Natural England Commissioned Report NECR041

Assessment of the impacts of the Countryside and Rights of Way (CROW) Act 2000 (Part 1) on upland bird populations

Results of the second season of the Upland Breeding Bird Survey: Assessing change between 2006 and 2007

First published 12 September 2011

www.naturalengland.org.uk

Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

The Countryside and Rights of Way (CROW) Act 2000 (Part 1) came into effect across England in 2005. The Act provides a new right of open access allowing people to walk freely over areas of mapped open country (mountain, moor, heath, down) and registered common land.

The National Open Access Monitoring Programme was set up to evaluate the long-term impact of implementing the new access rights by identifying the level of awareness, uptake, use, economic and biodiversity impacts from the introduction of the Open Access rights across England.

Visitors using this new right of open access could potentially increase disturbance to breeding bird populations, adversely impacting on biodiversity at the landscape scale.

The Upland Breeding Bird Survey (UBBS) was set up as a full scale annual survey in 2007 to monitor long-term upland bird trends across England to inform both the impact of Natura 2000 designated sites (both SPAs and SACs) in protecting species of interest and understand the impact of Open Access on upland bird populations, taking on board recommendations from the pilot study in 2006. Elements of this programme are being integrated into Natural England's Integrated Monitoring Programme and Species Surveillance Strategy.

This report contains the results of the first full scale field season in 2007, which has been designed to be a fully integrated survey to meet the following long-term objectives to:

- Improve the capacity to monitor key upland bird species and bird population trends on Natura 2000 designated sites and CROW access land in England.
- Develop an 'upland bird index' which will contribute to reporting on the health/condition of the suite of upland Natura 2000 sites and inform the England Biodiversity Strategy.
- Identify any early signs of significant impacts arising from open access.

This report also looks at the potential for the UBBS to be used in the future to:

- Assess the success of Agri-environment schemes in the uplands; and
- Act as an indicator to measure impacts of climate change or the ability of birds to adapt to it.

In 2009 UBBS data has already been successfully combined with BTO Breeding Bird Survey (BBS) data for the first time, filling a monitoring gap in the uplands, improving the accuracy and power of the overall BBS and trends it produces. Prior to this the uplands were under represented due to their remoteness, effecting volunteer effort. This was reported in the **BTO Breeding Bird Survey Report 2009**.

This report is being published as part of a package of reports relating to monitoring the impacts of (CROW) Act 2000 (Part 1). These include:

- Executive Summary, Communications and Access Management Commissioned Reports of the National Open Access Visitor Survey (NOAVS) 2006 to 2008, published in three parts NECR036a, NECR036b and NECR036c; and
- Breeding Bird Survey (BBS) Pilot Study (2006) NECR040.

This report should be cited as:

Noble, D., Davis, S. & Ockendon, N. 2007. *Assessment Report on the second year of the Upland Breeding Bird Survey: assessing change between 2006 and 2007*. BTO, Thetford. Natural England Commissioned Report, Number NECR041.

Natural England Project Manager - Rob Keane, 3rd Floor, Bridgewater House, 60 Whitworth Street, Manchester, M1 6LT
rob.keane@naturalengland.org.uk

Principle Bird Specialist - Andy Brown, 3rd Floor, Touthill Close, City Road, Peterborough, PE1 1XN

Contractor - Dave Noble, Sarah Davis & Andrew Joys - British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU

Keywords - Breeding bird survey, upland breeding bird survey, annual survey, long term bird trends, upland bird index, open access, agri-environment schemes, Natura 2000, designated sites, uplands, England, landscape scale, climate change

Further information
This report can be downloaded from the Natural England website: **www.naturalengland.org.uk**. For information on Natural England publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk**.

ISSN 2040-5545

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Executive Summary

1. The results of the second field season (2007) of the Upland Breeding Bird Survey (UBBS) are reported here. This survey has the multiple long-term aims of: (i) improving our capacity to monitor upland bird species, (ii) providing sufficient data for a range of upland bird species to permit production of an upland bird indicator, (iii) providing data in order to assess changes in key bird populations on designated land in England, and (iv) assessing the impact of increased access to upland areas in England as a result of the Countryside and Rights of Way (CROW) Act (Part 1) that came into effect across England and Wales between 2004 and 2005. This allows the public a new right of open access to areas of mountain, moor, heath, down and registered common land. Natural England contracted the BTO to carry out a pilot study to monitor the effect of the CROW Act on upland breeding bird populations, in 2006. The survey was expanded in 2007 to increase coverage and to reflect the other aims of the survey.

2. The BTO/RSPB/JNCC Breeding Bird Survey (BBS), an annual bird survey of random 1-km squares across Britain, provided the basis for the UBBS, through the comparison of population trends before and after implementation of CROW and comparisons of trends in areas experiencing different visitor use since the Act. There are approximately 70 BBS squares surveyed annually which contain a significant proportion of upland Open Access land. A power analysis of BBS data, carried out earlier in Phase 1 of this project found that augmenting the BBS sample in English upland open access areas to quadruple its current size would be necessary in order to detect significant population declines in key upland species, such as Golden Plover and Curlew.

3. In the baseline year 2006, 106 additional 1-km squares (53 randomly-selected pairs of adjacent 1-km squares) of upland Open Access land were surveyed by professional fieldworkers. In 2007 this was increased to 308 additional 1km-squares, of which 170 were at sites where >50% of the land was designated, as either Open Access, SSSI or SPA. In 2008 the target was to survey the same 308 squares. Additional information on the number of people and dogs seen on survey squares was also collected during surveys in 2007.

4. In 2007, most upland species were present more frequently, and were more abundant, in squares that contained >50% designated land than in squares that contained <50% designated land.

5. Between 2006 and 2007 there were significant increases in occurrence and abundance in three species (Stonechat, Blackbird, Carrion Crow), and significant increases in abundance only in a further four species (Red Grouse, Golden Plover, Wheatear and Snipe) across the 106 UBBS squares that were surveyed in both years. Rook and Curlew both showed a significant decline in abundance, with Rook being the only species to decline in occurrence significantly.

6. A comparison with data from the national volunteer BBS surveys on upland squares suggested that many species not defined as upland specialists were more frequent on these squares than on UBBS squares (i.e. Wren, Carrion Crow, chaffinch, Blackbird). Very few species showed significant change in abundance between 2006 and 2007 on upland squares covered by volunteers in the core BBS and no species showed significant changes in the opposite directions between 2006 and 2007, between the two samples (UBBS and BBS).

7. As yet there is little evidence that implementation of the CROW Act has had a significant detrimental effect on upland species, with most key upland species numbers either stable or increasing slightly on Open Access land between 2006-2007. However, only two consecutive years of data have been examined here, and bird numbers will be subject to many other influences that will result in between-year fluctuations in abundance and occurrence. Therefore several more years of data are required before the effects of the new policy on bird species can be assessed fully.

8. Through the UBBS, monitoring for the impact of the CROW Act on upland birds is integrated with more comprehensive monitoring of birds in all upland habitats of England, including marginal uplands with enclosed pasture and wooded areas as well as the open moors and heaths designated for open access. However, an additional sampling stratification including all Open Access land as well as designated sites is targeted for more intensive surveying. This effectively focuses effort on requirements to assess the impact of CROW as well as fulfilling statutory needs for monitoring of designated sites and species of conservation concern. Monitoring should be long-term, with the aim of increasing the core BBS sample in this upland stratum by about four-fold from pre-2005 levels, in order to be able to effectively assess changes in bird populations within three or four years. The increases in coverage and in the period of time of monitoring will increase the power to detect declines in key upland bird species and will result in a larger number of species for which robust population trends can be generated. This should enable the production of a more representative upland bird indicator, and provide data that could be used to assess the impact of other key drivers of bird population – such as the proposed Upland Environmental Stewardship Scheme and climate change.

9. Natural England should continue its on-site visitor monitoring on access land across England in order to gain a national picture of visitor use to use in the analyses of the bird data. This could be accomplished through an extensive survey, as planned through the On-Site Visitor Monitoring Surveys, or by undertaking visitor use assessments for existing bird survey sites.

1. INTRODUCTION

1.1 Background and Rationale

Prior to this survey, monitoring of upland birds in the UK fell under three ongoing programmes; the BTO/JNCC/RSPB Breeding Bird Survey (BBS), the Statutory Conservation Agency and RSPB Annual Breeding Bird Surveys (SCARABBS) and the Rare Breeding Bird Panel (RBBP) as well as the breeding bird atlases, periodic extensive surveys and targeted regional surveys. Although some species are well monitored, these programmes left many shortcomings – particularly in the provision of reliable trends for some common breeding birds in the uplands as well as gaps in coverage of some of the scarcer species. The need to improve upland bird monitoring in the UK was identified at workshops involving a consortium of statutory conservation agencies and bird NGOs and led to proposals for a new Upland Breeding Bird Survey, with a range of aims. These include: (i) improved trends for key species in the uplands, (ii) better monitoring of statutory designated sites, (iii) more regular coverage of SCARABBS species, and (iv) the capacity to produce indicators for upland birds at the UK, national and regional levels. Given the good level of coverage and rigorous design provided by the ongoing annual Breeding Bird Survey, the best option for taking forward was deemed to be an augmentation of the BBS, with the sample of sites surveyed expanded to deliver as many of the aims as possible.

Despite the recognised need to improve monitoring of upland bird populations in the UK (many of which are relatively scarce and/or of conservation concern) discussed above, the initial impetus for this project came from the Countryside Agency's interest in assessing the impact of the new Countryside and Rights of Way Act on populations of breeding birds. The Countryside and Rights of Way (CROW) Act (Part 1), which came into effect across England and Wales between 2004 and 2005, provided the public with a new right of open access to areas of mountain, moor, heath, down and registered common land that previously did not have open access rights.

The concern was that through the new rights there was a potential for increased disturbance to breeding bird populations that inhabit newly mapped access land from visitors which could potentially have a negative impact on their populations, depending on the extent and pattern of visitor use. Human disturbance can have an adverse impact on birds, including negatively affecting bird foraging behaviour (e.g. Fernandez-Juric and Tellaria 2000; Ronconi and St Clair 2002) and their time activity budgets (e.g. Riddington et al. 1996). The effects of such disturbance can be manifested as reduced breeding success (e.g. Nightjar, Murison 2002), or changes in distribution or abundance of breeding (e.g. Common Sandpiper: Yalden 1992; Golden Plover: Finney et al. 2005) and non-breeding birds (e.g. Pink-footed Goose: Gill et al. 1996). The extent to which the effects of disturbance are observed may be dependent on a number of factors, such as weather (e.g. West et al. 2002), predator presence (e.g. Mikola 1994) and the time of year (see Woodfield and Langston 2004 for review). Different species show differences in susceptibility to disturbance (Yalden and Yalden 1989), and habitat type (e.g. Kentish Plover: Schulz & Stock 1993) and breeding stage (e.g. Common Eider: Bolduc & Guillemette 2003) also affect this. With predictions of continually increasing use of the countryside for recreational purposes, it is important to assess the impact of human-generated disturbance. The Countryside Agency guided by English Nature (now Natural England) carried out Nature Conservation Assessments on over 1000 SSSIs identifying the need for either Positive Access Management measures or limited use of s26 nature conservation restrictions to protect breeding birds in particular sites. There remained, however, a need to monitor the impact of the CROW Act on breeding bird populations, and that was the rationale for the first phase of the project.

To this end, Natural England developed an Open Access National Monitoring Programme to monitor access land across England. As part of this programme, the British Trust for Ornithology (BTO) was commissioned to develop a method to monitor the impact of increased access on breeding bird populations. The best way of determining whether increased disturbance, due to the CROW Act, is having an impact on upland birds was to monitor bird populations over the period over which the impact was likely to occur. The best tool identified for this purpose was the Breeding Bird Survey (BBS), an extensive annual survey organised by the BTO. Each year, BBS participants use standardised

recording protocols to survey their randomly-allocated 1-km squares (more than 3500 per year) and collect information on all bird species detected. The BBS has been running since 1994, and the data collected enables the BTO to generate annual UK (and England) population trends for more than 100 species.

Overall, the BBS dataset enables a BACE approach to be carried out to monitor the impact of the CROW Act on upland bird populations. Firstly, as the BBS has been running since 1994, it provides an historical dataset from which to assess the population trends before (B) and after (A) the implementation of the CROW Act. Secondly, starting with the baseline year of this project, bird population trends on sites with high visitor use (E for experimental) can be compared to population trends on control (C) sites with low visitor use. Earlier analyses (Noble et al. 2006) revealed that approximately 70 currently surveyed BBS squares can be defined as Open Access land, defined as covering at least 25% of the 1-km square. These sites would be the basis for the before-after analyses. The existing BBS sites also provide the required information for the second set of analyses - to compare trends on Open Access land to control sites, with an important advantage that this sample can be augmented by additional surveys to increase the power to detect population changes.

1.2 Scoping Study and its Findings

Earlier discussions about upland bird monitoring led to a scoping study (Noble et al. 2006) to assess the capability of existing national bird monitoring programmes to provide the information required, and to explore the feasibility of increasing survey coverage to improve the power to detect significant population changes. This was achieved through power analyses on existing BBS data to determine whether the current BBS sample was adequate to detect a range of population changes that might arise due to the drivers of bird abundance in the uplands. The results of these analyses were then used to assess capacity to detect changes in key upland bird species due to implementation of the CROW Act over a five year period. Increases in coverage on upland areas were also simulated in power analyses to determine the degree to which this would improve the power to detect population changes in key species. The target measures for the simulations were 10% and 25% declines over 5, 10 and 25 years.

The BBS sample on open access land in 2005 (ca 70 upland sites, as well as 30 lowland, mainly heath sites) was estimated to have a high enough power to detect an amber-level (25%) decline over five years in three key ground-nesting passerines (Skylark, Meadow Pipit and Willow Warbler) and one wader (Curlew). It was therefore recommended that the BBS sample in open access land be augmented by carrying out additional BBS-style surveys targeted on upland open access land. The power analyses suggested that doubling the BBS sample would, over the initial five-year period following the implementation of CROW, significantly increase the power to detect 10% declines in species such as Curlew, Meadow Pipit, and Skylark, and to detect 25% declines in Pied Wagtail, Cuckoo, Chiffchaff and Yellowhammer. Quadrupling the BBS sample (an additional 210 1-km squares would increase capacity to detect 25% changes in Golden Plover, Snipe, Tree Pipit, Whinchat and Buzzard, and 10% declines in the more widespread species such as Meadow Pipit, Skylark and Carrion Crow.

1.3 Current Research and Aims of this Report

Following the pilot power analyses, in 2006 the Countryside Agency contracted the BTO to augment the BBS, as recommended, to more than double the existing coverage on upland access land. The results of the first season (2006) of surveying additional 1-km squares in areas of upland open access land in England were previously reported (Davis, Noble and Joys, 2006). These results demonstrated the effectiveness of the new survey (UBBS) in monitoring a range of key upland species including Curlew, Golden Plover, Red Grouse and its potential to improve coverage of scarcer species such as Ring Ouzel and Merlin.

Following recommendations from the first year's report, from 2007 the aims of the UBBS were broadened to encompass all of the original conservation objectives, including more reliable population trends for a range of upland species, the development of an upland bird indicator and the provision of monitoring for designated sites. Natural England and the RSPB, through the Action for Birds in England partnership agreement, supported the full scale survey of over 300 upland 1-km squares by BTO and RSPB fieldworkers in 2007 in areas including open access land, designated sites and marginal upland. This report covers the findings of the second season of fieldwork (2007) and focuses on comparisons of results from 2006 and 2007 from the additional sites surveyed in both years to provide an early indication of any changes occurring between the two years shortly after the CRoW legislation came into force. It is important to note, however, that although it is possible to look for marked changes in occurrence or abundance of bird species, or lack thereof, between the two years, a number of other factors may be responsible for a substantial level of inter-annual fluctuations. Changes in bird abundance between years due to other factors, such as weather conditions or food availability, highlight the importance of continuing monitoring over the medium to long term in order to conclusively attribute any effects to disturbance.

