Nowellia bryologica

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Fiche de récolte d'une bryophyte à identifier

Pays: ..... Province: .....

Localité :..... Lieu-dit: .....

Localisation latitude:..... Longitude: .....

Carré UTM : ..... Carré IFBL : .....

Coordonnées GPS: ..... Système coordon. utilisé: .....

Marque GPS et modèle: .....

Description du milieu où la récolte a été réalisée *(le plus exhaustif possible s.v.p.)* :
.....
.....
.....
.....
Date de la récolte *(jour/mois/année)* : .....

Exposition du substrat :.....
.....

Indices particuliers du substrat *(remblais, écorce morte, présence de tas de déchets miniers, feux au sol,...)* :.....
.....
.....
.....

Réponse(s) relative(s) à la détermination :

Nom de l'échantillon : .....

Hépatique O Sphaigne O Mousse O

A.) dans le milieu de récolte :

O très abondante O rare O très rare

B.) la zone de récolte : O mérite O ne mérite pas d'avoir une protection effective , mais demande une étude complémentaire , que nous vous demandons d'effectuer ou que vous souhaitez voir herborisée en détail.

Coordonnées complètes du récolteur:

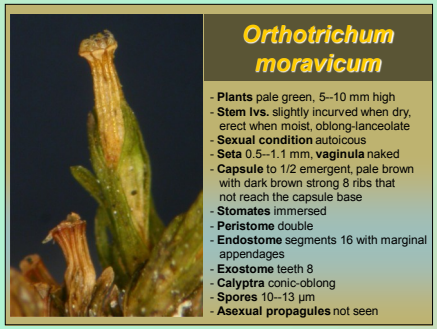
Nom : Prénom:
Date de naissance: Profession:
Adresse complète s.v.p. :

Code postal: Ville: Pays:
Téléphone : Télécopieur:
GSM: Courriel:

Remarque: le récolteur cède la propriété de l'échantillon et des photos à Nowellia bryologica (c./o. Ph. De Zuttere) afin qu'ils soient incorporés à l'herbier bryophytique.

Infographisme : C. Cassimans SDFAM 57127

NOWELLIA BRYOLOGICA



Orthotrichum moravicum

- **Plants** pale green, 5--10 mm high
- **Stem lvs.** slightly incurved when dry, erect when moist, oblong-lanceolate
- **Sexual condition** autoicous
- **Seta** 0.5--1.1 mm, **vaginula** naked
- **Capsule** to 1/2 emergent, pale brown with dark brown strong 8 ribs that not reach the capsule base
- **Stomates** immersed
- **Peristome** double
- **Endostome** segments 16 with marginal appendages
- **Exostome** teeth 8
- **Calyptra** conic-oblong
- **Spores** 10--13 µm
- **Asexual propagules** not seen

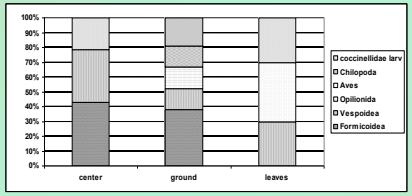
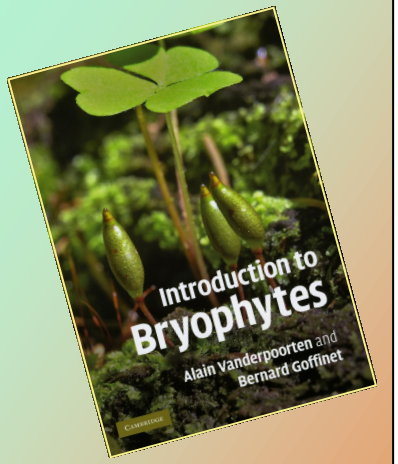


Fig 2: Proportion of predator taxa in different microhabitats within *Vaccinium* in the Jeseniky Mountains.



Revue spécialisée de bryologie
Numéro 38 — décembre 2009
Vierves-sur-Viroin (Belgique)

NOWELLIA BRYOLOGICA

Revue spécialisée de bryologie
Numéro 38 — décembre 2009 ISSN : (1377 - 8412)

Sommaire :

Nowellia bryologica est une revue de bryologie adressée aux bryologues amateurs et professionnels .

Elle est ouverte à tout bryologue belge ou étranger qui souhaite y publier un article. Les langues acceptées sont le français, le néerlandais, l'allemand et l'anglais. Nous souhaitons que les auteurs envoient un tirage de leur article sur papier blanc normal (format A4) et, dans la mesure du possible, le texte sur support informatique (rédigé avec Word pour PC) tel qu'une disquette 3,5 pouces, zip 100 MB., Cdrom, … Les articles publiés dans *Nowellia bryologica* n'engagent que la responsabilité de leur(s) auteur(s) .

Éditeur responsable : Ph. De Zuttere
Dactylographie, mise en page & illustrations : C. Cassimans (SOFAM 57/27)

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voir aussi : **http://users.skynet.be/fb062663/nowellia.htm**

Préface

Comme vous le remarquerez, ce numéro 38 de notre revue ne comporte que deux articles « belges » tandis que vous trouvez 4 articles de nos collègues bryologues des pays de l'Est.

Ceci est dû au fait que notre Rédacteur en Chef a malencontreusement rencontré deux problèmes de santé sur un laps de temps court et qu' il n'a pas été en mesure de vous livrer les articles prévus initialement.

Tout sera mis en œuvre pour vous les proposer dans le prochain numéro de juin 2010.

Nous profitons du présent numéro pour vous présenter nos vœux les meilleurs pour l'année 2010 qui approche à grands pas.

Que votre santé soit rayonnante et que vos prospections bryologiques vous amènent de grandes satisfactions.

Bonne et heureuse année 2010 !

First of all I should like to say that our periodical contains only two "Belgian" articles whereas you find 4 articles from our Eastern bryologic colleagues.

It is due to health problems of our general editor and he couldn't unfortunately provide the originally foreseen articles.

We will put all available means to propose them in the next number of June 2010.

We take advantage of this number to send you all our best wishes for the coming 2010.

We wish you good health and gratifying bryologic prospecting.

Happy New Year 2010 !

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COMMUNICATIONS

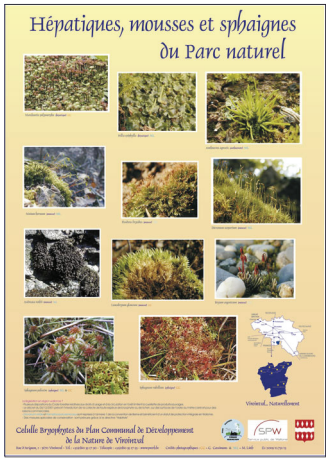
Les personnes qui souhaiteraient une version PDF (**Acrobat / *Adobe*®**) du numéro 27 (Bibliographie bryologique) peuvent nous en faire la demande à nowellia@skynet.be

De même, pour les personnes qui n'ont pas su participer au ***Colloque international de Bryologie d'août 2005, de juin 2007***, il est possible d'obtenir une version « papier » et/ou PDF des actes du colloque. Veuillez dès à présent nous le faire savoir à nowellia@skynet.be

Disponible aussi : la nouvelle **checklist européenne 2006** des noms de mousses obtenue grâce à l'excellente collaboration avec Mr. Mark HILL (UK). Pour l'obtenir, communiquez-nous votre adresse ***E-mail*** ou téléchargez-la à : http://www.britishbryologicalsociety.org.uk/

Un nouveau poster bryophytes !

Ce nouveau poster a été réalisé par la Cellule Bryophytes du PCDN de Viroinval (*Plan Communal de Développement de la Nature*).



Au format 50x70 cm avec des photos de qualités, il présente quelques espèces courantes présentes dans le Parc naturel Viroin-Hermeton.

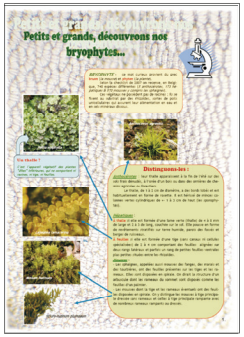
Pour l'obtenir :

- vous venez à la Maison du Parc Naturel, rue d'Avignon, 1 à 5670 Nismes, en semaine de 8h à 16h et on vous en remet un exemplaire (jusqu'à épuisement du stock).
- Vous nous envoyez votre nom, prénom et adresse complète ainsi que 5 unités de timbres-postes autocollantes (non collées !) et on vous envoie un exemplaire plié au format A4 sous enveloppe.
- Vous le téléchargez sur ***www.pnvh.be***

De bonnes découvertes bryophytiques !

Un nouveau document pédagogique

Comme première réalisation en 2009, un document pédagogique destiné au grand public a été édité grâce à une subvention (fiche-projet 2008) rentrée dans le cadre des actions du PCDN—Cellule bryophytes.



Il se nomme « ***Petits et grands, découvrons les bryophytes*** ».

Ce document de 8 pages A4 reprend les explications de base sur la vie des bryophytes (anthocérotes, hépatiques, mousses et sphaignes) ainsi que leur mode de reproduction.

Des chapitres simples mais précis abordent les aspects de protection légale, d'utilisation des bryophytes, des menaces, leur utilité, etc.

Au centre un mini-poster au format A3 illustre quelques exemplaires présents dans le Parc naturel Viroin-Hermeton.

