BTO RESEARCH REPORT 732

BirdTrends 2020: trends in numbers, breeding success and survival for UK breeding birds.

Woodward, I.D., Massimino, D., Hammond, M.J., Barber, L., Barimore, C., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Baillie, S.R. & Robinson, R.A.

BTO Birds Science People

BirdTrends 2020: trends in numbers, breeding success and survival for UK breeding birds

Meadow Pipit has raised a high alert for the first time. Photograph by Graham Clarke.

Key findings

Species list

Using the BirdTrends pages

The BTO's BirdTrends report is a one-stop shop for information about the population status of the common breeding birds of the wider UK countryside. The report is based on data gathered by the many thousands of volunteers who contribute to BTO-led surveys.

For each of 121 species, users can quickly access the latest information on trends in population size, breeding performance and survival rates, as measured by our long-term monitoring schemes. For each species, you will find:

- The latest conservation listings and estimates of UK population size
- A summary of changes in the size of the population and the possible causes of these changes
- Graphs and tables showing changes in UK population size, breeding performance and survival since our monitoring began
- Wherever possible, graphs and tables separately for UK countries (England, Scotland, Wales and Northern Ireland)
- Alerts, drawing attention to population declines of greater than 25%, or greater than 50%, that have occurred over the the most recent five-, ten- and 25-year assessment periods and the maximum period available (usually 50 years).

Text, tables, graphs and presentation for each species are updated annually to include the latest results alongside interpretative material from the literature. Information on demographic trends and on the causes of change is gradually being expanded.

There is far more to this report besides the species pages! Supporting pages describe the field and analytical methods that were used to produce the results for each species and to identify alerts. We discuss overall patterns of trends in abundance and breeding success, and compare the latest trend information and alerts with the Birds of Conservation Concern list, last updated in 2015 (Eaton *et al.* 2015). Summary tables list alerts and population changes by scheme, and you can use our 'table generator' to select and display tables of population change to your own specification. A detailed References section lists more than 820 of the most relevant recent publications, with onward links to abstracts or to full text where freely available, and is a valuable key to recent scientific work by BTO and other researchers.The Key findings page provides a brief overview of our main findings this year.

We would value your comments on this report and particularly any suggestions on how it can be improved:

EMAIL YOUR COMMENTS

Authors

These web pages constitute an annual report that is part of the BTO Research Report series. Authors were Ian Woodward, Dario Massimino, Mark Hammond, Sarah Harris, Dave Leech, David Noble, Ruth Walker, Carl Barimore, Stephen Baillie and Rob Robinson. The recommended citation for the report is as follows, and is given in the page footer throughout the report:

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Key findings

This section summarises the key findings of the report, under six headings, based on the results presented and discussed in the Summary tables and Discussion sections. It concentrates on the alerts raised by this edition of the report and changes to alerts since previous reports in this series.

Amber and red listings for breeding trends use similar criteria to the BirdTrends alerts and were reviewed in 2015. This report, using five further year's data not available to BoCC4, suggest potential updates to current conservation concern for Snipe, Redshank, House Martin, Meadow Pipit and Willow Warbler (from amber to red; though note that the trend for Snipe is based on a small sample), Sparrowhawk and Sedge Warbler (from green to amber) and Greenfinch (straight from green to red). However, it should be noted that Sedge Warbler has shown frequent fluctuations in trends over the long-term. In addition, although a long-term CBC/BBS trend is not available for Swift, the 23-year BBS trend suggests a potential update to the current conservation concern level for this species (from amber to red). This report also suggests that the listing for Oystercatcher could potentially be changed from green to amber for declines, although this would not change it's overall status as it is currently already amber listed based on other criteria.

Conversely this report also suggests potential downgrading of the alert status as a result of improved recent trends (and provided no changes in the other amber or red listing criteria have occurred), from red to amber for Song Thrush and Grey Wagtail, and from amber to green for Kestrel and Reed Bunting. These potential changes in status are also dependent on the recent upturns being sustained until the next listing review, and it should be noted in particular that Kestrel, Grey Wagtail and Reed Bunting have shown fluctuating long-term trends.

Declining species

Spotted Flycatcher became the sixth species showing a long-term decline of 90% or greater this year.

In the current report, there are 28 species for which our best long-term trends show statistically significant population declines of greater than 50% over periods of 31–51 years (see Latest long-term alerts).

These are Grey Partridge, Lapwing, Redshank, Woodcock, Snipe, Turtle Dove, Cuckoo, Little Owl, Willow Tit, Marsh Tit, Skylark, House Martin, Willow Warbler, Whitethroat, Starling, Mistle Thrush, Spotted Flycatcher, Nightingale, House Sparrow, Tree Sparrow, Yellow Wagtail, Meadow Pipit, Tree Pipit, Greenfinch, Linnet, Lesser Redpoll, Yellowhammer and Corn Bunting (taxonomic order).

Meadow Pipit has been added to this list in the current report as the 51-year decline is now greater than 50%. Little Grebe raised a formal alert in both the 2017 and 2019 reports but has been dropped from the list again this year as the trend is no longer statistically significant due to the wide confidence intervals around the estimates.

One further species shows a non-significant decline greater than 50% over a long timescale. Change for Lesser Spotted Woodpecker is non-significant over the longest period but only because data are sparse and monitoring ceased in 1999; a further strong decline has since been logged by Atlas data.

The steepest long-term populations declines we have measured are for Turtle Dove, Tree Sparrow, Nightingale, Grey Partridge, Willow Tit and Spotted Flycatcher, which have all declined by 90% or more since 1967, as, almost certainly, has Lesser Spotted Woodpecker. Turtle Dove shows the biggest decline of any species in this report (98%) and its rate of decline suggests it may soon disappear as a British breeding bird.

These 28 species that have halved in population size outweigh the 21 species found to show an equivalent increase, i.e. a doubling of population size, over similar periods. The gap between the numbers of species halving and doubling over the long-term has decreased by one species in this year's report.

Except for Whitethroat, which has shown sustained, though still limited, recovery following considerable losses in the late 1960s, all but one of these rapidly declining species already benefit from listing as either red or amber Birds of Conservation Concern (PSoB/BoCC4). The other exception is the green-listed Greenfinch, which raises a high alert after a rapid decline in the last ten years, following a period of sustained population increases during the 1980s and 1990s.

Four species listed as amber after the 2015 review (BoCC4) arguably meet red-list criteria for breeding population decline: these are Redshank, House Martin, Willow Warbler and Meadow Pipit. Snipe, which is currently amber-listed though not for population decline, also arguably now meets red-list criteria, although it should be noted that the WBS/WBBS decline reported for this species is based on a small sample.

A further seven species raise lower-level concern, as a result of statistically significant long-term declines of between 25% and 50%. These are Common Sandpiper, Sedge Warbler, Song Thrush, Dipper, Dunnock, Grey Wagtail and Bullfinch. These species are already on the amber list on account of their population declines, except for Song Thrush and Grey Wagtail which are red listed, and Sedge Warbler which for now remains on the green list. Populations Common Sandpiper have been in recent decline, whereas the more sustained recent increases by Song Thrush, Dunnock and Bullfinch have been insufficient to fully reverse earlier declines. Numbers of Sedge Warbler and Grey Wagtail have fluctuated recently.

Two further species which do not raise alerts over the long-term (51-year) period have recorded statistically significant declines of between 25% and 50% over the 25-year period and hence also raise lower-level alerts. These are Oystercatcher and Tawny Owl.

In addition, Curlew (now red listed) has declined by more than 25% (as also shown by atlas data), but raises no formal long-term alert because the confidence intervals around its change estimates are too wide.

Three species with much shorter monitoring histories have also decreased by more than half during just a 23-year period. Two of these are already red listed (Wood Warbler and Whinchat), and the third is currently amber listed (Swift). Set against these three species are eight that have more than doubled over equivalent shorter periods (see Positive changes). In addition, Pied Flycatcher and Wheatear, which also have a shorter monitoring history, declined by between 25% and 50% over a 23-year period. The former species is currently red-listed whereas the latter is green-listed and shows a fluctuating trend over this period.

Many of the declining species are farmland and woodland specialists, and some of the alerts may therefore relate to common pressures in these habitats which are reflected in the negative trends for both habitats in the UK Biodiversity Indicators, although some farmland and woodland species may be subject to more specific issues which are detailed in the species accounts, for example the Greenfinch decline has been linked to trichomonasis disease. Four species commonly associated with urban habitats (Swift, House Martin, Starling and House Sparrow) are also declining.

Recent changes to alerts

Following a severe recent decline attributed to disease caused by the *Trichomonas* parasite, Greenfinch could potentially move straight from the green to the red list when the list is next updated.

The *BirdTrends* report raises species alerts for population change to conservation bodies when the best available estimates of long-term decline are statistically significant and pass criteria set at -25% and -50%.

Species with declines close to these threshold values often change category between years. Discussion tables A1–A3 indicate six changes to the alerts since *BirdTrends 2019*, affecting six different species.

- For the amber-listed Meadow Pipit, the 51-year CBC/BBS decline for England now raises a high alert. The 25-year trend continues to raise a lower level alert.
- The 25-year CBC/BBS UK decline for Marsh Tit now raises a lower alert, with the trend suggesting that the rate of decline may have slowed slightly. However, the 51-year CBC/BBS trend for this species continues to raise a high alert.
- The amber-listed Dipper again raises formal lower level alerts, based on the 43-year WBS/WBBS trend. This species has raised a similar alert in previous reports but did not raise a formal alert in *BirdTrends 2019* as the estimates were not statistically significant due to wide confidence intervals.
- The 42-year WBS/WBBS trend for Little Grebe and the 51-year CBC/BBS trend for Garden Warbler again raise no formal alerts in this report. As for Dipper, both species have raised formal alerts in some of the recent BirdTrends reports but not in others, as the confidence intervals have changed and hence the estimates have not always been statistically significant.
- The amber-listed Oystercatcher is listed in Table A3 and raises a formal lower level alert as the 25-year decline now greater than 25%.

Amber and red listings use similar criteria and were reviewed in 2015. This report, using five further year's data not available to BoCC4, suggest potential updates to current conservation concern for Snipe, Redshank, Sparrowhawk, House Martin, Willow Warbler and Greenfinch (though note that the trend for Snipe is based on a small sample) and possibly Sedge Warbler. In addition, although a long-term CBC/BBS trend is not available for Swift, the 23-year BBS trend suggests a potential update to the current conservation concern level for this species (from amber to red).

The number of species for which potential updates to current conservation concern are suggested by the alerts has increased in recent years (Table 1).

Table 1: Summary of potential updates to BoCC4 conservation listings resulting from changes to population trends, based on alerts in recent BirdTrends reports. Note that the future update decisions will not necessarily follow the alerts in all cases but may take additional information into account, particularly for species for which alerts are based on a small sample, or long-term results are only available for England and not for the UK as a whole.

	2017	2018	2019	2020
Amber to Red	3	4	4	6
Green to Red	0	1	1	1
Red to Amber	1	2	2	2
POTENTIAL CHANGE TO RED LIST	+2	+3	+3	+5
Green to Amber	2	1	3	2
Amber to Green	2	2	2	2

POTENTIAL CHANGE TO AMBER LIST	-2	-3	-1	-4
POTENTIAL OVERALL CHANGE TO NUMBER OF LISTED SPECIES	0	0	+2	+1

Alerts from WBS/WBBS (Table A4) are unchanged, apart from the changes in alert status for Little Grebe and Dipper which are described above.

The alerts for CES (Table A5) show changes from *BirdTrends 2019* for two species. The 25-year and 34-year trends for Chaffinch now both raise a high level alert, as does the 25-year trend for Sedge Warbler (the 34-year trend for Sedge Warbler continues to raise a lower level alert, as in *BirdTrends 2019*).

Positive changes

The Great Spotted Woodpecker population has trebled in the UK since 1967.

Although much of this report focuses on declines and their conservation significance, there are many species that are increasing in number as breeding birds in the UK.

In the current report, there are 21 species for which our most representative long-term trends show a statistically significant doubling in population size over periods of 25–51 years.

These are Mute Swan, Greylag Goose, Canada Goose, Shelduck, Mallard, Goosander, Buzzard, Coot, Stock Dove, Woodpigeon, Collared Dove, Green Woodpecker, Great Spotted Woodpecker, Jackdaw, Carrion Crow, Long-tailed Tit, Chiffchaff, Blackcap, Nuthatch, Wren and Goldfinch (in taxonomic order). Long-tailed Tit has been added from this list in the current report after being dropped in the 2019 report, as the population increase is again just above the threshold for inclusion following increases between 2018 and 2019.

The steepest long-term increases we have measured have been for Buzzard, Greylag Goose, Great Spotted Woodpecker, Blackcap, and Shelduck, which have all increased by 300% or more since 1967 (or since 1975 for Greylag Goose); note however that the increase for Shelduck covers up to 1999 only as a combined CBC/BBS trend cannot be produced, so it is unclear whether the increases have been sustained subsequently.

The 21 species that have doubled over the long term are set against the 28 that have halved in number over similar periods (see Declining species).

Eight further species, monitored only over a shorter period, have also more than doubled (see Increasing species). These are Mandarin Duck, Gadwall, Little Egret, Red Kite, Barn Owl, Ring-necked Parakeet and Stonechat (all monitored by BBS over 23-years) and Cetti's Warbler (monitored by CES over the period 1990–2018). Three additional species have more than halved over this shorter period (see Declining species).

For twelve species that are listed in this report for a population decline over the long term – Ten-year trends and evidence of species recovery).

Five further formerly declining species – Snipe, Linnet, House Sparrow, Yellow Wagtail and Bullfinch – have reversed their population trend to show statistically significant increases over the last ten years. For all these species, however, overall population levels remain severely depleted, despite the recent increases.

Whilst many of the declining species are farmland and woodland specialists, several of the increasing species are associated with wetland habitats. Many of the others which were historically associated with woodland are generalists and have been able to successfully move into suburban habitats: these species have almost certainly benefited from the widespread provision of supplementary food in gardens. Some increases can also be attributed to species-specific reasons, for example reduced persecution (Buzzard) or successful reintroduction (Red Kite). Four of the increasing species are non-native and hence could raise concerns as they may impact on native breeding species.

Reduced breeding success

There is increasing evidence to suggest that Willow Warbler population declines have been driven, at least in part, by a reduction in breeding success.

Our best measure of nest-level breeding success is Fledglings Per Breeding Attempt (FPBA), calculated from brood sizes and nest failure rates recorded by participants in the Nest Record Scheme, which indicates the mean number of young fledging from each nest in a given year.

FPBA has changed significantly and is currently lower than in the late 1960s for 15 species: three red-listed species (Wood Warbler, Tree Pipit and Linnet), five amber-listed species (Nightjar, Willow Warbler, Dunnock, Meadow Pipit and Reed Bunting) and seven green-listed species (Moorhen, Great Tit, Long-tailed Tit, Garden Warbler, Treecreeper, Blackbird and Chaffinch).

While the overall trend in productivity of Great Tit, Willow Warbler, Garden Warbler and Linnet has been linear, i.e. falling over the last 51 years, trends for the other 11 species are curvilinear and for some species in this latter group, FPBA is currently only marginally lower than in the 1960s. For ten of the species showing curvilinear trends, FPBA increased between the mid 1960s and mid 1980s or mid 1990s and decreased thereafter; whereas in the case of Nightjar, productivity decreased from the mid 1960s until the mid 2000s but has increased slightly over the last ten years.

Productivity declines in migratory species: Nightjar, Willow Warbler, Garden Warbler and Tree Pipit, may be driven in part by birds returning in poorer condition as a result of changes in habitat or climate on their African wintering grounds. For Willow Warbler and Garden Warbler there is evidence that conditions on the breeding grounds and, in the case of the latter, grazing pressure from deer, may also be important. The majority of species exhibiting productivity declines, including residents such as Reed Bunting, are reliant on invertebrates to feed their young and there is increasing evidence that climatic change and/or anthropogenic factors, such as pesticides, are leading to a reduction in the size of prey populations. Additionally, climatic warming may have resulted in a developing asynchrony between laying dates and the availability of insect prey on the breeding grounds. So, although this report shows that many species are advancing laying dates (see early breeding), for some species these advances may not be sufficient to match the advances in peak food availability. Long-distance migrants are thought to be particularly susceptible to such disjunction but residents may also be affected, particularly those reliant on seasonal peaks in caterpillars, such as Great Tit, Chaffinch and, to a lesser extent, Treecreeper; however, numbers of Great Tit have increased over period covered by this report and we cannot exclude the possibility that the observed reduction in breeding success is due to density-dependent processes. Lack of food for nestling and parent Linnet due to a paucity of stubbles and weeds in more intensively farmed agricultural habitats is likely to have contributed to the reduction in the species' breeding success. The driver for increased Moorhen nest failure is at present unclear, but increases in aquatic mammalian predators and Coot populations have been proposed as potential causes.

The key breeding success parameter from CES ringing data, the ratio of juveniles to adults captured, provides an integrated measure of productivity across the whole season, and reflects both the number of young leaving the nest and the survival of these juveniles in the first few weeks after fledging. According to this measure, productivity has fallen significantly for seven of the 23 species monitored. Willow Tit, Sedge Warbler and Reed Bunting have exhibited declines of 50% or more over the last 34 years, while reductions of between 25% and 49% have been observed for Blue Tit, Blackbird, Song Thrush, and Garden Warbler. For species such as Blue Tit, where a population increase occurred until the mid-2000s, reductions in productivity may be at least partly driven by density-dependent processes, whereby increased competition for resources in an expanding population will mean that some pairs occupy poorer quality habitat and reduces the mean breeding success per pair. However, if this were the case we would expect productivity to have improved during the recent decline in Blue Tit abundance. Alternatively, climate induced mismatch with invertebrate food supplies may be impacting negatively on productivity and/or post-fledging survival, particularly in the case of the caterpillar-dependent tit species. Song Thrush and Sedge Warbler have experienced significant declines in abundance, either on CES sites or more widely (based on CBC/BBS figures), but previous analyses suggest that falling survival rates are likely to have been a more important contributor to population changes than reduced productivity. There is, however, evidence that a reduction in the number of offspring produced may be preventing recovery of the UK Reed Bunting population.

Increased breeding success

Nuthatch has exhibited the greatest increase in productivity of any species over the past 51 years, due to a combination of increasing brood sizes and nest survival rates

Our best overall measure of breeding success is Fledglings Per Breeding Attempt (FPBA), calculated from brood sizes and nest failure rates, which indicates the mean number of young leaving each nest in a given year.

FPBA has changed significantly and is currently higher than in the late 1960s for 29 species, across a wide range of taxonomic groups. This total includes 10 species for which the change has been linear, i.e. consistent increases in productivity across the last 50 years, and 19 species which show curvilinear trends (i.e. early decreases in FPBA were followed by increases, or vice-versa). For some species in the latter group, FPBA is currently only slightly higher than in the late 1960s.

Population trends are also positive for 17 of the 28 species, including raptors (Sparrowhawk, Buzzard, Barn Owl, Merlin, Peregrine), pigeons (Stock Dove, Woodpigeon, Collared Dove), corvids (Magpie, Jackdaw, Carrion Crow), and some small passerines (Reed Warbler,Nuthatch, Wren, Robin, Redstart and Pied Wagtail). It is therefore possible that increasing productivity has contributed to the population growth exhibited by these species over recent decades.

Conversely, 12 species (Turtle Dove, Little Owl, Tawny Owl, Kestrel, Skylark, Starling, Wheatear, Dipper, House Sparrow, Tree Sparrow, Grey Wagtail and Yellowhammer) have declined in number as FPBA has increased, suggesting that a density-dependent reduction in intraspecific competition, or a retreat into better quality habitat, may have enabled breeding success to rise.

CES ringing data integrate productivity across the whole season, including juvenile survival in the first few weeks or months after fledging. According to this measure, productivity has risen significantly for just one of the 23 species monitored (Chaffinch). The discrepancy between the positive Chaffinch CES trend and the decline in breeding success identified by the NRS warrants further study, but increased survival rates in post-fledging period could contribute to this, although data are sparse for this vital period.

Early breeding

The advance in Redstart laying dates is the greatest exhibited by any migratory species; the species now breeds a fortnight earlier, on average, than it did in the mid-1960s.

Data from the Nest Record Scheme provide strong evidence of shifts towards earlier laying in a range of species, linked to climatic change. This report identifies 38 species that, on average, are laying between three and 21 days earlier, on average, than in the mid 1960s.

The species now laying earlier in the year represent a wide range of taxonomic and ecological groups, including raptors (Kestrel – 8 days), waterbirds (Moorhen – 5 days), migrant insectivores (e.g. Pied Flycatcher – 10 days, Swallow – 12 days), resident insectivores (e.g. Robin – 10 days, Great Tit – 9 days), corvids (e.g. Magpie – 19 days) and resident seed-eaters (e.g. Greenfinch – 21 days, Corn Bunting – 9 days).

For some species these shifts towards earlier laying may be insufficient to match seasonal advances in the peaks of food availability. Recent research has shown that significantly stronger phenological responses to climate change are displayed at lower trophic levels (such as the food birds eat) than at higher levels (such as the birds themselves), increasing the potential for disjunction and resulting productivity declines. However, the evidence for a population-level effect of reduction in breeding success is mixed and more research is needed to determine the extent to which declines in abundance will result.

Only three species demonstrate a significant delay in average laying dates, of between one and 21 days: Woodpigeon, Barn Owl, and Yellowhammer (taxonomic order), and one species shows no change in average laying date (Blackbird). All of these species initiate multiple breeding attempts per season and there is increasing evidence that species which are less reliant on seasonal peaks in resource availability may be able to extend their breeding seasons further into the summer, resulting in a later mean value for laying date.

Introduction

Gathering quantitative information on the bird populations of the UK has been a key function of the BTO ever since its formation in 1933. Its nationwide network of volunteer observers, many of whom are highly skilled and long-term contributors to survey schemes, provides the ideal way to monitor bird populations, particularly for the commoner species that are widely distributed across the countryside. BTO data, from such schemes as the Common Birds Census, Nest Record Scheme and BTO/JNCC/RSPB Breeding Bird Survey, have been increasingly influential in determining nature conservation policy in the UK. The partnership between JNCC and BTO has ensured that these schemes are operated and developed in ways that provide high-quality information for nature conservation.

The value of the monitoring work undertaken by the BTO (and its partners in some schemes) is reflected in their use in government biodiversity and wildlife statistics. The schemes fulfil a considerable portion of the government's monitoring needs for UK birds, at species level and as multi-species *indicators* of bird population changes (Gregory *et al.* 2004). Indicators of trends in breeding birds (e.g. Defra 2015) help the government track the UK's progress towards international targets, such as those set by the Convention on Biological Diversity in October 2010. This approach has been extended more widely through a collaboration between EBCC, BirdLife and RSPB to produce pan-European bird indicators (PECBMS 2020b).

Our 2020 report is the latest in a series, begun in 1997, produced under the BTO's Partnership with the Joint Nature Conservation Committee (on behalf of Natural England, Scottish Natural Heritage, Natural Resources Wales, and the Department of Agriculture, Environment and Rural Affairs - Northern Ireland) as part of its programme of research into nature conservation.

Only the first two reports were published on paper, with subsequent ones being produced solely as web documents. A complete list of all the previous reports and links to those published online can be found here. The first 12 reports were titled *Breeding Birds in the Wider Countryside: their conservation status* but this is now known as 'the *BirdTrends* report', with an informal title that matches its web link.

All the commonest and most widespread UK breeding bird species have a *BirdTrends* page, updated annually to incorporate the latest survey data and assessments of trends. Colonial seabirds, which are well covered by the results of Seabird 2000 (Mitchell *et al.* 2004) and by the JNCC's Seabird Monitoring Programme (JNCC 2016), and species covered by the Rare Breeding Birds Panel (Holling & RBBP 2017), are in general not included here – though with a handful of exceptions.

The main emphasis of this report is on trends in the abundance and demography of individual breeding species. The system of alerts, derived from the BTO's census and nest record data, ensures that conservation bodies are quickly made aware of important demographic changes.

Trends in wintering populations of waterfowl are covered by the Wetland Bird Survey annual reports, also now fully available online (Frost *et al.* 2020), and by the *WeBS alerts* system (Woodward *et al.* 2019).

Monitoring UK breeding birds

Long-running bird surveys operated by BTO contribute to an overall programme of Integrated Population Monitoring (IPM) that has been developed by the BTO, in partnership with JNCC, to monitor the numbers, breeding performance and survival rates of a wide range of bird species. IPM has the following specific aims (Baillie 1990, 1991):

1. to establish thresholds that will be used to notify conservation bodies of requirements for further research or conservation action;
2. to identify the stage of the life cycle at which demographic changes are taking place;
3. to provide data that will assist in identifying the causes of such changes; and
4. to distinguish changes in population sizes or demographic rates induced by human activities from those that are due to natural fluctuations.

Changes in numbers of breeding birds have been measured by:

- the BTO/JNCC/RSPB Breeding Bird Survey (BBS) – which began in 1994 and replaced the CBC (below) as the major monitoring scheme for landbirds, after a seven-year overlap. BBS is based on around 3,000 1-km squares, within each of which birdwatchers count and record birds in a standardised manner along a 2-km transect. Because the survey squares are chosen randomly, the results are representative of all habitats and regions. Combined CBC/BBS indices now provide long-running and ongoing population monitoring for many common birds.
- the *Common Birds Census* (CBC) – which ran from 1962 to 2000. This scheme mapped the breeding territories of common birds through intensive fieldwork on 200–300 mainly farmland and woodland plots each year, averaging about 70 and 20 ha respectively.
- the Waterways Breeding Bird Survey (WBBS) – which began in 1998 and replaced the WBS (below) as the major monitoring scheme for breeding birds along rivers and canals, after a ten-year overlap. It is a transect scheme akin to BBS but with the transects running alongside linear waterways. Transects comprise up to ten 500-m sections and cover typically 3–3.5 km of bird-rich habitat. Around 250–300 sites are covered each year, mostly randomly selected. Combined WBS/WBBS indices now provide long-running and ongoing population monitoring for many common waterside birds.
- the *Waterways Bird Survey* (WBS) – which ran from 1974 to 2007. WBS observers mapped the territories of birds along rivers, streams and canals on 80–130 plots each year, each on average 4.5 km in length. Around 70 of these sites are currently incorporated within WBBS.
- the Constant Effort Sites scheme (CES) – which began in 1983 and is based on breeding-season bird ringing at over 100 sites. The catching effort is kept constant at each site during each year, so that changes in numbers of birds caught will reflect population changes and not variation in catching effort.
- the Heronries Census – through which counts of 'apparently occupied nests' have been collected from a high proportion of the UK's heronries every year since 1928.

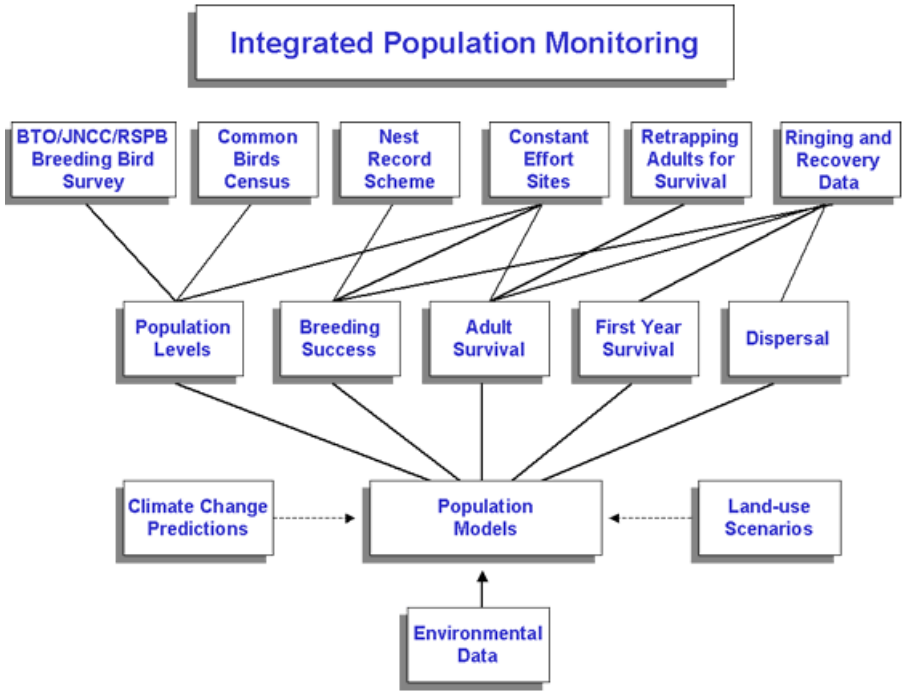
Changes in breeding performance are measured by:

- the Nest Record Scheme – which began in 1939 and collates standardised information on up to 35,000 individual nesting attempts per year. This allows the measurement of:
  - laying dates
  - clutch sizes
  - brood sizes
  - nesting success during egg and chick stages
  - fledglings per breeding attempt (integrating success across all nesting stages).
- CES (see above) – which provides information on overall productivity for a range of species by measuring the ratio of juveniles to adults caught each year.

Changes in survival are measured by:

- the British and Irish Ringing Scheme – which provides information on the finding circumstances and longevity of ringed birds found dead by members of the public.
- CES also provides information on survival rates, based on the recapture of ringed birds at constant-effort sites.
- Further information on survival rates is provided through the Retrapping Adults for Survival scheme (RAS).

The ways in which the schemes fit together are shown in the diagram below, which also demonstrates the way in which the BTO aims to combine all this information, using population models, to elucidate the mechanisms behind the changes we observe in population size.


Integrated Population Monitoring
BTO/JNCC/RSPB Breeding Bird Survey
Common Birds Census
Nest Record Scheme
Constant Effort Sites
Retrapping Adults for Survival
Ringing and Recovery Data
Population Levels
Breeding Success
Adult Survival
First Year Survival
Dispersal
Climate Change Predictions
Population Models
Land-use Scenarios
Environmental Data

Combining results from different schemes

Monitoring the changes in the size of a population does not in itself provide sufficient information on which to base an effective conservation strategy (Goss-Custard 1993, Furness & Greenwood 1993). Concurrent monitoring of breeding performance and survival rates is necessary to allow changes in population size to be properly interpreted (Temple & Wiens 1989, Crick *et al.* 2003) and, for long-lived species, can provide early warning of impending conservation problems (Pienkowski 1991).

Where good long-term data sets for breeding performance and survival are lacking, conservation action might have to be taken without an adequate understanding of the mechanisms involved or might need to wait years for detailed research to be undertaken. As this report demonstrates, however, there are many species for which BTO already holds the necessary data, collected by volunteer observers over periods of several decades (Greenwood 2000).

For a long-lived species, a decline in population may not begin until a long period of low survival or reduced reproductive output has already passed. The classic example is that of the Peregrine, which in the UK suffered from poor breeding performance during the 1940s and 1950s due to sub-lethal DDT contamination. This drop in productivity decreased the capacity of the non-breeding section of the population to buffer the severe mortality of breeding adults that occurred due to cyclodiene poisoning from the mid 1950s onward (Ratcliffe 1993). Monitoring of breeding performance gave an early warning of impending numerical decline (Pienkowski 1991). Another example of a decline in breeding performance that presaged population decline is the catastrophic breeding failures of seabirds, particularly Arctic Terns, in Shetland (Monaghan *et al.* 1989, 1992, Walsh *et al.* 1995, Mavor *et al.* 2003, 2004, Wanless *et al.* 2005).

Farmland birds

During the mid 1980s, the BTO identified rapid declines in the population sizes of several farmland bird species (O'Connor & Shrubb 1986, Fuller *et al.* 1995). The BTO has since been able to investigate the demographic mechanisms underlying these declines, using its long-term historical data sets (Siriwardena *et al.* 1998a, 2000a).

This investigation, which was funded by Government and undertaken jointly with Oxford University, looked at changes in population size, breeding performance and survival rates of a variety of species in relation to changing farming practice. It showed that species responded to different aspects of agricultural change, but that typically these aspects were linked to intensification or regional specialisation. Declines in survival rates were found to be the main factor driving population decline in these species, with the exception of Linnet, for which the main factor appears to have been a decline in nesting success at the egg stage (Siriwardena *et al.* 2000b). The study was therefore able to eliminate some possible causes of change, and identify areas for future research, thus helping conservation bodies to use their scarce resources productively. This work made an important contribution to the wider programme of work on farmland birds undertaken by many research and conservation organisations (Aebischer *et al.* 2000, Vickery *et al.* 2004).

This report describes a number of other cases where the combined analysis of BTO data sets has helped to identify the causes of population declines, for example on the pages for Integrated population analysis'.

Biodiversity Action Plans

The ability to quickly determine the stage of the life cycle exerting the greatest influence on population declines is particularly important for the conservation agencies when considering remedial action for species on the lists of conservation concern. Analysis of BTO data sets, which has already helped to build these lists, is a key point in several of the UK Government's biodiversity action plans for rapidly declining species. Once conservation actions have been initiated, the BTO's Integrated Population Monitoring programme has a further function, because the success of these actions will be measured and assessed by continued BTO monitoring.

The aims of this report

The BirdTrends report is used by conservation practitioners as a ready reference to changes in status among breeding birds in the UK. Here on the BTO website, it is available to a much wider audience including BTO supporters, who may have contributed data, and the general birdwatching public. We hope that it also provides a useful resource for schools, colleges and universities, the media, ecological consultants, Wildlife Trusts, decision-makers, local government, and the more general world of industry and commerce. In summary, its aims are:

1. To provide, to as wide a readership as possible, a species-by-species overview of the trends in breeding population, reproductive performance and survival rate for birds covered by BTO monitoring schemes since the 1960s, at the UK and UK-country scales.
2. To provide warning alerts to JNCC and country agencies and to other conservation bodies about worrying declines in population size or reproductive success, with special reference to species on the UK red and amber lists of Birds of Conservation Concern.

Acknowledgements

Volunteer fieldwork

The volunteers who collected the data on which this website is based deserve full credit for their achievement. The population trends and other results that we present rely on the sustained, long-term fieldwork effort of many thousands of BTO volunteers. Our knowledge of the conservation status of the UK's bird populations is possible only as a result of their dedication. The conservation community owes them all an enormous debt of gratitude for their work. Without their enthusiasm, the cause of conservation in the UK would be very much the poorer.

We are also very grateful to the many land managers and landowners who permitted census work, nest recording and ringing to take place on their land.

Report production and analysis

This website presents the latest in a series of reports, prepared within the partnership between the British Trust for Ornithology (BTO) and the Joint Nature Conservation Committee (JNCC) (on behalf of the Department of Agriculture, Environment and Rural Affairs - Northern Ireland, Natural England, Natural Resources Wales and Scottish Natural Heritage), as part of its programme of research into nature conservation.

Mr and Mrs J A Pye's Charitable Settlement provided additional support towards the development of the website.

Our report includes results from the Breeding Bird Survey, which is funded jointly by BTO, JNCC and RSPB. The BBS partners are very grateful to the Department of Agriculture, Environment and Rural Affiars in Northern Ireland and to the Royal Society for the Protection of Birds in Scotland for supporting professional surveys in areas that would otherwise be difficult to cover. The report also includes results from the Ringing Scheme, which is funded by the JNCC, BTO and the ringers themselves.

Paul Woodcock of JNCC provided helpful discussions, comments and support during the production of this report. Helen Baker, Chris Cheffings, Jacquie Clark, Nigel Clark, David Gibbons, Jeremy Greenwood, Rowena Langston, Ian McLean, Ian Mitchell, Deborah Procter, David Stroud, Pierre Tellier, Malcolm Vincent and Lawrence Way provided helpful comments on earlier editions of this publication.

The analyses would not have been possible without the hard work of many past and present BTO staff who have organised schemes, collated data sets, overseen analyses or contributed to the text in previous versions of this report, including: Sue Adams, Dawn Balmer, Lee Barber, Richard Bashford, Jeremy Blackburn, Jacquie Clark, Mark Collier, Greg Conway, Rachel Coombes, Humphrey Crick, Daria Dadam, Diana de Palacio, Sarah Eglington, Steve Freeman, Mark Grantham, Bridget Griffin, Andrew Joys, Allison Kew, John Marchant, Stuart Newson, Mike Raven, Brenda Read, Anna Renwick, Kate Risely, Sabine Schaeffer, Martin Sullivan, Richard Thewlis, Anne Trewhitt and Jane Waters.

The work is also heavily dependent on the BTO's computer and database systems overseen by Andy Musgrove. Iain Downie and Karen Wright were previously joint leaders of the BTO's IT team and contributed to the production of this report. Susan Waghorn, Laura Smith and Mandy Andrews also exercised great skill in helping to design and build the website. The site is now managed by William Skellorn.

We are very grateful to all of the organisations and individuals listed above for their contributions to this report.

Methods

Eight monitoring schemes have contributed data to this report. Six provide data on changes in abundance: these are the Breeding Bird Survey, Common Birds Census, Waterways Breeding Bird Survey, Waterways Bird Survey, Heronries Census and the Constant Effort Sites ringing scheme. Two schemes, the Nest Record Scheme and Constant Effort Sites, provide data on changes in breeding productivity. Data on survival rates come from detailed analyses of the retrappings and recoveries of ringed birds, from Retrapping Adults for Survival, Constant Effort Sites and the general Ringing Scheme. In addition, information on waterbirds from the Wetland Bird Survey is included where relevant.

The methodologies of the monitoring schemes are described in turn, including information on fieldwork, data preparation, sampling considerations and the statistical methods used in analysis. Most of the analyses were undertaken using R software (R Core Team 2018), while the preparation of tables and graphs were undertaken using SAS software (SAS 2011).

The two final parts of the methods section concern the alert system. These deal, first in descriptive terms and second in statistical detail, with the system by which the results of monitoring surveys raise alerts and thereby are brought to the attention of conservation bodies.

Breeding Bird Survey

The BTO/JNCC/RSPB Breeding Bird Survey (BBS) was launched in 1994, following two years of extensive pilot work and earlier desk-based studies. The introduction of the BBS was a move designed to overcome the limitations of the Common Birds Census (CBC), which had monitored bird populations since 1962. In particular, it improves the geographical spread of UK bird monitoring, thus boosting coverage of species and of habitats.

The BBS uses line transects rather than the more intensive territory-mapping method that had been used by the CBC. The average time observers spend per visit on counting birds is only around 90 minutes and, even with travel and data-input time, this survey is relatively quick to undertake and is therefore accessible to a large number of volunteers. Sampling units are the 1x1-km squares of the Ordnance Survey national grid, of which there are some 254,000 in the UK. From these we make random selections for inclusion in the scheme (see Square selection, below). The BBS requires a relatively large sample of survey squares, and the initial aim was to achieve coverage of about 2,500 squares (1%). This total is now well exceeded.

An important aspect of BBS is its coordination through a network of volunteer BBS Regional Organisers. The Regional Organisers find and encourage willing volunteers for their squares and provide paper forms as required. Since 2003, when online submission of BBS data was introduced, most data have been returned online – see the BBS pages of the main BTO website for details.

Fieldwork involves up to three visits to each survey square each year. The first is to record details of habitat and to establish or re-check the survey route, while the second and third (termed 'early' and 'late') are to count birds. A survey route is composed of two roughly parallel lines, each 1 km in length, although for practical reasons routes typically deviate somewhat from the ideal. Each of these lines is divided into five sections, making a total of ten 200-m sections, and birds and habitats are recorded within these ten units. The two bird-count visits are made about four weeks apart (ideally in early May and early June), ensuring that late-arriving migrants are recorded. Volunteers record all the birds they see or hear as they walk along their transect routes. Birds are noted in three distance categories (within 25 m, 25–100 m, or more than 100 m on either side of the line, measured at right angles to the transect line), or as in flight. Recording birds within distance bands provides a measure of bird detectability in different habitats and thus allows population densities to be estimated more accurately. The total numbers of each species, excluding juveniles, are recorded in each 200-m transect section and distance category, as well as the timing of the survey and weather conditions. In 2014, the optional recording of the method of detection was included in BBS for the first time, and observers can now record whether they detect each individual bird by sight, by song or by call. This information is not currently used to calculate trends, but it is anticipated that it will help further refine the calculation of population densities for some species.

By 1998, more than 2,300 BBS squares were being surveyed annually, close to the original target of 2,500. Only around a quarter of these plots were covered in 2001, owing to Foot & Mouth Disease access restrictions, but (thanks to our keen observers) the sample recovered immediately. The original target of 2,500 was surpassed in 2004 and coverage had increased further to 3,729 in 2007, running marginally below that level over the next few years during and just after the 2007–11 Bird Atlas, before increasing again, with over 4,000 squares being covered for the first time in 2018 (*Harris et al. 2019*). Squares are distributed throughout the UK and cover a broad range of habitats, including uplands and urban areas. There are now 117 species that are present on 40 or more BBS squares annually and so can be monitored with good precision at the UK scale (Joys *et al.* 2003, *Harris et al. 2020*), although a few present special difficulties because of their colonial or flocking habit or their wide-ranging behaviour. For most of these species, BBS can also assess annual population changes within England alone, using data from 30 or more squares, and for about half the species also within Scotland and Wales as separate units. Sample sizes in Northern Ireland already allow more than 30 species to be indexed annually. In the 2017 BBS report (*Harris et al. 2018*), shorter-term 5-year and 10-year trends were shown for the first time in addition to the trends covering the full BBS period since 1994. For five of the 117 species which can be monitored by BBS, results can only be produced over these shorter time periods, due to the lower sample sizes in the early years of the survey.

Square selection

Survey squares are chosen randomly using a stratified random sampling approach from within 83 sampling regions, which in most cases are the standard BTO regions. Survey squares are chosen at random within each region, to a density that varies with the number of BTO members resident there. Regions with larger numbers of potential volunteers are thereby allotted a larger number of squares, enabling more birdwatchers to become involved in these areas. This does not introduce bias into the results because the analysis takes the regional differences in sampling density into account.

Data analysis

Change measures between years are assessed using a log–linear model with Poisson error terms. For each species and square, counts are summed across all sections and distance bands for each visit ('early' and 'late') and the higher value is used in the model (or the single count if the square was visited only once). Counts are modelled as a function of square and year effects. Each observation is weighted by the number of 1-km squares in each region divided by the number of squares counted there, to correct for the differences in sampling density between regions. The upper and lower confidence limits of the changes indicate the certainty that can be attached to each change measure. When the limits are both positive or both negative, we can be 85% confident that a real change has taken place (see here for details).

Trends are presented as graphs in which annual population indices are shown alongside a smoothed trend and its 85% confidence limits. A caveat, 'small sample', is provided against the trends for England, Northern Ireland, Wales and Scotland where the mean sample size is between 30 and 40 plots per year.

Go to the BBS section of the BTO website.

Common Birds Census

The Common Birds Census (CBC) ran from 1962 to 2000 and was the first of the BTO's schemes for monitoring population trends among widespread breeding birds. It has now been superseded for this purpose by BBS.

The CBC was instigated to provide sound information on farmland bird populations in the face of rapid changes in agricultural practice. Although the original emphasis was on farmland, woodland plots were added by 1964. Fieldwork was carried out by a team of 250–300 volunteers. The same observers surveyed the same plots using the same methods year after year. On average, plots were censused for around seven consecutive years but a few dedicated observers surveyed the same sites for more than 30 years. Farmland plots averaged around 70 hectares in extent. Woodland plots were generally smaller, averaging just over 20 hectares. A small number of plots of other habitats, including heathlands and small wetlands, were also surveyed annually, especially before 1985.

A territory-mapping approach was used to estimate the number and positions of territories of each species present on each survey plot during the breeding season (

CBC instructions (PDF, 1.90 MB)
: Marchant 1983). Volunteers visited their survey plots typically eight to ten times between late March and early July and all contacts with birds, either by sight or sound, were plotted on outline maps at a standard scale of 1:2,500 (25 inches to the mile). Codes were used to note each bird's species, with sex and age where possible, and also to record activity such as song or nest-building. The registrations were then transferred to species maps and returned to BTO headquarters for analysis. The pattern of registrations on the species maps reveals the numbers of territories for each species. All assessments of territory number were made by a small team of trained BTO staff, applying rigorous guidelines, for maximum consistency between estimates across sites and years. Observers also provided maps and other details of the habitat on their plots. This makes it possible to match the distribution of bird territories with contemporaneous habitat features, providing the potential for detailed studies of bird–habitat relationships.
In 1990, the results from the CBC were brought together in the book*Population Trends in British Breeding Birds*(Marchant *et al.* 1990). This landmark publication discussed long-term population trends for the years 1962 to 1988 for 164 species, with CBC or Waterways Bird Survey population graphs for around two-thirds of these.

The weaknesses of the CBC as a monitor of UK-wide bird populations were largely related to the time-consuming nature of both fieldwork and analysis. This inevitably limited the number of volunteers able to participate in the scheme, with the result that areas with few birdwatchers were under-represented. Constrained by its relatively small sample size, CBC concentrated on farmland and woodland habitats. Bird population trends in built-up areas and the uplands were therefore poorly represented. Furthermore, as the plots were chosen by the observers, they might not have been representative of the surrounding countryside and some bias towards bird-rich habitats might be suspected. It is for these reasons that the BBS was introduced in 1994. The two surveys were run in parallel for seven years to allow calibration between the results: for many species, CBC and BBS trends can be linked to form joint CBC/BBS trends that provide ongoing monitoring, continuous since the 1960s (Freeman *et al.* 2003, 2007a).

The results from the CBC provided reliable population trends for more than 60 of the UK's commoner breeding species and, through the linking of CBC with BBS to form this report's long-term trends, continue to be hugely influential in determining conservation priorities in the UK countryside. The archive of detailed maps of almost a million birds' territories, collected through the CBC and maintained at BTO HQ since the early 1960s, is a uniquely valuable resource for investigating the relationships between breeding birds and their environment, over wide temporal and spatial scales.

Validation studies

The CBC was the first national breeding bird monitoring scheme of its kind anywhere in the world and its contribution is widely recognised. The territory-mapping method adopted by the CBC is acknowledged as the most efficient and practical way of estimating breeding bird numbers in small areas, and has been well validated. Although intensive nest searches may sometimes reveal more birds, a comparison by Snow (1965) concluded that mapping censuses were a good measure of the true breeding population for 70% of species. Experiments to test differences between observers' abilities to detect birds found that, although there was considerable variation between individual abilities, the observers were consistent from year to year (O'Connor & Marchant 1981). As the CBC relies on data from plots covered by the same observer in consecutive years, this source of bias has no implications for the CBC's ability to identify population trends. It has also been confirmed that the sample of plots from which CBC results are drawn changed little in composition or character over the years (Marchant *et al.* 1990) and that the results of territory analysis are not affected by changes in analysts, once trained (O'Connor & Marchant 1981). Fuller *et al.* (1985) found that farmland CBC plots were representative of ITE lowland land-classes throughout England (excluding the extreme north and southwest), and closely reflected the agricultural statistics for southern and eastern Britain.

Data analysis

Population changes are modelled using a generalised additive model (GAM), a type of log–linear regression model that incorporates a smoothing function (Fewster*et al.* 2000). This has replaced the Mountford model that employed a six-year moving window (Mountford 1982, 1985, Peach & Baillie 1994) and was used to produce annual population indices until 1999, but the principles are similar. These models are also very similar to log–linear Poisson regression as implemented by program TRIM (Pannekoek & van Strien 1996). Counts are modelled as the product of site and year effects on the assumption that between-year changes are homogeneous across plots. Smoothing is used to remove short-term fluctuations (e.g. those caused by periods of severe weather or by measurement error) and thus reveal the underlying pattern of population change. This is achieved by setting the degrees of freedom to about a third of the number of years in the series. Confidence limits on the indices are estimated by bootstrapping (a resampling method; Manly 1991), to avoid making any assumptions about the underlying distribution of counts.

CBC-only graphs and tabulated trends are presented in this report for a small number of species whose numbers have become too depleted for annual monitoring to continue. Smoothed indices are plotted as the blue line on these graphs. The two green lines on the graphs, above and below the index line, are the upper and lower 85% confidence limits. Caveats are provided to show where the data suffer from a 'Small sample' if the mean number of plots was less than 20. Data are flagged as 'Unrepresentative?' if the average abundance of a species in 10-km squares containing CBC plots was less than that in other 10-km squares of the species' distribution in the UK (as measured from 1988–91 Breeding Atlas data (Gibbons *et al.* 1993)) or, where average abundances could not be calculated, if expert opinion judged that CBC data might not be representative.

In practice nearly all CBC data included in this report have been combined with BBS data to provide joint CBC/BBS trends, using the methods described in the next section. These methods for producing joint trends represent an extension of those described above.

More information on the

Common Birds Census (PDF, 87.11 KB)
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CBC/BBS trends

CBC and BBS have been described separately in earlier sections. This page describes how the results have been combined to derive joint CBC/BBS trends, extending from the 1960s to the present.

As previously noted, the CBC has been an enormously influential project, providing the main source of information on national population levels in the UK since its inception in 1962. Coverage was predominantly in lowland England, where the numbers of potential volunteers are greatest, while coverage was more patchy in more sparsely populated regions and especially the uplands (Marchant *et al.* 1990). CBC plots were situated in a limited number of habitats, predominantly farmland and woodland. Within a large rectangle of southeastern Britain (covering England and Wales south and east from Seascale, Scarborough and Exeter), the plots are nevertheless believed to be broadly representative, at least of lowland land-classes (Fuller *et al.* 1985). For species such as Wood Warbler and Meadow Pipit that have the greater part of their numbers in the far west or north of Britain, however, the CBC may not have accurately reflected UK trends.

The BBS, on account of its more rigorous, stratified random sampling design, and its simplicity in the field, produces better coverage of the previously under-represented regions and habitats. In some early editions of 'Breeding Birds in the Wider Countryside' (e.g. Baillie *et al.* 2002), separate indices were published from CBC and BBS data, for those species with sufficiently large sample sizes. There being no new CBC data since 2000, however, it is unnecessary to present a CBC-only trend – except for those few species that are now so rare that BBS has been unable to contribute.

For most purposes, the presentation and analysis of longer time-series is required, dating back to before the establishment of the BBS but coming right up to the present day. The calculation of 25-year alert designations, as in this report, provides just one example. This need led the BTO to research the compatibility of indices from BBS and CBC data in various years and regions, and the possibility of deriving trustworthy long-term indices from the two data sources in combination (Freeman *et al.* 2003, 2007a). This research suggested that for the vast majority of species considered there was no significant difference between population trends, calculated from the two surveys, based on that part of the country where CBC data are sufficient to support a meaningful comparison. Where a statistically significant difference was found, this was sometimes for very abundant species for which the power to detect even a biologically insubstantial difference was considerable. Within this region, therefore, long-term trends based on CBC and BBS data can be produced for almost all species previously monitored by the CBC alone. For (Freeman *et al.* 2003, 2007a) this was the area covered by Fuller *et al.* (1985), because CBC plots in that region were shown to be representative of lowland farmland there. As this region covers the bulk of England, and for consistency with the rest of this report, we have produced joint indices for CBC/BBS for the whole of England (the CBC/BBS England index), rather than just the English part of the 'Fuller rectangle'.

A second question then is whether one can obtain reliable trends over the same period for the entire UK. That is, since prior to 1994 only CBC data are available, are the population trends within the region well covered by the CBC typical of those for the UK as a whole? The shortage of CBC data in the north and west means that the only way of investigating this is via the BBS data. Significant differences in trends between the area well covered by the CBC and the rest of the UK were found for approximately half the species (see Freeman *et al.* 2003, 2007a, for full details). For such species, a regional bias in CBC data means that no reliable UK index can be produced prior to 1994. In summary, joint population indices dating back to the start of the CBC can continue to be produced for that part of the country well served by the CBC (essentially England) for almost all common species. However, a similar UK index can be produced for only about 50% of species (CBC/BBS UK index).

Data analysis

This report presents joint CBC/BBS trends for the UK and/or England, as appropriate. Ideally the trends would have been estimated using generalised additive models (Fewster *et al.* 2000) but these were too computationally intensive, given the large number of sites involved. Therefore we fitted a generalised linear model, with counts assumed to follow a Poisson distribution, and a logarithmic link function, to the combined CBC/BBS data. Standard errors were calculated via a bootstrapping procedure and there is therefore no need to model overdispersion, as it does not affect the parameter estimates. BBS squares were weighted as in standard BBS trend analyses. CBC plots were assigned the average weight of all BBS squares as this allows them to be incorporated within the analysis while retaining the convention of not applying weights within the BBS sample. The population trend was smoothed using a thin-plate smoothing spline with degrees of freedom about one third the total number of years. Confidence intervals were calculated via a bootstrap procedure. Bootstrap samples were generated by resampling sites from the original data set, with replacement. A generalised linear model was then fitted to each bootstrap replicate and a smoothing spline fitted to the annual population indices as described above. Confidence limits were then calculated as the appropriate percentiles from the sets of smoothed estimates. The overall result is a smoothed trend that is mathematically equivalent to that produced from a generalised additive model. The method of estimation is less statistically efficient because the smoothing is not incorporated within the estimation procedure, and is likely to have resulted in more conservative statistical tests and wider confidence intervals. However this compromise was necessary to make it possible to fit the trends within a reasonable amount of computer time (still several weeks).

Data presentation

Indices are plotted on the graphs as annual estimates, with a smoothed trend and its 85% confidence interval.The CBC started on farmland in 1962 and on woodland in 1964. However, the early years of the CBC population indices are strongly influenced by the effects of the unusually severe winters of 1961/62 and 1962/63, as well as by developments in methodology (Marchant *et al.* 1990). Joint CBC/BBS indices have been calculated using only the data from 1966 onward, therefore, and population changes are calculated back to 1967.

Waterways Bird Survey & Waterways Breeding Bird Survey

Waterways Bird Survey 1974–2007

The Waterways Bird Survey (WBS) monitored the population trends of riparian bird species on canals and rivers throughout the UK during the breeding seasons of 1974–2007. WBS used a territory-mapping method like that of its parent scheme, the Common Birds Census, to estimate the breeding population of waterbirds on each of a number of observer-selected survey plots. Detailed territory maps were prepared alongside habitat data that show which features of linear waterways are important to breeding birds. The plots averaged 4.4 km in length. Almost half were slow-flowing lowland rivers with the rest either fast-flowing rivers/streams or canals. In the scheme's closing years there were around 90 plots distributed throughout the UK. The north and west of Britain were better represented by WBS than by the CBC although, as with CBC, coverage outside England was relatively poor (Marchant *et al.* 1990).

All fieldwork was carried out by BTO volunteers. Observers were asked to survey their plots on nine occasions between March and July, mapping all the birds seen or heard onto 1:10,000 maps (six inches to the mile). Registrations were then transferred to species maps, which were analysed to reveal the numbers and positions of territories for each species. For the first 20 years all territory analysis was performed by trained headquarters staff but, during 1994–2007, observers mostly completed their own territory analysis, based on the scheme's written guidelines, with results checked and corrected by BTO staff. As WBS employed very similar methods to those of CBC, the validation studies carried out for the latter generally held true for WBS (see CBC section). Marchant *et al.* (1990) found that there had been little change by 1988 in the composition of the WBS sample, in terms of waterway type or geographical spread.

Population changes along waterways have been reported historically for up to 25 riparian species. For specialist waterbirds, including Mute Swan, Goosander, Little Grebe, Common Sandpiper, Kingfisher, Sand Martin, Dipper and Grey Wagtail, targeted surveys along waterways can provide a better precision of monitoring than is possible through the more generalised BBS surveys. Waterways indices can also add a new perspective on trends in waterbirds that are monitored, largely in different habitats, by CBC/BBS. For Lapwing, for example, populations declined rapidly on arable farmland during the late 1980s while numbers on WBS plots, typically representing populations along river floodplains, were more stable. Yellow Wagtails have declined much more steeply alongside rivers and canals than elsewhere.

Waterways Breeding Bird Survey and joint indices

WBS had limitations as a monitoring scheme similar to those that led to the CBC's replacement by BBS. In particular, plot distribution was biased geographically and possibly also towards sites that were good for birds, and an intensive survey method was used that severely limited the sample size (Marchant *et al.* 1990). A drawback specific to WBS was that it only covered waterbirds.

BTO addressed these issues by setting up the Waterways Breeding Bird Survey (WBBS), which ran in parallel with WBS from 1998 to 2007 and now continues as a permanent annual survey, supplementing BBS. WBBS uses BBS-style transect methods along random waterways, and includes all species of birds (and mammals, too). WBBS has previously received some of its funding from the Environment Agency. In 2014, it began collecting most of its data online via the BBS Online web application. Since 2016, it has been fully integrated with BBS as part of the BTO/JNCC/RSPB BBS partnership, and WBBS results are now published annually in the BBS report.

Trends are available from WBBS alone for more than 80 species. These include the waterbirds previously covered by WBS and a further range of common species for which waterways are not the primary habitat. WBBS-only trends are of relatively short duration (since 1998) and are not presented in this report.

In a similar development to joint CBC/BBS indices, it has proved possible to link the two waterways schemes to provide joint WBS/WBBS indices, some dating back to 1974, for the species previously covered by WBS (see below).

Data analysis and presentation

Population trends are generated from the combined WBS and WBBS data using a generalised linear model with counts assumed to follow a Poisson distribution and a logarithmic link function. Standard errors were calculated via a bootstrapping procedure involving 199 replications. For presentation in the figures, both the population trend and its confidence limits were also subsequently smoothed using a thin-plate smoothing spline. The overall result is a smoothed trend that is mathematically equivalent to that produced from a generalised additive model, as previously used for the WBS data alone.

More information on

WBS (PDF, 77.53 KB)
and WBBS.

Heronries Census

As predators at the top of the freshwater food chain, herons may be excellent indicators of environmental health in the countryside. They build large stick nests, mostly in colonies at traditional sites, thus lending themselves to direct counts of active nests.

The BTO Heronries Census began in 1928 and is the longest-running breeding-season bird monitoring scheme in the world. The aim of this census is to collect annual nest counts of Grey Herons from as many sites as possible in the United Kingdom. Volunteer observers make counts of 'apparently occupied nests' at heron colonies each year. Changes in the numbers of nests, especially over periods of several years, provide a clear measure of the population trend.

In recent seasons, observers have also counted the nests of Little Egrets *Egretta garzetta*, which have been appearing in an increasing number of heronries since the first UK breeding records in 1996 and are now nesting as far north as Cumbria, and even of Cattle Egrets *Bubulcus ibis,* Night-herons *Nycticorax nycticorax* and Spoonbills *Platalea leucorodia*. Since egrets are fully included in the Heronries Census, data are requested from all breeding sites, whether or not Grey Herons are also present. Data submitted for the Heronries Census for Little Egrets and other rare species are shared with the Rare Breeding Birds Panel, who hold the more complete data sets. Counts of Cormorant colonies, which often occur alongside heronries, are also recorded and contribute to broader monitoring of that species (Newson *et al.* 2007, 2013).

Coverage is coordinated through a network of regional organisers. A core of birdwatchers and ringers monitor their local colonies annually, providing a backbone of regular counts. The number of heronries counted each year has grown in recent years to more than 600. Around two-thirds of the heronries in England and Wales are currently counted each year, with more-complete censuses carried out in 1929, 1954, 1964, 1985, 2003 and 2018. Historically rather few counts have been made of heronries in Scotland and Northern Ireland, except during the special surveys, but support there for the Heronries Census has been growing fast in recent years. Almost all the known heronries have been counted in Northern Ireland annually in recent years.

Online data submission was made available for Heronries Census observers for the first time in 2015.

Data analysis

Population changes are estimated using a ratio-estimators approach derived from that described by Thomas (1993). Essentially, the ratios of the populations in any two (not necessarily consecutive) years of the survey are estimated from counts at sites visited in each of those years. These ratios can be used to estimate the counts at sites that were not visited, and hence build an estimate of the total population. The population model also allows for cases where the extinction of colonies and the establishment of new ones had not been observed directly (Marchant *et al.* 2004).

Data presentation

On the Grey Heron page of this report, the UK trend is presented graphically as annual estimates of apparently occupied nests, with a smoothed trend and its 85% confidence limits. The smooth trend line is based on a non-parametric regression model, using thin-plate smoothing splines with degrees of freedom approximately 0.3 times the number of years in the model. Trends are also shown for England and Wales together, and for England, Wales and Scotland alone.

Visit the Heronries Census page of the BTO website.

Constant Effort Sites scheme

The Constant Effort Sites (CES) scheme uses changes in catch sizes across a network of standardised mist-netting sites to monitor changes in the abundance and breeding success of common passerines in scrub and wetland habitats. At each constant effort site, licensed ringers erect a series of mist nets in the same positions, for the same amount of time, during 12 visits evenly spaced between 1 May and 31 August (Peach *et al.* 1996). Year-to-year changes in the number of adults caught provide a measure of changing population size, while the ratio of young birds to adults in the total catch is used to monitor annual productivity (breeding success). By summing the abundance of young birds between May and August, the CES method should integrate contributions to annual productivity from the entire nesting season, including second and third broods for multi-brooded species, but will also include a small component of mortality during the immediate post-fledging period. More detailed information about analytical methods is given below and were also provided by Peach *et al.* (1998) (abundance) and Robinson *et al.* (2007) (productivity). Between-year recaptures of ringed birds are also used to calculate annual survival rates of adult birds using specialised analytical techniques (Peach 1993).

The CES scheme began in 1983 with 46 sites and now has approximately 140. The distribution of CES sites tends to reflect the distribution of ringers within Britain and Ireland. The majority are operated in England, and there are smaller numbers in Scotland, Wales, Northern Ireland and the Republic of Ireland. CES routinely monitors the populations of 24 species of passerines in scrub, woodland and reedbed habitats.

Data analysis

Smoothed trends in the abundance of adults and young are separately assessed using a generalised additive model (GAM), with 85% confidence intervals calculated by bootstrapping (Fewster *et al.* 2000). At sites where catching effort in a year falls below the standard 12 visits, but no more than four visits have been missed, annual catch sizes are corrected according to experience during years with complete coverage, by incorporating an offset into the model (see Peach *et al.* 1998 for full details). Sites with fewer than eight visits in a given year are omitted for the year in question.

Annual indices of productivity (young per adult) are estimated from logistic regression models applied to the proportions of juvenile birds in the catch, the year-effects then being transformed to measures of productivity relative to an arbitrary value of 100 in the most recent year. As above, catch sizes are corrected where small numbers of visits have been missed. It should be noted that these indices are only relative figures, and are not estimates of the actual numbers of young produced per adult (Robinson *et al.* 2007).

Annual estimates of adult survival are derived from a form of the standard Cormack–Jolly–Seber capture–mark–recapture model (Lebreton*et al.* 1992), modified to account for the presence of transient birds. Transients are birds passing through the site, or perhaps living on its periphery, and which therefore have a much lower probability of capture than resident birds living in the vicinity of the net rides. The presence of transients thus tends to decrease the estimated survival rates. We allow for this by introducing an additional 'survival period' in the year of first capture (Hines *et al.* 2003). As with our other schemes, we assume survival probabilities vary annually in a similar fashion across all sites, though mean survival probabilities may differ between sites. Because of the standardised capture protocol, we assume that recapture probabilities are site-specific, but constant through time. For each bird we also insert an additional period after the first capture, indicating whether the bird was caught subsequently in the same season. The probability of surviving this period can be regarded as the probability that the bird is resident on the site (that is the probability that it is available for recapture). The survival and recapture probabilities for this initial period are assumed constant across years and sites. Note that the annual estimates of annual survival presented are in fact the probability that adult birds return to the same CE site the following year; this will be lower (to a small but unknown extent) than the true survival rate. We do not estimate survival rates for juvenile birds, because of their much greater propensity to disperse.

Data presentation

Abundance and productivity data are presented graphically with a smoothed trend and its 85% confidence limits. No trend is currently fitted to the survival data, but the individual estimates are presented with 95% confidence limits. A caveat is provided for 'Small samples' when the average number of plots per year is between 10 and 20.

Visit the CES section of the BTO website.

Retrapping Adults for Survival scheme

RAS aims to provide information on adult survival for a range of species in a variety of habitats, particularly those not caught in sufficient numbers on CES sessions or during more general mist-netting. As with CES, between-year recaptures of ringed birds are used to calculate annual survival rates of adults (Peach 1993).

Each RAS project targets an individual species and operates within a defined study area, aiming to catch or resight the majority of the adults breeding within the site each year. RAS ringers often employ colour rings to increase the probability of detecting returning individuals. The minimum annual sample size should ideally be sufficient to include 30 individuals retrapped or resighted from previous years, whilst maintaining a constant trapping/resighting effort. Each RAS study must run for a minimum of five years, but preferably much longer, to allow calculation of long-term trends in survival rate. Examples of analyses of RAS data have been published by Robinson *et al.* (2008, 2010).

