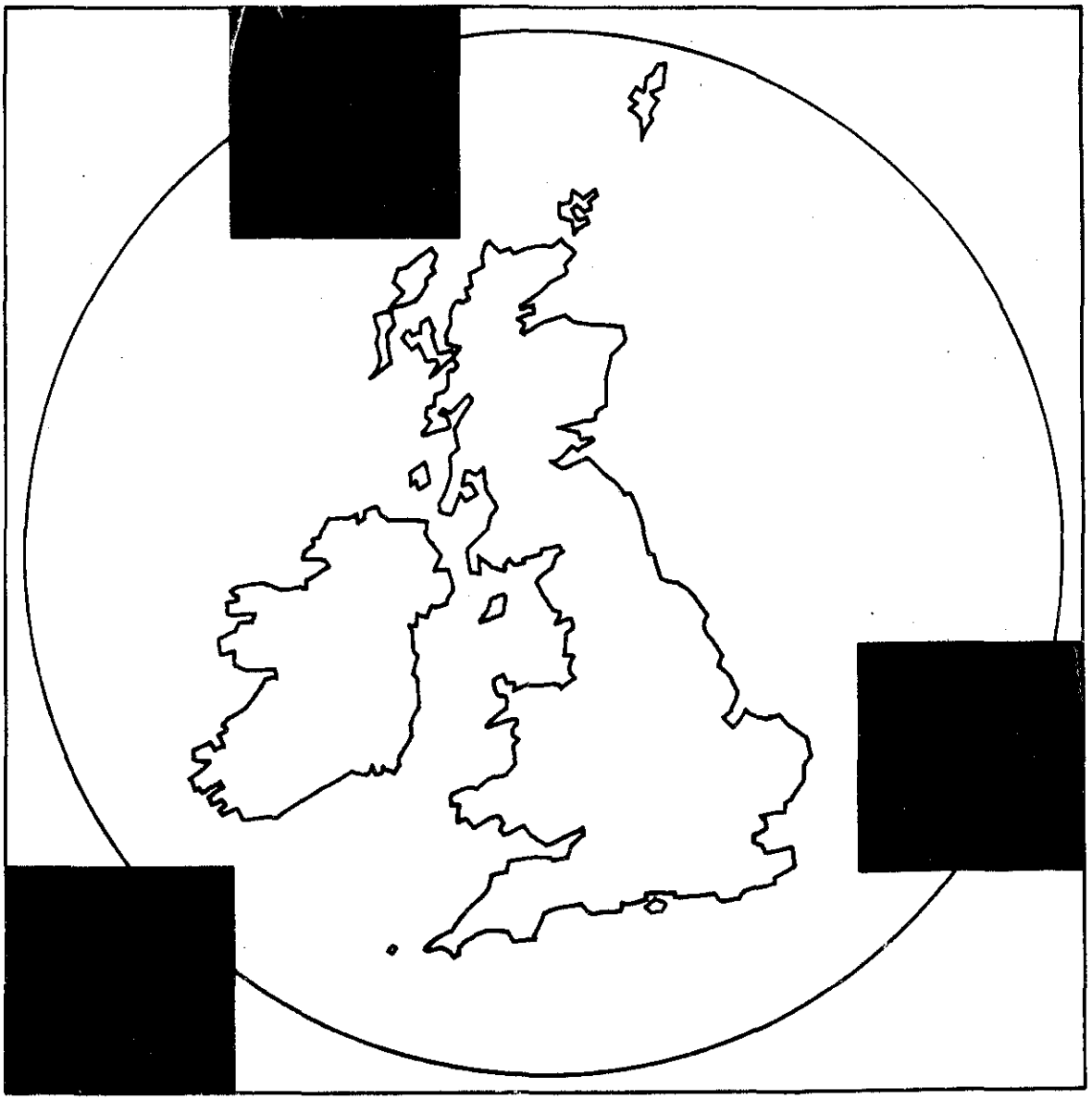
Tim



BSBI

MONITORING SCHEME

1987–1988

VOLUME 1
TEXT

THE BSBI MONITORING SCHEME 1987-1988

Report to the Nature Conservancy Council

T.C.G. Rich and E.R. Woodruff

March 1990

Nominated Officer: J Hellawell

Chief Scientist's Directorate Report

No. 1265

2012 preface

This is Volume 1 (text) of the original report for the BSBI Monitoring Scheme from 1987-1988, scanned from my personal copy with a few annotations but excluding Appendix III and the index to maps. The second volume contained the maps alone. Both volumes were published together as:

> Rich, T. C. G. & Woodruff, E. R. (1990). *BSBI Monitoring Scheme 1987-1988*. Chief Scientist's Directorate Report no. 1265. Nature Conservancy Council, Peterborough.

Appendix III has been excluded as the data were subsequently reworked with some additional information and published for Britain and Ireland separately as:

1. Rich, T. C. G. & Woodruff, E. R. (1996). Changes in the floras of England and Scotland between 1930-1960 and 1987-1988: The BSBI Monitoring Scheme. *Biological Conservation* **75**: 217-229.
2. Rich, T. C. G., Beesley, S. & Goodwillie, R. (2002). Changes in the vascular plant flora of Ireland between pre-1960 and 1987-1988: The BSBI Monitoring Scheme. *Irish Naturalists' Journal* **26**: 333-350.

which should be referred to for more up-to-date interpretation.

Other than setting out how the original 1987-88 scheme was organised, the text should be of interest in showing that the *Atlas of the British flora* records should be treated as summary 10-km square records for the decade unless there is clear evidence to the contrary, and for the difficulties of comparing sets of records (chapters 3-5).

TCGRich
January 2012

ACKNOWLEDGEMENTS

The Monitoring Scheme would not have been possible without the help, expertise and enthusiasm of the Botanical Society of the British Isles - the work is a credit to the Society and its members. Thanks are particularly extended to the 170 or so Vice-county Recorders and others who have organised the Scheme at a county level.

Thanks are also due to the staff of the Biological Records Centre, and other members of the Institute of Terrestrial Ecology. The support of Paul Harding has been of particular importance. The Monitoring Scheme Steering Committee has allowed me a large degree of autonomy, and John Hellawell (NCC) has handled much of the administration.

Finally, personal thanks to Mrs Rosemary Woodruff, without whose support, skill and motivation the Monitoring Scheme would have foundered in mid-stream.

Eimear Nic Lughadha has helped to compile the final report, which was typed with amazing proficiency and accuracy from my scribbled notes by Liz Guerin.

T.C.G. Rich

C O N T E N T S

SUMMARY

The BSBI Monitoring Scheme was set up to assess the current status of the flora of Britain and Ireland. Records for the Monitoring Scheme were collected by volunteers who were largely members of the Botanical Society of the British Isles. The scheme was based at the Biological Records Centre, Monks Wood and funded by the Nature Conservancy Council and the Department of the Environment, Northern Ireland.

The aims of the scheme were 1) to provide, by comparison with the results of the Atlas 10-km square survey, an objective assessment of the species which have changed in frequency over the last 25 years, and 2) to provide a network of tetrads (2 x 2 km squares) to be used in the future to monitor changes in the flora. 429 10-km squares (1 in 9 on a regular grid basis, approximately 11% of the total) throughout Britain and Ireland were selected for survey, and within each 10-km square, three tetrads were selected for more detailed recording.

During 1987 and 1988, 985,000 records representing 2660 different taxa were collected in the field by 1,600 botanists. An optional habitat survey was also run to collect site-based information. Over 99% of the 10-km squares were visited, and about 97% of the tetrads were recorded. The records were checked by the BSBI Vice-county Recorders and compiled into a computerised database. The error rate of the Monitoring Scheme records is estimated to be about 0.1%.

Records for the Atlas period (about 1930-1960 in Britain, before 1960 in Ireland) were collated into a separate database. About 225,000 records were compiled from original field cards, BRC databases and correspondence, representing about 2000 taxa. Analysis of the records showed them to be largely summary in nature and often unpredictable in quality and quantity. Error rates are estimated to be ±1% for Britain and ±8% for Ireland.

The Atlas and Monitoring Scheme databases were compared to assess the records. Generally, more taxa were recorded per square for the Monitoring Scheme, and the Atlas is more under-recorded than has been realised. The numbers of critical taxa, grasses and common species per square have been compared to evaluate the quality of recording, which is generally higher for the Monitoring Scheme than the Atlas. Alien taxa have probably increased, but due to bias in recording and data handling, it is not possible to determine the extent of the real increase. The seasonal variation in records is investigated and confirms the summary nature of the Atlas data.

Due to fundamental differences in design of the surveys, in data included and in recording there are difficulties in comparing the Atlas and Monitoring Scheme surveys to assess which species have changed since the Atlas. These differences, and how they are treated for the statistical comparison, are set out in detail. The major problem in comparing the surveys is correcting for the 16% more 10-km square records collected for the Monitoring Scheme resulting from a greater concentration of recording effort. The surveys have had to be assessed relative to each other and thus only the taxa which have changed most can be identified.

The records are presented as maps and tables for most species, and as summary statements for the rarer taxa. An indication of the statistical significance of the results is given, sometimes with comments to help with interpretation of the data.

The habitat survey has not been analysed.

There are surprisingly few distinct trends in the species which have changed in frequency, and there are always exceptions. Garden escapes have probably increased, and grassland taxa (especially of wet or open pastures) and arable weeds have probably declined. This lack of distinct trends may be related to the problem that only species which have changed most can be identified, or may be a picture of general change in the flora. There is considerable scope for further analysis of the results.

CHAPTER 1

INTRODUCTION

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Chapter 1

Introduction

1 Introduction

The Atlas of the British flora* (Perring & Walters 1962) was a monumental milestone in the study of the flora of Britain and Ireland. Although it was essentially a phytogeographic work which showed the distribution of plants in 10-km squares throughout the British Isles, pre- and post-1930 records were also distinguished to show changes of the flora with time. The use of this temporal information by conservationists proved to be one of the most significant applications of the Atlas; indeed no other single work has had so much influence on the development of nature conservation in Britain.

The records for the Atlas were largely collected in the field by members of the Botanical Society of the British Isles (BSBI) between 1954 and 1960, and were supplemented by additional historical records. The distribution maps thus largely represent the status of the British flora as the post-war agricultural revolution was coming into effect. Since publication of the first edition of the Atlas in 1962, a considerable body of additional knowledge has accrued and significant changes have taken place in the countryside. Many new records have been made, new species discovered, some taxa have spread, others have declined or been lost. Although new editions of the Atlas in 1976 and 1982 contained revised maps of about 320 rare taxa, many of which were under more or less continuous surveillance, the Atlas was becoming out-dated as an indication of the status of the remainder of the flora. The BSBI therefore began to investigate the methods whereby a new Atlas could be published in the 1990s.

During 1984 and 1985, it became apparent that there was an urgent need to study increasing and decreasing species, particularly those just outside the scope of the Red Data Book. The Nature Conservancy Council is statutorily required to review the status of the British flora every five years (Section 24, Wildlife and Countryside Act 1981). Also, there were thoughts that the agricultural revolution was slowing down: further changes in the countryside could be less marked, some changes could indeed be reversed. A study of the British flora might thus catch it at the end of a period of rapid change and before it settled into a period of relative stability. These constraints together with uncertainties about the reception of a comprehensive survey project by the BSBI membership in general, meant that a new Atlas per se was considered unfeasible.

It was therefore decided to set up a less ambitious scheme which could address these points, and which would be a first step towards a new Atlas. If set up properly, the scheme could also be used to monitor change in the future independent of the Atlas. After much discussion, notably with Dr John Dony, it was finally agreed that the scheme should be a short-term sample survey of one in every nine of the 10-km squares throughout Britain and Ireland. Specifically the aims of the scheme would be:-

To survey the flora of a sample of the 10-km squares in Great Britain and Ireland (approximately 11% of the total), so as to:-

1. **Provide by comparison with the results of the Atlas 10-km square survey (1954-1959) an objective assessment of the species which have changed in frequency over the last 25 years.**

* hereafter referred to simply as 'the Atlas'.

2. **Provide a selected network of 2 x 2 km squares (tetrads) from within the chosen 10-km squares to be used in the future to monitor changes in the flora.**

Finance for the Scheme was agreed with the Nature Conservancy Council and the Department of the Environment (N. Ireland), and the "BSBI Monitoring Scheme" was launched in 1986.

2 Organisation of the Monitoring Scheme

The Monitoring Scheme was based at the Biological Records Centre, Monks Wood (BRC). Plant records were collected in the field, verified by the BSBI Vice-county recorders, sent to BRC and compiled on the computer.

The botanists responsible for collecting records in the field were mainly members of the BSBI, but members of the Wild Flower Society, the British Pteridological Society, County Trusts for Nature Conservation and many local Botanical and Natural History Societies also contributed. Records have also been received from the Nature Conservancy Council, Department of the Environment (N. Ireland) and the Forest and Wildlife Service, Republic of Ireland.

The vast bulk of the organisation at a county level was undertaken by the VC Recorders and their delegates or other botanists. The role of these people in organising their field work, checking the incoming records from field workers and checking the BRC computer printouts has been central to the success of the Monitoring Scheme; the quality of the data collected is a credit to them.

National Co-ordinators helped co-ordinate work in the regions and supported the VC Recorders; these were Stan Beesley (N. Ireland), Gwŷnn Ellis (Wales), Roger Goodwillie (Republic of Ireland), Henry Noltie (Scotland) and Frank Perring (England).

The Scheme was overseen by the Monitoring Scheme Steering Committee:

Derek Wells (Chairman)
Frank Perring (Secretary)
Mike Walpole (Treasurer)
John Hellawell (N.C.C.)

David Allen	Gwynn Ellis	David McCosh
Stan Beesley	Roger Goodwillie	Henry Noltie
Mary Briggs	Geoff Halliday	Chris Preston

Chris Preston, David McCosh, Frank Perring and Derek Wells were responsible for the day to day running of the Scheme.

The Scheme was co-ordinated by Tim Rich, based at the Biological Records Centre, Monks Wood, assisted by Rosemary Woodruff. Other staff employed on a casual basis to help with data processing were Jayne Abblitt, Tina Waterman, Paul Smith, Karen Tomblin, John Needham, Stuart Green and Val Burton.

Advice and help were provided by the staff of the Biological Records Centre, Monks Wood. Additional help and advice were provided by other members of the Institute of Terrestrial Ecology, particularly Mark Hill and Dorian Moss. Computing support was provided by Claire Appleby, Dorothy Greene, Jeff Moller and Tina Waterman.

3 Selection of the 10-km squares

The 10-km squares in Britain were selected by taking the square with the largest area of land in the Scilly Isles, SV(00)/9.1, and then taking every third square with land north and east so as to cover the country.

The 10-km squares were selected for Ireland by taking the most south-westerly square on the Irish grid with land (V(00)/4.5) and then proceeding as for Britain.

The 10-km squares for the Channel Islands were based on the UTM grid, and were selected as a 'best fit' extension of the British one in nine sampling grid.

A map showing the selected 10-km squares is given in Figure 1. There are 317 selected 10-km squares in Britain, 110 in Ireland and 2 in the Channel Islands. These represent about 11% of the total number of 10-km squares.

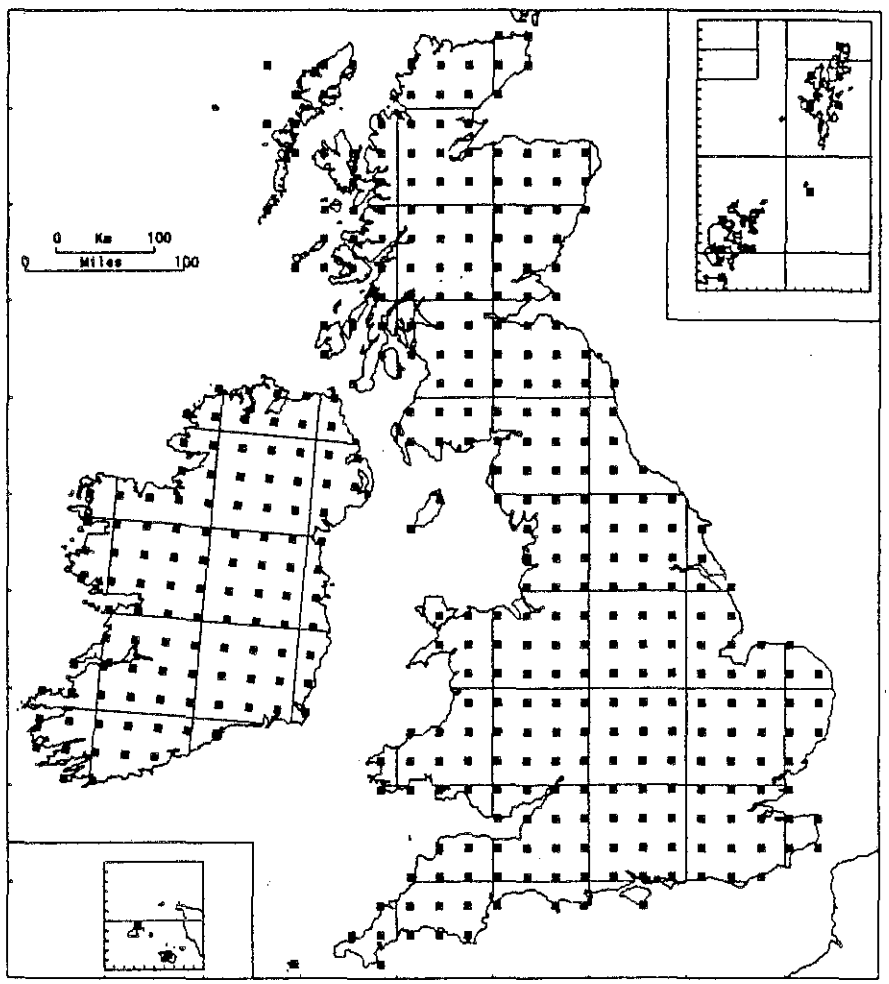

Figure 1. 10-km squares selected for the BSBI Monitoring Scheme.

Within each 10-km square, 3 tetrads (2 x 2 km squares) were selected for more detailed study. These tetrads are A, J and W following standard BSBI nomenclature (Figure 2; see also BSBI News, **43**: 9). These tetrads were selected to be as geographically separated as possible and to fit in with existing 2 x 2 km or 5 x 5 km recording networks.

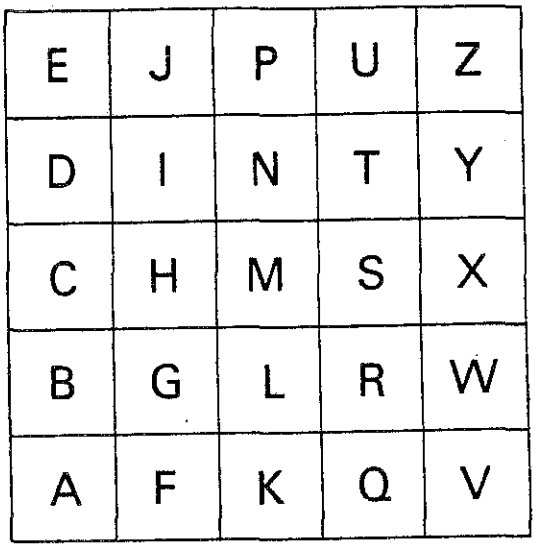

Figure 2. Diagram showing nomenclature of tetrads in a 10-km square. The tetrads selected for the Monitoring Scheme were A, J and W.

There are several advantages to selecting the 10-km squares on a regular grid rather than at random. First, the variance of sample estimates may be slightly reduced compared to random sampling. Second, each vice-county is represented. Third, they are considerably easier to remember or to work out from a known square. A fundamental assumption is that species are distributed at random with respect to the sampling units (i.e. national grid), and that no species show periodicity in their distribution with lags of 3 10-km squares, or multiples thereof.

CHAPTER 2

The Monitoring Scheme Database (1987-1988)

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CHAPTER 2

The Monitoring Scheme Database (1987-1988)

1 Introduction

This chapter documents how the data for the Monitoring Scheme have been collected and compiled into the 'Monitoring Scheme database'. A brief analysis of some of the data is given, but a more detailed comparison of the database with that compiled for the Atlas of the British Flora records (Chapter 3) is given in Chapters 4 and 5.

2 Collection of the 1987-1988 Monitoring Scheme records

The detailed instructions for the Monitoring Scheme were sent to all BSBI members with a sample record card in December 1986 with BSBI News **44.** The instructions were prepared as a special 8 page booklet, which is given in a slightly edited form in pages 6-16. These instructions are given in full so that the scheme can be repeated in identical form if desired.

BSBI MONITORING SCHEME: INSTRUCTIONS FOR RECORDERS

INTRODUCTION

Most members of the BSBI will be aware of the great changes that have taken place in the flora of Great Britain and Ireland since publication of the Atlas of the British Flora (1962) and the Critical Supplement (1968). Because information on the current status of the flora is urgently needed, the BSBI Monitoring (or Mapping) Scheme has been set up to assess the changes that have already taken place, and also to provide a means of monitoring further changes in the future. The flora of a sample of 10-km squares throughout the country will be surveyed during the next two years to give an objective assessment of the species which have changed in frequency and/or distribution over the last 25 years, and within each of these selected 10-km squares, three tetrads (2 x 2 km squares) will be surveyed in detail to establish the baseline for monitoring future changes. It is hoped that the Scheme will also be a first step towards a new Atlas in the 1990s.

The aims and outlines of the Monitoring Scheme in BSBI News **43:** 7 (Sept 1986) are the result of considerable thought and discussion by the Records Committee, the Monitoring Scheme Sub-Committee, three VC Recorders' Conferences and many individual members of the BSBI. The Scheme has the support of Council, and is funded by the Nature Conservancy Council. **ALL MEMBERS OF THE BSBI ARE INVITED TO PARTICIPATE IN THE SCHEME,** which we hope will be instructive and fun to do, as well as producing much important scientific data.

INSTRUCTIONS FOR THE SURVEY

There are two parts to the Scheme - species recording in selected 10-km squares and tetrads, and an optional habitat survey.

The 10-km squares selected for the Monitoring Scheme (one in nine on a grid basis - Figure 1) give a representative sample of species and habitats, as well as representing every vice-county. The tetrads selected for detailed survey (A, J and W) fit within existing tetrad or 5 x 5 km square recording networks, hence data can be incorporated into county Flora projects. It is very important that these selected 10-km squares and tetrads are recorded for the Scheme, irrespective of quality or area: they must not be changed for "better" squares. Coastal 10-km squares with only a small area of land should be recorded as they stand and not amalgamated with neighbouring squares, irrespective of treatment in the Atlas. If the A, J and W tetrads fall in the sea, they should be ignored (after you've checked for Zostera!).

VC Recorders will organize recording in their vice-counties, and they (or their delegates) will concentrate on the selected tetrads within the 10-km squares. BSBI members who wish to record for the Scheme should, if possible, contact the VC Recorder BEFORE recording to avoid duplication of work. Addresses of VC Recorders are given in the December 1985 list or contact me if you are uncertain as to which vice-county you will be recording in. Watsonian vice-county maps are available from Margaret Perring, BSBI Publications.

Members planning holidays in areas which are likely to be under-recorded will be especially welcome. The National Co-ordinators, who have responsibility for ensuring complete coverage of their countries, will be able to advise members on areas where help is needed and will also answer local problems and queries.

SPECIES RECORDING

Species lists form the basis of the Monitoring Scheme, and it is therefore very important that they are compiled as carefully and in as much detail as possible. Lists of species for 10-km squares will be compared with the Atlas records to assess which taxa have changed in distribution and frequency, and the detailed tetrad lists will form the baseline for monitoring future changes.

All native and introduced species (other than plants obviously cultivated or planted) occurring within the selected 10-km squares and tetrads should be recorded, including hybrids and all generally recognised infraspecific taxa. Nomenclature should follow Clapham, Tutin and Warburg Excursion Flora (3rd edition 1981), which is the recommended Flora for the Scheme as it is reasonably up to date, widely available and cheap! Please make full use of the panel of referees for critical species.

Only records for 1987 and 1988 will be accepted for the Scheme. Even if a species was present in 1986, do not record it unless you actually refind it during the survey. This is very important; we want a clear "snapshot" of the flora for this time period alone, and as with cameras, the longer the exposure time for the snapshot, the more blurred the picture. Records made in other years will be invaluable for the new Atlas, but must not be amalgamated with the Monitoring Scheme records.

Species cards

The special Monitoring Scheme species cards should be used for recording in the 10-km squares and tetrads. The cards are A4 in size to give room for all the data, and to enable them to be photocopied easily. The species list is printed on one side of the card, hence cards can be used as A4 to avoid endless turning or can be folded in half if a smaller card is preferred.

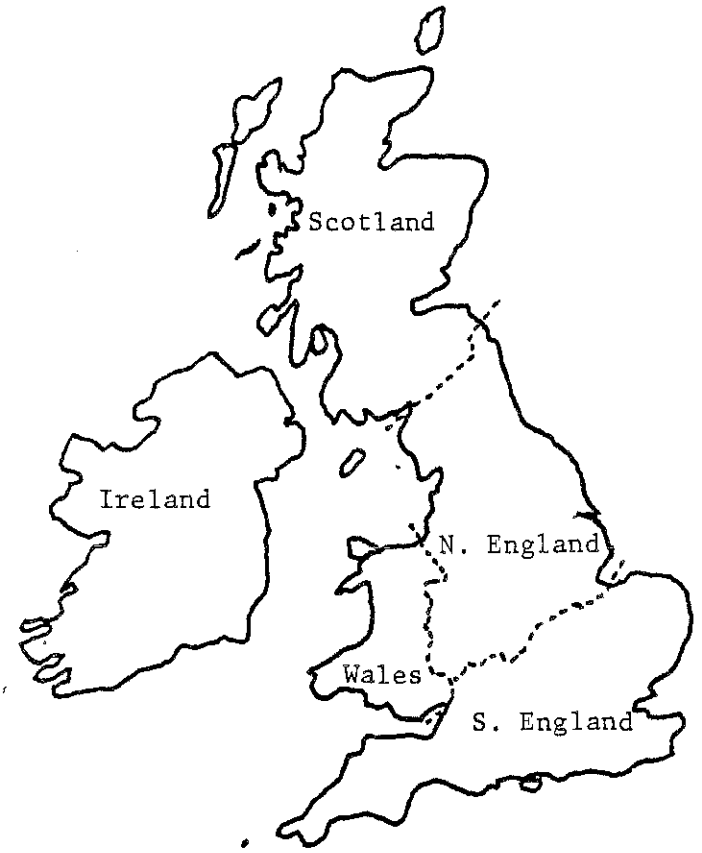
Cards for S England, N England, Ireland, Scotland and Wales are available (Figure 3), with nomenclature updated to follow the Excursion Flora. Records on the old BRC cards will also be acceptable provided they have the BRC species numbers against the names - Trust cards (which lack the species numbers) are NOT acceptable. When crossing through a species name, please avoid obscuring the BRC number which is used for computer input.

In addition, detailed information about rare, critical and other notable species found in the 10-km square or tetrad should be recorded on the Monitoring Scheme cards, or on the habitat record cards (see below). Notable species are those of local interest or importance. The exact decision about which species to include is left to individual recorders, but, for instance, new VC records and species which the recorder suspects are declining or increasing should be detailed. This information will be especially useful in 10 years time, and will enable a detailed eye to be kept on our more endangered plants.

Please complete a separate card for each recording visit to a tetrad or 10-km square, unless you record in the same area very frequently (say, more than twice a month), or actually live in it. Even in these latter cases, please use a new card each month to give us the spread of records through the seasons. Do not amalgamate records from separate cards yourself; this loses information, increases "transfer error" and involves extra work which can more easily be done by computer at BRC! If possible, localize recording to a tetrad or specific area within the 10-km square to help refind plants in 10 years time (VC

Recorders will give exact instructions on where and how to detail visits). Grid references should refer to the SW (i.e. bottom left-hand) corner of squares as usual. A completed example of the species card is shown in Figure 4.

Figure 3. Map showing areas covered by the 5 species cards.



ON FILE IN FULL

CARD Nº (Office use) 1 3 6 8 2 3 6 6 7 3 8 7 1 0 0 4

BSBI MONITORING SCHEME

LOCALITY
SANDY HIRST,
TYNINGHAME
EAST LOTHIAN

VICE-COUNTY 8 2
HADDINGTON

GRID REFERENCE (SW corner of square)
3 6 6 3 - 7 9 -
N T

NAME(S) OF RECORDER(S) 6 2 6 7
E·H·JACKSON
A·J·SILVERSIDE

DATE OF VISIT 0 4 0 5 8 7

TIME SPENT ON SURVEY 1½ hours

HABITAT(S)
Hippophae scrub/ broad-leaved wood
rabbit-grazed turf
beach: sand, broken rock, strandline
saltmarsh
sand dune
concrete top of bunker

TETRAD LETTER J

Tetrad nomenclature

E	J	P	U	Z
D	I	N	T	Y
C	H	M	S	X
B	G	L	R	W
A	F	K	Q	V

PLEASE DESCRIBE THE ROUTE TAKEN WHILST RECORDING (Place names, grid references, directions, etc.).
Enter tetrad from north, on west (saltmarsh) side of Sandy Hirst spit (36/634800) and start recording at conspicuous single sycamore at end of little bay. Walk south along shore with short forays into wood/scrub and on to saltmarsh (too early really). criss-cross open dune at end of spit and return along east (sea) shore. Hard to tell where to stop recording, but not many plants to add anyway, this side.

RARE, NOTABLE, CRITICAL AND OTHER SPECIES, AND INFRASPECIFIC TAXA NOT INCLUDED OVERLEAF

SPECIES	LOCALITY	6-FIG. GRID REF.	HABITAT	DATE	OTHER DETAILS (popn size, determiner, etc)
2008 Stellaria pallida	Sandy Hirst (westside)	634 799	sandy turf at edge of scrub	4/5/87	locally frequent
1870 Scrophularia vernalis	"	"	edge of Hippophae scrub	"	occasional
— Taraxacum section Hamata	Sandy Hirst	636 796	sand dune turf	"	det A.J. Silverside (444)
— Sechon Celtica	"	636 795	"	"	"
— Sechon Erythrosperma	"	"	"	"	"
3886 T. nordstedtii	"	"	"	"	"

Figure 4. Example of a species card.

Figure 4, continued.

RP 16

NOMENCLATURE FOLLOWS CLAPHAM, TUTIN & WARBURG EXCURSION FLORA OF THE BRITISH ISLES (3rd ed.,1981)

SCOTLAND

PLEASE CROSS THROUGH SPECIES NAMES ONLY

UNDERLINED = SUBSPECIES */AGG = AGGREGATE

X = HYBRID F = FORMA

CARD No(office use)

1 3 0 8 2 3 6 6 7 5 5 7 0 6 4

HABITAT SURVEY

Habitat surveys in the selected 10-km squares and tetrads will be used to provide information about habitat distribution and composition throughout the country, and will be used in parallel with species lists to monitor changes in the future. Although the habitat survey is optional, we wish to encourage habitat recording as much as possible. The data are very informative and often make some of the more interesting reading in county Floras. Members who feel their taxonomic expertise is not especially strong may prefer to concentrate on habitat survey; it can be fun to do as well as very instructive (see BSBI News **43,** 9).

Within each 10-km square or tetrad, a discrete habitat unit should be selected (i.e. a distinct area or vegetation type), and a separate habitat card completed for each habitat. For instance, a wood might be recorded as a whole, but river bank vegetation might be distinguished from species actually in the water. If possible, a representative sample of habitats in the 10-km square or tetrad shoule be covered - the list of habitats on the card can be used as a checklist of the main habitats in the area. Records from the same habitat in different areas of a tetrad should be kept separately.

Habitat cards

The Monitoring Scheme habitat cards should be used for the survey. The cards are designed to give maximum information for minimum effort, and, with practice, are quick and simple to use: it should take about 5 minutes to complete each card to a minimum level for each habitat. The cards are again A4 for photocopying, and may be used directly in the field with a clipboard, or completed later from notebooks.

On the card is a simple list of habitats, and the most appropriate best fit categories should be ticked. For instance, a woodland ride in a conifer plantation would be recorded as "coniferous", "plantation" and "path/road", whereas a churchyard would be simply "churchyard". The list is not 100% exhaustive, and habitats not included can be described in the appropriate space. The main dominant plants should be listed (eg, Calluna on grouse moors) together with other less abundant species, if possible, giving some measure of abundance using the standard annotation (R = rare, A = abundant, etc; see card for list). A species record card can be completed in addition to the habitat card to give a full list of plants for the habitat if required, though this is not necessary in every case. A few other brief details about the habitat are also requested. Please also give full details of the exact location of the habitat - either as a sketch map or on copies of the 1:10,000 or 1:25,000 scale maps - which will enable the site to be relocated and resurveyed in 10 years time. A completed example of the habitat card is shown in Figure 5.

GENERAL

Further supplies of species and habitat record cards are available on request to BRC. You may complete as many cards and give as much information as you like - the more data collected now, the better the changes can be monitored in the future. Please send all record cards direct to the VC Recorder either during, or at the end of, **each** field season. The VC Recorder will check the records before passing them on to me. Please do not take offence if unusual records are queried - it is these records which often turn out to be the more interesting ones.

CARD Nº (office use) 220447 A88 13

LOCALITY: ST. ANN'S CHAPEL, NR. CALLINGTON, CORNWALL.

VICE-COUNTY: 002 — EAST CORNWALL

BSBI Monitoring Scheme

NAME(S) OF RECORDER(S): 8883 — Mary Atkinson and Rose Murphy

DATE: 23/03/88 – 19/04/88

TIME SPENT ON SURVEYS: 2hrs

GRID REF.: 204047 06

DESCRIPTION OF SITE: 'GREEN' LANE:

A lane descending a hill, steeply at first, from the A390 down towards the Coombe Valley - Honicombe Road. The lane carries a rich growth in the centre, with tracks either side, but the growth is well trampled indicating good use. The top of the lane is shaded by tall beeches (up to 30ft.) on the eastern side, and Hawthorn (up to 12ft.) on the western side. Below this, the hedge on the eastern side is kept trimmed, to wall top in places - (fields on eastern side of lane are well-cultivated). The hedges on the western side are more mixed and taller, Salix cinerea reaching 15ft. With increasing light, the hedgebanks become more herb-rich towards the base of the lane.

ALTITUDE (m/ft): from 725ft. down to 630ft.

APPROX HEIGHT OF VEGETATION (m/ft): Very variable - from 1ft. up to 30ft.

APPROX % COVER OF VEGETATION: Centre of lane: 30%; Hedgebanks: 95-100%

SITE USE & MANAGEMENT

Top part of lane shows little management, kept in control by use, lower hedgebanks kept trimmed on eastern side.

SOIL: /

HABITAT TYPE: PLEASE TICK NEAREST CATEGORIES

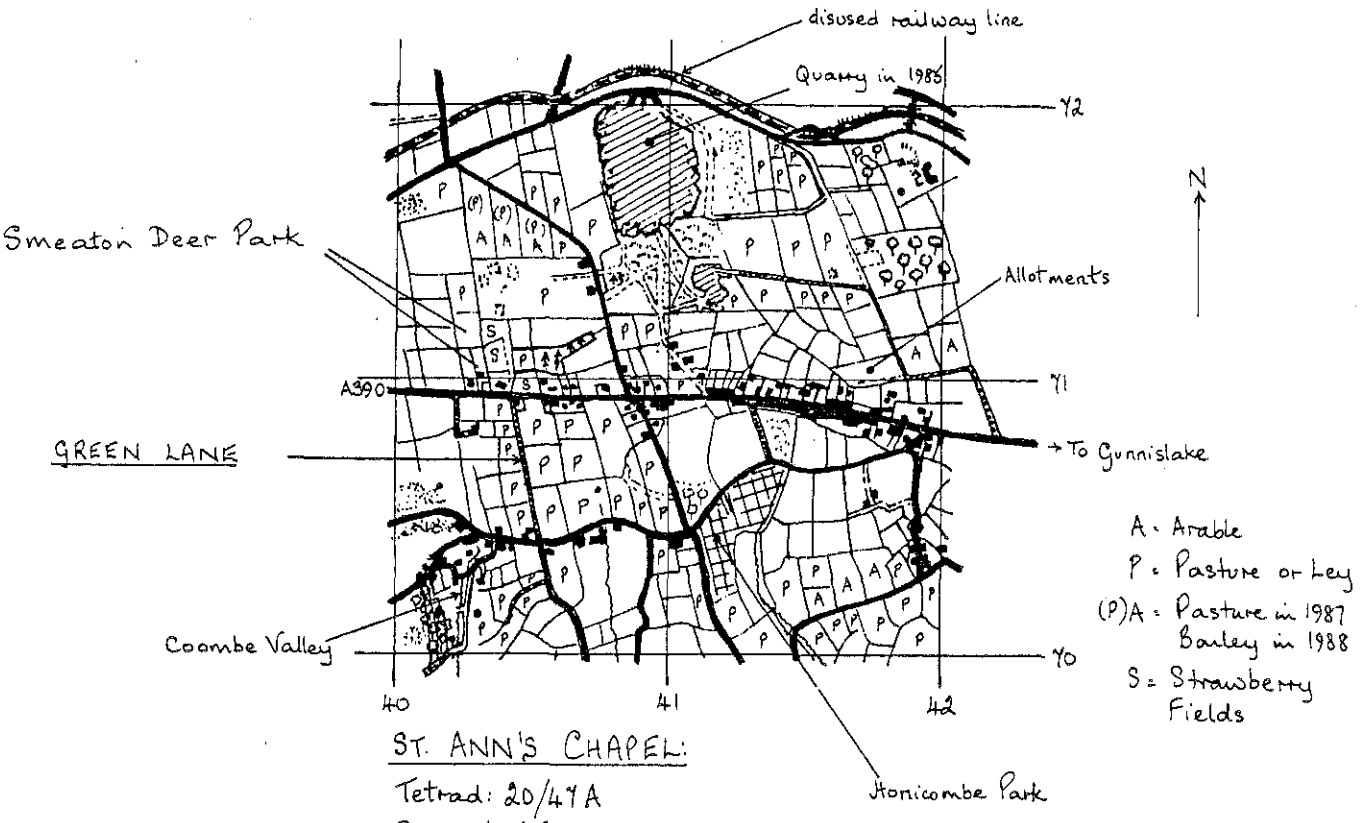
- WOODLAND: broad-leaved; coniferous; mixed
- WOODLAND: plantation; natural/seminat.; recently felled
- SCRUB: dense; open, grass+herbs
- HEDGEROW: ✓
- GRASSLAND: calcareous; neutral; acidic; marshy; improved
- HEATH & MOORLAND: gorse; dwarf-shrub; grass-lichen-rush; moss-lichen
- HEATH & MOORLAND: maritime; calcareous; wet; dry
- TALL HERB & FERN: bracken; riverbank; inland cliff
- TALL HERB & FERN: ruderal; non-ruderal
- SWAMPS, MIRES & BOGS: reedbed; fen; bog
- AQUATIC: marginal inundation; standing water; moving water
- AQUATIC: lake/pond; reservoir; stream/river; canal; ditch; flush/spring
- AQUATIC: nutrient-rich; nutrient-poor; brackish
- MARITIME: mudflat; saltmarsh; seawall; brackish marsh; strandline; shingle; sand dune; dune slack; rocky sea cliff; soft sea cliff; bird cliff; sea heath
- ROCK: inland cliff; ravine; crevice/ledge; quarry; wall; limest. pavement; scree; river shingle; bare ground
- OTHER: path; road; railway; arable; garden; parkland; amenity grassld.; churchyard; carpark; industrial waste; mine waste; waste ground; gravel pit; reclaimed land
- OTHER HABITATS: Cornish Hedge; Centre of lane

OTHER INTEREST (eg. butterflies)

Figure 5. Example of a habitat card.

MAP SHOWING PRECISE LOCATION OF HABITAT

(sketch map or copy of 1:10000 or 1:25000; indicate north & scale)



DOMINANT PLANTS	OTHER SPECIES *(please indicate frequency)*
Northern end of lane: Crataegus monogyna - West side Fagus sylvatica - East side Hedera hibernica (A) Middle section: very mixed hedge with Crataegus monogyna, Prunus spinosa and Salix cinerea oleifolia Lowest section: (southern end) Betula pubescens, then right at the end of the lane – Salix cinerea oleifolia on West side – mixed hedge, trimmed, on east side	Acer pseudoplatanus (O), Agrostis capillaris (O) A. stolonifera (O) Aegopodium podagraria (F) Anthoxanthum odoratum (O) Asplenium adiantum-nigrum (O) Blechnum spicant (O) Conopodium majus (O) Corylus avellana (O) Cymbalaria muralis (L) Dactylis glomerata (O) Dryopteris dilatata (F) D. filix-mas (O) Digitalis purpurea (O) Epilobium montanum (O) Fraxinus excelsior (O) Galium aparine (F) G. mollugo (F) G. odoratum (L) Galeobdolon variegatum (L) Geranium robertianum (F) Geum urbanum (O) Hyacinthoides non-scripta (F) Ilex aquifolium (O) Juncus effusus (L) Lapsana communis (O) Lolium perenne (L) - in the path Lonicera periclymenum (O) Ligustrum vulgare (O) Phyllitis scolopendrium (F) Polypodium interjectum (O) Ranunculus repens (O) Reynoutria japonica (L) Poa annua (L) - in the path Poa trivialis (F) Potentilla reptans (O) Rubus fruticosus (A) Rumex acetosa (O) Rumex obtusifolius (O) Quercus robur (O) Sambucus nigra (O) Silene dioica (F) Sonchus oleraceus (O) Sorbus aucuparia (R) Taraxacum (O), Taxus baccata (R), Teucrium scorodonia (O) Ulex europaeus (O) Umbilicus rupestris (O)

+ Plantago major (L) - in the path.

RARE, NOTABLE & CRITICAL SPECIES *(include pop^n size, determiner, etc.)*

D = dominant
A = abundant
F = frequent
O = occasional
R = rare
L = locally

CARD Nº (office use) 13

Figure 5, continued.

Please ask for permission for access to private land as usual and be careful, recording is at your own risk.

We do hope you will enjoy the challenge and participate in the Monitoring Scheme with the usual enthusiasm and efficiency for which the BSBI is renowned. If you have any further enquiries, do not hesitate to contact me.

SUMMARY OF THE MONITORING SCHEME

The BSBI Monitoring Scheme has been set up to assess the current status of the flora of Great Britain and Ireland.

All BSBI members are invited to participate in the Scheme. VC Recorders (or delegates) will organise the recording in their vice-counties, and BSBI members should contact them to offer help.

All native and introduced species (other than plants obviously cultivated) should be recorded for each of the selected 10-km squares, and for each of the A, J and W tetrads. Data on rare, notable and critical species should be given in detail on the species cards wherever possible.

Only records for 1987 and 1988 are acceptable.

Habitat surveys are optional, but should be attempted for the selected tetrads if possible.

Separate cards should be completed for each recording visit more than one month apart. All cards should be sent to the VC Recorder for checking; the VC Recorder will forward them to BRC.

You can do as much recording as you like. If you need any help or have further enquiries, do not hesitate to contact me.

Tim Rich
BSBI Monitoring Scheme Organizer

The instructions for the survey proved generally adequate, though clarification or expansion of some points was required. The following updates to the instructions are given in chronological order as they appeared in BSBI News.

BSBI News **45** (April 1987).

Planted and Naturalized Species
There have been requests for clarification on how to deal with planted and naturalized species; for instance, how far out of a garden does a plant have to be in order to be counted?

Any plant, either native or introduced, which has been deliberately planted or cultivated should not be recorded for the Monitoring Scheme. However,

as it is sometimes useful to know that they have been deliberately planted in 'wild' situations (eg Juniper on road cuttings in Hampshire, or 'wild flower' road verges) such information can be noted under 'other details' or species can be marked 'P' (for Planted) on the card.

Native species when naturalized in introduced localities (eg primroses in churchyards) should be marked 'I' (for Introduced). When both natural and introduced populations occur in the same square, native populations should be crossed off as usual and introduced sites noted on the front of the card.

There are 2 cases for introduced species. There should be no problem dealing with naturalized plants which are not cultivated (eg Cardaria draba); these can be recorded as usual. For garden species which occasionally escape (eg Hesperis, Lunaria), I suggest we follow Dr G Halliday's rule in Cumbria where such plants have to be more than 100 m from the nearest garden in order to count as naturalized. Plants less than 100 m away are most likely to be of direct garden origin (even if self-sown); they can still be recorded but should be marked 'I'.

I realise this definition of 'naturalized' will not be to everybody's liking, but it is a practical solution which will allow us to assess the flora objectively. If in doubt, note it on your cards giving as much information as you can.

Record Cards: Corrections and Reprints
I must apologise to Carex caryophyllea for consistently misspelling it on all the cards. There are a few other minor errors which have been corrected on the reprints, but one on the habitat card may cause confusion; the second line on the reverse side should read 'Sketch map or copy'.

To help those who find the 'small print' hard to read in the field, large size species lists are now available for N and S England, and we also have an additional 'additional species' card too. When requesting cards from me, **please** indicate which you want: and if I get my leg pulled any more about the colours of the species cards, I will make them all bright purple. You have been warned!

Habitat Survey
Please note that habitat cards should be used for individual sites (eg a wood, or a field, or a pond), and not for simply listing the habitats present in a tetrad. The idea is to get detailed information about particular sites and habitats so we can return to them in the future to assess change.

BSBI News **47** (December 1987)

Monitoring Scheme

1. Please write grid references in the boxes following these examples.

	Grid reference	Tetrad letter
For 10-km square records	221--5--	-
For tetrad records	221--5--	W
For 1-km square records (irrespective of tetrad)	2219-52-	W
For 6 figure records	22196527	W

2. When giving localities please use names on the 1:50,000 or 1:25,000 Ordnance Survey maps and follow their spelling. Please avoid local names because although you know where you mean, we do not. Please also avoid parish names or general names for areas eg "Pennines". Names of houses should be put in inverted commas unless named on the maps.

3. When crossing off species please take care. The aim is to make the appropriate BRC number instantly legible to the data processors who have to work at very high speed. Examples of how to cross off species (and how **NOT** to) are shown below.

   Most problems arise because recorders want to read the names they've crossed off. The best approach to this which allows cards to be photocopied and names to be read is to use a soft, thick pencil (hard pencil doesn't copy) or a thin blue or black biro. Felt pens tend to fade with time.

