

Meeting Report: BBS Annual Meeting and Conference

12-14 September 2014

David Long and Liz Kungu

report on the 2014 Autumn
Meeting held at the Royal
Botanic Garden, Edinburgh

The 2014 autumn meeting at the Royal Botanic Garden Edinburgh is the second one to be held in Scotland, 12 years after the earlier one, also at RBGE. On the Friday afternoon and evening, meetings were held of the Recording & Conservation Committee, Publications Committee and Education Committee followed by the Council Meeting at 7.30 pm. Next day, a total of 39 participants attended the symposium in the recently refurbished lecture theatre where the BBS was given a warm welcome by Prof. Pete Hollingsworth, Director of Science at RBGE. He emphasized the importance and success of collaboration between BBS members and RBGE scientists, and how bryophyte research, both traditional and molecular, is an important and growing part of RBGE's work. The seven presentations followed two broad themes, the first three covering boreal bryophytes in Scandinavia, the Scottish Highlands and southern Britain,

and the remainder on more specialised topics including application of modern techniques of investigation:

Arctic-alpine bryophytes in Scandinavia Kristian Hassel, Trondheim, Norway

Snowbed bryophytes - the permanent transects seven years on Gordon Rothero, Dunoon

Are boreal bryophytes dying of heat in southern Britain? Mark Hill, Cambridge

Bryophytes and the primary colonization of modern building surfaces Wolfgang Hofbauer, Valley, Germany

The genera of Polytrichaceae – recent circumscriptions explained Neil Bell, Helsinki

DNA barcoding for taxonomy and conservation in bryophytes David Bell, Vancouver, Canada

How rare is Aneura pinguis? Laura Forrest, Edinburgh

A well-attended AGM was held in the lecture theatre at 4 pm, followed at 7 pm by an excellent Conference Dinner provided at very moderate



cost by RBGE's in-house caterers. The BBS wishes to thank the organisers, staff and caterers at RBGE who provided excellent service and facilities for the meeting.

Excursion to Traprain Law

On Sunday 15 September over 25 participants travelled to Traprain Law, near East Linton in East Lothian (v.-c. 82). The hill, 221 metres high, is a prominent landmark rising steeply above the surrounding agricultural countryside. It is a basaltic intrusion of Lower Carboniferous age with extensive rock outcrops on all sides, though the east end has been disfigured by a massive but now disused quarry. The hill was the capital of the Votadini (the region's dominant indigenous Iron Age tribe) and is regarded as one of the most important hill forts in Scotland. The site was first fortified in the late Bronze Age (ca. 1500 BC) and occupation continued at Traprain through the Iron Age and Roman period until Medieval times. A famous treasure hoard of late Roman silver was found here in 1919 and is now on display in the National Museum of Scotland in Edinburgh.

From the car park we climbed a short distance to the lower north-facing crags with abundant *Reboulia hemisphaerica*, along with *Andreaea rupestris*, *Barbilophozia*



<Fig. 1 (left). A handsome cushion of *Grimmia decipiens* on a basalt outcrop. R. Hodd. <Fig. 2 (centre). *Grimmia montana* grows in large quantities around the summit of Traprain Law. J. Denyer. ΔFig.3 (right). Jo Denyer admiring the sheets of *Hedwigia integrifolia* at the west end of Traprain Law. R. Hodd.

hatcheri, *Bryum alpinum*, *Isopterygiopsis pulchella*, *Rhabdoweisia fugax* and much *Scapania compacta*. We worked along the crags to the north-west end where the bryoflora changes with an abundance of *Hedwigia stellata* and *H. integrifolia* in extensive sheets along with *Grimmia trichophylla*, *G. decipiens* and *Pterogonium gracile*. Nick Hodgetts located *Grimmia ovalis*, not seen since 1993. The group fragmented somewhat and one subgroup continued south along the west end of the hill, encountering more and more *Grimmia montana*, in one area with numerous sporophytes, and in this area Des Callaghan detected *Hedwigia ciliata* var. *leucophaea*, new to v.-c. 82, expertly spotted amongst the ubiquitous *H. stellata*. Some proceeded around to the sunny south-facing crags, where Tom Blockeel found *Grimmia laevigata*, in only its second East Lothian site (the other being North Berwick Law where it was first found by the BBS in 2002). One old record which eluded us was that for *Grimmia ramondii*, last found in 1928 by J.B. Duncan. The excursion for many (but not all) concluded with a climb to the summit to enjoy the wonderful panorama and also extensive colonies of *Grimmia montana*.

