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A breeding bird survey of The National Forest (English Midlands) in 2008

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A report to the National Forest Company

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BTO Research Report 520
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CONTENTS

LIST OF TABLES AND FIGURES

Tables

Figures

EXECUTIVE SUMMARY

1 The National Forest Company (NFC) commissioned a special survey of breeding birds in The National Forest to be undertaken in 2008 by BTO staff and volunteers. The 2008 survey was to form a baseline for repeat surveys that would aim to measure population change across The National Forest.

2 The survey employed the standard BTO/JNCC/RSPB Breeding Bird Survey (BBS) method, consisting of two breeding season transect walks in randomly selected 1-km squares of the Ordnance Survey national grid. Birds, habitat and mammals were recorded. The annual data collected by volunteers for the BBS monitor broad-scale population change in the UK and its regions, but are inadequate for small areas such as individual counties, unitary authorities and council areas. Boosting the results from BBS with extra data supplied from professional fieldworkers allows BTO to calculate population trends from relatively small regions of the UK, and to put those into broader regional, national and even international contexts.

3 The NFC required 10% coverage of the Forest area, equivalent to 46 1-km squares. Since it was estimated that volunteers would survey nine squares, NFC commissioned 37 squares to be surveyed by a professional fieldworker. Thanks to keen participation by BTO volunteers, 11 additional squares were surveyed and thus the initial overall target of 46 squares was exceeded. The 48 squares that were surveyed were all randomly selected and were distributed among The National Forest's landscape zones according to their area.

4 In all, 107 species of birds were recorded. Of these, 36 species, from a range of main habitat types, were present on at least 30 squares and would therefore provide a reasonably reliable measure of population change when compared with data from a future repeat survey. These include species occupying a range of habitat types.

5 Trends for widespread species could be combined to produce a representative indicator of trends across all main habitat types. Alternatively, trends for subsets of species occupying common habitat types or with similar biology could be combined to produce indicators of bird population change in those guilds or habitats within The National Forest, although each trend would be drawn from just a handful of species. The habitat categories used in the tables in this report (M, F, G, S and W) are not necessarily the ones that would make the most valuable indicators.

6 The most abundant species recorded was Woodpigeon, followed by Blackbird, Wren, Chaffinch, Robin and Starling, for each of which over 500 individual birds were recorded. The Charnwood landscape zone held the most birds per square and was especially good for species of woodland and scrub. The Mease Lowlands held the highest mean counts for several farmland species.

7 Among the 107 species of birds were 36 amber-listed and 16 red-listed species, according to the current lists of birds of conservation concern. The 16 red-listed species have all been subject to a rapid decline in UK population over the 25 years to 1999. The 2008 survey collected no useful data for either Barn Owl or Redstart, which are subject to Local Biodiversity Action Plans within The National Forest. The red-listed Tree Sparrow, a bird predominantly of farmland and scrub, was well represented in The National Forest in 2008, relative to the Midlands as a whole.

8 Comparison of the results of the survey with BBS data for a wider Midlands region and for England as a whole suggested that bird populations within The National Forest are at least on a par with those nearby and elsewhere in England. Among red-listed species, Willow Tit, Grasshopper Warbler, Bullfinch, Tree Sparrow and Marsh Tit were all recorded more abundantly in The National Forest than in the wider Midlands region, although chance effects may have played a part. These species are drawn from a variety of habitat types: wetland or young plantation (Grasshopper Warbler), farmland (Tree Sparrow), scrub or woodland edge (Bullfinch, Willow Tit) and mature woodland (Marsh Tit).

9 Eleven species of mammals were also observed. The BBS method is designed for recording birds and is inefficient at recording mammals, and each species is under-recorded to a degree that depends on its particular lifestyle and ecology. Mainly nocturnal animals, such as bats, Badger, Hedgehog, and small rodents, and diurnal but relatively scarce animals such as Stoat, were not observed at all.

10 Repeat surveys will allow comparisons with the 2008 baseline survey that will show how bird numbers and distribution are changing within The National Forest as the new woodlands develop. Woodland species can be expected to increase and spread, whereas species predominantly of farmland or scrub habitats may decrease.

11 BTO also recommends that, to maximise the reliability of change estimates from future repeat surveys, these surveys should follow the routes, dates and times of the 2008 survey as closely as possible. It would be better to include all 48 squares in every repeat survey than to vary the sample squares between years. Route maps for the 2008 survey have been supplied to NFC, along with spreadsheets detailing the bird and mammal observations made.

12 If budgets do not allow surveys to be repeated on an annual basis, a longer interval could be used. The longer the interval between surveys, the more difficult it will be to link bird population changes to local habitat change. Since bird communities in young plantations can change radically over periods as short as three years, we recommend that the interval between surveys does not exceed four years, at least while there are young plantations in the census sample. Relatively frequent repeats will also be advantageous because conclusions will become more certain as the number of repeat surveys grows.

1 INTRODUCTION

Bird population trends are increasingly a concern of both local and national government. At the UK level, government has adopted a formal commitment to reverse the long-term decline in the number of farmland birds by 2020. Following the publication of the UK Biodiversity Action Plan 1994, species action plans have been developed for a range of particularly vulnerable species of birds. These and other commitments bring a responsibility to all levels of government to consider the needs of wild bird populations.

The British Trust for Ornithology has a long history of organising bird monitoring programmes to which volunteers contribute their birdwatching skills. The largest scheme for monitoring the population levels of widespread breeding bird species is the Breeding Bird Survey (BBS), which is supported by BTO, the Joint Nature Conservation Committee and the Royal Society for the Protection of Birds. BBS, in combination with its predecessor the Common Birds Census, produces long-term trends for bird populations at UK, country and regional levels (Risely *et al.* 2008, Baillie *et al.* 2009). It is these trends that provide most of the data for the various government indicators of bird populations. Whereas trends can be produced separately for Scotland, Wales and Northern Ireland, and for Government Office regions within England, sample sizes generally do not allow trends to be generated for smaller regions. There is thus a gap in information at the level of regional government, such as counties, unitary authorities and council areas.

The National Forest is an area of about 500 square kilometres, lying across three counties of the English Midlands (Derbyshire, Leicestershire and Staffordshire), which has been selected for the creation of a new, forested landscape. New woodlands will complement ancient woodland, meadows, lakes and rivers, parks, towns and other visitor attractions within the area, for the benefit of local communities, visitors to the area and wildlife. To date, more than 7.5 million trees have been planted and this has increased woodland cover in the Forest from a starting point of 6% in 1991 to approximately 18%; the proportion of the designated area that is woodland is set to grow to around 33% over the coming years.

Sustainable development, meeting multiple environmental, economic and social objectives, has been the guiding principle of the Forest's creation since the publication of the first National Forest Strategy in 1994. The National Forest Company (NFC) is a non-departmental public body established by Government in April 1995 to oversee the creation of the Forest, and sponsored by Defra through grant-in-aid. According to its current corporate plan (National Forest Company 2008),

> "The purpose of the NFC is to lead the creation of The National Forest in accordance with the aims and objectives set out in the second National Forest Strategy, covering the period 2004 – 2014. It attracts and uses resources for ambitious, sensitive and imaginative Forest creation. It provides the setting for new businesses, recreation, tourism and an improved quality of life. It enhances wildlife and biodiversity. It is acknowledged as a national exemplar of sustainable development."

NFC therefore has responsibilities to ensure that its activities benefit the conservation of birds and other wildlife within the Forest, while also contributing to Defra's efforts to meet its Public Service Agreements concerning the wider UK environment.

In *The National Forest: an exemplar of sustainable development* (National Forest Company 2007), NFC set out the following four actions with regard to its environmental responsibilities:

> "The National Company will, with and through partners:
> 1. Continue to drive the creation of the Forest and its effective management to meet the objectives and woodland creation targets of the National Forest Strategy 2004 – 2014.
> 2. Extend and improve wildlife habitats to meet the Forest's Biodiversity Action Plan targets.
> 3. Monitor the quality of the habitats and species prioritised in The National Forest's Biodiversity Action Plan.
> 4. Monitor bird populations, particularly woodland birds."

The report also proposes 20 environmental, economic and social indicators that represent a balanced contribution to the sustainable development of the Forest area and how it can be monitored over time. The sixth of these relates to populations of wild birds.

To further its programme covering issues of forest quality and sustainable management, and to meet its 2007 commitment to a bird population indicator, NFC commissioned a survey of breeding birds across the whole of the Forest area in 2008. Whereas the results from 2008 alone would be purely descriptive and give no indication of population change, future repeat surveys would allow the generation of population trends, specific to The National Forest, for widespread species of common birds; such trends, when combined into an indicator, would help the Company to assess its environmental performance and measure its progress towards sustainable development. The aim of the 2008 survey was therefore not to be a monitoring survey in itself, but to set a baseline from which future surveys could measure bird population change.

This report gives the results of that survey, which was conducted by BTO staff and volunteers. The technique that was employed was to boost the existing sample of squares surveyed by BBS volunteers in 2008 with a further set of squares surveyed professionally. This method, maintaining complete compatibility with the UK-wide BBS, allows assessments to be made of population change for relatively small areas, while allowing direct comparison of results with estimates of change at larger geographical scales, up to UK and even European level.

2 METHODS

2.1 Survey design

Prior to the start of fieldwork in the spring of 2008, meetings and discussions were held between NFC and BTO to establish the methodology for the survey. It was decided that the survey would consist of two main parts: a professional survey of a random sample of 1-km squares of the Ordnance Survey (OS) national grid, using BBS methods, would be supplemented with similar data from volunteers contributing from The National Forest to the BBS itself. Results would be drawn from a combination of the two sets of fieldwork, and augmented with any extra information that became available.

NFC's preference, subject to tendered costs, was for the BBS survey to cover a 10% sample of the Forest area. This would require 46 1-km squares to be surveyed.

2.2 Site selection

BTO identified nine squares for which volunteer BBS data could reasonably be expected in 2008, based on participation during 1994–2007. These nine squares were a subset of the 15 squares selected randomly for BBS coverage that lay wholly or partly within the boundary of The National Forest. BBS sampling is stratified regionally so that the density of squares matches the density of BTO members, which differs slightly between the Forest's three counties, but in practice the 15 squares can be taken as a representative sample of the Forest area.

To cover the remainder of the 46 squares that were required, NFC used a GIS application to select a sample of 37 1-km squares for a BTO professional to survey, using BBS methods. The selection was drawn from all squares at least 90% within the forest boundary and constrained to ensure that no two adjacent squares were selected. Further, the selection was stratified according to the Forest's six landscape zones, to ensure that the proportion of squares in each zone matched its land area.

The BTO was contracted to survey these 37 squares in 2008, to integrate the results with BBS data from The National Forest collected by volunteers, and to report the results.

2.3 Fieldworkers

During the early part of 2008, candidates for a number of short-term fieldworker posts at BTO were given a series of interviews, at the BTO Scotland offices in Stirling and at the BTO's HQ in Thetford. Each was given a standardised test of their visual and aural bird identification skills and assessed during a practical field session, to ensure that they were fully capable of conducting surveys of breeding birds. In many cases, individuals are employed by BTO as fieldworkers on short-term contracts over many years, and are known to be experienced and fully reliable. All fieldworkers were briefed on the standard field protocols, health and safety procedures and the rationale for their projects.

The professional fieldworker employed for this survey was Steve Haynes (SH), a highly skilled and experienced field ornithologist with good local knowledge of the West Midlands in particular.

Volunteers for BBS are in general highly motivated birdwatchers with a high level of fieldwork skills, although these are not formally tested. The national BBS returns are subjected to a range of consistency checks to ensure as far as possible that the data are of high quality throughout.

2.4 Field methods

The field methods adopted for the professional survey were identical to those used by volunteers in the BBS scheme (Risely *et al* 2008). In summary, surveyors were asked to make two visits, one between early April and mid May (termed "early") and a second between mid May and the end of June ("late"). These two visits are intended to sample the birds that are active and conspicuous early in the breeding season, as well as summer migrants that arrive to breed in late spring and other species that are more detectable at this later stage of the year.

On each BBS visit, surveyors walk two pre-selected 1-km transects through each 1-km square and record all birds that they see and hear. Each transect is divided into five 200-m sections, and birds are recorded at the section level. Individual birds that can be seen or heard from several transect sections are recorded only once, in the section where first observed. The perpendicular distance of each bird from the transect line is also allocated to one of three categories, according to the position at which the bird was first detected (less than 25m, 25–100m and greater than 100m), and birds in flight are recorded separately in a fourth category. The use of distance bands allows data to be resolved at the level of 200m x 50m and 200m x 200m rectangles, if required for more complex analyses.

The standard placement of the two transect lines is parallel, running either north–south or east–west, 500m apart and 250m from the edge of the square. In almost all BBS squares, however, this pattern requires modification according to the nature of the terrain and the constraints of access. Transects can extend outside the nominal square if necessary.

The BBS method requires a simple assessment of habitat for each 200-m section of transect. Up to two habitat types can be coded, using a hierarchical system designed by BTO and employed for all BTO surveys (Crick 1992). The "first" habitat is defined as the one the observer considers to be the most relevant to birds along the section, and is normally the most extensive. A second habitat can also be described, where present. Each habitat can be described with up to four levels of coding.

BBS observers are also encouraged to record mammals. Most do, although recording is essentially casual and no special efforts are made to detect species that are difficult to observe. The geographical unit for mammal recording is the whole 1-km square. Mammal recording was set as a requirement for the professional surveys.

