



BBS Annual Meeting and Conference

Preston Montford, 10–12 October 2008

The 2008 meeting was held at the Preston Montford Field Centre, Shropshire, a familiar venue for many of us. Over 40 members and guests attended and it was good to welcome overseas members Irene Bisang and Lars Hedenäs from Sweden, and Jessica and Jim Beever from New Zealand.

Council, conservation and publications committee meetings were held on Friday night; the main programme started on Saturday morning with talks and a poster presentation around the theme of Bryophyte Ecology. Jeff Bates started proceedings with an update on the progress of the BRECOG project to date (p. 47), and this was followed by a full programme of talks:

- ▷ Irene Bisang – *Sexual reproduction in the world of unisexual mosses* (p. 48)
- ▷ Chris Preston – *No sex please we're British: non-fruiting bryophytes in the British Isles* (p. 49)
- ▷ Sylvia Pressel – *Studies on protonema* (p. 50)
- ▷ Ken Adams – *Woodpecker dust and mountain bikes – the organization and presentation of large*

*amounts of dynamic distribution data for red data species (ecology of *Zygodon forsteri*)* (p. 51)

Jeff Bates – *Salt tolerance and survival of *Schistidium maritimum** (p. 52)

- ▷ Michael Proctor – *Small is beautiful: optimum plants at a small scale* (p. 53)

In addition, Ken Adams gave an update on the library move, and there was an opportunity to visit it in its new location in the Field Centre, whilst Ian Atherton brought along the 'beta test version' of the new *Field Guide* in its almost finished form, much to the admiration of all.

The poster presentation by Robin Stevenson was on his continuing studies of the ecology of bryophytes in Norfolk following his paper with Mark Hill earlier this year in *Journal of Bryology*. We also had the opportunity to look at the first copies of June Chatfield's new book for beginners on *How Begin the Study of Mosses and Liverworts* (see review on p. 59).

An impromptu short field visit by Jeff Duckett and a few others to a crumbling clay bank in the



△ *Discelium nudum*. Jonathan Sleath

◁ The bright green protonemal mat of *Pogonatum* sp. (left and centre) contrasting with the duller green of *Discelium nudum* (upper right). Ian Atherton

◁ Opposite page. Preston Montford Field Centre. Ian Atherton

centre grounds turned up *Discelium nudum* and Jeff was able to demonstrate naked antheridia and newly developing setas with their characteristic spiral shape, as well as jizz features to distinguish its persistent protonema from that of *Pogonatum* spp.

The AGM was held at 1600, quickly followed by a meeting of the Tropical Bryology Group. After dinner Ken Adams held a workshop on microscopy techniques (p. 56), and the BRECOG steering group held a meeting.

On Sunday we had a slight departure from the norm with a choice of two field trips, an opportunity to carry out some BRECOG survey work at Ercall Hills led by Dan Wrench (p. 54) and a more conventional trip to Loton Park led by Mark Lawley (p. 54).

I would like to take this opportunity to thank the head of centre, Sue Townsend, and all of her staff for helping to make this meeting a success.

Martin Godfrey (e martinandrosie@aol.com)

ABSTRACTS OF TALKS

Toward an Ecological Atlas of Common British Bryophytes – Jeff Bates

Only a rudimentary understanding of the factors which distinguish the ecological niches of many of our most common British bryophytes exists at present. Besides the direct benefits of knowing what makes familiar species 'tick', hypotheses about the nature of bryophyte communities could

be tested if detailed quantitative data about the British and Irish bryophyte floras existed. It was for these reasons that the Society's Bryophyte Ecology Group (BRECOG) was initiated in March 2006. A major objective of BRECOG is to publish an 'Ecological Atlas' of our common species, bringing together the results of standardized field observations and laboratory investigations. The most appropriate existing model for such an atlas is *Comparative Plant Ecology: A Functional Approach to Common British*

Species by J.P. Grime, J.G. Hodgson & R. Hunt, published in a second, enlarged edition in 2007. It presents data on common vascular plants revealed by survey work in the Sheffield region of England. A comparable work on bryophytes would benefit from a nationwide rather than regional ecological survey, and inclusion of physiological data, the latter made possible by their smaller sizes and the smaller number of species compared to vascular plants.

