Breeding bird assemblage of a secondary ash-willow floodplain forest along the Morava River, Slovakia

Štruktúra vtáčieho zoskupenia druhotného jaseňovo-vŕbového lužného lesa pri rieke Morave, Slovensko

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Structure of a breeding bird assemblage of a secondary ash-willow floodplain forest growing along the Morava River in Slovakia (Dolný les National Nature Reserve) was studied in 1993 and 1995. Population abundances were estimated by the combined version of the mapping method from April to early July within a 10.5 ha study plot. Altogether, 55 bird species (48 breeders) were recorded within the reserve during the two-year research. Of these, 38 species bred in the study plot, reaching a mean total density of the assemblage across years 154.33 ± 6.67 (SD) pairs/10 ha. The annual rarefaction estimates [$E\,(S_{100\ pairs})$] were 24.75 species in 1993 and 25.58 species in 1995. The annual rarefaction estimates per unit area [$E\,(S_{10\ ha})$] were 27.18 species in 1993 and 28.15 species in 1995. Two species, the Blackcap (*Sylvia atricapilla*) and Chaffinch (*Fringilla coelebs*) were classified as eudominant ($x \geq 10\%$).

*Štruktúra hniezdnej ornitocenózy sekundárneho jaseňovo-vŕbového okrajového lužného lesa pri rieke Morava (Národná prírodná rezervácia Dolný les), Borská nížina, Slovensko, bola sledovaná v rokoch 1993 a 1995. Populačné hustoty boli zisťované kombinovanou verziou mapovacej metódy v 10,5 ha študijnej ploche od apríla do začiatku júla. Celkovo bolo v rezervácii počas dvoch rokov výskumu zistených 55 druhov vtákov (48 hniezdičov). Z toho 38 druhov hniezdilo v študijnom kvadráte, pričom dosiahlo priemernú celkovú hustotu 154,33 ± 6,67 (smerodajná odchýlka) párov/10 ha. Prepočet pomocou metódy „rarefaction" na štandardizovanú vzorku 100 párov [*E $(S_{100\ párov})$*] bol 24,75 druhov v roku 1993 a 25,58 druhov v roku 1995. Prepočet pomocou „rarefaction" na štandardizovanú plochu 10 ha [*E $(S_{10\ ha})$*] dosiahol hodnotu 27,18 druhov v roku 1993 a 28,15 druhov v roku 1995. Druhy* Sylvia atricapilla *a* Fringilla coelebs *boli klasifikované ako eudominantné* ($x \geq 10$ %).

Keywords: bird census, bird community; mapping method, population density, community structure, rarefaction

INTRODUCTION

Riparian wetland forests rank among the most species diverse and densely occupied habitats with the fastest energy flow in Slovakia. Wetland habitats occurring in lowlands such as the Danubian basin, the Borská basin (southwestern Slovakia) and the Východoslovenská basin (southeastern Slovakia) have been under strong human pressure due to the presence of very fertile soils primarily used for agriculture. The forested landscape in southern Slovakia was deforested and settled by the first inhabitants in the ancient times causing serious fragmentation and degradation of the original native forest communities. At present, majority of the lowland forest stands are secondary habitats with significant changes in floristic and habitat structure. These wetlands are commonly under ecological attack of non-native invasive species. The last remains of riverine hardwood wetland forest are found along the Morava River in the state border sectors intensively protected and guarded by military units during the Cold War period. In such areas the last fragments of wetland forests persisted in relatively well-preserved conditions. The best preserved and the most representative fragments were designated as nature reserves.

Nature reserves form core areas in ecological networks such as ÚSES (Territorial System of Ecological Stability), NECONET (National Ecological Network) or Natura 2000. The Birds Directive, requiring identification of Special Protection Areas as a part of Natura 2000, is a primary conservation measure for populations of wild birds in the European Union countries. For objective evaluation of the ecological value of a reserve in an ecological network, quantitative data on the structure of communities and demography of populations are needed. Various methods of population size estimates have been proposed with varying accuracy e.g. belt transect, line transect, point counts, net trapping (capture-recapture techniques), distance sampling, territory (spot) mapping, etc. Based on the number of field tests, the territory mapping method (especially its combined version) is considered as one of the most accurate census methods (Enemar et al. 1979, Tomiałojć 1980, Paul and Roth 1983, Tiainen and Bastian 1983, Hogstad 1984, Borowiec & Ranoszek 1984, Morozov 1994a), although serious difficulties with some species and with the observer and analyst variability still exist (Tomiałojć and Lontkowski 1989, Verner & Milne 1990, Morozov 1994b, Walankiewicz et al. 1997, Tomiałojć 2004). Population densities alone cannot be used as an objective indicator of habitat quality without demographic parameters of target populations (Van Horne 1983). Complex criteria for definition of the favourable conservation status of the species of conservation concern according to the Birds Directive and the national legislation are a basis of effective biodiversity conservation strategy.

The floodplain ecosystems of the Morava River in Slovakia were not studied from the ornithological aspect for a long time. The first report focused on the occurrence of selected species in this area was published by Horák (1931–1932) in the faunistic study of birds of Western Slovakia. Prior to 1989 only one ornithological report by Barčák & Cyprich (1971) was published. A complex multidisciplinary research of the Morava River floodplain ecosystems conducted by the Slovak Academy of Sciences and Comenius University started in 1990. The first study within this research was focused on species structure of the main habitats (Kalivodová et al. 1994). Structure of bird assemblages of the

main floodplain habitats in the period 1990–95 was evaluated by Kalivodová et al. (1996). The authors described the structure of bird assemblages from a pooled data set prepared from the quantitative survey of five one-hectare plots and two 50 m wide belt transects. The individual plot and transect samples were not separately evaluated; only population densities from pooled data from all samples were jointly presented. In the same period, three bird inventory studies of wetland ecosystems in the area of Devínske jazero and especially in the Dolný les National Nature Reserve were carried out (Petrakovič 1993, Tomovčík 1994, Korňan 1996). Tomovčík (1994) and Korňan (1996) analyzed quantitative structure of a breeding bird assemblage of the floodplain hardwood forest in the reserve by the mapping method. The two census plots having about the same size were placed in the same area and partly spatially overlapped. The census results of the Korňan's (1996) research are analyzed in this paper.

