BTO Research Report No. 294

The BTO Barn Owl Monitoring Programme: 2nd Report: Second Year 2001

Authors

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The BTO Barn Owl Monitoring Programme: 2nd Report: Pilot Year 2001

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A report by the British Trust for Ornithology
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EXECUTIVE SUMMARY

1. This is the second report of the BTO Barn Owl Monitoring Programme, set up with the aim: *To monitor Barn Owl populations through standardised recording of nest occupancy rates, breeding performance and survival at a set of Barn Owl nest sites broadly representative of the distribution of the Barn Owl in Britain.*

2. The Wildlife Conservation Partnership (WCP) has undertaken the development of the methodology to be used in the Programme and has carried out fieldwork at a set of core sites, distributed equally throughout five regions of England and matched for nest box design. A network of volunteer ornithologists has started to gather additional information over a wider geographical area using carefully designed protocols.

3. The general approach to fieldwork involves repeat visits to registered sites, particularly to paired nest boxes, over the Barn Owl nesting season between April and October.

4. The Monitoring Programme is being carried out at three levels:

   i) Primary information gathering carried out with minimal disturbance to Barn Owls, which includes the recording of site details, site occupancy, fledging success and any second breeding attempts.
   ii) Breeding performance recording, involving visits to the nest to record clutch size, hatching success, brood size, age of young, losses of young, prey stored in the nest and laying dates.
   iii) Qualified ringers are being encouraged to ring and measure young and adult birds at the nest to provide information on condition, survival and movements.

   WCP is carrying out a protocol of egg measurements to allow the estimation of laying dates, to establish the value of this method for determining laying dates.

5. Access restrictions, caused by the Foot and Mouth crisis, meant that it was not possible to visit a number of sites during 2001. However, the WCP managed to record information from 122 of the set of 125 core nest sites (designated for priority annual monitoring). Data was also collected at some additional sites, bringing the total number of sites monitored during 2001 to 168, 16 more than were visited during the 2000 breeding season. Approximately half of the sites were on tilled agricultural land and a third on mixed grass/tilled land. The majority of the remainder were on unimproved pastoral land or in rural areas. The proportion of survey sites being monitored in pastoral areas was reduced in 2001 due to the Foot and Mouth Disease outbreak.

6. Breeding Barn Owls occupied 61% of sites, a decrease of 22% from 2000, possibly due to the influence of flooding during autumn 2000 on small mammal abundance. Occupancy rates were greatest in arable areas, possibly due to the relatively high quality foraging habitat provided by the vegetated ditches and field margins found in this habitat. Other species utilising Barn Owl nest boxes included Kestrel, Stock Dove and Jackdaw. The number of these species breeding in Barn Owl boxes increased markedly in 2001, possibly due to the decrease in Barn Owl occupancy rates.

7. Mean clutch size at all WCP sites was 4.6 eggs and the mean brood size near fledging (excluding total nest failures) was 2.9 chicks. There was some evidence that hatching success decreased during the 2001 breeding season, although this decrease was not statistically significant. A reduction in the abundance of small mammals may have led to a decrease in parental condition, or a reduction in the mean quality of individuals attempting to breed due to over-winter mortality.

8. No evidence was found to suggest that Barn Owl breeding success differed significantly between arable and pastoral areas. There was some indication that productivity was related to nest box design, but closer inspection of the data revealed that this result may well have been due to a regional bias in the distribution of 'square' design boxes at WCP non-core sites.

9. More than 70 volunteer ringers or nest recorders expressed an interest in taking part in the Monitoring Programme. Unfortunately Foot and Mouth Disease severely restricted access to fieldwork sites during 2001, and the data supplied by volunteers were very limited because of this.

10. Fieldwork by WCP in 2001 also looked into methods for detecting second breeding attempts and this will continue in 2002.

1. INTRODUCTION

1.1 Previous Research

The Barn Owl is an iconic bird of farmland in Britain. Throughout the 18th and early 19th centuries, it was regarded as our most common species of owl (Latham 1781, Riviere 1830, Magillvray 1840, Holloway 1996). However, from about the middle of the 19th century, factors such as increasing persecution and collection of specimens for taxidermy are said to have contributed to a population decline. This prompted Blaker (1933, 1934) to organize one of the earliest national surveys of the breeding population of a wild bird. This involved the circulation of a request for information throughout England and Wales and resulted in a population estimate of *c* .12,000 breeding pairs, with evidence for a substantial decline over the previous 30-40 years (Figure 1.1.1).

The decline appears to have continued through the 1950s and 1960s (Parslow 1973, Prestt 1965) and was linked to the increased use of toxic chemicals (especially organochlorine pesticides), loss of hunting habitat, increased disturbance and the hard winters of 1946/47 and 1962/63 (Dobinson & Richards 1964). In the first Breeding Bird Atlas (Sharrock 1976), the population was estimated to be between 4,500 and 9,000, but this was based on largely untested assumptions about Barn Owl distributions.

Between 1982 and 1985, the Hawk & Owl Trust initiated a four-year survey of Barn Owls in Britain, which estimated the population to be 3,778 pairs in England & Wales, 640 pairs in Scotland and 33 pairs in the Channel Islands (Figure 1.1.2; Shawyer 1987). This suggested a decline of 69% in England & Wales since Blaker's survey. In recent years a great deal of conservation work has focused on the Barn Owl, much of this stimulated by the publication of the Hawk & Owl Trust's survey results and recommendations. Attention has been directed towards the creation and management of areas of suitable hunting habitat, increasing prey availability, providing habitat corridors to promote dispersal and coupled with the provision of nest boxes where a lack of nest and roost sites was believed to be a limiting factor.

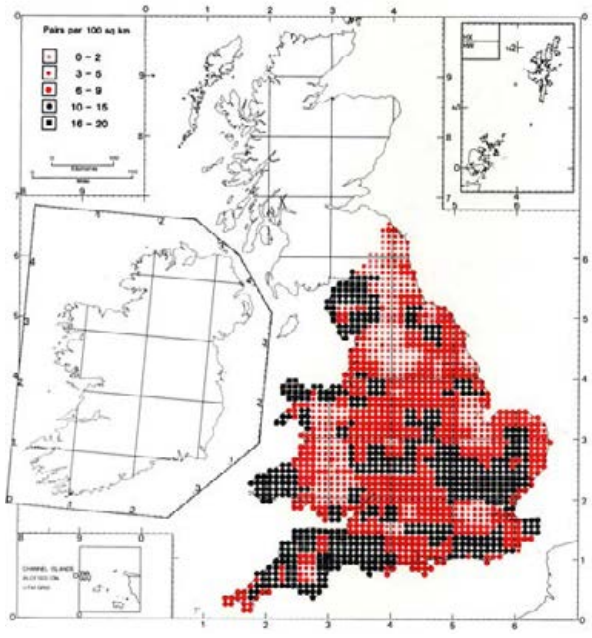

Figure 1.1.1 The Breeding density and distribution of the Barn Owl in England and Wales in 1932. (Re-drawn from Blaker, 1934, on the basis of 10km squares; from Shawyer 1987)

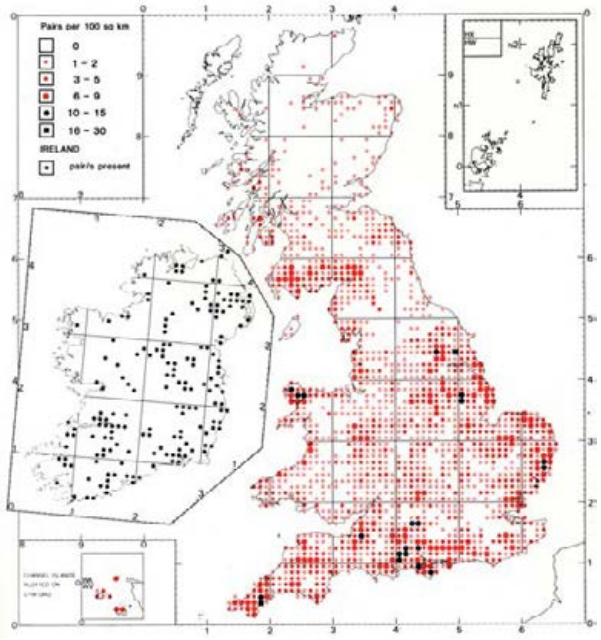

Figure 1.1.2 The breeding density and distribution of the Barn Owl in the British Isles1982-985 (from Shawyer 1987).

Over the same period, attention has also been focused on other factors that may have played a part in the Barn Owl's decline, in particular the use of "second generation" rodenticides and mortality due to collisions with road traffic (Bourquin 1983, Massemin & Zorn 1998, Shawyer & Dixon 1999). The second generation rodenticides difenacoum, bromadiolone, brodifacoum and flocoumafen are used to control Brown Rats *Rattus norvegicus* in and around agricultural premises, particularly in areas where resistance to warfarin is high (Harrison 1990, Shawyer 1985). Barn Owls are potentially vulnerable to secondary poisoning from ingesting poisoned rodents. Chemical residue monitoring by the Centre for Ecology and Hydrology has found that a small proportion of Barn Owl corpses contain potentially lethal doses of rodenticide (Newton *et al.* 1990, 1991; Newton & Wyllie 1992). The detection of any widespread detrimental impact of poisoning at the earliest opportunity therefore provides one clear reason why the monitoring of Barn Owl populations and their breeding performance and survival is necessary.

Concern about the status of the Barn Owl has led to the development of a conservation action plan for the species (RSPB Species Action Plan 0735) and a number of local Biodiversity Action Plans under Local Agenda 21 of the International Convention on Biodiversity. The Barn Owl has also been listed as a "Species of European Conservation Concern" because of its unfavourable conservation status throughout much of Europe (Tucker & Heath 1994). Despite this concern, conservation initiatives have been hampered by a lack of up-to-date information concerning population status and trends. Better information and annual monitoring are needed to maximise the benefits of future conservation effort in the UK.

Between 1994 and 1997, the BTO and Hawk & Owl Trust organised a survey of the Barn Owl population in the UK, *Project Barn Owl*. The aim was to produce a baseline against which population changes could be measured, using a method that could be repeated fully in the future. The survey estimated the UK population size to be *c*. 4000 breeding pairs (Toms *et al*. 2001). Regional population estimates suggested that numbers were similar to those found by the 1982-85 survey, except for a probable increase in East Anglia, where much conservation action had been undertaken. It was not possible to make meaningful, exact comparisons between the surveys because of differences in the methods employed (Toms *et al*. 2000).

1.2 The Need for a Barn Owl Monitoring Programme

Through *Project Barn Owl*, the lack of a specifically tailored annual monitoring programme for Barn Owls was identified as a key gap in the measures being undertaken to conserve the species (Toms 1997). Given the persistent concern over the Barn Owl's conservation status, it is important to ensure that further declines in the population do not go undetected and also to measure the effectiveness of conservation action at a national level. Furthermore, a carefully designed monitoring programme can be used to help identify the potential demographic mechanisms behind changes in abundance (*i.e.* whether changes in breeding performance or survival are important) and to link these to the effects of likely environmental causal factors such as habitat or land use change.

Barn Owl biology and behaviour means that the species is most easily surveyed by the monitoring of potential nest sites during the breeding season (Bunn *et al*. 1982, Bibby *et al.* 1992). Nest visits allow the recording of information concerning productivity and also provide good opportunities to trap and ring adult and young birds, thereby enabling dispersal and annual survival to be monitored. A key requirement of a nest site based monitoring programme is the definition of a core set of nesting sites, which will then be monitored *every* year to give consistency to the recording programme.

Absolute numbers of Barn Owls are difficult to assess (Toms *et* al. 2001) and so site occupancy rates could be used as a guide to overall population levels of *breeding* Barn Owls. The collection of detailed information concerning breeding performance and survival can be used to complement information gathered nationally by the BTO Nest Record and Ringing Schemes. The latter schemes do not impose a formal sampling regime on volunteers and the potential for changes in recording effort and methods to bias results as the set of sites monitored by volunteers changes over time

therefore exists. Finally, the monitoring programme should aim to cover populations within the core strongholds of the Barn Owl's range, which are most important to the species viability, as well as those on the periphery, where changes are likely to occur first.

The BTO Barn Owl Monitoring Programme (hereafter referred to as the Programme) described in this report was set up to address these needs with the overall aim being:

To monitor Barn Owl populations through standardised recording of nest occupancy rates, breeding performance and survival at a set of Barn Owl nest sites broadly representative of the distribution of the Barn Owl in Britain.

1.3 The Objectives of the Barn Owl Monitoring Programme

The key objectives of the Programme are as follows:

- To define a set of study areas, which provide a broadly representative coverage of the British Barn Owl population, in which a standardised set of Barn Owl sites are monitored annually.

- To monitor breeding productivity of Barn Owls through the use of standardised nest-recording methods.

- To monitor survival rates and dispersal of Barn Owls through the ringing of both young and adults.

