

BIOLOGICAL RECORDING IN THE UNITED KINGDOM

Present practice and future development

SUMMARY REPORT

Department of the Environment

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Prepared on behalf of the

Coordinating Commission for Biological Recording

by

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This Summary Report describes the contents of Volume I of a Report on work commissioned by the Department of the Environment and the Joint Nature Conservation Committee, and supported by the Institute of Terrestrial Ecology. Views expressed in it do not necessarily coincide with those of any of these organisations.

The full Report is published by the Department of the Environment in two volumes:

Volume I includes material summarised in this Summary Report

Volume II includes Appendices covering:

- membership of CCBR
- Questionnaire used in the CCBR survey
- a list of respondents to the CCBR Questionnaire
- a legal report prepared by Morrell, Peel & Gamlen, Oxford, for CCBR
- a full bibliography

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EXECUTIVE SUMMARY TO THE FULL REPORT

1. Since the end of the nineteenth century, when national legislation was introduced to protect birds and seals, and local authorities used bye-laws under the Local Government Act 1888 to protect plants, concern for the environment has grown with increasing rapidity. Over the last forty years, since the establishment of the Nature Conservancy in 1949, it has become accepted that informed policy and decisions on issues such as land use, planning, conservation and scientific enquiries, such as the detection of global warming, require a sound factual basis. An essential, crucially important element, therefore, is the public availability of accurate and extensive biological records.
2. Biological records describe the presence, abundance, associations and changes, both in time and space, of wildlife. They range from the simplest record of the presence or absence of an organism at a particular time in a specific place to extensive monitoring of many species over long periods. Continuity and complexity of observation, require increasingly sophisticated recording, analysis and interpretation, often on a regional or wider, comparative basis. The need for these activities is implicit in earlier national and international legislation of all kinds. In the 1990s the Government stated its broad policy to protect and enhance the beauty and diversity of the countryside and conserve its wildlife. Later it ratified its acceptance of the Biodiversity Convention which, *inter alia*, requires detailed knowledge of the nation's wildlife. Most recently the DOE has explicitly recognised (in England) the need for "fully adequate information about local species, habitats, geology and landforms" in its Planning Policy Guidance notes 9 (PPG 9, October 1994).
3. The UK is fortunate in possessing exceptionally rich holdings of contemporary and historical records of its variety of wildlife. In many cases these are irreplaceable. Their importance is not always fully recognised, in part because their extent and quality has never been fully documented nor their accessibility and utility objectively assessed. The requirements of current legislation coupled with a growing demand for environmental information suggest that it is now timely that the present and future importance of existing records and recording agencies should be considered and more fully recognised. This Report addresses these issues.
4. Firstly, the Report describes the findings of a Survey, made under the auspices of the Coordinating Commission for Biological Recording, of a representative sample of 355 organisations responsible for biological recording (Chapter 2). Their roles including making, compiling, interpreting and providing records. The Survey covers their staffing and funding; the sources, kinds, coverage in time and space and numbers of existing records; their reliability and validation; the methods used for obtaining, storing, compiling, exchanging and accessing them and the extent to which these records are computerised; how far they can be correlated with relevant non-biological data and, lastly, who uses such data and for what purposes. Secondly, legal aspects of making, keeping, compiling and providing such information are described in Chapter 3. Finally, the present and future national needs for biological recording are examined (Chapter 4), the essentials of a potential national system are described (Chapter 5) and the steps necessary to provide an effective system outlined (Chapter 6). Recommendations for action are provided (Chapter 7).
5. The findings of this Survey suggest that there are probably 2000+ organisations, agencies or societies concerned with record collection and storage. At least 60 000 individuals, predominantly voluntarily (70%), are actively involved in recording. Local records centres play an important role in compiling and maintaining records from various sources. They are unevenly distributed and in some cases absent, particularly in Scotland, Wales and Northern Ireland. The average permanent staff of the existing centres, overall, is two. Most are funded from a variety of sources, including local authority grants, contracts and benefactions. Few centres are securely financed in the long term.
6. The Survey confirmed the immense wealth of biological records in the UK. Of over 60 million species-based records identified in the Survey, those relating to birds (42%) and vascular plants (14%) predominated, whereas those relating to marine organisms were under-represented. Although considerable survey and monitoring data exist, they suffer from lack of comparability. The majority of records are still paper-based: only 10% of respondents used electronic recording and only 19% had fully computerised record systems. Manual management of data predominated.
7. Although many organisations provide data to the public on request, only a very limited exchange

of data occurs. It is very uneven between organisations and across the country. As a consequence, the availability and use made of biological records is neither adequate nor efficient. Nevertheless, there is a rudimentary national network for data exchange in which the Biological Records Centre at the Institute of Terrestrial Ecology, the British Trust for Ornithology and the Joint Nature Conservation Committee play pivotal, key roles.

8. The principal concerns identified are:

- Lack of agreed standards and protocols for recording, validating, compiling and exchanging data, thereby reducing its comparability and value.
- Widespread ignorance of what is available and where, and the poor use made of existing data because of this ignorance and the lack of efficient exchange mechanisms.
- Widespread ignorance and uncertainty of the law affecting ownership of the intellectual property rights of records and the legal obligations, especially copyright, when records are compiled, copied, exchanged or made accessible to the public and others, whether manually or electronically.
- The financial insecurity underlying many of the organisations concerned with recording.
- The need for some organisation or body to provide leadership to overcome these weaknesses, to build on existing strengths and to promote a proper recognition of the importance of biological recording.

9. In the light of the Report's findings it is concluded that the phased development of a national system is desirable to meet present and increasing, future demands for reliable biological records and to bring coherence to the present disparate range of activities. A national system could be developed most economically and efficiently by improving and developing present activities rather than by initiating a new system.

10. Essential steps to establish a national system are:

- The preparation of a publicly accessible, periodically updated, annotated directory of organisations involved in recording. It should indicate their holdings and mode of access.
- The preparation of an agreed standard for, and methods to control the quality of, biological records of all kinds, together with protocols defining procedures for their accession, validation, compilation, exchange and availability.
- The establishment of a network of adequately funded, inter-communicating, local records centres publicly recognised by some form of accreditation both for the centres and for their records.

- A sustained programme to inform and educate the public of the importance and uses of biological recording.

11. Consensus will have to be reached within the recording community to bring about these suggested changes. It is unlikely that rapid progress will be made without a clear lead from an authoritative body capable of developing and supporting a nationally recognised policy.

12. It is recommended that the Department of the Environment, the only body which covers all uses of biological records and is responsible for relevant international commitments, should assume this role. Practical implementation, however, could be devolved to a range of existing bodies, both governmental and non-governmental.

13. An equally essential requirement will be the establishment of a small, permanent coordinating body to be responsible for standardisation, agreed protocols and accreditation. It will need to have the confidence of the recording community and the public. Its activities would be strengthened if it were established and supported by subordinate legislation linked to the Wildlife and Countryside Act 1981 and/or the Environmental Protection Act 1990.

14. It is only possible to make a broad estimate of the approximate cost for establishing such a system because of the limited information available concerning current practice. It is estimated that a local record centre with five staff and computerised facilities to meet present and future needs would cost £15,000 to establish and £155,000 p.a. to maintain. So for a minimum of 70 local records centres (ideally 90) throughout the UK, start-up costs would be just over £1 million and the recurrent annual cost, £10.85 million. However, the actual costs would be significantly less since many local record centres already operate, albeit with fewer staff, poorer facilities and, often, insecure long-term funding. A detailed study is needed to establish precise costs. In addition, a permanent, national, coordinating agency of five staff would need to be serviced and funded at £150-200,000 p.a. Indirect evidence suggests that not more than 5% of recurrent costs could be recovered by charging for data.

15. A series of recommendations concerned with the establishment of policies for biological recording and the essential framework for constructive planning concludes the report.

1. INTRODUCTION

- 1.1 The report had its genesis in the observation in the Linnean Society's 1988 report *Biological Survey: need and network*, namely that:

"Although considerable effort is expended on biological survey and surveillance in the United Kingdom by voluntary, professional and statutory bodies, no effective system exists for the overall co-ordination of recording and monitoring of wildlife and habitat resources".

- 1.2 The Coordinating Commission for Biological Recording (CCBR), a voluntary body established as a result of widespread discussion of the Linnean Society's report by the recording community, is charged to promote the report's conclusions, recommendations and related issues. Before any informed action could be taken, it became evident that a more detailed knowledge of every aspect of biological recording in the UK was necessary, including legal aspects, some notion of the key uses and users of such information and their future needs. With the financial support of the Department of the Environment (DOE), (JNCC) and the Natural Environment Research Council (NERC), CCBR has investigated these issues. This report records the results of its enquiry and makes recommendations for future action. This report's final recommendations take cognizance of all government policy in the public domain up to 31st October 1994.

- 1.3 For the purposes of the report, biological recording is defined as:

The collection, collation, storage, dissemination and interpretation of information, both in space and time, concerning kinds and numbers of wildlife, assemblages of organisms, and their biotopes, especially when the records are related to localized sites. It excludes comparable information concerning agricultural, horticultural and forestry crops and stock, except in the context of general land use.

- 1.4 The investigation made a detailed assessment of:
- The kinds of biological records made and maintained;
 - The resources devoted to such work;
 - The purposes for which records were

made and kept and the use made of them.

In the light of these findings, the desirability and practicality of the establishment and operation of an integrated, computerised national system of biological records and recording are examined, and recommendations proposed.

- 1.5 The topics to be investigated and assessed included:

- The present situation concerning biological recording organisations, their holdings and activities;
- The principal current applications of biological recording;
- The legal aspects of holding such data and of making them available;
- Future needs and the necessary actions to meet them, including technical aspects of appropriate hardware and software; the establishment of operational standards and appropriate operating policies.

