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Population Trends of Common Birds in Bulgaria: Is Their Status Improving after the EU Accession?

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Abstract: In Europe, many rare birds species or species whose populations are with very local distribution have benefited from special protection under European Union (EU) policy (e.g. Directive 2009/147/EC and the Natura 2000 network), while the populations of many common and widespread species have declined, with the greatest losses reported for farmland birds. Based on monitoring data for the period 2005-2010, we studied the trends in abundance and species richness of common breeding birds in Bulgaria before and after the country joined the EU in 2007. We analysed the trends in birds of farmland, woodland and "other" habitats, and additionally, we tested whether indices of the commonest birds are representative of wider changes in bird populations. At species level (n = 32), significant declines were detected in 11 species (34%), and increases in just two (6%); 19 species (60%) had uncertain trends. There were mean declines of 15% in farmland birds, 5% in woodland birds and 24% in birds of other habitats. Both species richness and total abundance of common birds were higher before the accession of Bulgaria to the EU than after. These trends may be explained by two contrasting processes – agricultural intensification in the plains, and land abandonment in agriculturally less productive mountainous and hilly areas. Conservation measures, delivered through policy governing the management of agricultural land, should be funded adequately and targeted appropriately to stop and reverse the decline in common and widespread birds in Bulgaria.

Key words: Farmland birds, Common Bird Monitoring Scheme, population trends, TRIM

Introduction

In recent years, the European populations of many rare bird species or species whose populations are with very local distribution have benefited from special protection through European Union (EU) policies, most notably the Birds Directive (Directive 2009/147/EC) and the NATURA 2000 network (Donald *et al.* 2007). However, the populations of many common species have continued to decline (PECBMS 2013; Inger *et al.* 2014). The most severe declines have been reported for farmland birds and although the rate of decline appears to have levelled off in the recent years, Europe has lost half of its farmland birds in the last quarter of a century (Vorisek *et al.* 2010; PECBMS 2013). Agricultural intensification has been identified as the main driver of these declines (Donald *et al.* 2001, 2006), with land abandonment having an important role in some regions (Suárez-Seoane *et al.* 2002; Sirami *et al.* 2008). The state of farmland bird populations seems to be regionally dependent and the drivers of changes may differ across Europe (Reif *et al.* 2008a, Tryjanowski *et al.* 2011). Farmland bird populations are reported to be more stable in Central EU countries where more extensive land management is still widespread, compared to Western Europe where agricultural management is, on average, more intensive (e.g. Reif *et al.* 2008a; Báldi & Batáry 2011a,b). Most of the knowledge on farmland bird

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status in Europe comes from the Pan-European Common Bird Monitoring Scheme (PECBMS) which started in 2002. It aimed to pool data from bird monitoring schemes across Europe in order to produce continent-wide species trends and enable the development of indicators to reflect the wider state of nature across Europe. Although the number of countries actively contributing to the PECBMS data set has increased (to 27 countries by 2013), only three of them (Bulgaria, Greece and Romania) are from South-eastern Europe (PECBMS 2013).

Most South-eastern European countries have similar recent agricultural history (Csáki 1992). Before World War II agricultural land was managed extensively in small privately-owned parcels, characterised by high level of landscape heterogeneity and low levels of chemical treatment. Subsequently, under communist regimes private farms were transformed to state agricultural complexes; mosaics of small heterogeneous parcels were replaced by monoculture and extensive land management was replaced with intensive agriculture with high levels of mechanisation and chemical use. After the fall of communist regimes in the 1990s, land was returned to the original owners. However, most of the population had lost their capacity to cultivate the land and rear livestock and, together with the financial crisis following the change in political regimes, this caused a high rate of land abandonment (Dudwick *et al.* 2007). Land abandonment has been proven to have strong negative effects on common bird diversity on the Balkans (Nikolov 2010; Zakkak *et al.* 2013, 2015; Mikulić *et al.* 2014). The countries that joined the EU after 2000 have implemented its Common Agricultural Policy, via national Rural Development Programmes, and hence have adopted notable changes in farming policies. These have led to farming intensification, raising concerns of adverse impacts on farmland biodiversity (Dobrev *et al.* 2014). Agri-environment programmes have been developed, intending to encourage sustainable land use and biodiversity conservation alongside modern agricultural practices. However, still little is known on the effects of EU agricultural policies on the status of common birds in the recently-acceded EU member states. Therefore, the trends of common bird populations in South-eastern Europe are of considerable interest: will the large declines witnessed in the older EU member states be repeated in the newer members?

Based on national monitoring data for the period 2005-2010, the present study aims to investigate trends of common birds in Bulgaria before and after the country joined the EU in 2007. Additionally, we tested how patterns of change vary between major habitat types. This knowledge could inform national and EU policies on how to improve the conservation of common birds in South-eastern Europe, and may be of particular relevance for EU candidate or potential candidate countries from the region.

Materials and Methods

Bird monitoring

Bird data were collected by volunteer participants through the National Common Bird Monitoring scheme in Bulgaria during the period 2005-2010. Bird sampling followed the best practices guide for wild bird monitoring schemes (Voříšek *et al.* 2008) and was based on line-transects (Bibby *et al.* 2000) located within 1x1 km UTM sampling plots (n = 155; Fig. 1). The locations of sampling plots were identified through stratified random sampling: the country was divided into different regions; volunteers were allocated a sampling plot selected at random from all within a chosen region. In each sampling plot, two one-km line transects were established running in an east-west or north-south direction with a distance between them of 500 m wherever possible but no less than 200 m. All birds seen or heard while walking along the two line transects were counted, producing a plot total for each species. Visits were made twice per year by the same observer in the morning (6:00 – 11:00 AM) for the period 15th of April – 15th of June with approximately 30 days interval between visits; to boost sample size we have also used data from plots where only one visit was made.

