BBS

The Breeding Bird Survey 2020 *incorporating the Waterways Breeding Bird Survey*

Monitoring the UK's birds with the Breeding Bird Survey and Waterways Breeding Bird Survey

BTO Looking out for birds

JNCC

rspb giving nature a home

THE 2020 BBS REPORT

THE BBS PARTNERSHIP

The BTO/JNCC/RSPB Breeding Bird Survey is a partnership jointly funded by BTO, RSPB and JNCC, with fieldwork conducted by volunteers. The Breeding Bird Survey (BBS) now incorporates the Waterways Breeding Bird Survey (WBBS).

The members of the BBS Steering Committee in 2020 were James Pearce-Higgins (Chair, BTO), Dawn Balmer (BTO), Mark Eaton (RSPB), Simon Gillings (BTO), David Noble (BTO) and Paul Woodcock (JNCC).

British Trust for Ornithology

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THE BBS TEAM AT BTO

Sarah Harris is the BBS National Organiser and first point of contact for BBS or WBBS queries. Sarah is responsible for the day-to-day running of these surveys, liaising with BTO Regional Organisers and volunteers, maintaining the databases, promoting the schemes, and producing the annual report.

Dario Massimino, Research Ecologist in the Population Ecology and Modelling Team, produced the English bird population trends for 2020. David Noble is the Principal Ecologist for Monitoring, responsible for strategic developments in biodiversity monitoring. Dawn Balmer is Head of Surveys, which includes both BBS and WBBS, among other surveys. Maria Knight, Secretary in the Science Department, works closely with Sarah assisting with the running of the surveys. Simon Gillings oversees the BBS and WBBS research programmes, and James Pearce-Higgins is the Director of Science.

ONLINE RESOURCES

- Further information, including population trend graphs, can be found at www.bto.org/bbs.
- A full species-by-species discussion of BBS and WBBS trends, results from other surveys, and related research and conservation advice can be found on the BirdTrends website at www.bto.org/birdtrends.
- This report can be downloaded from www.bto.org/bbs-report.

Contact the BBS National Organiser

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Tweet us @BBS_birds

ACKNOWLEDGEMENTS

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We acknowledge the support of the Northern Ireland Environment Agency, who have funded professional fieldworkers to cover 52 squares in Northern Ireland. Natural England, NatureScot and Forestry Commission Scotland have contributed to additional surveys on Upland BBS and Scottish Woodland BBS squares in previous years. We are very grateful to the RSPB for funding the initial development of BBS Online, and to the BTO Information Systems Team who have continued to develop the system and provide technical support.

The founder sponsors of the 1998 WBBS pilot year were Thames Water, British Waterways, Severn Trent, Hyder (Welsh Water) and Anglian Water. Since then surveys have been funded by the Environment Agency, BTO, JNCC and RSPB and sponsored by Severn Trent, Anglian Water and by Essex & Suffolk Water. The WBBS was adopted into the BBS Partnership in 2017.

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INSIDE...

This is the twenty-sixth annual report of the BTO/JNCC/RSPB Breeding Bird Survey (BBS) and Waterways Breeding Bird Survey (WBBS), documenting these two surveys during the period 1994–2020 and 1998–2020 respectively. This report also presents the population trends of widespread breeding bird species in England. These are the main schemes for monitoring the population changes of the UK's common breeding birds, providing an important indicator of the health of the countryside.

STOCK DOVE: EDMUND FELLOWES/BTO

CITATION

Harris, S.J., Massimino, D., Balmer, D.E., Eaton, M.A., Noble, D.G., Pearce-Higgins, J.W., Woodcock, P. & Gillings, S. 2021. *The Breeding Bird Survey 2020.* BTO Research Report 736. British Trust for Ornithology, Thetford.

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The latest news from the Breeding Bird Survey

A year hit by the COVID-19 pandemic results in a limited suite of population trends, butterfly recording impacted to a lesser extent, and a time to reflect on the importance of the Breeding Bird Survey, Waterways Breeding Bird Survey and all the 'add-on' elements.

By **Sarah Harris**, BBS National Organiser, BTO

Given the circumstances and limitations for surveying in 2020, an impressive 2,025 squares were surveyed at least once for the BBS. The Wider Countryside Butterfly Survey coverage on BBS squares was down by 60 squares (112 with BBS and Butterfly Conservation squares combined) following a bumper year for coverage in 2019. Here's to a brighter 2021!

In this year's report population trends are presented where possible, but the main focus is to present some of the alternative uses of BBS data, beyond the population trends themselves, such as the various research projects taking place using BBS data. An explanation as to the impacts of the COVID-19 pandemic on the survey's dataset is also presented, highlighting what has been done to make the most of the data collected.

The BBS is a long-term survey and setbacks, such as that seen in the foot-and-mouth year of 2001 and now, in 2020, will not greatly impact the monitoring of the UK's birds, mammals, habitats, butterflies, day-flying moths and Odonata in the longer term. To all who took part in 2020, thank you and to all who could not take part, thank you for your continued support.

REGIONAL ORGANISERS

One of the highlights of 2020, in the middle of a pandemic, was the chance to embrace the world of virtual meetings and to arrange several virtual training sessions with the BTO Regional Organisers (ROs) who manage this survey locally. It was fantastic to see so many friendly faces and to chat about the survey management and BBS Online system. The BBS wouldn't be the survey it is today without the hard work and dedication of the Regional Organisers, and we look forward to more virtual training sessions and catch-ups in the future.

BBS ONLINE: DEVELOPMENTS

The BBS data entry system is regularly maintained and is currently undergoing redevelopment in order to make use even easier for volunteers, the Regional Organisers and the National Organiser at BTO HQ.

Many of the additions are to provide the Regional Organisers with the tools they need to manage the majority of the survey from within the BBS online application, to be able to see and store volunteer preferences (with regards to things such as receiving paper recording forms, willingness to assist with mentoring potential BBS volunteers, whether they are taking part in the WCBS), to better track route changes on squares going forwards, and more!

Another addition is the option for volunteers to see the average dates, both for visits on a square over the lifetime of the survey and since the allocated volunteer took on the given square. Analysis of the 2020 data showed that many visits were outside of the usual visit dates for the square and could change the 'normal average'. As such, 2020 dates are excluded from these average dates. Consistency with visit timing is important, as highlighted on pages 22–23. It is hoped that displaying the average dates on the system will assist volunteers in deciding when to visit their squares.

In Northern Ireland and the Channel Islands, a Road Map layer for the mapping pages of BBS Online is a planned addition in the coming months, and should make viewing the square online easier in the absence of the OS map layer enjoyed by the rest of the UK.

Further developments are underway and largely cater for the ROs. Guidance will be kept updated on how to use BBS Online at www.bto.org/bbs-online and volunteers and ROs will always be kept informed.

UPDATING PREFERENCES ONLINE

Volunteers are requested to ensure preferences are up to date within BBS Online, or via their RO, who can then update the system on their behalf.

Recording form preferences, how many BBS Reports are received and preferences surrounding the WCBS and mentoring can all be stored within BBS Online. This helps ensure everything is in place ahead of surveys. Preference options can be found in BBS Online, under 'Details and Settings'.

ADDING TO THE MIX

Over the years, the Breeding Bird Survey has changed, developed and expanded, all whilst maintaining that all-important core consistency vital for any long-term monitoring scheme. This means that with any change, great care was needed to ensure impact on those core elements of the scheme – from the basic methodological requirements (time, date, route, counts) through to not distracting or changing observational behaviours – were all carefully considered ahead of implementing anything new. The result is a host of 'additional extras' volunteers can choose to take part in, all adding to the data collected during a visit or from a site, without impacting on the core survey principles or forcing additional efforts on all volunteers.

Mammal Monitoring

The oldest addition to the BBS, the facility to record sightings of live mammals and their field-signs, or to indicate the presence of a species based on local knowledge, was introduced in 1995 and now makes a major contribution the survey. Mammal counts are made in around 90% of BBS squares, allowing population trends to be produced for nine species. Pages 30–31 cover mammal recording news, coverage and sightings for 2020.

Wider Countryside Butterfly Survey

The Wider Countryside Butterfly Survey (WCBS) was introduced to BBS squares in 2009, following two pilot years. The BBS route and method is similar to the WCBS approach; 200 m sectors along two transects, on a stratified random sample of sites. This provides a great opportunity to gather bird and butterfly data from the same sites. Volunteers are encouraged to revisit their transects later in the day, between May and August, to walk the BBS route and record butterflies, day-flying moths and Odonata. For more information, visit www.bto.org/butterflies.

Upland Adjacent – *for eligible BBS squares*

In 2010, steps were made to increase recording in hard to reach upland areas of the UK. Upland squares often require a long walk in, so to capitalise on this effort a second square is 'bolted on', ideally to the south of the core BBS square and surveyed during the same visit. This maximises the return for the effort in reaching these often remote squares.

Upland Adjacent squares can only be added to 'eligible' core BBS squares and this is based on ITE Land Classes codes. Any volunteers who think they are allocated a potentially eligible square and are interested in covering an adjacent square, contact bbs@bto.org to check eligibility.

Detection Type

Since 2014, recording how each individual bird on a BBS visit was first detected – by song, call or visually – has become second nature to many BBS volunteers and this information is now collected on c.80% of BBS squares.

Knowing how birds are detected, and ultimately, the probability of recording an individual – depending on species and/or sex – can help us to better estimate abundance by understanding what we are missing!

Breeding Wader Visits

New for 2021, volunteers who record waders on their official BBS visits have the opportunity to contribute to wader research by completing an additional third (or more!) visit between mid-June and mid-July, after their second ('Late') BBS visit, to collect information on wader breeding success. Through this trial we aim to inform and develop a simple methodology to obtain critical information on wader breeding success in different areas. To take part, visit www.bto.org/bbs-waders.

STANDARD SURVEY METHOD REMINDERS

Visit timing: the date of visits should be as consistent as possible year-on-year and with four weeks between Early and Late visits. Visits should start between 6 and 7am, although in remote areas we understand this isn't always possible. Two visits are vital in order to collect data for all species, from the early singers to the later 'arrivers'. The exception being for Upland Rovers squares.

Adult birds only: Sometimes easier said than done, especially during Late visits, but only adult birds are counted during the BBS. When encountering flocks, an estimate of the proportion of juvenile birds to be deducted from the total flock count may need to be calculated.

Colonies: Estimates of the number of Apparently Occupied Nests should be made for colonial nesting species for the 1 km square, as a whole. Adult birds of such species should also be counted along transects, in sector and distance bands as normal.

Birds on the move: Where possible, known individual birds, recorded in one sector and then detected in a later sector, should only be recorded once, on the first encounter.

Entering data: Data must be submitted either online (via BBS Online) or on paper forms posted to ROs or BTO HQ in Thetford by the end of August. We will always accept unentered data from previous years as these can be added to the 'pot' for future analysis.

NUTHATCH: LIZ CUTTING/BTO, BROWN HARE: JOHN HARDING/BTO, HOUSE MARTIN: JOHN W WALTON/BTO, LAPWING: ALLAN DREWITT/BTO, PAINTED LADY: LIZ CUTTING/BTO, NARROW-BORDERED FIVE-SPOT BURNET: EDMUND FELLOWES/BTO

Coverage and sightings in 2020

In 2020, challenges and considerations were plentiful due to the COVID-19 pandemic. Government legislation through to personal circumstances meant that for many, surveying for the BBS was not an option. We do appreciate the efforts of those who did manage a visit or two and are so grateful to everyone for their continued support.

COVERAGE LOW

Rather predictably and unavoidably, coverage was low and work by Research Ecologists and Statisticians has been extensive to make the most of the data collected. Further explanation as to what that means in practice can be found on pages 10 and 11, followed by limited trends for England only.

Here coverage is reviewed for the UK. The data gathered in 2020 will always be available for research where the coverage and timing biases do not prevent its use. Thankfully, statistical knowledge is always evolving and as the BBS contributes to such a wide breadth of research, nothing will be wasted.

BETTER THAN EXPECTED

Coverage in 2020 was about half the number of squares covered in recent years, which was more than expected. Geographically, this coverage was greatest in England, due largely to differences in government regulations and the timing of lockdown restrictions.

COMPARISONS

In 2019, 92% of all BBS squares were surveyed twice. In 2020, this figure was 18%; 85 Early visits, 1,578 Late visits and 362 both visits. In 2019, 2,772 volunteers participated in the BBS and in 2020, 1,442 volunteers took part.

Figure 1 The number of squares, by visit, surveyed for BBS across the UK.

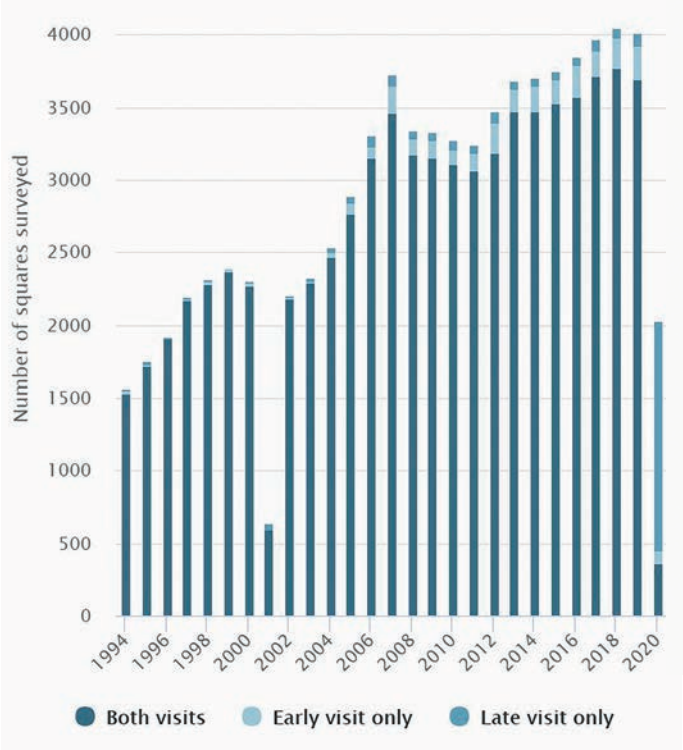


Figure 2 The number of volunteers participating in the BBS across the UK.

