Farmland Transect Bird Counts at FarmEco, Home Farm, Screveton Nottinghamshire 2021 - 2023

FarmEco
Community Farm

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Introduction

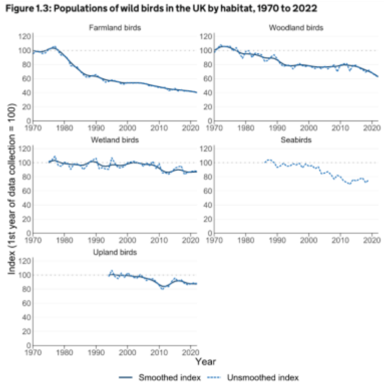
David Rose, the farmer had encouraged a programme of biodiversity monitoring at FarmEco using a variety of techniques as part of the development programme to diversify the agricultural habitat at FarmEco. There had been a varied programme of climatic, environmental, plant and wild life monitoring previously. Tom Staton's PhD recently combined agricultural, economic and wild life biodiversity into an agroforestry model which highlighted the biodiversity opportunities that mixed agricultural techniques offer. There are ongoing research projects focusing on the agroforestry currently. Mike Reid as an ecologist had conducted bird surveys previously and was asked to continue to lead regular surveys with support of enthusiastic and experienced observers including Francis Reeson, Alan Watson, Alex Turnbull, Jim Lennon and David Walker.

The FarmEco site is an established agroforestry, which has been developed over the past 10-15 years. The bio-surveillance observations are therefore reflective of that evolving diverse landscape. During the observation period between May '21 and November '23 there were four additional conservation interventions. 1) The introduction of expanded provision of winter feeding linked to Nottinghamshire Wildlife Trust support for nesting boxes, feeding stations and bird seed provision in 2021-2023. 2) The establishment of a new water feature on the flower meadow near the boundary ditch by Severn Trent in Summer 2022. 3) The placement of owl nesting boxes and surveillance visits including ringing by Jim Lennon and Alex Turnbull. 4) The agro-forestry management programme was undergoing organic conversion in 2022/23. There is an established bird shoot in land adjacent to the FarmEco habitats, managed by gamekeepers including predator control, ground feeding and cover crop margin management.

Context of UK Birdcount Trends

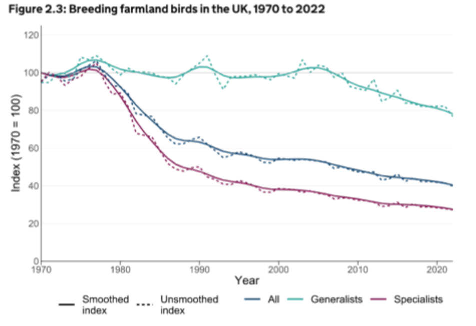
The UK has invested in bird count monitoring which has identified trends associated with climate change and land management practices. The BTO data shown below summarises trends and identifies that farmland bird counts have been the most noticeably affected over the past 4 decades.

Figure 1.3: Populations of wild birds in the UK by habitat, 1970 to 2022



Source: British Trust for Ornithology (BTO), Royal Society for the Protection of Birds (RSPB), and the Joint Nature Conservation Committee (JNCC).

Figure 2.3: Breeding farmland birds in the UK, 1970 to 2022



Source: British Trust for Ornithology (BTO), Royal Society for the Protection of Birds (RSPB), and the Joint Nature Conservation Committee (JNCC).

At Farmeco the purpose of the birdcount surveys was:

- To establish baseline data for future comparisons as the different elements of the habitat matured,

- To fulfill obligations for biodiversity monitoring as part of land management subsidies,
- To be in a position to make comparisons with other sites
- To contribute to awareness of the impact of historical and evolving farming innovation upon wildlife, where bird count data could acts as a marker of change.
- To establish research credentials to attract collaborative research programmes on to the farm as part of FarmEco's portfolio of activities as a social enterprise.

