British Trust for Ornithology

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The Hawk and Owl TRUST

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BTO Research Report No.177

Project Barn Owl

Evaluation of an Annual Monitoring Programme

Author

M.P. TOMS

A report by the British Trust for Ornithology,
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1.1 Background to the Annual Monitoring Programme

Barn Owl *Tyto alba* populations within the United Kingdom have shown a documented decline over the last 60 years (Blaker 1933, Sharrock 1976, Shawyer 1987, Gibbons *et al.* 1993). In England and Wales numbers have decreased by 70% from 12,000 breeding pairs in 1932 (Blaker 1933) to 3,800 breeding pairs in the mid-1980s (Shawyer 1987). Comparison between the BTO's two breeding Atlases (Sharrock 1976, Gibbons *et al.* 1993) shows a 37.5% decline in distribution over a 20-year period (1968-1988).

A number of possible causes for the decline have been put forward, the majority being linked to the general change in agricultural practices (Shawyer 1987, Percival 1990, 1991, Taylor 1994, Andries *et al.* 1994). The intensification of agriculture has reduced the amount of hunting habitat (rough grassland and wet meadows) and the availability of favoured prey species, specifically *Microtus agrestis* (Bright, 1993). Reduced availability of small mammal prey during the winter months may have been a major contributory factor in the decline, mediated through decreased overwinter survival.

Removal of hedgerows and mature hedgerow trees, and the loss of traditional agricultural buildings has reduced the availability of nest sites. Other factors have also been implicated in the decline, but their relative importance has yet to be quantified. These include Dutch Elm Disease (Osbourne 1982), changes in pesticide use (Shawyer 1987, Newton *et al.* 1991, Brown, 1992, Henderson *et al.* 1993), increased levels of road mortality (Shawyer 1994) and changes in winter weather conditions (Shawyer, 1987).

Similar changes in other Barn Owl populations have been noted elsewhere in Europe (Honer 1963, Julliard & Beuret 1983, De Bruijn 1994, Smets *et al.*, 1995) and in North America (Colvin 1985, Marti 1988).

Within the UK, data from the Barn Owl Conservation Network (BOCN) suggest that in some areas local Barn Owl populations are stable or even increasing. These are the areas where conservation work has been implemented (Shawyer, per com.). Demographic data (productivity and survival rates) support this view for some regions (Percival 1990, 1991). However, suggestions of increased productivity over recent years should be treated with caution since an increased amount of data may be coming from nest boxes rather than natural sites. Productivity at nest boxes may be higher than at natural sites (Percival 1988).

The proposal to carry out a full Barn Owl survey and long-term monitoring programme to determine the extent and level of population change emanated from the recommendations of The Hawk and Owl Trust's 1982/85 Survey Report (Shawyer 1987). This report was ratified by the Trust's Committee in 1989 as part of its Forward Research Plan. A full Barn Owl survey would additionally determine the success of those active conservation measures initiated following the 1987 report. The British Trust for Ornithology (BTO) was also keen to instigate a long-term monitoring programme to examine changes in various population parameters (productivity, mortality, etc.). This followed recommendations from the BTO's three-year

study on population trends in owls (Percival 1991). Project Barn Owl was initiated as a result of these joint aims.

1.2 The need for an Annual Monitoring Programme

A full survey of Barn Owl numbers, carried out every ten years, will provide data on the change in size of the breeding population between survey periods. On its own, regular survey of numbers will remain a passive system. It will tell us about the magnitude of change, but not necessarily the reasons for the change. To determine the reasons for the observed change we need to gather additional information on various population parameters and couple these with ongoing, detailed ecological studies.

Examination of mortality, movements and productivity will highlight some of the processes that are responsible for the changes in Barn Owl population size and will serve to deepen our understanding of Barn Owl ecology within the UK. Currently, much of our understanding comes from a number of detailed studies carried out in localised areas. UK-wide data is lacking and this could potentially lead to generalisations being made about Barn Owl dynamics, some of which may have a detrimental effect on future conservation measures. It is important that we gather information at the national level in a standardised manner. This can best be achieved by expanding the use of tested and accepted methods and by coordinating research at the national level.

Any annual monitoring programme would need a clearly defined regional structure and there is a strong ecological case for dividing the UK up into distinct regions. Such divisions may need to be based on landclass, but would no doubt be strongly influenced by administrative and other scientific considerations.

1.3 The aims of the Annual Monitoring Programme

The aims of the Annual Monitoring Programme have been defined as:-

a) To encourage a '*defined study area*' approach to integrate information on Barn Owl population levels with that on breeding performance and survival....

b) To monitor breeding productivity of Barn Owls by encouraging the use of standardised nest recording methods developed by the BTO's Owls Project (Percival 1990).

c) To monitor survival rates and dispersal of Barn Owls by the encouragement of ringing through the BTO Ringing Scheme.

d) To expand the network of local Barn Owl Study Groups and to encourage their contribution to the nationwide monitoring scheme.

e) To assess annual changes in relative abundance in '*key*' study areas from changes in site occupancy rates.

This document explores how each of these aims can be achieved and proposes a framework for an Annual Monitoring Programme.

2. STRUCTURE AND MECHANICS OF THE ANNUAL MONITORING PROGRAMME

2.1 Available Resources

The starting point for a coordinated monitoring programme would, by necessity, be the network of individuals and organisations already carrying out research on Barn Owls. The type of information currently gathered and its quality varies greatly from study to study. Some of this work is very detailed and already provides data of the sort that would be required for an Annual Monitoring Programme. Other studies would need to be developed and expanded to achieve the level of data quality required for an accurate monitoring programme.

The studies that are currently ongoing can be broadly grouped as follows:

Table I: Areas of study currently being carried out by Barn Owl fieldworkers within the United Kingdom.

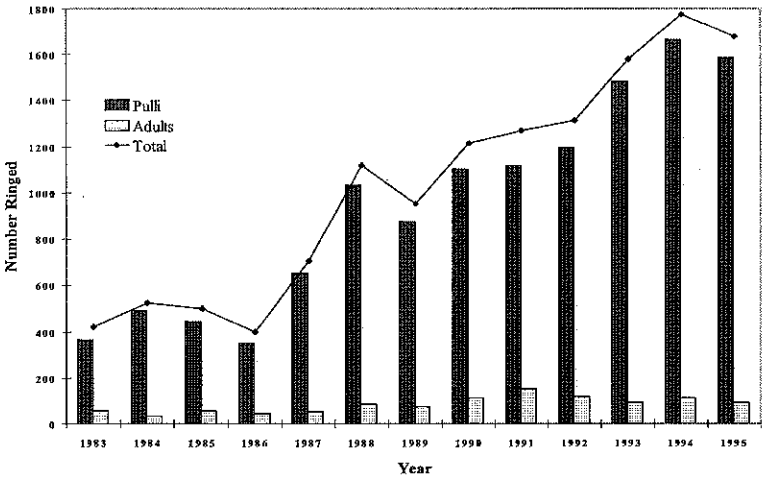
Study Type	Characteristics	Data Usage
Ringing	1. Usually only 1-2 visits made to a nest site each season. 2. Only a handful of ringers complete Nest Record Cards for sites visited.	Mortality Survival Movements
Nest Record Scheme	1. Several visits made to nest site each season. 2. Data gathered on nest stage, clutch and brood sizes. 3. Only a few recorders provide information on chick weight, size and egg density. 4. Data are not supplied on unoccupied sites.	Various measures of productivity and natal survival.
Provision of nest boxes	1. The provision of nest boxes is usually associated with some form of annual monitoring, although not all individuals contribute to either ringing or nest recording.	Can provide some information on those parameters outlined above.
Breeding and release	1. Post-release monitoring is often short-term and data is not made available to the Nest Record Scheme. 2. Since released birds have to be fitted with a BTO ring, some information is available to the Ringing Scheme.	Evaluation of the success of release schemes and the survival of released birds.

The Ringing Scheme, Nest Record Scheme and BOCN Project are the three obvious groups that could form the basis for an Annual Monitoring Programme. Data from breeding and release schemes, while of importance to an understanding of Barn Owl population dynamics in the wider context, falls outside the scope of the monitoring programme. Such data has been presented elsewhere (Ramsden & Ramsden 1989, Dockerty 1993, Andrews Ward Associates 1995).

