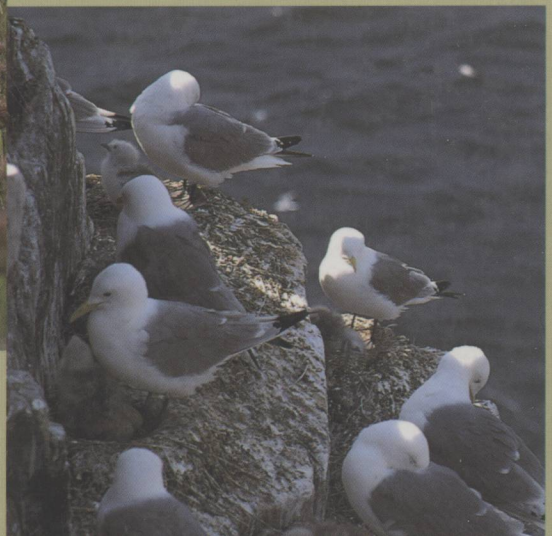
Handbook of Biodiversity Methods

Survey, Evaluation and Monitoring

Edited by
David Hill, Matthew Fasham, Graham Tucker, Michael Shewry and Philip Shaw



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Handbook of Biodiversity Methods

Biodiversity is recognised to be of global importance, yet species and habitats continue to be under increasing pressure from human-induced influences, whether in urban, rural or wilderness settings. Environmental concerns have never before been so high on the political agenda, driving increased legislation which places major emphasis on individual, public and corporate responsibility for conserving biodiversity and for managing development in an environmentally sensitive and sustainable way. The starting point for assessing legal compliance is the requirement for a comprehensive biodiversity audit. For those needing to undertake such audits, this *Handbook* provides standard procedures for planning and conducting a survey of any terrestrial or freshwater species or habitat and for evaluating the data so as to determine its local, national and international significance.

Organised in three parts, the *Handbook* first addresses planning, providing a pragmatic approach to method selection, sampling strategy, and data analysis and evaluation. The second part is devoted to habitats, describing survey, evaluation and monitoring methods for a broad range of habitats. Part III considers species and provides information on general methods before addressing specific methods of survey and monitoring for the major taxonomic groups (lower plants, fungi, vascular plants, invertebrates, fish, amphibians, reptiles, birds and mammals).

The *Handbook* provides an invaluable compendium for ecologists, wildlife managers, nature conservation professionals, local and national authorities, environmental managers, corporate bodies and companies, government conservation agencies and regulators involved in auditing ecological resources. It will enable practitioners to better monitor the condition of the biodiversity resource, resulting in improved data upon which to base future conservation, management, development and policy decisions and actions.

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Any opinions expressed are those of the authors and do not necessarily represent the views of RPS or Scottish Natural Heritage.

In memory of Colin J. Bibby,
an outstanding conservation scientist

Preface

This generation is living at a time when the world's biodiversity resources have never been so impoverished. If we take the UK as an example of what has happened across many parts of the planet, since 1945, largely as a result of agricultural intensification, we have lost over 50% of our ancient lowland woodlands, 150 000 miles of hedgerow, 95% of traditional hay meadows, 80% of chalk downland and 80% of wetland fens and mires. This has given rise to massive losses in some, once very common, farmland birds: in the past 30 years 40% of Song Thrushes, 54% of Yellowhammers, a staggering 87% of Starlings and 90% of Corn Buntings have disappeared.

In addition to agricultural intensification, development pressure as a result of industrialisation, human population expansion and resultant increases in the 'ecological footprint' of our own species through, for example, house building, airports, seaports, road infrastructure, water supply, energy generation, waste management, freight distribution and extraction of raw materials, has taken its toll on biodiversity. The UK government's sustainable development commission recently announced that the country has a very long way to go before existing developments, and the way we manage environmental resources, can be deemed to be 'sustainable'. This is without any consideration of the impending threat from climate change.

But it would be wrong to focus entirely on the negatives. There are signs that our attitudes to our environment are changing and there are a growing number of examples where the primary focus of governments, companies and individuals is towards the stitching back of the fabric of the environment and countryside. A range of agri-environment schemes is attempting to redress the damage caused to farmland biodiversity by the Common Agricultural Policy, reforming subsidies away from production and into environmental benefits. Organisations such as the RSPB continue to expand their reserve network and extend new habitats near existing ones by means of novel techniques based on scientific understanding. There is large-scale restoration of contaminated land sites. Coastal managed realignment offers opportunities to create massive areas of wet grassland, saltmarsh and reedbed habitat, which will provide substantial benefits to wildfowl and waders. Industry, too, is working with organisations to create large-scale reserves in currently uninteresting farmland, a prime example being the Great Fenland Project in the Cambridgeshire Fens of the UK.

