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Farmland Birds and Agricultural Land Abandonment: Evidences from Bulgaria

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Abstract: Farmland birds are reported to decrease strongly in numbers throughout Europe over the last 30 years. Agricultural land abandonment is considered amongst the main drivers for the negative population trends. This process has been studied widely in Western Europe but the evidence for Central and Eastern Europe is limited. We examined the differences in the bird community structure among several secondary succession stages after land abandonment (since the 1940s) in central Bulgaria. Our results demonstrated that avian species richness and diversity decreased with the secondary succession, while no significant difference in the overall bird abundance was observed. The shifts in bird community pattern were mainly related to grassland specialists, which decreased in species richness, diversity and abundance along the succession gradient. Birds of European Conservation Concern were also negatively affected by the woody vegetation overgrowth. We think that in order to stop and reverse the loss of farmland bird diversity in the low-productive mountainous regions of Bulgaria, the rural sustainable development should be reinforced by implementation of agri-environmental and other policy measures that encourage effectively small-scale extensive farming.

Keywords: Agricultural management, common agricultural policy, farmland biodiversity, secondary succession

Introduction

Over the last 30 years, most of the farmland birds have declined in Europe (PECBMS 2013). Land abandonment and agricultural intensification are considered the main drivers for the negative trends in the farmland bird populations (Henle *et al.* 2008, Stoate *et al.* 2009, Butler *et al.* 2010). While agricultural intensification is considered a more serious problem in Western Europe (Donald *et al.* 2001, 2006, Benton *et al.* 2002, Báldi, Batáry 2011a), land abandonment is of main concern in Central and Eastern Europe (Reif *et al.* 2008, Nikolov 2010, Sanderson *et al.* 2013, Radović *et al.* 2013, Zakkak *et al.* 2014). After the fall of the communist regimes in 1990, most of the countries in the region passed through a period of major market reforms. In Bulgaria, this process caused economic and agricultural crisis, which in turn led to high levels of depopulation and agricultural land abandonment in the regions, where agriculture was the main occupation. Both livestock breeding and crop production were affected, especially in the mountain regions, where the abandonment process locally began even earlier (in the 1970s). This affected farmland bird populations, which were reported to decline, even

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when some of the Eastern European countries joined the European Union (EU) and implemented agricultural eco-friendly reforms (Reif *et al.* 2008, Báldi, Batáry 2011b, Sanderson *et al.* 2013).

Land abandonment fosters secondary succession and allows regeneration of the native shrubland and woodland vegetation, which results in loss and fragmentation of the open habitats at the landscape scale (Farina1997, Sirami *et al.* 2007, 2008). These changes in vegetation structure lead to alterations in the availability of breeding sites and food supply for birds as well as in predation pressure (Fuller, Gough 1999). The mentioned changes are beneficial for shrubland and woodland birds but negative for grassland specialists (Pons *et al.* 2003, Verhulst *et al.* 2004, Reif *et al.* 2013). However, there is evidence that the biogeographic origin of the avifauna may determine whether land abandonment brings conservation benefits or detriments (Suárez–Seoane *et al.* 2002). Some studies in Central Europe demonstrated higher bird species richness in abandoned habitats compared to managed habitats (Laiolo *et al.* 2004, Verhulst *et al.* 2004, Reif *et al.* 2013). In Eastern Europe the processes that occur in bird assemblages along the secondary succession gradient can initially lead to an increase in the species richness, when shrubland and ecotone species are added to the species composition of open habitats (Nikolov *et al.* 2011, Zakkak *et al.* 2013). The woody vegetation overgrowth at late-succession stages gradually leads to long-term loss of avian diversity, particularly affecting the grassland birds (Zakkak *et al.* 2013, Mikulić *et al.* 2014). In the Balkan region, many farmland birds of conservation concern are associated with low intensity farming in mountainous or low productivity areas (Kati, Sekercioglu 2006, Nikolov 2010, Nikolov *et al.* 2011), which, in the last few decades, have been prone to land abandonment due to the economic depression and rural depopulation.

Bulgaria is a good example of the above scenario. Since 1989, land abandonment has been observed all over the country and according to the Rural Development Programme of the country for 2007-2013, the low productivity mountainous regions have been mostly affected. This trend remained even after the massive subsidization of agriculture due to the accession of Bulgaria to the EU in 2007 (via the Common Agricultural Policy, CAP): only 58.4% of the arable land in Bulgaria (concentrated in three main regions) is cultivated (Agrostatistics, 2011). The results from the Common Bird Monitoring in the country showed that the common bird index has a negative trend since 2005, with the most severe decline reported for farmland birds (Hristov, Petkov 2013).

To improve knowledge about the effects of land abandonment on farmland birds in Eastern Europe, where deficiency of evidence was reported (Báldi, Batáry 2011a), we tested a hypothesis that the agricultural land abandonment in Bulgaria leads to reduction of avian diversity. We also examined the differences in bird community structure (species richness, abundance and Shannon diversity) and composition among gradient secondary successional stages over a period of 50 years.

