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The potential virtue of garden bird feeders: More birds in citizen backyards close to intensive agricultural landscapes☆

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ABSTRACT

Farmland bird abundances have been declining for decades, an erosion associated with agricultural changes. Main drivers have already been identified: intensification of practices, modification of landscapes, leading to impoverished summer and winter food availability. In parallel, winter bird feeding in private gardens became a common practice. Such a food supplementation may represent a bonanza for seed-deprived bird communities. Using data collected by citizen providing food to wintering birds in > 1100 backyards, we analyzed the temporal and spatial trends in abundance of 30 species at feeders during four core winters periods and along a gradient of local agriculture intensification. Garden feeders located within intensively cultivated landscapes attracted more birds, the relationship being strongest for farmland species. We further found a temporal trend which strengthens this pattern as the winter progresses. These results confirm that supplying winter food to garden birds has not only a recreational value, but can also improve bird numbers hence probably winter survival rates, chiefly in intensive agricultural landscapes.

1. Introduction

Changes in agricultural policies and practices provoked unprecedented losses in biological diversity and associated ecosystem services from local to continental scales (Pe'er et al., 2014). The continuous decline of common birds illustrates the decline of biodiversity facing agricultural intensification (Donald et al., 2001; Gamero et al., 2017). Farmland constitutes the bulk of winter seed resources for many granivorous species (Butler et al., 2010; Robinson et al., 2001), while the availability of such resources is strongly affected by agricultural intensification (Newton, 2004). Changes in crop rotations, in ploughing and harvesting practices, in conjunction with the increased use of herbicides, led to a decrease in spilled grains and over-winter stubbles, amounting in a reduced availability of winter seeds in farmed habitats (Gibbons et al., 2006; Gillings et al., 2005; Moorcroft et al., 2002).

Enhancing winter seed availability is a solution to stem farmland bird populations decline (Robinson et al., 2004; Stoate et al., 2003, 2004), though often fails to meet seed demand in late winter (Perkins et al., 2008; Siriwardena et al., 2008). Besides, providing winter food to wild birds in private backyards is one of the most popular forms of human–wildlife interactions in developed countries (Jones, 2011; Reynolds et al., 2017). Garden bird feeding is important for urban biodiversity conservation (Fuller et al., 2008; Galbraith et al., 2015), and can represent a subsidy to natural diets for the seed-eating birds, enhancing winter survival and further breeding performance (Jansson et al., 1981; Robb et al., 2008b). However, we do not expect all bird species to respond in a similar way, but rather, their dependency on wild seeds in their diet, in addition to the degree of the intensity of surrounding farmland, are likely to influence their use of garden feeders. Indeed, we expected birds to visit garden feeders in larger numbers if the adjacent agriculture is more intensive. We also expected species with a stronger dependency to agricultural habitats to visit garden feeders in lower numbers than other species – because they would prefer to forage in the agricultural countryside - but to do so in larger numbers if the garden is located close to more intensively farmed landscapes – because the availability of wild seeds in intensive farmland would not meet their demand. We could also expect this pattern to strengthen as the winter progress, due to "natural" seed depletion (Robinson and Sutherland, 1999; Siriwardena et al., 2008).

The goal of this study was therefore to test the following hypotheses. i) Our first hypothesis was that farmland species visit garden feeders in lower numbers than other species: farmland species were not supposed to feed in gardens if there are enough natural resources in adjacent agricultural fields and gardens are not their main habitat. ii) It should

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be especially the case in low-intensity farmland areas: this means that we expected all the bird species to visit garden feeders in fewer numbers if the adjacent agriculture is less intensive, assuming that only intensive production practices reduced seed availability, but also that we expected an interaction between the bird species dependence to farmed habitat and to the degree of intensification of nearby agricultural practices. iii) We made the final hypothesis that birds species should visit garden feeders in larger number as the winter progress as seed scarcity augments during winter: this should mean that the temporal increase in the number of birds at feeders should be stronger/faster if the natural seed depletion is steeper in more intensive farmland and potentially more so for species with a higher dependency to farmland habitats. To do, we compared the overall abundances of the species and the temporal trends of these abundances by analyzing large scale bird counts recorded by volunteer citizen in their backyards. We used data collected by the French national garden birdwatch scheme in > 1100 private gardens with bird feeders and distributed across the whole country. We analyzed the spatial and temporal patterns of abundances for the 27 commonest bird species visiting the gardens, plus three less common seed-eating passerines. We compared their abundances during the core winter along a gradient of agriculture intensification characterized with a recent index of local agricultural Production Intensity developed for the French farmland (Teillard et al., 2012), associated with a species-specific index of dependency to agricultural habitats that we developed using data from the French Breeding Bird Survey (Jiguet et al., 2012).

