ACTA MYCOLOGICA
Vol. 36 (1): 21–29
2001

# Slime moulds occurring in the Bukowiec reserve (W Carpathians)

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Miśkiewicz A.: *Slime moulds occurring in the Bukowiec reserve* (*W Carpathians*). Acta Mycol. 36 (1): 21–29, 2001.

Two-year studies on the diversity and occurrence of slime moulds in the Bukowiec forest reserve (Pogórze Wiśnickie Region) were undertaken. 31 taxa of slime moulds found are listed. Two species, *Hemitrichia calyculata* and *Fuligo leviderma*, are recorded in Poland for the first time.

**Key words**: *Myxomycota*, *Hemitrichia calyculata*, *Fuligo leviderma*, Bukowiec reserve, W Carpathians, S Poland.

## INTRODUCTION

The first report dealing with slime moulds in this area concerned two species, *Diderma deplanatum* Fr. and *D. chondrioderma* (de Bary et Rostaf.) G. Lister (Miśkiewicz and Drozdowicz 1999), which had been recognized as extinct or probably extinct organisms (Stojanowska and Drozdowicz 1992).

The Bukowiec reserve is situated 15 km south from Brzesko (20°35′30″ E, 49°50′20″ N), in the Pogórze Wiśnickie region, Western Polish Carpathians. Localization of the reserve is given in the previous paper (Miśkiewicz 2000). Observations were carried out in two types of plant communities: beech forest (*Dentario glandulosae-Fagetum* and *Querco-Fagetum*) and alder forest (*Circaeo-Alnetum*) in the whole area (5.31 ha) of the reserve. Material was collected throughout two growing seasons, 1997 and 1998 (and, additionally, once in 1999), on average twice a month. The nomenclature, taxonomy and synonymes used are based on Neubert et al. (1993, 1995) and Nannenga-Bremekamp (1991). Furthermore, other monographs (Krzemieniewska 1960, Lister and Lister 1925, Martin and Alexopoulos 1969) were used for identification of species. The collection of slime moulds was deposited in the Herbarium of the Institute of Botany, Jagiellonian University (KRA). For the

species recorded in Poland for the first time as well as for the rare taxa, the distribution in our country and worldwide is given.

## RESULTS

Among a total of 31 taxa (25 species and 6 varietes) of slime moulds found in Bukowiec reserve, different orders are represented by the following numbers of taxa: 10 – *Trichiales*, 9 – *Physarales*, 6 – *Liceales*, 4 – *Stemonitales*, 2 – *Ceratiomyxales*.

The *Trichiaceae* family (6 species) was the most common. Five taxa belonged to genus *Diderma*, making it the most frequent one. Four of them are considered as rare in Poland. Two species: *Fuligo leviderma* and *Hemitrichia calyculata* have not been recorded in our country so far.

As many as 29 taxa occurred in beech forest, while only 5 species were found in alder forest (2 of them exclusively in this forest community). Slime moulds usually developed on beech logs or cut trunks deposited on the forest floor. Some species (*Diderma deplanatum, Fuligo leviderma, Hemitrichia serpula, Trichia favoginea*) formed sporangia on mosses. A few taxa occurred on other substrata like fern debris (*Diderma montanum* var. *montanum*) or dead aphyllophoraceous fungi (*Metatrichia vesparium* and *Trichia varia*). Three species (*Arcyria incarnata, Comatricha nigra* and *Diderma chondrioderma*) were found on small twigs of *Fagus sylvatica* or *Alnus glutinosa* and another two (*Diderma effusum, Fuligo septica* var. *septica*) on fallen leaves. Nevertheless, the same species of slime moulds usually developed on various types of substratum.

*Ceratiomyxa fruticulosa* var. *fruticulosa, C. fruticulosa* var. *poroides, Hemitrichia calyculata, H. serpula, Lycogala epidendrum, Metatrichia vesparium* and *Trichia favoginea* can be considered as common species in the investigated area.

In general, the most abundant occurrence of slime moulds in the Bukowiec reserve was observed in autumn 1997 and summer 1998. Phenology of species is demonstrated in tables 1 and 2.

