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Reports of BBS meetings

Throughout the following account, new vice-county records are indicated with an asterisk (*). Nomenclature follows Paton (1999), *The liverwort flora of the British Isles*, and Smith (2004), *The moss flora of Britain and Ireland*, 2nd edition.

AGM and Bryological Symposium 2005, Bangor

T.H. Blackstock

Countryside Council for Wales, Maes-y-Ffynnon, Penrhosgarnedd, Bangor, Gwynedd, LL57 2DW

The Annual General Meeting and Bryological Symposium were held at the University of Wales, Bangor, on 9-11 September 2005. Between 1950 and 2000, under the impetus of Paul Richards, who was Professor of Botany from 1950 to 1976, the university had been one of the major academic institutions in Britain with a strong bryological specialisation. Many prominent British bryologists of the last fifty years have worked or been trained at Bangor. Although students are no longer exposed to bryological research, there is a rich and well-studied bryophyte flora to explore in north-west Wales.

Some 45 participants attended the meeting, and it was a particular pleasure to welcome to Bangor three foreign BBS members – Sanna Laaka-Lindberg and Alain Vanderpoorten (who both gave presentations at the symposium) and Herman Stieperaere (a BBS Council member).

Bryological Symposium

The general theme of the symposium was the *Natural history of bryophytes*, but a wide diversity of subject matter was presented by the speakers, and the geographical range covered – Finland, Yunnan, Macaronesia and southern Chile, as well as western Europe – outdid the most remarkable of bryophyte disjunctions. I am very grateful to them all.

Short abstracts have been submitted by most speakers and these are presented on pp 11-16, together with the titles of other talks.

Studies in the liverwort genus *Mannia*

Daniela Schill (Royal Botanic Garden, Edinburgh)

The genus *Mannia* (Aytoniaceae, Marchantiales) was first described by Opiz in 1829 and it has not been entirely clear how many species it comprises worldwide. The generic and subgeneric division of *Mannia* has long been confused, and several attempts have been made to subdivide it into smaller genera. Morphologically it is typically characterised by a small and rather narrow thallus, cup-shaped involucres and the lack of a pseudoperianth. It includes both xeromorphic and mesomorphic species, which are all drought-tolerant. *Mannia* occurs predominantly in the northern hemisphere with exceptions in Africa and South America. It is found on rock, rocky soil or rock crevices in arctic-alpine and mediterranean climates. With its relatively large spores reaching up to about 90 µm diameter, the species within *Mannia* show striking spore ornamentation patterns, which are species-specific and have proved to be a very valuable tool in identification.

A worldwide revision of the genus has not been previously attempted, and earlier treatments focused on thallus morphology and limited geographic regions. Preliminary molecular studies using chloroplast *trn*L intron and nuclear ribosomal LSU suggest the genus is paraphyletic and has evolved from within its sister genus *Asterella*.

Trends in diversity and abundance of bryophytes in a managed landscape: implications for conservation management

Alain Vanderpoorten (University of Liège, Belgium)

Among the policies that are currently implemented in an increasing concern for nature protection, the EEC Habitats Directive aims to establish an international network of habitats of high conservation value. In this context, bryophytes may be useful bioindicators in a range of ecosystems where they substantially contribute to global diversity. The identification of areas of high diversity and/or originality requires a precise knowledge of species distributions. This involves a huge amount of fieldwork for comparatively few bryologists within a short period of time. One possibility is to assist fieldwork by defining potential species distributions from predictive models employing known landscape features. An example application was given of *Aneura maxima* in southern Belgium. The diversity patterns that have been observed in this region suggest that global species diversity is concentrated within a few hotspots. Calcareous grasslands constitute one of these hotspots, and the impact of different management regimes has been examined in more detail. Biodiversity and conservation assessments also currently take place in the context of a confusing taxonomy due to issues associated with the identification of species from difficult groups or unstable species concepts. Molecular systematics has therefore been strongly developed during the last decades to help to resolve such problems. The use of simple species-specific molecular markers to aid taxon identification was illustrated in the genus *Leucobryum*. Molecular phylogenies can be used to test traditional species concepts and present new, arguably more stable, classification systems that are needed for biodiversity assessments.

