Supplementary winter feeding for farmland birds

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Abstract

Farmland birds have declined dramatically since the 1970s and show little sign of recovering. Numerous agri-environment measures, including supplementary feeding, have been advocated but have yet to reverse this

trend. We have studied the effect of generous supplementary feeding for farmland arable specialists over three years on three farms. Supplementary food was scattered daily on field margins by hedges or in conjunction with cultivated wild bird seed plots (WBS) from mid November to mid May. Sown seed supplies were rapidly exhausted. Bird numbers nevertheless increased dramatically during winter, before birds dispersed in early spring to breed. We conclude that the application of supplementary winter feeding is both practical and essential, at least at present, to maintain and restore farmland bird populations.

Introduction

As part of a general decline in farmland biodiversity, granivorous farmland bird numbers have declined in Britain by about 80% since the 1970s (Macdonald & Feber 2015). The introduction of Stewardship agri-environment schemes (AES) by Defra in 1995 has had limited success and has yet to reverse the overall declines (Defra 2019). The collapse in bird numbers, in particular, has been attributed to modern intensive farming methods (Newton 2017) largely through loss of plant diversity in arable landscapes, and therefore fewer available insects and weed or crop seeds in arable land (Marshall *et al.* 2003). Competition from the large number of gamebirds released into the farmed environment may also be contributory (Larkman *et al.*2015). The introduction of entry-level AES in Britain has had little impact on bird numbers, probably because of the poor uptake of available arable options that could improve winter food resources (Davey *et al.* 2010; Riseley *et al.* 2011).

Bird abundance on arable farms has been shown to correlate closely with

food abundance and extensive agricultural methods (Ponce *et al.* 2014; Zellweger-Fischer *et al.* 2018). Sown wild bird seed plots (WBS) were added to address winter food scarcity. These plots are small areas of about 1 ha sown with plants to provide seed for farmland birds over winter. Subsequent studies showed that bird numbers still declined over winter on farms with WBS plots, though less than on farms without plots (Siriwardena *et al.* 2007). The problem with WBS plots is that they often run out of food in late winter and early spring, creating a 'hungry gap', when natural food is scarcest. Consequently, supplementary ground feeding was added to schemes to address this failure of WBS plots.

Further studies have shown variable results, particularly on mixed farms. AES measures on farms in North-east Scotland had little effect on the abundance of farmland birds on farms compared with control farms (Daskalova *et al.* 2018). However, other studies have shown that, in principle, AES that include supplementary feeding can maintain but not increase bird populations (Baker *et al.* 2012). Some studies on single farms have demonstrated modest local gains in the number of wintering and breeding birds (Siriwardena *et al.* 2008, 2010; Henderson *et al.* 2014; Aebischer *et al.* 2016; Redhead *et al.* 2018), but this has yet to produce wider-scale effects (Hinsley *et al.* 2010). The picture remains mixed, with field studies of numerous farms, mainly in eastern England, still showing winter declines of some target species, though declines are less where supplementary feeding takes place (Siriwardena *et al.* 2007).

37. Scattering seed along a track, Walk Farm, Oxfordshire, February 2012.

Farmland birds can move several kilometres in search of food and various methods of supplementary feed provision have been suggested. Typically, this involves a once- or twice-weekly supply of up to 25 kg of mixed seeds, spread directly on the ground or delivered via game hoppers. These measures can attract target birds while the food is available, but the results of trials have indicated that this regimen of supplementary feed can also be exhausted in the days between feeding (Siriwardena *et al.* 2007, 2008).

Despite the lack of a national upturn in granivorous farmland species, there is evidence that targeted measures for particular species can sometimes produce dramatic local results, such as for Cirl Buntings *Emberiza cirlus* in Devon (Peach *et al.* 2001), Grey Partridges *Perdix perdix* on the Sussex Downs (Ewald *et al.* 2012) and Tree Sparrows *Passer montanus* and Corn Buntings *E. calandra* on the Marlborough Downs (www.spacefornature.net).

Our case study, presented here, aimed to trial a more intensive supplementary feeding regimen than is currently offered in AES, and to address four questions: Are sown seed plots sufficient for maintaining food through the winter? Does generous supplementary winter feeding reliably sustain birds through the winter? Are feeding results consistent, across sites and time? And, which species benefit most?

We focused on 12 farmland species of conservation concern (Eaton *et al.* 2015) that were likely to benefit from sown bird-food plots or supplementary feed ('priority species'): Song Thrush *Turdus philomelos,* House Sparrow *P. domesticus*, Tree Sparrow, Dunnock *Prunella modularis*, Common Chaffinch *Fringilla coelebs*, Brambling *F. montifringilla*, Bullfinch *Pyrrhula pyrrhula*, Greenfinch *Chloris chloris*, Linnet *Linaria cannabina*, Goldfinch *Carduelis carduelis*, Yellowhammer *E. citrinella* and Reed Bunting *E. schoeniclus*.

