Vertical distribution of epiphytic algae on the mosses and their relation to moisture

Vertikální distribuce epifytických řas na mechorostech a jejich vztah k vlhkosti

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Abstract

The basic aim of this study is to determine the vertical distribution of algae on the *Sphagnum* plants and their relation to moisture. At the most dry site, the number of algae is increasing with increasing depth. The highest number of algae in the upper part of *Sphagnum* plant was observed at the most wet places. Epiphytic algal communities on mosses are dominated by diatoms.

Introduction

Mosses represent a suitable environment for diatoms to survive in. Moss diatom communities have been studied for a long time in different parts of the world, especially in the Antarctic region (BUNT 1954, HICKMAN & VITT 1973, VAN DE VIJVER & BEYENS 1999). The majority of these papers were focused on the floristic approach, withouth any effort to obtain quantitative data. Water content was determined with reference to the F-classification of JUNG (1936). This is a humidity scale, based on the water content of moss samples determined as follows: F1=submerged mosses, FII=free-floating mosses, FIII=very wet (water drips from the sample without pressure), FIV=wet (water drips by slight pressure), FV=quasi-wet (water drips after moderate pressure), FVI=moist (little water produced after high pressure), FVII=quasi-dry (only a few drops of water can be squeezed out), FVIII=dry probe. This scale is not very exact, that is why the true water content (in gramms of water per 1 g of dry bryophyte matter) was used in several following papers (POULÍČKOVÁ et al. 2000, POULÍČKOVÁ et al. in press.).

Results represent a part of complex ecological research in West Carpathians. The basic aim of this study is to determine the vertical distribution of algae on the *Sphagnum* plants and their relation to moisture.

Material and methods

The samples were taken in October 2001 at site Obidová (Czech Republic). The investigated spring is situated in the Beskydy Mts. and is classified according to HÁJEK & HÁBEROVÁ (2001) as mineral-poor acidic fen dominated by peat mooses (Carici echinatae-Sphagnetum). The geographical positions and basic characteristics are summarized in Table 1.

Table 1: Basic characteristic of the locality Obidová (according to HÁJEK et al. 2002).

Parameter	Locality Obidová
Coordinates	183322/492926
Altitude m a.s.l.	730
pH	stream: 6.2±0.72 hummock: 5.6±0.58
Conductivity $\mu S.cm^{-1}$	stream: 46.2±18.58 hummock:39.6±22.91
Temperature °C	stream: 11.3±3.94 hummock: 11.6±3.29
Ca ($mg.l^{-1}$)	stream: 8.1±5.57
PO_4^{3-} ($mg.l^{-1}$, methods: see Hájek et al. 2002)	stream: 0.2±0.12
$N\text{-}NO_3$ ($mg.l^{-1}$, methods: see Hájek et al. 2002)	stream: 1.2±0.78
$N\text{-}NH_3$ ($mg.l^{-1}$, methods: see Hájek et al. 2002)	stream: 2.9±1.24

Samples of bryophytes were taken at three sites – the most wet place, the place with moderate wetting, the most dry place and carried to a laboratory in polyethylene bags. The exact water content was measured in the laboratory as the difference between the fresh and dry weight of the bryophyte tufts. Samples for the estimation of vertical distribution were taken by cutting the layers of bryophytes 2 cm thick on the area of 20 cm^2. The fresh bryophyte sample was weighed and then washed out in 100 ml of distilled water and thoroughly squeezed. The content (water with algae and mud) was transferred quantitatively into a tall cylinder of small diameter (up to 20 mm). The sample was left to sediment for about 20 minutes, and then decanted. The sediment was fixed with formaldehyde and stored in a 50 ml sample container. The squeezed bryophyte material was used for the dry matter assessment. Dry-mass of each bryophyte sample was obtained after oven drying at 85° C for 48 hrs. The quantity of diatoms was expressed as a number of individuals per 1 g of dry bryophyte matter. The effectiveness of the washing procedure was experimentally tested by mineralizing the whole bryophyte sample and reached ~80% (POULÍČKOVÁ et al.

2001). Diatom frustules were mounted in Pleurax and identified according to KRAMMER & LANGE-BERTALOT (1986, 1988, 1991a,b). Relative abundances (%) of individual diatom species in samples were estimated by counting of 400 individuals in permanent preparations.

Results and discussion

The influence of moisture on the horizontal distribution of algae in the spring areas of West Carpathians were studied previously on linear transects from the most wet places to the most dry places (KŘENKOVÁ 2000). The diatom abundance, species richness and diversity were increasing with the increasing moisture. On the other hand, species dominance was increasing with the decreasing moisture (KŘENKOVÁ 2000).

