BBS Bryophyte Ecology Group

BRYOPHYTE HABITATS SURVEY

Recorder's Instructions

Introduction

The main aim of this project is to define, in a rigorous manner, the *ecological niches* of individual common bryophyte species. A practical definition of the niche is the range of *microhabitats* (see below) that each species occupies and the frequencies with which they do so. By collecting data in a standardised manner from a regular network of 10-km squares we should also be able to determine whether the niches of common species vary in response to geographical factors such as macroclimate.

This project requires the recorder to collect a more sophisticated set of information than in any previous BBS survey; however, it should lead to a more in-depth understanding of the ecology of British and Irish bryophytes than has been possible previously. Eventually, we hope to invite our recorders to write the summary accounts of the ecology of their favourite bryophytes in a planned *Ecological Compendium of Common British Bryophytes*. The *Compendium* will also contain information on other aspects of bryophyte biology to be gathered in separate BRECOG projects. It is anticipated that the field recording phase of the Bryophyte Habitats Survey will last for five years commencing in March 2007. However, this will depend on the time and enthusiasm that BRECOG/BBS members, and possibly other personnel, are willing to devote to the project.

Sampling in Grid Squares

To ensure that the sampling of habitats is representative of the British Isles as a whole, we have targeted a one-in-18 configuration of 10 km x 10 km grid squares (Fig. 1, see Appendix for list). The 209 target grid squares are based on the one-in-nine configuration used in the BSBI's Monitoring Scheme in the 1980s; however, we have omitted alternate squares in a regular fashion. This leaves us the option of adding in the omitted squares at some future date if it is felt that additional recording is necessary and possible. Recording is not limited to particular tetrads within each 10-km square unlike in the earlier Monitoring Scheme and Epiphyte Survey.

Recognising that some BBS members may wish to collect further data from their local patch, we also welcome data from additional grid squares. We hope that recorders will give precedence to completing their nearest 'official' target squares. However, records from additional squares may be particularly valuable if they include less common microhabitats not found in the target squares. Data from grid squares visited during holidays or other trips are also greatly welcomed. BRECOG will be organising a weekend workshop each year in a different part of Britain or Ireland to help record the more remote areas, to stimulate the recording effort and to bring recorders together for training sessions, exchange of ideas and reports of progress. However, completion of the ambitious sampling programme will depend to a very large extent on the enthusiasm of individuals working alone in their favourite habitats.