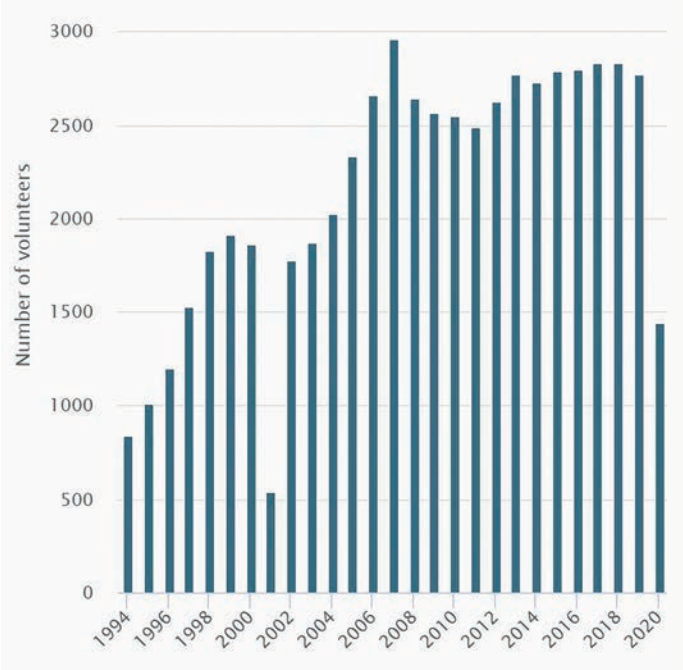


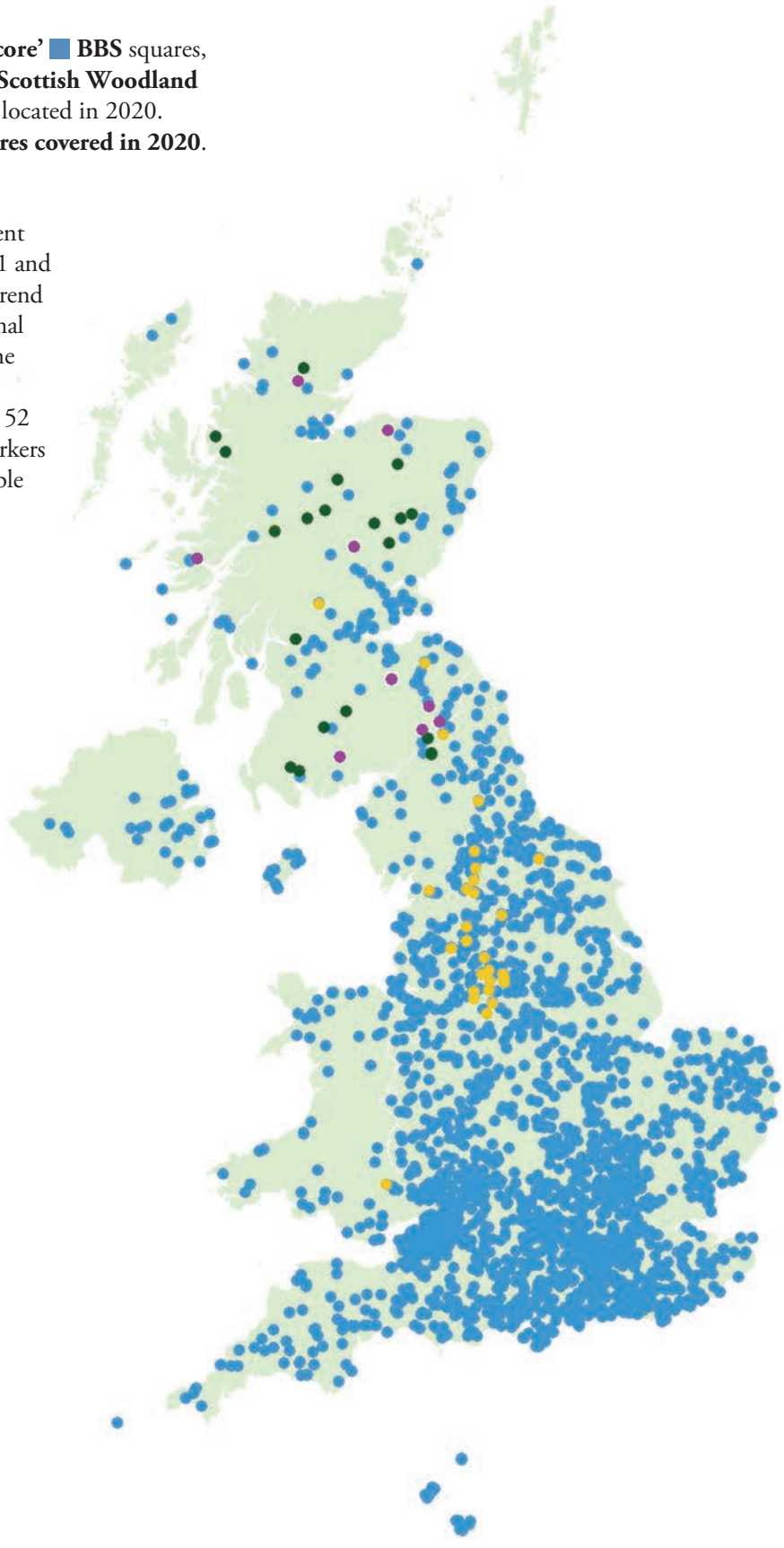
Table 1 The number of BBS squares with data received to date.

	1994	1995	1996	1997	1998	1999	2000	2001*	2002	2003	2004	2005
England	1,172	1,321	1,420	1,657	1,712	1,791	1,749	532	1,652	1,738	1,884	2,180
Scotland	245	283	308	313	309	275	246	78	231	255	273	305
Wales	122	121	116	138	192	223	213	22	215	214	253	271
Northern Ireland	25	17	65	75	85	95	83	-	97	109	102	120
Channel Islands	1	1	7	6	7	7	7	7	7	7	11	13
Isle of Man	4	4	4	6	6	5	3	-	3	4	6	3
UK total	**1,569**	**1,747**	**1,920**	**2,195**	**2,311**	**2,396**	**2,301**	**639**	**2,205**	**2,327**	**2,529**	**2,892**

COVERAGE OVERVIEW

This coverage map illustrates where the **1,967 'core'** **BBS** squares, **29 'add-on'** **Upland Adjacent** squares, **9** **Scottish Woodland** squares and **20** **Upland Rovers** squares were located in 2020. Combined, these make up the **2,025 BBS squares covered in 2020**.

Squares covered between 2006 and 2013 for the Upland BBS and Scottish Woodland BBS Adjacent schemes are not included in Table 1 and Figures 1 and 2, but data from these schemes do feed into the trend analysis. These squares were covered by professional fieldworkers and are no longer available within the BBS square-set. They therefore do not represent ongoing volunteer coverage efforts or the current 52 core BBS squares covered by professional fieldworkers in Northern Ireland (although this was not possible in 2020). Please see pages 11 and 15 for more information on these schemes and square 'types'.



STATS BOX

2,025 squares
surveyed in 2020

362 surveyed twice
in 2020; 85 Early and 1,578 Late only

4,669.6 km
walked during active surveying along transects in 2020

304,536.6 km
ever walked during active surveying for the BBS since 1994

197 bird species
recorded during the 2020 BBS, 13 species recorded for Colony Counts

64 species of bird
recorded on one square northwest of Swindon in 2020

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020**
2,569	2,822	2,556	2,569	2,565	2,537	2,670	2,729	2,733	2,832	2,875	2,948	2,990	2,934	1,757
336	487	405	397	331	358	383	471	482	476	490	524	581	608	156
272	269	242	235	246	223	274	331	339	341	333	338	330	324	58
107	129	121	116	115	110	117	127	120	78	127	131	119	119	28
19	16	15	17	16	15	21	26	27	23	24	28	20	21	17
5	4	1	-	-	-	4	-	-	3	2	3	4	8	9
3,308	**3,727**	**3,340**	**3,334**	**3,273**	**3,243**	**3,469**	**3,684**	**3,701**	**3,753**	**3,851**	**3,972**	**4,044**	**4,014**	**2,025**

**2001: foot-and-mouth disease **2020: COVID-19*

UPLAND ADJACENT COVERAGE

In recent years, a focus on increasing coverage in upland and remote areas has been at the fore. Initially, Upland Adjacent squares were advertised as a possibility, whereby volunteers could add a second square, ideally to the south, of their existing core square to collect twice as much data during the often arduous trip. The catch being that the core square needs to be categorized as an upland-type area in ITE Land Classes codes. Coverage has been stable, but there is scope to increase awareness of 'eligible' core squares and revive this option – possibly beyond the peak coverage of 112 squares in 2016. In 2020, 29 Upland Adjacent squares were covered. See Figure 3.

UPLAND ROVERS COVERAGE

Rarely, if ever, covered BBS squares have been selected to form part of the Upland Rovers set since 2017. The suite of carefully selected squares are in need of coverage in order to provide a more representative trend for certain upland species. Two visits are encouraged but these can be carried out by different surveyors and there is no long-term commitment – it could be one visit. This is completely unlike core BBS squares, where consistent year-on-year visits, twice a year, are paramount to provide the gold standard, consistent data that give BBS its strength. But the need for coverage in these areas means it is a vital compromise for these carefully selected squares. Coverage has increased year-on-year, with 125 in 2019 and curtailed somewhat by COVID-19 in 2020, with 20 covered. See Figure 4.

WIDER COUNTRYSIDE BUTTERFLY SURVEY

This involves revisits to BBS squares, and visits to Butterfly Conservation (BC) squares, to monitor butterflies along transect routes which feed into the WCBS. On average between 2009 and 2019, 9% of BBS squares received visits for the WCBS. Contributions to this survey from BBS squares peaked in 2013 with 374 BBS squares covered, and with BBS and BC squares combined, the grand WCBS total in 2013 was 857 squares. In 2020, 251 BBS squares and 466 BC squares were surveyed. See Figure 5.

SIGHTINGS IN 2020

One hundred and ninety-seven bird species were recorded during BBS in 2020. On average, squares had 26 bird species recorded: 51 squares recorded fewer than 10 bird species, nine squares recorded 50 or more and the highest count was 64 on a square near Swindon. On Upland Rovers squares, species counts ranged from three to 25. Yet, each and every square is as valuable as the next!

Species varied from nice surprises, such as Cattle Egret, Little Stint and Black Redstart, the free-flying Red-tailed Hawk in southern England and the Short-toed Treecreeper on the Channel Islands, which feel like old friends in the annual records, through to 50,991 individual Woodpigeon and 23,277 Blackbird!

Figure 3 Upland Adjacent square coverage – squares joined to core BBS squares (2010–2020).

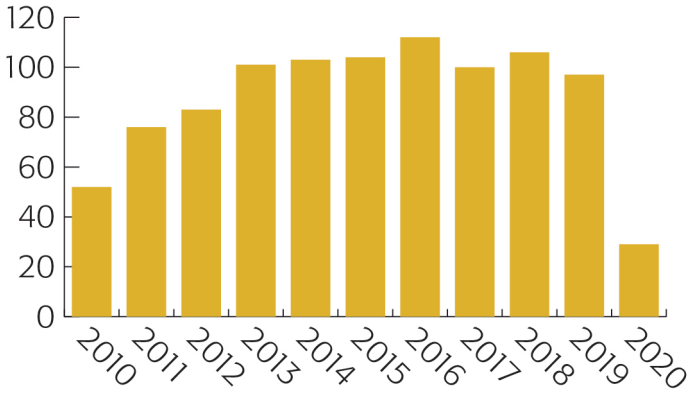


Figure 4 Upland Rover coverage (2017–2020).

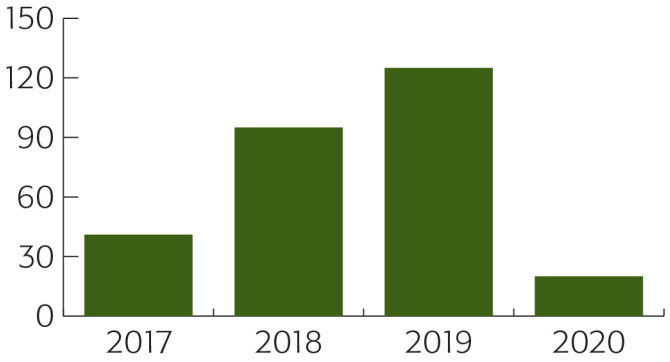
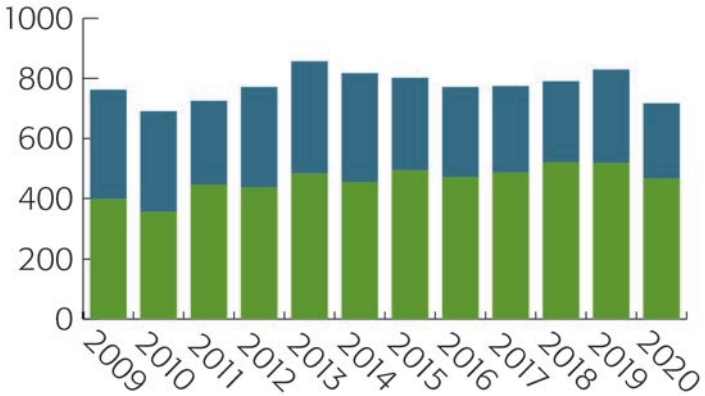
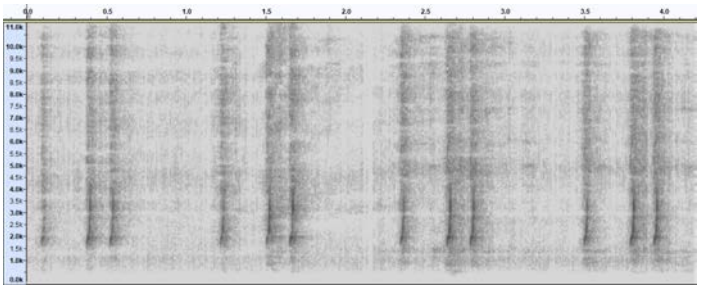


Figure 5 Wider Countryside Butterfly Survey coverage on BBS squares, at the top **in blue**, and Butterfly Conservation squares at the bottom of the bar, **in green**. (2009–2020).



A total of 10 records of Quail were submitted from BBS squares in 2020. One was recorded in Worcestershire and the sonogram can be seen below. You never know what might turn up on a BBS square! ▼



QUAIL SONOGRAM: SIMON EVANS

DETECTION TYPE

In 2014, when the option of recording how birds were first detected (song, call or visually) was introduced, this information was collected on 67% of squares. In 2019, this percentage had risen to 81% of squares. Maintaining the percentage increases, it is encouraging to see that in 2020, 83% of squares surveyed included Detection Type information.

COLONY RECORDING

Thirty-three bird species have been recorded for Colony Counts since the BBS started in 1994, whereby in addition to counting adult birds along the transects, any colonies within the 1 km square are recorded by submitting a count of Apparently Occupied Nests.

The most commonly recorded of the 13 colonial species submitted in 2020 was Rook, on 75 squares, followed by House Martin on 20 squares. Compared with the most recent normal year of surveying, 2019, when Rook were recorded on 361 squares and House Martin on 52 squares – being the most- and second-most record colonial species respectively. Jackdaw also features heavily in the Colony Counts, on 16 squares in 2020 and 35 in 2019 – making this the third most-recorded colonial species on BBS squares in recent years.

The 'top ten' most-recorded colonial species during the lifetime of the BBS, along with the number of different BBS squares colonies have been recorded in – shown in brackets, are as follows:

1. Rook (1,278)
2. House Martin (303)
3. Jackdaw (249)
4. Sand Martin (150)
5. Grey Heron (47)
6. Herring Gull (47)
7. Black-headed Gull (41)
8. Swift (39)
9. Lesser Black-backed Gull (29)
10. Common Gull (22)

Volunteers are urged to make a note of colonies during and after their BBS visits. Colony Counts should be kept separate from the transect counts. It doesn't matter if individual birds are counted during both the colony and transect counts. Please record all adult birds seen while walking transects, as with any other adult species along the route, even if they are also counted in the colony totals. Thank you to all who record Colony Count information on their squares.

SEDGE WARBLER: LIZ CUTTING/BTO, ROOK: EDMUND FELLOWES/BTO

The BBS in 2020

The impact of COVID-19 restrictions on BBS coverage and implications for trend production.

By **Simon Gillings**, Principal Data Scientist, BTO

The COVID-19 pandemic and associated lockdown restrictions had huge impacts on human activities in 2020, and biodiversity monitoring was no exception. Long-term monitoring programmes like BBS rely on unbiased coverage to provide robust assessments of biodiversity. So when exceptional circumstances like COVID-19 arise, it is important that we understand the knock-on effects of coverage changes on trend production.

LOCKDOWN

Lockdown started just as we prepared for early season BBS visits. In England, the Channel Islands and Isle of Man, restrictions were eased in time for Late visits but in Scotland, Wales, and Northern Ireland, some restrictions continued through the Late visit period. There were consequent reductions in the numbers of squares surveyed, with Early visits hit the hardest (Table 2).

The reductions were so severe in Scotland, Wales and Northern Ireland that the sample of surveyed squares was too small and seasonally biased to give reliable trends. To complicate matters further, travel restrictions caused subtle habitat biases, with fewer upland and remote habitats surveyed. The earlier easing of lockdown means coverage is potentially sufficient to produce some trends in England but unfortunately not elsewhere.

TESTING BIASES

To test the impact of coverage biases on trends, we 'degraded' the 2019 data to have coverage like 2020 and reproduced trends to see how they compared with the 'true' changes reported last year. Degrading simply involves 'throwing away' the 2019 data for visits not done in 2020 to simulate 2020-like coverage. For example, we know that Blackbirds decreased by 2% between 2018 and 2019 in England. But if we recalculate the trend using 2020-like coverage, a 13% decrease emerges. This is because on *c.*45% of squares the Early visit produces more Blackbirds than the Late visit. Losing Early visits meant we underestimated the number of Blackbirds and, unless corrected, would erroneously infer a decline. Overall, our normal trend routines would underestimate population changes for 95% of species!

	Squares	Early visits	Late visits
England	-40%	-86%	-40%
Scotland	-73%	-96%	-70%
Wales	-82%	-99%	-80%
Northern Ireland	-76%	-100%	-76%
Channel Islands	-19%	-57%	-10.5%
Isle of Man	+12%	-71%	+13%
UK	**-49%**	**-89%**	**-48%**

Table 2 Percentage changes in numbers of squares and visits made in 2020 compared to in 2019.