- To assess changes in numbers attempting to breed annually in defined study areas using changes in site occupancy rates.

- To examine breeding performance and site occupancy rates in relation to environmental variables, in particular the type of habitat surrounding each site and any changes in the nature of that habitat.

- To provide an annual report of each year's results and to provide analyses and interpretation to assist conservation action and research.

- Fieldwork is being undertaken by a combination of professionals and volunteers.

- The Wildlife Conservation Partnership (WCP) has been contracted to undertake fieldwork to monitor a set of core sites in England and to undertake methodological development.

- The BTO has encouraged, where possible, local Barn Owl fieldwork by volunteers in order to provide standardised information from additional study sites and to encourage extra contributions to the national Barn Owl databases held by BTO's Nest Record and Ringing Schemes.

2. OUTLINE WORKPLAN

The BTO has obtained funding for the first four years of the Barn Owl Monitoring Programme. This has enabled the development of the programme, including the establishment of a set of core monitoring sites in England, the piloting of various methodologies and the collection of a solid baseline of information over the longer term.

The general outline of the work programme for the first four years is as follows:

2000 breeding season: Funding for the programme was confirmed in June when fieldwork by WCP began. At this time, most nests already contained small young. This reduced the opportunities to catch adult birds (especially males) for ringing, which is best undertaken during incubation. Nevertheless, WCP defined a core set of sites for annual monitoring, piloted recording methods at these sites and gathered preliminary data. At the end of the breeding season, the methodology was reviewed and a network of potential volunteers was established.

2001 breeding season: Development of the volunteer network continued and recording methods were piloted by volunteers. Foot and Mouth Disease caused a major problem during the breeding season. Volunteers were unable to gain full access to many sites, and 20% of the core sites monitored by WCP could not be visited. Unfortunately access restrictions in some areas remained in place through to the end of the year, so the contingency plan for recording late broods in October could not be adopted.

2002 & 2003 breeding seasons: Full monitoring programme by WCP and volunteers, with further developments as necessary; reporting of results in *BTO News* and other publications.

Throughout the project, opportunities have been taken to publicise the Programme, to recruit more volunteers, to provide feedback to volunteers and to raise public awareness about the population status of the Barn Owl. We plan to produce an annual newsletter that will act as a forum for the exchange of ideas and information between volunteers, in addition to providing feedback concerning the results of the programme. The BTO will work with other organisations concerned with the conservation of Barn Owls when opportunities arise, thereby ensuring that the monitoring results provide effective guidance for conservation action.

3. WHAT IS BEING MEASURED?

The volunteer-based component of the Barn Owl Monitoring Programme is being carried out at two levels of commitment, for which detailed guidelines have been produced (see Appendix 1 - Guidance Notes).

At the first level, the key information can be gathered with minimal disturbance to Barn Owls. This involves checking nest sites regularly for signs of occupancy, assessing fledging success and checking for signs of re-nesting and second broods. The second level of monitoring, which can only be undertaken by experienced nest recorders and trained ringers, involves visiting nests to count and measure nest contents and, for ringers, to ring chicks and adults. Work by WCP has been carried out at the second level and also involves the testing of methods, including the estimation of laying dates through measuring egg density and techniques to accurately age both juvenile and adult Barn Owls.

It is important to note that Barn Owls tend not to be badly affected by disturbance from fieldwork that is carried out carefully (Percival 1990, Taylor 1991). A large number of long-term studies have been successfully undertaken on the breeding biology of Barn Owls, suggesting that the monitoring of active nest sites is unlikely to bring about desertion (Lenton 1984, Wilson *et al.* 1987, De Bruijn 1994, Taylor 1994). Percival (1990), using nest record data, demonstrated that nests visited only during the late chick stage did not fledge significantly more young than ones that had been visited at other stages of the breeding period. Taylor (1991) examined the effect of nest inspections and radio-tagging on breeding success of Barn Owls in southwest Scotland. He found that the various measures of productivity did not differ significantly 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 between consecutive breeding seasons. We are confident, therefore, that nest site inspections will not compromise the welfare of Barn Owls or the integrity of the data gathered, if they are carried out following the protocols that are described in detail in the Barn Owl Fieldwork Guidance Notes that have been given to all participants in the Programme. These guidelines build upon those that are provided in the *Nest Record Scheme Handbook*, which have been used successfully for many years by nest recorders (Crick *et al*. 1999), and also build upon the methods being tested by WCP.

3.1 Primary Information Gathering

The key information that is being gathered to ensure that the Barn Owl Monitoring Programme achieves its aims is as follows:

- *Site/box details*: Information concerning the type of nest site or design of box (floor area and positioning of entrance hole (top/bottom of box)) and siting information (*e.g.* mounted on a pole, in a barn, in a tree). The core sites selected at the outset of the project by WCP contain two nest box designs, the proportions of which are identical in four of the five study regions. Boxes in the fifth region, the southwest, are a hybrid of these two designs, having the characteristics of pole-boxes whilst being mounted on trees.

A minor change has been made to the definition of what constitutes a 'site'. Previously sites may have included two or more boxes. When inputting data, it was discovered that, in some instances, paired boxes were occupied at the same time (i.e. old young from the first brood and eggs from second broods). As a result, it has been decided to register each box separately, but also to record which boxes are paired with which.

- *Site location*: 6-figure grid reference. These are held in strictest confidence by the BTO in light of the species' protection listing on Schedule 1 of the Wildlife and Countryside Act 1981.

- *Habitat/land-use surrounding site*: The habitat surrounding the site is recorded using the standard BTO habitat codes (Crick 1992) which incorporate information concerning broad habitat types as well as more detailed information concerning crop types and livestock. Micro-habitat features near the nest (e.g. ditch banks within a landscape of large arable fields) are potentially the most important factors in terms of attracting Barn Owls to breed at many sites. Methods for recording such habitat features have been explored in 2001. Additional information concerning broader land-use over a wider scale may be obtained from remotely sensed, satellite-derived datasets such as the Centre for Ecology & Hydrology's Land Cover data.

- *Site occupancy*: A visit in late April/mid-May to the site usually reveals whether the site is occupied by Barn Owls (or has been during the current calendar year). Evidence of usage, including pellet remains, moulted feathers and prey items is recorded, as is the identity and reproductive status of any other species occupying the box.

Site occupancy rates provide a minimum estimate of Barn Owl abundance in a specified area, as they only include those individuals attempting to breed in monitored sites and do not record the presence of unpaired individuals, pairs not attempting to breed or any pairs breeding in unmonitored nest sites.

- *Fledging success*: The number of young fledged from a site. This must include zeros (*i.e.* failures) to give an accurate indication of the breeding performance of Barn Owls each year. In practice, this is likely to be measured as the number of young in the nest at 5-8 weeks old, when they are ringed (in mid-July/early August; see below), with the assumption that most chick losses will have occurred by this time, as is usually the case. Information from nests visited at a later stage may provide additional information concerning any significant occurrence of chick losses after this point. A late visit to the nest site is useful to record the presence of any remains or rings of chicks that died prior to fledging. A method of estimating post-ringing chick loss is being investigated by WCP. This involves visiting a sample of sites 6-8 weeks after ringing and making thorough searches of pellet debris at boxes where young have been ringed for a number of years.

- *2nd broods*: The occurrence of double brooding and the success of the second clutch. Barn Owls are capable of producing second broods, and these second broods can be important in determining the overall productivity of a pair. Instances of double brooding can be identified more reliably where nest boxes are placed in closely adjacent pairs, as second clutches are often laid at different sites to the first. For the most part, second broods are detected on the visit made in July/August (see below) because the female is sitting on eggs in an adjacent (paired) nest box while the male is still feeding young from the first brood (as well as his mate). The fledging success of second broods is assessed through a final site visit in October.

3.2 Breeding Performance

The gathering of more detailed information concerning nest contents will aid in interpreting changes in occupancy rates and fledging success and in understanding the causes of such changes. The Barn Owl Monitoring Programme and the existing BTO Nest Record Scheme provide complementary information and together provide a fuller picture than either scheme would on its own. While the Nest Record Scheme is able to provide detailed information concerning parameters such as clutch size and changes in the probability of nest failure throughout the nesting cycle, the Barn Owl Monitoring Programme provides information concerning partial losses of broods, brood sizes at fledging and double brooding, as well as more accurate measures of mean laying dates.

Whilst we have been able to encourage a significant proportion of current nest recorders to take part in the Barn Owl Monitoring Programme, there are others who are unable to guarantee the consistency of recording that the Programme requires. However, by contributing to the Nest Record Scheme in a less structured way, they are still able to provide valuable information concerning Barn owl breeding

attempts in other parts of the country, which can then be compared with information from core sites covered by the Barn Owl Monitoring Programme.

The following are be recorded where possible:

- *Clutch size*: a count of the number of eggs present – recorded during a visit in late April/mid May.
- *Hatching success*: evidence of unhatched eggs/egg shells.
- *Brood size*: a count of the number of young present, preferably at early and late nestling stages.
- *Age of young*: from development of down, feather length and wing length.
- *Losses of young*: counts of any dead young, chick disappearance.
- *Prey stored at nest*: presence, species composition, number (and, if possible, weight) of prey stored at nests, to provide an indication of food availability.
- *Laying/hatching/fledging dates*: these are recorded when visits coincide with these events, but hatching dates can also be deduced indirectly at any time during the chick stage from the age of the nestlings.

3.3 Measurements and Ringing at the Nest

Qualified ringers have been asked to undertake various measurements of eggs and young, when practical, in addition to ringing chicks and adults at the nest.

- *Measurements of eggs*. Currently these are only being undertaken by WCP until a full methodological evaluation has been carried out. When combined with egg weight, measurements of length and breadth of eggs can be used to assess egg-density, which declines predictably through incubation due to the respiration of the developing embryo (Rahn & Ar 1974). The use of a portable electronic pan-balance is necessary to enable weights to be measured accurately. These measurements may prove useful for determining a relatively precise date of egg-laying and can also be used by ringers to assess when to revisit the nest in order to maximise data gathering efficiency and to ring the chicks at six weeks old. A standard calibration curve is being calculated by WCP.

- *Ringing young*: this is important for measuring survival rates and dispersal when breeding adults are recaptured in subsequent years and when dead birds are found and reported under the BTO Ringing Scheme (10-15% of ringed Barn Owls are subsequently reported to the BTO's Ringing Office).

- *Measurements of young*: on each visit, ringers are being asked to measure wing length (maximum-chord method) and weight of chicks as well as the length of the 7th primary feather. The latter has been used by Shawyer (1998) as a potentially accurate ageing method, and is being validated as part of the Programme. When standardised using a measure of body size (such as wing length) and measured repeatedly to control for fluctuations due to the timing of measurement with respect to daily food intake, chick weight may provide a useful measure of condition; the value of this technique will also be assessed as part of the Programme. In addition, records of the degree of speckling on the underside of the body and wings of the nestlings' plumage can be used as a means of determining offspring sex.

- *Measurement of dead chicks (length of 7th primary)*: this is important in order to determine the age at which any dead young died.

- *Ringing adults*: only ringers who have experience of catching birds at a nest site are permitted to ring adults. Guidelines have been provided as part of the fieldwork Guidance Notes and we plan to encourage the sharing of information between ringers. Ringing of adult birds is important to permit the analysis of survival rates and will allow an assessment of dispersal and movements by breeding individuals. Very few adults are ringed each year, typically fewer than 100, and the ratio

of birds ringed as chicks to those ringed as adults is approximately 12:1. Increasing the numbers of adults ringed will be particularly valuable for providing robust estimates of survival.

- *Measurements of adults*: the age, sex, moult and brood patch condition of adult birds is recorded using standard techniques,

- in order to maximise the amount of subsequent recapture or recovery information collected.

4. THE VOLUNTEER NETWORK

4.1 Establishment of the Volunteer Network

A letter outlining the objectives of the Barn Owl Monitoring Programme was sent to more than 200 active Barn Owl ringers and/or nest recorders in early March 2001. The prospective volunteers were invited to take part on either Option 1 or Option 2 of the Monitoring Programme (the two levels of commitment discussed in Section 3). The details of the options are described below.

Option 1 Guarantee to monitor at least one Barn Owl nest site for the next three years, checking regularly to establish occupancy, record fledgling success and any signs of re-nesting and second broods. A series of brief visits at monthly intervals from April to October was recommended. Although this option involves minimal disturbance to Barn Owls, fieldworkers still require a nest disturbance licence to ensure full compliance with the Wildlife and Countryside Act 1981.

Option 2. As Option 1, but involves recording additional, more detailed information about eggs and young. The extra information recorded depends on whether the volunteer is a licensed nest recorder or a licensed ringer.

