

3.5 Species composition and diversity of lichens on anthropogenic substrata

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INTRODUCTION

In the European temperate region, biological soil crusts with participation of lichens occur besides natural habitats very often in various anthropogenic areas. Roadsites, quarries, sand-pits, mine waste dumps, sedimentation basins, etc. provide suitable conditions for soil lichens, especially microlichens and pioneer species from the genera *Cladonia*, *Peltigera*, etc.

A number of records of terricolous lichens occurring in man-made habitats are included in various floristic, taxonomic or ecological studies. Only several studies (from British Isles and Scandinavia) describing terricolous lichen communities are oriented directly to human-influenced substrates (Gilbert 1980, 1990; Purvis & Halls 1996; Thor 1993).

There exist also a few works on lichens growing on industrial substrates from Central Europe. Palice & Soldán (2004) published the results of an extensive study of lichens and bryophytes in sedimentation basins Chvaletice and Bukovina. Banášová (2006), Banášová et al. (2003, 2006), Lackovičová et al. (1977) and Lackovičová (1984) investigated vegetation including lichens of mine waste from the extraction of metals and the waste from ore smelters in Slovakia, which are substantially enriched in heavy metals compared to natural soils. Banášová & Lackovičová (2004) observed the degradation of grasslands in the vicinity of copper plant in the town of Krompachy (Slovakia). They mentioned the occurrence of a crust from tolerant lichens *Cladonia rei*, *C. fimbriata*, *Diploschistes muscorum*, *Placynthiella icmalea* and moss *Ceratodon purpureus* on naked soil and the rest of plants in bare immission areas.

This chapter describes lichens associated with biological soil crusts in three sedimentation basins in the Czech Republic.

MATERIAL AND METHODS

This chapter contains the results of a floristic study performed in the period 2005–2007 in ash-slag sedimentation basin near Chvaletice and ore-washery basins near Měděnec and Radvanice (localities are characterized in chapter 3.1). Two active cinders-washery basins in Ostrov a Dvůr Králové were excluded from the approach due to absence of soil li-

chens caused by periodical overflowing. Only top-plateaus (slag) and the nearest surroundings (dams of the sedimentation ponds, a part of access road to Chvaletice sed. basin) of the sedimentation basins were explored. Only lichens associated with biological soil crusts (growing on soil and plant debris) were included in this study.

The specimens of lichenized fungi have been studied using routine lichenological methods. For determination of collected specimens the works of Breuss (1996), Coppins (1983, 1987, 1995), Giralt et al. (1993), Orange (1991), Purvis et al. (1992), Wirth (1995) and other taxonomic publications have been used. The nomenclature of lichens follows Santesson et al. (2004) or respective works included in references. All investigated specimens have been deposited in the PL.

RESULTS AND DISCUSSION

During the recent floristic approach, 33 lichen taxa associated with biological soil crusts were found. A total of 44 terricolous lichens were noted in four sedimentation basins in the Czech Republic, 35 of them were already recorded by Z. Palice in the period 1994–2002 in sedimentation basins Chvaletice and Bukovina (Palice & Soldán 2004 and several previous works cited in their study). The results are summarized in Table 3.5.1.

Three lichen taxa – *Atla wheldonii*, *Placidopsis oreades* and *Staurothele geoica* represent new records to the Czech Republic.

The major part of lichen taxa growing in sedimentation basins belong to pioneer lichens characteristic for anthropogenic habitats including specialists for man-made or man-affected substrates like *Psorotichia lutophila* (Palice & Soldán 2004), *Verrucaria bryoctona* (Orange 1991) or *Veizdaea leprosa* (Ernst 1995). Poelt & Vězda (1990) classify a number of founded taxa among short-living (ephemeral) microscopic lichens (e.g., species of the genera *Absoconditella*, *Thelocarpon* and *Veizdaea*). A number of these inconspicuous species were often collected from heavy-metal-rich substrates (e.g., *Sarcosagium campestre*, *Steinia geophana* and *Veizdaea* spp. together with some *Cladonia* and *Peltigera* species – Purvis & Halls 1996).

11 species can be considered to be typical for sedimentation basins (they were recorded in two or three localities): *Cladonia coniocraea*, *C. fimbriata*, *C. chlorophaea*, *C. pyxida*

Table 3.5.1 The list of recorded lichen species. 1 – Chvaletice and Bukovina sedimentation basins (* Palice & Soldán 2004, species founded only in Bukovina basin are marked *B), 2 – Měděnec ore-washery basin, 3 – Radvanice ore-washery basin.