ANY 2020 TRENDS?

So can we produce any trends using the 2020 data? After testing different methods for producing trends we concluded that using only the Late visits from all years allows for production of trends in England for *c.*40% of species. These are the species considered in this report but **the change estimates reported should still be treated with caution because uncertainties remain**, such as the precise impact of shifted survey dates. Aside from identifying how to analyse the 2020 data, these analyses have brought home the critical importance of two visits and of maintaining visit date consistency across years.

A research paper detailing the process of identifying which species' trends appear to be least impacted by COVID-19 coverage is being prepared for publication.

BLACKBIRD: SARAH KELMAN/BTO

Interpreting 2020 BBS trends

The pages that follow (12–14) would normally contain the annual bird population trend statistics for the Breeding Bird Survey (BBS), for the UK and its constituent countries. Unfortunately, due to the direct impacts of COVID-19 restrictions on coverage, we can only confidently report indicative trends for a subset of species for England. Guidance on reading the tables and graphs is provided here, with other relevant tips on interpreting the information. Given the small sample sizes, biases and increased uncertainties in the 2020 data, we have not produced trends for BBS mammals or for the Waterways Breeding Bird Survey.

THRESHOLDS FOR TRENDS

In normal years, trends are produced for species that reach a minimum reporting threshold of 30 squares per year on average for countries and regions, and 40 for the UK. Trends are normally reported for various periods of time, including all-time, the most recent 10- and five-years, and for the most recent year.

However, this year, because of the impact of the COVID-19 pandemic on BBS coverage, we have had to be much more selective. Severe coverage reductions and biases preclude any trend production for Scotland, Wales and Northern Ireland, and by extension for the UK (see page 10, opposite).

For England, we checked whether each species' trend over different periods was resilient to the coverage changes. This is time consuming so we had to focus on just the all-time and one-year trends. We only report the changes that these analyses show to be robust, which means for some species we can only report either the all-time or the one-year trend. Given the constraints of the data, and a desire to limit over-interpretation of these indicative trends, we have not produced the usual confidence intervals around the smoothed trends and cannot infer which changes are statistically significant.

BBS 'ADD-ON' SQUARES

'Add-on' squares surveyed during the lifetime of the BBS, using BBS methodologies, have been included in these trends – these include Upland BBS and Upland Adjacent squares. Upland BBS squares were originally surveyed by professional fieldworkers and are no longer in the currently available BBS square set.

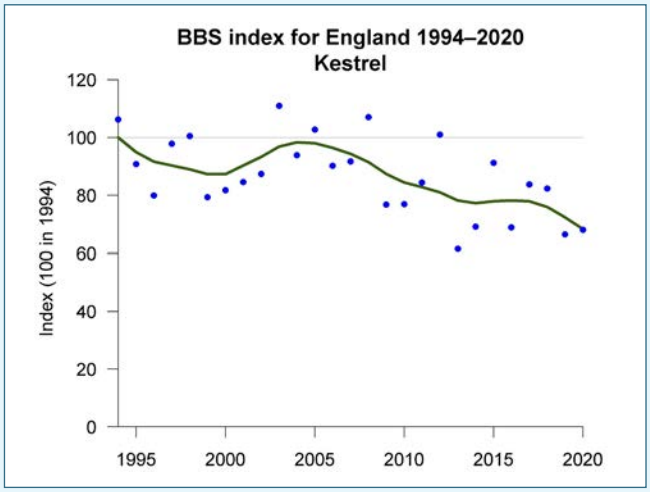
Upland Adjacent squares are covered by volunteers during visits to survey their core BBS square: these were introduced as an option to increase coverage in remote upland areas.

INTERPRETING GRAPHS

All BBS graphs are displayed in the same way. Beware, however, that the index axis does vary in scale as do the time periods covered. As mentioned, we have not produced confidence intervals around the smoothed trend this year.

BBS index graphs show:

- smoothed trend – dark green line
- annual index values – blue dots



TRENDS AND TABLES EXPLAINED

Species	1-year		24-year	
	Sample	(19–20)	Sample	(95–19)
Green Woodpecker	352	**7**	470	**19**
Kestrel	231	**2**	383	**-24**

- Trends for species in brackets are reported with caveats (explanation on page 15).
- For bird trends, **Red-listed** and **Amber-listed** species from 'Birds of Conservation Concern 4' are shown in the relevant colour.
- The 'Sample' for the long-term trend refers to the mean number of squares per year on which the species was recorded during BBS. For the one-year trend, we have included the number of squares each species was recorded on in 2020.
- Trends are presented as the percentage change over the whole 24-year survey period and the most recent one-year change from 2019 to 2020.
- The long-term changes cover the lifetime of the survey, with the first and last years removed for statistical reasons.

ONLINE RESOURCES

BBS bird results online: www.bto.org/bbs-results

England – 2020 population trends

Here we present the latest England trends produced for 2020. Due to the COVID-19 pandemic and associated restrictions, the number of surveys completed was much reduced, meaning that it was not possible to produce the full suite of species trends normally reported. Results presented here are limited to the 57 species for which analyses showed the trends to be resilient to the coverage changes. For each species, the long-term (24-year) and/or the most recent year-on-year (2019–2020) trends are presented, where possible. For 20 species, both trends are presented. Low coverage precluded production of trends for the UK and elsewhere. See page 10 for more information on the impact of the pandemic on the survey and page 11 for interpretation of this years' trends.

This year, population trends for both the long term (1995 to 2019) and one year (2019 to 2020) are presented for 20 species. For an additional 37 species, either the long-term or year-on-year trend were sufficiently resilient to be presented in this year's report.

The full set of the most up-to-date BBS trends for the UK, countries and English Regions, are available at www.bto.org/bbs-results.

STILL AT THE TOP

As has been the case in recent years with a full set of trends, **Turtle Dove** remains at the top of the list for the largest declines recorded by the BBS in England since the survey began, now by 96% from 1995 to 2019.

In England, low natural arable plant seed availability as a result of herbicide use and efficiency has been identified as limiting breeding success. As such, provision of agri-environment options and targeted conservation action on breeding grounds will be critical to improving their status locally.

Impacts on overwintering grounds (due to habitat deterioration) and on migration routes (particularly through hunting) could also be important factors influencing the decline of the species.

MIGRANT TREND

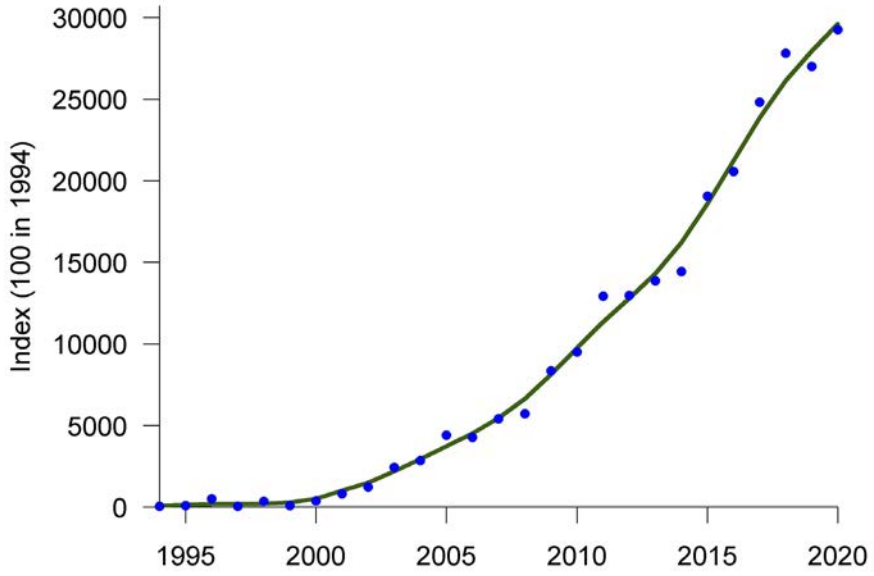
Willow Warbler populations have also been flagged as in trouble in England, with a decline of 45% recorded between 1995 and 2019.

Previous BBS reports containing Scotland- and Northern Ireland-specific trends for **Willow Warbler** show the long-term picture there is very different, with increases recorded.

Willow Warbler is one of a suite of species overwintering in the humid zone of West Africa and showing the strongest declines of migrant species groups. Two other species that fall into this declining humid zone group, are **Garden Warbler** and **Tree Pipit**, with long-term declines in England of 28% and 62% respectively.

Knowing where the greatest issues lie for a migrant species, and at what stage in their life cycle, is a crucial question to answer. Data from the BBS have been used to delve further into the reasons for such trends. See pages 24 to 27 for one example of this.

BBS index for England 1994–2020
Red Kite



ENDING ON A HIGH

Red Kite have increased by a staggering 18,695% over the long term. Reintroduction programmes in England, and the ability of this species to exploit a vacant niche, have no doubt been behind the increase recorded in England.

FIND OUT MORE...

Interpreting the results: see page 11

For the latest results from the BBS, including the limited 2020 trends and the full 2019 results:
www.bto.org/bbs-results

Table 3 England population trends during 2019–20 and 1995–2019.

Species	1-year		24-year	
	Sample	(19–20)	Sample	(95–19)
Greylag Goose	109	**54**	86	**365**
Mallard	457	**-1**		
Swift	413	**-15**		
Feral Pigeon	316	**-1**	436	**-30**
Turtle Dove			95	**-96**
Collared Dove			1,008	**-6**
Moorhen	289	**21**	424	**-16**
Coot	97	**-17**		
Little Grebe			38	**48**
Lapwing	144	**-23**		
(Common Tern)			51	**58**
(Cormorant)	103	**0**	129	**23**
(Grey Heron)	215	**3**	340	**-20**
Red Kite			117	**18,695**
Buzzard			595	**233**
(Barn Owl)			32	**276**
Little Owl	22	**45**		
Great Spotted Woodpecker	700	**11**	754	**117**
Green Woodpecker	352	**7**	470	**19**
Kestrel	231	**2**	383	**-24**
Ring-necked Parakeet	88	**3**		
Jay			450	**5**
Magpie	1,156	**9**	1,502	**2**
Jackdaw	1,173	**16**	1,328	**99**
Rook			852	**-10**
Carrion Crow			1,931	**25**
Marsh Tit			79	**-45**
Blue Tit			1,834	**-1**
Great Tit			1,530	**32**
Skylark	982	**9**	1,294	**-18**
House Martin	418	**-12**		
Long-tailed Tit			522	**16**
Willow Warbler	317	**8**	630	**-45**
Chiffchaff	1,163	**28**	1,184	**114**
Sedge Warbler			151	**-21**
Blackcap	1,234	**4**		
Garden Warbler	172	**-21**	265	**-28**
Whitethroat	943	**16**		
Goldcrest			446	**25**
Wren	1,527	**10**	1,937	**27**
Nuthatch			317	**105**
Starling			1,228	**-60**
Blackbird	1559	**-2**		
Song Thrush	1151	**7**		
Robin			1,822	**25**
House Sparrow	973	**2**	1,274	**-5**
Tree Sparrow	76	**-27**		
Dunnock	1,168	**5**	1,493	**7**
Grey Wagtail	79	**19**	103	**5**
Pied Wagtail	499	**4**	695	**-13**
Meadow Pipit	197	**8**		
Tree Pipit			53	**-62**
Chaffinch	1,334	**-6**		
Bullfinch	233	**-12**		
Siskin	35	**-10**		
Corn Bunting			109	**-23**
Yellowhammer	619	**7**	915	**-35**

KEY RESULTS

57 species trends

41 long-term trends (1995–2019)

36 one-year trends (2019–2020)

20 species with both trends

12 BoCC Red-list species with trends

10 BoCC Amber-list species with trends

Turtle Dove
largest long-term decline

Red Kite
largest long-term increase

Tree Sparrow
largest one-year decline

Greylag Goose
largest one-year increase

Country summaries

Unfortunately, due to coverage limitations and biases due to COVID-19, it was not possible to calculate population trends for the UK as a whole, Scotland, Wales or Northern Ireland. The data samples from the Channel Islands and Isle of Man do not reach reporting thresholds for trends in these locations specifically, but in a normal year would feed into the UK trends.

SCOTLAND

With restrictions as they were in 2020, totals for all countries were surprisingly high! Here, two squares were surveyed for the Early visit only, 131 for the Late visit only and 23 surveyed twice resulting in 156 squares being covered by 107 volunteers.

The result was 132 bird species recorded, from the scarcer records such as Manx Shearwater, Golden Eagle, Corncrake, Crested Tit and Corn Bunting, through to the top five most commonly recorded species on Scottish squares: Wren, Chaffinch, Woodpigeon, Blackbird and Willow Warbler.

WALES

Fifty-eight squares were covered in Wales by 45 volunteers, with 54 of these having Late visits only and the rest being covered twice.

One-hundred and one bird species were recorded, from Goshawk and Ring Ouzel, to a Muscovy Duck and the top five most frequently recorded species: Wren, Blackbird, Woodpigeon, Carrion Crow and Robin.

NORTHERN IRELAND

In a normal year, 52 squares are covered by professional fieldworkers to boost coverage in the country, something that is funded by the Northern Ireland Environment Agency. Understandably, it was not possible to cover these squares this year. Despite this, coverage in Northern Ireland reached 28 squares; all were Late visits only and were covered by 23 volunteers.

The result was 74 bird species recorded, with Little Tern, Sandwich Tern and Grasshopper Warbler a treat for the few and Woodpigeon, Blackbird, Wren, Chaffinch and Magpie the top five most commonly recorded species.

CHANNEL ISLANDS

Sixty-seven bird species were recorded by 13 volunteers covering 17 squares. Nine squares received two visits, and the remaining eight had Late visits only.

Of the 67 bird species recorded, Dotterel, Long-eared Owl and Nightjar contributed to the scarcer species recorded during BBS, and Short-toed Treecreeper made its annual appearance on the BBS species list thanks to the Channel Island volunteers. The top five most commonly recorded species were Carrion Crow, Goldfinch, Dunnock, Wren and Woodpigeon.

ISLE OF MAN

Despite all 2020 brought our way, the Isle of Man saw a **record-breaking year for coverage** with nine squares covered by eight volunteers. Two were covered twice and the remaining seven received Late visits recording 62 bird species in total.

The top five most recorded species were Herring Gull, Pheasant, Chaffinch, Jackdaw and Swallow, but Hen Harrier and Quail added variety at the scarcer end of the scale. A massive *well done!* to RO David Kennett and the volunteers on the Isle of Man on their impressive coverage total.

FIND OUT MORE...

Despite it not being possible to update trends for the UK (including Channel Islands and Isle of Man data), Scotland, Wales and Northern Ireland in 2020, the full set of country results, up until the 2019 surveys, can be found at:
www.bto.org/bbs-results

WREN: ALLAN DREWITT/BTO, CHAFFINCH: TOM STREETER/BTO, JACKDAW: EDMUND FELLOWES/BTO

Background and methods

The BBS was launched, in 1994, to provide more representative habitat and geographical coverage than the main survey running at the time, the Common Birds Census (CBC). The CBC ended in 2000, and the overlap period between 1994 and 2000 allowed BTO to develop methods for calculating long-term trends (from the 1960s to the present) using information from both schemes.

The BBS is a line-transect survey based on randomly located 1 km squares. Squares are chosen through stratified random sampling, with more squares in areas with more potential volunteers. The difference in sampling densities is taken into account when calculating trends. BBS volunteers make two early-morning visits to their square during the April–June survey period, recording all birds encountered while walking two 1 km transects across their square. Each 1 km transect is divided into five 200 m sections for ease of recording. Birds are recorded in three distance categories, or as 'in flight', in order to assess detectability and work out species density. To assess further the detectability of species the option of recording how birds were first detected (by song, call or visually) was introduced in 2014. Observers also record the habitat along the transects, and record any mammals seen during the survey. Surveying a BBS square involves around six hours of fieldwork per year, and the aim is for each volunteer to survey the same square (or squares) every year.

As BBS squares are selected randomly, they can turn up within any kind of habitat. Some squares can never be surveyed, and these truly 'uncoverable' sites are removed from the system. However, squares that are temporarily inaccessible, or which are not taken up due to their remote location, are retained in order to maintain the integrity of the sampling design.

The BBS National Organiser, based at BTO HQ, is responsible for the overall running of the scheme, and is the main point of contact for the network of volunteer Regional Organisers (ROs). ROs are responsible for finding new volunteers and allocating squares to observers in their region. At the end of the season they validate submissions made online, and collect paper submissions and return them to BTO HQ. We are very grateful for the assistance of the ROs.

