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Numéro spécial « Rencontres bryologiques internationales 2007 »

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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) .

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L'excursion au Ry d'Alysse (Vireux FR) fut guidée par l'agent O.N.F. M. Bassez et permis aux bryologues de faire quelques découvertes

L'excursion à la Roche Trouée (Nismes BE) s'effectua sous le soleil. Michèle Devidal et Claude Lerat appréçièrent ces biotopes calcaires

C'est grâce à M^{me} I. Gospodinova et son Assistant A. Beuf que la visite à l'étang de Bérulle connut un grand succès malgré l'obligation de constituer trois groupes.
M. M. Colcy (O.N.F.) assura la guidance préparatoire et celle des zones plus difficiles.

A. et O. Sotiaux apportèrent leur aide pour les déterminations lors d'excursions tandis que F. Bisqueret servit utilement pour les traductions en anglais.

Nous avons aussi eu le plaisir de compter H. Pohl parmi nous, vice-président de l'A.E.F.

Introduction

Cher(e)s collègues,

C'est grâce à vous, cher(e)s ami(e)s bryologues, que l'on doit en grande partie le succès de nos deuxièmes rencontres bryologiques internationales.

Non seulement de par votre compétence, votre disponibilité et votre collaboration, la réussite fut aussi assurée par un temps clément, qui accentua la bonne humeur et une sympathie mutuelle rapidement découverte par cette chaleur humaine qui anime la plupart des bryologues.

Je m'en voudrais de ne pas signaler que le résultat positif de notre rencontre fut aussi dû à l'excellente organisation effectuée par les membres du Centre Marie-Victorin, dont l'aide nous fut très précieuse, sous la direction de L. Woué.

Enfin, Francienne et Camille, avec une discrétion spontanée parfois trop apparente, ont réalisé un travail logistique de toute grande importance.

Que toutes et tous, scientifiques et autres, reçoivent ici mes meilleurs remerciements, et, dès à présent, je vous fixe rendez-vous en juin 2009.

Ph. De Zuttere

Introduction

Dear colleagues,

Thanks to you, dear friend(s), the second international bryologic meeting was a huge success.

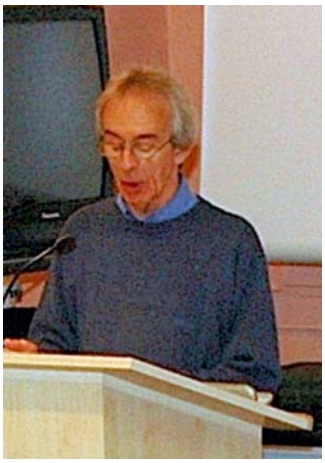
The successful results were due primarily to your competence, your availability and your collaboration but due also to a mild weather inducing positive mood and to a mutual sympathy and real human warmth that most of the bryologists quickly felt.

I would be angry with myself if I didn't mention that the positive result of our meeting was also due to the excellent organisation carried out by the members of the Centre Marie-Victorin, presided by Mr L. Woué, whose help was very useful.

At last, Francienne and Camille, with a spontaneous discretion, sometimes too visible, have executed a very important logistical work.

I thank scientists and all of you. Can I book an appointment in June 2009.

Ph De Zuttere



Mesdames, Messieurs,

C'est avec plaisir que nous vous accueillons au Gîte pour l'Environnement, extension du Centre Marie-Victorin.

Votre présence à Vierves honore notre maison. Durant quelques jours, les spécialistes que vous êtes, venus de plusieurs pays européens, vont se pencher sur des problèmes particuliers de bryologie. Nous vous souhaitons d'excellents travaux.

Il nous appartient de vous dire quelques mots sur notre société qui fût fondée en 1957.

Les Cercles des Naturalistes de Belgique (CNB) rassemblent des jeunes et des adultes intéressés par les sciences naturelles. Nous pouvons dire, sans aucune prétention, qu'aujourd'hui, nous sommes la plus importante société belge d'éducation à la nature.

Au travers de nos 40 sections, réparties dans les régions francophone et germanophone du Pays, nous faisons passer le message de la nécessité de la conservation de la nature face à tous les dangers qui menacent notre planète. Pour atteindre notre but, nous organisons environ 2000 activités par an : conférences, excursions, expositions, stages, classes de découverte, formations de Guides-nature, colloques… Les Cercles des Naturalistes sont agréés par le Ministère de la Communauté française de Belgique, par le Ministère de la Région wallonne et par l'Entente Nationale pour la Protection de la Nature.

Notre société dispose ici à Vierves, dans une région privilégiée qui recèle la plus grande richesse botanique de la Belgique d'un Centre d'étude et de recherche pour la conservation de la nature, dédié au célèbre botaniste québécois Marie-Victorin. Le Centre est associé à l'Université agronomique de Gembloux. Notre personnel comprend 26 personnes, temps plein, dont 12 spécialistes dans les domaines de l'écologie. 150 bénévoles nous apportent également une aide indispensable dans l'ensemble de nos sections. Chaque année, nous accueillons des étudiants belges et étrangers qui réalisent leurs travaux de fin d'étude : mémoires ou thèses.

Dans les 20 000 ha. qui couvrent l'Espace naturel Viroin-Hermeton, 74 % de la flore belge a été recensée, ce qui est vraiment exceptionnel. On y trouve des espèces végétales et animales à caractère subméditerranéen, particulièrement dans la zone appelée Calestienne aux versants calcaires exposés au sud. Comme vous vous en doutez, la bryoflore est tout aussi remarquable. Dans votre farde, vous trouverez un livre qui montre la richesse patrimoniale de la région.

Dans cet Espace, on trouve le Parc naturel Viroin-Hermeton, dont nous sommes les promoteurs, sur le territoire de Viroinval, ainsi que 500 ha de réserves naturelles gérées par la Division de la Nature et des Forêts de la Région wallonne et par notre société-sœur Ardenne et Gaume, en collaboration avec notre institution.

Le Centre Marie-Victorin dispose d'infrastructures d'accueil modernes, d'une grande bibliothèque, de laboratoires de chimie et biologie, de jardins botanique et de plantes médicinales, d'un sentier des hyménoptères, d'un écomusée de la barytine, d'un comptoir-nature, de l'herbier de lichens de Jacques Duvigneaud (1920-2006), qui restera un des plus grands botanistes belges du XX^{e} siècle. Bien entendu, nous disposons d'un important herbier bryologique : environ 15000 échantillons, disposé dans la maison privée de Philippe De Zuttere qui en assure la gestion.

Nous sommes convaincus que vous passerez un agréable séjour riche en découvertes botaniques et que vous apprécierez la beauté de la région.

Léon Woué
Président des CNB
Directeur du Centre Marie-Victorin

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Ladies and gentlemen,

It is with great pleasure that we welcome you to the extension of the « Centre Marie-Victorin : Gîte pour l'Environnement ». It is an honour to have your presence in Vierves. During these few days, you, as specialists coming from various European Countries, will consider some specific bryologist problems. We wish you fruitful debates. Let us tell you a little about our society which was created in 1957.

The « Cercles des Naturalistes de Belgique (CNB) » is a group of young people and adults who are interested by Natural Sciences. Today we can say, quite modestly, that we are the most important educational society for nature in Belgium.

Through our 40 sections in the French and German speaking regions of Belgium, we are sending the message on the necessity to preserve nature in view of all the dangers which threaten our planet. To achieve that goal, we are organising some 2.000 activities each year : conferences, excursions, exhibitions, training courses, discovery classes, Nature Guide classes, symposiums… The « Cercles des Naturalistes » is recognised by the « Ministère de la Communauté française de Belgique », by the « Ministère de la Région wallonne » and by the « Entente Nationale pour la Protection de la Nature ».

In a privileged area which contains the largest botanic diversity of Belgium, our Society has, here in Vierves, a research and study centre for nature preservation dedicated to the famous botanist Marie-Victorin. The centre is associated with the Agronomy University of Gembloux. The staff of 26 full-time members includes 12 specialists in all ecological areas. Some 150 volunteers provide essential help through the sections. Every year, we welcome belgian and foreign students who are preparing for their final dissertations.

In the 20.000 ha of the Natural Area Viroin-Hermeton, 74 % of Belgian flora has been recorded which is exceptional. One can find vegetation and animal life of sub-mediterranean character, more particularly in the area of Calestienne with its South-oriented chalky slopes. As you can guess, the bryoflora is also remarkable. In your folder, you will find a book explaining the wealth of diversity in the region.

In this area is the Viroin-Hermeton natural park which we promote in the district of Viroinval, as well as the 500 ha of natural reserves which are managed by the Forestry and Nature Division of the « Region wallonne » and by our sister society « Ardenne et Gaume », in collaboration with our establishment.

The « Centre Marie-Victorin » benefits from modern infrastructure, a large library, chemistry and biology laboratories, botanic and medicinal plant gardens, a path for hymenoptera, a eco-museum for barytine, a nature desk, the Jacques Duvigneaud's lichen herbarium. J. Duvigneaud will remain one of the greatest Belgian botanists of the XX century (J. Duvigneaud 1920-2006).

Obviously, we have an important bryologist herbarium containing some 15.000 samples, exhibited in the private house of Philippe De Zuttere who manages it. We are confident that you will spend a pleasant stay full of botanic discoveries and that you will appreciate the beauty of the area.

Léon Woué
President CNB
Director « Centre Marie-Victorin »

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Mesdames, Messieurs,

Qu'il me soit permis tout d'abord de vous adresser, au nom de l'Autorité communale et en celui de nos concitoyens unanimes, un message cordial et chaleureux de bienvenue chez nous !

Vous dire ensuite combien nous nous réjouissons que l'enthousiasme et la vitalité du Centre Marie Victorin de Vierves aient permis que se renouvelle à Viroinval la tenue d'un colloque assurément peu ordinaire, puisque adressé aux éminents spécialistes que vous êtes dans la science de la bryologie !

Et je veux aussi, dans le même esprit, remercier mon excellent ami Philippe De Zuttere, véritable cheville ouvrière de cette manifestation scientifique de haut vol ; lui dire aussi notre gratitude pour ses efforts et ceux de ses amis –bénévoles autant que passionnés !- qui, plus largement encore qu'au travers de la bryologie sont engagés depuis belle lurette dans l'indispensable défense et dans la mise en valeur de notre patrimoine naturel, assurément l'un de nos biens communs les plus précieux !

La bryologie ! Une question de « mousses » !

Le profane -qui ne réfléchit pas toujours plus loin que le bout de son nez !- pourrait imaginer qu'il s'agit de l'étude de ces mousses crémeuses qui coiffent nos bières-pression : quoi d'étonnant somme toute, au pays de tant et tant de chef d'œuvres brassicoles !

Pourtant, les mousses dont on parlera ici n'ont pas grand-chose à voir avec notre breuvage national ! Celles auxquelles vous consacrez vous recherches et vos travaux, Mesdames, Messieurs, sont en effet d'une toute autre nature, puisqu'elles concernent ces innombrables éléments qui appartiennent à notre environnement végétal familier : autant de mousses et de fougères qui se déclinent en mille et une définitions d'un lexique que seuls probablement les savants que vous êtes peuvent maîtriser, entre propagules, péristomes et autres élatères !

Et si vous venez de si loin pour en débattre, ce n'est assurément pas par hasard ! C'est que notre terroir doit être remarquable par la qualité de l'échantillonnage qu'il vous propose : qu'il doit être, en d'autres termes, le microcosme idéal pour la poursuite et l'avancement de vos travaux scientifiques ; il semble même acquis, que, de tous les congrès tenus dans de nombreux pays européens et comparables au vôtre, celui que Viroinval organise pour la deuxième fois soit à l'origine des résultats les plus probants et les plus spectaculaires !

Comment ne pas s'en réjouir, lorsque l'on sait l'importance et la pérennité des efforts que notre commune consacre précisément à la cause environnementale : elle y est d'ailleurs largement encouragée au travers des activités des deux Centres d'études qui y sont installés : le Centre Marie-Victorin dont nous sommes les hôtes aujourd'hui, et l'Asbl « DIRE », qui est, à Treignes, une émanation de l'Université libre de Bruxelles.

Et dans toute cette effervescence de bonnes volontés pour une si bonne cause, ce n'est pas non plus par hasard, si notre commune a choisi pour slogan: « Viroinval, naturellement » !

Car tout, autour de nous, est nature !

Nature riche, certes, mais fragile, parfois dangereusement exploitée, souvent malmenée, violentée même, mais donc, au-delà de notre vigilance à toutes et à tous, fort heureusement confiée à la sauvegarde d'hommes et d'institutions de qualité, parmi lesquels vous comptez assurément ; j'ajoute que notre statut de Parc naturel nous est, à ce titre, éminemment précieux, et le Plan communal de développement de la nature nous permet évidemment de multiplier les actions indispensables de préservation et de valorisation patrimoniales.

Voilà pourquoi, je le répète avec plaisir, nous ne pouvons que nous réjouir de vous accueillir aujourd'hui en nos murs, et pourquoi aussi il m'est personnellement agréable de souhaiter un plein succès à vos travaux !

Bienvenue à Viroinval et merci.

Bruno Buchet
Bourgmestre

Dear Sirs, Madams,

First of all, on behalf of the Communal Authority and in the name of our entire fellow citizen, I would like to welcome you to this meeting.

Let me say how pleased we are with the enthusiasm and the vitality of the Marie-Victorin Centre of Vierves that made possible the organization of this "out of the common" meeting because it brings together eminent specialists in bryology like you.

In the same way, I would like to thank my excellent friend, Philippe De Zuttere, real ankle worker of this highly scientific meeting organization. I would also like to express my gratitude to him and to his friends for their time and willingness - all acting as voluntaries and passionate – who are engaged for a long time, through bryology, in the indispensable protection and improvement of our natural patrimony, undoubtedly one of our most precious common good.

Bryology! A matter of "moss" !

In French we use the same word for moss and foam. The Mayor explains that confusion could be possible over this word because Belgium remains the country of beer.

The mosses, which you devote research and works to, dear Sirs, Madams, concern these innumerable elements that belong to our familiar vegetal environment : so many mosses and ferns which exist in thousand and one definitions of a lexicon, which probably only the scientists like you can manage, between propagule, peristome and other elater.

If you come from so far to debate this matter, for sure it isn't accidentally! Our soil must be remarkable by the quality of the samples proposed, an ideal microcosm for proceeding with scientific works.

It seems to be established that, among all the meetings held in other European countries and similar to this one, the bryologic meeting, which is organized in Viroinval for the second time, is at the origin of the most famous and most spectacular results!

How can we not be delighted with the important and perennial efforts that our village dedicates to the environmental cause? It is largely encouraged through activities of both study centres: The Marie-Victorin Centre, which welcomes us today and the non-profit making association "Dire" situated in Treignes and dependent of the University of Brussels (ULB).

And in all this excitement, good will for such a cause, it is also not accidentally that our village has chosen as slogan: "Viroinval, naturally!"

Because all around us is nature.

Opulent nature, indeed, but fragile, sometimes dangerously exploited, often maltreated or self, abused but, it is also, beyond the vigilance of all of us, entrusted to the protection of qualified humans and institutions, which you undoubtedly belong to. I'd like to add that our status of Natural Park is eminently precious and the Natural Development Plan allows us to multiply the indispensable actions that guaranty patrimonial preservation and valorisation.

Therefore, I repeat it with pleasure, we are pleased to welcome you today and I would like to wish you every happiness and success in all your works.

Welcome to Viroinval and thank you!

Mayor Bruno Buchet

FACTORS OR MOSSES – WHAT THE BRYOBIONTS PREFER ?

DROZD PAVEL, PLÁŠEK VÍTĚZSLAV, DOLNÝ ALEŠ, KOČÁREK PETR & JAŠÍK MARTIN

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Abstract of the poster

As the knowledge about bryophytes biology increase, recent papers show that mystery of terrestrial invertebrates living in bryophytes still remains.

We know that some of invertebrates use mosses as food, insulation against heat or cold, others as a hunting place. However information about bryophages host specificity or bryobionts habitat preferences are sporadic.

In 2006 our team started first preliminary field research creating a framework of our recent project focused on key factors affecting bryophagous insect communities. One of basic research objectives was to analyze forest communities of moss living insects and compare with communities occupying habitats without moss layer.

We found out a higher species richness of the mosses habitat insect communities (about 25 % of insect species was recorded only there). RDA with Monte-Carlo permutation tests shows moisture as a main significant factor affecting insect habitat preferences ($p = 0.028$, $F = 1.81$), while impact of moss layer presence was not significant.

We presume that habitat preferences of some insect species known as bryobionts could be explained just as affinity to microclimatic factors. For example insect species in habitats with dry conditions tend to occupy moss cushions and that is why they are considered as strict bryobionts.

The research is supported by grant project GA ČR No. 206/07/0811.

You can see on the next page the poster presented during the international bryological meeting (on format A4 for the publication)

Factors or mosses – what the bryobionts prefer?

DROZD Pavel, DOLNÝ Ales, JAŠÍK Martin, KOČÁREK Petr & PLÁŠEK Vitězslav

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Fig 1: *Tetrix ceperoi* (Hexapoda, Caelifera) feeding on *Atrichum undulatum*

Fig 2: Snow scorpionfly *Boreus westwoodi* (Hexapoda, Mecoptera)

INTRODUCTION

As the knowledge about bryophytes biology increase, recent papers show that a mystery of the terrestrial invertebrates (especially insects) living in the bryophytes still remains. We know that some of the insect species use mosses as a moisture microhabitat for laying eggs, larval development, others as a hunting place (GERSON 1982). The cushions provide an important refuge against predation and insulation against heat or cold. Relatively stable microclimatic conditions are also very important for over wintering of invertebrates (BYERS & LOFQVIST 1989).

Furthermore few insect species (e.g. Fig 1-2) can be considered as a bryophages (e.g. VARGA 1992, CHOWN 1993) although their biology including metabolic processes or host specificity are not known even for typical bryophages from family Byrrhidae (Fig 3-4) (OTTESEN 1996). A sample of moss cells (Polytrichaceae) from an alimentary tract of *Byrrhus luniger* found HRADÍLEK & BOUKAL (2003), KOPECKÝ (2001) implies host specificity of carabid species *Acupalpus dubius* strictly recorded from *Drepanocladus aduncus*.

In 2006 our team started first preliminary field research creating a framework of our recent project focused on key factors affecting bryophagous insect communities. One of basic research objectives was to analyze forest communities of moss living insects and compare with communities occupying habitats without moss layer. Coleoptera as the most abundant taxon was used for analysis.

MATERIAL AND METHODS

Samples were taken by pitfall traps from 3 sites with different soil humidity during season 2004 near Třinec close to boundary of the Beskydy Protected Landscape Area (Czech Republic). Two traps were situated within the cushions of *Polytrichum* sp. and two traps minimally 10 m far from the nearest cushions at each site. RDA (redundancy analysis) with Monte-Carlo permutation test was used to analyze impact of the selected factors (moss presence, soil humidity) on the community structure.

The study was supported by grant no. 206/07/0811 of the Czech Science Foundation (GACR).

RESULTS AND DISCUSSION

From a total of 56 coleopteran taxons (mostly species) from pitfall traps, only one specimen of bryophagous beetles (*Simplocaria* sp., Byrrhidae) was recorded. We found out a higher species richness of the moss habitat insect communities (about 25 % of insect species was recorded only there). RDA with Monte-Carlo permutation tests shows moisture as a main significant factor (Fig 5) affecting insect habitat preferences ($p = 0.028$, $F = 1.81$), while impact of moss layer presence was not significant. We presume that habitat preferences of some insect species known as bryobionts could be explained just as affinity to microclimatic factors. For example insect species in habitats with dry conditions tend to occupy moss cushions and that is why they are considered as strict bryobionts. However we cannot validate this hypothesis, several authors discuss on similar conclusions (SMETANA 1958, HŮRKA 1996, ANDREW et al. 2003).

Fig 3: Bryophagous beetle *Byrrhus pilula*

Fig 4: Bryophagous beetle *Cytilus sericeus*

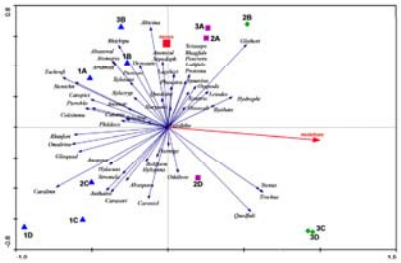

Fig 5: Direct gradient analysis RDA for 12 pitfall traps from 3 sites with different soil humidity (1-3); A, B = moss habitats; C, D = non-moss habitats; humidity (semiquantitative scale): < ▲ ■ ◆

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ORTHOTRICHUM, *ULOTA* & *ZYGODON* IN THE CENTRAL EUROPE – THEIR CHOROLOGY, ECOLOGY AND CONSERVATION PROBLEMS.

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Abstract of the lecture

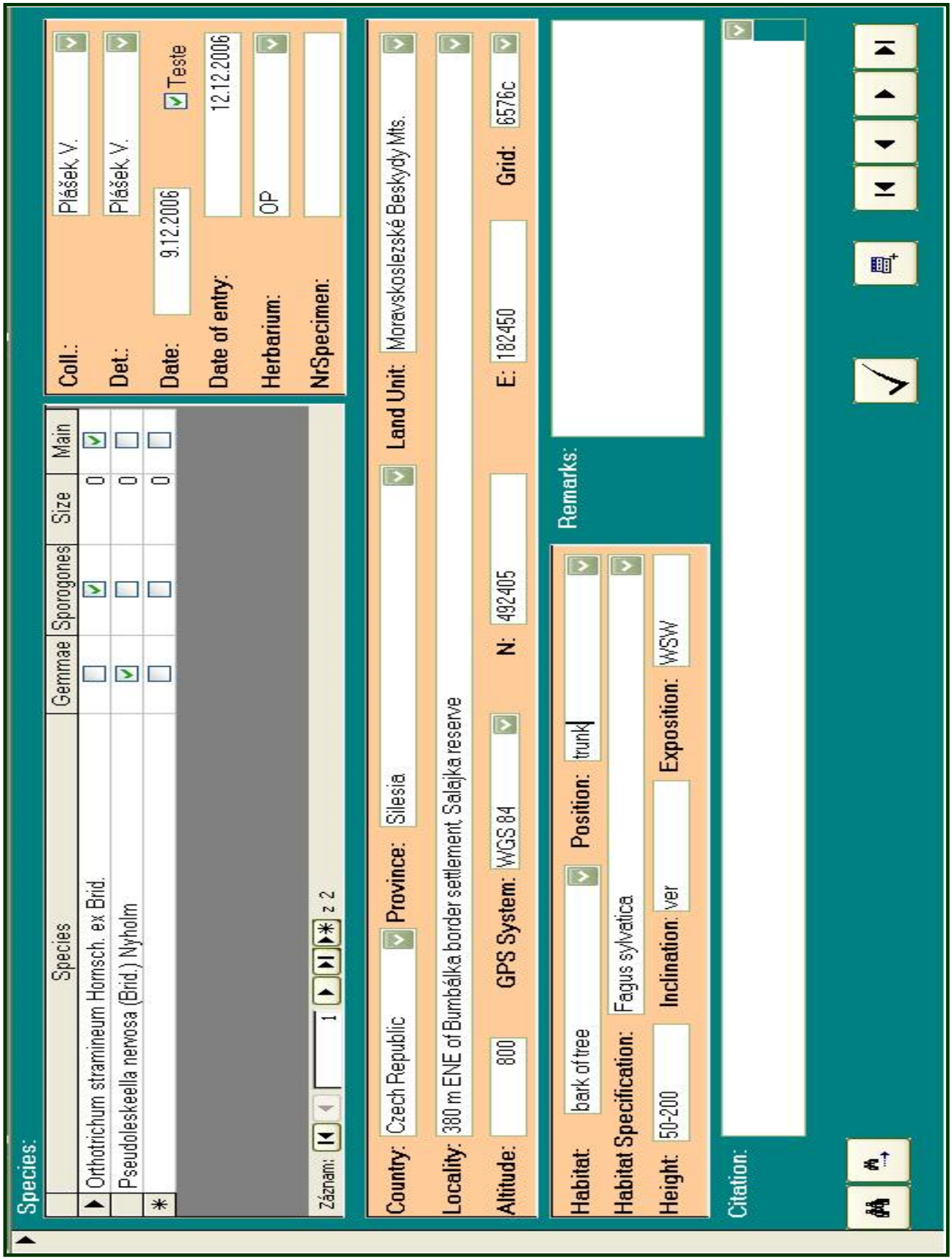
In the Central Europe, the epiphytic bryophytes started to be rare and threatened from 1950‘s in the respect of air pollution. Since 1990 the air quality was improved there and that is why the epiphytic mosses have been recolonizing the former habitats. The fact was confirmed during the field researches carried out in the Western Carpathians and Sudetes mountain ranges by authors.

The surveys were focused on the studying of distribution as well as ecological requirements of the epiphytic species. All recorded populations of the species were located by GPS and moreover their ecological data were noted (e.g. type of a habitat, tree species, height-position at the trunk, size of moss cover, exposition, inclination of substrate, moisture, shadow, fertility).

The known literature data were gathered too. For better summarizing of the information the database in MS Access was made up *(see thereinafter for the figure)*. Data analyzing and their evaluation can help us to understand basic ecological requirements of the studied bryophytes.

In addition these data will be very useful for creating conservation-manage.

Fig. 1: View on database using for data gathering



A review of main morphological features in European taxa of the genus *Chiloscyphus* Corda (Marchantiophyta, Geocalycaceae)

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Abstract *Chiloscyphus* (Marchantiophyta, Geocalycaceae) is represented in Europe by some taxa which haven't got unequivocaly determinate taxonomical position.
This paper presents a review of main morphological characteristics of species and varietes in this genus, described in well-know European floras and keys for identification of liverworts (Müller 1954, Arnell 1956, Vanden Berghen 1956, Schuster 1980, Järvinen 1983, Smith 1990, Gradstein & van Melic 1996, Paton 1999, Damsholt 2002, Schumacker and Vàńa 2005).

Among all features only a few have an important diagnostic value i.e. a dimension of median leaf cells, a number and a size of oil-bodies in median leaf cells, dimension and a shape of underleaves, a shape of perianth mouth, habitat. Besides, some of these characteristics are modified by environmental conditions (Schuster 1980, Järvinen 1983, Paton 1999), and that is a reason of incorrect identification of discussed taxa.

Introduction

Chiloscyphus Corda includes leafy liverworts species, which are polymorphous and responding readily to environmental changes (Schuster 1980).

The history of European taxa nomenclature of discussed genus started with the publication date of Linnaeus's „Species Plantarum" (1753), where for the first time *Jungermannia polyanthos* was described.

In 1829 r. Corda transfered this species from *Jungermannia* to new genus *Chilocyphos*. Dumortier in 1831 r. included there *Jungermannia pallescens* as *Chiloscyphus pallescens* (Järvinen 1983).

From that time among researches there is a lack of unequivocal opinion on division of *Chiloscyphus* on lower taxa. Müller (1954), Arnell (1956), Vanden Berghen 1956, Schuster (1980), Damsholt (2002), Schumacker and Vàńa (2005) considered existence of two terrestial species in Europe: *Chiloscyphus polyanthos* (L.) Corda and *C. pallescens* (Ehr. ex Hoff.) Dum., each one having ,,aquatic" variety: *C. polyanthos* var. *rivularis* (Schrad.) Gottsche et al. and *C. pallescens* var. *fragilis* (Roth.)Müll.

Others researchers treat *C. pallescens* as synonym (Järvinen 1983, Gradstein and van Melic 1996) or variety (Smith 1990) of *C. polyanthos*.

A separation of genera *Chiloscyphus* Corda and *Lophocolea* (L.) Dumort. from the family of *Geocalycaceae* is also a controversial subject.

Engel & Schuster (1984), Damsholt (2002), Schumacker and Vàńa (2005) merged both genera

under *Chiloscyphus* on the base of overlaping their morphological features. Recent studies based on the molecular data confirm it too (Hentschel et al. 2006) but not all authors accept this opinion (Paton 1999, Grole & Long 2000).

This paper presents a review of main morphological characteristic taxa of the genus *Chiloscyphus* (subgenus *Chiloscyphus*), described in well-know European floras and keys for identification of liverworts (Müller 1954, Arnell 1956, Vanden Berghen 1956, Schuster 1980, Järvinen 1983, Smith 1990, Paton 1999, Damsholt 2002, Schumacker and Vàňa 2005).

Morphological characters

Shoot and stem

The shoots of the most present taxa of *Chiloscyphus* are prostrate, irregularly branched, approximately 2-5 cm long and 2-5 mm wide. Sometimes, frequently at the *C. pallescens* shoots can be ascending (Järvinen 1983, Schuster 1980, Damsholt 2002). The colour of plants varies from deep to yellow or brownish green, most pale and pellucid at the *C. pallescens* and almost black in the aquatic varietes. Colourless rhizoids are located in small tufts on the ventral side at the base of underleaves and often absent at the submerged plants.