- 1.6 A detailed questionnaire was devised to obtain information about the present situation in the UK. It was sought under the following subheads:

- *Details of organisations:* Contact; type; status; geographical coverage; scope and use of data; data exchange arrangements; operating policies; services provided and use made of data; resources;
- *Data holdings:* Recording and storage media; species data; habitat (biotope)-based and land-type data; non-biological data;
- *Computing details:* Computing experience; computing hardware used; database software and applications used for management of records; small systems map-based software used; Geographical Information Systems (GIS) and other software used.

Information obtained from this questionnaire is referred to hereafter as being obtained from 'the Survey'.

- 1.7 The questionnaire was sent out to 600 organizations and backed up by means of telephone calls, visits and further discussions, or written submissions. They included national and local government departments, country conservation agencies, national

parks, local records centres, wildlife trusts, natural history societies, scientific societies and various smaller groups known to be involved with biological records. Of the 355 responses to the questionnaire, about 200 (59%) can be regarded as essentially complete

- 1.8 The information obtained from the questionnaire was stored in a purpose-designed database, using Advanced Revelation and Mapbase software, which was used both for recording and analysing the information. Analysis was also facilitated by the use of Quattro Pro, and Graphics Works was used for tables and figures.
- 1.9 Literature relating to the topics of enquiry or subsequent recommendations was consulted, assessed and a full bibliography prepared. Relevant national, EU and international legislation was examined.
- 1.10 Legal advice relevant to the owning and holding of individual biological records and collections of them was sought from solicitors and academic legal opinion, in particular, matters of intellectual property rights, especially relating to compilations and computerised databases in the UK and EU. Public access to biological records was also considered.
- 1.11 The responses to this enquiry provide detailed and overwhelming support for the view expressed in the Linnean Society's report (para 1.1) above: Indeed, biological recording in the UK in the 1990s is characterised by an array of dispersed and uncoordinated surveys, methods and organisations. This reflects the consequences of individuals and organisations responding to continuous changes in requirements for information, organisational policies, developments in information storage, transfer and availability, piecemeal policies and differing strategies for determining funding. The most important and, characteristically British, source of data, has been the continuing contribution of the numerous volunteer specialists and biological societies, usually operating in a recreational capacity.
- 1.12 The lack of coordination of biological recording has limited the utility of the records obtained through inefficient access and wastage of all kinds - human effort, effective interpretation, finance - with a consequential undervaluation of the importance and use of biological recording. During the course of this investigation, the UK Government signed the

Biodiversity Convention at Rio de Janeiro in 1992 and ratified it in 1994. Two important statements of policy were published early in 1994 - *Biodiversity: the UK Action Plan* (Cm 2428) and *Sustainable Development, the UK Strategy* (Cm 2426). These actions have reinforced the need to develop an effective strategy to improve accessibility to, and coordination of, existing databases, and the adoption of common standards for recording: indeed, for a national, coordinated biological recording system,

- 1.13 In order to meet international obligations and to ensure that the proud claim, that the flora and fauna of the UK is probably the best documented in the world, change is essential. Change is necessary in attitudes, in activities, in organisation and in support. Above all, harmonious change is needed which will maintain all that is best in the UK's traditions while responding to the growing needs of the future. In this report CCBR concludes by suggesting some changes required and by assessing the potential for developing a national recording system. It sets out an agenda of the necessary actions to be taken so that biological recording in the UK becomes an efficient, coordinated activity whose results are openly accessible and which will meet the increasing demands of science, conservation, planning and land management. The intrinsic importance, nationally and internationally, of biological recording needs to be adequately recognised in UK policy.

2. THE CURRENT STATE OF BIOLOGICAL RECORDING IN THE UK: FINDINGS OF THE SURVEY

Organisations

- 2.1 More than 2000 organisations have been identified as being concerned with biological recording although only a minority were established initially for that purpose. They include:
- Local records centres; county wildlife trusts; urban wildlife groups; voluntary conservation agencies; A diversity of groups concerned with specific organisms, eg. badgers, bats, butterflies, dragonflies, birds, mammals, reptiles, flowering plants, mosses, fungi and lichens; national organisations such as the British Trust for Ornithology (BTO), Botanical Society of the British Isles (BSBI), British Mycological Society and other, purely local groups; national and local natural history societies;
 - Museums with natural history collections; educational establishments at all levels, many with important collections; research councils and their units;
 - Statutory conservation agencies (English Nature (EN), Countryside Council for Wales (CCW), Scottish Natural Heritage (SNH) and the JNCC); environmental consultants; National Parks; National River Authority (NRA) regions; river purification boards;
 - Government departments such as DOE, the Ministry of Agriculture, Fisheries and Food (MAFF), Department of the Environment for Northern Ireland (DOENI) and their county counterparts; county/regional planning departments; other local government planning departments.
- 2.2 Only a minority of these organisations were established to hold or collate biological records. Many, such as some local government planning authorities or natural history societies, are believed to lack any formalised mechanisms to collate or hold such records. The respondents to the Survey include a reasonable sample (equivalent to 55% of the potentially available respondents) of the most effective organisations involved in biological recording except for the museums, which are under-represented.
- 2.3 For many organisations the formalisation of a role in biological recording activities and policy has been retrospective. For example, the national Biological Records Centre (BRC) at Monks Wood was established to map the distribution of species but this is now only one of many activities. Development to meet the needs of users has been varied, almost entirely without coordination or guidance and largely *ad hoc* to meet immediate perceived needs. The main practical purposes for which data are collected, collated and used are site, habitat and species conservation, development planning and biogeographical studies.
- 2.4 Recording organisations are well dispersed to meet local needs through local records centres, wildlife trusts, local specialist groups and BSBI vice-county recorders, together with the regional units of the country conservation agencies and National Park authorities. The coverage by local records centres is somewhat patchy, especially in Scotland and Wales.
- 2.5 The numbers of individuals directly and actively involved in recording in the UK cannot easily be estimated but certainly exceeds 60 000, of whom the vast majority are voluntarily engaged out of personal interest. The majority of taxa-based records, as well as an appreciable number of biotope-based records, are provided directly or indirectly by volunteers. Because biological recording is only one of many activities for which staff are responsible in many organisations, it is difficult to assess average staffing rates from the returns. Staff are predominantly professional scientists (278) and field workers (158) plus smaller numbers of managerial, clerical, computer support, data entry and financial staff. In addition, many organisations use both contract and volunteer labour; the former are predominantly professionals, the latter predominantly field workers. It appears that local records centres each have, on average, two salaried posts only. These estimates exclude the large numbers of nature reserve wardens, countryside rangers, and heritage coast wardens, all of whom may be involved at some time with biological recording. The majority of organisations were unable to give details of their funding, often because they were only part of a larger financial unit and their funding could not be disentangled. The best estimate for the average cost of a 2-staff, local records centre is £58,000 p.a., at 1992/93 prices. Funding for many local records centres is potentially insecure.

Organisations: standards and policies

- 2.6 There is an urgent need, long recognised, for agreed standards for biological recording which would both facilitate data collation and interpretation and enable an accreditation system to be introduced. Draft Codes of Practice have recently been published by the Museums and Galleries Commission and in a Manual of natural history curatorship (1994), but neither has been adopted by any respondent to the Survey. The Biological Recording in Scotland Campaign (BRISC) has established an accreditation system for collectors and collators of biological records. It has five increasingly demanding grades depending on criteria such as the number of plant and animal groups covered, the standard of record management and services provided etc. There is no other comparable system in the UK and even BRISC criteria do not require written policies or documented protocols to be provided by an organisation. The lack of clear statements of data quality and access undermines confidence in both suppliers of data and of users, particularly since there is evidence of a clear lack of comparability between local records centres.
- 2.7 Some 198 responses - 56% of the total - indicated that some progress is being made in producing statements of policy and 85 organisations had either written constitutions or policy statements. Many of these suffered from important omissions. For example, only 18 organisations had written statements on data validation, only 13 had a policy on data security and only 2 included data backup and archiving. Access to confidential data, such as the location of rarities, was universally controlled but there is no agreed policy. The position concerning access to data by the general public was obscure although most museum-based local records centres saw it as part of their duty to allow open access save for confidential data.
- 2.8 An important and evidently contentious area was charging policy. Most existing arrangements are informal. Only 28 organisations had a declared written charging policy although many had unwritten arrangements. Because of uncertainty and the possibility of contravening regulations concerning access to information, or disputes over ownership, published charges relate exclusively to costs of labour and resources for extracting and copying data, not for the data themselves. Typical hourly rates were £20-30 although site-based data could command £50 per hour. Increased

complexity of the product supplied increased the costs. An almost universal feature was that certain classes of user were not charged. Criteria were often vague but charging was uncommon for bona fide naturalists, natural history societies, educational users, BRC and conservation organisations; charging was common for consultants, private companies, NRA users and utility companies.

- 2.9 The notion, held by some, that records centres could be financed through charging for data is not supported by the responses received. Income made by providing commissioned surveys or expert advice ranged between £20 and £2 500 p.a., averaging about £500 p.a. Incidentally, evidence for the low income to be derived from charging for data elsewhere is provided by The Nature Conservancy in the USA which only obtains 5% of its income in this way, despite being a private organisation.