2.2 Ringing

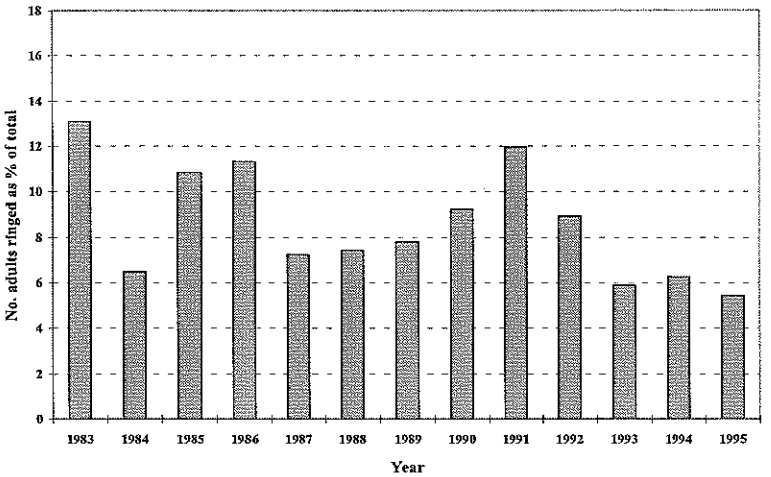
The number of Barn Owls ringed annually in the UK has continued to increase over the last decade. During the mid-1980s fewer than 600 birds were ringed annually. Today, some ten years on, around 1,500 birds are ringed each year.

Figure 1. Plot showing the number of Barn Owl *Tyto alba* adults and pulli ringed from 1983-95



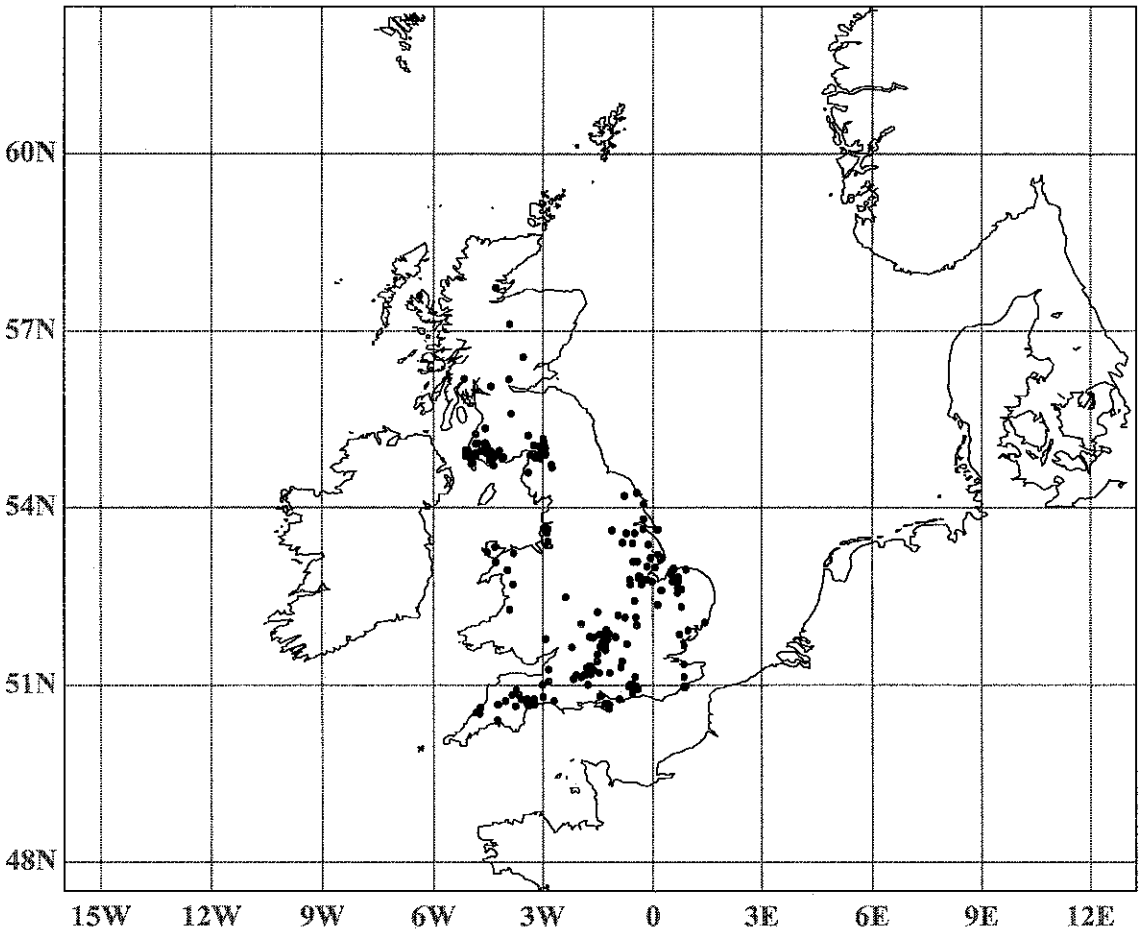
The ratio of birds ringed as pulli to those ringed as adults has remained roughly constant at approximately 12 pulli : 1 adult. Very few adults are ringed each year (typically less than 100) and efforts need to be made to increase the number of adults caught and ringed. The ringing of adults is important to our understanding of adult survival.

Figure 2. Plot showing the number of adult Barn Owls *Tyto alba* ringed as a proportion of total number ringed from 1983-95



The number of Barn Owl recoveries made each year has increased in line with the increase in the number of birds ringed. During 1994, 240 ringed birds were recovered. The bulk of recoveries are made during the winter months and are dominated by first year birds, with thirty-nine percent of first year birds recovered during their first winter (Glue, 1973). It is interesting to note that the peak period for juvenile recoveries is from September to January, while that for adult birds is from January to April (Glue, 1973; Percival, 1990).

Figure 3. Map showing the distribution of recoveries for Barn Owls *Tyto alba* made during 1994.



Under the BTO's Ringing Scheme, some 68 individuals, groups and partnerships fitted 1,677 rings to wild Barn Owls in 1995. 1,586 of these were pulli, the remaining 91 were adult birds. The biggest contributors are shown in the following table.

Table II: Main contributors to the annual ringing totals for Barn Owl in 1995. Note that the 'A'-permit holder is listed (i.e. the person to whom the rings were issued) rather than the actual person fitting the rings.

'A'-ringer	Adults	Pulli	Total
North Solway RG	28	177	205
Burton & Holder	2	179	181
Peter Wilkinson		130	130
Keith Grant	1	79	80
Adrian Blackburn	6	72	78
Peter Maynard	17	60	77
Harry James		60	60
Heather Woodland	3	57	60
Steve Petty	3	57	60
SW Lancs RG		53	53
B. Shaw		50	50
Alan Martin	8	35	43
James Gloyn		40	40
Whittles and Cross	3	34	37
Ian Spence	1	31	32
Ogilvie & Peacock	1	29	30
Dave Cooksey		29	29

The number of individuals listed corresponds to the number of permit holders to whom rings were issued. In many instances the rings would have been fitted to birds by one or more individuals operating under the person to whom the rings were issued. For example, three separate individuals fitted the 21 rings issued to the Wissey Ringing Group and used during 1995 (S. Browne, pers. com.). Of the 1677 birds ringed during 1995, 358 (21.35%) were ringed by ringing groups or bird observatories, 300 (17.89%) by partnerships and 1019 (60.76%) by individuals.

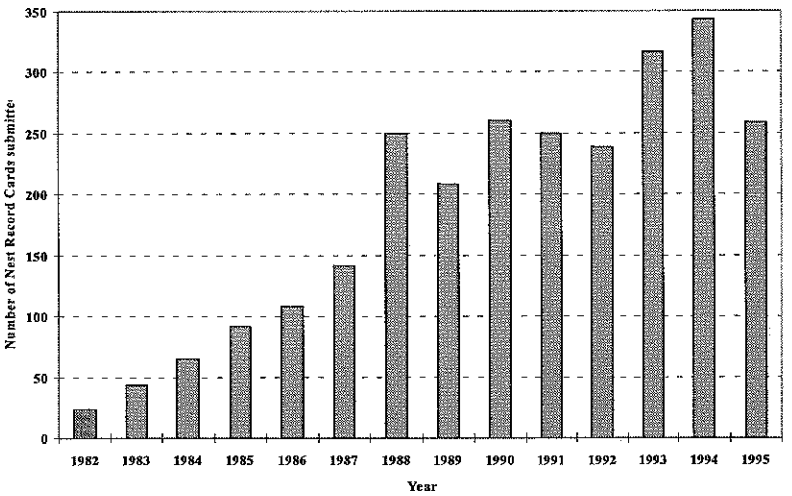
2.3 Nest Record Scheme

The Nest Record Scheme uses a network of volunteer ornithologists to gather data on the breeding performance of birds in the UK. Those involved complete standard Nest Record Cards for each nest they find, giving details of nest site, habitat, contents of the nest at each visit and evidence for success or failure. Visits to Barn Owl nest sites are carried out under Schedule 1 licences issued on behalf of the Country Agencies.

Changes in breeding performance are interpreted within the context of (a) the natural variation and long-term trends shown over the past 50 years; (b) population parameters measured by other BTO schemes; (c) weather and other environmental factors and (d) regional and habitat differences (Crick & Baillie, 1996).

The number of Barn Owl nest record cards submitted annually has increased dramatically since the early 1980s. However, from 1990 onwards the number submitted has stabilised at between 250 and 350 per year.