Nest recorders and ringers can record the following information:

- Clutch size
- Brood size
- Age and losses of young
- Presence of other species nesting in the box
- Presence, species composition, number and weight of prey stored in boxes

Ringers only can record the following information:

- Chick measurements
- Feather length, wing length and weight
- Ages/sex/moult/brood patch condition of adults captured at the nest
- Information on dispersal and survival can be obtained by the ringing of adults and young

Initially, volunteers have not been asked to take egg measurements, but they may be asked to do so once the methods have been tested fully.

The response by early April 2001 was very encouraging: 72 volunteers had expressed an interest in taking part in the Monitoring Programme. These observers were asked to register any Barn Owl sites that they would be able to monitor for the next three years.

For the 2001 season, recording packs were sent out to 34 observers who offered to cover 177 Barn Owl sites. Guidance Notes were produced for these volunteers, containing all the information required to carry out the fieldwork required for the Monitoring Programme.

Initially, in the light of the Foot and Mouth Disease outbreak, it was suggested that volunteers should exercise caution and avoid any potentially insensitive approaches to landowners. It was realised that many volunteers would be unable to visit nest sites during the early part of the season due to access restrictions. As the season progressed, however, it became clear that some of the sites could not be covered at all.

4.2 The Volunteer Network In 2001/02

Despite the problems with Foot and Mouth Disease, the volunteer network continued to grow throughout 2001 and early 2002. At the time of writing, 97 observers (mainly existing BTO ringers or nest recorders) have expressed an interest in the Barn Owl Monitoring Programme. Half of these people (48) have already registered sites for the programme, and more are likely to follow. This has been an excellent response: no fewer than 353 sites will be monitored by volunteers in 2002, very useful additions to the 254 nest sites being monitored by the Wildlife Conservation Partnership (WCP).

Peter Beaven took over from Dawn Balmer as the Coordinator of the programme in late 2001. He previously assisted with Project Barn Owl and has worked in the Ringing Office and the Nest Record Scheme for a number of years. He has a keen interest in owls generally, having erected a number of Barn Owl nest boxes in West Sussex prior to starting work at the BTO.

The map shown in Figure 4.2.1 shows the distribution of sites currently being monitored for the Programme. It clearly demonstrates the importance of the volunteer network in 'filling the gaps', enabling coverage of a broad selection of sites throughout the whole of the UK. Whilst we do already have very good coverage, we will be looking to find observers to cover certain areas, particularly Wales, Northern Ireland and parts of Scotland. A breakdown of the current coverage by county is given in Table 4.2.1.

Given that the estimated UK Barn Owl population is around 4,000 pairs (Toms *et al*. 2001), the 607 nest sites currently being monitored for the programme is likely to represent well over 10% of the national population. As there is often a high turnover of natural sites (due to barn conversions, disappearance of bales stacks, water logging, etc.) and recording of eggs and young is often difficult at such sites where nests are located within deep inaccessible cavities, we have encouraged observers to target nest box sites. As a result, all but 40 of the sites that have been registered are nest box sites. The widespread use of boxes clearly indicates the extent of the public's interest in Barn Owls and the benefit that conservation measures have had for the species. The majority of these boxes are already being checked by the individuals who erected them, so the Programme is providing a very useful means of collating these individual observations. The Programme will also ensure that the data are being recorded to a recognised standard.

A computerised "booking in/out" system for site recording forms has been developed, which enables us to monitor the number and location of all current sites. This system needs to be flexible enough both to cater for sites that have now withdrawn from the programme, and to allow modification of the details for existing sites.

Recording forms for new sites are produced in batches and can easily be created using the 'mail merge' facility. In order to maintain the confidentiality of Barn Owl nest sites, this also enables the use of coded site details rather than precise grid references for each site.

Good use is being made of Barn Owl observer's email addresses. This has cut down on a great deal of time/paperwork/postage, and has also facilitated the provision of information and other paperwork to new potential observers. We have now set up a separate email address barnowls@bto.org for general enquiries about the Programme.

Judging by the current response and interest shown to BOMP, it seems likely that many more Barn Owl enthusiasts will register sites for the Programme in the coming months.

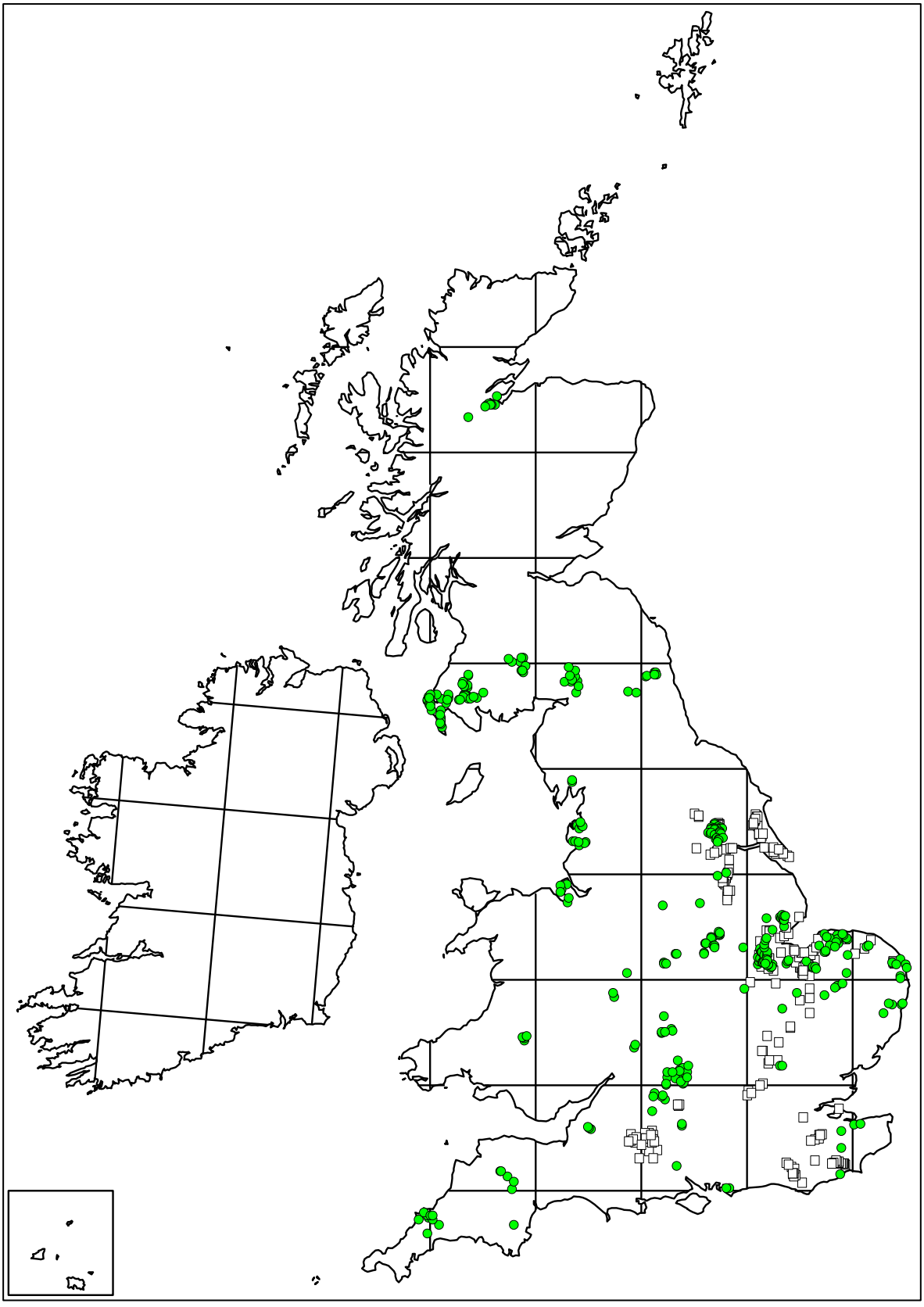

Figure 4.2.1 The Barn Owl nest sites being monitored as part of the programme (as at June 2002). White squares = sites being covered by Wildlife Conservation Partnership (total 254 sites). Shaded circles = sites being covered by volunteer observers (total 353 sites).

Table 4.2.1 Barn Owl Monitoring Programme sites by counties.

County	Total	WCP core sites
Avon	3	
Bedfordshire	1	1
Berkshire	6	4
Buckinghamshire	3	3
Cambridgeshire	10	8
Cheshire	2	
Cornwall	10	
Cumbria	2	
Derbyshire	8	
Devon	6	
Dumfries & Galloway	45	
Great London	1	1
Hampshire	1	
Herefordshire	2	
Hertfordshire	10	8
Highland	8	
Humberside	79	61
Kent	33	29
Lancashire	12	
Lincolnshire	85	39
Merseyside	4	
Norfolk	90	40
North Yorkshire	16	4
Northamptonshire	1	
Northumberland	12	
Nottinghamshire	35	8
Oxfordshire	21	
Powys	6	
Shropshire	2	
Staffordshire	1	
Strathclyde	20	
Suffolk	6	
Sussex	26	23
Warwickshire	10	
Wiltshire	30	25
TOTAL	**607**	**254**

5. RESULTS FOR THE 2000 AND 2001 FIELD SEASONS

5.1 Survey Coverage

During the 2000 pilot field season, 235 monitoring visits were performed at 152 separate potential nesting sites (mean visits per site = 1.6) as part of the Barn Owl Monitoring Programme (BOMP). In spite of the outbreak of Foot and Mouth Disease (FMD), a greater number of visits (N = 292) were performed at a greater number of sites (N = 168) during the 2001 field season (mean visits per site = 1.7), with access prevented at a further 21 sites due to governmental restrictions imposed to limit the spread of FMD. The total number of individual sites visited over the two-year study period was 199, with 121 (61%) sites visited during both field seasons.

The majority of sites from which data were collected during both years were core study sites (2000, N = 119, 78%; 2001 N = 122, 65%) as designated by the Wildlife Conservation Partnership (WCP) prior to the 2000 pilot survey. In total, 125 core sites were designated. These sites are visited during each study year in order to ensure a degree of standardisation, and have been chosen on the basis of the criteria outlined in the 2000 BOMP Report (Crick *et al*. 2001): all boxes had been in place at least three years prior to the 2000 survey, are in good condition, and are located in areas of both low and high Barn Owl density. Where possible, the WCP also monitor additional sites that will be included in the programme in as many years as is possible. Data from both core and additional sites are included in this analysis.

The addition of extra sites, at which volunteers collect data, facilitates the monitoring of Barn Owl breeding attempts over a greater proportion of England, and in Scotland and Wales. To this end, survey packs and monitoring forms were sent to volunteer Barn Owl observers during July 2001. Unfortunately, due to FMD access restrictions, very few such sites were monitored during 2001. 104 monitoring forms were returned to the BTO, but many volunteers were limited to making single visits due to outbreaks of FMD occurring during the second half of the breeding season. For this reason, no data collected by volunteers were included in this analysis

5.2 Data Processing

Data were recorded using standardised forms developed during 2000 (see Appendix for example) and the information collected was entered into a specially designed Microsoft Access database. SAS software (SAS 2000) was used for all data analysis. The main aim of the analysis was to identify temporal and regional variation in measures of Barn Owl reproductive success during the two study years. Data collected under the BOMP in 2001 was therefore compared with equivalent data collected under the programme during the 2000 field season. In addition, the influence of habitat type (arable, grassland or mixed farming areas) and nest box design ('Pole', 'A-Frame' and 'Square') on breeding parameters and associated factors were investigated in both study years. Barn Owl breeding data collected under the BTO Nest Record Scheme (NRS) between 1983 and 2001, the period during which the number of Barn Owl Nest Records received consistently exceeded 50 per annum, were also analysed with respect to year, habitat type and nest box design, and the results compared with those generated by analysis of the BOMP data. Whilst the NRS data set spans a longer period of time and has a greater coverage, individual records are less detailed and the two schemes are therefore complementary. Data concerning Barn Owl ringing recoveries analysed for the 2000 BOMP Report (Crick *et al*., 2001) was not reanalysed for the current report, as the number of additional records collected during 2001 was small relative to the total data set and would therefore be unlikely to significantly alter those trends highlighted in the previous report.

5.3 Monitoring Site Habitat Characteristics

The dominant habitat type surrounding the monitored sites was recorded using standard BTO habitat codes (Crick 1992). The distribution of habitat types was dominated by agricultural land in both study years (2000, 89%; 2001, 82%), reflecting the predominant land-use category in eastern England,

the area around which the majority of WCP-monitored sites are concentrated (see Figure 4.2.1). The slight reduction in the proportion of agricultural sites monitored in 2001 was caused by the governmental access restrictions that were imposed in stock farming areas following the outbreak of FMD. Tilled arable land was the dominant habitat category at 40% of monitoring sites during 2000, with stock or mixed farming areas accounting for a further 49% of sites (Figure 5.3.1). In 2001 this situation was reversed, with 48% of monitored sites situated in arable land and only 35% located in mixed and stock farming areas (Figure 5.3.2). FMD access restrictions therefore influenced the distribution of habitat categories within the two field seasons, and this should be taken into account when interpreting the results of the analyses included in this report.