Data analysis

Counts of adult birds were used in analyses, with the higher of the two visits made in each sample plot being used in trend analyses for each species. Unreliable data (due to observer error in either identification or counts of species) were identified by unlikely absence of abundant species, or conversely infeasibly high counts of rare species, and were excluded from the analyses. Data were used only from sampling plots that were surveyed at least three years in the study period or consecutively in the last two years. Population trend indices were derived from abundance data for all bird species by fitting log-linear models in the TRIM 3.53 software (Pannekoek & Van Strien 2001), with counts modelled as a function of site (sampling plot) and year effects, and accounting for overdispersion and serial correlation. We calculated annual index values, with a baseline of 1 in 2005, and a single slope estimate for the 2005-2010 period, for each species. These population trends

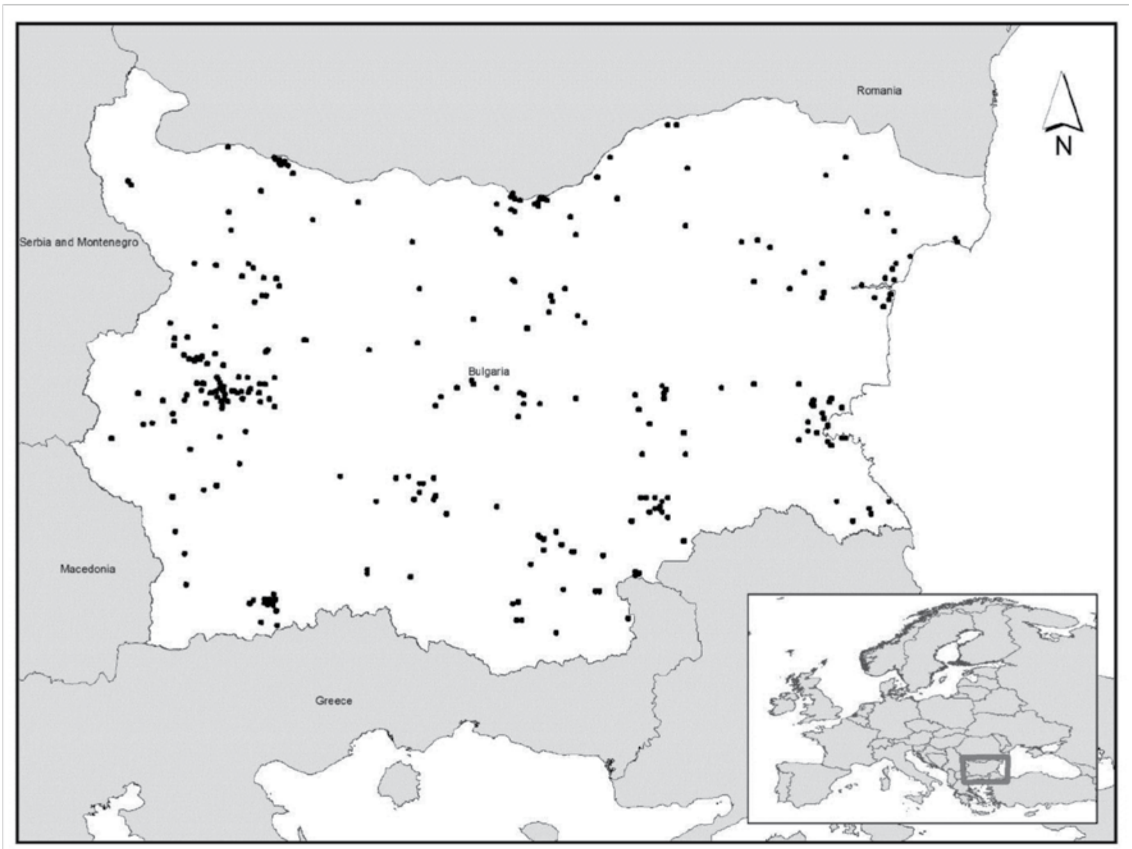

Fig. 1. Distribution of the 1 x 1 km sampling plots (n = 155) surveyed by the National Common Bird Monitoring scheme in Bulgaria during the period 2005-2010

were categorised following Gregory et al. (2007) using criteria based on slope and 95% confidence intervals (CI), as follows: strong increase (lower 95% CI > 1.05); moderate increase (1.00 < lower 95% CI < 1.05); stable (95% CI's enclose 1.00 but lower 95% CI > 0.95 and upper 95% CI < 1.05); moderate decline (0.95 < upper 95% CI < 1.00); strong decline (upper 95% CI < 0.95) Trends that did not fall into these categories were defined as uncertain, and direction of trend noted.

We identified 32 species as 'common' on account of being recorded in at least 60 (ca. 40%) of the studied sample plots. These were grouped as birds of farmland (ten species), woodland (nine species) and other habitats (including those inhabiting urban and scrubby territories and generalists utilising more than one habitat; 13 species) according to their habitat use in Bulgaria (Iankov 2007). Colonial species, diurnal and nocturnal raptors and water birds were excluded from the analysis. To obtain an overall Common Bird Index (CBI) we followed standard protocols employed for wild bird indicators e.g. for Europe (Gregory *et al.* 2005), calculating the average index value (baselined to a value of 100 in 2005) across all 32 species using the geometric mean (Van Strien *et al.* 2001). In addition, we calculated indices for farmland birds (FBI); woodland birds (WBI), and birds of other habitats (OBI).

To evaluate if the CBI represented changes in overall abundance and species richness in the wider bird community, we analysed data for all bird species (n = 212 species) recorded during the CBM survey for the period 2005-2010 based on year-to-year and before-after joining the EU comparisons. As data were not normally distributed and did not approach the normal distribution after transformation, non-parametric tests were applied, computed in STATISTICA 7.0 (StatSoft 2004).

Results

Significant decline was observed in 11 (34%) of the 32 common bird species and increase in two (6%; Table 1). The remaining 19 species (59%) showed an uncertain trend; within this group nine (28%) showed a non-significant increase, nine (28%) a non-significant decrease and one species (3%) a non-significant stable trend.

We found a short-term positive shift in the CBI after Bulgaria joined the EU but the overall trend was negative (Fig. 2a), and the same was valid for the trends at group level (Fig. 2b). For the studied period, the overall decline of FBI was 15%, 5% in the WBI and 24% in the OBI.

