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The status of terrestrial and freshwater invertebrate population monitoring in Britain and Ireland

A survey

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The Status of Terrestrial and Freshwater Invertebrate Population Monitoring in Britain and Ireland: A Survey

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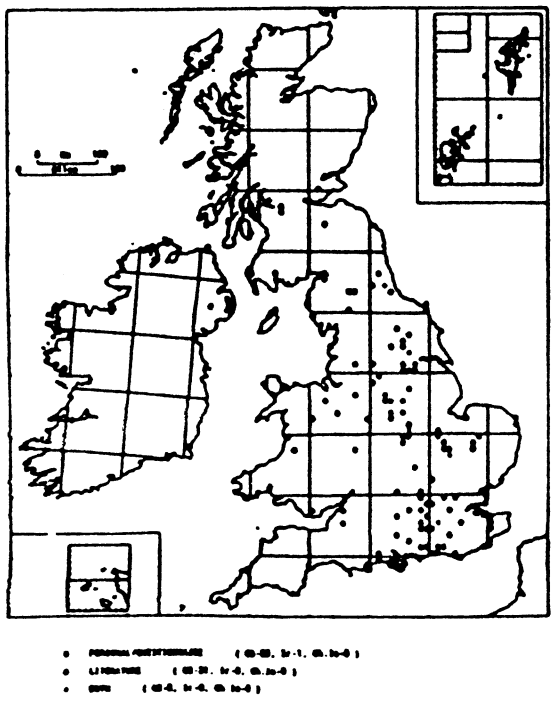
The Status of Terrestrial and Freshwater Invertebrate Population Monitoring in Britain and Ireland: A Survey

I

A Report to the Institute of Terrestrial Ecology and English Nature
From an Industrial Training Placement
5 May to 2 October 1992



PETER J. P. CROUCHER

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Preface

About this report:

This report describes work undertaken by the author during the 22 weeks from 5 May to 2 October 1992 whilst on training placement from the University of Bath. The work was undertaken at the Biological Records Centre of the Institute of Terrestrial Ecology's Monks Wood station, under the direct supervision of Brian Eversham (BCE) and also that of Martin Drake (CMD) at English Nature, Peterborough, with whom the project was jointly arranged.

The project was a survey into invertebrate population monitoring schemes in Britain and Northern Ireland. The main product of the project was to be a computerized database of such schemes and a report – a need which this placement report satisfies. Although I have tried to keep complexities such as 'computer–talk' out of the main body of the report by the use of appendices, the presentation and discussion of the results in particular is necessarily long.

Contents in brief

Contents index

1.0 Background

1.1 The Institute of Terrestrial Ecology and English Nature

The Institute of Terrestrial Ecology (ITE) was established in 1973, from the former Nature Conservancy's research stations and staff, joined later by the Institute of Tree Biology and the Culture Centre of Algae and Protozoa. The remainder of the Nature Conservancy became the Nature Conservancy Council (NCC), which was subsequently split in April 1991 to form English Nature (EN), Scottish Natural Heritage (SNH), and the Countryside Council for Wales (CCW); the equivalent authority in Northern Ireland is the Countryside Branch, DOE, Northern Ireland. ITE contributes to, and draws upon, the collective knowledge of the 21 sister institutes which make up the Natural Environment Research Council (NERC), spanning all the environmental sciences.

1.2 The Biological Records Centre

The Biological Records Centre (BRC) was created in 1964 at the Monks Wood Experimental Station of the Nature Conservancy. Nowadays BRC is run by ITE with financial support, under contract, from 'NCC'. The concept of a national centre developed from the distribution maps scheme of the Botanical Society of the British Isles, which began in 1954 and resulted in the publication of the Atlas of the British Flora in 1962. The idea, pioneered by the Botanical Society, of using mainly amateur naturalists to collect information on the occurrence of plants and animals has been expanded by BRC. (BRC, 1985).

BRC collects most of its information through some 60 national recording schemes (nearly 50 cover invertebrates (Harding & Eversham, 1989)). Each is organized by voluntary 'experts' and they cover over 15 000 species in total (Harding, 1992). BRC makes available special recording cards for this purpose. Original records are maintained in an archive and entered on to Britain's largest biogeographic database in NERC Computer Services (NCS) VAX/VMS computer network. One of the major products of the database is species distribution maps and atlases, but it is also available in various forms for research, monitoring, nature conservation, education and general information.

1.3 The Environmental Information Centre

BRC is now a major component of the Environmental Information Centre (EIC) which was set up in 1989 in ITE as a focus for the collation, analysis and dissemination of information on ecology and the terrestrial environment. EIC is developing the means of combining information from sources such as biological recording, remote sensing, ecological databases and digital mapping, using the technology of Geographical Information Systems (GIS) to support applications in ecology and land resource analysis. The centre will be of benefit to both environmentalists and planners and will encourage joint research projects both within the scientific community and with government and commercial users, such as local authorities, conservation bodies and land developers (Loder, 1990).

The invertebrate population monitoring project is an example of the new directions in which BRC is moving within EIC; co-ordination of invertebrate monitoring schemes is likely to be of increasing importance. At the time of writing, of the 17 people working in BRC around one-third are sandwich or CASE students with time to devote to individual projects. Other current projects include 'Using national species distribution data in Environmental Impact Assessment (EIA)' and 'Measurement of "naturalness" and "disturbance" in wildlife

habitats: an expert system for application to Environmental Assessment' among others. In other words, BRC is more than a database.

Figure 1: ITEs Position within the UK Research Council system.

The Institutes's position within the UK Research Council system is shown below. ITE is an integral part of the Natural Environment Research Council, which supports a wide range of basic and applied research in universities and institutes. It is able to draw on the expertise of about 400 colleagues in terrestrial and freshwater research, and on 1300 scientists within NERC.

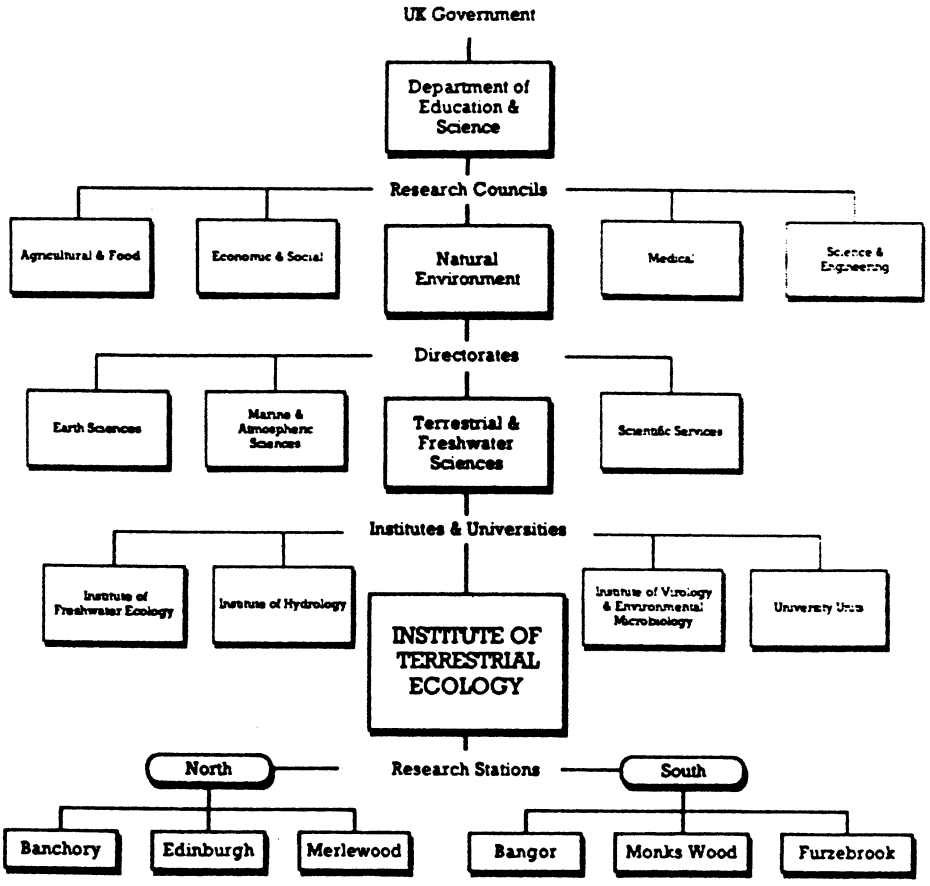
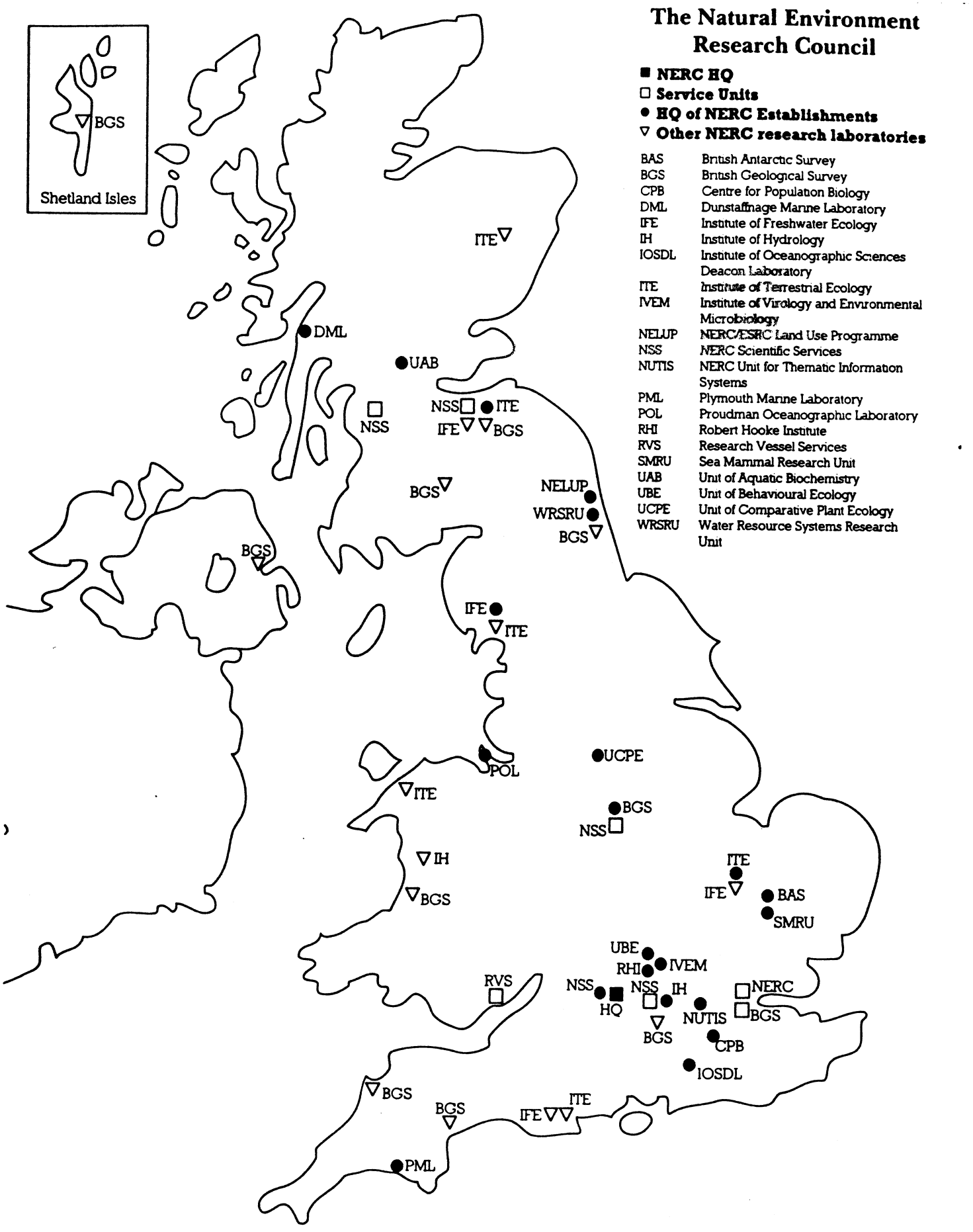


Figure 2: NERC.



2.0 Introduction

This project constituted a survey entitled 'invertebrate population monitoring in Britain and Northern Ireland'. The survey was performed via a questionnaire, personal contacts and a literature search, and resulted in a novel database of current and recent invertebrate studies relevant to monitoring. This would be the first time such information had been brought together to one centre.

2.1 What is monitoring?

John Hellawell (1991) defined survey, surveillance and monitoring. He stated that:

> 1) Survey is an exercise in which a set of qualitative or quantitative observations are made, usually by means of a standardized procedure and within a restricted period of time, but without any preconceptions of what the findings ought to be.
>
> 2) Surveillance is an extended series of surveys, undertaken in order to produce a time series, to ascertain the variability and/or range of states or values which might be encountered over time (but again without preconceptions of what these might be).
>
> 3) Monitoring was defined as intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from an expected norm.

For this project these definitions were accepted but the distinction between 'surveillance' and 'monitoring' were deemed somewhat arbitrary as the 'expected norm' in monitoring is only achieved after a period of surveillance.

2.2 Why monitor invertebrate populations?

There are a lot of species of arthropods, with estimates of 30 million species of insects (and optimistic estimates of 80 million species). As Robert May famously pointed out 'to a good approximation, all organisms are insects, because they so overwhelm other species in taxa number' (May, 1987).

With invertebrates making up around 90% of the species in any temperate habitat, there is surprisingly little coordination of their monitoring when compared with plants and vertebrates. Indeed there is little agreement among applied entomologists on the feasibility or value of invertebrate population monitoring (Eversham, pers. comm. 1992).

Invertebrate species may be the most sensitive to environmental change, but it is seldom easy to assess population levels non-destructively.

Few geographically widespread studies provide any index of invertebrate population sizes. ITE's Butterfly Monitoring Scheme (BMS) and the Rothamsted Insect Survey (RIS) light trap network are perhaps the only two. (See sections 3.1.3 & 4.12).

Via the database it was hoped to define and compare the characteristics of species whose populations have been chosen for monitoring, such features include species mobility, life cycle, behaviour, conspicuousness and ease of identification.

2.3 Applications

It is hoped that the results could eventually be applied to these areas in particular (as stated in the original project description):

> '1) Nature conservation: projects such as EN's Species Recovery Programme need clearer and more objective criteria for selecting a small number of endangered species for study and positive conservation. Invertebrates may be ideal indicators of the success of site management, but will only be used as such when guidelines for choosing and monitoring indicators have been defined.
>
> 2) Environmental Impact Assessments: in many EIAs, inexpensive and effective monitoring for change or deterioration at a site is needed. Invertebrates have much to recommend them, but the lack of agreed criteria for species selection hampers progress.
>
> 3) Environmental change: an overview of previous studies would be valuable in choosing species to monitor in the context of climate or land use change. Again, invertebrates may respond more quickly than plants or vertebrates, but are so numerous that species selection is a complex and critical question.
>
> 4) Biological recording: this study will help guide the development of national invertebrate recording schemes. A few are already showing an interest in population levels and year-to-year monitoring, at least at key sites. It is not yet clear how widely such methods could be applied beyond the largest and most "popular" invertebrates.'

Holdgate (1991) states that ecology must respond to the challenges imposed upon conservation by the pressures of mankind in three ways:

> 1) Through the provision of knowledge.
>
> 2) Through the application of that knowledge in conservation strategies and methodologies.
>
> 3) Through the combination with economic and social sciences to promote a broader insight and a sounder overall policy base.

This project was important in the collection of information on possible sources of temporal invertebrate population data in Britain and Northern Ireland. Without central coordination, much knowledge, often in the form of amateur naturalist's records, would be lost to the scientific community – it is not possible to finance biologists to do all the work that amateur naturalist's can do, nor should it be necessary. With a database of contacts such knowledge can be 'provisioned' in a coordinated way. The information gained about monitoring schemes could be used to suggest recommendations for the improvement of monitoring methodologies in relation to specific groups of invertebrates. The information gained also has sociological implications, of concern to bodies such as EN, as to who is actually doing the ecological research on monitoring etc; is it amateurs?, is it wardens and if so are they doing it unpaid in their spare time?

There follows a description of the work performed on this project and the methods used; this will be followed by an exploration and discussion of the results.

3.0 Methods and approach

3.1 Field work

3.1.1 Introduction

Some field work was undertaken whilst at Monks Wood. This was not directly part of the invertebrate population monitoring scheme survey, but it was of some indirect relevance and as such deserves a brief mention.

Two projects were involved. Firstly a visit was made to Thorne Moors National Nature Reserve in South Yorkshire with Brian Eversham to look at populations of two endangered beetle species that pose particularly acute problems to monitoring. (The night before was also spent charting the number of singing territorial nightingales for the spring records!). The Thorne Moors visit occurred on Friday 8 May.

Secondly the author was involved with ITE's Butterfly Monitoring Scheme (BMS) which involved training in walking three local butterfly transects. This meant that in most weeks at least one transect was performed by the author – giving an escape from the office and a taste for a truly successful monitoring scheme.

3.1.2 Thorne Moors

3.1.2.1 Background

Thorne Moors (National Grid Reference 44/7--1--) and Hatfield Moors (National Grid Reference 44/6--0-- to 44/7--0--) are two internationally important sites in South Yorkshire. Both are designated Sites of Special Scientific Interest (SSSIs) and the former contains areas of National Nature Reserve (NNRs) managed by EN. Both sites are largely owned by Fisons PLC who due to mounting environmental pressure against their peat-cutting operations have recently announced the transfer of ownership of the sites to EN, giving some hope to the conservation of these sites. The history of the Moors' mire, as with most of the British landscape, has been one of human intervention. Much drainage in the nineteenth century and 'warping' to produce agricultural land, compounded by modern peat-cutting activities means that little of the wettest mire (and its associated species) remain. Much of the surrounding fen grassland and reedbeds have vanished. The habitat remaining consists of compartments of dry peat; wet peat; aspen, hawthorn and elder woodland; sallow carr and hawthorn woodland; saltmarsh; fen meadows; and ponds (Eversham & Swindlehurst, 1992).

A comprehensive survey was carried out on invertebrates in 1990 on behalf of the Thorne and Hatfield Moors Conservation Forum and the results are summarized in a report (Heaver & Eversham, 1991). This survey found 14 Red Data Book species and 34 Nationally Scarce species and dozens of local species, many new to Northern England. 3 internationally endangered species are known only from Thorne and Hatfield Moors in Britain and at very few sites elsewhere in Europe. The visit to Thorne Moors concerned two of these, *Curimopsis nigrita* and *Bembidion humerale* (Heaver & Eversham, 1991). Monitoring such species is important to see if the recommended management of raising the water table and protecting a diversity of peat surfaces works.

3.1.2.2 Discussion

Bembidion humerale is a ground beetle (Carabidae) of about 3mm length and is characteristically black and shiny with two yellow spots on its shoulders. It is a small predator and is easily seen running across the peat surface on sunny days.

Curimopsis nigrita is a mire pill beetle (Byrrhidae) and is slightly smaller than *B. humerale*, rounded and dull in markings.

During the author's visit to Thorne Moors the weather was changeable and few individuals of either species were seen. Originally it was planned to try and assess the effectiveness of using 10cm by 10cm quadrats on suitable peat (*C. nigrita* prefers slightly mossy peat and *B. humerale* barer peat), however far too few individuals were evident for this to be practicable. Eventually BCE removed occasional 10cm by 10cm turves and took them home and fair numbers of *C. nigrita* adults, pupae and larvae emerged under the heat of a lamp – confirming its presence. Several individuals of *B. humerale* were seen in the field. It was observed that the Moor was drier than most years in May (BCE pers. comm., 1992).

BCE has been trying to assess *B. humerale* populations since 1979 mostly using 1m by 1m quadrats in around ten suitable areas each year ie where the beetle is found. Direct searching has also proved successful but the beetle rarely enters pitfall traps, even where common. It is hard to assess when peak adult numbers occur and there is no data on adult mobility or larvae. *B. humerale*'s activity and obviousness in the sun make it a better candidate for monitoring than *C. nigrita* which BCE has been looking at since 1987. This beetle has been looked at via direct search, pitfall traps and removal of turves at subsites – the latter is probably the only technique that could prove useful, but is destructive. *C. nigrita* spends far too long underground, only surfacing on very hot days and its habitat is too fragmented for easy quantification (all BCE pers. comm., 1992).

These beetles represent the difficult extreme in population monitoring but are so rare and indicative of the state of their habitat that perseverance must be important.

3.1.3 The Butterfly Monitoring Scheme

3.1.3.1 Background

ITE's Butterfly Monitoring Scheme (BMS) is one of only two nationally coordinated invertebrate monitoring schemes in Britain and Northern Ireland. It was officially launched in 1976 by ITE with joint funding from NCC and is now in its seventeenth year. The other scheme is the Rothamsted Insect Survey which started in 1936 and has been actively producing useful population data for moths since the 1960s via its network of light traps (see section 4.13). Although the BMS has been in operation for a shorter period it has the advantage in that counts are made over a relatively large area within the habitat of a species (Pollard *et al*, 1986). The scheme developed from the concern over the apparent concurrent decline in the abundance of butterflies as the effects of organochlorine pesticides on some birds were becoming clear in the 1960s (leading to the Common Bird Census).

The aims of the BMS are:

1) to provide information at regional and national levels on changes in abundance of butterflies and to detect trends which may affect the status of butterflies;

2) to monitor changes in the abundance of butterflies at individual sites and, by comparison with results elsewhere, assess the impact of local factors, such as habitat change.

The first aim is qualified in that the information, strictly, applies to the sites in the scheme and not necessarily the wider countryside (Pollard *et al*, 1986).

There are currently 100 BMS sites in operation plus many independent schemes following the same guidelines.

3.1.3.2 Discussion and methods

Whilst at Monks Wood the author was trained to walk three butterfly transects in the Monks Wood area; Monks Wood NNR, Bevill's Wood (Forestry Commission land), and Woodwalton Farm. Each walk took around an hour depending upon the number of butterflies present and at least one of these was walked each week.

Full details of the methods are available in the booklet 'Butterfly Monitoring Scheme: instructions for independent recorders' (Hall, 1981).

Essentially the methods are as follows. A series of counts are made along a transect (fixed route) through an area. These counts are used in the calculation of an index of abundance which is a measure of relative abundance from generation to generation or from year to year. No attempt is made to estimate actual population size.

Recording starts on 1 April and lasts for 26 weeks; in 1992 the 'butterfly week' ran from Wednesday to Tuesday. In order to provide as much standardization as possible the following criteria are observed:

1) Counts are started after 1045 hours and completed before 1545 hours British Summer Time.

2) Counts are not made when the temperature is below 13°C; from 13°C to 17°C, counts are made when there is 60% sunshine minimum; and above 17°C counts can be made in any conditions provided that it is not actually raining. In the northern and western upland sites the minimum temperature in sunny conditions is 11°C. A note is made of the end wind speed and temperature.

Transect routes are divided into no more than 15 sections, which as far as possible coincide with changes in the nature of the habitat being recorded. Notes are kept on each of these sections and the occurrence of butterflies in different habitats and the effects of management of habitats on butterfly numbers can be examined.

Transects are usually restricted to rides and paths. The transect should not really be more than about 5 m wide but the precise width is not that important provided the boundaries (ditches, canes, hedges etc) are permanent. Butterflies are recorded as far as around 5 m in front of the recorder. Butterflies that fly along in front of the recorder are only counted once unless there is any doubt that another butterfly is present. If for some reason a butterfly cannot be positively identified then it is recorded as the commoner of the likely alternatives present at that time. Some species can cause difficulties; no attempt has been made to distinguish Essex and small skippers and some recorders do not distinguish between the white butterflies. This recorder identified everything seen. An example of a filled in recording form can be seen in *figure 3*.

An index of abundance for each species at each site is worked out. This is the sum of the mean counts per transect per week (which normally means the total number of individuals seen). Where a butterfly has different generations that are separable or a species overwinters as adults and has autumn and spring populations then separate indexes are calculated. If a week's recording is missed then an estimate for each species is made from the means of the preceding and following weeks.

This index is a measure of relative abundance: it cannot be used in simple comparisons between sites because the values depend upon the routes used. However, gross differences in numbers of a species recorded do provide useful information.

Year to year differences in a site can be seen from ratio estimates of the indexes for each species for each year (Pollard, 1981). The BMS is an example of a very robust monitoring scheme. Its techniques are simple and repeatable, it works on a popular invertebrate group and was enthusiastically received.

The BMS does have its limitations though. It must always be remembered that changes within the sites of the BMS do not necessarily reflect the status of butterflies in the wider countryside; a large number of the BMS sites are nature reserves and some are specifically managed for butterflies. However, it is likely that the major features of true national trends will be reflected in the data. Also, there can be difficulties in interpreting data when there are frequent changes of recorder at a site. There would be advantages in a concurrent vegetation monitoring scheme at sites to aid interpretation of results but this is probably not feasible. There have also been occasional problems where people have changed the transect to include 'good' butterfly areas which has led to data interpretation problems (Pollard *et al*, 1986). All of these problems have relevance to the other monitoring projects elucidated by the invertebrate population monitoring survey.

The BMS served as a perfect illustration of what field population monitoring could involve.

Figure 3: A BMS recording form.

BUTTERFLY CENSUS

YEAR (1-2)	1992	DATE (3-5)	29/7	RECORDER (6-8)	P. J. CROUCHER
(9-11)		SITE NAME (12-17)	MONKS WOOD NNR	(18-19)	
START TIME (20-23)	11.00	END TEMP. °C (24-26)	22.8	%SUN (27-28)	96.4 %
END WIND SPEED (29)	3				

SECTION		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
BRIMSTONE	54																
COMMON BLUE	106									4							4
GREEN-VEINED WHITE	99	12				1	3	3	3	1	4	1	3	14	1		46
HEDGE BROWN	76	7	4	1		3	3	8	16	9	11	4	1	6			73
LARGE SKIPPER	88									2			1				3
LARGE WHITE	98	7	5	2	1		7	2	7	8	5	3		1			48
MEADOW BROWN	75		1			2	7		3	9		4					26
ORANGE TIP	4																
PEACOCK	84	5				1	1		1	1		3					12
RED ADMIRAL	122																
RINGLET	8	2	1		1	1		2	2		2	2	1	3			17
SMALL COPPER	68									1							1
SMALL HEATH	29																
SMALL SKIPPER	120									1							1
SMALL TORTOISESHELL	2																
SMALL WHITE	100	6	1	1			8		5	3	4	10	5	14			57
WALL	94																
S. WOOD				3	2	1		2						1	1		10
SECTION		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
SUNSHINE		S	S	S	S	S	S	S	S	S/C	S	S	S	S	S		

NOTES:

PLEASE TOTAL EACH SQUARE

3.2 Questionnaire

3.2.1 Introduction

In order to construct a database of current and recent invertebrate population monitoring activity in Britain and Northern Ireland it was first necessary to collect the information about this activity. Though this could partly be achieved through the literature, by far the quickest and most efficient way of collecting the information would be through a targeted questionnaire and personal contact.

This important aspect of the project grew to take up a very large percentage of the author's time at Monks Wood.

3.2.2 Design

A questionnaire should be designed in such a way that it:

a) is tactfully presented is not immediately discarded upon receipt;

b) provides answers to the questions that you intended to ask (not what the respondents 'thought you meant');

c) those answers are in a form such that they can be analysed and dealt with quickly and usefully.

This is a difficult and painstaking process requiring consultation and trial-runs on 'guinea-pigs'. It is probably impossible to design a questionnaire that will be answered as the designer desired 100% of the time, indeed this form of data collection runs the risk of being riddled with errors, misinterpretations and variables way beyond the "experimenter's" control or validation. The limitations can however be minimised by careful design, and questionnaires remain one of the most extensively used and economic methods of survey (at least of human activities!).

