# The Bryological Times

NEWSLETTER OF THE INTERNATIONAL ASSOCIATION OF BRYOLOGISTS

**June 2025**

**VOLUME 160**


## In this issue:

# IAB Presidential Address

Dear friends of the IAB,

Here in your hands is issue 160 of the IAB newsletter. Thank you to everyone for your contributions, so varied and surprising. Thanks, as well to the new editorial team, Andrew Franks, Chris Cargill and Juan Carlos Villarreal, for putting together this issue. And of course, thanks to Mereia Tabua for producing our 2024 newsletters.

In this troubled and sometimes disheartening world, we find comfort and joy in the presence of our loved ones—family, friends, colleagues... But bryophytes, these small and often overlooked plants, spark within us a unique kind of wonder, giving the impression that we are charting new paths of knowledge. Sometimes, behind my microscope, a strange feeling of futility creeps in; and then I realize that this tiny leaf, placed between a slide and cover slip, unites a real community of shared interest, despite our different origins, backgrounds, lifestyles, and beliefs. That is the essence of passionate pursuits, especially in the natural sciences, and undoubtedly one of the best reasons to encourage younger generations to discover these plants and, for those more deeply engaged, to share and take part in our community of bryologists.

This newsletter reflects the full diversity of our community, from the activities of local groups to the history of bryology, as well as the sharing of scientific results and projects that, in this issue, even extend to the potential colonization of other planets by mosses!

Among the projects supported by the IAB, and thanks to the initiative "Women in Bryology" launched two years ago, we aim to broaden the stories and production of bryologists past and present in a section of our web site entitled «The Bryological Community».

The IAB is also entering an election year to renew members of the Council and of the Executive Committee. Candidacies have now been submitted, and we strongly encourage as many of you as possible to participate in the voting process for these new representatives.

Finally, we will be meeting in person in Taiwan in October 2025 at the IAB Congress organized by our colleagues of the Taiwan Biodiversity Research Institute. Registration is open until the end of June. This will be a major event, and I truly hope many of us will be able to gather there.

Until then, happy reading to all!

Catherine Reeb

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## IAB Elections 2025

The International Association of Bryologists is governed by a council and executive committee composed of a President, two Vice-Presidents, a Secretary-Treasurer, the last President, nine council members as well as the editors of *Bryophyte Diversity and Evolution* and *The Bryological Times*. Except for the editors, all officials are elected by IAB members.

In 2025 the terms of one Vice-President, the Secretary-Treasurer and four council members come to an end, and hence elections are held to fill these positions. Council members are elected for specific regions, and departing members represent North America, Africa, and Australasia and Pacific Islands. The fourth position will be filled by a region-free vote among all nominees. The election committee will be composed of Bernard Goffinet (chair), Chris Cargill and Boon-Chuan Ho. The election judge will be Juan Larraín.

Following a call for nominations, the list of candidates has been composed. The election will be held in June 2025 through an on-line password protected ballot. All IAB members will receive instructions including a unique personal identification number to cast their vote. Voting closes on 28 June 2025.

Note that the IAB council adopted a by-law aimed at ensuring broad geographic representation of the IAB council. To this end IAB recognizes the following regions: North America (including Mexico), Europe (including Russia), Asia, Central & South America, Africa & Middle East, Australasia (including the islands of the South Pacific). To accommodate the goal of maintaining broad geographical representation across the six regions, the ballot for Council Member is composed of two parts: Part A to fill region specific seats, and Part B to complete the election with region-free candidates.

On behalf of the election committee,

Bernard Goffinet

♦ ◊ ♦

## IAB Membership

IAB membership follows the calendar year, that is, from 1 January to 31 December. Individual membership is either for one year (US$16) or five years (US$70). Students are eligible for free membership for one year. Discounted membership fees apply to citizens from eligible countries.

Relevant payment links, student forms, and list of eligible countries for discounted rates can be found on the IAB website. For further information or queries please do not hesitate to contact IAB secretary/treasurer, Matt von Konrat.

We encourage you to renew your membership and/or to invite others to consider joining and contribute to the IAB's mission of promoting the study of bryophytes and the cooperation and communication among bryologists.

♦ ◊ ♦

# In memoriam Jeannette-Leica Chavoutier (1943-2024)

Naturaliste et bryologue, Jeannette-Leica Chavoutier a consacré sa vie à l'observation, à l'étude et à la transmission des connaissances sur la biodiversité. Institutrice en Tarentaise tout au long de sa carrière, elle a su initier ses élèves à la reconnaissance et à l'intérêt pour les plantes, les insectes et les oiseaux.


Dans les années 1970, elle participe à l'élargissement des activités de la Société mycologique de Tarentaise (Savoie, France) vers une approche naturaliste plus globale. Elle mène de nombreuses explorations dans les environs de son village natal, Fontaine-le-Puits (Savoie, France), qui aboutissent à l'identification de plusieurs espèces peu connues.

Sa découverte de la bryologie, au début des années 1980, constitue une étape déterminante. À la demande du Parc national de la Vanoise, dans les Alpes, elle collabore avec Philippe Pellicier à la réalisation du premier inventaire bryofloristique du massif. En l'absence de documentation accessible en langue française, ce travail s'appuie sur l'expertise de bryologues comme Patricia Geissler et Marcel Contet.

Par la suite, elle intensifie ses prospections, notamment en Savoie, en Isère et en Andorre, en documentant de manière rigoureuse ses observations. Elle contribue à plusieurs inventaires régionaux menés par des organismes tels que le Conservatoire d'espaces naturels Rhône-Alpes et la Réserve naturelle du Marais de Lavours. Elle publie également de nombreux articles de vulgarisation dans des bulletins spécialisés.

Pionnière dans le domaine de la microphotographie appliquée aux bryophytes, elle développe dès les années 1990 une méthode simple et efficace utilisant un appareil compact adapté au microscope. La qualité de ses clichés, largement utilisés dans ses publications, est rapidement reconnue.

Son Atlas des bryophytes de Savoie, publié en 2013, synthétise plusieurs décennies de prospection et de compilation: près de 600 pages documentent environ les trois quarts des espèces françaises, constituant une référence majeure dans le domaine.

Sa collaboration avec Vincent Hugonnot aboutit à la publication de Bryophytes des Pyrénées-Orientales (2018), puis à sa participation significative à l'encyclopédie Les Bryophytes de France (deux volumes parus), pour laquelle elle réalise plus de 4000 photographies et coécrit de nombreuses monographies d'espèces.

Elle met également à disposition un Glossaire illustré de bryologie, publié en français puis en anglais, désormais utilisé comme ouvrage de référence par les amateurs comme par les chercheurs. Son travail est reconnu au niveau international, notamment par l'attribution du Prix Hattori de l'IAB (Interational Association of Bryology).

Malgré des problèmes de santé, elle poursuit ses recherches jusqu'à la fin de sa vie, contribuant encore à la connaissance de la bryoflore locale autour d'Aix-les-Bains, toujrous en Savoie.