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The Arctic-alpine bryophytes of the Scandinavian Peninsula

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The Arctic zone, defined as the area north of the Arctic woodland limit, has a flora consisting of about 900 species of mosses (Bryophyta) and liverworts (Marchantiophyta). This represents only about 5% of the total global species diversity of bryophytes. Most of the species have wide distributions and only 10-15% are restricted to the Arctic. Environmental conditions similar to those in the Arctic can also be found in mountain habitats further south, in areas otherwise dominated by boreal or temperate environmental conditions. The Scandinavian Peninsula is characterized by the Scandes mountain range running north-south. Only a small part of the northern tip of the peninsula is situated north of the Arctic woodland limit. Southernmost areas have temperate vegetation, with the majority characterized by boreal vegetation. There is also a strong west-east gradient in precipitation with the more continental mountain areas found in the eastern reaches of the Scandes. The Scandinavian

bryophyte flora consists of about 1,100 species of which approximately 10% are mainly restricted to the mountain areas. Based on their distribution pattern in the Scandes mountain range, these species can be divided into four main distribution categories; continuous, bicentric, southern unicentric and northern unicentric. The processes that have led to these patterns of distribution need further study. Gradual recolonization of the Scandes from the south and northeast following the retreat of the ice after the last glaciation, together with recent dispersal, are probably the main processes. But there are also a few examples indicating plant survival in glacial refugia on the Scandinavian Peninsula during the last glacial maximum.

△ Fig. 1 (above). Retreat of the ice left large areas of land available for colonization after the last glacial maximum. Here we see the Storebreen glacier in Jotunheimen, southern Scandes. K. Hassel. ▽ Fig. 2 (above right). *Bryum cryophilum* has a bicentric distribution in Scandinavia. K. Hassel. ▽ Fig. 3 (centre right). *Psilopilum cavifolium* has a northern unicentric distribution in Scandinavia. K. Hassel. ▽ Fig. 4 (lower right). *Voitia hyperborea* has a circum-Arctic distribution, but is not known from the Scandinavian Peninsula. K. Hassel.



Monitoring change in snowbed bryophyte communities in Scotland: the permanent transects seven years on

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In the Scottish mountains a lot of the winter precipitation above 700m is snow and this is redistributed by the wind onto lee slopes where it accumulates. The depth and extent of this accumulation depends on the catchment, which means that those hills with large areas above 1000m tend to have the largest accumulations. As the prevailing winds are from the south and west, the snow tends to accumulate on slopes with a north or north-easterly aspect, slopes which also receive limited insolation except in high summer. As the snow melts in spring and summer, the deepest and most sheltered snow patches persist often well into late summer and some will last through the year. This leaves a very short growing season for vascular plants and the 'snowbed vegetation' tends to be dominated by bryophytes. From the 1970's onwards it was clear that the snowbeds were melting out sooner, fewer were persisting through to the next snowfall and the presumption was that this must be having some effect on the plant communities. To try to test this presumption, a project was put together, funded by SNH and with the participation of John Birks and John Arvid Grytnes at Bergen University, and RBGE. As part of this project, in 2007-8, I set up a number of permanent transects and took fixed-point photos of snowbed sites, mostly in the Cairngorms National Park but also further north on Beinn Dearg and Ben Wyvis and further south on Ben Lawers.