The overall CBI correlated strongly with the FBI (Spearman Rank Correlation: r_s=0.93, p<0.05) but not with OBI (r_s=0.75, n.s.) and WBI (r_s=0.14, n.s.). The mean abundance of birds per sample declined over the years (Table 2, Fig. 3) but there was no significant trend in species richness (Table 2). Both abundance and species richness were lower after Bulgaria joining the EU (Table 2, Fig. 4). Analysed by groups, there was a significant decrease in abundance and species richness per sampling plot over the study period and after joining the EU in both farmland and other birds (Figs. 5 & 6), but not for woodland birds (Table 2).

Discussion

The present study provides the first quantitative data on population trends of the most widespread and numerous breeding bird species in Bulgaria, based on systematic sampling under the national Common Bird Monitoring Scheme. Although the relatively short time series means that trends in some species are as yet uncertain, more than 30% of the 32 commonest bird species reported declined between 2005 and 2010, including some of the most abundant and widespread bird species in the country (Iankov 2007). Some of these species (Eurasian skylark *Alauda arvensis*, common starling *Sturnus vulgaris*, corn bunting *Miliaria calandra* and house sparrow *Passer domesticus*) have shown declines across Europe, while others had more favourable trends with stable (red-backed shrike *Lanius collurio*) or even increasing (hooded crow *Corvus cornix*) populations at European scale (PECBMS 2013). These discrepancies, which could be due to regional and socio-economic differences in environmental conditions impacting bird populations (Báldi & Batáry 2011b), notwithstanding the overall negative trend that we found in the Bulgarian CBI, were in agreement with that of common bird populations throughout Europe since 1980 (PECBMS 2013).

At group level, our results showed negative trends in birds of farmland and other habitats, while the woodland bird index was approximately stable. Forest birds in other parts of Europe have been found to decline with much lower rates than farmland birds (Gregory *et a*l. 2005, 2007; Reif *et al*. 2008b) probably due to the less intensive anthropogenic disturbance of forest habitats compared to agricultural systems. Other potential factors that could play a role could be different migration strategies (Berthold *et al.* 1998; Sanderson *et al.* 2006; Vickery *et al.* 2014) and predation rates (Tryjanowski 2000; Tryjanowski *et al.* 2002) in these habitats. Indeed, the decline of common birds has been discussed principally with regard to farmland birds (PECBMS 2013) considering that agricultural land covers almost half the European land area (Eurostat 2012) and represents a major breeding habitat for a quarter of the European avifauna (Schifferli 2000). The intensification in agricultural management in Europe in recent decades has changed rural landscapes significantly and decreased the quality of farmland habitats for birds (Donald *et al.* 2001; Guerrero *et al.* 2011) for example by

Table 1. Mean species population trends per sample plot. Legend: FB – farmland birds; WB – woodland birds; OB – other birds; significant trends are shown as ↓↓ - strong decline; ↓ - moderate decline; ↑↑ - strong increase; ↑- moderate increase; S – stable; non-significant trends use the same symbols in parentheses; * p < 0.05, ** p < 0.01

No	Group	Species	Trend	Overall slope (± SE)
1	FB	*Coturnix coturnix*	↓	0.89 ± 0.04 **
2	FB	*Galerida cristata*	(↑↑)	1.06 ± 0.06 ns
3	FB	*Alauda arvensis*	↓	0.96 ± 0.02 *
4	FB	*Motacilla flava*	(↓)	0.97 ± 0.03 ns
5	FB	*Sylvia communis*	↑↑	1.19 ± 0.04 **
6	FB	*Lanius collurio*	↓↓	0.91 ± 0.02 *
7	FB	*Sturnus vulgaris*	↓	0.92 ± 0.02 **
8	FB	*Emberiza hortulana*	(↑)	1.04 ± 0.04 ns
9	FB	*Emberiza melanocephala*	↓	0.92 ± 0.03 **
10	FB	*Miliaria calandra*	↓	0.94 ± 0.02 **
11	WB	*Columba palumbus*	↑↑	1.26 ± 0.09 **
12	WB	*Dendrocopos major*	(↑)	1.01 ± 0.04 ns
13	WB	*Erithacus rubecula*	(↑)	1.02 ± 0.04 ns
14	WB	*Fringilla coelebs*	(↑)	1.01 ± 0.02 ns
15	WB	*Garrulus glandarius*	↓	0.93 ± 0.03 *
16	WB	*Oriolus oriolus*	↓	0.96 ± 0.02 *
17	WB	*Parus major*	(↑)	1.02 ± 0.02 ns
18	WB	*Sylvia atricapilla*	(↓)	0.96 ± 0.04 ns
19	WB	*Turdus philomelos*	(↑)	1.02 ± 0.05 ns
20	OB	*Cuculus canorus*	(↑)	1.02 ± 0.03 ns
21	OB	*Carduelis carduelis*	(↓)	0.99 ± 0.03 ns
22	OB	*Carduelis chloris*	(↑)	1.05 ± 0.04 ns
23	OB	*Corvus cornix*	↓↓	0.80 ± 0.03 **
24	OB	*Dendrocopos syriacus*	↓	0.87 ± 0.05 **
25	OB	*Luscinia megarhynchos*	(S)	0.99 ± 0.02 ns
26	OB	*Passer domesticus*	↓↓	0.90 ± 0.02 *
27	OB	*Passer montanus*	(↓↓)	0.94 ± 0.04 ns
28	OB	*Pica pica*	(↓)	0.97 ± 0.02 ns
29	OB	*Streptopelia decaocto*	(↓↓)	0.94 ± 0.04 ns
30	OB	*Streptopelia turtur*	(↓↓)	0.94 ± 0.03 ns
31	OB	*Upupa epops*	(↓)	0.95 ± 0.04 ns
32	OB	*Turdus merula*	(↓)	0.98 ± 0.02 ns

