Algal flora of the Červené blato peat bog (Třeboň Basin, Czech Republic)

Řasová flóra rašeliniště Červené blato u Třeboně

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Fifty six species of algae were found during phycological investigation of an extremely acid raised peat bog Červené blato near Třeboň (Třeboň Basin, Czech Republic) from 1994 to 1996. List of species, structure and seasonal changes of algal flora, statistical evaluation and chemical and physical parameters of water are given.

Keywords: Algae, peat bog, ecology, Červené blato mire, Czech Republic

Introduction

Peat bogs represent island-like ecosystems with specific structure and development, harbouring specific flora and fauna. In central Europe, two opposite processes have been acting in the development of basic mire types, as described in the Šumava Mountains (Soukupová 1996). In lower altitudes the lakes were changed by terrestrialization which gave origin to valley raised bogs. In higher altitudes (above 1000 m), paludification of very wet concave places has formed patterned sloping mires. Both these processes operated in the Třeboň Basin (Jankovská 1976) and gave origin to a different type of very acidic (pH 2.7–3.6) peat bogs, i. e. transient raised bogs.

The present paper reports on algal flora of the Červené blato bog in the Třeboň Basin. The study was carried out in 1994–1996. List of recorded species is presented, and the structure and seasonal dynamics of algal flora are evaluated, taking chemical and physical parameters of water into account.

Locality studied

Červené (Šalmanovické) blato bog (48° 52' N, 14° 48' E, altitude 465–475 m, area 331.4 ha), situated 15 km south of Třeboň, Czech Republic (Fig. 1), is a subcontinental forested raised bog with transient peat (Spitzer & Jaroš 1993). The center of this locality is occupied by natural stands of *Pinus rotundata*; in the scrub layer, the largest populations of *Ledum palustre* in Central Europe are present. The herb layer is relatively poor in species, with prevailing *Vaccinium uliginosum, V. myrtillus* and *V. vitis-idaea*; in the moss layer, *Sphagnum magellanicum* is dominant. Several artificial large shallow waterbodies, remnants of past traditional peat extraction, are a subject of secondary succession with occurrence of fen communities, with the most common *Eriophoro vaginati-Sphagnetum recurvi*. This locality belongs to protected areas registered by the Ramsar Convention.

More detailed information about history, geology, flora, fauna, protection, and ecology of the whole region is presented in Hudec et al. (1993).

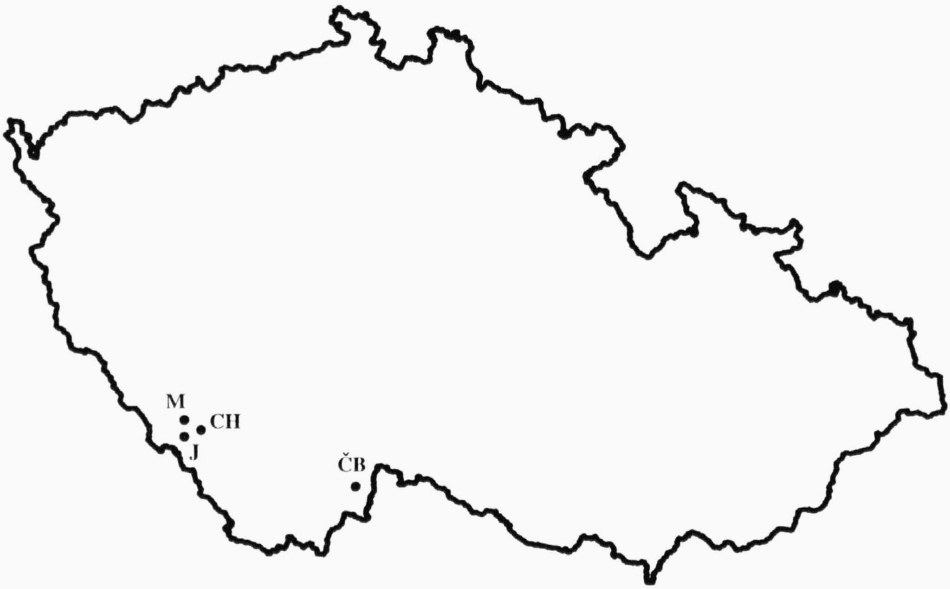

Fig. 1. – Location of the peat bogs studied. Habitat codes: CH = Chalupská slať, J = Jezerní slať, M = Mlynářská slať, ČB = Červené blato.