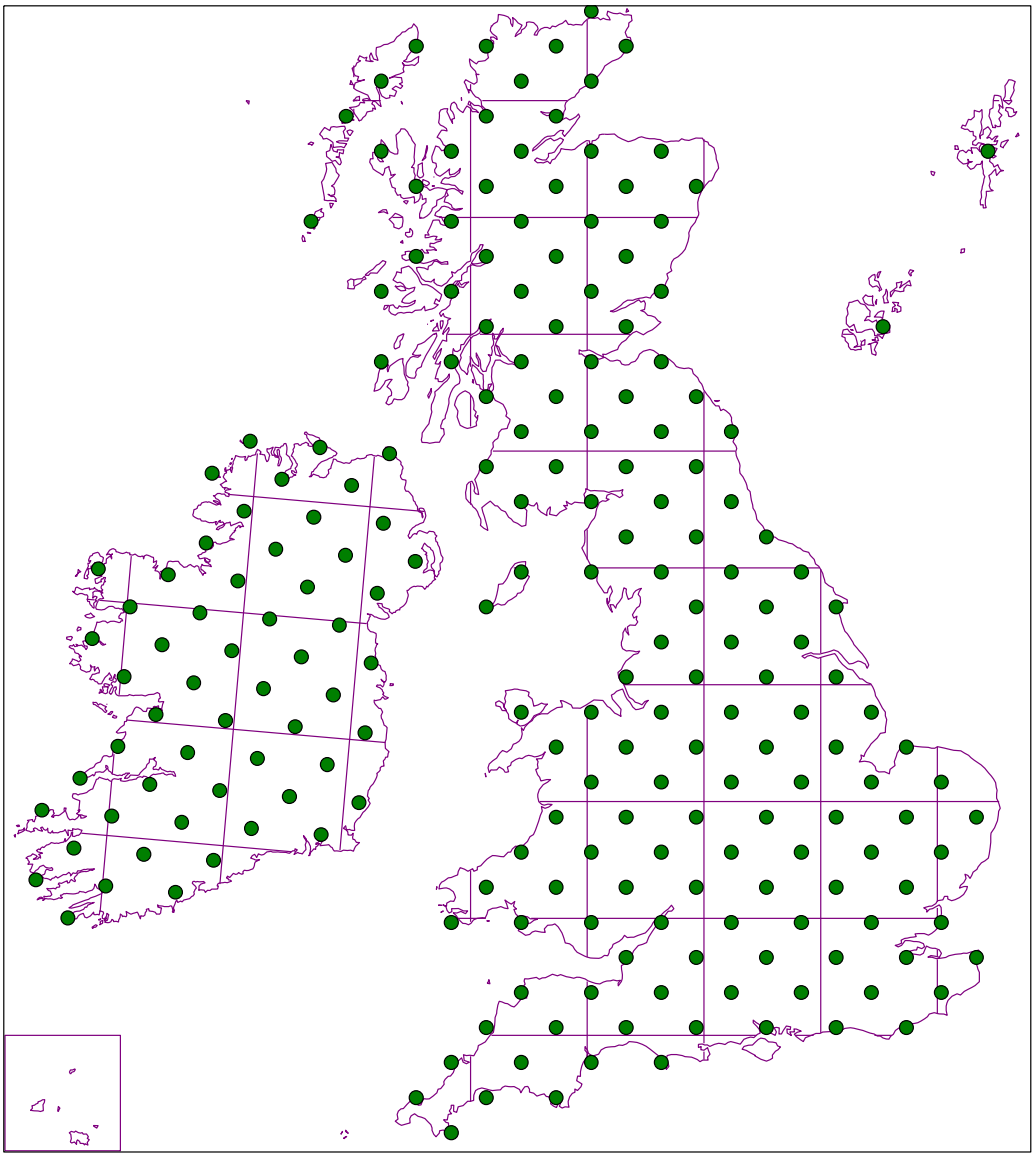

Fig. 1. The one-in-18 configuration of target 10-km grid squares. There are 211 squares of which a small number of marginal ones contain only very small areas of land. There are 155 in Britain and 56 in Ireland. See Appendix for grid references.

The emphasis should be on systematically studying the range of habitats present in one square before moving on to another (though several squares could be recorded in parallel). It will almost certainly require a number of visits to each square to record the main examples of bryophyte vegetation adequately unless a team of recorders is available. Incomplete recording in many different squares will be less useful, though some bryologists may prefer to specialise in a particular habitat which they survey extensively. It should not matter if more than one recorder submits data from the same grid square, though it is obviously better to avoid too much duplication of effort.

Field Equipment

Apart from the bryologist's normal accoutrements (hand lens, paper packets, collecting knife, GPS, etc.) and sensible clothing for field work, a few more specialist pieces of equipment are needed for the Bryophyte Habitats Survey:

- **Quadrats**. A rectangular quadrat, 50 cm x 25 cm, should be used to delimit the samples in this project. However, for sampling branches a narrow 'half-quadrat', 50 cm x 12.5 cm, will also be required. Both sizes can be made from any convenient material (string, wire, plastic tubing, etc.) and folding versions may be convenient for stowing in your field bag. Marking of 2.5 cm divisions along the sides can be helpful when estimating percentage cover (see below).
- **Sticky stuff**. Various improvisations may be required to attach your quadrat onto steep or hard surfaces. Pieces of Blutack or plasticine can be useful to attach the quadrat to vertical surfaces of rock. Alternatively, one or more long pieces of string tied to the quadrat and trailed across the top of a boulder can help to hold it in place on a sloping face. Drawing pins are probably the simplest means of attachment on tree trunks. Pieces of waterproof sticky tape wrapped around opposite sides can be used to pin the quadrat to bark.
- **Pencil with rubber attached**. The recommended way to fill in your record cards.
- **Ruler**. For measuring the height of the vegetation and the depth of the soil.
- **Domestic tape measure**. More useful than a ruler for measuring the girths of trees and their branches.
- **Compass**. To measure the direction of exposition. N.B. Wire or metal quadrats may interfere with the reading!
- **Clinometer**. This simple device, using the plumb-line principle, measures the slope of the surface being studied. Expensive models can be bought, but a homemade instrument is just as effective and much less costly if lost. That reproduced in Fig. 2 was devised using the 'radar chart' facility in Excel. No great claims are made for its accuracy. Photocopy this, cut out and glue to a suitably shaped piece of card or thin board and cover with sticky-back plastic to protect from moisture. Make a hole in the centre and use a straightened out paper clip or other piece of wire as a pointer. With care you should be able to estimate slope to the nearest degree or two; quite sufficient for our needs.
- **25-cm rigid probe**. Ideally made from an L-shaped piece of stiff wire this is used to measure soil depth. The shorter part of the 'L' acts as a handle. An old knitting needle may suffice.
- **Old teaspoon.** To act as a spatula for collecting small soil samples.
- **Surform Scraper**. This tool is available for £2-3 from hardware shops (e.g. *Homebase*). It is ideal for collecting bark. It does not dig in too deeply like a knife and produces fine slivers or shavings of surface bark which are perfect for steeping in water to make pH measurements.
- **Polythene bags**. These are required to collect soil samples for later analysis. Resealable bags, 10 x 6 inches (25 x 15 cm) are ideal. A felt-tip pen or other means for recording data on the bag is important.
- **Small paper envelopes**. Useful for collecting bark samples which may be allowed to air dry in the envelope before analysis.
- **pH meter (and buffer solutions)**. A small number of pH meters will be purchased for measuring the pH of soil extracts back at home and the pH of natural waters in the field.