Bryophyte survey of the Gaoligong Shan, Yunnan

David Long (Royal Botanic Garden, Edinburgh)

The Gaoligong Shan is a linear mountain range rising to 4435 m running north-south for 600 km on the Yunnan/Burma border. Western China, particularly Yunnan and Sichuan Provinces, is a global hotspot for bryophytes, but many areas are still poorly explored. The 'Biotic Survey of the Gaoligong Shan' aims to intensively sample major groups of plants and animals from throughout the range, covering all the main vegetation types in different seasons. The main funding is from the US National Science Foundation; collaborating institutes are the California Academy of Sciences, Academia Sinica, Kunming Institutes of Botany and Zoology, and the Royal Botanic Garden Edinburgh. The project runs for five years (2002 to 2006) and comprises 10 expeditions. The two bryologists (Jim Shevock and David Long) have now participated in six expeditions.

Bryological fieldwork to date has covered a range of vegetation types from lowland subtropical evergreen forest to the alpine zone up to 3700 m, mostly between the Nu Jiang (Salween River) and the Burmese border, but also in the Irrawadi (western) catchment at the northern end of the range. Four to six sets of specimens are collected and distributed to herbaria in China, USA and Edinburgh, and a series of papers is planned describing new species and other discoveries, as well as a check-list.

Many significant discoveries have been made, including mosses such as *Handeliobryum sikkimense*, *Hydrocryphaea wardii*, *Microdendron sinense* and *Takakia lepidozioides*, and the liverworts *Anastrophyllum joergensenii*, *Scaphophyllum speciosum*, *Schistochila macrodonta* and several other species disjunct with Scotland, and many epiphyllous Lejeuneaceae in the evergreen forests. The most recent expedition was to Fugong County around the middle of the range and 1,050 bryophytes were collected. For the first time on the project it was possible to collect extensively at high altitude in the alpine dwarf *Rhododendron* scrub on the Burmese border. This area was especially rich in bryophytes and the collections are likely to include some significant new finds. To date around 4,800 collections have been accumulated, and it is hoped that the resulting inventory of bryophytes will contribute to the large volume of data, strengthening the case for stringent protection of this outstanding mountain range.

Effects of simulated climatic changes on the bryophytes of a limestone grassland

Jeff Bates (Imperial College at Silwood Park, Ascot)

This talk focussed upon the effects of climatic warming and related drought on bryophytes. Most of us are aware that weather patterns today are subtly different from those that were once familiar, with winters tending to be less cold, spring arriving sooner, and summers warmer (and often drier) than they once were. These observations have been amplified in a number of studies that correlate rising global temperatures with increasing emissions of greenhouse gasses (notably carbon dioxide and methane), principally as a result of human activity. Predictions about future human population growth and industrial development suggest that the concentrations of greenhouse gases will continue to rise, and models based on these data, in turn, predict further significant temperature increases.

Effects of warming on British bryophytes are relatively unexplored. There are almost no unambiguous observations of bryophytes extending their ranges into previously cooler areas of the country. However, the tiny epiphyte *Cololejeunea minutissima*, formerly restricted to the south and west coasts, appears to be spreading into more inland areas, and the apparent recent spread of *Colura calyptrifolia* in Wales (Bosanquet, 2004) could possibly be related to rising temperatures, although the moisture factor is also likely to be important in this case.

Predictions of future climatic warming have stimulated a number of long-term studies involving the effects of simulations of temperature increase and related factors such as drought on a range of ecosystems. One such study has involved upland limestone grassland in the 'white peak' area near Buxton, Derbyshire. This was established in 1994 by Professor J.P. Grime and colleagues from the Unit of Comparative Plant Ecology at the University of Sheffield. A range of simulated climate treatments have been applied annually to 3 x 3 m plots in ancient sheep-grazed grassland: 'winter warming' is by means of closely-spaced soil-heating cables; 'summer drought' is effected by means of

transparent covers that slide across some of the plots whenever rainfall is detected; 'supplemented summer rainfall' (a possible consequence of warming in some regions) involves adding extra water to another set of plots. Thus, three levels of rainfall (summer drought, ambient, summer supplemented) were factorially combined with two levels of temperature (ambient, winter-warmed) and replicated five times.