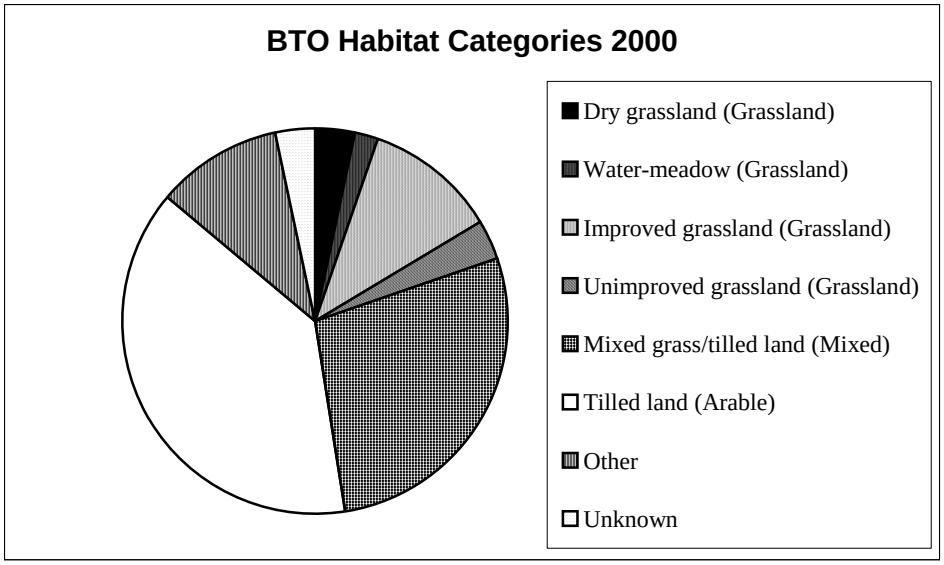

Figure 5.3.1 Distribution of habitat categories amongst sites monitored during the 2000 field season (N = 152) as indicated by BTO habitat codes. Habitat recording focused on the areas near the nest boxes that were likely to be utilised by Barn Owls. The category 'Other' includes those sites associated with rural areas and those sites associated with lakes and rivers.

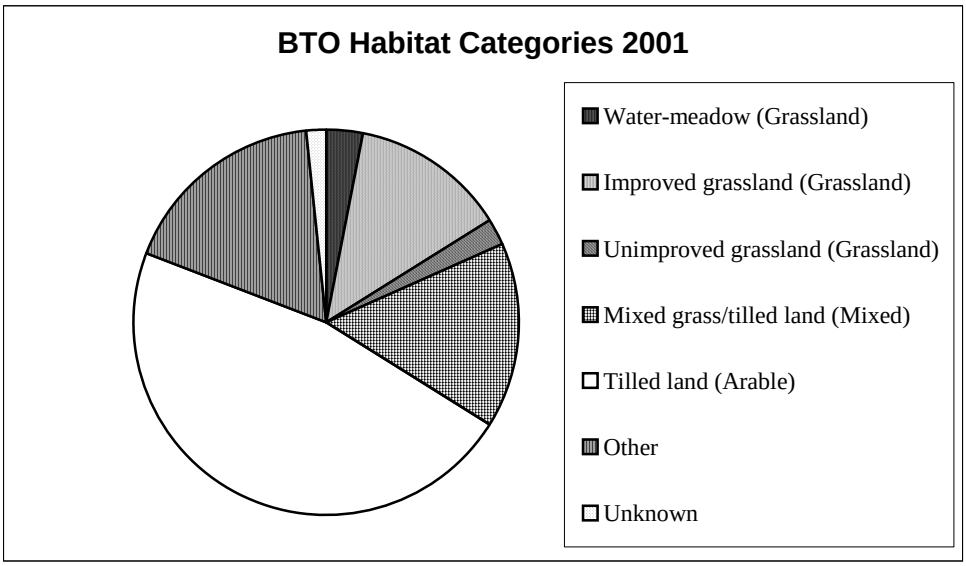

Figure 5.3.2 Distribution of habitat categories amongst sites monitored during the 2001 field season (N = 168), as indicated by BTO habitat codes. Habitat recording focused on the areas near the nest boxes that were likely to be utilised by Barn Owls. The category 'Other' includes those sites associated with rural areas and those sites associated with lakes and rivers.

5.4 Site Occupancy

Boxes were defined as occupied by Barn Owls if laying had commenced, irrespective of the subsequent success or failure of the clutch and/or brood contained within. An analysis of occupancy rates indicated that a significantly higher proportion of boxes (N = 320, $\chi^2 = 19.72$, $P < 0.0001$) were occupied during the 2000 breeding season (N = 126, 83%) than during the 2001 breeding season (N = 102, 61%) (Figure 5.4a). Heavy rains and subsequent flooding during the autumn of 2000 may have led to a shortage of small mammal prey over the winter period, resulting either in increased over-winter mortality rates or in a reduction in mean body condition. The size of the breeding Barn Owl population during the spring of 2001 may therefore have been reduced either due to a drop in the total population size, or to a reduction in the proportion of individuals attempting to breed. Controlling for this variation between years, occupancy rates also varied significantly between habitats in both years (N = 264, $\chi^2 = 12.23$, $P = 0.002$), the highest rates occurring in arable areas and the lowest in stock farming or mixed farming areas (Table 5.4.1, Figures 5.4b and 5.4c). These results suggest that arable areas represent the optimal breeding habitat for this species. Whilst the majority of arable land may provide few hunting opportunities relative to more pastoral habitats, prey species might be more numerous in the vegetated ditches and margins surrounding the fields than amongst the closely cropped sward of intensively grazed pasture. Therefore, although the mean prey density found in pastoral areas may exceed that found in arable areas, Barn Owls might be able to maximise their hunting success by restricting their activities to the small areas containing relatively high prey densities found in the latter habitat. Alternatively, nest box occupancy rates may differ between habitats due to variation in nest box densities or in the degree of disturbance caused by agricultural activities. Differences in the amount of habitat management performed specifically to ameliorate the environment for breeding Barn Owls between arable and stock-farming areas may also be responsible for the observed patterns of nest box occupancy.

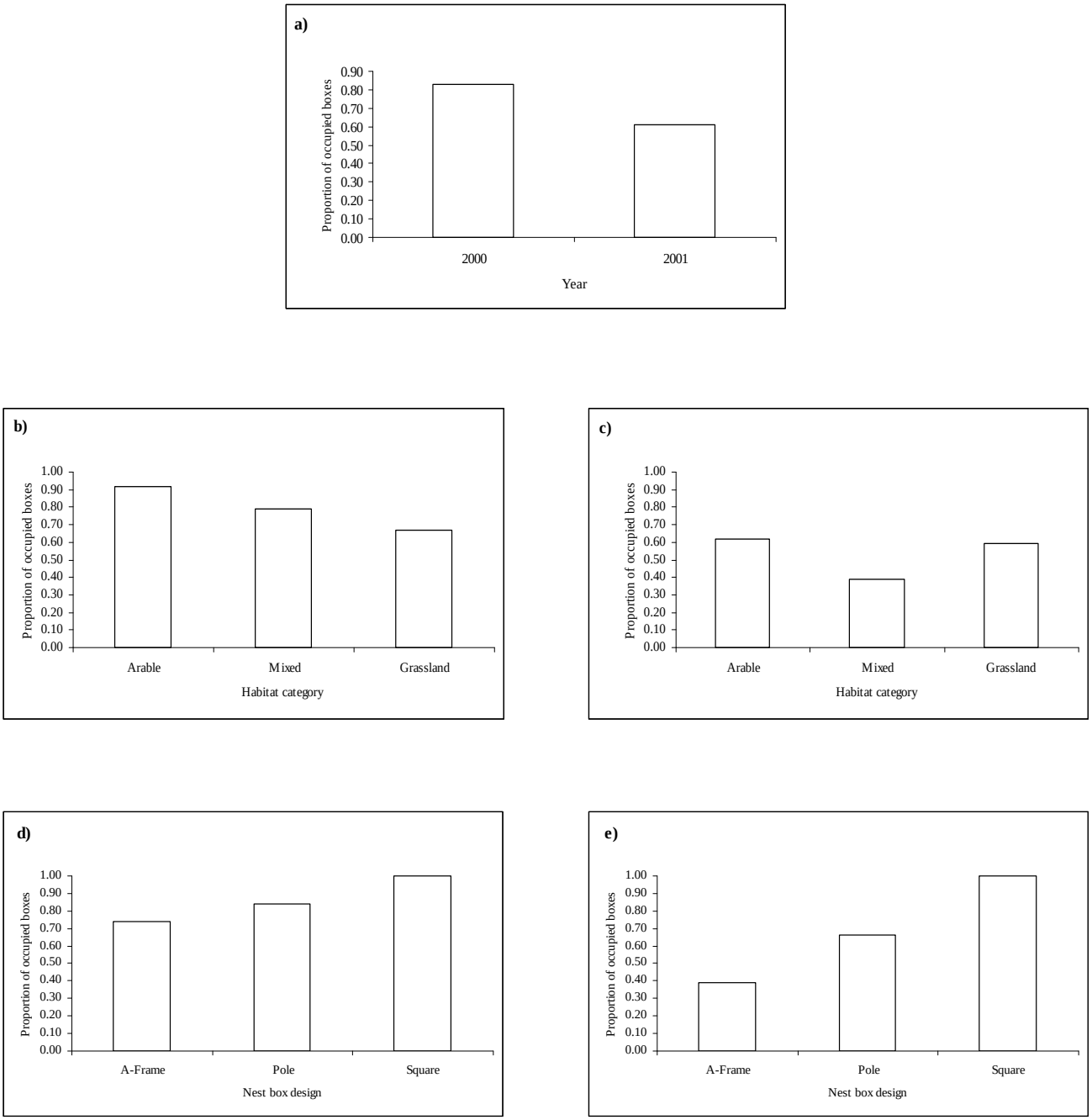

Figure 5.4. Relationship between nest box occupancy (proportion of boxes at which Barn Owl clutches were initiated) and:

a) Study year
b) Habitat category, 2000 field season
c) Habitat category, 2001 field season
d) Nest box design, 2000 field season
e) Nest box design, 2001 field season

Table 5.4.1 Nest box occupancy rates varied significantly between both habitat categories and nest box designs in both study years.

Year	Habitat type	N	%	Box design	N	%
2000	Arable	54	91.5	Pole box	58	84.1
	Mixed	33	78.6	A-frame box	43	74.1
	Grassland	19	65.5	Square box	25	100.0
2001	Arable	49	62.0	Pole box	48	65.8
	Mixed	12	38.7	A-frame box	25	38.5
	Grassland	14	58.3	Square box	24	100.0

Controlling for the variation between years, occupancy rates varied significantly between the three nest box designs used in the study (Table 5.4.1. N = 314, $\chi^2 = 49.21$, $P < 0.0001$). Occupancy rates were highest in square boxes and lowest in A-frame boxes in both years (Figures 5.4d and e). Although the design of a nest box may influence its suitability for a breeding attempt, a regional bias in the location of boxes of different designs may provide a more likely explanation for the observed relationship. The majority of square boxes are located on Salisbury Plain, an area that is likely to provide breeding habitat of a relatively high quality, and higher occupancy rates might therefore be predicted for this type of nest box.

Substantial numbers of other species also roost and/or breed in Barn Owl boxes, often when a breeding pair of owls is present. Table 5.4.2 summarises the numbers and breeding status of the other species found utilising these boxes during the two survey years. The increased incidence of box occupancy by species other than Barn Owls during the 2001 breeding season may be related to the decreased occupancy rates of Barn Owls themselves during this period.

Table 5.4.2 Numbers and breeding status of species other than Barn Owls occupying nest boxes during 2000 and 2001.

Year	Activity	Total	Tawny Owl	Little Owl	Kestrel	Jackdaw	Stock Dove	Grey Squirrel
2000	Breeding	24	1	1	8	6	8	-
	Roosting	6	0	0	4	0	1	1
2001	Breeding	70	2	2	17	18	31	-
	Roosting	16	0	0	7	1	3	5

5.5 Productivity

5.5.1 Barn Owl Monitoring Project Data

As far as was possible, measures of breeding success were calculated using standard methods employed by the BTO Nest Records Scheme (NRS). The NRS uses the Mayfield method (Mayfield 1961, 1973) to calculate failure rates at specific stages of the nesting cycle: the egg stage, the chick stage and the overall nesting stage. In order to perform these calculations, it is necessary to estimate accurately the timing of each nesting stage by visiting the nest on multiple occasions during the breeding period. As indicated in the 2000 BOMP Report (Crick *et al*. 2001), it was originally intended that multiple visits should be undertaken at each nest during the 2001 breeding season.

