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The influence of land abandonment on farmland bird communities: a case study from a floodplain landscape in Continental Croatia

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Abstract. The abandonment of less productive agricultural land and the intensification of agricultural land use are the main features of the Common Agricultural Policy (CAP) that Croatia will enforce now as new member of the EU. Due to demographic changes and the economic transition in Croatia resulting from war in the 1990s, substantial tracts of agricultural land were abandoned. We investigated two habitat types in the protected floodplain landscape of Lonjsko polje in the continental part of the country: arable land and pastures. Both habitats were maintained by agricultural management and suffered from partial abandonment. Land abandonment increased the susceptibility to encroachment by the invasive plant species *Amorpha fruticosa*. Data on bird communities were obtained during the breeding season in 2010 while there were high water levels in the floodplain. Data were collected from 63 points, and a total of 1447 individuals from 70 species were recorded during the study. We found that the bird community structure was primarily related to the presence/abandonment of agricultural land use and the habitat type. Further, we detected that the bird community structure in the same habitat type differed by management intensity. Open habitat specialists were most influenced by land abandonment. However, the conservation value (according to the Species of European Conservation Concern value, SPEC) of grazed pastures and abandoned pastures did not differ significantly, in part because the overgrown pastures with high water levels were found to be suitable for *Acrocephalus* species. The shift in bird community structure between abandoned and managed arable lands were smaller than those detected in the pastoral communities. Because land abandonment is a widespread phenomenon in Croatia, we emphasize the urgent need for a nationwide monitoring program for farmland birds to register the resulting changes in farmland bird communities and to develop appropriate agri-environment measures to mitigate the process.

Key words: agriculture, *Amorpha fruticosa*, invasion, management

Introduction

Currently, 66 % of farmland bird species in Europe have an unfavourable conservation status because of their negative population trends (BirdLife International 2004). Most of these population declines are related to the changes in agricultural practices that were implemented through the Common Agricultural Policy (CAP) (Donald et al. 2002, 2006, Verhulst et al. 2004). The CAP was initiated in 1957 and is regulated and financed by the European Commission. In general the CAP aimed to increase agricultural productivity, and in fact it stimulated two simultaneous and opposite processes: land use intensification in some areas (Donald et al. 2002) and land abandonment of other – less productive areas (Bignal 1998, Tryjanowski et al. 2009). Both phenomena are known to negatively affect farmland birds, but while the effect of agricultural intensification has been widely studied (e.g. Pärt & Söderstrom 1999, Donald et al. 2001, 2002, 2006, Hole et al. 2002, Gregory et al. 2004, 2005, Verhulst et al. 2004, Báldi et al. 2005), the effect of land abandonment is relatively poorly understood (Preiss et al. 1997, Suárez-Seoane et al. 2002, Sirami et al. 2007, Nikolov 2010). Moreover, most information about the effects of land abandonment on birds comes from Western, Central and Northern Europe (e.g. Pavel 2004, Verhulst et al. 2004, Báldi et al. 2005, Donald et al. 2006, Reif et al. 2008, Tryjanowski at al. 2011). The information from Southeastern Europe remains poor (Nikolov 2010), even though land abandonment is widespread there, particularly in the mountainous regions (Ostermann 1998). Similar to those of Western and Central Europe, the grasslands in Eastern Europe are more seriously affected by the abandonment of maintenance than other agricultural habitats (Stoate et al. 2009). Such abandoned grasslands became vulnerable to spreading invasive plant species (Stoate et al. 2009), as already seen in Hungary (Mihály & Demeter 2003).

Gellrich & Zimmermann (2007) found that, after the abandonment of agricultural production, there may be short-term positive effects on biodiversity because of forest re-growth, but this temporary uptick is followed by less permanent biological and landscape diversity. Accordingly, Brambilla et al. (2010) demonstrated that *Lanius collurio* is favoured in grasslands and scrubland with trees but that these habitats became completely unsuitable for this endangered species 30 years after abandonment. As a new member state of the European Union (EU), Croatia should implement the CAP and develop a national agri-environment program consisting of appropriate agri-environmental schemes (AES) to promote sustainable land use by considering biodiversity conservation within agricultural systems. So far, in many countries, there has been a "bad" experience with poor testing of the effectiveness of the AES (Kleijn & Sutherland 2003, Stoate et al. 2009) and the inadequate results of AES that are applied directly from one country or region to another without being tested first (e.g. Pärt & Söderström 1999, Wrbka et al. 2008, Nikolov 2010). This is because, as shown by Reif et al. (2008), the drivers of farmland bird populations differ across Europe, and regional investigations of farmland management are required. Information about the status and trends in common bird populations at the national level is crucial for understanding the impacts of agricultural land use changes on local avifauna and for providing effective management recommendations (Gregory et al. 2005).

According to the Red Data Book of Threatened Birds in Croatia (Radović et al. 2003), 11 bird species are directly and negatively affected by the abandonment of traditional livestock breeding. In Croatia, changes in agricultural practices on ploughed land tends toward agricultural intensification rather than land abandonment, and this is considered a direct cause of the population decreases in 34 bird species, whereas only one species is threatened by abandonment of traditional agriculture (Radović et al. 2003). The following processes bring about changes in landscape elements (Burel et al. 1998, Antrop 2005, Bender et al. 2005) and influence the bird community structure. The decrease in livestock numbers acted as trigger for the accelerated invasion of species such as the false indigo bush (*Amorpha fruticosa* L., family Fabaceae), a species that originated in North America (Hulina 2010). It was introduced to Europe because it is excellent for honey pasture, but it soon started to spread uncontrolled throughout southern and central Europe, as the light seeds were easily transported by floods. The species spreads extremely fast in alluvial lowlands (Botta-Dukát 2005). It is well known that poorly managed agricultural lands, disturbed areas and aquatic ecosystems are most prone to plant invasions (Török et al. 2003). Abandoned arable land and orchards are often invaded, and one of the most frequent invasives is the false indigo bush (Deák 2005) and its negative effects on the native vegetation in grasslands was proved (Sarateanu 2010). However, there are only few studies dealing with the impact of alien invasive plant species on bird communities (Flanders et al. 2006, Schneider & Geoghegan 2006, Skórka et al. 2010).

The false indigo bush is considered to be a threat to biological diversity and forest management in Croatia, where riparian vegetation, roadsides, forest edges and drainage habitats have been invaded (Boršić et al. 2008, Hulina 2010). The indigo bush finds more favourable conditions in disturbed habitats and it is spreading rapidly across riparian systems (Pedashenko et al. 2012), whereas regular grazing suppresses its spread (Zingstra 2009). The decrease of livestock on pastures has enabled a rapid transformation of landscape features because the false indigo grows quickly and there are no easy methods to halt this process. Attempted control by cutting provided poor results (Liović 2003).

