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CRYPTIC 2023: CRYPTOGRAMS' TRAITS IN THE CARPATHIANS

Cryptic 2023: A kriptogámok tulajdonságai a Kárpátokban

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The Cryptic project "CRYPTograms' Traits In the Carpathians" launched in 2016 and reached the first milestone in 2023 when the final report of OTKA 119208 was completed. The project has focused on diatoms in the mountain lakes of the Carpathians, but lowland lakes are also included in the studies, combining the neo- and palaeolimnological approach; for understanding the lake development in the Anthropocene. In the talk we present the long-term stories of Lake Ighiel Romania (924 m a.s.l.), as demonstrated by diatom assemblages. The possible associated stressors for climate variables (temperature, precipitation, NAO, AMO) were also analyzed. Lake Ighiel, a dominant natural hydroclimatic control on the lacustrine system was found between 1920–1960, followed by significant subsurface erosion across the catchment driven by intensified forestry. The multi-proxy analysis of sediment cores from Lake Ighiel evidenced changing landscape use (deforestation, grazing, construction), but demonstrates the role of atmospheric cycles (NAO) in lake processes, too. The community was completely transformed in two steps, where nitrogen from the atmosphere may have played a decisive role in the process. Zone boundaries and the duration of the zones defined on the base of taxonomical, biovolume, trait-based life-forms of diatoms showed different pattern, demonstrated that the taxonomical and trait-based approaches differ significantly and their responses for drivers are different.

Beyond trait-based analysis we also worked on alfa-taxonomy, the high-resolution taxonomical discovery. We have progress in the taxonomy of the genus *Gomphonema* in the Carpathians. *Gomphonema lacunicola* was reported from the subalpine lake of the Pâreng Mountains from Lake Câlcescu as the first Romanian data on the species. We reported and documented the first Romanian occurrence of the diatom *Gomphonema angustivalva* E. Reichardt 1997 from a lake sediment core of Lake Balea, a proglacial lake of the Carpathian Mountains. The research was supported by the NKFIH (119208).



TWO DECADES OF THE BRYOPHYTE BIODIVERSITY MONITORING SYSTEM IN HUNGARY

A Nemzeti Biodiverzitás-monitorozó rendszer keretében végzett
mohamonitorozás két évtizede

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Monitoring of bryophyte species and bryophyte vegetation is an ongoing activity started in 2000 in the frame of the National Biodiversity Monitoring System. In the course of species monitoring, the sizes of extant populations of species listed in EU Habitat Directive (*Buxbaumia viridis*, *Dicranum viride*, *Mannia triandra*, *Pyramidula tetragona*) have been traced. In bryophyte vegetation monitoring, 49 sampling plots in habitats rich in bryophytes have been investigated. The sampling is done every 4th year in forests, 3rd year in wetlands, 2nd year in dry grasslands, yearly in saline grasslands. The size of the permanent plots is 10 x 10 m in wetlands, dry grasslands, and saline areas, while in forests quadrates of 16 x 16 m are used. In forests sampling of epiphytic bryophyte vegetation has also been carried out in three levels: at 10 cm, 70 cm and 140 cm upwards from the base of the tree. According to the protocols changes in species composition (species pool, frequency, distribution), distribution of functional groups (distribution of ecological indicator values, life strategies), characteristic variables of assemblages (e. g. diversity) have been analysed. In this presentation we give a methodological overview and some results obtained.

There are no trend-like changes in population size of *Dicranum viride*, *Mannia triandra*, *Pyramidula tetragona*. In vegetation monitoring, changes based on species composition in dry grasslands, wetlands, and saline grasslands will be presented. Significant changes may occur in the bryophyte levels of sampling plots in two decades. Despite intensive dynamics, trend-like successional changes are rare in dry grasslands, but they are more frequent in wetlands. The bryophyte level can quickly regenerate after minor natural disturbances (e.g. burning, low-intensity or short flooding).



ON THE FLORISTIC DIVERSITY OF THE HUNGARIAN PTERIDOPHYTES

A magyarországi harasztflóra sokféleségéről

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Due to their specific morphology, pteridophytes have always been among the most difficult vascular plants to identify. Their taxonomy, which can be supported by modern phylogenetic studies, was not established until the 20th century. As a result, the study of their true species richness (from global to local scales) faced serious difficulties for a long time.

In our presentation, we focus on i) the change in the diversity and exploration of Hungarian pteridophytes based on references from the 20th-21st centuries, ii) we illustrate this diversity at different spatial scales (global, European, national, landscape), and iii) we highlight the taxonomic gaps that may prevent the detection of real species richness.

Based on our studies, the species richness of the Hungarian pteridophyte flora showed a 33% increase in the number of species from the beginning to the middle of the 20th century (including hybrids, this increase is 59%). As floristic, taxonomic and phytosociological research took a back seat, the situation hardly changed until the end of the century, and then a slight increase (5%) was observed in the first decade of the 21st century.

In order to compare the species richness of the Hungarian pteridophyte flora, we used the Red List of the European pteridophytes published in 2017 as a taxonomic reference, which counts 194 species/10⁷ km² (excluding hybrids). This species richness is negligible by global standards, assuming that it represents only 1.6% of the approximately 12,000 species of pteridophytes that spread easily by spores. Only one third of the European pteridophyte species can be found in Hungary. The number of pteridophytes found on a landscape scale (500 km²) in the Hungarian colline-montane region is 28-46 species, and it is much lower in the lowlands. On a finer spatial scale (100 m² or less) only scattered data are available. On the basis of some concrete examples, the richest pteridophyte flora, 9 species/8 m², 4 species/25 cm², can be found in synanthropic environments, on mortared walls. It can also be stated that the proportion of at least subspontaneous non-native pteridophyte species in Hungary is relatively low (8.7%), most of them live in synanthropic habitats and/or in warmer waters, and occur only locally as invasive plants.

The detection of true richness can also be influenced by taxonomic treatments. In this respect, the adaptation of the modern taxonomic approaches of the genera *Asplenium* and *Dryopteris* and their appearance in the Hungarian pteridophyte keys would lead to a significant change.



OCURRENCE OF *MYCOGONE ROSEA* LINK ON MACROFUNGI

Mycogone rosea Link megjelenése nagygyombákon

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Mycogone rosea Link is an intrahymenial ascomycete that forms a striking pink coating on the substrate. Chlamydo-spores of this species are distinctively round, 25-35 x 18-23 microns and located on a cladobotryum-type conidium holder. The infected fruiting body is reduced and deformed, does not form spores and has a rotting smell. This fruiting body will not be decomposed for weeks. According to the literature, it has appeared on the genera *Amanita*, *Agaricus*, *Cortinarius*, *Inocybe*, *Pholiota*, *Russula*, *Lactarius*, *Lepiota*, *Tricholoma*, but many species have not been described. It parasitizes mainly *Amanita* species. Previously we observed this species on *Amanita pantherina* (DC.) Krombh. and *Amanita citrina* Pers. in Hungary. We described it on the mycelium of *Amanita phalloides* (Fr.) Link in vitro experiment in 2019, however, it has not been found on the fruiting body. In addition, we detected it on *Amanita caesarea* (Scop.) Pers. in a hornbeam-oak forest of Parádfürdő, and on *Amanita rubescens* Pers. from a beech forest in Mátraháza. Besides these, we found it on *Entoloma rhodopolium* (Fr.) P. Kumm. in oak forest on Mátraháza. We observed that, the spores on the infected fruiting body are white at morning, which ripen and turn pink after 8 hours. We have photos of the infected substrates and we placed fungarium specimens in the natural science laboratory of the Mátra Forestry Technical College in Mátrafüred. Previously, *M. rosea* was not described such as substrate of genus *Entoloma*, so we expanded the list of substrates of this species to 10 fungal genera. *M. rosea* probably parasitizes several species of fungi therefore, we continue the investigations in order to get to know this species.



**TOLERANCE OF A SEMI-DESERT MOSS-DOMINATED CRYPTOBOTIC CRUST
TO A VARIETY OF NATURAL AND ARTIFICIAL STRESSES**

Egy félsivatagi, mohák dominálta kriptobiotikus kéreg toleranciája különféle természetes és mesterséges stressztényezőkkel szemben

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Many cryptogamic plants can survive and grow effectively in stressful environments. Several cyanobacterial crusts and cyanolichens are known as extremophiles. However, this is rarer in the case of moss-dominated crusts. To achieve an acceptable dry matter production, an efficient photosynthetic functioning is necessary even under such unfavorable conditions: the combined effects of many stress factors need to be tolerated at the same time. Accordingly, the photosynthetic responses were examined under different natural (desiccation, salt, heat) and artificial (hydrogen peroxide, methyl viologen, perchloric acid) stress factors in mosses (*Didymodon luridus* Hornsch., *Didymodon nicholsonii* Culm.) dominated intact semi-desert cryptobiotic crusts.