Material and Methods

Study area and sampling plots

The study area is part of the Fore-Balkan region in Central Bulgaria (Fig. 1), where rural depopulation and resulting land abandonment are widespread (Agrostatistics 2011). It is located in the Balkan mixed forest ecoregion of the temperate deciduous forest vegetation zone (Olson *et al.* 2001) and ranges within an altitude of up to 1000 m.

We used sampling plots of 1 x 1 km squares, based on the European Environmental Agency (EEA) grid (http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2#tab-gis-data). The sampling plots, which corresponded to the following criteria, were considered suitable for the study (Zakkak *et al.* 2013): (i) 100% covered by agricultural land used in the 1940s; (ii) currently with less than 30% of urban area and/or water bodies (to avoid potential bias due to bird species tied to settlements or wetlands); (iii) the distance between centres of two adjacent sampling plots is more than 4 km (to avoid bird data spatial autocorrelation). We compared the land cover from orthophoto imagery from 2011 with the land cover from aerial photographs of the same region from the past (1945-1946). A total of 64 sampling plots were found to meet the criteria. Out of those, we randomly selected 18 sampling plots (Fig. 1) distributed equally in three vegetation structure (VS) categories according to the degree of woody vegetation (both shrubs and forest) overgrowth, indicating succession rate (Sirami *et al.* 2007, Vallecillo *et al.* 2008, Zakkak *et al.* 2013): VS1: < 60%; VS2: 60-90%; VS3: >90%. There was no significant differences in the mean altitude among the studied vegetation structure categories (Kruskal-Wallis ANOVA, $H_{2,15} = 0.42$, $p = 0.81$).

Land cover mapping and interpretation

We used data from the orthophoto imagery from 2011 (Ministry of Regional Development da-

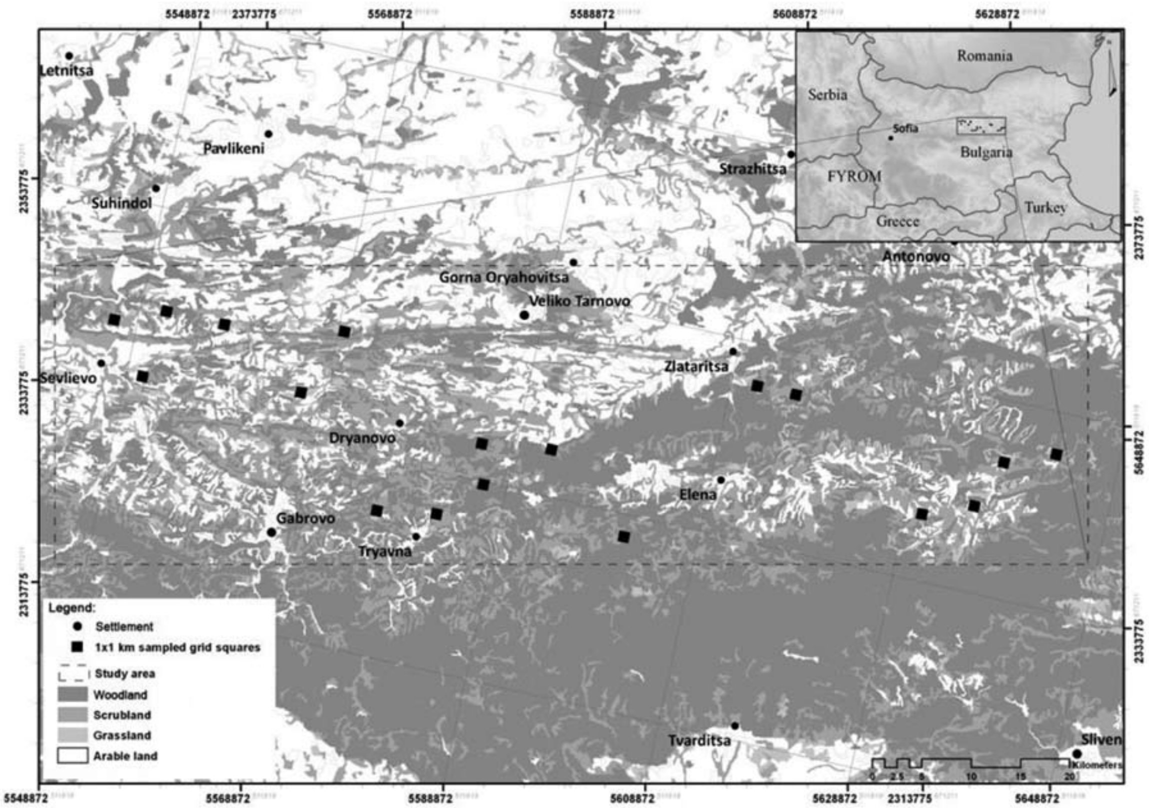

Fig. 1. Distribution of the sampling plots (N = 18) in the studied area

tabase – unpublished), with a grain size of 1 m as the spatio-thematic source for land cover mapping and interpretation. Only aerial features limited to a minimal mapping unit of 100 m² were digitalised as discrete landscape elements and the maximum width of linear elements, such as hedgerows, was set to 15 m. By applying a standard scale level of 1:1500 we could clearly identify and delineate landscape elements from the image data, which we classified by 22 land cover types (*i.e.* habitats), displaying the current state of land use, respectively, agricultural abandonment (Appendix 1).