At present, we have poor knowledge of the speed of landscape transformation in Croatia, particularly in areas where traditional livestock breeding has stopped or decreased significantly and which are now influenced by invasive plant species such as the false indigo bush. Similarly, we have poor knowledge of the changes in landscape elements in areas where agricultural intensification is an ongoing process. As in other Eastern European countries (Báldi & Faragó 2007), pasture and meadow transformation into forest

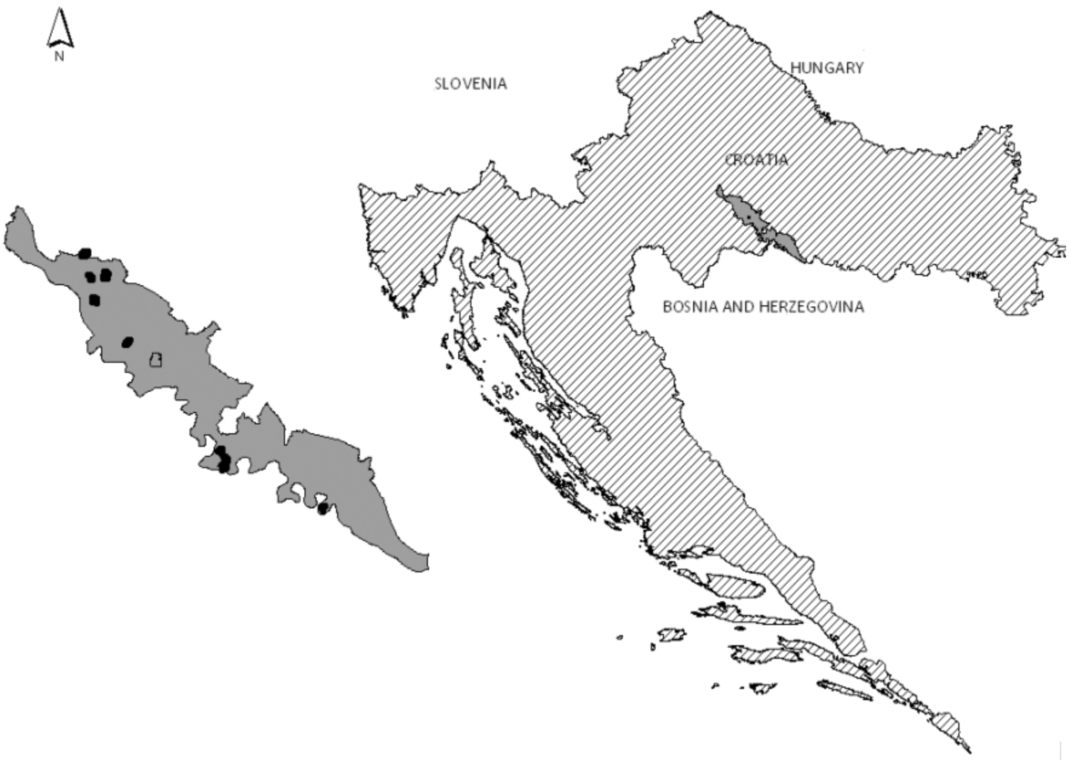

Fig. 1. Geographical position of the research plots within the Lonjsko Polje Nature Park (dark gray).

as a consequence of land abandonment is a recognized process in Croatia (Ljubičić et al. 2008, Gugić 2010, Alegro pers. comm.). The main goal of this research is to investigate how bird community structures alter along agricultural habitats (arable lands and pastures) that are managed with different intensities (traditionally managed and partially abandoned). The outputs from this study are expected to help decision makers involved in the preparation of national agro-environmental programs to improve management and to formulate recommendations for future planning processes.

Material and Methods

Study area

Our research was conducted in the Lonjsko Polje Nature Park (ca 45°4′ N, 17°8′ E, Fig. 1.) in Continental Croatia. The park spreads along the River Sava over an area of 50650 ha and constitutes one of the largest alluvial lowlands of the entire Danube catchment area. There are 246 bird species recorded in the area (Mužinić et al. 2004), of which 150 species are breeders (Schneider-Jacoby 1993), accounting for 65 % of the Croatian breeding avifauna (Radović et al. 2003). The Park encompasses complexes of alluvial oak and poplar forests (mostly inundated annually), several marshes, meadows, pastureland, permanent water in oxbows and streams without embankments, and it is used as a retention basin (Grimmet & Jones 1989). Approximately 15 % of the Park area is covered by grassland habitats, and 4 % is intensely managed arable land (Gugić 2008) with small fields.

The area is characterized by traditional system of land use. The medieval system of common pasturing, which was typical across Central Europe until the second half of the 19th century (Gugić 2009), is still practiced there. Some parts of the area have been drained and cultivated. The pasturing system in the research area is a combination of private and common pastures and meadows, but all are under low-intensity management. The sections managed by mowing are treated only once a year, almost without additional fertilizer. In general, the quantity of fertilizer on arable land in the research area is extremely low (Brundić et al. 2001).

Due to its natural value, Lonjsko polje is a designated Ramsar site and an Important Bird Area (IBA – BirdLife code HR009) (Heath et al. 2000) and has been proposed as Special Protection Area within the NATURA 2000 network (http://www.natura2000.hr). According to the habitat map of the study area, more than 26 % of the semi-natural grasslands are invaded with false indigo bush (Topić et al. 2006). The species is known indicator of land abandonment (Zavagno & D‘Auria 1999, Sarateanu 2010). Most of the land abandonment in the area happened at the beginning of 1990s during war activities in the area and many of the houses were destroyed stopping agricultural production on vast areas in short time period.

Study design

The research included two agricultural habitat types within the Park: arable land and pastures. We used 1 × 1 km squares as sampling units. We selected quadrants with homogeneous habitats as research plots for bird communities. Habitat homogeneity was assessed on the basis of habitat maps of the Nature Park, as well as partially abandoned areas that were defined as areas of false indigo encroachment (Topić 2006). Overall, 9 quadrants were selected for this study (Table 1).

Breeding bird communities were sampled using the point count method (Bibby et al. 2000). To avoid problems of double counting of individual birds in 1 × 1 km square, we placed nine sampling points 300 m apart. From these nine points, we collected data on bird communities for a period of 10 minutes during the greatest bird activity in the morning (from 6:00 till 9:00 a.m.). We did not sample on all 9 points per square because some points fell in unsuitable positions for sampling, such as roads, channels and private households or were inaccessible. In 2010 the water level of the Lonjsko polje floodplain was so high that it blocked some of the trails between the points. However, we managed to assess at least 5 points per square in all quadrants (five plots with five points, one with seven and four with nine points). Overall, 63 point counts were conducted across different agricultural habitat types (Table 1). We recorded all birds seen or heard (and additionally counted flyovers) in two distance belts: inside and outside a radius of 50 m from the point. Because our habitats of interest were very open in some places and it was not reasonable to expect that all individual birds would return to within 50 m while we were standing there, we carefully observed the movements of the individual birds. Vocal species whose sounds can be heard from very far, such as *Cuculus cannorus*, *Oriolus oriolus* and *Phylloscopus* sp., were counted only once and assigned to the closest points where the counts were made. Flyovers were not included in the statistical analysis, but they contributed to the list of bird species recorded (Appendix). Due to extreme weather conditions in spring 2010, with extensive floods occurring during the breeding period, we collected data only once between the 27^{th} of April and the 5^{th} of June, which includes the breeding season of both resident and migrating breeding birds in Lonjsko polje. We are aware of the limitation imposed by having only one visit during the breeding season, but single visit surveys are appropriate when the objective of the research does not include intra seasonal variation in bird communities.

Environmental parameters, distance from forest (d_for), distance from water (d_wat) and topographic wetness index (twi), which we assumed to have influence on bird communities, were generated using the SAGA System for Automated Geoscientific Analyses (http://www.saga-gis.org/en/index.html) and the relevant geographic information layers such as maps of habitat types (Gugić 2008) and the digital elevation model of the area at 30 meter resolution (source GISdata Ltd).

