



NATIONAL FEDERATION FOR BIOLOGICAL RECORDING

National Perspectives in Biological Recording in the UK

Report of the Annual Conference held at the Central Electricity
Generating Board in London on Thursday 11th May 1989

edited by G.Stansfield and P.T.Harding

National Federation for Biological Recording
Cambridge, 1990.

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Glossary of abbreviations and acronyms

AUTOCAD	A computer-aided design package
BBC	British Broadcasting Corporation
BCG	Biology Curators' Group
BM(NH)	Natural History Museum (London)
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
CBC	Common Birds Census
CEGB	Central Electricity Generating Board
COREDATA	Conservation Resources Database (NCC)
CP/M	Control Program Monitor - a disk operating system
DOE	Department of the Environment
EC	European Commission
EIC	Environmental Information Centre (ITE)
ESRC	Economic and Social Research Council
FC	Forestry Commission
GB	Great Britain
GIS	Geographical Information System
GWGS	Greenland White-fronted Goose Study
HQ	Headquarters
IBM	International Business Machines
ITE	Institute of Terrestrial Ecology
IUCN	International Union for the Conservation of Nature
IWRB	International Waterfowl & Wetlands Research Bureau
JANET	Joint Academic Network
MAFF	Ministry of Agriculture Fisheries and Food
MBS	Moorland Birds Study
MDA	Museum Documentation Association
MS/DOS	Microsoft (Corporation) Disk Operating System
NCC	Nature Conservancy Council
NERC	Natural Environment Research Council
NFBR	National Federation for Biological Recording
NGO	Non-governmental organization
NNR	National Nature Reserve
PC	Personal computer
PSS	Packet Switching System
RAD	Rural Areas Database
RBBP	Rare Breeding Birds Panel
RECORDER	Biological records computerization system devised for NCC & NFBR by Dr S G Ball
RSNC	Royal Society for Nature Conservation
RSPB	Royal Society for the Protection of Birds
SSSI	Site of Special Scientific Interest
UK	United Kingdom of Great Britain and Northern Ireland
VWT	Vincent Wildlife Trust
WSG	Wader Study Group

Introduction

Geoff Stansfield

Department of Museum Studies, University of Leicester, 105 Princess
Road East, Leicester LE1 7LG

The 5th Annual Meeting of the National Federation for Biological Recording was held at the offices of the Central Electricity Generating Board at Sudbury House in London and the Federation is pleased to record its appreciation to CEGB both for providing the venue for the meeting and for a financial contribution towards the publication of these proceedings.

It was thought appropriate that the fourth annual conference of the NFBR should focus on some national perspectives in biological recording in the United Kingdom. The papers which follow present a timely account of developments and issues relating to biological recording in the UK.

We have high hopes for the Coordinating Commission on Biological Recording in the UK which is shortly to start work. It is our belief that this conference report, together with the reports of previous conferences in 1986 and 1987 provide a lasting and valuable contribution to the philosophy and practice of biological recording, and provide an excellent basis for the work of the Commission.

Biological Survey: Need and Network - a review of progress towards national policies

Paul T Harding

Biological Records Centre, NERC Institute of Terrestrial Ecology, Monks Wood Experimental Station, Abbots Ripton Huntingdon, PE17 2LS

Introduction

The paper reviews recent initiatives in the co-ordination of biological recording in the United Kingdom, with special reference to the need for national policies. National and local recording are considered and changes in circumstances (particularly staff and computing capacity) and of priorities are noted. The roles of key organizations are described. The recommendations of a Linnean Society working party on biological recording were discussed at a meeting convened by NERC and the outcome of that meeting has been the formation of a steering group to facilitate the recommendations.

Oscillating natural history

In his presidential address to the Linnean Society Professor Berry (1983) discussed the growth of 'professional biology', at the expense of 'natural history' at the end of the 19th century. He noted, however, that since the Second World War 'natural history', particularly when linked to wildlife conservation, has regained impetus. I would go further to suggest that 'natural history' has never had so many followers, be they mainly somewhat passive, such as most members of the RSPB and wildlife trusts, or be they active practitioners - field naturalists. Increased leisure time (and the enforced leisure of unemployment and early retirement), greater mobility, constant media exposure and a boom in publishing have all fueled the fire of enthusiasm for natural history. However, the emphasis is less scientific than, say, before the 1939-45 war, with increased interest in conservation and in rare species. Few amateurs have published on the biology of species in recent decades, but this change may partly be due to competition (whether real or perceived) with professional scientists.

National recording

Biological recording has undergone significant changes since the first formalized national recording scheme began in 1954 with the BSBI's project to map the distribution of vascular plants and which culminated in the Atlas of the British Flora (Perring & Walters 1962). The Biological Records Centre (BRC) was set up in 1964, originally to map the flora and fauna of the British Isles, but its role has developed and changed significantly in the last 25 years (Harding 1984, 1985).

Local recording

Although the collection of information on wildlife has had a strong local bias for at least 150 years, formalized environmental recording, at a local level, came to the fore in the early 1970s. A conference in 1973 brought together the majority of those concerned with local biological records centres (Stansfield 1973) and in 1977, the Museums Association convened a Standing Committee on Environmental Record Centres (Stewart 1980a, b) which met annually for a few years up to 1981. Also in 1977, the Biological Recording in Scotland Committee (BRISC) was formed (Somerville 1977). A meeting of records centre organizers was held at Monks Wood in December 1977 and, as a result, a Handbook for Biological Records Centres was produced in 1978 (Flood & Perring 1978).

The last major review of local records centres was made in 1980 (Harding & Greenwood 1981, Greenwood & Harding 1982) which documented the work, facilities and staffing of over 60 centres. Most local centres were based at local authority-funded museums and worked without much reference to what similar organizations were doing. The Museum Documentation Association published an issue of MDA Information devoted to environmental recording (Anon 1984), which reviewed some of the major areas of work at the time.

Biology Curators' Group

In the absence of any 'parent body' or co-ordinating group, many local centre managers looked to the Biology Curators' Group (BCG) and its Newsletter as a medium through which to publicize their work and to discuss topics. By the early 1980s, a significant part of the BCG Newsletter was devoted to topics related to biological recording, including contributions by Whiteley (1983), Copp (1984), Ely (1984), Francis (1984), Garland & Whiteley (1984) and Harding (1984).

BCG convened an important seminar in September 1984 to discuss biological recording (Anon 1985). The seminar made the following conclusions:

1. The present situation both nationally and locally for biological recording, storage and retrieval of data is unsatisfactory.
2. Agreed standards should be set for biological recording, but due regard must be given to amateur naturalists who collect valuable information but who may not wish to be tied to particular methods of recording.
3. Where applicable, museums should provide a local biological data bank service.
4. Local biological data banks should provide a range of services to the public in general.
5. Biological recording is not adequately financed.

The seminar also resolved that "the Biology Curator's Group should set up a working group including other interested organizations to investigate the present situation in relation to biological recording and in the light of Nature Conservation in Great Britain (Nature Conservancy Council 1984) take steps to improve the situation and seek appropriate financial resources".

Resulting from this seminar, two initiatives developed. At a 'practical' level, BCG and BRC collaborated to set up the Biological Recording Forum, 1985 (Copp & Harding 1985) from which the National Federation for Biological Recording (NFBR) has developed and at a 'political' level, the Linnean Society set up a working party chaired by Professor Berry.

Independent of these two initiatives, in 1986 NCC and Wildlife Link formed the Joint NCC/NGO Data handling Group.

National Federation for Biological Recording

The National Federation for Biological Recording was launched at a conference at Cambridge in April 1986. It represents the concern of many scientists, conservationists and amateur naturalists in the UK that the importance of biological recording is not sufficiently recognized and that funding and co-ordination are needed.

NFBR is too young an organization to have much of a history. It was formed with great enthusiasm, but there are limitations to what a small group of volunteers, already in full-time employment, can achieve.

The Federation seeks to involve the many agencies active in biological recording and, in doing so, to help improve their effectiveness in gathering, managing and disseminating biological records. The immediate aim of the Federation has been to improve awareness of the importance of biological recording in all organizations concerned with the environment. It has looked at practical issues and has been involved in 'political' issues too. Three successful annual conferences precede this one: in 1986 on biological recording in a changing landscape (Harding & Roberts 1986), in 1987 on the products of biological recording (Stansfield & Harding 1988) and in 1988 on the use of computers in biological recording. NFBR communicates with its members through a periodic newsletter.

I may be biased, but without the intrusiveness and persistence of NFBR we might not have progressed as far as we have down the long road (Figure 1) identified at the BCG seminar in 1984.

Changing circumstances

The employment crisis of the late 1970s provided a means for local records centres to gain extra staff through various schemes operated by the Manpower Services Commission. Whilst they lasted, many centres flourished with numerous extra staff. In some cases, local centres set up using MSC schemes have formed the basis of new, local authority financed, centres. Employment Training appears to be less suitable for placing staff in centres and this valuable source of manpower has now almost completely ended. A few records centres have benefited from one or two extra members of staff, especially where the value of the centre's data is recognized, at the local authority headquarters.

Computers have come to play an increasingly important part in the thinking and in the practice of biological recording. In 1980, the BCG/BRC survey of local centres found that only 7% of the local centres responding had access to a computer (Greenwood & Harding 1982). By 1985, 30 centres and naturalists trusts made use of computers (Copp in Copp & Harding 1985). Up-to-date figures are not available, but the number of records centres with access to computers has probably increased considerably. The implementation of the RECORDER records management package, through collaboration between NCC, RSNC and WWF will lead to more computerization and greater standardization, and

will benefit from the experience gained through RSNC's attempts to provide a standard package for county naturalists trusts.

Computerized data lend themselves to analysis in a variety of ways including the use of Geographical Information Systems (GIS). Such systems integrate, analyse and display spatially-referenced data, for example to relate species distributions to the occurrence of habitat types, land ownership and land-use planning. A simplified type of GIS, using the computer software package AUTOCAD, was demonstrated by Claire Appleby at the opening of the Wiltshire Biological Records Centre in September 1987.

The present political climate has encouraged (and in some cases forced) some local centres to seek alternative sources of funding to maintain and expand their activities. For example, the Cornish Biological Records Unit has been highly successful in obtaining funding and resources for its activities, and in West Yorkshire an Ecological Advisory and Information Service has been formed from the first local records centre to be formally designated as such (Lavin 1985). There is also increased awareness of professional standards in data management with both the Working Panel of Local Authority Ecologists and NFBR stressing the need for training and standards.

Changing priorities

Emphasis in recording has changed over the last 25 years. In the early years mapping the distribution of species was almost the only objective of recording and this is still the case for some individuals and groups concerned with county atlas projects. Increasingly the emphasis has now shifted towards collecting, storing and using data which relate species records to sites and to compiling inventories of habitats and species at sites. Awareness of the use of this type of data is growing outside the immediate biological recording fraternity. Recent legislation places greater emphasis on the assessment of land development proposals using biological information. Environmental assessment is with us to stay and biological recording practitioners have never before been in a position where they are being sought out by developers. In some cases, local centres have already acted to fill the need for environmental information by acting as 'consultants' to planners and developers. The original concept, of biological record centres being within the natural history departments of museums, may no longer be entirely appropriate. As centres become increasingly 'user-driven', and where the main users are planners and developers, it may be that local authority funded centres should look increasingly to planning departments for financial support.

The Ministerial Committee of the Council for Europe approved in 1987 a recommendation (R (87) 13) that governments in member states should promote and support the development of local, regional and national environmental databanks and a variety of related activities (see Berry 1988, Appendix IV).

The greening of the present government has much to do with decisions made in Brussels. We should all be aware that a proposed EC directive on freedom of access to information on the environment which, if it is enacted, may have significant implications for those concerned with biological recording.

Joint NCC/NGO Data Handling Group

The group was formed in September 1986 and is administered jointly by NCC and Wildlife Link. Membership of the group is by invitation only and at present consists of organizations loosely classified as 'non-governmental organizations' with Wildlife Link providing the secretariat, (Annex 1).

The Group has the following terms of reference:

1. In furtherance of the objectives in 'Nature Conservation in Great Britain', to exchange information within the group's subject area, on
 - i respective bodies' current and future programmes to assist in developing complementary action.
 - ii respective bodies' development of policies in major relevant issues.
2. To review the collection, storage and processing of ecological data on habitats and species.
3. To endeavour to facilitate better means of exchange of ecological data.

The Group proposes to extend these terms of reference to include the promotion of standards for software and for species and habitat codings.

By acting as a forum, the Group allows the free-flow of information about computing developments at NCC and at constituent organizations. NCC has collated information on hardware, communications, software and

coding systems, and on the contents of datasets, at NGOs represented on the Group, but little progress has been made with using the information.

The Linnean Society Report

The Linnean Society Working Party, set up following the BCG seminar in 1984 and particularly in response to stimulus from the Steering Committee of NFBR during 1985, held its first meeting in May 1986. After 8 meetings, its report Biological Survey: Need and Network (Berry 1988) was publicly launched in July 1988. Press response was muted and in several cases linked with other newsworthy items such as proposed staff cuts at NERC. Production of the report was grant aided by the British Ecological Society, Department of the Environment, Nature Conservancy Council and World Wide Fund for Nature.

The report has its critics - 'nothing new', 'heard it all before', but when did they ever hear, or more importantly see, it being said with the support of such important backers. The Linnean Society report has brought the debate into a more political sphere, a sphere where decisions on policies and finance may be influenced.

Biological Recording in the U.K.

The Linnean Society report provided a starting point for a meeting titled 'Biological Recording in the U.K.' held at the Royal Society on 21 February 1989. The meeting was convened by NERC, with the NERC Director of Terrestrial and Freshwater Sciences, Dr Bernard Tinker, as chairman.

Invitations were sent to over 30 key national organizations actively involved with, or with an interest in the products of, the collation, storage and use of data from biological survey. The meeting was attended by 38 people representing 28 organizations (see Annex 2).

Professor Berry spoke on the Linnean Society Report, Dr Barry Wyatt on the ITE Environmental Information Centre and Ms Mandy Lane on the ESRC Rural Areas Database. Each organization had provided preparatory papers for the meeting to which representatives spoke briefly. In discussion, 7 main topics were dealt with in detail:

1. The scope of biological recording - defining the boundaries of the topic.
2. The need for baseline scientific information.