The first ones to appear in the spring (March – May) were *Diderma chondrioderma* (10.05.98), *D. deplanatum* (4.04.98) and *Hemitrichia clavata* (26.04.98). These species were found only once. On the contrary, *Comatricha nigra* (27.07.97; 10.05.98), *Hemitrichia calyculata* (14.11.97; 26.04, 3.08, 22.09.98) and *Stemonitis axifera* (29.05, 7.09.97; 1.07, 3.08.98) were recorded in spring, but they also occurred later in summer and autumn. *Fuligo septica* var. *septica* and *Lycogala epidendrum* formed sporangia in abundance throughout the year (Tables 1 and 2). In the beginning of the growing season, last year's sporangia of *Metatrichia vesparium* and *Trichia favoginea* were also observed.

The number of species increased considerably in the summer time (June – August). During this period, some slime moulds were encountered only once. They were: *Arcyria incarnata* (28.07.98), *Diderma effusum* (24.06.98), *D. radiatum* (24.07.97), *Fuligo leviderma* (27.07.97), *Lycogala conicum* (28.07.98), *Physarum nutans* (28.07.98), *Stemonitis fusca* var. *fusca* (3.08.98), *Stemonitopsis*

Table 1
Phenology of slime moulds in the Bukowiec reserve in 1997

| | 1997 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10.05 | 21.05 | 29.05 | 21.06 | 12.07 | 21.07 | 27.07 | 24.08 | 31.08 | 07.09 | 14.09 | 21.09 | 28.09 | 12.10 | 18.10 | 21.10 | 14.11 |
| *Lycogala epidendrum* | | + | + | | | + | + | | | + | + | | | + | | | + |
| *Fuligo septica* var. *septica* | | + | + | | | + | + | | + | + | + | | + | | | | |
| *Ceratiomyxa fruticulosa* var. *flexuosa* | | | + | | | | | | | | + | | | | | | |
| *Stemonitis axifera* | | | + | | | | | | | + | | | | | | | |
| *Tubifera ferruginosa* | | | | + | | | | | | | | | | | | | |
| *Arcyria cinerea* | | | | | + | | | | | + | | | | | | | |
| *Arcyria denudata* | | | | | | + | | | | | | | | | + | + | + |
| *Comatricha nigra* | | | | | | | + | | | | | | | | | | |
| *Fuligo leviderma* | | | | | | | + | | | | | | | | | | |
| *Fuligo septica* var. *candida* | | | | | | | + | + | | | | | | | | | |
| *Ceratiomyxa fruticulosa* var. *poroides* | | | | | | | + | | | | + | | + | | | | |
| *Diderma radiatum* | | | | | | | | + | | | | | | | | | |
| *Hemitrichia serpula* | | | | | | | | | | + | + | + | + | + | + | | + |
| *Trichia varia* | | | | | | | | | | + | + | | | | | | + |
| *Metatrichia vesparium* | | | | | | | | | | + | + | | | | | | |
| *Trichia favoginea* | | | | | | | | | | | + | | | | | | |
| *Cribraria aurantiaca* | | | | | | | | | | | + | | | | | | |
| *Hemitrichia calyculata* | | | | | | | | | | | | | | | | | + |
| *Cribraria argillacea* | | | | | | | | | | | | | | | | | + |
| Total number of species: | 0 | 2 | 4 | 1 | 1 | 3 | 6 | 2 | 1 | 7 | 9 | 1 | 3 | 2 | 2 | 1 | 7 |