Methods

The study was conducted on three small farms in the Cotswolds, Oxfordshire, over three winters from 2016/17 to 2018/19. Over Norton Park (101 ha) and Walk Farm (62 ha) are under the same management and have been in higher-level AES since 1998. Honeydale Farm (44 ha) adopted mixed farming and environmental delivery in 2015. Over Norton Park has a mixture of pasture, arable, hedges, scrub and woodland, while Walk Farm is mainly arable with flower-rich meadows and mature hedges. No active predator control or gamebird releases are undertaken on these farms.

Wild bird seed plots

Over Norton Park and Walk Farm had been planting WBS plots for 14 years as part of AES and Honeydale Farm for two years outside of AES. Most WBS plots were renewed annually in late spring. The mixture sown varied slightly across sites and between years, and the areas used were rotated between years. Each sowing used a multi-species mix with one-quarter of a cereal (wheat, barley or triticale) and five or more other species, such as Fodder Radish *Raphanus sativus*, Brown Mustard *Brassica juncea*, Quinoa *Chenopodium quinoa*, Millet *Panicum miliaceum*, Buckwheat *Fagopyrum esculentum* and linseed *Linum* spp., used in varying proportions. No herbicides or insecticides were used. The sown plots were conservatively estimated to yield about 0.5 tonnes per hectare at 'harvest time' in September.

38. Wild bird seed plot, Over Norton Park, Oxfordshire, July 2020.

Supplementary feeding on the farms was carried out close to cover on a track, along a field margin, or on a cultivated area near, or in, a WBS plot. Single feed sites were used at Honeydale and Over Norton Park, and two sites 600 m apart at Walk Farm (one on a track away from cultivated areas). Feeding was introduced gradually from mid November, building up to daily feeds by 1st December. Feeds were increased in amount and frequency, as birds appeared and food was cleared, to a daily regimen at a fixed rate based on the acreage of each farm site (10 kg/day per 40 ha). The feed was scattered thinly, by hand, over a wide area. Daily feeding continued until mid April, then reduced gradually in frequency and amount, ceasing in mid May. The full regimen lasted 130 days, delivering 6.5 tonnes of feed per winter across the three farms.

The bird seed used at Honeydale was a commercial, cereal-free mixture of black sunflower *Helianthus annuus* seeds (37.5%), canary seed *Phalaris canariensis* (15%), yellow and red millet, linseed (12.5% each) and sunflower hearts (10%). Feed for Over Norton Park and Walk Farm was produced on site using crushed barley and wheat (75%), white millet (8%), rapeseed *Brassica napus* (8%), whole wheat (5%) and linseed (4%). The aim was to provide mainly small seeds, some oil-rich, and cereal fragments, to favour small birds rather than corvids, gamebirds and pigeons. In addition, hanging feeders were kept filled with millet and hung near the feeding area. These feeders were provided to attract Tree Sparrows and Reed Buntings.

Bird surveys were conducted monthly during mornings with suitable weather between November and March. All birds associated with each WBS plot or feeding site were counted by first observing from a distance, then walking slowly through all areas of the plot to flush hidden birds. Great care was taken to avoid double counting. Data was also collected of seed-bearing plant

coverage in each plot, by estimating the percentage ground cover of each cultivated or wild species where this was greater than 1%. Seed availability on these plants over the season was estimated on each monthly survey by assessing the proportion of seed remaining on standing seed heads.

An index of seed availability was calculated for each seed-bearing plant species using the estimated proportion of remaining seed on the seed heads. The individual indices for each plant were then summed to give an overall seed-resource index for each plot. Seed depletion on each plot over the winter would therefore be reflected in a declining index. Seed index on the plots was modelled over the winter periods using a generalised linear model (GLM). We also tested for an interaction between treatment and year, and treatment and site (Broughton *et al.* 2021). Paired t-tests were also used for individual variables against counts during winter 2016/17, counts during each November, and counts at Honeydale Farm, after $\log_{10}$ transformation of the count data.

Results

Bird seed plots

A total of 26 WBS plots were sown over the three years, in ten locations on the farms. The plots generally grew well but seed productivity was variable and included grasses and other arable weeds that were not part of the seed mixes, such as Mugwort *Artemisia vulgaris*, Creeping Thistle *Cirsium arvense*, Fat-hen *Chenopodium album* and campion *Silene*, Oxeye Daisy *Leucanthemum vulgare* and Common Knapweed *Centaurea nigra*. Two plots at Walk Farm used for the study were annually cultivated margins that

contained a mixture of the predominantly arable annuals, such as Corn Marigold *Glebionis segetum*, Cornflower *Centaurea cyaneus,* Corn Chamomile *Anthemis austriaca* and Poppy *Papaver rhoeas*. Ground coverage of the 26 plots (eight or nine plots per year) in November averaged 86.6% (95% confidence interval ±7.3) across 8 ha.