As biodiversity has dwindled in the past 50 years, so policies and laws aimed at turning the tide have flourished. There are now over 200 legal instruments aimed at protecting the environment and which have an impact on countries such as the UK. The greatest successes have been achieved where there has been government regulation: we now have the best air and water quality in Britain for about 200 years, almost entirely as a result of regulation. Key instruments for biodiversity conservation in the UK are the Wildlife & Countryside Act, the Countryside and Rights of Way Act, The Nature Conservation (Scotland) Act EU Birds and Habitats Directives, the Habitats Regulations, the EIA Directive and EIA Regulations, the Hedgerow Regulations, Bonn Convention, Ramsar Convention, Bern Convention, European and National Red Lists of species of conservation concern, and Biodiversity Action Plans. A whole industry has developed to support biodiversity conservation, to save what we have and improve upon it. In parallel there has been increased site-based protection: the designation of local wildlife sites, green corridors, County Wildlife Sites, Sites of Special Scientific Interest, National Nature Reserves, Special Protection Areas, Special Areas of Conservation, Biosphere Reserves and World Heritage Sites.

During this recent period we have moved from a natural history mentality to an accountancy

mentality, where numbers and targets are the order of the day. Government has set out some ambitious targets for biodiversity: by 2010, for example, it wants 95% of all SSSIs in England to be in a Favourable Condition. We have a long way to go. Currently about 42% of the one million or so hectares of SSSIs in England fail to make the grade of 'Favourable Condition'. The percentages in unfavourable condition in England, according to selected habitats, are: rivers and streams 69%, upland grasslands and heaths *c.* 65%, fen, marsh and swamp 35%, and lowland broadleaved woodland 33%. This gives an idea of the widespread losses in quality that have taken place in addition to losses in habitat quantity. Changes to quality are being addressed by a plethora of site or conservation management plans, and similar mechanisms are being used to mitigate for development impacts, including Section 106 agreements, unilateral undertakings and mitigation plans.

So, against this background of biodiversity decline and a commitment to rebuild it, there are three observations I would make. First, ecology has a vital part to play in delivering a better quality environment and better quality of life for people. Second, environmental quality improvements are increasingly being seen as solutions rather than as costly problems at the levels of both the corporate entity and society at large. Third, there is a need for high-quality information on which to base decisions. We have written this *Handbook* in order to enable biodiversity data to be collected and evaluated according to standard procedures. Future decisions on policy reforms, land management, development impacts and biodiversity conservation initiatives at a range of spatial scales can then be based on fact rather than on conjecture.

The *Handbook* consists of three parts. The first (Part I) addresses planning and describes how to set objectives, what is it you actually want to do, selecting the appropriate method, how to design a survey and/or monitoring programme, sampling strategy and data analysis. There is then a section which describes generically how to evaluate the data collected: what does it mean at different spatial scales?

Part II is devoted to habitat survey, evaluation and monitoring, describing approaches for the full range of habitats in the UK but with direct relevance to many countries. For each habitat type the potential attributes that indicate condition are defined, together with appropriate and commonly used methods for surveying them and establishing a monitoring scheme for the habitat concerned. Based on structural similarities the methods can be applied to the full range of habitat types found in Europe and, indeed, in other parts of the world. Evaluation criteria are developed and defined for each habitat.

Part III is devoted to the survey, evaluation and monitoring of species. General methods applicable to a range of taxa are first described, such as total counts, timed searches, use of quadrats, distance sampling, line transects, point counts, etc. Each taxonomic group is then addressed, from fungi to mammals. For each group, the attributes for assessing condition are described, followed by survey and monitoring methods that can be applied, and then details of particular methods for species of conservation importance as appropriate. Finally, for each group there is a section that describes the currently applicable conservation evaluation criteria.

I hope that the approaches and methods described in this *Handbook* will stand the test of time and enable us to better monitor the condition of the biodiversity resource. We should then be able to plan improved biodiversity conservation and measure how well we are doing towards meeting targets in the years ahead.

David Hill

Acknowledgements

The writing of the *Handbook* has been a mammoth task. However, we have been very fortunate to have been able to assemble a highly competent team of authors who not only eased the task but were able to take the text to greater depths of detail than any one of the editors could possibly have achieved. Their wisdom, knowledge and experience shines through. We therefore thank our contributing authors for their superb support and hard work.

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Finally, we thank the many professionals who are striving to ensure we stitch back together the fabric of the countryside, both in the UK and abroad, to secure a future environment in which it is worth living. We hope this book plays some small part in assessing how well we are doing in the years to come.