The stem has a rather simple anatomy, with smaller medulla cells and larger cortex cells (30-35 µm diameter). In cross-section of the stem at the var. *rivularis* smaller size cells are observed than in other taxa (Järvinen 1983, Schuster 1980).

The shape of leaves and size of the cells

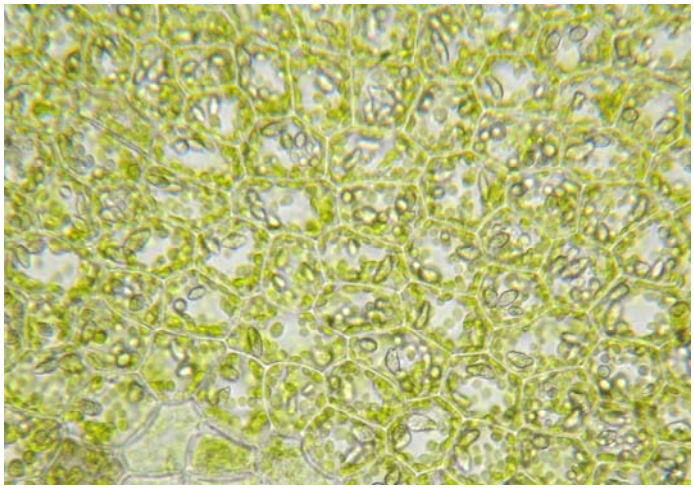
The leaves of *Chiloscyphus* have usually rounded-quadrate to rounded-rectangular shape with broad, rounded or truncated to weakly retuse apex. They are arrange alternatively, contiguoust to imbricate and often antically secund on the stem.

Järvinen (1983) noted that leaves generally are longer than wide except the aquatic var. *fragilis*, which has leaves as wide as long or even a little wider. Paton (1999) says the leaves at the *C. pallescens* are more often retuse or truncated than rounded.

A size of the cells in the middle part of the leaf is treated by most authors as a main diagnostic feature for identification of the species in *Chiloscyphus*. Generally *C. polyanthos* has smaller cells (24-30x30-40 µm or less) than *C. pallescens* (35-40x45-60 µm or larger). This disparity is sometimes not clear, mainly by strong influence of environmental factors e.g. calcareous substrates, temperature and the quality of the water (Järvinen 1983, Schuster 1980). The specimens of *C. pallescens* growing in dry localities can have leaf-cells as small as those of *C. polyanthos* (Paton 1999). Besides that the taxa of *Chiloscyphus* with double chromosome numbers have usually larger leaf cells than haploid ones (Müller 1942), just as in several morphologically similar liverworts e.g. *Riccia fluitans* L. (n=8) and *R. rhenana* Lorb. (n=16) (Paton 1999).

Number, shape and size of oil bodies

Chiloscyphus polyanthos have in median leaf cells aproximately 2-5 (Phot. 1.), fusiform to ellipsoidal, finely segmented of oil bodies (4-7×7-12 µm), whilst at *C. pallescens* they are more numerous (3-12) and have a little smaller dimension (4-5×8-9µm). Järvinen (1983) did not find difference in a number and a size of oil bodies between the taxa of *Chiloscyphus*.



Oil-bodies of *Chiloscyphus polyanthos* (phot. A. Salachna)

Underleaves

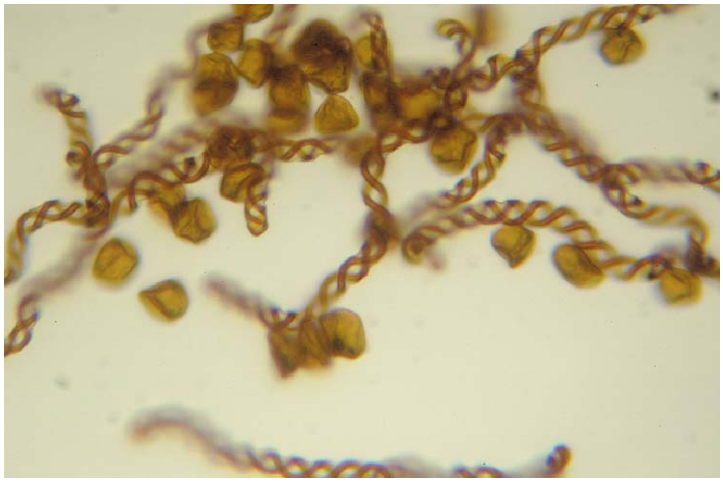
At *Chiloscyphus* they are usually oblong-ovate and bilobed with a lobes to 1/2-3/4 total length. Lobes have a subulate-acuminate to ciliate shape, with cilia 2-10 cells long. 1-2 cilia or teeth on the lateral margins of underleaves are present very often. Besides of their bases tufs with rhizoids are present.
The underleaves of *C. polyanthos* are often smaller than at *C. pallescens*, to 0.7(1.0) mm long and they are narrower than the stem (Schuster 1980, Paton 1999, Damsholt 2002). Sometimes at aquatic varietes their incomplete development or even total lack is observed (Arnell 1956, Järvinen 1983).

Reproductive organs

Chiloscyphus is an autoicous or dioecious plant. Androecium is located intercalary at axes and leafy branches and protected by male bracts similar to the leaves but with small inflexed lobe at the base on dorsal side. Gynoecium develops always at the apex of a very short lateral branches. Female bracts exist in few pairs, usually much smaller than leaves and shortly 2-3 lobed with acute or obtuse apices. Bracteoles are similar to bracts.

Sporophyte

Sporophyte at *Chiloscyphus* species is present during late winter and spring. The perianths develop in the short, leafless, lateral branches. They have cylindrical to campanulate shape and wide- trilolobed mouth.



Spores and elaters of *Chiloscyphus polyanthus* (phot. A. Salachna)

Müller (1954), Schuster (1980), Paton (1999), Damsholt (2002), Schumacker and Vàňa (2005) consider that the lobes of perianth mouth at *C. polyanthos* are mostly smooth (rarely with short teeth) whilst at *C. pallescens* they are often dentate to ciliat but Järvinen (1983) rejected this opinion.

According to Damsholt (2002) in mature sporophyte of *C. polyanthos* calyptra emerges from perianth more than that of *C. pallescens*.

Capsules are ovoid with 4-5 stratose wall. Spores have 12-21 µm diameter, yellowish brown and finely granular. Elaters 7-8,5 µm are wide and bispiral (Phot. 2).

Summary

The morphological features described above have different diagnostic value for the identification of the species and varietes of *Chiloscyphus*. Most often the following parameters are used: a dimension of median leaf cells, a number and a size of oil bodies in median leaf cells, a dimension and a shape of underleaves, a shape of perianth mouth.

Habitat can be very helpful in determination of discussed taxa. Despite that the terrain forms and substrates occupied by both species (Tab.1) are similar it's possible to notice some characteristic trends.

C. polyanthos is hygrophytic species which grows mainly on soil or silt-covered rocks, tree roots and rotting wood (rarely) along small streams and rivers (*var. polyanthus*) or submerged in the running water (var. *rivularis*). It occuring often with *Pellia epiphylla*, *P. neesiana, Marsupella emarginata* and *Scapania undulata* (Damsholt 2002).

Terrain forms	**Substrates**
Bed and banks of fast or slow-flowing streams, rivers and springs	Rocks and stones Rock détritus Submerged tree roots and rotting wood
Banks of standing water in ponds, pools and swamps	Topsoil Humus Leaf litter Rocks Decaying logs and rotting wood
Wet woodland tracks and floors	

Tab. 1. The kind of terrain forms and substrates occupied by taxa of *Chiloscyphus*.

In contrast to this species, *C. pallescens* is less hygrophytic and occurrs more often near standing water (e.g. ponds, swamps) on the decaying logs, leaf litter and humus, together with e.g. *Riccardia latifrons, Cephalozia catenulata, Aneura pinguis, Plagiochila asplenioides*. It tolerates strong calcerous sites and usually does not grow submerged in running water (Schuster 1980, Paton 1999, Damsholt 2002).

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Changes of the *Sphagnum* composition of peat cores

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For more than 30 years we are engageged in the distribution and ecology of Sphagna in SW-Germany. Results are published in the "Die Moose Baden-Württembergs" (edit. NEBEL & PHILIPPI 2005).

During mapping one learns a lot about the ecological demands of the mosses and one sees them as ecological indicators. If one walks over a peat surface one automaticly thinks what did happen below the feet and how the present status was reached.

So we started nearly at the same time to analyze peat cores for macrofossils and pollen, later for geochemistry too. We were astonished how well preserved subfossil mosses often are.

So recent vegetation and vegetation history are combined in our studies in a nearly ideal way.

From the beginning of our researches we cut the peat cores in slices of one centimeter to detect even very short changes. Usually 1mm of peat is produced in 1 year.

At first we hoped to find phases of humid or dry climate as did K.E. BARBER (for instance 1981). Especially we hopped to find the results of the so called Small Ice Age or the Roman Optimum.

Our first short peat core (HÖLZER & SCHLOSS, 1981) really showed some changes of the distribution of Sphagna and other mosses. Difficult was the interpretation of the result. The major problem was the separation of *S. nemoreum* and *Sphagnum rubellum*. But there were some stem leaves of the *rubellum*-type. But there should be considered that stem leaves of *S. nemoreum* are not preserved so easily because of the dryer growing situation.

During the following years we could analyze lots of other profiles. By fortune we could find the results of a fire in a short profile from the Blindensee-Moor (HÖLZER & HÖLZER, 1988a). Slightly burned *Sphagnum* heads were among the macrofossils. So the fire should have passed very quickly over the surface. The fire is also indicated by an increase of the immobile elements Silicon and Titanium which are enriched when the organic material burnes. Before the fire *S. magellanicum* was the dominating species, indicating a rather dry surface. Just after the fire all three species were present with very low values.

After a phase of the Section Actifolia (*S. rubellum*) the dominance of *S. magellanicum* was reached again.

Most important were profiles from the Hornisgrinde area in the Northern Black Forest for understanding the succession in peat profiles. In the year 1800 there was a big forest fire burning for six weeks. This was the key event for us. A fire means a lot of plant ash und after the destroy of the soil cover also mineral dust in the air which can be transported to the surface of the peat bog. The immobile part can be used as an indicator of soil erosion. Titanium is an excellent indicator of erosion as it is not present in plants and it is very common in the earth crust.

The ash covers the surface of the peat bogs and hinders water to penetrate. So the surface gets

wetter and it is fertilized. Other species can invade.

First we took a short profile near the centre of the fire in the Seemisse (HÖLZER & HÖLZER 1988b). Here *S. magellanicum* became the dominating species after the fire because people drained the area before planting new trees. Two small phases with low values of the Acutifolia can be seen, probably because of natural closing of the didges and reopening. The didges can be seen even today.

The area around the coring site ho3 was not reached by the fire, but only by the flying ash and some ersosional material. It was also not influenced by drainage. At a depth of 22 cm the ash layer can be seen, indicated by the increase of silicon an titanium, followed by a maximum of Acutifolia and finally *S. magellanicum*.

This typical succesion cannot be detected only in recent times but also a long time before human impact. Core ho5 reflects the time between 6000 and about 1500 BP (=before present). Two big and 3 minor fires can be detect by charcoal remains. Erosion follows the fires as indicated by Silicon and Titanium.

A typical cycle between the fires starts with *S. recurvum* coll. (*S. fallax*). Then a phase with S. Acutifolia, and finally *S. magellanicum* follows. If the input of nutrients is not sufficient the cycle starts with *S. Acutifolia* und ends with *S. magellanicum*.

During the past ten years we analyzed peat cores rather close to each other. The distance between Lindau 1 and Lindau 2 is only 2 meters, between Lindau 2 and Lindau 3 is 18 meters. The cores represent about the same time. There does not exist a common trend in the three cores even at these short distances.

By the combined analysis of pollen, macrofossils and geochemistry we could show that these changes of the moss composition are mostly caused by local events such as fires or erosion in the surrounding of the peat bogs. Correlations with known climatical events could not be detected so far. If they should exist they are probably hidden by the local events. But it is remarkable that fires usually start during *S. magellanicum* – phases which imply dryer phases or they show only that enough material was produced to allow a fire.

Probably the ecological system of peat bogs in the Black Forest of SW-Germany with precipitations of 1000 to more than 2000 mm/year is so stable that those changes of the climate do not influence it.

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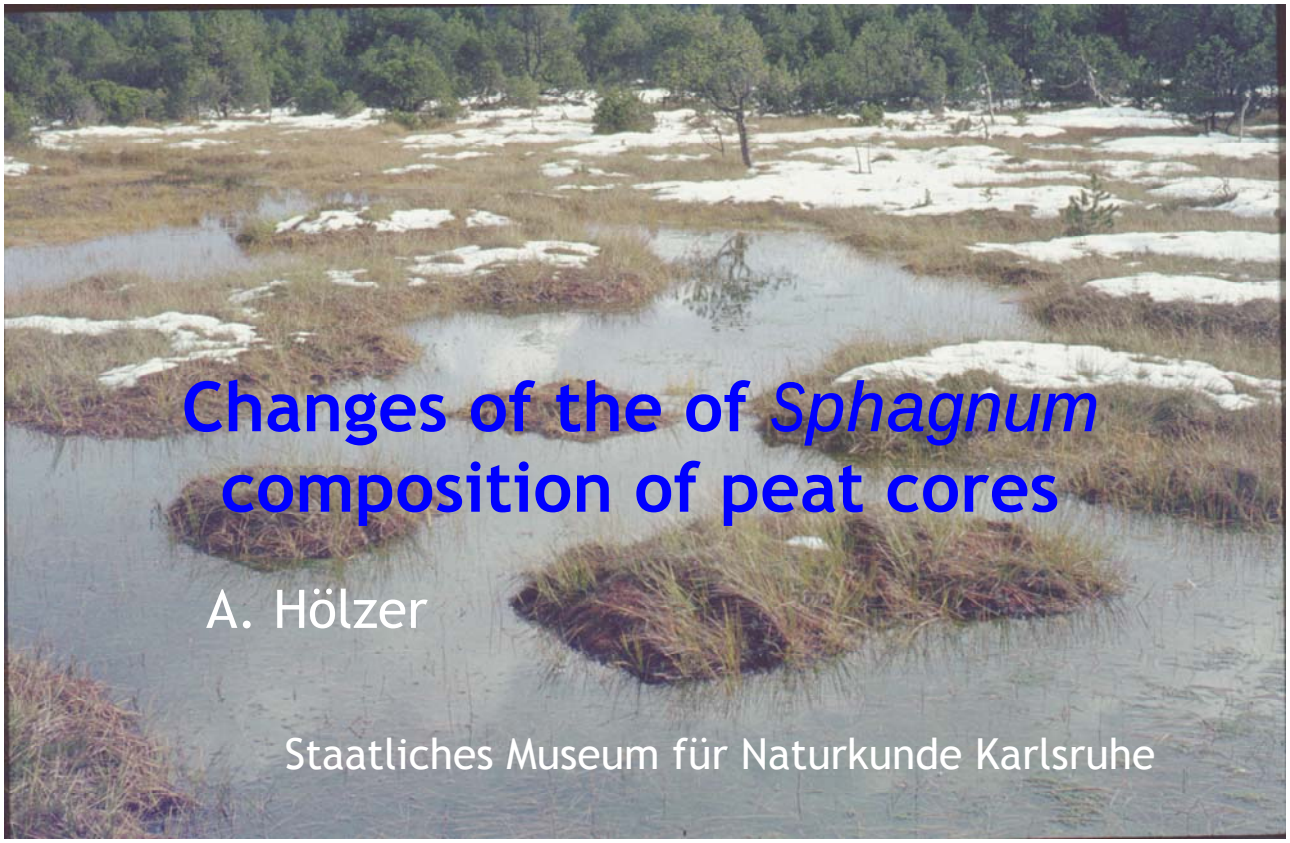
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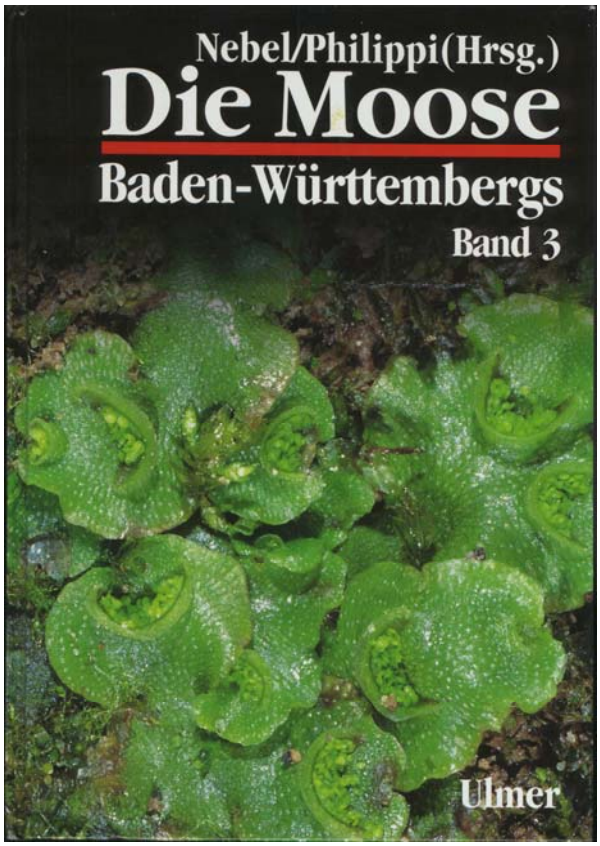
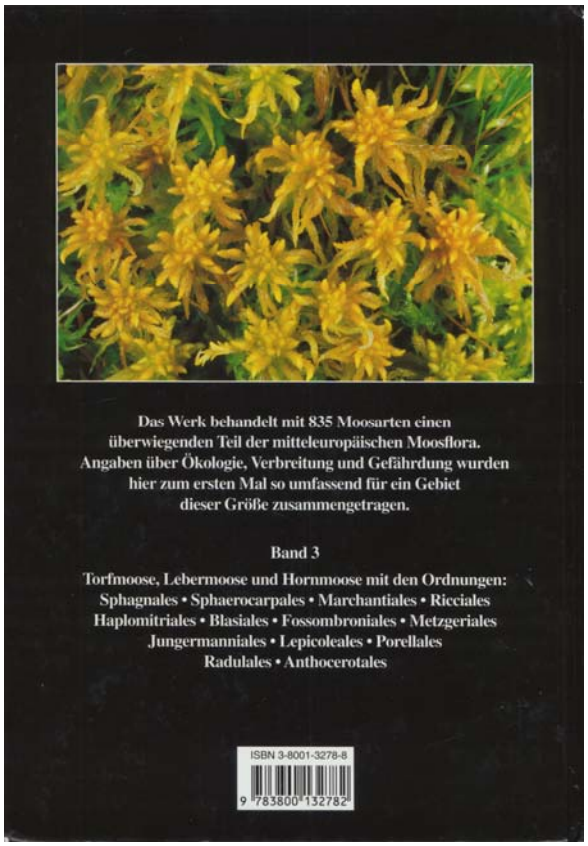
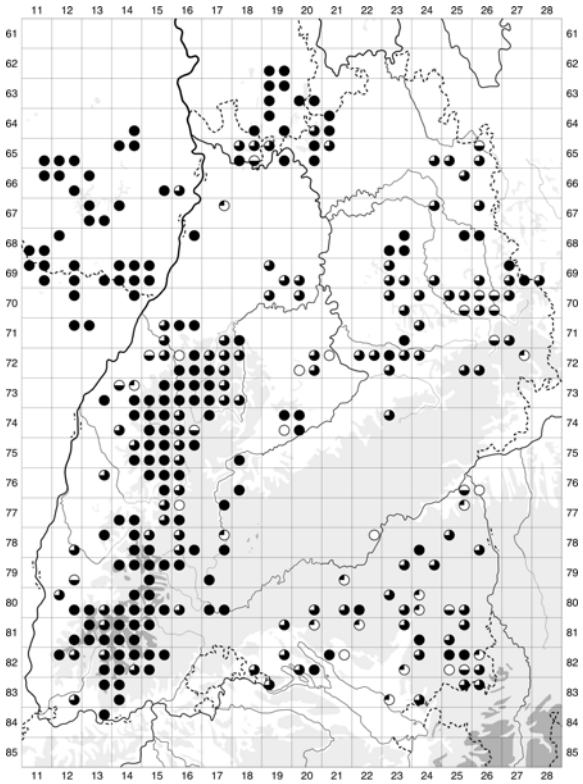
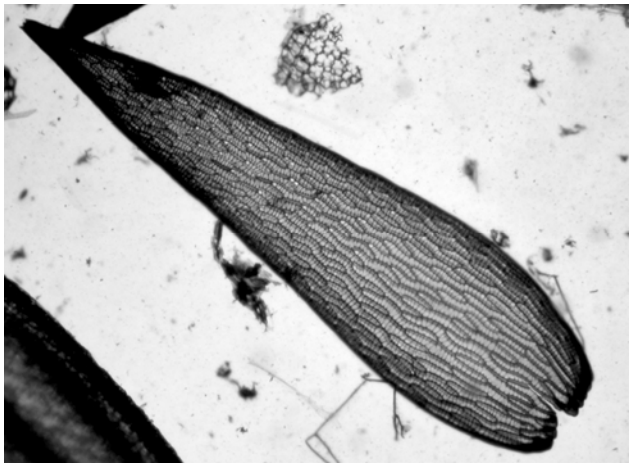

Nebel/Philippi(Hrsg.)
Die Moose
Baden-Württembergs
Band 3
Ulmer

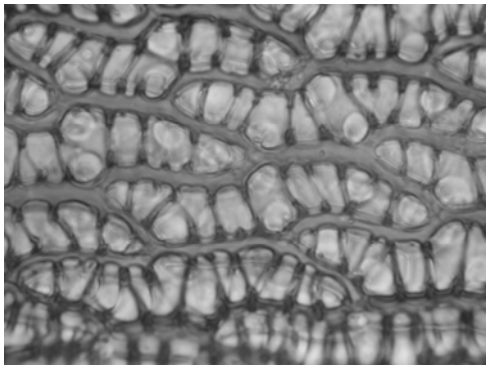

Das Werk behandelt mit 835 Moosarten einen überwiegenden Teil der mitteleuropäischen Moosflora. Angaben über Ökologie, Verbreitung und Gefährdung wurden hier zum ersten Mal so umfassend für ein Gebiet dieser Größe zusammengetragen.
Band 3
Torfmoose, Lebermoose und Hornmoose mit den Ordnungen:
Sphagnales • Sphaerocarpales • Marchantiales • Ricciales
Haplomitriales • Blasiales • Fossombroniales • Metzgeriales
Jungermanniales • Lepicoleales • Porellales
Radulales • Anthocerotales
ISBN 3-8001-3278-8

