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The state of knowledge of *Macromycetes* in xerothermic  
grasslands in Poland

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Stan zbadania *Macromycetes* muraw kserotermicznych w Polsce

SUMMARY

The short history of research on and the current state of knowledge of macromycetes occurring in xerothermic swards of the class *Festuco-Brometea* in Poland over the last 50 years are presented. Mycological investigations in most communities, e.g. *Sisymbrio-Stipetum capillatae* and *Thalictro-Salvietum pratensis* have been carried out rather occasionally and the information concerning steppe fungi has been reported in few papers only. Regular mycological studies have been conducted in five plant associations only: *Festucetum pallentis*, *Origano-Brachypodietum*, *Koelerio-Festucetum rupicola*, *Potentillo-Stipetum capillatae* and *Adonido-Brachypodietum pinnati*.

The list of species of fungi recorded in xerothermic swards in Poland is not long and comprises approximately 40 species. Some are very rare and put on the red-list as threatened macrofungi in Poland (36), e.g. *Calvatia candida*, *Disciseda bovista*, *D. candida*, *Gastrosporium simplex*, *Geastrum minimum*, *G. schmidelli*, *Leucopaxillus lepistoides*, *Montagnea radiosa*, *Myriostoma coliforme*, *Polyporus rhizophilus* and *Tulostoma melanocyclum*.

The mycological profile of xerothermic swards in Poland has been under-explored. Further investigations on macrofungi occurring in steppe swards, their distribution and ecology as well as threats resulting from the disappearance of this type of plant communities in Poland are necessary.

STRESZCZENIE

Praca prezentuje krótką historię badań i aktualny stan zbadania grzybów makroskopowych występujących w murawach kserotermicznych z klasy *Festuco-Brometea* w Polsce na przestrzeni

ostatnich 50 lat. Badania mikologiczne w większości zbiorowisk, np. *Sisymbrio-Stipetum capillatae* i *Thalictro-Salvietum pratensis*, prowadzono raczej sporadycznie. Stąd informacje o grzybach stepowych są zawarte tylko w nielicznych pracach. Systematyczne badania mikologiczne prowadzono tylko w pięciu zespołach: *Festucetum pallentis*, *Origano-Brachypodietum*, *Koelerio-Festucetum rupicolae*, *Potentillo-Stipetum capillatae* i *Adonido-Brachypodietum pinnati*.

Lista gatunków grzybów notowanych w murawach kserotermicznych w Polsce nie jest zbyt długa i obecnie liczy około 40 gatunków. Większość z nich jest rzadka i ujęta została na czerwonej liście grzybów wielkoowocnikowych w Polsce (36), m.in.: *Calvatia candida*, *Disciseda bovista*, *D. candida*, *Gastrosporium simplex*, *Geastrum minimum*, *G. schmidelli*, *Leucopaxillus lepistoides*, *Montagnea radiosa*, *Myriostoma coliforme*, *Polyporus rhizophilus* i *Tulostoma melanocyclum*.

Murawy kserotermiczne to jedne z najslabiej poznanych w Polsce zbiorowisk roślinnych pod względem mikologicznym. Konieczne są dalsze badania nad grzybami wielkoowocnikowymi występującymi w murawach stepowych, ich rozmieszczeniem, ekologią oraz zagrożeniami wynikającymi z zanikania tego typu zbiorowisk roślinnych w Polsce.

Keywords: macrofungi, *Gasteromycetes*, rare and threatened fungi, *Festuco-Brometea*.

#### INTRODUCTION

Xerothermic swards of the steppe character are found in the southern and south-eastern Europe in the areas with warm and dry climate as well as occur extra-zonally in the places with a particular combination of orographic, soil and local climatic conditions (12). In Poland, they belong to rare phytocenoses, most broadly spread in the southern and north-western part of the country. They occur insularly, in the places that are characterised by high temperatures and large insolation, low precipitation level and large calcium carbonate content in soil. Plant communities developing in such specific biotopic conditions are rich with respect to flora and are distinguished by characteristic species composition with a considerable participation of many rare taxa (27, 12). This causes that these communities are also very interesting with respect to mycology.

