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Short research contributions

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Wintering farmland bird assemblages in West Hungary

Abstract

Farmland bird populations declining rapidly all over Europe. Most of the knowledge is, however, from the breeding season, and much less is known about the winter period, especially from Central and Eastern Europe. We censused wintering farmland bird assemblages in West Hungary, in 2011/2012. The censuses covered semi-natural and seeded grasslands, plough fields and wheat fields. The available winter seed food was estimated for each field from the top soil and from the vegetation. We recorded 25 species with 844 individuals on the fields. Semi-natural grasslands were the most important habitats for species richness of all, granivorous, and resident species, with seeded grasslands as the second best habitat. Abundance showed similar pattern, although with no significant effect for granivorous species and for short-range migrants. Seed mass was significantly different among the habitat types, higher on seeded grasslands and semi-natural grasslands than on ploughed sites and winter wheat fields. Date had a significant effect on species richness and abundance with highest values in December. There was a positive significant correlation between bird species richness and seed mass only in December. Our results strengthen former findings that changes and drivers of wintering farmland bird populations may differ between Central and West Europe, and highlight the need for further, large scale studies to provide evidence base to guide agri-environmental programs.

Key words: Central Europe, food resources, seed mass, semi-natural and seeded grasslands, arable fields, habitat use

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Introduction

The decline of farmland bird populations is among the most important challenges for conservation in Europe (Inger et al. 2014). Most studies focused on the breeding season to search for explanations, although the harsh winter period and the lack of food resources reduce survival in winter, and pose a bottleneck for the populations. Winter climate, however, varies greatly across Europe, with cold, frosty weather and snow cover in Central Europe (Schonwiese & Rapp 1997). Farmland bird species and population sizes change considerably between breeding and wintering periods due to the large number of migrants. As harsh winter periods are „environmental bottlenecks" for the survival of populations, it is crucial to estimate bird population sizes and understand their habitat use (Reif 2013). This need is even more pronounced due to the ongoing climate change (Jenouvrier 2013).

In spite of this interesting situation, wintering farmland birds have got little attention in Central Europe, although differences between West and Central-East European farmland bird communities are well-known (Báldi & Batáry 2011, Tryjanowski et al. 2011, Sutcliffe et al. 2015). This difference is expected to exist for winter bird assemblages as well, due to the difference of the regions both in farmland management, and migratory habitats of birds. For example, Orlowski (2006) and Kasprzykowski and Goławski (2012) in Poland showed that a diverse winter bird assemblage used most field types. The Yellowhammer (*Emberiza citrinella*), a common farmland bird species, however, had significantly different winter diet in semi-natural versus agricultural fields (Orlowski et al. 2014). In Hungary Field et al. (2007) showed that there is no clear preference of wintering birds for conservation tillage. These observations are different from what is expected from West European observations, where there was clear difference in field use by wintering birds (e.g. Geiger et al. 2010). There is little understanding on how food resources on farmland affect bird communities in winter.

The main goal of this study is to explore the relationships between bird assemblages and winter seed food supply in a farmland from Hungary.

Study area and methods

Our study area was the Trans-Danubian Mezőföld (N47°03'; E18°44'), an intensively farmed area of Hungary. We censused wintering birds in the most widespread crop fields from the studied regions: semi-natural grasslands (5 fields), seeded grasslands (12), plough fields (previously sown by maize; 10) and autumn sown wheat fields (10). The sampled fields belonged to two regions, close to the cities Enying and Paks respectively (see the Google Earth KML file as online Appendix I).

The survey involved three censuses in the wintering period (date: 9-16 December 2011, 15-21 January 2012, 25-27 February 2012). We covered large areas within a short – one day – census time to avoid changes in weather conditions and bird assemblages, thus to get comparable data. We avoided to census in particularly cold, wet or windy days. Censuses were performed during the day, from an hour after dawn (c. 09 AM) and finish no later than one hour before sunset (c. 04 PM). The selected agricultural fields were scanned from a distance to spot birds before flushing. At each sampling site the number and behaviour of all birds on the field were recorded along one transect crossing the field (Field et al. 2011). Birds that were flying through the sampling sites were not used in the analysis. Crop/habitat type for each field was recorded.

