Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

JNCC Report

No. 370

BIOLOGICAL RECORDS CENTRE

REPORT 1999-2004

This report should be cited as:
Hill, M.O., Arnold, H.R., Broad, G.R., Burton, V.J., James, T.J., McLean, I.F.G., Preston, C.D., Rowland, F. & Roy, D.B. (2005) Biological Records Centre: Report 1999-2004
JNCC Report, No. 370

Nominated Officers:

Biological Records Centre

Dr Mark Hill
Biological Records Centre
CEH Monks Wood
Abbots Ripton
Huntingdon PE28 2LS

Joint Nature Conservation Committee

Dr Ian McLean
Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough PE1 1JY

For further information please contact:
Dr Ian McLean
Joint Nature Conservation Committee
Monkstone House, City Road
Peterborough PE1 1JY
ISSN 0963-8091 (Online)

TABLE OF CONTENTS

FOREWORD

The work of the Biological Records Centre (BRC) takes place as a partnership between the Joint Nature Conservation Committee (JNCC) and the Centre for Ecology and Hydrology (CEH), a research centre of the Natural Environment Research Council (NERC).

The work of BRC is possible, not only because of long-standing support from the funding partners, but because of the commitment of volunteers, recording schemes, government departments, local records centres, academic researchers, and non-government conservation organizations to the large-scale documentation of biodiversity.

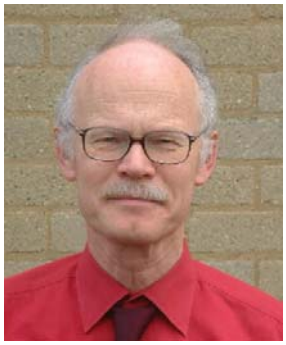
The main purpose of BRC is to document and interpret changes in species distributions at the geographical scale in the United Kingdom. Basic documentation requires the answer to four questions, all beginning with 'W'.

- Which species was found?
- Where was it found?
- When was it found?
- Who found it?

These are the basics but much additional information may be required. What habitat? How many? What sex? Does it appear to have been introduced? Is it newly arrived?

No single approach is sufficient to interpret changes in distribution and patterns of occurrence. We need to be aware of ecological factors, local history, broader biogeographical issues, and recorders' quirks. BRC's work is accordingly varied, and we have pleasure in reporting on some key activities in the pages that follow.

The period covered by this report has been an especially productive one for BRC. Many people have contributed to this success. However, one person stands out from the others, namely Paul Harding, who was Head of BRC from 1982 to 2003. During this long period, Paul worked patiently with the Co-ordinating Commission for Biological Recording, the National Federation for Biological Recording and many other groups, sowing the seeds of change. He and Charles Copp played a major part in setting up the National Biodiversity Network, which finally came to fruition under the leadership of Sir John Burnett. It is a particular pleasure in these pages to acknowledge Paul's contribution to biological recording. This was recognized by the nation in 2001 when he was appointed MBE, and by lepidopterists in 2004, when he was awarded Butterfly Conservation's lifetime achievement award for the conservation of butterflies and moths.



Dr Mark Hill
Biological Records Centre
March 2005

Dr Ian McLean
Joint Nature Conservation Committee

INTRODUCTION

The Joint Nature Conservation Committee (JNCC) is the forum through which the three Country Nature Conservation Agencies, the Countryside Council for Wales, English Nature and Scottish Natural Heritage, deliver their special statutory responsibilities for Great Britain as a whole and internationally. These responsibilities, known as special functions, contribute to sustaining and enriching biological diversity, enhancing geological features and sustaining natural systems. For the purposes of the Partnership with BRC, JNCC also represents the Environment and Heritage Service Northern Ireland.

The special functions are: to devise and maintain common standards and protocols for nature conservation; to promote, through common standards, the free interchange of data between the country agencies and with external Partners; to advise on nature conservation issues affecting Great Britain as a whole; to pursue wider international goals for nature conservation (encouraging sustainable development, biological diversity and earth science conservation), including the provision of relevant advice to the Government; and to commission new research and collate existing knowledge in support of these activities, and to disseminate the results.

The Biological Records Centre (BRC), established in 1964, is the national focus in the UK for terrestrial and freshwater species recording (other than birds). It works with the voluntary recording community throughout Britain and Ireland. The BRC database contains about 13.5 million records of more than 12000 species.

BRC is funded jointly by JNCC and NERC through a partnership based on a Memorandum of Agreement (MoA). The partnership started in 1973 when the Nature Conservancy was divided to form the successor bodies Nature Conservancy Council (NCC) and Institute of Terrestrial Ecology (ITE). NCC was in turn divided further to form JNCC, while ITE was merged with other NERC units to form CEH. Through all these changes, the partnership has been maintained. This report covers the period of the 6-year MoA for 1999-2004. At the time of writing, a new agreement for 2005-2010 is in place.

The period 1999-2004 was marked by rapid progress in information technology, with concomitant institutional developments. These have been highly beneficial for BRC, whose data are increasingly used, not only by the UK country conservation agencies but also by NGOs, research workers, policy makers and volunteers.

The outstanding achievement of the reporting period, underpinning most other developments, was the setting up of the National Biodiversity Network (NBN). This has transformed the way in which BRC works, not only by providing access to data through the NBN Gateway, but by bringing together providers and users of data in a way that was not hitherto possible. The resulting pattern of data flow is now quite complicated (Fig. 1).

Most of the data held by BRC are provided by specialist National Schemes and Societies (NSS), which not only collect data from volunteers, but raise standards of recording and, increasingly, maintain their own databases. Through these societies, the level of expertise in recording many groups has increased steadily, so that for biological recording, the early 21st century appears to be a golden age. Admittedly, museums and especially universities are generally less active in recording. Therefore, the future depends critically on volunteers and NSS. BRC, working in collaboration with the National Biodiversity Network (NBN), provides essential underpinning for NSS, notably through its contribution to the Networking Naturalists project of NBN. For taxonomic groups that lack an active society, e.g. fleas, BRC works directly with individual data holders, and helps them to bring their work to fruition.

Biodiversity data are valuable to society only if they can be used to understand and manage the environment. Although data capture and collation were the priority in the first thirty years of BRC's

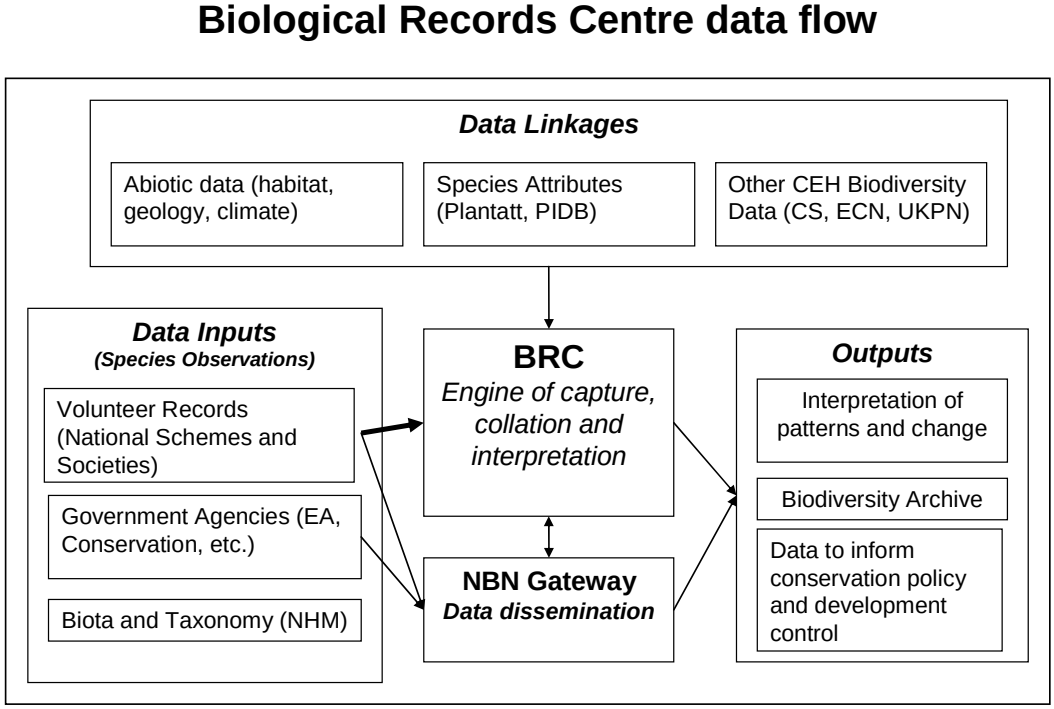


Fig. 1. Data flow in BRC at the end of 2004. Plantatt is the BRC database of plant attributes. Acronyms are: CEH Centre for Ecology and Hydrology, CS Countryside Survey, EA Environment Agency, ECN Environmental Change Network, NBN National Biodiversity Network, NHM Natural History Museum, PIDB Phytophagous Insects Database, UKPN United Kingdom Population Network.

existence, the interpretation of change is now almost equally important. For some purposes, such as inferring the climatic tolerances of species, rather crude data may suffice. For many others, it is essential to understand how records were compiled, and in particular how data may be biased by bursts of recording in particular areas. People not involved with recording schemes commonly imagine that data flow in at a steady rate. This is never the case. Most data capture is through recording projects, which collect data, validate them and then archive them. Results are interpreted by linking occurrence data to historical information, taxonomic databases and so forth, as well as by compiling information on species attributes.

Note about bibliographic references in the text
In order to save space, BRC publications cited in the text are not listed there, but in the list of BRC publications on pages 30-33.

ACKNOWLEDGEMENTS

Thanks to data providers
The main data providers are volunteers, managed by National Schemes and Societies. In addition, BRC receives data from statutory agencies, from individuals and from colleagues in CEH. To all of these, we offer our hearty thanks for their contribution. Their data are the rock on which BRC is built.

Thanks to contributors and photographers
We thank all members of BRC, past and present for their ongoing contribution. We are grateful to Paul Hackney and Jill Sutcliffe for permission to reproduce photos.

PROGRAMME 1: DEVELOPING CAPACITY OF RECORDING SCHEMES AND VOLUNTEERS

Developing National Schemes and Societies

Background

BRC's original remit was to collate and manage society and scheme data, to publish atlases and to assist with publicity. During the 1990s, it became clear that these aims could be promoted by enhancing the operation and capacity of recording schemes and societies themselves. Recorders now had desktop computers, which enabled them to take on greater responsibility for managing their own data. Many recorders needed help, which was provided by BRC, and later by the National Biodiversity Network (NBN) with funding from the Heritage Lottery Fund (2001-2004), and by Defra through the Joint Venture Agreement with NBN (2002-4).

Objectives

The basic aim was to help schemes and societies capture, collate and manage their own data. For this purpose, they should consider data quality, volunteer training, volunteer recruitment and the needs of conservation agencies and researchers. The logistics of transmitting data to BRC and the NBN should be reasonably simple. In addition potential users of data should be made more aware of the importance of schemes and societies in the process of documenting and monitoring the UK's biodiversity.

Methods

Schemes have been encouraged to work together and share resources, thereby enhancing the opportunity for networking and transfer of skills among scheme organizers and others. The BRC has obtained resources since 2001 to organize seminars for the benefit of the societies and schemes through the NBN.

Expectations for atlas production have been raised. Not only have there been more ambitious publications than previously, but also the information included in them has been enhanced to include more information on ecology and habitat.

BRC has promoted long-term plans for data management, and has worked with key partners in the NBN to improve data communication and quality. The NBN Gateway has been developed as a principal means of communicating scheme data, not only to users, but also as feedback to the voluntary recorders themselves. For a few schemes, it was used as a means of verifying data prior to publication.

Key Results

Recording schemes were linked together. At the beginning of the reporting period, the Dipterists Forum and the Bees Wasps and Ants Recording Society had demonstrated the benefits of bringing smaller recording groups together. Following on from this, BRC was active in setting up the British Myriapod and Isopod Group. More recently, the BRC has had some involvement in setting up the 'Camstars' Group, representing the schemes involved in recording river flies.

Atlas content has been enhanced. Atlases with extra content have included the *Millennium Atlas of Butterflies of Britain and Ireland*, the *New Atlas of the British and Irish Flora*, the *Atlas of the Land and Freshwater Molluscs of Britain and Ireland*, and *A Revised Checklist and Atlas of the Seaweeds of Britain and Ireland*. Some 'Provisional' atlases have also been enhanced significantly, notably the *Provisional atlas of British spiders (Arachnida, Araneae)*.

Plans have been laid for longer-term recording. There are new opportunities to collate records as a continuous process, not necessarily linked to a specific recording project. These are being grasped for butterflies, vascular plants and dragonflies. Other recording schemes will no doubt follow suit.

Specialists in different taxonomic groups have exchanged ideas. Through the NBN Networking Naturalists Project, BRC has been able to support annual conferences and seminars for schemes since 2001.

Systems for improving data quality have been put in place. NBN and BRC have devised systems for data validation and verification. These have been shown to recorders at meetings organized by the NBN Development Officer.

Key Events

BRC's capacity to support schemes and societies was greatly increased when the NBN Development Officer for National Societies and Recording Schemes was taken on in 2001.

The annual NBN Conference for Societies and Schemes, held since 2001, is a major shop window for BRC.

NBN annual Conference for Societies and Schemes 2003.
The NBN annual conferences provide a valuable opportunity for exchange of ideas and methods between specialists who would not ordinarily meet one another.

Further Sources of Information

The principal source of information on the Networking Naturalists Project is NBN News, posted on the NBN website. Reports from each of the NBN/BRC annual Conferences for Societies and Schemes are also available from the NBN Website, along with general guidance for societies and schemes on implementing development plans.

Websites: http://www.brc.ac.uk/, http://www.nbn.org.uk/

Contact: Trevor James is NBN Development Officer for National Societies and Recording Schemes. Email: tjj@ceh.ac.uk.

PROGRAMME 2: DATA CAPTURE AND DATABASE MANAGEMENT

BRC Main Database on Oracle

Background and Objectives

One of BRC's core functions is the management, maintenance and development of databases on the occurrence of species. The work programme covers several areas including:

- Management of existing, established datasets;
- Establishment of new datasets;
- Development of interpretive and presentational tools;
- Use and enhancement of data capture systems in ways that are efficient both for BRC and for collaborating National Schemes and Societies;
- Management of documentary archives of recording cards;
- Setting data standards in conjunction with the NBN.