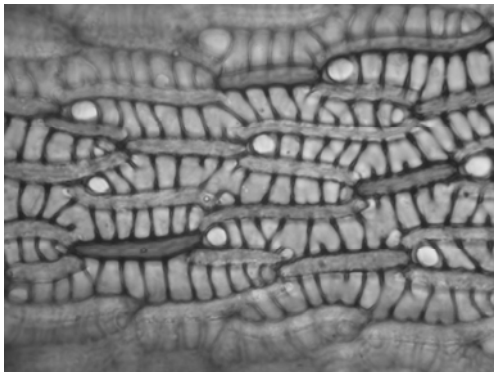


Sphagnum palustre

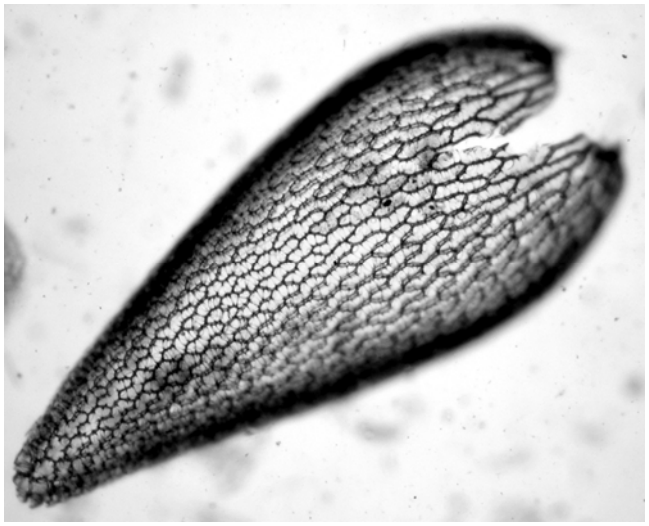
Sphagnum fallax

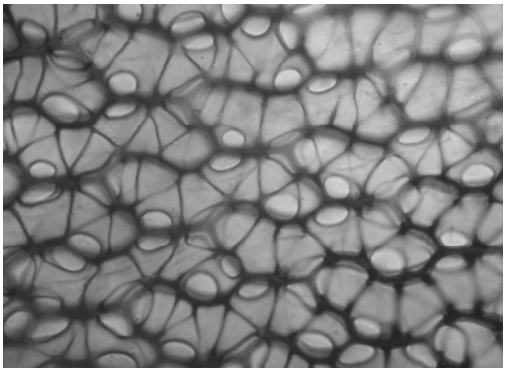


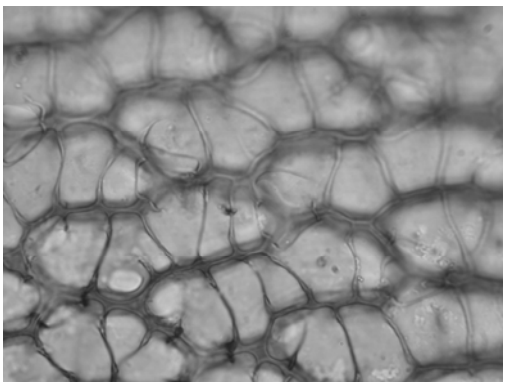




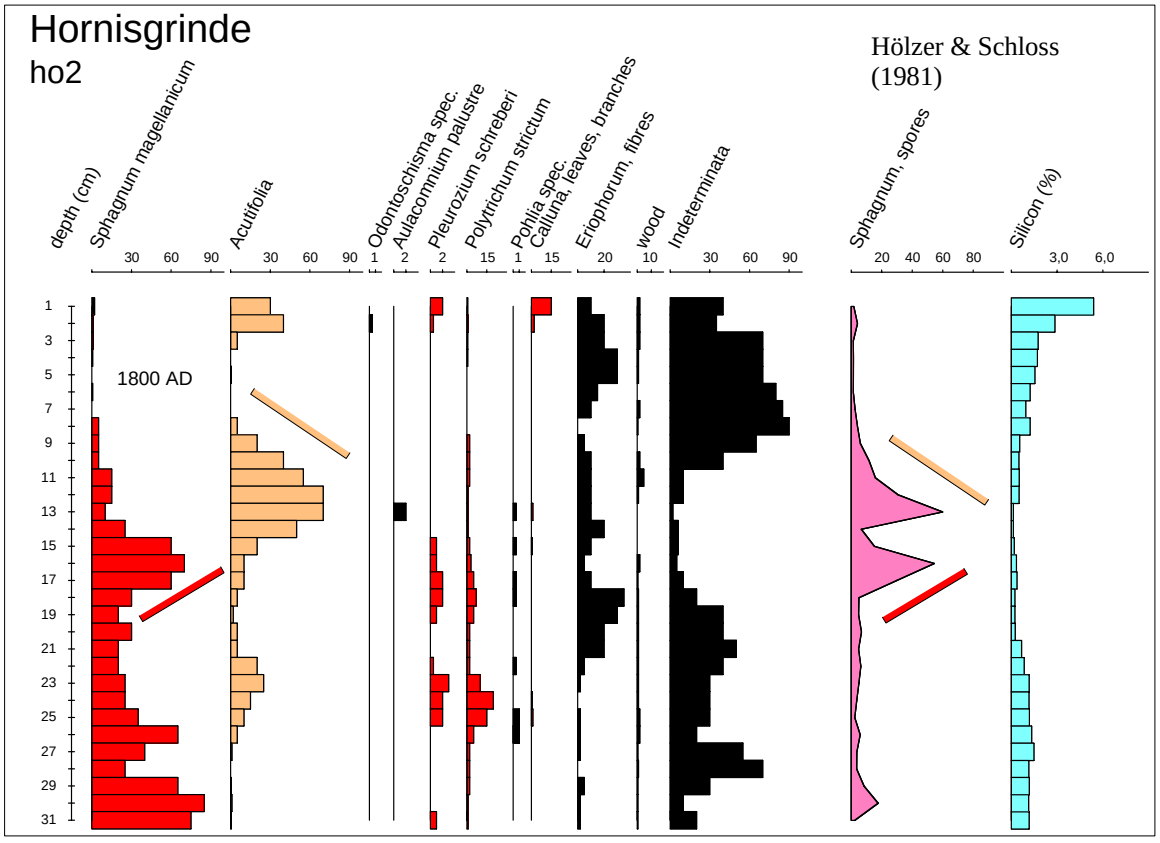
Sphagnum magellanicum



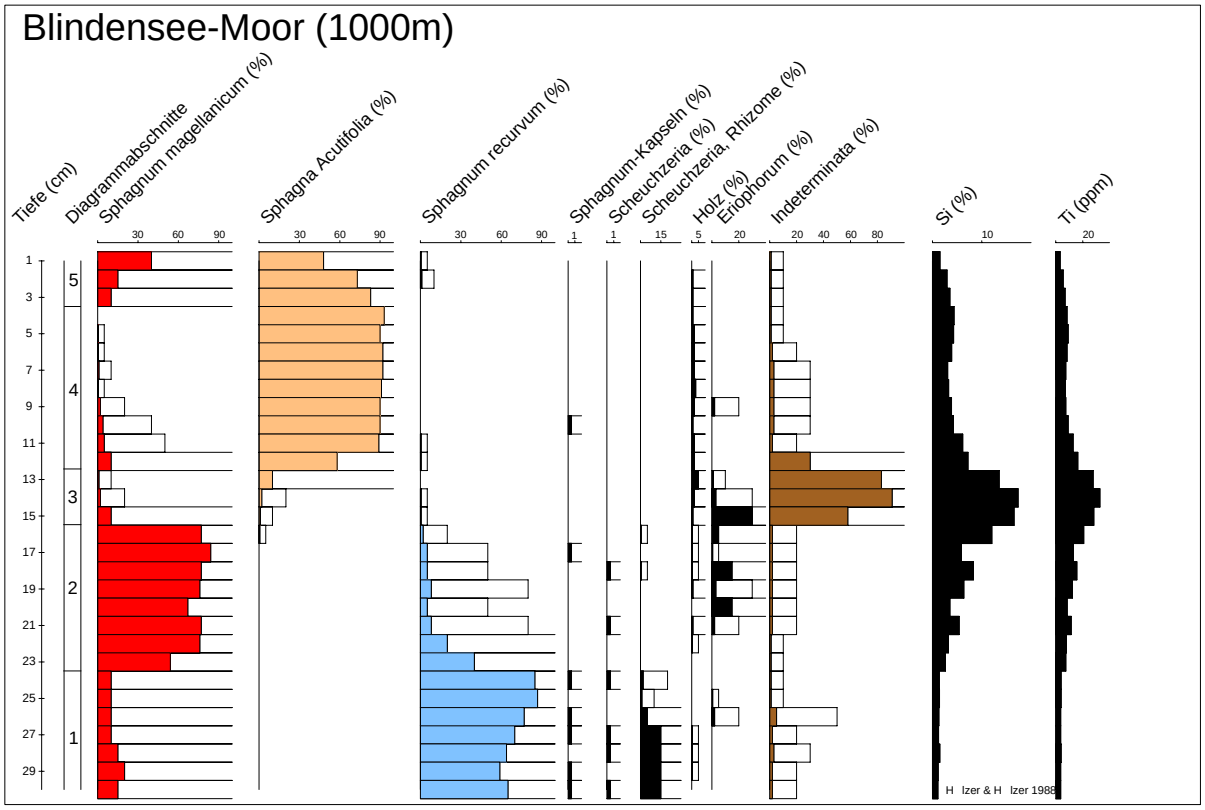


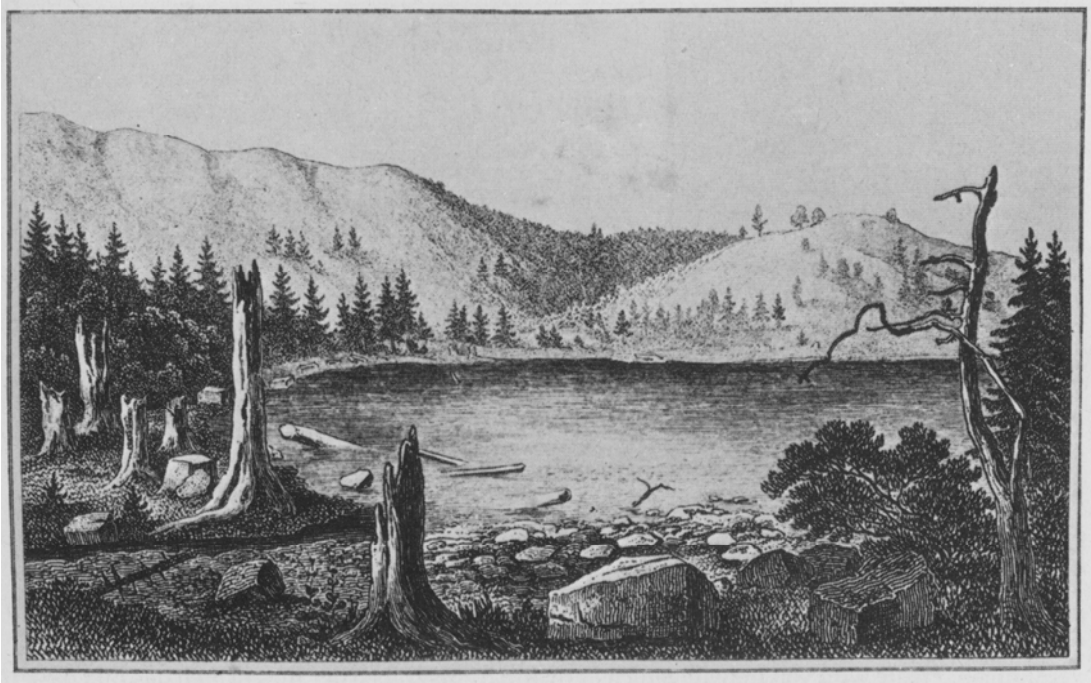



Hornisgrinde
ho2


Hornisgrinde
ho2
Hölzer & Schloss
(1981)
depth (cm)
Sphagnum magellanicum
Acutifolia
Odontoschisma spec.
Aulacomnium palustre
Pleurozium schreberi
Polytrichum strictum
Pohlia spec.
Calluna, leaves, branches
Eriophorum, fibres
wood
Indeterminata
Sphagnum, spores
Silicon (%)
1800 AD

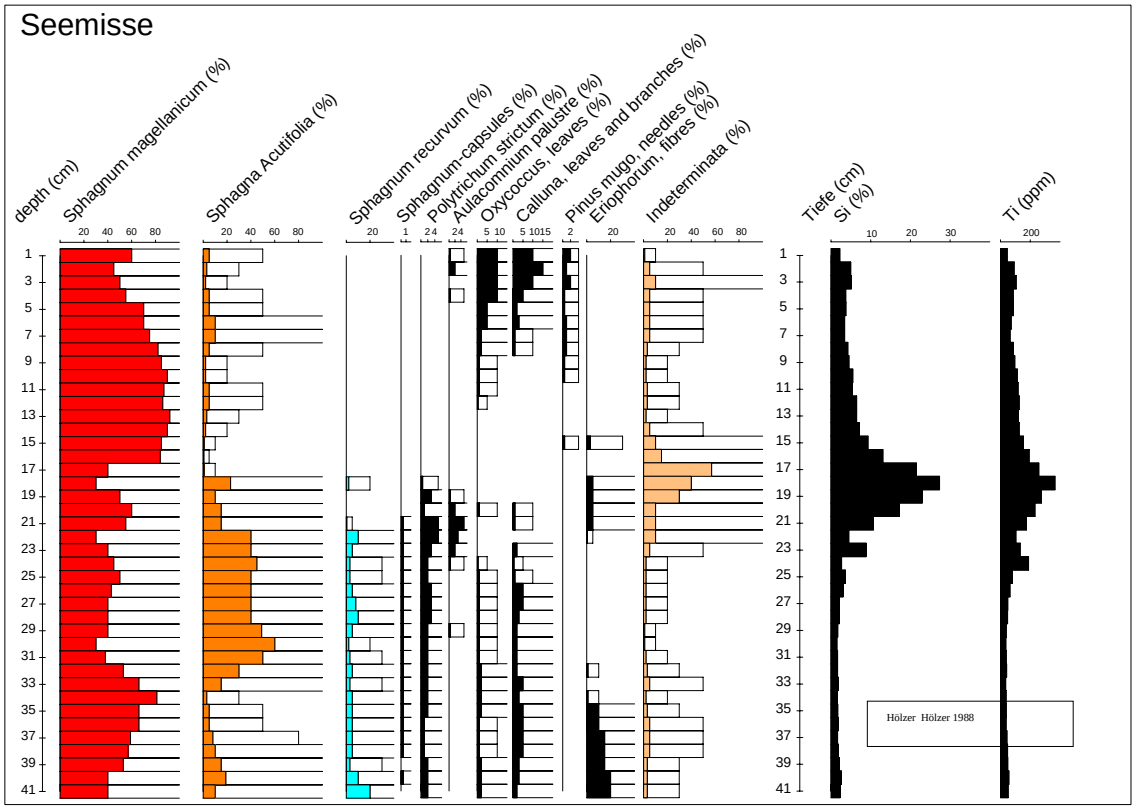

Blindense-Moor


Blindensee-Moor (1000m)
Tiefe (cm)
Diagrammabschnitte
Sphagnum magellanicum (%)
Sphagna Acutifolia (%)
Sphagnum recurvum (%)
Sphagnum-Kapseln (%)
Scheuchzeria (%)
Scheuchzeria, Rhizome (%)
Holz (%)
Eriophorum (%)
Indeterminata (%)
Si (%)
Ti (ppm)
H Izer & H Izer 1988

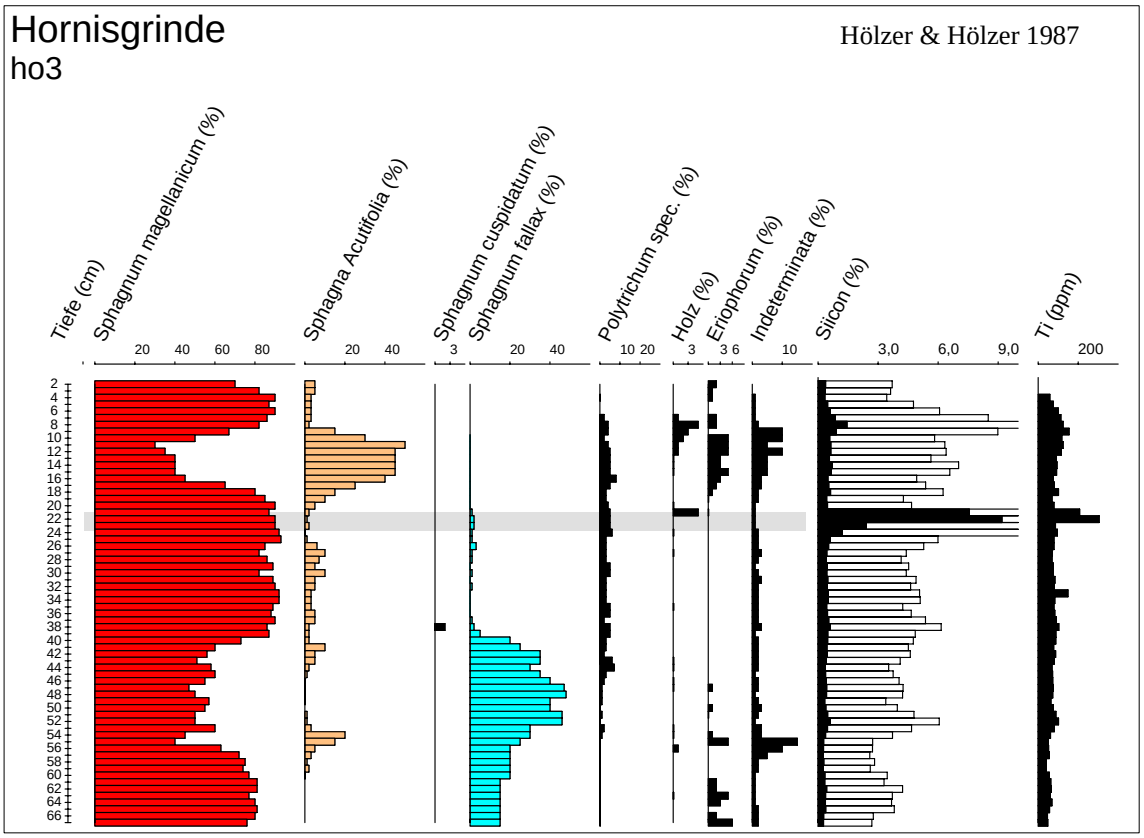


Seemisse

after the fire in 1800




Hornisgrinde
ho3

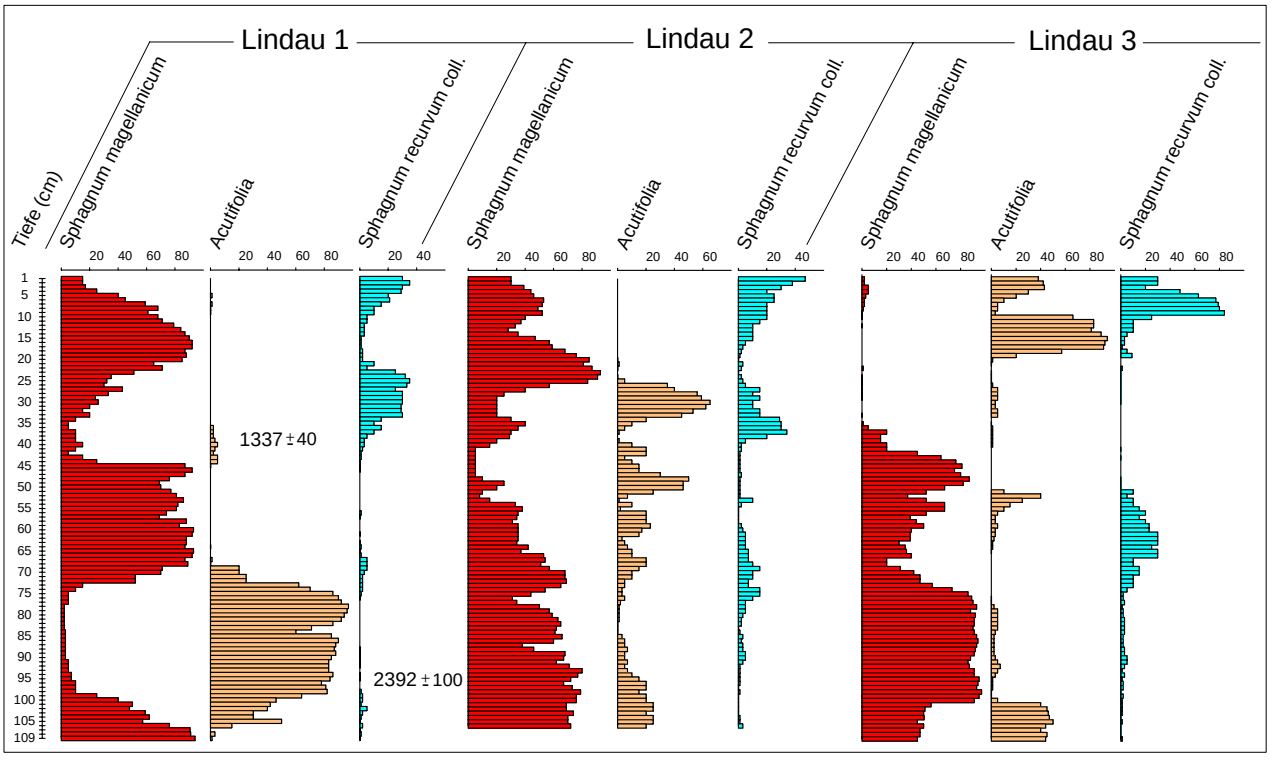

Hornisgrinde
ho3
Hölzer & Hölzer 1987
Tiefe (cm)
Sphagnum magellanicum (%)
Sphagna Acutifolia (%)
Sphagnum cuspidatum (%)
Sphagnum fallax (%)
Polytrichum spec. (%)
Holz (%)
Eriophorum (%)
Indeterminata (%)
Silicon (%)
Ti (ppm)

Lindau

Lindau 1

Lindau 2

Lindau 3


Lindau 1
Lindau 2
Lindau 3
Tiefe (cm)
Sphagnum magellanicum
Acutifolia
Sphagnum recurvum coll.
1337 ± 40
2392 ± 100

Conclusions:

- **General climatic trends could not be detected**
- **Local events as fires or human impact influence the succession**
- **More studies are needed**

OCCURRENCE OF SELECTED EUROPEAN THREATENED MOSSES IN THE POLISH PART OF THE CARPATHIANS

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INTRODUCTION

Fig. 1. Location of the Carpathians in Poland.

The Carpathians are the vast mountain chain located in the Central Europe. The Polish part covers an area of about 19 600 square km (Fig. 1). The highest point is Mount Rysy in the Tatras (2 499 m), while the lowest parts (about 200 m) lie in the Foothills belt.

In the Polish part of the Carpathians occurrence of 43 moss species which are considered as threatened in Europe (Schumacker & Martiny 1995) is noted. Most of them (15 species) belong to category R followed by those belonging to category RT (13), K (7), V (5), E (2) and T (1). The state of knowledge about distribution, ecology and threats of particular species is different. In this paper information about occurrence of *Brachydontium trichodes, Brachythecium geheebii, Callicladium haldanianum, Dicranum viride* and *Hamatocaulis vernicosus* is given.

Brachydontium trichodes (F.Weber) Milde

In Poland *Brachydontium trichodes* grows only in the mountain ranges of the Sudetes and the Carpathians. It is considered as threatened species (threat category R), both in whole Poland and the Polish part of the Carpathians (Żarnowiec *et al*. 2004). Since 2004 it has been strictly protected plant. It was placed on the 'Red-list of European Bryophytes' in the category R (Schumacker & Martiny 1995).

Distribution in the Polish Carpathians

Extent of distribution

In the Polish part of the Carpathians *B. trichodes* was discovered for the first time by Chałubiński (1886) in the Tatras. However, earlier Rehmann (1865) mentioned its occurrence in this region (now belonging both to Poland and Slovakia), but without details. Later *B. trichodes* has been reported from many localities in various ranges. Especially frequently it occurs in the Beskidy Zachodnie Mountains (Fig. 2).

Altitudinal range

The lowest locality of *B. trichodes* was found at ca 395 m in the Pogórze Wielickie Foothills (Stebel 2004), while the highest at 1670 m in the Tatras (Chałubiński 1886). Most stations of the species have

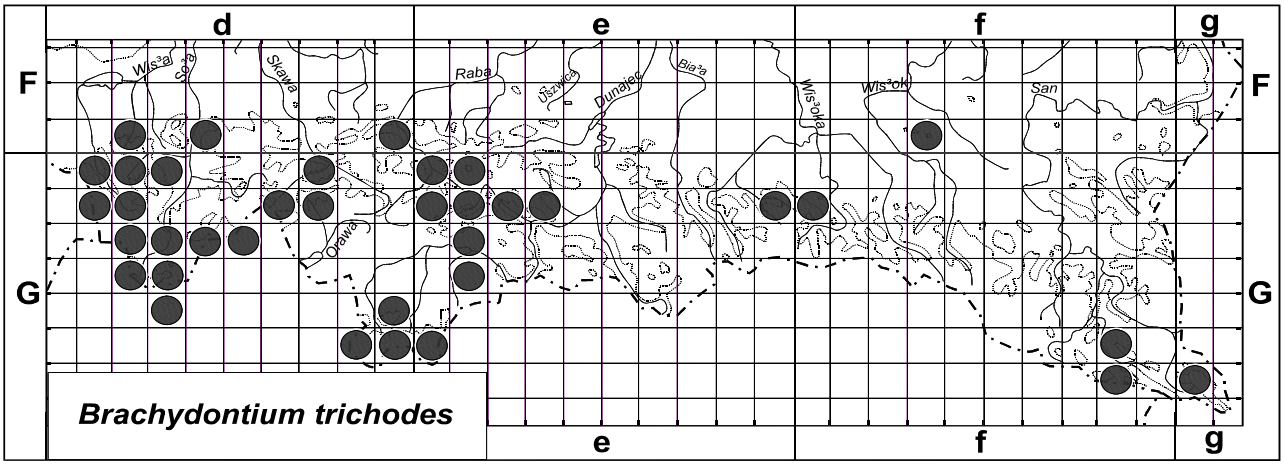

Fig. 2. Distribution of *Brachydontium trichodes* in the Polish part of the Carpathians.

been found at elevations between 700 and 1099 m (Fig. 3). In Poland *B. trichodes* is considered to be a multizonal mountain species (Stebel 2006).

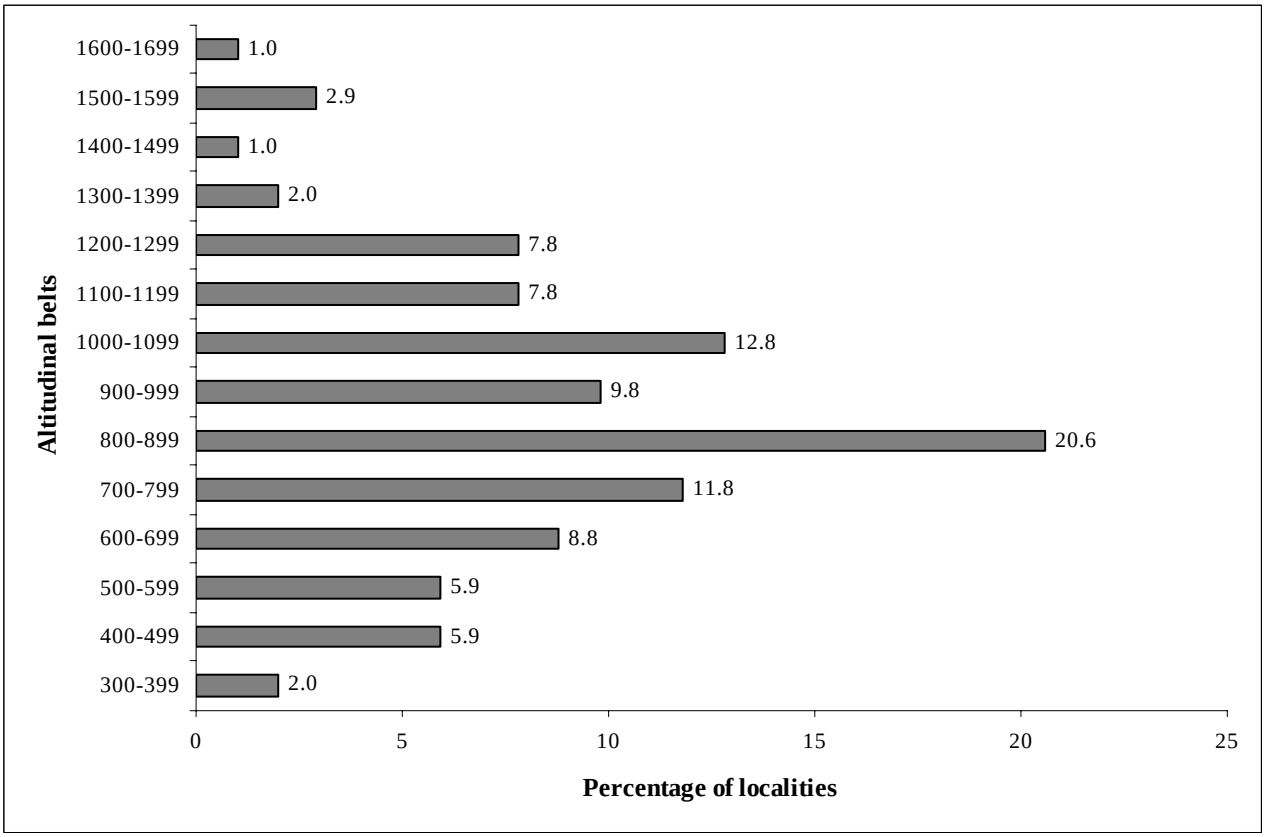

Fig. 3. Vertical distribution of *Brachydontium trichodes* at intervals of 100 metres.

Habitats

B. trichodes is a calcifuge obligate epilithic species. It occurs on wet, shaded sandstone boulders, very rarely on sandstone outcrops in forest. Especially frequently and abundantly it grows in stream valleys.

Populations

B. trichodes grows mainly in small populations, covering several square centimetres. However, rarely much bigger populations, in which the species grows on the area of several square metres, are observed.

Reproduction

B. trichodes commonly and abundantly produces sporophytes.

Accompanying species

B. trichodes most frequently grows in congeneric tufts. Sometimes it is associated with other small bryophytes, such as *Campylostelium saxicola* (F.Weber & D.Mohr) Bruch & Schimp., *Cephalozia bicuspidata* (L.) Dumort. and *Fissidens pusillus* (Wilson) Milde.

Threats

B. trichodes does not seem to be particulary threatened since its habitats are not directly affected by human activity. Situation of this species is interesting, because more and more of its localities are still being discovered. Of course, as the moss flora is still insufficiently known, it is also possible that *B. trichodes* is wider spread than published data suggest. However, this thesis seems to be low probable because in many localities mosses have been observed by the author for many years while floras of some other regions have been investigated in detail by other bryologists and there has been no one who saw this species earlier.

Brachythecium geheebii Milde

In Poland *Brachythecium geheebii* grows mainly in the mountain ranges in the Sudetes and the Carpathians, very rarely in the lowland. It is considered as threatened species (threat category V) in whole Poland as well as the Polish part of the Carpathians (Żarnowiec *et al*. 2004). Since 2004 it has been strictly protected. It was placed on the 'Red-list of European Bryophytes' in the category R (Schumacker & Martiny 1995).

Distribution in the Polish Carpathians

Extent of distribution

In the Polish part of the Carpathains this species was found for the first time by Krupa (1879) in the Beskid Śląski Range. It is known from scattered localities. Most of them have been reported from the Bieszczady Zachodnie Range located in the eastern part of the investigated area (Fig. 4).

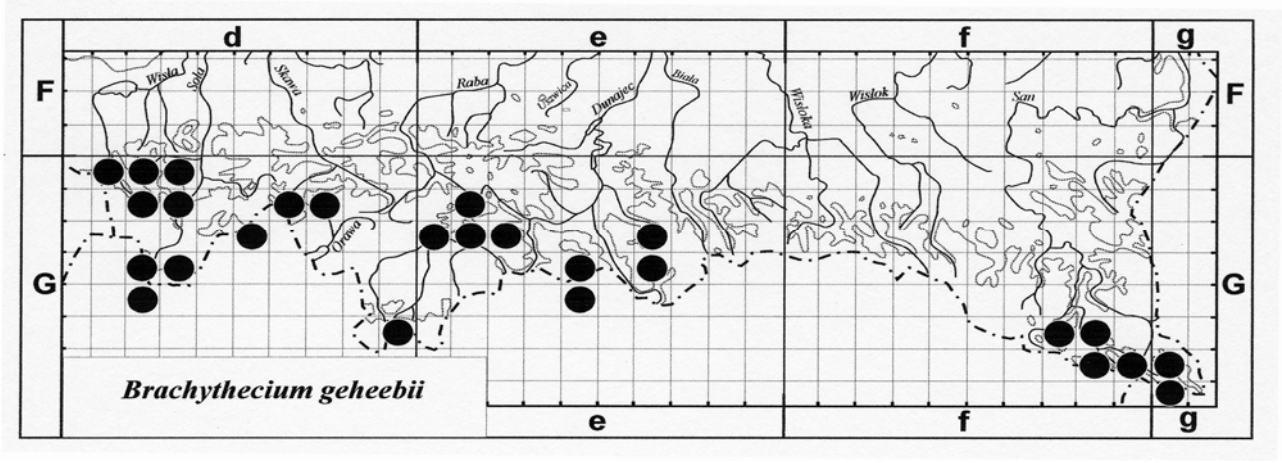

Fig. 4. Distribution of *Brachythecium geheebii* in the Polish part of the Carpathians.

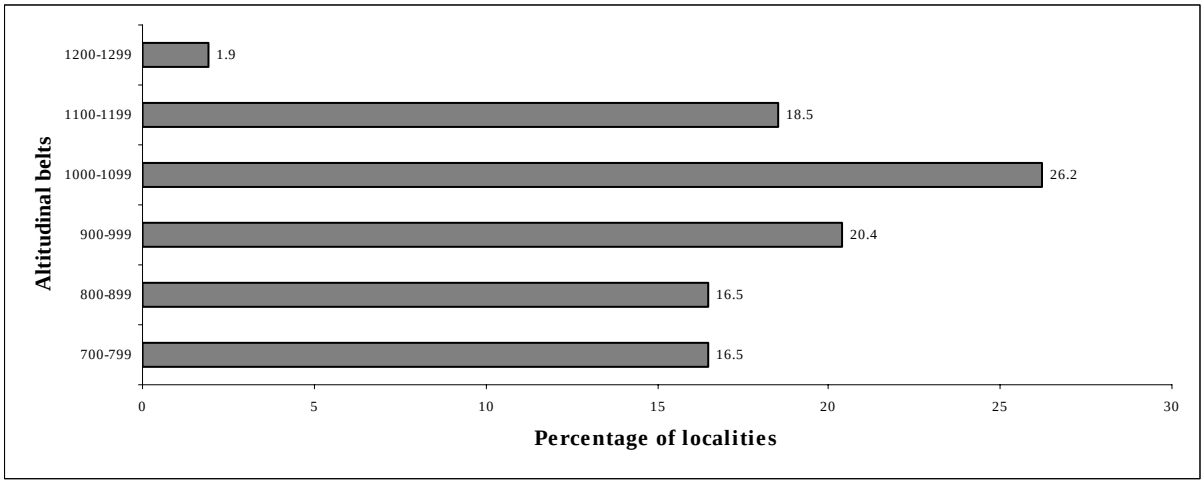

Fig. 5. Vertical distribution of *Brachythecium geheebii* at intervals of 100 metres.