The Bryophyte Habitats Survey, initiated in March 2007, involves a quadrat-based survey of bryophytes in individual microhabitats sampled within a 1-in-18 selection of 10-km grid squares in Britain and Ireland. Besides estimating percentage cover of the individual bryophyte species, information on fruiting and gemma production is recorded, and assessments are made for a number of simple environmental factors. The microhabitats are classified within a framework of major habitat types combined with different substrata (e.g. soil, rock, bark, etc.).

A brief resumé was given of the progress made in field recording during the first 18 months. Data

are also being collected systematically for common bryophyte species subjected to some standardized stresses in the laboratory. These include periods of desiccation up to 45 days at two intensities (relative humidity 23 and 74%) followed by assessment of recovery at 20 minutes and 24 hours after rehydration. This involves measuring quantum efficiency with a chlorophyll fluorometer. Light response curves are also being obtained using the same instrument. These studies are being undertaken by undergraduates on paid summer placements at Imperial College and they are already adding significantly to available published data. It would also be useful either to obtain direct measurements of relative growth rates of common bryophytes under standard conditions, or to determine a correlated 'soft trait'. However, no decision has yet been made on the best way to tackle this aspect.

Further details about this project can be found in *Ecology Matters* in this issue on p. 36.

Jeff Bates, Imperial College London, Silwood Park Campus, Berkshire (e.j.bates@imperial.ac.uk)

Sexual reproduction in the world of in unisexual mosses – Irene Bisang

A majority of bryophyte taxa worldwide are unisexual. Uneven frequencies of male and female gametophytes are often observed in nature, despite a theoretically expected 1♂:1♀ progeny gender ratio at meiosis. Recent investigations and compilations clearly show that female dominated sex expression appears to be the general pattern at different spatial scales.

Spatial segregation of sexes, which is accentuated by skewed sex ratios, affects the chance for sexual reproduction. Several 'models' have developed in bryophytes to overcome negative effects of gender separation, such as splash cups, dwarf males, or explosive discharge of spermatozoids in thalloid liverworts, though most species do not possess such means. We show in two epigeic pleurocarpous mosses that fertilization success is distance-dependent and limited by mate availability.

Maximum fertilization ranges are several times larger than previous estimates, which has implications for our understanding of population structures at the local scale.

Although the phenomenon of unbalanced adult phenotypic sex ratios has repeatedly been debated, the underlying causes are poorly understood to date. Lately, the prevalence of females expressing sex, i.e. male rarity, in unisexual bryophytes was proposed to result from higher realized cost of reproduction in males than in females. Since many bryophyte species and/or populations do not complete sexual reproduction to fertilization and sporophyte production, the 'realized cost' refers to pre-zygotic reproductive costs (formation of gametangia and associated structures). We tested this postulation in the female-biased and rarely sporophyte-bearing *Pseudocalliergon trifarium*. Gametangia formation did not incur a cost in terms of subsequent growth and reproduction.

Annual investment in sexual branches was larger in the more common females than in the rarer males, in this species. Thus, higher pre-zygotic reproductive costs in males than in females cannot serve as a general explanation for male rarity in unisexual mosses. Other possible mechanisms resulting in uneven adult sex ratios include sex-specific life history traits which may act at different ontogenetic stages, or habitat speciali-

zation of the sexes. Currently, we are investigating sex ratios as well as levels of sex expression and sporophyte frequencies in a phylogenetic context. Preliminary results in two clades of wetland taxa suggest that phylogenetic history plays a role in explaining sex expression patterns.