In this paper is presented the hitherto existing situation of research on macromycetes occurring in the Polish xerothermic swards of the steppe character.

#### SHORT CHARACTERISTICS OF XEROTHERMIC SWARDS

All xerothermic calciphilous lowland swards occurring in Poland belong – according to Matuszkiewicz (12) – to the *Festuco-Brometea* class and the *Festucetalia valesiaca* order, which includes communities with a continental-near-Mediterranean type of range of extent, referring from floristic and genetic point of view to steppes of the Pontic-Pannonic province of the European-Western Siberian region. Except for saxicolous swards *Festucetum pallentis* from the *Seslerio-Festucion duriusculae* alliance, they are connected with a substratum rich in calcium. The *Festuco-Stipion* alliance includes rather loose xerothermic swards with a predomination of steppe grass species, mainly esparto grasses (*Stipa*) and silver sea fescue (*Festuca valesiaca*), resembling the proper esparto steppes that occur in the south-eastern Europe. On the other hand, the *Cirsio-*

*Brachypodnion pinnati* alliance is represented by dense xerothermic swards with a predomination of grasses that form turfs, referring to the so called northern steppes or meadow steppes of the south-eastern Europe. These are semi-natural communities that survive only through their extensive use.

*FESTUCO-BROMETEA* Br. Bl. et R.Tx. 1943 (12)

*Festucetalia valesiacae* Br.-Bl. et R.Tx. 1943

*Seslerio-Festucion duriusculae* Klika (1931) 1948

1. *Festucetum pallentis* (Kozł. 1928) Kornaś 1950

*Festuco-Stipion* (Klika 1931) Krausch 1961

2. *Sisymbrio-Stipetum capillatae* (Dziub. 1925) Medw.-Korn. 1959

3. *Potentillo-Stipetum capillatae* Libb. 133 em. Krausch 1960

4. *Koelerio-Festucetum rupicolae* Kornaś 1952

*Cirsio-Brachypodnion pinnati* Hadač et Klika 1944 em. Krausch 1961

5. *Inuletum ensifoliae* Kozł. 1925

6. *Thalictro-Salvietum pratensis* Medw.-Korn. 1959

7. *Adonido-Brachypodietum pinnati* (Libb. 1933) Krausch 1960

8. *Seslerio-Scorzoneretum purpureae* Kozł. 1927 em. Medw.-Korn. 1959

9. Zbiorowisko *Carex glauca* – *Tetragonolopus maritimus* ssp. *siliquosus*  
Medw.-Korn. 1959

10. *Origano-Brachypodietum* Medw.-Korn. et Kornaś 1963

*Linosyridi-Stipetum pulcherrimae* (Libb. 1932/1933) Filipek 1974 (6)

The majority of the discussed communities of xerothermic swards are of regional character, e.g. *Potentillo-Stipetum capillatae* occurs in Pomerania, the Wielkopolska and Kujavia, *Sisymbrio-Stipetum capillatae* in upland areas of the southern Poland, including the Nida Basin, the Lublin Upland and the Kielce-Sandomierz Upland, while *Thalictro-Salvietum pratensis* – in the Małopolska Upland and the Wołyń-Podole Upland (12). Some of these plant communities develop in the form of small patches, e.g. the *Linosyridi-Stipetum pulcherrimae* association identified by Filipek (6) and occurring only in the “Bielinek” Reserve on the Odra River.

#### HISTORY OF STUDIES

Studies on the occurrence of macromycetes in xerothermic swards on the territory of our country, except for the Ojców National Park (30–32) and Western Pomerania (22), were carried out occasionally. Therefore the data on that subject are comprised in few publications (Tab. 1).

The first information on the fungi growing in xerothermic swards came from the precincts of Toruń, where at the end of the 40s W. and J. Zabłocki (37) carried out observations on the “Polish *Gasteromycetes*” in communities with

vegetation of the “Pontic-steppe” character. They reported stands of a few species from the *Tulostoma* genus and *Myriostoma coliforme*. On the other hand, Celiński and Filipek (3) reported the occurrence of *Trichaster melanocephalus* in the “Bielinek” forest-steppe reserve, including that species into a continental element with the main center of occurrence in the Pontic-Pannonian province.