Designing a questionnaire from 'the ground up' is especially difficult, but luckily questionnaires are commonly used and a skeleton was found in the form of Paul Harding's 1988 'Butterfly Recording in the British Isles' questionnaire for BRC, which gave an overall plan that could be modified and developed to suit. After the initial draft concept had been written to floppy-disk via 'WordPerfect' it was sent to the typist and copies of the questionnaire passed back and forth at least ten times until all the final changes had been completed. An example of the form at around version 5 is shown in *figure 4*. The questionnaire was passed around several staff for comment, and the data-manager further encouraged the use of tick-boxes and simple answers for later analyses. A visit was made to EN headquarters in Peterborough to discuss details with Martin Drake (CMD).

A detailed set of instructions and background information was written, separate from the questionnaire itself and each recipient also received a suitably customized covering letter.

A list of 'friendly' contacts was devised by BCE for a preliminary mailing on 2 June to gain some public feedback. This led to a few minor alterations to some apparent ambiguities but the final draft remained remarkably similar to the initial one of one month previous. The final copy of the instructions and questionnaire as mailed can be seen in *figure 5*.

Most of the sections on the questionnaire are self-explanatory and their relevance will be made clearer in the results and discussion. Essentially, one needed to know *(see figure 5)*:

a) what is being monitored? (Section 2.0);

b) where? (3.0) (eg Nature Reserves or gardens);

c) by whom? (7.0) (wardens or amateurs);

d) why? (4.0);

e) how? (6.1) (a list of the most likely methods to be used in monitoring was thought up);

f) when?, and for how long? (6.2).

The list of habitat(s) in which monitoring occurs section (5.0) underwent serious revision before the final draft. Many people have tried to create the definitive habitat classification and failed to 'box' what is after all a continuous gradient of variation. Most classifications are not interchangeable and many would be too daunting for the (mostly) amateurs answering this questionnaire. So, a unique classification of relevant habitats was distilled from BRC Recording Scheme cards, the EEC CORINE biotopes (CO-oRdinated INformation on the Environment, a Europe-wide habitat classification) and a habitat classification used by the 'Key Indicators for British Wildlife' project (Crawford, Toy and Usher, 1989). In all sections the questionnaire had to be simple, useful and not daunting, or people would not reply! It was also asked if the monitoring occurred whilst taking part in the BMS (as many projects undoubtedly do). Some questions about data storage also seemed pertinent.

3.2.3 Mailshot

In total around 536 people were mailed directly from BRC. Though spread over a month, an attempt was made to keep to a few large mailings as much as possible because bulk mailings are more efficient.

The questionnaire bred. People were encouraged to pass on photo-copies of the questionnaire to colleagues who they believed may be monitoring. This and the surprisingly enthusiastic reception which greeted the questionnaire means that it cannot accurately be said how many people received the questionnaire - probably between 550 and 600, no more (strong evidence from replies suggests that photo-copies frequently were sent to people already mailed by BRC).

The BRC computerized mailing list was used to create the survey mailing list. National recording scheme organisers and local biological/environmental records centres are marked 'sch', 'lrc' etc following their entries on the mailing list and so were easily selected. (BRC's mailing list entries all have a post-script string of codes to indicate the newsletters etc that individuals should receive). Paul Harding (PTH) and BCE also selected possible contacts from the mailing list by eye. CMD provided lists of relevant 'NCC' staff.

Table 1

Groups mailed:	*Questionnaires sent:*
(From the BRC mailing list)	
Wildlife Trusts	45
Local Biological/Environmental Records Centres	71
Recording Scheme Organisers	54
'Friendly' Academics and Forestry Commission	30
Other likely individuals	207
(From EN)	
EN Site Managers and EN Monitoring Officer	63 + 1
CCW Site Managers and CCW Monitoring Officer	14 + 1
SNH Site Managers and Chief Scientific Officer	18 + 1
Other EN Staff	10
ITE Staff	10
Field Study Centres	11
Total	536

Plus a handful of mailings following telephone conversations and any second-hand photocopies. (Preliminary mailing inclusive).

There was a standard covering letter *(figure 6)*, but some groups received modifications on this. Those in the preliminary mailing were personally headed *(figure 7)*, Recording Scheme Organisers had a minor variation *(figure 8)*, a few people received personal letters and minor correspondence occurred in a few cases. All people who replied received a letter of acknowledgement (frequently with additional comment), usually within 2 weeks *(figure 9)*.

The deadline for returns was 31 July. Additional questionnaires were being sent on request right up to that date, and replies tailed off around mid-August.

Figure 4: An early questionnaire draft (version 5).

INVERTEBRATE POPULATION MONITORING IN THE BRITISH ISLES

1. Contact Details (capitals please)

Your name: . . . . . .

Name of organisation (if applicable) . . . . . .

Full postal address: . . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . Postcode: . . . . . .

Telephone number: . . . . . Ext.: . . . . . .

Fax number: . . . . . Email: . . . . . .

2.0 Invertebrate Taxa Populations Being Monitored

Please define the species or group of species (eg '*Tettigonia viridissima*'; 'Anisoptera dragonflies' 'Carabidae', 'spiders other than Linyphiidae'):

Stage(s) of life cycle: Egg[ ] Larva[ ] Pupa[ ] Exuviae[ ]
Immature[ ] Adult[ ] [Tick all that apply]

3.0 Geographic Coverage of Monitoring

✓ Site	
[ ]	N.N.R. . . . . (name)
[ ]	L.N.R. . . . . (name)
[ ]	S.S.S.I. . . . . (name)
[ ]	N.T. Property . . . . . (name)
[ ]	County Trust . . . . . (name)
[ ]	R.S.P.B. . . . . (name)
[ ]	Other . . . . . (name)
	Grid reference of site . . . . . [ ][ ][ ][ ][ ][ ][ ][ ]
[ ]	Environmentally Sensitive Area . . . . . (name)
[ ]	National Park . . . . . (name)
[ ]	Urban Areas . . . . . (name)
[ ]	District or equivalent . . . . . (name)
[ ]	Biological Vice-County . . . . . (name)

[Tick all that apply]

4.0 Objectives of Monitoring/Recording

	✓
Species/group protection	[ ]
Species/group information	[ ]
Site management	[ ]
Site protection	[ ]
Site evaluation	[ ]
Computerized data bank	[ ]
Uncomputerized data bank	[ ]
Other (please specify)	

[Tick all that apply]

Does this monitoring occur as part of, or while taking part in an established monitoring scheme?

✓
[ ] part of . . . . . (scheme)
[ ] while taking part in . . . . . (scheme)
[ ] No

5.0 Monitoring Habitat(s)

	✓		✓
Shingle	[ ]	Woodland, deciduous	[ ]
Salt-marsh	[ ]	Woodland, coniferous	[ ]
Sand dune	[ ]	Woodland, mixed	[ ]
Heath/moor	[ ]	Waste ground	[ ]
Freshwater marsh	[ ]	Pond	[ ]
Grassland, calcareous	[ ]	Lake	[ ]
Grassland, other	[ ]	Stream	[ ]
Cultivated land	[ ]	River	[ ]
Scrub	[ ]	Canal	[ ]

Others (Specify) . . . . . .
[Tick all that apply] . . . . . .

Please expand where appropriate (eg rides/edge of woodland):

Altitude of site (if applicable):

6.0 Methodology

6.1 *Monitoring Techniques: Please give details (eg any methods of quantification or standardisation etc.) in space at right of tick-boxes:*

	✓
Direct Observation:	[ ]
total census etc.	[ ]
transects	[ ]
quadrats	[ ]
Sweep-net	[ ]
Beating	[ ]
"Grubbing about"	[ ]
Sieve and sort	[ ]
Pitfall trap	[ ]
glass[ ] plastic[ ] metal[ ]	
dimensions:	
other structural features:	
Extraction funnels or similar	[ ]
Vacuum sampler (D-vac)	[ ]
Suction trap (aerial sampler)	[ ]
height: 2m[ ] 12m[ ]	
Water trap	[ ]
colour:	
dimensions:	
other structural features:	
Sticky trap	[ ]
Malaise trap	[ ]
Light trap	[ ]
Aquatic sampling (please specify)	[ ]
Other (please specify)	[ ]

[Tick all that apply]

6.2 At what time of year does monitoring occur? . . . . . .
With what frequency (eg weekly/daily)? . . . . . .
For how many years has monitoring occurred? . . . . . .

Figure 4: An early questionnaire draft (version 5).

Please give any other information which you think may be relevant concerning techniques (you may continue on a separate sheet):

6.3 Do you feel that there are any particular features of this species/group that:

1) lend themselves well to population monitoring?
2) pose difficulties to population monitoring?

7.0 People and Resources

How many people are involved in the monitoring:

Full-time paid staff	[ ]	Part-time staff	[ ]
Volunteers	[ ]	County/society recorder	[ ]
Researcher	[ ]	Consultant	[ ]
N.R. Warden	[ ]	Amateur naturalist	[ ]
Field centre staff/teacher	[ ]	Other (please specify)	[ ]

[Please indicate numbers for all that apply]

About how many person-hours per week or year would you say were spent on these monitoring projects?

√ Hours[ ]/week or [ ]/year

Have you received special funding for this monitoring?

√ YES[ ] NO[ ]

If yes, please give details of the source of funds (eg 'NCC', WWF, naturalists trust, local companies or societies, etc.)

8.0 Data Handling

Where are your records stored (eg local museum, society/trust offices, home, etc.)?

Are your records computerized? √ YES[ ] NO[ ]

If yes, please give details of:
1) Computer used:
2) Data management system used:
3) Transfer media (disk, tape etc.)

9.0 Publications

Have there been any publications to publicize your monitoring or to give results?

√ YES[ ] NO[ ]

If yes, please give details (eg publicity, Instructions for monitors, recording forms, papers).

Full bibliographic references to, or copies of, any publications would be greatly appreciated.

Thank you for taking the time to complete this questionnaire. Some of the information you have provided will be kept on a data base registered under the Data Protection Act. Please do not hesitate to contact me if you have any queries.

Peter J P Croucher
Biological Records Centre
ITE Monks Wood, Abbots Ripton
Huntingdon, Cambs PE17 2LS

Telephone: 04873 3817 ext. 229

Fax: 04873 467

Figure 5: The questionnaire mailshot.

INVERTEBRATE POPULATION MONITORING IN THE U.K. QUESTIONNAIRE

Background and Instructions

Background

Invertebrates may potentially provide effective subjects for detecting change or deterioration at a site e.g. effectiveness of management on nature reserves, or climate and land use change in the wider countryside, and for Environmental Impact Assessments. However, it is vital that such population changes can be distinguished from cyclical or random fluctuations in numbers; and invertebrates are so numerous that species selection is a complex and critical question.

Projects such as English Nature's Species Recovery Programme could benefit from clearer and more objective criteria for selecting a small number of endangered species for study and positive conservation. Invertebrates may be ideal indicators of the success of site management, but will only be used when such guidelines for choosing and monitoring indicators have been defined.

In addition to the questionnaire, a literature review of invertebrate autecology is being undertaken. This will aim to review invertebrate studies (excluding butterflies, as these were surveyed in 1988) relevant to monitoring to evaluate techniques and define the characteristics of species whose populations have been shown to be suitable for cost effective monitoring.

Instructions

All returned questionnaires will be acknowledged and will be summarised in a report to ITE and English Nature. If you wish any information to be treated 'In Confidence', please mark each section in the questionnaire which you regard as sensitive. No confidential information will be published or disclosed outside BRC/English Nature without prior reference back to you.

2.0 Invertebrate Taxa Populations being Monitored

Please define the group or species you are working on as clearly as possible (preferably including taxonomic group). If you are working on more than one group or species and wish to fill in extra questionnaires we would be happy to provide them or you could photocopy this questionnaire.

Larva/immature should be taken to include all larvae, nymphs, hoppers, spiderlings, stadia, subadult molluscs, etc.

Exuvium e.g. the shed nymphal cases of emerged dragonflies found near water.

Other. If you feel the stages do not fit the ones given or you wish to be more specific please do so, for instance: subimagines of mayflies, pre-flight emergent, tenerals and 'post-teneral immature adult' dragonflies.

3.0 Geographic Coverage of Monitoring

Please give the site name and grid reference of site/transect centre (or start and end of transect) e.g.

TQ 05 58 67 or 51 05 58 67

Also, please give the altitude in metres, if possible.

Figure 5: The questionnaire mailshot.

One may be monitoring at several sites e.g. local nature reserves, within an area such as a county. Further forms for each site can be provided or photocopied if required.

4.0 **Objectives of Monitoring**

Please provide as much detail as possible.

5.0 **Habitat(s)** in which your Monitoring occurs.

Please tick all those that describe the site best. If monitoring occurs at more than one site please specify which tick applies to what site (or use further forms).

Hopefully the following list may clarify what we take each habitat type to mean in cases of uncertainty:

1	Coastal cliff	-	Steep and gentle.
2	Shingle	-	Spits, islands etc.
3	Sand dune	-	Dune, dune slack etc.
5	Open standing water	-	Ponds (<50m²), small waterbodies (50-450m²), lakes/reservoirs, artificial, natural.
6	Open running water	-	Stream (<3m wide), river (>3m wide).
7	Canal	-	Small (2-5m wide), large (75m), ditch with water (<2m)
9	Inland rock	-	Cliff, scree slope, limestone pavement, quarry, slag heap, mine, montane, cave.
11	Fen (and swamp)	-	Lowland, wet, non-acidic.
12	Bog	-	Acidic, peat, cotton grass, wet.
13	Mountain vegetation and moorland	-	High altitude, short-plants, heather high rainfall.
14	Wet heath	-	Acidic, heaths *Erica*, heather *Calluna*.
15	Dry heath	-	Acidic, heaths *Erica*, heather *Calluna*, Lowland, including breckland.
17	Improved grassland	-	Treated with fertiliser/herbicide, reseeded, even texture, few species.
19	Unimproved grassland	-	Not reseeded, species-rich.
27	Parkland and scattered trees	-	Large (overmature) trees spaced widely across grassland.
28	Carr	-	Damp, willow, aspen, alder - (typically on fenland).
32	Mixed	-	>10% broadleaved trees in coniferous woodland and *vice versa*.
33	Scrub	-	Woody shrubs, young trees <5m tall, downland or heath (gorse *Ulex* and broom *Cytisus* scrub).
36	Walls	-	Stone walls, buildings etc.

6.0 **Methodology**

6.1 It is particularly important that you record the methods used; please give as much detail as possible on techniques, trap construction etc and any other relevant information. Where methods refer to more than one group/species on the same form please indicate which method refers to which group/species.

You may for example wish to specify pitfall trap dimensions, manufacturing material, preservative type (if applicable), whether malaise traps are black or white, whether light traps are M.V., Actinic, Heath, Robinson, Skinner etc. If you walk transects what sort of route do you take? How long is your transect? What time of day, weather conditions do you impose? And so forth. You may continue on a separate sheet.

6.2 Here you are asked about the timing of your fieldwork i.e. what months, how often, start and end dates of the monitoring scheme e.g. START [1985] END [ON GOING]. Has the scheme been continuous i.e. without breaks; years with no monitoring?

7.0 **People and Resources**

Please indicate whether you are paid or voluntary and what describes yourself the best (Warden etc).

9.0 **Publications**

Details of any references to your work would be very valuable.

Figure 5: The questionnaire mailshot.

TERRESTRIAL AND FRESHWATER INVERTEBRATE POPULATION MONITORING IN THE U.K.

1. Contact Details (capitals please)

Your name: . . . . . .

Name of organisation (if applicable) . . . . . .

Full postal address: . . . . . .

. . . . . .

. . . . . Postcode: . . . . . .

Telephone number: . . . . . Ext.: . . . . . .

Fax number: . . . . . Email: . . . . . .

2.0 Invertebrate Taxa Populations Being Monitored

Please define the species or group of species (eg *'Tettigonia viridissima'*; 'Anisopteran dragonflies' 'Carabidae', 'spiders other than Linyphiidae'):

. . . . . .

Stage(s) of life cycle: Egg[ ] Larva/immature[ ] Pupa[ ]
Exuvium[ ] Adult[ ] Other[ ] . . . . . .
[Tick all that apply] (see notes)

3.0 Geographic Coverage of Monitoring

Site name: . . . . . .

Size of site area . . . . . .

Grid reference of site: ☐☐▮☐☐☐☐ Altitude (range, in m): . . . . . .

	Site status: ✓		Area status: ✓
1.	[ ] National Nature Reserve	12.	[ ] Area of Outstanding Natural Beauty
2.	[ ] Local Nature Reserve	13.	[ ] Environmentally Sensitive Area
3.	[ ] Site of Special Scientific Interest	14.	[ ] National Park
4.	[ ] National Trust Property	15.	[ ] Urban Area
5.	[ ] National Trust for Scotland Property		Region: ✓
6.	[ ] English Heritage Property	16.	[ ] District or equivalent: . .
7.	[ ] County Trust Reserve	17.	[ ] Biological Vice-County: . .
8.	[ ] R.S.P.B. Reserve	18.	[ ] County: . . . . .
9.	[ ] Woodland Trust Reserve		
10.	[ ] MOD Site		
11.	[ ] Other:		

[Tick all that apply]

4.0 Objectives of Monitoring

		✓
1.	Species/group protection	[ ]
2.	Species/group information or research	[ ]
3.	Site management	[ ]
4.	Site protection	[ ]
5.	Site evaluation	[ ]
6.	Enjoyment/recreation	[ ]
7.	Computerized data bank	[ ]
8.	Uncomputerized data bank	[ ]

Other (please specify) . . . . . [Tick all that apply]

Has your information been of practical use yet and if so by whom? Yes[ ] No[ ]

. . . . . .

. . . . . .

Does this monitoring occur whilst taking part in the Butterfly Monitoring Scheme? Yes[ ] No[ ].

Is any other monitoring (eg vegetation, birds) taking place in the area you are monitoring? Yes[ ] No[ ]. Don't know [ ] If Yes, please specify . . . . . .

. . . . . .

5.0 Monitoring Habitat(s) in which your Monitoring Occurs:

		✓			✓
1.	Cliff	[ ]	21.	neutral	[ ]
2.	Shingle	[ ]	22.	calcareous	[ ]
3.	Sand dune	[ ]	23.	grazed	[ ]
4.	Saltmarsh	[ ]	24.	Other (please specify)	[ ]
5.	Open standing Water	[ ]			
6.	Open running water	[ ]		Woodland:	
7.	Canal	[ ]	25.	deciduous	[ ]
8.	Quarry, chalk or gravel pits	[ ]	26.	coppice	[ ]
			27.	parkland and scattered trees	[ ]
9.	Inland rock	[ ]			
10.	Waterside vegetation	[ ]	28.	carr	[ ]
11.	Fen (and swamp)	[ ]	29.	coniferous	[ ]
12.	Bog	[ ]	30.	plantation	[ ]
13.	Mountain vegetation and moorland	[ ]	31.	caledonian pine	[ ]
			32.	mixed	[ ]
14.	Wet heath	[ ]	33.	scrub	[ ]
15.	Dry heath	[ ]			
16.	Arable	[ ]	34.	Churchyards	[ ]
	Grassland:		35.	Garden	[ ]
17.	improved	[ ]	36.	Walls	[ ]
18.	semi-improved	[ ]	37.	Hedgerow	[ ]
19.	unimproved	[ ]	38.	Roadside vegetation	[ ]
20.	acid	[ ]	39.	Wasteland	[ ]
			40.	Other (please specify)	[ ]

41. Urban [ ] 42. Suburban [ ] 43. Rural [ ]
[Tick all that apply]

6.0 Methodology

6.1 *Sampling methods used in monitoring: Please give details (eg any methods of quantification or standardisation etc.) in space at right of tick-boxes:*

		✓
1.	Direct Observation:	[ ]
2.	total census etc.	[ ]
3.	transects	[ ]
4.	walking, looking, no fixed route	[ ]
5.	quadrats	[ ]
6.	Sweep-net	[ ]
7.	Beating	[ ]
8.	Hand searching	[ ]
9.	Sieve and sort	[ ]
10.	Pitfall trap	[ ]
	Preservative: Yes[ ] No[ ]	
11.	Extraction funnels or similar	[ ]
12.	Vacuum sampler (D-vac)	[ ]

Figure 5: The questionnaire mailshot.

14. Water trap [ ]
    colour:
    dimensions:
    other structural features:
15. Malaise trap [ ]
16. Light trap [ ]
17. Emergence trap [ ]
18. Interception trap [ ]
19. Aquatic sampling (please specify) [ ]

Other (please specify) [ ]

[Tick all that apply]

6.2 At what time of year do you monitor?

J	F	M	A	M	J	J	A	S	O	N	D
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

With what frequency (eg weekly/daily)? . . . . . .

Start and end dates for monitoring scheme: START [ ] END [ ] .

Has the scheme been continuous? Yes[ ] No[ ]. If no, please explain . . . . . .

. . . . . .

Please give any other information which you think may be relevant concerning techniques (you may continue on a separate sheet): . . . . . .

. . . . . .

. . . . . .

. . . . . .

6.3 Do you feel that there are any particular features of this species/group that:

1) lend themselves well to population monitoring? . . . . . .

. . . . . .

. . . . . .

2) pose difficulties to population monitoring? . . . . . .

. . . . . .

. . . . . .

7.0 People and Resources

Are you:

Paid [ ] Voluntary [ ]

Which one describes you best?

	√
1. Researcher	[ ]
2. N.R. Warden	[ ]
3. Field centre staff/teacher	[ ]
4. Consultant	[ ]
5. County/society recorder	[ ]
6. Amateur naturalist	[ ]
7. Other (please specify)	[ ] . . . . .

Approximately how many person-hours per week or year would you say were spent on these monitoring projects?

√ Hours[ ]/week or [ ]/year

Have you received special funding for this monitoring?

√ YES[ ] NO[ ]

If yes, please give details of the source of funds (eg 'NCC', WWF, naturalists trust, local companies or societies, etc.)

8.0 Data Handling

Where are your records stored? local museum[ ] society/trust offices[ ] home[ ]

Other[ ] . . . . . .

Are your records computerized? √ YES[ ] NO[ ]

If yes, please give details of:

1) Computer used: . . . . . .

2) Data management system used: . . . . . .

3) Transfer media (disk, tape etc.) . . . . . .

9.0 Publications

Have there been any publications or reports to publicize your monitoring or to give results?

√ YES[ ] NO[ ]

If yes, please give details (eg publicity, Instructions for monitors, recording forms, papers).

Full bibliographic references to, or copies of, any publications would be greatly appreciated.

Thank you for taking the time to complete this questionnaire. Some of the information you have provided will be kept on a data base registered under the Data Protection Act. Please do not hesitate to contact me if you have any queries.

Peter J P Croucher
Biological Records Centre
ITE Monks Wood, Abbots Ripton
Huntingdon, Cambs PE17 2LS

Telephone: 04873 381 ext. 229

Fax: 04873 467

Figure 7: Personally headed (preliminary mailing) letter.

Mr Robin Scagell
1 Milverton Drive
Ickenham
Uxbridge
Middlesex UB10 8PP

2 June 1992

Dear Mr Scagell,

I have been advised to write to you by Brian Eversham at the Biological Records Centre here at Monks Wood. As you will see from the enclosures we are conducting a survey into terrestrial and freshwater invertebrate population monitoring in the United Kingdom. I am writing to you in the hope that you may be doing some monitoring yourself or know of people who are (and we would love to know about). A similar survey was performed for butterflies in 1988 and so we do not wish information about these.

We are also hoping that you can provide some friendly criticism of the questionnaire in its layout and content, for instance are any of the questions too obscure or ambiguous? Whether or not you can provide any monitoring information this would be very much appreciated before we produce our main mail-shot (hopefully any spelling mistakes should have been corrected by then!).

I do hope you can be of help. I would appreciate your reply to be as rapid as possible because we are anxious to send the final draft off.

Thank you.

Yours sincerely

Peter J P Croucher
Biological Records Centre

Encs

Figure 6: Standard covering letter.

ENVIRONMENTAL INFORMATION CENTRE

Institute of Terrestrial Ecology

Monks Wood Experimental Station

Abbots Ripton, Huntingdon
Cambridgeshire PE17 2LS
United Kingdom

Telephone (04873) 381/8
Telex 32416 MONITE G
Facsimile (04873) 590
JANET

16 June 1992

Your ref

Our ref

TERRESTRIAL AND FRESHWATER INVERTEBRATE POPULATION MONITORING IN THE U.K.

The Biological Records Centre (BRC) is conducting a survey of invertebrate population monitoring in the U.K. This survey is in collaboration with Brian Eversham at BRC and Martin Drake at English Nature.

Please note, monitoring does not mean one-off or sporadic surveys, rather we take it to mean an extended series of 'surveys' undertaken in order to provide a time series, to ascertain the changes in a population level over time.

The enclosed explanatory notes give more details of the rationale behind the survey.

If you or your organisation are involved in any form of invertebrate monitoring (other than butterflies), I should be very grateful if you would complete the enclosed questionnaire and return it to me, by the end of July, using the enclosed prepaid label. If you should require further questionnaires (because you are monitoring more than one group/species or you are monitoring at different sites) we would be glad to provide them, or you could photocopy this one. The questionnaire is being sent to all local biological/environmental records centres, national conservation agencies, county wildlife trusts, and field centres but not to MAFF or NRA regional offices. If you know of other organisations or individuals monitoring invertebrate populations (excluding butterflies) in your area, please let me know.

Please assume total ignorance on my part and send details of anything that seems remotely relevant!

Thank you for your co-operation.

Yours sincerely

Peter J P Croucher
Biological Records Centre

Encs

Natural Environment Research Council

ENVIRONMENTAL INFORMATION CENTRE

The Institute of Terrestrial Ecology

Monks Wood Experimental Station
Abbots Ripton, Huntingdon PE17 2LS
Telephone : Abbots Ripton (04873) 381
Facsimile : 04873467 Telex : 32416

Dear

Figure 8: Recording scheme organisers letter.

TERRESTRIAL AND FRESHWATER INVERTEBRATE POPULATION MONITORING IN THE U.K.

The Biological Records Centre (BRC) is conducting a survey of invertebrate population monitoring in the U.K. This survey is in collaboration with Brian Eversham at BRC and Martin Drake at English Nature.

Please note, monitoring does not mean one-off or sporadic surveys, rather we take it to mean an extended series of 'surveys' undertaken in order to provide a time series, to ascertain the changes in a population over time.

The enclosed explanatory notes give more details of the rationale behind the survey.

As a recording scheme organiser you are probably involved in such population monitoring or know of people who are. If you are monitoring any invertebrate populations, I should be very grateful if you would complete the enclosed questionnaire and return it me, by the end of July, using the enclosed prepaid label. If you know of any other people who are involved in such work could you please send their details to me and/or pass on copies of this questionnaire to them. Also, if you should require extra copies of this questionnaire (because you are monitoring more than one group/species or you are monitoring at different sites) we would be glad to provide them, or you could photocopy this one.

The questionnaire is being sent to all recording scheme organisers, local biological/environmental records centres, county wildlife trusts, and field centres but not to MAFF or NRA regional offices.

We do not wish information about butterflies as these were surveyed seperately in 1988.

Please send details of anything that seems remotely relevant!

Thank you for your co-operation.

Yours sincerely

Peter J P Croucher
Biological Records Centre

Encs

Natural Environment Research Council

ENVIRONMENTAL INFORMATION CENTRE

The Institute of Terrestrial Ecology

Monks Wood Experimental Station
Abbots Ripton, Huntingdon PE17 2LS
Telephone : Abbots Ripton (04873) 381
Facsimile : 04873467 Telex : 32416

Dear

TERRESTRIAL AND FRESHWATER INVERTEBRATE POPULATION MONITORING IN THE U.K.

Thank you very much for your reply to my recent letter and questionnaire regarding Invertebrate Population Monitoring.