FarmEco Habitat Map

Methods

Over the past two and a half years we have carried out bird transect surveys across the FarmEco agroforestry area guided by Mike Reid using a transect method. We followed similar transect routes from visit to visit after some early variations in 2021 making observations up to 4/5 times per year. We standardized the time of day to morning observations, we used combined hearing and observation sightings. We mapped observations contemporaneously and extracted bird count data to standard recording tables and entered them to a Excel spreadsheet for descriptive analysis with ranking of bird counts of overall all year and seasonal datasets and used the data to calculate the Shannon Diversity Index using the Omni on line calculator.

Shannon Diversity Index

The Shannon Diversity Index based using the Omni calculator has a maximum number of entries limited to 40. (ref). The Omni calculator using the formula they quote is associated with the following qualities and interpretation. (https://www.omnicalculator.com/ecology/shannon-index.

*"**The minimum value the Shannon diversity index can take is 0**. Such a number would tell us that there's **no diversity** - only one species is found in that habitat. **There's no upper limit to the index**. The maximum value occurs when all species have the same number of individuals. It equals `log(k)`, where `k` is the number of species. To give you **some perspective** on the Shannon diversity index's range of values (using the natural logarithm as the base): for 100 species, the maximum possible value would be `4.605`, for 1,000 species: `6.908`, for 10,000 species: `9.21`, for 1,000,000 species: `13.816`. For all*

eukaryotic [species discovered on Earth](), the maximum possible would equal `log(8,700,000) = 15.98`*. In real-world ecological data, the Shannon diversity index's range of values is [usually 1.5 - 3.5]().”*

Results

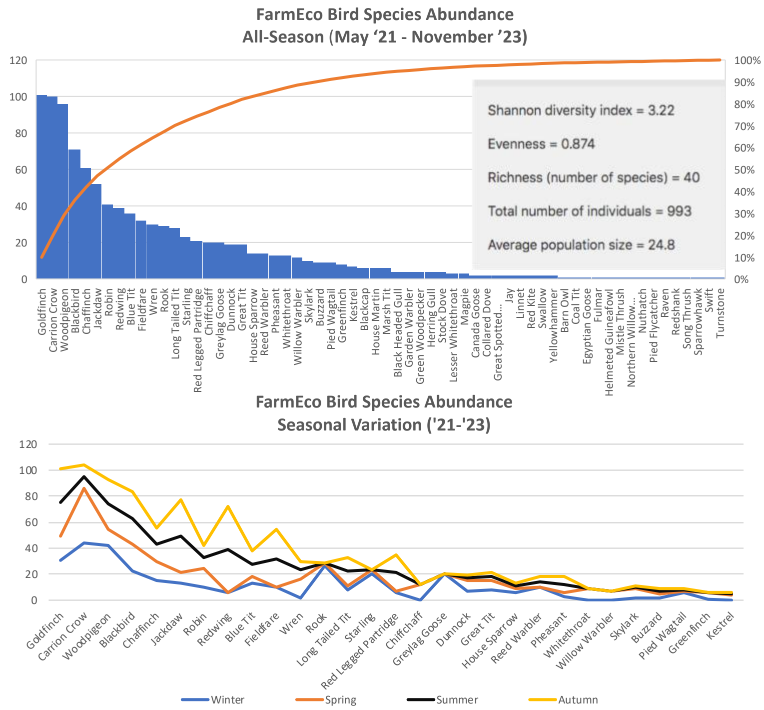


Fig A.1. This shows data from 62 bird species observed from May 2021- November 2023 at FarmEco, ranked by abundance and a calculated Shannon diversity index score with evenness estimate.