Studies of wetland forest bird assemblages in Slovakia using an accurate census method such as territory mapping have a very short history and are generally rare. A cluster of descriptive studies focused on the structure of breeding bird assemblages in secondary floodplain stands dominated by willows and poplars in the Danubian basin was published by Bohuš (1993, 2000), Bohuš et al. (1999) and Ilek (2005). More studies of bird assemblages of wetland forests using the mapping method were carried out in different habitat types in the Czech Republic, e.g. in the ash-oak forest (Chytil 1984, 1990), ash-oak-alder forest (Bureš & Maton 1984–1985, Bureš 1988), oak-elm forest (Pavelka 1988, Lemberk 2001), oak-spruce forest (Pykal 1991), oak-poplar-ash-alder forest (Storch 1998).

The aims of the present study are as follows: a) to analyse basic structural features of the bird assemblage such as population density, dominance, species diversity, evenness and species richness-sample size relationships by rarefaction; b) compare the present study with the results of bird assemblage studies of floodplain forests in Slovakia and the Czech Republic; c) evaluate the nature conservation value of the reserve from the aspect of bird assemblage structure.

MATERIAL AND METHODS

Study area

The study was conducted in the Dolný les National Nature Reserve located in the Morava River floodplain area, 2.3 km southeast of Vysoká pri Morave, southwestern Slovakia, (Fig. 1). The reserve was established in 1981. The study area represents a relatively compact and preserved fragment of a secondary riverine landscape of the lower reaches of the Morava River. The reserve, in total 186.26 ha in size (Slovenská agentúra životného prostredia & Slovenské múzeum ochrany prírody a jaskyniarstva 2010), consists of forest stands (172.92 ha) and meadows (3.93 ha). It is a part of the Dolnomoravská niva morphological sub-unit within the Záhorská nížina lowland or Vienna Basin (Oťaheľová et al. 1995). The elevation of the study area is 137–142 m a.s.l.

The hydrological regime of the Morava River is typical for rivers of highlands. The annual mean discharge is 95 $m^3.s^{-1}$ at the village of Moravský sv. Ján. The peak run off occurs in March, lower flow is recorded in autumn, gradually decreasing until October when there is the annual low discharge period (Oťaheľová et al. 1995). Dynamics of underground waters is closely dependent on dynamics of the stream discharge. In the periods of high discharge, water can flood terrain de-

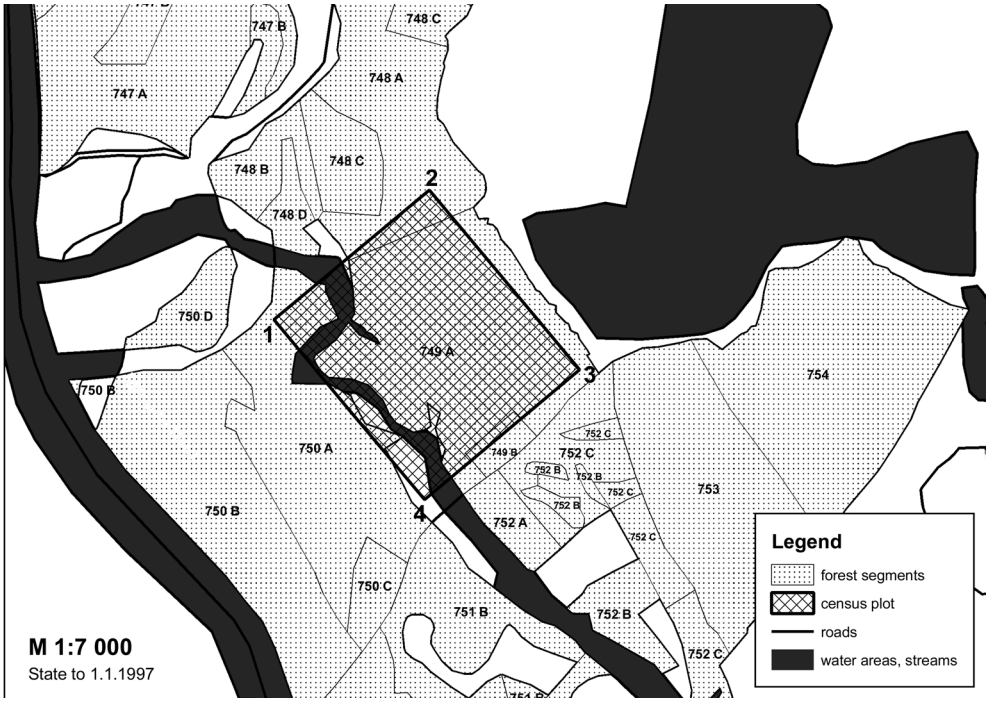

Fig. 1. Map of the study area and location of the census plot in the Dolný les National Nature Reserve. The plot was georeferenced (system WGS84) in the corners. The numbers in corners indicate geographic coordinates (1 = 16°54'19"E, 48°17'56.8"N; 2 = 16°54'29"E, 48°18'3.8"N; 3 = 16°54'41"E, 48°17'56"N; 4 = 16°54'31"E, 48°17'48.9"N).

Obr. 1. *Mapa študijnej oblasti s lokalizáciou sčítacej plochy v Národnej prírodnej rezervácii Dolný les. Plocha bola georeferencovaná (systém WGS84) v rohoch. Čísla pri rohoch korešpondujú zemepisným súradniciam (1 = 16°54'19" v.d., 48°17'56.8" s.š.; 2 = 16°54'29" v.d., 48°18'3.8" s.š.; 3 = 16°54'41" v.d., 48°17'56" s.š.; 4 = 16°54'31" v.d., 48°17'48.9" s.š.).*

pressions and oxbows to various extend. After water spill through riverbank happening commonly in March until April, less frequently in summer, local floods may reach the water level of up to 142 m a.s.l. (Petrakovič 1993).

The climate can be characterised as warm and little dry with a weak temperature inversion. The mean January temperature (1961–1990, station Kuchyňa) is –1.9 °C, whereas mean July temperature is 19.1 °C (Mikulová et al. 2008). The annual precipitation is 642 mm.