The BBS provides reliable population trends for a large proportion of our breeding species. Trends can also be produced for specific countries, regions or habitats. However, the COVID-19 pandemic had a significant impact on the survey in 2020 and therefore reliable population trends could only be produced for England and for c. 40% of the usual species. The pandemic has also had an impact on the way we conduct the analyses, due to the dramatic reduction in early visits (see page 10 for more details).

In normal years we produce population trends by taking the higher count from the two visits for each species, while this year we had to use only the Late visit data from all years. Only squares that have been surveyed in at least two years are included in the analyses. Population changes are estimated using a log-linear model with Poisson error terms. Counts are modelled as a function of year and site effects, weighted to account for differences in sampling densities across the UK.

Since 2009, data from additional randomly selected 1 km squares surveyed as part of the Scottish Woodland BBS and the Upland BBS have been included in the BBS sample. These squares were surveyed using the same methodology as standard BBS squares, and results were incorporated into the trends, accounting for additional sampling effort. Since 2010, the option of adding an Upland Adjacent square to an existing Eligible Upland BBS square has been encouraged, with the aim of increasing coverage in upland areas. These data are treated separately during the analyses.

Upland Rovers was introduced in 2017, with the aim of further increasing coverage in remote areas. Carefully selected squares are available to be surveyed just once by roving volunteers. These are core BBS squares with poor to no previous coverage, upland in habitat type and remote as identified by a combination of distance from road and local human population.

Work has been carried out to assess the reliability of BBS trends, to ensure that reported trends are based on reliable data and sufficient sample sizes. In addition, significant extra-work has been carried out by the BTO analysts to assess the impacts of the pandemic on the reliability of the estimated population trends. While we were only able to produce population trends for England, and for less than half of the usual species, here we describe the relevant exclusions and caveats that apply to 2020 trends and more generally to all years:

- We do not report population trends for five species of gull (Black-headed, Common, Great Black-backed, Herring and Lesser Black-backed), as a large proportion of the records are of non-breeding, wintering or migratory individuals.
- Trends for rare breeding species with substantial wintering populations (*e.g.* Fieldfare) are excluded.
- Trends for Common Tern, Cormorant and Grey Heron are reported with the caveat that counts may contain a high proportion of birds away from breeding sites.
- Trends for Barn Owl are reported with the caveat that the BBS monitors nocturnal species poorly.
- Counts for Lapwing are corrected to exclude counts from non-breeding flocks.

BBS achievements

After a year like 2020, with few survey visits possible, it is important to reflect on why this survey is so crucial and what it has brought to the world of ornithology and conservation over the years.

By **James Pearce-Higgins**, Director – Science, BTO

Here we take a tour of the outputs from the BBS and provide a flavour of the schemes and research data collected during surveys, and the uses it is put to! To view a collection of published papers using BBS data, please visit www.bto.org/bbs-science.

MONITORING

In a typical year, BBS data are used to produce **Official Statistics** in the form of population trends for over 100 bird species. All bird and mammal species are recorded during visits, providing information even for species where trends are not possible. Despite mammal recording being optional, records are collected on over 90% of squares each year, which forms one of the most extensive mammal monitoring programmes in the UK.

In addition, habitat information for every 200 m sector of the two 1 km transects walked is recorded and habitat data collected during the bird surveys have shown how citizen scientists can help track land-use change (Martay *et al.* 2018). Information on the detectability of species can be noted in all squares, and for those volunteers lucky to have colonial nesting species, **Colony Count** data can be submitted. Volunteers also have the option of revisiting their BBS squares to walk their transects to record butterflies, day-flying moths and Odonata for the **Wider Countryside Butterfly Survey**. These data feed into the broader **UK Butterfly Monitoring Scheme** from which trends for 58 butterfly species are produced. That's a lot of precious data from BBS squares!

Beyond the annual trends that first spring to mind when you think about the BBS, abundance (as opposed to the population change calculated for trends) is calculated for a suite of species. These abundance data feed into the periodic **Avian Population Estimates Panel** assessment for the UK and Great Britain.

Also, BBS data contribute to Government **biodiversity indicators**. These show trends for birds by habitat type and for generalist or specialist groupings.

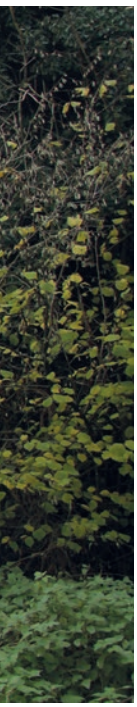
Data from lowland England were used to investigate the relationship between deer and bird species: Increases in lowland deer populations were found to negatively impact some woodland bird populations, particularly of Willow Tit and Nightingale (Newson, S.E *et al.* 2011). ▶

Looking at the bigger picture, BBS bird data feed into the **Pan-European Common Bird Monitoring Scheme** which produces population trends for bird species at a Europe-wide scale! In a normal year, BBS trends are calculated for the UK as a whole, the countries within the UK, English Regions and for area-specific scales *e.g.* for the Yorkshire Dales National Park. The ability to use the data for reporting across a wide-range of scales provides a powerful tool, especially for policy and decision-making.

Sticking to the big picture, 600,000 records from BBS contributed to the **European Breeding Bird Atlas 2** and more can be read about this on pages 28–29. BBS data have also been used in research that found bird communities have become less specialised through time in the UK, and across Europe (Davey *et al.* 2012, Le Voil *et al.* 2012), as populations of more common and widespread species have done better than habitat specialists (Sullivan *et al.* 2016).

This provides just a flavour of the wider uses of BBS data collected during just two visits to a 1 km square each year. Here, we provide an insight into some of the research carried out using these data and highlight some of the major breakthroughs thanks to BBS and the dedication and skill of thousands of volunteer surveyors.

Thank you to all who take part or have taken part in the past, and to all the researchers and statisticians putting this information to great use!



IMPACTS OF LAND USE CHANGE

BBS data continue to be used to evaluate the effectiveness of agri-environment schemes: In Wales this work has demonstrated positive impacts of woodland, scrub and hedgerow management in particular, and in England it has identified where interventions associated with the provision of overwinter food has benefited farmland birds (Baker *et al.* 2012, Dadam & Siriwardena 2019).

Urban areas became a focus for further research at BTO, after the production of separate bird population trends for different habitats showed for the first time large-scale declines in urban bird populations (Sullivan *et al.* 2015). Subsequent analysis of BBS data has shown how bird communities vary in response to the availability of greenspace (Plummer *et al.* 2020).

BBS data contributed to the National Ecosystem Assessment, which examined the potential impacts of future economic scenarios on biodiversity. The results suggest that, by designing land-use policies that are not just driven by market forces but which also optimise a wider range of ecosystem services, it is possible to promote the conservation of wild bird species (Bateman *et al.* 2013).

Increasing rates of gamebird release support greater populations of generalist avian predators, as revealed by analysing BBS data alongside Bird Atlas 2007–11 and captive poultry data (Pringle *et al.* 2019).

Research into the impact of roads on birds used BBS data and found that bird communities are negatively impacted by close proximity to roads (Cooke et al. 2020a,b).

WOODLAND: MIKE TOMS/BTO, PHEASANT: EDMUND FELLOWES/BTO

SPECIES OF CONSERVATION CONCERN

Long-term monitoring is capable of flagging-up species undergoing population change and in need of further research or conservation action, as well as tracking recovery in those species for which conservation action is in place. Below, we highlight how the BBS data have assisted beyond producing the annual trends of change and facilitated further investigation, drawing attention to species in trouble or doing particularly well, and where and why – that crucial evidence-base.

Curlew: Analysis of BBS data shows that intensive agriculture, forestry, increasing generalist predator populations and climate warming are all having negative impacts on Curlew populations and ultimately, driving their long-term decline (Franks *et al.* 2017).

Cuckoo: Analysis of BBS Cuckoo population trends show declines have been greatest in southern Britain, where agricultural intensification has been greatest, moth populations have crashed (Denerley *et al.* 2019) and where Cuckoos take a more westerly migratory route after the breeding season, which is associated with higher mortality (Hewson *et al.* 2016).

Tree Pipit and Lesser Redpoll: Common Birds Census (the territory-mapping predecessor survey to BBS) and BBS combined trend analyses show that declines in Tree Pipit and Lesser Redpoll populations are linked to losses of young conifer plantations in England (Burgess *et al.* 2015).

Greenfinch: Population declines in Greenfinch have been tracked using BBS data since 2007 and linked to the parasite *Trichomonas gallinae* (Lawson *et al.* 2012) which causes the disease finch trichomonosis, that that affects the upper digestive tract.

Willow Warbler: Integrated analyses of BBS and ringing data show that declines in Willow Warbler populations in the south of the UK are linked to lower breeding success (Morrison *et al.* 2016).

Long-distance migrants: Population declines in long-distance migrants are much greater in southern Britain, whereas many species are increasing in the north (Ockendon *et al.* 2012., Morrison *et al.* 2013).

Mountain specialists: Breeding bird data from the UK BBS upland squares, Fennoscandia, Iberia and the Alps were used to examine the population trends for species within mountainous areas. This highlighted worrying declines in Europes' mountain specialists (Lehikoinen *et al.* 2019).

Declining species: Integrated population modelling shows that limited recruitment may be impacting many declining bird species – suggesting that first-year survival is key (Robinson *et al.* 2014). This knowledge can then guide policy, for example, to target conservation action in this first year of life, rather than concentrating solely on breeding habitat.

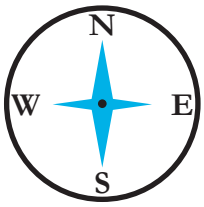
Lapwing: populations are declining as a result of the combined impact of adult mortality during harsh winters and long-term declines in productivity that prevent recovery from cold weather (Robinson *et al.* 2014).

CURLEW: TOM STREETER/BTO, CUCKOO: SARAH KELMAN/BTO, WILLOW WARBLER: ALLAN DREWITT/BTO, SNIPE & YELLOWHAMMER: LIZ CUTTING/BTO

CLIMATE CHANGE

The BBS achievements continue with much work focusing on climate change over the years and the changing world we live in. Again, BBS data prove vital to more than the all-important annual trends and the data have additional strength when used together with its predecessor survey, the Common Birds Census, and other long-term monitoring schemes both here in the UK, and abroad.

BBS data have contributed to **continent-wide assessments of climate change impacts** on birds (Devictor *et al.* 2012, Stephens *et al.* 2016).



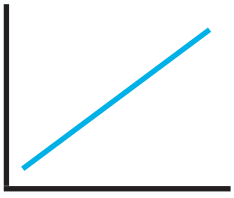
Analysis of the first 15 years of BBS showed that **in response to warming, species' northern range margins are shifting northwards** by an average of over 3 km per year. This indicates that a short-term response to climate change has been range expansion (Massimino *et al.* 2015).

Combined analysis of BBS and ringing data show that **Wren populations are locally adapted to their climate**, with populations in Scotland, where Wren are 0.5 g larger than in southern England, much better able to cope with cold winters (Morrison *et al.* 2016).

Populations of **woodland and farmland specialists are declining more in south-east England** than elsewhere (Harrison *et al.* 2014, Massinimo *et al.* 2015).

1/3

Combined analyses of Common Birds Census and BBS data show that one-third of the 68 species studied in England **show evidence of population responses to climatic variables**, leading to large (>10%) population increases in 13 and > 10% declines in three (Pearce-Higgins and Crick 2019).



Future impacts of climate change based on combined analysis of French and UK BBS data suggest **44% of species will increase in abundance as they expand northwards**, and 9% will decline, with existing species of conservation concern most likely to be negatively impacted (Massimino *et al.* 2017).

ACHIEVEMENTS FROM THE BREEDING BIRD SURVEY

As well as delivering UK, country-level and regional population trends for over 110 breeding bird species for almost 25 years, the large-scale and long-term nature of the Breeding Bird Survey means that the data can also be used for a wide range of research and conservation purposes. Not only are these trends foundational for conservation prioritisation, feeding into Birds of Conservation Concern, UK and country-level red-lists and the IUCN red-lists, but they have also underpinned research into the causes of decline of a range of species. In the case of farmland birds, BBS data have also been integral to monitoring responses to conservation interventions, such as the deployment of agri-environment schemes. Although disentangling the impacts of different pressures on a complex natural world can be difficult, the structured nature of BBS sampling over almost 25 years provides a large amount of variation between squares and years to enable associations between the impacts of different pressures, whether roads, urbanisation or climate change, and spatial and temporal variation in bird abundance to be quantified. Our ability to do this grows with increasing spatial coverage and length of the time-series. Therefore, by taking part in the Breeding Bird Survey, not only are you making an important contribution to monitoring the status of breeding bird populations, but you are also helping us to provide evidence that helps tackle a wide range of societal challenges, from tackling the current biodiversity crisis to understanding biological responses to the climate crisis. Thank you.

WREN SILHOUETTE: ALAN DREWITT/BTO

PAPERS FROM BBS ACHIEVEMENTS

Many papers from this summary of BBS achievements can be found at www.bto.org/bbs-science, but below, we list the references for easy finding! As is tradition in the BBS Report, the opposite page showcases all the most recent published papers using BBS data and really emphasises the importance of this gold-standard survey, only possible thanks to the dedication and skills of volunteer organisers and thousands of surveyors. Thank you.

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BBS and climate change

Could long-term changes in the timing of life cycle events and observers' behaviour impact the quality of BBS trends?

By **Dario Massimino**, Research Ecologist, BTO

Not only is climate change one of the biggest threats to biodiversity but it might also cause troubles for our surveys. We have recently investigated how the seasonal patterns of birds' detectability have changed since BBS started in 1994 and whether surveyors have also changed the dates of their visits. The combination of these changes may have an impact on our ability to estimate accurate population trends.

GOING THROUGH CHANGES

Many natural events do not occur at random times, but they take place at well-defined points in time so that individuals maximise their survival or reproductive success. For example, migratory birds that reach the breeding areas too early may find it is still too cold and there is not enough food, whilst those that arrive too late may find all breeding territories have already been taken: birds have evolved mechanisms to arrive at a time that maximises their chances of survival and breeding. The timing of life cycle events, such as migration and reproduction for birds, hibernation in some mammals, leaf fall in trees, is called phenology. Phenology has become more and more the focus of intensive research in the last decades because of the changes induced by climate change in the life cycles of many species.

PHENOLOGICAL MISMATCH

Scientists are particularly worried about the phenomenon of phenological mismatch, which happens when the timings of key events change at different rates for interacting species. For example, some bird species lay eggs so that the time of chick rearing matches the peak in caterpillar availability. However, with warmer springs, caterpillars are appearing earlier. If the birds cannot keep up with the pace of these changes, their chicks will miss the peak in caterpillar availability.

Phenological changes can also cause problems for long-term monitoring programmes such as the BBS, because if the timings of song output and of survey visit gradually change over many years, our ability to estimate accurate population trends could be affected. The situation is further complicated by the fact that the breeding phenology of each species is changing in subtly different ways, with some singing earlier and others singing later.

TRACKING BIRDS AND PEOPLE

Even BBS surveyors can change their phenology! In fact, our analysis showed that surveyors visited their sites 2–4 days earlier, on average, in the mid-2010s compared to the 1990s. We felt that a better understanding of these processes was needed. For this reason we conducted an exhaustive study of the timing of survey visits and bird detectability, we assessed the potential bias that changes in timing may cause and we tested some methods to account for changes in visit timing. Little could we have known how relevant these analyses would be in 2020 when so many aspects of survey timing changed.

For our research we had to choose a relatively small region with reasonably uniform climate and with as many BBS squares as possible, so South East England was our chosen area, but we also conducted similar analyses for the whole of the UK, so that we could check that our findings are of more general validity.

DETECTING BIRDS AND VISIT DATES

The first step of our analyses consisted of assessing how seasonality in bird detectability has changed since the start of the BBS in 1994. We looked at how the average number of birds detected changes through the BBS field season. We did this for the beginning of the BBS (1994–1998) and for five more recent years (2013–2017) and calculated the median date of all detections, which gives a measure of the middle of each species' breeding season. The good news is that the median detection date only advanced by about 0.8 days between 1994–98 and 2013–17, on average over the 68 species analysed. However, five of these species revealed larger and statistically significant changes, with Nuthatch showing an advance of 14 days!

