

Bird community in a Beech forest in Lower Savinja Valley (Slovenia)

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Abstract - Bird census work was carried out in the forest (30.8 ha) at the edge of the Dobrovlje karst plateau in Lower Savinja Valley (Slovenia), belonging to the *Luzulo-Fagetum* phytocenosis and *Blechno-Fagetum* forest. The main species of the forest are: *Fagus sylvatica*, *Quercus petraea*, *Pinus sylvestris* and *Picea abies*. Twenty-six bird species were reported in the forest and the average density was 30.2 pairs/10 ha. The abundance (biomass) of the bird community is 2078 g/10 ha. The highest densities of breeding pairs were noted for *Parus ater* and *Erithacus rubecula*. The Index of Diversity (H') was 2.82 and the Evenness Index (Je) was 0.87. Breeding communities were also analyzed in relation to the nesting site, feeding and migratory habits. Among the breeding species, five were trans-Saharan migrants and five were only short-distance migrants. Nine species (33.6 %) are insectivorous (carnivorous) species, four (15.4 %) are herbivorous and thirteen (50 %) are omnivorous. The density of the breeding avifauna in the beech forest depended primarily on the density of species nesting in the crowns of trees and from hole-nesters (both 11.4 pairs/10 ha), on the density of omnivorous species (19.1 pairs/10 ha) and residents (16.2 pairs/10 ha). The breeding population of the Žovnek beech forest has a species composition markedly different from other forests compared here (Sorensen's Index of Similarity varied from 27 to 75, and the Renkonen Index varied from 14.3 to 61.2).

In Slovenia, more than half of the total land area (53 %) is covered by forest (Perko & Pogačnik 1996). Nevertheless the forest birds of Slovenia are little known. Only one quantitative study of the forest bird community is available at present (Perušek 1991).

In this paper, I investigate the bird community of a *Luzulo-Fagetum* and *Blechno-Fagetum* forest in Lower Savinja Valley. The primary goal of the study was to demonstrate how many species and individuals occur in this forest type, and particularly to elucidate bird density and the implications of some general measures of habitat.

Lower Savinja Valley is situated in central Slovenia (Figure 1). The census was carried out in the forest at the edge of the Dobrovlje karst plateau near the Žovnek Castle ruin (46°16' N, 15°10' E, 400 m a.s.l.). This forest belongs to the phytocenosis *Luzulo-Fagetum* and *Blechno Fagetum* forest (Zavod za gozdove Slovenije, OE Celje 1992). The main species are: *Fagus sylvatica* (about 45% of the forest area), *Quercus petraea* (20%), *Pinus sylvestris* (10%), *Picea abies* (10%). The growing stock (m^3) in the surveyed location is reported in Table 1. The low and middle foliage included both the coppice growth itself and vegetation such as *Vaccinium myrtillus* and *Pteridium aquilinum*. The research area in which quantitative studies were carried out measured 30.8 ha; it consisted of

forest sections 89 and 90, parts of the inner area of the larger forest. According to Marinček (1987), the area belongs to the prealpine phytogeographical region.

Quantitative studies of the bird community were carried out with the mapping technique of Bibby et al. (1992) in the 30.8 ha area described above. The birds encountered were plotted on the contour maps at a scale of 1:5000 and the category of observation was recorded. The investigation was conducted mainly in the early morning and lasted up to 6 hours. Evening investigations were also carried out. The area was visited eight times, between the beginning of April and the end of June 1996. The following parameters were used in the data analysis:

Index of Diversity, according to the Shannon-Wiener formula (Hayek 1994): $H' = -\sum P_i \cdot \ln P_i$, $P_i = n_i/N$ where H' denotes the amount of information (expressed in bits per individual) in the set of species examined, n_i is the number of individuals of each species in the set examined, N is the total number of individuals of all species in a community.

The structure of species domination within a community (evenness or equitability) was determined by the formula given by Pielou (1966):

$$Je = H' / \ln S$$

where H' is Shannon-Wiener Index of diversity, S is the number of species.