Altitudinal range

The lowest locality of *B. geheebii* in the Polish Carpathians is at an altitude of 700 m in the Bieszczady Zachodnie and Beskid Śląski Ranges (Lisowski 1956; Stebel 2006), while the highest is at about 1250 m in the Bieszczady Zachodnie Range (Lisowski 1956). Locality from the altitude of 1760 m in the Tatras (Lisowski 1959) is most probably a misprint. Most stations of the species have been found at elevations between 900 and 1199 m (Fig. 5). In Poland *B. geheebii* is considered to be a mountain species, associated with the lower forest belt (Stebel 2006).

Habitats

B. geheebii is mainly an epiphytic species, associated with bark of deciduous trees, mainly *Fagus sylvatica*. Rarely it was found on bark of rotten logs and shaded sandstone outcrops (Fig. 6).

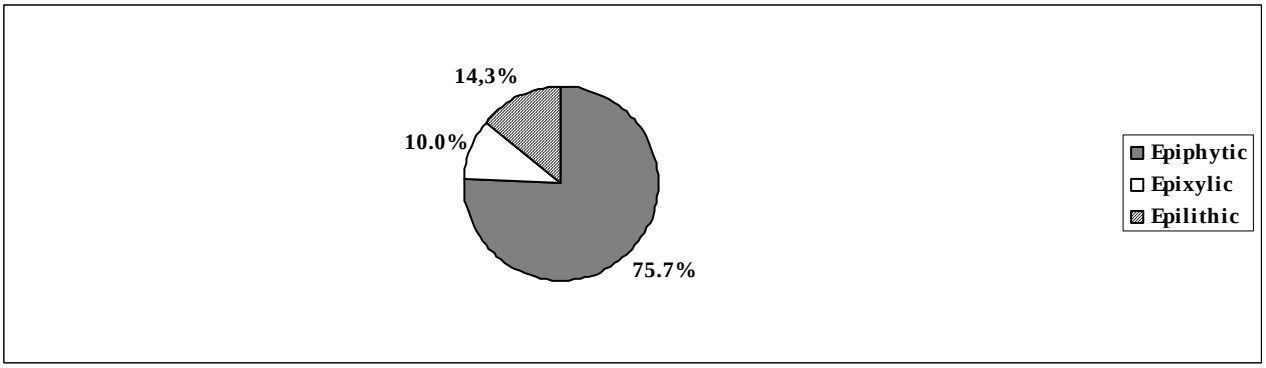

Fig. 6. Habitat preferences of *Brachythecium geheebii* in the Polish part of the Carpathians.

Populations

Populations of *Brachythecium geheebii* in the Polish Carpathians are rather small and cover about 0.1-0.5 square metres. The largest population recently found was about 1.5 square metre.

Reproduction

Populations of *B. geheebii* are mainly sterile.

Accompanying species

B. geheebii is fairly frequently associated with such species as *Anomodon attenuatus* (Hedw.) Huebener, *Neckera complanata* (Hedw.) Huebener, *Pterigynandrum filiforme* Hedw., *Rosulabryum moravicum* (Podp.) Ochyra & Stebel and *Ulota crispa* (Hedw.) Brid.

Threats

Nowadays intensive human activity, especially as far as forest management and air pollution are concerned, seems to be the main factor responsible for the decrease in the number of localities of this species.

Callicladium haldanianum (Grev.) H.A.Crum

In Poland *Callicladium haldanianum* grows in the whole area, mainly in the lowland. It had been considered as rare species until recently when a lot of its localities have been found. In some parts of Poland, e.g. in Silesia, it is fairly frequent species now (Stebel 1997). It was placed on the 'Red-list of European Bryophytes' in the category RT (Schumacker & Martiny 1995).

Distribution in the Polish Carpathians

Extent of distribution

In the Polish part of the Carpathians this species was found for the first time by Krupa (1882) in the Beskid Sądecki Range. Later *C. haldanianum* has been reported from scattered localities. Recently more and more stations have been discovered, mainly in the western part (Fig. 7).

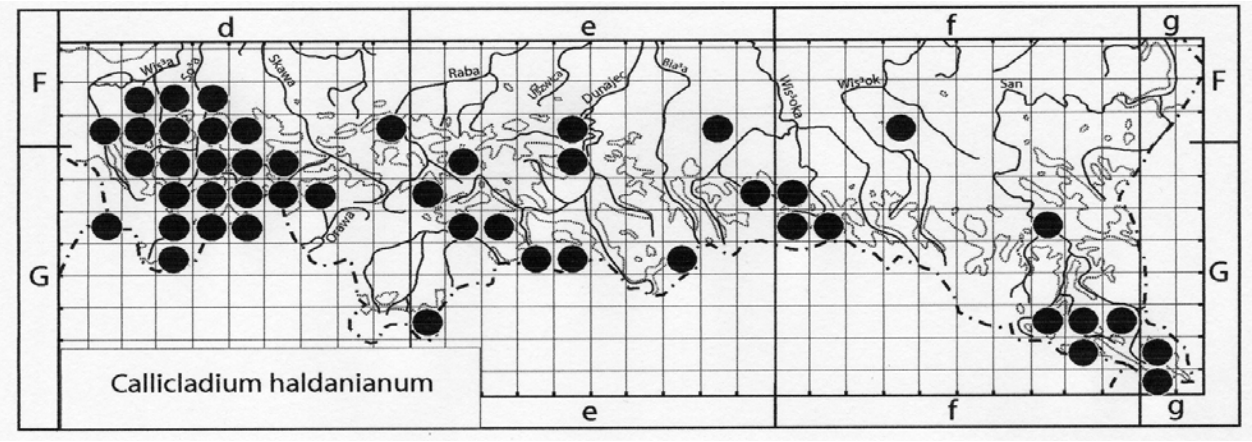

Fig. 7. Distribution of *Callicladium haldanianum* in the Polish part of the Carpathians.

Altitudinal range

In Poland *C. haldanianum* is considered to be a lowland species. In the Polish part of the Carpathians most stations are located up to 1000 m (Fig. 8). The highest locality, 1400 m, was reported from the Tatras (Kuc 1958).

Habitats

C. haldanianum grows mainly on epixylic habitats, especially rotten wood of deciduous trees. Rarely it occurs on bark of living trees (mainly at bases of deciduous trees), humic and mineral soil and shaded sandstone rocks (Fig. 9).

Populations

Populations of this species are quite large, frequently over 1 square metre. The largest populations were observed on rotten logs.

Reproduction

C. haldanianum is fairly frequently found with sporophytes.

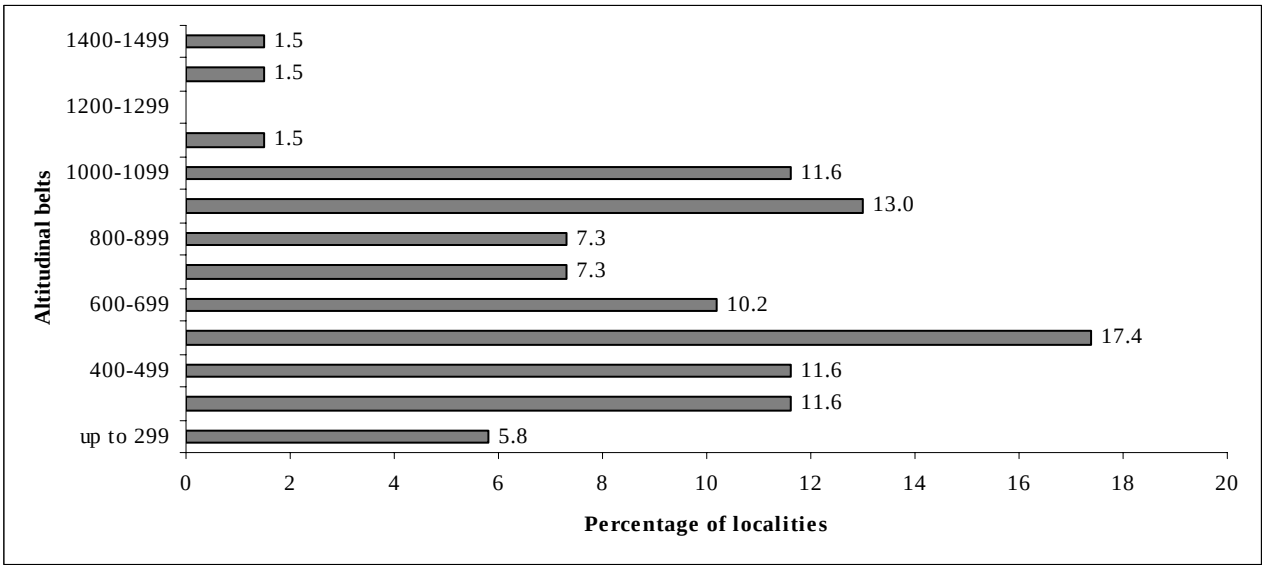

Fig. 8. Vertical distribution of *Callicladium haldanianum* at intervals of 100 metres.

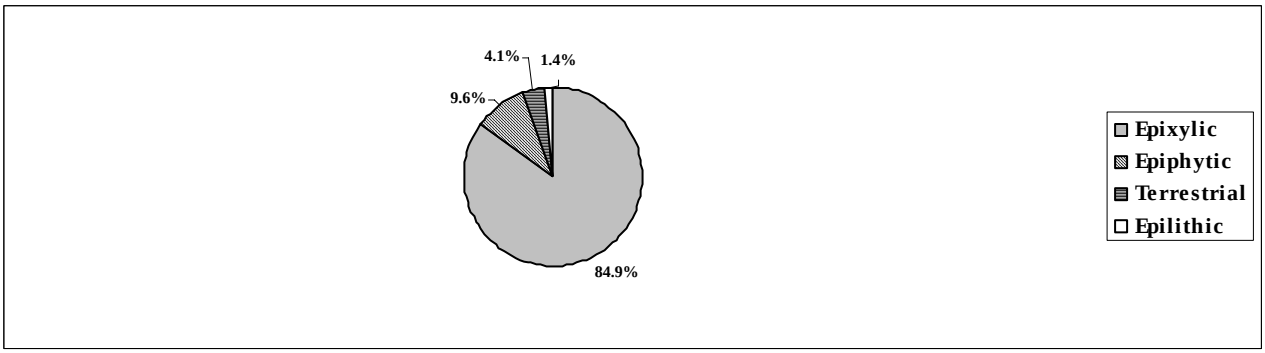

Fig. 9. Habitat preferences of *Callicladium haldanianum* in the Polish part of the Carpathians.

Accompanying species

C. haldanianum grows most frequently with common multihabitat species, as *Dicranum scoparium* Hedw., *Orthodicranum montanum* (Hedw.) Loeske, *Tetraphis pellucida* Hedw., *Ptilidium pulcherrimum* (Weber) Vainio, *Brachythecium salebrosum* (Hoffm. *ex* F.Weber & D.Mohr) Schimp. and *Lophocolea heterophylla* (Schrad.) Dumort.

Threats

At present, *C. haldanianum* is not threatened in the Polish part of the Carpathians. It seems to be spreading in this area, but this problem needs further studies.

Dicranum viride (Sull. & Lesq.) Lindb.

Dicranum viride grows probably in the whole area of Poland, but most frequently in lower parts of the Carpathians. It is considered as threatened species (threat category R), both in the whole Poland and

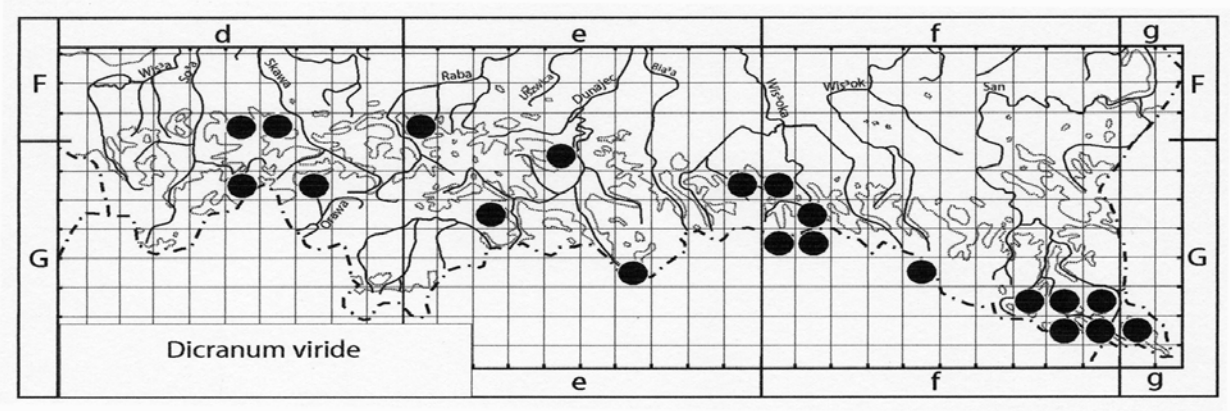

Fig. 10. Distribution of *Dicranum viride* in the Polish part of the Carpathians.

Polish part of the Carpathians (Żarnowiec *et al*. 2004). Since 2004 it has been a strictly protected plant. It was placed on the 'Red-list of European Bryophytes' in the category V (Schumacker & Martiny 1995).

Distribution in the Polish Carpathians

Extent of distribution

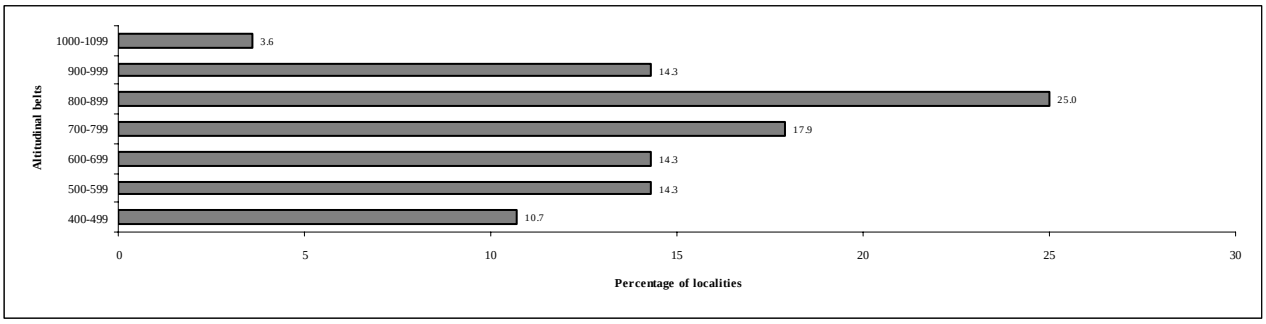

Fig. 11. Vertical distribution of *Dicranum viride* at intervals of 100 metres.

In the Polish part of the Carpathains *D. viride* was found for the first time by Rehmann (1869) in the Beskid Sądecki Range. Then many localities of this species were discovered, mainly in the eastern part of the Polish Carpathians. Till now it still has been unknown from the westernmost part of this area (Fig. 10).

Altitudinal range

The lowest locality of *D. viride* is at an altitude of 430 m in the Beskid Niski and Wysoki Ranges (Stebel & Ochyra 2000; Stebel 2006), while the highest is at about 1000 m in the Bieszczady Zachodnie Range (Lisowski 1956). Most stations of the species have been found at elevations between 500 and 999 m (Fig. 11). In Poland *D. viride* is considered to be a mountain species associated with the lower forest belt (Stebel 2006).

Habitats

D. viride is generally epiphytic species associated with bark of deciduous trees, mainly *Fagus sylvatica*. Rarely it has been found on shaded sandstone outcrops and on rotten logs and stumps (Fig. 12).

Populations

At present, populations of *D. viride* are small of about several square centimetres.

Reproduction

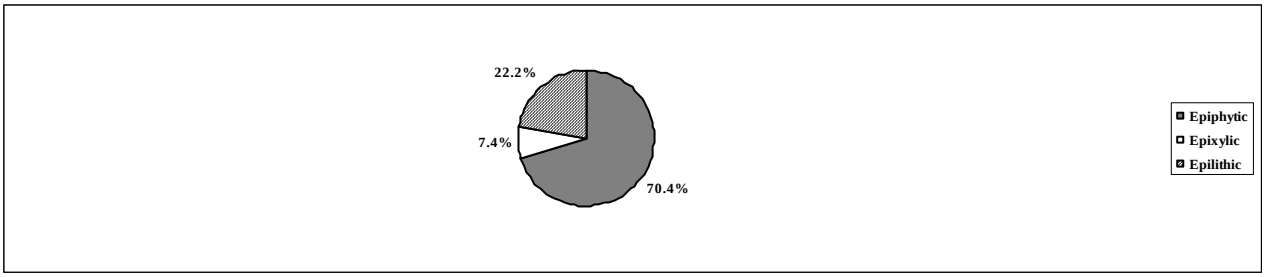

Fig. 12. Habitat preferences of *Dicranum viride* in the Polish part of the Carpathians.

Populations of *D. viride* in the Polish part of the Carpathians has been always sterile.

Accompanying species

D. viride grows mainly with such species as *Hypnum cupressiforme* Hedw., *Neckera complanata* (Hedw.) Huebener, *Pterigynandrum filiforme* Hedw., *Rosulabryum moravicum* (Podp.) Ochyra & Stebel and *Sciuro-hypnum reflexum* (Starke) Ignatov & Huttunen

Threats

The degree of threat of *D. viride* needs further investigations. Undoubtedly, intensive human activity, especially as far as forest management and air pollution are concerned, seems to be the main factor responsible for the decrease in the number of epiphytic localities of this species. On the other hand, epilithic localities seem to be rather not threatened.

Hamatocaulis vernicosus (Mitt.) Hedenäs

In Poland *Hamatocaulis vernicosus* grows in the whole area, mainly in the lowland. It is generally a rare species, especially in southern Poland and in mountains, but in northern Poland it occurs fairly frequently. Since 2004 it has been strictly protected. It was placed on the 'Red-list of European Bryophytes' in the category K (Schumacker & Martiny 1995).

Distribution in the Polish Carpathians

Extent of distribution

This species was reported for the first time by Chałubiński (1886). It seems to be rather a rare species

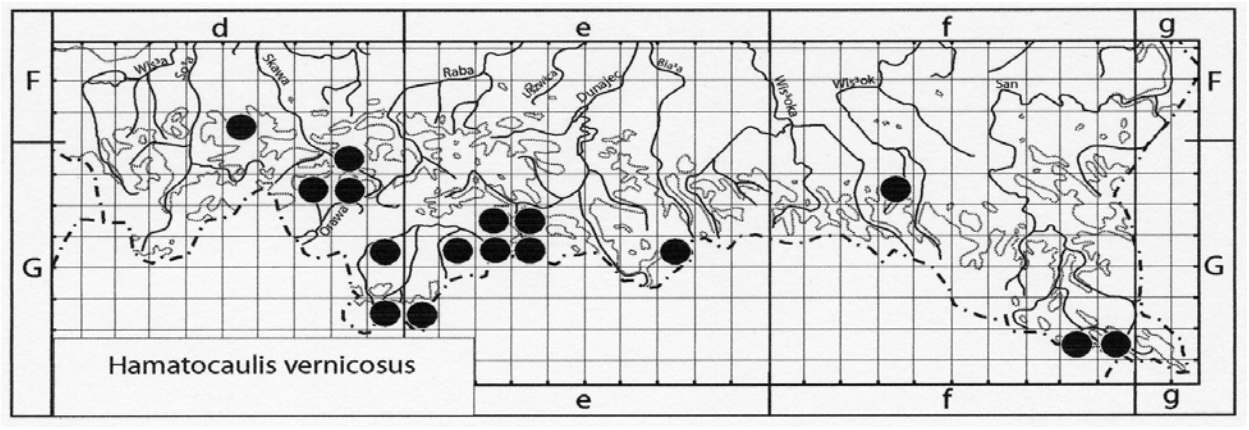

Fig. 13. Distribution of *Hamatocaulis vernicosus* in the Polish part of the Carpathians.

in this area and until now only a few localities have been reported (Fig. 13).

Altitudinal range

The lowest locality of *H. vernicosus* is at an altitude of about 400 m in the Gorce Range (Stebel 2006), while the highest at about 1135 m in the Tatras (Lisowski 1965). Most stations of the species have been found at elevations between 400 and 699 m (Fig. 14).

Habitats

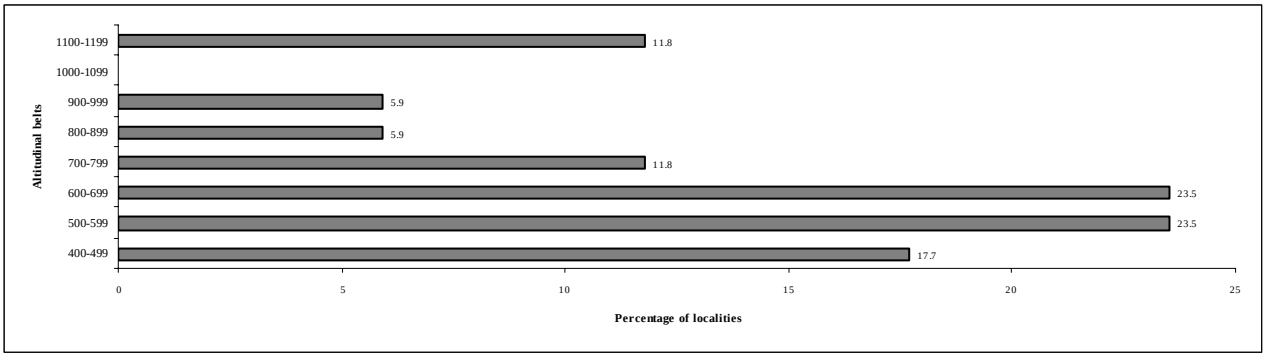

Fig. 14. Vertical distribution of *Hamatocaulis vernicosus* at intervals of 100 metres.

H. vernicossus occurs exclusively in bog-spring communities of the *Scheuchzerio-Caricetea nigrae* class.

Populations

Size of populations is different, but not more than 5 metres.

Reproduction

Populations of *H. vernicosus* in the Polish part of the Carpathians have been always sterile.

Accompanying species

H. vernicosus grows mainly in mesotrophic habitats, together with such species, as *Aulacomnium palustre* (Hedw.) Schwägr., *Calliergon cordifolium* (Hedw.) Kindb., *Sphagnum subsecundum* Nees and *Warnstorfia exannulata* (Schimp.) Loeske.

Threats

Human activity is generally harmful for paludicolous mosses. Agricultural drainage, water extraction and pollution have a detrimental effect to these species. Agricultural drainage and water extraction cause the relatively quick destruction of paludicolous ecosystems. The next threat is the process of succession. As sheep grazing diminishes, a large areas of non forest vegetation, meadows, pastures and bog-springs, are gradually becoming overgrown by forest. This process eliminates many species, e.g. *H. vernicosus*.

Acknowledgements

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Law-protected liverworts in Poland

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Abstract. The paper contains a disscusion on the low protection of the liverwort species in Poland. Within the current Ordinance of the Minister of Environment dealing with the designation of wild plants coming under protection (Official Gazette Announcing Current Legislation No. 168, item 1764, 2004), 25 liverwort species are strictly protected and a further 4 partly so. Thus, altogether 29 liverwort species belonging to 13 families are legally protected (12,4% of the total liverwort flora of Poland). The group of strictly protected species comprised 24 threatened liverworts in Poland, 6 threatened species in Europe, 15 lowland species, 3 lowland-mountain species, 7 mountain species. Most of strictly protected species (13 species) grew on peaty areas. 5 species occurred on rotten logs in forest communities and 5 – in calcareous grasslands.

Key words : liverworts, species protection, Poland.

Species protection in Poland in the light of the latest acts of law

Species protection is one of ten forms of nature conservation mentioned in the article 6 of the Nature Conservation Act of 16. April 2004 (Journal of Law No. 92, of April 30 2004, item 880). According to the Law "species protection is about to maintain of persistence of appropriate state of the wild-occurring plants, animals and fungus and their habitats; endangered, endemic species, vulnerable to threat and extinction and protected within international law as well as to maintain of species and genetic diversity". Moreover, " for purpose of protection of refuges and stands of plants and fungus under legal species protection or refuges, sites of procreation and regular occurrence of animals under species protection, zones of protection can be established".

The Act obligates a minister of environment protection to establish, by rule, *(1)* the list of plants – (*i*) strictly protected (*ii*) partially protected, (*iii*) partially protected but which can be collected and ways of their collection, (*iv*) requiring protection zones of their refuges or stands and size of these zones; *(2)* prohibitions for specific plant species or groups of species and exceptions for these prohibitions; *(3)* ways of plant species protection. It is worth mentioning that the Act obligates institutions of nature conservation to take up endeavors aiming at saving endangered species under law protection which consist in transport of these species into other sites, elimination of causes of threat, protection *ex situ* and creation of favorable conditions for reproduction. Furthermore, Minister of Environment is obliged to establish programs of protection of species vulnerable to extinction.

The current Ordinance of Minister of Environment on natural occurrence of plants under legal protection was issued on 9th July 2004 (Journal of Law No 168, item 1764). The list encompasses 653 species of plants including algae (27 species), bryophytes (231 species), pteridophytes (38 species) and seed plants (357 species). It is 4% of total flora of Poland (Tab. 1). The strictly protected group contains 597 species whilst group of partially protected species amounts to 56. For he first time, algae and so big representation of mosses and liverworts were listed. The share of protected species in particular

taxonomic groups ranges from 1 (*Phaeophyta*) to 92% (*Lycopodiophyta*) but the smallest proportions occur in algae (from 1% to 6%) and the largest amongst pteridophytes (from 20% to 92%). The groups with the highest contributions of protected species are as follows: Lycopodiophytes (92%), ferns (46%), gymnosperms (40%), mosses (29%) and monocotyledons (22%). In remaining groups the contribution of protected species is lower than 20% (Table 1).

The mentioned acts of law are important tool of activities concerning conservation of biodiversity at the species level, especially at the genetic diversity of species. It may even be claimed that they are considerable turn in attitude to law protection of species. For the first time guidelines on ways and methods of species protection appeared and also plant world is represented by nearly whole spectrum of its differentiation at the level of upper taxonomic units (except for algae which are represented by 3 taxa of upper rank). Also for the first time amongst strictly protected plants a group of species, which protection was treated as overriding any economic needs, as well as group of species requiring active protection were distinguished. Moreover, the plants were mentioned which refuges or stands are protected by establishment of species protection zones (Appendix n°. 4 of the Ordinance). Up to now, this type of protection was used only in some cases of birds and reptiles. It is worth mentioning that these new changed laws are result of the adaptation of Polish law, within nature conservation, to European standards pointed out by Bern Convention and Habitat Directive.

Geographic-ecological characteristics of law-protected liverworts

The list strictly protected species includes 25 liverworts and 4 are assigned to be protected within partial protection (Table 1). In case of strictly protected liverworts 4 species were distinguished – *Asterella saccata, Mannia fragrans, Oxymitra incrassata* and *Riccia ciliifera* – which require active protection. The protected species contribute more than 12% to total flora of liverworts in Poland and belong to 23 genera and 13 families.

Table 1. Law-protected plants in Poland

Taxonomic groups	Number of species in Poland*	Number of protected species			Percentage of flora ofPoland
		strictly	partly	total	
Algae Phaeophyta Rhodophyta Charophyta	**12 850** 103 321 328	23 1 2 20	4 4	27 1 6 20	**0,2** 1,0 1,9 6,1
Bryophytes *Marchantiophyta Bryophyta*	**940** 236 700	**200** 25 175	31 4 27	**231** 29 202	**24,6** 12,3 28,9
Pteridophytes Lycophytina Sphenophytina Pterophytina	75 13 10 52	38 12 2 24	-	38 12 2 24	50,7 92,3 20,0 46,2
Spermatophytes Pinophytina Magnoliophytina Magnoliopsida Liliopsida	2 **415** 10 2 405 1908 497	336 4 332 225 107	**21** 21 16 5	357 4 353 241 112	**14,8** 40,0 14,7 12,6 22,5
AH taxonomic groups	**16 278**	**597**	**56**	**653**	**4,0**

Key: * - number of species in Poland according: Andrzejewski & Weigle 2003, Klama 2006 a, Ochyra *et al.* 2003.