   The following methods of crossing off names are highly acceptable:

   2110 ~~Typha ang~~
   2111 ~~lat~~ — these best of all
   2112 Ulex eur
   2113 gal
   2114 min - but only if done very carefully like Arthur Chater does
   2119 Ulmus gla
   2123 sp min — to indicate an elm but you don't know which species
   2122 pro

   The following are **NOT** acceptable, and cards submitted like this will be sent back or filed in the little round basket on the floor!

   ~~1862~~ Scler ann
   ~~1865~~ ~~Scrop aur~~ — numbers obscured
   1867 nod - underlining alone, which is difficult to read quickly
   1868 sco — and gets mixed up with underlining of subspecies
   1872 ~~Scute~~ gal — meant to indicate a skull cap but not sure which species;
   1874 min — these get interpreted as Scutellaria galericulata
   1875 ~~Sedum~~ acr — meant to indicate Sedum anglicum only, but gets
   1876 alb — interpreted as both acre and anglicum
   1877 ~~ang~~

4. If a species is crossed off by mistake, 'correct' it by putting crosses both sides of the name, eg.

   1610 X~~Prune vul~~ X

   Having crossed it out you'll no doubt find it immediately, in which case write it on the front and don't try to correct your correction. Please don't use Tippex.

5. For introductions please put 'P' and 'I' (cf. BSBI News **45**) after the name, eg

   2241 ~~Aescu hip~~ I

   If you annotate your cards with other letters, write what they mean on the cards; we get very puzzled by some!

6. The most troublesome taxa with regard to changes in nomenclature are as follows (alphabetical order of old names).

Conyza canadensis	= Erigeron canadensis
Helictotrichon	= Avenula
Rorippa islandica	= R. palustris (unless you mean islandica s.s. in which case I want a voucher)
Scirpus setaceus	= Isolepis setacea
Thelypteris oreopteris	= Oreopteris limbosperma
Tripleurospermum maritimum subsp. inodorum	= Tripleurospermum inodorum

Has anyone discovered where Polygonum convolvulus has got to yet?

7. Please make sure you give details of the route whilst recording. I don't want to know which train you caught to get to the square!

Identification aids
The following are very highly recommended and we suggest you acquire them!

Wigginton, M.J. & Graham, G.G. (1981). Guide to the identification of some of the more difficult vascular plant species. NCC England Field Unit Occasional paper No. 1. Though intended primarily for the north of England, much of the guide is widely applicable elsewhere too.

Camus, J.M. & Jermy, A.C. (1987). The BM Fern Crib. By staff of the British Museum (Natural History) Fern Section. A booklet specially produced for the BSBI Monitoring Scheme to help identify pteridophyte species and hybrids which people frequently find difficult to distinguish. Available from Clive Jermy, British Museum (Natural History), Cromwell Road, LONDON SW7 5BD. With ferns like these, who needs anemones?

BSBI News, **48** (April 1988)

TACTICS FOR 1988
Please concentrate on areas and/or species not recorded in 1987. Do not re-record sites/plants adequately covered last year (the survey is cumulative over the 2 years).

If you have adequately covered your squares and your neighbours do not need help, concentrate on site recording at the most important sites.

FILLING IN CARDS
When giving your name, it would help us to sort out who is who if you would please include full initials and preferably titles. I like Christian names though, much less formal!

Two other names on the record cards are unclear:

1994 Spira agg refers to Spiraea aggregate
1997 Spira spi refers to Spiranthes spiralis (this has an asterisk on some cards by mistake, which doesn't help!)

And at least 8 people have rediscovered Polygonum convolvulus, it's disguised under Fallopia (Fallo con on the cards).

IDENTIFICATION AIDS

The Monitoring Scheme Plant Crib is, naturally enough (!), HIGHLY RECOMMENDED FOR PURCHASE. It covers genera such as Fumaria, Glyceria, Potamogeton, Carex, Orobanche and many others (but not ferns!). We hope it will clarify many of the taxonomic, identification and recording problems and become a valuable source of reference to one and all.

Progress reports, details of coverage, antics of recorders and other news were also given in BSBI News, **45** (April 1987) to BSBI News, **53** (December 1989). A leaflet entitled "Safety in the field" was also prepared and mailed with BSBI News, 45. (Appendix 1).

3 Composition and compilation of the 1987-1988 Monitoring Scheme database

Each species record card received for the Monitoring Scheme was checked for accuracy and consistency of geographic and recorder information. Details of all the species were then put into the computer with the following primary pieces of information (when given):-

1. Taxon (ie species, subspecies)
2. Grid reference (including tetrad)
3. Locality name
4. Vice-county
5. Date
6. Recorder(s)
7. Distribution status of taxon (ie native, introduced)
8. Details of expert determination and location of voucher specimens

It is thus possible to extract from the database details of each individual species - who recorded it, where and when. The minimum information compiled for any one record was taxon, 10-km square and year, but the majority of records include all the above details except the last.

Very few cards reaching BRC were rejected. Only about half the habitat cards were included in the database, mainly because of the amount of time required to code individual species with their BRC numbers, and also because the records were often duplicated on the species cards.

1. Taxon

Records for each species, subspecies, aggregate etc were allocated their BRC numbers and compiled as received. The taxonomic information was largely checked by VC recorders and only minor revisions or clarifications carried out at BRC. For instance, records of critical taxa were assumed to belong to aggregates rather than segregates (eg Rosa canina was input as 1708 R. canina s.l. rather than 1709 R. canina s.s.) unless otherwise stated or the recorders expertise was known.

At the start of the Scheme, numerous hybrids, critical taxa, casuals, crops and garden plants had no BRC number and consequently their inclusion in the database has been somewhat inconsistent and unsatisfactory. The majority of these taxa have now been incorporated (though often with only summarised information) but about 100 taxa, mostly garden plants which are probably not strictly naturalized, have not been included.

2. Grid reference

Grid references were checked against maps and routes, and queries returned to the recorders. In general, grid references which were ambiguous or where the route indicate that the recorder may have been outside a 1-km square or tetrad were changed to tetrad or 10-km square to avoid giving a spurious precision to the data.

Grid references were input into the computer in the following standard formats:-

10-km square	126--9--
Tetrad	126--9--W
1-km square	1268-93-W
6-figure	12687934W

Note that the national grid varies slightly between editions and scales of the ordnance survey maps (eg ponds often change tetrads on 10-km squares when close to or on a grid line). This source of inaccuracy is probably very minor.

The map-reading ability of botanists is usually excellent, but mishaps inevitably happen. Most of these mistakes are noticed in the field at the time when the species lists can be amended accordingly. Only 3 cards were received for non-Monitoring Scheme squares, and these have been deposited in the general BRC data banks.

3. Locality name

The localities were coded up following standard BRC procedure. Locality names are taken from the standard ordnance survey maps of Britain and Ireland and these often differ from the original localities given by recorders.

4. Vice-counties

Vice-counties were in general correct as originally cited, but corrections noticed during processing have been made. Where more than one VC is given on the cards, or no VC was given and cannot be derived from the route information, the VC has been coded as '0' in Britain and '200' in Ireland. This departs from standard BRC procedure but maintains the accuracy of the data.

5. Date

Dates were compiled with as much detail as possible following BRC date standards. If more than one date was given on the card, then the month, or year was taken as appropriate. Undated cards received during 1987 were dated 1987. Undated cards or records received during 1988 were coded as 1987C.

With the exception of VC20, where some 1986 records have been included with Hertfordshire Flora Survey data, all the records were made during 1987 or 1988. The number of 1986 records from Hertfordshire is very small and only includes relatively common species likely to be there in subsequent years; all other records have been rechecked (T T James pers. comm.).

6. Recorders

Each recorder, or combination of recorders, was allocated a unique recorder number. Where cards were indicated or known to be from BSBI field meetings they were allocated one number only, hence recorders who joined field meetings but did no separate recording may be missing from the list of contributors.

7. Distribution status

The distribution status of native plants has been assumed to be native unless otherwise stated (in many cases, this is very difficult to assess objectively, hence the data must be treated with caution). All non-native plants have been automatically noted as introduced. All taxa marked as deliberately planted have been compiled as planted.

8. Details of expert determination and location of voucher specimens

The determiner was treated in a similar manner to the recorder, and the herbarium code (following Kent & Allen 1984) noted to indicate where voucher specimens have been deposited.

Other data on the cards (eg population counts, habitat information) was not compiled and the time spent recording has been calculated for Ireland only. Examples of the records in the Monitoring Scheme database are shown for Britain and Ireland in Figure 6.

Records sent in computer-readable format

The first major transfer of vascular plant records to BRC in computer-readable format was received for the Monitoring Scheme from Stephen Evans (V.C.45). Records held in the BIORECS recording package (designed by S Coker), compatible in structure and, more importantly, in data content with the Monitoring Scheme database, were sent on floppy discs for each of the Monitoring Scheme squares.

Treatment of aggregates and segregates

Botanists differ in the way they record aggregates and segregates on the cards. Some, when they find a segregate, also cross off the aggregate. Others, cross off only the segregate and record aggregates only when the segregate cannot be determined.

Records were compiled as sent in, and no aggregate records were specially generated from segregate records in the database. Note that segregate records cannot be compiled from aggregate records with any degree of certainty. For the analysis and maps, aggregate records have been generated from segregate records to minimise differences in such recording. These records are included in the counts of species per square, or squares per species, given in Chapter 4 onwards.

Critical species

By their nature, critical taxa are difficult and often take time to identify. Not all records for critical taxa collected during the Monitoring Scheme have therefore yet been included in the database.

4 Sources of error

There are 2 types of major error in the database which are likely to affect the results, geographic and taxonomic. The geographic data have been checked and cross-checked at least 3 times and their error rate is now thought to be virtually nil at a 10-km square level. In the two cases where geographic errors were later picked up by the VC Recorders, the data had been sent in to BRC in summary form which could not be checked.

The taxonomic errors are more of a problem. Errors can arise for a number of reasons and from a number of sources.

i) Identification errors

Errors of identification are probably the largest single source of error, and consequently considerable effort was put into checking the records by the VC Recorders.

It is often helpful to know individual recorders when assessing their records. Some mistakes made by beginners are relatively easy to spot - eg Viola canina is often over-recorded, but some others are less easy to pick up. One newcomer recorded Veronica persica as V. filiformis for 6 months and none of the records were queried. Records from more experienced botanists are, not surprisingly, less often queried, no doubt because the error rate is lower but also because a well-known name adds "respectability"to the records.

Rorippa amphibia

SPECIES NO	STATUS	VC	SQUAR	E	N	T	DA	MO	YEAR	RECORDER	DETERMINER	LOCALITY
0920 1701	1	30	52/15	--	--	L	23	08	1987	2934		Tempsford,R Great Ouse W of
0920 1701	1	30	52/15	7-	9-	U	12	09	1987	6708		Eaton Socon
0920 1701	1	0	52/15	--	--	U	15	05	1987	6706		Eaton Socon
0920 1701	1	26	52/78	--	--	T	13	06	1988	9088		Brandon
0920 1701	1	39	33/94	--	--	E	24	05	1987	2570		Abbey Hulton area
0920 1701	1	24	42/82	--	--	Z	31	08	1987	422		Three Locks
0920 1701	1	24	42/82	9-	9-	Z			1987	6917		Paper Mill-Partridge Hill
0920 1701	1	37	32/95	3-	5-	H	01	09	1987	7866		Bow Wood
0920 1701	1	54	43/87	--	--	J	17	07	1987	7166	743	Torksey,R Trent+ponds
0920 1701	1	63	44/50	--	--	W	25	07	1987	3927		Doncaster
0920 1701	1	6	31/66	63	92	U		07	1987	8574		Londonderry Farm,R Avon nr
0920 1701	1	29	52/48	3-	0-	F	07	08	1987	268		Mepal,W of
0920 1701	1	29	52/48	7-	5-	S	05	08	1988	9449		Welches Dam,SE of
0920 1701	1	28	53/71	--	--				1987	287		
0920 1701	1	30	52/15	--	--	T	02	06	1987	2934		Wyboston,E of+Little Barford

Figure 6a. Example of Monitoring Scheme data from Britain.

Rorippa amphibia

SPECIES NO	STATUS	VC	SQUAR	E	N	T	DA	MO	YEAR	RECORDER	DETERMINER	LOCALITY
0920 1701	1	200	22/26	--	--	W	11	07	1987	1036		Ballygarvey,N bank of Inny R S of
0920 1701	1	223	22/26	--	--	W	20	07	1988	1036		Lough Nagall+Inny River,N bank
0920 1701	1	237	23/85	--	--	A			1987	6588		Benburb,S of R Blackwater nr
0920 1701	1	230	22/59	--	--	W	19	06	1988	2974		Gallon Lough+Lough Dargan
0920 1701	1	230	22/59	--	--	W	14	08	1988	2974		Gallon Lough+Lough Dargan
0920 1701	1	223	22/56	--	--	W	22	05	1988	1036		Delvin
0920 1701	1	217	12/33	--	--	W	03	08	1987	7697		Kiltroge Castle+R Clare
0920 1701	1	209	11/37	--	--	J	26	06	1988	547		Drehidnagower Bridge,R Fergus
0920 1701	1	209	11/37	--	--	J	21	05	1988	5541	743	Ennis,NW of
0920 1701	1	209	11/37	--	--	J	20	05	1988	9153		Drehidnagower Bridge area
0920 1701	1	232	22/89	--	--	J	28	08	1988	547		
0920 1701	1	224	12/96	--	--	W	09	08	1988	8768		Lough Ree,E shore
0920 1701	1	239	33/18	2-	2-	G	03	08	1988	6637		Corbally Ho,nr
0920 1701	1	239	33/18	4-	5-	M	18	07	1988	4365		Masserene Park,Lough Neagh
0920 1701	1	239	33/18	3-	6-	I	18	07	1988	4365		Lough Neagh,S of Antrim Marina
0920 1701	1	239	33/18	--	--	G	16	07	1987	4365		Lough Neagh,S of Dunore Point
0920 1701	1	200	12/99	--	--	J	26	08	1988	743		Carrick on Shannon

Figure 6b. Example of Monitoring Scheme data from Ireland.

Figure 6. Example of Monitoring Scheme data from Britain (6a) and Ireland (6b). The columns are as follows: SPECIES NO. = BRC species number for Rorippa amphibia (the first 4 digits show it is a flowering plant); STATUS = distribution status, the 1 indicates it is native at this site; VC = vice-county, the Irish VC's are prefixed 2. If no VC is known the VC is given as 0 (200 in Ireland). SQUAR = 10-km square, and E and N are the Eastings and Northings within that square. T = tetrad. DA, MO and YEAR are the date. RECORDER and DETERMINER = BRC recorder numbers to indicate original recorder or recorders (eg 4365 = W J Harron). LOCALITY is self explanatory.

Recorders outside their local patch are also more prone to error simply from recording in their usual, routine manner. Whilst it may be reasonable to record most vegetative gorse in eastern England as Ulex europaeus, it is not reasonable to do so in Ireland. Irish and Scottish botanists are often exasperated by the taxa that visiting English botanists record. Occasionally, however, these visitors know something the locals do not - the discovery of Epilobium ciliatum in Ireland by the Donys (Preston 1989) is a good example.

BSBI field meetings may also generate a high error rate due to the range of experience, and the unfamiliarity of the botanists with each other. Some records made in the heat of the moment and passed on by word of mouth inevitably do not get treated with the caution they deserve.

There is a nice example of a combination of these two effects. "The famous Castle of Mey teaparty/BSBI field meeting clocked up a huge number of supposed new Vice-county records which were indicated in the field meeting report. Four of us 'locals' spent years afterwards trying to check these 'records' and although we were successful with some, a number proved intractable". (Elaine Bullard pers. comm. 1988).

Some erroneous records result from increasing taxonomic awareness and knowledge. For example, Reynoutria populations in Galway were recorded as R. japonica for the Scheme, but in 1989, each population I examined proved to be R. japonica x sachalinensis and no R. japonica was found. Whilst these would best be regarded more as revisions than errors, the end result is the same. It is thus important to have some knowledge of both the taxonomic history and recording history of certain groups when interpreting the records - the two histories are not the same, the latter often lagging behind. Botanists cannot be expected to be 100% up-to-date or aware of every change to a taxonomic group. This phenomenon is illustrated in Table 1, which shows the number of records for 1987 and 1988 for selected taxonomic groups published in 1988 in Watsonia, the Fern Crib (Jermy & Camus 1988) and the Plant Crib (Rich & Rich 1988). Although there is an overall reduction in records for 1988, most of the more critical taxa show an increase in the number of records, reflecting increased awareness. This phenomenon also occurs in the long-term, as more is learnt about particular groups and they are more widely recorded.

Not only may the identification by a recorder be wrong, but expert determinations may also be wrong. In 1987 T C G Rich identified a young specimen of Thlaspi as T. alliaceum but re-examination of the material in 1989 showed it to be, to his absolute horror and embarrassment, T. arvense. Another well-known national authority mis-identified Carex divisa as Blysmus compressus. The point is that both recorders and experts are human and not perfect.

ii) Errors in crossing off on the cards

Given the small size of the print, similarity of abbreviated Latin names and updated nomenclature, it would not be surprising to find species erroneously crossed off on the cards now and again even when the original identification was correct. An error rate of about 0.025% is suggested for this source of error.

Some species are crossed off in error for each other due to the similarity of the abbreviated names. A classic example of this, for which there are about 10 occurrences of in the Monitoring Scheme data alone, is the crossing off of Filago vulgaris in error for Filipendula vulgaris. Other species pairs where this may happen are Galium mollugo and Geranium molle (G Halliday, pers. comm.) and Rumex acetosa and R. acetosella (P M Benoit, pers. comm.). The obvious answer is to use longer abbreviations.

Taxon	Number of Records 1987	1988
Juncus x surrejanus	10	16
Typha x glauca	2	4
Aira caryophyllea s.l.	223	226
both subspecies	5	11
Molinia caerulea s.l.	1021	970
both subspecies	4	33
Spiraea aggregate	72	57
Spiraea segregates	11	15
Dryopteris affinis s.l.	848	724
subsp. affinis	54	26
subsp. borreri	24	24
subsp. cambrensis	6	16

Table 1. Number of individual records for selected taxonomic groups for 1987 and 1988 during the Monitoring Scheme. These are uncorrected for the overall decrease in records in 1988.

In an attempt to assess more objectively the error rate from crossing off species, two 'spoof' species, 'Osenn nes' and 'Sonne nes', were quietly inserted into the second printings of the S England card, and the Scottish and Welsh cards respectively, next to very common species. Such a test is only of value if botanists are unaware of its presence and it is surprising that, even after 15 months of the cards being used only 6 people had actually asked what the 'species' were. Mrs Enid Hyde had even actually worked out that the spoof species were anagrams of 'nonsense'. It is difficult to say how many other people spotted the species but did not ask what it was. It may be its presence was not noticed on the card whilst recording, possibly because when looking for a particular name, all others were ignored. It is extremely pleasing that no records for either of these spoof species were received.

On reflection, the creation of spoof species names such as 'Epilobium vulgaris' or 'Ranunculus pratensis' might have produced more 'records'. None-the-less, it has been an interesting exercise.

iii) Erroneous BRC numbers
The following species have erroneous BRC numbers on some or all Monitoring Scheme cards:

Alchemilla filicaulis: A. filicaulis subsp. filicaulis was given the BRC number for subsp. vestita (= 57). As subsp. filicaulis is very rare in Ireland and subsp. vestita widespread, all 'A. filicaulis' records are assumed to refer to subsp. vestita.

Bromus hordeaceus subsp. thominii/B. x pseudothominii: the number for B. x pseudothominii was incorrectly given as 275 (= B. hordeaceus subsp. thominii) on some S England RP19 and RP19L cards (it should be 2383).

Carex muricata subsp. lamprocarpa is incorrectly given as 398 (= C. muricata) on most cards (it should be 398.2).

Melissa officinalis/Melittis melissophyllum: the number for Melissa was incorrectly given as 1269 (= Melittis) on some S England RP19 and RP19L cards (it should be 1268).

"Salvia ver" is not only ambiguous on S England RP19 and RP19L cards but is wrongly numbered. Recorders were asked to check which records referred to which of the following species:

1809 Salvia horminoides
1812 Salvia verbenaca
1813 Salvia verticillata

Ulmus minor/U. angustifolia: the number for U. minor is incorrectly given as 2123 (= U. angustifolia) on the cards (it should be 2115).

Records for all these taxa have been checked, though there is still doubt about some Salvia records.

iv) Errors in coding additional species
Additional species have been given their BRC numbers manually, and inevitably some have been coded incorrectly. Some errors are simply due to looking up the wrong number or writing it incorrectly, but a few result from lack of knowledge. For example, 'Veronica sp.' was once coded up as Veronica spicata and for a while Parthenocissus records were included under the Narcissus aggregate!

Although there is an initial small error rate, the records for additional species have been checked more thoroughly at BRC, and probably more closely by VC Recorders because of the prominent position of additional species on the cards, and it is hoped such sources of error are minimal.

v) Errors in data input
Given that nearly a million numbers up to 5 digits long have had to be typed manually into the computer, a small error rate would be expected and every effort has been made to minimise these sources of error. After initial input, each card was checked manually and corrected, and then a second automatic check was run.

Errors may result from typing numbers incorrectly or from mis-interpreting what has been crossed out. For instance, 1748 Rumex crispus was not infrequently typed as 1478 Pinguicula grandiflora resulting in a few amusing records. Sometimes adjacent numbers were read. A frustrating source of error is in sloppy crossing out of species names (one square near London was especially bad!). Sometimes species were missed accidentally, or deliberately left out when it was unclear whether they had been crossed out or not. If in doubt, records were either queried or ignored.

vi) Errors in data handling
Another potential source of error is in data handling on the computer. Fortunately, no examples have yet come to light .... though the Dryopteris affinis subspecies were once lost for three weeks. Some data have been lost during compilation of the tables included with the maps. The tables have not been corrected due to lack of time.

Errors overall
Needless to say considerable effort has been put into checking the taxonomic data. Major errors such as Ludwigia palustris in Ireland or Orchis militaris in Scotland are easy to pick up, but many errors are not. There has been no independent assessment of the error rate in the Monitoring Scheme database and there are no error rates for other BRC databases against which to compare it except that for our Atlas database. Squares where data have been checked by VC Recorders are shown in Figure 7.

It is hoped the overall error rate of taxonomic data is less than 0.1%, and thus unlikely to be of significance except in a few cases. This very low error rate upholds the traditional accuracy and quality of the records collected by the BSBI.

5. General assessment of the Monitoring Scheme database

There are about 985,000 individual records in the database, representing about 164,000 "dots" (i.e. unique species and squares). This is an average of about 2300 records or 395 species per square. A total of 2660 different taxa were recorded.

The 985,000 records over-estimate (perhaps by 2 or 3%) the actual number of records. Some species may be recorded twice on the same card - once on the back and again on the front with more details. Sometimes these duplicates have different locality names and more detailed grid references. There is also some duplication resulting from a small number of records being put into the database twice.

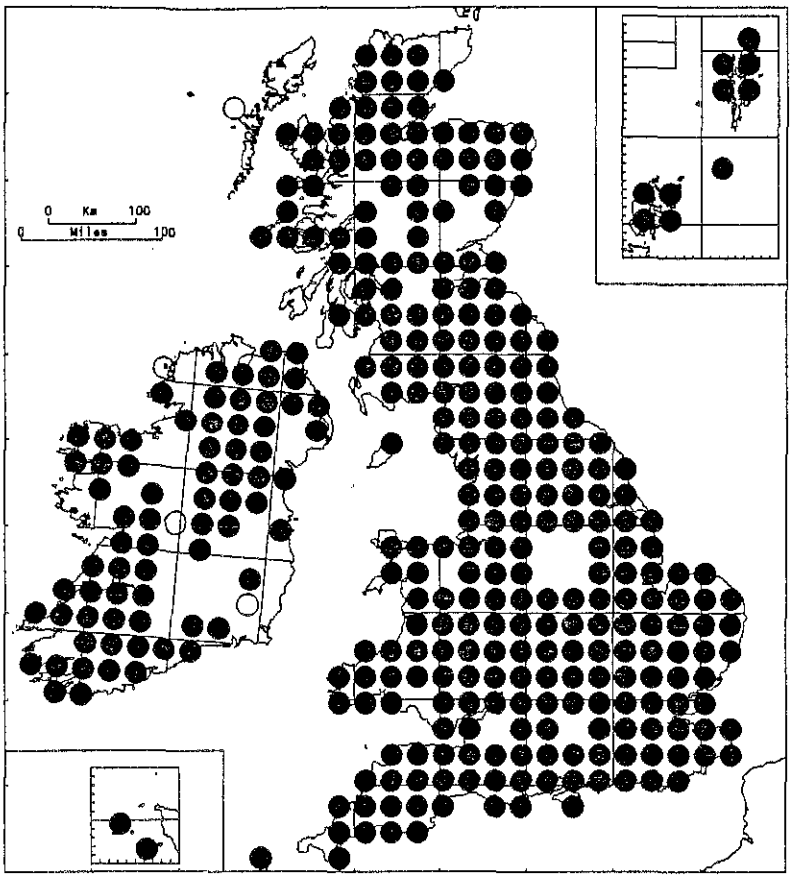


Figure 7. 10-km squares which have been checked for the Monitoring Scheme by the VC. Recorder. Squares not recorded are shown as open circles.

Compared to other BRC data sets this is quite a large number of records representing approximately 20% of the total BRC data holdings and 40% of the computerized information (as at 1989). There are 1,430,000 other vascular plant records held at BRC, 770,000 bryophyte records, over 45,000 mammal records, 250,000 butterfly records, 400,000 moth records and 144,000 non-marine slug and snail records. However, compared to the average county tetrad flora which has 250,000 records (some have over 500,000) and these are often handled by hand, the numbers are not so large.

Figure 8 shows the approximate rates at which records and species were accumulated during the 2 years of the Scheme. 57% of the records were collected in the first year, 43% in the second year. This decline in 1988 reflects the request for additional records only and the increasing difficulty of finding new species and new areas to record.

The total number of cards received by the end of 1989 was over 9000 (a stack 3 m high). The number of species per card ranges from one to over 350, and averages about 110.

Coverage

Records for 425 out of the total of 429 10-km squares have been received. A map showing 10-km squares and tetrads for which NO records have been received is shown in Figure 9. The coverage of N. Ireland and Wales is complete. The coverage of Scotland is absolutely outstanding, and that of the Republic of Ireland many times better than had been predicted. In England, cards for VC63 were apparently lost in the post, otherwise the coverage is nearly comprehensive. The only really poorly recorded areas are Wexford and Wicklow in SE Ireland.

Only 4 10-km squares (less than 1% of the total) have not been visited at all - two of these are remote, off-shore islands. Records have not been received for 35 tetrads (about 3% of the total) although attempts were made to visit some of these. Thus coverage is estimated to be in the order of 98%, an extremely satisfying total given the short duration of the field work. The presence of an un-recorded tetrad on the outskirts of London perhaps shows the quality of coverage elsewhere.

A minimum of 3 visits to each of the selected tetrads was requested (but not necessarily expected). Figure 10 shows the 10-km squares visited once or twice only for the Monitoring Scheme.

Missing Records

Following production of the maps, it became apparent that a very small number of records were 'missing'. Embarrassingly, some records were 'missing' because they had not been put on the cards! Some records were absent because the cards which were sent out for checking had not been returned; this applied to at least 7 cards. Other records had been included in summary cards (in one case, a record for *Erophila verna* s.s. had become *Erophila verna* s.l.).

Other records have been missed for other reasons. One record was noticed published in *Watsonia* (it must therefore have reached BRC but not the Monitoring Scheme office). Some cards may accidentally not have been put into the computer (purely administrative error), and some deliberately so (see habitat survey). More records will no doubt come to light when others examine the maps. Overall, these missing records are probably a tiny fraction of the total.

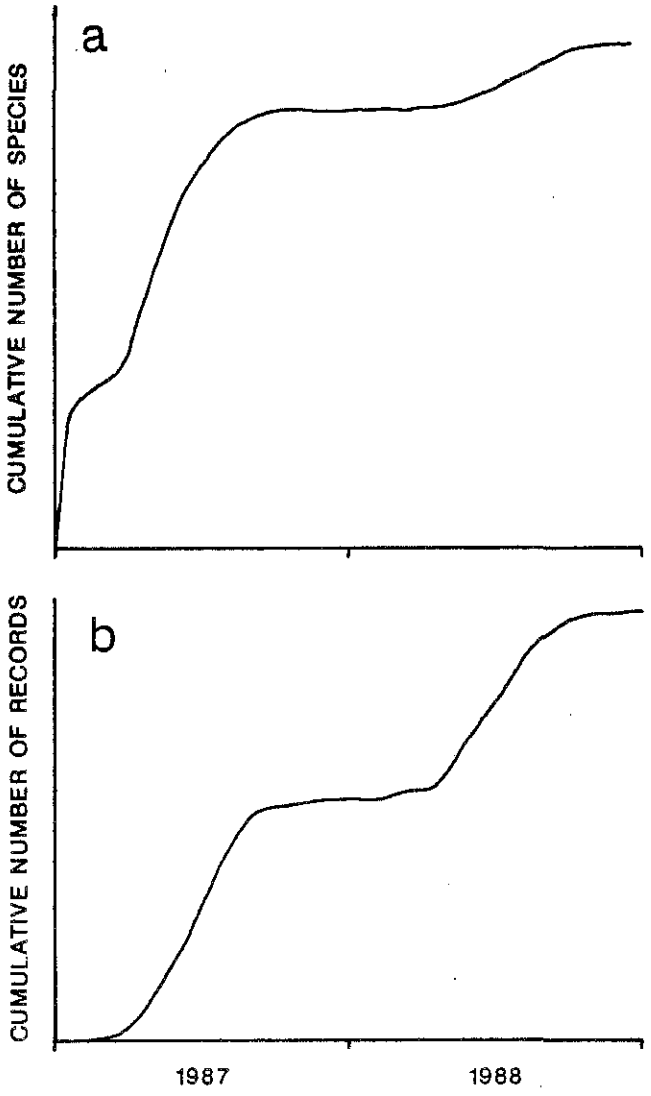


Figure 8. Cumulative numbers of species (a) and records (b) during the 2 years of the Monitoring Scheme.

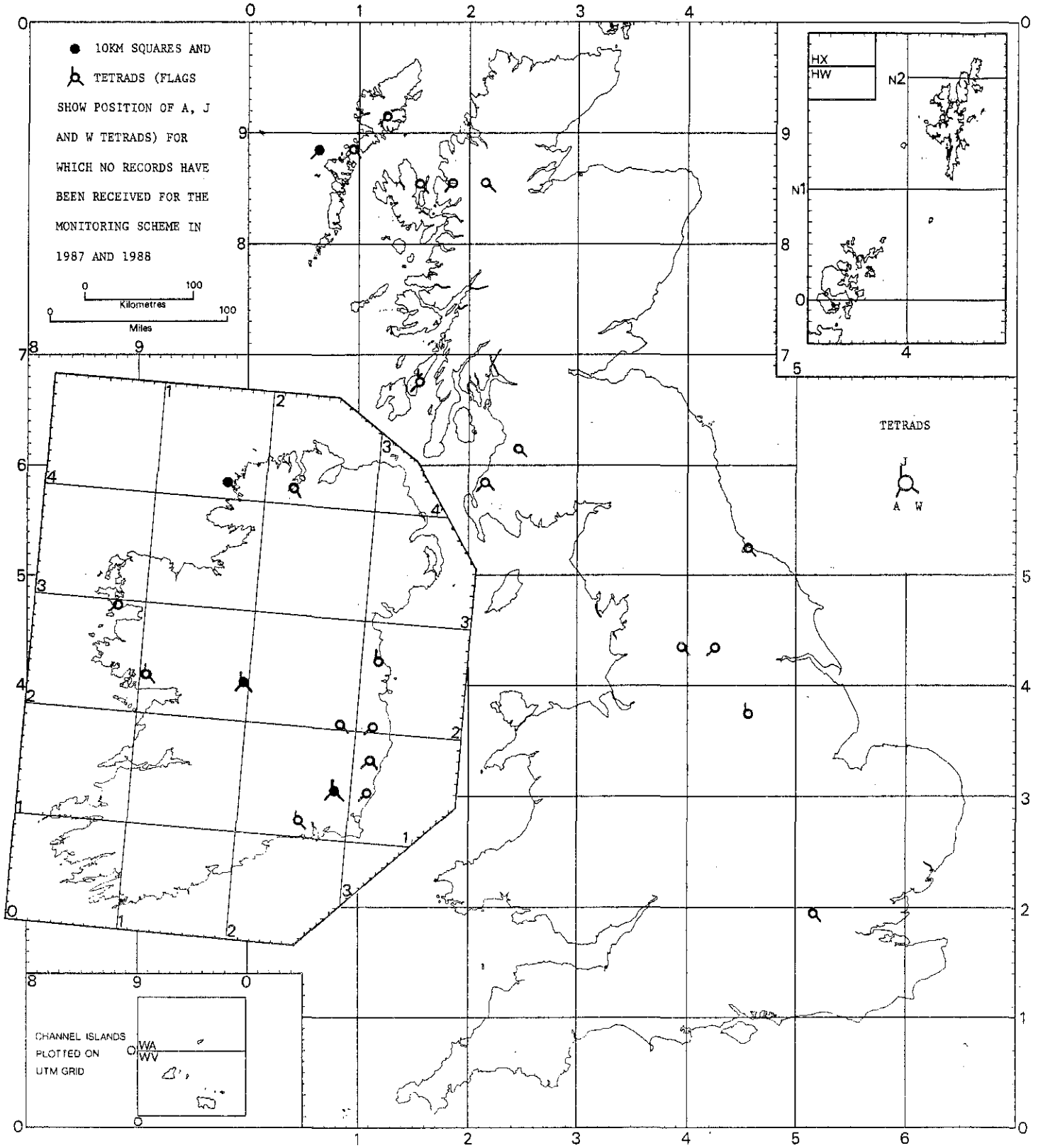


Figure 9. 10-km squares and tetrads for which no records have been received for the Monitoring Scheme.

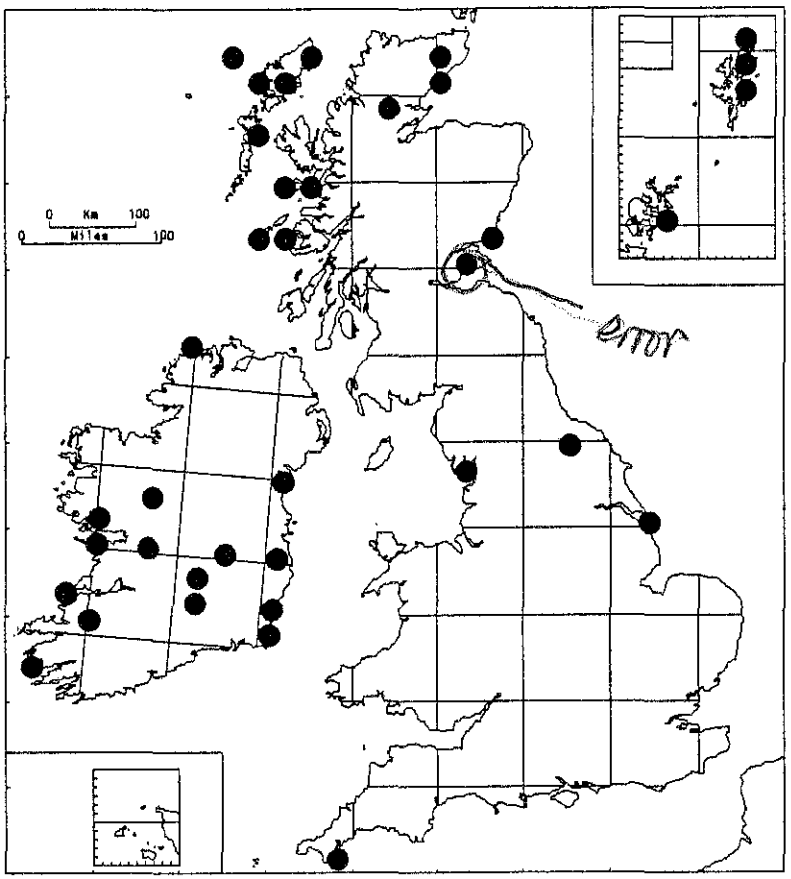


Figure 10. 10-km squares visited once or twice only for the Monitoring Scheme (a minimum number of 3 visits to each selected tetrad was requested).

Figure 11 shows the 10-km squares with the highest number of taxa recorded for England, Scotland, Wales, N. Ireland and the Republic of Ireland. These are actual numbers of species and do not include additional aggregate records generated later in the analysis. The lowest numbers of species recorded in Britain is 14 in the Outer Flannan Isles (09/6.4) and in Ireland 79 for the Burren square (12/0.0). Details of the number of taxa recorded per square including aggregates are given in Chapter 4.

Commonest species

Table 2a shows the 50 species most commonly recorded for the Monitoring Scheme, and Table 2b lists the 50 species recorded in the most 10-km squares. Note there are some marked differences between the lists.

SPECIES	NO. OF RECORDS
Urtica dioica	6514
Ranunculus repens	6303
Plantago lanceolata	6141
Taraxacum agg.	5799
Dactylis glomerata	5760
Crataegus monogyna	5742
Trifolium repens	5646
Cirsium arvense	5629
Plantago major	5610
Rubus fruticosus agg.	5574
Heracleum sphondylium	5429
Cirsium vulgare	5390
Galium aparine	5344
Poa annua	5335
Cerastium fontanum	5320
Bellis perennis	5265
Fraxinus excelsior	5226
Achillea millefolium	5214
Rumex obtusifolius	5056
Hedera helix	4975
Sambucus nigra	4922
Holcus lanatus	4919
Ranunculus acris	4637
Juncus effusus	4626
Rumex acetosa	4588
Geranium robertianum	4588
Anthriscus sylvestris	4576
Acer pseudoplatanus	4521
Veronica chamaedrys	4462
Trifolium pratense	4447
Lolium perenne subsp. perenne	4373
Centaurea nigra agg.	4331
Senecio jacobaea	4325
Filipendula ulmaria	4145
Prunella vulgaris	4126
Stachys sylvatica	4082
Pteridium aquilinum	4028
Arrhenatherum elatius	4002
Lotus corniculatus	3956
Prunus spinosa	3947
Anthoxanthum odoratum	3930
Dryopteris filix-mas	3869
Chamerion angustifolium	3836
Cirsium palustre	3821
Potentilla anserina	3778
Lathyrus pratensis	3689
Festuca rubra agg.	3680
Corylus avellana	3672
Deschampsia cespitosa	3670
Matricaria matricarioides	3653

Table 2a. The 50 species most commonly recorded for the Monitoring Scheme.

SPECIES	NUMBER OF 10-KM SQUARES RECORDED
Plantago lanceolata	423
Trifolium repens	421
Cerastium fontanum	420
Bellis perennis	420
Lotus corniculatus	419
Ranunculus repens	417
Holcus lanatus	417
Rumex acetosa	415
Ranunculus acris	415
Taraxacum agg.	415
Festuca rubra agg.	415
Prunella vulgaris	414
Urtica dioica	414
Poa annua	414
Cirsium vulgare	413
Achillea millefolium	413
Plantago major	412
Juncus effusus	410
Anthoxanthum odoratum	410
Trifolium pratense	408
Dactylis glomerata	408
Hypochaeris radicata	407
Cynosurus cristatus	403
Agrostis stolonifera	403
Sagina procumbens	402
Senecio jacobaea	401
Rumex obtusifolius	401
Lolium perenne subsp. perenne	401
Cirsium arvense	401
Angelica sylvestris	400
Heracleum sphondylium	399
Stellaria media sens. str.	398
Centaurea nigra agg.	397
Viola riviniana	396
Leontodon autumnalis	396
Cirsium palustre	393
Potentilla anserina	392
Pteridium aquilinum	392
Lathyrus pratensis	391
Arrhenatherum elatius	390
Rumex crispus	390
Galium aparine	390
Equisetum arvense	390
Cardamine pratensis	388
Filipendula ulmaria	388
Agrostis capillaris	388
Matricaria matricarioides	385
Veronica chamaedrys	384
Dryopteris dilatata	384
Acer pseudoplatanus	383

Table 2b. The 50 species with the most 10-km squares recorded.

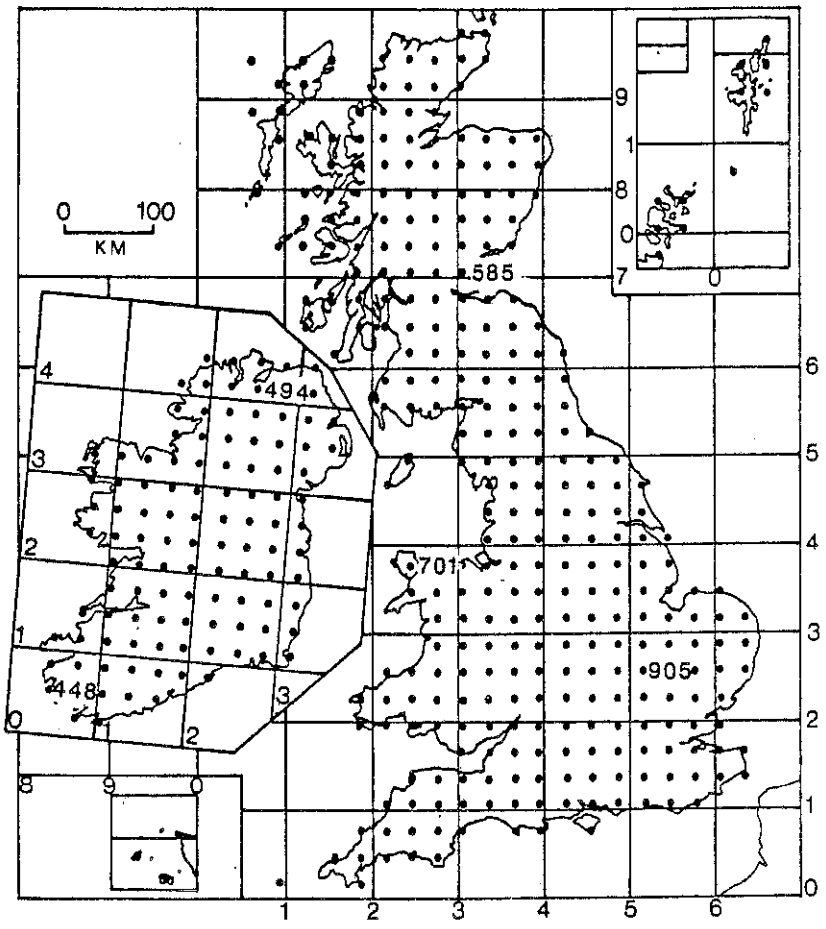


Figure 11. Highest number of taxa recorded per 10-km for England, Scotland, Wales, Republic of Ireland and N. Ireland.

Recorders

A list of contributors to the Monitoring Scheme is given in Appendix II. There are over 1600 people listed - more than listed for the Atlas. Table 3 lists the 'top 50 recorders' with the number of individual records they have contributed to the Scheme. These counts actually relate to the BRC recorder numbers (see above) and do not necessarily indicate the total number of records collected by each individual, eg some botanists who regularly record with different people are under-represented. Thus the lists represents the botanists who have done the most work in the same company.

If the total number of records collected by an individual is counted, the list changes - John Harron collected about 26,000 records, nearly 3% of the total. Often records were collected from distinct geographical areas (Figures 12-15).

BRC Recorder Number	Name(s)	No. of Records
4365	Harron, WJ	23578
158	Chater, AO	13650
6930	Coulson, BWH & MG	7677
7126	Pyner, T	7385
2934	Dony, Mrs CM & JG	7263
4908	White, Mrs PH & RG	6263
560	Corner, RWM	6134
523	Stewart, Mrs OM	6012
975	Porter, M	5999
2932	Tucker, WH	5967
288	Philp, EG	5713
6508	Addington, Rev R	5047
6789	Davies, Mrs MR & Roberts, RH	5020
3950	Green, Mrs JA	4905
7077	Thomson, Mrs SE	4824
2891	Braithwaite, ME	4818
6518	Leslie, Mrs JF, Page, K & Smith, Mrs JE	4735
823	Martin, Mrs MER	4685
150	Burton, RM	4538
8573	Crouch, Ms G & Green, IP & PR	4425
2971	Sharkey, G	4379
3128	Veall, RM	4357
58	Scannell, Miss MJP	4189
6958	Green, IP & PR	4127
2327	Noltie, HJ	4120
9430	Ison, JJ	4075
2570	Hopkins, IJ	3966
5213	Pennell, EV	3891
7041	Newton, Mrs JM	3800
246	Lewis, R	3768
1046	Welch, D	3644
5994	Devereau, Miss M	3643
6283	Muscott, Miss J	3567
743	Rich, TCG	3527
6996	Smith, PA	3473
6	Bowen, HJM	3435
2424	Thompson, BH	3418
4680	Dawson, N	3330
671	Bowman, RP	3327
95	Perring, FH & Webb, DA	3177
5893	Kitchen, C & Kitchen, MAR	3177
6825	Thomson, Mrs SE & P	3153
422	Maycock, R	3142
6708	Boon, CR & Dony, JG & Mrs CM	3090
6516	Port, C & J	3085
7814	Jackson, HM & Sanderson, MR	3068
3927	Bramley, Mrs D	3055
8846	Birse, EL & Birse, EM	3055

Table 3. 'Top 50' recorders for the Monitoring Scheme.