The bird censuses were conducted within a 10.5 ha (300 × 350 m) forest edge plot representing one of the best preserved fragments of a secondary hardwood riparian forest in the Záhorie region (Fig. 1). The plot was situated in the forest segments 749A, 749B and 750A shown in the forest typological map of the National Forestry Centre (Národné lesnícke centrum, Zvolen, Slovakia). The age of forest stand in the segment 749A was estimated at 70 years, in the segment 749B at 25 years and in the segment 750A at 65 years (as of 1 January 1997, data from the database of the National Forestry Centre). Birds were also recorded in a 100 m belt along the border of the census plot (categories "o+" and "p" in Table 2). Other habitat types,

e.g. a poplar monoculture or a young growth were present in the belt, therefore species in the categories "o+" and "p" cannot be taken as species of the ash-willow assemblage. The census plot is located along the 17th river kilometre at the margin of the reserve 0–ca 50 m from the forest edge near the gravel lake. The plot has no slope inclination except few terrain depressions formed by persisting or former oxbows covered by successional vegetation. The forest is unevenly aged with considerable vertical and horizontal heterogeneity. The extreme spatial habitat heterogeneity can be seen in high interior fragmentation caused by water ditches, oxbows, terrain depressions, local succession, etc. Fragmentation was partly caused by forestry; i.e. local successions of thinning regimes created two small patches of 5–20 year old poplar stands 0.05–0.1 ha in size in the segment 749A.

Plant communities correspond to the associations *Fraxino pannonicae-Ulmetum* and *Salici-Populetum* following the Braun-Blanquet phytosociological classification (Petrakovič 1993, Jarolímek 1994). The association *Fraxino pannonicae-Ulmetum* is typical for drier and elevated parts covering approximately 80 % of the plot, while the association *Salici-Populetum* occurs primarily along oxbows and covers about 20 % of the plot. The structure of the tree layer is described in Table 1. A hybrid Crack-willow (*Salix* × *rubens*, a hybrid of *Salix fragilis* and *S. alba*) was the largest growing tree in the plot reaching 144 cm (1.3 m) in diameter and 34.5 m high, followed by a Poplar (probably hybrids *Populus alba* × *nigra*) 65 cm wide and 35 m high, while the most common species, the Narrow-leafed Ash (*Fraxinus angustifolia*) had the maximum width of 60 cm and height of 33 m. The shrub layer consists of young saplings of the dominant tree species as well as the Midland Hawthorn (*Crataegus laevigata*), Dogwood (*Swida sanquinea*), Blackthorn (*Prunus spinosa*), European Spindle (*Euonymus europaeus*),

Table 1. Tree structure of the secondary riparian ash-willow floodplain forest (associations *Fraxino pannonicae-Ulmetum* and *Salici-Populetum*) in the Dolný les National Nature Reserve sampled by the 11.3 m diameter circular plot method. Values are given with standard deviations (SD).

Tab. 1. *Druhová štruktúra stromov v sekundárnom jaseňovo-vŕbovom lužnom lese (asociácia Fraxino pannonicae-Ulmetum and Salici-Populetum) v Národnej prírodnej rezervácii Dolný les. Výskum bol robený metódou kruhových plôch s polomerom 11,3 m. Hodnoty sú so smerodajnými odchýlkami.*

SPECIES	Abundance	Density	Dominance	Trunk diameter	Tree height
	(n)	(ex./ha)	(%)	(cm/1.3 m)	(m)
Fraxinus angustifolia	64	199.43 ± 148.39	82.05 ± 41.07	38.71 ± 10.42	26.80 ± 5.48
Salix × *rubens*	6	18.70 ± 37.09	7.69 ± 46.29	69.33 ± 45.19	21.57 ± 11.63
Populus sp.	3	9.35 ± 18.55	3.85 ± 7.59	46.00 ± 16.82	33.50 ± 1.50
Ulmus laevis	2	6.23 ± 17.63	2.56 ± 5.44	24.50 ± 10.61	13.90 ± 6.93
Ulmus minor	1	3.12 ± 8.81	1.28 ± 2.36	25.00	16.50
Acer campestre	1	3.12 ± 8.81	1.28 ± 2.36	19.00	9.80
Crataegus oxyacantha	1	3.12 ± 8.81	1.28 ± 3.93	11.00	6.50
Standing dead trees	9	28.04 ± 40.93	–	22.56 ± 6.41	13.61 ± 6.29
TOTAL	**87**	**243.05 ± 131.06**	**100.00**	**40.20 ± 18.05**	**25.72 ± 7.18**

Table 2. Annual and mean abundance, density and dominance of the breeding bird assemblage of the secondary ash-willow edge riparian forest in the Dolný les National Nature Reserve in the years 1993 and 1995.
Tab. 2. *Ročné a priemerné hodnoty početnosti, hustoty a dominancie hniezdnej ornitocenózy sekundárneho jaseňovo-vŕbového okrajového lužného lesa v Národnej prírodnej rezervácii Dolný les v rokoch 1993 a 1995.*