Other findings from the Survey

- 2.10 The remaining detailed responses to the Questionnaire are set out in the Annex to this Summary Report. The principal findings relevant to the subsequent discussion concerning the development of a national biological recording system are set out below:
- Over 60 million biological records were identified in 951 taxa-based datasets from the 1385 recorded. Of these 70% related to taxa of which 65% related to birds. In all, in the Survey, 41.3% of all records related to birds, 14% to vascular plants and much smaller percentages in other groups. Data on marine organisms were under-represented. There was a serious under-representation of records from museums in the Survey, in part because such records are largely specimens and are rarely available in any other readily accessible form.
 - Survey and monitoring data was quite extensive but of some 828 projects, only 10 were found to be immediately appropriate to DOE's needs in a review undertaken by York University.
 - Most records are still paper-based; only 10% of respondents used electronic recording. There were few agreed standards and this was especially true when describing land cover, habitats and biotopes.
 - There has only been limited progress in the use of Geographical Information Systems;

about 5% of the respondents, mostly larger organisations.

- Validation of taxa was largely carried out in house or by local experts. For critical species, national experts were often involved. Expertise was assessed by peer review.
- About 73% of organisations used computers for some aspect of recording but only 19% were fully computerised. Although about 42% of all taxon datasets are fully computerised, 70% are still managed manually
- Exchange of compiled data occurs but in a very limited way and is very uneven, in many cases being restricted to the immediate authority in charge of the record centre. However, there is a weak and somewhat rudimentary network through which data can be exchanged. Certain key organisations, notably BRC and JNCC, play important roles in these exchanges.
- Most of the data exchanged are paper- or floppy disk-based and computerised networks are very exceptional. There are no agreed protocols or standards.

3. BIOLOGICAL RECORDING AND THE LAW

- 3.1 There is evidence for considerable ignorance of, and uncertainty about, the application of law, both national and international, to original biological records and compilations and the rights and obligations of originators and compilers.
- 3.2 There appear to be no explicitly formal or binding obligations under present national or European legislation, or through international agreements, which require any individual, organisation, or agency in the UK to make, compile and maintain biological records. However, a number of international agreements and national Acts either imply that biological records should be made and kept, or could not in practice be met unless such actions had been taken. Most recently, the Planning Policy Guidance note on nature conservation (PPG 9) requires that local plans in England should be "based on fully adequate information about local species, habitats, geology and land forms"
- 3.3 Legislation concerning intellectual property rights (IPR), ie. the Copyright Designs and Patents Act 1988, applies to biological records. Copyright affords protection to a record in its permanent form, whether written, as an illustration, broadcast, an electronic recording, or as a film; and moral rights arise from the identification of the originator of the record as its author. The originator of a record also owns its copyright and acquires moral rights. The former can be assigned or licensed to another individual or organisation only in writing signed by the assignor, whereas moral rights cannot, although they may be waived. Moral rights require that the reproduction of a record, whether the copyright has been assigned or licensed, should be in the same form as the original to avoid misrepresentation, unless agreement has been given for a different specified form. Unauthorised alteration or misrepresentation is a derogation and an action could be brought by the owner of the moral rights. Under the Copyright Protection Directive (93/C27/09) copyright in the EU, including the UK, extends for 70 years from the moment the record becomes publicly available or from the end of the year in which the originator dies. If the record has been made under Crown Copyright (e.g. by a Government department or agency and their contractors), it lasts for 125 years unless published before the end of 75 years when it only lasts for a further 50 years.
- 3.4 If biological records are compiled then the compiler, if not the owner of the IPR, must have obtained each originators' permission in writing both to compile them and, if necessary, to a change in form. If the original record involves material carrying IPR (e.g. an Ordnance Survey map record), then not only the originator but also the compiler must have obtained written permission from the owner of the associated IPR. If a computer program is used for compilation, manipulation or retrieval of the records, it will attract its own IPR, also. This too will need to be satisfied by the compiler. In general, an acknowledgement of the use of such a program is sufficient to discharge the obligation. Under UK legislation a legally valid compilation acquires its own copyright but, under European law, copyright of a compilation is acquired only if it shows true originality and creativity! In Directive 93/C308/01 the EU has proposed that this must be a requirement for all electronic databases which will then be protected from extraction (i.e. data removal and incorporation elsewhere) for 15 years. Extraction can be licensed by a compiler during this period. However, this is a rapidly changing area which needs to be watched.
- 3.5 Compilers are subject to a variety of liabilities which are detailed in the report.
- 3.6 In Great Britain, the Environmental Information Regulations (EIR) (SI 1992 No. 3240) implement the EC Directive on Freedom of Access to Information. These are applicable, in principle, to biological records held in an accessible form. Any such records held by the Crown, government departments, local authorities and other persons carrying out functions of public administration in relation to the environment or authorised so to do by the foregoing, must make that data publicly available on request, if thought appropriate at a 'reasonable charge'. The regulations do not provide a definitive list of which bodies are so covered, nor an interpretation of the phrase quoted in the previous sentence. Organisations or individuals are required to decide for themselves on the application of the EIR to their information.
- 3.7 Access can be denied if information, whether in original or compiled form, has been received in confidence, or if its disclosure would increase the likelihood of damage to

the environment. An important proviso is that information is regarded as confidential if its supplier has not consented to disclosure. In the event of a dispute the legal position in the UK is unclear but the EU has proposed that it will be for the supplier of the information to prove that access should be denied.

4. FUTURE NEEDS IN BIOLOGICAL RECORDING

- 4.1 Two essential questions about biological recording need to be answered before planning for the future. They are:

- What are the requirements for such data?
- How can these requirements best be met?

There are several uncertainties: existing and probable future legislation; practical problems such as weaknesses in the present system, both technical and financial; the likely attitudes of providers and users to changes of all kinds; and the need for greater sophistication and complexity of data, its effective transfer to relevant users and access to it by users and the public.

- 4.2 The Government and its agencies are charged, implicitly, through their international and national obligations, to make, compile and maintain some biological records. In *Biodiversity: the UK Action Plan*, prepared in response to the adoption of the Biodiversity Convention, the Government has implicitly accepted responsibility for records, further defined as 'those components of biological diversity of importance for its conservation and sustainable use'. At present, the means for ensuring that even this limited amount of information is effectively supplied are not assured, although the establishment of the Data Sub-group of the Biodiversity Action Plan Steering Group is a recognition of the problem. The Survey has demonstrated already that potential sources of information exist to meet this and the other needs described earlier, but many are under-resourced and there is a lack of any truly effective, organisational framework. Resolving this situation is, therefore, a central issue for the future.

- 4.3 Several specific needs can be defined:

- A standard UK inventory of species, kept up to date by some body or bodies charged with this task, plus an inventory of UK biotopes based on a nationally agreed classification;
- Summaries of the geographic range and frequency of occurrence of each species and biotope, plus the area of the latter, in UK and Europe;
- A summary of biotopes associated with each species;
- Conservation status of each species; threats to and ability to resist them without loss of quality or range for each biotope;

- Time series measurements of key and characteristic features of these resources.

Biotopes are poorly defined at present. They need to be defined with precision and the definitions made widely available through publications and computerised systems, such as the Countryside Information System and the UK Digital Marine Atlas.

- 4.4 The measurement of change in the flora and fauna over time is an implicit requirement of present legislation and a scientific necessity. Only if this aspect is understood can resources be used intelligently to control or modify change in the environment.

Environmental audit is already becoming a tool used more widely but it needs to be further developed, both scientifically and as a determinant of administrative action. The DOE has already begun to address the question of biotope change but such work needs to be extended greatly bearing in mind the points raised in para. 4.3. Such observations have their basis in an unbiased view of the UK wildlife resource and an objective assessment of its change and stability, both of which are essential for the development of current and future policy and required under the EC Council Directives on the Conservation of Wild Birds (79/409/EEC) and the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/EEC).

- 4.5 If a reorganisation for improved coordination and accuracy of biological recording is to be implemented the options necessary to support a business case must be:

- Expressed clearly, the necessity for change being spelt out rationally;
- Defined in specific policies, after the potential roles of participants have been clarified and agreed by recording community, which can be readily understood by the public.

Since at least 70% of all taxon-data and 20% of biotope data are provided by volunteers it is essential that their contribution be recognized and their legitimate expectations for some return, in kind rather than financial, be rewarded. An adequate alternative human resource is inconceivable in the foreseeable future in the UK. While research can provide a rational bedrock, education at all levels, the provision of intelligible information, the promotion of intelligent public awareness and, indeed, participation need to be promoted.

5. THE ESSENTIALS OF, AND POTENTIAL FOR, A NATIONAL SYSTEM FOR BIOLOGICAL RECORDING

- 5.1 There is great biological recording activity in the UK at present, together with the undeveloped rudiments of a potential recording network (Figure 1), but there are also many weaknesses as described earlier and in the Annex.
- 5.2 National systems are already established in the USA and Australia. They are described and their relevance as possible models for the UK situation examined. The situation in the UK is different and more complex because:
- The UK is probably far richer in relevant information resources and sources than anywhere else;
 - There is a far higher number of different kinds of agencies and organisations already involved in biological recording;
 - The voluntary contribution is exceptionally high (70% for taxa-data, 20% for biotope data);
 - Funding of many organisations is inadequate and continuity of effort cannot be assumed or assured;
 - There is neither a clear policy nor supporting legislation for recording;
 - A loose and fragile potential network of record centres already exists (Figure 1).
- Nevertheless, it is concluded that an effective policy would be to develop, upgrade and, in due course, add to existing organisations, rather than to attempt to replace them by a new system on either the USA or Australian model. This would promote the accessibility of all sources of data at all levels, from the individual site to the international.
- 5.3 However, a sound basis in policy, preferably supported by legislation, such as both the USA and Australian systems enjoy, is highly desirable. Change in the UK will not arise spontaneously. To replace the present dispersed, uncoordinated activities by an organised system will take time and the outcome is unpredictable. It will have to be initiated through negotiated agreement, ultimately between all organisations involved in biological recording. Without agreement on the need for, and pattern of change to, a more coordinated system operating to agreed standards within which data transfer is open, easy and effective change, will hardly be possible. Clear and far-sighted, authoritative leadership will be essential. Ideally this should articulate government policy - since it is a national need - preferably through a government department. A widespread view, held by many within the non-governmental recording community, is that facilitating legislation could assist and speed change. The policy should address:
- The need to acquire, maintain and disseminate data;
 - The establishment and accreditation of a nationally dispersed range of biological data centres;
 - The means to audit national minimum standards for records;
 - The development of means to facilitate the open exchange of non-confidential, non-interpreted data;
 - The establishment and maintenance of publicly accessible metadata about the system.
- 5.4 The existing hierarchy and loose linkage between units at present (Figure 1) will have to be strengthened and made more efficient. The continuance of effective local records centres especially, needs to be ensured, their facilities upgraded, and, in some cases, their staff increased to meet the additional demands that a national system will impose on the centres. Additional data centres may be needed at some levels. In particular, the development, ultimately, of fully computerised, networking arrangements should be an important goal. It will provide the means of more effective data exchange and provide open access at selected sites. Open access has its own problems related to legislation on IPR, the potential misuse of sensitive data and the misinterpretation of information due to lack of background knowledge. None of these are insuperable provided that care is taken in planning, executing and controlling access to the system.
- 5.5 An implicit requirement of a policy of this kind (and appropriate for facilitating legislation) would be the establishment of a body or consortium to coordinate and regulate the system. It would be responsible for:
- Advising government on the availability and reliability of UK biological data;