Table 2

Phenology of slime moulds in the Bukowiec reserve in 1998 and in March 1999

| | 1998 | | | | | | | | | | | | | | | | | | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 04.04 | 22.04 | 26.04 | 10.05 | 10.06 | 24.06 | 01.07 | 12.07 | 28.07 | 03.08 | 01.09 | 08.09 | 22.09 | 27.09 | 01.10 | 12.10 | 26.10 | 06.11 | 06.03 |
| *Diderma deplanatum* | + | | | | | | | | | | | | | | | | | | |
| *Hemitrichia calyculata* | | | + | | | | | | | + | | | + | | | | | | |
| *Hemitrichia clavata* | | | + | | | | | | | | | | | | | | | | |
| *Lycogala epidendrum* | | | + | | + | + | + | | | + | + | + | + | | + | + | + | + | |
| *Metatrichia vesparium* | | | $z^+$ | | | | | | | | | | | + | | | + | + | $z^+$ |
| *Comatricha nigra* | | | | + | | | | | | | | | | | | | | | |
| *Diderma chondrioderma* | | | | + | | | | | | | | | | | | | | | |
| *Ceratiomyxa fruticulosa* var. *flexuosa* | | | | | + | + | + | + | | + | | | | | | | | | |
| *Tubifera ferruginosa* | | | | | | + | + | | | | | | | | | | | | |
| *Ceratiomyxa fruticulosa* var. *poroides* | | | | | | + | + | + | | + | | | | | | | | | |
| *Diderma effusum* | | | | | | + | | | | | | | | | | | | | |
| *Stemonitis axifera* | | | | | | | + | | | + | | | | | | | | | |
| *Fuligo septica* var. *septica* | | | | | | | + | + | + | | | | | | | | | | |
| *Cribraria macrocarpa* | | | | | | | + | | + | | | | | | | | | | |
| *Arcyria cinerea* | | | | | | | | + | | | | | | | | | | | |
| *Arcyria incarnata* | | | | | | | | | + | | | | | | | | | | |
| *Hemitrichia serpula* | | | | | | | | | + | + | + | + | + | | + | | + | + | |
| *Lycogala conicum* | | | | | | | | | + | | | | | | | | | | |
| *Physarum nutans* | | | | | | | | | + | | | | | | | | | | |
| *Fuligo septica* var. *candida* | | | | | | | | | | + | | | | | | | | | |
| *Stemonitis fusca* var. *fusca* | | | | | | | | | | + | | | | | | | | | |
| *Stemonitopsis typhina* | | | | | | | | | | + | | | | | | | | | |
| *Trichia botrytis* | | | | | | | | | | + | | | | | | | | | |
| *Trichia favoginea* | $z^+$ | $z^+$ | $z^+$ | | | | | | | | | | + | | | | + | + | $z^+$ |
| *Diderma montanum* var. *montanum* | | | | | | | | | | | | | | | | | + | | |
| Total number of species: | 2 | 1 | 5 | 5 | 2 | 5 | 7 | 4 | 6 | 10 | 2 | 2 | 4 | 1 | 2 | 1 | 5 | 4 | 2 |

$z^+$ – last year's sporangia

*typhina* (3.08.98) and *Trichia botrytis* (3.08.98). On the other hand, *Cribraria macrocarpa* (1.07, 28.07.98) and *Fuligo septica* var. *candida* (27.07, 28.08.97; 3.08.98) occurred more often. *Arcyria cinerea, Ceratiomyxa fruticulosa* var. *fruticulosa, C. fruticulosa* var. *poroides* and *Tubifera ferruginosa* were the most common species during the summer (Tables 1 and 2).

In autumn (September – November) some species: *Cribraria argillacea* (14.11.97), *C. aurantiaca* (14.09.97) and *Diderma montanum* var. *montanum* (26.10.98) were observed in the reserve only once. A characteristic feature of the slime moulds phenology in this period was the presence of numerous sporangia of *Hemitrichia serpula, Metatrichia vesparium, Trichia favoginea* and *T. varia* (Tables 1 and 2).

## DISCUSSION

The species new for Poland: *Fuligo leviderma* and *Hemitrichia calyculata*, which often appeared in the reserve, were recently presented by N e u b e r t et al. (1993, 1995). Moreover, *Fuligo leviderma* was distinguished by these authors as a new species. Noteworthy is the fact that both species mentioned had been found in Poland before and identified as *Hemitrichia clavata* Rost. and *Fuligo rufa* Pers. respectively (D r o z d o w i c z, personal information). The description and picture of *Fuligo rufa* given by K r z e m i e n i e w s k a (1960) matches the best the features of the new species distinguished by N e u b e r t et al. (1995). *Fuligo rufa* has a thin, uniform, smooth, yellow-brown to red-brown peridium. The most characteristic and distinguishing feature of *Fuligo leviderma* (Pl. I. A, Fig. 1) is a thick, uniform, smooth, cinnamon-brown peridium. As concerns *H. calyculata* (Pl. I. B, Fig. 2) and *H. clavata* (Pl. I. C, Fig. 3), the differences between them are shown in table 3.

T a b l e 3
The differences between *Hemitrichia calyculata* and H. *clavata*, according to N e u b e r t et al. (1993)

| | *H. calyculata* | *H. clavata* |
|---|---|---|
| sporangium | sometimes coalescent, gregarious | solitary, gregarious |
| hypothallus | brown | red-brown |
| stipe | 1–2 mm length, dark brown, distinct from sporangium | 0.3–1.5 mm length, dark brown at the base, lighter above, merged gradually into sporangium |
| peridium | scattered small warts visible in passing light | scattered small warts or net visible in passing light |
| capillitium | light brown in mass, very dense | yellow in mass, not dense |
| spores | 7–8 μm | 7–10 μm |
| plasmodium | yellow | white |

The specimens of these two genera collected in Polish herbaria require a revision.