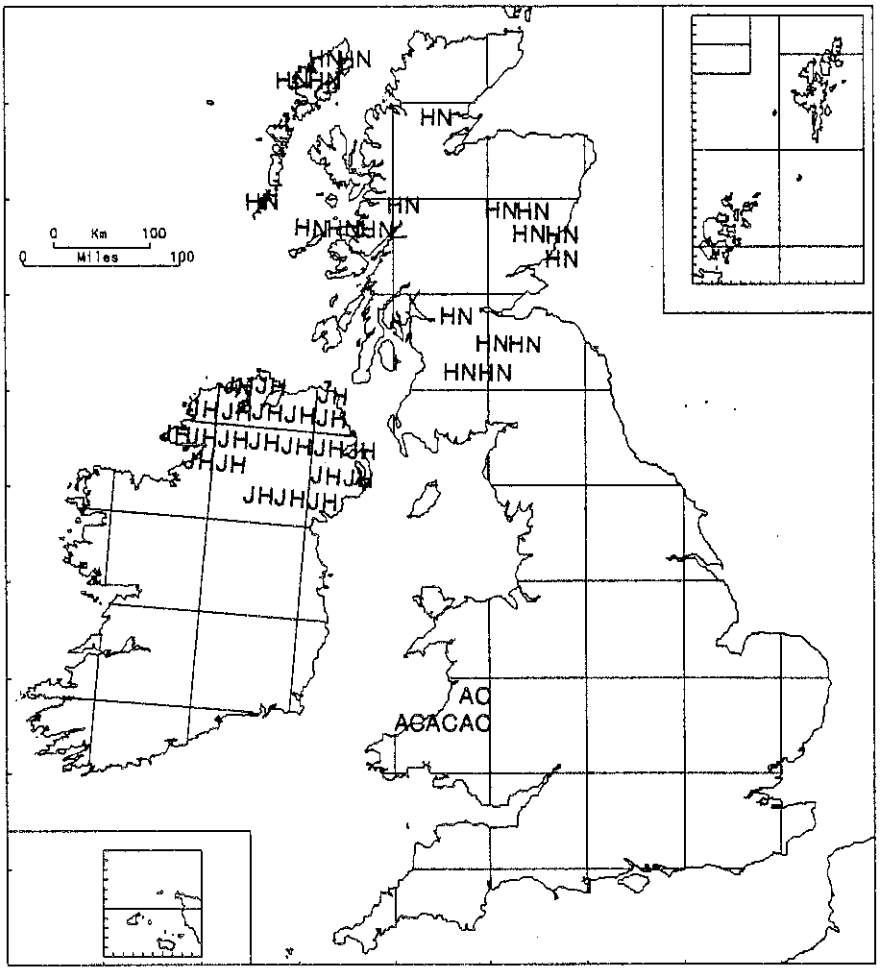


Figure 12. 10-km squares recorded by selected botanists. AC = A.O. Chater. JH = W.J. Harron. HN = H.J. Noltie.

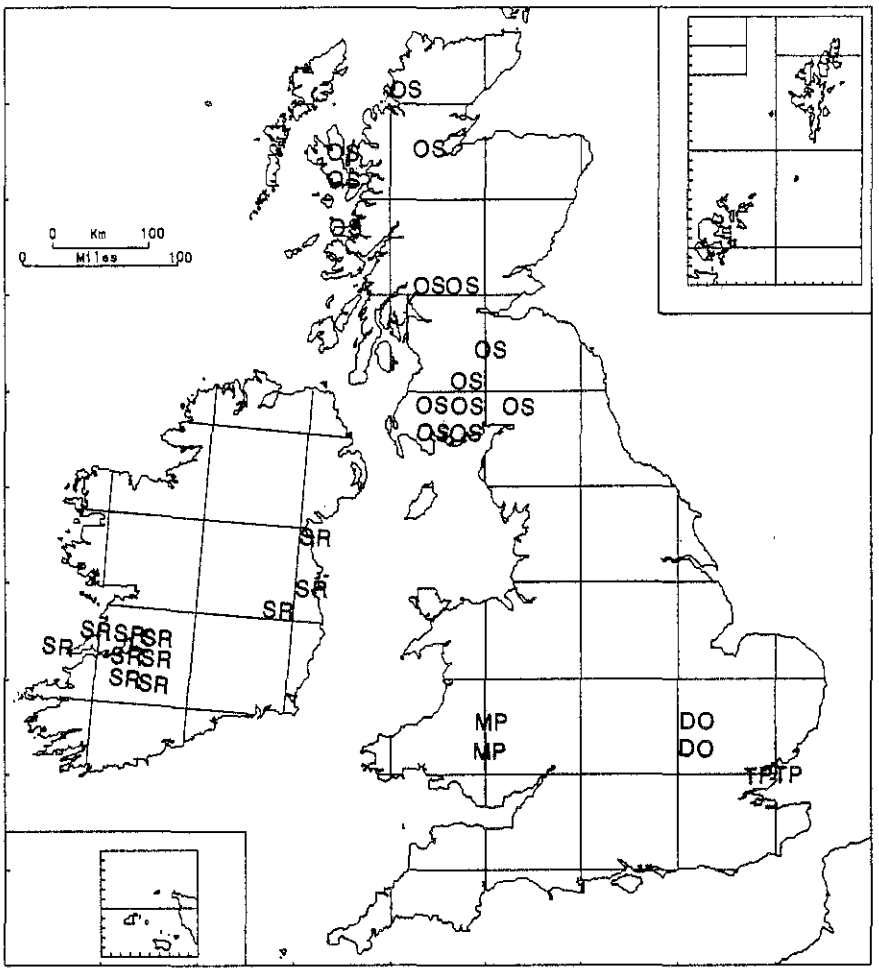


Figure 13. 10-km squares recorded by selected botanists. DO = J.G. & C.M. Dony. MP = M. Porter. OS = O.M. Stewart. SR = S. Reynolds. TP = T. Pyner.

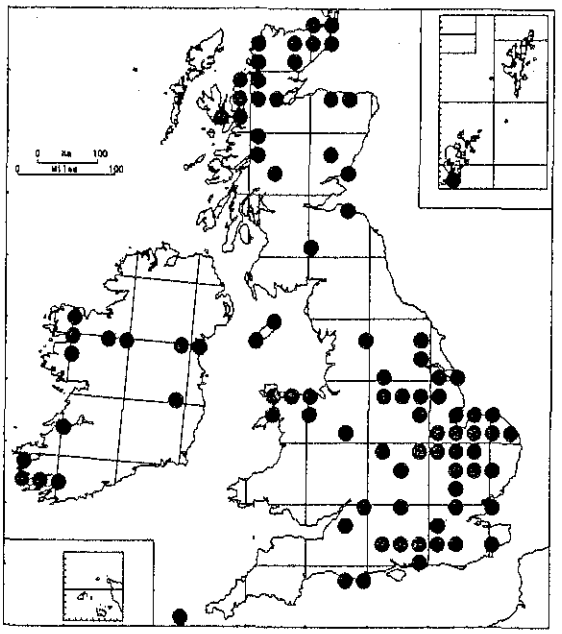


Figure 14. 10-km squares recorded by the Monitoring Scheme Organiser.

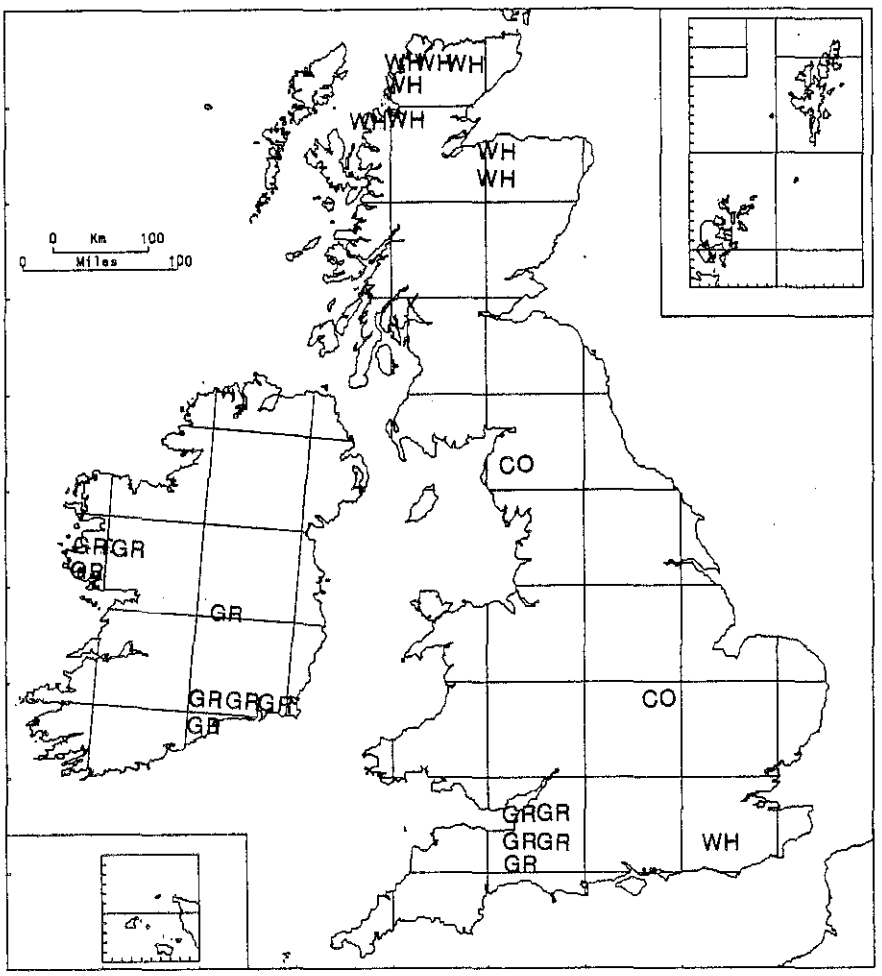


Figure 15. 10-km squares recorded by selected recorders whilst on holidays. CO = BWH & MG Coulson. GR = IP & PR Green. WH = PH & RG White.

The major point here is that the plant distribution maps may more closely reflect the distribution and interests of individual recorders, than be representative of the distribution of the plant. Correlate Figure 12 with the distribution map of Carex hostiana x viridula agg., or Figure 14 with the records for subspecies of Arrhenatherum, Pedicularis sylvatica or Potentilla erecta. Note how many Hieracium, Rubus and Taraxacum records are from Brecon. Olga Stewart and Sylvia Reynolds regularly record subspecies of Luzula multiflora. This point is certainly true of many critical and infraspecific taxa, though the effects become less marked and obvious as species become common and easy to identify.

CHAPTER 3

The Atlas of the British Flora database

Contents

1. Introduction

Details of how the records were collected for the Atlas were given by Perring & Walters (1962). This chapter documents how these records were compiled into the 'Atlas database' for comparison against the Monitoring Scheme database.

Since the records collected for the Atlas were originally processed using punch cards to produce the maps, they have undergone a number of changes in format, computer and location. The records are now held in a computerised database by BRC, in a largely summarised format, and could not be usefully compiled "at the touch of a button". Considerable effort was therefore put into compiling and assembling them into a new 'Atlas' database, which probably adequately represents the status of the flora between 1930-1960. The database is far from perfect (see below) but is the best that could be achieved within the time and with the resources available.

Due to differences in the availability of the records, the data for Britain and Ireland were compiled in different ways, and assessed separately. Some aspects of the combined records are briefly described here, but a more detailed analysis in comparison with the Monitoring Scheme database is given in Chapters 4 and 5.

2. Compilation of British records for the Atlas database

2a. Sources of records

Records in the 'Atlas' database were compiled from 3 sources.

(1) Original Atlas field cards

The original records for the Atlas were made on field cards, many of which are held at BRC. As the cards apparently contained much useful information on date, locality, etc, which was not available in the summarised BRC database, the cards were put into the computer with as much detail as possible.

Overall, these field cards contained about 71% of the records in the Atlas database, but this ranged from 0% (where no cards were available) to 90% of the records for any one 10-km square (calculated from a sample of ten 10-km squares).

(2) BRC Computer Databases

Data held in BRC computer databases relevant to the Monitoring Scheme have been compiled for the Atlas database. The data are from the following sources:

i) mastercard data received up to 1970
ii) "50 common species survey" data
iii) BSBI Carex Handbook
iv) Individual record card files for selected taxa

When records with a precise 1950-1960 date were available from the original field card records, mastercard records were ignored.

Overall, the BRC computer database records contributed about 23% of all the records for the Atlas database (excluding individual record card file data),

though they contributed from 1.5% to 91% of the records for any one 10-km square (calculated from a sample of ten 10-km squares).

i) Mastercard data received up to about 1970

All records from field cards, correspondence, etc, were routinely compiled onto one set of 10-km square mastercards up until about 1970 at BRC. The records from these mastercards were put into the computer and dated "1950" irrespective of the date of the original record. These data form the bulk of the species data held at BRC on the computer.

Few of these records have been checked systematically and there are a number of errors. For instance, Halimione portulacoides was erroneously given the BRC number for H. pedunculata on one reprint of the Atlas cards, resulting in a number of erroneous records. Data for 8 species (Juncus squarrosus, J. subnodulosus, J. tenuis, J. trifidus, J. triglumis, Juniperus communis (including subspecies), Kickxia elatine and K. spuria) were known to be corrupted, missing or incomplete. Data for at least 3 other species (Erigeron canadensis, Prunus spinosa and Salix aurita) also appear to be corrupted. A few minor data processing errors have also been noted, but in general the overall error rate is probably small.

These records are summary 10-km square data with a "generalised" date class.

ii) "50 common species survey"

Following publication of the Atlas, it became clear that some common species were apparently absent from a 10-km square simply because they had not been recorded. The "50 common species survey" attempted to add records for these species in 10-km squares for which they had not been recorded. The species are as follows (Scott 1975):-

Acer pseudoplatanus
Achillea millefolium
Angelica sylvestris
Anthoxanthum odoratum
Arrhenatherum elatius
Bellis perennis
Capsella bursa-pastoris
Centaurea nigra
Cerastium fontanum
Cirsium arvense
Cirsium palustre
Cirsium vulgare
Crataegus monogyna
Cynosurus cristatus
Dactylis glomerata
Deschampsia cespitosa
Filipendula ulmaria
Fraxinus excelsior
Galium aparine
Galium palustre
Geranium robertianum
Hedera helix
Heracleum sphondylium
Holcus lanatus
Hypochoeris radicata
Juncus effusus
Lathyrus pratensis
Leontodon autumnalis
Leucanthemum vulgare
Lolium perenne
Lotus corniculatus
Matricaria matricarioides
Plantago lanceolata
Plantago major
Poa annua
Potentilla anserina
Prunella vulgaris
Ranunculus acris
Ranunculus repens
Rumex acetosa
Rumex obtusifolius
Sambucus nigra
Senecio jacobaea
Senecio vulgaris
Trifolium pratense
Trifolium repens
Tussilago farfara
Urtica dioica
Veronica chamaedrys
Viola riviniana

New records for these species were compiled on the computer and dated "1950", though some were recorded up to at least 20 years after that date, and so are likely to be relatively over-represented in the Atlas records.

iii) BSBI Carex Handbook

Records for Carex were compiled and updated to produce the maps for the BSBI Carex Handbook (Jermy, Chater & David 1982). Lists of species prepared for some areas (Shetland, Cumbria, Northumberland) were dated "1950" on the computer, and are consequently included in the database although many were made after 1970. These data are a mixture of summary and detailed information, and are likely to slightly over-estimate the relative frequency of Carex to other taxa.

iv) Individual record card files for selected taxa

Detailed files compiled from individual record cards for selected rare or interesting taxa were abstracted for data relevant to the Monitoring Scheme. These records usually contained detailed information on date, locality, grid reference, etc, and have been checked previously for accuracy and the error rate should be very low.

Only approximately 1/4 of the individual record card records were available in computerised form, and the remainder were not compiled. There are a few systematic trends to indicate which data were, or were not, included: Potamogeton and Orobanche were included, but ferns, very rare or protected species, Chenopodiaceae and Polygonum were not compiled.

If all the individual record card records were available on the computer, they would contribute an average of 6% of the records for a square, ranging from 0% to nearly 10% for any one 10-km square (calculated from a sample of ten 10-km squares). As only 1/4 were available, however, it is likely that many rare or local taxa will be under-represented in the database.

(3) Additional records from VC Recorders

Preliminary lists of taxa were compiled from the Atlas field cards and the BRC computer databases (excluding the individual record card files which were unavailable at the time), and circulated to the VC Recorders. Some VC Recorders were able to provide additional records which were compiled into the database in a similar manner to the original field cards.

2b. Treatment of coastal squares

The 10-km sampling grid selected for the Monitoring Scheme differs from the Atlas in the treatment of coastal squares. This has implications for the comparison between the two surveys as 34 squares in Britain (c. 11% of the Monitoring Scheme squares) are involved.

For the Atlas (page xi) "The grid system has been strictly adhered to with a few exceptions ..... Some coastal squares contain ..... a small area of land ..... in these cases the records for the square concerned have been incorporated with those of an adjacent square". As a general rule of thumb (pers. comm. F H Perring) if a square contained less than 5% land, it was not recorded separately; this was apparently followed by many but not all field recorders.

Exactly which coastal squares were incorporated with which other squares for the Atlas was not completely documented at the time. In many cases, these can be traced from notes on the field and master cards. In cases where such notes are absent, the records for adjacent squares were carefully compared with each other and with the Atlas to establish their fate. Figure 3 of the Atlas of the British Flora (page xiv), showing "Records received and incorporated for each 10-km square, including pre-1930 records but excluding individual record cards", is also useful as a checklist of which squares were plotted, but is not wholly reliable.

There are three main ways in which the Atlas records were collected differently to the Monitoring Scheme for the coastal Monitoring Scheme squares:-

1. not recorded for the Atlas at all
2. records included in another square
3. records from other squares included in the Monitoring Scheme square.

1. The following 13 squares, selected for the Monitoring Scheme, were not recorded for the Atlas of the British Flora:

   07/9.3, 08/6.8, 10/8.1, 17/2.3, 17/2.9, 20/1.4, 20/4.4, 30/0.7, 34/3.6, 35/0.5, 54/4.0, 57/6.0, 61/3.3.

   [Monitoring Scheme records for these squares have been plotted on the maps but are not included in the analysis.]

2. The following 14 squares were recorded for the Atlas but the records were included and plotted in an adjacent square:

   09/6.4, 10/5.4*, 11/8.9*, 16/5.1*, 17/5.9, 21/1.0*, 26/1.4*, 37/6.0*, 37/6.3*, 39/0.7, 57/3.3, 67/2.6, 68/5.5, 69/5.1.

   For seven of these squares (*), it has been possible to distinguish and compile records for the original square. The records for these squares are often not representative of the flora and are thus not comparable with other data (see also Chapter 4).

   The remaining squares have no identifiable records and are thus treated as not recorded.

3. The following eight squares have had records from adjacent squares included in them for squares plotted in the Atlas:

   00/9.1, 17/5.6, 30/6.7, 36/6.7, 39/3.7, 45/2.8, 51/4.0, 61/3.6.

   When compiling the field card records, the records for adjacent squares were excluded. In some cases, combined records for two squares were included but are labelled in the database. Unfortunately, it has not proved possible to determine the original 10-km square for records for these squares from the summarised BRC databases, and it is likely that some records from non-Monitoring Scheme squares have been included in the Atlas database. With hindsight it would have been better not to include any summarised BRC records for these squares at all. The only square where this is likely to be very significant is in Scilly (00/9.1), hence records for this square have not been included in the analysis, but are plotted on the maps. All records for the other squares were included.

2c. Dates of records included

All records dated from 1930 to 1960 were included. The baseline of 1930 is consistent with the Atlas, but is not absolute; in some areas (eg Monmouthshire), records included in the Atlas were in fact made before 1930 (F H Perring pers. comm.). Similarly, as described above, the 1960 cutoff is not absolute since some computer records dated 1950 were made after 1960.

2d. Introduced species

Distribution status information has been compiled wherever available. All records, even of deliberately planted species, have been included to be consistent with the Monitoring Scheme recording, though the way they have been compiled differs slightly. For the Atlas database, introductions and deliberately planted species were not distinguished, but they were for the Monitoring Scheme database.

2e. Example of records

A typical selection of data from the Atlas files for Britain is shown in Figure 16.

2f. Assessment of the British records in Atlas database

Whilst compiling the British Atlas database, it became apparent there were a number of sources of error and uncertainty. Records for 10 selected 10-km squares were therefore compared with records published in the Atlas to assess correspondence. It is assumed that if there is a record for any taxon on a card and on the computer then the record is valid. This assumes taxonomic accuracy of the records though obvious errors were deleted (eg Polygala vulgaris was queried on one card but not on an almost duplicate card - the latter was therefore also deleted).

Ten 10-km squares were selected for investigation, simply for ease of abstracting records in the Atlas. These squares were 31/0.0, 0.9, 9.0, 9.9, 34/0.9, 9.0, 9.9 and 37/0.0, 0.9, 9.9. Species lists for each square, with appropriate date classes and status, were compiled by abstracting records from the Atlas (1st edition) and the Critical Supplement.

Computer records were compiled as above with the exception of individual record card files as these were incomplete; any record in the Atlas without a record on the computer was searched for manually in the individual record card records.

In all, 9082 records were investigated representing 3450 10-km square records (dots) in the Atlas. Error rates are presented per 'dot'; the error rates per individual record are lower. The analysis took 3 man weeks to complete; it is regretted more time was not available for a more comprehensive review.

The major source of discrepancy between the Atlas and the computer database was an extra 9.75% of records in the computer. About 3% of the taxa were not mapped in the Atlas (eg garden escapes such as Lunaria), and about 0.4% were not included for editorial reasons (eg Pinus sylvestris was widely recorded in S. England but not plotted there in the Atlas even as an introduction).

The remaining 6.5% of the records were apparently "missed" and can be accounted for in several ways. Some records on the computer, no doubt, represent post-1960 records even if dated "1950" on the computer (c.f. 50 common species survey). Some accurately dated pre-1960 records may have been sent in after the Atlas was published. Some discrepancies are also due to the order in which the maps were plotted: to complete the Atlas on time plotting of maps had to begin before all the data were incorporated and started with ferns and Ranunculaceae so the early maps did not include all the data available by the end of the scheme (F H Perring, pers. comm.).

Rorippa amphibia

SPECIES NO	STATUS	VC	SQUAR	E	N	T	DA	MO	YEAR	RECORDER	DETERMINER	LOCALITY
0920 1701	1	35	31/39	--	--				1950			
0920 1701	1	14	51/43	--	--				1958	1839		
0920 1701	1	17	51/16	--	--				1953			
0920 1701	1	21	51/16	--	--				1955			
0920 1701	1	29	52/45	--	--				1950			
0920 1701	1	17	51/13	--	--				1950	2497		
0920 1701	1	13	51/13	--	--				1952	363		Horsham
0920 1701	1	18	51/49	--	--				1957	3355		
0920 1701	1	31	52/18	--	--		16	05	1953	822		Holme,rly
0920 1701	1	38	42/25	--	--				1950	2379		
0920 1701	1	22	41/56	--	--				1960			
0920 1701	1	37	32/95	--	--				1957	1330		
0920 1701	1	0	32/98	--	--				1958	6368		Brierley Hill-Halesowen
0920 1701	1	30	52/15	--	--				1950			
0920 1701	1	54	43/87	--	--				1956	6566		Torksey
0920 1701	1	56	43/54	--	--				1950			
0920 1701	1	55	43/51	--	--				1957	4923		
0920 1701	1	55	43/51	--	--		03	07	1958	470		

Figure 16. Example of British Atlas data. For explanation see Figure 6.

The bulk of these extra records can therefore probably be accounted for. If these records are ignored, the discrepancies between records published in the Atlas and those in the computer database can be examined further. Table 5 given the number of records published for each square in the Atlas or Critical Supplement and the number of matching records in the Atlas database. On average about 2.6% of the records do not have backup records, though this ranges from 0.8% to about 8.6% for any one square. This 2.6% can be broken down further.

The data processing errors account for 0.2% of the discrepancies per dot (0.1% per individual record). It is probable that there is a data processing error rate of at least that magnitude for the original Atlas.

A further 0.2% of the records can be accounted for by extrapolation or interpretation, eg records for Juniperus communis in the Pennines were assumed to refer to subsp. communis as subsp. nana does not occur there, and Cochlearia alpina is included in C. officinalis agg. These require knowledge of the editorial policy; note that records for aggregates can be compiled from records for segregates, but not vice versa.

10-km square	Total Atlas species	Matching records	Discrepancy
31/0.0	383	377	6 (1.56%)
31/0.9	323	320	3 (0.93%)
31/9.0	508	504	4 (0.79%)
31/9.9	374	342	32 (8.56%)
34/0.9	464	455	9 (1.9%)
34/9.0	314	307	7 (2.23%)
34/9.9	280	272	8 (2.85%)
37/0.0	253	251	2 (0.79%)
37/0.9	291	283	8 (2.75%)
37/9.9	290	280	10 (3.45%)
		Average =	2.58%

Table 5. Analysis of British Atlas data. Discrepancy between number of records published in the Atlas and number of matching records held on the computer database.

This leaves about 2.2% of the records in the Atlas not accounted for in the database. 'Minor' discrepancies - for instance, a different status or date class plotted in the Atlas - account for $^2/_3$ (1.4%) of these records. The remaining $^1/_3$ (0.8%) of the discrepancies cannot be accounted for. These are assumed to be 'major' errors in the Atlas - for instance, a 10-km square or species number wrong. This may include a few records which do not correspond because the individual record cards are untraceable (3 examples of this were found whilst doing the analysis), and may include some valid records for which there are no cards.

It is likely therefore that about 0.8% is a reasonable indication of the potential error rate per 'dot' in the Atlas, and it is suggested that an error rate of ±1% is attached to the British records in the Atlas database. There have been no other exercises with BRC data sets with which to compare the results.

3. Compilation of Irish records for the Atlas database

3a. Sources of records

Irish records for the Atlas were collected on the 'BSBI' grid (an extension of the British grid - see Atlas for details), and are thus not directly related to the 10-km squares selected for the Monitoring Scheme. Also, few original data for Ireland are held at BRC, most of the information is summarised and held on the computer. The Atlas data for comparison have therefore been compiled in a different, much less satisfactory, way to the British data. Some of the analyses below have been carried out using all squares, and then the results applied to the Monitoring Scheme squares.

Records have been compiled from the following 3 sources:-

(1) BRC computerised databases (as above for the British data)

(2) Unchecked individual record card files
These files contain details of many local or rare taxa from individual record cards sent in for the original Atlas. Many of the records are not represented in the computerised databases and thus these records provide useful additional information. There is a small overall degree of duplication (4%) which ranges from 0% to 100% for individual species. The drawback of these data is that they have not been checked for accuracy of data processing. Errors spotted whilst compiling the data (eg "records" for Betula nana - a species not known in Ireland) have been deleted without attempting to check the origin of the error. The error rate is estimated to be between 2 and 5% of the records, but overall this will only be significant in a few cases.

(3) Record files with possible geographic errors
When records from the 'BSBI grid' were "converted" to the 'Irish grid' on the computer, possible geographic errors were introduced for a number of 10-km squares in Ireland (Figure 17). Records for squares for which there is a small discrepancy between grid reference and vice-county have been included, but those for which major discrepancies occur have been excluded (previous work by C D Preston).

Records not included in the Irish Atlas database

In addition to the taxa for which data were corrupted or not available noted above for Britain, there are also no Fumaria individual record card files for Ireland.

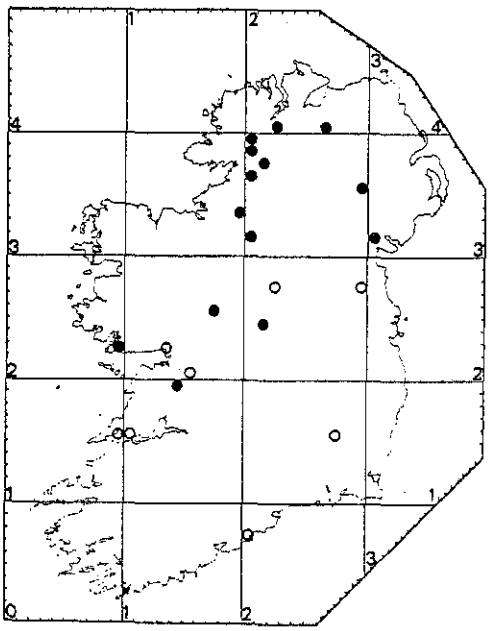


Figure 17. Squares with discrepancies between vice-county and grid reference; (o) minor discrepancies (●) major discrepancies.

3b. Treatment of coastal squares in Ireland

In Ireland, as in Britain, some coastal 10-km squares with only small areas of land were not recorded separately for the Atlas. A comparison of these against the Monitoring Scheme squares is complicated by the change in recording grid.

For the Atlas, 34 10-km squares on the British grid with a small area of land were not recorded. These squares were identified by comparing Fig. 3 of the Atlas with the set of Irish maps held at BRC marked with the original overlay of the British grid. There are a total of 988 squares with land in Ireland on the British grid.

A re-examination of coastal squares following the conversion of the records recorded on the British grid to the Irish grid shows there are 42 coastal 10-km squares with land (out of a total of 1006) without records on the computer.

Three coastal squares selected for the Monitoring Scheme, 13/6.5, 24/2.4 and 32/1.9 have no records from the Atlas period and the absence of any historical records is not considered significant. The Monitoring Scheme records for these squares have been plotted on the maps but are not included in the analysis.

3c. Dates of records included

The pre- and post-1930 date classes are not considered significant for Ireland (c.f. Atlas) and hence **all** records up to and including 1960 have been included. The date classes thus differ from those in Britain.

3d. Introduced species

Accurate computerised distribution status information was not available for some species in Ireland. All records have therefore been included. All species known to be introduced have been automatically changed to "introduced".

3e. Example of Irish records

The bulk of Irish records held in the Atlas database simply comprise of a species number, 10-km square and a "pre-1960" date class. An example is given in Figure 18.

3f. Assessment of the Irish Atlas data

From the notes on sources of the Irish data above, it is clear that estimates of the quality and quantity of the records are desirable. The records compiled on the computer were therefore compared for individual species with those published in the Atlas.

A direct 'dot for dot' comparison is not possible due to the change in recording grid. The comparison has been made for **all** the 10-km squares in Ireland due to the impracticality of quickly picking out the equivalent 10-km squares to those selected for Monitoring Scheme. Two approaches have been used, numerical and visual.

Numerical comparison

29 species were selected for analysis by taking the top left-hand map on pages 1,10,20,30, etc, systematically through the Atlas of the British flora 1st Edition (1962). Species not occurring in Ireland were ignored.

The number of 10-km squares were counted by eye by two people and differences resolved. All records were counted, irrespective of date class or distribution status (c.f. above). No attempt has been made to assess the potential complications implied from the 0.8% 'major' error rate per dot previously calculated for the British data.

The number of 10-km squares was counted on the computer for records dated up to 1960. Undated records were not counted on the computer hence there may be small (1%) discrepancies between undated records in the Atlas and those on the computer.

Comparison of the number of 10-km squares counted for dots published in the Atlas and records compiled on the computer show a wide range of discrepancies (Table 6).

There is an average of 93% of Atlas records in the computer database for each species, assuming a direct 1 : 1 correspondence between the records. Some sources of discrepancy can be accounted for: The low number of records in the computer for Lycopodium and Cystopteris is due, in part, to the absence of individual record card records (c.f. above). Rare native or introduced species such as Eleocharis and Crocus are not represented at all. Three species involved in the common species survey, Ranunculus, Lotus and Rumex are over-represented (c.f. above). If these species are eliminated, the average can be recalculated as 101.6% ± 3.56% (95% confidence limits).

Note that this average is derived from the total number of records for each species, and does not indicate the likely discrepancies. There are 481 records (Table 1) which cannot directly correspond (i.e. more records in the Atlas than in the computer, or vice versa), about 7.2% of the total. If the species for which there are known discrepancies are eliminated again, 198 records (3%) cannot correspond. Two thirds of those non-matching records are on the computer suggesting either that some records were not

Rorippa amphibia

SPECIES NO	STATUS	VC SQUAR	E	N	T	DATE	RECORDER	DETERMINER	LOCALITY
0920 1701	1	12/96				up to 1960			
0920 1701	1	12/99				up to 1960			
0920 1701	1	23/22				up to 1960			
0920 1701	1	23/25				up to 1960			
0920 1701	1	23/85				up to 1960			
0920 1701	1	24/81				up to 1960			
0920 1701	1	32/16				up to 1960			
0920 1701	1	33/18				up to 1960			

Figure 18. Example of Irish Atlas data. For explanation see Figure 6.

SPECIES	NO. OF ATLAS 10-KM SQUARES (A)	NO. OF COMPUTER 10-KM SQUARES (C)	DIFFERENCE (A-C)	% (C/A)
Lycopodium selago	128	113	-15	88.3%
Cystopteris fragilis	107	52	-55	48.6%
Ranunculus acris	771	900	+129	116.7%
Glaucium flavum	35	34	-1	97.1%
Hesperis matronalis	101	126	+25	124.7%
Hypericum elodes	151	173	+22	114.6%
Stellaria media	799	807	+8	101 %
Montia fontana	277	290	+13	104.7%
Lotus corniculatus	835	875	+40	104.8%
Rubus caesius	99	107	+8	108.1%
Prunus laurocerasus	35	35	0	100 %
Parnassia palustris	177	181	+4	102.2%
Myriophyllum spicatum	133	128	-5	96.2%
Euphorbia lathyrus	5	5	0	100 %
Rumex obtusifolius	802	842	+40	105 %
Salix nigricans	8	7	-1	87.5%
Armeria maritima	264	248	-16	93.9%
Solanum nigrum	27	29	+2	107.4%
Utricularia minor	189	175	-12	92.6%
Galeopsis angustifolia	23	23	0	100 %
Galium odoratum	119	121	+2	101.7%
Bidens cernua	146	145	-1	99.3%
Solidago virgaurea	357	331	-26	92.7%
Crepis capillaris	685	723	+38	105.5%
Groenlandia densa	22	24	+2	109.1%
Crocus purpureus	1	0	-1	0%
Eleocharis parvula	3	0	-3	0%
Poa alpina	2	2	0	100 %
Elymus repens	547	535	-12	97.8%

Table 6. Comparison of number of Atlas and computer 10-km square records for 29 selected species in Ireland. See text for analysis.

incorporated in the Atlas or that they were sent in after its publication (c.f. compilation of British data). If the % discrepancy is calculated for each species (excluding those with known discrepancies), the average is 5.36±2.67% (95% confidence limits). It is suggested therefore that an error limit of ± 8% is adopted to the total number of 10-km square records each species in Ireland to correct for inaccuracies in the database.

A broader examination of the Irish records shows a number of other features.

i) There are occasional groups in addition to the Ferns where there are records missing for various reasons (eg no Fumaria cards, some Carex taxa missing).

ii) There are occasional 'catastrophes' where taxa are very under-represented (eg Salix aurita, Prunus spinosa, Viola tricolor), or over-represented (eg Sorbus anglica, Cardaminopsis petraea).

iii) Critical groups are generally under- or not represented, especially for data published in the Critical Supplement (eg Rhinanthus minor agg, Anthyllis vulneraria agg, Hieracium spp.).

No other general patterns have been discerned which enable likely discrepancies to be identified.

Visual comparison

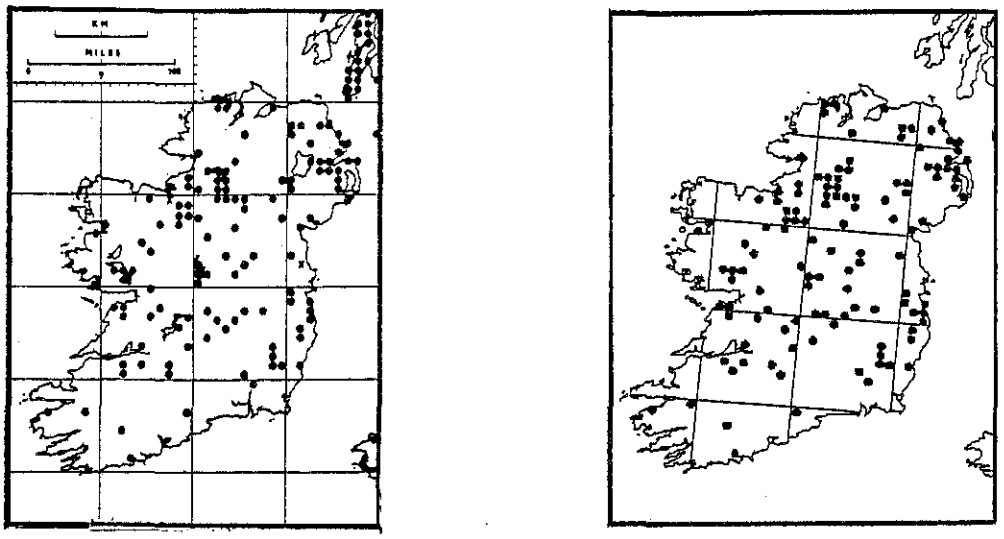
A simple visual comparison of maps has been used to give some idea of geographic correspondence between maps published in the Atlas and data held on the computer. 9 of the 29 species, mainly with 100-200 records, were selected and new maps printed from the data held on the computer (Figure 19).

In general the Atlas and new maps match well, allowing for the grid conversion, exclusion of records with major geographic errors (Figure 17) and addition of pre-1961 records to the BRC database after the Atlas was published. Discrepancies in the Cystopteris map are probably largely due to absence of the individual record card data (c.f. above).

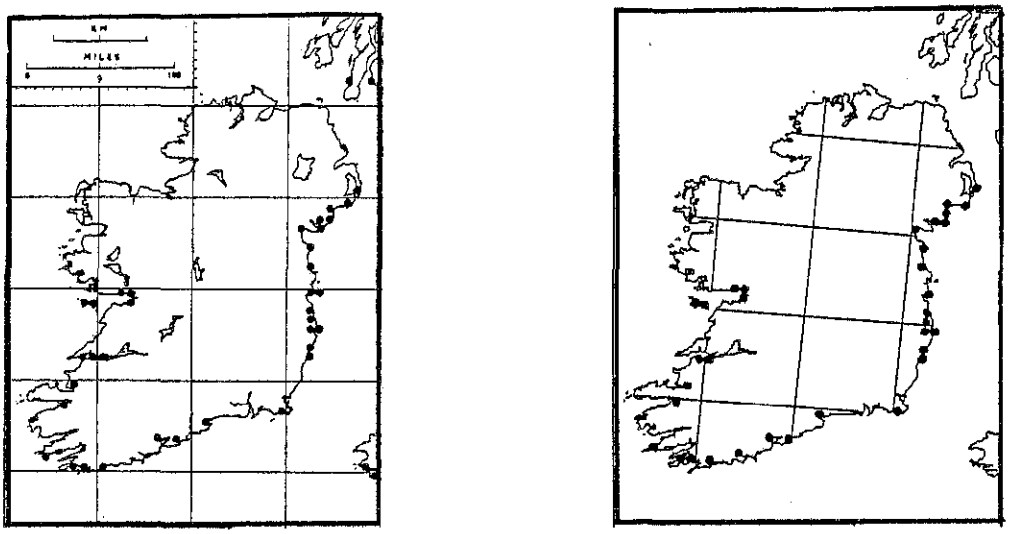
These assessments of the Irish Atlas records show that there are some significant discrepancies between the database and the records published. Some of the more obvious discrepancies are predictable (eg Ferns under-represented, common species over-represented), but others are small (±8%) and unpredictable. No attempt has been made to trace individual records (c.f. analysis for British data). It is likely the error rate per individual record is higher than that for Britain. Most of the discrepancies are due to addition or absence of individual records, but there are also a few major errors. Data for each species will have to be assessed before the records are taken as representative.

4. Channel Island Atlas Records

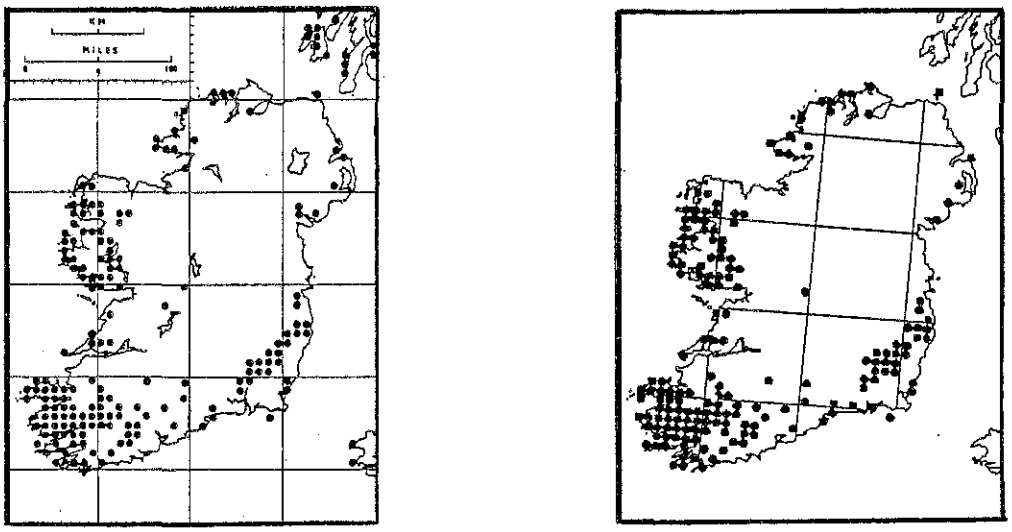
All records for Guernsey and Jersey were collated and plotted as a single 10-km square for the Atlas (these were gridded 90/1.5 and 90/4.2 respectively). It is now not possible to compile accurate, representative species lists for the Monitoring Scheme squares from the data available at BRC, and to include all the



Galium odoratum

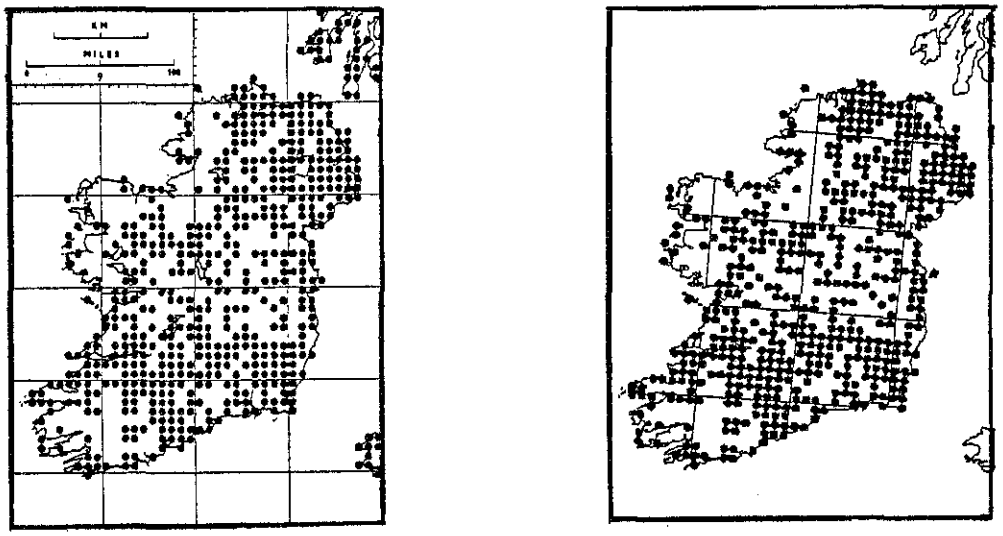


Glaucium flavum

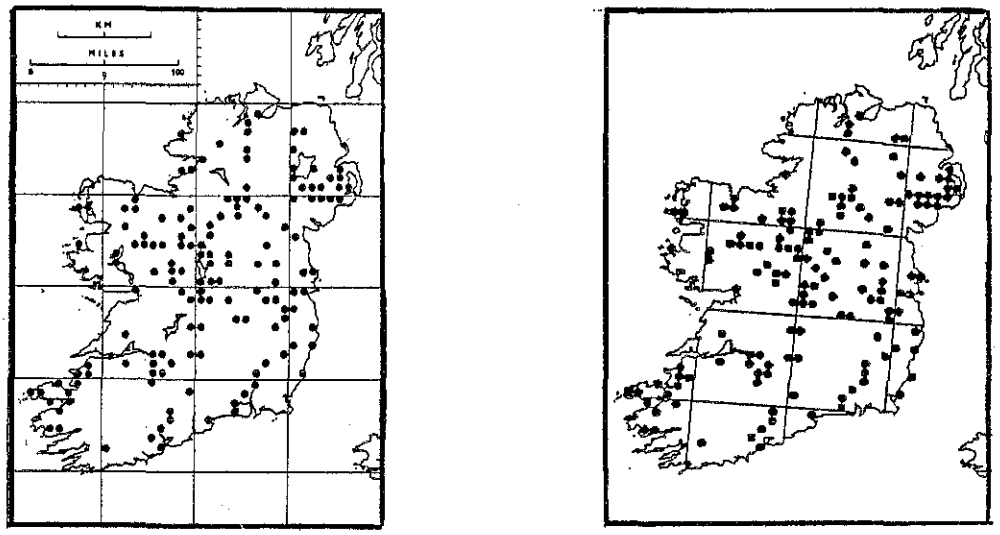


Hypericum elodes

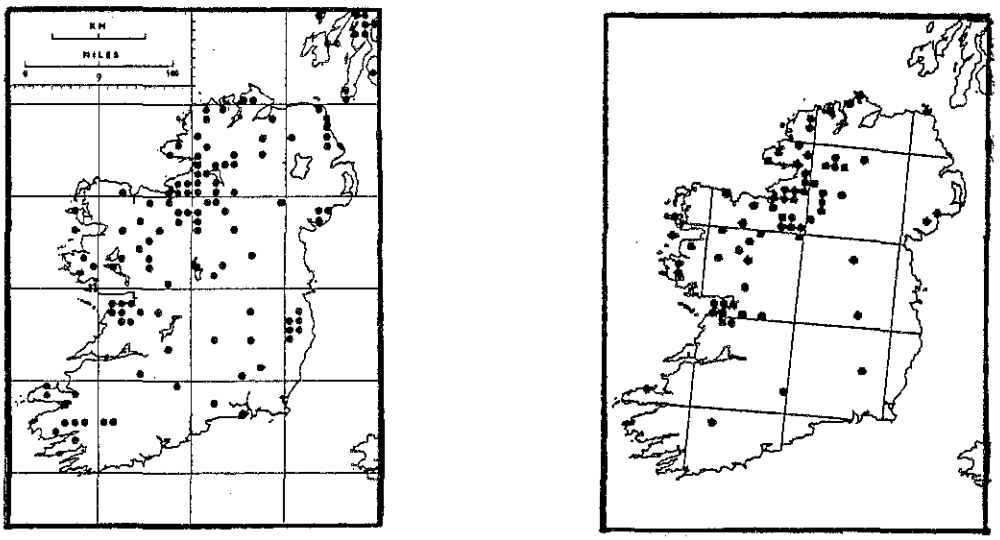
Figure 19. Comparison of maps published in the Atlas (left-hand side) with those compiled for records in the database (right-hand side) for 9 species in Ireland. Note the change in grid.