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No sex please, we're British: non-fruiting bryophytes in the British Isles – Chris Preston

We tend to think of bryophytes which rarely or never fruit as an unusual group, characterized by the hyperoceanic liverworts of western Scotland and Ireland. However, 20% of bryophyte species have never been recorded as fruiting in the British Isles (18% mosses, 25% liverworts, 0% hornworts) and such species can be found throughout the region. The vast majority are dioicous, and over half of them lack specialized vegetative propagules. Previous studies of non-fruiting species have been in the context of studies of rarity. The relationship between phytogeography and fruiting performance has not been studied in any detail. Half (49%) of

the mosses in the British Isles are at the edge of their world range (Arctic, Boreal, Mediterranean and Hyperoceanic), with a greater proportion of non-fruiting species (71%) than fruiting species (44%). For liverworts, 64% of all species are at the edge of their range, with 59% of fruiting species and 83% of non-fruiting species. Species which are not known to fruit anywhere in the world tend to have hyperoceanic or oceanic ranges, and include the famous western liverworts. Bryophytes, and in particular mosses, which have not been found fruiting in Britain but are known to fruit elsewhere tend to have northern or Mediterranean ranges.

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Highly unusual protonemal propagules: an ecological perspective – Silvia Pressel & Jeff Duckett

Numerous studies have shown that moss protonemata, including the asexual propagules that they produce, are a rich source of taxonomically useful characters. Orders that produce a typical filamentous protonemal system, as opposed to the thalloid protonemata typical of the Sphagnales, Andreales and Tetraphidales, can be distinguished by the presence or absence of protonemal gemmae. These are completely lacking in the Polytrichales, where rhizoidal tubers are also rare, and are generally highly infrequent in pleurocarpous mosses. When present, protonemal gemmae exhibit a range of different morphologies, including diverse abscission mechanisms, all of which are often diagnostic of particular groups.

For example, the morphology and abscission mechanism of gemmae within the genus *Zygodon* are remarkably consistent; gemmae are typically uni- or biseriata, cylindrical or clavate with short abscission cells (Duckett & Ligrone, 1992). *Z. forsteri* is a most striking exception. In culture this species produces spherical structures at the tips of filaments or along gemmiferous side-branches; following breakage of the cell wall a chloronemal filament develops from these structures and eventually becomes detached from the parent filament. These unique characters reinforce other molecular and morphological studies indicating that *Z. forsteri* should be excluded from the genus (Goffinet *et al.*, 2004; Matcham & O'Shea, 2005).

In some instances, however, striking and unique features in protonemal and gemma morphology are best explained in terms of their ecological role as units of dispersal. The gemmae of *Bryum schleicheri*, uniquely in the genus, exhibit a tetra-radiate arrangement and are remarkably similar to the tetra-radiate conidia of aquatic fungi (Pressel *et al.*, 2007). This commonality in structure most likely reflects a common function – to facilitate anchorage following transport by water, and may account for the local spread of *B. schleicheri* between upland flushes.

The protonemata of the tufa-forming *Eucladium verticillatum* grows in a calcium carbonate sludge. In contrast to the short gemmae and tuber-bearing filaments in other pottialean taxa, *E. verticillatum* produces long, unbranched axes with terminal gemmae. These filaments extend upwards to the surface of the sludge where the gemmae are dispersed by water. Another interesting example of asexual propagule formation closely linked to a particular highly specialized habitat are the colourless tubers produced approximately 1 cm below the ground by the rhizoids of *Discelium nudum* (Duckett & Pressel, 2003). These tubers are unusual because they are filled with starch, rather than the lipids typical of most moss tubers, and germinate rapidly, more like gemmae. The exposure of these rapidly germinating tubers in the early spring following soil exfoliation due to frost action during the winter months, affords *D. nudum* a distinctive advantage in colonizing unstable clay banks and enables this species to persist in this habitat ahead of more vigorous competitors.