Contents

Part I • Planning

1 • Introduction to planning

1.1 THE PURPOSE OF SURVEYING AND MONITORING

The development of a successful programme is dependent upon being clear about what you want to do and why, i.e. your objectives. It is therefore important to define what monitoring is and how surveys relate to monitoring. Survey and monitoring is undertaken for a wide range of objectives: for example, to measure a site's quality, or a species' abundance, to assess species and habitat trends, for Environmental Impact Assessment (EIA) studies, for corporate reporting, or to assess compliance with international conservation agreements. These operate at many different spatial scales and therefore necessitate targeted methods for different applications, objectives and deliverables. The significance and global importance of monitoring nature conservation is aptly summarised in Appendix 1, which describes the monitoring and reporting obligations under international conservation agreements as an example of the far-reaching implications of the need to use adequate methods.

1.1.1 General objectives of surveying and monitoring

For the purposes of Environmental Impact Assessment (EIA) studies, the term 'survey' defines the collection of spatial and/or temporal data about a species, a community or a habitat. The information provides a snapshot of presence, absence and, dependent on its design and sophistication, abundance and spatial distribution. In EIA studies the survey data are used to evaluate the ecological resource on a site, which is then assessed or evaluated against set agreed criteria. Impacts are considered in respect of this resource and assessed for significance. Parts II and III of this *Handbook* describe specific survey methods for habitats and the full range of species from lower plants to mammals. However, for some studies, particularly in relation to testing the effects of macro-environmental policy changes at a large spatial scale, actual monitoring is performed. The emphasis in Part I of this *Handbook* is the design of data collection and the analytical treatment of the data collected. Much of Part I therefore considers the planning, design and implementation of survey and monitoring, the latter often comprising a series of replicated surveys using standard methods.

Once the data have been collected they will need to be used for a specific purpose. One of the most important uses is to evaluate a site, species, community, habitat, region, etc. Part I therefore includes a section on generic approaches to evaluation of biodiversity data, with more specific treatment for habitats and species given in the relevant sections of Parts II and III.

As with monitoring, it is essential at the outset of a survey to define objectives. A project may not meet its full potential unless the aims are properly understood and researched before data collection begins. Before planning your survey methods, consider the variety of possible scenarios that could dictate your project's fieldwork techniques. Do the results need to apply to one site or to a wide geographical area? Are many species involved or just one? Are accurate counts needed (spatially referenced) or will relative counts or presence–absence data suffice? Answers to these questions will determine the time commitments required

and hence cost. In general terms, surveys conducted for EIA studies should aim to provide information on the following.

- What species and habitats occur (= the resource)?
- Where do they occur?
- How many of them are there or how much of the habitat is there?
- How does this amount of the resource relate to that existing in the wider area/biogeographical region?
- What are the seasonal changes and when is the most susceptible or sensitive period for these species/habitats?

Monitoring is often loosely regarded as a programme of repeated surveys in which qualitative or quantitative observations are made, usually by means of a standardised procedure. However, by itself this is merely surveillance as there is no preconception of what the findings ought to be. Monitoring can be more rigorously defined as 'intermittent (regular or irregular) surveillance undertaken to determine the extent of compliance with a predetermined standard or the degree of deviation from an expected norm' (Hellawell, 1991) . In this context, a standard can be a baseline position (e.g. maintenance of the existing area of a particular habitat or population of a particular species) or a position set as an objective (e.g. maintenance of more than 200 ha of a desired habitat or more than 200 individuals of a desired species).

Thus, whereas surveys and surveillance are to a large extent open-ended, a monitoring programme has a specific purpose that requires the standard to be defined or formulated in advance. This requires the identification of interest *features* (e.g. various habitats and species), their *attributes* (e.g. area, numbers, structure and reproductive success) and their target state, i.e. the *standard* that is to be monitored (see Glossary for detailed definitions of monitoring terms). Monitoring for conservation purposes should be closely linked to site management and should test whether conservation and management objectives have been achieved, as outlined in Figure 1.1.

The monitoring programme and methods chosen must be *focused and fit for their purpose* and should not attempt to describe the general ecology of a site. Unfortunately, monitoring schemes often resort to measuring a wide variety of variables, which may or may not be related to the questions that need to be addressed. As a result, resources may be spent collecting unnecessary data. Even worse, it may be found that key questions cannot be answered with the information obtained. This is because monitoring is often planned backwards, on a 'collect-now (data), think-later (of a useful question)' basis (Roberts, 1991).

Strictly speaking, the minimum requirement of monitoring is an assessment of adherence to, or deviation from, formulated standards. However, it is clearly desirable to collect data in such a way that gradual change can be detected to assist management decision-making. Management adjustments (at both field and policy level) require knowledge of the dynamic situation, i.e. whether the feature is moving towards or away from the standard, from which direction, and whether the change is expected, acceptable or otherwise (Rowell, 1993).