3. Determining priorities.
4. The need for a catalogue of data resources.
5. Ownership of data.
6. Taxonomy and training.
7. Local and regional structures in recording.

The meeting considered the recommendations of the Linnean Society Report. The minutes of the meeting record the following responses to the recommendations.

Recommendation 1: that a co-ordinating commission be established as soon as possible, under the lead of an appropriate body.

Endorsed. It was noted that the commission would be a short-lived group, to be disbanded once the objectives of recommendations 2, 3 & 4 had been achieved.

Recommendation 2: that the co-ordinating commission draw up a procedure for collaboration between elements such as local records centres, EIC, RAD and other appropriate sources of data.

Endorsed. It was noted that the procedure should include the collection, storage and dissemination of data. It was also noted that additional data sets should be considered when examining resources, for example, air and water pollution data and marine (coastal) surveys.

Recommendation 3: that a continuing body be established to oversee local records centres.

Endorsed with qualification. This body would be formed under the guidance of the commission (Recommendation 1) with the full agreement and with representation of statutory, voluntary and other appropriate organizations.

It was agreed that the co-ordinating body should administer the voluntary registration and accreditation of local centres and other sources of data rather than oversee them. Standards and transfer formats will be agreed by consensus.

Recommendation 4: that the co-ordinating commission seek funding from central governmental agencies for adequate software development and support, for the establishment of a coherent computer network and for providing trained personnel.

Endorsed. The co-ordinating commission would be asked to initiate a thorough review of biological recording resources in the UK, for example, to list local records centres, their data holdings, staffing and costs, and to assess the relevance of other data sources. The potential role of both RAD and the Museums Documentation Association in advising on a computer network and related problems was noted. It was also noted that NCC, RSNC and WWF have collaborated to develop and install the RECORDER recording package at a few selected records centres and county trusts. Funding should be sought from any relevant source and not solely from central government agencies.

Recommendation 5: that taxonomic training should be supervised initially by the co-ordinating commission, to foster improved competence in identification at the local level.

This recommendation was noted as a desirable aim, but somewhat outside the main theme of the meeting and discussion. BM(NH) said that the need for training in taxonomy and identification would be reported back to the Director BM(NH). The Linnean Society reported that an initiative on taxonomy was planned.

Recommendation 6: the standards for the operation of local records centres to be determined by the national interpretative unit.

This recommendation overlapped with Recommendation 3 and was regarded as a topic for consideration by the co-ordinating commission. It was noted that there must be interaction between data collectors, collators, and storers and data users to raise standards and to develop a mechanism for accreditation.

In his summing up, Dr Ronald Keay, President of the Institute of Biology, proposed that NERC should continue its close involvement in the topic by convening a small steering group to collate and formulate ideas and to form the nucleus of the co-ordinating commission proposed in Recommendation 1. In response, Dr Tinker agreed that a small steering group should be formed to draw up more detailed proposals based on the recommendations of the Linnean Society Working Party. Although NERC could not be ultimately responsible for the implementation of the recommendations endorsed by this meeting, it would act as convener until the co-ordinating commission had been formed.

The meeting agreed that the steering group should consist of representatives of NERC, DOE, NCC and NFBR and that it should report to the organizations represented at this meeting.

Biological recording steering group

The steering group met in May and June 1989 and plans to complete its work by the end of this year. It has discussed the scope of biological recording and the objectives and priorities of the co-ordinating commission. Criteria for representation on the commission have also been discussed.

Concluding remarks

Making and perfecting the prototype is always the most difficult and controversial phase of the production of a new machine. In Britain, we have potentially the largest and most sophisticated biological information-gathering 'machine' in the world. We have not had an original to copy and we have been faced with rapidly changing circumstances and priorities. The present phase of concerted effort towards national policies and a comprehensive overview began only in 1984. Since then, NFBR has been formed, the Rural Atlas Database and the ITE Environmental Information Centre have been set up and the Nature Conservancy Council has established its own internal computer network and the Coredata database. In the last 5 years we have made significant progress towards national policies (Fig. 1).

We (the biological recording practitioner) may still be a long distance from our particular Holy Grail, but we are now confident that we are not the only people who believe it exists!

Acknowledgements

I am pleased to acknowledge my personal thanks, and I am sure those of many others concerned with biological recording, to Sam Berry for his enthusiasm and energy in promoting the interests of biological recording during recent years. We needed a champion, a catalyst and an *eminence grise*; Sam has served as all three. I am also personally grateful to Charles Copp who provided much of the driving force in the formation of NFBR and the formulation of its thinking. He, and Claire Appleby, made several constructive comments on a draft of this paper.

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Annex 1

Joint NCC/NGO Data Handling Group

Membership (1989)

Chair: Nature Conservancy Council
Secretariat: Wildlife Link

Organizations represented:

Biological Records Centre
Botanical Society of the British Isles (Computer Users Group)
Conservation Association of Botanical Societies
Joint Committee for the conservation of British Insects
Linnean Society
Mammal Society
Marine Conservation Society
Museum Documentation Association
National Federation for Biological Recording
National Trust
Royal Society for Nature Conservation
Royal Society for the Protection of Birds
Wildfowl and Wetland Trust
World Wide Fund for Nature

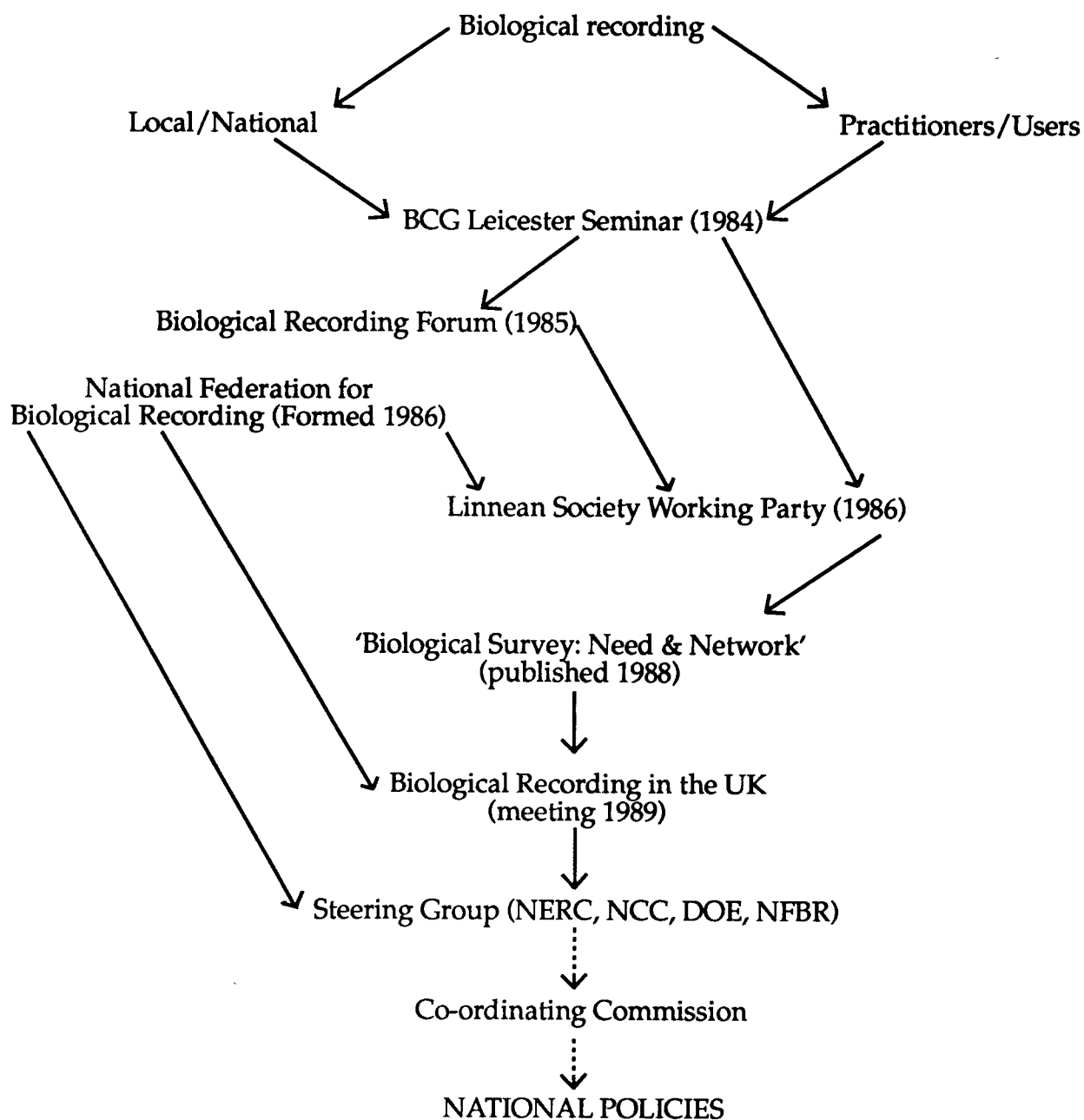
Annex 2

Biological Recording in the United Kingdom

Organizations represented at the meeting held at the Royal Society on Tuesday 21 February 1989.

Association of County Councils
Biological Recording in Scotland Campaign
Biological Resources Databank of Ireland
Biology Curators' Group
British Ecological Society
British Museum (Natural History)
British Trust for Ornithology
Countryside Commission
Department of Agriculture and Fisheries for Scotland
Department of Agriculture, Northern Ireland
Department of the Environment
Department of the Environment for Northern Ireland
Economic and Social Research Council (Rural Areas Database)
Forestry Commission
Institute of Biology
Linnean Society of London
London Ecology Unit
Ministry of Agriculture, Fisheries and Food
National Federation for Biological Recording
National Rivers Authority Advisory Committee
National Trust
Nature Conservancy Council
Natural Environment Research Council
Office of Arts and Libraries
Royal Society for Nature Conservation
Royal Society for the Protection of Birds
Scottish Development Department
Wildfowl and Wetland Trust
Working Panel of Local Authority Ecologists
World Conservation Monitoring Centre
World Wide Fund for Nature

BIOLOGICAL RECORDING: PROGRESS TOWARDS NATIONAL POLICIES



The Nature Conservancy Council's conservation resources database - COREDATA

Dr. Ian Baugh
Head of ITT Branch, Nature Conservancy Council,
Northminster House, Peterborough PE1 1UA

Introduction

Over the last 2 years the Nature Conservancy Council (NCC) has implemented the first phase of its computing strategy, which has involved the installation of a network of mini-computers in NCC's HQ offices and PC's in the Regional HQ office connected to the mini-computers by a computer network. The first phase has also involved the development and implementation of NCC's main scientific database - the CONservation RESources DATABASE (COREDATA).

The aim of this strategy and the development of COREDATA has been to store and process a large volume of information on NCC's statutory sites and to provide an information base for the whole of NCC. The strategy has aimed to improve the communications between NCC offices and to streamline the flow of data between the various offices. Figure 1 shows the computer network in diagrammatic form.

An important aim of NCC's computing strategy is to promote the development of compatible coding and classification systems to facilitate and encourage the exchange of data between organizations working in the field of nature conservation.

Coredata

In order to achieve the aims of storing data and providing improved access to data within NCC, the COREDATA system has been developed using a relational database ('Information' from Prime Ltd) and has been implemented as a distributed database. Thus the data for sites in Scotland are only held on the Scotland HQ mini-computer, similarly Welsh sites are held on the Wales HQ computer. The communications network between each Country HQ mini-computer allows data to be accessed from NCC's

HQ in Peterborough to provide GB statistics and summary data. Therefore data are not duplicated on several different mini-computers and offices and are held as close to the source of the data as possible.

COREDATA has been designed as a modular database to allow extra datasets to be added easily as the need arises. This structure allows access via a central index to a range of information held in several different files for complex enquiries, or directly to the relevant file. Figure 2 shows the structure and files contained in the COREDATA system.

The aim of COREDATA is to store information on both sites and subjects, hence it is not just a site-related database; many of the concepts used follow those adopted by Dr Stuart Ball's Invertebrate Site Register and latterly the Recorder package (see below). The COREDATA system can therefore store details on individual sites, eg areas, habitats, species, but can also store details on subjects, eg coverage of surveys, bibliographies, maps. The system allows questions to be asked such as "what do we know about this 10km square", or "what surveys have been carried out in this country". COREDATA stores not only basic data, but acts as an index to the availability and location of data within NCC, eg surveys, reports.

So far the Coredata system has been developed and implemented on NCC's network of mini-computers using the Prime Information database. The next phase will involve developing the Coredata system for direct use by NCC's regional staff using PC's capable of being linked to the mini-computers. This phase will involve rewriting certain parts of COREDATA in the Advanced Revelation database package to run on stand alone PC's. This phase is currently the subject of a detailed bid for resources to NCC's sponsoring department (DOE). If approval is gained, it is hoped to commence this next phase of development in 1990.

Coding Systems and Data Exchange

Through the agency of Wildlife Link NCC has worked with the NGO's to promote the development and use of compatible coding systems for habitats and species. With the further development of NCC's computer systems in regional offices, this will become increasingly important if NCC and NGO staff are to work closely together at a local level. NCC currently uses a standard habitat classification jointly agreed with RSNC, uses BRC species codes for plants and invertebrates and uses BTO codes for bird recording.

NCC has standardized on using IBM (AT) compatible PC's with the Advanced Revelation database package. NCC is able to read and supply data in a variety of formats and media types eg 5.25" and 3.25" floppy disks, magnetic tape, tape cartridges, and can handle MS-DOS, and CP/M operating systems.

Recorder Package

The Recorder package is a software package designed to handle species information for local record centres, it has been designed and developed by Dr Stuart Ball of NCC's Chief Scientist Directorate, using the Advanced Revelation database. In conjunction with RSNC, NCC has now appointed a contractor for an initial period of 2 years to develop this package further, to the point at which it can be made available to local record centres and NGO's with support and training being provided by NCC and RSNC.