Probably the most striking example of a highly specialized protonemal system is that of *Ephemeropsis tjiobodensis*, an epiphyllous species widespread in South East Asia (Goebel, 1888, 1905). Attachment in this moss is by means of highly regular side branch systems that secrete copious mucilage, the hapteres. Bristle-like appendages, which arise from side branches of the main axes opposite the hapteres, are also invested by mucilage containing abundant cyanobacteria – a possible source of nitrogen. Copious gemmae are produced at the tip of filaments that grow downwards in a highly characteristic spiral pattern, thus placing the gemmae in close proximity to the surface of the leaf. Short side branches at the base of the gemmae also produce copious mucilage and serve to anchor the gemmae to the substratum. These gemmae never germinate within the parent protonemal colonies; however, should these be washed away by torrential rains – a frequent occurrence in the habitat where *Ephemeropsis* grows, new colonies can be rapidly re-established from the firmly attached gemmae. Thus, the protonemal gemmae

in *Ephemeropsis* function as organs of perennation rather than dispersal.

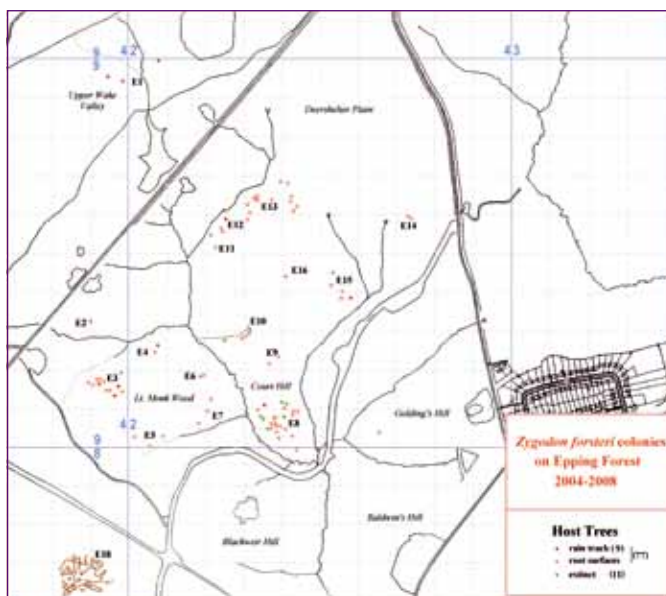
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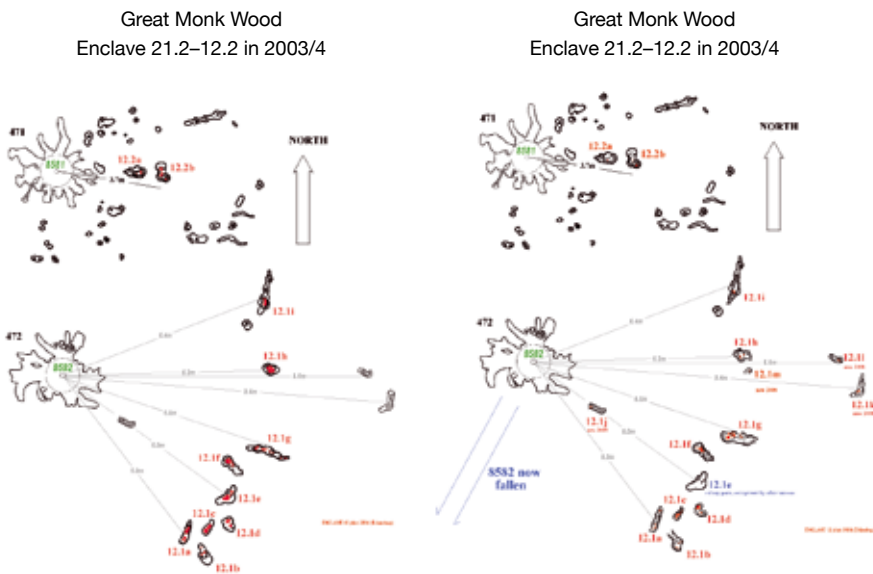
Recording fine scale distribution and abundance of red data mosses – problems and solutions in respect of Zygodon forsteri – Ken Adams