As part of a parallel initiative in the Natural England Open Access Monitoring Programme, an Open Access National On-Site Visitor Survey has been developed alongside the BTO Pilot Bird Survey Project. The aim of the On-Site Visitor Monitoring Survey is to gain a better understanding of:

- visitor awareness of access land
- their rights and responsibilities
- the use of the new access rights
- the potential impacts on sites with nature conservation value and concerns
- opportunities for recreation on access land
- the changes in levels and patterns of use across access land

It is hoped to make use of this information in the next phases of this project, in order to relate patterns and trends in bird abundance to changes in visitor use. A key recommendation from the pilot was to develop a visitor monitoring plan to align visitor monitoring across the upland landscape stratified layer. Linking the long-term findings of the Upland Breeding Bird Survey (UBBS) to monitoring of visitor patterns will help to ensure that any significant changes in bird populations can be correlated with the public access position, and that further investigation into any linkages can then be conducted and, if necessary, appropriate measures developed to manage access more effectively.

The National On-Site Visitor Survey was originally developed and piloted in 2005. Based on the recommendations from that pilot study, Natural England contracted Faber Maunsell to run the national 3-year visitor survey, which commenced in 2006 in the same year as the UBBS pilot, with 2008 being the final survey year of the project. Some results and conclusions from this parallel initiative are included here.

2. METHODS

2.1 Initial Survey Square Selection

In order to select a random sample of grid squares for survey, ArcView was used to create GIS layers of open access land and upland land in England, where upland was defined according to the standard CEH land classes (Environmental Zone 3 in England; Haines-Young *et al.* 2000). This was then used to select a sample of 300 squares at random from areas where the open access and upland layers overlapped. Any squares that contained less than 50% open access land were removed from this sample. Of the remaining 250 squares, the first 90 squares were looked up on Ordinance Survey maps to assess, for health and safety purposes, their terrain. Any squares that appeared to contain dangerous or very difficult terrain were removed from the sample. Due to practicality and time constraints any squares that had a walk in to the site of greater than 3 km were also removed from the sample. Fifteen sites were lost due to these reasons.

The open access pages of the Natural England website was also used to ascertain whether there were any access restrictions on the sites to be surveyed. One site had to be excluded completely due to a nature conservation restriction, and several other sites were restricted in the dates on which visits could be carried out.

The design of this survey means that each site consists of a pair of adjacent 1-km squares. This was achieved by randomly selecting 'main' squares and then allocating one of the adjacent squares to also be surveyed. Although surveying adjacent squares rather than independent squares results in some loss of power in assessing the significance of changes in populations, the efficiency benefits of doubling the area covered at each, often remote, site outweighs that disadvantage. This was done by selecting the southern square unless it was rejected due to either containing less than 50% open access land, or containing dangerous or very difficult terrain, e.g. MOD training sites, cliffs, or lakes. If the southern adjacent square was rejected for any of these reasons then the eastern square was considered, followed by the northern square and then the western square until a suitable square was found. All of the main selected squares had at least one adjacent square that was suitable for surveying. Consideration was also given to reducing the length of the walk in to the site by selecting an adjacent square that minimised this, if the walk in was between 2 and 3 km.

In 2006, five observers were allocated the first 55 sites (main squares plus adjacent squares) from the remaining 75 upland 1-km squares. Fifty-five sites were allocated so as to allow for a few sites not being surveyed due to bad weather, whilst not falling below the target of 50 sites. Ten of the remaining 20 'spare' squares were allocated to the fieldworkers as they discovered that ten of their squares had access or terrain problems when they arrived for their reconnaissance visit. These replacement squares were always in the same area (e.g. Peak District) as the rejected square.

All fieldworkers visited received an induction at the start of their contract (BTO or RSPB), with instructions on the survey, background on the aims of the project and health and safety training. They were provided with BBS instructions and recording forms (habitat, mammal and bird recording forms), two copies of maps for each of their sites, mobile phones (for health and safety purposes), GPS, an upland bird song CD to aid identification, and a copy of the spreadsheet for data entry.

2.2 Selection of additional squares in 2007 for expansion

In accordance with the wider aims of upland bird monitoring as well as specifically to provide a means of detecting changes caused by increased levels of disturbance, it was decided to extend the upland survey in 2007, in order to increase the power to detect changes in bird abundance. Based on resources and available manpower, it was decided that an additional 120-150 squares could be added to the survey in 2007. These were selected using the GIS layer of upland habitat in England created in Section 2.1 as a basis. The 106 squares that were surveyed in 2006 (53 main sites and 53 adjacent sites) and

BBS sites in upland areas that had been surveyed at least once between 1994 and 2005 were excluded, leaving a total of 15325 squares available for selection. GIS layers were created that described the area of designated land (i.e. SSSIs, SPAs or Open Access Land) in upland habitat. These were then used to calculate the total area of designated land within each potential 1-km survey square.

These potential survey squares were then split into two strata, depending on the proportion of designated land within them: stratum 1 contained squares with <50% designated land within them, (NB many contained no designated land), and stratum 2 squares had >50% designated land. Stratum 1 (hereafter referred to as the 'marginal upland stratum') mainly consists of land that might be considered 'marginal' upland below the moorland wall, whereas stratum 2 (hereafter referred to as the 'true upland stratum') contains a higher proportion of 'true' upland habitat types and, given that a large proportion is designated for nature conservation purposes, might be expected to hold higher densities of upland specialist birds. All of the squares surveyed in 2006 fell within the true upland stratum. Five hundred squares were initially chosen from the 15,325 1-km squares available for selection (i.e. from both strata) using the random generator extension called 'random point generator v 3.0' in Arcview (Figure 1). Each of these squares was allocated a random number, and sorted by this random number. Squares were then selected for sampling starting from the top of this list and working down as required. This resulted in a final selection of 45 new sites in the marginal upland stratum, and 82 new sites in the true upland stratum in 2007. A pair of 1-km squares were surveyed at each site, with adjacent squares selected as described previously. Therefore, 202 new squares were surveyed in 2007, and 106 squares covered in 2006 were re-surveyed, giving a total of 308 1-km survey squares in 2007 (Figure 2).

2.3 Field Methods

Field methods were identical to BBS methods in both 2006 and 2007 (Raven *et al*. 2005). In summary, all surveyors made two visits (first visit in April or early May, second visit in late May or June) to count birds along a 2 km pre-selected transect route through each 1-km square. All birds seen and heard were recorded in distance bands and in transect sections as for BBS, thereby providing a potential spatial resolution of the data to 200m x 50m, and 200m x 200m, for subsequent analyses as required. Fieldworkers also recorded habitat type for each transect section and any mammals or mammal field signs observed (see Appendix for detailed information on the BBS methodology). Estimates of abundance of all bird species on each 1-km square were estimated from the maximum count, summed over distance bands and transect sections, of the two visits. Comparisons of species richness and the occurrence and abundance of individual species were carried out between surveyed squares that contained section 15 land and those that did not.

Fieldworkers also recorded information on the numbers of people they observed during both their early and late visits to the sites to provide us with an indication of the level of human disturbance at each site. The information recorded consisted of the number of groups seen (broken down into size categories of 1, 2-10 and more than 10 people in the group) and whether there were dogs present, and if so whether they were on a lead or not.

2.4 Statistical Analysis

The main response variables in these analyses were bird abundance and occurrence. Abundance is defined as the maximum count of each bird species recorded during the BBS-style transect surveys. Occurrence identifies whether each species was present or absent (or not detected) within each square.

The differences in the frequency of occurrence of each species were analysed using Fisher's Exact Tests on a 2 x 2 contingency table. Differences in the mean abundance of species across upland squares were analysed using Mann-Whitney Wilcoxon tests while differences in mean abundance between years 2006 and 2007 were analysed with General Linear Models with a poisson distribution and a log link, using Proc Genmod in SAS.

3. RESULTS

3.1 Results of bird surveys

This report covers the results of the bird surveys carried out in upland areas of England in 2007; comparisons between surveys carried out by professional field workers on upland sites in 2007 (the UBBS sample of 308 1-km squares) and those carried out by volunteers in the core BBS (the BBS sample of 269 1-km upland squares), as well as comparisons between 2006 and 2007. The basis for the 2006-2007 comparisons in the UBBS sample is 106 1-km squares surveyed in both of the first two years of the project; the basis for the 2006-2007 comparisons in the BBS sample is 229 1-km squares that were surveyed by volunteers in both 2006 and 2007.

Three measures were used to compare results between samples and between years: (i) frequency of occurrence in the sample of squares surveyed, (ii) mean relative abundance in the sample of squares surveyed, and (iii) mean relative abundance in the sample of squares in which the species was detected. It should be noted that mean relative abundance is the maximum count attained for each species during either of the two visits in which a roughly 2-km transect was walked. This does not take into account detectability and hence these are not equivalent to measures of density and cannot be reliably used for comparisons across species.

3.1.1 UBBS Coverage in 2007

A total of 308 1-km squares at 154 sites were surveyed by nine professional fieldworkers in 2007. The sample was comprised of 80 squares from the marginal upland stratum and 228 squares from the true upland stratum. Of this sample, 106 1-km squares (at 53 sites, all true upland stratum) had been previously surveyed in 2006. Coverage of these squares was split between nine professional fieldworkers, five employed by the BTO and four by the RSPB.

3.1.2 Occurrence and abundance of birds in UBBS surveys 2007

Most species showed a significant difference in frequency between true upland and marginal upland in 2007 (Table 1), reflecting the differences in habitat (both in extent of habitat types, and quality) between the two categories. Species that were defined as 'upland' in the Phase 1 report were more likely to occur more frequently in the true upland stratum than those that were not. Differences in abundance rates corresponded closely to differences in occurrence rates, and all the species that occurred significantly more frequently in the true upland stratum compared to the marginal upland stratum, also showed a significantly higher abundance (Table 2). Species that occurred less frequently in the true upland stratum were also less abundant in this stratum. The species defined as upland in the Phase 1 report that were more abundant in the true upland stratum than the marginal upland stratum were Meadow Pipit, Curlew, Red Grouse, Wheatear, Golden Plover, Stonechat, Ring Ouzel, Peregrine, Merlin and Short-eared Owl. Upland species that were significantly less common in the true upland stratum squares compare to the marginal upland stratum squares were Tree Pipit, Redstart, Siskin, Wood Warbler and Dipper. Skylark and Snipe were not defined as upland species, but were significantly more frequent in the true upland stratum than the marginal upland stratum.

The frequency with which each species were recorded was investigated on an observer-by-observer basis, and no marked variation was observed, although obviously observer effects were likely to have been confounded by regional differences.

Meadow Pipit was the most widespread species, found in 88% of all squares, followed by Wren (78%), Skylark (73%), Curlew (72%) and Carrion Crow (71%). Meadow Pipits were also the most abundant species, followed by Skylark. Scarcer upland species such as Ring Ouzel, Peregrine and Merlin were

detected on a reasonable number of sites (17 to 26) but there were no reports of Hen Harrier, Red Kite, Dunlin, Black Grouse, Goosander or Red-breasted Merganser in 2007.

3.1.3 Changes in occurrence and abundance between UBBS survey 2006 and 2007

A total of 106 upland squares were surveyed in both 2006 and 2007. There was a significant increase in the occurrence of Blackbird, Stonechat and Carrion Crow between 2006 and 2007, with the number of squares in which Stonechat and Blackbird were seen more than doubling (Table 3). The only species that showed a significant decrease in occurrence was Rook. Meadow Pipit was present in all 106 surveyed squares in both years. Several of the other common, key upland species, such as Red Grouse, Curlew, Golden Plover and Wheatear, showed a non-significant increase in occurrence between 2006 and 2007. The only upland species that showed a near-significant decline in occurrence was Grey Wagtail, which was found in only 3/106 squares in 2007 compared to 10/106 in 2006.

Seven out of the nine species that showed a significant change in mean abundance between 2006 and 2007 had increased (Table 4). Stonechat, Carrion Crow and Blackbird underwent significant increases in both occurrence and abundance, whereas Rook was the only species that showed a significant decline in both measures. Red Grouse, Golden Plover, Wheatear and Snipe showed non-significant increases in occurrence, but significant increases in abundance across all squares (although for Golden Plover the increase in abundance was only just significant ($P = 0.05$)). Therefore the density of these species has increased at a greater rate than their range between 2006 and 2007. Curlew showed a non-significant increase in occurrence, but a decline in mean abundance, suggesting that this species was more widely dispersed, but present at a lower density in 2007 than in 2006.

Curlew was the only species that showed significant change in abundance in the squares where it was present, with a significant decrease in density between 2006 and 2007 (Table 5). However, many other species were only present in a small number of squares, reducing our ability to detect a significant change.

3.1.4 Comparison of changes in bird abundance on the UBBS sample and in the national BBS trend for the UK between 2006 and 2007

We compared changes in bird abundance between 2006 and 2007 on UBBS squares with the national BBS trends generated using data over the same time period from the volunteer surveys on all BBS across the whole of the UK. Stonechat numbers underwent a significant increase in both nationwide BBS squares (Table 6) and the UBBS squares (Table 4), suggesting that the species is increasing rapidly across Britain. However, few other species show such consistent and striking patterns. Although Carrion Crow and Rook showed a significant increase and decrease respectively in the upland surveys, their national populations were relatively stable. Blackbirds increased in occurrence dramatically in the UBBS squares but showed only a small, non-significant increase across all BBS squares. Snipe showed increases in national BBS squares and in UBBS squares, but Golden Plover numbers declined across all BBS squares despite a significant increase in abundance in UBBS squares. Similarly, Wheatear abundance increased significantly in the UBBS squares, but was stable nationally. Conversely, Raven numbers were relatively stable in the UBBS squares, but increased by >50% across all BBS squares.

3.1.5 Comparison of abundance and occurrence on UBBS squares and on the national BBS surveys undertaken on upland squares in 2007

Of the national BBS squares across the entire UK, 269 BBS squares fell within land defined as ‘upland’ in England, based on the definition agreed within the project using Environmental Zone three (see Methods). Data from these squares were compared with the results from the 308 UBBS upland squares

surveyed by professionals in 2007. In terms of frequency of occurrence, Meadow Pipit, Curlew, Red Grouse, Wheatear, Golden Plover and Stonechat were significantly more frequent on UBBS squares than on volunteer BBS squares (Table 7). Many of the non-upland specialists were significantly more frequent on the volunteer BBS squares, including Wren, Carrion Crow, Chaffinch, Pheasant and Blackbird. Across all squares, Black Grouse, Curlew, Peregrine, Red Grouse, Ring Ouzel, Short-eared Owl and Tree Pipit were found at significantly higher abundances in the UBBS squares than in the volunteer BBS squares (Table 8). Oystercatcher, Raven and Redstart occurred at significantly higher abundances on the volunteer BBS squares and none of the non-upland species were found at higher abundances in the UBBS squares. There were fewer significant differences in the mean abundance of species in squares only where they were present (Table 9), although again, where significant differences did arise, the majority of these indicated higher abundance on BBS squares as opposed to UBBS squares. Tree Pipit and Starling were the only species to occur at significantly higher abundances on UBBS squares.

3.1.6 Comparison of changes in occurrence and abundance between national BBS surveys undertaken on upland squares in 2006 and 2007

Two hundred and twenty-nine upland squares were surveyed by volunteers as part of the national BBS surveys in both 2006 and 2007. There was only one species, Short-eared Owl, which showed a significant difference in occurrence between the two years, occurring on significantly fewer squares in 2007 (Table 10). In terms of differences in abundance across all 229 squares surveyed, Carrion Crow, Jackdaw, Wren, Golden Plover, Siskin, Ring Ouzel and Merlin all showed a significant increase between 2006 and 2007. Short-eared Owl, Twite and Goshawk showed a significant decrease in abundance between the two years (Table 11). Carrion Crow, Jackdaw, Golden Plover and Siskin increased significantly in abundance where these species were present (Table 12).