The transects were set up across the snowbed vegetation, starting and finishing where possible in areas that were snow-free earlier and crossing areas with the longest snow cover. To avoid the use of fixed markers, the transects were set up

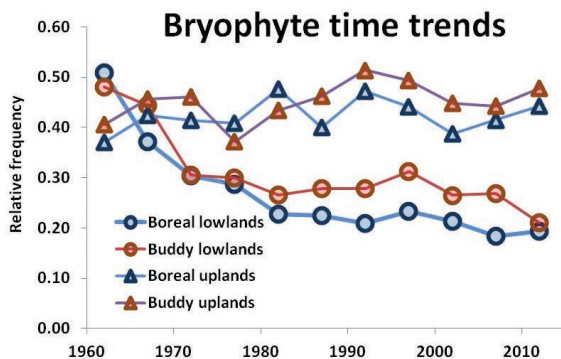
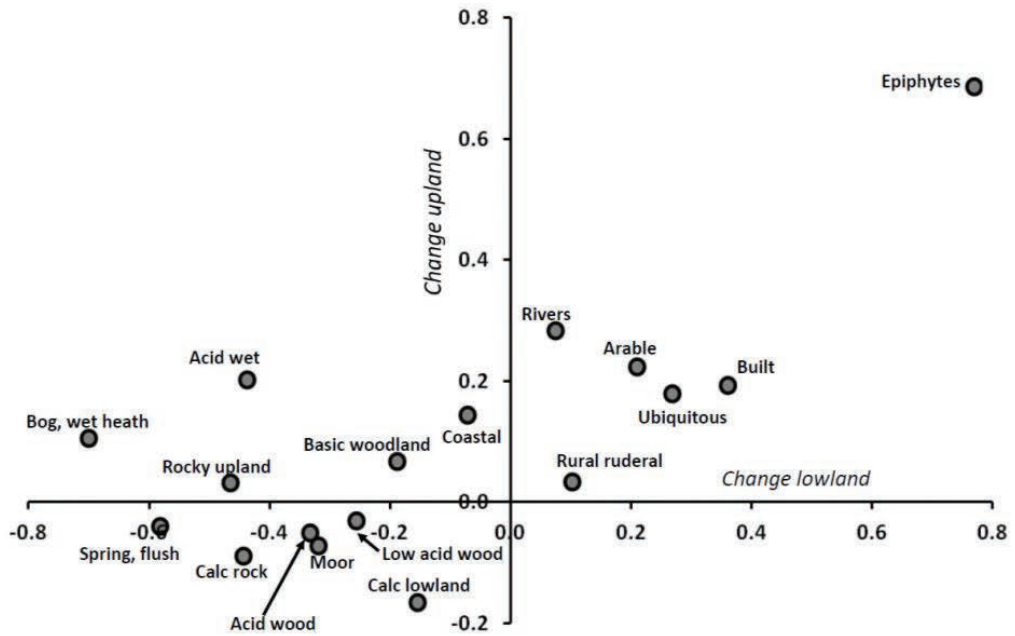




◁Fig. 1 (top). Recording fixed quadrats along a snowbed transect in the Cairngorms. J. Smith. ◁Fig. 2 (centre). Gordon Rothero with trainees Julie Smith and Clare Rickerby. D. Long. ◁Fig. 3 (below). *Conostomum tetragonum*, a typical snowbed moss, on Ben Nevis. G. Rothero.

with natural markers at the start, usually a large rock, and laid out with a 50m pre-stretched perlon cord marked every metre. To aid the re-setting of the transect line during any re-survey, the start point and several intermediate plots with distinct features were photographed. Plots along the transect were sampled with a 50 x 50cm quadrat every two or four metres depending on the total length of the transect as some were well over 100m in length. Species cover values were scored using the Domin scale to speed up the recording process as much as possible, and all bryophytes and vascular plants were recorded. In the end, 20 transects were set up and data from a total of 492 quadrats were collected. In addition, fixed point photographs were taken on all the transect sites and on a number of other snowbeds as well.

With Nick Hodgetts, I revisited two of the transects in 2012, both in the Cairngorms, in Coire Domhain and the Feith Buidhe. Both proved relatively easy to set up again and I am confident that the quadrat positions were within a couple of centimetres of the original set up. Only fairly simple analysis of this data has been attempted so far and, not surprisingly after only five years, significant differences are hard to discern. The current project, starting in 2014 and carrying on to 2016, has the aim of continuing this re-survey of the transects but also has a training element. As I drift into my dotage, and with other bryologists with the requisite knowledge no longer in the first flush of youth, it seems sensible to expose some younger bryologists, currently Clare Rickerby,



△ Fig. 1 (above). Average change in 35 yrs, uplands (y-axis) versus lowlands (x-axis), for bryophyte species grouped according to habitat. Values are natural logs of frequency ratios $\text{freq}(2000-2013)/\text{freq}(1960-1979)$. A change of 0.7 corresponds to a factor of two difference.