The available winter food (i.e. seed) was estimated in ten, 50 by 50 cm quadrates along the transects in each censused field, at least 20 m from the edge. The 0.5-1 cm top soil layer was collected. 500 cm3 of each soil sample was washed and seeds were sorted in laboratory. Seeds on shoots in the quadrats were also collected. The total weight of seeds per quadrat was used as an index of seed supply.

We used General Linear Mixed Models (GLMM) to explore the relationship between the response variables and explanatory variables. We used as response variables the species richness and abundance of (i) all bird species, (ii) granivorous species, (iii) resident species and (iv) short-distance migrant species.

Explanatory variables in all full models were: habitat type (grassland, semi-natural grassland, plough, winter wheat field), sampling date (as category: December, January, February) and seed mass. Two-fold interactions of the predictors were tested. Species richness and abundance data were logarithmically transformed to reach normal residual distribution, if necessary. The sampling region (Enying or Paks) and field were included as random factors. Non-significant variables ($p > 0.05$ from F-test) were excluded in backward selection, except being part of a significant interaction. Multivariate comparisons by means of Tukey contrasts were performed between habitat types. Seed mass was analysed in the function of habitat type at field level (only sampling region was applied as random factor). Analyses were performed using the *nlme* (Pinheiro et al. 2010) and *stats* packages of R 2.10.1 software (R Development Core Team 2009).

Results

During the three surveys we recorded 40 bird species. Out of these 25 species (total 844 individuals) were recorded in the study fields and thus were included in the analysis. There were 10 granivorous species (346 individuals), 14 resident species (191) and 10 short distance migrant species (652). Nearly half of the counted bird individuals belonged to only five species: Fieldfare (*Turdus pilaris* – 415 individuals), Goldfinch (*Carduelis carduelis* – 120), Linnet (*Carduelis cannabina* – 85), and Tree Sparrow (*Passer montanus* – 70) (full list is given in Appendix II).

The four agricultural habitats differed in both total species richness and abundance; semi-natural grasslands showed the highest values, these being followed by sown grasslands (Table 1, Fig. 1). Granivorous species richness – but not abundance – showed a similar pattern with semi-natural grasslands harbouring the highest species numbers (Table 1). Resident birds' species richness and abundance was significantly related to habitat type, with highest values in semi-natural grasslands, and date, with no significant pairwise comparison (Table 1). Species richness of short-range migrants was different among habitat types and dates, with a habitat x date interaction, which was also significant for abundance (Table 1). Due to the habitat x date interactions, no trend can be detected in neither variable, i.e. habitat and date. Seed mass was significantly different among the habitat types (df=33, F=6.74, p<0.001; Fig. 2), being higher on seeded grasslands and semi-natural grasslands than on ploughed sites (p=0.002 and p=0.022, respectively) and winter wheat fields (p=0.004 and p=0.035, respectively).

Date had a significant effect on total species richness and marginally on abundance; there was no significant difference when compared dates pairwise (Table 1), although most species and individuals were found in December. We found significant interaction between date and seed mass in the case of total bird species richness and species richness of resident birds, and marginal significant interaction in the case of the abundance of resident birds. There was a positive correlation in December in all the three cases, while no relationship was found in January and February (Table 1; Fig. 3).

Discussions

Farmlands in Hungary promote rich bird assemblages in winter, even in the studied intensive agricultural region (*cf* Geiger et al. 2010). As expected, semi-natural grasslands were the richest habitats, while plough fields and winter wheat fields were the poorest. Our results showed that winter bird assemblages are different among intensively (arable fields, sown grasslands) and extensively (semi-natural grasslands) used fields, which is in accordance with Kasprzykowski and Goławski (2012) and Orlowski et al. (2014). If the CAP reform will support intensification (including the conversion of grasslands to arable fields), which seems to be the case (Pe'er et al. 2014), the decline of winter food supply is expected (Donald et al. 2001), leading to further loss of farmland bird populations.