Table 13 presents a summary of the changes on each of the three measures of 'abundance' between the years 2006 and 2007 for target upland species on the UBBS survey squares and on the core BBS survey squares. No species showed significant changes in opposite directions by either UBBS or the BBS sample. However, it is clear from this table that the two surveys do produce some different results. For example, the UBBS survey found a significant increase in the occurrence of Stonechat while the only significant change in occurrence found by the BBS survey was a decrease for the Short-eared Owl. The UBBS survey detected a significant decrease in the abundance of Curlew between the two years, while the BBS survey found no such difference. Both surveys reported a significant increase in the abundance of Golden Plover and Stonechat (Table 13). This project is at an early stage and it is important to note that the magnitude of most of the changes shown in this table are small and that a two year change may not reflect an underlying trend, especially for the scarce species.

3.2 National and Local Visitor Survey 2007 Findings

The National Open Access On-Site Visitor Survey provides a possible explanation for the lack of any impacts of CROW found by the UBBS survey. Initial interim findings of the National Visitor Survey after only 2-3 years of the new CROW access rights suggests that, overall, impacts probably have been minimal after initial interim analysis of the National Sample sites surveyed across upland and lowland access land (Faber Maunsell, 2008). At some sites, there was already existing access and it is unlikely that this has changed substantially post-CROW; at other sites, the level of use is so low that any impacts will be insignificant.

Of the 26 national sample sites, eight have features that could make them vulnerable to use off paths or off public rights of way (PROW), but to date, any implications for land management are negligible. The surveys have not indicated any significant changes in patterns of use resulting from CROW at any of the survey sites.

It is clear from the data that people are visiting Open Access Land sites and exercising their rights of access. However, the usage of this right varies enormously from site to site. On sites where access is completely new, uptake is typically very low, especially when the site is remote from centres of population. Where access existed before CROW, whether by right or because it was simply tolerated, usage is higher but it is difficult to perceive any real increase or change in use over and above pre-CROW levels.

A visitor index was used to measure how access patterns differed on sites with new CROW rights, sites where access was previously tolerated, and sites that had existing access rights prior to CROW commencement. The table in Appendix one suggests that although people were using the right of open access in 2006, shortly after commencement of CROW, this was more likely to happen on land where access had previously been tolerated than on either areas where there was a completely new right, or areas where there had been rights prior to CROW commencement. In 2007, access users still favoured open access land on which access had previously been tolerated or where rights existed prior to commencement of CROW. However the weight of use of all three categories remains broadly consistent between 2006 and 2007. The table also suggests that people are less likely to leave PROW in 2007 than they were in 2006.

4. DISCUSSION AND CONCLUSIONS

4.1 Improving capacity to monitor upland bird species

The original survey was designed to increase upland BBS site coverage to a level that would allow changes in numbers of Golden Plovers to be statistically assessed with a reasonable power. This species was selected as the 'standard' because it was detected in too few core BBS squares for robust population trends to be generated, but is not as scarce as some of the upland raptors (e.g. Merlin) for which even a four-fold increase in coverage is unlikely to generate a sufficient sample. Given that the sample of BBS sites in open access land that were surveyed annually at the time of the scoping study was approximately 70 (there were an additional 30 BBS sites in 'open access' lowlands, mainly heath and downland that are not considered in these analyses), the expansion by 270 additional squares in land defined using the same criteria (i.e. true uplands) that we report here exceeds the target of an additional 210 squares required for a four-fold increase. Although some problems were encountered accessing sites, due in some cases to the difficulty of the terrain and in others access being denied by the landowner, replacement squares were quickly identified and surveyed so that the required sample size was still attained. Moreover, for assessing populations in all uplands (i.e. not just true uplands but also marginal uplands), the entire additional sample of 308 squares (154 sites) can be used.

It should be noted that in the assessment above, we have considered coverage as if all squares are independent. This is not the case, as squares were surveyed in adjacent pairs, and hence trend analyses will take this into account by treating paired squares as one site. Although this causes some reduction of the power to detect changes, modelling exercises undertaken during the scoping study suggest that this results in a relatively minor reduction of power, and it also has no effect on the estimate of the magnitude of the change.

4.2 Impact of the CROW Act on bird populations; early indications

There is little evidence from the two years of data presented here that Open Access has resulted in a decline in populations of bird species. Only one upland species, Curlew, showed a significant decline in either occurrence or abundance between 2006 and 2007 and many showed increases. However, effects of disturbance may take several years to take effect, for example if breeding success is reduced. It is also possible that levels of disturbance may continue to rise in the years following the CROW Act coming into effect, as increasing numbers of people become aware of the upland areas now available to them to use for recreation. It is difficult to draw robust conclusions from only two years of data, as many other variables such as weather or food availability may have strong influences on bird numbers in the short term. Therefore it is vital to continue monitoring these sensitive populations.

Although the comparison of results in 2006 and 2007 may reveal some interesting patterns, several more years of data are required before any firm conclusions can be drawn.

The National and Local Visitor Survey 2007 findings suggest that there are few sites where there are indications of impacts on nature conservation and/or land management arising directly as a result of public access provided via CROW implementation. This is not to say that public access does not cause challenges to land managers, just that it is hard to find evidence to suggest that these challenges are a function of CROW access at the moment.

A Nature Conservation Assessment and Review Process (NCARP) was developed and implemented prior to the commencement of CROW to assess the potential impact of the new rights of access on wildlife and biodiversity. The process focused particularly on designated sites with newly mapped access land. The joint aim of English Nature and the Countryside Agency (now Natural England) under this process was to identify and implement the least restrictive option in access terms, while enabling the relevant authority to decide on cases where some type of legal restriction of the CROW access rights or positive access management was necessary in order to protect important wildlife or habitats.

In its role as CROW relevant authority for all of England outside the national parks[1], Natural England is currently reviewing the decisions taken during that original process in order to ensure that the restrictions or positive access management put in place then are still appropriate and adequate to protect the species or habitat in question. On the relatively few sites where management measures have been used (including restrictions), they seem to have been reasonably successful (note that 100% compliance is never likely to be achieved and may not be necessary to achieve the desired mitigation and ensure there is no significant adverse impact on the integrity of a designated site).

The effects of disturbance on bird numbers and trends could be further investigated using the data collected by fieldworkers on numbers of people seen, including the effects of such factors as group size, frequency of groups and presence of dogs. However, given the timing of most bird surveys (April to June before the main holiday season, and very early in the morning before most walkers are active), this is unlikely to provide sufficient information. Subsequent analyses are planned to compare bird population trends in areas experiencing different levels of visitor activity as assessed by NE's parallel On-Site Visitor Monitoring.

4.3 The development of an upland bird indicator

The expansion of coverage in 2007 (and 2008) reflects the multiple aims of the survey. Increased coverage, over time, will improve our ability to monitor all upland bird species by improving the precision of trends for the more widespread species, and by collecting sufficient data to add some of the scarcer species to the list of species for which population trends can be calculated. This will allow development of a robust and representative upland bird indicator, which could be added to the suite of wild bird indicators for farmland, woodland and coastal areas already used by the government to assess progress towards its goal of sustainable biodiversity in the wider countryside. Quantitative indicators for habitats such as farmland and woodland have become valuable conservation tools in recent years, and there is a clear need for an equivalent for birds in uplands. In addition, newly available trends for more upland bird species (some of which are currently not represented in indicators) would allow the indicators for all habitats (e.g. Defra's Sustainable Development Strategy indicators for populations of wild birds in the UK) to become more representative. This would be particularly important for nations and regions for which upland areas form a significant proportion. The potential for developing a new upland bird indicator, for England as well as across the UK, is being discussed outside this project and there is an opportunity for synergies in these developments.

4.4 Monitoring designated sites

Another aim of this survey was to collect sufficient information on populations of upland birds in designated land areas (SSSIs, SACs and SPAs) so that population trends in these areas can be compared to those outside them. The statutory nature conservation agencies are required to assess the condition of designated sites over a six-year reporting cycle and sites which qualify for ornithological interests are assessed by monitoring the birds present and comparing the results with those present at the time of designation. Most individual SPAs (with the possible exception of the North Pennines) are still too small in area for population trends to be generated for species other than the most abundant, such as Meadow Pipit. However, by combining the core BBS data (once available) with the surveys conducted as part of this project, it should be possible to compare trends for key designated species (Curlew, Golden Plover) in and outside of SPAs overall.

[1] The Forestry Commission is normally the relevant authority for any areas of woodland subject to CROW access rights – usually land voluntarily dedicated by its owner.

4.5 Assessing the impacts of agricultural change (Upland Environmental Stewardship)

The UBBS will provide an opportunity to assess the impact of another important driver of changes in bird populations in the uplands; changes in agricultural practices. In the same way as augmented BBS-style surveys are being used to assess the impact of the Entry Level Scheme of Environmental Stewardship (ES) in lowland England, these upland sites could be used to assess the impact of the Upland Environmental Stewardship scheme planned for rollout in 2010. Data collected in the next few years will provide a valuable baseline for comparing changes as a result of uptake of the new scheme, as well as the impact of ES schemes already in place and other drivers of agricultural change in the uplands (CAP reform, economic changes, disease incidence and potential changes farming practices e.g. in the deployment of pesticides). This will allow the BACE approach outlined in section 1.1 above to be followed, providing an historical dataset from which to assess the population trends before and after changes.

It may be necessary to undertake some further work assessing whether the current sampling design and methods are sufficient to detect any changes in bird numbers in response to new agri-environment schemes. Survey coverage does not target farmland directly and there may need to be some further augmentation of survey squares to include more of this habitat. There may also be the possibility to include further taxa within the surveys, such as plants and mammals, and to undertake some form of habitat surveying.

4.6 Contribution to assessing the effects of climate change

The Upland Breeding Bird Survey, along with the volunteer-based BBS routes, delivers information on bird populations that can be used to assess potential impact of climate change across the UK. In northern and upland areas climate change may reduce the area of suitable habitat to the extent that many species may be extinct by 2050 (Thomas et al. 2004). Rising temperatures are expected to cause large changes in upland and high-latitude habitats, making upland and montane species particularly vulnerable.

Effects of climate change on bird species include changes to phenology, and Crick and Sparks (1999) predicted an advance in average laying dates of 75% of species in their study by 2080. Such changes in laying date may result in an asynchrony between hatching dates and the emergence of invertebrate prey, hence resulting in reduced food availability (e.g. for Golden Plover, Peace-Higgins et al., 2005). Other effects of climate change are linked to survival rates; for example climate change is thought to play a role in determining adult and/or juvenile survival in Ring Ouzels (Beale et al. 2006).

There may also be indirect effects of changing climate. For example, warming of the upland heathland in the UK increases its productivity, which could enable higher grazing densities (Wessel et al 2004). This may lead to problems for ground nesting birds through increased trampling rates or unsuitable vegetation structure. Other indirect effects include the spread of competitors from the lowlands and how these new species interact with traditional upland species.

According to models in the Climatic Atlas of European Breeding Birds, Golden Plover may see a range reduction in most of the southern half of its range, Curlew is predicted to experience a decrease in range distribution of more than 40% (Huntley et al 2007) and similar impacts are predicted for other upland species. The UBBS data will provide a means to monitor the effect of climate change. With its focus on uplands, the UBBS is best placed to deliver the required data on key upland bird species, and provide an early indication of the impacts of climate change. It could also provide data to produce trends in high latitude / high altitude species which may be a useful 'indicator of climate change'

4.7 Next steps – plans for further analysis and survey

This report focuses on comparisons of the professional and volunteer surveys undertaken in 2006 and 2007 and the results from both professionals and volunteers in 2007. The next step will be to provide a short progress report covering the 2008 UBBS field season, and the results of the surveys undertaken by professional field workers in that survey. Results from the core BBS sites surveyed annually by volunteers are submitted throughout the months following the field season, with the last 5% usually received in January (although data submitted online tends to be submitted earlier). Following a period of data collation and verification, the results of a particular field season are often not complete until March the following calendar year – hence comparisons of the results from professional fieldworkers with results from volunteers surveying core squares within the same season cannot be undertaken until then. Subsequent plans are to compare species occurrence and abundance between 2006, 2007 and 2008 with the full data set. Any differences in observation rates between professional fieldworkers and volunteers can also be tested for (although biases in habitat types and geographic region must be accounted for).

Other analyses that could be undertaken for inclusion in the next full report, subject to resources, include comparisons of abundance and trends in bird populations within and outside designated sites as well as measures of population change within individual SPAs or other designated sites. Data could also be analysed at a regional level, to investigate variation in abundance and rates of population change in different species in different parts of the country. For example upland birds could be being adversely affected by climate change in the south of the country as these areas become unsuitable for upland specialists, resulting in declines in their numbers in these areas.

It is envisaged that in future years volunteer BBS surveyors in the uplands will be asked to cover additional squares adjacent to the single square they survey currently, thus increasing coverage. As mentioned in section 4.5, additional professional coverage may be needed for the assessment of ELS. We will also work to secure funding to expand the UBBS into Scotland, Wales and Northern Ireland. Proportionally, England has less upland than any of the other three UK nations, with Scotland in particular holding the bulk of the population for many upland specialist birds. To report on trends in upland species in the UK, and to fulfil other objectives such as an upland indicator and climate change research, an extension of the English scheme across the UK's uplands is extremely important

ACKNOWLEDGEMENTS

The UBBS is currently supported mainly by Natural England, in partnership with RSPB and BTO. We are particularly grateful to Andy Brown (Natural England) and Rob Keane (Natural England) for their support for this project. We would also like to thank all fieldworkers employed on this project in 2006 and 2007, including Roy Bamford, Peter Brown, Geoff Carr, Allan Goddard, Richard Griffiths, Paul Medforth, Innes Muir, Dave Pearce, Will Price, Kate Swinburne and Sally Wilkinson. Andrew Joys carried out the work on square selection, and David Morris was responsible for managing the RSPB field component of the work and Mark Eaton the lead contact within the RSPB. Thanks also to all landowners and farmers for allowing permission to access their land for surveys.

REFERENCES

Beale, C.M., Burfield, I.J., Sim, I.M.W., Rebecca, G.W., Peace-Higgins, J.W. and Grant, M.C. (2006). Climate change may account for the decline in British ring ouzels *Turdus torquatus*. Journal of Animal Ecology, 75, 826–835

Burger, J. (2003) Personal watercraft and boats: Coastal conflicts with common terns. *Lake and Reservoir Management* **19**:26-34.

Crick, H.Q.P. and Sparks T.H. (1999). Climate change related to egg-laying trends. Nature, 399, 6735, 3 June 1999, Pages 423-424

Faber Maunsell (2008) Three Year Monitoring Research Programme to Monitor and Obtain Market Information on the Public Use of Open Access Land, Mapped Under the Countryside and Rights of Way Act 2000 Executive Summary, Access Management and Communications Report Year 2 (2007). Natural England. Cheltenham.

Fernandez-Juricic, E. & Telleria, J.L. (2000) Effects of human disturbance on spatial and temporal feeding patterns of Blackbirds *Turdus merula* in urban parks in Madrid, Spain. *Bird Study* **47**: 13-21.

Finney, S.K., Pearce-Higgins, J.W. & Yalden, D.W. (2005) The effect of recreational disturbance on an upland breeding bird, the golden plover *Pluvialis apricaria*. *Biological Conservation* **121**: 53-63.

Gill, J.A., Sutherland, W.J. & Watkinson, A.R. (1996) A method to quantify the effects of human disturbance on animal populations. *Journal of Applied Ecology* **33**: 786-792.