Data analysis

Analyses were performed on two sets of bird data: (1) the subset of species detected in the inner belt of 50 m from the sampling points (n = 24 species) that make the core of the community and are the most abundant species (Appendix) as suggested by Clarke & Warwick (2001) and (2) the total bird community detected at the sampling point (Fig. 2).

Bird community structure within the first distance belt (up to 50 m from the sampling point) was analyzed by the multivariate preferential analysis (MDPREF), which was performed with the PRINQUAL procedure in SAS (Carroll 1972) to produce biplots (Gabriel 1981) on the core subset of the species from the 50 m circle. Macro %PLOTIT was used to generate biplots that provide information on bird communities, as well as information on management type for each location. In MDPREF analysis the positions and length in of vectors were determined by the abundance of individual species at research points.

Total bird communities were analyzed using Non-metric Multi-dimensional Scaling (NMDS) (MASS package) based on a Bray-Curtis similarity matrix to present the differences/similarities in the community structure with superimposed vectors of the environmental parameters described earlier. NMDS analysis was performed on the total bird community at the sampling sites.

The two-way analysis of variance (ANOVA) for unbalanced data was generated using a general linear model (GLM) procedure (PROC GLM, SAS/STAT software, Version 9.1.3) on the rank scores because the data were not normality distributed (Iman 1982). A rank transformation was performed by the RANK procedure (PROC RANK) with ties = mean option before performing the analysis. According to the results of MDPREF (species placement on the biplots) (Fig. 3), we subset those found only on arable lands and those found only on pastures. The

Table 1. Location of the sampling points according to the studied habitat types.

Habitat types	Management	Management code	Number of sampling points	Total number of points per habitat/ management class
Mosaic of agricultural fields	Arable land under production (oil seed rape, maize, wheat)	A_I1	25	25
Mosaic of agricultural fields and natural vegetation/*Amorpha fruticosa*	Partially abandoned arable land (same landscape as mosaic agricultural fields before abandonment)	A_I2	9	9
Rorippo-Agrostidetum stoloniferae	Grazed pasture	P_I1	7	12
Rorippo-Agrostidetum stoloniferae/ Phragmiti-Typhetum minimae	Grazed pasture	P_I1	5	
Glycerietum maximae/*Amorpha fruticosa*	Partially abandoned pasture	P_I2	2	17
Rorippo-Agrostidetum stoloniferae/ *Amorpha fruticosa*	Partially abandoned pasture	P_I2	1	
Rorippo-Agrostidetum stoloniferae/ Glycerietum maximae/*Amorpha fruticosa*	Partially abandoned pasture	P_I2	2	
Rorippo-Agrostidetum stoloniferae/ Phragmiti-Typhetum minimae/*Amorpha fruticosa*	Partially abandoned pasture	P_I2	5	
Trifolio-Agrostidetum stoloniferae/ *Amorpha fruticosa*	Partially abandoned pasture	P_I2	7	

species that were not possible to attach to either group (because they were found on both types of habitats or the frequency of incidence during research period was low) were not considered specialists in our study area. We created two groups: (1) species associated with arable land *Erithacus megarhynchos* V6, *Passer domesticus* V13, *Sylvia atricapilla* V20, *Sylvia communis* V21, and *Turdus philomelos* V23 and (2) species associated with pastures *Acrocephalus schoenobaenus* V1, *Alauda arvensis* V2, *Locustella fluviatilis* V9, *Locustella luscinioides* V10, *Motacilla flava* V11, *Saxicola rubetra* V16 and *Vanellus vanellus* V24. We employed two community richness measures. The first displayed the total sum of individuals detected per sampling point (SR – sum raw) and the second was the weighted sum of individual birds (WS – weighted sum) set according to the conservation status of birds on European level (Species of European Conservation Concern SPEC, see Appendix). The WS was considered as a measure of the conservation value of the habitat.

This resulted in six GLM models according to the bird community – three for the total sum of individuals detected per sampling point (SR of total community, arable land related species and pasture related species), and three for the weighted sum of individual birds (WS of total community, arable land related species and pasture related species). Taking into account the different data subsets, there were two models for overall bird communities, two models for species tied with arable land and two models for species tied with pastures. For each model, we tested two effects (habitat type and management intensity) and their interactions. We expressed the null hypothesis in terms of no effect; therefore, we tested only for statistically significant effects and interactions.

Data integration and Non-metric Multi-dimensional Scaling was made using the R software package, Version 2.11.1 (The R Foundation for Statistical Computing 2010). For the general linear models (GLM) and the multivariate preferential analysis (MDPREF), we used the SAS software, Version 9.1.3 (SAS Institute Inc. 2006).

Results

We identified a total of 1447 individuals from 70 bird species (see Appendix). Species formed four main groups (Fig. 3). The first group with four vectors (*Hirundo rustica* V7, *Passer domesticus* V13, *Streptopelia decaocto* V18, *Sturnus vulgaris* V19) is placed in the upper right corner of the biplot and is obviously influenced by a single sampling point in cultivated arable land next to a human settlement. In addition, it is also characterized by the lowest topographic wetness potential (Fig. 3b, code 23). The second group (*Emberiza citrinella* V5, *Erithacus*

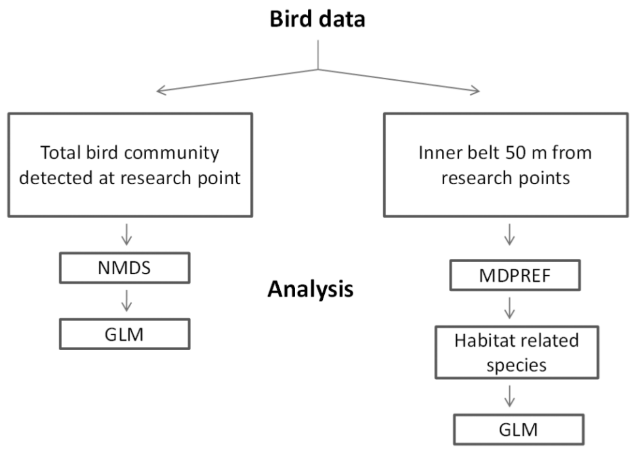

Fig. 2. Schematic of data sets and analyses.

megarhynchos V6, *Lanius collurio* V8, *Parus major* V12, *Saxicola torquata* V17, *Sylvia atricapilla* V20, *Turdus merula* V22 and *Turdus philomelos* V23) is placed in the upper part of the biplot and connected with arable lands. This is a heterogeneous group of species with diverse habitat requirements but most depend on shrubs and forest edges.

The third group, birds associated with abandoned lowland wet pastures of vectors creates a group of species on the lower part of the biplot, which is mainly influenced by the pasture sampling points. The group consists of the following species: *Acrocephalus schoenobaenus* V1, *Alauda arvensis* V2, *Locustella fluviatilis* V9, *Locustella luscinioides* V10, *Motacilla flava* V11, *Saxicola rubetra* V16 and *Vanellus vanellus* V24.

The fourth group is placed between the first two groups (middle part of the biplots) and is composed of the species *Anthus trivialis* V3, *Carduelis carduelis* V4, *Passer montanus* V14, *Phasianus colchicus* V15 and *Sylvia communis* V21. Shifting along an imaginary line passing through the centres of the third and second vector groups forms the gradient of habitats following intensity creating succession among groups as follows: P_I2, P_I1, A_I2, A_I1 (Fig. 3a).