The habitat type cover changed significantly along the land abandonment gradient, with arable land, grasslands (pastures and meadows), artificial land and orchards significantly decreasing (down to 0%), while shrubland and woodland significantly increasing (up to 100%) across the vegetation succession classes. The orchards, which did not present a significant differentiation along the gradient, and the wetlands and bare ground, which were present in less than five plots (overall cover < 5%), were not considered in the analysis (Fig. 2).

Bird sampling

Birds were recorded using the point count method (Gibbons, Gregory 2006). Initially, nine point count stations (PCS) were located systematically in each sampling plot, placed 300 m apart to avoid double counting of birds. The following PCS were excluded from the study: the PCS located closer than 150 meters from rivers, busy roads or settlements; those that are inaccessible due to physical factors of relief, fences or others; and those, in which activities disturbing birds (such as logging, hunting or agricultural activities) were present during the bird counts. As a result, each sampling plot contained at least six PCS suitable for the study and the total number of PCS considered in the analysis was143 for 2011 and 145 for 2012.

The PCS were visited during the greatest bird activity period: in the morning (05:00 – 11:00 a.m.), during the height of breeding season (June) in 2011 and in 2012. At each PCS, birds were counted within a radius of 100 m, based on visual and acoustic registrations of individuals during two consecutive 5 min sessions (Ralf *et al.* 1995, Bonthoux, Balent 2012).

Data analyses

We examined the bird communities using the following parameters (Krebs 1999): (i) Species richness – calculated from the means of maximum number of species recorded in all PCS in each sam-

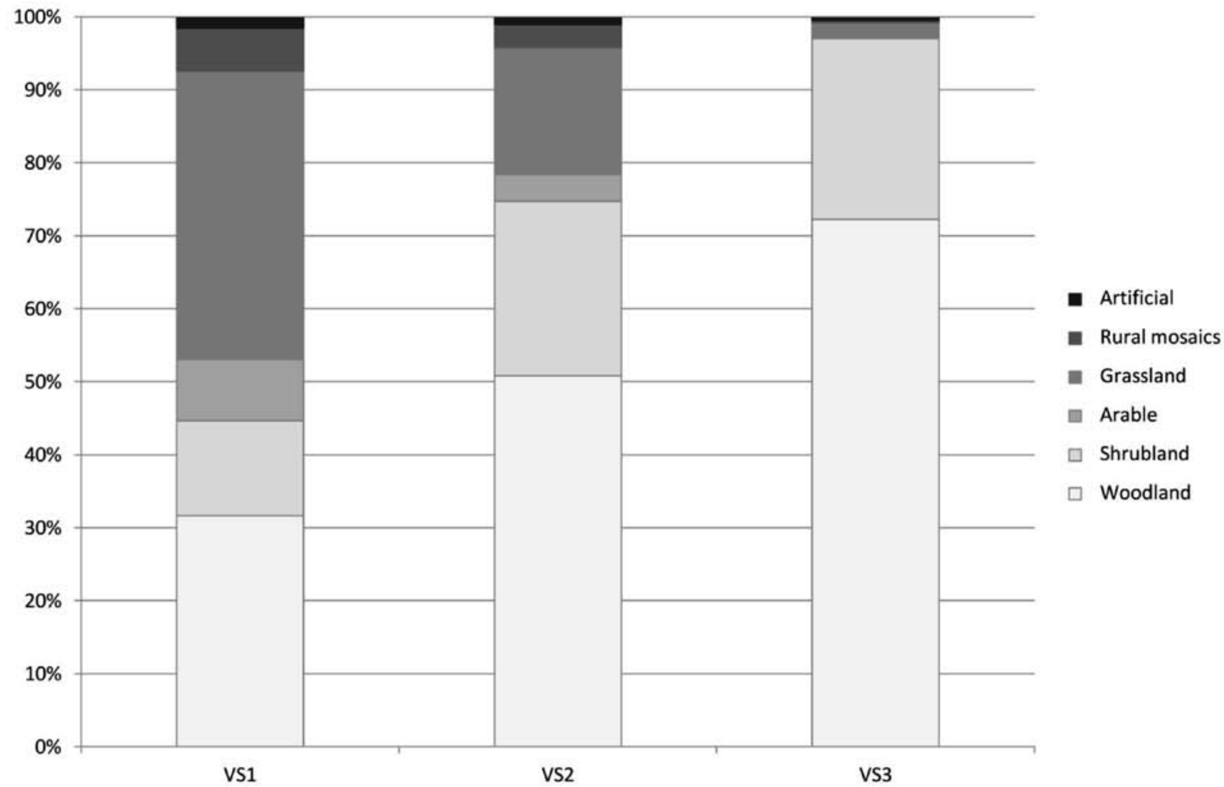

Fig. 2. Habitat cover across the three vegetation succession classes (VS1 : <60%, VS2: 60-90%, VS3: >90% of woody vegetation cover)

