Comparative Analysis of Breeding Bird Communities in Different Open Agricultural Habitats, Lajta Project, Western Hungary

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Abstract – This paper presents the results of a comparative ornithological study conducted in the area of the LAJTA Project to determine songbird species richness, density and diversity in various open agricultural habitats including intensively managed monocultures as well as fallow habitats and edge ecotones. In total 11 passerine bird species were recorded. Species richness and total density were relatively high on the grass fallow sites and grassy edges. Bird community diversity was the highest in fallow habitats while its values were extremely low in intensively managed monocultures. Two key farmland songbird species, the skylark (*Alauda arvensis*) and the corn bunting (*Emberiza calandra*), showing declines in many West European countries, were found with high density in almost every habitat studied.

Keywords: farmland birds / diversity / agricultural intensity / field edges

1. INTRODUCTION

The negative effects of agriculture intensification on biodiversity are recognized and have been studied at many spatial scales on plants, invertebrates and vertebrates (LAVELLE 1996, TUCKER & EVANS 1997, HAWES et al. 2010, PADOA-SCHIOPPA et al. 2005). Changes in bird community structure and declines in avian species richness are often observed with implementation of agricultural practices. The aim of this study was to investigate the role played by habitat diversity in landscape on open farmland bird community species richness and diversity.

2. MATERIAL AND METHODS

2.1. Study area

Field studies were carried out in the area of the LAJTA Project, Győr-Moson-Sopron county, 47°47'33"–47°52'18"N, 17°03'37"–17°09'50"E; 120m above sea level (*Figure 1*). The area's climate is continental with a mean annual temperature of 9.6°C. Both large and small-scale farming are practiced with different management intensity.

2.2. Bird survey

Bird censi were carried out twice during the breeding season in 2011 (once in April and once in late May) using the "double-visit fixed-radius point count technique" as suggested by the Hungarian Biodiversity Monitoring System (BÁLDI et al. 1997). Observations took place in

early mornings (about 6.00-9.00 am) inside a circle with fixed distance radius (100 m) around the sample points. The census-points were located in the following habitats: winter wheat, maize and alfalfa fields, grasslands and fallows. Bird communities of grassy, ruderal edges were surveyed using the line-transect method. The methods used were suitable for passerine bird (Passeriformes) species only.

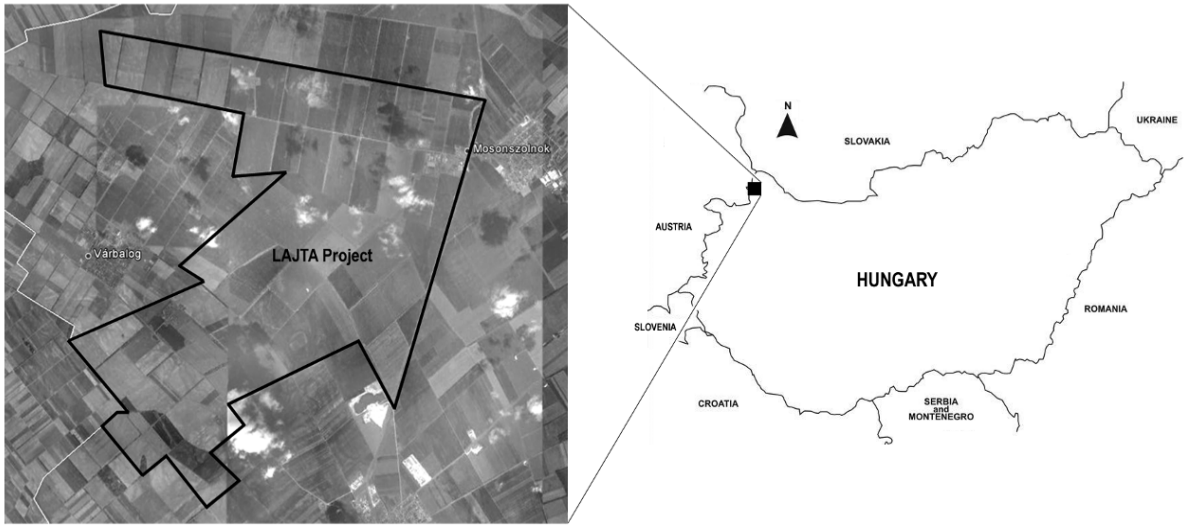

Figure 1. Study area (LAJTA Project)

2.3. Data analysis

The attributes of breeding bird communities in the sampled habitats are presented via comparison of species richness and diversity indices. Two measures of species α diversity were calculated for each habitat: the Shannon index (*H'*) and Pielou's equitability index (*J*). To compare bird community diversities a robust t-test was used as suggested by HUTCHESON (1970). The survey methods used made possible to calculate relative bird density for each habitats. Community structure comparison between the different agro-habitats was estimated using single linkage cluster analysis based on Jaccard's similarity index.