- **Conductivity meter**. A small number of conductivity meters will be purchased to measure the solute concentrations in natural waters.
- **Kneeler**. A garden kneeler is well worth including in your kit to save your knees on stony surfaces and it will also spread your weight over a greater area and reduce damage to the vegetation on softer surfaces.

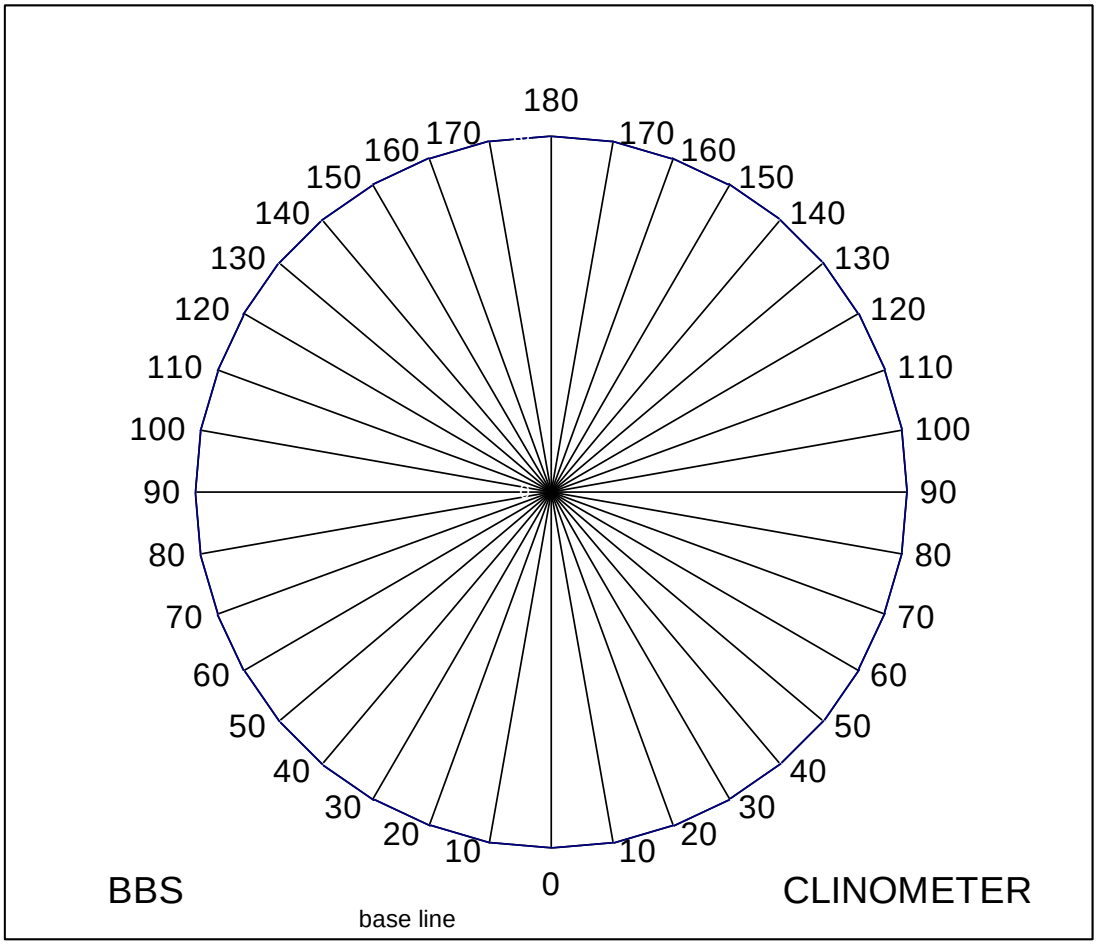

Fig. 2. Scale for homemade clinometer.

Environmental Settings

Having selected a 'habitat' for study, match this to one of the classes of 'environmental setting' listed below. The 34 types are closely based upon the EUNIS habitat classification. The categories are mostly those in the 'level 2' expansion of that scheme. However, some modifications have been incorporated to make it workable for bryological survey in Britain and Ireland. Indeed, several habitat descriptions may differ quite significantly from their original EUNIS definitions. A summary of this is given on the back of the 'field card'.

Marine

1. **Saltmarsh (Ma1).** Grassland or *Halimione* shrubland on littoral sediments, regularly or infrequently covered by the sea.