The goal of these activities is to ensure that increasing volumes of data captured by the BRC database are of *high quality* (particularly with regard to critical species), *high spatial resolution*, and *contemporary*. This ensures that data can be utilized fully by linking with other datasets. In order to achieve these goals BRC works closely with a number of National Schemes and Societies and the National Biodiversity Network (NBN).

The period 1999 to 2004 has seen a large increase in the BRC data holdings (Tables 1-3). Most of the increase was produced by major atlas projects. Atlases published during this period were, with a few exceptions, based on an underlying high resolution dataset.

NBN	Taxonomic group	Common name	Records added	Total records
✓	**Tracheophyta**	Flowering plants	4683185	9353621
✓	**Lepidoptera: Rhopalocera**	Butterflies	1613033	1865504
✓	**Arachnida: Araneae**	Spiders	515774	517836
✓	**Agnatha, Chondrichthyes and Osteichthyes**	Fish	285573	304899
	Algae (marine species)	Algae	182518	255097
✓	**Bryophyta**	Mosses, liverworts	149489	937729
✓	**Coleoptera: Carabidae**	Carabid beetles	39897	181555
	Isopoda (non-marine species)	Woodlice	32082	59136
	Myriapoda: Diplopoda	Millipedes	29156	47432
✓	**Coleoptera: Cantharoidea & Buprestoidea**	Beetles	26605	41071
✓	**Decapoda: Crayfish**	Crayfish	6955	10851
	Arachnida: Opiliones	Harvestmen	5698	17532
	Neuropterida (Neuroptera, Mecoptera & Megaloptera)	Lacewings, scorpion-flies etc.	4848	18893
✓	**Mammals**	Mammals	4569	129392
✓	**Orthoptera, Dermaptera, Dictyoptera & Phasmida**	Grasshoppers and allies	4465	46348
	Acariformes	Ticks	4151	4231
	Crustacea: Isopoda: Asellus spp.	Water-slaters	2956	3538
✓	**Amphibia & Reptilia**	Herptiles	513	53592
	Crustacea: Amphipoda	Amphipods	473	1055
	Algae: Charophytes	Stoneworts	23	9433
✓	**Mollusca (non-marine species)**	Molluscs	6	201240

Table 1. Growth in existing BRC datasets over the period 1999-2004. Taxonomic groups in bold are those for which datasets are available via the NBN Gateway.

NBN	Taxonomic group	Common name	Records added	Total records
	Coleoptera: Chrysomelidae & Bruchidae	Chrysomelids	128939	128939
✓	**Heteroptera (aquatic species)**	Aquatic bugs	45363	45363
✓	**Diptera: Tipuloidea & Ptychopteridae**	Craneflies	33700	33700
✓	**Lepidoptera: scarce macro-moths**	Scarce moths	24194	24194
	Siphonaptera	Fleas	21146	21146
✓	**Trichoptera**	Caddis flies	18665	18665
	Lepidoptera: Pterophoridae	Plume moths	2756	2756
	Lichens	Lichens	7	7

Table 2. New datasets added to the BRC database over the period 1999-2004. Taxonomic groups in bold are those for which datasets are available via the NBN Gateway.

NBN	Taxonomic group	Common name	Records added	Total records
	Lepidoptera	Macro-moths	0	378549
✓	**Odonata** (many records added on the NBN Gateway but new records not in BRC)	dragonflies & damselflies	0	164874
	Protozoa: Dinoflagellates	Dinoflagellates	0	27845
	Fungi: Myxomycetes	Myxomycetes	0	22725
	Diptera: Brachycera (larger species)	horse flies, etc	0	20980
	Myriapoda: Chilopoda	Centipedes	0	16054
✓	**Coleoptera: Cerambycidae**	Longhorn beetles	0	12867
✓	**Coleoptera: Cryptophagidae, Atomariinae**	Atomariinae beetles	0	10814
	Crustacea: Cladocera	Water-fleas	0	9557
✓	**Coleoptera: Coccinellidae**	Ladybirds	0	9340
	Coleoptera: Staphylinidae	Rove beetles	0	8644
	Diptera: Sepsidae	Sepsid flies	0	6083
	Zygaenidae	Zygaenid moths	0	5520
	Diptera: Tephritidae	Tephritid flies	0	4921
	Annelida: Hirudinae	Leeches	0	4414
	Diptera: Muscidae	Muscidae	0	2259
	Diptera: Syrphidae	Hoverflies	0	2044
	Diptera: Dixidae	meniscus midges	0	1463
	Fungi: Ascomycetes	Ascomycetes	0	1217
	Coleoptera: other	Various coleoptera	0	1030
	Coleoptera: Ciidae	Ciid beetles	0	736
	Diptera: Empididae	empid flies	0	582
	Platyhelminthes	Flatworms	0	496

Table 3. Datasets not added to during the period 1999-2004. Taxonomic groups in bold are those for which datasets are available via the NBN Gateway.

Key Results

- Increased coverage of taxonomic groups
- Major expansion of BRC's electronic data holdings (Tables 1-2)
- Delivery of the great majority of BRC's data holding via the NBN Gateway
- Development of a data entry system (BRC Inputter) for rapid data entry from recording cards. Custom versions of BRC Inputter have been developed for input of data from over 20 recording schemes.

Key Event: Launch of NBN gateway

Websites: http://www.brc.ac.uk; http://www.searchnbn.net

Staff involved: David Roy, Henry Arnold (database manager), Val Burton (data entry), Jon Cooper, Cassie Hoyland, Richard Ostler, Francis Rowland

Contacts:
David Roy Email dbr@ceh.ac.uk (main database)
Val Burton Email vjbu@ceh.ac.uk (BRC Inputter)

David Roy

Val Burton

BRC Taxon Dictionary

Background

The BRC Taxon Dictionary (held in the Oracle table TAXA) has developed slowly in BRC since 1954, when the BSBI recording scheme created a sequential numbering system for the vascular plant species listed in the *Flora of the British Isles* (Clapham, Tutin & Warburg, 1952), which was becoming the standard flora.

Species checklists were coded as and when they were required, usually when a recording scheme began. The bryophytes were the second group to be coded, in about 1960, followed by the butterflies in 1967.

Checklists were originally coded alphabetically, and each group was kept as a separate list. Gradually, as computing power increased, a more taxonomically-based coding system evolved. Some of the earlier checklists have been recoded. However, not all the earlier lists have been, or will be, recoded.

Full lists of synonyms are sometimes included, but for many groups these have yet to be added.

In the 1990s, Julian Dring, then the BRC Database Manager, unified the separate coded checklists into the TAXA table, using as his source the checklist of Kloet and Hincks (1945) and its successors. He included many insect groups for which BRC did not have a recording scheme. Most of these names still have no other records attached to them.

As well as taxonomic information, the TAXA table includes data in the following fields (not necessarily complete for every species):

- Status (native or introduced)
- Rarity (Red Data Book status)
- Protected status (inclusion in Wildlife and Countryside Act)
- BAP status (included in Biodiversity Action Plan lists)
- European Community Habitats Directive status (inclusion in various annexes).

The TAXA table also now includes the codes used on the NBN Gateway, each of which is termed a 'taxon version key', and starts with a prefix either NBNSYS or NHMSYS (Table 4).

Although the taxon version keys may appear to serve a similar role to BRC codes, they are actually rather different. This is because a taxon version key refers to a name, e.g. *Betula pendula* (the scientific name for silver birch). The name *Betula verrucosa*, which is a synonym, would have a different taxon version key, because it is a different name. However, a record of *B. pendula* is the same as a record of *B. verrucosa*; both tell us that a silver birch was found. Therefore both names will have the same BRC number 0920 239. BRC numbers carry with them an implied synonymy, whereas taxon version keys do not.

BRC No	NAME	AUTHORITY	TAXON VERSION KEY
6455 66	Coccinellidae		
6455 661	Epilachninae		
6455 57800	Subcoccinella		
6455 57801	Subcoccinella vigintiquattuorpunctata	(L.,1758)	NBNSYS0000008289
6455 57801	Syn. Subcoccinella 24-punctata auct.		
6455 662	Coccinellinae		
6455 57900	Coccidula		
6455 57901	Coccidula rufa	(Herbst,1783)	NBNSYS0000008290
6455 57902	Coccidula scutellata	(Herbst,1783)	NBNSYS0000008291
6455 58000	Rhyzobius		
6455 58001	Rhyzobius litura	(F.,1787)	NBNSYS0000008292
6455 58001	Syn. Rhizobiellus litura	(F.)	
6455 58001	Syn. Rhizobius litura	(F.)	
6455 58100	Clitostethus		
6455 58101	Clitostethus arcuatus	(Rossi,1794)	NBNSYS0000008293
6455 58101	Syn. Scymnus arcuatus	(Rossi)	
6455 58200	Stethorus		
6455 58201	Stethorus punctillum	(Weise,1891)	NBNSYS0000008294
6455 58201	Syn. Scymnus ater sensu auct. Brit.	not (Kugelann,1794)	
6455 58201	Syn. Scymnus minimus	(Rossi,1794)	
6455 58201	Syn. Scymnus punctillum	Weise	
6455 58300	Scymnus		
6455 58301	Scymnus femoralis	(Gyllenhal,1827)	NBNSYS0000008295

Table 4. Selected data from the BRC taxon dictionary table TAXA. The BRC number, which uniquely identifies each taxon, is a sequence such as 6455 58201, typically 10 digits. The prefix, here 6455, signifies a major group (the suborder Polyphaga of Coleoptera). The rest of the BRC number may signify a species, variety or higher taxon. Taxa are arranged hierarchically, and the taxonomic rank of each is stored as a field, not shown here, in TAXA.

Clapham, A.R., Tutin, T.G., & Warburg, E.F. 1952. *Flora of the British Isles*. Cambridge University Press

Kloet, G.S. & Hincks, W.D. 1945. A Check List of British Insects. Stockport

Contact: Henry Arnold is database manager for the Biological Records Centre. E-mail ha@ceh.ac.uk

PROGRAMME 3: MAJOR RECORDING PROJECTS

Butterflies for the New Millennium

Background

The *Butterflies for the New Millennium* (BNM) project was initiated because of widespread decline in the biological richness of the countryside, and built upon a previous atlas (Heath *et al.* 1984) that had drawn attention to possible declines in various butterfly species.

Objectives

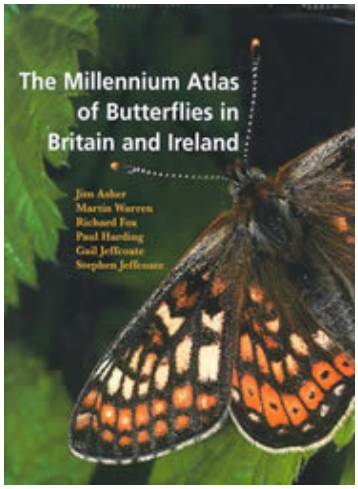
One of the main objectives of this project was to establish a permanent recording network, with local butterfly recorders distributed across Britain, Ireland, the Isle of Man and the Channel Islands. With coverage from the whole of the British Isles, the work of the first five years was to re-survey the

entire area to build a picture of change in butterfly distribution and numbers. This would also produce a firm foundation for monitoring further change.

Methods

The BNM project was a collaboration between BRC and Butterfly Conservation (BC) and much of its success was due to the establishment of a regional network of butterfly co-ordinators. Each area, corresponding to a vice county or aggregation of vice counties, had a local project co-ordinator. Recorders sent records to these co-ordinators, who compiled records. Over 10,000 recorders submitted over 1.6 million sightings. Data from the Butterfly Monitoring Scheme was also incorporated (see *Further sources of information*).

The Millennium Atlas



The cover of the *Millennium Atlas* figures Marsh Fritillary *Euphydryas aurinia*, a species protected under the EC Habitats and Species Directive. The attractive and informative atlas sold over 10,000 copies. The text includes an authoritative analysis of butterfly distribution and change up to the millennium. The dataset behind the BNM atlas has been used extensively to address a range of research questions.

Key Events

The *Millennium Atlas* was published on 1 March 2001 and officially launched at a ceremony in April.

Butterfly Conservation have sustained BNM recording and hold annual symposia.

BNM data, comprising 1,548,963 records of 58 species, were loaded on to the NBN Gateway in June 2004.

Further Sources of Information

NBN Gateway gives access to butterfly data published in the *Millennium Atlas*.
For information on analysis, see Critical evaluation of changes in butterfly distributions, p. 21.
Information about the *Butterfly Monitoring Scheme* can be found at http://www.bms.ceh.ac.uk/

Websites: www.butterfly-conservation.org/bnm
www.searchnbn.net

Contact Points
Gavin Broad is the co-ordinator of zoological data and research at the BRC. Email: gabro@ceh.ac.uk

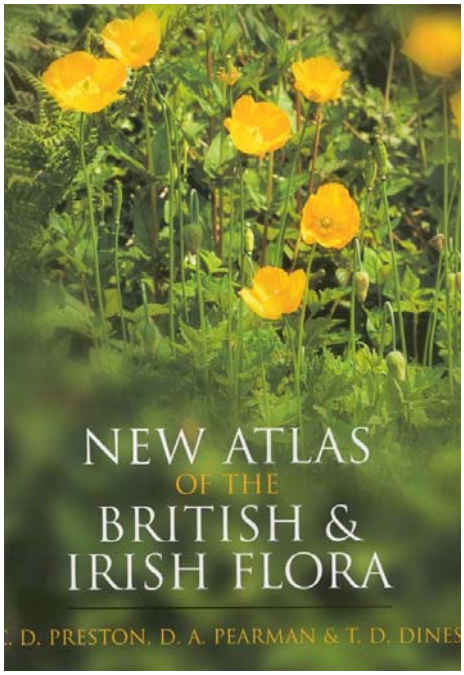
Nick Greatorex-Davies is the Butterfly Monitoring Scheme co-ordinator at the BRC. Email: ngd@ceh.ac.uk

New Atlas of the British and Irish Flora

Background

With the *Atlas of the British Flora* (1962), the Botanical Society of the British Isles pioneered the 10-km square mapping of the British and Irish fauna and flora. The techniques of biological recording have been developed by BSBI and many other specialist societies since the pioneer years of the 1950s, but even in the 1990s the 1962 *Atlas* remained the only available summary of the distribution of British and Irish vascular plants. In 1995 BRC and BSBI obtained agreement from the UK Department of the Environment (later Department for the Environment, Transport and the Regions, DETR, now Department for Environment Food and Rural Affairs, Defra) to support the production of a new atlas of British and Irish vascular plants. This was published in 2002 as *New Atlas of the British and Irish Flora* (Preston, Pearman & Dines 2002).