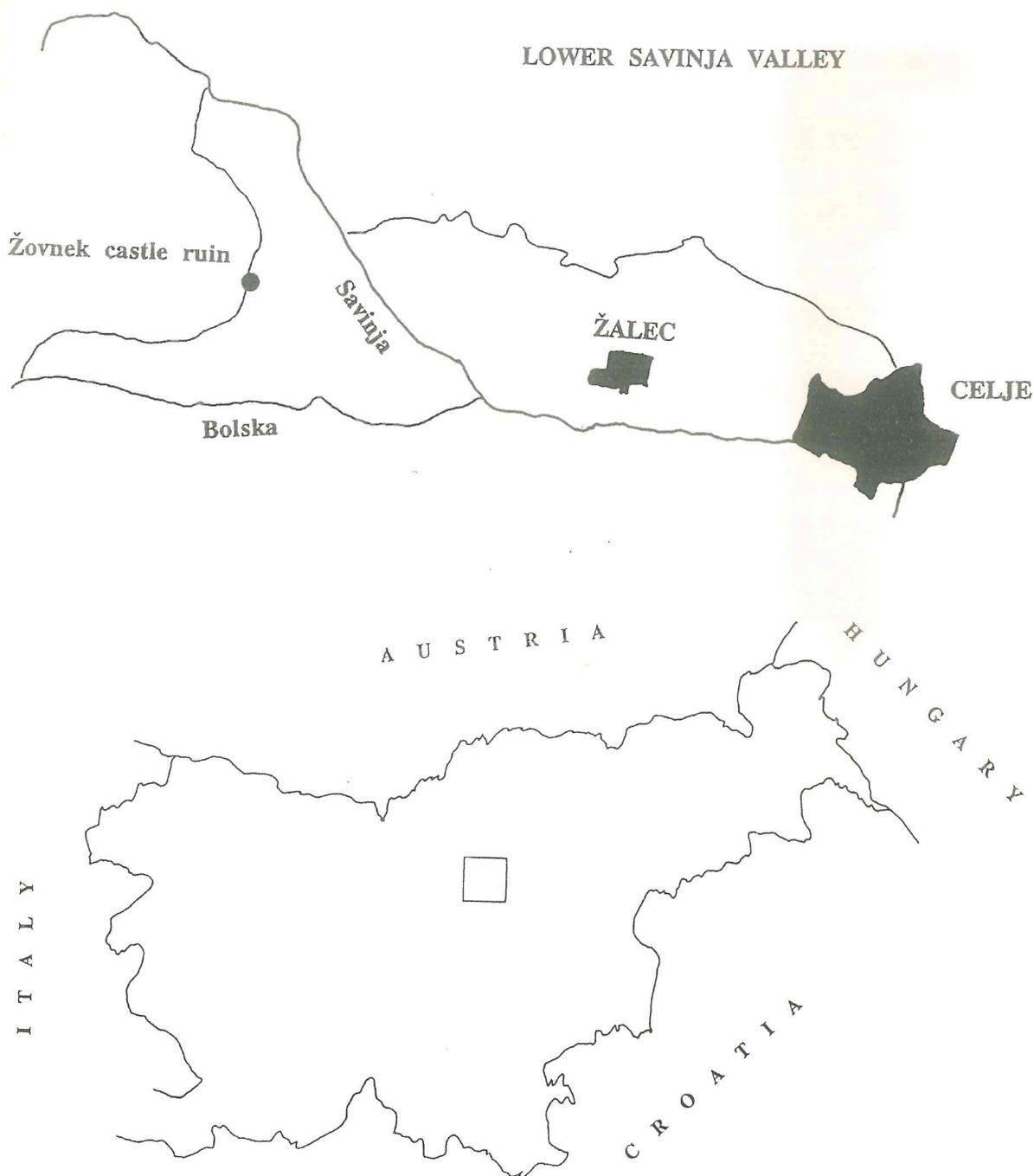


Figure 1

Sorensen's Index of Similarity (QS) was used to estimate the similarity of the species composition of particular communities:

$$QS = 2c / (a + b) \times 100 \text{ (Tomialojć et al. 1984)}$$

where c is the common part of the sets, a is the size of the first set and b is the size of the second set. A value

of QS exceeding 80% indicates great similarity of the communities (Biadun 1994).