Material and methods

The first systematic investigation of algal flora of the Červené blato peat bog started in 1994. Samples were taken monthly from March to November from 13 various types of microbiotopes (Table 1). The terminology of periphyton communities follows Weitzel (1979). Conductivity and pH were measured monthly "in situ" by conductivity-pH meter Gryf107, other chemical parameters were determined in the laboratory of the Institute of Botany in Třeboň. To summarize main trends in the variability of composition of biological communities and to compare algal flora of various types of peat bogs, two principal data sets were used. These data sets were based on algal community composition from four different peat bogs (Chalupská slať, Jezerní slať, Mlynářská slať in the Šumava Mts., and Červené blato in the Třeboň district). Occurrence of species in various types of microbiotopes and chemical properties of water were recorded (Lederer 1998). Presence/absence data were analysed by Canonical correspondence analysis (CCA, ter Braak & Prentice 1988, ter Braak & Verdonschot 1995). The effect of individual variables was tested independently using the Monte-Carlo Permutation Test (MCPT). The program CANOCO was used (ter Braak 1991) and the results were summarized by using CanoDraw (Šmilauer 1992) and CanoPost (unpublished) software packages.

Table 1. – Distribution of algae in the 13 types of microbiotopes of the peat bog Červené blato as recorded in 1994–1996: 1 – plankton of a bog pool; 2a – periphyton of littoral zone in bog pools (epidendric); 2 – periphyton of littoral zone in bog pools (epipelic); 3 – algal mats in hollows; 4 – periphyton of drainage channels; 6 – metaphyton of floating peat mosses; 7 – metaphyton of submersed peat mosses; 9 – bare soaked peat with water-filled hollows; 10a – bare wet peat (shaded); 10b – bare wet peat (unshaded); 11 – wet peat mosses; 12 – subaerophytic microhabitats on the wood; 13 – aerophytic communities on trees. The present species are marked x.

Taxon	Microhabitat												
	1	2 a	2 b	3	4	6	7	9	10 a	10 b	11	12	13
Cyanophyta:													
Anabaena augstumalis Schmidle	x						x						
Chroococcus cf. *turgidus*							x						
Nostoc sp.							x						
Pseudanabaena sp.				x			x						
Cryptophyta:													
Cryptomonas cf. *ovata*	x						x						
Cryptomonas sp.	x			x		x	x				x		
Rhodomonas sp.	x												
Dinophyta:													
Gymnodinium fuscum (Ehr.) Stein	x						x						
Chrysophyceae:													
Chromulina elegans Doflein	x						x						
Chromulina fischer-ankernii Wawrik					x								
Chrysosphaera paludosa (Korš.) Bourr.	x				x		x						
Dinobryon divergens Ihm.						x	x						
Dinobryon pediforme (Lemm.) Stein	x					x	x						
Mallomonas robusta Matv.							x						
Mallomonopsis robusta Matv.						x							
Synura sphagnicola Korš.						x	x						
Synura splendida Korš.	x					x	x						
Xanthophyceae:													
Myxochloris sphagnicola Pasch.						x							
Bacillariophyceae:													
Eunotia lunaris (Ehr.) Grun.	x			x	x		x						
Eunotia tenella (Grun.) Hust.				x	x		x						
Eunotia sp.							x						
Pinnularia sp.				x			x						
Euglenophyta:													
Euglena acus Ehr.							x						
Euglena hemichromata Skuja							x						
Euglena mutabilis Schmitz		x	x	x	x		x	x	x	x	x		
Menoidium sp.				x			x						
Chlorophyta:													
Carteria sp.	x												
Carteria turfosa Fott	x					x	x	x					
Chlamydomonas ambigua Gerl.							x						
Chlamydomonas isogama Korš. in Pasch.							x						
Chlamydomonas sp.				x		x	x	x					
Chloromonas maculata Korš.	x			x			x						
Chloromonas subdivisa (Jah. et Pasch.) Gerl. et Ettl							x						
Chloromonas sp.	x			x		x							
Coccomyxa confluens (Kütz.) Fott											x	x	x
Coccomyxa subglobosa Pasch.											x	x	x
Coccomyxa sp.											x	x	x
Desmococcus vulgaris (Näg.) Brand													x
Gloeocystis vesiculosa Näg.											x	x	
Gloeocystis sp.											x	x	

