

BRYOPHYTE RECORDING HANDBOOK

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A guide to recording mosses and liverworts prepared by members of the British Bryological Society



Published 2012 by the British Bryological Society www.britishbryologicalsociety.org.uk

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Bryophyte Recording Handbook C.D. Preston, T.H. Blackstock, S.D.S. Bosanquet, M.F. Godfrey, M.O. Hill, D.T. Holyoak & G.P. Rothero

ISBN 978-0-9561310-3-4 paperback

Printed by Latimer Trend & Company Ltd, Plymouth, UK Design Ian Atherton, Hampshire

Front cover: Bryum pallescens. David Holyoak

www.britishbryologicalsociety.org.uk

FOREWORD

It is my pleasure as Recording Secretary of the British Bryological Society to commend to you this *Handbook*, setting out our procedures and recommendations for the future. All the authors of the *Handbook* are seasoned recorders. The *Handbook* distils our experience.

In 1964, I recorded bryophytes on Harold Whitehouse's Cambridge excursions. In 2012, I continue to record the bryophytes of Cambridgeshire with great enjoyment. The changes over 47 years are remarkable. Back in the 1960s *Plagiochila asplenioides* and *Rhytidiadelphus triquetrus* were common and locally abundant in the boulder-clay woods. Now they are scarce and seen only in small quantity. In those days, pollution-sensitive epiphytes such as *Cryphaea heteromalla*, *Orthotrichum lyellii* and *O. pulchellum* were absent or very rare. Now we see them on most excursions.

Sometimes the causes of change are obvious: atmospheric sulfur has decreased dramatically, so the epiphytes have returned. But without good recording both here and in the rest of Europe, we cannot see clearly what is happening or understand its wider significance. *Orthotrichum pulchellum*, for example, has extended its range as well as its frequency. It used to be an 'Atlantic' species. Now it is widespread in central Europe. Likewise, *Didymodon nicholsonii*, long misunderstood on the Continent, has greatly increased and is now abundant along the Rhine. No longer does it have its headquarters beside the gurgling rivers of Yorkshire. Even more remarkable is the expansion of the hyperoceanic *Colura calyptrifolia* and *Daltonia splachnoides* in western Ireland and also Britain. *Cololejeunea minutissima*, formerly with a Mediterranean–Atlantic distribution, is rapidly colonizing eastern England. Are these species responding to climate change? They may be. Oceanic species are spreading also in the Alps.

These phenomena would not be observed, let alone understood without a network of recorders. Individually, an isolated observer can achieve relatively little. The really big gains come from sharing data. If you follow the advice in this *Handbook* you will have the cake of your recording project as well as the pleasure of eating it with other bryologists. By networking and sharing we paint the big picture. We need good records and sound authentication procedures. The BBS promotes both. The Society is the hub at the centre of the network for Britain and Ireland. We have done well and with your help we can do better. Perhaps with perseverance and better information technology, bryologists may one day be able to run a recording campaign across most of Europe.

Mark Hill, BBS Recording Secretary



CONTENTS

	Foreword	i
1	Introduction	3
2	Identification guides and referees	5
3	The BBS recording systems	9
4	The vice-county recording system	11
5	What is the appropriate geographical scale for recording in your area?	17
6	Recording cards	19
7	Recording rare species	23
8	Submitting your records on cards or in electronic form	27
9	BBS records on the NBN gateway	33
10	References	35
Appendix I	Duties of BBS Regional Recorders	39
Appendix II	Published or planned bryophyte floras at 5-km square or tetrad scale	41

1 INTRODUCTION

The British Bryological Society actively promotes bryophyte recording, and members take part in a range of projects at both the national and the county scale. However, there is surprisingly little formal guidance on how to record bryophytes. Most identification guides, from introductory booklets to advanced floras, explain how to identify bryophytes and deal with the collection and preservation of specimens, but none goes on to cover the basic techniques of recording. Beginners will usually learn how to record from colleagues, either in informal groups or at organized field meetings. Only surveys which have adopted a detailed and rather specialized recording protocol normally issue precise instructions to recorders.

The aim of this booklet is to provide an introductory guide to the recording of bryophytes in Britain and Ireland. It might be argued that the current healthy state of bryological recording shows that there is no need for any such formal guidance. However, it is all too easy to devise a recording project which focuses on collecting data for one particular project, but fails to consider how the records collected might contribute to other recording projects, or fit into the wider national picture, or be of use to future bryologists. One of the main reasons for producing this booklet is to ensure that recorders are aware of the need to make their records as precise as possible, both spatially and temporally, as this is the way to ensure that they are likely to be of most use to others. It is also helpful to consider at the start of a project how the data collected might be passed on to others, to avoid the timeconsuming manipulation of a large dataset at the end of a successful project.

We have not included information such as the names and addresses of BBS Officers and of Regional Recorders in this booklet. For up-to-date details, see the BBS website (www.britishbryologicalsociety.org.uk) or recent issues of *Field Bryology*.

This handbook has been compiled mainly by members of the BBS Recording and Conservation Committee. The following members drafted particular chapters: T.H. Blackstock & G.P. Rothero (4), S.D.S. Bosanquet (2, 5), M.F. Godfrey (8), M.O. Hill (3, 8), D.T. Holyoak (7) and C.D. Preston (1, 2, 6, 9).

2 IDENTIFICATION GUIDES AND REFEREES

Identification guides

The standard floras are Paton's *The Liverwort Flora of the British Isles* (1999) and Smith's *The Moss Flora of Britain and Ireland* (2004). Smith (1990) provides a less detailed treatment of the liverworts which is nevertheless useful as a more portable *aide memoire*. Of the older floras, Dixon (1924) still contains much valuable information, although obviously his treatment of some genera has been rendered obsolete by taxonomic revision.

Mosses and Liverworts of Britain and Ireland: a field guide (Atherton, Bosanquet & Lawley, 2010) includes photographs of most species and notes on their identification in the field. Watson's *British Mosses and Liverworts* (1981) was first published in 1955 but it is still the only beginner's guide which deals with both the field and the microscopic characters of a wide range of species; it remains useful despite the fact that it is now rather outdated. Lüth (2006–2011) provides photographs of the German mosses in the field as well as of morphological details such as cross-sections of leaves and stems. The broad overlap with the British and Irish flora makes this a very useful, although rather expensive, work. The first two volumes of a Nordic flora illustrated with photographs and coloured drawings have been published recently and cover, amongst other taxa, Dicranales, Grimmiales and Pottiales (Hallingbäck *et al.*, 2006; Hallingbäck, Lönnell & Weibull, 2008).

The more technical Nordic floras are often worth consulting, as they not only cover many of our species (with the obvious exception of the most southerly elements in our flora) but are also written in English. Nyholm's *Illustrated Flora of Nordic Mosses* (1987–1998) is incomplete and for the pleurocarpous mosses the relevant fascicles of her earlier *Illustrated Moss Flora of Fennoscandia* (1965–1969) have not yet been superseded. The equivalent work for liverworts is by Damsholt (2002), although this has a rather different taxonomic philosophy to the British floras, and recognizes many of the varieties which we do not now regard as distinct. The new Iberian flora, of which three volumes have been published to date (Guerra, Cano & Ros, 2006; Brugués, Cros & Guerra, 2007; Guerra *et al.*, 2010), covers the great majority of British and Irish species. The text is in Spanish. At the European level there are summary treatments of all bryophytes (Frey *et al.*, 2006) and of liverworts and hornworts (Schumacker & Váňa, 2005).