The Renkonen Index (Re) is calculated from the formula:

$$Re = \sum d_{imin} \text{ (Trojan 1981)}$$

d_{imin} is the smallest value of the dominance of partic-

Table 1. Growing stock (m³) in the surveyed location in Lower Savinja Valley.

Thickness (cm)	<i>Luzulo -</i>	<i>Fagetum</i>	<i>Blechno -</i>	<i>Fagetum</i>
	Coniferous trees	Deciduous trees	Coniferous trees	Deciduous trees
10-29	778	1350	324	1570
30-49	425	891	260	1085
over 50	—	133	—	—
Total	1203	2374	584	2655

ular species in two communities under comparison. A value of Re exceeding 70% indicates great similarity of the communities (Biadun 1994).

The bird community was split into three ecological groups according to: nesting guilds (hole-breeders, crown breeders and ground-breeders) (Tomialojć et al. 1984), feeding habits (insectivorous-carnivorous, omnivorous, herbivorous) (Tomialojć et al. 1984,

Cramp & Simmons 1986, Pearson & Lack 1992, Cramp & Perrins 1994) and migratory habits (resident species, tropical migrants - species wintering south of the Sahara, short-distance migrants) (Tomialojć et al. 1984, Morel & Yvonne Morel 1992, Pearson & Lack 1992). Ground-nesters are species which breed at heights of up to 1.5 m (Luniak 1980, Luniak 1981, Tomialojć et al. 1984, Biadun 1994).

Table 2. Composition of the bird community in the Žovnek beech forest (D - dominance (%), G - density (No. of pairs/10 ha), + - presence) and total biomass (g).

Species	D	G	Total biomass
<i>Parus ater</i>	12.9	3.9	288
<i>Erithacus rubecula</i>	10.7	3.2	300
<i>Fringilla coelebs</i>	9.7	2.9	432
<i>Sylvia atricapilla</i>	9.7	2.9	342
<i>Parus major</i>	7.5	2.3	266
<i>Phylloscopus collybita</i>	6.4	1.9	96
<i>Sitta europaea</i>	6.4	1.9	276
<i>Troglodytes troglodytes</i>	5.4	1.6	90
<i>Turdus philomelos</i>	5.4	1.6	700
<i>Turdus merula</i>	4.3	1.3	696
<i>Parus caeruleus</i>	3.2	1.0	66
<i>Oriolus oriolus</i>	2.1	0.6	276
<i>Phylloscopus sibilatrix</i>	2.1	0.6	36
<i>Parus palustris</i>	1.1	0.3	22
<i>Parus cristatus</i>	1.1	0.3	26
<i>Certhia familiaris</i>	1.1	0.3	16
<i>Phoenicurus phoenicurus</i>	1.1	0.3	30
<i>Turdus viscivorus</i>	1.1	0.3	220
<i>Pyrrhula pyrrhula</i>	1.1	0.3	48
<i>Coccothraustes coccothraustes</i>	1.1	0.3	110
<i>Garrulus glandarius</i>	1.1	0.3	320
<i>Dendrocopus major</i>	1.1	0.3	146
<i>Columba palumbus</i>	1.1	0.3	960
<i>Streptopelia turtur</i>	1.1	0.3	280
<i>Jynx torquilla</i>	1.1	0.3	70
<i>Picus canus</i>	1.1	0.3	290
<i>Cuculus canorus</i>	+	-	-
<i>Dryocopus martius</i>	+	-	-
<i>Corvus corax</i>	+	-	-
<i>Buteo buteo</i>	+	-	-
TOTAL		30.2	6402

The body mass of the various bird species, for use in calculating biomass, was determined from the literature (Kooiker 1994, Perrins 1987).

The Chi-square test was used for statistical comparisons (Sokal & Rohlf 1995).

Tables 2 to 4 present the results of the research. Twenty six bird species were reported in the forest under study. In the total area of 30.8 ha, 93 pairs of birds were breeding, with a density of 30.2 pairs/10 ha. The abundance (biomass) of the birds is 2078 g/10 ha. As many as 9 of the breeding species were recorded as dominants (over 5 %) (Table 2). The highest densities of breeding pairs were noted for *Parus ater* and *Erithacus rubecula*. The Diversity Index (H') was 2.82 and the Evenness Index (Je) was 0.87.