Heleochloris mucosa (Fott) Fott	x					x	x						
Klebsormidium flaccidum (Kütz.) Silva		x	x		x		x	x	x	x	x	x	
Koliella tatrae var. *saussurei* (Kol) Hind.				x									
Microspora aequabilis Wichmann	x	x	x	x	x	x		x	x	x	x		
Microthamnion kuetzingianum Näg.		x	x		x	x	x	x	x				
Microthamnion strictissimum Rabenh.		x	x		x	x	x						
Oedogonium sp. steril.	x	x	x	x		x	x						
Stichococcus bacillaris Näg.												x	
Stichococcus minor Näg.												x	
Trentepohlia cf. *aurea*												x	
Treubouxia cf. *cladoniae*												x	
Trebouxia sp.												x	x
Zygnematophyceae:													
Cylindrocystis brebissonii Menegh.					x		x	x	x	x	x		
Mesotaenium chlamydosporum De-Bary											x	x	
Mougeotia sp. steril.													
Zygogonium ericetorum Kütz.											x	x	

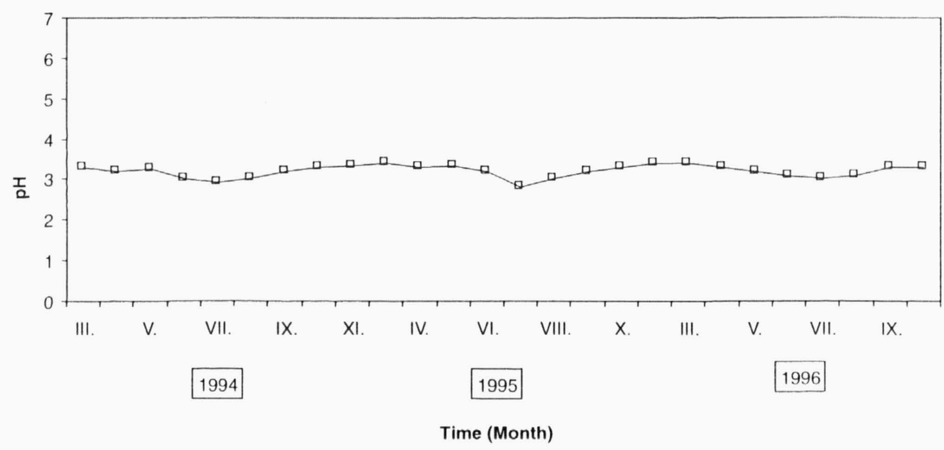

Fig. 2. – The seasonal course of pH values in water from a bog pool (1994–1996).

Results and discussion

Biodiversity of algae is influenced by specific chemical conditions of water (Hruška 1994), mainly pH (Fig. 2), very intensive fluctuations of groundwater level, and by historical and recent development (origin of peat bog, peat extraction, draining and revitalization). Only 56 species of algae (Table 1) were found during investigation of this extremely acid peat bog.