It is hoped that the programme of installation and training will start in late summer 1989.

NCC COMPUTER HARDWARE AND COMMUNICATIONS

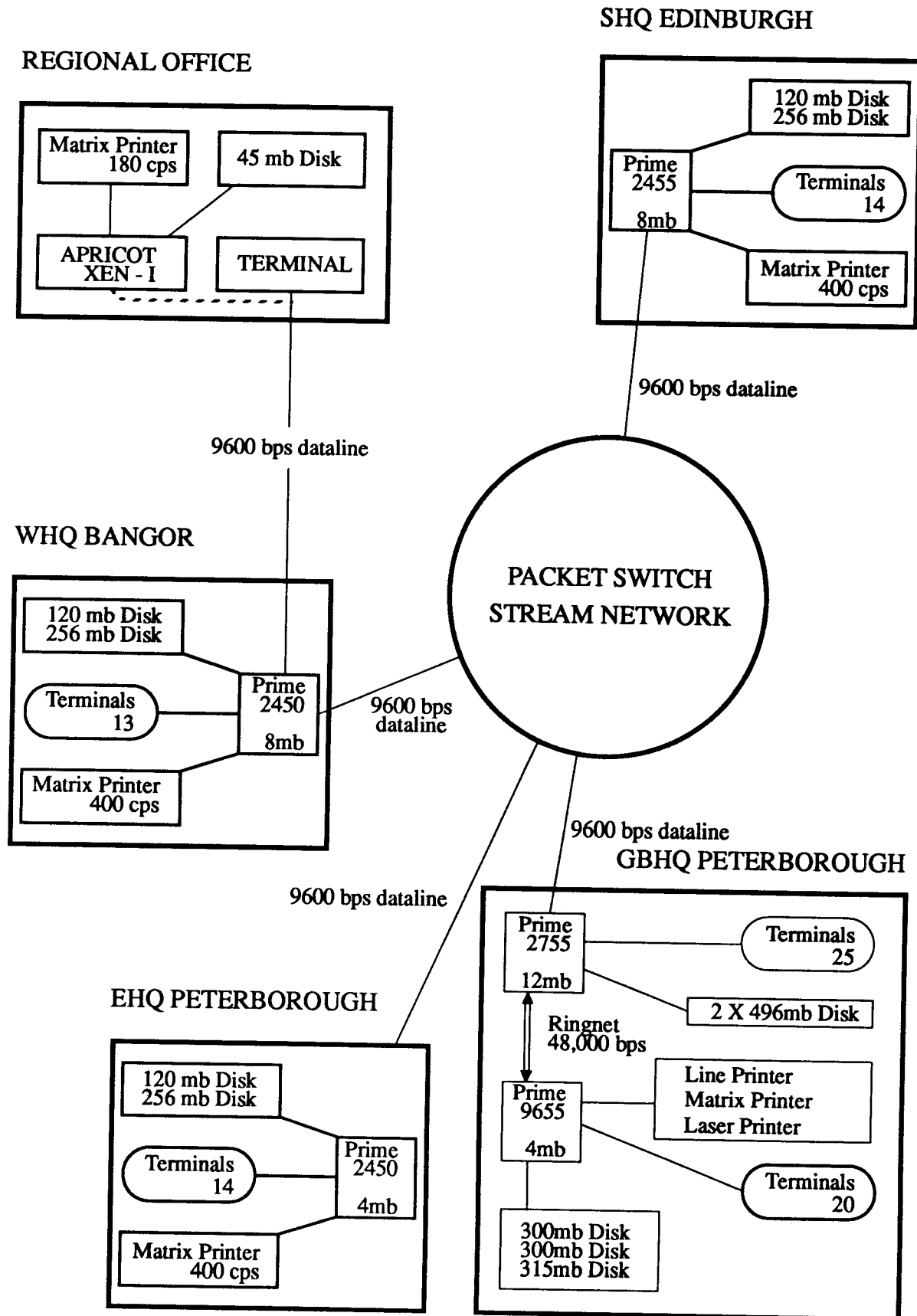


FIGURE 1.

COnseRvation REsource DATAbase

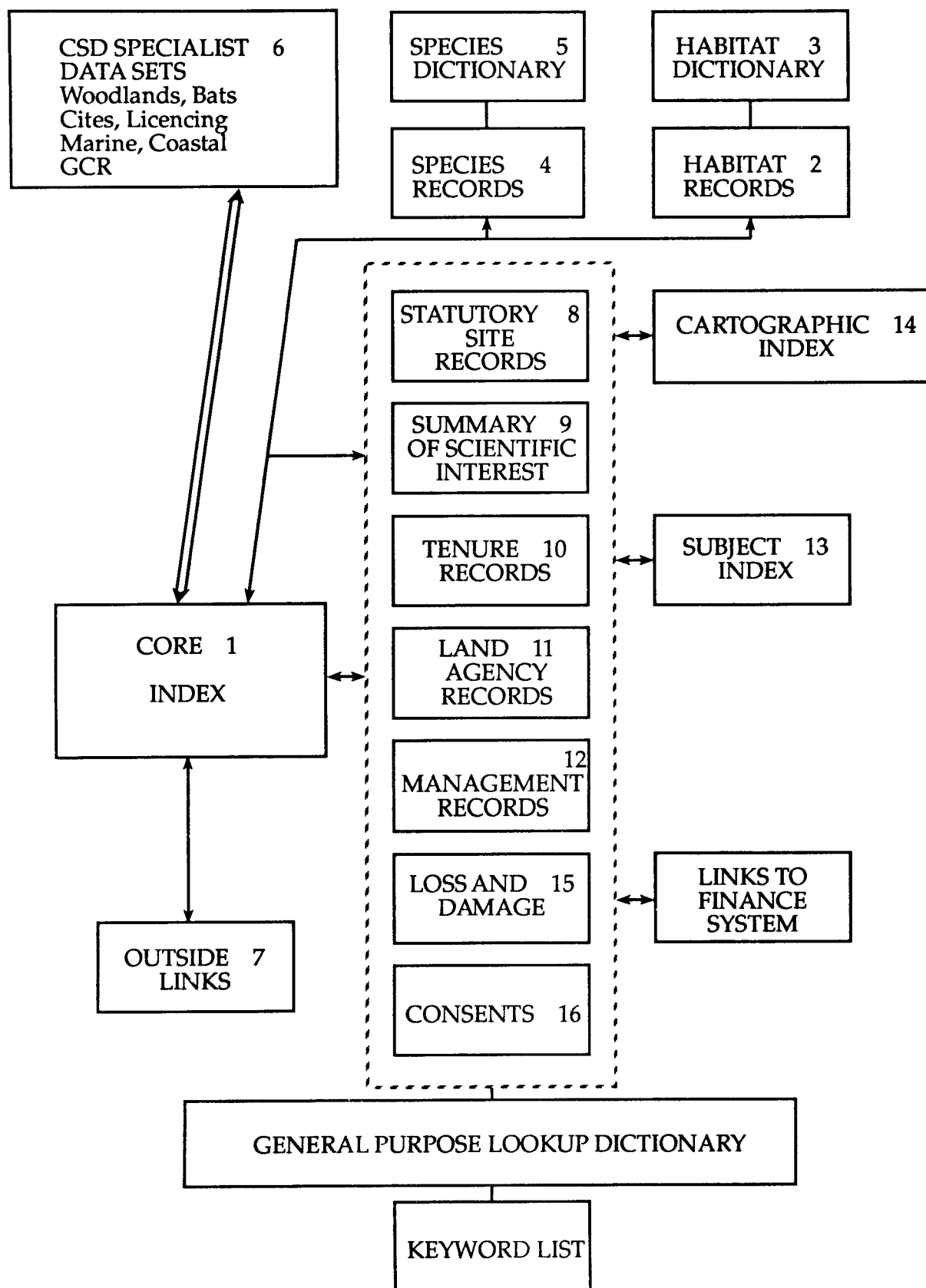


FIGURE 2.

The use of sites and species data in the County Trusts and the Royal Society for Nature Conservation

Bill Butcher

**Conservation Officer, Somerset Trust for Nature Conservation,
Fyne Court, Broomfield, Bridgewater, Somerset TA5 2EQ**

The county trusts have, in the last decade, accumulated a large quantity of information relating to the wildlife in their counties. Much of this information has been provided by local trust members and by surveyors employed under the now defunct Manpower Services Commission (MSC) Community Programme and co-ordinated by the trust's professional conservation staff. The 1980s have also seen a huge growth in demand, on the trusts, for wildlife data from many different quarters.

Sites and species data are used by the county trusts and the Royal Society for Nature Conservation (RSNC) in many different ways:

In the trusts:

1. Site safeguard/planning.
2. Liaison with landowners in advisory work.
3. Site evaluation for nature reserve acquisition.
4. Nature reserve recording and monitoring.
5. As a basis for environmental consultancy contracts.

In RSNC:

1. National enquiries relating to county trust nature reserves.
2. Promotion of the trust movement.

The trusts need mainly site-based information and are interested in all sites of county or local importance for nature conservation. Species distribution data is generally of secondary interest and is used only to put site-based species data into a wider context.

At the 1988 RSNC conservation conference, many conservation officers expressed dissatisfaction with the service provided by their local biological records centre. The main reason given for this dissatisfaction was the lack of site-based data, and the difficulties in extracting data where they did exist. There appears to be a wide gulf between the 'conservation recorders' and the 'distribution recorders' which needs to be bridged by discussion between all involved at the county level.

I should like to give two examples of actual cases from Somerset which have occurred within the last 12 months to illustrate the interaction of recording and conservation.

Case number 1.

The county trust receives an emergency call from a naturalist that a very important site is being destroyed by a bulldozer. It transpires that the site had over 150 species of higher plant, including a Red Data Book species, and a nationally rare invertebrate. At least 5 naturalists had been studying the site for many years, and one for over 20 years, and the species recorded had been entered in many distribution mapping schemes. The site was not an SSSI, but should have been. No-one had told the trust about it until it was being destroyed. No-one had told the landowner of the wildlife interest of his land. The site has now been seriously damaged and only saved from complete destruction with an enormous amount of difficulty and conservation effort.

Case number 2.

A government department approaches the county trust with a plan for emergency use of a disused quarry site. It has been told by locals that the site may have some interesting wildlife, and the department wishes to know whether the wildlife is important and whether its proposed use would damage the interest. It needs to know this by the following morning. Fortunately the site is in a part of the county already covered by the county Environmental Records Centre. The records centre has a site map, a description of the habitats present and species records collated from three different trust members and naturalists. The information includes a list of notable species and the status of those species within the county and nationally.

The trust, armed with a full site report from the records centre, meets a representative of the government department on site the same afternoon and advises that the proposed use will damage the wildlife interest. The following morning the department announces to the press that it is withdrawing from its proposed use of the quarry for wildlife reasons. It also expresses an interest in using the records centre to help locate a suitable quarry without significant wildlife interest.

What lesson can we draw from these cases?

1. Confrontation between conservationists and 'developers' can often be avoided by early consultation and the 'on-demand' availability of good, up-to-date, site-based records.
2. Naturalists have a key responsibility to supply their records centre with all of their records.
3. A strong case exists for much greater investment of resources in county environmental record centres.

How has the trust movement used computers for sites and species recording to date?

RSNC began developing a Site Recording Package in 1983 in liaison with Hatfield Polytechnic. The software was written in dBase II and used on Comart computers with the current CP/M operating system, almost state of the art technology at that time. Since then the hardware recommended by RSNC has moved through Wyse to the current IBM-compatible Opus computers. Examples of all three computers, together with various others can be found at trust offices.

The Site Recording Package has generally succeeded in terms of providing RSNC with reserves data from the county trusts for national use. However it has largely failed to provide trusts with a useful conservation tool at the county level. The reasons for this failure include:

1. Continuing problems with the software.
2. Possibly too ambitious a specification, which sought to cater for all conservation needs of all Trusts.
3. Slow development of site-based species recording.

These problems have forced the trust movement to investigate other packages, including "Recorder" developed in Advanced Revelation by Stuart Ball for the NFBR. The advantages and disadvantages of Recorder from the trusts' viewpoint can be listed:

The sophisticated handling of species records

Compatibility with NCC and those BRCs using Recorder.

Recorder requires relatively expensive hardware which few trusts are likely to be able to afford in the near future.

Recorder requires exclusive use of a computer.

Recorder is as yet untried in a county trust.

The current proposal is that joint Nature Conservancy Council (NCC)/Worldwide Fund for Nature (WWF) funding will support the development of Recorder in three trial trusts and at RSNC in a 12 month project starting very shortly, with a Project Officer based in the RSNC Computing Unit. The project will aim to develop Recorder for wider use in the county trusts and other non-governmental organizations.

Other options under investigation include a re-write of the Site Recording Package in dBase III/IV, and the use of BIORECS developed by Stephen Coker in Dyfed. The latter offers the attractive possibility of 'distributed data entry', whereby naturalists can undertake the bulk of the data entry on a home computer and feed records into a compatible records centre.

The next few years are likely to see:

1. The use of Recorder in some trusts, and other packages in other trusts, hopefully compatible with Recorder.
2. The far greater use of digital mapping and geographical information systems, enabling trusts to improve their presentation of data.
3. The development of the use of site-based data in county trusts in environmental consultancy work.
4. The growth of county environmental records centres, aimed primarily at conservation and planning uses and concentrating on habitat data and site-based records.
5. The development of closer cooperation between trusts and other organizations involved in biological recording.

The Rural Areas Database at the Economic and Social Research Council Data Archive

Marcia Taylor and Mandy Lane - ESRC Data Archive, University of Essex,
Wivenhoe Park, Colchester, Essex CO4 3SQ

The Rural Areas Database (RAD) was established in 1986 with the purpose of creating a central data resource for rural research and planning in the UK. The basis of the initiative was:

- i) The recognition that information about rural areas was scattered and unco-ordinated, with different organizations undertaking comparative studies, but using different definitions, classifications and spatial bases. There was little information about who was doing what, where and how, and much duplication of effort.
- ii) That the complexity of rural change demanded an inter-disciplinary information base - a facility for bringing together, cataloguing and integrating data from socio-economic, environmental and agricultural sources - to enable more effective research into the processes of rural change and provision of comprehensive information for forward planning.