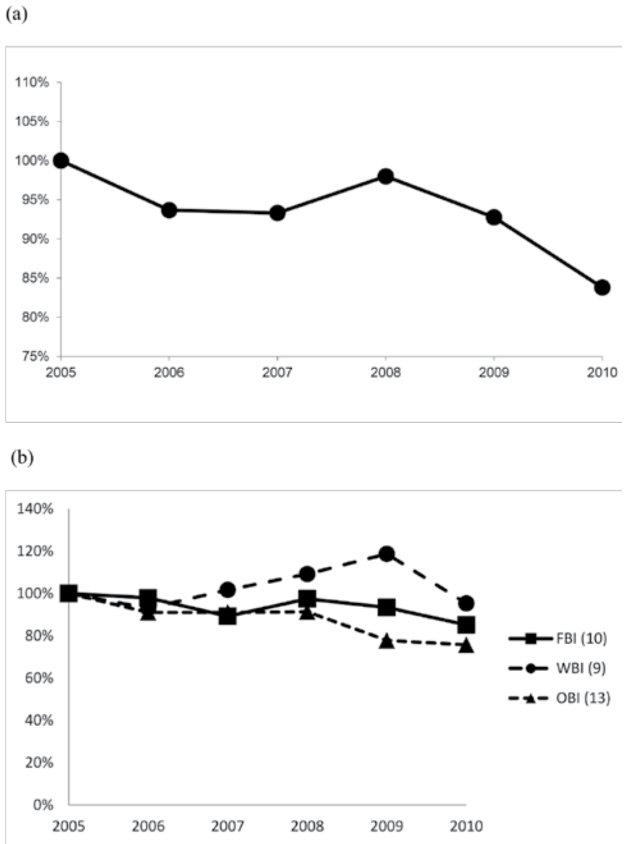

Fig. 2. Common bird indices for the period 2005-2010 in Bulgaria (a) for all common birds, and (b) separately for farmland birds (FBI), woodland birds (WBI) and other birds (OBI). Numbers in parentheses are the numbers of species in each index

reducing structural heterogeneity and availability of food and nest sites (Schifferli 2000). While modern agriculture is recognised as a major anthropogenic threat to avian diversity in Western Europe (Donald *et al*. 2001, 2006), agricultural abandonment of less productive areas is considered a serious threat to farmland bird diversity in Central (Reif *et al.* 2008a; Báldi & Batáry 2011b; Sanderson *et al.* 2013) and Eastern Europe (Nikolov 2010; Radović *et al*. 2013; Zakkak *et al.* 2013, 2015). Land abandonment results in secondary succession by shrub and forest encroachment (Farina 1997; Sirami *et al.* 2007, 2008), which have a strong negative impact on birds tied to grassland habitats (Verhulst *et al.* 2004; Reif *et al.* 2013) by altering their breeding sites, reducing food supply and increasing predation pressure (Fuller & Gough 1999). It is very probable that the decline we found in species richness and abundance of birds in agricultural lands in Bulgaria is a result from these two inherently conflicting processes: agricultural intensification and farmland abandonment. The intensification of farmland management in the country is related mostly to conversion of vast areas of semi-natural grasslands to arable lands, removal of shrubs and trees from pastures and meadows (Nikolov *et al*. 2014) and the high and improper input of pesticides (Gradinarov & Difova 2014). All these practices have been shown to have detrimental effects on farmland bird diversity, mainly in relation to grassland specialists (e.g. Eurasian skylark) and birds associated with shrubs (e.g. red-backed shrike, corn bunting and ortolan bunting *Emberiza hortulana*, see Nikolov 2010; Nikolov *et al.* 2011). Conversely, agricultural land abandonment, occurring mainly in less productive mountainous and hilly areas of Bulgaria, is known to impact on grassland specialists that decrease in species richness, diversity and abundance along the succession gradient (Dyulgerova *et al*. 2015).

We also found that the negative trend of farmland birds persisted at similar rate after the accession of Bulgaria to the EU in 2007. Such results were observed in other EU member states (e.g. the Czech Republic, Hungary and Poland) where farmland bird populations were recorded declining since the mid-1990s, with the negative trend continuing at a similar or even faster rate following accession (Voříšek *et al*. 2010; Szép *et al*. 2012; Sanderson *et al*. 2013). There are different mechanisms for conservation of avian diversity at EU level. For agricultural landscapes, agri-environmental schemes (AES) are considered the most important conservation tool implemented under the Common Agricultural Policy (CAP). However, AES are not always as effective as

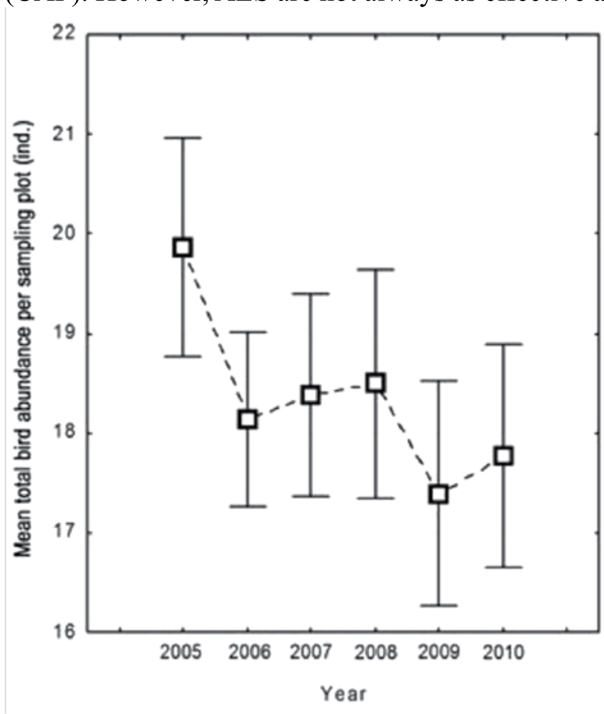

Fig. 3. Mean overall bird abundance per study plot for the period 2005-2010. Error bars show 95% CIs

