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THE LICHENS OF THE 'BÓR NA CZERWONEM' RAISED PEAT-BOG IN THE ORAWA-NOWY TARG BASIN (SOUTHERN POLAND)

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Abstract: The results of lichenological investigations carried out in 2000 and 2001 in the peat-bog reserve 'Bór na Czerwonem' in Kotlina Orawsko-Nowotarska Basin (Western Carpathians, S Poland) are presented. Of the 93 species of lichens reported, 14 are protected in Poland and 19 are included in the Red List of threatened species: 16 as vulnerable (V) and three as endangered (E). Most of the species reported are recorded for the first time from the Kotlina Orawsko-Nowotarska Basin. One of them, *Lecidea nylanderi* (Anzi) Th. Fr., is new to the Polish Carpathians. Many of the species found in the area are very rare in the country, e.g.: *Lecidea nylanderi* (Anzi) Th. Fr., *Agonimia tristicula* (Nyl.) Zahlbr., *Absconditella sphagnorum* (Vězda & Poelt), *Chaenotheca brunneola* (Ach.) Müll. Arg., *Micarea melaena*, *Omphalina hudsoniana* (H. S. Jenn.) and *O. umbellifera* (L.: Fr.) Quélet. The group of epigeic lichens, represented by 51 species, dominates the lichen cover of the area; epiphytic lichens are common as well (38 species).

Key words: lichens, distribution, raised bog, threat, Western Carpathians, Poland

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INTRODUCTION

The 'Bór na Czerwonem' raised bog has been for a long time one of the more interesting natural sites in southern Poland. Despite this fact it is still among the least known areas in the Polish Western Carpathians in respect of the lichen flora. Previous publications comprise information on the occurrence of 14 lichen species found in the 'Bór na Czerwonem' (Szafer 1928; Motyka 1936–1938; Nowak 1975; Bystrek & Górzyńska 1985; Bielczyk & Kiszka 2001). The present paper shows the present state of the lichen flora of this area.

The 'Bór na Czerwonem' bog is part of the group of raised bogs in the Orawa-Nowy Targ Basin, whose approx. 40 km arch stretches from Orava in Slovakia to Nowy Targ in Poland. The described site lies approx. 2 km to the south of Nowy Targ (49°26′–49°28′N, 20°02′–20°04′E) at an elevation of 609–622 m a.s.l. on the old high right-bank terrace of the Biały Dunajec River (Fig. 1). According to Obidowicz (1978, 1992) the development of the 'Bór na Czerwonem' bog started at the onset of the Atlantic period, that is about 5 000 years ago, when forests which grew there turned into a marsh.

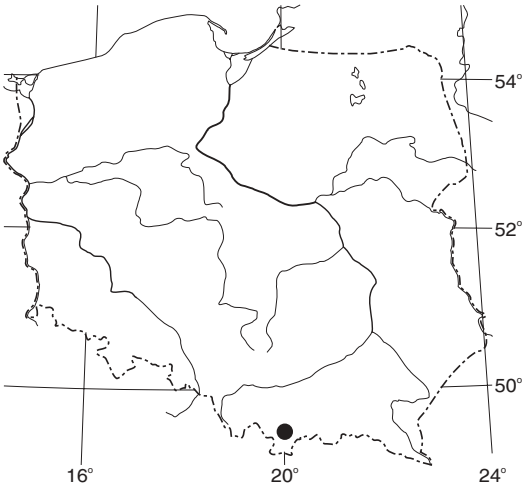

Fig. 1. The 'Bór na Czerwonem' raised peat-bog, ● – location of the study area.

The vegetation of the reserve is typical of that elevation in the Carpathians (lower montane forest zone). In plant species composition the site is similar to other parts of the Orawa-Nowy Targ Basin, forming the geobotanical subdistrict of Nowy Targ Pinewoods. It differs from other subdistricts of the Beskidy Mountains in that numerous bog plants occur there, while many forest tree species, and particularly beech and fir, are lacking. The flora is typical of raised bogs and forests growing in wet and marshy habitats. Two types of vegetation occur there. One is represented by acidophilous forest species that are typical of poor pine-spruce forests, the other by acidophilous species of non-forest habitats of raised bogs (Staszkiewicz 1992).

In the year 1925 a small fragment of this area was taken under protection as a nature reserve. In 1956 the reserve area was extended to 49.7 ha, and in 2001 it increased to 114.66 ha, of which 45 ha are occupied by a raised bog.

