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Comparison of breeding bird communities in the interior and on the edge of *Tilio-Carpinetum* hornbeam

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Comparison of breeding bird communities in the interior and on the edge of *Tilio-Carpinetum* hornbeam. – Čas. Slez. Muz. Opava (A), 62: 119-124, 2013.

Abstract: There are precious remnants of *Tilio-Carpinetum* vegetation in the Nysa Kłodzka Valley near Grodków forming three forests. During the years 2002-2004, the line transect method has been employed to assess dominance of birds breeding in these forests. Three transects were fixed in the forest interior and two transects on the edges along the Nysa Kłodzka river. A total of 63 bird species were recorded, inside the forests – 59, while on the edges – 51 species. Both in the interior and on the edges dominant species constituted 53%. However, species composition in the dominant groups were different. Both in interior and on the edges *Fringilla coelebs, Sturnus vulgaris, Phylloscopus collybita* and *Sylvia atricapilla* dominated; in interior forest *Parus major, Sitta europaea* and *Erithacus rubecula* were also dominants, while on the edges – *Turdus merula* and *Emberiza citrinella* were also in this group. In comparison with natural *Tilio-Carpinetum* hornbeam forest, the proportion of dominant species in hornbeam forests near Grodków was lower, what is probably the result of the edge effect.

Key words: breeding bird community, edge effect, nature conservation.

Introduction

Forest plant communities are classified into 7 orders, 11 associations and 54 communities in Poland (Matuszkiewicz 2002). They are equivalents of so called forest habitat types used in the forestry. The *Carpinion betuli* association (hornbeam forest) belongs to *Fagetalia sylvaticae* order and *Querco-Fagetea* class. This association is further divided into 3 communities, namely: *Tilio-Carpinetum, Galio sylvatici-Carpinetum* and *Stellario holosteae-Carpinetum.* The *Tilio-Carpinetum* subcontinental hornbeam comprises 56.1% of all hornbeam forests in Poland. The hornbeam forests are named in forestry as deciduous fresh forests and deciduous wet forests, mixed fresh and wet forests, and upland deciduous and mixed forests (Matuszkiewicz 2002).

The hornbeam forests are composed of various deciduous tree species and grow on mezzo- and eutrophic fresh or lightly wet environment. The stand of trees is composed mainly of the oak *Quercus robur,* hornbeam *Carpinus betulus* and lime *Tilia cordata,* while the shrub layer is composed mainly of the hazel *Corylus avellana.* The undergrowth is composed of numerous herbaceous plant species with admixture of mosses and ferns. In terms of plant diversity it is the richest forest type. However, the total surface area of this forest in mature stand comprises c.1000 km^2, i.e. 1% of the total afforested area in Poland, ranging in particular regions from 0.1 to 7.5%. In Lower Silesia it comprises c. 3.2% of afforested area (Matuszkiewicz 2002).

Due to a high level of biodiversity in hornbeam forests and their insignificant proportion in the afforested areas in Poland, they require special conservation, and intense research. This is especially true in respect to avifauna, where many indicator species have been distinguished. To date, such studies in Poland were conducted in Białowieża Primeval Forests (Tomiałojć et al. 1984; Tomiałojć, Wesołowski 1986; Wesołowski et al. 2006), Niepołomicka Forest (Głowaciński 1975), near Legnica (Tomiałojć 1974) and in Odra Valley (Dyrcz 1963; Ranoszek 1969; Tomiałojć, Profus 1977).

In Silesia, the largest hornbeam forests were preserved in Odra Valley between Opole and Wrocław. They are protected within the NATURA 2000 net (Gromadzki et al. 1994). However, relatively large hornbeam forests are also located in Nysa Kłodzka Valley, a left tributary of the Odra River. Some fragments of those forests have been recently designed as nature reserves (Kopij 2005), nevertheless the entire surface area of these forests should also be included to the NATURA 2000 net.

Only floristic investigation (Mazur 1992) and preliminary studies on birds in the nature reserves (Kopij 2005) have been hitherto conducted in those forests. The aim of this study was to investigate the whole breeding avifauna. Special emphasis was paid on the differences between avifauna breeding in interior forest and in forest edges.