In the group of strictly protected species 24 (96%) are threatened (Klama, 2006 b), including one probably extinct or lost, 10 endangered and 9 vulnerable (Table 2). It is noteworthy that more than half of strictly protected species (13 species) are characterized by suboceanic or suboceanic-mountain

Table 2. Biogeographical and ecological characterization and red data book categories of law-protected liverworts in Poland

Law-protected liverworts	Geographical elements (Duell 1983)	Altitudinal elements	Ecological groups	Life strategy category Dierßen 2001	Relicts of primeval forest (Klama 2002b)	Species threatened in Poland (Klama 2006a)	Species threatened in Europe (Schumacker, Martiny, 1995)
Anastrophyllum hellerianum (Nees *ex* Lindenb.) R.M.Schust.	bor-mt	m	Epx	Cp	Rp	V	.
Asterella saccata (Wahlenb.) A.Evans	subcont	l	K	S	.	E	V
Barbilophozia kunzeana (Huebener) Müll.Frib.	bor-mt	m	T	Cp	.	V	.
Cephalozia catenulata (Huebener) Lindb.	s.suboc-mt	m	Epx	C	Rp	V	.
Cladopodiella fluitans (Nees) H.Buch	n.suboc	l	T	C	.	V	.
Cladopodiella francisci (Hook.) Jörg.	n.suboc.	l	T	C	.	E	.
Geocalyx graveolens (Schrad.) Nees	subbor-mt	m	Epx, L	Cp	.	V	.
Haplomitrium hookeri (Sm.) Nees	n.suboc	lm	J	A	.	V	R
Jamesoniella undulifolia (Nees) Müll.Frib.	n.suboc-mt	m	T	C	.	Ex	E*
Leiocolea rutheana (Limpr.) Müll.Frib.	subarc	l	T	P	.	E	.
Lophozia capitata (Hook.) Macoun	n.suboc	l	T	C	.	E	.
Lophozia laxa (Lindb.) Grolle	n.suboc	l	T	C	.	I	RT
Mannia fragrans (Balbis) Frye & L.Clark	e.submed	l	K	L	.	E	.
Moerckia hibernica (Hook.) Gottsche	n.bor-dealp	m	T	L	.	E	.
Nowellia curvifolia (Dicks.) Mitt.	suboc-mt	lm	Epx	C	.	V	.
Odontoschisma denudatum (Mart.) Dumort.	suboc-mt	lm	Epx, T	C	.	.	.
Odontoschisma sphagni (Dicks.) Dumort.	suboc	l	T	C	.	V	.
Oxymitra incrassata (Brot.) Sérgio & Sim-Sim	submed	l	K	A	.	E	.
Pallavicinia lyellii (Hook.) Carruth.	suboc	l	T	S	.	E	V
Riccardia chamedryfolia (With.) Grolle	n.suboc-mt	l	T	C	.	E	.
Riccardia incurvata Lindb.	n.suboc	l	T	S	.	V	.
Riccia ciliifera Link *ex* Lindenb.	submed-suboc	l	K	A	.	E	.
Riccia huebeneriana Lindenb.	s.temp	l	S	A	.	I	R
Riccia trichocarpa M.Howe	submed	l	K	A	.	R	.
Scapania paludicola Loeske & Müll.Frib.	bor-mt	m	T	C	.	I	.
Bazzania trilobata (L.) Gray *	subbor	lm	L	Pc	Rp	.	.
Plagiochila asplenioides (L. *emend.* Taylor) Dumort.*	w.temp	lm	L, Epx	P	Rp	.	.
Ptilidium ciliare (L.) Hampe*	bor	lm	L	L	.	.	.
Trichocolea tomentella (Ehrh.) Dumort.*	suboc-mt	lm	L	P	.	.	.

Key: Geographical elements: bor – boreal, dealp – dealpine, e. – east, mt – montane, n. – north, s. – south, subbor – subboreal, subcont – subcontinental, submed – submediterranean, suboc – suboceanic, temp – temperate. Altitudinal elements: m – mountain species, l – lowland species, lm – lowland-mountain species. Ecological group: Epx – epixylic, in forest communities, L – epigeic, on soil in forest communities, J – epigeic, on moist sand on shores of oligotrophous lakes, K – epigeic, on soil in xerothermic communities, T – bogs, fens and heaths, S – epigeic, ephemeral pools of ponds, lakes and reservoirs. Life strategy categories: A – annual shuttle, C – colonists, Cp – pioneer colonists, L – long-lived shuttle, P – perennials, Pc – competitive perennials, S – short-lived shuttle. Relicts of primeval forest: Rp. The red data book categories: Ex – extinct and probably exctinct, E – endangered, E* - endangered in Europe and vulnerable in global scale, V – vulnerable, R – rare, I – indeterminate, RT – regionally threatened species; * - partly protected species.

type of range. Majority (72%) of strictly protected liverworts are lowland or lowland-mountain species. Only 7 species have, on the territory of Poland, their own centre of the occurrence in mountainside. Also ecological analysis of strictly protected species is interesting. Nearly the half of them (13 species) are associated with peatlands, swamps and heathlands. Five species are characteristic for forest communities; these are mainly epixylic species growing coarse wood debris. The high contribution is made by species occurring in xerothermic grasslands (Table 2); what is interesting is the fact that they are thallose liverworts belonging to orders *Marchantiales* and *Ricciales*.

The law-protected liverworts as umbrella species for endangered biocoenoses and biotopes

The ways of species protection, which are mentioned in Nature Conservation Act and the Ordinance on species protection enabling protection of whole ecosystems, in which protected species occur. Thus, these plants may become umbrella species for endangered biotopes and plant communities.

Below characteristics of protected liverworts which may play role as umbrella species for plant communities and habitats are given.

Umbrella species for mires and heathlands

Barbilophozia kunzeana grows in bogs (the *Oxycocco-Sphagnetea* class), heathlands (the *Calluno -Ulicetalia* order) and in pinewoods (the *Dicrano-Pinenion* suballiance). In mountains it is to be found in mires of lower montane zones and in *Sphagnum-Polytrichum* hummocks lying in subalpine zone and alpine zone (Szweykowski, 1962; Szweykowski, Buczkowska, 2000).

Cladopodiella fluitans grows in depressions of hummock-hollow complex of raised bogs (the *Oxycocco-Sphagnetea* class); also encountered in transitional mires (the *Rhynchosporion albae* order). In Poland the species is quite common.

Cladopodiella francisci – grows on wet sand in neighborhood of heathlands (the *Calluno-Ulicetalia* order), it appears also on uncovered peat.

Jamesoniella undulifolia – is one of the rarest liverworts of Poland. It grows on mires and transitional mires. It is recorded in seven localities located in north and west of the country in 19th century (Szweykowski, 1971), however, since that time the occurrence of this species was not confirmed. Probably *Jamesoniella undulifolia* is lost or extinct species in Poland.

Leiocolea rutheana – glacial relic species, its occurrence is limited to northern part of the country and is associated with the area of Baltic Glaciation (Ochyra et al., 1988). It occurs in mire communities of the *Scheuchzerio-Caricetea fuscae* class, accompanied by boreal, subartic mosses, associated with post-glacial lakes.

Lophozia laxa – very rare liverwort in Poland. It grows in raised bogs, especially forest bogs.

Moerckia hibernica - very rare liverwort in Poland. It occupies marshes and ferns of the *Scheuchzerio-Caricetea fuscae* class.

Odontoschisma sphagni – characteristic species for the *Sphagno-Ericetalia* order (Matuszkiewicz, 2001). It occurs in northern part of the country and in mountains at the south.

Pallavicinia lyellii- very rare liverwort in Poland. It grows on humid soils of oligotrophic habitats, noted basically in areas of the occurrence of seaside heathlands and bogs (Szweykowski,1967).

Umbrella species for developing communities on moist sand along banks of oligothrophic lakes and for heathland communities

Haplomitrium hookeri – in Poland it has meridian disjunction. It grows at north of the country and at the south in mountains. At the north is a characteristic constituent of phytocoenoses forming on moist

sand at banks of oligotrophic lakes (community *Haplomitrium-Fossombronia incurva* Ass. Koppe 1933) and heathlands (Szweykowski, 1962; Bączkiewicz, Szweykowski, 2001). In mountains above upper border of forest in mires, peaty sites, along streams.

Lophozia capitata – rare lowland species in Poland, it grows at north and west of the country (Szweykowski, 1969). It is characteristic element of communities forming on wet sand of banks of oligotrophic lakes. It occupies also dune sands and mires.

Riccardia incurvata – characteristic component of phytocoenoses (community *Haplomitrium-Fossombronia incurva* Ass. Koppe 1933) occurring on wet sand at banks of oligotrophic lakes and heathlands (Szweykowski, 1962). It occurs in whole Poland except for mountains.

Umbrella species for forest communities

Anastrophyllum hellerianum – very rare species in Poland. The relic of primeval forests, it a indicator of primary forest habitats, it occurs in natural pinewoods (*Peucedano-Pinetum*, *Leucobryo-Pinetum*), spruce forests (among others *Sphagno girgensohnii-Piceetum*, *Plagiothecio-Piceetum*, *Bazzanio-Piceetum*) and mixed forests (e.g. *Pino-Quercetum*, *Querco-Piceetum*) on lowlands and in mountains; epixylic liverwort growing wood of rotten large logs.

Cephalozia catenulata – liverwort occurring in submontane zones of all Polish mountain Ranges, but everywhere it is a rare species. It also appears at the north of Poland. The relic of primeval forests, indicator of primeval, natural and primary forest biotopes; it grows in natural pine woods (associations *Peucedano-Pinetum*, *Leucobryo-Pinetum*), spruce forests (among others associations *Sphagno girgensohnii-Piceetum*, *Plagiothecio-Piceetum* and *Bazzanio-Piceetum*) and mixed forests (e.g. associations *Pino-Quercetum* and *Querco-Piceetum*) on lowlands and mountains; epixylic species growing wood of rotten logs.

Geocalyx graveolens – species treated as relic of primeval forests, indicator of primeval, natural and primary forest biotopes; it grows in alder floodplain forests (the *Alno-Ulmion* alliance), alder carrs (the *Alnetea glutinosae* class), boreal spruce forest (the *Sphagno girgensohnii-Piceetum* association), mixed forest (the *Querco-Piceetum* association) (Klama, 2002a, b).

Nowellia curvifolia – common liverwort in Poland. The characteristic for natural patches of pinewoods (the *Dicrano-Pinion* alliance) and spruce phytocoenoses (the *Vaccinio-Piceenion* suballiance) resembling primeval forests on lowlands and in mountains; epixylic species growing decaying logs, mainly of dead spruce trees (ecological optimum – large logs with diameter above 10 cm) (Klama, 2002a).

Umbrella species for xerothermic grasslands

Asterella saccata – very rare liverwort in Poland. It grows in sunny sites on humus covering limestone rocks. The characteristic species of the *Festucetalia valesiacae* order (Matuszkiewicz, 2001).

Mannia fragrans – the component of xerothermic grasslands, especially on limestone substratum (limestone outcrops). It occurs in the patches of the following associations: *Festucetum pallentis*, *Sisymbrio-Stipetum capillatae* and *Koelerio-Festucetum rupicolae* (Szweykowski, 1962).

Oxymitra incrassata – very rare liverwort in Poland. There is only one known stand of the species. It grows in the vegetation patch resembling the *Potentillo-Stipetum capillatae* association (Szweykowski, Mendelak, 1968).

Riccia ciliifera – belongs to the rarest liverworts of Poland. It occupies bare humus in patches of grassland communities particularly on outcrops of limestone rocks.

Riccia trichocarpa – one of the rarest liverworts of Poland. It co-occurs with *Festuca rupicola*, *Filipendula vulgaris*, *Koeleria macrantha* and *Silene otites* in grasslands.

Partially protected liverwort as umbrella species for forest communities

Bazzania trilobata – species common in Poland. This is primeval relic, typical for natural spruce and mixed coniferous forests (characteristic species for the *Vaccinio-Piceetalia* order) as well as in alder floodplain forests (Klama, 2002a, b; Matuszkiewicz, 2001).

Plagiochila asplenioides – common species in Poland. The primeval relic species, typical for primary, natural forests; it occurs in alder floodplain forests (the *Alno-Ulmion* alliance) likewise in wet spruce forests (characteristic for the *Vaccinio-Piceetalia* order *)* especially on lowlands (Klama, 2002a, b; Matuszkiewicz, 2001).

Ptilidium ciliare – liverwort widely distributed in Poland. The species is diagnostic element for inland dry coniferous forests (the *Cladonio-Pinetum* association) and heathlands (the *Calluno-Ulicetalia* order) (Matuszkiewicz, 2001).

Trichocolea tomentella - liverwort also widely distributed in Poland. It is a characteristic species for alder carrs communities of the *Alnetea glutinosae* class (Matuszkiewicz, 2001); moreover, it distinguishes natural alder floodplain forests of the *Alno-Ulmion* alliance (Klama, 2002a).

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Pohlia melanodon

Protection of mosses in Poland

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ABSTRACT : As consequence of anthropogenic changes in natural environment a large number of highly specialized mosses disappear. The most important factor causing vanishing of hemerophobous mosses are: (1) changes in water conditions; (2) destruction of peat-bogs and mires; (3) air, soil and water pollution, and acid rains; (4) unsuitable forest management; (5) destruction of small-scale elements of nature which are refugees of mosses; (6) urbanization and (7) collecting of rare species.

The current Order of the Minister of Environmental Protection dealing with the designation of wild plants coming under protection include 171 strictly protected moss species and 27 partly so (28% of the total muscoflora of Poland). The key habitats for conservation of the strictly protected mosses are: (1) outcrops of rocks in mountains and uplands and erratic blocks in the lowlands; (2) all types of peatlands; (3) the large natural forest complexes with traits of primeval forests; (4) aquatic habitats; (5) bare soil on slopes and abruptnesses and (6) old field and roadside trees.

The life-strategies and ecological preferences of the mosses protected in Poland will be briefly assessed and considered.

KEY WORDS : Bryophyta, legally protected mosses, threatened mosses, ecological preferences, key habitatas

INTRODUCTION

Influence of human economic activity on natural ecosystems, during last 150 years, was mainly destroying. In these conditions some moss species of narrow ecological scale decreased range and some of them become extinct (Stewart 1995). The decline and the extinction of mosses intensified so much that attracted interests of briologists who tried to estimate scale of this phenomenon and take endeavors to prevent it. It believes that the most important causes of decline of mosses are: (1) changes in water conditions; (2) destruction of peat-bogs and mires; (3) air, soil and water pollution, and acid rains; (4) unsuitable forest management; (5) destruction of small-scale elements of nature which are refugees of mosses; (6) urbanization and (7) collecting of rare species.

The institution which coordinates activities associated with nature conservation of mosses and works on list of bryophytes threatened in Europe is European Committee for Conservation of Bryophytes which was established in 1988 (Schumacker 1989). The *Red Data Book of European Bryophytes* (ECCB 1995) was published and it was the first attempt of an estimation of decline of bryophytes on the scale of Europe. In 1991 Bryophyte Specialist Group was founded which is affiliated to the Species Survival Commission of the World Conservation Union. Nine years later the first *World Red List of Bryophytes* (Hallingbäck & Hodgetts 2000) was presented. The effect of actions of above-mentioned organizations was

taking into account of bryophytes in Bern Convention and in Habitats Directive, hitherto these species are legally protected in the area of European Union (Hallingbäck 2003).

The objective of presented paper is to show a development of idea of protection of mosses in Poland, to introduce current law devoting to protection of bryophytes in Poland and first of all to analyze ecological requirements of protected mosses and indicate key habitats for their maintenance.

HISTORICAL BACKGROUND OF PROTECTION OF MOSSES IN POLAND

Polish botanists noticed a problem of decline of sensitive mosses quite a long time ago. Such pioneer was W. Kulesza (1922), who wrote ["*For mosses and liverworts*, (…) *any land desiccation bring unavoidable extermination, also trees felling is harmful which suddenly lead to uncover,* (…)*, moist forest floor.* (…) *As regards epiphytic cryptogamous plants, its interesting flora can be encountered only in old -growth mixed forests.* (…)*; if some particularly old fragment of woodland, abundant in trees overgrown by mosses and lichens, is about to be cut with axe, - in such cases it is advisable to abandon some chosen trees in order to become an refuge of representatives of small, epiphytic vegetation.* (...)*. Thus, to protect particular species, whole stand in some area with surroundings should be protected,* (…) *it is necessary and obvious to establish protected area only due to presence of cryptogamous plants.*"]. Additionally he postulated the protection of stands, among others, of *Timmia megapolitana* (near Nakło in Poznań province, NW Poland), *Hookeria lucens* (on Barania Góra in the Silesian Beskid Mts, S Poland) and *Schistostega pennata* (all localities in Poland). His ideas considerably were ahead of his time. The conception by W. Kulesza (1922) is original, but less known and omitted contribution of Polish bryology to biological conservation of cryptogamous plants. Next years, M. Kuc gave proposals for network of nature reserves in the Silesia and the adjacent regions (S Poland) for protection of lowland stands of rare montane mosses and peatlands with relic glacial mosses (Szafran, Kuc 1955; Kuc 1958, 1959). Finally, 37 years later, only one of these objects – "Valley of Żabnik Stream" – became nature reserve (Żarnowiec *et al.* 1995; Klama *et al.* 1996). J. Szweykowski and Z. Tobolewski (1959) took up the problem of nature reserve protection for rare cryptogams. They distinguished five categories of areas for conservation of lichens, liverworts and/or mosses: "*1. Areas in which the spore-plants form the main component of the plant cover, 2. Areas in which relic species or even relic communities of lower plants occur, 3. Areas in which a* locus classicus *of a taxonomic unit is found, 4. Areas in which species or communities of the cryptogams attain their limit of distribution in Poland, 5. Areas in which species, usually sterile, develop a full life-cycle.*" (Szweykowski & Tobolewski 1959). Next, many papers were published in which protection of other areas due to the occurrence of unique and rare elements of bryoflora was suggested (e.g. Karczmarz 1963; Jasnowski *et al.* 1968, Żarnowiec *et al.* 1995, Stebel 1997).

Table 1. Numbers of species in the three editions of the Red-list of mosses in Poland.

Edition	Threat categories					Total threatened
	Extinct	Endangered	Vulnerable	Rare	Indeterminate	
Ochyra 1986	4	14	43	29	31	121
Ochyra 1992	4	17	45	29	42	137
Żarnowiec *et al.* 2004	7	52	31	84	57	231

The publication of *Red-list of Threatened Mosses in Poland* (Ochyra 1986) was the first attempt of

estimation of phenomenon of declining of this group of plants in our country. Six years later the second edition was issued (Ochyra 1992). The results of the studies on *Atlas of the Geographical Distribution of Mosses in Poland* (Ochyra & Szmajda 1983, Ochyra *et al*. 1985, 1988a, b, 1990, 1992; Bednarek-Ochyra *et al*. 1990, 1994; Szmajda *et al*. 1991) and the data obtained when *Census Catalogue of Polish Mosses* (Ochyra *et al*. 2003) was established enabled to edit 3rd edition of the red-list of Polish mosses and the first red-list of mosses in the Polish Carpathians (Żarnowiec *et al*. 2004). The differences in number of endangered species in three editions of red-lists only to some degree are consequences of increasing threat to bryophytes but basically are effects of our larger knowledge on state of bryophytes in Poland (Table 1). After many discussions the wide list of mosses proposed for species protection in Poland was prepared (Ochyra, Żarnowiec & Stebel in Żarnowiec 2003: p. 64, Table 6.3), which was included after small changes to the current Order of the Minister of Environmental Protection dealing with the designation of wild plants coming under protection.

CURRENT LAW ON PROTECTION OF MOSSES IN POLAND

Poland signed and ratified international conventions which protect, among others, mosses and/or their habitats. The most important are the two: (1) The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) – signed in 1979, effective in 1982 and ratified by Poland in 1995. The Convention contains the list of protected 26 mosses and 7 of which are known from Poland (*Buxbaumia viridis*, *Dichelyma capillaceum*, *Dicranum viride*, *Hamatocaulis vernicosus*, *Meesia longiseta*, *Orthotrichum rogeri* and *Pyramidula tetragona*). (2) Habitats Directive (directive 92/43/EEC of 1992) – effective in Poland since 1st May 2004. Annex II to this directive contains 24 bryophyte species and seven of which occurring in Poland are named above. Annex V protects *Sphagnum sp*. and *Leucobryum glaucum*, collecting of which for commercial purposes must be controlled.

The current Act of Nature Protection (Official Gazette Announcing Current Legislation No. 92, item 880, 2004) makes possible protection of mosses and their habitats in frames of prevention of biodiversity.

Table 2. List of mosses protected in Poland.

Strictly protected species: *Amblyodon dealbatus, Amblystegium saxatile, Anacamptodon splachnoides, Andreaea blyttii, A. crassinervia, A. frigida, A. nivalis, A. rothii, A. rupestris, Anomodon attenuatus, A. longifolius, A. rugelii, A. viticulosus, Antitrichia curtipendula, Brachydontium trichodes, Brachythecium geheebii, B. calophyllum, B. cyclophyllum, B. neodamense, B. salinum, B. subneodamense, B. warneum, B. weigelii, Buxbaumia viridis, Calliergon megalophyllum, C. richardsonii, Campylopus flexuosus, C. pyriformis, C. schimperi, Cinclidium stygium, Cinclidotus fontinaloides, C. riparius, Cirriphyllum tenuicaule, Cnestrum schistii, Coscinodon cribrosus, Cynodontium fallax, C. gracilescens, C. tenellum, Cyrto-hypnum minutulum, Dichelyma capillaceum, D. falcatum, Dicranodontium asperulum, Dicranum bonjeanii, D. fulvum, D. sendtneri, D. undulatum, D. viride, Discelium nudum, Drepanocladus capillifolius, D. sendtneri, D. sordidus, D. stagnatus, Dryptodon decipiens, D. orbicularis, Fissidens crassipes, F. fontanus, F. osmundoides, Fontinalis dalecarlica, F. hypnoides, F. squamosa, Grimmia anodon, G. crinita, Hamatocaulis vernicosus, Helodium blandowii, Hilpertia velenovskyi, Homalia trichomanoides, Hookeria lucens, Hygroamblystegium fluviatile, H. tenax, Hypnum pratense, H. sauteri, Leptodictyum humile, Loeskeobryum brevirostre, Meesia hexasticha, M. longiseta, M. triquetra, M. uliginosa, Neckera besseri, N. complanata, N. crispa, N. pennata, N. pumila, Orthogrimmia caespiticia, O. sessitana, Orthotrichum gymnostomum, O. lyellii, O. microcarpum, O. rogeri, O. rupestre, O. scanicum, O. tenellum, O. urnigerum, Paludella squarrosa, Philonotis arnellii, P. caespitosa, P. calcarea, P. marchica, P. seriata, P. tomentella, Pleurochaete squarrosa, Pseudobryum cinclidioides, Pseudocalliergon lycopodioides, P. trifarium, Pyramidula tetragona, Schistidium atrofuscum, S. brunnescens, S. flaccidum, S. trichodon, Scorpidium scorpioides, Seligeria*

calcarea, *S. campylopoda*, *S. patula*, *Sphagnum affine*, *S. angustifolium*, *S. balticum*, *S. capillifolium*, *S. centrale*, *S. compactum*, *S. contortum*, *S. cuspidatum*, *S. denticulatum*, *S. fimbriatum*, *S. flexuosum*, *S. fuscum*, *S. girgensohnii*, *S. inundatum*, *S. jensenii*, *S. lindbergii*, *S. magellanicum*, *S. majus*, *S. molle*, *S. obtusum*, *S. palustre*, *S. papillosum*, *S. platyphyllum*, *S. quinquefarium*, *S. riparium*, *S. rubellum*, *S. russowii*, *S. subfulvum*, *S. subnitens*, *S. subsecundum*, *S. tenellum*, *S. teres*, *S. warnstorfii*, *S. wulfianum*, *Splachnum ampullaceum*, *S. sphaericum*, *Syntrichia laevipila*, *S. latifolia*, *S. papillosa*, *S. sinensis*, *S. virescens*, *Tayloria serrata*, *Thamnobryum alopecurum*, *Timmia megapolitana*, *Tomentypnum nitens*, *Tortella flavovirens*, *T. fragilis*, *Tortula cernua*, *T. randii*, *Ulota bruchii*, *U. coarctata*, *U. crispa*, *U. drummondii*, *U. hutchinsiae*, *U. phyllantha*, *U. rehmannii*, *Warnstorfia trichophylla*, *Zygodon gracilis* and *Z. viridissimus*.

Partly protected species: *Abietinella abietina*, *Aulacomnium palustre*, *Buckiella undulata*, *Calliergonella cuspidata*, *Climacium dendroides*, *Dicranum polysetum*, *D. scoparium*, *Eurhynchium angustirete*, *E. striatum*, *Hylocomium splendens*, *Leucobryum glaucum*, *L. juniperoideum*, *Limprichtia cossonii*, *L. revolvens*, *Pleurozium schreberi*, *Polytrichum commune*, *P. strictum*, *Pseudoscleropodium purum*, *Ptilium crista-castrensis*, *Rhytidiadelphus squarrosus*, *R. triquetrus*, *Sphagnum fallax*, *S. squarrosum*, *Thuidium assimile*, *T. delicatulum*, *T. recognitum* and *T. tamariscinum*.

[source: Official Gazette Announcing Current Legislation No. 168, item 1764, 2004]

The current Order of the Minister of Environmental Protection dealing with the designation of wild plants coming under protection (Official Gazette Announcing Current Legislation No. 168, item 1764, 2004), contains 171 mosses on the list of strictly protected plants and additionally 27 species on the list of partly protected (altogether 198 moss species, i.e. 28% of the moss flora of Poland) (Tab. 2).

GENERAL CHARACTERISTICS OF LEGALLY PROTECTED MOSSES IN POLAND AND THEIR ECOLOGICAL REQUIREMENTS

The list of protected mosses contains seven species occurring in Poland which were listed in the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and in Annex II of the Habitats Directive – all in strictly protected group. In addition it contains 37 mosses from Annex V of the Habitats Directive – 34 species of *Sphagnum* on the list of strictly protected plants and three species (*Leucobryum glaucum*, *Sphagnum fallax* and *S. squarrosum*) in the partly protected group. Amongst strictly protected plants there are 38 which are listed in the '*Threatened bryophytes in Europe*

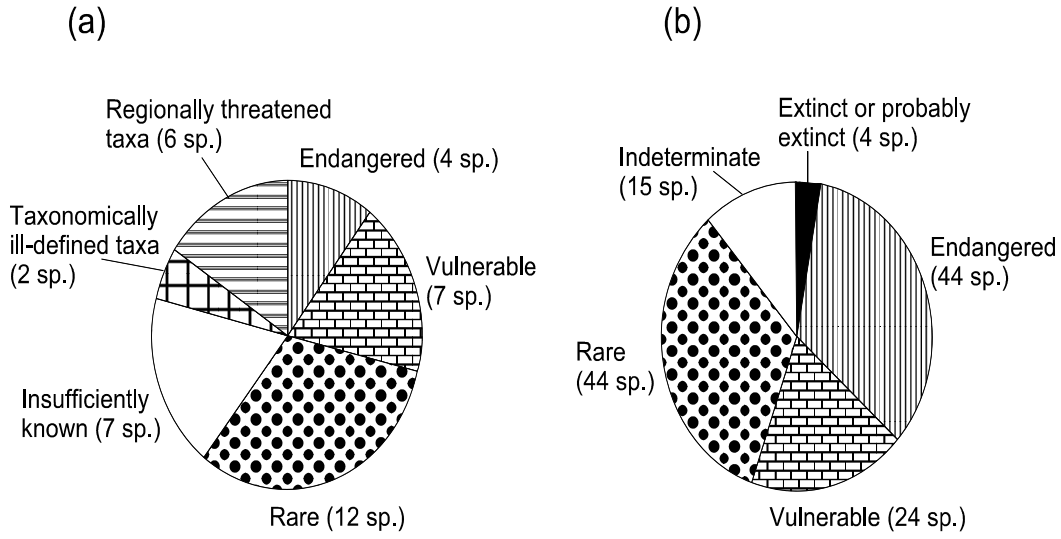

Fig. 1. Taxa threatened in Europe (a) and/or in Poland (b) among strictly protected mosses.

including Macaronesia' (Schumacker & Martiny 1995) and 131 mosses threatened in Poland (Żarnowiec *et al*. 2004). The share of species representing specific threat categories are shown on histogram (Fig. 1).

The partial protection concern large mosses especially forest and mire species, mostly frequent in the territory of Poland (Tab. 2), which were exploited on large scale and are threatened by commercial collection. This group will not be discussed in further part of the paper.