pling plot; (ii) Abundance – calculated from the means of maximum number of individuals counted in all PCS in each sampling plot; (iii) Shannon-Wiener diversity index. For the species richness, data from 10-min count periods were used to avoid overlooking of cryptic and rare species, while for the index of abundance and Shannon-Wiener diversity index, data from 5-min intervals were used to avoid double counting of the same individuals (Gibbons, Gregory 2006). Raptors, aerial feeders (swallows, swifts and bee-eaters) and nocturnal species (*e.g.* Corncrake *Crex crex*) were excluded from the analysis because the point-count method is not appropriate to assess their abundance (Sirami *et al.* 2007). Moreover, records of fly-overs, as well as data collected in bad weather conditions (visibility < 200 m; rain; wind > 2 Beaufort) were not considered in the analysis. As there were no significant differences of studied bird community parameters between years (Wilcoxon Matched Pairs Test: $T = 62.5$, $p = 0.32$ and $T = 63.0$, $p = 0.33$, respectively for the species richness and abundance), data were pooled for the analyses.

Birds were classified in functional groups according to their main habitat: grassland, shrubland, woodland or other type of habitat (Iankov 2007), as well as species from the European Conservation Concern (SPEC) list (BirdLife International 2004; see Appendix 2). Separately, we analysed the bird-habitat associations of all the species (n = 21) recorded in both years of the study, in more than five sampling plots per year and with total abundance of 20 or more individuals.

Because data were not normally distributed and did not approach the normal distribution even after transformation, non-parametric tests (Kruskal-Wallis ANOVA and Spearman-Rank Correlation test) were used. The statistical analysis was conducted by STATISTICA 7.0 (StatSoft 2004). The ordination analysis was applied using CANOCO 4.5 (ter-Braak, Smilauer 2002). The length of gradient in a dataset was checked by Detrended Correspondence Analysis (DCA). The bird associations along the studied landscape gradients were determined by Canonical Correspondence Analysis (CCA). The significance of canonical axes was assessed by the Monte Carlo Permutation test.

Results

Bird community structure along the secondary succession gradient

We recorded 61 bird species (3587 individuals), of which an important proportion of 30% was SPEC (Appendix 2). The dominant group was woodland

Table 1.Differences in bird community structure among three-scale vegetation succession gradient (VS1 : <60%, VS2: 60-90%, VS3: >90% of woody vegetation cover), based on Kruskal-Wallis ANOVA test (K-W), and relation between studied bird community parameters and woody vegetation cover, based on Spearman correlation coefficient (rho).*: p<0.05, **:p<0.01, ***:p<0.001, *ns*: p>0.05.

Bird group	Species richness		Shannon index		Abundance	
	K-W	rho	K-W	rho	K-W	rho
All species	6.25*	- 0.36*	13.34**	- 0.54*	5.71 ns	-
SPEC species	18.77***	- 0.77*	16.74***	-0.75*	16.74***	-0.73*
Grassland birds	20.87***	- 0.81*	9.98**	- 0.59*	17.87***	- 0.77*
Shrubland birds	3.36 ns	-	4.27 *ns*	-	0.36 *ns*	-
Woodland birds	3.38 ns	-	1.96 *ns*	-	0.83 *ns*	-

birds (66%), including a small proportion of SPEC species (23%). Grassland birds accounted for a small proportion of species richness (11%), but included the largest proportion of SPEC species (56%). Shrubland (16%) and other birds (7%) included also quite an important number of SPEC species (30% and 50%, respectively).

Bird species richness and Shannon-Wiener diversity index significantly decreased along the vegetation succession gradient (VS1 to VS3), when all bird species were considered; however, the overall abundance did not differ significantly among the vegetation succession classes (Table 1). The diversity of grassland and SPEC species (species richness, Shannon-Wiener diversity index, and abundance) also significantly and strongly decreased along the vegetation succession gradient. There were no significant differences in the shrubland and woodland bird diversity among the three vegetation succession classes (Table 1).

Bird-habitat associations

The main gradients in the landscape, which influenced the bird species composition, were related to secondary succession (transition from semi-natural grasslands and arable lands to woody vegetation) and the structure of farmlands (from arable lands to rural mosaics; Fig. 3). Accordingly, there were two main bird assemblages: (i) related to open landscapes (arable lands and semi-natural grasslands) and (ii) woody vegetation and rural mosaics. The early-successional stages were dominated by grassland (Corn Bunting *Emberiza calandra* and Skylark *Alauda arvensis*) and shrubland specialists (Blackbird *Turdus merula*, Red-backed Shrike *Lanius collurio,* Common Whitethroat *Sylvia communis*; Fig. 4a,b), while the latest successional stage was dominated by woodland birds (Common Chaffinch *Fringilla coelebes*, Common Chiffchaff *Phylloscopus collybita,* Great tit *Parus major,* Robin *Erithacus rubecula*, etc.; Fig.4c).