Study area and methods

Two forests located in the Nysa Kłodzka Valley (Grodków county, Brzeg district, Opole province, SW Poland) were selected for this study: 1) situated north of the village Głębocko, with a surface area of 454 ha; 2) situated north of the village Kopice – 449 ha. Both are administered by Dębina Forest District within the Tułowice Forest Inspectorate. The forests are separated with a distance of about 1.5 km.

In both forests, the dominant hornbeam stands are *Tilio-Carpinetum corydaletosum, Tilio-Carpinetum allietosum* and *Ficario-Ulmetum* (with a dense *Prunus padus* undergrowth) (Mazur 1992). The tallest layer is dominated by old oaks *Quercus robur,* with *Fraxinus excelsior* as an admixture. Many of those trees are about 150 years old. The second lower layer is composed mainly of *Tilia cordata, Acer pseudoplatanus, Acer platanoides, Fraxinus excelsior* and *Carpinus betulus.* The undergrowth is luxuriant and composed mainly of *Allium usrinum, Anemone nemorosa, Anemone ranunculoides, Corydalis cava, Corydalis fabacea, Ficaria verna, Gagea lutea, Gagea minima, Galanthus nivalis* and *Urtica dioica*

Studies were conducted in springs during the years 2002-2004. The line transect method has been employed (Bibby et al. 1992) to assess dominance structure in breeding bird communities and densities of particular bird species. Transects were fixed in interior forest, and on forest edges. In interior forest, three transects were fixed along roads, while on the edges two transects were designed along the Nysa Kłodzka river. Each transect was c. 100 m width and 2-4 km long. Each of them was surveyed three times: 1) in the first half of April, 2) in the first half of May, and 3) in June.

Counts were conducted in early mornings under sunny (or partly cloudy) and windless weather. On transects, all singing males were recorded, but also other birds showing breeding and/or territorial behavior. Excluded were birds which definitively were not breeding in the forest (e.g. herons or swifts flying high above the forest). The potentially breeding pair was a census unit. A locality of singing males was interpreted as occupied territory (=breeding pair), as was occupied nest and sites with birds showing nesting or territorial behavior.

As recommended for the Line Transect Method, the maximal number of pairs recorded in whatever counting day was assumed as the real number of breeding pairs on this transect (cf. Bibby et al.1992). Sörensen Similarity Index has been used to calculate the similarities between bird communities in interior forest and on forest edges: $S = 2z/[x+y]$, where z – number of species common for both communities compared, x – number of species in the community x, y – number of species in the community y. The S value changes from 0 (no similarity) to 1 (identical communities).

Results

A total of 63 breeding bird species were recorded in both forests, 57 in Kopice forest and 55 in Głębocko forest. There were 47 species common for both forests. The Similarity Index between bird communities in these forests has been calculated as S=0.84. In interior forest – 59, while on edges – 51 species were recorded.

Both in interior forests and on forest edges, species composition was very similar (S=0.95), as was also general dominance structure. The small differences in species composition accounted only for typical ecotone species, such as Ortolan Bunting *Emberiza hortulana* or typical forest species, such as the Black Woodpecker *Dryocopus martius* or Golden-crested Kinglet *Regulus regulus*.

In interior forest, 7 dominant species were recorded, they comprised 52.7% of all breeding pairs in interior forests. On forest edges, there were six dominant species,

Tab 1: Breeding bird community in interior and on edges of the hornbeam forests. Dominant species are indicated with bold case; ** p<0.001; * p<0.05