Most slime moulds found in the Bukowiec reserve developed on beech logs. This seems to be obvious, as this kind of wood is abundant in the reserve. Furthermore, beech wood is soft and less resistant for decomposition than coniferous wood because it lacks slowly degrading resins (S t o j a n o w s k a 1979), so it gets quickly inhabited by saprobionts. Some of the species found on decaying beech logs and trunks (*Arcyria cinerea, Arcyria denudata, Hemitrichia clavata, Lycogala epidendrum, Metatrichia vesparium, Stemonitis axifera*) were also recorded on the same substratum by other authors (D r o z d o w i c z 1992c, S t o j a n o w s k a 1979). *Ceratiomyxa fruticulosa* seems not to be connected with one kind of wood. It occurs on coniferous and broad-leaved wood as well (D r o z d o w i c z 1992c). There are very few data about the occurrence of slime moulds on dead carpophores of aphyllophoraceous fungi. There is no reason to presume that some species prefer dead carpophore as they also develop on wood.

On the other hand, K r z e m i e n i e w s k a (1957) noticed that members of *Physarales* occurred more often on litter elements than on other substrata. Studies in Bukowiec reserve confirm this suggestion. Among 8 species found on litter, as many as 5 species are representatives of this order.

S t o j a n o w s k a (1983a) summarizing her long-term studies on ecology of slime moulds gives a list of species attached specifically to litter. Among them there are a few species also found in the Bukowiec reserve: *Arcyria incarnata, Comatricha nigra* and *Diderma effusum*. According to these data, they form sporangia on fallen leaves, small fallen branches or other plant debris. It is noteworthy that some of them are strictly connected with a particular kind of substratum. For example *Arcyria incarnata* always occurs on twigs about 5 cm in diameter or *Diderma effusum* on fallen leaves.