Species	Abundance		Density (pairs/10 ha)			Dominance (%)		
	1993	1995	1993	1995	x̄	1993	1995	x̄
1. Sylvia atricapilla Blackcap	17.9	20.5	17.05	19.52	18.29	11.39	12.28	11.83
2. Fringilla coelebs Chaffinch	19.2	17.8	18.29	16.95	17.62	12.22	10.66	11.44
3. Sturnus vulgaris Starling	11.0	13.0	10.48	12.38	11.43	7.00	7.78	7.39
4. Cyanistes caeruleus Blue Tit	10.6	11.1	10.10	10.57	10.33	6.75	6.65	6.70
5. Phylloscopus collybita Chiffchaff	11.8	9.5	11.24	9.05	10.14	7.51	5.69	6.60
6. Parus major Great Tit	8.3	7.8	7.90	7.43	7.67	5.28	4.67	4.98
7. Ficedula albicollis Collared Flycatcher	6.7	7.0	6.38	6.67	6.52	4.26	4.19	4.23
8. Locustella fluviatilis River Warbler	6.7	6.0	6.38	5.71	6.05	4.26	3.59	3.93
9. Erithacus rubecula Robin	5.5	5.8	5.24	5.52	5.38	3.50	3.47	3.49
10. Muscicapa striata Spotted Flycatcher	5.6	5.5	5.33	5.24	5.29	3.56	3.29	3.43
11. Dendrocopos major Great Spotted Woodpecker	4.7	5.0	4.48	4.76	4.62	2.99	2.99	2.99
12. Oriolus oriolus Golden Oriole	3.8	5.5	3.62	5.24	4.43	2.42	3.29	2.86
13. Emberiza citrinella Yellowhammer	4.7	4.0	4.48	3.81	4.14	2.99	2.40	2.69
14. Dendrocopos minor Lesser Spotted Woodpecker	3.0	5.2	2.86	4.95	3.90	1.91	3.11	2.51
15. Certhia brachydactyla Short-toed Treecreeper	4.0	4.0	3.81	3.81	3.81	2.55	2.40	2.47
16. Prunella modularis Dunnock	4.2	3.0	4.00	2.86	3.43	2.67	1.80	2.23
17. Hippolais icterina Icterine Warbler	4.0	3.0	3.81	2.86	3.33	2.55	1.80	2.17
18. Coccothraustes coccothraustes Hawfinch	3.0	4.0	2.86	3.81	3.33	1.91	2.40	2.15
19. Carduelis carduelis Goldfinch	3.0	3.5	2.86	3.33	3.10	1.91	2.10	2.00
20. Anthus trivialis Tree Pipit	2.0	3.7	1.90	3.52	2.71	1.27	2.22	1.74
21. Chloris chloris Greenfinch	3.3	2.3	3.14	2.19	2.67	2.10	1.38	1.74
22. Turdus philomelos Song Thrush	2.1	3.3	2.00	3.14	2.57	1.34	1.98	1.66
23. Troglodytes troglodytes Wren	2.0	3.0	1.90	2.86	2.38	1.27	1.80	1.53
24. Passer montanus Tree Sparrow	2.0	3.0	1.90	2.86	2.38	1.27	1.80	1.53
25. Columba palumbus Woodpigeon	2.0	2.0	1.90	1.90	1.90	1.27	1.20	1.24
26. Sitta europaea Nuthatch	1.3	2.0	1.24	1.90	1.57	0.83	1.20	1.01
27. Turdus merula Blackbird	0.8	2.0	0.76	1.90	1.33	0.51	1.20	0.85
28. Poecile palustris March Tit	1.0	1.0	0.95	0.95	0.95	0.64	0.60	0.62
29. Serinus serinus Serin	0.7	1.0	0.67	0.95	0.81	0.45	0.60	0.52
30. Cuculus canorus Cuckoo	0.7	0.5	0.67	0.48	0.57	0.45	0.30	0.37
31. Jynx torquilla Wryneck	–	1.0	0.00	0.95	0.48	0.00	0.60	0.30
32. Dendrocopos medius Middle Spotted Woodpecker	1.0	o+	0.95	{0.2}	0.48	0.64	0.00	0.32

Species	Abundance		Density (pairs/10 ha)			Dominance (%)		
	1993	1995	1993	1995	x̄	1993	1995	x̄
33. Certhia familiaris Treecreeper	o+	1.0	{0.2}	0.95	0.48	0.00	0.60	0.30
34. Lanius collurio Red-backed Shrike	0.5	–	0.48	0.00	0.24	0.32	0.00	0.16
35. Buteo buteo Buzzard	+	+*	{0.1}	{0.1}	–	–	–	–
36. Streptopelia turtur Turtle Dove	+	o+	{0.2}	{0.1}	–	–	–	–
37. Dryocopus martius Black Woodpecker	o+	+	{0.1}	{0.2}	–	–	–	–
38. Corvus corone cornix Carrion Crow	+	–	{0.1}	0.00	–	–	–	–
39. Asio otus Long-eared Owl	o+	o+	{0.1}	{0.1}	–	–	–	–
40. Picus viridis Green Woodpecker	o+	o+	{0.2}	{0.2}	–	–	–	–
41. Acrocephalus palustris March Warbler	o+	o+	{0.2}	{0.2}	–	–	–	–
42. Phylloscopus sibilatrix Wood Warbler	o+	o+	{0.2}	{0.2}	–	–	–	–
43. Milvus migrans Black Kite	o+	–	{0.05}	0.00	–	–	–	–
44. Sylvia communis Whitethroat	o+	–	{0.2}	0.00	–	–	–	–
45. Sylvia borin Garden Warbler	o+	–	{0.2}	0.00	–	–	–	–
46. Phylloscopus trochilus Willow Warbler	o+	–	{0.2}	0.00	–	–	–	–
47. Poecile montanus Willow Tit	o+	–	{0.2}	0.00	–	–	–	–
48. Remiz pendulinus Penduline Tit	o+	–	{0.2}	0.00	–	–	–	–
49. Ardea cinerea Grey Heron	p	p	0.00	0.00	–	–	–	–
50. Ciconia nigra White Stork	p	p	0.00	0.00	–	–	–	–
51. Anas platyrhynchos Mallard	p	p	0.00	0.00	–	–	–	–
52. Motacilla alba Pied Wagtail	p	p	0.00	0.00	–	–	–	–
53. Ciconia ciconia White Stork	p	–	0.00	0.00	–	–	–	–
54. Anser anser Greylag Goose	p	–	0.00	0.00	–	–	–	–
55. Saxicola rubetra Whinchat	p	–	0.00	0.00	–	–	–	–
Total	**157.1**	**167.0**	**149.62**	**159.05**	**154.33**	**100.00**	**100.00**	**100.00**

Explanations: Plus sign ("+") indicates breeding abundance less than 0.5 territory (pair) per study plot; "o+" indicates very scarce breeding presence in the reserve, but the species was not detected as a breeder in the study plot; "p" is used for species detected in the study plot or reserve in this habitat type as non-breeders, transmigrants or rare visitors; "–" indicates absence; * – nest in the study plot. In the annual density columns, density estimates for "+" and "o+" species are qualified guesses based on observations in the reserve and area. Constant values of densities of "+" and "o+" species were roughly estimated. These density estimates are given in parentheses {} as approximations for calculations of diversity indices and rarefaction of the assemblage.