Coccoid green algae and flagellates (*Heleochloris mucosa*, *Cryptomonas* sp. div., *Rhodomonas* sp., *Carteria* sp. div., *Chloromonas* sp. div.) dominated the plankton (Fig. 3a). The filamentous green algae (*Microspora aequabilis, Microthamnion strictissimum, Oedogonium* sp. steril.) were often present in littoral zone of artificial depressions (Fig. 3b) and in channels (Fig. 3c). Metaphytic communities of submerged *Sphagnum* species were the richest microhabitat (Fig. 3d). *Cylindrocystis brebissonii, Klebsormidium flaccidum, Microthamnion kuetzingianum* and *Euglena mutabilis* were dominant on the

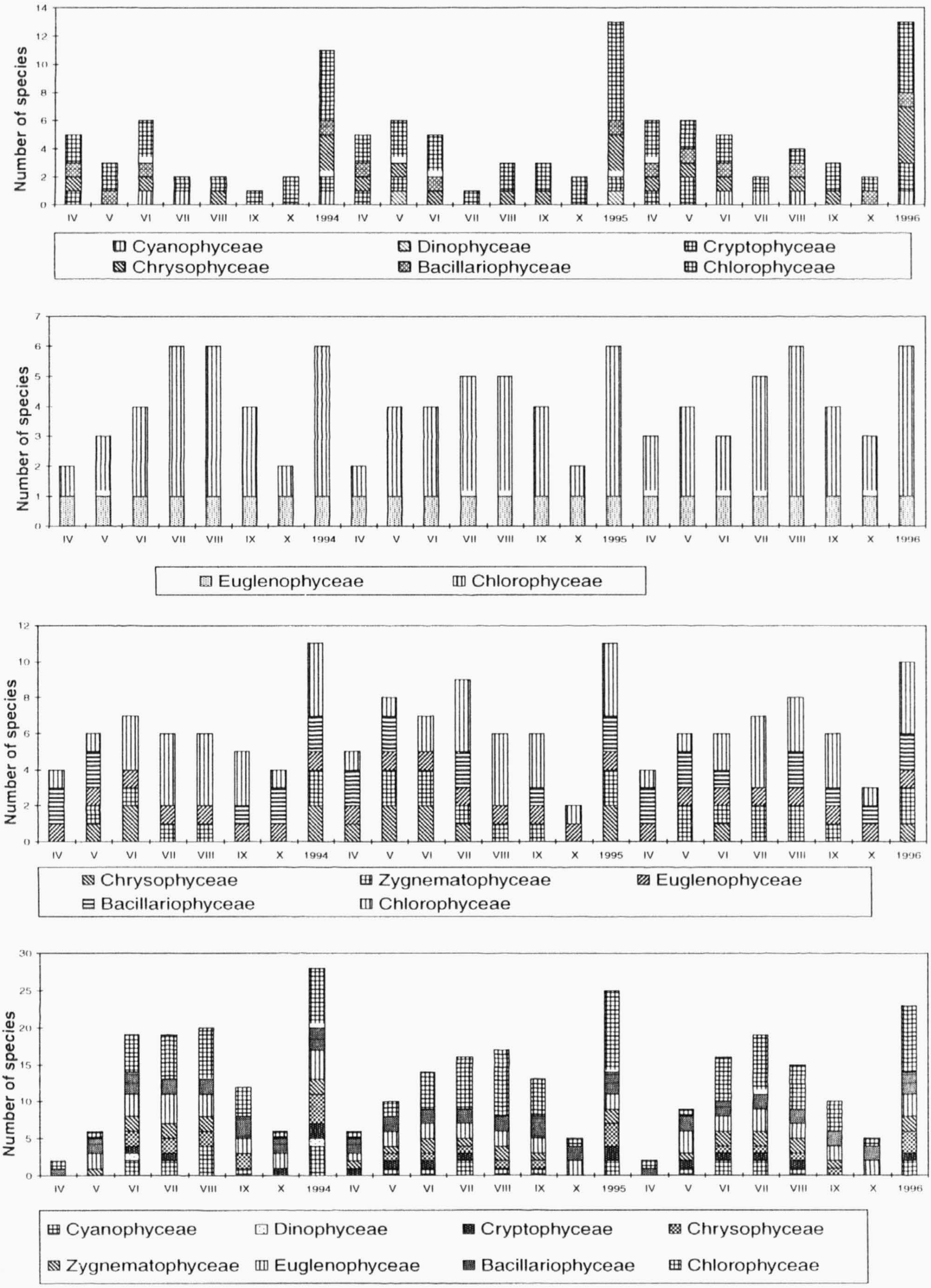

Fig. 3. – Seasonal dynamics of algal flora in the locality studied (1994–1996). (a) plankton in a peaty pool, (b) periphyton (epidendric) in a peaty pool, (c) periphyton in drainage channels, (d) metaphyton in submersed *Sphagnum* spp.