The RAS scheme was launched in 1998 and about 200 projects are currently active, covering about 60 species in total. Data for several of these are presented in this report. Study sites are well distributed throughout the UK.

Data analysis and presentation

Annual estimates of adult survival are derived from a form of the standard Cormack–Jolly–Seber capture–mark–recapture model (Lebreton et al. 1992). As with our other schemes, we assume survival probabilities vary annually in a similar fashion across all sites, though mean survival probabilities may differ between sites. Where individuals can be sexed we include a sex-specific intercept, but assume survival varies similarly across years for both sexes; where few individuals of one sex are caught, we exclude these from the models. We model the annual recapture probabilities as a function of either the number days on which the RAS project operated in that year or the amount of effort recorded, choosing the one that best fits the data. Note that the annual estimates of annual survival presented are in fact the probability that adult birds are found to have returned to the same RAS site the following year; this will be lower (to a small but unknown extent) than the true survival rate. We do not estimate survival rates for juvenile birds, because of their much greater propensity to disperse.

Visit the RAS section of the BTO website.

Nest Record Scheme

The BTO's Nest Record Scheme is the largest, longest-running and most highly computerised of such schemes in the world and employs the most advanced and efficient techniques of data gathering, data capture and analysis (Crick *et al.* 2003). BTO now holds more than 1.8 million nest records, of which approximately 60% are already computerised.

The primary aim of the Nest Record Scheme is to monitor the breeding performance of a wide range of UK birds annually as a key part of the BTO's data collection. Periodic reports are published in *BTO News* (e.g. Leech & Barimore 2008) or *Life Cycle* magazine and the significant results communicated immediately to JNCC. Another primary aim is to undertake detailed analyses of breeding performance of species of conservation interest (e.g. Crick *et al.* 1994, 2002, Brown *et al.* 1995, Peach *et al.* 1995a, Crick 1997, Chamberlain & Crick 1999, 2003, Siriwardena*et al.* 2001, Freeman & Crick 2003, Browne *et al.* 2005, Tryjanowski *et al.* 2006, Douglas et al. 2010b).

The Nest Record Scheme gathers data on the breeding performance of birds in the UK through a network of volunteer ornithologists. Each observer is given a code of conduct that emphasises the responsibility of recorders towards the safety of the birds they record and explains their legal responsibilities. These observers complete standard nest record cards for each nest they find, or submit computerised data, giving details of nest site, habitat, contents of the nest at each visit and evidence for success or failure. When cards are received by the BTO staff, they are checked, sorted and prepared for input and analysis. Data are prioritised for computer input according to their potential for population monitoring and for specific research projects. Those for Schedule 1 species are kept confidential. (These are species protected from disturbance at the nest by Schedule 1 of the Wildlife and Countryside Act 1981: they are generally rare species and the location of their nests may need to be protected from egg collecting (an illegal activity for every wild bird) or other potential disturbance. A special licence is required to visit any nest of a Schedule 1 species.) Computer programs developed by BTO check the data for errors and calculate first-egg date, clutch size and rates of nest loss at the egg and chick stages.

Currently the BTO collects c.40,000 nest records per year for about 180 species. Typically, more than 150 records are received each year for 50 species and over 100 for a further 15–25 species. The quality of records improved substantially in 1990 with the introduction of a new recording card, which promotes greater standardisation and clarity. Currently, volunteers may submit data on card, via the MS Windows software 'IPMR' or via the online portal 'Demography Online'. The general distribution of completed nest records is patchy at the county scale but is more even over larger regions of the UK. Overall, Northern Ireland and parts of Scotland (southeast, Western Isles) and parts of England (West Midlands, southwest) have relatively low coverage, often reflecting observer density. A major analysis of trends over time in various aspects of breeding performance found relatively few differences between major regions, when analysed using analysis of covariance (Crick *et al.* 1993). The scheme receives records from all the UK's major habitats. Most records come from woodland, farmland and freshwater sites, but the scheme also receives data from scrub, grassland, heathland and coastal areas.

Data analysis

Five different variables are analysed for this report: laying date; clutch size; brood size; and daily nest failure rates during egg and nestling stages, calculated using the methods of Mayfield (1961, 1975) and Johnson (1979) (see Crick *et al.* 2003 for a review).

To minimise the incidence of errors and inaccurately recorded nests, a set of rejection criteria was applied to the data: laying date included only cases where precision was within ±5 days; clutch size was not estimated for nests which had been visited only once, for nests which were visited when laying could still have been in progress, or for nests which were visited only after hatching; and maximum brood size was calculated only for nests which were observed after hatching. The last variable is an underestimate of brood size at hatching, because observers may miss early losses of individual chicks; it differs from clutch size because some eggs may be lost during incubation or fail to hatch.

Daily failure rates of whole nests were calculated using a formulation of Mayfield's (1961, 1975) method as a logit–linear model with a binomial error term, in which success or failure over a given number of days (as a binary variable) was modelled, with the number of days over which the nest was exposed during the egg and nestling periods as the binomial denominator (Crawley 1993, Etheridge *et al.* 1997, Aebischer 1999). Numbers of exposure days during the egg and nestling periods were calculated as the midpoint between the maximum and minimum possible, given the timing of nest visits recorded on each nest record (note that exposure days refer only to the time span for which data were recorded for each nest and do not represent the full length of the egg or nestling periods). Each calculation assumes that failure rates were constant during the period considered. Violations of this assumption of the Mayfield method can lead to biased estimates if sampling of nests is uneven over the course of each period. It is unlikely that any such bias would vary from year to year so, although absolute failure rates may be biased, annual comparisons should be unaffected (Crick *et al.* 2003). In this report, therefore, we present only temporal trends in daily nest failure rates.

As the combined influence of concurrent trends in these individual breeding parameters on overall productivity is difficult to assess, the estimates produced are used to derive an annual mean estimate of the number of 'fledglings produced per breeding attempt' (FPBA) according to the equation below (Crick *et al.* 2003):

$$FPBA = CS \times HS \times (1 - EF)^{EP} \times (1 - YF)^{YP}$$

where CS represents clutch size, HS represents hatching success, EF and YF represent egg- and chick-stage daily failure rates and EP and YP represent the length of the egg and nestling periods. Standard errors were derived using the formula given by Siriwardena *et al.* (2000b).

Statistical analyses of nest record data were undertaken using SAS programs (SAS 2011). Regressions through annual mean laying dates, clutch sizes and brood sizes were weighted by sample size. Nest survival was analysed by logistic regression. Quadratic regressions were used when the inclusion of a quadratic term provided a significant improvement over linear regression. These are described as 'curvilinear' in the tables on species pages. Significant linear trends are described as 'linear'. The better-fitting regressions (i.e. quadratic or linear) are presented on the figures in this report. Where neither regression is significant, the linear regression line is shown for illustration.

Data presentation

Results are presented only if the mean sample size of records for a particular variable and species exceeds 10 per year, and are presented with a caveat for small sample sizes if the mean number of records contributing data was between 10 and 30 per year.

Note that the data presented are modelled figures. As a result, the presented figures may appear anomalous under certain unusual circumstances, as was the case for Buzzard in the *BirdTrends 2017* report, which showed a figure for the number of fledglings per breeding attempt that was higher than the brood size in the same year. As each variable is modelled separately using the best fitting regression line for that variable, this anomaly can occur if the best fitting model is different for each variable.

Visit the Nest Record Scheme section of the BTO website.

Integrated population analysis

The BTO operates, in partnership with others, several schemes aimed at monitoring the numbers and demography of a range of widespread UK birds. A key aim of this monitoring is to investigate how and why bird populations change, and thus to make species conservation more effective and to contribute evidence that supports the conservation of wider biodiversity and the environment. All population changes are a consequence of underlying demographic factors, which are themselves determined largely by environmental conditions. Thus analyses of trends in numbers (from BBS, CES and other schemes) are complemented by the Ringing and Nest Record schemes which aim to monitor demographic patterns underlying population changes.

Populations may change because the number of individuals either entering the population (productivity) or leaving it (survival) changes. For an island such as Britain, immigration and emigration, which may also cause changes at more local scales, can be safely ignored (e.g. Robinson *et al.* 2012). To gain a full picture of how these processes operate, it is best to consider them simultaneously (along with the changes in numbers) in an integrated fashion and, ideally, incorporate them into a single statistical model (Besbeas *et al.* 2002, Buckland *et al.* 2004, Brooks *et al.* 2004). This is for a number of reasons. Firstly, it makes most efficient use of all the collected data and can help quantify processes for which the available data are sparse. Secondly, such factors might interact, through processes like density dependence, so to understand the consequences fully, they cannot be viewed in isolation. Thirdly, and perhaps most importantly, we do not have data on all the processes – for instance, the proportion of adults breeding or the number of nesting attempts made by individuals of multi-brooded species can be really hard to measure. By constructing an integrated model we can acknowledge this uncertainty and assess to what extent it affects our conclusions about the causes of population change.

Robinson *et al.* (2014) constructed integrated population models (IPMs) for 17 species of common birds. They did this using newly developed statistical techniques which, although they require a lot of computing power, enable one to combine data from different sources, by specifying a common underlying model – in our case of population change. Information on changes in numbers came from the CBC and BBS schemes, information on brood sizes (for some species) and nest success from the Nest Record Scheme and information on brood size (for some species) and survival of young and adult birds from the Ringing Scheme, with the number of individuals ringed and subsequently found dead (mostly by members of the public) enumerated for each year.

The population size in any given year (N_{t+1}) depends on the population size in the previous year (N_t) as follows:

$$N_{t+1} = 0.5N_t \rho_t (B_t \varphi_{egg,t} \varphi_{yng,t} \varphi_{fy,t}) + N_t \varphi_{ad,t}$$

where B represents the mean brood size, φ_{egg} and φ_{yng} survival of the nest at the egg and chick stages, φ_{fy} survival during the first year following hatching (which for some species we can separate into the post-fledging and first-winter periods) and φ_{ad} adult survival, all in year *t* (Robinson *et al.* 2014). The final parameter, ρ, represents the unmeasured demographic rates, i.e. the number of adults actually breeding, the number of nesting attempts made (particularly in multi-brooded species) and (for some species) survival during the post-fledging period. We employed a Bayesian state-space approach (Brooks *et al.* 2004), generating five sets of 200,000 samples (of which we discarded the first 100,000 as 'burn-in' and kept every 50^{th} to minimise autocorrelation) using uninformative priors and the MCMC sampling algorithm in JAGS (Plummer 2003). For further details see Robinson *et al.* (2014).

Alert system

General approach

The alert system used within this report is designed to draw attention to developing population declines that may be of conservation concern, and has been described in detail by Baillie & Rehfisch (2006). It also identifies cases where long-term declines have reversed, leading to an improvement in conservation status. It must be stressed that the alerts and reversals reported here are advisory and do not supersede the agreed, longer-term UK conservation listings (Eaton *et al.* 2015; see PSoB pages). They are based on similar criteria to *Birds of Conservation Concern*, however, and so provide an indication of likely changes at future revisions.

The system is based on statistical analyses of the population trend data for individual species. Alerts seek to identify rapid declines (>50%) and moderate declines (>25% but <50%). These declines are measured over a number of time-scales, depending on the availability of data – the full length of the available time series, and the most recent 25 years, 10 years and five years for which change can be estimated. The conservation emphasis is particularly on the longer periods, but short-term changes help to separate declines that are continuing – or accelerating – from those that have ceased or reversed.

The alerts are calculated annually using standard automated procedures. Where species are at the margin of two categories (e.g. a decline of about 25%) they may raise alerts in some years but not others or, if around 50%, different levels of alert in different years.

Data for some species might be biased, owing to possibly unrepresentative monitoring, or imprecise, owing to small sample sizes. Because these data often provide the only information that is available, our general approach is to report all the alerts raised but to flag up clearly any deficiencies in the data.

Smoothing population trends

Bird populations typically show long-term changes that are complex and do not follow simple mathematical trajectories. In addition to the long-term trends, annual population indices also show short-term fluctuations resulting from a combination of natural population variability and statistical error. We use smoothing techniques that aim to extract the long-term pattern of population change, without forcing it to follow any particular shape (such as a straight line or a polynomial curve). These methods remove most of the effects of short-term fluctuations, including natural year-to-year variability, so that the long-term trend is revealed more clearly.

Technical details available here

Years used for analysis

Once a smoothed population trend has been calculated, change measures are calculated from the ratio of the smoothed population indices for the two years of interest. Population indices for the first and last years of a smoothed time series are less reliable than the others, and so we always drop them before calculating alerts. Because the latest year is not included, the alerts are therefore less up-to-date than they could be, but fewer false alarms are generated. The latest year's data points do contribute, however, to the smoothed curve and are dropped only after the smoothing has taken place.

The time it takes BTO to collate and analyse each year's intake of bird monitoring data is another factor affecting the years that can be included in these analyses. Full analyses of data sets are not usually all available until 12–15 months after the end of a particular breeding season. Thus for a report prepared in year *x* (e.g. 2019) we have analyses of monitoring data up to year *x*-1 (e.g. 2018). As we drop the final year of the smoothed time series, we report here on change measures up to year *x*-2 (e.g. 2017).

Long-term changes for most of the species included in this report are calculated from joint Common Birds Census and Breeding Bird Survey data (CBC/BBS indices), with population changes calculated back to 1967.

Confidence limits and statistical testing

We show 90% confidence limits for population change measures wherever possible. Any decline where the confidence interval does not overlap zero (no change) is regarded as statistically significant and will trigger an alert if it is of sufficient magnitude. Note that, because we are seeking to detect only declines, we are using a one-tailed test – with a *P* value of 0.05. These confidence limits therefore do not indicate whether *increases* are statistically significant.

The graphs of population trends show 85% confidence limits because these allow an approximate visual test of whether the difference between the index values for any two given years is statistically significant: if the index values for two given years are assumed to be independent, and normally distributed with standard errors of comparable size (standard errors differing by a factor of up to about 2 are quite acceptable), then to a good approximation the difference between them is significant at the 5% level if there is no overlap in their 85% confidence intervals (Buckland *et al.* 1992, Anganuzzi 1993). This test is fairly robust, and the independence assumption is reasonable if the years are well separated.

Data-deficient species

There is uncertainty about the reliability of the results for some species, either because data may be unrepresentative or because they are based on a very small sample of plots. In these cases the cause of the uncertainty is recorded in the comment column of the population change table.

Unrepresentative data

In this report we present joint UK or England CBC/BBS trends only if there was no substantial or statistical difference between the trends from the two schemes over the period when they ran in parallel (Freeman *et al.* 2007a). Thus, since BBS results are drawn from a random sample, the trends are always considered to be representative of the region concerned.

For CBC data representativeness was assessed using the criteria developed by Gibbons *et al.* (1993). Data from the 1988–91 Breeding Atlas were used to compare the average abundance of a given species in 10-km squares with and without CBC plots. If average abundance is higher in squares without CBC plots, it is likely that much of the population is not well sampled by the CBC. In past reports, CBC data for such species were labelled as "unrepresentative". Where there are insufficient data to undertake such calculations, expert opinion was used instead.

Sample size

Sample size is assessed from the average number of plots contributing to the population indices for a given species in each year. A plot with a zero count would be included provided that the species had been recorded there in at least one year and that records for that plot were available for at least two years. Plots where a species has never been recorded do not enter the index calculations. These average sample sizes are shown in column four ('plots') of the population change tables. For CBC, WBS and CES, a mean of between 10 and 20 plots (when rounded to a whole number) is flagged as a small sample. For BBS indices for individual countries a mean in the range 30–40 plots is flagged as a small sample. UK BBS indices are presented only where samples reach at least 40 plots.

Statistical methods for alerts

The alert system page presents an overview of how the alert system works. More detail is given below about the statistical methods used to estimate population changes and their confidence intervals.

General structure of the data

The data for all of the schemes reported here consist of annual counts made over a period of years at a series of sites. They can thus be summarised as a data matrix of sites x years, within which a proportion of the cells contain missing values because not all of the sites are covered every year. Such data can be represented as a simple model:

log (count) = site effect + year effect

Each site has a single site-effect parameter. These site parameters are not usually of biological interest but they are important because abundance is likely to differ between sites. The main parameters of interest are the year effects. These can be modelled either with the same number of parameters as years (an annual model), or with a smaller number of parameters, representing a smoothed curve.

A simple annual model would be fitted as a generalised linear model with Poisson errors and a logarithmic link function. This is the main model provided by the program TRIM (Pannekoek & van Strien 1996), which is widely used for population monitoring.

Fitting smoothed trends

Our preferred method for generating a smoothed population trend is to fit a smoothed curve to the data directly using a generalised additive model (GAM) (Hastie & Tibshirani 1990, Fewster *et al.* 2000). Thus the model from the previous section becomes:

log (count) = site effect + smooth (year)

where smooth (year) represents some smoothing function of the year effect. It was not straightforward to fit GAMs to the bird census data and we have therefore fitted smoothed curves with a similar degree of smoothing to the annual indices (details below).

The non-parametric smoothed curve fitted in our models is based on a smoothing spline. The degree of smoothing is specified by the number of degrees of freedom (df). A simple linear trend has df = 1, whereas the full annual model has df = t-1, where t is the number of years in the time series. Here we set df to be approximately 0.3 times the number of years in the time series (Fewster *et al.* 2000). The degrees of freedom used for the main data sets presented in this report are summarised below.

	Years	Length of time series	df for smoothed index
CBC/BBS	1966–2019	54	16
WBS/WBBS	1974–2019	46	14
Breeding Bird Survey	1994–2019	26	8
Heronries Census	1928–2019	92	28
Constant Effort Sites	1983–2019	37	11

Note that the numbers of years shown here are different from those available for calculating change measures, because we use the whole time series available for analysis (i.e. prior to the truncation of end points), and because we count the number of years in the time series rather than the number of annual change measures.

CBC/BBS, WBS/WBBS and BBS trends

The model fitted to the combined CBC/BBS and WBS/WBBS data is that historically employed for the BBS – a generalised linear model with counts assumed to follow a Poisson distribution and a logarithmic link function. Standard errors were calculated via a bootstrapping procedure involving 199 replications. For presentation in the figures, both the population trend and its confidence limits were also subsequently smoothed using a thin-plate smoothing spline. The overall result is a smoothed trend that is mathematically equivalent to that produced from a generalised additive model.

Heronries Census trends

The Heronries Census data were analysed using a modified sites x years model based on ratio estimation which incorporates information about new colonies (sites) that have been established and other colonies from the sample that are known to have become extinct. The method was developed by Thomas (1993) specifically in relation to the heronries data set. Since then the heronries database has been substantially upgraded and the method has been applied to the full data set (Marchant *et al.* 2004).

Such a method of analysis cannot be easily applied within a GAM framework. Therefore we fitted a smooth curve to the annual population estimates. This was done using PROC TSPLINE of SAS (SAS 2011). This procedure should give very similar estimates to a GAM analysis but it does not provide confidence intervals for the smoothed population trend or the change measures derived from it. Bootstrapped confidence intervals, where available, are thus presented instead for the Grey Heron trend.

Constant Effort Sites trends

GAMs were fitted to the CES data for catches of adults and juveniles separately with the addition of an offset to correct for missing visits. Confidence limits were fitted using a bootstrap technique to avoid restrictive assumptions about the distribution of the data. Bootstrap samples were drawn from the data by sampling plots with replacement. We generated 199 bootstrap samples from each data set and fitted a GAM to each of them. Confidence limits for the smoothed population indices (85% cl) and change measures (90% cl) were determined by taking the appropriate percentiles from the distributions of the bootstrap estimates, in a similar manner to that employed for the WBS/WBBS trends.

Species

Access the page for a species by clicking its link on the list below. Each species page has alphabetical and taxonomic listings giving access to all the others.

Jump to

List of species (in BOU taxonomic order)

WILDFOWL

Mute Swan
Greylag Goose
Canada Goose
Shelduck
Gadwall
Mallard
Mandarin Duck
Tufted Duck
Goosander

GAMEBIRDS

Red-legged Partridge
Red Grouse
Grey Partridge
Pheasant

WATERBIRDS

Red-throated Diver
Cormorant
Little Egret
Grey Heron
Little Grebe
Great Crested Grebe

HAWKS, etc.

Red Kite
Hen Harrier
Sparrowhawk
Buzzard
Moorhen
Coot

WADERS

Oystercatcher
Golden Plover
Lapwing
Ringed Plover
Curlew
Common Sandpiper
Redshank
Woodcock
Snipe
Common Tern

PIGEONS, etc.

Feral Pigeon
Stock Dove
Woodpigeon
Collared Dove
Turtle Dove
Cuckoo

OWLS, etc

Barn Owl
Little Owl
Tawny Owl
Nightjar
Swift
Kingfisher
Green Woodpecker
Great Spotted Woodpecker
Lesser Spotted Woodpecker
Kestrel
Merlin
Hobby
Peregrine
Ring-necked Parakeet

CROWS, etc.

Magpie
Jay
Jackdaw
Rook
Carrion Crow
Hooded Crow
Raven

TITS, etc.

Goldcrest
Blue Tit
Great Tit
Coal Tit
Willow Tit
Marsh Tit

LARKS, etc.

Woodlark
Skylark
Sand Martin
Swallow
House Martin

WARBLERS, etc.

Cetti's Warbler
Long-tailed Tit
Wood Warbler
Chiffchaff
Willow Warbler
Blackcap
Garden Warbler
Lesser Whitethroat
Whitethroat Grasshopper Warbler
Sedge Warbler
Reed Warbler
Nuthatch
Treecreeper
Wren
Starling
Dipper

THRUSHES, etc.

Ring Ouzel
Blackbird
Song Thrush
Mistle Thrush
Spotted Flycatcher
Robin
Nightingale
Pied Flycatcher
Redstart
Whinchat
Stonechat
Wheatear

SPARROWS, etc.

Dunnock
House Sparrow
Tree Sparrow
Yellow Wagtail
Grey Wagtail
Pied Wagtail
Tree Pipit
Meadow Pipit

FINCHES, etc.

Chaffinch
Bullfinch
Greenfinch
Linnet
Lesser Redpoll
Common Crossbill
Goldfinch

BUNTINGS

Yellowhammer
Reed Bunting
Corn Bunting

Information to aid interpretation of the pages for individual species can be found on the Key to species texts page.

The following seabird species are not covered by *BirdTrends* but full trend information is available from the*JNCC 2020), a separate web site produced by a partnership of which both BTO and JNCC are part.*

SEABIRDS

Fulmar
Manx Shearwater
Storm Petrel
Leach's Petrel
Gannet
Shag
Arctic Skua
Great Skua
Kittiwake
Black-headed Gull
Mediterranean Gull
Common Gull
Lesser Black-backed Gull
Herring Gull
Great Black-backed Gull
Sandwich Tern
Roseate Tern
Arctic Tern
Little Tern
Guillemot
Razorbill
Black Guillemot
Puffin

Key to species texts

The 121 species in this report can be accessed in any order, via the alphabetic and taxonomic 'Species links'. The taxonomic sequence is that maintained by the British Ornithologists' Union and updated in in its current British List. The vernacular and scientific names we use are also drawn from that list. Given this report's limited geographical scope, we use British rather than the international English names. Depending on the availability of data, the following will be found beneath each species heading:

1. Conservation listings

Global, European and UK conservation categories are given, in that order.

Global listings

BirdLife International is responsible for maintaining the global red list for birds that is part of the cross-taxa listings being compiled by IUCN (International Union for Conservation of Nature). On the BirdLife International web site, there is a page of information for every species in which justification for its conservation listing is given (BirdLife International 2015a). We show the global conservation category for each species, with a link to its BirdLife species page.

The IUCN categories relevant to this report are:

- VULNERABLE (VU) - A species is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see IUCN Red List Criteria), and it is therefore considered to be facing a high risk of extinction in the wild.
- NEAR THREATENED (NT) - A species is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- LEAST CONCERN (LC) - A species is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant species are included in this category.

European listings

Conservation listings for Europe that use the same categories as the global assessment have been recently provided by BirdLife International for the first time (BirdLife International 2015b). A broad geographical definition is used for Europe as well as a political one (EU27) that covers the very much smaller area represented by the countries of the European Union. We show the whole-European red list category, with a link to the relevant species page on the BirdLife International web site, along with the EU27 listing if it is different.

These listings supersede the 'species of European concern' (SPEC) categories formerly used (BirdLife International 2004).

UK conservation listing

The UK conservation listing is taken from *The Population Status of Birds in the UK* (Eaton *et al.* 2015 (BoCC4); see PSoB pages). These assessments supersede three earlier Birds of Conservation Concern listings (Gibbons *et al.* 1996, Gregory *et al.* 2002, Eaton *et al.* 2009). There are three categories, as follows:

- Red – high conservation concern
- Amber– medium conservation concern
- Green– all other species (except introduced species, which are not classified)

The main reason or reasons for listing as red or amber, which are tabulated in the full paper (Eaton *et al.* 2015) are summarised here.

Like its predecessor, BoCC4 also classifies races, for polytypic species, where two or more races occur regularly in the UK. On occasion the listing for a race may differ from that for the species as a whole. These race-level assessments are given alongside those for species level in our species pages.

A note appears in this section if the species is one for which the Rare Breeding Birds Panel currently requires all UK breeding records to be submitted, or on which it has reported in the past.

2. Long-term trend

This summarises the headline trend in population size since 1967 from CBC/BBS,1975 from WBS/WBBS data, or 1984 from CES data. If there are no data available from these schemes, any assessment of trends covers the period since about the mid 1960s, but may also take historical data into account. Increases and declines that are described as 'shallow', 'moderate' or 'rapid' are generally statistically significant (see the population trends table). The following terms are used:

- Rapid decline: >50% population decline according to CBC/BBS, WBS/WBBS or CES
- Moderate decline: 25–50% population decline according to CBC/BBS, WBS/WBBS or CES
- Shallow decline: 10–25% population decline according to CBC/BBS, WBS/WBBS or CES
- Decline/Increase: information has been derived from sources other than CBC/BBS, WBS/WBBS or CES
- Probable/Possible increase/decline: information has been derived from sources other than CBC/BBS, WBS/WBBS or CES, and the information is uncertain – see the status summary for details
- Stable/Fluctuating, with no long-term trend: no overall change, or change <10%
- Uncertain: the information from two monitoring schemes conflicts, or the data are unrepresentative of the species' total UK population – see the status summary for details
- Unknown: no information on the UK population trend is available
- Shallow increase: 10–50% population increase according to CBC/BBS, WBS/WBBS or CES
- Moderate increase: 50–100% population increase according to CBC/BBS, WBS/WBBS or CES

- Rapid increase: >100% population increase according to CBC/BBS, WBS/WBBS or CES

3. UK population size

Estimates of population sizes of birds in Britain and in the UK, for the breeding season and for winter, are agreed periodically by the Avian Population Estimates Panel (APEP), on which BTO, GWCT, JNCC, RSPB and WWT are represented (Stone *et al.* 1997, Baker *et al.* 2006, Musgrove *et al.* 2013, Woodward *et al.* 2020). UK population estimates from APEP's fourth report (Woodward *et al.* 2020) are given for each of our species, with a shortened reference (APEP4) and a summary of how each estimate was derived. Any new information potentially superseding APEP4 is also presented.

4. Key facts table

This table giving a summary of key facts for migration, habitat and diet.

5. Status summary

This section provides a brief summary of the trends detailed for the species.

European trends are also described in this section for species for which they are published (PECBMS 2020a). Note that the terms used to describe the European trends are as given in the PECBMS report. These terms are sometimes the same in the PECBMS report as those used to describe UK long-term trends ('moderate decline'/'moderate increase'), but are assessed in a different way, as described on the PECBMS website, and so do not have the same meaning as the equivalent UK long-term trend categories used in this report, listed above. Therefore, to avoid potential confusion, the European trends within the species accounts in this report is usually described simply as 'decline' or 'increase'.

6. Population trend graphs

The first, headline graph shows the most representative long-term trend in abundance for the species, and is followed under the 'Population changes in detail' header by further graphs from other schemes, including BBS graphs for separate UK countries, as available. Generally for these graphs there are annual estimates (dots), with a smoothed trend line and its 85% confidence interval. The Methods section provides details about how the trend data are calculated for each scheme. Index values provide a relative measure of population size on an arithmetic scale relative to an arbitrary value of 100 in one of the years of the sequence. If an index value increases from 100 to 200, the population has doubled; if it declines from 100 to 50, it has halved. A narrow confidence interval indicates that the index series is estimated precisely, and a wider one that it is less precise, though the scale of the *y*-axis varies throughout and must always be taken into account. The use of 85% confidence limits allows relatively straightforward comparison of points along the modelled line: non-overlap of the 85% confidence limits is equivalent to a statistically significant difference at approximately the 5% level (Anganuzzi 1993).

CBC/BBS joint trends are produced only where there was no significant difference between CBC and BBS trends during the period of overlap between the two schemes (1994–2000). Where a joint CBC/BBS UK trend cannot be justified it is sometimes possible to present aCBC/BBS England one, provided that CBC and BBS trends were not significantly different across the 'Fuller rectangle' during the overlap period (see CBC/BBS trends, Alert system). CBC/BBS England trends use all data from England and become the headline trend if no long-term UK index is available.

7. Population trends table

This table provides details of summarised percentage changes in population size, over the maximum period from each source, and from the past 25 years, 10 years and 5 years, where these figures are available. Further columns indicate the years included, the average number of census plots included in the analysis for each year, the percentage change (an increase if presented with no sign) and the upper and lower 90% confidence limits of that change. Note that positive and negative percentage changes are not directly equivalent: for example, a decrease of 20% would require an increase of 25% to restore the population to its former level. Where the confidence interval does not include zero, population declines are regarded as statistically significant. The 'Alert' column indicates where a statistically significant population decline is estimated to be of greater than 50% (>50) or between 25% and 50% (>25) (see the Alerts section for further details). The 'Comment' column lists any caveats that must be considered when interpreting the estimates. The caveats include:

- Small sample: For CBC/BBS, WBS/WBBS and CES data, a mean sample size of less than 20 (but more than 10) census plots was available; for BBS data from individual countries, a mean sample of less than 40 (but more than 30) plots was available.
- Unrepresentative?: Some trends may be marked as possibly unrepresentative of the stated region, owing to the original CBC plots being self-selected by observers and thus potentially a biased sample. This judgment was made either because the species' average abundance in 10-km squares containing CBC plots was less than that in other occupied 10-km squares, as measured by 1988–91 Breeding Atlas timed counts or frequency indices (Gibbons *et al.* 1993) or, where these figures could not be calculated, on expert opinion.

8. Population trends by habitat

This section appears for a subset of the most abundant and widespread species. It refers to BBS data for the 16-year period 1995–2011 and has not been updated to the current year. A chart shows the species' BBS trends for each of 12 broad, mutually exclusive habitat types. The data presented vary by species according to their sample sizes. The vertical axis shows the estimated percentage change over the period, with its 95% confidence interval, in relation to the overall change, indicated by a dashed line. Under 'More on habitat trends', the data for each habitat trend are presented as a table and as a graph.The graphs allow the patterns of change to be compared between habitat categories over time. There is more information on these trends here on the BBS pages.

9. Demography graphs

Graphs from Constant Effort Sites, Nest Record Scheme or Ringing Scheme data illustrate trends in productivity and survival. NRS graphs show annual means, with error bars to denote ±1 standard error; and quadratic or linear regression lines with their 95% confidence interval. For CES data, the smoothed trends are plotted with their 85% confidence limits (see CES section for details). CES survival graphs and ringing recoveries survival graphs show annual estimates with their 95% confidence interval, but trends for these data have not been assessed.

10. Demography table

This provides details of changes in demographic variables since 1968 (or a more recent year, depending on the availability of data). It lists the period of years concerned, the mean annual sample, the type of trend ('curvilinear' is for a significant quadratic trend, 'linear' is for a significant linear trend, 'none' is where the linear trend is not significantly different from horizontal), the modelled values (from the appropriate regression) for the first and last years and their difference (provided only where the trend is significant), and any caveats that must be considered when interpreting the data. Changes are presented either in the units given or as percentages, and are increases unless a minus sign is shown. The caveat 'Small sample'; is given when the mean number of nest record cards contributing annually was in the range 10–30, or when the mean annual number of CES plots recording the species was less than 20 (but more than 10). Note that where the trend is curvilinear, although inclusion in the table

indicates that a significant quadratic trend has occurred, the overall change between 1968 and the current year may be small.

11. Causes of change

Further information on the causes of the population changes we have observed is given here. A brief summary is followed by more a detailed account which discusses any relevant references from the scientific literature and any relevant demographic information from this report which contribute towards our understanding of the drivers of population change. The length of this section is very variable: scientific research is usually focused on declining species which are of conservation concern and hence much more information tends to be available for these species. The evidence presented in this section is sparse or even lacking for some species; in most cases these are species which are increasing and are therefore of lower conservation concern.

12. Information on Conservation Actions

Further information relating to research about potential conservation actions is discussed in this section. As for the Causes of Change, the length of this section is very variable and most research has focused on actions to help declining species. For a small number of species which may be having a negative impact on other species, this section may also include information about conservation actions which aim to reduce these negative impacts.

13. Additional information

Links to atlas maps and tables from previous atlas surveys, and the relevant pages of BirdFacts, BirdTrack and Garden BirdWatch, as available from the BTO web site, are provided on the side bar of each species page.

Summary tables

Tables of alerts and population increases from CBC/BBS

NOTE: *The tables listed in this section only include those species for which combined CBC/BBS results are produced. For the 10 year and 5 year tables which are based on BBS data only, a more comprehensive list which includes additional species can be viewed under* Tables of population declines and increases from BBS

1a. CBC/BBS UK alerts – long term
1b. CBC/BBS England alerts – long term
2a. CBC/BBS UK alerts – 25 years
2b. CBC/BBS England alerts – 25 years
3a. CBC/BBS UK alerts – 10 years
3b. CBC/BBS England alerts – 10 years
4a. CBC/BBS UK alerts – 5 years
4b. CBC/BBS England alerts – 5 years
5a. CBC/BBS UK population increases of >50% – long term
5b. CBC/BBS England population increases of >50% – long term

Tables of alerts and population increases from WBS/WBBS
1. WBS/WBBS alerts – long term
2. WBS/WBBS alerts – 25 years
3. WBS/WBBS alerts – 10 years
4. WBS/WBBS alerts – 5 years
5. WBS/WBBS population increases of >50% – long term

Tables of alerts and population increases from CES
1. CES adults alerts – long term
2. CES adults alerts – 25 years
3. CES adults alerts – 10 years
4. CES adults alerts – 5 years
5. CES adults population increases of >50% – long term

Tables of population declines and increases from BBS
1. BBS – UK alerts – long term
2. BBS – England alerts – long term
3. BBS – Scotland alerts – long term
4. BBS – Wales alerts – long term
5. BBS – Northern Ireland alerts – long term
6. BBS – UK alerts – 10 years
7. BBS – England alerts – 10 years
8. BBS – Scotland alerts – 10 years
9. BBS – Wales alerts – 10 years
10. BBS – Northern Ireland alerts – 10 years
11. BBS – UK alert – 5 years
12. BBS – England alerts – 5 years
13. BBS – Scotland alerts – 5 years
14. BBS – Wales alerts – 5 years
15. BBS – Northern Ireland alerts – 5 years
16. BBS – UK population increases of >50%
17. BBS – England population increases of >50%
18. BBS – Scotland population increases of >50%
19. BBS – Wales population increases of >50%
20. BBS – Northern Ireland population increases of >50%

Tables of breeding performance
1. Clutch size
2. Brood size
3. Egg-stage nest failure rate
4. Chick-stage nest failure rate

WBS/WBBS alerts & population increases

1. WBS/WBBS alerts – long term
2. WBS/WBBSalerts – 25 years
3. WBS/WBBS alerts – 10 years
4. WBS/WBBS alerts – 5 years
5. WBS/WBBS population increases of >50% – long term

1. Table of alerts for WBS/WBBS waterways 1975-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Yellow Wagtail	43	22	-97	-99	-95	>50	
Snipe	43	14	-89	-99	-49	>50	Small sample
Redshank	43	23	-70	-93	-47	>50	
Pied Wagtail	43	121	-70	-79	-62	>50	
Sedge Warbler	43	75	-68	-82	-49	>50	
Reed Bunting	43	92	-68	-77	-54	>50	
Common Sandpiper	43	52	-49	-61	-36	>25	
Grey Wagtail	43	103	-45	-58	-28	>25	
Moorhen	43	129	-35	-52	-15	>25	
Dipper	43	70	-30	-47	-1	>25	

2. Table of alerts for WBS/WBBS waterways 1993-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Yellow Wagtail	25	20	-92	-96	-85	>50	
Redshank	25	25	-66	-85	-45	>50	
Lapwing	25	85	-59	-71	-47	>50	
Sedge Warbler	25	100	-58	-72	-37	>50	
Pied Wagtail	25	160	-47	-59	-31	>25	
Common Sandpiper	25	69	-40	-49	-28	>25	
Coot	25	83	-37	-59	-3	>25	
Curlew	25	61	-35	-56	-5	>25	
Oystercatcher	25	77	-30	-43	-8	>25	

3. Table of alerts for WBS/WBBS waterways 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Tufted Duck	10	47	-56	-68	-35	>50	
Yellow Wagtail	10	14	-55	-73	-24	>50	Small sample
Sedge Warbler	10	96	-48	-62	-30	>25	
Coot	10	74	-44	-57	-29	>25	
Lapwing	10	79	-37	-56	-21	>25	

4. Table of alerts for WBS/WBBS waterways 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Tufted Duck	5	46	-43	-54	-23	>25	
Sedge Warbler	5	96	-34	-53	-10	>25	
Canada Goose	5	125	-26	-40	-7	>25	

5. Table of population increases for WBS/WBBS waterways 1975-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Mute Swan	43	87	64	12	137		
Mallard	43	181	165	101	226		

CBC/BBS alerts & population increases

NOTE: *The tables listed in this section only include those species for which combined CBC/BBS results are produced. For the 10 year and 5 year tables which are based on BBS data only, a more comprehensive list which includes additional species can be viewed under* BBS population declines & increases.

1a. Table of population alerts for CBC/BBS UK 1967-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	51	96	-98	-99	-97	>50	
Grey Partridge	51	143	-92	-95	-90	>50	
Willow Tit	51	41	-92	-96	-86	>50	
Spotted Flycatcher	51	134	-90	-93	-85	>50	
Corn Bunting	51	84	-86	-93	-76	>50	
Marsh Tit	51	107	-78	-86	-71	>50	
Little Owl	51	62	-75	-85	-62	>50	
Yellow Wagtail	51	95	-72	-85	-47	>50	
Greenfinch	51	945	-65	-72	-56	>50	
Whitethroat	51	778	-63	-74	-49	>50	
Yellowhammer	51	672	-61	-69	-51	>50	
Mistle Thrush	51	660	-57	-66	-47	>50	
Lapwing	51	361	-55	-76	-29	>50	
Song Thrush	51	1162	-49	-56	-40	>25	
Sedge Warbler	51	176	-39	-67	-15	>25	
Dunnock	51	1194	-36	-45	-28	>25	
Bullfinch	51	411	-36	-48	-20	>25	

1b. Table of population alerts for CBC/BBS England 1967-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	51	95	-98	-99	-97	>50	
Tree Sparrow	51	109	-96	-98	-92	>50	
Spotted Flycatcher	51	99	-94	-96	-91	>50	
Grey Partridge	51	128	-93	-95	-90	>50	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Nightingale	51	25	-93	-98	-70	>50	
Willow Tit	51	38	-92	-96	-85	>50	
Starling	51	763	-89	-93	-85	>50	
Lesser Redpoll	51	53	-89	-96	-72	>50	
Tree Pipit	51	53	-88	-95	-78	>50	
Corn Bunting	51	80	-85	-94	-76	>50	
Cuckoo	51	313	-78	-83	-70	>50	
Marsh Tit	51	98	-76	-83	-65	>50	
House Martin	51	367	-75	-94	-9	>50	
Linnet	51	563	-72	-80	-64	>50	
Little Owl	51	59	-71	-82	-53	>50	
Yellow Wagtail	51	93	-70	-86	-34	>50	
Willow Warbler	51	553	-67	-76	-54	>50	
Yellowhammer	51	584	-66	-73	-54	>50	
Whitethroat	51	669	-65	-74	-50	>50	
Skylark	51	764	-63	-70	-56	>50	
Mistle Thrush	51	526	-63	-70	-56	>50	
Greenfinch	51	802	-61	-69	-49	>50	
Meadow Pipit	51	235	-52	-78	-22	>50	
Song Thrush	51	917	-51	-60	-42	>50	
Sedge Warbler	51	116	-47	-73	-22	>25	
Lapwing	51	304	-41	-70	-16	>25	
Bullfinch	51	328	-41	-55	-25	>25	
Dunnock	51	978	-39	-47	-31	>25	

2a. Table of population alerts for CBC/BBS UK 1993-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	25	128	-95	-97	-94	>50	
Willow Tit	25	48	-84	-89	-78	>50	
Grey Partridge	25	224	-65	-72	-60	>50	
Little Owl	25	96	-62	-70	-50	>50	
Greenfinch	25	1778	-62	-65	-59	>50	
Spotted Flycatcher	25	193	-54	-64	-44	>50	
Marsh Tit	25	160	-46	-55	-35	>25	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Yellow Wagtail	25	164	-42	-57	-28	>25	
Corn Bunting	25	145	-39	-53	-23	>25	
Lapwing	25	676	-38	-46	-29	>25	
Mistle Thrush	25	1194	-36	-41	-29	>25	
Yellowhammer	25	1226	-34	-38	-29	>25	
Tawny Owl	25	110	-32	-45	-13	>25	

2b. Table of population alerts for CBC/BBS England 1993-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	25	126	-95	-97	-93	>50	
Willow Tit	25	43	-84	-89	-78	>50	
Cuckoo	25	537	-72	-76	-69	>50	
Spotted Flycatcher	25	135	-72	-79	-64	>50	
Tree Pipit	25	76	-69	-81	-51	>50	
Starling	25	1439	-68	-72	-65	>50	
Grey Partridge	25	200	-63	-68	-55	>50	
Nightingale	25	35	-61	-73	-34	>50	
Greenfinch	25	1506	-60	-63	-57	>50	
Little Owl	25	94	-59	-68	-47	>50	
Lesser Redpoll	25	67	-57	-83	-22	>50	
Mistle Thrush	25	942	-47	-51	-42	>25	
House Martin	25	729	-45	-57	-26	>25	
Yellow Wagtail	25	160	-42	-57	-28	>25	
Marsh Tit	25	146	-42	-52	-29	>25	
Yellowhammer	25	1065	-42	-47	-37	>25	
Willow Warbler	25	958	-41	-47	-34	>25	
Corn Bunting	25	138	-40	-55	-24	>25	
Sparrowhawk	25	299	-36	-44	-26	>25	
Meadow Pipit	25	443	-36	-46	-25	>25	
Tawny Owl	25	95	-29	-45	-13	>25	
Skylark	25	1445	-27	-31	-22	>25	

3a. Table of population alerts for CBC/BBS UK 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	10	59	-82	-87	-75	>50	
Greenfinch	10	2025	-67	-69	-66	>50	
Little Owl	10	84	-46	-53	-36	>25	
Grey Partridge	10	209	-34	-44	-24	>25	
Willow Tit	10	34	-34	-49	-16	>25	
Lapwing	10	762	-33	-40	-27	>25	
Moorhen	10	753	-29	-33	-25	>25	
Chaffinch	10	3288	-27	-29	-25	>25	

3b. Table of population alerts for CBC/BBS England 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	10	58	-81	-86	-76	>50	
Greenfinch	10	1723	-66	-68	-64	>50	
Willow Tit	10	30	-55	-71	-28	>50	
Little Owl	10	81	-50	-59	-37	>25	
Grey Partridge	10	187	-36	-44	-24	>25	
Spotted Flycatcher	10	115	-36	-46	-25	>25	
Swallow	10	2004	-33	-36	-30	>25	
Chaffinch	10	2568	-33	-35	-32	>25	
Lapwing	10	653	-30	-36	-23	>25	
Starling	10	1606	-29	-33	-23	>25	
Sparrowhawk	10	330	-28	-34	-20	>25	
Moorhen	10	699	-28	-33	-22	>25	
House Martin	10	836	-28	-33	-22	>25	
Cuckoo	10	470	-27	-33	-21	>25	
Tree Pipit	10	78	-27	-45	-1	>25	

4a. Table of population alerts for CBC/BBS UK 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	1896	-47	-49	-44	>25	
Turtle Dove	5	33	-43	-61	-26	>25	

4b. Table of population alerts for CBC/BBS England 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	1620	-46	-48	-43	>25	
Turtle Dove	5	32	-42	-56	-23	>25	
Swallow	5	2033	-31	-34	-29	>25	
Lesser Redpoll	5	76	-31	-46	-13	>25	
Nightingale	5	35	-28	-44	-12	>25	
Chaffinch	5	2629	-28	-29	-26	>25	

5a. Table of population increases of >50% for UK CBC/BBS 1967-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Reed Warbler	51	81	93	17	287		
Magpie	51	1069	97	61	136		
Great Tit	51	1266	98	72	130		
Chiffchaff	51	905	105	71	161		
Wren	51	1400	109	82	141		
Coot	51	155	131	48	341		
Jackdaw	51	955	139	69	264		
Mallard	51	740	146	94	217		
Woodpigeon	51	1342	154	28	473		
Mute Swan	51	141	277	37	681		
Nuthatch	51	314	293	180	477		
Blackcap	51	958	338	259	451		
Great Spotted Woodpecker	51	630	387	248	610		

5b. Table of population increases of >50% for England CBC/BBS 1967-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Pied Wagtail	51	523	54	7	121		
Robin	51	1083	59	41	77		
Reed Warbler	51	77	71	14	214		

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Great Tit	51	1032	93	67	121		
Pheasant	51	861	95	54	165		
Wren	51	1105	105	76	136		
Magpie	51	899	105	66	167		
Chiffchaff	51	763	108	68	171		
Long-tailed Tit	51	517	108	54	196		
Coot	51	140	134	52	427		
Goldfinch	51	784	134	67	195		
Carrion Crow	51	1090	138	95	199		Includes Hooded Crow
Jackdaw	51	770	142	46	261		
Green Woodpecker	51	435	145	85	232		
Woodpigeon	51	1072	168	38	484		
Mallard	51	620	169	116	246		
Stock Dove	51	433	220	106	394		
Mute Swan	51	121	262	70	752		
Blackcap	51	818	293	217	402		
Nuthatch	51	271	323	196	484		
Great Spotted Woodpecker	51	549	328	212	557		
Buzzard	51	398	856	547	2734		

CES alerts & population increases

1. Table of alerts for CES adults 1984-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Willow Warbler	34	89	-77	-82	-71	>50	
Willow Tit	34	16	-77	-90	-60	>50	Small sample
Lesser Whitethroat	34	38	-65	-81	-40	>50	
Reed Bunting	34	61	-65	-77	-51	>50	
Sedge Warbler	34	68	-55	-68	-40	>50	
Chaffinch	34	76	-52	-72	-20	>50	
Whitethroat	34	65	-51	-68	-30	>50	
Reed Warbler	34	59	-29	-48	-4	>25	

2. Table of alerts for CES adults 1993-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	25	44	-76	-84	-62	>50	
Willow Tit	25	14	-72	-87	-45	>50	Small sample
Willow Warbler	25	95	-64	-71	-58	>50	
Lesser Whitethroat	25	39	-62	-76	-47	>50	
Chaffinch	25	83	-61	-70	-52	>50	
Sedge Warbler	25	76	-55	-61	-45	>50	
Reed Bunting	25	68	-46	-61	-30	>25	
Whitethroat	25	74	-31	-47	-8	>25	
Garden Warbler	25	70	-27	-41	-8	>25	

3. Table of alerts for CES adults 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	10	38	-71	-79	-59	>50	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Chaffinch	10	74	-59	-65	-53	>50	
Willow Warbler	10	90	-31	-38	-22	>25	
Sedge Warbler	10	75	-28	-36	-17	>25	

4. Table of alerts for CES adults 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	35	-57	-67	-42	>50	
Chaffinch	5	70	-45	-52	-39	>25	
Whitethroat	5	80	-30	-40	-22	>25	

5. Table of population increases for CES adults 1984-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Wren	34	103	63	36	92		
Goldfinch	34	37	81	17	312		
Blackcap	34	96	131	92	181		
Chiffchaff	34	81	298	159	570		

BBS population declines & increases

1. BBS – UK alerts – 23 years
2. BBS – England alerts – 23 years
3. BBS – Scotland alerts – 23 years
4. BBS – Wales alerts – 23 years
5. BBS – Northern Ireland alerts – 23 years
6. BBS – UK alerts – 10 years
7. BBS – England alerts – 10 years
8. BBS – Scotland alerts – 10 years
9. BBS – Wales alerts – 10 years
10. BBS – Northern Ireland alerts – 10 years
11. BBS – UK alert – 5 years
12. BBS – England alerts – 5 years
13. BBS – Scotland alerts – 5 years
14. BBS – Wales alerts – 5 years
15. BBS – Northern Ireland alerts – 5 years
16. BBS – UK population increases of >50%– 23 years
17. BBS – England population increases of >50%– 23 years
18. BBS – Scotland population increases of >50%– 23 years
19. BBS – Wales population increases of >50% – 23 years
20. BBS – Northern Ireland population increases of >50%– 23 years

1. Table of declines >25% for BBS UK 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	23	122	-95	-96	-93	>50	
Willow Tit	23	44	-82	-87	-75	>50	
Wood Warbler	23	52	-66	-78	-54	>50	
Grey Partridge	23	223	-64	-69	-57	>50	
Greenfinch	23	1848	-64	-66	-61	>50	
Little Owl	23	93	-62	-69	-54	>50	
Swift	23	1069	-58	-62	-53	>50	
Whinchat	23	78	-57	-69	-47	>50	
Starling	23	1843	-53	-56	-48	>50	
Spotted Flycatcher	23	190	-51	-60	-41	>50	
Curlew	23	540	-48	-54	-42	>25	
Lapwing	23	702	-43	-51	-38	>25	
Pied Flycatcher	23	40	-43	-70	-10	>25	
Redshank	23	90	-42	-60	-13	>25	
Yellow Wagtail	23	167	-42	-52	-31	>25	
Marsh Tit	23	152	-41	-49	-30	>25	
Peregrine	23	54	-39	-58	-16	>25	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Cuckoo	23	705	-38	-44	-32	>25	
Wheatear	23	372	-38	-47	-27	>25	
Kestrel	23	697	-35	-41	-28	>25	
Dipper	23	67	-33	-50	-12	>25	
Tawny Owl	23	98	-30	-43	-16	>25	Nocturnal species
Corn Bunting	23	146	-30	-42	-16	>25	
Mistle Thrush	23	1225	-28	-33	-23	>25	
Common Sandpiper	23	75	-26	-41	-10	>25	

2. Table of declines >25% for BBS England 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	23	120	-95	-96	-93	>50	
Willow Tit	23	39	-82	-87	-74	>50	
Cuckoo	23	534	-71	-74	-68	>50	
Spotted Flycatcher	23	131	-71	-77	-64	>50	
Grey Partridge	23	199	-62	-67	-55	>50	
Greenfinch	23	1563	-62	-64	-59	>50	
Little Owl	23	90	-61	-69	-51	>50	
Starling	23	1495	-61	-63	-58	>50	
Swift	23	921	-58	-62	-53	>50	
Tree Pipit	23	75	-56	-71	-34	>50	
Nightingale	23	33	-55	-69	-29	>50	
Dipper	23	32	-48	-71	-5	>25	
Whinchat	23	33	-47	-67	-32	>25	
Willow Warbler	23	963	-45	-51	-38	>25	
Grasshopper Warbler	23	41	-44	-63	-19	>25	
Redshank	23	64	-43	-57	-25	>25	
Yellow Wagtail	23	163	-41	-50	-32	>25	
Mistle Thrush	23	961	-41	-45	-37	>25	
Common Sandpiper	23	32	-40	-58	-15	>25	
House Martin	23	767	-40	-48	-30	>25	
Marsh Tit	23	138	-37	-46	-26	>25	
Yellowhammer	23	1095	-34	-39	-29	>25	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Sparrowhawk	23	300	-32	-39	-25	>25	
Curlew	23	355	-31	-40	-19	>25	
Wheatear	23	208	-31	-49	-5	>25	
Corn Bunting	23	139	-31	-43	-15	>25	
Lapwing	23	591	-30	-39	-21	>25	
Feral Pigeon/Rock Dove	23	600	-29	-38	-19	>25	
Tawny Owl	23	85	-27	-43	-7	>25	Nocturnal species
Garden Warbler	23	383	-27	-35	-18	>25	
Sedge Warbler	23	201	-26	-38	-10	>25	

3. Table of declines >25% for BBS Scotland 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	23	109	-67	-75	-56	>50	
Kestrel	23	41	-61	-75	-40	>50	
Curlew	23	131	-59	-67	-50	>50	
Lapwing	23	89	-56	-66	-46	>50	
Swift	23	57	-52	-67	-30	>50	
Hooded Crow	23	55	-44	-56	-25	>25	
Oystercatcher	23	144	-39	-47	-29	>25	
Wheatear	23	90	-39	-50	-23	>25	
Rook	23	125	-34	-46	-12	>25	
Starling	23	169	-29	-42	-9	>25	

4. Table of declines >25% for BBS Wales 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Swift	23	68	-72	-81	-60	>50	
Greenfinch	23	114	-71	-79	-61	>50	
Curlew	23	35	-69	-78	-58	>50	
Starling	23	83	-65	-77	-48	>50	
Yellowhammer	23	32	-64	-75	-54	>50	
Rook	23	83	-58	-71	-45	>50	
Goldcrest	23	94	-54	-68	-28	>50	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Wheatear	23	60	-48	-58	-33	>25	
Magpie	23	180	-43	-58	-23	>25	
Chaffinch	23	221	-38	-45	-28	>25	
Coal Tit	23	84	-32	-50	-3	>25	
Tree Pipit	23	37	-31	-52	-3	>25	
Green Woodpecker	23	49	-29	-48	-1	>25	
Whitethroat	23	95	-28	-42	-8	>25	

5. Table of declines >25% for BBS Northern Ireland 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	23	47	-82	-88	-66	>50	
Skylark	23	32	-46	-61	-35	>25	

6. Table of declines >25% for BBS UK 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	10	59	-82	-88	-75	>50	
Greenfinch	10	2025	-67	-69	-66	>50	
Little Owl	10	84	-46	-55	-36	>25	
Swift	10	1152	-41	-46	-35	>25	
Wheatear	10	458	-35	-43	-26	>25	
Grey Partridge	10	209	-34	-42	-24	>25	
Lapwing	10	762	-33	-42	-26	>25	
Barn Owl	10	75	-31	-43	-16	>25	
Swallow	10	2611	-31	-33	-28	>25	
Moorhen	10	753	-28	-33	-23	>25	
Crossbill	10	79	-28	-43	-5	>25	
Grasshopper Warbler	10	108	-27	-43	-11	>25	
Chaffinch	10	3288	-27	-29	-26	>25	
Kestrel	10	782	-26	-31	-21	>25	

7. Table of declines >25% for BBS England 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	10	58	-81	-87	-75	>50	
Greenfinch	10	1723	-66	-67	-64	>50	
Willow Tit	10	30	-54	-69	-27	>50	
Little Owl	10	81	-50	-60	-39	>25	
Swift	10	995	-40	-46	-33	>25	
Grey Partridge	10	187	-36	-45	-26	>25	
Spotted Flycatcher	10	115	-36	-46	-24	>25	
Swallow	10	2004	-33	-35	-29	>25	
Wheatear	10	270	-33	-44	-18	>25	
Chaffinch	10	2568	-33	-35	-32	>25	
Lapwing	10	653	-30	-38	-23	>25	
Redshank	10	71	-30	-45	-13	>25	
Grasshopper Warbler	10	52	-30	-47	-3	>25	
Starling	10	1606	-29	-32	-24	>25	
Sparrowhawk	10	330	-28	-34	-21	>25	
Moorhen	10	699	-28	-32	-23	>25	
House Martin	10	836	-28	-33	-22	>25	
Collared Dove	10	1480	-27	-30	-24	>25	
Cuckoo	10	470	-27	-33	-21	>25	
Grey Heron	10	653	-26	-31	-19	>25	Non-breeders included
Barn Owl	10	73	-26	-37	-12	>25	

8. Table of declines >25% for BBS Scotland 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	10	119	-68	-75	-61	>50	
Kestrel	10	39	-44	-60	-22	>25	
Lapwing	10	88	-39	-50	-23	>25	
Wheatear	10	101	-38	-47	-23	>25	
Swift	10	66	-30	-50	-2	>25	
Hooded Crow	10	58	-30	-43	-12	>25	
Stonechat	10	48	-29	-43	-13	>25	
Swallow	10	262	-28	-35	-19	>25	

9. Table of declines >25% for BBS Wales 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	10	119	-78	-82	-74	>50	
Swift	10	69	-50	-60	-36	>25	
Rook	10	89	-50	-62	-38	>25	
Curlew	10	31	-44	-58	-28	>25	
Wheatear	10	70	-41	-53	-25	>25	
Chaffinch	10	252	-28	-34	-21	>25	

10. Table of declines >25% for BBS Northern Ireland 2008-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	10	44	-86	-89	-82	>50	
Lesser Redpoll	10	35	-53	-63	-36	>50	
Linnet	10	43	-52	-64	-36	>50	
Swallow	10	100	-33	-39	-26	>25	
Goldcrest	10	57	-30	-47	-4	>25	

11. Table of declines >25% for BBS UK 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	1896	-47	-49	-45	>25	
Wheatear	5	459	-34	-39	-28	>25	
Crossbill	5	65	-33	-47	-17	>25	
Swallow	5	2688	-28	-30	-25	>25	
Swift	5	1123	-27	-33	-19	>25	

12. Table of declines >25% for BBS England 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	1620	-46	-48	-44	>25	
Turtle Dove	5	32	-42	-58	-23	>25	

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Wheatear	5	244	-40	-47	-33	>25	
Swallow	5	2033	-31	-34	-29	>25	
Lesser Redpoll	5	76	-31	-48	-13	>25	
Swift	5	963	-28	-35	-20	>25	
Nightingale	5	35	-28	-44	-10	>25	
Chaffinch	5	2629	-28	-29	-26	>25	

13. Table of declines >25% for BBS Scotland 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	109	-43	-54	-30	>25	
Wheatear	5	113	-27	-36	-16	>25	
Feral Pigeon/Rock Dove	5	103	-26	-39	-11	>25	
Siskin	5	122	-26	-36	-15	>25	

14. Table of declines >25% for BBS Wales 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	114	-58	-66	-48	>50	
Swift	5	71	-48	-58	-34	>25	
Wheatear	5	80	-39	-50	-29	>25	
Rook	5	94	-39	-50	-27	>25	
Chaffinch	5	280	-30	-35	-25	>25	
Redstart	5	105	-28	-35	-19	>25	
Tree Pipit	5	51	-26	-41	-7	>25	

15. Table of declines >25% for BBS Northern Ireland 2013-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greenfinch	5	33	-71	-78	-62	>50	

16. Table of population increases for BBS UK 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Jackdaw	23	1971	61	49	76		
Canada Goose	23	558	81	57	123		
Buzzard	23	1218	98	84	117		
Chiffchaff	23	1786	109	97	121		
Nuthatch	23	593	110	91	132		
Tree Sparrow	23	206	117	65	184		
Stonechat	23	173	118	72	182		
Great Spotted Woodpecker	23	1240	131	117	148		
Goldfinch	23	1928	155	140	170		
Greylag Goose	23	277	169	46	412		
Blackcap	23	1864	175	159	193		
Barn Owl	23	54	251	158	426		
Gadwall	23	48	253	91	526		
Cetti's Warbler	23	33	417	113	3096		
Mandarin	23	36	457	239	1172		
Red Kite	23	186	1738	1077	3236		
Ring-necked Parakeet	23	92	1776	882	9518		
Little Egret	23	57	2399	870	117671		

17. Table of population increases for BBS England 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Tree Sparrow	23	158	58	25	99		
Canada Goose	23	510	65	41	95		
Jackdaw	23	1587	79	65	92		
Great Spotted Woodpecker	23	1073	104	91	120		
Chiffchaff	23	1495	107	97	119		
Stonechat	23	74	117	58	218		
Nuthatch	23	506	126	102	155		
Goldfinch	23	1586	145	127	163		
Blackcap	23	1577	146	133	160		
Gadwall	23	45	221	96	540		
Buzzard	23	853	226	179	275		
Barn Owl	23	52	259	161	492		

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Greylag Goose	23	229	306	152	598		
Cetti's Warbler	23	30	314	108	2559		
Ring-necked Parakeet	23	92	1777	793	9550		
Little Egret	23	53	2129	733	53460		
Red Kite	23	143	21795	13385	74499		

18. Table of population increases for BBS Scotland 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
House Sparrow	23	118	51	18	87		
Cuckoo	23	87	54	29	92		
Wren	23	261	55	39	72		
Magpie	23	64	62	26	121		
Long-tailed Tit	23	36	63	10	128		
Raven	23	58	63	11	126		
Lesser Redpoll	23	57	67	20	123		
Reed Bunting	23	72	70	40	117		
Tree Pipit	23	40	80	45	128		
Stonechat	23	42	99	42	220		
House Martin	23	82	110	58	197		
Whitethroat	23	98	130	48	214		
Goldfinch	23	122	224	160	311		
Great Spotted Woodpecker	23	67	399	277	579		
Blackcap	23	84	539	362	839		
Chiffchaff	23	77	836	508	1435		

19. Table of population increases for BBS Wales 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Jay	23	84	52	20	97		
Chiffchaff	23	164	54	31	76		
House Sparrow	23	143	92	61	139		
Goldfinch	23	151	104	73	156		
Blackcap	23	147	143	97	204		

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Great Spotted Woodpecker	23	97	189	119	293		
Stonechat	23	45	191	108	322		

20. Table of population increases for BBS Northern Ireland 1995-2018

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Alert	Comment
Dunnock	23	75	64	20	130		
Song Thrush	23	83	65	33	100		
Wren	23	97	72	30	109		
Jackdaw	23	81	72	39	131		
House Martin	23	49	83	24	199		
Pheasant	23	45	104	30	281		
Woodpigeon	23	90	116	73	169		
Collared Dove	23	38	116	46	331		
Great Tit	23	79	135	89	188		
Hooded Crow	23	87	179	111	254		
Goldfinch	23	56	485	289	1088		
Buzzard	23	36	1305	588	3591		
Blackcap	23	46	1540	1081	3285		

Breeding performance

1. Clutch size
2. Brood size
3. Egg-stage nest failure rate
4. Chick-stage nest failure rate

1. Table of significant trends in Clutch size measured between 1967-2018

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Great Tit	51	464	Linear decline	8.31 eggs	7.14 eggs	-1.17 eggs	
Blue Tit	51	664	Linear decline	9.44 eggs	8.63 eggs	-0.81 eggs	
Grey Heron	51	14	Linear decline	4.01 eggs	3.4 eggs	-0.61 eggs	Small sample
Long-tailed Tit	51	48	Curvilinear	7.79 eggs	7.22 eggs	-0.57 eggs	
Peregrine	51	20	Curvilinear	3.9 eggs	3.33 eggs	-0.57 eggs	Small sample
Magpie	51	40	Curvilinear	5.87 eggs	5.32 eggs	-0.55 eggs	
Buzzard	51	37	Curvilinear	2.07 eggs	1.62 eggs	-0.45 eggs	
Great Crested Grebe	51	15	Linear decline	3.52 eggs	3.14 eggs	-0.38 eggs	Small sample
Meadow Pipit	51	42	Curvilinear	4.27 eggs	3.98 eggs	-0.29 eggs	
Woodpigeon	51	101	Linear decline	2.02 eggs	1.76 eggs	-0.26 eggs	
Pied Wagtail	51	67	Linear decline	5.09 eggs	4.88 eggs	-0.21 eggs	
Hen Harrier	51	11	Curvilinear	5.52 eggs	5.32 eggs	-0.2 eggs	Small sample
Ring Ouzel	51	11	Linear decline	4.05 eggs	3.88 eggs	-0.17 eggs	Small sample
Greenfinch	51	80	Linear decline	4.75 eggs	4.58 eggs	-0.17 eggs	
Linnet	51	127	Linear decline	4.75 eggs	4.6 eggs	-0.15 eggs	
Chaffinch	51	96	Linear decline	4.29 eggs	4.16 eggs	-0.13 eggs	
Common Sandpiper	51	12	Curvilinear	3.99 eggs	3.88 eggs	-0.11 eggs	Small sample
Wren	51	101	Curvilinear	5.56 eggs	5.45 eggs	-0.11 eggs	
Collared Dove	51	43	Linear decline	1.96 eggs	1.87 eggs	-0.09 eggs	
Spotted Flycatcher	51	76	Linear decline	4.27 eggs	4.19 eggs	-0.08 eggs	
Grey Wagtail	51	40	Curvilinear	4.78 eggs	4.73 eggs	-0.05 eggs	
Moorhen	51	110	Curvilinear	6.6 eggs	6.6 eggs	0 eggs	
Oystercatcher	51	158	Curvilinear	2.76 eggs	2.82 eggs	0.06 eggs	
Lapwing	51	187	Curvilinear	3.67 eggs	3.74 eggs	0.07 eggs	
Stock Dove	51	140	Curvilinear	2.08 eggs	2.16 eggs	0.08 eggs	
Carrion Crow	51	30	Curvilinear	4.03 eggs	4.11 eggs	0.08 eggs	Includes Hooded Crow
Stonechat	51	41	Curvilinear	4.95 eggs	5.05 eggs	0.1 eggs	
Dunnock	51	116	Curvilinear	3.88 eggs	4.02 eggs	0.14 eggs	
Skylark	51	34	Curvilinear	3.33 eggs	3.55 eggs	0.22 eggs	
Redstart	51	58	Curvilinear	5.93 eggs	6.22 eggs	0.29 eggs	
Little Owl	51	26	Linear increase	3.35 eggs	3.72 eggs	0.37 eggs	Small sample
Tree Sparrow	51	416	Curvilinear	4.78 eggs	5.18 eggs	0.4 eggs	
Starling	51	75	Linear increase	4.46 eggs	4.94 eggs	0.48 eggs	