Figure 4. Plot showing the number of Barn Owl Nest Record Cards submitted during the period 1982-95



A proportion of the cards submitted only contain details for a single nest inspection and are not used during the nest record analysis itself. Ninety-nine (34.36%) of the 288 cards submitted during 1995 were excluded from the analysis for this reason. Single visit cards contain important information about the types of nest site being used on a regional basis. Many of the individuals who participate in the Nest Record Scheme are also involved in the Ringing Scheme. These individuals are often those who only complete single visit cards, largely because the nest recording is an incidental part of their ringing activities. Ringers are encouraged to complete Nest Record Cards as part of their Schedule 1 licensing.

In recent years the majority of Barn Owl Nest Record Cards sent in refer to birds using nest boxes as opposed to natural sites. During 1995, cards for Barn Owls using nest boxes made up 78% of the total, with only 12% from nests in buildings and 8% from tree cavities. Given that productivity may vary with site type, some effort should be made to increase the amount of information gathered from natural sites.

The main contributors of Barn Owl Nest Record Cards for 1995 are listed overleaf in table III.

Table III: The main contributors of Barn Owl records to the BTO's Nest Record Scheme during 1995.

Contributor	Number of Cards submitted in 1995
Geoff Shaw	46
Nigel Lewis	39
Geoff Sheppard	25
Pat Wixey	23
Mick Canham	17
Tony Duckels	16
R. Hayden	13
Pawl Willett	10
Peter Dale	10

Many nest recorders do not have the training required to handle eggs and chicks. For those nest recorders who are not ringers, it would not be appropriate to ask for egg and chick measurements. It would be worth considering how to increase the level of expertise in nest recorders. One possibility is to put them in touch with a local 'A'-ringer, who could take the measurements and ring the chicks.

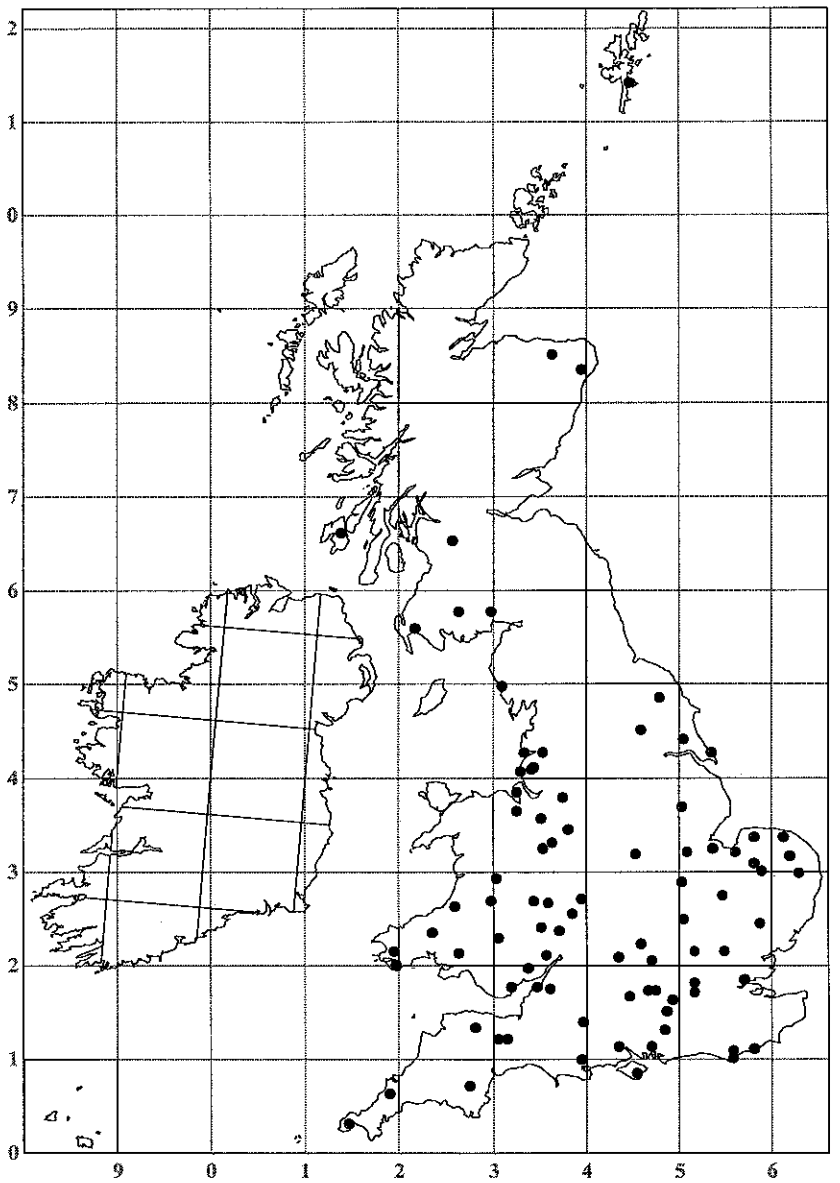
2.4 Barn Owl Conservation Network

The Barn Owl Conservation Network is a major project of the Hawk and Owl Trust, launched initially in 1988. Much of the Trust's conservation and monitoring work is targeted through the Network and it has been successful at coordinating work across the UK. The main aim of the Network is to secure the future of the Barn Owl and its habitat through a well-organised and fully coordinated national programme of conservation, research and education.

The Network currently comprises of over 100 active advisors, all of whom are volunteers, and many of whom are involved in the Nest Record and Ringing Schemes.

The BOCN regional advisors work in a practical way with land owners to create Barn Owl 'hunting habitat' and to erect nest boxes. The success of this work can be seen through the 3,656 Barn Owl nestbox sites now established across the UK.

Figure 5. Distribution of active Barn Owl Conservation Network advisors within the United Kingdom.



2.5 Other Groups

Other groups with a defined regional structure and an interest in Barn Owls operate under the banner of the Raptor Study Groups (RSGs). These originated in Scotland, which has eight groups, and there are now others in Northern England and Wales. Because of geographical location much of the Raptor Study Group work is concentrated on other raptor species, but there are individuals operating within the RSGs who have a special interest in Barn Owls (Ian Armstrong in Cumbria, Duncan Brown in Wales and Brian Little in Northumberland). A full review of the Raptor Study Groups and their activities is given in Crick, Baillie & Percival (1990).

2.6 National coverage and the distribution of Barn Owls

The distribution of groups and individuals concentrating on Barn Owl research broadly mirrors the distribution of the major Barn Owl populations within the UK. This can be explained by the fact that fieldworkers are more likely to concentrate on those areas where Barn Owls are readily available as a study species.

Published work on Barn Owl ecology in the UK comes from studies (many of which are ongoing) in Devon and Cornwall (Pearce, 1986; Grant *et al* 1993, 1994), East Anglia (Buckley & Goldsmith, 1975; Johnson, 1989, 1990; Cayford, 1992, Johnson, 1994), Scotland (Langford & Taylor, 1992; Taylor, 1992, 1993, 1994) Northwest England (Bunn *et al* 1982) and Wales (Bowman, 1980; Brown 1981, 1992).

Conservation work is additionally targeted in those areas where Barn Owl populations have shown a dramatic decline. Schemes, such as the Hawk and Owl Trust's ***Farmland, Riverside and Forestry Link Initiative***, aim to consolidate remaining populations and to expand these into areas where populations are at a lower level. The distribution of nest sites monitored through the Ringing and Nest Record Schemes is largely clumped, as can be seen from the maps shown in the following figures.

Figure 6. Map showing the distribution of 10-km squares within which Barn Owl pulli were ringed during 1995. Note that the map is derived from completed Ringing Schedules held on file. A number of schedules were not available at the time when the map was produced. The majority of these missing records refer to sites in Devon and Cornwall and the map is therefore not accurate for this region.