◁ Fig. 2 (left). Frequency of boreal species and their buddies in the lowland and upland zones.

Julie Smith and Oliver Moore, to the wonders of the snowbeds and the genus *Marsupella*. So far this has been very successful and as well as familiarization with the species, one further transect has been re-surveyed with the 'trainees'.

By 2016, it is probable that about half of the sites will have been re-surveyed, producing a mass of data which will require some sophisticated analysis to extract any general trends and, multivariate analysis not being my forte, it is fortunate that we have John Birks and John Arvid Grytnes at Bergen University to deal with this element. The site photographs are proving quite difficult to interpret as the appearance of the site varies considerably with the time since

the removal of the snow cover but they may well be more revealing over a longer time span.

Are boreal bryophytes dying of heat in southern Britain?

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Northern bryophytes such as *Paludella squarrosa* have steadily died out in southern Britain, but many of them disappeared before 1960 when the BBS recording scheme began. In most cases, habitat destruction was the immediate cause of loss. Since 1960, boreal bryophytes have decreased in lowland Britain by about 25%. We matched them with southern

species having similar ecological requirements ('buddies'). We found no evidence that boreal bryophytes declined more than their buddies. However, the increase of some southern species such as *Cryphaea heteromalla* and *Cololejeunea minutissima* does suggest that climate change is starting to have an effect on bryophytes.

Reference

Hill, M.O. & Preston, C.D. (2015). Disappearance of boreal plants in southern Britain: habitat loss or climate change? *Biological Journal of the Linnean Society*, 115, 598-610.

Bryophytes and the primary colonization of modern building surfaces

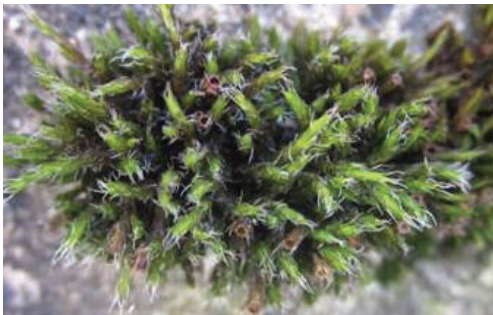
Wolfgang Hofbauer; wolfgang.hofbauer@ibp.fraunhofer.de

An overview of the initial colonization of the surface of modern external thermal insulation compound systems (ETICS) and the method of analysis were discussed. So far > 220 different organisms have been identified which are involved in the colonization of such surfaces during the first few years of service. This huge biodiversity was highly unexpected. Prevailing are algae (85 species), especially from the group Trebouxiophyceae and fungi in Ascomycetes (80 species), in particular representatives of the formerly so-called imperfect fungi. Amongst the first colonizers of ETICS surfaces are also some



mosses which may grow initially as protonemata only and therefore might be confused for algae. Some of the first mosses to colonize ETICS surfaces include: *Orthotrichum anomalum*, *Hypnum cupressiforme*, *Tortula muralis*, *Bryum argenteum*, *Bryum capillare* agg., *Tortella tortuosa*, *Encalypta streptocarpa*, *Grimmia* spp. and *Schistidium* spp. A short term SYNTHESYS project (GB-TAF-3881) at RBGE is now looking at the genetic aspects of populations of mosses (e.g. *Schistidium*) growing on modern building surfaces.

△Fig. 1 (above). Building showing emerging growth on its surface. W. Hofbauer. ▽Fig. 2 (below left). *Schistidium crassipilum*, a typical species growing on masonry in already perfect condition. W. Hofbauer. ▽Fig. 3 (below right). Specimens of masonry finishes exposed in Holzkirchen for several years to observe the first traces of growth. W. Hofbauer.