Fig A2 shows a comparison of observed bird species abundance across seasons from May 2021- November 2023 at FarmEco

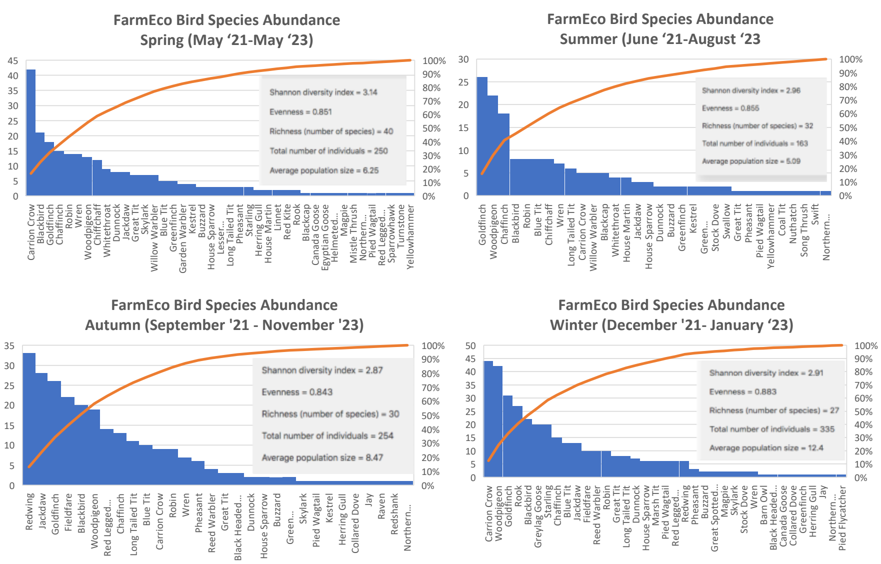


Fig B Bird species abundance and Shannon Diversity Index during: Springtime (B1) (n=41 species); B2 summertime (B2) (n=32); autumn (B3) (n=30); winter (B4) (n=37).

The aggregated data has allowed us to identify the range and abundance of bird species observed on the farm across the seasons. Of the total number of species recorded (n=62) there were 4 red listed species (Fieldfare, Marsh Tit, Pied Flycatcher, Song Thrush) and 4 amber listed species (Dunnock, Northern Willow Warbler, Song Thrush, Pied Flycatcher). The seasonal analysis over the two and a half year period identified minor variations in species abundance over the spring (n= 41), summer (n-32), autumn (n=41) and winter (n-37).   This "all season observations" gives a Shannon Diversity Index of 3.22 (Evenness 0.874) based upon data from 40 commonest species *(vide infrav(See Fig A1)*. The most abundant species permit seasonal comparisons to be made (See Fig A2) and highlight substantial variations in numbers for: Fieldfare, Redwing, Jackdaw, Blackbird, Woodpigeon and Goldfinch. The Shannon Index remained consistently high across the seasons at around H=3 .

Benchmark data on species abundance and diversity

Chris Stoates' work on farm bird life at Loddington represents a benchmark against which the FarmEco bird data can be compared (see Figs 2,3 & 4). Boatman, Stoate and Watts data showed the close relationship between availability of seeds across the autumn / winter seasons (Fig 2) and the abundance of birds feeding on the land from September to January (Fig 3). The data in fig 4 compares the number of breeding territories in two years before and after conservation management interventions.

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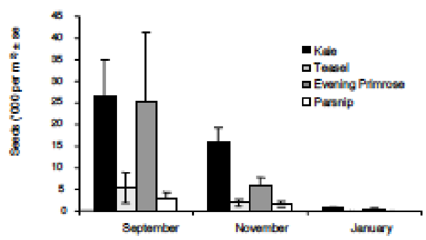

Figure 2. Availability of seeds on seedheads of crops in kale-based mixtures at Loddington between September 1997 and January 1998.

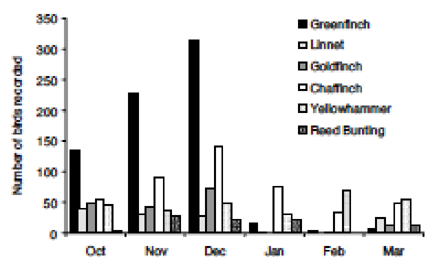

Figure 3. Numbers of finches and buntings recorded feeding in different winter months at Loddington.