According to the previous results, three sites were chosen – the most dry place, the most wet place and the place with moderate wetting. The relationship between the total algal abundance and water content is presented in Fig. 1. The abundance of algae significantly increased with the increasing water content.
The total abundance of algae in different layers and sites is presented in Fig. 2. At the most dry site (Fig. 2A), the number of algae is increasing with increasing depth. The site with moderate wetting can be characterized by well-balanced numbers in depths 4-16 cm under the surface (Fig. 2B). The highest number of algae in the upper part of *Sphagnum* plant (depth 4-6 cm) was observed at the most wet places (Fig. 2C).

The different vertical distribution of algae on mosses were previously observed in the Nature Reserve Adršpašsko-Teplické rocks (NOVÁKOVÁ 2002). The first type of distribution, with the highest numbers in the deepest part was observed near the pools or streams, where the substrate can be considered as the source of moisture. The opposite situation with the highest numbers near the surface were observed on rocks, where the air humidity represents the only source of moisture (NOVÁKOVÁ 2002).

Algal assemblages on mosses are mostly (80 – 90%) represented by diatoms (POULÍČKOVÁ et al. 2000), from other algal groups Desmidiales were frequently found, especially at acidic poor fens (*Actinotaenium, Closterium, Cosmarium, Euastrum, Mesotaenium, Netrium, Xanthidium)*. Cyanophytes were found at alkaline springs (*Cyanothece*, *Chroococcus*, *Nostoc*, *Oscillatoria*) (POULÍČKOVÁ et al. 2000).

The representation of other algae in different layers is presented in Fig 3. Mooreover, the representation of empty diatom frustules (which were not included in total abundances) is marked. The representation of other algae is decreasing with increasing depth, in the case of empty diatom frustules the opposit tendency was observed (Fig. 3). The deepest part of the *Sphagnum* plants represents probably the light limited environment, thus only selected algae, tolerating such conditions by mixotrophic nutrition, are able to survive there (POULÍČKOVÁ 1987).

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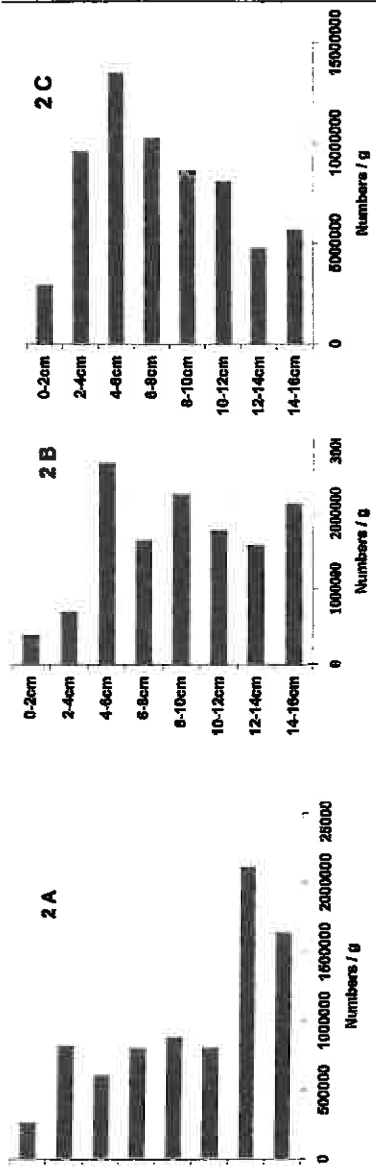

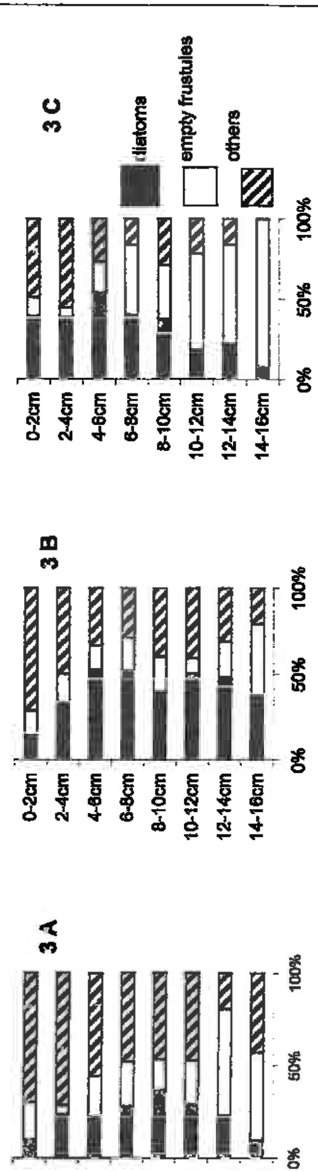

Fig. 2: Vertical distribution of algae at sites with different moisture (A – dry, B –middle, C – wet)

Fig. 3: The representation of algae in different layers at sites with different moisture (A – dry, B –middle, C – wet)

Fig. 1: Relationship between moisture and number of algae (abundance in individuals per 1 g of dry bryophyte matter, water content in g of water per 1 g of dry bryophyte matter)