New Atlas of the British and Irish Flora



The *New Atlas* includes maps of 2412 taxa, including all native species, introduced species recorded from at least 50 10-km squares, and a number of infraspecific taxa and hybrids. The records are mapped in three date classes, the latest being 1987-99, and for most taxa native occurrences are distinguished from introductions. The accompanying text describes the habitat of each taxon, summarizes trends in its frequency, summarizes its wider distribution and provides key references to further information. Similar information is provided for an additional 942 introduced taxa.

Measurement of change, 1930-1999

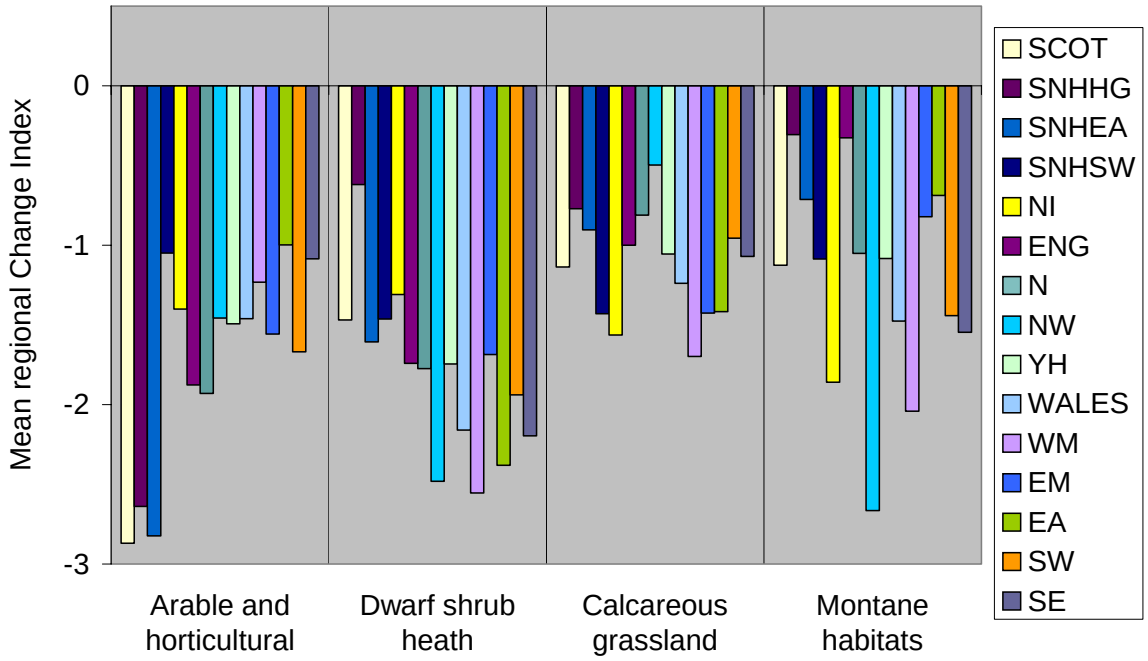
Comparison of the data collected for the 1962 *Atlas* and those gathered in 1987-99 for the *New Atlas* provides a unique opportunity to assess change in the national distribution of species. However, the comparison of the results of the schemes is not straightforward, being complicated by changes in taxonomy and recording practice and by differences in the intensity of recording between the two surveys. In order to compensate for the differences in intensity, a relative change index was devised and applied to those species mapped in both atlases (Telfer, Preston & Rothery 2002). This summarizes the change in species frequency relative to the average species. Index values can be worked out for Britain as a whole (the national index is published for each species in the *New Atlas*) or for particular regions (Preston *et al*., 2003) or habitats (Jackson, 2000).

What are the main changes?

Species were classified according to their preferences for Broad Habitats of the UK Biodiversity Action Plan (Jackson, 2000). In Britain as a whole, species characteristic of the *Arable and horticultural*, *Dwarf shrub heath*, *Calcareous grassland*, *Bog*, *Montane* and *Acid grassland* broad habitat categories have been the least successful, whereas those of *Improved grassland* and *Built-up areas and gardens* have done relatively well. When the results are analysed for individual countries and regions of the UK there is considerable geographical variation: species of *Arable and horticultural* habitats have done less well in Scotland than elsewhere, for example, whereas those of *Acidic grassland* show little change in Scotland but a marked decrease elsewhere.

There is also marked geographical variation in the patterns of change analysed for species with different ecological attributes.

- Species characteristic of high-nutrient habitats have been relatively successful except the Scottish Highlands, but in England the success of these species has been particularly marked.
- Species characteristic of sites with very acidic or very basic soils have been less successful than those of circum-neutral conditions in all areas except the Scottish Highlands.
- In many areas species of shaded conditions have been more successful than those of unshaded sites, but there is no significant trend in S.E. England, N. and N.W. England and Highland Scotland, and the trend is in the opposite direction in S.W. Scotland.
- Tall plants (which tend to be more competitive) have been more successful than short plants in all areas except Highland Scotland.
- Northern species have declined in all regions except Highland Scotland.



Mean change index for species characteristic of four Broad Habitats in the countries and regions of the UK: Scotland (SCOT) and its component regions Highland (SNHHG), Eastern Arable (SNHEA) and South Western Pasture (SNHSW), Northern Ireland (NI), England (ENG) and its component regions North (N), North West (NW), Yorkshire & Humberside (YH), West Midlands (WM), East Midlands (EM), East Anglia (EA), South West (SW) and South east (SE), and Wales (WALES). The diagram indicates a consistent decline in almost all regions for species characteristic of all these broad habitats.

Key events

The *New Atlas* was launched by the Secretary of State for Environment at an event hosted by Defra at Kew Gardens on 17 September 2002. It was selected by NERC Chief Executive, Sir John Lawton, as one of NERC's top ten achievements for 2002.

Websites: www.brc.ac.uk www.searchnbn.net www.bsbi.org.uk

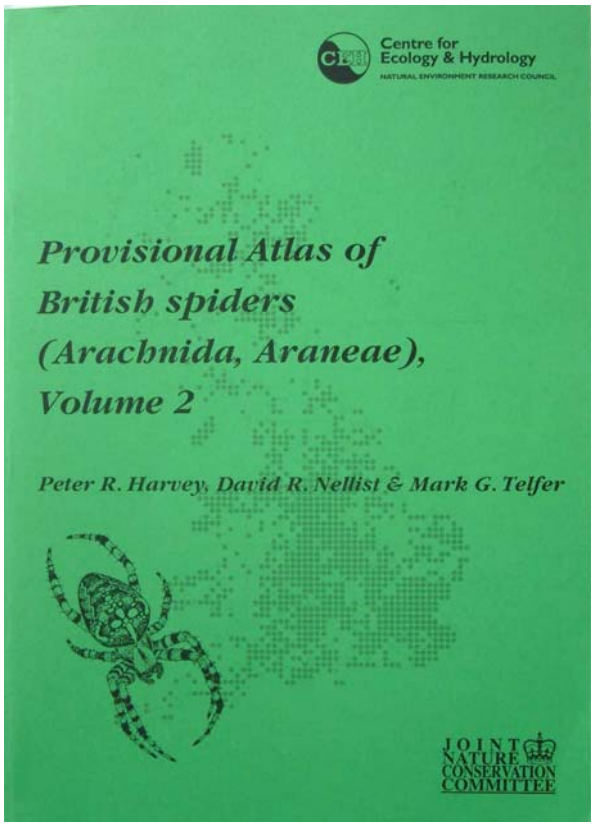
Jackson, D.L. 2000. *Guidance on the interpretation of the Biodiversity Broad Habitat Classification (terrestrial and freshwater types): Definitions and the relationship with other habitat classifications*. JNCC Report No. 307. JNCC, Peterborough.

Contact Chris Preston is BRC Head of Research. Email cdpr@ceh.ac.uk

Provisional Atlases 1999-2004

Background

BRC has, from its early days, published 'Provisional Atlases'. The original idea was to provide encouragement to recorders and to identify major gaps in geographical coverage. Such provisional atlases were intended as temporary documents, each presaging a main atlas with full coverage. Much of their original function can now be provided through the internet by maps on the NBN Gateway. Accordingly, the Provisional Atlases of the reporting period were much less provisional than their predecessors. Indeed, they were all substantial works, and were not really provisional in the old sense.



Methods

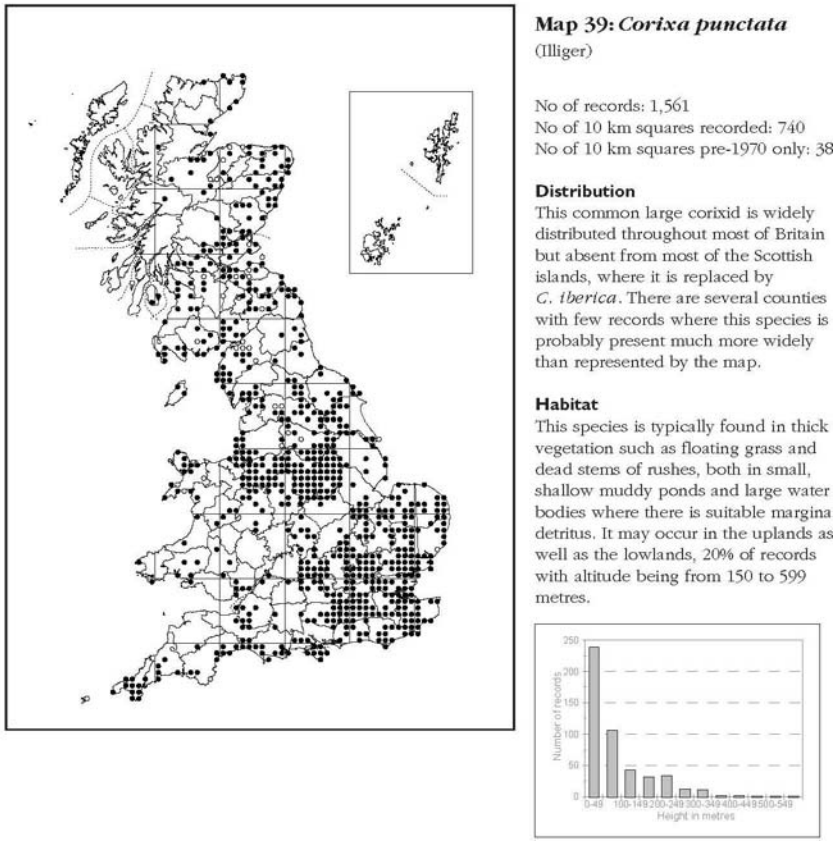
Collection of data for the spider atlas (Hervey *et al.*, 2002) trialled the new methodology of the internet. There was first the normal process of punching data, checking punch output, editing corrections, loading to a holding table, and running validation checks on the Oracle database. Temporary maps were then posted on the NBN Gateway and were validated by experts. Records that did not fit the known distributions of species were singled out for special treatment. The accuracy of computerization was double-checked. Records that had been computerized correctly were referred to the original recorder as well as to the relevant Area Organizer and other experts. Vice-county distributions were used as an additional check in cases of doubt. The whole process was efficient. It is clearly the forerunner of the standard methodology of the future.

Key Results

The spiders, comprising 647 species, were mapped in two volumes. The other groups mapped by provisional atlases were not as numerous and did not break new ground with their data validation, but were all, in their way, innovative. The atlas of hoverflies (Ball & Morris, 2000) has bar charts showing the phenology of 272 species, together with notes on biology and distribution. There are early-season species (e.g. *Melligramma euchromum*, peaking in May), and late-season species (e.g. *Volucella zonaria*, peaking in August); others such as *Melanostoma scalare* are bimodal. A few are perhaps only vagrants. It is remarkable how little is known of the biology of even some common species. *M. scalare* is 'widespread and common in grassy situations', but the normal habits of its larvae in the field remain unknown.

The aquatic Heteroptera (Huxley, 2003) are a much smaller group, comprising 61 species. This permitted the atlas to be more expansive, with information on distribution, habitat and altitude, and 'hepful hints' on species identification, often with diagrams. A large table lists the vice-county occurrence of each species. There is a glossary and a gazetteer. In spite of this wealth of information, this particular atlas shows the uneven species coverage characteristic of a group that needs more recording. The common pond skater *Gerris lacustris* is mapped as ubiquitous in Derbyshire and Nottinghamshire but almost completely absent from Leicestershire, Herefordshire and Wiltshire. A similar pattern can be seen in other species (e.g. *Corixa punctata*, Map 39). A provisional atlas can

stimulate new recording. In this case 'the whole project … mostly depended on a small number of dedicated people, with new recruits enrolled mainly through personally directed letters'.



Map 39: *Corixa punctata*
(Illiger)

No of records: 1,561
No of 10 km squares recorded: 740
No of 10 km squares pre-1970 only: 38

Distribution
This common large corixid is widely distributed throughout most of Britain but absent from most of the Scottish islands, where it is replaced by *C. iberica*. There are several counties with few records where this species is probably present much more widely than represented by the map.

Habitat
This species is typically found in thick vegetation such as floating grass and dead stems of rushes, both in small, shallow muddy ponds and large water bodies where there is suitable margina detritus. It may occur in the uplands as well as the lowlands, 20% of records with altitude being from 150 to 599 metres.

The *Provisional atlas of the British aquatic bugs (Hemiptera, Heteroptera)* includes much information in addition to species maps. It runs to 118 pages, of which only about half present distribution maps. Cheshire, noted for its relatively small vascular plant flora, is the richest county for aquatic bugs, with 48 species

Another provisional atlas mapped the Cantharoidea and Buprestoidea (Alexander, 2003); it showed an apparently strong decline of the glow worm *Lampyris noctiluca* in Scotland. Parts 3 and 4 (Edwards & Telfer, 2001, 2002) of the series mapping aculeate Hymenoptera were published during the reporting period. These BWARS (Bees, Wasps and Ants Recording Society) atlases have demonstrated the precipitous declines of several bumblebees, especially *Bombus ruderarius*, *B. sylvarum* and *B. distinguendus*, which is now certainly present only in the Hebrides and on the north Scottish coastline. The bumblebee *Bombus subterraneus* is probably extinct, with no records since 1988. On the other hand, there are the first UK records of the small solitary bee, *Colletes hederae*, only described in 1993, recorded from the Channel Islands in 1999, and increasingly being recorded across southern England.