Accounts of the treatment effects on flowering plants and their symbiotic fungi have appeared elsewhere (Grime *et al.*, 2000; Staddon *et al.*, 2003). The bryophytes were initially ignored but were surveyed by the speaker in 2001, i.e. after seven annual repetitions of the treatments. Bryophyte cover of the 30 plots was estimated using 15 quadrats of 30 x 30 cm randomly placed within each plot. The data were explored for individual species by factorial ANOVAs and collectively by ordination methods.

Thirty-nine bryophyte taxa were present. In terms of average cover, the five most abundant species in decreasing order were *Pseudoscleropodium purum*, *Rhytidiadelphus squarrosus*, *Ctenidium molluscum*, *Dicranum bonjeanii/scoparium* and *Thuidium tamariscinum*. ANOVAs served to emphasise two points: the relative paucity of species responses to the treatments and a strong block (replicate) effect for many species, presumably a result of the original plot selection being based upon the homogeneity of the vascular vegetation rather than that of the bryophytes. An unconstrained ordination (Detrended Correspondence Analysis) of the bryophyte cover data failed to detect a clear signal caused by the experimental treatments but instead emphasises natural variations, perhaps arising from slope differences, soil depth variations and moisture seepages. Only in the case of a Canonical Correspondence Analysis ordination constrained by the climatic treatments was an unambiguous 'warm and dry' versus 'cold and wet' axis identified (for further details see Bates, Thompson & Grime, 2005). The clearest 'increasers' with imposed summer drought and/or winter warming were *Campyliadelphus chrysophyllus* and *Fissidens dubius*, both mosses whose distributions extend into the tropics. The clearest 'decreasers' under winter warming were *Rhytidiadelphus squarrosus* and *Lophocolea bidentata*. *R. squarrosus* and *Calliergonella cuspidata* were the only common species to increase with supplemental summer rainfall.

Several possible reasons for the resilience of the grassland bryophytes to simulated climatic change were discussed. These include the fact that most grassland bryophytes are desiccation-tolerant to some degree (and once dry, also heat-tolerant), so that warm-dry periods can be easily endured. A possible flaw with all such experiments is that potential 'increasers' are absent or scarce in the upland flora. At Buxton the modest thermophile *Homalothecium lutescens* was recorded in only one of the 450 quadrats sampled and there was no evidence for invasion by other thermophiles. Lastly, it is possible that the dependence of the growth of grassland bryophytes on conventional rainfall has been over-emphasised. Dewfall may be more important for their hydration, particularly in an upland context, than has previously been realised. If this is the case, the rainfall treatments employed might be expected to have only a limited influence.

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Bryophytes of southern Chile

Shaun Russell (University of Wales, Bangor)

The UK Government's Department for Environment, Food and Rural Affairs' 'Darwin Initiative' is an international scheme of funding for biodiversity conservation. It is supporting a three-year project entitled: Inventory and Conservation of the Bryoflora of South-Western Patagonia. The southernmost province of Chile is a hotspot for bryophytes, which far outnumber vascular plants in the region. But the local ecology is under threat from logging, fish-farming, gravel and peat extraction, and tourism interests. A UK

team of bryologists led by Prof. Jeff Duckett (Queen Mary & Westfield College, London) and Dr Shaun Russell (University of Wales, Bangor) is collaborating with Chilean biologists to collect and catalogue the local bryoflora, train local biologists in the science of bryology, set up a cryptogamic research laboratory and bryophyte herbarium, and raise awareness of the richness and value of the southern flora at the local, regional and national levels in Chile. In year one of the project (2005), during a two-week ship-borne expedition in the southern channels of Tierra del Fuego, a multinational team of experts from the UK, Chile, USA, Germany and Finland collected approximately 4,000 specimens from 30 localities. The specialist cryptogam laboratory has been established at the Magellanic University in Punta Arenas, 16 Chileans were trained in the field, and 90 more attended a one-day conference in Santiago where the visitor potential of 'The Miniature Forests of Cape Horn' was promoted, and the concept of 'Tourism with a Handlens' was explored.

