2.3 Species composition of lichens in biological soil crusts on natural substrata

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INTRODUCTION

Lichens play an important role in soil-crust communities. As autotrophic organisms, they participate markedly in carbon fixation, and cyanolichens also show N-fixation activity (Belnap 2001). Lichen/moss crust obstructs a fast water runoff by roughening soil surfaces. Subterranean structures of lichens (hyphae, rhizinae) contribute considerably to soil stability and resistance to wind and water erosion (Warren 2001).

Both phycolichens and cyanolichens with different thallus types occur in soil crusts (crustose, foliose, fruticose) including special forms of arid regions like Fensterflechten (window lichen) (Belnap et al. 2001). In total, 13 cyanolichen and 69 phycolichen genera are reported from soil crusts of the Earth. The proportion of lichens in the crusts is higher on substrates with more carbonate, gypsum and silt content than on poor soils (Büdel 2001).

Lichens occur in biological soil crusts of different geographical areas and vegetation types. Within the European temperate region, specific soil-lichen communities can be found in xerothermic steppe formations, coastal as well as inland dunes, on open soil in heaths and very often on less or more extensive, often anthropogenic, disturbed areas (sand-pits, quarries, roadsides, etc.; Büdel 2001). In the Czech Republic, biological soil crusts with a predominance of lichens occur except antropogenic substrata, mainly in natural habitats of sandstone regions or isolated inland dunes and in steppe formations of warm regions.

This chapter describes terricolous lichens of biological soil crusts founded in three (semi)natural habitats: Střezovská rokle gorge, the margin of airport in Ralsko and Nature Reserve Babylon in Bohemian Switzerland.

MATERIAL AND METHODS

This chapter contains the results of a floristic study performed in the period 2005–2007 in selected localities: the Nature Monument Střezovská rokle, the former military Ralsko airport and the Nature Reserve Babylon in Bohemian Switzerland National Park (see chapter 2.1). For complete results of the floristic approach of Babylon Nature Reserve see Svoboda et al. (2006). Only terricolous lichens associated with biological soil crusts are included.

The specimens of lichenized fungi have been studied using routine lichenological methods. For determination of collected specimens, the works of Coppins (1987), Giralt et al. (1993), Purvis et al. (1992), Tønsberg (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

In all localities, well-developed biological soil crusts with distinct participation of lichens were observed. Moreover, there occur some areas with dominance of terricolous lichens in each of the localities (open sites with naked soil and low competion of vascular plants). A total of 46 taxa of terricolous lichens were recorded during the recent floristic approach (summarized in Table 2.3.1). The major part of the records belongs to the genera *Cladonia* (30) and *Placynthiella* (4). The most frequent species occurring in all of localities are *Cladonia coccifera*, *C. furcata*, *C. macilenta*, *C. pyxidata* and *Placynthiella icmalea*, which represent the common species of acidic substrates in open habitats (naked soil, humus, rotted wood). Several records are considered to be an uncommon or rare species to the Czech Republic, e.g., *Cladonia incrassata*, *C. polycarpoides*, *C. portentosa* and *C. subcervicornis*.

The highest diversity (33 species) of terricolous lichens was detected in sandstone rocks and gorges of the Nature Reserve Babylon, probably due to the highest variety of microhabitats and good natural state of the locality.

Babylon Nature Reserve

is characterized with presence of climatically very different habitats: deep cold humid gorges and dry plateaus of sandstone rocks covered by relic pine forests. Due to this microclimatic diversity together with the climatic conditions of Bohemian Switzerland as whole, some species with different ecological requirements (sub-Atlantic, mountain) grow in this area.

The locality is characterized by high number of recorded terricolous lichens (33), especially *Cladonia* species (23 compared with 13 and 14 in other two localities) including rare species *Cladonia incrassata*, *C. portentosa* and *C. subcervicornis.* Mainly on the plateaus, often near the rims of

Table 2.3.1 The list of recorded lichen species. **1** – the Babylon Nature Reserve (* Palice et al. 2002, and Svoboda et al. 2006), **2** – airport in Ralsko, **3** – Střezovská rokle gorge.

Taxon	1	2	3
Baeomyces rufus	+	+	
Cetraria aculeata	+	+	+
Cetraria islandica	+		
Cladonia arbuscula ssp. *arbuscula*	+	+	
Cladonia arbuscula ssp. *mitis*			+
Cladonia cervicornis	+	+	
Cladonia ciliata		+	
Cladonia coccifera	+	+	+
Cladonia coniocraea	+		+
Cladonia cornuta	+	+	
Cladonia deformis	+	+	
Cladonia digitata	+		
Cladonia fimbriata	+		+
Cladonia foliacea			+
Cladonia furcata	+	+	+
Cladonia glauca	*		
Cladonia gracilis	+	+	
Cladonia chlorophaea		+	+
Cladonia incrassata	+		
Cladonia macilenta	+	+	+
Cladonia ochrochlora	+		
Cladonia polycarpoides			+
Cladonia polydactyla	+		
Cladonia portentosa	+		
Cladonia pyxidata	+	+	+
Cladonia ramulosa	+		+
Cladonia rangiferina	+		
Cladonia rangiformis			+
Cladonia rei		+	+
Cladonia squamosa	+		
Cladonia subcervicornis	*+		
Cladonia subulata		+	+
Cladonia uncialis	+		
Cladonia verticillata	+		
Dibaeis baeomyces			+
Icmadophila ericetorum	+		
Peltigera didactyla		+	
Placynthiella dasaea	+	+	
Placynthiella icmalea	+	+	+
Placynthiella oligotropha	*+	+	
Placynthiella uliginosa	+	+	
Steinia geophana			+
Thelidium zwackhii			+
Trapelia coarctata			+
Trapeliopsis glaucolepidea	+		
Trapeliopsis granulosa	+	+	
Vezdaea acicularis		+	

sandstone rocks with relatively thin humus layer and low participation of vascular plants, species rich community of terricolous lichens is developed (see Colour plates, Fig. 2.3.1). It is composed mostly of crustose lichens from the genera *Placynthiella* and *Trapeliopsis* and fruticose "Cladonias" headed by "reindeer lichens" *Cladonia arbuscula*, *C. portentosa*, *C. rangiferina* and other species like *C. gracilis* and *C. uncialis*.