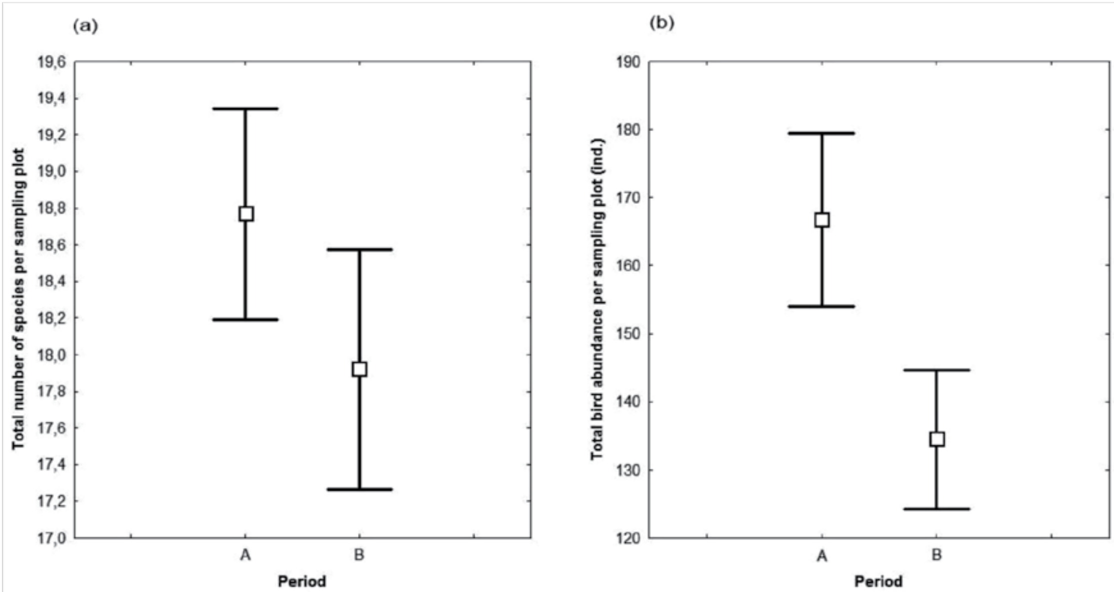

Fig. 4. Mean species richness (a) and abundance (b) of birds before (A) and after (B) Bulgaria's accession to the EU. Error bars show 95% CIs

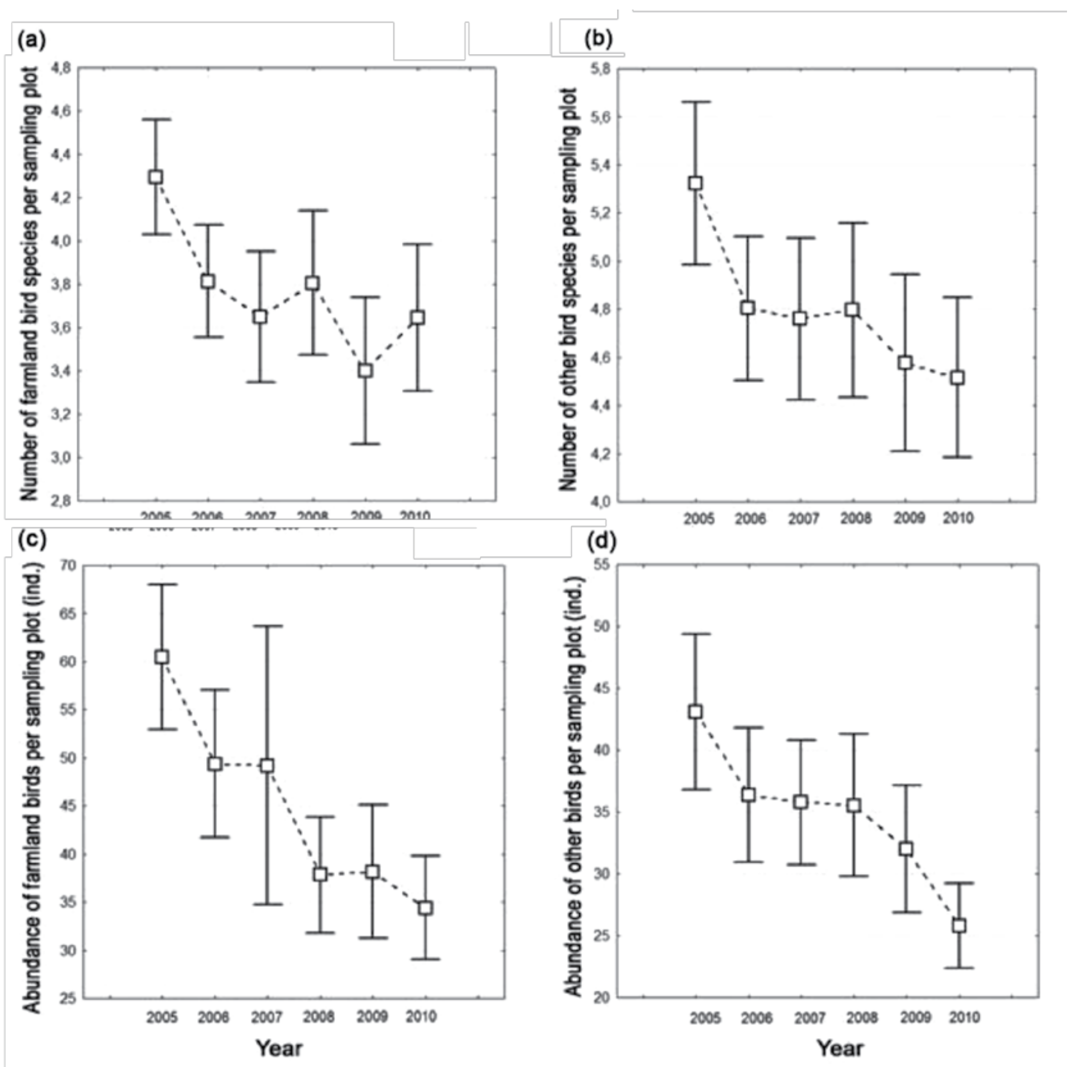

Fig. 5. Mean species richness and abundance of farmland (a, c) and other birds (b, d) per sampling plot over the study period. Error bars show 95% CIs