Pour l'obtenir :

- envoyer votre nom, prénom, adresse complète et deux unités de timbres-poste autocollants (non collées!) à notre secrétariat :
  PCDN-Cellule bryophytes Rue d'Avignon, 1—5670 Nismes.
- vous venez à la Maison du Parc Naturel, rue d'Avignon, 1 à 5670 Nismes, en semaine de 8h à 16h et on vous en remet un exemplaire (jusqu'à épuisement du stock).
- vous pouvez aussi le visionner sur **www.pnvh.be** à la rubrique « PCDN-média » puis « téléchargements » puis « PCDN posters »

Au sommet de la tour Brassico à Ghlin (prov. Hainaut)

C. Cassimans (Col. De Zuttere, Ph.)

Résumé : un univers hostile tel qu'une toiture industrielle en roofing recèle la présence de deux bryophytes et une phanérophyte.

Samenvatting : Desondanks een onvoordelige biotoop zoals een industriële roofingdakbedekking werden twee bryofieten en één fanerofyt aangetroffen.

Summary : Despite a disadvantageous biotope such as an industrial roofing covering were two bryophytes and one phanerophyte found.

Dans le cadre de nos activités professionnelles en vue de l'installation éventuelle d'un pont WI-FI (*liaison internet par ondes hertziennes*), il nous a été possible de visiter le sommet de la Tour Brassico, située dans le zoning privé ***Q Invest*** à Ghlin, grâce à M. Bondroit gestionnaire du site.

Du haut de ses huit étages, à 45 m. du sol, la vue est imprenable sur le Borinage !

Contrairement à nos attentes, les deux parties de la toiture recouvertes par du roofing et lestées par des galets ronds, hébergent deux espèces de bryophytes et une phanérophyte.

Vue du sommet de la tour

1.) Historique de la tour Brassico

Il faut remonter à 1873 et 1875 lors de l'installation à Bruxelles, dans le quartier Nord, de la brasserie Caulier-Sapin qui va ensuite s'étendre et devenir en 1959 une s.a. lors de sa fusion avec la brasserie d'Anderlecht.

Mais, en 1960, une nouvelle société anonyme est créée, la « Brasserie de Ghlin s.a. » grâce à l'apport de bâtiments à Bruxelles, Anvers, Anderlecht et Mons, ainsi qu'une importante quantité de matériel de brassage installé à Ghlin.

Début des années 70, elle fut reprise par un brasseur américain (Schlitz) qui tenta de s'établir en Europe. Suite à cet échec, il fut demandé par le premier-ministre Leburton que les brasseries Piedboeuf et Artois s'accordent pour continuer les activités de la Brasserie de Ghlin. Ce fut la naissance de Belbrew, qui devint Interbrew et maintenant Inbev.

Dès 1971, des investissement furent consentis à Ghlin pour produire la « Jupiler 5 ».

Hélas, le 2 juillet 1993, un dernier soutirage de 36.000 bouteilles de

Jupiler, destinées au personnel, eut lieu suite à la décision d'Interbrew de cesser les activités.
Le site fut reconverti en zoning industriel ; la Tour Brassico fut victime d'un incendie et actuellement un projet de réaffection économique est en cours.

Grimmia pulvinata photo : M. Lüth

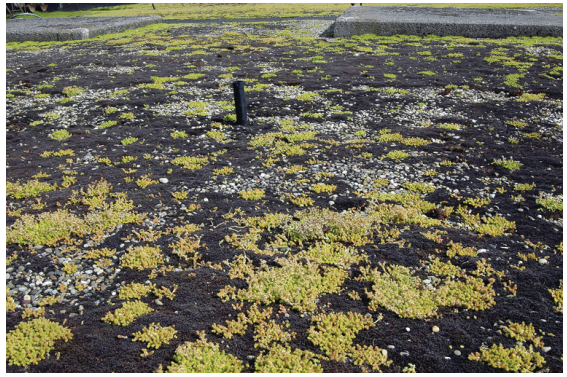
2.) Les espèces vues

Durant notre bref passage, nous avons pu découvrir en grosse majorité des tapis de *Syntrichia (Tortula) ruralis* et, sur certains murets, *Grimmia pulvinata* (***cf. Nowellia bryologica n° 32 - juin 2007 - page 29 pour les caractéristiques des deux espèces***).

Le substrat est constitué d'une charge de galets ronds posés sur la toiture en roofing.

Les conditions de sécheresse sont fortes en été vu qu'il n'y a pas d'ombre au-dessus de ces plantes et, par contre, lors des pluies importantes, il peut y avoir une période d'inondation relativement courte, le temps que la toiture se vide de l'eau tombée.

Nous avons aussi rencontré le *Sedum acre*, plante grasse particulièrement bien adaptée à ces milieux secs.



Tapis de bryophytes et de Sedum acre

3. Bibliographie :

- **Dirßen, K. 2001** . - Distribution, ecological amplitude and phytosociological characterization of European bryophytes. Bryophytorum Bibliotheca , Bd. 56 , J. Cramer, Stuttgart : 289 pp.
- **Hill, M.O. & al.,** 2006 . - Bryological Monograph. An annotated check-list of the mosses of Europe and Macaronesia. J. Bryol., 28 : 198-297 .

Publication des actes des Troisièmes Rencontres Bryologiques

Nous avons le plaisir de vous annoncer la sortie de presse des actes des « Troisièmes Rencontres Bryologiques Internationales » qui se sont tenues en juin dernier à Vierves-sur-Viroin.

L'ouvrage au format A4, accompagné d'un Cdrom, comporte 173 pages qui reprennent les communications présentées durant ces rencontres, les montages powerpoint présentés lors des communications ainsi que diverses listes d'espèces observées par les participants durant les excursions programmées.

Pour obtenir l'ouvrage il suffit d'exécuter un virement international européen de type SEPA à savoir :

Bénéficiaire : PCDN Viroinval-cellule bryophytes
Code IBAN : BE36.6528.0624.4581
Code BIC : HBKABE22

Montant pour la Belgique : 25 euros à verser
Montant pour la France : 30 euros à verser

Dès réception du montant l'ouvrage vous sera envoyé par la poste.

of Europe.
R.B. Pierrot : Les Bryophytes du Centre-Ouest.
Hens Siebel en Heinjo During : Beknopte Mosflora van Nederland en België.

Dicranum scoparium photo : M. Lüth

Dicranum viride photo : M. Lüth

The Bryoflora of the Wigierski National Park (NE Poland)

Sylwia Wierzcholska, Vítězslav Plášek, Anna Krzysztofiak & Lech Krzysztofiak

Résumé : La bryoflore du Parc National Wigierski fait l'objet de recherches intensives depuis l'année 2008. La région étudiée se situe au N-E de la Pologne dans une aire créée lors de la glaciation au Quaternaire. Le territoire couvre environ 150 km^2. Une diversité géologique et phytogéographique importante semble être la raison principale de la grande richesse d'espèces de bryophytes. Il y existe une mosaïque variée de communautés de plantes. Parmi les habitats typiques, citons les forêts de conifères (*Querco roboris-Pinetum* et *Vaccinio uliginosi-Pinetum sylvestris*), les prés xérothermiques (*Festuco-Brometea*), les aires de sources, les marais, les tourbières et les vallées ombragées. Des reliques glaciaires, e.a. *Helodium blandowii*, *Scorpidium scorpioides*, *Paludella squarrosa*, *Tomentypnum nitens*, et des espèces protégées au niveau européen telles que *Dicranum viride* et *Hamatocaulis vernicosus* sont les espèces de bryophytes les plus intéressantes de la région.

Samenvatting : Sinds het jaar 2008 worden uitgebreide wetenschappelijke onderzoeken verricht naar de bryoflora van het Wigierski Nationaal Park. De onderzochte streek ligt in Noordoost-Polen, in een regio die zich tijdens de quartaire ijstijd ontwikkelde. Het gebied beslaat ongeveer een oppervlakte van 150 km^2. Een aanmerkelijke geologische en fytogeografische verscheidenheid blijkt de belangrijkste reden te zijn voor de vele soorten bryofieten. In het gebied bestaat er een gevarieerd mozaïek van plantengemeenschappen. Tussen de typische leefgebieden, kunnen we naaldwouden (*Querco roboris-Pinetum* en *Vaccinio uliginosi-Pinetum sylvestris*), xerothermische graslanden (*Festuco-Brometea*), brongebied, moerassen, veengronden en schaduwrijke stroomgebieden onderscheiden. Relikwieën uit de ijstijd, o.a. *Helodium blandowii*, *Scorpidium scorpioides*, *Paludella squarrosa*, *Tomentypnum nitens*, en Europese beschermde soorten zoals *Dicranum viride* en *Hamatocaulis vernicosus* zijn de interessantste soorten bryofieten in de regio.

The project has been carried out thanks to the support given by Iceland, Liechtenstein and Norway by financing it from the means of The European Economic Area Financial Mechanism and Norwegian Financial Mechanism, as well as thank to Polish budget.

1. Abstract :

The bryoflora of the Wigierski National Park is under extensive research since the year 2008. The study area is located in NE Poland in the region historically created by the Quaternary glacial. The territory covers about 150 km^2. A significant geological and phytogeographical diversity seems to be the main reason for high species richness of bryophytes. A various mosaic of plant communities was created here. Among typical habitats coniferous forests (*Querco roboris-Pinetum*) and (*Vaccinio uliginosi-Pinetum sylvestris*), xerothermic grassland (*Festuco-Brometea*), spring areas, mires, peat bogs and shaded stream valleys can be mentioned. Glacial relics, e.g. *Helodium blandowii*, *Scorpidium scorpioides*, *Paludella squarrosa*, *Tomentypnum nitens*, and protected European species such as *Dicranum viride* and *Hamatocaulis vernicosus* are the most interesting species of bryophytes in the area.