The collaborating scientists are currently working on their collections; several new and interesting taxa and range extensions have emerged and will be reported upon in the bryological literature. Specimens from the region are also throwing light upon the early evolution of the hepatics. Contributions have been made to a popular Spanish language natural history field guide to Fuegia, and to a successful effort to have the region declared a Biosphere Reserve by UNESCO.

Bryophyte disjunctions: a new taxon and hidden sex

Jane Squirrell (Royal Botanic Garden, Edinburgh)

In bryophytes disjunct distributions are a common feature. However, it is as yet unclear as to the relative roles of long-distance dispersal or ancient vicariance as determinants of these patterns.

Scotland's hepatic mat communities consist of a number of liverworts that show extreme intercontinental disjunct distributions. By using genetic markers to assess patterns of genetic diversity between disjunct populations our aim has been to evaluate the roles long-distance dispersal and vicariance have played in establishing their current distribution. Two unexpected outcomes of this research were also discussed. Firstly, the taxonomic re-evaluation of *Anastrophyllum joergensenii* populations. Secondly, the presence of genetic diversity within Scottish populations of *A. alpinum* where sporophytes have yet to be found, suggesting that although sexual reproduction has not been observed in these populations, sex must have occurred at some time.

Bryophyte phylogeny: where we were five years ago, where we are now and where we want to be

Jeff Duckett (Queen Mary & Westfield College, London)

Introduction

This is a compilation of the collective endeavours, ideas and inspiration of Joel Duff, Roberto Ligrone, Brent Mischler, Karen Renzaglia, Scott Schuette and Jon Shaw. The full text and bibliography of this synthesis will shortly be published in the *Bryologist*.

Background

When I joined the British Bryological Society 41 years ago, the phylogeny of bryophytes was a deeply unpopular subject. In the absence of significant new data it was increasingly regarded as the province of ageing armchair bryologists who did little more than revamp antediluvian ideas based solely on morphology and with little or no insight into unravelling convergences, parallelisms and reductions. Today we are in the middle of a new age in systematics where molecular and total evidence phylogenies are increasingly replacing guesswork and intuition. A veritable goldmine of new information is revolutionising understanding of relationships between bryophytes and other land plants, between the different bryophyte groups, and within the various bryophyte lineages. This situation is clearly reflected in the exponential rise in the number of papers with phylogeny in their title published in the *Bryologist* since 2000. Thus in 2005, the year of the XVII Botanical Congress in Vienna, it seemed appropriate to take stock of progress in understanding

bryophyte phylogeny since the last congress in St Louis, 1999, and to look forward to future challenges.

Relationships between groups

By 2000 it was well established, from a compilation of chloroplast genome sequences plus morphology, including major contributions from spermatogenesis and placental ultrastructure, that bryophytes are a monophyletic group. Liverworts had replaced hornworts as the basal lineage in the land plant tree, a situation clearly in line with their simple sporophytes and absence of stomata. Mosses were still considered as a possible sister group to vascular plants, a key commonality being the long-held notion of homology between polytrichalean hydroids and tracheary elements.

2005 sees liverworts even more firmly rooted (perhaps more accurately rhizoided) at the base of the land plant tree but, based on mitochondrial intron data, hornworts now appear as sister to tracheophytes – a situation profoundly disturbing to those nurtured on the notion of their primitive status. However, congruent with this new position is the recent discovery of xylans (major cellulose-linking polysaccharides in secondary walls in higher plants) in the walls of the pseudoelaters and spores of hornworts and their absence in the gametophytes and sporophytes of mosses and liverworts. Reappraisal of the key features of hornworts previously used to support their basal status (*viz.* symmetrical, dextrally-coiled spermatozoids, monoplastidic vegetative cells, pyrenoids and highly distinctive patterns of cell division in gametangial ontogeny) is an exciting major challenge for the future. New ultrastructural and immunocytochemical data have clearly demonstrated the multiple evolution of water-conducting cells in bryophytes (at least twice in liverworts: *Haplomitrium* and Pallavicineaceae, and three times in mosses: *Takakia,* Polytrichales and Arthrodontae), and it is now becoming widely accepted that hydroids are not homologous with tracheids.

