surprising that when Roberto mentioned the possibility of a further BBS meeting in Italy, the suggestion was greeted with much enthusiasm.

We also thank Dr Mario Calvi for supporting the Accellica excursion, all the local naturalists whose help at individual sites contributed much to the success of the week, and Mario Cano, Francisco Lara and Eva Maier for their comments on some of the specimens we collected. A special word of gratitude is due to Jeff Duckett, who first suggested the meeting and who did much to help organise it by acting as liaison between Roberto and the British contingent.

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Bryophyte ecology workshop 2006, Silwood Park

Jeff Bates

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Background

This year's workshop was used to launch the Bryophyte Ecology Group (BRECOG), a new specialist section of the Society. The meeting was held on 10-12 March 2006 at Silwood Park, the 'country campus' of Imperial College London, on the edge of Windsor Great Park, near Ascot, Berkshire. Approximately 40 people were present for the Saturday session, which was devoted to a series of 30-minute talks by invited speakers under the general heading *Ecological traits of common British bryophytes: what should we measure and how?* Many also joined Professor Mick Crawley's interesting botanical tour of the grounds before the talks got underway. About half the party stayed overnight on Saturday and joined the local organiser Jeff Bates and his wife Joyce at *The Hatchet* pub in nearby Cranbourne for a very enjoyable evening meal. The majority also took part in a trial of a simple quadrat-based technique for recording bryophyte habitats on the Sunday morning. As described in one of the talks below, it is hoped to use a version of this technique for undertaking a BBS habitat survey of common British bryophytes.

Presentations, 11 March

For the Saturday session several speakers were given the brief of proposing ecological/biological projects that could form the basis of the group's activities. Others, including two guest speakers, Professor Grime and Dr Soudzilovskaia, reported on closely-related projects from which we could draw useful lessons. Brief summaries of the presentations are given below.

Aims of the BBS Bryophyte Ecology Group (BRECOG)

Jeff Bates (Imperial College London)

Setting the scene for the meeting, this brief talk outlined some of the main objectives of BRECOG. First, the group would promote members' individual studies of rarer bryophytes for publication under the 'Bryophyte Profiles' scheme in *Journal of Bryology*. Second, it would initiate a wide-ranging study of the ecology (including reproductive biology) of common British bryophytes in which all BBS members would be invited to contribute. It was envisaged that this would be published as an 'Ecological Compendium' with individual species accounts being written by group members. It was also proposed that the group be adventurous about acquiring and maintaining specialist equipment to carry out its activities. Working liaisons between professional bryologists in laboratories and amateurs with little specialist equipment at their disposal can be mutually profitable and were encouraged. These could be of an informal nature or even involve members enrolling to do part-time PhDs. It was suggested that members of the group should come together annually to participate in a weekend workshop that would act as a focus for data recording in different regions, and as a forum for demonstrating techniques and reporting progress.

Comparative plant ecology: the vascular plant experience

J. Philip Grime FRS (University of Sheffield)

In ebullient style, and very supportive of the workshop's aims, Professor Grime described his experiences in compiling vascular plant traits for the book *Comparative plant ecology: a functional approach to common British species* (Grime, Hodgson & Hunt, 1988). The original work comprised a two-page summary for each of a range of common species encountered in a vegetation survey of the Sheffield region. Professor Grime described the elements of each account, consisting of data on a range of traits in a standardised format, and explained how recent improvements had been made, including much additional vegetation sampling to define habitat profiles, for a second edition that will be published soon. He spoke in favour of 'soft' traits, ones that could be measured relatively easily, to provide realistic alternatives for some of the more demanding species characteristics such as relative growth rate. Facsimiles of pages in the original and newly revised versions of *Comparative plant ecology* were shown, and copies of a manual of methods for measuring traits in vascular plants, *The LEDA Traitbase. Collecting and measuring standards of life-history traits of the Northwest European flora*, were made available to the meeting.

Reference

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Ellenberg values and life forms for bryophytes: do they work and what do they tell us?