It is impossible to do justice to all these works in this brief report; nor indeed to two of the full atlases, covering non-marine molluscs (Kerney, 1999) and seaweeds (Hardy & Guiry, 2003). Space does not permit this, but the interested reader is strongly encouraged to peruse them.

Further Sources of Information

Provisional and main atlases are listed with other BRC publications on p. 30.

Website: http://www.brc.ac.uk/publications.htm

Contact: Dr Gavin Broad is the coordinator of zoological data at BRC. Email: gabro@ceh.ac.uk; Dr Chris Preston is coordinator of botanical data. Email crpr@ceh.ac.uk.

Database and Atlas of Freshwater Fishes

Background

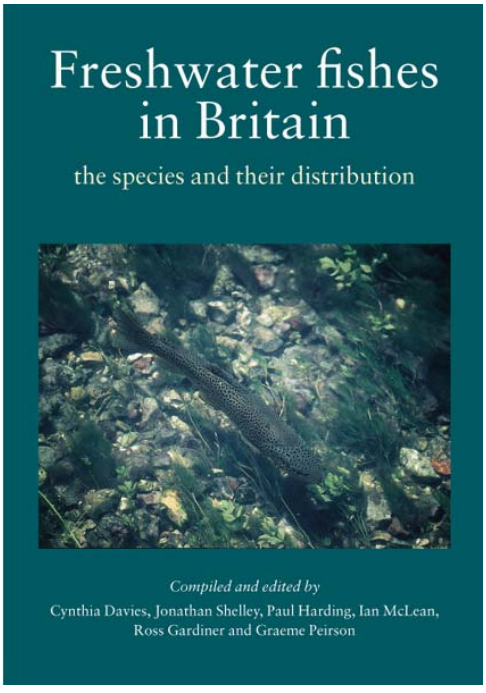
In the early 1990s, British freshwater fishes were a group for which up-to-date distribution data were either lacking or had not been brought together. The *Key to British freshwater fishes* (Maitland, 1972) included distribution maps, but these were not supported by accessible computerized data on the source of records and suffered from incomplete coverage in some parts of the country. It was this lack of easily accessible data, and the conviction that the data must be out there, that led Paul Harding of the BRC and Ian Winfield of the (then) Institute of Freshwater Ecology to undertake a feasibility study in 1996, followed by a pilot study in 1997. Building on these, the DAFF (Database and Atlas of Freshwater Fishes) project was set up, with funding from CEH, JNCC and the Environment Agency.

Methods

The DAFF project and its predecessors ran from 1996 to 2002. The DAFF project was led by Cynthia Davies of BRC. The project gathered data on freshwater fishes of Britain (including the Channel Islands and the Isle of Man) and Northern Ireland, although the atlas does not include Northern Ireland, for which coverage was patchy.

The vast bulk of English and Welsh data came from the Environment Agency's scattered databases. Other sources of data were local records centres, museums, water companies and individual recorders' observations. Scottish data were obtained from the Scottish Fisheries Co-ordination Centre, the Fisheries Research Services Freshwater Laboratory, and Peter Maitland. Channel Island data came from the Guernsey Museum and Art Gallery and the Environmental Services Unit, Jersey. The relevant data were extracted from these disparate sources and brought together in the BRC's Oracle database. Species accounts were written by a large number of specialists.

Key Results



The data behind the atlas were based on 278,570 records for 78 taxa, including hybrids. There are in fact only 29 native fish species that are confined to freshwaters, of which the Burbot is extinct and the Crucian Carp is doubtfully native. A further 6 live in the sea and breed in freshwater, while the Eel famously does the reverse. Sturgeon and Houting are vagrants. Flounder and Thin-lipped Grey Mullet will penetrate freshwaters but do not breed there. Thirteen introduced species are more or less established. The introduced Largemouth Bass and Redbelly Tilapia are now extinct. Other introduced species have not properly established.

Key Events

The book, *Freshwater Fishes in Britain – the species and their distribution* (Davies *et al*., 2004) was published in September 2004. It elicited considerable press interest, including an article in the Times.

Further Sources of Information

The history of the DAFF project, and much else besides, can be found in the book itself, *Freshwater fishes in Britain*. The data can be searched interactively on the NBN Gateway (url below).

Website: http://www.searchnbn.net/

Maitland, P.S. 1972. *Key to British Freshwater Fishes*. Ambleside: Freshwater Biological Association.

Contact: Dr Gavin Broad is the co-ordinator of zoological data and research at the BRC. Email: gabro@ceh.ac.uk

Survey of Bryophytes of Arable Land

Background

Arable land has a distinctive bryophyte flora, which is best developed in autumn and winter and which in cereal fields is therefore a feature of autumn and over-wintering stubbles. It was not until the 1960s that the taxonomy of many of its characteristic species was clarified. The distribution of these species is still under-recorded. We have less background information on their habitat and ecology than for we have for bryophytes of better-known habitats, and very little idea of how the arable bryophyte flora is changing. Bryologists in mainland Europe probably know even less about their arable bryophytes than we do in Britain.

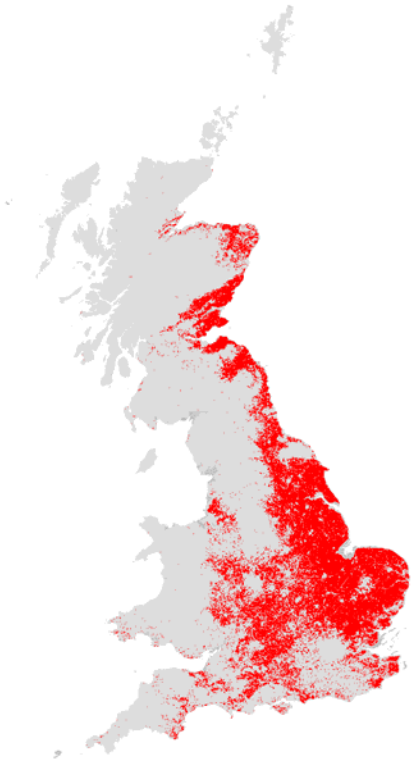
In 2000 Ron Porley of English Nature reviewed the current state of knowledge of arable bryophytes. He concluded that 'more survey work is needed in both Britain and Ireland to understand the distribution, status and occurrence of bryophytes in different crop types and under various management regimes, particularly in relation to organic farming'. He therefore proposed a nationwide survey of bryophytes on arable land. The British Bryological Society's Conservation and Recording Committee endorsed Porley's proposals. Details of the Survey of Bryophytes of Arable Land (SBAL) recording scheme were thrashed out by a Steering Group consisting of Ron Porley (EN), Jonathan Sleath (BBS), Mark Hill and Chris Preston (BRC) and Gill Stevens (Natural History Museum). After a trial season the Scheme was launched in the autumn of 2002. Three winters (2002/3, 2003/4 and 2004/5) were allocated for field survey. At the time of writing, the field survey is nearly complete; we can report on the methods of SBAL and give an interim account of the coverage attained, but the results have not yet been analysed.

Methods

The basic survey unit of the SBAL scheme is the individual field. There are two aspects to the Scheme: the survey of 2 fields in each of 100 tetrads (2 × 2 km squares) selected as a stratified random sample in the main arable areas of Britain, and the survey of additional fields in Britain and Ireland selected by individual recorders.

The *'random tetrads'* were selected from the arable regions of the country using the Landcover Map of Great Britain (Fuller, Groom & Jones, 1994). We initially identified those 100-km squares with at least 15% arable land (there were 22 such squares). The number of tetrads selected from each 100-km square was in proportion to the total land area (not merely the arable area) of that square. This requirement allowed us to avoid over-sampling 100-km squares with little land area but much sea, and also spread the sample out, so that the most intensively arable parts of the country would not completely dominate the selection.

Other fields were selected by the recorders themselves, the only requirement being that they should be 'in suitable condition' for recording (i.e. not recently ploughed, spread



The main arable areas in Britain. The map shows the 1-km squares where arable land is the largest single land cover class

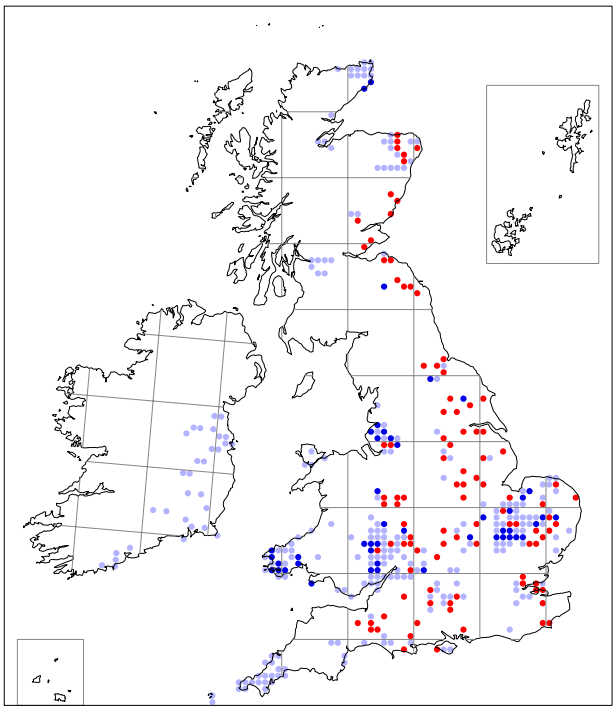
with muck etc.). Recorders were asked to specify whether the '*recorder-selected fields*' were chosen as 'ordinary' or as 'special' (the latter category includes fields already known to have populations of rare bryophytes, an interesting vascular plant weed flora, special management etc.).

The standard methodology for the Survey was introduced to recorders at the launch of the project and subsequently at other BBS meetings or by personal contact. Recorders were asked to list bryophytes present, assess their abundance, note any reproductive organs, and record field location, crop type, soil characters (including pH) and the overall cover of vascular plants, bryophytes, trash and bare soil.

Although the Survey was designed with arable bryophytes in mind, it is also interesting from BRC's perspective as a test of the extent to which volunteers are prepared to take part in survey which includes an element of direction to randomly selected tetrads.

Coverage achieved

The survey of the 200 randomly selected fields was completed in February 2005. By March 2005 over 500 recorder-selected fields had also been recorded, many more than anticipated at the start of the Survey. The random fields provided a repeatable sample whilst recorder-selected fields allowed bryologists to take part in the Survey even if they lived in areas lacking random tetrads. They could continue to take part after recording their random tetrads.



Coverage of the SBAL recording project (to March 2005). The red 10-km squares include the randomly selected tetrads, all of which have been surveyed. Blue squares include recorder-selected fields; 1-2 fields have been surveyed in light blue squares and 3-9 fields in dark blue squares.

Results

Photo: H.L.K. Whitehouse

The underground reproductive structures ('tubers') of *Bryum violaceum* are borne on purple rhizoids. The tubers are about 0.08 mm in diameter. This under-recorded species has proved to be one of the most frequent plants on arable land in Britain.

The survey has resulted in many new records of threatened and nationally rare or scarce species. Such species include the first records from arable land of the Critically Endangered *Amblystegium radicale*, and new arable records of such species as *Bryum gemmilucens* (Data Deficient), *Chenia leptophylla* (a rare introduction), *Didymodon tomaculosus* (Near Threatened; BAP Priority), *Ephemerum sessile* (Near Threatened), *Phaeoceros carolinianus* (Endangered), *Sphaerocarpos texanus* (Vulnerable), *Weissia rostellata* (Near Threatened; BAP Priority) and *Weissia squarrosa* (Endangered; BAP Priority) and at least 15 more nationally scarce species.

Website:
http://www.jonathan.sleath.btinternet.co.uk/SBAL/intro.htm

Contact Chris Preston Email cdpr@ceh.ac.uk

PROGRAMME 4: ANALYSIS AND INTERPRETATION

Archaeophytes in Britain

Background

When the plans for the *New Atlas of the British Flora* were developed, it was decided that the native range of a species within the British Isles should be distinguished from that part of the range where it was present only as an introduction. In preparing the maps along these lines, Chris Preston (BRC) and David Pearman (BSBI) soon discovered that there was a group of species which were supposedly native (according to standard sources) but never occurred in semi-natural habitats. Many of these species seemed more likely to be ancient introductions than true natives. Botanists in Central and Northern Europe have used the term *archaeophytes* for species which were introduced to their areas by AD 1500, and it seemed likely that this term could be usefully adopted in Britain. We therefore joined Allan Hall (English Heritage) in a project aimed at developing criteria by which archaeophytes could be recognized, and applying them to the British Flora.

Criteria for recognition of archaeophytes

We developed six criteria which archaeophytes would be expected to satisfy:

- There should be no fossil (remains from this period are more strictly described as sub-fossil) evidence for the presence of archaeophytes in the Holocene before human impact.
- Archaeophytes, like neophytes, are likely to be restricted to man-made habitats, or much more frequent in man-made than semi-natural habitats.
- Archaeophytes should have been recorded in the wild in Britain before AD 1700.
- Archaeophytes in Britain are likely to have had stable ranges since AD 1700, or to have increased or decreased in response to environmental change or human practices, but are unlikely to have expanded rapidly into previously available habitats.
- The native range of British archaeophytes in Europe is likely to be uncertain.
- Archaeophytes are likely to have spread to the 'neo-Europes' of N. America, Australia and New Zealand.

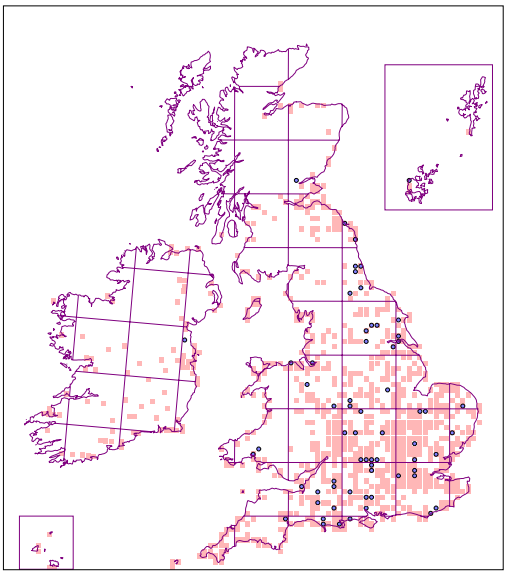
No single criterion provides a definitive way of recognising an archaeophyte, and most species can be identified as archaeophytes only on the balance of probability. Preston, Pearman & Hall (2004) used the above criteria to list 157 probable archaeophytes in Britain. Some of these have usually been classified as natives (e.g. *Anthemis arvensis*, *Lamium album*); others have long been recognized as introductions (e.g. *Adonis annua*, *Inula helenium*).