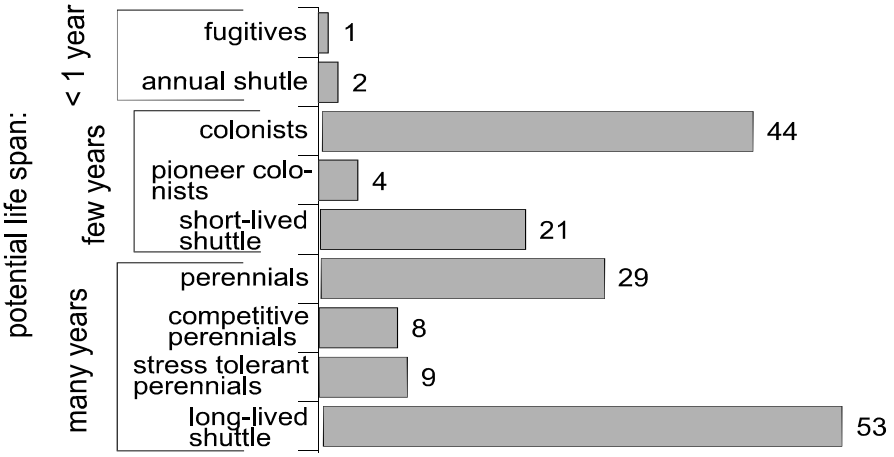

Fig. 2. Life strategy categories represented in the group of strictly protected mosses.

Life strategy analysis. Mosses belonging to strictly protected represent nine life strategy categories (Fig. 2). The 57.9% of them are plants of potential life span amounted to many years and, among them, in terms of abundance long-lived shuttle (53 species) predominate and perennials *s.l.* (46). Within the last group the most numerous are perennials *s.s.*, and small number belong to competitive perennials and stress tolerant perennials. Taxa with potential life span few years contribute to 40.3% of total strictly protected mosses and distinctly colonists dominate over short-lived shuttle and pioneer colonists. Mosses of life span shorter than year are only 1.8% of taxa of described group and belong here *Buxbaumia viridis, Discelium nudum* and *Pyramidula tetragona*.

Substrate preferences analysis. Amongst strictly protected species, mosses growing on rocks prevail – epilithic (24.6%) and on peat – turficolous (21.6%), quite abundant are species occurring on water-logged sites e.g. mires – helophytic (17.3%), growing on bark of living trees – epiphytic (13.2%), growing on earth (e.g. on clay or sandy soil) – epigaeic (12.6%) and in the rivers and/or lakes – aquatic (7.9%). Few species occur on dung of herbivores – coprophytic (2.0%) and on decaying wood of logs and stumps – epixylic (0.9%) (Fig. 3a).

Realized niches with respect to the humidity. Majority of mosses of described group are water-demand species, adapted to tolerate inundation (hydrophytes), temporary submerged (amphiphytes) and/or grow in wet sites (hygrophytes) – in total 63.7% of all strictly protected taxa (Fig. 3b). Almost a half of them are species occurring in extremely wet to very wet habitats (52 species). Taxa adapted to prolonged desiccation grow in moderately dry to very dry sites form rather small group and make contribution 11.7% to total number of strictly protected mosses. The remaining are mesophytes or grow in moderately wet to moderately dry sites.

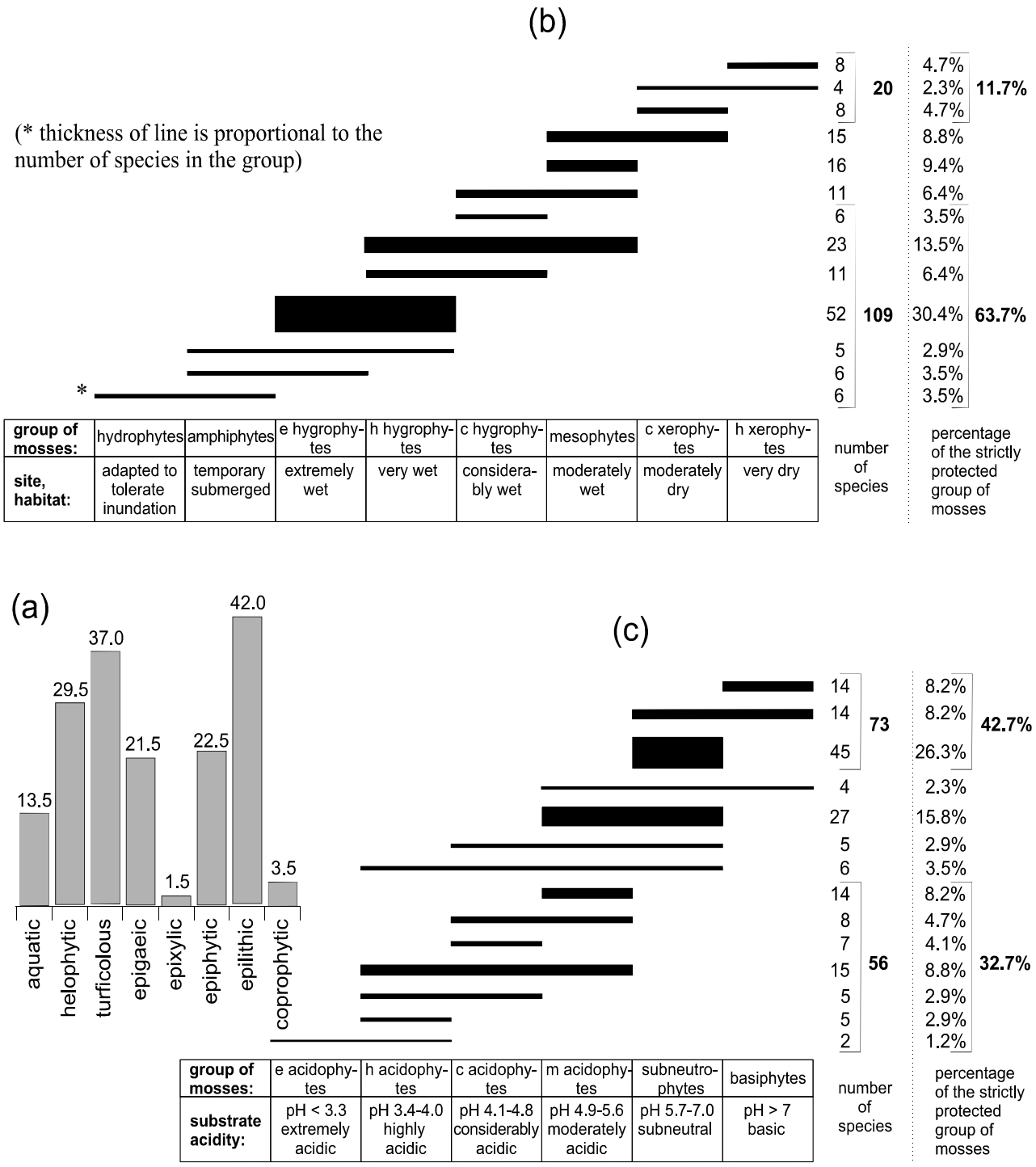

Fig. 3. Habitat preferences (a) of the mosses strictly protected in Poland and their ecological groups in relation to the humidity (b) and acidity (c) of substrates.

Ecological groups in relation to acidity of substrates. Almost the half strictly protected mosses are species occurring on basic and/or subneutral substrates (42.7%). The opposite group are acidophytes

overgrown extremely to moderately acidic sites (32.7%). From remaining quite numerous are mosses growing on soils with pH 4.9–7.0 (moderately acidic to subneutral habitats), which contribute 15.8% of total strictly protected species (Fig. 3c).

KEY HABITATS FOR PROTECTED MOSSES; FINAL REMARKS AND CONCLUSIONS

Poland posses extensive list of protected species (Tab. 2), which help to preserve species diversity of this, sensitive to changes in environment, group of plants. To preserve the rarest elements of muscoflora we must protect their habitats and localities. More than 98% of protected mosses in Poland are plants of potential life span from few to many years and almost 2% are mosses of life span shorter than year. Analysis of these preferences and realized niches in relation to the humidity and acidity of substrates distinctly indicate that for their maintenance the protection of the following habitats is the most important:

(I) Outcrops of rocks in mountains and uplands and erratic blocks in the lowlands. The majority of mosses strictly protected occur on shaded moist outcrops of rocks. In conditions of low competition with vascular plants, epilithic mosses form numerous populations. On limestone rocks in mountain regions and/or in uplands in southern Poland one can find very rare mosses e.g.: *Cnestrum schistii*, *Neckera besseri*, *Pleurochaete squarrosa*, *Schistidium atrofuscum*, *S. brunnescens*, *S. trichodon*, *Seligeria calcarea*, *S. campylopoda* and *Zygodon gracilis*. Non-calcareous rocks in mountains are site of the occurrence e.g.: *Andreaea crassinervia*, *A. frigida*, *A. nivalis*, *A. rupestris*, *Brachydontium trichodes*, *Campylopus flexuosus*, *Coscinodon cribrosus*, *Dicranodontium asperulum*, *Dryptodon decipiens*, *Orthogrimmia caespiticia* and *O. sessitana*. Numerous montane epilithic mosses have relic localities on erratic blocks in northern Poland but now majority of this flora was destroyed. The most important factor treating to epilithic mosses is change in micro-climatic conditions i.e. insolation and humidity. It concern especially shade-tolerant species and hygrophilous species growing on shaded rock outcrops under tree canopy.

(ii) All types of peatlands. In minerotrophic mires and ombrotrophic bogs mosses are majority of biomass and are the most important peat-forming plants. In specific ecological conditions of mires there are very rare stenotopic mosses, including glacial relics. Calcitrophic and minerotrophic fens are sites of the occurrence of strictly protected: *Amblyodon dealbatus*, *Cinclidium stygium*, *Drepanocladus sendtneri*, *Hamatocaulis vernicosus*, *Helodium blandowii*, *Hypnum pratense*, *Meesia longiseta*, *Paludella squarrosa*, *Pseudocalliergon lycopodioides*, *Scorpidium scorpioides*, *Timmia megapolitana* and *Tomentypnum nitens*. In ombrotrophic bogs characterizing by completely other ecological conditions and flora, mainly in N Poland, there are rare species to be found: *Sphagnum fuscum*, *S. lindbergii*, *S. magellanicum*, *S. molle*, *S. obtusum* *and* *S. tenellum*. The moss flora of swamps in last decades, as a result of exploitation of peat, land reclamation and desiccation, rapidly vanish and needs protection.

(iii) The large natural forest complexes with traits of primeval forests. Old-growth forests of lower and upper montane zone (especially Carpathian Primeval Forest) and other quite huge woodland areas of natural forests in western and north-eastern Poland are habitats for rare and specialized mosses. The most precious elements of moss flora grow as epiphytic species e.g. *Anacamptodon splachnoides*, *Anomodon longifolius*, *Antitrichia curtipendula*, *Brachythecium geheebii*, *Neckera pennata*, *N. pumila*, *Ulota drummondii* and *Zygodon viridissimus*. On forest floor one of the rarest species are *Cyrtohypnum minutulum* and *Loeskeobryum brevirostre* and growing on scarps of forest streams – *Hookeria lucens*. On decaying stumps in mountains sporadically *Buxbaumia viridis* occurs. The dung of herbivores (especially deers) are substrates on which very rare coprophytic mosses – *Splachnum ampul-*

laceum, S. sphaericum and *Tayloria serrata* grow. The areas of natural and primeval forests quite fast decrease and become fragmented including specialized muscoflora.

(iv) Aquatic habitats. In oligothrophic freshwater of lakes there are sporadic: *Drepanocladus capillifolius, D. sordidus, Fontinalis dalecarlica, F. hypnoides* and *Warnstorfia trichophylla*. The increasing eutrophization of waters is a threat to protected mosses. The natural river-beds and streams and in their vicinity are the sites of the occurrence: *Cinclidotus riparius, Fissidens crassipes, Fontinalis squamosa* and *Hygroamblystegium fluviatile*. The pollution of montane water and their regulation result in decline of specialized flora of stream mosses.

(v) Bare soil. In conditions of lack of the competition with vascular plants, on moist bare soil on abruptnesses and slopes, mosses have good conditions for development. On clay soils sporadically one can encounter *Discelium nudum, Hilpertia velenovskyi* and *Pyramidula tetragona*. In northern Poland on sandy neutral or little basic soils sporadically very rare species occur: *Bryum salinum, B. warneum, Tortella flavovirens* and *Tortula randii*.

(vi) Old field and roadside trees. In unpolluted arable landscape particularly in northern Poland and in lower submontane regions on solitary roadside and field trees among other strictly protected species grow: *Syntrichia laevipila, S. latifolia, S. papillosa* and *S. virescens*. These tress are frequently cut and together with them the mosses die.

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Oxyrrhynchium schleicheri

The *Hypnum cupressiforme* complex in LBL B Herbarium (Lublin, Poland) - taxonomic revision and some biometric notes.

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Abstract :

The *Hypnum cupressiforme* complex comprises widespread and very variable pleurocarpous mosses. As the basis of revision is an anatomical and morphological analysis of vegetative leaf characters of 414 specimens belonging to the *Hypnum cupressiforme* complex housed in the **LBL B** Herbarium at the Maria Curie-Sklodowska University. The short historical background of the taxonomic and nomenclature changes within the complex is provided, an ecological preferences of all revised species are given and the suitability of such data for their diagnosis is assessed. Some taxonomically important characters of the gametophytes are reviewed and discussed and the main results of the biometric analysis of selected leaves characters is shortly described.

Key words: Bryophyta, Musci, Hypnaceae, *Hypnum cupressiforme*, biometric analysis, variability, ecology, Poland, Lublin.

Introduction

Hypnum cupressiforme is a widely distributed and fairly variable moss. There are only some 15 taxa in the rank of varieties and forms within the complex. The representatives of this group are characterised by a great ecological plasticity and a broad variability amplitude. In Poland *Hypnum cupressiforme* is a very widely distributed too. A great diversity of its varieties and forms is observed here. Zdzisława Wiśniewska was the first to perform a taxomonic verification of the complex in Poland (only in KRAM – previously Herbarium of Institute of Botany at the Jagiellonian University) and to research it in depth (1957). She collaborated with Professor Bronisław Szafran, who later on also placed it in his moss flora (1961).

Clearly, a great variability of the representatives of the *Hypnum cupressiforme* complex has caused is likely to cause many problems regarding their appropriate classification. Therefore their taxonomic position, classification and nomenclature are differently interpreted.

In the Bryophyte Herbarium (**LBL B**) at the Maria Curie-Skłodowska University (Lublin, Poland) 414 specimens are housed as *Hypnum cupressiforme*. In the last 25 years world bryologists have proposed many taxonomical and nomenclatural changes on the division of the complex. Arrangement of taxa of the *Hypnum cupressiforme* group in LBL B Herbarium not correspond with our present state of knowledge, so the results of taxonomic revision presented below in connection with a biometric analysis

put the new light on the variability of *Hypnum cupressiforme* in Poland and Central Europe.

Historical background

The taxonomic rank and systematic position of taxa within the complex have changed over the years. Whereas in his study *Species muscorum frondosorum* (1801), Hedwig described a single taxon only, as many as 19 varieties were recorded by Bridel (1827) . Four important studies on this moss group, conducted and published in Europe, have come out in the last 60 years. Doignon (1950) described taxa for France, Barkman (1966) for Denmark, Hedenäs (1987, 1991) for Sweden and Smith (1997, 2004) for British Isles.

They treated the *Hypnum cupressiforme* complex in very different ways. However, it seems Ando's monograph of the entire genus *Hypnum* offers the most comprehensive taxonomic study (1986, 1987, 1989, 1990, 1992). His work was mostly based on the material from Asia, so bryologists from the Old World noticed a few differences between the European material and Ando's diagnoses (comp. Smith 2004). Still, his conception seems to the most consistent with our knowledge about this complex. It should be noticed that the taxonomic rank and systematic position of intraspecific taxa within the complex have changed over the years, and many have been recognised as species (cf. Smith 1978, 1997, 2004). New varieties have also been described (Smith 1997, 2004).

In the latest *Census Catalogue of Polish Mosses* (Ochyra et al. 2003) presenting the classification and richness of mosses occurring in Poland, the conception of the division of the *Hypnum cupressiforme* complex is very similar to the approach proposed by Ando (1972, 1973, 1976, 1986, 1987, 1989, 1990, 1992).

The eventful taxonomic history of the complex suggests that its division so far is not final. Some selected conceptions of the division of this complex are given below in chronological order (species not occurred in Europe are not listed).

I. EUROPEAN TAXA

1. Ando (1987-1992)

sectio: *Hypnum*

species:

1) *Hypnum mammillatum=Hypnum andoi*
2) *Hypnum jutlandicum*
3) *Hypnum uncinatulum*
4) *Hypnum cupressiforme*
   a) var. *cupressiforme*
   b) var. *julaceum*
   c) var. *lacunosum*
   d) var. *subjulaceum*
   e) var. *resupinatum*
   f) var. *filiforme*

2. Smith A. J. E. (2004)

sectio: *Hypnum*

species:

1) *Hypnum cupressiforme*
2) *Hypnum lacunosum*
   a) var. *lacunosum*
   b) var. *tectorum*
3) *Hypnum andoi*
4) *Hypnum uncinatulum*
5) *Hypnum resupinatum*
6) *Hypnum jutlandicum*
7) *Hypnum imponens*

II. POLISH TAXA

1. Wiśniewska Z. (1952) & Szafran B. (1961)

sectio: *Euhypnum*

species:

1) *Hypnum cupressiforme*
   a) fo. typica = var. *cupressiforme*
   b) var. *ericetorum*
   c) var. *mammillatum*
   d) var. *subjulaceum*
   e) var. *resupinatum*
   f) var. *uncinatulum*
2) *Hypnum vaucheri*

2. Ochyra R., Żarnowiec J. & Bednarek-Ochyra H. (2003)

sectio: *Hypnum*

species:

1) *Hypnum vaucheri*
2) *Hypnum cupressiforme*
   var. *cupressiforme*
   var. *filiforme*
   var. *resupinatum*
   var. *subjulaceum*
   var. *lacunosum*
3) *Hypnum andoi*
4) *Hypnum jutlandicum*
5) *Hypnum imponens*

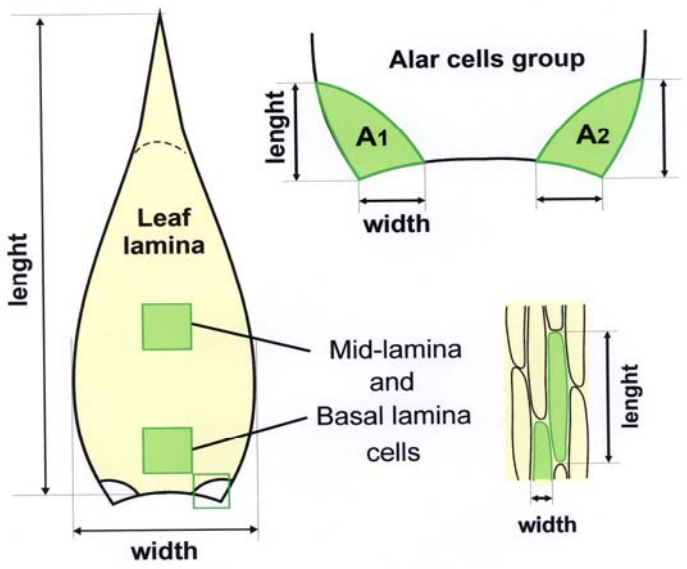
Material and methods

During the course of study all specimens have been examined. The morphology and anatomy of plants was analyzed using a stereo- and compound microscope. Also the habitat preferences of all examined specimens were noted. Arrangement of taxonomic classifications follows Ando (1987-1992) and Ochyra *et al.* (2003). Names of liverworts follows Klama (2006). During the examination of the herbarium material 80 specimens were selected for biometric analysis. In total, over 20 000 separate measurements of morphological and anatomical characters are made. Measurements include the vegetative leaf characters like length and width of leaf lamina, alar cell group as well as length and width of mid-leaf and basal cells (Fig 1). Permanent slides were prepared with polyvinyl alcohol solution (Błaszkowski,

Tadych & Madej 1999).

The ecological characterisation of taxa belonging to the complex was made with using the information given on the herbarium labels.

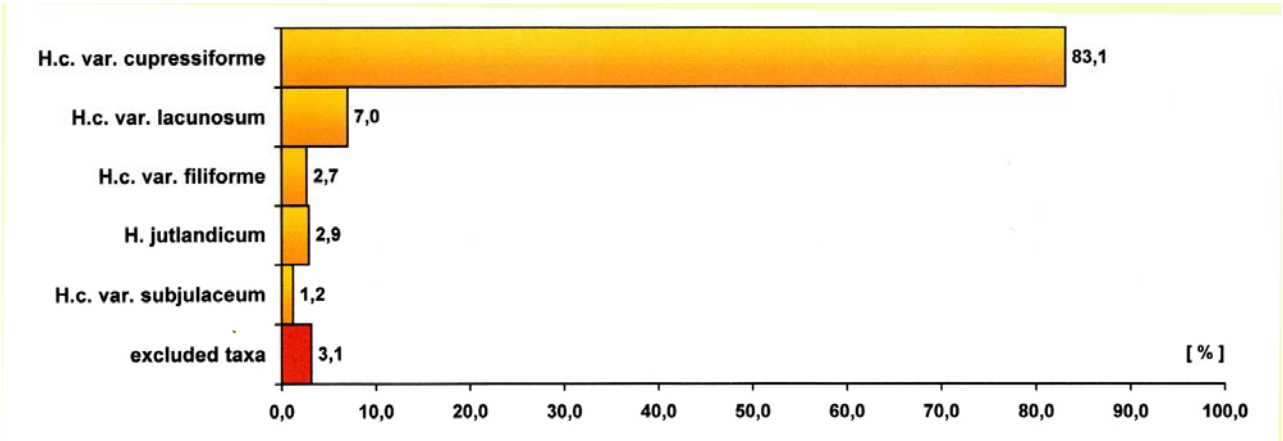
Figure 1. Leaf and cell dimensions and location of measured cells.



Results

After revision, taxonomic or nomenclatural status of 200 specimens has changed. Finally, in revised material, 6 species and 4 varieties were recognized. Only two species and all varieties (over 97% of analysed material) belonging to the *Hypnum cupressiforme* complex including *Hypnum jutlandicum* (12 specimens), typical form of *H. cupressiforme* (344) and three other varieties: *filiforme* (11), *lacunosum* (29) and *subjulaceum* (5). Remained 13 specimens (3%) were excluded from the complex. They contained predominantly the *Hypnum lindbergii* (9 specimens) and additionally four another species like *Herzogiella seligeri*, *H. pallescens*, *Platygyrium repens* and *Rhytidium rugosum* (Fig. 2). *Hypnum andoi* belong to the *H. cupressiforme* complex, but specimens of this species are not present in LBL B Herbarium.

Figure 2. *Hypnum cupressiforme* complex in LBL Herbarium after revision



The results of biometric analysis provided the basis for the checking range of variability observed within the studied material. The variability level of all measured leaf characters is given on Fig 3 and 4. Additionally on figure 5 an ecological preferences of all studied specimens and all analysed taxa are presented.

Figure 3. Range of variation of mean values of selected characters.; solid line – usual values, dotted line – exceptional values.; *H.c.* var. *filiforme* (A), *H. jutlandicum* (B), *H.c.* var. *cupressiforme* (C), *H.c.* var. *subjulaceum* (D) *H.c.* var. *lacunosum* (E).

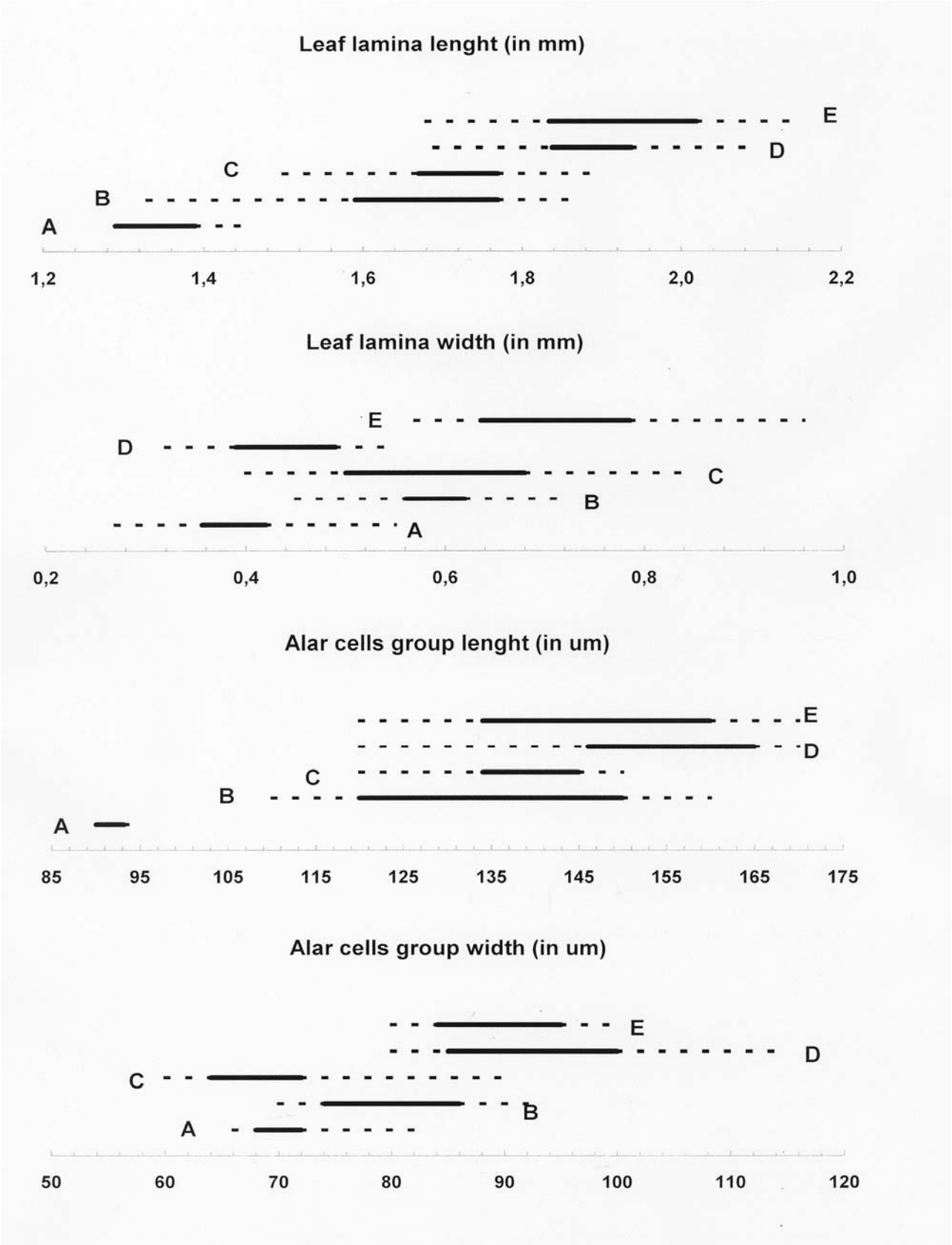


Figure 4. Scatter diagram based on the mean values of measurements of selected characters in the *Hypnum cupressiforme* group.