We conducted a similar analysis on the survey dates and we found that surveyors also visited their squares a bit earlier in recent years compared to the beginning of the BBS. In particular, the Early visits advanced by four days and the Late visits advanced by two days. This

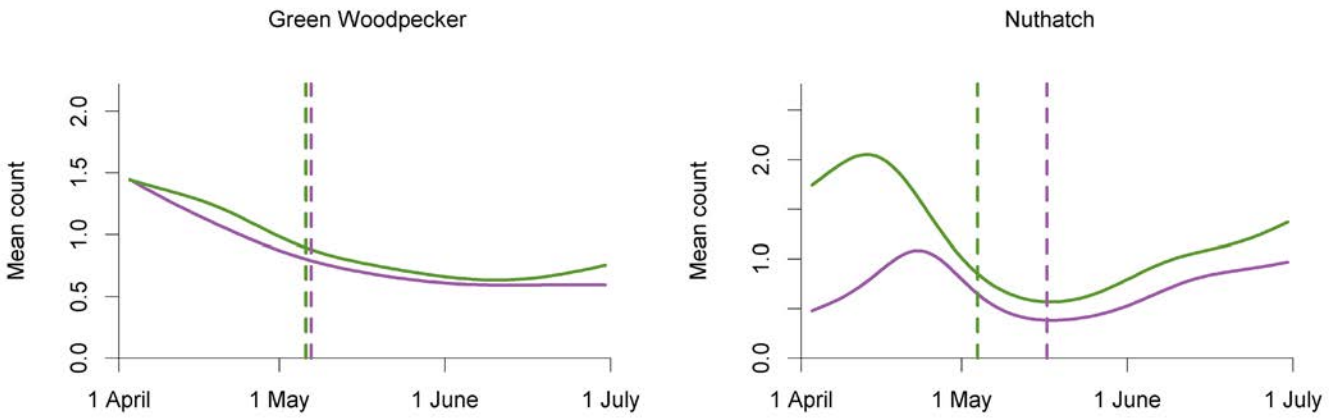


Figure 6 Seasonal variation in detections for two example species, the Green Woodpecker and the Nuthatch, in South East England. The **solid lines show the smoothed average number of birds detected by date** in 1994–98 (purple line) and 2013–17 (green line). The **vertical dashed lines represent the median detection dates**. Although both species are resident in the study area, their changes in detection rates have been very different: the Nuthatch has shown the largest advance (14 days) in detection dates of all species analysed, while no significant change was detected for the Green Woodpecker. Note that overall detections of Nuthatch have increased in time due to population growth.

shows that, on average, the surveyors have changed their 'phenology' faster than the birds!

WHAT ABOUT THE TRENDS?

Our next step consisted of estimating the impact of these changes on the accuracy of population trends. Reassuringly, the potential impact in terms of bias in the estimated population trends was negligible for the majority of species. However, for a small number of species the combined effects of changes in species phenology and visit dates could introduce a larger bias, up to 16% for the Meadow Pipit, the worst affected species. This means that the current long-term 44% decline of this species in South East England might be an underestimate and the real decline could even be 60%!

Finally, we tested a method to account for changes in visit timing, which consisted of including an additional term for the visit date, in the statistical model that is used to estimate the population trends. The method proved effective to control for changes in visit timing, but it also has important limitations. First, it can only control for changes in visit timing and not for changes in species phenology. Second, the changes in visit timing have so far been very small (only very few days on average) and there is no guarantee that a statistical model could compensate major changes to visit dates, should these occur in the future. Third, such a model is far more computationally intensive and takes a much longer time to run.

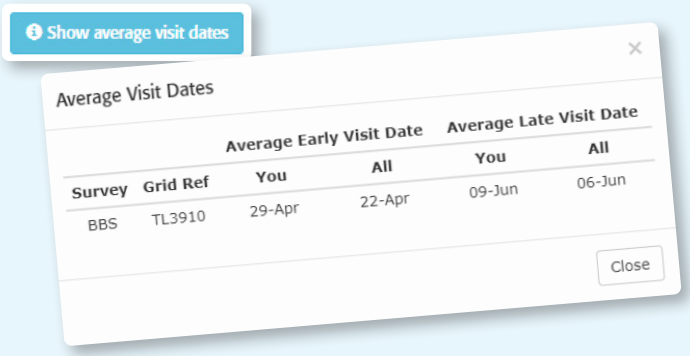
CONSISTENT VISIT TIMING NEEDED

Our conclusion is that phenological changes in birds have so far had a minor impact on our ability to estimate accurate trends, but as phenological changes are expected to accelerate under a changing climate, this issue is likely to become more important in the future. Small changes to the survey dates can be accounted for, but at a high cost in terms of computational time.

Major long-term changes in the survey dates can become problematic. These findings have practical implication for our surveyors as they highlight the need for consistent survey dates. Even if springtime events are advancing, not all birds are breeding earlier and the pace of change also differs between species. This makes it impossible to simply adjust survey visits to effectively track the changing phenologies of all bird species. Therefore we reiterate our advice that surveyors should try to make their visits at around the same time each year. To make this easier we have made modifications to BBS Online to give greater visibility of your normal visit dates.

BBS ONLINE UPDATE

To make visit planning for BBS and WBBS visits easier, volunteers can now view the average visit date for both their own visits to each site and all visits to the site in BBS Online.



FIND OUT MORE...

Massimino, D., Harris, S.J. & Gillings, S. 2020. Phenological mismatch between breeding birds and their surveyors and implications for estimating population trends. *Journal of Ornithology* **162**: 143–154.

Identifying targets for conservation action

Using citizen science data, such as those generated by the BBS, to reveal targets for conservation action.

By **Catriona Morrison**, Senior Research Associate, University of East Anglia

Since its launch in 1994, BBS data have helped to highlight the severe declines of many migratory bird species that overwinter in the humid zone of Africa, in countries such as Côte d'Ivoire and Ghana. However, these declines are not occurring everywhere; the distribution of BBS squares right across the UK allowed us to show previously that, while populations of humid zone migrants have declined in England, they have remained stable – or in some cases – increased in Scotland, and that these divergent trends are also occurring in many resident species.

THE HIGHS AND LOWS

During my PhD, we explored the possible drivers of these patterns, in one humid zone species, the Willow Warbler. Data on abundance from the BBS, productivity from the BTO/JNCC Nest Record Scheme, and survival rates from the BTO/JNCC Constant Effort Sites were brought together and showed that in a couple of years at the start of the 2000s, mortality rates were high and caused sharp population declines in both Scotland and England.

Survival rates subsequently recovered in both countries and, in Scotland, these years of good survival were also years in which productivity was high, allowing the population to recover within a decade. However, in England, productivity was not high enough to allow a similar recovery, and so numbers have remained low (Morrison *et al.* 2016). A similar effect has also been shown using data for the UK population of Lapwing, where low productivity prevented the population from recovering after a period of high mortality during the 1980s (Robinson *et al.* 2014). It therefore seems that when productivity is sufficiently high, across a sufficiently large number of sites, populations can potentially bounce back after periods of high mortality.

WHERE TO TARGET ACTION?

These are fascinating findings; data have revealed regional-scale differences within the UK which suggest that breeding season conditions are influencing migrant population trends. However, to be sure this is the case, we need to know whether the residents and migrants breeding on the same sites show similar population trends. This could help us to understand where conservation actions should be targeted; if sites are consistently good or consistently poor for whole bird communities, then we could potentially target conservation actions to boost productivity at poor sites to hopefully influence population trends. So, are there sites that are consistently good or poor for breeding birds?

◀ Low breeding productivity was shown to prevent Lapwing from recovering after a period of high mortality during the 1980s in the UK (Robinson *et al.* 2014).

LAPWING:: CHRIS KNIGHTS/BTO

▲ Data from BTO monitoring schemes tracking abundance, survival rates and productivity revealed that at the start of the 2000s, high mortality led to population declines in Scotland and England, but that subsequently productivity varied between the countries, resulting in population recovery in Scotland but not England (Morrison *et al.* 2016).

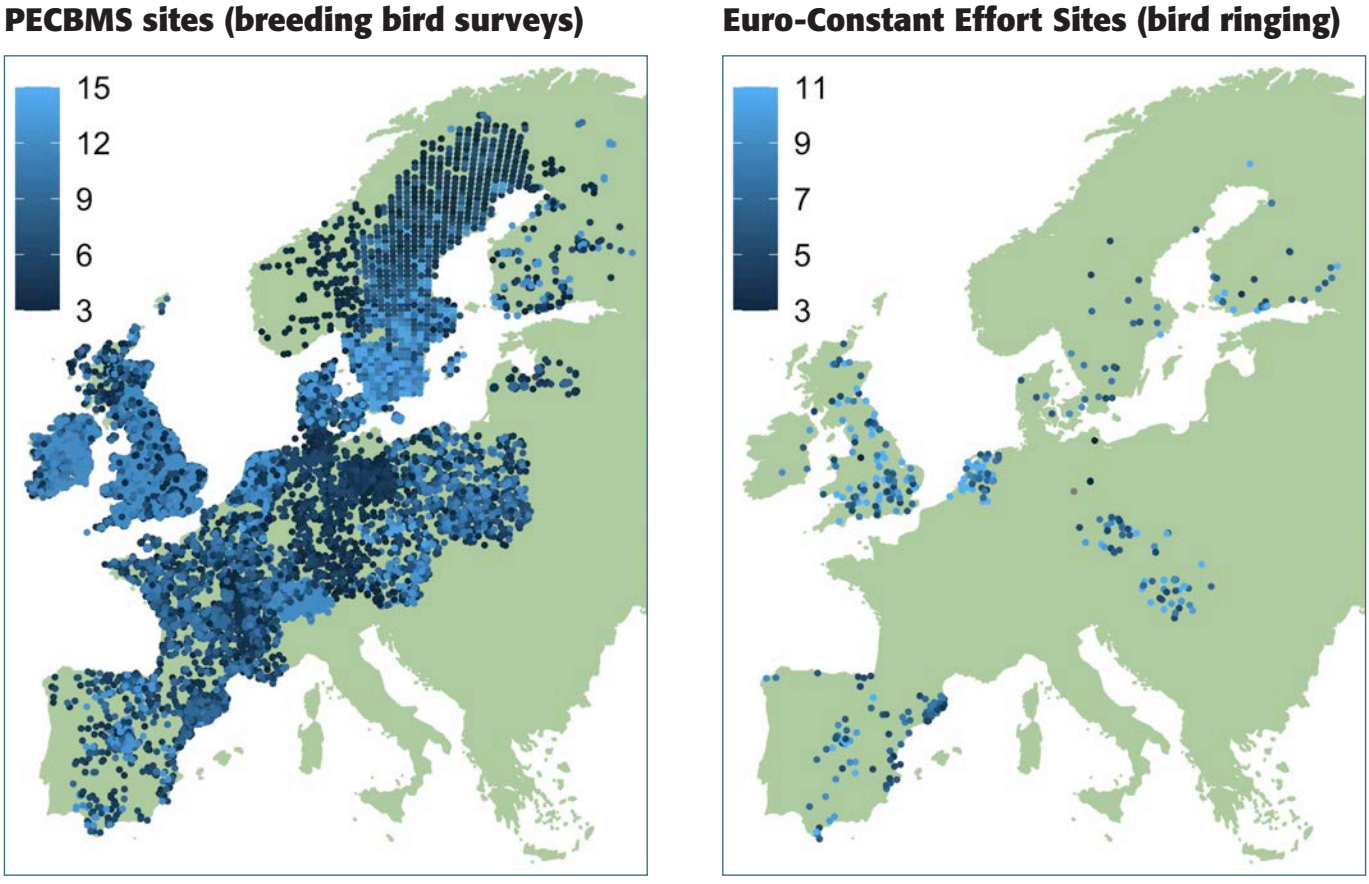


Figure 7 The location of **Pan-European Common Bird Monitoring Scheme (PECBMS) sites** and **Euro-Constant Effort Sites** (Euro-CES) in Europe. Colours indicate the number of years sites were active during the study period. PECBMS: 1994 to 2013 and Euro-CES: 2004 to 2014 (Morrison *et al.* 2021).

WILLOW WARBLER: EDMUND FELLOWES/BTO

ARE SITES CONSISTENTLY GOOD OR POOR?

Across Europe, surveys of numbers of breeding birds, including the UK's BBS, are collated by the Pan-European Common Bird Monitoring Scheme (PECBMS). Using standardised (to ensure consistency) data from 13,859 PECBMS sites (Figure 7, page 25) over the last two decades, we recently showed that migrants (from both arid and humid zones) and residents in the same sites tend to be showing the same population changes.

CHALLENGING BUT FEASIBLE

We then used bird ringing data from 336 European Constant Effort Sites (Euro-CES) to show that productivity (numbers of young caught per adult captured) also varies consistently between sites. For both resident and migrants, there are good sites which consistently produce lots of young, and poor sites which consistently produce few young (Figure 8c, d). We also used Euro-CES data to measure annual survival rates but found no such patterns (Figure 8e, f). This suggests that targeting conservation actions at survival rates within Europe is likely to prove extremely challenging, as mortality can occur at any point in the year, and mortality rates can vary greatly within and between species breeding at the same sites. However, targeting actions in sites with consistently low productivity does appear to be potentially feasible.

INCREASING THE GOOD

Our next steps are to try to identify how conditions differ between good and poor sites, and the types of conservation actions that might be needed to increase the frequency of good sites. This has the potential to benefit migrant and resident species alike. Once again, BBS data will play a key role in allowing us to continue this research. Thank you to all the volunteers who make this research possible.

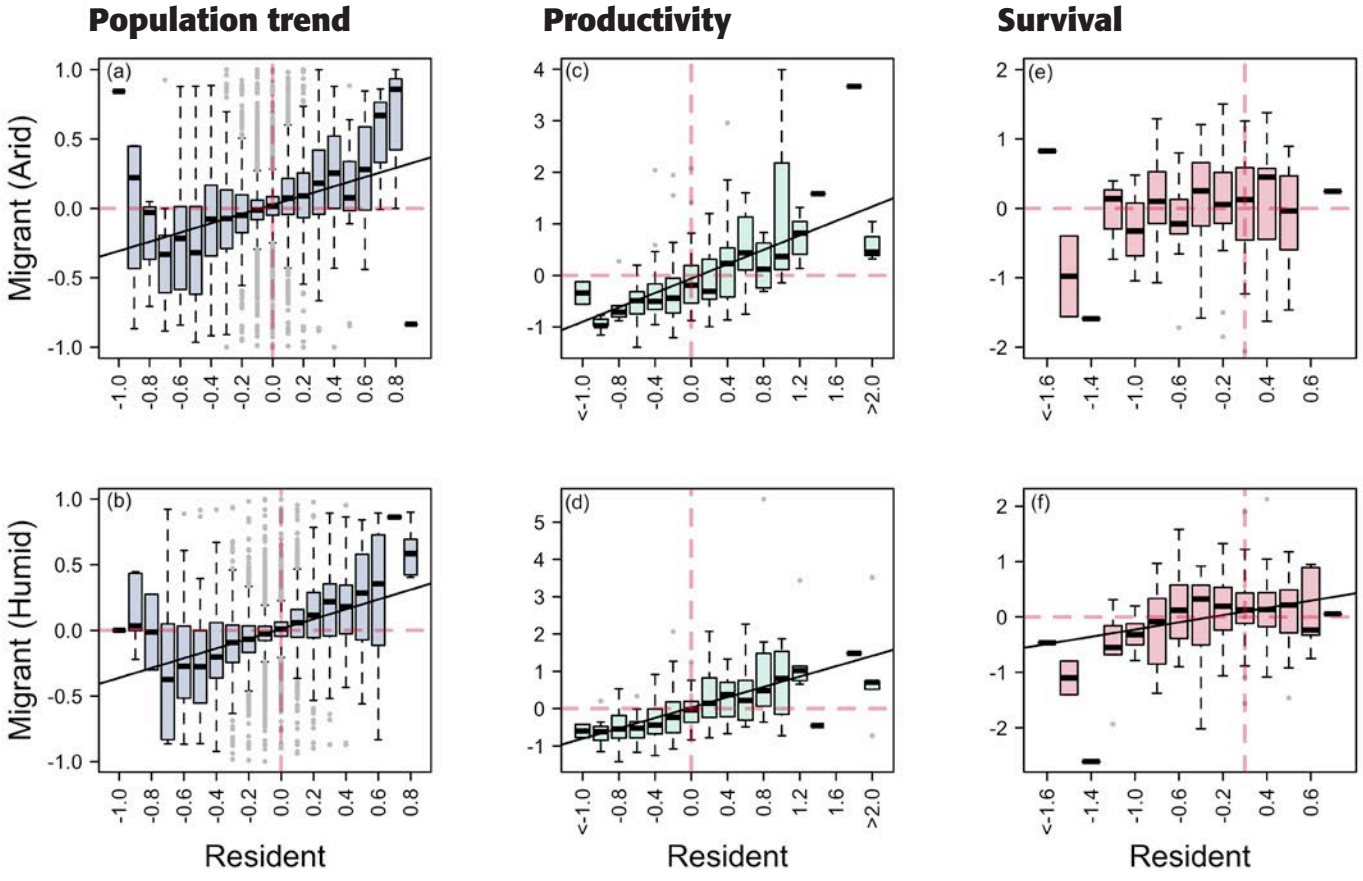


Figure 8 Resident and migrants species breeding at the same sites have similar population trends and productivity but not survival rates. The breeding season site-level association between resident and migrant (Arid = top row and Humid zone = bottom row) mean: (a) and (b) population trends, (c) and (d) productivity, and (e) and (f) survival rates. Lines of best fit are shown for significant associations (Morrison *et al.* 2021).