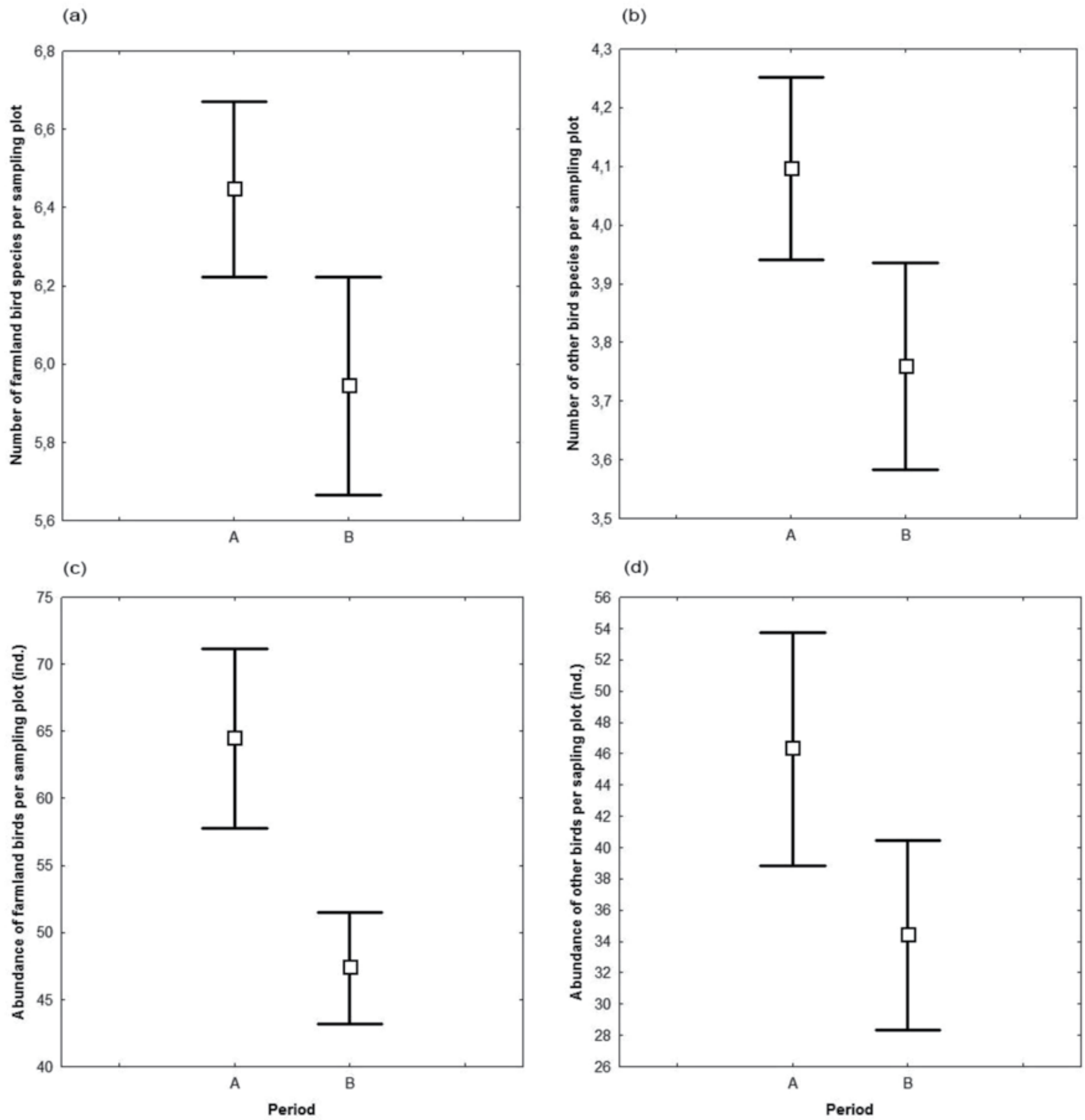

Fig. 6. Mean species richness and abundance of farmland (a, c) and other birds (b, d) per sampling plot before (A) and after (B) Bulgarian's accession to the EU. Error bars show 95% CIs

Table 2. Comparisons of species richness and abundance of common birds in Bulgaria between years (2005-2010) by use of Kruskal-Wallis test (H) and before/after joining the EU by use of Mann-Whitney U test (Z). *:p<0.05, **:p<0.01, ***:p<0.001, *ns*: p>0.05

Parameter	Bird indices	H	Z
Number of species	All species	10.43 ns	- 2.07*
	FBI	18.94 **	- 2.38 *
	WBI	2.66 ns	0.86 ns
	OBI	13.62 *	- 2.30 *
Bird abundance	All species	30.45 ***	- 4.40 ***
	FBI	50.24 ***	- 5.52 ***
	WBI	5.23 ns	1.37 ns
	OBI	11.08 *	- 2.13 *

expected (Kleijn & Sutherland 2003; Kleijn *et al*. 2004; Wrbka *et al*. 2008), and sometimes even not effective at all, especially in new member states where AES have often been implemented without regional adaptation (Tryjanowski *et al*. 2011; Sutcliffe *et al*. 2015), which is the case in Bulgaria (Nikolov 2010; Nikolov *et al*. 2011). Indeed, in some instances land management under CAP has been demonstrated to result in serious loss and fragmentation of grassland habitats protected under Habitat Directive (Directive 92/43/EEC) and as a consequence harming important biodiversity, including birds included in Annex 1 of Bird Directive (Directive 2009/147/EC; see Dobrev *et al.* 2014).

The consistent negative trend in the populations of birds of 'other' habitats could be explained by a range of factors, as these species exhibit a wide range of habitat preferences. However, many of the species in this group could be influenced by changes in farmland or areas influenced by agricultural activities, such as linear structures of trees, bushes and grassland between the farming land plots (Iankov 2007; Ivanov 2011). Thus, to some extent this group of birds may be vulnerable to the same factors causing declines in farmland bird populations.

In conclusion, considering that farmland birds are regarded as a useful surrogate for trends in other elements of biodiversity in agricultural lands (Gregory *et al*. 2005), initial indications from Bulgaria raise concerns about the long-term conservation of biodiversity in agricultural lands in the context of recent EU member state accession. Further work to identify and study the drivers of decline in farmland birds and other common and widespread bird species in Bulgaria is needed urgently in order to inform adequate conservation efforts in relation to the national Agri-environmental Programme and the Rural Development Programme for the current programme period (2014-2020). This should include management measures for Natura 2000 Special Protection Areas (Nikolov *et al.* 2014) that were designated for protection of widespread species with unfavourable conservation status, listed in Annex I of Directive 2009/147/EC. Recognising the impacts of intensive agricultural practices on common bird populations, and identifying how to mitigate the harmful impacts of such land management, is essential for future improvements in favour of avian diversity.