Species	**Głębocko**					**Kopice**				
	interior		edge		x^2	interior		edge		x^2
	N	%	N	%	test	N	%	N	%	test
Sturnus vulgaris	**49**	**14.8**	**14**	**5.9**	12.2**	**54**	**15.9**	**22**	**9.5**	5.3*
Fringilla coelebs	**43**	**13.0**	**28**	**11.8**	0.1	**24**	**7.1**	**43**	**18.6**	18.1**
Phylloscopus collybita	**25**	**7.6**	**31**	**13.1**	5.4*	**20**	**5.9**	**14**	**6.1**	0.0
Sylvia atricapilla	**20**	**6.1**	**21**	**8.9**	2.0	13	3.8	**23**	**10.0**	9.5**
Parus major	**19**	**5.8**	**12**	**5.1**	0.1	**23**	**6.8**	6	2.6	6.2*
Turdus merula	15	4.5	**16**	**6.8**	1.6	12	3.5	11	4.8	0.7
Sitta europaea	**21**	**6.4**	6	2.5	5.2*	**18**	**5.3**	6	2.6	3.1
Erithacus rubecula	16	4.8	11	4.6	0.0	**18**	**5.3**	1	0.4	14.0**
Coccothr.coccothraustes	11	3.3	8	3.4	0.0	12	3.5	7	3.0	0.1
Parus caeruleus	10	3.0	8	3.4	0.1	14	4.1	3	1.3	4.9*
Ficedula albicollis	16	4.8	6	2.5	2.2	9	2.6	4	1.7	0.6
Emberiza citrinella	5	1.5	**12**	**5.1**	6.7*	3	0.9	**14**	**6.1**	13.3**
Dendrocopos major	3	0.9	3	1.3	0.2	**18**	**5.3**	4	1.7	6.1*
Troglodytes troglodytes	10	3.0	3	1.3	2.3	7	2.1	2	0.9	1.6
Dendrocopos medius	8	2.4	2	0.8	2.4	4	1.2	6	2.6	1.9
Muscicapa striata	7	2.1	3	1.3	0.7	6	1.8	3	1.3	0.2
Turdus philomelos	3	0.9	6	2.5	2.7	6	1.8	4	1.7	0.0
Oriolus oriolus	2	0.6	5	2.1	2.9	4	1.2	5	2.2	1.0
Columba palumbus	2	0.6	2	0.8	0.2	9	2.6	2	0.9	3.0
Certhia brachydactyla	3	0.9	3	1.3	0.2	5	1.5	1	0.4	1.9
Cuculus canorus	3	0.9	2	0.8	0.0	5	1.5	1	0.4	1.9
Acrocephalus palustris	2	0.6	0	0.0	2.0	0	0.0	9	3.9	13.4**
Sylvia borin	2	0.6	0	0.0	2.0	1	0.3	8	3.5	9.2**
Certhia familiaris	2	0.6	1	0.4	0.1	5	1.5	1	0.4	1.9
Aegithalos caudatus	1	0.3	4	1.7	3.3	2	0.6	1	0.4	0.1
Phylloscopus trochilus	1	0.3	3	1.3	2.0	1	0.3	3	1.3	2.2
Regulus regulus	1	0.3	0	0.0	1.0	6	1.8	0	0.0	6.0*
Buteo buteo	4	1.2	1	0.4	1.2	1	0.3	1	0.4	0.1
Parus palustris	1	0.3	1	0.4	0.1	4	1.2	1	0.4	1.2
Hippolais icterina	1	0.3	2	0.8	0.9	1	0.3	3	1.3	2.2