The City of London Corporation commissioned Ken Adams and Fred Rumsey to determine the distribution and abundance of the red data moss *Zygodon forsteri* in Epping Forest in 2003/4. K.A. was commissioned to repeat the survey in 2008 and asked to set up a system of monitoring that could be repeated at 4- to 5-year intervals in the future. The first problem was of course to locate the colonies. A few occur on rain tracks, but the majority occur as small cushions in cracks and knotholes on the exposed roots of ancient beech pollards that are suitably spaced to allow sufficient light levels for growth of *Z. forsteri*, and coincidentally, carpets of *Leucobryum glaucum/juniperoidesum*, *Dicranum scoparium/majus* and *Polytrichastrum formosum*. An area of around 2 km² on the Claygate Beds and Bagshot Sands were searched by the two of us walking parallel linear transects across the Forest, searching the root exposures around every tree in our path. Having located colonies and noted their GPS co-ordinates, each colony was revisited by K.A. and photographed and mapped in detail. The colonies were found to occur in residual enclaves of beech pollards and mature maidens which had escaped the wholesale death and decay of beech



△ Fig. 1. Maps showing the distribution of *Z. forsteri* colonies Epping Forest in 2004 and 2008.

pollards that has befallen much of the higher parts of the Forest, now largely enveloped in dense thickets of birch and regenerating beech, bramble and bracken. To facilitate the refinding of colonies, detailed sketches were made of the numerous root exposures surrounding each of the 76 host trees (Fig. 1.)



◁ Fig. 2. Minimaps showing the distribution of *Zygodon forsteri* cushions in knotholes on the exposed roots of two beech pollards in 2004 and 2008.

and all the trees in each enclave were positioned by laser rangefinder triangulation in order to compile maps of each enclave. The maps were drafted using PaintshopPro version 5, and sites and close-up digital photographs were hyperlinked into an interactive Microsoft Front Page file. The minimaps of each set of root outcrops were annotated with patches to show the exact location and approximate size of each cushion in a crack or knothole in 2003/4 and in 2008, with as many as 14 separate colonies associated with a single host tree (Fig. 2). Identification of and estimation of the extent of the *Z. forsteri* cushions is often difficult as *Z. viridisimus*, *Z. stirtonii* and *Dicranoweisia cirrata* also occur in the cracks and knotholes on many of

the root exposures and can be intermixed. Although the presence or absence of cushions in individual knotholes can be assessed reasonably well by different experienced observers, it is less easy for different observers to assess

the size and health of colonies in a comparable manner. Although many thousands of capsules are produced, less than 1% survive predation to release their spores. Predators pluck off the capsules and leave the setae behind, however, so irrespective of the time of year it is possible to assess cushion productivity by counting the number of setae. By hyperlinking the enclave maps, the minimaps and the hundreds of close-up photographs as an interactive Microsoft Front Page file, it is possible to check images on the screen of a hand-held PC against individual colonies in the field.

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Salinity tolerance and survival of rocky shore seashore bryophytes – Jeff Bates

The majority of vascular plant halophytes appear to be 'salt ameliorators'. Upon exposure to saline water, Na⁺ and Cl⁻ ions enter the cells, enabling a degree of osmotic adjustment, but are quickly removed from the cytoplasm, where they may poison enzymes, by active pumping into the vacuole or

exterior. They also produce secondary metabolites in the cytoplasm, allowing its osmotic equilibration with the salty vacuole and exterior, and often possess elevated antioxidant defences to combat reactive oxygen species generated by photosynthetic excitation energy during periods of osmotic stress. Earlier work on rocky seashore bryophytes (*Schistidium maritimum*, *Tortella flavovirens*)

