розвитку більшості міксоміцетів у НПП „Зачарований край”, є ялина (*Picea abies*) та бук (*Fagus sylvatica*). На відміну від Карпатського біосферного заповідника та НПП „Сколівські Бескиди”, де міксоміцети переважно

використовують як субстрат деревину бука, біота міксоміцетів НПП „Зачарований край” продемонструвала зворотний тип асоціації зі субстратом, надавши перевагу деревині шпилькової породи – ялини.

Ключові слова: Національний природний парк „Зачарований край”, Мухомуцетес, слизовики, праліси та старовікові ліси, таксономічне різноманіття, субстратні уподобання.

МИКСОМИЦЕТЫ КОРЕННЫХ БУКОВЫХ И СТАРОВОЗРАСТНЫХ ЕЛОВЫХ ЛЕСОВ НАЦИОНАЛЬНОГО ПРИРОДНОГО ПАРКА «ЗАЧАРОВАННЫЙ КРАЙ» (УКРАИНСКИЕ КАРПАТЫ)

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Микологические наблюдения, проведенные в июле 2011 г. в коренных буковых и старовозрастных еловых лесах Национального природного парка (далее НПП) „Зачарованный край”, позволили обнаружить 20 видов миксомицетов. *Ceratiomyxa fruticulosa* – единственный вид, относящийся к подклассу *Ceratiomyxomycetidae*, остальные 19 видов являются представителями подкласса *Muxogastromycetidae*, в составе которого распределены между четырьмя порядками: *Trichiales* (8 видов), *Physarales* (5), *Liceales* и *Stemonitales* (по 3 вида в каждом). Наибольшей частотой встречаемости характеризуются *Ceratiomyxa fruticulosa*, *Arcyria cinerea* и *Lycogala epidendrum*. *Dictydiaethalium plumbeum* является видом с довольно ограниченным распространением в Украине и особенно в Украинских Карпатах. Изучение субстратных предпочтений миксомицетов показало, что чаще других древесных пород в НПП „Зачарованный край” обеспечивают развитие миксомицетов субстраты из ели (*Picea abies*) и бука (*Fagus sylvatica*). В отличие от Карпатского биосферного заповедника и НПП „Сколевские Бескиды”, где миксомицеты преимущественно используют как субстрат древесину бука, биота миксомицетов НПП „Зачарованный край” продемонстрировала обратный тип ассоциации с субстратом, отдавая предпочтение древесине хвойной породы – ели.

Ключевые слова: Национальный природный парк „Зачарованный край”, Мухомуцетес, слизевики, коренные и старовозрастные леса, таксономическое разнообразие, субстратные предпочтения.

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