Monitoring should not be confused with research aimed at investigating ecological processes. Nevertheless, data collected for monitoring purposes can sometimes also be used to examine possible causes of change and to investigate the relationship between features of interest and environmental variables and pressures. Such information can then be used to formulate appropriate responses. For example, comparison of sward composition with stocking density may predict optimal management regimes. Further monitoring of the vegetation and stocking rates can then confirm whether management and habitat objectives are being met.

Thus, in summary, monitoring can:

- establish whether standards are being met;
- detect change and trigger responses if any of the changes are undesirable;
- contribute to the diagnosis of the causes of change; and
- assess the success of actions taken to maintain standards or to reverse undesirable changes, and, where necessary, contribute to their improvement.

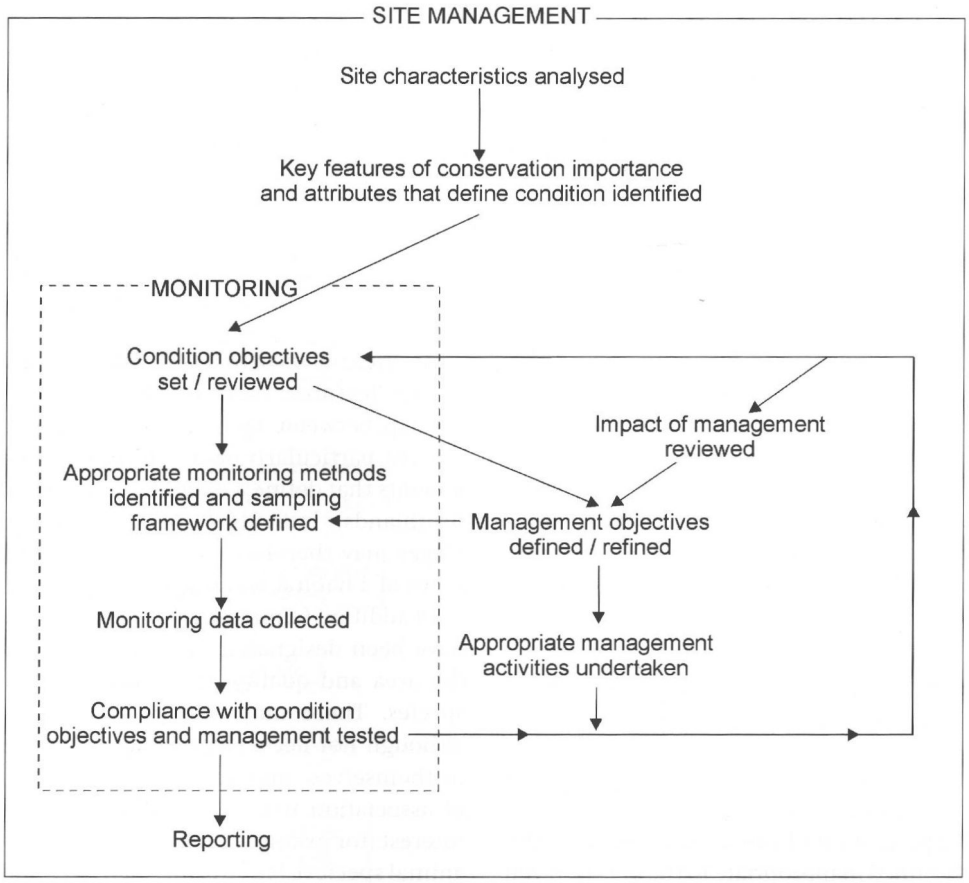

Figure 1.1. A schematic representation of the relationship between site management and monitoring.

Monitoring should therefore be an integral part of all conservation programmes.

1.1.2 Common Standards Monitoring in the UK

The UK statutory conservation agencies (the Countryside Council for Wales, English Nature, the Environment and Heritage Service in Northern Ireland, and Scottish Natural Heritage) have undertaken to monitor statutory protected sites to determine whether the features of interest for which each site has been designated are being maintained in a *favourable condition*. To provide a basic framework that will ensure consistent monitoring throughout the UK, a *Statement of Common Standards for Monitoring Designated Sites* (JNCC, 1997) has been adopted by the agencies and the Joint Nature Conservation Committee (JNCC). This formalises the monitoring principles outlined above and provides standards for the setting of objectives, judging the condition of site features, recording activities and management measures, and monitoring and reporting within an agreed time-frame.

For further information on the Common Standards approach see Rowell (1993, 1997) and Brown (1994). See Shaw & Wind (1997) for a discussion of monitoring European conservation sites. Detailed guidance on the interpretation and application of Common Standards Monitoring has been prepared by the statutory agencies and is available from them.