The BTO's professional fieldworkers are required to follow set health and safety procedures, which include phoning in to a central number at the start and end of each visit. This assists rescue in the event of any incident, even if the fieldworker is unable to call for help.

2.5 Data capture and analysis

After the completion of fieldwork, SH transcribed the data onto a paper summary sheet, as totals for each transect section and distance category. He then input the data into a standard BBS input spreadsheet. All paperwork was then returned to BTO HQ. This included a map of each of the surveyed squares with the route and transect-section boundaries marked on it, to enable the same route to be followed in subsequent years.

Transcription and input of BBS data are both stages at which errors can be made. To combat such errors, extensive checks were made of the summary sheets for missing or incorrectly transcribed data, and the Excel spreadsheets were subjected to consistency checking, with special attention to unexpected species or counts. Errors found were corrected in the Excel workbook, which remained the top copy of the data.

Data for the general BBS are captured both on paper summary sheets, that required input, and on line, using a standard web form and avoiding the need for subsequent processing. Six sets of volunteer data were supplied to BTO HQ on paper, and a further five were supplied on line. Bird counts for these 11 squares were extracted and added to the Excel workbook alongside the professionally collected data.

Analyses were made using a program that was specially written in SAS (statistical analysis software developed by SAS Institute Inc., Cary, North Carolina) and reads directly from the Excel workbook. The program first sums the counts for each species, square and visit across transect sections and distance categories. The count that is tabulated for each species and square is the higher of these two summed values, from the “early” and “late “ visits. This higher, summed count is the value that is standardly used in comparisons of BBS bird counts, for example across years to estimate bird population change.

3 RESULTS

3.1 Coverage obtained

The 37 squares selected by NFC were all surveyed by SH, except for two that proved to be difficult or dangerous to access, and therefore uncoverable. Of the 15 squares selected randomly for BBS coverage and lying wholly or partly within the Forest area, volunteers surveyed 11 squares in 2008, and a further two were surveyed by SH in compensation for the two uncoverable squares in the NFC sample. The combination of professional and volunteer observers thus surveyed 48 squares (Table 1). Because BTO volunteers surveyed two more squares than expected, total coverage surpassed the planned total of 46 squares.

Table 1. Numbers of 1-km squares selected for coverage and surveyed in 2008, by National Forest landscape zone. In all, 52 squares were selected and 48 surveyed.

NF landscape zone	NFC sample			BTO sample		
	Total	Surveyed in 2008	Not surveyed	Total	Surveyed in 2008	Not surveyed
Charnwood	6	6		1	1	
Coalfield	14	13	1	7	7	
Mease Lowlands	4	4		1	1	
Melbourne Parklands	4	4		2	2	
Needwood	5	5		2	1	1
Trent Valley	4	3	1	2	1	1
Total	**37**	**35**	**2**	**15**	**13**	**2**

Since 48 from a total of 52 possible squares were surveyed, and just two squares from each selection were not covered, there was little scope for any observer bias in selecting which of the squares were surveyed. The squares surveyed are mapped in Figure 1 and listed in Table 2.

Squares from the BTO sample were distributed across all six landscape zones. In three cases, BTO squares abutted squares in the NFC sample, and in a further three cases they met at a corner.

Figure 1. Distribution of the 48 squares surveyed in 2008, in relation to The National Forest's six landscape character areas. Open squares (blue) – NFC sample, closed squares (buff) – BTO sample.

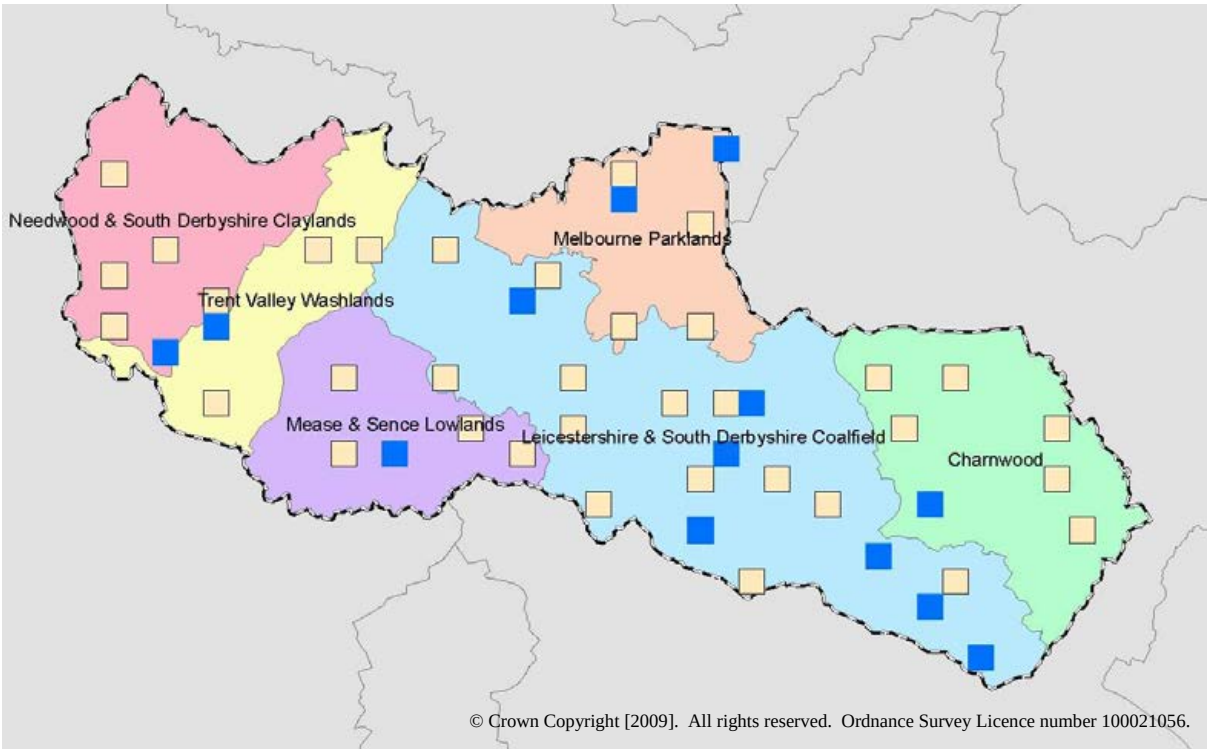


Table 2. Squares surveyed in 2008, with visit dates. The two parts of the sample are listed, each ordered by square reference. Four selected squares were not surveyed.

Square	landscape zone	place name	early	late	observer
BTO					
SK1218	Needwood	Morrey			
SK1617	Needwood	Wychnor Park	11-May-08	28-Jun-08	Miss H F Greatorex
SK1818	Trent Valley	Barton-under-Needwood	6-May-08	15-Jun-08	Miss M Holley
SK2319	Trent Valley	Walton-on-Trent			
SK2513	Mease Lowlands	Lullington	8-May-08	17-Jun-08	Steve Haynes
SK3019	Coalfield	Swadlincote d	11-May-08	26-Jun-08	Steve Haynes
SK3423	Melbourne Parklands	Ticknall a	3-May-08	6-Jun-08	Mr R M R James
SK3710	Coalfield	Swepstone	25-Apr-08	14-Jun-08	Mr A Pocock
SK3813	Coalfield	Normanton le Heath a	4-May-08	8-Jun-08	Mr P A Newton
SK3825	Melbourne Parklands	Melbourne	10-May-08	5-Jul-08	Miss A Tipping
SK3915	Coalfield	Coleorton a	7-May-08	9-Jun-08	Mr R Black
SK4409	Coalfield	Bagworth Wood	6-May-08	26-Jun-08	Mr A B Gibney
SK4607	Coalfield	Thornton a	29-May-08	30-Jul-08	Mr A Johnson
SK4611	Charnwood	Billa Barra	19-Apr-08	25-Jun-08	Mr A B Gibney
SK4805	Coalfield	Botcheston	22-Apr-08	23-May-08	Mr S E Saunders

Square	landscape zone	place name	early	late	observer
NFC					
SK1418	Needwood	Yoxall a	21-Apr-08	23-May-08	Steve Haynes
SK1420	Needwood	Yoxall b	22-Apr-08	19-Jun-08	Steve Haynes
SK1424	Needwood	Newborough	22-Apr-08	29-May-08	Steve Haynes
SK1621	Needwood	Needwood	23-Apr-08	29-May-08	Steve Haynes
SK1815	Trent Valley	Alrewas	23-Apr-08	30-May-08	Steve Haynes
SK1819	Needwood	Smith Hills, Barton	28-Apr-08	30-May-08	Steve Haynes
SK2219	Trent Valley	Drakelow Power Station			
SK2221	Trent Valley	Branston	24-Apr-08	27-May-08	Steve Haynes
SK2313	Mease Lowlands	Coton	12-May-08	17-Jun-08	Steve Haynes
SK2316	Mease Lowlands	Rosliston	25-Apr-08	31-May-08	Steve Haynes
SK2421	Trent Valley	Burton	24-Apr-08	31-May-08	Steve Haynes
SK2716	Coalfield	Linton	25-Apr-08	2-Jun-08	Steve Haynes
SK2721	Coalfield	Swadlincote a	28-Apr-08	2-Jun-08	Steve Haynes
SK2814	Mease Lowlands	Overseal	28-Apr-08	4-Jun-08	Steve Haynes
SK2818	Coalfield	Swadlincote c			
SK3013	Mease Lowlands	Acresford	19-Apr-08	4-Jun-08	Steve Haynes
SK3120	Coalfield	Swadlincote b	30-Apr-08	9-Jun-08	Steve Haynes
SK3214	Coalfield	Donisthorpe Pools	29-Apr-08	5-Jun-08	Steve Haynes
SK3216	Coalfield	Blackfordby	29-Apr-08	5-Jun-08	Steve Haynes
SK3311	Coalfield	Measham	29-Apr-08	9-Jun-08	Steve Haynes
SK3418	Melbourne Parklands	Smisby	30-Apr-08	10-Jun-08	Steve Haynes
SK3424	Melbourne Parklands	Ticknall b	11-May-08	13-Jun-08	Steve Haynes
SK3615	Coalfield	Coleorton b	1-May-08	10-Jun-08	Steve Haynes
SK3712	Coalfield	Normanton le Heath b	1-May-08	11-Jun-08	Steve Haynes
SK3718	Melbourne Parklands	Ashby	3-May-08	11-Jun-08	Steve Haynes
SK3722	Melbourne Parklands	Staunton Harold	3-May-08	16-Jun-08	Steve Haynes
SK3815	Coalfield	Coleorton c	8-May-08	13-Jun-08	Steve Haynes
SK3908	Coalfield	Odstone	6-May-08	16-Jun-08	Steve Haynes
SK4012	Coalfield	Ravenstone	6-May-08	23-Jun-08	Steve Haynes
SK4211	Coalfield	Ellistown	7-May-08	23-Jun-08	Steve Haynes
SK4416	Charnwood	Whitwick	10-May-08	14-Jun-08	Steve Haynes
SK4514	Charnwood	Agar Nook	2-May-08	23-Jun-08	Steve Haynes
SK4708	Coalfield	Thornton b	17-Apr-08	28-May-08	Steve Haynes
SK4716	Charnwood	Shepshed	19-May-08	26-Jun-08	Steve Haynes
SK5112	Charnwood	Benscliffe Wood	19-May-08	24-Jun-08	Steve Haynes
SK5114	Charnwood	Beacon CP	9-May-08	24-Jun-08	Steve Haynes
SK5210	Charnwood	Charnwood	9-May-08	24-Jun-08	Steve Haynes

Early visits were all made within the recommended period of 1 April to 15 May, except for two visits on 19 May and one on 29 May. Late visits all fell within the period 16 May to 30 June, except for single visits made by volunteers on 5 July and 30 July.

3.2 Habitats covered by professional surveys in 2008

Table 3 summarises the first two levels of habitat recording for the 370 sample 200-m sections, ten per square, across the 37 1-km squares surveyed by SH. Summing the percentages for the first-level codes, farmland was noted for 46% of first habitats and woodland or scrub for 29%.

The second-level habitat codes (e.g. A1, A2) describe habitat type more precisely. Improved grassland and tilled land were the most widespread farmland types in the sample, followed by mixed grassland/tilled land. Codes B4 and B5 were the most frequently used woodland codes; B4 is defined by BTO as 'young coppice' but in practice both codes referred to newly planted woodlands. Among more mature woods, broad-leaved woodland was much more abundant than mixed broad-leaved/coniferous, and there were few pure coniferous stands. Semi-natural grassland, dry heath, human sites, water bodies and spoil heaps were also noted.

Owing to the random nature of the initial square selection by NFC, and to the close match between the selected squares and the ones that were actually surveyed (two substitutions of nearby squares), these data should be a broadly representative sample of bird habitat types within The National Forest, although influenced to some extent by the placement of transect routes.

Table 3. Frequency of habitat categories as "first" or "second" habitats within the 370 200-m transect sections surveyed professionally in The National Forest in 2008. Codes B4 and B5 both refer to newly planted woodlands.