My apologies for this being a blanket aknowledgement but time does not permit personal replies to everyone.

The survey appears to be going well and we are receiving lots of useful data.

Thank you.

Yours sincerely

Peter J P Croucher
Biological Records Centre

Figure 9: Letter of aknowledgement.

3.3 Literature

3.3.1 Introduction

The questionnaire was not the only way of collecting information about current and recent invertebrate population monitoring in Britain and Northern Ireland. Information was also collected through a literature search using selected ecological publications. Such a review of invertebrate population monitoring has probably never been undertaken before. It was hoped that this approach would yield information on different aspects, such as detailed techniques, not achieved via the questionnaire and form the basis of an on-going literature database.

3.3.2 Facilities

The main library used was the excellent ecological library at Monks Wood; however, occasional use was also made of the Cambridge University main (copyright) library and the Balfour library of the zoology department in Cambridge. The EN library in Peterborough was also accessed for references, but not specifically in connection with the literature search.

3.3.3 Journals and approach

Initially, it was hoped that the literature search would form a simple, autonomous review of invertebrate population monitoring literature, which could perhaps even be published (rather in the vein of the BRC butterfly survey of 1988 which also involved a questionnaire and literature search; the latter led to the booklet 'Recent surveys and research on butterflies in Britain and Ireland: a species index and bibliography' (Harding & Green, 1991)). However, although such publications may be possible, it soon became apparent that a full literature search was going to be a mammoth and painstaking task, mainly for these reasons:

1) All terrestrial and freshwater invertebrates (excluding butterflies) were to be covered, though naturally this number could be reduced to the groups deemed most likely for study in the UK. The number was further reduced by not looking in pest-orientated journals, which were likely to contain information of low conservation value.

2) There are relatively few papers dealing **explicitly** with monitoring. 'Population monitoring' mostly occurs within the methods section of papers and is rarely their focus, just an aspect of technique (for example, in elucidating life-history parameters). Hence papers including population monitoring are hard to find by standard bibliographic retrieval techniques, as 'monitoring' is rarely listed in the keywords or abstracts.

Mainly because of the latter problem, the literature search got off to a slow start using abstracts journals. Such journals included 'Entomology Abstracts', 'Ecological Abstracts', and 'Ecology Abstracts'. Their international (rather than purely British) coverage also increased searching time. It was eventually decided that targeting specific journals was the best way forward. So, after scanning very many publications, the following list was drawn up and worked through, volume by volume, from current to January 1980 (where possible):

Antenna
Biological Conservation
Dipterist's Digest (since 1988 only)
Ecological Entomology
Odonatologica
The Entomologist (since 1988 only)
The Entomologist's Gazette
The Entomologist's Monthly Magazine
The Entomologist's Record and
Journal of Variation
The Journal of Animal Ecology

In order to facilitate and provide a focus for data extraction from papers a form was created. This was a cannibalised questionnaire that had all the unnecessary sections such as 'people and resources' and 'data storage' cut from it. These were deemed irrelevant to the literature search as most papers would not provide such information. This form was photo-reduced to A4 size and a filled-in copy attached to a photocopy of the paper in question for filing.

Although the search was not as comprehensive as it could have been, it was eventually productive (leading to 51 entries to the database). Time constraints meant that the questionnaire was given priority at all times because it would elucidate **current** research of direct conservation value (because of the people targeted). The literature would tend to produce articles of more 'pure' research. Furthermore the database can be continually added to from the literature as useful articles are 'found', whereas the questionnaire was more of a 'one-off' exercise.

One could argue that research papers, often of a non-conservation orientation, would not be relevant to the questionnaire. However, the techniques described are relevant and a considerable overlap between the literature and the questionnaire was found. Generally, if a scheme appeared in both, the personal contact (questionnaire) took priority and the literature article was merely cited as a reference to the questionnaire.

3.4 Database

Perhaps the most important product of this project was the setting up of a computerized database of invertebrate population monitoring activity in Britain and Northern Ireland. This aspect occupied about half of the author's time at Monks Wood. For the sake of clarity and brevity the detailed discussion of the computing involved in producing and interrogating the database has been placed in appendix A.

The database management system was built using the relational package 'Advanced Revelation' (1990, Revelation Technologies Incorporated) on an IBM PS2 personal computer. This was used in preference to systems such as 'Oracle' on the mainframe VAX/VMS system at Keyworth, Swindon, on which most BRC work is kept, because it is particularly user friendly, is very powerful, and was on the computer most easily available in BRC because of space limitations in the building and the current use of other equipment!

Some thought to the structure of the database had to be given whilst designing the questionnaire; however, most of the database work fell in the last half of the project.

The work fell into this pattern:

1) Design and construction of the database.

2) Data input from returned questionnaires.

3) Data input from the literature.

4) Data extraction and analysis.

It was not possible to put all the information received into the database, though most of it is there. The original questionnaires, literature forms and papers will be stored in the BRC archive; people are recommended to refer back to the originals for extra details when examining an individual record. Advanced Revelation allows its structure to be altered as it is used, within limits, and as with the design of the questionnaire the database's structure evolved further during data entry, mostly with the addition of occasional extra fields for unexpected answers that were common enough to warrant inclusion.

4.0 Results to survey

4.1 Introduction

The 536 questionnaires mailed (and hence 550 to 600 received because of photo-copying by recipients) led to 164 replies, a return rate of 30.6% of 536. 98 of these replies were positive with regard to monitoring, a return rate of 18.3% of 536, and 66 were negative, a return rate of 12.3 % of 536; many of the notes in the negative replies could also be of use as they often highlighted the reasons why monitoring was not being performed. The return rate of 18.3% for positive replies was quite high and led to 127 entries to the database which was the sort of figure to be aimed at if any useful conclusions were to be drawn from the results.

The literature search led to 51 entries to the database and in the analysis of the information, entries for literature and questionnaires (or 'personal') will be treated both individually and combined in order to draw comparisons between the two as they differed in the nature of the individuals targeted, the literature being largely academic.

In total 178 entries were made to the database. The methods of extracting information from the database are discussed in appendix A.

The database contains a lot of information on from a wide variety of topics and the possible number of permutations for comparisons in data extraction are huge. Unfortunately, it would take too much time to explore all the possibilities so the results are restricted to the basic summing of the possible entries in record fields and those comparisons of most biological or conservation interest. The results are largely presented in the same order as the sections appear on the questionnaire and the database from which they come. Most comparisons presented followed from discussion of the preliminary R/list reports from the database (appendix B) and the summation of the various data-entry fields.

The reader is urged to look at the copy of the questionnaire in *figure 5*, the R/list reports in Appendix B, and the list of data entry fields for the database in appendix A.

4.2 Contacts

4.2.1 Summary

The table 'CONTACTS' contained 87 records relating to questionnaires and 42 records relating to literature.

These results show the organisations that are involved in monitoring invertebrates. It is no surprise that in the literature search most of the contacts were university based (78.57%) – this is a reflection of the fact that relatively few amateurs publish scientific notes and papers. The results from the questionnaires are probably of more interest. Again the universities were important (11.49%) but the combined numbers of Government funded organisations such as EN, SNH, CCW, ITE, JNCC and the Forestry Authority outweigh them. The amateur based Wildlife Trusts and Natural History Societies made up over 20% of the contacts. The structure of this table could simply reflect the pattern of the mailshot but scrutiny of Table 1 (section 3.2.3) does not support this and so the table below is probably a fair reflection of the relative involvement of various organisations. It should be pointed out that this does not directly reflect organisational involvement in individual schemes as one contact may be involved in several schemes. Also not all contacts were affiliated to any organisation – about 31% were unaffiliated amateurs (that is excluding the 20% plus belonging to societies and trusts). As far as individual schemes were concerned most people by far were amateurs (section 4.8.2).

4.2.2 Organisations involved in monitoring

Table 2
Number of contacts associated with various types of organisation – from questionnaires. (This does not relate directly to the number of monitoring schemes associated with each type of organisation as some of the contacts are involved in more than one scheme).

Total fields filled = 60 out of a possible 87 (68.97%)

ORGANISATION	NUMBER	% (OF 87)
EN	11	12.64
University	10	11.49
Natural History Societies	9	10.34
Wildlife trusts	9	10.34
Consultants and commercial researchers	4	4.60
Museums	4	4.60
Field Studies Council or similar	2	2.30
SNH	2	2.30
CCW	1	1.15
ITE	1	1.15
JNCC	1	1.15
National Trust	1	1.15
Dept. of agriculture N. I.	1	1.15
The Forestry Authority	1	1.15
Manx National Heritage	1	1.15
Ministry of Defence	1	1.15

Table 3
Number of contacts associated with various types of organisation – from literature. (This does not directly relate to the number of monitoring schemes associated with each type of organisation as some of the contacts are involved in more than one scheme).

Total fields filled = 40 out of a possible 42 (95.24%).

ORGANISATION	NUMBER	% (OF 42)
University	33	78.57
NERC/ITE	4	9.52
NCC (ex)	1	2.38
Game Conservancy	1	2.38
Freshwater Biological Association	1	2.38

4.3 Invertebrate taxa populations being monitored

4.3.1 Summary

The taxa table received 126 specific taxa entries, of which 88 related to questionnaires, 52 related to literature, and 12 related to both literature and questionnaires (see appendix B). The individual taxa can be conveniently grouped by, for instance, order.

The results for the occurrence of taxa in monitoring schemes below (*Tables 4, 5, 6*) have been largely grouped by taxonomic order except where this was inappropriate (eg invertebrates (general)). There are clearly a large variety of taxa being monitored but there are relatively few key groups for which there is a large body of work. The results are summarized in three pie charts (*figures 10, 11, 12*). The results were similar for literature and questionnaires except that in the literature the more 'awkward' groups such as hemiptera and diptera tended to dominate (reflecting the professional bias of the literature). *Figure 12*, showing the relative occurrence of taxa (combined), shows the overall monitoring effort by taxa. Taxa appear to have this order of preference: odonata> coleoptera> lepidoptera> diptera> hemiptera> hymenoptera> arachnida> orthoptera.

The life-cycle stages being used in monitoring were also looked at (*Tables 7, 8*). It would seem that the majority of monitoring schemes concern adult invertebrates (89.76% of questionnaires, 84.31% of literature), followed by larvae/immatures. The higher count for exuviae in the questionnaires reflects the large number of people monitoring odonata. Similarly the higher count for eggs in the literature reflects the professional research bias of the literature compared to the amateur bias of the questionnaires - monitoring eggs probably often requires specialist knowledge and is time consuming.

The adults are probably the most 'exciting' and easily sampled life-history stages but it would seem pertinent to ask whether the other stages being monitored were being so instead of adults or as well as adults, hence *Tables 9, 10*. These tables show that for questionnaires, of those monitoring adults, 41.23% were monitoring adults ONLY. 25.20% (out of all questionnaire records) were monitoring adults AND larvae/immatures, 11.81% were monitoring adults AND exuviae. For literature, of those monitoring adults, 18.60% were monitoring adults ONLY. 41.18% (out of all literature records were monitoring adults AND larvae/immatures, and 11.76% were monitoring adults AND eggs. As mentioned above the occurrence of eggs in the literature and exuviae in the questionnaires reflects the professional bias of the literature and the largely amateur bias of the questionnaire; favouring less tedious groups such as dragonflies.

Figure 10:

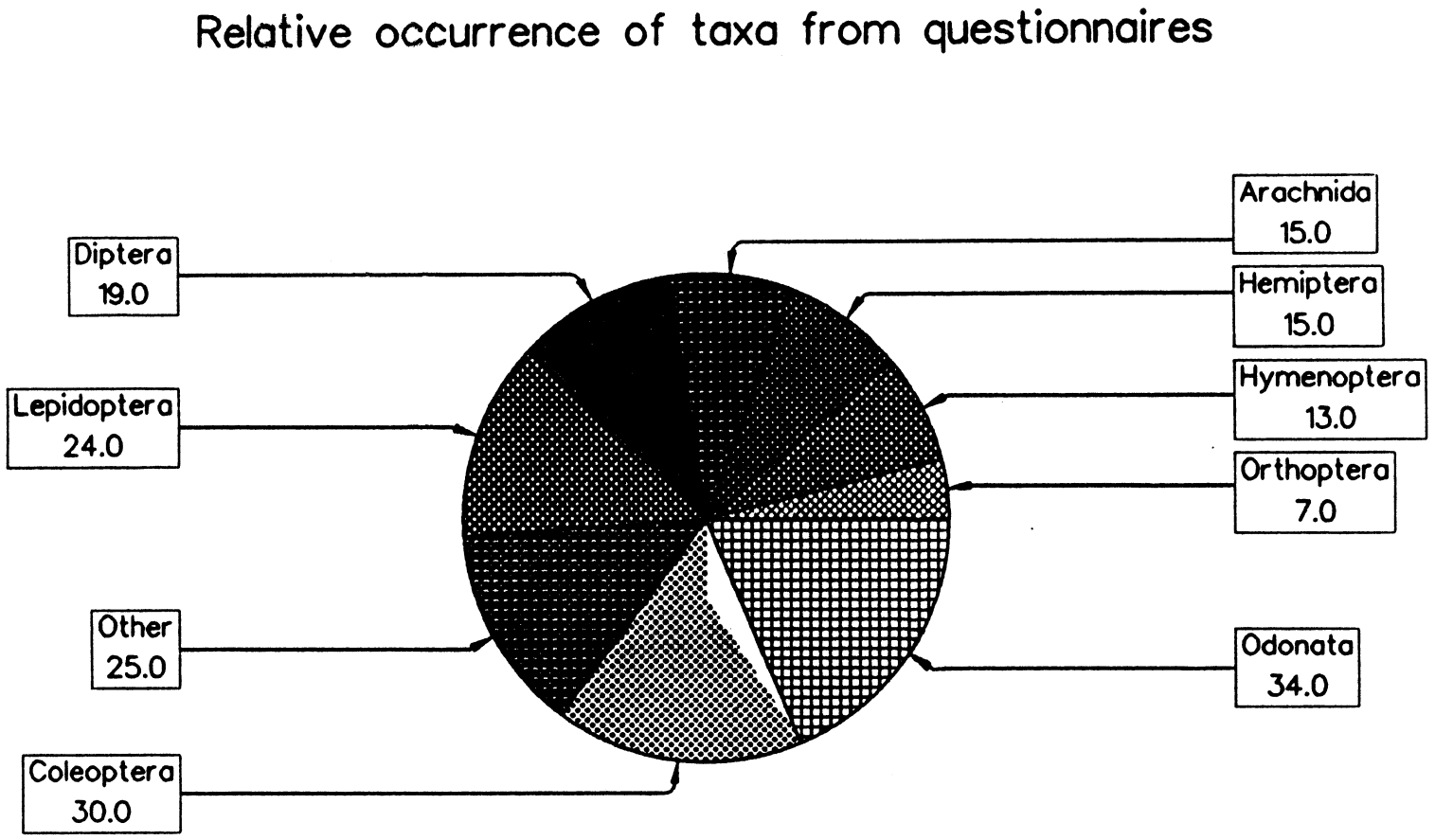

Relative occurrence of taxa from questionnaires
Arachnida
15.0
Hemiptera
15.0
Hymenoptera
13.0
Orthoptera
7.0
Odonata
34.0
Coleoptera
30.0
Other
25.0
Lepidoptera
24.0
Diptera
19.0

Figure 11:

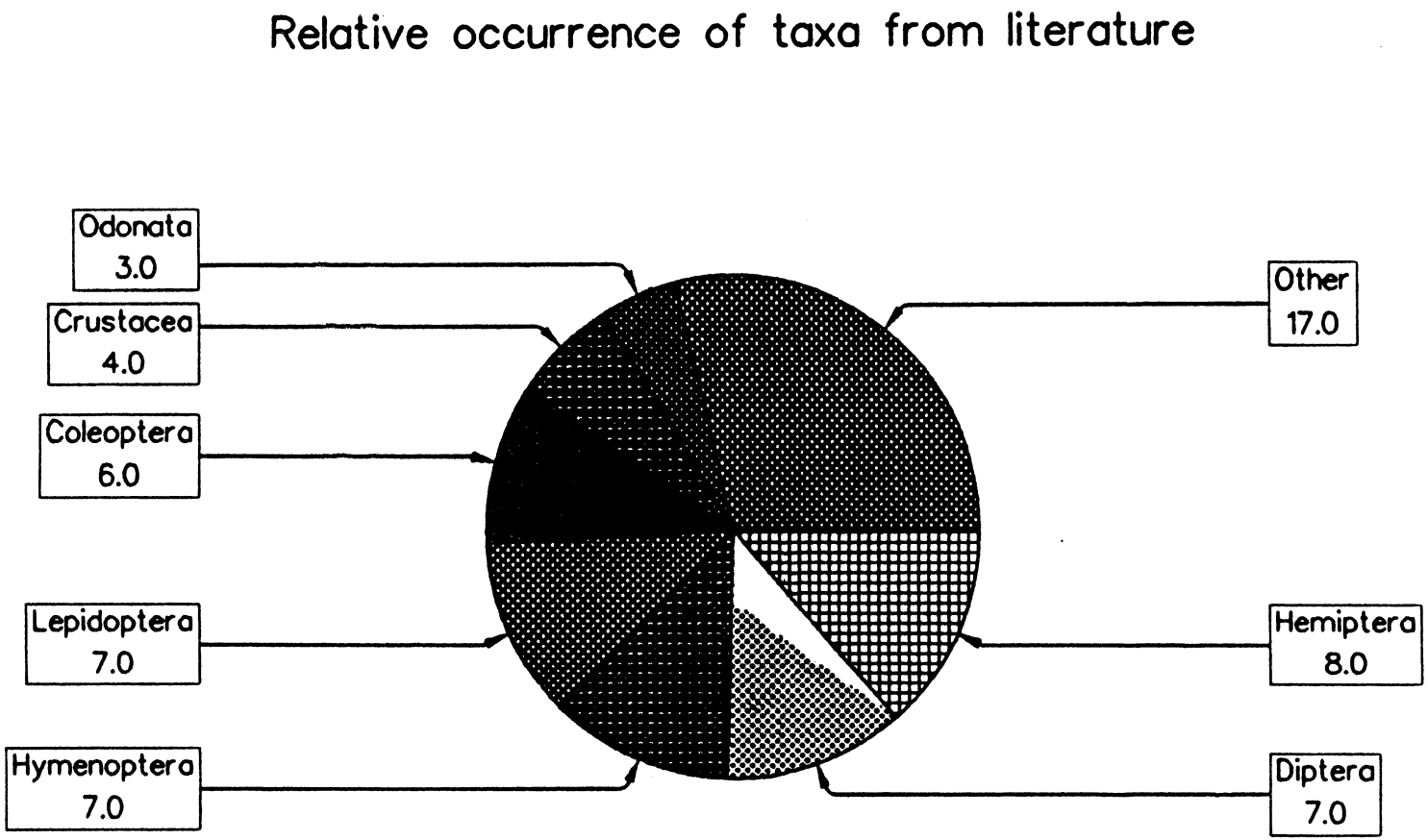
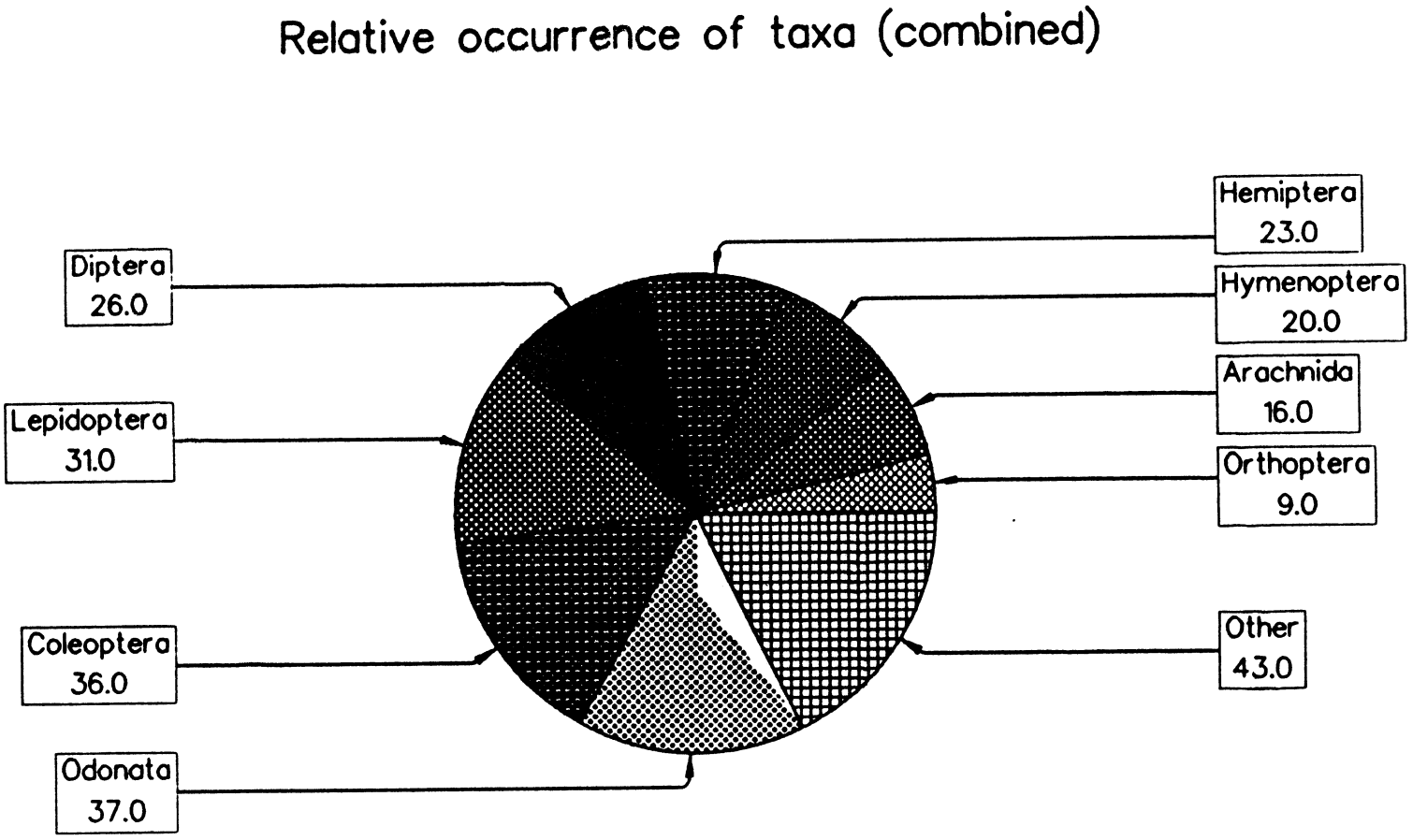

Relative occurrence of taxa from literature
Odonata
3.0
Crustacea
4.0
Coleoptera
6.0
Lepidoptera
7.0
Hymenoptera
7.0
Other
17.0
Hemiptera
8.0
Diptera
7.0

Figure 12:


Relative occurrence of taxa (combined)
Hemiptera 23.0
Hymenoptera 20.0
Arachnida 16.0
Orthoptera 9.0
Other 43.0
Diptera 26.0
Lepidoptera 31.0
Coleoptera 36.0
Odonata 37.0

4.3.2 Taxa being monitored

Table 4
Number of monitoring schemes using various taxa (grouped) – from questionnaires.
In order of percentage.

(Remember that one monitoring scheme equals one record in the database. One monitoring scheme may study several taxa or groups, sometimes unrelated, and may also study several sites (though not different taxa at different sites – this would represent separate records on the database)).

TAXA	NUMBER	% (OF 127)
Odonata (all)	34	26.77
Odonata: anisoptera	32	25.20
Coleoptera	30	23.62
Odonata: zygoptera	28	22.05
Lepidoptera: (all)	24	18.90
Lepidoptera (macro)	23	18.11
Diptera	19	14.96
Arachnida	15	11.81
Hemiptera	15	11.81
Hymenoptera	13	10.24
Lepidoptera (micro)	8	6.30
Orthoptera	7	5.51
Mollusca	4	3.15
Arthropoda	3	2.36
Crustacea	3	2.36
Invertebrates (general)	3	2.36
Annelida: Hirudinea	1	0.79
Collembola	1	0.79
Dermaptera	1	0.79
Dictyoptera	1	0.79
Diplopoda	1	0.79
Ephemeroptera	1	0.79
Invertebrates Freshwater (general)	1	0.79
Neuroptera	1	0.79
Platyhelminthes	1	0.79
Plecoptera	1	0.79
Thysanura: Lepisma saccharina	1	0.79
Trichoptera	1	0.79

Table 5
Number of monitoring schemes using various taxa (grouped) – from literature.
In order of percentage.

TAXA	NUMBER	% (OF 51)
Hemiptera	8	15.67
Diptera	7	13.73
Hymenoptera	7	13.73
Lepidoptera: (all)	7	13.73
Coleoptera	6	11.76
Lepidoptera (macro)	6	11.76
Crustacea	4	7.84
Lepidoptera (micro)	3	5.88
Odonata (all)	3	5.88
Odonata: anisoptera	3	5.88
Odonata: zygoptera	2	3.92
Collembola	2	3.92
Orthoptera	2	3.92
Psocoptera	2	3.92
Annelida: Hirudinea	1	1.96
Arachnida	1	1.96
Arthropoda	1	1.96
Chilopoda	1	1.96
Diplopoda	1	1.96
Ephemeroptera	1	1.96
Invertebrates (general)	1	1.96
Mollusca	1	1.96
Neuroptera	1	1.96
Platyhelminthes	1	1.96
Siphonaptera	1	1.96

Table 6
Number of monitoring schemes using various taxa (grouped) from questionnaires and literature combined. In order of percentage.

TAXA	NUMBER	% (OF 178)
Odonata (all)	37	20.79
Coleoptera	36	20.22
Odonata: anisoptera	35	19.66
Lepidoptera: (all)	31	17.42
Odonata: zygoptera	30	16.85
Lepidoptera (macro)	29	16.29
Diptera	26	14.61
Hemiptera	23	12.92
Hymenoptera	20	11.24
Arachnida	16	8.99
Lepidoptera (micro)	11	6.18
Orthoptera	9	5.06
Crustacea	7	3.93
Mollusca	5	2.81
Arthropoda	4	2.25
Invertebrates (general)	4	2.25
Collembola	3	1.69
Annelida: Hirudinea	2	1.12
Diplopoda	2	1.12
Ephemeroptera	2	1.12
Neuroptera	2	1.12
Platyhelminthes	2	1.12
Psocoptera	2	1.12
Chilopoda	1	0.56
Dermaptera	1	0.56
Dictyoptera	1	0.56
Invertebrates Freshwater (general)	1	0.56
Plecoptera	1	0.56
Thysanura: Lepisma saccharina	1	0.56
Trichoptera	1	0.56
Siphonaptera	1	0.56

4.3.3 Life-history stages

Table 7
Number of monitoring schemes using various life-history stages - from questionnaires.

Total fields filled = 126 out of a possible 127 (99.21%).

CODE	STAGES	NUMBER	% (OF 127)
5	Adult	114	89.76
2	Larva/immature	37	29.13
4	Exuvium	17	13.39
3	Pupa	11	8.66
1	Egg	7	5.51
6	No. of nests	4	3.15
7	Other	4	3.15
	*	1	0.79

Table 8
Number of monitoring schemes using various life-history stages - -from literature.

Total fields filled = 51 out of a possible 51 (100%).

CODE	STAGES	NUMBER	% (OF 51)
5	Adult	43	84.31
2	Larva/immature	29	56.86
1	Egg	7	13.73
3	Pupa	5	9.80
7	Other	3	5.88
4	Exuvium	1	1.96
6	No. of nests	1	1.96

Table 9
Number of monitoring schemes using adults **and** other life-history stages - from questionnaires.