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References

Báldi, A. & Batáry, P. 2011a. The past and future of farmland birds in Hungary. – *Bird Study,* **58**: 365-377.

Báldi, A. & Batáry, P. 2011b. Spatial heterogeneity and farmland birds: different perspectives in Western and Eastern Europe. – *Ibis,* **153**: 875-876.

Bibby, C. J., Burgess, N. D., Hill, D. A. & Mustoe, S.H. 2000. Bird census techniques, 2nd edn. London, UK (Academic Press).

Berthold, P., Fiedler, W., Schlenker, R. & Querner, U. 1998. 25-year study of the population development of Central European songbirds: a general decline, most evident in long-distance migrants. – *Naturwissenschaften,* **85**: 350-353.

Csáki, C. 1992. Transformation of agriculture in Central Eastern Europe and the former USSR. Major policy issues and perspectives. WPS 888, Agriculture and Rural Development Department and Country Economics Department (The World Bank).

Dobrev, V., Popgeorgiev, G. & Plachiyski, D. 2014. Effects of the Common Agricultural Policy on the coverage of grassland habitats in Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria. – *Acta Zoologica Bulgarica,* **Suppl. 5**: 147-155.

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

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. – *Agriculture, Ecosystems and Environment,* **116**: 189-196.

Donald, P. F., Sanderson, F. J., Burfield, I. J., Bierman, S. M., Gregory, R. D. & Waliczky, Z. 2007. International conservation policy delivers benefits for birds in Europe. – *Science,* **317**(5839): 810-813.

Dudwick, N., Fock, K. & Sedik, D. J. 2007. Land reform and farm restructuring in transition countries. The experience of Bulgaria, Moldova, Azerbaijan, and Kazakhstan. Washington DC (World Bank).

Dyulgerova, S., Gramatikov, M., Pedashenko, H., Vassilev, K., Kati, V. & Nikolov, S. C. 2015. Farmland Birds and Agricultural Land Abandonment: Evidences from Bulgaria. – *Acta Zoologica Bulgarica,* 67(2): 223-234.

Eurostat 2012. http://ec.europa.eu/eurostat/web/lucas/statistics-illustrated (Accessed on 02.1.2015)

Farina, A. 1997. Landscape structure and breeding bird distribution in a sub-Mediterranean agro-ecosystem. – *Landscape Ecology,* **12**: 365-378.

Fuller, R. J. & Gough, S. J. 1999. Changes in sheep numbers in Britain: implications for bird populations. – *Biological Conservation,* **91**: 73-89.

Gradinarov, D. & Difova, E. 2014. Use of pesticides, chemicals and poisons in the region of Rusenski Lom Nature Park (Lomovete SPA). Case study report under action A3 of the LIFE+ project "The Return of the Neophron" (LIFE10 NAT/BG/000152). Sofia (BSPB),. 16 p. (Available at: http://lifeneophron.eu/files/docs/1421154627_520.pdf

Gregory, R. D., van Strien, A., Vorisek, P., Meyling, A. W. G., 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.

Gregory, R. D., Vorisek, P., van Strien, A., Meyling, A. W. G., Jiguet, F., Fornasari, L., Reif, J., Chylarecki, P. & Burfield, I. J. 2007. Population trend of wide spread woodland birds in Europe. – *Ibis*, **149 (Suppl. 2)**: 78-97.

Guerrero, I., Morales, M. B., Oñate, J. J., Aavik, T., Bengtsson, J., Berendse, F., Clement, L. W., Dennis, C., Eggers, S., Emmerson, M., Fischer, C., Flohre, A., Geiger, F., Hawro, V., Inchausti, P., Kalamees, A., Kinks, R., Liira, J., Meléndez, L., Pärt, T., Thies, C., Tscharntke, T., Olszewski, A. & Weisser, W. W. 2011. Taxonomic and functional diversity of farmland bird communities across Europe: effects of biogeography and agricultural intensification. – *Biodiversity and Conservation*, **20**: 3663-3681.

Iankov, P. (ed.) 2007. Atlas of Breeding Birds in Bulgaria. Bulgarian Society of the Protection of Birds, Conservation Series, Book 10. Sofia (BSPB).

Inger, R., Gregory, R., Duffy, J. P., Stolt, I., Vorisek, P. & Gaston, K.J. 2014. Common European birds are declining rapidly while less abundant species' numbers are rising. – *Ecology Letters,* **18**: 28-36.

Ivanov, B. 2011. Fauna of Bulgaria. Aves. Part 3. Sofia (Prof. M. Drinov). (In Bulgarian).

Kleijn, D. & Sutherland, W. J. 2003. How effective are European agri-environment schemes in conserving and promoting biodiversity? – *Journal of Applied Ecology,* **40**: 947-969.

Kleijn, D., Berendse, F., Smit, R., Gilissen, N., Smit, J., Brak, B. & Groeneveld, R. 2004. The ecological effectiveness of agri-environment schemes in different agricultural landscapes in the Netherlands. – *Conservation Biology,* **18**: 775-786.

Mikulić, K., Radović, A., Kati, V., Jelanska, S. D. & Tepić, N. 2014. Effects of land abandonment on bird communities of smallholder farming landscapes in post-war Croatia: implications for conservation policies. – *Community Ecology*, **15**(2): 169-179.

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

Nikolov, S. C., Demerdzhiev, D. A., Popgeorgiev, G. S. & Plachiyski, D. G. 2011. Bird community patterns in sub–Mediterranean pastures: the effects of shrub cover and grazing intensity. – *Animal Biodiversity and Conservation,* **34**(1): 11-21.

Nikolov, S. C., Kornilev, Y., Popgeorgiev, G., Stoychev, S. & Georgiev, B. B. 2014. Challenges for habitat and species conservation in the Natura 2000 network, Bulgaria: an overview from two Special Protection Areas. – *Acta Zoologica Bulgarica*, **Suppl. 5**: 3-8.

PECBMS 2013. Population Trends of Common European Breeding Birds 2013. Prague (CSO).