WOODCHAT SHRIKE: PHILIP CROFT/BTO

Table 4 Migratory status of species used in the analysis and the number of PECBMS and Euro-CES sites in which species were found in sufficient numbers to include in the analysis (Morrison *et al.* 2021).

Species	Migration	PECBMS	Euro-CES	Species	Migration	PECBMS	Euro-CES
Bonelli's Warbler	Arid	931	na	**Chiffchaff**	Resident	10,376	136
Grasshopper Warbler	Arid	2,396	na	**Cirl Bunting**	Resident	1,407	na
Lesser Whitethroat	Arid	5,572	24	**Coal Tit**	Resident	6,578	na
Northern Wheatear	Arid	3,178	na	**Common Redpoll**	Resident	1,592	na
Ortolan Bunting	Arid	650	na	**Corn Bunting**	Resident	2,673	na
Redstart	Arid	4,376	na	**Crested Tit**	Resident	3,281	na
Sand Martin	Arid	1,450	na	**Dunnock**	Resident	10,615	118
Sedge Warbler	Arid	2,873	121	**Fieldfare**	Resident	3,379	na
Short-toed Lark	Arid	224	na	**Firecrest**	Resident	2,426	na
Subalpine Warbler	Arid	364	na	**Goldcrest**	Resident	6,472	na
Tawny Pipit	Arid	392	na	**Goldfinch**	Resident	8,734	17
Western Orphean Warbler	Arid	171	na	**Great Tit**	Resident	12,564	211
Whitethroat	Arid	8,878	80	**Greenfinch**	Resident	10,267	37
Woodchat Shrike	Arid	470	na	**Grey Wagtail**	Resident	2,628	na
Yellow Wagtail	Arid	3,355	na	**Hawfinch**	Resident	2,636	na
Barn Swallow	Humid & Southern	10,167	na	**House Sparrow**	Resident	8,089	19
Collared Flycatcher	Humid & Southern	171	na	**Jay**	Resident	9,207	na
Common Nightingale	Humid & Southern	2,905	29	**Linnet**	Resident	8,066	na
Garden Warbler	Humid & Southern	7,902	78	**Long-tailed Tit**	Resident	7,437	85
Golden Oriole	Humid & Southern	3,543	na	**Marsh Tit**	Resident	3,955	na
House Martin	Humid & Southern	7,075	na	**Meadow Pipit**	Resident	5,118	na
Icterine Warbler	Humid & Southern	2,457	na	**Mistle Thrush**	Resident	8,321	na
Marsh Warbler	Humid & Southern	2,883	32	**Nuthatch**	Resident	5,936	na
Melodious Warbler	Humid & Southern	1,418	na	**Crossbill**	Resident	1,395	na
Pied Flycatcher	Humid & Southern	2,759	na	**Redwing**	Resident	1,526	na
Red-backed Shrike	Humid & Southern	3,218	na	**Reed Bunting**	Resident	5,168	86
Reed Warbler	Humid & Southern	2,644	151	**Robin**	Resident	11,942	170
River Warbler	Humid & Southern	396	na	**Serin**	Resident	2,914	na
Spotted Flycatcher	Humid & Southern	4,598	na	**Short-toed Treecreeper**	Resident	3,863	na
Thrush Nightingale	Humid & Southern	1,331	na	**Siskin**	Resident	2,634	na
Tree Pipit	Humid & Southern	5,366	na	**Skylark**	Resident	8,884	na
Whinchat	Humid & Southern	3,236	na	**Song Thrush**	Resident	11,602	45
Willow Warbler	Humid & Southern	9,627	150	**Stonechat**	Resident	3,541	na
Wood Warbler	Humid & Southern	3,191	na	**Tree Sparrow**	Resident	4,091	19
Bearded Tit	Resident	na	18	**Treecreeper**	Resident	3,812	na
Black Redstart	Resident	3,451	na	**White Wagtail**	Resident	10,489	na
Blackbird	Resident	12,866	185	**Willow Tit**	Resident	3,299	na
Blackcap	Resident	11,261	210	**Woodlark**	Resident	2,272	na
Blue Tit	Resident	11,552	190	**Wren**	Resident	11,715	125
Bullfinch	Resident	5,924	48	**Yellowhammer**	Resident	8,276	na
Chaffinch	Resident	13,060	60				

FIND OUT MORE...

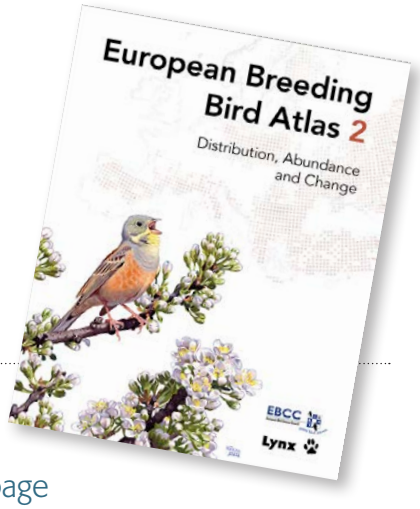
Morrison, C.A., Butler, S.J., Robinson, R.A., Clark, J.A., Arizaga, J., Aunins, A., Baltà, O., Cepák, J., Chodkiewicz, T., Escandell, V., Foppen, R.P.B., Gregory, R.D., Husby, M., Jiguet, F., Kålås, J.A., Lehikoinen, A., Lindström, A., Moshøj, C.M., Nagy, K., Nebot, A.L., Piha, M., Reif, J., Sattler, T., Škorpilová, J., Szép, T., Teufelbauer, N., Thorup, K., Turnhout, C.V., Wenninger, T. & Gill, J.A. 2021. Covariation in population trends and demography reveals targets for conservation action. *Proceedings of the Royal Society B* **288**: 1,471–2,954.

Morrison, C.A., Robinson, R.A., Butler, S.J., Clark, J.A. & Gill, J.A. 2016. Demographic drivers of decline and recovery in an Afro-Palaearctic migratory bird population. *Proceedings of the Royal Society B* **283**: 20161387.

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(12)**: 1,361–1,372.

The European Breeding Bird Atlas 2: BBS plays its part

A decade of work from across Europe brings together a mass biodiversity mapping exercise.



By **Mark Eaton**, Principal Conservation Scientist, RSPB and European Bird Census Council Chair

The *European Breeding Bird Atlas 2* (EBBA2) was published in December 2020, and can claim to be one of the most ambitious biodiversity mapping exercises ever completed. This mighty 5 kg, 1,000 page book was the result of a decade of work by the European Bird Census Council (EBCC; www.ebcc.info) drawing on the fieldwork efforts of 120,000 volunteers across Europe, from the Azores to the Ural Mountains.

CHANGES ACROSS EUROPE

The fieldwork for EBBA2 recorded 596 species breeding in Europe, of which 539 were native and 57 non-native. The book presents full accounts for 556 species, with illustrations, texts and multiple maps. As the title suggests, this is the second EBCC atlas, following the first published in 1997 and based on data collected in the mid-1980s. As the new atlas draws on fieldwork during 2013–17, it gives an opportunity not just to look at the current distribution of breeding birds across Europe, but also at change over the past three decades.

Europe's birds have experienced strong anthropogenic pressures in recent years, from changes in land management in agriculture and forestry, habitat loss and creation, improvements in protection, and the impacts of climate change. The latter impact can be seen in many of the change maps, with a consistent pattern of northward movement in bird distributions.

This map for Cetti's Warbler shows how the species has expanded northwards in the UK and the Low Countries since the 1980s, a change also reflected by the BBS trend of +417% between 1995 and 2018.

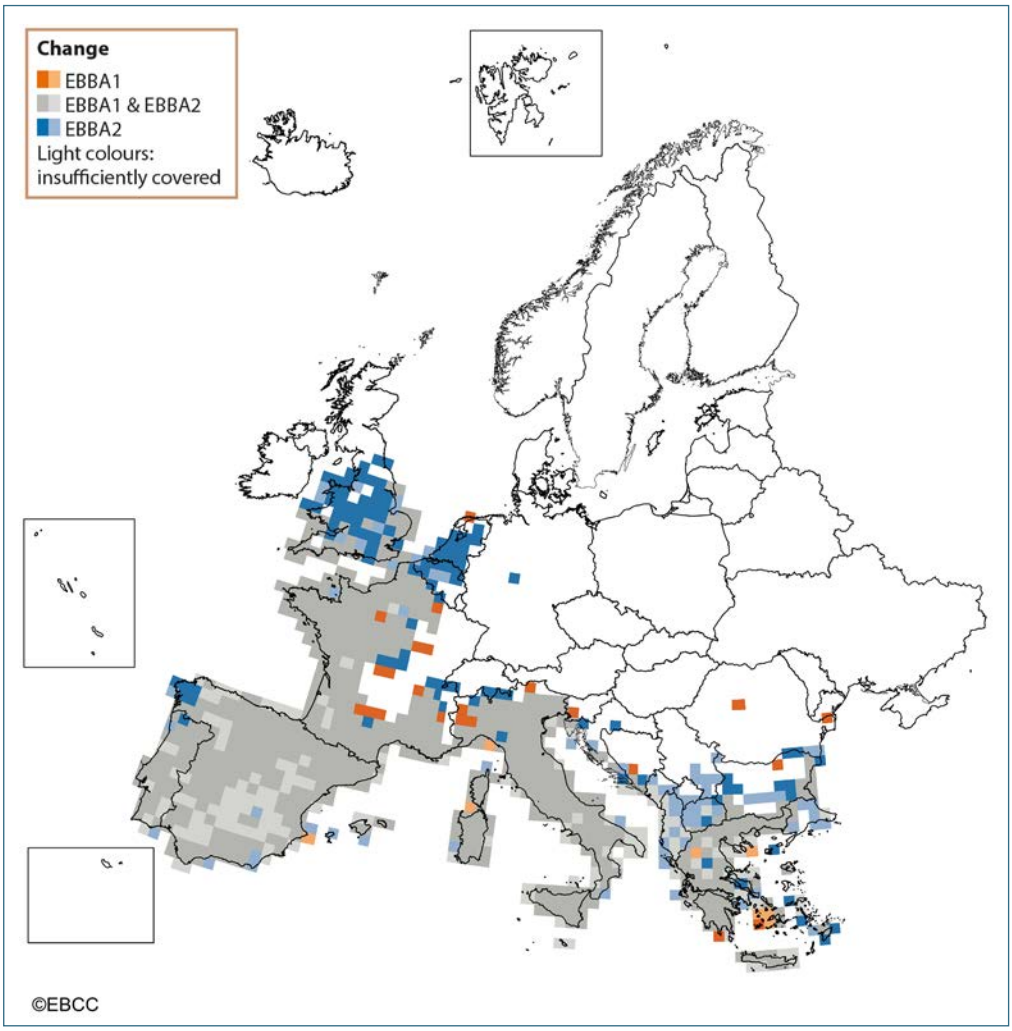


Figure 9 The EBBA2 map for Cetti's Warbler illustrates in **blue (gains)** and **orange (losses)** the distribution change between the first Europe-wide atlas and this latest one; since the mid-1980s. The grey is for areas of no change.

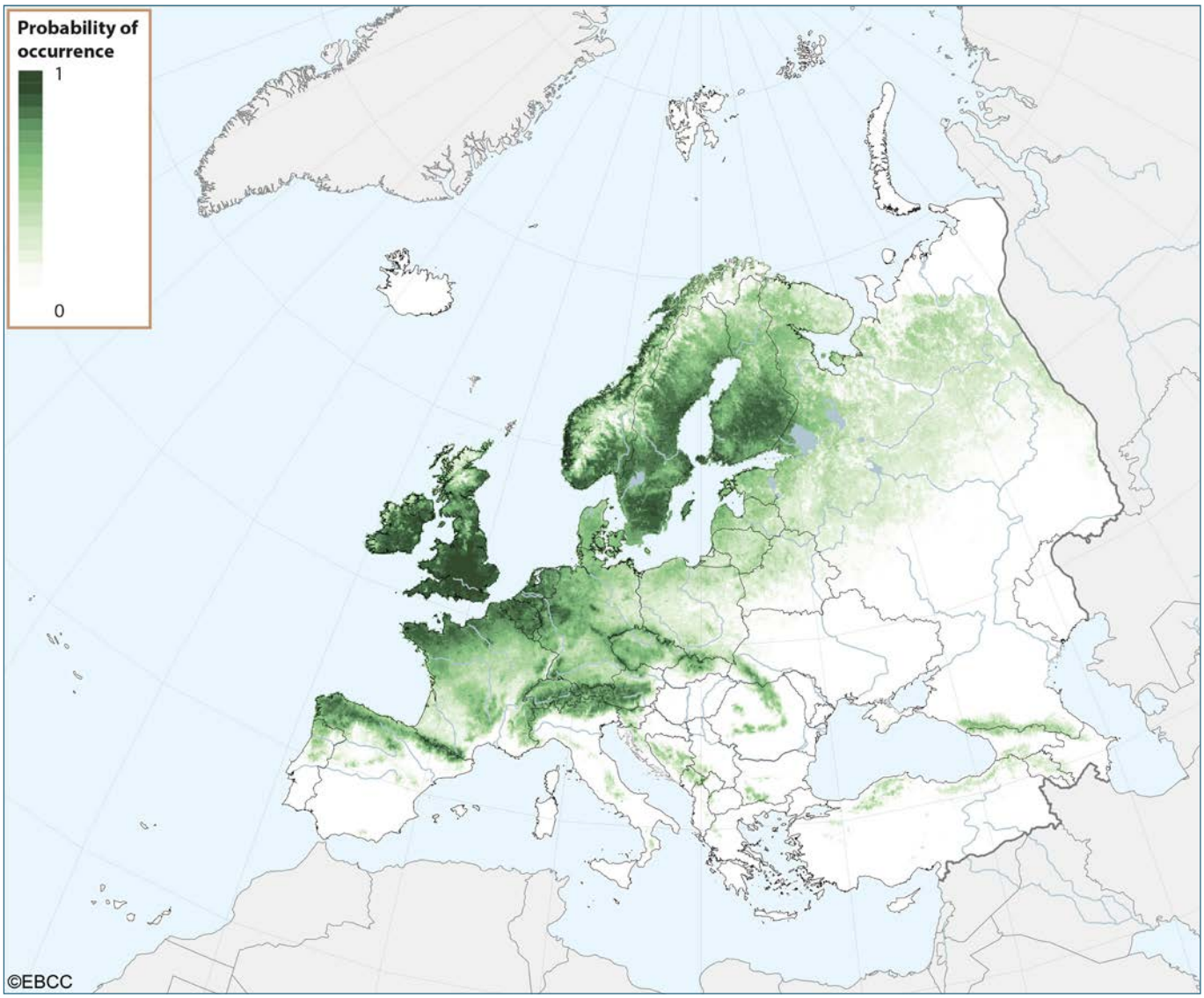


Figure 10 The range for Dunnock shows a high probability of occurrence in lowland areas of the UK, a contrast to the pattern seen across southern Europe, notably in southern Europe in the high-altitude areas of the Pyrenees, Alps and Carpathians.