Crusts were collected from a lime-sandstone rock with semi-desert vegetation 17 km of Tataouine, between old and new Chenini, Tunisia. Before the measurements the samples were rehydrated and transferred to a growth chamber for two days. All stress treatments were performed on original crusts together with their substrate. The responses of the *in vivo* chlorophyll *a* fluorescence to different stress factors were measured in dark-adapted green segments with a pulse amplitude modulation fluorometer (Imaging PAM M-series, Walz, Effeltrich, Germany). For determination of the breakpoints (T_c) of F_0 vs. T or F_s vs. T curves the method of heat induction of fluorescence was applied.

Our results show that the photosynthetic apparatus of the moss components of the crusts has extreme stress tolerance. Their photosynthetic apparatus operated at a promising level both during stress conditions and recovery time. Furthermore, they also tolerate some very extreme Mars-like conditions in several cases. All this confirms that cryptobiotic crusts dominated by mosses can also have extreme stress tolerance and suggest that the long- and short-term acclimation/acclimatization processes, which protect against the single and simultaneous environmental factors have a pronounced ecological significance and explain the survival of the examined crusts even under extreme conditions.



USNIC ACID ENANTIOMERS IN LICHENS IN EUROPE AND AFRICA

Uzneasav enantiomerek európai és afrikai zuzmókban

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Both (+)- and (-)-usnic acid (UA) enantiomers occur in lichens naturally. Some lichens produce (+)-, others (-)-form and a few of them contains both. *Cladonia foliacea* (Huds.) Willd. was known to produce (-)-UA, but it was not known if this character is widely distributed in its populations and also the produced amount was little known. Another species *Flavoparmelia caperata* (L.) Hale produces (+)-UA with less known quantitative relations. We aimed to fill in the above knowledge gaps. About 30–30 samples of the two species were collected in Central and Southern Europe, and *F. caperata* also from East Africa. The presence and contents of (-)-UA were determined in *C. foliacea* from Europe using a chiral chromatographic method described earlier and analysed by HPLC-PDA. The content shows a substantial variation (4.08–34.27 mg/g dry weight). Since the (-)-UA enantiomer may have higher bioactive (e.g., bactericide, fungicide, anticancer, insecticide) potential or radiation filtering role, than the (+)-UA, the application of the extracted (-)-UA or crude extracts from the investigated populations may lead to promising results in further studies testing its role. In case crude extract is used, the potential bioactivity of the fumarprotocetraric acid (1.44–9.87 mg/g dry weight), produced also by this species, cannot be neglected.

Since the production of UA, – as other physiological activities – , is influenced by the environmental conditions, we supposed that the macroclimatically different temperature, radiation and humidity in European continental and African tropical habitats resulted in difference in the concentrations measured in the specimens. The content of (+)-UA shows a substantial variation in both continents (5.08–26.43 mg/g – Europe; 6.15–23.54 mg/g – Africa), however, its comparison did not result in significant differences. This can be explained by supposing that the microclimatic conditions of the natural habitats are similar in both continents and most probably consistent with the specific niche requirements of *F. caperata*. The known concentrations support considerations on further investigations and applications of this species in various geographic regions.

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**REVISION OF THE MOSSES OF PIERS-HERBARIUM IN SAVARIA MUSEUM,
SZOMBATHELY (SAMU)**

A szombathelyi Savaria Múzeum (SAMU) Piers-herbáriumának revíziója

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The herbarium, associated with Vilmos Piers (1838-1920), a military officer and teacher at the military sub-school in Kőszeg, covers the period from the last quarter of the 19th century to the early 1910s with more than 17 000 specimens. From the cryptogams, mosses represent the largest amount of the collection after fungi, including lichens (approx. 4,700 records).

Based on the revision data, their number is 2,611, which the companion species add a further 2,479 records to, so the total number means 5,090. The bulk of the collection was placed in collecting bags (capsules), supplemented by a few display sheets and 155 slides.

The collection was purchased by the Benedictine Abbey of Pannonhalma in the year of Piers's death, and it was handed over together with the entire herbarium of Pannonhalma to the predecessor of the Janus Pannonius University of Pécs between 1969 and 1977. From there it returned to the Savaria Museum in Szombathely (SAMU) between 1980 and 1981. The data of the moss herbarium have been used several times in scientific publications (Á. Boros, A. Latzel, Z. Purger, Z. Purger et al.), mostly without a detailed revision of the published species. During the present revision, 15% of the main species were proved to be misidentified, or as a previously undetermined sample or as species described after the 1920s. The number of records of accompanying species increased with 2166 records during the recent revision.

The majority of the moss herbarium originates from the Kőszeg Mountains and its immediate surroundings (V. Piers, A. Latzel, V. Cypers, K. Tief.), but also from the Czech Republic (Cypers, V., Bauer, E.), Lower Austria (Tief, K.), Österreich-Silesia (now Poland) (Cypers, V., Piers V.), from the Highlands (today Slovak Republic) (Piers V.), from the Austrian-ruled Galicia (today Ukraine) (Piers V.). There are also scattered data from Western, Northern and Southern Europe.

Due to the changed political boundaries and geographical names an important part of the monograph of the collection is the geographical index, which aims that researchers of the 21st century can place the collection data in the context of today's political conditions.



**EVALUATING THE EFFECTS OF FORESTRY TREATMENTS ON
ECTOMYCORRHIZAL FUNGAL COMMUNITIES IN A PANNONIAN
OAK-HORNBEAM FOREST**

Különböző erdészeti üzemmódok hatása az ektomikorrizás gombaközösségek diverzitására és összetételére

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Ectomycorrhizal (EM) fungi are one of the most ecologically and culturally important fungi in temperate forest ecosystems, as root contacts with EM fungi are essential for the survival of most forest tree species. The Pilis Forestry Systems Experiment, ongoing since 2016, compares five different forest management methods (four treatments and control) in terms of their effects on abiotic environmental variables, vegetation and mesofauna. The project presented here provides the first insight in our country on the impact of forest management on the composition of EM fungal communities based on DNA data from soil. A total of 4480 fungal genotype DNA sequences were determined in 30 plots sampled in October 2020, more than half of which could be identified at the genus level or higher. Of these, EM fungi were represented by 534 genotypes from 38 genera. Silvicultural practices affected both diversity and composition of fungal communities. Diversity of EM fungi was reduced in the clear-cut and 20 m gap treatments compared to the control. Within EM fungi, there were also significant differences in habitat preferences of individual genera. For example, *Amanita* species were most abundant in the control, whereas *Laccaria* species were most abundant in the more heavily disturbed plots. Significant compositional differences were found between treatments, with clear-cut and gap plots being separated from the other treatments. Of the measured environmental variables, understorey cover and species richness, as well as soil moisture, correlated most strongly with changes in fungal community composition. A thorough understanding of the environmental factors that influence forest microbiome dynamics is essential for the sustainable management of Pannonian forests so that they continue to provide us with ecosystem functions and services that are key to sustainable development.



THE ROLE OF THE MIGRATORY WATERBIRDS IN ALGAE DISPERSION

A vándorló vízi madarak szerepe a mikroalgák diszperziójában

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Dispersion plays an important role in the organisation of communities and for understanding population dynamic processes. Animal-mediated dispersion is one of the most common and long-studied mechanisms in ecology. Among animals, waterbirds are highly mobile, migrate in huge flocks and have long migratory routes, thus, they can be considered as the main vehicles for the transport of many aquatic plants in freshwater systems both at local and regional scales. Endozoochory by waterbirds has been demonstrated for a range of aquatic invertebrates, soft plant parts and seeds. However, very few publications have exclusively investigated the endozoochory of microalgae.

In this study, we investigated the microalgal flora of the faeces of various waterbirds collected in an isolated nature reserve in Hungary (Andaháza) and focused on elucidating the role of eight waterbird species as dispersal vectors of algae. Our goal was to determine: (1) which algae species can the waterbirds disperse; (2) which algae traits play the most important role in survival during the digestion; (3) which waterbird traits have effect on the composition of dispersed microalgae species. The waterbird faeces contained 157 algal species. Most of the species belonged to the *Chlorophyta* (38%) and *Bacillariophyta* (22%) phyla. The highest number of algae taxa was observed in the samples taken from *Gallinago gallinago* (26 species) and *Lymnocyrtus minimus* (20 species).

Among algae traits, the colonial structure and the presence of the silicious cell wall are able to protect algae from digestion. In case of waterbirds, mostly the trophic niche is influenced the ingestion and digestion, and likely the survival of algae. Besides the trophic niche, viability could be influenced by the beak morphology of the waterbirds. Our study supports that waterbirds are probable dispersers of several algae species, however the role of the different waterbird species in algae dispersion are divergent.