2. The study area :

Wigierski National Park (abbreviation WNP) was established on the first of January 1989. WNP is located in the North – Eastern part of Poland

near the Lithuanian border. The total area is 150 km² covered mainly by forests (about 62% of the area). A mosaic of forests, lakes, arable fields, meadows, peat-bogs and pastures is characteristic for the Park's landscapes (Kirpluk et al 2001).

From the geological view, the area is typical for early post-glacial landscape, built mainly by granites, gneisses, diorites, migmatites, and lamprophyres. In the composition of rocks formations sandstones, limestones, marlstones, claystones, slates comprise a lesser percentage. This kind of alkaline rocks can mainly be observed on the top of the hills, where xerothermic grasslands thrive (Solon 2001).

The landscape structure was built by the activity of the Scandinavian glacier during the Northern Polish glaciations. The impact of the activity formed valleys with steep slopes and uneven beds. Especially the Northern part of the Park is a typical example of glacial activity with many hills and elevations of the terminal moraine, relief-like sands, tills, gravels and glacial erratics. And the Southern part is composed merely of sander plains.

Mineral clays and sands are the main soils in the Park area. They are chemically and physically diverse and form a mosaic structure. Organic soils are typical of deep beds and lakes. They are peats, peat-silts and gyttias (Smolska & Szulc-Rojan 2001).

All the area described lies in the Czarna Hańcza and Kamionka basin, and its central part is Wigry lake, the deepest one (75 m) in the Park. Furthermore, there are a few dystrophic lakes surrounded by peat-bogs and located among forest communities (Bajakiewicz-Grabowska 2001).

The climate is under the influence of the Baltic Sea air mass and the continental impact with polar-continental air mass. Precipitation is very slight. The average annual amount of precipitation is about 600 mm. Average annual air temperature is 6.3 °C (Kicińska et al. 2001)

3. Results :

WNP is characterized by a richness of the flora which reflects the diversified relief as well as the mosaic of habitats stemming from the relief. From amongst all the recorded taxa, we have chosen the most interesting to be commented in the article. The mentioned-below species were divided according to different types of habitat.

Coniferous forests. Coniferous forests prevail among the forests within the Park territory. Associations and communities consisting of syntaxa from the *Vaccinio-Piceeta* class (*Querco-Piceetum, Sphagno girgensoh-*

Dicranum scoparium une mousse commune aux caractéristiques bien marquées

Wielant, L.

Résumé : *Dicranum scoparium* est une mousse assez commune. Nous en donnons içi les principales caractéristiques aux néophytes et débutants.
Samenvatting :*Dicranum scoparium* komt redelijk algemeen voor. Hierbij geven wij, voor neofieten en beginnelingen, de karakteristieken ervan.
Summary : *Dicranum scoparium* is a rather common moss. The main characteristics are given for neophytes and beginners.

Au cours d'un sortie en forêt votre attention peut être attirée par des tapis ou des coussinets de mousse plus ou moins lâche vert jaune à vert olive d'une hauteur de un à six centimètres et dont la majorité des feuilles est tournée d'un même côté, un peu comme l'étaient les balais usagés en bruyère, bouleaux ou genêts de nos aïeux. Si vous êtes en milieu plutôt acide, il y a de bonnes chances que vous ayez rencontré *Dicranum scoparium*.

C'est le moment d'utiliser la loupe (grossissement au moins dix fois, tenue très près de l'œil et à contre-jour).

D'abord, outre que les feuilles soient falciformes et tournées du même côté, la partie supérieur de celles-ci est vaguement ondulée et nettement dentée.

Sur la tige, vous apercevrez un tomentum (sorte de manchon formé par de très nombreux rhizoïdes groupés autour d'un organe).

Pour plus de certitudes, c'est le moment de prélever un échantillon pour l'examen microscopique.

Quelques feuilles entre lame et lamelle montreront clairement leur extrémité dentée, tandis que le bord du reste du limbe est entier. La nervure se termine dans l'apex.

Une coupe perpendiculaire des feuilles révélera les lamelles courant sur la nervure.

N.B. : pour la coupe, il existe plusieurs méthodes, la plus simple, que je vous conseille pour sa rapidité est celle dite du hachis.

Attention, il existe en Belgique une douzaine de *Dicranum* : *D. majus*, plus grand, aux feuilles plus longues. Fortement recourbées, régulières. *D. tauricum*, dont le bout des feuilles est très fragile et casse au toucher. *D. undulatum (= bergeri)*, *bonjeanii* aux feuilles ondulées, *fuscescens* ,aux feuilles crispées à sec *flagellare*, *fulvum*, *montanum*, *polysetum*, *spurium*, *viride*.

Bibliographie

A.J.E. Smith : The Moss Flora of Britain and Ireland.
W. Fry, J.-P. Fraham, E. Fisher and W.Lobin : The Liverworths, Mosses and ferns

Oechel W.C. & Van Cleve K., 1986: The role of bryophytes in nutrient cycling in the taiga. In: Van Cleve K., Chapin III F. S., Flanagan P.W., Viereck L.A. & Dyrness C.T. (eds.), Forest Ecosystems in the Alaskan Taiga. Springer, New York, pp. 121–137.

Smrz J., 1992: The ecology of the microarthropod community inhabiting the moss cover of roofs. Pedobiologia, 36: 331–340.

Steiner W., 1994: The influence of air pollution on moss-dwelling animals: 1. Methodology and composition of flora and fauna. Revue Suisse de Zoologie, 101: 533–556.

Strong J., 1967: Ecology of terrestrial arthropods at Palmer Station, Antarctic Peninsula. In: Gressitt, J. L. (ed) Entomology of Antarctica. Antarctic Research Series. American Geophysical Union 10, pp. 357-371.

Suren A.M., 1993: Bryophytes and associated invertebrates in first-order alpine streams of Arthur's Pass, New Zealand. New Zealand Journal of Marine and Freshwater Research 27: 479–494.

Tilbrook P.J., 1967: Arthropod ecology in the maritime Antarctic. In: Gressitt, J. L. (ed.) Entomology of Antarctica. Antarctic Research Series. American Geophysical Union 10, pp. 331-356.

Turetsky M.R., 2003: The Role of Bryophytes in Carbon and Nitrogen Cycling. The Bryologist 106(3): 395-409.

Eurhynchium angustirete photo : M. Lüth

nii-Piceetum,*Vaccinio uliginosi-Pinetum sylvestris* and *Querco robis-Pinetum*) cover a wide area in the WNP. The bryoflora is relatively rich, and thanks to moisture microclimate conditions the species create large populations here. Bryophytes of coniferous forest are represented by e.g. *Hylocomium splendens*, *Nowellia curvifolia*, *Ptilium crista-castrensis* or *Bazzania trilobata*.

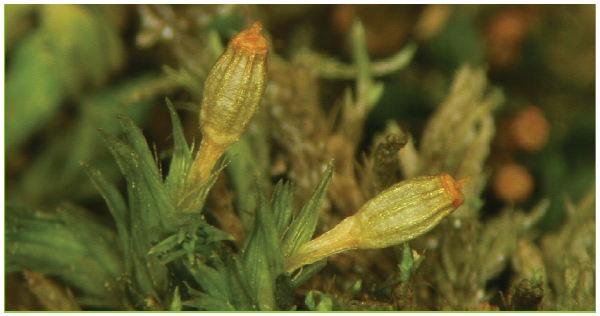
Deciduous forests. The best developed and most diverse bryophytes occurred in the riverside alder forest and riparian forest. In these kinds of communities e.g. *Dicranum viride*, *Conocephalum conicum*, *Plagiochila asplenioides*, *Brachythecium* sp. div., *Plagiomnium* sp. div. and others grow.

Solitary trees. The bark of solitary deciduous trees such as *Acer* sp. div., *Fraxinus excelsior*, *Salix* sp. div., *Populus* sp. div., or cultivated apple trees (*Malus domestica* s.l.) is often covered by epiphytic bryophytes. *Platygyrium repens*, *Pylaisia polyantha*, *Orthotrichum speciosum*, *O. diaphanum* or *O. pumilum* can be mentioned among common species, whereas *Orthotrichum stramineum*, *Ulota bruchii* or *U. crispa* are rarely found.

Paludicolous habitats. Bryophytes associated with paludicolous habitats occur in different types of mires. In the WNP three types of mires classified on the basis of their mode of water supply can be observed. These are fens, poor-fens and bogs from the *Scheuchzerio-Caricetea nigrae* and *Oxycocco-Sphagnetea* classes. In the whole bryoflora of the WNP these types of habitats play a significant role. Fens are the more precious types. The most important species associated with this kind of habitat are the glacial relics e.g. *Helodium blandowii*, *Scorpidium scorpioides*, *Paludella squarrosa* and *Tomentypnum nitens*.

Poor-fens are built mainly by *Sphagnum* species as well as the above-mentioned rare species from fens. Bogs represent a lesser percentage of all mires types and are formed in the surroundings of dystrophic lakes. This type is composed mainly of *Sphagnum* species e.g. *S. magellanicum, S. rubellum, S. warnstorfii, S. fuscum* and other bryophytes such as *Calypogeia sphagnicola, Cladopodiella fluitans, Mylia anomala, Warnstorfia fluitans* and *Odontoschisma denudatum* (Karczmarz & Sokołowski 1985).