Elymus repens

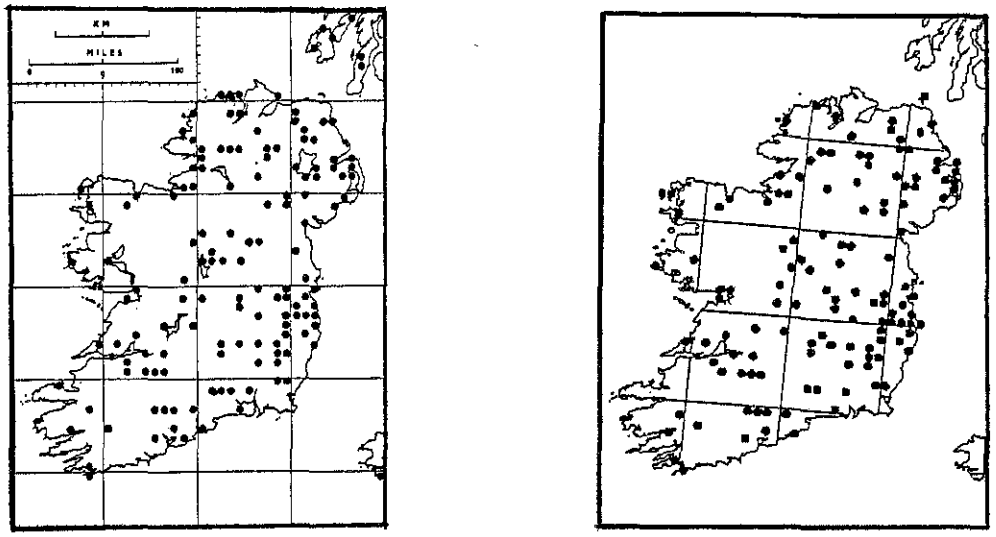


Bidens cernua

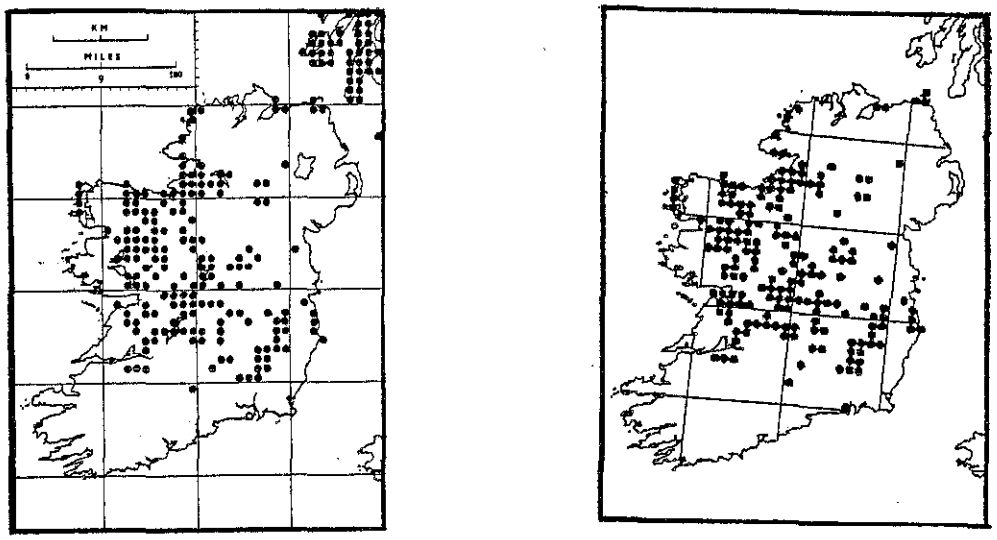


Cystopteris fragilis

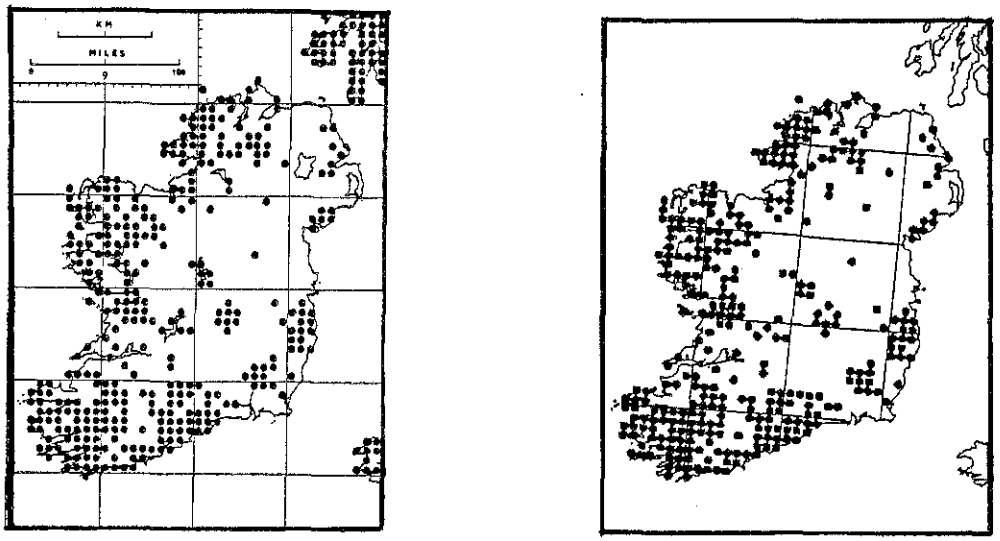
Figure 19 continued.



Myriophyllum spicatum



Parnassia palustris



Solidago virgaurea

Figure 19 continued.

records for each island would be meaningless. Therefore no Atlas data have been compiled for the Channel Islands, and hence the absence of an Atlas period record from the maps cannot be considered significant.

5. General description of Atlas database

There is a total of about 225,000 individual records in the 'Atlas' database, representing about 144,000 'dots' (i.e. distinct 10-km square/species records). The average number of records per square is about 550 and the average number of taxa per square is 330 (362 in Britain, 240 in Ireland). Note this average per square is below the 400 noted in the Atlas. The reason for this discrepancy has not been ascertained. There are 2006 taxa represented in the database.

It is evident from the discussion above that there have been considerable problems with compiling and checking the records to be included in the Atlas database. This is the most unsatisfactory aspect of the Monitoring Scheme as a whole, and the first question to be answered whenever a change or something unexpected is noted is whether the records in the Atlas database are representative or not. Many of the sources of error above for the Monitoring Scheme database (Chapter 2) also apply here in addition to those pointed out above in Sections 2f and 3f.

One additional drawback of re-inputting the original field cards discovered during the exercise was that a number of records known to be dubious or wrong were put into the computer (eg Orthilia in Cheshire). Many of these records had been spotted when the mastercards were compiled or at a later date; they had been corrected on the mastercards but not on the original field cards. A number of these records have been picked up by the VC Recorders, but many have not. Some errors stand out, but many of the less obvious ones do not (eg Primula veris in one square in Devon). A thorough check of species recorded on the field cards and later deleted from the mastercards has not been made but is the next desirable quality-control check.

It is likely that the geographic information for the Atlas records is less accurate than that for the Monitoring Scheme. At least 1% of the field cards in Scotland were originally given the wrong grid reference, and the records had presumably therefore been erroneously included on the mastercards and then published in the Atlas and also compiled into the database. It is likely that a similar % of cards are wrongly located elsewhere too.

Treatment of Aggregates/Segregates

Records for aggregates and segregates have been treated for the Atlas database as described in Chapter 2 for the Monitoring Scheme database.

The relative numbers of records for each year of the Atlas period are shown in Figure 20. If all the records are taken, including those with approximate dates (eg "1950+"), the graph shows isolated peaks at 1930, 1950 and 1960, with a general peak in the mid-1950s. The peaks at 1930, 1950 and 1960 are summary data and disappear if only records with exact dates are taken. The apparent peak at 1956 and 1957 might suggest this was the highest period of activity of recording for the Atlas but is an artefact; cards were often dated from the first time they were used and subsequent records simply added to this list (without changing the date information) or additional records only were sent in on later cards. Further evidence for the 'summary' nature of many of these cards is given in Chapter 4; although the date information on some cards is

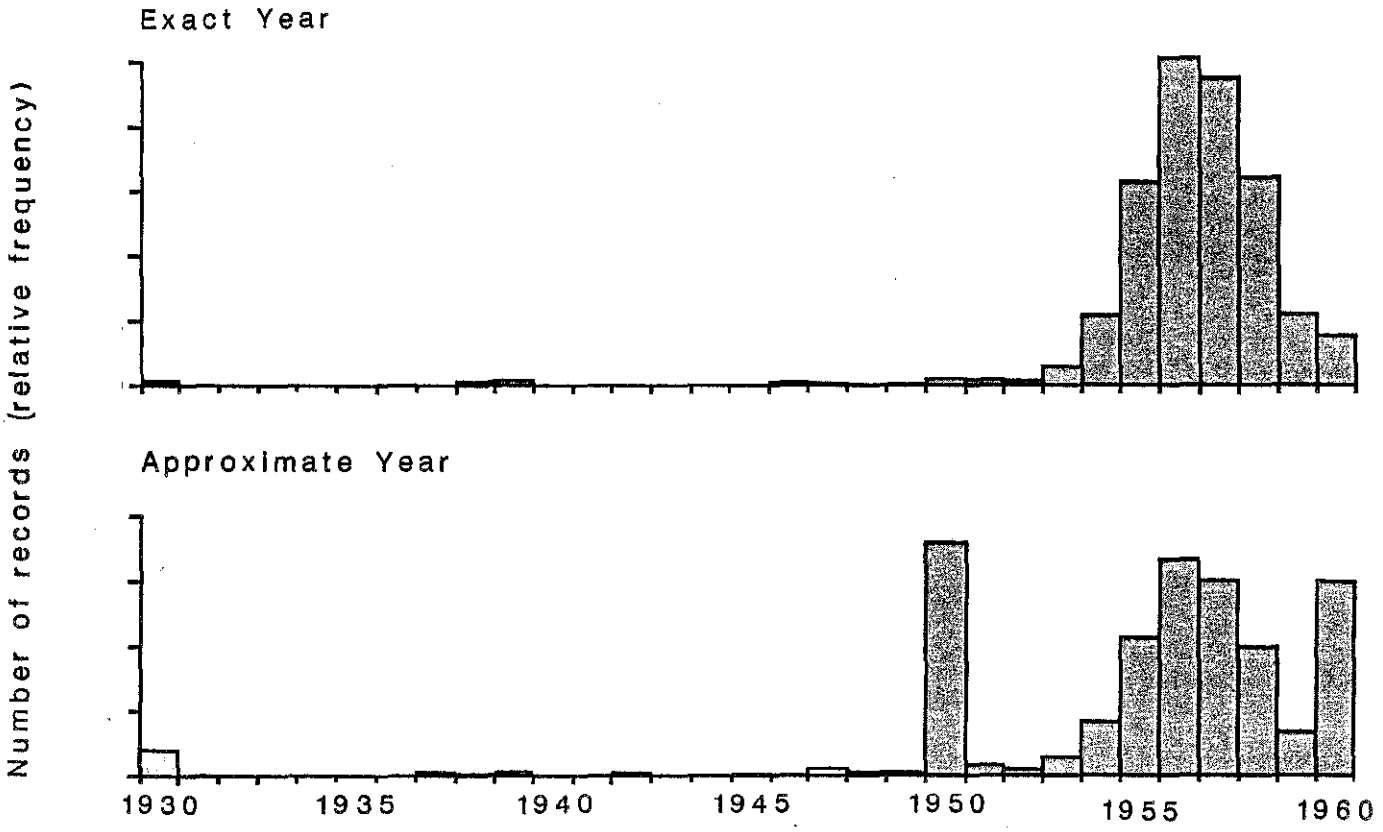


Figure 20. Relative number of records for each year in the Atlas database. Records which are apparently dated to exact year are compared with approximately dated (i.e. 1950+) records.

precise, it is difficult to identify which. It is suggested that any records collected for the Atlas are best regarded as belonging to a decade rather than an individual year.

Figure 20 shows that the bulk of the records in the Atlas database from 1950 to 1960, and that less than 5% are from before this time. Although there are clearly post-1960 records also included in the database, it can thus be taken to largely represent the status of the flora between 1950 and 1960.

In summary, there are therefore a number of implications for interpretation of the results of comparison of the Monitoring Scheme database with the Atlas database.

1) Care has to be taken to treat aggregates and segregates equally.

2) Rarer species, which have a high proportion of individual record cards which are not computerised, will be under-represented in the Atlas database.

3) The '50 common species' may be over-represented in the Atlas database.

4) There are significant numbers of coastal squares which have not been recorded properly or representatively for the Atlas.

5) There are significant numbers of records additional to those published in the Atlas. Many of these are probably acceptable, but some have dubious date information (estimated to be about 1-2% of the records).

6) There are significant differences in the quality and quantity of records between the British and Irish records included in the Atlas database. Confidence limits of ±1% are adopted for the British records and ±8% for the Irish records.

7) Many of the records in the Atlas database are summary information, and the fine details should be treated with caution.

There are few other examples of distinct trends and biases in the records.

Finally, a very important point must be stressed: the Atlas records were collected primarily for phytogeographic purposes and were not envisaged at the time as needing to meet the strict temporal requirements of the Monitoring Scheme. We may be imposing stricter requirements on the records than can be met.

CHAPTER 4

General comparison of the Atlas and Monitoring Scheme databases

Contents

1. Introduction

One main objective of the Monitoring Scheme was to assess by how much species have changed in distribution and/or frequency (at a 10-km square level) over the last 25-35 years. Interpretation of changes in distribution is somewhat dependent on geographic variation in recording, hence this chapter compares a number of regional aspects of recording during the two surveys.

2. Comparison of numbers of taxa recorded

Table 7 lists for each square, the combined number of species in both databases, the number (and % of the total) of species recorded for the Atlas, the number (and %) of species recorded for the Monitoring Scheme, and the number (and %) of species recorded in both the surveys.

Squares with more species recorded for the Monitoring Scheme than the Atlas are shown in Figure 21a and those for which more species were recorded for the Atlas than the Monitoring Scheme are shown in Figure 21b (excluding squares not recorded for either one or both surveys). These maps show the generally higher numbers of species per square recorded for the Monitoring Scheme, but there is wide variation in the actual numbers recorded. Figure 22 illustrates this graphically. Some comparison of the amount of variation is therefore desirable.

The Atlas included a quantitative assessment of recording in the form of an overlay which indicated the 10-km squares which were believed to be underworked. It attempted "to take into account the total flora likely to be found in an area before deciding whether a list received is adequate or not. 'Adequate' might be taken as meaning that over 60 per cent of the possible flora has been recorded".

In the Atlas database, there are over 80 Monitoring Scheme squares with less than 60% of the combined total number of species (excluding squares for which there are no records at all); Table 7. This is 5 times greater than indicated by the Atlas overlay.

In Britain, eight of the squares selected for the Monitoring Scheme are noted on the overlay as underworked for the Atlas. Four of these (38/6.2, 41/8.6, 57/6.3 and 68/5.8) have more than 60% of the combined total number of species, and discussed later. The remaining four squares (31/6.3, 32/9.5, 41/8.9 and 44/5.9) have less than 60%. The Atlas also noted a number of "poorly recorded areas" which includes only one Monitoring Scheme square (42/8.2) which also has less than 60% of the combined total number of species.

In Ireland, direct comparison of the Atlas overlay with the Atlas database is not possible due to the change of grid. 74 out of the 954 squares (7.7%) are given on the overlay as underworked, virtually all of which are in the centre of Ireland. Therefore about 8 Monitoring Scheme squares would be expected to have been underworked for the Atlas.

This 5-fold discrepancy between the number of squares indicated as underworked on the Atlas overlay and in our analysis requires further investigation; there are 3 possible explanations. First, the records in the Atlas database may under-represent the Atlas records due to the difficulty in compiling the records (c.f. Chapter 3). Second, there may have been significant increases in the number of species in these squares since the records were collected for the Atlas. Third, the overlay may under-estimate the extent of under-recording for the Atlas.

Table 7. Comparison of number of taxa recorded per square for the Monitoring Scheme and the Atlas. The table gives for each square the combined total number of taxa recorded, the number in the Atlas database (and % of the combined total), the number recorded for the Monitoring Scheme (and % of the combined total), and the number recorded in both surveys (and % of combined total).

10 KM SQUARE	NUMBER OF TAXA RECORDED (AND % OF TOTAL) TOTAL	ATLAS	MONITORING SCHEME	BOTH SURVEYS
Britain				
00/91	631	536 (84.9%)	438 (69.4%)	348 (55.2%)
07/69	456	407 (89.3%)	346 (75.9%)	304 (66.7%)
07/93	194	0 (0%)	194 (100%)	0 (0%)
08/68	0	0 (0%)	0 (0%)	0 (0%)
08/95	142	0 (0%)	142 (100%)	0 (0%)
08/98	411	365 (88.8%)	300 (73%)	257 (62.5%)
09/64	14	0 (0%)	14 (100%)	0 (0%)
09/91	315	292 (92.7%)	181 (57.5%)	161 (51.1%)
10/54	439	377 (85.9%)	283 (64.5%)	221 (50.3%)
10/81	114	0 (0%)	114 (100%)	0 (0%)
10/84	637	452 (71%)	563 (88.4%)	381 (59.8%)
10/87	473	419 (88.6%)	303 (64.1%)	251 (53.1%)
11/89	396	156 (39.4%)	370 (93.4%)	132 (33.3%)
12/82	573	426 (74.3%)	490 (85.5%)	346 (60.4%)
16/24	317	282 (89%)	239 (75.4%)	209 (65.9%)
16/27	384	343 (89.3%)	272 (70.8%)	237 (61.7%)
16/51	284	160 (56.3%)	257 (90.5%)	135 (47.5%)
16/57	384	363 (94.5%)	218 (56.8%)	199 (51.8%)
16/84	541	424 (78.4%)	440 (81.3%)	326 (60.3%)
16/87	517	410 (79.3%)	452 (87.4%)	348 (67.3%)
17/23	150	129 (86%)	105 (70%)	87 (58%)
17/26	488	388 (79.5%)	431 (88.3%)	335 (68.7%)
17/29	72	0 (0%)	72 (100%)	0 (0%)
17/53	465	408 (87.7%)	365 (78.5%)	313 (67.3%)
17/56	426	315 (73.9%)	398 (93.4%)	293 (68.8%)
17/59	80	1 (1.3%)	79 (98.8%)	0 (0%)
17/80	605	426 (70.4%)	569 (94%)	397 (65.6%)
17/83	603	483 (80.1%)	509 (84.4%)	393 (65.2%)
17/86	395	274 (69.4%)	357 (90.4%)	242 (61.3%)
17/89	347	235 (67.7%)	331 (95.4%)	224 (64.6%)
18/25	362	269 (74.3%)	314 (86.7%)	226 (62.4%)
18/52	404	270 (66.8%)	375 (92.8%)	245 (60.6%)
18/55	297	136 (45.8%)	287 (96.6%)	128 (43.1%)
18/82	398	288 (72.4%)	341 (85.7%)	235 (59.1%)
18/85	417	387 (92.8%)	265 (63.5%)	239 (57.3%)
18/88	369	229 (62.1%)	341 (92.4%)	204 (55.3%)
19/21	176	165 (93.8%)	76 (43.2%)	67 (38.1%)
19/24	378	359 (95%)	214 (56.6%)	198 (52.4%)
19/54	291	261 (89.7%)	196 (67.4%)	169 (58.1%)
20/14	150	0 (0%)	150 (100%)	0 (0%)
20/17	481	312 (64.9%)	432 (89.8%)	264 (54.9%)
20/44	412	6 (1.5%)	411 (99.8%)	5 (1.2%)
20/47	683	520 (76.1%)	582 (85.2%)	424 (62.1%)
20/74	606	473 (78.1%)	519 (85.6%)	391 (64.5%)
20/77	497	286 (57.5%)	458 (92.2%)	251 (50.5%)
21/10	366	259 (70.8%)	323 (88.3%)	222 (60.7%)
21/19	619	425 (68.7%)	546 (88.2%)	356 (57.5%)
21/40	570	378 (66.3%)	528 (92.6%)	338 (59.3%)
21/43	932	806 (86.5%)	748 (80.3%)	627 (67.3%)
21/49	753	505 (67.1%)	715 (95%)	470 (62.4%)
21/70	611	494 (80.9%)	514 (84.1%)	402 (65.8%)
21/73	487	369 (75.8%)	405 (83.2%)	292 (60%)
21/79	682	398 (58.4%)	628 (92.1%)	347 (50.9%)
22/12	569	292 (51.3%)	550 (96.7%)	278 (48.9%)
22/15	452	298 (65.9%)	415 (91.8%)	265 (58.6%)
22/42	661	322 (48.7%)	633 (95.8%)	297 (44.9%)
22/45	620	296 (47.7%)	598 (96.5%)	277 (44.7%)
22/72	623	303 (48.6%)	603 (96.8%)	286 (45.9%)
22/75	362	198 (54.7%)	345 (95.3%)	185 (51.1%)
22/78	470	150 (31.9%)	462 (98.3%)	144 (30.6%)
23/44	526	380 (72.2%)	430 (81.7%)	288 (54.8%)
23/47	614	371 (60.4%)	570 (92.8%)	330 (53.8%)
23/71	637	542 (85.1%)	549 (86.2%)	460 (72.2%)
23/74	413	279 (67.6%)	368 (89.1%)	238 (57.6%)
23/77	795	610 (76.7%)	718 (90.3%)	538 (67.7%)
24/16	494	389 (78.7%)	411 (83.2%)	311 (63%)
24/49	680	540 (79.4%)	585 (86%)	454 (66.8%)
25/15	560	370 (66.1%)	485 (86.6%)	299 (53.4%)
25/18	471	414 (87.9%)	304 (64.5%)	251 (53.3%)
25/45	652	456 (69.9%)	597 (91.6%)	406 (62.3%)
25/48	397	254 (64%)	375 (94.5%)	236 (59.5%)
25/75	622	466 (74.9%)	572 (92%)	421 (67.7%)
25/78	479	308 (64.3%)	454 (94.8%)	288 (60.1%)
26/14	393	324 (82.4%)	226 (57.5%)	157 (40%)
26/17	480	332 (69.2%)	439 (91.5%)	296 (61.7%)
26/41	405	359 (88.6%)	251 (62%)	209 (51.6%)
26/44	327	220 (67.3%)	277 (84.7%)	171 (52.3%)
26/47	615	363 (59%)	566 (92%)	317 (51.5%)
26/71	441	383 (86.8%)	326 (73.9%)	273 (61.9%)
26/74	360	284 (78.9%)	287 (79.7%)	214 (59.4%)
26/77	523	416 (79.5%)	405 (77.4%)	303 (57.9%)
27/10	514	383 (74.5%)	468 (91.1%)	342 (66.5%)
27/13	348	221 (63.5%)	319 (91.7%)	195 (56%)
27/16	416	270 (64.9%)	394 (94.7%)	251 (60.3%)
27/19	309	233 (75.4%)	274 (88.7%)	203 (65.7%)
27/40	395	174 (44.1%)	388 (98.2%)	169 (42.8%)
27/43	320	287 (89.7%)	235 (73.4%)	206 (64.4%)
27/46	292	213 (72.9%)	259 (88.7%)	185 (63.4%)
27/49	237	203 (85.7%)	167 (70.5%)	137 (57.8%)
27/70	515	333 (64.7%)	459 (89.1%)	283 (55%)
27/73	312	232 (74.4%)	244 (78.2%)	167 (53.5%)
27/76	328	195 (59.5%)	310 (94.5%)	182 (55.5%)
27/79	430	405 (94.2%)	288 (67%)	269 (62.6%)
28/12	329	290 (88.1%)	248 (75.4%)	211 (64.1%)
28/15	318	243 (76.4%)	263 (82.7%)	192 (60.4%)
28/18	387	292 (75.5%)	349 (90.2%)	259 (66.9%)
28/42	508	426 (83.9%)	438 (86.2%)	362 (71.3%)
28/45	589	537 (91.2%)	387 (65.7%)	340 (57.7%)
28/48	274	220 (80.3%)	224 (81.8%)	174 (63.5%)
28/72	333	286 (85.9%)	247 (74.2%)	206 (61.9%)
28/75	540	492 (91.1%)	333 (61.7%)	292 (54.1%)
28/78	538	470 (87.4%)	354 (65.8%)	292 (54.3%)
29/11	319	244 (76.5%)	283 (88.7%)	214 (67.1%)
29/14	433	316 (73%)	387 (89.4%)	272 (62.8%)
29/41	208	164 (78.8%)	158 (76%)	117 (56.3%)
29/44	326	227 (69.6%)	295 (90.5%)	199 (61%)
29/71	316	184 (58.2%)	292 (92.4%)	163 (51.6%)
29/74	332	209 (63%)	312 (94%)	192 (57.8%)
30/07	250	0 (0%)	250 (100%)	0 (0%)
30/67	735	568 (77.3%)	613 (83.4%)	448 (61%)

Table 7, continued.

10 KM SQUARE	NUMBER OF TAXA RECORDED (AND % OF TOTAL) TOTAL	ATLAS	MONITORING SCHEME	BOTH SURVEYS
30/97	611	450 (73.6%)	517 (84.6%)	357 (58.4%)
31/00	603	485 (80.4%)	487 (80.8%)	376 (62.4%)
31/03	629	441 (70.1%)	578 (91.9%)	396 (63%)
31/06	678	523 (77.1%)	571 (84.2%)	417 (61.5%)
31/09	480	298 (62.1%)	431 (89.8%)	251 (52.3%)
31/30	633	428 (67.6%)	549 (86.7%)	346 (54.7%)
31/33	731	487 (66.6%)	695 (95.1%)	454 (62.1%)
31/36	573	520 (90.8%)	354 (61.8%)	305 (53.2%)
31/39	686	302 (44%)	636 (92.7%)	259 (37.8%)
31/60	634	456 (71.9%)	564 (89%)	387 (61%)
31/63	626	346 (55.3%)	607 (97%)	327 (52.2%)
31/66	665	479 (72%)	587 (88.3%)	404 (60.8%)
31/69	652	523 (80.2%)	534 (81.9%)	407 (62.4%)
31/90	682	498 (73%)	600 (88%)	417 (61.1%)
31/93	592	532 (89.9%)	447 (75.5%)	390 (65.9%)
31/96	679	618 (91%)	435 (64.1%)	383 (56.4%)
31/99	615	344 (55.9%)	568 (92.4%)	301 (48.9%)
32/02	749	186 (24.8%)	744 (99.3%)	183 (24.4%)
32/05	626	468 (74.8%)	570 (91.1%)	413 (66%)
32/08	506	323 (63.8%)	462 (91.3%)	281 (55.5%)
32/32	633	415 (65.6%)	596 (94.2%)	381 (60.2%)
32/35	581	433 (74.5%)	526 (90.5%)	379 (65.2%)
32/38	553	402 (72.7%)	445 (80.5%)	296 (53.5%)
32/62	603	144 (23.9%)	597 (99%)	138 (22.9%)
32/65	525	359 (68.4%)	479 (91.2%)	316 (60.2%)
32/68	441	327 (74.1%)	375 (85%)	262 (59.4%)
32/92	731	456 (62.4%)	697 (95.3%)	422 (57.7%)
32/95	585	262 (44.8%)	575 (98.3%)	253 (43.3%)
32/98	698	427 (61.2%)	655 (93.8%)	384 (55%)
33/01	445	266 (59.8%)	422 (94.8%)	249 (56%)
33/04	531	378 (71.2%)	480 (90.4%)	329 (62%)
33/07	687	497 (72.3%)	598 (87%)	408 (59.4%)
33/31	488	315 (64.5%)	447 (91.6%)	277 (56.8%)
33/34	521	344 (66%)	490 (94%)	313 (60.1%)
33/37	651	546 (83.9%)	431 (66.2%)	327 (50.2%)
33/61	436	294 (67.4%)	373 (85.6%)	231 (53%)
33/64	520	333 (64%)	473 (91%)	288 (55.4%)
33/67	691	517 (74.8%)	555 (80.3%)	382 (55.3%)
33/91	570	426 (74.7%)	494 (86.7%)	355 (62.3%)
33/94	605	307 (50.7%)	585 (96.7%)	287 (47.4%)
33/97	608	338 (55.6%)	565 (92.9%)	295 (48.5%)
34/09	703	493 (70.1%)	618 (87.9%)	411 (58.5%)
34/30	593	359 (60.5%)	555 (93.6%)	324 (54.6%)
34/33	646	378 (58.5%)	595 (92.1%)	333 (51.6%)
34/36	35	0 (0%)	35 (100%)	0 (0%)
34/39	627	543 (86.6%)	486 (77.5%)	409 (65.2%)
34/60	628	527 (83.9%)	466 (74.2%)	369 (58.8%)
34/63	540	399 (73.9%)	461 (85.4%)	324 (60%)
34/66	538	391 (72.7%)	496 (92.2%)	356 (66.2%)
34/69	560	322 (57.5%)	537 (95.9%)	301 (53.8%)
34/90	491	312 (63.5%)	440 (89.6%)	264 (53.8%)
34/93	413	301 (72.9%)	335 (81.1%)	226 (54.7%)
34/96	626	453 (72.4%)	580 (92.7%)	412 (65.8%)
34/99	464	332 (71.6%)	399 (86%)	269 (58%)
35/02	551	508 (92.2%)	306 (55.5%)	267 (48.5%)

10 KM SQUARE	NUMBER OF TAXA RECORDED (AND % OF TOTAL) TOTAL	ATLAS	MONITORING SCHEME	BOTH SURVEYS
35/05	209	0 (0%)	209 (100%)	0 (0%)
35/08	532	373 (70.1%)	448 (84.2%)	292 (54.9%)
35/32	594	469 (79%)	493 (83%)	375 (63.1%)
35/35	711	579 (81.4%)	544 (76.5%)	414 (58.2%)
35/38	501	359 (71.7%)	399 (79.6%)	258 (51.5%)
35762	542	313 (57.7%)	509 (93.9%)	280 (51.7%)
35/65	523	423 (80.9%)	454 (86.8%)	360 (68.8%)
35/68	399	353 (88.5%)	273 (68.4%)	233 (58.4%)
35/92	473	320 (67.7%)	411 (86.9%)	261 (55.2%)
35/95	493	387 (78.5%)	386 (78.3%)	283 (57.4%)
35/98	483	427 (88.4%)	357 (73.9%)	307 (63.6%)
36/01	427	307 (71.9%)	382 (89.5%)	262 (61.4%)
36/04	385	254 (66%)	346 (89.9%)	220 (57.1%)
36/07	603	412 (68.3%)	529 (87.7%)	342 (56.7%)
36/31	462	315 (68.2%)	442 (95.7%)	300 (64.9%)
36/34	415	332 (80%)	295 (71.1%)	217 (52.3%)
36/37	553	358 (64.7%)	501 (90.6%)	311 (56.2%)
36/61	507	302 (59.6%)	492 (97%)	288 (56.8%)
36/64	488	235 (48.2%)	473 (96.9%)	220 (45.1%)
36/67	727	552 (75.9%)	603 (82.9%)	432 (59.4%)
36/91	366	330 (90.2%)	260 (71%)	230 (62.8%)
36/94	484	397 (82%)	414 (85.5%)	330 (68.2%)
37/00	525	257 (49%)	515 (98.1%)	250 (47.6%)
37/03	419	344 (82.1%)	305 (72.8%)	232 (55.4%)
37/06	337	253 (75.1%)	286 (84.9%)	205 (60.8%)
37/09	292	259 (88.7%)	210 (71.9%)	182 (62.3%)
37/30	626	172 (27.5%)	620 (99%)	168 (26.8%)
37/33	431	381 (88.4%)	250 (58%)	203 (47.1%)
37/36	345	275 (79.7%)	282 (81.7%)	216 (62.6%)
37/39	487	391 (80.3%)	396 (81.3%)	305 (62.6%)
37/60	405	38 (9.4%)	400 (98.8%)	34 (8.4%)
37/63	384	303 (78.9%)	282 (73.4%)	207 (53.9%)
37/66	483	361 (74.7%)	367 (76%)	250 (51.8%)
37/69	496	368 (74.2%)	435 (87.7%)	317 (63.9%)
37/99	403	304 (75.4%)	344 (85.4%)	248 (61.5%)
38/02	503	416 (82.7%)	401 (79.7%)	318 (63.2%)
38/05	670	587 (87.6%)	494 (73.7%)	419 (62.5%)
38/32	341	223 (65.4%)	307 (90%)	191 (56%)
38/35	486	375 (77.2%)	424 (87.2%)	319 (65.6%)
38/62	434	270 (62.2%)	410 (94.5%)	252 (58.1%)
38/65	389	243 (62.5%)	348 (89.5%)	202 (51.9%)
38/92	417	235 (56.4%)	371 (89%)	191 (45.8%)
38/95	360	246 (68.3%)	322 (89.4%)	211 (58.6%)
39/01	394	372 (94.4%)	155 (39.3%)	134 (34%)
39/04	266	209 (78.6%)	214 (80.5%)	160 (60.2%)
39/07	210	1 (0.5%)	210 (100%)	1 (0.5%)
39/34	345	217 (62.9%)	299 (86.7%)	172 (49.9%)
39/37	234	158 (67.5%)	194 (82.9%)	118 (50.4%)
40/57	560	458 (81.8%)	417 (74.5%)	317 (56.6%)
41/20	783	560 (71.5%)	713 (91.1%)	494 (63.1%)
41/23	663	397 (59.9%)	630 (95%)	364 (54.9%)
41/26	619	557 (90%)	436 (70.4%)	376 (60.7%)
41/29	651	253 (38.9%)	619 (95.1%)	225 (34.6%)
41/50	869	686 (78.9%)	761 (87.6%)	585 (67.3%)

Table 7, continued.

10 KM SQUARE	NUMBER OF TAXA RECORDED (AND % OF TOTAL) TOTAL	ATLAS	MONITORING SCHEME	BOTH SURVEYS
41/53	603	458 (76%)	478 (79.3%)	335 (55.6%)
41/56	812	644 (79.3%)	735 (90.5%)	574 (70.7%)
41/59	798	603 (75.6%)	695 (87.1%)	505 (63.3%)
41/80	713	480 (67.3%)	626 (87.8%)	395 (55.4%)
41/83	840	695 (82.7%)	672 (80%)	531 (63.2%)
41/86	747	532 (71.2%)	682 (91.3%)	470 (62.9%)
41/89	726	415 (57.2%)	706 (97.2%)	397 (54.7%)
42/22	646	457 (70.7%)	587 (90.9%)	400 (61.9%)
42/25	872	661 (75.8%)	775 (88.9%)	564 (64.7%)
42/28	791	646 (81.7%)	598 (75.6%)	454 (57.4%)
42/52	593	397 (66.9%)	536 (90.4%)	341 (57.5%)
42/55	597	368 (61.6%)	571 (95.6%)	343 (57.5%)
42/58	478	410 (85.8%)	377 (78.9%)	310 (64.9%)
42/82	601	358 (59.6%)	556 (92.5%)	315 (52.4%)
42/85	678	433 (63.9%)	641 (94.5%)	397 (58.6%)
42/88	660	425 (64.4%)	591 (89.5%)	359 (54.4%)
43/21	503	441 (87.7%)	327 (65%)	266 (52.9%)
43/24	603	525 (87.1%)	404 (67%)	327 (54.2%)
43/27	647	484 (74.8%)	528 (81.6%)	370 (57.2%)
43/51	638	556 (87.1%)	465 (72.9%)	384 (60.2%)
43/54	554	503 (90.8%)	314 (56.7%)	264 (47.7%)
43/57	533	500 (93.8%)	276 (51.8%)	244 (45.8%)
43/81	476	350 (73.5%)	405 (85.1%)	280 (58.8%)
43/84	587	379 (64.6%)	535 (91.1%)	328 (55.9%)
43/87	638	552 (86.5%)	484 (75.9%)	400 (62.7%)
44/20	389	315 (81%)	257 (66.1%)	184 (47.3%)
44/23	599	329 (54.9%)	562 (93.8%)	293 (48.9%)
44/26	648	427 (65.9%)	578 (89.2%)	361 (55.7%)
44/29	534	423 (79.2%)	420 (78.7%)	308 (57.7%)
44/50	589	417 (70.8%)	522 (88.6%)	351 (59.6%)
44/53	512	355 (69.3%)	460 (89.8%)	305 (59.6%)
44/56	407	312 (76.7%)	300 (73.7%)	205 (50.4%)
44/59	374	208 (55.6%)	334 (89.3%)	171 (45.7%)
44/80	590	483 (81.9%)	454 (76.9%)	349 (59.2%)
44/83	630	467 (74.1%)	527 (83.7%)	364 (57.8%)
44/86	479	423 (88.3%)	328 (68.5%)	274 (57.2%)
44/89	635	580 (91.3%)	408 (64.3%)	355 (55.9%)
45/22	489	367 (75.1%)	409 (83.6%)	289 (59.1%)
45/25	651	590 (90.6%)	359 (55.1%)	301 (46.2%)
45/28	499	448 (89.8%)	319 (63.9%)	271 (54.3%)
45/52	496	362 (73%)	411 (82.9%)	279 (56.3%)
46/21	599	495 (82.6%)	461 (77%)	363 (60.6%)
51/10	766	539 (70.4%)	663 (86.6%)	439 (57.3%)
51/13	712	612 (86%)	587 (82.4%)	497 (69.8%)
51/16	971	653 (67.3%)	898 (92.5%)	582 (59.9%)
51/19	691	545 (78.9%)	561 (81.2%)	417 (60.4%)
51/40	816	703 (86.2%)	618 (75.7%)	507 (62.1%)
51/43	658	555 (84.3%)	555 (84.3%)	457 (69.5%)
51/46	949	715 (75.3%)	862 (90.8%)	630 (66.4%)
51/49	642	434 (67.6%)	582 (90.7%)	376 (58.6%)
51/70	601	420 (69.9%)	478 (79.5%)	301 (50.1%)
51/73	628	561 (89.3%)	452 (72%)	395 (62.9%)
51/76	743	618 (83.2%)	597 (80.3%)	480 (64.6%)
51/79	638	416 (65.2%)	569 (89.2%)	348 (54.6%)
52/12	743	570 (76.7%)	660 (88.8%)	492 (66.2%)
52/15	731	533 (72.9%)	633 (86.6%)	442 (60.5%)
52/18	507	354 (69.8%)	442 (87.2%)	292 (57.6%)
52/42	760	576 (75.8%)	681 (89.6%)	499 (65.7%)
52/45	1093	850 (77.8%)	936 (85.6%)	704 (64.4%)
52/48	615	511 (83.1%)	470 (76.4%)	369 (60%)
52/72	598	488 (81.6%)	516 (86.3%)	409 (68.4%)
52/75	608	457 (75.2%)	525 (86.3%)	375 (61.7%)
52/78	793	572 (72.1%)	683 (86.1%)	464 (58.5%)
53/11	540	384 (71.1%)	460 (85.2%)	304 (56.3%)
53/14	510	370 (72.5%)	460 (90.2%)	320 (62.8%)
53/17	606	472 (77.9%)	530 (87.5%)	399 (65.8%)
53/41	531	343 (64.6%)	464 (87.4%)	277 (52.2%)
53/44	280	211 (75.4%)	218 (77.9%)	149 (53.2%)
53/47	539	418 (77.6%)	476 (88.3%)	356 (66.1%)
53/71	792	628 (79.3%)	645 (81.4%)	487 (61.5%)
53/74	649	484 (74.6%)	577 (88.9%)	414 (63.8%)
54/10	548	424 (77.4%)	445 (81.2%)	321 (58.6%)
54/13	426	282 (66.2%)	370 (86.9%)	228 (53.5%)
54/16	562	370 (65.8%)	477 (84.9%)	287 (51.1%)
54/40	164	2 (1.2%)	163 (99.4%)	1 (0.6%)
57/30	348	230 (66.1%)	308 (88.5%)	191 (54.9%)
57/33	249	188 (75.5%)	191 (76.7%)	135 (54.2%)
57/60	52	0 (0%)	52 (100%)	0 (0%)
57/63	286	226 (79%)	258 (90.2%)	200 (69.9%)
61/03	577	416 (72.1%)	387 (67.1%)	231 (40%)
61/06	711	654 (92%)	441 (62%)	392 (55.1%)
61/09	325	258 (79.4%)	235 (72.3%)	170 (52.3%)
61/33	194	1 (0.5%)	194 (100%)	1 (0.5%)
61/36	632	507 (80.2%)	488 (77.2%)	371 (58.7%)
62/02	515	327 (63.5%)	427 (82.9%)	242 (47%)
62/05	701	523 (74.6%)	623 (88.9%)	447 (63.8%)
62/08	469	344 (73.3%)	328 (69.9%)	206 (43.9%)
62/35	656	478 (72.9%)	549 (83.7%)	372 (56.7%)
62/38	635	428 (67.4%)	550 (86.6%)	345 (54.3%)
63/01	628	433 (68.9%)	555 (88.4%)	365 (58.1%)
63/04	722	632 (87.5%)	427 (59.1%)	337 (46.7%)
63/31	629	507 (80.6%)	494 (78.5%)	377 (59.9%)
67/26	104	0 (0%)	104 (100%)	0 (0%)
68/25	261	212 (81.2%)	208 (79.7%)	160 (61.3%)
68/28	199	168 (84.4%)	145 (72.9%)	116 (58.3%)
68/55	82	0 (0%)	82 (100%)	0 (0%)
68/58	173	113 (65.3%)	147 (85%)	89 (51.5%)
69/51	122	0 (0%)	122 (100%)	0 (0%)
Channel Islands				
90/38	528	0 (0%)	528 (100%)	0 (0%)
90/65	590	0 (0%)	590 (100%)	0 (0%)

Table 7, continued.