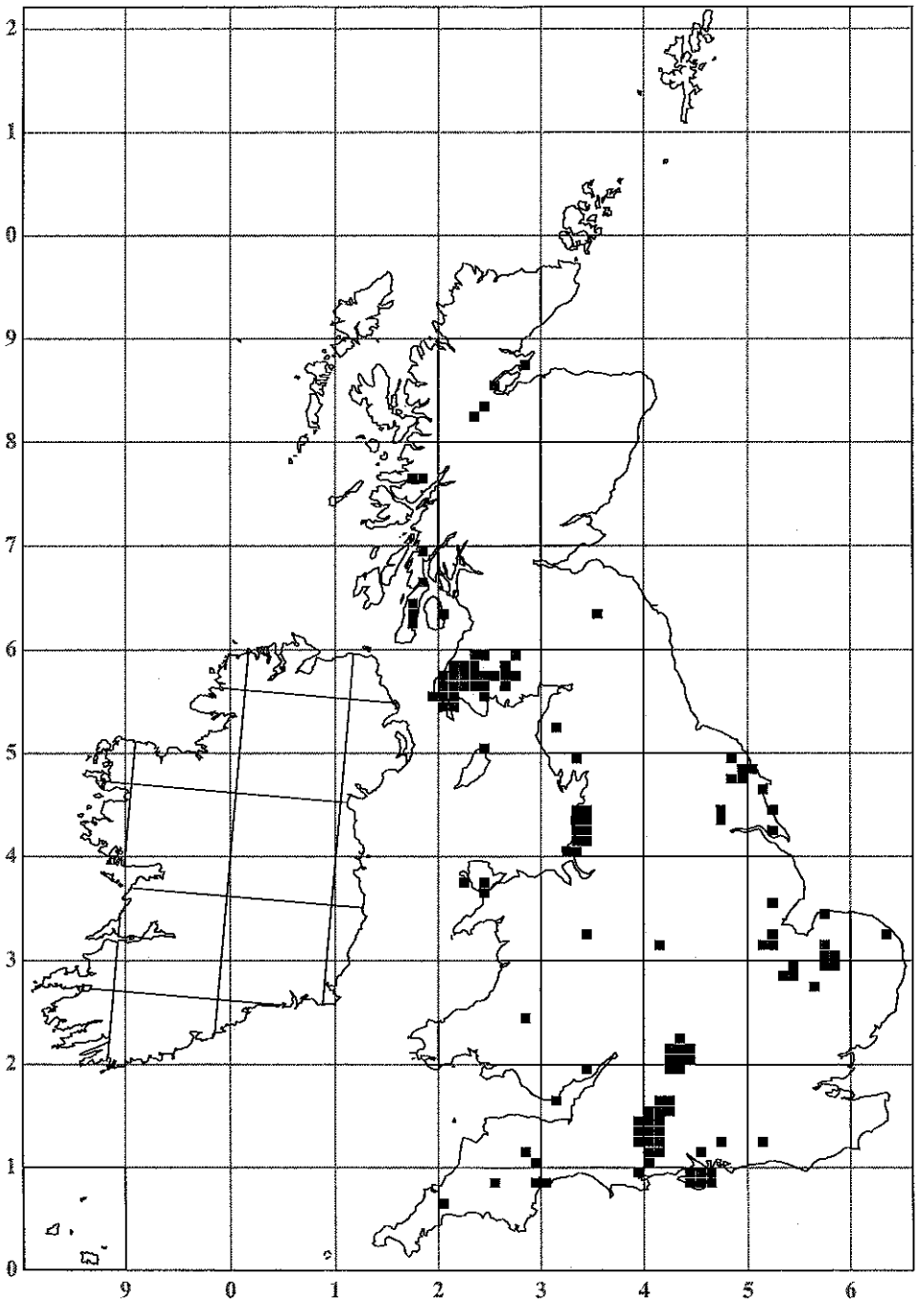
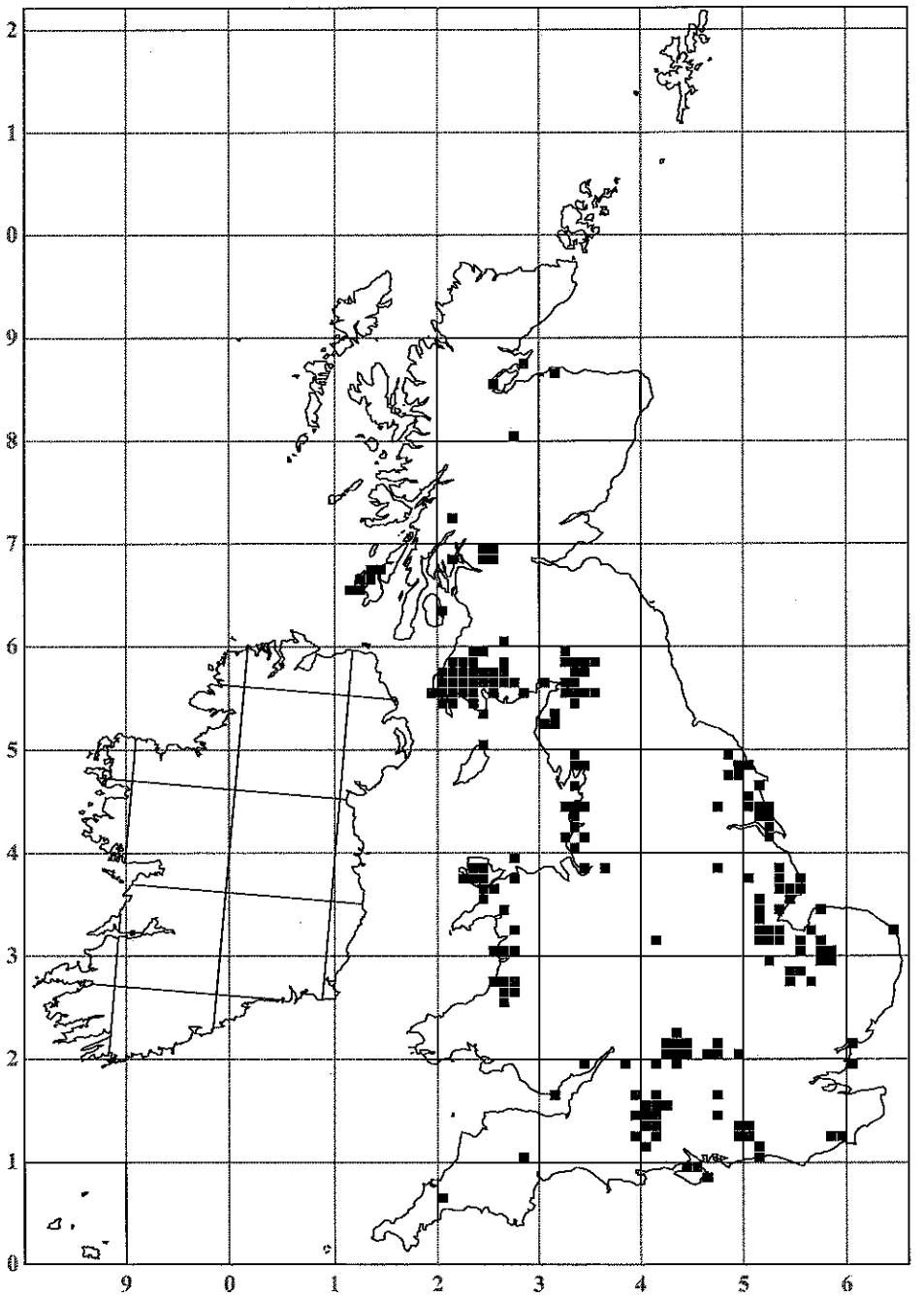


Figure 7. Map showing the distribution of 10-km squares from which one or more Nest Record Cards were received for 1995.



The two maps show the coverage of the Ringing and Nest Record Schemes and, when taken in conjunction with the map for BOCN advisors, some idea of current national work can be determined. There are one or two areas where Barn Owl fieldwork is known to be taking place, but where the individuals concerned do not contribute to a national scheme. However, it is clear that a structure for the proposed Annual Monitoring Programme already exists within the UK.