Among the breeding species, five (19.2 %) were trans-Saharan migrants and five were only short-distance migrants, occasionally wintering in Slovenia (Sovinc 1994) (Table 3). Nine species (33.6 %) are insectivorous (carnivorous), four (15.4 %) are herbivorous and thirteen (50 %) are omnivorous (Table 3).

The breeding communities of the Žovnek forest were also analyzed in relation to the nesting site. Eleven species were hole-nesting birds, eleven nested in the crowns of trees and four (15.4%) nested on the ground (Table 3). Among cavity-nesting species only *Dendrocopus major* and *Picus canus* are birds that excavate holes (excavators). The density of the breeding avifauna in the beech forest depended primarily on the density of species nesting in the crowns of trees and hole-nesters (both 11.4 pairs/10 ha), on the density of omnivorous species (19.1 pairs/10 ha) and residents (16.2 pairs/10 ha). The proportion of other ecological groups was low (Table 4). The differences between numbers of pairs according to feeding and migratory habits is significant (Chi-square = 48.8 and 31.1, both: $P < 0.005$), whereas the differences between numbers of pairs according to nesting habit is not significant ($P > 0.05$).

Comparisons of the basic biocenotic indices, i.e., the number of species, number of breeding pairs, species diversity and Evenness Index is given in Table 5.

Table 3. A classification of breeding birds in the Žovnek beech forest according to feeding, nesting and migratory habits. Nesting habits: PD - primary hole breeders (excavators), D - hole breeders, P - open nests (crown nesting in trees), T - ground breeders. Feeding habits: C - insectivorous (carnivorous), O - omnivorous, H - herbivorous. Migratory habits: S - resident species, T - tropical migrants, species wintering south of the Sahara, K - short-distance migrants.

Species	Nesting habits	Feeding habits	Migratory habits
<i>Parus ater</i>	H	C	S
<i>Erithacus rubecula</i>	T	O	S
<i>Fringilla coelebs</i>	P	O	S
<i>Sylvia atricapilla</i>	P	O	K
<i>Parus major</i>	D	O	S
<i>Phylloscopus collybita</i>	T	C	K
<i>Sitta europaea</i>	D	O	S
<i>Troglodytes troglodytes</i>	T	C	K
<i>Turdus philomelos</i>	P	O	K
<i>Turdus merula</i>	P	O	S
<i>Parus caeruleus</i>	D	O	S
<i>Oriolus oriolus</i>	P	O	TS
<i>Phylloscopus sibilatrix</i>	T	C	TS
<i>Parus palustris</i>	D	O	S
<i>Parus cristatus</i>	D	C	S
<i>Certhia familiaris</i>	D	C	S
<i>Phoenicurus phoenicurus</i>	D	C	TS
<i>Turdus viscivorus</i>	P	O	S
<i>Pyrrhula pyrrhula</i>	P	H	S
<i>Coccothraustes coccothraustes</i>	P	H	S
<i>Garrulus glandarius</i>	P	O	S
<i>Dendrocopus major</i>	PD	O	S
<i>Columba palumbus</i>	P	H	K
<i>Streptopelia turtur</i>	P	H	TS
<i>Jynx torquilla</i>	D	C	TS
<i>Picus canus</i>	PD	C	S

Table 4. Total biomass (g), density - G (no. of pairs/10 ha) and dominance - D (%) of breeders of the Žovnek beech forest according to feeding, nesting and migratory habits.

	Total biomass	G	D
Carnivorous	942	9.7	32.3
Omnivorous	4062	19.1	63.3
Herbivorous	1398	1.3	4.4
Hole nesters	1496	11.4	37.7
Crown breeders	4384	11.4	37.7
Ground breeders	522	7.5	24.6
Resident species	3522	16.2	53.8
Tropical migrants	692	2.3	7.5
Short-distance migrants	2188	11.7	38.7

Table 5. A comparison of the results of quantitative studies in the Žovnek beech forest and in other forests of Central Europe (* - data from 1988, ** - average value [1979-1990]).