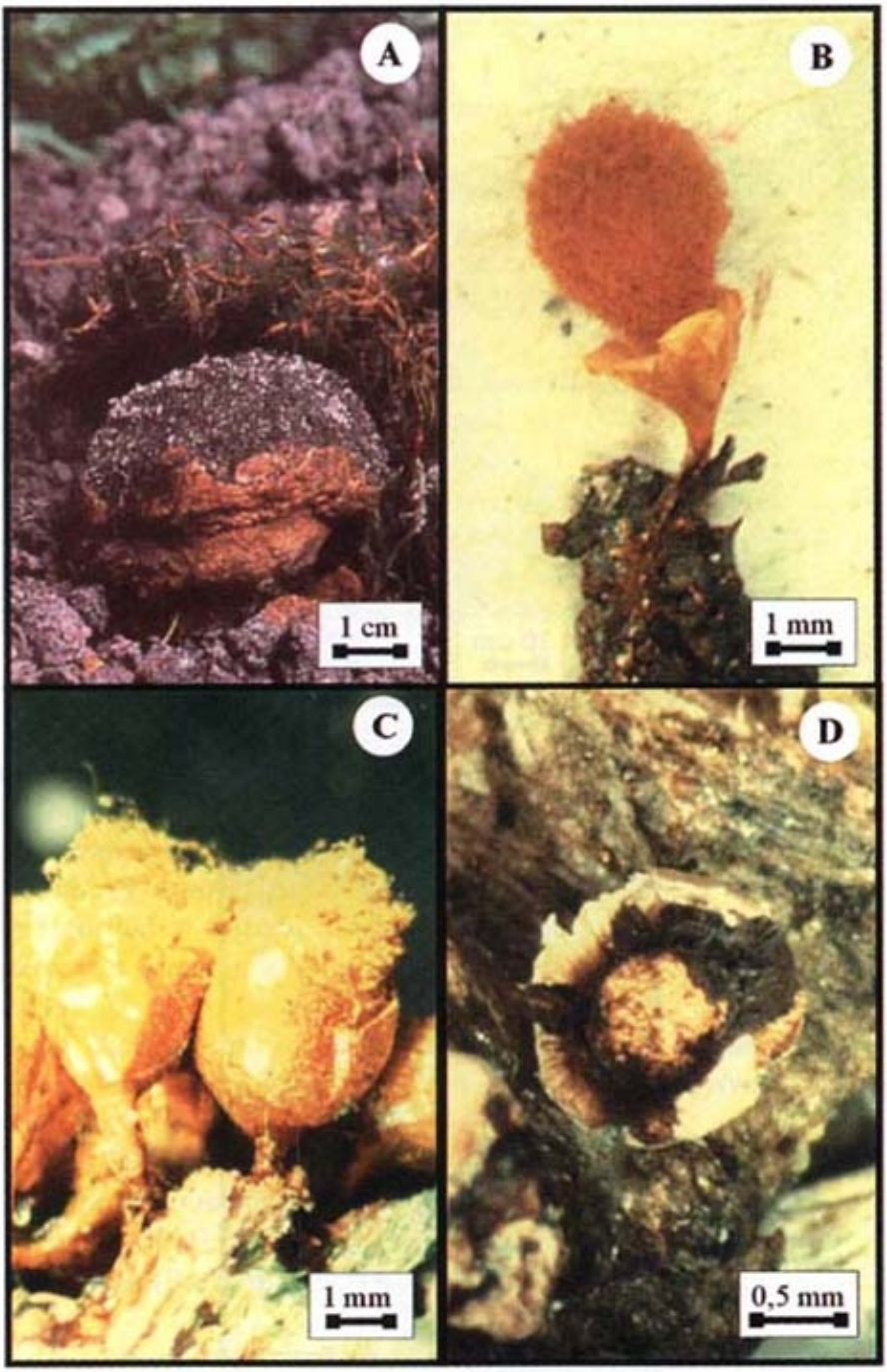
Nevertheless, according to (S t o j a n o w s k a 1983a) most slime moulds do not show high substratum specifity and form sporangia either on decaying wood or on litter (e.g. *Arcyria cinerea*). Some of them, however, prefer wood: *Arcyria denudata, Ceratiomyxa fruticulosa, Fuligo septica, Hemitrichia clavata, H. serpula, Lycogala epidendrum, Physarum nutans, Stemonitis fusca, Trichia botrytis, T. favoginea, T. varia* and *Tubifera ferruginosa*.

Results of the observations carried out in the Bukowiec reserve also support ecological studies on *Myxomycetes* by D r o z d o w i c z (1992b), who announced that the diversity of microsites and stage of wood decomposition had a significant influence on the diversity of slime moulds species.

## LIST OF SPECIES

Abbreviations used: **F** – beech forest; **C-A** – alder forest; !! – species new for Poland; ! – species rare in Poland; +++ – found often; ++ – found a few times; + – found only once.

**PLATE I**




A. *Fuligo leviderma* – aethalium
B. *Hemitrichia calyculata* – sporangium
C. *Hemitrichia clavata* – sporangia
D. *Diderma radiatum* – sporangium