Sandy slopes as well as rotting wood in humid gorges might be covered by crust lichens adapted to the lack of light like *Baeomyces rufus* and *Icmadophila ericetorum* as well as much less conspicuous *Trapeliopsis glaucolepidea*. Due to the specific character of sandstone (high porosity, etc.), these primary terricolous species can also often grow directly on rocks, especially weathered and moist.

The former military airport Ralsko

represents "semi-natural" habitat – initially probably bare and open (grassy) area not far from the runway is recently colonized by pines, birches, etc. Biological soil crusts with predominance of terricolous lichens are well developed especially in the heather moor – on naked sandy soil among the heather shrubs with minimal participation of other vascular plants (see Colour plates, Fig. 2.3.2). The composition of the local lichen community is similar to that of open sites of Babylon (except the rare species!) due to similar substrate – sandy soil. Several species of *Cladonia* (*C. coccifera*, *C. furcata*, *C. macilenta*, *C. pyxidata* and *C. subulata*) together with *Cetraria aculeata* and crustose lichens from the genus *Placynthiella* predominate in the biological soil crust. Some *Cladonia* species (predominantly squamules of *Cladonia pyxidata*) are often infected by lichenicolous fungus *Arthrorhaphis aeruginosa*, which evokes an atypical deep bluegreen colouration of the thallus. Naked soil, mosses and lichens, are often covered by inconspicious apothecia and goniocysts of *Vezdaea acicularis* observable especially during wet periods of the year.

Střezovská rokle Nature Monument

differs from other two localities mainly by the presence of species typical for sunny habitats with more alkalic substrates, e.g., *Cladonia foliacea* (see Colour plates, Fig. 2.3.3), *C. polycarpoides* and *C. rangiformis*. The mentioned species are bound to the small grassy plateaous on the ridges and upper parts of the steep slopes of erosion cones, together with other dominants as *Cetraria aculeata*, *Cladonia mitis* and *C. subulata* (see Colour plates, Fig. 2.3.4). In shaded humid sites at the bases of slopes, ephemeral microscopic lichens like *Steinia geophana* and *Thelidium zwackhii* can be found. Small rests of heat stands are occupied mainly by pioneer lichens like *Dibaeis baeomyces*, *Cladonia coccifera*, *C. coniocraea*, *C. macilenta*, *C. pyxidata* and *Trapelia coarctata* (the last species grows here except the small pebbles also directly on naked soil).

Noteworthy lichen species

Cladonia incrassata

Suza (1938) calls *C. incrassata* a characteristic "peat-lichen", solely due to it's ecological relationship to the peat

bogs (pine-forest bogs) of the Bohemian massif. Litterski & Ahti (2004) described it as a holarctic oceanic species with a disjuncted distribution pattern, occuring in Europe especially on peaty soil in bogs. In the locality of Babylon, this red-fruited species with small podetia was collected at the base of an old pine in a relic pine forest on sandstone rock. In the same habitat, its typical companions *C. macilenta*, *C. deformis* and *Trapeliopsis granulosa* were also recorded.

Cladonia polycarpoides

Conspicious species typical for sun-exposed habitats with more alkalic sandy or stony soils mainly in xerotherm regions (steppes), often growing together with *Cladonia foliacea* (Kovář 1912; Suza 1947; Wirth 1995). The rests of steppe vegetation in the locality of Střezovská rokle ravine represent a typical habitat of the species.

Cladonia subcervicornis

Rare species with the centre of distribution in the Atlantic floristic province (Litterski & Ahti 2004). In the Babylon Nature Reserve was firstly recorded in 2002 – commented together with other species with similar ecology (*Cladonia glauca*, *C. portentosa*) in Palice et al. (2002) and Palice et al. (2007). Compared with recently known distribution of *C. subcervicornis* (Litterski & Ahti 2004), the region of Bohemian Switzerland represent very isolated and inland locality of the species.

CONCLUSIONS

Terricolous lichens of biological soil crusts were studied in the three natural or seminatural localities in the North Bohemia. A total of 46 taxa of terricolous lichens were recorded during the recent floristic approach. The highest diversity of lichens was detected in the Nature Reserve Babylon in Bohemian Switzerland, probably due to the highest variety of microhabitats and good natural state of the locality.

The major part of the lichen records belongs to the genera *Cladonia* (30) and *Placynthiella* (4). The most frequent species occuring in all of localities (*Cladonia coccifera*, *C. furcata*, *C. macilenta*, *C. pyxidata*, *Placynthiella icmalea*) represent common "pioneer lichens" typical for acidic substrates in open habitats (often disturbed). Several records belong to rare species of well–preserved plant communities (*Cladonia incrassata*, *C. portentosa*, *C. subcervicornis* – Babylon, *C. polycarpoides* – Střezovská rokle).