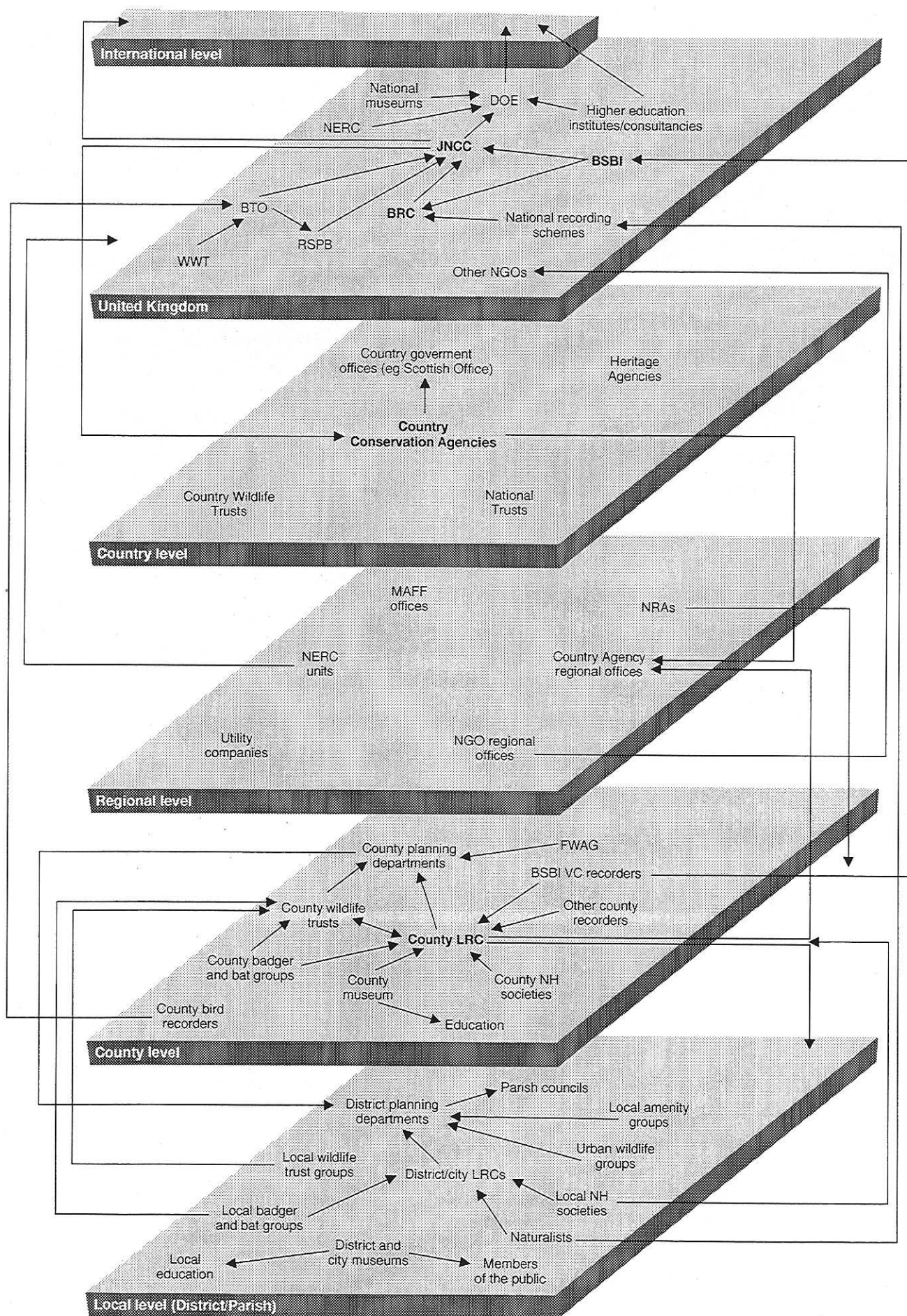


Figure 1. Schematic diagram of the hierarchical relationships between organisations involved in the collection, management and use of biological records

- Developing and administering nationally agreed standards for data and technical standards for computing;
- Accrediting component agencies in the system;
- Evaluating and overseeing relevant training and the production of appropriate manuals;
- Operating the national metadatabase of information on the system.

Although JNCC is, at present, charged with some of these functions in respect of nature conservation, no existing body carries out all these functions at all levels, from international to local, and embracing the full range of applications of biological records. Indeed, it may be that these functions should be carried out by bodies at both national and local levels.

- Define and secure resources for a national system;
- Compile and maintain a metadatabase;
- Establish a voluntary accreditation system amongst existing organisations; select accredited centres for access by user community;
- Establish data transfer system between all units.

Ongoing issues are, *inter alia*, likely to ensure the stability and continuity of key data centres, and to establish formalised relationships between data centres and potential users.

5.6 Publicly available directories (metadata) concerning the system will largely overcome the present ignorance amongst the recording community of what and where relevant data are located. In addition, information is needed on data quality, origins, original purpose, possible uses and means of access. A computerised database developed from the CCBR Survey database already deposited with the DOE, JNCC and NERC could provide a starting point for such a directory (metadatabase) which would resemble that suggested in *Biodiversity: the UK Action Plan*. It would require, of course, to be kept updated. Provided it was given a user-friendly, public interface it could both act as a 'shop window' to the national system and play an important educational role.

5.7 It will be evident that a complex programme of change such as that outlined would need to be phased and be the subject of wide consultation amongst the recording community. A possible sequence for implementing change would be:

- Agree a remit of data required and agree minimum standards for the operation of data centres;
- Negotiate agreement, where appropriate supported by facilitating legislation, to establish a national system;
- Promote formalised links at local levels between data centres, voluntary conservation organisations and planning authorities;
- Develop and promote technical standards for all stages of data management;

6. IMPLEMENTING A NATIONAL SYSTEM FOR BIOLOGICAL RECORDING

- 6.1 A broad and long term view needs to be taken in specifying the requirements of a national system. Because of the many and differing users and uses of biological records it is insufficient to think only in terms of immediate needs for either conservation or biodiversity, for example. Both the needs and uses are changing and developing. It is, therefore, likely to be more rewarding at this juncture to address issues such as standards and protocols before deciding on precise methods of immediate, practical implementation. Even so, there are several preparatory actions which could be taken, such as promoting greater voluntary cooperation, developing a biological record data standard and a metarecord for existing databases and ensuring that they meet legal requirements. Organisations already exist which could take these actions.
- 6.2 An agreed biological record data standard is crucial to bringing order to the present situation. Its adoption will rapidly improve consistency and the efficiency of recording, quality control and data management and enable comparability of datasets to be assessed. Some progress has already been made by JNCC and the country conservation agencies but further development is necessary and, in particular, a model should allow the maximum of flexibility to accommodate future developments. In practice, local and other standards can be developed in relation to this standard. Recorder is not a full data standard but could be related to one. Data quality is especially important and is highly dependent on agreed terminologies involving conventions governing both syntax and vocabulary. Such agreed terminologies will have to be developed: no nationally or internationally agreed terminologies exist at present. Validation and error trapping are essential to quality control and good models exist already but need to be generally agreed and accepted; much the same applies to spatial and geographical referencing. Action needs to be taken in devising an agreed standard to ensure that the considerable mass of paper-based and historical records are not excluded, since they form an invaluable basis for various uses and for resolving certain types of problems.
- 6.3 To assist users, it is desirable that information should be available, for each dataset, about the data (metarecord), its form, content, quality and availability. The metarecords, designed to an agreed format and standard, should be available through an openly available metadatabase. The legal implications concerning the compilation and transfer of records will need to be applied both to existing datasets as rapidly as possible and to suitable protocols drawn up for future compiling and data transfer procedures in accordance with the information in section 3 above.
- 6.4 The physical network will need to be based on the loose arrangements already described in para. 5.4. It is important to ensure that the roles of existing organisations are not eroded if development is to proceed smoothly. Responsibility for particular functions would continue to be assumed by different types of organisation. For example wildlife trusts might assume an important role in collating data, promoting action on conservation and have a strong input into education in one region, but the same functions might be associated with a local records centre located in a museum in another. The network would depend upon the development of a multi-layered nodal structure such as that in Figure 2. Encouragement should be given to centres to develop as nodes in the national system. A recognised node would provide metarecords, adopt the national standards and accept the jurisdiction of the proposed regulating body. It would be expected to have its records, and its record management, computerised. Records exchange could be achieved through the medium of floppy disks containing copies of relevant data. New centres would have to be developed for those areas where local records centres are sparse in order to provide adequate geographical coverage. This simple physical network could be extended, in a second phase, by a fully computerised, electronic network. Some additional funding would certainly be required but this development could be phased in gradually. At its simplest, a first step might be to achieve direct connection of all data centres to the metadatabase through dial-up modem links. More sophisticated networking would need careful planning and testing before being adopted and should not be hurried. Much can be achieved by adopting simple practices such as E-mail communication.