*Vysvetlivky: Znak plus ("+") indikuje hniezdnu početnosť nižšiu ako 0,5 teritória (páru) v sčítacom kvadráte; znak "o+" indikuje veľmi nízku hniezdnu početnosť v rezervácii, pričom druh nebol zaznamenaný ako hniezdič v sčítacom kvadráte; znak "p" je použitý pre druhy zaznamenané v študijnej ploche alebo rezervácii v tomto type biotopu ako nehniezdič, transmigrant alebo zatúlanec; znak "–" indikuje absenciu, * – hniezdo v sčítacej ploche. V kolónkach ročných hustôt sú hustoty pre "+" a "o+" druhy vyjadrené kvalifikovanými odhadmi založenými na pozorovaniach v rezervácii a oblasti. Konštantné hodnoty hustoty pre "+" a "o+" treba chápať ako hrubé odhady. Hodnoty týchto odhadov sú uvádzané v zátvorkách {} ako aproximácie pre výpočet indexov druhovej diverzity a "rarefaction" zoskupenia.*

Pedunculate Oak (*Quercus robur*), Field Maple (*Acer campestre*) and species of the genus *Ulmus*. The herb layer consists mostly of the Confused Michaelmas-daisy (*Aster novi-belgii*), Common Nettle (*Urtica dioica*), Raspberry (*Rubus idaeus*), Ground-ivy (*Glechoma hederacea*) and Common Chickweed (*Stellaria media*). Other species such as the Reed Canary-grass (*Phalaroides arundinacea*), Field Bindweed (*Convolvulus arvensis*), Woolly Burdock (*Arctium tomentosum*), Cut-leaf Teasel (*Dipsacus laciniatus*) and Narrow-leaf Dock (*Rumex stenophyllus*) were present less frequently.

Quantitative description of vegetation structure and floristics of the 10.5 ha study plot was conducted by a 11.3 m (0.04 ha) circular plot method originally proposed for studies on bird-habitat relationships (Noon 1981, Korňan 1996). In total, 8 randomly spaced circular plots were used for a detailed description of the plot. The measurements were taken in the period 7–14 October 1995. The mean values and sample standard deviations (SD) of vegetation parameters were computed from all measurements from all circular plots except the SD values of density and dominance, which were computed from values in circular plots (n = 8). The mean height of the herb layer was 1.08 ± 0.51 m. The mean height of the shrub layer was 1.00 ± 0.67 m. The density of shrubs was 671.84 ± 280.37 ind./ha. The mean closest distance between two trees was estimated at 8.72 ± 5.13 m, while that between two shrubs at 8.67 ± 4.08 m. The horizontal foliage coverages in the 10 height classes were as follows: 99.38 ± 1.77% (0–0.3 m), 81.25 ± 14.58 % (0.3–1 m), 26.88 ± 11.32 % (1–2 m), 7.50 ± 7.07 % (2–3 m), 15.63 ± 12.37 % (3–5 m), 15.00 ± 8.02 % (5–7 m), 16.25 ± 7.44 % (7–10 m), 30.00 ± 7.07 % (10–15 m), 32.50 ± 15.81 % (15–20 m), 61.25 ± 26.83 % (> 20 m).

Bird census

Population densities were estimated by the combined version of the mapping method (Tomiałojć 1980, Korňan 1996). In order to construct an effective orientation system within the study plot, a 50 × 50 m grid system based on a colour plastic tape marking on tree trunks was established in the 10.5 ha (300 ×350 m) rectangular study plot. Breeding bird censuses were carried out in the years 1993 and 1995 from April to the beginning of July. Bird counts were performed in the time period beginning at 04:30 and ending usually by 9:00 CET (sometimes by 10:00 CET) for morning visits, from 16:45 to 20:30 CET for evening visits, and from 19:00 to 22:00 CET for night visits. Altogether 14 visits (in 1993) and 11 visits (in 1995) including three evenings and one night in each season were carried out. Night visits in early April focused on owl registrations. While censusing, all acoustic and visual registrations, nests or other important data related to bird occurrence and dispersal patterns were recorded in the maps of the scale 1:1667. The study design controlled effects of weather and season on density estimates. The criteria for territory interpretation were principally based on the IBCC (1969) recommendations. However, in the case of some secretive species or species with not well-evolved territorial behaviour (listed in Korňan 2009b), species specific minimum number of registrations (acceptance level of territory), and other criteria required to accept a cluster of registrations as a territory may have been modified (Svensson 1978). More details regarding the mapping procedure and principles of species map evaluation are given in the studies by Korňan (1996, 2009a, b). Abundance estimates of the Starling (*Sturnus vulgaris*) were based on nest

searching in the period when nestlings called from cavities.

In order to correctly identify the proportions of edge territories in the study plots, bird registrations were recorded to 100 m distance behind the plot edge lines. The overlap of edge territories to the study plot was estimated at ¼, ⅓, ½, however, only the species with abundance of 0.5 pair per study plot or higher were included in the total count of breeding pairs (territories). In the case of species with abundance lower than 0.5 pair per plot, only breeding presence "+" denoting the stationary occurrence of a part of a bird territory within the boundaries of a plot was stated. This symbol was primarily used for the species with territory sizes much larger than the study plot size such as some woodpeckers, owls, birds of prey, and corvids (Tomiałojć 1980, Korňan 1996). In order to describe the bird species diversity of the reserve more completely, a new symbol ("o+") of census data evaluation was applied for species breeding in the reserve but outside the borders of the census plots. In case of passerines, this applied to the species breeding in the 100 m belt lined along the census plot, and in case of non-passerines, to the species breeding in the rest of the reserve, but whose breeding territory did not overlap the census plot. This symbol was not used in the original design of census data presentation in the combined version of the mapping method (Tomiałojć 1980). These data were collected on the way to the census plot and back and while searching for Starling nests.

Numerical analyses

To assess the bird assemblage structure, I analysed population abundance, density, dominance, species diversity, evenness, and rarefaction (species richness estimate on a standardized sample size of territorial pairs or area).

Species diversity and evenness were measured by three common formulas – the Shannon, Simpson, and Brillouin indices and rarefaction (Magurran 1991). These three indices were selected for comparison purposes because they were the most commonly used in community ecology in the past decades. We also used rarefaction as a more objective measure of species diversity because the index values confound several community parameters such as number of species, relative abundance and area into one non-metric number (Hurlbert 1971, James & Rathbun 1981). The rarefaction was calculated on a standardised number of territorial pairs and area size (Table 3). To include species with very low population densities in the study plot ("+") to the computation of species diversity, evenness, and similarity of assemblage structure, constant numbers of densities (see Table 2 for the constant values given in parentheses) were added to these species. Similarities in the structure of assemblages were measured by the qualitative Sørensen index and quantitative Czekanowski-Sørensen index (Magurran 1991). Species diversity indices and evenness were calculated using NUCOSA 1.05 (Tóthmérész 1993). Rarefaction was computed using Maxima 5.17.0.