	1	2	3
<i>Absconditella celata</i>	*+		
<i>Absconditella delutula</i>	*B		
<i>Atla wheldonii</i>			+
<i>Bacidina</i> sp.	*		
<i>Baeomyces rufus</i>		+	
<i>Cladonia carneola</i>	*		
<i>Cladonia coccifera</i>	*+		
<i>Cladonia coniocraea</i>	*+	+	
<i>Cladonia fimbriata</i>	*+	+	
<i>Cladonia humilis</i>	*		
<i>Cladonia chlorophaea</i>	*+	+	
<i>Cladonia macilenta</i>	*+		
<i>Cladonia pyxidata</i>	+	+	
<i>Cladonia ramulosa</i>	+		
<i>Cladonia rei</i>	*+	+	+
<i>Cladonia subulata</i>	*+		
<i>Collema limosum</i>	*		
<i>Collema tenax</i>	*		+
<i>Diploschistes muscorum</i>	*+		
<i>Evernia prunastri</i>	+		
<i>Lecanora saligna</i>	*B		
<i>Leptogium byssinum</i>	*		
<i>Micarea denigrata</i>	+		
<i>Micarea</i> sp.	*+		
<i>Peltigera didactyla</i>	*+	+	
<i>Peltigera rufescens</i>		+	
<i>Placidiopsis oreades</i>			+
<i>Placynthiella icmalea</i>	*+	+	
<i>Placynthiella oligotropha</i>	*+		
<i>Placynthiella uliginosa</i>	*+		
<i>Psorotichia lutophila</i>	*		
<i>Sarcosagium campestre</i>	*+	+	
<i>Staurothele geioca</i>			+
<i>Steinia geophana</i>	*+	+	
<i>Thelidium zwackhii</i>	*+		
<i>Thelocarpon epibolum</i>	*		
<i>Thelocarpon intermediellum</i>	*		
<i>Thelocarpon</i> sp.	*+		
<i>Thrombium epigaeum</i>	*+		
<i>Trapeliopsis granulosa</i>	*+		
<i>Verrucaria bryoctona</i>	*	+	+
<i>Veizdaea acicularis</i>	*+		
<i>Veizdaea leprosa</i>	*+		
<i>Veizdaea retigera</i>	*		

ta, *C. rei*, *Peltigera didactyla* (see Colour plates, Fig. 3.5.3), *Placynthiella icmalea*, *Sarcosagium campestre* (see Colour plates, Fig. 3.5.4), *Steinia geophana* and *Verrucaria bryoctona*.

The diversity of lichens is influenced except the light and moisture mainly with stability and pH of a substrate. From five studied localities, lichens growing directly on the slag in sedimentation basin were found only in Chvaletice and Radvanice basins. The sediment of ore-washery basin in Měděnec is formed by extremely unstable and dusty material not suitable for growth of lichens. Similar effect was described by Palice & Soldán (2004) from the Bukovina sedimentation basin. The basins in Ostrov and Dvůr Králové are still active – periodical overflowing of the basins unfortunately precludes development of soil associated lichen flora.

The highest number of lichens (38) was detected in the locality of Chvaletice probably due to occurrence of both acidic and basic substrates. The major part of sedimentation basin (ash-slag) as well as the margin of the basin and access road is acidic, occupied mainly by *Cladonia* spp. (*C. coniocraea*, *C. rei*, *C. chlorophaea*, *C. macilenta* and *C. coccifera* predominate; the first three species are often invaded by *Diploschistes muscorum*, see Colour plates, Fig. 3.5.1, 3.5.2), *Micarea* sp., *Placynthiella icmalea* and *Veizdaea acicularis*. On the lime-enriched soils, cyanolichens and pyrenocarpos species were collected, e.g., *Collema* spp., *Leptogium byssinum*, *Psorotichia lutophila*, *Thelidium zwackhii* and *Verrucaria bryoctona* (Palice & Soldán 2004; unfortunately I did not find the patches of basic soils during the study of biological soil crusts).