Although it is not an identification guide, the copiously illustrated glossary by Malcolm & Malcolm (2006) is a very useful companion to all these works.

There are innumerable other papers and books which can be helpful in identifying particular species. The relevant papers in the *Journal of Bryology* are usually cited in the standard floras. The following works are particularly useful guides to some of the larger and more troublesome genera.

Calliergon, Drepanocladus and related genera

The pleurocarpous mosses are less well covered by identification guides than other bryophyte groups, with the splendid exception of the account of these genera by Hedenäs (2003). It can be used in conjunction with the photographs on the Amblystegiaceae page of the BBS website.

Didymodon

Kučera (2000) includes detailed illustrations of the central European species (including most of ours); Jiménez (2006) published a comprehensive revision of this genus with descriptions and illustrations of all the European species.

Grimmia

The most thorough and accurate treatment of European *Grimmia* is by Maier & Geissler (1995). Maier's later monograph (2010) is a worldwide account and includes detailed figures of all the species (though she does not recognize some commonly accepted taxa, e.g. *G. arenaria*). The difficult *G. trichophylla* complex is covered by Maier (2002).

Orthotrichum

Bosanquet (2009) provides a beginners guide to the British and Irish species, illustrated by photographs of plants in the field. For drawings of all our species, see Lewinsky-Haapasaari (1995).

Pleurocarpous mosses

Good line drawings of many of our pleurocarpous mosses are given by Ignatov & Ignatova (2004). The Cyrillic script makes them difficult to interpret, but the quality of the drawings is exceptional, and they include whole-plant illustrations.

Schistidium

Blom's account in Nyholm (1998) is particularly useful.

Sphagnum

Flatberg's field guide to the Norwegian species (2002) and Laine *et al.*'s (2009) guide to the macro- and microscopic characters of the Finnish species include colour photographs of most of our plants. The illustrations in Hölzer's (2010) account of the German species, which include photomicrographs, have been described as the best *Sphagnum* illustrations yet produced. For a more technical illustrated monograph of the European species, see Daniels & Eddy (1990).

In addition to these works on taxonomically defined groups, there is a field guide to the species of arable fields (Porley, 2008).

Referees

The BBS maintains a panel of referees. The refereeing service is intended to provide assistance to members who have genuine difficulty in naming their British and Irish collections. It is not intended as a 'free-for-all' identification facility, least of all for bulk collections. Please therefore respect the following guidelines when submitting material.

- If possible, avoid sending large quantities at any one time. Do not send material if you are not prepared to examine it yourself in advance.
- Please ensure that fragile specimens are adequately protected in the post. This applies particularly to material with lumps of soil attached. It is dispiriting to open a packet and find nothing but a pile of dust inside! Small boxes or tins are ideal for protection from crushing.
- Please label all packets clearly with full collection details, including habitat, locality, altitude and at least a 10-km grid reference.
- Always enclose a stamped addressed envelope (or label), even if material is sent to universities or institutions. Otherwise you may not receive a reply. However, it is not necessary to enclose a pre-paid envelope if the referee is based in a different country from yourself.

The referees are listed on the BBS website and periodically in Field Bryology.

3 THE BBS RECORDING SYSTEMS

The BBS runs two main recording schemes with accompanying databases. The earliest recording scheme is the Vice-county Recording Scheme (VCRS), which was established in its present form in 1937. From then on, new vice-records were published annually, first in the Report of the British Bryological Society, and subsequently in the Transactions of the British Bryological Society, Journal of Bryology, Bulletin of the British Bryological Society and now in Field Bryology. The purpose of the VCRS is to maintain a reliable register of species present (or formerly present) in each vice-county. New records are verified and checked. There are 111 vice-counties in Great Britain (including Shetland, Orkney and Hebrides), 40 vice-counties in Ireland, 1 vice-county for the Isle of Man and 1 for the Channel Islands. The essence of the VCRS is that specimens are kept, so that if a record is doubted or a species is revised, then a check can be made. Vicecounty distributions of species are published at intervals in Census Catalogues, of which the most recent is that of Hill et al. (2008). Updated versions are posted about every two years on the BBS website. The VCRS is the responsibility of the Recorder for Mosses and the Recorder for Hepatics. For further details of the Scheme, including an explanation of vice-counties, see Chapter 4.

The other major recording scheme is the BBS Mapping Scheme (BBSMS), for which data are maintained in the BBS database (BBSDB). BBSMS was started in 1960 and resulted in a published atlas (Hill, Preston & Smith, 1991–1994). The BBS database is currently held within a larger Oracle database at the Biological Records Centre (BRC), formerly based at Monks Wood and now at Wallingford. It is closely linked to VCRS, in that all new vice-county records are incorporated in BBSDB.

The diagram on p. 10 (Fig. 1) shows the main data flows for bryological data. The Vice-county Database is maintained by the Recording Secretary, and is posted in various forms on the BBS website. At the time of writing it is available in Census Catalogue format.

There are Regional Recorders for many (but by no means all) vice-counties. Their duties are set out in Appendix I. The Recorders are active bryologists who collate and curate records for the vice-county, passing them on at intervals to the Recording Secretary. If you have records from a county you should make sure that you send them to the Regional Recorder, and if you have the opportunity to do any recording in an area it is always a good idea to consult the Recorder in advance, to ensure that wherever possible your recording is compatible with their own fieldwork. The Regional Recorders are listed on the BBS website, which provides



Fig. 1. Main data flow for bryological recording by the BBS.

other basic information on vice-counties (including accounts of BBS meetings held there and references to any recent county floras).

The two main BBS recording schemes are closely linked. In particular, all vicecounty records and amendments are logged in BBSDB. The vice-county database is used to check observational data entering BBSDB. If a species record in BBSDB is from a vice-county for which the species is not accepted in the Vice-county Database, then the record is examined critically, and may be flagged to indicate that the species is not recorded for the vice-county and that the record should therefore not be accepted for mapping. Another link between the databases is in distinguishing old records. If a species has not been recorded in a vice-county for 50 years, it is normally signified as an old record (in brackets). At intervals, the old (bracketed) records are reviewed and updated in the Vice-county Database using the data from BBSDB.

The Vice-county Database is published through Census Catalogues and the BBS Website. The main dataset BBSDB is published through the internet on the NBN Gateway, which allows records for any selected area to be searched (see Chapter 9). Those requiring large datasets – e.g. the entire data for a vice-county – should apply to the Recording Secretary for a download direct from BRC.