CODE	STAGE	NUMBER	% (OF 127)
5	Adult	114	89.76
5&2	& Larva/immature	32	25.20
5&4	& Exuvium	15	11.81
5&3	& Pupa	8	6.30
5&1	& Egg	6	4.72
5&7	& Other	4	3.15
5&6	& No. of nests	2	1.57
	*	1	0.79

Those looking at adults ONLY = 47 (41.23% of 114 looking at adults).

Table 10
Number of monitoring schemes using adults **and** other life-history stages - from literature.

CODE	STAGE	NUMBER	% (OF 51)
5	Adult	43	84.31
5&2	& Larva/immature	21	41.18
5&1	& Egg	6	11.76
5&3	& Pupa	3	5.88
5&7	& Other	3	5.88
5&4	& Exuvium	1	1.96
5&6	& No. of nests	1	1.96

Those looking at adults ONLY = 8 (18.60% of 43 looking at adults).

4.4 Objectives of monitoring

4.4.1 Summary

This section aims to elucidate the objectives of peoples monitoring schemes. Not surprisingly 100% of the literature was classified as being for species/group information or research – having come from papers etc. However some papers were classified as having other objectives also and are worth scrutiny; however these classifications are very subjective (especially enjoyment/recreation!). For the questionnaires, 71.65% of schemes were deemed to be for group information or research, 52.76% for site management and 42.52% for species/group protection. 32.28% were for enjoyment/recreation (in conjunction with other objectives) and 28.35 were for site protection. 38.58 said that their monitoring was for site evaluation – monitoring is surely a very tedious way to evaluate a site. Perhaps this answer should be taken to mean monitoring for the continued existence of a scarce species?

Three of these objectives were related to peoples professions in *Tables 13, 14, 15* (for questionnaires only). Of those schemes undertaken for species/group information or research, 48.35% were carried out by amateurs and 38.46% by professional researchers, all other groups lagged well behind these two. Of those schemes undertaken for species/group protection most were by amateurs (53.70%), with wardens, researchers and county/society recorders also important (20–30% each). Of those schemes expressing enjoyment/recreation as an objective, 87.80% were carried out by amateurs, much than any other group. So amateurs do it for fun but also for many other reasons.

51.97% of questionnaires stated that their results had been of practical use so far (*Table 16*), that is nearly half the schemes had been of no practical use. This may simply be a reflection of the recentness of the schemes, for example of those schemes that have been of practical use only 13 started in 1990 or later, whereas, of those schemes that have been of no practical use yet 26 started in 1990 or later (see the R/LIST report in appendix B).

Only 5.51% of questionnaires stated that monitoring took place whilst doing the BMS (*Table 17*). In other words very few BMS people do other things. This implies that new networks would probably be required if monitoring other groups was to be coordinated centrally.

67.72% of questionnaires stated that other monitoring was occurring at their monitoring site, this is a lot. 13.39% did not know (*Table 18*). Of those sites with other monitoring, about 72% had monitoring of vegetation, 55% birds, 31% butterflies and other invertebrates, 17% mammals, and 10% water table/quality (*Table 19*). This suggests that habitat is or could quite easily be monitored in terms of vegetation at most invertebrate sites. However, this was generally not done by the people answering the questionnaire and one doubts if **most** people really know what others are doing at their sites.

4.4.2 Objectives

Table 11
Number of monitoring schemes expressing various objectives – from questionnaires.

Total fields filled = 127 out of a possible 127 (100%).

CODE	OBJECTIVE	NUMBER	% (OF 127)
2	Species/group information or research	91	71.65
3	Site management	67	52.76
1	Species/group protection	54	42.52
5	Site evaluation	49	38.58
6	Enjoyment/recreation	41	32.28
4	Site protection	36	28.35
7	Computerized data bank	24	18.90
8	Uncomputerized data bank	23	18.11
9	Other	22	17.32

Number of monitoring schemes commenting on their objectives – from questionnaires.

Total fields filled = 36 out of a possible 127 (28.35%).

Table 12
Number of monitoring schemes with various objectives – from literature.

Total fields filled = 51 out of a possible 51 (100%).

CODE	OBJECTIVE	NUMBER	% (OF 51)
2	Species/group information or research	51	100.00
3	Site management	13	25.49
6	Enjoyment/recreation	11	21.57
1	Species/group protection	7	13.73
4	Site protection	4	7.84
5	Site evaluation	2	3.92

Number of monitoring schemes with a comment on their objectives – from literature.

Total fields filled = 9 out of a possible 51 (17.65%).

4.4.3 Objectives related to profession

Do the objectives of species/group information or research, species/group protection, and enjoyment/recreation, relate to peoples professions? (See section 4.8.2). (Data from questionnaires only).

Table 13
Species/group information or research

CODE	PERSON TYPE	NUMBER	% (OF 91)
6	Amateur naturalist	44	48.35
1	Researcher	35	38.46
5	County/society recorder	18	19.78
7	Other	16	17.58
2	NR Warden	13	14.29
4	Consultant	6	6.59
3	Field centre staff/ teacher	3	3.30

Table 14
Species/group protection

CODE	PERSON TYPE	NUMBER	% (OF 54)
6	Amateur naturalist	29	53.70
2	NR Warden	16	29.63
1	Researcher	16	29.63
5	County/society recorder	11	20.73
7	Other	6	11.11
4	Consultant	4	7.41
3	Field centre staff/ teacher	1	1.85

Table 15
Enjoyment/recreation

CODE	PERSON TYPE	NUMBER	% (OF 41)
6	Amateur naturalist	36	87.80
5	County/society recorder	9	21.95
1	Researcher	7	17.07
7	Other	4	9.76
2	NR Warden	3	7.32
4	Consultant	1	2.44
3	Field centre staff/ teacher	1	2.44

4.4.4 Results of practical use yet?

Table 16
Number of monitoring schemes stating that their results have been of practical use yet – from questionnaires.

Total fields filled = 125 out of a possible 127 (98.43%).

PRACTICAL USE YET?	NUMBER	% (OF 127)
Yes	66	51.97
No	59	46.46
*	2	1.57

Number of monitoring schemes making a comment on this practical use – from questionnaires.

Total fields filled = 68 out of a possible 127 (53.54%).

4.4.5 Monitoring whilst BMS?

Table 17
Number of monitoring schemes in which monitoring occurs whilst performing transects of the BMS – from questionnaires.

Total fields filled = 126 out of a possible 127 (99.21%).

BMS?	NUMBER	% (OF 127)
Yes	7	5.51
No	119	93.70
*	1	0.79

4.4.6 Other monitoring at the site?

Table 18
Number of monitoring schemes stating that monitoring other than invertebrates was occurring at the site – from questionnaires.

Total fields filled = 126 out of a possible 127 (99.21%).

OTHER MONITORING?	NUMBER	% (OF 127)
Yes	86	67.72
No	23	18.11
Don't know	17	13.39
*	1	0.79

Number of monitoring schemes making comment on the other monitoring occurring at the site – from questionnaires.

Total fields filled = 83 out of a possible 127 (65.35%).

Number saying yes to other monitoring but giving no comment = 4 out of a possible 127 (3.15%). (A sign of a user friendly questionnaire?).

Number saying no to other monitoring and giving no comment = 22 out of a possible 127 (17.32%).

Number saying "don't know" to other monitoring and giving no comment = 16 out of possible 127 (12.60%).

What was this other monitoring? This has been roughly calculated, for the main examples, from the comments supplied by the 86 schemes that knew about other monitoring. Exact figures are not possible because comments such as 'all life-forms' leaves one sceptical over whether mammals or birds or worms really are being monitored there; no-one can monitor everything. It is also doubtful whether much of this really counts as other monitoring in strict terms, do people really know what other people are doing in detail on the same site?

Table 19

OTHER MONITORING	NUMBER (APPROXIMATE)	% (OF 86)
Vegetation	62	72.09
Birds	47	54.65
Butterflies & other invertebrates	27	31.40
Mammals	15	17.44
Water table/quality	9	10.47

4.5 Habitats in which monitoring occurs

4.5.1 Summary

The full results for this section are given below but *tables 22, 23* divide the habitats into broad categories which may be more useful. The fact that only 22.83% of questionnaires needed a written 'habitat comment' suggests that the codes provided allowed people to say what they wanted and justifies this as a robust habitat classification (no habitat classification can be universally appropriate). These tables are self-explanatory and hold few surprises. In both literature and questionnaires 'woodland and scrub' was a very common habitat type, as were 'grassland' and 'heath and moorland'. The relatively high position for 'manmade, arable and garden' in the literature is probably due to the influence of the many schemes from a Leicester garden (Owen, 1991). The high position of 'open water, waterside vegetation and mire' in the questionnaires reflects the large number of odonata schemes which they recorded.

4.5.2 Habitats

Table 20
Number of monitoring schemes using various habitats - from questionnaires.

Total fields filled = 125 out of a possible 127 (98.43%).

Please see over:-

CODE	HABITAT	NUMBER	% (OF 127)
25	Woodland deciduous	41	32.28
19	Grassland unimproved	37	29.13
5	Open standing water	30	23.62
23	Grassland grazed	29	22.83
33	Woodland scrub	29	22.83
10	Waterside vegetation	28	22.05
12	Bog	28	22.05
21	Grassland neutral	23	18.11
14	Wet heath	22	17.32
18	Grassland semi-improved	22	17.32
37	Hedgerow	21	16.54
6	Open running water	20	15.75
15	Dry heath	20	15.75
32	Woodland mixed	20	15.75
20	Grassland acid	18	14.17
27	Woodland parkland	18	14.17
35	Garden	18	14.17
36	Walls	17	13.39
22	Grassland calcareous	16	12.60
29	Woodland coniferous	16	12.60
28	Woodland carr	15	11.81
11	Fen (and swamp)	14	11.02
17	Grassland improved	14	11.02
24	Grassland other	13	10.24
26	Woodland coppice	13	10.24
30	Woodland plantation	12	9.45
13	Mountain and moorland	10	7.87
38	Roadside vegetation	10	7.87
7	Canal	9	7.09
39	Wasteland	9	7.09
3	Sand dune	8	6.30
4	Saltmarsh	8	6.30
40	Other	8	6.30
16	Arable	7	5.51
8	Quarry, chalk, gravel pit	6	4.72
1	Cliff	5	3.94
2	Shingle	5	3.94
34	Churchyards	5	3.94
9	Inland rock	3	2.36
31	Woodland Caledonian pine	1	0.79
	*	2	1.57
43	Rural	101	79.53
42	Suburban	23	18.11
41	Urban	11	8.66

Number of monitoring schemes making a 'habitat comment' – from questionnaires.

Total fields filled = 29 out of a possible 127 (22.83%).

Table 21
Number of monitoring schemes using various habitats – from literature.

Total fields filled = 51 out of a possible 51 (100%).

CODE	HABITAT	NUMBER	% (OF 51)
25	Woodland deciduous	11	21.57
32	Woodland mixed	10	19.61
35	Garden	10	19.61
22	Grassland calcareous	9	17.65
29	Woodland coniferous	9	17.65
23	Grassland grazed	7	13.73
19	Grassland unimproved	6	11.76
5	Open standing water	4	7.84
6	Open running water	4	7.84
15	Dry heath	4	7.84
27	Woodland parkland	4	7.84
13	Mountain and moorland	3	5.88
16	Arable	3	5.88
33	Woodland scrub	3	5.88
10	Waterside vegetation	2	3.92
20	Grassland acid	2	3.92
30	Woodland plantation	2	3.92
1	Cliff	1	1.96
11	Fen (and swamp)	1	1.96
17	Grassland improved	1	1.96
28	Woodland carr	1	1.96
36	Walls	1	1.96
37	Hedgerow	1	1.96
40	Other	1	1.96
43	Rural	40	78.43
42	Suburban	12	23.53
41	Urban	2	3.92

Number of monitoring schemes with a 'habitat comment' – from literature.

Total fields filled = 10 out of a possible 51 (19.61%).

4.5.3 Broadly defined habitats

The habitats have been split into the broad heading shown below, these are not perfect but they help to simplify the picture:

Table 22
Questionnaires.

BROAD HABITAT	MEAN NUMBER	MEAN % (OF 127)
Grassland	21.50	16.93
Open water, waterside vegetation & mire	21.50	16.93
Woodland and scrub	18.33	14.44
Heath, mountain & moorland	17.33	13.65
Manmade, arable & garden	11.67	9.19
Other	8.00	6.30
Coastal & salt	7.00	5.51
Rock	7.75	6.10
*	2.00	1.57

Table 23
Literature.

BROAD HABITAT	MEAN NUMBER	MEAN % (OF 51)
Woodland and scrub	5.71	11.20
Grassland	5.00	9.80
Manmade, arable & garden	4.67	9.15
Heath, mountain & moorland	3.50	6.86
Open water, waterside vegetation & mire	2.75	5.39
Coastal & salt	1.00	1.96
Rock	1.00	1.96
Other	1.00	1.96

4.6 Methodology

4.6.1 Methods

4.6.1.1 Summary

The pros. and cons. of the various methods and their distribution is addressed further in the discussion. Essentially one can see that for the questionnaires 'direct observation' and 'walking, looking, no fixed route' occur most frequently – these are not easily quantified methods and suggests that many monitoring schemes can not give a reliable index of abundance (without improvement). Most of the rigorously repeatable methods fall well down the list. As can be expected, the literature shows more rigorous methods, however, direct observation is still the most common method.

4.6.1.2 Methods

Table 24
Number of monitoring schemes using various methods – from questionnaires. In order of percentage.

Total number of fields filled = 127 out of a possible 127 (100%).

CODE	METHOD	NUMBER	% (OF 127)
1	Direct observation	77	60.63
4	Walking, looking, no fixed route	47	37.01
6	Sweep-net	39	30.71
3	Transects	36	28.35
8	Hand searching	36	28.35
10	Pitfall trap	28	22.05
7	Beating	25	19.69
2	Total census	22	17.32
9	Sieve and sort	21	16.54
16	Light trap	21	16.54
5	Quadrats	12	9.45
19	Aquatic sampling	10	7.87
20	Other	9	7.09
15	Malaise trap	6	4.72
11	Extraction funnels or similar	4	3.15
14	Water trap	4	3.15
12	Vacuum sampler (D-Vac)	3	2.36
18	Interception trap	3	2.36
17	Emergence trap	2	1.57
13	Suction trap (aerial sampler)	1	0.79

Table 25
Number of monitoring schemes using various methods - from literature.

Total fields filled = 51 out of a possible 51 (100%).

CODE	METHOD	NUMBER	% (OF 51)
1	Direct observation	11	21.57
20	Other	11	21.57
8	Hand searching	8	15.69
15	Malaise trap	8	15.69
5	Quadrats	7	13.73
11	Extraction funnels or similar	6	11.76
19	Aquatic sampling	5	9.80
3	Transects	4	7.84
10	Pitfall trap	4	7.84
16	Light trap	4	7.84
2	Total census	3	5.88
6	Sweep-net	3	5.88
7	Beating	3	5.88
12	Vacuum sampler (D-Vac)	3	5.88
4	Walking, looking, no fixed route	2	3.92
17	Emergence trap	2	3.92
9	Sieve and sort	1	1.96
13	Suction trap (aerial sampler)	1	1.96

4.6.2 Sampling timings

4.6.2.1 Summary

The sampling months are shown graphically in *figures 13, 14*. For both questionnaires and literature most sampling occurs between April and October with a peak in June. This would tie-in with the adult stages of most invertebrates in a Northern temperate climate. However as can be seen much monitoring occurs in the winter months and some occurs all year round (26.77% for questionnaires and 31.37% for literature).

The frequency of monitoring results (*tables 28, 29*) show a fair range of sampling intervals. For both questionnaires and literature weekly and monthly samples were the most common. The results show that people tend to follow 'standard' time intervals (ie weekly, monthly, fortnightly). The results represent a pigeon-holing of a myriad of complex responses and anyone designing a questionnaire would do well to avoid this. It was difficult when extracting information from literature as sampling frequencies often varied as techniques were modified within a paper covering a run of data.

A question was asked about monitoring scheme's continuity (*table 31, 32*) ie were there extended breaks in the recording. For the questionnaires 80.32% of schemes were continuous which is good (only 3.94% of questionnaires had no response to this question) and for the literature 88.24% of schemes were continuous.

4.6.2.2 Months

Table 26
Months in which monitoring takes place – from questionnaires.

Total fields filled = 125 out of a possible 127 (98.43%)

MONTH	NUMBER	% (OF 127)
1	40	31.50
2	42	33.07
3	57	44.88
4	76	59.84
5	105	82.68
6	112	88.19
7	106	83.46
8	106	83.46
9	98	77.17
10	78	61.42
11	50	39.37
12	39	30.71
All year	34	26.77

Table 27
Months in which monitoring takes place – from literature.

Total fields filled = 48 out of a possible 51 (94.12%).

MONTH	NUMBER	% (OF 51)
1	16	31.37
2	18	35.29
3	19	37.25
4	38	74.51
5	40	78.43
6	42	82.35
7	42	82.35
8	40	78.43
9	40	78.43
10	32	62.75
11	20	39.22
12	18	35.29
All year	16	31.37

Figure 13:

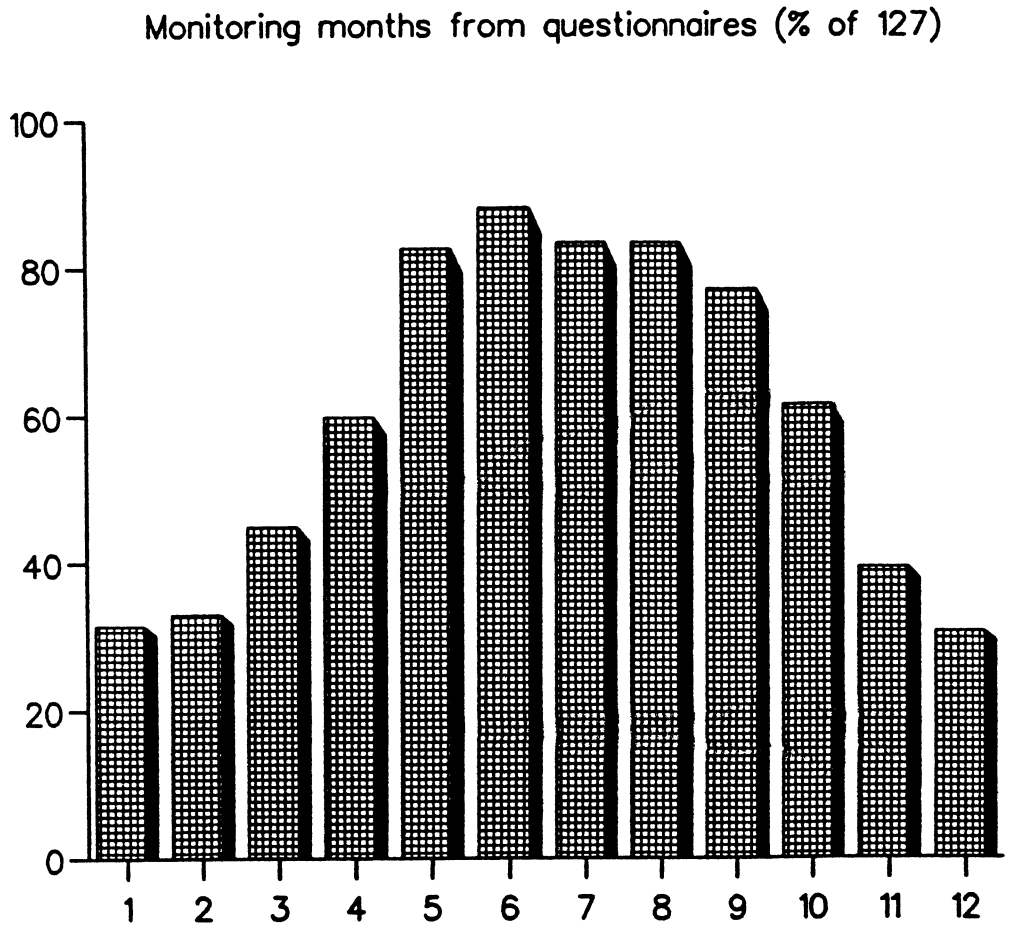
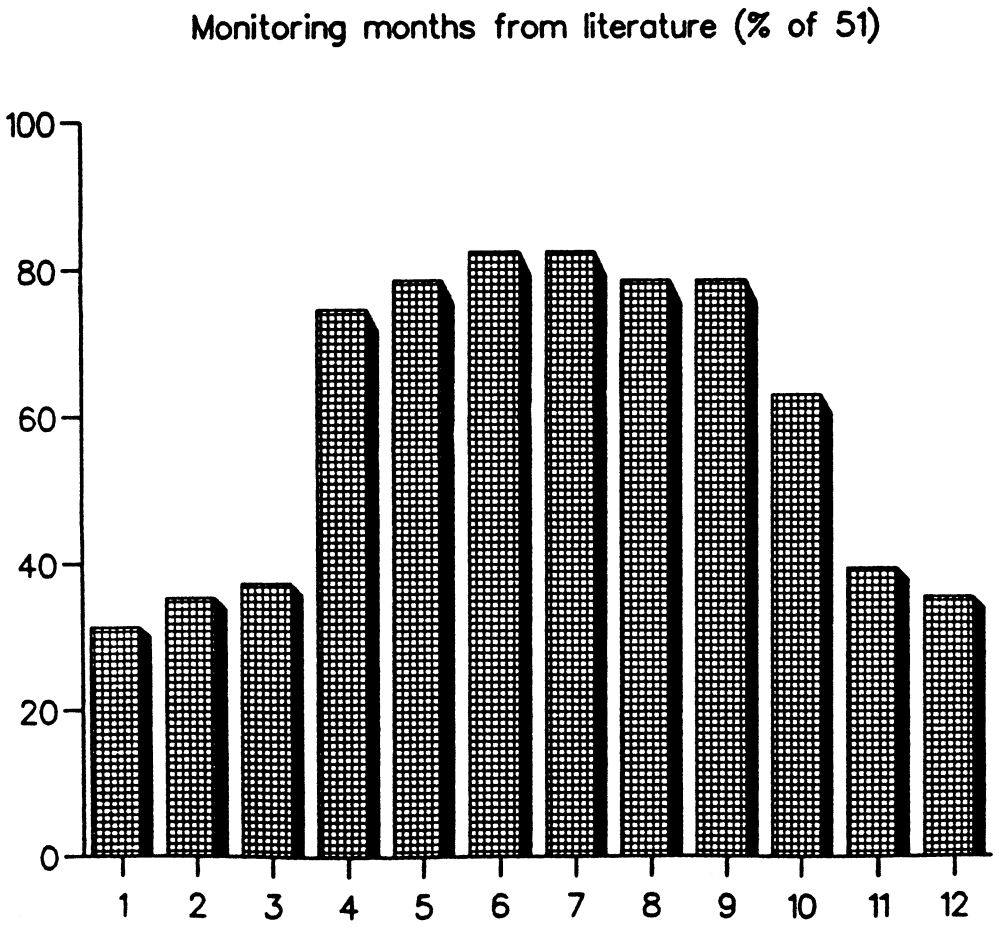


Figure 14:



4.6.2.3 Frequency

Table 28
Frequency of monitoring in monitoring schemes – from questionnaires.

Total fields filled = 125 out of a possible 127 (98.43%).

FREQUENCY	NUMBER	% (OF 127)
Yearly	17	13.38
6–monthly or 2 times/year	2	1.57
More than 2 times/year but not monthly	2	1.57
Monthly	26	20.47
More than monthly but less than fortnightly	2	1.57
Fortnightly	20	15.75
Weekly	30	23.62
More than weekly but not daily	17	13.38
Daily	12	9.45
Irregular, variable, as required or fund permitting	9	7.09

Table 29
Frequency of monitoring occurring in monitoring schemes – from literature.

Total fields filled = 45 out of a possible 51 (88.24%).

FREQUENCY	NUMBER	% (OF 51)
Yearly	3	5.88
6–monthly or 2 times/year	2	3.92
More than 2 times/year but not monthly	4	7.84
Monthly	11	21.57
More than monthly but less than fortnightly	1	1.96
Fortnightly	8	15.69
Weekly	14	27.45
More than weekly but not daily	2	3.92
Daily	4	7.84

4.6.2.4 Continuity

Table 30
Number of monitoring schemes that are continuous (without breaks) - from questionnaires. In order of percentage.

Total fields filled = 122 out of a possible 127 (96.06%).

CONTINUOUS?	NUMBER	% (OF 127)
Yes	102	80.32
No	20	15.75
*	5	3.94

Number of monitoring schemes making comment on their continuity - from questionnaires.

Total fields filled = 31 out of a possible 127 (24.41%).

Table 31
Number of monitoring schemes that are continuous (without breaks) - from literature.

Total fields filled = 51 out of a possible 51 (100%).

CONTINUOUS?	NUMBER	% (OF 51)
Yes	45	88.24
No	6	11.76

Number of monitoring schemes making comment on their continuity - from literature.

Total Fields filled = 22 out of a possible 51 (43.14%).

4.6.3 Other comments about technique

4.6.3.1 Summary

The 'METHODS.COMMENT' field on the computer was an 'associated multi-valued field' with the 'METHODS' field. This meant that each method had a space for a comment particular to that method beside it. This could only be one line and although it was used most information concerning methods was entered as free text in the 'OTHER.TECH.COMMENTS' field. Therefore the 'other technique comments' consist of a large mountain of useful data for manual analysis.(See appendix B).

4.6.3.2 Other comments

Number of monitoring schemes making 'other technique comments' – from questionnaires.

Total fields filled = 81 out of a possible 127 (63.78%).

Number of monitoring schemes with 'other technique comments' – from literature.

Total fields filled = 49 out of a possible 51 (96.08%).

4.7 Taxon positive/negative comments with regard to monitoring

4.7.1 Summary

52.76% of questionnaires made negative comments with regard to monitoring the taxa concerned and 62.99% made positive comments. This is a large and useful body of data which, for the more important taxa, could help in the production of guidance notes and recommendations for monitoring. The author tried to make such comments when extracting literature data but these are naturally subjective. (See Appendix B).

4.7.2 Positive/negative comments

Number of monitoring schemes making 'taxon negative comments' – from questionnaires.

Total fields filled = 67 out of a possible 127 (52.76%).

Number of monitoring schemes making 'taxon negative comments' – from literature.

Total fields filled = 46 out of a possible 51 (90.20%).

Number of monitoring schemes making 'taxon positive comments' – from questionnaires.

Total fields filled = 80 out of a possible 127 (62.99%).

Number of monitoring schemes making 'taxon positive comments' – from literature.

Total fields filled = 49 out of a possible 51 (96.08%).

4.8 People and resources

4.8.1 Is monitoring done on a paid or voluntary basis?

4.8.1.1 Summary

62.20% of schemes from questionnaires being performed by voluntary workers suggests that a great deal of good work can be carried out very cheaply. Twice as many schemes were voluntary as paid.

4.8.1.2 Paid/voluntary

Table 32
Number of monitoring schemes 'paid or voluntary' – from questionnaires.

Total fields filled = 125 out of a possible 127 (98.43%).

PAID OR VOLUNTARY	NUMBER	% (OF 127)
Voluntary	79	62.20
Paid	45	35.43
Both (!)	1	0.79

4.8.2 Types of people involved in monitoring

4.8.2.1 Summary

See also section 4.4. Around half the schemes from questionnaires were being performed by amateur naturalists (which also ties in with 4.8.1.2) and one third were professional researchers (33.07%).

4.8.2.2 Person type

Table 33
Number of monitoring schemes of various 'person types' – from questionnaires.

Total fields filled = 127 out of a possible 127 (100%).

