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Breeding birds of shelterbelts near Sombor (NW Serbia)

Gnezdilke drevoredov pri Somboru (SZ Srbija)

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In 2008, breeding birds were studied in the shelterbelts surrounded by arable land NW of Sombor (Vojvodina, NW Serbia). Seven 500 m long sections of wooded shelterbelts were selected and surveyed for birds six times between May and July. Sampling plots differed in tree species composition and dominance, in height of trees, and presence and composition of shrub and herb layers. 22 breeding species were found with a mean density of 9.86 ± 1.47 pairs/km of shelterbelt. The mean number of species per shelterbelt was 8.3 ± 1.2. Species richness ranged from 4 (shelterbelt G) to 14 (shelterbelt D) species. Similarity, measured by the Sørensen index, showed strong qualitative similarity (over 70%) between the compared communities in only 19% of all possible pairs of shelterbelts. The most abundant breeding species were Golden Oriole *Oriolus oriolus* and Greenfinch *Carduelis chloris*, with overall linear densities of 2.9 and 2.6 pairs/km, respectively. Overall linear densities of a further four species (Red-backed Shrike *Lanius collurio*, Syrian Woodpecker *Dendrocopos syriacus*, Whitethroat *Sylvia communis* and Cuckoo *Cuculus canorus*) exceeded 1 pair/km. The densities of breeding birds are compared to those obtained during other studies in Europe and elsewhere.

Key words: shelterbelts, agricultural landscape, breeding birds, linear density, Sombor, Vojvodina, Serbia
Ključne besede: drevoredi, kmetijska krajina, gnezdilke, linearna gostota, Sombor, Vojvodina, Srbija

1. Introduction

Shelterbelts are man-made habitats consisting mainly of rows of trees and shrub. They are excellent habitats for a variety of birds and other animals (Schroeder *et al.* 1992). A study in the United States showed that, of 108 bird species using shelterbelts in agricultural areas, 29 benefited substantially from their existence, 37 moderately and 42 only a little (Johnson & Beck 1988). The number of species recorded in old, diverse small wooded areas in farmland in Poland (avenues, shelterbelts and clumps of trees) was 68, but only 18 in young shelterbelts (Kujawa 1997 & 2004). Recently, 100 species were reported to be breeding in small wooded areas of this kind in Poland (Tryjanowski *et al.* 2009).

The density of breeding birds in shelterbelts and other wooded areas surrounded by arable land varies. In South Dakota (United States), the mean density of birds in multi-row windbreaks was 82.6 individuals/ha, but only 48.8 in single-row windbreaks (Emmerich & Vohs 1982). In Minnesota (United States), the mean density of breeding birds in shelterbelts was 88.5 nests/ha, with a range from 28.8 to 186.4 nests/ha (Yahner 1982). Research carried out in parks and wooded areas surrounded by arable land in Poland yielded breeding densities of 165.2 and 282 pairs/10 ha, respectively (Kujawa 1992).

The protection of European avifauna and wider environment depends on ecologically oriented land use. Intensive farming is recognized as a factor that affects very importantly the breeding birds of Europe (Tucker *et al.* 1994, Tucker & Evans 1997). Wooded areas surrounded by arable land are very important for the protection of biodiversity in agricultural landscapes (Ryszkowszki *et al.* 1999), and efforts

Table 1: Physical characteristics of the shelterbelts studied

Tabela 1: Fizične značilnosti preučevanih drevoredov

Shelterbelt/ Drevored	Road next to the shelterbelt/ Cesta ob drevoredu	No. of tree rows/ Št. nizov dreves	Orientation/ Usmerjenost	Width/ Širina (m)	No. of tree and shrub species/ Št. vrst dreves in grmov	Crops alongside the shelterbelt/ Vrsta pridelka vzdolž drevoreda
A	Dirt/ makadam	4	west – east/ zahod – vzhod	14	3	corn / koruza
B	Asphalt/ asfalt	4	west – east/ zahod – vzhod	14	2	wheat, sugar beet/ pšenica, sladkorna pesa
C	Dirt/ makadam	4	west – east/ zahod – vzhod	14	2	soya bean, sugar beet/ soja, sladkorna pesa
D	Asphalt/ asfalt	4	west – east/ zahod – vzhod	14	3	forest belt, sugar beet/ pas gozda, sladkorna pesa
E	Dirt/ makadam	4	west – east/ zahod – vzhod	15	4	corn, sugar beet/ koruza, sladkorna pesa
F	Asphalt/ asfalt	4	west – east/ zahod – vzhod	16	5	sugar beet / sladkorna pesa
G	Asphalt/ asfalt	3	south – north/ sever – jug	11	2	corn / koruza