However, due to the restrictions imposed by the FMD outbreak, multiple visits only took place at 66% of sites at which breeding Barn Owls were present. Furthermore, many of these sites were visited during the egg stage only, and therefore provide no data concerning the length of the nestling period or the fledging success of the brood. It was, therefore, not possible to calculate Mayfield estimates for the 2001 BOMP breeding data, although such calculations will hopefully be possible in future years.

5.5.1.1 Clutch size

Clutch size was estimated as the maximum number of eggs found in a nest over the course of the monitoring visits. Clutch size was not estimated at any nest that had only been visited when chicks alone were present, as some egg or chick mortality was likely to have occurred by this stage (infertile or unhatched eggs usually disappear through breakage or trampling into the debris at the bottom of a nest). In addition, clutch size was not estimated at any nest where the maximum observed brood size exceeded the maximum number of eggs recorded.

5.5.1.2 Brood size

Brood size was recorded as the maximum number of chicks found in a nest over the course of the monitoring visits. As Barn Owl chicks hatch asynchronously within broods and brood reduction is not uncommon, the brood size at fledging is often less than the maximum and is an important demographic parameter for the species. This parameter is difficult to record because nests have to have been visited when fledging is almost complete and because the chicks are likely to fledge and disperse over a period of two to four weeks. In the 2000 study, the number of live chicks present at the last nest visit was used as an estimate of the size of the brood at fledging. However, as the frequency of nest visits during the nestling stage is low, the age of the chicks when the last visit is made may vary considerably. For the purpose of this report, we use the number of chicks ringed as our estimate of brood size at fledging. This estimate is likely to be fairly accurate as the mortality rate of nestlings at post-ringing ages is low.

An estimate of hatching success was calculated by dividing the maximum observed brood size by the maximum observed clutch size. Similarly, an estimate of fledging success was calculated by dividing the number of chicks ringed by the maximum observed brood size, and an overall measure of egg success was calculated by dividing the number of chicks ringed by the maximum observed clutch size. The success code given to each nest is a binary variable that has a value of 1 if at least one chick was fledged from the nest (a 'successful' nest), and a value of 0 if a breeding attempt had occurred but no chicks were fledged.

5.5.1.3 Annual variation in breeding success

None of the breeding success parameters measured varied significantly between the 2000 and the 2001 field seasons (Table 5.5.1). However, hatching success demonstrated a non-significant tendency to be greater during the 2000 breeding season (2000, mean ± 1 SE, 0.68 ± 0.05; 2001, mean ± 1 SE =0.56 ± 0.04). A reduction in prey availability caused by flooding during the autumn of 2000 may have negatively influenced adult body condition during the spring of 2001, which in turn may have affected parenting ability or investment. Alternatively, above average rates of over-winter mortality resulting from decreased prey availability may have led to reduced competition for nesting sites. Birds of below average quality, normally excluded from boxes by individuals of relatively higher quality, may therefore have been able to secure nest sites. If parental quality is related to breeding success, a reduction in parameters such as hatching success might therefore be predicted during 2001.

Table 5.5.1.1 Variation in breeding success parameters between survey years. Test results show χ^2 statistics for likelihood-ratio tests of the difference in model deviance between constant models and models allowing values for the year categories to differ (SAS 2000). Estimated values (Est.) and Upper and Lower Wald 95% Confidence Intervals (UCI, LCI) are taken from the Genmod test output in SAS 2000. A *P* value of less than 0.05 would indicate a statistically significant difference between years.

Variable	2000				2001					
	N	Est.	UCI	LCI	N	Est.	UCI	LCI	χ^2	*P*
Clutch size	50	4.00	3.54	4.46	59	4.45	4.04	4.88	2.08	0.150
Brood size	107	3.13	2.90	3.36	82	3.07	2.81	3.34	0.10	0.747
Hatching success	29	0.64	0.55	0.72	37	0.52	0.45	0.60	3.67	0.055
Fledging success	107	0.76	0.71	0.80	81	0.72	0.66	0.77	1.95	0.162
Overall success	29	0.48	0.38	0.57	37	0.42	0.35	0.50	1.51	0.162
Nest success	107	0.81	0.73	0.88	83	0.88	0.79	0.93	1.58	0.208

5.5.1.4 Influence of habitat type on breeding success

Although pastoral land is predicted to provide a better foraging habitat for Barn Owls than arable land on the basis of prey availability (but see Section 5.4), we found no evidence that habitat type significantly influenced any of the breeding parameters measured once the influence of annual variation on breeding success had been controlled for (Table 5.5.2). These results are not consistent with the findings of the 2000 BOMP Report (Crick *et al*. 2001), which indicated that both hatching success and overall egg success were greater in arable areas during 2000. It is possible that a general decrease in prey availability during 2001 reduced the degree to which the different habitat categories varied with respect to prey numbers, thus obscuring the relationship between land use and breeding success observed during the 2000 breeding season.

Table 5.5.1.2 Variation in breeding success parameters between habitat types controlling for annual variation. Test results show χ^2 statistics for likelihood-ratio tests of the difference in model deviance between constant models and models allowing values for the arable and grazing/mixed categories to differ (SAS 2000). A *P* value of less than 0.05 would indicate a statistically significant difference between habitats.

Variable	Number of sites			Likelihood-ratio test results	
	Arable	Mixed	Grassland	χ^2	*P*
Clutch size	48	24	15	1.04	0.595
Brood size	79	39	29	1.75	0.416
Hatching success	24	13	11	3.22	0.200
Fledging success	79	39	29	2.12	0.346
Overall success	24	13	11	0.82	0.663
Nest success	79	39	29	1.84	0.399

5.5.1.5 Influence of nest box design on breeding success

Fledging success, overall egg success (the proportion of eggs which hatched offspring that subsequently fledged) and nest success (the proportion of nests that fledged at least one offspring) all varied significantly between the different nest box designs (Table 5.5.3). Birds breeding in square (S) nest boxes were more successful than birds breeding in either A-frame (A) or pole (P) boxes in terms of fledging at least one offspring (Figures 5.5.1.3a and 5.5.1.3b), overall egg success (2000 only) (Figures 5.5.1.3c and 5.5.1.3d) and fledging success (Figures 5.5.1.3e and 5.5.1.3f) and. While it is theoretically possible that the design of the box could influence breeding success directly, for example by the degree of protection it offers the brood against predation, it is much more probable that the observed differences are due either to regional or biases in the location of the different box designs for WCP non-core sites and volunteer sites. As the majority of square boxes are located on Salisbury Plain, the observation that birds in square boxes experienced the greatest reproductive success lends further support to the theory that the Salisbury Plain area provides breeding habitat of relatively high quality (Section 5.4).

Table 5.5.1.3 Variation in breeding success parameters between box designs controlling for annual variation. Test results show χ^2 statistics for likelihood-ratio tests of the difference in model deviance between constant models and models allowing values for the box design categories to differ (SAS 2000). A *P* value of less than 0.05 indicates a statistically significant difference between box types.

Variable	Number of boxes			Likelihood-ratio test results	
	Pole	A-Frame	Square	χ^2	*P*
Clutch size	50	36	22	0.16	0.925
Brood size	86	45	46	5.03	0.081
Hatching success	28	15	19	0.03	0.984
Fledging success	85	45	46	36.04	<0.0001
Overall success	30	15	20	9.31	0.001
Nest success	90	48	47	19.55	<0.0001

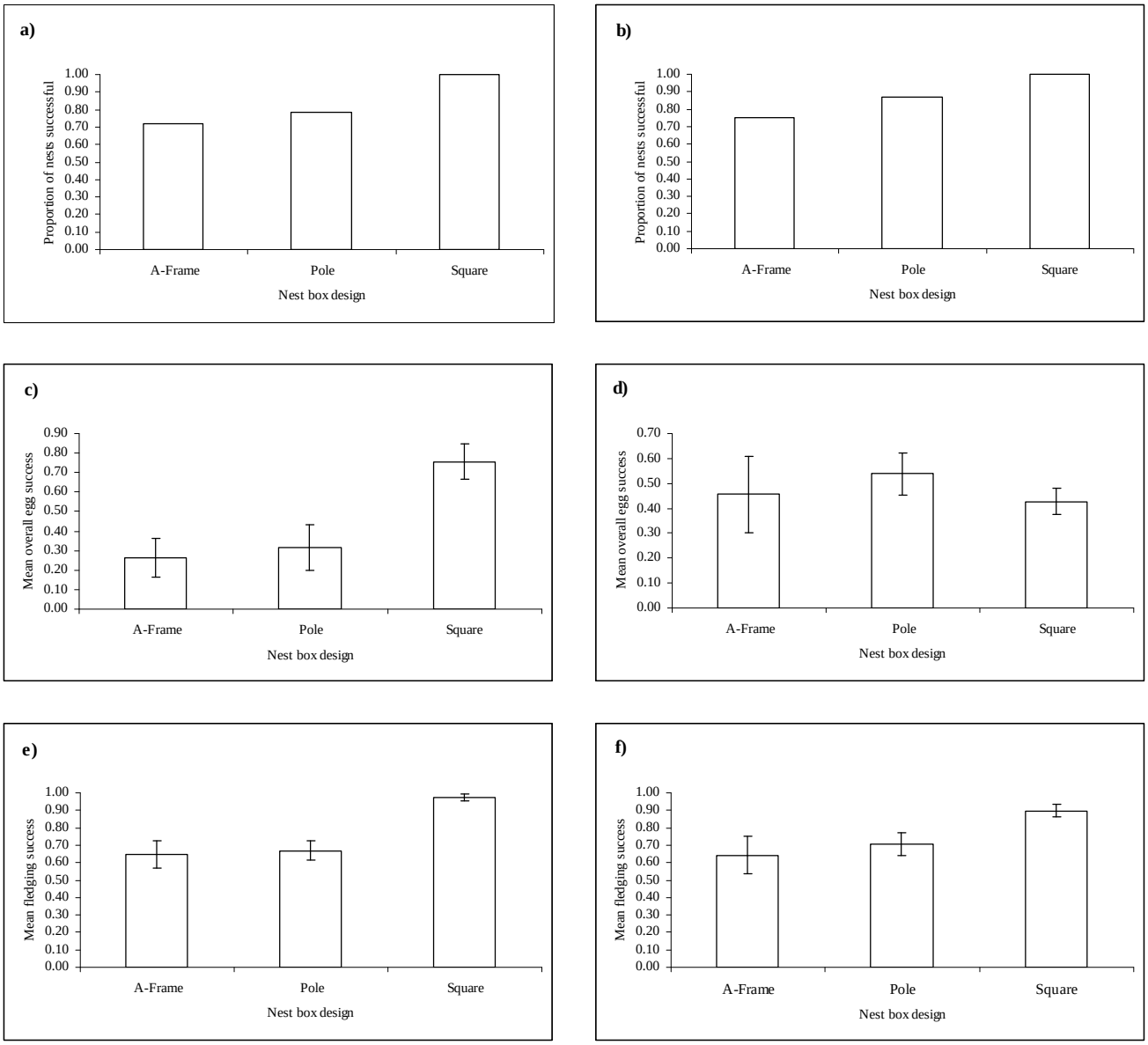

Figure 5.5.1.3 Relationship between nest box design and:

a) Proportion of successful nests (those which fledged at least one offspring), 2000 field season.
b) Proportion of successful nests (those which fledged at least one offspring), 2001 field season.
c) Mean overall egg success (no. fledged offspring expressed as a proportion of maximum clutch size), 2000 field season, ± 1 SE.
d) Mean overall egg success (no. fledged offspring expressed as a proportion of maximum clutch size), 2001 field season, ± 1 SE.
e) Mean fledging success (no. fledged offspring expressed as a proportion of maximum brood size), 2000 field season, ± 1 SE.
f) Mean fledging success (no. fledged offspring expressed as a proportion of maximum brood size), 2001 field season, ± 1 SE.

5.5.2 Nest Record Scheme Data

A key goal of long-term Barn Owl monitoring is to produce data that complement existing monitoring schemes such as the BTO's Nest Record Scheme. Together with the additional Barn Owl-specific fieldwork undertaken by volunteers, nest records provide a wider context in which to view the results from the core monitoring sites, as well as providing information on additional aspects of breeding success. For example, recording visits are likely to be more frequent in the course of nest recording than in long-term Barn Owl monitoring, providing better information on nest failure rates, especially during the egg period. Here, we present summary analyses of nest record data from 1983-2001, the period during which the number of Barn Owl Nest Records received consistently exceeded 50 per annum, showing both temporal variation and differences with respect to the same broad farmland habitat split as was investigated for the BOMP data above. The analysis of NRS data with respect to nest site compares the breeding performance of box-nesting pairs with that of pairs breeding in natural nest cavities during the period 1983-2001. Prior to 1983, relatively few Nest Records involved Barn Owls breeding in nest boxes. Nesting in boxes may improve Barn Owl breeding success, as the nesting environment has been specially designed for this purpose. Furthermore, nest recorders may remove old nests from boxes at the end of the breeding season, potentially reducing parasite loads in the box. However, nest boxes may be more obvious to predators and may provide less shelter from the elements.