THE COLLECTION OF VIETNAM BRYOPHYTES & LICHENS IN EGR HERBARIUM

Az egeri herbárium (EGR) vietnámi moha és zuzmó gyűjteménye

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Since the late XIX century, research on bryophytes and lichens in Vietnam has been heavily influenced by experts from other countries. Numerous Vietnamese bryophyte and lichen specimens can be found at the Eger herbarium thanks to the active involvement of Prof. Tamás Pócs, who has a long history of collecting in Vietnam. About 2200 Vietnamese specimens have been looked through and pulled out from the collection at EGR with the help of the Biodiversity Information Fund for Asia (BIFA) for identification and computerization. They include 61 specimens of lichen and more than 1600 bryophytes, of which 1000 have photos published on GBIF. The collection is made up of specimens that Pételot (1927), Bussière, Jeanplong, Grusvickij, Kis, Topál, Tixier, Tran Ninh, etc. (1950s–1970s) gathered, and the majority coming from Pócs *et al.* (from the 1960s to the present). These specimens are particularly valuable in taxonomy and floristic studies, as they contain hundreds of new species and new records for Vietnam.



NON-STRUCTURAL CARBOHYDRATES OF BRYOPHYTES IN RELATION TO THEIR ENVIRONMENTAL RESILIENCE

A mohák nem-strukturális szénhidrátjai összefüggésben a környezeti ellenállóképességükkel

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Non-structural carbohydrates are photosynthesis products, provide substrates for growth and metabolism, and serve as energy storage components. Leafy liverworts (Jungermanniales) contain a diverse range of soluble carbohydrates, including sucrose, fructan and polyols such as mannitol, sorbitol and volemitol. Unlike leafy liverworts, mosses have a simple soluble carbohydrate pool consisting of sucrose, although *Sphagnum* species contain fructans. In both leafy liverworts and mosses, starch and reducing sugars are present at relatively low concentration. Carbohydrate composition of bryophytes in relation to their environmental resilience is discussed in the lecture. Sucrose and trehalose have shapes suitable for association with the polar head groups of phospholipids in place of water and for prevention of damaging phase transitions in membranes during desiccation. Additionally, these sugars maintain a vitreous phase in the cytoplasm of desiccated cells, which minimizes protein denaturation. Fructans can be inserted between the head groups of different kinds of phospholipids with some preference for phosphatidylethanolamine. They are the key regulators of adaptation to various environmental stresses, act as antioxidants, scavenging ROS and preventing cell damage under abiotic stress conditions. Fructan-accumulating species contain only traces (~1%) of starch, which means that fructan is a real alternative to starch. Fructans accumulate in the vacuole, where they play an important role in turgor regulation. More molecules mean that these cells are more resistant to osmotic pressure or even cold. The size of fructan polymers can be altered quickly; this could be an explanation for their role in osmotic adjustment. It is likely that fructans protect plants from various environmental stresses such as frost and drought by stabilizing membranes. Starch synthesis drops dramatically when the temperature decreases below 10°C, but photosynthesis and fructan production are much less sensitive to low temperatures, suggesting that fructan production benefits those plants, which actively photosynthesize during the winter and early spring. Reunion *Sphagna* generally increased the synthesis of fructans as the altitude increased. The soluble carbohydrate pool is well-balanced in bryophytes (sugar feeding, darkening, dehydration and cold have little effect), fructans are conserved at the expense of a substantial sucrose stock. Ultimately, desiccation, low and high temperature, salt and osmotic stresses all induce a water deficit at the bryophyte cell level. Accordingly, bryophyte resilience showed here share a common physiological basis.



HUNGARIAN ASPECTS OF THE EUROPEAN CHAROPHYTE ATLAS

Az európai csillárkaatlasz hazai vonatkozásai

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The knowledge and study of the Charophyceae species has reached another milestone with the completion of the atlas of European stoneworts, a collaborative effort of European researchers. The atlas not only shows the distribution of all the species occurring in Europe, but also describes each taxon in detail and summarises the most recent results. The monograph contains 63 species, 23 of which occur in Hungary. The Hungarian Charophyceae flora is well known, thanks to the work of Nándor Filarszky (1858-1941) and to the field research of the last two decades. In addition to the critical revisings and databasing the Hungarian herbarium and field data the authors also have played a role in resolving long-standing taxonomic problems. The most mysterious species is *C. mucronata* described by Filarszky, which name is illegitimate, because *C. mucronata* A. Braun 1827 has priority. This Hungarian taxon has therefore been described under a new name (*C. filarszkyana* Romanov & Mesterházy). Unfortunately, the type specimen of this species has been lost, only a detailed drawing is known. The only known habitat has also disappeared, so its taxonomic status will probably never be resolved. *C. hungarica*, which also lived in thermal springs of Buda, was considered a dubious taxon. According to the most recent studies, it has also been synonymised in the atlas, as it is identical with *C. squamosa*, a southern European taxon. Some nomenclatural and taxonomic corrections concerning additional Hungarian taxa were also made in the monograph. On the basis of molecular and phylogenetic studies, the genus *Tolypella* was split into the genera *Tolypella* and *Sphaerochara*. The latter new name also applies to the two species found in Hungary (*S. intricata*, *S. prolifera*). In addition to the solved systematic problems, there are still open questions. Based on morphological characters, the taxon living in the swamps of Belső-Somogy, previously reported as *Nitella mucronata*, is identical with *N. brachyteles* described from Algeria. This taxon is currently listed as „doubtful” in the monograph and needs clarification. Also, the taxon found in the rice fields of Szarvas and reported in the monograph as *C. fibrosa* needs further investigation. On the basis of the information received, the authors have compiled a European Red List, which also includes some Hungarian species. One species extinct in the world flora (*C. filarszkyana*) occurred in Hungary, but the list also includes *C. tenuispina* (EN), *Lychnothamnus barbatus* (EN), *Sphaerochara prolifera* and *intricata* (VU), and *C. squamosa* (DD).



RECENT PROGRESS IN THE STUDY OF LICHENS IN KENYA AND TANZANIA (EAST AFRICA)

A zuzmókutatás legújabb eredményei a kelet-afrikai Kenyában és Tanzániában

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Hungarian collections of lichens from Kenya and Tanzania were studied recently analysing morphological and anatomical characters, as well as secondary chemistry by hih performance thin layer chromatography. Altogether 39 species of lichen-forming fungi have been recognized and deposited in VBI. The lichens *Bulbothrix kenyana* Kirika, Divakar & Lumbsch, *Chrysothrix xanthina* (Vain.) Kalb, *Lobaria discolor* (Bory ex Delise) Hue, *Parmotrema durumae* (Krog & Swinscow) Krog & Swinscow and *P. taitae* (Krog & Swinscow) Krog & Swinscow were discovered as new for Tanzania; *Usnea abissinica* Motyka and *U. sanguinea* Swinscow & Krog are new for Kenya.

Of the c. 900 lichen species known from Kenya, 178 belong to the parmelioid clade including the genera – number of representing species in brackets – *Bulborrhizina* (1), *Bulbothrix* (9), *Canoparmelia* (9), *Cetrelia* (1), *Crespoa* (1), *Flavoparmelia* (4), *Flavopunctelia* (2), *Hypotrachyna* (37), *Melanelixia* (1), *Myelochroa* (1), *Parmelia* (2), *Parmelinella* (1), *Parmotrema* (64), *Pseudoparmelia* (2), *Punctelia* (9), *Relicina* (4), *Remototrachyna* (1) and *Xanthoparmelia* (29). Several of these parmelioid taxa require further revisionary studies. An identification key to the species of the parmelioid clade, based on updated nomenclature, is produced to support the practical work in collecting and selecting certain parmelioid lichens for further research.

This research was funded by the National Research Development and Innovation Fund, grant number NKFI K 124341, and the Stipendium Hungaricum Scholarship (2020–2024).



**HABITAT PREFERENCES OF THE THREATENED KNOTHOLE MOSSES
CODONBLEPHARON FORSTERI AND *ANACAMPTODON SPLACHNOIDES* IN
ABANDONED COPPICE OAK FORESTS**

A veszélyeztetett odúlakó *Codonoblepharon forsteri* és *Anacamptodon splachnoides* élőhelyi viszonyai idős, sarjztatott tölgyesekben

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Water-filled holes in trees (dendrotelms) are rather rare microhabitats in woodlands intensively managed by rotation forestry system. However, some traditional management practices (e.g. coppicing) may provide microhabitats for knothole mosses and other water-filled tree hole specialists, increasing biodiversity in managed forest ecosystems.