39. Flock of Linnets *Linaria cannabina* feeding on seed scattered as part of a supplementary feeding programme, Oxfordshire, January 2011.

By the time of the first survey in November, most seed had either been shed or been consumed, such that three plots (11%) were already spent. The mean seed index (measured against a starting point of 100%) at the time of the first survey in November was only 23.8% (±4.6) and by December had dropped to 6.1% (±1.4). Thereafter, the index was below 1% and the plots were effectively empty. By January, only six of 26 (23%) plots retained any seed and by March no seed was detectable in any of the plots. The decline in seed availability

was highly significant (p<0.001) but there were no differences in coverage or seed index between plots, sites or years of the study (Broughton *et al.* 2021).

Bird numbers, species present and distribution

Overall, numbers of priority species increased significantly (P<0.001) at each farm as winter progressed, peaking in January or February with three- to five-fold increases compared to November counts, though the overall number of birds differed significantly between farms (fig. 1). The total counts increased each year, with the third year 45.3% (P<0.05) higher than the first (fig. 2)

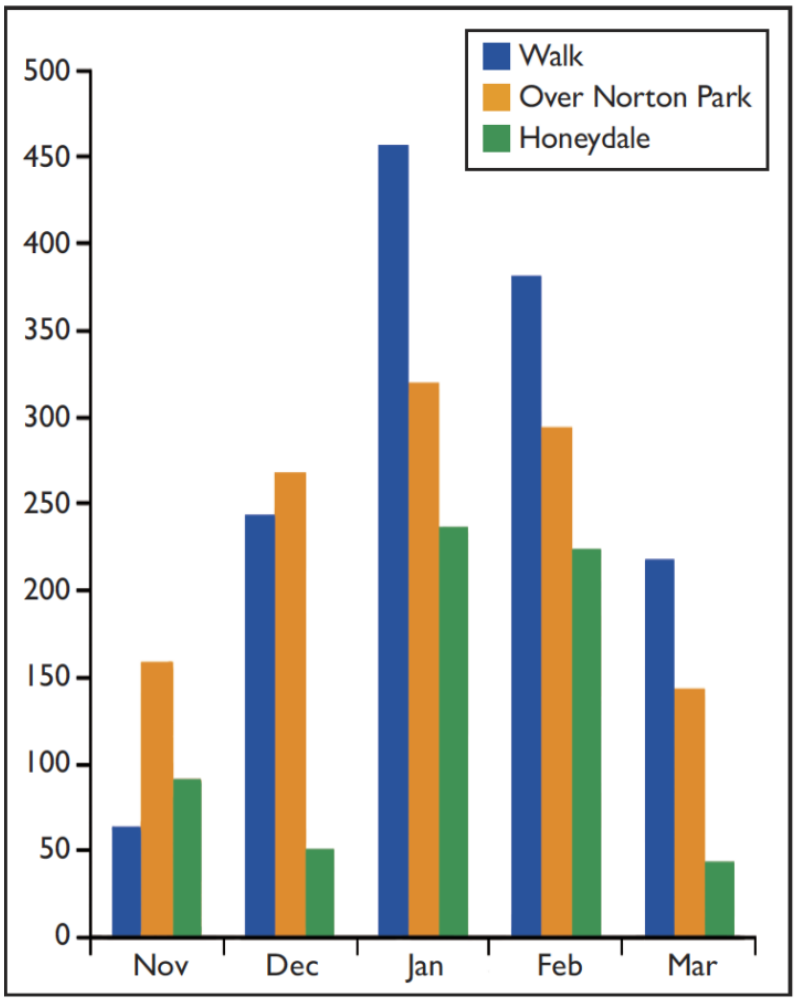

Fig. 1. Average monthly counts of birds of all

species by farm, 2016/17вЂ“2018/19.