RESULTS

In total, 55 bird species including 48 breeding species were recorded in the ash-willow forest habitat in the Dolný les National Nature Reserve during two years of study (Table 2). Altogether 54 species were observed in 1993, whereas 44 species were detected in 1995. As many as 47 species bred in 1993, while only 40 in 1995. Within the 10.5 ha study plot, a to-

tal of 38 breeding species were recorded, 35 in 1993 and 34 in 1995. Similarity of species structure between years was estimated by the qualitative Sørensen index and quantitative Czekanowski-Sørensen index. Both indices reached the value 0.90, indicating very high between-year similarities in species structure of the assemblage.

The mean total density summing all species of the ash-willow assemblage was 154.33 p/10 ha. The total density of breeding birds was 149.62 p/10 ha in 1993 and 159.05 p/10 ha in 1995 (Table 2). Based on mean values, the eudominant species ($x \geq 10\%$) contributed by 23.27% (cumulative value of eudominants) to the total assemblage abundance. The yearly variation was 22.93–23.62%. Only two species, *Sylvia atricapilla* and *Fringilla coelebs*, belonged to this dominance class. Ten species, *Asio otus*, *Picus viridis*, *Acrocephalus palustris*, *Phylloscopus sibilatrix*, *Milvus migrans*, *Sylvia communis*, *Sylvia borin*, *Phylloscopus trochilus*, *Poecile montanus* and *Remiz pendulinus* bred in the patchy habitat outside the study plot.

Table 3. Estimates of species diversity and evenness of the breeding bird assemblage of the secondary ash-willow forest in the Dolný les National Nature Reserve by standard indices and rarefaction. Only breeding species recorded in the study plot (including "+" trace species) were included. The Shannon diversity index is calculated in bites in this table.
Tab. 3. *Odhady druhovej diverzity a equitability hniezdnej ornitocenózy sekundárneho jaseňovo-vŕbového lesa v Národnej prírodnej rezervácii Dolný les podľa štandardných indexov a "rarefaction". Do výpočtov boli zahrnuté len hniezdiče v sčítacom kvadráte (vrátane "+" stopových druhov). Shannonov index je v tejto tabuľke počítaný v bitoch.*

Diversity measures	1993	1995	Mean
Total number of species	54	44	49.00
Total number of breeders	47	40	43.50
Number of breeders in plot	35	34	34.50
Shannon (H')	4.49	4.55	4.52
Brillouin (HB)	2.81	2.86	2.84
Simpson (D)	0.94	0.94	0.94
Rarefaction E ($S_{50\ pairs}$)	19.43	20.13	19.78
Rarefaction E ($S_{100\ pairs}$)	24.75	25.58	25.17
Rarefaction E ($S_{5\ ha}$)	22.69	24.00	23.35
Rarefaction E ($S_{10\ ha}$)	27.18	28.15	27.67
Evenness measures			
Evenness Shannon (J')	0.87	0.89	0.88
Evenness Brillouin (E_{HB})	0.88	0.90	0.89
Evenness Simpson (E_D)	0.97	0.97	0.97

All indices of species diversity showed slightly higher values in the year 1995 compared to the year 1993 (Table 3). Similarly, rarefaction estimates of species richness on a standardized sample of individuals and area indicated higher values in the year 1995 than in 1993. The Shannon ($\log_2$) and Brillouin evenness indices also reached slightly higher values in 1995. The Simpson evenness index showed the same values in both years. Relatively shallow hyperbolic shape of the community curve is believed to indicate stable assemblage organization (Fig. 2, Magurran 1991).

Conservation value

The habitat seems to be very valuable for flycatchers *Ficedula albicollis* and *Muscicapa striata* which reached high population densities compared to other forest habitats in Slovakia (Krištín 1991; Bohuš 1993; Kropil 1993; Saniga 1994, 1995a, b; Korňan 1996; Krištín 1996; Kropil 1996a, b; Fiala 1997; Mošanský 1997; Kocian 1998; Bohuš et al. 1999; Krištín 1999; Bohuš 2000; Olekšák 2000; Topercer 2000; Lešo 2001; Pochopová & Kropil 2002; Lešo 2003a, b; Ceľuch & Kropil 2004; Korňan 2004; Ilek 2005; Baláž & Kocian 2006; Baláž 2008; Korňan 2009a, b; Mošanský 2009). In addition, many other protected species (species of national importance) also show high

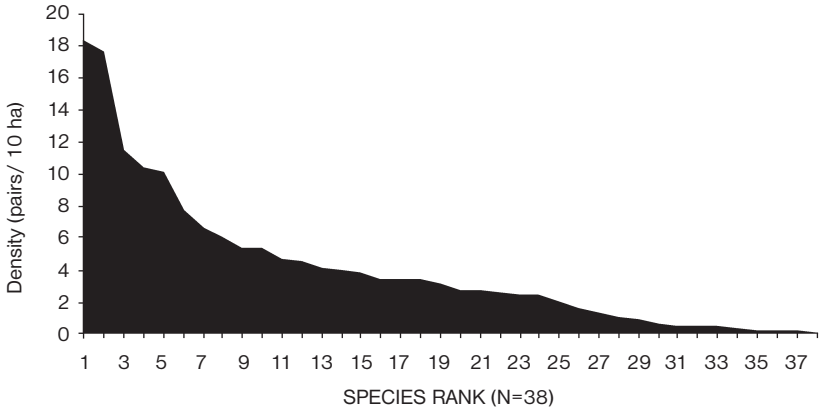

Fig. 2. Assemblage curve of the breeding bird assemblage of the secondary ash-willow wetland forest in the Dolný les National Nature Reserve. Pooled data from the years 1993 and 1995 were used. Only species breeding in the 10.5 ha study plot are included. Species are ranked in descending order.

Obr. 2. *Distribučná krivka hustoty hniezdnej ornitocenózy sekundárneho jaseňovo-vŕbového lužného lesa v Národnej prírodnej rezervácii Dolný les. Prezentované sú sumárne údaje z rokov 1993 a 1995. Zoradené sú len druhy, ktoré hniezdili v 10,5 ha sčítacej ploche. Druhy sú zoradené v klesajúcom poradí.*

population densities in the area. This is documented by the total mean assemblage density that is one of the highest recorded so far in the country (see citations above). In addition, species richness is one of the highest for lowland forest habitats in Slovakia (Bohuš 1993; Korňan 1996; Bohuš et al. 1999; Bohuš 2000; Ilek 2005; Korňan 2009a, b; Mošanský 2009).