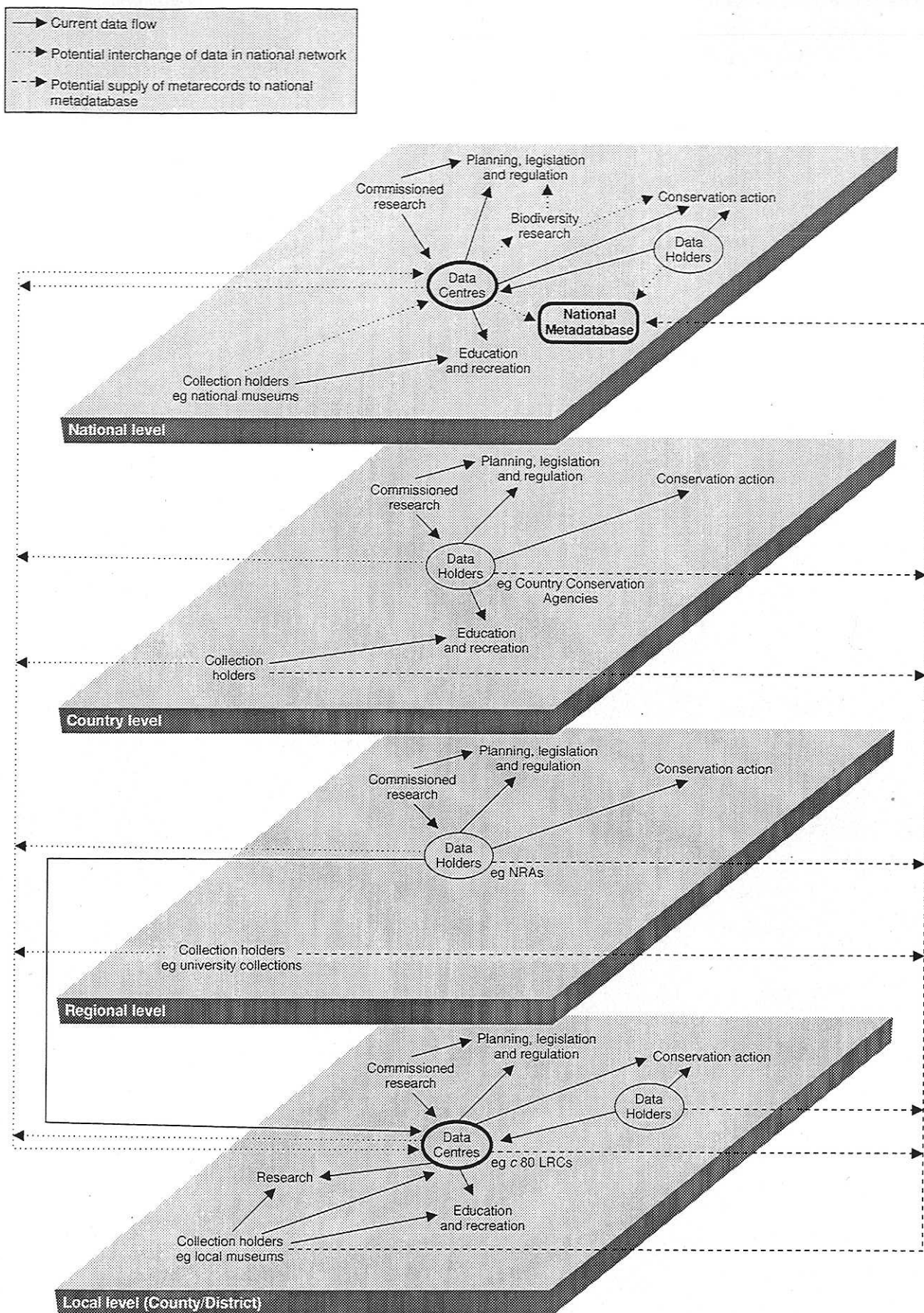


Figure 2. Current and potential national biological records networks

- 6.5 While entry to the national system should be on a voluntary basis, membership must involve acceptance of the rules for coordination and regulation of the system. A single body or representative consortium should be responsible for regulation but none exists for biological recording activities. Whatever its constitution it must be and be seen to be non-partisan, if it is to command the support of the whole recording community. The Museums and Galleries Commission (MGC) is a possible model but there is nothing comparable for biological recording with the infra-structure through which MGC operates. The tasks of a coordinating and accrediting agency were set out in para. 5.5. It is clear that it will need to be resourced independently of other parts of the system, i.e. it will need a 'ring-fenced' budget. Whatever the constitution, the agency will need to consult with participating data centres, data holders and users from all levels of the potential network to be successful. Partnership between statutory agencies, local government and voluntary organisations will be central to the willing adoption and success of a national system. From the outset, the contents, control and access to the metadatabase will be a yardstick by which the voluntary sector, in particular, will judge how far their role is not being taken for granted and that true partnership will underlie proposed changes. They will also expect to receive something in return for their participation and efforts. It might, therefore, be sensible to start by setting up a technical working group to propose, in consultation, a range of scenarios both for policy and its implementation. Written policies at all levels are desirable and will, in themselves, help to promote standards, coherence and, ultimately, the accreditation criteria and processes. They should cover quality control, format and mobility of data and rules for access. The JNCC or the Biodiversity Action Plan Steering Group's Data Sub-group might well be capable of undertaking some of these technical tasks
- 6.6 The principle of open access to data is inherent in the Environmental Information Regulations. Nevertheless, it will be necessary to establish procedures to prevent totally uncontrolled access to all data. In the first instance, access should be provided through the metadatabase. Procedures for further access to nodal centres need to be devised. In the long term a formal computerised protocol will have to be devised by which to make data available. In the immediate future, however, simpler formats (e.g. paper or floppy disk) will have to suffice. Whatever the form it will need to be subject to careful quality control.
- 6.7 However well planned and enthusiastically received a national system may be, it will not be operational unless it is secure and sufficiently funded. As already indicated in para. 5.3, security would be promoted by official recognition of the importance of biological recording as an essential resource for effective environmental policy affecting conservation, planning, scientific research, education and public awareness. Whether a national system should be developed through a voluntarily regulated scheme or through a quasi-official coordinating agency such as regulates museums is for discussion. In any event, the coordinating structure is likely to be developed as new.
- 6.8 Most of the existing resources would be subsumed under a new system and some gradual expansion will be needed. On the basis of the information obtained from the Survey, it is not possible to provide precise estimates of the costs of a national system. The figures given below can be taken only as an informed and considered guide to the probable costs. Whatever relocation of existing funding could be achieved amongst the organisations involved, some additional funding will be needed to establish national standards and meet new technological developments, and, eventually, to expanded computerisation and GIS. The main additional funding is likely to be needed for local units in the system since these will form important, essential nodes in the new system. A best estimate of the (1994) costs, overall, to provide a basic network (the first phase - para. 6.4), assuming a staff of five per centre, but excluding the costs of premises is of the order of £150,000 p.a. with £3-5,000 p.a. for computer maintenance, i.e. £155,000 p.a. Start-up costs, largely for equipment, are of the order of £10-15,000 and might be spread over two years. In a fully operational system throughout the UK, a minimum of 70 nodal centres would be desirable to give adequate geographical coverage, although as many as 90 might be required eventually. Upper limits for establishing a system would be, therefore, just over £1 million for start up costs and, thereafter, minimally £10.8 million p.a. Expenditure of this order would, of course, be phased in over several years and, as at present, funding could be derived from more than one source, provided that it was assured. It should be remembered also that these totals are overestimates because several

centres exist already and only need to be upgraded. Looking further ahead, the introduction of GIS facilities would involve appreciable capital costs, which cannot be estimated accurately in a rapidly changing market, and increased recurrent costs of £5-8,000 p.a. for each records centre. A further saving might be made by combining biological records centres with existing local archaeological and geological centres and sharing costs. The potential costs of coordinating and regulating the system are difficult to quantify since no obvious model exists. However, a staff of 5 with a budget for staff and overheads of £150-200,000 p.a. would probably be adequate. Start up costs would be additional. The cost of establishing the metadatabase, assuming it were to be developed from the CCBR database, would be about £100,000. Thereafter, the costs of maintaining and updating it would depend on the frequency of updating, its size and costs of accessing it.

6.9 In contemplating the costs of a national system, the possibility of income generation should not be overestimated. The metadatabase is unlikely to be fully self-financing. Charges for access to data are unlikely to provide an appreciable return. For data exchange within the system to be effective, a working rule could be that non-interpreted data should be freely interchangeable within the system and that any charges made should reflect only the costs of data compilation and management. However, interpreted data, being a value-added product, would be additionally chargeable. Government and EU policy are clearly involved in resolving this issue but, in addition, the voluntary sector sees 'payment in kind' through access to original or compiled data as a reward for their basic record contributions. Income from all sources, apart from contract work, is unlikely to exceed 5% at the most, if that. This figure is the highest achieved in the USA by The Nature Conservancy, a private enterprise with some State and Federal support. In the UK, the private sector is not a large user of data and the complexities of data protection and copyright will militate against the rapid exploitation of biological information.