2.7 Monitoring Regions

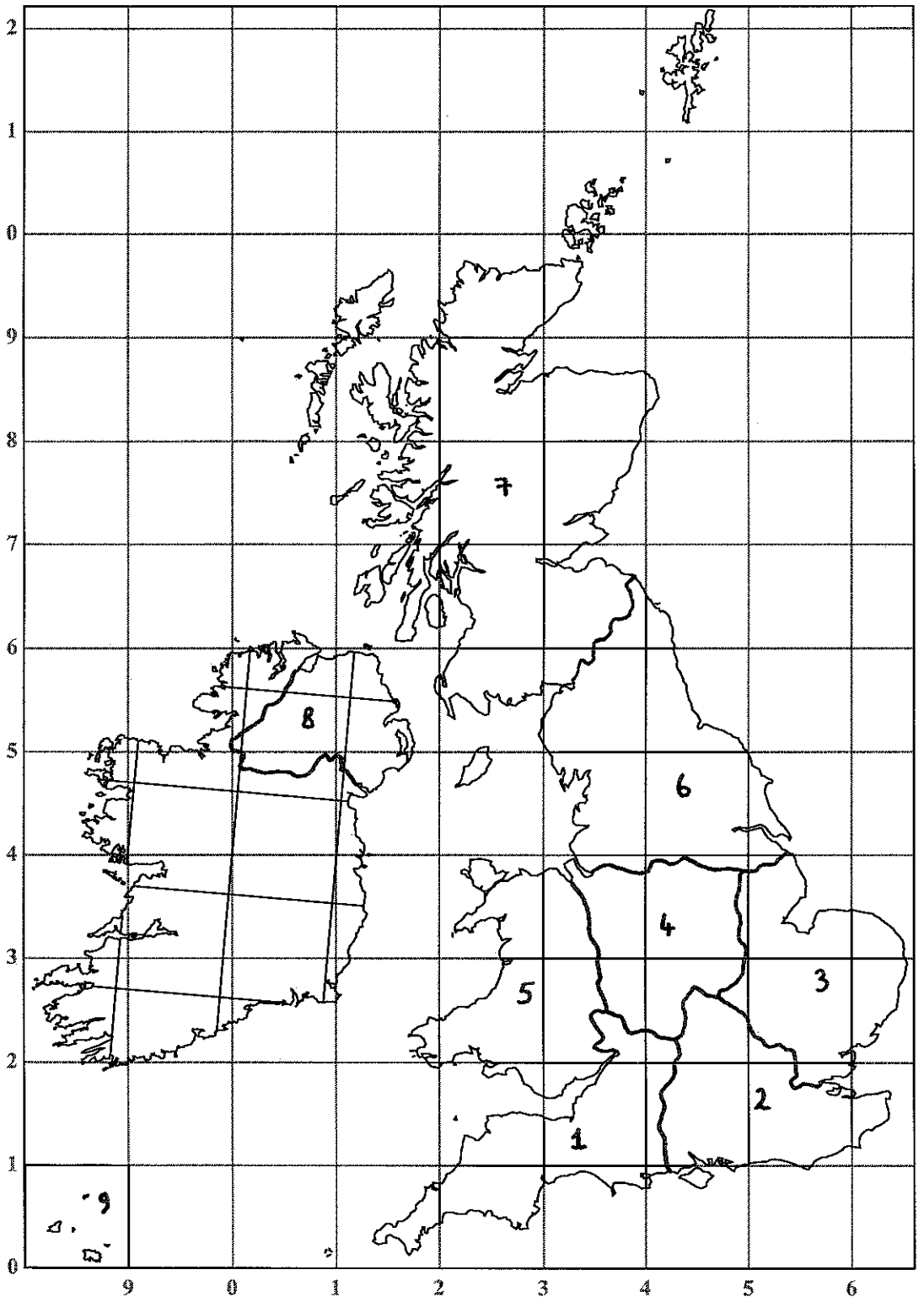
The development of '***monitoring regions***' makes sense from both scheme management and data analysis perspectives. The existing spatial structure of Barn Owl groups and fieldworkers will need to be taken into account when regions are selected for this programme. The majority of fieldworkers have their own clearly defined study areas and there has been some tension in the past between groups operating in close proximity to each other. Political considerations will also need to be taken into account.

It would be prudent to analyse data on a regional basis, thus allowing identification of any regional trends or differences in productivity and survival rates. These have been demonstrated by Percival (1990) and there is clear evidence that productivity varies with geographical position and weather patterns. This needs to be accounted for in any analysis. The regional breakdown used to analyse the data does not have to be the same as that used in the coordination of the fieldwork. However, if the two are similar, it would help in the management of the scheme and the production of local reports.

Each '***monitoring region***' needs to be large enough to accommodate a sufficient number of sites at which monitoring can take place. Ideally 30 to 50 sites should be monitored in each region every year.

Taking into account these various factors, a division of the UK into the nine regions outlined on the following map is suggested.

Figure 8. Map showing the proposed divisions for the Annual Monitoring Programme.



2.8 Political considerations

Any attempt to organise the long-term monitoring of Barn Owl populations at the national level will require cooperation from those groups/individuals carrying out fieldwork across the UK. Experience of national coordination, gathered during the running of Project Barn Owl, has highlighted some of the difficulties and tensions that exist between the various groups. Generally, individuals are possessive of their Barn Owl sites and of the data they gather from them. This is something that could be overcome by offering certain guarantees about site confidentiality and data usage. Additionally, the presentation of the Annual Monitoring Programme as something of great value to **all** involved (and to the Barn Owl), could serve to overcome some of the reservations expressed by various groups.

The production of an annual report presenting the productivity data from each region could serve to maintain the interest of those involved. It could also be used to induce those with reservations into the programme. It is vitally important that those involved receive regular feedback about the monitoring programme so that they have a sense of being part of it. The annual report could encourage participation in the programme because local groups could use it to attract interest into their own work. They could approach landowners and sponsors as part of a recognised national scheme rather than just as a local group.

The area of greatest concern is likely to be the disclosure of nest site locations to The Hawk and Owl Trust and the BTO. Certain groups have stated that they will not disclose information to one or other organisation. It is essential that the monitoring programme be seen as being an independent entity, with the locations of nest sites being used only within the monitoring programme. The Raptor Study Groups may be more willing to give data for national monitoring purposes, especially if the programme retains some degree of independence.

The contributors to the monitoring programme must feel that the data they contribute is being used to further their work and that of Barn Owl conservation. They must not feel that the data they are supplying is being used by another organisation to further its own work and profile. **The scheme must be for the benefit of the Barn Owl, Barn Owl conservation and our understanding of the species**.

The Country Agencies and JNCC should be involved with the programme. Much of the information generated through the monitoring programme will be relevant to their remits and long-term monitoring roles. To ensure that the programme involves groups and individuals across the UK it should seek to recruit fieldworkers through personal contact. The coordinator should visit the individuals concerned and explain how the programme has been set up, how it will work and what benefits it will offer participants. By doing this, it is thought that many of the initial reservations shown by groups can be overcome.

The use of the data gathered needs to be determined in advance. The objectives of the monitoring programme are to integrate information on Barn Owl population levels with that on breeding performance and survival and to encourage the contributions made by local workers to a nationwide monitoring programme. Data provided by recorders could be used to achieve these objectives without the ownership of data passing from the recorders to the BTO and the Hawk and Owl Trust.

2.9 Management of the programme and the flow of information

Information from fieldworkers would be passed to the national coordinator at the end of each breeding season. This would then be used to produce the annual monitoring report and to feed the appropriate data into other schemes (where agreed), e.g. Nest Recorders would still want information to go into the Nest Record Scheme. Copies of the report would be made available to all those involved in the annual monitoring programme. The proposed roles of the individuals involved in the programme can be defined as follows:

Individual	Proposed Role
National Coordinator	Establishment of programme and links with Barn Owl groups/individuals Coordination of data collection and general administrative enquiries. Analysis of data gathered on a regional basis, in relation to environmental variables, prey populations and other factors. Production of annual monitoring report Personal Liaison with individuals involved in the programme and with BOCN Coordinator, Raptor Study Groups, Country Agencies and DoE
Fieldworkers	Monitoring of specified nest sites within a clearly defined study area Provision of data for analysis at regional and national levels.

2.10 Annual Report

An annual report should be produced detailing a regional analysis of the data gathered during the year. This report should include information from all aspects of the monitoring programme. Additionally, information could be sought from DoE and ITE on Barn Owl releases and pollutant loads respectively. Any current developments stemming from research into Barn Owls could also be reported. This would give the report a high profile, effectively making it a review for the species.

The production of the report should be carried out by the Project Coordinator and should be completed prior to the following season. Data should be collated by the end of October and analysed by December/January with the report completed by February/ March. The report should be made available to all contributors, the Country Agencies, DoE, ITE and other relevant bodies, where it can be used to enhance local conservation efforts.

The report will draw together detailed data from across the country and will present the most precise picture of Barn Owl status and productivity that has been available in the UK. In conservation terms, this means that the annual report will be extremely important. Nationally, the annual reports can be used to determine policy and to target research effectively towards those areas in which data is lacking. At the local level, the report can be used to evaluate conservation efforts and to establish the best conservation practice.

2.11 Finance

A budget for the amount of expenditure required to maintain the monitoring programme beyond the end of Project Barn Owl falls outside the scope of this report. However, once set up the monitoring programme will require a coordinator to be available on a daily basis, although he/she is likely to be involved in other projects as well.

3. MONITORING METHODOLOGY

3.1. Introduction to Monitoring methodology

The monitoring methodology has been designed to gather information on breeding performance, post-fledging survival and dispersal. Extended nest recording, coupled with the gathering of additional data on adults, will enable us to better understand the mechanics of the processes governing changes in Barn Owl populations. Little data is available on the growth rates of nestling Barn Owls in Europe and there is even less on how these rates vary with region, habitat, latitude or brood parameters. We need to understand these processes if we are to monitor productivity for signs of impact by a detrimental external variable.

The monitoring methodology has several components, each targeted at addressing specific aims. The recording of information on egg density and chick growth will enable hatching date and age to be calculated. Both are important if we are to carry out age-specific analyses. Additionally, the data on growth rates could potentially be used to establish how successful the owls are in different areas or in different years.

The ringing of nestlings and adults will provide information on post-fledging survival, natal dispersal and adult survival. The methodology needs to establish standard techniques by which adults can be successfully aged and these could utilise moult stage, development of the talon flange and plumage colouration.

Recording of the information needs to be standardised to allow comparison spatially and temporally. The development of a standard recording form will be an important element of this.

3.2 Register of Barn Owl sites

Fieldworkers will be asked to register long-term sites at the beginning of the monitoring project. This will enable the recording forms to be produced in a consistent manner, with repeat information already preprinted on the sheets. Additionally, the registration of sites will help us assess annual changes in relative abundance and thus address Aim e (1.3.).