Huntley, B., Green, R.E., Collingham, Y.C., and Willis, S.G. (2007). *A Climatic Atlas of European Breeding Birds*. Durham University, The RSPB and Lynx Edicions, Barcelona.

Mikola, J., Miettinen, M., Lehikoinen, E. & Lehtila, K. (1994) The effects of disturbance caused by boating on survival behaviour of velvet scoter *Melanitta fusca* ducklings. *Biological Conservation* **67**: 119-124.

Murrison, G. (2002) *The impact of human disturbance on the breeding success of nightjar* Caprimulugus europeus *on heathlands in south Dorset*. English Nature research Report **483**. English Nature, Peterborough.

Noble, D.G., Davis, S.E. & Joys, A.C. (2006) Phase 1 Report: Pilot Breeding Bird Monitoring Survey.

Pearce-Higgins, J.W., Yalden, D.W. and Whittingham, M.J. (2005). Warmer springs advance the breeding phenology of golden plovers *Pluvialis apricaria* and their prey (Tipulidae). Oecologia, 143, 3, 470-476

Raven, M.J., Noble, D.G. & Baillie, S.R. (2005) *The Breeding Bird Survey 2005*. British Trust for Ornithology, Thetford.

Riddington, R., Hassal, M., Lane, S.J., Turner, P.A. & Walters, R. (1996) The impact of disturbance on the behaviour of Brent Geese *Brenta b bernicula*. *Bird Study* **43**: 269-279.

Ronconi, R.A. & St Clair, C.C. (2002) Management options to reduce boat disturbance on foraging black guillemots *Cepphus grille* in the Bay of Fundy. *Biological conservation* **108**: 265-271.

Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., Ferreira de Siqueira, M., Grainger, A., Hannah, L., Hughes, L., Huntley, B., van Jaarsveld,

A.S., Midgley, G.F., Miles, L., Ortega-Huerta, M.A., Peterson, A.T., Phillips, O.L. and Williams, S.E. (2004) Extinction risk from climate
change. Nature, 427, 145–148.

Wessel W.W., Tietema A., Beier C., Emmett B.A., Penuelas J. and Riis-Nielsen T., 2004. A qualitative ecosystem assessment for different shrublands in western Europe under impact of climate change. Ecosystems, 7, 6, 662-671

West, A.D., Goss-Custard, J.D., Stillman, R.A., Caldow, R.W.G., Le V dit Durrell, S.E.A. & McGrorty, S. (2002) Predicting the impacts of disturbance on shore birds mortality using a behavioural model. *Biological Conservation* **106**: 319-328.

Woodfield, E. & Langston, R. (2004) *Literature Review on the Impact on Bird Populations on Disturbance due to Human Access on Foot*. RSPB Research Report no. **9**. RSPB, Sandy.

Yalden, D.W. (1992) The influence of recreational disturbance on common sandpipers *Actitis hypoleucos* breeding by an upland reservoir, in England. *Biological Conservation* **61**: 41-49.

Table 1. Frequency of occurrence (and number of squares in which they were present) across all 308 upland squares and in each stratum for each species in 2007. *P*-value derived from Fisher's Exact Test on a 2x2 contingency table for each species. Upland species (as defined in the scoping study) are shown in bold and all presented, along with non-upland species present in at least 25% of sites. In all tests of significance, * $p < 0.05$, ** $p < 0.01$.

Species	**All UBBS squares (n=308)**	**Marginal upland Stratum (n=80)**	**True upland Stratum (n=228)**	***p*-value**
Meadow Pipit	0.88 (271)	0.55 (44)	1.00 (227)	< 0.01**
Wren	0.78 (241)	0.99 (79)	0.71 (162)	< 0.01**
Skylark	0.73 (226)	0.56 (45)	0.79 (181)	< 0.01**
Curlew	0.72 (222)	0.63 (50)	0.75 (172)	0.03*
Carrion Crow	0.71 (218)	0.99 (79)	0.61 (139)	< 0.01**
Chaffinch	0.53 (162)	0.99 (79)	0.36 (83)	< 0.01**
Pheasant	0.52 (159)	0.81 (65)	0.41 (94)	< 0.01**
Woodpigeon	0.47 (146)	0.93 (74)	0.32 (72)	< 0.01**
Willow Warbler	0.46 (143)	0.88 (70)	0.32 (73)	< 0.01**
Blackbird	0.45 (139)	0.98 (78)	0.27 (61)	< 0.01**
Red Grouse	0.44 (136)	0.08 (6)	0.57 (130)	< 0.01**
Wheatear	0.44 (136)	0.14 (11)	0.55 (125)	< 0.01**
Swallow	0.44 (134)	0.78 (62)	0.32 (72)	< 0.01**
Robin	0.39 (121)	0.84 (67)	0.24 (54)	< 0.01**
Jackdaw	0.36 (110)	0.66 (53)	0.25 (57)	< 0.01**
Lapwing	0.35 (109)	0.31 (25)	0.37 (84)	0.50
Golden Plover	0.34 (106)	0.05 (4)	0.45 (102)	< 0.01**
Rook	0.32 (99)	0.60 (48)	0.22 (51)	< 0.01**
Buzzard	0.31 (95)	0.49 (39)	0.25 (56)	< 0.01**
Pied Wagtail	0.31 (95)	0.70 (56)	0.17 (39)	< 0.01**
Song Thrush	0.30 (93)	0.70 (56)	0.16 (37)	< 0.01**
Blue Tit	0.30 (92)	0.83 (66)	0.11 (26)	< 0.01**
Snipe	0.30 (91)	0.16 (13)	0.34 (78)	< 0.01**
Great Tit	0.28 (87)	0.78 (62)	0.11 (25)	< 0.01**
Stonechat	0.28 (86)	0.14 (11)	0.33 (75)	< 0.01**
Mistle Thrush	0.27 (83)	0.53 (42)	0.18 (41)	< 0.01**
Black-headed Gull	0.25 (77)	0.33 (26)	0.22 (51)	0.10
Raven	0.20 (62)	0.16 (13)	0.21 (49)	0.34
Oystercatcher	0.18 (54)	0.23 (18)	0.16 (36)	0.18
Tree Pipit	0.13 (41)	0.26 (21)	0.09 (20)	< 0.01**
Siskin	0.10 (30)	0.20 (16)	0.06 (14)	< 0.01**
Redstart	0.09 (29)	0.24 (19)	0.04 (10)	< 0.01**
Ring Ouzel	0.08 (26)	0.01 (1)	0.11 (25)	< 0.01**
Peregrine	0.07 (21)	0.00 (0)	0.09 (21)	< 0.01**
Whinchat	0.07 (21)	0.03 (2)	0.08 (19)	0.12
Grey Wagtail	0.06 (20)	0.08 (6)	0.06 (14)	0.79
Merlin	0.06 (17)	0.00 (0)	0.07 (17)	0.01*
Common Sandpiper	0.05 (15)	0.04 (3)	0.05 (12)	0.77
Lesser Redpoll	0.05 (15)	0.08 (6)	0.04 (9)	0.23
Short-eared Owl	0.04 (12)	0.00 (0)	0.05 (12)	0.04*
Dipper	0.03 (9)	0.06 (5)	0.02 (4)	0.05*
Twite	0.01 (3)	0.01 (1)	0.01 (2)	1.00
Wood Warbler	0.01 (3)	0.04 (3)	0.00 (0)	0.02*
Goshawk	0.003 (1)	0.00 (0)	0.004 (1)	1.00
Wigeon	0.003 (1)	0.00 (0)	0.004 (1)	1.00

Table 2. Mean abundance (± S.E.) of species across all upland squares and in each stratum in 2007. Mann-Whitney Wilcoxon tests were used to test for significant differences in abundance between the two strata for each species.

Species	All squares (n=308)	Marginal upland Stratum (n=80)	True upland Stratum (n=228)	*p*-value (Wilcoxon 2 sample test)
Meadow Pipit	15.41 ± 0.64	4.06 ± 0.72	19.39 ± 0.65	<0.01**
Skylark	6.81 ± 0.46	3.26 ± 0.51	8.05 ± 0.57	<0.01**
Chaffinch	6.27 ± 0.65	17.50 ± 1.82	2.33 ± 0.33	<0.01**
Curlew	5.66 ± 0.40	3.25 ± 0.53	6.50 ± 0.49	<0.01**
Rook	4.64 ± 0.66	10.16 ± 1.65	2.70 ± 0.63	<0.01**
Jackdaw	4.56 ± 0.62	9.73 ± 1.51	2.74 ± 0.60	<0.01**
Carrion Crow	4.40 ± 0.36	8.31 ± 0.80	3.03 ± 0.35	<0.01**
Wren	3.73 ± 0.23	6.95 ± 0.55	2.60 ± 0.20	<0.01**
Woodpigeon	3.38 ± 0.39	9.73 ± 1.16	1.15 ± 0.16	<0.01**
Lapwing	3.35 ± 0.46	4.54 ± 1.13	2.93 ± 0.48	0.87
Red Grouse	3.14 ± 0.36	0.11 ± 0.05	4.19 ± 0.46	<0.01**
Swallow	2.63 ± 0.30	6.45 ± 0.87	1.29 ± 0.21	<0.01**
Black-headed Gull	2.48 ± 0.68	2.84 ± 0.92	2.35 ± 0.87	0.05
Golden Plover	2.42 ± 0.53	2.33 ± 1.92	2.45 ± 0.27	<0.01**
Blackbird	2.39 ± 0.25	7.11 ± 0.70	0.73 ± 0.11	<0.01**
Robin	2.35 ± 0.27	6.96 ± 0.78	0.73 ± 0.13	<0.01**
Willow Warbler	2.14 ± 0.20	4.19 ± 0.47	1.43 ± 0.20	<0.01**
Pheasant	1.99 ± 0.19	4.34 ± 0.54	1.17 ± 0.14	<0.01**
Blue Tit	1.34 ± 0.17	4.54 ± 0.47	0.22 ± 0.05	<0.01**
Wheatear	1.28 ± 0.12	0.29 ± 0.10	1.63 ± 0.15	<0.01**
Great Tit	1.03 ± 0.13	3.53 ± 0.37	0.15 ± 0.03	<0.01**
Siskin	1.00 ± 0.27	3.13 ± 0.97	0.25 ± 0.09	<0.01**
Pied Wagtail	0.71 ± 0.08	1.73 ± 0.20	0.36 ± 0.07	<0.01**
Song Thrush	0.67 ± 0.08	1.76 ± 0.22	0.29 ± 0.05	<0.01**
Stonechat	0.64 ± 0.08	0.25 ± 0.09	0.78 ± 0.10	<0.01**
Mistle Thrush	0.58 ± 0.07	1.13 ± 0.16	0.39 ± 0.07	<0.01**
Snipe	0.57 ± 0.07	0.29 ± 0.08	0.67 ± 0.08	<0.01**
Tree Pipit	0.54 ± 0.11	1.31 ± 0.37	0.27 ± 0.08	<0.01**
Oystercatcher	0.51 ± 0.10	0.90 ± 0.30	0.37 ± 0.07	0.14
Buzzard	0.50 ± 0.05	0.96 ± 0.14	0.33 ± 0.05	<0.01**
Raven	0.32 ± 0.05	0.28 ± 0.09	0.34 ± 0.06	0.33
Redstart	0.22 ± 0.05	0.69 ± 0.19	0.06 ± 0.02	<0.01**
Ring Ouzel	0.18 ± 0.04	0.01 ± 0.01	0.24 ± 0.06	0.01*
Lesser Redpoll	0.12 ± 0.03	0.19 ± 0.08	0.10 ± 0.04	0.20
Whinchat	0.09 ± 0.02	0.04 ± 0.03	0.11 ± 0.03	0.08
Grey Wagtail	0.09 ± 0.02	0.09 ± 0.04	0.09 ± 0.02	0.69
Peregrine	0.08 ± 0.02	0.00 ± 0.00	0.1 ± 0.03	0.01*
Common Sandpiper	0.07 ± 0.02	0.08 ± 0.05	0.07 ± 0.02	0.60
Merlin	0.06 ± 0.02	0.00 ± 0.00	0.09 ± 0.02	0.01*
Short-eared Owl	0.04 ± 0.01	0.00 ± 0.00	0.06 ± 0.02	0.04*
Dipper	0.04 ± 0.01	0.09 ± 0.04	0.02 ± 0.01	0.04*
Twite	0.02 ± 0.01	0.03 ± 0.03	0.02 ± 0.01	0.77
Wood Warbler	0.01 ± 0.005	0.04 ± 0.02	0.00 ± 0.00	<0.01**
Goshawk	0.003 ± 0.003	0.00 ± 0.00	0.004 ± 0.004	0.56
Wigeon	0.003 ± 0.003	0 .00± 0.00	0.004 ± 0.004	0.56

Table 3. The occurrence rate of species in the 106 upland squares that were surveyed in both 2006 and 2007 (number of squares in which a species was seen shown in brackets). *P*-values derived from Fisher's Exact Tests on 2x2 contingency tables for each species.

Species	Occurrence in 2006	Occurrence in 2007	*P*-value
Meadow Pipit	1.00 (106)	1.00 (106)	1.00
Skylark	0.85 (90)	0.84 (89)	1.00
Curlew	0.74 (78)	0.77 (82)	0.63
Wren	0.64 (68)	0.68 (72)	0.66
Red Grouse	0.58 (62)	0.61 (65)	0.78
Golden Plover	0.56 (59)	0.61 (65)	0.49
Carrion Crow	0.41 (43)	0.57 (60)	0.03*
Lapwing	0.40 (42)	0.38 (40)	0.78
Pheasant	0.40 (42)	0.41 (43)	1.00
Wheatear	0.40 (42)	0.51 (54)	0.13
Chaffinch	0.34 (36)	0.27 (29)	0.37
Swallow	0.31 (33)	0.23 (24)	0.22
Willow Warbler	0.30 (32)	0.25 (27)	0.54
Rook	0.26 (28)	0.14 (15)	0.04*
Snipe	0.24 (25)	0.36 (38)	0.07
Wood Pigeon	0.23 (24)	0.27 (29)	0.53
Jackdaw	0.22 (23)	0.24 (25)	0.87
Black-headed Gull	0.19 (20)	0.17 (18)	0.86
Buzzard	0.19 (20)	0.18 (19)	1.00
Raven	0.18 (19)	0.21 (22)	0.73
Robin	0.14 (15)	0.18 (19)	0.58
Stonechat	0.14 (15)	0.30 (32)	0.01*
Pied Wagtail	0.14 (15)	0.12 (13)	0.84
Song Thrush	0.10 (11)	0.11 (12)	1.00
Oystercatcher	0.11 (12)	0.14 (15)	0.68
Grey Wagtail	0.09 (10)	0.03 (3)	0.08
Ring Ouzel	0.09 (10)	0.11 (12)	0.82
Merlin	0.08 (8)	0.08 (9)	1.00
Blackbird	0.06 (6)	0.20 (21)	<0.01**
Lesser Redpoll	0.06 (6)	0.06 (6)	1.00
Peregrine	0.06 (6)	0.05 (5)	1.00
Short-eared Owl	0.06 (6)	0.05 (5)	1.00
Redstart	0.05 (5)	0.04 (4)	1.00
Tree Pipit	0.05 (5)	0.04 (4)	1.00
Whinchat	0.05 (5)	0.08 (8)	0.57
Blue Tit	0.04 (4)	0.06 (6)	0.75
Siskin	0.03 (3)	0.05 (5)	0.72
Great Tit	0.03 (3)	0.02 (2)	1.00
Dipper	0.02 (2)	0.01 (1)	1.00
Goshawk	0.02 (2)	0.00 (0)	0.50
Common Sandpiper	0.01 (1)	0.04 (4)	0.37
Twite	0.01 (1)	0.00 (0)	1.00
Mistle Thrush	0.01 (1)	0.01 (1)	1.00
Wigeon	0.01 (1)	0.01 (1)	1.00
Wood Warbler	0.01 (1)	0.00 (0)	1.00

Table 4. Mean abundance (± S.E.) of species across the 106 squares surveyed in both 2006 and 2007. Table also shows *p*-value from Wilcoxon matched-pair signed rank tests for each species, to test for significant differences in abundance between 2006 and 2007.