6.10 The CCBR authors' recommendations which conclude the Report address four key issues, namely, that:

- The need for biological recording data has been consistently underestimated in national policies and legislation and at local government level;

- Consequential under-resourcing of the supply and management of data has resulted in an inability to deliver it effectively or consistently;
- Recent developments in technology offer an opportunity to store, manage and transfer such data;
- There is an overriding need for improved coordination and regulation through the establishment of standards for biological data if their mobility and access to them is to be improved to the level required now and in the future.

6.11 The recommendations are concerned with the establishment of policies and a framework for constructive planning rather than prescriptive practical and technical details. There is no shortage of experienced, informed, technical opinion, what is almost totally lacking at present is positive and progressive policies and planned coordination of recording activities. However, if a national scheme for biological recording is to be achieved in the foreseeable future it is essential that a lead be given. The only existing organisation with responsibility for the environment as a whole, environmental statistics, nature conservation at national and international levels, planning and land use is the Department of the Environment. It is recommended that this department should accept the lead role in implementing the recommendations set out below. Action would, of course, involve other Government departments, statutory bodies (such as JNCC) and local government, especially where cooperative action is well established, e.g. MAFF. The Biodiversity Action Plan Steering Group, chaired by DOE, has a wide remit which includes a consideration of most of these issues through a sub-group on data chaired by the Chief Officer of JNCC. Nevertheless, leadership by the Department of the Environment should:

- Secure national recognition for the need for a national system;
- Facilitate the need for future, preferably 'ring-fenced' commitments for the additional funding which will be required, especially for the proposed independent coordinating body (para. 5.5).

7. RECOMMENDATIONS

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| <p>1. REVIEW STATUTORY REQUIREMENTS FOR BIOLOGICAL RECORDS</p> <p>1.1 Define the requirements of governmental agencies and local government for the products of biological recording, as determined by present Government policies and legislation.</p> <p>1.2 Secure the recognition of the need for a national system</p> <p>1.3 Identify the priorities of statutory bodies for the collection, management, dissemination and analysis of data.</p> <p>ESTABLISH BIOLOGICAL RECORDING IN A FORMALISED FRAMEWORK</p> <p>2.1 Establish biological recording in a formal and recognised framework, based on negotiated agreement or legislation, to identify and secure the processes of collection, management, dissemination and analysis of data.</p> <p>2.2 Secure a long-term, ring-fenced funding commitment for a deputed coordinating body</p> <p>ESTABLISH A BIOLOGICAL RECORD DATA STANDARD</p> <p>3.1 Develop a general data model which will encompass existing database development, standardised terminology and syntax control.</p> <p>3.2 Define the structure of individual records for specific applications.</p> <p>3.3 Retain flexibility to accommodate new categories and concepts within the standard.</p> <p>ESTABLISH METHODS TO CONTROL THE QUALITY OF DATA</p> <p>4.1 Define, make available and maintain preferred terminological standards, especially term lists such as taxonomic checklists and synonymies.</p> <p>4.2 Define preferred validation procedures and establish accepted routes for the validation of data, for example in the identification of taxa or biotopes and the trapping of terminological and syntax errors.</p> | <p>4.3 Ensure consistency of format for data by use of standard recording formats and comprehensive instruction and training which are compatible with the data standard.</p> <p>4.4 Promote the use of precise spatial referencing of all types of data.</p> <p>4.5 Promote the use of the data standard in establishing priorities and best methods for providing access to non-computerised and other forms of historical records.</p> <p>5. ESTABLISH PROTOCOLS FOR THE COMPILATION AND CONTENT OF DATABASES</p> <p>5.1 Define the characteristics of each discrete dataset or database as a metarecord, including data attributes and the validation procedures used.</p> <p>5.2 Define legal responsibilities in the management and use of data, including the copyright and ownership of data, and obligations and liabilities in the supply of data.</p> <p>5.3 Establish the supply, management and dissemination of data to comply with these legal responsibilities.</p> <p>5.4 Establish the supply, management and dissemination of data to fulfil the requirements of major data users of all types.</p> <p>5.5 Establish the supply, management and dissemination of data to fulfil the aspirations of major data suppliers, particularly those in the voluntary sector.</p> <p>5.6 Promote the adoption of recognised standards and protocols by organisations which fund biological recording, particularly when commissioning environmental information.</p> <p>ESTABLISH A DISPERSED NATIONAL SYSTEM FOR BIOLOGICAL RECORDING</p> <p>6.1 Prepare design specifications for a metadatabase of biological recording in the UK, based on standardised <i>metarecords</i>, as an index to the content and availability of datasets and databases within the system.</p> |
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- 6.2 **Compile, maintain and update the metadata base.**
- 6.3 **Provide access to the metadata base** via, for example, an appropriate national computer network (or networks), and as published summaries in paper and CD-ROM forms, to achieve the widest possible dissemination.
- 6.4 **Promote the development of a recognised physical network of data centres and data holders**, through the adoption of the data standard and agreed protocols, and the establishment of the metadata base.
- 6.5 **Promote the establishment of local data centres to achieve complete coverage of the UK.**
- 6.6 **Secure funding mechanisms for accredited data centres** in the system.
- 6.7 **Promote the development of computerised networked links** between the components of the physical network.
- 6.8 **Promote open access to data** throughout the national system.

ESTABLISH A MANAGEMENT MECHANISM FOR A NATIONAL SYSTEM FOR BIOLOGICAL RECORDING

- 7.1 **Establish a small permanent coordinating body** to develop and promote the establishment of a national system.
- 7.2 **Ensure the involvement of all levels of the biological recording community** in the management of the national system and the coordinating body.
- 7.3 **Promote quality assured management of data and services** to users by data centres.
- 7.4 **Develop an accreditation scheme** for operational units in the national system, with **formal policies** for quality assurance, audit and review, provision for **training** and the preparation of **technical manuals**.
- 7.5 **Develop protocols for the mobility of data** throughout the system, whilst ensuring the autonomy and independence of individual data units.

ANNEX SUMMARY OF RESPONSES TO THE CCBR QUESTIONNAIRE SURVEY

A1 Organisations: data holdings

A1.1 Quantified returns for 951 datasets were obtained, 29% directly contributed by voluntary activity, predominantly for taxon-based records (70% of total). In fact, the contribution from such volunteers is far higher since records extracted from collections, in publications, or copied from such sources, and appreciable amounts of data provided through contracts with conservation agencies etc., are derived from this source. Ornithological records are predominantly provided by volunteers and since about 65% of UK taxa records are for birds this is a significant input. Some organisations collect records predominantly in-house, e.g. NRA regions, and many surveys are carried out by local government or government-funded agencies. Even so, in the Survey, overall, local planning authority ecologists contributed only about 10% of the taxa datasets although they carry out a higher proportion of biotope surveys. In general, site-based data are largely the work of full-time or contracted staff - just over 19% of such data appeared to be contributed by volunteers.

A1.2 Records have not accumulated at a constant rate and, indeed, the majority have been obtained since 1970 (85% for taxa; 95% for site-based and biotope records). However, this obscures a serious deficit in pre-1940 taxa data since the major sources of earlier records - museum collections and herbaria - most of which are not available in readily usable form, were not included in the Survey. There are significant differences in the temporal range of records held by different organisations. Those concerned primarily with development planning and conservation hold few or no pre-1980 records and this is true also for those which have only recently engaged in intensive monitoring, such as the National Parks. Their records are principally concerned with biotope, land type and monitoring records and reflect the increasing concern with landscape change and conservation since 1970-1980. BRC, BSBI, national recording schemes, museums and research councils, concerned more with taxonomic research and biogeography, not only hold larger percentages of taxon-based records but also have a much wider temporal range. A few natural history organisations,

e.g. Yorkshire Naturalists Union, have records going back over 100 years.

A1.3 Taxon-based datasets, representing over 60 million records, vary quantitatively between different kinds of organisation. The numbers of records for different kinds of organism differ greatly. Bird records, at over 41.3 million, are the commonest amongst the 1385 datasets returned in the Survey, with vascular plants at almost 14 million coming next. Fish at about 31 000 are the most poorly represented apart from microscopic plants and animals for which records are abysmally low. Several organisations hold over one million records each: the largest single dataset being the 23 million bird-ringing records out of a total of over 28 million bird records held by the British Trust for Ornithology. The largest and most comprehensive taxon-based dataset - 6.2 million covering over 9000 taxa - is held by BRC. BRC works closely with over 60 national schemes for which it acts as a repository for data: the main exceptions are birds, lichens and fungi which are held by societies. Vertebrates, especially mammals were under-represented in the Survey because details of several important holdings were not available from MAFF, the Forestry Authority, Bristol University and the Mammal Society, amongst others. Many organisations were unable to give accurate quantified information but, conservatively, the total number of taxon-based records in the UK must be at least 80 million.

A1.4 Collections in museums and herbaria are catalogued in such a way that taxon-data cannot be recovered easily. Addressing this problem is an urgent necessity for historical records. Indeed, only a beginning has been made in collecting and publishing metadata on museum collections through the activities of the Federation for Natural Science Collections Research Units. In the absence of such a metadatabase it is difficult even to locate collections.

A1.5 Publications of all kinds are an invaluable source of records but, hitherto, the dearth of effective abstracting publications for many taxonomic groups makes their location difficult. Several sources are listed. Handbooks, guides and atlases often synthesise data and the Ecological Flora

database of the British Ecological Society includes ecological data on over 1000 flowering plants.

methodological uncertainties. Biotope surveys are fewer in number than taxon surveys but are more standardised.