Mark Hill, Chris Preston & Sam Bosanquet (CEH, Monks Wood & CCW, Pembroke)

Mark Hill reminded us that Ellenberg indicator values and life forms are attributes of species that characterise their realised niche and their growth habit. Ellenberg first published his indicator values for arable weeds in 1950. A full set of values for vascular plants of central Europe followed later (Ellenberg, 1979). Düll (1991) listed values for bryophytes. Each Ellenberg value provides an indication of the conditions under which a species grows.

There are seven main scales, each specified by a letter: L – Light, T – Temperature (biogeographical), K – Continentality (biogeographical), F – Moisture (Feuchtigkeit), R – Reaction (pH), N – Nitrogen (general fertility), S – Salt. The scales T and K are biogeographical and were not discussed further. If we consider *Scorpidium scorpioides*, its Ellenberg values are L 9 (meaning that it is found mostly in full sun), F 10 (meaning that it is found in shallow water, at most temporarily dry), R 8 (in basic but not exclusively calcareous waters), N 1 (in extremely infertile sites), and S 0 (in freshwater only). The problem for bryologists is how to link bryophyte Ellenberg values with those of

vascular plants. Making the link for *S. scorpioides* is relatively easy, because it often grows with vascular plants and can be matched with its associates. Under a project funded by Defra, we have extended these values to all British bryophytes, including those that do not normally grow with vascular plants.

Life forms of vascular plants are well known to users of Clapham, Tutin & Warburg (1962). Those of bryophytes are less well known, but were developed over a period of years from about 1950 and were critically reviewed by Bates (1998). Bryophyte life forms are in fact mostly growth forms, and include types such as Short Turf, Weft, Fan and Small Cushion. Bates (1998) urged bryologists to investigate their relationships to other attributes of bryophyte life strategy. This has so far not happened, possibly because the present list is incomplete.

We are currently working on a project called Bryoatt, to complete a list of attributes for the British bryophyte flora. We hope to finish during 2006. Ellenberg values and life forms will be included.

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Comparative cryptogam ecology: screening for traits that affect ecosystem functioning in arctic and alpine biomes

Nadia Soudzilovskaia & Hans Cornelissen (Vrije Universieit, Amsterdam)

Investigations of plant functional traits in recent decades have been biased almost exclusively towards vascular plants. Very little is known about the role and applicability of functional traits in non-vascular cryptogams, particularly bryophytes and lichens. Yet cryptogams are paramount determinants of ecosystem functioning in many biomes (particularly cold biomes and tropical rainforests), where they contribute substantially to above-ground biomass and therefore control soil temperature, hydrology and pH. However, the role of cryptogam functional traits underlying these processes is poorly understood, partly due to the general unfamiliarity of ecologists with cryptogams, and partly due to the absence of protocols for cryptogam trait investigations.

Recently we started a project aimed at investigating functional traits of cryptogams in two regions, the Caucasus mountains and sub-arctic Sweden, with special emphasis on traits that strongly affect ecosystem functioning. This will involve screening multiple bryophyte and lichen species for traits using standardised assays. We aim to:

- test fundamental relationships in the design and function of cryptogams in cold biomes;
- test the effects of particular cryptogam traits on ecosystem functions or processes; and
- compare the two regions for plant functional trait spectra in relation to climate-vegetation patterns.

We are especially interested in traits that are related to acidification, water retention and insulation capacity of different cryptogam species. We will test whether soft (i.e. easy-to-measure) traits such as tissue chemistry, cushion density and cell structure can be predictors of these capacities. All the data obtained within the project will be stored in a database that will contain, besides cryptogam traits, detailed data on the habitats from which the cryptogam material has been collected. The data on habitats will include geographical location, soil parameters and ecosystem description.

Reproductive biology and population ecology: what parameters could BRECOG realistically investigate?

Royce Longton (School of Biological Sciences, The University of Reading)

Studies of reproductive biology are of interest in their own right, and provide data relevant to wider issues such as the life history strategies of bryophytes occupying different ecological niches. The significance

of the most important parameters is discussed below. Many of the variables are relatively easy to study from home with a minimum of sophisticated equipment beyond high-power and dissecting microscopes.