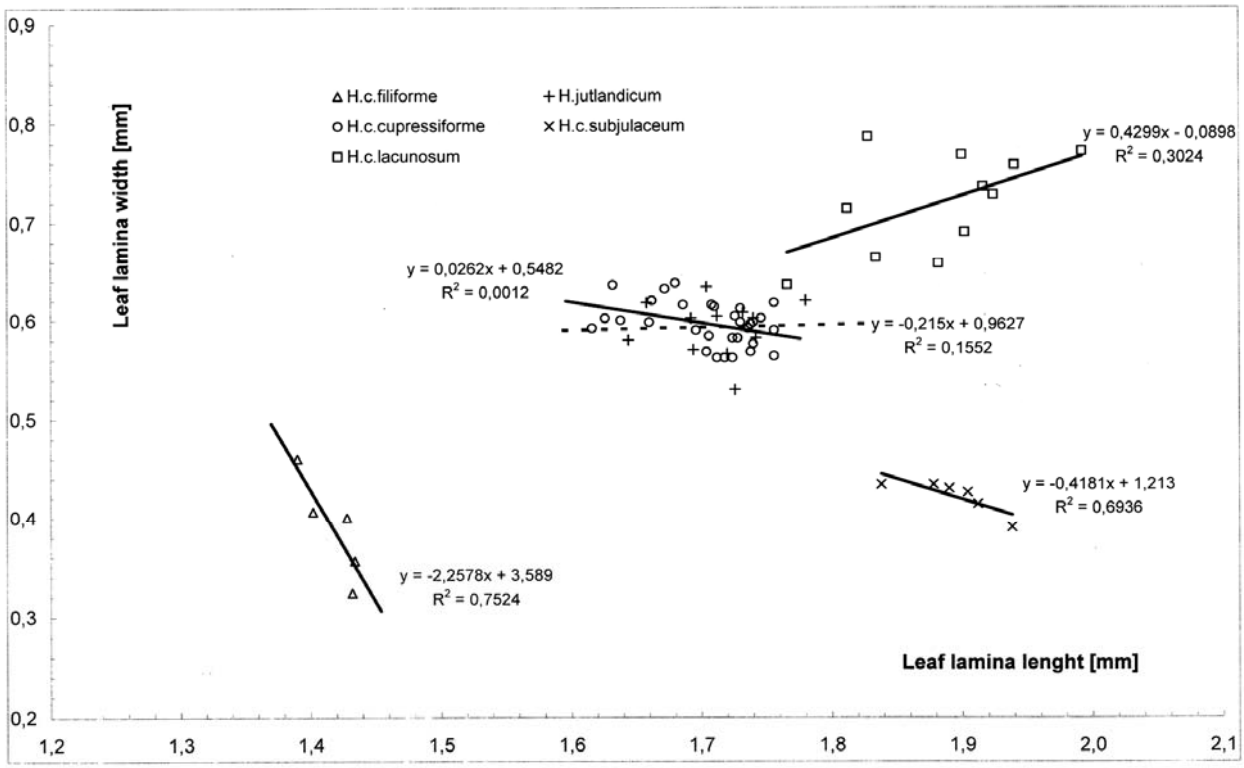
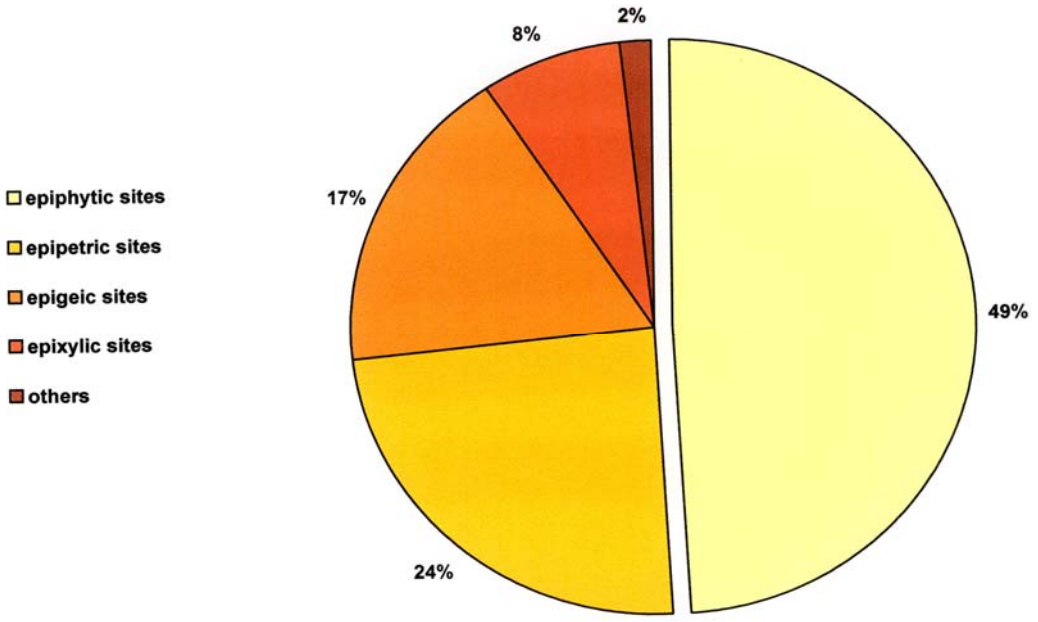


Figure 5. Ecological preferences of the *Hypnum cupressiforme* group based on the revised material.



While revising the herbarium material and examining specimens of the complex in question, I also came across other bryophyte species. They additionally co-occurred in the *Hypnum cupressiforme* herbarium samples. These are mostly epiphytic taxa, and they include 9 moss species and 7 liverwort species:

Liverworts	Mosses
Blepharostoma trichophyllum	*Brachytheciastrum velutinum*
Lejeunea cavifolia	*Neckera complanata*
Lepidozia reptans	*Neckera crispa*
Lophocolea heterophylla	*Orthodicranum montanum*
Metzgeria furcata	*Orthotrichum obtusifolium*
Plagiochila porelloides	*Orthotrichum speciosum*
Ptilidium pulcherrimum	*Pylaisia polyantha*
	Rosulabryum laevifilum
	Sciuro-hypnum populeum

Discussion

The analysis of morphological characters shows that *H.c.* var. *lacunosum* and *H.c.* var. *filiforme* are the easiest and the quickest to recognise of all the varieties in the *Hypnum cupressiforme* complex as these taxa are clearly differentiated by the habit and leaf dimensions. The shape and size of leaves vary within the group but are fairly consistent within varieties. *H.c.* var. *lacunosum* has the largest leaves while *H.c.* var. *filiforme* has the smallest ones.

The variability analysis of anatomical characters of individual elements of the leaf lamina and leaf cells demonstrates that they may be very useful in differentiating *H.c.* var. *filiforme*, *H.c.* var. *lacunosum* and *H. jutlandicum*. Measurements of individual characters or the ratio analysis of various elements of leaf lamina or leaf cells are not reliable enough in the case of other varieties. They do not give clear-cut and unambiguous results that could provide a correct taxonomic verification of the specimens.

Allies of the *Hypnum cupressiforme* complex display different ranges of ecological preference. Epigeic taxa like *H. jutlandicum* and *H.c.* var. *lacunosum* as well as epipetric *subjulaceum* and epiphytic *filiforme* are rather stenotopic whereas the *H.c.* var. *cupressiforme* has widest ecological tolerance and occurs in various site conditions.

Specimens may be determined with much certainty although the ranges of character variability in individual varieties overlap, often significantly. However, it should be remembered that only the combination of morphological and anatomical characters, the size of organs and their parts as well as substrate and habitat data give the full body of information necessary to determine correctly one of the most variable – and at the same time common – mosses, that is *Hypnum cupressiforme*.

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OBSERVATIONS SOCIO-ECOLOGIQUES EFFECTUEES DANS LE NORD DE LA FRANCE SUR LES GROUPEMENTS MUSCINAUX EPIPHYTIQUES DES *NECKERETEA COMPLANATAE* MARSTALLER 1986

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Résumé

Les communautés de Bryophytes épiphytiques implantées sur l'écorce des arbres présents dans les chênaies-frênaies-acéraies basiphiles du nord de la France ont été étudiées ; neuf tableaux phytosociologiques les décrivent. La répartition des phorophytes sur lesquels ces communautés sont implantées ainsi que la localisation stationnelle précise de celles-ci sur les troncs et les souches sont envisagées.

Summary

Some epiphytic communities of Bryophytes have been studied in the notrh of France and in Picardie. About 230 lists of species have been realized, collected in nine tables. The ecology of these communities have shown specially the precise localization and the kinds of the barks on which these mosses are planted.

Préambule

Ayant pu rassembler depuis une trentaine d'années des observations sur les groupements bryophytiques implantés à la base des troncs d'arbres croissant dans les vallons forestiers, sur les talus boisés ou bien dans les milieux humides ou inondables, ayant constaté par ailleurs que ces groupements homogènes dans leur composition floristique et leur écologie présentaient une réelle diversité dans leur faciès, j'ai jugé opportun de rassembler l'ensemble des observations effectuées dans les départements de l'ouest du nord de la France (Pas-de-Calais, Somme, Oise occidentale essentiellement).

Tout comme les phytocoenoses, les groupements de Bryophytes ont retenu l'attention des botanistes et des bryologues ; maintes associations terricoles, saxicoles et/ou épiphytiques ont été décrites ; un bryosynsystème a été élaboré.

von Hübschmann (1986) a fait paraître le « Prodromus der Moosgesellschaften Zentraleuropas » ; cet ouvrage a fait la synthèse des connaissances éparses qui existaient pour l'Europe.

Récemment, Bardat et Hauguel (2002) ont réalisé un « Synopsis bryosociologique pour la France » qui comble une lacune ; il était regrettable en effet qu'une étude d'ensemble sur les associations de Bryophytes du territoire français n'ait pas été faite, compte-tenu de la richesse de la bryoflore de ce pays.

Le but poursuivi est d'ampleur plus modeste ; compte-tenu des observations méthodiques effectuées (235 relevés de végétation) et plutôt que de créer de nouvelles associations de Bryophytes ou même de refonder partiellement le bryosynsystème, j'ai préféré :

- indiquer du mieux possible la **localisation stationnelle** des communautés de bryophytes étudiées.
- préciser la **nature des essences forestières** (les phorophytes) sur lesquelles ces communautés ont été observées.

A chaque relevé bryosociologique correspondait le lieu et l'époque de sa réalisation ; il n'a pas été possible de faire figurer la liste des très nombreuses localités ; seule la répartition globale par département est indiquée ; cette liste pourrait être mise à la disposition de toute personne intéressée.

Rappel de Synsystématique bryologique

Toutefois un bref rappel de la synsystématique des communautés de Bryophytes implantées sur les écorces des arbres vivants apparaît nécessaire.
Au préalable, je tiens à rappeler qu'une des premières études effectuées en France portant sur les associations de Bryophytes épiphytiques a été réalisée par le regretté A. Lecointe dans la Brenne (1975) à l'occasion de sessions phytosociologiques s'étant tenues dans les années 1970 dans cette belle région du centre de la France.

von Hübschmann (1986) distingue dans la classe des *Hypnetea cupressiformis* Jesek et Vondracek 1962, trois ordres, en particulier celui des *Leucodontetalia* v. Hübschmann 1952. A l'intérieur de cet ordre, figurent quatre alliances ; l'une d'elles est celle de l'*Anomodontion europaeum* Barkman 1958 ; elle rassemble « des associations de Bryophytes épiphytiques propres aux associations forestières riches du *Carpinion* et de *l'Alno-Padion* ». Toutefois, Barkman distinguait deux sous-alliances de façon à subdiviser *l'Anomodontion europaeum* :

> « la sous-alliance de *l'Anomodonto-Leucodontion* regroupant les associations muscinales des emplacements plus éclairés dont la répartition optimale s'étend en remontant depuis la base jusqu'à mi-hauteur du tronc ; là peuvent dominer *Leucodon sciuroides, Amblystegium serpens, Leskea nervosa* ou *Frullania dilatata* ;
>
> la seconde sous-alliance est l'*Homalion* rassemblant des associations muscinales des stations plus humides et ombragées limitées à la base des troncs et à la partie supérieure des racines sorties de terre [qu'elles recouvrent] entièrement. Les espèces constantes de cette sous-alliance sont *Homalia trichomanoides, Plagiomnium cuspidatum, Isothecium myurum* et *I. myosuroides, Brachytecium rutabulum* et les espèces de *Metzgeria* et de *Porella* ». (rapporté par von Hübschmann 1986).

Plusieurs associations s'insèrent dans ces deux sous-alliances en particulier l'*Anomodonto-Isothecietum* initialement décrite par Lippmaa en Estonie (1935) ; von Hübschmann indique qu'il lui correspond plusieurs associations synonymes. Il précise que : « les espèces caractéristiques de cette association aiment l'ombre et l'humidité » ; on l'observe « sur des troncs d'arbres âgés, présents dans les forêts humides et ombragées, sur des sols riches en bases, dans les régions de plaines et de collines ».

von Hübschmann ajoute encore que dans cette association : « plusieurs espèces ont tendance à former des faciès, en particulier les trois espèces *d'Anomodon, Isothecium myurum, Homalia, Porella platyphylla* et plus près du sol également *Eurhynchium praelongum* s.sp. *stokesii* ; de tels éléments ne peuvent être individualisés qu'en tant que variante ou faciès. »

Assez différente est l'interprétation que retiennent Bardat et Hauguel (2002) des mêmes communautés, insérées cette fois dans la classe des *Neckeretea complanatae* Marstaller 1986. Celle-ci comporte trois ordres ; deux d'entre eux concernent les régions planitiaires ou collinnéennes.

> Les *Neckeretalia complanatae* Jesek et Vondracek 1962 regroupant « des communautés des parois et des écorces en station fraîche » ; s'y insère l'alliance du *Neckerion complanatae* Klika et Hadac 1944, mise en synonymie avec *l'Anomodontion europaeum* Barkmann 1958 ; celle-ci a été scindée en quatre sous-alliances.
>
> Les *Brachythecietalia rutabulo-salebrosi* Marstaller 1987, rassemblant « les communau-

tés plutôt humo-corticoles souvent à la base des troncs ». Une seule alliance y figure, le *Bryo-Brachythecion rutabuli* Lecointe 1977.

Bardat et Hauguel (2002) ont recensé une vingtaine de bryoassociations qu'ils ont réparties entre ces alliances et sous-alliances. Les groupements muscinaux décrits en Picardie occidentale offrent des points communs avec ces associations.

Cependant plusieurs espèces - tel *Homalia trichomanoides* - figurent en tant qu'espèces caractéristiques dans plusieurs alliances et associations ce qui révèle la diversité offerte -selon les régions- par les communautés de Bryophytes épiphytiques. On perçoit la difficulté de bâtir un bryosynsystème qui tienne compte de toutes ces nuances.

Les bryocoenoses décrites

Il est possible de répartir les nombreux relevés bryologiques effectués (près de 230) en neuf ensembles physionomiquement caractérisés par une espèce prédominante. Seule la classe de présence (C.P.) des espèces observées figure sur les tableaux réalisés. Ceux-ci ne correspondent pas obligatoirement à une association végétale précise ; cependant dans certains cas, la relation existant avec une association bryologique antérieurement décrite sera rappelée. Un tableau récapitulatif regroupe l'ensemble des données bryosociologiques.

I - Groupement à *Isothecium alopecuroides* (= *I. myurum*) (tableau 1)

Cette communauté est plutôt discrète ; elle forme des plages de superficie limitée à la base des troncs et sur la partie supérieure des racines.
Le frêne est l'essence sur laquelle elle est le plus souvent implantée ; compte tenu de la présence discrète d'*Eurhynchium striatum* dans un seul relevé, un rapprochement avec l'association à *I. myurum* et *E. striatum* décrite par Ochsner et revue par Lecointe en Brenne est envisageable ; par ailleurs Bardat et Hauguel rapportent l'existence de *l'Isothecium myuri* Hilitzer 1925.

Tableau 1

Groupement à *Isothecium alopecuroides* (= *I. myurum*)

Espèces caractéristiques d'association
(*Eurynchio-Isothecietum myuri* (Ochsner) Lecointe 1975)
Isothecium alopecuroides V
Eurhynchium striatum I

Espèces caractéristiques d'alliance
Homalia trichomanoides I
Anomodon viticulosus I

Espèces caractéristiques d'ordre
Neckera complanata II
Homalothecium sericeum I
Porella platiphylla I
Metzgeria furcata I

Compagnes
Hypnum cupressiforme s. l. V
Brachythecium rutabulum IV
Isothecium myosuroides I
Lepraria sp. II

Espèces accidentelles : 5

14 relevés ont été réalisés ; 7 proviennent de la Somme, 4 du Pas-de-Calais, 3 de l'Oise.

Remarque

Le groupement à *I. myosuroides* est implanté sur les écorces de pH bas, telles celles des chênes ; il est généralement paucispécifique et n'a pas été pris en considération compte tenu de son édaphologie différente.

II - Groupement à *Anomodon viticulosus* (tableau 2)

Du fait de la vigueur des tiges feuillées d' *A. viticulosus*, cette communauté est probablement celle que l'on remarque le plus facilement ; elle est susceptible d'occuper des superficies assez importantes. On l'observe principalement sur le frêne et le hêtre.

Elle se localise de préférence à la base des troncs et sur la partie supérieure des racines formant contrefort. Lippmaa a décrit antérieurement une association nommée *Anomodonto-Isothecietum* qui paraît regrouper des « groupements bryophytiques » différents.

Ultérieurement Wisniewski a décrit une autre association, intitulée *Anomodonto viticulosi-Leucodontetum sciuroides* ; malgré l'absence de *Leucodon sciuroides* le groupement « picard » est susceptible de s'y rattacher.

Tableau 2
Groupement à *Anomodon viticulosus*

Anomodon viticulosus V

Espèces caractéristiques d'alliance
Isothecium alopecuroides I
Homalia trichomanoides I

Espèces caractéristiques d'ordre
Neckera complanata III
Homalothecium sericeum III
Amblystegium serpens II
Porella platiphylla I
Metzgeria furcata I

Compagnes
Brachythecium rutabulum IV
Thamnobryum alopecurum II
Tortula subulata I
Lepraria sp. III

Espèces accidentelles : 6

31 relevés ont été réalisés : 14 dans la Somme, 12 dans le Pas-de-Calais, 2 dans l'Oise et la Seine-maritime, 1 dans l'Aisne.

Remarque

Les autres espèces d'*Anomodon (A. longifolius, A. attenuatus)* n'ont pas été observées dans la dition .

III- Groupement à *Neckera complanata* (tableau 3)

Du fait de la disposition le plus souvent « étagée » des rameaux feuillés et de l'aspect brillant de ceux-ci, les plages de *Neckera complanata* sont particulièrement reconnaissables ; certaines d'entre elles recouvrent des surfaces notables, sur les troncs, les racines contreforts et surtout sur les souches.
La répartition des essences révèle la diversité des substrats sur lesquels *N. complanata* est implanté :

l'orme (antérieurement) et le frêne prédominent.

Neckera complanata caractérise l'alliance du *Neckerion complanatae* décrite de Tchéquie et reprise par Bardat et Hauguel. La présence de *Leptodon smithii* procure une « teinte » méditerranéo-atlantique au groupement.

52 relevés ont été réalisés ; 29 l'ont été dans le Pas-de-Calais, 19 dans la Somme, 2 dans l'Oise et

Tableau 3

Groupement à *Neckera complanata*
Neckera complanata V

Espèce différentielle méditerranéo-atlantique
Leptodon smithii I

Espèces caractéristiques d'alliance
Anomodon viticulosus I
Isothecium alopecuroides I
Homalia trichomanoides I

Espèces caractéristiques d'ordre
Homalothecium sericeum III
Porella platiphylla I
Amblystegium serpens I
Metzgeria furcata I
Cirriphyllum crassinervium I

Compagnes
Brachythecium rutabulum IV
Hypnum cupressiforme s. l. II
Thamnobryum alopecurum I
Eurhynchium confertum I
Bryum capillare I
Leucodon sciuroides I
Lepraria sp. II

Espèces accidentelles : 9

la Seine-maritime.

Remarque

N. pumila n'a pas été observé lors des prospections effectuées ; avant la mort des ormes, cette espèce de répartition occidentale était présente dans le Boulonnais et les collines d'Artois, régions plus arrosées.

IV- Groupement à *Homalia trichomanoides* **(tableau 4)**

Les 64 relevés ayant servi à bâtir le tableau attestent de l'intérêt apporté à décrire ce groupement bryologique, davantage méso-hygrophile que les autres groupements.

En effet, la base des troncs et les souches représentent la localisation préférentielle de ce groupement ; le frêne et dans une moindre mesure le hêtre sont les phorophytes les plus favorables à son implantation. A la suite de Lecointe (1975), il est souhaitable de rattacher l'ensemble des relevés du tableau à l'association à *Homalia trichomanoides* et *Eurhynchium stokesii*, observée initialement en Brenne ; son comportement y est « hygrophile, neutrophile et sciaphile ».

Lecointe a proposé la création d'une alliance du *Bryo-Brachythecion rutabuli* où s'insère l'association pré-citée.

La répartition géographique des 64 relevés est la suivante : Somme : 29, Pas-de-Calais : 27, Oise :

Tableau 4
Groupement à *Homalia trichomanoides*

Espèces caractéristiques d'association
(*Eurhynchio-Homalietum* Lecointe 1975)
Homalia trichomanoides V
Kindbergia praelonga III

Espèces caractéristiques d'alliance
(*Bryo-Brachythecion rutabuli* Lecointe 1975)
Isothecium alopecuroides I
Anomodon viticulosus I

Espèces caractéristiques d'ordre
Homalothecium sericeum II
Amblystegium serpens II
Neckera complanata I
Bryum capillare I
Metzgeria furcata I

Compagnes
Brachythecium rutabulum IV
Thamnobryum alopecurum II
Isothecium myosuroides I
Plagiothecium nemorale I
Rhizomnium punctatum
Lepraria sp. II

Espèces accidentelles : 8

6, Aisne : 2.

V- Groupement à *Cirriphyllum crassinervium* (= *Eurhynchium crassinervium*) (tableau 5)

La diversité des substrats sur lesquels *C. crassinervium* est susceptible de s'installer a fait l'objet d'une étude (J.R Wattez 1999). Les écorces sont parfois recouvertes de plages homogènes de cette Hypnale comme l'attestent les 15 relevés du tableau 5.

Ceux-ci ont été réalisés sur les parties aériennes des racines formant contrefort, plus rarement sur les souches ; le hêtre paraît être l'essence recherchée de préférence par *C. crassinervium*.

Faute de références bibliographiques, il est prudent de considérer l'ensemble des relevés comme un groupement à *C. crassinervium* dont la place dans le bryosynsystème demeure imprécise.

La répartition des 15 relevés est la suivante : 11 dans la Somme, 2 dans le Pas-de-Calais et 2 dans

Tableau 5
Groupement à *Cirriphyllum crassinervium*
Cirriphyllum crassinervium
Espèces caractéristiques d'alliance
Anomodon viticulosus II
Isothecium alopecuroides I
Homalia trichomanoides I

Espèces caractéristiques d'ordre
Neckera complanata II
Porella platiphylla II

Compagnes
Brachythecium rutabulum III
Hypnum cupressiforme s. l. III
Thamnobryum alopecurum I
Kindbergia praelonga I

Espèces accidentelles : 6

l'Oise.

VI – Groupement à *Porella platiphylla* (tableau 6)

La belle couleur vert foncé de *Porella platiphylla* retient l'attention et signale la présence de ce groupement que l'on observe principalement à la partie supérieure des racines et sur les troncs.
Près de 60% des relevés effectués l'ont été sur l'écorce lisse des hêtres ; le frêne est également concerné.

Le rattachement de ce groupement à l'association à *Homalothecium sericeum* et *Porella platiphylla*, étudiée et décrite par Lecointe en Brenne (1975) s'impose; elle s'insère dans la sous-alliance de *l'Anomodonto-Leucodontenion* (Barkman) Lecointe 1975.

La provenance des 17 relevés est la suivante : 13 dans la Somme, 3 dans le Pas-de-Calais, un seul

Tableau VI
Groupement à *Porella platiphylla*

Espèces caractéristiques d'association
(*Homalothecio-Porelletum* Lecointe 1975)
Porella platiphylla V
Homalothecium sericeum V

Espèces caractéristiques d'alliance
(*Anomodonto-Leucodontenion* Lecointe 1975)
Anomodon viticulosus III
Isothecium alopecuroides I

Espèces caractéristiques d'ordre
Neckera complanata III
Metzgeria furcata II
Amblystegium serpens I

Compagnes
Brachythecium rutabulum IV
Hypnum cupressiforme s. l. II
Lophocolea heterophylla I
Lepraria sp. III

Espèces accidentelles : 4

dans l'Oise.

VII- Groupement à *Radula complanata* (tableau 7)

La composition floristique du groupement à *Radula complanata* diffère de celle des autres groupements ; cette particularité résulte de la localisation des relevés ; la plupart se situent à la base des troncs et sur la partie supérieure des racines mais ils se trouvent également en contact avec des plages de *Frullania dilatata* et des peuplements *d'Orthotrichum affine*.

Les hêtres et les frênes représentent les phorophytes préférentiels.

Malgré la rareté de *Cryphaea arborea*, il semble possible de rattacher ce groupement à l'association à *Radula complanata* et *Cryphaea arborea* initialement décrite par Lecointe en Brenne (1975) ; *C. arborea* (= *C. heteromala*) est une espèce polluosensible, peu commune dans le Nord de la France, hormis sur le littoral.

Tableau 7

Groupement à *Radula complanata*
Espèces caractéristiques de l'association
(*Radulo-Cryphaetum arboreae* Lecointe 1975)
Radula complanata V
Cryphaea arborea I

Espèces caractéristiques d'alliance et d'ordre
Amblystegium serpens IV
Homalothecium sericeum III
Neckera complanata I
Metzgeria furcata I
Brachythecium velutinum I

Compagnes
Brachythecium rutabulum III
Hypnum cupressiforme s. l. III
Bryum capillare II
Frullania dilatata II
Kindbergia praelonga II
Ctenidium molluscum I
Orthotrichum affine I
Eurhynchium confertum I
Zygodon viridissimus I
Lepraria sp. III

Espèces accidentelles : 8

16 relevés ont été réalisés ; 10 dans la Somme, 3 dans l'Oise et 2 dans le Pas-de-Calais.

VIII- Groupement à *Homalothecium sericeum* (tableau 8)

H. sericeum est une espèce à la fois saxicole et corticole qui colonise les substrats xériques ; en tant que corticole, on l'observe principalement sur les troncs où elle constitue parfois des plages importantes ;

Les essences sur lequelles *H. sericeum* est implanté sont variées : ormes (autrefois), frênes et hêtres.

Il semble que l'on puisse également rapporter ce groupement à l'association à *Homalothecium sericeum* et *Porella platiphylla*, initialement décrite et bien étudiée par A. Lecointe en Brenne ; ce groupement où prédomine largement *H. sericeum* en représenterait une variante xérique

La présence de *Leptodon smithii* représente une variante occidentale de l'association ; celle de *Leucodon sciuroides* est à souligner également. Ces deux espèces ont considérablement régressé dans le Nord de la France par suite de la disparition des grands des ormes, du fait de la graphiose.

Tableau 8
Groupement à *Homalothecium sericeum*

Espèces caractéristiques d'association
(*Homalothecio-Porelletum platiphyllae* Lecointe 1975)
Homalothecium sericeum V
Porella platiphylla I

Différentielle méditerranéo-atlantique
Leptodon smithii I

Espèces caractéristiques d'alliance et d'ordre
Neckera complanata I
Anomodon viticulosus I
Leucodon sciuroides I
Cirriphyllum crassinervium I

Compagnes
Brachythecium rutabulum II
Hypnum cupressiforme s.l. II
Eurhynchium confertum I
Lepraria sp. III

Espèces accidentelles : 4

La répartition des 17 relevés effectués est la suivante : 13 dans la Somme et 4 dans le Pas-de-Calais.

IX- Groupement à *Thamnobryum alopecurum* (tableau 9)

Le groupement à *Thamnobryum alopecurum* est uniquement localisé à la base des troncs et sur la partie supérieure des racines. Probablement s'agit-il d'une colonisation à partir des plages importantes que cette mousse forestière terricole, basiphile constitue fréquemment sur les sols crayeux et frais.

Les frênes et dans une moindre mesure les hêtres sont les essences que parait privilégier *T. alopecurum*.

Bien que la composition floristique du tableau 9 soit comparable à celle des autres tableaux, le statut bryologique de ce groupement demeure imprécis.

On notera que le nombre des compagnes est relativement important ainsi que la présence du lierre, *Hedera helix*, espèce colonisatrice des souches et des troncs, en provenance des sols forestiers voi-

Tableau 9

Groupement à *Thamnobryum alopecurum*
Thamnobryum alopecurum V
Espèces caractéristiques d'alliance
Anomodon viticulosus II
Isothecium alopecuroides I

Espèces caractéristiques d'ordre
Neckera complanata III
Porella platiphylla I

Compagnes
Brachythecium rutabulum IV
Kindbergia praelonga II
Hypnum cupressiforme s. l. I
Plagiothecium denticulatum I
Lophocolea heterophylla I
Hedera helix II
Lepraria sp. II

Espèces accidentelles : 2

sins. 12 relevés ont été réalisés ; 9 proviennent de la Somme ; 3 du Pas-de-Calais et autant de l'Oise.

Edaphologie des Bryocoenoses

L'apport original de ce travail porte sur deux points ; il s'agit :

- d'une part, de l'identification des essences sur lesquelles les bryocoenoses sont implantées ; le tableau **A** résume les observations effectuées. Les frênes, hêtres, érables et autrefois les ormes prédominent car ils recherchent des substrats argilo-calcaires, riches en bases qui leur sont particulièrement favorables.

-d'autre part, est précisée la localisation stationnelle sur les phorophytes des communautés de bryophytes ; le tableau **B** regroupe les résultats ; trois « emplacements » ont été distingués :

-le tronc des arbres proprement dit (le « fût »)

-la base de celui-ci ainsi que les souches d'arbres récemment abattus

-la partie supérieure des racines formant une sorte de contrefort, particulièrement bien développé lorsque les arbres croissent sur une dénivellation ou sur un talus.

Des différences significatives apparaissent selon les groupements de bryophytes étudiés.

Remarque

La fructification des espèces prises en considération a été estimée ; trois comportements sont à distinguer :

-espèces fructifiant régulièrement lors des périodes pluvieuses

-*Homalia trichomanoides*

-*Thamnobryum alopecurum*

-*Radula complanata*

-espèces dont la fructification paraît être occasionnelle

-*Isothecium alopecuroides*

-*Homalothecium sericeum*

-*Porella platiphylla*

-espèces n'ayant pas été observées munies de sporogones

- *Anomodon viticulosus*

- *Neckera complanata*

- *Cirriphyllum crassinervium*

Conclusion

Ce travail regroupe les observations effectuées pendant une trentaine d'années dans le nord de la France et la Picardie. Il représente un apport à la connaissance des bryocoenoses épiphytiques régionales et de leur écologie. Une comparaison entre les neuf tableaux de végétation réalisés et d'autres tableaux bryosociologiques devrait permettre de mieux apprécier la diversité des bryocoenoses épiphytiques et de progresser dans la compréhension du synsystème. Mais, pour que de telles observations puissent se poursuivre ultérieurement, il importe que subsistent des peuplements de vieux arbres, que les essences indigènes soient privilégiées et que les forêts ne soient pas « jardinées » avec trop de régularité. Ce ne sont pas malheureusement les modes d'exploitation actuels que privilégient désormais les gestionnaires forestiers (publics ou privés)…

L'auteur tient à remercier C. Cassimans pour son aide précieuse dans la mise au point du texte de la communication.