Species	2006	2007	*p*-value
Meadow Pipit	18.46 ± 0.91	20.47 ± 0.98	0.07
Skylark	9.56 ± 0.85	9.00 ± 0.88	0.21
Rook	8.97 ± 2.96	1.38 ± 0.48	0.03*
Curlew	8.15 ± 0.83	6.86 ± 0.78	0.03*
Red Grouse	3.13 ± 0.44	4.46 ± 0.66	0.01*
Lapwing	2.70 ± 0.60	3.06 ± 0.68	0.66
Golden Plover	2.50 ± 0.35	3.13 ± 0.38	0.05*
Wren	1.92 ± 0.23	2.27 ± 0.26	0.13
Jackdaw	1.73 ± 0.47	2.63 ± 0.84	0.94
Carrion Crow	1.54 ± 0.26	3.05 ± 0.56	<0.01**
Chaffinch	1.08 ± 0.21	1.35 ± 0.35	0.39
Pheasant	0.97 ± 0.17	1.05 ± 0.20	0.79
Willow Warbler	0.97 ± 0.21	0.93 ± 0.22	0.97
Wheatear	0.90 ± 0.17	1.41 ± 0.22	<0.01**
Woodpigeon	0.78 ± 0.19	0.92 ± 0.20	0.19
Black-headed Gull	0.66 ± 0.20	0.41 ± 0.10	0.66
Swallow	0.62 ± 0.15	0.71 ± 0.24	0.64
Snipe	0.42 ± 0.09	0.75 ± 0.14	<0.01**
Robin	0.35 ± 0.11	0.45 ± 0.13	0.18
Raven	0.28 ± 0.07	0.30 ± 0.07	0.88
Stonechat	0.27 ± 0.07	0.80 ± 0.15	<0.01**
Buzzard	0.26 ± 0.06	0.23 ± 0.05	0.58
Ring Ouzel	0.25 ± 0.11	0.29 ± 0.11	0.82
Oystercatcher	0.20 ± 0.07	0.36 ± 0.13	0.17
Song Thrush	0.19 ± 0.07	0.23 ± 0.08	0.55
Pied Wagtail	0.17 ± 0.04	0.23 ± 0.07	0.64
Mistle Thrush	0.15 ± 0.05	0.21 ± 0.06	0.32
Grey Wagtail	0.13 ± 0.05	0.06 ± 0.04	0.21
Lesser Redpoll	0.12 ± 0.05	0.15 ± 0.07	0.64
Tree Pipit	0.11 ± 0.06	0.06 ± 0.03	0.44
Blackbird	0.09 ± 0.04	0.42 ± 0.11	<0.01**
Merlin	0.08 ± 0.03	0.09 ± 0.03	0.83
Whinchat	0.08 ± 0.03	0.12 ± 0.05	0.44
Peregrine	0.06 ± 0.02	0.05 ± 0.02	1.00
Redstart	0.06 ± 0.03	0.04 ± 0.02	0.73
Short-eared Owl	0.06 ± 0.02	0.05 ± 0.02	1.00
Blue Tit	0.06 ± 0.03	0.09 ± 0.05	0.36
Great Tit	0.05 ± 0.03	0.02 ± 0.01	0.44
Siskin	0.04 ± 0.02	0.20 ± 0.10	0.16
Wigeon	0.04 ± 0.04	0.01 ± 0.01	1.00
Common Sandpiper	0.03 ± 0.03	0.05 ± 0.02	0.63
Dipper	0.02 ± 0.01	0.01 ± 0.01	1.00
Twite	0.01 ± 0.01	0.00 ± 0.00	1.00
Goshawk	0.02 ± 0.01	0.00 ± 0.00	0.50
Wood Warbler	0.02 ± 0.02	0.00 ± 0.00	1.00

Table 5. Mean abundance (± S.E.) of species in the squares where they were present out of the 106 Open Access squares surveyed in 2006 and 2007 (number of squares present in brackets). (*P*-values calculated from Mann-Whitney Wilcoxon test).

Species	2006	2007
Meadow Pipit	18.46 ± 0.91 (106)	20.47 ± 0.98 (106)
Skylark	11.26 ± 0.89 (90)	10.72 ± 0.95 (89)
Curlew	11.08 ± 0.93 (78)*	8.87 ± 0.90 (82)*
Wren	2.99 ± 0.28 (68)	3.35 ± 0.31 (72)
Red Grouse	5.35 ± 0.61 (62)	7.28 ± 0.93 (65)
Golden Plover	4.49 ± 0.50 (59)	5.11 ± 0.48 (65)
Carrion Crow	3.79 ± 0.48 (43)	5.38 ± 0.88 (60)
Wheatear	2.26 ± 0.32 (42)	2.76 ± 0.34 (54)
Pheasant	2.45 ± 0.30 (42)	2.58 ± 0.39 (43)
Lapwing	6.81 ± 1.28 (42)	8.10 ± 1.50 (40)
Snipe	1.76 ± 0.23 (25)	2.08 ± 0.27 (38)
Stonechat	1.93 ± 0.21 (15)	2.66 ± 0.32 (32)
Chaffinch	3.19 ± 0.44 (36)	4.93 ± 1.02 (29)
Woodpigeon	3.46 ± 0.55 (24)	3.38 ± 0.51 (29)
Willow Warbler	3.22 ± 0.50 (32)	3.67 ± 0.62 (27)
Jackdaw	7.96 ± 1.58 (23)	11.16 ± 3.04 (25)
Swallow	2.00 ± 0.38 (33)	3.13 ± 0.91 (24)
Raven	1.58 ± 0.18 (19)	1.45 ± 0.19 (22)
Blackbird	1.67 ± 0.42 (6)	2.10 ± 0.35 (21)
Robin	2.47 ± 0.52 (15)	2.53 ± 0.52 (19)
Buzzard	1.40 ± 0.15 (20)	1.26 ± 0.13 (19)
Black-headed Gull	3.50 ± 0.82 (20)	2.39 ± 0.26 (18)
Rook	33.96 ± 9.89 (28)	9.73 ± 2.56 (15)
Oystercatcher	1.75 ± 0.43 (12)	2.53 ± 0.70 (15)
Mistle Thrush	1.38 ± 0.18 (13)	1.57 ± 0.25 (14)
Pied Wagtail	1.20 ± 0.11 (15)	1.85 ± 0.39 (13)
Ring Ouzel	2.70 ± 0.91 (10)	2.58 ± 0.66 (12)
Song Thrush	1.82 ± 0.44 (11)	2.00 ± 0.51 (12)
Blue Tit	1.50 ± 0.29 (4)	1.67 ± 0.49 (6)
Great Tit	1.67 ± 0.33 (3)	1.00 ± 0.00 (2)
Merlin	1.00 ± 0.00 (8)	1.11 ± 0.11 (9)
Whinchat	1.60 ± 0.24 (5)	1.63 ± 0.26 (8)
Lesser Redpoll	2.17 ± 0.48 (6)	2.67 ± 0.61 (6)
Siskin	1.33 ± 0.33 (3)	4.20 ± 1.16 (5)
Peregrine	1.00 ± 0.00 (6)	1.00 ± 0.00 (5)
Short-eared Owl	1.00 ± 0.00 (6)	1.00 ± 0.00 (5)
Tree Pipit	2.40 ± 0.98 (5)	1.50 ± 0.29 (4)
Redstart	1.20 ± 0.20 (5)	1.00 ± 0.00 (4)
Common Sandpiper	3.00 ± 0.00 (1)	1.25 ± 0.25 (4)
Grey Wagtail	1.4 0± 0.31 (10)	2.00 ± 0.58 (3)
Wigeon	4 .00± 0.00 (1)	1.00 ± 0.00 (1)
Dipper	1.00 ± 0.00 (2)	1.00 ± 0.00 (1)
Wood Warbler	2.00 ± 0.00 (1)	0.00 ± 0.00 (0)
Goshawk	1.00 ± 0.00 (2)	0.00 ± 0.00 (0)
Twite	1.00 ± 0.00 (1)	0.00 ± 0.00 (0)

Table 6. Population change in upland species in BBS squares across the UK between 2006-2007. Table shows species present in Table 2 that were present in an average of at least 30 volunteer-surveyed BBS squares per year, and number of BBS squares in which they were recorded. *represents a significant change between 2006-2007.

Species	N	Percentage change
Blackbird	2129	4.2
Black-headed Gull	477	-32.52*
Buzzard	680	5.41
Carrion Crow	2019	-3.25
Chaffinch	2132	-1.72
Common Sandpiper	60	-1.2
Curlew	449	3.23
Dipper	50	-17.76
Golden Plover	54	-16.53
Grey Wagtail	193	8.62
Jackdaw	1427	11.11
Lapwing	615	-4.65
Lesser Redpoll	131	5.66
Meadow Pipit	701	1.2
Mistle Thrush	1078	1.15
Oystercatcher	275	-6.74
Peregrine	35	-14.93
Pheasant	1522	2.19
Pied Wagtail	1132	0.88
Raven	220	50.97*
Robin	2038	2.54
Rook	1140	3.19
Siskin	121	50*
Skylark	1540	1.16
Snipe	133	18.97
Song Thrush	1693	0.85
Stonechat	128	34.52*
Swallow	1680	-8.76
Tree Pipit	123	8.54
Wheatear	271	0.89
Whinchat	73	5.71
Willow Warbler	1268	8.6
Wood Warbler	53	-5.71
Woodpigeon	2144	2.52
Wren	2111	12.61*

Table 7. Comparison of frequency of occurrence and number of squares in which species were present in 2007 on UBBS squares and all upland squares surveyed by volunteer BBS surveyors. Upland species (as defined in the scoping study) are shown in bold and all presented, along with non-upland species present in at least 25% of sites. *P* values derived from Fisher's Exact Tests on 2 x 2 contingency tables for each species. In all tests of significance, * $p < 0.05$, ** $p < 0.01$

Species	Frequency of occurrence, UBBS squares (n=308)	No. UBBS squares species present (n=308)	Frequency of occurrence, all upland BBS squares (n=269)	No. upland BBS squares species present (269)	*P* value
Meadow Pipit	0.88	271	0.75	203	0.0001 **
Wren	0.78	241	0.85	229	0.04 *
Skylark	0.73	226	0.65	176	0.05
Curlew	0.72	222	0.65	176	0.09
Carrion Crow	0.71	218	0.86	231	<0.0001 **
Chaffinch	0.53	162	0.81	218	<0.0001 **
Pheasant	0.52	159	0.70	187	<0.0001 **
Woodpigeon	0.47	146	0.75	202	<0.0001 **
Willow Warbler	0.46	143	0.66	178	<0.0001 **
Blackbird	0.45	139	0.69	185	<0.0001 **
Red Grouse	0.44	136	0.29	77	0.0001 **
Swallow	0.44	134	0.77	206	<0.0001 **
Wheatear	0.44	136	0.38	101	0.13
Robin	0.39	131	0.67	181	<0.0001 **
Jackdaw	0.36	110	0.53	142	<0.0001 **
Lapwing	0.35	109	0.46	123	0.01 *
Golden Plover	0.34	106	0.17	45	<0.0001 **
Rook	0.32	99	0.41	109	0.04 *
Buzzard	0.31	95	0.30	82	0.93
Pied Wagtail	0.31	95	0.52	140	<0.0001 **
Blue Tit	0.30	92	0.64	173	<0.0001 **
Snipe	0.30	91	0.26	69	0.31
Song Thrush	0.30	93	0.51	136	<0.0001 **
Great Tit	0.28	87	0.54	146	<0.0001 **
Stonechat	0.28	86	0.20	55	0.04 *
Mistle Thrush	0.27	83	0.46	123	<0.0001 **
Black-headed Gull	0.25	77	0.27	72	0.63
Dunnock	0.25	76	0.47	126	0.0001 **
Goldfinch	0.24	75	0.46	125	0.0001 **
Starling	0.22	67	0.41	109	<0.0001 **
Mallard	0.20	62	0.41	111	<0.0001 **
Raven	0.20	62	0.22	59	0.61
Great spotted woodpecker	0.18	55	0.27	72	0.009 **
Oystercatcher	0.18	54	0.20	54	0.46
Coal Tit	0.17	52	0.27	72	0.004 **
Greenfinch	0.17	51	0.36	97	<0.0001 **
Magpie	0.17	53	0.42	114	<0.0001 **
Kestrel	0.16	48	0.26	69	0.004 **
Linnet	0.14	43	0.31	84	<0.0001 **
Tree Pipit	0.13	41	0.11	30	0.45
Blackcap	0.10	31	0.31	84	<0.0001 **
House Sparrow	0.10	32	0.28	75	<0.0001 **
Siskin	0.10	30	0.06	17	0.17
Redstart	0.09	29	0.20	54	0.0003 **
Ring Ouzel	0.08	26	0.06	16	0.27

Peregrine	0.07	21	0.04	11	0.20
Whinchat	0.07	21	0.07	19	1
Grey Wagtail	0.06	20	0.20	55	<0.0001 **
Merlin	0.06	17	0.03	8	0.15
Common Sandpiper	0.05	15	0.07	19	0.29
Lesser Redpoll	0.05	15	0.10	27	0.02 *
Short-eared Owl	0.04	12	0.01	4	0.12
Black Grouse	0.03	9	0.02	6	0.79
Dipper	0.03	9	0.07	19	0.03 *
Dunlin	0.02	5	0.01	3	0.73
Goosander	0.02	7	0.03	7	0.79
Twite	0.01	3	0.01	4	0.71
Wood Warbler	0.01	2	0.04	11	0.03 *
Hen harrier	0.006	2	0.01	2	1
Goshawk	0.003	1	0.01	2	0.60
Red kite	0.003	1	0.00	1	1
Wigeon	0.003	1	0.00	1	1
Red-breasted merganser	0.00	0	0.01	2	

Table 8. Comparison of mean abundance on all UBBS squares and all upland BBS squares surveyed by volunteer surveyors in 2007. Upland species (as defined in the scoping study) are shown in bold and all presented, along with non-upland species present in at least 25% of sites. GLMs were used to test for significant differences in abundance. In all tests of significance, * $p < 0.05$, ** $p < 0.01$