A1.6 Published reviews of well documented collations of data on site and biotope records were not reproduced in the report. Some 522 datasets were reported including maps, notes on Phase 1 surveys and land-use data at 1km square resolution in the Countryside Information System (CIS) which has been developed by the Institute of Terrestrial Ecology (ITE) for DOE and will be publicly available in 1995. The cover achieved is considerable. Phase 1 Habitat surveys probably represent more than 3 million land parcels, mainly in rural areas, while wildlife trusts probably have records on about 150 000 sites ranging from roadsides to extensive moorlands. Biotope and land type surveys are, not unexpectedly, biased to general land use/cover (19%), woodland (12%), and grassland (10.5%).

A1.7 Marine biota are largely covered by statutory conservation agencies and the Marine Conservation Society. Some 70 000 records of seaweeds and 7 000 of marine fish are included in the Marine Nature Conservation Review's database held by JNCC. Seabirds are covered also. NERC, through its marine research covers plankton in N. Atlantic and European coastal waters; records of algae and dinoflagellates are held at BRC. Information on the extensive data held by MAFF and NRA was not available to the Survey. Despite these activities, information on marine taxa and biotopes has been neglected and this neglect is reflected in *Biodiversity: the UK Action Plan*.

A2 Survey, surveillance and monitoring

A2.1 These topics were examined only briefly in the Survey. The most significant features to emerge were the dearth of standard survey techniques and of methods capable of ensuring effective replication of results, or of providing reliable quantitative data. Exceptions are national surveys such as the Phase 1 Habitat surveys, the Breeding Bird survey, the Butterfly Monitoring Scheme and Countryside Survey 1990. The methodologies required are often complex and tend to be confined to the most experienced field workers. Apart from the exceptions just mentioned, datasets which also document the sampling methods adequately are rare. Comparisons of different studies are, therefore, unreliable because of these

A2.2 Although much surveillance and monitoring is undertaken on the national scale and some baselines have been established, a review of 828 projects undertaken by York University for DOE indicated that only 10 were appropriate to DOE's needs and only 30 more would be suitable with additional work. While many studies are annual, some cover a longer time span up to 11+ years. The importance of such long term studies has been shown in the interpretation of butterfly abundance data and changes in the breeding distribution of British birds.

A3 Methodologies: recording media & data entry

A3.1 Historically, personal notebooks and collections have been the basic source of records. They are very vulnerable sources, rarely adequately archived or even preserved. Record cards are now preferred by 80% of the 194 organisations providing information to the Survey as a primary recording tool although 153 represent unique designs of which about half were based on BRC designs. *Species list* cards are used for listing taxa; *single species* cards for basic data such as grid reference, locality, recorder's name and date. This type of card is useful when dealing with collections. *Individual record* cards for one location at one date, often with additional ecological or other data, are normally used for uncommon species or records. Many local records centres have customised cards with a local map and other attributes to promote easy and accurate recording as well as storage and summarising of data. Biotope surveys frequently use customised cards. In general, customised cards are used for special studies and, although effective for such a purpose, often result in lack of consistency and compatibility of data.

A3.2 Record cards impose a restriction on management of data because of their one-dimensional nature, e.g. in cross referencing, but this can be overcome by electronic recording in the field. Only 10 (5%) of respondents used electronic recording and only 6 (3%) used hand-held computers. There are still important technical constraints on the use of electronic devices in the field, including cost, robustness, weight and size and battery life. However, pen-based recorders and portable, backpack, notebook

computers capable of operating with a global positioning system are becoming available and will become both cheaper and smaller with time.

- A3.3 Data entry can become a bottleneck, especially when converting to a computerised system, entering old records or entering repetitious data. 'Key to disk' is normal where data is entered into a data-entry programme or database direct. Double-keying, as a form of validation, is no longer used - only by 6% of the 1227 datasets of 5 organisations - since in practice it does not reduce copying errors. Optical scanning, transcribing written data by Optical Character and Optical Mark Recognition is becoming cheaper and more reliable and can be used in conjunction with any written or printed record either for recording written data or transferring it to a database. The principal sources of error arise from poor text quality.

A4 Data standards and validation

- A4.1 Validation presupposes unambiguous and agreed terminological standards but only a limited number of these exist for biological records. There is, for example, no official register of UK taxa, no readily accessible source of checklists, nor is any organisation or agency authorised to be responsible for their preparation and maintenance. Such lists as exist have been compiled by experts, often amateurs, and their publication undertaken voluntarily by scientific societies. Lists of vernacular names have been compiled and published in a similar manner, supposedly to assist non-specialists, but different regional usage, for example, can cause confusion. Codification of names, sequential, hierarchical or mnemonic, is often employed with particular groups as an aid to data management in the same way. Some 35% of the 339 returns employed the Recorder taxonomic coding systems for this purpose, 27% used BRC coding systems and 6% the Maitland system for freshwater fauna.
- A4.2 Standards for describing land cover, habitat and biotopes are diverse and neither readily agreed nor reconciled. Phase 1 Habitat survey conventions are similar to those used in the Royal Society for Nature Conservation/Nature Conservancy Council classification so that 37% of respondents' data was comparable. The ITE Land Cover: Definitions study for DOE and has provided a standard framework for the classification and comparison of land cover categories of

national importance and includes, in addition to natural vegetation types, agricultural use and the built environment as well as semi-natural vegetation types. These defined interrelationships between land cover classifications can be accessed interactively through CIS.

- A4.3 Spatial and geographical referencing is crucial to the use of most biological records. Names can be ambiguous because of different spellings and frequent occurrences of places with the same name. OS grid references, especially for 1km or 100m squares reduce ambiguity considerably, as can accurate latitude/longitude for marine data, especially if combined with a Geographical Information System mapbase (see para. A8.1). Similarly, spatial referencing can be achieved with increasing precision by using 10, 2 (tetrad) or 1 km grid squares, the last being employed in CIS. Site-based data can be related often to grid referenced data and of 1092 datasets reported on in the Survey, 55% of taxonomic data could be so site related, although it needs to be remembered that 65% of all such records refer to birds. Wildlife trusts and county planning departments include higher proportions of site-based records - 83% and 91% respectively. For the last 15 years, BRC's policy has been to include both detailed grid references and locality names, when provided by recorders, for all newly incorporated records. The principal problem with referencing site-based data is the delineation of site boundaries. This problem has only been solved partially. The development of GIS should make this problem amenable to resolution although a limiting factor will always be the availability of digital data on map units of sufficient spatial resolution for the site records. At present GIS for biological recording is only used by about 5% of the organisations surveyed. The spatial units used by different organisations differ according to their needs, e.g. grid-based for survey data collected by country agencies, site-based by local records centres and wildlife trusts for conservation purposes: 406 biotope, site and monitoring datasets are shown.
- A4.4 Validation of taxa depends predominantly on the knowledge and experience of the collector, collator, or identifier. Mistakes with common species are uncommon but with rare or critical taxa they are difficult to eliminate unless the record falls well outside the normal geographic range. There are no agreed national criteria by which experts, often

amateurs, are recognised other than by cumulative peer review. Early versions of Recorder included an estimate of the identifier's known ability but this has been dropped from later versions, largely because of the provisions of the Data Protection Act. The Survey revealed a range of taxonomic validation procedures in use and that significantly different techniques applied to different taxonomic groups. About half of all records are checked by staff in the originating organisation, others by local experts, so that about 80% are checked in this way. National experts probably check about 10%, generally difficult or critical taxa. Voucher specimens are a further check and supported about 18% of the Survey datasets. Over 6% of datasets were checked against specimens in collections. In some groups checking against collections or the use of voucher material is rare, notably with birds where identification is almost entirely based on sightings. However, local and national vetting panels are used extensively, especially for rare taxa or unusual migrant species. Vertebrates in general are rarely checked against collections; in-house experts are usually responsible for validation. Collections are important for checking lichens, and invertebrates other than lepidoptera. Butterflies and macro-moths are so well known and documented that it is only the micro-lepidoptera that cause problems requiring expert opinion in most cases. Of the different types of organisation, local records centres apply the widest range of validation techniques while wildlife trusts apply the least, relying almost entirely on in-house skills.

- A4.5 No information was collected in the Survey concerning the reliability of assigned land cover and biotopes. Existing evidence suggests that reliability will vary between different types of survey and between surveyors, depending on their experience. The problem is exacerbated by the variety of descriptive terms and the lack of agreed terminology, but this has to some extent been addressed in the ITE study of Land Cover Definitions.
- A4.6 The commonest errors are the transposition of grid references and misspelling of place names. About 75% of all datasets in the Survey have their grid references checked but this practice differs between organisations. Less than half of the bird organisations, wildlife trusts and statutory nature conservation agencies check grid references and only about half the local

planning departments and central government departments do so. The Recorder package has a built in check for format, eastings and northings. The spelling of place names is a common source of error which can be checked only by reference to a gazetteer and this was done by most organisations in the Survey. Site and biotope datasets are more often checked against local site lists (47%) than against gazetteers (19%). 'Ground-truthing' is widely used by local authorities and National Parks, probably reflecting the increasing use of aerial photography for survey purposes.

A5 The computerisation of biological records

- A5.1 The move to organised recording over the last 40 years, the consequential huge increase in data and the development of computers able to handle big blocks of information have made the adoption of computerised recording inevitable. Comparison of the use of computers, by a number of organisations involved with recording, in 1985 and in the Survey eight years later, showed an increase in use of about 8%, i.e. about 1% p.a. In the Survey, 73% of the organisations used computers for some aspect of biological recording. Of these, 19% were fully integrated into procedures and in a further 34% they played important roles.