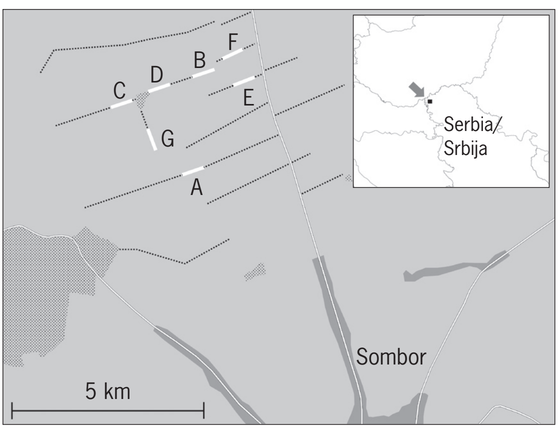

Figure 1: Distribution of the 500 m long shelterbelt sampling plots in the study area (A–G; marked with lines)

Slika 1: Razporeditev 500 m dolgih vzorčnih ploskev drevoredov na območju raziskave (A–G; označeno z linijami)

should thus be made to conserve and renew them to preserve the birds. Wooded areas surrounded by arable land are characterized by higher species richness and higher population densities of birds in the breeding communities than other elements of agricultural landscape in the lowlands of Europe (Bezzel 1982).

The aim of this study was to investigate the breeding bird communities of shelterbelts near Sombor in NW Serbia. The part of the northern province of Vojvodina we studied is a typical agricultural area with a dense shelterbelt network and many wooded areas surrounded by arable land. Here we present the first findings on the abundance and density of breeding birds and the similarity of bird communities in shelterbelts in Serbia.

2. Study area and methods

2.1. Study area

The research was conducted in the shelterbelts NW of Sombor (UTM CR47 & 48, NW Serbia). Seven shelterbelts were selected from the whole shelterbelt network in the area bounded by the settlements of Gakovo, Bezdan and Sombor. The 500 m long sampling plots were selected according to their characteristics (Figure 1, Table 1).

The age of these shelterbelts is about 20 years. There were no gaps between individual trees greater than 10 m. Sampling plots differed in tree species composition and their dominance, height of trees and presence and composition of shrub and herb layers (Table 2).

2.2. Methods

All sampling plots were surveyed six times between 26 May and 19 Jul 2008 in the early morning,

Table 2: Description of vegetation characteristics of the shelterbelts studied

Tabela 2: Opis značilnosti vegetacije preučevanih drevoredov

Shelterbelt/ Drevored	Trees / Drevesa			Shrubs / Grmi			Herbs / Zeli
	Cover/ Pokrovnost (%)	Species and dominance[1]/ Vrste in dominanca[1]	Height/ Višina (m)	Cover/ Pokrovnost (%)	Species / Vrste	Height/ Višina (m)	Dominant species/ Dominantne vrste
A	90	*Ulmus pumila* (3), *Robinia pseudacacia* (4)	8–12	< 10	*Rosa canina, Rubus caesius*	0.5–2	*Bromus sterilis, Calamagrostis* sp., *Elymus* sp., *Arrhenatherum* sp.
B	100	*Ulmus pumila* (2), *Robinia pseudacacia* (4)	8–13	–	–		*Bromus sterilis*
C	80	*Morus alba* (2), *Robinia pseudacacia* (5)	7–10	–	–		*Bromus sterilis, Elymus* sp., *Arrhenatherum* sp.
D	100	*Morus alba* (1), *Ulmus pumila* (+), *Robinia pseudacacia* (5)	6–10	–	–		*Bromus sterilis*
E	90	*Populus alba* (4), *Robinia pseudacacia* (3)	8–18	20	*Sambucus nigra, Robinia pseudacacia, Rosa canina*	1–3	*Bromus sterilis, Calamagrostis* sp.
F	80	*Populus alba* (4), *Robinia pseudacacia* (3)	7–20	30	*Sambucus nigra, Robinia pseudacacia, Rosa canina, Cornus sanguinea*	1–3	*Bromus sterilis, Arrhenatherum* sp.
G	90	*Gleditschia triacanthos* (3), *Robinia pseudacacia* (4)	7–8	–	–		*Bromus sterilis, Arrhenatherum* sp.