Land management type was the most influential factor determining the bird community structure in the area (Table 2) followed by topographic potential for water accumulation. Distances from water as

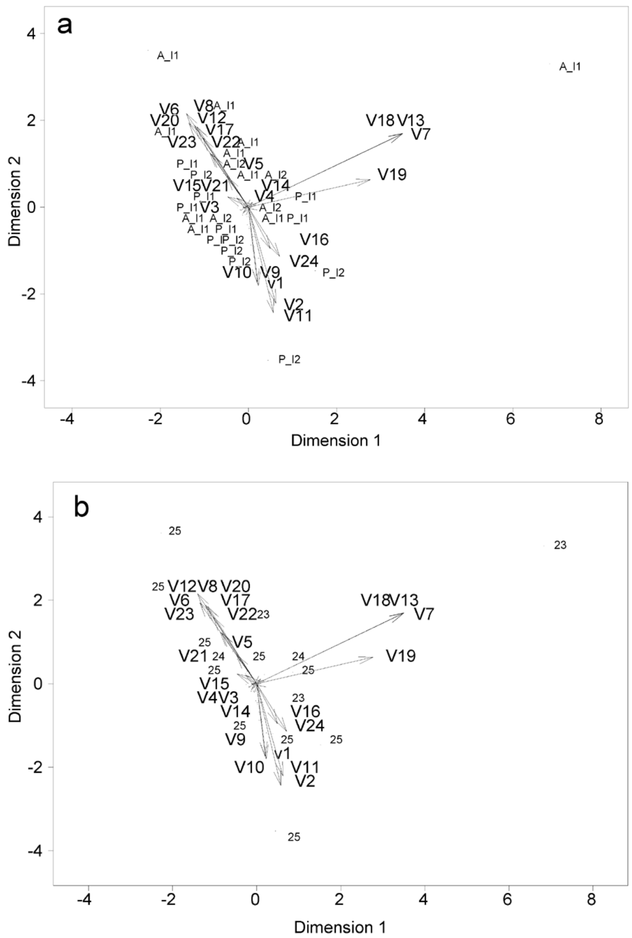

Fig. 3. a) Results of multivariate preferential analysis (MDPREF) of the bird community structure within the radius of 50 m from the sampling point, with information on habitat management. Habitats are indicated with the following codes: A_I1 – arable intensity 1, A_I2 – arable intensity 2, P_I1 – pasture intensity 1, P_I2 – pasture intensity 2. b) The twi index indicated as follows: 23 – lowest wetness potential, 24 – middle and 25 – highest potential wetness of the terrain.

well as distance from forest were the two factors not significantly connected with the community structure. Both models (SR/WS) are statistically significant (p = 0.0085 and p = 0.0044) and note the existence of effects on habitat and habitat/management intensity interaction.

All four models for habitat related species were statistically significant (*P*-value < 0.0001), but only models for pasture related species revealed

Table 2. Results of the function that fit environmental factors onto an NMDS ordination of all research points. *P*-values are based on 1000 permutations and significant *P*-values are in bold. Codes: NMDS1 – first axis of the Non-metric Multi-dimensional Scaling; NMDS2 r2 – second axis of the Non-metric Multi-dimensional Scaling.

Environmental factor	NMDS1	NMDS2	r2	*P*-value
Distance from forest	–0.781112	–0.624391	0.1810	0.059
Topographic wetness index	0.999472	0.032489	0.3387	**0.004**
Distance from water	–0.456765	0.889587	0.1288	0.133
Management type	0.887413	0.460976	0.6105	**0.001**

an interaction between habitat and management intensity (Table 4, *P*-value = 0.0052). The total sum of individual bird species that were connected to specific habitats differed significantly between different intensity types (Table 4), but the conservation value for those groups of species did not show significant effects (Table 4, *P*-value = 0.0554).

Discussion

The results show that the structure of bird communities in the same habitat type varies according to the management intensity (see Fig. 3). Bird community structure is primarily determined by management intensity and habitat type (see Fig. 3 and Tables 3, 4). The abandonment of agricultural practices mostly influences specialist birds that are found in pastures, statistically significantly higher numbers of birds found in abandoned pastures compared to grazed ones (Tables 3, 4). We believe that reason for this is the extremely wet year that allowed *Acrocephalus* species to breed there. Similarly, in central Europe, Verhulst et al. (2004) showed that abandoned pastures hosted more species diversity and higher bird densities than grazed pastures because abandoned sites were covered by bushes and contained many non-grassland species. A similar study in Bulgaria showed that pastureland abandonment influences farmland bird community structures and, in particular, negatively affects the species richness and diversity of bird communities, though there is little effect on bird abundance (Nikolov 2010). However, the same study demonstrated that intensively grazed pastures supported lower species numbers, less diversity and lower densities than extensively used pastures. In another study from central Europe (Batáry et al. 2007a) comparing extensively and intensively used pastures, grassland specialists were more abundant in extensive than in intensive fields. It is known that changes in vegetation structure and subsequent effects on bird populations through the loss of preferred breeding sites, alteration

Table 3. Differences between group means for the total sum/weighted sum of bird community. Significant *P*-values (95 % confidence level) are in bold. Estimated means and their errors are given in parenthesis.

Effects and contrasts	*P*-value (SR)	F value	*P*-value (WS)	F value
Effects				
Habitat	**0.0194**	**5.78**	**0.0011**	**11.82**
Intensity	0.3880	0.76	0.4755	0.52
Interaction between habitat and intensity	**0.0017**	**10.77**	**0.0127**	**6.61**
Contrasts				
Arable *vs.* pasture for intensity 1	0.4091 (4.2 ± 5.0)	0.69	0.29	10.29
Arable *vs.* pasture for intensity 2	**0.0014** (–27.1 ± 8.1)	**11.20**	**0.0005**	**13.8**
Intensity 1 *vs.* intensity 2 for arable	0.0933 (11.5 ± 6.7)	2.91	0.0950	2.88
Intensity 1 *vs.* intensity 2 for pasture	**0.0048** (–19.8 ± 6.7)	**8.61**	**0.0214**	**5.41**

Table 4. Contrasts for univariate analysis of variance for differences between region means (95 % confidence level) for the sum of the birds connected with specific habitat (inner circle). Significant *P*-values are in bold. Estimated means and their errors are given in parenthesis.

Effects and contrasts	Arable land species *P*-value	F value	Pasture species *P*-value	F value	Arable land species (weighted) *P*-value	F value	Pasture species (weighted) *P*-value	F value
Effects								
Habitat	**< 0.0001**	**20.72**	**< 0.0001**	**42.02**	**< 0.0001**	**24.95**	**< 0.0001**	**37.56**
Intensity	0.8097	0.06	0.4313	0.44	0.8097	0.06	0.4741	0.12
Interaction between habitat and intensity	0.8396	0.04	**0.0052**	**8.42**	0.8396	0.04	**0.0127**	**5.81**
Contrasts								
Arable *vs.* pasture for intensity 1	**0.0001** (17.0 ± 4.1)	**17.17**	**0.0003** (–14.6 ± 3.7)	**15.19**	**0.0001**	**17.17**	**0.0003** (15.3±3.9)	**15.16**
Arable *vs.* pasture for intensity 2	**0.0062** (19.0 ± 6.7)	**7.80**	**< 0.0001** (–35.4 ± 6.1)	**33.75**	**0.0070**	**7.8**	**< 0.0001** (–33.4 ± 6.4)	**27.37**
Intensity 1 *vs.* intensity 2 for arable	0.7533 (–2.2 ± **5.5)**	0.1	0.1403 (7.5 ± **5.0)**	2.23	0.7533	0.1	0.1514 (7.7 ± 5.3)	2.11
Intensity 1 *vs.* intensity 2 for pasture	0.9784 (–0.1 ± 5.6)	0.01	**0.0116** (–0.2 ± 5.6)	**6.79**	0.9784	0.9784	**0.0554** (–10.4 ± 5.3)	**3.82**

of food supplies and predation pressure appear to be the primary consequences of pasture abandonment (Fuller & Gough 1999).