indicated that they are 'salt excluders'. By restricting salt entry they risk osmotic water loss, but the majority are also highly desiccation tolerant. A new study has been undertaken using chlorophyll fluorometry to monitor the physiological effects of seawater on both seashore and inland bryophytes. Surprisingly, all bryophytes investigated were able to rehydrate following desiccation and recover substantial photosynthetic activity in seawater. However, there is a slight depression of quantum efficiency compared to distilled water controls that is reversible and probably largely due to osmotic stress. A range of inland species withstood incubations in seawater of several days, providing light levels were low. At realistic light levels, however, seawater incubation led to a rapid decline in photosynthetic activity of inland bryophytes and a smaller but significant degree of injury in *S. maritimum*. These experiments indicate that the primary effect of seawater is a modest osmotic one, but that in conjunction with light it leads to severe photo-oxidative injury in the inland species. There was evidence of elevated non-photochemical quenching in the two halophytes studied during seawater incubation, as in vascular halophytes.

An update was also given on the survival of cushions of *S. maritimum* at a rocky seashore site in Cornwall, originally described in a talk to the BBS in September 2003 (*Field Bryology* 82, 39–41). Cushions have been monitored photographically in fifteen 20×20 cm plots, annually from 1995 to 2003, and in 2007 and 2008. In the first 8 years there was little change apart from a slow expansion in sizes of individual cushions and occasional losses. By 2007, striking losses of cushions had occurred, particularly at lower positions on the shore. They were probably the result of severe southerly gales corresponding with spring tides during the period 27–29 October 2004. Five plots that had been artificially cleared of their cushions in 2003 showed significant recovery in 2008, but only in microsites that had been formerly occupied by *S. maritimum*.

The picture emerging for this species is of a photosynthetic productivity continually limited by episodes of osmotic stress and desiccation, plus intermittent local catastrophes from which it appears to have appreciable recovery powers.

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Small is beautiful – but it has its own problems: two facets of bryophyte photosynthetic physiology – Michael Proctor

Sunlight is the essential source of energy for all green plants (and indeed for all life), but, as with other good things, excess can be harmful. We are aware of the dangers to ourselves of excessive exposure to the sun. Equally, sunlight beyond that needed for photosynthesis, and beyond the capacity of photo-protective mechanisms of the plant to handle safely, can lead to production of damaging free radicals (reactive oxygen species).

Photosynthesis in bryophytes with unistratose leaves is limited by the rate at which CO₂ can diffuse through the leaf surface. At current atmospheric CO₂ concentrations, the maximum rate at which CO₂ can diffuse through a single surface against the

diffusion resistance of a representative bryophyte (or mesophyll) cell can be powered by about 14% full sunlight; more light than this would produce no more photosynthesis. This limits the maximum rate of photosynthesis of a typical thalloid liverwort with chloroplasts concentrated on its upper side. Of course, bryophyte leaves have two surfaces for CO₂ capture, and most mosses and many leafy liverworts have overlapping leaves. Nevertheless, photosynthesis in most mosses saturates at around a quarter, and in very few at over a half, of full sunlight.

There are two possible solutions to this problem. The Anthocerotae evolved a carbon-concentrating mechanism, which has the effect of raising the limiting rate of CO₂ diffusion by a factor of two or three. The Marchantiales (and *Polytrichum*) have

evolved ventilated photosynthetic tissues (analogous to leaves) which increase the area for CO₂ uptake without enlarging the bryophyte's footprint on the ground. They can photosynthesize at much higher irradiances, often matching vascular plants.

How do the many desiccation-tolerant bryophytes with unistratose leaves that grow in sun-exposed places cope with excess sunlight? Chlorophyll-fluorescence shows that two mechanisms are important. These bryophytes generally have very high values of non-photochemical quenching (NPQ). This reflects the operation of a photo-protective mechanism which dissipates part of the light absorbed by chlorophyll harmlessly as heat. Also,

much of the light energy (and reducing power) in excess of that used for photosynthesis is used to reduce oxygen to water. Between them, these two mechanisms account for most (up to 90%) of the energy absorbed by chlorophyll that is not used for photosynthesis, and add up to very effective sun protection.