2. Material and methods

2.1. Garden Birdwatch data

2.1.1. The French Garden Birdwatch scheme

Bird counts came from the French Garden Birdwatch scheme (see www.oiseauxdesjardins.fr), a citizen science program started in spring 2012 and operated by the Ligue pour la Protection des Oiseaux (LPO) and the French National Museum of Natural History (MNHN). The aim of this program is to register volunteer-based bird counts in private backyards throughout the year at a national scale. The program provides online resources to help participants to correctly identify gardens birds. These resources include forms, species description (including appearance, behavior or habitat) and pictures, and include warnings regarding common identification errors. Moreover, about a hundred of skilled ornithologists validate the data every day (from the LPO or others French naturalist NGOs).

2.1.2. Garden information and the correction for confounding effects

Each volunteer pinpoints his garden and provide a brief description of this garden online (including garden area, local urban/rural context, presence/absence of winter food supply, distance to the closest agricultural field, to the closest wood according to the perception of the observer himself); each garden has a unique garden identity. Each bird count is associated with a date, time and duration, and corresponds to the maximum simultaneous abundance of each species observed during the session. There is no standardization of the date, time, duration, meteorological conditions and spatial observation area for the observation sessions, but this information is recorded by observers, hence the effect of such confounding parameters can be considered prior to estimating the impact of landscape context and of the winter progress in statistical models.

2.1.3. Garden selection

This study considered 1180 gardens, with the subset of the 27 commonest bird species observed by the volunteer in winter. The garden selection process was done according to the following steps. Since 2012, > 20,000 gardens have been described across France, covering a representative range of garden types and geographic distribution, but less than half of these gardens following birds at least once during the winter season (our period of interest, here considering winter as the non-breeding period i.e. from September to March). Within the gardens surveyed in winter, we restrained our subset to garden with winter food supply (e.g. 90% of all gardens) and then to rural gardens (according to the observers themselves) as we wanted to explore the link between birds and agricultural landscape. After these considerations, the sample size then consisted of 6244 gardens followed at least once from September to March. When there was more than one session per year per garden, we retained only sessions separated by at least five days. To study the pattern of birds visiting the gardens in winter, we first explored all data collected from these 6244 gardens from September to March, more exactly from September 2012 to March 2016 (four winter periods). This preliminary study revealed that species abundance increased almost linearly from early November to the end of January (see Appendix A: A.1 for supplemental materials and methods and Fig. A.2), so we restricted our analysis to observations submitted from 1st November to 20th January (as the core winter period). Moreover, we did not consider the last ten days of January to exclude thousands of gardens counted only once a year during the annual national winter bird count, organized each year during the last week-end of January. During these events, the protocol is noticeably different as observation are only reported for one hour and for only one session per weekend. These events are widely promoted (media for the general public, naturalist networks…) and attract a lot of observers which participate only once. So, we excluded all bird counts before the 1st November and after the 20th January, excluding 5064 gardens which were surveyed only outside this core winter period. The final sample size was then of 1180 gardens.

2.1.4. Species selection and distribution validation

We considered the subset of the 27 commonest bird species observed by the volunteers, those detected at least once in > 10% of gardens (see the Table B1 in Appendix B) during the overall winter period, i.e. from September to March. We did not consider Brambling (*Fringilla montifringilla*) and Rose-ringed parakeet (*Psittacula krameri*) because we could not compute the species dependency for farmland habitats for these species. As volunteers report only the species they have seen, we zero-filled the dataset to include absence data. We further deleted observations corresponding to a true absence of the species in a region (species outside its winter range) by cross-referring the zero-amplified database with the distribution maps published recently in the latest French Winter Bird Atlas (Issa and Muller, 2015) and deleting those zeros obtained in gardens outside atlas cells where the species had been recorded in winter during the atlas period (2009–2013).

2.1.5. A second species and gardens subset to confirm detected trends

To further confirm the detected trends on more farmland seed-eating species, we conducted a second analysis where gardens were only included if at least one of the following three species was recorded at least once during the core winter period: Cirl Bunting (*Emberiza cirlus*), Yellowhammer (*Emberiza citrinella*), Common linnet (*Linaria cannabina*) and Tree sparrow (*Passer montanus*). All but Tree sparrow were not considered in the first analysis because they were observed in < 10% of all gardens, as they are quite uncommon in gardens in winter, probably due to their stronger dependence to agricultural habitats. This second study then considered an enlarged set of 30 species (the same 27 previous ones plus three new) but was based on 200 gardens only (see Appendix C - Fig. C.1) and aimed to confirm trends detected with the global dataset where there were fewer farmland species.

2.2. Species Farmland Dependency to agricultural landscape

To compute a species Farmland Dependency index to agricultural habitats (FarmDep), we used bird data from the French Breeding Bird