2. Table of significant trends in Brood size measured between 1967-2018

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Great Tit	51	1002	Linear decline	7.43 chicks	6.03 chicks	-1.4 chicks	
Blue Tit	51	1272	Linear decline	8.41 chicks	7.19 chicks	-1.22 chicks	
Long-tailed Tit	51	40	Linear decline	6.6 chicks	5.47 chicks	-1.13 chicks	
Sand Martin	51	107	Curvilinear	4.71 chicks	3.68 chicks	-1.03 chicks	
Carrion Crow	51	77	Curvilinear	2.94 chicks	2.39 chicks	-0.55 chicks	Includes Hooded Crow
Grey Heron	51	87	Linear decline	2.86 chicks	2.34 chicks	-0.52 chicks	
Chiffchaff	51	52	Linear decline	5.06 chicks	4.69 chicks	-0.37 chicks	
Magpie	51	76	Curvilinear	3.4 chicks	3.06 chicks	-0.34 chicks	
Greenfinch	51	99	Linear decline	4.09 chicks	3.75 chicks	-0.34 chicks	
House Sparrow	51	175	Linear decline	3.48 chicks	3.16 chicks	-0.32 chicks	
Rook	51	71	Curvilinear	2.2 chicks	1.89 chicks	-0.31 chicks	
Wood Warbler	51	41	Linear decline	5.56 chicks	5.25 chicks	-0.31 chicks	
Meadow Pipit	51	87	Curvilinear	3.93 chicks	3.69 chicks	-0.24 chicks	
Hobby	51	31	Curvilinear	2.36 chicks	2.13 chicks	-0.23 chicks	
Coal Tit	51	75	Curvilinear	7.47 chicks	7.24 chicks	-0.23 chicks	
Ring Ouzel	51	23	Linear decline	3.77 chicks	3.55 chicks	-0.22 chicks	Small sample
Pied Wagtail	51	136	Linear decline	4.5 chicks	4.32 chicks	-0.18 chicks	
Raven	51	75	Curvilinear	3.27 chicks	3.11 chicks	-0.16 chicks	
Reed Bunting	51	62	Curvilinear	4.03 chicks	3.91 chicks	-0.12 chicks	
Woodpigeon	51	144	Curvilinear	1.8 chicks	1.72 chicks	-0.08 chicks	
Robin	51	239	Curvilinear	4.41 chicks	4.33 chicks	-0.08 chicks	
Linnet	51	147	Curvilinear	4.1 chicks	4.05 chicks	-0.05 chicks	
Buzzard	51	119	Curvilinear	1.86 chicks	1.84 chicks	-0.02 chicks	
Dunnock	51	129	Curvilinear	3.41 chicks	3.39 chicks	-0.02 chicks	
Kestrel	51	190	Curvilinear	3.78 chicks	3.77 chicks	-0.01 chicks	
Yellowhammer	51	64	Curvilinear	2.98 chicks	2.97 chicks	-0.01 chicks	
Tree Pipit	51	32	Curvilinear	4.24 chicks	4.25 chicks	0.01 chicks	
Stonechat	51	83	Curvilinear	4.63 chicks	4.64 chicks	0.01 chicks	
Collared Dove	51	72	Curvilinear	1.74 chicks	1.76 chicks	0.02 chicks	
Mute Swan	51	68	Curvilinear	4.46 chicks	4.53 chicks	0.07 chicks	
Sparrowhawk	51	64	Curvilinear	3.14 chicks	3.22 chicks	0.08 chicks	
Grey Wagtail	51	84	Curvilinear	4.07 chicks	4.16 chicks	0.09 chicks	
Spotted Flycatcher	51	125	Linear increase	3.69 chicks	3.8 chicks	0.11 chicks	
Corn Bunting	51	14	Curvilinear	3.3 chicks	3.44 chicks	0.14 chicks	Small sample
Skylark	51	63	Curvilinear	3.09 chicks	3.26 chicks	0.17 chicks	
Peregrine	51	63	Linear increase	2.39 chicks	2.6 chicks	0.21 chicks	
Willow Warbler	51	150	Linear increase	5.14 chicks	5.36 chicks	0.22 chicks	

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Dipper	51	172	Curvilinear	3.43 chicks	3.67 chicks	0.24 chicks	
Tree Sparrow	51	537	Curvilinear	3.84 chicks	4.14 chicks	0.3 chicks	
Merlin	51	60	Curvilinear	3.32 chicks	3.63 chicks	0.31 chicks	
Little Owl	51	57	Linear increase	2.51 chicks	2.9 chicks	0.39 chicks	
Redstart	51	101	Curvilinear	5.13 chicks	5.57 chicks	0.44 chicks	
Moorhen	51	104	Curvilinear	2.52 chicks	3.08 chicks	0.56 chicks	
Starling	51	237	Linear increase	3.22 chicks	3.8 chicks	0.58 chicks	
Jay	51	11	Linear increase	3.39 chicks	4.03 chicks	0.64 chicks	Small sample
Wren	51	134	Curvilinear	3.59 chicks	4.29 chicks	0.7 chicks	
Nuthatch	51	92	Linear increase	4.93 chicks	5.83 chicks	0.9 chicks	

3. Table of significant trends in Daily failure rate (eggs) measured between 1967-2018

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Magpie	51	46	Curvilinear	0.0322 nests/day	0.0045 nests/day	-0.0277 nests/day	
Redshank	51	28	Linear decline	0.0396 nests/day	0.0123 nests/day	-0.0273 nests/day	Small sample
Long-tailed Tit	51	66	Curvilinear	0.0396 nests/day	0.0131 nests/day	-0.0265 nests/day	
Dipper	51	130	Curvilinear	0.0305 nests/day	0.0054 nests/day	-0.0251 nests/day	
Yellowhammer	51	61	Curvilinear	0.05 nests/day	0.028 nests/day	-0.022 nests/day	
Snipe	51	13	Linear decline	0.0318 nests/day	0.012 nests/day	-0.0198 nests/day	Small sample
Woodlark	51	27	Curvilinear	0.0477 nests/day	0.0286 nests/day	-0.0191 nests/day	Small sample
Wheatear	51	15	Linear decline	0.0219 nests/day	0.0038 nests/day	-0.0181 nests/day	Small sample
Carrion Crow	51	46	Curvilinear	0.0212 nests/day	0.0061 nests/day	-0.0151 nests/day	Includes Hooded Crow
Woodpigeon	51	115	Curvilinear	0.0457 nests/day	0.0308 nests/day	-0.0149 nests/day	
Stock Dove	51	130	Curvilinear	0.0185 nests/day	0.0063 nests/day	-0.0122 nests/day	
Pied Wagtail	51	90	Linear decline	0.0175 nests/day	0.0067 nests/day	-0.0108 nests/day	
Robin	51	233	Curvilinear	0.0248 nests/day	0.0145 nests/day	-0.0103 nests/day	
Great Crested Grebe	51	23	Curvilinear	0.0295 nests/day	0.0193 nests/day	-0.0102 nests/day	Small sample
Tawny Owl	51	68	Curvilinear	0.0116 nests/day	0.0022 nests/day	-0.0094 nests/day	Nocturnal species
Starling	51	122	Linear decline	0.0112 nests/day	0.0021 nests/day	-0.0091 nests/day	
Grey Wagtail	51	60	Linear decline	0.0172 nests/day	0.0095 nests/day	-0.0077 nests/day	
Buzzard	51	30	Linear decline	0.0081 nests/day	0.0004 nests/day	-0.0077 nests/day	
House Sparrow	51	130	Linear decline	0.011 nests/day	0.0033 nests/day	-0.0077 nests/day	
Barn Owl	51	39	Linear decline	0.0078 nests/day	0.0004 nests/day	-0.0074 nests/day	
Nuthatch	51	70	Linear decline	0.0091 nests/day	0.0018 nests/day	-0.0073 nests/day	
Wood Warbler	51	27	Curvilinear	0.0244 nests/day	0.0172 nests/day	-0.0072 nests/day	Small sample
Kestrel	51	44	Curvilinear	0.008 nests/day	0.0013 nests/day	-0.0067 nests/day	
Wren	51	145	Linear decline	0.0183 nests/day	0.0119 nests/day	-0.0064 nests/day	
Marsh Tit	51	22	Linear decline	0.0073 nests/day	0.001 nests/day	-0.0063 nests/day	Small sample

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Redstart	51	87	Curvilinear	0.015 nests/day	0.009 nests/day	-0.006 nests/day	
Jackdaw	51	81	Curvilinear	0.0087 nests/day	0.0032 nests/day	-0.0055 nests/day	
Tree Sparrow	51	537	Linear decline	0.0084 nests/day	0.0029 nests/day	-0.0055 nests/day	
Merlin	51	23	Linear decline	0.0068 nests/day	0.0015 nests/day	-0.0053 nests/day	Small sample
Peregrine	51	28	Linear decline	0.0073 nests/day	0.0024 nests/day	-0.0049 nests/day	Small sample
Sparrowhawk	51	29	Linear decline	0.0042 nests/day	0.0006 nests/day	-0.0036 nests/day	Small sample
Raven	51	23	Curvilinear	0.0034 nests/day	0.0002 nests/day	-0.0032 nests/day	Small sample
Tree Pipit	51	16	Curvilinear	0.044 nests/day	0.0408 nests/day	-0.0032 nests/day	Small sample
Pied Flycatcher	51	528	Curvilinear	0.0062 nests/day	0.0032 nests/day	-0.003 nests/day	
Spotted Flycatcher	51	111	Curvilinear	0.0175 nests/day	0.0148 nests/day	-0.0027 nests/day	
Great Tit	51	901	Linear decline	0.005 nests/day	0.0023 nests/day	-0.0027 nests/day	
Sand Martin	51	91	Curvilinear	0.0107 nests/day	0.008 nests/day	-0.0027 nests/day	
Coal Tit	51	57	Linear decline	0.0042 nests/day	0.0018 nests/day	-0.0024 nests/day	
Blue Tit	51	1185	Curvilinear	0.0039 nests/day	0.0023 nests/day	-0.0016 nests/day	
Greenfinch	51	112	Curvilinear	0.027 nests/day	0.0255 nests/day	-0.0015 nests/day	
Swallow	51	689	Curvilinear	0.0047 nests/day	0.004 nests/day	-0.0007 nests/day	
Treecreeper	51	23	Curvilinear	0.0239 nests/day	0.0237 nests/day	-0.0002 nests/day	Small sample
Grey Heron	51	16	Curvilinear	0.0001 nests/day	0.0003 nests/day	0.0002 nests/day	Small sample
Curlew	51	21	Curvilinear	0.0277 nests/day	0.028 nests/day	0.0003 nests/day	Small sample
Chiffchaff	51	57	Curvilinear	0.0209 nests/day	0.0213 nests/day	0.0004 nests/day	
Collared Dove	51	61	Curvilinear	0.0301 nests/day	0.0312 nests/day	0.0011 nests/day	
Dunnock	51	162	Curvilinear	0.0257 nests/day	0.0279 nests/day	0.0022 nests/day	
Little Grebe	51	14	Curvilinear	0.0358 nests/day	0.04 nests/day	0.0042 nests/day	Small sample
Reed Warbler	51	228	Curvilinear	0.0192 nests/day	0.0242 nests/day	0.005 nests/day	
Stonechat	51	47	Linear increase	0.0056 nests/day	0.0109 nests/day	0.0053 nests/day	
Linnet	51	176	Linear increase	0.0184 nests/day	0.0241 nests/day	0.0057 nests/day	
Sedge Warbler	51	38	Curvilinear	0.015 nests/day	0.0208 nests/day	0.0058 nests/day	
Whitethroat	51	45	Curvilinear	0.0099 nests/day	0.0163 nests/day	0.0064 nests/day	
Garden Warbler	51	25	Curvilinear	0.0167 nests/day	0.0268 nests/day	0.0101 nests/day	Small sample
Willow Warbler	51	69	Linear increase	0.0091 nests/day	0.0196 nests/day	0.0105 nests/day	
Goldfinch	51	41	Linear increase	0.0188 nests/day	0.0302 nests/day	0.0114 nests/day	
Nightjar	51	29	Curvilinear	0.0079 nests/day	0.0198 nests/day	0.0119 nests/day	Small sample
Meadow Pipit	51	52	Curvilinear	0.0221 nests/day	0.0342 nests/day	0.0121 nests/day	
Lapwing	51	207	Curvilinear	0.016 nests/day	0.03 nests/day	0.014 nests/day	
Chaffinch	51	182	Curvilinear	0.029 nests/day	0.0433 nests/day	0.0143 nests/day	
Moorhen	51	137	Linear increase	0.0103 nests/day	0.0259 nests/day	0.0156 nests/day	
Ringed Plover	51	125	Curvilinear	0.0253 nests/day	0.0424 nests/day	0.0171 nests/day	
Blackbird	51	355	Curvilinear	0.0246 nests/day	0.0418 nests/day	0.0172 nests/day	
Skylark	51	42	Curvilinear	0.0373 nests/day	0.0551 nests/day	0.0178 nests/day	
Oystercatcher	51	174	Curvilinear	0.0102 nests/day	0.0282 nests/day	0.018 nests/day	
Whinchat	51	20	Linear increase	0.0069 nests/day	0.0293 nests/day	0.0224 nests/day	Small sample

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Reed Bunting	51	52	Linear increase	0.0074 nests/day	0.0302 nests/day	0.0228 nests/day	

4. Table of significant trends in Daily failure rate (chicks) measured between 1967-2018

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Sand Martin	51	114	Curvilinear	0.0314 nests/day	0.0016 nests/day	-0.0298 nests/day	
Skylark	51	51	Linear decline	0.0483 nests/day	0.0284 nests/day	-0.0199 nests/day	
Magpie	51	44	Curvilinear	0.0228 nests/day	0.0043 nests/day	-0.0185 nests/day	
Reed Warbler	51	177	Curvilinear	0.0235 nests/day	0.0116 nests/day	-0.0119 nests/day	
Grey Wagtail	51	59	Linear decline	0.0192 nests/day	0.0089 nests/day	-0.0103 nests/day	
Jackdaw	51	72	Curvilinear	0.0138 nests/day	0.0036 nests/day	-0.0102 nests/day	
Blackbird	51	286	Curvilinear	0.0318 nests/day	0.0225 nests/day	-0.0093 nests/day	
Tree Sparrow	51	376	Curvilinear	0.0157 nests/day	0.0064 nests/day	-0.0093 nests/day	
Merlin	51	31	Linear decline	0.0101 nests/day	0.0015 nests/day	-0.0086 nests/day	
Redstart	51	63	Curvilinear	0.0145 nests/day	0.0061 nests/day	-0.0084 nests/day	
House Sparrow	51	129	Curvilinear	0.0156 nests/day	0.0087 nests/day	-0.0069 nests/day	
Yellowhammer	51	49	Curvilinear	0.0434 nests/day	0.0377 nests/day	-0.0057 nests/day	
Carrion Crow	51	39	Linear decline	0.0064 nests/day	0.0012 nests/day	-0.0052 nests/day	Includes Hooded Crow
Collared Dove	51	54	Curvilinear	0.0212 nests/day	0.0179 nests/day	-0.0033 nests/day	
Barn Owl	51	196	Curvilinear	0.0033 nests/day	0.0003 nests/day	-0.003 nests/day	
Starling	51	137	Curvilinear	0.0068 nests/day	0.0038 nests/day	-0.003 nests/day	
Stock Dove	51	84	Linear decline	0.0104 nests/day	0.0075 nests/day	-0.0029 nests/day	
Tawny Owl	51	109	Curvilinear	0.0034 nests/day	0.0006 nests/day	-0.0028 nests/day	Nocturnal species
Meadow Pipit	51	75	Curvilinear	0.0344 nests/day	0.0317 nests/day	-0.0027 nests/day	
Nuthatch	51	77	Linear decline	0.0042 nests/day	0.002 nests/day	-0.0022 nests/day	
Peregrine	51	34	Linear decline	0.0029 nests/day	0.001 nests/day	-0.0019 nests/day	
Kestrel	51	80	Linear decline	0.002 nests/day	0.0009 nests/day	-0.0011 nests/day	
Great Tit	51	617	Curvilinear	0.0056 nests/day	0.0058 nests/day	0.0002 nests/day	
Spotted Flycatcher	51	101	Curvilinear	0.0087 nests/day	0.0095 nests/day	0.0008 nests/day	
Stonechat	51	78	Curvilinear	0.0155 nests/day	0.0173 nests/day	0.0018 nests/day	
Swallow	51	572	Linear increase	0.0028 nests/day	0.0049 nests/day	0.0021 nests/day	
Woodpigeon	51	93	Curvilinear	0.0204 nests/day	0.0229 nests/day	0.0025 nests/day	
Whinchat	51	33	Curvilinear	0.0237 nests/day	0.0264 nests/day	0.0027 nests/day	
Moorhen	51	50	Linear increase	0.0002 nests/day	0.0032 nests/day	0.003 nests/day	
Pied Flycatcher	51	446	Linear increase	0.0038 nests/day	0.007 nests/day	0.0032 nests/day	
Corn Bunting	51	14	Curvilinear	0.0492 nests/day	0.0535 nests/day	0.0043 nests/day	Small sample
Wren	51	99	Linear increase	0.0072 nests/day	0.0116 nests/day	0.0044 nests/day	
Linnet	51	126	Linear increase	0.0162 nests/day	0.0215 nests/day	0.0053 nests/day	
Nightjar	51	26	Curvilinear	0.002 nests/day	0.0085 nests/day	0.0065 nests/day	Small sample

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Reed Bunting	51	52	Curvilinear	0.0277 nests/day	0.04 nests/day	0.0123 nests/day	
Long-tailed Tit	51	45	Linear increase	0.008 nests/day	0.0208 nests/day	0.0128 nests/day	
Garden Warbler	51	21	Linear increase	0.0116 nests/day	0.0269 nests/day	0.0153 nests/day	Small sample
Wood Warbler	51	34	Curvilinear	0.0224 nests/day	0.0487 nests/day	0.0263 nests/day	

Discussion

In this discussion we:

1. Review the latest population change measures and alerts for species that are on the Birds of Conservation Concern (BoCC4) red or amber lists for the UK for reasons of population decline (Eaton *et al*. 2015) (*here*).
2. Identify species not on the BoCC4 lists but which raise alerts on account of long-term declines and, conversely, currently listed species where recovery may be sufficient to downgrade their listing status in the future (*here*).
3. Briefly review declines along waterways and in scrub and wetland habitats as shown by the WBS/WBBS and CES schemes (*here*).
4. Review trends over the last 10 years in species that have shown long-term declines, to identify the extent of ongoing declines and check for any evidence of recovery (*here*).
5. Review trends by seven different species groups to discuss common themes among the species within those groups: waterbirds; raptors, owls and raven; waders; woodland residents; woodland migrants; farmland residents; farmland migrants (*here*)
6. Identify those species that have shown rapid long-term population increases (*here*).
7. Discuss patterns of changes in breeding performance and relationships between trends in abundance and breeding performance (*here*).
8. Summarise the overall patterns found (*here*).

Except where otherwise indicated, our discussion is based on the best long-term trend that is available for each species. This is usually a joint CBC/BBS UK trend or, if this trend could not be constructed because CBC and BBS trends were different during the period of overlap of the two schemes, a CBC/BBS England trend (see Key to species texts). A WBS/WBBS trend replaces these for certain waterway species.

Details of estimating and comparing trends are given in the Methods section. Full details of all trends available for each species are given on the Species pages. Summary tables of all alerts raised by each scheme are presented in the Summary tables.

Of course, a number of species included in the BoCC4 red and amber lists are not covered by this report, and not every species listed red or amber is in UK population decline. Thus our tables relating to birds listed red or amber do not include every species on these lists.

Latest long-term alerts

A standardised system for setting 'alerts' in this report has been agreed between the providers and users of population monitoring information in the UK. Alerts are raised by population declines of 25–50% and of >50% over short, medium and longer terms (five years, ten years and 25+ years respectively) and noted in the 'Alert' column in the population change and demography tables. These help to highlight the scale and timing of declines, and act as an aid to interpreting the trend graphs presented.

These alerts are important for conservation practitioners who need to set priorities for conservation action, but we hope that they will also interest readers of the report more generally. Similar Alerts for wetland birds are provided by the Wetland Bird Survey (Woodward *et al.* 2019).

Our main emphasis in this section is on long-term declines measured over the longest period available (usually 51 years) and over 25 years, which is one of the periods used to determine 'Birds of Conservation Concern' red and amber listing for the UK (Eaton *et al.* 2015).

Alerts triggered over the short term should be considered as early warnings, indicating that conservation issues may be developing for the species concerned. Some short-term declines might stem, however, from normal fluctuations in abundance, from which the population is able to recover without assistance. The steep decline of a suite of species of similar ecology should be considered as a stronger indication that potential problems may be developing (see the Species Groups section of this report). Details of the methodology used to raise alerts are given in the Methods section.

Where this section discusses red-listed or amber-listed species, it uses the current version of these lists, introduced in December 2015 and abbreviated as BoCC4. The full paper (Eaton *et al.* 2015) details the criteria by which each listed species qualifies for its red or amber status and these criteria are also summarised on our species pages under 'Conservation listings' (see Key to species texts). Our tables here of red and amber species include only those that met the criteria (red or amber, respectively) for UK breeding population decline.

Long-term trends of 'Birds of Conservation Concern' red-listed species

The species considered in this section are red listed under BoCC4 wholly or partly because of severe UK population declines revealed by annual census data, amounting to more than 50% over the 25-year period 1987–2012, the 45-year period 1967–2012, or both. The latest long-term population changes and alerts for these severely declining species are shown in Table A1, over the maximum period available (usually the 51 years 1967–2018) and over 25 years (1993–2018). This table thus updates the figures that were used to produce the new BoCC4 red list, by six years.

The 24 species in Table A1 are listed in descending order of their longest-term percentage change.Turtle Dove remains the species with the strongest long-term UK decline (-98%). Tree Sparrow, which headed this table recently, has shown significant increases in numbers since 1995 and is now in second place, albeit still with a decline of 96% since 1967. The figures for Lesser Spotted Woodpecker are likely to be a very large underestimate of the current population change, because the species had by 1999 become too rare for further annual monitoring. Were recent data available, this species might easily surpass Turtle Dove and Tree Sparrow in the strength of its decline. Similarly, there is strong evidence that the decline for Woodcock has continued since it was last included in CBC/BBS monitoring.

Three other species, which are also red listed under BoCC4 because of severe UK population declines, are not included in Table A1 as long-term monitoring data are not available: Wood Warbler, Pied Flycatcher and Whinchat. Shorter monitoring histories from BBS show thatWood Warbler and Whinchat have both declined by more than 50% over 23 years (1995–2018), whilst Pied Flycatcher has declined by more than 25% but less than 50% over the same period.

Table A1 Latest trends for red-listed species

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	51	CBC/BBS UK	-98	-99	-97	>50	
Turtle Dove	25	CBC/BBS UK	-95	-97	-94	>50	
Tree Sparrow	51	CBC/BBS England	-96	-98	-92	>50	
Tree Sparrow	25	CBC/BBS England	26	-21	86		
Nightingale	51	CBC/BBS England	-93	-98	-70	>50	
Nightingale	25	CBC/BBS England	-61	-73	-34	>50	
Grey Partridge	51	CBC/BBS UK	-92	-95	-90	>50	
Grey Partridge	25	CBC/BBS UK	-65	-72	-60	>50	
Willow Tit	51	CBC/BBS UK	-92	-96	-86	>50	
Willow Tit	25	CBC/BBS UK	-84	-89	-78	>50	
Spotted Flycatcher	51	CBC/BBS UK	-90	-93	-85	>50	
Spotted Flycatcher	25	CBC/BBS UK	-54	-64	-44	>50	
Starling	51	CBC/BBS England	-89	-93	-85	>50	
Starling	25	CBC/BBS England	-68	-72	-65	>50	

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Lesser Redpoll	51	CBC/BBS England	-89	-96	-72	>50	
Lesser Redpoll	25	CBC/BBS England	-57	-83	-22	>50	
Tree Pipit	51	CBC/BBS England	-88	-95	-78	>50	
Tree Pipit	25	CBC/BBS England	-69	-81	-51	>50	
Corn Bunting	51	CBC/BBS UK	-86	-93	-76	>50	
Corn Bunting	25	CBC/BBS UK	-39	-53	-23	>25	
Cuckoo	51	CBC/BBS England	-78	-83	-70	>50	
Cuckoo	25	CBC/BBS England	-72	-76	-69	>50	
Marsh Tit	51	CBC/BBS UK	-78	-86	-71	>50	
Marsh Tit	25	CBC/BBS UK	-46	-55	-35	>25	
Woodcock	31	CBC to 1999	-74	-88	-49	>50	Small sample
Woodcock	25	CBC to 1999	-76	-88	-51	>50	Small sample
Yellow Wagtail	51	CBC/BBS UK	-72	-85	-47	>50	
Yellow Wagtail	25	CBC/BBS UK	-42	-57	-28	>25	
Linnet	51	CBC/BBS England	-72	-80	-64	>50	
Linnet	25	CBC/BBS England	-18	-25	-10		
House Sparrow	41	CBC/BBS England	-69	-79	-59	>50	
House Sparrow	25	CBC/BBS England	-15	-25	-5		
Skylark	51	CBC/BBS England	-63	-70	-56	>50	
Skylark	25	CBC/BBS England	-27	-31	-22	>25	
Yellowhammer	51	CBC/BBS UK	-61	-69	-51	>50	
Yellowhammer	25	CBC/BBS UK	-34	-38	-29	>25	
Lesser Spotted Woodpecker	31	CBC to 1999	-60	-81	40		Small sample
Lesser Spotted Woodpecker	25	CBC to 1999	-73	-86	-31	>50	Small sample
Mistle Thrush	51	CBC/BBS UK	-57	-66	-47	>50	
Mistle Thrush	25	CBC/BBS UK	-36	-41	-29	>25	
Lapwing	51	CBC/BBS UK	-55	-76	-29	>50	
Lapwing	25	CBC/BBS UK	-38	-46	-29	>25	
Song Thrush	51	CBC/BBS UK	-49	-56	-40	>25	
Song Thrush	25	CBC/BBS UK	27	21	35		
Grey Wagtail	43	WBS/WBBS waterways	-45	-58	-28	>25	
Grey Wagtail	25	WBS/WBBS waterways	-5	-20	14		
Curlew	51	CBC/BBS England	-38	-77	1		
Curlew	25	CBC/BBS England	-23	-34	-10		

For Song Thrush and Grey Wagtail, the populations have increased over the last five years, so the long-term decline is now less than 50%, prompting a lower level alert; and the 25-year decline is now less than 25% for both species so no longer triggers an alert. These species were on the red list under BoCC4. Based on current figures

they could potentially be changed to amber when the list is next reviewed.

For 11 other species – Lapwing, Marsh Tit, Skylark, Mistle Thrush, House Sparrow, Tree Sparrow, Yellow Wagtail, Linnet, Corn Bunting and Yellowhammer (listed in taxonomic order) – the 25-year change is now less than 50%, indicating that, while these species meet red-list criteria for long-term change, their rate of decline in more recent years has been slower than for most other red-listed birds, although their populations are still at a much lower level than in the 1960s. For Grey Wagtail and Tree Sparrow, the 25-year trend is effectively stable, and Song Thrush numbers have increased slightly. Although Curlew is red-listed for its UK breeding population decline, its long-term CBC/BBS trends do not currently meet the >50% criterion; the key information for red-listing comes from other surveys.

Long-term trends of declining amber-listed species

There are 25 amber-listed species under BoCC4 that are included in this report, of which about half (13 species) are listed because of UK population declines over the periods 1987–2012 or 1967–2012. Long-term trends are available from annual census data for 12 of these species (all except Swift); their trends are listed in Table A2 in descending order of longest-term percentage change (normally over the 51 years 1967–2018). A 25-year change (1993–2018) is also shown.

Table A2 Latest trends for declining amber-listed species

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
House Martin	51	CBC/BBS England	-75	-94	-9	>50	
House Martin	25	CBC/BBS England	-45	-57	-26	>25	
Redshank	43	WBS/WBBS waterways	-70	-93	-47	>50	
Redshank	25	WBS/WBBS waterways	-66	-85	-45	>50	
Willow Warbler	51	CBC/BBS England	-67	-76	-54	>50	
Willow Warbler	25	CBC/BBS England	-41	-47	-34	>25	
Meadow Pipit	51	CBC/BBS England	-52	-78	-22	>50	
Meadow Pipit	25	CBC/BBS England	-36	-46	-25	>25	
Common Sandpiper	43	WBS/WBBS waterways	-49	-61	-36	>25	
Common Sandpiper	25	WBS/WBBS waterways	-40	-49	-28	>25	
Dunnock	51	CBC/BBS UK	-36	-45	-28	>25	
Dunnock	25	CBC/BBS UK	19	12	26		
Bullfinch	51	CBC/BBS UK	-36	-48	-20	>25	
Bullfinch	25	CBC/BBS UK	17	5	27		
Dipper	43	WBS/WBBS waterways	-30	-47	-1	>25	
Dipper	25	WBS/WBBS waterways	-13	-30	12		
Tawny Owl	51	CBC/BBS UK	-23	-47	18		
Tawny Owl	25	CBC/BBS UK	-32	-45	-13	>25	
Kestrel	51	CBC/BBS England	-17	-42	33		
Kestrel	25	CBC/BBS England	-24	-32	-15		
Reed Bunting	51	CBC/BBS UK	-15	-36	10		
Reed Bunting	25	CBC/BBS UK	21	7	39		
Shelduck	31	CBC to 1999	300	94	787		Small sample
Shelduck	25	CBC to 1999	12	-40	118		

Four amber-listed species raise high alerts, having shown significant declines of greater than 50%, and so potentially are red-list candidates:

- Redshank has declined steeply in lowland Britain, according to waterways surveys (see below), raising high alerts; a major decline is also documented for its breeding sites on saltmarsh, and BBS data show that declines have occurred recently across a wide range of habitats. BBS declines do not yet meet the red-list

criterion, however.

- The English House Martin population meets the red-list criterion for long-term population decline measured by CBC/BBS trends (over 51-years), although BBS shows that numbers in Scotland and Northern Ireland have increased over 23 years (the longest trend available for this species in those countries), and consequently the decline in the UK as a whole since 1995 does not raise an alert.
- English Willow Warblers also meet the red-list criterion for long-term population decline (over 51-years), but there has been little change in Wales and the overall change in Scotland and Northern Ireland since 1995 has been upward.
- The English Meadow Pipit population also meets the red-list criterion over the long-term period (51-years), although there has been little change over 23 years (since 1995) in Scotland, Wales or Northern Ireland.

Although it is not included in Table A2 as no long-term trend is available, the shorter length trend from BBS (1995–2018) shows that a significant decline of greater than 50% has also occurred for Swift over 23 years.

Five other species raise only the lower level of alert. Common Sandpiper meets the 25% criterion (equivalent to amber listing) in both the 25-year and the 51-year periods. Populations of Dipper, Dunnock and Bullfinch have been recovering and show increasing trends over the shorter, 25-year period. Tawny Owl raises an alert over the 25-year period but does not do so over the longer 51-year period. Though amber listed for population decline, Shelduck, Kestrel and Reed Bunting do not formally raise alerts on the present data (note that in the case of Shelduck long-term CBC/BBS trends cannot be produced and the data presented here are for the 31-year period to 1999).

Long-term declines of species that are not currently red or amber listed (for declines)

This section of the report draws attention to declines which currently surpass red or amber criteria but which were not recognised in the BoCC4 listings (Table A3). These species may be candidates for conservation listing (for declines) at the next review.

Table A3 Long-term trends for declining species not on the red or amber list (for declines)

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Snipe	43	WBS/WBBS waterways	-89	-99	-49	>50	Small sample
Snipe	25	WBS/WBBS waterways	-62	-96	24		Small sample
Little Owl	51	CBC/BBS UK	-75	-85	-62	>50	
Little Owl	25	CBC/BBS UK	-62	-70	-50	>50	
Greenfinch	51	CBC/BBS UK	-65	-72	-56	>50	
Greenfinch	25	CBC/BBS UK	-62	-65	-59	>50	
Whitethroat	51	CBC/BBS UK	-63	-74	-49	>50	
Little Grebe	43	WBS/WBBS waterways	-51	-78	12		
Little Grebe	25	WBS/WBBS waterways	-33	-63	17		
Tufted Duck	25	WBS/WBBS waterways	-41	-64	5		
Sedge Warbler	51	CBC/BBS UK	-39	-67	-15	>25	
Sparrowhawk	25	CBC/BBS England	-36	-44	-26	>25	
Oystercatcher	25	WBS/WBBS waterways	-30	-43	-8	>25	
Garden Warbler	51	CBC/BBS UK	-27	-48	16		

The WBS/WBBS trend for Snipe is based now on a very small sample of plots, the species having deserted so many of its former riverside haunts. It is currently amber-listed because its UK breeding range has contracted sharply, especially in lowland England, and not for UK population decline. BBS data do not show any decline at the UK scale over the longest period covered by this survey (23 years).

Little Owl meets red-list criteria for population decline but, as a species introduced to the UK, is not eligible for any conservation listing. Whitethroat also raises a high alert over the long term, but the species is currently in recovery from its sudden losses in the late 1960s and therefore does not warrant a conservation listing. WBS/WBBS also indicates a possible strong decline for Little Grebe over both the 43-year and 25-year timescales, although, due to wide confidence intervals, it does not raise a formal alert in this report.

Stanbury *et al.* 2017). Another green listed species, Sparrowhawk, raises an alert having declined by more than 25% over 25-years, as does Oystercatcher, whose current amber listing does not result from population declines.

Potential declines of >25% have also occurred for Little Grebe over both 43-year and 25-year periods, and for both Tufted Duck and Garden Warbler over the 25-year period, for these estimates have wide confidence intervals and are not statistically significant, so do not formally raise an alert. For Little Grebe, the potential 43-year

decline from WBS/WBBS is > 50%. However, small waterbodies are not well-covered by WBBS and relative stability on BBS squares casts doubt upon the true nature of this species' population trend.

Declines along linear waterways

The Waterways Bird Survey and Waterways Breeding Bird Survey supplement the results from CBC and BBS, which include all habitat types, by measuring trends in bird populations alongside rivers and canals (which are not well represented in the main survey). Joint WBS/WBBS trends allow trend assessments to be continuous since 1974 for up to 25 species that were covered by WBS. WBBS, ongoing since 1998, includes all bird species but trends are presented here only for waterway-specialist species, for which joint WBS/WBBS trends are available.

For 13 species that are abundant in waterway habitats, WBS/WBBS provides the headline population trend for this report, generally because sample sizes exceed those from CBC/BBS. These species include one that is red-listed (Grey Wagtail), seven amber-listed species (Greylag Goose, Oystercatcher, Common Sandpiper, Redshank, Snipe, Kingfisher and Dipper) and four green-listed species Tufted Duck, Goosander, Little Grebe and Sand Martin), along with Canada Goose, which, as a non-native species in the UK, is excluded from the BoCC4 listings.

For six of the WBS/WBBS headline species that are in decline Oystercatcher, Common Sandpiper, Redshank, Snipe, Dipper and Grey Wagtail), latest trends appear also in Tables A1, A2 or A3, as appropriate. One other species (Tufted Duck) appears in Table A3 as a result of potential declines (of >25%, but not statistically significant). Even where WBS/WBBS is not the headline trend for a species, however, the waterways data provide valuable supplementary information from these sensitive habitats.

Table A4 lists all statistically significant declines of greater than 25% recorded from the full period of waterway monitoring (normally 43 years, 1975–2018).

Table A4 Population declines of greater than 25% recorded by the joint Waterways Bird Survey/Waterways Breeding Bird Survey (WBS/WBBS) between 1975 and 2018

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Yellow Wagtail	43	WBS/WBBS waterways	-97	-99	-95	>50	
Snipe	43	WBS/WBBS waterways	-89	-99	-49	>50	Small sample
Redshank	43	WBS/WBBS waterways	-70	-93	-47	>50	
Pied Wagtail	43	WBS/WBBS waterways	-70	-79	-62	>50	
Sedge Warbler	43	WBS/WBBS waterways	-68	-82	-49	>50	
Reed Bunting	43	WBS/WBBS waterways	-68	-77	-54	>50	
Lapwing	38	WBS/WBBS waterways	-58	-77	-21	>50	
Common Sandpiper	43	WBS/WBBS waterways	-49	-61	-36	>25	
Grey Wagtail	43	WBS/WBBS waterways	-45	-58	-28	>25	
Moorhen	43	WBS/WBBS waterways	-35	-52	-15	>25	
Dipper	43	WBS/WBBS waterways	-30	-47	-1	>25	

Six species are included here for which the WBS/WBBS trend is not the headline one and so is not listed in Tables A1–A3. These species are discussed briefly below. The trends for Yellow Wagtail and Sedge Warbler are consistent in direction with the 51-year trends reported from CBC/BBS, but the declines on waterways have been more severe. The CBC/BBS trend for Reed Bunting is not statistically significant, but shows a substantial increase in the first eight years until the mid-1970s followed by a substantial decline in the late 1970s and early 1980s, and therefore would be consistent with WBS/WBBS if both trends had started in 1975. The Pied Wagtail declines along waterways are particularly intriguing because they contrast markedly with the fluctuating but generally upward trend, in more terrestrial habitats, as measured by CBC/BBS.

In the early 1980s, population increases forLapwing reported by WBS/WBBS contrasted sharply with decline on CBC/BBS sites but long-term trends from both schemes show there has been a steep decline. It is possible that the initial WBS/WBBS increases may have been caused by redistribution of breeding birds into wetland areas during the early stages of the decline. Moorhen numbers have dipped sharply by all measures over the last ten years, perhaps through extra mortality in cold winters, and its long-term WBS/WBBS change has tipped over the alert threshold.

Alerts raised by WBS/WBBS, and long-term increases detected by that index, are tabulated in WBS/WBBS alerts and population increases. A full set of this year's WBS/WBBS trends can be obtained from the Table generator.

Declines on CES plots

The Constant Effort Sites Scheme provides trends from standardised ringing in scrub and wetland habitats. It is possibly our best scheme for monitoring some bird populations inhabiting reed beds, but its main objective is to collect integrated data on relative abundance, productivity and survival for a suite of species. The longest trends currently available from the CES cover a period of 34 years (Table A5).

Table A5 Population declines of greater than 25% recorded by the Constant Effort Sites scheme between 1984 and 2018

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Willow Warbler	34	CES adults	-77	-82	-71	>50	
Willow Warbler	25	CES adults	-64	-71	-58	>50	
Willow Tit	34	CES adults	-77	-90	-60	>50	Small sample
Willow Tit	25	CES adults	-72	-87	-45	>50	Small sample
Greenfinch	25	CES adults	-76	-84	-62	>50	
Lesser Whitethroat	34	CES adults	-65	-81	-40	>50	
Lesser Whitethroat	25	CES adults	-62	-76	-47	>50	
Reed Bunting	34	CES adults	-65	-77	-51	>50	
Reed Bunting	25	CES adults	-46	-61	-30	>25	
Sedge Warbler	34	CES adults	-55	-68	-40	>50	
Sedge Warbler	25	CES adults	-55	-61	-45	>50	
Chaffinch	34	CES adults	-52	-72	-20	>50	
Chaffinch	25	CES adults	-61	-70	-52	>50	
Whitethroat	34	CES adults	-51	-68	-30	>50	
Whitethroat	25	CES adults	-31	-47	-8	>25	
Reed Warbler	34	CES adults	-29	-48	-4	>25	
Garden Warbler	25	CES adults	-27	-41	-8	>25	

Most of the species that are declining on CES sites show broadly similar trends to those from CBC/BBS or WBS/WBBS data.Willow Tit is red listed on the strength of its long-term CBC/BBS declines (Table A1). Willow Warbler and Reed Bunting are similarly amber listed (Table A2).Greenfinch and Sedge Warbler are currently green listed but the long-term population trends now show a decline of >50% and >25% respectively (Table A3).

CES trends for Whitethroat, Reed Bunting and especially Lesser Whitethroat are considerably more negative than those from census data over similar periods, which may indicate habitat-specific differences in population status.

Chaffinch also raises a CES alert following several years of population decline. Recent BBS data also show a sharp decline but as this followed longer-term increases it has not yet triggered any BBS alerts.

A full set of alerts raised by CES and long-term increases are tabulated in CES alerts and population increases.

Ten-year trends and evidence of species recovery

If the status of species that have shown long-term declines were now improving, we would expect to find trends to be more positive in recent years than in the earlier part of the time series. To examine this, we list in Table B1 the best change estimates over the most recent ten-year period for which we have data (2008–18 in all but three cases), for all of the declining species listed in Tables A1–A3 (previous section). For Lesser Spotted Woodpecker, Woodcock and Shelduck, the ten-year period for which data are tabulated is 1989–99.

Table B1 also includes four further species that are listed red or amber in BoCC4 because of recent breeding decline, and for which we can report ten-year trends, but which lacked annual monitoring data before 1994. These are Whinchat, Grasshopper Warbler and Wood Warbler (all red listed), and Swift (amber listed).

Table B1 Ten-year trends for species that have shown long-term declines

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Turtle Dove	10	CBC/BBS UK	-82	-87	-75	>50	
Greenfinch	10	CBC/BBS UK	-67	-69	-66	>50	
Tufted Duck	10	WBS/WBBS waterways	-56	-68	-35	>50	
Lesser Spotted Woodpecker	10	CBC to 1999	-51	-75	-22	>50	Small sample
Little Owl	10	CBC/BBS UK	-46	-53	-36	>25	
Swift	10	BBS UK	-41	-46	-35	>25	
Woodcock	10	CBC to 1999	-40	-62	-11	>25	Small sample
Grey Partridge	10	CBC/BBS UK	-34	-44	-24	>25	
Willow Tit	10	CBC/BBS UK	-34	-49	-16	>25	
Lapwing	10	CBC/BBS UK	-33	-40	-27	>25	
Starling	10	CBC/BBS England	-29	-33	-23	>25	
Sparrowhawk	10	CBC/BBS England	-28	-34	-20	>25	
House Martin	10	CBC/BBS England	-28	-33	-22	>25	
Cuckoo	10	CBC/BBS England	-27	-33	-21	>25	
Tree Pipit	10	CBC/BBS England	-27	-45	-1	>25	
Grasshopper Warbler	10	BBS UK	-27	-43	-11	>25	
Oystercatcher	10	WBS/WBBS waterways	-24	-34	-9		
Sedge Warbler	10	CBC/BBS UK	-24	-33	-13		
Marsh Tit	10	CBC/BBS UK	-24	-36	-14		
Grey Wagtail	10	WBS/WBBS waterways	-22	-32	-9		
Wood Warbler	10	BBS UK	-22	-47	2		
Little Grebe	10	WBS/WBBS waterways	-20	-38	13		Small sample
Kestrel	10	CBC/BBS England	-19	-25	-14		
Common Sandpiper	10	WBS/WBBS waterways	-19	-29	-7		
Willow Warbler	10	CBC/BBS England	-18	-23	-11		
Redshank	10	WBS/WBBS waterways	-16	-56	15		
Mistle Thrush	10	CBC/BBS UK	-15	-20	-11		
Whinchat	10	BBS UK	-14	-32	7		
Garden Warbler	10	CBC/BBS UK	-12	-21	-2		

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Nightingale	10	CBC/BBS England	-11	-38	26		
Spotted Flycatcher	10	CBC/BBS UK	-11	-20	2		
Yellowhammer	10	CBC/BBS UK	-11	-16	-6		
Tawny Owl	10	CBC/BBS UK	-8	-21	9		
Skylark	10	CBC/BBS England	-6	-9	-3		
Dipper	10	WBS/WBBS waterways	-6	-20	8		
Curlew	10	CBC/BBS England	-5	-13	7		
Dunnock	10	CBC/BBS UK	-4	-7	-1		
Meadow Pipit	10	CBC/BBS England	-2	-9	6		
Song Thrush	10	CBC/BBS UK	2	-1	4		
Whitethroat	10	CBC/BBS UK	2	-3	7		
Shelduck	10	CBC to 1999	3	-21	40		
Reed Bunting	10	CBC/BBS UK	5	-2	12		
House Sparrow	10	CBC/BBS England	6	2	11		
Lesser Redpoll	10	CBC/BBS England	7	-17	42		
Corn Bunting	10	CBC/BBS UK	7	-11	26		
Tree Sparrow	10	CBC/BBS England	14	-4	38		
Linnet	10	CBC/BBS England	19	13	27		
Bullfinch	10	CBC/BBS UK	21	14	28		
Yellow Wagtail	10	CBC/BBS UK	25	8	47		
Snipe	10	WBS/WBBS waterways	59	5	109		

Species are listed in ascending order of population change. Thus the species with the steepest recent decline appear first. Towards the foot of the table are species that remain in long-term decline but have shown partial recovery of those losses during the recent ten-year period.

As indicated by their position at the top of Table B1, there is high confidence that the populations ofTurtle Dove, Greenfinch and Tufted Duck have halved within just the last ten years, or even a shorter period. These are the only species in long-term decline that suffered a 50% fall during 2008–18 (but Lesser Spotted Woodpecker also met these criteria during the most recent ten-year period for which data are available). Note that whilst the 25-year WBS/WBBS decline for Tufted Duck in Table A3 does not raise a formal alert due to wide confidence intervals, the 10-year decline is statistically significant so does raise a high alert: unless this recent steep decline is reversed it is likely that formal alerts will be raised against the longer-term trends in the future. A further 12 species also raise alerts, having declined significantly by more than 25% (but less than 50%) in their most recent ten-year period. All these declines compound earlier losses for these species.

The ongoing declines of so many of the species listed in Table B1 raises serious conservation concern. A special case isTurtle Dove, for which the 10-year decline has remained at 80% or greater in each of the last ten BirdTrend report and shows no sign of slowing.

The 25% threshold, which is used to define decreases over the 25-year period that are worthy of amber listing, is equivalent to a change of 10.9% over ten years, assuming a constant rate of change. Thus a decrease of 11% or greater listed in Table B1 indicates that these species (32 in all, including non-significant declines for Little Grebe, Redshank, Wood Warbler, Spotted Flycatcher, Nightingale and Whinchat) are on course for new or renewed red or amber listing for breeding population decline.

A smaller decrease, or an increase, indicates that the population decline may be easing off. Species that have declined in the longer term but with losses smaller than 11%, or with no significant population change, over the ten-year period are Shelduck, Curlew, Tawny Owl, Skylark, Whitethroat, Song Thrush, Dipper, Tree Sparrow, Dunnock, Meadow Pipit, Lesser Redpoll, Corn Bunting, Yellowhammer and Reed Bunting.

Five species at the foot of the table show significant gains in population over the last ten years. The increases inSnipe, House Sparrow, Yellow Wagtail, Bullfinch and Linnet numbers is very welcome but the upturns are coming from such a low level that numbers remain far below those of the mid 1970s, with the population trend graphs still showing little sign of clear recovery.

Species groups

Waterbirds

Species	Long-term Trend	Primary Demographic	Primary Ecological
Mute Swan	Rapid Increase (UK, Eng)	Survival	Other
Greylag Goose	Rapid Increase (UK)	Unknown	Unknown
Canada Goose	Rapid Increase (UK)	Unknown	Unknown
Gadwall	Rapid Increase (UK, Eng)	Unknown	Unknown
Mallard	Rapid Increase (UK, Eng)	Unknown	Unknown
Mandarin Duck	Increase (UK, Eng)	Unknown	Unknown
Tufted Duck	Possible Increase	Unknown	Unknown
Goosander	Rapid Increase (UK)	Unknown	Unknown
Moorhen	Fluctuating (UK)	Unknown	Unknown
Coot	Rapid Increase (UK, Eng)	Unknown	Unknown
Little Grebe	Uncertain (UK)	Unknown	Unknown
Great-crested Grebe	Stable (UK)	Unknown	Unknown
Cormorant	Increase (UK)	Unknown	Unknown
Grey Heron	Possible shallow increase (UK, Eng) Probable moderate decline (Scot, Wales)	Survival	Unknown
Little Egret	Rapid Increase (UK, Eng)	Unknown	Unknown

Most waterbird species are increasing in the UK. It is likely that increased water quality and warmer winter temperatures, reducing mortality, are at least partly responsible but there is little direct evidence on the causes of change for most species. For Wood *et al* 2019). Ingestion of lead shot similarly appears to be associated with population declines in wintering ducks (Green & Pain 2016).

Both Greylag Goose and Canada Goose extensively exploit urban habitats where low mortality rates of adult birds and a relatively high reproductive rate may both contribute to the population increases.

Study of breeding populations of ducks is difficult, the adults are not easy to catch and nest are hard to find and access, so less is known about these species than almost any other group of British birds.

Until the 1990s the Musgrove 2002). There is little direct evidence as to why this might be, but a combination of warmer winters, increased water quality and provision of new habitat, in the form of remediated gravel pits may all have played a part. It is likely other species, such as Purple Heron, Great White Egret and Cattle Egret may join the Little Egret as British breeding species in the near future, all have successfully bred for the first time in recent years. Herons and egrets, though, are susceptible to cold winters reducing prey availability and increasing mortality (Holt 2012), and the effects of the recent cold winters can be seen in downturns in the trend of both Little Egret and Grey Heron.

Raptors, Owls and Raven

Species	Long-term Trend	Primary Demographic	Primary Ecological
Sparrowhawk	Moderate Increase (Eng)	Breeding Success	Other
Hen Harrier	Probable Increase (UK)	Breeding Success	Other
Red Kite	Rapid Increase (UK, Eng)	Unknown	Unknown
Buzzard	Rapid Increase (Eng)	Breeding Success	Other
Barn Owl	Possible Decline (UK)	Survival	Other
Tawny Owl	Shallow Decline (UK, Eng)	Unknown	Unknown
Little Owl	Rapid Decline (UK, Eng)	Juvenile Survival	Agricultural Intensification
Kestrel	Fluctuating (Eng)	Survival	Unknown

Merlin	Probable increase (UK)	Unknown	Unknown
Hobby	Increase (UK, Eng)	Unknown	Unknown
Peregrine	Increase (UK, Eng, NI); Recent Decline (Scot, Wales)	Breeding Success	Ban on organochlorine pesticides
Raven	Increase (UK)	Unknown	Unknown

In the last few decades, most birds of prey have increased in number as a result of reduction in the use of certain pesticides, reductions in persecution and, for some species, changes in habitat availability.

During the 1950s and 1960s the widespread use of organochlorine and organophosphate pesticides reduced population numbers of many raptor species, of which the Newton 2013). Following a ban on their use, numbers gradually increased. Being towards the top of the food chain, though, birds of prey remain vulnerable to the risk of secondary poisoning, and there are current concerns more recently around the use of anticoagulant rodenticides which bear further investigation (Christensen *et al.* 2012; Walker *et al.* 2013, 2014, 2019).

Concurrent with these changes, increased legal protection of these species led to a reduction in levels of control and persecution, particularly in lowland areas for species such as Elliott & Avery 1991). Illegal persecution, in particular of Murgatroyd *et al.* 2019). Similar considerations apply to the Wilson *et al.* 2019) .

Positive conservation measures have been particularly successful for two species. Provision of nest boxes for Carter 2001).

The two species found most commonly on farmland (Kettel *et al* 2018b).

Waders

Species	Long-term Trend	Primary Demographic	Primary Ecological
Oystercatcher	Shallow Increase (UK)	Unknown	Unknown
Lapwing	Rapid Decline (UK); Moderate Decline (Eng)	Breeding Success	Agricultural Intensification
Golden Plover	Probable Decline (UK)	Unknown	Unknown
Ringed Plover	Decline (UK)	Breeding Success	Unknown
Curlew	Moderate Decline (Eng)	Breeding Success	Agricultural Intensification
Woodcock	Probable Rapid Decline (UK)	Unknown	Unknown
Snipe	Rapid Decline (UK)	Unknown	Unknown
Common Sandpiper	Moderate Decline (UK)	Unknown	Unknown
Redshank	Rapid Decline (UK)	Unknown	Agricultural Intensification

Breeding populations of most waders in Britain are declining, mostly as a result of habitat loss/intensification. They are also among the species most vulnerable to nest predation.

A key reason for the decline in breeding wader species, particularly Wilson *et al.* 2005a) and more intensive grassland management (Smart*et al.* 2008). As they nest on the ground, waders are vulnerable to nest predation and densities of generalist predators are higher in UK than elsewhere in Europe (Roos *et al.* 2018). Some species may also be vulnerable in some habitats to nest trampling from livestock, such as Redshank in saltmarsh (Norris et al. 2003, Malpas et al. 2012). Habitat loss has concentrated breeding populations into smaller areas increasing their vulnerability (Bolton *et al.* 2007). Predation of nests is also an issue in other habitats, such as in the Uists where populations of Calladine *et al.* 2017).

Woodland Residents

Species	Long-term Trend	Primary Demographic	Primary Ecological
Lesser Spotted Woodpecker	Rapid Decline	Unknown	Unknown
Great Spotted Woodpecker	Rapid Increase (UK, Eng)	Breeding Success	Decreased Competition for nests
Jay	Fluctuating (UK, Eng)	Unknown	Unknown
Coal Tit	Fluctuating (UK, Eng)	Unknown	Unknown
Marsh Tit	Rapid Decline (UK, Eng)	Survival	Changes in Woodland
Willow Tit	Rapid Decline (UK, Eng)	Unknown	Changes in Woodland

Blue Tit	Shallow Increase (UK, Eng)	Survival	Other
Great Tit	Moderate Increase (UK, Eng)	Survival	Other
Long-tailed Tit	Rapid Increase (Eng)	Survival	Weather
Goldcrest	Fluctuating (Eng)	Unknown	Unknown
Wren	Rapid Increase (UK, Eng)	Survival	Climate Change
Nuthatch	Rapid Increase (UK, Eng)	Breeding Success	Unknown
Treecreeper	Fluctuating (UK, Eng)	Survival	Weather
Blackbird	Shallow Decline (UK, Eng)	Survival	Unkown
Song Thrush	Moderate Decline (UK); Rapid Decline (Eng)	Juvenile survival	Unknown
Robin	Shallow Increase (UK); Moderate Increase (Eng)	Productivity	Unknown
Dunnock	Moderate Decline (UK, England)	Survival	Agricultural Intensification
Chaffinch	Fluctuating (UK, Eng)	Survival	Other
Lesser Redpoll	Rapid Decline (Eng)	Survival	Changes in Woodland
Siskin	Increase (UK)	Unknown	Unknown

Most resident species of woodland habitats are increasing, with the exception of those that have specialised habitat requirements, notably Lesser Spotted Woodpecker, Willow Tit and Marsh Tit.

In part, these increases are due to flexible, generalist nature of the habitat requirements of these species. Most are species of the woodland edge and leafy suburban habitats, in particular, provide a suitable alternative habitat for many, with the extensive provision of food in gardens being an additional attraction. Indeed, those species that have increased their use of gardens the most, such as Plummer *et al.* 2019).

In many species this has led to relatively high survival, perhaps particularly overwinter, although warmer winters will also have played a role, contributing to the population increases. One notable recent exception is the Lawson *et al.* 2018).

The causes of decline in the woodland specialist species are less clear, but the scale of the changes, especially in Lesser Spotted Woodpecker (which is now so uncommon that we can no longer monitor its population through BBS), Lesser Redpoll and Willow Tit suggest fundamental changes in woodland habitat quality in the last few decades.

Woodland Migratory Species

Species	Long-term Trend	Primary Demographic	Primary Ecological
Nightjar	Uncertain	Unknown	Changes in Heath and woodland
Wood Warbler	Decline (UK)	Unknown	Unknown
Willow Warbler	Rapid Decline (Eng)	Breeding Success	Climate Change?
Chiffchaff	Rapid Increase (UK, Eng)	Survival	Unknown
Blackcap	Rapid Increase (UK, Eng)	Unknown	Unknown
Garden Warbler	Fluctuating/possible decline (UK)	Unknown	Unknown
Spotted Flycatcher	Rapid Decline (UK, Eng)	Survival	Unknown
Nightingale	Decline (Eng)	Unknown	Changes in Woodland
Pied Flycatcher	Decline (UK)	Survival	Wintering Habitat Change
Redstart	Fluctuating (UK, Eng)	Productivity	Unknown
Tree Pipit	Rapid Decline (Eng)	Breeding Success	Changes in Woodland

Population trends in migratory species in woodland habitats depend largely on migration distance: those with shorter migratory journeys (wintering in Europe or North Africa) tend to be increasing, while those with longer journeys (wintering in central Africa) tend to be decreasing (Thaxter *et al.* 2010).

Increases in the short-distance migratory species are likely a result of climate change and warmer winters, with species such as Plummer *et al.* 2015).

Reasons for the declines in the longer distance migratory species are less well known, although in at least some species, such as Hewson *et al.* 2005), although this may not be true for all species (Mallord *et al.* 2016). Conditions on migration (or in the wintering destination) are likely to be important for some species, for example spatial variation in Hewson *et al.* 2016), a route taken by many of our migratory species. However, spatial variation in population trends of Morrison *et al.* 2016), indicating a mix of factors may be involved.

Farmland Resident Species

Species	Long-term Trend	Primary Demographic	Primary Ecological
Woodpigeon	Rapid Increase (UK, Eng)	Survival	Agricultural Intensification
Skylark	Rapid decline (Eng)	Breeding success	Agricultural Intensification
Starling	Rapid Decline (Eng)	Juvenile Survival	Agricultural Intensification
Song Thrush	Moderate Decline (UK); Rapid Decline (Eng)	Juvenile Survival	Unknown
Stonechat	Fluctuating (UK)	Unknown	Unknown
Chaffinch	Fluctuating (UK, Eng)	Survival	Other
Bullfinch	Moderate Decline (UK, Eng)	Adult Survival	Agricultural Intensification
Greenfinch	Rapid Decline (UK, Eng)	Survival	Trichomonosis disease
Linnet	Rapid Decline (Eng)	Breeding Success	Agricultural Intensification
Goldfinch	Rapid Increase (Eng)	Survival	Availability of Food
Yellowhammer	Rapid Decline (UK, England)	Survival	Agricultural Intensification
Reed Bunting	Fluctuating (UK, Eng)	Survival	Agricultural Intensification
Corn Bunting	Rapid Decline (UK, Eng)	Unknown	Agricultural Intensification

Most resident species on farmland are declining, or have declined in the past, with these trends generally reflecting fluctuations in food supply.

The declines in farmland bird are well studied and generally relate to the reduced availability of food resources, especially in seeds in winter for species like Robinson & Sutherland 2002). These declines generally reverse earlier increases in the 1950s and 60s as agriculture (particularly arable) expanded in extent from a previous low. Food availability in grassland habitats has also likely reduced affecting those that feed primarily on soil invertebrates such as Baker *et al.* 2012; Dadam & Siriwardena 2019). Recent research has also focused on the relative benefits of 'land sparing' (which combines highly intensive agriculture with land set aside for nature) and 'land sharing' (wildlife-friendly farming over a wide area); this suggests that 'land sparing' may promote greater avian diversity than 'land sharing' but that an intermediate approach may be best (Finch *et al.* 2019).

In contrast, those species that are increasing have adapted to using other food resources, such as gardens in the case of Lawson *et al.* 2018).

Farmland Migratory Species

Species	Long-term Trend	Primary Demographic	Primary Ecological
Turtle Dove	Rapid Decline (UK, Eng)	Breeding Success	Agricultural Intensification
Lesser Whitethroat	Uncertain (UK)	Unknown	Unknown
Whitethroat	Rapid Decline (UK, Eng)	Survival	Changes on Wintering Grounds
Whinchat	Decline (UK)	Breeding Success	Agricultural Intensification
Wheatear	Possible Decline (UK)	Unknown	Unknown
Yellow Wagtail	Rapid Decline (UK, Eng)	Unknown	Agricultural Intensification

All migratory species living on farmland, with the possible exception of Lesser Whitethroat, are declining in both numbers and range and some (Whinchat, Wheatear) are now restricted to marginal habitats in more upland areas.

The declines have generally been caused by intensification of agricultural practices in both grass (Vickery *et al.* 2001) and arable (Browne & Aebischer 2001) habitats. The catastrophic decline of the Whitethroat in the late 1960s was caused by drought conditions on its wintering grounds in the Sahelian region of Africa from which it is yet to recover.

Increasing species

Population changes of species for which our best long-term trend estimate from CBC/BBS (usually over 51 years) or from WBS/WBBS (a maximum of 43 years) shows an increase of more than 50% are shown in Table C1. There are 28 species listed, two fewer than in *BirdTrends 2019;* the increases for Pied Wagtail and Robin are now just below the cut-off and they are no longer listed in the table. Twenty-one of the species have more than doubled their population size over the periods in which they have been monitored (25–51 years).

Table C1 Long-term population increases of greater than 50% from CBC/BBS (1967-2018) or WBS/WBBS (1975-2018), using the best survey for each species

Species	Period (yrs)	Source	Change (%)	Lower limit	Upper limit	Alert	Comment
Buzzard	51	CBC/BBS England	856	547	2734		
Greylag Goose	25	WBS/WBBS waterways	485	184	1500		
Great Spotted Woodpecker	51	CBC/BBS UK	387	248	610		
Blackcap	51	CBC/BBS UK	338	259	451		
Shelduck	31	CBC to 1999	300	94	787		Small sample
Nuthatch	51	CBC/BBS UK	293	180	477		
Mute Swan	51	CBC/BBS UK	277	37	681		
Collared Dove	46	CBC/BBS UK	266	144	492		
Stock Dove	51	CBC/BBS England	220	106	394		
Woodpigeon	51	CBC/BBS UK	154	28	473		
Goosander	37	WBS/WBBS waterways	149	60	340		
Mallard	51	CBC/BBS UK	146	94	217		
Green Woodpecker	51	CBC/BBS England	145	85	232		
Jackdaw	51	CBC/BBS UK	139	69	264		
Carrion Crow	51	CBC/BBS England	138	95	199		
Goldfinch	51	CBC/BBS England	134	67	195		
Coot	51	CBC/BBS UK	131	48	341		
Canada Goose	37	WBS/WBBS waterways	124	14	630		
Wren	51	CBC/BBS UK	109	82	141		
Long-tailed Tit	51	CBC/BBS England	108	54	196		
Chiffchaff	51	CBC/BBS UK	105	71	161		
Great Tit	51	CBC/BBS UK	98	72	130		
Magpie	51	CBC/BBS UK	97	61	136		
Pheasant	51	CBC/BBS England	95	54	165		
Reed Warbler	51	CBC/BBS UK	93	17	287		
Sparrowhawk	43	CBC/BBS England	79	17	219		
Coal Tit	51	CBC/BBS UK	61	-3	157		
Goldcrest	51	CBC/BBS England	52	-12	201		

Table C1 is led by Buzzard, by a wide margin, but it should be noted that seven of the fastest-increasing species in this report are actually not included here, because their monitoring data cover too short a period. The UK's non-native population of Ring-necked Parakeets is estimated to have risen by 1,776% (more than a 18-fold

increase) over the 23 years 1995–2018. Arguably, however, this is more a conservation problem than a success! Mandarin Duck (+457% over 1995-2018) is another fast-increasing non-native species. Undoubted success stories are the growth during 1995–2018, estimated through BBS, of Little Egret, which has increased by more than 20-fold, the re-introduced Red Kite (+1,738%), Cetti's Warbler (+417%), Gadwall (+253%) and Barn Owl (+251%), and and. The headline trend for the Cetti's Warbler, a recently established native species, comes from CES rather than BBS with CES estimating a higher increase than BBS (691% during 1992–2018), even though the trajectory has been moderated by recent cold-weather-related setbacks. An eighth species, Stonechat, is also not included in the table but has also more than doubled its population over the period 1995–2018 (+118%).