Registration of sites is potentially the most politically sensitive aspect of the project and will have to be carried out in a considered manner. Some recorders may be deterred by an initial approach asking for details of nest sites. This could be overcome by ensuring a personal approach, especially for those people not already involved in either the Nest Record Scheme or the Ringing Scheme. Nest sites could be coded, such that only a 10-km grid reference is revealed. This would be acceptable to those groups sensitive to the release of site locations and would not be detrimental to the monitoring methodology.

Historical information on nest sites can be extracted from Nest Record Cards and through contact with the recorder. This information can then be used to highlight those sites best suited to the monitoring programme.

The register of sites must remain a confidential document and be solely used to enable efficient management of the programme. This will be essential to provide the necessary guarantees that many of the fieldworkers will expect.

3.3 Recording Form Structure

An expansion of the schemes currently being carried out will require recording forms to be standardised for the UK as a whole. Space must be available for both ringing and nest record data and the form should be easy to use. The recording form could be based on the Nest Record Card, but should allow more detailed information to be recorded. Nest Record Cards are expensive to produce and a new record card that can be optically read by a computer OMR is probably not economically viable. It would be better to input the data by hand and then transfer the appropriate data through to the various schemes.

The suggested design for the recording form is based on the BTO Owls Project form, but has been expanded to include elements from the Nest Record Card. To encourage recorders to submit data on all sites (even if unused in a given year), the forms will be merged with the sites' database before being sent out. Recorders will not have to fill in repeat information (Name, County, etc.) and will thus be more likely to complete the form. The form layout is shown overleaf.

British Trust for Ornithology

Project Barn Owl
National Monitoring Programme
Record Card

Hawk and Owl TRUST

Recorder:		Recorder Code:		Year:	
Site Code:		Grid Ref:		County	
Locality:		Nest Site:		Species:	

SITE DETAILS (tick all boxes that apply)

Tree ☐
Species.....
Alive ☐
Dead ☐
Isolated ☐
In hedge ☐
Small Copse ☐
Edge of wood ☐
In nest box ☐
In cavity ☐
Other.....
.....

Building Type ☐
Farm ☐
Domestic ☐
Church ☐
Military ☐
Used ☐
Disused ☐
In nestbox ☐
In roofspace ☐
Other.....
.....

Other ☐

Polebox ☐
Balestack ☐
Inside ☐
Outside ☐

Other.....
.....
.....
.....

HABITAT (see coding sheet)

(H1)		A	B	C	(H2)		A	B	C
Wood	A	1	1	1	Wood	A	1	1	1
Scrub	B	2	2	2	Scrub	B	2	2	2
Grass	C	3	3	3	Grass	C	3	3	3
Heath	D	4	4	4	Heath	D	4	4	4
Farm	E	5	5	5	Farm	E	5	5	5
Human	F	6	6	6	Human	F	6	6	6
Water	G	7	7	7	Water	G	7	7	7
Coast	H	8	8	8	Coast	H	8	8	8
Rock	I	9	9	9	Rock	I	9	9	9
Misc	J	10	10	10	Misc	J	10	10	10

Date	Time	Eggs	Young	Comments (record egg and chick measurements on reverse)			

OUTCOME OF NEST (please tick one box in Section 1 and any appropriate boxes in section 2)

Site not used this year ☐	Used as a roost by pair ☐ or Single bird ☐ Occupied by other species ☐ Species?.....
Outcome Unknown ☐	Evidence for or against success is inconclusive ☐ Observations on nest were not continued ☐
Nesting attempt failed ☐	Nest or eggs : empty ☐ damaged ☐ fallen ☐ removed ☐ deserted ☐ all infertile or addled ☐ Young: all dead ☐ injured ☐ uninjured ☐ obviously starved ☐
Nesting attempt successful ☐	Young capable of leaving nest when last seen ☐ Young seen leaving nest naturally ☐ Young seen and/or heard near nest ☐ Parent birds seen carrying food into nest site ☐ In nest: hatched shells ☐ feathers from young ☐ Other evidence?.....

Sponsored by Bayer AG; LIPHA SA; Sorex Ltd; Zeneca Agrochemicals

National Monitoring Programme
Record Card - Instructions

Use this table to record information on eggs and chicks - take measurements of egg length, breadth and weight; chick wing length, head & bill length and weight.

Eggs					Chicks				
Date	Egg No.	Length	Width	Weight	Date	Chick No.	Wing Length	Head/Bill	Weight

Nest Site: Please enter your name for the nest site, eg. *Oak Farmhouse nestbox.*

Species: Please enter the species using the nest site or record 'UNUSED' if the site is not in use.

Site Details: Tick all the boxes that apply within the category of site type that you select. See the example sheet supplied if you are unsure how to fill in this section.

Habitat: The habitat codes used are the same as those used in the Nest Record Scheme. If you are already familiar with these then this section should be straightforward. If you have not used this habitat recording system before, please see the sheet on habitat coding.

Nest Details: Record the date and time of each visit and the number of eggs and young. Please take measurements as detailed on the measurement's sheet and record any observations that you feel are relevant. For example: *Were adult birds present? Were there any prey items at the site? Was the site damp? Were there any addled eggs?* Record anything that you feel may be of use. The measurements should only be taken by qualified ringers and these should include egg weight, length and breadth and for chicks the wing length or head + bill length. Please record the ring numbers of chicks and parents if they are ringed.

If you can make more than one visit to the site, then we will be able to use your data to produce age-specific survival estimates. These are important to our understanding of Barn Owl ecology. By taking the measurements of chicks and eggs you should be able to time your visit to get the maximum amount of information with the minimum amount of effort.

Outcome of nest: If you can determine the outcome of the nest site then this will increase the value of the data you have already recorded. Tick one of the four boxes in the first column and then tick those boxes that apply in the second corresponding column. If you are unsure please see the example sheet.

Disturbance: As with all bird species, care must be taken around the nest site so as not to cause the birds any unnecessary stress. Research has shown that Barn Owls are tolerant of repeated nest visits, so long as they are carried out with care. It is possible to visit the site during the incubation period without causing the birds to desert, but do try to avoid the hatching period. All nest visits need to be carried out under a Schedule 1 Licence so please ensure that you have a valid licence on you when you visit the nest site.

British Trust for Ornithology

Project Barn Owl
National Monitoring Programme
Record Card

Hawk and Owl Trust

Recorder:	M P Toms	Recorder Code:	M P T R R	Year:	1997
Site Code:	M T 1 5	Grid Ref:	T G 1 6 9 0 7 5	County	G B N K
Locality:	HATHWAITE HALL	Nest Site:	OLD BARN SITE	Species:	BAROW

SITE DETAILS (tick all boxes that apply)

Tree ☐
Species.....
Alive ☐
Dead ☐
Isolated ☐
In hedge ☐
Small Copse ☐
Edge of wood ☐
In nest box ☐
In cavity ☐
Other.....
.....

Building ☑
Type
Farm ☑
Domestic ☐
Church ☐
Military ☐
Used ☐
Disused ☐
In nestbox ☑
In roofspace ☐
Other.....
.....

Other ☐

Polebox ☐
Balestack ☐
Inside ☐
Outside ☐

Other.....
.....
.....
.....
.....

HABITAT (see coding sheet)

(H1)		A	B	C	(H2)		A	B	C
Wood	A	1	1	(1)	Wood	A	1	1	1
Scrub	B	(2)	2	2	Scrub	B	2	2	2
Grass	C	3	3	3	Grass	C	3	3	3
Heath	D	4	4	4	Heath	D	4	4	4
Farm	(E)	5	5	5	Farm	E	5	5	5
Human	F	6	(6)	6	Human	F	6	6	6
Water	G	7	7	7	Water	G	7	7	7
Coast	H	8	8	8	Coast	H	8	8	8
Rock	I	9	9	9	Rock	I	9	9	9
Misc	J	10	10	10	Misc	J	10	10	10

Date	Time	Eggs	Young	Comments (record egg and chick measurements on reverse)			
25/5	1940	4	0	WA	FT		4♀ on eggs GF51964 ringed
30/5	2000	3	1	HA	NA		♀ on eggs + 1 yng
27/6	1530	1	3	FM	FL	AN.	1 addled egg removed and destroyed
06/7	1700		3	FL			ringed 3/5 pulli
21/7	2000		3	RF	LB		young out of box, moving in building

OUTCOME OF NEST (please tick one box in Section 1 and any appropriate boxes in section 2)

Site not used this year ☐	Used as a roost by pair ☐ or Single bird ☐ Occupied by other species ☐ Species?.....
Outcome Unknown ☐	Evidence for or against success is inconclusive ☐ Observations on nest were not continued ☐
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Nesting attempt successful ☑	Young capable of leaving nest when last seen ☐ Young seen leaving nest naturally ☐ Young seen and/or heard near nest ☑ Parent birds seen carrying food into nest site ☐ In nest: hatched shells ☐ feathers from young ☑ Other evidence?.....

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National Monitoring Programme
Record Card - Instructions

Use this table to record information on eggs and chicks - take measurements of egg length, breadth and weight; chick wing length, head & bill length and weight.