Coastal

2. **Coastal dune (Co1).** Sandy beaches, shifting and more stable dune sand among Marram grass or open vegetation, including damp dune slacks, but not permanent pools in dune areas. (Place fixed dune grassland in Gr1**,**

dune heath in HS3, dune scrub in HS2 and dune woodland in Wo1-4 as appropriate.)

3. **Shingle beach (Co2).** Habitats of varying stability, and potentially saline, on shingle ridges and pebbly shores. (See Co1 for treatment of scrub and woodland.)
4. **Coastal cliffs and rocky shores (Co3).** The supralittoral zone, i.e. above high tide but subject to appreciable salt-spray deposition; the vegetation is usually sparse and dominated by halophytic vascular plants and lichens. (Place coastal grasslands in Gr1 or Gr2 and coastal heath in HS3).

Freshwater

5. **Standing freshwater (Fr1).** Aquatic communities in lakes, reservoirs, pools, ponds, very slow-moving canals, dune pools, bog pools; includes seasonal pools. (Owing to an inevitable bias to marginal habitats, shallow-water habitats are not recognised separately.)
6. **Flowing freshwater (Fr2).** Aquatic communities in rivers, streams, springs and waterfalls, including seasonal watercourses, and films of water running over rocky watercourse margins and irrigated cliffs
7. **Littoral zone of lakes and rivers (Fr3).** Restrict this class to communities affected by seasonal changes in water level and silt deposition. Include (i) draw-down zone of reservoirs, (ii) mud and built riverbanks, (iii) shingle by natural lakes and rivers; (iv) the bases of trees liable to inundation (see pp. 9-10 for details). (Place communities based around the tall emergents of shallow waters in Fr1 or 2 as appropriate, also see BF4.) Some of these features depart significantly from EUNIS definitions.

Bogs, Fens & Flushes

8. **Raised bogs and blanket bogs (BF1).** Acidic (ombrotrophic) mires dependent on rainfall for their water and nutrients.
9. **Valley bogs, poor fens and flushes (BF2)** Acidic or slightly basic (soligenous) mires and flushes that are principally fed by streams or springs.
10. **Base-rich fens (BF3).** Mires, montane flushes and springs receiving calcareous water (e.g. from limestone) and containing vascular plant indicators of such enrichment.
11. **Sedge and reed beds without free-standing water (BF4)**

Grasslands

12. **Dry grasslands (Gr1).** Includes swards on rock debris (including that rich in bryophytes and lichens at metal mine sites) and decomposed rock surfaces, rock edges with annuals and succulents, non-Mediterranean dry acidic grassland, inland and coastal fixed dune grassland, inland *Carex arenaria* swards, calcareous grassland including Mesobromion, *Sesleria* grassland of N. England, grassland of coastal cliff tops and slopes.
13. **Mesic grasslands (Gr2).** Pastures, hay meadows, improved grassland, sports fields and lawns.
14. **Wet and seasonally-wet grasslands (Gr3).** Moist or wet eutrophic, mesotrophic and oligotrophic grasslands, inc. *Juncus effusus* meadows.

15. **Alpine and subalpine grasslands (Gr4).** Snow-patch grassland, moss- and lichen-dominated snow-patch communities and exposed moss- and lichen-dominated mountain summits, ridges and plateaux as well as montane grassland.
16. **Tall-herb communities (Gr5).** Includes subalpine (e.g. *Cicerbita alpina*) tall-herb communities, herbaceous woodland-edge communities, bracken fields, lowland anthropogenic tall-herb communities in eutrophic places or on abandoned land (e.g. nettle beds, *Chamerion* stands, etc.).
17. **Parkland (Gr6).** Sparsely wooded grasslands as in deer and cattle parks.

Heath, Scrub & Tundra

18. **Montane scrub and tundra (HS1).** Includes dwarf willow vegetation in and around snow patches in the Scottish Highlands, dwarf or prostrate wind-pruned ericaceous vegetation, dwarf juniper and *Dryas* heaths. (Also see HS3.)
19. **Temperate scrub (HS2).** Thickets of *Corylus*, *Crataegus*, *Prunus*, *Rubus*, *Sambucus* and *Ulex* scrub.
20. **Heathland (HS3).** Includes wet and dry heaths and moors, and *Molinia caerulea*-dominated communities.
21. **Riverine and fen scrubs (HS3).** This includes willow carr, fen scrub with *Rhamnus*, *Frangula*, etc., boreo-alpine willow scrub.
22. **Hedgerows (HS4)**

Woodland

23. **Broadleaved deciduous woodland (Wo1).** Established woodland where broadleaved trees constitute >75% cover; includes poplar plantations and orchards.
24. **Coniferous woodland (Wo2).** Established woodland where conifers constitute >75% cover; includes Caledonian pine woods, conifer plantations, yew woods and juniper woods.
25. **Mixed broadleaved and coniferous woodland (Wo3).** Established woods where neither the broadleaves nor the conifers achieve >75% cover; both natural and plantations.
26. **Young plantations, coppices and shelter-belts (Wo4).** Comprises the very early successional stages of woodland, including recent plantations in various configurations, early re-growth stages of coppice where there are no standards, recently clear-felled or burnt woodland.