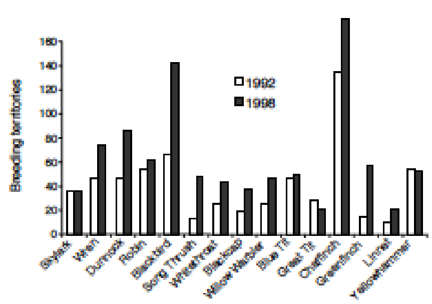

Figure 4. Numbers of breeding territories of the most abundant passerines at Loddington in 1992 (baseline, before conservation management) and 1998 (sixth year of conservation management).

Ref: Practical management solutions for birds on lowland arable farmland. Boatman, N.G.; Stoate,C & Watts,P.N. British Ornithology Union

Using data from the whole study period at FarmEco the SDI H=3.22 (Evenness 0.874) ranging from SDI H= 2.87 (0.843) to H=3.14 (0.851) using seasonal data. The Shannon Diversity Index at Loddington was reported from 1992-1998 as 1.1-1.16. It is not clear whether the Loddington data was derived from a comparable bird count strategy or which Index calculation formula / method was used. The difference in SDI is curious and may be reflective of specific aspects of the habitat diversity and local climatic conditions. (ref) The FarmEco data, when considered independently, supports the view that there is a high diversity of species in this recent time period.

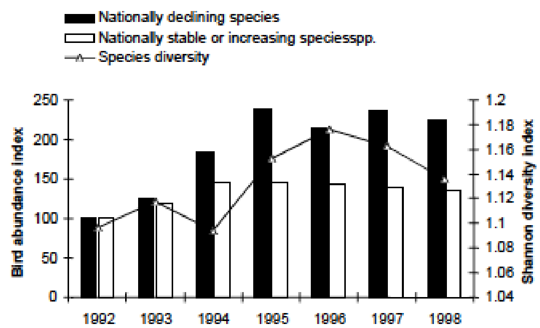

Fig. 4. Bird species diversity and relative abundance of 'nationally declining species', 'nationally stable or increasing species' at Loddington.

We are unable to compare FarmEco data on species abundance to the Loddington nesting data of common passerines (perching birds)(see Fig 4) in the 1990s because of differences in methodology. The nesting data is gathered by intensive and prolonged habitat observation of nesting sites. Loddington practice is to do annual transect surveys and 5 yearly nesting habitat surveys. We have not, as yet, undertaken a nesting habitat survey at FarmEco but would be interested in working with specialists who may be prepared to do so. Despite this discrepancy in methods we formed the view that there were many similarities in the range and relative frequency of passerines and other species we have observed at FarmEco. We note the infrequency of Yellowhammer and Greenfinch which would seem to be underrepresented in the FarmEco data. There has been a recognized decline in Greenfinch which may be linked to viral infection whilst Yellowhammer are sensitive to habitat characteristics

Seasonal Variation

Seasonal variation has been studied across UK by Lennon et al where they were able to use mapping data to look at resident and migratory species abundance in seasonal comparisons. They conclude that seasonal temperature variations are most impactful on bird diversity variations and highlight this factor in the climate change trends currently active.

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Bird diversity and environmental gradients in Britain: a test of the species–energy hypothesis

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Summary

1. We tested the species diversity–energy hypothesis using the British bird fauna. This predicts that temperature patterns should match diversity patterns. We also tested the hypothesis that the mechanism operates directly through effects of temperature on thermoregulatory loads; this further predicts that seasonal changes in temperature cause matching changes in patterns of diversity, and that species' body mass is influential.

2. We defined four assemblages using migration status (residents or visitors) and season (summer or winter distribution). Records of species' presence/absence in a total of 2362, 10 × 10-km, quadrats covering most of Britain were used, together with a wide selection of habitat, topographic and seasonal climatic data.