Reproductive phenology, the seasonal pattern of gametangial and sporophyte development, is of great interest. Do, for example, species of particular habitats have similarities in their developmental cycles that are of adaptive value in that habitat? Also, a knowledge of the seasonal pattern of development is an essential prerequisite to planning other studies in reproductive biology. The frequency of sporophytes varies widely between species, and often within the range of a single species. How does this affect the balance between sexual and asexual reproduction, and therefore patterns of evolution and possibly the long-term survival of a taxon? The frequency of sporophytes is often governed by the distribution of gametangia, with rarity of sporophytes commonly associated with unbalanced sex ratios in dioicous species. Knowledge of the relative distribution of gametangia and sporophytes can also give an insight into the fertilisation range within populations, and thus into local patterns of gene flow. Spore size, and spore output from a sporophyte, or from a colony, are relatively simple to estimate, and combined with information on spore dispersal tell us about the potential for gene flow over greater distances, and for the establishment of new populations. However, most if not all bryophytes can reproduce asexually without recourse to spores, and so if we want to understand the balance between sexual and asexual reproduction we need to assess the effectiveness of spores as opposed to asexual propagules in colony establishment. It is also of interest to determine reproductive effort, the nutritional cost to a gametophyte of producing gametangia and bearing sporophytes, while gametophyte longevity is also fundamental to the concept of life history strategies.

In vitro cultivation: its contributions to bryophyte ecology

Silvia Pressel, Jeffrey G. Duckett & Jenny Rowntree (Queen Mary, University of London & Royal Botanic Gardens, Kew)

Whereas most studies involving the *in vitro* cultivation of bryophytes have centred either on understanding cytological and molecular mechanisms in morphogenesis (almost exclusively based on protonema of *Physcomitrella*) or on the use of juvenile characters in systematics and phylogeny, this technique is now becoming increasingly important in bryophyte ecology. The production in culture of vegetative diaspores, and particularly protonemal gemmae in mosses, has subsequently led to their discovery in natural situations. This has added a new dimension to moss reproductive biology and explains how many taxa, having these propagules but rarely reproducing sexually, are able to colonise new and often unstable habitats.

In vitro cultivation is a prerequisite for reintroduction trials and long-term cryo-preservation of rare and endangered species. Two successful pioneer experiments indicate the feasibility of successfully reintroducing species via *in vitro* cultivation. New colonies of *Zygodon gracilis* have been re-established in the wild via cultivation of plants onto pieces of its native limestone rock placed into Phytagel medium. In cultivation this rare moss also produces previously undescribed protonemal gemmae. Phytagel cultures of the critically endangered moss *Bryum schleicheri* var. *latifolium* were placed in muslin bags and pegged into its native flush habitat. Two years later thriving new colonies had become established. Pre-treatment of protonemata with abscisic acid and sucrose is proving to be the key to successful cryo-preservation of mosses, whilst desiccation experiments have led to the discovery that cytoskeletal dynamics have a vital role in the ability of mosses to survive dehydration.

Liverworts form diverse associations with fungi, which can be cultured axenically. Isolation and re-synthesis experiments have shown that a range of bog liverworts (e.g. several *Cephalozia* species) share their rhizoidal ascomycetes with mycorrhizal roots in the Ericaceae, whilst *Cryptothallus* obtains its carbon from *Betula* via a common basidiomycete.

Comparative physiology of bryophytes: what data would be useful, and what resources would be needed to provide them?

Michael Proctor (University of Exeter)

Three kinds of physiological measurement are of particular relevance in an ecologically-oriented screening programme.

Water relations

In the past, the osmotic potential of bryophyte cells was seen as important, and many measurements were made using plasmolysis, which inherently gives estimates more negative (numerically greater) than the true value. We do not now regard osmotic potential as being so important, and more recent measurements using thermocouple psychrometry have given values in the same range as vascular mesophytes; the technique is demanding and time-consuming! More accessible, and more widely useful, are estimates of field water content, and water content at full turgor but with external capillary water removed by careful blotting, expressed as percentage of oven-dry weight. This needs a good (mg) balance, a drying oven, simple glass/plastic ware, and care.