Four groups stand out among the increasing species: corvids – especially Carrion Crow, Magpie and Jackdaw; doves – Collared Dove, Stock Dove and Woodpigeon; woodpeckers and other smaller species of woodland and gardens; and some waterbirds. Corvids appear to have benefited from changed gamebird management practices in recent years, and the larger doves from the increased acreage of brassica crops (particularly oilseed rape).

The majority of the third group are species primarily of woodland that are also common in gardens in some areas: Eglington *et al.* 2015). Declines on CES plots suggest the benefits might not be universal, with the habitat quality in 'core' sites possibly decreasing, while warming climates facilitate the colonisation of new sites.

A number of species associated with freshwater habitats are becoming more abundant, although differences between their ecological requirements make it unlikely that there is a single causal factor common to all. For Mallard, the CBC/BBS increase was matched by a WBS/WBBS increase of 165% over 43 years. The long-term increases recorded for Mute Swan on both CBC/BBS and WBS/WBBS plots are likely to be the result, at least in part, of banning the use of lead weights by anglers, which took effect in 1986. Greylag Goose, Shelduck, Canada Goose, Coot and Goosander are other wildfowl among this report's increasing species.

Two widespread raptors have shown remarkable recoveries from low population levels after the banning of certain poisonous farmland pesticides in the early 1960s, assisted by lower levels of illegal predator control. Buzzards increased in England by 856% between 1967 and 2018. Sparrowhawks, too scarce for CBC to monitor until the mid 1970s, show a 79% increase over the 43-year period from 1975 to 2018. However, their recovery appears to have been completed earlier than Buzzard's, and the population is now in moderate decline (for unknown reasons), prompting a lower level alert to be raised over the 25-year period (see Latest long-term alerts).

While Pheasant holds a place in this table, its increase in census data has been driven largely by increasing, but poorly quantified, scale of releases of artificially reared poults for shooting. Corvids, and other generalist predators, may also have benefited, exploiting both through the food provided for poults and the high mortality of poults, resulting in an abundant level of carcasses.

Changes in breeding performance

Changes in a range of aspects of breeding performance can be measured under the Nest Record Scheme (NRS) and the Constant Effort Sites (CES) scheme. The NRS provides information on components of breeding performance (clutch size, brood size and failure rates at the egg and nestling stages) that can be combined to give an overall estimate of productivity per nesting attempt (FPBA) – see NRS page for further information. The CES scheme provides an index of breeding performance accrued over all nesting attempts in a particular year. CES results also take into account any changes in the survival rates of fledglings in the first few weeks after leaving the nest, a period when losses of young can be high.

Breeding performance may be influenced by a variety of factors, including food availability, predation pressure and weather conditions. Variation in breeding performance may contribute to fluctuations in abundance and even be the main demographic factor responsible for determining the size of the population. Conversely, the breeding performance of a population may be inversely related to its size, with productivity decreasing as the number of individuals increases, and vice versa. Such a relationship might occur due to the action of density-dependent factors, such as competition for resources: as numbers increase, competition for resources is likely to increase, possibly resulting in poorer productivity. Alternatively, increases in abundance may be accompanied by range expansion into less suitable habitats or areas where breeding performance is poorer, thus reducing the average productivity of the population. The converse is also true, and where declines result from the loss of individuals from these suboptimal habitats, there may be a subsequent increase in average productivity recorded depending on how the driver of change affects the population.

Changes in Fledglings Per Breeding Attempt from Nest Record Scheme data

The NRS started collating nest histories of individual breeding attempts in 1939 and sufficient data are available for trends to be produced from the mid 1960s onward. The data collected allow annual variation in clutch size, brood size and stage-specific nest failure rates to be assessed, and these breeding parameters are included in the Summary tables. While detailed exploration of annual variation in productivity is essential if the impacts of environmental factors on breeding success are to be fully understood, the combined effects of concurrent changes in the number of offspring and failure rates can be difficult to interpret. These measures are therefore integrated into a single annual figure representing the mean number of young leaving each nest, termed Fledglings per Breeding Attempt (FPBA; Siriwardena *et al.* 2000b, Crick *et al.* 2003).

All species displaying significant temporal trends in mean FPBA over the full report period (51 years) are included in Table D1. In total, 44 species exhibited significant trends in productivity, of which 15 species now show lower FPBA: three red-listed species (Wood Warbler, Tree Pipit and Linnet), five amber-listed species (Nightjar, Willow Warbler, Dunnock, Meadow Pipit and Reed Bunting) and seven green-listed species (Moorhen, Great Tit, Long-tailed Tit,Garden Warbler, Treecreeper, Blackbird and Chaffinch). While the trend for Great Tit, Willow Warbler, Garden Warbler and Linnet has been linear, i.e. falling consistently over the last 51 years, trends for the other 11 species are curvilinear, and for some species in this latter group, FPBA is currently only marginally lower than in the 1960s. For ten of the species showing curvilinear trends, FPBA increased between the mid 1960s and mid 1980s or mid 1990s and decreased thereafter; whereas in the case of Nightjar, productivity decreased from the mid 1960s until the mid 2000s but has increased slightly over the last ten years.

Two further species have recorded significant trends in FPBA but are not listed in Table D1 as the data do not cover the full 51-year period. The red-listed Song Thrush shows a curvilinear trend in productivity (an increase followed by a decrease) over 37 years (1981-2018), and the green-listed Coot shows a linear decline in FPBA over 27 years (1991-2018).

Table D1 Significant trends in fledglings per breeding attempt measured between 1967 and 2018

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Moorhen	51	50	Curvilinear	2.41 fledglings	1.51 fledglings	-0.9 fledglings	
Reed Bunting	51	48	Curvilinear	2.55 fledglings	1.66 fledglings	-0.89 fledglings	
Garden Warbler	51	20	Linear decline	3.07 fledglings	2.28 fledglings	-0.79 fledglings	Small sample
Great Tit	51	617	Linear decline	5.95 fledglings	5.3 fledglings	-0.65 fledglings	
Willow Warbler	51	69	Linear decline	3.59 fledglings	3.14 fledglings	-0.45 fledglings	
Nightjar	51	25	Curvilinear	1.58 fledglings	1.14 fledglings	-0.44 fledglings	Small sample
Linnet	51	126	Linear decline	2.7 fledglings	2.33 fledglings	-0.37 fledglings	
Wood Warbler	51	26	Curvilinear	2.85 fledglings	2.56 fledglings	-0.29 fledglings	Small sample
Chaffinch	51	124	Curvilinear	1.63 fledglings	1.34 fledglings	-0.29 fledglings	
Meadow Pipit	51	52	Curvilinear	2 fledglings	1.74 fledglings	-0.26 fledglings	
Treecreeper	51	21	Curvilinear	2.77 fledglings	2.61 fledglings	-0.16 fledglings	Small sample
Long-tailed Tit	51	38	Curvilinear	3.43 fledglings	3.29 fledglings	-0.14 fledglings	
Blackbird	51	285	Curvilinear	1.48 fledglings	1.37 fledglings	-0.11 fledglings	
Tree Pipit	51	16	Curvilinear	1.75 fledglings	1.67 fledglings	-0.08 fledglings	Small sample
Dunnock	51	126	Curvilinear	1.68 fledglings	1.61 fledglings	-0.07 fledglings	
Collared Dove	51	54	Curvilinear	0.8 fledglings	0.81 fledglings	0.01 fledglings	
Woodpigeon	51	93	Curvilinear	0.52 fledglings	0.59 fledglings	0.07 fledglings	
Reed Warbler	51	176	Curvilinear	2.25 fledglings	2.4 fledglings	0.15 fledglings	

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Robin	51	213	Curvilinear	2.3 fledglings	2.54 fledglings	0.24 fledglings	
Skylark	51	40	Curvilinear	0.91 fledglings	1.16 fledglings	0.25 fledglings	
House Sparrow	51	116	Curvilinear	2.33 fledglings	2.58 fledglings	0.25 fledglings	
Yellowhammer	51	48	Curvilinear	0.83 fledglings	1.14 fledglings	0.31 fledglings	
Carrion Crow	51	38	Curvilinear	1.66 fledglings	1.98 fledglings	0.32 fledglings	Includes Hooded Crow
Sparrowhawk	51	29	Curvilinear	2.57 fledglings	2.9 fledglings	0.33 fledglings	Small sample
Stock Dove	51	84	Linear increase	1.01 fledglings	1.37 fledglings	0.36 fledglings	
Buzzard	51	30	Curvilinear	1.34 fledglings	1.72 fledglings	0.38 fledglings	
Pied Wagtail	51	89	Curvilinear	2.88 fledglings	3.34 fledglings	0.46 fledglings	
Wren	51	99	Curvilinear	2.36 fledglings	2.84 fledglings	0.48 fledglings	
Turtle Dove	51	10	Linear increase	0.73 fledglings	1.22 fledglings	0.49 fledglings	Small sample
Kestrel	51	43	Curvilinear	2.9 fledglings	3.44 fledglings	0.54 fledglings	
Peregrine	51	26	Linear increase	1.77 fledglings	2.32 fledglings	0.55 fledglings	Small sample
Little Owl	51	19	Linear increase	1.88 fledglings	2.45 fledglings	0.57 fledglings	Small sample
Tawny Owl	51	68	Linear increase	1.39 fledglings	2 fledglings	0.61 fledglings	Nocturnal species
Grey Wagtail	51	56	Linear increase	2.65 fledglings	3.36 fledglings	0.71 fledglings	
Barn Owl	51	39	Curvilinear	2.06 fledglings	2.84 fledglings	0.78 fledglings	
Jackdaw	51	69	Curvilinear	1.53 fledglings	2.31 fledglings	0.78 fledglings	
Dipper	51	95	Curvilinear	2.01 fledglings	2.87 fledglings	0.86 fledglings	
Merlin	51	21	Linear increase	2.48 fledglings	3.41 fledglings	0.93 fledglings	Small sample
Starling	51	114	Linear increase	2.55 fledglings	3.52 fledglings	0.97 fledglings	
Tree Sparrow	51	376	Curvilinear	2.61 fledglings	3.63 fledglings	1.02 fledglings	
Wheatear	51	15	Linear increase	3.5 fledglings	4.54 fledglings	1.04 fledglings	Small sample
Redstart	51	63	Curvilinear	3.38 fledglings	4.59 fledglings	1.21 fledglings	
Magpie	51	40	Curvilinear	1.12 fledglings	2.34 fledglings	1.22 fledglings	
Nuthatch	51	69	Linear increase	3.71 fledglings	5.52 fledglings	1.81 fledglings	

See Key to species texts for help with interpretation

A recent review paper focusing on long-distance migrant declines (Vickery *et al.* 2014) highlighted the important role demographic data play in the identification of mechanisms. Work by Morrison *et al.* (2013b) using BBS data reported a consistent positive relationship between latitude and the trajectory of long-distance migrant population trends within the UK, suggesting that abundance is, at least in part, determined by breeding success. This conclusion was supported by a study focusing specifically on contrasting regional trends in Willow Warbler numbers (Morrison *et al.* 2016c), which identified reduced productivity at lower latitudes as the underlying driver. There is increasing evidence that organisms at lower trophic levels are responding to climatic change more rapidly than those towards the top of the food chain (Visser & Both 2005, Thackeray *et al.* 2010, 2016). Resulting mismatches in the timing of food availability and of offspring food demand, referred to as phenological disjunction, can have severe impacts on breeding success and ultimately on population trends of bird species (Both *et al.* 2009), although there is evidence that the magnitude of these impacts may vary with diet and breeding habitat (Dunn & Møller 2014).

Long-distance migrants are thought to be particularly susceptible todisjunction between birds and their preydue to their later arrival on the breeding grounds and the energetic demands of their journey northwards, which may constrain their ability to advance their laying dates (Rubolini *et al.* 2010, Ockendon *et al.* 2012, Gilroy et al. 2016 but see Goodenough *et al.* 2011, Winkler *et al.* 2014); the resultant negative impacts on breeding success may be exacerbated by increased competition with less disadvantaged residents (Wittwer *et al.* 2015). Recent studies have detected negative correlations between May temperatures and both the population trajectories (Pearce-Higgins *et al.* 2015) and the extincton risk (Mustin *et al.* 2014) in a range of migrant species, lending weight to this hypothesis and potentially explaining the productivity declines reported here for Nightjar, Tree Pipit, Willow Warbler and Garden Warbler. Alteration to some habitats by humans may increase competition further by causing a reduction in nest site availability (Higginson 2017).

Trans-Saharan migrants may also be experiencing negative impacts ofclimate change in their African wintering grounds or on passage, with reduced rainfall leading to a fall in insect abundance and a subsequent loss of condition, resulting in a lower reproductive output during the following spring (Saino *et al.* 2004, 2012, Schaub *et al.* 2011, Finch *et al.* 2014); although for most species breeding ground climatic effects may be more important (Ockendon*et al.* 2013). Similar carry-over effects has been found for Dobson *et al.* 2017). The importance of conditions outside the breeding grounds was emphasised by Gilroy*et al.* (2016), who found that species inhabiting larger wintering ranges relative to the size of their breeding range were less likely to exhibit population declines, this increased migratory diversity potentially buffers the impacts of reduced quality within individual wintering regions or habitats. Climate change in the UK is also affecting bird populations, mainly through increased over-winter survival, but changes to rainfall and temperature during breeding and post-breeding may also affect productivity for some species, particularly in the longer

term (Pearce-Higgins & Crick 2019). This may also lead to some species being limited to areas where suitable climatic conditions exist, for example Massimino *et al.* 2020)

Long-distance migrants are not alone in being at risk from changes to the timing of seasonal events, and short-distance migrants and residents may also be affected (Franks *et al.* 2018). Lower productivity in the Lesser Spotted Woodpecker, which has experienced severe declines and can no longer be monitored by annual surveys, is believed to have been exacerbated by the effects of warmer springs (Smith & Smith 2019). The gap between the timing of seasonal events can also vary at different latitudes, and hence the effects of mismatch may differ across the UK (Burgess *et al.* 2018, Bell *et al.* 2019). Disjunction risk is predicted to vary spatially in relation to the duration of resource peaks and previous research has reported more marked migrant population declines in highly seasonal habitats (Both *et al.* 2010), of which woodlands are a prime example. Invertebrate food availability in the canopy increases rapidly during the brief period when larval Lepidoptera emerge to take advantage of the spring leaf burst, prior to the foliage toughening and developing chemical defences. As springs have become warmer, oak leafing dates have advanced, a shift matched by caterpillars (Buse *et al.* 1999), but apparently not by tits (Visser *et al.* 1998) or flycatchers (Both *et al.* 2009), despite the apparent plasticity of passerine laying dates in response to environmental drivers (Phillimore *et al.* 2016). The figures presented in this report indicate that Greenwood & Baillie 2008). The population level impacts of disjunction-related productivity declines are still unclear and there is some evidence that reduced productivity under warmer temperatures may be buffered by density-dependent increases in survival in some species, including Reed *et al.* 2012, 2013, 2015), and possibly also in clutch size (Saether *et al.* 2016, Bodey *et al.* 2020). Although advances in laying dates do not necessarily match the shifts of food sources, the potential resultant declines may be offset by other benefits, e.g. increased fledgling development time is believed to have contributed to better first year survival for Pied Flycatchers in the Netherlands (Tomotani *et al.* 2018).

Recent declines in the number of aerial insects (Shortall *et al.* 2009), particularly moths (Conrad *et al.* 2006, Fox 2013) and butterflies (Fox *et al.* 2015), have been reported across the UK. These invertebrate groups form a significant element of the diet of all the long-distance migrants identified as displaying productivity declines and a reduction in food availability may increase the incidence of whole brood failure due to starvation or desertion by under-nourished parents. The latitudinal variation in population trends identified by Morrison *et al.* (2013b) in the UK may reflect a more pronounced drop in invertebrate numbers in the south where conditions are generally drier. An alternative explanation may be a lower usage of neonicotinoid pesticides in the north, as it is becoming apparent that detrimental impacts on invertebrate numbers may not be limited to the agricultural areas to which they are applied (Hallmann *et al.* 2014). Looking at trends in insectivorous bird species across Europe, Bowler *et al.* (2019) found that declines in these species were mostly associated with agricultural intensification and loss of grasslands.

Clearly, declining food availability due to changes in farming practices, including agrochemical usage, may also be an issue for farmland bird species displaying negative trends in FPBA. Brickle *et al.* (2000) observed that Siriwardena *et al.* 1998b, Peach *et al.* 1999, Siriwardena *et al.* 2000b). If adults of stubble-feeding species are in poorer condition at the start of the breeding season, their investment in reproduction may also be reduced, and the granivorous diet of Siriwardena *et al.* 1999, 2000b). The possible effects of neonicotinoids on survival has been the subject of more recent research: there was limited evidence of potential direct effects (on Lennon *et al* 2019).

Egg-stage failure rates are implicated in the reduced productivity of nine of the 14 species exhibiting significant declines in FPBA (Groom 1993, Stoate & Szczur 2001, 2006, White *et al.* 2014), previous studies have failed to find any evidence of a significant impact at a national scale for many prey species (Gooch *et al.* 1991, Thomson *et al.* 1998, Chamberlain *et al.* 2009, Newson *et al.* 2009, Vögeli *et al.* 2011, reviewed by Madden *et al.* 2015). However, ground nesting birds, in particular waders, may be vulnerable to predation from mammals such as red fox and hedgehogs, and several studies have identified predation as a factor or partial factor causing low productivity and hence population declines (e.g. Teunissen *et al.* 2008, MacDonald & Bolton 2008b, Mason *et al.* 2017, Calladine *et al.* 2017, Zielonka *et al.* 2019; see also review by Roos *et al.* 2018). Moreover, lower abundance may further worsen productivity for some wader species through density-dependent effects, as fewer breeding pairs may become less efficient at defending nests (Moller *et al.* 2018). Several recent studies have also suggested that predation pressure may increase in response to climatic warming. For example, Cox *et al.* (2013) found that the incidence of nest predation by birds and snakes, but not mammals, increased with temperature in the USA; Auer & Martin (2013) demonstrated an increase in the proportion of predated nests across a range of species due to climate-induced shifts in plant–herbivore interactions. Kubelka *et al.* (2018) linked shifts in patterns of wader nest predation to changes of climate though the robustness of these patterns is debated (Bulla *et al.* 2019, Kubelka *et al.* 2019). Development of land can also alter predator type and number, with negative consequences for nest survival, as demonstrated by Hethcoat & Chalfoun (2015). Large-scale releases of pheasants and red-legged partridges have also been linked to higher numbers of avian predators, as they provide additional food resources, enhancing over-winter survival and hence abundance during subsequent breeding seasons (Pringle *et al.* 2019). Predation rates may therefore be increasing and further research into the impacts of nest predators on population trajectories, at a variety of spatial scales, is urgently required.

Increased grazing pressure by deer, numbers of which are rising rapidly in many areas of the UK (Newson *et al.* 2012), has been identified as a possible driver of population declines in the UK (Fuller *et al.* 2005) and the USA (Martin *et al.* 2011), the removal of the herb and shrub layers potentially reducing the availability of both food and well-concealed nesting sites. Mustin *et al.* (2014) demonstrated that Garden Warbler were less likely to colonise woodland sites with poorly developed undergrowth and experimental exclusion of deer has been shown to impact positively on this species. Similarly, Holt *et al.* (2010, 2011) showed that Nightingale territory density was much higher within deer exclosures, and Newson *et al.* (2012) identified a negative correlation between deer and the population trends of five woodland species, including Willow Warbler, which may also have been driven by reduced productivity.

Increasing human activity in the countryside, resulting from a growing population, could increase disturbance levels, in turn influencing the rates of predation and desertion. An investigation of Langston *et al.* 2007a) and a review of recreational disturbance impacts found breeding success to be adversely affected by human activity levels in 28 out of 33 papers cited (Steven *et al.* 2011). However, Lowe *et al.* (2014) observed that, while Nightjar territory selection was influenced by disturbance, there appeared to be no concurrent impact on breeding success.

The colonisation of urban habitats by Chamberlain *et al.* 2009a) and more research is needed to see whether these are representative at a national scale. Supplementary feeding in gardens is influencing the composition of bird communities across large spatial scales (Plummer *et al.* 2019), which may in turn affect productivity through density-dependent and interspecific effects. Whilst the effect of feeding on bird populations may be positive for some species, it may also increase risks of disease transmission (Lawson *et al.* 2018). The recent outbreak of trichomonosis, which has significantly and rapidly reduced the abundance of Robinson *et al.* 2010b; Lawson et al. 2018), although with no apparent reduction in breeding success, suggesting the impacts are primarily on adult survival, with limited density-dependent effects.

FPBA has changed significantly and is currently higher than in the late 1960s for 29 species, across a wide range of taxonomic groups. This total includes ten species for which the change has been linear, i.e. consistent increases in productivity across the last 51 years, and 19 species which show curvilinear trends (i.e. early decreases in FPBA were followed by increases, or vice-versa). For some species in the latter group, FPBA is currently only slightly higher than in the late 1960s. Population trends are also positive for 17 of the 29 species, including raptors (Sparrowhawk, Buzzard, Barn Owl, Merlin, Peregrine), pigeons (Stock Dove, Woodpigeon, Collared Dove), corvids (Magpie, Jackdaw, Carrion Crow), and some small passerines (Reed Warbler, Nuthatch, Wren, Robin, Redstart and Pied Wagtail). It is therefore possible that increasing productivity has contributed to the population growth exhibited by these species over recent decades. Conversely, 12 species (Turtle Dove, Little Owl, Tawny Owl, Kestrel, Skylark, Starling, Wheatear, Dipper, House Sparrow, Tree Sparrow, Grey Wagtail and Yellowhammer) have declined in number as FPBA has increased, suggesting that a density-dependent reduction in intraspecific competition, or a retreat into better quality habitat, may have enabled breeding success to rise.

Changes in productivity from Constant Effort Sites ringing data

The CES started monitoring populations in 1983, so the changes in productivity (Table D2) cover roughly half the period of the Nest Record Scheme results. The CES data set is unique in providing relative measures of adult abundance and productivity from the same set of sites in mostly wetland and scrub habitats. While the NRS data set monitors the productivity of individual nesting attempts, the proportion of juveniles in the CES catch provides a relative measure of annual variation in

productivity that integrates the effects of the number of fledglings produced per attempt, number of nesting attempts and immediate post-fledging survival. Use of these two techniques in combination provides a powerful method of determining which factors are responsible for observed declines in recruitment of young birds into the breeding population.

Table D2 Changes in productivity indices (percentage juveniles) for CES, 1984-2018, calculated from smoothed trend

Species	Period (yrs)	Plots (n)	Change (%)	Lower limit	Upper limit	Comment
Willow Tit	34	26	-62	-84	-1	
Reed Bunting	34	64	-56	-78	-10	
Sedge Warbler	34	75	-50	-70	-25	
Garden Warbler	34	79	-46	-66	-17	
Blue Tit	34	107	-38	-55	-18	
Song Thrush	34	93	-36	-55	-9	
Blackbird	34	104	-26	-41	-7	
Chaffinch	34	84	161	39	371	

See Key to species texts for help with interpretation

Overall, seven species exhibit significant declines in the proportion of juveniles captured (Table D2). The apparent productivity of Willow Tit, Reed Bunting and Sedge Warbler has fallen by more than 50% over the last 25 years, while Garden Warbler, Blue Tit, Song Thrush and Blackbird show reductions in relative productivity of between 25% and 50%.

Although three of these species, Peach *et al.* 1991, 1995a, 1999, Robinson *et al.* 2004, 2010, 2014, Baillie *et al.* 2009). The causes of decline for Willow Tit are uncertain.

Peach *et al.* 1999). For species such as 2019) found that, whilst Great Tit density effects were driven mainly by intraspecific competition, Blue Tits were also be affected by competition with Great Tits: this could possibly explain the relatively greater decrease in breeding performance for Blue Tit following increases in the populations of both species.

Only one of the 23 species monitored shows significant positive trends in CES productivity Chaffinch). The discrepancy between the positive Chaffinch CES trend and the decline in breeding success identified by the NRS warrants further study, but increased survival rates in post-fledging period could contribute to this, although data are sparse for this vital period.

A positive trend might be predicted if climatic warming enabled multi-brooded species, such as Reed Warbler, to extend their breeding season, increasing the number of broods reared per adult (Dunn & Møller 2014). Eglington *et al.* (2015) found that, using CES data from across Europe, Reed Warbler was the one species experiencing temperature dependent increases in productivity, particularly in the north of its range and results of a recent food supplementation study suggest that this is as predicted if climatic change has increased food availability (Vafidis *et al.* 2016).

Changes in average laying dates from Nest Record Scheme data

Since the mid 1970s, many species have exhibited a trend towards progressively earlier clutch initiation (Crick *et al.* 1997) with laying dates showing curvilinear responses over the past 50 years as spring temperatures have cooled and then warmed (Crick & Sparks 1999). Table D3 confirms that the majority of species exhibiting significant trends since the late 1960s have advanced laying. Thus 40 species are laying between three and 21 days earlier, on average, than they were 50 years ago.

The results of previous studies predict laying-date advancement to be more constrained in long-distance migrants (Both *et al.* 2009, Rubolini *et al.* 2010, Kluen *et al.* 2016, Samplonius *et al.* 2018), although the extent to which populations are able to adjust migratory strategies in response to environmental pressures and the predicted impact on population size is currently the focus of much discussion (James & Abbott 2014, Winkler *et al.* 2014, Kristensen *et al.* 2016). Species which have advanced their laying date least, whether migrants or residents, have generally experienced the biggest negative population trends (Franks *et al.* 2018). It is interesting to note that the magnitude of the laying-date shift in both Pied Flycatcher and Redstart (10 days and 14 days respectively) is greater than that displayed by many resident species, although their mean laying date is still approximately a fortnight later than non-migratory species with similar nestling diets, such as Blue Tit and Great Tit. No taxonomic or ecological associations are apparent within the group of species displaying laying-date advancements and a wide range of taxa demonstrate trends of a similar magnitude (Crick *et al.* 1997).

Table D3 Significant trends in laying date measured between 1967 and 2018

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Greenfinch	51	82	Linear decline	May 26	May 5	-21 days	
Goldfinch	51	27	Curvilinear	Jun 5	May 16	-20 days	Small sample

Species	Period (yrs)	Mean annual sample	Trend	Predicted in first year	Predicted in last year	Change	Comment
Magpie	51	31	Curvilinear	Apr 27	Apr 8	-19 days	
Long-tailed Tit	51	60	Linear decline	Apr 20	Apr 4	-16 days	
Redstart	51	73	Linear decline	May 24	May 10	-14 days	
Blackcap	51	49	Linear decline	May 24	May 11	-13 days	
Coal Tit	51	45	Linear decline	May 3	Apr 20	-13 days	
Swallow	51	246	Linear decline	Jun 24	Jun 12	-12 days	
Dipper	51	82	Linear decline	Apr 18	Apr 6	-12 days	
Chaffinch	51	116	Linear decline	May 12	Apr 30	-12 days	
Reed Warbler	51	255	Linear decline	Jun 20	Jun 9	-11 days	
Chiffchaff	51	66	Linear decline	May 14	May 3	-11 days	
Marsh Tit	51	15	Linear decline	Apr 28	Apr 17	-11 days	Small sample
Nuthatch	51	41	Linear decline	May 1	Apr 20	-11 days	
Grey Wagtail	51	64	Linear decline	May 9	Apr 29	-10 days	
Robin	51	150	Linear decline	Apr 28	Apr 18	-10 days	
Stonechat	51	53	Linear decline	May 7	Apr 27	-10 days	
Sedge Warbler	51	44	Curvilinear	May 29	May 19	-10 days	
Pied Flycatcher	51	531	Linear decline	May 20	May 10	-10 days	
Whitethroat	51	21	Curvilinear	May 27	May 18	-9 days	Small sample
Garden Warbler	51	23	Linear decline	May 28	May 19	-9 days	Small sample
Great Tit	51	553	Linear decline	May 3	Apr 24	-9 days	
Treecreeper	51	13	Linear decline	May 6	Apr 27	-9 days	Small sample
House Sparrow	51	71	Linear decline	May 25	May 16	-9 days	
Corn Bunting	51	16	Linear decline	Jun 24	Jun 15	-9 days	Small sample
Kestrel	51	26	Linear decline	May 4	Apr 26	-8 days	Small sample
Ring Ouzel	51	24	Linear decline	May 14	May 6	-8 days	Small sample
Willow Warbler	51	89	Linear decline	May 20	May 12	-8 days	
Carrion Crow	51	28	Linear decline	Apr 17	Apr 9	-8 days	Includes Hooded Crow
Tree Pipit	51	24	Curvilinear	May 27	May 21	-6 days	Small sample
Wren	51	91	Linear decline	May 14	May 8	-6 days	
Jackdaw	51	34	Linear decline	Apr 25	Apr 19	-6 days	
Moorhen	51	80	Linear decline	May 9	May 4	-5 days	
Wood Warbler	51	39	Linear decline	May 25	May 20	-5 days	
Linnet	51	127	Linear decline	May 24	May 19	-5 days	
Dunnock	51	89	Linear decline	May 3	Apr 29	-4 days	
Starling	51	85	Linear decline	Apr 28	Apr 24	-4 days	
Tree Sparrow	51	411	Linear decline	May 27	May 24	-3 days	
Blackbird	51	284	Curvilinear	Apr 23	Apr 23	0 days	
Yellowhammer	51	25	Linear increase	May 30	Jun 9	10 days	Small sample
Barn Owl	51	24	Linear increase	May 2	May 20	18 days	Small sample
Woodpigeon	51	105	Linear increase	Jun 2	Jun 24	22 days	

See Key to species texts for help with interpretation

The population-level consequences of phenological change are the subject of many current scientific studies, including several ongoing projects at BTO. Advanced laying is typically beneficial as early-nesting parents have an increased chance of recruiting offspring into the next generation (Visser *et al.* 1998). Climate-induced advances in phenology have been observed across a wide range of taxa and are occuring most rapidly at lower trophic levels, so that the annual cycles of predators are increasingly mis-timed with those of their prey (Thackeray *et al.* 2016). A frequently used model system is that of woodland passerines, where the timing of leaf emergence is advanced and the speed of caterpillar development is increased at higher temperatures (Buse *et al.* 1999, Visser & Holleman 2001), resulting in a food peak advancement that nesting birds are unable to match and a subsequent reduction in breeding success (though see Phillimore *et al.* 2016).

Both *et al.* (2006) demonstrated that mismatches between periods of food availability and chick demand can affect abundance in Dutch Pied Flycatcher populations, with those exhibiting the largest disjunction between arrival in spring and peak caterpillar abundance experiencing the greatest declines. Another study by Both and his colleagues, also in the Netherlands, suggested that the magnitude of disjunction may be mediated by habitat type, with species in more seasonal habitats at greatest risk of negative impacts on productivity (Both *et al.* 2010). However, while Dutch Reed *et al.* 2012, 2013, 2015). The ability to switch to different food sources to provide for chicks, as demonstrated for Wood Warbler (Mallord *et al.* 2017), may provide another buffer for some species. Whether such compensations will persist as the climate warms further remains to be seen and the population-level significance of trophic mismatches remains an active research area with potentially important policy implications for conservation. Projections of climatic suitability in Great Britain under future climate scenarios suggest that climatic suitability could increase for 44% of species and reduce for 9% of species by 2080, with the largest gains in abundance expected to occur in northern and western areas; however many of the species which are expected to reduce are those that are already red listed following long-term population declines (Massimino *et al.* 2017).

Only four species exhibit significant trends towards later laying (Cornulier *et al.* 2009) which, as mean laying dates are calculated across all broods, would result in the observed shift. Increased production of repeat broods could be stimulated by climatic amelioration, with later nests being more productive in warmer conditions, or by movement of birds away from farmland and into habitats where they are released from constraints on multiple brooding. A recent study using data from North America and Europe identified a positive temporal trend in the length of the breeding season of multi-brooded, but not single-brooded, bird species, consistent with the hypothesis that climate change is extending the window of opportunity for nesting for species less reliant on peaks in seasonal resources (Dunn & Møller 2014).

It is possible that the laying dates of the majority of those species that do not show a significant trend in timing of breeding, such as Raven, are related to weather, but that their weather-mediated cues do not show any trend over time (Crick & Sparks 1999).

Conclusion

This report is designed to be useful as a ready source of information for conservation practitioners, and as a source of information for those involved in more strategic conservation policy-making, as well as to the general student of bird populations. It provides a relatively simple and concise overview of the way in which populations are changing, suggesting areas where further research is required or where conservation action needs to be taken. The information presented here is a summary of a very extensive and much more detailed data set held by the BTO.

Alerts are raised as a result of declines in the population sizes of a considerable number of species. These alerts will help conservation organisations to prioritise future conservation action, alongside the Birds of Conservation Concern list (Eaton *et al.* 2015) and other information.

The demographic information contained in this report should also help conservation organisations to target their resources more effectively. For declining species of conservation importance, declines in breeding performance may indicate that conservation action should be targeted towards the breeding season; such responses may sometimes be masked, however, by density-dependent improvements in breeding success as the population declines (Green 1999). The lack of a decline in breeding performance may suggest that factors other than nesting success, such as loss of habitat or changes in survival rates are more likely to be influencing the observed population declines. An analysis looking across species (Robinson et al. 2014) suggested that temporal variation in declining species was associated more with productivity and recruitment of young, while for increasing species, adult survival was relatively more important in determining population change. However, as evidenced by Lapwing, the effect of demographic rates may interact, so they need to be considered in the context of the life-cycle as a whole. A report of this kind can provide only an initial summary of such information, and a full assessment of the population dynamics of a declining species will generally require more detailed investigations (e.g. Peach *et al.* 1999, Freeman & Crick 2003, Robinson *et al.* 2004, 2014).

Finally, we hope that users of this report will provide feedback on how it can be improved. We would welcome comments on any aspect of this report, as they will help us to produce a better and more useful next edition.

EMAIL YOUR COMMENTS

Utilities

With the exception of the trends by habitat, the tables of population change that appear on the species pages are species-based selections from a single unified table, with data newly calculated for this edition of the report. A number of additional selections from this table, by scheme and time period, are presented in the Summary tables and Discussion sections. Using the Table generator, you can interrogate the master table by data source or time period, for all species or for your own selection of species, and choose how your extract will be sorted.

This edition of the BirdTrends report is the latest in an annual series that began in 1997. Citations for previous editions are listed under Previous reports. Links are given to the full text of previous reports, which are mostly still available online.

The Utilities section also holds a unified list of the References that have been cited throughout the report.

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Graphs used in this report should be acknowledged as coming from the*BTO/JNCC BirdTrends Report* when reproduced, with the acknowledgement displayed alongside the graph, and should be referenced using the report citation, which is shown at the bottom of all pages and on the BirdTrends report Home page.

Note that graphs which show only Breeding Bird Survey (BBS) trends are also available to download from the BBS pages on the BTO website. In addition, the BBS download page also includes more BBS graphs which are not shown in BirdTrends, such as graphs showing trends for the nine English government regions. Any graphs obtained from the BBS pages should be given the appropriate BBS acknowledgement/citation which is provided on the BBS download pages.

Which graphs are available to download?

All the graphs which are have been updated in BirdTrends 2020 are currently available to download. This includes all demography graphs, and all trend graphs with the exception of the trend graphs for Shelduck, Woodcock and Lesser Spotted Woodpecker, which show only CBC data and have not therefore been updated since 1999. In addition to these three graphs, the graphs showing population trends by habitat are also not currently available to download.

How do I download graphs or csv files?

Each graph can be downloaded by clicking on the icons at the bottom right of the image. A csv file containing the data can also be downloaded if you wish to recreate the graph using a different design (re-designed graphs must be acknowledged in the same way as downloaded graphs).

Description of fields in the csv files

CBC/BBS, BBS and CES graphs:

- unsm – the (unsmoothed) index value for the survey year.
- sm – the smoothed index value for the survey year.
- sm_ll85 and sm_ul85 – the lower and upper 85% confidence intervals for the smoothed index values.

Further information about the survey methodology and data analysis can be found on the survey information pages in this report: Breeding Bird Survey; CBC/BBS trends; CES Scheme.

BTO Heronries Census:

- unsm – the (unsmoothed) estimate of the number of 'apparently occupied nests' for the survey year.
- unsm_ll85 and unsm_ul85 – the lower and upper 85% confidence intervals for the (unsmoothed) estimate of the number of 'apparently occupied nests'.
- sm – the smoothed estimate of the number of 'apparently occupied nests' for the survey year.

Further information about the survey methodology and calculations can be found on the Heronries Census page in this report.

Demography graphs:

(i.e. Fledglings per breeding attempt, laying date, Clutch size, brood size, egg and chick stage nest failures)

- unsm - the (unsmoothed) index value for the survey year
- unsm_ll and unsm_ul - the lower and upper 85% confidence intervals for the (unsmoothed) index values
- sm - the smoothed index value for the survey year
- sm_ll and sm_ul - the lower and upper 85% confidence intervals for the smoothed index values

Further information about the survey methodology and calculations can be found on the Nest Record Scheme page in this report.

Survival graphs (CES and ringing recoveries):

- unsm - the (unsmoothed) estimate of the proportion of birds surviving for the survey year
- sm_ll and sm_ul - the lower and upper 95% confidence intervals for the survival estimate

Previous reports

Previous reports in this series are listed, from the most recent to the earliest. The first two (Crick *et al.* 1997, 1998) were produced as paper reports, but all subsequent editions are purely web-based and url addresses must be included in their citations.

Note that www.bto.org/birdtrends will always link to the home page of the most recent version of this report. Web addresses including a year (e.g. .../birdtrends/2014/...) may lead you to earlier reports in the series, now superseded.

BirdTrends 2019: trends in numbers, breeding success and survival for UK breeding birds

Massimino, D., Woodward, I.D., Hammond, M.J., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Barimore, C., Dadam, D., Eglington, S.M., Marchant, J.H., Sullivan, M.J.P., Baillie, S.R. & Robinson, R.A. (2019) *BirdTrends 2019: trends in numbers, breeding success and survival for UK breeding birds.*Research Report 722. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2019

BirdTrends 2018: trends in numbers, breeding success and survival for UK breeding birds

Woodward, I.D., Massimino, D., Hammond, M.J., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Barimore, C., Dadam, D., Eglington, S.M., Marchant, J.H., Sullivan, M.J.P., Baillie, S.R. & Robinson, R.A. (2018) *BirdTrends 2018: trends in numbers, breeding success and survival for UK breeding birds.*Research Report 708. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2018

BirdTrends 2017: trends in numbers, breeding success and survival for UK breeding birds

Massimino, D., Woodward, I.D., Hammond, M.J., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Barimore, C., Dadam, D., Eglington, S.M., Marchant, J.H., Sullivan, M.J.P., Baillie, S.R. & Robinson, R.A. (2017) *BirdTrends 2017: trends in numbers, breeding success and survival for UK breeding birds.*Research Report 704. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2017

BirdTrends 2016: trends in numbers, breeding success and survival for UK breeding birds

Robinson, R.A., Leech, D.I., Massimino, D., Woodward, I., Eglington, S.M., Marchant, J.H., Sullivan, M.J.P., Barimore, C., Dadam, D., Hammond, M.J., Harris, S.J., Noble, D.G., Walker, R.H. & Baillie, S.R. (2016) *BirdTrends 2016: trends in numbers, breeding success and survival for UK breeding birds.*Research Report 691. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2016

BirdTrends 2015: trends in numbers, breeding success and survival for UK breeding birds

Robinson, R.A., Marchant, J.H., Leech, D.I., Massimino, D., Sullivan, M.J.P., Eglington, S.M., Barimore, C., Dadam, D., Downie, I.S., Hammond, M.J., Harris, S.J., Noble, D.G., Walker, R.H. & Baillie, S.R. (2015) *BirdTrends 2015: trends in numbers, breeding success and survival for UK breeding birds.*Research Report 678. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2015

BirdTrends 2014: trends in numbers, breeding success and survival for UK breeding birds

Baillie, S.R., Marchant, J.H., Leech, D.I., Massimino, D., Sullivan, M.J.P., Eglington, S.M., Barimore, C., Dadam, D., Downie, I.S., Harris, S.J., Kew, A.J., Newson, S.E., Noble, D.G., Risely, K. & Robinson, R.A. (2014) *BirdTrends 2014: trends in numbers, breeding success and survival for UK breeding birds.*Research Report 662. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2014

BirdTrends 2013: trends in numbers, breeding success and survival for UK breeding birds

Baillie, S.R., Marchant, J.H., Leech, D.I., Massimino, D., Eglington, S.M., Johnston, A., Noble, D.G., Barimore, C., Kew, A.J., Downie, I.S., Risely, K. & Robinson, R.A. (2014) *BirdTrends 2013: trends in numbers, breeding success and survival for UK breeding birds* Research Report 652. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2013

BirdTrends 2012: trends in numbers, breeding success and survival for UK breeding birds

Baillie, S.R., Marchant, J.H., Leech, D.I., Massimino, D., Eglington, S.M., Johnston, A., Noble, D.G., Barimore, C., Kew, A.J., Downie, I.S., Risely, K. & Robinson, R.A. (2013) *BirdTrends 2012: trends in numbers, breeding success and survival for UK breeding birds* Research Report 644. BTO, Thetford. www.bto.org/our-science/publications/birdtrends/2012

BirdTrends 2011: trends in numbers and demography for UK breeding birds

Baillie, S.R., Marchant, J.H., Leech, D.I., Renwick, A.R., Eglington, S.M., Joys, A.C., Noble, D.G., Barimore, C., Conway, G.J., Downie, I.S., Risely, K. & Robinson, R.A. (2012) *BirdTrends 2011: trends in numbers and demography for UK breeding birds* Research Report 609. BTO, Thetford. (www.bto.org/our-science/publications/birdtrends/2011)

Breeding Birds in the Wider Countryside: their conservation status 2010

Baillie, S.R., Marchant, J.H., Leech, D.I., Renwick, A.R., Joys, A.C., Noble, D.G., Barimore, C., Conway, G.J., Downie, I.S., Risely, K. & Robinson, R.A. (2010) *Breeding Birds in the Wider Countryside: their conservation status 2010.* Research Report 565. BTO, Thetford. (www.bto.org/birdtrends2010/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2009

Baillie, S.R., Marchant, J.H., Leech, D.I., Joys, A.C., Noble, D.G., Barimore, C., Downie, I.S., Grantham, M.J., Risely, K. & Robinson, R.A. (2010) *Breeding Birds in the Wider Countryside: their conservation status 2009.* Research Report 541. BTO, Thetford. (www.bto.org/birdtrends2009/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2008

Baillie, S.R., Marchant, J.H., Leech, D.I., Joys, A.C., Noble, D.G., Barimore, C., Downie, I.S., Grantham, M.J., Risely, K. & Robinson, R.A. (2009) *Breeding Birds in the Wider Countryside: their conservation status 2008.* Research Report 516. BTO, Thetford. (www.bto.org/birdtrends2008/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2007

Baillie, S.R., Marchant, J.H., Crick, H.Q.P., Noble, D.G., Balmer, D.E., Barimore, C., Coombes, R.H.,Downie, I.S., Freeman, S.N., Joys, A.C., Leech, D.I., Raven, M.J., Robinson, R.A. & Thewlis, R.M. (2007) *Breeding Birds in the Wider Countryside: their conservation status 2007.*Research Report 487. BTO, Thetford. (www.bto.org/birdtrends2007/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2006

Baillie, S.R., Marchant, J.H., Crick, H.Q.P., Noble, D.G., Balmer, D.E., Barimore, C., Coombes, R.H., Downie, I.S., Freeman, S.N., Joys, A.C., Leech, D.I., Raven, M.J., Robinson, R.A. & Thewlis, R.M. (2007) *Breeding Birds in the Wider Countryside: their conservation status 2006* Research Report 470. BTO, Thetford.

(www.bto.org/birdtrends2006/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2005

Baillie, S.R., Marchant, J.H., Crick, H.Q.P., Noble, D.G., Balmer, D.E., Coombes, R.H., Downie, I.S., Freeman, S.N., Joys, A.C., Leech, D.I., Raven, M.J., Robinson, R.A. & Thewlis, R.M. (2006) *Breeding Birds in the Wider Countryside: their conservation status 2005.*Research Report 435. BTO, Thetford.
(www.bto.org/birdtrends2005/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2004

Baillie, S.R., Marchant, J.H., Crick, H.Q.P., Noble, D.G., Balmer, D.E., Beaven, L.P., Coombes, R.H., Downie, I.S., Freeman, S.N., Joys, A.C., Leech, D.I., Raven, M.J., Robinson, R.A. & Thewlis, R.M. (2005) *Breeding Birds in the Wider Countryside: their conservation status 2004* Research Report 385. BTO, Thetford.
(www.bto.org/birdtrends2004/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2003

Crick, H.Q.P., Marchant, J.H., Noble, D.G., Baillie, S.R., Balmer, D.E., Beaven, L.P., Coombes, R.H., Downie, I.S., Freeman, S.N., Joys, A.C., Leech, D.I., Raven, M.J., Robinson, R.A. & Thewlis, R.M. (2004) *Breeding Birds in the Wider Countryside: their conservation status 2003* Research Report 353. BTO, Thetford.
(www.bto.org/birdtrends2003/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2001

Baillie, S.R., Crick, H.Q.P., Balmer, D.E., Beaven, L.P., Downie, I.S., Freeman, S.N., Leech, D.I., Marchant, J.H., Noble, D.G., Raven, M.J., Simpkin, A.P., Thewlis, R.M. & Wernham, C.V. (2002) *Breeding Birds in the Wider Countryside: their conservation status 2001* Research Report 278. BTO, Thetford.
(www.bto.org/birdtrends2001/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 2000

Baillie, S.R., Crick, H.Q.P., Balmer, D.E., Bashford, R.I., Beaven, L.P., Freeman, S.N., Marchant, J.H., Noble, D.G., Raven, M.J., Siriwardena, G.M., Thewlis, R. & Wernham, C.V. (2001) *Breeding Birds in the Wider Countryside: their conservation status 2000.*Research Report 252. BTO, Thetford.
(www.bto.org/birdtrends2000/index.htm)

Breeding Birds in the Wider Countryside: their conservation status 1972–1996

Crick, H.Q.P., Baillie, S.R., Balmer, D.E., Bashford, R.I., Beaven, L.P., Dudley, C., Glue, D.E., Gregory, R.D., Marchant, J.H., Peach, W.J. & Wilson, A.M. (1998) *Breeding Birds in the Wider Countryside: their conservation status (1972–1996).*Research Report 198. BTO, Thetford.

Breeding Birds in the Wider Countryside: their conservation status 1971–1995

Crick, H.Q.P., Baillie, S.R., Balmer, D.E., Bashford, R.I., Dudley, C., Glue, D.E., Gregory, R.D., Marchant, J.H., Peach, W.J. & Wilson, A.M. (1997) *Breeding Birds in the Wider Countryside: their conservation status (1971–1995).* Research Report 187. BTO, Thetford.

References

Clicking on reference links within the text of this report will bring you to its full details in this section: the reference sought will be at the very top of your view.

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Most of the listed publications are available in printed form to BTO members and other bona fide researchers through the Chris Mead Library at BTO headquarters in Thetford. Further information on how to access freely available ornithological publications online is here on the BTO web site.

Aebischer, N.J. (1995) Investigating the effects of hunting on the survival of British pigeons and doves by analysis of ringing recoveries. *Journal of Applied Statistics* 22: 923–934.

Aebischer, N.J. (1999) Multi-way comparisons and generalised linear models of nest success: extensions of the Mayfield method. *Bird Study* 46: S22–S31.

Aebischer, N.J. (2019) Fifty-year trends in UK hunting bags of birds and mammals, and clibrated estimation of national bag size, using GWCT's National Gamebag Census. *European Journal of Wildlife Research* 65: 64.

Aebischer, N.J. & Ewald, J.A. (2004) Managing the UK Grey Partridge *Perdix perdix* recovery: population change, reproduction, habitat and shooting. *Ibis* 146 (S2): 181–191.

Aebischer, N.J. & Ewald, J. (2010) Grey Partridge *Perdix perdix* in the UK: recovery status, set-aside and shooting. *Ibis* 152: 530–542.

Aebischer, N.J. & Potts, G.R. (1998) Spatial changes in Grey Partridge (*Perdix perdix*) distribution in relation to 25 years of changing agriculture in Sussex, UK. *Gibier Faune Sauvage* 15: 293–308.

Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A. (2000) *The Ecology and Conservation of Lowland Farmland Birds.* British Ornithologists' Union, Tring.

Ahola, M.P., Laaksonen, T., Eeva, T. & Lehikoinen, E. (2009) Great Tits lay increasingly smaller clutches than selected for: a study of climate- and density-related changes in reproductive traits. *Journal of Animal Ecology* 78: 1298–1306.

Alder, D. & Marsden, S. (2010) Characteristics of feeding-site selection by breeding Green Woodpeckers *Picus viridis* in a UK agricultural landscape. *Bird Study* 57: 100–107.

Allen, D.S. (1995) Habitat selection by Whinchats: a case for bracken in the uplands. In *Heaths and Moorland: Cultural Landscapes* (eds Thompson, D.B.A., Hester, A.J. & Usher, M.B.), pp 200–205. HMSO, Edinburgh.

Altewischer, A., Buschewski, U., Ehrke, C., Fröhlich, J., Gärtner, A., Giese, P., Günter, F., Heitmann, N., Hestermann, M., Hoffmann, H., Kleinschmidt, F., Kniepkamp, B., Linke, W., Mayland-Quellhorst, T., Pape, J., Peterson, T., Schendel, V., Schwieger, S., Wadenstorfer, A. & Fischer, K. (2015) Habitat preferences of male Corn Buntings *Emberiza calandra* in North-Eastern Germany. *Acta Ornithologica* 50 (1): 1–10. doi: 10.3161/00016454AO2015.50.1.001

Altwegg, R., Roulin, A., Kestenholz, M. & Jenni, L. (2006) Demographic effects of extreme winter weather in the barn owl *Oecologia* 149, 44–51.

Amar, A. (2014) *Hen Harriers: going, going.* British Ornithologists' Union. Full text [accessed 17 Dec 2014]

Amar, A. & Redpath, S. (2002) Determining the cause of the Hen Harrier decline on the Orkney Islands: an experimental test of two hypotheses. *Animal Conservation* 5: 21–28.

Amar, A. & Redpath, S.M. (2005) Habitat use by Hen Harriers *Circus cyaneus* on Orkney: implications of land-use change for this declining population. *Ibis* 147: 37–47.

Amar, A., Arroyo, B. & Redpath, S. (2002) *Analysis of breeding success of Orkney Hen Harriers in relation to habitat.* Unpublished contract report to SNH: BAT/PA02e/01/02/100.

Amar, A., Redpath, S. & Thirgood, S. (2003) Evidence for food limitation in the declining hen harrier population on the Orkney Islands, Scotland. *Biological Conservation* 111: 377–384.

Amar, A., Picozzi, N., Meek, E.R., Redpath, S.M. & Lambin, X. (2005) Decline of the Orkney Hen Harrier *Circus cyaneus* population: do changes to demographic parameters and mating system fit a declining food hypothesis? *Bird Study* 52: 18–24.

Amar, A., Hewson, C.M., Thewlis, R.M., Smith, K.W., Fuller, R.J., Lindsell, J.A., Conway, G., Butler, S. & MacDonald, M.A. (2006) *What's Happening to Our Woodland Birds? Long-term changes in the populations of woodland birds*. BTO Research Report 169 & RSPB Research Report 19. BTO, Thetford and RSPB, Sandy. Full text

Amar, A., Arroyo, B., Meek, E., Redpath, S. & Riley, H. (2008a) Influence of habitat on breeding performance of Hen Harriers *Circus cyaneus* in Orkney. *Ibis* 150: 400–404.

Amar, A., Thirgood, S., Pearce-Higgins, J. & Redpath, S. (2008b) The impact of raptors on the abundance of upland passerines and waders *Oikos* 117: 1143–1152.

Amar, A., Smith, K.W., Butler, S., Lindsell, J.A., Hewson, C.M., Fuller, R.J. & Charman, E.C. (2010a) Recent patterns of change in vegetation structure and tree composition of British broadleaved woodland: evidence from large-scale surveys. *Forestry* 83: 345–356.

Amar, A., Redpath, S., Sim, I. & Buchanan, G. (2010b) Spatial and temporal associations between recovering populations of common raven Corvus corax and British upland wader populations. *Journal of Applied Ecology* 47: 253–262.

Amar, A., Grant, M., Buchanan, G., Sim, I., Wilson, J., Pearce-Higgins, J.W. & Redpath, S. (2011) Exploring the relationships between wader declines and current land-use in the British uplands. *Bird Study* 58: 13–26.

Amar, A., Court, I.R., Davison, M., Downing, S., Grimshaw, T., Pickford, T. & Raw, D. (2012) Linking nest histories, remotely sensed land use data and wildlife crime records to explore the impact of grouse moor management on peregrine falcon populations. *Biological Conservation* 145: 86–94. doi:10.1016/j.biocon.2011.10.014

Ambrosini, R., Rubolini, D., Trovo, P. & Liberini, G. (2012) Maintenance of livestock farming may buffer population decline of the Barn Swallow *Hirundo rustica*. *Bird Conservation International* 22: 411–428.

Anderson, D.E. (2014) Yellowhammer (*Emberiza citrinella*) ecology in an intensive pastoral dominated farming landscape. PhD Thesis. University of Glasgow.

Andrén, H. (1992) Corvid density and nest predation in relation to forest fragmentation: a landscape perspective. *Ecology* 73: 794–804.

Andries, A.M., Gulinck, H. & Herremans, M. (1994) Spatial modelling of the barn owl habitat using landscape characteristics from SPOT data. *Ecography* 17: 278–287.

Anganuzzi, A.A. (1993) A comparison of tests for detecting trends in abundance indices of dolphins. *Fishery Bulletin* 91: 183–194.

Angelstam, P., Breuss, M., Mikusinski, G., Stenström, M., Stighäll, K. & Thorell, D. (2002) Effects of forest structure on the presence of woodpeckers with different specialisation in a landscape history gradient in NE Poland. *Avian Landscape Ecology: pure and applied issues in the large-scale ecology of birds: Proceedings of the 11th annual IALE(UK) conference, 10–13 September 2002* (eds Chamberlain, D. & Wilson, A.), 25–38. University of East Anglia.

Araújo, P.M., Lopes, P.B., da Silva, L.P. & Ramos, J.A. (2016) The importance of reedbeds and riparian areas for Cetti's Warbler *Cettia cetti* throughout its annual cycle. *Wetlands* 36: 875–887.

Archaux, F. (2007) Are mountains refuges for farmland bird species? A case study in the northern French Alps. *Bird Study* 54: 73–79.

Aschwanden, J., Birrer, S. & Jenni, L. (2005) Are ecological compensation areas attractive hunting sites for common kestrels (*Falco tinnunculus*) and long-eared owls (*Asio otus*)? *Journal of Ornithology* 146: 279–286.

Aschwanden, J., Holzgang, O. & Jenni, L. (2007) Importance of ecological compensation areas for small mammals in intensively farmed areas. *Wildlife Biology* 13: 150–158.

Askew, N.P. (2006) *Barn Owl* Tyto alba *conservation in Britain – identifying priority conservation areas*. PhD thesis, University of York.

Askew, N.P., Searle, J.B. & Moore, N.P. (2007) Agri-environment schemes and foraging of barn owls *Tyto alba* . *Agriculture, Ecosystems & Environment* 118: 109–114.

Atkinson, P.W., Clark, N.A., Bell, M.C., are, P.J., Clark, J.A. & Ireland, P.L. (2003) Changes in commercially fished shellfish stocks and shorebird populations in the Wash, England. *Biological Conservation* 114: 127–141.

Atkinson, P.W., Buckingham, D. & Morris, T. (2004) What factors determine where invertebrate-feeding birds forage in dry grasslands? *Ibis* 146 (suppl. 2): 99–107.

Auer, S.K. & Martin, T.E. (2013) Climate change has indirect effects on resource use and overlap among coexisting bird species with negative consequences for their reproductive success. *Global Change Biology* 19: 411–419. doi: 10.1111/gcb.12062

Ausden, M. & Hirons, G.J.M. (2002) Grassland nature reserves for breeding wading birds in England and the implications for the ESA agri-environment scheme. *Biological Conservation* 106: 279–291.

Ausden, M., Sutherland, W.J. & James, R. (2001) The effects of flooding lowland wet grassland on soil macroinvertebrate prey of breeding wading birds. *Journal of Applied Ecology* 38: 320–338.

Austin, G.E. & Houston, D.C. (1997) The breeding performance of the Buzzard *Buteo buteo* in Argyll, Scotland and a comparison with other areas in Britain. *Bird Study* 44: 146–154.

Austin, G.E, Rehfisch, M.M., Allan, J.R. & Holloway, S.J. (2007) Population size and differential population growth of introduced Greater Canada Geese *Branta canadensis* and re-established Greylag Geese *Anser anser* across habitats in Great Britain in the year 2000. *Bird Study* 54: 343–352. Abstract

Austin, G.E., Collier, M.P., Calbrade, N.A., Hall, C. & Musgrove, A.J. (2008) *Waterbirds in the UK 2006/07: The Wetland Bird Survey*. BTO/WWT/RSPB/JNCC, Thetford. Full text

Baillie, S.R. (1990) Integrated population monitoring of breeding birds in Britain and Ireland. *Ibis* 132: 151–166.

Baillie, S.R. (1991) Monitoring terrestrial breeding bird populations. *In* Goldsmith, F.B. (ed.) *Monitoring for Conservation and Ecology*: 112–132. Chapman & Hall, London.

Baillie, S.R. & Peach, W.J. (1992) Population limitation in Palaearctic–African migrant passerines. *Ibis* 134 Suppl. 1: 120–132.

Baillie, S.R. & Rehfisch, M.M. (eds) (2006) *National and site-based alert systems for UK birds*. Research Report 226. BTO, Thetford.

Full text (PDF, 1.28 MB)
Baillie, S.R., Crick, H.Q.P., Balmer, D.E., Beaven, L.P., Downie, I.S., Freeman, S.N., Leech, D.I., Marchant, J.H., Noble, D.G., Raven, M.J., Simpkin, A.P., Thewlis, R.M. & Wernham, C.V. (2002) *Breeding Birds in the Wider Countryside: their conservation status 2001* Research Report 278. BTO, Thetford. (www.bto.org/birdtrends2001)

Baillie, S.R., Brooks, S.P., King, R. & Thomas, L. (2009) Using a state-space model of the British Song Thrush *Turdus philomelos* population to diagnose the causes of a population decline. In *Modeling Demographic Processes in Marked Populations* (eds Thomson, D.L., Cooch, E.G. & Conroy, M.J.), pp 541–561. Springer, New York. Contents

Bainbridge, I. (2017) Goose management in Scotland: An Overview. *Ambio* 46(Suppl 2): 224–230. doi:10.1007/s13280-016-0883-5

Baines, D. (1990) The roles of predation, food and agricultural practice in determining the breeding success of the Lapwing (*Vanellus vanellus*) on upland grasslands. *Journal of Animal Ecology* 59: 915–929.

Baines, D. & Richardson, M. (2013) Hen harriers on a Scottish grouse moor: multiple factors predict breeding density and productivity. *Journal of Applied Ecology* 50: 1397–1405.

Baines, D., Redpath, S., Richardson, M. & Thirgood, S. (2008) The direct and indirect effects of predation by Hen Harriers *Circus cyaneus* on trends in breeding birds on a Scottish grouse moor. *Ibis* 150: 27–36.

Baker, H., Stroud, D.A., Aebischer, N.J., Cranswick, P.A., Gregory, R.D., McSorley, C.A., Noble, D.G. & Rehfisch, M.M. (2006) Population estimates of birds in Great Britain and the United Kingdom. *British Birds* 99: 25–44. (APEP06)

Balmer, D.E., Adams, S.Y. & Crick H.Q.P. (2000) *Report on Barn Owl Release Scheme: Monitoring Project Phase II*. Research Report 250. BTO, Thetford.

Full text (PDF, 118.85 KB)
Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. & Fuller, R.J. (eds) (2013) *Bird Atlas 2007–11: the breeding and wintering birds of Britain and Ireland*. BTO Books, Thetford.

Banks, A.N., Coombes, R.H. & Crick, H.Q.P. (2003) *The Peregrine Falcon breeding population of the UK & Isle of Man in 2002*. Research Report 330. BTO, Thetford.

Full text (PDF, 176.59 KB)
Banks, A.N., Crick, H.Q.P., Coombes, R., Benn, S., Ratcliffe, D.A. & Humphreys, E.M. (2010) The breeding status of Peregrine Falcons *Falco peregrinus* in the UK and Isle of Man in 2002. *Bird Study* 57: 421–436. doi: 10.1080/00063657.2010.511148

Battaglia, A., Ghidini, S., Campanini, G. & Spaggiari, R. (2005) Heavy metal contamination in Little Owl (*Athene noctua*) and Common Buzzard (*Buteo buteo*) from northern Italy. *Ecotoxicology and Environmental Safety* 60: 61–66.

Batten, L.A. (1978) The seasonal distribution of receoveries and causes of Blackbird mortality. *Bird Study* 78: 23–32

Bauer, Z., Trnka, M., Bauerová, J., Mozný, M., Stepánek, P., Bartosová, L. & Zalud, Z. (2010) Changing climate and the phenological response of Great Tit and Collared Flycatcher populations in floodplain forest ecosystems in Central Europe. *International Journal of Biometeorology* 54: 99–111.

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

Behrens, V., Rauschmayer, F. & Wittmer, H. (2008) Managing international 'problem' species: why pan-European cormorant management is so difficult. *Environmental Conservation* 35: 55–63.

Beintema, J. & Müskens, G.J.D.M. (1987) Nesting success of birds breeding in Dutch agricultural grasslands *Journal of Applied Ecology* 24: 743–758.

Bell, C.P., Baker, S.W., Parkes, N.G., Brooke, M. de L. & Chamberlain, D.E. (2010) The role of the Eurasian Sparrowhawk (*Accipiter nisus*) in the decline of the House Sparrow (*Passer domesticus*) in Britain. *Auk* 127: 411–420.

Bell, M.V. & John Calladine, J. (2017) The decline of a population of farmland breeding waders: a twenty-five-year case study. *Bird Study* 64: 264–273. doi: 10.1080/00063657.2017.1319903

Bell, J.R., Botham, M.S., Henrys, P.A., Leech, D.I., Pearce-Higgins, J.W., Shortall, C.R., Brereton, T.M., Pickup, J. & Thackeray, S.J. (2019) Spatial and habitat variation in aphid, butterfly, moth and bird phenologies over the last half century. *Global Change Biology* 25: 1982–1994. doi:10.1111/gcb.14592

Bellamy, P.E., Brown, N.J., Enoksson, B., Firbank, L.B., Fuller, R.J., Hinsley, S.A. & Schotman, A.G.M. (1998) The influences of habitat, landscape structure and climate on local distribution patterns of the nuthatch (*Sitta europaea* L.). *Oecologia* 115: 127–136.

Bellamy, P.E., Shore, R.F., Ardeshir, D., Treweek, J.R. & Sparks, T.H. (2000) Road verges as habitat for small mammals in Britain *Mammal Review* 30: 131–139.

Bellamy, P.E., Hill, R.A., Rothery, P., Hinsley, S.A., Fuller, R.J. & Broughton, R.K. (2009) Willow Warbler *Phylloscopus trochilus* habitat in woods with different structure and management in southern England. *Bird Study* 56: 338–348. doi: 10.1080/00063650902806914

Bellamy, P.E., Malcolm D. Burgess, M.D., Mallord, J.W., Cristinacce, A., Orsman, C.J., Davis, T., Grice, P.V. & Charman, E.C. (2017) Nest predation and the infuence of habitat structure on nest predation of Wood Warbler *Phylloscopus sibilatrix*, a ground-nesting forest passerine. *Journal of Ornithology* 159: 493–506. doi: 10.1007/s10336-018-1558-8

Bellebaum, J. & Bock, C. (2009) Influence of ground predators and water levels on Lapwing *Vanellus vanellus* breeding success in two continental wetlands. *Journal of Ornithology* 150: 221–230.