Relationships within groups

Turning to the individual groups of bryophytes, in 2000 no molecular studies had been carried out on hornworts. And, from morphology alone, *Notothylas*, with its small estomate sporophytes, was generally regarded as the most likely basal genus. In mosses, in contrast, consequent on multilocus DNA sequencing and a reappraisal of morphological characters with a significant new input from protonemal features, interrelationships were beginning to solidify. *Sphagnum* and *Takakia* were identified as the basal clade, though which of these is sister to *Andreaea* and *Andreaeobryum* was not resolved. A nematodont clade comprising the Polytrichales, Tetraphidales and, surprisingly, *Oedipodium*, formerly placed in the Funariales, lies between the last two genera and the arthrodont mosses. Molecular sampling of liverworts was limited to single gene analyses, with the most intensive studies on the Marchantiales, now including *Blasia* as the basal taxon, a position previously predicted from spermatid ultrastructure. Genera such as *Monoclea* and *Riccia* were repositioned from near-basal to derived representatives at the ends of reduction series. Relationships within and between the Jungermanniales and Metzgeriales remained unclear.

In 2005 the overall picture has changed considerably with many unsuspected and surprising revelations.

Hornworts in 2005

As a result of intensive sequencing, particularly of southern hemisphere taxa, *Leiosporoceros,* a remarkable genus lacking pyrenoids and with *Nostoc* distributed in channels along its thallus rather than in spherical colonies, comes out as the basal genus, whereas genera lacking stomata (*Notothylas*, *Megaceros* and *Dendroceros*) are derived. *Megaceros* and *Phaeoceros* are both polyphyletic.

Mosses in 2005

In mosses, despite five more years of intensive molecular sampling, the major questions of 2000 still remain unanswered. Whether *Sphagnum* or *Takakia*, or a clade containing both, is the earliest divergent lineage is unresolved, as is the precise location of *Oedipodium* in relation to peristomate mosses. Relationships amongst the three arthrodont subclasses (Funariidae, Dicraniidae and Bryiidae) remain ambiguous, as does the placement of the Timmiaceae. On the other hand, progress includes the separation of *Diphyscium* from *Buxbaumia*, the latter now being included in the nematodont clade, and the grouping of Seligeriaceae and Ptychomitriaceae within the Grimmiales. Paradoxically in today's molecularcentric world, moss phylogeny now cries out for major new inputs from morphology. Areas most likely to provide key data include comparative spermatology (mosses are very poorly investigated compared to liverworts), protonemal morphology, and the ultrastructure and immunocytochemistry of conducting cells, peristomes and placentas.

Liverworts in 2005

Since 2000, analyses of several heterogeneous data sets have led to the establishment of a well supported

backbone phylogeny for liverworts. Whilst some long-held views on relationships are maintained, several surprising new affinities have come to light. *Haplomitrium* and *Treubia* are resolved in a basal monophyletic group clearly distinct from all other liverworts. The complex thalloid taxa form a natural assemblage with *Blasia* and *Cavicularia* at the base, whilst *Riccia* is derived and reduced and *Monoclea* and *Dumortiera* are examples of the loss of air chambers associated with recent shifts from xeric to mesic habitats.

The simple thalloid taxa cluster into two distinct paraphyletic groups: Metzgeriales 1 and Metgeriales 2. The former includes most traditional simple thalloid genera, including *Phyllothallia*, *Moerckia*, *Fossombronia* and *Petalophyllum*, and taxa with thick-walled water-conducting cells (*Hymenophyton*, *Pallavicinia* and *Jensenia*) form the crown assemblage. Metzgeriales 2 is a small clade including *Pleurozia* at its base (thus providing an explanation for its unique 'upside down' shoots), *Metzgeria* and a derived group including the Aneuraceae together with *Verdoornia*, a genus previously regarded as basal and isolated by Schuster. A final major clade embraces all the leafy liverworts excluding *Pleurozia*.

The distribution of endophytic fungi in liverworts shows a striking parallel with the current phylogenetic tree. Unique lump-forming glomeromycete associations, found in *Treubia* and *Haplomitrium*, are perhaps the most ancient of all land plant-fungus symbioses, whilst the ascomycete and basidiomycete relationships found in some leafy liverworts, the Aneuraceae and *Verdoornia* are almost certainly more recent in origin. The most promising line of enquiry for further insights into liverwort phylogeny would appear to be more of the same as that over the past five years but with sampling of far more leafy taxa and a superimposed analysis of fungal associations.