Codonoblepharon forsteri and *Anacamptodon splachnoides* are two epiphytic habitat specialists characteristically limited to the vicinity of dendrotelms. Due to the sporadic occurrence of this special microhabitat, the distribution of these red listed moss species is rather scattered and less revealed. Therefore, we aimed to map the distribution of the species in detail across two sites where new populations were discovered and assess the microhabitat conditions of the dendrotelms the species occupy. We have surveyed two abandoned coppice oak forests in Cserhát Mts. (Bokri Hill) and Balaton Uplands (Koloska Valley), where all the dendrotelms colonized by *C. forsteri* and *A. splachnoides* were mapped and their abiotic variables were measured. The microclimatic conditions of 40 dendrotelms occupied by *C. forsteri* and 40 uncolonized dendrotelms were also measured. In Bokri Hill, 52 trees were found to be colonized by *C. forsteri*, covering ~800 cm² as mature plant and ~2900 cm² as protonema, and *A. splachnoides* on four trees covering ~180 cm². In Koloska Valley, *C. forsteri* was found on 32 trees with ~410 cm² coverage of mature plants and ~1470 cm² protonema, and *A. splachnoides* on 16 trees with ~830 cm² coverage. The relatively high total coverage of *C. forsteri* on 84 *Quercus cerris* trees is of great significance both on a European and a global scale. Three different types of microhabitats colonized by the two moss species were distinguished: 1) edge of wet tree hole with wide entrance and ± permanently filled with water (81%); 2) bare surface of the ring of callus growing around a small water-filled hole (14%); 3) in bark fissures around a wound without any visible hole (5 %). The main drivers of the colonization of *C. forsteri* seemed to be the distance from the closest colonized trees and the amount of diffuse light. Both species are pioneer with colonist life strategy and low competitiveness. For successful colonization the moisture provided by dendrotelms might be essential, as well as the bare bark surface which is maintained by the continuous leakage of alkaline water from the tree-hole interior, locally eradicating the competitor bryophyte species.



**THE INFLUENCE OF CITIZEN SCIENCE IN REVEALING THE BIODIVERSITY OF
MACROFUNGI IN HUNGARY: A CASE STUDY OF *VOLVARIELLA BOMBYCINA***

A közösségi tudomány jelentősége a hazai nagygombák biodiverzitásának
kutatásában: Esettanulmány a *Volvariella bombycina* példáján keresztül

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Volvariella bombycina is a widely distributed lignicolous fungal species that forms agaricoid basidiomata, easily recognizable based on its distinctive morphological features. This edible fungus was designated as a protected species in Hungary in 2005 due to the low number of recorded locations and the decreasing amount of old, decayed woody material required for its growth. Despite Hollós having reported *V. bombycina* from the Kiskunság in 1896, only 26 additional occurrences were observed from Hungary until 2005 based on literature data and samples preserved in herbaria. In recent years, the interest in macrofungi has increased in Hungary, which has been demonstrated by the activity of mushroom hunting groups on social media. Consequently, rare and protected species are also increasingly photographed and shared on these platforms. For *V. bombycina*, we have been collecting data from such shared information since 2019. Following the validation of posted photos, we contacted collectors to refine details such as the precise location, collection date, and host plant information. These data were used to construct a database, which currently contains 251 new validated records from Hungary. Based on our data, *V. bombycina* is frequently found in urban environments, and it has been identified on a total of 16 different genera of deciduous trees, with the majority of records originating from *Populus* and *Quercus* species. Gathering data through citizen science acquired have facilitated a more comprehensive understanding of the distribution, and ecological role of *V. bombycina* in Hungary.

The authors express their gratitude to the 186 amateur mycologists and citizen scientists who contributed to this work with their collection data. The work of Viktor Papp was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences and the ÚNKP-22-5 New National Excellence Program of the Ministry for Innovation and Technology from the National Research, Development and Innovation Fund. The work of Bálint Dima was supported by the National Research, Development and Innovation Office (OTKA FK-143061) and the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.



TYPE STUDIES ON TWO LEPIOTOID FUNGI DESCRIBED FROM HUNGARY

Magyarországról leírt lepiotoid taxonok típusvizsgálata

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Lepiotoid fungi are saprotrophic species belonging to various genera in the family *Agaricaceae*, characterized by agaricoid basidiomes and white spore print. Within this group, notable edible and toxic species exist, underscoring their considerable significance. However, their identification based solely on morphological characteristics can be exceptionally challenging and often unreliable. Several decades ago, two species from this group, *Leucoagaricus brunneolilacinus* Babos and *Macrolepiota citrinascens* Vasas, were described from Hungary based on morphological features. The aim of our work was the type study of these species in order to clarify their taxonomic status. Therefore, examination of the nrDNA ITS region of the type materials was carried out. The type specimen of *M. citrinascens* was successfully sequenced, and our molecular phylogenetic analyses show that based on the ITS region, it belongs to the genus *Leucoagaricus* Locq. ex Singer. The molecular examination of the type specimen of *L. brunneolilacinus* has not yet been successful, however, two other recently collected specimens were studied – one from the National Botanical Garden at Vácrátót, the other from the Botanical Garden of the University of Vienna, Austria. The ITS sequences show no close relationship with other members of the genus *Leucoagaricus*, therefore, the current generic placement of this species is uncertain. Further investigations, including multigene phylogenetic analyses is necessary to clarify its exact taxonomic status.

The work of Bálint Dima was supported by the National Research, Development and Innovation Office (OTKA FK-143061) and the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.



DEBRECEN, AS AN ALGOLOGIST SEES IT

Eső után Debrecen, avagy a teresztris algák virágzása

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Algae are known to be cosmopolitan. Algae are not only found in freshwater or marine ecosystems, but they also are common in terrestrial environments. In addition, they can be also found in unusual environments such as surface of snow and ice. The terrestrial algae occur on the surface or even several centimetres deep in soil, living in and on rocks and in caves. These are habitat characterized by very low light intensities. The most important environmental factors that seem to regulate terrestrial algal populations are light, humidity, temperature, nutrient availability and pH. A rainy year, the different surfaces of cities can become almost green or red after the precipitation. This event was studied in Debrecen in 2023. After a heavy rainfall, samples were collected with toothbrushes from the surface of rocks, buildings, stones and trees from different parts of Debrecen. The fresh samples were immediately studied at 100 - 1000× magnification using a Zeiss Axio Observer 7 inverted microscope and the observed species were documented by Canon EOS R6 digital camera. Organisms were identified at the lowest possible taxonomic level. Since their physical structure is very simple, typically with a few types (unicellular, unicellular filamentous, sarcinoid colony), and they provide very few taxonomically and systematically useful features, therefore the identification and classification of terrestrial algae are complicated. Various species from cyanobacteria, chlorophytes and diatoms were characteristic components of the studied terrestrial community in Debrecen. Green algae (*Klebsormidium* sp., *Treuboxia* sp., *Apatococcus* sp.) represent the dominant element in all samples. Regardless of the rainfall, the surface of trees was covered by *Trentepohlia* species. A rare Cyanobacteria species, the *Hassallia byssoidea* Hassall ex Bornet & Flahault was found on a concrete plate in the courtyard of the Atomki.



SOME LICHENICOLOUS FUNGI FROM EAST AFRICA (KENYA AND TANZANIA)
Néhány zuzmólakó gomba a kelet-afrikai Kenyából és Tanzániából

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Lichenological investigations in Africa are rather intense in some regions mainly in the equatorial and mountain regions. Despite this, we still have a limited knowledge on the number and host range of lichenicolous fungi. Drastic land use and transformations of natural habitats increase the importance of natural history collections from a nature conservation point of view. Our aim is to incorporate so far undetermined collections to our herbaria that our knowledge on past and present biodiversity could be analysed in various geographical regions. During the investigation and identification of parmelioid lichen material from East Africa – collected mainly by Tamás Pócs and Edit Farkas in the 1980s – deposited in VBI, lichenicolous fungi were observed relatively frequently. These species often cause obvious change in the colour of the host thalli for easier detection. Among them *Didymocyrtis melanelixiae*, *Lichenocodium erodens* and *Spirographa lichenicola* are the most widespread species. These lichenicolous fungi were found on various *Parmotrema* host species, thus presenting a moderate host specificity. However, some recent taxonomist specialists are becoming more and more convinced about that the *Spirographa* species complex is more host-specific than it was thought earlier. Investigations of our relatively old collections represent an important contribution in answering such research questions. Our research was supported by the National Research Development and Innovation Fund, grant number NKFI K 124341.



REVEALING THE LONG-TERM EFFECT OF UV-PROTECTANT USNIC ACID REMOVAL ON DIFFERENT LIGHT PROTECTION MECHANISMS

Az UV-védő uzneasav eltávolításának különböző fényvédelemi mechanizmusokra gyakorolt hosszú távú hatása

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Terricolous lichens are abundant inhabitants of semi-arid grasslands, where the lichen thalli are exposed to high irradiation and have to defend themselves against harmful excess light energy reaching algal cells. Since the algal partner produces the primer carbon source for both symbionts, the photoprotection of the algae is essential. The UV-protectant lichen metabolites and different quenching procedures of the alga ensure adequate defending mechanisms. However, what happens when one of the protection mechanisms is reduced near zero? Since the long-term effect of diminishing UV-protectant lichen metabolites had been unknown, a major part of usnic acid was removed from *Cladonia foliacea* thalli deriving from lowland and mountain sites by acetone rinsing. After that, the lichens were maintained under field conditions to investigate the effect on both symbionts for three years. Similarly, treated thalli of mountain origin were transplanted to the lowland site to study the potential difference between functions deriving from long-term adaptation and short-term acclimation mechanisms. We aimed to determine if the decreased level of usnic acid caused an elevated photoprotection in the algae and to reveal the dynamics of metabolite production in lowland and mountain thalli. Photosynthetic activity and light protection were checked by chlorophyll *a* fluorescence kinetics measurements, and the concentration of usnic acid was monitored by chromatographic methods every six months. Our results pointed out that seasonality had a more pronounced effect than that of acetone treatment on the photosynthetic and photoprotective function of algae over a long-term scale. The concentration of usnic acid has started to increase in acetone-treated thalli; however, even after three years, the treated thalli contained half as much usnic acid as the control thalli, and the level of photoprotection remained unchanged in the algae. Usnic acid showed higher concentrations in the lowland than in the mountain samples during the whole investigation period, which can be explained by a long-term adaptation of the fungi that did not change with transplantation. Our results also showed that the available humidity was a more critical limiting environmental factor than the amount of incoming irradiation affecting usnic acid production under semi-arid environmental conditions. This research was supported by the grant NKFI K 124341.