Benton, T.G., Bryant, D.M., Cole, L. & Crick, H.Q.P. (2002) Linking agricultural practice to insect and bird populations: a historical study over three decades *Journal of Applied Ecology* 39: 673–687.

Berg, Å. (1994) Maintenance of populations and causes of population changes of Curlews *Numenius arquata* breeding on farmland. *Biological Conservation* 67: 233–238.

Berg, C. (1992) Habitat selection by breeding Curlews *Numenius arquata* on mosaic farmland. *Ibis* 134: 355–360.

Besbeas, P., Freeman, S.N., Morgan, B.J.T. & Catchpole, E.A. (2002) Integrating mark–recapture–recovery and census data to estimate animal abundance and demographic parameters. *Biometrics* 58: 540–547.

Bibby, C.J. (1989) A survey of breeding Wood Warblers *Phylloscopus sibilatrix*, in Britain 1984–85. *Bird Study* 36: 56–72.

Bibby, C.J. & Etheridge, B. (1993) Status of the Hen Harrier *Circus cyaneus* in Scotland in 1988–89. *Bird Study* 40: 1–11.

BirdLife International (2004) *Birds in Europe: population estimates, trends and conservation status*. BirdLife Conservation Series no 12. BirdLife International, Cambridge.

BirdLife International (2015a) IUCN Red List for birds. www.birdlife.org/datazone/home

BirdLife International (2015b) *European Red List of birds*. Office for Official Publications of the European Communities, Luxembourg. Full text

Birkhead, M. & Perrins, C. (1985) The breeding biology of the Mute Swan *Cygnus olor* on the River Thames with special reference to lead poisoning. *Biological Conservation* 32: 1–11.

Birkhead, M., Bacon, P.J. & Walter, P. (1983) Factors affecting the breeding success of the Mute Swan *Cygnus olor*. *Journal of Animal Ecology* 52: 727–741.

Blackburn, E. & Cresswell, W. (2016a) High winter site fidelity in a long-distance migrant: implications for wintering ecology and survival estimates. *Journal of Ornithology* 157: 93. doi: 10.1007/s10336-015-1252-z

Blackburn, E. & Cresswell, W. (2016b) High within-winter and annual survival rates in a declining Afro-Palaearctic migratory bird suggest that wintering conditions do not limit populations. *Ibis* 158: 92–105. doi: 10.1111/ibi.12319

Blaker, G.B. (1933) The Barn Owl in England: results of the census. I and II. *Bird Notes and News* 15: 169–172.

Blaker, G.B. (1934) *The Barn Owl in England and Wales*. RSPB, London.

Blus, L.J. (1994) A review of lead poisoning in swans. *Comparative Biochemistry and Physiology Part C Pharmacology, Toxicology and Endocrinology* 108: 259–267.

Boatman, N.D., Brickle, N.W., Hart, J.D., Milsom, T.P., Morris, A.J., Murray, A.W.A., Murray, K.A. & Robertson, P.A. (2004) Evidence for the indirect effects of pesticides on farmland birds. *Ibis* 146: 131–143.

Bodey, T.W., McDonald, R.A., Sheldon, R.D. & Bearhop, S. (2011) Absence of effects of predator control on nesting success of Northern Lapwings *Vanellus vanellus*: implications for conservation. *Ibis* 153: 543–555.

Bodey, T.W., Barnett, R., du Feu, C.R., Clark, J.R. & Bearhop, S. (2020) Nesting outcomes under anthropogenic change - effects of changing climate and nestbox provision on the reproduction of Great Tits *Parus major*. *Ibis* [early view] doi: 10.1111/ibi.12847

Bolton, M., Tyler, G., Smith, K. & Bamford, R. (2007) The impact of predator control on lapwing *Vanellus vanellus* breeding success on wet grassland nature reserves. *Journal of Applied Ecology* 44: 534–544.

Bond, G., Burnside, N.G., Metcalfe, D.J., Scott, D.M. & Blamire, J. (2005) The effects of land-use and landscape structure on Barn Owl (*Tyto alba*) breeding success in southern England, U.K. *Landscape Ecology* 20: 555–566.

Bonham, P.F. & Robertson, J.C.M. (1975) The spread of Cetti's Warbler in north-west Europe. *British Birds* 68: 393–408.

Border, J., Henderson, I.G., Redhead, J.W. & Hartley, I.R. (2016) Habitat selection by breeding Whinchats *Saxicola rubetra* at territory and landscape scales. *Ibis* doi: 10.1111/ibi.12433

Border, J.A., Henderson, I.G. & Hartley, I.R. (2017) Characterising demographic contributions to observed population change in a declining migrant bird. *Journal of Avian Biology* 48:1139–1149. doi: 10.1111/jav.01305

Both, C. (2002) Nemen Bonte Vliegenvangers *Ficedula hypoleuca* af door klimaatsverandering? [Decrease of European Pied Flycatchers due to climate change?] *Limosa* 75: 73–78.

Both, C. (2010) Flexibility of timing of avian migration to climate change masked by environmental constraints en route. *Current Biology* 20: 243–248.

Both, C., Bouwhuis, S., Lessells, C.M. & Visser, M.E. (2006) Climate change and population declines in a long-distance migratory bird. *Nature* 441 (4): 81–83. Full text

Both, C., van Asch, M., Bijlsma, R.G., van den Burg, A.B. & Visser, M.E. (2009) Climate change and unequal phenological changes across four trophic levels: constraints or adaptations? *Journal of Animal Ecology* 78: 73–83.

Both, C., Van Turnhout, C.A.M., Bijlsma, R.G., Siepel, H., Van Strien, A.J. & Foppen, R.P.B. (2010) Avian population consequences of climate change are most severe for long-distance migrants in seasonal habitats. *Proceedings of the Royal Society of London Series B* 277: 1259–1266. Full text

Both, C., Burger, C., Ouwehand, J., Samplonius, J.M., Ubels, R. & Bijlsma, R.G. (2017) Delayed Age at First Breeding and Experimental Removals Show Large Non-Breeding Surplus in Pied Flycatchers. *Ardea* 105: 43–60. doi: 10.5253/arde.v105i1.a2

Bourquin, J.D. (1983) Mortalité des rapaces le long de l'autoroute Genève–Lausanne. *Nos Oiseaux* 37: 149–169.

Bowler, D.E., Heldbjerg, H., Fox, A.D., de Jong, M., Bohning-Gaese, K. (2019) Long-term declines of European insectivorous bird populations and potential causes. *Conservation Biology* 33: 1120-1130. doi: 10.1111/cobi.13307

Bradbury, R.B. & Bradter, U. (2004) Habitat associations of Yellow Wagtails *Motacilla flava flavissima* on lowland wet grassland. *Ibis* 146: 241–246.

Bradbury, R. & Stoate, C. (2000) The ecology of Yellowhammers *Emberiza citrinella* on lowland farmland. In *Ecology and Conservation of Lowland Farmland Birds* (eds Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A.), 165–172. British Ornithologists' Union, Tring.

Brickle, N.W. (1999) *The effect of agricultural intensification on the decline of the Corn Bunting,* Miliaria calandra. DPhil thesis, University of Sussex.

Brickle, N.W. & Harper, D.G.C. (1999) Diet of nestling Corn Buntings *Miliaria calandra* in southern England examined by compositional analysis of faeces. *Bird Study* 46: 319–329.

Brickle, N.W. & Harper, D.G.C. (2000) Habitat use by Corn Buntings *Miliaria calandra* in winter and summer. In *Ecology and Conservation of Lowland Farmland Birds* (eds Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A.), 156–164. British Ornithologists' Union, Tring.

Brickle, N.W. & Harper, D.G. (2002) Agricultural intensification and the timing of breeding of Corn Buntings *Miliaria calandra*. *Bird Study* 49: 219–228.

Brickle, N.W., Harper, D.G.C., Aebischer, N.J. & Cockayne, S.H. (2000) Effects of agricultural intensification on the breeding success of Corn Buntings *Miliaria calandra*. *Journal of Applied Ecology* 37: 742–755.

Brindley, E., Norris, K., Cook, T., Babbs, S., Forster-Browne, C. & Yaxley, R. (1998) The abundance and conservation status of redshank (*Tringa totanus*) nesting on saltmarshes in Great Britain. *Biological Conservation* 86: 289–297.

Brinkhof, M.W.G. & Cavé, A.J. (1997) Food supply and seasonal variation in breeding success: an experiment in the European Coot *Proceedings of the Royal Society B Biological Sciences* 264: 291–296.

Britschgi, A., Spaar, R. & Arlettaz, R. (2006) Impact of grassland farming intensification on the breeding ecology of an indicator insectivorous passerine, the Whinchat *Saxicola rubetra*: lessons for overall Alpine meadowland management. *Biological Conservation* 130: 193–205.

Bro, E., Sarrazin, F., Clobert, J. & Reitz, F. (2000) Demography and the decline of the Grey Partridge *Perdix perdix* in France. *Journal of Applied Ecology* 37: 432–448.

Brooke, M. de L. & Davies, N.B. (1987) Recent changes in host usage by cuckoos *Cuculus canorus* in Britain. *Journal of Animal Ecology* 56: 873–883.

Brooks, S.P., King, R. & Morgan, B.J.T. (2004) A Bayesian approach to combining animal abundance and demographic data *Animal Biodiversity and Conservation* 27: 515–529.

Broughton, R.K. & Hinsley, S.A. (2015) The ecology and conservation of the Marsh Tit in Britain. *British Birds* 108: 12–29.

Broughton, R., Hinsley, S., Bellamy, P., Hill, R. & Rothery, P. (2006) Marsh Tit *Poecile palustris* territories in a British broad-leaved wood. *Ibis* 148: 744–752.

Broughton, R.K., Hill, R.A., Freeman, S.N., Bellamy, P.E. & Hinsley, S.A. (2012) Describing habitat occupancy by woodland birds with territory mapping and remotely sensed data: an example using the Marsh Tit (*Poecile palustris*). *The Condor* 114: 812–822. doi:10.1525/cond.2012.110171

Brown, A.F., Crick, H.Q.P. & Stillman, R.A. (1995) The distribution, numbers and breeding ecology of Twite *Acanthis flavirostris* in the south Pennines of England. *Bird Study* 42: 107–121.

Brown, A.W. & Brown, L.M. (1984) The status of the Mute Swan in the Lothians. *Scottish Birds* 13: 8–15.

Brown, D., Wilson, J., Douglas, D., Thompson, P., Foster, S., McCulloch, N., Phillips, J., Stroud, D., Whitehead, S., Crockford, N. & Sheldon, R. (2015) The Eurasian Curlew – the most pressing bird conservation priority in the UK? *British Birds* 108: 660–668.

Browne, S. & Aebischer, N. (2001) *The role of agricultural intensification in the decline of the Turtle Dove* Streptopelia turtur. English Nature, Peterborough.

Browne, S. & Aebischer, N. (2002) Temporal changes in the breeding and feeding ecology of Turtle Doves (*Streptopelia turtur*) in the UK: an overview. *Zeitschrift für Jagdwissenschaft* 48: 215–221.

Browne, S.J. & Aebischer, N.J. (2003) Temporal changes in the migration phenology of Turtle Doves *Streptopelia turtur* in Britain, based on sightings from coastal bird observatories. *Journal of Avian Biology* 34: 65–71.

Browne,S.J. & Aebischer, N.J. (2003b) Habitat use, foraging ecology and diet of Turtle Doves *Streptopelia turtur* in Britain. *Ibis* 145: 572–582. doi:10.1111/j.1474-919X.2003.00185.x

Browne, S.J. & Aebischer, N.J. (2004) Temporal changes in the breeding ecology of European Turtle Doves *Streptopelia turtur* in Britain, and implications for conservation. *Ibis* 146: 125–137.

Browne, S. & Aebischer, N. (2005) Studies of West Palearctic birds: Turtle Dove. *British Birds* 98: 58–72.

Browne, S., Vickery, J.A. & Chamberlain, D.E. (2000) Densities and population estimates of breeding Skylarks *Alauda arvensis* in Britain in 1997. *Bird Study* 47: 52–65. doi: 10.1080/00063650009461

Browne, S., Aebischer, N., Yfantis, G. & Marchant, J.H. (2004) Habitat availability and use by Turtle Doves *Streptopelia turtur* between 1965 and 1995: an analysis of Common Birds Census data. *Bird Study* 51: 1–11.

Browne, S.J., Aebischer, N.J. & Crick, H.Q.P. (2005) The breeding ecology of Turtle Doves *Streptopelia turtur* in Britain during the period 1941 to 2000: an analysis of BTO Nest Record Card

160s. *Bird Study* 52: 1–9. doi:10.1080/00063650509461368

Browne, S.J., Aebischer, N.J., Moreby, S.J. & Teague, L. (2006) The diet and disease susceptibility of Grey Partridges *Perdix perdix* on arable farmland in East Anglia, England. *Wildlife Biology* 12: 3–10.

Broyer, J. (2009) Whinchat *Saxicola rubetra* reproductive success according to hay cutting schedule and meadow passerine density in alluvial and upland meadows in France. *Journal for Nature Conservation* 17: 160–167.

Bryant, D.M. (1975). Breeding biology of house martins *Delichon urbica* in relation to aerial insect abundance. *Ibis* 117: 180-216.

Bryant, D.M. (1979). Reproductive costs in the House Martin (*Delichon urbica*). *Journal of Animal Ecology* 48: 655-675.

BTO. (2015) Managing scrub for Nightingale. A BTO guide for land managers and conservation practitioners. Conservation Advice No. 1. British Trust for Ornithology, Thetford. https://www.bto.org/our-science/publications/conservation-advice-notes/managing-scrub-nightingales

Buchanan, G.M., Pearce-Higgins, J.W., Wotton, S.R., Grant, M.C. & Whitfield, D.P. (2003) Correlates of the change in Ring Ouzel *Turdus torquatus* abundance in Scotland from 1988–91 to 1999. *Bird Study* 50: 97–105. doi: 10.1080/00063650309461300

Buchanan, G.M., Pearce-Higgins, J.W., Douglas, D.J.T. & Grant, M.C. (2017) Quantifying the importance of multi-scale management and environmental variables on moorland bird abundance. *Ibis* 159: 744–756. doi: 10.1111/ibi.12488

Buchanan, G.M., Mallord, J.W., Orsman, C.J., Roberts, J.T., Bofo, K., Skeen, R.Q., Whytock, R.C., Hulme, M.F., Guilain, T., Segniagbeto, G.H., Assou, D. & Vickery, J.A. (2018) Changes in the area of optimal tree cover of a declining Afro-Palearctic migrant across the species' wintering range. *Ibis* 162: 175–186. doi: 10.1111/ibi.12690

Buckland, S.T., Cattanach, K.L. & Anganuzzi, A.A. (1992) Estimating trends in abundance of dolphins associated with tuna in the eastern tropical Pacific Ocean, using sightings data collected on commercial tuna vessels. *Fishery Bulletin* 90: 1–20.

Buckland, S.T., Newman, K.B., Thomas, L. & Kösters, N. (2004) State-space models for the dynamics of wild animal populations. *Ecological Modelling* 171, 157–175.

Bulla et al. (2019). No clear evidence that "the Arctic is no longer a safe haven for shorebirds" (comment on "Global pattern of nest predation is disrupted by climate change in shorebirds"). Science 364: 6445. doi: 10.1126/science.aaw8529

Bunn, D.S., Warburton, A.B. & Wilson, R.D.S. (1982) *The Barn Owl*. T. & A.D. Poyser, Calton.

Burfield, I.J. & Brooke, M. de L. (2005) The decline of the Ring Ouzel *Turdus torquatus* in Britain: evidence from bird observatory data. *Ringing & Migration* 22: 199–204.

Burger, J. & Leonard, J. (2000) Conflict resolution in coastal waters: the case of personal watercraft. *Marine Policy* 24: 61–67.

Burgess, G.P. & Morris, R.D. (1992) Shelters decrease gull predation on chicks at a common tern colony. *Journal of Field Ornithology* 63: 186–189.

Burgess, M.D., Bellamy, P.E., Gillings, S., Noble, D., Grice, P.V. & Conway, G.J. (2015a) The impact of changing habitat availability on population trends of woodland birds associated with early successional plantation woodland. *Bird Study* 62: 39–55. doi: 10.1080/00063657.2014.998622

Burgess, M.D., Bright, J.A., Morris, A.J., Field, R.H., Grice, P.V., Cooke, A.I. & Peach, W. (2015b) Influence of agri-environment scheme options on territory settlement by Yellowhammer (*Emberiza citrinella*) and Corn Bunting (*Emberiza calandra*). *Journal of Ornithology* 156: 153–163.

Burgess, M.D., Smith, K.W., Evans, K.L., Leech, D., Pearce-Higgins, J.W., Branston, C.J., Briggs, K., Clark, J.R., du Feu, C.R., Lewthwaithe, K., Nager, R.G., Sheldon, B.C., Smith, J.A., Whytock, J.C., Willis, S.G. & Phillimore, A.B. (2018) Tritrophic phenological match-mismatch in space and time. *Nature Ecology & Evolution* 2: 970–975.

Burgess, M.D., Finch, T., Border, J.A., Castello, J., Conway, G., Kethcher, M., Lawrence,M., Orsman, C.J., Mateus, J., Proud, A., Westerberg, S., Wiffen T. & Henderson, I.G. (2020) Weak migratory connectivity, loop migration and multiple non-breeding site use in British breeding Whinchats *Saxicola rubetra*. *Ibis* [early view]. doi: 10.1111/ibi.12825

Burgess, N.D., Evans, C.E. & Sorensen, J. (1990) The management of lowland heath for nightjars at Minsmere, Suffolk, Great Britain. *Journal of Environmental Management* 31: 351–359. doi: 10.1016/S0301-4797(05)80063-5

Burton, N.H.K. (2007) Influences of restock age and habitat patchiness on Tree Pipits *Anthus trivialis* breeding in Breckland pine plantations. *Ibis* 149 (suppl. 2): 193–204. doi: 10.1111/j.1474-919X.2007.00737.x

Burton, N.H.K. (2009) Reproductive success of Tree Pipits *Anthus trivialis* in relation to habitat selection in conifer plantations. *Ibis* 151: 361–372.

Burton, N.H.K. & Conway, G.J. (2008) *Assessing population change of breeding Ringed Plovers in the UK between 1984 & 2007*. Research Report 503. BTO, Thetford.

Buse, A., Dury, S.J., Woodburn, R.J.W., Perrins, C.M. & Good, J.E.G. (1999) Effects of elevated temperature on multi-species interactions: the case of pedunculate oak, winter moth and tits. *Functional Ecology* 13 (suppl.): 74–82.

Butler, C. (2002) Breeding parrots in Britain. *British Birds* 95: 345–348.

Butler, C.J. (2003) Population biology of the introduced Rose-ringed Parakeet *Psittacula krameri* in the UK. PhD thesis, University of Oxford.

Butler, C.J., Cresswell, W., Gosler, A. & Perrins, C. (2013) The breeding biology of Rose-ringed Parakeets *Psittacula krameri* in England during a period of rapid population expansion. *Bird Study* 60: 527–532.

Byars, T., Curtis, D.J. & McDonald, I. (1991) The breeding distribution and habitat requirements of the Lesser Whitethroat in Strathclyde. *Scottish Birds* 16: 66–76.

Calbrade, N.A., Holt, C.A., Austin, G.E., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Musgrove, A.J. (2010) *Waterbirds in the UK 2008/09: the Wetland Bird Survey*. BTO/RSPB/JNCC in association with WWT, Thetford.

Calladine, J. & Bray, J. (2012) The importance of altitude and aspect for breeding Whinchat *Saxicola rubetra* in the uplands: limitations of the uplands as a refuge for a declining, formerly widespread species? *Bird Study* 59: 43–51. doi: 10.1080/00063657.2011.623767

Calladine, J., Critchley, C.N.R., Baker, D., Towers, J. & Thiel, A. (2014a) Conservation management of moorland: a case study of the effectiveness of a combined suite of management prescriptions which aim to enhance breeding bird populations. *Bird Study* 61: 56–72. doi: 10.1080/00063657.2013.876615

Calladine, J., Pakeman, R.J., Humphreys, E., Huband, S. & Fuller, R.J. (2014b) Changes in breeding wader assemblages, vegetation and land use within machair environments over three decades, *Bird Study* 61:287–300, doi: 10.1080/00063657.2014.917604

Calladine, J., Humphreys, E.M. & Boyle, J. (2015) Changes in breeding wader populations of the Uist machair between 1983 and 2014.*Scottish Birds* 35: 207–215.

Calladine, J., Humphreys, E.M., Gilbert, L., Furness, R.W., Robinson, R.A., Fuller, R.J., Littlewood, N.A., Pakeman, R.J., Ferguson, J. & Thompson, C. (2017) Continuing influences of introduced hedgehogs *Erinaceus europaeus* as a predator of wader (*Charadrii*) eggs four decades after their release on the Outer Hebrides, Scotland. *Biological Invasions* 19: 1981–1987. doi: 10.1007/s10530-017-1422-4

Campbell, L.H., Avery, M.I., Donald, P., Evans, A.D., Green, R.E. & Wilson, J.D. (1997)*A review of the indirect effects of pesticides on birds.*JNCC, Peterborough.

Caravaggi, A., Irwin, S., Lusby, J., Ruddock, M., O.Toole, L., Mee, A., Nagle, T., O'Neill, S., Tierney, D., McCarthy, A. & O'Halloran, J. (2019a) Factors influencing Han Harrier *Circus cyaneus* territory site selection and breeding success. *Bird Study* 66: 366–377. doi: 10.1080/00063657.2019.1692778

Caravaggi, A., Irwin, S., Lusby, J., Ruddock, M., Mee, A., Nagle, T., O'Toole, L., O'Neill, S & O'Halloran, J. (2019b) Anthropogenic pressures within the breeding range of the Hen Harrier *Circus cyaneus* in Ireland. *Bird Study* 66: 461–470. doi: 10.1080/00063657.2020.1725420

Carpenter, J. (2008) *An investigation of causes of population decline in the Marsh Tit*Poecile palustris *in Britain.* DPhil thesis, University of Oxford.

Carpenter, J.E., Charman, E.C., Smart, J., Amar, A., Gruar, D., Bierman, S. & Grice, P. (2009)*Habitat associations of woodland birds II: completing the picture for woodland indicator species.* RSPB, Sandy.

Carpenter, J., Smart, J., Amar, A., Gosler, A., Hinsley, S. & Charman, E. (2010) National-scale analyses of habitat associations of Marsh Tits*Poecile palustris* and Blue Tits *Cyanistes caeruleus*: two species with opposing population trends in Britain.*Bird Study* 57: 31–43. doi: 10.1080/0006365090302610

Carter, I. (2001) *The Red Kite*. Arlequin Press, Chelmsford.

Challis, A., Edwards, C., Heavisides, A., Holling, M., Kortland, K., Mattingley, W., Riddle, G., Roos, S., Stevenson, A. Stirling-Aird, P.K., Stroud, D.A., Wernham, C.V. & Wilson, M.W. (2018) The Scottish Raptor Monitoring Scheme: recent developments in good practice monitoring. *Bird Study* 65 (Sup1): S21–S34. doi:10.1080/00063657.2018.147737

Chamberlain, D.E. & Crick, H.Q.P. (1999) Population declines and reproductive performance of skylarks*Alauda arvensis* in different regions and habitats of Great Britain. *Ibis* 141: 38–51.

Chamberlain, D.E. & Crick, H.Q.P. (2003) Temporal and spatial associations in aspects of reproductive performance of Lapwings*Vanellus vanellus* in the United Kingdom, 1962–99. *Ardea* 91: 183–196. Abstract

Chamberlain, D. & Fuller, R. (2000) Local extinctions and changes in species richness of lowland farmland birds in England and Wales in relation to recent changes in agricultural land-use. *Agriculture, Ecosystems & Environment* 78: 1–17.

Chamberlain, D.E. & Fuller, R.J. (2001) Contrasting patterns of change in the distribution and abundance of farmland birds in relation to farming system in lowland Britain. *Global Ecology and Biogeography* 10: 399–409.

Chamberlain, D.E. & Siriwardena, G.M. (2000) The effects of agricultural intensification on Skylarks*Alauda arvensis*: evidence from monitoring studies in Great Britain. *Environmental Reviews* 8: 95–113.

Chamberlain, D., Wilson, A., Browne, S. & Vickery, J. (1999) Effects of habitat type and management on the abundance of Skylarks in the breeding season*Journal of Applied Ecology* 36: 856–870.

Chamberlain, D.E., Vickery, J.A. & Gough, S. (2000a) Spatial and temporal distribution of breeding Skylarks*Alauda arvensis* in relation to crop type in periods of population increase and decrease. *Ardea* 88: 61–73.

Chamberlain, D.E., Fuller, R.J., Bunce, R.G.H., Duckworth, J.C. & Shrubb, M. (2000b) Changes in the abundance of farmland birds in relation to the timing of agricultural intensification in England and Wales. *Journal of Applied Ecology* 37: 771–788.

Chamberlain, D.E., Toms, M.P., Cleary-McHarg, R. & Banks, A.N. (2007) House Sparrow (*Passer domesticus*) habitat use in urbanized landscapes. *Journal of Ornithology* 148: 453–462. doi: 10.1007/s10336-007-0165-x

Chamberlain, D.E., Cannon, A.R., Toms, M.P., Leech, D.I., Hatchwell, B.J. & Gaston, K.J. (2009a). Avian productivity in urban landscapes: a review and meta-analysis. *Ibis* 151: 1–18. doi: 10.1111/j.1474-919X.2008.00899.x

Chamberlain, D.E., Glue, D.E. & Toms, M.P. (2009b) Sparrowhawk *Accipiter nisus* presence and winter bird abundance. *Journal of Ornithology* 150: 247–254. doi: 10.1007/s10336-008-0344-4

Chamberlain, D.E., Austin, G.E., Green, R.E., Hulme, M.F. & Burton, N.H.K. (2013) Improved estimates of population trends of Great Cormorants*Phalacrocorax carbo* in England and Wales for effective management of a protected species at the centre of a human–wildlife conflict. *Bird Study* 60: 335–344.

Champagnon, J., Legagneux, P., Souchay, G., Inchausti, P., Bretagnolle, V., Bourguemestre, F., Van Ingen, L., Guillemain, M. (2016) Robust estimation of survival and contribution of captive-bred Mallards *Anas platyrhynchos* to a wild population in a large-scale release programme. *Ibis* 158: 343–352. doi: 10.1111/ibi.12341

Charman, E., Carpenter, J. & Gruar, D. (2009) *Understanding the causes of decline in breeding bird numbers in England: a review of the evidence base for declining species in the woodland indicator for England.* Research Report 37. RSPB, Sandy. Full text

Charman, E.C., Smith, K.W., Gruar, D.J., Dodd, S. & Grice, P.V. (2010) Characteristics of woods used recently and historically by Lesser Spotted Woodpeckers *Dendrocopos minor* in England. *Ibis* 152: 543–555. doi: 10.1111/j.1474-919X.2010.01020.x

Charman, E.C., Smith, K.W., Dillon, I.A., Dodd, S., Gruar, D.J., Cristinacce, A., Grice, P.V. & Gregory, R.D. (2012) Drivers of low breeding success in the Lesser Spotted Woodpecker *Dendrocopos minor* in England: testing hypotheses for the decline.*Bird Study* 59: 255–265.

Chernetsov, N. & Huettmann, F. (2005) Linking global climate grid surfaces with local long-term migration monitoring data: spatial computations for the Pied Flycatcher to

assess climate-related population dynamics on a continental scale. *Lecture Notes in Computer Science* 3482: 133–142. Full text

Chi, J.F., Lawson, B., Durrant, C. & Beckmann, K. (2013) The finch epidemic strain of *Trichomonas gallinae* is predominant in British non-passerines. *Parasitology* 140: 1234–1245. doi: 10.1017/S0031182013000930

Christensen, T.K., Lassen, P. & Elmeros, M. (2012) High exposure rates of anticoagulant rodenticides in predatory bird species in intensively managed landscapes in Denmark. *Archives of Environmental Contamination and Toxicology* 63: 437–444.

Čížková, D., Javůrková,V., Champagnon, J. & Kreisinger, J. (2012) Duck's not dead: does restocking with captive bred individuals affect the genetic integrity of wild mallard *Anas platyrhynchos*) population? *Biological Conservation* 152: 231–240. doi: 10.1016/j.biocon.2012.04.008

Clark, J.A. (2011) Barn Owl mortality. *British Birds* 104: 160.

Clements, R. (2001) The Hobby in Britain: a new population estimate. *British Birds* 94: 402–408.

Clements, R. (2002) The Common Buzzard in Britain: a new population estimate. *British Birds* 95: 377–383.

Clements, R. (2008) The Common Kestrel population in Britain. *British Birds* 101: 228–234.

Clements, R.J. & Everett, C.M. (2012) Densities and dispersion of breeding Eurasian Hobbies *Falco subbuteo* in southeast England. *Bird Study* 59: 74–82.

Clements, R., Everett, C. & Messenger, A. (2016) The Hobby in Britain - a revised population estimate. *British Birds* 109: 316–323.

Cole, E.F., Long, P.R., Zelazowski, P., Szulkin, M. & Sheldon, B.C. (2015) Predicting bird phenology from space: satellite-derived vegetation green-up signal uncovers spatial variation in phenological synchrony between birds and their environment. *Ecology and Evolution* (early view). doi: 10.1002/ece3.1745

Coleman, A.E., Coleman, J.T., Coleman, P.A. & Minton, C.D.T. (2001) A 39-year study of a Mute Swan *Cygnus olor* population in the English Midlands. *Ardea* 89: 123–133.

Colhoun, K., Mawhinney, K. & Peach, W.J. (2015) Population estimates and changes in abundance of breeding waders in Northern Ireland up to 2013 *Bird Study* 62: 394–403. doi: 10.1080/00063657.2015.1058746

Colhoun, K., Mawhinney, K., McLaughlin, M., Barnett, C., McDevitt, A., Bradbury R.B. & Peach, W. (2017) Agri-environment scheme enhances breeding populations of some priority farmland birds in Northern Ireland. *Bird Study* 64: 545–556. doi: 10.1080/00063657.2017.1415296

Colwell, M.A. & Haig, S.M. (Eds). (2019) *The population ecology and conservation of Charadrius plovers.* CRC Press, Boca Raton, Florida, US.

Conrad, K.F., Warren, M.S., Fox, R., Parsons, M.S. & Woiwod, I.P. (2006) Rapid declines of common, widespread British moths provide evidence of an insect biodiversity crisis. *Biological Conservation* 132: 279–291.

Conway, G., Wotton, S., Henderson, I., Langston, R., Drewitt, A. & Currie, F. (2007) Status and distribution of European Nightjars *Caprimulgus europaeus* in the UK in 2004. *Bird Study* 54: 98–111. doi: 10.1080/00063650709461461

Conway, G., Wotton, S., Henderson, I., Eaton, M., Drewitt, A. & Spencer, J. (2009) The status of breeding Woodlarks *Lullula arborea* in Britain in 2006. *Bird Study* 56: 310–325.

Conway, G.J., Austin, G.E., Handschuh, M., Drewitt, A.L. & Burton, N.H.K. (2019) Breeding populations of Little Ringed Plover *Charadrius dubius* and Ringed Plover *Charadrius hiaticula* in the United Kingdom in 2007. *Bird Study* 66: 22–31. doi: 10.106/j.agee.2019.03.006

Cook-Haley, B.S. & Millenbah, B.F. (2002) Impacts of vegetative manipulations on common tern nest success at Lime Island, Michagan. *Journal of Field Ornithology* 73: 174–179.

Cornulier, T., Elston, D.A., Arcese, P., Benton , T.G., Douglas, D.J.T., Lambin, X., Reid, J., Robinson, R.A. & Sutherland, W.J. (2009) Estimating the annual number of breeding attempts from breeding dates using mixture models. *Ecology Letters* 12: 1184–1193. Abstract

Cosgrove, P. (2003) Mandarin Ducks in northern Scotland and the potential consequences for breeding Goldeneye. *Scottish Birds* 24: 1–10.

Cowley E. & Siriwardena, G.M. (2005) Long-term variation in survival rates of Sand Martins *Riparia riparia*: dependence on breeding and wintering ground weather, age and sex, and their population consequences. *Bird Study* 52: 237–251. doi: 10.1080/00063650509461397

Cox, W.A., Thompson III, F.R. & Reidy, J.L. (2013) The effects of temperature on nest predation by mammals, birds, and snakes *Auk* 130: 784–790.

Crabtree, B., Humphreys, L., Moxey, A. & Wernham, C. (2010) *2010 Review of goose management in Scotland.* Report to Scottish Government. BTO Scotland, Stirling.

Cramp, S. & Perrins, C.M. (1994) *Handbook of the Birds of Europe, the Middle East and North Africa: the birds of the Western Palearctic.* Volume 8. Oxford University Press, Oxford.

Crawley, M.J. (1993) *GLIM for Ecologists*. Blackwell Science, Oxford, UK.

Cresswell, W. (2015) How the importance of survival estimates in estimating Whinchat population dynamics depends on the scale of migratory connectivity and site fidelity. In H-V Bastian & J Feulner (eds) *Proceedings of the 1st European Whinchat Symposium: Living on the edge of extinction in Europe* pp.145–158. Landesbund fur Vogelschutz / Kreisgruppe Hof, LBV Hof Helmsbrechts, Germany.

Crick, H.Q.P. (1992) *Trends in the breeding performance of Golden Plover in Britain.* Research Report 76. BTO, Thetford. Full text

Crick, H.Q.P. (1993) Trends in breeding success of Merlins (*Falco columbarius*) in Britain from 1937–1989. In *Biology and Conservation of Small Falcons* (eds Nicholls,

M.K. & Clarke, R.), pp 30–38. Hawk & Owl Trust, London.

Crick, H.Q.P. (1997) Long-term trends in Corn Bunting *Miliaria calandra* productivity in Britain. In Donald, P.F. & Aebischer, N.J. (eds.) *The Ecology and Conservation of Corn Buntings* Miliaria calandra: 52–64. UK Nature Conservation No. 13. JNCC, Peterborough.

Crick, H.Q.P. (1998) Decline in clutch size of Hen Harriers: reply. *BTO News* 218: 23.

Crick, H.Q.P. & Ratcliffe, D.A. (1995) The Peregrine *Falco peregrinus* population of the United Kingdom in 1991. *Bird Study* 42: 1–19.

Crick, H.Q.P. & Siriwardena, G.M. (2002) National trends in the breeding performance of House Sparrows. In *Investigation into the causes of the decline of Starlings and House Sparrows in Great Britain* (eds Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A. & Rickard, A.D.), 163–191. Research Report 290. BTO, Thetford.

Crick, H.Q.P. & Sparks, T.H. (1999) Climate change related to egg-laying trends. *Nature* 399: 423–424.

Crick, H.Q.P., Dudley, C. & Glue, D.E. (1993) Breeding birds in 1991. *BTO News* 185: 15–18.

Crick, H.Q.P., Dudley, C., Evans, A.D. & Smith, K.W. (1994) Causes of nest failure among buntings in the UK. *Bird Study* 41: 88–94.

Crick, H.Q.P., Dudley, C., Glue, D.E. & Thomson, D.L. (1997) UK birds are laying eggs earlier. *Nature* 388: 526.

Crick, H.Q.P., Baillie, S.R., Balmer, D.E., Bashford, R.I., Beaven, L.P., Dudley, C., Glue, D.E., Gregory, R.D., Marchant, J.H., Peach, W.J. & Wilson, A.M. (1998) *Breeding birds in the wider countryside: their conservation status (1972–1996).* Research Report 198. BTO, Thetford.

Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A. & Rickard, A.D. (eds) (2002) *Investigations into the causes of the decline of Starlings and House Sparrows in Great Britain.* BTO Research Report 290. 305 pp. DEFRA, Bristol.

Crick, H.Q.P., Baillie, S.R. & Leech, D.I. (2003) The UK Nest Record Scheme: its value for science and conservation. *Bird Study* 50: 254–270.

Cross, T. (2002) Common Raven (Raven) *Corvus corax*. In *The Migration Atlas: movements of the birds of Britain and Ireland* (eds Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. & Baillie, S.R.), pp 626–628. T. & A.D. Poyser, London.

Crowe, O. (2012) *CBS trend 1998-2010.* BirdWatch Ireland unpublished report.

Crowe, O., Coombes, R.H., Lysaght, L., O'Brien, C., Choudhury, K.R., Walsh, A.J., Wilson, J.H. & O'Halloran, J. (2010) Population trends of widespread breeding birds in the Republic of Ireland 1998–2008. *Bird Study* 57: 267–280. doi: 10.1080/00063651003615147

Croxton, P.J., Sparks, T.H., Cade, M. & Loxton, R.G. (2006) Trends and temperature effects in the arrival of spring migrants in Portland (United Kingdom) 1959–2005. *Acta Ornithologica* 41: 103–111.

Dadam, D. & Siriwardena, G.M. (2019) Agri-environment effects on birds in Wales: Tir Gofal benefited woodland and hedgerow species *Agriculture, Ecosystems & Environment* 284: 106587. doi: 10.1016/j.agee.2019.106587

Dadam, D., Barimore, C.J. & Leech, D.I. (2011) *The BTO Barn Owl Monitoring Programme: final report 2000–2009.* Research Report 577. BTO, Thetford.

Full text (PDF, 7.50 MB)
Dadam, D., Robinson, R.A., Clements, A., Peach, W.J., Bennett, M., Rowcliffe, J.M. & Cunningham, A.A. (2019) Avian malaria-mediated population decline of a widespread iconic bird species. Royal Society Open Science 6: 182197. doi: 10.1098/rsos.182197

Davies, A.K. (1988) The distribution and status of the Mandarin Duck Aix galericulata in Britain. *Bird Study* 35: 203–208.

Davies, J., Arthur, D. & White, S. (2014) Effects of variation in breeding habitat on Ring Ouzel *Turdus torquatus* productivity and chick condition. *Bird Study* 61:162–170.

Davies, S.R., Sayer, C.D., Greaves, H., Siriwardena, G.M. & Axmacher, J.C. (2016) A new role for pond management in farmland bird conservation *Agriculture, Ecosystems & Environment* 233: 179–191. doi: 10.1016/j.agee.2016.09.005

De Leo, G., Focardi, S., Gatto, M. & Cattadori, I. (2004) The decline of the Grey Partridge in Europe: comparing demographies in traditional and modern agricultural landscapes. *Ecological Modelling* 177: 313–335.

Defra (2015) *Wild bird populations in the UK, 1970 to 2014.* Home, full text

Delany, S., Greenwood, J.J.D. & Kirby, J. (1992) *National Mute Swan Survey 1990.* Report to the Joint Nature Conservation Committee. Wildfowl & Wetlands Trust, Slimbridge.

Denac, D & Božič, L. 2020. Breeding population dynamics of Common Tern *Sterna hirundo* and associated gull species with overview of conservation management in continental Slovenia. *Acrocephalus* 40: 180–181

Denerley, C. (2014) *The impact of land use change on a brood parasite system: cuckoos, their hosts and prey.* PhD thesis, University of Aberdeen. Full text

Denerley, C., Redpath, S.M., van der Wal, R., Newson, S.L., Chapman, J.W. & Wilson, J.D. (2018) Breeding ground correlates of the distribution and decline of the Common Cuckoo *Cuculus canorus* at two spatial scales *Ibis* 161: 346–358. doi: 10.1111/ibi.12612

Devereux, C.L., McKeever, C.U., Benton, T.& Whittingham, M.J. (2004) The effect of sward height and drainage on Common Starlings *Sturnus vulgaris* and Northern Lapwings *Vanellus vanellus* foraging in grassland habitats. *Ibis* 145 (issue s2): 115–122. doi: 10.1111/j.1474-919X.2004.00355.x

Dillon, I.A., Morris, A.J., Bailey, C.M & Uney, G. (2009a) Assessing the vegetation response to different establishment methods of 'Skylark Plots' in winter wheat at Grange Farm, Cambridgeshire, England. *Conservation Evidence* 6: 89–97.

Dillon, I.A., Smith, T.D., Williams, S.J., Haysom, S. & Eaton, M.A. (2009b) Status of Red-throated Divers *Gavia stellata* in Britain in 2006. *Bird Study* 56: 147–157.

Dillon, I.A., Morris, A.J., Bailey, C.M & Uney, G. (2009b) Assessing the vegetation response to different establishment methods of 'Skylark Plots' in winter wheat at Grange Farm, Cambridgeshire, England. Conservation Evidence 6: 89–97.

Dixon, A., Richards, C., Haffield, P., Roberts, G., Thomas, M. & Lowe, A. (2008) The National Peregrine Survey 2002: how accurate are the published results for Wales? *Welsh Birds* 5: 276–283.

Dobinson, H.M. & Richards, A.J. (1964) The effects of the severe winter of 1962/63 on birds in Britain *British Birds* 57: 373–434.

Dobson, A.P. & Hudson, P.J. (1992) Regulation and stability of a free-living host–parasite system *Trichostrongylus tenuis* in Red Grouse. II Population models. *Journal of Animal Ecology* 61: 487–500.

Dobson, F. Stephen; Becker, Peter H.; Arnaud, Coline M.; et al. (2017) Plasticity results in delayed breeding in a long-distant migrant seabird. *Ecology & Evolution* 7: 3100–3109

Dolman, P.M. (2010) *Woodlark and Nightjar recreational disturbance and nest predator study 2008 and 2009. Final report February 2010.* University of East Anglia, Norwich. Full text

Dolman, P.M. & Morrison, C. (2012) *Temporal change in territory density and habitat quality for Breckland Forest SSSI woodlark and nightjar populations.* University of East Anglia, Norwich.

Dolton, C.S. & Brooke M. de L. (1999) Changes in the biomass of birds breeding in Great Britain, 1968–88 *Bird Study* 46: 274–278.

Donald, P.F. (1997) The Corn Bunting *Miliaria calandra* in Britain: a review of current status, patterns of decline and possible causes *In* Donald, P.F. & Aebischer, N.J. (eds.) *The Ecology and Conservation of Corn Buntings* Miliaria calandra: 11–26. UK Nature Conservation no 13. Joint Nature Conservation Committee, Peterborough.

Donald, P.F. & Evans, A.D. (1994) Habitat selection by Corn Buntings *Miliaria calandra* in winter. *Bird Study* 41: 199–210.

Donald, P.F. & Evans, A.D. (1995) Habitat selection and population size of Corn Buntings *Miliaria calandra* breeding in Britain in 1993. *Bird Study* 42: 190–204.

Donald, P.F. & Forrest, C. (1995) The effects of agricultural change on population size of Corn Buntings *Miliaria calandra* on individual farms. *Bird Study* 42: 205–215.

Donald, P.F. & Morris, T.J. (2005) Saving the Sky Lark: new solutions for a declining farmland bird. *British Birds* 98: 570–578.

Donald, P.F. & Vickery, J.A. (2000) The importance of cereal fields to breeding and wintering skylarks *Alauda arvensis* in the UK. In *Proceedings of the 1999 BOU Spring Conference: Ecology and Conservation of Lowland Farmland Birds* (eds Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A.), pp 140–150. British Orinthologists' Union, Tring.

Donald, P.F. & Vickery, J.A. (2001) *The ecology and conservation of Skylarks.* RSPB, Sandy.

Donald, P., Muirhead, L., Buckingham, D., Evans, A., Kirby, W. & Gruar, D. (2001) Body condition, growth rates and diet of Skylark *Alauda arvensis* nestlings on lowland farmland. *Ibis* 143: 658–669.

Donald, P.F., Evans, A.D., Muirhead, L.B., Buckingham, D.L., Kirby, W.B. & Schmitt, S.I.A. (2002) Survival rates, causes of failure and productivity of Skylark *Alauda arvensis* nests on lowland farmland. *Ibis* 144: 652–664. doi: 10.1046/j.1474-919X.2002.00101.x

Dougall, T.W., Holland, P.K. & Yalden, D.W. (2004) A revised estimate of the breeding population of Common Sandpipers *Actitis hypoleucos* in Great Britain and Ireland. *Wader Study Group Bulletin* 105: 42–49.

Dougall, T.W., Holland, P.K. & Yalden, D.W. (2010) The population biology of Common Sandpipers in Britain. *British Birds* 103: 100–114.

Douglas, D.J.T. & Pearce-Higgins, J.W. (2019) Variation in ectoparasitic sheep tick Ixodes ricinus infestation on European Golden Plover chicks *Pluvialis apricaria* and implications for growth and survival. *Bird Study* 66: 92–102.. doi: 10.1080/00063657.2019.1617234

Douglas, D.J.T., Benton, T.G. & Vickery, J.A. (2010a) Contrasting patch selection of breeding Yellowhammers *Emberiza citrinella* in set-aside and cereal crops. *Bird Study* 57: 69–74.

Douglas, D.J.T., Newson, S.E., Leech, D.I., Noble, D.G. & Robinson, R.A. (2010b) How important are climate-induced changes in host availability for population processes in an obligate brood parasite, the European cuckoo? *Oikos* 119: 1834–1840. doi: 10.1111/j.1600-0706.2010.18388.x

Douglas, D.J.T., Bellamy, P.E., Stephen, L.S., Pearce-Higgins, J.W., Wilson, J.D. & Grant, M.C. (2014) Upland land use predicts population decline in a globally near-threatened wader. *Journal of Applied Ecology* 51: 194–203.

Douglas, D.J.T., Beresford, A., Selvidge, J., Garnett, S., Buchanan, G.M., Gullett, P. & Grant, M.C. (2017) Changes in upland bird abundances show associations with moorland management. *Bird Study* 64: 242–254. doi: 10.1080/00063657.2017.1317326

Driver, J. (2006) Raven *Corvus corax* population census of northwest Wales, 1998 to 2005. *Welsh Birds* 4: 442–453.

Dunlop, C.L., Blokpoel, H. & Jarvie, S. (1991) Nesting rafts as a management tool for a declining Common Tern (*Sterna hirundo*) colony. *Colonial Waterbirds* 14: 116–120.

Dunn, J.C. & Morris, A.J. (2012) Which features of UK farmland are important in retaining territories of the rapidly declining Turtle Dove *Streptopelia turtur*? *Bird Study* 59: 394–402. doi: 10.1080/00063657.2012.725710

Dunn, J.C., Hamer, K.C. & Benton, T.G. (2015) Anthropogenically-mediated density dependence in a declining farmland bird *PLoS ONE* 10 (10): e0139492. doi:

10.1371/journal.pone.0139492

Dunn, J.C., Morris, A.J. & Grice, P.V. (2015) Testing bespoke management of foraging habitat for European turtle doves *Streptopelia turtur*. *Journal for Nature Conservation* 25: 23–34.

Dunn, J.C., Morris, A.J. & Grice, P.V. (2016) Post-fledging habitat selection in a rapidly declining farmland bird, the European Turtle Dove *Streptopelia turtur*. *Bird Conservation International* 27: 45–57. doi: 10.1017/S0959270916000022

Dunn, J.C., Stockdale, J.E., Moorhouse-Gann, R.J., McCubbin, A, Hipperson, H., Morris, A.J., Grice, P.V. & Symondson, W.O.C. (2018) The decline of the Turtle Dove: dietary associations with body condition and competition with other columbids analysed using high throughput sequencing. *Molecular Ecology* 27: 3386–3407. doi: 10.1111/mec.14766

Dunn, P.O. & Møller, A.P. (2014) Changes in breeding phenology and population size of birds. *Journal of Animal Ecology* 83: 729–739. doi: 10.1111/1365-2656.12162

Durant, D., Tichit, M., Fritz, H. & Kerneis, E. (2008) Field occupancy by breeding Lapwings *Vanellus vanellus* and Redshanks *Tringa totanus* in agricultural wet grasslands. *Agriculture, Ecosystems & Environment* 128: 146–150.

Eaton, M.A., Brown, A.F., Noble, D.G., Musgrove, A.J., Hearn, R.D., Aebischer, N.J., Gibbons, D.W., Evans, A. & Gregory, R.D. (2009) Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds* 102: 296–341. (BoCC3) Leaflet, full text

Eaton, M.A., Aebischer, N.J., Brown, A.F., Hearn, R.D., Lock, L., Musgrove, A.J., Noble, D.G., Stroud, D.A. & Gregory, R.D. (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds* 108: 708–746. (BoCC4)

Leaflet (PDF, 1.60 MB)
, full text
Eglington, S.M., Gill, J.A., Bolton, M., Smart, M.A., Sutherland, W.J. & Watkinson, A.R. (2008) Restoration of wet features for breeding waders on lowland grasslands. *Journal of Applied Ecology* 45: 305–314.

Eglington, S., Bolton, M., Smart, M., Sutherland, W., Watkinson, A. & Gill, J. (2010) Managing water levels on wet grasslands to improve foraging conditions for breeding Northern Lapwing *Vanellus vanellus*. *Journal of Applied Ecology* 47: 451–458. doi: 10.1111/j.1365-2664.2010.01783.x

Eglington, S.M., Julliard, R., Gargallo, G., van der Jeugd, H., Pearce-Higgins, J.W., Baillie, S. & Robinson, R.A. (2015) Latitudinal gradients in productivity of European migrant warblers have not shifted northwards during a period of climate change. *Global Ecology & Biogeography* 24: 427–436.

Elliott, G.D. & Avery, M.I. (1991) A review of reports of buzzard persecution 1975–1989. *Bird Study* 38: 52–56.

Elston, D.A., Spezia, L., Baines, D. & Redpath, S.M. (2014) Working with stakeholders to reduce conflict – modelling the impact of varying hen harrier *Circus cyaneus* densities on red grouse *Lagopus lagopus* populations. *Journal of Applied Ecology* 51: 1236–1245. doi: 10.1111/1365-2664.12315

Enoksson, B. (1990) Autumn territories and population regulation in the Nuthatch *Sitta europaea*: an experimental study. *Journal of Animal Ecology* 59: 1047–1062.

Enoksson, B. & Nilsson, S.G. (1983) Territory size and population density in relation to food supply in the Nuthatch *Sitta europaea* (Aves). *Journal of Animal Ecology* 52: 927–935.

Eraud, C., Boutin, J.-M., Riviere, M., Brun, J., Barbraud, C. & Lormee, H. (2009) Survival of Turtle Doves *Streptopelia turtur* in relation to western Africa environmental conditions. *Ibis* 151: 186–190.

Esselink, H. & Beekman, J.H. (1991) Between year variation and causes of mortality in the non-breeding population of the Mute Swan *Cygnus olor* in the Netherlands, with special reference to hunting. *Wildfowl* 42: 110–119.

Etheridge, B., Summers, R.W. & Green, R.E. (1997) The effects of illegal killing and destruction of nests by humans on the population dynamics of the hen harrier *Circus cyaneus* in Scotland. *Journal of Applied Ecology* 34: 1081–1105.

Evans, D. M. & Day, K.R. (2002) Hunting disturbance on a large shallow lake: the effectiveness of wildfowl refuges. *Ibis* 144: 2–8.

Evans, D.M., Redpath, S.M., Evans, S.A., Elston, D.A., Gardner, C.J., Dennis, P. & Pakeman, R.J. (2006) Low intensity, mixed livestock grazing improves the breeding abundance of a common insectivorous passerine. *Biology Letters* 2: 636–638. doi: 10.1098/rsbl.2006.0543 Full text

Evans, I.M. & Pienkowski, M.W. (1991) World status of the red kite: a background to the experimental reintroduction to England and Scotland. *British Birds* 84: 171–187.

Evans, J., Wilson, J. & Browne, S. (1995) *The effect of organic farming regimes on breeding and winter bird populations – Part III. Habitat selection and breeding success of Skylarks (Alauda arvensis) on organic and conventional farmland.* Research Report 154. BTO, Thetford.

Evans, K. (2004) The potential for interactions between predation and habitat change to cause population declines of farmland birds. *Ibis* 146: 1–13.

Evans, K.L. & Robinson, R.A. (2004) Barn Swallows and agriculture. *British Birds* 97: 218–230.

Evans, K.L., Wilson, J.D. & Bradbury, R.B. (2007) Effects of crop type and aerial invertebrate abundance on foraging barn swallows *Hirundo rustica*. *Agriculture, Ecosystems & Environment* 122: 267–273. doi: 10.1016/j.agee.2007.01.015

Evens, R, Beenaerts, N., Witters, N. & Artois, T. (2017) Study on the foraging behaviour of the European Nightjar *Caprimulgus europaeus* reveals the need for a change in conservation strategy in Belgium. *Journal of Avian Biology* 48: 1238–1245. doi: 10.1111/jav.00996

Evens, R., Beenaerts, N., Neyens, T., Witters, N., Smeets, K. & Artois, T. (2018) Proximity of breeding and foraging areas affects foraging effort of a crepuscular, insectivorous bird. *Scientific Reports* 8: 3008.

Ewald, J.A., Aebischer, N.J., Brickle, N.W., Moreby, S.J., Potts, G.R. & Wakeham-Dawson, A. (2002) Spatial variation in densities of farmland birds in relation to pesticide use and avian food resources. *Avian Landscape Ecology: pure and applied issues in the large-scale ecology of birds: Proceedings of the 11th annual IALE(UK) conference, 10–13 September 2002* (eds Chamberlain, D. & Wilson, A.), 305–312. University of East Anglia.

Ewald, J.A., Aebischer, N.J., Richardson, S.M., Grice, P.V. & Cooke, A.I. (2010) The effect of agri-environment schemes on grey partridges at the farm level in England. *Agriculture, Ecosystems and Environment* 138: 55–63.

Ewing, S.R., Rebecca, G.W., Heavisides, A., Court, I., Lindley, P., Ruddock, M., Cohen, S. & Eaton, M.A. (2011) Breeding status of the Merlin *Falco columbarius* in the UK in 2008. *Bird Study* 58: 379–389.

Ewing, S.R., Scragg, E.S., Butcher, N. & Douglas, D.J.T. (2017) GPS tracking reveals temporal patterns in breeding season habitat use and activity of a globally Near Threatened wader, the Eurasian Curlew. *Wader Study* 124: 206–214. doi: 10.18194/ws.00090

Exo, K-M., Wellbrook, A.H., Sondermann, J. & Maier, M. (2017) Assessing the impact of mowing on Common Redshanks *Tringa totanus* breeding on saltmarshes: lessons for conservation management. *Bird Conservation International* 27: 440–453. doi: 10.1017/S0959270916000896

Facey, R.W., Vafidis, J.O., Smith, J.A., Vaughan, I.P. & Thomas, R.J. (2020) Contrasting sensitivity of nestling and fledgling Barn Swallow *Hirundo rustica* body mass to local weather conditions. *Ibis* [early view] doi: 10.1111/ibi.12824

Fasola, M. & Canova, L. (1996) Conservation of gull and tern colony sites in northeastern Italy, an internationally Important Bird Area. *Colonial Waterbirds* 19 (S1): 59–67.

Fay, R., Schaub, M., Banik,M.V.,Border, J.A., Henderson, I.G., Faul, G., Feulner, J., Horch, P., Korner,F., Muller, M., Michel, V., Rebstock, H., Shitikov, D., Tome, D., Vogeli, M. & Grűebler, M.U. (2020) Whinchat survival estimates across Europe: can excessive adult mortality explain population declines? *Animal Conservation* [early view] doi: 10.1111/acv.12594

Fernández-Bellon, D., Lusby,J., Bos, J. & Schaub, T. (2020) Expert knowledge assessment of threats and conservation strategies for breeding Hen Harrier and Short-eared Owl across Europe. *Bird Conservation International* [early view]. doi: 10.1017/S0959270920000349

Fewster, R.M., Buckland, S.T., Siriwardena, G.M., Baillie, S.R. & Wilson, J.D. (2000) Analysis of population trends for farmland birds using generalized additive models. *Ecology* 81: 1970–1984.

Field, R.H. & Anderson, G.Q.A. (2004) Habitat use by breeding Tree Sparrows *Passer montanus*. *Ibis* 146: 60–68.

Field, R.H., Anderson, G.Q.A. & Gruar, D.J. (2010) Land-use correlates of breeding performance and diet in Tree Sparrows *Passer montanus*. *Bird Study* 55: 280–289. doi: 10.1080/00063650809461533

Fielding, A., Haworth, P., Whitfield, P., McLeod, D. & Riley, H. (2011) *A conservation framework for Hen Harriers in the United Kingdom*. JNCC report 441. JNCC, Peterborough. Full text

Finch, T., Pearce-Higgins, J.W., Leech, D.I. & Evans, K.L. (2014) Carry-over effects from passage regions are more important than breeding climate in determining the breeding phenology and performance of three avian migrants of conservation concern. *Biodiversity and Conservation* 23: 2427–2444.

Finch, T., Gillings, S., Green, R.E., Massimino, D., Peach, W.J. & Balmford, A. 2019. Bird conservation and the landscape sharing-sparing continuum in farmland-dominated landscapes of lowland England. *Conservation Biology* 33: 1045–1055. doi: 10.1111/cobi.13316

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.

Fisher, G. & Walker, M. (2015) Habitat restoration for Curlew *Numenius arquata* at the Lake Vyrnwy reserve, Wales. *Conservation Evidence* 12: 48–52.

Fleming, L.V., Douse, A.F. & Williams, N.P. (2011) Captive breeding of peregrine and other falcons in Great Britain and implications for conservation of wild populations. *Endangered Species Research* 14: 243–257. doi: 10.3354/esr00352

Fletcher, K., Aebischer, N.J., Baines, D., Foster, R. & Hoodless, A.N. (2010) Changes in breeding success and abundance of ground-nesting moorland birds in relation to the experimental deployment of legal predator control. *Journal of Applied Ecology* 47: 263–272.

Fletcher, K., Howarth, D., Kirby, A., Dunn, R. & Smith, A. (2013) Effect of climate change on breeding phenology, clutch size and chick survival of an upland bird. *Ibis* 155: 456–463.

Flowerdew, J.R., Shore, R.F., Poulton, S.M.C. & Sparks, T.H. (2004) Live trapping to monitor small mammals in Britain. *Mammal Review* 34: 31–50.

Flyckt, G. (1999) Breeding biology of the Yellow Wagtail *Motacilla f. flava* in shore meadows in north-eastern Scania. *Ornis Svecica* 9: 217–223.

Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. & Grundy, D.S. (2007) *The Birds of Scotland*. Scottish Ornithologists' Club, Aberlady.

Fox, A.D. & Madsen, J. (2017) Threated species to super-abundance: The unexpected international implications of successful goose conservation. *Ambio* 46 (Suppl. 2): 179–187.

Fox, R. (2013) The decline of moths in Great Britain: a review of possible causes. *Insect Conservation and Diversity* 6: 5–19. doi: 10.1111/j.1752-4598.2012.00186.x

Fox, T. & Heldbjerg, H. (2008) Which regional features of Danish agriculture favour the Corn Bunting in the contemporary farming landscape? *Agriculture, Ecosystems & Environment* 126: 261–269.

Fox, R., Brereton, T.M., Asher, J., August, T.A., Botham, M.S., Bourn, N.A.D., Cruickshanks, K.L., Bulman, C.R., Ellis, S., Harrower, C.A., Middlebrook, I., Noble, D.G., Powney, G.D., Randle, Z., Warren, M.S. & Roy, D.B. (2015) The State of the UK's Butterflies 2015. Butterfly Conservation and the Centre for Ecology & Hydrology,

Wareham, Dorset.

Francksen, R.M., Whittingham, M. J. & Baines, D. (2016a) Assessing prey provisioned to Common Buzzard Buteo buteo chicks: a comparison of methods *Bird Study* 63: 303–310. doi: 10.1080/00063657.2016.1183111

Francksen, R.M., Whittingham, M.J., Ludwig, S.C. & Baines, D. (2016b) Winter diet of Common Buzzards Buteo buteo on a Scottish grouse moor. Bird Study 63: 525–532. doi: 10.1080/00063657.2016.1238868

Francksen, R.M., Whittingham, M.J., Ludwig, S.C., Roos, S. & Baines, D. (2017) Numerical and functional response of Common Buzzards Buteo buteo to prey abundance on a Scottish grouse moor. *Ibis* 159: 541–553. doi: 10.1111/ibi.12471

Francksen, R.M., Aebischer, N.J., Ludwig, S.C., Baines, D. & Whitteingham, M.J. (2019) Measures of predator diet alone may underestimate the collective imapct on pry: Common buzzard *Buteo buteo* consumption of economically important *red grouse* Lagopus lagopus scotica. *PLoS One* 14: e0221404. doi: 10.1371/journal.pone.0221404

Franks, S.E., Douglas, D.J.T., Gillings, S. & Pearce-Higgins, J.W. (2017) Environmental correlates of breeding abundance and population change of Eurasian Curlew Numenius arquata in Britain. *Bird Study* 64: 393–409. doi: 10.1080/00063657.2017.1359233

Franks, S.E., Pearce-Higgins, J.W.P., Atkinson, S., Bell, J.R., Botham, M.S., Brereton, T.M., Harrington, R. & Leech, D.I. (2018) The sensitivity of breeding songbirds to changes in seasonal timing is linked to population change but cannot be directly attributed to the effects of trophic asynchrony on productivity. *Global Change Biology* 24: 957–971. doi: 10.1111/gcb.13960

Frederiksen, M., Lebreton, J-D. & Bregnballe, T. 2001. The interplay between culling and density-dependence in the great cormorant: a modelling approach *Journal of Applied Ecology* 38: 617–627. doi: 10.1046/j.1365-2664.2001.00620.x

Frederiksen, M., Korner-Nievergelt, F., Marion, L. & Bregnballe, T. 2018. Where do wintering cormorants come from? Long-term changes in the geographical origin of a migratory bird on a continental scale. *Journal of Applied Ecology* 55: 2019–2032. doi: 10.1111/1365-2664.13106

Freeman, S.N. & Crick, H.Q.P. (2002) Population dynamics of House Sparrows *Passer domesticus* breeding in Britain: an integrated analysis. In *Investigation into the causes of the decline of starlings and house sparrows in Great Britain* (eds Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A. & Rickard, A.D.), pp 193–211. Research Report 290. BTO, Thetford.

Freeman, S.N. & Crick, H.Q.P. (2003) The decline of the Spotted Flycatcher *Muscicapa striata* in the UK: an integrated population model. *Ibis* 145: 400–412.

Freeman, S.N., Wernham, C.V. & Balmer, D.E. (2001) *Long-term changes in the productivity of common songbirds in Britain and Ireland from constant effort ringing* Unpublished report. BTO, Thetford.

Freeman, S.N., Robinson, R.A., Clark, J.A., Griffin, B.M. & Adams, S.Y. (2002) Population dynamics of Starling *Sturnus vulgaris* breeding in Britain: an integrated analysis. In *Investigation into the causes of the decline of starlings and house sparrows in Great Britain* (eds Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A. & Rickard, A.D.), pp 121–139. Research Report 290. BTO, Thetford.

Freeman, S.N., Noble, D.G., Newson, S.E. & Baillie, S.R. (2003) *Modelling bird population changes using data from the Common Birds Census and the Breeding Bird Survey*. Research Report 303. BTO, Thetford.

Full text (PDF, 526.15 KB)
Freeman, S.N., Noble, D.G., Newson, S.E. & Baillie, S.R. (2007a) Modelling bird population changes using data from different surveys: the Common Birds Census and the Breeding Bird Survey. *Bird Study* 54: 61–72. doi: 10.1080/00063650709461457

Freeman, S.N., Robinson, R.A., Clark, J.A., Griffin, B.M. & Adams, S.Y. (2007b) Changing demography and population decline in the Common Starling *Sturnus vulgaris*: a multisite approach to Integrated Population Monitoring. *Ibis* 149: 587–596. doi: 10.1111/j.1474-919X.2007.00684.x

Freeman, S.N., Balmer, D.E. & Crick, H.Q.P. (2007c) Tawny Owl Survey 2005. *BTO News* 268: 6–7.

Frith, M. (2010) As British as curry? Hot and bothered over parakeets. *ECOS* 31: 11–1.

Frost, D. (2008) The use of 'flight diverters' reduces Mute Swan Cygnus olor collision with power lines at Abberton Reservoir, Essex. Conservation Evidence 5: 83–91

Frost, T., Austin, G., Hearn, R., McAvoy, S., Robinson, A., Stroud, D., Woodward, I. & Wotton, S. (2019b) Population estimates of wintering waterbirds in Great Britain. *British Birds* 112: 130–145.