4 THE VICE-COUNTY RECORDING SYSTEM

Background

For over 100 years the Watsonian vice-counties have provided an effective and practical spatial scale for recording and compiling information on the distribution of mosses and liverworts across Britain and Ireland. The British vice-county network was established by H.C. Watson in 1852; R.L. Praeger extended it to Ireland in 1901. It was originally devised for recording flowering plants and ferns, and has been successfully adopted for bryophytes and some invertebrate groups. In many cases, resident field botanists have found that their local county provides a stimulating and manageable geographical area, in terms of extent and habitat range, over which to explore and often map the local bryophyte flora. More ambitious recorders have recorded across two or more adjoining counties, and others have worked remote vice-counties in their spare time and on holidays. County recording projects have been undertaken by amateur and professional bryologists alike.

With the advent of grid-square recording and national atlas publication in the second half of the 20th century, vice-county recording may appear somewhat outmoded and redundant. But the two approaches have proved to be fortuitously complementary. Recording the presence of species in 10-km squares for national mapping schemes has mostly been co-ordinated locally by Regional Recorders who are very well placed to assess the effectiveness of recording in squares within their county. Indeed, many Recorders today map their county bryophyte flora at the more refined 2×2-km square ('tetrad') scale. Additionally, field meetings of the BBS in Britain and Ireland have traditionally been organised in vice-counties and have been a productive source of new local records.

The BBS is also closely involved with vice-county recording over the verification and publication of new local records. From the early 1900s, records of new bryophyte species to a county have appeared annually in one of the society's publications, and are currently listed in *Field Bryology*. Since 1946, such records have only been accepted if accompanied by a voucher specimen that has almost always been confirmed by either the Recorder for Mosses or the Recorder for Hepatics (who also covers hornworts); in some cases, the Recorders send on critical or difficult vouchers for the views of other expert bryologists. Vouchers are also submitted to support updated old records (currently pre-1960) for taxa in a particular vice-county. The vouchers are curated and stored in the herbarium BBSUK, housed within the cryptogamic herbarium at the National Museum & Gallery in Cardiff. In this way, useful sets of herbarium specimens are being built up for future reference and checking by local recorders. Material in BBSUK also provides valuable source of samples, from across a wide range of Britain and Ireland, for taxonomic and other scientific investigation.

Periodically, the BBS publishes Census Catalogues that list, in different date classes, the vice-counties in which each bryophyte species (and some infraspecific taxa) have been recorded. The most recent printed catalogues, by Corley & Hill (1981), Blockeel & Long (1998) and Hill *et al.* (2008), also provide more detailed chronological accounts of bryophyte recording in the vice-counties of Britain and Ireland. The vice-county census is also now kept up-to-date on the BBS website.

Vice-counties and their boundaries

The division of Britain into vice-counties was devised and delineated in the 19th century by Watson (1852), and an equivalent division of Ireland was more recently undertaken by Praeger (1901). For practical purposes, the maps at 1:625,000 scale and accompanying explanatory booklet prepared by Dandy (1969) provide the most accessible printed source of definitive information on the vice-county boundaries for Britain. For Ireland, a similarly thorough account has been published by Webb (1980). These publications are widely available in academic and other libraries, and can also be obtained on loan from the BBS Librarian. For serious vice-county field recording, reference to definitive maps is essential as many lengths of the original county boundaries are likely to be unfamiliar. The detailed boundaries of the British vice-counties can be consulted on the NBN website (see Chapter 9) and a table of their areas can be downloaded from www.bsbi.org.uk. A singular advantage of adopting the vice-county network as a basis for natural history recording is that the boundaries are fixed over time, giving geographical stability to the accumulating biodiversity data. By contrast, administrative county boundaries change with sufficient frequency to create at best highly tedious data transfer from time to time, and at worst highly unreliable county-level floristic datasets due to the impracticality of undertaking such transfer.

The use of consistent geographical division for recording also allows relatively straightforward assessment of changes in local bryophyte floras. In addition, local recorders usually become familiar with the whereabouts of rare and interesting species throughout their vice-counties, and often play an informative role in local conservation initiatives and botanical investigations.

Vice-county records and their compilation in Census Catalogues

The vice-county census has been a core BBS product for over 100 years and has played a fundamental role in providing reliable geographical data on the distribution of British and Irish bryophytes. The first attempts to collate the vice-county occurrences of British bryophytes in Census Catalogues date back to the early 1900s; updated and revised versions have been published since then as outlined in Table 1.

The Census Catalogues prepared before 1950 were largely based on available literature records and unpublished regional and county sources. Since 1950, many early errors of omission and commission have been corrected by painstaking critical work undertaken by the compilers. Regional Recorders have also made a substantial contribution in the revision of the national census. Likewise, much helpful information has arisen from taxonomic studies of British and Irish bryophytes. Recently, Holyoak (2003) has comprehensively drawn together a complete census of the vice-county distribution of the bryophytes of Ireland. Before the modern electronic era, the BBS Recorders for Mosses and Liverworts also maintained handwritten notebooks and annotated catalogues of new vice-county records.

The most recent Census Catalogue has separated pre-1960 vice-county records (in brackets) from those recorded from 1960 onwards. The allocation of bracketed records was substantially amended using information on dated records held in a database of bryological records that was established in association with the BBS

 Table 1. Census Catalogue editions of the vice-county distributions of mosses and

 liverworts in Britain and Ireland.

Mosses	Liverworts and Hornworts
1. Ingham (1907)	1. Macvicar (1905)
2. Duncan (1926) Supplement (1935)	2. Ingham (1913)
<i>Census Catalogues of British</i> <i>Sphagna</i> (Sherrin 1937, 1946)	3. Wilson (1930) Supplement (1935)
3. Warburg (1963)	4. Paton (1965)
Mosses, Liverworts and Hornworts	
1. Corley & Hill (1981)	
2. Blockeel & Long (1998)	
3. Hill et al. (2008)	

mapping scheme at the Biological Records Centre at Wallingford (BBSDB). Entries that lacked a localised record in the database and could not be confirmed from other sources have been deleted from recent Census Catalogues.

Voucher preparation and submission

Vouchers for new vice-county records are normally submitted to the Recorder for Mosses or the Recorder for Hepatics, but for critical genera like *Bryum*, *Grimmia* and *Scapania* it may be sensible to have them checked by the appropriate referee before sending them to the Recorder.

One of the advantages of working on bryophytes compared to many other groups of plants is the ease of preparing and examining herbarium specimens. In temperate environments they can be readily dried indoors and stored in simple paper packets folded much like an envelope but without any sticky margin. The method of folding packets is outlined by Rothero & Blackstock (2005) and is described in various handbooks to mosses and liverworts. Specimens need to be properly dried following initial examination and can usually be readily re-wetted for subsequent study.

The BBS protocol for accepting a new or updated record for a species in a particular vice-county is to have a voucher specimen for the record verified by the appropriate Recorder. Vouchers should normally be submitted in a dry condition within packets on the outside of which relevant collection and locality details are given. For some taxa, especially those with diagnostic features that disappear shortly after drying, such as oil bodies in the liverwort genus *Lejeunea*, it is helpful to submit fresh moist material. The information on the packets should include:

- the name of the taxon
- the habitat in which it was found
- the name of the locality and nearby town (which are best taken from Ordnance Survey maps)
- the name of the vice-county in which the locality is situated
- the national grid reference (usually 6 figures with lettered prefix, but 4 or even 2 figures are acceptable and, using Geographical Positioning Systems, 8 figures are increasingly being noted, these being especially relevant for rare and scarce species)
- the name of the collector and other authorities who may have examined the material
- the date of collection

It is also very useful to note on the packet if gametangia, sporophytes, gemmae or other asexual propagules have been observed.