The RAD is situated within the Economic and Social Research Council (ESRC) Data Archive, based at the University of Essex in Colchester. The initiative is sponsored by a consortium of organizations concerned with rural affairs and research, including the Department of the Environment (DOE), the Ministry of Agriculture (MAFF), the Nature Conservancy Council (NCC) and the ESRC, who have provided the Database with major national datasets. The RAD has well established links with other national bodies, for example the Natural Environment Research Council. In particular, valuable cooperation is continuing with the Institute of Terrestrial Ecology, who have provided some important national environmental datasets. Some examples of national databases held in RAD are :

Agricultural Census
Scottish Agricultural Census
Monitoring Landscape Change

Ministry of Agriculture Fisheries and Food
Dept. of Agriculture for Scotland
Dept. of Environment

Land Characteristics Database	NERC - Institute of Terrestrial Ecology
Land Classification data	NERC - Institute of Terrestrial Ecology
Biological Records data	NERC - Institute of Terrestrial Ecology
Breeding and Wintering Birds data	British Trust for Ornithology
Census of Woodlands	Forestry Commission
Forest Sub-compartment Database	Forestry Commission
SSSI Database	Nature Conservancy Council
National Countryside Monitoring Scheme data	Nature Conservancy Council
National Survey of Countryside Recreation	Countryside Commission
Upland Landscapes Survey	Countryside Commission
Country Parks and Natural Open Space Surveys	Countryside Commission for Scotland

Local organizations are also making valuable contributions, for example local authority habitat surveys and county naturalist trust data. The RAD aims to link these data into a national framework where possible along with major national databases.

The ESRC Data Archive

A database of the scale and complexity of the RAD requires significant supporting infrastructure and resources; provided by the Economic and Social Research Council Data Archive, a national, multi-disciplinary research facility with an established reputation both within the UK and internationally. It is the largest British repository of accessible computer-readable data from a variety of sources - academic, commercial and government bodies - and it currently holds over 3000 discrete datasets. The Archive has more than 20 years experience in handling large quantities of sources, and has particular expertise in the following principle areas of data resource management:-

1) Data "Brokerage" - The Archive acts as a mediator between data supplier and data user involving:

- i) Negotiations with data depositors for acquisition and access to data, especially government departments and public agencies.

ii) The administration of legal and contractual responsibilities relating to the deposit and use of data. The Archive does not own data deposited with it. Instead it has only a license to distribute data under conditions laid down by the depositor, and users are required to sign an undertaking which governs their use of the data. This system, of licensing by depositor and of access controls, has dealt successfully for many years with problems of confidentiality, sensitivity, ownership and copyright. The archive has generally been able to overcome reluctance to deposit data through its proven role as a responsible agency, having a system which is seen to acknowledge the data originator's role, and which provides for required terms and conditions of data access.

2) Data Handling, Archiving and Dissemination.

The Archive also accepts data for safekeeping on a range of different computer media and in different formats, but requests that the data is provided as an ASCII character file wherever possible so that it is not tied into any particular software package or hardware system. This data archiving service is provided free of charge, and includes data conversion, data validation and long-term protection of the data from media deterioration, fire and flood.

Data are checked for internal consistency and translated into an internal format for archiving. This use of standard format for all datasets renders the Archive's holdings in effect "immune" to technological changes in hardware and software among the user-community.

Data are distributed to users on media and in formats suitable for analysis by their own computer resources, using the suite of conversion software developed by the Archive. (The Archive often receives requests to convert data between particular tape and disk formats for users updating their computing equipment.) The JANET or PSS networks are also used for data transfer from suppliers and to users.

3) Documentation, Cataloguing, Indexing and Information Retrieval

i) The development and maintenance of documentation standards are clearly important, as data are only as useful as their documentation. Within the Archive, significant effort goes into ensuring that proper documentation accompanies the data and that the information is comprehensive and complete.

The Archive, as a national data co-ordination centre, is concerned with publicizing and promoting its data holdings through the production of catalogues and through running workshops to bring users together.

ii) The Archive maintains full descriptions of its data holdings through a comprehensive catalogue database, including detailed substantive, bibliographic, technical and administrative information about each dataset, which is available on-line to users over the JANET or PSS networks. Although there are no universal standards for describing and cataloguing machine-readable data, international agreements now exist between European archives and also organizations outside Europe for the use of common data protocols and study descriptions to enable data interchange. The system at the Archive has been deliberately developed to be open-ended and flexible so that it can be adapted and enhanced to cater for future requirements, and can easily be restructured into formats compatible with other organizations. The Archive has been a leader in the development of library cataloguing standards for machine-readable data and has developed software which converts its own catalogue records into standard library form.

Attached to each dataset description are up to 200 keywords which provide the link between the catalogue database and the indexing system. This is a thesaurus-based index which provides the mechanism for searching the catalogue of data holdings and uses a controlled vocabulary of terms with defined relationships. The index is continually being developed and has been able to cater for the particular requirements of environmental and also spatial data which form part of the Rural Areas Database. At any given time the index directly reflects the current data holdings of the Archive, and is flexible enough to adapt to the requirements of almost all data types, their classifications and relationships.

The Archive plays a key role in the dissemination of government-generated data for which it provides a specialized maintenance, research and information service. It now holds most of the major government surveys and has continuing arrangements for acquiring updates and new surveys as they become available. The Archive also holds data from overseas and has strong links with other computerized national Archives. Although traditionally socio-economic data have been the primary data resource, the Archive has expanded into other research areas, both actively and in response to user-demand. This relates particularly to the

management of environmental data, including biological records, through the Rural Areas Database initiative in 1986.

The Archive's core activities are diverse and by no means limited to archiving in terms of a passive data store. It has a far more active role as a national data co-ordination centre, as an information 'broker' between data suppliers and data users of all kinds, and as a "research support" facility through the manipulation and transformation of databases for secondary use. In addition, the Archive supports a number of research units and initiatives, of which the Rural Areas Database is one.

The Rural Areas Database and Data Integration

The resources provided by the Data Archive and the quantity and variety of important rural data now included within the Database provide the basis for one of the major aims of RAD, which is to integrate data from different environmental and socio-economic sources. The costs and time involved in new survey makes it important to make maximum use of existing data resources. The RAD is investigating ways of linking together the major national datasets to allow them to be analyzed in combination and so provide fuller information for planning and continuing research. Local surveys will be linked with national data and, where possible, will also be linked together to form a mosaic from which national pictures can be derived. At the same time, the RAD is trying to encourage standards and co-ordinated strategies for new surveys, where appropriate, in terms of definitions, classifications, methodology and spatial referencing in order to maximize comparability.

The geographic or spatial component of the data is of considerable importance in integrating data from different sources. Datasets relate to a wide variety of spatial units (wards, parishes, grid squares, postcodes) and spatial features (fields, roads, waterways), and are represented and arranged according to different models and structures. These differences are related to the particular application for which the survey was initiated, the constraints of the methods and techniques used, and also to different perceptions of the real world. Where spatial units or features are non-nesting and overlap, this presents immediate problems for data comparison and integration, over and above definition and classification problems. How, for example, do you relate MAFF Agricultural Census data available on a parish base to vegetation and habitat data on a grid-square base? How can classified satellite data be combined with field survey information and with air-photo information to gain more information about land-use and land-use change? As well as using

established administrative boundary networks, rural policy matters are frequently concerned with identifying area designations - placing irregular boundaries around areas of particular need or which merit special attention - for example, National Parks, SSSIs, and so on. The need to monitor and to assess the affects of changes and developments in these areas requires access to detailed information. Equally important is the ability to locate and identify areas of overlap or conflicting pressures. Meeting these types of requirement is a major strength of the RAD, through the creation of the Database and its associated software.

Geographical Information Systems (GIS) are a central, component of the RAD's computing resources, providing the necessary spatial manipulation and database management capabilities for integrating data from different bases and performing spatial analyses. At present, "Arc/Info", one of the more well-known GISs, provides for many of the RAD's requirements in combination with a range of other specialized software. There are plans to enhance these GIS facilities in the near future, with particular regard to raster data and image-processing.

The RAD is compiling a collection of digital boundary and topographic datasets in addition to its substantive holdings, for example digital co-ordinate information defining the boundary of Rural Development Areas, parishes, National Parks, Areas of Outstanding Natural Beauty, etc., as well as defining linear features such as rivers and roadways. These datasets are catalogued within the Archive's Information Retrieval System and linked through the spatial index to associated datasets. Users can use this system to extract datasets on the basis of spatial unit (for example, "find all datasets concerned with land-use which relate to 10 km grid-squares"). An associated gazetteer system is under development which relates spatial units to one-another (for example "which 1km grid squares lie within which National Park or Environmentally Sensitive Area?"), used internally by the RAD as a useful "look-up" facility in conjunction with associated GIS software, but also providing an important spatial data facility for users without access to sophisticated GIS resources.

Rural Areas Database Services

The Rural Areas Database has two principle roles: i) a central data resource for rural data in the UK, and ii) a research and analysis unit, with particular emphasis on the integration of socio-economic and environmental data relating to rural areas.

Some 1000 rural datasets have so far been identified, and agreement has been obtained for their incorporation within the Database. More that 400

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of these have now been "deposited", and reside with the RAD as part of the ESRC Data Archive's holdings. The RAD publishes a catalogue containing extensive information about each dataset, for example: purpose of study (free text abstract), main variables studied, spatial indices, principle investigator, ownership and copyright information, access levels and quality indicators. This information is also in computer-readable form, accessible over the PSS or JANET network through using the Data Archive's information retrieval system. Datasets can be obtained from the RAD, subject to access conditions, on a wide variety of data media (including floppy disk, network access, hard copy) and in a wide variety of formats to suit the user's own computing environment.

The RAD attempts to obtain data at as fine a spatial resolution as possible, in order to maintain flexibility for aggregating or approximating to different spatial units which allow comparison with other data. Where datasets are sensitive or include confidential information at fine levels of resolution, arrangements can be made through the licence agreement to release the data to potential users only at a specified, coarse resolution.

The Rural Areas Database offers a wide range of research and analytical services ranging from simple subsetting, tabulation and mapping tasks to larger scale research programmes involving rural data and the use of Geographic Information System techniques. Some examples of the types of work which the RAD provide are:

- i) The generation of "data profiles" - user-specified collections of datasets and subsets relating to particular spatial units, for example land use, species and habitat data in combination with population, housing and employment data, on a grid square base. Some of the data making up these profiles will be derived, using digital overlay techniques, from their original spatial units, and therefore represent approximations. The RAD is careful to ensure that users have full information about methods of derivation of such data so that correct interpretation can be made.
- ii) Spatial searching and modelling to locate land areas affected by, for example industrial development, and to analyze the likely affects of such development on protected or designated sites. This, in combination with the generation of data profiles, is particularly relevant to environmental assessment, for planning and conservation authorities and also for developers with respect to recent EC directives

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The Rural Areas Database continues to grow both in terms of the number and range of datasets it holds, and in terms of its analytical capabilities, particularly relating to spatial data. As a national data co-ordination centre, the ESRC Data Archive provides the ideal form for the integration of data from a range of different sources, having well established protocols and resources for data access, data deposit, data manipulation, cataloguing, indexing, legal issues, and the many other areas of large-scale data resource management. Analysis of rural change now requires access to a wide spectrum of information from socio-economic and environmental sources. The Archive and the RAD together provide an important opportunity for centralized data access and integrated analyses of all types of data relating to rural areas and rural issues in the UK.

Birds - an overview of survey and monitoring work in Britain

Dr M W Pienkowski

**Head of Ornithology, Nature Conservancy Council, Northminster House, Peterborough
PE1 1UA**

Introduction

Britain is fortunate in having a large number of skilled amateur ornithologists - but the popular interest in birds also leads to a high public expectation that bird information should be available and presented in most conservation cases. One of our challenges is to use this resource of volunteers to enable effective conservation of a range of wildlife interest, not just limited to birds; some examples will be given later in this paper.

In undertaking the biological recording work for birds that underlies these needs, the Nature Conservancy Council (NCC) usually works in partnership with various independent societies. The largest segment of such work is done with the British Trust for Ornithology (BTO). This society is notable in being devoted solely to research, involving over 90% of its 8000 members in active field-work. Comparable work on waterfowl involve the Wildfowl Trust, recently renamed the Wildfowl and Wetlands Trust (WWT). This trust has a variety of roles, including research, such as the National Wildfowl Counts, but active surveyors are a small proportion of the membership. The Royal Society for the Protection of Birds (RSPB), the largest national voluntary conservation body, generally does not organize membership-based surveys, but has a strong research department and, like NCC, undertakes research by employing scientists or commissioning others, including the bodies mentioned above.

There are also several specialist groups for particular birds which can provide a concentrated level of expertise. For example, the Seabird Colony Register, is a joint project between the Seabird Group (which provides the volunteer surveyors) and NCC (which employs a co-ordinator and gives some support for the expenses of surveyors in difficult areas). These specialist groups often have a wider geographical base which is essential in assessing the context of British populations, both in terms of overall population sizes and in analysing networks essential to maintain migratory populations. There have been several such collaborative ventures between NCC and, for example, the Wader Study Group (WSG) and the Greenland White-fronted Goose Study (GWGS).

This paper reviews the sort of biological recording schemes undertaken for birds from the viewpoint of someone whose task is to make available the information required for conservation purposes. The information needed by NCC and other conservation bodies can be divided into several, overlapping subject areas. One such classification is outlined below, and will be used to structure the paper.

Site identification and safeguard

Context: national, international and networks

Wider countryside: marine and terrestrial

Monitoring: species, sites and countryside

Habitat management and impacts

Target setting

Present and future developments

In the remainder of this paper, I shall indicate how techniques of biological recording of birds contribute to these subject areas.