Origin and evolution of the Macaronesian bryoflora

Alain Vanderpoorten (University of Liège, Belgium)

The Macaronesian islands host a rich bryoflora from various geographic origins and include a number of endemic taxa. They constitute therefore a model of prime importance for addressing a number of questions related to dispersal ability, evolution and speciation processes.

The phytogeographic patterns in the Macaronesian bryoflora involve a substantial number of long-distance dispersal events. Similarly, current evidence of the relationships of endemic species suggests an evolution from species stocks currently located in a range of continents including Oceania and southern America. The apparent conflict between the long-distance dispersion ability of bryophytes and the evolution of endemics raises a number of questions that we aim at addressing in the context of a programme of work on the origin and evolution of the Macaronesian bryoflora.

Other talks

Using 'barcodes' to explore diversity in the British bryoflora. *Angela Newton (Natural History Museum, London).*

Reproductive ecology of epixylic hepatics. *Sanna Laaka-Lindberg (Lammi Biological Station, Finland).*

Bryophytes of arable land in Britain and Ireland. *Chris Preston & Mark Hill (Centre for Ecology and Hydrology, Monks Wood).*

Celebration of a new bryophyte book

After the AGM, we had the happy occasion – made happier by a generous quantity of champagne supplied by Chris Preston – of celebrating the publication of *Mosses and liverworts* (in the Collins New Naturalist series) by two very active BBS members, Ron Porley and Nick Hodgetts. It was a great pleasure to warmly congratulate

the authors on their splendid publication, and also to mark the occasion by presenting each of them with a framed copy of the very effective cover illustration by Robert Gillmor, arranged by Jill Sutcliffe (Ron's boss at English Nature).

Field excursion to Snowdonia

On Sunday 11 September most participants joined the field excursion to Nant Gywnant. We concentrated on the bryophytes in a stand of ash-alder woodland above Hafod Rhisgl (mostly in SH6552) on the east slopes of the valley opposite Snowdon. It has an impressive Atlantic flora on rock outcrops, boulders and trees and in seepage zones and stream gullies. *Plagiochila spinulosa* and *P. punctata* were frequent; *P. bifaria* was also detected, and Gordon Rothero located *P. exigua* and a patch of *P. atlantica**. *Jubula hutchinsiae* was locally abundant on wet rocks by the main stream, and mats of *Riccardia palmata* outshone *Nowellia curvifolia* on many rotting tree trunks. *Conocephalum* attracted attention, with big shiny patches of *C. conicum* and dull smaller growth of *C. salebrosum* growing in close proximity. The rarities *Radula voluta* and *Sematophyllum demissum* were refound, both in very small quantity.

Before dispersing, in the early afternoon we moved to Pont Aberglaslyn (SH5946), south of Beddgelert, to admire *Fissidens polyphyllus* which grows in considerable abundance in the riparian zone of the Afon Glaslyn at this locality.

Reports of local meetings

A regional meeting in south-west Scotland, October 2005

David Chamberlain & Liz Kungu

Department of Botany, Royal Botanic Garden, Edinburgh, EH3 5LR

This meeting was planned as a square-bashing exercise to cover poorly recorded 10-km squares within one hour's journey of Hightae in Dumfries over a long weekend. The seven participants came and went as time allowed; the core team stayed in a self-catering house at the invitation of Liz Kungu. New vice-county records are denoted with an asterisk.

On Thursday 6 October, David Chamberlain and Liz Kungu stopped off en route from Edinburgh in a square around Crawford John in Lanarkshire (v.-c. 77). Red Moss produced 14 species of *Sphagnum*, including *S. angustifolium**, *S. subsecundum**, *S. teres* and *S. warnstorfii*. The relatively base-rich flushes that supported the last two species also contained *Rhizomnium pseudopunctatum* and *Tomentypnum nitens*. A visit to the abandoned limestone workings at Whitecleugh turned up *Leiocolea badensis* and