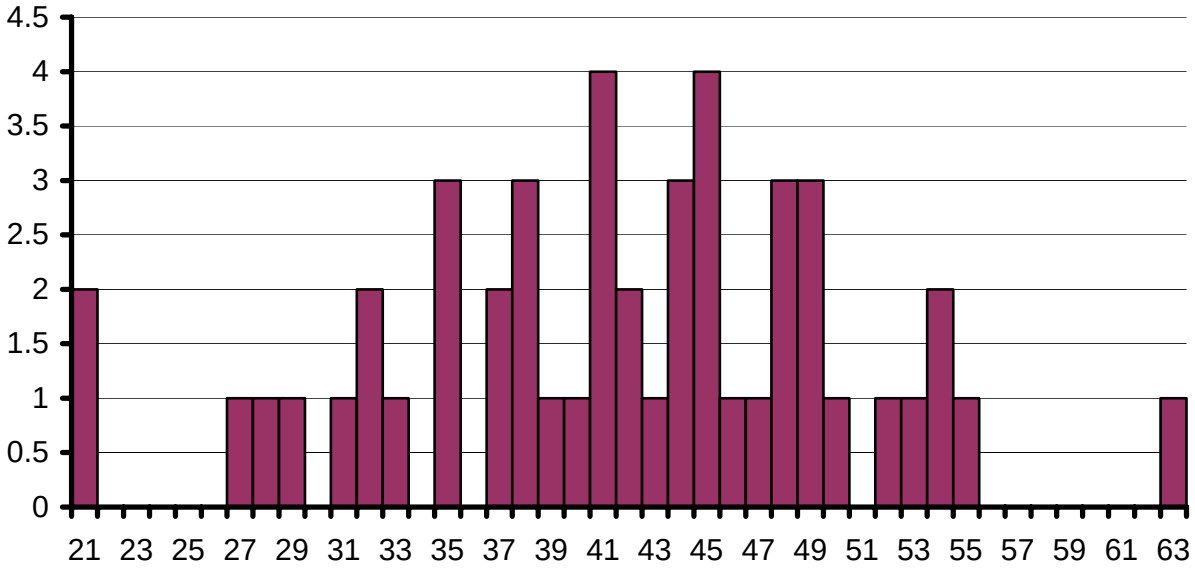
Code	Habitat category	First habitat		Second habitat		Total and ranking	
		n	%	n	%	n	rank
A	**Woodland**						
A1	Broad-leaved woodland	24	6.5	19	5.1	43	4=
A2	Coniferous woodland	3	0.8	1	0.3	4	
A3	Mixed woodland	11	3.0	8	2.2	19	9
B	**Scrubland or young woodland <5m tall**						
B1	Regenerating natural or semi-natural woodland	3	0.8	2	0.5	5	
B4	Young coppice	61	16.5	24	6.5	85	3
B5	New plantation	5	1.4	1	0.3	6	
B7	Other			1	0.3	1	
C	**Semi-natural grassland/marsh**						
C5	Other dry grassland	16	4.3	24	6.5	40	6
C6	Water-meadow/grazing marsh			4	1.1	4	
D	**Heathland and bogs**						
D1	Dry heath	5	1.4	8	2.2	13	10
E	**Farmland**						
E1	Improved grassland	63	17.0	31	8.4	94	1
E2	Unimproved grassland	5	1.4	1	0.3	6	
E3	Mixed grass/tilled land	41	11.1	2	0.5	43	4=
E4	Tilled land	61	16.5	25	6.8	86	2
F	**Human sites**						
F1	Urban	11	3.0			11	
F2	Suburban	24	6.5	2	0.5	26	7=
F3	Rural	16	4.3	10	2.7	26	7=
G	**Water bodies (fresh water)**						
G1	Pond <50 sq m			2	0.5	2	
G2	Small water body (50-450 sq m)	3	0.8	4	1.1	7	
G3	Lake/unlined reservoir	2	0.5	4	1.1	6	
G5	Gravel pit, sand pit, etc	10	2.7	1	0.3	11	
G6	Stream (<3m wide)			3	0.8	3	
G7	River (>3m wide)	5	1.4	2	0.5	7	
I	**Inland rock**						
I5	Quarry			3	0.8	3	
I6	Mine/spoil/slag heap	1	0.3			1	
	None			188	50.8		

3.3 Birds detected by the 2008 survey

Surveys in the 48 1-km squares produced records of 107 species. Summing the maxima for each visit across species and squares gave a grand total of 18,260 individual birds recorded.

The mean number of species per square was 41.5, with a range of 21–63 and modal values of 41 and 45 (Figure 2). Comparable figures for the wider Midlands region, drawn from BBS data for 2007, were a mean of 32.3 species, a range of 4–66, and a mode of 31. Figures from The National Forest were relatively high, therefore, reflecting the diversity of habitat found in many of the squares, and confirming that the fieldwork was conducted to a high standard. The highest species richness was the 63 species at SK3214, Donisthorpe Pools, where the water bodies attracted a variety of breeding and migrant birds.

Figure 2. Frequency distribution of the total numbers of bird species recorded in each square (n=48).



Bird species recorded during both parts of the 2008 survey are listed in Table 4, in taxonomic order, together with their main habitats, total counts, and the numbers and percentages of squares occupied. The taxonomic sequence begins with wildfowl and other waterbirds, continues through birds of prey, rails, waders, gulls and terns, pigeons and other near-passerines, and finishes with the passerine or perching-bird families including larks, swallows, pipits and wagtails, chats and thrushes, warblers, tits, corvids, sparrows, finches and buntings. Peacock, which is listed as a non-established non-native species in Britain, and is not on the official British List of bird species, appears at the end of the sequence.

The total of 107 bird species recorded included most of the species expected to occur abundantly in The National Forest, although the true number of species present or passing through the area during the survey period would certainly have been much higher. There were few records of owls and of rarer breeding species, reflecting the lack of nocturnal visits and that only about 10% of squares were visited.

Table 4. Bird species detected during the breeding bird surveys within The National Forest in 2008. 'BoCC' shows the current UK conservation listing (Gregory *et al.* 2002). Species marked with an asterisk were certainly not breeding within the Forest area, being either outside their breeding range or not observed in possible breeding habitat. Main habitats are summarised under five broad headings: M marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland.

BoCC	Species	Scientific name	Main habitats					Total birds	Squares occupied	% squares occupied
			M	F	G	S	W			
amber	Mute Swan	*Cygnus olor*	●					49	6	12.5
amber	Greylag Goose	*Anser anser*	●					57	6	12.5
	Canada Goose	*Branta canadensis*	●					134	16	33.3
	Mandarin	*Aix galericulata*	●				●	2	1	2.1
amber	Gadwall	*Anas strepera*	●					5	2	4.2
	Mallard	*Anas platyrhynchos*	●	●				136	26	54.2
amber	Pochard	*Aythya ferina*	●					2	1	2.1
	Tufted Duck	*Aythya fuligula*	●					70	10	20.8
	Red-legged Partridge	*Alectoris rufa*		●		●		59	21	43.8
red	Grey Partridge	*Perdix perdix*		●				3	2	4.2
	Pheasant	*Phasianus colchicus*		●		●	●	203	44	91.7
	Little Grebe	*Tachybaptus ruficollis*	●					17	8	16.7
	Great Crested Grebe	*Podiceps cristatus*	●					13	3	6.3
amber	Cormorant	*Phalacrocorax carbo*	●					17	9	18.8
	Grey Heron	*Ardea cinerea*	●				●	17	14	29.2
amber	Red Kite	*Milvus milvus*		●			●	1	1	2.1
	Sparrowhawk	*Accipiter nisus*			●	●	●	6	6	12.5
	Buzzard	*Buteo buteo*		●			●	57	32	66.7
amber	Kestrel	*Falco tinnunculus*		●				56	35	72.9
	Hobby	*Falco subbuteo*	●	●			●	2	2	4.2
amber	Peregrine	*Falco peregrinus*		●	●			1	1	2.1
	Moorhen	*Gallinula chloropus*	●	●				45	23	47.9
	Coot	*Fulica atra*	●					63	13	27.1

BoCC	Species	Scientific name	Main habitats					Total birds	Squares occupied	% squares occupied
			M	F	G	S	W			
amber	Oystercatcher	*Haematopus ostralegus*	●	●				4	2	4.2
	Little Ringed Plover	*Charadrius dubius*	●					2	1	2.1
amber	Lapwing	*Vanellus vanellus*	●	●				81	13	27.1
amber	Whimbrel*	*Numenius phaeopus*	●					1	1	2.1
amber	Curlew	*Numenius arquata*	●	●				5	2	4.2
	Common Sandpiper*	*Actitis hypoleucos*	●					4	3	6.3
amber	Redshank	*Tringa totanus*	●					2	1	2.1
amber	Black-headed Gull	*Chroicocephalus ridibundus*	●	●	●			160	16	33.3
amber	Lesser Black-backed Gull*	*Larus fuscus*	●	●				72	14	29.2
amber	Herring Gull*	*Larus argentatus*	●	●				2	2	4.2
	Common Tern	*Sterna hirundo*	●					8	3	6.3
	Feral Pigeon	*Columba livia*		●	●			18	9	18.8
amber	Stock Dove	*Columba oenas*		●			●	91	33	68.8
	Woodpigeon	*Columba palumbus*		●	●	●	●	1309	48	100.0
	Collared Dove	*Streptopelia decaocto*			●			182	33	68.8
red	Turtle Dove	*Streptopelia turtur*		●		●		1	1	2.1
amber	Cuckoo	*Cuculus canorus*	●	●		●		15	12	25.0
amber	Barn Owl	*Tyto alba*		●				1	1	2.1
	Little Owl	*Athene noctua*		●				4	4	8.3
	Tawny Owl	*Strix aluco*			●		●	6	5	10.4
	Swift	*Apus apus*			●			269	31	64.6
amber	Kingfisher	*Alcedo atthis*	●					2	2	4.2
amber	Green Woodpecker	*Picus viridis*			●		●	50	33	68.8
	Great Spotted Woodpecker	*Dendrocopos major*			●		●	51	31	64.6
red	Skylark	*Alauda arvensis*		●				301	40	83.3
amber	Sand Martin	*Riparia riparia*	●					19	6	12.5
amber	Swallow	*Hirundo rustica*		●				203	42	87.5
amber	House Martin	*Delichon urbicum*			●			157	25	52.1

BoCC	Species	Scientific name	Main habitats					Total birds	Squares occupied	% squares occupied
			M	F	G	S	W			
amber	Tree Pipit	*Anthus trivialis*				●		6	2	4.2
amber	Meadow Pipit	*Anthus pratensis*	●	●		●		38	10	20.8
amber	Yellow Wagtail	*Motacilla flava*		●				9	7	14.6
amber	Grey Wagtail	*Motacilla cinerea*	●					3	3	6.3
	Pied Wagtail	*Motacilla alba*	●	●	●			58	33	68.8
	Wren	*Troglodytes troglodytes*		●	●	●	●	612	48	100.0
amber	Dunnock	*Prunella modularis*		●	●	●	●	286	47	97.9
	Robin	*Erithacus rubecula*		●	●	●	●	513	48	100.0
amber	Black Redstart*	*Phoenicurus ochruros*			●			1	1	2.1
	Whinchat	*Saxicola rubetra*		●		●		2	2	4.2
	Wheatear	*Oenanthe oenanthe*		●				7	2	4.2
	Blackbird	*Turdus merula*		●	●	●	●	898	48	100.0
amber	Fieldfare*	*Turdus pilaris*		●		●		18	1	2.1
red	Song Thrush	*Turdus philomelos*			●	●	●	190	47	97.9
amber	Mistle Thrush	*Turdus viscivorus*		●	●		●	49	31	64.6
red	Grasshopper Warbler	*Locustella naevia*	●			●		4	3	6.3
	Sedge Warbler	*Acrocephalus schoenobaenus*	●					22	3	6.3
	Reed Warbler	*Acrocephalus scirpaceus*	●					4	1	2.1
	Blackcap	*Sylvia atricapilla*			●	●	●	143	39	81.3
	Garden Warbler	*Sylvia borin*				●	●	27	14	29.2
	Lesser Whitethroat	*Sylvia curruca*		●		●		27	21	43.8
	Whitethroat	*Sylvia communis*		●		●		198	41	85.4
amber	Wood Warbler	*Phylloscopus sibilatrix*					●	2	1	2.1
	Chiffchaff	*Phylloscopus collybita*				●	●	135	41	85.4
amber	Willow Warbler	*Phylloscopus trochilus*				●		155	31	64.6
amber	Goldcrest	*Regulus regulus*			●		●	50	24	50.0
red	Spotted Flycatcher	*Muscicapa striata*			●		●	2	1	2.1
	Long-tailed Tit	*Aegithalos caudatus*			●	●	●	119	40	83.3

BoCC	Species	Scientific name	Main habitats					Total birds	Squares occupied	% squares occupied
			M	F	G	S	W			
	Blue Tit	*Cyanistes caeruleus*			●		●	433	47	97.9
	Great Tit	*Parus major*			●		●	318	48	100.0
	Coal Tit	*Periparus ater*			●		●	55	20	41.7
red	Willow Tit	*Poecile montana*				●	●	5	4	8.3
red	Marsh Tit	*Poecile palustris*					●	7	5	10.4
	Nuthatch	*Sitta europaea*					●	31	17	35.4
	Treecreeper	*Certhia familiaris*					●	18	13	27.1
	Jay	*Garrulus glandarius*			●	●	●	24	15	31.3
	Magpie	*Pica pica*		●	●	●	●	254	47	97.9
	Jackdaw	*Corvus monedula*		●	●		●	359	42	87.5
	Rook	*Corvus frugilegus*		●			●	446	28	58.3
	Carrion Crow	*Corvus corone*		●			●	486	48	100.0
	Raven	*Corvus corax*		●			●	5	2	4.2
red	Starling	*Sturnus vulgaris*		●	●			513	40	83.3
red	House Sparrow	*Passer domesticus*		●	●			476	38	79.2
red	Tree Sparrow	*Passer montanus*		●		●		87	23	47.9
	Chaffinch	*Fringilla coelebs*		●	●	●	●	531	48	100.0
	Greenfinch	*Carduelis chloris*			●	●		258	45	93.8
	Goldfinch	*Carduelis carduelis*			●	●		221	45	93.8
	Siskin	*Carduelis spinus*					●	14	2	4.2
red	Linnet	*Carduelis cannabina*		●		●		196	36	75.0
amber	Lesser Redpoll	*Carduelis cabaret*					●	7	2	4.2
	Common Crossbill	*Loxia curvirostra*					●	32	3	6.3
red	Bullfinch	*Pyrrhula pyrrhula*				●		81	36	75.0
red	Yellowhammer	*Emberiza citrinella*		●		●		204	36	75.0
red	Reed Bunting	*Emberiza schoeniclus*	●	●				40	15	31.3
red	Corn Bunting	*Emberiza calandra*		●				8	2	4.2
	Peacock	*Pavo cristatus*			●			1	1	2.1

Table 4 shows that the most abundant species recorded was Woodpigeon, followed by Blackbird, Wren, Chaffinch, Robin and Starling, for each of which over 500 individual birds were recorded. Apart from Starling, these were all species that were found in all 48 sample squares. Large totals for Starling and Woodpigeon are to be expected, because these are species that feed in large flocks in open landscapes, and are therefore highly conspicuous, even during the breeding season. Blackbird, Wren, Chaffinch and Robin would normally be encountered singly or in small groups, but amassed high totals because they occupy a wide range of habitats and were present in every square.