Lichens are connected in the site with such habitats as peat, bark of trunks and branches of trees, shrubs and dwarf-shrubs, cushions of living and dying bryophytes, rotting wood, and soil. The vegetation of the site has undoubtedly been influenced by changes in hydrological and edaphic conditions, occurring there over the years. They are among more important factors governing the composition of the lichen flora of bogs, and particularly of epigeic species (Fabiszewski 1975). The development of epiphytic species is now conditioned to a high degree by air pollutants emitted by the neighbouring urban agglomeration, as shown by the presence of many toxitolerant species in the reserve. Old peat-pits and drainage ditches are a direct effect of human activity on the site. However, in view of very scarce earlier information about lichens in the Nowy Targ bogs, it is impossible to make comparisons and to analyse the resultant changes in the lichen flora of the area.

MATERIAL AND METHODS

Field research was carried out in the years 2000 and 2001. The collected specimens of lichens were deposited in the herbarium of the W. Szafer Institute of Botany of the Polish Academy of Sciences in Kraków (KRAM-L). The list of species is presented in alphabetical order. The nomenclature of species followed the publication by Fałtynowicz (1993), updated by Vězda and Liška (1999). For each species a habitat type is given. Species included in the national Red List of lichens (Cieśliński *et al*. 1992) are marked with E (endangered species) or V (vulnerable species), and protected species with P (Bielczyk 1998).

LIST OF SPECIES

Absconditella sphagnorum Vězda & Poelt – on decaying *Sphagnum*.

Agonimia tristicula (Nyl.) Zahlbr. – over mosses and plant debris.

Amandinea punctata (Hoffm.) Coppins & Scheid. [= *Buellia punctata* (Hoffm.) Massal.] – corticolous, on all kinds of trees.

Arthonia spadicea Leight. – on smooth bark of *Alnus*.

Arthonia vinosa Leight. – on bark of *Alnus*.

Arthothelium ruanum (A. Massal.) Koerb. – (V), on smooth bark of *Sorbus, Frangula*.

Baeomyces rufus (Huds.) Rebent. – on peaty and humus-rich soil.

Biatora efflorescens (Hedl.) Räsänen – (V), on bark of *Sorbus*.

Buellia griseovirens (Turner & Borrer *ex* Sm.) Almb. – on bark of *Sorbus aucuparia*.

Caloplaca holocarpa (Hoffm. *ex* Ach.) A. E. Wade. – corticolous, on bark of *Betula*.

Cetraria aculeata (Schreb.) Fr. [= *Coelocaulon aculeatum* (Schreb.) Link] – on sandy soil.

Cetraria islandica (L.) Ach. – (V, P), on soil.

Cetraria sepincola (Ehrh.) Ach. [= *Tuckermannopsis sepincola* (Ehrh.) Hale] – (V, P), on thin branches of *Betula, Pinus*.

Chaenotheca brunneola (Ach.) Müll. Arg. – (V), on standing decorticated wood.

Chaenotheca chrysocephala (Turner *ex* Ach.) Th. Fr. – on bark of *Picea abies*.

Chaenotheca ferruginea (Turner & Borrer) Mig. – on bark of *Pinus sylvestris* and *Picea abies*.

Chaenotheca furfuracea (L.) Tibell – (V), on roots of *Picea*.

Cladonia arbuscula (Wallr.) Flot. subsp. ***squarrosa*** (Wallr.) Ruoss [= *Cladonia sylvatica* auct.] – (P), on peat soil.

Cladonia botrytes (K. G. Hagen.) Willd. – (V), lignicolous, on old stumps.

Cladonia cenotea (Ach.) Schaer. – on soil and decaying wood.

Cladonia cervicornis (Ach.) Flot. – on humus-rich soil.

Cladonia chlorophaea s. lat. – on soil, on decaying wood, on bases of trees.

Cladonia coccifera s. lat. – on humid turfy soil.

Cladonia coniocraea (Flörke) Spreng. – on soil, on decaying wood, on bases of trees.

Cladonia cornuta (L.) Hoffm. – on soil and on decaying wood.

Cladonia crispata (Ach.) Flot. var. ***crispata*** – on peat soil.

Cladonia deformis (L.) Hoffm. – on humus.

Cladonia digitata (L.) Hoffm. – on decaying wood and on bases of trunks.

Cladonia fimbriata (L.) Fr. – on soil, on decaying wood and on bases of trunks.

Cladonia furcata (Huds.) Schrad. – on soil.

Cladonia glauca Flörke – on soil.

Cladonia gracilis (L.) Willd. – on peat soil.

Cladonia grayi G. Merr. *ex* Sandst. – on rotting trunks or stumps.