The fossil history of British archaeophytes

The Archaeobotanical Computer Database (ABCD), maintained by Allan Hall, was used to investigate the fossil history of the plants identified as probable archaeophytes. Of the 157 archaeophytes, 97 have been found as fossils between the Neolithic and the Medieval periods. Only five of these were first recorded as fossils in the Neolithic, and only 11 by the mid Bronze Age. However, 18 are first recorded in Late Bronze Age contexts, and a further 15 in the Iron Age. We cannot be sure that these figures accurately reflect the period when species were introduced, but it is interesting to note that the Late Bronze Age was a period of agricultural intensification, with the introduction of new crops and new agricultural methods, and also a time when there was increasing contact with continental Europe. The short Roman and Romano-British period was also marked by a large number of first fossil occurrences, including a number of herbs and pot-herbs which were almost certainly Roman introductions.

Photo: Paul Hackney
Source: http://www.habitas.org.uk/flora/

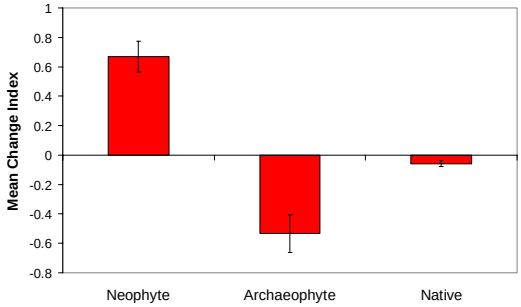
The archaeophyte *Hyoscyamus niger*, known as a fossil from the Early Bronze Age.



Recent distribution of *Hyoscyamus niger* (red squares) compared with fossil records (blue dots).

Archaeophytes in the modern landscape

Analysis of the *New Atlas* database reveals a striking difference between archaeophytes and more recent introductions. Whereas plants introduced after AD 1500 ('neophytes') show a strong and unsurprising tendency to have increased, the archaeophytes as a group have suffered a relative decline. In part this reflects the fact that many are arable weeds, many of which have declined as a result of agricultural intensification. However, other species have also decreased, including several ruderal *Chenopodium* species and plants such as *Cichorium intybus* which were formerly cultivated. The great difference in the success of archaeophytes and neophytes provides a strong justification for treating them separately, rather than simply lumping them into a single 'introduced' category.



The relative success of neophytes, archaeophytes and native species in Britain, comparing the periods 1930-69 and 1987-99. Success is measured by a change index; the greater the value, the greater the relative success (p. 11).

BRC Contact Chris Preston Email cdpr@ceh.ac.uk

Attributes of plants

Background

Environmental change results in changes in plant distributions. Warming of the climate is predicted to produce a northward shift of southern plants and a loss of northern plants, especially arctic-montane species. Likewise, the loss of particular habitats such as calcareous grassland can be expected to result in the loss of specialists of this habitat. Many factors can have an effect, especially changes in land use, but also climate change, atmospheric nitrogen deposition, water abstraction, and natural processes such as soil leaching. If we are to understand how these factors result in changes in plant distributions, and how they produce patterns of distribution, then there is a need to generalize. Generalization requires an understanding of the attributes of plants.

There are several published sources for plant attributes, notably the *Ecological Flora Database* (Fitter & Peat, 1994), data from the Unit of Comparative Plant Ecology (Hodgson *et al.*, 1994), the indicator values of Ellenberg (Ellenberg *et al.*, 1991), and *Clopla1*, a central European dataset on clonality (Klimeš, 2003). None of these sources was complete for the British and Irish flora, although Ellenberg's indicator values were complete for the central European flora. Over the course of several years, and especially during the six years reported here, we have assembled attribute data for the British and Irish flora. In the longer term, BRC aims to bring together more extensive data on both flora and fauna, building on datasets such as the *Phytophagous Insects Database* (Ward, Hackshaw & Clarke, 2003), which are a long-term maintained resource.

Objectives

The main aim was to provide a reliable set of attributes, complete for all British and Irish plants, bringing together results from our work over a period of years. We particularly wished to present results on biogeography, origins, native status and Ellenberg indicator values. A moderate number of gaps could be filled by new observations and measurements.

Category	**No. of attributes**	**Attributes reported**
Taxonomic	2	Taxon name, Family
Status, change	4	Native status, Conservation status, Rarity status, Change Index
Size	2	Height (terrestrial) or length (aquatic)
Life attributes	7	Perennation (2), Life form (2), Woodiness, Clonal spread (2)
Biogeography	3	Limits outside Britain: Latitude, Eastern limit, Continentality
Origin	1	Native range of alien taxa
Frequency	3	Number of 10-km squares: Britain, Ireland, Channel Islands
Climate	3	Mean climate of 10-km squares where present: January mean temperature, July mean temperature, Annual precipitation
Habitat	2	Whether coastal, preference for Broad Habitats
Indicator values	5	Ellenberg indicator values: light, moisture, pH, fertility and salt

Table 5. Attributes reported in *Plantatt* (Hill, Preston & Roy, 2004); those with suffix (2) have two entries, because some species are variably annual or biennial, hemicryptophyte or chamaephyte, etc.

Methods

Data were assembled on 30 attributes of plants, in addition to the name and family of each species (Table 5). The first set of data to be assembled was a set of Ellenberg indicator values. These values were derived from a training set, consisting of Ellenberg's values for central Europe, together with information on the associates of each species, derived from extensive quadrat sampling (Hill *et al.*, 2000). Basically, the method consists of finding out which plants occur with a chosen species, such as Round-leaved Sundew *Drosera rotundifolia*, and using these to characterize its preferences. Round-leaved Sundew generally occurs in wet, acid places, and its associates will show this.

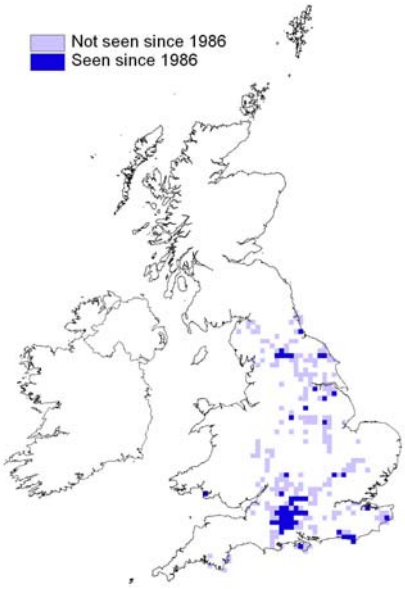
Many other attributes were drawn directly from the *New Atlas* (Preston, Pearman & Dines, 2002), where a more detailed explanation of methodology is given. In a few cases, such as plant height, we took data from a variety of published sources, and also made some measurements on plants in the field and the herbarium. Maximum plant heights are meant to be typical maxima, but the floras too often give extreme values. The biggest plant of Common Mallow *Malva sylvestris* seen by us was an

astonishing 2.3 m tall when growing on mud slubbed from the River Cam; the typical maximum height is reported as a mere 1.5 m.

Key Results

The attributes were used to report the changes found in the flora of the UK (Preston *et al.*, 2002). Small plants declined; plants of low-nutrient conditions (low Ellenberg N) declined; habitat specialists of calcareous grassland declined.

Photo: Jill Sutcliffe



Burnt Orchid
Orchis ustulata

A plant with the wrong attributes for survival in the modern world.

Maximum height 15 cm
Ellenberg fertility score 2
Broad habitat: calcareous grassland

Further Sources of Information (BRC publications are listed separately, p. 30).

Ellenberg, H., Weber, H.E., Düll, R., Wirth, V., Werner, W. & Paulissen, D. (1991) Zeigerwerte von Pflanzen in Mitteleuropa. *Scripta Geobotanica*, **18**, 1-248.

Fitter, A.H. & Peat, H.J. (1994) The Ecological Flora Database. *Journal of Ecology*, **82**, 415-425. http://www.york.ac.uk/res/ecoflora/cfm/ecofl/index.cfm

Hodgson, J.G., Grime, J.P., Hunt, K. & Thompson, K. (1994) *The electronic comparative plant ecology*. Chapman & Hall, London.

Klimeš, L. (2003) *Clopla1* http://www.butbn.cas.cz/klimes/iclopla1.html

Ward, L.K., Hackshaw, A. & Clarke, R.T. (2003) Do food-plant preferences of modern families of phytophagous insects and mites reflect past evolution with plants? *Biological Journal of the Linnean Society*, **78**, 51-83.

Website: http://www.brc.ac.uk/resources.htm

Contact: Mark Hill has a long-standing interest in plant attributes. E-mail moh@ceh.ac.uk

Critical evaluation of changes in butterfly distributions

Background

Habitat degradation and climate change are altering the distribution and abundance of animals and plants throughout the world. There is growing concern about increased rates of regional and global extinction. Are extinction rates for one group of organisms are similar to those for others? Comprehensive surveys of plants, birds and butterflies have all been repeated in Britain over the past 20 to 45 years. These allow us for the first time to address the question of whether butterflies have declined as badly as birds or plants over similar time periods. They also allow us to examine the causes of change in butterfly distributions.

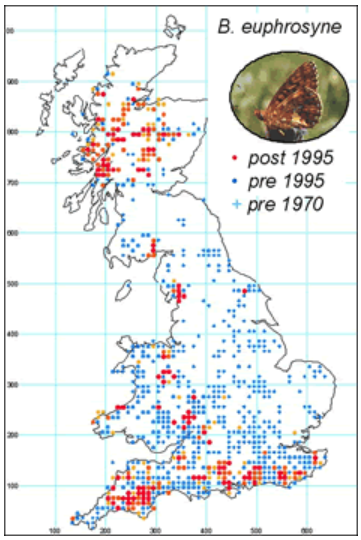
Methods

BRC has collaborated with the Botanical Society of the British Isles, Butterfly Conservation, British Trust for Ornithology, and the Universities of Leeds, York and Durham to address these questions. We evaluated changes in the distribution sizes and abundances of 46 species of butterflies that approach their northern climatic range margins in Britain. These insects might be expected to respond positively to climate warming. Results were compared with local population changes observed by the Butterfly Monitoring Scheme (BMS).

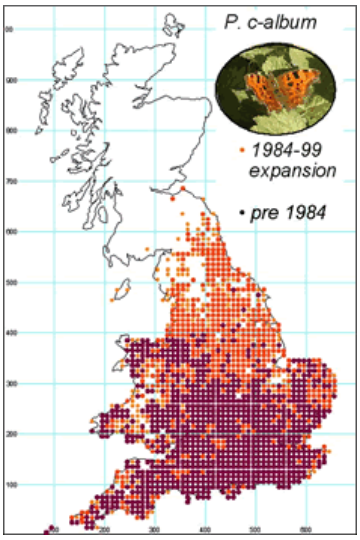
In a broader comparison, we compared distributional changes between the 1254 native species of vascular plants, 58 breeding butterfly species and 201 native breeding bird species.

Key Results

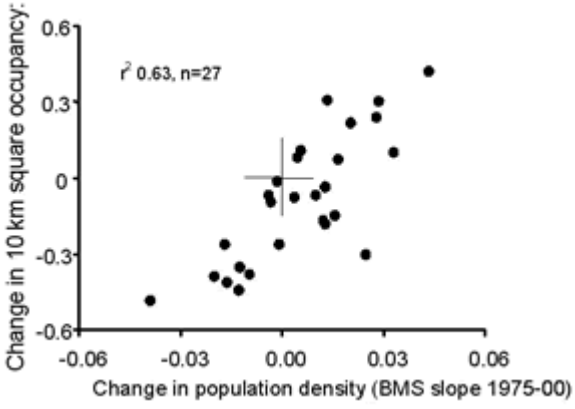
Half of the species that were mobile and habitat generalists increased their distribution sizes over this period (consistent with climate change), whereas the other generalists and 89% of the habitat specialists declined in distribution size (consistent with habitat limitation). Over the past 30 years, three-quarters of butterfly species with northern range margins declined: negative responses to habitat loss have outweighed positive responses to climate warming. The dual forces of habitat modification and climate change are likely to cause specialists to decline, leaving biological communities with reduced numbers of species and dominated by mobile and widespread habitat generalists.



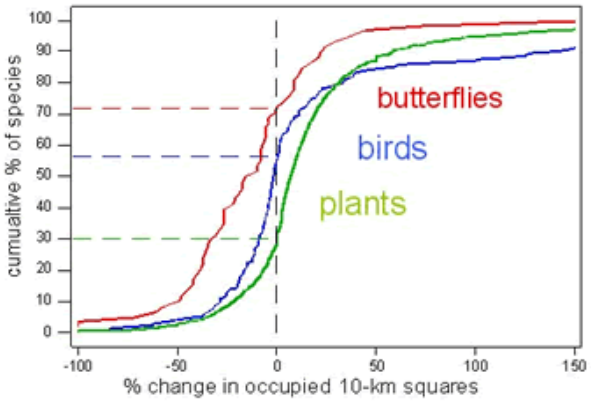
Decreasing and increasing species of butterfly. The Small Pearl-bordered Fritillary (*Boloria euphrosyne*) occurs in woodland clearings and rough hillsides with bracken. It was once widespread, but has declined rapidly in recent decades, and is now highly threatened in England and Wales. In contrast, mobile habitat generalist Comma (*Polygonia c-album*) has expanded northwards at a remarkable rate over the last two decades.



Changes in distribution are closely matched changes in abundance. Butterfly species showed similar trends in frequency at the geographical scale and local populations densities as measured by the Butterfly Monitoring Scheme.



When butterflies were compared with vascular plants and birds, butterflies experienced the greatest net losses, disappearing on average from 13% of their previously occupied 10-kilometre squares. **Most butterfly species declined.** We found that 28% of native plant species decreased in Britain over the past 40 years, 54% of native bird species decreased over 20 years, and 71% of butterflies decreased over ~20 years.