Par son approche méthodique, son engagement constant et la qualité de ses productions, Jeannette-Leica Chavoutier a durablement influencé la bryologie francophone. Son apport scientifique et pédagogique demeure une source précieuse pour les naturalistes et les chercheurs.

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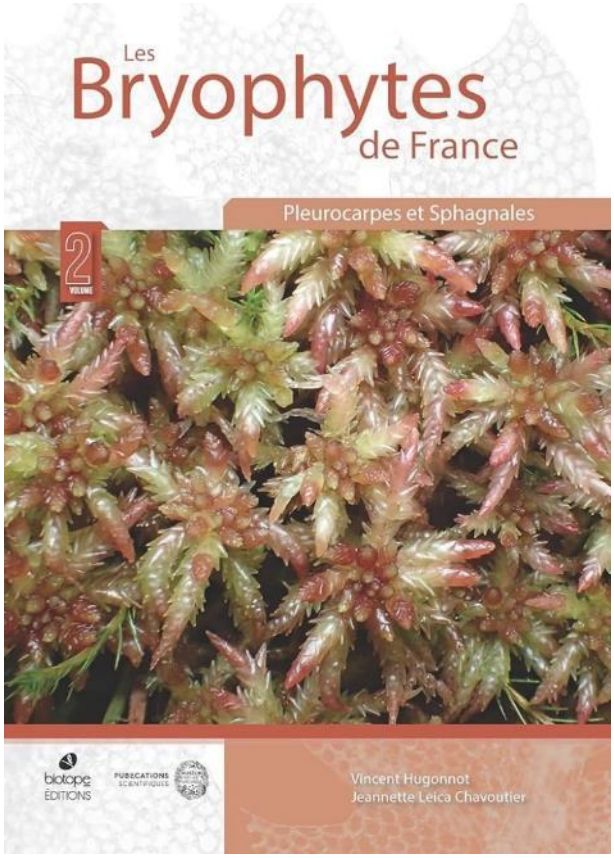


French naturalist and bryologist Jeannette-Leica Chavoutier dedicated her life to observing, studying and sharing knowledge about biodiversity. Throughout her career as a school teacher in Tarentaise (Savoie, France), she taught her students to recognize and appreciate plants, insects, and birds.

In the 1970s, she helped expand the activities of the Société mycologique de Tarentaise toward a more global naturalist approach. She led numerous expeditions around her native village of Fontaine-le-Puits (Savoie), which led to the identification of several little-known species.

Her discovery of bryology at the beginning of the 1980s was a decisive step. At the request of the Vanoise National Park in the Alps, she collaborated with Philippe Pellicier on the first bryofloristic inventory of the massif. In the absence of accessible documentation in French, this work relied on the expertise of bryologists such as Patricia Geissler and Marcel Contet.

She then intensified her surveys, particularly in Savoie, Isère and Andorra, and rigorously documented her observations. She contributed to several regional inventories carried out by organizations such as the Conservatoire d'espaces naturels Rhône-Alpes and the Réserve naturelle du Marais de Lavours. She also published a number of popular articles in professional newsletters.

A pioneer in the field of microphotography applied to bryophytes, in the 1990s she developed a simple and effective method using a compact camera adapted to the microscope. The quality of her images, widely used in her publications, was quickly recognized.

Her Atlas des Bryophytes de Savoie, published in 2013, synthesizes several decades of prospecting and compilation: nearly 600 pages document about three-quarters of the French species, constituting a major reference in the field.

Her collaboration with Vincent Hugonnot led to the publication of Bryophytes des Pyrénées-Orientales (2018), then to her major contribution to the encyclopedia Les Bryophytes de France (two volumes published), for which she took over 4,000 photographs and co-authored numerous species monographs.

She also published an Illustrated Glossary of Bryology, first in French and then in English, which is now used as a reference work by amateurs and researchers alike. Her work has received international recognition, including the Hattori Prize awarded by the IAB (International Association of Bryology).

Despite health problems, she continued her research until the end of her life, contributing to the knowledge of the local bryoflora around Aix-les-Bains, still in Savoie.

Jeannette-Leica Chavoutier's methodical approach, her constant commitment and the quality of her work have had a lasting influence on French-speaking bryology. Her scientific and educational contribution remains a precious resource for naturalists and researchers.

Vincent Hugonnot

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## Upcoming Biennial Conference of the International Association of Bryologists Taiwan 2025

The 2025 International Association of Bryologists Conference will be held from October 13 to 15, 2025, in Jiji Township, Nantou County, Taiwan. The conference theme is "Bryological Advances in Asia and Beyond." This event aims to bring together bryologists, ecologists, conservationists, and plant scientists from around the world to share recent research developments, foster interdisciplinary collaboration, and discuss future directions for bryophyte studies and conservation, particularly for the Asia region.

The conference will focus on recent advances in taxonomy, systematics, molecular biology, ecology, conservation, and biogeography of bryophytes. By bringing together researchers from diverse regions and disciplines, the conference aims to highlight regional discoveries, cross-border collaborations, and the global relevance of bryophyte studies. Through sharing cutting-edge research and innovative approaches, the conference seeks to foster dialogue, inspire future research directions, and contribute to a deeper understanding of bryophyte diversity and its ecological significance.

Registration fee: Student: 5855 NTD (ca. US$180, possibility of free lodging)

Regular - early bird (before 1 July 2025): 7970 NTD (ca. US$245)

Regular – (after 1 July 2025): 9110 NTD (ca. US$280).

Post-conference field excursion options (October 16 to 17): Sun-Link-Sea Forest Recreation Area, Xitou and Lienhuachih Research Center.

For more information: https://sites.google.com/view/iab2025signup/home

Or contact Kuei-Yu Yao (vulqthu@hotmail.com).

♦ ◊ ♦

# New Award for IAB Named after a Prominent Female Bryologist

D. Christine Cargill & Josephine Milne

One of the aims of the International Association of Bryologists (IAB) is to 'promote international co-operation and communication among persons interested in bryophytes'. One way to achieve this is to ensure representation of the Society's diverse membership. First as an elected IAB Council member and then as the 2nd Vice President, Christine Cargill (first author) initiated a project to raise the profile of women bryologists. This project was a collaboration with Fijian bryologist Mereia Tabua (former *The Bryological Times* editor, and past Council member) and Australian bryologist Josephine (Pina) Milne (second author) (retired Collections Manager, National Herbarium of Victoria, Royal Botanic Gardens Victoria, and now an Honorary Associate).

Many women have contributed significantly to the field of bryology over the last 200 years or so, but how many IAB members today know of those early women bryologists and their achievements? We only recently discovered through the British Bryological Society website that 'Ireland's first female botanist', Ellen Hutchins, was a cryptogamist collecting and publishing on seaweeds, lichens and bryophytes in the early 1800s. Two liverworts and a moss are named for her and there is even an annual festival held in her honour! For more information, see: https://www.britishbryologicalsociety.org.uk/wp-content/uploads/2021/01/ELLEN-HUTCHINS.pdf

The aim of the Women in Bryology project is to raise the profiles of living female bryologists from around the world. We wanted to make the bryological and botanical community aware of the past and current contributions by these women, no matter how large or small. We also wanted to explore why they came to bryology or in some cases why they had to abandon the field.