Site identification and safeguard

Site-safeguard measures provide one aspect of the legislative basis of wildlife conservation in Britain. Such measures provide particularly for the protection of a range of semi-natural biotopes and for species which occur in concentrations. Sound distributional and quantitative data are the basis both of identification of these sites and of rational discussion on the impact of proposed developments. Two of the most frequently used surveys in the latter context relate to wetlands - reflecting the severe level of threats to these habitats. The surveys concerned are the WWT/NCC National Wildfowl Counts and the BTO/NCC/RSPB Birds of Estuaries Enquiry. More details of these can be found in Owen et al. (1986) and Prater (1981), respectively, and in the annual summaries (eg Salmon et al 1988) produced under contract to NCC.

Both surveys, which are repeated annually provide a monitoring function, which is also important in site-safeguard. Surveys repeated less frequently also help in monitoring. "Operation Seafarer" surveyed

seabird colonies in 1969-70 and the Seabird Group/NCC Seabird Colony Register organized surveys in 1986-88, as well as collating information gathered in the interim. The results will be published as a book (Lloyd, Tasker & Partridge 1990). For example cormorants Phalacrocorax carbo have increased along most coasts of Britain and Ireland, but decreased in western and northern Scotland. As the latter areas are those of major developments in marine fish-farming in this period, it seems likely that these features are linked.

Systematic surveys of less concentrated bird localities are inevitably more difficult. The BTO/NCC Register of Ornithological Sites in 1973-77, which resulted also in the book "Bird Habitats in Britain" (Fuller 1982), was a major development in this area. Sites were selected by observers, leading to benefits from local knowledge, but some disadvantages in the subjective nature of selection (which could be addressed at the analysis stage). In the BTO/NCC/RSPB survey of Breeding Waders of Wet Meadows in England and Wales in 1982, coverage was arranged for all remaining fragments of this greatly reduced habitat. The result was striking in demonstrating that breeding waders had become even more restricted by drainage activities than had been expected. For example, 48% of snipe Gallinago gallinago recorded and 36% of redshank Tringa totanus were on only 5 sites (Smith 1983).

It is important to be able to identify which survey needs can be met by volunteer effort and which require an alternative approach. The latter may involve areas remote from high densities of people (including bird-watchers) and an information need to be met rapidly or at short notice. One such case is the surveys required of birds of moorland areas, currently subject to major, rapid, large-scale developments, most notably afforestation with dense plantations of exotic conifers. NCC staff operate the Moorland Bird Study (MBS) which undertakes surveys of sample sites in moorland habitats. By relating bird usage to landscape features, results can be used to assess bird populations over the wider area from which the sample sites were drawn. This approach was used by NCC to detail the outstanding importance of the peatlands of Caithness and Sutherland (Stroud et al 1987). NCC are developing the principle further by the use of satellite-imagery to extend the field survey results (Belward et al 1989, Harding & Stroud in press).

In other situations, a combination of employed surveyors and volunteers can meet the needs. A good example concerns surveys in the crofts and farmlands of the Scottish islands, where information was needed urgently to advise on safeguarding wildlife in the Agricultural Development Programmes for the islands. In the Western Isles, WSG volunteers and

NCC staff surveyed the breeding waders (Fuller et al. 1986) and a joint NCC/RSPB study investigated the needs of corncrakes Crex crex. In Shetland, NCC's MBS surveyed the moorland areas (Rothwell et al. 1989) while joint RSPB/NCC surveys covered the lower areas on both Shetland and Orkney (Campbell et al 1988a,b). NCC brought together a consortium to survey various aspects of the wildlife of Tiree and Coll (Stroud 1989), and conducted detailed studies on bird and land-type relationships on Islay (Bignal et al. 1988).

Context: national, international and networks

Many of the areas indicated above are of international importance. Birds lie at the centre of some of the international agreements, which can be very useful aids to effective conservation. The role of birds in supporting international conservation measures follows from public interest in them, the information available from ornithology's army of volunteers, and the migratory nature of most bird species. The two main measures concerned with birds are the "Ramsar" Convention on Wetlands of International Importance Especially as Waterfowl Habitat, and EEC Directive 79/409 on the Conservation of Wild Birds. Both have site-designation measures ("Ramsar" sites and EC Special Protection Areas) as well as requirements for conservation in the wider countryside. To implement these measures, government requires a great deal of factual information, both on the importance of sites and their context.

At a national level, in addition to the national surveys of wintering waterfowl and breeding seabirds already mentioned, the BTO's Atlases of breeding and wintering birds (Sharrock 1976, Lack 1986) are the stalwarts for this work. A new breeding bird atlas survey, partly funded by both NCC and CEGB, is currently in progress.

An international context for wintering waterfowl is provided by the counts co-ordinated by the International Waterfowl and Wetlands Research Bureau (IWRB). International contexts for more dispersed populations are very difficult. A recent major development concerned breeding waders in Europe. Especially with the major changes in land-use which were destroying the habitat of moorland breeding waders, and others which might influence those of low-intensity farmland, it was important to establish the international context. NCC and the Netherlands conservation authority supported a collation by the voluntary efforts of WSG to estimate breeding populations of waders in Europe (Piersma 1986).

The networks of areas required by migratory species are another international context which needs description. These areas have been identified by observations and ringing studies for those species whose populations remain separate at all times, most notably several geese. For example, the three populations of brent geese Branta bernicla wintering in western Europe use different areas and well over half the world population of the Svalbard-breeding population depends on Lindisfarne NNR at some times. Different populations of barnacle and white-fronted geese similarly remain separate in winter, and substantial proportions of both depend on restricted areas of Islay (eg Owen et al.1986, Bignal et al. 1988).

For species whose breeding populations overlap at other times of year, including many ducks and waders, the networks of sites used require much disentangling. Co-ordinated studies commissioned by NCC and the Commission of the European Communities were undertaken by WSG and Durham University to investigate the complex network of movements of waders in the non-breeding season in western Europe. The studies depended on systematic marking and observing by a large number of people.

Wider countryside: marine and terrestrial

Whilst site-safeguard is an essential component of conservation measures, many species - particularly large and mobile ones such as birds - require conservation measures over the countryside as a whole. Indeed, it is this wider countryside which most people experience and wish to maintain. Information on the distribution of birds and their relationships to other features is required for the wider countryside as much as on sites. The various changes in agriculture, as a result of production surpluses, provide opportunities for building conservation measures into new countryside policies. However, to do so requires sound information on the distributions of, in this case, birds and the relations of these to habitat and land-use. We are undertaking such work based on the information gathered by the sort of wide-scale survey outlined above.

One of the major developments in the last year was to make use of these extensive bird data-sets to contribute to land-use planning over extensive areas in relation to afforestation. Regional Councils in Scotland are developing forest planting strategies to give locational guidance to the Forestry Commission and private forest companies. These strategies consider the balance between forestry and other land-uses, such as agriculture, tourism and nature conservation. During the latter part of

1988, NCC scientists were asked to comment on proposals from Strathclyde Region, and at the end of the year, also to contribute to the strategies for Borders and Grampian. The assessment of the conservation interest in the wider countryside was developed by Dr Colin Galbraith, of NCC's Ornithology Branch, and based on the distributions and abundances of an assemblage of "indicator" bird species of conservation importance, assessed on a 10km grid. This information, collated with the help of many local ornithologists and clubs, was then presented to the Regional Council in a summary form with 10km squares being allocated to high, medium or low conservation value. Because of this detailed information, Strathclyde Region felt able to change the classification of about 13% of the Region's area to take further account of conservation interest. Bird distribution was used as the basis of the assessment since the large number of volunteers in this subject area, co-ordinated by NCC's Ornithology Branch and voluntary societies, makes this data-set sufficiently comprehensive on the necessary wide scale. Birds are also an appropriate basis because of the need for such wider countryside measures to implement UK's commitments under EC Directive 79/409 on the Conservation of Wild Birds. The methodology developed by Ornithology Branch for NCC's scientific response in this case is being further developed for use in the other Regional Forest Strategies being produced at present. Data on other interests is being incorporated as it becomes available.

The importance of our wider marine environment is sometimes overlooked. However, the need to survey this vast area became apparent with the development of the oil industry and the need to take account of natural interest in planning surveys. Use of volunteer effort to survey seabirds at sea is impracticable, and full-time staff are required. The current phase of NCC's Seabirds at Sea programme aims to determine which areas of Britain's waters are particularly important for seabirds and how these vary during the year, with particular reference to the seas west of Britain. This programme is of special relevance to the oil industry and Government Departments concerned with mitigating the impacts of oil spills. NCC has brought together a consortium with three Government Departments (Transport, Energy and Environment (Northern Ireland)) and five oil/gas companies (British Petroleum, Esso, Shell, Chevron and British Gas) to undertake this work. NCC could not afford to fund this necessarily expensive work from within its normal budget. In addition, the research receives much help in kind from ferry operators, other marine research organizations and the Royal Navy. The results of the previous phase of the project, concerning the North Sea, were published in 1987 (Tasker et al 1987). To make available to those responsible for managing the oil industry the results of this project and those of related

commissioned work on coasts, a special publication mapping vulnerable concentrations of birds for each month of the year was also produced for the North Sea (Tasker & Pienkowski 1987).

Monitoring: species, sites and countryside

Under both domestic and international legislation, NCC has a duty to monitor changes in our wildlife resource. As noted also in the following contribution to this conference, birds are among the most appropriate organisms on which to base a wildlife monitoring scheme. This is because of their positions at the top of food-chains, their observability, the popular interest, and the network of observers to provide the results in a very cost-effective way. NCC has worked with the BTO and other bodies for many years to build up this network.

The monitoring roles of the WWT/NCC National Wildfowl Counts and the BTO/NCC/RSPB Birds of Estuaries Enquiry have already been mentioned. In view of the changing nature of the countryside and the threats posed by agrochemicals, in the early 1960s, the Nature Conservancy asked BTO to start a Common Birds Census (CBC) in farmland and woodland. This has now produced an index of population changes over many years. A book on population trends, as revealed by CBC, will appear later this year (Marchant 1989).

In addition to the monitoring of population density, measures of performance (breeding and survival rates, etc) are important in order to give early warnings of problems, to analyse the population dynamics, and to give some clue as to areas to investigate for causes. Within NCC's contract with BTO are several studies related to this need, including the Nest Record Scheme and the National Bird Ringing Scheme. Work is in progress to draw these together into an integrated programme, with rapid automated analysis to give early warning of potential problems.

Work on the wider marine environment is also important. Like land-bird monitoring, this is required both because of the international importance of Britain's bird populations and also because these animals provide one of the few practicable means of monitoring the condition of the wider environment; the availability of skilled volunteers is also an important element here. Over the last 3 years, NCC (partly by contract to the Institute of Terrestrial Ecology (ITE)) has been reviewing and streamlining its long-running programmes of seabird monitoring, and developing ways of integrating population and performance measures, as noted above for land-birds. A programme of monitoring at several key

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sites around the country is now being implemented, by work in partnership with Fair Isle Bird Observatory, Highland Ringing Group, ITE, and Oxford University. Work by other volunteers is also being encouraged, and RSPB is continuing its complementary work on the monitoring of terns.

The importance of NCC's seabird monitoring programme was highlighted this year when continued breeding failure of some seabirds in Shetland led to alarm in several quarters. The programme was able to show that problems for seabirds were more widespread than just Shetland, but not so pronounced elsewhere. The already low nesting success of kittiwakes Rissa tridactyla in Shetland in 1987 compared with other areas, and the larger further fall in 1989. These data, in turn, help to point to possible causes, and our studies were able to provide light and remove heat from discussions between the fishing industry and conservationists.

Habitat management and impacts

Although many of the extensive biological recording schemes for birds were designed primarily as survey or monitoring projects, the potential of many for examining habitat requirements soon became apparent. For example, the BTO/NCC CBC has resulted in a major book on farming and birds (O'Connor & Shrubbs 1986), with several further studies and guidance on habitat management in progress. The woodlands CBC has provided the raw material for a great deal of work on habitat relationships. NCC will shortly be publishing the first of a series of habitat management booklets based on this work; the first two will deal with coppice management (Fuller & Warren 1989), and rides and glades (Warren & Fuller 1989).

Similarly, the results from the BTO/NCC/RSPB Birds of Estuaries Enquiry can be analysed in relation to habitat. It was such an analysis by Goss-Custard & Moser (1988) which demonstrated the relationship between the decline in the numbers of wintering Dunlins Calidris alpina and the loss of feeding habitat due to spread of Spartina over mud-flats. This was the first demonstrated relationship, at a national scale, between habitat loss and a decline in wintering wader populations on estuaries.

On a more local scale, the systematic recording of birds can also be used in examining habitat relationships, especially if effort is quantified, for example simply by recording the route followed. This approach was used in our detailed study of land-types and bird habitats on Islay (Bignal, et al 1988). Recording cards were provided with a simple map of Islay,

marking 1 km National Grid squares, which were the basic recording unit. This provides a remarkably effective means both of assessing the areas on which wide-ranging species depend and of analysing the relationships with habitat-types and land-use practices, thereby providing a sound basis for conservation measures.

Target setting

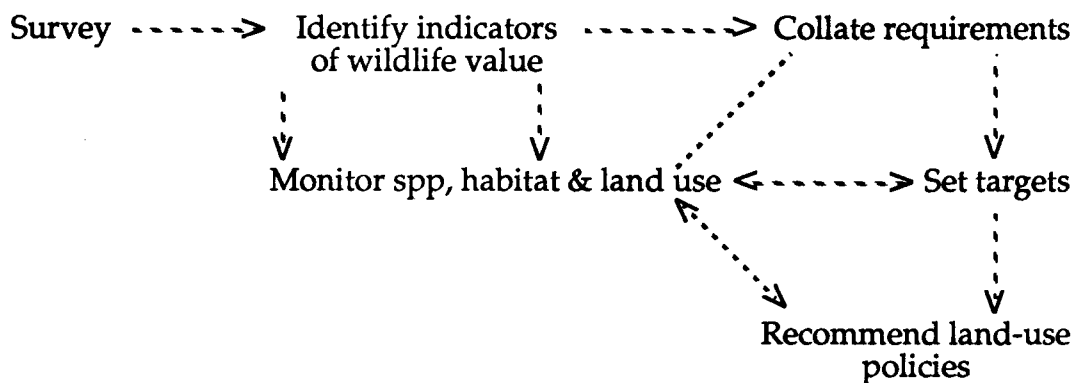
If one combines the monitoring of wildlife with the information on relationships with habitats and the land-use practices which influence those habitats, one can move towards a position of setting positive targets for conservation in the countryside and monitoring how well those are achieved. One such scheme, towards which we are moving, is outlined below.