Cladonia incrassata Flörke – (V), on peat soil.

Cladonia macilenta Hoffm. – on soil, on decaying wood, on bases of trees.

Cladonia ochrochlora Flörke – on rotting wood.

Cladonia phyllophora Hoffm. – on soil.

Cladonia pleurota (Flörke) Schaer. – on peat soil.

Cladonia pyxidata (L.) Hoffm. – on soil.

Cladonia ramulosa (With.) J. R. Laundon – on humus.

Cladonia rangiferina (L.) Weber *ex* F. H. Wigg. [= *Cladina rangiferina* (L.) Nyl.] – (P), on soil between mosses and shrubs of *Pinus mugo*.

Cladonia squamosa Hoffm. – on peat and humus-rich soil.

Cladonia subulata (L.) Weber *ex* F. H. Wigg. – on soil.

Cladonia uncialis (L.) Weber *ex* F. H. Wigg. subsp. ***biuncialis*** (Hoffm.) M. Choisy – on soil in bogs.

Dibaeis baeomyces (L. fil.) Rambold & Hertel [= *Baeomyces roseus* Pers.] – on peaty soil.

Dimerella pineti (Schrad. *ex* Ach.) Vězda [= *Dimerella diluta* (Pers.) Trevis.] – on the bark of *Picea abies*.

Fellhanera subtilis (Vězda) Diederich & Sérus. – on small branches of *Vaccinium myrtillus*.

Fuscidea pusilla Tønsberg – on bark of *Sorbus aucuparia*.

Haematomma ochroleucum (Neck.) J. R. Laundon var. ***ochroleucum*** – (V), on the bark of *Salix*.

Hypocenomyce caradocensis (Leight. *ex* Nyl.) P. James & Gotth. Schneid. – (V), on bark of *Pinus sylvestris* and *Picea abies*.

Hypocenomyce scalaris (Ach.). M. Choisy – lignicolous, corticolous mainly on coniferous trees.

Hypogymnia physodes (L.) Nyl. – corticolous on all kinds of trees, especially well-developed on acidified bark.

Hypogymnia tubulosa (Schaer.) Hav. – (V, P), on bark of *Betula*.

Imshaugia aleurites (Ach.) S. L. F. Meyer – (P), on bark of *Pinus sylvestris*.

Lecanora conizaeoides Nyl. *ex* Crombie – very common on bark and lignum.

Lecanora expallens Ach. – on bark of *Betula pubescens* and *Pinus sylvestris*.

Lecanora pulicaris (Pers.) Ach. – corticolous on coniferous and deciduous trees, lignicolous.

Lecanora saligna (Schrad.) Zahlbr. – lignicolous, corticolous, on the bark of *Frangula*.

Lecanora symmicta (Ach.) Ach. – corticolous on bark of *Pinus* and on branches of *Ledum palustre*.

Lecanora varia (Hoffm.) Ach. – on the bark of *Pinus sylvestris*.

Lecidea nylanderi (Anzi) Th. Fr. – (E), on bark of *Pinus sylvestris*.

Lecidella elaeochroma (Ach.) M. Choisy – on bark of *Salix*.

Lepraria jackii Tønsberg – on bark and lignum of *Pinus* and *Picea* .

Loxospora elatina (Ach.) A. Massal. – (E), on the bark of *Pinus sylvestris*.

Micarea denigrata (Fr.) Hedl. – on decaying mosses.

Micarea lignaria (Ach.) Hedl. – over mosses and plant debris.

Micarea melaena (Nyl.) Hedl. – (V), on wood of stumps and on peaty turf.

Micarea prasina s. lat. – on wood.

Mycoblastus fucatus (Stirt.) Zahlbr. – on bark of *Sorbus aucuparia*.

Omphalina hudsoniana (H. S. Jenn.) H. E. Bigelow [= *Coriscium viride* (Ach.) Vain.] – on peat or decaying plants and mosses.

Omphalina umbellifera (L.: Fr.) Quélet [= *Botrydina vulgaris* Bréb.] – on decaying plants and mosses, rarely on lignum.

Parmelia saxatilis (L.) Ach. – (P), on bark of *Betula* and *Pinus*.

Parmelia sulcata Taylor – on the bark of *Betula, Pinus, Sorbus*.

Parmeliopsis ambigua (Wulfen) Nyl. – (P), corticolous, on the bark of *Betula, Pinus, Picea*.

Peltigera polydactylon (Neck.) Hoffm. – (P), on soil and on mosses.