Apart from naked soil, small debris of herbs and wood can be also overgrown by biological crusts. Especially microlichens like *Micarea denigrata*, *Steinia geophana* and *Veizdaea* spp. grow on rotting leaves, together with some *Cladonia* species.

The border area (dam) of the ore-washery basin in Měděnec is formed by mixture of acidic soil and waste material as bricks, concrete, etc. Twelve terricolous lichens including acidophilic (*Baeomyces rufus*, *C. coniocraea*, *C. fimbriata*) as well as basiphilic species (*Peltigera rufescens*, *Verrucaria bryoctona*) were recorded on these substrates. The deposition of a dust from toxic sediment on the dam implicates the occurrence of heavy-metal-tolerant species like *Sarcosagium campestre* and *Veizdaea leprosa*.

The ore-washery basin in Radvanice has a very specific lichen flora due to universally high pH of the sediment and also specific microclimatic conditions. The basin is located in the deep valley of the Jívka brook with cold inversion clima. The major part of the basin is covered by birch-alder and Scots pine wood. Basiphilic pyrenocarpos microlichens *Atla wheldonii*, *Placidiopsis oreades*, *Staurothele geioca*, *Verrucaria bryoctona* and cyanolichen *Collema tenax* grow on naked toxic soil in the rests of opened sites. Only one representative of the genera *Cladonia* – *C. rei* grows directly on the sediment in this locality.

As well as the terricolous species, some primary epiphytic lichens can sometimes grow on soil within the biological soil crust. In well-developed moss-lichen crust near the access road to the Chvaletice sedimentation basin, a prosperous thallus of *Evernia prunastri* was observed.

Noteworthy lichen species

Atla wheldonii (Travis) Savić & Tibell
(syn. *Polyblastia wheldonii*)

Poorly known and probably overlooked inconspicuous pyrenocarpous species collected only in several localities in Europe. Based on molecular phylogeny it was recently transferred to genus *Atla* (Savić & Tibell 2007). The authors described it as typical for damp, basic and unstable soils colonized by cyanobacteria and mosses in anthropogenic habitats as ditches along the roads, etc. The character of the Radvanice ore-washery basin agrees with this description very well.

Placidiopsis oreades Breuss

The majority of representatives of pyrenocarpous genera *Placidiopsis* are known as terricolous or muscicolous species. *P. oreades* distinguished from other related species by squamules with distinct brown paraplectenchymatous lower cortex, closely adjacent to the substrate. This species has been collected only in high mountains (Alps, Carpathian Mountains and Central Tjan Shan) often on marly substrates (Breuss 1996). Radvanice ore-washery basin with an altitude of 500 m represents the lowest locality of the species (the second is from Belianske Tatry Mts, 1620 m). Its appearance is probably caused by cold inversion clima together with very specific substrate.

P. oreades is new to the Czech Republic, concurrently it is a first record of the genera *Placidiopsis* to the CR.

Staurothele geoica Zschacke

Sparsely collected pyrenocarpous species known only from Europe (Anonymus 1991; Tretiach & Castello 1992; Zschacke 1918) is very exceptional within the genus *Staurothele* due to its terricolous growth (majority of species are saxicolous). Its blackish thallus with black perithecia forms a quiet extensive crust on the slag soil in opened parts of

Radvanice ore-washery basin together with *Placidiopsis oreades*. Unfortunately, the relative fast invasion of the forest can danger the occurrence of the species in this unique locality.

CONCLUSIONS

Terricolous lichens of biological soil crusts were studied in specific anthropogenic habitats – the sedimentation basins near Chvaletice, Měděnec and Radvanice. A total of 33 taxa of terricolous lichens were recorded during the investigation of biological soil crusts. The highest diversity of lichens (26 taxa recently; 37 including records of Z. Palice in Palice & Soldán 2004) was detected in the Chvaletice sedimentation basin, probably due to broad range of pH of local soils and diversity of habitats. The ore-washery basin in Radvanice is specific by universally high pH of the slag and cold microclima, which provide suitable conditions for occurrence of rare species – *Atla wheldonii*, *Placidiopsis oreades* and *Staurothele geoica*, which are new to the Czech Republic.

The major part of the records belongs to the pioneer lichens characteristic for anthropogenic habitats and man-made substrates including toxitolerant species characteristic for heavy-metal-rich substrates, e.g., short-living lichen species of the genera *Sarcosagium*, *Steinia* and *Veizdaea*.

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