Sparse vegetation

27. **Screes (SV1).** Extensive beds of boulders or blocks, usually beneath cliff faces and often on steep slopes. Similar features in old quarries should be included here rather than in SV2. (Screes or 'clitter' in woodland should be classified as the appropriate woodland category, often Wo1.)
28. **Inland cliffs, rock pavements and outcrops (SV2).** Cliffs where there is no saline influence, treeless areas dominated by rock outcrops or thickly strewn with boulders or blocks, limestone pavements, disused quarries. (If there is a tree canopy place in Wo1 or Wo2, etc.)
29. **Sparsely vegetated inland habitats (SV3).** Restrict this to bare soils or stony ground, including inland dunes, trampled ground, unpaved paths and tracks (these may be amended with sand, clay or stones), sites of

bonfires or more extensive fires that have removed the original vegetation.

Arable

30. **Arable land (Ar1).** Includes regularly cultivated ground, fallow areas and other recently abandoned cultivated land in fields, allotments and gardens.

Built environment

31. **Buildings in cities, towns and villages (BE1)**
32. **Low density buildings (BE2).** Scattered residential and agricultural buildings, fences, field walls and sea walls; includes churchyards.
33. **Extractive industry sites (BE3).** Sparsely vegetated areas of active mines and opencast sites and recently abandoned extraction sites and quarries.
34. **Roads and pavements (BE4).** Includes all paved components of the transport network including roads, station platforms, pavements, runways, patios and car parks. (Include dirt tracks and paths in SV3.)

Some habitats may present difficulties in chosing a 'setting'. Here are some examples.

Example 1. In a churchyard, the grass or lawn habitat would qualify as Mesic Grassland (Gr2), the church itself, any graves and the churchyard retaining wall would be entered as Low Density Buildings (BE2) and pathways would go down as either Sparsely Vegetated Inland Habitats (SV3) or Roads and Pavements (BE4), depending on whether they were made of grit or paved.

Example 2. On an old lead mine site with derelict buildings and perhaps mortar enrichment of the stony ground, areas of closed, well-drained grassland might be best placed in Gr1, sparsely-vegetated 'tailings' would qualify as SV3, the remaining old walls as BE2. These communities might merge into more natural areas of heath or moor (HS3) and boulder-strewn areas could qualify as SV2. Other, more upland or bog communities might also occur as at many Welsh mine sites.

Substratum

Once the habitat has been matched with one of the foregoing categories, the other important decision to be made is about the nature of the substratum under study. Ten major substratum categories are defined below. It will be appreciated that many bryophytes, especially pleurocarpous mosses and leafy liverworts in grasslands, actually grow perched on or even attached to other plants or leaf litter without direct contact to the 'substratum'. In these cases it is the underlying substratum (usually soil) that is supporting the plant community as a whole and should be entered on your field card.

A. **Soil.** Includes a very wide range of materials embracing the normal inorganic (clay, sand, silt, gravel) and organic (leaf litter, humus, peat) components of soil in varying admixture. It also includes sand, gravel, clay, etc. used in simple 'made' paths and tracks. Texture analysis of a general soil sample will later permit a more precise classification.
B. **Natural rock.** This ranges from cobbles or blocks as in scree, through boulders of varying sizes, to extensive outcrops including limestone pavements and cliffs.

C. **Bark of living shrubs and trees.** Special conditions apply to the sampling of epiphytes on trees and shrubs (see p. 10 for full details).

D. **Dead wood.** Treat the following four decay stages of logs and stumps as separate substrata within this category: (i) with bark still intact, wood firm; (ii) decorticated (i.e. bark lost) but with wood surface relatively firm and undamaged; (iii) decorticated, wood surface soft, rough and degraded; (iv) log or stump in final stage of decomposition, becoming subsumed into the soil. Record each on a separate card.

E. **Masonry.** Includes the whole range of hard building materials either cemented using mortar (bricks, natural stone) or containing cement as a major ingredient (concrete, 'asbestos' roofing). The cement imparts an initially strong alkaline reaction, slowly declining with age.

F. **Drystone.** Restricted here to the use of stone in building without the addition of mortar or cement. Important substrata from the bryological point of view include various types of 'drystone' wall, roofing slates and some types of traditional paving and 'rag-stone' tiles and cobbles. Ceramic and terracotta roof tiles should be included here if not cemented.

G. **Tarmac.** The commonest material used for constructing roads and for waterproofing flat roofs. It consists of stone chippings coated and held together with asphalt, a bituminous petroleum tar. Often colonised by bryophytes when degraded or has accumulated a thin soil covering.