Eggs					Chicks				
Date	Egg No.	Length	Width	Weight	Date	Chick No.	Wing Length	Head/Bill	Weight
25/5	1	37·6	31·1	20·8	30/5	1	46mm	42mm	26
	2	37·9	31·0	21·1					
	3	37·7	31·0	20·6	27/6	1	132mm	61mm	308
	4	38·3	30·8	18·7		2	118mm	58mm	272
30/5	1	—	—	19·4		3	112mm	54mm	263
	2	—	—	20·2					
	3	—	—	18·2	06/7	1	201mm	66mm	361
27/6	2	—	—	19·9		2	189mm	63mm	358
						3	191mm	67mm	360

Nest Site: Please enter your name for the nest site, eg. *Oak Farmhouse nestbox.*

Species: Please enter the species using the nest site or record 'UNUSED' if the site is not in use.

Site Details: Tick all the boxes that apply within the category of site type that you select. See the example sheet supplied if you are unsure how to fill in this section.

Habitat: The habitat codes used are the same as those used in the Nest Record Scheme. If you are already familiar with these then this section should be straightforward. If you have not used this habitat recording system before, please see the sheet on habitat coding.

Nest Details: Record the date and time of each visit and the number of eggs and young. Please take measurements as detailed on the measurement's sheet and record any observations that you feel are relevant. For example: *Were adult birds present? Were there any prey items at the site? Was the site damp? Were there any addled eggs?* Record anything that you feel may be of use. The measurements should only be taken by qualified ringers and these should include egg weight, length and breadth and for chicks the wing length or head + bill length. Please record the ring numbers of chicks and parents if they are ringed.

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Outcome of nest: If you can determine the outcome of the nest site then this will increase the value of the data you have already recorded. Tick one of the four boxes in the first column and then tick those boxes that apply in the second corresponding column. If you are unsure please see the example sheet.

Disturbance: As with all bird species, care must be taken around the nest site so as not to cause the birds any unnecessary stress. Research has shown that Barn Owls are tolerant of repeated nest visits, so long as they are carried out with care. It is possible to visit the site during the incubation period without causing the birds to desert, but do try to avoid the hatching period. All nest visits need to be carried out under a Schedule 1 Licence so please ensure that you have a valid licence on you when you visit the nest site.

4. MEASUREMENTS TAKEN

4.1 Egg Density

During incubation all eggs lose approximately 16% of their initial weight (Rahn & Ar 1974, Hoyt 1979) and under natural conditions the rate of weight loss is roughly constant from day to day. This loss can be attributed almost exclusively to the loss of water vapour from the developing embryo (Rahn & Ar 1974). Incubation time is inversely proportional to the daily water loss, which is in turn a function of water vapour conductivity (shell pore area) and the water vapour gradient. Incubation time and the daily changes in egg density will be influenced by egg shape, nest situation and incubation behaviour of the parent.

The density of an egg declines as the incubation period progresses (Hoyt 1979, Furness & Furness 1981). This means that the measurement of egg density can be used to estimate the time left to hatching from a standard curve. Knowledge of the hatching date will provide age-specific information of value to the monitoring programme. The calculation of age-specific survival rates relies on the ability to accurately age chicks and/or eggs.

Egg density is calculated using the volume of the egg and its weight. Volume is described by the following equation:

$$V = K_v . LB^2$$

where L is egg length, B is egg breadth at the equator and K_v is the volume constant.

The volume constant K_v is applicable to the eggs of all but a few species in which the eggs are very pointed and has been obtained for 115 species of birds producing a mean of 0.509 $\pm$0.008 (SD) (Hoyt 1979). The constant is a function of egg shape, and because there is as much intraspecific variability in K_v as interspecific variability, the volume of most avian eggs can be estimated from its linear dimensions using a single value for K_v.

A value of 0.507 for K_v was used by Percival (1990) for calculation of egg density for Barn Owls and Tawny Owls. This value is based on the analysis of 26 bird species by Hoyt (1979) and is quoted in Furness & Furness (1981). If the calibration graphs produced by Percival are to be used then the volume constant used should be 0.507.

The egg density can thus be determined for Barn Owl eggs using the equation:

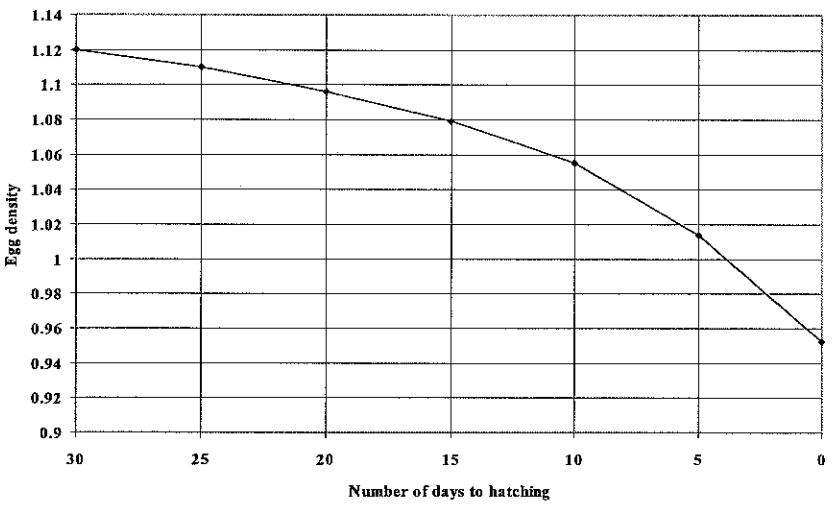
$$Egg\ Density = \frac{W}{0.507 . LB^2}$$

The calibration curves produced by Percival need to be evaluated during the monitoring programme and attempts should be made to gather additional data from other sites of known age. The egg density curve for Tawny Owls was based on a sample of only eight nests. This is not a large enough sample to ensure independence of observations. Although Percival does

not give any figures for the construction of the corresponding Barn Owl curve, it seems unlikely that the resultant calibration curve is any more reliable.

Consequently, attempts to gather additional data should be a priority and fieldworkers contributing to the Annual Monitoring Programme will need to supply egg weights, lengths and breadths rather than egg density measurements. These can be converted at a point when more reliable curves are available.

Figure 9. Calibration curve used to estimate the number of days to hatching from measurement of egg density for Barn Owl *Tyto alba* (after Percival 1990).



Addled eggs do not lose water as fast as developing eggs (Furness & Furness 1981) and thus their age cannot be estimated from a calibration curve. Recorders will need to be aware of this because an addled egg will have a greater egg density and it will consequently appear to have been laid more recently than the rest of the clutch. By numbering eggs the presence of addled eggs will be easier to detect. On repeat visits the change in egg density of an addled egg will be proportionally less than for eggs showing normal development.

4.2 Chicks

For the purposes of the monitoring work, it is important to establish the age of individual chicks. It is unlikely, and indeed undesirable (see 4.7.), for visits to be made on a daily basis, thus allowing precise ageing to be carried out. Instead, it will be necessary to predict the age of a chick in similar manner to that used for predicting hatching date. As a chick ages, there are associated increases in various aspects of body size. Where these follow a predictable form, it is possible to calculate the age of the chick from a measurement taken in the field.

Growth in birds is usually described in terms of an increase in weight over time. Calibration curves of weight against age could be used to allow prediction of age from body weight. However, weight is not the only variable that can be used: wing length, tarsus length and head-bill length can equally be applied. Indeed, in the case of the Barn Owl these last three measurements may be better predictors of age than body weight.

Growth curves, using a named parameter against age (eg. weight), can be fitted to data derived from individuals of known age. The data can be fitted to a curve of known form, typically using either a Logistic, von Betalanffy or Gompertz equation (Ricklefs 1968, 1973, Brown & Rothery 1993, Barkowska *et al.* 1995). These all belong to the Richards' family of growth models (Richards 1959).

The logistic equation most frequently provides the best fit for avian data and this has been demonstrated for the Barn Owl age/weight relationship (O'Connor 1984, Wilson *et al.* 1986). With this equation the growth rate declines linearly with size, and the curve itself is symmetrical about its point of inflection at 50% of the asymptote.

A number of different measures have been examined as predictors of chick age and these are discussed in turn with respect to their usefulness.

4.3 Weight

The weight/age relationship has been examined for *Tyto alba alba* by Radu (1973), Schonfeld & Girbig (1975) and Percival (1990), *Tyto alba affinis* by Wilson *et al.* (1987), *Tyto alba javanica* by Lenton (1984) and *Tyto alba pratincola* by Ricklefs (1968) (using data from Sumner (1929) and Pickwell (1948)).

Percival found that weight was not as useful a predictor as other measurements, because chicks of the same age showed quite large variation in weight. Examination of Lenton's data shows increased variation in the later stages of development, as the asymptote is approached, but not necessarily enough to drastically reduce the predictive potential of using body weight to age Barn Owl chicks. Intuitively you would expect body weight to reflect body condition as well as growth stage, thus increasing variation.