There are several inter-related needs, some of which can exploit different aspects of the results of single projects, as noted above.

These needs are:

1. Resource survey (both to assess the overall resource and to identify areas for site-survey / put sites in context).
2. Assess requirements of wildlife.
3. Set targets for conservation.
4. Monitor change in the wider countryside.

The needs can be linked as follows:



NCC is developing work in these areas, in collaboration with several of the other organizations mentioned earlier. NCC is keen to work with others to take advantage of opportunities for enhancing our wildlife resource.

Future developments

Rather than summarise the content of this presentation, some of the major present and future developments as they relate to biological recording projects for birds will be highlighted.

1. There is a great deal of scope for systematic data-gathering for projects in fairly small areas, such as that developed for Islay. Provided that projects are well planned from the start, with clear objectives, they can provide urgently needed information very cost-effectively.
2. The concept of regional conservation strategies is being further developed. The first manifestation of these has been as input into Scottish Regional Council forestry strategies, but this was by virtue of using, as it arose, a partnership opportunity to provide a means of implementation of a part of our more comprehensive regional conservation strategies already in development.
3. Further integration of population and performance monitoring for birds will be a major development area, as has been indicated. It is planned to move progressively to increasingly automated and rapid analyses which will provide not just national measures but also appropriate regional or habitat-based ones. "Alert limits" will be progressively developed, to allow signalling of when performance measures fall outside their normal range of fluctuations.
4. Building on all the foregoing, inter-related modelling of bird and other wildlife interest with land-types and countryside policies are being developed, allowing target-setting and monitoring of the achievement of these.

All these activities depend on the continued participation of large numbers of skilled, volunteer ornithologists and other naturalists, which has proved so effective.

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Key indicators for British wildlife: Stage 1.

Terence J.Crawford, * Robin Toy and Michael B.Usher

Department of Biology, University of York, York YO1 5DD, UK

* Current address: Shell Research Ltd., Sittingbourne Research Centre,
Sittingbourne, Kent ME9 8AG, UK

Introduction

The Department of the Environment (DoE) is currently funding research into 'Key Indicators for British Wildlife'. The aim is to select, and subsequently to publish regularly, series of national statistics and indicators that will reflect the status of the British flora and fauna and their habitats. The research is divided into two stages. The broad objective of Stage 1 is to identify data which could immediately provide a national series of wildlife statistics. The aim of Stage 2 is to assess the utility of available data, and to identify any extra data needed to fill gaps, with a view to developing indices and other indicators. This paper deals specifically with Stage 1 of the research (see also Crawford *et al.*, 1989)

Potentially useful data identified during Stage 1 had to be examined in relation to the following eight considerations.

- (a) The data should be currently collected, and readily available from existing sources, without significant additional expense.
- (b) The data may need to be split from a national series into sub-sets for England, Wales and Scotland.
- (c) The data should cover a wide range of taxonomic groups, e.g. plants, molluscs, insects, arachnids, fish, amphibians, reptiles, birds and mammals.
- (d) The data should include species falling into the International Union for the Conservation of Nature and Natural Resources (IUCN) categories of endangered, vulnerable and rare.
- (e) The possible costs or constraints (e.g. confidentiality) affecting the use of data in DoE publications.

(f) The availability of a past run of data, that could provide information on trends and fluctuations against which current and future data could be assessed, would increase the value of the dataset.

(g) The prospects for future continuation of data collection.

(h) The data should be accurate, not prone to misinterpretation, and acceptable as independent and authoritative to a wide spectrum of opinion and potential users.

On this basis, datasets fall into a continuum of usefulness, ranging from those that are currently available and require a minimum of further analysis or collation to those which are at present unsuitable because there are gaps to be filled and collation and/or further analysis is required. In this paper attention will be concentrated on the datasets with the most immediate potential.

Data acquisition

Information was sought from as many relevant public and voluntary sector organizations and individuals as possible. Initial contact was by letter which requested brief answers to six questions. The aim was to establish which organizations might collect or hold data of interest to the project; it was important to avoid burdening irrelevant organizations with a lot of detailed questions. The letter was sent to some 270 organizations or individuals and achieved a response rate of 72%.

Early responses indicated the need for clear definitions of different types of activities. The following definitions were adopted and stated explicitly in further communications so that respondents had guidelines within which to frame their answers.

Monitoring is the collection of data during repeated visits to the same site(s), where the intention of the visits is to identify changes in the quality or quantity of the habitat, or in the status of particular species or groups of species.

Surveying is the collection of data as a one-off undertaking, where the intention is to identify the wildlife interest in a particular area.

Recording is the collection of data on a more ad hoc basis where there is no preconceived intention. Data in this category include one-off, casual observations of a species.

It should be noted that some organizations distinguish between monitoring, where a comparison is made against a known standard and surveillance, where there is no standard; monitoring, in the above definition, therefore includes both activities.

Further lines of enquiry depended on the type of response to the initial letter and on other knowledge of organizations' activities. In twenty-two cases the range of activities was so extensive or complicated that personal fact-finding visits to relevant individuals in the organizations were arranged. In some other cases the replies to the initial letter were sufficiently detailed that any further information required could be obtained by a personal letter or telephone conversation. For the majority of organizations, however, additional details were collected through a questionnaire survey. The three main sections of the questionnaire dealt separately with monitoring, surveying and recording, with the first two sections being sub-divided into habitat-orientated and species-orientated activities. The response rate to the questionnaire was about 60% at the end of stage 1, with returns still being received four months later.

Data presentation

It was decided to concentrate on monitoring and surveying activities; recording was unlikely to produce data relevant to Stage 1 of the project except when periodically collated into co-ordinated recording schemes. The available information was abstracted into a tabular format with entries arranged by taxonomic groups or habitat types. Only one entry was made where a co-ordinating organization received data from a number of sources. The tables, an Appendix in Crawford et al. (1989), contain the following information.

- (a) Habitat type, taxonomic group, species name or title of a recognized scheme, as appropriate.
- (b) Period during which baseline data were collected.
- (c) The frequency with which subsequent observations have been or will be made, and if relevant, the date on which observations were discontinued.

(d) Geographical coverage, including the approximate location of the study (region, county or city) and the numbers and types of sites (e.g. nature reserves, SSSIs) involved.

(e) For habitat entries, the methods used in determining the area of the habitat and the quality or composition of the habitat. For taxonomic entries, the methods used in determining species presence or abundance. For both types of entry a distinction was made, where possible, between qualitative and quantitative approaches.

(f) Data availability, including costs of data provision and limitations to access arising from confidentiality or restrictions in manpower.

(g) The organization from which the information was obtained, which was usually but not always the organization that did the work.

Extra information or qualifying details accompany the tables as notes. This was usually only necessary for the large schemes; the tabular format was satisfactory for 94% of the 832 entries. The distribution of entries between habitat types or taxonomic groups is shown in Table 1.

Results

Range of habitat data

General vegetation (Phase 1) surveys are unlikely to be repeated because of their cost, but they have identified specific sites of value to wildlife which are now monitored. There are, however, three schemes which may allow monitoring on the larger scale. The Land Classification Scheme of the Institute of Terrestrial Ecology (ITE) estimated, on a national scale, changes in land-use and land-cover between 1978 and 1984. In England and Wales, the Monitoring Landscape Change project of the DoE and Countryside Commission used aerial photography to identify changes in land-cover between the 1940s, 1969-72 and 1979-81. The National Countryside Monitoring Scheme of the Nature Conservancy Council is concerned with changes in the area of land-features, but it has yet to achieve national coverage and the time between repeated observations is approximately 30 years.

On the local scale, the specific habitats receiving most monitoring attention using quantitative methods are broad-leaved woodland, calcareous grassland, neutral grassland, dry heathland and saltmarsh. In addition, at least five monitoring programmes have been discovered for each of acidic grassland, sand dunes, mixed or unspecified woodland, open standing water and open running water.

Monitoring of marine habitats is more limited, although some sub-littoral programmes have been initiated by the NCC and, in the littoral zone, rocky shores attract some attention.

Range of species data

Plants: a number of species of vascular plants are monitored locally, usually on an annual basis. Orchids, in particular, are the subject of many monitoring programmes. The status of more than 300 species of plants falling within IUCN categories of endangered, vulnerable and rare is reassessed periodically for the compilation of successive editions of the Red Data Book (Perring and Farrell, 1977, 1983). In particular, 62 species are currently included in Schedule 8 of the Wildlife and Countryside Act (1981) and the NCC has a statutory obligation to review their status on a quinquennial basis. In the marine environment, monthly recording of plankton has been conducted since 1958 in the North Sea and north-eastern Atlantic by the Institute of Marine Environmental Research (Plymouth Marine Laboratory).

Invertebrates: amongst terrestrial invertebrates, Lepidoptera (butterflies and moths) are the target of most monitoring activities. National schemes are co-ordinated by the Rothamsted Insect Survey for moths and by the ITE Butterfly Monitoring Scheme. In addition, there are undoubtedly many monitoring activities that are not currently utilized because of the lack of co-ordination. Odonata (dragonflies and damselflies) also receive significant attention.

Because freshwater invertebrates are good indicator species for water quality there is a wealth of monitoring information available from Water Authorities (England and Wales) and the River Purification Boards (Scotland). Most monitoring of marine invertebrates has concerned those living in the littoral zone, but many of these schemes have recently terminated.

Vertebrates: birds have been the subject of detailed monitoring for many years. The nationally co-ordinated schemes of the British Trust for

Ornithology (BTO), the Royal Society for the Protection of Birds (RSPB), the Wildfowl and Wetland Trust (WWT) and the Rare Breeding Birds Panel (RBBP), together with current moves to co-ordinate monitoring of seabirds, cover between them most of the British avifauna. The monitoring of mammals has a shorter history and is less intensive; the best data are for squirrels, red deer, otters and sea mammals. Marine fish are intensively monitored, but in the context of fisheries management rather than wildlife assessment. Extensive data for freshwater fish are collected by the Water Authorities, the River Purification Boards, the Institute for Freshwater Ecology and the Department of Agriculture and Fisheries for Scotland. The extent of monitoring for amphibians and reptiles remains unclear, but a current survey of all British amphibian species should lead to a nationally co-ordinated monitoring scheme.

Suitability of data

Data are very variable in quality and quantity. Those with most immediate potential for inclusion in a series of wildlife statistics come from programmes that are nationally co-ordinated with regularly published results. Other data suffer, to varying degrees, from lack of co-ordination, collation or analysis, or by having gaps in geographical coverage. Many datasets do, however, have potential if additional resources were to become available (see Table 2). Those in the upper part of Table 2 are briefly described below; fuller discussion of all of the datasets is given in Crawford *et al.* (1989).

Data suitable for immediate use

Seven of the datasets in Table 2 are currently available, are collected annually, and can be used immediately with little additional analysis. The other three datasets that are currently available are collected with a periodicity of up to 10 years.

The annual reports of the NCC give information on the number and area of sites of SSSI status, and also on the number of SSSIs damaged to varying degrees of severity during the preceding year. It would be more valuable if the area of land that had been damaged, and the habitats affected, were included so that some indication could be given of the habitats most prone to damage.

The ITE Land Classification Scheme divides Great Britain into land-classes using information from Ordnance Survey maps, etc. Field visits to a

sample of sites in each land-class are then used to estimate land-use, land-cover and vegetation composition. The surveys were conducted in 1978 and assessments of land-use and land-cover were repeated in 1984. The changes over this six-year period are documented in Barr *et al.* (1986). The ITE intend to undertake further reassessments in 1990.

The Red Data Books for plants (Perring and Farrell, 1977, 1983) categorize species endangered, vulnerable or rare according to the IUCN definitions, and assign each species a Threat Number within the range 1 to 15 (maximum threat). The Threat Number incorporates data on species' contraction in 10km square records, the number of localities (effectively 1km square records), its attractiveness, the proportion of sites with conservation status, as well as the remoteness and accessibility of those sites. Because the raw data used to compile the Threat Numbers are presented in tables, comparison between successive editions of the Red Data Books can be used to analyse the change in status of threatened species over time (care is required, however, to avoid confusing change in our knowledge with true change in status). A third edition is planned for 1993 (L. Farrell, pers. comm.)

The Butterfly Monitoring Scheme is co-ordinated by the ITE. Weekly traverses along fixed routes are undertaken at about 80 sites between 1 April and 29 September and sightings of individuals of each species are recorded. Annual changes in relative abundance are reflected in indices for each species calculated by a method similar to that pioneered by the Common Birds Census. The total scores from all sites which were surveyed in both of two successive years are used to provide a ratio by which the earlier year's index is multiplied to yield the next year's index. The baseline year was 1976, with an index value of 100, and subsequent index values are summarized in Pollard *et al.* (1986). The majority of sites co-ordinated by the scheme are on nature reserves, but the methodology is being used more widely, often on sites not primarily managed for wildlife.

The Rothamsted Insect Survey, that has operated for over 20 years, co-ordinates a national network of light-traps, between 70 and 80 in recent years. The annual total counts of 31 moth species of agricultural importance are summarized for each trap in the annual Rothamsted Reports. Although indices are not produced, it would not be difficult to do so along the lines of the Butterfly Monitoring Scheme.

The following BTO schemes (with their years of inception) generate annual indices for species of birds: the Common Bird Census (1962) covers 60 species of farmland and/or woodland habitats; the Birds of Estuaries Enquiry (1970) covers species of waders and wildfowl; the Waterways

Bird Survey (1974) covers 18 riparian species; and the Constant Effort Site Scheme (1981) monitors passerines by mist-netting and ringing, and compiles indices for 23 species. Each scheme has selected a 'typical' year to which a baseline index of 100 is assigned. In addition, annual national wildfowl counts have been organized by the WWT since 1947; the results for 1960 to 1983 are reviewed in Owen *et al.* (1986). These counts also generate indices which are published by the WWT in its annual report, together with those of the BTO Birds of Estuaries Enquiry; indices from the other BTO schemes are published annually in BTO News. The RSPB compiles data, submitted via County Bird Recorders, on the breeding success of rare birds, i.e. non-feral species with fewer than 300 breeding pairs. The number of sites and estimates of breeding success for each species have been published annually since 1973 in British Birds.