[1] dominance classes / dominančni razredi: (+) 0.1–1%, (1) 1.1–5%, (2) 5.1–25%, (3) 25.1–50%, (4) 50.1–75%, (5) 75.1–100% (Braun-Blanquet 1994)

approximately once every ten days. The survey of a single plot lasted for about 20–40 min, depending on the number of species. Attempts were made to observe and record every breeding bird. If no nest or nesting behaviour was observed, a localised bird was interpreted as a breeding territory only when male territorial behaviour (singing) was registered at least twice during the study period. Individuals not meeting the above criteria were excluded from the study. The percentage cover of a given vegetation layer was estimated by the basic method used for general coenological surveying (Braun-Blanquet 1994).

Since the breeding birds' territories were distributed along the shelterbelt, their density is expressed as a number of pairs per km of shelterbelt (herein referred to as linear density). Breeding density was analysed and presented based on total data from all shelterbelts.

Statistical analysis was performed using the software Biostat 2008 (AnalystSoft 2008). The similarity of bird communities between all possible pairs of

Table 3: Number of pairs, overall linear density and dominance of breeding birds in the shelterbelts (total length = 3.5 km)

Tabela 3: Število parov, skupna linearna gostota in dominance gnezdilk drevoredov (skupna dolžina = 3,5 km)

Species / Vrsta	Shelterbelt – No. of pairs/ Drevored – št. parov							Total / Skupaj		
	A	B	C	D	E	F	G	No. of pairs/ Št. parov	Linear density/ Linearna gostota (p/km)	Dominance/ Dominanca (%)
Carduelis chloris	1	4	2	2			1	10	2.9	14.5
Oriolus oriolus	1	1	1	2	2	2		9	2.6	13.0
Lanius collurio			1	1	2	1	1	6	1.7	8.7
Dendrocopos syriacus	1	1	1	1	1	1		6	1.7	8.7
Sylvia communis		1	2	2		1		6	1.7	8.7
Cuculus canorus	1		1	1		1		4	1.1	5.8
Sylvia atricapilla	1	1				1		3	0.9	4.3
Carduelis carduelis		1				1	1	3	0.9	4.3
Luscinia megarhynchos				1	1		1	3	0.9	4.3
Falco tinnunculus	1				1			2	0.6	2.9
Corvus cornix	1		1					2	0.6	2.9
Pica pica				1		1		2	0.6	2.9
Picus viridis				1	1			2	0.6	2.9
Parus major				1	1			2	0.6	2.9
Fringilla coelebs	1			1				2	0.6	2.9
Streptopelia decaocto				1				1	0.3	1.4
Passer montanus				1				1	0.3	1.4
Sturnus vulgaris					1			1	0.3	1.4
Muscicapa striata			1					1	0.3	1.4
Turdus merula				1				1	0.3	1.4
Coccothraustes coccothraustes						1		1	0.3	1.4
Motacilla alba			1					1	0.3	1.4
Total / Skupaj (22 species / vrst)	8	9	11	17	10	10	4	69	19.7	100.0

the studied shelterbelts, C_S, was calculated by the Sørensen index (Podani 1997, Majer 2004):

$$C_S = \frac{2c}{a + b} 100$$

(a = the number of species in one community; b = the number of species in the other community; c = the number of species common to both communities)

The diversity of each shelterbelt was calculated by the Shannon-Wiener (H) and Simpson diversity indexes (D) (Colinvaux 1973):

$$H = -\sum_{i=1}^{S} n_i \log n_i \,; \quad D = 1 - \frac{\sum_{i=1}^{S} n_i (n_i - 1)}{N(N-1)}$$

(S = the number of species in the sample, N = the total number of individuals in the sample; n_i = the number of individuals of every species in the sample)

3. Results

69 breeding pairs of 22 bird species were found in the seven shelterbelt sampling plots. The most abundant breeding species were Greenfinch *Carduelis chloris* and Golden Oriole *Oriolus oriolus*, with total linear densities of 2.9 and 2.6 pairs/km, respectively. The total linear densities of a further four species exceeded 1 pair/km. Seven species bred in densities lower than 0.5 pairs/km, while other species bred in densities between 0.5 and 1 pair/km (Table 3).