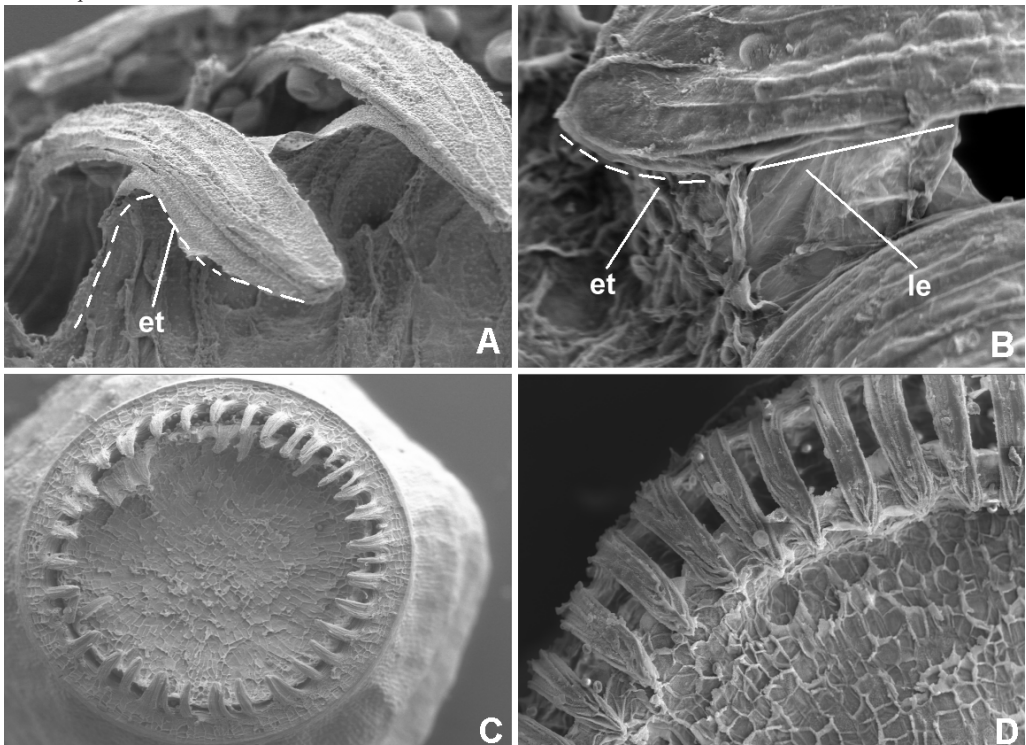
The genera of the Polytrichaceae – recent circumscriptions explained

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Recent molecular phylogenetic studies within the family Polytrichaceae have largely supported pre-existing generic concepts. Exceptions are the genera *Polytrichum*, *Polytrichastrum* and *Oligotrichum*, for which new circumscriptions have been proposed based on unequivocal evidence from molecular data supported by new

perspectives on morphology and biogeography. The genus *Polytrichastrum* G.L. Smith, segregated from *Polytrichum* in 1971, is retained for *P. alpinum* and related species (including the second U.K. representative, *P. sexangulare*), while the species previously placed in *Polytrichastrum* sect. *Aporotheca* (including the U.K. representatives *P. formosum* and *P. longisetum*) are recognised once more under *Polytrichum*. A number of sporophyte features support this, including reinterpretations of the peristome and epiphragm characters on which the segregation of *Polytrichastrum* was

▽ Fig. 1. Scanning electron micrographs showing peristome and epiphragm structures in *Polytrichum* and *Polytrichastrum* as now circumscribed. **A** - *Polytrichastrum alpinum* showing elongated "epiphragm teeth" (et) projecting above dorsal epiphragm surface and attached to long peristome teeth. **B** - Immature *Polytrichum commune*. As in *Polytrichastrum*, the peristome teeth are always attached to what is developmentally the lateral epiphragm surface (le). However in *Polytrichum* this part of the lateral surface usually becomes more or less inrolled and flattened onto the dorsal surface at maturity. Small projections homologous to epiphragm teeth (et) may still be present. **C** - Mature peristome and epiphragm of *Polytrichastrum alpinum*. **D** - Mature peristome and epiphragm of *Polytrichum xanthopilum* (previously *Polytrichastrum xanthopilum*).



based. Species of the genus *Oligotrichum* s.l. have been shown to occur in two major distantly related groups predominantly distributed in the northern and southern hemispheres respectively, with the southern species now recognised under *Itatiella* and *Notoligotrichum*. Based on new field collections, molecular analysis and new information on sporophyte morphology, the trans-Himalayan *O. glaciale* and the East African montane *O. cavallii* (recently also found on Réunion) appear to represent a previously unrecognised generic level grouping with affinities to *Psilopilum*, *Atrichum* and *Steereobryon*.