The original reason for initiating this project was because we wanted to see a better gender balance within the Association. When we looked at the history of recipients of the various awards given by the IAB (https://bryology.org/get_involved/awards-grants/) we found that most awards have gone to male bryologists.

The Women in Bryology project has been very successful, with 90 women from across the world having contributed to date. But we wanted to build on this momentum and continue to improve the society's gender balance, so why not institute an award named for a prominent female bryologist?

All current awards and grants offered by the IAB, bar one which is not eponymous, are named for a prominent male bryologist, e.g. the Hedwig Medal, the Richard Spruce Award, etc. Also, when looking at other cryptogamic societies and associations, we are lagging somewhat behind in recognising a female scientist in naming our awards:

https://ial-lichenology.org/awards/

https://intphycsociety.org/Grants-and-Awards

https://protistologists.org/programs/awards/

Given the important contributions that women have made to our field throughout the history of bryology, we are proposing to create through the IAB an additional award named for a prominent female bryologist.

When considering the naming of the award, rather than having a top-down decision made by the IAB Executive Committee or the IAB Council, we would like the whole of the IAB membership to have the opportunity to nominate a prominent woman in bryology. We are thus calling for

nominations from the membership, which should include a short summary about the main achievements of the nominee and the field of bryology to which she has made a significant contribution.

All nominations will be considered, and the Council will compose a shortlist of nominees to be included in a ballot for the vote by Council members.

As a starting point, a call out was made to all members of the IAB Council to put forward their nominations. These are listed below with a short biography given here including a link provided to a comprehensive online biography of the nominee:

1. **Ellen Hutchins** (1785-1815) (Ireland)
   Ellen Hutchins, educated in Dublin, was Ireland's first female botanist. She focused on collecting cryptogams, in particular algae and bryophytes in and around Bantry Bay, West Cork. Unfortunately, Ellen died young at the age of 29 years. *Jungermannia* (*Jubula*) *hutchinsiae* is one liverwort named in her honour.
   https://ellenhutchins.com/ellen-hutchins/

2. **Nancy Slack** (1930-2022) (USA)
   Nancy Slack graduated from Cornell University with BSc (1952) and received her PhD (1971) in ecology from the University at Albany SUNY for her thesis, 'Species Diversity and Community Structure in Bryophytes'. She completed research and published widely on bryophytes, the ecology of peatlands, ecological niche theory, and the history of ecology and botany. With her collaborator Dale Vitt, "she published the first North American study of the ecology of mosses in fens, and went on to publish more than 20 articles on bryophyte ecology in peer-reviewed journals, and co-edit the book *Bryophyte Ecology and Climate Change* (2011)" (Margaret (Mari) Eggers, *Evansia* 40 (1): 37). Nancy also loved teaching and mentoring students. After her PhD she secured a faculty position at Russell Sage College (RSC), where she taught for more than 30 years.
   https://bryology.org/women-in-bryology/past-women-in-bryology/
   https://en.wikipedia.org/wiki/Nancy_Guttmann_Slack

3. **Karen Renzaglia** (1953-) (USA)
   Karen Sue Renzaglia holds a MSc (1977) and PhD degree (1981) in Plant Biology from Southern Illinois University Carbondale (SIUC), USA. For her degrees she studied the development and morphology of hornworts and liverworts, becoming a leading expert in the field. Karen began her professional career as an assistant professor (1980) at East Tennessee State University, becoming an associate professor in 1985 and served in that position until 1997. In the early 1980s, Karen spent time at Queen Mary College in London, England working with Jeffrey G. Duckett. In 1996, Karen returned to SIUC as visiting professor and was appointed as an assistant professor of Plant Biology in 2005. Karen continues innovative work on ultrastructure, morphology and development of tissues and organs of seed and seed-free plants, especially sperm cells, sporogenesis, plant cytoskeleton and evolution of key phylogenetic groups, such as the hornworts. With over 150 publications, Karen has a global recognition with a large number of students trained and collaborations worldwide. Currently, Karen is emeritus faculty in the department of Plant Biology (SIUC) and previously held the position of Dean of Undergraduate studies.

4. **Janice Glime** (1941-) (USA)
   Janice Glime received her PhD (1968) from Michigan State University. The title of her dissertation was 'Aquatic Insect Communities Among Appalachian Stream Bryophytes'. Janice is currently Professor Emerita at Michigan Technological University. She is well-known for her work on the aquatic moss *Fontinalis*, management of Bryonet, an invaluable international email discussion forum, and for her Ebook *Bryophyte Ecology* with free access on the internet. In 2013. Janice received the IAB Hattori Award for her book.
   https://www.biotaxa.org/dbe/article/view/bde.39.1.3
   https://bryology.org/janice-glime/

5. **Suzanne Jovet-Ast** (1914-2006) (France)
   Suzanne Jovet-Ast devoted her life to botany and especially to bryology. In 1941, she joined the Laboratoire de Cryptogamie ([PC], Muséum National d'Histoire Naturelle, Paris) as an "assistant", and finished her career as the director of this laboratory (1975–1982). Retiring in 1982, she continued working until her death. Interested in taxonomy and biogeography, she was a specialist in the liverwort genus *Riccia*.
   https://sciencepress.mnhn.fr/en/periodiques/bryologie/28/2/suzanne-jovet-ast-8-fevrier-1914-paris-22-fevrier-2006-biarritz

6. **Helen Hewson** (1938 – 2007) (Australia)
   The PhD studies of Helen Hewson focused on the liverwort family Aneuraceae. Helen was a botanist, scientific editor and botanical artist. Several bryophytes are named in her honour: *Jungermannia hewsoniae* Amakawa & Grolle, *Plagiochila hewsoniana* Inoue & Grolle, and *Fossombronia hewsoniae* G.A.M.Scott & D.C.Pike.
   https://www.anbg.gov.au/biography/hewson-helen.html

7. **Sarie Perold** (1928-2011) (South Africa)
   Sarie Perold embarked on a career in bryology late in life at the age of 51 but made up for lost time by completing her PhD in 1991 on the Ricciaceae in southern Africa later becoming known as a world-renowned expert in the group and in thalloid liverworts and the Fossombroniaceae in this region. By 1999 she had published the landmark Facscicle 1 Marchantiidae for the Flora of Southern Africa which included descriptions, illustrations, images and maps for 78 species of thalloid liverworts. She served from 2000-2005 on the IAPT permanent committee for bryophytes and was a member of the IAB.
   https://www.tandfonline.com/doi/pdf/10.1179/1743282012Y.0000000035