H. **Thatch.** Reed or straw used for roofing. Note its condition, whether decayed or not.

I. **Wood.** Refers to man-made wooden surfaces of planks, palings, seats, signboards, board walks, pilings, jetties, etc. It is rather unlikely that areas of sufficient size for sampling with quadrats will be found in most grid squares.

J. Free-floating. Aquatics without firm connections to solid surfaces or other vegetation.

Biotopes, Microhabitats and Niches

Collectively, the 'environmental setting' and 'substratum' define a category of habitat known as a 'biotope'. The biotope may be represented by combining the appropriate codes given in the two preceding lists. For example soil (A) in broadleaved deciduous woodland (Wo1) is abbreviated to Wo1/A. In theory there could be 34 x 10 = 340 biotopes in a given 10-km square. In practice many biotope combinations will be absent and some are virtually impossible (e.g. Ma1/C, Ma1/H and Ma1/J) which makes our task of sampling them feasible.

Nevertheless, within a single 10-km square, some biotopes may be divisible into a number of distinct microhabitats, each supporting noticeably different bryophyte vegetation. Taking soil in broadleaved deciduous woodland (Wo1/A) as an example, one might notice a quite different bryophyte community growing on steep banks compared to that occupying flatter areas of woodland floor. More careful inspection may suggest that there are marked community differences within each of these 'microhabitats' according to variations in the amount of shading by the tree canopy. Furthermore, the same biotope may produce a quite different set of communities where the soil type is markedly different. It would be very difficult indeed to define, in advance, the nature of all the microhabitats that support bryophytes in the British Isles, which is why the cruder biotopes have been chosen as the framework for this survey. Individual recorders are encouraged to seek out as many different microhabitats as they can discover. The standard 'environmental data'

that are recorded should help to pin down the main reasons for the differences between microhabitats.

Using the Field Card

A separate field card should be completed for each microhabitat that is surveyed at each site in a given 10-km square. If used in conjunction with a clipboard it is best to print the 'card' on two sheets of paper that are stapled together with the print uppermost.

1. Complete the boxes at the top of the form taking care to define the 'microhabitat description' as fully as possible. Soil texture only applies to samples where the substratum is soil and should be assessed on a general collection of the local soil (see separate protocol). Soil or bark pH should also be measured later as described in separate protocols. Do not neglect to record the altitude and position as accurately as possible.
2. There is space to enter data for up to ten replicate quadrats. Fewer than ten may be recorded if it is felt that the variation at the site has been represented adequately.
3. Lines 1-17 are for entering the names of all the bryophytes present in your quadrats. A further 13 lines are available on the reverse side of the card. Either write the full names of the bryophytes or use the BRC abbreviations.

Recording the Quadrats

Just how you place your quadrats will depend on the microhabitat being sampled. The aim should always be to obtain a representative sample of the vegetation you have focussed upon. With this in mind introduce an element of randomness into both the placing of the quadrat within the site and its orientation. Avoid placing quadrats specifically to contain a particular bryophyte species. In extensive habitats it might make sense to walk along a line (transect) through the area placing the quadrat at pre-determined intervals (e.g. 5 paces) chosen to match the space available. Avoid placing quadrats very near to each other as we aim to average out any local aberrations in the distribution of species caused by small scale disturbances, etc. Also make a simple rule for changing the quadrat's orientation in consecutive samples, e.g. align the first one with the transect axis, align the second quadrat at right angles to it, and so on (but not on tree trunks, see below). It does not matter if some quadrats entirely lack bryophytes, as it is the mean cover scores for the set of quadrats that will ultimately be used to characterise the bryophyte flora of the microhabitat being studied. The same approach should be employed irrespective of whether the habitat is a continuous one such as the soil surface, or in discrete units such as logs, trees and boulders.

Having positioned a quadrat in the chosen microhabitat, firstly estimate the total bryophyte cover. This is a useful check on the apportionment of cover among the species later. Now make a list of the bryophyte species present. Collect a voucher specimen of anything you cannot name with certainty, using a temporary code name on the recording card. Now go systematically through the list and write down your visual estimations of percentage cover for each bryophyte present. Cover should be estimated to the nearest 5%, or for the scarcer plants (<5% cover) to the nearest 1%. Award an arbitrary score of 0.1% to any bryophyte that is present in the quadrat but with a cover below 1%. Remember, in the 50 x 25 cm quadrat a bryophyte patch measuring 5 cm by 2.5 cm is equivalent to a coverage of only 1%. The summed cover of all the bryophytes present may exceed the 'total bryophyte cover' if the canopies of individual bryophytes overlap one another. However, the summed total should not be

less than 'total bryophyte cover'. If it is then check your estimates! Also make cover estimates for areas of plant litter, any lichens and vascular plants, and the total bare surface within the quadrat.