Our study showed that the conservation value of pastures for pasture related species did not change significantly with respect to land abandonment (Table 4). In contrast, a study from the uplands of Bulgaria (Nikolov 2010) found that grazed pastures sheltered more species of conservation priority than abandoned ones. In addition, a study from Hungary (Batáry et al. 2007b) demonstrated that the conservation status altered with agricultural intensification of grasslands and was higher in extensive fields than intensive ones. However, regional differences in land abandonment effects could be explained by the intensity of grazing management, by the time since a pasture was abandoned and by landscapes that provide sources of plant species that are prone to invading abandoned land. The reason that an abandoned pasture in Lonjsko polje sustained similar conservation value is presumably due to our study took place in a particularly rainy year. The abandoned pastures with high water levels were therefore suitable for species of the genera *Locustella* and *Acrocephalus*. This is most likely not the case in years without standing water throughout the breeding season. Another reason is the fact that the indigo bush has not reached a late succession stage. In early succession stages, it forms vegetation structures suitable for the breeding of the genera *Locustella* and *Acrocephalus*. Areas without false indigo bush but with same wetness potential are suitable for species such as *Motacilla flava* (Radović et al., unpublished data). Further spread of the false indigo bush on pastures may have positive effects on the abundance and density of the genera *Locustella*/*Acrocephalus* on the one hand but will negatively impact *Motacilla flava* and *Alauda arvensis.* The author's recent research on changes in the structure of grasslands along the Central Sava Basin revealed significant changes in the Enhanced Vegetation Index (EVI) during 2000-2008 along 9 % of the pastures in the area (Radović et al. 2012). These changes were explained to some extent by the dispersal of this invasive species. The process of invasion is complex because it is facilitated by human-altered habitats such as those under agricultural production, particularly when these habitats are abandoned without an established ecological stability (Parks et al. 2005, Haider et al. 2010). We assume that abandoned pastures, partially invaded with the false indigo bush, will eventually become unsuitable for *Locustella*/*Acrocephalus* species because the vegetation structure will become too dense with time. The process is similar to the succession of abandoned arable lands into forest (Debussche & Lepart 1992). With this pilot study, we are not able to prove this statement but based on our observations in the field, fully grown false indigo stands were occupied by few birds of any species. Similarly, Skórka et al. (2010) found lower species richness and fewer breeding pairs of birds in meadows invaded with goldenrods (*Solidago* ssp.) than in meadows without them. In general, the effects of pasture abandonment depend on the intensity of the management within the prime habitat (Fuller et al. 2004, Verhulst et al. 2004, Sirami et al. 2007, Nikolov 2010). Our results showed that in abandoned alluvial lowlands in Croatia, some species with unfavourable conservation status in Europe and associated with pastures such as *Vanellus vanellus* and *Alauda arvensis* are replaced by other species such as *Acrocephalus schoenobaenus*. Moreover, in our study we did not consider species that only feed on agricultural lands due to the small sample sizes. Nevertheless, we may expect a significant impact of pasture abandonment on several other SPEC species such as *Ciconia ciconia* and *Aquila pomarina* because the quality of breeding habitat for both species depends on the availability of pastures and other open habitats in the vicinity of breeding grounds (Hagemeijer & Blair 1997).

Our results for arable land show a different pattern than those for pastures because on arable land neither the total number of individuals that depend on arable land nor the conservation value of this type of habitat differed significantly. The difference between the effect of abandonment in pastureland and arable land could be explained by the faster succession rate of pastures into dense scrub, which results from a higher rate of dispersion of the invasive false indigo (Hulina 2010). This is consistent with the findings of Gellrich & Zimmermann (2007) that changes of landscape elements due to land abandonment take place more rapidly in pastures than in arable lands. In the present study, all research points on pastures with less management intensity are characterized by high wetness potential (see Fig. 3). The false indigo occupies moist habitats because it spreads its seeds during flooding (Hulina 2010). In the research area, the pastures are placed in topographically lower areas (higher value of topographic wetness index) that are more influenced by flooding than is the case with arable lands placed on higher grounds. The difference in altitudes of only a few meters makes a great difference in flood duration. Bird community structure in the research area is not primarily driven by the distance to forests. The agricultural fields in the research area encompass diverse landscape elements such different types of scrubs and hedges and none is far from a forest. These parcels are rather small compared to fields in most of the agricultural complexes in Europe. Crops within the research area also represent an important feeding/breeding/stopover habitat for a number of bird species. Regarding the conservation status, 30 out of 70 detected species have a SPEC status. This fact underscores the importance of proper management/protection of different elements of the agricultural land that comprises great parts of European landscapes (Stanners & Bordeau 1995, Stoate et al. 2009). Our results concur with the high species richness that has been detected throughout Europe in areas of mixed farming and high proportions of forest edge habitat (Sanderson et al. 2008). The preservation of the present habitat diversity around arable fields (uncultivated/woodlands) is essential and is recognized as the major management recommendation for the improvement of suitability of fields for bird species in European countries (Kati & Sekercioglu 2006, Tsiakiris et al. 2009). The need to preserve the heterogeneity of agricultural habitats is crucial for several farmland species with declining populations in northern and western Europe such as *Emberiza citrinella* (Bradbury et al. 2000), *Sylvia communis* (Kati & Sekercioglu 2006, Tsiakiris et al. 2009) and *Lanius collurio* (Brambilla et al. 2007, Tsiakiris et al. 2009). Further research on the influence of the fast growing invasive false indigo bush is needed in both habitat types.

Farmland specialist birds are in general more prone to steep declines than generalist species (Reif et al. 2008) and such a pattern of population decline has been observed in different regions across Europe (Chamberlain et al. 2000, Donald et al. 2001, 2006, Gregory et al. 2005, Archaux 2007, Báldi & Faragó 2007, Wretenberg et al. 2007). In western Europe, most of these negative population trends were explained by agricultural intensification (Donald et al. 2001, 2006), while in the eastern part of Europe, Reif et al. (2008) argued that the effects of land abandonment are most likely more important in the less productive agricultural areas. The presented results here are in agreement with the argument by Reif et al. (2008) that in addition to the negative effects on farmland birds that should be expected under agricultural intensification (Donald et al. 2001, 2006), land abandonment should be considered an important negative factor for Croatian farmland avifauna, particularly for grassland specialists.

Finally, we emphasize the urgent need for a national monitoring program for birds in agricultural systems in Croatia, as new member of EU, in order to register the resulting changes in farmland bird communities and to develop appropriate agri-environment measures to mitigate this process.

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Literature

Antrop M. 2005: Why landscapes of the past are important for the future. *Landscape Urban Plan. 70: 21–34*.

Archaux F. 2007: Are mountains refuges for farmland bird species? A case study in the northern French Alps. *Bird Study 54: 73–79*.

Báldi A. & Faragó S. 2007: Long-term changes of farmland game populations in a post-socialist country (Hungary). *Agric. Ecosyst. Environ. 118: 307–311*.