Orthotrichum stramineum



Xerothermic grasslands. Very small patches of calcicole grasslands are consist of the *Festuco-Brometea* class. This kind of habitat is very rare for the described area and

grows in a few places only. Species related to these associations are *Encalypta vulgaris, Campyliadelphus chrysophyllus, Abietinella abietina, Bryoerythrophyllum recurvirostrum, Entosthodon fasciculatus, Fissidens dubius* var. *mucronatus Tortula modica, Tortula acaulon, Niphotrichum elongatum, N. canescens, Brachythecium albicans* and *Syntrichia ruraliformis*.

Peatbogs

Arable fields. Owing to the ability of bryophytes to complete their life-cycle in very short time periods they can survive in the arable environment. During the late autumn months an interesting flora with such species as *Ephemerrum serratum* var. *angustifolium, Tortula acaulon, Tortula modica, Physcomitrium pyriforme, Fossombronia wondraczekii* and *Bryum rubens* can be observed. Nevertheless, the total lack of hornworts is a surprising fact and is apparently caused by to pure, unfruitful, arenaceous soil.

Rock habitats. Epilitic species growing on the surface of the glacial erratics occure in the Northern part of the WNP. *Hedwigia ciliata, Sciurohypnum plumosum, Schistidium apocarpum, Dryptodon pulvinatus, Orthotrichum cupulatum* and *O. anomalum* where collected there.

4. Conclusions :

The above-mentioned species are only a part of all the recorded bryophytes in the WNP. In this paper very interesting species were presented in the light of their habitat. The bryoflora of the WNP consists of species threatened in Poland (Żarnowiec et al. 2004) such as *Cladopodiella fluitans* (V), *Dicranum viride* (R), *Entosthodon fascicularis* (R), *Ephemerrum serratum* var. *angustifolium* (R), *Fossombronia wondraczekii* (E), *Helodium blandowii* (E), *Nowellia curvifolia* (V), *Orthotrichum stramineum* (V), *Palludella squarrosa* (E), *Scorpidium scorpioides* (E), *Ulota bruchii* (V), *U. crispa* (V) and of ones protected by European law (Schumacker & Martiny 1995) as *Hamatocaulis vernicosus* and *Dicranum viride*.

5. Literature :

Bajkiewicz-Grabowska E. : 2001. Stosunki wodne i ich wpływ na dynamikę środowiska przyrodniczego Wigierskiego Parku Narodowego. – *In*: Richling **A.**, Memoranda Societatis pro Fauna et Flora Fennica 65: 109-128.

Bonnet L., Cassagnau P. & Trave J., 1975: Ecology of moss-living arthropods by the light of factorial analysis of correspondences: Collembola and Oribata of Sidobre (Tarn, France). Oecologia 21: 359-373.

Booth R.G. & Usher M.B., 1984: Arthropod communities in a maritime Antarctic moss-turf habitat: Effects of the physical and chemical environment. Journal of Animal Ecology 53: 879-893.

Booth R.G. & Usher M.B., 1986: Arthropod communities in a maritime Antarctic moss turf. Habitat, life history strategies of the prostigmatid mites. Pedobiologia 29: 209-218.

During H.J. & Van Tooren B.F., 1990: Bryophyte interactions with other plants. Botanical Journal of the Linnean Society. 104(1-3): 79-98.

Englund G., 1991: Effects of disturbance on stream moss and invertebrate community structure. Journal of the North American Benthological Society 10: 143–153.

Fraembs H., 1994: The importance of habitat structure and food supply for carabid beetles (Coleoptera, Carabidae) in peat bogs. Symposium on Terrestrial Peatland Arthropods, Montreal, Quebec, Canada, 1991 Memoirs of the Entomological Society of Canada 69: 145-159.

Gerson U., 1969: Moss-arthropod associations. Bryologist 72: 495-500.

Gerson U., 1982: Bryophytes and Invertebrates. In: Smith, A.J.E., Bryophyte Ecology. Chapman and Hall, London, pp. 291–332.

Gerson, U., 1987: Mites which feed on mosses. Symposia Biologica. Hungarica 35: 721-724.

Glime J. M., 1994. Bryophytes as homes for stream insects. Hikobia 11: 483-497.

Glime J.M., Wetzel R.G. & Kennedy B.J., 1982: The effects of bryophytes on succession from alkaline marsh to *Sphagnum* bog. American Midland Naturalist, 108(2): 209–223.

Habdija I., Primc Habdija B., Matoničkin R., Kučinić M., Radanović I., Miliša M. & Mihaljević Z., 2004: Current velocity and food supply as factors affecting the composition of macroinvertebrates in bryophyte habitats in karst running water. Biologia, Bratislava, 59: 577 – 593.

Heino J. & Korsu K., 2008: Testing species-stone area and species-bryophyte cover relationships in riverine macroinvertebrates at small scales. Freshwater Biology 53(3): 558 – 568.

Henrikson B.I., 1993 *Sphagnum* mosses as a microhabitat for invertebrates in acidified lakes and the colour adaptation and substrate preference in *Leucorrhinia dubia* (Odonata, Anisoptera). Ecography 16: 143-153.

Hodkinson I.D., Coulson S.J. & Webb N.R., 2003: Community assembly along proglacial chronosequences in the high Arctic: vegetation and soil development in north-west Svalbard. Journal of Ecology, 91: 651–663.

Kinchin I.M., 1990: The moss fauna 3: Arthropods. Journal of Biological Education 24(2): 93–99.

Lindegaard C. & Thorup J., 1975: The invertebrate fauna of the moss carpet in the Danish spring Ravnkilde and its seasonal, vertical, and horizontal distribution. Archives of Hydrobiology 75: 109-139.

Marsh W.M. & Koerner J.M, 1972: Role of Moss in Slope Formation. *Ecology 53(3):* 489-493.

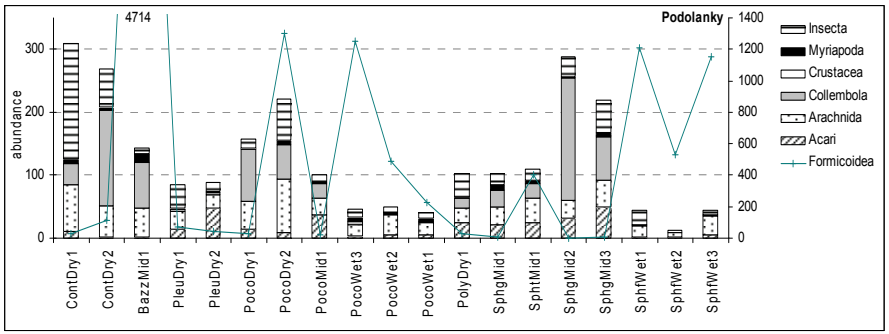


Fig 1-5: Abundance of taxonomical groups in the pitfall traps. Because of strong bias, ants (Formicoidea) were drawn separately for Podolánky data. Abbrev of mosses: Poco – *Polytrichum commune*, Poly – *Polytrichastrum formosum*, Spht – *Sphagnum teres*, Sphg – *S. girgensohnii*, Sphf – *S. fallax*, Bazz – *Bazzania trilobata*, Pleu – *Pleurozium schreberi*., Eurh – *Eurhynchium angustirete*, Olig – *Oligotrichum hercynicum*, Spha – *Sphagnum* spp., Cont – litter. Moisture: high – Wet, middle – Mid, low – Dry.

5. Acknowledgements

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6. References

Andre H.M., 1983: Notes on the ecology of corticolous epiphyte dwellers. 2. Collembola. Pedobiologia 25: 271–278.

Andrew N.R., Rodgerson L. & Dunlop M., 2003:Variation in invertebrate–bryophyte community structure at different spatial scales along altitudinal gradients. Journal of Biogeography 30: 731–746.

Badcock R.M., 1949: Studies in stream life in tributaries of the Welsh Dee. Journal of Animal Ecology 18: 193-208.

Barendse J., Mercer R.D., Marshall D.J. & Chown, S.L., 2002: Habitat specificity of mites on sub-Antarctic Marion Island. Environmental Entomology 31(4): 612-625.

Bengtson S.-A., Fjellberg A. & Solhy T., 1974: Abundance of tundra arthropods in Spitsbergen. Entomologica Scandinavica 5: 137-142.

Biström, O. & Pajunen, T., 1989: Occurrence of Araneae, Pseudoscorpionida, Opilones, Diplopoda, Chilopoda and Symphyla in *Polytrichum commune* and *Sphagnum* spp. moss stands in two locations in southern Finland.

Solon :J. (eds.). 2001. Z badań nad strukturą i funkcjonowaniem Wigierskiego Parku Narodowego. Praca zbiorowa. Dialog, Warszawa, pp. 55-82.

Karczmarz K. Sokołowski A.J.: 1985.Brioflora projektowanego Wigierskiego Parku Narodowego. Annales Universitatis Mariae Curie-Skłodowska, Lublin, Sectio C, vol. XL (18): 193-213.

Kicińska B., Olszewski K., Żmudzka E.: 2001. Warunki klimatyczne i topoklimatyczne Wigierskiego Parku Narodoweo. – *In*: Richling A., Solon J. (eds.). 2001. Z badań nad strukturą i funkcjonowaniem Wigierskiego Parku Narodowego. Praca zbiorowa. Dialog, Warszawa, pp.47-54

Kirpluk I., Kukier-Wyrwicka M., Werblan-Jakubiec H.: 2001. Ogólna charakterystyka flory i wybrane zagadnienia kształtowania różnorodności florystycznej. – *In:* Richling A., Solon J. (eds.). 2001. Z badań nad strukturą i funkcjonowaniem Wigierskiego Parku Narodowego. Praca zbiorowa. Dialog, Warszawa, pp. 101-122

Schumacker R., Martiny P. 1995.: Red Data Book of European bryophytes. Part 2. Threatened bryophytes in Europe including Macaronesia. – The European Committee for Conservation of Bryophytes, Trondheim: pp. 29-193.