▽ Fig. 2. Gametophytes and sporophyte of *Polytrichum commune*.

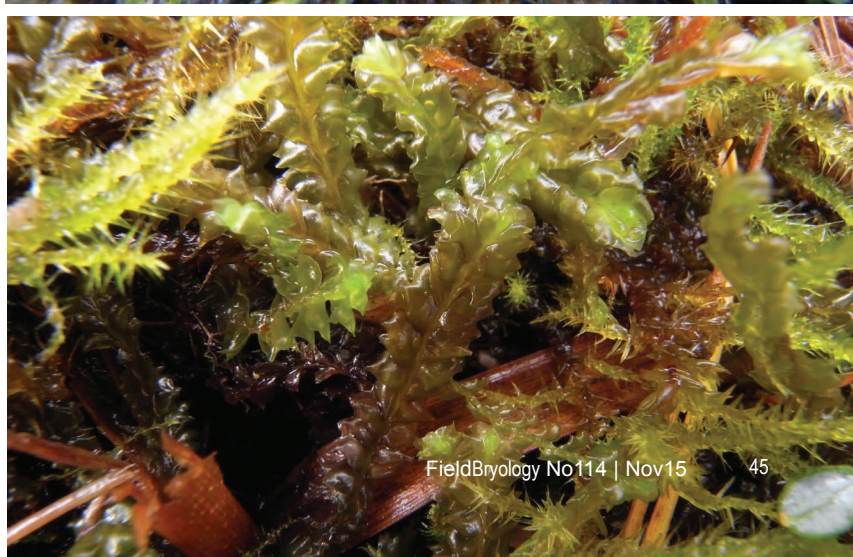


DNA barcoding for taxonomy and conservation in bryophytes

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Species based conservation programmes need to be founded on a sound and stable taxonomic framework to be effective. Bryophytes (mosses, liverworts and hornworts) represent the earliest-diverging lineages of land plants and have an important ecological role in many ecosystems, but conservation strategies are undermined due to taxonomic problems caused by their diminutive size and subtle distinguishing features, coupled with a general shortage of taxonomic expertise. DNA barcoding involves using one or a few standard regions of DNA as a universal tool for species identification. The ultimate goal is to develop a reference library of DNA barcode sequences against which any unknown samples can be compared for identification. The technique has a broad range of applications from general biological monitoring to identifying fragmented samples for forensic investigations and the illegal trade in endangered species, and it has also contributed to the discovery of new species. This study used DNA barcoding data (from the *rbcl*, *matK*, *psbA-trnH* & *ITS2* barcoding markers) in conjunction with morphological and ecological data to assess the taxonomic status and conservation value of 30 UK priority bryophyte species which displayed some level of taxonomic uncertainty posing barriers to the effective implementation of conservation strategies. Species discrimination was generally high across the species sampled, although amplification of *matK* was problematic for some moss lineages due to primer specificity. The effective species limits of 16 of the 30 priority species studied were supported by the DNA barcoding data, but additional complexity was encountered with the remaining species, which needs to be addressed

for effective allocation of conservation resources. This research shows how DNA barcoding can be a powerful tool for taxonomic science, assisting in the clarification of taxonomic uncertainty and as a result help to more efficiently prioritise the distribution of resources for biodiversity conservation. This is essential for ensuring that distinct endangered species with subtle distinguishing characters are not overlooked and to avoid expending resources in conservation action on dubious 'species' that turn out not to be distinct. The resolving power of DNA barcoding also shows the technique's potential for surveys and monitoring work when morphologically intermediate or aberrant specimens cannot be identified confidently by morphological methods alone.