Frost, T.M., Calbrade, N.A., Birtles, G.A., Mellan, H.J., Hall, C., Robinson, A.E., Wotton, S.R., Balmer, D.E. & Austin, G.E. (2020). Waterbirds in the UK 2018/19: The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT. British Trust for Ornithology, Thetford. WeBS interactive report

Fuller, R.J. (1995) *Bird life of woodland and forest.* Cambridge University Press, Cambridge.

Fuller, R.J. (1996) *Relationships between grazing and birds with particular reference to sheep in the British uplands* Research Report 164. BTO, Thetford.

Fuller, R. (2000) Relationships between recent changes in lowland British agriculture and farmland bird populations: an overview. In *Ecology and Conservation of Lowland Farmland Birds* (eds Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A.), 5–16. British Ornithologists' Union, Tring.

Fuller, R. (2018) Breeding waderson three Outer Hebridean dune systems over three decades: influences of habitat quality *Hebridean Naturalist* 17: 56–65.

Fuller, R. & Ausden, M. (2008) Birds and habitat change in Britain. Part 1: a review of losses and gains in the twentieth century *British Birds* 101: 644–675.

Fuller, R.J. & Gough, S.J. (1999) Changes in sheep numbers in Britain: implications for bird populations. *Biological Conservation* 91: 73–89.

Fuller, R.J. & Henderson, A.C.B. (1992) Distribution of breeding songbirds in Bradfield Woods, Suffolk, in relation to vegetation and coppice management *Bird Study* 39:

73–88.

Fuller, R. & Moreton, B. (1987) Breeding bird populations of Kentish sweet chestnut (*Castanea sativa*) coppice in relation to age and structure of the coppice. *Journal of Applied Ecology* 24: 13–27.

Fuller, R.J., Marchant, J.H. & Morgan, R.A. (1985) How representative of agricultural practice in Britain are Common Birds Census farmland plots? *Bird Study* 32: 56–70.

Fuller, R.J., Gregory, R.D., Gibbons, D.W., Marchant, J.H., Wilson, J.D., Baillie, S.R. & Carter, N. (1995) Population declines and range contractions among lowland farmland birds in Britain. *Conservation Biology* 9: 1425–1441.

Fuller, R.J., Henderson, A.C.B. & Wilson, A.M. (1999) The Nightingale in England. *British Wildlife* 9: 221–230.

Fuller, R.J., Chamberlain, D.E., Burton, N.H.K. & Gough, S.J. (2001) Distributions of birds in lowland agricultural landscapes of England and Wales: how distinctive are bird communities of hedgerows and woodland? *Agriculture, Ecosystems & Environment* 84: 79–92.

Fuller, R.J., Noble, D.G., Smith, K.W. & Vanhinsbergh, D. (2005) Recent declines in populations of woodland birds in Britain: a review of possible causes. *British Birds* 98: 116–143.

Fuller, R., Atkinson, P., Garnett, M., Conway, G., Bibby, C. & Johnstone, I. (2006) Breeding bird communities in the upland margins (ffridd) of Wales in the mid-1980s. *Bird Study* 53: 177–186.

Furness, R.W. & Greenwood, J.J.D. (eds.) (1993) *Birds as Monitors of Environmental Change*. Chapman & Hall, London.

Furness, R.W., Wader, H.M. & Masden, E.A. (2013) Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management* 119: 56–66.

Galbraith, H. (1988) Effects of agriculture on the breeding ecology of lapwings *Vanellus vanellus*. *Journal of Applied Ecology* 25: 487–503.

Gamelon, M., Vriend, S.J.G., Engen, S. et al. (2019) Accounting for interspecific competition and age structure in demographoc analyses of density dependence improves predictions of flucatuations in population size. *Ecology Letters* 22: 797-806 doi:10.1111/ele.13237

Garratt, C.M., Hughes, M., Eagle, G., Fowler, T., Grice, P.V. & Whittingham, M.J. (2011) Foraging habitat selection by breeding common kestrels *Falco tinnunculus* on lowland farmland in England. *Bird Study* 58: 90–98. doi:10.1080/00063657.2010.526192

Gasparini, J., Erin, N., Bertin, C., Jacquin, L., Vorimore, F., Frantz, A., Lenouvel, P. & Laroucau, K. (2011) Impact of urban environment and host phenotype on the epidemiology of Chlamydiaceae in feral pigeons (*Columba livia*). *Environmental microbiology* 13: 3186–3193. doi:10.1111/j.1462-2920.2011.02575.x

Geary, M., Haworth, P.F., & Fielding, A.H. (2018) Hen harrier *Circus cyaneus* nest sites on the Isle of Mull are associated with habitat mosaics and constrained by topography. *Bird Study* 65: 62–71.

Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) *The New Atlas of Breeding Birds in Britain and Ireland: 1988–1991*. T. & A.D. Poyser, London.

Gibbons, D., Gates, S., Green, R.E., Fuller, R.J. & Fuller, R.M. (1995) Buzzards *Buteo buteo* and Ravens *Corvus corax* in the uplands of Britain: limits to distribution and abundance. *Ibis* 137: 75–84.

Gibbons, D.W., Avery, M.I., Baillie, S.R., Gregory, R.D., Kirby, J., Porter, R.F., Tucker, G.M. & Williams, G. (1996) Bird species of conservation concern in the United Kingdom, Channel Islands and Isle of Man: revising the Red Data List. *RSPB Conservation Review* 10: 7–18.

Gibbons, D.W., Bainbridge, I.P., Mudge, G.P., Tharme, A.P. & Ellis, P.M. (1997) The status and distribution of the Red-throated Diver *Gavia stellata* in Britain in 1994. *Bird Study* 44: 194–205.

Gilbert, G. (2012) Grasshopper Warbler *Locustella naevia* breeding habitat in Britain. *Bird Study* 59: 303–314.

Giles, N. (1994) Tufted Duck (*Aythya fuligula*) habitat use and brood survival increases after fish removal from gravel pit lakes. *Hydrobiologia* 279/280: 387–292.

Gill, R.M.A. & Beardall, V. (2001) The impact of deer on woodlands: the effects of browsing and seed dispersal on vegetation structure and composition. *Forestry* 74: 209–218.

Gill, R.M.A. & Fuller, R.J. (2007) The effects of deer browsing on woodland structure and songbirds in lowland Britain. *Ibis* 149 suppl. 2: 119–127. doi:10.1111/j.1474-919X.2007.00731.x

Gillings, S., Fuller, R.J. & Balmer, D.E. (2000) Breeding birds in scrub in the Scottish Highlands: variation in community composition between scrub type and successional stage. *Scottish Forestry* 54: 73–85.

Gillings, S., Newson, S.E., Noble, D.G. & Vickery, J.A. (2005) Winter availability of cereal stubbles attracts declining farmland birds and positively influences breeding population trends. *Proceedings of the Royal Society B* 272: 733–739. Full text

Gillings, S., Newson, S. & Sellers, R.M. (2007) Breeding population estimates for Northern Wheatear in Britain. *British Birds* 100: 179–181.

Gilroy, J., Anderson, G., Grice, P., Vickery, J., Bray, I., Watts, P.N. & Sutherland, W. (2008) Could soil degradation contribute to farmland bird declines? Links between soil penetrability and the abundance of Yellow Wagtails *Motacilla flava* in arable fields. *Biological Conservation* 14: 3116–3126.

Gilroy, J.J., Anderson, G.Q.A., Grice, P.V., Vickery, J.A., Watts, P.N. & Sutherland, W.J. (2009) Foraging habitat selection, diet and nestling condition in Yellow Wagtails *Motacilla flava* breeding on arable farmland. *Bird Study* 56: 221–232.

Gilroy, J.J., Anderson, G.Q.A., Grice, P.V., Vickery, J.A. & Sutherland, W.J. (2010) Mid-season shifts in the habitat associations of Yellow Wagtails *Motacilla flava*

breeding in arable farmland. *Ibis* 152: 90–104.

Gilroy, J. J., Gill, J. A., Butchart, S. H., Jones, V. R., & Franco, A. (2016) Migratory diversity predicts population declines in birds. *Ecology letters* 19(3): 308–317

Glue, D. (1974) Food of the Barn Owl in Britain and Ireland. *Bird Study* 21, 200–210.

Glue, D.E. (1990) Breeding biology of the Grasshopper Warbler in Britain. *British Birds* 83: 131–145.

Glue, D. (1993) Report on Garden Bird Feeding Survey. *BTO News* 188: 24.

Glue, D. (1995) Report on Garden Bird Feeding Survey. *BTO News* 200: 5.

Glue, D. (1997) Report on Garden Bird Feeding Survey 1996/1997. *BTO News* 212: 6–7.

Glue, D.E. (2006) Cuckoos in crisis? *BTO News* 263: 22–23.

Glue, D. & Boswell, T. (1994) Comparative nesting ecology of the three British breeding woodpeckers. *British Birds* 87: 253–269.

Gomersall, C.H., Morton, J.S. & Wynde, R.M. (1984) Status of breeding Red-throated Divers in Shetland, 1983. *Bird Study* 31: 223–229.

Gooch, S., Baillie, S.R. & Birkhead, T.R. (1991) Magpie *Pica pica* and songbird populations – retrospective investigation of trends in population density and breeding success. *Journal of Applied Ecology* 28: 1068–1086.

Goodenough, A.E., Elliot, S.L. & Hart, A.G. (2009) The challenges of conservation for declining migrants:are reserve-based initiatives during the breeding season appropriate for the Pied Flycatcher *Ficedula hypoleuca*? *Ibis* 151: 429–439.

Goodenough, A.E., Hart, A.G. & Elliot, S.L. (2011) What prevents phenological adjustment to climate change in migrant bird species? Evidence against the “arrival constraint” hypothesis. *International Journal of Biometeorology* 55: 97–102.

Gosler, A.G. (1990) The Birds of Wytham – an historical survey. *Fritillary* 1: 29–74.

Goss-Custard, J.C. (1993) The effect of migration and scale on the study of bird populations: 1991 Witherby Lecture. *Bird Study* 40: 81–96.

Goss-Custard, J.D., Bowgen, K. & Stillman, R.A. 2019. Increasing the harvest for mussels *Mytilus edulis* without harming Oystercatchers *Haematopus ostralegus*. *Mar Ecol Prog Series* 612: 101–110. doi: 10.3354/meps12875

Goszczynski, J. (1997) Density and productivity of Common Buzzard *Buteo buteo* and Goshawk *Accipiter gentilis* populations in Rogow, central Poland. *Acta Ornithologica* 32: 149–154.

Goszczynski, J. (2001) The breeding performance of the Common Buzzard *Buteo buteo* and Goshawk *Accipiter gentilis* in central Poland. *Acta Ornithologica* 36: 105–110.

Gottschalk, T.K., Ekschmitt, K. & Wolters, V. (2011) Efficient placing of nest boxes for the Little Owl (*Athene noctua*). *Journal of Raptor Research* 45: 1–14.

Graham, I.M., Redpath, S.M. & Thirgood, S.J. (1995) The diet and breeding density of Common Buzzards *Buteo buteo* in relation to indices of prey abundance. *Bird Study* 42: 165–173.

Grant, M.C., Orsman, C., Easton, J., Lodge, C., Smith, M., Thompson, G., Rodwell, S. & Moore, N. (1999) Breeding success and causes of breeding failure of Curlew *Numenius arquata* in Northern Ireland. *Journal of Applied Ecology* 36: 59–74.

Graveland, J. (1999) Effects of reed cutting on density and breeding success of Reed Warbler *Acrocephalus scirpacaeus* (sic) and Sedge Warbler *A. schoenobaenus*. *Journal of Avian Biology* 30: 469–482.

Green, M., Kaleta, R. & Keirle, I. (2012) Habitat associations and winter distribution of Ring Ouzels in the Atlas Mountains, Morocco. *British Birds* 105: 674–682.

Green, R.E. (1988) Effects of environmental factors on the timing and success of breeding snipe (Aves: Scolopacidae). *Journal of Applied Ecology* 25: 79–93.

Green, R.E. (1999) Applications of large-scale studies of demographic rates to bird conservation. *Bird Study* 46 (Suppl.): S279–S288.

Green, R.E. & Pain.D.J. (2016) Possible effects of ingested lead gunshot on populations of ducks wintering in the UK. *Ibis* 158: 699–710. doi: 10.1111/ibi.12400

Green, R.E. & Robins, M. (1993) The decline of the ornithological importance of the Somerset Levels and Moors, England and the changes in the management of water levels. *Biological Conservation* 66: 95–106.

Greenwood, J.J.D. (2000) How BTO’s monitoring of birds contributes to conservation. In *European Monitoring for Nature Conservation, Bonn-Bad Godesberg (Bundesamt fur Naturschutz)*, ed. by C. Bischoff & R. Droschmeister. *Schriftenreiche fur Landschaftspflege und Naturschutz* 62: 105–117.

Greenwood, J.J.D. & Baillie, S.R. (1991) Effects of density-dependence and weather on population changes of English passerines using a non-experimental paradigm. *Ibis* 133: 121–133. doi: 10.1111/j.1474-919X.1991.tb07675.x

Gregory, R.D. & Marchant, J.H. (1996) Population trends of Jays, Magpies, Jackdaws and Carrion Crows in the United Kingdom. *Bird Study* 43: 28–37.

Gregory, R.D., Carter, S.P. & Baillie, S.R. (1997) Abundance, distribution and habitat use of breeding Goosanders *Mergus merganser* and Red-breasted Mergansers *Mergus serrator* on British rivers. *Bird Study* 44: 1–12.

Gregory, R.D., Wilkinson, N.I., Noble, D.G., Robinson, J.A., Brown, A.F., Hughes, J., Procter, D., Gibbons, D.W. & Galbraith, C.A. (2002) The population status of birds in

the United Kingdom, Channel Islands and Isle of Man: an analysis of conservation concern 2002–2007. *British Birds* 95: 410–448.

Gregory, R.D., Noble, D.G. & Custance, J. (2004) The state of play of farmland birds: population trends and conservation status of lowland farmland birds in the United Kingdom. *Ibis* 146 (suppl. 2): 1–13.

Grendelmeier, A., Arlettaz, R., Gerber, M. & Pasinelli, G. (2015) Reproductive performance of a declining forest passerine in relation to environmental and social factors: implications for species conservation. *PLoS One* 10: e0130954. doi: 10.1371/journal.pone.0130954

Grimm, A., Weiss, B.M., Kulik, L., Mihoub, J-B., Mundry, R., Köppen, U., Brueckmann, T., Thomsen, R. & Widdig, A. (2015) Earlier breeding, lower success: does the spatial scale of climatic conditions matter in a migratory passerine bird? *Ecology & Evolution* 5: 5722–5734. doi: 10.1002/ece3.1824

Groom, D.W. (1993) Magpie *Pica pica* predation on Blackbird *Turdus merula* nests in urban areas. *Bird Study* 40: 55–62.

Gruar, D., Barritt, D. & Peach, W.J. (2006) Summer utilization of Oilseed Rape by Reed Buntings *Emberiza schoeniclus* and other farmland birds. *Bird Study* 53: 47–54.

Grüebler, M.U., Schuler, H., Müller, M.M., Spaar, R., Horch, P. & Naef-Daenzer, B. (2008) Female biased mortality caused by anthropogenic nest loss contributes to population decline and adult sex ratio of a meadow bird. *Biological Conservation* 141: 3040–3049.

Grüebler, M.U., Korner-Nievergelt, F. & von Hirschheydt, J. (2010) The reproductive benefits of livestock farming in barn swallows *Hirundo rustica*: quality of nest site or foraging habitat? *Journal of Applied Ecology* 47: 1340–1347. doi: 10.1111/j.1365-2664.2010.01873.x

Guillemain, M., Elmberg, J., Gauthier-Clerc, M., Massez, G., Hearn, R., Champagnon, J. & Simon, G. (2010) Wintering French Mallard and Teal are heavier and in better body condition than 30 years ago: effects of a changing environment? *Ambio* 39: 170–180.

Guillemette, M. & Brousseau, P. (2001) Does culling of predatory gulls enhance the productivity of breeding common terns? *Journal of Applied Ecology* 38: 1–8.

Gulickx, M.M.C. & Kemp, J.B. (2007) Provision of nest cages to reduce little ringed plover *Charadrius dubius* nest predation at Welney, Norfolk, England. *Conservation Evidence* 4: 30–32.

Gulickx, M.M.C., Beecroft, R.C. & Green, A.C. (2007) Creation of artificial Sand Martin *Riparia riparia* burrows at Kingfisher's Bridge, Cambridgeshire, England. *Conservation Evidence* 4: 51–53.

Gullett, P., Evans, K.L., Robinson, R.A. & Hatchwell, B.J. (2014) Climate change and annual survival in a temperate passerine: partitioning seasonal effects and predicting future patterns. *Oikos* 123: 389–400. doi: 10.1111/j.1600-0706.2013.00620.x

Gullett, P.R., Hatchwell, B.J., Robinson, R.A. & Evans, K.L. (2015) Breeding season weather determines long-tailed tit reproductive success through impacts on recruitment. *Journal of Avian Biology* 46: 441–451. doi: 10.1111/jav.00560

Haftorn, S. (1993) Is the Coal Tit *Parus ater* really the most subordinate of the Scandinavian tits? *Ornis Scandinavica* 24: 335–338.

Halley, D.J. (1993) Population changes and territorial distribution of Common Buzzards *Buteo buteo* in the Central Highlands, Scotland. *Bird Study* 40: 24–30.

Hallmann, C.A., Foppen, R.P.B., van Turnhout, C.A.M., de Kroon, H. & Jongejans, E. (2014) Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature* 511: 341–343.

Halupka, L., Dyrcz, A. & Borowiec, M. (2008) Climate change affects breeding of Reed Warblers *Acrocephalus scirpaceus*. *Journal of Avian Biology* 39: 95–100.

Hancock, M.H. & Wilson, J.D. (2003) Winter habitat associations of seed-eating passerines on Scottish farmland. *Bird Study* 50: 116–130.

Hansson, L. (1977) Spatial dynamics of field voles *Microtus agrestis* in heterogeneous landscape. *Oikos* 29: 539–544.

Hardey, J., Crick, H.Q.P., Wernham, C.V., Riley, H.T., Etheridge, B. & Thompson, D.B.A. (eds) (2009) *Raptors: a field guide to survey and monitoring*. Second edition. The Stationery Office, Edinburgh.

Harris, S., Morris, P., Wray, S. & Yalden, D. (1995) *A review of British mammals: population estimates and conservation status of British mammals other than cetaceans.* JNCC, Peterborough.

Harris, S.J., Massimino, D., Gillings, S., Eaton, M.A., Noble, D.G., Balmer, D.E., Procter, D. & Pearce-Higgins, J.W. & Woodcock, P. (2018) *The Breeding Bird Survey 2017*. BTO Research Report 706. BTO, Thetford. Full text

Harris, S.J., Massimino, D., Eaton, M.A., Gillings, S., Noble, D.G., Balmer, D.E., Pearce-Higgins, J.W. & Woodcock, P. (2019) *The Breeding Bird Survey 2018*. BTO Research Report 717. BTO, Thetford. Full text

Harris, S.J., Massimino, D., Balmer, D.E., Eaton, M.A., Noble, D.G., Pearce-Higgins, J.W., Woodcock, P. & Gillings, S. (2020) *The Breeding Bird Survey 2019*. BTO Research Report 726. British Trust for Ornithology, Thetford. Full text

Harrison, E. (1990) Rodenticides and Barn Owls: assessing the hazards. *Shell Agriculture* 8: 15–17.

Hart, J.D., Milsom, T.P., Baxter, A., Kelly, P.F. & Parkin, W.K. (2002) The impact of livestock on Lapwing *Vanellus vanellus* breeding densities and performance on coastal grazing marsh. *Bird Study* 49: 67–78. doi: 10.1080/00063650209461246

Hart, J., Milsom, T., Fisher, G., Wilkins, V., Moreby, S., Murray, A. & Robertson, P. (2006) The relationship between Yellowhammer breeding performance, arthropod abundance and insecticide applications on arable farmland. *Journal of Applied Ecology* 43: 81–91.

Hastie, T.J. & Tibshirani, R.J. (1990) *Generalized additive models*. Chapman & Hall, London.

Hawkes, R.W., Smart, J., Brown, A., Jones, H. & Dolman, P.M. (2019) Experimental evidence that ground-disturbance benefits Woodlark *Lullula arborea*. *Ibis* 161: 447–452.

Hayhow, D.B., Eaton, M.A., Bladwell, S., Etheridge, B., Ewing, S.R., Ruddock, M., Saunders, R., Sharpe, C., Sim, I.M.W. & Stevenson, A. (2013) The status of the Hen Harrier, *Circus cyaneus*, in the UK and Isle of Man in 2010. *Bird Study* 60: 446–458.

Hayhow, D.B., Bond, A.L., Eaton, M.A., Grice, P.V., Hall, C., Hall, J., Harris, S.J., Hearn, R.D., Holt, C.A., Noble, D.G., Stroud, D.A. & Wotton, S. (2015) *The state of the UK's birds 2015*. RSPB, BTO, WWT, JNCC, NE, NIEA, NRW and SNH, Sandy, Bedfordshire. Full text

Heath, D.J. & Whitehead, A. (1992) A survey of pond loss in Essex, south-east England. *Aquatic Conservation* 2: 267–273. doi: 10.1002/aqc.3270020306

Heavisides, A., Barker, A & Poxton, I. (2017) Population and breeding biology of Merlins in the Lammermuir Hills. *British Birds* 110: 138–154.

Heinänen, S., Žydelis, R., Kleinschmidt, B., Dorsch, M., Burger, C., Morkūnas, J., Quillfeldt, P. & Nehls, G. (2020) Satellite telemetry and digital aerial surveys show strong displacement of red-throated divers (*Gavia stellata*) from offshore wind farms. *Marine Environmental Research* 160: 104989. doi: 10.1016/j.marenvres.2020.104989

Heldbjerg, H. & Fox, T. (2008) Long-term population declines in Danish trans-Saharan migrant birds. *Bird Study* 55: 267–279.

Heldbjerg, H., Fox, A.D., Levin, G. & Nyegaard, T. (2016) The decline of the Starling *Sturnus vulgaris* in Denmark is related to changes in grassland extent and intensity of cattle grazing. *Agriculture, Ecosystems & Environment* 230: 24–31. doi: 10.1016/j.agee.2016.05.025

Heldbjerg , H., Fox, A.D., Thellesen, P.V., Dalby, L. & Sunde, P. (2017) Common Starlings (*Sturnus vulgaris*) increasingly select for grazed areas with increasing distance-to-nest. *Plos One* 12(8): e0182504. doi: 10.1371/journal.pone.0182504

Heldbjerg, H., Fox, A.D., Lehikoinen, A., Sunde, P., Aunins, A., Balmer, D.E., Calvi, G., Chodkiewicz, T., Chylarecki, P., Escandell, V., Foppen, R., Gamero, A., Hristov, I., Husby, M., Jiguet, f., Kmecl, P., Kålås, J.A., Lewis, L.J., Lindström, Å., Moshøj. C., Nellis, R., Paquet, J-Y., Portolou, D., Ridzoň, J., Schmid, H., Skorpilová, J., Szabó, Z.D., Szép, T., Teufelbauer, N., Trautmann, S., van Turnhout, C., Vermouzek, Z., Voříšek, P & Weiserbs, A. 2019. Contrasting population trends of Common Starlings (*Sturnus vulgaris*) across Europe. *Ornis Fennica* 96: 153-168.

Henderson, I.G. & Hart, P.J.B. (1993) Provisioning, parental investment and reproductive success in Jackdaws *Corvus monedula*. *Ornis Scandinavica* 24: 142–148.

Henderson, I.G., Wilson, A.M., Steele, D. & Vickery, J.A. (2002) Population estimates, trends and habitat associations of breeding Lapwing *Vanellus vanellus*, Curlew *Numenius arquata* and Snipe *Gallinago gallinago* in Northern Ireland in 1999. *Bird Study* 49: 17–25. doi: 10.1080/00063650209461240

Henderson, I.G., Fuller, R.J., Conway, G.J. & Gough, S.J. (2004) Evidence for declines in populations of grassland-associated birds in marginal upland areas of Britain. *Bird Study* 51: 12–19.

Henderson, I., Holt, C. & Vickery, J. (2007) National and regional patterns of habitat association with foraging Barn Swallows *Hirundo rustica* in the UK. *Bird Study* 54: 371–377. doi: 10.1080/00063650709461497

Henderson, I., Calladine, J., Massimino, D., Taylor, J.A. & Gillings, S. (2014) Evidence for contrasting causes of population change in two closely related, sympatric breeding species the Whinchat *Saxicola rubetra* and Stonechat *Saxicola torquata* in Britain. *Bird Study* 61: 553–565. doi: 10.1080/00063657.2014.962482

Henderson, I., Noble, D & Jones, K. (2017) A survey of Wheatear, Stonechat and Whinchat in Wales, 2012 and 2013 *Birds of Wales* 14: 10–19.

Henderson, I., Hunter, D. & Conway, G. (2018) Comparing moth abundance between the breeding and foraging locations of the European Nightjar Caprimulgus europaeus, in Thetford Forest. A BOU-funded project report. BOU, Peterborough, UK.

Hernández-Brito, D., Carrete, M., Ibáñez, C., Juste, J. & Tella, J.L. (2018) Nest-site competition and killing by invasive parakeets cause the decline of a threatened bat population. *R. Soc. Open Sci.* 5: 172477. doi: 10.1098/rsos.172477

Hethcoat, M. G., & Chalfoun, A. D. (2015) Towards a mechanistic understanding of human-induced rapid environmental change: a case study linking energy development, nest predation and predators. *Journal of Applied Ecology* 52: 1492 –1499.

Heward, C.J., Hoodless, A.N., Conway, G.J., Aebischer, N.J., Gillings, S. & Fuller, R.J. (2015) Current status and recent trend of the Eurasian Woodcock *Scolopax rusticola* as a breeding bird in Britain. *Bird Study* 62: 535–551. doi: 10.1080/00063657.2015.1092497

Heward, C.J., Hoodless, A.N., Conway, G.J., Fuller, R.J., MacColl, A.D.C. & Aebischer, N.J. (2018) Habitat correlates of Eurasian Woodcock *Scolopax rusticola* abundance in a declining resident population. *Journal of Ornithology* 159: 955–965. doi: 10.1007/s10336-018-1570-z

Hewson, C. & Noble, D. (2009) Population trends of breeding birds in British woodlands over a 32-year period: relationships with food, habitat use and migratory behaviour. *Ibis* 151: 464–486.

Hewson, C.M., Fuller, R.J. & Day, C. (2005) An investigation of habitat occupancy by the Nightingale *Luscinia megarhynchos* with respect to population change at the edge of its range in England. *Journal of Ornithology* 146: 244–248.

Hewson, C.M., Amar, A., Lindsell, J.A., Thewlis, R.M., Butler, S., Smith, K. & Fuller, R.J. (2007) Recent changes in bird populations in British broadleaved woodland. *Ibis* 149 (suppl. 2): 14–28. doi: 10.1111/j.1474-919X.2007.00745.x

Hewson, C.M., Thorup, K., Pearce-Higgins, J.W. & Atkinson, P.W. (2016) Population decline is linked to migration route in the Common Cuckoo. *Nature Communications* 7: 12296. doi:10.1038/ncomms12296

Hewson, C.M., Miller, M., Johnston, A., Conway, G.J., Saunders, R., Marchant, J.H., Fuller, R.J. (2018) Estimating national population sizes: Methodological challenges and applications illustrated in the common nightingale, a declining songbird in the UK. *Journal of Applied Ecology* 55: 2008–2018. doi: 10.1111/1365-2664.13120

Higginson, A.D. (2017) Conflict over non-partitioned resources may explain between-species differences in declines: the anthropogenic competition hypothesis.

Behavioural Ecology and Sociobiology 71: 99. doi: 10.1007/s00265-017-2327-z

Hill, D.A. (1984) Population regulation in the Mallard (*Anas platyrhynchos*). *Journal of Animal Ecology* 53: 191–202.

Hines, J.E., Kendall, W.L., Nichols, J.D. & Thompson, F.R. III (2003) On the use of the robust design with transient capture–recapture models*Auk* 120: 1151–1158. doi: 10.1642/0004-8038(2003)120[1151:OTUOTR]2.0.CO;2

Hinsley, S.A., Bellamy, P.E., Newton, I. & Sparks, T.H. (1995) Habitat and landscape factors influencing the presence of individual breeding bird species in woodland fragments. *Journal of Avian Biology* 26: 94–104.

Hinsley, S.A., Carpenter, J.E., Broughton, R.K., Bellamy, P.E., Rothery, P., Amar, A., Hewson, C.M. & Gosler, A.G. (2007) Habitat selection by Marsh Tits*Poecile palustris* in the UK. *Ibis* 149 (suppl. 2): 224–233.

Hodgson, I.D., Redpath, S.M., Fischer, A. & Young, J. (2018) Fighting talk: Organisational discourses of the conflict over raptors and grouse moor management in Scotland. Land Use Policy 77: 332–343. doi: 10.1016/j.landusepol.2018.05.042

Hodgson, I.D., Redpath, S.M., Fischer, A. & Young, J. (2019) Who knows best? Understanding the use of research-based knowledge in conservation conflicts*Journal of Environmental Management* 231: 1065–1075. doi: 10.1016/j.jenvman.2018.09.023

Hogstad, O. & Slagsvold, T. (2018) Survival of Willow tits *Poecile montanus*: the significance of flock membership, social rank and body size. *Ornis Norvegica* 41: 13–18. doi: 10.15845/on.v41i0.140

Hole, D.G. (2001) *The population ecology and ecological genetics of the house sparrow*Passer domesticus *on farmland in Oxfordshire.* PhD thesis, University of Oxford.

Hole, D.G., Whittinham, M.J., Bradbury, R.B., Anderson, g.Q.A., Lee, P.L.M., Wilson, J.D. & Krebs, J.R. (2002) Widespread local house-sparrows extinctions – agricultural intensification is blamed for the plummeting populations of these birds. Nature 418: 931–932.

Holland, P.K. & Yalden, D.W. (2002) Population dynamics of Common Sandpipers *Actitis hypoleucos* in the Peak District of Derbyshire – a different decade: a report of the failure of a population to recover from a catastrophic snow storm. *Bird Study* 49: 131–138.

Holling, M. & the Rare Breeding Birds Panel (2007a) Rare breeding birds in the United Kingdom in 2003 and 2004*British Birds* 100: 321–367. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2007b) Non-native breeding birds in the United Kingdom in 2003, 2004 and 2005*British Birds* 100: 638–649. Full text

Holling, M. & the Rare Breeding Birds Panel (2008) Rare breeding birds in the United Kingdom in 2005*British Birds* 101: 276–316. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2009) Rare breeding birds in the United Kingdom in 2006*British Birds* 102: 158–202. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2010a) Rare breeding birds in the United Kingdom in 2007*British Birds* 103: 2–52. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2010b) Rare breeding birds in the United Kingdom in 2008*British Birds* 103: 482–538. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2011a) Non-native breeding birds in the United Kingdom in 2006, 2007 and 2008*British Birds* 104: 114–138. Full text

Holling, M. & the Rare Breeding Birds Panel (2011b) Rare breeding birds in the United Kingdom in 2009*British Birds* 104: 476–537. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2012) Rare breeding birds in the United Kingdom in 2010*British Birds* 105: 352–416. Full text RBBP reports online

Holling, M. & the Rare Breeding Birds Panel (2013) Rare breeding birds in the United Kingdom in 2011*British Birds* 106: 496–554.

Holling, M. & the Rare Breeding Birds Panel (2014) Rare breeding birds in the United Kingdom in 2012*British Birds* 107: 504–560.

Holling, M. & the Rare Breeding Birds Panel (2015) Rare breeding birds in the United Kingdom in 2013*British Birds* 108: 373–422.

Holling, M & the Rare Breeding Birds Panel (2019) Rare breeding birds in the UK in 2017.*British Birds* 112: 706–758.

Holloway, S. (1996) *The Historical Atlas of Breeding Birds in Britain and Ireland 1875–1900*.T. & A.D. Poyser, London.

Holt, C. (2012) Freezing winters: a test for Britain's wintering Little Egrets.*British Birds* 105: 744–745.

Holt, C.A., Fuller, R.J. & Dolman, P.M. (2010) Experimental evidence that deer browsing reduces habitat suitability for breeding Common Nightingales*Luscinia megarhynchos*. *Ibis* 152: 335–346.

Holt, C.A., Fuller, R.J. & Dolman, P.M. (2011) Breeding and post-breeding responses of woodland birds to modification of habitat structure by deer*Biological Conservation* 144: 2151–2162.

Holt, C.A., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Musgrove, A.J. (2012a)*Waterbirds in the UK 2010/11: the Wetland Bird Survey*. BTO/RSPB/JNCC, Thetford. Full text

Holt, C.A., Hewson, C.M. & Fuller, R.J. (2012b) The Nightingale in Britain: status, ecology and conservation needs*British Birds* 105: 172–187.

Holt, C.A., Fraser, K.H., Bull, A.J. & Dolman, P.M. (2012c) Habitat use by Nightingales in a scrub–woodland mosaic in central England*Bird Study* 59: 416–425. doi: 10.1080/00063657.2012.722191

Holt, C.A., Fuller, R.J. & Dolman, P.M. (2012d) Deer reduce habitat quality for a woodland songbird: evidence from settlement patterns, demographic parameters and

body condition. *Auk* 130: 13–20. Full text

Holt, C.A., Fuller, R.J. & Dolman, P.M. (2014) Exclusion of deer affects responses of birds to woodland regeneration in winter and summer*Ibis* 156: 116–131.

Holton, N. & Allcorn, R.I. (2006) The effectiveness of opening up rush patches on encouraging breeding common snipe*Gallinago gallinago* at Rogersceugh Farm, Campfield Marsh RSPB reserve, Cumbria, England. *Conservation Evidence* 3: 79–80.

Hoodless, A.N. & Hirons, G.J.M. (2007) Habitat selection and foraging behaviour of breeding Eurasian Woodcock*Scolopax rusticola*: a comparison between contrasting landscapes. *Ibis* 149: 234–249. doi:10.1111/j.1474-919X.2007.00725.x

Hoodless, A.N., Lang, D., Aebischer, N.J., Fuller, R.J. & Ewald, J.A. (2009) Densities and population estimates of breeding Eurasian Woodcock*Scolopax rusticola* in Britain in 2003. *Bird Study* 56: 15–25.

Hoodless, A.N., Ewald, J.A. & Baines, D. (2010) Habitat use and diet of Common Snipe*Gallinago gallinago* breeding on moorland in northern England. *Bird Study* 54: 182–191.

Hopkins, L. (2001) *Best Practice Guidelines: Artificial bank creation for sand martins and kingfishers* The Environment Agency. Full text

Hopkins, J.J. & Kirby, K.J. (2007) Ecological change in British broadleaved woodland since 1947.*Ibis* 149: 29–40.

Hõrak, P. & Lebreton, J.-D. (1998) Survival of adult Great Tits*Parus major* in relation to sex and habitat: a comparison of urban and rural populations.*Ibis* 140: 205–209.

Hötker, H. (1991) Waders breeding on wet grasslands in the countries of the European Community – a brief summary of current knowledge on population sizes and population trends. *Wader Study Group Bulletin* 61 (suppl.): 50–55.

Huber, N., Kéry, M. & Pasinelli, G. (2017) Occupancy dynamics of the Wood Warbler*Phylloscopus sibilatrix* assessed with habitat and remote sensing data. *Ibis* 159: 623–637. doi: 10.1111/ibi.12472

Hudson, P.J. (1992) *Grouse in space and time.* Game Conservancy Trust, Fordingbridge.

Hudson, R. (1972) Collared Doves in Britain and Ireland during 1965–70. *British Birds* 65: 139–155.

Hudson, R., Tucker, G.M. & Fuller, R.J. (1994) Lapwing *Vanellus vanellus* populations in relation to agricultural changes: a review. *In* Tucker, G.M., Davies, S.M. & Fuller, R.J. (eds) *The Ecology and Conservation of Lapwings* Vanellus vanellus*:* 1–33. UK Nature Conservation no 9. JNCC, Peterborough.

Hughes, S.W.M., Bacon, P. & Flegg, J.J.M. (1979) The 1975 census of the Great Crested Grebe in Britain.*Bird Study* 26: 213–226.

Huhta, E., Aho, T., Jäntti, A., Suorsa, P., Kuitunen, M., Nikula, A. & Hakkarainen, H. (2004) Forest fragmentation increases predation in the Eurasian Treecreeper. *Conservation Biology* 18: 148–155. doi: 10.1111/j.1523-1739.2004.00270.x

Huhta, E., Jokimakp, J. & Rahko, P. (2008) Distribution and reproductive success of the Pied Flycatcher*Ficedula hypoleuca* in relation to forest patch size and vegetation characteristics; the effect of scale. *Ibis* 140: 214–222. Doi: 10.1111/j.1474-919X.1998.tb04382.x

Hutchinson, C.D. (1989) *Birds in Ireland.* T. & A.D. Poyser, Calton.

Imlay, T.L. & Leonard, M.L. 2019. A review of the threats to adult survival for swallows (Family:*Hirundinidae*). *Bird Study* 66: 251–263. doi:10.1080/00063657.2019.1655527

Inglis, I.R., Isaacson, A.J., Smith, G.C., Haynes, P.J. & Thearle, R.J.P. (1997) The effect on the Woodpigeon (*Columba palumbus*) of the introduction of oilseed rape into Britain. *Agriculture, Ecosystems & Environment* 61: 113–121.

Jackson, D.B. (2007) Factors affecting the abundance of introduced hedgehogs (*Erinaceus europaeus*) to the Hebridean island of South Uist in the absence of natural predators and implications for nesting birds. *Journal of Zoology* 271: 210–217.

Jackson, D. & Green, R. (2000) The importance of the introduced hedgehog (*Erinaceus europaeus*) as a predator of the eggs of waders (Charadrii) on machair in South Uist, Scotland. *Biological Conservation* 93: 333–348.

Jackson, D.B., Fuller, R.J. & Campbell, S.T. (2004) Long-term population changes among breeding shorebirds in the Outer Hebrides, Scotland, in relation to introduced hedgehogs (*Erinaceus europaeus*). *Biological Conservation* 117: 151–166.

Jackson, H., Strubbe, D., Tollington, S., Prys-Jones, R., Matthysen, E. & Groombridge, J.J. (2015) Ancestral origins and invasion pathways in a globally invasive bird correlate with climate and influences from bird trade. *Molecular Ecology* 24: 4269–4285. doi: 10.1111/mec.13307

James, A.R. & Abbott, K.C. (2014) Phenological and geographical shifts have interactive effects on migratory bird populations.*American Naturalist* 183: 40–53.

Jansson, G. & Saari, L. (1999) Suitable habitat distribution for the Long-tailed Tit (*Aegithalos caudatus*) as indicated by the frequency of occurrence – a long-term study. *Ornis Fennica* 76: 115–122.

Jeffries, M.J. (2012) Ponds and the importance of their history: an audit of pond numbers, turnover and the relationship between the origins of ponds and their contemporary plant communities in south-east Northumberland, UK. *Hydrobiologia* 689: 11–21. doi: 10.1007/s10750-011-0678-4

Jenny, M. (1990) Populationsdynamik der Feldlerche *Alauda arvensis* in einer intensiv genutzten Agrarlandschaft der schweizerischen Mittellandes. *Ornithologische Beobachter* 8: 153–163.

JNCC (1996) *Birds of Conservation Importance.* Press release (31 May 1996). Joint Nature Conservation Committee, Peterborough.

JNCC (2020) *Seabird Monitoring Programme Report: 1986–2018*. Joint Nature Conservation Committee. Updated 10 March 2020. Full text

Johnson, D.H. (1979) Estimating nest success: The Mayfield method and an alternative. *Auk* 96: 651–661.

Johnston, A., Robinson, R.A., Gargallo, G., Julliard, R., van der Jeugd, H., Baillie, S.R. (2016) Survival of Afro-Palaearctic passerine migrants in western Europe and the impacts of seasonal weather variables. *Ibis* 158: 465–480. doi: 10.1111/ibi.12366

Johnstone, I., Dyda, J. & Lindley, P. (2007) The population status and hatching success of Curlews *Numenius arquata* in Wales in 2006. *Welsh Birds* 5: 78–87.

Johnstone, I., Dyda, J. & Lindley, P. (2008) The population status of breeding Golden Plover and Dunlin in Wales in 2007 *Welsh Birds* 5: 300–310.

Johnstone, I., Elliot, D., Mellenchip, C. & Peach, W.J. (2017) Correlates of distribution and nesting success in a Welsh upland Eurasian Curlew *Numenius arquata* population. *Bird Study* 64: 535–544. doi: 10.1080/00063657.2017.1411466

Johnstone, I., Dodd, S. & Peach, W.J. (2019) Seeded ryegrass fills the late winter' hungry gap' but fails to enhance local population size of seed-eating farmland birds. *Agriculture, Ecosystems & Environment* 285: 106619. doi: 10.1016/j.agee.2019.106619

Josefsson, J., Berg, Å., Hiron, M., Pärt, T. & Eggers, S. (2013) Grass buffer strips benefit invertebrate and breeding skylark numbers in a heterogeneous agricultural landscape. *Agriculture, Ecosystems and Environment* 181: 101–107. doi: 10.1016/j.agee.2013.09.018

Joys, A.C., Noble, D.G. & Baillie, S.R. (2003) *Evaluation of species coverage and precision using the BBS indexing method*. Research Report 317. BTO, Thetford.

Full text (PDF, 330.42 KB)
Julliard, R. (2004) Estimating the contribution of survival and recruitment to large scale population dynamics. *Animal Biodiversity and Conservation* 27: 417–426.

Kaasiku, T., Rannap, R. & Kaart, T. (2019) Managing coastal wetlands for endangered wader species can give positive results only when expanding the area of open landscape. Journal for Nature Conservation 48: 12–19.

Kaliński, A., Skwarska, J., Wawrzyniak, J. & Banbura, J. (2009) Opportunity makes a predator: Great Spotted Woodpecker predation on tit broods depends on nest box design. *Ornis Fennica* 86: 109–112.

Kallander, H. (1997) The Nuthatch *Sitta europaea* population of Dalby Soderskog during 15 years: trend and fluctuations. *Ornis Svecica* 7: 143–148.

Kämpfer, S. & Fartmann, T. (2019) Breeding populations of a declining farmland bird are dependent on a burrowing, herbivorous ecosystem engineer. *Ecological Engineering* 140: 105592. doi: 10.1016/j.ecoleng.2019.105592

Kelleher, K.M. & O'Halloran, J. (2010) Influence of nesting habitat on breeding Song Thrushes *Turdus philomelos*. *Bird Study* 54: 221–229. doi: 10.1080/00063650709461478

Keller, V. & Korner-Nievergelt, P. (2019) Effect of trophic status of a deep-water lake on breeding Great Crested Grebes *Podiceps cristatus* during a phase of recoveryfrom eutrophication: a long-term study. *Bird Study* 66: 1–10. doi: 10.1080/00063657.2019.1618241

Kenny et al. (2015) *Timing of mowing for the conservation of Whinchat (Saxicola rubetra) in Ireland* Proc 1st European Whinchat Symposium.

Kettel, E.F., Gentle, L.K., Quinn, J.L. & Yarnell, R.W. (2018a) The breeding performance of raptors in urban landscapes: a review and meta-analysis. *Journal of Ornithology* 159: 1–18.

Kettel, E.F., Gentle, L.K., Yarnell, R.W. & Quinn, J.L. (2018b) Breeding performance of an apex predator, the peregrine falcon, across urban and rural landscapes. *Urbans Secosystems* 22: 117–125. doi: 10.1007/s11252-018-0799-x

King, R., Brooks, S.P., Mazzetta, C., Freeman, S.N. & Morgan, B.J.T. (2008) Identifying and diagnosing population declines: a Bayesian assessment of Lapwings in the UK. *Applied Statistics* 57: 609–632.

Kirby, J., Delany, S. & Quinn, J. (1994) Mute Swans in Great Britain: a review, current status and long-term trends. *Hydrobiologia* 279–280: 467–482.

Kirby, J.S., Holmes, J.S. & Sellers, R.M. (1996) Cormorants *Phalacrocorax carbo* as fish predators: an appraisal of their conservation and management in Great Britain. *Biological Conservation* 75: 191–199. doi: 10.1016/0006-3207(95)00043-7

Kirby, W.B., Anderson, G.Q.A., Grice, P.V., Soanes, L., Thompson, C. & Peach, W.J. (2012) Breeding ecology of Yellow Wagtails *Motacilla flava* in an arable landscape dominated by autumn-sown crops. *Bird Study* 59: 383–393.

Klein, A., Nagy, T., Csörgö, T. & Mátics, R. (2007) Exterior nest-boxes may negatively affect Barn Owl *Tyto alba* survival: an ecological trap. *Bird Conservation International* 17: 273–281. doi: 10.1017/S0959270907000792

Kluen, E., Nousiainen, R., & Lehikoinen, A. (2016) Breeding phenological response to spring weather conditions in common Finnish birds: resident species respond stronger than migratory species. Journal of Avian Biology. doi: 10.1111/jav.01110

Kostrzewa, A. & Kostrzewa, R. (1990) The relationship of spring and summer weather with density and breeding performance of the Buzzard *Buteo buteo*, Goshawk *Accipiter gentilis* and Kestrel *Falco tinnunculus*. *Ibis* 132: 550–559.

Kostrzewa, R. & Kostrzewa, A. (1991) Winter weather, spring and summer density, and subsequent breeding success of Eurasian Kestrels, Common Buzzards, and Northern Goshawks. *Auk* 108: 342–347.

Krebs, J.R., Wilson, J.D., Bradbury R.B. & Siriwardena, G.M. (1999) The second silent spring? *Nature* 400: 611–612.

Kristiansen, J.N. (1998) Nest site preference by greylag geese *Anser anser* in reedbeds of different harvest age. *Bird Study* 45: 337–343.

Kristensen, N. P., Johansson, J., Ripa, J., & Jonzén, N. (2015) Phenology of two interdependent traits in migratory birds in response to climate change. *Proceedings of the Royal Society B* 282: 20150288. doi: 10.1098/rspb.2015.0288
Kruk, M., Noordervliet, M.A.W. & ter Keurs, W.J. (1996) Hatching dates of waders and mowing dates in intensively exploited grassland areas in different years. *Biological Conservation* 77: 213–218.

Kubelka, V., Šálek, M., Tomkovich, P., Végvári, Z., Freckleton, R.P. & Székely, T. (2018) Global pattern of nest predation is disrupted by climate change in shorebirds. *Science* 362: 680–683. doi:10.1126/science.aat8695

Kubelka et al. (2019) Response to Comment on "Global pattern of nest predation is disrupted by climate change in shorebirds". Science 364: 6445.. doi: 10.1126/science.aaw9893

Kuijper, D.P.J., Oosterveld, E. & Wymenga, E. (2009) Decline and potential recovery of the European Grey Partridge (*Perdix perdix*) population – a review. *European Journal of Wildlife Research* 55: 455–463. Full text

Kusack,J.W., Mitchell, G.W., Evans, D.R., Cadman, M.D. &Hobson, K.A. (2020) Effects of agricultural intensification on nestling condition and number of young fledged of barn swallows (*Hirundo rustica*). *Science of the Total Environment* 709: 136195. doi:10.1016/scitotenv.2019.136195

Kyrkos, A. (1997) *Behavioural and demographic responses of yellowhammers to variation in agricultural practices*. DPhil thesis, University of Oxford.

Kyrkos, A., Wilson, J. & Fuller, R. (1998) Farmland habitat change and abundance of Yellowhammers *Emberiza citrinella*: an analysis of Common Birds Census data. *Bird Study* 45: 232–246.

Laidlaw, R.A., Smart, J., Smart, M.A. & Gill, J.A. (2015) The influence of landscape features on nest predation rates of grassland-breeding waders. Ibis 157: 700–712. doi: 10.1111/ibi.12293

Laidlaw, R.A., Smart, J., Smart, M.A. & Gill, J.A. (2017) Scenarios of habitat management options to reduce predator impacts on nesting waders. *Journal of Applied Ecology* 54: 1219–1229. doi: 10.1111/1365–2664.12838

Laidlaw, R.A., Smart, J., smart, M.A., Bodey, T.W., Coledale, T. & Gill, J.A. (2019) Foxes, voles and waders: drivers of predator activity in wet grassland landscapes. *Avian Conservation & Ecology* 14 (2): 4. doi:10.5751/ACE-01414-140204

Lampila, S., Orell, M., Belda, E. & Koivula, K. (2006) Importance of adult survival, local recruitment and immigration in a declining boreal forest passerine, the Willow Tit *Parus montanus*. *Oecologia* 148: 405–413.

Langston, R.H.W., Liley, D., Murison, G., Woodfield, E. & Clarke, R.T. (2007a) What effects do walkers and dogs have on the distribution and productivity of breeding European Nightjar *Caprimulgus europaeus*? *Ibis* 149, supplement 1: 27–36.

Langston, R.H.W., Wotton, S.R., Conway, G.J., Wright, L.J., Mallord, J.W., Currie, F.A., Drewitt, A.L., Grice, P.V., Hoccom, D.G. & Symes, N. (2007b) Nightjar *Caprimulgus europaeus* and Woodlark *Lullula arborea* – recovering species in Britain? *Ibis* 149: 250–260.

Lawson, B., Lachish, S., Colvile, K.M., Durrant, C., Peck, K.M., Toms, M.P., Sheldon, B.C. & Cunningham, A.A. (2012a) Emergence of a novel avian pox disease in British tit species. *PLoS ONE* 7(11): e40176. doi10.1371/journal.pone.0040176

Lawson, B., Robinson, R.A., Colvile, K.M., Peck, K.M., Chantrey, J., Pennycott, T.W., Simpson, V.R., Toms, M.P. & Cunningham, A.A. (2012b) The emergence and spread of finch trichomonosis in the British Isles. *Philosophical Transactions of the Royal Society B* 367: 2852–2863. doi:10.1098/rstb.2012.0130

Lawson, B., Robinson, R.A., Toms, M.P., Risely, K., MacDonald, S. & Cunningham, A.A. (2018) Health hazards to wild birds and risk factors associated with anthropogenic food provisioning. *Phil. Trans. R. Soc. B* 373:20170091. doi: 10.1098/rstb.2017.0091

Lebreton, J.-D., Burnham, K.P., Clobert, J. & Anderson, D.R. (1992) Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies. *Ecological Monographs* 62: 67–118. Full text

Leech, D. & Barimore, C. (2008) Is avian breeding success weathering the storms? *BTO News* 279: 19–20.

Leech, D. & Crick, H. (2005) Nest Record Scheme breeding trends – latest results. *BTO News* 261: 18–19.

Leech, D.I., Crick, H.Q.P. & Shawyer, C.R. (2005) *The BTO Barn Owl Monitoring Programme: fourth year 2003.* Research Report 411. BTO, Thetford.

Abstract (PDF, 362.61 KB)
Leech, D., Crick, H. & Shawyer, C. (2006a) Barn Owls and winter weather. *BTO News* 262: 8–9.

Leech, D., Barimore, C. & Crick, H. (2006b) NRS Concern List – five new species added. *BTO News* 267: 4–5.

Leech, D., Barimore, C. & Crick, H. (2007) Volunteer boom. *BTO News* 273: 18–19.

Le Gouar, P.J., Schekkerman, H., van der Jeugd, H.P., Boele, A., van Harxen, R., Fuchs, P., Stroeken, P. & van Noordwijk, A.J. (2011) Long-term trends in survival of a declining population: the case of the Little Owl (*Athene noctua*) in the Netherlands. *Oecologia* 166: 369–379.

Lehikoinen, A., Lehikoinen, E., Valkama, J., Väisänen, R.A. & Isomursu, M. (2013) Impacts of trichomonosis epidemics on Greenfinch *Chloris chloris* and Chaffinch *Fringilla coelebs* populations in Finland. *Ibis* 155: 357–366.

Lehikoinen, A., Green, M., Husby, M., Kålås, J.A. & Lindström, Å. (2014) Common montane birds are declining in northern Europe. *Journal of Avian Biology* 45: 3–14. doi: 10.1111/j.1600-048X.2013.00177.x

Lehikoinen, A., Rintala, J., Lammi, E. & Pöysä, H. (2016) Habitat-specific population trajectories in boreal waterbirds: alarming trends and bioindicators for wetlands. *Animal Conservation* 19: 88–95. doi: 10.1111/acv.12226

Le Louarn, M., Couillens, B., Deschamps-Cottin, M. & Clergeau, P. (2016) Interference competition between an invasive parakeet and native bird species at feeding sites. *Journal of Ethology* 34: 291–298. doi: 10.1007/s10164-016-0474-8

Lennon, R.J., Isaac, N.J.B., Shore, R.F., Peach. W.J., Dunn, J.C., Pereira, M.G., Arnold, K.E., Garthwaite, D. & Brown, C.D. 2019. Using long-term datasets to assess the impacts of dietary exposure to neonicotinoids on farmland bird populations in England. PLoS One 2019: 0223093. doi: 10.1371/journal.pone.0223093

Letty, J., Génot, J.-C. & Sarrazin, F. (2001) Analysis of population viability of Little Owl (*Athene noctua*) in the Northern Vosges natural park (north-eastern France). *Alauda* 69: 359–372.

Lever, C. (2013) *The Mandarin Duck*. T & AD Poyser, London.

Lewis, A.J.G., Amar, A., Cordi-Piec, D. & Thewlis, R.M. (2007) Factors influencing Willow Tit *Poecile montanus* site occupancy: a comparison of abandoned and occupied woods. *Ibis* 149 (suppl. 2): 205–213. doi: 10.1111/j.1474-919X.2007.00733.x

Lewis, A.J.G., Amar, A., Daniells, L., Charman, E.C., Grice, P. & Smith, K. (2009a) Factors influencing patch occupancy and within-patch habitat use in an apparently stable population of Willow Tits *Poecile montanus kleinschmidti* in Britain. *Bird Study* 56: 326–337.

Lewis, A.J.G., Amar, A., Charman, E.C. & Stewart, F.R.P. (2009b) The decline of the Willow Tit in Britain. *British Birds* 102: 386–393.

Liker, A. & Szekely, T. (1997) The impact of grazing and road use on hatching success of Lapwings (*Vanellus vanellus*). *Acta Zoologica Academiae Scientiarum Hungaricae* 43: 85–92.

Liley, D. & Clarke, R.T. (2003) The impact of urban development and human disturbance on the numbers of nightjar *Caprimulgus europaeus* on heathlands in Dorset, England. *Biological Conservation* 114: 219–230. doi: 10.1016/S0006-3207(03)00042-9

Liley, D. & Sutherland, W.J. (2007) Predicting the population consequences of human disturbance for Ringed Plovers *Charadrius hiaticula*: a game theory approach. *Ibis* 149, supplement 1: 82–94.

Little, B., Davison, M. & Jardine, D. (1995) Merlins *Falco columbarius* in Kielder Forest: influences of habitat on breeding performance. *Forest Ecology and Management* 79: 147–152. Abstract

Littlewood, N.A., Mason, T.H.E., Hughes, M., Jaques, R., Whittingham, M.J., Willis, S.G. (2019) The influence of different aspects of grouse moorland management on nontarget bird assemblages. *Ecology & Evolution* 9: 11089–11101. doi: 10.1002/ece3.5613

LMDP Partners (Langholm Moor Demonstration Project Partners (2019) *Managing moorland for birds of prey and Red Grouse: The final report of the Langholm Moor Demonstration Project Partners 2008-2017*. Langholm Moor Demonstration Project Partners. Full text

Lock, L. & Cook, K. (1998) The Little Egret in Britain: a successful colonist. *British Birds* 91: 273–280.

Lormée, H.,Barbraud, C., Peach, W. & Carboneras, C. (2019) Assessing the sustainability of harvest of the European Turtle-dove along the European western flyway. Bird Conservation International [early view]. doi: 10.1017/S0959270919000479

Lowe, A., Rogers, A.C. & Durrant, K.L. (2014) Effect of human disturbance on long-term habitat use and breeding success of the European Nightjar *Caprimulgus europaeus*. *Avian Conservation & Ecology* 9 (2), art 6. doi: 10.5751/ACE-00690-090206

Ludwig, S.C., Roos, S., Bubb, D. & Baines, D. (2017) Long-term trends in abundance and breeding success of red grouse and hen harriers in relation to changing management of a Scottish grouse moor. *Wildlife Biology* :wlb.00246. doi: 10.2981/wlb.00246

Ludwig, S.C. McCluskie, A., Keane, P., Barlow, C., Francksen, R.M. & Bubb, D. (2018a) Diversionary feeding and nestling diet of Hen Harriers *Circus cyaneus*. *Bird Study* 65: 431–443. doi: 10.1080/00063657.2018.1519524

Ludwig, S.C., Aebischer, N.J., Bubb, D. et al. (2018b) Survival of chicks and adults explains variation in population growth in a recovering red grouse *Lagopus lagopus scotica* population. *Wildlife Biology* wlb.00430 doi: 10.2981/wlb.00430

Ludwig, S.C., Roos, S., Baines, D. (2019) Responses of breeding waders to restoration of grouse management on a moor in South-West Scotland. *Journal of Ornithology* 160: 789–797.

Ludwig, S.C., Roos, S., Rollie, C.J. & Baines, D. (2020a) Long-term changes in the abundance and breeding success of raptors and ravens in periods of varying management of a Scottish grouse moor. *Avian Conservation & Ecology* 15:21. doi: 10.5751/ACE-01568-150121

Ludwig, S.C., Roos, S., & Baines, D. (2020b) Fluctuations in field vole abundance indirectly influence red grouse productivity via a shared predator guild. *Wildlife Biology*: wlb00642. doi: 10.2981/wlb.00642

Lusby, J., Corkery, I., McGuiness, S., Fernández-Bellon, D., Toal, L., Norriss, D., Breen, D., O'Donaill, A., Clarke, D., Irwin, S., Quinn, J.L. & O'Halloran, J. (2017) Breeding ecology and habitat selection of Merlin *Falco columbarius* in forested landscapes. *Bird Study* 64: 445–454. doi: 10.1080/00063657.2017.1408565

Macdonald, D.W., Tattersall, F.H., Service, K.M., Firbank, L.G. & Feber, R.E. (2007) Mammals, agri-environment schemes and set-aside – what are the putative benefits? *Mammal Review* 37: 259–277.

MacDonald, M.A. & Bolton, M. (2008a) Predation on wader nests in Europe. *Ibis* 150 (suppl 1): 54–73.

MacDonald, M.A. & Bolton, M. (2008b) Predation of Lapwing *Vanellus vanellus* nests on lowland wet grassland in England and Wales: effects of nest density, habitat and predator abundance. *Journal of Ornithology* 149: 555–563.

MacLeod, R., Clark, J. & Cresswell, W. (2008) The starvation–predation risk trade-off, body mass and population status in the Common Starling *Sturnus vulgaris*. *Ibis* 150 (suppl. 1): 199–208.

MacMillan, D.C. & Leader-Williams, N. (2008) When successful conservation breeds conflict: an economic perspective on wild goose management. *Bird Conservation International* 18 (Suppl S1): S200–S210. doi: 10.1017/S0959270908000282

MacMillan, D., Hanley, N. & Daw, M. (2004) Costs and benefits of wild goose conservation in Scotland. *Biological Conservation* 119: 475–485. doi: 10.1016/j.biocon.2004.01.008

Madden, C.F., Arroyo, B. & Amar, A. (2015) A review of the impacts of corvids on bird productivity and abundance. *Ibis* 157: 1–16. doi: 10.1111/ibi.12223

Madden, J.R., Hall, A. & Whiteside, M.A. (2018) Why do many pheasants in the UK die, and how can we best reduce their natural mortality? *European Journal of Wildlife Research*. doi: 10.1007/s10344-018-1199-5

Madders, M. (2000) Habitat selection and foraging success of Hen Harriers *Circus cyaneus* in west Scotland. *Bird Study* 47: 32–40.

Mainwaring, M.C. & Hartley, I.R. (2008) Covering nest boxes with wire mesh reduces great spotted woodpecker *Dendrocopos major* predation of blue tit *Cyanistes caeruleus* nestlings, Lancashire, England. *Conservation Evidence* 5: 45–46.

Mallord, J.W., Dolman, P.M., Brown, A.F. & Sutherland, W.J. (2007) Linking recreational disturbance to population size in a ground-nesting passerine. *Journal of Applied Ecology* 44: 185–195. doi: 10.1111/j.1365-2664.2006.01242.x

Mallord, J.W., Orsman, C.J., Cristinacce, A., Butcher, N., Stowe, T.J. & Charman, E.C. (2012a) Mortality of Wood Warbler *Phylloscopus sibilatrix* nests in Welsh oakwoods: predation rates and the identification of nest predators using miniature nest cameras, *Bird Study* 59: 286–295.

Mallord, J.W., Charman, E.C., Cristinacce, A. & Orsman, C.J. (2012b) Habitat associations of Wood Warblers *Phylloscopus sibilatrix* breeding in Welsh oakwoods. *Bird Study* 59: 403–415.

Mallord, J.W., Smith, K.W., Bellamy, P.E., Charman, E.C. & Gregory, R.D. (2016) Are changes in breeding habitat responsible for recent population changes of long-distance migrant birds? *Bird Study* 63: 250–261. doi: 10.1080/00063657.2016.1182467

Mallord, J.W., Orsman, C.J., Cristinacce, A., Stowe, T.J., Charman, E.C. & Gregory, R.D. (2017) Diet flexibility in a declining long-distance migrant may allow it to escape the consequences of phenological mismatch with its caterpillar food supply. *Ibis* 159: 76–90. doi: 10.1111/ibi.12437

Mallord, J.W., Orsman, C.J., Roberts, J.T., Boafo, K., Skeen, R.Q., Sheehan, D.K. & Vickery, J.A. (2018) Apparent resilience of a declining Afro-Palaearctic migrant to forest loss on the wintering grounds. *Ibis* 160: 805–815. doi: 10.1111/ibi.12572

Malm, L.E., Pearce-Higgins, J.W., Littlewood, N.A., Karley, A.J., Karaszewska, E., Jacques, R., Pakeman, R.J., Redpath, S.M. & Evans, D.M. (2020) Livestock grazing impacts components of the breeding productivity of a common upland insectivorous passerine: Results from a long-term experiment. Journal of Applied Ecology 57: 1514–1523. doi: 10.1111/1365-2664.13647

Malpas, L.R., Smart, J., Drewitt, A., Sharps, E. & Garbutt, A. (2013a) Continued declines of Redshank *Tringa totanus* breeding on saltmarsh in Great Britain: is there a solution to this conservation problem? *Bird Study* 60: 370–383. doi: 10.1080/00063657.2013.781112

Malpas, L.R., Kennerley, R.J., Hirons, G.J.M., Sheldon, R.D., Ausden, M., Gilbert, J.C. & Smart, J. (2013b) The use of predator-exclusion fencing as a management tool improves the breeding success of waders on lowland wet grassland. *Journal for Nature Conservation* 21: 37-47. doi: 10.1016/j.jnc.2012.09.002

Manly, B.F.J. (1991) *Randomisation and Monte Carlo Methods in Biology*. Chapman & Hall, London.

Marchant, J.H. (1983) *BTO Common Birds Census instructions*. BTO, Tring.

Full text (PDF, 1.90 MB)
Marchant, J.H. & Gregory, R.D. (1999) Numbers of nesting Rooks *Corvus frugilegus* in the United Kingdom in 1996. *Bird Study* 46: 258–273. Abstract

Marchant, J.H., Hudson, R., Carter, S.P. & Whittington, P.A. (1990) *Population Trends in British Breeding Birds* BTO, Tring.

Marchant, J.H., Freeman, S.N., Crick, H.Q.P. & Beaven, L.P. (2004) The BTO Heronries Census of England and Wales 1928–2000: new indices and a comparison of analytical methods. *Ibis* 146: 323–334. doi: 10.1111/j.1474-919X.2004.00272.x

Marquiss, M. (2007) Seasonal pattern in hawk predation on Common Bullfinches *Pyrrhula pyrrhula*: evidence of an interaction with habitat affecting food availability. *Bird Study* 54: 1–11.

Marquiss, M., Newton, I. & Ratcliffe, D.A. (1978) The decline of the Raven *Corvus corax* in relation to afforestation in southern Scotland and northern England. *Journal of Applied Ecology* 15: 129–144.

Martin, T.G., Arcese, P. & Scheerder, N. (2011) Browsing down our natural heritage: deer impacts on vegetation structure and songbird assemblages across an island archipelago. *Biological Conservation* 144: 459–469.