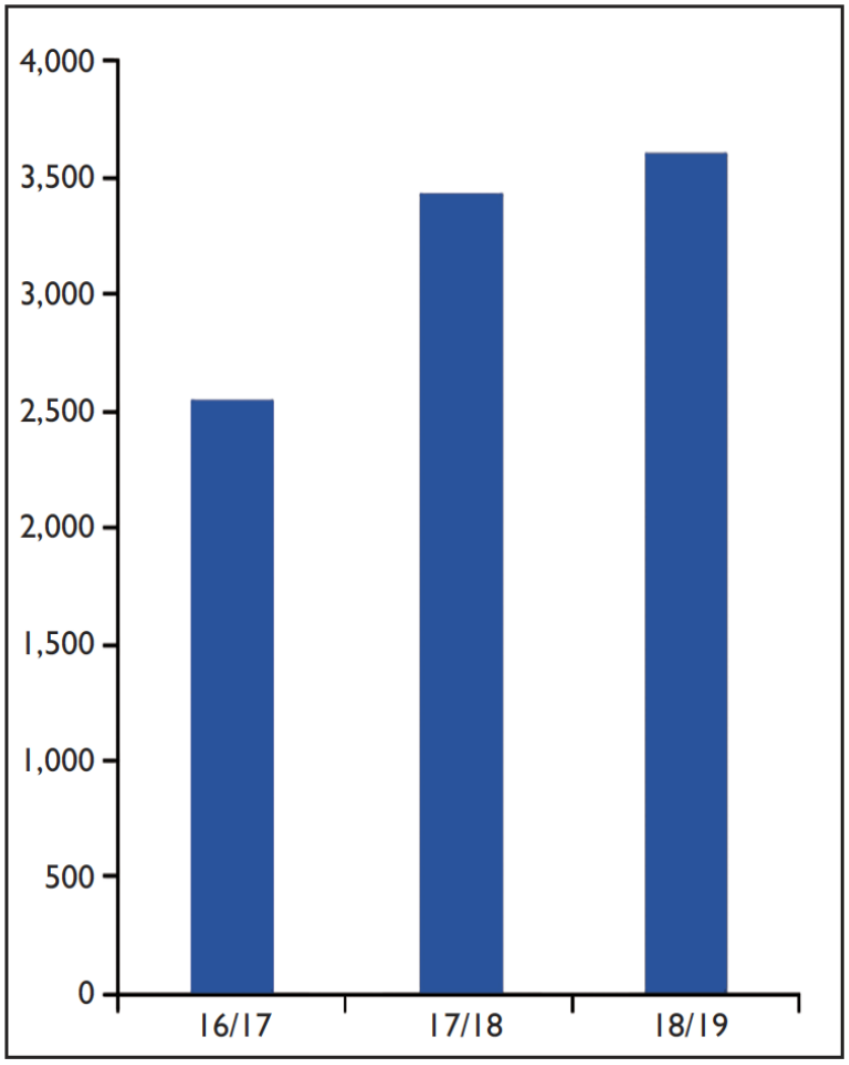

Fig. 2. Total counts of birds across each winter, all farms combined, 2016/17вЂ“2018/19.

The most abundant species were Linnet (fig. 3), Chaffinch and Yellowhammer (fig. 4). Chaffinch and Yellowhammer numbers both increased as winter progressed with no significant differences between years. Linnet numbers

also increased as the winter progressed and numbers rose significantly (P<0.001) over the study period, from a total of 185 in winter 2016/17 to 951 in 2017/18 and 1,370 in 2018/19.