The number of breeding bird species per shelterbelt varied greatly – from four (shelterbelt G)

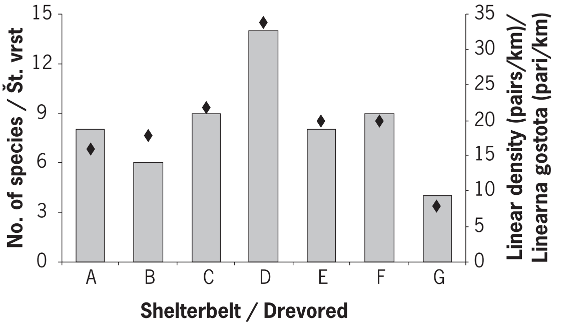

Figure 2: Number of species (bars) and overall linear density (dots) of breeding birds in the shelterbelts

Slika 2: Število vrst (stolpci) in skupna linearna gostota (točke) gnezdilk v drevoredih

to 14 (shelterbelt D) (Figure 2). The mean number of species per shelterbelt (± SE) was 8.3 ± 1.2, and the mean density of breeding pairs per shelterbelt reached 9.86 ± 1.47 pairs/km. Golden Oriole was present in all shelterbelts except G. Greenfinch breeding pairs were absent from shelterbelts E and F. Their linear densities in the occupied shelterbelts ranged from 2.0 to 4.0 pairs and 2.0 to 8.0 pairs/km, respectively.

In most cases, the diversity of the breeding bird species in the shelterbelts was similar. The highest value was obtained for shelterbelt D and the lowest values for shelterbelts B and G (Table 4).

52.4% of the Sørensen index values were over 50%, indicating a high qualitative similarity between the breeding bird communities in different shelterbelts, while of all compared communities only 19% indicated a strong (over 70%) similarity (Table 5).

4. Discussion

22 breeding bird species were found in shelterbelts during this study. This finding is in accordance with research in lowland Poland that revealed 18 species in young shelterbelts (Kujawa 2004), 50 in parks and 44 in wooded areas surrounded by arable land (Kujawa 1992). Another study from Poland demonstrates that, between 1964 and 1994, the number of breeding species of small mid-field woodlots increased from 44 in the 1960s to 51 in the 1990s (Kujawa 2002). In

Table 4: The diversity of breeding bird species at the shelterbelts studied, calculated by the Shannon-Wiener and Simpson diversity indexes

Tabela 4: Vrstna diverziteta gnezdilk preučevanih drevoredov, izračunana na podlagi Shannon-Wienerjevega in Simpsonovega indeksa

Shelterbelt / Drevored	A	B	C	D	E	F	G
Shannon-Wiener (H)	2.08	1.58	2.15	2.59	2.03	2.16	1.39
Simpson (1 – D)	0.88	0.74	0.88	0.92	0.86	0.88	0.75

Table 5: Similarities of breeding bird communities between all possible pairs of shelterbelts studied, calculated by the Sørensen index (C_s)

Tabela 5: Vrstna identičnost združb gnezdilk med vsemi možnimi pari preučevanih drevoredov, izračunana na podlagi Sørensenovega indeksa (C_s)

Compared shelterbelts/ Primerjan par drevoredov	C_S value/ vrednost (%)	Compared shelterbelts/ Primerjan par drevoredov	C_S value/ vrednost (%)	Compared shelterbelts/ Primerjan par drevoredov	C_S value/ vrednost (%)
A vs. B	57.1	B vs. D	30.0	C vs. G	46.2
A vs. C	58.8	B vs. E	57.1	D vs. E	45.5
A vs. D	45.5	B vs. F	80.0	D vs. F	43.5
A vs. E	62.5	B vs. G	40.0	D vs. G	33.3
A vs. F	70.6	C vs. D	52.1	E vs. F	35.3
A vs. G	33.3	C vs. E	70.6	E vs. G	50.0
B vs. C	66.7	C vs. F	77.8	F vs. G	46.2

considering the smaller numbers in the present study, it should be pointed out that early breeding birds like the Great Tit *Parus major*, Starling *Sturnus vulgaris* or Hooded Crow *Corvus cornix* are probably under-represented in this study owing to the late start of the fieldwork. However, because of the relatively young age of these shelterbelts, the probability of finding significantly more pairs of these early breeding species is low.