Nest record data were analysed using standard methods to estimate first egg date, clutch size, (maximum) brood size, hatching success, and daily nest failure rates in the egg, nestling and whole nest periods (see, e.g. Siriwardena *et al.* 2000). The sample sizes available for analysis are shown in Table 5.5.2.

Both brood size (Figure 5.5.2a) and hatching success (Figure 5.5.2b) varied significantly between years (Table 5.5.2). The value for mean brood size was low in 2001, (mean ± 1SE = 2.87 ± 0.18) relative to the mean of 3.38 over the period 1983-2000, providing further evidence that 2001 was a poor breeding year. In agreement with the BOMP productivity data, mean hatching success in 2001 was also low (mean ± 1SE = 0.66 ± 0.07) relative to the average for the period 1983-2000 (0.70), although this difference was small, suggesting that the relatively small brood sizes observed were not likely to have been the result solely of a reduction in the proportion of eggs that hatched successfully.

Table 5.5.2 Variation in breeding success parameters between years, between habitat types and between box-nesting individuals and those nesting in natural nest-holes. Test results show χ^2 statistics for likelihood-ratio tests of the difference in model deviance between constant models and models allowing values for the year, habitat type and nest site categories to differ (SAS 2000). A *P* value of less than 0.05 would indicate a statistically significant difference between years, habitat types or nest sites.

Variable	Year (1983-2001)			Habitat type (1983-2001)			Nest site (1983-2001)		
	N	χ^2	*P*	N	χ^2	*P*	N	χ^2	*P*
Clutch size	367	25.58	0.110	205	2.50	0.286	341	4.87	0.027
Brood size	2147	77.61	<0.0001	1259	0.31	0.856	1974	1.08	0.299
Hatching success	335	31.29	0.027	188	1.64	0.440	310	0.02	0.901
Egg stage failure rate	1352	27.16	0.076	741	0.97	0.615	1243	3.58	0.058
Nestling stage failure rate	1517	25.66	0.108	933	2.31	0.316	1388	0.55	0.458
Nest stage failure rate	2068	23.36	0.177	1203	0.33	0.848	1888	4.02	0.045
First egg date	135	20.55	0.303	60	4.81	0.090	127	2.34	0.126

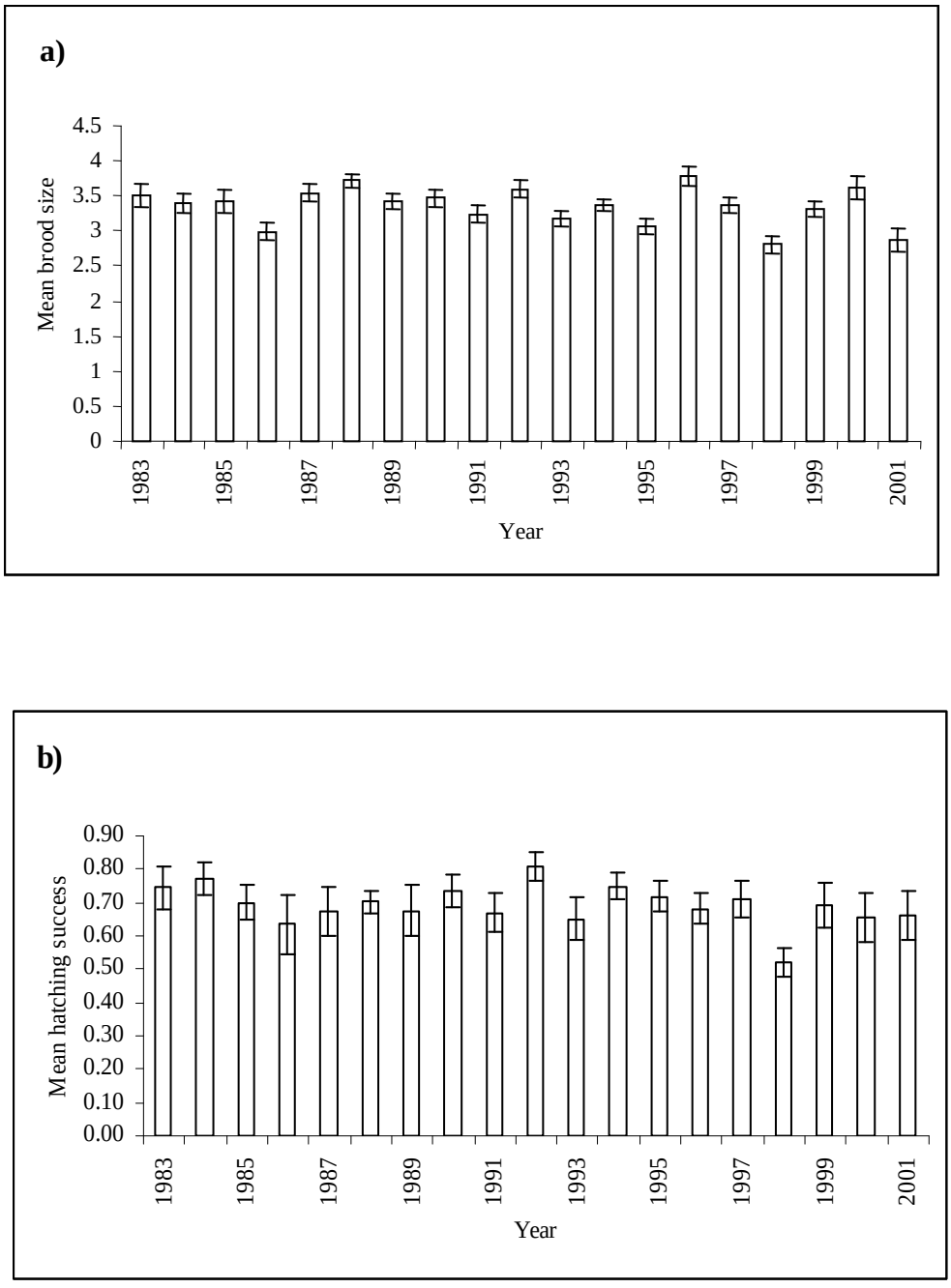

Figure 5.5.2 Annual variation in a) mean brood size and b) mean hatching success (brood size expressed as a proportion of maximum clutch size) over the period 1983-2001 as indicated by BTO Nest Record Scheme data, ± 1 SE.

As was the case with the BOMP data, we found no evidence that any of the aspects of breeding performance measured were related to the dominant habitat type surrounding the nest site. However, differences in productivity between pairs nesting in natural nest holes and those occupying nest boxes were identified. Clutch sizes in nest boxes were significantly higher than those in natural nest holes.

Such a relationship might occur if Barn Owls favoured boxes over natural nest sites. If this were the case, large individuals may out-compete relatively smaller individuals for nest boxes. If large females also lay larger clutches, the mean clutch size found in nest boxes would be greater than that found at natural nest sites. Alternatively, the distribution of nest boxes may be biased towards the south of Britain. As winter conditions are likely to be more favourable in this area, females may be in relatively better condition prior to laying, and may therefore produce larger clutches. Failure rates over the whole nesting period were also higher in nest boxes, possibly due to the larger clutch sizes produced.

5.6 Phenology of Barn Owl Breeding Attempts

Both the BOMP and the NRS data sets also provide information concerning the seasonal timing of Barn Owl reproductive events. The regular nest visits performed during the collection of Nest Record data allow an accurate estimation of the first egg date, the date on which the first egg of the clutch is laid, as individual nests are often visited repeatedly during the laying period. The NRS data presented in Table 5.5.2 indicate that first egg date was not observed to vary significantly between years or between habitat categories over the period 1983-2000. Furthermore, the mean date of clutch initiation of box-nesting individuals did not differ significantly from that of pairs nesting in natural nest holes.

As nests at BOMP sites are visited less frequently, the probability of multiple visits occurring during the laying period is greatly reduced. The date on which the first egg hatched, which is likely to correlate closely with first egg date, is therefore calculated indirectly at BOMP sites using measurements obtained from the eggs (267 measured in 2001) or chicks (427 measured in 2001). The period between egg measurement and hatching can be estimated by measuring egg density and then relating this measurement to a standard growth curve (Shawyer 1998 and pers. comm.; a revision of Percival's (1990) method). Nestling age can be estimated in a similar manner by measuring the length of the feather or the pin of the 7th primary and relating these measurements to two separate (pin and feather) growth curves (Shawyer 1998). Known second broods, and nesting attempts judged to be second broods from their estimated hatch dates were excluded from the analysis. Egg data sufficient to calculate hatch dates were available from very few BOMP sites (N = 53 sites) over the period 2000-2001, whereas sufficient nestling data was available from 161 sites over this period. The two data sets were analysed separately. Hatch date as calculated from egg density was not observed to differ between study years (N = 53, $\chi^2 = 1.98$, $P = 0.160$), habitat categories (N = 49, $\chi^2 = 2.68$, $P = 0.262$) or nest box designs (N = 52, $\chi^2 = 3.19$, $P = 0.203$). Similarly, hatch date as calculated from chick 7th primary length was not observed to differ between study years (N = 161, $\chi^2 = 0.95$, $P = 0.331$), habitat categories (N = 124, $\chi^2 = 2.62$, $P = 0.270$) or box designs (N = 158, $\chi^2 = 1.45$, $P = 0.484$).

The relationship between hatch date as calculated from nestling measurements and the success of the breeding attempt was also investigated. Again, known second broods, and nesting attempts judged to be second broods from their estimated hatch dates were excluded from the analysis. No significant relationship was observed between hatch date and hatching success (N = 50, $\chi^2 = 1.25$, $P = 0.264$), or between hatch date and brood size (N = 160, $\chi^2 = 2.21$, $P = 0.137$), or between hatch date and the probability of the nest fledging at least one offspring (N = 161, $\chi^2 = 1.40$, $P = 0.236$). However, hatching date was significantly positively related to clutch size (N = 50, $\chi^2 = 4.21$, $P = 0.040$), indicating that clutches produced at later stages of the breeding season were larger than those produced at relatively earlier stages. The production of larger clutches as the breeding season progresses may be due to an increase in food availability during the summer months. The BOMP data set also indicates that overall egg success, the proportion of eggs which produced offspring that fledged successfully, decreases significantly as the breeding season progresses (N = 49, $\chi^2 = 4.26$, $P = 0.039$), possibly due to the fact that clutch sizes are increasing whilst survival rates of eggs and/or chicks remain constant or even decrease.

5.7 Variation in Egg Measurements

As discussed in the 2000 BOMP Report (Crick *et al*. 2001), variance in egg size within a nest may reflect nutritional stress experienced by laying birds, with variance increasing as parental condition decreases. We therefore compared the within-brood variance in egg length and egg width measurements between the two study years and between the different habitat categories. Variance in egg weight and density were not investigated, as both are dependent on the age of the chick contained within. We found no evidence to suggest that the variance in the width or in the length of eggs within a clutch was dependent either on the study year or on habitat type (Table 5.7.1). In addition, we did not observe any significant relationship between mean width or length measurements and either study year or habitat category. Further investigation is necessary in order to calibrate measures of variation in egg morphology against levels of nutritional stress.

Table 5.7.1 Variation in egg measurements between years, between habitat types and between nest box designs. Test results show χ^2 statistics for likelihood-ratio tests of the difference in model deviance between constant models and models allowing values for the year, habitat type and nest box design to differ (SAS 2000). A *P* value of less than 0.05 would indicate a statistically significant difference between years, habitat types or nest sites.

Variable	Year			Habitat type		
	N	χ^2	*P*	N	χ^2	*P*
Egg width	87	1.43	0.231	76	2.41	0.299
Egg length	87	0.43	0.511	76	2.36	0.308
Variance in egg width	68	0.50	0.479	61	0.26	0.876
Variance in egg length	68	0.90	0.343	61	1.76	0.415

5.8 Variation in Prey Items

The identity and, where possible, the weight of prey items found in BOMP nests during monitoring visits is also recorded. Of the seven prey types recorded, only two – Field Vole and bird sp. - were present in sufficient quantities to enable analysis of the data, and an insufficient number of birds were weighed to permit analysis of this variable. Neither the number nor the total weight of Field Voles found in Barn Owl nests differed significantly between years (number, N = 34, χ^2 = 0.23, *P* = 0.633; weight, N = 30, χ^2 = 0.07, *P* = 0.794) or between habitats (number, N = 30, χ^2 = 1.17, *P* = 0.556; weight, N = 27, χ^2 = 1.55, *P* = 0.460). Similarly, the number of birds found in Barn Owl nests was independent of study year (number, N = 23, χ^2 = 0.98, *P* = 0.323) and habitat category (number, N = 17, χ^2 = 5.53, *P* = 0.629), as was the total number of prey items of all species recorded (year, N = 65, χ^2 = 0.00, *P* = 0.990; habitat, N = 56, χ^2 = 1.97, *P* = 0.373). The total weight of all species of prey item recorded was independent of study year (N = 44, χ^2 = 0.04, *P* = 0.835), but did vary significantly with habitat type (N = 40, χ^2 = 6.60, *P* = 0.037). Although the sample size was small, the total prey weight was highest in arable sites. As the number and type of prey did not vary significantly between habitat categories, this result suggests that prey items caught by Barn Owls nesting in arable areas are larger than those caught by Barn Owls in stock or mixed farming habitats. Although these results suggest that the rate of prey delivery, in terms of prey mass per hour, is greater in arable than in pastoral or mixed farming, nesting attempts in arable areas did not produce a significantly larger number of chicks, nor did they fledge a greater proportion of their brood (Sections 5.5.1.2 and 5.5.2).