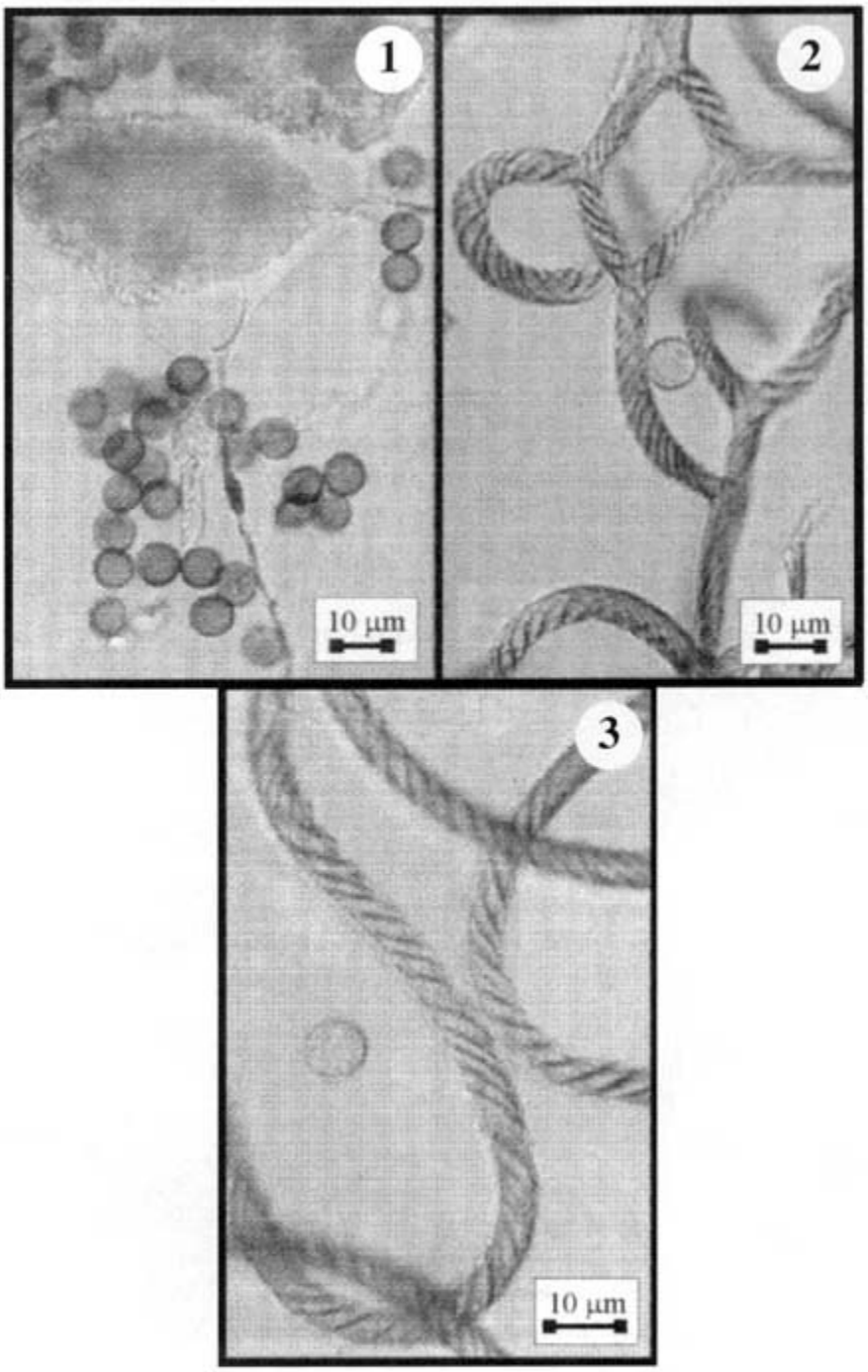



Fig. 1. *Fuligo leviderma* – pseudocapillitium and spores
Fig. 2. *Hemitrichia calyculata* – capillitium and a spore
Fig. 3. *Hemitrichia clovata* – capillitium and a spore

## *CERATIOMYXALES*

*Ceratiomyxa fruticulosa* Macbr. var. *fruticulosa* Lister – usually on logs of *Fagus sylvatica*, + + +, F, C-A.
*Ceratiomyxa fruticulosa* Macbr. var. poroides Lister – usually on logs of *Fagus sylvatica*, + + +, F.

## *LICEALES*

*Cribraria argillacea* (Pers.) Pers. – on decaying wood, +, F.
*Cribraria aurantiaca* Schrad. – on wood, +, F.
*Cribraria macrocarpa* Schrad. – on wood, +, F.
*Lycogala conicum* Pers. – on wood, +, F.
*Lycogala epidendrum* (L.) Fr. – usually on logs of *Fagus sylvatica*, + + +, F, C-A.
*Tubifera ferruginosa* Gmel. – on logs, +, F.

## *TRICHIALES*

*Arcyria cinerea* (Bull.) Pers. – on logs of *Fagus sylvatica*, + + +, F.
*Arcyria denudata* (L.) Wettstein – on wood of *Fagus sylvatica*, + + +, F.
*Arcyria incarnata* (Pers.) Pers. – on fallen twig of broad-leaved tree, +, F.
!!*Hemitrichia calyculata* (Speg.) Farr. – on logs, + + +, F. This species is not often recorded in Europe, probably because it is confused with *H. clavata*. Moreover, it sometimes appears in mosaic with this species (N e u b e r t et al. 1993).
*Hemitrichia clavata* (Pers.) Rost. – on cut trunks of *Fagus sylvatica*, +, F.
*Hemitrichia serpula* (Scop.) Rost. – on logs of *Fagus sylvatica*, often under bark or among mosses, + + +, F.
*Metatrichia vesparium* (Batsch) Nann. – on wood and dead carpophore of aphyllophoraceous fungus, + + +, F.
*Trichia botrytis* (J. F. Gmel.) Pers. – on wood, +, F.
*Trichia favoginea* (Batsch) Pers. – on cut trunks, often among mosses + + +, F.
*Trichia varia* (Pers.) Pers. – on wood and dead carpophore of aphyllophoraceous fungus, + + +, F.