10 KM SQUARE	NUMBER OF TAXA RECORDED (AND % OF TOTAL) TOTAL	ATLAS	MONITORING SCHEME	BOTH SURVEYS
Ireland				
00/45	192	93 (48.4%)	177 (92.2%)	78 (40.6%)
00/48	326	179 (54.9%)	302 (92.6%)	156 (47.9%)
00/72	333	195 (58.6%)	284 (85.3%)	147 (44.1%)
00/75	355	237 (66.8%)	295 (83.1%)	178 (50.1%)
00/78	385	348 (90.4%)	246 (63.9%)	211 (54.8%)
01/41	325	244 (75.1%)	260 (80%)	182 (56%)
01/71	353	269 (76.2%)	253 (71.7%)	170 (48.2%)
01/74	294	242 (82.3%)	219 (74.5%)	169 (57.5%)
02/73	362	62 (17.1%)	348 (96.1%)	48 (13.3%)
02/76	381	238 (62.5%)	313 (82.2%)	171 (44.9%)
02/79	348	307 (88.2%)	204 (58.6%)	166 (47.7%)
03/72	298	227 (76.2%)	201 (67.4%)	132 (44.3%)
10/02	443	347 (78.3%)	333 (75.2%)	239 (54%)
10/05	475	219 (46.1%)	462 (97.3%)	207 (43.6%)
10/08	354	305 (86.2%)	272 (76.8%)	227 (64.1%)
10/35	353	218 (61.8%)	308 (87.3%)	177 (50.1%)
10/38	303	223 (73.6%)	239 (78.9%)	160 (52.8%)
10/65	355	198 (55.8%)	316 (89%)	159 (44.8%)
10/68	316	198 (62.7%)	272 (86.1%)	156 (49.4%)
10/98	358	274 (76.5%)	282 (78.8%)	201 (56.2%)
11/01	294	253 (86.1%)	178 (60.5%)	139 (47.3%)
11/04	416	290 (69.7%)	322 (77.4%)	198 (47.6%)
11/07	361	241 (66.8%)	295 (81.7%)	178 (49.3%)
11/31	320	240 (75%)	274 (85.6%)	198 (61.9%)
11/34	427	326 (76.3%)	347 (81.3%)	250 (58.6%)
11/37	395	224 (56.7%)	328 (83%)	157 (39.8%)
11/61	349	222 (63.6%)	321 (92%)	197 (56.5%)
11/64	360	235 (65.3%)	309 (85.8%)	186 (51.7%)
11/67	420	342 (81.4%)	317 (75.5%)	241 (57.4%)
11/91	316	186 (58.9%)	279 (88.3%)	151 (47.8%)
11/94	342	238 (69.6%)	300 (87.7%)	198 (57.9%)
11/97	367	219 (59.7%)	332 (90.5%)	185 (50.4%)
12/00	246	233 (94.7%)	79 (32.1%)	67 (27.2%)
12/03	266	213 (80.1%)	194 (72.9%)	144 (54.1%)
12/06	370	285 (77%)	291 (78.6%)	209 (56.5%)
12/09	362	92 (25.4%)	350 (96.7%)	80 (22.1%)
12/30	368	262 (71.2%)	302 (82.1%)	200 (54.4%)
12/33	411	286 (69.6%)	313 (76.2%)	189 (46%)
12/36	255	96 (37.6%)	228 (89.4%)	69 (27.1%)
12/39	265	112 (42.3%)	250 (94.3%)	98 (37%)
12/60	328	266 (81.1%)	249 (75.9%)	188 (57.3%)
12/63	319	229 (71.8%)	261 (81.8%)	172 (53.9%)
12/66	322	217 (67.4%)	274 (85.1%)	171 (53.1%)
12/69	401	95 (23.7%)	397 (99%)	92 (22.9%)
12/90	402	279 (69.4%)	315 (78.4%)	193 (48%)
12/93	214	214 (100%)	0 (0%)	0 (0%)
12/96	442	266 (60.2%)	398 (90%)	224 (50.7%)
12/99	384	200 (52.1%)	342 (89.1%)	159 (41.4%)
13/02	372	269 (72.3%)	322 (86.6%)	223 (60%)
13/32	325	177 (54.5%)	300 (92.3%)	155 (47.7%)
13/62	464	339 (73.1%)	311 (67%)	189 (40.7%)
13/65	213	0 (0%)	213 (100%)	0 (0%)
13/68	330	201 (60.9%)	292 (88.5%)	167 (50.6%)
13/92	305	184 (60.3%)	261 (85.6%)	143 (46.9%)
13/95	501	314 (62.7%)	449 (89.6%)	268 (53.5%)
13/98	422	261 (61.8%)	382 (90.5%)	223 (52.8%)
14/61	248	248 (100%)	0 (0%)	0 (0%)
14/91	342	278 (81.3%)	266 (77.8%)	205 (59.9%)
14/94	119	0 (0%)	119 (100%)	0 (0%)
20/28	353	244 (69.1%)	299 (84.7%)	194 (55%)
21/21	341	242 (71%)	284 (83.3%)	188 (55.1%)
21/24	326	284 (87.1%)	192 (58.9%)	152 (46.6%)
21/27	305	255 (83.6%)	167 (54.8%)	117 (38.4%)
21/51	381	268 (70.3%)	280 (73.5%)	169 (44.4%)
21/54	361	285 (78.9%)	279 (77.3%)	205 (56.8%)
21/57	293	226 (77.1%)	232 (79.2%)	166 (56.7%)
21/81	448	283 (63.2%)	411 (91.7%)	250 (55.8%)
21/84	358	358 (100%)	0 (0%)	0 (0%)
21/87	422	335 (79.4%)	308 (73%)	222 (52.6%)
22/20	359	326 (90.8%)	225 (62.7%)	195 (54.3%)
22/23	346	260 (75.1%)	233 (67.3%)	146 (42.2%)
22/26	343	170 (49.6%)	320 (93.3%)	148 (43.2%)
22/29	397	231 (58.2%)	360 (90.7%)	195 (49.1%)
22/50	346	304 (87.9%)	160 (46.2%)	119 (34.4%)
22/53	304	254 (83.6%)	192 (63.2%)	143 (47%)
22/56	385	242 (62.9%)	317 (82.3%)	176 (45.7%)
22/59	344	199 (57.8%)	308 (89.5%)	167 (48.6%)
22/80	428	238 (55.6%)	347 (81.1%)	158 (36.9%)
22/83	316	192 (60.8%)	258 (81.6%)	134 (42.4%)
22/86	349	187 (53.6%)	296 (84.8%)	136 (39%)
22/89	455	220 (48.4%)	434 (95.4%)	200 (44%)
23/22	415	260 (62.7%)	359 (86.5%)	204 (49.2%)
23/25	478	373 (78%)	401 (83.9%)	298 (62.3%)
23/28	422	236 (55.9%)	401 (95%)	217 (51.4%)
23/52	443	267 (60.3%)	407 (91.9%)	231 (52.1%)
23/55	459	265 (57.7%)	428 (93.2%)	236 (51.4%)
23/58	398	261 (65.6%)	366 (92%)	234 (58.8%)
23/82	434	242 (55.8%)	417 (96.1%)	230 (53%)
23/85	500	272 (54.4%)	475 (95%)	250 (50%)
23/88	537	315 (58.7%)	491 (91.4%)	271 (50.5%)
24/21	321	196 (61.1%)	283 (88.2%)	158 (49.2%)
24/24	478	359 (75.1%)	391 (81.8%)	280 (58.6%)
24/51	434	192 (44.2%)	429 (98.8%)	187 (43.1%)
24/54	396	168 (42.4%)	380 (96%)	152 (38.4%)
24/81	538	241 (44.8%)	516 (95.9%)	220 (40.9%)
24/84	278	4 (1.4%)	275 (98.9%)	1 (0.4%)
31/11	364	303 (83.2%)	188 (51.6%)	129 (35.4%)
31/14	368	297 (80.7%)	252 (68.5%)	184 (50%)
31/17	324	224 (69.1%)	221 (68.2%)	122 (37.7%)
32/10	241	222 (92.1%)	81 (33.6%)	64 (26.6%)
32/13	408	309 (75.7%)	234 (57.4%)	136 (33.3%)
32/16	467	382 (81.8%)	291 (62.3%)	209 (44.8%)
32/19	181	0 (0%)	181 (100%)	0 (0%)
33/12	445	188 (42.2%)	430 (96.6%)	174 (39.1%)
33/15	473	261 (55.2%)	425 (89.9%)	213 (45%)
33/18	565	374 (66.2%)	464 (82.1%)	274 (48.5%)
33/45	543	377 (69.4%)	477 (87.8%)	314 (57.8%)
33/48	587	382 (65.1%)	485 (82.6%)	286 (48.7%)
34/11	470	309 (65.7%)	419 (89.1%)	264 (56.2%)
34/14	567	339 (59.8%)	512 (90.3%)	290 (51.2%)

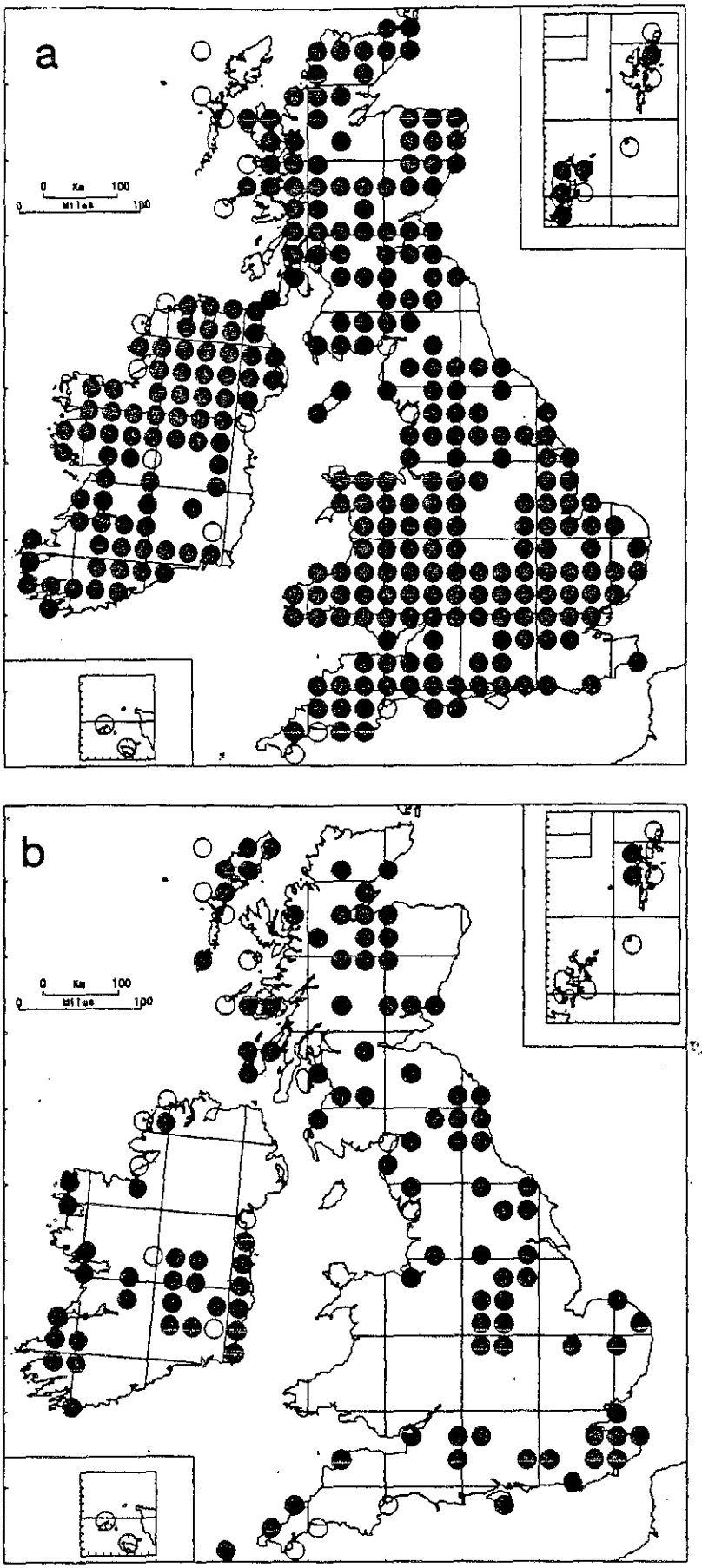


Figure 21. Comparison of number of taxa recorded for the Monitoring Scheme and the Atlas. (a) more taxa recorded for the Monitoring Scheme. (b) more taxa recorded for the Atlas. Squares not recorded for either survey are shown as open circles.

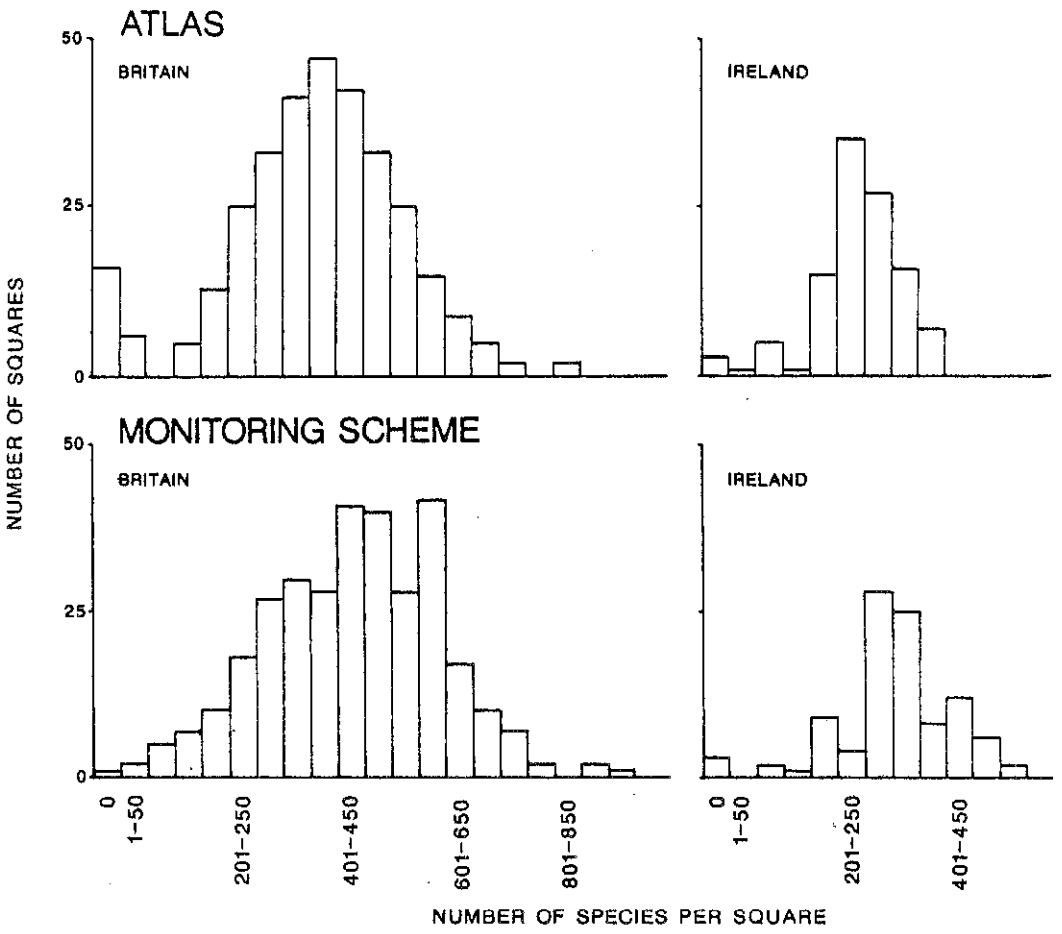


Figure 22. Bar-charts illustrating the frequency distribution of 10-km squares containing the stated number of species in Britain and Ireland for the Monitoring Scheme and Atlas surveys.

To assess the first possibility, that the database under-represents the species recorded for the Atlas, the numbers of records for squares with less than 60% of the combined total in the database were compared with Figure 3 of the Atlas which indicates the approximate number of records per square included in the Atlas.

For Britain, 26 of the squares have equivalent numbers of records and another 5 squares have more records in the Atlas database than in Figure 3 of the Atlas. 2 squares (22/7.8 and 32/0.2) have far fewer records on the original Atlas mastercards than is suggested by Figure 3 of the Atlas which is thus considered erroneous for the squares. The records in the Atlas database for these 33 squares were therefore considered to be respresentative of the flora recorded for the Atlas. Of the remaining squares, 8 are coastal with partial lists or single records and 5 squares (31/3.9, 32/6.2, 34/3.3, 36/6.4 and 41/2.9) appear to have significantly fewer records than expected. Under-recording in these latter 13 squares can be explained and they are excluded from the investigation of the second and third possible explanations.

In Ireland, the number of taxa in the database matches the records in Figure 3 of the Atlas for 33 squares, there are more records in the database for 1, and 3

are coastal and not plotted in the Atlas. The Irish data appear to match Figure 3 well and are thus considered representative of the records. For 6 of these squares there are less than 100 taxa recorded clearly under-estimating the true flora (eg compare the number Atlas and Monitoring Scheme records in Table 7) and these squares are thus considered very unrepresentative and are excluded. The remaining squares can therefore be regarded as under-recorded.

Under-representation in the database of the taxa recorded for the Atlas can therefore account for some of the discrepancy between the Atlas overlay and our figures. The second and third possibilities are therefore considered for the remaining 60 squares (Figure 23).

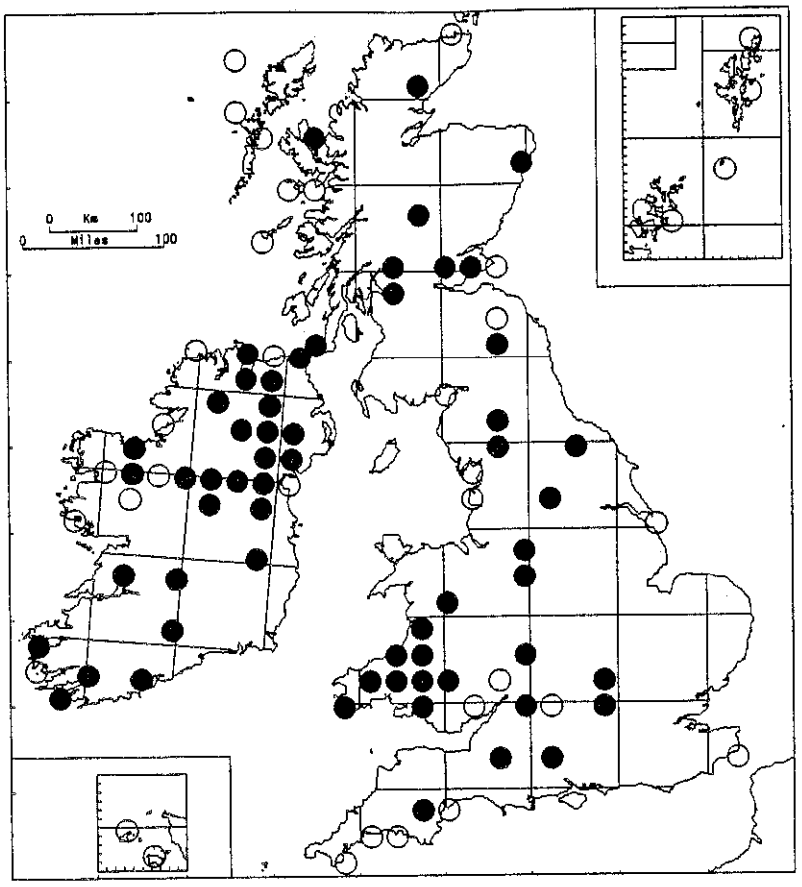


Figure 23. 10-km squares for which 60% or less of the combined total flora is represented in the Atlas database. Squares not recorded for the Atlas, or with very unrepresentative data, are shown as open circles.

The second possibility, that there have been real, significant increases in the flora cannot be assessed directly since it cannot be distinguished from poor initial recording on numerical grounds alone. However, if there have been significant increases in the flora it is likely that many new species will be aliens, i.e. there will be a qualitative as well as a quantitative change.

The 60 under-recorded squares were examined to see if they showed a consistently higher than average number of alien taxa recorded during the Monitoring Scheme (see also below). 37 of the squares have an above average number of aliens but this is not statistically significant ($P > 0.05$ using X^2) and most of the squares are only marginally above the average. Hence it is unlikely overall that dramatic increases in the flora account for the increase in the number of squares under-recorded for the Atlas.

The third possibility, that the overlay under-estimates under-recording, is also not easy to assess but can be approached in 2 ways. If the squares were under-recorded for the Atlas, it is likely that a high percentage of their Atlas records will have been refound during the Monitoring Scheme. Hence the number of species in common between the two surveys was calculated and divided by the number of Atlas species recorded. 56 out of the 60 'under-recorded' squares had an above average number of species in common, a highly significant correlation ($P < 0.001$ using X^2).

The second approach examination of records for individual squares, picks out others which are known to be well-recorded for the Monitoring Scheme eg all those in Wales have been comprehensively recorded during the current survey (especially those in VC35, 42, 44, 45, 46 and 52). Those in VC85 have been thoroughly recorded by George Ballantyne, and 29/7.1 and 16/5.1 were covered by BSBI field meetings. Those around the coast in SW Ireland have small areas of land which were probably poorly recorded for the Atlas and the Bantry Bay square (10/0.5) is the best recorded square in the Republic of Ireland. N Ireland has had a specially high intensity of recording for the Monitoring Scheme, and Central Ireland was noted as under-recorded for the Atlas. Thus it seems the bulk of these 60 squares were indeed under-recorded during the Atlas.

Returning to the 4 squares on the overlay which have more than 60% of the total flora in the Atlas database, 3 have probably been as under-recorded for the Monitoring Scheme as for the Atlas (these are all remote squares) and one, 41/8.6, has considerably more records in the database (resulting from records sent in by H J M Bowen) than shown in the Atlas.

It is concluded that, in light of further recording and in terms of numbers of species alone, the overlay in the Atlas significantly under-estimates the extent of under-recording. It might be argued that as the overlay also incorporates pre-1930 records this comparison is not strictly justified. However, the percentage of pre-1930 records overall is very small (less than 3%) and many of the discrepancies are much larger than this.

Figure 24 shows the 21 10-km squares where only 60 per cent or less of the flora was recorded for the Monitoring Scheme. Some explanations are immediately apparent. Nottinghamshire was thoroughly recorded by the Howitts for the Atlas and the Hebrides by Heslop-Harrison et al., both have received reasonable but not comprehensive coverage for the Monitoring Scheme. In Ireland, Wicklow, Wexford and South Tipperary have been poorly recorded, as has the rich Burren square 12/0.0. Only 5 of these squares (19/2.1 and 39/0.1 in Scotland and 12/0.0, 22/5.0 and 32/1.0 in Ireland) have less than 50% of the total flora recorded.

These comparisons show that in general the Monitoring Scheme recording has been considerably better in terms of numbers of taxa than the Atlas.

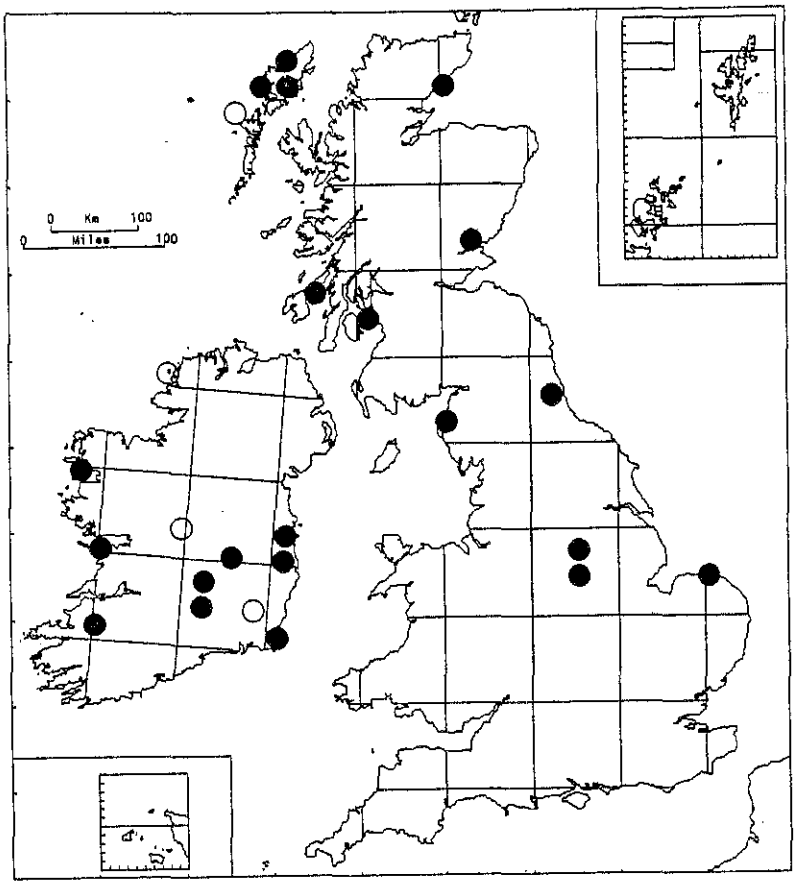


Figure 24. 10-km squares for which 60% or less of the combined flora has been recorded for the Monitoring Scheme. Squares not recorded at all are shown as open circles.

3. Comparison of quality of recording

Assessing the quantity of recording is fairly direct as shown above. Assessing how well that recording has been carried out is another matter. Three qualitative tests of recording have been investigated here in an attempt to measure the relative quality of the records.

i) ratio of 'difficult' taxa to all taxa
ii) ratio of grasses to all taxa
iii) % of known common taxa recorded.

For these assessments, Britain and Ireland have been treated independently due to the inherent differences between the floras. Also, due to the somewhat subjective nature of the ratios chosen, squares are simply divided into above and below average.

(i) ratio of 'difficult' taxa to all taxa

The idea behind this measure is that in general, the better and more careful the botanist, the more 'difficult' taxa will be recorded.

Defining what is a 'difficult' taxon and what is not is clearly a matter of opinion depending upon an individuals experience, training and preferences. Difficult taxa, for the purpose of this analysis, have been defined to include:

- critical genera (Rubus, Taraxacum, Rosa, etc)
- hybrids, excluding a few simple ones (eg Tilia x vulgaris)
- infraspecific taxa (where more than one is present)
- miscellaneous other taxa where there are problems (eg Aphanes, Arenaria)

Approximately 970 taxa are included under this definition, approximately 1/3 of the total number of taxa recorded for the Monitoring Scheme and Atlas databases.

Figure 25 shows the 10-km squares for which there is an above average % of difficult taxa recorded for each survey. The average % per square of critical taxa recorded for the Atlas is 6% in Britain and 6.2% for Ireland. For the Monitoring Scheme, the average % of critical taxa recorded per square is 10.4% in Britain and 8.8% in Ireland. The differences between the averages for the two surveys is, at least in part, attributable to the absence of records from the Critical Supplement.

When combined, the figures show few geographical trends to suggest that some areas are inherently richer in critical taxa than others. N Ireland, N Scotland and SE England stand out as having consistently higher numbers of critical taxa recorded and so perhaps do the Borders, but this may also be a function of good recording. Thus the ratio of critical to all taxa may be a useful indicator of good (or bad) recording.

(ii) ratio of grasses to all taxa

It is generally known that grasses are recorded best by the more experienced botanists. Hence a high ratio of grasses to all species recorded in a square may pick out areas where the quality of recording is high.

The average percentage of grass species per square was about 10.5% of all the species recorded irrespective of country or survey (though the averages are fractionally higher for the Monitoring Scheme). Figure 26 shows squares with an above average % of grasses recorded for the Atlas and the Monitoring Scheme respectively. For the Atlas, the squares appear to be relatively random in occurrence across Britain and Ireland, though NW Scotland and the coasts are generally poorly represented. For the Monitoring Scheme there is a clear SW-NE bias in Britain but not in Ireland. The origin of this bias is probably not related to the distribution of recorders.

(iii) proportion of common species recorded

Common species, defined as those occurring in 350 or more of the Monitoring Scheme squares (the commonest 5% of the flora), are only likely to have been overlooked on any scale in under-recorded squares. The number of common species recorded during each survey were therefore compared with the total number of common species known for each square. Figure 27 shows the squares with an above average % of the common species recorded for each survey.

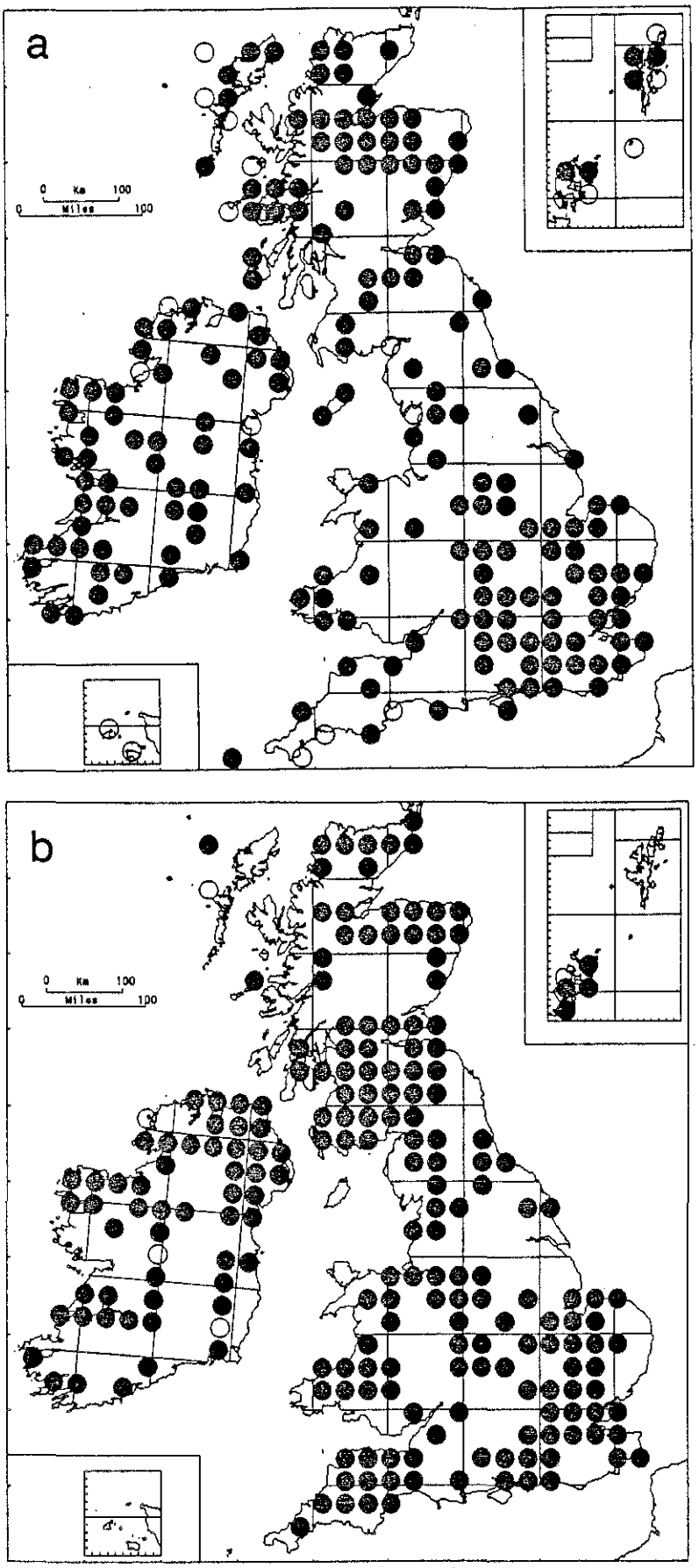


Figure 25. 10-km squares with an above average % of critical taxa recorded (number of critical taxa per square ÷ number of taxa per square for each survey). (a) Atlas. (b) Monitoring Scheme. Squares not recorded for either survey are shown as open circles.

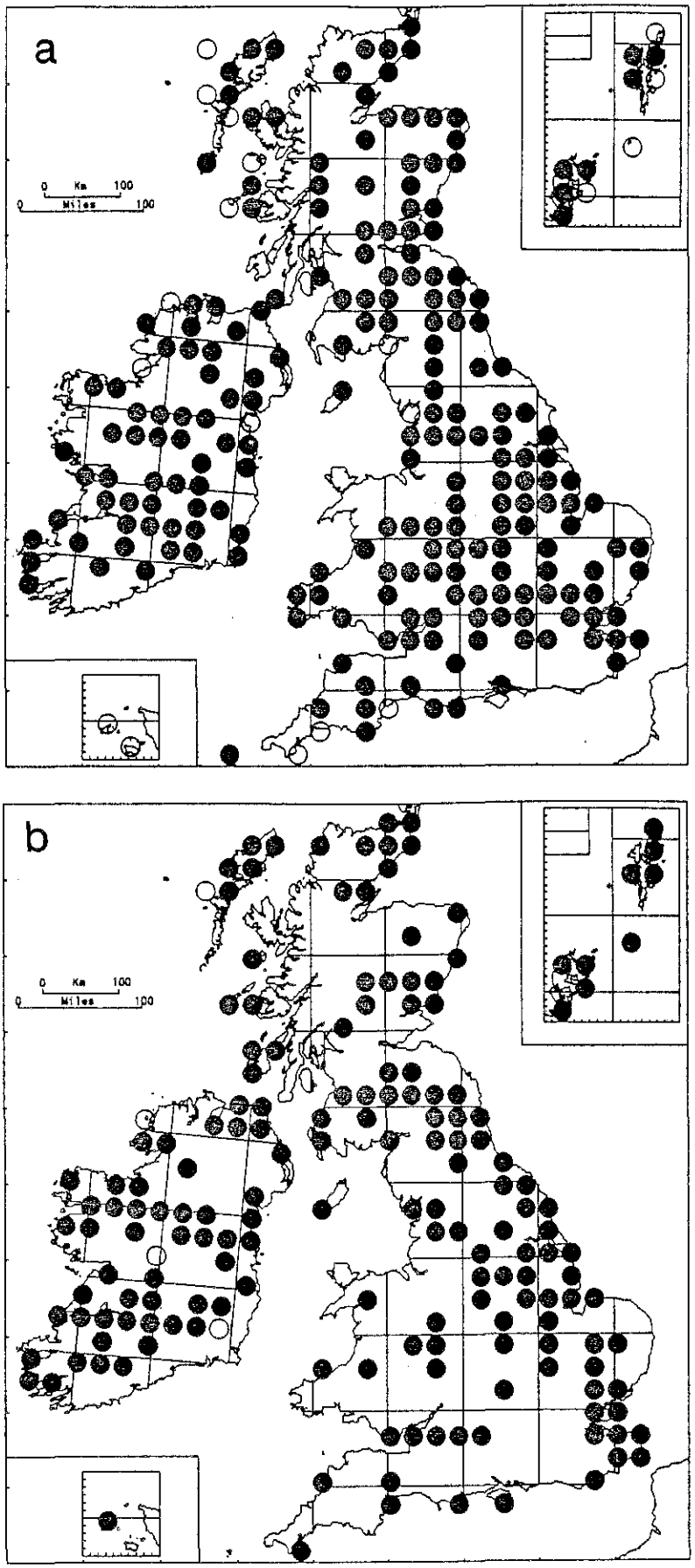


Figure 26. 10-km squares with an above average % of grasses recorded (number of grasses per square ÷ number of taxa per square for each survey). (a) Atlas. (b) Monitoring Scheme. Squares not recorded for either survey are shown as open circles.

For the Atlas the squares with an above average % of common species are generally randomly distributed, though they appear poor in the uplands and the centre of Ireland. For the Monitoring Scheme there is a definite SW-NE trend in Britain and a N-S trend in Ireland. The origin of this bias in Britain may be that common species are relatively more common in the SW than the NE, but in Ireland the trend is probably due to differences in recording.

Interestingly, this relationship is opposite to that shown for the grasses for Britain for the Monitoring Scheme data. There is a significant negative correlation ($P<0.05$ using X^2) between an above average % of grasses (expressed as a % of all taxa recorded for the Monitoring Scheme) and an above average % of common species recorded (expressed as a % of all the common species recorded irrespective of date) (i.e. if there are more common species it is likely the % of grasses will be low). Note that these two variables are not completely independent. For Ireland, and for all the Atlas data, there is no such relationship ($P>0.1$ using X^2).

Independently, such qualitative measures of recording are prone to recorder bias. For instance, in Hampshire, David Allen (pers. comm.) "did little other than Rubus", and David McCosh (VC78) recorded Hieracium with enthusiasm but avoided grasses. All 3 qualitative assessments were therefore combined and squares qualitatively well-recorded on at least 2 counts are shown in Figure 28. Note that due to the negative correlation between grasses and common species, the overall quality of the recording is under-estimated for the Monitoring Scheme.

A converse, squares which are qualitatively poorly recorded on at least 2 counts, is shown in Figure 29.

In summary, a comparison of these three qualitative measures of recording within each survey can pick out areas well or poorly recorded. It is difficult to compare the quality of recording for individual squares between surveys due to the overall greater amount of recording for the Monitoring Scheme.

4. Comparison of alien taxa recorded

The average number of aliens recorded per square for the Atlas is 23 (5.4% of the taxa recorded) for Britain and 17.3 (7% of the taxa recorded) for Ireland. Squares with an above average number and % of aliens recorded for the Atlas are shown in Figure 30.

The average number of aliens recorded per square for the Monitoring Scheme is 42.3 (8.4% of the taxa recorded) for Britain and 24 (7.7% of the taxa recorded) for Ireland. Squares with an above average number and % of aliens recorded for the Monitoring Scheme are shown in Fig. 31.

The increase in the number of aliens recorded at least in part reflects changing attitudes to recording aliens. It is much more widely accepted now to record garden escapes and introductions such as Laburnum, Aesculus and Lunaria, though there are records (and maps) from the Atlas period. Recording of aliens (what to leave in, what to leave out) is still a matter of personal opinion and varies between recorders. The large numbers of aliens recorded in the Inverness area for the Atlas reflects the interests of Mary McCallum Webster. The large number of aliens recorded in the Cambridge square for the Monitoring Scheme is a result of one botanist recording casuals in the Botanic Garden. Not only does recording of aliens vary between botanists, it also varies with the species concerned, for instance, most botanists are happy to record oil-seed rape on road verges, but few will record cereals.

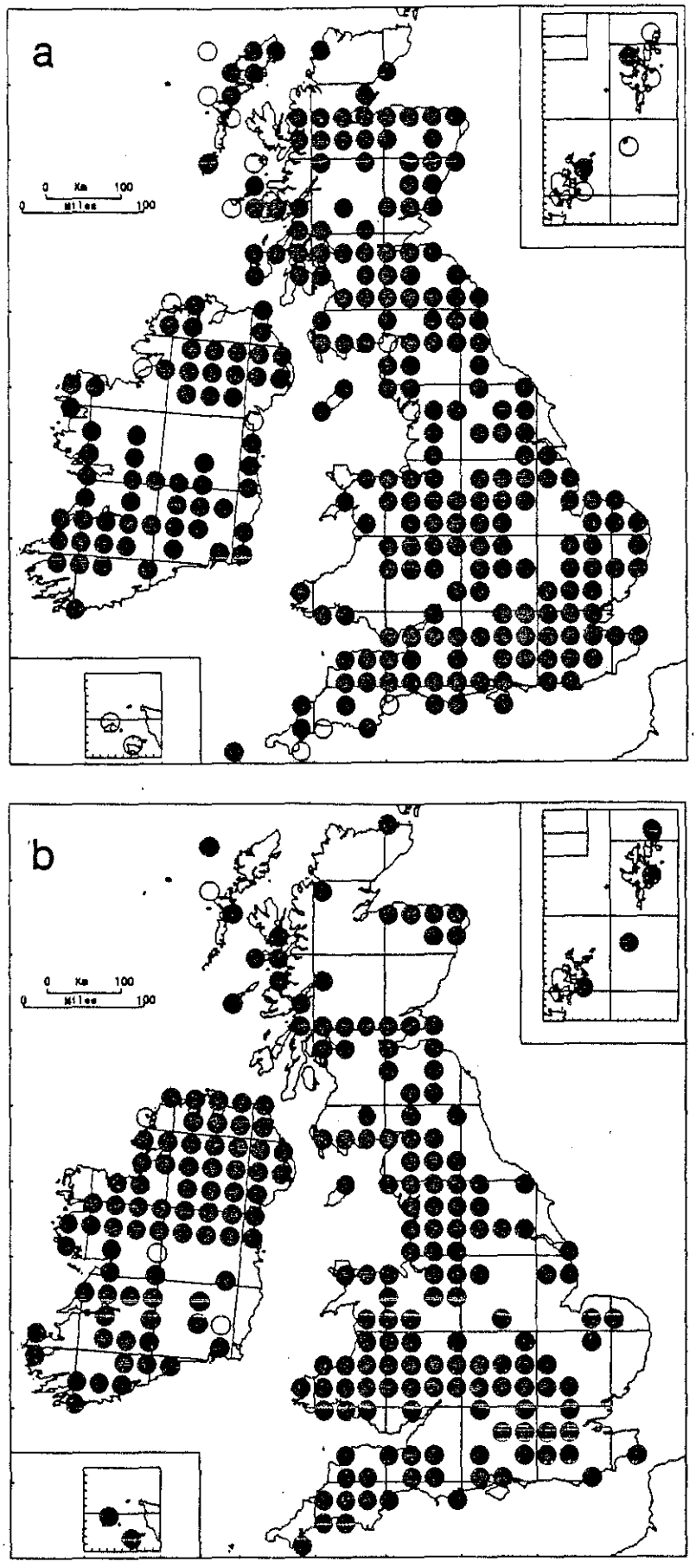
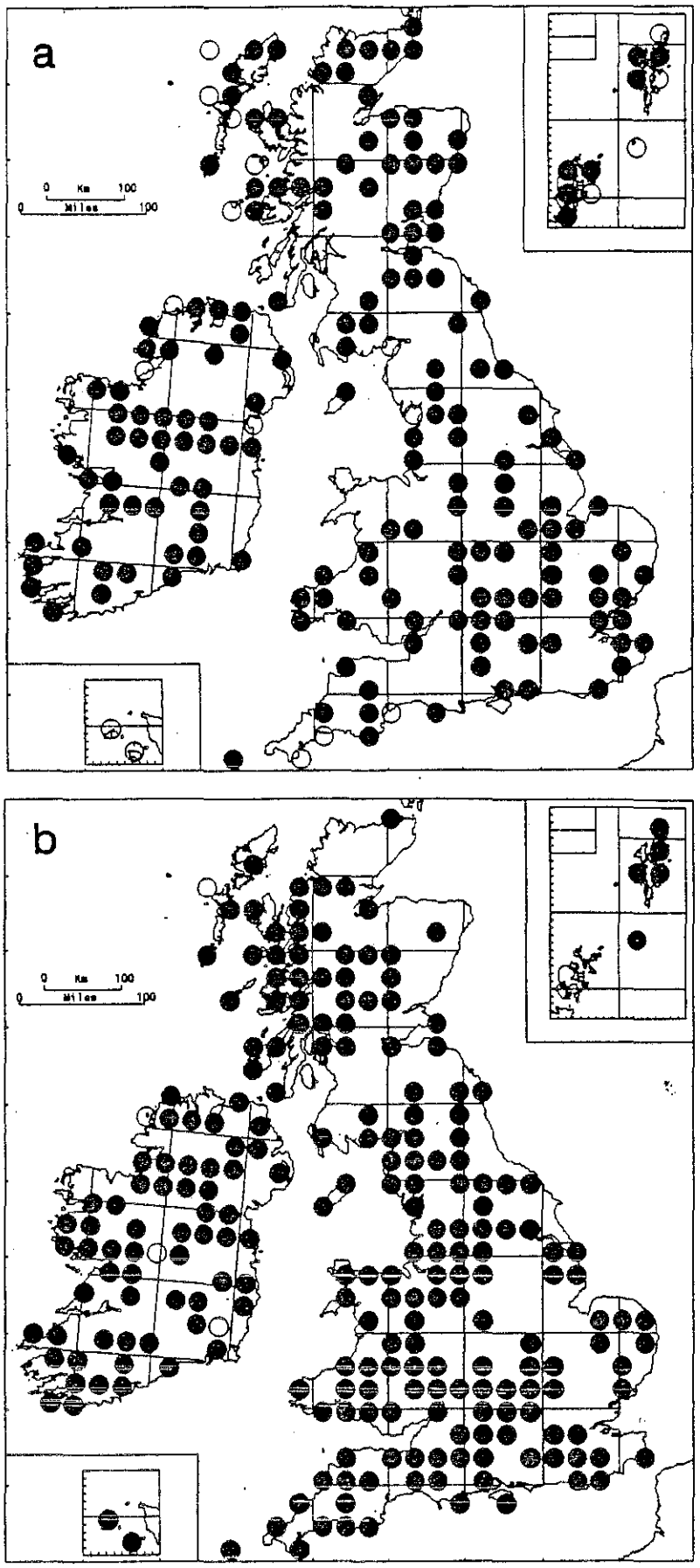
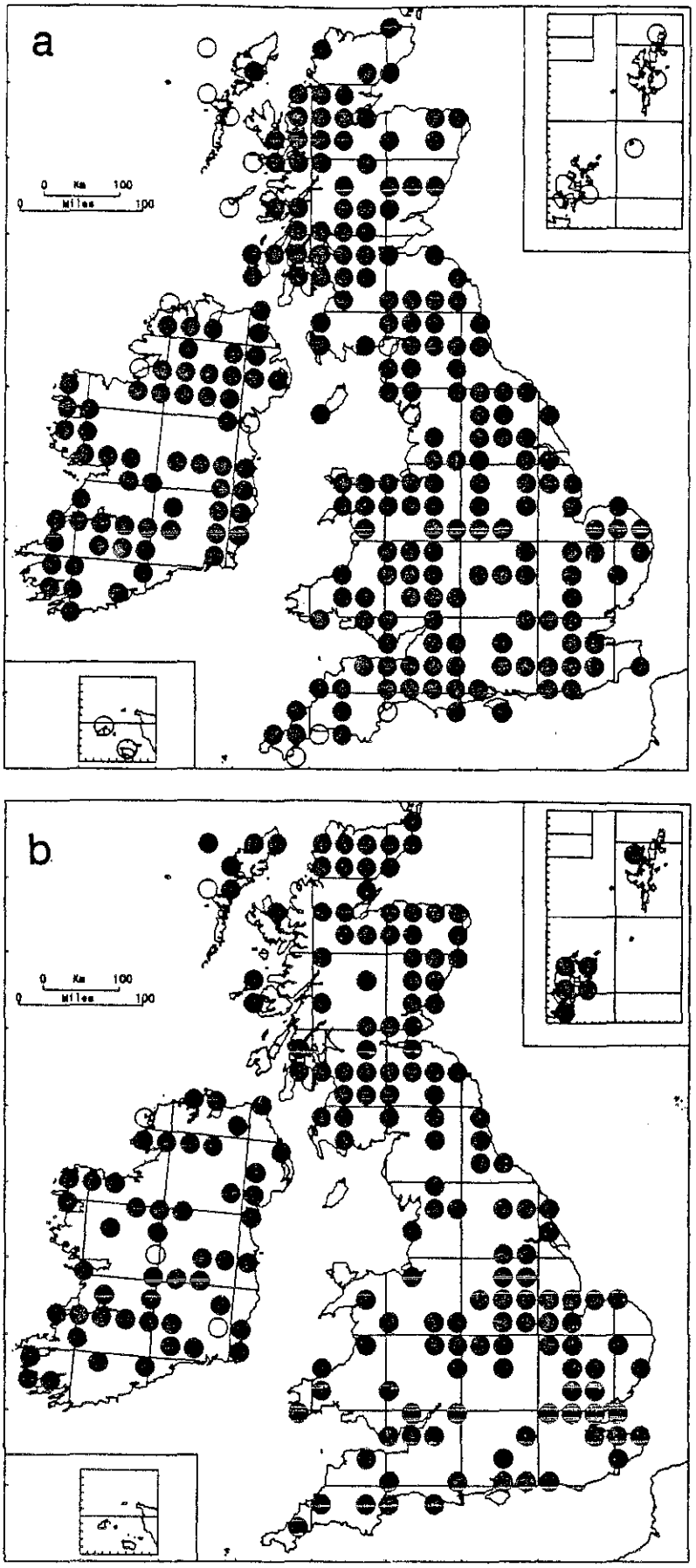


Figure 27. 10-km squares with an above average % of common species recorded. (number of common species per square for each survey ÷ combined total number of common species). (a) Atlas. (b) Monitoring Scheme. Squares not recorded for either survey are shown as open circles.



← This figure wrong, swap with 29b

Figure 28. 10-km squares which have been qualitatively well-recorded on at least 2 counts (eg above average % of common species and critical taxa, etc). (a) Atlas. (b) Monitoring Scheme. Squares not recorded for either survey are shown as open circles.



← This figure wrong — see 28b

Figure 29. 10-km squares qualitatively poorly recorded on at least 2 counts (eg below average % of critical taxa and grasses, etc). (a) Atlas. (b) Monitoring Scheme. Squares not recorded for either survey are shown as open circles.

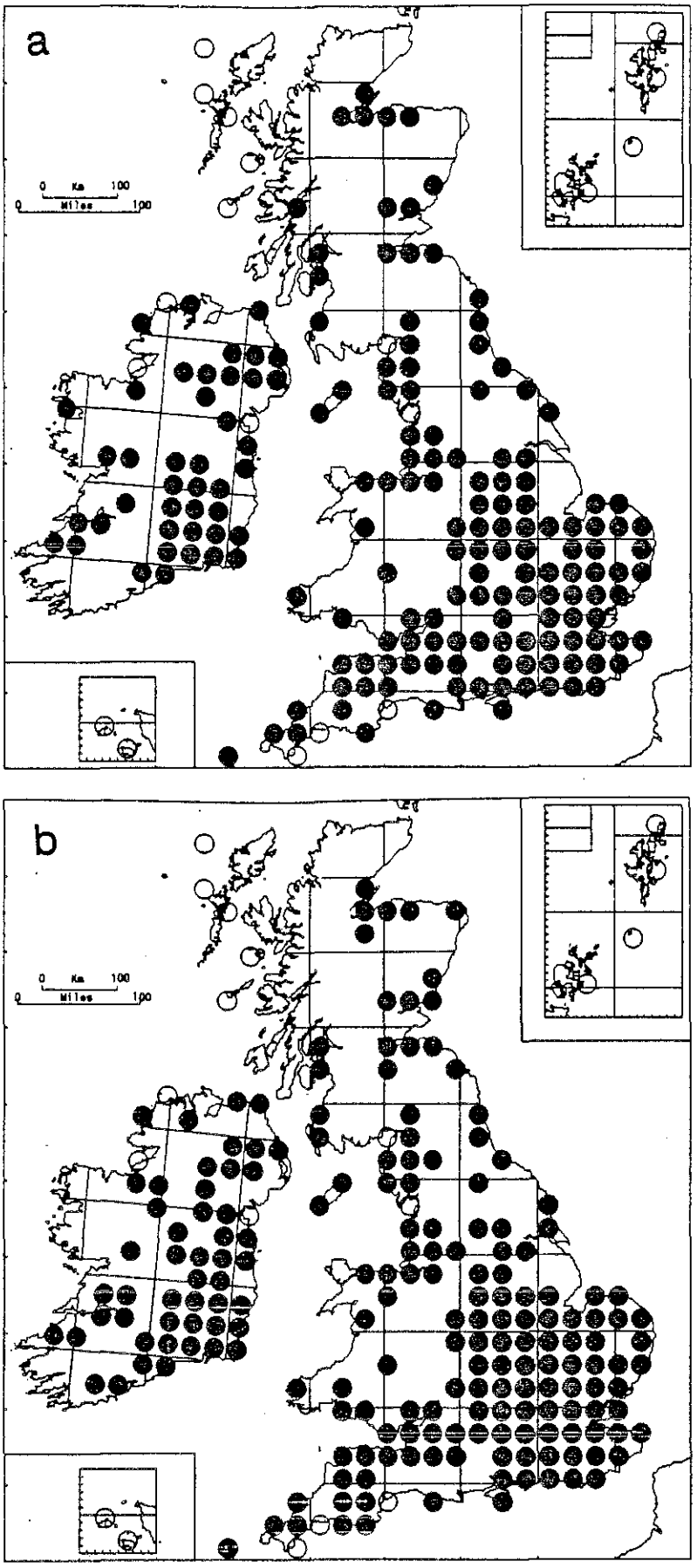


Figure 30. 10-km squares with a more than average alien component in the flora during the Atlas. (a) above average number of aliens. (b) above average % of aliens. Squares not recorded for the Atlas are shown as open circles.