Báldi A., Batáry P. & Erdös S. 2005: Effects of grazing intensity on bird assemblages and populations of Hungarian grasslands. *Agric. Ecosyst. Environ. 108: 251–263*.

Batáry P., Báldi A. & Erdös S. 2007a: Grassland versus non-grassland bird abundance and diversity in managed grasslands: local, landscape and regional scale effects. *Biodivers. Conserv. 16: 871–881*.

Batáry P., Báldi A. & Erdös S. 2007b: The effects of using different species conservation priority lists on the evaluation of habitat importance within Hungarian grasslands. *Birdlife Conserv. Int. 17: 35–43*.

Bender O., Boehmer H.J., Jens D. & Schumacher K.M. 2005: Using GIS to analyse long-term cultural landscape change in Southern Germany. *Landscape Urban Plan. 70: 111–125*.

Bibby C.J., Burgess N.D., Hill D.A. & Mustoe S.H. 2000: Bird census techniques, 2nd ed. *Academic Press, London*.

Bignal E.M. 1998: Using an ecological understanding of farmland to reconcile nature conservation requirements, EU agriculture policy and world trade agreements. *J. Appl. Ecol. 6: 949–954*.

BirdLife International 2004: Birds in Europe: population, estimates, trends and conservation status. *BirdLife International, Cambridge, U.K.*

Boršić I., Milović M., Dujmović I., Bogdanović S., Cigić P., Rešetnik I., Nikolić T. & Mitić B. 2008: Preliminary check-list of invasive alien plant species (IAS) in Croatia. *Nat. Croat. 17 (2): 55–71*.

Botta-Dukát Z. 2005: Invasion of alien species to Hungarian semi-natural habitats. *Acta Bot. Hung. 50: 219–227*.

Bradbury R.B., Kyrkos A., Morris A.J., Clark S.C., Perkins A.J. & Wilson J.D. 2000: Habitat associations and breeding success of yellowhammers on lowland farmland. *J. Appl. Ecol. 37: 789–805*.

Brambilla M., Casale F., Bergero V., Bogliani G., Crovetto G.M., Falco R., Roati M. & Negri I. 2010: Glorious past, uncertain present, bad future? Assessing effects of land-use changes on habitat suitability for a threatened farmland bird species. *Biol. Conserv. 143: 2770–2778*.

Brambilla M., Rubolini D. & Guidali F. 2007: Between land abandonment and agricultural intensification: habitat preferences of red-backed shrikes *Lanius collurio* in low-intensity farming conditions. *Bird Study 54: 160–167.*

Brundić D., Barbalić D., Omerbegović V., Schneider-Jacoby M. & Tusić Z. 2001: Alluvial wetlands preservation in Croatia; the experience of the Central Sava Basin flood control system. In: Nijland H.J. & Cals M.J.R. (eds.), River restoration in Europe; practical approaches. *Proceedings from the conference on river restoration, Wageningen, the Netherlands, 2000. RIZA report 2001.023, Lelystad: 109–118.*

Burel F., Baudry J., Butet A., Clergeau P., Delettre Y., Le Coeur D., Dubs F., Morvan N., Paillat G., Petit S., Thenail C., Brunel E. & Lefeuvre J.C. 1998: Comparative biodiversity along a gradient of agricultural landscapes. *Acta Oecol. 19: 47–60.*

Carroll J.D. 1972: Individual differences and multi-dimensional scaling. In: Shepard R.N., Romney A.K. & Nerlove S.B. (eds.), Multi-dimensional scaling: theory and applications in the behavioral sciences. *Seminar Press, New York: 105–155.*

Chamberlain D.E., Fuller R.J., Bunce R.G.H., Duckworth J.C. & Shrubb M. 2000: Changes in the abundance of farmland birds in relation to the timing of agricultural intensification in England and Wales. *J. Appl. Ecol. 37: 771–788.*

Clarke K.R. & Warwick R.M. 2001: Change in marine communities: an approach to statistical analysis and interpretation, 2nd edition. *PREMIER-E Plymouth, U.K.*

Deák J.Á. 2005: Landscape ecological researches in the Western Marosszög (Hungary). *Acta Climatologica et Chorologica Universitatis Szegediensis 38–39: 33–46.*

Debussche M. & Lepart J. 1992: Establishment of woody plants in Mediterranean old fields: opportunity in space and time. *Landscape Ecol. 6: 133–145.*

Donald P.F., Green R.E. & Heath M.F. 2001: Agricultural intensification and the collapse of Europe's farmland bird populations. *Proc. Roy. Soc. Lond. B 268: 25–29.*

Donald P.F., Pisano G., Rayment M.D. & Pain D.J. 2002: The common agricultural policy, EU enlargement and the conservation of Europe's farmland birds. *Agric. Ecosyst. Environ. 89: 167–182.*

Donald P.F., Sanderson F.J., Burfield I.J. & van Bommel F.P.J. 2006: Further evidence of continent-wide impacts of agricultural intensification of European farmland birds, 1990-2000. *Agric. Ecosyst. Environ. 116: 189–196.*

Flanders A.A., Kuvlesky W.P., Rythven D.C., Zaiglin R.E., Bingham R.L., Fulbright T.E., Hernandez F. & Brennan L.A. 2006: Effects of invasive exotic grasses on South Texas rangeland breeding birds. *Auk: 171–182.*

Fuller R.J. & Gough S.J. 1999: Changes in sheep numbers in Britain: implications for bird populations. *Biol. Conserv. 91: 73–89.*

Fuller R.J., Hinsley S.A. & Swetnam R.D. 2004: The relevance of non-farmland habitats, uncropped areas and habitat diversity to the conservation of farmland birds. *Ibis 146: 22–31.*

Gabriel K.R. 1981: Biplot display of multivariate matrices for inspection of data and diagnosis. In: Barnet V. (ed.), Interpreting multivariate data. *John Wiley and Sons, Inc., London: 147–173.*

Gellrich M. & Zimmermann N.E. 2007: Agricultural land abandonment and natural forest re-growth in Swiss mountains: a spatially explicity economic analysis. *Agric. Ecosyst. Environ. 118: 93–108.*

Gregory R.D., Noble D.G. & Custance J. 2004: The state of play of farmland birds: population trends and conservation status of lowland farmland birds in the United Kingdom. *Ibis 146 (Suppl. 2): 1–13.*

Gregory R.D., Van Strien A., Vorisek P., Gmelig Meyling A.W., Noble D.G., Foppen R.P.B. & Gibbons D.W. 2005: Developing indicators for European birds. *Phil. Trans R. Soc. Lond. B 360: 269–288.*

Grimmet R.F.A. & Jones T.A. 1989: Important bird areas in Europe. *International Council for Bird Preservation.*

Gugić G. 2008: Handbook for habitat mapping and management in Nature Park Lonjsko polje. *Krapje. (in Croatian)*

Gugić G. 2009: Managing sustainability in conditions of change and unpredictability. *The living landscape and floodplain ecosystem of the Central Sava River Basin, Lonjsko Polje Nature Park Public Service.*

Gugić G. 2010: Nature park Lonjsko polje. *Living landscape and alluvial ecosystem of Middle Posavina region, Management plan. (in Croatian)*

Hagemeijer W.J.M. & Blair M.J. 1997: The EBCC atlas of European breeding birds. *T & A.D. Poyser, London.*

Haider S., Alexander J., Dietz H., Trepl L., Edwards P.J. & Kueffer C. 2010: The role of bioclimatic origin, residence time and habitat context in shaping non-native plant distributions along an altitudinal gradient. *Biol. Invasions 12: 4003–4018.*