For monitoring purposes, the species that occurred on more than 30 squares are of special interest. This is because experience with general BBS data indicates that reliable data on population change can be drawn from species where counts are available from 30 or more sites, although a sample size of 40 or more gives greater precision and is more appropriate for national monitoring (Joys *et al.* 2003). Data from 2008 for these species are repeated in Table 5, in descending order of number of squares. Given comparable data from future repeat surveys of The National Forest, trends for these species would almost certainly be available to contribute to local indicators of bird population change.

In Table 4, and subsequent tables in this report, an attempt is made to classify each species according to the main habitat types it occupies during the main BBS counting season of April to June, as a guide to interpreting the results of the present survey. The allocation of species to habitat type is not clear-cut, however, because of the fine differences between species in the nature and range of habitats that they occupy.

The species listed in Table 5, with a large sample of squares, and thus potentially available for inclusion in a National Forest indicator of bird populations, include species predominantly of open country (Swallow, Skylark), farmland (Pheasant, Yellowhammer) and woodland (Blackcap, Great Spotted Woodpecker). Trends for these species could therefore be combined to produce an indicator of bird population change across all main habitat types. Alternatively, trends for subsets of species occupying common habitat types or with similar biology could be combined to produce indicators of bird population change in those guilds or habitats within The National Forest, although each trend would be drawn from just a handful of species. A pragmatic approach would be needed to constructing such indicators, to be discussed and agreed by interested parties. The habitat categories used in the tables in this report (M, F, G, S and W) are not necessarily the ones that would make the most valuable indicators.

Table 5. Summary of data for the 36 bird species recorded on at least 30 squares in The National Forest in 2008. Mean and standard error are taken across occupied squares only. Main habitats are summarised as follows: M marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland.

Species	Main habitat types					Squares occupied	Total birds	Mean birds per square	Std error
	M	F	G	S	W				
Woodpigeon		●	●	●	●	48	1309	27.27	29.63
Wren		●	●	●	●	48	612	12.75	5.96
Robin		●	●	●	●	48	513	10.69	5.45
Blackbird		●	●	●	●	48	898	18.71	7.29
Great Tit			●		●	48	318	6.63	3.47
Carrion Crow		●			●	48	486	10.13	8.76
Chaffinch		●	●	●	●	48	531	11.06	4.97
Dunnock		●	●	●	●	47	286	6.09	3.33
Song Thrush			●	●	●	47	190	4.04	2.32
Blue Tit			●		●	47	433	9.21	4.39
Magpie		●	●	●	●	47	254	5.40	4.08
Greenfinch			●	●		45	258	5.73	7.56
Goldfinch			●	●		45	221	4.91	2.78
Pheasant		●		●	●	44	203	4.61	3.49
Swallow		●				42	203	4.83	3.17
Jackdaw		●	●		●	42	359	8.55	10.83
Whitethroat		●		●		41	198	4.83	3.58
Chiffchaff				●	●	41	135	3.29	2.16
Skylark		●				40	301	7.53	6.15
Long-tailed Tit			●	●	●	40	119	2.98	1.98
Starling		●	●			40	513	12.83	11.34
Blackcap			●	●	●	39	143	3.67	2.76
House Sparrow		●	●			38	476	12.53	10.65
Linnet		●		●		36	196	5.44	5.86
Bullfinch				●		36	81	2.25	1.20
Yellowhammer		●		●		36	204	5.67	3.86
Kestrel		●				35	56	1.60	0.88
Stock Dove		●			●	33	91	2.76	1.58
Collared Dove			●			33	182	5.52	6.90
Green Woodpecker			●		●	33	50	1.52	0.83
Pied Wagtail	●	●	●			33	58	1.76	1.37
Buzzard		●			●	32	57	1.78	1.74
Swift			●			31	269	8.68	13.20
Great Spotted Woodpecker			●		●	31	51	1.65	0.88
Mistle Thrush		●	●		●	31	49	1.58	0.81
Willow Warbler				●		31	155	5.00	5.08

3.4 Occurrence of birds by landscape character zone

The 48 squares surveyed were distributed fairly evenly across The National Forest's six landscape character zones, according to their land area (Figure 1). This sample was designed to measure bird population change across The National Forest as a whole, rather than to investigate whether there were any differences in bird densities between the landscape character zones. To answer the latter question, it should have been more efficient to survey an approximately equal number of squares in each of the zones. Any conclusions emerging from the 2008 survey about differences between zones must be regarded as tentative, therefore.

Mean bird counts by zone are tabulated in Table 6. The highest mean count is highlighted for each species, but it is important to note that the rankings of mean counts may be influenced by the sample size of squares (n) from which the means were drawn. A small sample size (seven squares or fewer in this case) may lead by chance to a mean count per square that is unusually high or low, whereas the sample of 20 squares in the Leicestershire and South Derbyshire Coalfield zone is more likely to produce a figure that is close to the true mean for squares in that region. The Coalfield zone did not have the highest mean count for any of the 36 species tabulated, but this could be a statistical artefact of the much larger sample size of squares there, which would have tended to prevent any mean figures from being unrepresentatively high or low. We present no evidence here of statistically significant differences in density between zones for any particular species.

Ranking the species approximately from specialist to generalist habitat use and from open to closed habitat type, as in Table 6, did not bring to light any obvious patterns in the data with regard to these factors. For a third of the species tabulated, the highest mean counts per square were made in Charnwood. These were a high proportion of those species characterised as woodland or scrub species, together with Carrion Crow, Woodpigeon and Swift. Charnwood also had the highest sum of mean counts across all species.

The lowest sum of mean counts across all species was in the Trent Valley, which was apparently, however, the region apparently most suited to Magpie, Starling and Pied Wagtail. The Mease Lowlands zone scored highly among farmland species.

Whether any of these apparent regional differences are real, or whether they stem from chance effects within small samples, is uncertain, because the samples of squares from most of the landscape zones were quite small. Repeat surveys in future years will add a temporal factor but should nevertheless help to investigate this spatial question.

Table 6. Occurrence of birds across National Forest landscape character zones. Only those species occurring on more than 30 1-km squares in the present survey are tabulated. Species are ordered approximately from specialist to generalist habitat use and from open to closed habitat type. Main habitats are summarised as follows: M marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland. Figures are mean counts per 1-km square, across all squares surveyed within each zone; n is the sample size of squares; the highest value for each row is highlighted.

Species	Main habitats					Charn-wood n=7	Coal-field n=20	Mease Lowlands n=5	Melbourne Parklands n=6	Need-wood n=6	Trent Valley n=4
	M	F	G	S	W						
Swallow		●				2.9	4.0	4.2	7.0	4.5	3.5
Skylark		●				2.1	8.3	10.4	7.0	3.7	1.0
Kestrel		●				0.9	1.1	1.6	1.3	1.7	0.8
Collared Dove			●			2.6	3.0	1.2	10.5	2.0	6.0
Swift			●			10.9	5.3	9.6	2.7		6.0
Bullfinch				●		2.7	1.8	1.4	1.7	1.2	0.5
Willow Warbler				●		9.9	2.8	0.8	2.8	0.7	1.3
Starling		●	●			7.6	10.8	7.2	14.7	4.8	23.0
House Sparrow		●	●			3.9	12.4	5.4	15.7	4.2	13.8
Linnet		●		●		3.3	5.6	5.6	2.0	2.5	1.8
Pied Wagtail	●	●	●			0.9	1.1	1.6	1.2	1.3	2.0
Yellowhammer		●		●		4.3	5.5	6.6	4.2	1.2	
Whitethroat		●		●		3.9	3.9	6.0	4.7	2.7	5.0
Carrion Crow		●			●	13.4	11.2	11.0	6.3	8.0	6.8
Stock Dove		●			●	1.1	1.9	4.2	1.8	1.7	0.8
Buzzard		●			●	1.3	1.1	2.4	1.0	1.3	
Greenfinch			●	●		4.3	4.1	4.6	12.8	4.0	5.8
Goldfinch			●	●		5.1	4.4	4.2	5.7	5.3	2.8
Green Woodpecker			●		●	1.3	1.0	0.6	2.0	1.0	
Great Spotted Woodp'r			●		●	1.3	0.9	1.6	0.5	1.7	0.8
Great Tit			●		●	7.4	7.0	7.0	5.8	6.3	4.8
Blue Tit			●		●	13.1	8.2	7.6	6.8	10.2	9.3
Chiffchaff				●	●	3.9	2.6	2.6	1.8	4.7	1.3
Jackdaw		●	●		●	8.0	7.0	4.6	9.8	10.0	5.3
Mistle Thrush		●	●		●	2.0	0.8	0.8	0.7	1.2	1.3
Pheasant		●		●	●	3.9	3.3	7.0	5.0	5.8	2.5
Blackcap			●	●	●	6.3	2.1	2.2	3.3	3.0	2.3
Song Thrush			●	●	●	3.9	3.2	4.6	5.0	5.3	3.8
Long-tailed Tit			●	●	●	3.3	2.3	2.4	1.2	4.3	1.5
Woodpigeon		●	●	●	●	47.9	26.4	29.6	18.7	20.8	15.3

Species	Main habitats					Charn-wood n=7	Coal-field n=20	Mease Lowlands n=5	Melbourne Parklands n=6	Need-wood n=6	Trent Valley n=4
	M	F	G	S	W						
Magpie		●	●	●	●	5.9	5.2	5.0	3.7	3.5	10.3
Wren		●	●	●	●	16.3	11.4	15.4	12.0	13.7	10.0
Robin		●	●	●	●	16.3	10.2	10.4	10.3	11.3	3.5
Blackbird		●	●	●	●	17.1	18.8	18.4	20.7	17.7	20.3
Chaffinch		●	●	●	●	12.9	10.5	12.2	11.2	12.7	6.8
Dunnock		●	●	●	●	5.6	6.5	6.2	6.5	4.8	4.8
Sum (107 species)						**294.7**	**255.8**	**276.0**	**266.3**	**258.5**	**254.0**

3.5 Mammals detected by the 2008 survey

The collection of mammal data is optional for volunteers but, although not of direct relevance to the bird survey, was requested from the BTO's professional fieldworker. From the overall total of 48 1-km squares surveyed, mammal data were returned from all but two squares covered by volunteers (SK3423 and SK3825).

The number of mammal species per square is summarised in Table 7. Most squares provided records of three or four mammal species. On one square (SK3615, near Coleorton in the Coalfield zone) mammals were looked for but none was seen.

Table 7. Frequency distribution of number of mammals per square.

Number of mammal species detected	Number of squares
0	1
1	10
2	6
3	12
4	12
5	5
Total: 11 species	**Total: 46 squares**

The 11 species of mammals that were recorded, with the numbers of animals counted and the number of squares, are listed in Table 8. Rabbit was the species found most frequently among the 46 squares that were surveyed, and was also the most numerous in terms of live animals observed during survey visits. Grey Squirrel and Mole were also widespread, although all records of Mole were from field signs (molehills) rather than live animals seen.

Table 8. Mammal species recorded during the 2008 bird survey, sorted by the number of 1-km squares found to be occupied.

Species	Scientific name	Number of occupied squares	Animals counted
Rabbit	*Oryctolagus cuniculus*	38	184
Grey Squirrel	*Sciurus carolinensis*	28	44
Mole	*Talpa europaea*	25	0
Brown Hare	*Lepus europaeus*	14	33
Red Fox	*Vulpes vulpes*	13	10
Feral/domestic cat	*Felis catus*	8	9
Red Deer	*Cervus elaphus*	1	5
European Roe Deer	*Capreolus capreolus*	1	1
Fallow Deer	*Dama dama*	1	10
Common Rat	*Rattus norvegicus*	1	0
Weasel	*Mustela nivalis*	1	0
Total	**11 species**	**46**	**296**

The BBS method is designed for recording birds and is inefficient at recording mammals, and each species is under-recorded to a degree that depends on its particular lifestyle and ecology. Mainly nocturnal animals, such as bats, Badger *Meles meles*, Hedgehog *Erinaceus europaeus* and small rodents, and diurnal but relatively scarce animals, such as Stoat *Mustela erminea*, were not observed at all.