Pannekoek, J. & Van Strien, A. J. 2001. TRIM 3 Manual. TRends and Indices for Monitoring Data. Research paper No. 0102. Voorburg, The Netherlands (Statistics Netherlands).

Radović, A., Nikolov, S. C., Tepić, N., Mikulić, K., Jelaska, S. D. & Budinski, I. 2013. The influence of land abandonment on farmland bird communities: a case study from a floodplain landscape in Continental Croatia. – *Folia Zoologica*, **62** (4): 269-281.

Reif, J., Marhoul, P. & Koptík, J. 2013. Bird communities in habitats along a successional gradient: Divergent patterns of species richness, specialization and threat. – *Basic and Applied Ecology*, **14**: 423-431.

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

Reif, J., Storch, D., Voříšek, P., Šťastný, K. & Bejček, V. 2008b. Bird-habitat associations predict population trends in central European forest and farmland birds. – *Biodiversity and Conservation,* **17**: 3307-3319.

Sanderson, F. J., Donald, P. F., Pain, D. J., Burfield, I. J. & Van Bommel, F. P. J. 2006. Long-term population declines in Afro-Palearctic migrant birds. – *Biological Conservation,* **131**: 93-105.

Sanderson, F. J., Kucharz, M., Jobda, M. & Donald, P. F. 2013. Impacts of agricultural intensification and abandonment on farmland birds in Poland following EU accession. – *Agriculture, Ecosystems and Environment*, **168**:16-24.

Schifferli, L. 2000. Changes in agriculture and the status of birds breeding in European farmland. In: Aebischer N. J., A. D. Evans, P. V. Grice and J.A. Vickery (eds) Ecology and conservation of low land farmland birds. Proceedings of the British Ornithologist's Union conference 1999., Tring (British Ornithologist's Union). pp 17-25.

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

Sirami, C., Brotons, L., Burfield, I., Fonerflick, J. & Martin, J.-L. 2008. Is land abandonment having impact on biodiversity? A meta-analytical approach to bird distribution changes in the north-western Mediterranean. – *Biological Conservation,* **141**: 450-459.

StatSoft (2004) STATISTICA 7.0. Data analysis software. StatSoft Inc.,Tulsa, USA: http://www.statsoft.com/

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. – *Biological Conservation,* **105**: 333-344.

Sutcliffe, L. M. E., Batáry, P., Kormann, U., Báldi, A., Dicks, L. V., Herzon, I., Kleijn, D., Tryjanowski, P., Apostolova, I., Arlettaz, R., Aunins, A., Aviron, S., Baležentiene, L., Fischer, C., Halada, L., Hartel, T., Helm, A., Hristov, I., Jelaska, S. D., Kaligarič, M., Kamp, J., Klimek, S., Koorberg, P., Kostiuková, J., Kovács-Hostyánszki, A., Kuemmerle, T., Leuschner, C., Lindborg, R., Loos, J., Maccherini, S., Marja, R., Máthé, O., Paulini, I., Proença, V., Rey-Benayas, J., Sans, F. X., Seifert, C., Stalenga, J., Timaeus, J., Török, P., van Swaay, C., Viik, E. & Tscharntke, T. 2015. Harnessing the biodiversity value of Central and Eastern European farmland. – *Diversity and Distributions,* **21**(6): 722-730.

Szép, T., Nagy, K., Nagy, K. & G. Halmos 2012. Population trends of common breeding and wintering birds in Hungary, decline of long-distance migrant and farmland birds during 1999–2012. – *Ornis Hungarica,* **20**(2): 13-63.

Tryjanowski, P. 2000. Changes in breeding populations of some farmland birds in W Poland in relation to changes in crop structure, weather conditions and number of predators. – *Folia zoologica,* **49**: 305-315.

Tryjanowski, P., Gołdyn, B. & Surmacki, A. 2002. Influence of the red fox (*Vulpes vulpes*) on distribution and number of breeding birds in an intensively used farmland. – *Ecological Research,* **17**: 395-399.

Tryjanowski, P., Hartel, T., Báldi, A., Szymański, P., Tobolka, M., Herzon, I., Goławski, A., Konvička, M., Hromada, M., Jerzak, L., Kujawa, K., Lenda, M., Orłowski, M., Panek, M., Skórka, P., Sparks, T. H., Tworek, S., Wuczyński, A. & Żmihorski, M. 2011. Conservation of farmland birds faces different challenges in Western and Central-Eastern Europe. – *Acta Ornithologica,* **46**: 1-12.

Van Strien, A. J., Pannekoek, J. & Gibbons, D. W. 2001. Indexing European bird population trends using results of national monitoring schemes: a trial of a new method. – *Bird Study*, **48**: 200-213.

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

Vickery, J. A., Ewing, S. R., Smith, K. W., Pain, D. J., Bairlein, F., Jbkorpilova, J. & Gregory, R. D. 2014. The decline of Afro-Palearctic migrants and an assessment of potential causes. – *Ibis,* **156**:1-22.

Voříšek, P., Klavaňová, A., Wotton, S. & Gregory, R. D. (Eds.) 2008. A best practice guide for wild bird monitoring schemes. Czech Republic (CSO/RSPB).

Voříšek, P., Jiguet, F., van Strien, A., Skorpilová, J., Klvănová, A. & Gregory, R. D. 2010. Trends in abundance and biomass of widespread European farmland birds: how much have we lost. BOU Online Proceedings: Lowland Farmland Birds III. http://www.bou.org.uk

Wrbka, T., Schindler, S., Pollheimer, M., Schmitzberger, I. & Peterseil, J. 2008. Impact of the Austrian agri-environmental scheme on diversity of landscape, plants and birds. – *Community Ecology,* **9**: 217-227.

Zakkak, S., Kakalis, E., Radović, A., Halley, J. M. & Kati, V. 2013. The impact of forest encroachment after agricultural land abandonment on passerine bird communities: The case of Greece. – *Journal for Nature Conservation,* **22**(2): 157-165.

Zakkak, S., Radović, A., Nikolov, S. C., Shumka, S., Kakalis, E. & Kati, V. 2015. Assessing the effect of agricultural land abandonment on bird communities in southern-eastern Europe. – *Journal of Environmental Management,* **164**: 171-179.

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