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The impact of Covid-19 on the UK Breeding Bird Survey and the production of population trends

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Introduction

The UK Breeding Bird Survey (BBS) has run annually since 1994, with volunteers visiting a stratified random sample of up to c. 4000 1-km squares. BBS data are used to produce population trends for about 120 bird species and nine mammal species and feed into Government statistics, indicators and PECBMS trends. Until 2020, the BBS had only experienced one year of poor coverage, during 2001 when an outbreak of Foot and Mouth disease prevented access to the countryside. The emergence of the Covid-19 pandemic in early 2020 changed that. Governments around the world adopted different strategies to manage the pandemic. In the UK, restrictions on people leaving their homes for nonessential travel were key measures employed to limit the spread of the virus. This nationwide 'lockdown' commenced on 23 March 2020, just prior to the start of BBS fieldwork, and ecological fieldwork did not qualify as a permitted activity. The four UK countries relaxed restrictions at different times, meaning fieldwork could commence to varying degrees at varying times across the UK. These temporally and spatially varying constraints on fieldwork had major impacts on volunteers' ability to undertake fieldwork, leading to concerns that data from 2020 would be insufficient and/or too biased to be used for trend production. As we move beyond 2020, that field season gradually recedes through the time series, but we need to understand the implications of using or removing these data on the trends we produce. We undertook a thorough analysis of patterns of coverage and biases, and tested the impact of these patterns on emergent population trends. Full details of these analyses can be found in Gillings et al. (2022) and in Noble & Gillings (2022), and a summary is provided here.

BBS coverage in 2020

Across the UK, 2029 1-km squares were surveyed in 2020, around half the number surveyed in recent years. Coverage reductions varied between countries, being most extreme in Wales (–82%) (Fig. 1). The survey design relies on two visits per square to increase the detection of scarce species, and to encompass the phenologies of a wide range of species: in 2020 only 10% of squares received both visits, with this figure varying widely between countries. Crucially, it was the early season visits that were missing (89% reduction versus 48% reduction for late season visits at UK level), and those few early visits were made on atypical dates. Squares surveyed in 2020 were biased with respect to habitats, especially on early visits and for squares in Scotland where people had to stay close to home.

BBS trends with 2020 as the final year

BBS data in 2020 were therefore limited in scale, biased spatially, temporally and with respect to habitats covered: by all accounts, it seems unlikely that such data would be suitable for trend production. Nevertheless, as several thousand volunteers took the time to make the surveys, and given the keen interest in how bird numbers varied through the pandemic, we felt it was important to test whether any robust trends could be produced. Owing to the very small sample sizes and large biases in 2020 data for Scotland, Wales and Northern Ireland, we tested whether robust trends could be produced for England. We used the complete BBS time series from 1994 to 2019 for which we knew the true observed trends (e.g. as published in Harris et al. 2020), and then degraded the 2019 data to replicate as closely as possible the levels of coverage reductions and

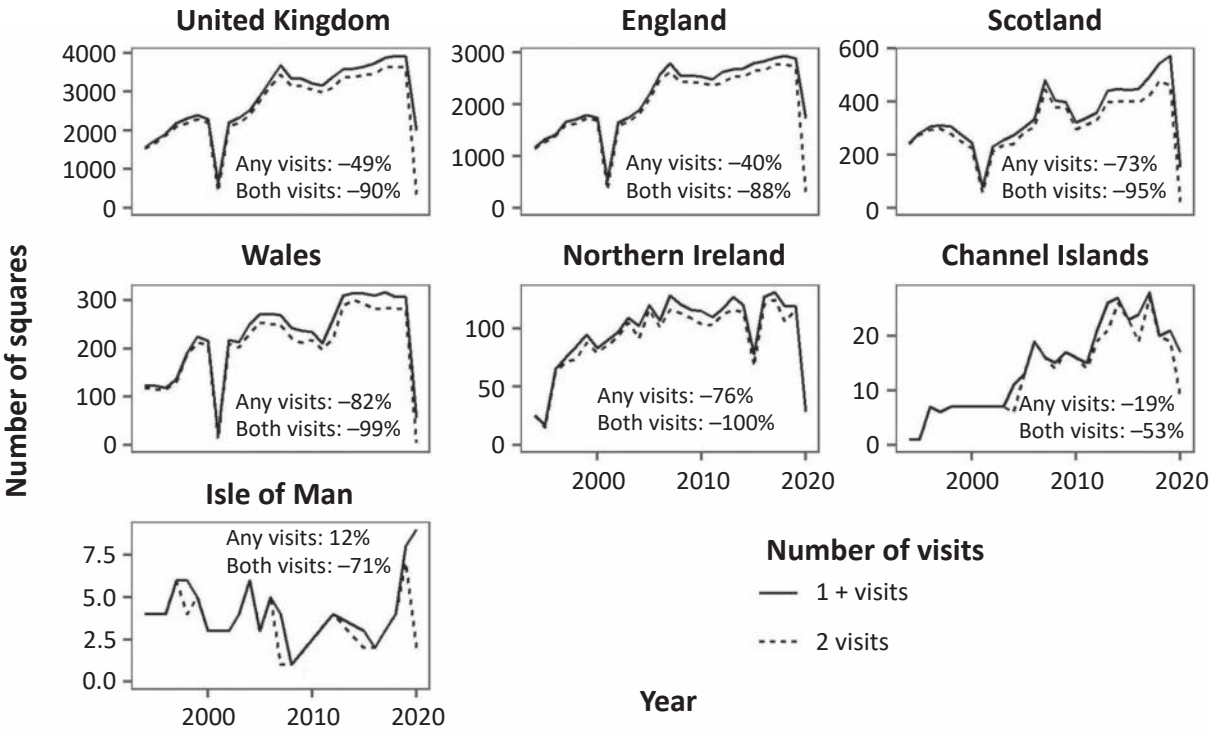

Figure 1. Numbers of BBS squares surveyed annually in the UK and constituent countries and dependencies. Separate lines are shown for the number of squares surveyed once (solid line) or twice (dashed line).