4 DISCUSSION

4.1 Species observed during the survey

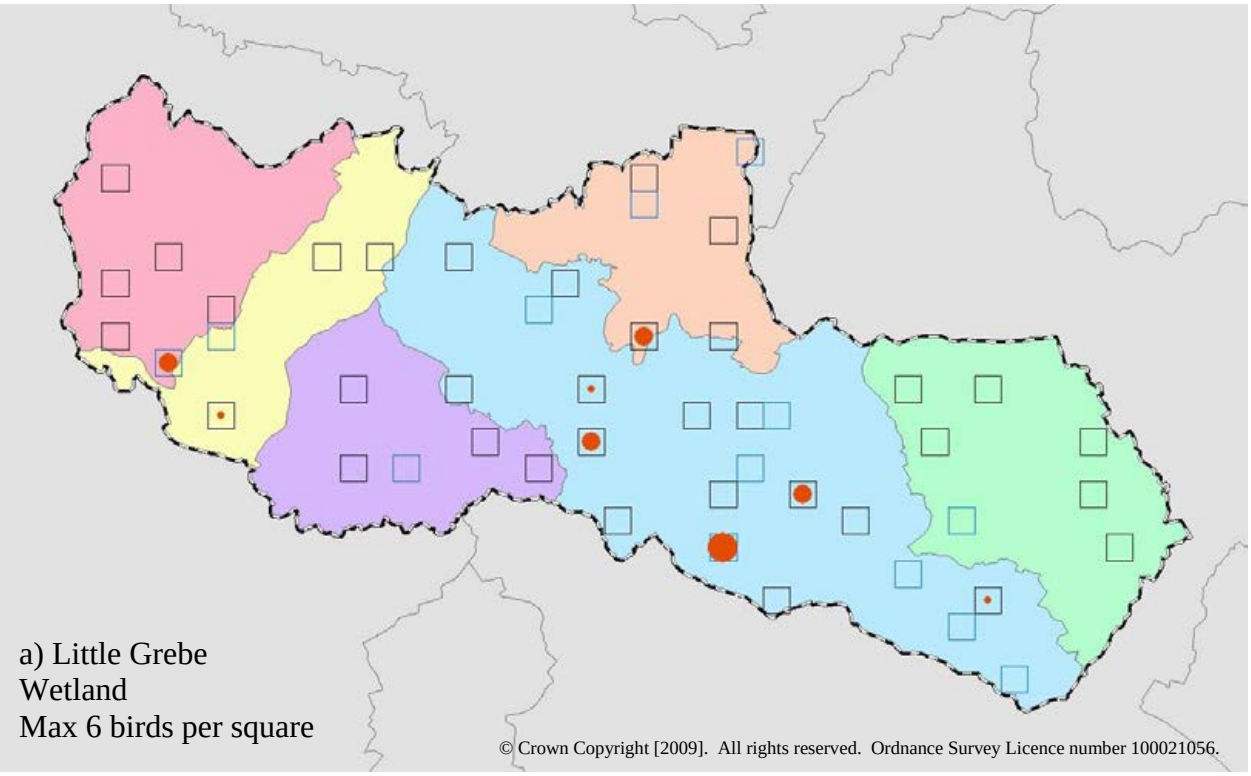
A substantial list of bird species (107) was amassed during the course of the survey. More species were observed per square than in BBS surveys in the broader Midlands region, and this higher average will have fed through into the total list for the survey. Seven species (Woodpigeon, Wren, Robin, Blackbird, Great Tit, Carrion Crow and Chaffinch) were found in every square.

Not all of the 107 species observed were breeding within The National Forest area, and some were recorded as passage migrants or late winter visitors. Where this is clearly the case, the species is marked with an asterisk in Table 4. Black Redstart and Whimbrel were chance observations of passage migrants, for example. The former species is common in urban areas across much of continental Europe but is a scarce nesting species in England, although migrants occur widely at the coast and inland. Most Whimbrels observed in England are on passage between breeding grounds in Iceland and Scandinavia and wintering grounds in West Africa. In a number of other cases, it was not possible to determine whether the birds observed were on passage or were nesting nearby. Flocks of Crossbills seen in June 2008, for example, were almost certainly part of the small continental immigration that was noted across Britain that year, although it is likely that in some years nesting would occur within The National Forest.

The list contains a very creditable number of species, given the nature of the survey as a two-visit daytime survey of sample squares, but it is far from being a complete list of bird species that would have occurred in The National Forest during the survey period. Some known breeding species were missed, such as Redstart *Phoenicurus phoenicurus* (Peat 2005), as well as further species that will have occurred as passage migrants, such as Common Gull *Larus canus*. Comparison with regional and national lists (section 4.4) gives further insight into the species likely to have been overlooked during the 2008 survey, as well as into which species observed in The National Forest were particularly unusual.

Quantified distribution maps for a selection of species, chosen to represent a range of habitat types, are presented in Figure 3. Little Grebe (Figure 3a) occupied eight well-scattered squares with suitable wetlands. Buzzard (Figure 3b) was surprisingly widespread, although Kestrel was the most commonly observed raptor, and a further four raptor species were observed. Lapwing (Figure 3c) was common only in the central southern part of the Forest, whereas Skylark (Figure 3d), also a farmland specialist, was more widespread but still notably scarce in the more wooded Needwood and Charnwood regions. Song Thrush and Whitethroat counts (Figures 3e & 3f) showed local variation but no clear overall pattern. Figures 3g–3j are discussed in later sections.

Figure 3. Quantified distribution maps for ten selected species from the 2008 survey. Boundaries of survey squares are marked black for the NFC sample and blue for extra squares from BBS. Dot size is scaled to the count within each 1-km square. No birds were seen in other surveyed squares. (See pages 30–34.)


a) Little Grebe
Wetland
Max 6 birds per square
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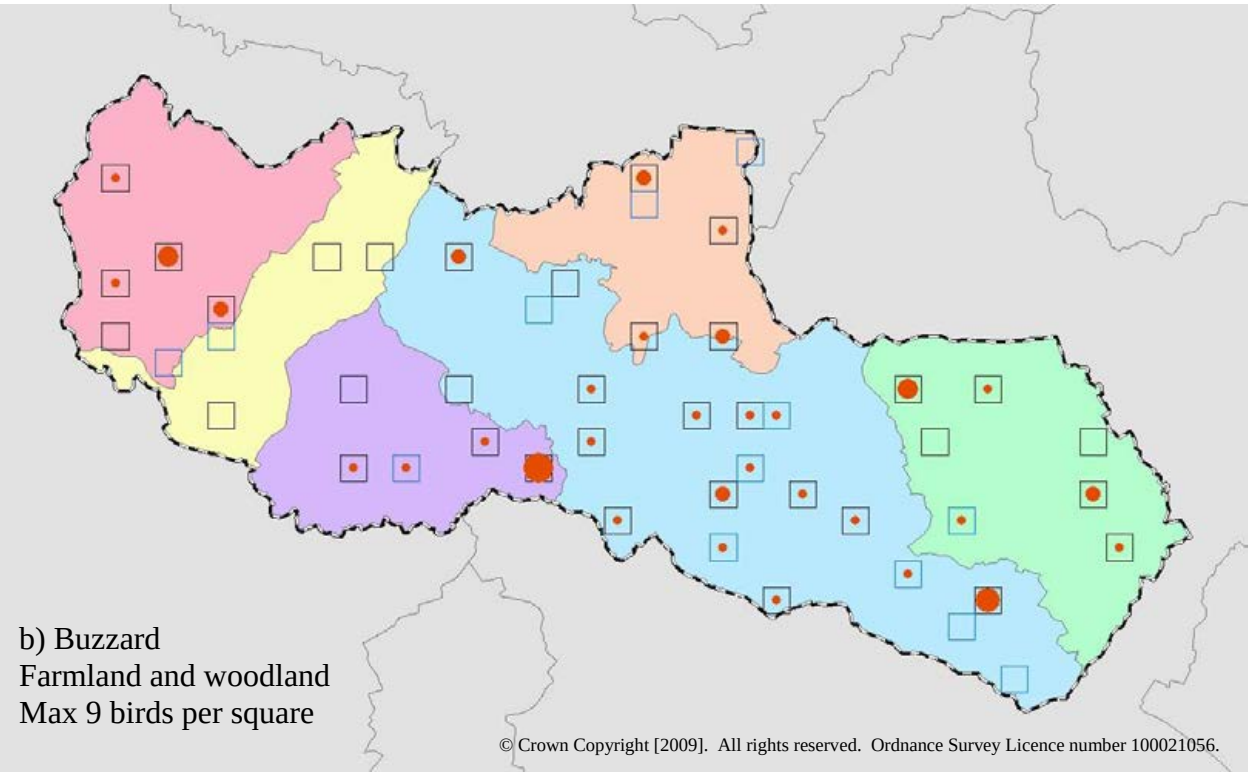
b) Buzzard
Farmland and woodland
Max 9 birds per square
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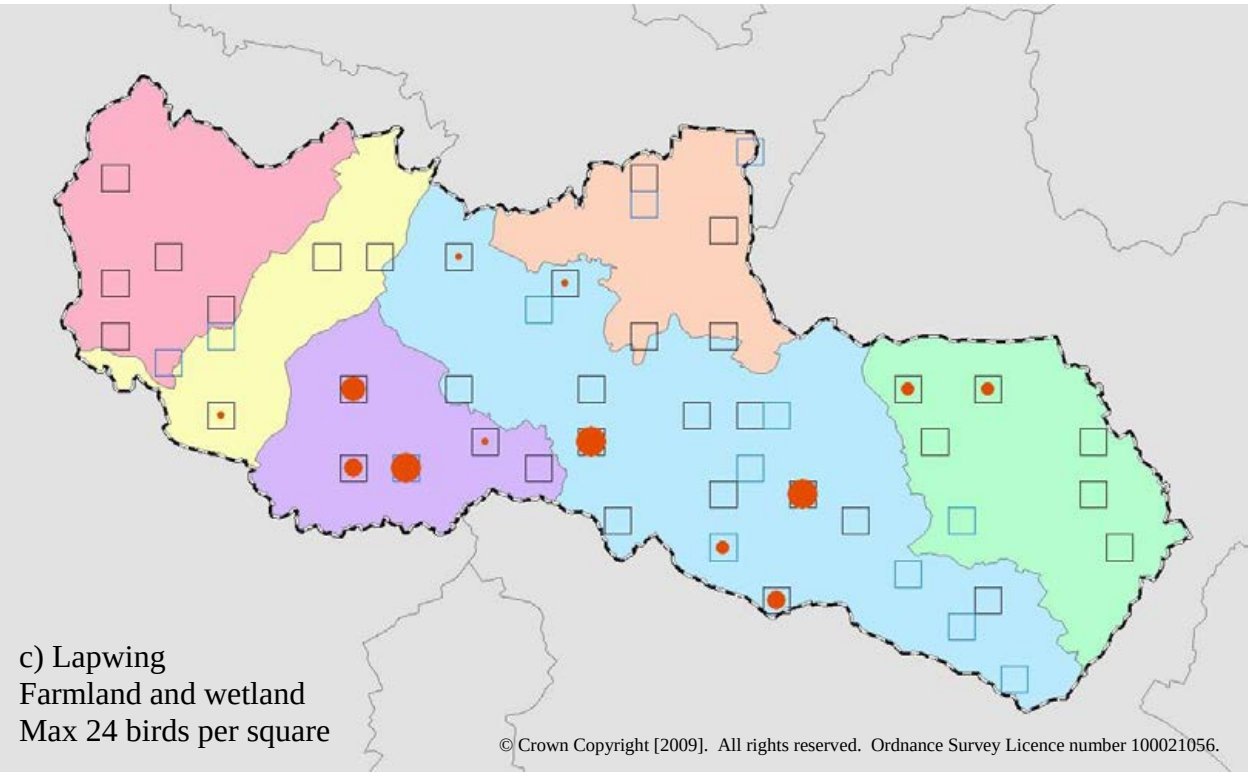
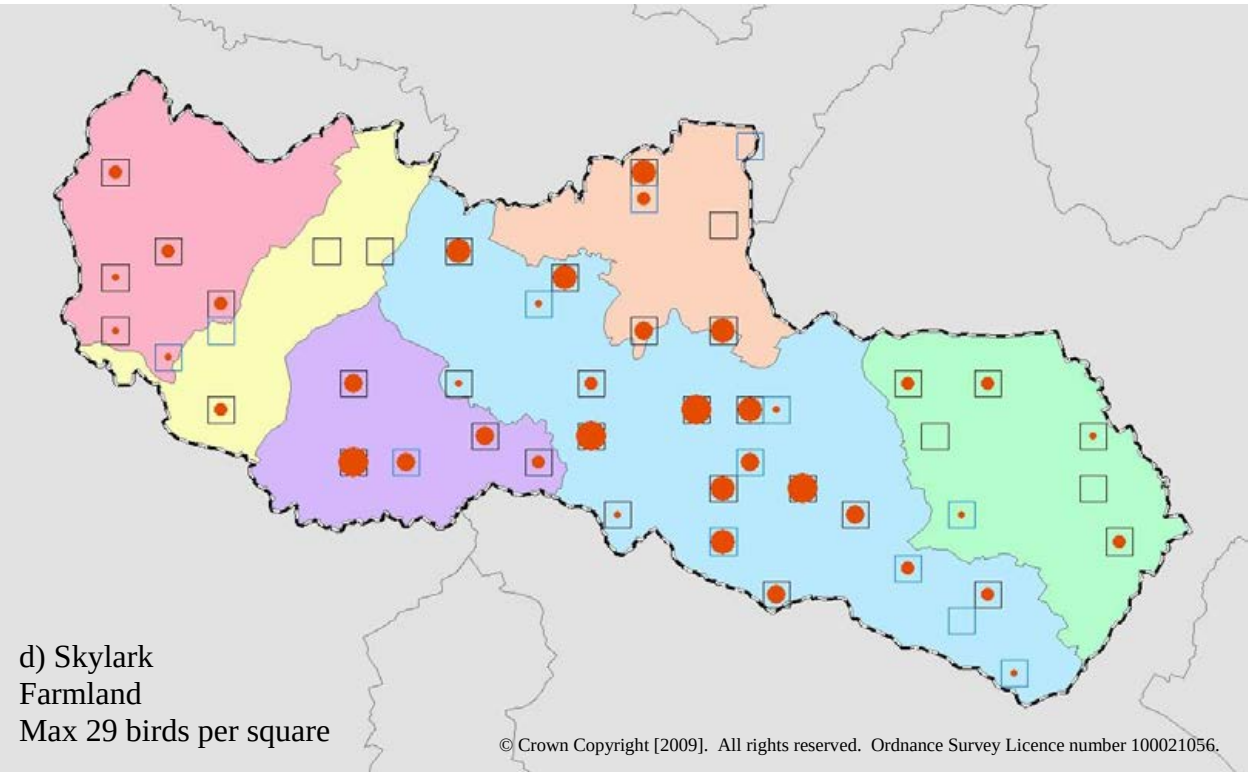
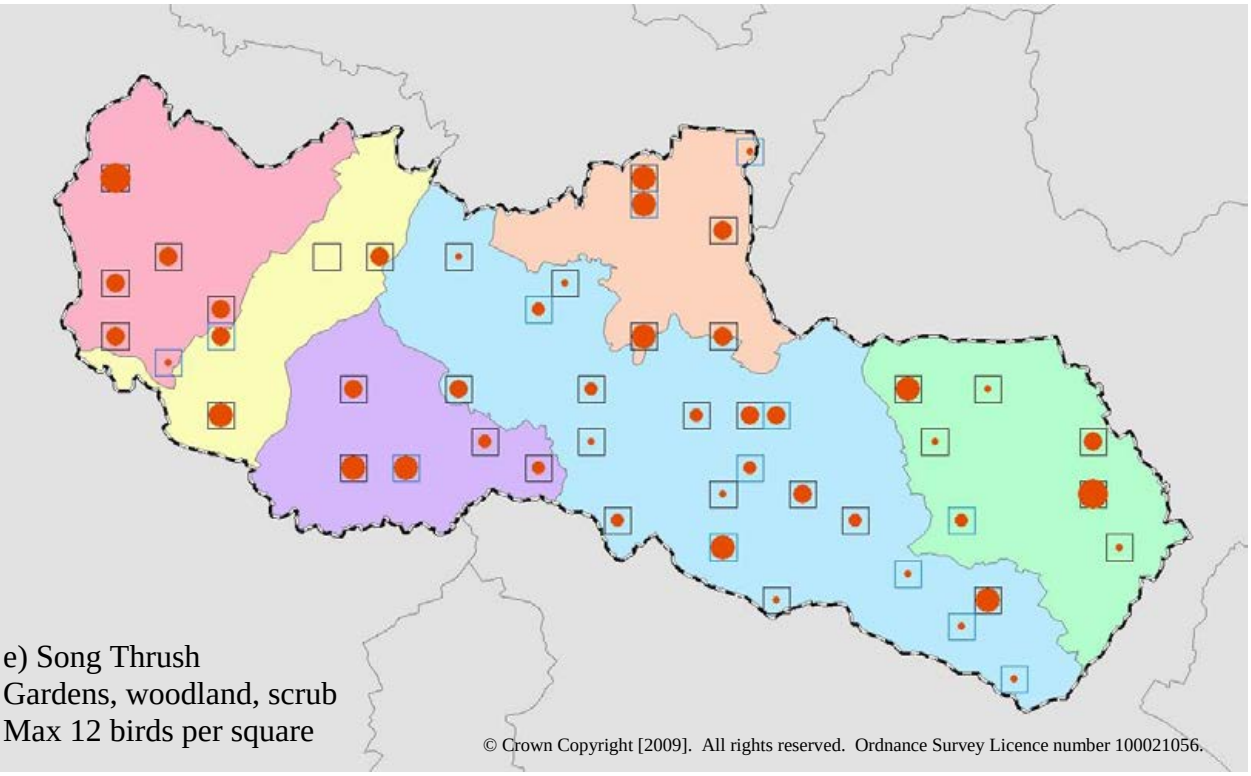