But it is in the field that most care and attention is required to obtain an effective voucher. Adequate but not excessive material needs to be collected, with particular emphasis on reproductive and other features that aid or may be critical for reliable identification. It is also very helpful for the Recorders, as well as others who may study the specimen, if the part of the sample examined by the collector is placed in a mini-packet within the main specimen packet. For rarities, minimal collections are appropriate, but they should still be sufficient for accurate determination; reliable and experienced recorders may very occasionally choose to forgo collection, particularly in the case of extreme rarities, but there is then the disadvantage of lack of reference material for subsequent enquiry. Some species are protected by law and collection should only be undertaken under licence. Digital images may be accepted for very rare species – though few of these are likely to be identifiable from a photograph.

Finally, care needs to be taken in packing vouchers for sending to the Recorders. Padded envelopes are useful in many cases, especially for bulky material and multiple vouchers, and it is most important that vouchers are protected against leakage from their packets. If the specimen is attached to lumps of soil (as in the case of tuber-bearing mosses), it should be protected in a crush-proof container. It is also helpful to note that the package contains plant specimens for study and especially to indicate if fresh undried material is included.

5 WHAT IS THE APPROPRIATE GEOGRAPHICAL SCALE FOR RECORDING IN YOUR AREA?

The key thing to consider when you are choosing what scale to record bryophytes at is the usefulness of your data to current and future users. A record of a species 'on a rock near Tintern' is of little use except at a vice-county scale. A flora writer who eschews 'dot maps' can use it easily, but one who wants to present some visual information on distribution has to work out how near Tintern 'near' is. In some cases a vague location name is enough to work out in which 1-km square a record was made; other localities, including Tintern, are impossible to place even within a hectad (10×10 -km square). Most recent British county floras have used the Ordnance Survey National Grid and this seems likely to continue, in most cases, for the foreseeable future. Therefore, please think how to make your recording most useful when you record bryophytes.

The scale of recording within a county or region depends on the size of the area covered, the time available to the recorder(s) and their keenness. Hectad maps present a very informative picture at a national scale but are rather uninformative within vice-counties; 5-km maps are more informative at a local scale and thorough coverage is possible, but subtle patterns are not always apparent. Tetrad maps have become popular in the vascular plant recording community and can present quite detailed patterns within a vice-county, but there are an awful lot of them in the average recorder's patch; 1-km maps are wonderfully detailed, but the chances of getting full enough coverage within a vice-county for the maps to be meaningful are tiny. The standard names of the 5-km squares are straightforward and self-explanatory (NE, NW, SE, SW); the standard 'DINTY' nomenclature for tetrads is shown in Fig. 2 on p. 18. Most local recording schemes are operating at 5-km or tetrad scales (Appendix II), although few operate in a way that allows transfer between the two scales because the central cross of tetrads (C, H, K-P, S & X) each overlap two or four 5-km squares. Still, the practice of recording 6-figure or even 8-figure grid references for notable species means that at least the more important records may be ascribed to either mapping scale.

The travelling bryologist also needs to consider what scale to record at. The first thing you need to ascertain is whether somebody is already recording within the region you are visiting and to ensure your records can be used by them. The obvious way to find this out is to consult the Regional Recorder, if there is one. There is no need to record at a coarser scale than you would normally – you

Bryophyte Recording Handbook

8,9	E	J	Р	U	Z
6,7	D	I	Ν	Т	Y
4,5	С	н	Μ	S	х
2,3	В	G	L	R	W
0,1	А	F	к	Q	V
	0,1	2,3	4,5	6,7	8,9

Fig. 2. DINTY tetrad nomenclature. Numerals in the left-hand column are the 1-km square northings and those in the bottom row are the 1-km square eastings.

should merely pay attention to where you are in relation to hectad, 5-km or tetrad boundaries. Even if nobody is currently recording, it could still be worth trying to record within relatively tightly defined areas as somebody may start up in a few years time and it would be a pity if they could not use any of your data.

In the age of computerisation, the need for tetrad or 5-km 'master cards' is less than it was in the past, although they can usefully focus attention on gaps in recording. Even if you use them, it is important to avoid recording just onto a 'master card' as data recorded solely at the 5-km or tetrad scale are pretty meaningless and are of very limited use for conservationists, developers or others who might want/need to use the data. It is preferable to record separately on individual sites within a square, using separate cards when possible rather than elaborate and muddling coding on a single card. Data can be made most useful by using a site/square scheme, whereby different squares within a site are recorded separately, as are different sites within a square. In parts of south Wales, 1-km squares (identified by 4-figure grid references) are recorded separately wherever possible as these can be displayed equally well as tetrad, 5-km or hectad maps. Clearly there is no need to visit every habitat in every 1-km square unless you want to spend a lifetime in a single county - lists for different habitats in one or two 1-km squares build up into reasonably good tetrad coverage. Nor is it necessary to re-record everything in each 1-km square that is visited within a larger square, although producing relatively complete lists for individual sites is desirable.

Finally, it is important not to make records appear artificially accurate. If you write down a 4-figure grid reference on your recording card then please stick within that 1-km square, otherwise use a tetrad, 5-km or hectad reference. 6-figure site 'centroids' are even more muddling, especially when a site crosses several squares: a broad approach, backed up with precise 6-figure or 8-figure readings for notable species, is preferable.

6. RECORDING CARDS

Recording cards are available for the use of recorders who intend to contribute to the BBS databases. The current recording cards were created in 2005, replacing the RP22 (general) and RP23 (SE England) cards which were first printed in 1992. The nomenclature of the cards follows Blockeel & Long (1998).

Four cards are available:

SE England (RP33) - vice-counties 7-32 and 53-54.

Middle Britain (RP34) – vice-counties 1–6, 33–52 and 55–95 (i.e. the areas not covered by the SE England and NW Scotland cards)

NW Scotland (RP35) - vice-counties 96-112

Ireland (RP36) - vice-counties H1-H40

The most frequent species in the vice-counties listed are included on the record cards. In general, the appropriate card to use will be given by the vice-county list above, but there will be exceptions. Recorders in arable lowlands or chalk wolds of SE Yorkshire (vice-county 61), for example, might find that the SE England card is more suitable than the Middle Britain card.

Cards are available free of charge to bona fide recorders. Please order them by e-mail from Björn Beckmann (bjck@ceh.ac.uk) or write to him at Biological Records Centre, CEH Wallingford, Maclean Building, Crowmarsh Gifford, Wallingford, Oxon OX10 8BB, citing the code number of the card you want (RP33, etc.) and the number of cards you require. Please don't just ask for '*a good number*' of cards or '*enough to keep me going for a year or two*'!

Alternatively, PDF files of the cards can be downloaded from the BBS website and used to print your own cards. There is also a downloadable Excel spreadsheet on the website with the Blockeel & Long (1998) names, abbreviated names and BRC numbers of all species, for those wishing to create their own county cards. If you are doing a lot of recording in a single county, consider whether it is worth creating your own card, as this will allow you to list only the commoner species and thus ensure that local rarities are treated as 'write-ins' and given detailed grid references.