Locustella fluviatilis	0	0.0	0	0.0		1	0.3	6	2.6	6.3*
Garrulus glandarius	2	0.6	0	0.0	2.0	3	0.9	1	0.4	0.5
Dryocopus martius	2	0.6	0	0.0	2.0	3	0.9	0	0.0	3.0
Phylloscopus sibilatrix	3	0.9	1	0.4	0.6	1	0.3	0	0.0	1.0
Serinus serinus	3	0.9	0	0.0	3.0	2	0.6	0	0.0	2.0
Corvus corax	1	0.3	1	0.4	0.1	2	0.6	1	0.4	0.1
Regulus ignicapillus	0	0.0	1	0.4	1.4	3	0.9	0	0.0	3.0
Sylvia communis	0	0.0	0	0.0		0	0.0	4	1.7	5.9*
Sylvia curruca	2	0.6	0	0.0	2.0	1	0.3	0	0.0	1.0
Dendrocopos minor	1	0.3	0	0.0	1.0	2	0.6	0	0.0	2.0
Accipiter gentilis	2	0.6	0	0.0	2.0	1	0.3	0	0.0	1.0
Corvus cornix	2	0.6	1	0.4	0.1	0	0.0	0	0.0	
Carduelis carduelis	0	0.0	3	1.3	4.3*	0	0.0	0	0.0	
Carduelis chloris	0	0.0	2	0.8	2.9	0	0.0	1	0.4	1.5
Remiz pendulinus	0	0.0	1	0.4	1.4	0	0.0	2	0.9	3.0
Passer montanus	0	0.0	0	0.0		2	0.6	0	0.0	2.0
Anas platyrhynchos	1	0.3	0	0.0	1.0	1	0.3	0	0.0	1.0
Carduelis chloris	0	0.0	0	0.0		2	0.6	0	0.0	2.0
Streptopelia turtur	1	0.3	0	0.0	1.0	1	0.3	0	0.0	1.0
Luscinia megarhynchos	1	0.3	1	0.4	0.1	0	0.0	0	0.0	
Streptopelia decaocto	0	0.0	0	0.0		2	0.6	0	0.0	2.0
Anthus trivialis	1	0.3	1	0.4	0.1	0	0.0	0	0.0	
Picus viridis	0	0.0	1	0.4	1.4	1	0.3	0	0.0	1.0
Picus canus	0	0.0	0	0.0		1	0.3	1	0.4	0.1
Mergus merganser	0	0.0	1	0.4	1.4	0	0.0	1	0.4	1.5
Alcedo atthis	0	0.0	1	0.4	1.4	0	0.0	1	0.4	1.5
Motacilla cinerea	0	0.0	0	0.0		1	0.3	0	0.0	1.0
Phasianus colchicus	0	0.0	0	0.0		1	0.3	0	0.0	1.0
Parus ater	0	0.0	0	0.0		1	0.3	0	0.0	1.0
Columba oenas	1	0.3	0	0.0	1.0	0	0.0	0	0.0	
Turdus viscivorus	0	0.0	0	0.0		1	0.3	0	0.0	1.0
Emberiza hortulana	1	0.3	0	0.0	1.0	0	0.0	0	0.0	
Jynx torquilla	0	0.0	0	0.0		1	0.3	0	0.0	1.0
Ciconia nigra	0	0.0	0	0.0		1	0.3	0	0.0	1.0
Passer montanus	0	0.0	1	0.4	1.4	0	0.0	0	0.0	
Accipiter nisus	0	0.0	0	0.0		0	0.0	1	0.4	1.5
Parus ater	0	0.0	0	0.0		0	0.0	1	0.4	1.5
Actitic hypoleucos	0	0.0	1	0.4	1.4	0	0.0	0	0.0	
Total	**330**		**231**			**340**		**229**		