Smolska E, Szulc-Rojan E. : 2001. Budowa geologiczna i rzeźba terenu Wigierskiego Parku Narodowego. – In: Richling A., Solon J. (eds.). 2001. Z badań nad strukturą i funkcjonowaniem Wigierskiego Parku Narodowego. Praca zbiorowa. Dialog, Warszawa, pp. 35-46.

Solon J.: 2001. Ogólna charakterystyka szaty roślinnej Wigierskiego Parku Narodowego. – In: Richling A., Solon J. (eds.).2001. Z badań nad strukturą i funkcjonowaniem Wigierskiego Parku Narodowego.Praca zbiorowa. Dialog, Warszawa, pp. 95-100

Żarnowiec J., Stebel A., Ochyra R. : 2004. Threatened moss species in the Polish Carpathians in the light of a new Red-list of mosses in Poland. – *In*: A. Stebel & R. Ochyra (eds.), Bryological Studies in the Western Carpathians, Sorus, Poznań: pp. 9-28.

The Moss *Orthotrichum moravicum*, an endemic species of Moravskoslezské Beskydy Mts. (Western Carpathians Mountain Range)

Vítězslav Plášek & Jakub Sawicki

Résumé : Les bryophytes se reproduisent grâce à leurs spores ou leurs organes végétatifs. Leur distribution aisée sur de longues distances peut donner l'impression que les bryophytes sont largement répandues sur la Terre entière. En effet, beaucoup d'espèces (même stériles) font état de larges superficies transcontinentales. Mais d'un autre côté, il existe de nombreux exemples de distribution limitée à très limitée en dépit d'une riche production de diaspores. Ceci est expliqué par des niches écologiques étroites, l'âge des taxons, l'extinction locale ou des événements historiques comme des glaciations (Frahm 2008).

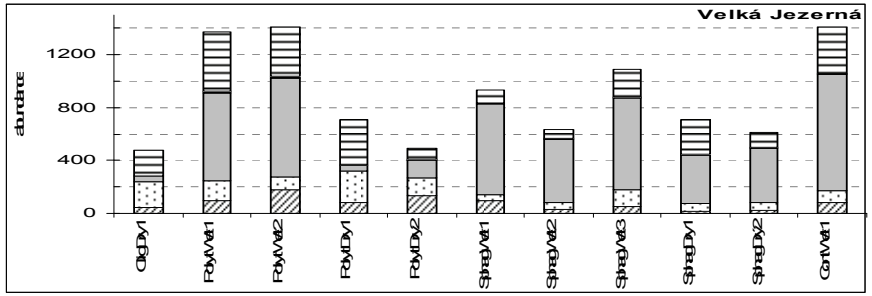
Samenvatting : De bryofieten planten zich voort met sporen of ongeslachtelijke broedknoppen. Hun gemakkelijke verspreiding over lange afstanden schept de indruk dat bryofieten over heel de Aarde voorkomen. Vele soorten (zelfs de steriele) komen inderdaad voor in uitgestrekte transcontinentale verspreidingsgebieden. Aan de andere kant zijn er veel voorbeelden van beperkte tot zeer beperkte verspreiding ondanks een overvloedige aanmaak van diasporen. Dit is te wijten aan de smalle ecologische nissen, de leeftijd van taxonomische groepen, het plaatselijk uitsterven of aan historische gebeurtenissen zoals ijstijdperken (Frahm 2008).

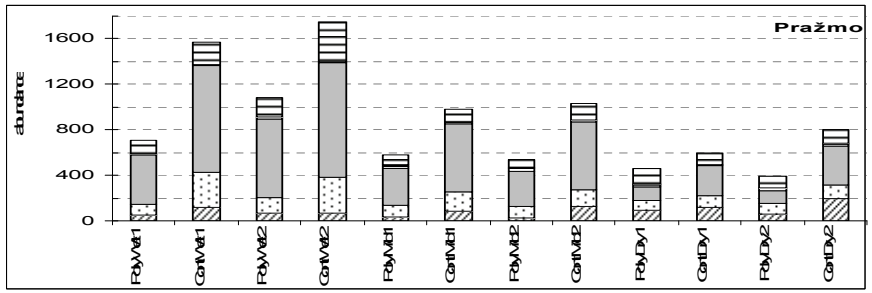
1. Abstract : The Bryophytes reproduce with the small spores or vegetative gemmae. Their easy distribution over long distances can create the impression that the bryophytes are widespread throughout the Earth. Indeed, many (even sterile) species show wide transcontinental ranges. But on the other hand, there are many examples of limited to very limited distribution in spite of a rich production of diaspores. These are explained by narrow ecological niches, age of taxa, local extinction or historical events such as ice ages (Frahm 2008).

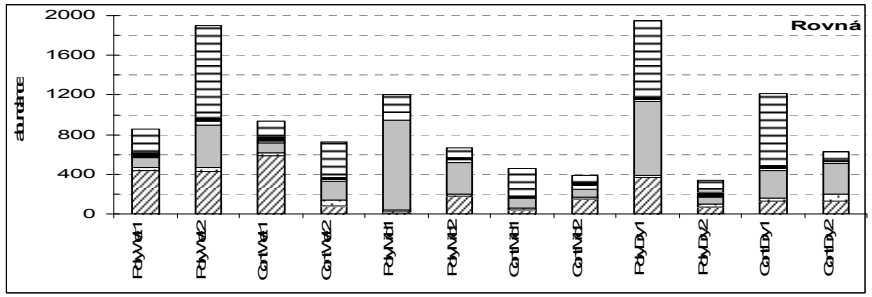
Orthotrichum moravicum

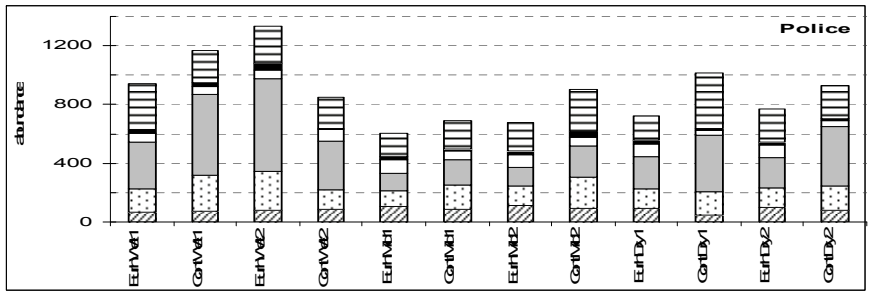
Among the representatives of the families Orthotrichaceae are known examples of endemic species in different geographical size, e.g. *O. subexsertum* (an African endemic), *O. transvaaliense* (an endemic of southeastern Africa), *O. kellmanii* (endemic moss of California), etc. During bryological research in the Western Carpathians, a new moss *Orthotrichum moravicum* Plášek & Sawicki was found in the Moravskoslezské Beskydy Mts. (Plášek et al. 2009).

The species seems to be as well an endemic species. It is known only from one locality (3 km NE of Bílá village, valley









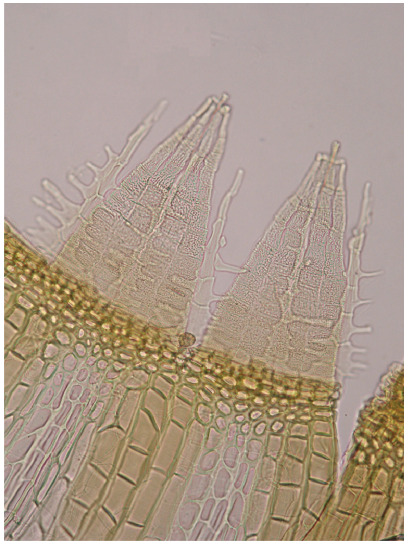
tors is obvious also for the remaining data but more variability and inconsistency occurs. Why one design produces consistent results and other inconsistent? We are convinced that we should search for the answer in scaling of habitat fragmentation. Bryophytes under slightly different conditions can form specific microhabitats even in relatively homogenous ecosystem. Significant contrast between cushion samples vs. controls can be concealed by other influences.

These findings also correspond with Andrew et al. (2003) and could be useful for explanation of their outcomes. They found different trends in abundance and diversity of invertebrate-bryophyte communities along altitudinal gradient (significance vary for different mountain complexes). To generalize and standardize their results we propose to use microhabitats characteristics as co-variables.

We are aware of a problematic interpretation of our study and the need of more complex experimental design to prove our conclusions. We suppose that identification into species level will give us more precise information for modeling interaction between arthropods and bryophytes. Such research is substantial to uncover the mechanisms forming the patterns of epigeic communities in forest ecosystems.

Tab 1: Summary of main characteristics for each site. M – traps in moss cushions, L – traps in litter. Distance means distance between traps. B – Beskydy Mts., H – Hostýnské vrchy Hills, J – Jeseníky Mts. Special design was at the Pražmo site where each moss trap was 2 m apart from the control and each pair about 10 m from other pairs.