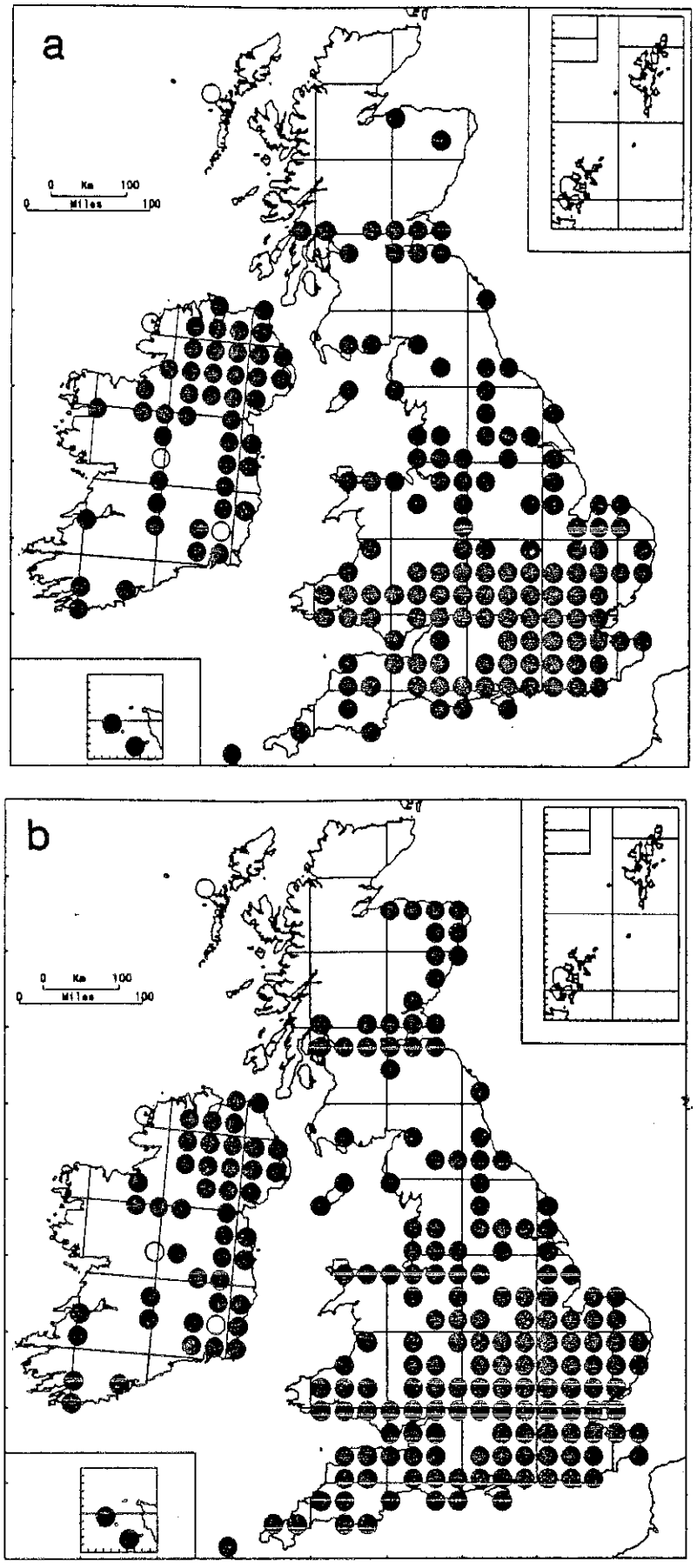


Figure 31. 10-km squares with an above average alien component in the flora recorded for the Monitoring Scheme. (a) above average number of aliens. (b) above average % of aliens. Squares not recorded for the Monitoring Scheme are shown as open circles.

The increase in numbers of aliens also reflects changes in record handling at BRC. Aliens which had no BRC number were ignored when the Atlas database was compiled, but many were later allocated numbers whilst the Monitoring Scheme data were being processed and included. There has not been time to rework the Atlas records. It is thus not possible to determine exactly the real increase in numbers of aliens due to recording and data handling bias. However, the numbers have almost certainly increased since the Atlas and will no doubt go on increasing.

The spread of some alien species over the last 30 years adds to the overall numbers recorded per square. Examples such as Heracleum mantegazzianum, Senecio squalidus, Veronica filiformis, Elodea species and Crassula helmsii can be seen on the maps. Also, many of these aliens are perennial and persistent; once established they can be virtually impossible to eradicate eg Reynoutria japonica. Other species have declined, however, especially arable weeds and grain aliens such as Scandix or Ranunculus arvensis. Many of these species are casual and not persistent. It is likely that not only a change in quantity has occurred but also a change in the type of plant too.

The large increase of aliens in Britain relative to Ireland probably partially results from an increase in the variety and quantity of garden plants deliberately dumped or accidentally escaping into the wild.

In summary, it is not possible to compare the numbers and changing influence of alien species between the two surveys due to changes in recording practice. It is likely, however, that the numbers of alien species has indeed increased during the last 30 years and that these increases are particularly concentrated in areas of high population.

5. Comparative distribution of records by month and day

The seasonality of appearance of plants is well-known. In the genus Scilla, for example, S. verna is most conspicuous in spring and early summer, whilst S. autumnalis is found mostly in late summer and early autumn. The seasonality of recording by botanists is also well-known - the greatest activity taking place during the summer. Species which are most conspicuous at the beginning or the ends of seasons are likely to be less consistently recorded than those most conspicuous in the summer. An extreme example of this is Gagea bohemica which escaped detection in Britain until 1967, because it usually flowers in February before most botanists come out of hibernation at Easter.

It is noted in the Atlas (p.xv) that some species had probably died down before the observers arrived to record them and thus appear to be rarer on the maps than they actually are. This effect was particularly marked in SW Ireland due to the early flowering season and the remoteness of the SW from the main centres of botanical activity. As seasonal recording bias was already known, the Atlas and Monitoring Scheme databases were compared for seasonal trends.

Figure 32 is a histogram showing the total number of records collected in each month for the Atlas and the Monitoring Scheme. The graph shows that the bulk of records were collected between May and September reflecting the seasonality of both plants and recorders. This seasonality has been investigated further for selected species, and data are presented as relative number of records per month for that species. Note that the general seasonality of recording has a marked influence on the shape of the graphs and that a different picture would be

obtained if the data were presented as a percentage of all records for each month. Also, note that these graphs do not indicate when a plant flowers, only when it is recorded. The distribution of records by month is first described for the Monitoring Scheme, and then for the Atlas.

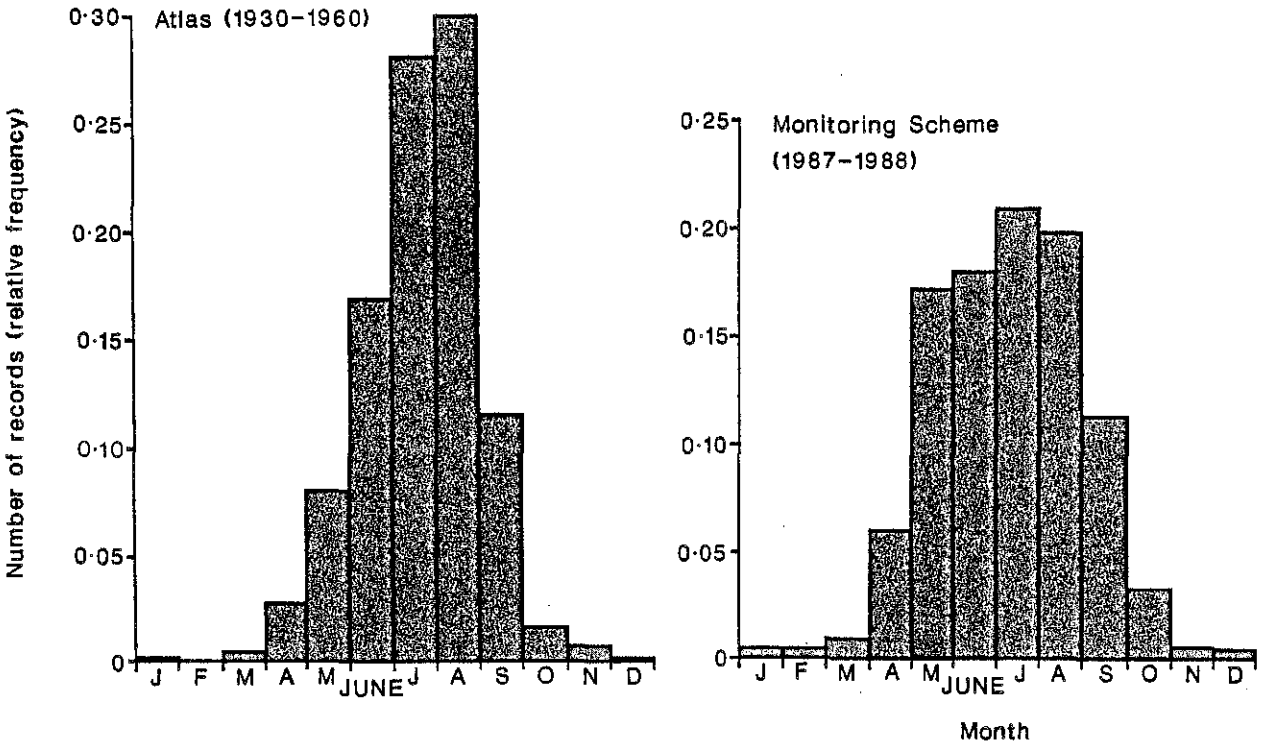


Figure 32. Number of records collected per month for the Atlas and the Monitoring Scheme.

Trifolium repens and Bellis perennis were selected as virtually ubiquitous species present all year; their seasonal recording pattern would therefore be expected to show a similar pattern to Figure 32. The pattern for Trifolium repens (Fig. 33a) is indeed very similar, suggesting that recording is not biased by season. Surprisingly, the pattern for Bellis (Fig. 33b) is different with a peak of records in May and a gradual decline during the summer. Does this decline represent a decrease in the relative conspicuousness of Bellis through the season as vegetation grows up hiding smaller plants and as lawns are cut, or does it suggest that once botanists have recorded Bellis from a square they get bored and do not bother to record it again? Perhaps the botanical joke "we've found Bellis, we can go home now" is not simply a joke after all!

The seasonal occurrence of many spring-flowering woodland species which die back during the summer is well-known. The seasonal recording pattern of two woodland species are shown in Figures 33c and 33d. Records for Adoxa show a marked peak in April and May, with a few records in June and July when the plant dies back. One record for October noticed during preparation of this graph was subsequently

queried and withdrawn, but what of the 6 records for August? Five of these records are for southern England and may be errors (Adoxa is next to Aegopodium on the cards?), whilst one record is from Scotland and could reflect differences in macroclimate. Note that these errors have only come to light as a result of this analysis, and probably would never have been otherwise queried. Late records for Bluebell on the other hand are acceptable as the fruiting heads remain conspicuous well into the autumn, and sometimes to the winter.

The seasonal recording pattern of two vernal species of open habitats, Veronica hederifolia and Ranunculus bulbosus, are shown in Figs. 33e and 33f. Veronica hederifolia is an annual of gardens, disturbed ground, fields etc and certainly peaks in abundance in early summer; the pattern shown may indeed reflect its frequency at different times of year. Ranunculus bulbosus is a perennial plant of grassland and sand dunes and flowers in April, May and June. For the remainder of the summer, it is present only as leaves or as a 1 cm diameter hole in the turf (J. Rodwell, pers. comm.); the marked difference between early and late summer may suggest that it is mostly recorded when flowering and conspicuous, but is very overlooked when vegetative.

Figure 34a shows 10-km squares which were not recorded for the Monitoring Scheme before 1 July in 1987 or 1988. Whilst this may be of little importance in Scotland, such squares might be expected to be under-recorded for spring species in Ireland, particularly in the south-west.

In contrast, autumn-flowering species show marked peaks late in the season (Figs. 33g-i). Records for Spiranthes spiralis are all from August and September - vegetative rosettes are present earlier in the year but are very inconspicuous (T.C.E. Wells, pers. comm.) (during preparation of this figure a number of records of Spiraea were found to have been erroneously included as Spiranthes, c.f. chapter 2). Records for Salicornia europaea sensu stricto are all from August to October reflecting the problems of identification in this critical genus. Gentianella amarella is more widely recorded through the year. The records in spring presumably refer to the previous year's fruiting heads which remain conspicuous in grassland until early summer. The small peak of records in June also presumably reflects this and not confusion with Gentianella anglica which flowers at this time.

Figure 34b shows 10-km squares which were not recorded after the end of June in 1987 and 1988. Compared to spring-flowering species, autumn-flowering species are less likely to be under-represented in the Monitoring Scheme data.

Figures 33j and 33k show two species with interesting bimodal seasonality in records. Arum maculatum is conspicuous in spring as the leaves and inflorescences appear, but becomes much less obvious in June and July as hedgerows etc become more overgrown with other vegetation and the fruiting heads are small and green. In August when the fruits begin to turn red the plant is once again noticed and the records increase. Note that the plant has been present in June and July and should therefore follow a similar pattern to all records, - it is just relatively under-recorded at this time of year.

The seasonality of mistletoe recording is not quite as might be predicted. Records rise to a peak in May and then drop as leaves appear on trees. A rise might be predicted in October when leaves are shed, but there is a surprising peak in late August instead. Perhaps botanists spot it in August when they go scrumping apples in orchards? The small peak at Christmas is predictable!

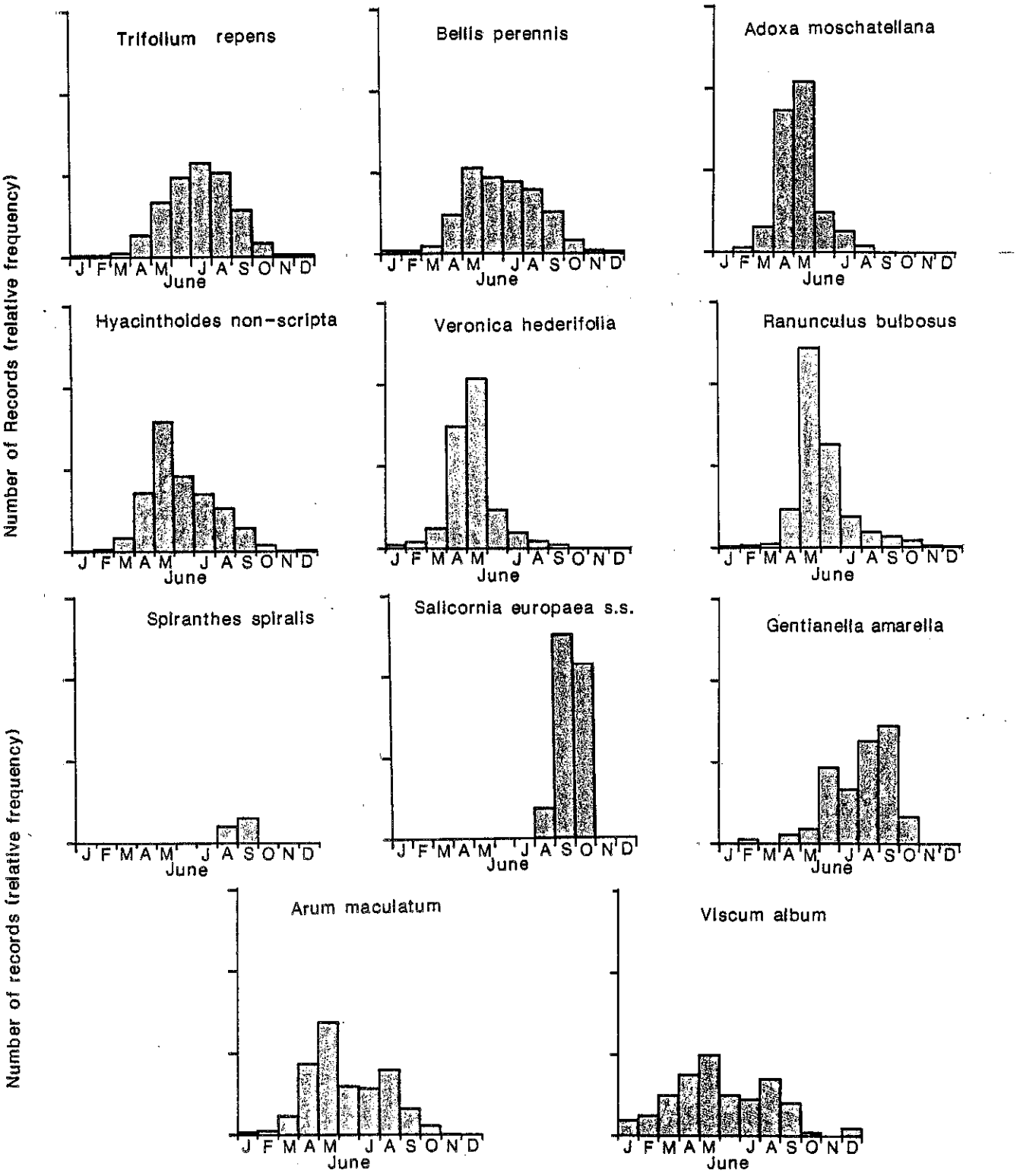
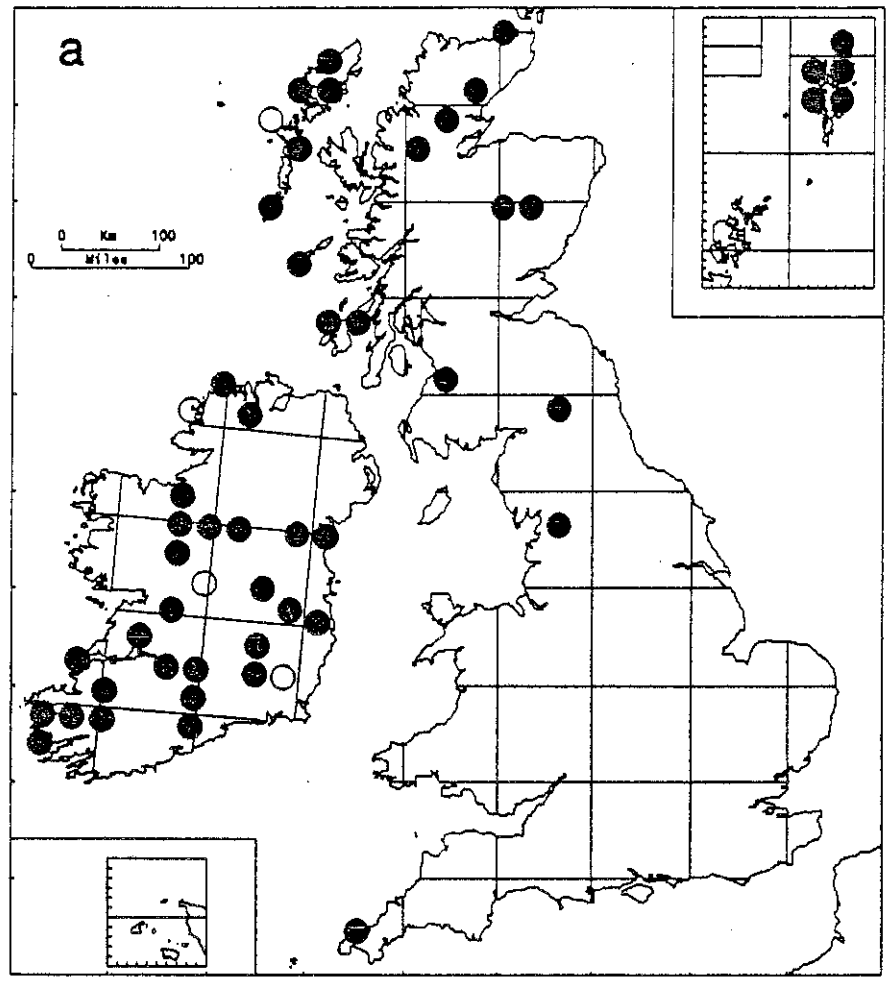


Figure 33. Distribution of Monitoring Scheme records by month for selected species. (a) Trifolium repens. (b) Bellis perennis. (c) Adoxa moschatellina. (d) Hyancinthoides non-scripta. (e) Veronica hederifolia s.l. (f) Ranunculus bulbosus. (g) Spiranthes spiralis. (h) Salicornia europaea s.s. (i) Gentianella amarella. (j) Arum maculatum. (k) Viscum album.



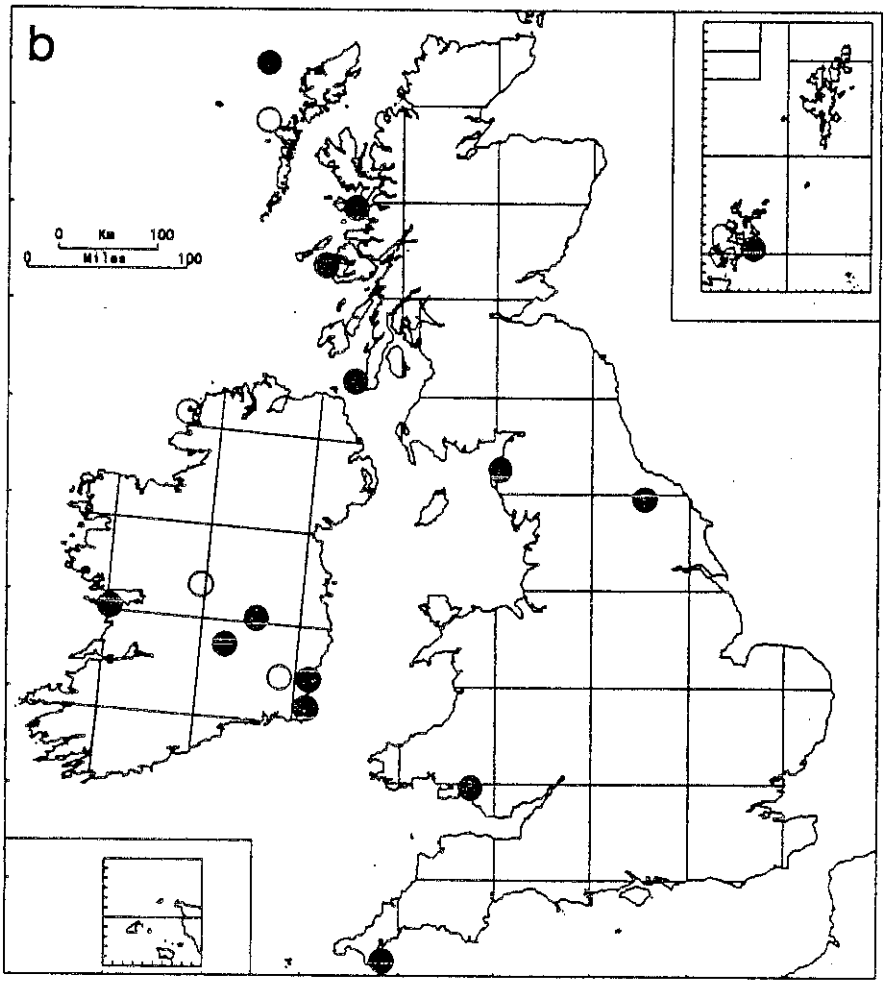


Figure 34. 10-km squares with a seasonal bias to the records for the Monitoring Scheme. (a) squares not recorded before July. (b) squares not recorded after June.

When a similar exercise is repeated for the Atlas records, a different picture emerges (Figure 35). Spring-flowering species such as Adoxa and Hyacinthoides are apparently recorded throughout the year, Spiranthes appears to be recorded a month earlier and Salicornia europaea is apparently determinable in March. The relative number of records for other species appears to be closer to what is expected; Gentianella amarella is recorded mostly in late summer, Viscum shows a nice bimodal monthly distribution consistent with the appearance of leaves on the trees and Arum shows no seasonality.

The most likely explanation for this is that the Atlas field cards, from which most of this data information has been derived, are frequently summary cards to which species have been added from all times of year. Any apparently precise date information from the Atlas period is probably misleading unless it can be verified from an independent source. This further confirms the conclusions drawn in Chapter 3 regarding the records in the Atlas database; they are largely summary data which do not benefit from closer inspection. Maps showing squares recorded only late or early in the season for the Atlas period (like those in Figure 34 for the Monitoring Scheme) would therefore be misleading.

In conclusion, a comparison of seasonal trends in recording between the Atlas and Monitoring Scheme databases is not feasible due to the summary nature of the Atlas records.

Distribution of records by day

A significant bias towards records collected at weekends compared to weekdays would be expected, but there should be no reason to expect that there would be more records for the 1st day of any month compared to the 2nd and subsequent days unless cards were being dated from the beginning of the month and added to subsequently. The number of individual records for each day of the month were therefore compared for records in the Monitoring Scheme and Atlas databases.

For the Monitoring Scheme there is little variation through the month - the influence of the first, last and Whitsun day hunts being swamped within the total records. However, for the Atlas period, there is a general decline through the month with large fluctuations between individual days. Some of the fluctuations might be explained by individual recorders during the Atlas compiling all records for their area on the same day and giving the date of compilation, not recording, but the general decline is inexplicable. Surprisingly, there are also more records for the 31st day than the 30th for both sets of records. What this means (if anything) remains to be resolved!

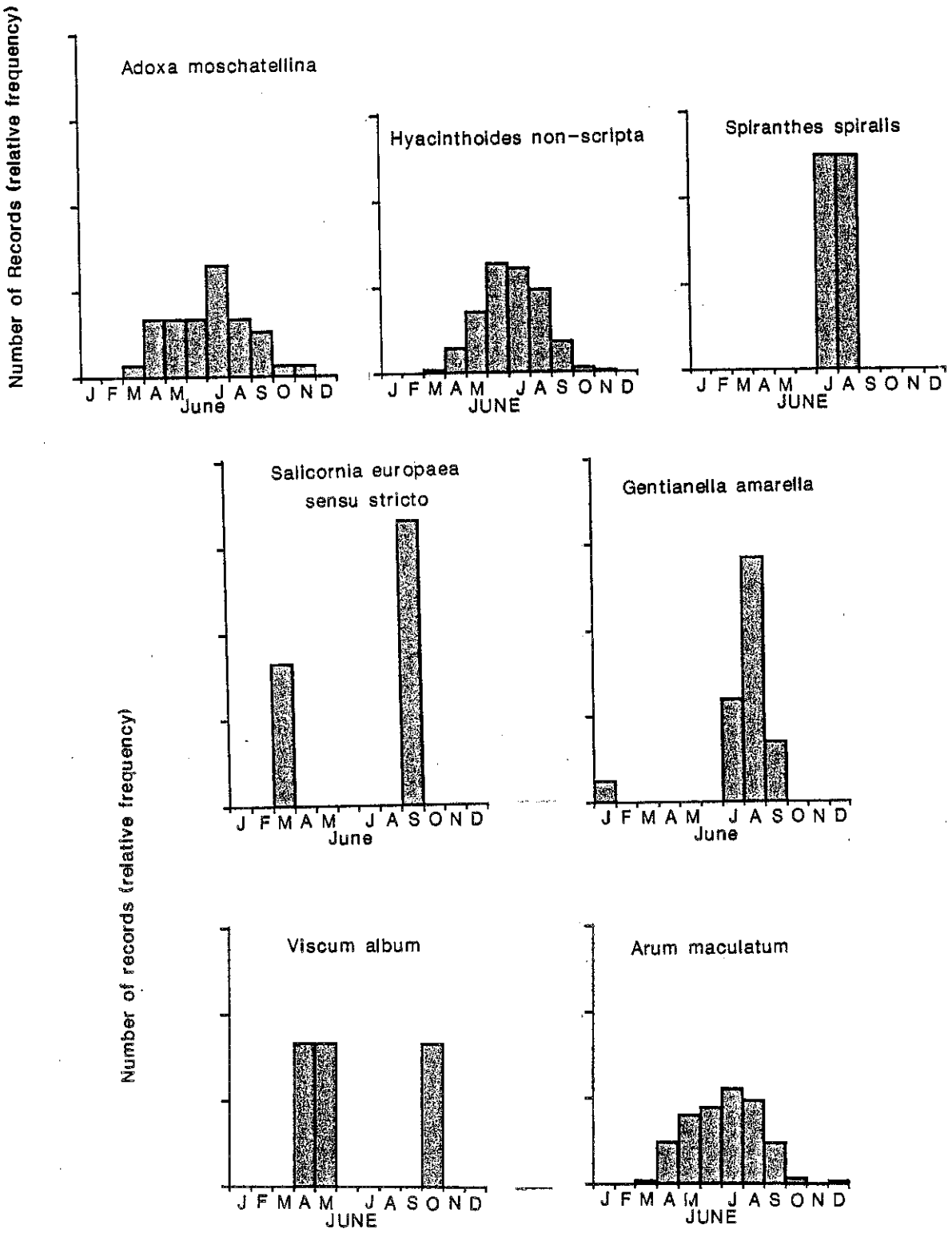


Figure 35. Distribution of Atlas records by month for selected species. (a) Adoxa moschatellina. (b) Hyacinthoides non-scripta. (c) Spiranthes spiralis. (d) Salicornia europaea s.s. (e) Gentianella amarella. (f) Viscum album. (g) Arum maculatum.

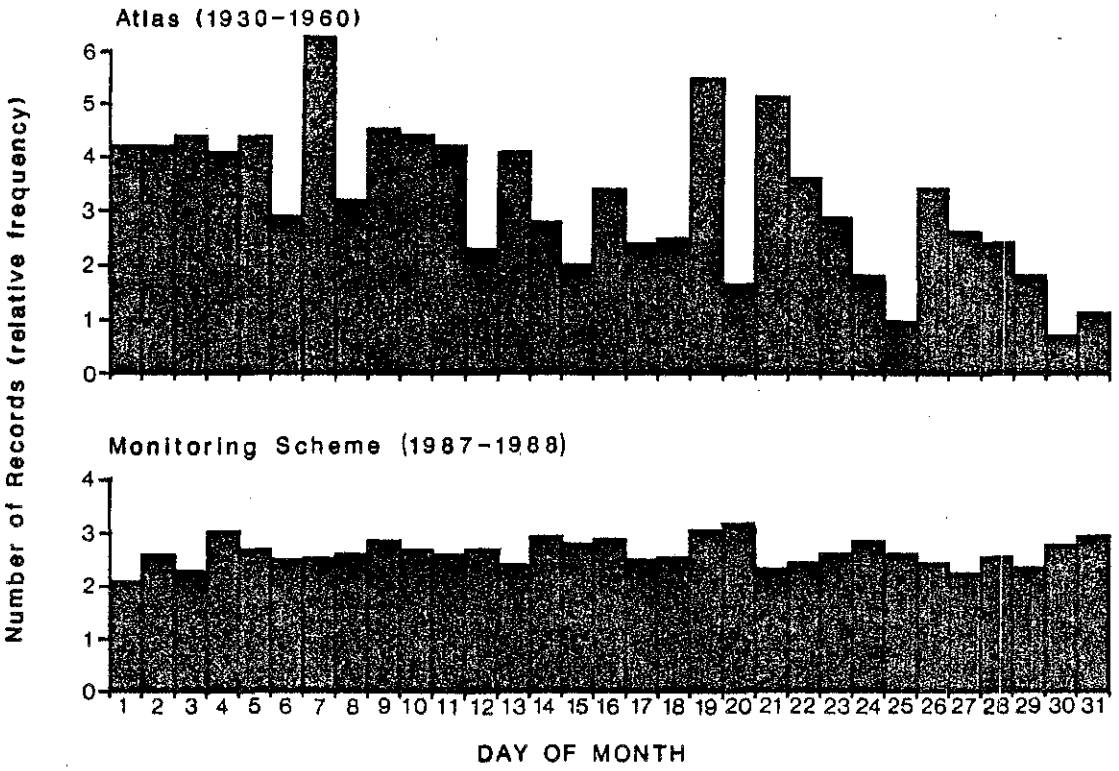


Figure 36. Comparison of number of records per day for the Atlas and Monitoring Scheme databases.

explanation of Fig 36:

- the Atlas field cards did not have enough room to write full dates in the small box on the cards, so short dates eg 1/6/51 would fit but not 31/10/58 - hence more records for days 1–11 than later 12–31!

- no such problem with Monitoring Scheme!

CHAPTER 5

Detailed comparison of the Atlas and Monitoring Scheme surveys and assessment of changes in distribution and/or frequency of species

Contents

1. Introduction

There are a number of fundamental differences between the Atlas survey and the Monitoring Scheme. To assess which species have changed in frequency and/or distribution, the Monitoring Scheme records need to be compared with the Atlas records objectively, though the two surveys are not strictly comparable. It should be emphasised that, when originally collected, the Atlas records were never envisaged as being used to monitor the flora in this way. The Monitoring Scheme survey was also designed differently deliberately, to give a more sensitive means of monitoring the flora in the future by using the network of tetrads.

This chapter sets out the main differences between the surveys, and how they have been treated to make the comparison as objective as possible. Some differences relate to the basic designs of the surveys, some to the data included and others to the recording. These differences need to be minimised before the significance of any changes can be assessed.

The importance of assessing recording bias before assessing change can be illustrated as follows. Two 10-km squares recorded for the Monitoring Scheme in Sussex have been compared with records in the Sussex Plant Atlas (Hall 1980) by Alan Knapp and Betty Bishop respectively with additional comments by Mary Briggs and Breda Burt. The Sussex Plant Atlas was selected for the comparison rather than the Atlas records because it is recent and admirably comprehensive; thus change can be distinguished from recorder bias.

41/8.0 (Alan Knapp)

" 54 species were recorded in the Sussex Plant Atlas in 2 or more tetrads in the 10-km square but were not recorded for the Monitoring Scheme.

47 species were recorded as 'new' to the 10-km square during the Monitoring Scheme, though 4 had certainly been around for some time but were not recorded.

21 species have either been under-recorded for the Monitoring Scheme or have decreased in abundance since the Sussex Plant Atlas.

10 species have more records for the Monitoring Scheme than the Sussex Plant Atlas and have either increased or were previously under-recorded.

It is apparent that some of the absences compared to the Sussex Plant Atlas are a result of the concentration of recording into the 3 special (AJW) tetrads in this survey. For example, a lot of the fresh water habitat in 41/8.0 is in the canal and the gravel pits around Chichester, none of which fall within A, J or W. They are concentrated in F, K, R and X, none of which appear to have been recorded. Of the species which have not been recorded or are under-recorded for the Monitoring Scheme more are associated with wet habitats than with any other single habitat type.

Other species (eg Agrostis capillaris, Avena fatua, Carpinus betulus, Coronopus squamatus, Equisetum palustre, Humulus lupulus, Knautia arvensis, Mentha arvensis, Odontites verna, Petroselinum segetum, Scrophularia auriculata, Torilis japonica, Verbascum nigrum and Vicia hirsuta) would have had to have suffered a very large and local decline to account for their rarity or absence from the Monitoring Scheme survey. Their absence or scarcity in this survey is presumably the result of simply being over-looked. Part of the reason may be that some of these, Carpinus betulus, Odontites verna and Torilis japonica for

example, although widespread are very localised in that area. Pinus sylvestris was probably regarded as planted and ignored. The species which are most likely to have suffered a real reduction I feel would be:

Petroselinum segetum (present in 4 of the tetrads covered here, but very easy to miss)

Scandix pecten-veneris (2 of 3 Sussex Plant Atlas records in tetrads covered here)

Scleranthus annuus (both Sussex Plant Atlas records in tetrads covered here)

Spergula arvensis (1 of 3 Sussex Plant Atlas records in tetrad covered here)

Of the species which are new or increased, some like Valerianella locusta, Leontodon taraxacoides, Oenanthe pimpinelloides, the Rubus and Salicornia species and some aliens, are almost certainly due to increased awareness or expertise in the recorders. I am virtually certain that some species have simply been missed before. For genuine increases I would select as the most likely candidates:

Lamium maculatum (seems to be appearing in many places)
Mahonia aquifolium
Solidago canadensis
Solidago gigantea

Ranunculus parviflorus appeared as a garden weed and is almost certainly new in that location (but where did it come from?). Lonicera japonica, I am certain was ignored before. Malus domestica was probably mis-recorded as Malus sylvestris."

One result of this investigation was that it was discovered that some of the unrecorded species had indeed been recorded for the Monitoring Scheme but the records had got lost somewhere between the original recording and the Monitoring Scheme database - another case of 'missing cards' (Chapter 2).

51/4.0 (Betty Bishop)

"Monitoring Scheme records are under-represented due to insufficient visits, and early- and late-flowering plants were often absent. The Sussex Plant Atlas was recorded over 14 years.

Some species recorded for the 10-km square in the Sussex Plant Atlas occur in habitats not represented in the A, J and W tetrads and not visited for the Monitoring Scheme.

Some species have been lost from tetrad A as Peacehaven is a "disaster area" for plants owing to building and development.

A number of species recorded in the Lewes ditches have declined in recent years owing to eutrophication by fertilizer run-off.

There was some confusion about recording in the 10-km square for the Monitoring Scheme - some botanists thought that only A, J and W tetrad records were to be sent in." (This point caused TCGR and others some consternation when it became apparent this was not an isolated occurrence; the original Monitoring Scheme instructions may not have made it clear that both the A, J and W tetrads and the 10-km squares were to be recorded comprehensively).

Many of the themes in these two examples (differences in time span of records, number of visits, under-recording, concentration on the A, J and W tetrads) show the differences due to recording may be greater than real change. These and other themes are now discussed in more detail. Other differences such as the absence of many critical taxa from the Atlas database and treatment of coastal squares have been pointed out in Chapter 2-4.

2. Differences between the surveys

2a. Change of grid in Ireland

The change of recording grid in Ireland has meant that the areas recorded for the Monitoring Scheme do not directly compare with the areas recorded for the Atlas, as they do in Britain. The conversion of the Irish Atlas records from the old British grid to the new Irish grid is reasonably acceptable for about 1/6 of the squares, but for another 1/6 it is poor (eg some coastal species appear inland and some mountainous species appear in the lowlands). This effect may be particularly significant in N. Ireland.

2b. Concentration on the selected A, J and W tetrads

For the Atlas survey, botanists compiled lists for each 10-km square, selecting the areas to visit themselves. For the Monitoring Scheme, lists were required for each of the A, J and W tetrads and also a combined one for the 10-km square including other areas. Provided both 10-km square lists are reasonably comprehensive, the concentration on the A, J and W tetrads is of no significance when comparing the two surveys.

However, the request for comprehensive lists from the 3 tetrads in addition to the 10-km square has imposed considerably more work on the botanists (an estimated 2-3 times the amount) and forced detailed attention to the selected areas, and it would not be surprising if the 10-km square lists were more representative of the selected tetrads than the square as a whole. This is particularly true in the Republic of Ireland where it was decided to record the A, J and W tetrads in detail and ignore the remainder of the square unless time was available later.

One result of concentrating on the A, J and W tetrads is that species which occur elsewhere in the 10-km square may not be recorded. Numerous examples can be found by examining any recent tetrad flora. Not only may individual species be missed, but whole habitats and their flora may be unrepresented. Some estimate of the extent to which the 10-km square list really does represent the flora of the square and not just the flora the A, J and W tetrads is therefore required.

This problem has been solved for the Monitoring Scheme by John Dony. Dony (1963, 1976) derived an equation which can be used to predict the average expected number of species (S) in an area (A) from a regression of the number of species recorded from known areas against area (Figure 37):-

$$S = cA^z$$

$$\text{or} \quad \log S = \log c + z . \log A$$

where c and z are constants. A satisfactory fit to the data examined is given by $z = 0.22$ and $c = 223$ (where area is given in km^2; note this figure

is corrected from Dony 1986). Predictions of the equation for selected areas are compared with real data as follows (J.G. Dony, pers. comm.):-

tetrad ..... 303 species (average 262 in Bedfordshire and 261 in Hertfordshire)
10-km square .... 620 species (average 636 for five complete 10-km squares in Bedfordshire)
Bedfordshire .... 1019 species (1061 species recorded)
British Isles ... 2612 species (Dandy listed 3,000 - 3,500)
The prediction of 10 species in a quadrat (1 m^2) is also satisfactory.

As this equation is principally derived from data collected in S. England, its predictions may not be applicable to other areas in absolute terms, though they may be in relative terms. The useful predictions of relative numbers of species in tetrads for a 10-km square are as follows:

i) About 1.7% of the species in a tetrad will be unique to that tetrad (ie will not occur elsewhere in the 10-km square).

ii) The number of species in any one tetrad on average will be c. 49% of the total number for the 10-km square.

iii) The number of species expected from any 2 tetrads will on average be about 57% of the total species for the 10-km square.

iv) The number of species expected from any 3 tetrads (eg A, J and W) will be on average about 62.5% of the total species for the 10-km square.

The 25 tetrads in any 10-km square will have minor differences from each other and the wider the tetrads apart from each other the greater the differences are likely to be. The predictions for 2 or 3 tetrads assume that the area involved is continuous (i.e. the tetrads are adjacent) which is not the case; the average % of the total 10-km square flora for these is likely to be higher in both these cases than given above (exactly how much higher remains to be resolved) and these estimates are rounded up to 60% and 65% respectively.

Note that these predictions are estimates which may not hold for individual squares. For example tetrad W of the square 34/6.6 on the Lancashire/ Yorkshire border is very species-poor moorland with only 5% of the flora of the 10-km square, whilst tetrad J has 63%.

The number of different taxa in the A, J and W tetrads was therefore compared to the total number of species for each 10-km square for the Monitoring Scheme records (Table 8). The average percentage of taxa recorded in the selected A, J and W tetrads only (i.e. excluding the remainder of the 10-km) was about 74%, approximately 10% higher than would be expected if the 10-km squares had been recorded in equal detail to the selected tetrads. Therefore, the 10-km square lists represent more closely the flora of the selected tetrads than the whole 10-km square.

Whilst this technique can be used to pick out areas which are likely to be relatively under-recorded due to a concentration of the A, J and W tetrads (note if the whole square is under-recorded including the selected tetrads this will not show up), it cannot be applied to the Atlas records as there are no systematic tetrad data available. In practice it is also difficult to know how much concentrating in detail on small areas has actually

Britain

SQUARE	EXPEC-TED %	ACTUAL %	SQUARE	EXPEC-TED %	ACTUAL %	SQUARE	EXPEC-TED %	ACTUAL %	SQUARE	EXPEC-TED %	ACTUAL %
00/91	49%	86%	20/17	65%	71%	26/77	65%	84%	31/63	65%	49%
07/69	49%	29%	20/44	49%	87%	27/10	65%	77%	31/66	65%	61%
07/93	49%	33%	20/47	65%	79%	27/13	65%	67%	31/69	65%	70%
08/68	49%	0%	20/74	65%	82%	27/16	65%	80%	31/90	65%	58%
08/95	49%	32%	20/77	65%	80%	27/19	65%	87%	31/93	65%	68%
08/98	60%	67%	21/10	49%	66%	27/40	65%	74%	31/96	65%	94%
09/64	0%	0%	21/19	49%	50%	27/43	65%	91%	31/99	65%	67%
09/91	49%	93%	21/40	65%	67%	27/46	65%	91%	32/02	65%	58%
10/54	60%	95%	21/43	60%	59%	27/49	65%	80%	32/05	65%	55%
10/81	0%	0%	21/49	65%	57%	27/70	65%	83%	32/08	65%	90%
10/84	65%	59%	21/70	65%	76%	27/73	65%	96%	32/32	65%	65%
10/87	49%	73%	21/73	65%	73%	27/76	65%	94%	32/35	65%	66%
11/89	0%	0%	21/79	60%	39%	27/79	65%	67%	32/38	65%	93%
12/82	60%	64%	22/12	65%	73%	28/12	65%	73%	32/62	65%	68%
16/24	49%	72%	22/15	49%	52%	28/15	65%	57%	32/65	65%	70%
16/27	60%	92%	22/42	65%	73%	28/18	65%	89%	32/68	65%	71%
16/51	49%	77%	22/45	65%	75%	28/42	65%	61%	32/92	65%	64%
16/57	60%	0%	22/72	65%	58%	28/45	65%	51%	32/95	65%	77%
16/84	65%	60%	22/75	65%	76%	28/48	65%	49%	32/98	65%	67%
16/87	60%	37%	22/78	65%	76%	28/72	65%	56%	33/01	65%	83%
17/23	0%	0%	23/44	65%	82%	28/75	60%	65%	33/04	65%	74%
17/26	49%	77%	23/47	65%	53%	28/78	65%	93%	33/07	65%	83%
17/29	0%	0%	23/71	65%	59%	29/11	65%	76%	33/31	65%	82%
17/53	65%	78%	23/74	65%	82%	29/14	60%	45%	33/34	65%	81%
17/56	60%	91%	23/77	65%	64%	29/41	65%	95%	33/37	65%	62%
17/59	0%	0%	24/16	0%	0%	29/44	65%	59%	33/61	65%	86%
17/80	65%	68%	24/49	60%	40%	29/71	65%	86%	33/64	65%	66%
17/83	60%	78%	25/15	60%	72%	29/74	65%	91%	33/67	65%	64%
17/86	65%	82%	25/18	65%	30%	30/07	49%	78%	33/91	65%	76%
17/89	65%	63%	25/45	65%	61%	30/67	60%	53%	33/94	65%	52%
18/25	65%	77%	25/48	65%	75%	30/97	49%	49%	33/97	65%	70%
18/52	65%	38%	25/75	65%	74%	31/00	65%	78%	34/09	49%	64%
18/55	65%	71%	25/78	65%	59%	31/03	65%	60%	34/30	65%	73%
18/82	65%	90%	26/14	0%	0%	31/06	49%	57%	34/33	65%	79%
18/85	65%	67%	26/17	60%	65%	31/09	65%	83%	34/36	0%	0%
18/88	65%	50%	26/41	65%	53%	31/30	65%	80%	34/39	65%	66%
19/21	65%	96%	26/44	65%	67%	31/33	65%	44%	34/60	65%	78%
19/24	60%	74%	26/47	65%	46%	31/36	60%	53%	34/63	65%	70%
19/54	60%	89%	26/71	65%	84%	31/39	65%	67%	34/66	65%	69%
20/14	0%	0%	26/74	65%	85%	31/60	65%	63%	34/69	65%	76%

Table 8. Percentage of the Monitoring Scheme records species recorded in each square recorded. The expected percentages (see text) are also given.