▷Fig. 1 (top). The moss *Atrichum angustatum*, where DNA barcoding confirmed its distinctness from *A. undulatum* (photographed in Portugal). D. Long.

▷Fig. 2 (centre). The liverwort *Riccia canaliculata*, a member of the taxonomically difficult subgenus *Ricciella*, but well-supported by DNA barcoding. D. Bell.

▷Fig. 3 (below). The liverwort *Leiocolea rutheana*, which DNA barcoding showed to contain two distinct species. D. Long.

How rare is *Aneura pinguis*? A report from the RBGE *Aneura* workshop, 11-12 September 2014

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Participants: David Bell, Neil Bell, Anita Bollmann, Laura Forrest, Mikael Giolái, Kristian Hassel, Elizabeth Kungu, David Long, Oliver Pescott, Ana Seneca, Lars Söderström.

Although literature reports for *Aneura pinguis* L. give it an astounding distribution that ranges from the arctic to the tropics, bryologists have long acknowledged that the species represents “a nightmarish problem... probably requiring more than a single lifetime of research for a minimum understanding” (Proskauer, 1971). Indeed the first phylogenies to include more than one representative of *Aneura pinguis* showed that *Aneura mirabilis* (Malmb.) Wickett & Goffinet (*Cryptothallus*), the only confirmed non-photosynthetic bryophyte species, nested within *A. pinguis*. Recent reports of a third *Aneura* species, the Indonesian *Aneura maxima* (Schiffn.) Steph., as widespread within Europe have further complicated the issue.

To examine diversity within *Aneura pinguis*, over 200 *Aneura* accessions have been sequenced for DNA barcoding loci *rbcl* and *matK* at the Royal Botanic Garden Edinburgh and the Norwegian University of Science and Technology, Trondheim. Although mostly focused on British and Norwegian accessions, the data set contains samples from around the world, including material of *A. pellioides* (Horik) Inoue from Japan, *A. crateriformis* Furuki & D.G. Long from China, *A. sharpii* Inoue & N.G. Mill. from the United States and *A. maxima* from Java, as well as material determined as *A. maxima* from continental Europe.

Within Europe, at least nine distinct *Aneura* lineages occur in addition to the morphologically

distinct *Aneura mirabilis*; seven of these are found in Britain. These are not genetic matches to any of the named taxa that we have sampled, thus ruling out application of the epithets *PELLIOIDES*, *CRATERIFORMIS*, *SHARPII* and *MAXIMA*. All lineages can be easily distinguished using standard DNA sequence data. Morphologically, features like oil body size, presence or absence of hyaline thallus margins, rhizoid abundance, position and colour, thallus cross-section shape, and frequency of slime papillae may be characteristic. Many of these characters are best observed from living material, making it difficult to apply them to historic collections.

Of the molecular lineages, only one is considered to match the type concept of *Aneura pinguis*, which was based on collections that Dillenius (1742) described from near Oxford. This true *Aneura pinguis* seems to be ecologically restricted to free-draining and sand-dune habitats. It has not yet been sampled from outside Britain and Ireland.

It is unlikely that all European *Aneura* diversity has yet been sampled, particularly as our samples are predominantly from northern Europe. Furthermore, some lineages have been collected very rarely (perhaps indicating that the lineages themselves are rare); for example a single collection from Cors y Sarnau, Merioneth in Wales forms the sister lineage to *Aneura mirabilis*. Thus collections of *Aneura*, particularly from unusual habitats, are still required.

Acknowledgements

Michelle Hart, Alex Clark and Ruth Hollands (RBGE) generated part of the data set, which was funded by the Scottish Government's Rural and Environment Science and Analytical Services Division and Norwegian University of Science and Technology, Trondheim. Juan Carlos Villarreal helped arrange the meeting.



△Fig. 1 (top). *Aneura pinguis*, the sand-dune taxon considered to match Dillenius' type material of the species. D. Long.

△Fig. 2 (below). *Aneura*, the large taxon growing in damp woodlands. D. Long.

References

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Proskauer, J. (1971). Notes on Hepaticae – V. *The Bryologist*, 74, 1-9.