Discussion

Shifts in bird community structure

Our results demonstrated that the overall species richness and Shannon-Wiener diversity index decreased along the succession gradient, while the overall bird abundance remained stable. Similar results were reported for the extensively grazed and abandoned upland pastures in Western Bulgaria (Nikolov 2010). These results could be explained with the similarity in the ecological capacity of the natural habitats to host as much avian diversity as farmland environment (Navarro, Pereira 2012, Guilherme, Miguel Pereira 2013). Previous works (*e.g.* Santos 2000, Laiolo *et al.* 2004, Sirami *et al.* 2008, Nikolov *et al.*, 2011, Zakkak *et al.* 2013) reported an increase in species richness and diversity in the successional stages just after abandonment due to an influx of shrubland and ecotone species to the community, while open habitat species still persist there. A gradual decrease in the species richness and Shannon-Wiener diversity index with vegetation succession in this study could be explained by the fact, that the study did not include the intensively managed farmland as starting point of the succession. Such intensive agricultural land use (on one extreme end of the gradient) is considered the main driver of the widespread farmland bird declines observed in Europe (Donald *et al.* 2001, 2006). At the same time, the late-successional habitats as scrubland and woodland (on the other extremity of the gradient) were reported to support high avian species richness in Central and Western Europe (Guilherme, Miguel Pereira 2013, Reif *et al.* 2013).

We found that the diversity of grassland birds and SPEC birds was affected negatively by the post-abandonment vegetation succession. This result supports the view that the secondary succession through the agricultural land abandonment is the reason for the grassland bird diversity loss, as it is already

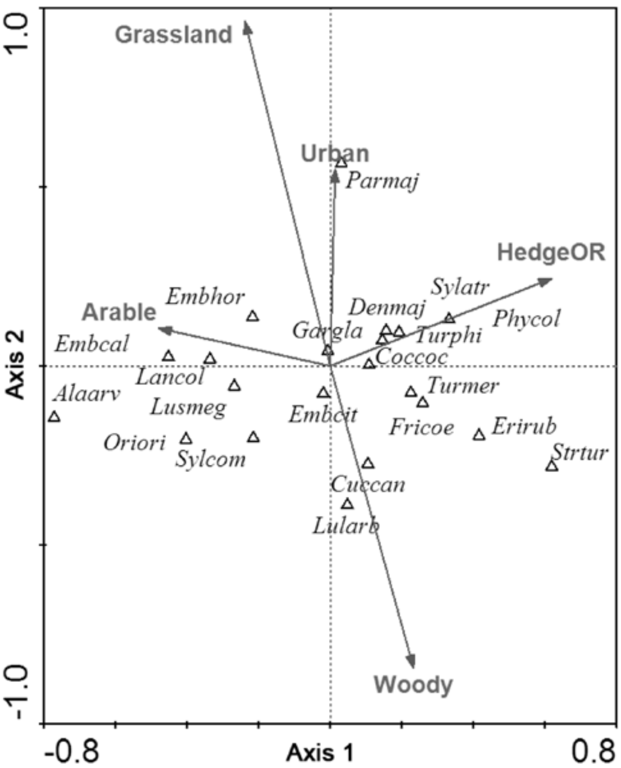

Fig. 3. CCA biplot graph of bird species and main habitat types. Canonical axes were statistically significant (Monte Carlo permutation test, $F = 1.48$, $p = 0.03$) and the model explained 89.6% of data variability. Bird species are indicated as triangles (see Appendix 2 for acronyms). Habitat variables are indicated as arrows: *Woody* – forests and shrubs; *Arable* – arable lands; *HedgeOR* – rural mosaics (hedges and orchards); *Urban* – roads and artificial structures; *Grassland* – meadows and pastures

known for the Mediterranean region (Preiss *et al.* 1997, Farina 1997, Santos 2000) and recently described for the Balkans (Nikolov 2010, Zakkak *et al.* 2013, Mikulić *et al.* 2014). Actually, the early-successional stages in the present study, with which these groups of birds were associated, were similar to the heterogeneous agricultural landscape under traditional extensive farming, known to be beneficial for farmland biodiversity (Kati, Sekercioglu 2006, Kati *et al.* 2009, Nikolov *et al.* 2011).

Effects of secondary succession at species level

The common bird species composition along the succession gradient showed the expected initial prevailing of open habitat species (*e.g.* Corn Bunting, Red-backed Shrike and Skylark), displaced at late-successional stages by shrubland (*e.g.* Blackbird and Common Whitethroat) and ecotone species (*e.g.* Common Chiffchaff and Robin), and finally, predominated by woodland species (*e.g.* Common Chaffinch, Great Tit and Song Thrush).