Completing field recording cards

The cards are intended for use in the field. They can sometimes also be useful in extracting information from sources such as notebooks, reports and publications,

and thus converting such records into a format which can more easily be input into a database.

When you fill in a field card, please make the place and date of recording as specific as possible. Cards are most useful if they refer to a single visit to a single site or tetrad. Please don't use different colours on a single card to distinguish different sites or visits – it is much more time-consuming and error-inducing to input four sets of data from one card than it is to input four cards, and of course the colours are lost on photocopies. On no account record species occurring in two 10-km squares on a single card, even if they grow at a single site. An equally reprehensible habit is to compile records from various visits over a prolonged period onto a single summary card or 'master card'. This has caused much frustration for local flora writers who find that, when writing their floras years after the cards were completed, they are unable to trace the original details of the records.

Record species on the card either by striking though the species name (extending up to but not through the adjoining number) or by underlining the name and turning the line upwards at the right-hand end of the name:

89 Bryum arge

To delete records which have been marked off in error, add an 'X' on each side of the species name:

89 Bryum arge

X 89 Bryum arge X

If you find a taxon that isn't included on the species list on the back of the card, you have a 'write-in'. Use the columns on the front to record it. Don't annotate the list on the back with tiny comments such as 's.s.' or 'var. obt'. It is all too likely that your annotation will be overlooked and the printed taxon input into a database. Instead, you should make full use of the column on the front of the card to record the precise localities of locally or nationally uncommon species, or other noteworthy information. If you have a long list of write-ins, don't hesitate to continue it on a second card, repeating the basic site information in the boxes at the top. Don't cram the records onto a single card so that they become illegible, or write records very close to the margins where they may be lost on photocopies.

Recording sporophytes

The presence of sporophytes can be recorded by adding 'f' after the species name:

89 Bryum arge f

Information on the incidence of fruiting is much more valuable if it is recorded systematically than if it is recorded solely for species which are not usually found

with sporophytes. There is rather little basic information on the frequency and phenology of sporophyte production, so the systematic recording of this information is worthwhile. The following stages are based on those described by Bates (2010).

Moss sporophyte maturity

- 1. Calyptrae visible amongst perichaetial leaves.
- 2. Setae visible but capsules not fully swollen.
- 3. Capsules fully swollen, green; calyptrae still present.
- 4. Capsules fully swollen and calyptrae lost but lids still in place.
- 5. Lids of capsules shed; spores dispersing.
- 6. Capsules empty.

Liverwort sporophyte maturity

- 1. Green capsules visible inside perianths or calyptrae.
- 2. Capsules emerging from perianths or calyptrae.
- 3. Setae fully elongated; capsules undehisced.
- 4. Capsules dehisced.

More than one of these stages may be present at the same time. This system is probably too elaborate for general recording, but could usefully be incorporated into plans for flora projects or other specialist surveys.

Details of a BBS project which aims to gather detailed data on the fruiting times of bryophytes by repeat visits to colonies of common species are given on the Society's website.

The composition of the aggregates on the cards

Aggregates are indicated on the cards by an asterisk; the components of the aggregate are detailed below. Some synonyms are given in brackets. Think carefully about recording aggregates as opposed to species and species as opposed to varieties: the aim should be to record the more precise taxon when you can, but to base your decision on the characters of the specimen rather than on assumptions about the taxon you would expect to be present in your area.

Barbula **convoluta* is *B. convoluta* as defined by Blockeel & Long (1998), including the varieties they subsume within it, var. *commutata* and var. *convoluta*, but which are again recognised as var. *sardoa* and var. *convoluta* by Hill *et al.* (2008). The asterisk has been added as it has been suggested that var. *commutata* should be treated as a species, *B. commutata* (*B. sardoa*).

Dichodontium * pellucidum includes D. flavescens and D. pellucidum.

Ditrichum *flexicaule includes D. flexicaule and D. gracile (D. crispatissimum). Fissidens *pusillus includes F. crispus, F. gracilifolius (F. pusillus var. tenuifolius), F. pusillus and F. viridulus.

Grimmia **trichophylla* includes three species treated by Smith (2004), *G. dissimulata, G. lisae* and *G. trichophylla*. The taxonomy of this group has changed since the publication of Blockeel & Long (1998), where *G. trichophylla* and *G. retracta* are listed.

Racomitrium * canescens includes R. canescens, R. elongatum and R. ericoides. Racomitrium * heterostichum includes R. affine, R. macounii subsp. alpinum, R. heterostichum, R. himalayanum and R. sudeticum.

Rhynchostegiella * tenella includes R. litorea (R. tenella var. litorea) and R. tenella.

Schistidium *apocarpum includes species 21.5–18 in Hill et al. (2008) and Smith's (2004) species 5–17 ('Schistidium apocarpum complex'). They are S. apocarpum, S. atrofuscum, S. confertum, S. crassipilum, S. dupretii, S. elegantulum, S. flaccidum, S. flexipile, S. frigidum (with vars frigidum and havaasii), S. papillosum, S. pruinosum, S. robustum, S. strictum and S. trichodon. To these may be added S. helveticum, which has recently been found in Britain. Additional members of the aggregate which might be found in the British Isles are listed by Smith (2004).

Sphagnum *recurvum includes S. angustifolium (S. recurvum var. tenue), S. fallax (S. recurvum var. mucronatum) and S. flexuosum (S. recurvum var. amblyphyllum). Two subspecies of S. fallax, subsp. fallax and subsp. isoviitae, are recognised by Blockeel & Long (1998), but subsequent genetic research has suggested that they should not be treated as distinct taxa – see Hill in Smith (2004). S. recurvum itself is an American species but the name is retained in our area as a conveniently unambiguous one for the aggregate.

*Sphagnum *subsecundum* includes *S. denticulatum*, *S. inundatum* and *S. subsecundum*.

Ulota *crispa includes U. bruchii (U. crispa var. norvegica) and U. crispa.

Chiloscyphus * polyanthos includes C. pallescens and C. polyanthos.

*Phaeoceros *laevis* includes *P. carolinianus (P. laevis* subsp. *carolinianus)* and *P. laevis*.

7 RECORDING RARE SPECIES

Populations of rare bryophytes in Britain and Ireland need careful observation because many are being lost, mainly through habitat changes or accidental destruction. Losses occur not only through changes in land use, such as drainage and afforestation, but also, for example, from infilling of ditches and quarries, burning of heathland, widening of roads, felling of trees and all too often merely from vegetation succession following cessation of grazing.

Detailed information on the location and strength of populations of rare bryophytes provides the essential basis for minimising future losses. An overview of methodology developed for recording and monitoring populations is presented here. The three main processes involved will be considered in turn: (1) refinding or finding populations; (2) documenting locations and sizes of populations as a basis for future monitoring; and (3) detailed monitoring methods for individual populations involving repeated visits.