Heath M.F., Evans M.I., Hoccom D.G., Payne A.J. & Peet N.B. 2000: Important bird areas in Europe: priority sites for conservation. Volume 2: Southern Europe. *BirdLife International, Cambridge, U.K.*

Hole D.G., Whittingham M.J., Bradbury R.B., Anderson G.Q.A., Lee P.L.M., Wilson J.D. & Krebs J.R. 2002: Agriculture: widespread local house-sparrow extinctions. *Nature 418: 931–932.*

Hulina N. 2010: "Planta Hortifuga" in flora of the continental part of Croatia. *Agriculturae Conspectus Scientificus 75: 57–65.*

Iman R.L. 1982: Some aspects of the rank transform in analysis of variance problems. *Proceedings of the 7th Annual SAS Users Group International Conference: 676–680.*

Kati V.I. & Sekercioglu C.H. 2006: Diversity, ecological structure, and conservation of the landbird community of Dadia reserve, Greece. *Divers. Distrib. 12: 620–629.*

Kleijn D. & Sutherland W.J. 2003: How effective are the European argi-environment schemes in conserving and promoting biodiversity? *J. Appl. Ecol. 40: 947–969.*

Liović B. 2003: False indigo (*Amorpha fruticosa* L.) – an invasive plant species in Croatia: control strategies. In: Fosbroke D.E., Sandra L.C. & Gottschalk K.W. (eds.), Department of agriculture, forest service, northeastern research station, 15-18 January 2002, Annapolis, MD. *Gen. Tech. Rep. NE-300. Newtown Square, PA: U.S.: 59.*

Ljubičić I., Britvec M., Jelaska S.D., Salopek Z. & Kutnjak H. 2008: Vegetation dynamics pastures on lithosol of the Island Pag 3. In: Pospišil M. (ed.), *Međunarodni Simpozij Agronoma, Hrvatski i 3, Zagreb: 32–33. (in Croatian)*

Mihály B. & Demeter A. 2003: Invasive alien species in Hungary. *Ministry of Environment and Water, Budapest, Hungary.*

Mužinić J., Vasilik Ž. & Radović A. 2004: Bird checklist of the Sisačka Posavina area, 1881-1998. *Nat. Croat. 13: 81–91.*

Nikolov S.C. 2010: Effects of land abandonment and changing habitat structure on avian assemblages in upland pastures of Bulgaria. *Bird Conserv. Int. 20: 200–213.*

Ostermann O.P. 1998: The need for management of nature conservation sites designated under Natura 2000. *J. Appl. Ecol. 35: 968–973.*

Parks C.G., Radosevich S.R., Endress B.A., Naylor B.J., Anzinger D., Rew L.J., Maxwell B.D. & Dwire K.A. 2005: Natural and land-use history of the Northwest mountain ecoregions (USA) in relation to patterns of plant invasions. *Perspect. Plant Ecol. 7 (3): 137–158.*

Pärt T. & Söderström B. 1999: The effects of management regimes and location in landscape on the conservation of farmland birds breeding in semi-natural pastures. *Biol. Conserv. 90: 113–123.*

Pavel V. 2004: The impact of grazing animals on nesting success of grassland passerines in farmland and natural habitats: a field experiment. *Folia Zool. 53: 171–178.*

Pedashenko H.P., Apostolova I.I. & Vassilev K.V. 2012: *Amorpha fruticosa* invasibility of different habitats in lower Danube. *Phytologia Balcanica 285: 285–291.*

Preiss E., Martin J.-L. & Debussche M. 1997: Rural depopulation and recent landscape changes in a Mediterranean region: consequences to the breeding avifauna. *Landscape Ecol. 12: 51–61.*

Radović A., Fontana-Pudić K., Dolenec Z. & Jelaska S.D. 2012: Detecting habitat changes using MODIS EVI images: a case study of spoonbill *Platalea leucorodia* in Croatia. *Acrocephalus 32: 135–141.*

Radović D., Kralj J., Tutiš V. & Ćiković D. 2003: Red book of threatened birds of Republic of Croatia. *Ministry of Environmental Protection and Physical Planning, Zagreb, Croatia.*

Reif J., Voříšek P., Šťastný K., Bejček V. & Petr J. 2008: Agricultural intensification and farmland birds: new insights from a central European country. *Ibis 150: 596–605.*

Sanderson F.J., Kloch A., Sachanowicz K. & Donald P.F. 2008: Predicting the effects of agricultural change on farmland bird populations in Poland. *Agric. Ecosyst. Environ. (1–3): 37–42.*

Sarateanu V. 2010: Assessing the influence of *Amorpha fruticosa* L. invasive schrub species on some grassland vegetation types from western Romania. *Res. J. Agricultural Sci. 42: 536.*

Schneider L.C. & Geoghegan J. 2006: Land abandonment in an agricultural frontier after a plant invasion: the case of bracken fern in Southern Yucatán, Mexico. *Agriculture and Resource Economics Review: 167–177.*

Schneider-Jacoby M. 1993: Vögel als Indikatoren für das ökologische Potential der Saveauen und Möglichkeiten für deren Erhaltung. *Dissertation an der Universität Konstanz, erschienen 1995, Naturerbe Verlag* Jürgen *Resch, Überlingen.*

Sirami C., Brotons L. & Martin J.L. 2007: Vegetation and songbird response to land abandonment: from landscape to census plot. *Divers. Distrib. 13: 42–52.*

Skórka P., Lenda M. & Tryjanowski P. 2010: Invasive alien goldenrods negatively affect grassland bird communities in Eastern Europe. *Biol. Conserv. 143: 856–861.*

Stanners D. & Bourdeau P. (eds.) 1995: Europe's environment the Dobříš. *Assessment, European Environment Agency, Copenhagen, Denmark: 676.*

Stoate C., Báldi A., Beja P., Boatman N.D., Herzon I., van Doorn A., de Snoo G.R., Rakosy L. & Ramwell C. 2009: Ecological impacts of early 21st century agricultural change in Europe – a review. *J. Environ. Manage. 91: 22–46.*

Suárez-Seoane S., Osborne P.E. & Baudry J. 2002: Responses of birds of different biogeographic origins and habitat requirements to agricultural land abandonment in northern Spain. *Biol. Conserv. 105: 333–344.*

Topić Lj., Ilijanić Lj., Tvrtković N. & Nikolić T. 2006: Habitats – Handbook for inventarisation, mapping and monitoring. *State Institute for Nature Protection, Zagreb, Croatia. (in Croatian)*

Török K., Botta-Dukaát Z., Dancza I., Németh I., Kiss J., Mihály Y.B. & Magyar D. 2003: Invasion gateways and corridors in the Carpathian Basin: biological invasions in Hungary. *Biol. Invasions 5: 349–356.*

Tryjanowski P., Hartel T., Báldi A., Szymanski P., Tobolka M., Herzon I., Golawski A., Konvicka M., Hromada M., Jerzak L., Kujawa K., Lenda M., Orłowski G., Panek M., Skórka P., Sparks T.H., Tworek S. & Zmihorski M. 2011: Conservation of farmland birds faces different challenges in Western and Central-Eastern Europe. *Acta Ornithol. 46: 79–90.*

Tryjanowski P., Kuźniak S., Kujawa K. & Jerzak L. 2009: Ecology of birds in the agricultural landscape. *Bogucki Wydawnictwo Naukowe, Poznań, Poland.*