Peltigera praetextata (Flörke *ex* Sommerf.) Zopf – (E, P), on terricolous mosses.

Phlyctis argena (Spreng.) Flot. – on bark of *Sambucus racemosa*.

Placynthiella icmalea (Ach.) Coppins & P. James – on mosses, on plant debris and lignicolous.

Placynthiella uliginosa (Schrad.) Coppins & P. James – on mosses, on plant debris and lignicolous.

Platismatia glauca (L.) W. L. Culb. & C. F. Culb. – (V, P), on the bark of Pinus.

Porina aenea (Wallr.) Zahlbr. – corticolous on smooth bark of *Sambucus* and *Frangula*.

Pseudevernia furfuracea (L.) Zopf – (P), on bark of *Pinus and Betula*.

Pycnothelia papillaria (Ehrh.) Dufour – (V), terricolous on sand soil.

Ropalospora viridis (Tønsberg) Tønsberg – on bark of *Sorbus aucuparia*.

Scoliciosporum chlorococcum (Graewe *ex* Stenh.) Vězda – corticolous, on all kinds of trees, also present on branches of *Pinus*.

Thelocarpon laureri (Flot.) Nyl. – on decorticated wood of *Pinus*.

Trapeliopsis flexuosa (Fr.) Coppins & P. James – lignicolous and terricolous over peaty or humus-rich soil.

Trapeliopsis granulosa (Hoffm.) Lumbsch – on mosses and on plant debris.

Trapeliopsis pseudogranulosa Coppins & P. James – on dying mosses and plant debris on soil.

Usnea hirta (L.) Weber *ex* F. H. Wigg. – (V, P), on bark of *Pinus and Betula*.

Vulpicida pinastri (Scop.) J. E. Mattsson & M. J. Lai [= *Cetraria pinastri* (Scop.) Ach.] – (V, P), on the bark of various trees, often on small branches and twigs.

Xanthoria parietina (L.) Th. Fr. – on bark of *Salix*.

Xanthoria polycarpa (Hoffm.) Th. Fr. *ex* Rieber – on dead branches.

DISCUSSION

The first data on lichens in the 'Bór na Czerwonem' bog were given by Motyka and published in the publication by Szafer (1928). The author reported 10 lichen species from the site, of which 8 have recently been confirmed. Among the epigeic species there are *Cladonia glauca, C. chlorophaea, C. fimbriata* and *C. rangiferina*. Unfortunately, a search for *Cladonia stellaris* (Opiz) Pouzar & Vězda, an arctic-boreal-mountain species, known from raised bogs in the Polish lowlands as

a glacial relic (Tobolewski 1954; Tobolewski & Kupczyk 1977), was not found. It is a very rare and threatened species in Poland (Cieśliński *et al*. 1992; Fałtynowicz 1986), and probably has become extinct in the 'Bór na Czerwonem'. Of the epiphytes that were mentioned by Szafer (1928), four (*Hypogymnia physodes*, *H. tubulosa*, *Pseudevernia furfuracea* and *Usnea hirta*) still grow in the area. The identification of *Usnea fragilescens* Hav. *ex* Lynge must have been erroneus. It was impossible to gain access to herbarium materials and verify the identification, but this taxon has not been given in any other published lists of lichens in Poland (Nowak & Tobolewski 1975; Fałtynowicz 1993). Also, Motyka (1962) did not note it from Poland, reporting its presence only from England, France, Norway and Germany. Two species, *Usnea faginea* Motyka and *U. glabrata* (Ach.) Vain., collected by Motyka in the1930s (Motyka 1936–1938; Bystrek & Górzyńska 1985) have not been rediscovered. Nowak (1975) informed about the occurrence of two lichen species, *Cladonia chlorophaea* and *Cladonia deformis*, in the site and both are still present there. The recent studies on the lichens growing in Bory Nowotarskie (Nowy Targ Pinewoods) yielded data on the occurrence of *Absconditella sphagnorum*, which is a very rare species.

At the present time the occurrence of 93 lichen species has been confirmed for the 'Bór na Czerwonem' reserve. Most of the species are reported for the first time for the Orawa-Nowy Targ Basin; *Lecidea nylanderi* is a new species for the Polish Carpathians. The list comprises 13 species under strict protection and one taxon under partial protection. The 19 taxa identified from the site are on the national red list of threatened lichens: 16 with category V (vulnerable) and 3 with category E (endangered). The list of species is indicative of the great natural value of the site. Firstly, the number of species is quite large, although the list does not comprise epilithic taxa that usually add much to the floristic lists of lichens for many sites. Secondly, the proportion of species of special conservation interest, i.e. protected, endangered and very rare in the country, such as *Agonimia tristicula*, *Absconditella sphagnorum*, *Lecidea nylanderi*, *Chaenotheca brunneola*, *Micarea melaena*, *Omphalina hudsoniana* or *O. umbellifera*, is relatively high. On the other hand, the frequent occurrence of toxitolerant species (e.g., *Lecanora conizaeoides*, *Scoliciosporum chlorococcum*, *Amandinea punctata*, *Chaenotheca ferruginea*, and *Hypocenomyce scalaris*) is evidence of unfavourable aero-sanitary conditions in the area.