THE BBS PLAYING A PART

Data submitted to the UK's BBS played a part in the atlas project. BBS counts were used in an exciting new modelling approach. Pooling data from similar annual monitoring schemes across Europe, combined with standardised counts from countries where such schemes don't yet exist, enabled analyses of species' occurrence at the 10 x 10 km scale for 222 species. These modelled maps show the probability of species occurring within 10 km squares which can, with caution, be interpreted as a rough proxy for abundance.

The map for Dunnock (Figure 10), illustrates the importance of the UK for the species, with a higher probability of occurrence across our lowlands than anywhere else in its range. It also shows very clearly how in southern Europe the Dunnock is a high-altitude specialist, found in mountain ranges such as the Pyrenees, Alps and Carpathians – very different from its distribution in the UK!

FIND OUT MORE...

The publication of the EBBA2 book is just one outcome from this massive project. The underlying dataset will undoubtedly support a huge amount of research on Europe's avifauna for years to come (the first atlas has been cited in 3,150 scientific publications!), and underpin conservation action across the Continent.

In addition, an online resource providing all the species' maps will be published in late 2021. Copies of the EBBA2 book can be purchased at www.lynxeds.com/product/european-breeding-bird-atlas-2-distribution-abundance-and-change.

The profits from book sales will go to supporting the development of new monitoring and atlasing projects in eastern and southeastern Europe.

Mammal monitoring

BBS volunteers have the option of recording live mammals, their fieldsigns and use local knowledge of their presence during the bird surveys.

Since 1995, mammal monitoring on BBS squares has taken place and population trends produced. Unfortunately, due to the COVID-19 pandemic, coverage in 2020 was reduced and it was not possible to produce population trends, although data will remain available for future research and analysis.

Mammal recording is optional, yet 1,829 squares in 2020 contain mammal recording, including live counts, signs of mammals, local knowledge and null returns (where the surveyor looked but did not find any evidence of mammals). This is 90% of all BBS squares covered in 2020 and on par with recent years, when full coverage of the UK was possible.

Thank you to all who opt into this element of the BBS. Previously published trends are available online at www.bto.org/bbs-mammals.

RECORDS IN 2020

As mentioned above, there are several types of mammal records and in 2020, mammals were looked for but no evidence found (null return) on 285 squares. Live mammals were detected on 1,474 squares and indirect evidence (signs or remains) were submitted for 70 squares.

SPECIES BREAKDOWN

Forty-two species were recorded, including **Domestic Cat**, and **Park Cattle**. **Mountain/Irish Hare** is grouped together in this total and in addition to the 42 species, an unidentified pipistrelle was noted.

Domestic Cat was recorded on 164 squares out of the 1,829 containing mammal recording information, just 9% of mammal monitoring squares, and is likely to be vastly overlooked.

ELUSIVE SPECIES

In 2020, seven mammal species were recorded only via signs, remains or local knowledge, these were **European Beaver**, **Lesser White-toothed Shrew**, **Daubenton's Bat**, **Pine Marten**, **Polecat**, **American Mink** and **Pygmy Shrew**.

WIDESPREAD SPECIES

At the other end of the scale, **Rabbit** was the most frequently encountered species, with 5,848 live counts recorded over 862 of the 917 squares with **Rabbit** presence also noted.

Grey Squirrel, **Brown Hare**, **Roe Deer** and **Red Fox** formed the rest of the top five most recorded mammal species. See Table 5 for a full tally of 2020 counts.

COMPARED TO 2019

For the nine species for which population trends are usually counted, in a normal year, the percentage of total mammal monitoring squares (1,829) on which each species was recorded in 2020 and 2019 are displayed in Table 6. Note, however, the 2020 coverage for BBS was biased towards England and by habitat type and therefore, these figures are purely for interest and not an indication of population change between years.

Domestic Cat were recorded on 9% of the squares monitored for mammals in 2020.

DOMESTIC CAT: AMY LEWIS/BTO

Table 5 All mammal species recorded in 2020.

Species	Squares recorded	Squares with live counts	Maximum count, summed
Red-necked Wallaby	1	1	2
Brown Hare	462	452	1,505
Mountain/Irish Hare	25	25	97
Rabbit	917	862	5,848
Grey Squirrel	647	625	1,377
Red Squirrel	15	9	14
Edible Dormouse	1	1	1
European Beaver	1	0	
Water Vole	3	2	3
Field Vole	20	10	21
Bank Vole	8	3	3
Wood Mouse	15	3	4
House Mouse	3	1	1
Brown Rat	27	10	19
Lesser White-toothed Shrew	1	0	
Common Shrew	19	9	9
Pygmy Shrew	4	0	
Mole	193	2	2
Hedgehog	11	1	1
Wild Boar	4	1	8
Harbour Porpoise	1	1	3
Roe Deer	330	302	566
Red Deer	35	23	153
Sika Deer	10	7	24
Fallow Deer	70	46	556
Reeves's Muntjac	118	95	147
Chinese Water Deer	8	8	37
Park Cattle	3	2	72
Feral Goat	1	1	24
Daubenton's Bat	1	0	
Unidentified pipistrelle	7	1	1
Domestic Cat	164	154	242
Red Fox	193	115	151
Grey Seal	4	4	11
Common Seal	1	1	1
Otter	8	3	4
Pine Marten	2	0	
Badger	106	2	2
Stoat	15	11	13
Weasel	8	5	5
Polecat	2	0	
American Mink	2	0	

Table 6 Percentage of squares surveyed for mammals containing each species; a comparison between 2020 and 2019. Note, small samples and biased coverage in 2020. Species from remote areas likely underrecorded.

Species	Percentage of squares recorded on in 2020 (squares covered: 1,829)	Percentage of squares recorded on in 2019 (squares covered: 3,607)
Mountain/Irish Hare	1%	2%
Red Deer	2%	5%
Fallow Deer	4%	3%
Reeves's Muntjac	6%	7%
Red Fox	11%	14%
Roe Deer	18%	25%
Brown Hare	25%	29%
Grey Squirrel	35%	35%
Rabbit	50%	50%

◀ **Squares recorded:** include counts of live mammals, field signs, dead mammals and local knowledge. **Squares with live counts:** number of squares with counts of live mammals only, **Maximum count, summed:** the peak count from the two visits on each square are taken forwards and summed, providing the total max-counts across all squares for 2020.

RED SQUIRREL: SARAH KELMAN/BTO

The latest news, coverage and sightings from the WBBS

The Waterways Breeding Bird Survey (WBBS) forms part of the BTO/JNCC/RSPB Breeding Bird Survey partnership agreement. The survey was previously managed and funded by BTO, with financial assistance from the Environment Agency. The WBBS focuses on monitoring waterway specialists.

The COVID-19 pandemic greatly impacted coverage for the WBBS in 2020, with 150 waterway stretches covered compared to 284 in 2019. The timing of local restrictions and lockdowns also meant that the majority of these stretches (80%) were surveyed just the once – for the Late visit. Coverage was also biased to England, again largely due to differences in the timing of local legislation and guidance in the UK's devolved countries. Having said all that, the dedication of WBBS volunteers never disappoints and the coverage exceeded anything that could have been predicted.

We know personal circumstances, as well as local legislation, meant there was a lot to consider in 2020, before thinking about completing surveys. We are so grateful to everyone who took part and everyone who couldn't, but continues to support the survey. Thank you.

ONLINE DEVELOPMENTS

Looking forwards, there are some exciting developments happening in BBS Online, the online data submission application used by the WBBS. These developments are largely for the BTO Regional Organisers, but there are, of course, some functions for volunteers as well and more information on these can be found in the BBS section of the report on page 4.

In addition, and specific to WBBS, the survey will soon have its own public interactive map on the BTO WBBS webpage, enabling potential volunteers to view areas containing vacant sites nearby. On finding an area (10 km) a volunteer is willing to survey within, a short form can be filled in and sent to the relevant BTO Regional Organiser who will be able to make contact and discuss WBBS options. Hopefully, this will increase the visibility of areas in need of observers and increase coverage for WBBS!

BREEDING WADERS

As mentioned on page 5, 2021 sees the trial of additional visits between mid-June and mid-July, to WBBS sites to record information on breeding waders and contribute to wader research. Additional visits are needed to stretches that held breeding waders in the Early and/or Late visits. It is hoped a simple methodology for collation of crucial wader breeding success information can be developed. To take part, visit www.bto.org/wbbs-waders.

DETECTION TYPE RECORDING

Another optional extra to WBBS recording is Detection Type, which logs how an individual bird was first detected: by song, call or visually. This information will help in estimating abundance, by identifying which species and sexes are easily detected, and what might be going undetected. This option was introduced in 2014 and in both 2019 and during 2020, detection information was recorded on 75% and 79% of stretches respectively.

MAMMALS ALONG WATERWAYS

Mammal monitoring also forms an additional piece of recording for WBBS visits and, like BBS, mammal monitoring takes place, on average, on just under 90% of survey sites. In 2020 specifically, live mammal counts, evidence of mammals or records of local knowledge were submitted for 132 stretches – 88% of those surveyed. Nine stretches had evidence only information, 22 looked for mammals and signs of mammals but found none (null returns) and 101 saw and counted mammals during visits. The most commonly recorded mammal was **Rabbit**.

COLONIES COUNT

The two most frequently recorded colonial species overall, since the survey started in 1998, are **Rook**, followed by **Sand Martin**. In 2020, the most frequently recorded colonial species was **Sand Martin**. Twenty-four waterways had colony information provided in 2020 (16% of stretches surveyed), compared to 57 in 2019 (20% of stretches surveyed), though, it is worth noting that the majority of waterways in 2020 were visited only once.

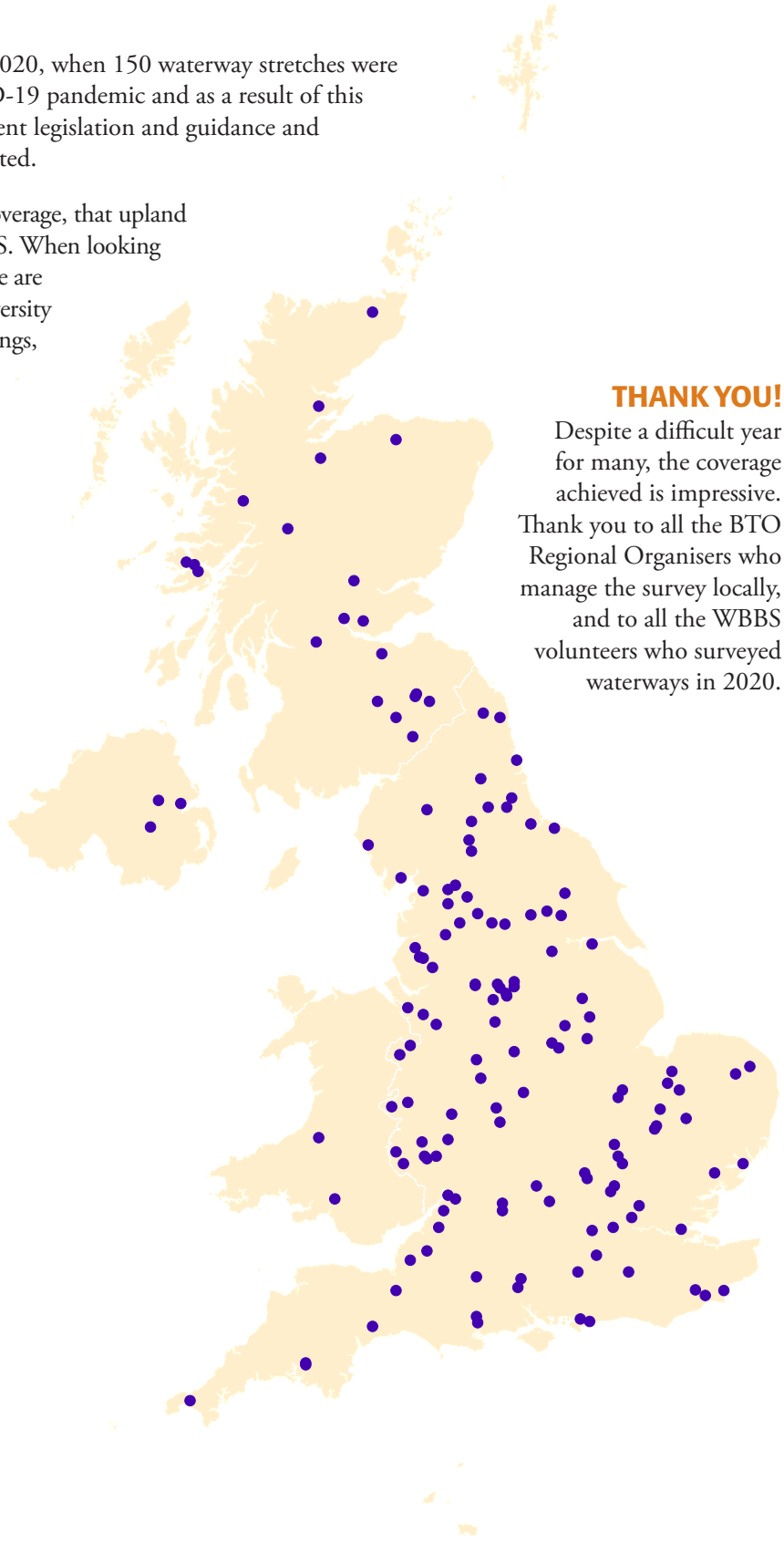
Table 7 The number of WBBS stretches with data received to date.

	1998	1999	2000	2001*	2002	2003	2004	2005
England	133	133	129	38	151	178	191	210
Scotland	27	36	32	12	49	53	59	52
Wales	8	14	14	1	26	30	37	39
Northern Ireland	-	3	1	-	2	1	-	-
UK total	**168**	**186**	**176**	**51**	**228**	**262**	**287**	**301**

COVERAGE OVERVIEW

The map displayed here shows the coverage for 2020, when 150 waterway stretches were surveyed. Coverage was restricted by the COVID-19 pandemic and as a result of this – and the biases which came with local government legislation and guidance and timings – population trends could not be calculated.

It is notable, possibly even more so with limited coverage, that upland and remote areas are under-recorded for the WBBS. When looking at some of the waterways in need of coverage, some are obviously a challenge, but not all, and with the diversity and natural route into upland areas a waterway brings, some look rather appealing! There are currently no stretches available to survey on the Isle of Man or Channel Islands.



THANK YOU!

Despite a difficult year for many, the coverage achieved is impressive. Thank you to all the BTO Regional Organisers who manage the survey locally, and to all the WBBS volunteers who surveyed waterways in 2020.

STATS BOX

150 stretches
surveyed in 2020

28 surveyed twice
in 2020; two Early and 120 Late only

603.5 km
walked during active surveying along waterway stretches in 2020

52,543 km
ever walked during active surveying for the WBBS since 1998

145 bird species
recorded during the 2020 WBBS, five species recorded for Colony Counts

65 species of bird
recorded along the River Wear near Durham in 2020

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020**
202	190	200	212	204	207	204	206	203	214	215	222	219	210	125
57	48	48	47	43	44	57	52	53	61	57	55	49	50	20
32	32	27	25	22	19	20	22	26	27	29	25	23	22	2
4	-	1	1	1	3	3	2	2	2	2	3	2	2	3
295	**270**	**276**	**285**	**270**	**273**	**284**	**282**	**284**	**304**	**303**	**305**	**293**	**284**	**150**

**2001: foot-and-mouth disease **2020: COVID-19*

COVERAGE CONTINUED...

One hundred and thirty-three volunteers took part in the WBBS in 2020 and, as mentioned, 150 stretches were surveyed. Coverage for the WBBS has been relatively stable since the mid-2000s and limited in part by ongoing difficulties in developing a method for randomly selecting new WBBS stretches. It is hoped this work will continue in the year to come.

It should be noted that there are available sites at the moment – especially in the more remote areas of the UK. With the new interactive map on the WBBS webpages, it is hoped interest in the survey and the waterways in need of coverage will grow.

SIGHTINGS FROM 150 WBBS STRETCHES

Just two stretches had fewer than 10 bird species recorded – one in remote Scotland, the other in Wales and 12 stretches had 50 or more species. On average, 35 bird species were seen on WBBS stretches in 2020, compared to the average of 26 bird species recorded on WBBS in 2020.