CODE	PERSON TYPE	NUMBER	% (OF 127)
6	Amateur naturalist	63	49.61
1	Researcher	42	33.07
5	County/society recorder	22	17.32
2	NR Warden	21	16.54
7	Other	20	15.75
4	Consultant	6	4.72
3	Field centre staff/teacher	3	2.36

4.8.3 Amount of time people spend on monitoring

4.8.3.1 Summary

People were asked about the amount of time they spent on monitoring per week or per year. Only 48.03% of the questionnaires contained a figure for the number of hours per week and only 47.24% contained a figure for the number of hours per year. 'Per week' and 'per year' were not mutually exclusive and frequently respondents simply multiplied or divided to derive the other figure, is this meaningful? Some people would have included laboratory identification times in these figures, others would not. In general one feels that this question was too difficult. These results should be interpreted with care.

On average people spent 5.84 +/- 1.16 hours per week on monitoring projects, some spent 40 hours and some spent 0.1 hours (6 minutes - clearly a false division of the hours per year). According to the answers for person hours per year, people on average spent 48.98 +/- 7.17 hours per year on monitoring (that is less than one hour per week which does not tie in with the above figures). The most anyone spent on any one project was 250 hours per year (10.4 days). The least time spent was 0.4 hours (24 minutes - rather short?). The one thing that the results do indicate is that useful results may be possible with relatively little time spent in the field.

4.8.3.2 Hours

Table 34
Time spent on various monitoring schemes - from questionnaires.

PERSON HOURS PER WEEK:

Number of fields filled = 61 out of a possible 127 (48.03%).

SUM = 362.1 hours.

MEAN = 5.84 +/- 1.16 hours.

MAX = 40.0 hours.

MIN = 0.1 hours.

PERSON HOURS PER YEAR:

Number of fields filled = 60 out of a possible 127 (47.24%).

SUM = 2987.6 hours.

MEAN = 48.98 +/- 7.17 hours.

MAX = 250.0 hours.

MIN = 0.4 hours.

4.8.4 Monitoring schemes receiving special funding

4.8.4.1 Summary

Very few monitoring schemes received any special funding (16.54%). Naturally this precludes any internal funding for university or government funded bodies. In other words most work is not only voluntary (section 4.8.1) but any incidental expenses tend to come out of the person's pocket.

A report for funds can be seen in appendix B. Only 19 questionnaires gave details of funding which was from various sources such as 'NCC', the British Ecological Society, and businesses.

4.8.4.2 Funding

Table 35
Number of monitoring schemes receiving funding - from questionnaires.

Total fields filled = 126 out of a possible 127 (99.21%).

FUNDING?	NUMBER	% (OF 127)
Yes	21	16.54
No	105	82.68
*	1	0.79

Number of monitoring schemes giving details of their source of funds- from questionnaires.

Total fields filled = 19 out of a possible 21 (90.48%).

4.9 Data handling

4.9.1 Data storage

4.9.1.1 Summary

Most people store their data at home (67.72%), which means that much valuable data is not made available for general use, eg by BRC or EN, which means this data may well be lost when people die; this is a waste. 'Other' is a large category and refers mainly to locations such as university departments and other organisations, it also contains such expressions as 'in my head'! Only about 20% of questionnaires stated that their data was sent to 'NCC' or BRC.

4.9.1.2 Data locations

Table 36
Number of monitoring schemes storing data in various locations – from questionnaires.

Total fields filled = 127 out of a possible 127 (100%).

CODE	STORAGE TYPE	NUMBER	% (OF 127)
3	Home	86	67.72
8	Other	38	29.92
1	Local museum	18	14.17
2	Society/trust office	18	14.17
5	EN	14	11.02
4	BRC	7	5.51
6	CCW	4	3.15
9	NT offices	2	1.57
7	SNH	0	0.00

4.9.2 Computerized records?

4.9.2.1 Summary

29.92% of questionnaires stated that data was held on computer. This was more than was expected and is useful as such data may be more easily transferable to databases (eg in BRC or EN) than written data.

Those using computers stated that disk was the transfer media (15.79% of computer users did not answer this question). The use of disks implies that everyone uses PCs, which is not surprising.

4.9.2.2 Computerized?

Table 37
Number of monitoring schemes with computerized records – from questionnaires.

Total fields filled = 127 out of a possible 127 (100%).

COMPUTERIZED?	NUMBER	% (OF 127)
Yes	38	29.92
No	89	70.08

Table 38
Of the 38 cases where records were computerized, what was their transfer media? – From questionnaires.

Total fields filled = 32 out of a possible 38.

TRANSFER MEDIA	NUMBER	% (OF 38)
Disk	32	84.21
*	6	15.79

4.10 Publications

4.10.1 Summary

43.31% of questionnaires stated that they had associated publications. Of these 50.91% were papers or in journals and 32.73% were notes/reports. Reports are generally hard to get hold of and so of can be said that only about 22% of the questionnaires had easily available publications associated with them. The references for the literature search mainly consisted as papers (about 85% of schemes) and the rest came from books; namely 'The ecology of a garden' (Owen, 1991).

4.10.2 Publications

Table 39
Number of monitoring schemes having publications associated with them – from questionnaires.

Total fields filled = 127 out of a possible 127 (100%).

PUBLICATIONS?	NUMBER	% (OF 127)
Yes	55	43.31
No	72	56.69

Publication types– from questionnaires.

Total fields filled = 54 out of a possible 127 (42.52%).

Number of forms stating publications but not giving publication type = 7 out of 55 (12.73%).

Number of forms stating publications and giving publication type = 48 out 55 (87.27%).

Number of forms stating no publications but still giving a comment = 6 out of 72 (8.33%).

Table 40

PUBLICATION TYPE	NUMBER	% (OF 55)
Paper/journal	28	50.91
Report/note	18	32.73
Book	2	3.64

Number of monitoring schemes having publications associated with them – from literature = 100% by default.

Table 41
Publication types – from literature.

Total fields filled = 51 out of a possible 51 (100%).

PUBLICATION TYPE	NUMBER	% (OF 51)
Paper	44	86.27
Paper only	43	84.31
Book	8	15.68
Book only	7	13.73
Book and paper	1	1.96

4.11 Geographic coverage of monitoring

4.11.1 Summary

The table 'SITES' contained 122 records relating to questionnaires and 53 records relating to literature. Overall 'SITES' contained 174 records, hence, only three sites were common to both literature and questionnaires.

The question about site area in the questionnaires was surprisingly well received (64.75%), less area information was gained from the literature (only 28.30% of literature). Of the questionnaires responding to this question only 7.59% gave a transect length in km; most answers were in hectares. For the literature only 1.89% gave an answer in km. The area information could be useful in determining the detail of monitoring ie detail is probably inversely proportional to site area.

Grid references were gained for most sites (except those that cover a **very** large area or were confidential). These were used in plotting maps (section 4.12).

Site altitude data (metres above sea level (asl)) was analysed for questionnaires. 67.21% of questionnaires gave altitude data. The maximum altitude of a site was 500m asl and the minimum was 0m asl (NB there were few coastal sites). The mean altitude was 71.58m asl. Where an altitude range was given the mean maximum altitude was 90.74 m asl and the mean minimum was 52.74 m asl. It could be useful to plot a histogram of altitude for each of the major taxa if one wanted to collate data from sites of different altitude in order to look at the climatic effects on species.

A question was asked about the status of the site (Site of Special Scientific Interest etc). For the questionnaires 34.43% of sites received the 'other' classification ie those sites with no official status designation according to the list, hence most monitoring, according to the questionnaires, occurs on sites with special designations – SSSIs being the most common (40.16%). In contrast, in the literature most sites were 'other' (71.70%); researchers obviously do not specialise in sites that have already been noted as 'special' (however, it must be remembered that such site data may not be well reported in the literature – the 'other' field could be much smaller).

The status of the general area of the site was also considered. For the questionnaires 'Areas of Outstanding Natural Beauty' were the most common. Only 38.52% responded to this section which is of dubious value. No data was available from literature.

The counties and biological Vice-county (VC) numbers were asked for. The VC numbers allow grid references to be checked and the county list may be of value to EN.

4.11.2 Area

Area of sites used in monitoring schemes – from questionnaires.

Total fields filled = 79 out of a possible 122 (64.75%).

Number answering in 'ha' (ie giving an area) = 73 out of a possible 79 (92.41%).

Number answering in 'km' (ie giving a transect length) = 6 out of a possible 79 (7.59%).

Number answering in both 'ha' and 'km' (ie giving both an area and a length) = 1 out of a possible 79 (1.27%).

Area of sites used in monitoring schemes – from literature.

Total fields filled = 15 out of a possible 53 (28.30%).

Number answering in 'ha' (ie giving an area) = 14 out of a possible 53 (26.42%).

Number answering in 'km' (ie giving a transect length) = 1 out of a possible 53 (1.89%).

Number answering in both 'ha' and 'km' (ie giving both an area and a length) = 0 out of a possible 53 (0%).

4.11.3 Grid reference

Number of sites given a grid reference – from questionnaires.

Total fields filled = 106 out of a possible 122 (86.89%).

Number of sites giving a grid reference – from literature.

Total fields filled = 47 out of a possible 53 (88.68%).

4.11.4 Altitude

Altitude of sites (metres asl) – from questionnaires.

'Alt1' (minimum or average altitude asl):

Total number of fields filled = 82 out of a possible 122 (67.21%).

SUM Alt1 (all) = 5128

'Alt2' (maximum altitude asl):

Total number of fields filled = 39 out of a possible 122 (31.97%).

SUM Alt2 = 3539

MEAN Alt2 = 3539/39 = 90.74

SUM Alt1 (less minimum altitudes ie those only given as averages) = 3071

MEAN Alt1 (less minimum altitudes) = 3071/(82–39) = 71.42

SUM Alt1 (just minimum altitudes) = 5128–3071 = 2057

MEAN Alt1 (just minimum altitudes) = 2057/39 = 52.74

So, Average minimum altitude given = 52.74 m asl.

Average maximum altitude given = 90.74 m asl.

MEAN maximum and minimum = (52.74+90.74)/2 = 71.74

Overall MEAN altitude = (71.74+71.42)/2 = 71.58 m asl.

ABSOLUTE maximum altitude = 500 m asl.

ABSOLUTE minimum altitude = 0 m asl.

Altitude of sites (metres asl) – from literature.

Mostly through lack of time and because 'ALT1' contained only 15 records the altitude data has not been analysed.

4.11.5 Site status

Table 42
Status of sites used in monitoring – from questionnaires.

Total number of fields filled = 121 out of a possible 122 (99.18%).

CODE	STATUS	NUMBER	% (OF 122)
3	Site of Special Scientific Interest	49	40.16
2	Other	42	34.43
1	National Nature Reserve	30	24.59
7	County Trust Reserve	16	13.11
2	Local Nature Reserve	15	12.30
4	National Trust Property	11	9.02
11	Garden (Private Property)	10	8.20
12	Estate	6	4.92
10	Ministry of Defence Property	6	4.92
13	Park	2	1.64
8	RSPB Property	2	1.64
6	English Heritage Property	0	0.00
5	National Trust for Scotland	0	0.00
9	Woodland Trust Reserve	0	0.00

Table 43
Status of sites used in monitoring – from literature.

Total number of fields filled = 50 out of a possible 53 (94.34%).

CODE	STATUS	NUMBER	% (OF 122)
2	Other	38	71.70
4	National Trust Property	16	30.19
1	National Nature Reserve	6	11.32
3	Site of Special Scientific Interest	4	7.55
7	County Trust Reserve	1	1.89
2	Local Nature Reserve	1	1.89
11	Garden (Private Property)	2	3.77
12	Estate	2	3.77
10	Ministry of Defence Property	0	0.00
13	Park	0	0.00
8	RSPB Property	0	0.00
6	English Heritage Property	0	0.00
5	National Trust for Scotland	0	0.00
9	Woodland Trust Reserve	0	0.00

Table 44
Area status of sites used in monitoring – from questionnaires.

AREA STATUS	NUMBER	% (OF 122)
Area of Outstanding Natural Beauty	17	13.93
Urban area	13	10.66
National Park	9	7.38
Environmentally Sensitive Area	8	6.56

Area status of sites used in monitoring – from literature.

No data available.

The DISTRICT prompt was deemed defunct – only 4 responses.

4.11.6 Vice-counties/counties

Number of sites used in monitoring with completed Vice-counties - from questionnaires.

Total fields filled = 119 out of a possible 122 (97.54%).

Number of sites used in monitoring with completed Vice-counties - from literature.

Total fields filled = 51 out of a possible 53 (96.23%).

Number of sites used in monitoring with completed counties - from questionnaires.

Total fields filled = 119 out of a possible 122 (97.54%).

Number of sites used in monitoring with completed counties - from literature.

Total fields filled = 51 out of a possible 53 (96.23%).

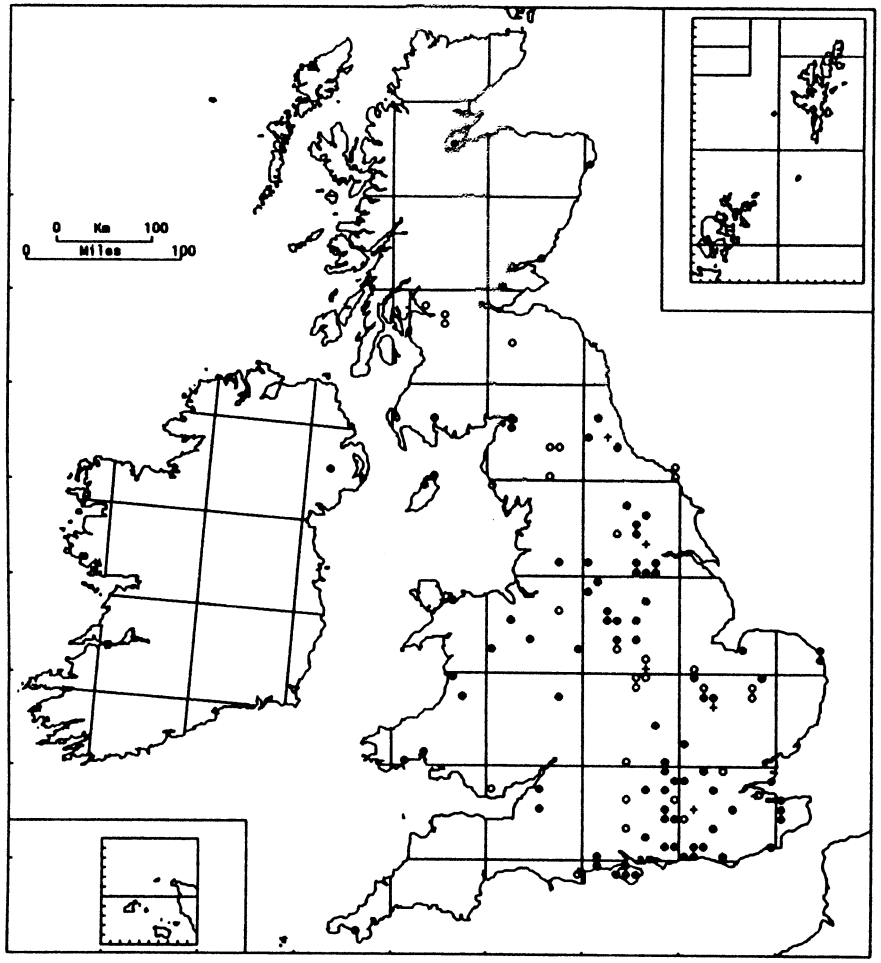
4.12 Taxa/site maps

A series of maps were produced for all the main taxa recorded in the survey. Maps were produced for all groups that had ten or more schemes involving them. For each taxa a mapping file was created on the VAX/VMS computer, the files are included in appendix B for reference. Each file contained a list of all the site grid references. Each grid reference consisted of a 1 or 2 (Britain or Ireland), followed by a two-figure Easting, followed by a two-figure Northing, and ending with a code for the symbol to be plotted at this 10 km square. The maps are *figures 15-24.*

The maps largely speak for themselves and show that for some groups, (notably odonata, coleoptera and diptera) there is quite a well distributed network of monitoring sites for which attempts at coordination could occur if desired.

Figure 15:

LOCATION OF ALL MONITORING SITES



● PERSONAL/QUESTIONNAIRE (GB-88, Ir-1, Ch.Is-0)
○ LITERATURE (GB-31, Ir-0, Ch.Is-0)
+ BOTH (GB-6, Ir-0, Ch.Is-0)

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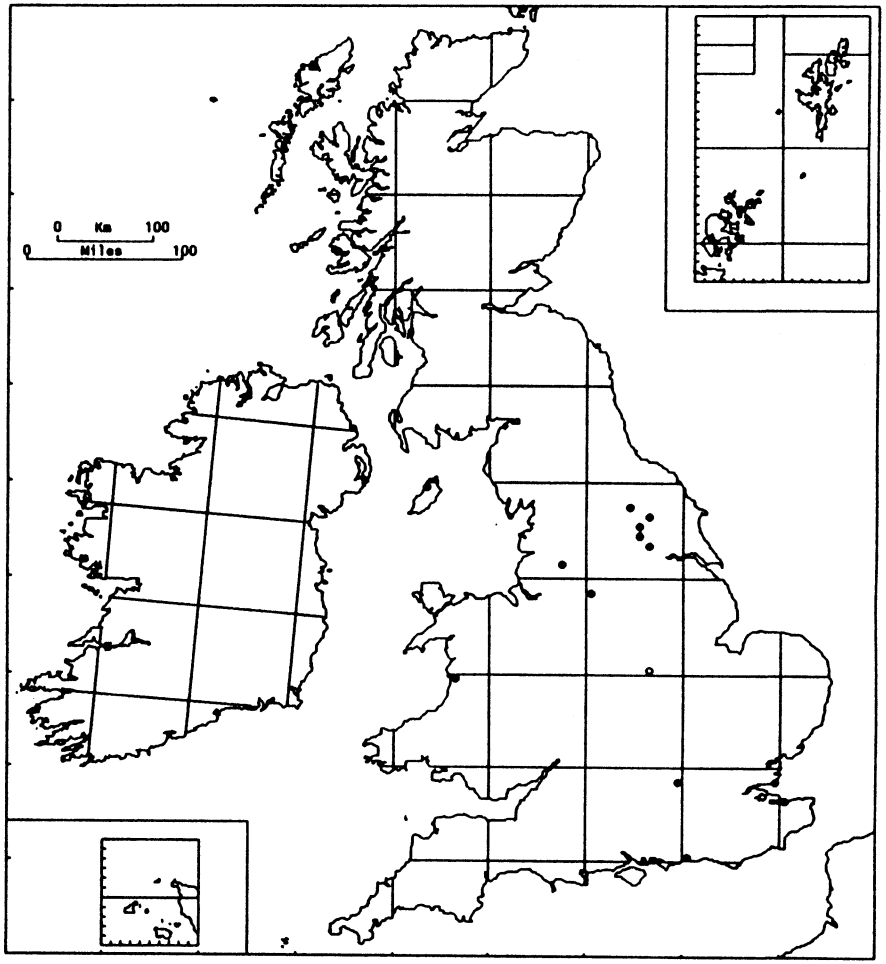
Figure 16:

LOCATION OF SITES MONITORING ARACHNIDA



● PERSONAL/QUESTIONNAIRE (GB-13, Ir-0, Ch.Is-0)
○ LITERATURE (GB-1, Ir-0, Ch.Is-0)
+ BOTH (GB-0, Ir-0, Ch.Is-0)

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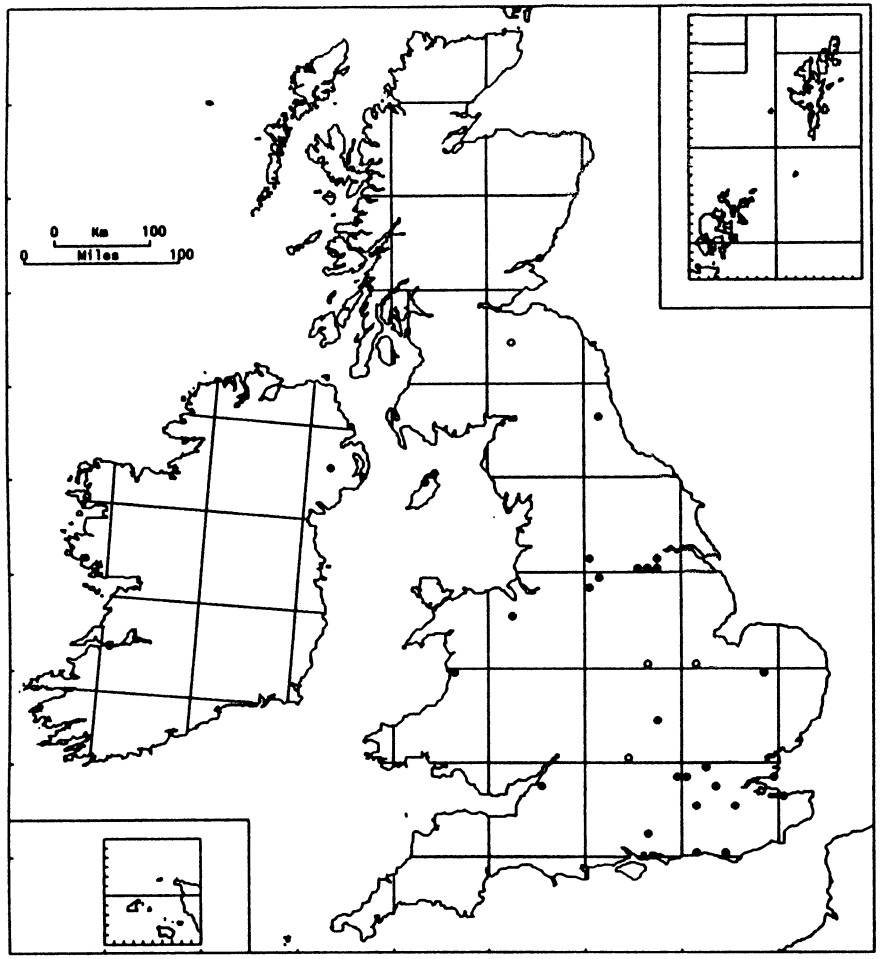
Figure 17.

LOCATION OF SITES MONITORING COLEOPTERA



• PERSONAL/QUESTIONNAIRE (GB-27, Ir-1, Ch.Is-0)
o LITERATURE (GB-4, Ir-0, Ch.Is-0)
+ BOTH (GB-0, Ir-0, Ch.Is-0)

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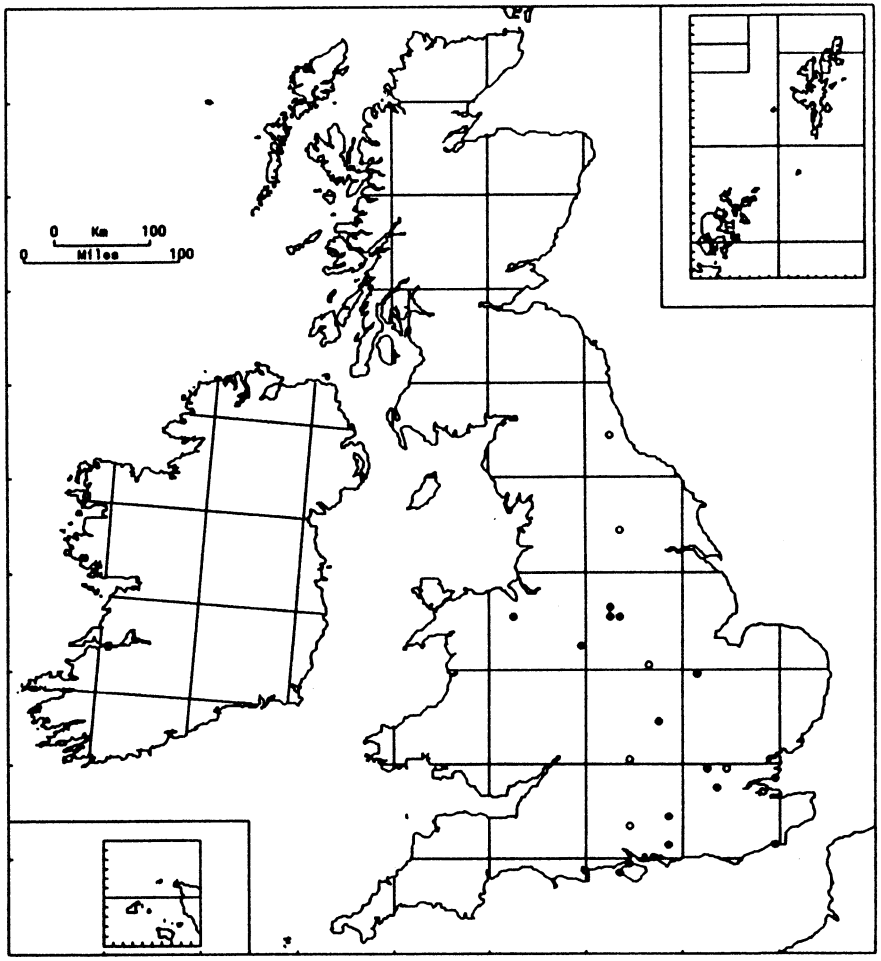
Figure 18:

LOCATION OF SITES MONITORING DIPTERA



• PERSONAL/QUESTIONNAIRE (GB-15, Ir-0, Ch.Is-0)
o LITERATURE (GB-7, Ir-0, Ch.Is-0)
+ BOTH (GB-0, Ir-0, Ch.Is-0)

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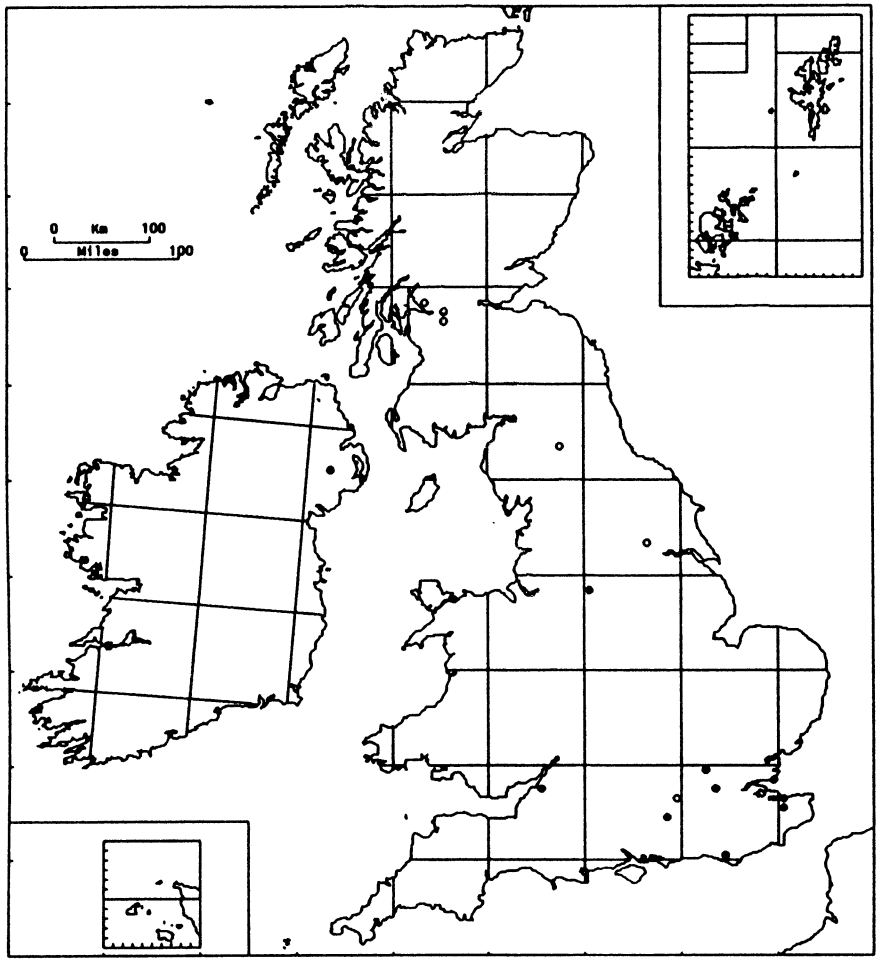
Figure 19:

LOCATION OF SITES MONITORING HEMIPTERA



● PERSONAL/QUESTIONNAIRE (GB-10, Ir-1, Ch.Is-0)
○ LITERATURE (GB-8, Ir-0, Ch.Is-0)
+ BOTH (GB-0, Ir-0, Ch.Is-0)

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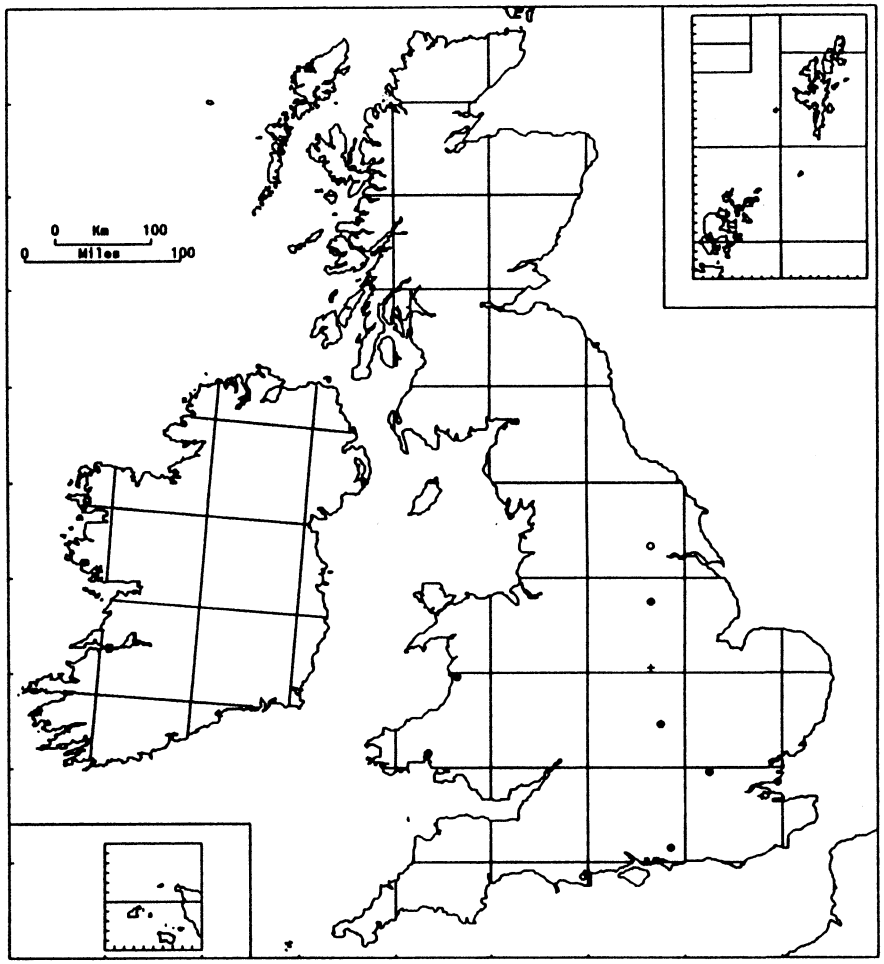
Figure 20:

LOCATION OF SITES MONITORING HYMENOPTERA



● PERSONAL/QUESTIONNAIRE (GB-7, Ir-0, Ch.Is-0)
○ LITERATURE (GB-2, Ir-0, Ch.Is-0)
+ BOTH (GB-1, Ir-0, Ch.Is-0)

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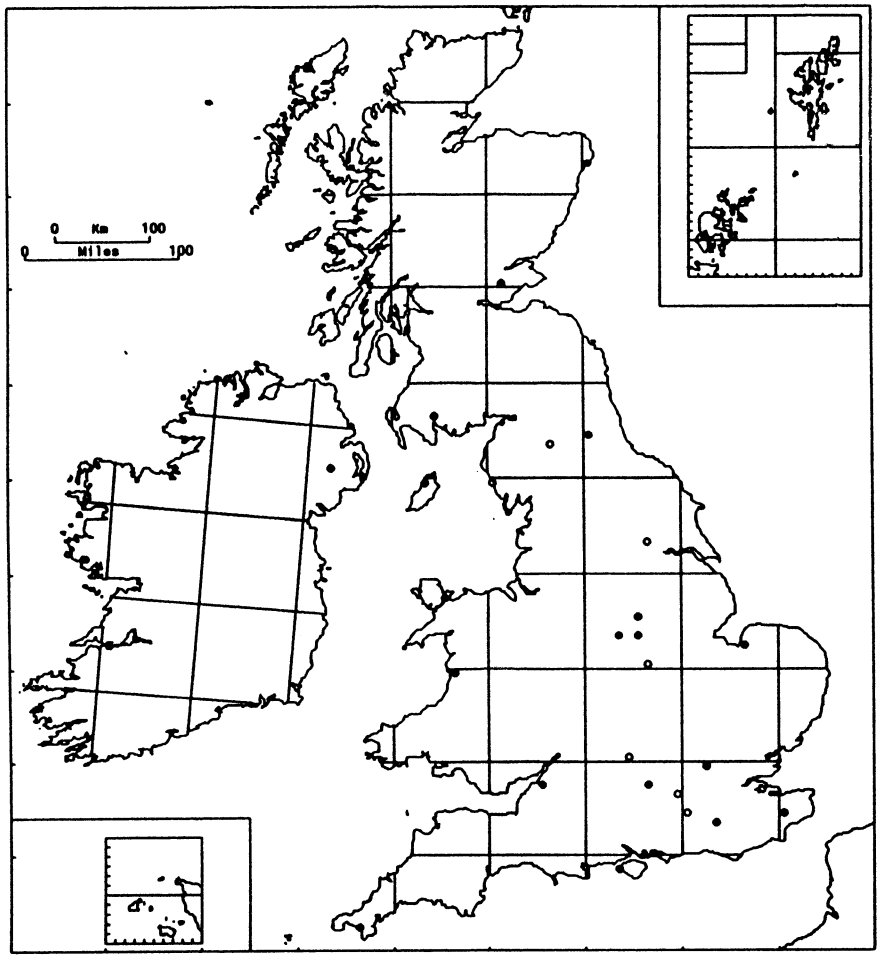
Figure 21:

LOCATION OF SITES MONITORING LEPIDOPTERA (MOTHS)

(OTHER THAN ROTHAMSTED)



- PERSONAL/QUESTIONNAIRE (GB-18, Ir-1, Ch.Is-0)
- LITERATURE (GB-7, Ir-0, Ch.Is-0)
- \+ OTHER (GB-0, Ir-0, Ch.Is-0)

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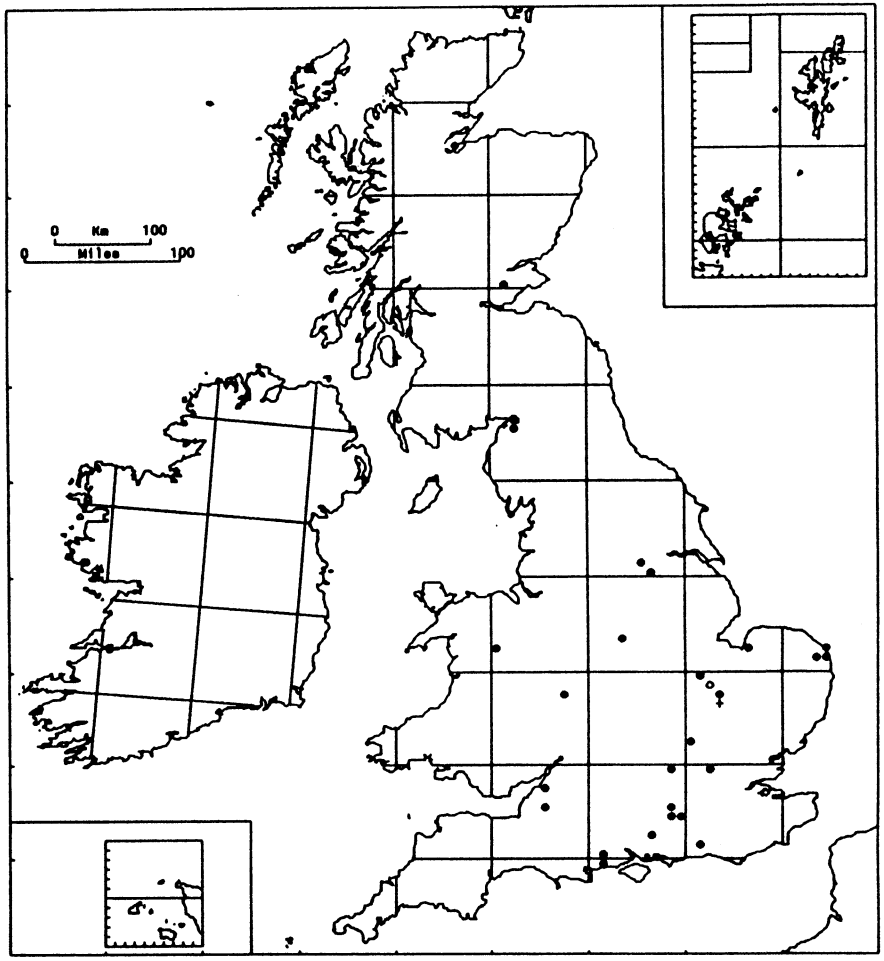
Figure 22:

LOCATION OF SITES MONITORING ODONATA (ANISOPTERA AND ZYGOPTERA)



- PERSONAL/QUESTIONNAIRE (GB-27, Ir-0, Ch.Is-0)
- LITERATURE (GB-1, Ir-0, Ch.Is-0)
- \+ BOTH (GB-1, Ir-0, Ch.Is-0)

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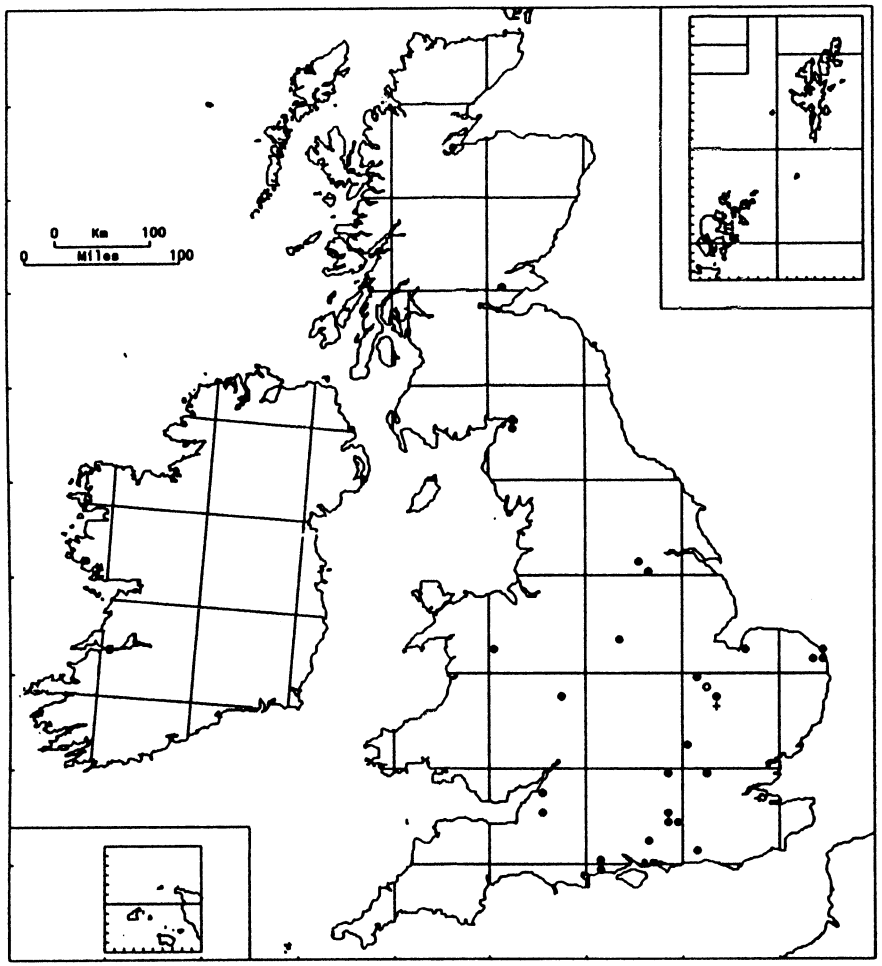
Figure 23:

LOCATION OF SITES MONITORING ODONATA: ANISOPTERA



- PERSONAL/QUESTIONNAIRE (GB-27, Ir-0, Ch.Is-0)
- LITERATURE (GB-1, Ir-0, Ch.Is-0)
+ BOTH (GB-1, Ir-0, Ch.Is-0)

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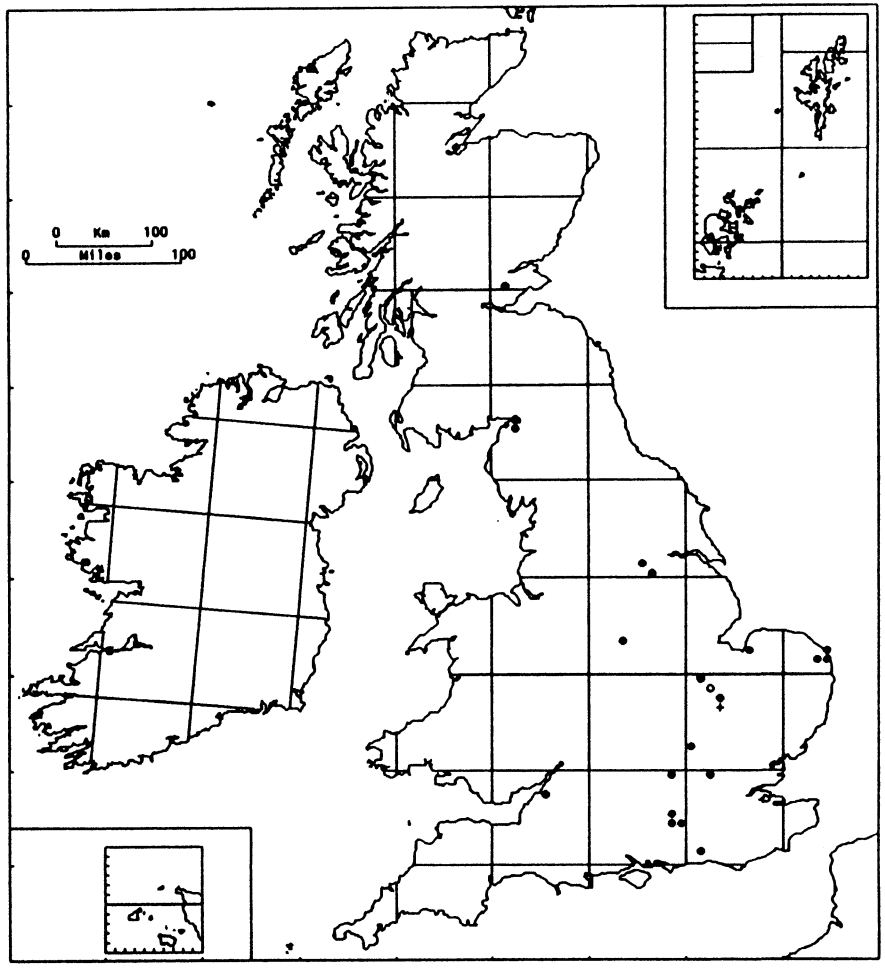
Figure 24:

LOCATION OF SITES MONITORING ODONATA: ZYGOPTERA



- PERSONAL/QUESTIONNAIRE (GB-21, Ir-0, Ch.Is-0)
- LITERATURE (GB-1, Ir-0, Ch.Is-0)
+ BOTH (GB-1, Ir-0, Ch.Is-0)

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4.13 Rothamsted Insect Survey (RIS)

The Rothamsted Insect Survey (RIS), based at the Rothamsted Experimental Station, Harpenden, Hertfordshire, has been monitoring the abundance of flying insects for over 25 years via two networks of sampling devices. There is a network of 12 m (40 foot) high aerial suction traps through which aphids are monitored and identified by experts, the information gained is largely supplied to the agriculture industry to improve the timing of insecticide applications; because of its agricultural bias this network was of minor interest to this project. However, the national network of largely amateur run light-traps monitoring all larger moths (macrolepidoptera) on a daily basis was of great interest. The data from this network is used mainly to monitor long-term changes in insect populations in relation to environmental change (Woiwod & Riley, 1992).

Adrian Riley of RIS, kindly supplied BRC with a list of all light-trap sites that there have ever been, their National Grid References and the dates of their periods of operation. The first trap started operation in 1933 at Barnfield (National Grid Reference 51/322135) and, after a few periods of disuse, is still working today.

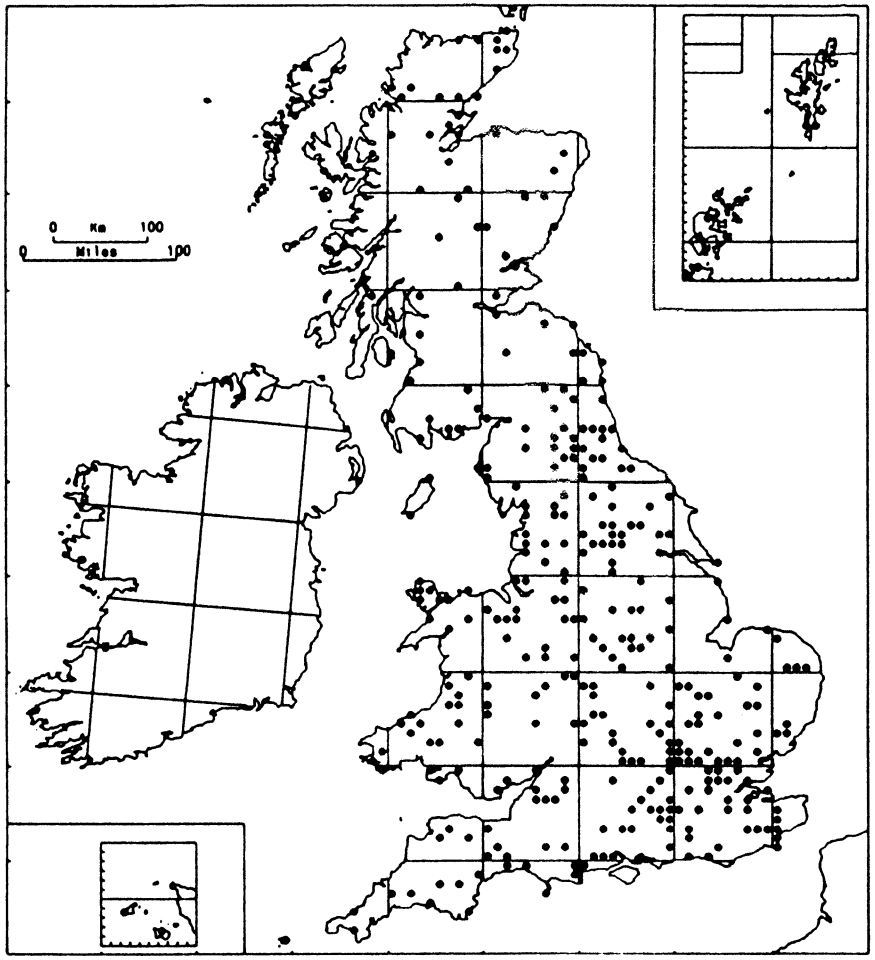
Though RIS is relevant to the invertebrate population monitoring survey it was decided not to enter this information into the database. Entering all the RIS site names, grid references and dates (there was little other information) would have given an unnatural bias towards macromoths, the database was not designed for storing and retrieving information about well known national schemes. Wendy Forrest of BRC entered the data onto the Monks Wood VAX/VMS computer and Henry Arnold produced maps for 1992 (current), 1987 and 1982; older maps could be produced if desired. The computer mapping file required for the Rothamsted maps was somewhat more complicated than the normal mapping files (section 4.12) because of the date ranges to be included. This was the first time that BRC has had such RIS site data. The resulting maps can be seen in *figures 25-28*. A map showing the 1992 BMS sites is also included for comparison (*figure 29*). It is also worth comparing these maps to the survey taxa/site maps (section 4.12) to see how these extensive established networks compare to, say, the odonata sites.

Some RIS light trap sites have other groups of insects sorted in addition to macromoths, such groups include micromoths, heteroptera and parasitic hymenoptera, however, there are insufficient data or sites involved to warrant mapping.

It is now known that the orders neuroptera, megaloptera, raphidioptera and mecoptera have been sorted for all light trap sites on a monthly basis since 1989 under the coordination of C. W. Plant of the Passmore Edwards Museum, East Ham Nature Reserve, London; this has been made possible through grants from the British Ecological Society, The Entomological Club and The Royal Entomological Society. Hence, the 1992 map for RIS sites applies to these orders as well as macromoths.

Figure 25:

Rothamsted Trap Sites



• all sites (GB-352, Ir-0, Ch.Is-2)

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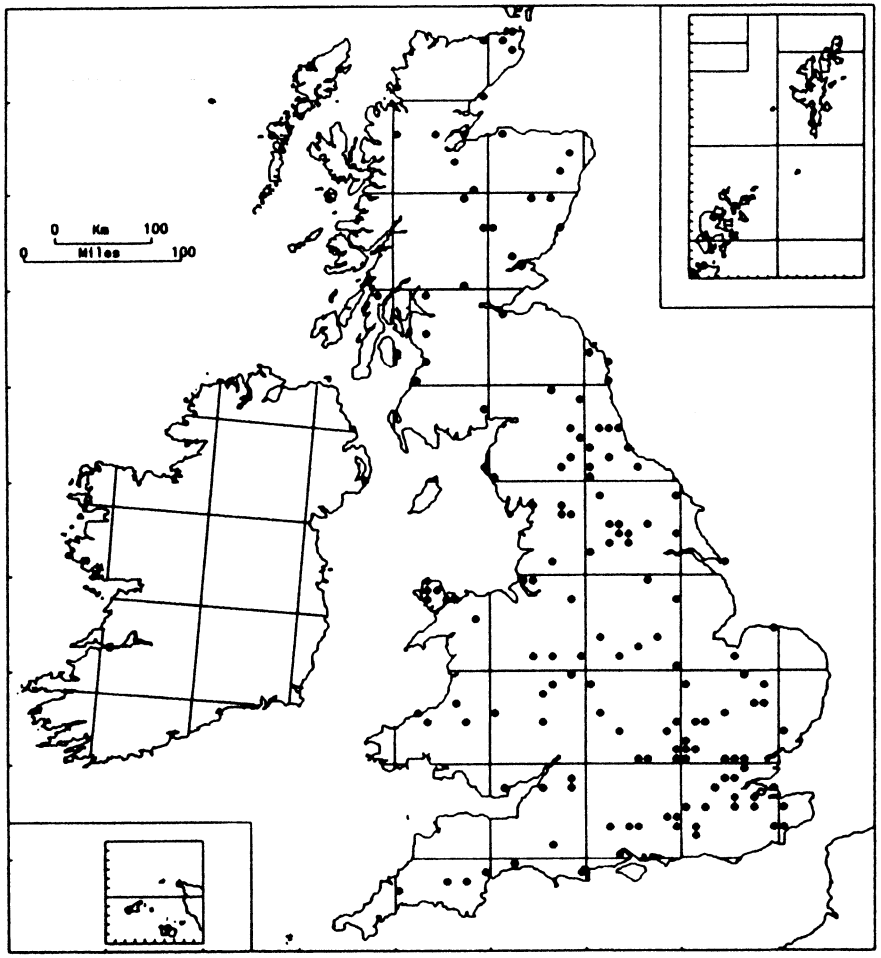
Figure 26:

Rothamsted Trap Sites in 1992



• all sites (GB-164, Ir-0, Ch.Is-2)

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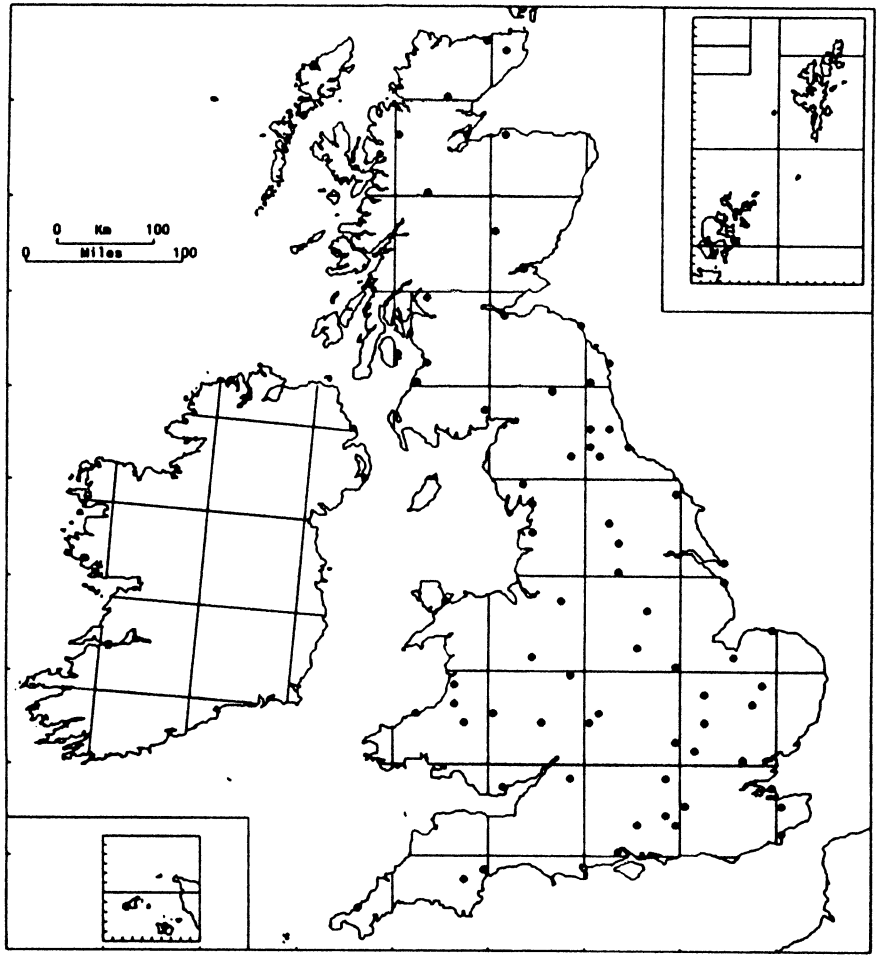
Figure 27:

Rothamsted Trap Sites in 1987



• all sites (08-75, Ir-0, Ch.Is-2)