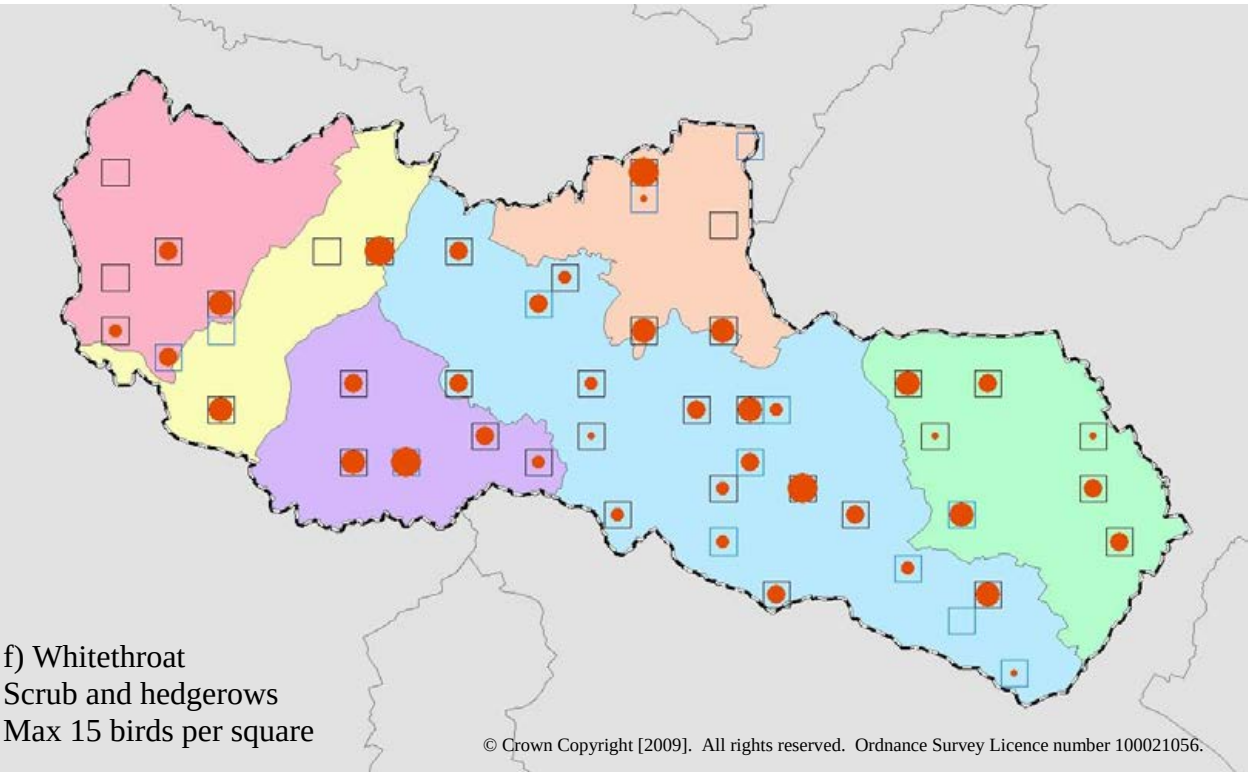
c) Lapwing
Farmland and wetland
Max 24 birds per square



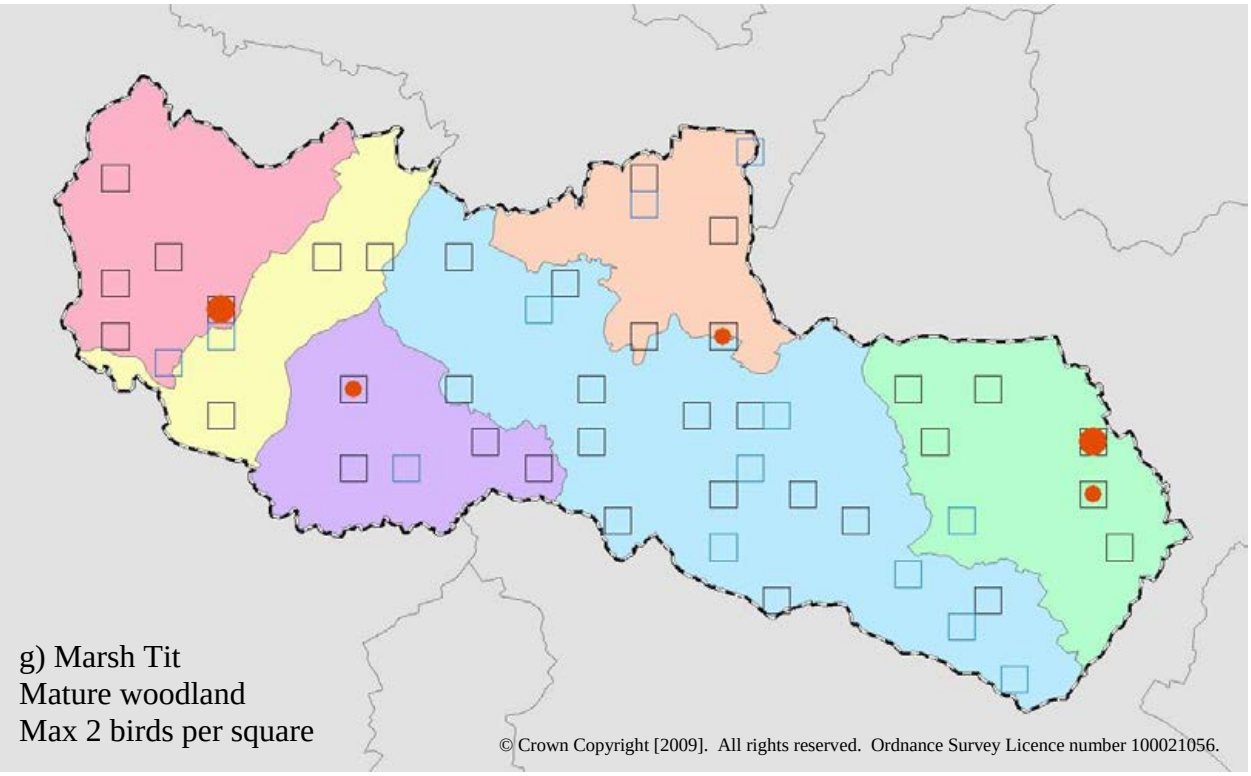
d) Skylark
Farmland
Max 29 birds per square



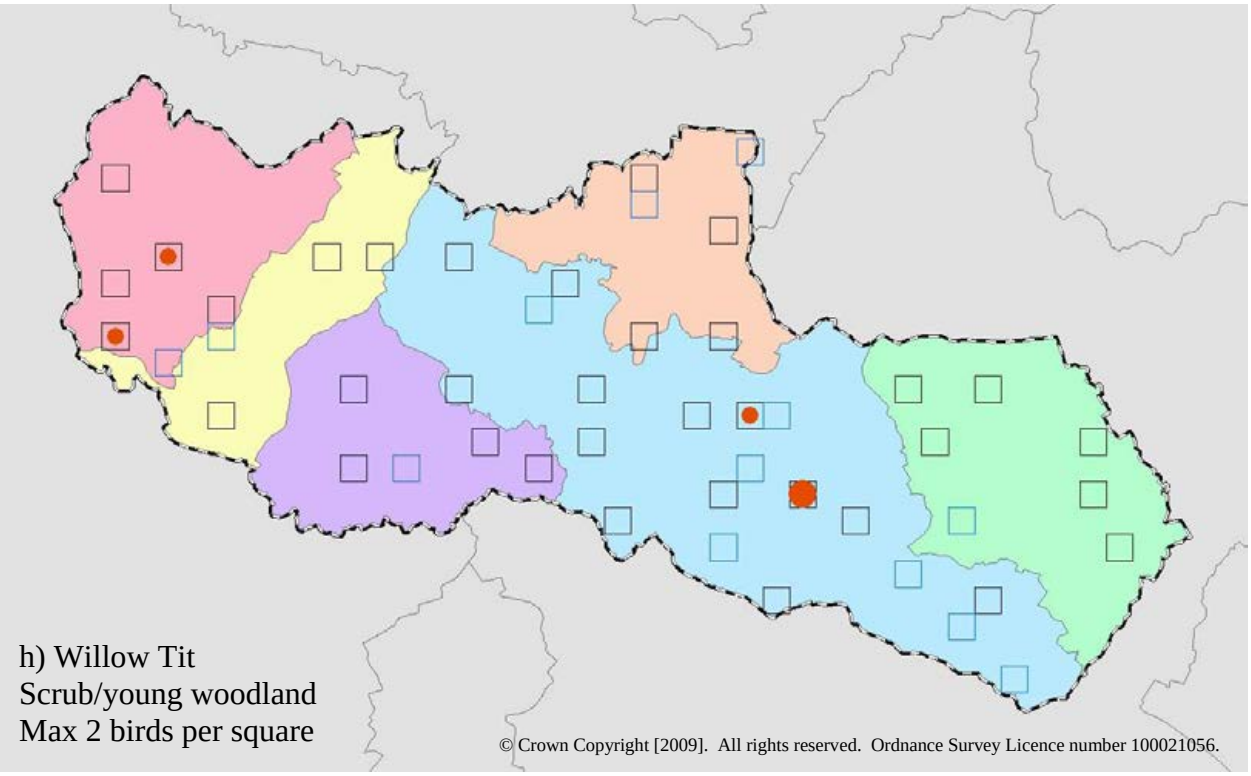
e) Song Thrush
Gardens, woodland, scrub
Max 12 birds per square