The Forestry Commission (FC) has monitored the presence or absence in its forests of red and grey squirrels (Sciurus vulgaris and S. carolinensis) since 1961. Annual 10 km square distribution maps are published for each species and indicate, for all squares containing FC land, squirrel distribution during the previous year.

A national survey for signs of otters (Lutra lutra) was conducted from 1977 to 1979 by Exeter University and the NCC in England, by the NCC and the Royal Society for Nature Conservation (RSNC) in Wales and by the Vincent Wildlife Trust (VWT) in Scotland. The survey was repeated from 1984 to 1986 by the NCC in England and by the VWT in Wales and Scotland. Reports on the second surveys in Wales and Scotland have been published by the VWT (Andrews and Crawford, 1986; Green and Green, 1987) and contain detailed statistical comparisons with the results of the first surveys. Further surveys may be undertaken in the 1990s.

Possible future data

Three further schemes were identified that could, if they become established, yield suitable data. Dragonflies and damselflies (Odonata) are the subjects of a number of unco-ordinated local monitoring schemes. However, the Biological Records Centre is organizing a Key Sites Project which may lead to a nationally co-ordinated monitoring programme. A national distribution survey of Amphibia co-ordinated by Dr R. Oldham (Leicester Polytechnic) and funded by NCC, is nearly complete. It is hoped that this will generate a series of sites that would be suitable for annual monitoring. A national survey of badgers (Meles meles) was co-ordinated by Dr S. Harris (University of Bristol) during 1982 to 1985. It is hoped that the survey will be repeated in the late 1990s.

Discussion

Although a wide variety of organizations was approached it was accepted that the seven month time-scale of Stage 1 would not allow complete searching for all relevant datasets. As an exercise to assess the thoroughness of coverage, details of the distribution of general vegetation classification surveys (Phase 1 surveys) obtained during this project were compared with the NCC's record of such surveys. Of the 34 counties, or similarly-sized administrative areas, with Phase 1 surveys known to the NCC, this project had independently ascertained 29. This would suggest that a success rate of about 85% for wildlife monitoring at the county or regional levels.

Some information on penetration at the more local level emerged from an exercise designed to estimate the time required to extract details of monitoring activities on those National Nature Reserves (NNRs) that had used Event Record Cards. This exercise involved Castle Hill NNR as a case-study. All animal monitoring was reported to co-ordinators of national programmes (e.g. butterfly monitoring). Of the five plant species subject to annual monitoring only one, the early spider orchid (Ophrys sphegodes), had already been discovered from another source.

A particular problem in determining wildlife monitoring at the local level is that the headquarters or parent body of an organization is sometimes unable to provide details of the activities of its constituent parts. For example, the authors are personally aware of bee orchid (Ophrys apifera) monitoring on a nature reserve managed by a County Trust, but not reported by the headquarters of that Trust. This problem is probably most acute for NNRs and reserves of the RSPB and County Trusts. Once the NCC's computer-based Project Recording Scheme (which is also being adopted by the RSPB, the National Trust and some County Trusts and other organizations) is fully operational, it will be very easy to obtain information on monitoring activities at sites covered by the scheme. Another method by which further information on specific taxonomic groups could be obtained would be through publicity in a journal such as Natural World, the membership magazine of the RSNC, which penetrates to lower levels within County Trusts.

Even allowing for some incompleteness at the local level, the quantity of information obtained during stage 1 should provide a representative picture of monitoring activities. The orchids, in particular, have emerged as a taxonomic group subject to many monitoring programmes that are unco-ordinated. The problems associated with introducing co-ordination,

and the resources required to achieve this should not, however, be underestimated. Moves towards more standard methodologies to facilitate data collation would conflict with local desires to maintain comparability with long runs of past data. In addition it would need to be clearly apparent that the perceived benefits to be gained from national co-ordination outweighed the costs. In this context it is worth noting, for example, that the majority of orchid monitoring occurs in southern England and is largely confined to sites managed for wildlife conservation. If national monitoring of the wildlife resource in the wider countryside, as well as that of nature reserves, were thought to be a priority, orchids would be a poor choice of a group to monitor. Resources might be better directed towards expanding already established national schemes, for example the butterfly and moth schemes, since these species will reflect the status of a group of commoner plant species on which their juvenile stages feed.

One criterion that has been used to classify datasets is whether results are collated annually or with longer periodicity. For taxa with short life-cycles, annual reassessments are desirable. For longer-lived species, such as trees, many mammals and birds, longer intervals are more acceptable. but it must be remembered that long-lived species can suffer from acute declines, particularly as a result of epidemic diseases, for example Dutch elm disease (*Ceratocystis ulmi*) and the recent viral disease of seals, or from deterioration of food resources, for example accumulation of pesticide residues in food-chains. For longer-lived species, regular monitoring of breeding performance together with less regular monitoring of abundance may be a good strategy.

In general, habitat monitoring can be repeated less frequently than species monitoring, and landscape monitoring even less frequently than that of habitats. Accepting these practical limitations it is desirable that an annual series of wildlife statistics should be supplemented by others based on, for example, quinquennial, decennial, or even longer-term reassessments, where appropriate.

Some issues of a more technical nature have emerged during the project. Delays between data collection and data publication vary between organizations and could make it difficult to produce, concurrently, indices relating to a common time-period. Biological recording is still plagued by the diversity of computer hardware and software adopted by different organizations in their un-co-ordinated moves to become computerized during the last decade. Steps are being taken to alleviate this problem. A third issue about which concern has often been expressed is that of the shrinking pool of taxonomic expertise in British universities and museums. For accurate wildlife assessments it is absolutely essential that plants and animals be assigned correctly to their species. It is perceived

that there is now a tendency to regard taxonomy as a Cinderella science in contrast to the more glamorous areas of biological endeavour, such as biotechnology. Unless this trend is halted, it will become increasingly difficult to monitor in detail the responses of our wildlife resources at a time of potentially intense attrition. For example, the patterns of climatic shifts that are being suggested as possible during the next few decades would require communities of plants and animals to respond within an evolutionary time-scale which is without precedent.

Conclusions

Much effort is devoted to the monitoring, surveying and recording of British Wildlife, often as a voluntary activity. The co-ordination of this effort, and the collation and analysis of results are, however, time-consuming and expensive. A series of wildlife statistics that could be started now, without significant extra resources, would be restricted to birds, mammals (otters and squirrels), some insects (butterflies and moths), rare plants, damage to SSSIs and changes in land-use; Odonata, Amphibia and badgers might be added to the series in the future. Relatively modest extra resources could lead to the inclusion of marine species, greater coverage of birds and some mammals, and more frequent mapping of selected taxa. Major extra resources would be required to include freshwater species, to increase further the coverage of mammals and invertebrates, or to co-ordinate detailed monitoring of specific habitat types or plant taxa (e.g. orchids).

Acknowledgements

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Table 1 The distribution of entries between habitat types or taxonomic groups in the Appendix of Crawford *et al.* (1989)

Habitat type	Number of entries	Taxonomic group	Number of entries
General vegetation	84	Lichens	7
Acidic grassland	13	Algae	4
Broadleaf woodland	36	Bryophytes	3
Cliffs	4	Pteridophytes	3
Sand dunes	16	Orchidaceae	28
Arable	3	Other vascular plants	47
Fen and swamp	11	Marine algae and plankton	15
Unspecified grassland	11	Non-marine invertebrates (general)	33
Shingle	7	Butterflies	29
Coniferous woodland	14	Odonata	7
Churchyards	1	Other specific non-marine invertebrate taxa	36
Parkland and scattered trees	6	Marine molluscs	9
Calcareous grassland	31	Other specific marine invertebrate taxa	10
Mixed or unspecified woodland	15	Fauna of particular marine habitats	11
Mountain vegetation and moorland	13	Marine fish	12
Neutral grassland	19	Freshwater fish	26
Bog	5	Reptiles and amphibia	11
Open standing water and ponds	20	Birds	80
Quarry, abandoned colliery and open rock	5	Mammals	43
Open running water, rivers and streams	18	Game species	2
Saltmarsh	14		
Wet heath	4		
Urban environments	3		
Roadside vegetation	2		
Waterside vegetation	7		
Hedgerow	10		
Dry heath	15		
Other specific habitats	3		
Marine habitats	23		
Total	413	Total	419

Table 2. Datasets which are potentially useful for inclusion in a national series of wildlife statistics

Category	Habitats and land features	Plant and animal species
Available now	SSSI damage (NCC) Land-use classification (ITE)	Red Data Book plant species (RSNC,NCC) Butterflies (ITE) Some moths (Rothamsted) Common birds (BTO) Wildfowl (WT) Rare birds (RSPB) Red and grey squirrels (FC) Otters (VWT,RSNC,NCC)
Will become available	—	Odonata (BRC) Amphibia Badgers (NCC)
Substantial analysis required	—	Plant phenological record (BNA) Plant distribution maps (BRC,BSBI) Marine plankton (IMER) Invertebrate distribution maps (BRC) Further moths and other insectorders (Rothamsted) Marine fish (MAFF,DAFS) Seabirds (RSPB,NCC,ITE, SOTEAG) Nesting birds (BTO) Game and vermin (GCT) Mammal distribution (FC)
Substantial collation and analysis required	Freshwater communities (IFE)	Marine fish and shellfish (Sea Fishery Committees) Freshwater fauna (Water Authorities) Bats (ITE,NCC)

Gap-filling,
collation
and/or
analysis
required

National Countryside
Monitoring Scheme
Monitoring of
Landscape Change
Project (DoE, CC)
Specific habitats

Orchids
Freshwater plankton and
fauna (IFE)
Arable land invertebrates
(GCT)
Partridges (GCT)
Small mammals
Red deer (RDC)

Biological records, development and the planning process

Dr Richard Tapper - Corporate Environment Unit, Central Electricity Generating Board, Courtenay House, 18 Warwick Lane, London EC4P 4EB

Introduction

Biological records of all types are valuable in planning developments and in preparing environmental assessments for such plans. This is particularly true for large industries, but the recent implementation of legislation on environmental assessments means that biological records will have an increasing role in the planning of future developments. The demand for records that are comprehensive and up-to-date will grow for records at all levels of resolution, and for all types of coverage, from national to local surveys. This demand needs to be matched by setting up new ways of accessing and presenting accumulated knowledge on all types of organisms and their distributions.

Why is biological information required?

The Central Electricity Generating Board's (CEGB) requirement for biological information arises from the obligations placed on it by Section 37 of the Electricity Act, 1957. This Section states that:

In formulating or considering any proposals relating to the functions of the Generating Board or of any of the Area Boards..., the Board in question..., having regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest, and of protecting buildings and other objects of architectural or historical interest, shall each take into account any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, buildings or objects.

The Section 37 requirement is comprehensive, but not very detailed. As part of its interpretation of the environmental obligations under Section 37, the CEGB undertakes detailed investigations into the flora and fauna which may potentially be affected by the operations of the electricity

supply industries. A provision similar to Section 37 is being incorporated into Schedule 9 of the proposed legislation that deals with the privatisation of the industry. The original wording of Section 37 grew out of earlier legislation covering developments of hydro-electric power stations in North Wales. Thus the antecedents of CEEB's approach to the treatment of environmental matters, and biological and wildlife considerations, go back a long way.

Environmental Assessments and new development

The CEEB has made a commitment to carry out environmental assessments for all new major projects. The CEEB, like other industries, also complies with the EC Directive on Environmental Assessment (No. 85/337) which came into force in the UK in July 1988 under The Town and Country Planning (Regulation of Environmental Effects) Regulations 1988, and which are described in the Department of the Environment's Circular on Environmental Assessment (Circular 15/88).

The Environmental Assessment legislation requires that environmental assessments shall be carried out for all power station developments in excess of 300 megawatt thermal capacity, and for any developments of whatever type or size, which may have potentially significant environmental impacts. Almost all generation developments will therefore require environmental assessments. Environmental assessments may also be required for major transmission line projects, under Schedule 2 of the Regulations and under The Electricity and Pipelines (Assessment of Environmental Effects) Regulations 1989, and for any major developments which may potentially affect any nearby SSSIs or similarly designated sites. By placing statutory requirements for environmental assessment of many major developments across all areas of industry and business, the legislation that came into effect during July 1988 is likely to lead to a greater demand from developers for biological records and related information.

An environmental statement identifies and describes the significant effects that the construction and operation of a proposed development would have on the environment. The topics included in an environmental statement summarize the results of environmental assessments undertaken on various aspects of a proposed development. These topics are selected following discussions with local authorities and other statutory bodies to ensure that none of importance are omitted from investigation. Once it has been completed, copies of an environmental statement, and its supporting reference documents, are submitted to the

appropriate planning authorities, accompanying the consent application for a proposed development. The environmental statement and its supporting documents are also available to members of the public to inform them of matters in which they may be interested or about which they may be concerned.

Biological information is required in planning, and undertaking environmental assessments for all new power station developments and major modifications to existing sites, such as the construction of new flue gas desulphurisation plant at Drax Power Station to reduce emissions of sulphur dioxide.

Some countries, such as France and the United States of America, have required environmental statements, for certain major projects, for more than a decade, but the requirement for such statements in most member countries of the Organisation for Economic Cooperation and Development is more recent. Consequently, details of the scope, structure and presentation of such statements may vary between countries and different types of development project, and all preparation of environmental statements is still being developed in response to the early experience of both developers and users of environmental statements.

The environmental statements produced by the CEGB begin with an introduction and project description which describe the CEGB and its system, the statutory background, the need for new generating capacity, the site, the plant and its operation, and construction activities.