FOR THE 90TH BIRTHDAY OF TAMÁS PÓCS
A 90 éves Pócs Tamás köszöntése

Sándor Orbán

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The excellent Hungarian botanist and bryologist Prof. Tamás Pócs, who is the professor emeritus of Eszterházy Károly Catholic University, is 90 years old during the Conference of Cryptogams 2023 in Eger.

He is a professor with Széchenyi Professor Grant, an ordinary member of the Hungarian Academy of Sciences, board member of international and national scientific organizations and participates in the public life of the local scientific community. He used to be the Head of our Department for several years and he founded the Herbarium of Eger.

In recognition of his educational and scientific activities, he has received many honours and awards: the Albert Szent-Györgyi Award (1996), the Pro Natura Award (2001), the Szilárd Leó Professor Scholarship (2003), The Hungarian Republic Cross of Merit (2010) and Széchenyi Prize (2014).



STUDYING DYNAMICS OF CRYPTOGAMIC COMMUNITIES IN ACIDIC PANNONIAN DRY GRASSLANDS CAUSED BY MANAGEMENT CHANGE

Kriptogám közösségek kezelésváltozás okozta dinamikájának elemzése
mészkérülő pannon szárazgyepekben

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Lichens and bryophytes, often neglected in vegetation dynamics studies, compose a large part of biomass and can largely contribute to the biodiversity at sandy grasslands. Since the work of Verseggy (1970s), their productivity has hardly been analyzed in Hungary. We studied dynamics of cryptogams at two East-Hungarian dry sandy grassland sites. The sites of *Corynephorus canescens* and of *Festuca vaginata* dominance, respectively, belonging to the community *Festuco vaginatae-Corynephorum* have been monitored. We aimed at 1) quantifying the floristic composition, diversity and biomass of terricolous cryptogamic communities; 2) exploring the response of cryptogams to management changes (subject to different grazing pressure); 3) studying the effect of an experimental change (fencing) of management on the cryptogamic assemblages also with regard to the performance of the legally protected lichen, *Cladonia magyarica*. Cryptogamic vegetation has been compared in both sites in 2013 and 2018, respectively, at an experimentally fenced part as well as a non-fenced part subject to changing grazing pressures, respectively. Forty microplots per site per management have been analyzed in both years. Samples of lichens and bryophytes were hand-sorted, dried then measured. Spot tests and HPTLC have also been applied in identification of lichen taxa in addition to morphological studies. Fencing has led to increased biomass of cryptogams within a few years. Lichens in general benefited comparatively more from enclosure than did bryophytes. Increase of lichen biomass (especially that of *Cladonia rangiformis*) was clearly due to the over 10-year absence of grazing. The only lichen favoured by moderate grazing was the legally protected *C. magyarica*. Short spells of low intensity grazing can promote species richness of cryptogams in the community.



COPPER AND ZINC EFFECTS ON SPORE GERMINABILITY OF RARE AND THREATENED MOSS *PHYSCOMITRIUM EURYSTOMUM*

A réz és a cink hatása a ritka és veszélyeztetett *Physcomitrium eurystomum* lombosmoha spóráinak csírázására

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Physcomitrium eurystomum (Funariaceae) is a rare and threatened ephemeric acrocarpous moss on the European continent (IUCN:VU; EU28:EN). It manifests a shuttle life strategy with fast ontogenesis that takes only a couple of weeks to complete (spore to spore) on ephemeral muddy soil deposits in the vicinity of water bodies. As a part of the species conservation action plan, axenic *in vitro* cultures were developed and propagated on a minimal KNOP media. Afterward, the sporophyte phase was induced in order to obtain germplasm of viable spores that can be used for species propagation and which is of great importance for species conservation as it preserves genetic diversity due to meiosis occurring in a process of spore formation. Using this germplasm of viable spores, a conservation physiology approach was conducted in order to examine the effects of zinc and copper on the spore germinability of the species, as potentially toxic elements, such as these two, can be found in water bodies affecting this species sites and this present a real threat for species survival. Spores produced in laboratory conditions to avoid population pressure were divided into the aliquots, and these were exposed to two concentration levels (200 μ M and 700 μ M) of zinc and copper acetate for two hours, prior to rinsing the material and placing it on KNOP minimal media. Germination percentage was examined each 4 days, subsequently up to 44 days until fully developed protonemal buds emerged, whose number was also compared among the experimental groups through time. It was observed that all treated experimental groups had a lower germination percentage compared to the control group. However, copper acetate had a much stronger inhibitory effect on spore germinability in both concentrations than the other treated experimental groups which showed similar germination percentages, including plants treated with sterile water. In addition, the number of newly formed protonemal buds of the treated plants was lagging behind the control groups, especially when treated with copper acetate, but the difference seems to be smaller in later time categories suggesting that they can potentially overcome the negative effect of temporary exposure to copper and complete their life cycle.



NEW RECORDS OF SLIME MOLD (*PROTOZOA: MYXOMYCETES*) SPECIES FOR HUNGARIAN FLORA AND DATA OF ITS SUBSTRATES

Új nyálkagombafajok Magyarország flórájára és szubsztrátum adataik

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Slime mold species (*Myxomycetes*) are less researched organisms in Hungary. In the last century, many studies presented this taxon, but after publication of the slime mold list in 2008, only one new Hungarian data is reported in the literature. The aim of our research is to assess the appearance, distribution and substrates of slime mold species.

During our data collection, using our own and the results of amateur researchers, we managed to identify four new species and two macrofungi substrates in Hungary. Besides this, we used the citizen science. We identified four species that had not been found in Hungary yet: *Diderma donkii* Nann.-Bremek., *Trichia favoginea* (Batsch) Pers, *Tubifera applanata* (D.V. Leontyev & K.A. Fefelov) D.V. Leontyev & K.A. Fefelov, *Tubulifera arachnoidea* Jacq. In addition to this data, we have found two species of which substrates were macrofungi. No such substrate data have been published for Hungary. *Stemonitis fusca* Roth was found on *Mycena renati* Quél. and the *Trichia varia* (Pers. ex J.F.Gmel.) Pers., was occurred on *Pluteus cervinus* (Schaeff.) P. Kumm. fungi species.

It can be said that, with the help of citizen science and continuation of research on slime mold, more and more new data can be detected, which contributes to the knowledge of this taxon.



**LEWINSKYA SHAWII (WILSON) F.LARA, GARILLETI & GOFFINET,
A NEW MEMBER OF THE HUNGARIAN BRYOPHYTE FLORA**
A magyar mohaflóra új tagja – *Lewinskya shawii* (*Orthotrichum shawii*)

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During a joint excursion in the foothills of Mátra Mts, a species of the Orthotrichaceae family new to the bryophyte flora of Hungary was discovered: *Lewinskya shawii* (Wilson) F.Lara, Garilleti & Goffinet, formerly known as *Orthotrichum shawii* Wilson.

Heves County, [8185.3] (Central European Mapping Scheme), southern foothills of Mátra Mountains, beside the road leading from Gyöngyös to Gyöngyösoroszi, ca 1 km south of Gyöngyösoroszi, on the bark of *Acer pseudoplatanus* L. together with *Lewinskya affinis* (Schr. ex Brid.) F.Lara, Garilleti & Goffinet, *Syntrichia papillosa* (Wilson ex Spruce) Spruce, *Leskea polycarpa* Hedw., ca. 210 m a.s.l., 47°48'46.6"N, 19°54'16.0"E, 01 July 2023, leg. P. Szűcs & P. Erzberger, det. P. Erzberger (B-Erzberger 28840).

Lewinskya shawii was described as *Orthotrichum shawii* Wilson in 1864 from Scotland. From the original site and in fact the British Isles the species must be considered to be extinct, because it has never been re-found in spite of repeated efforts to do so. The species has a complicated taxonomic and nomenclatural history: it has been treated as a hybrid between *L. rupestris* (Schleich. ex Schwägr.) F.Lara, Garilleti & Goffinet and *L. striata* (Hedw.) F.Lara, Garilleti & Goffinet, as a subspecies of *L. rupestris* or of *L. striata* or as synonymous with the latter.