6. THE 2002 FIELD SEASON

6.1 General

The programme will continue to follow the methodology that has already been established during 2001. However, it is hoped that the coverage in 2002 will enable us to make up for last year, when Foot and Mouth Disease put paid to much of the fieldwork.

General site visiting schedule: In order to provide information concerning the key events in the Barn Owl's breeding cycle, the following schedule has been adopted as standard for the volunteer network.

Visit Period		*Information Sought / Ringing Activity*
1. Late April/mid-May	-	Site occupancy
		Clutch size/No. chicks just hatched
		Catch and ring adults
		Collect/identify moulted feathers
2. Mid-July/early August	-	No. chicks at 6-8 weeks old
		Ring chicks
		Identify whether 2nd broods begun
		Collect/identify moulted feathers
3. October	-	No. chicks at 6-8 weeks old for 2nd broods
		Ring chicks

Validation work to be carried out by WCP: Given the restrictions due to Foot and Mouth Disease, the 2002 field season will give WCP further opportunity to validate the techniques used to detect the presence of second broods. Thus, fieldwork starts with sites being checked from April/May, and continuing to October to look for second broods and permit the validation of:

(a) the presence of shredded pellets and incubating females at the July/August visit as an effective indicator of second breeding attempts;

(b) the presence of moulted wing feathers from the female at the late April to mid-July visit as an effective indicator that a second brood will not be attempted.

"Micro-habitat" recording methodology: WCP slightly modified the recording form used for fieldwork in 2001. This has enabled the recording of small-scale habitat features of potential importance to Barn Owls, such as grass strips, ditches, etc. This method appears to be clear and straightforward and therefore should be able to be used unambiguously by volunteer contributors to the Programme.

Validation of egg-density curve: The standard equation used to relate egg density to egg measurements derives from a study by Hoyt (1979) based on information from 115 species. This equation is generally applicable to the eggs of all but a few species with relatively "pointed" eggs. Percival (1990) used a slightly different equation, based on a smaller number of species reported by Hoyt (1979) and Furness & Furness (1981), and created a curve that relates egg density to hatching date, based on a sample of Barn Owl egg measurements. Shawyer (see above) has further adapted this, but these curves need to be validated for use as part of the Barn Owl Monitoring Programme, to make sure that a curve specific to Barn Owls is available.

WCP has been undertaking egg measurements at suitable sites. In addition, as part of the validation process, we had hoped to find owl keepers, who breed Barn Owls in captivity, and encourage them to make more regular measurements of eggs. However, despite making extensive enquiries at wildlife parks, zoos, falconry centres etc, it has not been possible locate any Barn Owl breeders who would be able to undertake such a study. Many breeders would prefer to avoid disturbing sitting birds. There also seems to have been a reduction in the number of captive breeder of Barn Owls, due in part to the

fact that captive-bred Barn Owls can no longer be legally released into the wild. It is hoped that sufficient data on recently laid eggs have now been collected to enable a calibration curve to be fitted by computer.

6.2 Publicity and Dissemination of Results

Publicity & dissemination of results: The Rare Breeding Birds Panel, which publishes annual reports in the journal *British Birds*, will be alerted to the provision of annual monitoring information for Barn Owls. The survey results will be put forward for inclusion in the annual *The State of the UK's Birds* report of the BTO, WWT and RSPB in 2002.

Other news about the programme to date include:

- Two BTO staff, Peter Beaven and Deborah Lang attended the Barn Owl Conservation Network Symposium at Sheepdrove Farm in March 2002. This was found to be most useful, and enabled them to meet a number of existing BOMP observers and make several new contacts.

- An article about the Barn Owl Monitoring Programme appeared in BTO News 239 (March-April 2002) – see Appendix 3 - which has already generated a great deal of interest from potential observers and local media.

- The BTO has received an enquiry from a Barn Owl and Kestrel monitoring scheme that has recently been set up in Switzerland. They requested details of our programme, and are intending to adopt a similar methodology to BOMP. As a result, it may be possible to compare their results with ours in the future.

- A talk about Barn Owls and the BOMP has been prepared and given to members of the West Midlands Bird Club in May 2002. This is also available for use at other bird clubs. A shortened version of this talk will be given at the Rutland Bird Watching Fair in mid August 2002.

- A newsletter will be sent out to BOMP fieldworkers shortly. A brief article summarising the findings to date appeared in the September 2002 edition of BTO News. Both will provide valuable feedback to volunteers and encourage the exchange of ideas that observers have found useful.

Acknowledgements

We are extremely grateful to the Sheepdrove Trust for providing funding to permit the development and operation of this urgently needed programme.

The BTO and the Wildlife Conservation Partnership are grateful to all the landowners who have allowed them access to Barn Owl sites for monitoring purposes. The WCP expresses special thanks to Major Nigel Lewis for assisting them and for providing much of the data for the South-west region.

We are very grateful to the volunteer network of Barn Owl observers who have registered sites for the Programme, particularly those who were able to complete fieldwork under difficult access conditions caused by the Foot and Mouth crisis.

The BTO Nest Record Scheme data are gathered as part of the partnership of the BTO and Joint Nature Conservation Committee (on behalf of English Nature, Scottish Natural Heritage, the Countryside Council for Wales, and also on behalf of the Environmental Heritage Service in Northern Ireland).

We are grateful to Mike Toms and Andy Musgrove for help with the development of the Barn Owl Monitoring Programme database. Grateful thanks are also due to Angela Rickard who has done a sterling job in producing recording forms.

Finally thanks to Heidi Mellan, Nicki Read and Angela Rickard for formatting the report.

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Barn Owl Monitoring Programme Guidance Notes

British Trust for Ornithology

Thank you for contributing to the Barn Owl Monitoring Programme, your information will be of great value. To clarify how to complete the recording form, we are providing these guidance notes to help you. Before carrying out any fieldwork please ensure that you have a valid Schedule One Licence, if in any doubt please contact Jez Blackburn, Licensing Officer in the Ringing Unit.

Summary of breeding attempts
Please answer the four questions concerning the number of breeding attempts by the pair you are monitoring. This is to help us understand more about the number of pairs that make a second breeding attempt and whether they move sites between attempts.

Area Map
We are providing you a 1km square map based on the grid reference you provided. Please mark the location of the nest site, together with any other occupied sites in your monitoring area and also other known potential breeding sites.

Habitat Recording
Using the map provided, please try to estimate the percentage (to the nearest 5%) of the habitats listed in the table. To do this, we suggest that you visit a number of points in the square where you can view the habitat within the square and using coloured pencils shade in areas of each habitat. This will help you estimate the percentage of each habitat type within the square. The codes are those used by all BTO surveys including ringing and nest recording. The percentages should add up to 100%.

Important Features for Barn Owls
Twelve features (mostly linear) are listed. Please put a tick in the relevant boxes if the features are present in your square.

Site Details
This section is designed to give us more information about the nest site. If the nest site is in a tree, please name the species of tree and then tick all boxes that apply. For nest sites in buildings or other situations please tick all boxes that apply.

Visit Details
After each visit to the nest site please fill in the details in this box. The first eight columns are based on the BTO's Nest Record Card so should be familiar to many of you. The remaining columns provide important additional information and these data are required for each visit. The bottom line of the table provides a quick and easy summary of the outcome of the nesting attempt. Information required for each column is described in detail below.

Appendix 1

Date: Please record the date as dd/mm *e.g.* 10th June would be 10/06.

Time: Please record the time using 24 hour clock e*g* 18 instead of 6pm

No. Live Eggs: Write in the number of viable eggs. Also use this column if you are uncertain whether the eggs are infertile/addled.

No. Dead Eggs: Use this column if you are certain the eggs are infertile/addled, or to record broken eggs inside the nest.

No. Live Young: Write in the number of live young.

No. Dead Young: Write in the number of dead young.

Approximate Counts

If it is not possible to accurately count the number of eggs and/or young please use the following examples to guide you.

? - if the contents cannot be counted with certainty or if the adult is sitting and you cannot see the contents.

6+ - if there are six-or-more eggs or young

(6) - if there are about six eggs or young

Status Codes: These two-letter codes provide an easy way to describe the stage of development of the nest, eggs and young, as well as the observed activities of the parent birds and the eventual outcome of the nest. **Please ensure your status codes always comprise of two characters.** A full list of status codes is printed on the **Status Codes Card**, which should be taken into the field with you to act as a memory jogger. The codes are described in greater detail on page 7. Some of the codes on the card do not apply to Barn Owls. These are self evident.

Birds present?: On each visit please record if birds are present at the nest site. Use '**M'** for male, '**F'** for female and '**P'** for pair. Even if the pair are not making a nesting attempt in the nest site this year, they may still use the box as a roost site; please record their presence.

Other species present?: If another species is present in the nest site please use the BTO 5 letter code to record it. The most likely species are:

Jackdaw	'JACKD'	Tawny Owl	'TAWOW'
Stock Dove	'STODO'	Little Owl	'LITOW'
Kestrel	'KESTR'		

Pellets found: Please record the presence ('**Y'** for yes) or absence ('**N'** for no) of pellets at the nest site. Where possible count the number of whole pellets found and write the number in the table. If you find pellets from other species please make a note in the comments box. Barn Owls typically shred pellets when they are intending to lay.

No. prey items found: If you find any corpses of small mammals please use the guide provided to identify the species, then count the number of individuals of that species and write the number under the appropriate column. Space has been provided to write in additional species found.

Appendix 1

Ringing details and biometrics (Option 2 only)
THIS SECTION IS TO BE COMPLETED BY RINGERS ONLY. The codes used for adults and chicks are described in detail below**.**

Date: Please record the date as dd/mm *e.g.* '10th June' would be '10/06'.

Ring Number: Please record the ring number in full *e.g.* 'GF72936'

Sex: Using Figure 1 and Table 1 as a guideline, please record females as '**F**', males as '**M**' and unsexed birds as '**U**'.

Brood Patch: Please record the development of the brood patch on the 0-5 scale as follows:

0 – absent
1 – starting
2 – well defined
3 – veined and red
4 – wrinkled
5 – feathering over

These are the same codes as those used by B-RING and IPMR to record brood patch. Some of the codes are not well defined or are mutually exclusive (probably designed with passerines in mind!). Please use the codes as a hierarchy, for example if the brood patch is veined and red (3) AND winkled (4), record the brood patch as '4'.

Wing Length: Maximum chord in mm..

Moult: Please record if there is evidence of body moult '**B**' and/or wing moult '**W**' or if moult is absent '**A**'.

Weight: Record weight in grams (g).

Talon Flanges: Use Figure 2 to record the score of the talon flanges (scale of 1-5). It has been shown that Barn Owls can be aged by examination of the talon flange on the third innermost talon. The combed flange develops with age. Young birds have a slight ridge (less than 0.5mm wide) and mature birds may have flanges greater than 1.5 or 2mm. With age, notches develop in the flange and these increase in size. Old birds have flanges with a worn, deeply notched appearance. Please note that there has been some concern over the accuracy of this technique so we want to gather information to test it. If the bird is of known age, please make a note on the form.

P7: Using Fig 3 as a guideline, please record the length of P7 in mm. If the 7th primary is in pin (no feather emerging) then record the length of the sheath. If the feather is emerging, measure the length of the emerged feather (NOT the sheath). Primary number 7 is the 7th feather when counting from the innermost primary outwards.

Head/bill: Please record total head and bill length in mm using callipers. Position the callipers at the centre of the back of the skull (nape) and measure to the bill tip, so that the callipers form a right angle to an imaginary line from the bill tip to the centre rear of the skull. Do not exert excessive pressure when closing the callipers.

Appendix 1

Table 1: Sexing Adult Barn Owls

Males	Females
Lighter than females on the ventral surface and facial disc.	Darker than male on the ventral surfaces and facial disc.
Lighter background colour to plumage on dorsal surface and weaker wing and tail bars than female.	Darker background colour to plumage on dorsal surface and stronger wing and tail bars than males.
Fewer and smaller breast spots than female (see below).	More and larger breast spots than male (see below).
No brood patch.	Brood patch may be present.