The part of the environmental statement which deals with environmental analysis covers land use and quality, geology, topography and soils, river physiography, air quality, water quality, terrestrial ecology, aquatic ecology, landscape and architecture, solid products, noise (and vibration), and socio-economic effects. Biological records are particularly relevant in the assessment studies that are concerned with terrestrial and aquatic ecology, and with land use.

Each main section of the environmental analysis is backed up by detailed reports, of which the chapters in the environmental statement provide a summary. In planning new development, the CEGB commissions a whole range of studies which deal with all aspects of site suitability, from engineering to environmental aspects. The assessment studies are based on site-specific surveys which collect new data on any site proposed for development and its immediate surroundings which might potentially be affected by a proposed development. Information from these surveys is collated with any existing information on a site from previous surveys, and, in the case of some CEGB sites, with records of birds and other

species that may have been collected in the past by associated field centres or bird clubs. By beginning assessment studies at an early stage in the planning process, their initial findings feed through into key design phases, enabling projects to be planned from the outset to minimise their environmental impacts.

Planning new developments

Figure 1 illustrates the main areas that the CEGB has considered when planning to develop new power stations. The planning process includes consideration of environmental constraints, and of engineering requirements, as well as liaison with local authorities, regulatory bodies and other groups. The earlier that biological and environmental information is put into the planning process, the more possibilities there are to design projects that minimise any potential environmental effects of development.

Biological records consist of information about identification, biology and ecology of plant and animal species. Comprehensive biological records are built up by collating the observations which have been collected by individual recorders and ecologists. Information about the distributions of species that results is often represented in maps at different scales of resolution and of different types. Other recorded information is incorporated into summaries of the taxonomy and ecology of species and species assemblages.

In planning new developments, the CEGB uses biological records and information relating to all major groups. The main groups of organisms that have been examined to date are vertebrates, higher plants, invertebrates and lichens. For example, the ecological reports prepared for the Environmental Statement for the proposed West Burton 'B' Power Station included information on the national distribution of great crested newts, a protected species that was found on the site proposed for development, along with similar detail for many other species.

The other information that is important for the CEGB concerns land designations for conservation or landscape value, particularly Sites of Special Scientific Interest, National Nature Reserves, sites of county importance, National Parks, Areas of Outstanding Natural Beauty, Green Belt and Environmentally Sensitive Areas. Information about the areas covered by such designations is an important input to siting new developments, and in planning the management of sites that lie near to, or within, such designated land areas. A computer database and geographical information system that covers these areas is being

established within the CEEB.

Information is required at all scales of resolution by the CEEB.

Geographically, information is needed at a national level to enable local records to be placed in a national context. When preparing for developments it is also necessary to look at data at regional and county level, since this often provides more detailed resolution than the 10 km grid squares of national recording schemes. In addition, site-based surveys and records are needed to provide up-to-date information about each site to be developed, which necessitates the commissioning of detailed site surveys.

Using biological records in environmental assessment

At the outset of assessment studies, past local and regional records can be useful in considering the scope and design of site surveys and related studies. Once these studies have been completed, biological records, at regional and national levels, enable site-based findings to be evaluated within a proper overall context. For example, the conservation importance of particular habitats associated with any site may be considered in relation to criteria of size, diversity, naturalness, rarity, fragility, typicalness, recorded history, contiguity of sites, potential value, and intrinsic appeal which are used in such considerations.

For such evaluation to be possible, it is necessary that biological records should be as complete and as accurate and up-to-date as possible. The assessment of plant ecology for the proposed West Burton 'B' Power Station illustrates the range of biological information that is utilised during environmental assessments. In this assessment, the Atlas of the British Flora was used as a source of information about plant distributions at a national level; taxonomic information was obtained from the Flora of the British Isles; the Nature Conservation Review prepared by the Nature Conservancy Council provided information about habitats and plant communities, supplemented by local information from an earlier survey of the Trent Valley; and detailed ecological information was extracted from published studies of ancient woodlands, grasslands, and wetland and riparian plants. Published information on methods used for assessing the conservation value of habitats as a whole, and for carrying out specific site-surveys, was also used in the planning and evaluation of the studies on plant ecology. The environmental statement itself consolidates work that has been carried out by various groups to provide a full environmental and ecological survey of the site, and which in this case, includes detailed surveys of higher plants, lichens, and ornithology.

The users of biological records

There are many users of biological records. They include local authorities, various government departments, some statutory bodies, voluntary groups concerned with conservation and the environment, researchers, and the various industrial sectors. Industrial users range from the large primary industries, of which the CEGB is one example, through to the service industries, and perhaps increasingly in the future, small local businesses. Already there are examples in this country where local concerns about the distribution of rare moths and butterflies have had significant influences on the siting of new supermarkets and on the determination of planning permission.

Because users vary so widely in their activities, their requirements may be very different. Table 1 lists some of the areas where users vary in their requirements for biological records and information on environmental matters. In the commercial sector, companies dealing with small scale developments may only need local data. Companies which have a large number of scattered sites, or where individual site developments might potentially have a major impact on the biological environment, need to be able to place local and regional data in a wider, national, context.

Another way in which users vary, is in how fast they need the information that they require. Companies which are regularly involved in major projects know that biological information will be needed about flora and fauna in all, or almost all, of their projects, and, therefore, may take a long-term view of their operations, allocating resources towards maintaining staff to monitor company developments and the need for biological records, and making links with those groups that are able to provide appropriate data. On the other hand, there are occasions when endangered species, protected by law, are found on a site at a late stage in the planning of a development, and the developer needs to become acquainted with biological records very quickly.

Users may also vary in the points in the progression from initial planning, to seeking consent, to eventual implementation of a development project at which they start to consider their need for biological information, and in how they will be able to use such information in the planning of projects.

The providers of biological records

As a developer using biological records, the CEGB has the following requirements for:

- i) a comprehensive data bank with national coverage,
- ii) a data bank that includes the most up-to-date information,
- iii) information about past changes as well as point-in-time data, and ready accessibility.

It is worth mentioning that other users may have different priorities, and or the BBC's Domesday Project, by way of contrast, these included data processing to the special formats requested by that project, and rights to publish the information that was supplied.

Whatever the requirements of different users of biological records, it is important that the providers of those records are keeping up with new research and techniques in biological recording and analysis, and are also in a financially-sound position to be able to apply new ideas that are relevant to their work and the needs of users. It is important that adequate facilities to access and use biological records should be available, and also that there should be sufficient expertise available with the providers for the regular collection and analysis of biological records.

In addition to their expertise, data providers offer valuable services in retrieving data from their archives of biological records, and particularly in converting data into different forms of presentation that may be requested by users, which may be special data formats, or aggregations of data to various spatial units, or statistical summaries that are required for specific purposes. The real value of providers of biological and environmental records lies in their ability to process and analyse records to provide answers to specific questions, and in their skills in handling and interpreting complex data.

Consider for a moment the presentation of data in map form. The data that have been used to construct the map may have been collected at different levels of spatial resolution, and by a variety of sampling methods. As a result, different sets of information, presented at the same scales of aggregation and geographical units, may not be suitable for comparison in some cases. The processing of data into various mappable forms may frequently involve interpolation, particularly where the mappable forms use different aggregations or geographical units from

those employed for the original data collection. The assumptions that lie behind the transformation of data into forms to make it compatible, in numerical terms, with other datasets are complex, and this is an area where the knowledge and advice of data providers is essential. Processing of this type is an important part of data analysis and presentation, and in using such methods it is necessary to understand the hidden assumptions that are introduced by such methods of data handling, as well as any constraints inherent within the original data. For example, the Annual Census of Agriculture is collected on a parish basis, but the parish only refers to the parish in which a farmstead is situated. If a farm has land in another parish, then the land is aggregated into the same parish as the farmstead. So some parishes end up with more land allocated to them than their land surface areas. Furthermore, the agricultural census is often presented as a set of grid square aggregations computed from the original parish data, by a process which introduces assumptions about land capability to prevent cattle from appearing to graze large bodies of water, or crops from seeming to grow on tracts of moorland.

In dealing with biological records, developers require the expert knowledge of the data providers in three areas. The first area concerns the ecological and environmental aspects of particular datasets, including details of how, why and when the data were collected, and ways in which seasonal or regional variations in the organisms to which the data refer, have been accounted for. Secondly, advice and knowledge is required about statistical aspects of biological survey data, limitations on the interpretation of any single dataset, or combined sets of data. In certain complex uses of data, this includes advice on the 'ecological fallacy' that can result in spurious correlations when the aggregated distribution of two or more organisms with similar ranges across sampling units, but with uncorrelated, or negatively correlated distributions within any single sampling unit, are compared.

The third requirement from record providers is the ability to interpret new concepts in terms of old data. This ability is important where the definitions of biological taxa undergo changes, while a geological example is provided by maps of the geology of Britain, which are based on information first gathered over a century ago, and which is still available for reinterpretation in the light of new geological concepts.

Conclusion

To conclude this paper, the CEEB and its successors, as organizations which undertake major new industrial developments, recognize the value

of biological records, in enabling them to plan development proposals to limit the potential effects they may have on the environment, and in discharging the various responsibilities that are placed on them by legislation at national and international levels. They maintain staff to undertake or supervise environmental assessments for all major projects, and utilize biological records and information particularly in assessments of terrestrial and aquatic ecology.

The CEEGB and its successors also recognize that there are some areas where the base of biological records needs to be improved, and as a demonstration of their commitment to the importance of such records, they are providing support for various recording projects. Currently the British Trust for Ornithology is being funded to set up field recording and data analysis for an updated Atlas of Breeding Birds of Britain and Ireland to be published in the early 1990s. Funds are also being provided to support work on the Atlas of British Lichens, and at a more local level, for a survey of common butterflies in the Avon region. Various other projects that involve an element of recording have also received support through the CEEGB's programme of sponsorship with the World Wide Fund for Nature.

Biological records provide an important complement to the site surveys that the CEEGB and its successors carry out in advance of any major developments, and will continue to remain so in the future.

Acknowledgements

This paper was prepared in the Corporate Environment Unit and is published by permission of the Central Electricity Generating Board.

FIGURE 1.

THE MAJOR AREAS CONSIDERED IN PLANNING NEW POWER STATIONS

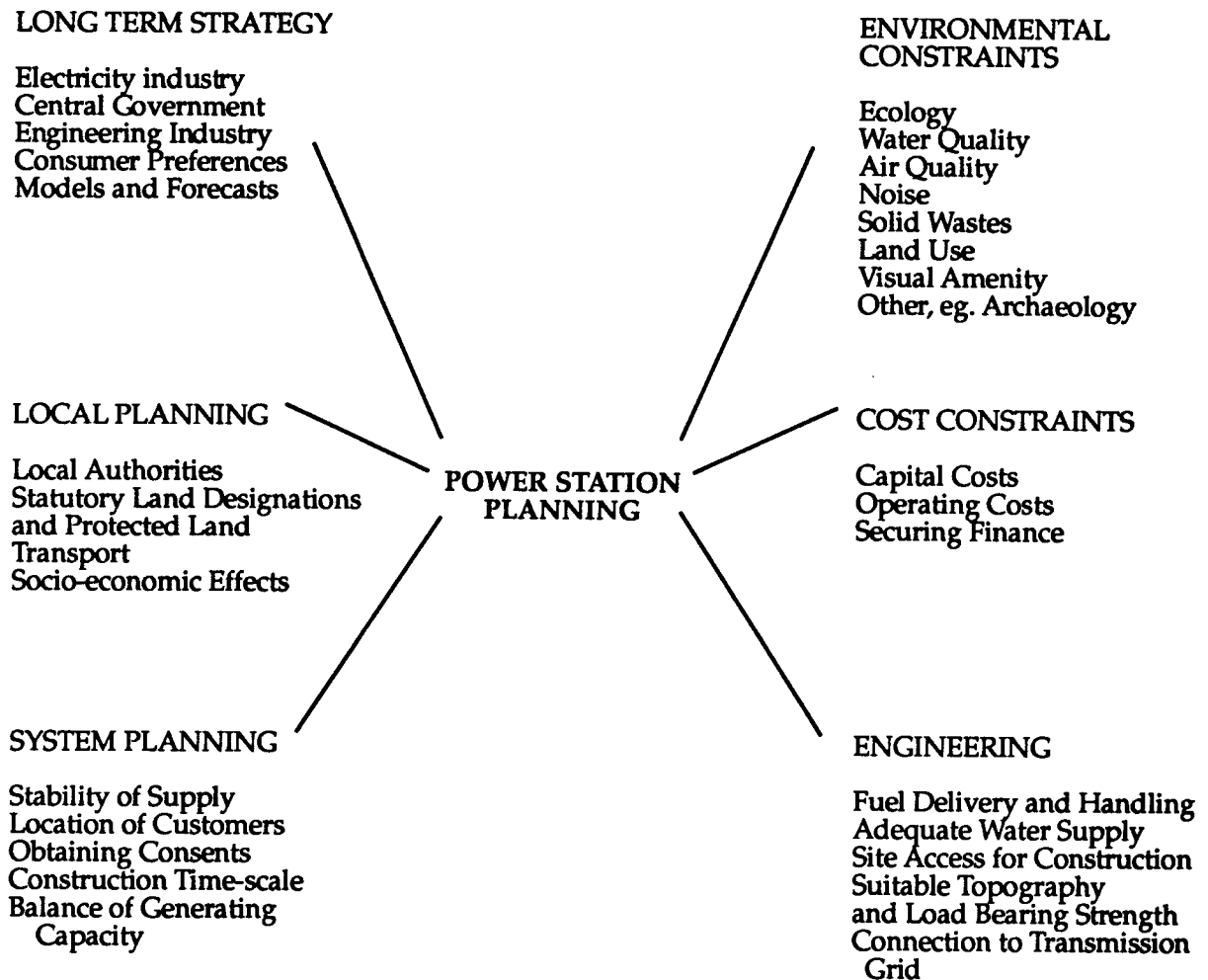


TABLE 1. Profiles of the users of biological records

Users vary in:

- The type of information they need
- The uses they make of biological information
- How fast they need information
- The points in any project schedule when they ask for information
- The form in which they want information to be provided
- Their ability to handle and interpret information
- The amount of expert advice that they seek from the information provider
- The extent and frequency of their contacts with information providers