3. RESULTS

During the surveys a total of 11 bird species were recorded. *Table 1* shows the density of breeding pairs of each bird species occurred. The most important structural properties of breeding bird communities are presented in *Table 2*.
Density of the eurasian skylark (*Alauda arvensis*) and of the corn bunting (*Emberiza calandra*), two farmland bird species of special attention, were the highest on less intensively managed yet not abandoned farmlands and edges. Populations of corn bunting have declined steeply in Western Europe (BRICKLE et al. 2000) during the last 40 years. The estimated breeding population in Hungary is 165 000–225 000 pairs (MME NOMENCLATOR BIZOTTSÁG 2008), which is still relatively high, although local population declines been observed also in Hungary. Other characteristic farmland species in the area include the common stonechat (*Saxicola torquatus*) and the northern wheatear (*Oenanthe oenanthe*) while the regular occurrence of the hole nesting great tit (*Parus major*) in open agricultural fields is an interesting phenomenon. These are probably non-breeding youngsters crowded out from the shelterbelts, the only suitable nesting habitat for tits that are available in the area.

Table 1. Density values (pairs/10 ha) of breeding bird species in the studied agro-habitats

	winter wheat	maize	alfalfa	grassland	fallow	grassy edges
Alauda arvensis	1.062	0.910	1.062	0.637	1.274	0.694
Motacilla alba					0.637	
Saxicola torquatus	0.531		0.531		0.637	
Saxicola rubetra						0.694
Oenanthe oenanthe					0.637	
Sylvia curruca		0.455				
Parus major		0.455				
Lanius collurio						0.694
Fringilla coelebs		0.455				
Emberiza citrinella			0.531	0.637	1.274	2.778
Emberiza calandra	0.531			0.637	0.637	0.694
∑	2.123	2.275	2.123	1.911	5.096	5.556

Standardized bird species richness and total density were relatively high on the grass fallow sites and grassy edges. Bird community diversity was the highest in fallow habitats while its values were lower in intensively managed fields. The comparatively high diversity in maize cultures can be explained by the different habitat structure that provides nesting opportunities for shrub-nesting species such as the lesser whitethroat (*Sylvia curruca*), and even for the typical canopy nester chaffinch (*Fringilla coelebs*). The high values of Pielou's equitability in almost every habitats are explicable by the low number of species, with a relevant implication on the algorithm used.

Table 2. Structural properties of bird communities of the different studied habitats

	winter wheat	maize	alfalfa	grassland	fallow	ruderal edges
Species richness (S)	3	4	3	3	6	5
Total bird density (pairs/10 ha)	1.592	2.275	2.123	1.911	5.096	5.556
Shannon diversity (H')	1.040	1.332	1.040	1.099	1.733	1.386
Equitability (J)	0.946	0.961	0.946	0.865	0.967	0.861

Hutcheson's diversity t-test yielded significant differences in six cases only (*Table 3*). There are no remarkable differences between the diversities of breeding bird communities found in intensively managed plant cultures (winter wheat, maize and alfalfa). Significant differences ($P<0.05$) can principally be observed comparing bird diversities of fallow habitats and edge ecotones with the last mentioned managed habitats.

Table 3. Results (t-values) of comparison of Shannon diversity (H') values
significant differences (P<0.05) are italicized

	winter wheat	maize	alfalfa	grassland	fallow
maize	0.5786				
alfalfa	0.0000	0.5786			
grassland	1.8903	1.8662	1.7903		
fallow	*2.3471*	*2.6482*	*2.4471*	1.2187	
ruderal edges	*2.4108*	*2.2493*	*2.3083*	0.8873	0.7450

The agglomerative cluster analysis based on Jaccard's single linear similarity index (*Figure 2*) clearly demonstrates the differences and similarities between breeding bird communities in different habitat types.

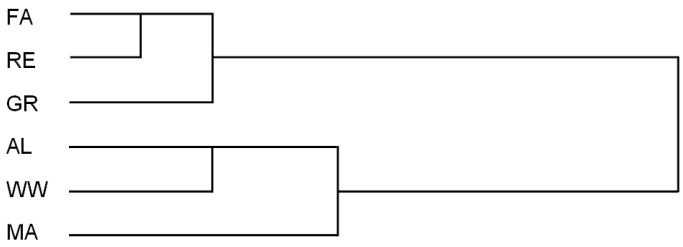

Figure 2. Dendrogram based on cluster analysis using Jaccard's coefficient of similarity on the bird communities of the sampled habitats
(WW – winter wheat, MA – maize, AL – alfalfa, GR – grassland, FA – fallow, RE – ruderal edges)

Cluster analysis separated the surveyed habitats into two main groups: there is a complete separation between intensively managed monocultures (winter wheat, maize and alfalfa) and unmanaged grassy habitats (grasslands, fallows and ruderal edges).

Acknowledgements: The study was made possible with the support of the Social Renewal Operation Programme TÁMOP 4.2.1.B-09/1/KONV-2010-0006 research project co-funded by the European Social Fund.

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