Tsiakiris R., Stara K., Pantis J. & Sgardelis S. 2009: Microhabitat selection by three common bird species of montane farmlands in northern Greece. *Environ. Manage. 44: 874–887.*

Verhulst J., Báldi A. & Kleijn D. 2004: Relationship between land-use intensity and species richness and abundance of birds in Hungary. *Agric. Ecosyst. Environ. 104: 465–473.*

Wrbka T., Schindler S., Pollheimer M., Schmitzberger I. & Peterseil J. 2008: Impact of the Austrian Agri-Environmental scheme on diversity of landscapes, plants and birds. *Comm. Ecol. 9: 217–227.*

Wretenberg J., Lindström Å., Svensson S. & Pärt T. 2007: Linking agricultural policies to population trends of Swedish farmland birds in different agricultural regions. *J. Appl. Ecol. 44: 933–941.*

Zavagno F. & D'Auria G. 1999: Synecology and dynamics of *Amorpha fruticosa* L. communities in Po plain – Italy. *5th International Conference Ecology of Invasive Alien Plants, La Maddalena, Sardinia, Italy.*

Zingstra H., Kiš A., Ribarić A., Ilijaš I., Jeremić J. & Predić T. (eds.) 2009: The relevance of farmland and farming for the protection of the landscape and biodiversity of the Sava Floodplains. *Final Report of Task C of the EU LIFE TCY 06/INT/246 Project, Wageningen International, the Netherlands: 78.*

Appendix. List of all bird species detected in the research area with notes on habitat usage. Core species are labelled as well as the weights used in pondering importance according to the SPEC status of the species. Ponder values after Pons et al. 2003. Code system: SPEC 0 – European species of no global conservation concerns, species with favourable conservation status in Europe, global population not concentrated in Europe; SPEC 1 – European species of global conservation concern; SPEC 2 – European species of no global conservation concerns, species with unfavourable conservation status in Europe; SPEC 3 – species with favourable conservation status in Europe, global population concentrated in Europe; SPEC 4 – species with favourable conservation status in Europe, global population not concentrated in Europe; parenthesis stands for possible usage, not proved.

Species	Usage of habitats in interest	LABEL	SPEC	Weight	IUCN
Accipiter gentilis	(breeding), foraging		NON_SPEC	1	NO
Acrocephalus palustris	breeding		NON_SPEC	1	NO
Acrocephalus arundinaceus	(breeding)		NON_SPEC	1	NO
Acrocephalus schoenobaenus	breeding	V1	NON_SPEC^{E}	2	NO
Alauda arvensis	breeding	V2	SPEC3	3	NO
Alcedo atthis	(breeding)		SPEC3	3	NO
Anas querquedula	stopover		SPEC3	3	NO
Anthus trivialis	breeding	V3	NON_SPEC	1	NO
Aquila pomarina	(breeding), foraging		SPEC3	3	NO
Ardea cinerea	(breeding), foraging		NON_SPEC	1	NO
Buteo buteo	(breeding), foraging		NON_SPEC	1	NO
Carduelis carduelis	(breeding), foraging	V4	NON_SPEC	1	NO
Carduelis chloris	(breeding), feeding		NON_SPEC^{E}	2	NO
Casmerodius albus	(breeding), foraging		NON_SPEC	1	NO
Chlidonias hybridus	stopover		SPEC3	3	NO
Chlidonias leucopterus	stopover		NON_SPEC	1	NO
Ciconia ciconia	(breeding), foraging		SPEC2	4	NO
Ciconia nigra	(breeding), foraging		SPEC3	3	NO
Circus aeruginosus	(breeding), foraging		NON_SPEC	1	NO
Coccothraustes coccothraustes	(breeding), foraging		NON_SPEC	1	NO
Columba palumbus	(breeding), foraging		NON_SPEC^{E}	2	NO
Corvus corax	(breeding), foraging		NON_SPEC	1	NO
Corvus cornix	(breeding), foraging		NON_SPEC^{E}	2	NO
Coturnix coturnix	breeding		SPEC3	3	NO
Cuculus canorus	(breeding)		NON_SPEC	1	NO
Cygnus olor	(breeding)		NON_SPEC	1	NO
Egretta garzetta	(breeding), foraging		NON_SPEC	1	NO
Emberiza citrinella	(breeding), foraging	V5	NON_SPEC^{E}	2	NO
Erithacus megarhynchos	(breeding), foraging	V6	NON_SPEC^{E}	2	NO
Erithacus rubecula	(breeding), foraging		NON_SPEC^{E}	2	NO
Falco tinnunculus	(breeding), foraging		SPEC3	3	NO
Falco vespertinus	stopover		SPEC3	3	VU
Fringilla coelebs	(breeding)		NON_SPEC	1	NO
Garrulus glandarius	(breeding)		NON_SPEC	1	NO
Hirundo rustica	(breeding), foraging	V7	SPEC3	3	NO
Jynx torquilla	(breeding)		SPEC3	3	NO
Lanius collurio	(breeding), foraging	V8	SPEC3	3	NO
Locustella fluviatilis	breeding	V9	NON_SPEC	1	NO
Locustella luscinioides	breeding	V10	NON_SPEC	1	NO
Locustella naevia	breeding		NON_SPEC	1	NO
Lymnocryptes minimus	stopover		SPEC3	3	NO
Motacilla alba	foraging		NON_SPEC	1	NO
Motacilla flava	(breeding), foraging	V11	NON_SPEC	1	NO
Nycticorax nycticorax	breeding		SPEC3	3	NO
Oriolus oriolus	(breeding)		NON_SPEC	1	NO
Parus major	(breeding)	V12	NON_SPEC	1	NO
Poecile palustris	(breeding)		SPEC3	3	NO
Passer domesticus	(breeding)	V13	SPEC3	3	NO
Passer montanus	(breeding), foraging	V14	SPEC3	3	NO
Phalacrocorax carbo	(breeding), foraging		NON_SPEC	1	NO
Phasianus colchicus	(breeding)	V15	NON_SPEC	1	NO
Phoenicurus ochruros	breeding		NON_SPEC	1	NO
Phylloscopus collybitus	(breeding)		NON_SPEC	1	NO
Phylloscopus sibilatrix	flyover		SPEC2	4	NO

Pica pica	(breeding), feeding		NON_SPEC	1	NO
Saxicola rubetra	breeding	V16	NON_SPEC[E]	1	NO
Saxicola torquatus	breeding	V17	NON_SPEC	1	NO
Streptopelia decaocto	(breeding), foraging	V18	NON_SPEC	1	NO
Streptopelia turtur	(breeding), foraging		SPEC3	3	NO
Sturnus vulgaris	(breeding), foraging	V19	SPEC3	3	NO
Sylvia atricapilla	(breeding)	V20	NON_SPEC	1	NO
Sylvia communis	breeding	V21	NON_SPEC	1	NO
Sylvia nisoria	breeding		NON_SPEC	1	NO
Tachybaptus ruficollis	(breeding)		NON_SPEC	1	NO
Tringa glareola	stopover		SPEC3	3	NO
Turdus merula	(breeding), foraging	V22	NON_SPEC	1	NO
Turdus philomelos	(breeding), foraging	V23	NON_SPEC	1	NO
Vanellus vanellus	breeding	V24	SPEC2	4	VU
Larus ridibundus	(breeding), foraging		SPEC3	3	NO
Larus minutus	flying		SPEC3	3	NO