In 2000, Mazimpaka, Lara, Garilleti *et al.* reinstated *O. shawii* as a species in its own right, based on recent collections in Spain and Sicily. At first glance, *L. shawii* might be confused with *L. striata* due to the smooth capsule wall of both species. The main difference is the complete lack of an endostome in *L. shawii*. However, careful examination of capsules with their lid still on is needed to verify this character, since in deoperculate capsules of *L. striata*, the endostome is often lost to a variable degree. Stomata are superficial (phaneropore) in *L. shawii*, *L. striata* and in *L. rupestris* as well, therefore these species were transferred to the newly created genus *Lewinskya* when the large traditional genus *Orthotrichum* was split up. *Lewinskya shawii* has a disjunct distribution, occurring also in California apart from Europe. It is locally frequent in South Europe, rare but possibly overlooked in Central and Western Europe.

According to the most recent checklist of Hungarian bryophytes, *L. shawii* does not occur in Hungary, although there were old reports, but the corresponding specimens could not be verified. With the addition of *L. shawii*, the Hungarian list of bryophytes now counts 699 taxa.



**ECTOMYCORRHIZAL FUNGI IN A PANNONIAN SANDY FOREST STEPPE
LANDSCAPE: A COMPARISON OF OPEN AND CLOSED GRASSLANDS AND
POPLAR WOODLANDS**

Ektomikorrhiza gombaközösségek kiskunsági homoki nyílt és zárt gyepekben
és nyárfaerdőkben

József Geml

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Ectomycorrhizal (EM) fungi are among the most diverse and dominant fungal groups in temperate ecosystems. In Pannonian biogeographic region, they are most diverse and abundant in forest ecosystems. Nonetheless, they constitute an ecologically important and little-studied group of organisms in steppe ecosystems with woody plants, where they likely play crucial roles in the water and nutrient supply of their hosts. The forest steppe vegetation in central Hungary is a mosaic of open grassland communities on sand dunes, closed interdune grasslands, and open woodlands. The primary EM hosts are sprawling needle sunrose (*Fumana procumbens*), rosemary-leaved willow (*Salix rosmarinifolia*), and white poplar (*Populus alba*), respectively. The topic of this presentation is a pilot study to assess the diversity and community composition of EM fungi in the above habitats in a well-preserved steppe in the Kiskunság National Park in central Hungary, based on DNA metabarcoding of fungi from soil samples. The data show that EM fungi associated with *Fumana* on open sand dunes include genera *Deastria*, *Geopora*, *Inocybe*, while *Cenococcum*, *Cortinarius*, *Geopora*, *Hebeloma*, *Inocybe*, *Sebacina*, *Tomentella*, and *Tuber* species dominate EM fungal communities in soils around *S. rosmarinifolia* and *P. alba*. Species richness of EM fungi is greatest under interdune willows and in white poplar woodlands, while EM fungal communities in the sandy soil around *Fumana* typically have less species. Several EM fungal genera showed significant differences in richness, read abundance, and composition among habitats, likely driven by environmental factors and possibly by host preference. Despite shared fungal genera and similar diversity, the composition of willow- and poplar-associated EM fungal communities differed substantially at species level. Overall, our pilot study shows that EM fungi are moderately diverse in the sand forest steppes of central Hungary and occupy niches along a moisture gradient ranging from the subarid sand dunes to the more mesic interdune grasslands. Further studies are undoubtedly needed for a more thorough characterization of EM fungal communities in Pannonian forest steppes.

J. Geml is grateful to G.M. Kovács, D. Knapp, D. Seress, and L.G. Nagy for help during the 2010 sampling, and to the Kiskunság National Park Directorate for the permits to G.M. Kovács. The molecular work was supported by the Naturalis Biodiversity Center (the Netherlands).



INFLUENCE OF PLANT GROWTH REGULATORS ON MULTIPLICATION OF RARE AND THREATEN MOSS *DREPANOCLODUS LYCOPODIODES* (AMBLYSTEGIACEAE) IN *IN VITRO* CONDITIONS

Növényi növekedés szabályozók hatása a ritka és veszélyeztetett *Drepanocladus lycopodioides* (Amblystegiaceae) lombosmoha szaporodására *in vitro* körülmények között

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Pleurocarpus moss *Drepanocladus lycopodioides* (Brid.) Warnst. is an European rare and vulnerable species usually inhabiting areas around water bodies, which are sites highly threaten due to anthropogenic influences, as well as climate change. Since the conservation and preservation of such species from extinction is crucial, one of the first steps is establishment of the axenic *in vitro* cultures and examination of the species biology features. Therefore, the main aim of this research was to obtain data for mass propagation in *in vitro* and laboratory conditions of *D. lycopodioides* and thus enable its potential successful reintroduction to the natural habitats. Experiments were carried out to study the influences of essential plant growth regulators, namely indole-3-butyric acid (IBA) and 6-benzylamino purine (BAP) on moss growth and development. The moss explants were grown on minimal KNOP medium supplemented with exogenously added IBA and BAP (both 0.03, 0.3 and 3 mM and control without growth regulators) for 4 and 6 weeks. After the experiment, morphogenetic parameters such as survival and index of multiplication i.e. appearance of newly developed shoots (IM) measured. All explants survived the treatment with IBA and BAP. However, growth regulators inhibited the formation of new shoots (IM) and development of secondary protonema, which was invisible. Since the IM was the highest in the control group, it could be inferred that using the minimal KNOP medium is the most suitable method of mass propagation in culture *in vitro* for *D. lycopodioides*. In addition to the results obtained for mass propagation, interesting data related to the development of sexual organs of the selected species were also documented. Considering that *D. lycopodioides* is a dioecious species and that the production of sexual organs is extremely rare, the occurrence of archegonia in plants grown on media supplemented with 3 mM BAP indicated the possible methodology for sexual reproduction of this species *in vitro*. This research highly contributes to conservation and multiplication of *D. lycopodioides* and proposed elegant method for preventing the extinction of this species from its natural habitats.



THE IMPORTANCE OF LICHENS AND THEIR CONSERVATION

A zuzmók és természetvédelmük jelentősége

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Although we are not always aware of their existence, lichens play vital roles in nature and in human life. However, they are prone to threats due to environmental uncertainty. Therefore, their redlisting and conservation by law is necessary and justified. Lichens in addition to their importance in the ecosystem (in soil production, primary succession, allelopathic effects), give additional services to humans by their contributions to the biodiversity, functioning as biological indicators, providing a huge number of bioactive products (of antibiotic, analgesic or antitumor nature). The aim of our recent review was to investigate the status of lichen conservation and its research worldwide, including the role of the IUCN in the conservation of lichen species. Data collected from journal publications (n=29) originated from simultaneous searches of 4 databases (Google Scholar, Recent Literature on Lichens, Scopus and Web of Science) were discussed referring altogether 91 publications. The publications were analysed by the threats to lichen conservation, the factors influencing conservation challenges, the measures of recovery and the geographic regions studied. The research and identification problems, habitat destruction and shrinking, human pressure, industry, erroneous conservation practice, global change, low population size, human pressure, lichens' vulnerability to the environment and climate change represent major threats to lichens. While Europe has a leading role in conserving its heritage of lichens compared to other continents, tropical areas, especially Africa, lack sufficient data in the research on lichens. Institutional measures of protecting nature through policies would serve as control and conservation methods of lichens. Despite the lack of data on lichens, they are known to have a supreme role in the ecosystem and human life, thus the extended knowledge gaps in certain areas should not cause a delay in quick implementation of conservation policies that prevent further threat.

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THE ALLELOPATHIC POTENTIAL OF THE MOSS *FONTINALIS ANTIPTYRETICA* ETHANOLIC EXTRACTS

A *Fontinalis antipyretica* lombosmoha etanolos kivonatának
allelopátiás potenciálja

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Bryophytes synthesize and accumulate different chemical compounds including specific metabolites such as phenolics and terpenoids, whose concentration and content may vary on environmental conditions. Some of the chemical compounds found in bryophytes can affect the vegetative growth and reproduction of nearby plants. It is unknown and thus rather important to investigate if aquatic bryophytes display allelopathic potential on other plants naturally absent from water. Therefore, the aquatic moss *Fontinalis antipyretica* Hedw. was selected to examine its allelopathic potential. The main aims of this study were to examine the effects of different concentrations of ethanolic extract (10^{-2} , 10^{-3} , 10^{-4} mg/ml) on seed germination of lettuce and radish, and on the length of hypocotyl after three and five days. Moreover, the effects of those extracts on the total chlorophyll content in radish and lettuce seedlings were documented after five days. The highest concentration of extract (10^{-2} mg/ml) manifested positive effects on the seed germination of lettuce after both three and five days. Nevertheless, neither of the tested extract concentrations had any positive or negative effects on the hypocotyl length of radish and lettuce. On the other hand, the highest concentrated extract (10^{-2} mg/ml) exhibited a slight inhibitory effect on the seed germination of radish. In addition, the highest concentration of *F. antipyretica* ethanolic extracts affected the total chlorophyll content of lettuce and radish seedlings after the fifth day, significantly reducing the concentrations of those photosynthetic pigments compared to control groups. Although *F. antipyretica* is aquatic species, it displays different effects on lettuce and radish seed germination, growth, and development suggesting that it contains some compounds with potential allelopathic effects. Therefore, *F. antipyretica* might be a chemically interesting species used as a natural bioherbicide or biopesticide in the future.