Site	Altitude	Year	Distance	Studied mosses	Nr. traps
Rovná (B)	384 m a.s.l.	2005	>10 m	*Polytrichastrum*	6 M, 6 L
Pražmo (B)	500 m a.s.l.	2007	2 m & 10 m	*Polytrichastrum*	6 M, 6 L
Podolánky (B)	690 m a.s.l	2007	1.5 – 30 m	*Polytrichastrum, Polytrichum, Sphagnum* spp., *Bazzania, Pleurozium*	17 M, 2 L
Police (H)	432 m a.s.l	2008	>10 m	*Eurhynchium angustirete*	6 M, 6 L
Vel. Jezerná (J)	1200 m a.s.l.	2007	>10 m	*Polytrichastrum, Polytrichum, Sphagnum* spp., *Oligotrichum*	10 M, 1 L



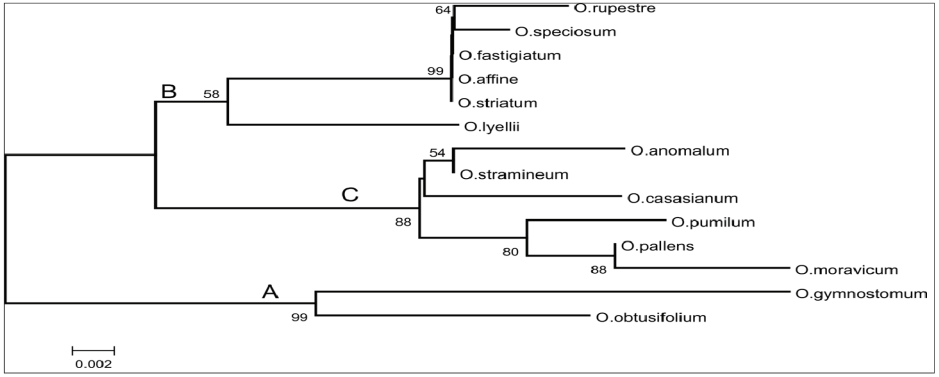
Detail view of exostome and endostome

of Chladná voda stream, 645 m a.s.l.) where its population grows on three trees (*Salix caprea*). Its occurrence in other parts of Moravskoslezské Beskydy Mts. is very unlikely, because the area was from 1999 under a detailed bryological research, during which about 3,000 samples have been studied.

Moreover, with regard to its remarkable morphological features (e.g. marginal appendages in the endostome segments) can be assumed that if the species was widespread, certainly would has been already found in the territory of other states of Europe.

There are known many examples of very small ranges or local endemism in bryophytes. This fact can be explained by exogenous effects such as narrow ecological requirements /climatic, habitat/ (Frahm 2008). But this explanation does not work for our case.

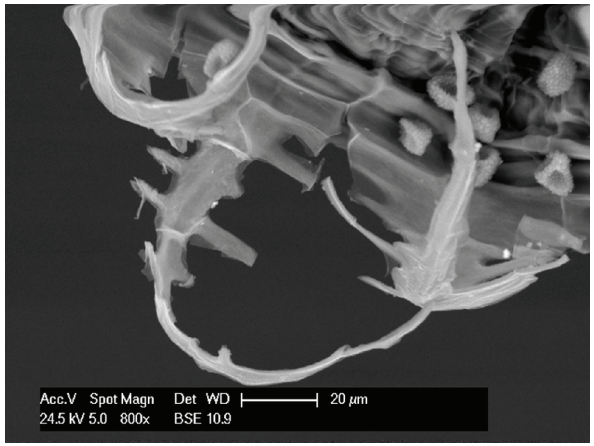
Locality, where the species was found, does not differ from other similar valleys in the studied area. Climatic conditions and composition of forest cover is analogous in the whole Moravskoslezské Beskydy mountain range.



Minimum evolution tree of the ITS2 sequences

Lack of strong geographic bariers in Western Carpatians do not support allopatric speciation. Except of *O. moravicum* only *Ochyraea tatrensis*, which grows in the Nizké Tatry National Park in Central Slovakia. Several other species, which were considered endemic for Werstern Carpa-

tians like *Bryum vilhelmii*, *Brachythecium vanekii* or *Oxyrrhynchium tatrense*, seems to be only a environmental forms of common species (Ochyra 1996). The other taxon desribed from Tatra Mountains, *Ulota rehmannii*, were also found in Alps and Caucas (Ignatov and Ochyra 1994).



SEM photo of endostome segments with marginal appendages

Based on previous studies its rather difficult to point out the closes relatives of *O. moravicum*. The analysis of nuclear ITS-2 regions showed closed relationships to morphologically similar *O. pallens* (Plášek et. al. 2009). However later studies based on whole ITS region including both spacer and sequences of ribosomal genes, resolved *O. moravicum* as sister taxa to *O. pumilum* and *O. diaphanum* (Sawicki et al. 2009).

The main problem is a low genetic variation of used regions among species of the genus *Orthotrichum* with immersed stomata and further studies based on more variable markers should deeper resolve phylogeny and relationships among these taxa.

2. References

Frahm, J.-P., 2008.— Diversity, dispersal and biogeography of bryophytes (mosses). - Biodivers Conserv 17:277–284.

Ignatov M.S., Ochyra, R., 1994. - Bryophytes of the Altai Mountains. IV. The genus *Ulota* (Orthotrichaceae, Musci).- Arctoa 3: 59-66.

Ochyra, R., 1996.— Mchy. In: Mirek Z., Głowaciński Z., Klimek K., Piękoś-Mirkowa H. (eds), Przyroda Tatrzańskiego Parku Narodowego. Tatrzański Park Narodowy, Kraków.

Plášek V., Sawicki J., Trávníčková V. & Pasečná M., 2009.— *Orthotrichum moravicum* (Orthotrichaceae), a new moss species from the Czech Republic.- Bryologist 112(2):329–336.

Sawicki J., Plášek, V., Szczecińska M., 2009.— Preliminary Studies on the Phylogeny of the Genus *Orthotrichum* Inferred from Nuclear ITS Sequences.- Ann. Bot. Fenn. (in press)

Olygotrichum hercynicum photo: M. Lüth

– Isopoda, Insecta, Myriapoda – including Chilopoda and Diplopoda, Collembola and Arachnida (including Araneida, Opilionida, Pseudoscorpionida, excluding Acarina). Other category Hymenoptera was consequently separated for the Podolanky site where ants represent 95 % of all insect individuals and produce a strong bias in final analyses (Fig 5).

At first sight there are several remarkable relationships between abundance, structure of association and observed factors. More precise analyses of data presented in figures 1–5 show that the moss presence, moss species and the moisture are very important characteristics for modeling the total abundance as well as abundances of studied taxonomical groups. The most noticeable difference between moss cushion and litter samples along moisture gradient we can see in Fig. 2 (data from Pražmo). Surprisingly the total arthropod abundance and abundance almost for all of the groups is higher in the litter samples than in moss cushions (linear model, $F = 35.5$, $p = 0.0003$).

There is also strong dependence on the moisture (linear model, $F = 49$, $p = 0.0001$) and even interactions of the factors is significant (linear model, $F = 5.8$, $p = 0.042$). These results proved the contrary of our predictions.

There are two reasons why one should assume higher or same abundance in moss cushions. At first, the distance between every moss sample and control litter sample was always 2 meters maximally and we expected homogenous spatial distribution surface active arthropods within the range of several meters. At second, higher abundance in moss cushions also results from concept that mosses provide a shelter against predators (e.g. Gerson 1982). However, this argument can also support the opposite explanation.

Considerable amount of surface active arthropods are predators searching for prey. Density of moss cushion does not allow them to move quickly and effectively thus they can avoid "the bushy obstacle". On the other hand bryophages and detritivorous arthropods have no reason to move all the time and the probability of capture in the traps is low. Of course low abundance can be caused by low nutrient availability for consumers (Gerson 1982) and the fact that arthropods use bryophytes as a shelter against predators and desiccation only temporarily.

The trend of different abundance in relation to the observed fac-

tic ecosystems (Tilbrook 1967, Strong 1967, Booth & Usher 1984, 1986, Bengtson et al. 1974), running water ecosystems (Badcock 1949, Habidja 2004, Heino & Korsu 2008, Lindegaard & Thorup 1975, Eglund 1991, Suren 1993, Glime 1994, Habidja 2004) or peatbogs (Henrikson 1993, Fraembs 1994). Only several authors analyzed associations of moss-dwelling arthropods in temperate terrestrial ecosystems (Gerson 1969, 1982; Bonnet et al. 1975; Biström & Pajunen 1989; Kinchin 1990; Smrz 1992; Steiner 1994, Andrew et al. 2003).

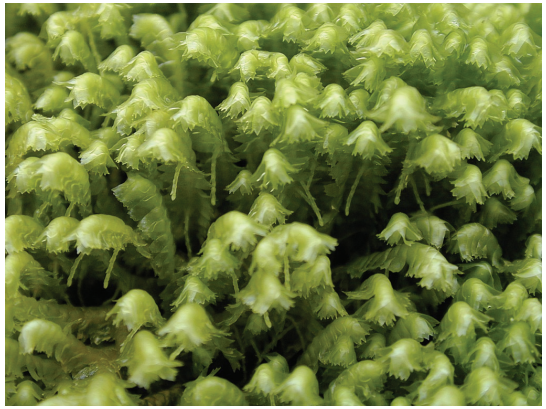
As we identified material into higher taxa level only at the present, our research is a preliminary analysis of the surface active arthropod samples from three mountain ranges. The main aim of the study is to describe general patterns of abundance and structure of the arthropod association in relation to moisture and the presence of the moss cushions.