Location	Size (ha)	No. of species	No. of pairs/10 ha	H'	Je	Source
Žovnek beech forest	30.8	26	30.2	2.82	0.87	this work
Warszawa (urban forest)	19	18	75	3.4	-	Luniak 1981
Bieszczady (<i>Dentario glandulosae-Fagetum</i>)	40	23*	40.9	3.45	0.75	Cichon & Zajac 1991
Polana (<i>Acereto-Piceetum</i>)	18	28	49.6	2.52	0.83	Kropil 1992
Ojcow (<i>Pino-Quercetum</i>)	10	21**	70.4	4.03	0.92	Tomek 1992
Žofinsky virgin forest (<i>Abieto-Fagetum</i>)	102.2	34	52.6	3.74	0.72	Bürger & Kloubec 1994
Eckau (alpine-mixed forest)	17	25	44.3	2.77	0.86	Pechacek 1994
Kühroint (subalpine spruce forest)	11.5	19	52	2.50	0.78	Pechacek 1994
Jenner (subalpine spruce forest)	15	21	45.3	2.61	0.86	Pechacek 1994
Blatna Castle park (<i>Carpinion</i>)	29	41	82.4	4.37	-	Klimes 1994
Vel'ka and Mala Fatra (spruce forest)	51	44	67.8	4.08	0.75	Saniga 1995

The bird communities observed in other or similar forest types generally had similar numbers of species, but for the most part higher levels of density of pairs, than those in the beech forest of Lower Savinja Valley (e.g. Schaffner 1990, Cichon & Zajac 1991, Kropil 1992, Perušek 1991, Tomek 1992, Kosinski 1993, Bürger & Kloubec 1994, Pechacek 1994, Klimes 1994). However, the density recorded in this study was very similar to that found by Micevski & Dimovski (1989) in a *Quercetum frainetto-cerris* forest and by Oelke (1989) in mature spruce stands.

The commonest forest species (dominance over 5%) exhibited very high densities and formed almost three quarters of the number of pairs in the community. Similar results were obtained by other authors (Cichon & Zajac 1991, Kieš 1991, Kosinski 1993, Pechacek 1994). The qualitative structure of the dominant species is similar to that in the Eckau alpine-mixed forest (Pechacek 1994).

The presence of warblers is low. According to Glowacinski (1981), Cody (1985), Fuller & Moreton (1987), Fuller et al. (1989) and Fuller & Henderson (1992), warblers are characteristic of earlier stages of

forest succession and of well-developed low foliage density. The density of hole-nesters was lower than the density in the Dabrowa forest (Kosinski 1993), similar to the density in the Babia Gora beech forest (Kieš 1991) and higher than the density in the Bieszczady forest (Cichon & Zajac 1991). The density of ground nesters in the Žovnek beech forest was low compared to that at Babia Gora (Kieš 1991).

According to Glowacinski (1981), in general the presence of a large number of species and the high density of hole-nesting birds are characteristic of climax deciduous forests, containing old trees with many holes in which birds can find good nesting places. According to some authors, e.g. Martin (1992) and Martin (1995), a high proportion of excavators and a low one of ground nesters depends on predators. In the research area, I observed the following potential predators (mammals and reptiles only): *Erinaceus concolor*, *Sciurus vulgaris*, *Martes martes*, *Vulpes vulpes*, *Felis silvestris*, *Elaphe longissima*, although only two of them (*Erinaceus concolor*, *Sciurus vulgaris*) are common (observed at each visit).