biases seen in 2020. We then reanalysed this 'degraded dataset' to test how trends were affected in comparison to the true trends extracted from the complete dataset. BBS trends are calculated using a generalised linear model with site and year effects, applied to a dataset comprising the maximum count of each species per square and year. Using this conventional approach trends were underestimated for 94% of species, with the errors being greatest for species that are usually detected in greatest numbers on early visits. We tested several alternative ways of producing trends and found that acceptably accurate trends could be produced for a subset of 57 species (about 40% of the normal total) if we used only the late visit data from all years. This allowed us to publish indicative trends for this subset of species in England, with the aim to revert to standard trend production techniques in subsequent years once normal coverage was resumed.

BBS trends with 2020 as the penultimate year

Coverage in 2021 returned to normal levels, and upon completion of fieldwork the 1994–2021 data would normally be used to produce smoothed population trends. By convention we use data from the full time series to calculate the smoothed trend but change estimates are calculated between the 2nd and penultimate years owing to greater uncertainty at the ends of the fitted smoothing splines. Given the coverage issues and biases outlined above, we intended to exclude all 2020 data from trend production. Consequently, the penultimate year would be 2020 so we needed to test that a smoothed trend estimate for 2020 would be robust in the absence of data for that year. We tested this using data for the period 1994–2019. We computed the true trends as normal, i.e. smoothed trends and change estimates with bootstrapped confidence limits for the period 1995–2018. We then omitted the 2018 data and repeated the process and compared change estimates from these degraded data to the true data. In general, errors were very small and centred on zero, albeit with a slight positive bias. This small bias was a year specific effect. When we repeated this analysis for a different period (1994–2018 data, with 2017 omitted) the bias was small and negative. This is because many species trends have inter-annual fluctuations (or observation biases) that mean individual trend points are above or below the smoothed line. Omitting such points causes these small deviations in the smoothed trend line. Reassuringly, these differ-

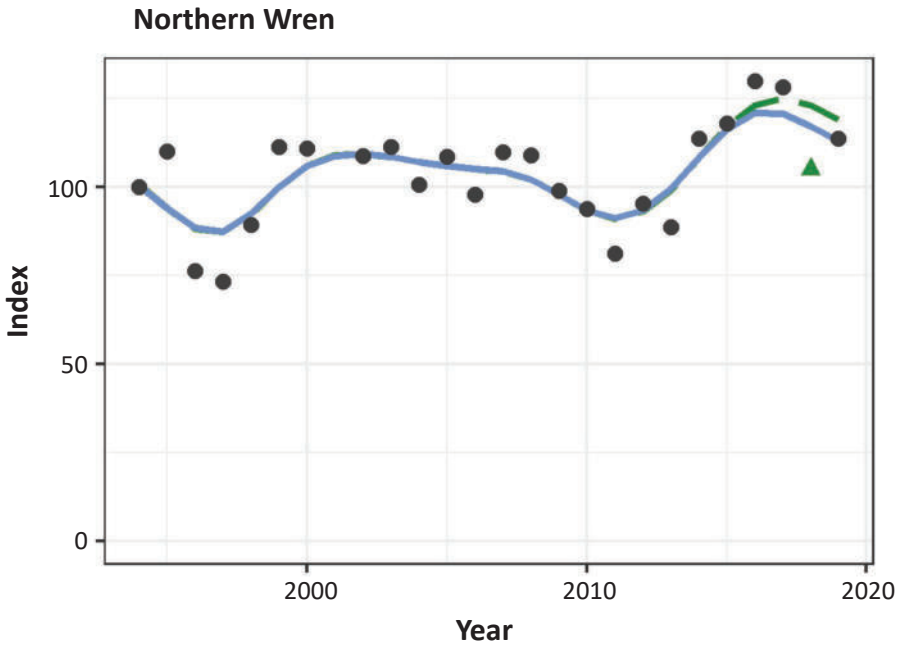

Figure 2. The true smoothed population trend for Wren (solid line) compared to the smoothed trend apparent when the penultimate year was omitted (dashed line). Points show the annual unsmoothed index values (the triangle marks the value for 2018 that was omitted when producing the degraded trend).

BTO volunteer conducting a BBS survey. Photo: David Tipling/BTO

ences are very small and for all but two species (Common Whitethroat *Sylvia communis* and Nortchern Wren *Troglodytes troglodytes*; Fig. 2) there was no significant difference between the degraded and true change estimates. This gives us confidence in 1995–2020 trend estimates produced using data for 1994–2021, with 2020 data omitted entirely.

Conclusion

The effects of Covid-19 restrictions on volunteer bird surveys in the UK in 2020 were significant and large enough to impact our ability to produce population trends in the immediate aftermath. Fortunately, as we move beyond 2020 these effects are dampened by a rapid return to high coverage. Being able to test coverage patterns against the structured survey design enabled us to easily evaluate the scale of any problems in coverage. Degrading data according to realistic scenarios was an effective tool for testing alternative ways of generating robust population trends.

Acknowledgements

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