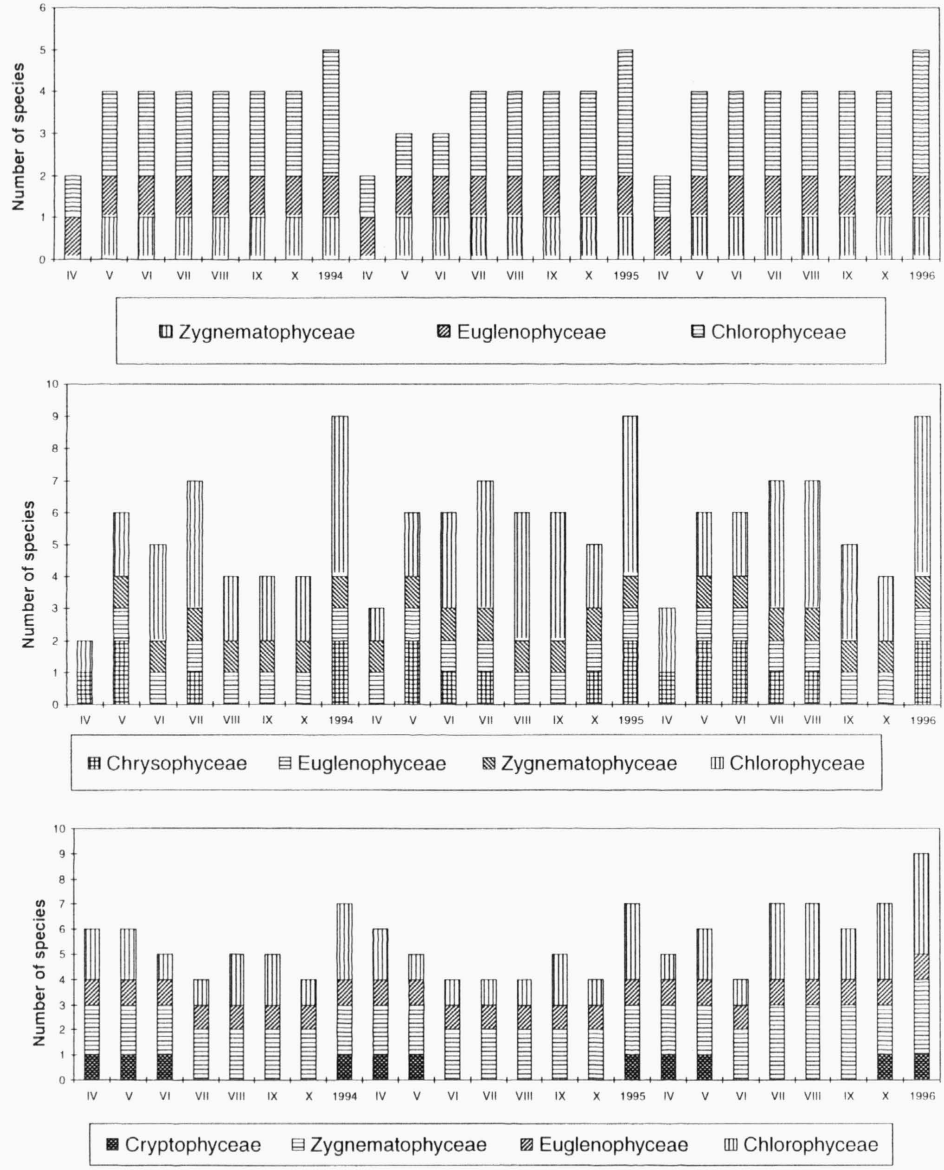

Fig. 4. – Seasonal dynamics of microflora in the locality studied (1994–1996). (a) bare wet peat, (b) bare soked peat, (c) wet peat mosses.