Other Sources of Information

Comparative analyses were published in *Nature* (Warren *et al*., 2001; Wilson *et al*., 2004) and *Science* (Thomas *et al*., 2004). The references are listed with other BRC publications on pp. 30-32.

Contact: David Roy Email dbr@ceh.ac.uk (butterflies); Chris Preston Email cdpr@ceh.ac.uk (plants)

PROGRAMME 5: COMMUNICATIONS AND OUTREACH

BRC on the Internet

Background

One of the key activities of the BRC is to facilitate the flow of biological data from its collection source to its user end point. At the heart of this is its engine of capture, collation and interpretation of data. BRC is also at the forefront of disseminating these data by means of novel web applications.

The BRC website itself is an important way for it to engage with the volunteer recording community, and the public. BRC is also heavily involved with the development of the National Biodiversity Network (NBN) Gateway, a web site which allows users to view distribution maps and download UK wildlife data via a variety of interactive tools.

BRC is able to draw upon high-level skills in programming, database design, GIS and web development to maintain websites that are informative and useful, and which allow us to share information about Britain's biodiversity.

Objectives

BRC websites are designed to provide information and resources for the recording community and government agencies, and to make it possible for recording schemes to have a valuable web presence. BRC is also able to apply its in-house web development skills to a range of other projects which have an online aspect.

Methods

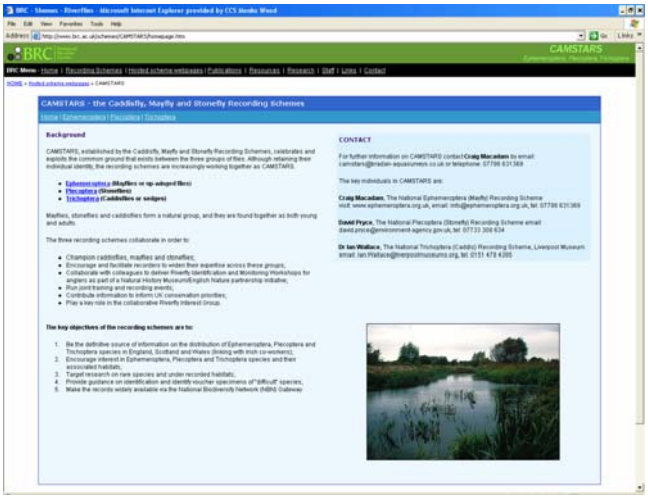
Within BRC, there are members of staff who possess skills in design, programming, database

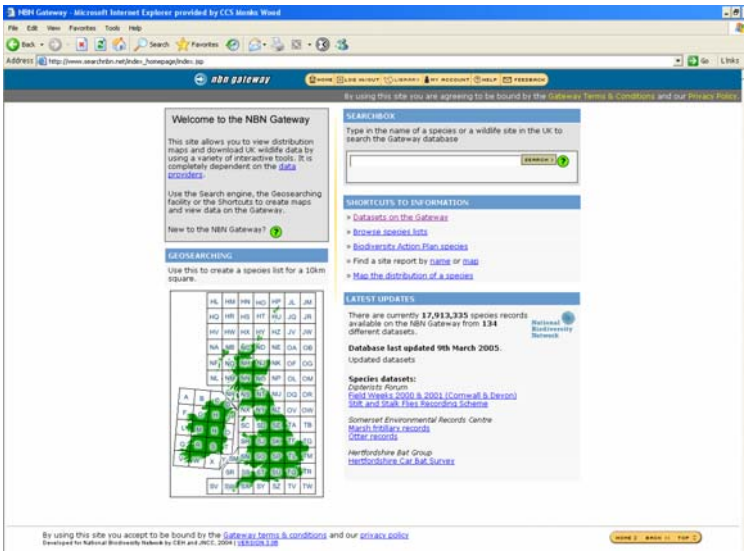
interaction, and GIS. They liaise with external technical or non-technical 'customers', gauge their requirements, and then translate these into project goals and activities. These staff members are then able to combine technical know-how, both in terms of hardware and software, with an appreciation of user needs and a close relationship with schemes, societies, agencies, and other users.

Key Results

The main BRC website was launched in 2001, and thoroughly overhauled and relaunched in 2004. The current website is aimed more accurately at its target audience of volunteer recorders, recording scheme organizers and conservation agency staff.

BRC plans to provide a web presence for recording schemes that do not have the resources to maintain their own website. This should raise their profile, and make them more accessible to data providers and data users. Hosted pages for CAMSTARS, the joint riverflies recording scheme, are the prototype for this kind of service from BRC. The CAMSTARS pages were launched at the Natural History Museum in November 2004.





BRC contributed to development of the NBN Gateway, not merely by providing data. BRC staff worked closely with members of JNCC, the NBN Trust, and external collaborators and contractors. The Gateway allows anyone from an interested member of the public to an agency policy maker to query and investigate a variety of datasets at a national or local level.

Key Events

The year 2004 was an active one, with the relaunch of the NBN Gateway (June), a complete overhaul of the BRC website (August) and the launch of the CAMSTARS hosted web pages (November). In March 2005, websites for the UK Ladybird and Harlequin Ladybird Surveys were launched at the Darwin Centre of the Natural History Museum. These will be followed by a new and more powerful website for the Butterfly Monitoring Scheme.

Websites: http://www.brc.ac.uk/ http://www.brc.ac.uk/schemes/ http://www.seachnbn.net/

Contact: Francis Rowland Email fro@ceh.ac.uk

PROGRAMME 6: MANAGING CHANGE

Development of the National Biodiversity Network

Background

The National Biodiversity Network is mentioned frequently in this Report, because it has helped the BRC to fulfil a number of its other principal objectives. In the early 1990s, BRC found that on its own it could not deliver all the data needs of conservation bodies, researchers and others. This resulted in a sense of frustration among data providers and data users. The solution was the NBN. BRC was involved from the outset in the discussions that brought together the consortium of organizations that founded the NBN. Thus, the contribution of BRC to the development of NBN was itself one of the outstanding achievements of BRC during the reporting period. Since 1999, BRC has been a central player in setting up and running some of the principal functions that underpin the Network: notably the NBN Gateway, Linking Societies & Schemes, and Linking Larger Biodiversity Organizations projects in the NBN Business Plan. Significant contributions have also been made to the Species Dictionary and Habitats Dictionary projects; and to the Data Access project. Indeed, some contributions have been made to most of the areas of activity in the NBN Programme.

Objectives

The objective, from the point of view of the BRC, has been to set up a working mechanism for making BRC and voluntary sector data available to users across the UK. The mechanism must be acceptable to all those taking part.

Methods

The BRC's approach to the development of the NBN has been to take a lead in promoting the interests of the voluntary sector in discussions; to use its position in CEH to tap into resources to enable practical solutions to be developed; and to use its co-ordinating role in UK biodiversity recording to communicate with and encourage participation by other organizations.

Key Results

BRC participation was pivotal in setting up the fully operational NBN Gateway during 2004. By the end of March 2005, almost 18 million records, largely from BRC-related voluntary sector sources, had been mobilized on the NBN Gateway. This has been a crucial factor in encouraging many societies to see the NBN as their own mechanism to communicate information to both their members and others.

From October 2001, BRC participated in the NBN Networking Naturalists Project (Programme 1, p. 4). BRC was also involved in development of the NBN Habitats Dictionary, and sent checklists to the NBN Species Dictionary Project, run by the Natural History Museum. Some taxonomic checklists were used on the Gateway in parallel with datasets from the Species Dictionary Project.

Finally, the BRC has been represented on almost all the main development and steering committees of the NBN since its inception.

Key Events

The NBN Trust was set up in March 2000. In October 2001, the Networking Naturalists Project was launched for three years, with funding from Heritage Lottery Fund and Defra (Programme 1, p. 4). The prototype NBN Gateway was developed during 2000-2002. The Gateway became fully operational in June 2004.

The panel at the NBN annual conference 2001. From left to right:-
Trevor James (NBN/BRC)
Paul Harding (Head of BRC)
Ian McLean (JNCC)
Mark Telfer (BRC)
Dorian Moss (BRC)

Further Sources of Information

Annual reports of the National Biodiversity Network Trust; NBN Newsletters.

Website: http://www.nbn.org.uk

Contact: Trevor James is NBN Development Officer for National Societies and Recording Schemes. Email: tjj@ceh.ac.uk.

Biological Records Centre Management Advisory Group (BRCMAG)

Background

In 1999, it was expected that the period of the six-year Memorandum of Agreement (MoA) between JNCC and the Institute of Terrestrial Ecology (now incorporated in the Centre for Ecology and Hydrology) would be one of rapid change. Information technology was forging ahead, with astonishing advances in Internet access, personal computing and database management. The National Biodiversity Network was being set up. The shortage of biological recorders in academic institutions was becoming noticeable and was expected to become acute. Campaigning organizations such as Plantlife and the Royal Society for the Protection of Birds had been very successful in persuading the UK government of the importance of conservation. If BRC was to make the most of these emerging

opportunities, it needed a steering committee to represent its stakeholders. BRCMAG was therefore set up.

Membership of BRCMAG

The main areas of representation on BRCMAG are users of data (NERC, JNCC, DETR, conservation NGOs, academic) and suppliers of data (e.g. national societies and schemes, local records centres).

1999	2004	Affiliation	Constituency
Chairman			
Sir John Burnett Chairman of BRCMAG 1999-2004		Co-ordinating Commission for Biological Recording	
Committee members			
	Dr James Munford	NBN Programme Director	National Biodiversity Network
Dr Michael Archer	Dr Michael Archer	President, Bees, Wasps and Ants	Recording Society
Ruth Davies	Nicola Hutchinson	Plantlife	Conservation NGO
Paul Harding	Dr Mark Hill	Head of BRC	CEH nominated officer
Dr Mark Hill	Dr Michael Morecroft	Natural Environment Research Council	NERC users of data
Trevor James	Nicky Court	Head, Hertfordshire Biological Records	Local Records Centres
Dr Ian McLean	Dr Ian McLean	JNCC	Nominated officer for BRC contract
Dr Mark Taylor	Dr David Webb	Central government and devolved administrations	DETR, later Defra
Dr Stephen Ward	Ray Woods	SNH, later CCW	Country conservation agencies
Dr Mark Young	Dr Mark Young	Aberdeen University	Academic data users
In attendance			
	Trevor James	BRC/NBN	NBN interface with National Schemes and Societies

Table 6. Members of BRCMAG, 1999 and 2004

Terms of reference

Ensure that the interests and concerns of the biological recording community are taken into account when planning and undertaking the BRC work programme. The recording community includes volunteer recorders, recording scheme organizers, local records centres and specialist societies.

Advise the Nominated Officers on the content of the annual work programme of BRC and recommend a suite of projects to be undertaken each year, with costs and timescales attached to each project. The BRCMAG will have access to financial information on BRC costs and income, to assess retrospectively the budget of the annual work programme and to enable informed discussions of short and long term investment in BRC by the funding partners.

Advise on the balance of work, to find any gaps in the programme and to look for opportunities for developing the work of BRC, bearing in mind the need to achieve good value for money.

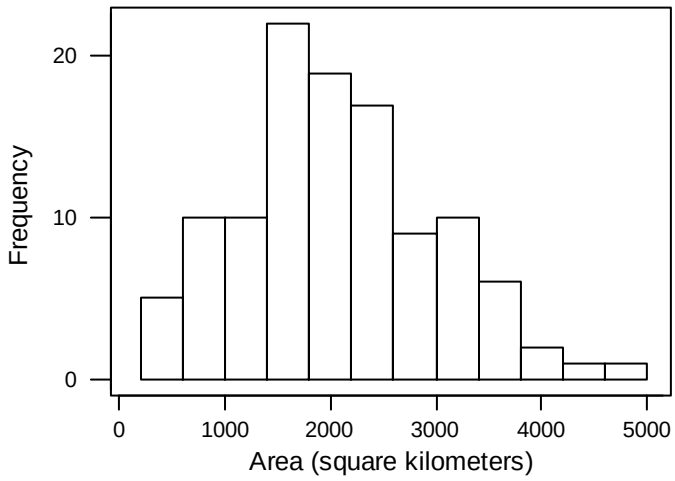
Assess the staff time and skills available to BRC and advise on the need for additional or alternative staff if it considers these necessary to deliver the work required by the funding partners.

Monitor the quality of BRC products and services and advise on how these may be altered or improved as necessary.

Advise on the co-ordination of BRC work with the activities of the National Biodiversity Network (NBN).

Meetings and their outcome

BRCMAG met twice-yearly during the six years of the MoA, six times in London, four times at Monks Wood, once in York and once in Edinburgh. For part of the period, the group served also as a steering group for the Networking Naturalists project, financed by the Heritage Lottery Fund. It advised on many matters, but in the event scarcely at all on funding. Its advice was particularly valuable in managing the changing role of BRC in relation to the emerging National Biodiversity Network. An incidental and unanticipated outcome was the complete digitization of the Watsonian vice-county boundaries by the National Biodiversity Network. Mark Hill (at that time representing NERC users) suggested to Jim Munford (NBN) that this would benefit recording in the longer term. Jim, with great skill, persuaded Defra to fund the project, and it became a reality.



How big are the 112 Watsonian vice-counties of Great Britain? Digitizing their boundaries was an unexpected outcome of BRCMAG

Key Recommendations

- BRC should publish a data access policy.
- BRC should prepare or revise Memoranda of Understanding with National Schemes and Societies.
- BRC should not undertake any new work to obtain or manage more documentary archives but should maintain the *status quo* with existing archives.
- BRC should help individual schemes and societies to look for sources of funding to deal with data backlogs.
- BRC should prepare a communications strategy, and raise its profile with key audiences.
- An informal system for prioritizing work on various taxonomic groups was proposed.
- BRC should make NERC aware of the potential dangers of the forthcoming Environmental Information Regulations in undermining the trust of volunteers.
- BRC should develop better links to local records centres.

Website: http://www.brc.ac.uk/BRCMAG.htm

Contact: Mark Hill E-mail moh@ceh.ac.uk

BRC PUBLICATIONS 1999-2004

The following list includes all atlases and provisional atlases published by the Biological Records Centre over the reporting period. Other publications are listed more selectively, but the list should give a flavour of what has been produced. Numerous other publications such as the autecological accounts in the *Biological Flora of the British Isles* use BRC data. No attempt has been made to include these here.

MAIN ATLASES

Asher, J., Warren, M., Fox, R., Harding, P., Jeffcoate, G. & Jeffcoate, S. 2001. *The millennium atlas of butterflies in Britain and Ireland*. Oxford: Oxford University Press.