Woodpigeon and **Wren** are the first and second commonest species to be recorded on surveys, with **Mallard** being the third – and first waterway specialist – in the most recorded list! More unusual encounters during 2020 surveys included **Scaup** (see image below), **Hen Harrier**, **Dartford Warbler** and **Lesser Spotted Woodpecker** – all representing single records and keeping surveyors on their toes.

SCAUP: CHRIS FARTHING

Figure 11 The number of stretches, by visit, surveyed for WBBS across the UK.

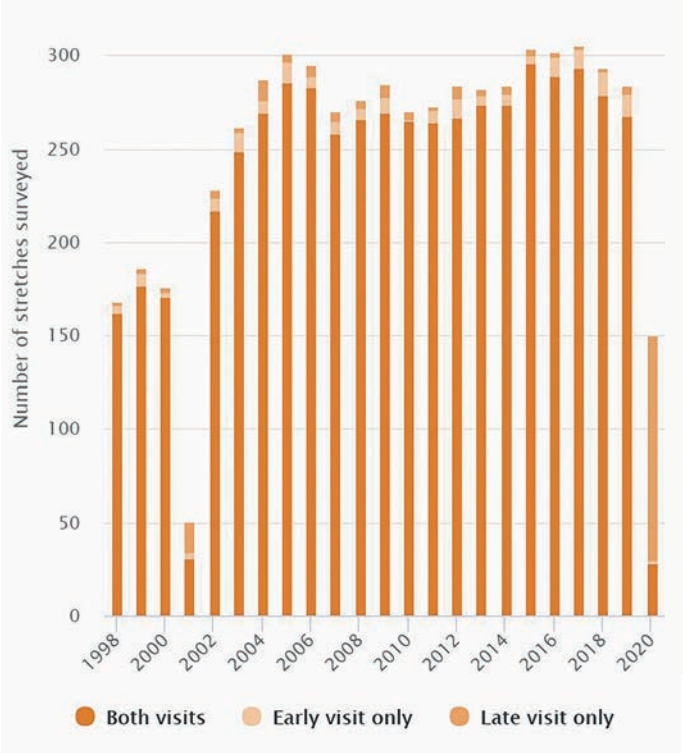
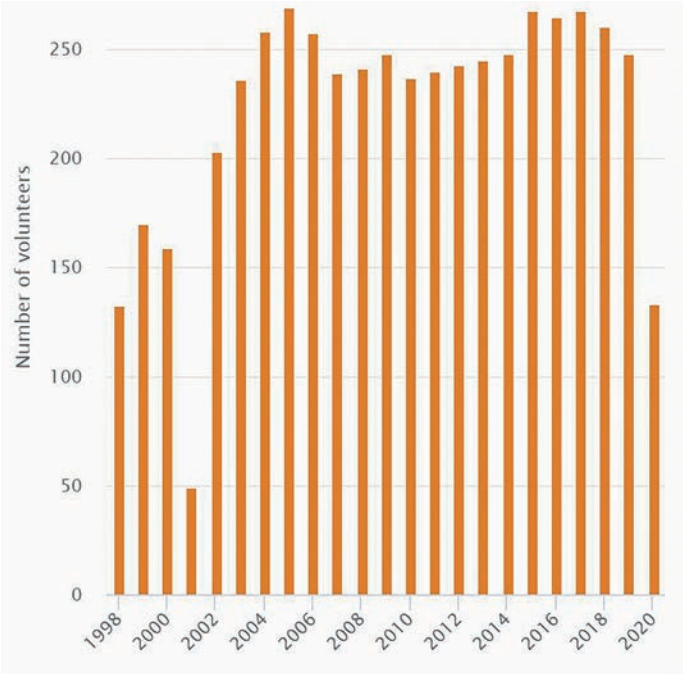
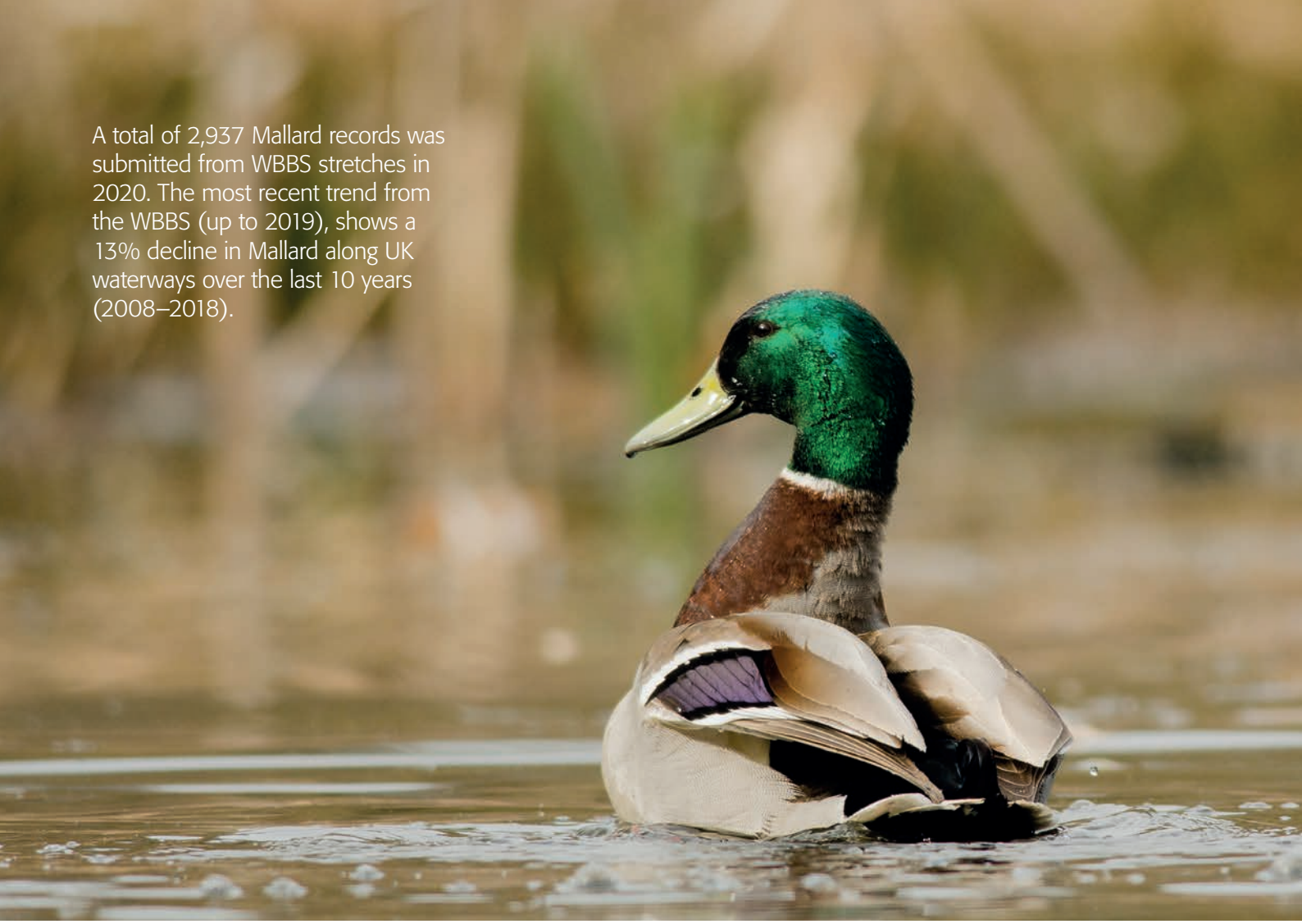


Figure 12 The number of volunteers participating in the WBBS across the UK.



METHOD AND PURPOSE

Methods are similar to the Breeding Bird Survey, but there are some differences. Rather than two 1 km parallel transect routes, divided into 200 m sections, the WBBS runs as one long transect, alongside a waterway and with sections being 500 m long. Each WBBS stretch can range in length from a single 500 m section to a 5 km stretch. The survey is especially valuable for monitoring the population trends of species strongly associated with linear waterways. Due to the COVID-19 pandemic, calculating population trends was not possible this year but the data collected during the 2020 season will always be available for future use.



A total of 2,937 Mallard records was submitted from WBBS stretches in 2020. The most recent trend from the WBBS (up to 2019), shows a 13% decline in Mallard along UK waterways over the last 10 years (2008–2018).

MALLARD: RICHARD JACKSON/BTO

LONG-TERM MONITORING OF WATERWAYS

Despite the setback in 2020, this is a long-term survey and continued waterway monitoring remains crucial in tracking the health of this habitat type. It is hoped coverage will bounce back and calculating trend production will be possible next year. Thank you for the continued support of the Waterways Breeding Bird Survey.

FIND OUT MORE...

For the previously published population trends from the WBBS, visit: www.bto.org/volunteer-surveys/wbbs/results

SPECIAL THANKS

As is the case with the Breeding Bird Survey (see back cover), the Waterways Breeding Bird Survey also relies on the dedication and enthusiasm of BTO Regional Organisers (RO), who manage the survey locally. Without these volunteers, it would not be possible to manage such large surveys and we are in debt to them all.

The back cover shows a complete list of the ROs who manage the Breeding Bird Survey locally; many of these ROs also manage the WBBS. Please see opposite for the list of those WBBS Regional Organisers who focus solely on managing WBBS (and are therefore not listed on the back page). Please do email wbbs@bto.org if you would like to find out more about becoming a Regional Organiser for WBBS and/or BBS in a vacant region, and to see what is involved.

Once again, a huge thanks goes out to all the Regional Organisers, volunteers and landowners who enable this survey to be the success it is. Thank you all.

WBBS-specific Regional Organisers in 2019:

ENGLAND

Huntingdon & Peterborough	Derek Langslow
Staffordshire (North, South, West)	Scott Petrek (now **VACANT**)

NORTHERN IRELAND

Antrim & Belfast, Armagh, Down, Londonderry and Tyrone.	Michael Stinson

Many thanks are due to Scott Petrek for his efforts managing the WBBS locally and who retired from the role of WBBS Regional Organiser during the past year for Staffordshire (North, South, West). The following BTO Regions currently have vacancies for Regional Organisers: Angus, Essex (South), Lancashire (East), Merseyside, Northamptonshire, Nottinghamshire, Staffordshire (North, South, West) and Yorkshire (North-West)

SPECIAL THANKS

We would like to thank all surveyors and ROs for making the BBS the success it is today. Space does not permit all observers to be acknowledged individually, but we would especially like to thank the ROs for their efforts.

BBS Regional Organisers in 2020:

ENGLAND

Avon	Dave Stoddard
Bedfordshire	Judith Knight
Berkshire	Sean Murphy
Birmingham & West Midlands	Steve Davies
Buckinghamshire	Phil Tizzard
Cambridgeshire	Rob Pople
Cheshire (Mid)	Paul Miller
Cheshire (North-East and South)	Hugh Pulsford
Cleveland	Michael Leakey
Cornwall	Michael Williams
Cumbria	Colin Gay
Derbyshire (North, South)	Dave Budworth
Devon	Stella Beavan
Dorset	Jack Winsper
Durham	David Sowerbutts
Essex (North-East)	Rod Bleach
Essex (North-West)	Graham Smith
Essex (South)	**VACANT**
Gloucestershire	Gordon Kirk
Hampshire	Glynne Evans
Herefordshire	Chris Robinson
Hertfordshire	Martin Ketcher
Huntingdon & Peterborough	Mick Twinn
Isle of Wight	Jim Baldwin
Isles of Scilly	Will Wagstaff
Kent	Bob Knight
Lancashire (East)	Tony Cooper (now **VACANT**)
Lancashire (North-West)	Jean Roberts
Lancashire (South)	Stephen Dunstan
Leicestershire & Rutland	Dave Wright
Lincolnshire (East)	Phil Espin
Lincolnshire (North)	Chris Gunn
Lincolnshire (South)	**VACANT** (now Jo Hubbard)
Lincolnshire (West)	Mike Daly
London (North)	**VACANT** (now Sabrina Schalz)
London (South)	Richard Arnold
Manchester	Nick Hilton
Merseyside	**VACANT**
Norfolk (North-East)	Chris Hudson
Norfolk (North-West)	**VACANT** (now Jonathan Martin)
Norfolk (South-East)	Rachel Warren
Norfolk (South-West)	Vince Matthews
Northamptonshire	Barrie Galpin
Northumberland	Muriel Cadwallender
Nottinghamshire	Lynda Milner (now **VACANT**)
Oxfordshire (North)	Frances Buckel
Oxfordshire (South)	John Melling
Shropshire	Jonathan Groom
Somerset	Eve Tigwell
Staffordshire (North, South, West)	Gerald Gittens
Suffolk	Mick Wright
Surrey	Penny Williams
Sussex	Helen Crabtree
The Wirral	Paul Miller
Warwickshire	Annette Jarratt-Knock
Wiltshire (North, South)	Bill Quantrill & Claire Jones (now Polly Marino)
Worcestershire	Steve Davies
Yorkshire (Bradford)	Mike Denton
Yorkshire (Central)	Mike Brown
Yorkshire (East, Hull)	Brian Walker
Yorkshire (Leeds & Wakefield)	Rachael Dixey
Yorkshire (North-East)	Nicholas Gibbons
Yorkshire (North-West)	Alex Gould (now **VACANT**)
Yorkshire (Richmond)	Mike Gibson
Yorkshire (South-East)	**VACANT** (temporarily Grant Bigg)
Yorkshire (South-West)	Grant Bigg
Yorkshire (York)	Rob Chapman

SCOTLAND

Aberdeen	Moray Souter
Angus	**VACANT** (temporarily Steve Willis)
Argyll (Mull, Coll, Tiree & Morven)	Ewan Miles
Argyll (mainland & Gigha) & Bute	Nigel Scriven
Arran	James Cassels
Ayrshire	Dave McGarvie
Benbecula & The Uists	Yvonne Benting
Borders	Neil Stratton
Caithness	Donald Omand
Central	Neil Bielby
Dumfries	Andy Riches
Fife & Kinross	Norman Elkins (now Paul Blackburn)
Inverness (East & Speyside, West)	Hugh Insley
Islay, Jura & Colonsay	David Wood
Kincardine & Deeside	Claire Marsden
Kirkcudbright	Andrew Bielinski
Lanark, Renfrew & Dunbarton	Gordon Brady
Lewis & Harris	Chris Reynolds (now Craig Ferries)
Lothian	Stephen Metcalfe
Moray & Nairn	Melvin Morrison
Orkney	Colin Corse
Perthshire	Mike Bell
Rhum, Eigg, Canna & Muck	Bob Swann
Ross-shire	Simon Cohen
Shetland	Dave Okill
Skye	Carol Hawley
Sutherland	Bob Swann
Wigtown	**VACANT** (temporarily Andrew Bielinski)

WALES

Anglesey	Ian Hawkins
Brecknock	Andrew King
Caernarfon	Geoff Gibbs (now Rhion Pritchard)
Cardigan	Naomi Davis
Carmarthen	Paul Aubrey (now Emma-Louise Cole)
Clwyd (East)	Anne Brenchley
Clwyd (West)	Mel ab Owain
Glamorgan (Mid, South)	Wayne Morris
Glamorgan (West)	Lyndon Jeffery
Gwent	Richard Clarke
Merioneth	Dave Anning
Montgomery	Jane Kelsall
Pembrokeshire	Annie Haycock
Radnorshire	Carlton Parry

NORTHERN IRELAND

Antrim & Belfast	Kevin Mawhinney
Armagh	Stephen Hewitt
Down	Alastair McIlwain
Fermanagh	Michael Stinson
Londonderry	John Clarke
Tyrone	Michael Stinson (now Steven Fyffe)

CHANNEL ISLANDS

Channel Islands (excl. Jersey)	Chris Mourant
Jersey	Tony Paintin

ISLE OF MAN

Isle of Man	David Kennett

We would be grateful for help organising the BBS in regions currently without a Regional Organiser (marked **VACANT**). If you live in one of these regions and would be interested in taking on the role, please let us know.

Many thanks are due to the following ROs who retired during the past year, having supported the BBS in their regions: Paul Aubrey, Tony Cooper, Norman Elkins, Geoff Gibbs, Alex Gould, Claire Jones (Claire remains Regional Representative in Wiltshire North and South), Lynda Milner, Dave Piercy, Bill Quantrill, Chris Reynolds and Michael Stinson (Tyrone).

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Finally, we would like to thank all the landowners who kindly allow volunteers to walk BBS and WBBS transects on their land.

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