Species	Abundance on all UBBS (n = 308)	Abundance on all upland BBS (n = 269)	*P* value
Meadow Pipit	15.41 ± 0.64	14.91 ± 1.04	0.68
Starling	6.66 ± 2.58	7.16 ± 1.42	0.69
Skylark	6.81 ± 0.46	5.66 ± 0.49	0.07
Chaffinch	6.27 ± 0.65	8.41 ± 0.85	0.008 **
Curlew	5.66 ± 0.40	4.61 ± 0.39	0.04 *
Rook	4.64 ± 0.66	7.70 ± 1	0.0005 **
Jackdaw	4.56 ± 0.62	10.84 ± 1.30	<0.0001 **
Carrion Crow	4.40 ± 0.36	9.46 ± 0.87	<0.0001 **
Wren	3.73 ± 0.23	6.16 ± 0.39	<0.0001 **
Lapwing	3.35 ± 0.46	4.35 ± 0.59	0.07
Woodpigeon	3.38 ± 0.39	6.85 ± 0.55	<0.0001 **
Red Grouse	3.14 ± 0.36	1.61 ± 0.31	<0.0001 **
Black-headed Gull	2.48 ± 0.68	3.45 ± 0.87	0.07
Golden Plover	2.42 ± 0.53	2.91 ± 1.24	0.32
Swallow	2.63 ± 0.30	5.96 ± 0.46	<0.0001 **
Blackbird	2.39 ± 0.25	4.89 ± 0.40	<0.0001 **
Robin	2.35 ± 0.27	3.59 ± 0.27	0.0004 **
Willow Warbler	2.14 ± 0.20	4.13 ± 0.35	<0.0001 **
Pheasant	1.99 ± 0.19	3.07 ± 0.24	<0.0001 **
Blue Tit	1.34 ± 0.17	4.14 ± 0.34	<0.0001 **
Wheatear	1.28 ± 0.12	1.17 ± 0.14	0.47
Siskin	1.00 ± 0.27	1.04 ± 0.49	0.18
Great Tit	1.03 ± 0.13	2.37 ± 0.22	<0.0001 **
Goldfinch	0.98 ± 0.12	1.86 ± 0. 21	<0.0001 **
Mallard	0.89 ± 0.17	2.12 ± 0.39	<0.0001 **
House Sparrow	0.75 ± 0.20	2.97 ± 0.43	<0.0001 **
Pied Wagtail	0.71 ± 0.08	1.22 ± 0.10	<0.0001 **
Dunnock	0.66 ± 0.09	1.41 ± 0.13	<0.0001 **
Song Thrush	0.67 ± 0.08	1.45 ± 0.13	<0.0001 **
Stonechat	0.64 ± 0.08	0.51 ± 0.08	0.06
Coal Tit	0.58 ± 0.10	1.00 ± 0.28	0.002 **
Mistle Thrush	0.58 ± 0.07	1.04 ± 0.10	<0.0001 **
Tree Pipit	0.54 ± 0.11	0.26 ± 0.06	0.0002 **
Snipe	0.57 ± 0.07	0.63 ± 0.09	0.49
Oystercatcher	0.51 ± 0.10	0.87 ± 0.16	0.002 **
Buzzard	0.50 ± 0.05	0.52 ± 0.06	0.73
Greenfinch	0.45 ± 0.08	1.41 ± 0.16	<0.0001 **
Linnet	0.45 ± 0.08	1.31 ± 0.19	<0.0001 **
Magpie	0.42 ± 0.07	1.71 ± 0.18	<0.0001 **
Great spotted woodpecker	0.34 ± 0.05	0.50 ± 0.07	0.01 *
Raven	0.32 ± 0.05	0.49 ± 0.09	0.009 **
Blackcap	0.28 ± 0.06	0.79 ± 0.09	<0.0001 **
Redstart	0.22 ± 0.05	0.51 ± 0.08	<0.0001 **
Kestrel	0.19 ± 0.03	0.34 ± 0.04	0.0002 **
Ring Ouzel	0.18 ± 0.04	0.12 ± 0.04	0.05
Black Grouse	0.10 ± 0.05	0.03 ± 0.01	<0.0001 **
Lesser Redpoll	0.12 ± 0.03	0.39 ± 0.10	0.02 *

Grey Wagtail	0.09 ± 0.02	0.36 ± 0.05	<0.0001 **
Whinchat	0.09 ± 0.02	0.19 ± 0.06	0.0005 **
Peregrine	0.08 ± 0.02	0.06 ± 0.02	0.05 *
Common Sandpiper	0.07 ± 0.02	0.15 ± 0.04	0.0002 **
Merlin	0.06 ± 0.02	0.04 ± 0.02	0.14
Goosander	0.05 ± 0.02	0.06 ± 0.02	0.25
Dipper	0.04 ± 0.01	0.12 ± 0.03	<0.0001 **
Short-eared Owl	0.04 ± 0.01	0.03± 0.01	0.04 *
Dunlin	0.03 ± 0.01	0.02 ± 0.01	0.54
Twite	0.02 ± 0.01	0.03 ± 0.02	0.09
Wood Warbler	0.01 ± 0.005	0.06 ± 0.02	<0.0001 **
Hen harrier	0.006 ± 0.005	0.01 ± 0.01	0.61
Goshawk	0.003 ± 0.003	0.01 ± 0.01	0.003 **
Red kite	0.003 ± 0.003	0.00 ± 0.004	0.63
Wigeon	0.003 ± 0.003	0.01 ± 0.01	0.004 **
Red-breasted merganser	0.00	0.01 ± 0.01	

Table 9. Comparison of mean abundance on UBBS squares and upland BBS squares surveyed by volunteer surveyors in 2007 where species were present. Upland species (as defined in the scoping study) are shown in bold and all presented, along with non-upland species present in at least 25% of sites. GLMs were used to test for significant differences in abundance. In all tests of significance, * p <0.05, ** p<0.01

Species	Abundance on UBBS where present	Abundance on upland BBS where present	*P* value
Starling	30.60 ± 11.46	17.68 ± 3.25	0.03 *
Meadow Pipit	17.52 ± 0.63	19.76 ± 1.2	0.07
Rook	14.42 ± 1.67	19.01 ± 2.02	0.05
Jackdaw	12.75 ± 1.43	20.53 ± 2.16	0.0005 **
Chaffinch	11.93 ± 1.06	10.38 ± 1	0.16
Black-headed Gull	9.91 ± 2.57	12.9 ± 2.97	0.23
Siskin	10.23 ± 2.13	16.53 ± 6.81	0.18
Lapwing	9.47 ± 1.09	9.51 ± 1.13	0.97
Skylark	9.27 ± 0.53	8.65 ± 0.65	0.43
House Sparrow	7.22 ± 1.46	10.65 ± 1.13	0.05
Golden Plover	7.03 ± 1.46	17.38 ± 7.07	0.0002 **
Curlew	7.85 ± 0.48	7.04 ± 0.51	0.21
Woodpigeon	7.12 ± 0.70	9.12 ± 0.66	0.02 *
Red Grouse	7.10 ± 0.67	5.64 ± 0.94	0.11
Carrion Crow	6.22 ± 0.45	11.01 ± 0.97	<0.0001 **
Swallow	6.04 ± 0.58	7.79±0.54	0.02 **
Robin	5.98 ± 0.55	5.33 ± 0.34	0.26
Blackbird	5.29 ± 0.45	7.11 ± 0.51	0.004 **
Mallard	4.44 ± 0.69	5.14 ± 0.86	0.40
Wren	4.76 ± 0.26	7.24 ± 0.41	<0.0001 **
Willow Warbler	4.62 ± 0.33	6.25 ± 0.45	0.001 **
Blue Tit	4.50 ± 0.40	6.45 ± 0.45	0.002 **
Black Grouse	3.56 ± 1.20	1.17 ± 0.17	0.06
Tree Pipit	4.07 ± 0.62	2.37 ± 0.31	0.01 *
Goldfinch	4.04 ± 0.31	4 ± 0.37	0.93
Pheasant	3.85 ± 0.30	4.42 ± 0.3	0.13
Great Tit	3.64 ± 0.32	4.36 ± 0.31	0.10
Coal Tit	3.44 ± 0.45	3.74 ± 0.99	0.70
Linnet	3.26 ± 0.39	4.19 ± 0.47	0.12
Oystercatcher	2.89 ± 0.43	4.33 ± 0.63	0.02 *
Greenfinch	2.75 ± 0.38	3.191 ± 0.32	0.01 *
Blackcap	2.74 ± 0.37	2.52 ± 0.2	0.55
Wheatear	2.90 ± 0.20	3.11 ± 0.27	0.47
Dunnock	2.68 ± 0.26	3 ± 0.2	0.30
Lesser Redpoll	2.53 ± 0.27	3.85 ± 0.72	0.13
Redstart	2.34 ± 0.41	2.56 ± 0.28	0.62
Magpie	2.43 ± 0.25	4.04 ± 0.31	0.0002**
Goosander	2.00 ± 0.58	2.29 ± 0.47	0.70
Ring Ouzel	2.15 ± 0.34	2.06 ± 0.48	0.85
Pied Wagtail	2.32 ± 0.16	2.35 ± 0.13	0.86
Stonechat	2.29 ± 0.18	2.49 ± 0.23	0.45
Song Thrush	2.22 ± 0.17	2.88 ± 0.18	0.005 **
Mistle Thrush	2.14 ± 0.15	2.28 ± 0.16	0.49
Great spotted woodpecker	1.89 ± 0.18	1.88 ± 0.17	0.82
Snipe	1.92 ± 0.14	2.45 ± 0.23	0.02 *
Twite	2.00	2 ± 0.41	1
Dunlin	1.60 ± 0.24	2 ± 0.58	0.49

Raven	1.60 ± 0.15	2.22 ± 0.31	0.01 *
Common Sandpiper	1.47 ± 0.22	2.16 ± 0.26	0.04 *
Whinchat	1.38 ± 0.13	2.74 ± 0.64	0.007 **
Grey Wagtail	1.35 ± 0.13	1.78 ± 0.14	0.05
Peregrine	1.24 ± 0.15	1.36 ± 0.2	0.58
Dipper	1.22 ± 0.15	1.74 ± 0.17	0.05
Kestrel	1.23 ± 0.09	1.33 ± 0.1	0.39
Merlin	1.18 ± 0.10	1.5 ± 0.38	0.20
Buzzard	1.16 ± 0.10	1.71 ± 0.11	0.48
Short-eared Owl	1.08 ± 0.08	1.75 ± 0.47	0.03 *
Goshawk	1.00	1.00	1
Hen harrier	1.00	1.00	1
Red kite	1.00	1.00	1
Wigeon	1.00	2.00	
Wood Warbler	1.00	1.55 ± 0.31	0.31
Red-breasted merganser	0.00	1.5 ± 0.5	

Table 10. Frequency of occurrence (and number of squares in which they were present) across all 229 volunteer BBS squares surveyed in uplands in both 2006 and 2007. *P*-value derived from Fisher's Exact Test on a 2x2 contingency table for each species. In all tests of significance, * $p < 0.05$, ** $p < 0.01$

Species	Occurrence in volunteer BBS squares 2006 (n=229)		Occurrence in volunteer BBS squares 2007 (n=229)		*p*-value
Carrion Crow	0.85	195	0.87	199	0.69
Wren	0.82	188	0.86	196	0.10
Chaffinch	0.79	182	0.81	185	0.82
Meadow Pipit	0.77	176	0.76	175	1.00
Swallow	0.74	170	0.77	176	0.59
Woodpigeon	0.73	168	0.76	174	0.59
Blackbird	0.72	166	0.69	159	0.54
Skylark	0.69	158	0.66	150	0.49
Robin	0.68	155	0.67	154	1.00
Curlew	0.66	150	0.66	150	1.00
Willow Warbler	0.66	151	0.66	151	1.00
Pheasant	0.65	148	0.69	158	0.37
Blue Tit	0.62	141	0.63	145	0.77
Great Tit	0.55	126	0.53	121	0.71
Song Thrush	0.54	124	0.51	117	0.58
Jackdaw	0.52	120	0.52	118	0.93
Pied Wagtail	0.48	110	0.52	118	0.51
Lapwing	0.45	102	0.46	106	0.78
Mistle Thrush	0.45	102	0.45	104	1.00
Rook	0.34	79	0.39	89	0.38
Wheatear	0.32	74	0.40	92	0.10
Black-headed Gull	0.30	68	0.27	61	0.53
Red Grouse	0.28	63	0.28	65	0.92
Buzzard	0.27	61	0.31	71	0.35
Snipe	0.24	54	0.27	61	0.52
Redstart	0.22	50	0.20	46	0.73
Oystercatcher	0.20	45	0.20	45	1.00
Golden Plover	0.19	44	0.16	36	0.39
Raven	0.17	40	0.21	49	0.35
Stonechat	0.16	36	0.22	50	0.12
Grey Wagtail	0.16	36	0.21	47	0.23
Lesser Redpoll	0.12	27	0.11	25	0.88
Tree Pipit	0.10	24	0.11	25	1.00
Siskin	0.08	18	0.07	15	0.72
Dipper	0.08	18	0.06	14	0.58
Whinchat	0.07	16	0.08	18	0.86
Common Sandpiper	0.06	13	0.06	13	1.00
Short-eared Owl	0.06	14	0.02	4	0.03 *
Peregrine	0.05	11	0.05	11	1.00
Wood Warbler	0.04	10	0.05	11	1.00
Ring Ouzel	0.03	8	0.06	13	0.37
Merlin	0.03	6	0.03	7	1.00
Twite	0.02	5	0.02	4	1.00
Goshawk	0.01	3	0.01	2	1.00

Table 11. Mean abundance (± S.E.) of species across all upland volunteer squares covered in both 2006 and 2007. GLMs were used to test for significant differences in abundance. In all tests of significance, * p <0.05, ** p<0.01

Species	**Volunteer BBS 2006** (n=229)			**Volunteer BBS 2007 (n=229)**			***p*-value**
Meadow Pipit	13.29	±	0.95	15.49	±	1.15	0.13
Chaffinch	8.13	±	0.77	8.34	±	0.97	0.82
Carrion Crow	7.58	±	0.60	9.80	±	1.00	0.01 *
Jackdaw	7.12	±	0.79	9.70	±	1.32	0.03 *
Rook	6.98	±	1.22	7.66	±	1.11	0.58
Woodpigeon	6.03	±	0.56	6.68	±	0.57	0.36
Swallow	5.83	±	0.44	5.52	±	0.43	0.61
Skylark	5.79	±	0.55	6.10	±	0.57	0.66
Wren	5.07	±	0.37	6.14	±	0.41	0.04 *
Blackbird	4.82	±	0.42	4.94	±	0.44	0.83
Lapwing	4.40	±	0.57	4.44	±	0.64	0.95
Curlew	4.38	±	0.39	4.63	±	0.43	0.63
Blue Tit	3.80	±	0.34	4.03	±	0.37	0.62
Willow Warbler	3.75	±	0.36	4.08	±	0.37	0.48
Robin	3.61	±	0.33	3.59	±	0.30	0.97
Black-headed Gull	3.51	±	0.87	3.55	±	0.97	0.96
Pheasant	2.95	±	0.26	2.98	±	0.26	0.93
Great Tit	2.56	±	0.25	2.32	±	0.22	0.43
Song Thrush	1.53	±	0.15	1.49	±	0.14	0.84
Golden Plover	1.26	±	0.43	2.63	±	1.36	0.002 **
Red Grouse	1.25	±	0.21	1.37	±	0.25	0.60
Wheatear	1.05	±	0.16	1.16	±	0.13	0.50
Pied Wagtail	1.04	±	0.10	1.16	±	0.10	0.38
Oystercatcher	0.72	±	0.13	0.76	±	0.16	0.82
Redstart	0.62	±	0.10	0.53	±	0.09	0.37
Snipe	0.56	±	0.10	0.65	±	0.10	0.40
Buzzard	0.50	±	0.08	0.53	±	0.06	0.71
Raven	0.43	±	0.08	0.48	±	0.10	0.56
Lesser Redpoll	0.42	±	0.09	0.45	±	0.12	0.77
Stonechat	0.34	±	0.07	0.52	±	0.08	0.03 *
Siskin	0.31	±	0.10	1.22	±	0.57	<0.0001 **
Grey Wagtail	0.28	±	0.05	0.34	±	0.05	0.24
Tree Pipit	0.26	±	0.06	0.25	±	0.06	0.93
Whinchat	0.18	±	0.07	0.22	±	0.07	0.57
Common Sandpiper	0.10	±	0.03	0.14	±	0.04	0.19
Dipper	0.10	±	0.03	0.10	±	0.03	1.00
Short-eared Owl	0.08	±	0.02	0.03	±	0.02	0.0002 **
Ring Ouzel	0.07	±	0.03	0.11	±	0.04	0.03 *
Wood Warbler	0.07	±	0.02	0.07	±	0.03	0.80
Peregrine	0.06	±	0.02	0.07	±	0.02	0.77
Twite	0.06	±	0.03	0.03	±	0.02	0.04 *
Mistle Thrush	0.05	±	0.02	0.07	±	0.03	0.16
Merlin	0.03	±	0.01	0.05	±	0.02	0.02 *
Goshawk	0.02	±		0.01	±	0.01	0.02 *