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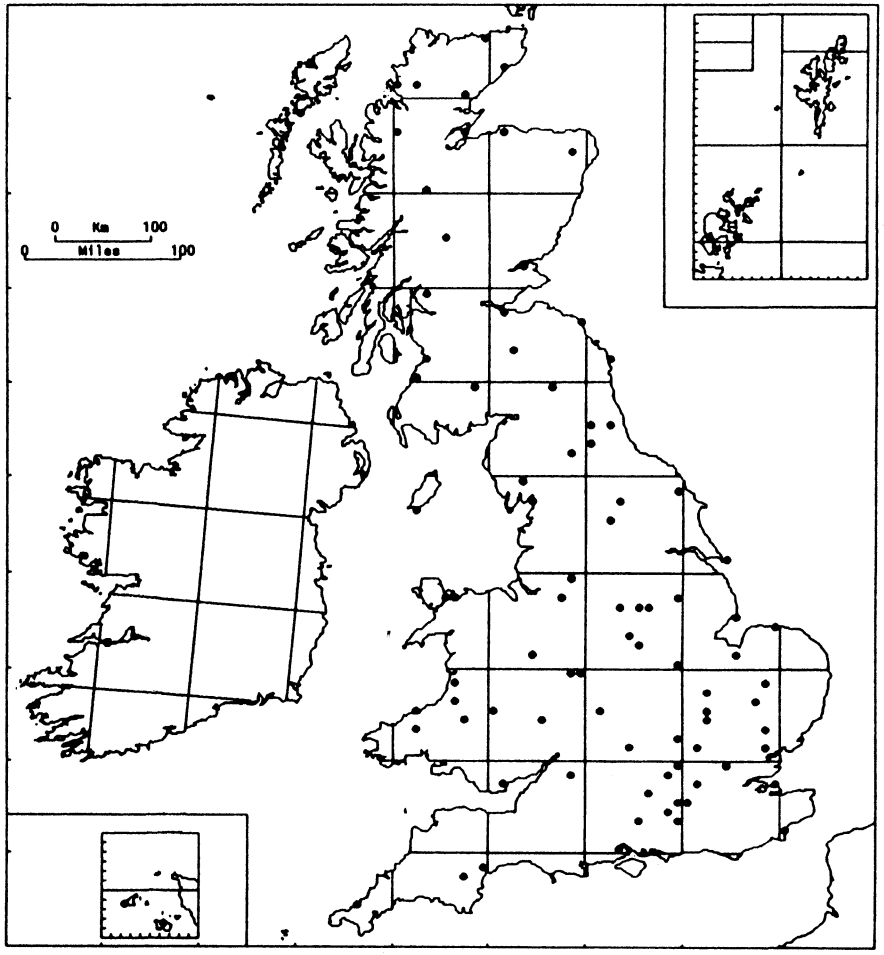
Figure 28:

Rothamsted Trap Sites in 1982



• all sites (08-86, Ir-0, Ch.Is-2)

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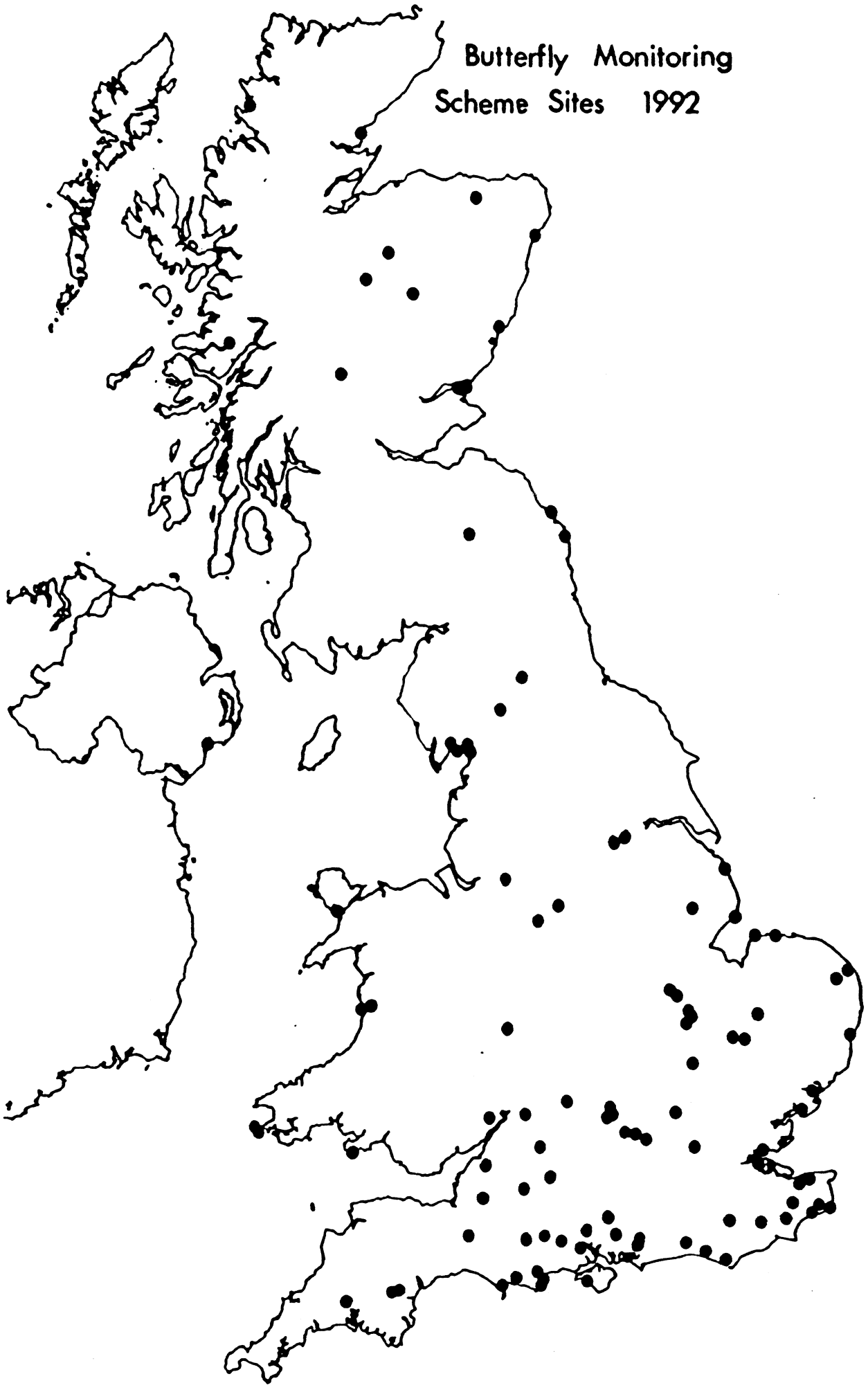
Figure 29:



5.0 Discussion

5.1 Introduction

The survey generated a large amount of results and although these have only been explored in a preliminary manner in most cases, it is not possible to go into a detailed discussion of them all here; the results section is largely self-contained and the reader is urged to look at the summaries for each section. This discussion aims to discuss a few questions pertinant to conservation and monitoring.

5.2 Who does most of the work?

Clearly there is much invertebrate population monitoring (or work that could easily be adopted for monitoring with minor alterations) occurring in Britain and Northern Ireland, not all of which would have been picked up by the survey. Who does this work?

Over three-fifths (62.20%) of the monitoring schemes from questionnaires were performed by voluntary workers as opposed to paid workers (section 4.8.1).

Around half (49.61%) of the schemes from questionnaires were being performed by amateur naturalists and one third (33.07%) by professional researchers/academics. One-sixth of people classed themselves as county/society recorders (17.32%), one-sixth as Nature Reserve wardens, and one-sixth as 'other' - a category that would include the natural history societies and non-governmental conservation organisations. Remembering that people could give more than one answer it would be fair to say that much of the 'other' group is a subset of the amateur naturalists. So, as far as the individual schemes were concerned the majority were being performed by amateurs and researchers as opposed to the one-sixth of schemes involving wardens (EN, CCW, SNH, etc), and the one-sixth or so involving county/society recorders (museums, individuals and some trusts). (Section 4.8.2).

These results are backed up when one looks at the data for the individual contacts from questionnaires (one contact may be involved in more than one monitoring scheme) (section 4.2). About 31% of the contacts were unaffiliated to any one organisation and would have been mostly amateurs. Another 20% plus belonged to societies and trusts and would have been mostly amateurs. So, in the contacts over half were amateur. Also, if one combines the numbers belonging to universities and consultancies one gets a figure of around one-sixth, and likewise for EN, CCW, and SNH. A small remainder is made up of museums and FSC staff etc. (The figures in this case approximately make 100%, and not more, as most people belong to only one organisation, if any, and so multiple answers were infrequent).

The contacts for the literature were mostly university-based ie researchers (78.57%), less than 5% were unaffiliated to any organisation (amateur), the rest being NERC (ITE etc) or similar. This simply reflects the fact that it is mainly professional researchers that publish research articles. (It should perhaps be restated that the literature articles may not often represent the most practical or conservationally orientated monitoring schemes but do elucidate techniques).

To sum-up, it seems that the major conservation organisations are outweighed at least two-to-one by amateurs and researchers. This suggests that their is considerable room for expansion in 'NCC' with regards to monitoring. However, the predominance of amateurs is not a bad thing - lots of good work can be done very cheaply. Indeed it is well known in general biological recording circles that professional biologists could never replace the body of amateur naturalists in Britain and Northern Ireland.

5.3 How much does monitoring cost?

It is very hard to assess the cost of monitoring schemes. Clearly if most people involved are amateurs then there is no cost as such. Very few schemes received special funding or support (section 4.8.4) but grants to meet expenses might encourage more monitoring schemes to be started. Indeed several questionnaires stated that their continuation was 'fund permitting' and several negative replies hinted that the fiscal resources were not available for monitoring to be started.

No direct questions relating to expenditure were asked but section 4.8.3 shows the results to the questions asked in the questionnaires about the number of person hours per week and per year that each scheme required. These may hopefully give some idea of cost but it must be reiterated that these questions were poorly received and there are some reservations about the data (see section 4.8.3). However, the results do suggest the important point that useful results can probably be gained by spending relatively little time in the field (with an average of 5.84 +/- 1.86 hours per week and 48.98 +/- 7.17 hours per year).

5.4 Which sites receive most attention?

A question was asked about the status of the site (Site of Special Scientific Interest etc). For the questionnaires 34.43% of sites received the 'other' classification ie those sites with no official status designation according to the list. Hence, two-thirds of monitoring, according to the questionnaires, occurs on sites with special designations - SSSIs being the most common (40.16%, 49 sites). One-quarter of sites were National Nature Reserves (24.59%, 30 sites), 13.11% were County Trust Reserves (16 sites), and 12.30% were Local Nature Reserves. Although one-third of sites had no special status designation the majority did and this has implications for any future coordinated networks for monitoring (say odonata; see maps, *figures 15-24*). Any such networks may be subject to the same limitations as the BMS (section 3.1.3.2) in that any abundance changes within or between sites (being mostly nature reserves and subject to management and protection) may not necessarily reflect the status of the group in question in the wider countryside.

In contrast, in the literature most sites were 'other' (71.70%). Researchers obviously do not specialise in sites that have already been noted as 'special' (however, it must be remembered that such site data may not be well reported in the literature - the 'other' field could be much smaller). The literature involves fewer sites and has a different aspect and so was not included in the above discussion of monitoring networks.

Few specific sites had more than one or two schemes occurring on them except the Leicester garden (Owen, 1991) which accounted for nine database entries and must be one of the most thoroughly recorded sites in Britain and Northern Ireland.

5.5 Important methods and taxa.

5.5.1 Methods

Please refer to section 4.6.1.

The list of method options given on the questionnaire can be roughly divided into three categories:

a) Rigorously repeatable, giving quantifiable data, providing a few provisos are met (eg trap-sites are re-findable for repeat samples).

Pitfall trap
Total census
Light trap
Quadrats
Malaise trap
Extraction funnels or similar
Water trap
Vacuum sampler (D-vac)
Interception trap
Emergence trap
Suction trap (aerial sampler)

b) Semi-quantitive. Methods that could easily be used for monitoring (or at least surveillance) to provide a fair index.

Sweep-net
Transects
Hand searching
Beating
Sieve and sort

c) Probably not easily quantified.

Direct observation
Walking, looking, no fixed route
Aquatic sampling? (Depending on what this is).

For the questionnaires (remembering that most people ticked more than one box - so summed percentages exceed 100) 106 out of 127 (83.46%) fell into category 'a' and as such are rigorously repeatable, 157 out of 127 (123.62%) fell into category 'b' and so may be useful, and 134 out of 127 (105.51%) fell into category 'c' and as such employed some methods that may not be very useful. This indicates that statistically rigorous methods are not employed as often as the other methods and that semi-quantitive methods are the most used. The large number of methods that are hard to quantify is partly an artifact of the data (many people ticked 'direct observation' along with more rigorous methods). However, this may also be a reflection of the amateur bias of the people involved and if it truly is an indication of lack of statistical validity then it is a shame that many people are producing data that is limited in its application.

For the literature 37 out of 51 (72.54%) schemes fell into category 'a', 8 out of 51 (15.68%) fell into category 'b', and 17 out of 51 (33.33%) fell into category 'c'. The large number in 'a' reflects the professional research bias of the literature (it must be remembered that many of the papers were not specifically concerned with monitoring for conservation). Methods falling into category 'a' would fit into Hellawell's definition of monitoring (Hellawell, 1991), those in 'b' would tend to fit into the role of surveillance. As a comparison, the BMS operates via transects and gives only an index of abundance (not an absolute value). As such it is a form of surveillance, however, it must be regarded as one of the most successful 'monitoring' schemes around. One must acknowledge the value of the semi-quantitive methods (provided they are rigorously performed).

Drake (CMD pers. comm., 1992) talks of 'real versus pseudo-exactness, the level of exactness that is needed, the cost of random sampling and the need to target sampling effectively at microhabitats'. Byrne (1991) stressed the importance of taking truly random samples when monitoring vegetation in order to satisfy basic

statistical requirements, this applies equally with invertebrates. Many of the more semi-quantitive methods may be able to produce data for certain groups that are sufficiently precise to allow comparative measurements to be made and even allow indications of when action should be taken when thresholds are crossed (though theorists would prefer more statistically precise measurements).

The above means more when taken in the context of the taxa being monitored most frequently in the survey:

5.5.2 Taxa

Arachnida (araneae and opiliones)

The arachnida were monitored at 13 questionnaire sites and one literature site (see *figure 16*). These were mostly monitored using pitfall trapping techniques for which there are a large number of methodological papers (mostly concerning coleoptera). However, other techniques were used to catch arachnids such as sweep-netting, hand searching and beating. Most of these techniques are easily standardised and quantifiable. The problem with harvestmen and spiders, in particular, is that most will rarely be caught in pitfall traps; most spiders are not ground-dwelling predators (eg wolf-spiders) and many are largely sedentary (in webs) which is why the latter techniques are important. In monitoring spiders a range of collecting techniques may have to be applied and with their relative taxonomic difficulty this may limit their usefulness (though several good monographs have recently been published). Arachnids may be one of the most valuable groups to monitoring because as a class they are relatively few in species, they are ubiquitous. Also, they are fairly independent of their habitat's vegetation species and prey species being more reliant upon the geometry and morphology of the habitat in which they build their webs. Arachnids may also be more susceptible to desiccation than many insects. As such they may be ideal indicators of general habitat health.

Coleoptera

The coleoptera were monitored at 28 questionnaire sites and 4 literature sites (see *figure 17*). Seven of the schemes related to the glow-worm *Lampyris noctiluca*. There have been several attempts over the years at assessing the status of glow-worms in the British Isles. The most recent is the glow-worm survey of 1991 and 1992, organised by amateurs and advertised in the press, whereby volunteers are encouraged to go out to local areas at night in the summer months to look for the glowing females. In general transects are walked, though these may be fairly flexible, and there is a fair chance of achieving a total census of the females active that night. With sufficient backing (from ITE?) this could easily become a national monitoring scheme. The major drawback is that we still don't know a lot about glow-worms, for instance, how long does the female glow for? Most of these questions could be easily answered.

For the other beetles, most of which were carabids, pitfall trapping was the most frequently used method. The caribidae probably present the most useful and well studied group and many methodological pitfall trapping papers have been written concerning this group (eg Wratten & Halsall, 1988). Coleoptera were also sampled using other techniques but the pitfall trapping of caribidae probably represents the most replicable and accessible method. Some small coleoptera may present taxonomic difficulties.

The glow-worm survey represents a good single species study where as the caribidae represents a study of a species suite covering several trophic levels and as such may represent the general 'health' of the habitat.

Diptera

The diptera were monitored at 15 questionnaire sites and 7 literature sites (see *figure 18*). Diptera were sampled in many ways and they represent a large resource for conservation monitoring. The main problems are ones of large numbers of species and taxonomic obscurity in many families. It is not therefore surprising to find that the families most monitored are the larger and more colourful species, notably syrphids (hoverflies) and brachycerans (horse-flies etc). Diptera can be sampled by quantitive methods such as water traps but the brachycera were always sampled by sweep-netting (semi-quantitive). Syrphids were sampled by several techniques. The most notable example is that of the malaise trap run by Dr Jennifer Owen in her Leicestershire garden since 1972 which has been used to monitor many insects. The trap caught 43 749 individuals of 91 species of hoverfly in the first fifteen years (Owen, 1991). Malaise traps are very efficient. Though it would be nice to recommend the use of malaise traps to monitor flies and flying insects in general they are expensive, catch a vast amount of material, are dependent on position in relation to flight path (and must not be moved if results are to be comparable), and so are probably not a realistic option in monitoring. Syrphids can probably be effectively monitored using guidelines similar to the BMS, whereby one follows a fixed route, around say a garden, noting the occurrence of the more readily identifiable species and deriving an index of abundance for year to year comparison. Several people already 'monitor' by this method and this could be extended. Hoverflies may be a little more esoteric than butterflies and dragonflies (see later) but changes in the species structure of an area could indicate (providing migrations can be accounted for) changes in the environment; the adults are all nectar and pollen feeders but the larvae have diverse habits.

Hemiptera

The hemiptera were monitored at 11 questionnaire sites and 6 literature sites (see *figure 19*). Hemiptera were sampled by a whole range of techniques, some more quantitive than others. Beating and sweeping were frequently used but the survey showed a range of species from water-bugs to frog-hoppers (which were quite popular) and it is hard to recommend any one technique that could be used in coordinating monitoring schemes between sites.

Hymenoptera

The hymenoptera were monitored at 8 questionnaire sites and 3 literature sites (one site was common to both) (see *figure 20*). The hymenoptera can be divided into social and solitary species. Assessing populations of social insects arouses the dilemma of collectivism versus individualism. Is an ant or wasp colony the individual ecological unit or are the foragers of the colonies the individual units? The answer is probably both in that colonies can be different sizes which may reflect their success and hence the health of their habitat. A true assessment of populations should measure the number of colonies or nests and the number of individuals, especially the foragers. The approaches to monitoring social hymenopteran colonies in the survey reflected this dichotomy. Malaise traps and pitfall traps have been used to collect foragers. Archer (1990) suggests that the efficiency and species selectivity of malaise traps for social vespines is unknown but for common species the catch probably does reflect the activity of aerial insects. Such information may be lacking for most trapping techniques and most insect species and further work, plus the pooling of the data would be very useful. Techniques for ant colonies included using quadrats to monitor nest numbers. Occasional nests being dug up to assess the size and structure of the colony.

Monitoring the social hymenoptera could potentially be very time consuming but simple counts of nests or foragers for the social wasps along a transect or quadrat could be useful.

The solitary species elucidated by the survey were all wasps (apart from solitary wasps and bees from the malaise trap in the Leicester garden (Owen, 1991)). These species were either gall-makers or gall-maker parasitoids. Quite a few schemes monitored galls and mines including dipteran

and lepidopteran examples. Such static objects are clearly easily monitored using quadrats or even individual trees though parasitoid identification in particular can be difficult. The data obtained can lend itself well to rigorous statistics.

Lepidoptera

The lepidoptera (moths) were monitored at 18 questionnaire sites and 7 literature sites (see *figure 21*). The majority of the schemes related to light-traps and there is a strong possibility of coordinating the data to form a national network that could supplement the RIS network. RIS has standardised traps with a light bulb that is 'not too efficient'. The largely amateur network of independent lepidopterists use a variety of traps of different makes and attractiveness to moths and this should be considered in comparing site data. Again little is known about the species selectivity of different light sources. The other schemes for lepidoptera involved mainly larvae and pupae in single species studies which were performed using quadrats and hand searching, sweep-nets etc.

Odonata (anisoptera and zygoptera)

The odonata were being monitored at 28 questionnaire sites and 2 literature sites (one site was common to both). Anisoptera (dragonflies) were being looked at on all these sites but zygoptera were only being looked at on 22 of the questionnaire sites (including the site common to both questionnaire and literature) (see *figures 22, 23, 24*). After butterflies, dragonflies and damselflies are probably the most popular insect group. Odonata are generally large, relatively easy to identify on the wing, and have a moderate number of species. They also have a special place in most natural historians' hearts and are also insects that are obviously affected by environmental change. The populations of certain species of dragonflies in nature reserves, SSSIs and other places with outstanding dragonfly faunas should be monitored. Otherwise those responsible for the sites cannot tell if their management is successful or needs to be changed. (Moore & Corbet, 1990). Most people in the schemes follow the guidelines set by the British Dragonfly Society (Moore & Corbet, 1990) where by a transect similar to that of the BMS is used. There is no need to restate the methods here. Drake (CMD, pers. comm., 1992) suggests that the dragonfly monitoring scheme would be more widely accepted if it had a focus from an institution such as ITE.

Some species of damselfly are hard to count because of sheer numbers. The only way to gain an exact population count is to collect all exuviae which is too time consuming in most cases but was used for *Cordulegaster boltoni* and some libellulids.

5.6 How much effort went into monitoring rare species, common species, whole suites of species?

Red Data Book (RDB) species were marked 'RDB' after the taxon name in the 'TAXA' table in the database. In total 11 sites out of 122 (9.02%) had RDB species being monitored on them. This figure does not include all the rare species being monitored, for instance, Schedule 5 species on the Wildlife and Countryside act are not included (though this could easily be done).

The RDB species are:

Coleoptera:
Curimopsis nigrita
Bembidion humerale

Crustacea:
Austropotamobius pallipes

Hymenoptera:
Formica transkaucasica

Lepidoptera:
Eustroma reticulatum
Siona lineata
Eugraphe subrosea
Luperina nickerlii leechi

Orthoptera:
Decticus verrucivorus

Clearly few rare species are being singled out for monitoring. The other species being monitored are not necessarily 'common' even if they not included on Schedule 5! Most people responding to the questionnaires were monitoring suites of species eg syrphidae in general, araneae in general, and macromoths, which could be used as a reflection of habitat 'health'. Most of the literature related to single species studies which are useful in developing techniques.

5.7 What is the best time of year for monitoring? (See section 4.6.2).

To reduce sampling effort, Pollard and Yates (1991) suggested that the season for recording butterflies could be restricted to the period of their peak abundance and that the start of the monitoring would be signalled, presumably by ITE, from the monitoring of key sites early in the season. If this happens, ITE could provide the service of cuing the start of monitoring of other groups, taking regional differences in weather into consideration.

In an essay on monitoring invertebrates Drake (CMD, pers. comm., 1992) gave a table of suggested times of maximum activity for some likely indicator groups:

Table 45 Proposed times of maximum activity of some suggested monitoring groups (from CMD, pers. comm., 1992).

– = several species may be found; + = peak months; l = larvae can be recorded

	J F M A M J J A S O N D
Carabidae	– – – – – – – – – – – –
Macromoths (adults)	– – + + + + + –
Hoverflies	– – + + + + – –
Water beetles	– – + + + + – – + + – –
Mollusca (incl. f/w)	– – – – – – – – – – – –
Butterflies	– – + + + –
Orthoptera	– – + + + –
Odonata	l l – + + + + –
Bumble bees	– – + + + + + –
Spiders	– – – – + + + + + + – –
Leaf hoppers	– – + + + + + –
Woodlice	– – – – – – – – – – – –
Wasps	– + + + + + –
Bees (solitary)	– + + + + + –
Caddisflies	l l l – – + + + – – l l
Gall formers	
Leaf miners	

The survey largely agrees with this table looking at the months that people spend working on the various groups. The only comments to make are that hoverflies (syrphidae) are on the wing from April to September, spiders may be monitored year–round, carabids may be monitored year round but have a peak from April to October, and leaf hoppers may be monitored year round in some cases (especially if eggs are looked at for known localities).

5.8 Indicator species?

The taxa discussed in the above section on important methods and taxa (section 5.5) represent the most readily useful 'indicator' species for habitat quality in that they are already in use for monitoring. In terms of the following criteria all fair well (with any reservations discussed in the prior mentioned section): Popularity, sampling methods, dispersal ability (a problem with moths, hoverflies and dragonflies?), known biology, geographic range (dragonflies limited), wide ecology (dragonflies rather specialised), ease of identification, and moderate number of taxa.

These taxa may or may not be the best monitoring species in real terms. Too few insect groups have had their population biology explored in sufficient detail to make these judgements. However, if invertebrate population monitoring is to be implemented with any speed then it makes sense to build, at least at first, on those groups for which there is a popularity and a body of information ie those groups highlighted by this survey. These groups cover a wide variety of habitat types.

5.9 Invertebrate monitoring versus other monitoring

Does invertebrate monitoring tell us anything that cannot be better, more quickly or more cheaply done by looking at other features such as vegetation composition or structure? The results in section 4.4.4 concern

whether questionnaire results have been of practical use yet. Looking at these clearly gives a resounding 'yes' to the question above. Over 51% of schemes relating to questionnaires had been put to some practical use so far. These include: 'Nature reserve management plan', 'canal management group', 'Derbyshire wildlife trust', 'base-line information for monitoring', and 'site defence'. In these schemes invertebrate monitoring was not always the only monitoring occurring at the site. 67.72 schemes said that other monitoring was occurring. However, their use in making site decisions does indicate that invertebrates make a valuable addition to the monitoring armoury. One can speculate that it may be easier to encourage amateurs to perform monitoring of the 'surveillance' kind (re BMS, odonata) for popular insect groups than performing repeated fixed quadrats on vegetation.

Although the above discussion has focused on a few most commonly looked at groups it would be worthwhile examining the information for the other groups, especially in terms of methods and whether practical use has been made of the results. These other groups may well hold taxa that are much more favourable for monitoring, perhaps, after a little research.

6.0 Conclusions

The results have shown that in many cases a valuable input to conservation and management can be gained for relatively little time in the field. Naturally, statistically rigorous censuses and 'over-thorough' trapping techniques (in particular malaise traps) could become very time consuming but schemes providing comparable indexes could be implemented for many groups and involve relatively little time, albeit regularly. Given the strong amateur interest invertebrate monitoring could be a practical proposition despite tight cash limits.

The negative returns to the questionnaire showed that cash posed limitations on monitoring for most trusts, wardens and other professional bodies. The money simply is not made available and there is still a strong tendency among professional field biologists to perform one-off surveys to show presence or absence in the evaluation of sites. Clearly one useful, but not so thorough way of 'monitoring', is to encourage repeat surveys after regular time intervals.

Among the amateurs there is also a tendency for one-off surveys and a desire to increase their personal or county 'list' of species. This is valid in itself and such records, as held by BRC and local records centres can show changes in species distribution. However, many amateurs do seem to have a favourite group and many perform year-to-year monitoring.

Many contacts doubted that their replies really constituted 'monitoring'. In most cases they did or would do if minor changes were made to their techniques such as walking transects instead of aimless wandering. Not surprisingly many amateurs are not sufficiently knowledgeable about statistical sampling techniques to see the problems unless prodded, this is where BRC, EN and influential natural history societies come in. For the major taxa discussed (as a start) all the information about the groups should be brought together and recommendations for monitoring practices should be drawn up for each group. These should be made available to the potentially monitoring public. Good monographs exist for these major groups but for many of the lesser taxa the biological information is still spread through the literature and this should be brought together, hopefully the literature search part of this survey goes someway towards initiating this.

The maps in *figures 15-24* show that for some of these more important groups there is a widespread distribution of monitoring sites. It is suggested than an institution such as ITE takes on board the concerned individuals and produces networks of monitoring sites in the vein of the BMS and RIS. The main difference is that these other groups mainly involve amateurs (and not wardens and universities etc) and so techniques must be standardised centrally. This may not be always possible eg the variety of light-traps in use for which base-line studies of moth selectivity could be performed. Also amateurs may not take kindly in being told how to perform their hobby but providing the reasoning is addressed carefully this should not pose a problem. ITE could disseminate information, coordinate, and extend these networks.

As far as the literature search was concerned it would have been useful to see the use of terms such as 'population monitoring' occurring in the keywords and abstracts of papers, even if this is not the direct concern of the article. The methods reported in papers are rarely reported in the keywords unless the paper is expressly methodological.