3. We fitted a logistic regression model to each species' distribution using the environmental data. We then combined these individual species models mathematically to form a diversity model. Analysis of this composite model revealed that summer temperature was the factor most strongly associated with diversity.

4. Although the species–energy hypothesis was supported, the direct mechanism, predicting an important role for body mass and matching seasonal patterns of change between diversity and temperature, was not supported.

5. However, summer temperature is the best overall explanation for bird diversity patterns in Britain. It is a better predictor of winter diversity than winter temperature. Winter diversity is predicted more precisely from environmental factors than summer diversity.

6. Climate change is likely to influence the diversity of different areas to different extents; for resident species, low diversity areas may respond more strongly as climate change progresses. For winter visitors, higher diversity areas may respond more strongly, while summer visitors are approximately neutral.

Key-words: biodiversity, climate change, species distribution, richness, turnover.

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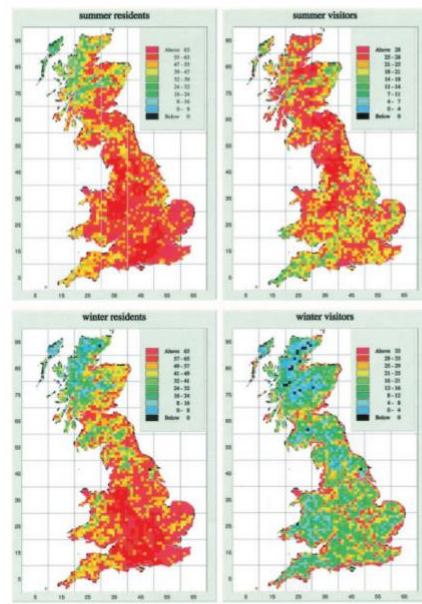

Discussion

We have reported two and a half years of bird counts using the transect method at Farmeco. We have identified the wide range of bird life resident on and over the farm. We have estimated the diversity of species using the Shannon Diversity Index and made simple comparison to benchmark data from the farm at Loddington. Boatman, Stoate and Watts data showed the close relationship between availability of seeds across the autumn / winter seasons (Fig 2) and the abundance of birds feeding on the land (Fig 3). The data in fig 4 compares the number of breeding territories in two years before and after conservation management interventions.

The seasonal observations at FarmEco highlight variations worthy of further study. The report by Lennon et al investigated the impact of multiple factors on bird species diversity using seasonal and migratory mapping method. They concluded that summer temperature was the strongest predictor for winter diversity. They did not find that body weight as a marker of energy status predicted for diversity, which challenges the simplicity of the seed availability hypothesis investigated by Stoate et al. The importance of temperature variation on diversity highlights an unpredictable future in the current trend of climate change.

These data at FarmEco and their analysis represent important baseline data for future comparison. They are of value as part of land stewardship, highlight the value of sustained seasonal observations and the use of standardized indices for comparisons of a) trends with time and seasons, b) environmental interventions, c) geographical factors and d) habitat management and diversity.

FarmEco was established using the evidence of studies testing the impact of land management and feeding strategies on farmland birds and other wildlife population with the intention of generating a farming landscape that would attract greater diversity of wildlife, whilst sustaining economic viability of food production as part of the land's economy. These observations of high species diversity identify the success of that strategy as far as the bird life is concerned. It justifies consideration to be given to look at other forms of wildlife in the various habitats that exist across the FarmEco habitats. Mammals, insects, amphibians, reptiles, invertebrates and plant life including those at a cellular level are being offered the opportunity to coexist with the biodiverse farming techniques in use. There have been and still are research studies taking place on the site investigating hypotheses related to the relationship between agricultural management and wildlife diversity. The habitats at FarmEco are being used for research currently and have much to offer other researchers with relevant questions about how agricultural land management interacts with, and attracts, its diverse wildlife.