Three ecological groups of lichens: epiphytic, epixylic and epigeic, are represented at the site. Trees and shrubs of different ages are habitat of epiphytic lichens. Species occurring on trees constitute a very numerous group in the lichen flora of the site. Most taxa were identified on the dominating *Pinus sylvestis* and *Pinus mugo* and their hybrids. The most frequent species on the bark of trunks and branches of these phorophytes are *Lecanora conizaeoides*, *Scoliciosporum chlorococcum*, *Lepraria jackii*, *Cladonia coniocraea*, *Cladonia fimbriata*, *Hypogymnia physodes*, *Trapeliopsis flexuosa* and *Hypocenomyce scalaris*. Of rare species one should mention *Vulpicida pinastri*, *Parmeliopsis ambigua*, *Hypogymnia tubulosa* and *Pseudevernia furfuracea*; these species comprising the *Parmeliopsidetum ambiguae* Hil. 1925, a typical acidophilous community of epiphytic lichens. The bark of old pines is occupied by *Hypocenomycetum caradocensis* Czarnota 1997 community dominated by *Chaenotheca ferruginea* and *Hypocenomyce caradocensis*. Uncovered and well-lit places at the base of pine, spruce and birch trunks harbour the association of *Hypocenomycetum scalaris* Hil. 1925 with the prevailing *Hypocenomyce scalaris*. Other lichen species, such as *Dimerella pineti*, *Amandinea punctata*, *Arthonia spadicea*, *Arthothelium ruanum*, *Buellia griseovirens*, *Porina aenea*, *Arthonia vinosa*, *Lecanora saligna*, *L. expallens* and *Lecidella elaeochroma* were found on the smooth bark of alder, black dogwood and elder. These lichen species are rare in the area, noted from single stations. Also *Fellhanera subtilis*, found on twigs of *Vaccinium myrtillus*, should be assigned as a rare species.

Epixylic lichens grow on rotting fallen logs of trees and stumps, and also on injured tree trunks. These are mainly species from the genus *Cladonia*, e.g. *Cladonia macilenta*, *C. chlorophaea*, *C. bot-*

rytes, C. cenotea, C. coniocraea, C. fimbriata, C. pyxidata, and *C. squamosa*. Of other systematic groups, one may find there *Imshaugia aleurites, Lecanora conizaeoides, Micarea denigrata, M. prasina, Placynthiella icmalea, P. uliginosa, Trapeliopsis flexuos* and *T. gelatinosa*.

In the investigated area epigeic lichens occupy less frequented paths, forest margins, glades, and places between patches of dwarf-pine. Dense stands of trees are not an usual habitat for them. On fresh soil, not covered by plants, one may find *Baeomyces rufus, Dibaeis baeomyces* (individuals with fructifications, which is a rare phenomenon), *Pycnothelia papillaria* (very large population), *Peltigera canina* and some *Cladonia*. On forest edges and among dwarf-pine patches one may found *Cetraria islandica, Cladonia arbuscula, C. rangiferina, C. uncialis, C. cornuta, C. furcata, C. pyxidata, Placynthiella icmalea, P. uliginosa, Trapeliopsis flexuosa, T. granulosa* and others. Particularly noteworthy is the presence of small crustose lichens, named epibryophytes, which grow on dead leaves and shoots of flowering plants and bryophytes. They are represented by *Micarea lignaria, M. cinerea, Trapeliopsis pseudogranulosa*, and also *Omphalina hudsoniana* and *O. umbellifera*. On withering *Sphagnum, Absconditella sphagnorum* was found. It is a very rare lichen species not only in Poland but also in the whole of Europe (Bielczyk & Kiszka 2001). In Poland the species has so far been reported only from five stations on the Nowy Targ bogs. Another very rare species, *Agonimia tristicula*, was discovered on withering plant remains. It is known in Poland only from the Tatra and Pieniny Mountains, and from one station in the Masurian Lake District (Olech & Kiszka 1999).

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