Desiccation tolerance

Desiccation tolerance is an important characteristic of bryophytes. We need to know whether species are desiccation tolerant or not, and if they are, for how long, and at what intensity of desiccation, and what length of time is needed for recovery. We need to know too whether tolerance is constitutive, or whether it is induced by slow drying, and what the effects are of repeated desiccation. The desiccation responses of developing sporophytes have been little investigated. A lab-based researcher may use an infra-red gas analyser (IRGA) or chlorophyll fluorescence to monitor recovery, but useful work can be done using visual observation of recovery, plasmolysis, or cresol red as an indicator of CO_2 uptake in closed glass vials.

Photosynthetic parameters

Light-response curves require an IRGA or a modulated chlorophyll fluorometer, and so can only be obtained in a well-equipped lab. Pigment measurements (total chlorophyll, chlorophyll a:b ratios, chlorophyll:carotenoid ratios) also require a reasonably well-equipped lab, with a good spectrophotometer.

A lot of interesting observations can be made on desiccation tolerance and light adaptation using 25×50 mm glass vials with snap-on polythene tops, containing a smaller vial with a drop of M/1000 bicarbonate coloured with cresol red. This is an apricot to salmon colour at ambient CO_2 concentration; respiration raises CO_2 and turns the indicator yellow, while photosynthesis depletes CO_2 and turns the indicator pink.

Proposal for a BBS 'Bryophyte Habitats Survey'

Jeff Bates (Imperial College London)

Following the recent and sophisticated BBS surveys of epiphytes and arable-field bryophytes, it was argued that the time is right to undertake a relatively demanding survey of the habitats of common bryophytes in the British Isles. Its aims are:

- to provide a definitive list and ranking of the abundance of our common bryophytes;
- to provide a quantitative profile of the range of habitats occupied by each species; and
- to gather comparative data on the environmental 'preferences' of each species.

Hopefully, such a project would appeal widely to the BBS membership. The data collected would form the backbone of the 'Ecological Compendium' described in the introductory talk as a primary aim of BRECOG. Producing a formal classification of British bryophyte communities, although not a primary aim, was another possible outcome of the project. Where possible, other information, e.g. on reproductive biology, should be recorded in this survey. Information on environmental preferences could be obtained by comparing species abundances in regions of Britain with contrasted climates and also by systematically recording simple data such as altitude, geology, slope, aspect, and pH.

Sampling would involve the use of quadrats, an argument being presented for these being of rectangular shape and standard size (50 x 25 cm), although different sizes (e.g. 50 x 5 cm) would be necessary for sampling epiphytes on twigs and branches. The most effective abundance measure is percentage cover, which can usually be estimated reasonably accurately, following

brief training, to the nearest 5%, or to the nearest 1% where the cover is below 5%.

Sampling would probably focus on specific 'target' grid squares. In the field the bryophyte ecologist would firstly distinguish the different bryophyte habitats present and then systematically sample a number of replicates of each. A draft field card has been produced that enables data from up to ten replicate quadrats to be entered. Probably, the mean abundance values for each species over these replicates would be used for determining habitat profiles, but the individual quadrat scores might be used to produce graphs showing aspect preferences, etc.

The talk ended in rhetorical mode by considering whether it was necessary to provide a list of the habitats to be sampled or whether this should be left to individual field workers to decide. This matter was discussed after the field session on Sunday morning.

Life history strategies: a catalogue of population biology parameters for bryophytes occurring in north-western Europe

Lars Söderström (NTNU, Trondheim)

BRYOPLANET (Bryophyte Population and Landscape Analysis Network) was a network of bryologists working on the population and landscape ecology of bryophytes in the Nordic and Baltic countries that was funded by NORFA from 2001-2006. The main aim was to increase the movements of students between different research groups and to arrange courses and meetings for the benefit of students. The network had 12 meetings during the period and these were attended by persons from all over the world.

One of the lasting results from the network is a database of population biology parameters for bryophytes occurring in north-western Europe. This is a web-based database (www.bio.ntnu.no/bryo) to which interested bryologsts can add data from literature or their own data. A wide range of parameters (121 different measurements) can be added. At the moment, few data are being added but hopefully the database will attract sufficient interest to grow and reach a critical mass that will be able to generate results.