**MOLECULAR AND MORPHOLOGICAL IDENTIFICATION OF
CHROOGOMPHUS MEDITERRANEUS NEW TO THE HUNGARIAN FUNGA**

A *Chroogomphus mediterraneus* első magyarországi azonosítása molekuláris
és morfológiai alapon

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During a regional study of the morphologically recognisable species of the conifer associated basidiomycetous *Chroogomphus* (Singer) O.K. Mill. (*Boletales*), a new, unresolved question arose about the recently discovered cryptic diversity of this genus. In Hungary, *Chroogomphus* had previously been examined solely based on morphology, and according to this, published data were only available for the species *C. rutilus* (Schaeff.) O.K. Mill. and *C. helveticus* (Singer) M.M. Moser. In Hungary, *C. rutilus* is an officially authorized fungus species for retail sale, therefore it is a frequently collected and consumed mushroom. However, based on literature data, *C. mediterraneus* (Finschow) Vila, Pérez-De-Greg. & G. Mir with a similar appearance to *C. rutilus* s. str. can presumably occur in Hungary as well, necessitating a re-evaluation of previous identifications. In this study, we examined a total of 30 samples from 16 localities using both morphological and molecular genetic methods. Our phylogenetic analyses based on the nrDNA ITS region confirmed the presence of *C. mediterraneus* from Hungary. The ecological context of these occurrences in Hungarian *Pinus* plantations are evaluated based on bioclimatic, edaphic and forestry data. As additional support for species delimitation and morphological based identification, some novel morphological characters are also presented.

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**NEW BRYOPHYTE DATA FROM A RECLAIMED MINING AREA NEAR VARTEG,
SOUTH WALES**

A wales-i Varteg beerdősített terület változó mohafldrája

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The survey covered a 30 old reforested area with the method “Cradle for Nature” strategy using mosaic tree planting. Except for a 2005 bryophyte survey no recording of mosses and liverworts has been carried out on the Varteg Colliery site in the past so its bryophyte flora was totally unknown before 2005 The bryophytes were collected from soil and from tree trunks in 3 subplots within the reforestation plots. The several thousand different tree species and the plot localities were recorded. The Varteg test sites are located between 360 and 370 metres above mean sea level on the western outcrop of the South Wales Coalfield in Torfaen County Borough. The data will be the part of the heritage of Cradle for Nature project. The author was one of the volunteers working at the site in 2017 so the collection of the bryophyte species was made by the author. The results show a typical total for a semi-upland site where woodland species have been present only since the forest plantation had been getting older and saxicolous species are primarily acidophil. Concerning the distribution of the woodland species from the surrounding areas the bryophyte species of some neighbouring old Welsh oak trees were collected. On the basis of the results the number of species is 54 in the plantation plots and the rate of woodland species have grown in the plots which generated higher species number for the whole region which is higher than 100. The acid grassland is not a bryophyte-rich habitat, although frequent *Rhytidiadelphus squarrosus* and some *Fissidens adianthoides* occur where there is some surface flushing and *Ceratodon purpureus*, *Pohlia nutans* and *Polytrichum piliferum* where soils are poor. Dry heath, dominated by heather and bilberry, supports abundant *H. jutlandicum*, *Pleurozium schreberi* and *R. squarrosus*, as well as some *Dicranum scoparium*. *Gymnocolea inflata* grows in hollows. Two areas of wet heath lie near the centre of the field and at its southern side. Locally abundant *Aulacomnium palustre*, *Sphagnum denticulatum* with *Calliergon stramineum* also grow in the examined site. From among the species which are new as woodland ones *Orthotrichum*, *Anomodon* and *Frullania dilatata* and *Leucodon sciuroides* species are important. Cradle for Nature reforested area was founded by professor Martin Haigh who died in February 2022.



SYSTEMATIC AND PHYLOGENY OF *LEUCOBRYUM* (LEUCOBRYACEAE, BRYOPHYTA) FROM INDIAN OCEAN

Az Indiai-Óceáni térség *Leucobryum* fajainak törzsfajlódése és rendszertana

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The genus *Leucobryum* Hampe (Leucobryaceae, Bryophyta) is a genus of moss that has been poorly explored in the African region and especially in the western part of the Indian Ocean.

A morphological analysis of the types specimen of the Herbarium de Cryptogamie (PC) (Paris, MNHN) of Paris as well as of specimens collected between 1994 and 2019 has been conducted. Twelve morphological clusters were proposed. A molecular analysis based on the amplification of 3 markers will be treated. Various methods of species delimitation were used ABGD, ASAP, based on the analysis of genetic distance, mPPT, GMYC, based on the analysis of speciation event regarding coalescence events from a phylogenetic tree. Within the framework of an integrative taxonomy approach, the CoMa decision tool allowed to highlight 7 species well delineated for the area (*L. cambouei*, *L. boryanum*, *L. cuculatum*, *L. isleanum*, *L. perrotii*, *L. boivinianum* and *L. madagassum*) and 4 species (*L. sancta-mariae*, *L. acutifolium*, *L. comorense*, *L. mayottense*) grouped in a multispecies complex. A phylogeny at a large scale is proposed.



**PRELIMINARY RESULTS ON THE *SPHAGNUM* COLLECTION (EGR):
CONTRIBUTIONS TO THE BRYOFLORA OF MADAGASCAR
AND RÉUNION ISLAND**

A *Sphagnum* gyűjtemény (EGR) határozásának előzetes eredményei: Madagaszkar és Réunion tőzegmoha adatai

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The Cryptogam Herbarium of the Eszterházy Károly Catholic University of Eger (Acronym: EGR) is considered to be one of the most important collections of this kind in Central Europe. Bryophyte specimens held at EGR count around 200.000 bryophyte specimens, of which around 6500 are the specimens collected from Madagascar and the Indian Ocean Islands. During the last forty years Tamás Pócs and several of his colleagues from the Botanical Department participated at several fieldtrips and gathered bryophytes from continental Africa, Madagascar and the Indian Ocean Islands. The very rich *Sphagnum* (peat moss) collection is partly identified. In this work, as an introductory study we are reporting our preliminary results of the very rich *Sphagnum* specimens collected mainly from Madagascar (1994, 1998) and the Réunion Island (1996). Altogether 110 specimens deposited at the Herbarium of ECKU (EGR) were identified by the third author during her stay in Eger in the November 2021, which leads to recognition of eleven taxa. Two varieties are newly reported from Madagascar: *Sphagnum tumidulum* Besch. var. *confusum* (Massif de l'Ankaratra) and *Sphagnum truncatum* Hornsch. var. *truncatum* (Andringitra Mts.). Further studies are planned to be carried out to get an whole insight into the *Sphagnum* flora of this region.



THREAT FACTORS AND CONSERVATION STATUS OF PROTECTED LICHEN SPECIES IN THE BAKONY REGION (HUNGARY)

Védett zuzmófajok veszélyeztető tényezői, természetvédelmi helyzete a Bakonyban

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The occurrence, population size, status and habitat characteristics of nine protected lichen species (*Cetraria aculeata*, *C. islandica*, *Cladonia arbuscula*, *Cl. mitis*, *Cl. rangiferina*, *Solorina saccata*, *Peltigera leucophlebia*, *Xanthoparmelia pulvinaris*, *X. pokornyi*) were investigated in 2 m × 2 m field plots. More than half of the 149 field records (82) are part of a Natura 2000 site. 17 sample quadrats were registered in strict specially protected natural areas and 14 in protected natural areas (Balaton-felvidék National Park). The distribution of protected lichen species in the Bakony Region is correlated with areas of conservation value and the joint occurrence of several protected species. The risk of extinction due to disturbance is higher for rare lichen species than for common ones. When disturbance is reduced, lichens appear, as most species reproduce vegetatively. If disturbance is persistent, the cryptobiotic crust is stuck at the early successional stage. The main disturbance factor is the trampling and grazing of animals. Field surveys have shown that animals produce a mass of small thallus fragments, that seems to be advantageous for the spreading of protected lichen species. However, frequent and intense disturbance can cause fragmented thalli that fail to develop. *C. aculeata*, *C. islandica*, *X. pulvinaris* and *X. pokornyi* are exposed to sheep grazing. Trampling and chewing of games predominate in the habitats of the reindeer lichens, *S. saccata* and *P. leucophlebia*. Field experience has shown that if the level of disturbance increases, the number of fruiting bodies decreases and the thalli die out partially or completely. In the case of *S. saccata* thalli, it can be observed that most of the fruiting bodies develop in undisturbed areas. There were some records where the vitality reached 600 and 300 fruiting bodies, but the value around 100 fruiting bodies is also significant. At a weak disturbance value, it is more likely to observe fruiting bodies below 100 (mostly 0 and 50). For the protected lichen species adapted to a site or habitat type, similar conservation management can be proposed, and it is worth planning for their conservation together in the future. This research was funded by the grant NKFI K 124341.