Table 1. Index of xerothermic swards community with macromycetes data

Community	References
<i>Festucetum pallentis</i>	Wojewoda 1974, 1975, 1977
<i>Sisymbrio-Stipetum capillatae</i>	Šmarda 1957; Sałata 1977; Flisińska, Sałata 1991; Łuszczzyński, Łuszczzyńska 1991–1992
<i>Potentillo-Stipetum capillatae</i>	Šmarda 1957; Stasińska 2002, 2005
<i>Inuletum ensifoliae</i>	Flisińska, Sałata 1991
<i>Thalictro-Salvietum pratensis</i>	Sałata, Ostas 1975; Łuszczzyński, Łuszczzyńska 1991–1992; Łuszczzyński 2000, 2006
<i>Adonido-Brachypodietum pinnati</i>	Stasińska 2005; Łuszczzyński 2006
<i>Origano-Brachypodietum</i>	Wojewoda 1974, 1975, 1977
<i>Linosyridi-Stipetum pulcherrimae</i>	Bujakiewicz 1997

Next data on the fungi growing in steppe swards appeared at the end of the 50s. The author of them is Šmarda (28) who found in the patches of „*Stipetum capillatae*” during his studies in some xerothermic reserves, among others in the “Bielinek” Reserve on the Odra River, the “Skorocice” Reserve near Busko and the “Góry Pieprzowe” (Pepper Mountains) Reserve near Sandomierz, 7 fungi species, including *Calvatia candida*, *Gastrosporium simplex*, *Gastrum hungaricum*, *G. minimum* and *G. schmidelli*.

In 1958, the occurrence of *Montagnea radiosa* in the patches of sward with participation of *Stipa* in the “Bielinek” Reserve on the Odra River was stated by Skirgiełło (19). In the 70s, much attention was paid to xerothermic fungi by Bujakiewicz (1), who carried out mycological studies in the “Bielinek” Reserve on the Odra River. This author found the occurrence of four fungi species in the patches of *Linosyridi-Stipetum pulcherrimae*, including three sward species: *Crinipellis scabellus*, *Gastrosporium simplex* and *Gastrum minimum*.

A number of fungi species from xerothermic swards of the Małopolska and Lublin Uplands was reported, among others from the patches of *Sisymbrio-Stipetum capillatae* and *Thalictro-Salvietum pratensis*, were reported by Sałata and Ostas (18), Sałata (17) and Flisińska and Sałata (7). Among the mentioned taxa, attention is called to *Disciseda bovista* and *Gastrum minimum* as well as to *Polyporus rhizophilus* that grows on the roots of different grass species, including esparto grasses (*Stipa*) (17).

Łuszczzyński and Łuszczzyńska (11) reported the occurrence of three species: *Tulostoma brumale*, *Gastrosporium simplex* and *Gastrum minimum* in the patches

of *Sisymbrio-Stipetum capillatae* in the precincts of Busko Zdrój in the Ponidzie. In the same area, Łuszczynski (9) found *Tulostoma melanocyclum* in the patches *Thalicthro-Salvietum pratensis* and *Leucopaxillus lepistoides* in the patches of *Adonido-Brachypodietum pinnati* (10).

In Western Pomerania, information on the occurrence of *Gastrosporium simplex* in the patches of *Potentillo-Stipetum capillatae* are reported by Stasińska (20) and on *Montagnae radiosa* in the patches of xerothermic sward with participation of *Veronica sp.* and *Dianthus sp.* (*Cirsio-Brachypodnion pinnati*) by Stasińska and Prajs (24, 25).

Regular mycological studies were carried out so far only in the patches of five associations: *Festucetum pallentis*, *Origano-Brachypodietum*, *Koelerio-Festucetum rupicolae* (30–32), *Potentillo-Stipetum capillatae* and *Adonido-Brachypodietum pinnati* (22). The occurrence of fungi was not found in the patches of *Koelerio-Festucetum rupicolae*. Other associations are poor in mycological sense. For example, in the patches of *Festucetum pallentis* and *Potentillo-Stipetum capillatae* 10 taxa were stated in each. The largest number of species – 23 was found in *Origano-Brachypodietum*.