As we bryologize, we can think of the remarkably wide range of light environments to which bryophytes have adapted, from deeply shaded moist humid forests to sun-baked rocks and exposed mountain summits.

Michael Proctor, School of Biosciences, University of Exeter



△ Mark Duffell (and friend), Dan Wrench and Mark Hill hard at it at the BRECOG Field Meeting at Ercall Hall. *Martin Godfrey*

BRECOG FIELD MEETING AT THE ERCALL HILL, SHROPSHIRE – 12 OCTOBER 2008

Some 12 members of the society assembled in a car park at the base of the Ercall to begin our surveys. As over half those attending were unfamiliar with the techniques, we held an impromptu workshop and then paired up more experienced BRECOGers with novices and allocated habitats to survey. The woodland was largely acid oak wood with a rather impoverished ground flora, but had some nice rotting wood and sandstone rock exposures, giving a decent span of different things to look at and an opportunity for the novices to get to grips with their new-found skills. No exotic new county records were found, but we were able to record a good number of quadrats from all of the major habitats to add to Jeff Bates' growing database.

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EXCURSION TO LOTON PARK, ALBERBURY, SHROPSHIRE – 12 OCTOBER 2008

Once a summer-warm sun had burnt off the early morning's vapours, conditions for bryology became perfect for our excursion to Loton Park, Alberbury (SJ3513, 3514 and 3613), 5 miles west of Shrewsbury, by kind permission of Sir Michael Leighton. Tracks through the park are frequently used for

motor-racing events, but all was quiet on the day of our visit save for croaking ravens, barking deer, and babbling bryologists. Several members took their fabulous, spanking new, 'warm-off-the-press' prototype field guides for a spin.

Exposures of sandstone that vary in their calcareous content outcrop in several places within the deer park, and one particularly calcareous breccia



held *Grimmia orbicularis* growing with *G. pulvinata*. We compared the capsules of *G. orbicularis* (hardly longer than wide and with a stubby lid) with those of *G. pulvinata* which were clearly longer than wide, and with a longer lid. *Encalypta streptocarpa* grew beside *E. vulgaris*, and *Aloina aloides*, *Didymodon acutus*, *Microbryum davallianum/starckeanum* and *Tortula modica* flourished on shallow soil near the rock, but we could find no trace of *Pterygoneurum ovatum* which was there in 2006. Other calcicoles included *Ditrichum gracile*, *Rhynchostegiella tenella* and *Rhynchostegium murale*, but everyone turned into shrinking violets when it came to the *Schistidium* which abounded on the rock.

A cutting through base-rich rock at the southern end of the park occupied us for a while either side of lunchtime, with additional small, abandoned quarries nearby. Des Callaghan discovered *Thuidium assimile* (only the second time this uncommon pleurocarp has been reported from Shropshire), answering my concern about what I had overlooked on previous visits to the park, as well as *Microbryum rectum* new to Loton.

After lunch several members departed on their long journeys home, while a hardcore of eight members moved on to an abandoned quarry just outside the deer park (SJ3613), where secondary woodland added considerably to our tally of species: *Cryphaea heteromalla*, *Leskea polycarpa*, *Orthotrichum pulchellum*, *Ulota bruchii*,

◁ *Thuidium assimile*. Des Callaghan

△ An extra 'guest' hunts for lunch amongst cushions of *Grimmia orbicularis* and *G. pulvinata*. Ian Atherton

▽ Mark Lawley atop the cutting at the southern end of Loton Park. Ian Atherton

U. crispa, *Zygodon viridissimus*, *Metzgeria violacea* (=fruticulosa) and *Radula complanata* on the trees, *Cirriphyllum piliferum*, *C. crassinervium*, *Climacium dendroides* and fruiting *Homalia trichomanoides* on the ground, and *Hymenostylium recurvirostrum* on lime-rich rock at its only known locality in Shropshire, along with *Oxyrrhynchium pumilum* (= *Rhynchostegiella pumila*), *Rhynchostegiella tenella*, *Rhynchostegium murale* and *Tortella tortuosa*.