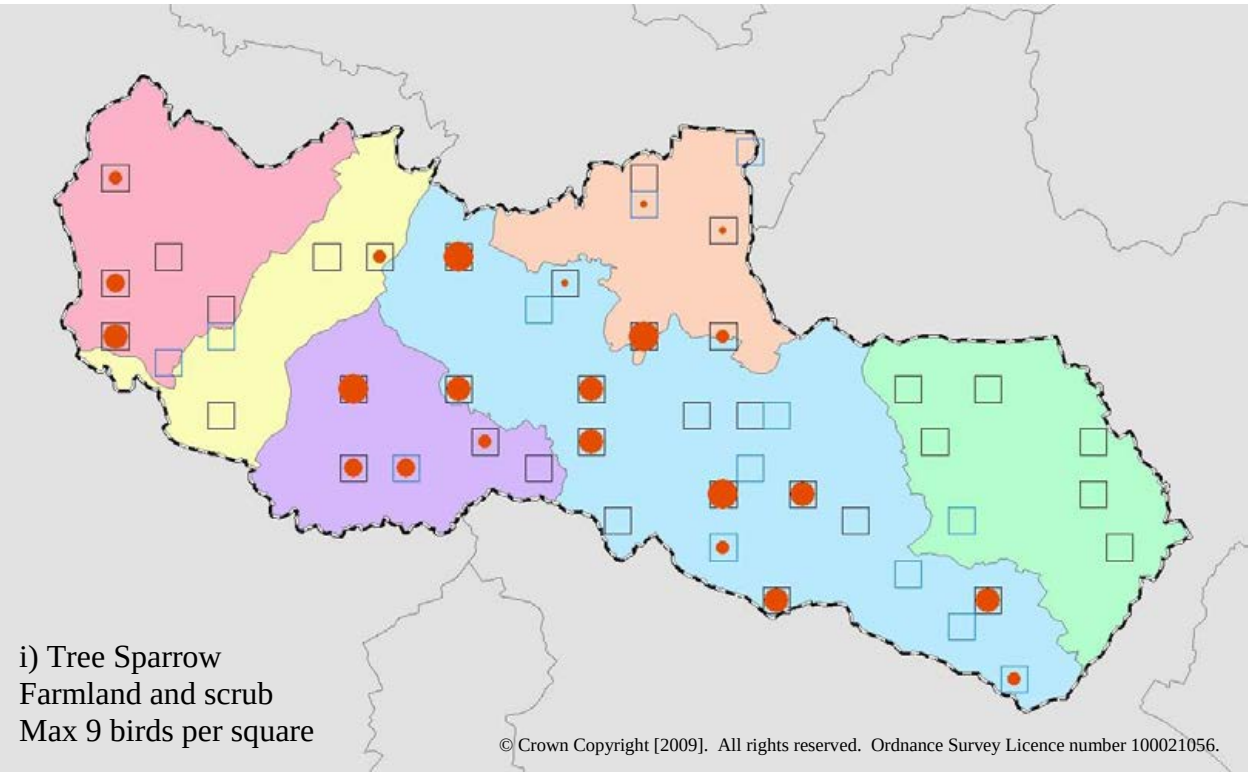
f) Whitethroat
Scrub and hedgerows
Max 15 birds per square



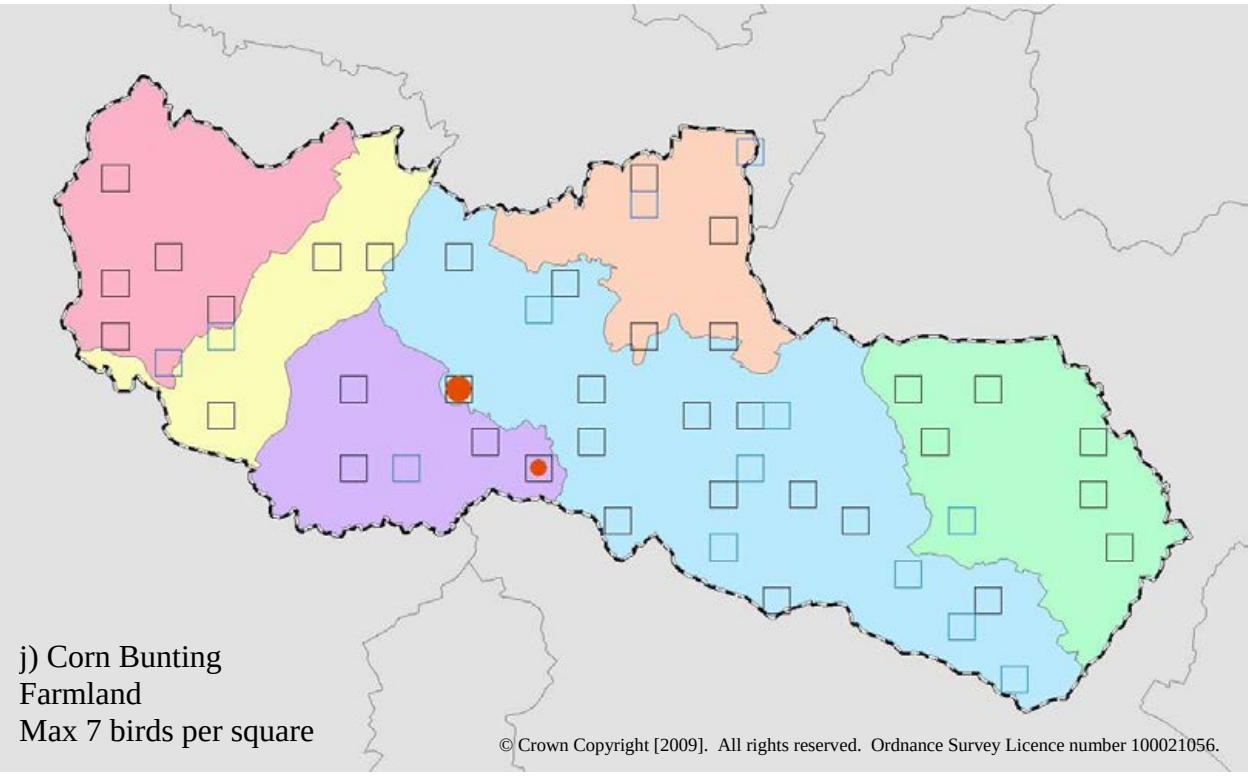
g) Marsh Tit
Mature woodland
Max 2 birds per square



h) Willow Tit
Scrub/young woodland
Max 2 birds per square



i) Tree Sparrow
Farmland and scrub
Max 9 birds per square



j) Corn Bunting
Farmland
Max 7 birds per square

4.2 Birds of Conservation Concern

The current conservation listings for UK birds are those that apply to 2002–07 (Gregory *et al.* 2002); an updated version of the red and amber lists is in preparation. The conservation listings for the 107 species observed during the 2008 survey are given in Table 4. In total, there were 55 green-listed or unlisted species, 36 amber-listed species, and 16 red-listed species.

Amber-list designations often relate to factors that do not apply directly to the UK, for example where a species has an unfavourable conservation status in Europe, according to BirdLife International, or where the UK holds 20% or more of a species' European breeding population (Gregory *et al.* 2002; see *www.bto.org/psob/index.htm*). UK populations of amber-listed species are often either stable or increasing, with the exception of those designated because of a moderate population decline in the UK. An amber listing is not necessarily relevant to conservation issues within The National Forest, therefore.

The 16 red-listed species that were recorded within The National Forest, on the other hand, all have this conservation status because they underwent a decline of more than 50% in UK population over the 25 years 1974–99. These are listed in Table 9, in descending order of abundance, as measured by the total numbers of birds observed during the 2008 survey.

Table 9. Red-listed birds observed in The National Forest during the 2008 survey. Population change data are from Baillie *et al.* (2009). Main habitats are summarised as follows: M marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland.

Species	Main habitat types					Total birds	Squares occupied	English population change 1981–2006
	M	F	G	S	W			
Starling		●	●			513	40	-78%
House Sparrow		●	●			476	38	-59%
Skylark		●				301	40	-47%
Yellowhammer		●		●		204	36	-57%
Linnet		●		●		196	36	-47%
Song Thrush			●	●	●	190	47	-18%
Tree Sparrow		●		●		87	23	-93%
Bullfinch				●		81	36	-31%
Reed Bunting	●	●				40	15	+7%
Corn Bunting		●				8	2	-83%
Marsh Tit					●	7	5	-37%
Willow Tit				●	●	5	4	-82%
Grasshopper Warbler	●			●		4	3	(no estimate)
Grey Partridge		●				3	2	-78%
Spotted Flycatcher			●		●	2	1	-82%
Turtle Dove		●		●		1	1	-82%

The 2008 survey has confirmed that The National Forest retains a valuable population of Tree Sparrows (Figure 3i), a species predominantly of farmland that has declined very sharply in England as a whole during the most recent 25-year period (Baillie *et al.* 2009). In contrast, however, Grey Partridge, Spotted Flycatcher, Turtle Dove and Corn Bunting (Figure 3j) were each observed on only one or two sites and, although they are all still known to be present within The National Forest, breeding densities are likely to be low. Turtle Doves have been withdrawing from the western and northern parts of their former breeding range in England and Wales (*http://blx1.bto.org/atlases/TD-atlas.html*), and are now at the limit of their geographical range in The National Forest.

In view of their recent sharp rate of decline in England as a whole, some or all of these species may be vulnerable to extinction within the Forest area unless these national trends reverse. It will be important to see how their populations change over the course of future repeat surveys in The National Forest.

4.3 Local Biodiversity Action Plan species

There are two bird species, Barn Owl and Redstart, that have individual action plans under The National Forest's Local Biodiversity Action Plan (National Forest Company 2004). Table 10 summarises the current plan for each of these species.

The 2008 survey was unable to provide useful data for either of these species. Barn Owls are known to be distributed widely but thinly across The National Forest (Peat 2005), but only a single bird was observed during the survey. This was in SK2316, near Rosliston, on 31 May. The BBS method is known to be inefficient for nocturnal and crepuscular species, such as owls, because the diurnal timing of visits is designed to hit peaks of songbird activity. A few pairs of Redstarts breed in the Charnwood area (Peat 2005), and the species is also occasionally seen in the west of The National Forest, but none was observed during the survey. More specific survey methods are required to fulfil the National Forest Company's BAP requirements for determining the current population sizes of these species.

Table 10. Summary of Local Biodiversity Action Plans for birds within The National Forest (from National Forest Company 2004).

BAP species	Current plan
Barn Owl	• Determine current status of the species in The National Forest • Increase the breeding population in The National Forest by 2010 • Establish a network of nest boxes across the Forest area by 2010
Redstart	• Determine the population in the Forest • Increase the population in the National Forest area to a total of 30 breeding pairs

4.4 Comparison of bird distribution with regional and national data

Use of the standard BBS method for surveying The National Forest allows direct comparisons with other data sets collected by BTO using the same methodology. Using national and regional BBS data, therefore, it is possible to assess whether the survey of The National Forest found the expected species, and how the species counts compare with those made elsewhere.

In Tables 11 and 12, a comparison is made between BBS counts from 2007 and those made in the present survey. BBS counts for 2008 would have made a more direct comparison, but were not fully available at the time of the analysis (BBS data for a given year are not fully accessible until about March of the following year). The difference of year is likely to be of significance only for species, such as Crossbill, whose abundance could have been widely different in these two years.

Four species, Peregrine, Whimbrel, Black Redstart and Crossbill, were recorded by the 2008 survey of The National Forest but not at all by BBS surveys across the Midlands in 2007. These differences between data from The National Forest and the wider Midlands region seem highly likely to be due simply to chance observations, and are not therefore of special biological significance. Peregrine is a rare breeding species within The National Forest and also nests elsewhere in the Midlands, but is a relatively recent colonist in this part of England. The other species occur as migrants and presumably would also have been recordable as they passed through other areas of the Midlands.