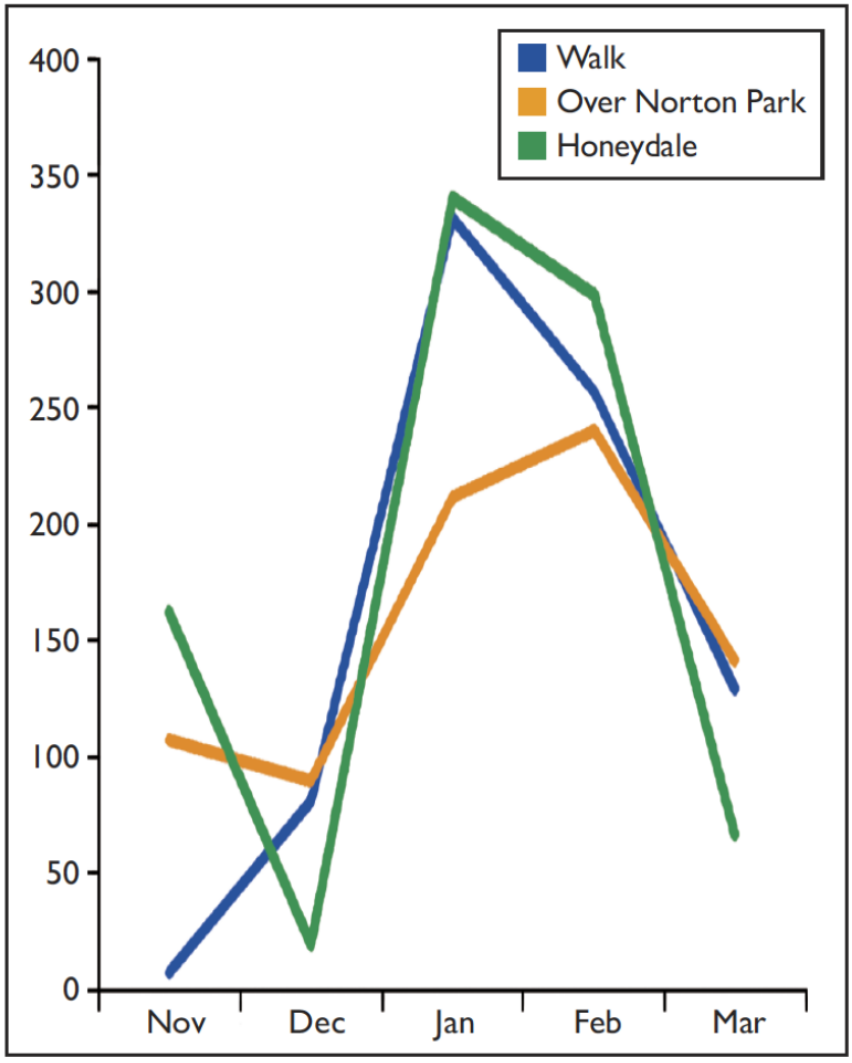

Fig. 3. Combined three-year totals of Linnets *Linaria cannabina* by month from each farm.

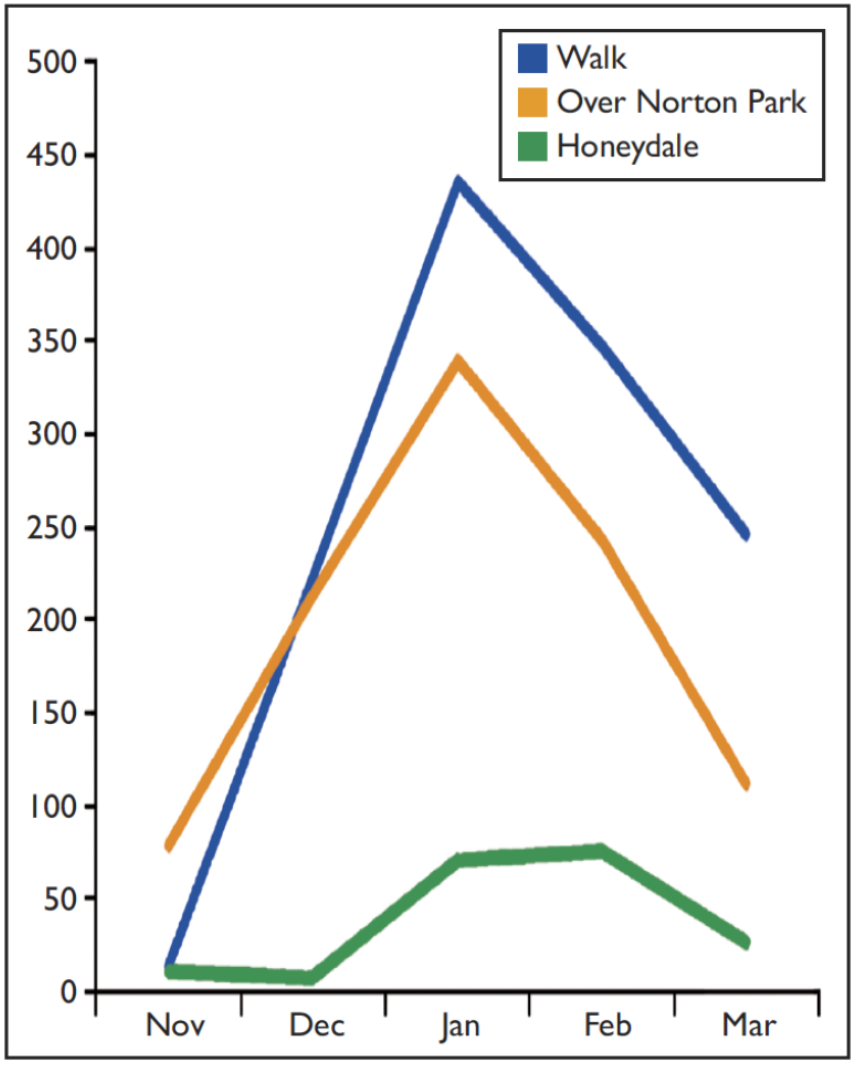

Fig. 4. Combined three-year totals of Yellowhammers *Emberiza citrinella* by month from each farm.

40. Mixed flock of Common Chaffinches *Fringilla coelebs*, Bramblings *F. montifringilla*, Linnets and Yellowhammers *Emberiza citrinella*, Over Norton Park farm, Oxfordshire, February 2021.