Species respond in an idiosyncratic way to the habitat types analysed, given their different degree of specialisation (Fuller *et al.* 2004). Some open habitat species (*e.g.* Skylark, Corn and Ortolan Buntings) respond negatively to land abandonment due to habitat loss through the turnover in late-successional stages (Vallecillo *et al.* 2008), and negative forest edge effects (Fonderflick *et al.* 2013). Others (*e.g.* Woodlark, Red-backed Shrike and Common Whitethroat) are more tolerant to secondary succession due to 'complementation' type response, being favored by the coexistence of both farmland and shrubland landscapes (Kati, Sekercioglu 2006, Tsiakiris *et al.* 2009, Zakkak *et al.* 2013) and should be expected to persist longer in the changing habitat.

In the present study, most of the predominant species at late-successional stages (*e.g.* Blackbird, Common Chaffinch, Great Tit, and Robin) were generalists (Kati, Sekercioglu 2006, Iankov 2007), while relatively more SPEC species were tied to early-successional stages and responded negatively to agricultural land abandonment. The results are in agreement with the work of Reif *et al.* (2013) and Zakkak *et al.* (2013), showing that early-successional stages host bird communities with the highest habitat specialisation and threat level (but see Radović *et al.* 2013, Mikulić *et al.* 2014). Therefore, the population declines of the common bird species in Bulgaria (Hristov, Petkov 2013) tied to open habitats (arable lands and grasslands) and found to respond negatively to secondary succession (*e.g.* Skylark, Red-backed Shrike, Ortolan and Corn Buntings), should be further investigated in relation to the nationwide abandonment of arable lands in the low-productivity mountainous regions, besides the other operating factors.

Conservation implications

Conservation implications for biodiversity vary since the arable land abandonment results from multiple drivers and is not *per se* a positive or negative process (Beilin *et al.* 2014). Extensive grazing in the former hilly and mountainous cultivations has been proposed by some authors (Nikolov 2010, Nikolov *et al.* 2011, Zakkak *et al.* 2013) as an alternative solution to maintain open landscape structure and open-land farmland birds. Under appropriate zonation regime, this type of management has been suggested as an efficient measure also for sustaining vegetation diversity in open-grassland and mid-successional grassland communities in the Balkan uplands (Vassilev *et al.* 2012). Nevertheless, grazing is not an adequate solution in all cases, as many of the farmland bird species are tied to arable land rather