Table 8, continued.

SQUARE	EXPECTED %	ACTUAL %
34/90	65%	69%
34/93	65%	80%
34/96	65%	64%
34/99	65%	86%
35/02	65%	95%
35/05	0%	0%
35/08	65%	80%
35/32	65%	72%
35/35	65%	67%
35/38	65%	91%
35/62	65%	79%
35/65	65%	75%
35/68	65%	85%
35/92	65%	75%
35/95	65%	75%
35/98	65%	71%
36/01	65%	61%
36/04	65%	83%
36/07	65%	61%
36/31	65%	64%
36/34	65%	47%
36/37	60%	56%
36/61	65%	67%
36/64	65%	65%
36/67	65%	64%
36/91	65%	92%
36/94	65%	91%
37/00	65%	77%
37/03	65%	97%
37/06	65%	72%
37/09	65%	71%
37/30	65%	78%
37/33	65%	96%
37/36	65%	96%
37/39	65%	62%
37/60	49%	70%
37/63	49%	47%
37/66	65%	91%
37/69	65%	88%
37/99	60%	94%
38/02	65%	82%
38/05	65%	88%
38/32	65%	63%
38/35	65%	88%
38/62	65%	81%
38/65	65%	85%
38/92	65%	77%
38/95	65%	89%
39/01	49%	81%
39/04	65%	65%
39/07	0%	0%
39/34	60%	93%
39/37	60%	80%
40/57	49%	52%
41/20	65%	71%
41/23	65%	72%
41/26	65%	97%
41/29	65%	85%
41/50	60%	53%
41/53	65%	66%
41/56	65%	72%
41/59	65%	77%
41/80	65%	77%
41/83	65%	64%
41/86	65%	76%
41/89	65%	77%
42/22	65%	72%
42/25	65%	67%
42/28	65%	90%
42/52	65%	92%
42/55	65%	56%
42/58	65%	81%
42/82	65%	72%
42/85	65%	61%
42/88	65%	65%
43/21	65%	96%
43/24	65%	87%
43/27	65%	69%
43/51	65%	78%
43/54	65%	53%
43/57	65%	85%
43/81	65%	75%
43/84	65%	63%
43/87	65%	72%
44/20	65%	90%
44/23	65%	55%
44/26	65%	64%
44/29	65%	89%
44/50	65%	66%
44/53	65%	67%
44/56	65%	81%
44/59	65%	95%
44/80	65%	49%
44/83	65%	86%
44/86	65%	73%
44/89	65%	97%
45/22	65%	87%
45/25	65%	95%
45/28	65%	92%
45/52	65%	81%
46/21	60%	70%
51/10	65%	68%
51/13	65%	81%
51/16	65%	64%
51/19	65%	85%
51/40	65%	72%
51/43	65%	79%
51/46	65%	63%
51/49	65%	66%
51/70	49%	39%
51/73	65%	75%
51/76	65%	70%
51/79	65%	65%
52/12	65%	72%
52/15	65%	64%
52/18	65%	79%
52/42	65%	70%
52/45	65%	49%
52/48	65%	66%
52/72	65%	72%
52/75	65%	75%
52/78	65%	57%
53/11	65%	69%
53/14	65%	61%
53/17	65%	63%
53/41	65%	60%
53/44	60%	44%
53/47	65%	63%
53/71	65%	49%
53/74	60%	53%
54/10	65%	86%
54/13	65%	74%
54/16	60%	58%
54/40	49%	94%
57/30	49%	41%
57/33	49%	83%
57/60	49%	90%
57/63	49%	60%
61/03	65%	70%
61/06	65%	68%
61/09	60%	58%
61/33	0%	0%
61/36	60%	60%
62/02	65%	97%
62/05	65%	67%
62/08	65%	93%
62/35	65%	53%
62/38	65%	61%
63/01	65%	96%
63/04	60%	91%
63/31	65%	77%
67/26	0%	0%
68/25	65%	69%
68/28	60%	81%
68/55	0%	0%
68/58	60%	93%
69/51	49%	93%
CHANNEL ISLANDS		
90/38	49%	49%
90/65	60%	52%

Table 8, continued.

Ireland

SQUARE	EXPECTED %	ACTUAL %
00/45	0%	0%
00/48	60%	69%
00/72	0%	0%
00/75	65%	60%
00/78	65%	64%
01/41	60%	60%
01/71	65%	94%
01/74	49%	80%
02/73	60%	70%
02/76	65%	92%
02/79	65%	94%
03/72	60%	93%
10/02	49%	52%
10/05	65%	83%
10/08	65%	71%
10/35	65%	55%
10/38	65%	72%
10/65	65%	67%
10/68	65%	76%
10/98	65%	66%
11/01	65%	94%
11/04	65%	68%
11/07	65%	91%
11/31	65%	85%
11/34	65%	78%
11/37	65%	80%
11/61	65%	86%
11/64	65%	80%
11/67	65%	82%
11/91	65%	94%
11/94	65%	95%
11/97	65%	95%
12/00	49%	95%
12/03	65%	66%
12/06	60%	89%
12/09	65%	88%
12/30	65%	75%
12/33	65%	96%
12/36	65%	93%
12/39	65%	93%
12/60	65%	97%
12/63	65%	97%
12/66	65%	94%
12/69	65%	90%
12/90	65%	95%
12/93	65%	0%
12/96	65%	88%
12/99	65%	94%
13/02	65%	88%
13/32	65%	95%
13/62	65%	92%
13/65	49%	74%
13/68	65%	63%
13/92	65%	96%
13/95	65%	73%
13/98	65%	77%
14/61	49%	0%
14/91	65%	76%
14/94	0%	0%
20/28	65%	87%
21/21	65%	70%
21/24	60%	96%
21/27	60%	97%
21/51	65%	44%
21/54	65%	94%
21/57	65%	94%
21/81	65%	82%
21/84	65%	0%
21/87	65%	94%
22/20	65%	89%
22/23	65%	95%
22/26	65%	96%
22/29	65%	89%
22/50	65%	94%
22/53	65%	95%
22/56	65%	96%
22/59	65%	83%
22/80	65%	96%
22/83	65%	95%
22/86	65%	95%
22/89	65%	94%
23/22	65%	81%
23/25	65%	69%
23/28	65%	70%
23/52	65%	74%
23/55	65%	84%
23/58	65%	70%
23/82	65%	76%
23/85	65%	73%
23/88	65%	74%
24/21	65%	70%
24/24	60%	44%
24/51	65%	82%
24/54	65%	80%
24/81	65%	62%
24/84	0%	0%
31/11	49%	95%
31/14	65%	96%
31/17	65%	80%
32/10	65%	96%
32/13	65%	95%
32/16	65%	95%
32/19	49%	96%
33/12	65%	73%
33/15	65%	72%
33/18	65%	65%
33/45	65%	66%
33/48	65%	58%
34/11	65%	54%
34/14	60%	69%

improved the overall list for the square as many areas which would otherwise have been ignored or glossed over, have been examined. It was often said during the Monitoring Scheme how many unexpected finds turned up in tetrads, and it certainly may have improved coverage for many 'frequent' (i.e. not 'rare' or 'common') species. When compiling lists for a 10-km square only it is often tempting to go for the 'honey-pots' and ignore the less interesting areas, and it is equally likely that the Atlas records in many cases are also representative of small areas covered in detail and not of the 10-km square as a whole.

No wholly reliable estimate of how under-recorded either survey is on a national basis can be made because no technique is currently available which can be used to estimate how many species would be expected from the one in nine grid. There is however, one interesting statistic. The average number of taxa per square for the Monitoring Scheme is 397 which is at least 10% under-recorded according to the analysis above; therefore a total average of 437 taxa would be expected per square. The average number of taxa in the Atlas database is 331; assuming change is negligible the Atlas may therefore be at least 25% under-recorded. The real figure for under-recording of both surveys are probably higher as neither are 100% comprehensive on a national basis.

2c. Time span of records

The Monitoring Scheme records covered a time span of only 2 years, compared to 31 years for the Atlas survey. This 15-fold difference may influence the results in a number of ways.

Natural population cycles make some species much more conspicuous in some years than others, and hence the probability of a species being recorded may depend on how the survey coincides with the natural population fluctuations. An example of this type of variation is Lotus angustissimus in Jersey (Le Sueur 1985): "In the mid-1950s, it was decidedly rare, only very few plants being seen over several years, then suddenly in 1958, there was a resurgence of it, so that it was common, sometimes abundant, in many places. The resurgence died away almost as quickly as it came and, within a year or two, L. angustissimus was again rare. It was not seen again between 1971 and 1981 but in 1982 and 1983 a few plants were found again in one area".

Population cycles of other plants may be related to climate. It is well-known that many annuals benefit in years subsequent to hot, dry summers due to the increase in open soil (for example, Gastridium ventricosum in the Avon Gorge, Lovatt 1981). Such species are not as widely recorded as they might have been for the Monitoring Scheme due to the series of cool, wet summers 1985-1988. Conversely, frost-sensitive species were hit in early 1987 by a long cold period during which it even snowed in Scilly.

Hot, dry summers may also make some species more accessible when lake and river levels drop giving better access to aquatic and emergent vegetation. In 1989, lakes in Mayo and the R. Shannon in Roscommon were an estimated 0.5-1 m lower than in 1988 when the same areas were visited, allowing a greater range of aquatic species to be recorded. Hence, aquatics may also not have been as well recorded as they might have been.

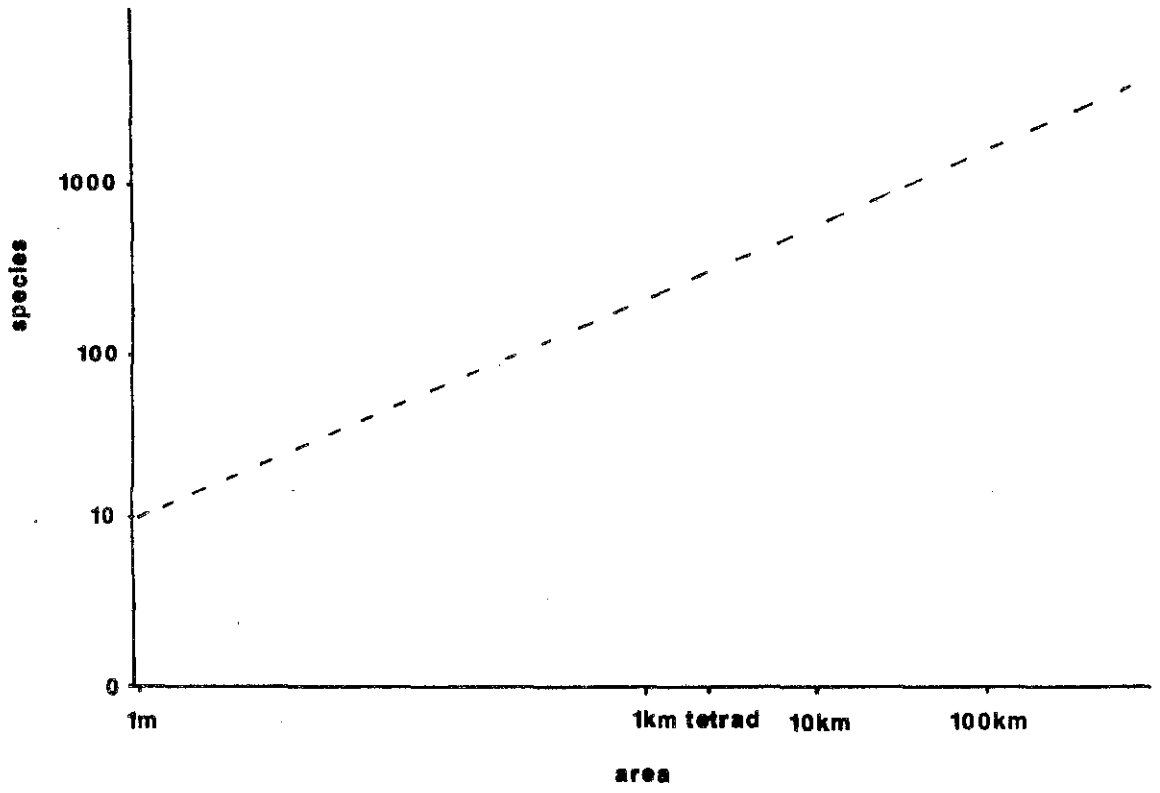


Figure 37. The relationship between number of species and area surveyed (Dony 1976).

Whilst on the subject of climate and weather, it would be worth pointing out that the damp, cold summers of 1987 and 1988 did little to dampen the enthusiasm of the botanists, though visits to mountains to record alpines may have been limited by the weather. This is especially true of the rich squares 27/4.3 and 37/0.9 in Scotland and 01/7.1 in Ireland.

Casuals are unpredictable in occurrence and botanists are notoriously variable in the way that they record them. There are likely to be more 10-km squares recorded for casuals over longer than shorter periods as records accumulate with time. This is illustrated for 5 casual Cucifers for which the total number of 10-km squares recorded (i.e. not just Monitoring Scheme squares) for 1930-1960 and 1987-1988 are compared in Table 9. In all cases there are considerably more records for 1930-1960 than 1987-1988 and it might be concluded that these species have decreased in frequency in recent years. However, if the frequency per year (i.e. number of 10-km squares/time span of records) is calculated, all species have apparently become more common in recent years.

This argument can be applied to many other casual species such as Scandix, Ranunculus arvensis or Agrostemma, but neither conclusion is strictly valid because the numbers of records or numbers of records per year need to be corrected relative to each other to take into account the overall amount of recording effort during these periods which has generated these records. This theme of effort is returned to later.

Any species whose population size or occurrence varies with time, or which may be better recorded under some weather conditions than others, is thus likely to be more widely and better recorded over a long period rather than a short period. Unfortunately, it is not possible to quantify this phenomenon from data currently available.

2d. The Botanists

The botanists are the key factors in determining the quality and quantity of the records, and it would not be surprising to find some differences between the surveys simply related to the recorders. A few recorders (David Webb, Francis Rose, Eva Crackles, the Donys', to name but a few) have recorded for both the Atlas and Monitoring Scheme surveys, but the majority have contributed either to one or the other.

There were many legendary contributors to the Atlas; Mary McCallum Webster, Ted Wallace, Pat Kirtland, Ted Lousley, Ursula Duncan, John Raven, the Halls, Evelyn Booth, the Howitts, W. Arthur Sledge, and so on. The field meeting reports, obituaries and other contributions in the Proceedings and Journals of the BSBI provide testimony to the enthusiasm and dedication of recorders generated by the original Mapping Scheme.

However, the Monitoring Scheme also produced its legends. One of the best all-round botanists in the country, Mike Porter, recorded everything in his two squares in Brecon, not only Taraxacum but also Rubus, Euphrasia and Hieracium. Another outstanding all-round botanist, Archie Kenneth, covered Kintyre in his usual detail; his death in 1989 is a sad loss. Other botanists are notable for the sheer quantity of records (Table 2). Others have covered large, difficult or inaccessible areas - Alf Slack, Maura Scannell, Gerry Sharkey and Ken Butler, not to mention the Murrays on Skye where all the tetrads are vertical. Graham Easy, Rodney Burton, Jackie

Table 9. Number of 10-km squares recorded and frequency per year of five casual species of crucifer for 1930-1960 and 1987-1988 (records compiled for BSBI Cruciferae Handbook including non-Monitoring Scheme square records).

	Total Number of 10-km squares recorded		Frequency of records per year	
Species	1930-1960	1987-1988	1930-1960	1987-1988
Berteroa incana	19	2	0.6	1
Brassica juncea	33	5	1.06	2.5
Bunias orientalis	68	6	2.2	3
Erucastrum gallicum	36	9	1.16	4.5
Sisymbrium loeselii	20	3	0.65	1.5

Muscott and the McNeills have concentrated massive effort on particular squares. Rod Corner had some especially outstanding finds in squares which at first sight appeared somewhat mundane; it just goes to show that it is always worth having a look.

There are numerous people who also deserve to be mentioned, but it must be remembered that some differences in the species recorded are due to different geographical location of individuals with particular expertise or interest. The correlation between records of particular taxa and the distribution of botanists has been noted in Chapter 2.

There has also been an enormous increase in the amount of detailed knowledge about the distribution of individual species as a direct result of publication of the Atlas and numerous local county floras, and this cannot have failed to influence the species recorded. Similarly, revision and improvement of taxonomic texts such as the BSBI Handbooks must also have added to the general quality and quantity of records in some areas. For instance, there are 24% more 10-km square records for the Monitoring Scheme than the Atlas for five selected genera covered by the Handbooks (Carex, Polygonum, Populus, Rumex and Salix) compared to the overall average of 16%.

Quantifying the effects of differences in recorders and knowledge overall is impossible, and no general measure can be built into the analysis. Individual species or 10-km squares show such bias, and some of these are pointed out where appropriate.

2e. Repeatability of surveys

Different surveys rarely produce identical results even when apparently sampling the same population. Good non-botanical examples of this are the different results returned from opinion polls before elections. Botanical surveys might also be expected to produce different results even if carried out on similar sites.

The following two examples have been selected to assess the repeatability of botanical surveys. Neither example was deliberately set up to assess similarities between surveys and they are thus not strictly comparable. Nonetheless, the results are quite revealing.

Repeat visits to tetrads

As a result of lack of central co-ordination some 10-km squares in Roscommon were recorded twice for the Monitoring Scheme about 6 weeks apart in 1988. The records for one of these squares, 12/6.9, were selected for closer investigation.

The first visit by David Webb and Frank Perring took place on 12 and 13 July. Each of the selected tetrads was visited in turn and some time was also spent in the 10-km square. The second visit by Tim Rich, Chris Preston, Nick Stewart and Agnes Walker took place on 22 August. The party split up to record the selected tetrads and then rejoined for a final session in the 10-km square. Each selected tetrad was recorded 'comprehensively' but only additions were recorded from elsewhere in the 10-km square.

The 10-km square is fairly uniform and representative of much of the centre of Ireland, containing a range of habitats such as farms and houses, bogs, heaths, fields, streams, hedges, lakes and road verges and there are no very rich areas. Both parties visited a range of habitats within each of the selected tetrads, but did not cover exactly the same ground.

Overall, approximately the same length of time was spent in the tetrads, at least in terms of botanist hours (Table 10). Clearly, there were differences in actual time spent recording, and it is doubtful whether one botanist recording for 3 hours will record the same as two botanists for 1½ hours. The relative effectiveness of individuals, pairs or groups in recording an area would be worth further investigation.

Interestingly, both parties independently thought they had made a reasonably comprehensive job of recording the tetrads. It is assumed for the purpose of this analysis that the results are comparable, though clearly differences in the areas and habitats visited, time and recorder behaviour etc will all contribute to the variation.

Given the undoubted reliability of the recorders concerned(!), it is assumed that all the records are correct for the purpose of this analysis. Whilst this is extremely unlikely the error rate will be low (<1%) and consequently insignificant to the general results. There is a 6 week difference in the date between visits, but very few, if any, differences in the species recorded are likely to be due to season. It is also assumed that no significant changes to the flora have taken place during the 6 weeks; a potato patch may have been weeded here, or a field sprayed there, but overall these effects should be minimal.

The numbers of taxa recorded in the tetrads and 10-km square for the visits and their percentages relative to the totals are shown in Table 11. On average, more species were recorded during the second visit - possibly related to the 'card hours' (see 2f below) spent recording. Note, however, that despite both parties considering their lists comprehensive, the average number of taxa recorded in each of the tetrads is only 76% of their combined totals. No doubt these totals also under-estimate the real number of species present in the tetrads.

There is a staggeringly small correspondence between records for the selected tetrads; on average, only 51.7% of the species were recorded by both parties (Table 12). Similar figures were reported by Woodell (1975).

Examination of the differences between the species lists shows that about 5% of the differences can be accounted for by records at different taxonomic levels (eg Webb and Perring recorded Arctium minus subspecies whilst Rich et al. only recorded the aggregate, or Rich et al. recorded Arrhenatherum subspecies while Webb and Perring only recorded the species). The remainder of the species appear to be common, unremarkable, readily-recognisable taxa which would be expected from the area. No distinct patterns can be picked out to suggest one party recorded a habitat not included by the other.

The percentage of species in common between different tetrads was also compared for these visits (Table 12). The average percent in common between the different tetrads for the same recorder is about 46%. The average percent in common for different tetrads and different recorders (i.e. Rich et al. tetrad J was compared with Webb & Perring tetrad W, etc) is about 41%. These results are interpreted to suggest that the same recorders are more likely to record the same plants. The fact that some recorders know or 'have their eye in' for particular species is well-known - reflecting personal interest or familiarity (eg Rich has his eye in for Crucifers). Hopefully, the better the botanist, the less this effect will be important.

The bulk of the differences remain to be accounted for, and may simply reflect which side of a path is looked on, or perhaps that a habitat examined by one recorder was slightly richer than a similar one examined by the other recorder, etc. As botanists cannot cover a whole 10-km square, tetrad or even site comprehensively, the species list will reflect time, expertise, number of recorders, distance travelled, etc as well as the absolute frequency of the plants and their relative conspicuousness.

If the tetrad records are aggregated up to give a list for the 10-km square for each group, the percentage in common rises to 62%, or 56% if species elsewhere in the 10-km square are included. This is presumably due to species missed in one tetrad being recorded in another. Given further visits by both parties to the same and different areas the percentage in common would be expected to rise further, but how much further is not known as suitable data are unavailable.

When the comparisons were repeated for the neighbouring square 12/9.9, very similar results were obtained. A repeat of this experiment, set up in a more rigorous, scientific way would be very worthwhile, though I suspect the results would probably not be very different.

A second comparison resulting from re-recording the same route is also fortuitously available. This is described below.

Re-recording of route

On 23 August 1988 Tim Rich recorded tetrad J of the 13/0.2 10-km square in Mayo, Ireland for the Monitoring Scheme. When the same tetrad was revisited on 27 July 1989 to check the identity of a certain sedge, the opportunity was taken to re-record the route taken in 1988 to assess the repeatability of the survey.

The only physical change noted in the tetrad between the two visits was that the road had been re-tarred (probably in 1989). No 'new' casuals had been introduced and no damage to the verges was seen. Hence the site and the flora are not considered significantly different between the visits.

Table 10. Time spent recording in the 10-km square 12/6.9 in 1988.

Tetrad	First Visit Webb & Perring		Second Visit Rich et al	
	Card hours	Botanist hours	Card hours	Botanist hours
A	2	4	3½	3½
J	1½	3	3½	3½
W	2	4	3	3
-	1½	3	1	4
Total	7	14	10½	14

Table 11. Number and percentages of taxa recorded on different visits to the 10-km square 12/6.9.

	First Visit		Second Visit		Total no. taxa
	Total no. taxa	First visit only	Total no. taxa	Second visit only	
Tetrad A % within tetrad	193 (78%)	59 (24%)	189 (76%)	55 (22%)	248
Tetrad J % within tetrad	141 (59%)	22 (9%)	217 (91%)	98 (41%)	239
Tetrad W % within tetrad	142 (67%)	33 (16%)	179 (84%)	70 (33%)	212
Other tetrads	2 (8%)	2 (8%)	22 (92%)	22 (92%)	24
10-km square % for square	249 (66%)	39 (10%)	340 (90%)	130 (34%)	379

Table 12. Percentages of taxa in common between different visits and tetrads for the 10-km square 12/6.9.

Visit		2nd Visit			1st Visit		
	Tetrad	W	J	A	W	J	A
1st Visit	A	48%	45%	54%	54%	46%	-
	J	36%	50%	36%	40%	-	
	W	49%	37%	42%	-		
2nd Visit	A	48%	46%	-			
	J	41%	-				
	W	-					

The major factor in repeating a survey is thus the recording. In 1988, Rich was somewhat pressed for time, but in 1989 there was no such pressure. Somewhat fortuitously 2 hours were spent recording on both occasions, so time per se should not contribute to differences in the lists.

Extensive afforestation and out-of-date maps meant the tetrad boundaries were somewhat uncertain, so particular attention was paid to the route in 1988. It was therefore possible to rigorously adhere to the same route in 1989 (with one exception - see below).

The main difference in the recording between the two visits was that in 1989 Rich was accompanied by four VC Recorders (Gerry Sharkey, Maura Scannell, Graham Kay and Eimear Nic Lughadha), a month earlier in the season, and that Rich had some knowledge of the site. To minimise the impact of previous knowledge of the tetrad, Rich relied only on memory and the others were not shown the 1988 records prior to the visit. The comparison is thus not perfect but will do as an approximation.

Results and analysis of the differences

No. taxa found in 1988	133 (78%)
No. taxa found in 1989	153 (90%)
No. taxa only recorded in 1988	17
No. taxa only recorded in 1989	37
Total no. taxa	170
No. taxa found in both visits	116 (68%)

When the differences were investigated in more detail, the following explanations emerged:-

1. Known errors.
   Two corrections to the 1988 records were noted - Euphrasia nemorosa was withdrawn and Sparganium angustifolium was mis-identified in 1988 as S. emersum.

2. Season.
   Two 1989 records only were attributed to the month difference between the two visits; Dactylorhiza fuchsii and D. incarnata which were both still in flower in 1989. In 1989, D. maculata was the only taxon recorded.

3. Species not crossed off in 1988.
   Three species were seen in 1988 and remembered precisely in 1989, but for some inexplicable reason were not crossed off in 1988. These were Betula pubescens, Glyceria fluitans and Agrostis canina.

4. Knowledge of site.
   Four species were remembered by Rich and would probably otherwise have been overlooked (i.e. Rich recorded them after the others had passed by). These were Poa pratensis, Epilobium ciliatum, Potentilla erecta subsp. strictissima and Blechnum spicant.

5. Possible errors and unexplained discrepancies.
   There were a number of "pairs" of relatively common taxa of which one

was recorded in 1988, the other in 1989. Examples are:

1988	1989
Dryopteris filix-mas	D. affinis
Achillea millefolium	A. ptarmica
Eleocharis multicaulis	E. quinqueflora
Polygonum persicaria	P. hydropiper
Pedicularis sylvatica	P. palustris

Could these be errors in identification or crossing off, or are the differences real? It is assumed they were recorded reliably in 1988, although Rich had no recollection of them.

6. Different route.
One ditch examined in 1989 by Maura Scannell (but not in 1988 by Rich) produced Juncus foliosus.

7. Extra recorders and expertise in 1989.
Three 1989 records in particular are directly attributable to the extra manpower and expertise - Juncus foliosus, Oreopteris limbosperma and Isolepis cernua.

After these "explicable" differences are taken into account, there are still 15 species in 1988 and 27 in 1989 for which no obvious reason for the discrepancy can be found. Most are relatively common, readily identifiable plants, and their presence or absence may again simply depend on which section of a ditch or verge was examined. The local frequency of these plants is a big factor in determining the probability of their being recorded.

There are thus significant differences between the two visits, and only 68% of the total flora was recorded on both occasions. 40% of the differences can in this case be accounted for by direct differences in recording behaviour but the remaining 60% are unexplained. The % in common when the same route is followed is higher than when the same tetrad is recorded, but the similarities between the visits are still surprisingly small.

On a wider scale, Figure 10 showed the 10-km squares for which there were only 1 or 2 visits. These squares are likely to be under-recorded. A considerable body of information relating to recorder behaviour (eg route taken, date of visit, time spent recording, number of recorders etc) is available for the Monitoring Scheme and must be analysed in detail if the survey is ever repeated. Note that there are many tetrads which have not been visited three times (data not presented).

The main implication for the Monitoring Scheme from these comparisons is that there is significant variation between visits. If only 56% of the species were found in common between two relatively comparable surveys only 6 weeks apart, what is the likely correspondence between surveys 30 years apart? And how can the real changes in the flora during this time be separated from such sampling bias?

The biases in sampling will begin to decrease with more visits and with visits by different recorders. As the records build up, so the species list becomes less a function of the recorder and more representative of the 10-km square. It can also be assumed that many of the differences in recording will average out overall, but they clearly add 'noise' and increase the confidence limits of the system.

Interestingly, when all the Atlas and Monitoring Scheme records are compared, only 54% of the species records have been found in the same 10-km square during both surveys (ignoring species with known recording bias). This is almost identical with the 56% similarity between visits in the one 10-km square, but probably includes real change in addition to all the other recording biases discussed here.

The results of these comparisons also indicate the value of repeated visits to a tetrad or 10-km square by the same or different recorders (Woodell 1975). The more time and effort is put into recording a square, and the more comprehensive coverage is obtained, the better. The difficult point to judge is when the law of diminishing returns comes into operation. A critical evaluation of this point would be of considerable use to botanists everywhere.

2f. Overall effort

It is clear that the Monitoring Scheme has been comparatively better recorded overall than the Atlas, and that the inadequacies of the Atlas database accentuate this effect. The greater overall response for the Monitoring Scheme is not surprising given the concentration on only every ninth square, the greater numbers of recorders and the urgency imposed by a 2 year survey.

This greater overall response or 'effort' is the greatest single difference between the Monitoring Scheme and Atlas surveys. Effort is somewhat difficult to define and quantify, and it incorporates recorder-dictated factors such as time spent recording, area of ground covered, number of visits, number (and quality) of botanists visiting, time of year, etc. Generally, the greater the effort the more taxa recorded, but the effects are qualitative as well as quantitative.

The first example of how effort is related to the number of taxa recorded is given in Figure 38 which relates the time spent recording* to the number of taxa recorded. (Note that this graph cannot be used to suggest how long to spend recording in an area in order to get a reasonably comprehensive list).

* The number of hours spent recording has been calculated from information given on the cards. When the actual time was not given the hours were calculated as follows. When the time spent recording was a "day" or "½ day" these were assumed to be 8 and 4 hours respectively (with hindsight, 6 and 3 hours might be more realistic). Where no time was given (94 cards), these were allocated a time of 2 hours per card (the average time spent per card was 2 hours 6 minutes, thus this is felt to be a reasonable estimate). The total hours spent recording in a tetrad or 10-km square was then rounded up to the nearest ½ hour.

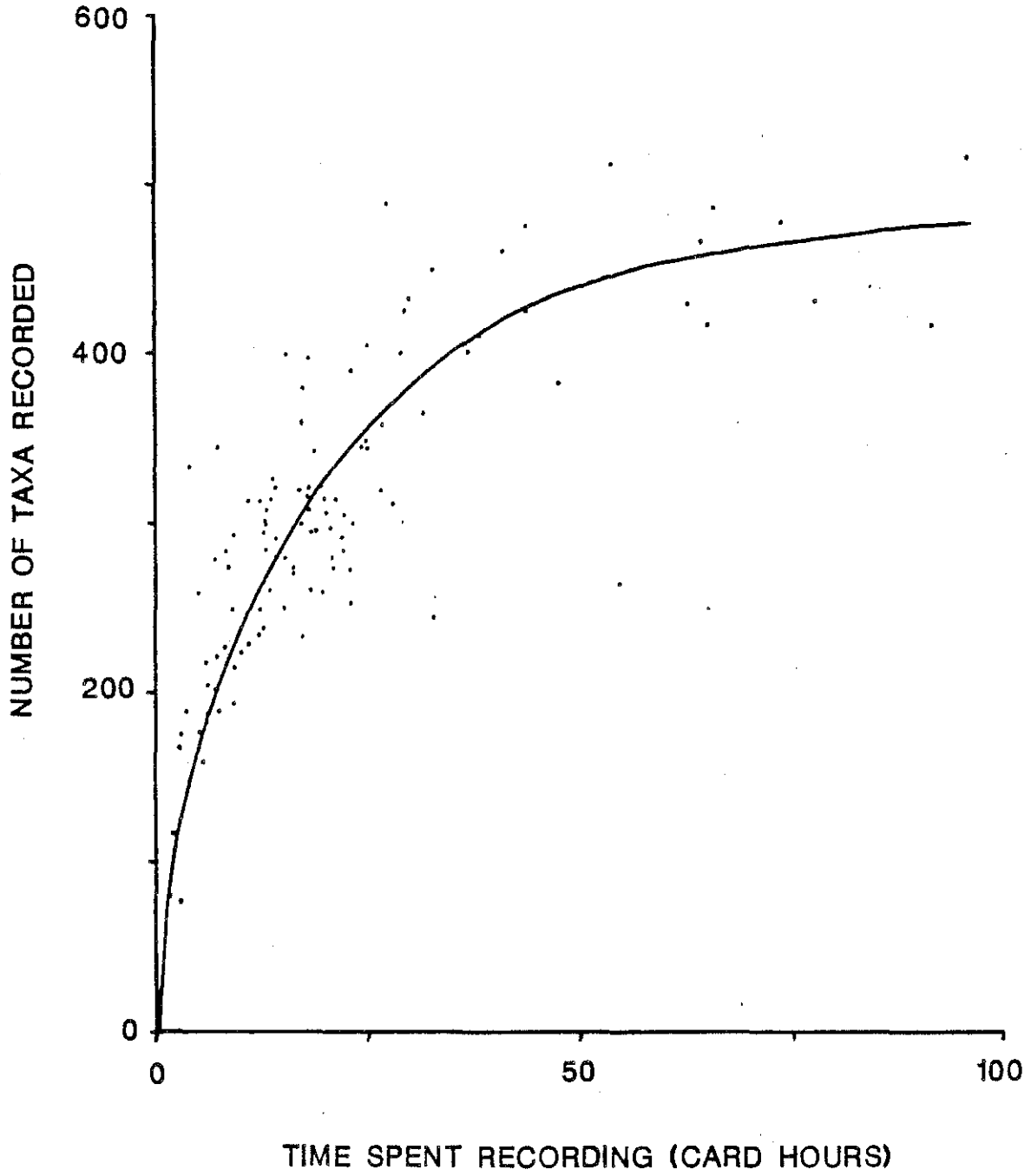


Figure 38. Relationship between number of taxa recorded and time spent recording for the Monitoring Scheme squares in Ireland. The line has been fitted by eye.

The number of taxa recorded in each square in Ireland during the Monitoring Scheme is clearly related to the time spent recording (data for Britain have not been compiled due to lack of time). It is an interesting coincidence that the 10-km square with the most taxa recorded is also the square in which the most time has been spent recording.

A second example, the extent of under-recording, between the two surveys is also an expression of effort. To get an overall measure of under-recording, squares with less than 60% of the total combined flora, and qualitatively under-recorded on at least 2 counts (i.e. combining figures 23, 24 and 29), have been selected for each survey (Figure 39). This shows that there are 25 Monitoring Scheme squares under-recorded for the Atlas and only 5 for the Monitoring Scheme. The under-recorded squares for the Atlas are particularly concentrated in N. Ireland and S.W. Wales; any changes in the flora of these areas in particular (or any of the under-recorded squares in general) cannot be considered significant.

A third example is shown in Figure 40 which shows how recorder effort varies with time for records of Thlaspi perfoliatum. When the number of individual records per decade is plotted, there are large fluctuations. These fluctuations are probably better explained in terms of the recording behaviour of botanists rather than changes in the frequency of the plant as the activities of the various national botanical societies certainly account for some of the peaks. Collections by the Botanical Society of London may account for the peaks in the 1830-40s, and its collapse in the 1850s results in a trough. Collecting by the Botanical Exchange Club gives rise to an increase in the 1860s and 1870s, with a peak in the 1890s. The major trough in the 1890s is difficult to explain, but those in the 1920s and 1940s may be due to the depression and Second World War respectively. A further peak in the 1950s and 1960s could be attributed to the BSBI Maps Scheme. Note that these variations are superimposed on real change, a probable overall decrease in the number of sites.

The spread of Cardaria draba has been documented by Scurfield (1962). If the spread is presented as the cumulative number of 10-km squares from which the plant is known to have been recorded (Figure 41), there is an enormous increase in the 1950s. This increase coincides with the Atlas field work (Figure 20) and presumably largely reflects an increase in the number of records (or effort) rather than a dramatic spread of the plant. Similar patterns can be seen in Impatiens glandulifera, Veronica filiformis and Epilobium ciliatum. If no account is taken of the difference in effort pre- and post-1950, the real rate of expansion will be over-estimated, and the decline of decreasing species will be under-estimated.

Corrections would also be needed for differences in recording aliens, critical taxa, infraspecific taxa, etc. A general assessment of effort and other correction factors is required to interpret the changes in frequency shown by many species with time.

Understandably, there is no information available on time spent recording, areas covered, etc for the Atlas which can be compared to the Monitoring Scheme to correct for differences in effort. Overall there are 16% more 10-km square records collected for the Monitoring Scheme than in the Atlas database. If the known differences due to recording are eliminated (eg records for critical taxa), there is still an additional overall 8.5% of records. Note that this additional 16% of records has taken considerably more than 16% extra effort to record.

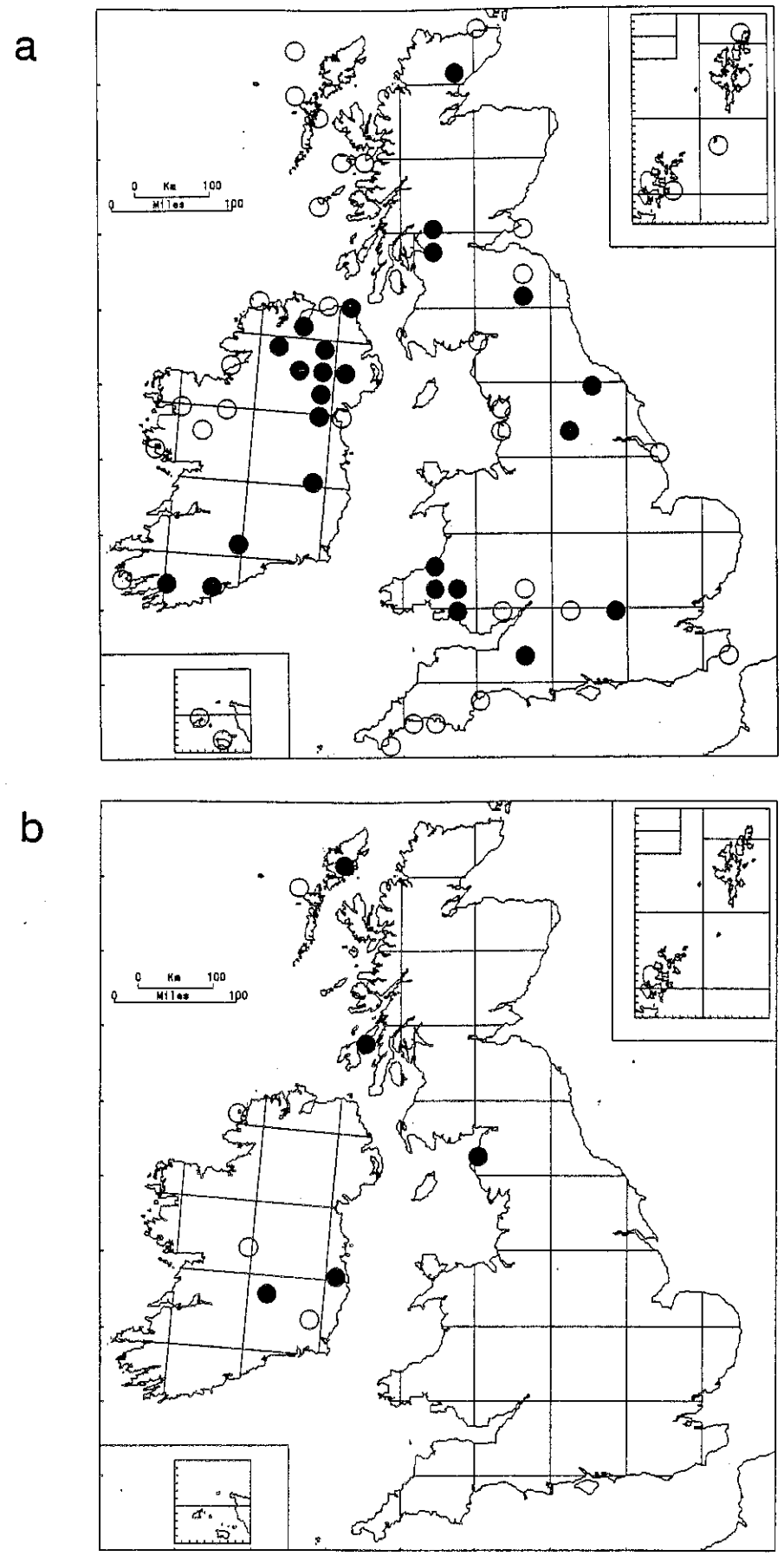


Figure 39. Under-recorded squares. (a) Atlas. (b) Monitoring Scheme. Unrecorded squares or those with very unrepresentative data are shown as open circles. See section 2f for details.

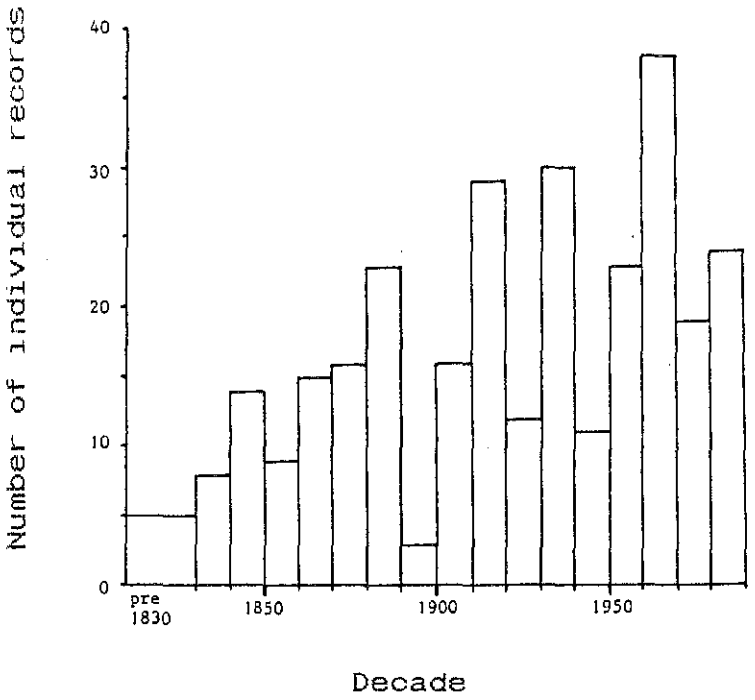


Figure 40. Barchart showing how the number of individual records of Thlaspi perfoliatum varies with time.

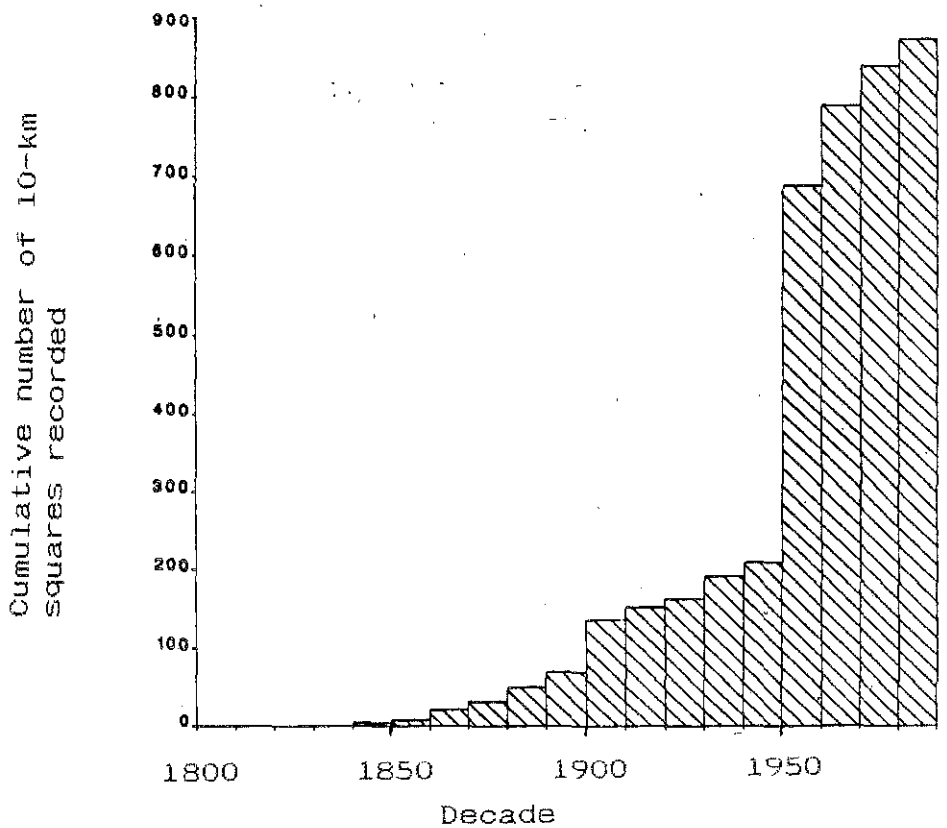


Figure 41. Cumulative increase in the number of 10-km square records of Cardaria draba with time.

2g. Correction and addition of records

Time also operates in another way. Following publication of the Atlas errors have been corrected, missing records resubmitted and critical taxa determined. A small refinement of the quality of the Atlas records would be expected during the last 30 years. This is the first general circulation of the Monitoring Scheme records and no doubt similar refinements will also be forthcoming (some are already known). However, this difference between the surveys is probably insignificant compared to the number of errors recreated when the original Atlas field cards were compiled (Chapter 3).

3. Analysis of the records

In order to compare the records as objectively as possible, recording bias and systematic trends in the data need to be eliminated or minimised before any general statistics are applied.

The basic observation used here to assess the status of the flora is the presence of a taxon in a selected 10-km square. It is assumed that the number of 10-km squares in an area in which a plant is recorded gives an estimate of the absolute frequency of the plant, and that changes in observed frequencies of of 10-km squares recorded between surveys reflect changes in absolute frequency of the plant.