comprising 53.3% of all pairs breeding on edges. The proportion of dominant group was, therefore, almost identical in interior forest and on forest edge. Its species composition was, however, different. The Chaffinch *Fringilla coelebs*, Starling *Sturnus vulgaris*, Chiffchaff *Phylloscopus collybita*, and Blackcap *Sylvia atricapilla* were dominants in both habitats compared; the Great Tit *Parus major*, Nuthatch *Sitta europaea* and Robin *Erithacus rubecula* dominated in interior forest, while the Blackbird *Turdus merula* and Yellow Hammer *Emberiza citrinella* in forest edges (Table 1).

The proportions of subdominant group were again very similar in both habitats compared (21.2% in interior forest against 23.0% in forest edge), but also here their species composition differed: in interior forest this group was represented by six, while on forest edges – by nine species; only three species, the Blue Tit *Parus caeruleus*, Collared Flycatcher *Ficedula albicollis* and Hawfinch *Coccothraustes coccothraustes*, were common in both habitats compared.

In interior forest, hole-nesting birds were more numerous, while species nesting low in trees or in shrubs were more numerous on forest edges (Fig. 1). The proportion of species nesting high in trees and those nesting on the ground or in herbaceous vegetation was similar in both habitats compared.

Tab 2: Dominant species in the hornbeam forests near Grodków and their dominance in other hornbeam forests in Poland.

Region	**Dominant species**							**Source**
	Sv	*Fc*	*Pc*	*Pm*	*Sa*	*Se*	*Er*	
Białowieża	0,1-5,9	19,8-	0,4-	2,9-	2,2-	1,4-	8,0-	Tomiałojć et al. 1984
National Park		24,0	1,0	3,9	3,2	2,5	11,3	
Białowieża	0,0-5,4	20,4-	0,9-	4,2-	2,8-	1,6-	6,1-	Wesołowski et al. 2006
National Park		24,9	1,1	5,2	4,3	2,2	7,6	
Lubuskie Lakeland, Zielona Góra vicinity	18,0	22,0	3,8	9,4	2,4	2,9	5,2	Jermaczek 1991
Odra Valley, Legnica vicinity,	22,4	16,5	3,0	6,5	4,7	4,1	3,5	Tomiałojć 1974
Odra Valley Wołów vicinity	4,7	11,5	2,6	8,4	2,6	7,4	7,4	Ranoszek 1969
Odra Valley	10,6-	11,5-	2,5-	5,1-	3,2-	4,4-	3,8-	Tomiałojć, Profus 1977
Wrocław vicinity	20,1	13,8	6,5	7,7	7,9	5,7	5,1	
Niemodlińska Plain Korfantow vicinity	13,0	12,2	8,4	5,3	11,5	3,1	5,3	Kopij 2000
Nysy Kłodzka Valley near Grodków	12,9	9,7	6,8	6,4	6,0	5,6	5,3	this study

** Sv – Sturnus vulgaris, Fc – Fringilla coelebs, Pc – Phylloscopus collybita, Pm – Parus major, Sa – Sylvia atricapilla, Se – Sitta europaea, Er – Erithacus rubecula.*

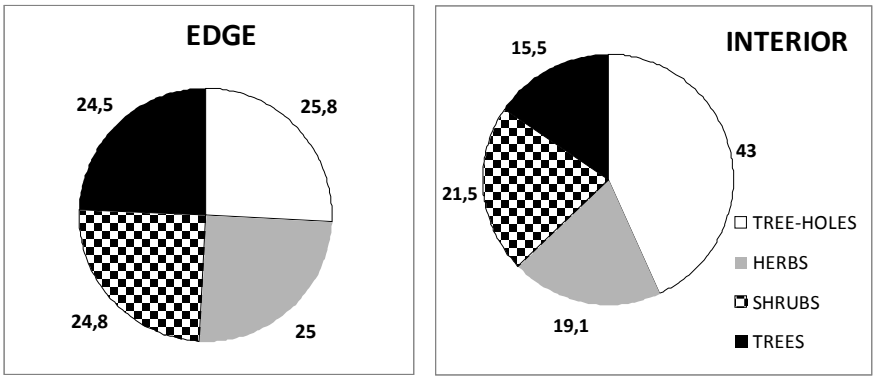

Fig 1: Proportions (in percentage) of nesting guilds on the edge and in the interior and of hornbeam forest.

Discussion

Species composition in the hornbeam stands on the Nysa Kłodzka is similar both to natural (Tomiałojć et al. 1986; Tomiałojć, Wesołowski 1986; Wesołowski et al. 2006) and managed (Dyrcz 1963; Jermaczek 1991; Ranoszek 1969; Tomiałojć 1974; Tomiałojć, Profus 1977) hornbeam forests in Poland. In regard to general dominance structure the hornbeam forests in Nysa Kłodzka Valley are similar to the managed hornbeam forests in the Odra Valley, but different from the natural ones in Białowieża National Park (Table 2). Much higher densities of Chiffchaff, Starling, Blackcap and Nuthatch were recorded in Nysa Kłodzka hornbeam (Table 1), while much higher densities of the Wood Warbler *Phyloscopus trochilus*, Collared Flycatcher and Song Thrush *Turdus philomelos* were in the hornbeam in Białowieża National Park (Tomiałojć et al. 1986; Wesołowski et al. 2006).