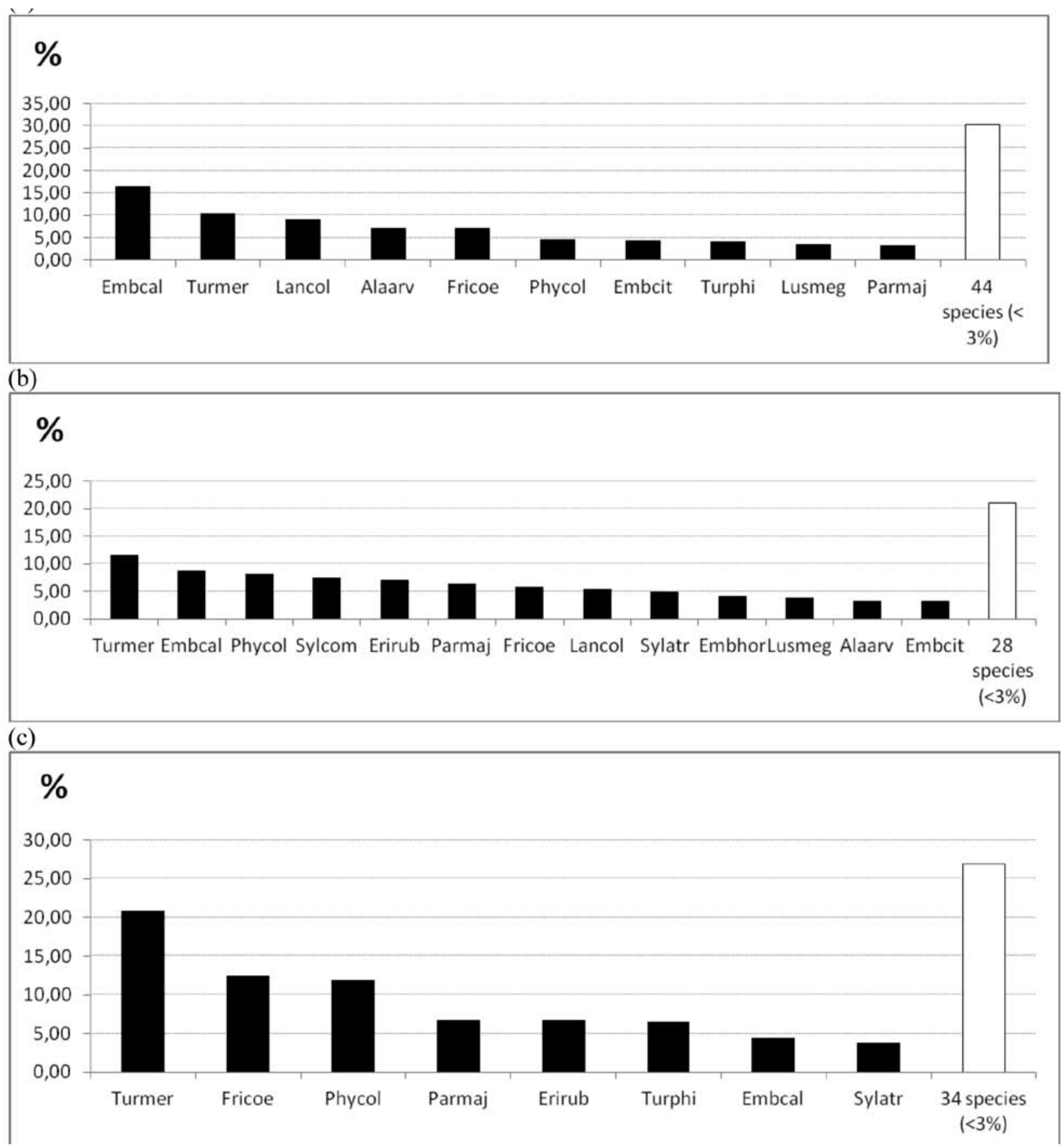

Fig. 4. Dominant structure of bird communities in the studied successional stages (a) VS1: <60%, (b) VS2: 60-90%, and (c) VS3: >90% of woody vegetation cover (see Appendix 2 for bird species acronyms)

than to pastures only (Nikolov *et al.* 2011, Zakkak *et al.* 2013). Shrub-clearing (Boccaccio *et al.* 2009) and logging in former agricultural land (Zakkak *et al.* 2013) have been also promoted to maintain open spaces in the Balkan context. Based on the assumption that bird communities can adapt to land-use changes derived from farmland abandonment, Guilherme, Miguel Pereira (2013) argued that rewilding may be a suitable management option for many European mountain areas. Indeed, at metapopulation level, an animal species can temporarily persist (*i.e.* can have a low local extinction rate) even after severe habitat fragmentation or after a sharp decrease in habitat quality (Sirami *et al.* 2008). However, the results from the present study clearly indicated a decrease in the species richness, abundance and diversity of grassland birds, while a simultaneous opposite trend in the shrubland and woodland birds was not observed. Therefore, at least for the studied region, rewilding cannot be considered an appropriate compensation method for the farmland bird diversity loss. Most of the conservation implications for reversing the negative effects of agricultural land abandonment on birds are related to maintenance of extensive traditional farming and livestock rearing within rural mosaics (Kati *et al.* 2009, Nikolov *et al.* 2011, Zakkak *et al.* 2013, Herzon *et al.* 2014), which fully corresponds to the agricultural management and habitat configuration of the studied area in the past (unpublished data from questionnaires of old people and aerial photographs from 1945-1946, collected during the present study).

Land abandonment is more strongly influenced by socio-economic factors, such as farming subsidies and land reforms, than the characteristics of the land itself (Alcantara *et al.* 2013). Therefore, the low productive mountainous regions in Bulgaria need appropriate management, not only for the benefit of biological diversity, but also for the sake of quality of life of the rural communities. The latter is particularly important, as the rural poverty and low standard of living tied to small scale extensive farming cannot be promoted only on the grounds of their association with high nature conservation-value farmland (McCracken *et al.* 1997). An integrated approach to agricultural, environmental and social policies for such areas is, therefore, highly recommended (Laiolo *et al.* 2004). Similarly to the results from Greece (Zakkak *et al.* 2013) and from Croatia (Mikulić *et al.* 2014), this study suggests that these policies could be developed and implemented at the Balkan rather than national level, at least for the EU member states or candidate member states. They may include promotion of extensive farming, establishment of an adequate market system for local products, and subsidies for both extensive cultivation and grazing in order to enhance the income of agricultural activities in remote mountain areas (Zakkak *et al.* 2013).

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Appendix 1. Land cover types (*i.e.* habitats) description

Land Cover Type	**Description**
Arable Land (AL)	Grain, forage crops, root crops
Meadow (ME)	No bare soil, uniform texture, traces of mowing
Pasture (PA)	Obvious signs of pastoral use like trampling
Orchard (OR)	Fruit tree plantation
Vineyard (VY)	Vineyards
Coarse grassland (CGR)	Extensively used grasslands (including fallow lands), showing a coarse texture
Heterogeneous grassland (HGR)	Extensively used grasslands (including fallow lands), showing a heterogeneous structure
Shrublands (SHR)	Shrubby vegetation (> 75 % shrub cover)
Broad-leaved forest (BLFO)	Forest with < 20 % coniferous trees
Coniferous forest (CFO)	Forest with < 20 % broad-leaved trees
Mixed forest (MFO)	Forest with > 20 % broad-leaved and coniferous trees
Open forest (OFO)	30 - 50 % tree cover