The reason why shelterbelt G had markedly smaller number of bird species probably lies in its younger tree stand and different composition of tree species. Shelterbelt G contained Honeylocust *Gleditschia triacanthos*, a tree species disliked by most breeding species because of its very bushy and dense growth with long thorns. However, a habitat like this is a good nesting place for the Red-backed Shrike *Lanius collurio*, which requires large bush or shrub vegetation growing in warm and dry areas for nesting (Fuisz *et al.* 1998), with high insect richness (Jakober & Stauber 1987). Indeed, this was one of only four species registered in shelterbelt G. On the other hand, shelterbelt D adjoined a larger wooded area with older trees, which was probably the main factor, not only for the much higer number of bird species, but also for the presence of several hole-nesting birds species that were generally sparsely distributed in the studied shelterbelts.

The linear density of the most abundant species in our study (Greenfinch with 2.9 pairs/km) was similar to that of Corn Bunting *Miliaria calandra* in young shelterbelts in Poland (2.78 pairs/km), the most numerous species in the study of Kujawa (2004). A comparison of these results with those from mature shelterbelts revealed much higher densities in the latter, where the density of the most abundant species was 22.8 pairs/10 ha, while in parks the mean density of the most abundant species, the Starling, was 33 pairs/10 ha (Kujawa 1992 & 1997). In Slovakian shelterbelts, the density of Nightingale *Luscinia megarhynchos* varied between 2.44 and 3.55 pairs/ha (Némethová 2007).

The generally high qualitative similarity of the compared communities confirmed that the breeding species composition variability between individual shelterbelts was low. However, by comparing the results of this study to others, we concluded that the similarities between the compared communities were lower. Indeed, the high similarity of the communities might be the result of a fairly similar vegetation structure in our samples (plant species and vegetation layers in shelterbelts). In Poland, a study that compared wood belts with tree clumps resulted in a qualitative similarity of 79%, whereas the comparison of wood belts with avenues and tree clumps with avenues yielded the similarities of 70% and 59%, respectively (Kujawa 1997). In yet another study, Kujawa (1992) gives the similarity of 70% with the breeding communities of parks and systems of wooded areas compared.

The linear densities of the two most abundant species, Golden Oriole and Greenfinch, are generally higher than in studies from Poland (Kujawa 1992, 1997). In the case of Golden Oriole, this can be explained by different latitudes of the two countries' study areas. Populations of the Golden Oriole show an increase in densities towards the southern and south-eastern regions of Europe (Wassmann 1997).

Many studies conclude that shelterbelts and other types of wooded areas situated in large expanses of arable land are important habitats for a number of breeding birds. On the other hand, shelterbelts and similar plantations could also negatively affect the birds of open country (e.g. Avery 1989, Pierce *et al.* 2001). In the Great Plains (United States), bird species exhibiting significant population increases were primarily associated with human-made structures and woody vegetation, while those exhibiting significant decline were primarily grassland and wetland breeding birds (Igl & Johnson 1997). Similar trends have been observed in common birds throughout Europe (e.g. PECBMS 2007). In this study, the relatively high densities of several woodland birds in shelterbelts indicate the importance of small wooded areas surrounded by large areas of unsuitable habitat as refuges for at least some woodland breeding birds.

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5. Povzetek

Leta 2008 je avtor članka preučeval gnezdilke v drevoredih, obdanih z orno zemljo, SZ od Sombora (Vojvodina, SZ Srbija). Za šestkratno popisovanje med majem in julijem je izbral sedem 500 m dolgih odsekov drevoredov. Vzorčne ploskve so se razlikovale po sestavi drevesnih vrst in njihovi dominanci, višini dreves ter prisotnosti in sestavi grmovnega in zeliščnega sloja. Zabeležil je 22 gnezdečih ptičjih vrst s povprečno gostoto 9,86 ± 1,47 para/km drevoreda. Povprečno število vrst na drevored je bilo 8,3 ± 1,2, medtem ko se je število vrst gibalo med 4 (drevored G) in 14 (drevored 14) vrstami. Vrstna identičnost, izmerjena s Sørensonovim indeksom, je le v 19% vseh možnih

parov preučevanih drevoredov pokazala veliko vrstno podobnost (prek 70%) med primerjanimi združbami gnezdilk. Najbolj številčni vrsti sta bili kobilar *Oriolus oriolus* in zelenec *Carduelis chloris* s skupno linearno gostoto 2,9 oz. 2,6 para/km. Skupna linearna gostota naslednjih štirih vrst (rjavi srakoper *Lanius collurio*, sirijski detel *Dendrocopos syriacus*, rjava penica *Sylvia communis* in kukavica *Cuculus canorus*) je presegala 1 par/km. Gostoto gnezdilk avtor primerja z gostotami, ugotovljenimi v drugih študijah v Evropi in drugod.

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