8. **Elizabeth Gertrude Britton** (1858-1934) (USA)
   Elizabeth Britton was a bryologist, educator, and one of the founding members of the New York Botanical Garden (NYBG). She was the curator of mosses for the Torrey Botanical Club (1884-1885) and in 1912 became Honorary Curator of Mosses at NYBG. She published 346 papers, 170 of which were on mosses. She was one of the foremost authorities in bryology of her time.
   https://www.nybg.org/library/finding_guide/archv/E_G_Brittonb.html

9. **Margaret Hannah Fulford** (1904-1999) (USA)
   Prof. Margaret Fulford was an internationally renowned botanist and recognized as a worldwide authority on bryology in particular on the liverworts. Fulford obtained three degrees in education, botany and a master's also in botany at the University of Cincinnati. She went onto to her earn her PhD at Yale University under the mentorship of the well-known bryologist Dr Alexander W. Evans. Her 4-volume 'Manual of the Leafy Hepaticae of

Latin America' still remains an important reference. Not only was her contribution to research considerable and significant, but she also was the curator of the ABLS herbarium, created and published the "Recent Literature on hepatics and mosses" in *The Bryologist*, was on the nomenclature committee for bryophytes, associate editor of the *The Bryologist* and mentored many students, including Ray and Barbara Stotler.
https://www.jstor.org/stable/3243090
https://en.wikipedia.org/wiki/Margaret_Hannah_Fulford

10. **Barbara Crandall-Stotler** (1942-) (USA)
Under the mentorship and guidance of hepaticologist Dr Magaret Fulford, at the University of Cincinnati, Barbara earned both an MSc and a PhD in botany within a four-year period. Her graduate studies of comparative liverwort ontogenies culminated in the comprehensive work "Morphology and development of branches in the leafy Hepaticae" (Crandall 1969), which is a landmark publication. But it is in partnership with her late husband Dr Raymond Stotler that she is best known for their publications focusing on the elucidation of relationships within and among liverwort and hornwort taxa to clarify phylogenetic positions.
https//doi.org/10.1639/00007-2745-114.1.1

We are also calling for suggestions for what the award will recognise, such as career excellence and/or a significant achievement in the field of bryology. Some thoughts are listed below:

1. Best PhD in bryology for the past year
2. Actions and activities to promote bryophyte collections and/or botanical conservation
3. Bryophyte developmental biology
4. Bryophyte evolutionary biology, including phylogenomics, evo-devo, evolutionary ecology
5. Mentoring award: effective training of the next generation of bryologists including non-professionals
6. Recognising public outreach in bryology.

We would also value your opinions as to whether the award should have a monetary value. We recognise that this could be the more difficult part of the award – raising funds which will be available in perpetuity. If IAB obtains non-profit status, this award could be funded through member donations when renewing their subscriptions each year.

Please send your suggestions of:

* who the award should be named for,
* what achievement the award should recognise,
* and/or what the recipient should be awarded

to Christine Cargill at: christine.cargill@csiro.au

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# The Making of a Central American Liverwort and Hornwort Catalogue

Gregorio Dauphin & Juan Carlos Villarreal

Almost 30 years ago, when we used to write and send letters per snail mail and even include portions of plant material in the envelopes, GD received a mysterious shipment from Missouri containing copies of a draft manuscript. The manuscript was authored by Alan Whittemore and contained a literature-based draft treatment of the liverworts of Central America. It was certainly a boost for my activity as a bryologist then starting the bryophyte collections at the former Instituto Nacional de Biodiversidad (INBio). Now those collections are hosted by the National Herbarium of Costa Rica (CR).

Probably intending to, Alan fueled my promise to improve our knowledge of Central American liverworts and eventually produce a work that would parallel Bruce Allen's Moss Flora of Central America. Throughout years of collaborations with Professor Noris Salazar Allen (then at University of Panama and Smithsonian Tropical Research Institute) and her students Juan Carlos Villarreal, Adriel Sierra and José Gudiño, we produced research and workshops that increased our knowledge of the Panamanian and Costa Rican floras. Our paths diverged and mine led me to Göttingen to specialize in morphological taxonomy of the genus *Ceratolejeunea*, under the guidance of professor Dr. Robbert Gradstein. Juan Carlos left for Southern Illinois University (Carbondale) to deepen his molecular studies on hornworts with Karen Renzaglia and then a doctoral degree with Bernard Goffinet (University of Connecticut).

Back in the region, GD pursued his floristic works, and produced checklists that included herbarium, and sometimes field work from different regions. Checklists with specimen citations were produced from Costa Rica, Venezuela, Panama, Dominican Republic and Florida. Our experience in the region added to the richness of the oncoming Catalog.

Through their publication of the unique World Checklist of Hornworts and Liverworts in 2016, Lars Söderström, Anders Hagborg and Matt von Konrat from the Early Land Plants Group (ELPG) became an obligate reference for bryologists. GD contacted the ELPG and started our collaboration. A great impulse for the catalogue happened with GD's visit to Missouri Botanical Garden's herbarium in 2017, and a short personal meeting with the ELPT group members based in Chicago.

Putting all the pieces together was a laborious task involving bryologists, orchestrated by Lars' and Anders' proficiency with databases. Completing it probably would have taken much longer without the development of communications that allowed us to evolve from sending letters via post to having heated online meetings that helped us survive the pandemic time.

Our goal of publishing the Catalogue online, with free access was finally attained, and to our delight it can be downloaded here: https://doi.org/10.5479/si.28400228

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# Hide and seek in the tundra: Decoding cryptic diversity in *Racomitrium lanuginosum* populations

Dennis Alejandro Escolástico-Ortiz[1,2,3,4], Nicolas Derome[1,2] & Juan Carlos Villarreal A.[1,2,3,4]

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[4]Centre d'étude de la forêt (CEF), Université Laval, Québec, QC, Canada

Cryptic species are common in Arctic and Subarctic ecosystems. Assessing genetic diversity in cryptic species can be complex, leading to inflation in diversity estimates or masking the real variation across habitats. Such a situation is exacerbated in clonal organisms spread and intermingled in mats, and therefore, a multilevel pattern of interspecific and intraspecific genetic variation arises.

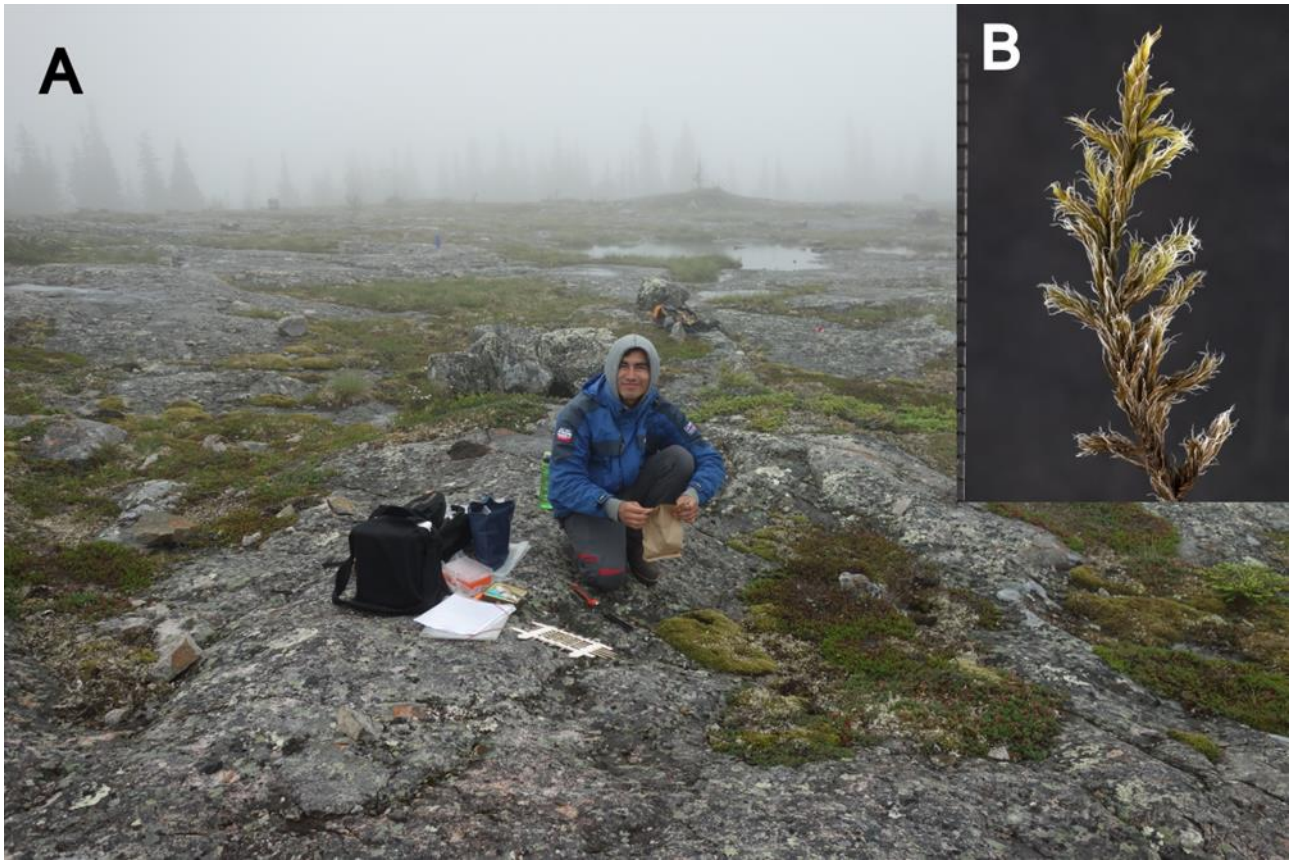


**Fig. 1.** Dennis collecting *Racomitrium lanuginosum* (inset) in the Canadian tundra. Photo by Kim Damboise.

As part of DAEO's PhD thesis, this research explored the population genetics and clonal structure of the moss *Racomitrium lanuginosum* (Hedw.) Brid. in a forest-tundra zone to decoupling genetic variation for an accurate biodiversity assessment in cold environments (Escolástico-Ortiz et al. 2023). We performed genotyping-by-sequencing to produce genomic data. Cryptic molecular lineages within populations were identified using haplotype-based coancestry matrices and phylogenetic analyses of a combined dataset of the species north distribution range. We tested the accuracy of genetic diversity estimates in two scenarios: one single species or two cryptic lineages (genetic groups). The clonal structure was characterized by multilocus genotypes at population

and fine scales. Microbial community covariation with cryptic lineages was studied. The characterization of cryptic lineages in *R. lanuginosum* revealed genetic diversity differences between habitats and suggested inflation of genetic estimates when treating cryptic lineages as a single species. Clonal growth influences the genetic structure of *R. lanuginosum* populations at the local scale with no apparent sexual reproduction. No significant genetic-microbial association was detected. This plant exemplifies the multilevel genetic variation in cryptic species and highlights the importance of decoupling genetic partition in arctic and subarctic environments. The full research will be available soon as an article.

**Reference**

Escolástico-Ortiz DA, Hedenäs L, Quandt D, Harpke D, Larraín J, Stech M, Villarreal J-C (2023) Cryptic speciation shapes the biogeographic history of a northern distributed moss. *Botanical Journal of the Linnean Society* 201: 114-134.

♦ ◊ ♦

# At the centennial of Stephani's *Species Hepaticarum* – where do we stand?

S. Robbert Gradstein

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This year marks the 100th anniversary of the publication of *Species Hepaticarum* (Fig. 1) a 6-volume treatment of all the species of liverworts and hornworts of the world by the German bryologist Franz Stephani (1842–1927). The work, which appeared between 1898 and 1925, is the only publication of its kind produced in the last 150 years and is unique. Unfortunately, it also holds the reputation of being one of the most notorious publications in bryology. Verdoorn (1934) called it an "Opus excludendum" and Schuster (1966) described its appearance as a "lasting shock" that created "a severe trauma from which hepaticology will not recover for many years."

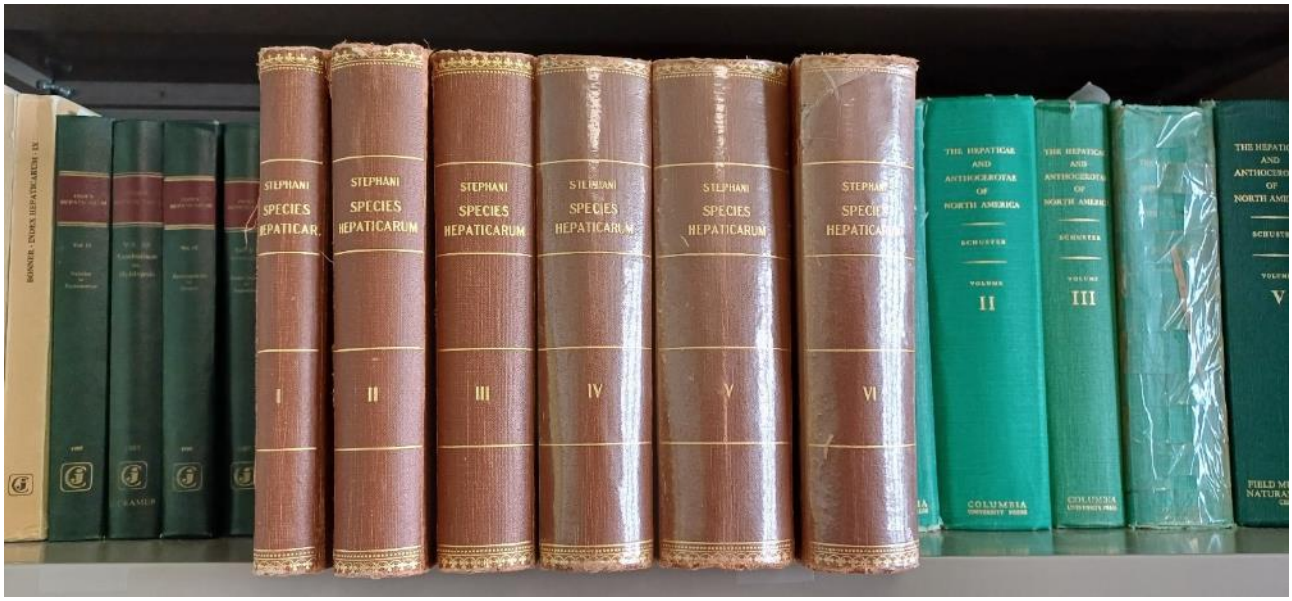


**Fig. 1.** Species Hepaticarum (library S.R. Gradstein).

Who was this man who turned hepaticology upside down? Franz Stephani was a well-to-do businessman, who had received no formal training in botany or bryology and studied liverworts and hornworts as a hobby. He was a hard worker but had almost no experience with the plants in the field. After completing his training in business administration in Europe and the U.S.A., he never left Germany except for family vacations in the Alps. His *Species Hepaticarum* contains descriptions of almost 10,000 species, including more than 4,000 described as new to science by Stephani, all of them briefly characterized, in Latin, in a very uniform and rather schematic manner, without keys or discussions and with hardly any information on geographical distribution. The species descriptions are usually little informative; they do not highlight important diagnostic characters and often contain errors. Species are described over and over again under different names, sometimes even based on the same specimen, and are often placed in the wrong genus. It is estimated that more than 80% of the new species described by Stephani were superfluous (Gradstein 2006). For example, *Acrolejeunea emergens* (Mitt.) Steph., a widespread pantropical species, was described under eight different names, including twice based on the same specimen, and the Asiatic *A. fertilis* (Reinw. et al.) Schiffn. was described under nine different names, in four different genera (Gradstein 1975). *Plagiochila longiramea* Steph., an endemic species from Bolivia, was described five times as new to science based on specimens all from the same locality (Heinrichs & Gradstein 1999). And a recent revision of *Taxilejeunea* species described by Stephani revealed that all of them were synonyms (Gradstein 2025). Numerous further examples could be cited. The impact of *Species Hepaticarum* was particularly dramatic in the genus *Plagiochila*, which grew from 400–500 to almost 1600 species, the majority of them being synonyms.

Due to the vast number of ill-founded species names in *Species Hepaticarum*, work on exotic liverworts came almost to a standstill for several decades. For example, the great European hepaticologist Victor Schiffner (1862–1944), who had just authored the Hepaticae in Engler & Prantl's *Die Natürlichen Pflanzenfamilien*, gave up working on tropical liverworts after the appearance of the first installments of *Species Hepaticarum*, and the leading American hepaticologist Alexander W. Evans (1868–1959) restricted his attention mainly to North American liverwort species and eventually switched to lichenology. Recovery of hepaticology in the post-Stephani era was very slow. Much time went into clarifying the identity of Stephani's species and Schuster (1988) estimated that liverwort monographers spent over 50% of their time on Stephani's taxa. One of the first was Frans Verdoorn (1906–1984), a brilliant Dutch hepaticologist, who studied about five hundred species for his dissertation on Asiatic Lejeuneaceae (Verdoorn 1934), more than half of them created by Stephani (and mostly turning out to be synonyms). The study of Stephani's types, which were at that time housed under the roof of an old school building, was a very tedious job and because of that Verdoorn eventually gave up (Gradstein & Richards 1986).

Very fortunately, Stephani's collections, which contain thousands of types, are now kept in excellent condition in the herbarium of Geneva, together with his drawings totaling more than 12,000 plates (Geissler 1982). These Icones, which are also available on microfiche (Stephani 1985), are an important tool for species typification, together with the online herbarium catalogue of Geneva, because the legends of the plates contain detailed information on the specimen labels which are lacking in the book. Although the type specimens are sometimes rather scrappy, the conditions for the study of Stephani types are nowadays fortunately very good.

So, how much progress has been made in cleaning Stephani's Augian stables? Where do we stand? To try to answer this question, I have checked the World Checklist of Hornworts and

Liverworts (Söderström *et al.* 2016) and found that it contains about 1750 species described by Stephani. Of these, ca. 400 are marked as accepted species (***), 350 are dubious ones (*) and the rest are marked as taxa with a knowledge problem (**). It thus appears that about 1350 Stephani types still needed critical examination by the time of appearance of the World Checklist. Although some good progress has been made in the last ten years, I estimate that at least one thousand species or about 25% of Stephani's new taxa still need examination. Thus, if revisionary work on the Stephani types continues at the same speed as in the past one hundred years, the revision of his legacy may take at least another thirty years to complete. By then, raise the flag!

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# Bryomycology in Australia: Fungal Associates of the Moss *Leucobryum candidum* (Brid. ex P.Beauv.) Wilson in Southeast Queensland, Australia.

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The suite of fungi that associate with mosses, bryophilous fungi, can be explored further to provide insights into the symbiotic functionality of mosses as well as the ecosystems in which they reside (Davey & Currah 2006). Despite increasing global attention to bryomycological diversity, there has been a notable absence of in-depth studies on the symbiosis, taxonomy, ecology, and physiological functions of fungi associated with *Leucobryum candidum*, an Australasian moss species. This study sought to bridge that gap by combining selective isolation and molecular characterisation techniques to investigate the fungal associates of *L. candidum*.

*Leucobryum candidum* in situ on a rotting log

During a survey of culturable bryophilous fungi inhabiting *L. candidum* in Southeast Queensland, several cryptic fungi were isolated from surface-sterilized gametophytes. These isolates are considered endophytic, parasitic, or saprophytic associates *sensu lato* (fungi actively growing within host tissues) based on the premise that surface sterilization excluded phylloplane fungi and non-active surface contaminants. Molecular analysis of the internal transcribed spacer (ITS) region of fungal DNA was used to assess whether these isolates represented novel taxonomic diversity and to determine their affinities with fungal groups known to perform specific ecological functions. Specimens of *L. candidum* were collected from six locations across Southeast Queensland, encompassing coastal, forested, and urban environments. A diverse community of fungal species, representing 10 orders and 17 families, was identified. Of the 33 fungal isolates sequenced, 25 were determined to be unique species, indicating high beta diversity. Coastal and forested sites yielded the greatest number of culturable isolates, while urban sites yielded the fewest.

In vitro growth assays were performed to assess the potential impacts of two isolates (USC-F426 and USC-F427) on *L. candidum*. In an axenic system, inoculation with their fermentation extracts revealed a statistically significant ($p \leq 0.05$) difference in moss height between treatments, though weight and diameter remained unaffected. These findings suggest active colonisation and potentially intimate ecological roles for these cryptic fungal associates.

This research underscores the hidden diversity of bryophilous fungi in Australasia and positions *L. candidum* as a valuable model for studying moss–fungus interactions in varied environmental contexts (Misic *et al.* 2025).

The whole thesis linked to this research as well as supplementary material such as Transmission Electron Micrographs and explorative phylogenetic trees are available upon request.

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# Bryomycology: Unveiling the Hidden World of Fungi Associated with Bryophytes in Northwestern Argentina

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Northwestern Argentina is home to extraordinary biodiversity, encompassing a wide range of ecosystems that support thriving bryophyte communities. Among them, fungi that grow in association with mosses, liverworts, and hornworts play a fundamental ecological role, relying on these plants for nutrients. Although bryophilous fungi play important ecological roles, their tiny size often causes them to be overlooked by mycologists (Németh 2017), making their discovery and collection largely incidental, and usually carried out by bryologists. These fungi are frequently discovered by chance during the collection of bryophytes for other research purposes. Bryomycology - the study of fungi associated with bryophytes - sheds light on these hidden interactions, revealing the intricate and often overlooked microscopic ecosystems that contribute to the balance of nature.

In 2020, amid the constraints of the pandemic, a new tiny, orange-colored fungus was observed growing on *Dimerontium balansae* Müll.Hal. ex Besch., an epiphytic pleurocarpous moss found on *Jacaranda mimosifolia* D.Don. in a city in Northwestern Argentina (Suárez *et al.* 2023). This discovery led to the identification of a previously undescribed species (Eckstein 2016). Since then, research has revealed that fungi belonging to the genus *Octospora* are widely distributed in the

region, making them the most frequently recorded bryophilous Pezizales to date (Suárez *et al.* 2025). These fungi thrive particularly in cloud forests and montane woodlands, showcasing remarkable morphological diversity, with species varying in size, colour, and sporoma structure and host.

Beyond expanding our understanding of fungal diversity, these studies also highlight the ecological relevance of bryophyte–fungus interactions, offering valuable insights for the conservation of bryophyte communities and their associated microfungi in the face of global environmental change.


**Fig. 1.** Bryophilous species of *Octospora* associated with different moss hosts from Northwestern Argentina: A- *Octospora excipulata* with the host, *Funaria calvescens*. B- *Octospora* sp. nov. C- *Octospora gemmicola* var. *tetraspora* with the host, *Bryum klinggraeffi*. D- *Octospora tucumanensis* with the host, *Dimerodontium balansae*.

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# 200,000 Bryophytes now accessioned in the CAS Herbarium

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The California Academy of Sciences (CAS) established in 1853 is located in Golden Gate Park, San Francisco, California. It has a long history of collections-based science and biodiversity expeditions. It maintains collections of numerous taxonomic groups. Among these various collections, the CAS herbarium is estimated to exceed 2.2 million tracheophyte specimens.

At the end of May 2025, the bryophyte component of the CAS herbarium accessioned its 200,000$^{th}$ bryophyte specimen. For over the past decade, a talented volunteer cadre has processed over 1,000 bryophyte collections each and every month into the herbarium. Currently, over 103,000 North American bryophyte specimens are barcoded with their label data digitized and readily accessible online. During the summer of 2025, the remainder of the bryophyte collection will be barcoded, imaged and labels digitized through the auspices of a grant and contract to digitize and image the entire CAS herbarium.

The CAS bryophyte collection is stored in a herbarium cabinet compactor system (Fig. 1). Specimens are stored by the palm folder method (Fig. 2) and the entire collection is arranged alphabetically by families. Within a family, genera are arranged alphabetically, then by species followed by geographical areas for ease of filing and retrieval of specimens for study. Palm folders are colour-coded by geographical area which also aids in locating specimens of interest quickly.

CAS also has an active bryophyte specimen exchange program, and we seek new institutional partners to further the species diversity housed in the CAS herbarium. Of special interest to broaden the species diversity within the CAS herbarium is the acquisition of additional specimens from tropical and subtropical regions, worldwide. Sending bryophyte herbarium specimens into the United States is simple. No phytosanitary permit is required, and they are simply sent by post.

**Fig. 1.** View of compactors cabinets at CAS.

While CAS lacks a full-time resident bryologist on staff, several botany research associates contribute in various ways to grow and curate the bryophyte collection. These include: Jim Shevock, David Toren, Alan Whittemore, John Spence, and Jason Brooks. Shevock supervises the bryophyte volunteer cadre and sets the priorities for specimens to be accessioned. Toren and Whittemore provide identifications for North American collections. Spence and Brooks through their field activities contribute specimens. Members of the bryophyte volunteer cadre digitize label data while other cadre members focus on filing specimens into the herbarium. CAS is also in the process of integrating various private bryophyte herbaria from estates and bequests into the CAS herbarium. A major undertaking currently underway is the integration of the personal herbarium of the late Judith A. Harpel. Her herbarium is estimated to contain at least 50,000 bryophyte specimens primarily from western North America. We anticipate bryophyte accessions at CAS will reach 250,000 specimens by 2029.


**Fig. 2.** View of palm folders arranged by family, genus, taxon and geography (left). Contents of palm folders displaying packets laying flat (right).

If you are interested in the CAS bryophyte collection, how we expedite bryophyte curation through a volunteer cadre program, or would like to start a specimen exchange, contact Jim Shevock at: jshevock@calacademy.org.

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## News from China:
## Space Moss - *Syntrichia caninervis*

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We are pleased to report that the research team head by Dr. Prof. Zhang Yuanming and Dr. Prof. Zhang Daoyuan of Xinjiang, Ecology and Geography Institute of Chinese Academy of Science published an article entitled “The extremotolerant desert moss is a promising pioneer plant for colonizing extraterrestrial environments” last year. The article was published at Volume 5 Issue 1 of the well-known international journal *The Innovation* on 1 July 2024. The article was the cover story of the issue. Congratulations!

**Introduction to the Space Moss**


Extremophiles are valuable biological resources, and the study of extremophiles is of great significance for exploring the mysteries of life, revealing the origins and evolution of life on Earth, and colonizing extraterrestrial planets. *Syntrichia caninervis*, a desert moss that has a super adaptability of life to extreme environments and exhibits extreme desiccation tolerance. In fact, this moss can survive and regenerate new plants in simulated Mars conditions. *S. caninervis* is one of the toughest plants on Earth. Its super resistance and survival ability make the species a promising pioneer plant for future Mars colonization and terraforming.

**Infographics about *Syntrichia caninervis***

(1) *Syntrichia caninervis* Mitt. belongs to Pottiaceae and, like most bryophytes, the moss has haploid gametophytes. The moss is a typical desiccation-tolerant species, common and abundant in temperate and cold temperate deserts of Central Asia and North America, and also occurs in high-mountain forests and meadows. *S. caninervis* can form biological crusts with microbes and soil, and may play a crucial role in controlling hydrological processes, nutrient cycling, and other essential ecological processes.

(2) *Syntrichia caninervis*, a typically desert-adapted plant, exhibits remarkable stress tolerance: 1. Survives 98% water loss, reviving within seconds upon rehydration. 2. Endures -80°C for 5 years and retains regenerative ability after -196°C for a month. 3. Withstands gamma radiation with LD50 exceeding 5000 Gy, and 4. Survives 7 days under simulated Martian conditions. More recent and ongoing tests show: 1. Viability after 6 months at -196°C. 2. Survival in simulated Martian conditions for a month. 3. Growth in simulated Martian soil. This condensed version of the article conveys the essential information about *S. caninervis* extraordinary resilience to extreme conditions.

(3) *S. caninervis* adaptations:

1. Morphology: 1. Overlapping leaves adapted to conserve water and protect from sunlight. 2. White leaf awns reflect radiation and enhance water efficiency. 3. Twisted leaves minimize surface area, reducing transpiration.
2. Cell Physiology: Maintains cellular integrity in dehydrated state. Enters selective metabolic dormancy under stress. Preserves key metabolites (sucrose, maltose) as protectants. Possesses strong reactive oxygen species (ROS) scavenging ability.
3. Molecular regulatory mechanisms: Expanded stress-related genes (LEA, catalase). Tandem duplication of photoprotective ELIP genes. Selective upregulation of critical stress

response pathways Provide continuous cellular protection Rapidly repair and recover under favorable conditions.

(4) Mars terraforming with *S. caninervis*:

1. Ecological Strategies: Replicate Earth's extreme ecosystems on Mars. Transplant *S. caninervis* with its symbiotic microorganisms.
2. Symbiotic Consortiums: Engineer artificial ecosystems using microbial consortiums. Create self-sustaining biospheres for oxygenation and nutrient cycling.
3. Seeding Technologies: Drones and robots can be used to distribute desiccated moss fragments. Exploit moss's clonal reproduction and regenerative abilities
4. Stress-Resistant Genetic Resources: Study genome for stress-resistance genes. Develop Mars-adapted super crops.
5. Space Pharmaceuticals: Explore moss compounds for astronaut health applications.

We believe and hope that *Syntrichia caninervisis* will become a real space moss in the near future.

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Li X, Bai W, Yang Q, Yin B, Zhang Z, Zhao B, Kuang T, Zhang Y, Zhang D (2024) The extremotolerant desert moss *Syntrichia caninervis* is a promising pioneer plant for colonizing extraterrestrial environments. *The Innovation* 5: 100657. https://doi.org/10.1016/j.xinn.2024.100657

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# Field trip to Mount Kinabalu, Sabah, Borneo

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Towering 4,095 metres above sea level, Mount Kinabalu is one of the most prominent mountains of South-East Asia. This isolated peak forms the highest point between the Himalayas and New Guinea. Like other tropical mountains, it features strong vertical ecological gradients - from tropical rainforests at its base via subalpine shrublands to rocky summits at its peak. This diverse range of habitats supports over 6,000 plant species, making it one of the most biodiverse places on Earth. The mountain is home to many unique and fascinating plants, including the giant *Rafflesia* flower and *Nepenthes* pitcher plants (Fig. 1).

**Fig. 1.** View of Mount Kinabalu from the south and prominent examples of the unique plants growing there (*Nepenthes villosa* and *Rafflesia keithii*).

Recognized as a UNESCO World Heritage Site and a Key Biodiversity Area, Mount Kinabalu not only plays a crucial role in regulating ecosystems by storing carbon and sustaining freshwater supplies but also holds deep cultural significance for local communities. The Kadazan-Dusun people revere the mountain as the resting place of their ancestors' spirits, shaping their traditions and ceremonies. These ecological and cultural values have made Mount Kinabalu one of Southeast Asia's most popular tourist destinations, attracting over 250,000 domestic and 74,000 international visitors in 2023.

Mount Kinabalu is also home to over 1,000 bryophyte species (Akiyama *et al*. 2001; Frahm *et al*. 1990), colonizing various substrates along its elevational gradient. To study the diversity of bryophytes and assess the impact of tourist trails, our research team conducted fieldwork in November and December 2024. The team included Dr. Xiangbo Yin and Dr. Maaike Bader from Marburg University, Dr. Lee Ping Ang from Göttingen University, and local bryologists Dr. Monica Suleiman, and Ms. Andi Maryani A. Mustapeng (Fig. 2).

**Fig. 2.** Fieldwork photos, Mount Kinabalu 2024.

This excursion was an unforgettable experience, allowing us to document a wide range of bryophyte species, including (see Fig. 3):

*Riccardia* – The largest genus of simple thalloid liverworts, with over 200 recognized species (Söderström *et al.* 2016). *Riccardia* has a global distribution, from Arctic regions (e.g., Greenland) to tropical ecosystems (e.g., Malaysia). During our expedition, we identified over 10 species, including *Riccardia albo-marginata*, *R. crassa*, *R. elata*, *R. grollei*, and *R. graeffei*.

*Dawsonia superba* – The tallest known moss (though *Dendroligotrichum dendroides* from southern Chile, also in the Polytrichaceae, is a strong contender), growing up to 70 cm. This genus has a limited distribution, found only in Malaysia, the Philippines, Indonesia, Australia, and New Zealand (van Zanten 1973; Smith 1972).

*Pleurozia* – A genus of liverworts found in moist, shaded habitats, including tropical rainforests, cloud forests, and alpine regions. Some species have leaf structures resembling carnivorous plant traps, leading to speculation that they may capture and digest microorganisms for nutrients (Hess *et al*. 2005).

**Fig. 3.** Some bryophyte species from the fieldwork on Mount Kinabalu. *Riccardia*, *Pleurozia*, *Dawsonia*.

As part of our fieldwork, we also organized a workshop titled “Bryophyte Diversity and Ecosystem Functions in the Tropical Mountain Ecosystem of Mount Kinabalu (2024)” on November 28, 2024, in a hybrid format at the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah (Fig. 4). Over 70 participants from various countries joined in person and online. The workshop provided an opportunity for young researchers from diverse fields of bryophyte studies, including taxonomy and ecology, to connect and exchange knowledge. It highlighted the crucial role of bryophytes in maintaining biodiversity and ecosystem functions in tropical mountains.


**Fig. 4.** The workshop on bryophytes at Universiti Malaysia Sabah, November 2024.

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The International Association of Bryologists was established in 1969 to promote international cooperation and communication among all persons interested in the biology of bryophytes. This is achieved through sponsorship and arrangement of meetings and symposia that relate to the various aspects of bryology, and by IAB-sponsored publications including *The Bryological Times* and *Bryophyte Diversity and Evolution*. The Association also supports the publication of reviews, lists, software, and compendia.

**Website: www.bryology.org**



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Cover photo by Andrew Franks: *Sphagnum falcatulum*.
Photographed *in situ* at Springbrook, Queensland, Australia in 2021