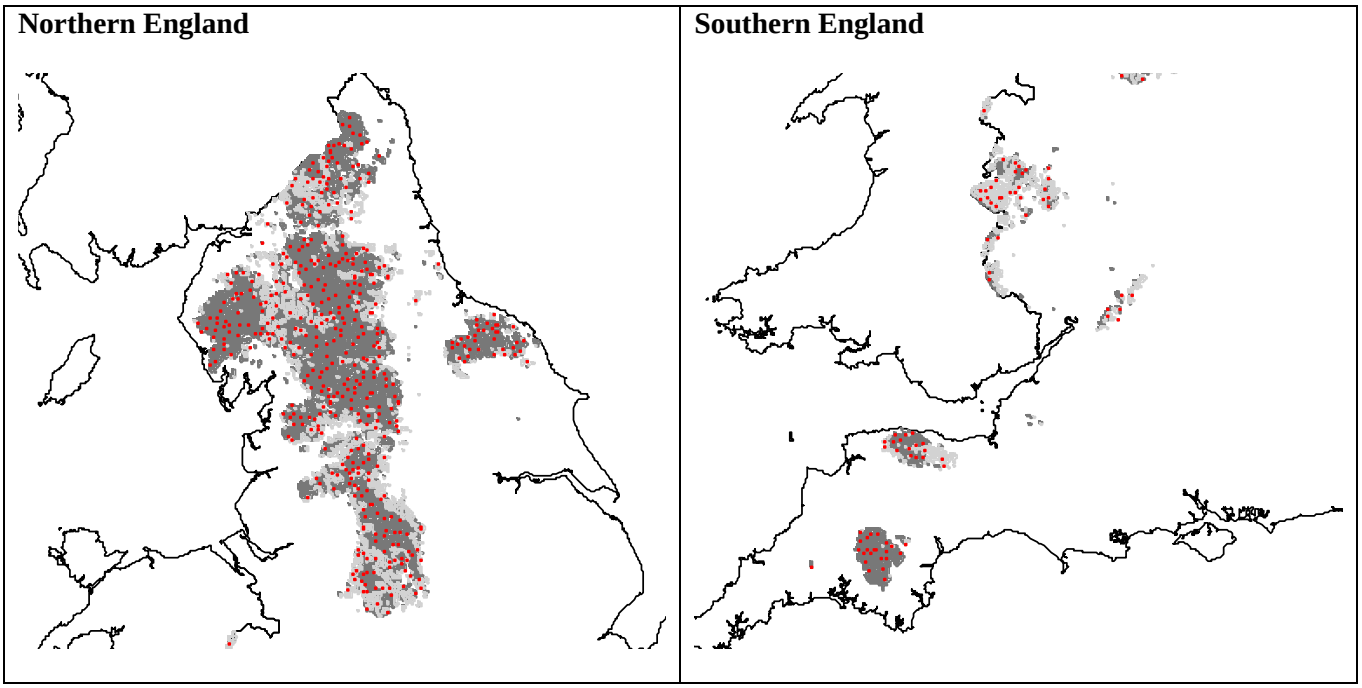
Table 12. Mean abundance (± S.E.) of species across upland volunteer squares covered in both 2006 and 2007 where species were present. GLMs were used to test for significant differences in abundance. In all tests of significance, * $p < 0.05$, ** $p < 0.01$

Species	Volunteer BBS 2006 (n=229)			Volunteer BBS 2007 (n=229)			*p*-value
Rook	20.24	±	3.04	19.70	±	2.35	0.87
Meadow Pipit	17.29	±	1.07	20.27	±	1.31	0.06
Jackdaw	13.59	±	1.23	18.82	±	2.26	0.01 *
Black-headed Gull	11.82	±	2.67	13.31	±	3.34	0.63
Chaffinch	10.23	±	0.90	10.32	±	1.15	0.93
Lapwing	9.87	±	1.04	9.59	±	1.21	0.84
Carrion Crow	8.90	±	0.66	11.28	±	1.11	0.01 *
Skylark	8.39	±	0.70	9.31	±	0.74	0.32
Woodpigeon	8.23	±	0.69	8.79	±	0.68	0.50
Swallow	7.85	±	0.50	7.19	±	0.49	0.32
Curlew	6.68	±	0.50	7.07	±	0.56	0.56
Blackbird	6.65	±	0.52	7.11	±	0.56	0.50
Golden Plover	6.57	±	2.06	16.75	±	8.39	0.01 *
Blue Tit	6.18	±	0.45	6.37	±	0.48	0.75
Wren	6.17	±	0.40	7.17	±	0.44	0.07
Willow Warbler	5.69	±	0.47	6.19	±	0.49	0.41
Robin	5.33	±	0.42	5.34	±	0.37	0.99
Great Tit	4.66	±	0.35	4.39	±	0.32	0.55
Pheasant	4.57	±	0.34	4.32	±	0.33	0.56
Red Grouse	4.56	±	0.57	4.83	±	0.74	0.73
Siskin	3.94	±	0.93	18.60	±	7.58	0.002 **
Oystercatcher	3.69	±	0.41	3.84	±	0.65	0.81
Lesser Redpoll	3.56	±	0.41	4.08	±	0.76	0.51
Wheatear	3.24	±	0.39	2.89	±	0.24	0.36
Redstart	2.86	±	0.28	2.65	±	0.32	0.60
Song Thrush	2.83	±	0.21	2.92	±	0.20	0.72
Twite	2.80	±	0.73	2.00	±	0.41	0.39
Whinchat	2.63	±	0.81	2.78	±	0.67	0.86
Tree Pipit	2.46	±	0.39	2.32	±	0.36	0.78
Raven	2.45	±	0.31	2.22	±	0.35	0.54
Snipe	2.39	±	0.32	2.44	±	0.26	0.88
Stonechat	2.19	±	0.25	2.36	±	0.23	0.58
Pied Wagtail	2.17	±	0.13	2.25	±	0.12	0.63
Ring Ouzel	1.88	±	0.48	2.00	±	0.57	0.86
Buzzard	1.87	±	0.20	1.70	±	0.11	0.38
Common Sandpiper	1.77	±	0.23	2.38	±	0.35	0.14
Grey Wagtail	1.75	±	0.17	1.66	±	0.13	0.65
Wood Warbler	1.60	±	0.22	1.55	±	0.31	0.88
Mistle Thrush	1.50	±	0.33	1.89	±	0.39	0.44
Dipper	1.33	±	0.18	1.71	±	0.19	0.13
Goshawk	1.33	±	0.33	1.00	±	0.00	0.46
Short-eared Owl	1.29	±	0.13	1.75	±	0.48	0.17
Peregrine	1.27	±	0.14	1.36	±	0.20	0.70
Merlin	1.00	±	0.00	1.57	±	0.43	0.16

Table 13. Summary table showing changes in occurrence and abundance of upland species in UBBS surveys 2006 and 2007 (n = 106) and BBS surveys 2006 and 2007 (n = 229)

	UBBS			Volunteer BBS		
	Change occurrence 06/07	**Change Abundance all 06/07**	**Change Abundance present 06/07**	**Change occurrence 06/07**	**Change Abundance all 06/07**	**Change Abundance present 06/07**
Buzzard	- 1	- 0.03	+ 0.14	+ 4	+ 0.03	-0.17
Common Sandpiper	+ 3	+ 0.02	- 1.75	0	+ 0.04	+ 0.61
Curlew	+ 3	- 1.29 *	- 2.21 *	0	+ 0.25	+ 0.39
Dipper	- 1	- 0.01	0	- 2	0	+ 0.38
Golden Plover	+ 5	+ 0.63 *	+ 0.62	- 3	+ 1.37 **	+ 10.18 *
Goshawk	- 2	- 0.02	- 1.00	0	- 0.01 *	-0.33
Grey Wagtail	- 6	-0.07	+ 0.60	+ 5	+ 0.06	-0.09
Lesser Redpoll	0	+ 0.03	+ 0.50	- 1	+ 0.03	+ 0.52
Meadow Pipit	0	+ 2.01	+ 2.01	-1	+ 2.2	+ 2.98
Merlin	0	+ 0.01	+ 0.11	0	+ 0.02 *	+ 0.57
Oystercatcher	+ 3	+ 0.16	+ 0.78	0	+ 0.04	+ 0.15
Peregrine	- 1	-0.01	0	0	+ 0.01	+ 0.09
Raven	+ 3	+ 0.02	- 0.14	+4	+ 0.05	- 0.23
Red Grouse	+ 3	+ 1.33 *	+ 1.93	0	+ 0.12	+ 0.27
Redstart	-1	-0.02	- 0.20	- 2	- 0.09	- 0.21
Ring Ouzel	+ 2	+ 0.04	- 0.12	+ 3	+ 0.04 *	+ 0.12
Short-eared Owl	- 1	- 0.01	0	- 4 *	- 0.05 **	+ 0.46
Siskin	+ 2	+ 0.16	+ 2.87	- 1	+ 0.91 **	+ 14.66 **
Stonechat	+ 16 *	+ 0.53 *	+ 0.73	+ 6	+ 0.18 *	+ 0.17
Tree Pipit	- 1	-0.05	- 0.90	+1	- 0.01	- 0.14
Twite	- 1	- 0.01	- 1.00	0	- 0.03 *	- 0.8
Wheatear	+ 11	+ 0.51 *	+ 0.50	+ 8	+ 0.11	- 0.35
Whinchat	+ 3	+ 0.04	+ 0.03	+1	+ 0.04	+ 0.15
Wigeon	-1	- 0.03	- 3.00	0	0	- 0.05
Wood Warbler	0	- 0.02	- 2.00	+1	+ 0.03	- 0.17

Figure 1. Location of random 500 squares in upland areas from which new squares surveyed in 2007 were selected



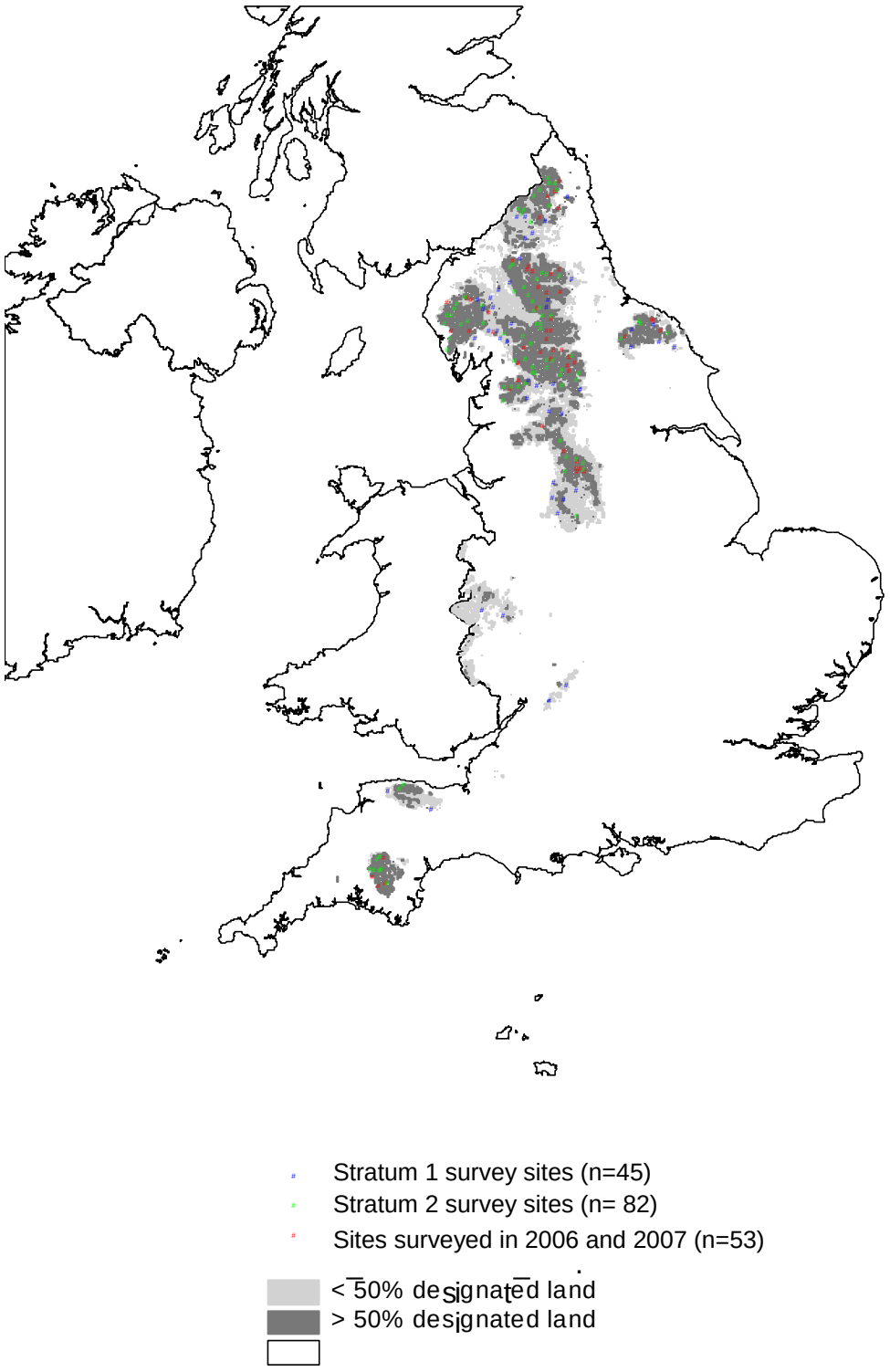


Figure 2. Location of the sites surveyed in 2007. New squares selected for survey in 2007 shown in green or blue, and sites surveyed in 2006 in red. New squares were defined according to the amount of Open Access land present within them: stratum 1 includes squares with <50% designated land in each 1km square (blue); level 2 includes squares with >50% designated land (green).