Appendix 1. Continued

Land Cover Type	Description
Small woodlot (WL)	All forest types < 1,500 m²
Artificial surface (AS)	Built up areas, incl. settlements, parking spaces, extraction sites, etc.
Bare surface (BAR)	Bare rock or soil, eroded areas
Baulk (BA)	Field margins, ridges, embankments
Burnt surface (BUR)	Burnt areas, especially forests and shrublands
Hedge (HD)	Hedgerows of shrubs and/or trees
Road (RO)	Sealed, gravel or dirt roads
Sparsely vegetated areas (SVA)	< 50 % vegetation cover (all types)
Standing waterbody (WBSN)	Lakes, ponds, water reservoirs
Streaming waterbody (WBSR)	Rivers, streams, channels

Appendix 2. Bird species, overall abundance, habitat preference, and conservation status. G: Grassland birds, S: Shrubland birds, W: Woodland birds, O: Other birds (Iankov 2007). SPEC 1: Species in Europe of global conservation concern, SPEC2: Species, whose global population is concentrated in Europe, with unfavourable conservation status in Europe, SPEC3: Species, whose population is not concentrated in Europe, with unfavourable conservation status in Europe (Birdlife International 2004)

Bird species	Code	Abundance	Habitat	Conservation status
Aegithalos caudatus	Aegcau	7	W	-
Alauda arvensis	Alaarv	134	G	SPEC 3
Anthus trivialis	Anttri	19	W	-
Carduelis cannabina	Carcan	3	G	SPEC 2
Carduelis carduelis	Carcar	4	W	-
Carduelis chloris	Carchl	10	W	-
Certhia brachydactyla	Cerbra	8	W	-
Coccothraustes coccothraustes	Coccoc	40	W	-
Columba palumbus	Colpal	17	W	-
Corvus corone	Corcor	2	W	-
Coturnix coturnix	Cotcot	13	G	-
Crex crex	Crecre	5	G	SPEC 1
Cuculus canorus	Cuccan	59	W	-
Cyanistes caeruleus	Cyacae	40	W	-
Dendrocopos major	Denmaj	28	W	-
Dendrocopos minor	Denmin	5	W	-
Dendrocopos syriacus	Densyr	1	W	-
Dryocopus martius	Drymar	7	W	-
Emberiza calandra	Embcal	376	G	-
Emberiza citrinella	Embcit	125	W	-
Emberiza hortulana	Embhor	115	S	-
Emberiza melanocephala	Embmel	2	S	-
Erithacus rubecula	Erirub	173	W	-
Ficedula semitorquata	Ficsem	1	W	SPEC 2
Fringilla coelebs	Fricoe	293	W	-
Garrulus glandarius	Gargla	78	W	-
Hippolais pallida	Hippal	4	S	SPEC 3
Jynx torquilla	Jyntor	10	W	SPEC 3

Appendix 2. Continued

Bird species	**Code**	**Abundance**	**Habitat**	**Conservation status**
Lanius collurio	Lancol	209	S	SPEC 3
Lanius senator	Lansen	1	S	SPEC 2
Lullula arborea	Lularb	24	G	SPEC 2
Luscinia megarhynchos	Lusmeg	117	W	-
Motacilla flava	Motfla	9	G	-
Muscicapa striata	Musstr	3	W	SPEC 3
Oriolus oriolus	Oriori	28	W	-
Parus lugubris	Parlug	4	W	-
Parus major	Parmaj	187	W	-
Parus montanus	Parmon	3	O	-
Passer domesticus	Pasdom	42	O	SPEC 3
Passer montanus	Pasmon	2	O	SPEC 3
Phasianus colchicus	Phacol	5	O	-
Phoenicurus ochruros	Phooch	1	S	-
Phylloscopus collybita	Phycol	283	W	-
Phylloscopus sibilatrix	Physib	12	W	SPEC 2
Phylloscopus trochilus	Phytro	5	W	-
Picus canus	Piccan	3	W	SPEC 3
Picus viridis	Picvir	18	W	SPEC 2
Poecile palustris	Poepal	9	W	-
Sitta europaea	Siteur	30	W	-
Streptopelia turtur	Strtur	21	W	SPEC 3
Sturnus vulgaris	Stuvul	18	W	SPEC 3
Sylvia atricapilla	Sylatr	124	W	-
Sylvia borin	Sylbor	2	W	-
Sylvia communis	Sylcom	140	S	-
Sylvia curruca	Sylcur	3	S	-
Sylvia nisoria	Sylnis	16	S	-
Troglodytes troglodytes	Trotro	9	W	-
Tudus merula	Turmer	498	S	-
Turdus philomelos	Turphi	158	W	-
Turdus viscivorus	Turvis	12	W	-
Upupa epops	Upuepo	12	W	SPEC 3
Total	61	3587		