Other species that occurred in greater numbers than expected in the survey of The National Forest, relative to the Midlands as a whole, are listed in Table 11. They include five red-listed species for which the populations in The National Forest may be especially important: Willow Tit (Figure 3h), Grasshopper Warbler, Bullfinch, Tree Sparrow (Figure 3i) and Marsh Tit (Figure 3g). These species, illustrated in Figure 4, are drawn from a variety of habitat types: wetland or young plantation (Grasshopper Warbler), farmland (Tree Sparrow), scrub or woodland edge (Bullfinch, Willow Tit) and mature woodland (Marsh Tit). It is difficult to draw further conclusions, however, since the presence of species in this table could have been generated by chance events.

There were 39 species that occurred on Midlands BBS squares in 2007 but not in the 2008 National Forest survey. This high number is largely the result of the considerable disparity between the 505 squares surveyed in the Midlands and the much smaller sample of 48 surveyed in The National Forest. Redstart, Shelduck *Tadorna tadorna* and Stonechat *Saxicola torquatus* are the breeding species that occurred in highest numbers in the Midlands but were missing from the Forest survey. Arguably therefore, these are the most likely additional species to have been recorded by the 2008 survey, and their absence from the survey is unlikely to mean that they were absent from The National Forest.

Table 11. Species well represented in The National Forest in comparison to a wider Midlands region (West and East Midlands government office regions combined). The 15 species with the greatest National Forest:Midlands ratios of counts per square are shown. Main habitats are summarised as follows: M marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland. Species marked with an asterisk were certainly not breeding within the Forest.

Species	Main habitats					% occupation of 1-km squares			Birds counted per 10 1-km squares			Ratio of previous two columns
	M	F	G	S	W	England (n=2783)	Midlands (n=505)	NF (n=48)	England (n=2783)	Midlands (n=505)	NF (n=48)	
Siskin					●	2.2	0.8	4.2	1.5	0.1	2.9	24.4
Lesser Redpoll					●	1.8	0.6	4.2	0.6	0.1	1.5	18.9
Common Sandpiper*	●					1.3	0.8	6.3	0.2	0.1	0.8	8.1
Little Grebe	●					2.2	2.6	16.7	0.4	0.6	3.5	5.5
Willow Tit				●	●	1.7	1.8	8.3	0.3	0.2	1	4.6
Grasshopper Warbler	●			●		1.9	1.4	6.3	0.3	0.2	0.8	4.5
Black-headed Gull	●	●	●			21.6	13.3	33.3	25.0	7.8	33.3	4.2
Pochard	●					0.8	0.4	2.1	0.4	0.1	0.4	4.0
Tawny Owl			●		●	4.1	2.8	10.4	0.5	0.4	1.3	3.6
Bullfinch				●		20.8	25.9	75	3.8	4.8	16.9	3.6
Kestrel		●				26.8	25.3	72.9	3.4	3.3	11.7	3.5
Tree Sparrow		●		●		5.8	11.9	47.9	2.3	5.4	18.1	3.3
Cormorant	●					10.7	6.1	18.8	2.5	1.2	3.5	2.9
Marsh Tit					●	5.7	4.0	10.4	1.0	0.6	1.5	2.4
Lesser Whitethroat		●		●		12.8	15.4	43.8	2.0	2.3	5.6	2.4

Species that occurred in the survey of The National Forest, but in lower numbers than expected relative to the Midlands as a whole, are listed in Table 12. Again, these differences could be due simply to chance. Table 12 includes two red-listed species, Grey Partridge and Starling, for which the populations in The National Forest may therefore be relatively weak. Several of the species listed are wetland birds and only one (Wood Warbler) is a woodland specialist.

For species not listed in either Table 11 or Table 12, the percentage occupancy and counts per square in The National Forest were closer to the values for the Midlands as a whole.

Figure 4. Red-listed bird species well represented in the 2008 survey of The National Forest, compared to a wider Midlands region.

Marsh Tit and Willow Tit appear very similar. This is a Marsh Tit (photo: John Harding). Marsh Tits prefer mature woodlands, whereas Willow Tits are found more in scrub, often near water.

Grasshopper Warbler (photo: Ron Marshall). This species is a summer visitor, nesting in dense low vegetation in wetlands or young woodlands.

Bullfinch (photo: Rosie Rees). Bullfinches are found mostly in scrubby areas with plenty of fruiting trees.

Tree Sparrow (photo: Ron Marshall). Tree Sparrows occur mostly around scrubby areas or woodland edge, nesting around farmsteads or in holes in large trees.

Some real differences in bird populations might be expected between The National Forest and the wider Midlands region, owing to the nature of the Forest area as an area with a wide habitat diversity of inland, mainly lowland habitats. This brief analysis provides no clear evidence, however, that the bird population of The National Forest in 2008 was in any way different to that expected from broader-scale surveys. Tentative overall conclusions might be, first, that the bird population is broadly similar to that of the wider region and, second, that the quality of data collection during the National Forest survey was at least as high as in the general BBS.

Repeat surveys in future years will allow trends in bird population to be compared with trends in wider regions.

Table 12. Species poorly represented in The National Forest in comparison to a wider Midlands region (West and East Midlands government office regions combined). The 15 species with the smallest National Forest:Midlands ratios of counts per square are shown. Main habitats are summarised as follows: M marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland. Species marked with an asterisk were certainly not breeding within the Forest.

Species	Main habitats					% occupation of 1-km squares			Birds counted per 10 1-km squares			Ratio of previous two columns
	M	F	G	S	W	England (n=2783)	Midlands (n=505)	NF (n=48)	England (n=2783)	Midlands (n=505)	NF (n=48)	
Herring Gull*	●	●				23.5	7.7	4.2	28.2	3.6	0.4	0.1
Feral Pigeon		●	●			25.7	23.2	18.8	43.8	29.4	3.8	0.1
Grey Partridge		●				9.6	8.9	4.2	2.3	2.3	0.6	0.3
Curlew	●	●				13.6	9.9	4.2	7.2	3.0	1	0.3
Turtle Dove		●		●		5.0	3.0	2.1	0.9	0.5	0.2	0.4
Fieldfare*		●		●		1.3	3.0	2.1	2.6	8.7	3.8	0.4
Peacock			●			1.4	2.0	2.1	0.3	0.4	0.2	0.5
Raven		●			●	7.1	9.5	4.2	1.5	1.9	1	0.5
Reed Warbler	●					6.0	5.0	2.1	2.4	1.3	0.8	0.6
Grey Heron	●					28.8	31.5	29.2	4.9	5.4	3.5	0.6
Grey Wagtail	●					8.2	6.1	6.3	1.3	0.9	0.6	0.6
Starling		●	●			67.9	70.7	83.3	144.9	163.5	106.9	0.7
Wood Warbler					●	1.1	1.8	2.1	0.3	0.6	0.4	0.7
Mallard	●	●				53.5	58.0	54.2	35.1	40.6	28.3	0.7
Rook		●			●	49.2	46.3	58.3	126.2	127.0	92.9	0.7

4.5 Predicted changes to bird populations

The development of new plantings is likely to bring many changes to the bird populations of the Forest area, although, as the populations will also be influenced by other factors, it is not possible to predict these precisely. The role of the present survey is to set a baseline against which future change can be measured and interpreted. Some predictions can be made, however, based on the simple assumptions that the woodland cover will continue to increase as planned and that young woodlands will develop to maturity.

In simple terms, therefore, as a greater area becomes covered by mature woodland and less by farmland and other open country as the Forest develops, species that specialise in woodland are likely to become more numerous and widespread, whereas farmland specialists may become more restricted and less numerous. Among the red-listed species, Marsh Tit (Figure 3g) may well increase in the longer term as more mature woodland habitat is created for it, whereas Corn Bunting (Figure 3j), which is largely restricted to certain types of farmland, may decline if those habitats are lost. Species that are common in a wide range of habitat types, such as Blackbird and Robin, may change relatively little in population size, despite the change in habitat.

A number of species, including Yellowhammer, Grasshopper Warbler and Whitethroat (Figure 3f) do not nest within mature woodland but can be temporarily abundant at young stages of tree growth. Their numbers may therefore increase temporarily during the period that an increased area of suitable young woodland is available to them.

A further set of population changes will no doubt be driven by factors operating largely outside The National Forest. In recent years, for example, Buzzards (Figure 3b) have expanded their range strongly eastwards across central and eastern England from previous strongholds in upland areas of Wales and western England. Their population increase has been associated with reduced persecution, the recovery of rabbit populations from the effects of myxomatosis and release from the deleterious effects of organochlorine pesticides (Baillie *et al.* 2009). Suitable Buzzard habitats that existed within The National Forest, as elsewhere in the Midlands and eastern England, have been colonised, mostly since the Forest's inception in 1991. Redstarts, which were not observed during the current survey, have become increasingly restricted in breeding range in lowland England (see *http://blx1.bto.org/atlases/RT-atlas.html*) and, if that broader trend continues, may not be able to benefit from the increase in suitable habitat that the maturation of the new plantings would provide for them within The National Forest in future decades.

4.6 Recommendations for further work

Further work on the current data set

Although beyond the scope of this initial project, the results of The National Forest bird surveys constitute a valuable set of data that could be further explored to address ecological issues and forest management in relation to this changing matrix of forest, farmland and other habitats. Changes in bird community structure, as well as changes in populations of individual species,

may relate to overall increase in the amount of woodland (due to continued growth of The National Forest), successional changes (as new plantations mature) or due to changes in habitat heterogeneity as the number of forest fragments increases in relation to surrounding farmland. Additional landscape measures are obtainable through external data sets such as the UK Land Cover Map, the Forestry Commission's update of the National Inventory of Woodland and Trees (NIWT), as well as non-woodland information (farm cropping and stocking patterns, uptake of Environmental Stewardship, effects of urbanisation). With further resources, there may also be better methods of comparing the current patterns of abundance of birds in The National Forest with those in sites outside it, matched by habitat. Repeat surveys of the squares (see below) would greatly increase the value of the data set, and further information on scarcer species might later be gleaned from more comprehensive coverage currently under way as part of the BTO's Bird Atlas 2007–11 and BirdTrack, and also from other sources such as county bird records.

The estimation of absolute population size of bird species within The National Forest was not an integral part of the 2008 survey but, given that 48 squares were surveyed, a distance analysis could be undertaken, at least for the species recorded in the largest numbers (e.g. >50 sightings). Such an analysis would take into account the relative numbers of birds recorded in the three distance bands, from which the decrease in detectability with distance from the transect line can be calculated. Using these figures, which vary between species and landscapes, more precise estimates can be made of total density within each square. These density estimates, stratified by landscape character zone, could be extrapolated to produce an overall population estimate for The National Forest as a whole in 2008, for some of the most abundant species.

Note that the use of distance analysis is not a prerequisite to population trend assessment. The latter uses total counts of birds observed, a relative index of abundance, rather than a calculated density, and can thus be applied to species occurring at low densities. A distance analysis would only be of value if it were necessary to estimate absolute population sizes of abundant species from the survey data, or to make a rigorous comparison of population size estimates between these species.

Repeat breeding bird surveys of The National Forest

The full value of the 2008 survey for monitoring will only be realised when further breeding bird surveys are undertaken and comparisons made between the results. A first repeat survey would enable an assessment of overall population change between the two survey years, while subsequent repeats would allow increasingly more complex (and non-linear) models of population change to be fitted.

The use of the BBS method, with its standard and well-established field protocol, ensures that the survey can be repeated closely in a future year. We would strongly recommend that the same sample squares and transect routes are used for future repeat surveys. Copies of the route maps for the 2008 survey have been supplied to NFC, along with spreadsheets detailing the bird and mammal observations made. Using the same transect routes removes route as a factor affecting the results of repeat surveys.

All BBS surveys are subject to variation according to weather, season, time of day, and the skill of the observer. It is recommended that future repeats of this survey be undertaken that match the dates and times of the 2008 survey as closely as possible, to minimise the variation that stems from these sources also.

It would be ideal to aim to include the full sample of 48 squares surveyed in 2008 in every repeat survey, rather than resurveying different parts of the sample in different years. This would ensure as far as possible that differences in bird counts between surveys were the result of population change between years and were not due to differences in the nature of the sample squares. If required, data points for years without a full survey could be estimated from the sample of BBS squares covered annually within the Forest area by BTO volunteers.

Consideration could be given to increasing the sample beyond the 48 squares, for example by surveying additional squares from the BBS random selection. This would tend to increase the extent and precision of monitoring achievable by subsequent surveys but, if professional staff conducted the extra fieldwork rather than BTO volunteers, it would also increase the costs of the survey. Otherwise, the costs for repeat surveys should be similar to those incurred in 2008.

If budgets do not allow surveys to be repeated on an annual basis, a longer interval could be used. The power of repeat surveys to detect significant change is related to the frequency of repeat visits as well as sample size, but varies across species because it also depends on variation between sites and between years, and sampling error. This makes it difficult to quantify the predicted increase in power that would be achieved by annual rather than periodic sampling. A second point is that the longer the interval between surveys, however, the more difficult it will be to link bird population changes to local habitat change. Bird communities in young plantations can change radically over periods as short as three years, as species that nest in young plantations, such as Yellowhammer and Whitethroat, gradually give way to species that require a thicker shrub layer, such as Blackcap and Song Thrush, and eventually to woodland specialists. There could therefore be short-term peaks that surveys at long intervals may miss, in species preferring intermediate stages of forest growth. On these grounds, we recommend that the interval between surveys does not exceed four years, at least while there are young plantations in the census sample. Relatively frequent repeats, say at two-year or three-year intervals, will also be advantageous because data will amass more quickly: conclusions will become more certain as the number of repeat surveys grows.

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