bare wet peat (Fig. 4a), as well as on bare soaked peat (Fig. 4b). In the latter habitat, small hollows with water were occupied by green flagellates, i. e. *Carteria turfosa*, and *Chlamydomonas* species. The most frequent microbiotope, i. e. communities of wet peat mosses (Fig. 4c), harboured *Zygogonium ericetorum, Euglena mutabilis,* and species of the genera *Cryptomonas*, *Coccomyxa* and *Gloeocystis*.

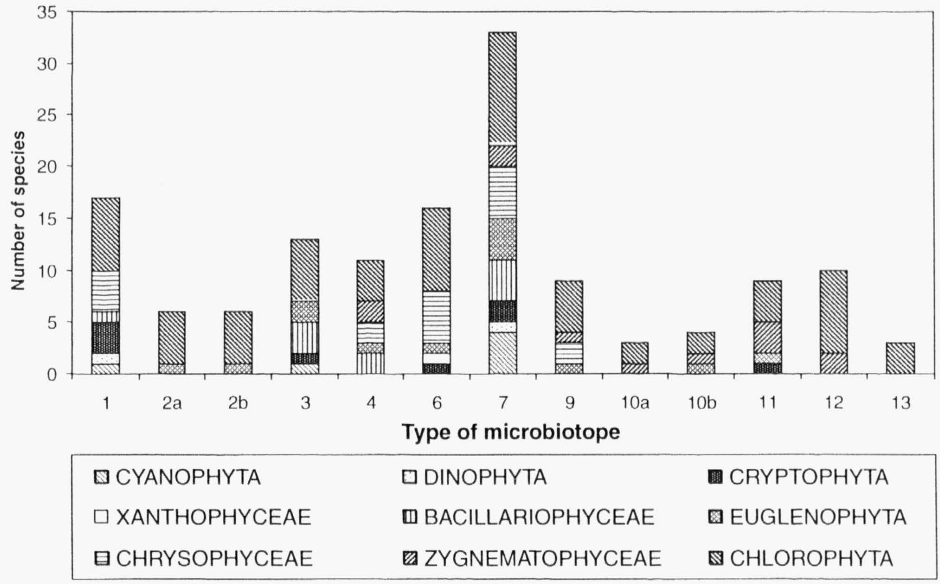

Fig. 5. – Comparison of algal flora in particular microbiotopes of the Červené blato peat bog as recorded in 1994–1996.

Comparison of microflora of particular microbiotopes is shown in Fig. 5. *Euglena mutabilis* (*Euglenophyta*) was the most frequent species in all types of microbiotopes. *Microspora aequabilis* (*Microsporales, Chlorophyta*) was dominant in draining channel and very frequent in other microbiotopes. Floras of *Cyanophyta* and *Zygnematophyceae* were very poor in species.

Algal flora of this peat bog is different from the nearest peat bogs in the Šumava Mts. (Lederer 1997, 1998), being poorer in species. In Šumava, 90–140 species were reported from sloping mires (Mlynářská slať, Jezerní slať, Rokytecká slať, Luzenská slať) and 50–55 species from valley raised bogs (Malá Niva, Hůrecká slať, Chalupská slať). The extremely low pH of the Červené blato can be considered as a factor limiting the number of present species. Some valley raised bogs in the Šumava Mts. have similar algal microflora, but it is a consequence of their low habitat diversity. Comparison of algal floras (the best fitted species, sampling sites, and species richness) of several peat bogs in the Šumava Mts. with that of the Červené blato bog is shown in Fig. 6. Many species occur in all localities (*Cylindrocystis brebissonii*, *Zygogonium ericetorum*, *Mougeotia* sp. ster., *Oedogonium* sp. ster., *Coccomyxa* sp. div., *Cryptomonas* sp., *Eunotia bilunaris*, *Microthamnion kuetzingianum*, *Euglena mutabilis* etc.) but some are specific for particular peat bogs (found exclusively there or being most frequent in particular microbiotopes).