Bird counts at the three farms differed in species composition but totals on all farms showed a similar quadratic pattern for overall numbers over each winter. Greater numbers of each species, except Linnet, were recorded at Walk Farm and Over Norton Park. The numbers and mix of the species, discounting Chaffinch, Yellowhammer and Linnet, were significantly different between Walk Farm and Over Norton Park (fig. 5). Over Norton Park was the only site to host Bramblings, present during winter 2017/18. Tree Sparrows, which had been plentiful at Walk Farm in the decade before the study, were present in only small numbers during the first year of the study, were absent by the end of the second winter and not seen at all in the final winter (2018/19) or since. Walk Farm was also the only farm to host House

Sparrows. In the winter of 2016/17, a Little Bunting *Emberiza pusilla* was recorded and wintered near the Over Norton Park feeding area (plate 41).

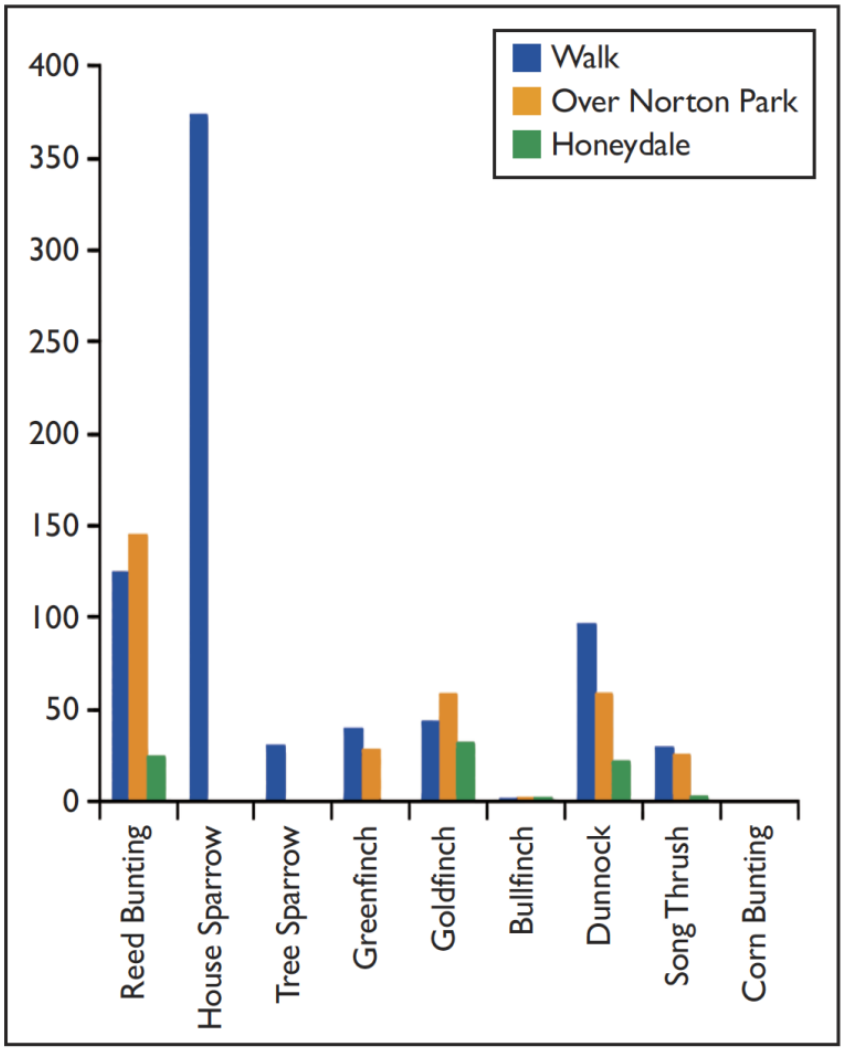

Fig. 5. Total counts of other species for each farm.

005. Little Bunting *Emberiza pusilla*, Over Norton Park, Oxfordshire, January 2017.

Bird numbers were much greater in fed plots (three-year winter total: 3,194 birds counted) compared with the unfed controls (three-year winter total: 1,154 birds counted) (fig. 6).