Davies, C., Shelley, J., Harding, P., McLean, I., Gardiner, R. & Peirson, G., eds. 2004. *Freshwater fishes in Britain - the species and their distribution*. Harley Books, Colchester.

Hardy, F.G. & Guiry, M.D. 2003 *A check-list and atlas of the seaweeds of Britain and Ireland.* London: British Phycological Society.

Kerney, M. P. 1999. *Atlas of the land and freshwater molluscs of Britain and Ireland*. Colchester: Harley Books.

Preston, C.D., Pearman, D.A. & Dines, T.D. (editors) **2002.** *New Atlas of the British and Irish Flora.* Oxford: Oxford University Press.

PROVISIONAL ATLASES

Alexander, K.N.A. 2003. *Provisional atlas of the Cantharoidea and Buprestoidea (Coleoptera) of Britain and Ireland.* Huntingdon: Biological Records Centre.

Ball, S.G. & Morris, R.K.A. 2000. *Provisional atlas of British hoverflies (Diptera, Syrphidae).* Huntingdon: Biological Records Centre.

Edwards, R. & Telfer, M.G. (editors) **2001.** *Provisional atlas of the aculeate Hymenoptera of Britain and Ireland*, Part 3. Bees, Wasps and Ants Recording Society. Huntingdon: Biological Records Centre.

Edwards, R. & Telfer, M.G. (editors) **2002**. *Provisional atlas of the aculeate Hymenoptera of Britain and Ireland*, Part 4. Bees, Wasps and Ants Recording Society. Huntingdon: Biological Records Centre.

Harvey, P.R., Nellist, D.R. & Telfer, M.G. (editors) **2002.** *Provisional atlas of British spiders (Arachnida, Araneae)* 2 vols. Huntingdon: Biological Records Centre.

Huxley, T. 2003. *Provisional atlas of the British aquatic bugs (Hemiptera, Heteroptera).* Huntingdon: Biological Records Centre.

STARTER PACKS

Stubbs, A. 2003. *Dipterists Forum - Starter Pack.* Huntingdon: Biological Records Centre.

RED DATA BOOKS WITH SUBSTANTIAL BRC INPUT

Church, J.M., Hodgetts, N.G., Preston, C.D. & Stewart, N.F. (comps & eds) **2001**. *British Red Data Books: mosses and liverworts*. 168pp. Peterborough: Joint Nature Conservation Committee.

Wigginton, M.J. (ed.) **1999.** *British Red Data Books: 1 Vascular plants* (3rd edition). Peterborough: Joint Nature Conservation Committee.

BOOKS AND BOOK CHAPTERS OTHER THAN BRC ATLASES

Hill, M.O. 2004. Sphagnopsida. In *The moss flora of Britain and Ireland*, 2 edn (by A.J.E. Smith), pp. 43-102. Cambridge University Press, Cambridge.

Hill, M.O. & Edwards, B. 2003 *Mosses and liverworts of Dorset.* Dorset Environmental Records Centre, Dorchester. 176 pp.

Hill, M.O., Mountford, J.O., Roy, D.B. & Bunce, R.G.H. 1999. *Ellenberg's indicator values for British plants.* ECOFACT Volume 2 Technical Annex. Huntingdon: ITE.

Hill, M.O., Preston, C.D., & Roy, D.B. 2004. PLANTATT Attributes of British and Irish plants: status, size, life history, geography and habitats. *Huntingdon: Centre for Ecology and Hydrology*

Pearman, D.A. & Preston, C.D. 2000. *A Flora of Tiree, Gunna and Coll.* 168 pp. Dorchester.

Preston, C.D., Telfer, M.G., Arnold, H.R., Carey, P.D., Cooper, J.M., Dines, T.D., Hill, M.O., Pearman, D.A., Roy, D.B. & Smart, S.M. 2002 *The changing flora of the UK*. Defra, London.

PAPERS IN THE OPEN LITERATURE (selected)

Bates, J.W., Roy, D.B., & Preston, C.D. 2004. Occurrence of epiphytic bryophytes in a 'tetrad' transect across southern Britain. 2. Analysis and modelling of epiphyte-environment relationships. *Journal of Bryology*, **26**, 181-197.

Broad, G.R. 2004. Generic synonymies affecting the Orthocentrinae (Hym., Ichneumonidae), with notes on the composition of the subfamily. *Entomologist's Monthly Magazine*, **140**, 297-299.

Dennis, R.L.H., Hodgson, J.G., Grenyer, R., Shreeve, T.G., & Roy, D.B. 2004. Host plants and butterfly biology. Do host-plant strategies drive butterfly status? *Ecological Entomology*, **29**, 12-26.

Fant, J.B. & Preston, C.D. 2004. Genetic structure and morphological variation of British populations of the hybrid *Potamogeton* x *salicifolius*. *Botanical Journal of the Linnean Society*, **144**, 99-111.

Griffiths, G.H., Eversham, B.C., & Roy, D.B. 1999. Integrating species and habitat data for nature conservation in Great Britain: data sources and methods. *Global Ecology and Biogeography*, **8**, 329-345.

Harding, P.T. 2004. Distribution of freshwater Isopoda in Britain and Ireland. *Bulletin of the British Myriapod and Isopod Group*, **20**, 4-6.

Hill, M.O. **2003** Using data from local floras for ecological research. *Watsonia*, **24**, 321-329.

Hill, M.O. 2004. Rare and interesting bryophytes in Britain and Ireland. *Field Bryology*, **83**, 45-47.

Hill, M.O. & Preston, C.D. 2002 *New Atlas* genera in their natural orders. *BSBI News*, **91**, 18-23.

Hill, M.O., Roy, D.B. & Thompson, K. 2002 Hemeroby, urbanity and ruderality: bioindicators of disturbance and human impact. *Journal of Applied Ecology*, **39**, 708-720.

King, R.A., Gornall, R.J., Preston, C.D. & Croft, J.M. 2002. Population differentiation of *Potamogeton pectinatus* in the Baltic Sea with reference to waterfowl dispersal. *Molecular Ecology* **11**: 1947-1956.

Porley, R.D., Preston, C.D., & Hill, M.O. 2004. *Grimmia trichophylla* and related mosses in Cambridgeshire. *Nature in Cambridgeshire*, **46**, 72-76.

Preston, C.D. 2000. Engulfed by suburbia or destroyed by the plough: the ecology of extinction in Middlesex and Cambridgeshire. *Watsonia* **23**, 59-81.

Preston, C.D. 2002. '*Babingtonia pestifera*' – the explosive spread of *Elodea canadensis* and its intellectual ramifications. *Nature in Cambridgeshire*, no. **44**: 40-49.

Preston, C.D. 2003. Perceptions of change in English county floras, 1660-1960. *Watsonia* **24**: 287-304.

Preston, C.D. 2004. John Raven's report on his visit to the Hebrides, 1948. *Watsonia*, **25**, 17-44.

Preston, C.D. 2004. Should conservationists continue to ignore plant hybrids? *British Wildlife*, **15**, 411-415.

Preston, C.D. 2004. An updated list of British and Irish bryophytes from which tubers have been reported. *Field Bryology*, **83**, 2-13.

Preston, C. D. & Hill, M. O. 1999. The geographical relationships of the British and Irish flora: a comparison of pteridophytes, flowering plants, liverworts and mosses. *Journal of Biogeography* **26,** 629-642.

Preston, C.D., Pearman, D.A., & Hall, A.R. 2004. Archaeophytes in Britain. *Botanical Journal of the Linnean Society*, **145**, 257-294.

Preston, C.D., Stewart, N.F. & Palmer, M.A. 2000. The standing waters of Coll and Tiree in a national and international context. *Botanical Journal of Scotland* **52**, 43-64.

Preston, C.D. & Walker, K.J. 2003. Creeping inflation in the length of English county floras, 1730-1960. *Watsonia* **24**: 447-449.

Palmer, M.A. & Roy, D.B. 2001 A method for estimating the extent of standing fresh waters of different trophic status in Great Britain. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **11**, 199-216.

Proudlove, G.S., Wood, P.J., Harding, P.T., Horne, D.J., Gledhill, T. & Knight, L.R.F.D., 2003. A review of the status and distribution of the subterranean aquatic Crustacea of Britain and Ireland. *Cave and Karst Science*, **30**, 9-22.

Roy, D.B., Hill, M.O., Rothery, P. 1999. Effects of urban land cover on the local species pool in Britain. *Ecography*, **21**, 507-515.

Shreeve, T., Dennis, R.L.H., Roy, D.B., & Moss, D. 2001 An ecological classification of British butterflies: ecological attributes and biotope occupancy. *Journal of Insect Conservation*, **5,** 145-161.

Small, E., Sadler, J.P. & Telfer, M. 2003. Carabid beetle assemblages and successional processes on urban derelict sites in Birmingham, UK. *Journal of Insect Conservation*, **6**, 233-246.

Telfer, M.G., Preston, C.D. & Rothery, P. 2002. A general method for measuring relative changes in range size from biological atlas data. *Biological Conservation* **107**, 99-109.

Thomas, J.A., Telfer, M.G., Roy, D.B., Preston, C.D., Greenwood, J.J.D., Asher, J., Fox, R., Clarke, R.T., & Lawton, J.H. 2004. Comparative losses of British butterflies, birds, and plants and the global extinction crisis. *Science*, **303**, 1879-1881.

Tudor, O., Dennis, R.L.H., Greatorex-Davies, J.N., & Sparks, T.H. 2004. Flower preferences of woodland butterflies in the UK: nectaring specialists are species of conservation concern. *Biological Conservation*, **119**, 397-403.

Warren, M. S., Hill, J. K., Thomas, J. A., Asher, J., Fox, R., Huntley, B., Roy, D. B., Telfer, M. G., Jeffcoate, S., Harding, P., Jeffcoate, G., Willis, S. G., Greatorex-Davies, J. N., Moss, D. & Thomas, C. D. 2001 Rapid responses of British butterflies to opposing forces of climate and habitat change. *Nature*, **414,** 65 - 69.

Wilson, R.J., Thomas, C.D., Fox, R., Roy, D.B., & Kunin, W.E. 2004. Spatial patterns in species distributions reveal biodiversity change. *Nature*, **432**, 393-396.

REPORTS TO COUNTRY AGENCIES, JNCC, DEFRA AND EUROPEAN TOPIC CENTRE

Brooker, R.W., Carss, D., Marquiss, M., Mitchell, R., Preston, C., Sparks, T., Hammond, P., Sharples, R., & Hiscock, K. 2004. Incorporation of climate impacts into Biodiversity Action Plans relevant to Scotland, edited by R. Brooker. Report to Scottish Natural Heritage. 38pp.

Davies, C.E., Moss, D., & Hill, M.O. 2004. EUNIS habitat classification revised 2004. 311pp. Report to European Topic Centre for Nature Conservation.

Hill, M.O., Davies, C.E., Harris, M.P., Marquiss, M., Harding, P.T., Preston, C.D., Roy, D.B., Telfer, M.G., & Welch, D. 2002. Biodiversity assessment: the state of and changes in Scotland's biodiversity. *Scottish Natural Heritage Research, Survey and Monitoring Report* **185**, 1-210.

Hill, M.O., Downing, T.E., Berry, P.M., Coppins, B.J., Hammond, P.S., Marquiss, M., Roy, D.B., Telfer, M.G., & Welch, D. 1999 Climate changes and Scotland's natural heritage: an environmental audit. *Scottish Natural Heritage Research, Survey and Monitoring Report* No. 132. SNH, Battleby.

Mountford, J.O., Cooper, J.M., Roy, D.B., & Warman, E.A. 1999. Targeting areas for the restoration and re-creation of coastal and floodplain grazing marsh, Rep. No. 332. Peterborough: English Nature.

Palmer, M.A. & Roy, D.B. 2001. An estimate of the extent of dystrophic, oligotrophic, mesotrophic and eutrophic standing fresh water in Great Britain. JNCC, Peterborough.

Preston, C.D., Telfer, M.G., Roy, D.B., Carey, P.D., Hill, M.O., Meek, W.R., Rothery, P., Smart, S.M., Smith, G.M., Walker, K.J. & Pearman, D.A. 2003. The changing distribution of the flora of the United Kingdom: technical report. Report to Defra. CEH, Abbots Ripton.

Preston, C.D., van der Wal, R., Welch, D., Roy, D.B., & Hill, M.O. 2004. Scottish trends in vascular plants. Report to Scottish Natural Heritage. 46pp.

Welch, D., Carss, D.N., Gornall, J., Manchester, S.J., Marquiss, M., Preston, C.D., Telfer, M.G., Arnold, H. & Holbrook, J. 2001. *An audit of alien species in Scotland.* Scottish Natural Heritage Review no. 139. Edinburgh and Battleby: Scottish Natural Heritage.

CONFERENCE REPORTS

Harding, P.T., 2003. The National Biodiversity Network in the UK. In: *Changes in ranges: invertebrates on the move*. Proceedings of the 13th International Colloquium of the European Invertebrate Survey, Leiden, 2-5 September 2001, edited by M. Reemer, P.J. van Helsdingen & R.M.J.C.Kleukers, 111-114. Leiden: EIS Nederland.

James, T. 2004. The appliance of science: biological recording for new applications. Summary report of the 3rd annual conference for National Societies and Recording Schemes held at the Huxley Theatre, Zoological Society of London, Regents Park, 14th November 2003, compiled by Trevor James. *Abbots Ripton: Biological Records Centre & National Biodiversity Network Trust*. 21pp.

James, T. 2004. Data validation and verification. Report of a Networking Naturalists Seminar, Medical Research Council, Park Crescent, London, 16th June 2004, edited by T. James. *Abbots Ripton: Biological Records Centre & National Biodiversity Network Trust.* 17pp.

James, T.J. 2004. Natural partners: biodiversity observations and collections. Report of a conference held at the National Museum & Gallery of Wales, Cardiff, 2-3 July 2004, compiled by Trevor James. *National Federation for Biological Recording and National Biodiversity Network*. 24pp.

FINANCIAL STATEMENT

The figures presented here are the costs of running the core project of BRC, which is that reported here. In the earlier years of the reporting period, substantial funding was obtained from the Department of Environment, Transport and the Regions for the *New Atlas of the British and Irish* Flora. In the later years of the reporting period, JNCC and CEH augmented this activity with work to develop the National Biodiversity Network Gateway. Additional funding was obtained from JNCC and the Environment Agency in support of *Freshwater Fishes in Britain*. These activities are not included in the financial statement, but are included in this report.