Green flagellates *Carteria turfosa*, *Chloromonas maculata*, *Chloromonas subdivisa*, *Chlamydomonas* sp., dominating green filamentous algae *Microspora aequabilis*, and *Microthamnion strictissimum* are typical of the extremely acid Červené blato peat bog. The structure of microflora as well as the presence of several species of the genus *Euglena* (*E. mutabilis*, *E. acus*, *E. hemichromata*) is quite characteristic for these types of extreme biotopes (Fott 1956, Prát 1955).

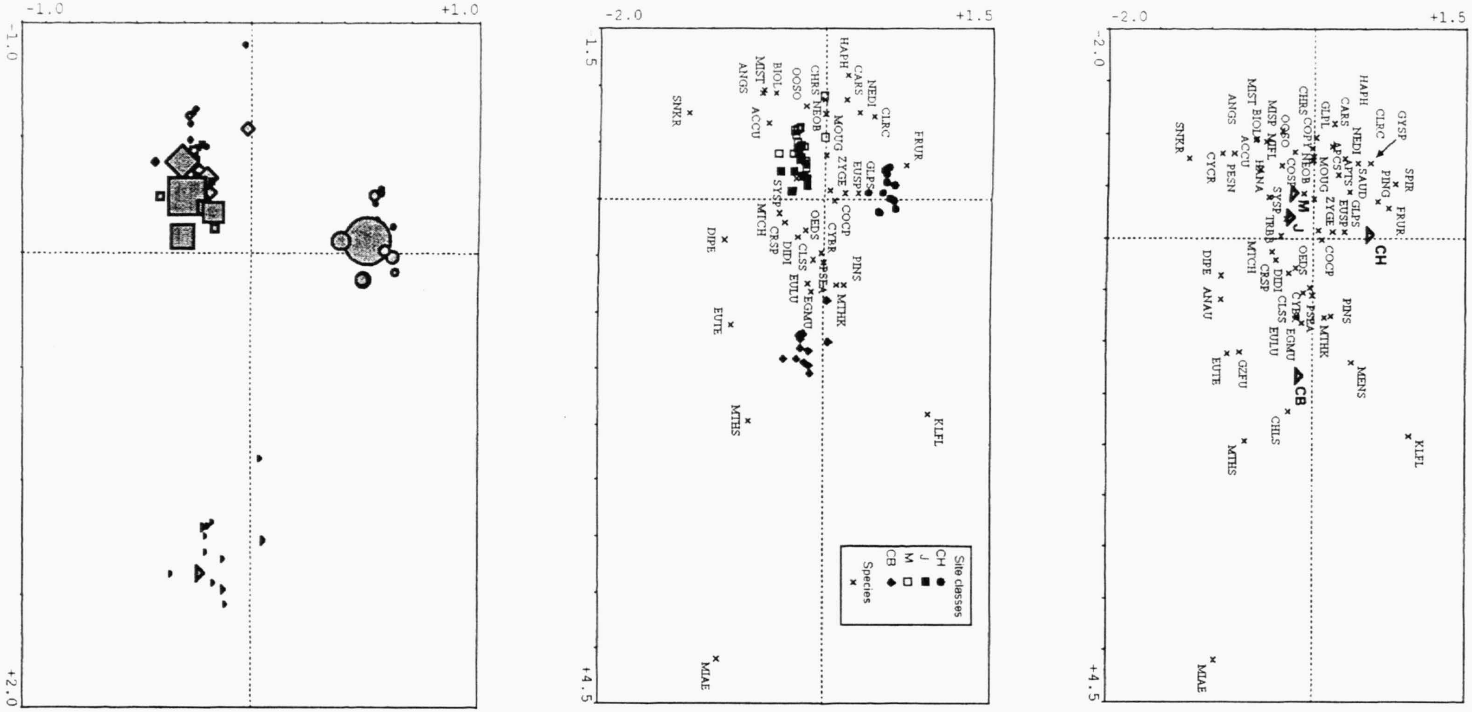

Fig. 6. – Results of the canonical correspondence analysis (CCA) of algal flora of peat bogs in the Šumava Mts. (Chalupská slať, Jezerní slať, Mlynářská slať) and Červené blato peat bog in the Třeboň Basin. Habitat codes: CH = Chalupská slať, J = Jezerní slať, M = Mlynářská slať, CB = Červené blato. Species abbreviations: ACCU – *Actinotaenium cucurbita;* ANAU – *Anabaena augstumalis;* ANGS – *Ankistrodesmopsis gabretae-silvae;* APCS – *Aphanocapsa* sp.; APTS – *Aphanothece* sp.; BIOL – *Bitrichia ollula;* CARS – *Carteria* sp.; CLSS – *Chloromonas* sp.; COCC – *Coccomyxa confluens;* COCP – *Coccomyxa* sp.; COCS – *Coccomyxa subglobosa;* COPY – *Cosmarium pygmaeum;* COSP – *Cosmarium* sp. div.; CRSP – *Cryptomonas* sp.; CYBR – *Cylindrocystis brebissonii;* CYCR – *Cylindrocystis crassa;* DIDI – *Dinobryon divergens;* DIPE – *Dinobryon pediforme;* EGMU – *Euglena mutabilis;* EULU – *Eunotia lunaris;* EUSP – *Eunotia* sp.; EUTE – *Eunotia tenella;* FRUR – *Frustulia rhomboides;* GLPL – *Gloeocystis polydermatica;* GLPS – *Gloeocystis* sp.; GYSP – *Gymnodinium* sp.; GZFU – *Gymnodinium fuscum;* HAPH – *Hapalosiphon hibernicus;* CHLS – *Chlamydomonas* sp.; CHRS – *Chroococcus subnudus;* KLFL – *Klebsormidium