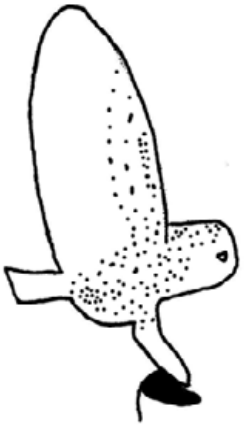
Figure 1: Sexing Barn Owls by the density/area of spotting

Grade 0

Grade 1

Grade 2

Grade 3

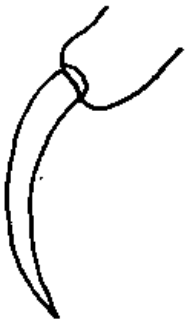


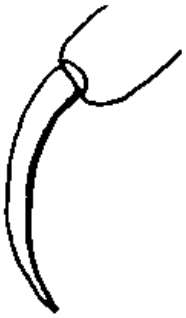
Grade 4

Grades	
0	Male
1	Male or Female
2	Female
3	Female
4	Female

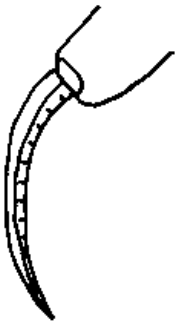
Appendix 1

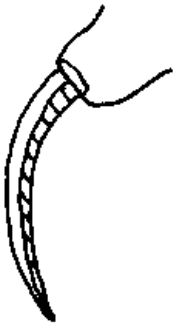
Figure 2: Talon Flanges





No flange	Ridge <0.5mm	Smooth flange >1.5mm ♂ >2mm ♀
AGE: Fledgling	AGE: 65-75 days	AGE: 7 mths
SCORE 1	SCORE 2	SCORE 3

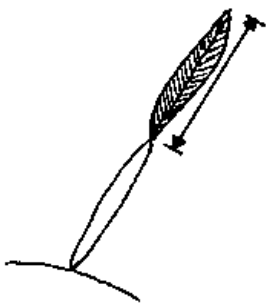




Notched flange >1.5mm ♂ >2mm ♀	Flanges deeply slotted
AGE: 7 mths – 2 yrs	AGE: > 2 yrs
SCORE 4	SCORE 5

Figure 3: P7

If Primary 7 is in pin only (no feather visible) measure the length of the sheath.



If Primary 7 has a feather visible, measure the length of the feather only.

Appendix 1

Nest Record Card Status Codes

NEST BUILDING STAGE

N0	=	Nest site empty	**N3**	=	3/4 built
N1	=	third built	**N4**	=	Complete, unlined
N2	=	half built	**NL**	=	Lined

EGGS

CO	=	Cold	**WA**	=	Warm
UN	=	Uncovered	**CV**	=	Covered
FR	=	Fresh	**DE**	=	Growing embryo present
HA	=	Hatching	**PE**	=	Pipping/calling from egg

YOUNG

NA	=	Naked
TO	=	Egg tooth present
DO	=	Downy
BL	=	Blind
EY	=	Eyes just open
IP	=	Primary feathers in pin
FS	=	Primary feathers short; less than 1/3 emerged from sheath
FM	=	Primary feathers medium ; 1/3 to 2/3 emerged from sheath
FL	=	Primary feathers large; more than 2/3 emerged from sheath
RF	=	Ready to fledge
LB	=	Young left nest naturally before fledging; still nearby
YR	=	Ringed
AY	=	Audible young in nest

ADULT ACTIVITY

Combine (*e.g.* **AN**, **PD,** etc)

1st letter		**2nd letter**	
A	= Adult	**D**	= Dead
M	= Male	**F**	= Feeding young at nest
F	= Female	**I**	= Identified by colour mark, at nest
P	= Pair	**N**	= On/at nest
		T	= Trapped at/near nest
		V	= In vicinity of occupied nest – visibly alarmed or carrying food
		B	= Building nest or carrying nest material

Appendix 1

OUTCOME: SUCCESS

Use these when some/all young have successfully left the nest

AC = Adult carrying food near nest
EX = Young exploded from nest
HS = Hatched shell fragments in empty nest of owls, gamebirds, waders, etc.
MR = Marked young retrapped/resighted
NE = Nest empty, undisturbed with well-trodden lining, containing feather scale, remains of down in nest and/or droppings.
NN = Fledged young near nest
SY = Some young fledged, other live young still in nest
SL = Last young seen leaving
VA = Adult visibly agitated or alarms near nest
YC = Young capable of leaving nest on the previous visit

OUTCOME: FAILURE

Use these codes on any visit to describe the fate of individual eggs and/or young

Combine (e.g. **EP**, **XF,** etc)

1st letter		2nd letter	
E	= At egg stage	**A**	= Eggs not hatched, infertile, or addled
J	= At young stage	**B**	= Injured/broken
X	= At egg or young stage	**C**	= Killed or thrown out by Cuckoo
		D	= Deserted/starved/dead
		E	= Empty damaged nest
		F	= Flooded
		I	= Man - intentional
		L	= Livestock
		M	= Man – unintentional
		O	= Other/unknown
		P	= Predation
		T	= Thrown/fallen out
		U	= Usurped from nest by another species
		W	= Wing Damage

OUTCOME: UNKNOWN = OU

NB: For partially successful nests (i.e. where only part of clutch/brood produces fledged young) write both success and failure codes.

Some Status Codes Explained

EGG STAGE

EGGS Eggs Cold/Warm CO/WA: If the eggs can be easily reached, very carefully feel them to see if they are cold or warm.

PE Pipping egg: some chicks call from within the egg for 1 to 2 days before hatching. Before the chick has broken through the shell, "starring" of the shell occurs where the chick has cracked the shell from within.

YOUNG

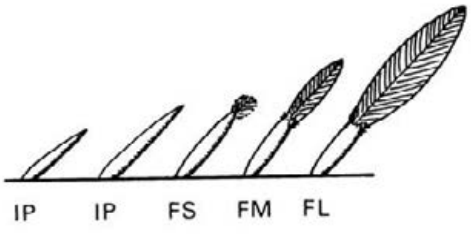
Recording growth of species whose young hatch asynchronously. The broods of some species (*e.g.* owls) normally have young at various stages of growth. In these cases, please record in the columns, status codes to describe the age of the **oldest** chick only. Codes to describe the growth of younger birds may be recorded in the comments section.

TO Egg Tooth present: The egg tooth is a horny bump on the upper side of the beak that is used by nestlings to break through the shell and out of the egg. In Barn Owls the egg tooth is best described as a small white bump on the tip of the beak.

IP Primary feathers In Pin: Primary feathers (the large flight feathers that form the outer half of the wing) which are completely enclosed within the shiny sheath are called 'in pin' (because of their pointed shape).

FS/FM/FL Primary feather growth stages.

RF



Ready to Fledge: When the nestlings are well feathered and look ready to leave the nest (whether they can fly or not), please leave well alone and record this code. Please note that the status code 'YC' (Young capable of leaving nest on the previous visit) is a **success** code and should not be confused with 'RF'. 'RF' should be used when young look ready to fledge but none have yet done so. 'YC' should be used when some or all of the young have fledged and may follow a visit where young are described as 'RF'.

SY Some young fledged; other live young still in nest.

YR Young Ringed: Use every time some young are ringed, even if only part of the brood is ringed.

AY Audible Young in nest: When food-begging or hunger calls of the young are heard in the nest.

ADULT ACTIVITY

Recording the activity of adult birds at or near the nest can be useful when determining the stage of the nest, particularly when the contents cannot be seen (as in the case of a species nesting high in a tree). For example, an adult sitting tight on the nest implies that it contains eggs and/or young; and adults regularly going to and from the nest with food implies that young are present.

Appendix 1

The adult activity codes "AN" (Adult on/at nest) and "FN" (Female on/at nest) are probably the most useful, but there are other codes to use if an adult is found dead, feeding young, trapped at/near the nest for ringing purposes, or in the vicinity of the nest.

NB Ringers: when an adult is trapped on the nest, please use both status codes **AT** and **AN** (See guidelines on page 10).

OUTCOME
Put down **all** appropriate codes. If only some young die, then put both failure codes and success codes.

Outcome success codes for nidicolous species. For young that hatch naked, blind and helpless *e.g*. Barn Owl, outcome success codes should only be used when all of the live young have fledged (e.g. codes 'VA' and 'AC').

Partial success. Failure codes for individual eggs or chicks can be written for any visit. When a nest is partially successful (i.e. where only part of the clutch/brood produces fledged young), this can be indicated by putting both a success code (*e.g*. NE) and a failure code (*e.g*. JD) on the final line. Although the code 'NE' means 'Nest empty, undisturbed and well-trodden lining, containing feather scale and/or droppings'.

Also, in the case of nidicolous species such as owls, if some young have fledged whilst others are still in the nest, use the code 'SY' (some young fledged; other live young still in nest), but only record the number of young still in the nest in the young column. The number of young seen outside the nest may be written in the comments section. If you see the last live young leave the nest or the entire brood leaves together, record the date and use the success code 'SL' (last young seen leaving).

OUTCOME: UNKNOWN = OU
If you are unable to make a final visit to the nest site, please use the code 'OU'.

Appendix 1

GUIDELINES FOR TRAPPING ADULTS AT THE NEST (for qualified ringers only)

Disturbance

Historically, some fieldworkers have expressed concern that Barn Owls are sensitive to disturbance, especially during the early stages of breeding, and that this disturbance may bring about breeding failure. ***While there is little evidence to support this view we do not want any nest recorder or ringer to do something that they are not confident in doing or are concerned about doing.***

Two studies have been carried out specifically examining the effect of human disturbance on active Barn Owl nests (Percival 1990, Taylor 1991).

Percival examined the possible effects of observers visiting active nests for both Tawny Owl and Barn Owl. Initially he used a questionnaire asking fieldworkers about their opinions and experiences on working around active nests. He then went on to examine nest record data to calculate measures of productivity in relation to the timing and number of visits to the nest. This work suggested that while a number of fieldworker felt it was unsafe to visit nest sites during the pre-laying and hatching stages, the nest record analyses suggested that it was only during the hatching period that birds were sensitive to disturbance. Outside this period, the desertion rate from **all** causes was found to be very low. Nests that were visited only during the late chick stage did not fledge significantly more young than ones that had been visited at other stages of the breeding period.

Taylor examined the effect of nest inspections and radio-tagging on breeding success of Barn Owls in southwest 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 these two studies supports the view that the Barn Owl is generally tolerant of nest visiting (including the capture of adults). In these studies, the fieldworkers all made an effort to minimise disturbance during the incubation period.

Guidelines for trapping adults at the nest

Adult Barn Owls can be safely caught at the nest site during the breeding season. Birds should be caught upon leaving the nest rather than in the nest itself. This reduces the risk of damage to eggs or chicks.

It is important to approach the nest quietly. Where possible, park well away from the site and approach silently on foot. When near the nest site, have a hand net ready. The hand-held net should have a deep bag and padded rim. Gently place the net over the entrance to the nest site, if possible, before putting the ladder up. Birds can then be caught as they emerge from the nest site. In some cases the female will sit tightly and will not leave the nest. In these cases, with great care, lift the female from the box, making sure that the eggs are not damaged. The female can be held in a bird bag while the nest contents are inspected, she can then be processed and returned to the nest. **It is important that the bird is put back on the nest and not released.** If you have caught both adults, place the female

back first followed by the male. When putting the bird/s back into the nest, release it gently so that it does not flap or run in the box and potentially cause damage to the eggs. Place the bird through the nest entrance. It is advisable to then cover the entrance by placing some material (sacking etc) over the hole and leave for a few minutes to allow the bird/s to settle. Remove the covering gently and retreat quietly.

Adults can be caught safely during incubation and at the chick stage. During the hatching period birds are sensitive to disturbance (generally the end of May/early June).

Please keep handling time to a minimum.

If you are in any doubt about procedure, contact BTO and we will provide advice and will try to put you in contact with other ringers who are familiar with this technique.

References

Percival, S.M. 1990. *Population trends in British Barn Owls* Tyto alba *and Tawny Owls* Strix aluco *in relation to environmental change*. British Trust for Ornithology Research Report 57. British Trust for Ornithology, Thetford.

Taylor, I.R. 1991. Effects of nest inspections and radiotagging on Barn Owl breeding success. *Journal of Wildlife Management* 55: 312-315.

Acknowledgements

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23rd July 2001

The Barn Owl Monitoring Programme is generously sponsored by the Sheepdrove Trust. For more information about the Sheepdrove Trust visit their website at http://www.sheepdrove.com/conserv.htm

Appendix 1

Barn Owl Monitoring Programme: Site Registration Form

British Trust for Ornithology

Name:	Permit No.:	NRS Code:	Our Code:	Postcode:

Site Number	Site Name	Natural (N) or Box (B)?	Grid Reference (6 figure)	Year site first visited for monitoring	Your Code	Option 1 or 2
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Please return your completed form to:
Peter Beaven, BTO, The Nunnery, Thetford, Norfolk IP24 2PU

Appendix 2

Appendix 4

Appendix 4