## *PHYSARALES*

! *Diderma chondrioderma* (de Bary et Rost.) G. Lister – on fallen twig of *Alnus glutinosa*, +, C-A. Detailed description and chorology of this species is given by M i ś k i e w i c z and D r o z d o w i c z (1999).
! *Diderma deplanatum* Fr. – on stems of moss *Plagiothecium denticulatum* (Hedw.) B., S. & G. covering beech log, +, F. Detailed description and

chorology of this species is given by M i ś k i e w i c z and D r o z d o w i c z (1999).

! *Diderma effusum* (Schwein) Morgan – on leaf of *Fagus sylvatica*, +, F; the collected specimen has been lost. In the Herbarium there are only slides. This species appears in Europe (England, Romania, Hungary, Germany, France) and in the tropical zone (K r z e m i e n i e w s k a 1960, N e u b e r t et al. 1995). In Poland it was found for the first time near Stryj, outside of actual borders of country (N a m y s ł o w s k a 1937), then in Silesia (F i r i c h 1962), in the Sudety Mts (S t o j a n o w s k a 1983b) and in the Ojców National Park (D r o z d o w i c z 1992a).

*Diderma montanum* var. *montanum* (Meyl.) Meyl. – on wood and fern debris, +, F.

! *Diderma radiatum* (L.) Morgan – on wood, +, F. (Pl. I. D)
This species is scattered throughout the world (K r z e m i e n i e w s k a 1960). In the Alps it reaches 1450 m above sea level (N e u b e r t et al. 1995). In Poland it was found in Kłodzko (S c h r o e t e r 1889), in the Białowieża Primaeval Forest (J a r o c k i 1924, K r z e m i e n i e w s k a 1957), the Mazury lake district, near Warsaw, in the Świętokrzyskie Mts, the Pieniny Mts, the Karpaty Mts and in the Lower Silesia (K r z e m i e n i e w s k a 1960). Recently it was also recorded in the Sudety Mts (S t o j a n o w s k a 1983b, 1984).

!! *Fuligo leviderma* Neubert, Nowotny et Baumann – among mosses, on ground and on roots of *Fagus sylvatica* log, ++, F.
This species is characteristic for mountain and submountain beech wood. In the Alps it was found at 1200 m above sea level (N e u b e r t et al. 1995). It is a common species in Finland (H ä r k ö n e n et al. 1999).

*Fuligo septica* var. *septica* (L.) Wiggers – on wood and on leaves of *Fagus sylvatica*, +++, F, C-A.

*Fuligo septica* var. *candida* (Pers.) R. E. Fr. – on wood, +++, F.

*Physarum nutans* Pers. – on log covered with mosses, +, F.

## *STEMONITALES*

*Comatricha nigra* (Pers.) Schroet. – on fallen twigs, ++, C-A.

*Stemonitis axifera* (Bull.) Macbr. – on log of *Fagus sylvatica*, ++, F.

*Stemonitis fusca* var. fusca Roth – on wood, +, F.

*Stemonitopsis typhina* (Wiggers) Nann.-Brem. – on log of *Fagus sylvatica*, +, F.

**Aknowledgements**: I am deeply greatful to dr Anna Drozdowicz for confirming the identification of slime moulds, helpful suggestions and making the litterature accessible for me. I also greatly appreciate Prof. dr hab. Barbara Gumińska's generous help and advice given during my research.

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## Śluzorośla występujące w rezerwacie „Bukowiec" (Pogórze Wiśnickie)

### Streszczenie


Obserwacje nad występowaniem śluzorośli zostały przeprowadzone w latach 1997 i 1998 oraz, jednorazowo, w marcu 1999. Materiał zbierano na całym terenie rezerwatu „Bukowiec", w dwóch typach lasu: buczynie i łęgu. Zanotowano obecność 31 gatunków, z których 4 są rzadkie w Polsce a dwa, *Hemitrichia calyculata* i *Fuligo leviderma*, zanotowano po raz pierwszy.