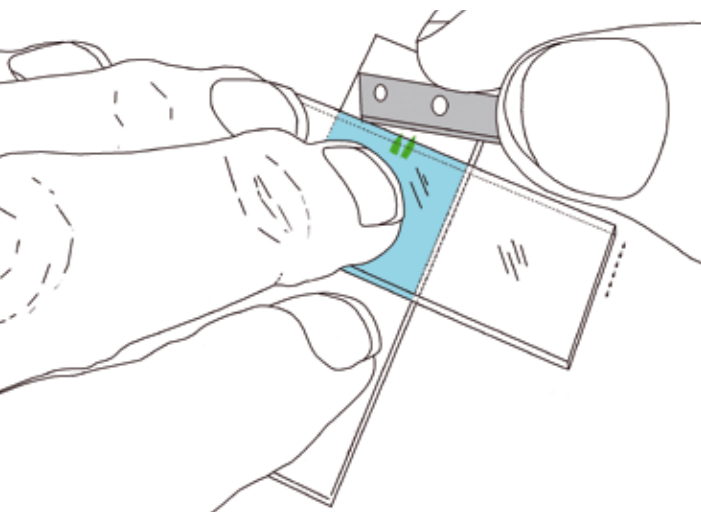
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MICROSCOPE TECHNIQUES WORKSHOP

Participants at this workshop tried out several simple microscope techniques for gaining additional information about bryophyte material. They successfully tried out the use of ‘miniblades’ from twin-bladed disposable razors for cutting true vertical thin sections as described in *Field Bryology* 88, pp. 7–8. The ideal positioning of the fingers and crossed slides for this technique is shown in Fig. 1 below. For multiple sections, an adequate film of water needs to be trapped between the slides, and the whole sequence needs to be carried out under the dissecting microscope. By relaxing the pressure slightly and flexing the second (longest) finger, the upper slide can be repeatedly displaced backwards a minute amount to reveal a narrow segment of the specimen for successive sections. With a little practice the degree of each displacement required can be judged from the sections cut to give very thin sections.

▽ Fig. 1. Section cutting with miniblades



They also tried out two pieces of Polaroid film for emphasizing the border and costa of moss leaves. It works particularly well with *Fissidens* where it helps to discern whether or not the costa is confluent with the border at the apex. The principle of the technique depends on the regular crystalline nature of those moss cell walls that have their cellulose fibres so tightly stacked in precisely orientated parallel arrays that they rotate the plane of polarized light. Where the fibres are dispersed in an amorphous ‘hemicellulose’ matrix, however, the effect is either absent or minimal. To observe the effect, an old pair of cheap Polaroid sunglasses can be cut up to provide the two circular filters. One is cut to fit the filter holder just beneath the sub-stage condenser lens mount, the other being roughly cut the same diameter as the eyepiece. With the substage filter in place, the other piece can be mounted between finger and thumb on top of the eyepiece and rotated until the image blacks out, except for the brightly illuminated border and costa. The majority of the image blacks out because in this position the planes of polarization of the two filters are at right angles, and the light polarized to vibrate in one plane by the first filter is blocked by the second, except that is, for the light that has had its plane of polarization rotated by the crystalline cellulose.

Please note that I now supply miniblades for section cutting and cheap plastic eyepiece micrometer scales for measuring cell sizes as advertised on the BBS Library & Sales page (see inside back cover of this issue).

A word of caution for those wishing to extract their own miniblades. I suggest using a sharp penknife and long-pointed pliers rather than attempting to hold the plastic mount in the hand as one can inadvertently sustain a very nasty cut across the finger tips!

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