Total	**JNCC**	**CEH**
1998/99		
£70,000	£35,000	£35,000
1999/2000		
£300,000	£150,000	£150,000
2000/01		
£300,000	£150,000	£150,000
2001/02		
£300,000	£150,000	£150,000
2002/03		
£300,000	£150,000	£150,000
2003/04		
£300,000	£150,000	£150,000
2004/05		
£250,000	£125,000	£125,000
Total		
£1,820,000	**£910,000**	**£910,000**

Table 7. Annual expenditure on the core project of BRC, 1999-2004. The Memorandum of Agreement was written so that contributions by JNCC and CEH were equal.

APPENDIX 1 Staff and students 1999-2004

Name	Band	Job title (at last reckoning)	Joined
Hill, Mark Oliver	4	Head of BRC	Jul-03
Preston, Christopher David (Chris)	4	Head of research / botanist	Sep-80
Roy, David Brian	5	Head of database and web development / ecologist	Jul-03
Arnold, Henry Richard	6	Database manager	Feb-72
Broad, Gavin Roy	6	Coordinator of zoological data & research	Sep-03
Cooper, Jonathan (Jon)	6	Information scientist	Jun-99
Greatorex-Davies, John Nicholas (Nick)	6	Biological recorder	Jan-95
Hoyland, Cassandra Jane (Cassie)	6	Environmental data scientist	Feb-04
James, Trevor John	6	NBN development officer	Oct-01
Ostler, Richard James	6	Database specialist / NBN developer	Oct-99
Rowland, Francis	7	Environmental scientist / web developer	Apr-03
Burton, Valerie Jean (Val)	8	Data processor / archivist	Apr-86
Francis, Juliet	8	Section administrator	Apr-04

Table A1. BRC staff in December 2004

Name	Band	Job title (at last reckoning)	Left
Harding, Paul T	4	Head of BRC	Jul-03
Moss, Dorian	4	Head of Environmental Information Centre	Jul-03
Collett, Geoffrey	6	Information scientist	Mar-03
Davies, Cynthia	6	Project leader, Database and Atlas of Freshwater Fish	Nov-02
Telfer, Mark G	6	Coordinator of zoological data & research	Dec-02
Croft, Jane	7	Botanist	Jun-01
Schofield, Marilyn	8	Section admin	Dec-03
Forrest, Wendy	9	Data entry	Dec-02

Table A2. BRC staff in January 1999, who had departed by December 2004

Name	University	BRC Supervisor	University Supervisor	Dates	Thesis Title
Bennie, Jon	Durham	Hill	Prof. Brian Huntley & Dr R Baxter	Oct-99 - Oct 2003	Ecological effects of slope and aspect
Finnie, Tom	Imperial Silwood	Preston	Prof. M J Crawley	Sep-02	Colonization and extinction: the large-scale dynamics of the British flora.
Gurney, Mark	Cambridge	Preston	Dr David Briggs	Oct-97 - Sep 2000	Population genetics and conservation biology of *Primula elatior*
Hickling, Rachael	Leeds	Roy	Dr J K Hill	Oct-03	Analysing changes at species' southern boundaries: importance of spatial and temporal scale.
Jewell, Carolyn	York	Roy	Dr J K Hill	Oct-04	Evolution of migration in a changing climate
McMullan, John	Leicester	Preston	Dr R J Gornall	Sep-02	Metapopulation structure and gene flow in a discontinuous aquatic habitat.
Musgrove, Nick	Wolverhampton	Hill	Prof. I Trueman	Oct-99	The influence of land use on the vegetation of the Long Mynd region of Shropshire (Part-time Ph.D., based at Wolverhampton)
Small, Emma	Birmingham	Telfer	Dr J.P. Sadler	Oct 98 - Oct 2001	Beetles in urban spaces: Biodiversity and population dynamics in fragmented habitats
Walker, Kevin	Durham	Preston & Hill	Prof. Brian Huntley	Oct-97	Long Term Floristic Change (Part-time Ph.D., based at Monks Wood)

Table A3. Students supervised by BRC staff between 1999 and 2004

APPENDIX 2 National schemes and societies December 2004

Group	Name of society or recording scheme	Contact (other details on BRC website)
Algae (marine species) (seaweeds)	British Phycological Society	Dr F.G. Hardy
Algae: Characeae (stoneworts)	Botanical Society of the British Isles	Mr N.F. Stewart
Bryophyta (mosses & liverworts)	British Bryological Society	Dr Mark Hill
Tracheophyta (ferns & flowering plants)	Botanical Society of the British Isles	Mr A.J. Lockton
Lichens (lichens)	British Lichen Society	Mrs J. Simkin
Fungi (fungi)	British Mycological Society	Dr P. Kirk
Fungi (fungi)	Association of British Fungus Groups	Mr M. Jordan
Myxomycetes (slime moulds)	Slime Mould Recording Scheme	Dr B. Ing
Coleoptera (aquatic species) (aquatic beetles)	Balfour-Browne Club	Dr G.N. Foster
Coleoptera: Cantharoidea & Buprestoidea (soldier and jewel beetles, glow-worm and allies)	Cantharoidea & Buprestoidea Recording Scheme	Dr K.N.A. Alexander
Coleoptera: Carabidae (ground beetles)	Ground Beetle Recording Scheme	Dr Mark G. Telfer
Coleoptera: Cerambycidae (longhorn beetles)	Cerambycidae Recording Scheme	Dr Martin Rejzek
Coleoptera: Chrysomelidae & Bruchidae (leaf-and seed-beetles)	Bruchidae & Chrysomelidae Recording Scheme	Dr M.L. Cox
Coleoptera: Coccinellidae (ladybirds)	Ladybird Recording Scheme	Dr M.E.N. Majerus
Coleoptera: Cryptophagidae, Atomariinae (atomariine beetles)	Atomariinae Recording Scheme	Mr C. Johnson
Coleoptera: Curculionidae (orthocerous species) (orthocerous weevils)	Orthocerous Weevils Recording Scheme	Dr P.S. Hyman
Coleoptera: Dermestoidea & Bostrichoidea (dermestoid and bostrichoid beetles)	Dermestoidea & Bostrichoidea Recording Scheme	Mr B. Constantine
Coleoptera: Elateroidea (click beetles and allies)	Elateroidea Recording Scheme	Mr H. Mendel
Coleoptera: Ptiliidae (ptiliid beetles)	Ptiliidae Recording Scheme	Mr C. Johnson
Coleoptera: Scarabaeoidea (dung beetles and chafers)	Scarabaeoidea Recording Scheme	Mr D.J. Mann
Coleoptera: Scolytidae (bark beetles)	Scolytidae Recording Scheme	Dr T.G. Winter
Coleoptera: Staphylinidae (rove beetles)	Staphylinidae Recording Scheme	Mr P.M. Hammond
Coleoptera: Scirtidae (scirtid beetles)	Scirtidae Recording Scheme	Mr. Jonty Denton
Coleoptera: Stenini (staphylinid beetles: Stenus and Dianous)	Stenini Recording Scheme	Mr. Jonty Denton
Diptera: Anthomyiidae (anthomyiid flies)	Dipterists Forum, Anthomyiidae Study Group	Mr M. Ackland
Diptera: Chironomidae (chironomid flies)	Dipterists Forum, Chironomidae Study Group	Dr P. Roper
Diptera: Conopidae & Lonchopteridae (conopid & lonchopterid flies)	Dipterists Forum, Conopidae & Lonchopteridae Recording Scheme	Mr D.K. Clements
Diptera: Culicidae (mosquitoes)	Dipterists Forum, Culicidae Recording Scheme	

Diptera: Empididae (empid flies)	Dipterists Forum, Empididae Recording Scheme	Dr Adrian R. Plant
Diptera: Ulidiidae, Platystomatidae & Pallopteridae (picture-winged flies)	Dipterists Forum, Picture-winged Fly Recording Scheme	Mr D.K. Clements
Diptera: Syrphidae (hoverflies)	Dipterists Forum, Hoverfly Recording Scheme	Dr S.G. Ball & Mr R.K.A. Morris
Diptera: Brachycera (larger species) (horse flies, etc)	Dipterists Forum, larger Brachycera Recording Scheme	Mr S.J. Hayhow
Diptera: Dixidae (meniscus midges)	Dipterists Forum, Dixidae Recording Scheme	Dr R.H.L. Disney
Diptera: Drosophilidae (fruit flies)	Dipterists Forum, Drosophilidae Recording Scheme	Dr B. Pitkin
Diptera: Nerioidea: Pseudopomyzidae, Micropezidae; Diopsoidea: Tanypezidae, Strongylophthalmidae, Megamerinidae & Psilidae (stilt and stalk flies)	Dipterists Forum, Stilt & Stalk Fly Study Group	Mr. D. Sumner
Diptera: Mycetophilidae and allies (fungus gnats)	Dipterists Forum, Fungus Gnat Recording Scheme	Mr P.J. Chandler
Diptera: Pipunculidae (pipunculid flies)	Dipterists Forum, Pipunculidae Study Group	Mr A.E. Stubbs
Diptera: Sciomyzidae (snail-killing flies)	Dipterists Forum, Sciomyzidae Recording Scheme	Dr I.F.G. McLean
Diptera: Simuliidae (simuliid flies)	Simuliidae Study Group	Dr R. Crosskey
Diptera: Tephritidae (tephritid flies)	Dipterists Forum, Tephritidae Recording Scheme	Mr L. Clemons
Diptera: Tipuloidea & Ptychopteridae (craneflies)	Dipterists Forum, Cranefly Recording Scheme	Mr A.E. Stubbs
Diptera: Tachinidae (tachinid flies)	Dipterists Forum, Tachinidae Recording Scheme	Mr. Chris Raper
Ephemeroptera (mayflies)	Ephemeroptera Recording Scheme	Mr Craig MacAdam
Heteroptera (aquatic species) (water bugs)	Aquatic Heteroptera Recording Scheme	Mrs Sheila Brooke
Heteroptera (terrestrial species) (land bugs)	Heteroptera Study Group	Dr B.S. Nau
Homoptera: Auchenorhyncha (leafhoppers & froghoppers)	Auchenorhyncha Recording Scheme	Dr A.J.A. Stewart
Hymenoptera: Aculeata (bees, wasps, ants)	Bees, Wasps and Ants Recording Society	Mr M. Jenner
Hymenoptera: Symphyta (sawflies)	Symphyta Recording Scheme	Dr D.A. Sheppard
Lepidoptera (butterflies & moths)	Butterfly Conservation	
Lepidoptera: Gelechiidae, Blastobasidae, Momphidae, Cosmopterigidae & Scythrididae (gelechiid moths and allies)	'Gelechiidae plus' Recording Scheme	Mr Graham Irving
Lepidoptera: Incurvarioidea (longhorn moths and allies)	Incurvarioidea Recording Scheme	Mr K.P. Bland
Lepidoptera: leaf-miners (leaf-mining moths)	Leaf-mining Moth Recording Scheme	Mr Martin Ellis
Lepidoptera: Pyralidae & Pterophoridae (pyralid and plume moths)	Pyralidae & Plume Moths Recording Scheme	Mr Tony Davis
Lepidoptera: scarce macro-moths (scarce macro-moths)	Scarce Macro-Moth Scheme	

Neuropterida (Neuroptera, Mecoptera & Megaloptera) (lacewings, scorpion-flies, snake-flies and allies)	British Isles Neuropterida Recording Scheme	Mr C.W. Plant
Odonata (dragonflies & damselflies)	British Dragonfly Society, Dragonfly Recording Network	Mr S. Cham
Odonata (migrant species) (dragonflies & damselflies)	British Dragonfly Society, Migrant Dragonfly Project	Mr A. Parr
Orthoptera, Dermaptera, Dictyoptera & Phasmida (grasshoppers and allies)	Orthoptera Recording Scheme	Dr P. Sutton
Siphonaptera (fleas)	Siphonaptera Recording Scheme	Mr R.S. George
Trichoptera (caddisflies)	Trichoptera Recording Scheme	Dr I.D. Wallace
Plecoptera (stoneflies)	Plecoptera Recording Scheme	David Pryce
Arachnida: Araneae (spiders)	British Arachnological Society, Spider Recording Scheme	Mr P.R. Harvey
Arachnida: Opiliones (harvestmen)	British Arachnological Society, Opiliones Recording Scheme	Mr P.D. Hillyard
Arachnida: Pseudoscorpiones (pseudoscorpions)	British Arachnological Society, Pseudoscorpion Recorders' Group	Dr G. Legg
Crustacea (hypogean species) (Cave amphipods and other Crustacea)	Hypogean Crustacea Recording Scheme	Mr L.R.F.D. Knight
Isopoda (non-marine species) (woodlice)	British Myriapod and Isopod Group, Non-marine Isopoda Recording Scheme	Mr S. Gregory
Myriapoda: Chilopoda (centipedes)	British Myriapod and Isopod Group, Centipede Recording Scheme	Mr A.D. Barber
Myriapoda: Diplopoda (millipedes)	British Myriapod and Isopod Group, Millipede Recording Scheme	Mr P. Lee
Collembola (springtails)	Collembola Recording Scheme	Dr. Steve P. Hopkin
Tricladida (freshwater species) (freshwater flatworms)	Freshwater Flatworm Recording Scheme	Dr L.S. Bellamy
Tricladida (terrestrial species) (terrestrial flatworms)	Terrestrial Flatworm Recording Scheme	
Mollusca (non-marine species) (non-marine molluscs)	Conchological Society of Great Britain and Ireland	Geraldine Holyoak
Agnatha, Chondrichthyes & Osteichthyes (freshwater fish)	Database & Atlas of Freshwater Fishes	Mr H.R. Arnold
Amphibia & Reptilia (amphibians & reptiles)	British Herpetological Society	Dr R. Bustard
Amphibia & Reptilia (amphibians & reptiles)	Herptile Recording Scheme	Mr H.R. Arnold
Amphibia & Reptilia (amphibians & reptiles)	Froglife	Mr Jim Mortimer
Aves (birds)	British Trust for Ornithology	
Mammalia (mammals)	Mammal Society, Look Out for Mammals Project	
Mammalia (mammals)	Mammal Recording Scheme	Mr H.R. Arnold