The expected correlation between food and bird assemblages (Hammers et al. 2015) was found only for the December census, with more bird species on fields with higher seed mass. We were not able to find this correlation in January and February. We suppose that this is a result of the heterogeneous landscape, where the major food resources are supported not necessarily by the fields. In addition, weather has a huge influence on the bird assemblages, especially snow cover limits the availability of food on the ground surface (Goławski & Kasprzykowski 2010). Weedy field margins and bushes, hedgerows, forest edges seemed to be more important as the winter progress. This is supported by the large number of fieldfares (*Turdus pilaris*) we censused on the fields, although their feed on berries (Haraszthy 1984). This assumption is in line with the known importance of linear semi-natural habitats in agricultural areas (Batáry et al. 2012). A non-exclusive alternative explanation can be based on resource depletion that is fields with high seed resources attract more birds in early winter, where depletion is faster, thus diminishing the positive correlation between bird abundance and seed mass (Geiger et al. 2014).

Studies in Hungary did not find the expected relationship between wintering birds and food supply (Field et al. 2007, partly this study). However, these studies did not consider every habitat types in the landscape. We propose that the better understanding of wintering bird communities and the role of food needs surveys at the landscape level, and monitoring of both birds and food resources during the whole non-breeding season.

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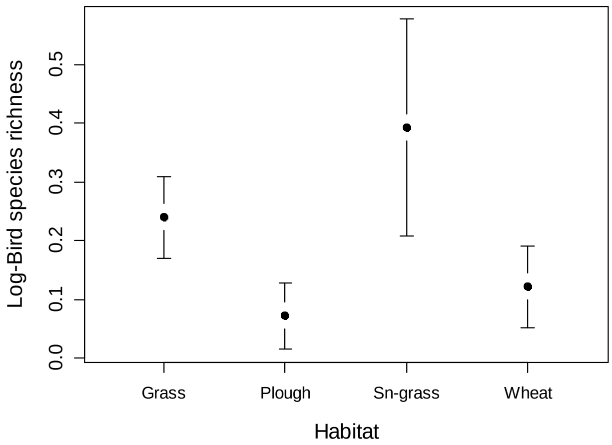
Table 1. The results of GLMM models testing habitat, date and seed mass effects on winter bird assemblages in a Hungarian farmland. Significant effects are in bold.

	df	F	p	
Total				
Species richness				
Habitat	3, 31	7.72	**0.001**	Gr, Sn-Gr >P; Sn-Gr >W
Date	2, 70	3.39	**0.039**	
Seed mass	1, 31	4.03	0.054	
Date*Seed mass	2, 70	3.14	**0.049**	
Abundance				
Habitat	3, 31	4.06	**0.015**	Gr, Sn-Gr >P
Date	2, 70	3.04	0.054	
Seed mass	1, 31	2.60	0.117	
Date*Seed mass	2, 70	2.45	0.093	
Granivore				
Species richness				
Habitat	3, 32	4.23	**0.013**	Sn-Gr > Gr, P
Abundance				
			NS	
Resident				
Species richness				
Habitat	3, 31	6.05	**0.002**	Sn-Gr > Gr, P, W
Date	2, 70	3.33	**0.042**	
Seed mass	1, 31	1.80	0.189	
Date*Seed mass	2, 70	4.21	**0.019**	
Abundance				
Habitat	3, 31	5.33	**0.005**	Sn-Gr > Gr, P, W
Date	2, 70	3.57	**0.033**	(Dec > Jan)
Seed mass	1, 31	0.94	0.339	
Date*Seed mass	2, 70	2.97	0.058	
Short-range migrant				
Species richness				
Habitat	3, 32	3.55	**0.025**	
Date	2, 66	3.19	**0.048**	
Habitat*Date	6, 66	3.31	**0.007**	
Abundance				
Habitat	3, 32	2.49	0.078	

Date	2, 66	2.33	0.105
Habitat*Date	6, 66	2.25	**0.049**

Gr – seeded grassland, P – ploughed arable field, Sn-Gr – semi-natural grassland, W – winter wheat field



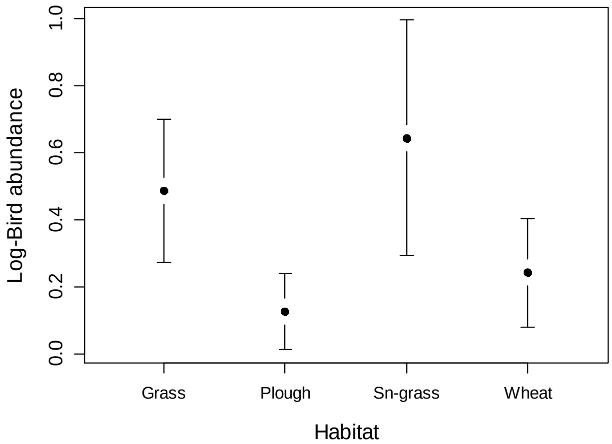


Fig. 1. The effect of habitat type on the (a) species richness and (b) abundance of birds (Grass – seeded grassland, Plough – ploughed arable field, Sn-Grass – semi-natural grassland, Wheat – winter wheat field).