Martinez, J.A. & Zuberogoitia, I. (2004) Effects of habitat loss on perceived and actual abundance of the Little Owl *Athene noctua* in eastern Spain. *Ardeola* 51: 215–219.

Martinez, N., Jenni, L., Wyss, E. & Zbinden, N. (2010) Habitat structure versus food abundance: the importance of sparse vegetation for common redstart *Phoenicurus phoenicurus*. *Journal of Ornithology* 151: 297–307.

Martínez-Padilla, J., Redpath, S.M., Zeineddine, M. & Mougeot, F. (2014) Insights into population ecology from long-term studies of red grouse *Lagopus lagopus scoticus*. *Journal of Animal Ecology* 83: 85–98. doi: 10.1111/1365-2656.12098

Masoero, G., Tamietti, A., Boano, G. & Caprio, E. (2016) Apparent constant adult survival of a Sand Martin *Riparia riparia* population in relation to climatic variables. *Ardea* 104: 253–262. doi: 10.5253/arde.v104i3.a1

Mason, C. & Macdonald, S. (1999) Habitat use by Lapwings and Golden Plovers in a largely arable landscape. *Bird Study* 46: 89–99.

Mason, C. & Macdonald, S. (2000a) Influence of landscape and land-use on the distribution of breeding birds in farmland in eastern England. *Journal of Zoology* 251: 339–348.

Mason, C.F. & MacDonald, S.M. (2000b) Corn Bunting *Miliaria calandra* populations, landscape and land-use in an arable district of eastern England. *Bird Conservation International* 10: 169–186. doi: 10.1017/S0959270900000150

Mason, C.F. & Macdonald, S.M. (2006) Recent marked decline in Corn Bunting numbers in northeast Essex. *British Birds* 99: 206–214.

Mason, L.R., Smart, J & Drewitt, A.L. (2018) Tracking day and night provides insights into the relative importance of different wader chick predators. *Ibis* 160: 71–88. doi: 10.1111/ibi.12523

Mason, L.R., Feather, A., Godden, N., Vreugdenhil, C.C. & Smart, J. (2019) Are agri-environment schemes successful in delivering conservation grazing management on saltmarsh? *Journal of Applied Ecology* 56: 1597–1609. doi: 10.1111/1365-2664.13405

Mason, W.L. (2007) Changes in the management of British forests between 1945 and 2000 and possible future trends. *Ibis* 149: 41–52.

Massemin, S. & Zorn, T. (1998) Highway mortality of Barn Owls in northeastern France. *Journal of Raptor Research* 32: 229–232.

Massimino, D., Johnstone, A. & Pearce-Higgins, J.W. (2011) *Producing regional population estimates for upland waders*. BTO Research Report No. 586. BTO, Thetford.

Massimino, D., Johnston, A., Pearce-Higgins, J. & Baillie, S. (2013) *Maps of population density and trends*. www.bto.org/volunteer-surveys/bbs/latest-results/maps-population-density-and-trends

Massimino, D., Johnston, A., Gillings, S., Jiguet, F. & Pearce-Higgins, J.W. (2017) Projected reductions in climatic suitability for vulnerable British Birds. *Climatic Change*. doi: 10.1007/s10584-017-2081-2

Massimino, D., Beale, C.M., Suggitt, A.J., Crick,H.Q.P., MacGragor,N.A., Carroll, M.J., Maclean, I.M.D. & Pearce-Higgins, J.W. (2020) Can microclimate offer refuge to an upland bird species under climate change? *Landscape Ecology* [early view]. doi: 10.1007/s10980-020-01069-7

Matthysen, E. (1989) Nuthatch *Sitta europaea* demography, beech mast, and territoriality. *Ornis Scandinavica* 20: 278–282.

Mavor, R.A., Parsons, M., Heubeck, M., Pickerell, G. & Schmitt, S. (2003) *Seabirds numbers and breeding success in Britain and Ireland, 2002*. UK Nature Conservation no. 27. JNCC, Peterborough. Abstract/Full text

Mavor, R.A., Parsons, M., Heubeck, M. & Schmitt, S. (2004) *Seabird numbers and breeding success in Britain and Ireland, 2003*. UK Nature Conservation no. 28. JNCC, Peterborough. Abstract/Full text

Mavor, R.A., Parsons, M., Heubeck, M. & Schmitt, S. (2006) *Seabird numbers and breeding success in Britain and Ireland, 2005*. UK Nature Conservation no. 30. JNCC, Peterborough. Abstract/Full text

Mavor, R.A., Heubeck, M. Schmitt, S. & Parsons, M. (2008) *Seabird numbers and breeding success in Britain and Ireland, 2006*. UK Nature Conservation no. 31. JNCC, Peterborough. Abstract/Full text

Maxwell, J. (2002) Nest-site competition with Blue Tits and Great Tits as a possible cause of declines in Willow Tit numbers: observations in the Clyde area. *Glasgow Naturalist* 24: 47–50.

Maxwell, J. (2003) Scottish Willow Tits hanging on. *BTO News* 244: 24.

Mayfield, H. (1961) Nesting success calculated from exposure. *Wilson Bulletin* 73: 255–261.

Mayfield, H. (1975) Suggestions for calculating nest success. *Wilson Bulletin* 87: 456–466.

Maziarz, M., Grendelmeier, A., Wesolowski, T., Arlettaz, R., Broughton, R.K. & Pasinelli, G. (2019) Patterns of predator behaviour and Wood Warbler *Phylloscopus sibilatrix* nest survival in a primaeval forest. *Ibis* 161: 854–866. doi: 10.1111/ibi.12679

McCallum, H.M., Park, K.J., O'Brien, M.G., Gimona, A., Poggio, L. & Wilson, J.D. (2015) Soil pH and organic matter content add explanatory power to Northern Lapwing *Vanellus vanellus* distribution models and suggest soil amendment as a conservation measure on upland farmland. *Ibis* 157: 677–687. doi: 10.1111/ibi.12286

McCallum, H.M., Wilson, J.D., Beaumont, D., Sheldon, R., O'Brien, M.G. & Park, K.J. (2016) A role for liming as a conservation intervention? Earthworm abundance is associated with higher soil pH and foraging activity of a threatened shorebird in upland grasslands. *Agriculture, Ecosystems & Environment* 223: 182–189.

McGowan, P.C., Sullivan, J.D., Callahan, C.R., Schultz, W., Watt, J.L & Prosser, D.J. 2019. Promoting change in Common Tern (*Sterna hirundo*) nest site selection to minimise construction related disturbance. *Ecological Restoration* 37: 143–147.

McHugh, N.M., Prior, M., Leather, S.R. & Holland, J.M. (2016a) The diet of Eurasian Tree Sparrow *Passer montanus* nestlings in relation to agri-environment scheme habitats. *Bird Study* 63: 279–283. doi: 10.1080/00063657.2016.1182964

McHugh, N.M., Goodwin, C.E.D., Hughes, S., Leather, S.R. & Holland, J.M. (2016b) Agri-Environment Scheme Habitat Preferences of Yellowhammer Emberiza citrinella on English Farmland. Acta Ornithologica 51: 199–209. doi: 10.3161/00016454AO2016.51.2.006

McHugh, N.M., Prior, M., Grice, P.V., Leather, S.R. & Holland, J.M. (2017) Agri-environmental measures and the breeding ecology of a declining farmland bird. *Biological Conservation* 212: 230–239. doi: 10.1016/j.biocon.2017.06.023

McMahon, B.J., Johnasson, M.P., Piertney, S.B., Buckley, K. & Höglund, J. (2012) Genetic variation among endangered Irish red grouse (*lagopus lagopus hibernicus*)

populations: implications for conservation and management. *Conservation Genetics* 13: 639-647.

McNab, E., Summers, R., Harrison, G. & Park, K.J. (2019) How important are different non-native conifers in Britain to Common Crossbills *Loxia curvirostra curvirostra*? *Bird Study* 66: 64–72. doi: 10.1080/00063657.2019.1614143

McShea, W.J. & Rappole, J.H. (2000) Managing the abundance and diversity of breeding bird populations through manipulation of deer densities. *Conservation Biology* 14: 1161–1170.

Mearns, R. (1983) The status of the Raven in southern Scotland and Northumbria. *Scottish Birds* 12: 211–218.

Meek, W.R, Burman, P.J., Nowakowski, M., Sparks, T.H. & Burman, N.J. (2003) Barn owl release in lowland southern England – a twenty-one year study. *Biological Conservation* 109: 271–282.

Messenger, A. & Roome, M. (2007) The breeding population of the Hobby in Derbyshire. *British Birds* 100: 594–608.

Meyrier E, Jenni L, Bötsch Y, Strebel S, Erne B, Tablado Z. (2017) Happy to breed in the city? Urban food resources limit reproductive output in Western Jackdaws. *Ecology & Evolution* 7: 1363–1374. doi: 10.1002/ece3.2733

Mezquida, E.T., Svenning, J-C., Summers, R.W. & Benkman, C.W. (2018) Higher spring temperatures increase food scarcity and limit the current and future distributions of crossbills. *Diversity & Distributions* 24: 473–484. doi: 10.1111/ddi.12694

Michel, V. T., Naef-Daenzer, B., Keil, H., & Grüebler, M.U. (2017) Reproductive consequences of farmland heterogeneity in little owls (*Athene noctua*). *Oecologia* 183: 1019–1029. doi: 10.1007/s00442-017-3823-6

Miller, M.W., Leech, D.I., Pearce-Higgins, J.W. & Robinson, R.A. (2017) Multi-state, multi-stage modeling of nest-success suggests interaction between weather and land-use. *Ecology* 98: 175–186. doi: 10.1002/ecy.1629

Millon, A., Petty, S.J., Little, B., Giminez, O., Cornulier, T. & Lambin, X. (2014) Dampening prey cycle overrides the impact of climate change on predator population dynamics: a long-term demographic study on tawny owls. *Global Change Biology* 20: 1770–1781. doi: 10.1111/gcb.12546

Mills, L.J., Wilson, J.D., Lange, A., Moore, K., Henwood, B., Knipe, H., Chaput, D.L. & Tyler, C.R. (2020) Using molecular and crowd-sourcing methods to assess breeding ground diet of a migratory brood parasite of conservation concern. Journal of Avian Biology [early view]. doi: 10.1111/jav.02474

Milsom, T.P. (2005) Decline of Northern Lapwing *Vanellus vanellus* breeding on arable farmland in relation to loss of spring tillage. *Bird Study* 52: 297–306.

Milsom, T.P., Langton, S.D., Parkin, W.K., Peel, S., Bishop, J.D., Hart, J.D. & Moore, N.P. (2000) Habitat models of bird species' distribution: an aid to the management of coastal grazing marshes. *Journal of Applied Ecology* 37: 706–727.

Milsom, T.P., Hart, J.D., Parkin, W.K. & Peel, S. (2002) Management of coastal grazing marshes for breeding waders: the importance of surface topography and wetness. *Biological Conservation* 103: 199–207.

Mitchell, C., Patterson, D., Boyer, P., Cunningham, P., McDonald, R., Meek, E., Okill, J.D. & Symonds, F. (2000) The summer status and distribution of Greylag Geese in north and west Scotland. *Scottish Birds* 21: 69–77.

Mitchell, C., King, R. & Cook, T. (2002) Mallard *Anas platyrhynchos*. In *The Migration Atlas: movements of the birds of Britain and Ireland* (eds Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. & Baillie, S.R.), pp 193–195. T. & A.D. Poyser, London.

Mitchell, C., Griffin, L., Trinder, M., Newth, J. & Urquhart, C. (2011) The status and distribution of summering Greylag Geese *Anser anser* in Scotland, 2008–09. *Bird Study* 58: 338–348.

Mitchell, C., Hearn, R. & Stroud, D. (2012) The merging of populations of Greylag Geese breeding in Britain. *British Birds* 105: 498–505.

Mitchell, L.J., Kohler, T., White, P.C.L. & Arnold, K.E. (2020) High interindividual variability in habitat selection and functional habitat relationships in European Nightjars over a period of habitat change. *Ecology & Evolution* 10: 5932–5945. doi: 10.1002/ece3.6331

Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. (2004) *Seabird Populations of Britain and Ireland*. T. & A.D. Poyser, London. Summary

Molenaar. F.M., Jaffe, J.E., Carter, I., Barnett, E.A., Shore, R.F., Rowcliffe, J.M., Sainsbury, A.W. (2017) Poisoning of reintroduced red kites (*Milvus Milvus*) in England. *European Journal of Wildlife Research* 63: 94.

Møller, A.P. (1984). Geographical trends in breeding parameters of swallows *Hirundo rustica* and house martins *Delichon urbica*. *Ornis Scandinavica* 15: 43-54.

Møller, A.P. (2001) The effect of dairy farming on barn swallow *Hirundo rustica* abundance, distribution and reproduction. *Journal of Applied Ecology* 38: 378–389. doi: 10.1046/j.1365-2664.2001.00593.x

Møller, A.P. (2019) Parallel declines in abundance of insecs and insectivorous birds in Denmark over 22 years. *Ecology and Evolution* 9: 6581–6587. doi:10.1002/ece3.5236

Møller, A.P., Saino, N., Adamík, P., Ambrosini, R., Antonov, A., Campobello, D., Stokke, B.G., Fossøy, F., Lehikoinen, E., Martin-Vivaldi, M., Moksnes, A., Moskat, C., Røskaft, E., Rubolini, D., Schulze-Hagen, K., Soler, M. & Shykoff, J.A. (2011) Rapid change in host use of the Common Cuckoo *Cuculus canorus* linked to climate change. *Proceedings of the Royal Society B Biological Sciences* 278: 733–738.

Møller, A.P., Thorup, O. & Laursen, K. (2018) Predation and nutrients drive population declines in breeding waders. *Ecological Applications* 28: 1292–1301. doi:10.1002/eap.1729

Monaghan, P., Uttley, J.D., Burns, M.D., Thaine, C. & Blackwood, J. (1989) The relationship between food supply, reproductive effort and breeding success in Arctic

Terns *Sterna paradisaea*. *Journal of Animal Ecology* 58: 261–274.

Monaghan, P., Uttley, J.D. & Burns, M.D. (1992) Effect of changes in food availability on reproductive effort in Arctic terns *Sterna paradisaea*. *Ardea* 80: 71–81.

Mondain-Monval, T.O., Briggs, K., Wilson, J. & Sharp, S.P. (2020) Climatic conditions during migration affect population size and arrival dates in an Afro-Palaearctic migrant. *Ibis* 162: 572–580. doi:10.1111/ibi.12801

Moorcroft, D. & Wilson, J.D. (2000) The ecology of Linnets *Carduelis cannabina* on lowland farmland. In *Ecology and Conservation of Lowland Farmland Birds* (eds Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A.), pp 173–181. British Ornithologists' Union, Tring.

Moorcroft, D., Bradbury, R.B. & Wilson, J.D. (1997) The diet of nestling Linnets *Carduelis cannabina* before and after agricultural intensification. *1997 Brighton Crop Protection Conference – Weeds, Conference Proceedings* 3: 923–928. British Crop Protection Council, Farnham.

Moorcroft, D., Whittingham, M.J., Bradbury, R.B. & Wilson, J.D. (2002) The selection of stubble fields by wintering granivorous birds reflects vegetation cover and food abundance. *Journal of Applied Ecology* 39: 535–547.

Moorcroft, D., Wilson, J.D. & Bradbury, R.B. (2006) The diet of nestling Linnets *Carduelis cannabina* on lowland farmland before and after agricultural intensification. *Bird Study* 53: 156–162.

Morris, A.J. & Gilroy, J.J. (2008) Close to the edge: predation risks for two declining farmland passerines. *Ibis* 150: 168–177.

Morris, A., Burges, D., Fuller, R.J., Evans, A.D. & Smith, K.W. (1994) The status and distribution of Nightjars *Caprimulgus europaeus* in Britain in 1992. *Bird Study* 41: 181–191.

Morris, A., Wilson, J., Whittingham, M. & Bradbury, R. (2005) Indirect effects of pesticides on breeding Yellowhammer (*Emberiza citrinella*). *Agriculture, Ecosystems & Environment* 106: 1–16.

Morrison, C.A., Robinson, R.A., Clark, J.A. & Gill, J.A. (2010) Spatial and temporal variation in population trends in a long-distance migratory bird. *Diversity & Distributions* 16: 620–627.

Morrison, C.A., Robinson, R.A., Clark, J.A., Marca, A.D., Newton, J. & Gill, J.A. (2013a) Using stable isotopes to link breeding population trends to winter ecology in Willow Warblers, *Phylloscopus trochilus*. *Bird Study* 60: 211–220.

Morrison, C.A, Robinson, R.A., Clark, J.A., Risely, K. & Gill, J.A. (2013b) Recent population declines in Afro-Palaearctic migratory birds: the influence of breeding and non-breeding seasons. *Diversity & Distributions* 19: 1051–1058. doi:10.1111/ddi.12084

Morrison, C.A., Robinson, R.A., Leech, D.I., Dadam, D. & Toms, M. (2014) Using citizen science to investigate the role of productivity in House Sparrow *Passer domesticus* population trends. *Bird Study* 61: 91–100. doi:10.1080/00063657.2013.874975

Morrison, C.A., Robinson, R.A., Clark, J.A., Leech, D.I. & Gill, J.A. (2015) Season-long consequences of shifts in timing of breeding for productivity in Willow Warblers, *Phylloscopus trochilus*. *Bird Study* 62: 161–169.

Morrison. C.A., Robinson, R.A. & Pearce-Higgins, J.W. (2016a) Winter wren populations show adaptation to local climate. *Royal Society Open Science* 3:160250. doi: 10.1098/rsos.160250

Morrison, C.A., Robinson, R.A., Clark, J.A. & Gill, J.A. (2016b) Causes and consequences of spatial variation in sex ratios in a declining bird species. *Journal of Animal Ecology* 85: 1298–1306. doi:10.1111/1365-2656.12556

Morrison, C. A., Robinson, R. A., Butler, S. J., Clark, J. A., & Gill, J. A. (2016c) Demographic drivers of decline and recovery in an Afro-Palaearctic migratory bird population. *Proceedings of the Royal Society B* 283 (1842): 20161387. doi:10.1098/rspb.2016.1387

Moss, D. & Moss, G.M. (1993) Breeding biology of the Little Grebe *Tachybaptus ruficollis* in Britain and Ireland. *Bird Study* 40: 107–114.

Mountford, M.D. (1982) Estimation of population fluctuations with application to the Common Birds Census. *Applied Statistics* 31: 135–143.

Mountford, M.D. (1985) An index of population change with an application to the Common Birds Census. *In* Morgan, B.J.T. & North, P.M. (eds) *Statistics in Ornithology*. 121–132. Springer-Verlag, Berlin.

Müller, M., Spaar, R., Schifferli, L. & Jenni, L. (2005) Effects of changes in farming of subalpine meadows on a grassland bird, the Whinchat (*Saxicola rubetra*). *Journal of Ornithology* 146: 14–23.

Murgatroyd, M., Redpath, S.M., Murphy, S.G., Douglas, D.J.T., Saunders, R. & Amar, A. (2019) Patterns of satellite tagged hen harrier disappearances suggest widespread illegal killing on British grouse moors. Nature Communications 10: 1094. doi: 10.1038/s41467-019009044-w

Murray, C., Minderman, J., Allison, J. & Calladine, J. (2016) Vegetation structure influences foraging decisions in a declining grassland bird: the importance of fine-scale habitat and grazing regime. *Bird Study* 63: 223–232. doi:10.1080/00063657.2016.1180342

Musgrove, A.J. (2002) The non-breeding status of the Little Egret in Britain. *British Birds* 95: 62–80.

Musgrove, A.J., Austin, G.E., Hearn, R.D., Holt, C.A., Stroud, D.A. & Wotton, S.R. (2011) Overwinter population estimates of British waterbirds. *British Birds* 104: 364–397.

Musgrove, A.J., Aebischer, N.J., Eaton, M.A., Hearn, R.D., Newson, S.E., Noble, D.G., Parsons, M., Risely, K. & Stroud, D.A. (2013) Population estimates of birds in Great Britain and the United Kingdom. *British Birds* 106: 64–100.

Mustin, K., Amar, A. & Redpath, S.M. (2014) Colonization and extinction dynamics of a declining migratory bird are influenced by climate and habitat degradation. *Ibis*

156: 788–798. doi: 10.1111/ibi.12173

Nelson, S.H., Court, I., Vickery, J.A., Watts, P.N. & Bradbury, R.B. (2003) The status and ecology of the Yellow Wagtail in Britain *British Wildlife* 14: 270–274.

Newbold, S. & Eadie, J.M. (2004) Using Species-Habitat models to target conservation: a case study with breeding Mallards. *Ecological Applications* 14: 1384–1393. doi: 10.1890/03-5193

Newson, S.E., Woodburn, R.J.W., Noble, D.G., Baillie, S.R. & Gregory, R.D. (2005) Evaluating the Breeding Bird Survey for producing national population size and density estimates. *Bird Study* 52: 42–54. doi: 10.1080/00063650509461373

Newson, S.E., Ekins, G.R., Marchant, J.H., Rehfisch, M.M. & Sellers, R.M. (2006) *The status of inland and coastal breeding Great Cormorants* Phalacrocorax carbo *in England*. Research Report 433. BTO, Thetford.

Abstract (PDF, 405.10 KB)
Newson, S.E., Marchant, J.H., Ekins, G.R. & Sellers, R.M. (2007) The status of inland-breeding Great Cormorants in England. *British Birds* 100: 289–299.

Newson, S.E., Evans, K.L., Noble, D.G., Greenwood, J.J.D. & Gaston, K.J. (2008) Use of distance sampling to improve estimates of national population sizes for common and widespread breeding birds in the UK. *Journal of Applied Ecology* 45: 1330–1338. Full text

Newson, S.E., Ockendon, N., Joys, A., Noble, D.G. & Baillie, S.R. (2009) Comparison of habitat-specific trends in the abundance of breeding birds in the UK *Bird Study* 56: 233–243.

Newson, S.E., Leech D.I., Hewson, C.M., Crick, H.Q.P. & Grice, P.V. (2010) Potential impact of grey squirrels *Sciurus carolinensis* on woodland bird populations in England. *Journal of Ornithology* 151: 211–218.

Newson, S.E., Rexstad, E.A., Baillie, S.R., Buckland, S.T. & Aebischer, N.J. (2010b) Population change of avian predators and grey squirrels in England: is there evidence for an impact on avian prey populations? *Journal of Applied Ecology* 47: 244–252.

Newson, S.E., Johnston, A., Parrott, D. & Leech, D.I. (2011) Evaluating the population-level impact of an invasive species, Ring-necked Parakeet *Psittacula krameri*, on native avifauna. *Ibis* 153: 509–516. Abstract

Newson, S.E., Johnston, A., Renwick, A.R., Baillie, S.R. & Fuller, R.J. (2012) Modelling large-scale relationships between changes in woodland deer and bird populations. *Journal of Applied Ecology* 49: 278–286.

Newson, S.E., Marchant, J.H., Sellers, R.M., Ekins, G.R., Hearn, R.D. & Burton, N.H.K. (2013) Colonisation and range expansion of inland-breeding Cormorants in England. *British Birds* 106: 737–743.

Newson, S.E., Moran, N.J., Musgrove, A.J., Pearce-Higgins, J.W., Gillings, S., Atkinson, P.W., Miller, R., Grantham, M.J. & Baillie, S.R. (2016) Long-term changes in the migration phenology of UK breeding birds detected by large-scale citizen science recording schemes. *Ibis* 158: 481–495.

Newton, I. (1986) *The Sparrowhawk*. T. & A.D. Poyser, Calton.

Newton, I. (1988) A key factor analysis of a sparrowhawk population. *Oecologia* 76: 588–596.

Newton, I. (2004) The recent declines of farmland bird populations in Britain: an appraisal of causal factors and conservation actions *Ibis* 146: 579–600.

Newton, I. (2006) Movement patterns of Common Crossbills *Loxia curvirostra* in Europe. *Ibis* 148: 782–788.

Newton, I. (2013) Organochlorine pesticides and birds. *British Birds* 106: 189–205.

Newton, I. & Marquiss, M. (1986) Population regulation in Sparrowhawks. *Journal of Animal Ecology* 55: 463–480.

Newton, I. & Wyllie, I. (1992a) Effects of new rodenticides on owls. In *The ecology and conservation of European Owls* (eds Galbraith, C.A., Taylor, I.R., Percival, S. & Davies, S.M.), pp 49–54. UK Nature Conservation series 5. JNCC, Peterborough.

Newton, I. & Wyllie, I. (1992b) Recovery of a Sparrowhawk population in relation to declining pesticide contamination *Journal of Applied Ecology* 29: 476–484.

Newton, I., Wyllie, I. & Asher, A. (1991) Mortality causes in British Barn Owls *Tyto alba*, with a discussion of aldrin–dieldrin poisoning. *Ibis* 133: 162–169.

Newton, I., Wyllie, I. & Dale, L. (1999) Trends in the numbers and mortality patterns of sparrowhawks (*Accipiter nisus*) and kestrels (*Falco tinnunculus*) in Britain, as revealed by carcass analyses. *Journal of Zoology* 248: 139–147.

Nilsson, A.L.K., Knudsen, E., Jerstad, K., Røstad, O.W., Walseng, B., Slagsvold, T. & Stenseth, N.C. (2011) Climate effects on population fluctuations of the white-throated dipper *Cinclus cinclus*. *Journal of Animal Ecology* 80: 235–243.

Nilsson, S.G. (1982) Seasonal variation in the survival rate of adult Nuthatches *Sitta europaea* in Sweden. *Ibis* 124: 96–100.

Nilsson, S.G. (1987) Limitation and regulation of population density in the Nuthatch *Sitta europaea* (Aves) breeding in natural cavities. *Journal of Animal Ecology* 56: 921–937.

Nilsson, S.G., Olsson, O., Svensson, S. & Wiktander, U. (1992) Population trends and fluctuations in Swedish woodpeckers. *Ornis Svecica* 2: 13–21.

Nordberg, K & Salmi, P. 2019. Addressing the gap between participatory ideals and the reality of environmental management: the case of the coromorant population in Finland. *Environmental Policy & Governance* 29: 251–261.

Norman, D. & Peach, W.J. (2013) Density-dependent survival and recruitment in a long-distance Palaearctic migrant, the Sand Martin *Riparia riparia*. *Ibis* 155: 284–296.

Norris, K., Bannister, R.C.A. & Walker, P.W. (1998a) Changes in the number of Oystercatchers *Haematopus ostralegus* wintering in the Burry Inlet in relation to the biomass of cockles Cerastoderma edule and its commercial exploitation. *Journal of Applied Ecology* 35: 75–85. doi: 10.1046/j.1365-2664.1998.00279.x

Norris, K., Brindley, E., Cook, T., Babbs, S., Forster-Brown, C. & Yaxley, R. (1998b) Is the density of Redshank *Tringa totanus* nesting on saltmarshes in Great Britain declining due to changes in grazing management? *Journal of Applied Ecology* 35: 621–634. doi: 10.1046/j.1365-2664.1998.355339.x

North East Scotland Raptor Study Group (2015) Peregrines in North-east Scotland in 2014 – further decline in the uplands. *Scottish Birds* 35, 10–14.

O'Brien, M. (2004) Estimating the number of farmland waders breeding in the United Kingdom. *Breeding Waders in Europe 2000. International Wader Studies* 14 (2006): 135–139.

O'Brien, M. & Wilson, J.D. (2011) Population changes of breeding waders on farmland in relation to agri-environment management. *Bird Study* 58: 399–408.

O'Hare, M.T., Stillman, R.A., McDonnell, J. & Wood, L.R. (2007) Effects of mute swan grazing on a keystone macrophyte. *Freshwater Biology* 52: 2463–2475. doi: 10.1111/j.1365-2427.2007.01841.x

Ockendon, N., Hewson, C.M., Johnston, A. & Atkinson, P.W. (2012) Declines in British-breeding populations of Afro-Palaearctic migrant birds are linked to bioclimatic wintering zone in Africa, possibly via constraints on arrival time advancement. *Bird Study* 59: 111–125. doi: 10.1080/00063657.2011.645798

Ockendon, N., Leech, D. & Pearce-Higgins, J.W. (2013) Climatic effects on breeding grounds are more important drivers of breeding phenology in migrant birds than carry-over effects from wintering grounds. *Biology Letters* 9. doi: 10.1098/rsbl.2013.0669

Ockendon, N., Johnston, A. & Baillie, S. (2014) Rainfall on wintering grounds affects population change in many species of Afro-Palaearctic migrants. *Journal of Ornithology* 155: 905–917. doi 10.1007/s10336-014-1073-5

O'Connor, R.J. & Marchant, J.H. (1981) *A field validation of some Common Birds Census techniques.* Research Report 4. BTO, Tring.

O'Connor, R.J. & Mead, C.J. (1984) The Stock Dove in Britain, 1930–1980. *British Birds* 77: 181–201.

O'Connor, R.J. & Shrubb, M. (1986) *Farming and Birds*. Cambridge University Press, Cambridge.

Orell, M. (1989) Population fluctuations and survival of Great Tits *Parus major* dependent on food supplied by man in winter. *Ibis* 131: 112–127.

Ormerod, S.J. & Tyler, S.J. (1987a) Dippers *Cinclus cinclus* and Grey Wagtail *Motacilla cinerea* as indicators of stream acidity in upland Wales. In *The Value of Birds* (eds Diamond, A.W. & Filion, F.L.), pp 191–208. ICBP Technical Publication 6. International Council for Bird Preservation, Cambridge.

Ormerod, S.J. & Tyler, S.J. (1987b) Aspects of the breeding ecology of Welsh Grey Wagtail *Motacilla cinerea*. *Bird Study* 34: 43–51.

Ormerod, S.J. & Tyler, S.J. (1989) Long-term change in the suitability of Welsh streams for Dippers *Cinclus cinclus* as a result of acidification and recovery: a modelling study. *Environmental Pollution* 62: 171–182.

Ormerod, S.J. & Tyler, S.J. (1990) Environmental pollutants in the eggs of Welsh Dippers *Cinclus cinclus*: a potential monitor of organochlorine and mercury contamination in upland rivers. *Bird Study* 37: 171–176.

Ormerod, S.J. & Tyler, S.J. (1991) The influence of stream acidification and riparian land use on the feeding ecology of Grey Wagtails *Motacilla cinerea* in Wales. *Ibis* 133: 53–61.

Ormerod, S.J. & Tyler, S.J. (1992) Patterns of contamination by organochlorines and mercury in the eggs of two river passerines in Britain and Ireland with reference to individual PCB congeners. *Environmental Pollution* 76: 233–243.

Ormerod, S.J., O'Halloran, J., Gribbin, S.D. & Tyler, S.J. (1991) The ecology of Dippers *Cinclus cinclus* in relation to stream acidity in upland Wales: breeding performance, calcium physiology and nestling growth. *Journal of Applied Ecology* 28: 419–433.

Orros, M.E. & Fellowes, M.D.E. (2014) Supplementary feeding of the reintroduced Red Kite *Milvus milvus* in UK gardens. *Bird Study* 61: 260–263.

Orros, M.E. & Fellowes, M.D.E. (2015) Widespread supplementary feeding in domestic gardens explains the return of reintroduced Red Kites *Milvus milvus* to an urban area. *Ibis* 157: 230–238. doi: 10.1111/ibi.12237

Owen, M., Atkinson-Willes, G.L. & Salmon, D.G. (1986) *Wildfowl in Great Britain.* Cambridge University Press, Cambridge.

PACEC (2006) *The Economic and Environmental Impact of Sporting Shooting.* Public and Corporate Economic Consultants, Cambridge. Full text

Panek, M. (2005) Demography of Grey Partridges *Perdix perdix* in Poland in the years 1991–2004: reasons of population decline. *European Journal of Wildlife Research* 51: 14–18.

Panek, M. & Hušek, J. (2014) The effect of oilseed rape occurrence on main prey abundance and breeding success of the Common Buzzard *Buteo buteo*. *Bird Study* 61: 457–464. doi:10.1080/00063657.2014.969192

Pannekoek, J. & van Strien, A. (1996) *TRIM (TRends and Indices for Monitoring data)* Research paper 9634. Statistics Netherlands, Voorburg.

Paquet, M., Arlt, D., Low, M., Forslund, P. & Part, T. (2019) Quantifying the links between land use and population growth rate in a declining Swedish bird. *Ecology & Evolution* 9: 868–879. doi: 10.1002/ece3.4766

Parkin, D.T., Collinson, M., Helbig, A.J., Knox, A.G. & Sangster, G. (2003) The taxonomic status of Carrion and Hooded Crows. *British Birds* 96: 274–290.

Parr, R. (1993) Nest predation and numbers of golden plovers *Pluvialis apricaria* and other moorland waders. *Bird Study* 40: 223–231.

Parr, S.J. (1994) Changes in the population size and nest sites of Merlins *Falco columbarius* in Wales between 1970 and 1991. *Bird Study* 41: 42–47.

Parry, W. & Broughton, R.K. (2019) Nesting behaviour and breeding success of Willow Tits *Poecile montanus* in north-west England. Ringing & Migration 33: 75–85. doi: 10.1080/03078698.2018.1631610

Parslow, J.L.F. (1973) *Breeding Birds of Britain and Ireland.* T. & A.D. Poyser, Berkhamsted.

Partridge, J.K. & Smith, K.W. (1992) Breeding wader populations in Northern Ireland, 1985–87. *Irish Birds* 4: 497–518.

Pasinelli, G. & Schlegg, K. (2006) Fragmentation within and between wetland reserves: the importance of spatial scales for nest predation in reed buntings *Ecography* 29: 721–732. doi: 10.1111/j.2006.0906-7590.04728.x

Payevsky, V. (2006) Mechanisms of population dynamics in trans-Saharan bird migrants: a review. *Zoologichesky Zhurnal* 85: 368–381.

Peach, W.J. (1993) Combining mark recapture data sets for small passerines. In *Marked Individuals in the Study of Bird Populations* (eds J.-D. Lebreton & P.M. North), pp. 107–122. Birkhauser Verlag, Basel, Switzerland.

Peach, W.J. & Baillie, S.R. (1994) Implementation of the Mountford indexing method for the Common Birds Census. *In* Hagemeijer, W. & Verstrael, T. (eds.) *Bird Numbers 1992.* Distribution, Monitoring and Ecological Aspects: 653–662. Proc. 12th Int. Conf. International Bird Census Council and European Ornithological Atlas Committee. SOVON, Beek-Ubbergen.

Peach, W.J., Baillie, S.R. & Underhill, L. (1991) Survival of British Sedge Warblers *Acrocephalus schoenobaenus* in relation to west African rainfall. *Ibis* 133: 300–305.

Peach, W.J., Crick, H.Q.P. & Marchant, J.H. (1995a) The demography of the decline in the British Willow Warbler population. *Journal of Applied Statistics* 22: 905–922.

Peach, W.J., du Feu, C. & McMeeking, J. (1995b) Site tenacity and survival rates of Wrens *Troglodytes troglodytes* and Treecreepers *Certhia familiaris* in a Nottinghamshire wood. *Ibis* 137: 497–507.

Peach, W.J., Buckland, S.T. & Baillie, S.R. (1996) The use of constant effort mist-netting to measure between-year changes in the abundance and productivity of common passerines. *Bird Study* 43: 142–156.

Peach, W.J., Baillie, S.R. & Balmer, D.E. (1998) Long-term changes in the abundance of passerines in Britain and Ireland as measured by constant effort mist-netting. *Bird Study* 45: 257–275.

Peach, W.J., Siriwardena, G.M. & Gregory, R.D. (1999) Long-term changes in over-winter survival rates explain the decline of Reed Buntings *Emberiza schoeniclus* in Britain. *Journal of Applied Ecology* 36: 798–811. Abstract

Peach, W.J., Robinson, R.A. & Murray, K.A. (2004) Demographic and environmental causes of the decline of rural Song Thrushes *Turdus philomelos* in lowland Britain. *Ibis* 146 (Suppl. 2): 50–59. doi: 10.1111/j.1474-919X.2004.00362.x

Peach, W.J., Vincent, K.E., Fowler, J.A. & Grice, P.V. (2008) Reproductive success of house sparrows along an urban gradient. *Animal Conservation* 11: 493–503. doi 10.1111/j.1469-1795.2008.00209.x

Peach, W.J., Sheehan, D.K. & Kirby, W.B. (2014) Supplementary feeding of mealworms enhances reproductive success in garden nesting House Sparrows *Passer domesticus. Bird Study* 61: 378–385. doi: 10.1080/00063657.2014.918577

Peach, W.J., Mallord, J.W., Ockendon, N., Orsman, C.J. & Haines, W.G. (2015) Invertebrate prey availability limits reproductive success but not breeding population size in suburban House Sparrows *Passer domesticus. Ibis* 157: 601–613. doi: 10.1111/ibi.12264

Peach, W.J., Mallord, J.W., Ockendon, N., Orsman, C.J. & Haines, W.G. (2018) Depleted suburban House Sparrow Passer domesticus population not limited by food availablity doi: 10.1007/s11252-018-0784-4

Pearce-Higgins, J.W. (2011) Modelling conservation management options for a southern range-margin population of Golden Plover *Pluvialis apricaria* vulnerable to climate change. *Ibis* 153: 345–356. doi: 10.1111/j.1474-919X.2011.01108.x

Pearce-Higgins, J.W. & Crick, H.Q.P. (2019) One-third of English breeding bird species show evidence of population responses to climatic variables over 50 years *Bird Study* 66: 159–172. doi: 10.1080/00063657.2019.1630360

Pearce-Higgins, J.W. & Grant, M.C. (2006) Relationships between bird abundance and the composition and structure of moorland vegetation. *Bird Study* 53: 112–125.

Pearce-Higgins, J.W. & Yalden, D.W. (2004) Habitat selection, diet, arthropod availability and growth of a moorland wader: the ecology of European Golden Plover *Pluvialis apricaria* chicks. *Ibis* 146: 335–346. doi: 10.1111/j.1474-919X.2004.00278.x

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

Pearce-Higgins, J.W., Finney, S.K. & Yalden, D.W. (2007) Testing the effects of recreational disturbance on two upland breeding waders. *Ibis* 149: 45–55. doi: 10.1111/1474-919X.2007.00644.x

Pearce-Higgins, J.W., Dennis, P., Whittingham, M.J. & Yalden, D.W. (2010) Impacts of climate on prey abundance account for fluctuations in a population of a northern wader at the southern edge of its range. *Global Change Biology* 16: 12–23. doi: 10.1111/j.1365-2486.2009.01883.x

Pearce-Higgins, J. W., Eglington, S. M., Martay, B., & Chamberlain, D. E. (2015) Drivers of climate change impacts on bird communities. *Journal of Animal Ecology* 84(4): 943–954.

Pearce-Higgins, J.W., Brown, D.J., Doulas, D.J.T., Alves, J.A., Bellio, M, Bocher, P., Buchanan, G.M., Clay, R.P., Conklin, J., Crockford, N., Dann, P., Elts, J., Friis, C.,

Fuller, R.A., Gill, J.A., Gosbell, K., Johnson, J.A., Marquez-Ferrando, R., Masero, J.A., Melville, D.S., Millington, S., Minton, C., Mundkur, T., Nol, E., Pehlak, H., Piersma, T., Robin, F., Rogers, D.I., Ruthrauff, D.R., Senner, N.R., Shah, J.N., Sjeldon, R.D., Soloviev, S.A., Tomkovich, P.S. & Verkuil, Y.I. (2017) A global threats overview for Numeniini populations: synthesising expert knowledge for a group of declining migratory birds. *Bird Conservation International* 27: 6–34. doi: 10.1017/S0959270916000678

PECBMS (2007) *The State of Europe's Common Birds 2007.* CSO/RSPB, Prague. Full text

PECBMS (2009) *The State of Europe's Common Birds 2008.* CSO/RSPB, Prague. Full text

PECBMS (2010) *Trends of common birds in Europe, 2010 update.* European Bird Census Council, Prague. (www.ebcc.info/index.php?ID=387)

PECBMS (2011a) *Population Trends of Common European Breeding Birds 2011.* CSO, Prague. www.ebcc.info/index.php?ID=469 (leaflet), www.ebcc.info/index.php?ID=457 (full report, including graphs and methods)

PECBMS (2011b) European wild bird indicators, 2011 update. www.ebcc.info/index.php?ID=459

PECBMS (2012a) *Population trends of common European breeding birds 2012.* CSO, Prague. Leaflet, full text (including graphs and methods)

PECBMS (2012b) *European wild bird indicators, 2012 update.* Full text

PECBMS (2020a) *Trends of common birds in Europe, 2020 update.* EBCC, Prague. Full text

PECBMS (2020b) *European wild bird indicators, 2018 update.* Full text

Peck, H.L., Pringle, H.E., Marshall, H.H., Owens, I.P.F. & Lord, A M. (2014) Experimental evidence of impacts of an invasive parakeet on foraging behavior of native birds. *Behavioral Ecology* 25: 582–590. doi: 10.1093/beheco/aru025

Percival, S.M. (1990) *Population trends in British Barn Owls,* Tyto alba*, and Tawny Owls,* Strix aluco*, in relation to environmental change.* Research Report 57. BTO, Tring.

Perdeck, A.C., Visser, M.E. & Van Balen, J.H. (2000) Great Tit *Parus major* survival and the beech-crop cycle. *Ardea* 88: 99–108.

Perkins, A., Whittingham, M., Bradbury, R., Wilson, J., Morris, A. & Barnett, P. (2000) Habitat characteristics affecting use of lowland agricultural grassland by birds in winter. *Biological Conservation* 95: 279–294.

Perkins, A.J., Maggs, H.E., Wilson, J.D., Watson, A. & Smout, C. (2008) Targeted management intervention reduces rate of population decline of Corn Buntings *Emberiza calandra* in eastern Scotland. *Bird Study* 55: 52–58.

Perkins, A.J., Maggs, H.E., Watson, A. & Wilson, J.D. (2011) Adaptive management and targeting of agri-environment schemes does benefit biodiversity: a case study of the Corn Bunting *Emberiza calandra*. *Journal of Applied Ecology* 48: 514–522.

Perkins, A.J., Watson, A., Maggs, H.E. & Wilson, J.D. (2012) Conservation insights from changing associations between habitat, territory distribution and mating system of Corn Buntings *Emberiza calandra* over a 20-year population decline. *Ibis* 154: 601–615. doi: 10.1111/j.1474-919X.2012.01246.x

Perkins, A. J., Maggs, H. E., Wilson, J. D., & Watson, A. (2013) Delayed mowing increases corn bunting *Emberiza calandra* nest success in an agri-environment scheme trial. *Agriculture, Ecosystems & Environment* 181: 80–89. doi: 10.1016/j.agee.2013.09.010

Perkins, A.J., Maggs, H.E. & Wilson, J.D. (2015) Crop sward structure explains seasonal variation in nest site selection and informs agri-environment scheme design for a species of high conservation concern: the Corn Bunting *Emberiza calandra*. *Bird Study* 62: 474–485. doi: 10.1080/00063657.2015.1076763

Perkins, A.J., Maggs, H., Stephan, Y., Corrigan, A. & Wilson, J.D. (2017) Effectiveness of SRDP in corn bunting conservation: assessing the impact of six years of targeted agrienvironment schemes. Scottish Natural Heritage Commissioned Report No. 941. Full report

Perrig, M., Grüebler, M.U., Keil, H. & Naef-Daenzer, B. (2017) Post-fledging survival of Little Owls *Athene noctua* in relation to nestling food supply. *Ibis* 159: 532–540.

Perrins, C. (2003) The status of Marsh and Willow Tits in the UK. *British Birds* 96: 418–426.

Perrins, C.M. & Martin, P. (1999) *The impact of lost and discarded fishing line and tackle on Mute Swans.* Phase 1, R & D Technical Report W200. Environment Agency, Bristol.

Perrins, C.M. & Overall, R. (2001) Effect of increasing numbers of deer on bird populations in Wytham Woods, central England *Forestry* 74: 299–309.

Perrins, C.M. & Sears, J. (1991) Collisions with overhead wires as a cause of mortality in Mute Swans *Cygnus olor*. *Wildfowl* 42: 5–11.

Petty, S.J., Shaw, G. & Anderson, D.I.K. (1994) Value of nest boxes for population studies and conservation of owls in coniferous forests in Britain *Journal of Raptor Research* 28: 134–142.

Petty, S.J., Anderson, D.I.K., Davison, M., Little, B., Sherratt, T.N., Thomas, C.J. & Lambin, X. (2003) The decline of Common Kestrels *Falco tinnunculus* in a forested area of northern England: the role of predation by Northern Goshawk *Accipiter gentilis*. *Ibis* 145: 472–483.

Phillimore, A. B., Leech, D. I., Pearce-Higgins, J. W., & Hadfield, J. D. (2016) Passerines may be sufficiently plastic to track temperature-mediated shifts in optimum lay date. *Global Change Biology* 22: 3259–3272. doi: 10.1111/gcb.13302

Pienkowski, M.W. (1991) Using long-term ornithological studies in setting targets for conservation in Britain. *Ibis* 133 (Suppl. 1): 62–75.

Piersma, T. (2013) Timing, nest site selection and multiple breeding in House Martins: age-related variation and the preference for self-built mud nests *Ardea* 101: 23–

32.

Plummer, K.E., Siriwadena, G.M., Conway, G.J., Risely, K. & Toms, M.P. (2015) Is supplementary feeding in gardens a driver of evolutionary change in a migratory bird species? *Global Change Biology* 21: 4353–4363. doi: 10.1111/gcb.13070

Plummer, K.E., Risely, K., Toms, M.P. & Siriwardena, G.M. (2019) The composition of British bird communities is associated with long-term garden bird feeding *Nature Communications* 10: 2088. doi:10.1038/s41467-019-10111-5

Plummer, M. (2003) *JAGS: a program for analysis of Bayesian graphical models using Gibbs sampling.* Proceedings of the Third International Workshop on Distributed Statistical Computing, Vienna, Austria. doi 10.1.1.13.3406 Full text

Potts, G. (1980) The effects of modern agriculture, nest predation and game management on the population ecology of partridges *Perdix perdix* and *Alectoris rufa*. *Advances in Ecological Research* 11: 2–79.

Potts, G.R. (2012) *Partridges.* Collins, London.

Potts, G. & Aebischer, N. (1995) Population dynamics of the Grey Partridge *Perdix perdix* 1793–1993: monitoring, modelling and management. *Ibis* 137: 29–37.

Poulin, B., Lefebvre, G. and Paz, L. (2010). Red flag for green spray: adverse trophic effects of Bti on breeding birds. *Journal of Applied Ecology* 47: 884-889.

Pouwels, R., van Eupen, M., Walvoort, D.J.J. & Jochem, R. (2020) Using GPS tracking to understand the impact of management interventions on visitor densities and bird populations. *Applied Geography* 116: 102154. doi: 10.1016/j.apgeog.2020.102154

Powolny, T., Eraud, C., LeRest, K. & Bretagnolle, V. (2018) Seed depletion and landscape structure affect aggregative response in two wintering passerine birds *Bird Study* 65: 98–107. doi: 10.1080/00063657.2017.1414144

Prater, A.J. (1989) Ringed Plover *Charadrius hiaticula* breeding population of the United Kingdom in 1984. *Bird Study* 36: 154–159.

Prestt, I. (1965) An enquiry into the recent breeding status of some smaller birds of prey and crows in Britain *Bird Study* 12: 196–221.

Prince, P. & Clarke, R. (1993) The hobby's breeding range in Britain. *British Wildlife* 4: 341–346.

Pringle, H., Wilson, M., Calladine, J. & Siriwardena, G. (2019) Associations between gamebird releases and generalist predators *Journal of Applied Ecology* 56: 2102–2113. doi:10.1111/1365-2664.13451

Proffitt, F.M., Newton, I., Wilson, J.D. & Siriwardena, G.M. (2004) Bullfinch *Pyrrhula pyrrhula* breeding ecology in lowland farmland and woodland: comparisons across time and habitat. *Ibis* 146 (Suppl. 2): 78–86. doi: 10.1111/j.1474-919X.2004.00363.x

Prytherch, R.J. (2013) The breeding biology of the Common Buzzard. *British Birds* 106: 264–279.

R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Rands, M. (1985) Pesticide use on cereals and the survival of Grey Partridge chicks: a field experiment. *Journal of Applied Ecology* 22: 49–54.

Ratcliffe, D.A. (1993) *The Peregrine Falcon*. Second edition. T. & A.D. Poyser, London.

Ravenscroft, N.O.M. (1989) The status and habitat of the Nightjar *Caprimulgus europaeus* in coastal Suffolk. *Bird Study* 36: 161–169. doi: 10.1080/00063658909477021

Rebecca, G.W. (2011) Spatial and habitat-related influences on the breeding performance of Merlins in Britain. *British Birds* 104: 202–216.

Rebecca, G.W. & Bainbridge, I.P. (1998) The breeding status of the Merlin *Falco columbarius* in Britain in 1993–94. *Bird Study* 45: 172–187.

Rebecca, G., Cosnette, B., Craib, J., Duncan, A., Etheridge, B., Francis, I., Hardey, J., Pout, A. & Steele, L. (2016) The past, current and potential status of breeding Hen Harriers in North-east Scotland. *British Birds* 109: 69–134.

Redpath, S.M. (1995) Habitat fragmentation and the individual: tawny owl *Strix aluco* in woodland patches. *Journal of Applied Ecology* 64: 652–661.

Redpath, S. & Thirgood, S. (1997) *Birds of Prey and Red Grouse* HMSO, London.

Redpath, S. & Thirgood, S. (1999) Numerical and functional responses in generalist predators: Hen Harriers and Peregrines on Scottish grouse moors *Journal of Animal Ecology* 68: 879–892.

Redpath, S. & Thirgood, S. (2009) Hen harriers and red grouse: moving towards consensus? *Journal of Applied Ecology* 46: 961–963. doi: 10.1111/j.1365-2664.2009.01702.x

Redpath, S., Thirgood, S. & Clarke, R. (2002a) Field vole *Microtus agrestis* abundance and Hen Harrier *Circus cyaneus* diet and breeding in Scotland. *Ibis* 144: E33–E38.

Redpath, S., Arroyo, B., Etheridge, B., Leckie, F., Bouwman, K. & Thirgood, S. (2002b) Temperature and Hen Harrier productivity: from local mechanisms to geographical patterns. *Ecography* 25: 533–540.

Reed, T. (1985) Estimates of British breeding wader populations. *Wader Study Group Bulletin* 45: 11–12.

Reed, T.E., Jenouvrier, S. & Visser, M.E. (2012) Phenological mismatch strongly affects individual fitness but not population demography in a woodland passerine. *Journal of Animal Ecology*. doi: 10.1111/j.1365-2656.2012.02020.x

Reed, T.E., Grøtan, V., Jenouvrier, S., Sæther, B.-E. & Visser, M.E. (2013) Population growth in a wild bird is buffered against phenological mismatch. *Science* 340

(6131): 488–491. doi: 10.1126/science.1232870

Reed, T.E., Gienapp, P. & Visser, M.E. (2015) Density dependence and microevolution interactively determine effects of phenology mismatch on population dynamics. *Oikos* 124: 81–91.

Rehfisch, M.M., Wernham, C.V. & Marchant, J.H. (eds) (1999) *Population, distribution, movements and survival of fish-eating birds in Great Britain.* DETR, London.

Rehfisch, M.M, Austin, G.E., Holloway, S.J., Allan, J.R. & O'Connell, M. (2002) An approach to the assessment of change in the numbers of Canada Geese *Branta canadensis* and Greylag Geese *Anser anser* in southern Britain. *Bird Study* 49: 50–59.

Reijnen, R. & Foppen, R. (1994) The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for willow warblers (*Phylloscopus trochilus*) breeding close to a highway. *Journal of Applied Ecology* 31: 85–94.

Renwick, A.R., Massimino, D., Newson, S.E., Chamberlain, D.E., Pearce-Higgins, J.W. & Johnston, A. (2012) Modelling changes in species' abundance in response to projected climate change. *Diversity and Distributions* 18: 121–132.

Reyns, N., Casaer, J., De Smet, L., Devos, K., Huysentruyt, F., Robertson, P.A., Verbeke, T. & Adriaens, T. (2018) Cost-benefit analysis for invasive species control: the case of greater Canada goose *Branta canadensis* in Flanders (northern Belgium). *Peer J* 6: e4283. doi: 10.7717/peerj.4283

Rhymer, C.M., Devereux, C.L., Denny, M.J.H. & Whittingham, M.J. (2012) Diet of Starling *Sturnus vulgaris* nestlings on farmland: the importance of Tipulidae larvae. *Bird Study* 59: 426–436.

Richner, H. (1992) The effect of extra food on fitness in breeding Carrion Crows. *Ecology* 73: 330–335.

Rickenbach, O., Grüebler, M.U., Schaub, M., Koller, A., Naef-Daenzer, B. & Schifferli, L. (2011) Exclusion of ground predators improves Northern Lapwing *Vanellus vanellus* chick survival. *Ibis* 153: 531–542. doi: 10.1111/j.1474-919X.2011.01136.x

Riddiford, N. (1983) Recent declines of Grasshopper Warblers *Locustella naevia* at British bird observatories. *Bird Study* 30: 143–148.

Rinaud, T., Harmange, C., Pays, O., Sarasa, M., Saillard, M. & Bretagnolle, V. (2020) Interspecific competition between two partridges in farmland landscapes *Animal Behaviour* 165: 23–34.

Risely, K., Baillie, S.R., Eaton, M.A., Joys, A.C., Musgrove, A.J., Noble, D.G., Renwick, A.R. & Wright, L.J. (2010) *The Breeding Bird Survey 2009.* Research Report 559. BTO, Thetford.

Full text (PDF, 1.17 MB)
Risely, K., Renwick, A.R., Dadam, D., Eaton, M.A., Johnston, A., Baillie, S.R., Musgrove, A.J. & Noble, D.G. (2011) *The Breeding Bird Survey 2010.* Research Report 597. British Trust for Ornithology, Thetford.

Full text (PDF, 1.59 MB)
Risely, K., Massimino, D., Johnston, A., Newson, S.E., Eaton, M.A., Musgrove, A.J., Noble, D.G., Procter, D. & Baillie, S.R. (2012) *The Breeding Bird Survey 2011.* Research Report 624. British Trust for Ornithology, Thetford.

Full text (PDF, 2.85 MB)
Risely, K., Massimino, D., Newson, S.E., Eaton, M.A., Musgrove, A.J., Noble, D.G., Procter, D. & Baillie, S.R. (2013) *The Breeding Bird Survey 2012.* Research Report 645. British Trust for Ornithology, Thetford.

Full text (PDF, 3.11 MB)
Robertson, D. (2003) Eurasian Reed Warblers in Scotland: a review of probable breeding records. *Scottish Birds* 24: 36–39.

Robertson, G.S., Aebischer, N.J. & Baines, D. (2017) Using harvesting data to examine temporal and regional variation in red grouse abundance in the British uplands. *Wildlife Biology* 2017(1):wlb.00276. 2017. doi: 10.2981/wlb.00276

Robertson, H.A. (1990) Breeding of Collared Doves *Streptopelia decaocto* in rural Oxfordshire, England. *Bird Study* 37: 73–83.

Robertson, P.A. (1991) Estimating the nesting success and productivity of British Pheasants *Phasianus colchicus* from nest-record schemes. *Bird Study* 38: 73–79.

Robertson, P.A., Mill, A.C., Rushton, S.P., McKenzie, A.J., Sage, R.B. & Aebischer, N.J. (2017) Pheasant release in Great Britain: long-term and large-sclae changes in the survival of a managed bird. *European Journal of Wildlife Research* 63: 100. doi: 10.1007/s10344-017-1157-7

Robertson, P.A., Woodburn, M.I.A., Tapper, S.C. & Stoate, C. (1989) *Estimating game densities in Britain from land-use maps.* Institute of Terrestrial Ecology, Grange-over-Sands.

Robinson, R.A. & Sutherland, W.J. (2002) Post-war changes in arable farming and biodiversity in Great Britain *Journal of Applied Ecology* 39: 157–176.

Robinson, R.A., Wilson, J.D. & Crick, H.Q.P. (2001) The importance of arable habitat for farmland birds in grassland landscapes *Journal of Applied Ecology* 38: 1059–1069.

Robinson, R.A., Siriwardena, G.M. & Crick, H.Q.P. (2002) Status and population trends of the Starling *Sturnus vulgaris* in Great Britain. In *Investigation into the causes of the decline of starlings and house sparrows in Great Britain* (eds Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A. & Rickard, A.D.), pp 11–32. Research Report 290. BTO, Thetford.

Robinson, R.A., Crick, H.Q.P. & Peach, W.J. (2003) Population trends of Swallows *Hirundo rustica* breeding in Britain. *Bird Study* 50: 1–7. doi: 10.1080/00063650309461283

Robinson, R.A., Green, R.E., Baillie, S.R., Peach, W.J. & Thomson, D.L. (2004) Demographic mechanisms of the population decline of the song thrush *Turdus philomelos* in Britain. *Journal of Animal Ecology* 73: 670–682. doi: 10.1111/j.0021-8790.2004.00841.x

Robinson, R.A., Siriwardena, G.M. & Crick, H.Q.P. (2005a) Status and population trends of Starling *Sturnus vulgaris* in Great Britain. *Bird Study* 52: 252–260.

Robinson, R.A., Siriwardena, G.M. & Crick, H.Q.P. (2005b) Size and trends of the House Sparrow *Passer domesticus* population in Great Britain. *Ibis* 147: 552–562. doi: 10.1111/j.1474-919x.2005.00427.x

Robinson, R.A., Siriwardena, G.M. & Crick, H.Q.P. (2006) The population decline of the Starling *Sturnus vulgaris* in Great Britain: patterns and causes. *Acta Zoologica Sinica* 52 (Supplement): 550–553

Robinson, R.A., Freeman, S.N., Balmer, D.E. & Grantham, M.J. (2007a) Cetti's Warbler *Cettia cetti*: analysis of an expanding population. *Bird Study* 54: 230–235. doi: 10.1080/00063650709461479

Robinson, R.A., Baillie, S.R. & Crick, H.Q.P. (2007b) Weather-dependent survival: implications of climate change for passerine population processes *Ibis* 149: 357–364.

Robinson, R.A., Balmer, D.E. & Marchant, J.H. (2008) Survival rates of hirundines in relation to British and African rainfall *Ringing & Migration* 24: 1–6.

Robinson, R.A., Kew, J.J. & Kew, A.J. (2010a) Survival of suburban blackbirds *Turdus merula* varies seasonally but not by sex. *Journal of Avian Biology* 41: 83–87. doi: 10.1111/j.1600-048X.2009.04789.x

Robinson, R.A., Lawson, B., Toms, M.P., Peck, K.M., Kirkwood, J.K., Chantrey, J., Clatworthy, I.R., Evans, A.D., Hughes, L.A., Hutchinson, O.C., John, S.K., Pennycott, T.W., Perkins, M.W., Rowley, P.S., Simpson, V.R., Tyler, K.M. & Cunningham, A.A. (2010b) Emerging infectious disease leads to rapid population declines of common British birds. *PLoS ONE* 5(8): e12215. Abstract/Full text

Robinson, R.A., Baillie, S.R. & King, R. (2012) Population processes in European Blackbirds *Turdus merula*: a state–space approach. *Journal of Ornithology* 152: 419–433. Abstract

Robinson, R.A., Morrison, C.A. & Baillie, S.R. (2014) Integrating demographic data: towards a framework for monitoring wildlife populations at large spatial scales. *Methods in Ecology and Evolution* 5: 1361–1372. doi: 10.1111/2041-210X.12204

Robinson, R.A., Sanders, J.D. & Rees, E.C. (2020) Survival of Eurasian Curlew *Numenius arquata* differs by season but not by breeding origin. *Wader Study* 127: 25–30.

Rodrigues, M. & Crick, H.Q.P. (2010) The breeding biology of the Chiffchaff *Phylloscopus collybita* in Britain: a comparison of an intensive study with records of the BTO Nest Record Scheme. *Bird Study* 44: 374–383. doi: 10.1080/00063659709461073

Ronka, M.T.H., Saari, C.L.V., Lehikoinen, E.A., Suomela, J. & Hakkila, K. (2005) Environmental changes and population trends of breeding waterfowl in northern Baltic Sea. *Annales Zoologici Fennici* 42: 587–602.

Rooney, E., Reid, N. & Montgomery, W.I. (2015) Supplementary feeding increases Common Buzzard *Buteo buteo* productivity but only in poor-quality habitat. *Ibis* 157: 181–185. doi: 10.1111/ibi.12218

Roos, S., Smart, J., Gibbons, D.W. & Wilson, J.D. (2018) A review of predation as a limiting factor for bird populations in mesopredator-rich landscapes: a case study of the UK. *Biological Reviews* 93: 1915–1937. doi: 10.1111/brv.12426

Rossmanith, E., Hontsch, K., Blaum, N. & Jeltsch, F. (2007) Reproductive success and nestling diet in the Lesser Spotted Woodpecker (*Picoides minor*): the early bird gets the caterpillar. *Journal of Ornithology* 148: 323–332.

Rowell, H.E. & Spray, C.J. (2004) *The Mute Swan* Cygnus olor *(Britain and Ireland populations) in Britain and Northern Ireland 1960/61 – 2000/01*. Waterbird Review Series, The Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.

Rubolini, D., Saino, N. & Møller, A.P. (2010) Migratory behaviour constrains the phenological response of birds to climate change. *Climate Research* 42: 45–55.

Sæther, B. E., Visser, M. E., Grøtan, V., & Engen, S. (2016, April). Evidence for r-and K-selection in a wild bird population: a reciprocal link between ecology and evolution. *Proceedings of the Royal Society B* 283 (1829): 20152411. doi: 10.1098/rspb.2015.2411

Sage, R.B., Woodbum, M.I.A., Davis, C., Aebischer, N.J. (2002) The effect of an experimental infection of the nematode *Heterakis gallinarum* on hand-reared grey partridges *Perdix perdix*. *Parasitology* 124: 529–535.

Sage. R.B., Turner, C.V., Woodburn, M.I.A., Hoodless, A.N., Draycott, R.A.H. & Sotherton, N.W. (2018) Predation of released pheasants *Phasianus colchicus* on lowland farmland in the UK and the effect of predator control. *European Journal of Wildlife Research* 64: 14. doi:10.1007/s10344-018-1174-1

Saino, N., Szép, T., Ambrosini, R., Romano, M. & Møller, A.P. (2004) Ecological conditions during winter affect sexual selection and breeding in a migratory bird. *Proceedings of the Royal Society of London Series B* 271: 681–686. Full text

Saino, N., Rubolini, D., Lehikoinen, E., Sokolov, L., Bonisoli-Alquati, A., Ambrosini, R., Boncoraglio, G. & Møller, A. (2009) Climate change effects on migration phenology may mismatch brood parasitic cuckoos and their hosts. *Biology Letters* 5: 539–541.

Saino, N., Romano, M., Caprioli, M., Ambrosini, R., Rubolini, D., Scandolara, C. & Romano, A. (2012) A ptilochronological study of carry-over effects of conditions during wintering on breeding performance in the barn swallow *Hirundo rustica*. *Journal of Avian Biology* 43: 513–524. doi: 10.1111/j.1600-048X.2012.05622.x

Šálek, M. & Lovy, M. (2011) Spatial ecology and habitat selection of Little Owl *Athene noctua* during the breeding season in central European farmland. *Bird Conservation International* 22: 328–338. doi: 10.1017/S0959270911000268

Sálek, M. & Schröpfer, L. (2008) Population decline of the Little Owl (*Athene noctua* Scop.) in the Czech Republic. *Polish Journal of Ecology* 56: 527–534.

Samplonius, J.M., Bartošová, L., Burgess, M.D., Bushuev, A.V., Eeva, T., Ivankina, E.V., Kerimov, A.B., Krams, I., Laaksonen, T., Mägi, M., Mänd, R., Potti, Török, J., Trnka, M., Visser, M.E., Zang, H. & Both, C. (2018) Phenological sensitivity to climate change is higher in resident than in migrant bird populations among European cavity breeders. *Global Change Biology* 24: 3780–3790. doi: 10.1111/gcb.14160

Samplonius, J.M. & Both, C. (2019) Climate change may affect fatal competition between two bird species. *Current Biology* 29: 327–331. doi:10.1016/j.cub.2018.11.063

Sanderson, F.J., Donald, P.F., Pain, D.J., Burfield, I.J. & van Bommel, F.P.J. (2006) Long-term population declines in Afro–Palearctic migrant birds. *Biological Conservation* 131: 93–105.