The lower density of some bird species (e.g. *Certhia*

Table 6. Comparison between bird communities with Sorensen's Index (QS) and the Renkonen (Re) Index in %: DOB - Žovnek beech forest - 30.8 ha (this work), PR - urban forest - 19 ha (LUNIAK 1981), TC - Białowieża virgin forest (*Peucedano-Pinetum*) - 25 ha (TOMIALOJČ et al. 1984), GA - "Galičica" National Park (*Quercetum frainetto-cerris*) - 10 ha (MICEVSKI & DIMOVSKI 1989), OV - Odertal mature spruce stands - 25 ha (OELKE 1989), CG - Combe-Grede (*Abieto-Fagetum*) - 70 ha (SCHAFFNER 1990), BNP - Bieszczady National Park (*Dentario glandulosae-Fagetum*) - 14 ha (CICHON & ZAJAC 1991), BG - Babia Gora (*Fagetum carpaticum*) - 12 ha (KIEŠ 1991), RP - Rajhenav virgin forest (*Abieto-Fagetum dinaricum*) - 20 ha (PERUŠEK 1991), RGG - Rajhenav managed forest (*Abieto-Fagetum dinaricum*) - 20 ha (PERUŠEK 1991), PPS - Pecka virgin forest north (*Abieto-Fagetum dinaricum*) - 20 ha (PERUŠEK 1991), PPJ - Pecka virgin forest south (*Abieto-Fagetum dinaricum*) - 20 ha (PERUŠEK 1991), PWC - Western Carpathians (*Piceetum excelsae-Tatricum*) - 10 ha (SLIZOWSKI 1991), PO - Polana (*Acereto-Piceetum*) - 18 ha (KROPIL 1992), OJ - Ojcow National Park (*Pino-Quercetum*) - 10 ha (TOMEK 1992), DA - Dabrow (*Molinio (caeruleae)-Quercetum*) - 29.75 ha (KOSINSKI 1993), ŽP - Žofinsky virgin forest (*Abieto-Fagetum*) - 102.2 ha (BÜRGER & KLOUBEC 1994), EC - Eckau (alpine-mixed forest) - 17 ha (PECHACEK 1994), KU - Kühroint (subalpine spruce forest) - 11.5 ha (PECHACEK 1994), JE - Jenner (subalpine spruce forest) - 15 ha (PECHACEK 1994), BL - Blatna Castle park (*Carpinion*) - 29 ha (KLIMEŠ 1994), VMF - Vel'ka and Mala Fatra (spruce forest) - 51 ha (SANIGA 1995).

	QS	Re
DOB : PR	27	14.3
DOB : TC	59	50.2
DOB : GA	51	—
DOB : OV	52	—
DOB : CG	59	—
DOB : BNP	65.3	49.0
DOB : BG	62.5	50.9
DOB : RP	75	58.7
DOB : RGG	72.4	61.2
DOB : PPS	68	59.1
DOB : PPJ	69	59.5
DOB : PWC	29	32.7
DOB : PO	63.8	49.9
DOB : OJ	71.1	—
DOB : DA	62.9	48.6
DOB : ŽP	73.3	51.4
DOB : EC	54.9	55.6
DOB : KU	44	45.7
DOB : JE	51	53.1
DOB : BL	53	42.9
DOB : VMF	48.6	35.4

familiaris, *Parus cristatus*) is explained by the fact that they are specialized for mature forests and have large territories (Helle & Järvinen 1986, Kuitunen 1989). The values of the indices of species diversity (H') and structure of dominance (J') are in general similar to those of the other research areas (Table 5) except those in Norway (Hogstad & Stenberg 1994).

In comparisons between the Lower Savinja Salley beech forest and some other forests, the Sorensen's Index of Similarity (QS) varied from 27 to 75 and the Renkonen Index (Re) from 14.3 to 61.2 (Table 6). Comparison of breeding communities in particular areas revealed that ten communities showed clear similarity, with QS values of 60-80%. There was similarity of the dominant species in the community (Re) in nine forests.

It is interesting that the bird community of the *Dentario glandulosae-Fagetum* forest type (Bieszczady National Park), where beech is the dominant tree species (Cichon & Zajac 1991), shows only similarity to the bird community of Lower Savinja Valley. From these results, it is obvious that similarity between bird communities does not depend only on the same association but also on the age and geographical position of a locality (e.g. Helle 1985, Virkkala 1987, Micevski & Dimovski 1989).

Acknowledgments - The work was supported by the community of Žalec. Funds were provided also by Finomehanika Dobrajc (Mr. Dobrajc), Celje and by Dikplast Celje (Mr. Kregar), Celje. For help during research work, I wish to thank my wife N. Vogrin. Comments by an anonymous referee improved the manuscript.

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