DISCUSSION

Bird assemblages of wetland forests in the Slovak and Czech Republic

In total, 16 bird censuses in wetland forests conducted by the mapping method in the period 1978–2004 were selected for comparison with the current study (Table 4). Due to the strong area effect on species richness (Wiens 1989), the species diversity of forests was standardized by rarefaction on the subsamples of 50 pairs and area of 5 ha. Based on the values of species diversity estimated by rarefaction, all types of forests reached similar species diversity with peaks in stands dominated by ash, oak and alder. Poplar and willow stands showed general tendency of slightly lower values, however, ranges for these two groups overlapped. Values of the Shannon diversity index show similar results (Table 4), even though this measure of diversity has been criticized as it confounds several community parameters e.g. number of species, their relative abundance and area sampled into one non-metric number (James & Rathbun 1981, Wiens 1989).

The total densities of bird assemblages were in the range 75.3–431.9 p/10 ha (Table 4). It is impossible to draw any general conclusion or tendency from the distribution of the total assemblage densities among forest types. The highest value (431.9 p/10 ha) was detected in a willow-poplar forest in the Danubian basin (Ilek 2005), whereas the lowest

Table 4. Comparison of the breeding bird assemblage structure of wetland forests in the Slovak and Czech Republic. Only studies in which the mapping method was applied to estimate population densities were selected. List of dominant species and basic assemblage parameters are given. The presented assemblage parameters were not calculated in all studies. Therefore, the published primary data were reanalysed and the parameters were computed. Natural logarithms were used for calculation of the Shannon diversity index and evenness. From larger and overlapping temporal scales in some studies (Bohuš 2000, site 1b, here Bo1), only samples corresponding to the years 1993 and 1995 were selected for comparison with the results of this study. The assemblage parameters were first calculated for individual years and then averaged for mean values. In cases, when trace species (marked "+") were listed as breeders in an assemblage in any study, constant values of density (see Table 2) were added to these species to include them for computations of diversity, evenness and rarefaction. Explanations: KoCu – current study, Ko1 – Korňan 2009a, Ko2 – Korňan 2009b, Ch – Chytil 1990, BuMa – Bureš & Maton 1984–1985, Pa – Pavelka 1988, Py – Pykal 1991, St – Storch 1998, Le1–Le4 – Lemberk 2001, Bo1–Bo5 – Bohuš et al. 1999 (Bo1 – site 1b, Bo2 – site 2, Bo4 – site 4, Bo5 – site 5), Il – Ilek 2005, ? – information not given.

Tab. 4. *Porovnanie štruktúry hniezdnych ornitocenóz lužných lesov v Slovenskej a Českej republike. Vybrané boli len práce, kde bola použitá mapovacia metóda na odhady populačných hustôt. Zoznam dominantných druhov a základné parametre zoskupení sú uvedené. Prezentované parametre vtáčích zoskupení neboli počítané vo všetkých prácach, preto publikované primárne údaje boli znovu analyzované a parametre vypočítané. Prirodzený logaritmus bol použitý vo výpočte Shannonovho indexu a equitability. V prípade väčších a prekrývajúcich sa časových škál v niektorých štúdiách (Bohuš et al. 1999, plocha 1b, tu Bo1) boli na porovnanie s výsledkami tohto štúdia použité len vzorky korešpondujúce rokom 1993 a 1995. Parametre zoskupení boli najprv počítané pre jednotlivé roky a potom spriemerované. V prípade, že stopové druhy (označené „+") patrili medzi hniezdiče v nejakom štúdiu, konštantné hodnoty hustoty (pozri Tab. 2 pre konštantné hodnoty) boli pridané týmto druhom pre výpočet diverzity, equitability a „rarefaction". Vysvetlivky: KoCu – prezentovaná práca, Ko1 – Korňan 2009a, Ko2 – Korňan 2009b, Ch – Chytil 1990, BuMa – Bureš & Maton 1984–1985, Pa – Pavelka 1988, Py – Pykal 1991, St – Storch 1998, Le1–Le4 – Lemberk 2001, Bo1–Bo5 – Bohuš et al. 1999 (Bo1 – plocha 1b, Bo2 – plocha 2, Bo4 – plocha 4, Bo5 – plocha 5), Il – Ilek 2005, ? – informácia sa v publikácii nenachádza.*

Authors	KoCu	Ko1	Ko2	Ch	BuMa	Pa	Py	St	Le1	Le2	Le3	Le4	Bo1	Bo2	Bo4	Bo5	Il
Area (ha)	10.5	16	16	10	3.4–7.5	10	21.9	12	32	50.8	52	43	10	10.4	8.4–9	8.5	3.6
Age of forest stand/s	25–70	100–107	45–105	?	130	70–90	55–220	?	250	250	240–280	256–261	32–49	42–47	17–38	26–32	54
Dominant trees	*Fraxinus, Salix*	*Alnus*	*Alnus, Ulmus, Salix*	*Quercus, Fraxinus, Carpinus*	*Fraxinus, Quercus, Alnus*	*Carpinus, Tilia, Fraxinus, Quercus*	*Quercus, Picea*	*Quercus, Populus, Fraxinus, Alnus*	*Quercus, Ulmus, Carpinus, Alnus*	*Quercus, Ulmus, Carpinus, Alnus*	*Quercus, Ulmus, Carpinus, Alnus*	*Quercus, Ulmus, Carpinus, Alnus*	*Populus, Salix*	*Populus, Acer, Alnus*	*Populus, Salix*	*Populus*	*Salix, Populus*
Census years	1993, 1995	1992–93, 1995	1995	1978-79	1982-84	1979	1989	?	2000	1999	2000	1999	1993, 1995	1995–96	1994–95	1991	2003–04
Species richness	34.5	33.3	50	38.0	31.0	25.0	36.0	30.0	44.0	40.0	42.0	41.0	27.5	27.0	25.5	17.0	29.5
Species diversity (*H'*)	3.14	2.81	3.04	3.16	3.18	2.78	2.98	2.68	3.22	2.91	3.04	3.04	2.73	2.81	2.63	2.35	2.67