3. Material and Methods

Pitfall traps with small roof were used to sample surface active arthropods from 3 sites at the Beskydy Mts., 1 site at the Jeseníky Mts. and 1 site at the Hostýnské vrchy Hills. Main characteristics of each site are given in Tab 1. Despite the designs differ site by site (distance between traps, altitude, number of the traps), traps were placed along humidity gradient at each site (semiquantitative scaling from low to high moisture) and moss cushions samples were compared with control samples from a litter (at two sites we can perform a comparison between several different moss species).

We sampled from following moss species: *Polytrichum commune* Hedw., *Polytrichastrum formosum* Hedw., *Sphagnum teres* (Schimp.) Ångström, *Sphagnum girgensohnii* Russow, *Sphagnum fallax* (H. Klinggr.) H. Klinggr., *Bazzania trilobata* (L.) Gray, *Pleurozium schreberi* (Brid.) Mitt., *Eurhynchium angustirete* (Broth.) T. J. Kop. and *Oligotrichum hercynicum* De Cand.

Bazzania trilobata photo: M. Lüth



4. Results and Discussion

More than 55,000 specimens were obtained from all 5 sites in total which means 850 individuals per trap in average. Although material was identified into orders or families (subsequently into species level in future) we used 6 main categories: Acarina, Crustacea

Predation risk for insects living in moss cushions: comparison between different strata of mountain forest

Drozdová M., Šipoš J. & Drozd P.

Résumé : La prédation est un procédé de grande importance affectant la distribution, l'abondance et la diversité des espèces dans les écosystèmes. Ainsi la recherche au niveau de la prédation est assez intensive pour le moment et des plans très sophistiqués sont développés pour mesurer les phénomènes complexes tels que l'existence de "ennemy free space" (aire sans ennemi) et d'interactions tritrophiques. Dans le cadre de nos recherches, nous utilisons des appâts vivants afin de mesurer le risque de prédation dans différents micro-habitats le long d'un axe vertical (surface du sol, coussins de mousses, buissons et troncs d'arbres).
L'hypothèse principale de nos recherches est que les coussins de mousses sont un habitat unique qui peut fournir un abri contre les prédateurs. En nous basant sur la comparaison du risque de prédation dans différentes couches dans deux habitats de montagne et de micro-habitats au sol (coussins de mousses versus litière), nous avons essayé de décrire la structure spécifique des prédateurs d'insectes, qui est probablement unique pour les micro-habitats bryologiques.

Samenvatting : Predatie is een belangrijke werkwijze die de verdeling, overvloed en soortendiversiteit in ecosystemen beïnvloedt. Zo zijn ecologische onderzoeken naar predatie op dit ogenblik heel intensief en worden heel verfijnde ontwerpen ontwikkeld om complexe fenomenen te meten zoals het bestaan van een ruimte zonder vijanden en tritrofische interacties. Voor ons onderzoek werd levend aas gebruikt voor de evaluatie van de predatiekans in verschillende microhabitatten langs verticale hellingen (oppervlakteniveau, moskussens, struiken en boomstammen).
De hoofdhypothese van ons onderzoek is dat moskussens unieke leefgebieden zijn, die een schuilplaats tegen predators kunnen verlenen. Gebaseerd op de vergelijking tussen de predatiekans in verschillende lagen in twee bergleefgebieden en in twee vlakte microhabitatten (moskussen versus humuslaag), hebben wij geprobeerd de specifieke structuur van insectenpredatoren te beschrijven, die waarschijnlijk uniek is voor de microhabitatten bij mossen.

1. Abstract

Predation is a process of a major importance affecting the distribution, abundance, and diversity of species in ecosystems. Thus ecological research of predation is very intensive at present and very sophisticated designs are proposed to measure complex phenomena such as existence of an enemy-free space and tritrophic interactions. In our research we used living baits for a measurement of the predation risk in various microhabitats along vertical gradient (surface level, moss cushions, bushes and trunk of trees).

The main hypothesis of our research is that moss cushions are unique habitat that can provide a shelter against predators. Based on the comparison of the predation risk in different strata in two mountain habitats and ground microhabitats (moss cushions vs. litter) we tried to describe specific structure of insect predator guild probably unique for the moss microhabitats.

2. Introduction

Predation risk is one of the very important factors affecting the whole life history of each animal species (Hairston et al., 1960). The exis-

tence of predation strongly influences the host–enemy coevolution (Kniskern & Rausher 2001). As the consequence of a predation pressure there is a number of various adaptations to avoid detection or capture by predator (Lichtenberg & Lichtenberg 2003, Novotný et al. 1999).

Dicranella rufescens photo: M. Lüth

These ways of living that reduce or eliminate predation risk or species vulnerability are commonly called “enemy free space” (Jeffries & Lawton 1984, Strong et al. 2000, Weseloh 1988, Denno et al. 1990).

Recent studies give us evidence that also spatial distribution of the prey can be the result of predation especially when species prefer to “escape from the battlefield” to refugees with low predation risk caused by various factors (Novotný et al. 1999, Schuler 1990).

The most of the studies that tested predation pressure measure the predator impact by comparison of sites where predator is eliminated and control sites (e.g. Gunnarsson 1996, Haemig 1999). Various cages or boxes that avoid the access of natural enemies are often used in these "enclosure" experiments (Low & Conner 2003).

Contrary we can study the contrast between a number of baits attacked by predator under different conditions. First method is more sufficient for total predation pressure estimates when second method can measure relative predation rate and it is more flexible and less difficult. Of course there is also a problem with the type of the bait (Church et al. 1997).

Despite a number of predation studies concerned tritrophic interactions of predator, prey and major plant taxonomic groups, especially woody species important for pest management and plant herbivorous studies (Bianchi et al. 2005, Jones & Sieving 2006) informations about predation risk within moss cushions are very sporadic (Wotton & Mcrritt 1988). Although mosses are mentioned as potential shelters for arthropods and bryophytes provide them great camouflage (Gerson 1982).

The main object of our study was to describe diversity and structure of insect predators within moss cushions in comparision with other vertical strata.

Patterns of abundance and higher taxa composition of moss arthropod association in submountain and mountain forest ecosystem.

P. Drozd, A. Dolný, P. Kočárek & V. Plášek

Résumé : Nous avons analysé des échantillons d'arthropodes actifs à la surface, obtenus en plaçant des pièges le long d'axes humides dans les coussins de mousses et d'autres pièges dans la litière dont les mousses étaient exclues.
L'étude a été effectuée sur 5 sites différents dans les montagnes et habitats forestiers sous-montagnards en Tchéquie.
En nous basant sur le matériel récolté dans 66 pièges provenant de 3 étages de montagne, nous sommes convaincus que la structure des associations, même à un niveau taxonomique plus élevé, reflète une interaction entre la présence de mousses et les autres caractéristiques des micro-habitats.

Samenvatting : We analyseerden staaltjes van aan de oppervlakte actieve geleedpotigen, verkregen door valkuiken te plaatsen langs vochtige hellingen in moskussens en vallen in strooisel zonder aanwezigheid van mossen.
Onderzoeken hebben plaats gevonden in 5 verschillende locaties in bergen en submontane wouden in Tsjechië.
Gesteund door materiaal uit 66 vallen uit 3 berggebieden zijn we overtuigd dat de structuur van verbindingen, zelf op een hoger taxonomische niveau, een interactie weergeeft tussen de aanwezigheid van mossen en andere kenmerken van microhabitatten.

Keywords
Bryobionts, moss cushions, pitfall traps, Isopoda, Acarina, Insecta, Myriapoda, Arachnida, Collembola.

1. Abstract

We analyzed samples of surface active arthropods obtained by pitfall traps placed along moisture gradient in moss cushions and control traps in litter without moss presence.

Research was maintained at 5 different sites in mountain and submontane forest habitats in Czech Republic.

Based on material from 66 traps from three mountain ranges we are convinced that structure of associations even at higher taxonomical level reflects an interaction between moss presence and other microhabitat features.

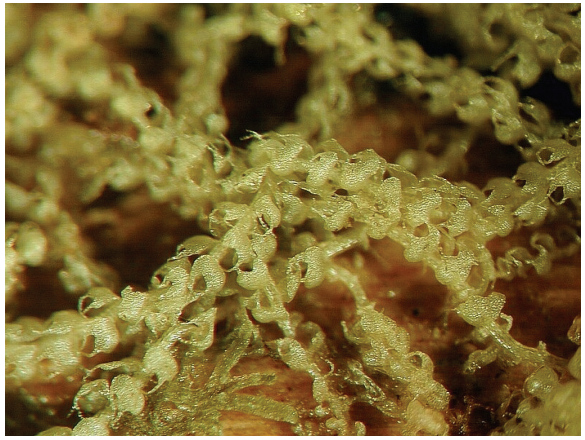
2. Introduction

Despite well-known and evident importance of mosses in plant and consequently in animal succession (e.g. Oechel & Cleve 1986, Glime et al. 1982, Marsh & Koerner 1972, Turetsky 2003, Hodkinson et al. 2003, During & Van Tooren 1990) we have still poor information on factors influencing arthropod associations in mosses.

Most of the studies engage in species composition of some taxonomical group such as mites (Barendse et al. 2002, Gerson 1987), beetles (Fraembs 1994), springtails (Bonet et al. 1975, Andre 1983) etc.