flaccidum;* MENS – *Menoidium* sp.; MIAE – *Microspora aequabilis;* MIFL – *Microspora floccosa;* MISP – *Microspora* sp.; MIST – *Microspora stagnorum;* MOUG – *Mougeotia* sp. steril.; MTHK – *Microthamnion kuetzingianum;* MTHS – *Microthamnion strictissimum;* MTCH – *Mesotaenium chlamydosporum;* NEDI – *Netrium digitus;* NEOB – *Netrium oblongum;* OEDS – *Oedogonium* sp. steril.; OOSO – *Oocystis solitaria;* PESN – *Penium silvae-nigrae;* PINS – *Pinnularia* sp.; PSEA – *Pseudanabaena* sp.; SAUD – *Staurastrum* sp.; SNKR – *Stauroneis kriegeri;* SPIR – *Spirogyra* sp. steril.; SYSP – *Synura sphagnicola;* TRBB – *Trebouxia* sp.; ZYGE – *Zygogonium ericetorum.* (a) Scatter of species optima on the first two ordination axes of CCA with centroids of sample classes based on their locality. (b) Joint plot of sample points and species optima on the first two ordination axes of CCA, with samples coded by different symbols based on their locality. (c) Diagram showing pattern of sample richness accross the ordination plane of the first two CCA axes. The size of the symbols is proportional to the number of species present in the sample.

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Souhrn

Řasová flóra přechodového rašeliniště Červené blato u Třeboně byla soustavně sledována v letech 1994–1996. Díky extrémním podmínkám (pH 2,7–3,6, odvodňování, kolísání hladiny pozemní vody), vzniku a vývoji tohoto unikátního blatkového rašeliniště je řasová flóra ve srovnání např. s rašeliništi na Šumavě velmi chudá. Bylo nalezeno 56 druhů sinic a řas, nejfrekventovanější byli zelení bičíkovci, krásnočka a zelené vláknité řasy – vše druhy typické pro extrémně kyselá stanoviště.

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