1. Refinding or finding populations

The difficulty in refinding bryophyte populations known in the past varies greatly according to the age and precision of information available on their locations. Unfortunately, recorded localities are often imprecise or even deliberately vague, especially with old records which merely indicate the nearest village or town. Use of all available data from literature and herbaria often helps, but direct contact with the bryologist involved in making the original record is invaluable when it is still possible. Experience of the species involved should allow searches in the most likely places, and searches at the correct season may be important for some species. It has often been assumed that short-lived ephemeral species are highly mobile and impersistent at individual localities, so that searching for them might appear pointless, but experience suggests that even *Acaulon triquetrum* usually recurs from year to year and others such as *Weissia multicapsularis* persist for decades. Plants of inundation zones beside lakes and reservoirs can be found only in dry years, so that one has to be prepared to devote time to surveying these at short notice in favourable seasons.

'Needle in a haystack' searches covering large areas in an attempt to refind a small bryophyte take patience, persistence and an optimistic approach. Success rates in refinding large numbers of old records in Irish counties in recent years have ranged from 10–45%, being highest where good habitats survive undamaged and the available bryophyte data are mainly recent (e.g. in Co. Leitrim). Success rates above 50% have nevertheless been achieved using data from the past decade recorded by a few bryologists who made careful habitat notes and recorded accurate grid references. Enthusiastic searches for poorly localised old records sometimes succeed, even if what is eventually found may not be the original site, but other new finds are often made by scouring appropriate habitats.

2. Documenting populations as a basis for future monitoring

Careful documentation of locations is essential to maximise chances of refinding populations for future site protection and monitoring. The recent development and wide availability of hand-held Global Positioning Systems (GPS) have revolutionised the accurate recording of locations. Suitable GPS equipment costs upwards from about £70 and allows locations to be recorded to within less than 10 metres in open country. Unfortunately, the signals from navigation satellites used by GPS are not available in deep ravines and they are often weak in woodland or on crags, so careful attention to signal strength is needed in using a GPS and traditional map reading techniques will sometimes still be required. Altitudes obtained from older hand-held GPS are often wildly inaccurate so these should be obtained from 1:50,000 or 1:25,000 maps using the grid reference as a guide. However, the best modern 'High Sensitivity' GPS are more accurate and also much better in woods and ravines. Care may also be needed to correctly set up the GPS equipment before use, typically involving choice of the correct Position Format (e.g. British Grid or Irish Grid) and Map Datum (e.g. Ord Srvy GB or Ireland 1965).

In addition to notes (and sketch maps) of the habitat and location in relation to local landmarks, photographs provide a valuable record and these are now very easy and cheap to record using small-format digital cameras. The most helpful photos for refinding locations show not only the exact position of the rare bryophyte (marked e.g. with knife or rucksack) and its habitat, but also some more distant and permanent landmarks. It is easy to label successive digital photos by using the next image to record notebook details, for example of the voucher specimen number, grid reference, date and time.

If return visits are planned and the site is not too public it usually helps to refind a rare bryophyte if the location is marked. The suitability of different kinds of markers varies widely according to the site; in remote bogs sticks or bamboo canes (placed say 5 m from the bryophyte) may be appropriate, in remote private woodland plastic supermarket bags tied to branches may provide the best hope of refinding part of a crag. At closer range, plastic-covered vehicle wiring wire (long persistent and available in many colours), plant labels, cocktail sticks or hidden transponders may be suitable for different conditions. In order that identification of populations of rare bryophytes can be checked and if necessary revised, a small voucher specimen is advisable if: (a) the population is large enough to withstand collecting; (b) no recent voucher exists from the population; (c) for Schedule 8 species or on SSSIs an appropriate licence has been obtained from the national conservation agency, e.g. Natural England in England; and (d) the landowner has given permission. The voucher specimen should be fully labelled with habitat and grid reference details (to 10 m accuracy if possible) and lodged in one of the national herbaria. Bryologists carrying out extensive surveys are encouraged to serially number all their field specimens as this avoids uncertainty about which specimen is the voucher for which record, and also to routinely record 8-figure grid references from the GPS so that even unexpected finds are well localised.

Detailed records of the locations and populations of rare bryophytes are of little or no value for their conservation unless they are shared. Accurate grid references (from the GPS) and digital photos are easily shared, both locally with Site Managers, Conservation Officers (e.g. of Natural England) and the BBS Regional Recorder and/or BBS Recording Secretary.

3. Detailed monitoring methods for individual populations

Regularly repeated monitoring of individual bryophyte populations is timeconsuming, rather dull and very expensive if travel costs or paid surveyors are involved. Persistent monitoring also uses up skilled bryological time that could be used for new surveys. Monitoring is therefore only recommended for the rarest and most vulnerable populations, and with these mainly as a way of informing the character and extent of concurrent work to manage the bryophyte habitat. For example, annual monitoring of *Ditrichum cornubicum* at Phoenix United Mine SSSI in Cornwall revealed the need to exclude sheep because their dung was fertilising the ground on which the moss grows, leading to it becoming overgrown by *Rhytidiadelphus squarrosus*. Patches of ground were therefore scraped clear of competing *R. squarrosus* after fencing was erected by English Nature; ongoing monitoring has since recorded recovery of the populations of *D. cornubicum*.

When monitoring is undertaken, the repeat visits will benefit from use of GPS data and photos to relocate bryophyte populations. Overall habitat changes such as those due to scrub growth can be reassessed on repeat visits and recorded photographically, ideally with 'fixed-point photos' (from standardised locations, at the same season and using similar photographic equipment on subsequent visits). Methods of measuring population sizes need to be developed separately for

different species; plants of some can be counted (e.g. thalli of *Petalophyllum ralfsii*); with others the patch dimensions can be measured using a ruler (e.g. *Leucodon sciuroides*, some patches of *Weissia multicapsularis*); for some it may be necessary to count squares occupied using a 1-cm gridded transparent overlay (e.g. *Lejeunea mandonii*).

Careful documentation of localities of rare bryophytes, the strength of their populations and the habitat characteristics provide the best guides for management intervention if the populations show serious declines or become threatened by habitat change. There are now many instances of responsible landowners cooperating in allowing monitoring and conservation management work to benefit bryophytes and other wildlife on their land. Nevertheless, on rare occasions when habitats of rare bryophytes are deliberately or thoughtlessly damaged, detailed documentation should prove what has been lost. Indeed, notes, photos and voucher specimens have provided evidence allowing English Nature to prosecute landowners for damage on SSSIs and the photos have provided a factual basis for reinstating the habitats under court orders.

8 SUBMITTING YOUR RECORDS ON CARDS OR IN ELECTRONIC FORM

Cards

Most recorders computerise records themselves and submit records electronically. The different options available for doing this are discussed in the following section. If you are unable to computerise your records, completed Recording Cards should be sent to the Regional Recorder or to the Recording Secretary. Please send them in at least annually; do not wait until you have accumulated a mountain of cards. As a precaution, when you pass on recording cards you should either photocopy them directly or request that the Recording Secretary copies them and returns a copy. It is not advisable to send large amounts of valuable and unique data through the post.