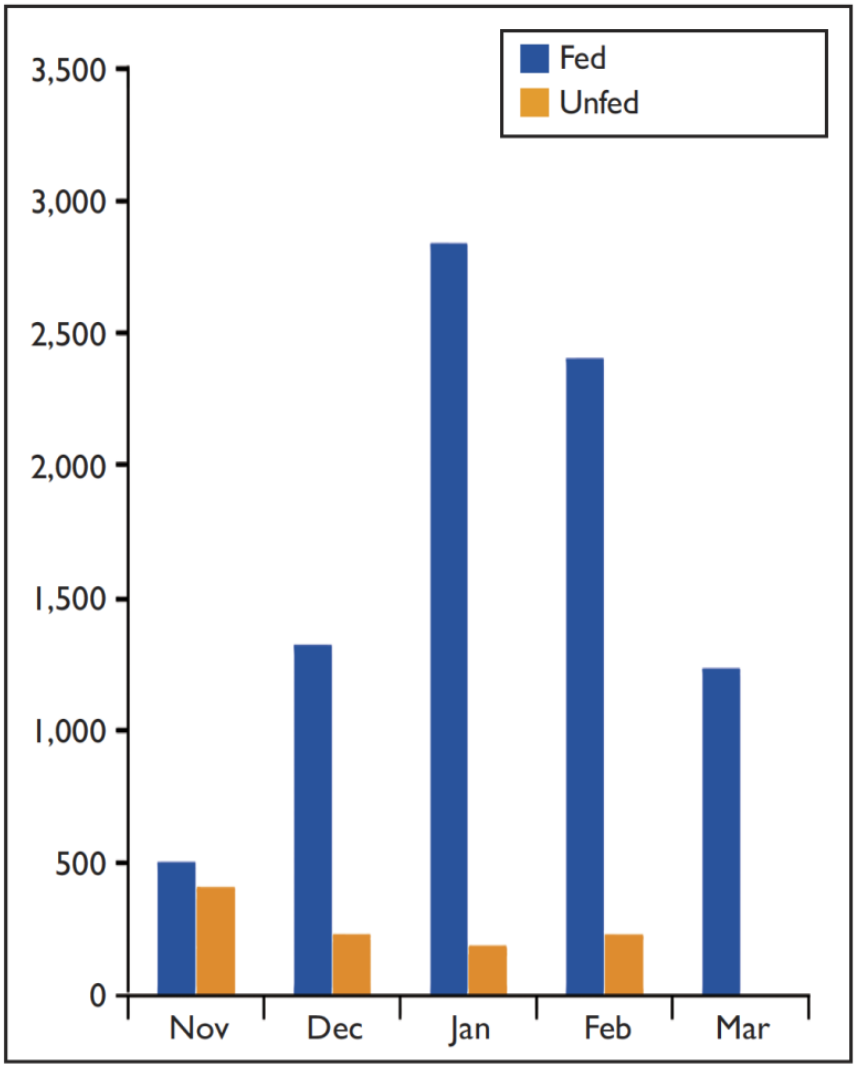

Fig. 6. Distribution of birds (all species) by month between fed plots and control WBS plots. Totals are the sum of all three years.

Discussion

Our study showed that WBS plots of around 8 ha across the three study farms (4% of the total farmed area) were not able to produce enough seed to sustain granivorous species right through the winter period, and left a 'hungry gap' in later winter/early spring. However, generous daily supplementary

feeding (1.5–3.2 tonnes per farm over the course of a winter), alongside these sown plots, reliably attracted and sustained large numbers of priority farmland birds over the winter and into early spring.

The highly significant increases on each farm over each winter period were dominated by just three species, while the increase in overall bird numbers during the three-year study period was largely due to greater numbers of Linnets, although the cause for this increase is unclear. The biggest differences were seen in the number of Linnets, although the cause for this increase is unclear. Henderson *et al.* (2014) found that supplementary feeding can result in better breeding locally, although it is more likely that the increase in numbers in this study came from immigration onto the farm; flocks of non-breeding Linnets are known to be large and mobile (Swann *et al.* 2014)

Less numerous species responded with much smaller increases than did the three commonest species, and the reasons for this are not clear. It is possible that species such as Greenfinch and Goldfinch were attracted to numerous nearby garden feeders.

Blackbirds *Turdus merula*, not formally counted, increased as winter progressed with a strong male preponderance, presumably through immigration and migration.

In 2000, 13 Corn Bunting territories were recorded at Walk Farm. Despite supplementary feeding, the population has since declined to 0–1 pairs.

While our findings support previous feeding studies in demonstrating enhanced winter survival, they contrast in the scale of the response (Henderson *et al.* 2014; Redhead *et al.* 2018). The first monthly count likely

represented the birds resident in each farm's immediate locality, which was augmented by birds migrating in as time passed and local food sources dwindled (Siriwardena *et al.* 2008; Daskalova *et al.* 2018). The scale of the response is, almost certainly, the result of the quantity and regularity of feeding. Previous studies show that schemes with seed plots and, importantly, regular supplementary feeding, are currently crucial in maintaining farmland granivores throughout winter (Hinsley *et al.* 2010; Redhead *et al.* 2018).

We assume that the decline in numbers, from peaks in January and February, into early spring is mainly due to dispersal to breeding sites. We must also assume temporal limits to inward migration, natural wastage, predation and perhaps disease as potential contributors, which were beyond the scope of this study. Eurasian Sparrowhawks *Accipiter nisus* regularly patrolled feed sites.

The differences observed between the three farms, despite their proximity, were probably due to differences in local habitat (Zellweger-Fischer *et al.* 2018). Farm size, a surrogate measure of habitat diversity, could also affect numbers. Conversely, small farms have been shown to host more birds than large ones by a factor of two (Siriwardena *et al.* 2008).