Although this was a demanding day, many participants were obviously fired-up by what they had heard from the speakers and the subsequent discussions. During the final summing-up session, the very clear message emanating from the meeting was that we should not let these ideas lapse. Indeed, I received unequivocal instructions to put together a 'steering committee' and get the main proposals put into practice!

Fieldwork, 12 March

Around 20 people stayed on for the Sunday morning session. This was taken up trying out a proposed methodology for surveying the abundance (percentage cover) of bryophytes in different habitats using quadrats. I was very gratified by the eager way in which both professional and amateur bryologists knuckled down together and tried out the technique in a variety of man-made and semi-natural habitats around Silwood manor house. Furthermore, a very positive debriefing session was held in the laboratory afterwards, allowing improvements to be made to the draft version of the field card and suggesting various alternative habitat classifications that could be employed to give structure to a BBS survey.

Postscript

Following the meeting I invited the following to join me in forming the BRECOG Steering Committee: Jeff Duckett, Martin Godfrey, Royce Longton, John O'Reilly, Michael Proctor and Mike Walton. The Steering Committee met for the first time on 5 June 2006 at the University of Reading and endorsed some of the main proposals made at the workshop.

The next workshop meeting of BRECOG is planned for the weekend 9-11 March 2007. Further details are given on page 59 of this issue of *Field Bryology*.

Spring field meeting 2006, Staffordshire

M.F. Godfrey

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Introduction

Twenty-nine BBS members were present for at least part of this five-day meeting, one or two attending for the odd day whilst others stayed for the whole period. Attendees were Jessica Beever, John Blackburn, Tim Blackstock, Sam Bosanquet, Des Callaghan, Rachel Carter, Tessa Carrick, Sean Edwards, Joan Egan, Bob Ellis, Lorna Fraser, Richard Fisk, Mary Ghullam, Martin Godfrey, Mark Hill, Nick Hodgetts, David Holyoak, Joan James, Liz Kungu, Mark Lawley, Brian O'Shea, Mark Pool, Ron Porley, Chris Preston, Herman Stieperaere, Jonathan Sleath, Ray Tangney, Colin Wall and Jo Wilbraham. It was particularly nice to welcome Jessica Beever from New Zealand, on her first visit to Britain for about 15 years, and Herman Stieperaere from Belgium. We were joined on a few days by local mycologist Neville Walters, keen to learn more about 'green stuff', and by two members of staff from the Staffordshire Wildlife Trust (SWT), Dave Cadman and Claire Waterson.

The cost and financial commitment for the Society meant that using university rooms for the meeting was impractical, and so the majority of people used hotel and B&B accommodation, with one hardy soul camping on Cannock Chase.

All localities visited were in Staffordshire (v.-c. 39). It was hoped that exploration of this varied, but very under-recorded, county would contribute significantly to our understanding of its bryophytes, and prior to the meeting I published a provisional on-line atlas to give people some idea of what to expect. In the event, nearly 260 taxa were recorded, including some 30 new or 'unbracketed' vice-county records, as well as a possible new species for England in the form of *Aneura maxima*, which is the subject of further study to establish its credentials.

Thursday 6 April

A group of a dozen or so of us met in icy winds near **Knotbury** to explore a small part of the Staffordshire moorlands. The rock here is mixed, with some limestone as well as more acid substrates, and this gave rise to surprised exclamations as calcicoles such as *Encalypta streptocarpa* were found growing on moorland as we walked from the cars. The pattern of finding vice-county records started just a few hundred metres from the cars when Herman Stieperaere found a small tuft of *Orthotrichum stramineum** on an ash alongside the track. The commoner moorland species were quickly found but the sheer quantity of some, such as the blankets of *Barbilophozia floerkei* on drystone walls, were cause of comment. Small springs along the valley sides were not as productive as hoped but did turn up *Chiloscyphus pallescens*, *Riccardia chamedryfolia*, *Scapania undulata*, *Cratoneuron filicinum* and *Philonotis fontana*. A bit of oak