APPENDIX 1

The Average visitor index and Open Access visitor index across different types of land in 2006 and 2007. Average visitor index indicates whether the site is heavily visited or not: the higher the index number, the heavier the use. Open access index indicates whether visitors walked off public rights of way or not: the higher the index number, the less they kept to public rights of way. Index Range 0 to 5 (for VI, 0= no use, 5 = high use; for OAI 0=no off-PROW use, 5=very heavy off-PROW use)

Type of site	Average visitor index 2006	Open access index 2006	Average visitor index 2007	Open access index 2007
New CROW access land	1.0	1.6	1.2	1.2
Access previously tolerated	2.0	4.0	2.2	2.8
Rights prior to CROW commencement	2.7	3.0	2.6	2.6

Source; National Open Access On-Site Visitor Survey, Faber Maunsell, 2008

APPENDIX 2

List of all species seen on 2007 surveys

118 species were seen across all squares on the 2007 survey.
103 species were seen on the marginal upland stratum squares, of which 9 were seen in this stratum only (within [ ])
109 species were seen on the true upland stratum squares, of which 15 were seen in this stratum only (within ( ))

Blackbird
Blackcap
Black-headed Gull
(Black Grouse)
Blue Tit
Bullfinch
Buzzard
Canada Goose
Carrion Crow
Chaffinch
Chiffchaff
Coal Tit
Collared Dove
(Common Gull)
Common Sandpiper
Coot
[Cormorant]
Crossbill
Cuckoo
Curlew
(Dartford Warbler)
Dipper
(Dunlin)
Dunnock
Feral Pigeon
[Fieldfare]
Garden Warbler
Goldcrest
Golden Plover
Goldfinch
Goosander
(Goshawk)
Grasshopper Warbler
Great Black-backed Gull
Great Crested Grebe
Great Spotted Woodpecker
Great Tit
Greenfinch
Green Woodpecker
Grey Heron
Greylag Goose
Grey Partridge
Grey Wagtail
(Hen Harrier)
Herring Gull
(Hobby)
House Martin
House Sparrow
Jackdaw
Jay
Kestrel
(Kingfisher)
Lapwing
Lesser Black-backed Gull
Lesser Redpoll
Lesser Whitethroat
Linnet
Little Owl
(Long-eared Owl)
Long-tailed Tit
Magpie
Mallard
(Mandarin)
Marsh Tit
Meadow Pipit
(Merlin)
Mistle Thrush
Moorhen
[Mute Swan]
Nuthatch
Oystercatcher
(Peregrine)
Pheasant
[Pied Flycatcher]
Pied Wagtail
Raven
Red Grouse
Red-legged Partridge
[Red Kite]
Redshank
Redstart
Reed Bunting
[Ringed Plover]
Ring Ouzel
Robin
Rook
Sand Martin
Sedge Warbler
(Short-eared Owl)
Siskin
Skylark
Snipe
Song Thrush
Sparrowhawk
Spotted Flycatcher
Starling
Stock Dove
Stonechat
Swallow
Swift
Tawny Owl
Teal
Treecreeper
Tree Pipit
[Tree Sparrow]
[Tufted Duck]
Twite
Wheatear
Whinchat
Whitethroat
(Wigeon)
Willow Warbler
Woodcock
Woodpigeon
[Wood Warbler]
Wren
Yellowhammer
(Yellow Wagtail)

APPENDIX 3

Breeding Bird Survey Instructions

The survey is designed to be a quick, simple and, most importantly, an enjoyable birdwatching exercise. Plots are 1x1-kilometre (km) squares of the National Grid. Observers make just three visits to specially selected squares, the first to record habitat types and to set up a suitable survey route, and the second and third to record birds that are seen or heard while walking along the route.

Main aims

- To provide information on year-to-year, and longer term, changes in population levels for a wide range of breeding birds across a variety of habitats throughout the UK. Knowing to what extent bird populations are increasing or decreasing is fundamental to bird conservation. Monitoring birds has the added advantage that they act as valuable indicators to the health of the countryside.

- To promote a greater understanding of the population biology of birds and in particular to focus on factors responsible for declines. The BBS is a key component of the BTO's Integrated Population Monitoring Programme.

- To promote bird conservation through the involvement of large numbers of volunteers in survey work in the UK.

Which square should you survey?

Either your RO or National Organiser will have provided you with the Ordnance Survey (OS) grid reference of the 1-km square we would like you to survey. Grid references are in standard OS format (i.e. two letters for the 100-km square, two numbers representing the 'easting' and two numbers representing the 'northing'). Please check carefully the reference of the square you have been allocated. Squares have been chosen according to a formal sampling strategy to cover all habitats and regions. Comprehensive coverage is vital to the survey design. Please make every effort to cover the square that is assigned to you. **We will not be able to use data collected from additional or substituted squares.**

In cases where survey work proves impossible in a large part of the square you have been allocated, e.g. because it is physically impossible to visit or access permissions are not granted, please report this to your RO immediately so that a replacement square can be provided. It is very important not to reject squares on the grounds that they appear uninteresting - squares containing few species are just as valuable as squares with many species. For squares containing a large area of water, estimate how many of the 10 ideal transect sections are located on dry land (above Mean High Water). If this is less than 4 (i.e. less than 800m of transect) regard the square as 'uncoverable' and report it to Census Unit via your RO.

Tips to volunteers:

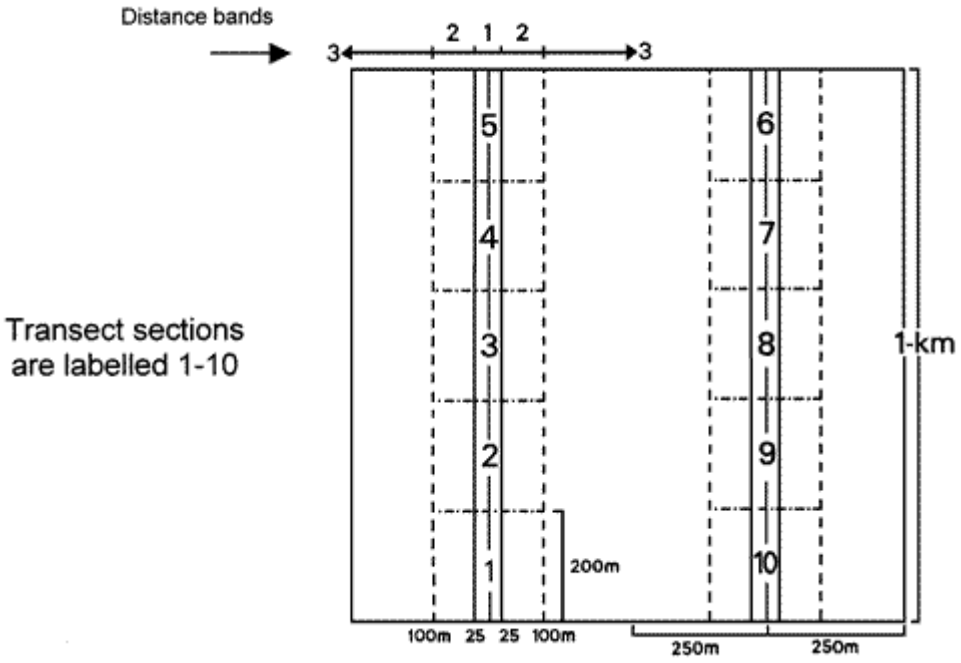
- Do not record birds you see or hear before or after your transect-line (i.e. behind your first 200m section or in front of your last 200m section).
- Record all birds to the sides of your transect-line.
- Record all birds from your transect-line that are beyond your 1km square (i.e. in adjacent 1-km squares) that are to the sides of your transect-line.
- Record habitat details each year. If you are only able to fill in the first two columns on the habitat form, this is still extremely useful.
- Ensure that only the number of birds recorded is written in each box on the count summary forms. Additional information such as "+" or "many" complicates the forms and should be avoided.
- Birds can be listed in any order on the Count Summary Sheet.
- Please put your forms in the following order on completion - from top to bottom: habitat, summary 1, summary 2, mammal, field 1, field 2. This will help speed up the processing of forms.

Finding and marking a route

If the square has been surveyed before, your RO should provide you with a sketch map of the counting route (the transect line) taken by the previous BBS observer. This route must be followed to ensure consistency of recording on that square (i.e. if a different route is taken, different birds will probably be recorded). If the route has to be changed because you can no longer get access to it, please consult your RO and return the completed Habitat Recording Form, with a sketch map of the new route on it. If, and only if the square has never been covered before (your RO will tell you this), will you need to create your own transect route across it.

The transect line through the square should ideally consist of two parallel lines, north-south or east-west, each 1-km long. **Please ensure that the route followed is the same as in previous years.** Transect lines should be 500 metres (m) apart and 250m in from the edge of the square. Each transect line should be divided into 5 equal sections of 200m in length, making a total of ten (2x5), numbered 1 to 10. It is important to note the starting points of each transect section either by using permanent landmarks (trees, hedges, boulders, houses etc) or by using temporary markers (coloured tape or cord etc).

Figure 1 - Transect route



In practice, your transect lines are likely to deviate from the 'ideal' because of problems with access, or barriers such as roads, rivers, and canals: possible solutions are given below. Once you have decided upon a route, it is of the greatest importance that the same route is followed year after year. In cases where the transect lines deviate considerably from the 'ideal', at no point should the two lines be closer together than 200m. **Minor intrusions into adjacent squares are perfectly acceptable and may provide the only practical way to carry out the survey. Please record the exact route taken in the box provided on the green habitat form.**

Summary of Fieldwork	
1. March - April	Reconnaissance visit to set up or check census route and record habitat
2. Early April - mid-May	Complete 'early' transect count
3. Mid-May - late June	Complete 'late' transect count
4. July - August	**BBS Online user:** Please ensure that you have entered all your data onto BBS Online.
	Paper form user: Return completed forms to your RO or directly to the BTO Census Unit if you have no acting organiser.
NB: The fieldwork should begin and end later in more northerly parts of the UK	

When to visit

The main part of the breeding season, roughly between 1st April and 30th June, in the lowlands of southern Britain, should be divided into two counting periods (early season visit = April to mid-May; late season visit = mid-May to late June) and one visit should be made in each half. **Visits should be at least 4 weeks apart.** The first should coincide with the main activity period of the resident breeding birds in an area, while the second should take place after the arrival of the latest migrant breeding birds. Where local conditions dictate, for example, at higher altitudes or further north, visits should be shifted later in the season, but the final transect count should be completed by mid-July. From late-June, counts will almost certainly include a much greater proportion of unidentified young birds, and most species will have reduced or stopped singing.

Counts should be made during the morning, beginning ideally between 6am and 7am, and no later than 9am. Please try to keep the starting times similar within a breeding season and across years, preferably to within half-an-hour. Please also try to keep the visit dates similar across the years. Counts will be more productive earlier in the day, with birds generally becoming quiet and inactive from late morning until mid afternoon (11am to 3pm). Starting times can be shifted to begin later in more remote and less accessible areas. If survey times extend beyond midday please use the 24-hour clock.

Weather

Please do not attempt to census birds in conditions of heavy rain, poor visibility or strong wind. Birds generally become inactive and quiet in windy and wet conditions, although activity often increases considerably after rain showers and therefore showery weather is generally okay to conduct a survey in. Bird activity also becomes quieter earlier in the day if there have been several previous days of fine weather, so an earlier start is therefore advisable. Please record weather conditions in the boxes provided on the forms that describe cloud cover, rain, wind speed, and visibility. Choose one number (1-3) from each of the four headings below and enter these in the box provided on the Field Recording Sheets. If the weather conditions change halfway through your survey, then record the mid-point; e.g. if cloud cover = 1 at the start of your survey visit and 3 at the end, then record 2.

Cloud cover		Rain		Wind		Visibility	
0-33%	= 1	None	= 1	Calm	= 1	Good	= 1
33-66%	= 2	Drizzle	= 2	Light	= 2	Moderate	= 2
66-100%	= 3	Showers	= 3	Breezy	= 3	Poor	= 3

Recording birds

Please record all the birds you see or hear as you walk along the two linear transects. Birds should be noted in the appropriate distance category, measured at right angles to the transect line. Do not record birds that are behind you as you begin a census or beyond the end of the transect.

From your chosen starting point, begin to walk the first half of your transect route at a slow and methodical pace. We recommend that you pause briefly to listen for bird songs and scan for birds flying

overhead. Please remember to note the starting and finishing times of each transect (using a 24-hour clock, e.g. 0630, six-thirty in the morning, 1300, one o'clock in the afternoon). As a guide an average visit should last around an hour and a half. Record all the birds you see and hear on the Field Recording Sheets in the appropriate transect sections 1-10 and in the appropriate distance category (see below).

Birds should be recorded in one of the following four categories when they were first noted:

1. within 25 metres either side of the line;
2. between 25 and 100 metres either side of the line;
3. more than 100 metres either side of the line, **including birds outside the 1-km square boundary**; or
F. birds in flight only (at any distance).

The transect is divided into 200m sections for convenience; please don't worry about birds at the boundary of two sections: record them in the one that seems more appropriate, but not in both. At the end of the first half (section 5) of the transect, record the time and break from recording while you make your way to the start of the second half of the transect route. Commence recording again through sections 6-10. Try not to record the same individual bird twice. So for example, a Mistle Thrush that can be heard singing from several transect stretches should be recorded once, where it was first detected.

We would strongly encourage observers to use the standard BTO species codes. Please familiarise yourself with the most likely codes before you go into the field. If a species is not listed please give the full common name. There is no need to record the activity or sex of the birds you encounter, although you may wish to do so. Please distinguish juvenile birds recorded from adults in those species where this is possible (e.g. B.juv, juvenile Blackbird), because counts of juveniles should not be entered onto BBS Online or the Count Summary Sheets. Please also note any feral species on transects.

Please note that distances are measured perpendicular to the transect line (i.e. at right angles to the line). A bird seen 200m ahead of the observer but close to the transect line should be recorded in category 1. We recommend that observers measure out distance categories (25m and 100m) using a combination of a tape measure and pacing to familiarise themselves with these before fieldwork begins. Category F, Birds in flight, relates to those flying over. Draw an arrow through the species' two-letter code to indicate that it is in flight. If a bird is seen to take off or land it should be recorded in the appropriate distance category (1-3) at that position. **N.B. Skylarks in display flight and hovering Kestrels should be recorded in the relevant distance category.** Please record swifts, swallows and martins in the flight category, unless they are seen to land or fly into a nest site, such as a barn or the eve of a roof.

If you have difficulty distinguishing adult and young birds, simply estimate to the best of your ability how many adults were present. We appreciate that mixed-aged flocks of crows or Starlings, for example, will present problems later in the season and ask that you observe and record with great care. Colonial nesters should be entered in the box provided at the end of the summary form (paper form users only).

Juvenile birds

Juvenile birds can be recorded on the Field Recording Sheets, but must NOT be entered onto BBS Online or the Count Summary Sheets. If you have difficulty distinguishing adult and young birds simply estimate, to the best of your ability, how many adults were present. We appreciate that mixed-aged flocks of crows or Starlings, for example, will present problems later in the season and ask that you observe and record with great care. Colonial nesters should be entered separately on BBS Online or in the box provided at the end of the Count Summary Sheet (paper form users only).

Colonial nesting birds

Birds nesting in dense colonies within the square (Rook, Sand Martin and gulls) will not be adequately censused using the standard method, and we ask observers to count or estimate the number of nests in the whole 1-km square. Colony counts should be conducted separately from the transects, and only for those species listed above. Please do not exclude counts of adult birds seen at these colonies during your normal line-transect counts (i.e. record the number of adults seen during your two line-transect counts as well as the number of active nests counted on your separate colony counts).

Habitat recording

Habitat recording is an essential part of the BBS because it allows changes in bird numbers to be related to changes in habitat available to them. **Habitat forms must be completed each year** using the coding scheme that is common to a range of BTO projects. This is shown on the back of the green form. The habitat recording system can be used without specialist knowledge. We advise that habitat details are recorded on your reconnaissance visit or following a count. Please do not record birds and habitat at the same time.

Habitat should be recorded separately for each of the 10 transect sections. Please record what you feel to be the most appropriate codes for each section (i.e. the area within a box 200m long by 50m wide). Codes allow you to describe both the predominant habitat, termed the **First habitat** on the form, and the secondary habitat, termed the **Second habitat** on the form. In many cases, two habitats will have equal importance and the order they are entered does not matter. For each habitat, choose one habitat code from each of levels 1 and 2, and up to two codes from levels 3 and 4. Please complete as much detail as you feel able: the first two levels are most important. If there is no appropriate code in levels 3 or 4 please put a dash ('-') in that column.

Please note that for squares covered for the first time, we ask for the habitat actually covered and the habitat of the ideal (straight) transects. After the first year, observers can use the more simple form as shown above, recording only the actual habitat details. 'Ideal' transects can be either North to South or East to West, depending on your chosen route. If major habitat changes occur on your square through the course of the survey, these changes should be recorded in the box provided. Please enter the transect number and the new codes. Examples of major habitat change include ploughing of set-aside, introduction or removal of animal stock and tree felling.

Visits made to your square

Please tick one of the three boxes indicating the number of visits made to your square during this season (January to July). If you have only visited your square during the three BBS visits (one habitat & two counts) then tick the first box (BBS visits only); if you have made up to three extra visits tick the second box (1-3 extra visits) and if you have made more than three extra visits tick the third box (4 or more extra visits). If you have only managed one or two visits to your square during the season also tick the first box (BBS visits only).