The amount of food spread at each site was based on farm acreage, which could be important if food became critical or limiting. However, 10 kg daily could, theoretically, feed at least 1,000 small birds adequately (Crocker *et al.* 2002). Furthermore, Walk Farm, second largest by area (and therefore also by feed quantity), was the site with the greatest numbers of birds. Feeding could therefore reasonably be considered *ad libitum* at each site. The feed mixes, though different, delivered a high proportion of small 'seeds' that

attracted Linnets in particular. While we cannot discount that farm size, quantity and quality of feed affected bird abundance and richness, we consider that any effect was small and habitat driven. Notwithstanding these differences, the pattern of response to feeding was similar across farms and years.

Whether the level of supplementary feeding was necessary or excessive and therefore perhaps not widely applicable is debatable. We found no significant correlation between the weight of daily feed and bird numbers recorded. The current Defra supplementary feeding recommendation offers one-third of that actually delivered and would be unlikely to meet the evident local demand or the objectives of sustaining sufficient birds to reverse recent trends. There is a close correlation between the amount of food provided and bird abundance in urban settings (Fuller *et al*. 2008). Siriwardena *et al.* (2010) have also shown that bird use of intermittent feeding is erratic, declining as feed runs out before increasing slowly again when replenished. Larger-scale trials are required to test a variety of feeding regimens to prove whether this level of winter feeding is currently necessary to sustain sufficient birds to enable wider population restoration.

The supplementary feed mix provided 17–22 kJ/g, which equates to 8–10 g/bird of food daily for target species to survive (Crocker *et al.* 2002). The amount delivered could theoretically be sufficient to support three to four times more birds than the number counted. Standard counting techniques may underestimate total numbers, but not fourfold. Nevertheless, it is entirely possible that more birds were feeding 'in shifts' as the surveys did not cover entire farms. Non-target species such as gamebirds, pigeons, corvids, Common Starlings *Sturnus vulgaris*, Blackbirds and Robins *Erithacus rubecula* were also regular visitors but seldom in large numbers. Larger

species, such as gamebirds, are recognised competitors for any food supplies, but their feeding rate becomes less efficient the smaller the feed particles and the wider the distribution (Larkman *et al.* 2015).

Widespread winter feeding of suburban birds maintains an abundance of birds but risks altering the predator/prey balance (Malpass *et al.* 2017), inducing epidemics of disease (Adelman *et al.* 2015) and causing anthropogenic dependency (Jones 2011). The same could apply to farmland birds but may be mitigated by mimicking nature and spreading feed widely, while slowly rotating feed areas.

From the estimated total yield of 4 tonnes of seed from the WBS plots, reserves had fallen by some three-quarters by November, leaving about 1 tonne across the three farms to last the winter. This was exhausted by January, despite 50 days of concurrent supplementary feeding. Field margins and areas of stubble may also contribute food (Field *et al.* 2011) but, without supplementary feeding such resources alone are currently insufficient to sustain large numbers of farmland birds. It follows that much greater areas of WBS plots and productive winter stubbles are necessary if they are to be the mainspring of restoring farmland bird populations, alongside standard modern, autumn-sown, monoculture, and arable cultivations. Increasing the area and quality of AES options from 5% to 15% can, disproportionally, increase butterflies and birds (Zingg *et al.* 2019), but competes with conventional farm production. The alternative demonstrated by this study is that generous, regular, tailored supplementary feeding works, and is probably a more economic means of supporting farmland birds. The 6.5 tonnes of mixed supplementary feed represents the produce of a 2–3 ha area (<1% of the study area) conventionally cropped. We believe this method is pragmatic and, if widely practised, has the real potential to maintain and restore

farmland bird numbers. Siriwardena (2010) considered that for AES to be fully effective nationally, birds require sufficient food supplies at a range of every 1–2 km and so, by implication, generous supplementary feeding should also be available almost as frequently. Larger, randomised trials of daily supplementary feeding will establish if the method continues to show the same – or greater – benefits over larger areas.

This study demonstrates clearly that supplementary feeding can be effective at maintaining and locally increasing bird numbers, but it is not the single solution to the declines of all farmland bird species as it does not guarantee abundance or richness of all priority species. Other environmental and habitat factors remain crucial. Scale and linkage are important to maximise increases throughout the country and across all species (Siriwardena 2010), and it goes without saying that the priority species also require sufficient suitable breeding habitat (Pickett & Siriwardena 2011).

However, we strongly support supplementary feeding and suggest it should be more frequent and regular, using mainly small seeds and particles, scattered thinly, over a wide area near cover or even in the middle of large fields, where birds can escape surprise and ambush by predators. It should also be replicated widely in order to have a national effect.

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