The survey has increased the body of information concerning monitoring and hopefully shown areas for work and highlighted what we know and what we do not know. The data produced has hardly been discussed in this report and there is much more work that could be done; but at least the information is together. It would have been good to discuss the negative return comments in more detail. Despite the limitations of the literature search and room for some misinterpretation in the questionnaire (most of which comes out in the analysis) some important trends were shown and there is clearly a lot of work to do.

7.0 Conclusions over the placement

The placement was very successful. An enormous amount of original data was collected for BRC, indeed from a personal viewpoint, too much data was collected for one man to collate and analyse in six months and the author is left feeling that there were many questions that could have been answered and areas that could have been discussed that have not been because of lack of time. At the time of writing the author is well into his final year at university and must draw things to a close. Importantly, the results have been presented. There is a large amount of untapped data, not only on the computer but in the form of the raw questionnaires, literature references and the negative returns.

Much was learnt on the placement in terms of computing, designing questionnaires and databases. A great deal was learnt in the areas of interpersonal skills, writing effectively and quickly, and in presentation. Moreover, although this report makes the work sound administrative in some respects, a great deal of biology and natural history was learnt. A sound background in ecology and natural history was essential in designing the questionnaire and asking pertinant questions. BRC and Monks Wood is a melting pot of good scientists, many of whom are excellent naturalists and an infectious enthusiasm rubs off (rekindling the interests of childhood).

The staff at Monks Wood are all very friendly, helpful and encouraging. This was a very enjoyable placement (though the write up did become somewhat time-consuming) and has only fired my interests further and confirmed my desires to work in conservation, ecology and bahavioural ecology. I feel this placement provided an ideal background with which to further these desires.

8.0 Acknowledgements

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Most of all Brian Eversham must be thanked for everything; for his guidance and help both inside and outside of work and for being the best supervisor/boss one could hope for on placement.

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Appendix A

A user's guide to the invertebrate monitoring database 'MONIT' in Advanced Revelation

Contents

Appendix A

A user's guide to the invertebrate monitoring database 'MONIT' in Advanced Revelation

A.1 Introduction

This appendix aims to describe the basic design and features of the invertebrate monitoring database. It does not intend to explain in detail the installation and administration of the Advanced Revelation system, the package comes with a detailed set of manuals and instructions and such details are beyond the scope of this project. Throughout the user guide the convention <KEY> is used eg <RTN> means press enter or return, <C^> means press control.

Advanced Revelation (AREV) (Revelation Technologies, Inc., 1990) is a computer database management system (DBMS) that allows the user to build unique databases for specific data sets. AREV is an hierarchical system to which relational features have been added; a relational system is simply one that allows the manipulation and comparison of data from different records and from different parts of the same record or different tables (or files). AREV is an enormously complex system and has very powerful potential yet it is relatively easy for a complete novice to quickly build a complex database or application.

In designing a relational database one needs to think about the 'entities' that make up the data such as names and addresses or monitoring sites, their 'attributes' such as the post code, and the 'relationships' or 'relations' between them.

A.2 Features of AREV

A.2.1 Basics

Data is held in TABLES or FILES, each of which represents an entity. Files contain a varying number of RECORDS, representing individuals of that entity. Each record consists of a number of FIELDS representing the attributes of that entity. Each record has a unique identifier called the KEY or CODE which is always the first field of the record. Each table has a data DICTIONARY which describes the fields and assigns them numbers; KEY being zero. A dictionary requires the following information about any one field: Field Name, Type, Field Number, Single or Multi-valued, Justification (left or right), Field Length, Output Pattern, Indexing, and Description.

Field types may either be REAL (F) (these contain data) or SYMBOLIC (S) (tiny programs entered into the dictionary, bringing data into the table from other tables or doing transformations on data in a real field, but acting in all other respects like a real field). Symbolic fields are generally used for the XLATE function (see A.6.1).

Fields may also be either single-valued or multi-valued. Multi-valued fields lead to multi-lined prompts on data entry windows and may be filled with data from multi-valued popups or, as is often the case in 'MONIT', with free-text.

Indexing. There are three sorts of index: relational, btree and cross reference. At the time of writing only relational indexing is in use in 'MONIT' (see XLATE, A.6.1), but other indexes should probably be added to decrease data retrieval times.

Relational indexes define relationships between tables, and are used when there are one-to-many relationships between tables. For example a record in the SITES table may refer to several records in the FORMS table and vice-versa (see XLATE, A.6.1).

Btree indexes are basically ordered lists of all the contents of a field in a particular table, with pointers from each element in the list to the records in which that element occurs. The indexes are kept in a separate indexing file and are automatically updated. Cross reference indexes are essentially the same except that the contents of the indexed field is first broken up into individual words and then ordered with pointers to the relevant records. Please refer to the AREV manuals for more details.

A.2.2 The AREV environment

Starting up is described in section A.3.1.

The basic AREV screen has a main MENU bar across the top from which selections are made using the arrow keys and the <RTN> key. The main menu can be recalled anywhere within the system by pressing <F10>. Selections lead to further menus and you can return to earlier menus via <ESC>.

A STATUS LINE is always present across the bottom of the screen and reports on whether the system is in edit mode, updating indexes and so forth.

DATA ENTRY WINDOWS are directly associated with data tables. Each window has a PROMPT for each field in the record being created or updated. In 'MONIT' the prompts follow the same order and have the same names as the corresponding fields. Most prompts have help messages (<F1>) and many have option popups (<F2>). Data entered at multivalue prompts will scroll upwards and disappear as new lines are entered but will return on pressing <RTN>. Windows are moved around in using the <RTN> and <DownArrow> keys. Once all the data is entered <F9> will save it or the window can simply be left without saving by <ESC>.

Pressing <F1> not only produces HELP messages at prompts but gives access to the extensive AREV on-line help system at other times.

At many prompts the user will see 'OPTIONS' displayed on the status line. Pressing <F2> when options is displayed will produce a popup giving either the allowed answers for a prompt ('yes', 'no', 'don't know' etc) or a list of the records for that prompt/field previously entered (though these currently are not in alphabetical order). Popups are small windows that allow users to make choices and there are two types: single-choice (returning a single value) and multi-choice (returning a list of values). At a single choice popup the option is highlighted using the <DownArrow> key and selected by pressing <RTN>. At a multi-choice popup options are highlighted using the <DownArrow> key plus <RTN> and selected using <F9>.

The data entry windows in 'MONIT' are joined (possess 'relations') such that a single key stroke will

take the user from the main entry window ('FORMS.ENTRY') directly into other data entry windows (see sections A.4.3, A.6.2).

A.2.3 Tools

Some aspects of this section are discussed more elsewhere but are briefly introduced here.

The Command Level (TCL) is the AREV command language and the most direct way of issuing commands to the system. TCL can either be selected from the main menu or by pressing <F5> at any point to produce a popup window into which commands are typed. Limited use of TCL, outside of what can also be done via the menu system, was made in building this database.

AREV possesses a powerful programming language called R/BASIC which allows manipulation of the data and the database. The only current user implemented example of R/BASIC is the XLATE function (see section A.6.1).

AREV has several report producing tools. This project used AREV's own query language, R/LIST, to produce columnar reports but there is also a paint-type forms processor, a mailing label processor and a merge processor allowing output to be merged with other documents. R/LIST is discussed in more detail in the section on accessing data from 'MONIT' (A.5.3). Also discussed in this section is EasyWriter which is a menu and window driven program to help in the creation of R/LIST statements (programs) for reports and queries. QUERY (see below) is part of R/LIST. R/LIST commands generally include 'WITH' and 'BY' clauses which have the effect of selecting subsets of records from a table and determining the order in which they are to be presented. This happens afresh every time a command is executed. The process of creating ordered subsets of records is called FILTERING. A filter remains active once created until it is cleared by producing a report, typing 'CLEAR' in TCL or logging out. When a filter is active further R/LIST commands will produce a subset of the subset. A filter can be saved in, and recalled from, the LISTS file. This forms a 'SELECT LIST' which is an ordered set of keys for later use (these are historical and will not be automatically updated to take account of new records – they should be made with caution). Filters can either be created from the reports menu (R/LIST, EasyWriter etc) or from the filtering menu using the command SELECT for which there is extensive on-line help.

Query can be used when in a data entry window in order to search for a particular record for which the KEY is not known (for instance, to make sure it is not a repeat entry or to edit it). When at the 'KEY' prompt in any data entry window the QUERY function can be accessed by typing <\> <RTN>. A shaded area will appear over the prompts data entry area. This can be moved from prompt to prompt using the cursor arrow keys or <RTN> key. Any prompt can be used to search for any string of characters (in capitals) or numbers. More details are given in section A.5.2, including a list of qualifiers. One of the most useful qualifiers is '[character string]', the '[]' meaning 'containing'. Press <F9> to initiate the search and return the relevant records for editing.

AREV also offers Structured Query Language (SQL), not used in this project. SQL is the standard language for querying relational databases; such as BRC's distribution database which is held in a DBMS called ORACLE.

Also, AREV has powerful application development tools. For example the Paint tool allows you to build data entry windows (and simultaneously the table dictionary if desired) by painting prompts on to the screen. It is also possible to change any aspect of a window or menu at any time by simply editing its 'template'.

AREV can also be networked with other computers and bonded to other programs.

A.3 The database structure

The easiest way to understand the structure of the database is to use it. However, what follows is a basic outline of the tables and data entry windows that make up the monitoring database. The 'entering data' section (A.4) expands on the structure.

Essentially the database follows the outline of the questionnaire that was sent out. There is a main, central table or file called 'FORMS' into which most of the data from the questionnaires is put. Each field in the FORMS dictionary relates to questions on the questionnaire, in the order in which they appeared on the questionnaire. Other smaller tables were also created, these were designed to store specific details that could relate to more than one record in the database, for instance one site could be being looked at for different species by different people but its details need only be entered once. The first field in any table (or prompt in its entry window) is always the code or KEY which is the unique identifier of the record. So, the only site data in a FORMS record is the site KEY (additional data from SITES can be brought into the FORMS table via symbolic fields).

The data tables in the database are:

FORMS
CONTACTS
FUNDS
HABITATS
METHODS
MONTHS
OBJECTIVES
PERSON.TYPE
REFS
SITES
STAGES
STORAGE
TAXA

Each of these tables has a corresponding data entry window called *TABLE*.ENTRY. To see the list of attached tables or (files) one would type 'F5' (TCL - The Command Level), this produces a small popup window. Then type 'listfiles mondata'<RTN>. One could also list the tables by selecting 'DESIGN' from the main menu followed by 'LIST FILES'.

To see the list of fields/prompts that appear in each of the main tables/data entry windows see section A.4 and the reports in appendix B; the headings of the columns are the same as the field headings in the tables (though sometimes abbreviated).

A.4 Entering data

A.4.1 Introduction

This section aims to take the user through the process of entering data, either from a questionnaire or a literature form, into the database. The new user is advised to make use of the help system by pressing <F1> and also to look at the R/LIST reports in appendix B if in doubt about the nature of the information that should be entered at any prompt.

At the time of writing the database is located on an IBM PS/2 in Julian Dring's office in BRC.

1) Turn the computer on and boot-up, entering the password.

2) At the 'C:\' prompt type 'monit' - this takes the user directly into AREV and the monitoring database directory. A start-up window appears with a menu bar across the top of the screen.

A.4.2 FORMS.ENTRY window

1) Use the cursor keys and <RTN> to select 'ACCESS'. A further menu will appear - select 'WINDOW' and type 'FORMS.ENTRY' to enter the main data entry window. This window is laid out in a similar order to the questionnaire. (It would be possible to design a customized set of menus for 'MONIT' so that the user can go directly into data entry windows or reports).

The prompts appearing in FORMS.ENTRY, in order:

1 KEY*	2 CONTACTS*$
3 RECORD.TYPE*	4 TAXA*$
5 STAGES*	6 SITES*$
7 OBJECTIVES*	8 OBJ.COMMENTS*
9 PRACT.USE.YET	10 PRACT.COMMENT
11 BMS	12 OTHER.MONIT
13 OTHER.MONIT.COMMENT	14 HABITATS.CODE*
15 HABITAT.COMMENT*	16 METHODS*
17 METHOD.COMMENTS*	18 MONTHS*
19 FREQUENCY*	20 START.YEAR*
21 END.YEAR*	22 CONTINUOUS*
23 CONT.COMMENT*	24 OTHER.TECH.COMMENTS*
25 TAXON.POS.COMMENTS*	26 TAXON.NEG.COMMENTS*
27 PAID.OR.VOLUNTARY	28 PERSON.TYPE
29 PERSON.TYPE.OTHER	30 P.H.W
31 P.H.Y	32 FUNDING
33 FUNDS$	34 STORAGE
35 COMPUTERIZED	36 COMPUTER.TYPE
37 DBMS.TYPE	38 TRANSFER.MEDIA
39 PUBLICATIONS*	40 PUBLICATION.TYPE*
41 REFS*$	

All prompts are relevant to questionnaire data but only those marked '*'are relevant to literature data.
Those marked '$' have related data entry windows (eg SITES.ENTRY giving site details) which the user may wish to fill in before entering the codes at these prompts (see A.4.3-7).

2) At the 'KEY' prompt the user is given a default value which increases sequentially as records are entered (a previous record can be edited by typing in its record key). To select the default key <RTN>. The 'KEY' prompt is 'required' and cannot be skipped.

Throughout data entry pressing <F1> at a prompt will normally give an explanation of the prompt. If 'OPTIONS' is displayed on the status line pressing <F2> will give you data entry options in a form of a popup. As an illustration of these facilities at the 'RECORD.TYPE' prompt press <F1>. Now press <ESC>. Now press <F2> – is the record from literature or is it personal (ie questionnaire)?

3) The 'CONTACTS' prompt asks for a key. Pressing 'F2' will give a list of the names of all contacts on the database and their keys, but this is not in alphabetical order yet. (If the name is not already present call the 'CONTACTS.ENTRY' window; when completed press <F9> to save the information and then <ESC> to return to the 'FORMS.ENTRY' window. Enter the key for the contact that was just entered).

4) The 'TAXA' prompt works in the same way as the 'CONTACTS' prompt with <F2> listing the taxa. (If the taxon is not present call the 'TAXA.ENTRY' window. Again enter the taxa key in the 'FORMS.ENTRY' window). A symbolic field has been placed after this prompt and will cause the taxon name to be shown when the user moves on as a check that the correct taxa code has been entered.

'TAXA' is the first of many multivalue fields in the 'FORMS' table and as such can accept many taxa keys which will appear in a vertical list.

The rest of the data entry process works along similar lines; the <F1> help key, the 'OPTIONS' note in the bottom bar and <F2> key, and the <C^F6> key providing most information that is needed. There are however a few fields that deserve a further mention. Many prompts will be seen to end in '.COMMENT(S)'; these are generally free text fields allowing the input of large amounts of text. The text should aim to be as concise as possible. The fields are multivalue and so fall onto more than one line. Although the database will allow lines of text longer than the entry lines this is not to be recommended as it complicates report production; carriage returns should be used to move to the next line. (This problem could be overcome by fixing the prompts to allow only a fields width of data to be entered. Text type fields could be made to do an automatic line return).

The only comments field that is not multivalue is the 'METHODS.COMMENT' field, this cannot be multivalue because it is linked to the 'METHODS' fields as an Associated Multi-valued Field (AMV) ie each method code entered has a method comment directly related to it. The 'METHODS.COMMENT' field was found not to be very useful as it was too small and most method detail ended up in the 'OTHER.TECH.COMMENTS' field.

When entering data into the 'FREQUENCY' field try to keep entries consistent to as few terms as possible eg 'daily', 'yearly', 'weekly', 'monthly', '6-monthly', '2 times/week'.

If the scheme is on going then 'on going' is entered in preference to a figure at the 'END.YEAR' prompt.

When the record is complete 'F9' saves it and refreshes the window for the next record.

Entering literature data is exactly the same as entering questionnaire data except that there are fewer fields to be filled (those marked '*'). The 'CONTACTS' file contains the name and address and the 'REFS' file contains the literature details – the same applies to the questionnaire when references are given.

A.4.3 Other data entry windows

The prompts marked '$' in the description of the FORMS.ENTRY window (A.4.2) have related windows for record details that may relate to more than one FORMS record. These are normally accessed from the FORMS.ENTRY window via a single key stroke and a full list is given in section A.6.2 (They can of course be accessed from the main menu by selecting 'ACCESS', 'WINDOW' and giving the desired window name). The CONTACTS.ENTRY window gives a good example:

A.4.3.1 CONTACTS.ENTRY window

Whilst in FORMS.ENTRY press <C^F6> – this gives a list of the 'relations' that are available and the keys used to access them. The 'CONTACTS.ENTRY' window can be highlighted from this popup but normally the familiar user would press **<ALT F1>** which takes the user straight to that data entry window. Name, address, etc can be entered. When completed press <F9> to save the information and then <ESC> to return to the 'FORMS.ENTRY' window. Enter the key for the contact that was just entered.

The prompts appearing in CONTACTS.ENTRY, in order:

1 KEY	2 NAME
3 ORGANISATION	4 ADDRESS
5 POSTCODE	6 TEL
7 EXT	8 FAX
9 EMAIL	

All apply to both questionnaires and literature (though 6–9 are rarely available from literature).

A.4.3.2 TAXA.ENTRY window

Press <ALT F2> in FORMS.ENTRY.

The prompts appearing in TAXA.ENTRY, in order:

1 NUMBER	2 TAXON.NAME
3 TAXON.TYPE	4 DESCRIPTION

All apply to both questionnaires and literature. Please see appendix B for details of the format of data entry. TAXON.TYPE is a three character code: ORD = order, FAM = family etc.

A.4.3.3 SITES.ENTRY window

Press <ALT F4> in FORMS.ENTRY.

The prompts appearing in SITES.ENTRY, in order:

1 KEY	2 NAME
3 AREA	4 GRIDREF
5 ALT1	6 ALT2
7 STATUS	8 AONB
9 ESA	10 NP
11 URB	12 DISTRICT
13 VC	14 COUNTY

All apply to both questionnaires and literature. AREA should be entered in 'ha' (or km for transects). Grid references should be eight figures of this format: 51342456, where '51' is the 100 kilometre square. ALT1 is the minimum altitude or the average if only this is given. ALT2 is the maximum altitude. Use the popup options to select site STATUS. Enter 'AONB', 'NP' etc at prompts 8–11 as appropriate. The DISTRICT prompt is probably best ignored (the survey produced very few entries). At VC enter the Vice–County number(s), and the county name at COUNTY.

A.4.3.4 FUNDS.ENTRY window

Press <ALT F9> in FORMS.ENTRY.

The prompts appearing in FUNDS.ENTRY, in order:

1 KEY	2 ORGANISATION
3 FUNDS	4 ADDRESS

All apply to both questionnaires and literature. The value of this table seems somewhat questionable in light of the survey - with only 18 responses. ORGANISATION means the funding body. FUNDS is the nature of the funds (eg a grant for travel expenses).

A.4.3.5 REFS.ENTRY window

Press <SHIFT F1> in FORMS.ENTRY.

The prompts appearing in REFS.ENTRY, in order:

1 KEY	2 AUTHOR
3 YEAR	4 TITLE
5 JOURNAL	6 VOLPAGE

This window holds any references given by people filling in questionnaires but most importantly it holds the details of any literature search references.

A.5 Accessing data

A.5.1 Introduction

The invertebrate population monitoring survey generated a lot of data. AREV potentially allows complex analysis and manipulation of the data it contains and in the time available report production was not really explored fully. However, a vast amount of useful output was obtained by creating R/LIST reports and using the QUERY function within the application windows.

A.5.2 QUERY

This has already been briefly mentioned in the preceding sections (A.2 & A.4). This is a manual process in that printed reports are not produced. In any data application window one simply types <\> at the key prompt followed by <RTN>. This initiates the query process. Data to be searched for can be entered at any prompt (but must be entered as uppercase - this is the only time when AREV will not convert all case to uppercase). A number of operators exist that can be added to the data, these include:

= (equals)
> (greater than)
< (less than)
>= (greater than or equal)
<= (less than or equal)
...] (beginning with)
[... (ending with)
[...] (containing)
... (range, from-to)
% (matching the pattern...)
# (logical not)
; (logical or)
& (logical and)

Selections can be made on more than one field at a time and previous queries can be accessed by typing <\\>. Query actually initiates an R/LIST program and forms an ordered LIST of record keys which can be accessed later for use with R/LIST statements if it is saved in the FILTERS file as a SELECT LIST (press <F2> and follow instructions whilst in query). During the current session recent queries are automatically saved and can be retrieved when making R/LIST statements. One can BROWSE through the selected record list using <ALT F> and <ALT B>.

Query was not generally used to create select lists in this report. When a query is made and the records have been selected the number of records selected is flashed onto the screen, in this way the data in various fields could be counted, eg the number of people monitoring 'DAILY' at the 'FREQUENCY' prompt.

Entering <''><''> (two single inverted commas) will show how many records have that particular field empty.

QUERY invokes an R/LIST statement (see below).

A.5.3 R/LIST Reports

R/LIST reports were used to obtain listings of the data in the database. This was useful in that a visual check could be made on the data entry and in that the reports can be ordered in any way you like eg sorted numerically by key or alphabetically by name.

Creating an R/LIST report is simple and examples make up appendix B.

To create a report start at either the 'ACCESS' or 'DESIGN' menu, choose 'REPORT' and then choose 'EASYWRITER'. EasyWriter is a special program designed to make writing R/LIST programs or statements

easy by the use of window and menu driven prompts. (As for accessing application windows it should be easy to design a menu to call standard reports, customized reports being added via R/LIST or EasyWriter as required). After selecting easy writer the user is presented with a small popup giving a list of options:

1) CREATE a report
2) SELECT records for processing
3) Quick OVERVIEW of EasyWriter
4) Retrieve UNSAVED QUERIES (see above)
5) Retrieve from LIBRARY
6) Change SETTINGS

In most cases 1) would be selected, or 5) to retrieve previously saved R/LIST statements. An R/LIST statement is a piece of program and as such will generate a new list each time it is executed and so will always produce an up to date list. EasyWriter is really very simple to use if the menu options are selected in turn and so does not merit detailed explanation, if this is required turn to section H.5 in the manual.

A typical R/LIST statement would read:

LIST FORMS KEY JUSTLEN "3" CONTACTS JUSTLEN "3" TAXA JUSTLEN "3" STAGES SITES JUSTLEN "3" PAID.OR.VOLUNTARY PERSON.TYPE PERSON.TYPE.OTHER JUSTLEN "30" P.H.W P.H.Y FUNDING FUNDS BY KEY HEADING "'DF'" ID-SUPP DBL-SPC (P)

A statement such as the above can be produced in a couple of minutes.

Examples of R/LIST statements can be seen by retrieving some saved ones from the library (many of which could probably be deleted).

A.5.4 Obtaining hard copy of R/LIST reports

The computer is not directly linked to a printer and so printing reports is a slightly convoluted procedure. Reports must be sent to floppy disk (they are simple ASCII text files). When in easy writer, having test run the report, press <F5> to access TCL. Type 'PDISK A:*FILENAME* <RTN>' - this redirects printer output to the floppy disk (make sure there is one in the drive). Select the option for output to be sent to the 'SCREEN' (not logical but a quirk of AREV). 'RUN'.

When the report has been sent to the disk, exit from AREV (saving the query first) and choose drive I at the 'C:\' prompt by typing 'I:'. The PC must be on the network as the file is to be sent to the Monks Wood VAX. If appropriate select the correct subdirectory (eg 'D [.PETER]') and type 'COPY A:*FILENAME*'. The file can next be edited in 'EVE' from a VAX terminal to remove any extra headings that may appear, to tidy it and to see if the report will fit the paper.(Editing should not be necessary if the page width, length and headings are designed as standard at the R/LIST stage). Then print as normal using the laserprinter. (One word of advice, if printing in landscape mode choose 39 lines per page to prevent odd spacing and blank pages. Also choose 0.75" margins).

A.6 Other

A.6.1 'XLATE' and Relational Indexes

Although one can move from application window to application window easily when entering data it is also often necessary when creating reports and comparisons to draw together data from two different tables. To do this it is necessary to import data from one table into another, this requires the use of 'RELATIONAL INDEXES' and an R/BASIC programming command 'XLATE'.

The easiest way to explain this is to give a worked example. Suppose one wanted to create a report using the 'SITES' table to list various details about monitoring sites. If it was necessary to sort the records according to whether they relate to literature or questionnaires it would be necessary to import this data from the 'RECORD.TYPE' field in the 'FORMS' table.

A relational index must be set up. Go into TCL and type 'DICT SITES' and create a field called 'FORMS' in the 'SITES' dictionary, this must be 'real', 'integer' and multivariate, it will hold the 'KEYS' of the 'FORMS' table. Save this field and exit to return to the main menu. Choose 'TOOLS', 'FILES', 'INDEXING' and 'RELATIONAL' and enter the following information:

FROM		
	Source file	FORMS
	Related key field	SITES
TO		
	Destination file	SITES
	Index field	FORMS
	Sort mode	AR
	Indexing on	Yes
	Case insensitive index	Yes

Save this and select to update the index at the prompt.

Return to the 'SITES' dictionary and create a field called 'RECORD.TYPE' which must be multivariate, have a character data type and is symbolic (type 'S' at the field type prompt). Under 'FORMULA' type '@ANS=XLATE('FORMS',{FORMS},'RECORD.TYPE','X'). These arguments relate to the table name, the key location, the field name, and the format, and are fully explained along with a full explanation of XLATE in the manual under section N4.213.

R/LIST reports using the 'SITES' table and 'RECORD.TYPE' should now be possible. If the 'RECORD.TYPE' prompt is added to the 'SITES.ENTRY' application window template then queries can also be made on this field (no data need be entered here when inputting data to the database however as the information is automatically returned from the 'FORMS' table).

Naturally, if one simply wanted to retrieve data from a table and its record KEYs were stored in a field present in the current table then a relational index is not necessary; only XLATE need be used. For instance in the FORMS.ENTRY window taxa KEYs relating to the TAXA table are entered at the 'TAXA' prompt. A symbolic field for 'TAXA.NAME' has been set up in the FORMS table and appears as a hidden prompt in the FORMS.ENTRY window; when taxa KEYs or codes have been entered the taxon name is returned as a verification of correct entry.

The above is an important and useful process.

A.6.2 Function keys of particular use to the monitoring database:

C^F6 = Related application windows:
ALT F1 = CONTACTS.ENTRY window (name and address)
ALT F2 = TAXA.ENTRY window (taxa details)
ALT F4 = SITES.ENTRY window (site details)
ALT F9 = FUNDS.ENTRY window (details of funding bodies)
SHIFT F1 = REFS.ENTRY (literature references)

Other related windows would only be called if the 'OPTIONS' popup (F2) needed changing, these are:
ALT F3 = STAGES.ENTRY
ALT F5 = OBJECTIVES.ENTRY
ALT F6 = HABITATS.ENTRY
ALT F7 = METHODS.ENTRY
ALT F8 = PERSON.TYPE.ENTRY
ALT F10 = STORAGE.ENTRY

Also useful:
F1 = PROMPT/FIELD DESCRIPTION
C^F1 = GENERAL HELP
F2 = OPTIONS POPUP
C^F2 = CONCEPT HELP
F3 = ZOOM (would allow reading of a whole multivalue entry)
F4 = EDIT
F5 = TCL (allows access to the command level at any time)
F8 = REFRESH (clears a data entry window)
C^F9 = SAVE (ENTER IN A POPUP)
<RTN> = ENTER/CARRIAGE RETURN
CURSOR KEYS

A.7 Reference

General reference:

Dring, J. 1991. *Site integrity monitoring database user's manual.* Internal report: England Field Unit, Nature Conservancy Council.