A least-squares analysis of variance by Wilson *et al.* (1987) showed that both year and month of hatching influenced growth (as determined by weight), but did not reveal any patterns with regard to order of hatching. With competition for food among nestlings, you would expect some relationship to the order of hatching. Williams may not have found a significant relationship because he looked across all broods, rather than within broods, or because prey was not limiting in his study area.

Using body weight as a predictor of age has two distinct advantages. It can be readily recorded and the magnitude of change is large, thereby reducing sample error. However, since it also reflects body condition and because weight levels off, or even decreases (Ricklefs 1968b), around the asymptote it is not necessarily an entirely accurate predictor. One further complication is that the body weight of young owls will change dramatically once they have produced a pellet or swallowed a prey item (Pickwell, 1948).

4.4 Bill Length, Head and Bill Length

Percival (1988) found the measurement of Bill Length to be of little use in the prediction of age of young Tawny Owls *Strix aluco*. Although Bill Length increased with age, it did so at a slow rate and there was only slight variation through the growing period. This meant that

the accuracy of the measurement would have to be particularly high. The same problem would almost certainly apply to Barn Owls. Head and Bill Length was found to be more useful and was applied by Percival to both Tawny Owls and Barn Owls as part of the BTO Owls Project. In the Barn Owl this measurement increased from an average of 42mm on day six to 65mm on day 60. Percival's data suggests that the increase reaches the asymptote at between day 45 and day 50, reducing the usefulness of this measure in late stage chicks. Ringing visits are often made during this period.

4.5 Wing Length

Both wing span and wing length were examined by Wilson *et al.* (1987) and were found to be useful measures of age. Unlike many of the other variables examined by Wilson *et al.*, wing length and wing span did not reach the asymptote before fledging, but were still increasing at day 60. In terms of being able to age chicks late in the fledging period, this makes a standard measure of wing length an appropriate choice.

Wing length is less reliable, and potentially more difficult to obtain, for young chicks (Percival, 1990). However, it has been widely used in The Netherlands and a standard curve for wing length is available. This curve is based on a larger data set than that of Percival and shows less variation.

The use of wing length as the favoured measure for estimating age is supported by:

a) the ease with which a standard measure can be obtained.

b) the availability of a tested calibration curve.

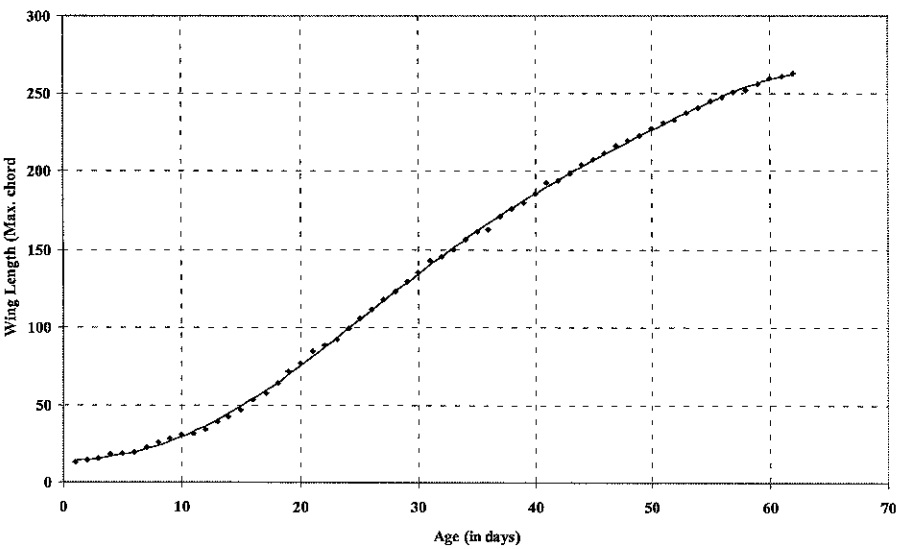
c) small variation about the mean for a given age.

d) a large range between day 1 and day 60 reducing the impact of sampling error.

e) the asymptote being reached beyond fledging, thus allowing age to be established during late visits.

f) familiarity of ringers with the technique

Figure 10. Calibration curve showing the mean wing length of Barn Owl chicks in relation to age.



4.6 Adults

It is widely accepted that additional data needs to be gathered on adult survival through the ringing of an increased number of adults. This can best be achieved during the breeding season when adults can be caught at the nest site. Birds should be caught upon leaving the nest rather than in the nest itself. This reduces the risk of damage to eggs or chicks. Birds can be caught as they emerge from the site, by using a hand-held net with a deep bag and padded rim. The bird can then be bagged while the nest contents are inspected before being processed itself and returned to the site.

Fieldworkers should be encouraged to catch and ring adults by the provision of a subsidy on rings fitted to adults. They should also be encouraged to age and sex individuals using the guidelines outlined by Johnson (1992) and Baker (1993). Any evidence of moult should also be recorded.

4.7 Disturbance

Concern has been expressed that nesting Barn Owls are sensitive to human disturbance, especially during the early stages of breeding (Shawyer, 1987), and that this disturbance may cause failure of nesting attempts. However, there is little evidence to support this view. The large number of long-term studies that have been successfully carried out could suggest that the monitoring of active nest sites is unlikely to bring about desertion (Colvin 1984, Lenton 1984, Wilson *et al.* 1987, De Bruijn 1994, Taylor 1994).

Two studies have been carried out specifically examining the effect of human disturbance on active Barn Owl nests (Percival 1990, Taylor 1991) while a third included Barn Owl among 135 other species (Kania 1992). The Barn Owl data presented in the Kania paper (Kania 1992) suggest that disturbance could result in desertion. However, the data are drawn from a small number of ringers across Europe. The majority of the data relating to desertion rates come from a single ringer operating in Switzerland, who gives desertion rates as high as 16.7% for the incubation and laying periods. However, with sample sizes of only 18 and 6 nests respectively, these data cannot be viewed subjectively.

Percival examined the possible effects of observers visiting active nests for both Tawny Owl and Barn Owl. The analysis was based on a questionnaire asking Barn Owl fieldworkers about their opinions and experiences on working around active nests. Percival then went on to examine nest record data to calculate measures of productivity in relation to timing and number of visits. Percival's work suggested that many fieldworkers regarded it as being unsafe to visit nest sites during the pre-laying and hatching stages. However, few could provide any evidence to substantiate their views.

For those people who supplied data, Percival was able to identify the hatching period as the period when birds were sensitive to disturbance. Outside of this period, the desertion rate (from **all** causes) was less than 5% of all nests. Analysis of the nest record data showed that nests only visited during the late chick stage did not fledge significantly more young than ones that had been visited in other stages of the breeding period.

Taylor (1991) examined the effect of nest inspections and radiotagging on breeding success of

Barn Owls in South West Scotland. He found that the various measures of productivity were similar between those nests only visited at the late chick stage and those that received multiple visits. Taylor also noted that site fidelity was high with only 0.9% of males and 5.6% of females changing nest sites in consecutive breeding seasons.

The evidence from Taylor and Percival supports the view that the Barn Owl is generally tolerant of nest visiting (including the capture of adults). It would be fair to say that for those researchers upon whom the data are based, all made an effort to minimise disturbance during the incubation period.

The monitoring instructions should refer to the work of Taylor and Percival to ensure that the recorders are aware that Barn Owls are generally tolerant, but it should be stressed that visits should be carried out in a manner to minimise any disturbance.

5. CONCLUSIONS

An annual monitoring programme is clearly required if we are to examine changes in the various population parameters that influence population change in the Barn Owl. An understanding of these factors is vital to the development of successful conservation strategies for this species.

It is important that this information be gathered from across the UK and that it does not rely just on data from areas in which Barn Owls have already been studied. Data gathered solely from areas where Barn Owls are doing well does not give a complete picture and may actually threaten future conservation efforts.

The monitoring programme requires a network of recorders gathered from the Nest Record Scheme, Ringing Scheme, Barn Owl Conservation Network and Raptor Study Groups.

Politically, the management of the programme and the flow of data are sensitive issues. Consequently, the establishment phase of the programme will require the greatest inputs and must be carefully considered.

Data should be analysed on a regional basis, allowing data to be evaluated in relation to environmental variables and to account for regional variation in recovery rates from ringing data. Recording should be based around nest recording to allow age-specific survival rates to be calculated. Survival rates for the complete life-cycle will additionally rely on ringing data and efforts should be made to encourage ringing of both adults and pulli.

Measurements should be taken of egg density, wing length, weight and head and bill length. These can then be used to predict chick age and hatching date, thus allowing the examination of age-specific survival rates.

An annual report should be produced. This is essential to ensure that contributors feel that the programme is working for or with them, rather than just exploiting their contributions. Data gathered and published, should be used to further our understanding of Barn Owl ecology and to support conservation work by providing a sound knowledge base on which successful strategies can be developed.

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