The recording of **epiphytes** growing on the living bark (substratum category C) of tree trunks and branches constitutes a special case with potentially many complexities. The following rules have been devised to simplify and standardise sampling, and remove the need for tree climbing. The trees and shrubs selected for detailed study cover a very wide range of bark conditions.

Trunk epiphytes (not subject to seasonal flooding)

1. Record the following trees only, giving precedence to one of each pair of alternatives (extra keen recorders may sample the other alternative later):
    - *Fagus sylvatica* (Beech) **or** *Betula* sp. (Birch)
    - *Fraxinus excelsior* (Ash) **or** *Acer pseudoplatanus* (Sycamore)
    - *Quercus* sp. (native Oak) **or** *Sorbus aucuparia* (Rowan).
2. Sample three alternative trunk positions only (use a vertical 50 x 25 cm quadrat); trees must have girth >75 cm at breast height (i.e. 1.3 m).
    - **Trunk base** base (narrow edge) of quadrat rests on ground
    - **Mid trunk** base of quadrat at 62.5 cm above ground
    - **Upper trunk** base of quadrat at 125 cm above ground.
3. Do not sample more than one quadrat per tree.
4. Record each trunk position (in replicate) for each tree species on a separate card.
5. Sample each trunk at a random aspect.

Trunk epiphytes in the flood zone

1. Limit sampling of floodzone epiphytes to Ash, Alder (*Alnus glutinosa*) **or** Willow (*Salix* sp.).
2. Sample in the same manner as described above, but only where the trunk zones are affected by flooding and the trees are >75 cm girth at breast height.

Branch epiphytes

1. Restrict the sampling to shrubby (multi-stemmed) *Sambucus nigra* (Elder) **or** a *Salix* sp. (Willow/Sallow) **or** *Corylus avellana* (Hazel), and then only in a zone 1-2 m above the ground.
2. Sample branch epiphytes using the 50 x 12.5 cm **half-quadrat**; record one half-quadrat on two separate branches of each shrub and put each dataset in a separate column of the field card (i.e. a maximum of 5 double samples/card).

Environmental Data

The following environmental data should now be recorded for each replicate quadrat (or half-quadrat) completed.

- **Shade index** Chose one of the following shade categories for the overall vegetation of the quadrat. **1**, fully exposed to sunlight at all times, **2**, shaded from direct sunlight for up to half the day; **3**, receiving significant direct sunlight but for less than half the day; **4**, moderately shaded from direct sunlight, e.g. by a light-medium deciduous tree canopy, receiving some sunflecks; **5,** permanently shaded from direct sunlight but otherwise open to the sky (i.e. with north-facing aspect) **6**, in deep woodland (e.g. coniferous or in ravine) shade with no sunflecks; **7**, in perpetual, very deep shade as in a cave entrance. Allow for likely seasonal changes when making your estimates. You are free to enter an intermediate score if you think the situation merits it, e.g. 3.5 for a quadrat at the edge of a wood receiving some direct sunlight.

- **Slope** Measure the average angle (in degrees) from the horizontal in the direction of greatest slope with a clinometer. Overhangs should be expressed as angles above 90° rather than as negative quantities.
- **Aspect** Record the bearing of the quadrat (in degrees) in the direction of greatest slope using a compass or GPS.
- **Sward height** Use your ruler to determine the average height (mm) of the vegetation canopy (bryophyte + lichen + vascular) in the quadrat.
- **Soil or water depth, or tree or branch girth** If the substratum is 'soil', please estimate its depth by pushing the pin as far as it will go in the centre of the quadrat. [Very careful workers may make five measurements per quadrat - the centre and near each corner - and enter the average.] In the case of aquatics estimate the average depth of the water in the quadrat. In both cases enter values in excess of 250 mm (approx 10 inches) as '>250'. For trunk epiphytes determine the girth of each tree studied at 1.3 m height. For branch epiphytes measure the branch girth in the centre of the quadrat.
- **Collect a substratum sample for analysis** How you collect will depend on the nature of the substratum. A single measurement of pH will be made on the bulked samples from each set of replicate quadrats.
    - **Soils.** Using an old (but clean) teaspoon, take your soil sample from several different points in the quadrat to reach a total volume equivalent to that of a cherry, always limiting the collection to the upper 1 cm of the profile. Combine the collections from your replicate quadrats in a single labelled bag. Tick the box at the foot of the field card to show a sample has been taken. **NB.** A separate, general soil sample (from greater depth) should be used to assess **soil texture** for the whole sample.
    - **Bark.** Use the Surform scraper tool to remove about a teaspoonful of surface bark shavings from with the quadrat area. Avoid exposing the living wood. Combine the samples from replicate quadrats. Tick the box to show a sample has been taken. Clean scraper between samples.
    - **Rocks, masonry, tiles & tarmac.** Where possible, collect accumulated soil present on the rock surface, otherwise take dead organic material from within or beneath the bryophyte colonies, or a mixture of both. See 'soils' for volume required. Do not attempt to chip off rock or masonry samples. Combine samples from replicate quadrats. Tick the box to show a sample has been taken.
    - **Aquatic including bog, fen and flush environments.** Recorders with access to field pH and conductivity meters should make instantaneous readings of both for each replicate quadrat and enter the values in the pH and conductivity boxes. Others should collect a bottom sediment or peat sample for later determination of pH and conductivity, again bulking samples from replicate quadrats.