Selection of records for analysis

Records for critical species, hybrids and infraspecific taxa are usually related to the activities of individual recorders and thus contain a large recording bias. Also, given the general absence of any computerised historical data for such taxa, the records from the Atlas period are under-represented. For these reasons, any records for critical taxa have been dropped from the analysis and any differences regarded as of unknown significance.

In the Atlas, a number of maps of species were presented as provisional. As the data for these species are known to be somewhat doubtful they have not been included in the analysis and any changes must be regarded as of unknown significance.

Species for which the BRC Atlas data are known to be corrupted (see Chapter 2) are not included in the analysis and changes are of unknown significance.

There are many more records for garden escapes for the Monitoring Scheme than the Atlas, probably reflecting both changes in recording practice as well as a probable increase in the number of aliens established in the wild. Those aliens which had a BRC number during the Atlas and were probably acceptable to record have been included in the analysis. Those taxa which were allocated a BRC number after the Atlas have not been included in the analysis; changes in these species are probably largely (but not always wholly) due to changes in recording.

No distinction was made whilst compiling the Atlas database between deliberately planted and other introduced species. All records of deliberately planted species and introduced species have therefore been included for consistency.

10-km squares without any records for the Atlas or for the Monitoring Scheme, or where the data are clearly very unrepresentative have not been included in the analysis though the records are plotted on the maps. Squares which are

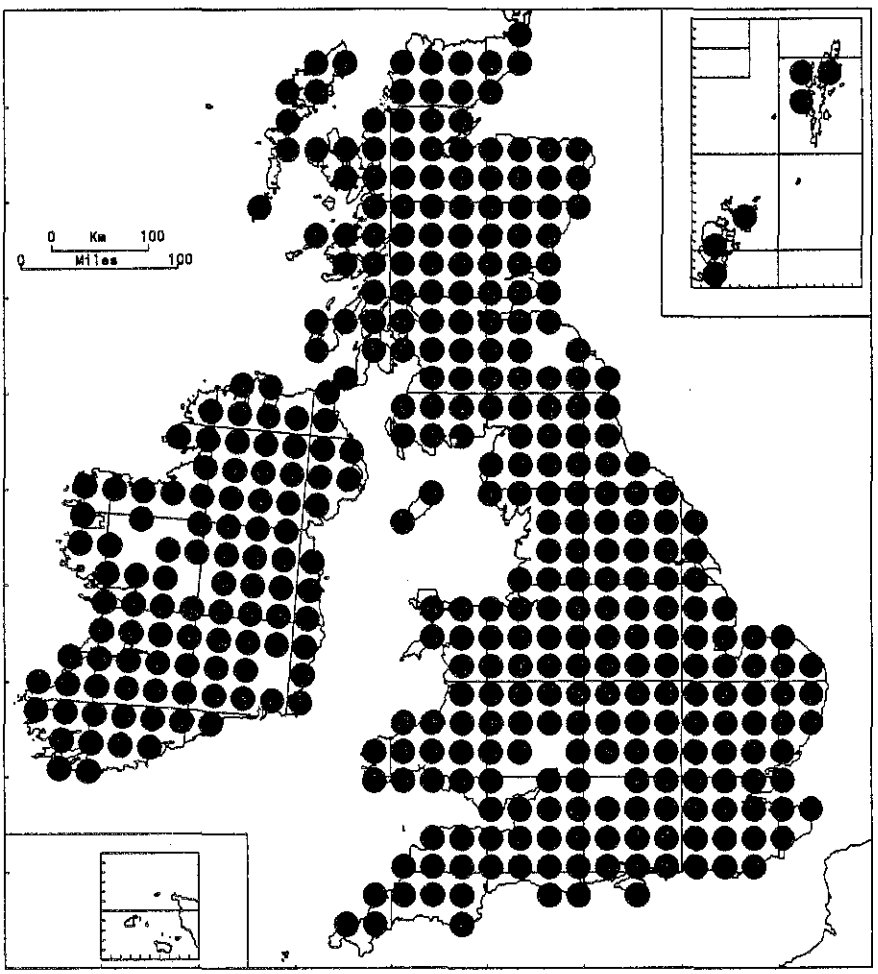


Figure 42. 10-km squares included in the analysis.

under-recorded have, however, been included (with hindsight these would have been better not included). The squares for which records are included in the analysis are shown in Figure 42.

Some 10-km squares are shared between England and Wales or Scotland, and between N. Ireland and the Republic of Ireland have been allocated to one of the countries only for the analysis of changes by country. This is due to the summary nature of the Atlas records where many cannot be allocated to one country. The records for the squares have been examined and allocated as follows:

Britain		Ireland	
32/3.2	Wales	13/9.5	N. Ireland
33/3.1	England	23/5.2	R. of Ireland
33/3.4	Wales	23/8.2	N. Ireland
33/3.7	England		
36/9.4	England		

3b Statistical comparison of the records

The variation added by the change of recording grid in Ireland is small compared to the large error limits of the Irish data in general and is thus ignored.

The bias caused by concentrating on the selected A, J and W tetrads is clearly of significance. It is likely the Atlas similarly represents records collected from a number of relatively small areas but no data are available which can be used to assess this. If it is assumed that both surveys returned lists which were representative for the 10-km square, this effect can be assumed to average out overall and is thus ignored.

The variation due to differences in the time span of recording is ignored as it probably affects relatively few species (mainly casuals and annuals) and is a small component of the overall variation.

Variation due to botanists and/or changes in knowledge are assumed to be of small significance overall and are ignored.

Variation due to repetition of surveys is assumed to average out overall.

Differences in effort are less easy to correct for. One approach to correct for differences in effort would be to add or delete records to the Atlas and Monitoring Scheme database at random until the relative numbers of records are the same. This, however, adds unacceptable uncertainty.

A second approach of reducing the Monitoring Scheme records or increasing the Atlas records proportionally across the board to give equivalent numbers of records can be used if it is assumed that the differences in relative rather than absolute frequency can be used to measure change, and that the proportional 'effort' correction applied is the same under all conditions.

The first assumption is probably acceptable but the second is not. The effort correction factors have a strong geographical bias reflecting the realtive amounts of effort put into the Atlas and the Monitoring Scheme.

This is best illustrated at a national level where there are about 4% extra records in England for the Monitoring Scheme but over 40% more in N. Ireland - if the overall 8.5% effort correction factor was applied to assess change in these regions it would be an over-estimate by a factor of 2 and under-estimated by a factor of 5 respectively.

Similarly, a 40% increase in effort in N. Ireland may result in 40% more records for rarer species, but cannot for common species because any occurring in more than 70% of the original squares will, after correction apparently occur in more squares than is possible. For instance, a species occurring in 15 out of the 18 squares in N. Ireland would be corrected to 15 x 1.40 = 21 squares. Some correction for relative commoness/rarity is therefore also needed.

The Atlas records have therefore been corrected for effort using the equation below (suggested following discussions with Mark Hill based on the best evidence available). This correction equation is partly experimental; the derivation of an objective would depend on the development of a more complex model of recording.

$$\text{Corrected number of Atlas records} = C.A_O + (1-C).\ \frac{A_O^2}{T}$$

Where A_O = original number of Atlas 10-km squares records, T = number of Monitoring squares in area and C is a constant correction factor. A graphical illustration of this equation is given in figure 43; in effect there is an approximate direct proportional increase for rarer species and an increasingly smaller increase for common species. Note for small values of T and large values of C this may still give corrected values fractionally above the total number of squares.

Values for C, the effort correction factors, have therefore been derived for each area under investigation, such that the corrected total number of Atlas records approximately equals the total number of Monitoring Scheme records for species without known recording bias. These values are as follows:

England	1.1
Wales	1.93
Scotland	1.1
Britain	1.17
R. Ireland	1.22
N. Ireland	2.27
Ireland	1.35
B. Isles	1.2

It should be emphasised that these correction factors are crude and must be only taken as first approximations; they are designed to be applied across the board and do not take into account qualitative bias in recording such as changes in popularity of certain groups (c.f. the BSBI Handbook series), the type of data available, the type of species (eg introductions, casuals), etc. A thorough investigation of this problem is essential to interpret the results of the Monitoring Scheme more accurately.

The significance of differences between the numbers of squares recorded for each survey has been tested by comparing the percentages of squares within

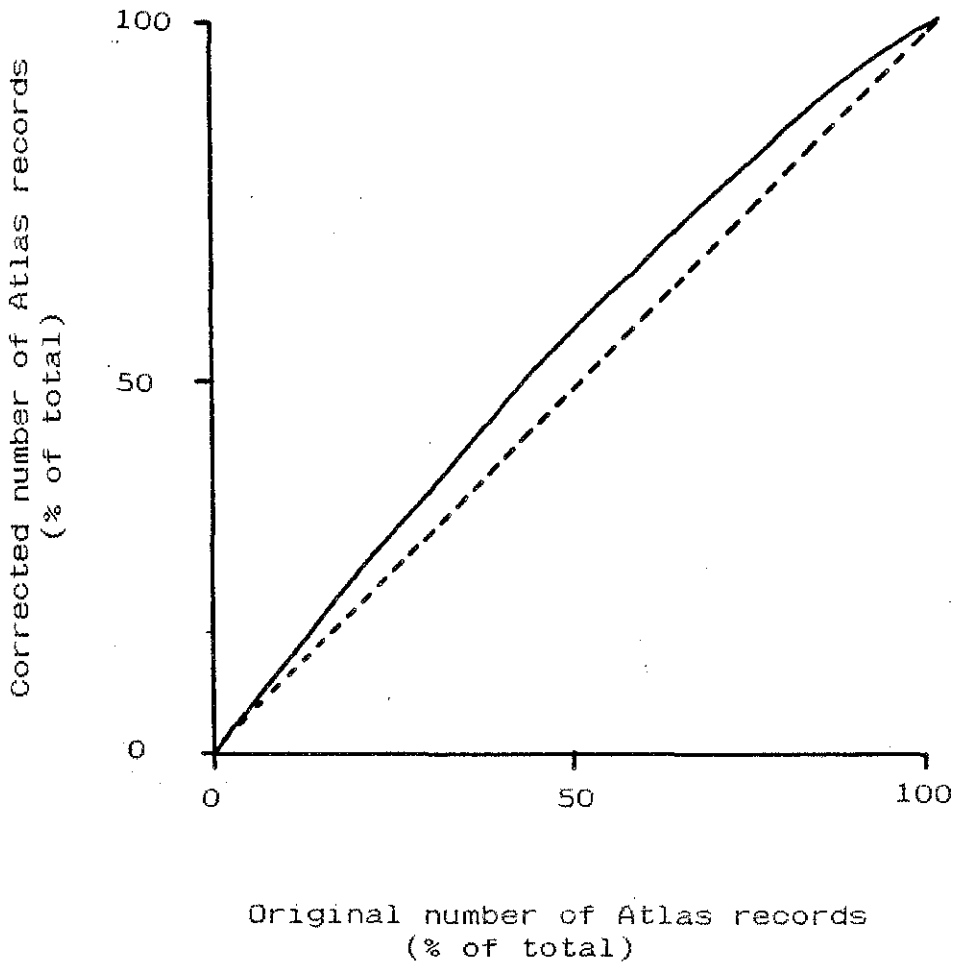


Figure 43. Graphical illustration of the effort correction equation (see text). A 1:1 relationship is also shown (---).

$$t_s = \frac{\text{arcsine } \sqrt{p1} - \text{arcsine } \sqrt{p2}}{\sqrt{820.8 \left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

where p_1 and p_2 are the percentages of squares recorded and n_1 and n_2 are the number of squares in each area, and 820.8 is a constant representing the parametric variance of a distribution of arcsine transformations of proportions or percentages.

If t_s 2 (i.e. with more than 2 standard deviation units), the species can be regarded as having increased significantly (approximate 95% confidence limits), and if t_s -2 the species can be regarded as having decreased significantly.

CHAPTER 6

Maps and Interpretations

Contents

1. Presentation of the records

Records for the taxa represented in the Atlas and Monitoring Scheme databases are given below. Maps and tables are given for most taxa but those with less than 3 or 4 records are usually given in note form. Native species which have not been recorded at all are noted.

The taxa are given in approximate taxonomic order following Clapham, Tutin & Moore (1987) (with Zannichellia reinstated). The nomenclature also largely follows Clapham, Tutin & Moore (1987) but is occasionally inconsistent and out of date.

There are no records for the Channel Islands for the Atlas (Chapter 3), but the Monitoring Scheme records have been presented in full.

The symbols used on the maps are as follows:-

○ Recorded as present in the selected 10-km square for the Atlas (1930-1960 in Britain, before 1960 in Ireland) (but see also Chapter 3).

✚ Recorded as present in the selected 10-km square for the Monitoring Scheme (1987-1988).

● Recorded as present in the selected 10-km square for both the Atlas and Monitoring Scheme surveys (dates as above).

The symbols are centred on the selected squares and have been deliberately enlarged to cover more than the original 10-km square so that they are clear when the maps are reduced.

Records for ONLY the 10-km squares selected for the Monitoring Scheme are presented - there are many other records for the intervening squares. The purpose of the maps is to illustrate changes with time; they cannot and must not be taken to represent the overall distribution of the plants, as the distributions shown depend on the squares selected for the survey which may not be representative. For example, all records of Cephalanthera longifolia are from Ireland, the British localities having been missed by chance. Conversely, the 10-km squares selected include by chance 3 of the 4 major sites for Matthiola sinuata. The importance of this effect can be seen in Figure 44 which shows all records for Rorippa amphibia, and records for Monitoring Scheme squares only (the latter plotted with dots of two different scales to show the effect of enlarging them). Many of the more scattered localities are not represented, but a general impression of the distribution is obtained.

Results are also presented numerically in the tables. For each country or region, the total numbers of selected 10-km squares recorded for the Atlas and Monitoring Scheme are given. The areas covered by the individual countries are largely self-explanatory with the following exceptions. England includes the Isle of Man. "Britn" includes England, Scotland and Wales. "Ireld" includes the Republic of Ireland and N. Ireland. "Total" includes all squares except for the Channel Islands.

A crude indication of the percentage change in frequency is given in the third column (positive for increase, negative for decrease). These have been calculated from the corrected square totals expressed as a percentage of the squares for each region, and cannot be derived directly from the first two columns.

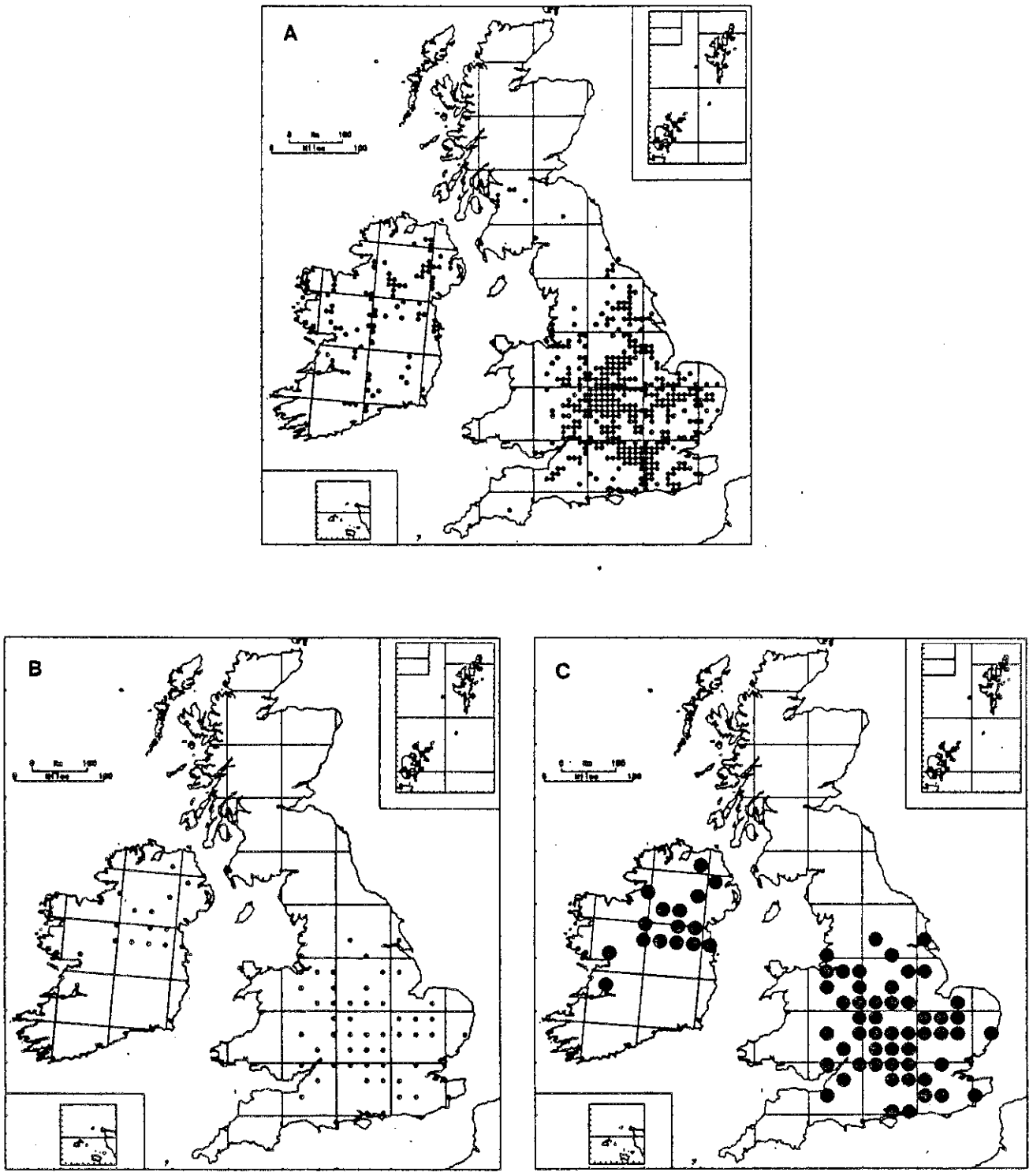


Figure 44. Maps of Rorippa amphibia showing the effect of only including Monitoring Scheme squares on the apparent distribution pattern. (a) all records (b) records from Monitoring Scheme squares only (small dots) (c) records from Monitoring Scheme squares only (large dots).

The statistical significance of any changes is indicated in the final column at approximately 95% confidence limits. For many taxa where the data are incomplete, provisional, or show recording bias, etc, the significance is unknown and is labelled as such. Some taxa which show possible increases or decreases but are subject to recording bias have been qualified with a question mark. Unless otherwise stated, it can be assumed that changes are not significant or that further work is required. Lists summarizing the taxa which have statistically significant changes are given for each country in Appendix III.

The statistics are least satisfactory in Wales and N. Ireland due to the small numbers of squares involved. These might be better re-assessed using another technique but there has not been time to do this.

Brief comments are included for many taxa to help interpret the results which are self-explanatory with the following exception. "Computerised historical data unavailable" or "incomplete" relates to a number of critical, rare or locally rare taxa for which records for the Atlas period are not, or only partially, computerised. Due to the large number of taxa involved it has not been possible to search for or compile records manually. Most of these taxa have been labelled (including some which do not occur in the selected squares anyway eg Rhynchosinapis wrightii) to indicate that the absence of any historical records is due to inadequacies in data compilation and is not significant. In any case, the changes in frequency of taxa which only occur in a few squares are unlikely to be statistically significant and many are Red Data Book species being monitored in another way.

Figure 45 shows the BRC numbering of the 10-km squares which will help locate the grid references cited in the text. The only likely sources of confusion are the Channel Islands (grid references start "90/...") and Orkney and Shetland (grid references start "57/..." to "69/...").

2. Some examples of interpretation

Before assuming that the changes illustrated on the maps are real, it is important to question firstly, whether the data are correct and/or representative, and secondly, whether the differences can be better explained by recording or survey bias. Many of these problems have been outlined in Chapters 2-5, and a series of examples is listed below to illustrate them further.

Examples of errors in the data for individual species include Myosoton in Cumbria, Listera cordata in S. Wales and Cerastium cerastoides in Scotland. Examples of more widespread taxonomic confusion include Oenothera, Juncus bulbosus and Vicia sativa s.l.

Examples of incomplete or unrepresentative data include the absence of Atlas records for the Channel Islands, some arctic/alpines in Brecon, a general paucity of fern data, and under-recording for the Monitoring Scheme in SE Ireland (eg Ranunculus acris). Examples of species with corrupted data include Prunus spinosa and Kickxia spp.

There are some errors in the tables which have not been corrected due to lack of time; if in doubt the maps are most likely to be correct. Examples include Geranium sylvaticum, Hirschfeldia incana, Carex muricata and Epipactis leptochila.

Examples of species which are probably over-recorded in the Atlas data-bank include Viola canina and Brassica napus. Species under-recorded include Anemone nemorosa, Chrysosplenium oppositifolium, Papaver lecoqii, Chenopodium ficifolium and Acer platanoides.

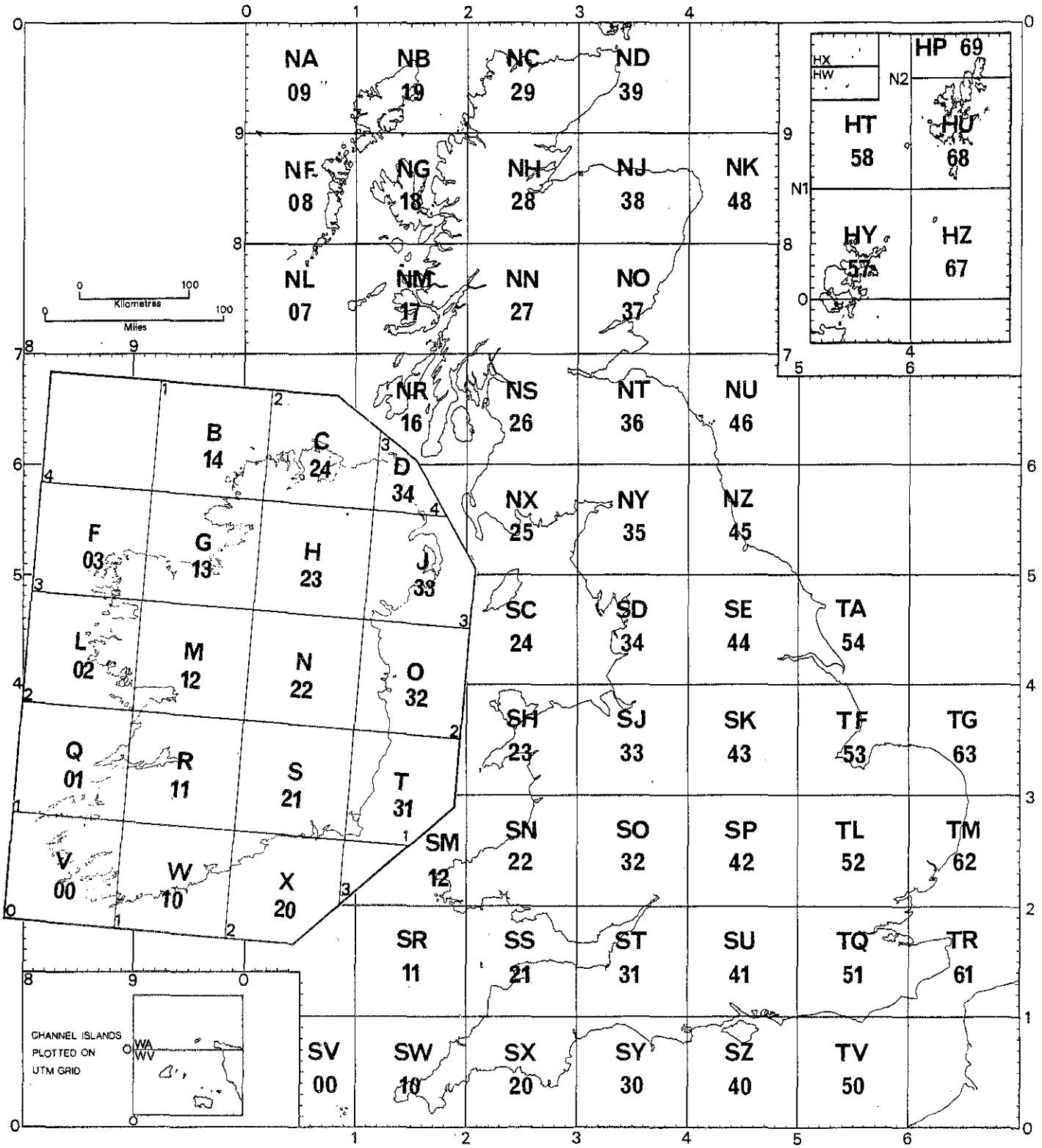


Figure 45. BRC numbering of 100-km squares used in text.

Examples of taxa over-recorded for the Monitoring Scheme include Dryopteris expansa, Nasturtium x sterile and Hyacinthoides hispanicus. Taxa under-recorded for the Monitoring Scheme include Geranium endresii x versicolor, and arctic/alpines in C. Scotland and SW Ireland.

Examples of taxa whose distribution reflects the occurrence of selected taxa on the record cards include Malus segregates, Veronica serpyllifolia subsp. serpyllifolia and Juniperus communis subsp. communis.

Examples of taxa whose records are strongly correlated with the activities of individual recorders include Carex demissa agg. x hostiana, Polypodium x mantoniae, Dryopteris affinis subspecies, Luzula multiflora varieties etc. Sometimes the type infraspecific taxon is assumed and consequently under-recorded relative to other infraspecific taxa (eg Hedera helix var. hibernica).

Most critical or infraspecific taxa are much better represented for the Monitoring Scheme than the Atlas. Examples of critical genera which were better recorded for the Atlas are Euphrasia and Rhinanthus.

Many introduced taxa have been better recorded for the Monitoring Scheme due to changes in the acceptability of records. Examples of crops being recorded as casuals include Hordeum vulgare, Solanum tuberosum and Beta vulgaris. There are many examples of the increased recording of planted forestry crops in the Gymnosperms. Examples of increased recording of garden escapes include Lunaria annua, Hyacinthoides hispanicus and Mahonia aquifolium.

These, and other effects like them, tend to obscure and add uncertainty to the results, and only when they have been assessed can the likely changes in distribution and/or frequency be picked out. Separating real from artificial changes requires knowledge of the plant concerned, how it is recorded and its taxonomic history, its habitat, general distribution and frequency, quality of the computerised records, etc and each case needs to be judged on its merits. A few examples of real change are given below before all the maps and tables are presented. The interpretations should be at least 90% correct overall.

Alien taxa often show marked increases - these include Lactuca serriola, Reynoutria japonica and Heracleum mantegazzianum. Some native taxa have also increased; Chamerion angustifolium, Ranunculus lingua, and possibly Polystichum aculeatum and P. setiferum.

Examples of taxa which have decreased are Artemisia vulgaris, Hydrocotyle vulgaris, Orchis morio and many arable weeds such as Agrostemma githago, Silene gallica and Scandix pecten-veneris.

Taxa which have shown little change overall include Alchemilla alpina, Tamus communis, Cardaria draba and Oenanthe crocata (this may have decreased locally in the east).

3. The maps and interpretations of change

The maps and interpretations of change are presented separately in volume II.

CHAPTER 7

Habitat survey

The data collected for the habitat survey have not been analysed due to lack of time. The following notes indicate some of the problems involved.

In the original proposals for the Monitoring Scheme, the habitat survey was placed equal in importance to the species survey, with two main aims. First, to collect data which would be of use to NCC at a regional level. Second, to collect data on the distribution and frequency of particular habitats which could be monitored in parallel with species in the future. As one of the major factors affecting species distribution and frequency is habitat change, if species change parallels habitat change this would suggest a possible reason for the observed changes.

However, given the scale of the species survey and the general novelty of the habitat survey to many BSBI members, a decision was made at BSBI Records Committee to drop the habitat survey as a priority and to concentrate on the species survey. The habitat survey would than be run in Britain as a trial to assess feasibility, interest and usefulness. In Ireland where botanist-power was more limited, the habitat survey was dropped completely from the outset, though some cards were completed.

The response to the survey was highly patchy. In some areas considerable interest was shown and the data are outstanding (VC 2 and VC 46 especially so), but in many other areas the response was variable or virtually nil. This, to an extent, reflects allocation of more resources to the species survey than lack of interest. The main problems were found to be in both defining and delimiting a habitat - is the hedge around an old meadow to be included or not? Some cards simply listed the habitats present in a 10-km square or tetrad and did not relate to sites at all. The difficulties encountered possibly reflect lack of clarity in the instructions or perhaps the novelty of the survey.

The habitat data collected have only partially been computerised and do not have habitat coding. No systematic attempt has been made to assess or interpret the data. The main problem with compiling the data was the time taken to code up species lists with BRC numbers, and hence sometimes records for only the more interesting taxa were computerised.

Given the interest in habitats and the potential value of the data, a comprehensive habitat survey would be useful. It would be run best as a distinct survey in its own right (such as the ITE Countryside Survey) and not in conjunction with a species survey. The data collected for the Scheme this time should be used to modify instructions and methods before the exercise is repeated.

CHAPTER 8

Conclusions and recommendations

The Monitoring Scheme 1987-1988 has been an unqualified success in demonstrating, once again, that the BSBI can be relied on as the national botanical recording organization. The quantity and quality of the data collected are a credit to them, and without such volunatry assistance, this assessment of the current state of the British and Irish floras would not have been possible. There can be little doubt that recording for an "Atlas of the British and Irish floras 2000" would be taken up with equal enthusiasm.

The extent to which the Monitoring Scheme has met its first aim, that of assessing which species have changed in frequency since the Atlas, has been limited by fundamental differences between the two surveys, and this report has not only highlighted many unforeseen problems but also broken new ground in analysis of the records. Recording bias, different survey methods and incomplete historical data are major sources of uncertainty in the results and have to be carefully assessed before changes can be taken as significant. Although it is possible to correct for many problems, the uncertainty introduced by the greater overall concentration of effort for the Monitoring Scheme is such that it is only possible to assess which species have changed most in frequency. There can be little doubt that the majority of native species have declined during the last 25, 50 or 100 years due to agriculture, forestry, industry, urbanization, etc, and that many introduced plants have spread; only the more dramatic changes will have been picked up here. A comprehensive survey would document these changes more clearly.

The next step is to provide an explanation of the changes, but it is surprisingly difficult to draw general conclusions about the causes. The three major trends which can be picked out are loss of grassland taxa (especially of wet and open pastures), an increase in aliens and garden escapes, and a decline in arable weeds, which can all be related to man. Even these trends show puzzling exceptions. Other changes are more subtle and are difficult to explain. Why has Artemisia vulgaris declined in Scotland and Ireland, and why has Cerastium glomeratum spread? The lack of clear directional changes may result from the emphasis on those species which have changed most, but changes are certainly widespread. The results of this 10-km square survey therefore give a picture which can be used to direct further study. Each case can also be examined in detail, the approach of Foley (1987) being exemplary.

The second aim of the scheme, to provide a network of tetrads which can be used to monitor change in the future, has been achieved, but to what extent monitoring the tetrads will give a more reliable estimate of change in the future than monitoring 10-km squares remains to be seen. It is clear from Chapter 5 that areas even as small as tetrads are prone to recording bias, and consequently the most valuable contribution of the tetrads may be towards more representative lists for the 10-km squares. This must be tested before the survey is repeated. Monitoring sites would probably give a better picture of change, but to do this may be impractical given limited resources and time.

Much work remains to be carried out on analysis of the records, such as examination of regional changes in more detail using selected taxa characteristic of certain habitats (eg wet meadows in the Midlands), further investigation of recording and sampling bias, and correlation of the changes observed in this study against other studies.

Recommendations

The primary recommendation of this report, following the documentation of widespread and general change, is that a comprehensive survey should be undertaken to produce a new Atlas of the British flora. For conservation purposes, an accurate assessment of the current status of a plant (such as that provided by a comprehensive survey) is probably of greater significance and more easily obtainable than the degree of change with time (such as presented here). A comprehensive survey will give a more consistent assessment of the relative frequencies and detailed current distribution of plants than the tantalizing picture presented here. An appropriate timescale for the work would be 1987-1999, - an "Atlas of the British and Irish floras 2000".

Other more general points and recommendations are as follows:-

1) If other historical data sets are to be used in a similar way, a small scale, detailed trial should be carried out first to assess if it is worthwhile. With hindsight, the effort spent compiling the Atlas records would have been better directed at adding IRC data to the summarized data on the computer.

2) Changes between surveys will be subject to recorder bias unless carried out in identical fashion. Numerous examples of recording bias have been highlighted here, and similar bias probably exists in recording of most other taxonomic groups but is rarely presented.

3) All data sets should have assessments of quality and quantity of recording, and of data processing accuracy. They should also be properly documented.

4) Recording Schemes should be carefully directed at gleaning more recording information from the original recorders.

5) A general review and assessment of variations in recording effort since 1800 should be compiled to help with interpretation of change (including RDB species).

6) A national plan for recording in the future (eg there should be an obvious break in compiling summary records at the year 2000) should be drawn up to forewarn recorders of national projects which will impinge on their own work. Some BSBI Recorders managed to incorporate the Monitoring Scheme into their County Flora projects, but others had to repeat large amounts of recent work.

7) Any records collected for the Atlas of the British flora should be treated as summary, 10-km square records, unless there is good evidence to the contrary.

If the Monitoring Scheme is to be repeated, the following points and recommendations are also made:-

1) Before any repeat survey is attempted, a 6 month trial of the most repeatable recording techniques (ie site-based, tetrads, or 10-km squares) should be carried out on a small sample of, say, 5-10 10-km squares. It is very much regretted that time was not available at the start of the Monitoring Scheme to assess recording techniques properly.

2) Processing of records should be restricted to summary tetrad and 10-km square records. Processing every record for the Monitoring Scheme resulted

in 6 times more data than were actually used. Original data should still be collected including recording information, but do not need to be processed in detail.

3) It is likely that the main use of the tetrad data will be to help standardize 10-km square lists.

4) Effort should be directed particularly towards recompiling and re-analysing the Irish Atlas data. The work here is very preliminary.

5) The habitat survey would be better run as a separate exercise.

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APPENDIX I

SAFETY IN THE FIELD

Whether you want to be reminded or not, botanizing in the field has its dangers. ACCIDENTS HAPPEN, irrespective of where, or when, or however experienced you are. These guidelines are therefore intended

1. to minimise risk of an accident before it happens (prevention is better than cure)

2. in the event of an accident, to minimise further risk and subsequently to help others help you.

Simple precautions need not interfere with either recording or your enjoyment. Most are common sense. Even if you know better already, read them; they may help you save someone else's life if not your own.

It is obviously impossible to draw hard and fast safety rules to cover every eventuality - these would prove frustrating, inhibitory and would doubtless mostly be ignored anyway. The guidelines will not be equally applicable to botanizing in the highlands of Scotland and the lowlands in the south east, so adapt them to your local needs. The point is be aware and be prepared.

BOTANICAL RECORDS ARE NOT WORTH TAKING RISKS FOR

In all cases it is safer to go in pairs or groups rather than alone.

Footwear and clothing

Take with you or wear clothing suitable for the season and general environment, especially in the wilder areas

a. Waterproofs - Jackets, hoods and leggings. Bright colours have the advantage of making the wearer conspicuous from a distance but some, especially yellow, attract annoying flying insects.
b. Warm clothing, including hats and gloves.
c. Suitable footwear in good condition with good tread (eg stout walking boots or shoes, or wellington boots). Spare laces could also be useful.

Equipment

General items such as maps, compass, LUNCH (food and water), watches, etc should be standard anywhere. For the more remote areas, a safety kit containing spare clothing (in waterproof bags), spare food (especially high energy biscuits, chocolate, sweets, etc - calories galore!), whistle, torch with spare batteries, basic first aid kit and a survival bag ("space blankets" are not recommended) are also highly recommended. Other items such as suntan lotion, insect repellent and bite treatment ointment are left to personal choice. If a safety kit is carried it will give you an excuse not to take all 5 volumes of Flora Europaea.

A suitable basic first aid kit should contain

2 x triangular bandages
1 x large prepacked sterile dressing
1 x 6.25 cm (2½") wide crepe bandage
1 x packet sterilised cotton wool 25 g (½ oz) size
12 x adhesive wound dressing (assorted sizes)

6 x safety pins
1 x tube of antiseptic cream
1 x tube of antihistamine cream
pencil and paper

General health

Innoculation against Tetanus is strongly recommended for anyone engaged in field work with a booster every 5 years, obtainable free on the NHS from your GP.

If you receive special medical treatment (eg a course of injections) or suffer medical conditions such as diabetes, allergies etc it is advisable to carry a card or some other indication of your special requirements. Where applicable, sufficient additional medicines should also be carried on field trips.

Weather

Unpredictable though our climate is, weather is well worth checking in advance from local radio, television or telephone reports, particularly in coastal or mountainous areas.

Itinerary

Details of the planned route for the day's work and estimated time of return should be left with a responsible person. If operating from a hotel/B&B then this should be left with the manager, or staff informed that such information will be left in the bedroom. If using a vehicle, also give the registration number. Include details of WHO should be informed, and WHEN (eg 'after dark') in the event of non-return.

These precautions are necessary in order to alert the rescue/emergency services and to initiate searches. If you make arrangements and later change plans, don't forget to inform your contact.

Hazardous sites

Avoid wild and aggressive animals, shooting parties, machinery and heavy plant (non-botanical!) operations, forestry, mine workings and other unstable sites, recently sprayed crops, stubble burning and other fires, etc. Additional precautions should be taken in the following sites:

1. Rivers, streams and lakes

Banks may collapse when undermined.
If wading, use a stout pole to check water depth and nature of the bottom (soft mud, holes, rubbish, broken glass, etc).
Avoid streams and rivers in spate, and watch for flash floods.
Take special care near weirs, locks, spillways and sewage farms.
A life jacket might be considered for additional safety, even if you can swim.

2. Bogs, mines and swamps

Floating mats of vegetation (recognized by swaying movements of the surface eg quaking bogs) can close over a victim if breached.
Bare peat in certain circumstances can be very liquified and could be a danger to the unsuspecting.
If you have to cross a bog etc, try to walk on tussocks of vegetation as they give more support.
Take care not to twist or sprain ankles on uneven, undulating vegetation.

If you find yourself sinking and haven't reached firm ground after the initial panic:

1. lie flat on your back (spreading weight) and remove rucksack straps
2. try to get some support by inflating survival bag or using rucksack
3. try to get your legs free and into horizontal position
4. turn onto your front and move back to firm ground using tussocks of vegetation for support. Use strap to pull rucksack along as you go, then you won't have to go back in again to fetch it.

3. Roads and motorways

A permit must be obtained from the Department of Transport before surveying the side of any motorway, and their safety instructions followed.
On other roads, wear high visibility, reflective clothing. Do not work on roadsides in poor visibility weather.
Park in a safe place off the road.
Particular care must be taken near bends, hill crests, junctions, road works and in narrow cuttings.
Two people should be involved - one look-out, and one recorder.

4. Railways

No botanist should attempt to record on railways without permission from British Rail. Their safety instructions must be followed exactly.

5. Ministry of Defence land

Once again, do not attempt to record on MOD land without prior permission and without safety instructions.

6. Coastal

Tide tables, correctly understood and adjusted for BST, GMT or local conditions are ESSENTIAL.
Weather conditions can markedly change time and state of tides. An onshore wind can bring forward the time and increase height of an high tide.
Beware of quicksand/mud - use a wading pole if crossing channels etc. Walking across soft sediments is slow and very tiring. Soft mud is best crossed using short rapid steps.
Tides advance very quickly over flat terrain.
Make sure escape routes are clear - tidal creeks can fill very quickly even at the top of marshes.
If working on exposed rocky coast when a swell is prevalent, make sure one member of the party keeps an eye open for unusually large waves.
Take particular care climbing down to beaches on steeply backed shores.
Beware of the danger of falling rocks from cliffs.
It is also advisable to be on the lookout for unexploded mines and bombs and other suspicious objects. If you come across any, do not touch but mark their location and inform the coastguard or military of your find.
A folded or inflatable life jacket might be prudent.

7. Cliffs and crags

Many botanical investigations will need little more than a steep walk or scramble. If you want to inspect cliff faces and crags it is best to do so only under guidance from experienced rock climbers and mountaineers, using appropriate ropes and safety equipment. Training is essential.
Otherwise, beware of falling and loose rocks (a danger to yourself and anyone below), and avoid cliffs in anything but the gentlest weather.

8. Upland areas

Take suitable protective clothing and safety kit (cf above).
Be aware of changing weather conditions and for symptoms of hypothermia (complaints of feeling cold, tired or listless, unreasonable behaviour or irritability, sudden uncontrollable shivering, increasing slowness of physical and mental response, stumbling or falling, dizziness, slurring of speech and difficulty of vision, physical resistance to help, collapse, stupor or unconsciousness). Temperatures fall by approximately 1°C for every 150 m of elevation.
Surprisingly, dehydration contributes to exhaustion and exposure; maintain calorie and fluid intake and minimise heat loss.
Set off early to avoid being benighted.
Lightning kills or injures a few people on the hills each year. If caught in a storm, AVOID caves and rock crevices and stay in the open. Try to find a broken rock scree, in a safe situation, away from the crest of the hill, and sit on top of a dry rucksack or rope, with your knees up and you hands in your lap. Do not attempt to support yourself on your hands or by leaning back - the object is to keep your points of contact with the ground as close and as dry as possible.

9. Inner cities

Predatory "humanoids" (how else can we describe them?) are unpredictable financial and biological hazards of parks, cemeteries and densely populated areas in general. Botanists with their eyes on the ground are relatively easy prey.

Procedures in an emergency

a. Getting lost If you find you are not quite where you thought you were on the map (easily done!), first try to reconstruct your route. If that doesn't work, study the map carefully for landmarks and then hold your course (with compass) until you reach a feature you can identify to locate yourself. Don't take short cuts and don't ford rivers.
Finally, have a good laugh at yourself and think how many other people have done the same thing.

b. International distress calls The Alpine distress call is 6 long, rapidly repeated whistle blasts/torch flashes repeated at one minute intervals until answered. An SOS call (...---...) is also likely to be understood.
If you observe such signals, it is probably best to summon properly equipped help immediately rather than try to help yourself.

c. Injuries First aid as available, pay particular attention to staunching blood flow and preventing hypothermia. Try to keep warm and dry and summon help immediately: if alone use the distress calls; if with colleagues send for help making sure the victim can be relocated.

d. Missing persons If a colleague is missing at time of rendezvous, commence a search of the itinerary route. Leave your own note to say you have started search. If no trace is found after ? (agree beforehand) hours, inform police.

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APPENDIX II

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Thomas, N.
Thomas, R.E.
Thomas, S.
Thompson, B.H.
Thompson, D.
Thompson, E.
Thompson, J.
Thompson, M.
Thompson, Ms M.
Thompson, Ms P.
Thompson, W.A.
Thomson, Mrs S.E.
Thomson, P.
Thomson, V.
Thurlow, B.P.
Tinston, D.J.
Titterington, R.
Tofts, R.J.
Tolfree, Miss M.P.G.
Tonks, E.S.
Townsend, C.C.
Tranter, B.C.
Trist, P.J.O.
Trueman, I.C.
Tucker, K.
Tucker, K.M.
Tucker, Mrs K.M.
Tucker, W.H.
Tulloh, Mrs M.
Turner, C.
Turner, J.
Turner, J.H.
Turner, J.M.
Turner, K.A.
Turner, Mrs E.M.
Turner, Mrs M.
Turner, Mrs S.N.
Turner, Ms J.
Turner, S.R.
Tyson, J.F.
Vachell, Miss E.
Vaughan, D.
Vaughan, Mrs I.M.
Veall, R.M.
Verrall, Mrs P.K.
Vials, A.S.
Vickers, D.J.
Vincent, J.
Waddingham, N.
Wain, C.
Wain, Mrs C.
Wainwright, Mrs M.
Wake, A.J.
Waldren, Miss L.
Walker, A.
Walker, B.
Walker, C.G.J.
Walker, D.
Walker, J.
Walker, Mrs A.
Walker, Mrs J.
Walker, P.E.G.
Wallace, A.
Walls, R.M.
Walters, S.M.
Walton, J.S.
Walton, Mrs M.V.
Wanstall, P.J.
Warburton, Tony
Ward, Z.

Warren, J.A.
Warren, Mrs J.A.
Waterhouse, G.
Waterman, Tony
Watson, K.
Watson, K.J.
Watson, L.
Watson, M.
Watson, M.F.
Watson, Mrs S.
Watton, R.
Way, L.S.
Wear, E.H.
Webb, C.
Webb, D.A.
Webb, F.H.
Webber, Miss N.
Webster, S.D.
Wedderburn, M.E.
Weightman, Mrs J.
Welch, D.
Wells, D.A.
Wells, R.V
Wells, S.E.
Wells, T.C.E.
West, N.
Weston, C.
Weston, Mrs I.
Weston, R.P.
Westwood, B.
Weyl, R.S.
Wheeldon, G.S.
Wheeldon, Mrs G.W.
Whetton, Mrs R.
Whetton, R.
Whild, S.
White, J.
White, Mrs P.H. and R.G.
Whitehouse, A.A.K.
Wigginton, M.
Wild Flower Society
Wild, C.E.
Wild, C.J.
Wilde, J.
Wilkin, V.
Wilkinson, M.
Wilks, H.M.
Williams, D.H.
Williams, Mrs V.A.
Williamson, H.
Williamson, Ms H.
Willmot, A.
Willmot, F.C.
Wilmore, G.T.D.
Wilson, A.R.
Wilson, G.
Wilson, J.
Wilson, J.B.
Wilson, K.
Wilson, K.T.
Wilson, Miss T.
Wilson, Mrs A.
Wilson, Mrs M.
Wilson, P.J.
Wilson, R.
Wilson, R.A.
Wilson, T.
Wiltshire, Mrs P.E.J.
Winfield, M.
Winham, J.
Wisniewski, P.L.
Wood, D.C.
Wood, J.J.
Wood, Mrs C.M.
Wood, Mrs E.G.
Woodall, A.
Woodall, H.
Woodell, S.R.J.
Woodman, F.
Woodman, Mrs F.L.
Woodruff, P.
Woodruffe, P.M.
Woods, M.
Woods, R.G.
Wormell, P.
Wort, J.
Wortham, P.
Wurzell, B.
Wyatt, G.
Wynn, S.J.
Wynne, G.
Yates, M.
Yates, M.J.
Yeo, P.F.
Yeoman, G.
Yorkshire Naturalists' Union
Young, M.G.
Young, R.
Youngman, R.E.