#### SITUATION OF RESEARCH

Xerothermic swards belong in Poland to most poorly examined plant communities with respect to their mycology. The list of macromycetes species found in the swards of the *Festuco-Brometea* class, compiled on the grounds of literature data during last fifty years, includes about 40 taxa. The most interesting species include among others *Calvatia candida*, *Disciseda bovista*, *D. candida*, *Gastrosporium simplex*, *Geastrum hungaricum*, *G. minimum*, *G. schmidelli*, *Leucopaxillus lepistoides*, *Montagnea radiosa*, *Myriostoma coliforme*, *Polyporus rhizophilus* and *Tulostoma melanocyclum*.

Among macromycetes species recorded so far in the swards of steppe character, 16 taxa are included on the red list of macrofungi in Poland (36), whereas 9 species are under total protection (13).

List of rare, protected and endangered macromycetes found in xerothermic swards of the *Festuco-Brometea* class

The terminology of macromycetes was adopted after Wojewoda (35) and Chmiel (5), while threat categories are mainly according to Wojewoda and Ławrynowicz (36): E – endangered, V – vulnerable, R – rare, I – indeterminate; § – denotes species under total protection (13).

*Bovista aestivalis* (Bonard.) Demoulin [= *B. polymorpha* (Vittad.) Kreisel]

*B. plumbea* Pers.: Pers.

- B. dermoxantha* (Vittad.) Toni [= *B. pusilla* (Batsch): Pers.]  
*B. tomentosa* (Vittad.) Quél. – V  
*Calvatia candida* (Rostk.) Hollós – E  
*Crinipellis scabella* ('*scabellus*') (Alb. & Schwein.: Fr.) Murrill. [= *C. stipitarius* (Fr.) Pat.]  
*Disciseda bovista* (Klotzsch) P. Henn. – E  
*D. candida* (Schwein.) C. G. Lloyd [= *D. calva* (Moravec) Moravec] – E  
*Gastrosporium simplex* Mattir. – E  
*Geastrum hungaricum* Hollós – E, §  
*G. minimum* Schwein. – E, §  
*G. schmidelli* Vittad. [= *G. nanum* Pers.] – E, §  
*Leucopaxillus lepistoides* (Maire) Singer – EN (10)  
*Lycoperdon lividum* Pers. [= *L. spadiceum* Pers.]  
*Montagnea radiosa* (Pallas) Šebek [= *M. arenaria* (DC.) Zeller] – E  
*Morchella esculenta* (L.) Pers. – R, §  
*Myriostoma coliforme* (With.: Pers.) Corda – E, §  
*Polyporus rhizophilus* (Pat.) Sacc. – E  
*Trichaster melanocephalus* Czern. [= *Geastrum melanocephalum* (Czern.) V. J. Staňěk] – E, §  
*Tulostoma* ('*Tylostoma*') *brumale* Pers.: Pers. – R, §  
*T. fimbriatum* Fr. – V, §  
*T. melanocyclum* Bres. – E, §

The species mentioned above grow not only in the discussed communities but are also met in biotopes, where ecological conditions are very similar to those that prevail in steppe swards, e.g. sand swards, dunes and ruderal sites. Therefore, data on the stands of these fungi species are found in the papers of many authors, including Teodorowicz (29), Rudnicka (14), Rudnicka-Jeziarska (15, 16), Wojewoda (33, 34), Calonge and Ławrynowicz (2), Ceynowa-Gieldon (4), Stasińska (22, 23) and Stasińska and Prajs (26). The maps of distribution in Poland have been so far prepared for three species only, i.e. for *Trichaster melanocephalus* (8), *Montagnea radiosa* (24) and *Leucopaxillus lepistoides* (10). The extent of examination of steppe fungi distribution requires a separate study. Thus, further studies on macrofungi occurring in the swards of the steppe character are necessary that refer to their distribution, ecology and threats, resulting from disappearance of the plant communities of that type in Poland.

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