In hornbeams, where Wood Warbler is numerous, the Chiffchaff is uncommon and vice versa. This difference is caused probably by different level of humidity and insolation. Much higher density of the Blackcap and lower of the Song Thrush in Nysa Kłodzka hornbeam as compared to Białowieża hornbeam might be a result of a rapid increase of the former species, while a decline of the latter one in the last few decades (Bauer, Berthold 1997).

In managed hornbeam in Nysa Kłodzka, dominant species comprised 53% of all breeding birds, while in the natural hornbeam forests of Białowieża National Park, their contribution varied in 6 study plots from 55 to 66% (Tomiałojć et al. 1986; Wesołowski et al. 2006). This was unexpected, as in natural habitats dominant group comprises lower proportion than in same habitats, but under management (Weiner 1999). This could be caused by edge effect: all study plots with the hornbeam forests in Białowieża National Park were situated in interior forests, while those in Nysa Kłodzka Valley are located in close proximity to farmland and river.

References

Bauer H.-G. & Berthold P. (1997): Die Brutvögel Mitteleuropas. Bestand und Gefährdung. Wiesbaden, Aula Verlag.

Bibby C. J., Burgess N. D. & Hill D. A. (1992): Bird census technique. London, Academic Press.

Bogucki Z. (1977): Ptaki rezerwatu „Dębina" pod Wągrowcem. – Bad. fizjograf. Pol. zach., Ser. C, Zool. 30: 169-183.

Dyrcz A. (1963): Badania porównawcze nad awifauną środowiska leśnego i parkowego. – Acta orn. 7: 337-385.

Gromadzki M., Dyrcz A., Głowaciński Z. & Wieloch M. [red.] (1994): Ostoje ptaków w Polsce. Gdańsk. OTOP.

Jermaczek A. (1991): Ugrupowania ptaków lęgowych lasów liściastych Ziemi Lubuskiej. – Prz. przyr. 2 (2/3): 3-64.

Kopij G. (2000): Badania ilościowe nad ptakami lęgowymi w lasach Nadleśnictwa Tułowice. – Przyr. Śląska opol. 6: 24-30.

– (2005b): Ptaki lęgowe rezerwatów przyrody „Dębina" i „Kokorycz" w grądach nad Nysą Kłodzką koło Kopic. – Przyr. Śląska opol. 11: 35-37.

Matuszkiewicz M. (2002): Zespoły leśne Polski. Warszawa. PWN.

Mazur S. (1992): Podzespół grądu kokoryczkowego *Tilio-Carpinetum corydaletosum* oraz podzespół grądu czosnkowego *Tilio-Carpinetum allietosum* w Dolinie Nysy Kłodzkiej. – Zesz. przyr. OTPN 28: 39-53.

Ranoszek E. (1969): Ilościowe obserwacje ptaków w grądzie nadodrzańskim. – Not. orn. 10: 10-14.

Tomiałojć L. (1974): Charakterystyka ilościowa lęgowej i zimowej awifauny lasów okolic Legnicy (Śląsk Dolny). – Acta orn. 14: 59-97.

Tomiałojć L. & Profus P. (1977): Comparative analysis of breeding bird communities in two parks of Wrocław and in an adjacent *Querco-Carpinetum* forest. – Acta orn. 16: 117-177.

Tomiałojć L. & Wesołowski T. (1986): Structure of primaeval forest bird community during 1970s and 1990s (Bialowieza National Park). Acta orn., 20: 121-310.

Tomiałojć L., Wesołowski T. & Walankiewicz W. (1984): Breeding bird community of a primeval temperate forest (Białowieża National Park, Poland). – Acta orn. 20: 241-310.
Weiner J. (1999): Życie i ewolucja biosfery. Podręcznik ekologii ogólnej. Warszawa, PWN.
Wesołowski T., Rowiński P., Mitrus C. & Czeszczewik D. (2006): Breeding bird community of a primeval temperate forest (Białowieża National Park, Poland) at the beginning of the 21st century. – Acta orn. 41: 55-70.

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