Sansom, A., Etheridge, B., Smart, J. & Roos, S. (2016) Population modelling of North Scotland red kites in relation to the cumulative impacts of wildlife crime and wind farm mortality. Scottish Natural Heritage Commissioned Report No. 904. Full Report

Sanz, J.J. (2002) Climate change and breeding parameters of Great and Blue Tits throughout the Western Palaearctic. *Global Change Biology* 8: 409–422.

SAS Institute (2011) *SAS/STAT 9.4 user's guide.* SAS Institute, Cary, North Carolina.

Sauter, A., Korner-Nievergelt, F. & Jenni, L. (2010) Evidence of climate change effects on within-winter movements of European Mallards *Anas platyrhynchos*. *Ibis* 152: 600–609.

Schaub, M. (2012) Spatial distribution of wind farms is crucial for the survival of red kite populations. Biological Conservation 155: 111–118. doi: 10.1016/j.biocon.2012.06.021

Schaub, M., Ullrich, B., Knötzsch, G., Albrecht, P. & Meisser, C. (2006) Local population dynamics and the impact of scale and isolation: a study on different Little Owl populations. *Oikos* 115: 389–400.

Schaub, M., Jakober, H. & Stauber, W. (2011) Demographic response to environmental variation in breeding, stopover and non-breeding areas in a migratory passerine. *Oecologia* 167: 445–459.

Schaub, T., Meffert, P.J. & Kerth, G. (2016) Nest-boxes for Common Swifts *Apus apus* as compensatory measures in the context of building renovation: efficacy and predictors of occupancy. *Bird Conservation International* 26: 164–176. doi: 10.1017/S0959270914000525

Schekkerman, H., Teunissen, W.A. & Oosterveld, E. (2009) Mortality of Black-tailed Godwit *Limosa limosa* and Northern Lapwing *Vanellus vanellus* chicks in wet grasslands: influence of predation and agriculture. *Journal of Ornithology* 150: 133–145.

Schmidt, J., Eilers, A., Schimkat, M., Krause-Heiber, J., Timm, A., Nachtigall, W., & Kleber, A. (2017a) Effect of Sky Lark plots and additional tramlines on territory densisities of the Sky Lark *Alauda arvensis* in an intensively managed agricultural landscape. *BirdStudy* 64: 1–11. doi: 10.1080/00063657.2016.1271394

Schmidt, J-U., Eilers, A., Schimkat, M., Krause-Heiber, J., Timm, A., Siegel, S., Nachtigall, W. & Kleber, A. (2017b) Factors influencing the success of within-field AES fallow plots as key sites for the Northern Lapwing *Vanellus vanellus* in an industrialised agricultural landscape of Central Europe. *Journal for Nature Conservation* 35: 66–76. doi 10.1016/j.jnc.2016.12.001

Scholl, E.M. & Hille, S.M. 2020. Heavy and persistent rainfall leads to brood reduction and nest failure in a passerine bird. Journal of Avian Biology 51: e02418. doi: 10.1111/jav.02418

Scott, G.W., Jardine, D.C., Hills, G. & Sweeney, B. (1998) Changes in Nightjar *Caprimulgus europaeus* populations in upland forests in Yorkshire. *Bird Study* 45: 219–225.

Selas, V., Steen, R., Kobro, S., Lislevand, T. & Stenberg, I. (2008) Direct and indirect weather impacts on spring populations of Lesser Spotted Woodpecker (*Dendrocopos minor*) in Norway. *Scandinavian Journal of Forest Research* 23: 148–153.

Sellers, R.M. (2006) Breeding population estimate for Northern Wheatear in Britain. *British Birds* 99: 533–535.

Senar, J. C., Montalvo, T., Pascual, J. & Peracho, V. (2017) Reducing the availability of food to control feral pigeons: changes in population size and composition. *Pest Management Science* 73: 313–317. doi: 10.1002/ps.4272

Sergio, F., Boto, A., Scandolara, C. & Bogliani, G. (2002) Density, nest sites, diet, and productivity of Common Buzzards (*Buteo buteo*) in the Italian pre-Alps. *Journal of Raptor Research* 36: 24–32.

Sergio, F., Scandolara, C., Marchesi, L., Pedrini, P. & Penteriani, V. (2005) Effect of agro-forestry and landscape changes on Common Buzzards (*Buteo buteo*) in the Alps: implications for conservation. *Animal Conservation* 8: 17–25.

Setchfield, R.P., Mucklow, C., Davey, A., Bradter, U. & Anderson, G.Q.A. (2012) An agri-environment option boosts productivity of Corn Buntings *Emberiza calandra* in the UK. *Ibis* 154: 235–247. doi: 10.1111/j.1474-919X.2011.01207.x

Setchfield, R. P. and Peach, W. J. (2016), The influence of crop tiller density on the breeding performance of a cereal-nesting specialist. *Journal of Applied Ecology* 53: 1403–1439. doi: 10.1111/1365-2664.12704

Sharpe, F., Clark, J. & Leech, D. (2008) Does variation in demographic parameters account for regional variation in Northern Lapwing *Vanellus vanellus* population declines across Great Britain? *Bird Study* 55: 247–256.

Sharps, E., Smart, J., Skov, M.W., Garbutt, A. & Hiddink, J.G. (2015) Light grazing of saltmarshes is a direct and indirect cause of nest failure in Common Redshank *Tringa totanus. Ibis* 157: 239–249. doi: 10.1111/ibi.12249

Sharps, E., Garbutt, A., Hiddink, J.G., Smart, J. & Skov, M.W. (2016) Light grazing of saltmarshes increases the availability of nest sites for Common Redshank *Tringa totanus*, but reduces their quality. *Agriculture, Ecosystems & Environment* 221: 71-78. doi: 10.1016/j.agee.2016.01.030

Sharps, E., Smart, J., Mason, L.R., Jones, K., Skov, M.W., Garbutt, A. & Hiddink, J.G. (2017) Nest trampling and ground nesting birds: Quantifying temporal and spatial overlap between cattle activity and breeding redshank. *Ecology & Evolution* 7: 6622-6633. doi: 10.1002/ece3.3271

Sharps, K., Henderson, I., Conway, G., Armour-Chelu, N. & Dolman, P.M. (2015) Home-range size and habitat use of European Nightjars *Caprimulgus europaeus* nesting in a complex plantation-forest landscape. *Ibis* 157: 260–272.

Sharrock, J.T.R. (1976) *The Atlas of Breeding Birds in Britain and Ireland.* T. & A.D. Poyser, Berkhamsted.

Shaw, L.M., Chamberlain, D.E. & Evans, M.R. (2008) The house sparrow *Passer domesticus* in urban areas: reviewing a possible link between post-decline distribution and human socioeconomic status. *Journal of Ornithology* 149: 293–299. Abstract doi: 10.1007/s10336-008-0285-y

Shaw, L.M., Chamberlain, D., Conway, G. & Toms, M. (2011) *Spatial distribution and habitat preferences of the House Sparrow* Passer domesticus *in urbanised landscapes.* Research Report 599. BTO, Thetford.

Full text (PDF, 628.20 KB)
Shawyer, C.R. (1985) *Rodenticides: a review and assessment of their potential hazard to non-target wildlife with special reference to the Barn Owl* Tyto alba. The Hawk Trust, London.

Shawyer, C.R. (1987) *The Barn Owl in the British Isles: its past, present and future.* The Hawk Trust, London.

Shawyer, C.R. (1998) *The Barn Owl.* Arlequin Press, Chelmsford.

Shawyer, C.R. & Dixon, N. (1999) *Impact of roads on Barn Owl* Tyto alba *populations.* Highways Agency, London.

Sheldon, R.D., Chaney, K. & Tyler, G.A. (2007) Factors affecting nest survival of northern lapwings *Vanellus vanellus* in arable farmland: an agri-environment scheme prescription can enhance nest survival. *Bird Study* 54: 168–175.

Sheridan, K., Monaghan, J., Tierney, T.D., Doyle, S., Tweney, C., Redpath, S.M. & McMahon, B.I. (2020) The influence of habitat edge on a ground nesting bird species: Hen Harrier *Circus cyaneus*. *Wildlife Biology* 2020:00677. doi: 10.2981/wlb.00677

Shirley. (2010) Ducking and diving – mixing science and values in ruddy duck control. *ECOS*: 31: 16–21.

Shore, R.F., Meek, W.R., Sparks, T.H., Pywell, R.F. & Nowakowski, M. (2005) Will Environmental Stewardship enhance small mammal abundance on intensively managed farmland? *Mammal Review* 34: 277–284.

Shortall, C.R., Moore, A., Smith, E., Hall, M.J., Woiwod, I.P. & Harrington, R. (2009) Long-term changes in the abundance of flying insects *Insect Conservation and Diversity* 2: 251–260. doi: 10.1111/j.1752-4598.2009.00062.x

Shrubb, M. (1990) Effects of agricultural change on nesting Lapwings *Vanellus vanellus* in England and Wales. *Bird Study* 37: 115–127.

Shrubb, M. (1993) *The Kestrel.* Hamlyn, London.

Shrubb, M., Lack, P. & Greenwood, J. (1991) The numbers and distribution of Lapwings *Vanellus vanellus* nesting in England and Wales in 1987. *Bird Study* 38: 20–37.

Sicurella, B., Caprioli, M., Romano, A. & Romano, M. (2014) Hayfields enhance colony size of the Barn Swallow *Hirundo rustica* in northern Italy. *Bird Conservation International* 24: 17–31.

Sierro, A. & Erhardt, A. (2019) Light pollution hampers recolonization of revitalised European Nightjar habitats in the Valais (Swiss Alps) *Journal of Ornithology* 160: 749–761. doi:10.1007/s10336-019-01659-6

Silva, C.C., Lourenço, R., Godhinho, S., Gomes, E., Sabino-Marques, H., Medinas, D., Neves, V., Silva,C., Rabaça, J. & Miro, A. (2012) Major roads have a negative impact on the Tawny Owl *Strix aluco* and the Little Owl *Athene noctua* populations. *Acta Ornithologica* 47: 47–54. doi: 10.3161/000164512X653917

Sim, I.M.W. (2012) Demographic and ecological approaches to understanding Ring Ouzel (*Turdus torquatus*) population declines. PhD Thesis. University of Aberdeen.

Sim, I.M.W., Campbell, L., Pain, D.J. & Wilson, J.D. (2000) Correlates of the populatin increase of Common Buzzards *Buteo buteo* in the West Midlands between 1983 and 1996. *Bird Study* 47: 154–164.

Sim, I.M.W., Cross, A.V., Lamacraft, D.L. & Pain, D.J. (2001a) Correlates of Common Buzzard *Buteo buteo* density and breeding success in the West Midlands. *Bird Study* 48: 317–329.

Sim, I.M.W., Gibbons, D.W., Bainbridge, I.P. & Mattingley, W.A. (2001b) Status of the Hen Harrier *Circus cyaneus* in the UK and the Isle of Man in 1998. *Bird Study* 48: 341–353.

Sim, I.M.W., Gregory, R.D., Hancock, M.H. & Brown, A.F. (2005) Recent changes in the abundance of British upland breeding birds *Bird Study* 52: 261–275.

Sim, I.M.W., Dillon, I.A., Eaton, M.A., Etheridge, B., Lindley, P., Riley, H., Saunders, R., Sharpe, C. & Tickner, M. (2007a) Status of the Hen Harrier *Circus cyaneus* in the UK and Isle of Man in 2004, and a comparison with the 1988/89 and 1998 surveys. *Bird Study* 54: 256–267.

Sim, I.M.W., Burfield, I.J., Grant, M.C., Pearce-Higgins, J.W. & Brooke, M. de L. (2007b) The role of habitat composition in determining breeding site occupancy in a declining Ring Ouzel *Turdus torquatus* population. *Ibis* 149: 374–385.

Sim, I., Rollie, C., Arthur, D., Benn, S., Booker, H., Fairbrother, V., Green, M., Hutchinson, K., Ludwig, S., Nicoll, M., Poxton, I., Rebecca, G., Smith, L., Stanbury, A. & Wilson, P. (2010) The decline of the Ring Ouzel in Britain. *British Birds* 103, 229–239.

Sim, I.M.W., Rebecca, G.W., Ludwig, S.C., Grant, M.C. & Reid, J.M. (2011) Characterizing demographic variation and contributions to population growth rate in a declining population. *Journal of Animal Ecology* 80: 159–170.

Sim, I.M.W., Wilkinson, N.I., Scridel, D., Anderson, D. & Roos, S. (2015) Food supplementation does not increase demographic rates in a passerine species of conservation concern. *Nature Conservation* 10: 25–43. doi: 10.3897/natureconservation.10.4556

Simberloff, D. (1996) Hybridization between native and introduced wildlife species: importance for conservation.*Wildlife Biology* 2: 143–150. doi: 10.2981/wlb.1996.012

Simms, E. (1989) *The Song Thrush*. Shire Natural History, Aylesbury.

Sirami, C., Brotons, L & Martin, J-L. (2010) Woodlarks *Lullula arborea* and landscape heterogeneity created by land abandonment. *Bird Study* 58: 99–106. doi: 10.1080/00063657.2010.532861

Siriwardena, G.M. (2004) Possible roles of habitat, competition and avian nest predation in the decline of the Willow Tit*Parus montanus* in Britain. *Bird Study* 51: 193–202. doi: 10.1080/00063650409461354

Siriwardena, G.M. (2006) Avian nest predation, competition and the decline of British Marsh Tits*Parus palustris*. *Ibis* 148: 255–265. doi: 10.1111/j.1474-919X.2006.00525.x

Siriwardena, G,M, & Crick, H.Q.P. (2002) National trends in the breeding performance of starlings*Sturnus vulgaris*. In: Crick H.Q.P., Robinson R.A., Appleton G.F., Clark N.A., Rickard A.D. (eds). *Investigation into the Causes of the Decline of Starlings and House Sparrows in Great Britain* Thetford: British Trust for Ornithology, pp91–116.

Siriwardena, G.M. & Stevens, D.K. (2004) Effects of habitat on the use of supplementary food by farmland birds in winter*Ibis* 146: 144–154.

Siriwardena, G.M., Baillie, S.R., Buckland, S.T., Fewster, R.M., Marchant, J.H. & Wilson, J.D. (1998a) Trends in the abundance of farmland birds: a quantitative comparison of smoothed Common Birds Census indices. *Journal of Applied Ecology* 35: 24–43. doi: 10.1046/j.1365-2664.1998.00275.x

Siriwardena, G.M., Baillie, S.R. & Wilson, J.D. (1998b) Variation in the survival rates of British passerines with respect to their population trends on farmland*Bird Study* 45: 276–292.

Siriwardena, G.M., Baillie, S.R. & Wilson, J.D. (1999) Temporal variation in the annual survival rates of six granivorous birds with contrasting population trends*Ibis* 141: 621–636.

Siriwardena, G.M., Baillie, S.R., Crick, H.Q.P., Wilson, J.D. & Gates, S. (2000a) The demography of lowland farmland birds. In*Proceedings of the 1999 BOU Spring Conference: Ecology and Conservation of Lowland Farmland Birds* (eds. N.J. Aebischer, A.D. Evans, P.V. Grice & J.A. Vickery), pp 117–133. British Ornithologists' Union, Tring.

Siriwardena, G.M., Baillie, S.R., Crick, H.Q.P. & Wilson, J.D. (2000b) The importance of variation in the breeding performance of seed-eating birds for their population trends on farmland. *Journal of Applied Ecology* 37: 128–148. Abstract/Full text

Siriwardena, G.M., Crick, H.Q.P., Baillie, S.R. & Wilson, J.D. (2000c) Agricultural habitat-type and the breeding performance of granivorous farmland birds in Britain*Bird Study* 47: 66–81.

Siriwardena, G.M., Freeman, S.N. & Crick, H.Q.P. (2001a) The decline of the Bullfinch*Pyrrhula pyrrhula* in Britain: is the mechanism known?*Acta Ornithologica* 36: 143–152.

Siriwardena, G., Baillie, S., Crick, H. & Wilson, J. (2001b) Changes in agricultural land-use and breeding performance of some granivorous farmland passerines in Britain. *Agriculture, Ecosystems & Environment* 84: 191–206.

Siriwardena, G.M., Wilson, J.D., Baillie, S.R. & Crick, H.Q.P. (2001c) Can the historical CBC trend for Skylark be 'recovered' using present-day agricultural habitat preferences and changes in agricultural land use? In *The Ecology and Conservation of Skylarks* (eds Donald, P.F. & Vickery, J.A.), 56–60. RSPB, Sandy.

Siriwardena, G.M., Robinson, R.A. & Crick, H.Q.P. (2002) Status and population trends of the house sparrow*Passer domesticus* in Great Britain. In *Investigation into the causes of the decline of starlings and house sparrows in Great Britain* (eds Crick, H.Q.P., Robinson, R.A., Appleton, G.F., Clark, N.A. & Rickard, A.D.), pp 33–52. Research Report 290. BTO, Thetford.

Siriwardena, G.M., Stevens, D.K., Anderson, G.Q.A., Vickery, J.A., Calbrade, N.A. & Dodd, S. (2007) The effect of supplementary winter seed food on breeding populations of farmland birds: evidence from two large-scale experiments. *Journal of Applied Ecology* 44: 920–932.

Siriwardena, G.M., Calbrade, N.A. & Vickery, J.A. (2008) Farmland birds and late-winter food: does seed supply fail to meet demand?*Ibis* 150: 585–595.

Sitters, H.P., Fuller, R.J., Hoblyn, R.A., Wright, M.T., Cowie, N. & Bowden, C.G.R. (1996) The Woodlark*Lullula arborea* in Britain: population trends, distribution and habitat occupancy. *Bird Study* 43: 172–187.

Smart, J., Gill, J.A., Sutherland, W.J. & Watkinson, A.R. (2006) Grassland-breeding waders: identifying key habitat requirements for management.*Journal of Applied Ecology* 43: 454–463.

Smart, J., Taylor, E., Amar, A., Smith, K., Bierman, S., Carpenter, J., Grice, P., Currie, F., Smithers, R., Fuller, R. & Hewson, C. (2007)*Habitat associations of woodland birds: implications for woodland management for declining species*. Research Report 26. RSPB, Sandy. Full text

Smart, J., Amar, A., O'Brien, M., Grice, P. & Smith, K. (2008) Changing land management of lowland wet grasslands of the UK: impacts on snipe abundance and habitat quality. *Animal Conservation* 11: 339–351.

Smart, J., Amar, A., O'Brien, M., Grice, P. & Smith, K. (2008) Changing land management of lowland wet grasslands of the UK: impacts on snipe abundance and habitat quality. *Animal Conservation* 11: 339–351.

Smart, J., Amar, A., Sim, I.M.W., Etheridge, B., Cameron, D., Christie, G. & Wilson, J.D. (2010) Illegal killing slows population recovery of a re-introduced raptor of high conservation concern – the Red Kite *Milvus milvus*. *Biological Conservation* 143: 1278–1286. doi: 10.1016/j.biocon.2010.03.002

Smart, J., Bolton, M., Hunter, F., Quayle, H., Thomas, G. & Gregory, R.D. (2013) Managing uplands for biodiversity: do agri-environment schemes deliver benefits for

breeding lapwing *Vanellus vanellus*? *Journal of Applied Ecology* 50: 794–804. doi: 10.1111/1365-2664.12081

Smith, K.W. & Smith, L. (2019) Does the abundance and timing of defoliating caterpillars influencethe nest survival and productivity of Great Spotted Woodpeckers *Dendrocopos major*? *Bird Study* 66: 187–197. doi: 10.1080/00063657.2019.1637396

Smith, A.A., Redpath, S.M., Campbell, S.T. & Thirgood, S.J. (2001) Meadow Pipits, Red Grouse and the habitat characteristics of managed grouse moors. *Journal of Applied Ecology* 38: 390–400. doi: 10.1046/j.1365-2664.2001.00601.x

Smith, K.W. (1997) Nest site selection of the great spotted woodpecker *Dendrocopos major* in two oak woods in southern England and its implications for woodland management. *Biological Conservation* 80: 283–288.

Smith, K.W. (2005) Has the reduction in nest-site competition from Starlings *Sturnus vulgaris* been a factor in the recent increase of Great Spotted Woodpecker *Dendrocopos major* numbers in Britain? *Bird Study* 52: 307–313.

Smith, K.W. (2006) The implications of nest site competition from starlings *Sturnus vulgaris* and the effect of spring temperatures on the timing and breeding performance of great spotted woodpeckers *Dendrocopos major* in southern England. *Annales Zoologici Fennici* 43: 177–185. Full text

Smith, K.W. (2007) The utilization of dead wood resources by woodpeckers in Britain. *Ibis* 149: 183–192.

Smith, K.W. & Charman, E.C. (2012) The ecology and conservation of the Lesser Spotted Woodpecker. *British Birds* 105: 294–307.

Smith, K.W. & Smith, L. (2013) The effect of supplementary feeding in early spring on the breeding performance of the Great Spotted Woodpecker *Dendrocopos major*. *Bird Study* 60: 169–175.

Smith, K.W. & Smith, L. 2020. Long-term trends in the nest survival and productivity of the Lesser Spotted Woodpecker *Dryobates minor* in Britain. *Bird Study* 67: 109–118. doi: 10.1080/00063657.2020.1780195

Smith, T.D., Okill, J.D., Ellis, P.M. & Dillon, I.A. (2009) The status and distribution of breeding red-throated divers in Shetland in 2006. *Scottish Birds* 29: 111–125.

Snow, D.W. (1965) The relationship between census results and the breeding population of birds on farmland. *Bird Study* 12: 287–304.

Soler, M. & Soler, J.J. (1996) Effects of experimental food provisioning on reproduction in the Jackdaw *Corvus monedula*, a semi-colonial species. *Ibis* 138: 377–383.

Sotherton, N., Robertson, P.A. & Dowell, S. (1993) Manipulating pesticide use to increase the production of wild game birds in Britain. In *Quail III: National Quail Symposium* (eds Church, K.E. & Dailey, T.V.), 92–101. Kansas Department of Wildlife and Parks, Pratt.

Sotherton, N., Tapper, S. & Smith, A. (2009) Hen harriers and red grouse: economic aspects of red grouse shooting and the implications for moorland conservation. *Journal of Applied Ecology* 46: 955–960. doi: 10.1111/j.1365.2664.2009.01688.x

Sotherton, N.W., Aebischer, N.J. & Ewald, J.A. (2014) Research into action: grey partridge conservation as a case study. *Journal of Applied Ecology* 51: 1–5. doi: 10.1111/1365-2664.12162

Sotherton, N., Baines, D. & Aebischer, N.J. (2017) An alternative view of moorland management for Red Grouse *Lagopus lagopus scotica*. *Ibis* 159: 693–698. doi: 10.1111/ibi.12489

Sparks, T.H., Atkinson, S., Lewthwaite, K., Dhap, R., Moran, N.J., Tryjanowski, P. (2017) Can bird abundance declines be detected by citizen science programmes? A case study using Common Cuckoo *Cuculus canorus*. *Avian Biology Research* 10: 241–245. doi: 10.3184/175815617X15036738758862

Spennemann, D.H.R., Pike, M., Watson, M.J. (2017) Effects of acid pigeon excreta on building conservation. *International Journal of Building Pathology and Adaptation* 35: 2–15. doi: 10.1108/IJBPA-09-2016-0023

Spray, C.J. (1981) An isolated population of *Cygnus olor* in Scotland. In *Proceedings of 2nd International Swan Symposium, Sapporo, Japan 1980* (eds Matthews, G.V.T. & Smart, M.), 191–203. International Waterfowl Research Bureau, Slimbridge.

Stacey, P., O'Kiely, P. Hackett, R., Rice, B. & O'Mara, F.P. (2006) Changes in yield and composition of barley, wheat and triticale grains harvested during advanced stages of ripening. *Irish Journal of Agricultural & Food Research* 45: 197–209.

Stanbury, A., Brown, A., Eaton, M., Aebischer, N., Gillings, S., Hearn, R., Noble, D., Stroud, D. & Gregory, R. (2017) the risk of extinction for birds in Great Britain. British Birds 110: 502–517.

Steen, R., Selas, V. & Stenberg, I. (2006) Impact of weather on annual fluctuations in breeding numbers of Lesser Spotted Woodpecker *Dendrocopos minor* in Norway. *Ardea* 94: 225–231.

Steven, R., Pickering, C. & Castley, J.G. (2011) A review of the impacts of nature-based recreation on birds. *Journal of Environmental Management* 92: 2287–2294. doi: 10.1016/j.jenvman.2011.05.005

Stevens, D.K., Anderson, G.Q.A., Grice, P.V. & Norris, K. (2007) Breeding success of Spotted Flycatchers *Muscicapa striata* in southern England – is woodland a good habitat for this species? *Ibis* 149: 214–223.

Stevens, D.K., Anderson, G.Q.A., Grice, P.V., Norris, K. & Butcher, N. (2008) Predators of Spotted Flycatcher *Muscicapa striata* nests in southern England as determined by digital nest-cameras. *Bird Study* 55: 179–187.

Stevens, D.K., Anderson, G.Q.A., Grice, P.V., Norris, K. & Butcher, N. (2010) Predators of Spotted flycatcher *Muscicapa striata* nests in southern England as determined by digital nest-cameras. *Bird Study* 55: 179–187. doi:10.1080/000636590809461520

Stevens, M., Sheehan, D., Wilson, J., Buchanan, G. & Cresswell, W. (2010) Changes in Sahelian bird biodiversity and tree density over a five-year period in northern

Nigeria. *Bird Study* 57: 156–174.

Stevens, M., Murn, C. & Hennessey, R. (2019) Population change of Common Buzzards *Buteo buteo* in central southern England between 2011 and 2016. *Bird Study* 66: 378–389. doi: 10.1080/00063657.2019.1693960

Stevens, M, Murn, C. & Hennessey, R. (2020) Population change of Red Kite *Milvus milvus* in central southern England between 2011 and 2016 derived fromline transect surveys and multiple covariate distance sampling. *Acta Ornithologica* 54: 243–254. doi: 10.3161/00016454AO2019.54.2.010

Stillman, R.A. & Brown, A.F. (1994) Population sizes and habitat associations of upland breeding birds in the south Pennines, England *Biological Conservation* 69: 307–314.

St. John, F.A.V., Steadman, J., Austin, G. & Redpath, S.M. (2018) Value diversity and conservation conflict: Lessons from the management of red grouse and hen harriers in England. *People & Nature* 1: 6–17. doi: 10.1002/pan3.5

Stoate, C. & Szczur, J. (2001a) Whitethroat *Sylvia communis* and Yellowhammer *Emberiza citrinella* nesting success and breeding distribution in relation to field boundary vegetation. *Bird Study* 48: 229–235.

Stoate, C. & Szczur, J. (2001b) Could game management have a role in the conservation of farmland passerines? A case study from a Leicestershire farm *Bird Study* 48: 279–292.

Stoate, C. & Szczur, J. (2006) Potential influence of habitat and predation on local breeding success and population in Spotted Flycatchers *Muscicapa striata. Bird Study* 53: 328–330.

Stock, B. & Haag-Wackernagel, D. (2016) Food shortage affects reproduction of Feral Pigeons *Columba livia* at rearing of nestlings. *Ibis* 158: 776–783. doi: 10.1111/ibi.12385

Stockdale, J.E., Dunn, J.C., Goodman, S.J., Morris, A.J., Sheehan, D.K., Grice, P.V. & Hamer, K.C. (2015) The protozoan parasite *Trichomonas gallinae* causes adult and nestling mortality in a declining population of European Turtle Doves, *Streptopelia turtur. Parasitology* 142: 490–498. doi:10.1017/S0031182014001474

Stoddart, A. (2013) Redpolls: a review of their taxonomy, identification and British status. *British Birds* 106: 708–736.

Stone, B.H., Sears, J., Cranswick, P.A., Gregory, R.D., Gibbons, D.W., Rehfisch, M.M., Aebischer, N.J. & Reid, J.B. (1997) Population estimates of birds in Britain and in the United Kingdom. *British Birds* 90: 1–22.

Strebel, G., Jacot, A., Horch, P. & Spaar, R. (2015) Effects of grassland intensification on Whinchats *Saxicola rubetra* and implications for conservation in upland habitats. *Ibis* 157: 250–259. doi: 10.1111/ibi.12250

Stroud, D.A., Reed, T.M., Pienkowski, M.W. & Lindsay, R.A. (1987) *Birds, Bogs and Forestry.* Nature Conservancy Council, Peterborough.

Strubbe, D. & Matthysen, E. (2007) Invasive ring-necked parakeets *Psittacula krameri* in Belgium: habitat selection and impact on native birds. *Ecography* 30: 578–588.

Strubbe, D. & Matthysen, E. (2009) Experimental evidence for nest-site competition between invasive Ring-necked Parakeets (*Psittacula krameri*) and native Nuthatches (*Sitta europaea*). *Biological Conservation* 142: 1588–1594.

Strubbe, D., Matthysen, E. & Graham, C.H. (2010) Assessing the potential impact of invasive ring-necked parakeets *Psittacula krameri* on native nuthatches *Sitta europaea* in Belgium. *Journal of Applied Ecology* 47: 549–557. doi: 10.1111/j.1365-2664.2010.01808.x

Summers, R. (1998) The decline in clutch size of Hen Harriers. *BTO News* 218: 23.

Summers, R.W. (1999) Numerical responses of crossbills *Loxia* spp. to annual fluctuations in cone crops. *Ornis Fennica* 76: 141–144.

Summers, R.W. & Buckland, S.T. (2010) A first survey of the global population size and distribution of the Scottish Crossbill *Loxia scotica. Bird Conservation International.* Available on CJO 11 Jan 2010. doi:10.1017/S0959270909990323

Summers, R.W., de Radd. A. L., Bates, B., Etheridge, B. & Elkins, N. (2019) Non-breeding areas and timing of migration in relation to weather of Scottish-breeding common sandpipers *Actitis hypoleucos*. *Journal of Avian Biology* 50: e01877 doi: 10.1111/jav.01877. doi: 10.1111/jav.01877

Summers-Smith, J.D. (1989) A history of the status of the Tree Sparrow *Passer montanus* in the British Isles. *Bird Study* 36: 23–31.

Summers-Smith, J.D. (2003) The decline of the House Sparrow: a review. *British Birds* 96: 439–446.

Summers-Smith, J.D. (2007) Is unleaded petrol a factor in urban House Sparrow decline? *British Birds* 100: 558–559.

Suorsa, P., Huhta, E., Jäntti, A., Nikula, A., Helle, H., Kuitunen, M., Koivunen, V. & Hakkarainen, H. (2005) Thresholds in selection of breeding habitat by the Eurasian Treecreeper *Certhia familiaris*. *Biological Conservation* 121: 443–452. doi: 10.1016/j.biocon.2004.05.014

Swann, R.L. & Etheridge, B. (1995) A comparison of breeding success and prey of the Common Buzzard *Buteo buteo* in two areas of northern Scotland. *Bird Study* 42: 37–43.

Szép, T. (1995) Relationship between west African rainfall and the survival of central European Sand Martins *Riparia riparia*. *Ibis* 137: 162–168.

Szymański, P. & Antczak, M. (2013) Structural heterogeneity of linear habitats positively affects Barred Warbler *Sylvia nisoria*, Common Whitethroat *Sylvia communis* and Lesser Whitethroat *Sylvia curruca* in farmland of western Poland. *Bird Study* 60: 484–490.

Takacs, V., Mazera, T., Kujawa, D. & O'Brien, C.D. (2020) Can't see the Woodlark for the trees? Commercial forests as a habitat for a bird of conservation concern. *Forest Ecology & Management* 476: 118409. doi: 10.1016/j.foreco.2020.118409

Tapper, S. (1992) *Game Heritage: an ecological review from shooting and gamekeeping records*. Game Conservancy, Fordingbridge.

Tapper, S. (1999) *A question of balance: game animals and their role in the British countryside*. The Game Conservancy Trust, Hampshire, UK.

Tapper, S. & France, J. (1992) The National Game Bag Census 1991. *Game Conservancy Annual Review* 23: 38–40.

Tapper, S.C., Potts, G.R. & Brockless, M.H. (1996) The effect of an experimental reduction in predation pressure on the breeding success and population density of grey partridges (*Perdix perdix*). *Journal of Applied Ecology* 33: 965–978.

Taylor, A.J. & O'Halloran, J. (2002) The decline of the Corn Bunting *Miliaria calandra* in the Republic of Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* 102: 165–175.

Taylor, I. & Grant, M. (2004) Long-term trends in the abundance of breeding Lapwing *Vanellus vanellus* in relation to land-use change on upland farmland in southern Scotland. *Bird Study* 51: 133–142.

Taylor, I.R., Dowell, A., Irving, T., Langford, I.K. & Shaw, G. (1988) The distribution and abundance of the Barn Owl in south-west Scotland. *Scottish Birds* 15: 40–43.

Taylor, J. A. (2015) Determinants of variation in productivity, adult survival and recruitment in a declining migrant bird: the Whinchat *Saxicola rubetra*. PhD thesis. Lancaster University. Lancaster, UK.

Teglhøj, P.G. (2018) Artificial nests for Barn Swallows *Hirundo rustica*: a conservation option for a declining passerine? *Bird Study* 65: 385–395. doi: 10.1080/00063657.2018.1516192

Temple, S.A. & Wiens, J.A. (1989) Bird populations and environmental changes: can birds be bio-indicators? *American Birds* 43: 260–270.

Teunissen, W., Schekkerman, H., Willems, F. & Majoor, F. (2008) Identifying predators of eggs and chicks of Lapwing *Vanellus vanellus* and Black-tailed Godwit *Limosa limosa* in the Netherlands and the importance of predation on wader reproductive output. *Ibis* 150: 74–85.

Thackeray, S.J., Sparks, T.H., Frederiksen, M., Burthe, S., Bacon, P.J., Bell, J.R., Botham, M.S., Brereton, T.M., Bright, P.W., Carvalho, L., Clutton-Brock, T., Dawson, A., Edwards, M., Elliott, J.M., Harrington, R., Johns, D., Jones, I.D., Jones, J.T., Leech, D.I., Roy, D.B., Scott, W.A., Smith, M., Smithers, R.J., Winfield, I.J. & Wanless, S. (2010) Trophic level asynchrony in rates of phenological change for marine, freshwater and terrestrial environments. *Global Change Biology* 16: 3304–3313. doi: 10.1111/j.1365-2486.2010.02165.x

Thackeray, S. J., Henrys, P. A., Hemming, D., Bell, J. R., Botham, M. S., Burthe, S., Helaouet, P., Johns, D.G., Leech, D.I., Mackay, E. B., Massimino, D., Atkinson, S., Bacon, P.J., Brereton, T.M., Carvalho, L., Clutton-Brock, T.H., Duck, C., Edwards, M., Elliott, J.M., Hall, S.J.G., Harrington, R., Pearce-Higgins, J.W., Høye, T.T., Kruuk, L.E.B., Pemberton, J.M., Sparks, T.H., Thompson, P.M., White, I., Winfoeld, I.J. & Wanless, S. (2016). Phenological sensitivity to climate across taxa and trophic levels. *Nature* 535(7611), 241-245. doi: 10.1038/nature18608

Tharme, A.P., Green, R.E., Baines, D., Bainbridge, I.P. & O'Brien, M. (2001) The effect of management for Red Grouse shooting on the population density of breeding birds on heather-dominated moorland. *Journal of Applied Ecology* 38: 439–457.

Thaxter, C.B., Redfern, C.P.F. & Bevan, R.M. (2006) Survival rates of adult Reed Warblers *Acrocephalus scirpaceus* at a northern and southern site in England. *Ringing & Migration* 23: 65–79.

Thaxter, C.B., Joys, A.C., Gregory, R.D., Baillie, S.R. & Noble, D.G. (2010) Hypotheses to explain patterns of population change among breeding bird species in England. *Biological Conservation* 143: 2006–2019. doi: 19.1016/j.biocon.2010.05.004

Thingstad, P.G., Nyholm, N.E.I. & Fjeldheim, B. (2006) Pied Flycatcher *Ficedula hypoleuca* population dynamics in peripheral habitats in Scandinavia. *Ardea* 94: 211–223.

Thirgood, S. & Redpath, S. (2008) Hen harriers and red grouse: science, politics and human-wildlife conflict. *Journal of Applied Ecology* 45: 1550-1554. doi: 10.1111/j.1365–2664.2008.01519.x

Thirgood, S.J., Redpath, S.M., Haydon, D.T., Rothery, P., Newton, I & Hudson, P.J. (2000) Habitat loss and raptor predation: disentangling long- and short-term causes of red grouse declines. *Proceedings of the Royal Society B.* 267: 651–656. doi: 10.1098/rspb.2000.1051

Thomas, G.E. (1993) Estimating annual total heron population counts. *Applied Statistics* 42: 473–486.

Thompson, D.B.A., MacDonald, A.J., Marsden, J.H. & Galbraith, C.A. (1995) Upland heather moorland in Great Britain: a review of international importance, vegetation change and some objectives for nature conservation. *Biological Conservation* 71: 163–178.

Thompson, P.S., Amar, A., Hoccom, D.G., Knott, J. & Wilson, J.D. (2009) Resolving the conflict between driven-grouse shooting and conservation of hen harriers. *Journal of Applied Ecology* 46: 950–954.

Thompson, P.S., Douglas, D.J.T., Hoccom, D.G., Knott, J., Roos, S. & Wilson, J.D. (2016) Environmental impacts of high-output driven shooting of Red Grouse *Lagopus lagopus scotica*. *Ibis* 158: 446–452. doi: 10.1111/ibi.12356

Thomson, D.L., Baillie, S.R. & Peach, W.J. (1997) The demography and age-specific annual survival of British song thrushes *Turdus philomelos* during periods of population stability and decline. *Journal of Animal Ecology* 66: 414–424.

Thomson, D.L., Green, R.E., Gregory, R.D. & Baillie, S.R. (1998) The widespread declines of songbirds in rural Britain do not correlate with the spread of their avian predators. *Proceedings of the Royal Society of London Series B* 265: 2057–2062. Full text

Thornton, M., Todd, I. & Roos, S. (2017) Breeding success and productivity of urban and rural Eurasian sparrowhawks *Accipiter nisus* in Scotland. *Ecoscience* 24: 115–126. doi: 10.1080/11956860.2017.1374322

Thorup, K., Sunde, P., Jacobsen, L.B. & Rahbek, C. (2010) Breeding season food limitation drives population decline of the Little Owl *Athene noctua* in Denmark. *Ibis*

152: 803–814.

Tome, D. & Denac, D. (2012) Survival and development of predator avoidance in the post-fledging period of the Whinchat (*Saxicola rubetra*): consequences for conservation measures. *Journal of Onithology* 153: 131–138.

Tome, D., Denac, D. & Vrezec, A. (2020) Mowing is the greatest threat to Whinchat *Saxicola rubetra* nests even when compare to several natural induced threats. *Journal for Nature Conservation* 54: 125781. doi: 10.1016/j.jnc.2019.125781

Tomé, R. & Valkama, J. (2001) Seasonal variation in the abundance and habitat use of barn owls (*Tyto alba*) on lowland farmland. *Ornis Fennica* 78: 109–118.

Tomotani B.M., van der Jeugd H., Gienapp P., de la Hera I., Pilzecker J., Teichmann C. & Visser M.E. (2018) Climate change leads to differential shifts in the timing of annual cycle stages in a migratory bird. *Global Change Biology* 24: 823–835. doi: 10.1111/gcb.14006

Tompkins, D.M., Draycott, R.A.H. & Hudson, P.J. (2000a) Field evidence for apparent competition mediated via the shared parasites of two gamebird species *Ecology Letters* 3: 10–14.

Tompkins, D., Greenman, J., Robertson, P. & Hudson, P. (2000b) The role of shared parasites in the exclusion of wildlife hosts *Heterakis gallinarum* in the Ring-necked Pheasant and the Grey Partridge. *Journal of Animal Ecology* 69: 829–840.

Toms, M.P. (1997) *Project Barn Owl – evaluation of an annual monitoring programme.* Research Report 177. BTO, Thetford.

Toms, M.P., Crick, H.Q.P. & Shawyer, C.R. (2000) *Project Barn Owl Final Report.* Research Report 197/ HOT Research Report 98/1. BTO/Hawk & Owl Trust, Thetford.

Toms, M.P., Crick, H.Q.P. & Shawyer, C.R. (2001) The status of breeding Barn Owls *Tyto alba* in the United Kingdom 1995–97. *Bird Study* 48: 23–37.

Topping, C.J., Sibly, R.M., Akçakaya, H.R., Smith, G.C. & Crocker, D.R. (2005) Risk assessment of UK Skylark populations using life-history and individual-based models. *Ecotoxicology* 14: 925–936.

Tryjanowski, P. and Kuczyński, L. (1999). Shifting from outdoor to indoor breeding: house martin's (*Delichon urbica*) defence against house sparrow (*Passer domesticus*). *Folia Zoologica* 48: 101-106.

Tryjanowski, P., Sparks, T.H. & Crick, H.Q.P. (2006) Red-backed Shrike (*Lanius collurio*) nest performance in a declining British population: a comparison with a stable population in Poland. *Ornis Fennica* 83: 181–186.

Tucker, G.M. & Heath, M.F. (1994) *Birds in Europe: their conservation status.* Conservation Series no. 3. BirdLife International, Cambridge.

Turner, A. (2009) Climate change: a Swallow's eye view. *British Birds* 102: 3–16.

Tye, A. (1992) Assessment of territory quality and its effects on breeding success in a migrant passerine, the Wheatear *Oenanthe oenanthe*. *Bird Study* 134: 273–285. doi: 10.1111/j.174-919X.1992.tb03810.x

Vafidis, J.O., Vaughan, I.P., Jones, T.H., Facey, R.J., Parry, R. & Thomas, R.J. (2016) The effects of Supplementary Food on the Breeding Performance of Eurasian Reed Warblers *Acrocephalus scirpaceus*; Implications for Climate Change Impacts. *Plos One* 11(7): e0159933. doi: 10.1371/journal.pone.0159933

Vafidis, J., Facey, R., Leech, D. and Thomas, R. (2018) Supplemental food alters nest defence and incubation behaviour of an open-nesting wetland songbird *Journal of Avian Biology*. ISSN 0908-8857 [In Press] Full text

van de Pol, M., Atkinson, P.W., Blew, J., Duriez, O.P.M., Ens, B.J., Hälterlein, B., Hötker, H., Laursen, K., Oosterbeek, K.H., Petersen, A., Thorup, O., Tjørve, K., Triplet, P & Yésou, P. (2014) A global assessment of the conservation status of the nominate subspecies of Eurasian Oystercatcher *Haematopus ostralegus ostralegus*. *International Wader Studies* 20: 47–61.

van der Horst, S., Goytre, F., Marques, A., Santos, S., Mira, A. & Lourenço, R. (2019) Road effects on species abundance and population trend: a case study on tawny owl. *European Journal of Wildlife Research* 65: 277.

van der Wal, R. & Palmer, S.C.F. (2008) Is breeding of farmland wading birds depressed by a combination of predator abundance and grazing? *Biology Letters* 4: 256–258.

van Kleunen, A. & Lemaire, A. (2015) *A risk assessment of Mandarin Duck (Aix galericulata) in the Netherlands. Sovon report 2014/15* Sovon Dutch Centre for Field Ornithology. Nijmegen, The Netherlands.

van Langevelde, F. (2008) Scale of habitat connectivity and colonization in fragmented nuthatch populations. *Ecography* 23: 614–622. doi: 10.1111/j.1600-0587.2000.tb00180.x

van Oosten, H.H., Van Turnhout, C., Hallmann, C.A., Majoor, F., Roodbergen, M., Schekkerman, H., Versluijs, R., Waasdorp, S. & Siepel, H. (2015) Site-specific dynamics in remnant populations of Northern Wheatears *Oenanthe oenanthe* in the Netherlands. *Ibis* 157: 91–102. doi: 10.1111/ibi.12205

van Turnhout, C., Klok, C., Willems, F., Ebbinge, B., Voslamber, B. & Schekkerman, H. (2010) Analysis of population development and effectiveness of management in resident greylag geese *Anser anser* in the Netherlands. *Animal Biology* 60: 373–393. doi: 10.1163/157075610X523260

Vandenberghe, C., Prior, G., Littlewood, N.A., Brooker, R. & Pakeman, R. (2009) Influence of livestock grazing on meadow pipit foraging behaviour in upland grassland. *Basic and Applied Ecology* 10: 662–670. doi: 10.1016/j.baae.2009.03.009

Vanhinsberg, D.P. & Chamberlain, D.E. (2001) Habitat association of breeding Meadow Pipits *Anthus pratensis* in the British uplands. *Bird Study* 48: 159–172. Doi: 10.1080/00063650109461214

Vanhinsbergh, D., Fuller, R. & Noble, D. (2003) *A review of possible causes of recent changes in populations of woodland birds in Britain* Research Report 245. BTO,

Thetford.

Verboom, J., Schotman, A., Opdam, P. & Metz, J.A.J. (1991) European nuthatch metapopulations in a fragmented agricultural landscape. *Oikos* 61: 149–156.

Verhulst, S. (1992) Effects of density, beech crop and winter feeding on survival of juvenile Great Tits: an analysis of Kluyver's removal experiment. *Ardea* 80: 285–292.

Versluijs, M., van Turnhout, C. A. M., Kleijn, D. & van der Jeugd, H.P. (2016) Demographic changes underpinning the population decline of Starlings *Sturnus vulgaris* in The Netherlands. *Ardea* 104: 153–165. doi: 10.5253/arde.v104i2.a7

Verstraeten, G., Baeten, L. & Verheyen, K. (2011) Habitat preferences of European Nightjars *Caprimulgus europaeus* in forest on sandy soils. *Bird Study* 58: 120–129. doi: 10.1080/00063657.2010.547562

Vickery, J.A. (1991) Breeding density of Dippers *Cinclus cinclus*, Grey Wagtails *Motacilla cinerea* and Common Sandpipers *Actitis hypoleucos* in relation to the acidity of streams in south-west Scotland. *Ibis* 133: 178–185.

Vickery, J.A. (1992) The reproductive success of the Dipper *Cinclus cinclus* in relation to the acidity of streams in south-west Scotland. *Freshwater Biology* 28: 195–205.

Vickery, J.A., Sutherland, W.J., O'Brien, M., Watkinson, A.R. & Yallop, A. (1997) Managing coastal grazing marshes for breeding waders and overwintering geese: is there a conflict? *Biological Conservation* 79: 23–34.

Vickery, J.A., Tallowin, J.T., Feber, R.E., Asteraki, E.A., Atkinson, P.W., Fuller, R.J. & Brown, V.K. (2001) The management of lowland neutral grasslands in Britain: effects of agricultural practices on birds and their food resources. *Journal of Applied Ecology* 38: 647–664.

Vickery, J.A., Bradbury, R.B., Henderson, I.G., Eaton, M.A. & Grice, P.V. (2004) The role of agri-environment schemes and farm management practices in reversing the decline of farmland birds in England. *Biological Conservation* 119: 19–39.

Vickery, J.A., Ewing, S.R., Smith, K.W., Pain, D.J., Bairlein, F., Škorpilová, J. & Gregory, R.D. (2014) The decline of Afro-Palaearctic migrants and an assessment of potential causes. *Ibis* 156: 1–22. doi: 10.1111/ibi.12118

Vincent, K.E. (2005) *Investigating the causes of the decline of the urban House Sparrow* Passer domesticus *population in Britain*. Unpublished PhD thesis, De Montfort University. Full text

Visser, M.E. & Both, C. (2005) Shifts in phenology due to global climate change: the need for a yardstick. *Proceedings of the Royal Society B* 272: 2561–2569. Full text

Visser, M.E. & Holleman, L.J.M. (2001) Warmer springs disrupt the synchrony of oak and winter moth phenology. *Proceedings of the Royal Society of London Series B* 268: 289–294. Full text

Visser, M.E., van Noordwijk, A.J., Tinbergen, J.M. & Lessells, C.M. (1998) Warmer springs lead to mistimed reproduction in Great Tits (*Parus major*). *Proceedings of the Royal Society of London Series B* 265: 1867–1870. Full text

Visser, M.E., Holleman, L.J.M. & Caro, S.P. (2009) Temperature has a causal effect on avian timing of reproduction. *Proceedings of the Royal Society B Biological Sciences* 276: 2323–2331.

Vögeli, M., Laiolo, P., Serrano, D. & Tella, J.L. (2011) Predation of experimental nests is linked to local population dynamics in a fragmented bird population *Biology Letters* 7: 954– 957.

von Post, M. & Smith, H.G. (2015) Effects on rural House Sparrow and Tree Sparrow populations by experimental nest-site addition. *Journal of Ornithology* 156: 231–237.

Wade, H.M., Masden, E.A., Jackson, A.C. & Furness, R.W. (2016) Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments. *Marine Policy* 70: 108–113.

Walker, L.A., Chaplow, J.S., Llewellyn, N.R., Pereira, M.G., Potter, E.D., Sainsbury, A.W. & Shore, R.F. (2013) *Anticoagulant rodenticides in predatory birds 2011: a Predatory Bird Monitoring Scheme (PBMS) report.* Centre for Ecology & Hydrology, Lancaster. Full text

Walker, L.A., Chaplow, J.S., Llewellyn, N.R., Pereira, M.G., Potter, E.D., Sainsbury, A.W. & Shore, R.F. (2014) *Anticoagulant rodenticides in predatory birds 2012: a Predatory Bird Monitoring Scheme (PBMS) report.* Centre for Ecology & Hydrology, Lancaster. Full text

Walker, L.A., Jaffe, J.E., Barnett, E.A., Chaplow, J.S., Charman, S., Giela, A., Hunt, A.G., Jones, A., Pereira, M.G., Potter,E.D., Sainsbury, A.W., Sleep, D., Senior, C., Sharp, E.A., Vyas, D.F. & Shore, A.F. (2019) *Anticoagulant rodenticides in red kites Milvus milvus in Britain in 2017 and 2018* Lancaster, NERC/Centre for Ecology & Hydrology. Full text

Walls, S. & Kenward, R. 2020. *The Common Buzzard*. T & AD Poyser, London.

Walsh, P.M.. Brindley, E. &Heubeck, M. (1995) *Seabird numbers and breeding success in Britain and Ireland, 1994*.JNCC, Peterborough.

Wanless, S., Harris, M.P., Redman, P.& Speakman, J.R. (2005) Low energy values of fish as a probable cause of a major seabird breeding failure in the North Sea. *Marine Ecology Progress Series* 294: 1–8.

Ward, R.M., Cranswick, P.A., Kershaw, M., Austin, G.E., Brown, A.W., Brown, L.M., Coleman, J.T., Chisholm, H.K. & Spray, C.J. (2007) Numbers of Mute Swans *Cygnus olor* in Great Britain: results of the national census in 2002. *Wildfowl* 57: 3–20.

Warren, P., Hornby, T. & Baines, D. (2017) Habitat use, nest-sites and chick diet of Grey Partridge *Perdix perdix* on hill farms in north east England. *Bird Study* 64: 138–145 doi: 10.1080/00063657.2017.1306485

Watson, A., Perkins, A.J., Maggs, H.E. & Wilson, J.D. (2009) Decline of Corn Buntings *Emberiza calandra* on east Scottish study areas in 1989-2007. *Bird Study* 56:

213–220.

Watson, M., Aebischer, N.J., Potts, G.R. & Ewald, J.A. (2007) The relative effects of raptor predation and shooting on overwinter mortality of grey partridges in the United Kingdom. *Journal of Applied Ecology* 44: 972–982.

Werritty, A., Hester, A., Jameson, A., Newton, I.. Oddy, M. & Reid, C. (2019) *Grouse Moor Management Review Group. Report to Scottish Government* Scottish Government. Full report

Wesolowski, T. (1985) The breeding ecology of the Wood Warbler *Phylloscopus sibilatrix* in primeval forest. *Ornis Scandinavica* 16: 49–60.

Wesolowski, T. & Maziarz, M. (2009) Changes in breeding phenology and performance of Wood Warblers *Phylloscopus sibilatrix* in a primeval forest: a thirty-year perspective. *Acta Ornithologica* 44: 69–80.

Wesolowski, T. & Stawarczyk, T. (1991) Survival and population dynamics of Nuthatches *Sitta europaea* breeding in natural cavities in a primeval temperate forest. *Ornis Scandinavica* 22: 143–154.

Wesolowski, T. & Tomialojc, L. (1986) The breeding ecology of woodpeckers in a temperate primaeval forest – preliminary data. *Acta Ornithologica* 22: 1–21.

White, P.J., Stoate, C., Szczur, J. & Norris, K. (2014) Predator reduction with habitat management can improve songbird nest success *Journal of Wildlife Management* 78: 402–412.

Whitfield, D., Fielding, A. & Whitehead, S. (2008) Long-term increase in the fecundity of Hen Harriers in Wales is explained by reduced human interference and warmer weather. *Animal Conservation* 11: 144–152.

Whittingham, M.J., Percival, S.M. & Brown, A.F. (2001) Habitat selection by golden plover *Pluvialis apricaria* chicks. *Basic & Applied Ecology* 2: 177–191.

Whittingham, M.J., Swetnam, R.D., Wilson, J.D., Chamberlain, D.E. & Freckleton, R.P. (2005) Habitat selection by yellowhammers *Emberiza citrinella* on lowland farmland at two spatial scales: implications for conservation management. *Journal of Applied Ecology* 42: 270–290. Abstract/Full text

Wiktander, U., Nilsson, I., Nilsson, S., Olsson, O., Pettersson, B. & Stagen, A. (1992) Occurrence of the Lesser Spotted Woodpecker *Dendrocopos minor* in relation to area of deciduous forest. *Ornis Fennica* 69: 113–118.

Wiktander, U., Olsson, O. & Nilsson, S. G. (2001) Annual and seasonal reproductive trends in the Lesser Spotted Woodpecker *Dendrocopos minor*. *Ibis* 143: 72–82.

Wilkinson, N. (2010) Factors influencing the small-scale distribution of House Sparrows *Passer domesticus* in a suburban environment. *Bird Study* 53: 39–46. doi: 10.1080/00063650609461414

Wilson, A.M. & Vickery, J.A. (2005) Decline in Yellow Wagtail *Motacilla flava flavissima* breeding on lowland wet grassland in England and Wales between 1982 and 2002. *Bird Study* 52: 88–92.

Wilson, A.M., Marchant, J.H., Gregory, R.D., Siriwardena, G.M. & Baillie, S.R. (1998) *Enhancements for monitoring of opportunistic bird populations.* Research Report 200. BTO, Thetford.

Full text (PDF, 1.66 MB)
Wilson, A.M., Vickery, J.A. & Browne, S.J. (2001) Numbers and distribution of Northern Lapwings *Vanellus vanellus* breeding in England and Wales in 1998. *Bird Study* 48: 2–17.

Wilson, A.M., Henderson, A.C.B. & Fuller, R.J. (2002) Status of the Common Nightingale *Luscinia megarhynchos* in England at the end of the 20th century with particular reference to climate change. *Bird Study* 49: 193–204. doi: 10.1080/00063650209461266

Wilson, A.M., Ausden, M. & Milsom, T.P. (2004) Changes in breeding wader populations on lowland wet grasslands in England and Wales: causes and potential solutions. *Ibis* 146: 32–40.

Wilson, A.M., Vickery, J.A., Brown, A., Langston, R.H.W., Smallshire, D., Wotton, S. & Vanhinsbergh, D. (2005a) Changes in the numbers of breeding waders on lowland wet grasslands in England and Wales between 1982 and 2002. *Bird Study* 52: 55–69. doi: 10.1080/00063650509461374

Wilson, A.M., Fuller, R.J., Day, C. & Smith, G. (2005b) Nightingales *Luscinia megarhynchos* in scrub habitats in the southern fens of East Anglia, England: associations with soil type and vegetation structure. *Ibis* 147: 498–511.

Wilson, A., Vickery, J. & Pendlebury, C. (2007) Agri-environment schemes as a tool for reversing declining populations of grassland waders: mixed benefits from environmentally sensitive areas in England. *Biological Conservation* 136: 128–135.

Wilson, J.D. (2001) Weeds as a food resource for farmland birds: what, where and how many should we leave? *BCPC Conference – Weeds 2001*, 1–2: 391–398.

Wilson, J. (2005) Removal of grass by scraping to enhance nesting areas for breeding waders at Leighton Moss RSPB reserve, Lancashire, England *Conservation Evidence* 2: 60–61.

Wilson, J.D., Taylor, R. & Muirhead, L.B. (1996) Field use by farmland birds in winter: an analysis of field type preferences using resampling methods *Bird Study* 43: 320–332.

Wilson, J.D., Evans, J., Browne, S.J. & King, J.R. (1997) Territory distribution and breeding success of skylarks *Alauda arvensis* on organic and intensive farmland in Southern England. *Journal of Applied Ecology* 34: 1462–1478. Abstract

Wilson, J.D., Morris, A.J., Arroyo, B.E., Clark, S.C. & Bradbury, R.B. (1999) A review of the abundance and diversity of invertebrate and plant foods of granivorous birds in northern Europe in relation to agricultural change. *Agriculture, Ecosystems & Environment* 75: 13–30.

Wilson, J.D., Boyle, J., Jackson, D.B., Lowe, B. & Wilkinson, N.I. (2007) Effect of cereal harvesting method on a recent population decline of Corn Buntings *Emberiza calandra* on the Western Isles of Scotland. *Bird Study* 54: 362–370.

Wilson, J.M. & Cresswell, W. (2006) How robust are Palearctic migrants to habitat loss and degradation in the Sahel? *Ibis* 148: 789–800.

Wilson, M.W., Austin, G.E., Gillings, S. & Wernham, C.V. (2015) *Natural Heritage Zone Bird Population Estimates.* Commissioned report SWBSG_1504. Scottish Windfarm Bird Steering Group. Full text

Wilson, M.W., Fernández-Bellon, D., Irwin, S. & O'Halloran, J. (2017) Hen Harrier *Circus cyaneus* population trends in relation to wind farms. *Bird Study* 64: 20–29. doi: 10.1080/00063657.2016.1262815

Wilson, M.W., Balmer, D.E., Jones, K., King, V.A., Raw, D., Rollie, C.J., Rooney, E., Ruddock, M., Smith, G.D., Stevenson, A., Stirling-Aird, P.K., Wernham, C.V. Weston, J.M. & Noble, D.G. (2018) The breeding population of Peregrine Falcon *Falco peregrinus* in the United Kingdom, Isle of Man and Channel Islands in 2014. *Bird Study* 65: 1–19. doi: 10.1080/00063657.2017.1421610

Wilson, M.W., Cook, A.S.C.P., Horswill, C., Robinson, R.A. & Wernham, C.V. 2019 *Population modelling for the Scottish Northern raven population* Scottish Natural Heritage Research Report No. 1012. Full report

Winiger, N., Korner, P., Arlettaz, R., Jacot, A. (2018) Vegetation structure and decreased moth abundance limit the recolonisation of restored habitat by the European Nightjar. *Rethiking Ecology* 3: 25–39. doi:10.3897/rethinkingecology.3.29338

Winkler, D.W., Jørgensen, C., Both, C., Houston, A.I., McNamara, J.M., Levey, D.J., Partecke, J., Fudickar, A., Kacelnik, A., Roshier, D. & Piersma, T. (2014) Cues, strategies, and outcomes: how migrating vertebrates track environmental change. *Movement Ecology* 2: 10. Full text

Winstanley, D., Spencer, R. & Williamson, K. (1974) Where have all the Whitethroats gone? *Bird Study* 21: 1–14.

Wittwer, T., O'Hara, R.B., Caplat, P., Hickler, T. & Smith, H.G. (2015) Long-term population dynamics of a migrant bird suggests interaction of climate change and competition with resident species. *Oikos* 124: 1151–1159.

Wood, K.A., Stillman, R.A, Daunt, F. & O'Hare, M.T. (2014) Chalk streams and grazing mute swans. *British Wildlife* 25: 171–176.

Wood, K.A., Brown, M.J., Cromie, R.L., Hilton, G.M., Mackenzie, C., Newth, J.L., Pain, D.J., Perrins, C.M. & Rees, E.C. (2019) Regulation of lead fishing weights results in mute swan population recovery. *Biological Conservation* 230: 67–74. doi: 10.1016/j.biocon.2018.12.010

Woodward, I.D., Frost, T.M., Hammond, M.J., and Austin, G.E. (2019). *Wetland Bird Survey Alerts 2016/2017: Changes in numbers of wintering waterbirds in the Constituent Countries of the United Kingdom, Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSIs) and Areas of Special Scientific interest (ASSIs).* BTO Research Report 721. BTO, Thetford. www.bto.org/webs-reporting-alerts

Woodward, I., Aebischer, N., Burnell,D., Eaton, M., Frost, T., Hall, C., Stroud, D. & Noble, D. (2020) Population estimates of birds in Great Britain and the United Kingdom. *British Birds* 113: 69–104

Wotton, S.R. & Gillings, S. (2000) The status of breeding Woodlarks *Lullula arborea* in Britain in 1997. *Bird Study* 47: 212–224. doi: 10.1080/00063650009461176

Wotton, S., Gibbons, D.W., Dilger, M. & Grice, P.V. (1998) Cetti's Warblers in the United Kingdom and the Channel Islands in 1996. *British Birds* 91: 77–89.

Wotton, S.R., Langston, R.H.W. & Gregory, R.D. (2002a) The breeding status of the Ring Ouzel *Turdus torquatus* in the UK in 1999. *Bird Study* 49: 26–34.

Wotton, S.R., Carter, I., Cross, A.V., Etheridge, B., Snell, N., Duffy, K., Thorpe, R. & Gregory, R.D. (2002b) Breeding status of the Red Kite *Milvus milvus* in Britain in 2000. *Bird Study* 49: 278–286.

Wotton, S.R., Stanbury, A.J., Douse, A. & Eaton, M.A. (2016) The status of the Ring Ouzel *Turdus torquatus* in the UK in 2012. *Bird Study* 63: 155–164. doi: 10.1080/00063657.2016.1159180

Wotton, S.R., Bladwell, S., Mattingley, W., Morris, N.G., Raw, D., Ruddock, M., Stevenson A. & Eaton, M.A. (2018) Status of the Hen Harrier *Circus cyaneus* in the UK and Isle of Man in 2016. *Bird Study 65: 145–160.* doi: 10.1080/00063657.2018.1476462

Wright, L.J. (2006) Demography and productivity of Woodlarks *Lullula arborea* in Breckland. PhD Thesis. University of East Anglia.

Wright, L.J., Hoblyn, R.A., Sutherland, W.J. & Dolman, P.M. (2007) Reproductive success of Woodlarks *Lullula arborea* in traditional and recently colonized habitats. *Bird Study* 54: 315–323. doi: 10.1080/00063650709461491

Wright, L.J., Hoblyn, R.A., Green, R.E., Bowden, C.G.R., Mallord, J.W., Sutherland, W.J. & Dolman, P.M. (2009) Importance of climatic and environmental change in the demography of a multi-brooded passerine, the Woodlark *Lullula arborea*. *Journal of Animal Ecology* 78: 1191–1202. doi: 10.1111/j.1365-2656.2009.01582.x

Wright, P.M. (2005) *Merlins of the south-east Yorkshire Dales.* Tarnmoor, Skipton.

Wyllie, I. & Newton, I. (1991) Demography of an increasing population of Sparrowhawks. *Journal of Animal Ecology* 60: 749–766.

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.

Yom-Tov, Y. (1974) The effect of food and predation on breeding density and success, clutch size and laying date of the crow (*Corvus corone* L.). *Journal of Animal Ecology* 43: 479–498.

Young, J.C., McCluskey, A., Kelly, S.B.A., O'Donohue, B., Donaghy, A.M., Colhoun, K. & McMahon, B.J. 2020. A transdisciplinary approach to a conservation crisis: A case study of the Eurasian Curlew (*Numenius arquata*) in Ireland. *Conservation Science and Practice* 2: e206. doi: 10.1111/csp2.206

Zielonka, N.B., Hawkes, R.W., Jones, H., Burnside, R.J. & Dolman, P.M. 2019. Placement, survival and predator identity of Eurasian Curlew *Numenius arquata* nests on lowland grass-heaths. *Bird Study* 66: 471–483

Zmihorski, M., Altenburg-Bacia, D., Romanowski, J., Kowalski, M. & Osojca, G. (2006) Long-term decline of the little owl (*Athene noctua* Scop., 1769) in central Poland. *Polish Journal of Ecology* 54: 321–324.

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BirdTrends 2020: trends in numbers, breeding success and survival for UK breeding birds.

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Woodward, I.D., Massimino, D., Hammond, M.J., Barber, L., Barimore, C., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Baillie, S.R. & Robinson, R.A. 2020. BirdTrends 2020: trends in numbers, breeding success and survival for UK breeding birds.. *BTO Research Report* **732**, BTO, Thetford, UK.

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