See separate protocols for making pH and other soil measurements. Always air dry soils and bark on paper towel or newspaper if it is not possible to measure pH within a day or two of collection. Dried bark samples may be sent to the scheme coordinator for pH measurement. Addresses of other people who have agreed to undertake pH analyses will be advertised on the website.

Reproductive Biology

The last five columns of the field card are designed to record some simply observed information about the reproduction of bryophytes. Once the first column of cover values and environmental data has been completed turn your attention to the reproductive structures present.

♂, enter a small tick or gatemark for each species in which one or more male inflorescences is visible within the quadrat. This will mainly include the mosses with conspicuous discoid perigonia but should also applied to liverworts where possible. Repeat for each quadrat studied so that a tally is accumulated.

F, if current season's sporophytes or perianths are present, enter a small tick or gatemark. Repeat for each quadrat studied.

C, write down the letter code for the most commonly represented developmental stages of any current season's sporophytes (inc. perianths) present. Add further different codes if other stages are prevalent in other quadrats.

For mosses (excluding embryo stages)
C, calyptra partially exerted from perichaetial bracts
S, seta elongating with calyptra on top
W, distal end of seta expands in width within calyptra
G, green capsule widens fully, lid starting to brown
B, capsule brown, lid still closed
D, lid detaches, > ½ spore mass remains
MT, empty, fewer than ½ spores remain
A, abortive, seta apex browns or shrivels

For liverworts (may need to adapt for some)
V, no capsule visible in perianth (lens)
P, capsule in perianth present but < half mature diameter
M, capsule in perianth, > half mature diameter
E, capsule exserted from perianth but undehisced
D, capsule dehisced but seta remains erect
S, capsule dehisced and seta shrivelled

P, enter a tick or gatemark if previous seasons' sporophytes are present as well in the quadrat. Repeat for each quadrat sampled.

G, enter a tick or gatemark if gemmae, tubers, bulbils or deciduous leaves or shootlets are observed (lens) in the quadrat. Repeat for each quadrat sampled.

Completed field cards should be sent to the Bryophyte Habitats Survey coordinator:

Dr Jeff Bates, Division of Biology, Imperial College London, Silwood Park Campus, Ascot, Berkshire SL5 7PY, U.K.

Appendix

A list of the grid references of the target grid squares shown in Fig. 1.

Ireland & Northern Ireland

B61 B94 C21 C54 C81 D14 F72 G32 G65 G92 G98 H25 H52 H58 H85
J12 J18 J45 L76 M03 M09 M30 M36 M63 M69 M90 M96 N23 N29 N50
N56 N83 N89 O10 O16 Q41 Q74 R01 R07 R34 R61 R67 R94 S21 S27
S54 S81 S87 T14 V45 V72 V78 W05 W38 W65 W98 (56 squares)

Britain

North

HY50 HU45 NB21 NB54 NC14 NC41 NC74 ND01 ND07 ND34 NF98 NG25 NG52
NG85 NH12 NH18 NH45 NH72 NH78 NJ05 NJ32 NJ65 NJ92 NL69 NM23 NM56
NM83 NM89 NN10 NN16 NN43 NN49 NN70 NN76 NO03 NO09 NO30 NO36
NO63 NO69 NR27 NR87 NS14 NS41 NS47 NS74 NT01 NT07 NT34 NT61 NT67
NT94 NU21 NX18 NX45 NX78 NY05 NY32 NY38 NY65 NY92 NY98 NZ25 NZ52

South

SC16 SC49 SD09 SD30 SD63 SD69 SD90 SD96 SE23 SE29 SE50 SE56 SE83 SE89
TA10 TA16 SH47 SH74 SJ01 SJ07 SJ34 SJ61 SJ67 SJ94 SK21 SK27 SK54 SK81
SK87 TF14 TF41 TF47 TF74 TG01 SN12 SN45 SN72 SN78 SO05 SO32 SO38
SO65 SO92 SO98 SP25 SP52 SP58 SP85 TL12 TL18 TL45 TL72 TL78 TM05
TM38 SR89 SS10 SS43 SS49 SS70 ST03 ST09 ST30 ST36 ST63 ST69 ST90 ST96
SU23 SU29 SU50 SU56 SU83 SU89 TQ10 TQ16 TQ43 TQ49 TQ70 TQ76 TR03
TR09 TR36 SW54 SW81 SW87 SX14 SX47 SX74 SY07 SY67 (155 squares)