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Wattez J.R., 1999. - Répartition et localisation stationnelle de *Eurhynchium crassinervium* dans le nord de la France. *Nowellia bryologica* n° 15-16, p. 2-8.

Diapo 1 : racines apparentes d'un hêtre croissant sur un talus en forêt de Chantilly (OISE – FR)

Diapo 2 : souche d'arbre recouverte par les bryophytes en forêt de Canaples (SOMME – FR)

Diapo 3 : racine apparente recouverte par *Anomodon viticulosus* (Picardie – FR)

Diapo 4 : *Eurhynchium crassinervum* colonise des racines apparentes dans la région de Poix (SOMME – FR)

Tableau A

Phorophytes / Groupements à	*Neckera complanata*	*Homalia trichomanoides*	*Anomodon viticulosus*	*Isothecium alopecuroides*	*Cirriphyllum crassinervum*	*Homalothecium sericeum*	*Thamnobryum alopecurum*	*Porella platiphylla*	*Radula complanata*
Fraxinus	34.6%	46.1%	35.4%	60.1%	6.6%	20%	44.5%	17.6%	12.5%
Fagus	13.4%	26.1%	38.7%	26.6%	80%	20%	22.2%	58.8%	43.7%
Ulmus	30.7%	1.5%	12.9%			33.3%		5.8%	
Quercus	2%	6.1%		13.3%			11.1%		
Populus	2%	1.5%			6.6%	13.3%			
Tilia	3.8%	1.5%							
Acer pseudoplatanus et A. campestre	7.7%	6.1%	6.4%				11.1%	11.8%	6.2%
Carpinus	2%								6.2%
Salix	2%					6.7%			
Sambucus								5.8%	6.2%
Corylus									
Buxus			3.2%					5.8%	
Crataegus									
Malus						6.7%			
Inconnu ou arbre mort	2%	7.7%	3.2%		6.6%		11.1%		25%
Nombre de relevés	52	64	31	13	15	15	12	17	16

Tableau B

Implantation précise des groupements à ...	*Isothecium alopecuroides*	*Anomodon viticulosus*	*Neckera complanata*	*Homalia trichomanoides*	*Cirriphyllum crassinervum*	*Porella platiphylla*	*Radula complanata*	*Homalothecium sericeum*	*Thamnobryum alopecurum*
Nombre de relevés	14	31	52	64	15	17	16	17	12
Bases des troncs et souches	8 57.1%	9 28.1%	26 50%	45 70.3%	3 20%	3 17.6%	5 31.2%	2 12%	8 66.6%
Troncs proprement dits	1 7.2%	3 9.4%	11 21.1%	2 3.2%	–	5 29.4%	1 6.3%	11 64.5%	–
Partie aérienne des racines formant contrefort	5 35.7%	13 40.6%	11 21.1%	14 21.8%	12 80%	8 47%	7 43.7%	4 23.5%	4 33.4%
(Branches)	–	–	–	–	–	1 6%	1 6.3%	–	–
Non précisé	–	6 21.4%	4 7.8%	3 4.7%	–	–	2 12.5%	–	–

Tableau récapitulatif

Espèces caractérisant les groupements à	*Neckera complanata*	*Homalia trichomanoides*	*Anomodon viticulosus*	*Isothecium alopecuroides*	*Cirriphyllum crassinervum*	*Homalothecium sericeum*	*Thamnobruym alopecurum*	*Porella platiphylla*	*Radula complanata*
Neckera complanata	V	I_5	III_{15}	II_3	II_4	I_2	I_2	III_9	I_1
Homalia trichomanoides	I_2	V	I_1	I_1	–	–	–	–	–
Anomodon viticulosus	I_8	I_4	V	I_1	II_4	I_1	I_2	III_{10}	I_1
Isothecium alopecuroides	I_4	I_5	I_3	V	I_1	–	I_2	I_2	I_1
Cirriphyllum crassinervum	I_1	–	I_1	–	V	I_1	–	–	–
Homalothecium sericeum	III_{31}	II_{14}	III_{13}	I_1	I_1	V	–	V_{14}	III_8
Thamnobryum alopecurum	I_7	II_{16}	II_9	–	–	–	V	–	–
Porella platiphylla	I_8	–	I_4	I_1	II_3	I_1	I_1	V	I_1
Radula complanata	I_1	I_2	I_1	–	I_1	–	–	I_1	V
Metzgeria furcata	I_7	I_7	I_3	I_1	–	I_1	–	II_4	I_3
Leucodon sciuroides	I_2	–	–	–	–	–	–	–	–
Brachytecium rutabulum	III_{32}	IV_{44}	IV_{21}	IV_{10}	III_7	III_6	IV_9	III_9	III_7
Nombre de relevés	52	64	31	14	15	15	12	17	16

Remarque : La nomenclature suivie pour toutes les listes est la dernière check-list de Hill. & al. (2006), excepté pour *Sphagnum fallax* pour les motifs que l'on connaît (= *S. apiculatum* H. Lindb.).

List of bryophytes collected during Bryological Meeting 2007 by Adam Hoelzer

05/06/2007 Vallée du Ri de Wel et environs, Vierves-sur-Viroin, Belgique, IFBL:J5.43.33 UTM:FR14
Sphagnum apiculatum, S. flexuosum, S. inudatum, S. palustre

07/06/2007 Etang de Bérulles, rive occidentale, France, IFBL:K4.58.12 UTM:FR02
Sphagnum apiculatum, S. capillifolium, S. cuspidatum, S. fimbriatum, S. inundatum, S. palustre, S. papillosum, S. squarrosum

08/06/2007 Oignies-en-Thiérache, FUMAY, ravin d'Alysse, IFBL:K5.13.31 UTM:FR13
Sphagnum angustifolium, S. apiculatum, S. auriculatum, S. cuspidatum, S. flexuosum, S. inundatum, S. girgensohni, S. papillosum, S. russowii

09/06/2007 Willerzie, Fange de l'Abîme, IFBL:K5.26.31 UTM:FR33
Sphagnum apiculatum, S. auriculatum, S. capillifolium, S. centrale, S. fimbriatum, S. inundatum, S. papillosum

09/06/2007 Willerzie, Fange de Marotel, IFBL:K5.26 UTM:FR33
Sphagnum apiculatum, S. capillifolium, S. fimbriatum, S. inundatum, S. palustre, S. papillosum, S. rubellum, S. subnitens, S. subsecundum

09/06/2007 Gué Molira, IFBL:K5.25.42 UTM:FR33
Sphagnum apiculatum, S. auriculatum, S. palustre, S. rubellum, S. quinquefarium

09/06/2007 Croix-Scaille IFBL:K5.26.41 UTM:FR33
Sphagnum apiculatum

09/06/2007 Hargnies—ouest (France) IFBL:K5.25.33 UTM:FR23
Sphagnum auriculatum, S. palustre

List of *Marchantiophyta* collected during Bryological Meeting 2007 by Anna SALACHNA

06/06/2007 La Roche Trouée, Nismes (Belgique) IFBL:J5.41.32 UTM:FR14

Frullania dilatata .....on the bark of *Quercus robur*
Porella platyphylla ..... on the acid rocks
Radula complanata .....on the bark of *Quercus robur, Crataegus monogyna*

07/06/2007 Vireux - Molhain (France) IFBL:J5.44.11 UTM:FR25

Fossombronia wondraczekii ..... on the soil
Lophocolea bidentata ..... on the soil
L. heterophylla ..... on the acid rock
Lophozia ventricosa ..... on the soil
Radula complanata ..... on the bark of *Salix caprea*
Scapania nemorea ..... on the soil

07/06/2007 Etang de Bérulle (France), IFBL: K4.58.12 UTM:FR.02

Cephalozia bicuspidata ..... on the rooting logs, on the peat
Cephalozia connivens ..... on the base of *Betula verrucosa*, on the peat, on the rooting logs
Lepidozia reptans ..... on the peat

Lophocolea bidentata .....on the forest litter
Lophocolea heterophylla .....on the rooting logs
Nowellia curvifolia .....on the rooting logs
Pellia epiphylla ..... on the wet soil
Scapania nemorea .....on the rooting logs, on the peat

08/06/2007 Ravin d'Alysse in Oignies-en-Thiérache (Belgique), IFBL:K5.13-14/31 UTM:FR23

Calypogeia arguta .....on the bank of the stream (soil)
C. fissa ..... on the bank of the stream (soil)
Chiloscyphus polyanthos ..... on the sprinkled stone
Diplophylum albicans ..... on the bank of the stream (soil)
Lejeunea cavifolia ..... on the sprinkled stone, on the branch in the stream
Metzgeria furcata ..... on the bark of *Fagus sylvatica*
Pellia epiphylla ..... on the sprinkled stone
Plagiochila porelloides ..... on the sprinkled stone
Porella platyphylla ..... on the branch in the stream
Riccardia multifida ..... on the branch in the stream, on the stone submerged in the water
Riccia sorocarpa ..... on the uncover soil on the forest road
Scapania scandica ..... on the uncover soil on the forest road
Scapania undulata ..... on the stone submerged in the water
Trichocolea tomentella .....on the bank of stream (soil)

Bryophytes récoltées par André & Odette SOTIAUX durant les Rencontres bryologiques internationales

07/06/2007 Ga Dép. Ardennes, Vireux, vallée du Déluve, ancienne carrière IFBL:J5.44.11 UTM:FR24

Barbilophozia barbata, *Cephaloziella divaricata, Gymnocolea inflata*, *Lophocolea bidentata, Lophozia ventricosa*, *Radula complanata*, *Scapania nemorea*

Atrichum undulatum, Barbula unguiculata, Brachythecium rutabulum, Bryum argenteum, Bryum capillare, Calliergonella cuspidata, Ceratodon purpureus, Climacium dendroides, Dicranella heteromalla, Dicranoweisia cirrata, Dicranum montanum, Dicranum scoparium, Dicranum tauricum, Didymodon vinealis, Eurhynchium striatum, Fissidens bryoides, Fissidens dubius, Grimmia pulvinata, Grimmia trichophylla, Homalia trichomanoides, Homalothecium lutescens, Homalothecium sericeum, Hylocomium splendens, Hypnum jutlandicum, Isothecium alopecuroides, Isothecium myosuroides, Mnium hornum, Orthotrichum anomalum, Plagiothecium succulentum, Pleurozium schreberi, Pohlia nutans, Polytrichum juniperinum, Polytrichum piliferum, Pseudoscleropodium purum, Pseudotaxiphyllum elegans, Ptychomitrium polyphyllum, Racomitrium elongatum, Rhabdoweisia fugax, Rhytidiadelphus squarrosus, Rhytidiadelphus triquetrus, Sanionia uncinata, Schistidium apocarpum s.l., Sciuro-hypnum plumosum, Thuidium tamariscinum, Ulota bruchii, Weissia controversa

07/06/2007 Ga Dép. Ardennes, Le Châtelet-sur-Sormonne, étang de Bérulle IFBL:K4.58.12 UTM:FR02

Calypogeia muelleriana, Cephalozia bicuspidata, Cephalozia connivens, Frullania dilatata, Lepidozia reptans, Lophocolea heterophylla, Lophozia ventricosa, Nowellia curvifolia, *Pellia epiphylla*, *Radula complanata*

Aulacomnium androgynum, Aulacomnium palustre, Brachythecium salebrosum, Campylopus flexuosus, Campylopus introflexus, Campylopus pyriformis, Dicranella heteromalla, Dicranoweisia cirrata, Dicranum montanum, Dicranum scoparium, Eurhynchium striatum, Hypnum cupressiforme, Hypnum jutlandicum, Isothecium myosuroides, Kindbergia praelonga, Leucobryum glaucum, Loeskeobryum brevirostre, Mnium hornum, Orthotrichum affine, Plagiothecium laetum, Pleurozium schreberi, Polytrichastrum formosum, Polytrichum commune, Polytrichum strictum, Sphagnum apiculatum, Sphagnum auriculatum, Sphagnum capillifolium, Sphagnum cuspidatum, Sphagnum fimbriatum, Sphagnum palustre, Sphagnum papillosum, Sphagnum rubellum, Tetraphis pellucida, Thuidium tamariscinum, Ulota bruchii, Ulota crispa

Bryophytes collected during the Bryological Meeting in Vierves-sur-Viroin by Adam STEBEL

06/06/2007 Belgium, Ardennes, Viroinval commune, Nismes, The „Roche Trouée" chalky area IFBL:J5.41.32 UTM:FR14
Frullania dilatata, *Porella platyphylla*, *Radula complanata*

Barbula unguiculata, *Brachythecium populeum*, *Camptothecium lutescens*, *Ctenidium molluscum*, *Eurhynchium striatum, Fissidens taxifolius*, *Homalothecium sericeum*, *Hylocomium splendens*, *Hypnum cupressiforme var. filiforme*, *Hypnum cupressiforme var. lacunosum*, *Isothecium myosuroides*, *Neckera complanata*, *Orthotrichum affine*, *Orthotrichum lyellii*, *Pseudoscleropodium purum*, *Rhytidiadelphus triquetrus*, *Rhytidium rugosum*, *Syntrichia calcicola*, *Tortella tortuosa*, *Ulota bruchii*

07/06/2007 FRANCE, Ardennes, Vireux-Molhain, Abandoned emsien sandstone quarry IFBL:J5.44.11 UTM:FR25
Frullania dilatata

Brachythecium plumosum, Camptothecium lutescens, *Dicranoweisia cirrata*, *Dicranum scoparium*, *Fissidens bryoides*, *Fissidens dubius*, *Hypnum cupressiforme var. lacunosum*, *Hypnum jutlandicum*, *Isothecium alopecuroides*, *Isothecium myosuroides*, *Kindbergia praelonga (=Stokesiella praelonga)*, *Dicranum tauricum* ,*Orthotrichum affine*, *Orthotrichum lyellii*, *Pogonatum urnigerum*, *Pseudoscleropodium purum*, *Ptychomitrium polyphyllum*, *Racomitrium elongatum*, *Rhytidiadelphus triquetrus*, *Thuidium tamariscinum*, *Ulota bruchii*, *Ulota crispa*, *Weissia controversa*

FRANCE, Ardennes, commune de Le Châtelet-sur-Sormonne, Etang de Bérulle, réserve naturelle IFBL:K4.58.12 UTM:FR12
Campylopus flexuosus, Campylopus introflexus, *Orthotrichum affine*, *Polytrichum strictum*, *Rhytidiadelphus loreus*, *Sphagnum flexuosum*, *Sphagnum magellanicum*, *Sphagnum palustre*, *Sphagnum rubellum*, *Ulota bruchii*, *Ulota crispa*

08/06/2007 Belgium, Ardennes, Viroinval commune, Oignies-en-Thiérache, Ravin d'Alysse IFBL:K5.13-14/31 UTM:FR13
Campylopus flexuosus, Ctenidium molluscum, *Hookeria lucens*, *Hyocomium armoricum*, *Isothecium myosuroides*, *Loeskeabryum brevirostre*, *Platyhypnidium riparioides*, *Pleuridium subulatum*, *Racomitrium affine*, *Thamnobryum alopecurum*, *Ulota bruchii*

France, Ardennes,commune de FUMAY, Ravin d'Alysse IFBL:K5.13-14/31 UTM:FR13

Diplophyllum albicans, *Fontinalis squamosa*, *Fossombronnia wondraczekii, Dicranum scoparium,* , *Hookeria lucens, Pleurozium schreberi*, *Pohlia melanodon*, *Rhytidiadelphus loreus*, *Sphagnum subsecundum Nees*

<u>Bryophytes collected during the Bryological Meeting in Vierves-sur-Viroin by Vítězslav Plášek (herb. OP) & Sylwia Wierzcholska (priv. coll.)</u>

June, 6th 2007 (Roche trouée /BE/ in Nismes) IFBL:J5.41.32 UTM:FR14
Frullania dilatata, Metzgeria furcata, Porella platyphylla

Anomodon viticulosus, Barbula unguiculata, Bryum capillare, Ctenidium molluscum, Dicranum montanum, Eurhynchium striatum, Hypnum lacunosum, Kindbergia praelonga, Neckera complanata, Orthotrichum anomalum, Orthotrichum speciosum, Rhytidium rugosum, Syntrichia ruralis, Ulota bruchii, Weissia controversa

June, 7th 2007 (old quarry from emsien sandstone in Vireux-Molhain) IFBL:J5.44.11 UTM:FR25
Fossombronia wondraczekii, Lophocolea bidentata

Barbula vinealis, Brachythecium plumosum, Dicranoweisia cirrata, Dicranum tauricum, Eurhynchium striatum, Fissidens bryoides, Fissidens dubius, Homalia trichomanoides, Homalothecium lutescens, Hypnum cupressiforme, Isothecium myosuroides, Kindbergia praelonga, Mnium hornum, Orthotrichum anomalum, Orthotrichum speciosum, Ptychomitrium polyphyllum, Racomitrium ericoides, Rhytidiadelphus

triquetrus, Thuidium tamariscinum, Weissia controversa

June, 7th 2007 (Etang de Bérulle) IFBL:K4.58.12 UTM: FR02
Cephalozia bicuspidata, Lophozia ventricosa,Nowellia curvifolia

Dicranoweisia cirrata, Dicranum montanum, Dicranum tauricum, Hylocomium brevirostre, Leucobryum glaucum, Orthotrichum affine, Orthotrichum speciosum, Ulota bruchii, Ulota crispa

June, 8th 2007 Oignies & Fumay (FR), Alysse valley IFBL:K5.13-14/31 UTM:FR23
Calypogeia fissa, Diplophyllum albicans, Lejeunea cavifolia, Plagiochila asplenioides, Trichocolea tomentella,

Campylopus flexuosus, Dicranella heteromalla, Dicranum montanum, Dicranum scoparium, Oxyrrhynchium hians, Fontinalis squamosa, Herzogiella seligeri, Hookeria lucens, Hylocomium splendens, Hyocomnium armoricum, Isothecium mysuroides, Loeskeobryum brevirostre, Neckera crispa, Orthotrichum affine, Orthotrichum speciosum, Platygyrium repens, Platyhypnidium riparioides, Pleuridium subulatum, Pleurozium schreberi, Pogonatum aloides, Pohlia wahlenbergii, Polychastrum formosum, Pseudoscleropodium purum, Rhytidiadelphus triquetrus, Ulota bruchii

Bryophytes récoltées par Ph. De Zuttere lors des Rencontres bryologiques internationales

07/06/2007 FRANCE, Ardennes, Vireux-Molhain, ancienne carrière d'emsien au-dessus de la vallée du Deluve IFBL:J5.44.11 UTM:FR25

Didymodon rigidulus : rocher exposé au nord;
Grimmia trichophylla (dét. E. Maier). échantillon à la limite de *G. lisae* : rocher exposé au nord
Racomitrium elongatum : cailloutis du chemin vers la carrière;
Schistidium trichodon : bloc rocheux ombragé.

FRANCE, Ardennes, commune de Le Châtelet-sur-Sormonne, étang de Bérulle, réserve naturelle IFBL:K4.58.12 UTM:FR12

Tourbière à la pointe nord de l'étang :
Sphagnum flexuosum, S. magellanicum, S. papillosum, S. rubellum

Dans et bords du ruisseau partant de la rive orientale de l'étang :
Dichodontium pellucidum, Dicranella rufescens

Saulaie-aulnaie de la rive orientale :
Cephalozia bicuspidata, Scapania nemorea

Herzogiella seligeri, Sphagnum apiculatum, S. girgensohnii, S. palustre, S. subnitens

LIST OF MOSSES COLLECTED BY JAN ŻARNOWIEC DURING THE "*INTERNATIONAL BRYOLOGICAL MEETING 2007*"

Locality: Belgium, Wallonia, Nismes, "Roche trouée", chalky area, 50^{0}03'88''N 04^{0}33'61''E, alt. ca 210 m; date: 6.06.2007 IFBL:J5.41.32 UTM:FR14

List of species: *Abietinella abietina* (Hedw.) M.Fleisch. – in xerothermic grass-land, *Amblystegium serpens* (Hedw.) Schimp. – on dry rock, *Anomodon viticulosus* (Hedw.) Hook. & Taylor – on rocks, *Campyliadelphus chrysophyllus* (Brid.) R.S.Chopra – at base of rocks, *Cirriphyllum crassinervium* (Taylor) Loeske & M.Fleisch. – at base of trees, *Ctenidium molluscum* (Hedw.) Mitt. – on rock in forest, *Eurhynchium striatum* (Schreb. *ex* Hedw.) Schimp. – on soil in forest, *Homalothecium lutescens* (Hedw.) H.Rob. – in dry meadow, *Homalothecium sericeum* (Hedw.) Schimp. – on rocks, *Hypnum cupressiforme* Hedw. – on bark of *Quercus robur* and on rocks, *Isothecium alopecuroides* (Lam. *ex* Dubois) Isov. – on

bark of trees, *Kindbergia praelonga* (Hedw.) Ochyra - on soil in brushwood, *Mnium hornum* Hedw. - at base of trees, *Neckera complanata* (Hedw.) Huebener - on bark of *Quercus robur* and on shaded rock, *Orthotrichum affine* Schrad. *ex* Brid. - on bark of *Quercus robur*, *Orthotrichum anomalum* Hedw. - on rocks, *Orthotrichum striatum* Hedw. - on bark of *Quercus robur*, *Pseudoscleropodium purum* (Hedw.) M.Fleisch. *ex* Broth. - in xerothermic meadow, *Rhytidiadelphus triquetrus* (Hedw.) Warnst. - on soil at the margin of forest, *Rhytidium rugosum* (Ehrh. *ex* Hedw.) Kindb. - in xerothermic grass-land and on rocks, *Schistidium crassipilum* H.H.Blom - on rocks, *Ulota bruchii* Hornsch *ex* Brid. - on bark of *Quercus robur*.

Locality: France, Vireux-Molhain, old quarry, 50^{0}05'07''N 04^{0}43'13''E, alt. ca 160 m; date: 7.06.2007. IFBL:J5.44.11 UTM:FR25

List of species: *Brachythecium rutabulum* (Hedw.) Schimp. - at base of *Populus* sp., *Calliergonella cuspidata* (Hedw.) Loeske - in meadow, *Ceratodon purpureus* (Hedw.) Brid. - on soil in dry meadow, *Climacium dendroides* (Hedw.) F.Weber & D.Mohr - on soil in meadow, *Dicranoweissia cirrata* (Hedw.) Lindb. - on bark of *Betula pendula*, *Dicranum scoparium* Hedw. - on humus in forest floor and in dry meadow, *Grimmia pulvinata* (Hedw.) Brid. - on rocks, *Homalothecium lutescens* (Hedw.) H.Rob. - in xerothermic grass-land, *Hypnum cupressiforme* Hedw. - on soil and rocks, *Hypnum cupressiforme* var. *filiforme* Brid. - on bark of *Populus* sp., *Hypnum jutlandicum* Holmen & E.Warncke - in meadow at margin of the forest, *Isothecium myosuroides* Brid. - at base of *Carpinus betulus*, *Racomitrium elongatum* Ehrh. *ex* Frisvoll - on dry soil in xerothermic grass-land, *Dicranum tauricum* Sapjegin - on bark of *Betula pendula*, *Orthotrichum affine* Schrad. *ex* Brid. - on bark of *Populus* sp., *Orthotrichum anomalum* Hedw. - on rocks, *Orthotrichum lyellii* Hook. & Taylor - on bark of *Populus* sp., *Polytrichum piliferum* Hedw. - on soil in dry meadow, *Pseudoscleropodium purum* (Hedw.) M.Fleisch. *ex* Broth. - in dry meadow, *Ptychomitrium polyphyllum* (Dicks. *ex* Sw.) Bruch & Schimp. - on rock, *Rhytidiadelphus squarrosus* (Hedw.) Warnst. - in dry meadow, *Rhytidiadelphus triquetrus* (Hedw.) Warnst. - on soil in forest floor, *Rhytidium rugosum* (Ehrh. *ex* Hedw.) Kindb. - in dry meadow, *Bryum capillare* Hedw. - on soil at the base of rocks, *Thuidium tamariscinum* (Hedw.) Schimp. - on soil in forest, *Ulota bruchii* Hornsch *ex* Brid. - on bark of *Populus* sp. and *Quercus robur*, *Weissia controversa* Hedw. - on clay.

Locality: France, N of Rimogne, nature reserve "Etang de Bérulle", Site Natura 2000 n° 25, 49^{0}52'11''N 04^{0}31'19''E, alt. ca 350 m; date: 7.06.2007. IFBL:K4.58.12 UTM:FR12

List of species: *Campylopus flexuosus* (Hedw.) Brid. - on soil and on decaying log, *Dicranoweissia cirrata* (Hedw.) Lindb. - on bark of *Betula pubescens* in *Alnus* forest, *Dicranum scoparium* Hedw. - on decaying log and on bark of *Betula pubescens* in *Alnus* forest, *Hypnum cupressiforme* Hedw. - on log, *Hypnum cupressiforme* var. *filiforme* Brid. - on bark of trees in *Alnus* forest, *Isothecium myosuroides* Brid. - on log in forest, *Mnium hornum* Hedw. - on soil and on mouldering logs in *Alnus* forest, *Orthodicranum montanum* (Hedw.) Loeske - on bark of *Alnus glutinosa*, *Polytrichum commune* Hedw. - on peat, *Polytrichum strictum* Menzies *ex* Brid. - on peat, *Rhytidiadelphus loreus* (Hedw.) Warnst. - on decaying log in *Alnus* forest, *Rhytidiadelphus squarrosus* (Hedw.) Warnst. - in meadow, *Sphagnum angustifolium* (C.E.O.Jensen *ex* Russow) C.E.O.Jensen - on peat, *Sphagnum capillifolium* (Ehrh.) Hedw. - on peat, *Sphagnum palustre* L. - on peat, *Tetraphis pellucida* Hedw. - on mouldering log, *Ulota bruchii* Hornsch *ex* Brid. - on bark of *Alnus glutinosa* in forest.

Locality: Belgium, Prov. Namur, Viroinval, forest communal on Belgian side of Meuse river, 49^{0}59'82''N 04^{0}39'98''E, alt. ca 180 m; date: 8.06.2007.

List of species: *Dicranum scoparium* Hedw. - at base of *Quercus robur*, *Fontinalis squamosa* Hedw. - on rock in river, *Hyocomium armoricum* (Brid.) Wijk & Margad. - on wet soil at margin of the river, *Isothecium myosuroides* Brid. - at base of *Carpinus betulus*, *Loeskeobryum brevirostre* (Brid.) M.Fleisch. *ex* Broth. - on humus on rock in *Carpinus* forest, *Platyhypnidium riparioides* (Hedw.) Dixon - in water, *Rhi-*

zomnium punctatum (Hedw.) T.J.Kop. – on decaying log in forest, *Thuidium tamariscinum* (Hedw.) Schimp. – on litter.

Locality: France, Prov. Ardennes, Forêt des Ardennes, ravin d'Alysse in Oignies-en-Thiérache, coniferous forest on French side of Meuse river, ca 49^{0}59'80''N 04^{0}39'96''E, alt. ca 180 m; date: 8.06.2007. IFBL:K5.13-14/31 UTM:FR13

List of species: *Brachythecium rivulare* Schimp. – on wet soil at margin of the river, *Dicranum scoparium* Hedw. - on mouldering log, *Eurhynchium striatum* (Schreb. *ex* Hedw.) Schimp. – at base of the *Picea abies*, *Fontinalis squamosa* Hedw. – in water, *Hookeria lucens* (Hedw.) Sm. – on soil at the margin of river, *Hypnum cupressiforme* Hedw. – at base of *Picea abies* in forest, *Hypnum jutlandicum* Holmen & E.Warncke – on litter in forest, *Mnium hornum* Hedw. – at base of *Picea abies*, *Plagiothecium laetum* Schimp. – at base of *Picea abies*, *Platyhypnidium riparioides* (Hedw.) Dixon – on rocks in river, *Rhizomnium punctatum* (Hedw.) T.J.Kop. – on wet humus at margin of river, *Sphagnum inundatum* Russow – on wet soil near river, *Sphagnum palustre* L. – on wet soil near river, *Tetraphis pellucida* Hedw. – on decaying log, *Thuidium delicatulum* (Hedw.) Schimp. – on humus and at base of trees, *Thuidium tamariscinum* (Hedw.) Schimp. – on litter, *Ulota bruchii* Hornsch *ex* Brid. – on bark of *Quercus robur* in forest.