Keeping records electronically

If you intend to keep many records then there will come a point when it makes sense to consider keeping them on some sort of electronic database. This will enable you to sort and view the data in a variety of ways and be able to retrieve them quickly for analysis and to produce reports. Electronic storage also makes it far simpler to share large amounts of data. How you store your records is your personal decision depending on your purposes and skill. There is no standard or recommended package and the Recording Secretary is happy to receive data in spreadsheet or database form. Some notes on the different options are provided here, but it makes sense to consult bryologists who are using the different systems before making your final choice.

At its most simple your database could consist of Excel spreadsheets. The advantage of using Excel is its ready availability on most home computers and its relative ease of use, allowing you to design a layout exactly to suit your requirements. It is also easy to import data into and it enables you to export data to other users using the well-known Microsoft software inter-compatibility. There are disadvantages: actually entering data using this software is a bit long-winded and, because there are no look-up tables for common data items, it can be prone to error. Excel also has no built-in maps or queries to help with analysis. However, exporting data to DMAP following data entry allows quick checking and visual analysis of patterns and gaps. One relatively easy way of computerising your data is to use the 'electronic recording cards' which can be downloaded from the BBS website. These allow data entry from electronic facsimiles of the BBS recording cards (see Chapter 6), and the resulting Excel spreadsheet may be used to compile a spreadsheet for your own use, or to send your data to other people.

To improve on the levels of accuracy and accessibility it makes sense to use software based on a proper relational database model. You could write your own system using Microsoft Access, but there are proprietary systems available which have done the work for you. The standard professional package is Recorder in its various incarnations. Designed primarily for professional use and record centres, this is a very powerful tool. Many amateur recorders find that it is too elaborate for the home user and it is far from intuitive to use, being based on recording events rather than on records.

Over recent years MapMate software, designed for the amateur, has proved most successful and is now even used for some national recording schemes by the BSBI and the RSPB. MapMate is based on Microsoft Access and is easy and intuitive to use. You can select your recording area in both UK national, administrative or vice-county boundaries and can record at a variety of scales using species lists selected from an in-built taxon library. You build up tables of sites, recorders and any external record sources, like books and journals, as you need them. If you are a travelling bryologist then you can create a variety of base maps to view your records as the data are held centrally on a series of tables – you can even create maps and queries to look at information at a national scale.

Data entry is via an on-screen recording card on which you can 'lock' common fields, like date and place of recording, to make input quicker. As details like species, sites, recorders and so on are held in look-up tables there is far less chance of input error. Basic distribution maps are produced automatically for each species and it is possible to produce customised maps splitting records based on, for example, year groups or mapping more than one species together in coincidence maps. There are a number of built-in queries to enable you to extract data and you can also write your own using the SQL query language.

Although MapMate can record all the mandatory, and many of the optional, fields required by the BBS database it does not have a direct facility for holding them all. Although it has a field for recording sporophytes, for example, it does not record gemmae or tubers and it has no provision for recording altitude. It does, however, have an extensive notes field for additional information.

As the system was designed for local and recording schemes it has a system of sharing data between communities of recorders via a central 'controller' – a boon

for Regional Recorders. You can import data into MapMate using Excel tables, and it has a self-checking system to ensure that you are not importing rubbish. You can also extract data from MapMate into Excel so that you can share it with others who do not run the same system. Finally, MapMate maps and data tables can also be easily extracted and pasted into reports written in any of the common PC formats.

Other commercially available database management systems include AditSite and BioBase. Further details of these, and the other options listed here, are given by James [2008]. Any summary of the advantages and disadvantages of each is essentially subjective, and James' account should be read for another viewpoint.

Format for submitting records electronically

For vice-county recording and for ordinary observational data, data are stored in a standard format (Table 2). This format can be loaded readily to the main BBS database (BBSDB).

 Table 2. Standard format for submission of electronic data.

The six fields in bold type (with grey background) are obligatory. The other fields are optional.

BRC no	BRC number as on record card – not essential if you use a
	standard BBS name list
Name	Name of species; if you use abbreviations, please ensure that
	a full list of these is sent to Recording Secretary
Micr chk	Enter Y if checked microscopically
Fruit	Enter Y if sporophytes present, even young ones
Male	Enter Y if male plants present (dioecious species only)
Female	Enter Y if female plants present (dioecious species only)
Gemmae	Enter Y if gemmae present
Bulbils	Enter Y if bulbils present
Tubers	Enter Y if tubers present
Habitat_locality	Habitat in words, applicable to the site, e.g. farmyard, mountain summit
Habitat_species	Habitat in words, applicable to the particular species recorded, e.g. asbestos roof of pigsty, snowpatch at foot of
	crag

Alt m	Integer – must be metres, feet not acceptable; negative integers if below sea level
Location	Location in words; it is helpful if SSSI is added where appropriate, e.g. Monks Wood SSSI
Grid ref	Grid ref, e.g. TL5679 to accuracy that you know it; if a tetrad or quadrant record, give 10-km square, e.g. TL57 and then A–Z in tetrad column or quadrant in quadrant
Tetrad Quadrant	 column Capital letter A–Z, except O; essential if record is localised to tetrad but you do not have a more accurate location 5-km square SW, NW, SE, NE; essential if record is localised only to quadrant – in that case Grid ref refers only to 10-km
VC	square Number of vice-county; Irish vice-counties either as H3, etc., or as 203
Date1	Any non-American format will do, e.g. 2005, 21/12/05, Dec 2005; year must be given; if a date range, give start date
Date2	Use for the end date if there is a date range, otherwise leave blank
Recorder	Recorder name in words, or list of recorders if several
Coll No	Collection number if herbarium specimen taken and numbered
Conf/det	Name of person confirming or determining record if not the recorder
Herbarium	Give abbreviation of institution, e.g. NMW, E, CGE, BBSUK, or surname for personal herbarium of collector, e.g. Motley
Lit Ref	In full or as a citation, e.g. Bosanquet (2004) – but then please then let Recording Secretary know the full reference
Comment	Any additional information, not habitat or location, e.g. abundance, capsules dehiscing, slug damage
Confidential	Enter C if the record is to be treated as confidential (e.g. land-owner promised that site not to be made public)

9 BBS RECORDS ON THE NBN GATEWAY

The data in the BBS database (BBSDB) (see Chapter 3 for details) are available on the NBN Gateway (www.searchnbn.net). This is updated frequently from the master copy of the database held by BRC. In general, all internet users have access to the full details of the data. However, there is provision for sensitive data to be labelled as confidential and for BBS Regional Recorders who are in the process of compiling datasets (e.g. for a county flora) to restrict access to 10-km square resolution.

This chapter outlines some of the ways in which the NBN Gateway can be used to view the BBS records. It does not provide a detailed explanation of how to use the Gateway. For instructions, see the Gateway users' guidebook on the Gateway. As with many internet sites, the Gateway appears complex at first, but it is easy to learn how to perform a range of standard tasks.

It is important to remember that the BBS data, although checked to some extent, have not necessarily been subjected to the same sort of detailed checking for errors and omissions that is applied to distribution maps published in a county or national bryophyte atlas. Bear in mind the possibility that some records may be erroneous, and notify the Recording Secretary if you detect doubtful or erroneous records. One useful function of the Gateway is to expose the BBS dataset to such public scrutiny. Furthermore, records of bryophytes may be contributed to the Gateway by many organisations other than BBS; in some cases the records may not have been checked by a competent bryologist. It is possible to restrict the datasets which are displayed by selecting or deselecting them from the list of available datasets provided for each species. One can, for example, select only the records from the BBS dataset (which constitutes the vast majority of bryophyte records on the Gateway).