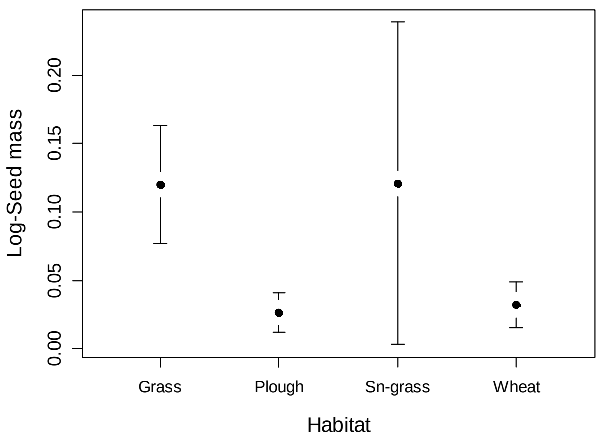


Fig. 2. Seed mass in four habitats in Hungarian farmlands (Grass – seeded grassland, Plough – ploughed arable field, Sn-Grass – semi-natural grassland, Wheat – winter wheat field).

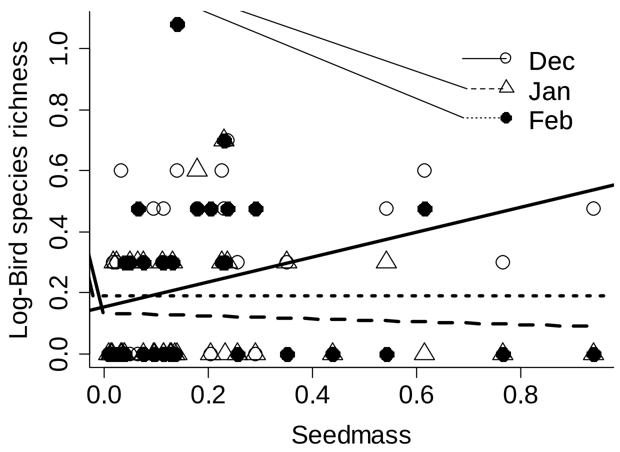


Fig. 3. Relationship of bird species richness and seed mass on the three census dates. Significant positive relationship was found for the December census only.

Appendix I. Google Earth KML file showing the sample areas of winter bird censuses in West Hungary.

Appendix II. Bird species with number of individuals recorded during winter bird censuses in West Hungarian agricultural fields.

Fieldfare	*Turdus pilaris*	415
Goldfinch	*Carduelis carduelis*	120
Linnet	*Carduelis cannabina*	85
Tree sparrow	*Passer montanus*	70
Buzzard	*Buteo buteo*	24
Yellowhammer	*Emberiza citrinella*	15
Greenfinch	*Carduelis chloris*	14
Skylark	*Alauda arvensis*	13
Hooded Crow	*Corvus corone cornix*	12
Great Tit	*Parus major*	11
Crested Lark	*Galerida cristata*	11
Pheasant	*Phasianus colchicus*	9
Magpie	*Pica pica*	8
Reed Bunting	*Emberiza schoeniclus*	8
Blackbird	*Turdus merula*	6
Sparrowhawk	*Accipiter nisus*	4
Long-tailed Tit	*Aegithalos caudatus*	4
Hen Harrier	*Circus cyaneus*	3
Great Grey Shrike	*Lanius excubitor*	3
Mallard	*Anas platyrhynchos*	2
Kestrel	*Falco tinnunculus*	2
Jay	*Garrulus glandarius*	2
Grey Heron	*Ardea cinerea*	1
Great Spotted Woodpecker	*Dendrocopos major*	1
Chaffinch	*Fringilla coelebs*	1