Papers concerning with general concept are mainly focused on the ecosystems where the bryophyte role is striking, such as arctic and antarc-

178-184.
HAIRSTON N.G., SMITH F.E. & SLOBOTKIN L.B., 1960 : Community structure, population control, and competition. The American Naturalist 94: 421-425.
JEFFRIES M.L. & LAWTON J.H., 1984 : Enemy free space and the structure of ecological communities. Biological Journal of the Linnean Society 23: 269-286.
JONES G.A. & SIEVING K.E., 2006 : Intercropping sunflower in organic vegetables to augment bird predators of arthropods. Agriculture, Ecosystem and Environment 117: 171-177.
KNISKERN J. & RAUSHER M.D., 2001 : Two mode of host-enemy coevolution. Population Ecology 43: 3-14.
LICHTENBERG J.S. & LICHTENBERG D.A., 2003 : Predation of caterpillars on understory saplings in an ozark forest. Southeastern Naturalist 2: 423-432.
LOW C. & CONNOR E.F., 2003 : Birds have no impact on folivorous insect hulds on a montane willow. Oikos 103: 579-589.
NOVOTNÝ V., BASSET Y., AUGA J., BOEN W., DAL C., DROZD P., KASBAL M., ISUA B., KUTIL R., MANUMBOR M. & MOLEM K., 1999 : Predation risk for herbivorous insects on tropical vegetation: A search for enemy-free space and time. Australian Journal of Ecology 24(5): 477-483.
PLATNICK & NORMAN I., 2009 : The World Spider Catalog. Version 9.5. American Museum of Natural History.
SCHULER W., 1990 : Avian predatory behavior and prey distribution. In: EVANS D.L. & SCHMIDT J.O., 1990: Insect defences. Chapter 6.
SCHULTZ T., 2000 : In search of ant ancestors. Proceedings of the National Academy of Sciences 97 (26): 14028–14029.
STRONG A. M., SHERRY T. W. & HOLMES R. T., 2000 : Bird predation on herbivorous insects: Indirect effects on sugar maple saplings. Oecologia 125(3): 370-379.
WESELOH R.M., 1988 : Effects of microhabitat, time of day, and weather on predation of gypsy moth larvae. Oecologia 77: 250-254.
WOTTON R.S. & MCRRITT R.W., 1988 : Expeeriments on predation and substratum choice by larvae of the mucidy fly, Limnopbora riparia. Holarctic Ecology 11: 151-159.



Nowellia curvifolia photo: M. Lüth

3. Methods

Experiments were performed on two sites in the submontane forest of the Beskydy Mountains and the Jeseníky Mountains in the Northern Moravia (Czech Republic) during the years 2004-2008. Living larvae of blowfly *Calliphora vicina* (Calliphoridae, Diptera) that are palatable and tasteful for most of insect predators were used as a baits. The great advantage is also their agility during all exposition interval.

All the time 20 baits for each test were pinned on leaves, trunk, phyloids or forest floor in studied microhabitats: bushes of blueberries (*Vaccinium myrtillus*), moss cushions (*Polytrichastrum formosum, Polytrichum comunne, Dicranella sp.*), trunk of spruce (*Picea abies*). Attacked and missing larvae were counted and presence predators were identified into higher taxonomical levels after 30 minutes of the exposition time.

4. Results and discussion

Taxonomical structure of predators is approximately same for similar microhabitats at the both localities (Fig 1 and Fig 2). The most dominant taxa of predators on the surface level are Formicoidea and Araneida - the major groups of diurnal surface active invertebrate predators in temperate forests. Ecological dominance of ants is represented by their biomass, and estimation for different environments shows that they contribute 15–20% of the total temperate terrestrial animal biomass (Schultz 2000). Also spiders are established in all terrestrial ecological niches (Platnick & Norman 2009, Greenstone 1999).

Predation rate inside the moss cushions is almost same to rate on the ground (litter), but there are obvious differences in the taxonomical structure of the predators (cf. Fig 1 and Fig 2). Millipedes (Chilopoda) were found as a dominant predators on *Dicranella* and inside the cushions of *Polytrichum* followed by spiders and beetles (Carabidae and Staphylinidae). Simultaneously Chilopoda were recorded also from the ground below *Vaccinium*, where mosses occurred. It is evident that they are well adapted to dense vegetation typical for moss cushions.

Bird predation that dominated on the leaves of *Vaccinium* can be explained by better accessibility for birds in the Jeseníky site where the sampling was maintained near forest clearance.

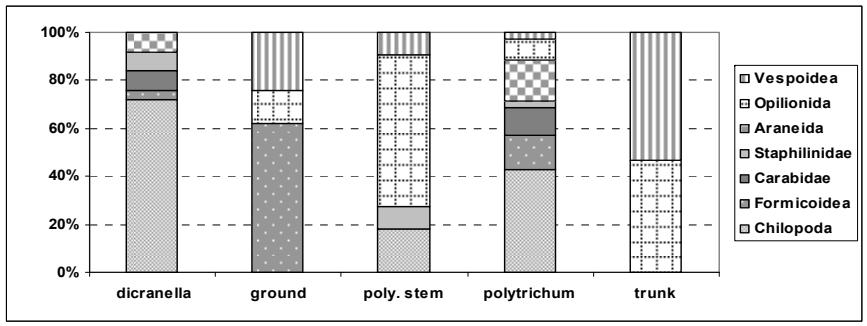


Fig 1: Proportion of predator taxa in different microhabitats in the Beskydy Mountains.
(poly.stem = terminal part of *Polytrichum*,
polytrichum = inside cushion of *Polytrichum*)

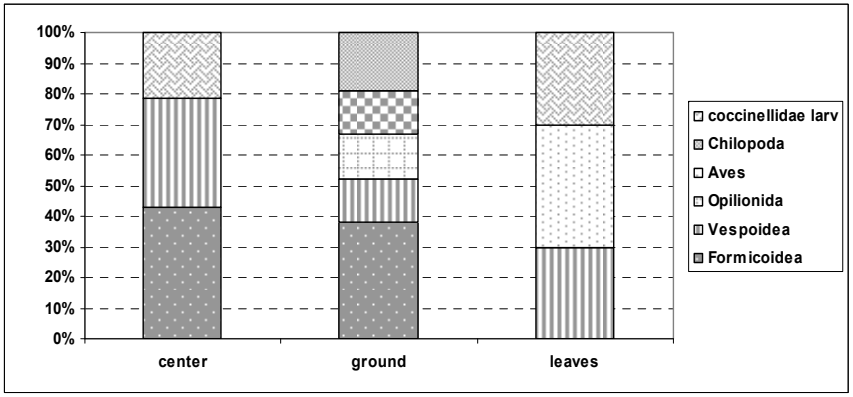


Fig 2: Proportion of predator taxa in different microhabitats within *Vaccinium* in the Jeseníky Mountains.

Analysis of variance shows significant differences of predation risk between different microhabitats within moss cushion and other strata in the Beskydy site ($p<0.001$, Fig 3 on next page). The highest probability of predation was found inside the cushion of *Polytrichum*. Predation of the baits mounted on the terminal parts of *Polytrichum* was same as predation rate on the trunk of trees.

The most intensive predation risk was recorded from the forest ground in the Jeseníky Mts site. Higher predation was probably caused by extreme abundance of ant nests (*Formica lugubris*) and relatively high heterogeneity of the habitat in comparison with spruce wood monoculture in the Beskydy Mts. site.

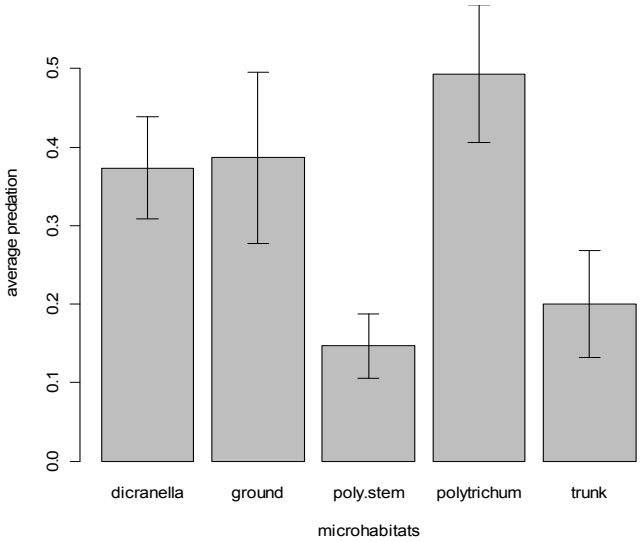


Fig 3: Mean number of attacks per experiment (with standard error).

5. Acknowledgements

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6. References

BIANCHI F.J.J.A., van WINGERDEN W.K.R.E., GRIFFIOEN A.J., van der VEEN M., van der STRATEN M.J.J., WEGMAN R.M.A. & MEEUWSEN H.A.M., 2005 : Landscape factors affecting the control of *Mamestra brassicae* by natural enemies in Brussels sprout. Agriculture, Ecosystem and Environment 107: 145-150.
CHURCH S.C., JOWERS M. & ALLEN J.A., 1997 : Does prey dispersion affect frequency – dependent predation by wild birds? Oecologia 111: 292-296.
DENNO R.F., LARSSON S. & OLMSTEAD K.L., 1990 : Role of enemy-free space and plant quality in host-plant selection by willow beetles. Ecology, Vol. 71: 124-137.
GERSON U., 1982 : Brophytes and invertebrates. In Smith A.J.E., Bryophyte Ecology. Chapman and Hall, London, pp 291-332.
GREENSTONE M.H., 1999 : Spider predation – How and why we study it. The Journal of Arachnology 27: 333-342.
GUNNARSSON B., 1996 : Bird predation and vegetation structure affecting spruce-living arthropods in a temperate forest. Journal of Animal Ecology 65: 389-397.
HAEMIG P.D., 1999 : Predation risk alters interactions among species – competition and facilitation between ants and nesting birds in a boreal forest. Ecology Letters 2: