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IAB Presidential Address

Dear IAB members,

Here is the June issue of our newsletter. It is always a pleasure to see everyone's efforts to maintain and develop this publication come to fruition. On behalf of all of us, I would once again like to express our warmest thanks to Andrew and Chris for their effective and inspiring work.

The upcoming activities for 2026 will fall into two main categories. First, the organisational life of the IAB, including the renewal of several positions on the Executive Committee and the IAB Council, with several terms ending in 2027. Second, our activities directly linked to bryology.



Regarding the IAB elections, the process will remain as open as possible and will begin this Autumn with the call for nomination of candidates and the preparation of short biographies. This will be announced via email and via our website. The elections themselves will take place during March 2027, and the newly elected members will officially take office during the congress in Bogotá in July 2027.

Concerning bryological activities, we would like to organise a virtual event in Autumn 2026, in a new format that may include one or several lectures. We hope this initiative will encourage volunteers to continue supporting and developing the project so that it can grow over time. Please keep an eye on future announcements and emails on this topic, likely beginning in early September.

Finally, a few words about our website... Some of you may feel that it has become something of a “sea serpent” project that, like a phoenix, reappears with every issue of BT. Well - no! I had hoped it would already be online for this issue, and although it is not quite ready yet, it is now very close to completion and should soon be announced via Bryonet. Our web designer has been working on the public section of the site, and I am pleased to reveal part of the banner here for the first time (see below). It may still undergo a few changes, but it will most likely become the visual identity of our new website.

No sooner is one issue published than we begin thinking about the next one, so I would once again encourage all of you to send articles, news, announcements, or any other contributions for the December issue of Bryological Times.

Best bryological regards,

Catherine Reeb



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, Dr. 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: John Edward Braggins (1944–2025)

Among Ferns, Liverworts, and Lives Changed

Matt von Konrat

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John Edward Braggins - “JEB” to generations of students - was a botanist of remarkable depth and rare breadth, a scholar equally at home among ferns, liverworts, and plants generally. John was a mentor whose influence extended far beyond taxonomy. Born in Wellington, New Zealand, on 9 August 1944, John’s fascination with plants began early, sparked by a childhood love of ferns that never left him. That early curiosity grew into a distinguished career at the University of Auckland,

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where he taught from 1969 until 2000¹* and helped shape a generation of botanists, many of whom would go on to become leaders in their own right.

John's scientific legacy is substantial. His doctoral work on the fern genus *Pteris* demonstrated the careful, patient observation that defined his approach, recognizing distinctions that would only later be formally acknowledged. Over decades, he contributed to the discovery and description of numerous species, particularly among New Zealand's liverworts, and played an important role in advancing hepaticology in the region. His collaborations, including those with John Engel, were foundational to our understanding of the liverwort flora of New Zealand and beyond.



Fig. 1. Alivereti Naikatini and John Braggins (left), with John taking great delight Fiji-collecting style! (Photo: Matt von Konrat, 2006).

But JEB was never just a taxonomist. He was a true naturalist in the fullest sense, someone who could move seamlessly from bryophytes to ferns, from ecology to geology, reading landscapes with a depth of understanding that is increasingly rare. In the field, this breadth came alive. You could watch him pause, look, and then begin to explain, not just what was there, but why it was there. For many of us, those moments were transformative.

¹ Wikipedia contributors. (2025, October 19). John E. Braggins. In Wikipedia, The Free Encyclopedia. Retrieved May 3, 2026, from https://en.wikipedia.org/w/index.php?title=John_E._Braggins&oldid=1317741939



Fig. 2. John Braggins (right) with his signature field hat crossing a river on Viti Levu, Fiji with an international team of bryologists and lichenologists. (Photo: Matt von Konrat, 2010).

For me personally, JEB opened a window. It is no exaggeration to say that my career path and indeed much of my life's journey, would not have unfolded as it did without him. He had a way of inspiring without ever imposing, guiding without ever directing too forcefully. You simply found yourself drawn in, wanting to know more, to see more, to understand more.

And yet, alongside this intellectual generosity was a personality that made every interaction memorable. John had a mischievous, wicked sense of humor, paired with a quiet confidence that allowed him to get away with things no one else could. He was always content in himself, often with that unmistakable, slightly cheeky expression, as if he knew something the rest of us were just about to discover.

Fieldwork with John was, in every sense, an experience. I had the privilege of joining him on several expeditions, including unforgettable trips to Fiji. The images from those trips, presses spread across verandas, specimens laid out carefully on the hood of a vehicle in the rain, laughter shared between bouts of work, capture something essential about him. He brought a sense of purpose to the work, but also joy. Even in challenging conditions, wet, muddy, or mist-shrouded forests, there was always a sense that we were exactly where we were meant to be.



Fig. 3. There were no barriers for John (right) when it came to collecting liverworts, in the highlands of Viti Levu, Fiji. (Photo: Matt von Konrat, 2006).

His driving, however, was legendary, and not always in a reassuring way. It built a reputation of its own. One vivid memory is returning from Puketi Forest in Northland, with a student, Paul Cashmore, dozing peacefully in the back seat. John glanced in the mirror and said to me, “This will wake him up,” before proceeding to take three speed bumps at speed. It did, indeed, wake him up! On another occasion, he took great delight in driving over an object that had fallen from a trailer, leaving its unfortunate owner in visible despair, while John carried on with a grin. These moments, absurd as they were, became part of the shared mythology of those who worked with him.

Back in the classroom, John’s style was equally distinctive. His handwriting, whether on the blackboard or scrawled across student papers, was famously indecipherable. It often required what we jokingly referred to as a team of “JEB handwriting specialists” to interpret. And yet, hidden within those scribbles were insights that mattered. You learned quickly that the effort to decipher them was always worthwhile.

He also had a subtle, playful competitiveness. I remember being particularly proud of a specimen I had collected. While I was examining it under the microscope in the basement of his home, with John Engel nearby, John Braggins walked past, gently flicked the back of my head, and said, “But my collection has sporophytes!” before continuing on, chuckling. It was classic John; disarming, humorous, and just enough to keep you grounded.



Fig. 4. Classic John Braggins on a local hike in New Zealand. (Photo: Josh Salter, 2024).

In the field, he was also a storyteller. Between collections and identifications, he would speak with great pride about his family, his wife Thelma and both his three children and those of Thelma's. These moments revealed another side of John: a deeply committed family man whose life in science was always balanced by a strong sense of home and connection. Those stories, shared casually while standing in forests or along riverbanks, remain some of the most meaningful memories.

And there were the small rituals of field life. The honking of the horn when it was time to leave, sometimes impatient, sometimes playful. On one occasion, we returned the favor, honking back like a group of mischievous children. John took it in stride, perhaps even appreciating the reversal.

John's legacy is immense. It is found in the taxa he described or helped describe, the thousands of specimens he collected, and the foundational contributions he made to our understanding of ferns and bryophytes. But it is equally found in the people he mentored, students who have gone on to

build careers across the world, carrying with them something of his curiosity, his rigor, and his humor.

For those of us fortunate enough to have known him, John Braggins was more than a scientist. He was a guide, a mentor, a colleague, and a friend. He reminded us that botany is not just about plants; it is about people, places, and the stories that connect them.

And for me, the window he opened remains wide. Through it, I see a life in botany shaped by his influence, his generosity, and his example. It is a view I will always be grateful for.



Update on the new Janice Glime Award

D. Christine Cargill & Josephine Milne

In Bryological Times 161 (December 2025 p.10) we announced that the new IAB award to recognise a prominent female bryologist would be named after Janice Glime. We also mentioned that the next step was for the IAB council to determine the details of the award, in particular what the new Janice Glime award should recognise and the frequency of the award.

Four topics were selected after feedback from IAB members for what the Janice Glime Award could be awarded. The topics were:

1. Best PhD in bryology
2. Significant contributions to Bryophyte developmental biology, evolutionary biology or evolutionary ecology
3. Actions and activities to promote bryophyte collections and/or bryological conservation
4. Excellence in promoting bryology through mentoring or outreach

Voting for which topic the award would recognise was confined to members of the IAB Council. A document was compiled for the IAB Council outlining the background and pros and cons for each of the topics.

Voting commenced at the end of March 2026 and 14 votes were cast. The breakdown of the votes is provided here:

- 11 votes for Excellence in mentoring and outreach in bryology
- 2 votes for Significant contributions to Bryophyte developmental biology, evolutionary biology or evolutionary ecology and,
- 1 vote for Best PhD in bryology.

It has also been decided that the award will be made every six years at the IAB conference held in conjunction with the International Botanical Conference (IBC). The next IBC will be held in Cape Town, South Africa in 2029. So, get your thinking caps on as to who you would like to nominate for the inaugural Janice Glime Award.

[NOTE: what the successful recipient will be awarded is yet to be finalised. Once all details of the award are finalised the Janice Glime Award will be included under Awards and Grants section of the IAB website].





HIGH-MOUNTAIN BRYOPHYTES
“INSIGHTS INTO EVOLUTION AND CONSERVATION”

COLOMBIA - BOGOTÁ, JULY 26–30, 2027
International Association of Bryologists - IAB

From Asia to the Andes in South America:
The IAB Congress 2027 Opens a New Chapter in Colombia

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Following the success of the *International Association of Bryologists (IAB) Congress 2025* in Taiwan, which brought together the global bryological community in one of Asia's most dynamic scientific hubs, the journey of our discipline continues across continents. In 2027, South America opens its doors welcoming researchers, students, and enthusiasts to a new setting: the tropical Andes of Colombia.

The IAB Congress 2027, to be held from July 26–30, 2027, at the Universidad Nacional de Colombia in Bogotá, will gather the international community under the theme “*High-Mountain Bryophytes: Insights into Evolution and Conservation*”. This announcement marks the beginning of a new chapter, one that bridges continents, ecosystems, and perspectives within bryology.

Colombia: A Crossroads of Biodiversity and Discovery

Few places in the world offer such an extraordinary convergence of ecological conditions as Colombia. Located at the northern tip of South America and shaped by the uplift of the Andes, the country hosts an unparalleled diversity of habitats, from lowland rainforests to Andean ecosystems. Within this mosaic, high-mountain environments stand out as centers of endemism, ecological complexity, and evolutionary innovation.

The páramos ecosystems are among the most distinctive features of the Colombian Andes. Characterized by persistent humidity, intense solar radiation, and temperature fluctuations, these environments create ideal conditions for bryophytes. Mosses, liverworts, and hornworts are not only abundant but often dominant, forming dense carpets and epiphytic layers that structure entire ecosystems.

Colombia's bryophyte diversity ranks among the highest globally, reflecting both its geographic complexity and the still ongoing exploration of its flora. Hosting the IAB Congress in this context provides a rare opportunity to engage directly with ecosystems that are both biologically rich and scientifically essential.



Fig. 1. High-mountain páramo ecosystems, highlighting the dominance of *Espeletia* (frailejones) and the presence of the emblematic Andean bear (*Tremarctos ornatus*). (Photos: Laura V. Campos, Lucho Linares).

High-Mountain Bryophytes: From Evolution to Conservation

High-mountain ecosystems have long fascinated researchers as natural laboratories for studying adaptation and diversification. In these environments, bryophytes occupy a central role, responding rapidly to environmental gradients and contributing to key ecological processes.

Their ability to retain water, regulate microclimates, and influence nutrient dynamics makes them fundamental to ecosystem functioning. In páramo landscapes, bryophytes are intimately linked to hydrological regulation, capturing and slowly releasing water that sustains both local biodiversity and human populations downstream.

At the same time, these ecosystems are increasingly vulnerable. Climate change, land use transformation, and fragmentation are altering the delicate balance that sustains high-mountain biodiversity. Bryophytes, with their sensitivity to environmental shifts, provide early signals of these changes and serve as essential indicators for monitoring ecosystem health.

The theme of the IAB Congress 2027 reflects this dual perspective: high-mountain bryophytes as windows into evolutionary processes, and as key elements in the urgent conversation on conservation.



Fig. 2. Bryophytes growing on rock in a high-Andean ecosystem, showing liverworts of the genus *Herbertus*. (Photo: Laura V. Campos).

Host Institution: Universidad Nacional de Colombia and the Instituto de Ciencias Naturales

The congress will be hosted by the Universidad Nacional de Colombia, the country's foremost public university and a leading centre for biological research in Latin America. Its Bogotá campus is a vibrant academic space where tradition and innovation converge, offering an ideal environment for international scientific exchange.

Central to the study of plant diversity in Colombia is the Instituto de Ciencias Naturales (ICN), whose collections and research programs have been instrumental in documenting the country's flora. The ICN houses one of the most important biological collections in the region, including extensive bryophyte specimens that continue to support taxonomic, ecological, and biogeographic research.

The combination of institutional strength, scientific expertise, and a long-standing commitment to biodiversity research makes this venue particularly fitting for hosting the global bryological community.



Fig. 3. Universidad Nacional de Colombia – Gloria Galeano building (top) and Instituto de Ciencias Naturales (ICN) (bottom).
<https://unal.edu.co/>

Bogotá: Between Mountains, Culture, and Science

Located at over 2,600 metres above sea level, Bogotá offers a unique experience as a high-mountain metropolis. Surrounded by Andean landscapes, the city combines cultural richness, historical depth, and a dynamic scientific environment.

Visitors will find a city that is both vibrant and reflective, where museums, cultural institutions, and academic centres coexist with access to nearby natural areas. Bogotá's location provides an ideal gateway to explore the ecosystems that define the region, including cloud forests and páramos.

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Just beyond the city lies Chingaza National Natural Park, a vast protected area that exemplifies the ecological importance of high-mountain environments. Its wetlands and slopes are covered by bryophyte rich communities that play a crucial role in water regulation and ecosystem resilience.



Fig. 4. Bogotá city (top) (<https://bogota.gov.co/>). Chingaza National Natural Park (bottom) (Photo: Gabriel Eisenband).

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A Meeting Point for the International Bryological Community

The IAB Congress 2027 is envisioned as a space for dialogue and collaboration. Building on the momentum of previous academic events, including the recent congress in Taiwan, this gathering will continue strengthening interinstitutional connections, among others.

By bringing the congress to Colombia, the IAB highlights the importance of tropical ecosystems in advancing bryological research. It also provides an opportunity to engage with new perspectives, foster collaborations, and support emerging scientists from diverse backgrounds.

An Invitation to the Colombian Andes

As we look ahead to 2027, we invite the international bryological community to join us in Bogotá for a congress that promises both scientific depth and an unforgettable experience. The Andes will provide not only a stunning backdrop, but also a living laboratory where the themes from evolution to conservation come vividly to life.

Further details about the congress will be shared soon. For now, we encourage you to mark your calendars and prepare to be part of a gathering that will bring together ideas, people, and ecosystems in one of the most extraordinary regions of the world.



News from the IAB journal Bryophyte Diversity and Evolution

Executive Committee of the IAB: Catherine Reed, Chris Cargill, Matt von Konrat, Bernard Goffinet & Michelle Price

The official scientific journal of the International Association of Byologists (IAB), called [Bryophyte Diversity and Evolution](#), has a new Chief Editor. We are pleased to welcome Dr Tian-Xiong Zheng to this role. Tian-Xiong Zheng is the Director of the Herbarium of the Hattori Botanical Laboratory (NICH) and a specialist in the taxonomy and diversity of the Marchantiopsida.

Bryophyte Diversity and Evolution was created in 2013 as a continuation of the journal *Tropical Bryology*. This journal ran from 1989 to 2013 (Volumes 1-35) with a digital-first format that was very innovative for its time. Bryophyte Diversity and Evolution is a peer-reviewed international journal of the IAB that is run by the Chief Editor and an Editorial Board and published by Magnolia Press.

Bryophyte Diversity and Evolution currently focuses on the topics of bryophyte diversity and biology, including chemistry, conservation, ecology, genetics, genomics, ontogeny, mutualism, phylogeography, physiology, and systematics. IAB members are encouraged to visit the journal website, and to submit their research articles to Bryophyte Diversity and Evolution via the submission portal: <https://bryology.org/publications/bryophyte-diversity-and-evolution-2/>



“O’ercome with moss”

William Shakespeare’s “dramatic mosses” - A short note

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During the last years, I have been working on a monograph on plants in Shakespeare's works which was finally published in 2023 (in German). He names over 120 quite precisely identifiable plant taxa as real objects, plants them in the minds of his audience and furnishes the empty stage with them and uses them as metaphors or symbols. “Mosses” are also mentioned in six different plays, although it is not always entirely clear whether the Bard is referring to mosses or lichens, which were not differentiated at that time (and sometimes still today: see reindeer or caribou moss for *Cetraria* spp. or Irish moss for the red alga *Chondrus* spp.).

This short note lists and comments on the complete quotations in Shakespeare’s plays. All quotations are after Greenblatt et al. (2016).

In Shakespeare's time, very little distinction was made between mosses and liverworts, lichens, lycopods, spikemosses and even habitually similar marine organisms (“sea moss or coralline”: Gerard 1597: 1378ff). All these organisms were all, more or less, generally referred to as “moss”. For this reason, it is impossible to try an exact determination of Shakespearean “mosses”.

The “Herball” of John Gerard (1545-1612) from 1597 serves as a reference to the state of knowledge at the Bard’s time. Gerard was a highly respected surgeon, botanist, and gardener. He kept his own garden and was responsible for the parks and gardens as well as the botanical collections of William Cecil, 1st Baron Burghley, the most important politician under Elizabeth I. In 1597 Gerard authored a Herbal of nearly 1470 pages and more than 2190 woodcuts which remained a reference work for a significant time and set standards in terms of content, botany and language. He was also a theatregoer and had one of his offices immediately adjacent to Shakespeare’s then home in Silver Street. It can be assumed that the two prominent citizens - Shakespeare and Gerard were at the height of their fame at that time - knew each other personally. Several authors assume, as do I, that Shakespeare even owned a copy of the “Herball” - the wealthy theatre entrepreneur and investor could undoubtedly afford it at that time.

“Moss” was used for sealing, as fodder or bedding, or as a magic and witch plant. For example, the bank moss (in German “Widerton” from “to do against something”) *Polytrichum* was considered effective against sorcery or the water moss *Fontinalis antipyretica* Hedw., which floats under the surface of clean and cold running waters, as a remedy against fire (epithet: “against fire”!) and fever - the latter in the sense of the doctrine of signatures. The organisms usually characterised as “cold” in the sense of the theory of temperaments also had a haemostatic effect, so much so that Gerard also attributed one or other healing properties to them.

Peat mosses, in particular (genus *Sphagnum*), have an enormous water storage capacity and are rich in tannins, so that they were actually used effectively alongside other species to stop bleeding or for menstrual hygiene - the latter is documented by medieval and early modern latrine finds.

Gerard recommends it, for example, for sitz baths or - and here lichens are certainly meant - for perfuming in this time thirsting for fragrances ("It is fit to be used in compositions which serve for sweet perfume, and that take away wearisomnesse; for which things is best of all which is most sweete of smell"). Even today, the oakmoss *Evernia prunastri* (L.) Ach. is still used for perfume production – "Mousse de chêne" or "Mousse odorante" is distilled from the thallus of this shrub lichen.

The Comedy of Errors 2.2.175ff: Adriana Thou art an Elm, my husband, I a vine,/ Whose weakness married to the stronger state/ Makes me with thy strength to communicate:/ If aught possess thee from me, it is dross,/ Usurping ivy, brier, or idle moss,/ Who, all for want of pruning, with intrusion,/ Infect thy sap, and live on thy confusion.

Shakespeare's idea in *Comedy of Errors* 2.2.179 that mosses and lichens damage their bearer tree by invading and sucking it out cannot be dispelled even today. As we all know, this does not correspond to the facts. Of course, they compete with their host trees (to a very modest extent!) for resources, but they do not invade them and certainly do not suck them dry.

As You Like It 4.3.103: Oliver Under an old oak, whose boughs were moss'd with age/ And high top bald with dry antiquity.

Timon of Athens 4.3.224: Apemantus Will these mossed trees/ That have outlived the eagle, pay thy heels?

King Henry IV., 1st part 3.1.32: Hotspur By the imprisoning of unruly wind/ Within her womb, which for enlargement striving/ Shakes the old beldam earth and topples down/ Steeples and moss-grown towers.

Symbolically, mosses and lichens stood for age and venerability, but also for loneliness, wasteland and wilderness. They characterise old oaks in the Forest of Arden in *As You Like It* or *Timon of Athens* or underline the force of an earthquake, to which the fall of the king in the first part of *Henry IV* by Hotspur is compared: This would even bring down old, mossy church towers. They also symbolize graves and cemeteries and therefore death. This becomes very impressively clear in the herball of John Gerard 1597: 1374: a human skull is depicted next to a lycopod, on which a curly turf is growing (Fig. 1). Judging by the two annual spikes of sporophylls at the tip of the shoot, the lycopodium is the club moss (*Lycopodium clavatum* L.), but considering the growth habit and the lack of hairs on the leaf tips, it is more likely to be the sprouting lycopodium *Lycopodium annotinum* L. Of course, it is not possible to identify the moss on the skull – "Moss ex cranio humano - Mosse growing upon the scull of a man". It is most likely to be a fork-toothed moss, i.e. a species of the genus *Dicranum*.



Fig. 1. From left: Oak, covered with epiphytic lichens; *Marchantia* sp., *Polytrichum* sp., *Dicranum* sp. (?)

However, the German legend “Moß vom Todtenkopff” is interesting (Fig. 1). The printer and publisher had borrowed the printing blocks for the woodcuts in Germany; they originally illustrated the *Icones stirpium* by Tabernaemontanus printed in Frankfurt in 1590. And the wooden printing block used here had been left in its original form with the German-language legend, without carving out the German letters – it was only loaned and had to be given back in an intact state. In the second, greatly expanded and improved new edition of 1633 by the apothecary Thomas Johnson, only a few of the original printing blocks were used, instead being replaced by new ones - but the “Todtenkopff” appears to have remained the same, apart from the German legend. However, subtle differences show that it is only a copy of the old woodcut.

Cymbeline 4.2.224: *Arviragus* Bring thee all this;/ Yea, and furr'd moss besides.
When flowers are none,/ To winter-ground thy corpse.

In *Cymbeline* 4.2.242ff a decoration of grave is described, which in future is to be overgrown with flowers such as cowslips and bluebells, sheltered by trees, wild roses inhabited by singing birds. Moss cushions are also to be added. Here the mosses, green even in winter, are a symbol of death, peace and eternal remembrance.

Titus Andronicus 2.2.94: *Tamora* The trees, though summer, yet forlorn and lean,/ O'ercome with moss and baleful mistletoe.

In an impressive scene in *Titus Andronicus* 2.2, mosses serve as word backdrops and, together with mistletoe (*Viscum album* L.), point to a barren, deadly landscape. Withered trees overgrown with moss and mistletoe “darken” and “poison” an initially green, erotically stimulating, warm and sunny wooded area to introduce a bloody rape and revenge scene, inspired by Ovid’s “Metamorphoses” – a masterpiece of the Bard’s “word scenery”.

Another detail can be found in “Henslowe’s Diary”. Philip Henslowe (c. 1555-1616) was an entrepreneur who worked in the theatre industry of Renaissance London. In 1587, he built the “Rose” playhouse, which became the home to a series of different playing companies.

Shakespeare's company gave performances in the "Rose". We have a unique window into his personal life and work and the life of the theatres and their companies thanks to the survival of a collection of documents which have become known, rather misleadingly, as "Henslowe's Diary". It is a collection of papers, lists, documents, and notes. The lists offer valuable insights into the theatrical world of Shakespeare's time, as nothing else like this batch of documents survived for any other theatre in Early Modern England. The "diary" lists stage items such as cauldrons, robes, weapons, sceptres, beds, and even a "baye tree". Sometimes we can identify plays by means of these lists. In a detailed inventory of March, 10. 1598, we find a "mose banckes" – perhaps a furniture for park scenes as in *Twelfth Night* or *What You Will*, covered with moss, perhaps the bank moss *Polytrichum* sp. (see Foakes 2002: 319ff).

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Combating plant blindness in bryophytes through citizen science: Insights from the five editions of the Bioblitz of Spanish Flora

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The Bioblitz of Spanish Flora (BioFE) has become Spain's most visible citizen-science project (Martínez-Sagarra *et al.* 2022). The initiative was conceived as a response to plant blindness, the tendency to ignore plants in perception, education, and daily conversation (Parsley 2020; Márquez-Corro *et al.* 2021). While BioFE covers all plant lineages, its importance for bryology is especially significant. Bryophytes are among the most overlooked plant groups, and they are particularly impacted by plant blindness: they are small, often concealed, and generally require expert knowledge to identify their diversity (Ronquillo *et al.* 2020; Cerrejón *et al.* 2025).

BioFE combines field exploration with a collaborative identification process through the iNaturalist platform. Observations uploaded by participants are refined through interactions between observers and identifiers, enabling records to attain "research-grade" status and serve as digital biodiversity vouchers (Márquez-Corro *et al.* 2021; Campbell *et al.* 2023). Like most citizen-science datasets, however, observations are unevenly spread across space and time, reflecting variations in observer activity and site accessibility. Therefore, interpreting BioFE outputs requires acknowledging the

potential biases associated with sampling effort and the spatial distribution of recorders (Mair & Ruete 2016; Pocock *et al.* 2023; López-Guillén *et al.* 2024).

From a bryological perspective, initiatives such as BioFE are particularly valuable because bryophytes remain under-represented in many biodiversity datasets, and their distribution in the Iberian Peninsula still shows significant knowledge gaps (Ronquillo *et al.* 2020). Increasing observer effort, geographic coverage, and taxonomic curiosity can therefore yield disproportionate benefits for this group, especially when supported by expert-mediated identification spaces. A clear example can be seen in BioFE 2025 activities in the peatlands of the La Siberia Biosphere Reserve (“Turberas de Las Navas”, Badajoz), where organisers highlighted *Sphagnum*, a keystone moss genus whose exceptional water-holding capacity and acidifying properties drive peat formation and long-term carbon storage (van de Koot *et al.* 2024). For many participants, this experience goes beyond simply observing plants: it reveals bryophytes as ecosystem engineers that structure habitats supporting specialised plant communities. Such moments reflect a conceptual shift from viewing vegetation to recognising identifiable, functionally relevant organisms, a shift that plant-blindness frameworks aim to promote (Parsley 2020).



Fig. 1. *Breutelia chrysocoma* in the new location found thanks to the BioFE (© Irene Lafuente).

BioFE has also been shown to highlight taxa that are seldom documented on public biodiversity platforms. During the first edition, several species not previously recorded on iNaturalist in Spain were documented, including the moss *Lewinskya shawii* (Márquez-Corro *et al.* 2021). Additionally, in the same edition, new Spanish populations of the endangered *Breutelia chrysocoma* (Fig. 1) were identified on iNaturalist through BioFE (Lafuente *et al.* 2026). This demonstrates how citizen science events can be valuable not only for enhancing knowledge of bryophyte occurrences but also for conserving restricted or rare taxa.

The initiative further supports this process through the Datablitz, a post-event identification effort aimed at resolving difficult or overlooked taxa (Márquez-Corro *et al.* 2021; Cerrejón *et al.* 2025). Such expert-guided identification is especially important for bryophytes, whose identification often requires taxonomic experts to recognise and confirm species.

Taken together, these outcomes suggest that BioFE addresses plant blindness through two complementary mechanisms. First, it broadens attention by encouraging participants to actively search for all plant groups, making the observation of small cryptogams socially visible and rewarding. Second, it builds competence by connecting observers with expert identifiers and collaborative tools that transform sightings into validated biodiversity records (Márquez-Corro *et al.* 2021; Campbell *et al.* 2023; Rodríguez & Mairal 2024).

In this sense, BioFE demonstrates that combating plant blindness is not just an educational goal. Through widespread participation supported by collaborative digital platforms and expert

engagement, citizen science can broaden botanical knowledge and bring bryophytes into people's view as ecologically important and scientifically manageable parts of Spain's flora (Márquez-Corro *et al.* 2021; Ronquillo *et al.* 2020).

Since the first BioFE edition in 2021, bryophyte observation localities recorded during the event have become progressively more widespread across Spain (Fig. 2). Notably, recent editions include records from regions that lacked observations during the first edition, such as the Canary Islands, Andalusia, Cantabria, Valencia, Castilla-La Mancha, and La Rioja. This expansion likely reflects increased participation, improved outreach, and growing interest in bryophyte documentation. Although these results do not approach those obtained for vascular plants, where nearly 50% of the Spanish flora has been identified (Molino *et al.* 2025), the outcomes for bryophytes are promising.

Across the five BioFE editions, 1,931 bryophyte observations have been documented (Table 1). Of these, 1,612 have been identified to genus level (83%) and 1,392 to species level (72%), representing 240 identified species, which account for 17% of the bryophytes known from Spain. Among the taxonomic groups, 181 moss species (18%), 56 liverwort species (15%), and 3 hornwort species (50%) were recorded.

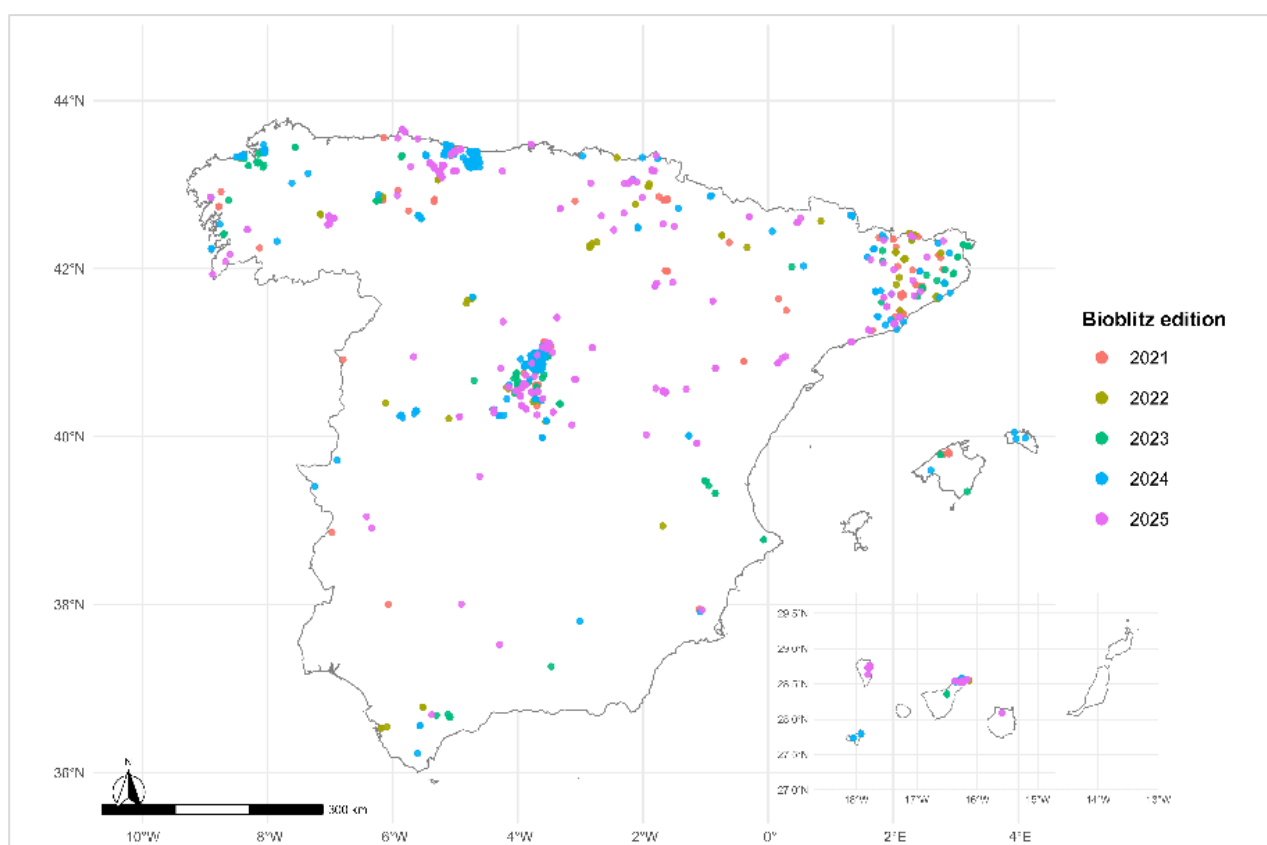


Fig. 2. Distribution of the bryophyte records in the five editions of BioFE.

The most represented genera across all editions were *Polytrichum* (99 records), *Homalothecium* (83), *Plagiomnium* (75), *Tortella* (74), *Hypnum* (65), and *Grimmia* (58) (Table 1). Similarly, the most frequently recorded species overall were *Plagiomnium undulatum* (63 records), *Tortella squarrosa* (57), *Homalothecium sericeum* (56), *Hypnum cupressiforme* (50), *Grimmia pulvinata* (32), and *Lunularia cruciata* (32) (Table 1). These taxa share traits that favour repeated reporting: broad Iberian distributions, frequent occurrence in accessible habitats, and comparatively recognisable macromorphology. Their recurrence suggests that BioFE bryophyte results are conditioned by the

detectability of widespread species, with rarer taxa added depending on local habitat availability, observer effort, and the presence of identifiers. The communities with the highest bryophyte records were Madrid (511 observations), Asturias (501), Catalonia (247), and Galicia (202).

Across five BioFE editions, bryophyte records have increased significantly in both volume and geographic coverage, confirming BioFE as an effective tool for improving knowledge of Spain's bryoflora. The expansion of observations into previously under sampled regions shows that BioFE is engaging new observers and focusing attention on overlooked habitats, helping to reduce persistent spatial and observational biases. While detectability and observer effort inevitably influence the dataset, consistent reporting of widespread species establishes a reliable baseline from which rarer, habitat-restricted taxa can gradually be recognised as coverage expands. As this evidence base grows, BioFE data can complement traditional floristic surveys by refining distribution maps, uncovering overlooked populations, and identifying priority areas for bryological research.

Table 1. Bryophyte observations in each edition of BioFE.

Bryophyte records summary (2021–2025)						
Observations, identified taxa, and most frequently recorded genera and species						
Year	Observations	Identified species	Genera most identified		Species most identified	
2021	198 Mosses (174) Liverworts (24) Hornworts (0)	63 Mosses (51) Liverworts (12) Hornworts (0)	<i>Plagiomnium</i> (12) <i>Polytrichum</i> (11) <i>Grimmia</i> (9)	<i>Hypnum</i> (9) <i>Homalothecium</i> (8) <i>Pseudoscleropodium</i> (7)	<i>Plagiomnium undulatum</i> (11) <i>Hypnum cupressiforme</i> (8) <i>Homalothecium sericeum</i> (8)	<i>Polytrichum commune</i> (5) <i>Pseudoscleropodium purum</i> (5) <i>Tortella squarrosa</i> (5)
2022	205 Mosses (174) Liverworts (31) Hornworts (0)	88 Mosses (68) Liverworts (20) Hornworts (0)	<i>Homalothecium</i> (12) <i>Orthotrichum</i> (9) <i>Tortella</i> (9) <i>Plagiomnium</i> (8) <i>Hypnum</i> (7)	<i>Ptychostomum</i> (7) <i>Tortula</i> (7) <i>Grimmia</i> (6) <i>Syntrichia</i> (6) <i>Polytrichum</i> (6)	<i>Homalothecium sericeum</i> (8) <i>Tortella squarrosa</i> (8) <i>Orthotrichum diaphanum</i> (6)	<i>Plagiomnium undulatum</i> (5) <i>Hypnum cupressiforme</i> (5) <i>Pulvigerella lyellii</i> (5)
2023	260 Mosses (230) Liverworts (30) Hornworts (0)	82 Mosses (70) Liverworts (12) Hornworts (0)	<i>Grimmia</i> (19) <i>Homalothecium</i> (19) <i>Hypnum</i> (18)	<i>Plagiomnium</i> (14) <i>Tortella</i> (13) <i>Polytrichum</i> (12)	<i>Hypnum cupressiforme</i> (15) <i>Homalothecium sericeum</i> (13) <i>Grimmia pulvinata</i> (12)	<i>Plagiomnium undulatum</i> (10) <i>Tortella squarrosa</i> (10) <i>Polytrichum formosum</i> (8)
2024	657 Mosses (539) Liverworts (116) Hornworts (2)	140 Mosses (105) Liverworts (34) Hornworts (1)	<i>Polytrichum</i> (36) <i>Ptychostomum</i> (28) <i>Tortella</i> (26)	<i>Plagiomnium</i> (26) <i>Homalothecium</i> (25) <i>Hypnum</i> (23)	<i>Tortella squarrosa</i> (19) <i>Plagiomnium undulatum</i> (18) <i>Lunularia cruciata</i> (16)	<i>Homalothecium sericeum</i> (15) <i>Hypnum cupressiforme</i> (14) <i>Polytrichum formosum</i> (12)
2025	611 Mosses (480) Liverworts (128) Hornworts (3)	160 Mosses (117) Liverworts (40) Hornworts (3)	<i>Polytrichum</i> (33) <i>Plagiomnium</i> (28) <i>Homalothecium</i> (28)	<i>Tortella</i> (24) <i>Ptychostomum</i> (21) <i>Hypnum</i> (20)	<i>Plagiomnium undulatum</i> (21) <i>Homalothecium sericeum</i> (16) <i>Tortula muralis</i> (13) <i>Tortella squarrosa</i> (13)	<i>Grimmia pulvinata</i> (11) <i>Polytrichum formosum</i> (11) <i>Lunularia cruciata</i> (11)

Ultimately, BioFE demonstrates that citizen science can do much more than simply raise public awareness or address plant blindness. By engaging citizen scientists in recording bryophytes, the initiative not only brings botanical knowledge closer to the public but also creates a growing collection of high-quality, georeferenced biodiversity data. These records help address distribution gaps, identify overlooked populations, and enhance our understanding of bryophyte diversity in Spain, while providing valuable evidence to support the conservation and monitoring of threatened species.

This year celebrates the sixth edition of BioFE, and we hope to see increased bryophyte representation compared to previous years. If you want to learn more about the project or the activities they have undertaken, be sure to visit the project website at www.biomaratonflora.com/.

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2nd Bryological Meeting of the National Botanical Conservatories (Pyrenees, France)

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More than twenty bryologists work within the network of Conservatoires Botaniques Nationaux (National Botanical Conservatories) in France. Each Conservatory (CBN) carries out its part of research and conservation of flora, fungi and vegetation within a specific territory; together, these territories cover the whole of France, with a network comprising 14 CBNs in force and 3 emerging CBNs, located on mainland France and its overseas territories. The technical coordination of the CBNs is currently managed by the French Biodiversity Agency (OFB) in conjunction with the Federation of National Botanical Conservatories (FCBN) (<https://www.fcbn.fr/content/le-reseau-des-cbn>).

Consequently, a growing sense of collective purpose is emerging, with shared objectives such as cataloguing bryophytes in France, establishing common protocols for studying species distribution and bryofloristic diversity, and contributing to bryophyte conservation by participating in the development of nationally protected lists and various monitoring programmes for threatened bryophytes. The data generated by the CBNs are available on various portals; in particular, six of the metropolitan CBNs have now joined the Lobelia information system (<https://lobelia-cbn.fr/>). One of the most recent objectives was the Bryophyte Departmental Atlas (Celle et al. 2024), which establishes the known (but rapidly evolving) distribution of the 1,409 bryophyte taxa recorded on mainland France.

Following the first Meetings held in 2022 in the Vosges (north-eastern France) organised by CB Alsace-Lorraine, this second meeting took place between 8 and 12 September 2025 in the Pyrenees in southern France, this time organised by CBN des Pyrénées et de Midi-Pyrénées, with 18 people taking part.



Fig. 1. Cirque de Troumouse (Central Pyrénées, France).

The Pyrenees range extends 440 km from west to east, between the latitudes of 42 – 43.3°N, extending over three countries (France, Spain and Andorra), and containing more than a hundred peaks over 3,000 m. A still evolving list includes 1121 plant taxa (Atlas of the Flora of the Pyrenees, <https://www.atlasflorapyrenaea.eu/src/home/index.php?idma=0>).



Fig. 2. Cirque de Troumouse (Central Pyrénées, France).

The sites visited were located in the departments of Hautes-Pyrénées and Pyrénées-Atlantiques, covering an elevation range of almost 2,000 m, from the foothills to the subalpine zone; across a wide variety of substrates, ranging from limestone to granite, including an outcrop of lerzholite, fir and beech forests, streams, mires and rocky outcrops.

Over the course of the three days, around 300 bryophyte species were recorded. In the subalpine zone of the Troumouse cirque, more than 160 species were identified, notably *Anthelia juratzkana*, *Brachythecium turgidum*, *Catoscopium nigrum*, *Clevea hyalina*, *Distichium inclinatum*, *Gymnomitrium concinnum*, *Jungermannia pumila* subsp. *polaris*, *Lophozia wenzelii*, *Mannia gracilis*, *Mesoptychia heterocolpos*, *Myurella julacea*, *Oncophorus integerrimus*, *Pohlia drummondii*, *Saelania glaucescens*, *Syntrichia norvegica*, *Timmia austriaca*, *T. bavarica* or *T. norvegica*.

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On the journey from Troumouse to the Lutour Valley, a population of the rare metalophilous species *Scopelophila ligulata* was visited (Fig. 3). Once in the granitic Lutour Valley near Cauterets, more than 120 species were observed in *Abies alba* forests and more open areas. Notable discoveries included wood-dwelling species such as *Buxbaumia viridis*, *Crossocalyx hellerianus*, and *Lophozia ascendens*; humus-dwelling species such as *Eurhynchium angustirete* and *Ptilium crista-castrensis*; *Plagiothecium piliferum*, *Riccardia incurvata*, *Imbriobryum tenuisetum*, and bark-dwelling species such as *Orthotrichum rogeri* and *O. hispanicum*.



Fig. 3. Observing the *Scopelophila ligulata* population (left) and *Abies alba* forest in Lutour Valley (right)

On the final day, in the foothills of the Pyrenean mountain range, we visited the l'Auga peat bog (Fig. 4), home to *Sphagnum molle*; and the Moncaut butte and its surroundings, where around a hundred species were observed; including the European endemic *Breutelia chrysocoma*, and others such as *Campylopus atrovirens*, *Harpalejeunea molleri*, *Drepanolejeunea hamatifolia*, *Phaeoceros laevis*, *Lejeunea lamacerina*, and *Pedinophyllum interruptum*.



Fig. 4. Towards l'Auga peatbog (left) and Moncaut butte on Iherzolites (right).

Participants

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Promoting digital access to bryophyte type specimens in Geneva (G): The liverwort and hornwort types in the Franz Stephani collection

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Providing digital access to bryophyte type specimens has been a priority for the Cryptogamic section of the Geneva herbarium (G) since 2005. One of the first goals of this long-term project was to make the large volume of type material for the liverwort and hornwort names described by Franz Stephani (see Geissler, 1982), as well as any types from other authors present in his large herbarium collection, digitally available and freely accessible. This has been done using institutional resources with efforts boosted by additional funding from the Global Biodiversity Information Facility Switzerland (GBIF.ch) in 2006 and the Global Plants Initiative of the Andrew W. Mellon Foundation from 2007 to 2011. The digitisation of the liverwort and hornwort type specimens in G involved several preparatory stages that included the transfer of all the liverwort names from the institutions' Index Hepaticarum Names Database (the digital version of Index Hepaticarum for the years 1753-1973) into our herbarium management database so that the scientific names and protologue information were directly available for use in specimen databasing; the extraction of marked types from the herbarium; and reconditioning of specimens, where necessary, to improve their conservation status. Once the marked type specimens had been extracted and reconditioned, a barcode was added to the specimen packet, and the label information was databased. Note, in G, the barcodes assigned to specimens are unique identifiers and should be cited when referencing specimens (e.g. "G (GXXXXXXXXX)"). After databasing, the herbarium sheets containing the type specimens were scanned. To ensure maximal data capture per scan, specimens were extracted from the packets and imaged along with the specimen label, specimen packet, barcode and annotation label(s).

There has been debate on the utility of scanning bryophyte specimens, as images of scanned specimens are of limited taxonomic utility; however, a decision was made in G to capture an image of the type specimens themselves, as digital access to a visual record of them informs on the size and condition of the material. For archival purposes, a scan captures the preserved plants at the time of scanning, creating a digitally date-stamped image. Scans of the herbarium sheets and contents were done at 600 dpi with a HerbScan unit that was periodically calibrated. A colour chart and scale were included for each scan. For the Stephani material, a second close-up scan of the plants at 1000 dpi was made, as it was quickly realised that his type specimens were frequently depauperate.

In a second phase, the names in use in the herbarium for the estimated 110,000 liverwort and hornwort specimens in G were catalogued in preparation for a large-scale herbarium update and reorganisation, and any previously unmarked types encountered were processed. Just over 15,000 types of liverworts and hornworts in G have been made digitally available to the bryological community via our in-house herbarium catalogue (Catalogue des herbiers de Genève), in French and English. A substantial number of Stephani specimens remain out on loan, so the final number of liverwort types in G will be higher, as these loaned specimens have not yet been digitally processed. Their return to G is a priority to ensure that digital information on the full holding of the Stephani type material in G is available to the bryological community. This is particularly important due to the somewhat controversial influence Stephani has had on liverwort taxonomy (Gradstein 2006).

To access information on and images of liverwort and hornwort types in G, a simple search by scientific name can be done, or an advanced search option is available that has a larger range of search fields (see links below). When using the catalogue, it should be noted that, for the liverworts and hornworts, it serves as a reference for the type material that is physically present in G. It is not (yet) a reference for the typification of the names linked to the material. The 'type of type', as indicated in the catalogue, should be confirmed in the literature. We are always grateful to receive information on published typifications for the type specimens that are in G so we can update our database and curate the data that is available online. The ideal pathway towards the community curation of this data is through the feedback option on the page for each catalogue entry. In the feedback box, specific information on the typification can be added (e.g., author(s), year, article title, journal title, volume, page). Any other issues or corrections to the data that was transcribed from the specimen labels by staff and project collaborators can be signalled in this way, as the data is intended as a community resource that can be continually improved and corrected by its users.

Catalogue des herbiers de Genève (CHG) links

Simple search: <https://collections.geneve.ch/jardinbotaniquegeneve/herbier/search.php?lang=en>

Advanced search:

<https://collections.geneve.ch/jardinbotaniquegeneve/herbier/advanced.php?lang=en>

Recommended citation of the Geneva Catalogue

Catalogue des herbiers de Genève (CHG). Jardin botanique de Genève. (date accessed)
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Introducing Moss Pals: A group connecting students and early-career researchers in bryology from around the world

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There are a small number of bryologists worldwide, and fewer still is the number of graduate students in bryology. Students in bryology are often separated by substantial geographic distances and connecting with and staying connected to one another has been a consistent challenge. In the internet era, we believe this challenge is something that can be addressed. Therefore, it is with much excitement that we introduce to you and extend an invitation to undergraduate students, graduate students, and recent graduates with an interest in bryology to join Moss Pals.

Moss Pals is all about facilitating connections! Originally inspired by the *soirées bryologiques virtuelles* hosted by the Société québécoise de bryologie (Leclerc et al. 2025), Moss Pals began in the fall of 2023 as occasional, informal virtual meetings to connect bryology students across Canada to facilitate the sharing of techniques and resources. The group quickly expanded to include students from across North America and the organisation of regular monthly meetings followed. In 2025, some Moss Pals members travelled to Taiwan for the International Association of Bryologists Conference and following the conference, we realised that Moss Pals had the potential to serve the broader community of bryology students and early-career bryologists from around the world. On January 29, 2026, we invited students and recent graduates from across the world to join Moss Pals via Bryonet-L, and as of March 1, 2026, 61 people from 12 time zones and five continents have joined the group.

Members have access to the Moss Pals Discord server, through which we organise 2-hour meetings once or twice a month at rotating times to allow members from various time zones to attend. Meetings are primarily conducted in English and typically begin with a quick presentation from a member of the group introducing or providing updates on their research, followed by open-ended discussion. These presentations serve as an excellent place for students to practice giving presentations in a no stakes, constructive environment where they can share ideas and seek advice. For non-native speakers, it has also provided an opportunity to practice presentation skills in English. Recent meetings have included presentations on the Sematophyllaceae of Taiwan, bryophyte biogeography of alpine British Columbia, fossil bryophytes of Antarctica, and the results of many recent expeditions.

The Discord server also provides a platform for exchanging ideas, tools and techniques, resources, job and research opportunities, conferences, photography, and bryophyte-inspired art. Members can seek assistance with identification and collaboration on external projects.

We seek to continue to grow this community and invite interested undergraduate students, graduate students, or recent graduates to contact us at mossypals@gmail.com. We also seek the assistance of the broader bryological community to share this with students and early-career researchers in

their networks. The growing number of members will enable us to facilitate more connection and collaboration among students globally and enable the organisation of more meetings for more time zones.

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Progress on A Flora of the Liverworts and Hornworts of New Zealand

John J. Engel and David Glenný

Three volumes of the New Zealand liverwort and hornwort flora are already published: volume 1 in 2008, volumes 2 and 3 in 2017 (Fig. 1). All three can be purchased through the Missouri Botanic Gardens Press (<https://www.mbgpress.org/category-s/175.htm>). A draft of volume 4 will be completed by mid-2027 and will cover Marchantiales, Neohodgsoniales, Lunulariales, Pelliales, Pallaviciniales and *Radula*. This will leave *Frullania*, Lejeuneaceae, Aneuraceae, *Metzgeria*, and the hornworts remaining for the final volume 5 with a projected publication around 2032.



Fig. 1. A Flora of the Liverworts and Hornworts of New Zealand volume 1 (left), volume 2 (centre), and volume 3 (right).

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Mosses as sentinels of Antarctica's changing climate

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When you think of Antarctica you probably don't picture lush green moss beds, but for Sharon Robinson these are what drew her to the icy continent. On the doorstep of Australia's Antarctic research base Casey Station, the strikingly green moss beds are extremely important features of the Antarctic ecosystem. These mosses form low, green carpets pressed between rocks and wind-carved ice and threaded along meltwater streams, vibrantly contrasting with the blue and white hues of their surroundings. Growing extremely slowly during the short window of the (slightly) warmer, wetter conditions of austral summers, Antarctic mosses carry a century of history; their tissues quietly recording atmospheric carbon from nuclear tests, storms and summers long gone.



Fields of moss. Top left: Undulating moss near Casey Station, Windmill Islands, East Antarctica; Top right: various colours of mosses at Botany Bay, Ross Sea Region, East Antarctica; Bottom: Extensive moss carpets on King George Island, South Shetland Islands, Maritime Antarctica.

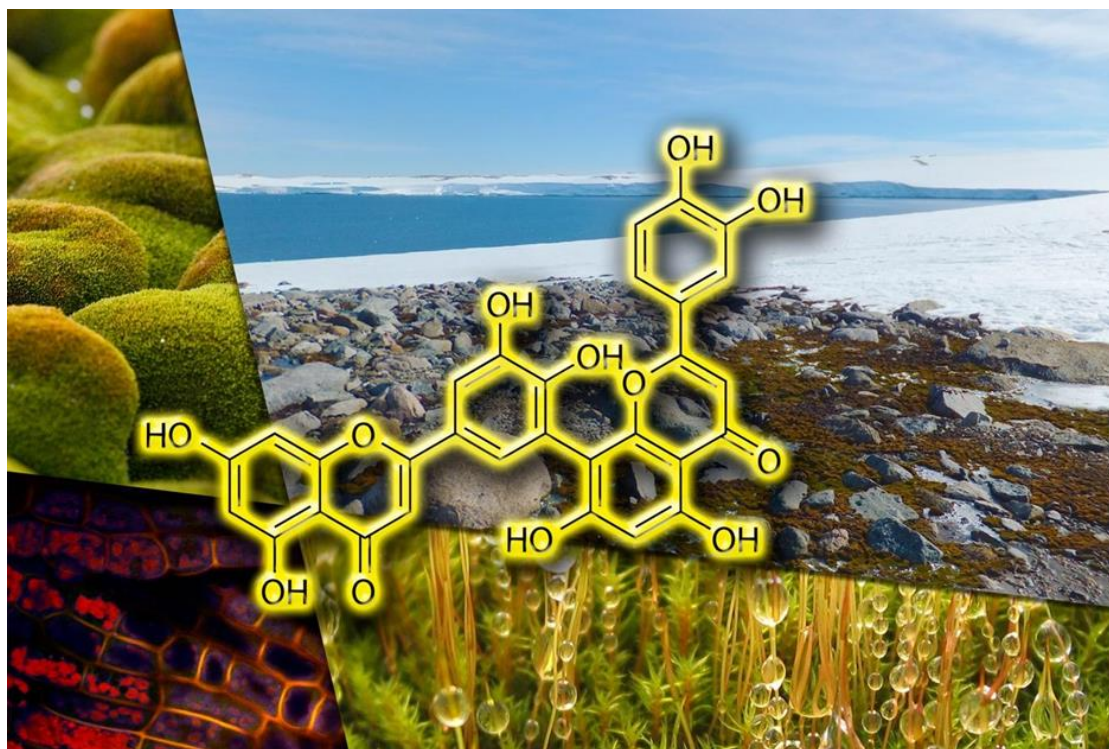
Years ago, on one of her early trips south, Sharon Robinson knelt beside moss beds only a few centimetres deep and immediately realised that this was a rich system for exploring plant responses to environmental stress. Back in Wollongong, that insight grew into a thriving research group where students and collaborators pore over tiny cores of moss, run experiments, date cores, and stitch

together maps that show which moss patches are thriving and which aren't doing so well as the winds strengthen, water sources shift, and the landscape transforms.

Season after season, the team has returned to the same Antarctic 'forest' to ask the same deceptively simple question, "What has changed?", knowing that the answer now carries global weight. Their measurements feed into international climate reports and new continental-scale observing systems, so that when policymakers sit down to decide how the world will protect Antarctica's fragile life, the quiet signals from those moss beds, decoded in Robinson's lab at the University of Wollongong, are part of the conversation.

Sharon Robinson and her team at the University of Wollongong have been working on Antarctic mosses for three decades and are leaders in understanding how Antarctica's ancient moss 'forests' are responding to a rapidly changing climate. Through their involvement in the Australian Research Council Special Research Initiative 'Securing Antarctica's Environmental Future' (SAEF) their research now underpins national and international efforts to protect polar ecosystems.

Starting this work in the 1990s when ozone depletion was a major concern, they first focussed on how Antarctic mosses were impacted by increased UV radiation under the ozone hole. By placing screens in the field, they were able to show that mosses responded to UV radiation by producing sunscreens, some of which are unique to these mosses. By comparing Antarctic species with congeners in Australia, they showed that Antarctic species invest more in cell-wall bound sunscreen compounds. Within the Antarctic populations, the Antarctic endemic species *Schistidium antarctici* was found to be less protected than two cosmopolitan species *Bryum pseudotriquetrum* and *Ceratodon purpureus*. But all three species were very resistant to UV-B damage when they were desiccated.



Protective sunscreens in moss. Cosmopolitan moss species *Ceratodon purpureus* produces complex sunscreen compounds and stores them in its cells and cell walls. These UV-absorbing compounds protect the chlorophyll and DNA from UV-induced damage, even while the moss is desiccated, a strategy that is incredibly valuable in a cold desert like Antarctica.

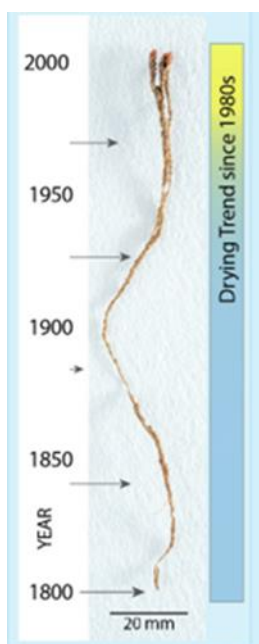
Antarctic moss fields

Across Antarctica, mosses are confined to the continent's scattered ice-free areas, which provide refugia in coastal, inland and mountainous locations. These habitats, representing less than 1% of the Antarctic land surface, occur where glaciers retreat, snow melt persists through summer, and liquid water becomes intermittently available. Mosses need a delicate balance of reliable moisture, nutrients and light availability during the short growing season. Sheltered ice-free locations are beneficial to many species, buffering plants from wind desiccation while enhancing solar heating at the canopy surface. As a result, moss beds form highly patchy, microclimate-driven mosaics.

Near Casey Station in East Antarctica, dense *S. antarctici* turf dominates the mossy landscape. Cohabiting are the less abundant cosmopolitan mosses *B. pseudotriquetrum* and *C. purpureus*. Dense turf made up of individual moss shoots of these species form miniature mountains that are green, especially in the valleys. All three moss species need to survive regular freeze-thaw cycles, intermittent inundation, drying out from strong winds, and harmful UV – all of which amount to a very short window for growth. Moss tips exposed in the mountain crests are often reddened from stress, but if conditions become too harsh, the mosses turn grey or black as they die, providing real estate for colourful lichens.

Research activities

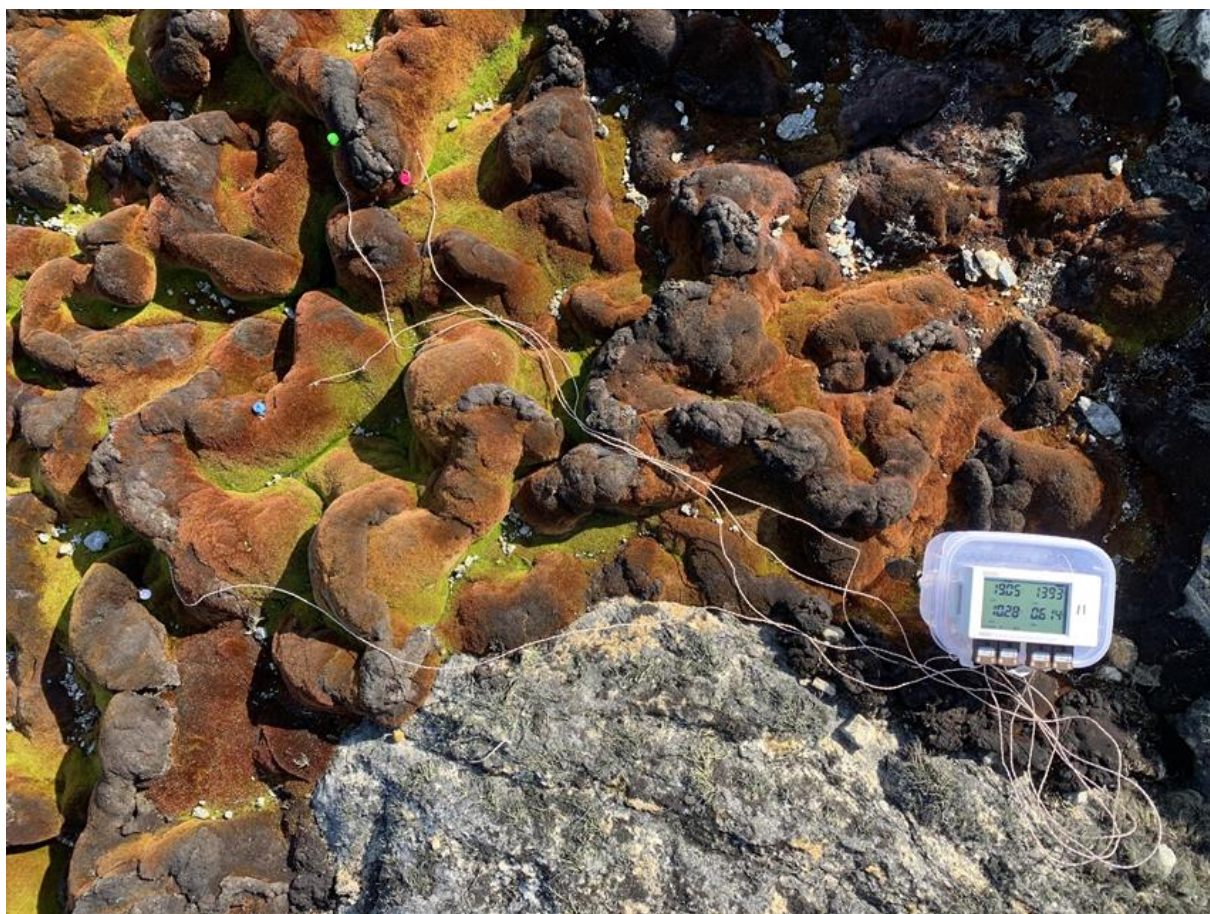
Robinson and her team focus on how Antarctic plants, especially mosses and other bryophytes, respond to environmental change, particularly ozone depletion, shifting water availability and temperature fluctuations. They read climate history in moss shoots much like tree rings, using radiocarbon 'bomb-spike' signatures from mid-20th-century nuclear testing to date growth and reconstruct past environmental conditions along the Antarctic coast. Declining health in mosses over recent decades has been shown to be driven more by the increased wind speeds and cooler summers that have accompanied ozone depletion; than by the increased UV-B radiation that first brought Sharon's team to Antarctic research.



Ancient Antarctic mosses: Radiocarbon dating of the three moss species in the Windmill Islands region, East Antarctica has demonstrated that mosses can be used as proxies for their local water environment and reveal evidence of a drying climate over the past 50 years; in this figure the blue to yellow gradient indicates how the environment that the mosses grow in has changed from wet to dry over time. Cooler summers and increased wind speeds have made the mosses local environment even drier.

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The team has demonstrated East Antarctic mosses optimise photosynthesis at surprisingly warm canopy temperatures (20–30°C) despite ambient air being near freezing. Their photosynthetic machinery is tuned to take advantage of short windows of warmth and moisture for carbon gain. When comparing the microclimate in crests and valleys, canopy temperatures of Antarctic moss patches have as much variation as mountain ranges in other parts of the world. At the crests, the microclimates are strongly driven by solar radiation and the mosses warm up to their photosynthetic optimums at solar noon. However, this is short lived. As the sun's position lowers in the sky during the afternoon and evening hours, moss canopy temperatures rapidly drop to sub-zero, meaning mosses living on the crests experience extreme diurnal temperature fluctuations and rapid freezing events. Just centimetres away, the valleys are a more sheltered and stable place to grow. Processes unique to the valleys, such as radiative trapping, curb overnight freezing so that the mosses consistently remain at temperatures above 0°C, potentially explaining why mosses in the valleys can be vibrant and healthy, while their crest-dwelling counterparts show signs of stress. This microclimate-focused research is helping the team to develop spatio-temporal microclimate models, simulate Antarctic environments in laboratory chambers, and design environmental sensor platforms.



Temperatures vary over tiny scales: Measuring how the moss canopy temperatures vary spatially within a moss bed allows researchers to understand the drivers underpinning changes in moss health. In the image above, moss canopies in the sun register temperatures at 10°C (adjacent to the blue marker) and 19°C (red marker), while just centimetres away mosses in the shade remain close to freezing (1.4°C at the green marker and 0.6°C at the white marker).

The group is also pioneers in near-remote sensing, using drones and satellites, chlorophyll fluorescence and spectroscopic tools to monitor plant health and productivity non-destructively across moss beds in East Antarctica. Recent work in the lab is also integrating artificial intelligence and remote sensing approaches with drones and satellites to map Antarctic vegetation at multiple

scales. These methods allow researchers to translate centimetre-scale drone observations into landscape- and continental-scale monitoring systems for tracking ecosystem change.



Flying high – or not so high. Measuring moss health and cover by flying drones over Antarctic moss valleys allows researchers to assess vast areas of the terrestrial ecosystem in a non-invasive way. Main: Ryan Haynes (University of Tasmania) piloting a drone over moss beds near Casey Station, East Antarctica. Top right: Drone pilots Barbara Bollard and Ashray Doshi navigate a custom-built drone over scattered moss beds in East Antarctica. Bottom right: Sharon Robinson and Georgia Watson collecting tiny moss samples to validate drone measurements at Casey Station.

Success and impact

The lab's long-term monitoring, begun in 2000, has produced some of the first clear evidence that climate change and ozone depletion are already altering East Antarctic terrestrial communities, driving shifts in species composition and declining moss health in drying regions. Their work on these extensive moss forests has shown that once-lush green beds are turning red or grey as stronger winds and colder summers dry out coastal areas, positioning Antarctic mosses as sentinels of a rapidly changing polar climate. Their Antarctic research has informed major assessments by bodies such as the Intergovernmental Panel on Climate Change and the United Nations Environment Programme, and Robinson now leads a prestigious Australian Research Council Laureate Fellowship project, "Islands in the Ice", building a real-time autonomous observing system for Antarctic ecosystems.

Role in Antarctic research

Within Australia's Antarctic science landscape, the lab is central to the ARC Special Research Initiative "Securing Antarctica's Environmental Future" (SAEF), where Robinson serves as Deputy Director for science implementation and leads the University of Wollongong node. For over three decades she and her research team have travelled to, and collected data from sites in East Antarctica, the Antarctic Peninsula and the South Shetland Islands, using repeat visits and new technology to track what has changed and to identify biodiversity most at risk. This research directly supports environmental managers by providing tools and data to assess ecosystem health, design protection and remediation strategies, and helps Australia meet its Antarctic Treaty and State of the Environment obligations.

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Antarctic mosses matter because they sit at the edge of possibility. Living close to the limits of hydration, temperature, and light, they respond rapidly and visibly to subtle shifts in microclimate, making them exceptional sentinels of environmental change. Their pigments, photosynthetic machinery, growth form, and spatial distribution record the combined influence of drying, warming, and radiation at scales ranging from individual cells to entire landscapes. Through their sensitivity, mosses reveal how climate change operates not only through regional trends, but through fine-scale interactions between topography, moisture, and solar exposure - interactions that ultimately determine survival or collapse.

From her first conference inspiration through interdisciplinary co-leadership, Sharon Robinson and her group have reshaped Antarctic bryology: transforming moss from a niche curiosity to a robust model system central to climate change biology, remote sensing, and ecosystem monitoring.

Their ever-evolving work demonstrates how mosses can be monitored across vast and remote regions, providing early warning of ecological thresholds and informing both conservation policy and global climate assessments. In listening closely to Antarctic mosses, through pigments, photons, and pixels, the Robinson group has shown how the smallest plants can communicate clearly about our rapidly changing world.

Further reading

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<https://theconversation.com/antarcticas-moss-forests-are-drying-and-dying-103751>

<https://theconversation.com/the-ozone-hole-leaves-a-lasting-impression-on-southern-climate-34043>

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A Glimpse of Bryophytes of Qomolangma National Nature Reserve, Xizang, China

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Qomolangma (Mt. Everest) National Nature Reserve (hereinafter referred to as Qomolangma Reserve) is located in the southern part of Xizang (Tibet) Autonomous Region, China, bordering with Nepal to the south, 27°48' – 29°15'N, 84°27' – 88°23'E. With a land area of 33,819 km², it is the world's highest natural reserve in terms of elevation. It aims to protect alpine ecosystems, biodiversity, natural landscapes, geological relics, and Tibetan historical and cultural heritage.

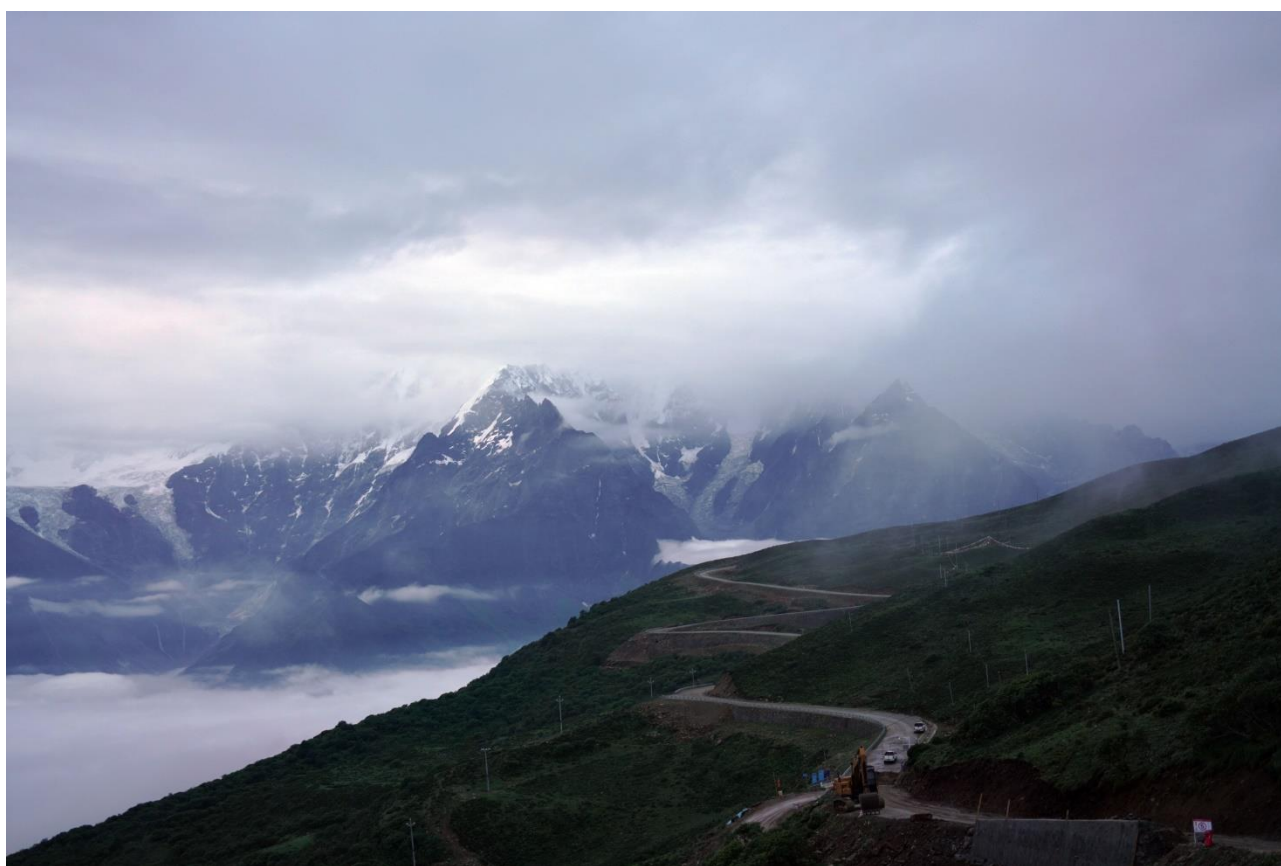


Fig. 1. Spectacular view of Salexiang Bealock, Jilong Valley (alt. 4,000 m).

The Qomolangma Reserve was established in 1988 and contains rugged terrain and spectacular scenery. The lowest point of the reserve is 1,440 m above sea level, and the highest point at the summit of Mt. Qomolangma at 8,849 m, a relative elevation difference of over 7,400 m. The topography is steep, the climate is variable, and the habitats are diverse which include glaciers, rivers, lakes, canyons, forests, desert, grasslands, and alpine scree zones, providing homes for many wild animals and plants. Within a range of several tens of kilometres, one can ascend from evergreen forests to permanently snow-capped mountains, showcasing typical vertical vegetation zones. With regards to the southern slope, it can roughly be divided into the following vegetation zones: evergreen broadleaf forest (1,400 – 2,500 m), mixed coniferous and broadleaf forest (2,500 –

3,000 m), coniferous forest (3,000 – 3,800 m), alpine shrubs and meadow (3,800 – 5,200 m), and scree zone (above 5,200 m to the snow line) (Fig. 2) (Chang & Jiang 1973).



Fig. 2. Alpine scree of Mt. Pushilashan (alt. 5,300 m).

The Qomolangma Reserve is located within the Himalaya, one of the 36 global biodiversity hotspots (Habel et al. 2019). Although it covers only about 3% of China's territory, 11% of China's animal and plant species live here, highlighting its importance. The reserve is home to 2,106 species of angiosperms, 20 species of gymnosperms, 222 species of ferns, 472 species of bryophytes, 172 species of lichens, 136 species of fungi, 53 species of mammals, 206 species of birds, 8 species of amphibians, 6 species of reptiles, and 5 species of fish. Many nationally protected animals also inhabit the reserve, including the Tibetan antelope, snow leopards, and golden jackals (<https://www.fnrrc.com/ziranbaohuqujianjie/9857.html>).

Due to its remote location and low traffic, the reserve was difficult to reach previously. Even today, some localities of the reserve remain barely visited. The earliest research on bryophytes of the Qomolangma Reserve was conducted by Prof. P. C. Chen, the founder of Chinese bryology. Prof. Chen studied 107 specimens collected by Mr. X.-G. Wang and his colleagues on the eastern slope of Mt. Qomolangma (around Rongbuk Monastery and Rongxia Valley) in 1959, and he recognised 107 species of bryophytes, including three new species: *Grimmia himalayana* (now *Schistidium chenii*), *Brotherella himalayana* (now *B. curvirostris*), and *Pogonatum thomsonii* var. *tibetanum* (now *P. perichaetiale* subsp. *thomsonii*). The results were published in the book entitled *Scientific Expedition Report of the Mount Qomolangma Region* by Science Press in 1962 (Chen 1962). Starting in 1975, the Chinese Academy of Sciences (CAS) organised the *Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau*. Prof. M. Zang from the Kunming Institute of Botany, Chinese Academy of Sciences (hereinafter referred to as KIB) participated in the field survey as an

expert in cryptogamic botany, collected a large number of bryophyte, fungi, and lichen specimens from Xizang. The bryophyte specimens from his collection were studied by a team of bryologists led by Prof. X.-J. Li (KIB), and after nearly ten years, the *Bryoflora of Xizang* was published in 1985, containing many species collected from the Qomolangma region (Li 1985).

From July 12 to 25, 2025, I was invited to participate in a two-week scientific expedition. The expedition team included experts in animals, fungi, and flowering plants, and I was the only bryologist. Considering the vast area of Qomolangma Reserve, the duration of this expedition was too short. We mainly focused on the southern slope of Mt. Qomolangma, carrying out field surveys in selected places of Gama Valley, Jilong Valley, Zhangmu Valley, Rongxia Valley, and Chentang Valley (Fig. 3). During the survey, I reached the lowest point at Zhangmu Port (1,700 m) and the highest point at Pushilashan Bealock (5,487 m).



Fig. 3. Countryside view of nearby Chentang Town (alt. 2,500 m)

This article lists some of the common and interesting bryophytes found during the expedition according to the vertical vegetation zones in the order from low to high altitude.

Evergreen broadleaf forest zone (1,700 – 2,500 m). Dominant trees include *Quercus glauca* and *Lithocarpus elegans*. This zone is abundant in rainfall, with high humidity, supporting many tropical and subtropical bryophytes, including: *Campylopus umbellatus*, *Anomobryum auratum*, *Rhodobryum ontariense*, *Breutelia dicranacea*, *Trachypodopsis serrulata* var. *crispatula*, *Clastobryopsis* sp., *Duthiella* sp., *Toloxis semitorta*, *Neodiciadiella pendula*, *Herpetineuron toccoeae*, *Leptohymenium tenue*, *Atrichum crispulum*, *Pogonatum microstomum*, *Metacalypogeia cordifolia*, *Plagiochila* spp., *Cyathodium cavernarum*, *Conocephalum conicum*, *Sandea japonica*, *Marchantia polymorpha*, and *Phaeoceros* sp., among others.

Mixed conifer-broadleaf forest zone (2,500 – 3,500 m). Dominant species are *Tsuga dumosa* and *Quercus semicarpifolia*. Except for subtropical and temperate species, some thalloid liverworts mainly distributed in the Himalayan region are found in this zone. *Sphagnum platyphylloides*, *Orthodontium lignicola*, *Mnium laevinerve*, *Plagiomnium* spp., *Aulacomnium androgynum*, *Macrocoma sullivantii*, *Leucodon* spp., *Trachypus bicolor*, *Neckera pennata*, *Sphaerotherciella sphaerocarpa*, *Cyathophorum hookeriana*, *Anomodon rugelii*, *Rozea pterogonioides*, *Porella campylophylla*, *Spruceanthus semirepandus*, *Apometzgeria pubescens*, *Exormotheca bischlerae*, *Cryptomitrium himalayense*, and *Targionia hypophylla*, among others (Fig. 4).



Fig. 4. Representative bryophytes found in Qomolangma Reserve (alt. 2,500 - 3,500 m). a. *Exormotheca bischlerae*, b. *Cryptomitrium himalayense*, c. *Diaphanodon blandus*, d. *Cyathophorum hookeriana*, e. *Breutelia dicranacea*, f. *Campylopodiella flagellacea*.

Coniferous forest zone (3,500 – 4,000 m). The dominant species are *Abies spectabilis*, *Taxus wallichiana*, and *Picea smithiana*. Most of bryophytes found in this zone are temperate and alpine species, for example: *Aongstroemia orientalis*, *Oncophorus wahlenbergii*, *Campylopodiella*

flagellacea, *Plagiomnium rhynchophorum*, *Bartramia halleriana*, *Ulota* spp., *Hedwigia sinica*, *Actinotuidium hookeri*, *Diaphanodon thuidioides*, *Thuidium* spp., *Plagiothecium* spp., *Pleurozium schreberi*, *Rhytidiadelphus triquetrus*, *Pogonatum urnigerum*, *Bazzania tricenata*, *Lophozia* spp., *Scapania* spp., *Frullania* spp., and *Blasia pusilla* (Fig. 5).

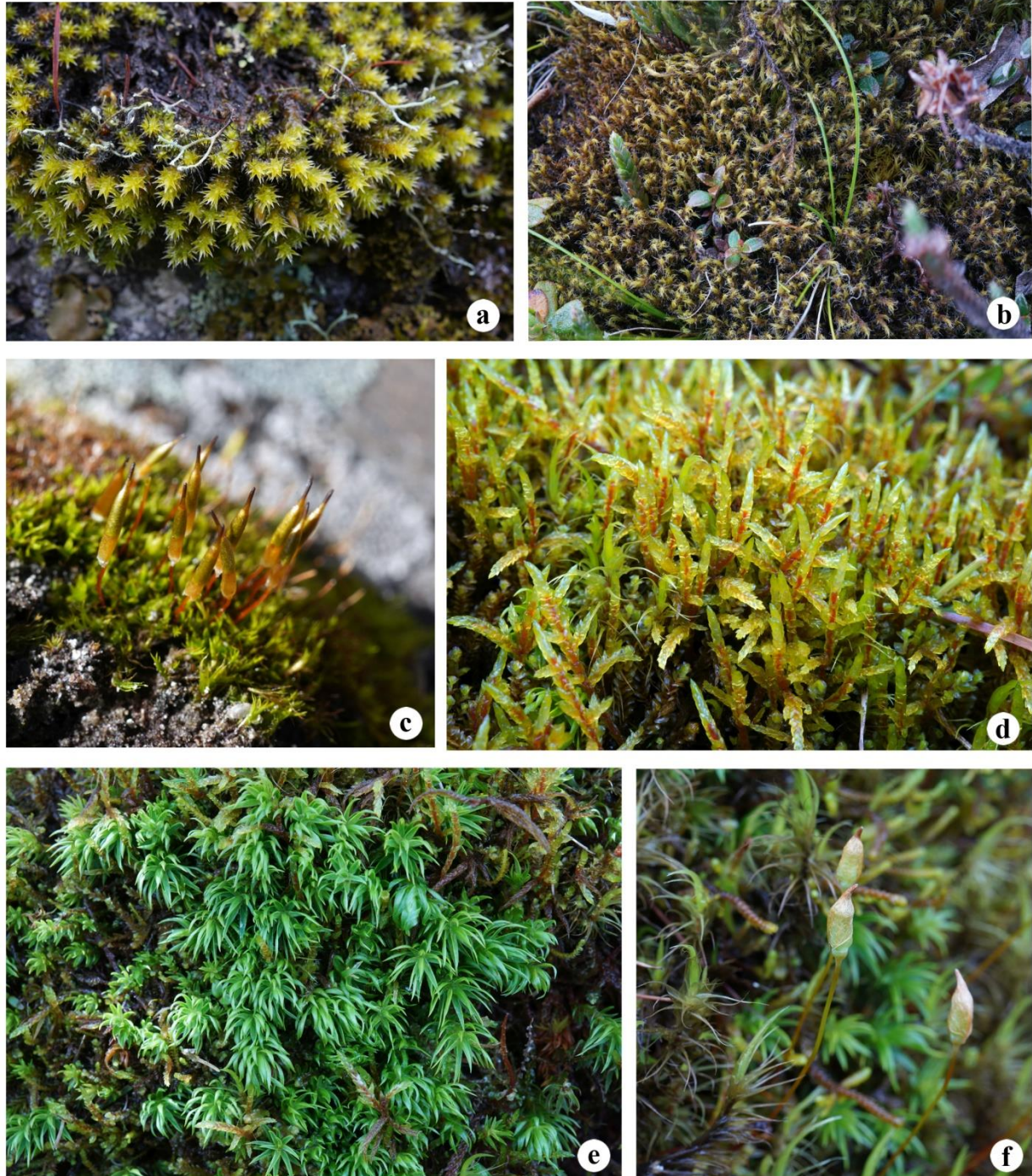


Fig. 5. Representative bryophytes found in Qomolangma Reserve (alt. 3,500 - 4,400 m). a. *Hedwigia sinica*, b. *Racomitrium* cf. *himalayanum*, c. *Encalypta spathulata*, d. *Pleurozium schreberi*, e-f. *Polytrichastrum xanthopilum*.

Alpine Shrub and Meadow Zone (4,000 – 5,000 m). *Rhododendron* shrubs are prominent, and in early summer they bloom brilliantly. Species adapted to high latitude and cold environments are common, for example: *Andreaea rupestris*, *Distichium capillaceum*, *Oreas martiana*, *Paraleucobryum enerve*, *Aloina rigida*, *Syntrichia* spp., *Encalypta spathulata*, *Grimmia* spp.,

Racomitrium spp., *Tetraplodon mnioides*, *Brachythecium* spp., *Rhytidium rugosum*, *Oligotrichum obtusatum*, *Pogonatum perichaetiale* subsp. *thomsonii*, *Polytrichastrum xanthopilum*, *Polytrichum piliferum*, *Herbertus* spp., *Apomarsupella verrucosa*, *Frullania yuennanensis*, *Lophozia* spp., *Reboulia hemisphaerica*, *Riccia* sp., and *Sauteria spongiosa* (Fig. 6).



Fig. 6. Representative bryophytes found in Qomolangma Reserve (alt. 4,400 - 5,500 m). a. *Tetraplodon mnioides*, b. *Lewinskya iwatsukii*, c. *Apomarsupella verrucosa*, d. *Schistidium chenii*, e. *Syntrichia* sp., f. *Andreaea* cf. *frigida*.

Scree zone (5,000 – 5,500 m). The environment is harsh, with strong ultraviolet radiation, cold, and strong winds. Vegetation is sparse, with occasional cushion plants such as *Saussurea medusa*, *Eremogone pulvinata*, and *Meconopsis* spp. Only some species of Pottiaceae, Grimmiaceae, Andreaeaceae, and Orthotrichaceae are occasionally seen, mostly growing in rock crevices, for example: *Didymodon anserinocapitatus*, *Didymodon nigrescens*, *Schistidium chenii*, *Andreaea* cf. *frigida*, and *Lewinskya iwatsukii* (Fig. 6).

According to my preliminary observation, the vertical zones of bryophytes are not as distinct as that of flowering plants, with only 3 – 4 zones recognised, and the boundaries between the zones obscure. The vertical zones of bryophytes definitely need more research in the future.

In addition, we are compiling an *Updated Checklist of Bryophytes of Xizang* based on the identification of available specimens (mainly from SZG) and reviews of past literature. It is planned to be completed this year. By then, our understanding of the overall bryophyte diversity in Xizang will be significantly enhanced.

Acknowledgements

I am grateful to Fairy Lake Botanical Garden, Qomolangma National Nature Reserve, Southwest Forestry University and SWILD for their various help. Thanks are also extended to Dr. Chris Cargill for reviewing the manuscript and Ms. Ya-Xian Tian for preparing the plates.

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Moss Garden of the Fairy Lake Botanic Gardens Shenzhen

D. Christine Cargill

In December 2025 I was lucky to have the chance to visit the Fairy Lake Botanical Gardens in Shenzhen. My family were on holiday in China and of course I took the opportunity to contact bryologists in two of the main cities we were visiting, Guangzhou and Shenzhen both in the Chinese Province of Guangdong (Fig. 1).

Dr Li Zhang is the Deputy Director of the Fairy Lake Botanical Garden in Shenzhen and well-known Chinese bryologist and after reading about the moss garden he had set up along with horticultural colleagues from the Garden (see BT vol 161), I just had to make an effort to visit both Li Zhang and

the moss garden. I have known Li Zhang for several years, as we were both students of Dr Barbara Crandall-Stotler and Dr Ray Stotler at Southern Illinois University, though not concurrently. We have met up from time to time at various conference meetings, but I have never visited his Botanical Gardens.



Fig. 1. Map of China, showing the province of Guangdong in red. The yellow dot is location of Shenzhen

Fairy Lake Botanical Gardens is one of the best if not the best botanic gardens in the whole of China and that was clear from the tour that Li Zhang gave us around the Gardens. But the highlight for me was the moss garden. And this was not a small moss garden with one or two dominant mosses. This was a substantial area where the ground cover was dominated by bryophytes (Fig. 2 & 3). The moss garden itself is fenced off from the public unfortunately and is only open upon invitation to select visitors. This is due to past trampling by the public over the moss surfaces which has damaged them.

Together there were mosses, liverworts and hornworts such as the moss *Thuidium kanedae* (Fig. 2), growing in the beautifully landscaped garden, with winding paths amongst lush ferns and flowering plants, rocks and trickling creeks (Fig. 2 & 3).

If you ever have the chance to visit Guangdong, make the effort to visit the famous city of Shenzhen and the Fairy Lake Botanical Garden. It will be well worth your while.



Fig. 2. One of the mossy scenes at the Fairy Lake Botanic gardens moss garden (left) and signage for the moss *Thuidium kanedae* (right).



Fig. 3. Beautiful *Thuidium* lawn in the moss garden (left) and mossy covered rocks in the moss garden (right).





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Cover photo by Andrew Franks: *Balantiopsis diplophylla* (Balantiopsidaceae), photographed *in situ* at Springbrook National Park, Queensland, Australia in 2023.