A6 Data management

- A6.1 About 42% of all taxon-based datasets are fully computerised but 70% are managed manually, some organisations running a dual system. Only 26% of land type and biotope datasets are kept in summary form on computers, presumably because they include both textual and graphical data, for which suitable programmes are either still too expensive or need to be developed. Paper records, therefore, still predominate. Data management in BRC, and in NERC generally, is highly computerised, as are a few local records centres, 40% having some degree of computerised management, but this is less frequent within National Parks and, surprisingly, in county planning departments (4.3% of taxa-based datasets, 26.2% of site-based datasets). Amongst voluntary groups, bird organisations have two-thirds of their species observations computerised but, more typically, only 16.5% of BSBI vice-county recorders had fully computerised records. There is, therefore, a wide range in the degree of computerised management and organisations like BRC, JNCC and BTO act as

foci for development. Nevertheless, about 55% of the potential national network is already computerised in part. To assist comparisons of different datasets it is highly desirable that agreed minimal standards be established both for records and for the subsequent data management.

A7 Computers and software in use

- A7.1 IBM-compatible, DOS-based PCs are used most commonly (85%) by respondents to the Survey and ranged from the near obsolete 8088 processor to 486 machines using Windows operating systems (55% with 386-type, 24% with 486-type); only 2/148 (<1.5%) respondents used Apple Macintosh machines. Some 14.5% of respondents were connected into local area networks, the majority DOS-based using NOVELL Netware, but 6 were UNIX-based. These last were in major organisations with specialist computer support. Mini-computers running on UNIX are used by BRC, BTO and the country conservation agencies and a few local records centres where they are linked to university or local authority systems. Their great advantage is that they can be used simultaneously by many users but demand specialist technical support. Only 8% of respondents used mainframe computers, mostly associated with local authorities or governmental agencies.
- A7.2 Originally, suitable software, whether for applications or management, was not available and various programs were developed in-house. Few have persisted but MUSCAT, developed by the Museums Documentation Association is still available although technically difficult to use. As computer software developed, various methods for biological recording developed also. Non-database text (word processor files) and spreadsheets were adapted; in-house databases were written in popular programming languages such as Visual BASIC, e.g. BIORECS. Commercially written databases to order are also in use such as that used for the Marine Conservation Review, the Sites and Species database of the Royal Society for the Protection of Birds (RSPB) in Advanced REVELATION, or the BRC database in ORACLE.
- A7.3 So long as a full biological record standard does not exist the Recorder database package (developed by the former Nature Conservancy Council, and currently available from English Nature) is the best available and the most widely used implementation. Its

principal drawback is that data exchange between copies is difficult, although a data exchange program is under development. About 160 copies are in use and at least 15% of all Survey respondents use it. BIORECS is simpler and has about 50 registered users while COBRA is used as a bird recording database by several county bird societies. None of these software packages is available for mini- or mainframe computers where only in-house software is employed e.g. ERICA, developed by the Cornish Biological Records Unit. Another notable but limited database is the British Ecological Society's Ecological Flora database.

- A7.4 Distribution maps are widely used to present biological records and several computerised mapping programmes are now available and in use. The most widely used are PLOT5, DMAP and UKDMAP. PLOT5 is a dot-distribution mapping program which can be linked to Recorder, or is available separately. It has an outline map which can be scaled dynamically and on which various grids can be superimposed. Distributions can be plotted directly from a grid reference file in a variety of icons and colours. UKDMAP, used by NERC and country conservation agencies, was originally developed for marine plotting especially of spatial information. More widely used is DMAP which can draw outline maps from coordinate files and plots from ASCII files. It can also be configured to run in a variety of formats and is, therefore, highly versatile and can be integrated into a variety of databases; drivers are available to integrate with Recorder and COBRA. Some 265 registered users of DMAP include 123 organisations and 142 individuals involved with biological records. It is now available in a Windows operating version. In addition, a number of commercial packages are available but most are prohibitively expensive save for corporate users. One inexpensive program is MAPBASE, which has town, village, road and other overlay features plus a gazetteer.

A8 Geographical Information Systems (GIS) in use

- A8.1 These systems are now coming into general use. One in four county planning departments - 11 in all - used GIS in 1992 but the Survey revealed another 18 organisations using them, EN, SNH, government departments, NRA regions, 2 local records centres, BRC and NERC. Several other organisations are actively investigating their use. There are, therefore, probably 50

organisations now using GIS, excluding research units and universities. A variety of programs are in use at all levels: at the national strategic level by DOE using ARC/INFO and CIS and by the country conservation agencies; for regional planning by National Parks using the SPAN system, Peaks Park using WINGS; for national and international research by ITE/BRC using IDRISI an academic system; by national non-governmental organisations such as the National Trust for property recording and by the RSPB for collaborative research on wader populations in the Flow country; for county planning in several counties (e.g. ARC/INFO by Berkshire, Hampshire and Kent), while four wildlife trusts and local records centres use various other programs. The potential value of low-cost PC GIS as tools is evident from the diverse uses to which they are being put but their general use in biological recording will probably have to await an appreciable reduction in price for most systems, or the networking of smaller recording units with major corporate centres.

A9 Communications

- A9.1 Communications are still largely paper-based amongst the recording community. However, BTO transmits data on floppy disks and fax is increasingly used for shorter communications. In addition, the development of E-mail and of international networking systems such as INTERNET, or national networks such as JANET between universities and major agency research groups in the UK, provide rapid and effective communication channels. As yet less than 1% of the respondents to the Survey gave an E-mail address although 11 (3.5%) exchanged or provided data over a computer network. This kind of development is expected to grow rapidly.

A10 Data exchange and transfer

- A10.1 Data exchange appears to be very limited as judged by the Survey findings. Wildlife trusts received information from the widest range of sources. 71% of local records centres supplied wildlife trusts with information and 82% provided information to the public. Although a formal network for information flow does not exist in the UK, the potential for developing one is there (Figure 1, page 8). Many of the links, however, are very fragile, often depending on a single interested individual. There are certain important and well established key interfaces. For example, at the national level, the main interface

between centrally funded agencies and the voluntary sector is through JNCC and BRC. At governmental level little data comes directly from the main source of data, the voluntary sector, although some comes indirectly through bodies such as JNCC. At the county level, wildlife trusts, local records centres and county/district planning authorities can, and do, exchange some data. However, in most local networks the flow is often one-way - from the funded body to the funding source! Indeed, much exchange of information is determined by contractual constraints or service contracts which impose artificial restrictions on potential free flow. In summary, there is no single route whereby information can enter the quasi-system nor, once in, for it to be routed preferentially to where it could be of greatest value and available for a variety of applications.

- A10.2 Over 82% of 169 respondent organisations provide photocopies of original data, 54% provide interpreted data and 57% would provide mapped data. Only 27% provide data on floppy disks and 7% on magnetic tape and the same percentage could provide data over a computer network - mostly the large, publicly funded bodies. The commonest format was in ASCII (46%) or as DBASE, SQL or LOTUS1-2-3 files. It is evident that data exchange currently relies heavily on manual methods and is, in general, inefficient. Moreover, even in a more computerised system there is still an important place for maps and field notes which are the only means of transferring spatial information in the absence of GIS facilities.

A11 Non-biological data

- A11.1 Non-biological data such as climatic, meteorological, geological, pedological, or information concerning ownership, management or protection status, is nearly always required for interpretation. Sources are described in the excellent but neglected Chorley report, *Handling geographical information*, published by DOE in 1987. The Survey showed that organisations concerned with conservation, planning and land use used such data most extensively and held appreciable quantities. Most of such information is spatially referenced, some temporally referenced. It is correlated with biological data about twice as frequently (108:56) by paper maps of all kinds as by computerised methods, including GIS.
- A11.2 A serious problem facing biological recorders is that many computerised and digitised non-

biological datasets of national and key importance are held by government agencies or commercial companies. Examples are soils and geology base maps, weather records and the boundaries of all types of designated sites. Under the DTI Tradeable Information Initiative (1986) agencies are charged either to recover full costs or commercial rates and the recent EIR permit a 'reasonable charge' to be made (see para. 3.6). This has made some datasets prohibitively expensive for many voluntary organisations and even for some potential agency users. The UK situation contrasts notably with that in the USA where such government-obtained data is supplied either free or at cost to recognised, *bona fide* organisations.

Uses and users of biological records

- A31. The purposes for which biological records have been made have changed greatly with time and increased in complexity. Thirteen key uses were identified in the CCBR Questionnaire and a further four important uses were identified by respondents. The major uses are for site, habitat and species conservation and a surprisingly low usage for biogeography and taxonomic research. The majority of organisations used data largely within their own organisation, ie. in-house. Only 24% of data was used by the parental bodies of organisations, although local records centres and museums provided nearly 37% of data externally, as might be expected. This usage reflects the poor data exchange activities of organisation referred to in para. A11.1.

GLOSSARY OF ABBREVIATIONS

ASCII	American Standard Code for Information Interchange
BRC	Biological Records Centre (ITE, Monks Wood)
BRISC	Biological Recording in Scotland Campaign
BSBI	Botanical Society of the British Isles
BTO	British Trust for Ornithology
CCBR	Coordinating Commission for Biological Recording
CCW	Countryside Council for Wales
CIS	Countryside Information System
DOE	Department of the Environment
DOENI	Department of the Environment for Northern Ireland
DTI	Department of Trade and Industry
EIR	Environmental Information Regulations
EN	English Nature
EU	European Union
GIS	Geographical information system
IPR	Intellectual property rights
ITE	NERC Institute of Terrestrial Ecology
JANET	Joint Academic Network
JNCC	Joint Nature Conservation Committee
MAFF	Ministry of Agriculture, Fisheries and Food
MGC	Museums and Galleries Commission
NERC	Natural Environment Research Council
NFBR	National Federation for Biological Recording
NRA	National Rivers Authority
OS	Ordnance Survey
PPG	DOE Planning Policy Guidance Notes
SNH	Scottish Natural Heritage
SQL	Structured Query Language
UK	United Kingdom of Great Britain and Northern Ireland
USA	United States of America