The Gateway can be used to:

- map the distribution of a species in 10-km squares, tetrads or 1-km squares in Great Britain, Ireland or both together
- map these records at the county scale against the backdrop of a particular vice-county boundary
- produce these maps using recommended date-classes (+1950) or date-classes you select yourself
- zoom in on the national map and show the available records in the

selected area at 10-km, tetrad and/or 1-km square resolution against a backdrop of the Ordnance Survey map

- select an area and show the available records at 10-km, tetrad and/or 1-km square resolution against a backdrop of the Ordnance Survey map and either vice-county or SSSI/ASSI boundaries
- map records over a backdrop of aerial photographs or of certain habitats
- select records on a map and inspect the underlying data
- generate a 'site report' for SSSIs or other site types, choosing whether to include only species which must occur in the site (i.e. those for which the recorded grid reference lies entirely within the boundary of the site) or all those which may occur there (i.e. those for which the recorded grid reference lies partly within the boundary of the site)
- download data from Gateway maps as a spreadsheet
- produce printable versions of the maps displayed on screen
- list the mosses or liverworts in a 10-km square and download the list as a spreadsheet.

In generating site reports, remember that only the grid reference is used to create the species list. The locality name associated with a record may also show that it was recorded from a specific site, so an alternative approach is to download the records from the 10-km square in which the site lies and sort them by locality.

Vice-county boundaries can be viewed against a backdrop of the Ordnance Survey map by looking at the Interactive Map for any species (choose one which does not occur in the area of interest if you just want to see where the vice-county boundary lies).

Maps on the Gateway will often reveal the limitations of available data. A 10-km square distribution map of *Brachythecium rutabulum* in Great Britain will produce an accurate picture of its distribution, but a national tetrad map will simply illustrate the (surprisingly numerous) areas from which we hold data at the tetrad scale. Similarly a map showing records before and after 1950 is meaningful as we have good national coverage from 1950 onwards; a map showing records from 2000 onwards merely shows those areas from which we have recent records.

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APPENDIX I DUTIES OF BBS REGIONAL RECORDERS

Regional Recorders are appointed by the Recording Secretary on behalf of the Conservation & Recording Committee, normally for a period of 4 years.

The principal role of Regional Recorders is to receive distributional data (species and site records) collected in their region by individual bryological recorders and, with these recorders' approval, to forward records at intervals (e.g. at the end of each year) to the Recording Secretary for eventual inclusion in the BBS database.

Each Regional Recorder is responsible for a different part of the British Isles. Typically a region consists of a vice-county or a pair of vice-counties but in thinly populated areas a larger geographical unit may be employed.

The Regional Recorder is normally expected to:

- become familiar with the region's bryophyte flora so that particularly interesting records can be recognised and doubtful ones questioned;
- liaise with and encourage members active in their region, e.g. by organising local forays, offering advice on determinations, etc.;
- make his/her existence known to the local officer of the relevant conservation body (e.g. Natural England), Wildlife Trust and others (e.g. museum) with an interest in biological recording in the region; and
- be aware of existing regional herbaria and, where possible, encourage their continuation and/or future development.

Regional Recorders should normally receive records from recorders on BBS standard cards or in electronic form. Regional Recorders keep copies of data from their areas. They should keep the Recording Secretary informed of local flora projects in the region.

APPENDIX II PUBLISHED OR PLANNED BRYOPHYTE FLORAS AT 5-KM SQUARE OR TETRAD SCALE

Published floras at the tetrad or 5-km square scale are listed below, as are current flora projects at these scales (for details of other floras, see the relevant vice-county page on the BBS website). We have also listed counties where the Regional Recorder asks visiting bryologists to record at a particular scale. A request for tetrad or 5-km records should not be taken as a request for generalised tetrad or 5-km data, rather that bryologists should pay regard to tetrad or 5-km boundaries when recording sites such as woods, nature reserves, churchyards, etc.

Vice-counties	Published floras and/or current recording practice
1–2, Cornwall	Tetrad flora published online (Holyoak, 2012)
3–4, Devon	Tetrad flora in progress
6, N. Somerset	Recording is at 1-km scale with a view to a possible flora
7, N. Wilts.	Recording is at 1-km scale with a view to a possible flora
9, Dorset	Tetrad flora published (Hill & Edwards, 2003)
10, Wight	Tetrad flora and maps published (Snow, 1989, 1992, 1997, 2003)
11, S. Hants.	5-km square flora published (Stern, 2010)
12, N. Hants.	5-km square flora in progress
17, Surrey	5-km square flora published (Gardiner, 1981)
20, Herts.	Scale of future flora uncertain; please record in 1-km squares
22, Berks.	5-km square flora published (Bates, 1995)
25–26, Suffolk	Tetrad flora published (Sanford & Fisk, 2010)
27–28, Norfolk	Scale of future flora uncertain; please record in 1-km squares
29, Cambs.	Flora in progress, recording in 5-km squares (for comparison with previous records) and tetrads
30, Beds.	Tetrad flora published (Outen, 1989; Boon & Outen, 2011)
35, Mons.	Tetrad flora in progress

Bryophyte Recording Handbook

38, Warks.	Tetrad flora published (Laflin, 1971)
39, Staffs.	Tetrad flora in progress; for interim results see www.staffs- ecology.org.uk
42, Brecs.	5-km square flora published (Woods, 2006); recording now at tetrad scale
43, Rads.	5-km square flora published (Woods, 1993); recording now at tetrad scale
44, Carms.	Tetrad flora published (Bosanquet, Graham & Motley, 2006)
45, Pembs.	Tetrad flora published (Bosanquet, 2010)
46, Cards.	Tetrad flora in progress, and a large part of the county is also being covered by a 5-km square flora of Mid-West Wales; ensure that records are useable at both scales
47, Monts.	5-km square flora of Mid-West Wales covers significant parts of the county
48, Merioneth	5-km square flora of Mid-West Wales covers significant parts of the county
55, Leics.	Separate tetrad floras have been published for Rutland (Jackson, 1991) and Leicestershire (Ballard, 2008)
57, Derbys.	Tetrad flora in progress
59, S. Lancs.	Tetrad flora in progress
60, W. Lancs.	Tetrad flora published (Wigginton, 1995)
66, Durham	Tetrad flora published (Graham, 1988); updated tetrad records for vice-counties 66–68 are mapped on <i>The Flora</i> <i>of North-east England</i> website (http://botanicalkeys.co.uk/ northumbria/search.asp)
67 & 68,	See 66, Durham
Northumberland	
78, Peebless.,	Recording is at tetrad scale with a view to a possible flora
79, Selkirks., 80,	
Roxburghs. & 81, Berwicks.	
104, N. Ebudes	Tetrad flora of Rum published (Pearman <i>et al.</i> , 2008); tetrad flora of Skye in progress
108, W. Sutherland	Tetrad flora of Assynt published (Rothero, 2002); recording in rest of vice-county at tetrad scale



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