COMPARISON OF SITES OF PROTECTED LICHEN SPECIES IN THE BAKONY REGION (HUNGARY)

Védett zuzmófajok bakonyi lelőhelyeinek összehasonlítása

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Nine protected lichen species (*Cetraria aculeata*, *C. islandica*, *Cladonia arbuscula*, *Cl. mitis*, *Cl. rangiferina*, *Solorina saccata*, *Peltigera leucophlebia*, *Xanthoparmelia pulvinaris*, *X. pokornyii*) in the Bakony Region, their population size, status and habitat characteristics were investigated in 149 field sample units. 268 previous herbarium records and 6 literature records have been analysed. New occurrences of these species were also discovered. The field recordings were analysed in 2 m × 2 m sample plots (149) to detect the factors determining their occurrence. A total of 501 species were recorded, i. e. 297 vascular plant, 106 lichen and 98 bryophyte species. The principal component analysis based on the cover (%) of all species distinguished three major groups separated partly by protected lichen species and partly by habitat type. The permutation multivariate analysis of variance also showed a significant difference between the groups. *C. aculeata*, *C. islandica*, *X. pokornyii* and *X. pulvinaris* formed a group, records of *S. saccata* and *P. leucophlebia* were separated together and a third group included records from the habitats of the three *Cladonia* species. One acidic and two calcareous species communities have been outlined. The difference between the two calcareous groups is caused by differences in soil pH and CaCO₃ content, vascular plant species, moss cover and soil depth, based on an RDA analysis of environmental variables. RDA analysis shows that the calcareous habitat types form a separate group from the reindeer lichen species quadrats, the dry grassland group of *Cetraria* and *Xanthoparmelia* species, and the rocky habitats of *saccata* and *P. leucophlebia*. The two calcareous groups differ in canopy closure, rock cover and disturbance. The separation of *S. saccata* and *P. leucophlebia* is largely explained by canopy closure and rock cover. The protected lichen species occurring in the Bakony are of different ecological tolerance, that makes them suitable for indexing their environment. This survey also allowed their conservation assessment. This research was funded by the grant NKFI K 124341.



DOES CESIUM AFFECT ENZYMATIC ACTIVITY IN *ATRICHUM UNDULATUM* IN *IN VITRO* CONDITIONS?

Hatással van a cézium az *Atrichum undulatum* lombosmoha enzimatiszus aktivitására *in vitro* körülmények között?

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Due to their unique morphological and physiological features, mosses are very useful indicators of various contaminants. After the Chernobyl accident, an interest in mosses as biomonitors of radioactivity increased, and they were used for mapping ¹³⁷Cs deposition in contaminated areas. Cesium is chemically similar to potassium, which is essential element for plants. Therefore, it could compete with K⁺ causing a significant reduction in its transport, which can lead to the potential metabolic interference and poor growth. In addition, radionuclides could directly or indirectly cause the outbreak of reactive oxygen species (ROS). One of the common protective mechanisms to ROS is an increase in antioxidant enzyme activities. Therefore, the aim of this research was to investigate whether the nonradioactive ¹³³Cs affect the activity of antioxidative enzymes (catalases (CAT), peroxidases (POX), and superoxide dismutase (SOD)) and thus potentially cause the oxidative stress in moss *Atrichum undulatum* (Hedw.) P. Beauv *in vitro*.

The present study evaluated the impact of cesium acetate at four concentrations (0, 0.5, 1, and 1.5 mM) and different exposure times. Three treatments were used: Plants were grown in solid MS medium supplemented with different cesium concentrations for 5 weeks (T1); Plants were kept in water solution with different cesium concentrations for 2 (T2) or 24 (T3) hours and then transferred to the solid MS medium free of cesium for 5 weeks. Results clearly showed that cesium did not affect the activities of SOD and POX in T1 while CAT activity in *A. undulatum* increased with rise of the cesium concentration. For T2, the highest CAT activity was quantified in mosses kept in water solution with 0.5 mM concentration of cesium, while the highest SOD activity was detected in those kept in water solution with 1.5 mM cesium concentration. On the other hand, POX activity was even for all cesium concentrations. The control groups of T3 showed the highest activities of SOD and CAT. Opposite to that, POX manifested the highest activity for plants kept in water solution with 1.5 mM cesium concentration. Although addition of Cs in this form slightly affected enzymes activities depends on exposure time, those changes were not drastic suggesting that Cs in this form did not lead to oxidative burst in *A. undulatum*.



THE EXPLORATION OF TAMÁS PÓCS IN VIETNAM

Pócs Tamás felfedező útjai Vietnámban

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Tamás Pócs, Professor Emeritus, is a distinguished botanist who has dedicated his entire life to the study of plants, particularly bryophytes. We can infer from a review of his field trip notes, cryptogamic collection, and online data that he visited Vietnam, and carried out surveys there in 1963, 1965–1966, 1998, 2002, and 2018. Until now, he continuously authored and co-authored over 20 publications, discovered 12 new bryophyte and flowering plant taxa, and significantly established the first fundamental step for Vietnam bryology by supervising Tran Ninh, the country's first bryologist. This poster aims to provide an outline of his exploration, accomplishments, and legacies to Vietnam flora.



**LICHENS AND LICHENICOLOUS FUNGI FROM *OLEA EUROPAEA*
IN MONTENEGRO**

Montenegrói olajfások zuzmói és zuzmólakó gombái

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Olea europaea is one of the main crops in the Mediterranean countries. Traditionally managed extensive olive groves represent a special agricultural area, i.e. a kind of semi-natural habitat of high biodiversity, where a remarkable number of animal and plant species can survive, like orchids, bryophytes or lichens. The bark of olive tree is regarded to be acidic to neutral, basically a suitable substrate for acidofrequent cryptogams.

Several oceanic lichen species like *Collema furfuraceum*, *Fuscopannaria olivacea*, *Leptogium teretiusculum*, *Nephroma laevigatum*, *Normandina pulchella*, and *Pectenia plumbea* were found, and approximately 40 other lichens and lichenicolous fungi were detected from four olive groves in the coastal region of Montenegro.

Lichenicolous fungi are less studied and known from Montenegro than lichen-forming fungi. At least six species were identified from our collection from *Olea* bark, among them a new distribution record for the country. The most interesting lichenicolous fungi species was *Sclerococcum parasiticum* growing on *Pertusaria*. One of the apothecia contained two-celled, brown ascospores and another one had only four-celled, similarly ripe ascospores side by side. Further records of lichens and lichenicolous fungi are expected from the area.

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DO NOT JUDGE BY APPEARANCE! – RESULTS OF A MORPHOMETRIC ANALYSIS ON THE *CLADONIA CHLOROPHAEA* SPECIES GROUP RICH IN LICHEN SECONDARY METABOLITES

Ne ítélj a külső alapján! – A másodlagos zuzmóanyagokban gazdag *Cladonia chlorophaea* fajcsoport morfolometriai vizsgálatának eredményei

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Cladonia is one of the most species-rich lichen genus characterised by variable appearance and high chemical diversity. The species belonging to the *Cladonia chlorophaea* group are characterised by a horizontal thallus and a densely sorediate podetium (consisting of a stalk and a cup). They occur mainly on soil but are also found on bark or dead wood. The morphological characters, differentiating these species according to the literature data usually given, are less obvious because the range of values broadly and often overlaps. Moreover, identification, based on additional lichen secondary metabolite analysis, needs facilities of limited access, available only for a few specialists. To find a possibly easier, still an adequately precise method for differentiating these species based on their secondary metabolite composition, we focused on revealing the most relevant properties of the species within the *C. chlorophaea* group. Therefore a chemical and a morphometric analysis were carried out simultaneously. The 281 Hungarian specimens kept in herbaria as *Cladonia chlorophaea* s. l., were revised by high-performance thin-layer chromatography. A detailed morphometric study of 227 podetia was carried out on selected specimens, where the size of podetia, cup, stalk, soredia and squamules were measured and analysed. Conditional inference trees were created to separate the species according to chemical and morphological characteristics. The chemical analysis allowed to separate *C. asahinae*, *C. cryptochlorophaea*, *C. grayi*, *C. merochlorophaea* and *C. novochlorophaea* from *C. chlorophaea* s. str. Three species, *C. asahinae*, *C. grayi* and *C. novochlorophaea*, represented new distribution records to Hungary. Specimens containing cryptochlorophaeic acid and thamnolic acid were mainly *C. cryptochlorophaea* (around 85%). Specimens containing rangiformic acid were mainly *C. asahinae* (around 75%), while this metabolite was always missing from the specimens of *C. chlorophaea*, *C. grayi* and *C. novochlorophaea*. Among the morphological characters size of the podetia seemed to be the most relevant properties. *C. asahinae* and *C. cryptochlorophaea* were found to be usually smaller than the robust *C. chlorophaea* or *C. merochlorophaea*. Our results revealed that the separation of *C. chlorophaea*-like specimens by chemical analysis is more reliable compared to morphometric analysis. This research was supported by the grant NKFI K 124341.