Authors	KoCu	Ko1	Ko2	Ch	BuMa	Pa	Py	St	Le1	Le2	Le3	Le4	Bo1	Bo2	Bo4	Bo5	Il
Evenness (J')	0.89	0.80	0.78	0.87	0.93	0.87	0.83	0.79	0.85	0.79	0.81	0.82	0.82	0.85	0.81	0.83	0.79
Rarefaction E ($S_{50\ pairs}$)	19.78	16.90	18.81	21.49	24.46	17.08	19.76	16.73	21.39	17.76	19.20	19.49	18.54	18.69	17.98	15.15	17.20
Rarefaction E ($S_{5\ ha}$)	23.35	18.39	26.99	26.40	28.57†	17.85	20.82	24.23	21.58	17.76	19.86	17.50	21.90	21.09	20.95	13.15	–
Total density (p/ 10 ha)	155.9	125.2	213.7	170.0*	186.2	113.0	112.3*	272.5	103.4	101.7*	109.4	80.5	161.0	138.5*	142.8	75.3	431.9*
Density of dominants (p/10 ha)																	
Anas platyrhynchos	–	15.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cyanistes caeruleus	10.4	–	–	11.8	11.2	–	7.8	–	10.3	11.6	10.2	7.0	–	–	–	–	–
Erithacus rubecula	–	6.4	–	–	–	–	6.8	–	–	–	–	–	8.5	–	7.5	–	–
Ficedula albicollis	–	10.6	–	–	–	15.5	–	–	–	–	–	–	12.5	–	–	–	–
Fringilla coelebs	17.7	10.5	15.1	9.5	11.2	10.0	14.6	47.5	9.7	9.5	11.3	6.7	24.0	21.2	25.8	13.0	40.3
Hippolais icterina	–	–	–	–	–	–	–	20.0	–	–	–	–	–	–	–	4.7	–
Muscicapa striata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.2	37.5
Passer montanus	–	–	36.3	9.5	–	–	–	–	–	–	–	–	–	–	–	–	66.7
Parus major	–	7.4	–	13.5	10.8	16.5	–	–	9.1	13.2	12.5	8.8	10.0	11.5	8.1	7.1	29.2
Phylloscopus collybita	10.2	10.3	11.8	–	12.5	–	11.9	26.7	5.9	6.5	7.3	7.2	11.0	11.1	9.2	4.7	–
Sturnus vulgaris	11.5	22.5	32.5	27.5	13.4	11.0	16.9	15.0	7.5	14.6	10.0	6.7	8.5	–	–	–	84.7
Sylvia atricapilla	18.3	7.3	15.4	13.0	19.8	14.5	6.4	60.8	9.1	7.9	11.7	11.9	27.0	25.5	35.8	20.0	51.4
Turdus merula	–	–	–	–	–	–	6.8	–	5.3	5.3	6.7	–	–	–	–	–	–

* the values of total density were mistakenly summed in the original paper, the recalculated values are presented

** hodnoty celkovej hustoty boli chybne spočítané v pôvodnej práci, prezentované sú prepočítané údaje*

† rarefaction per area could not be computed for the samples 1983 and 1984 due to small census plot size, less than 5 ha; only sample 1982 (7.5 ha) is rarefactioned

† prepočet "rarefaction" na plochu nebol možný vo vzorkách z rokoch 1983 a 1984 z dôvodu malej veľkosti sčítacieho kvadrátu, menej ako 5 ha; len vzorka z roku 1982 (7,5 ha) je prepočítaná "rarefaction"

(75.3 p/10 ha) in the Danubian poplar monoculture (Bohuš et al. 1999). Here, it is important to mention that the set of the compared stands is very heterogeneous, and thus difficult to compare objectively. Firstly, in many cases the census plot represents small forest fragments strongly influenced by edge effect that may have the general tendency to increase species diversity and population densities (Sisk & Battin 2002, Korňan 2009b). Secondly, the census plots represent various developmental stages of forests (17–280 years) that significantly influence structure and diversity of bird assemblages (Głowaciński 1975, Głowaciński & Weiner 1983, Blondel & Farré 1988, Holmes & Sherry 2001). Thirdly, the size of a census plot is a factor that significantly influences patterns of species richness due to the general rule of increasing species richness with area (Wiens 1989). In addition, censusing birds on too small spots, not even meeting the recommended minimum size of 10 ha for the mapping method censuses in forest habitats (IBCC 1969), may seriously bias the results because of the so called "checkerboard" effect (Wiens 1981). Fourthly, inter-observer and inter-analyst variability in the mapping method estimates can have a significant effect on species diversity and population densities of individual censuses (Verner & Milne 1990, Morozov 1994b). Fifthly, many studies reported significant declines of long distance migrants and increase of other birds (e.g. Böhming-Gaese 1992, Karlsson et al. 2005, Sanderson et al. 2006, Reif et al. 2006, Gregory et al. 2007). Because this comparison involves studies in a relatively large time span (1978–2004), the population declines may be responsible for differences in the results that were obtained in different time periods. Sixthly, majority of censuses were conducted within very short periods of time (1–2 years). This is too short for estimating mean population densities of birds in a forest habitat. In fact, these comparisons can be very biased because it is impossible to identify whether the populations in a census year/s were at minimum, maximum or reached intermediate values. Seventhly, the landscape and habitat matrix surrounding a census plot and the area of a forest patch influence the structure and diversity of bird assemblages (Wiens 1994, Rodewald & Yahner 2001). This information is not provided in any of the compared studies dealing with the structure of wetland forest bird assemblages, therefore it impossible to estimate their effect on the detected patterns. Considering all the above discussed problems of the comparison, any drawn conclusions have to be taken very cautiously. In order to compare objectively species diversity and population densities in various types of forests, a new study conducted within plots of at least 10 ha in size, well isolated from edges, conducted in the same time period at least during 3–5 consecutive years in a similar landscape matrix and carried out by well-trained observers would be needed.

Dominant species

Primary data from the published sources were analyzed for dominant species (Table 4). In total, 13 dominant species *(x ≥ 5 %)* (*Anas platyrhynchos*, *Cyanistes caeruleus*, *Erithacus rubecula*, *Ficedula albicollis*, *Fringilla coelebs*, *Hippolais icterina*, *Muscicapa striata*, *Parus major*, *Passer montanus*, *Phylloscopus collybita*, *Sturnus vulgaris*, *Sylvia atricapilla* and *Turdus merula*) were detected in the cited studies of floodplain forest bird assemblages (Table 4). Only two species *Fringilla coelebs* and *Sylvia at-*

ricapilla were detected as dominants in all census plots. Both species can be considered as habitat generalists occurring in all types of forests from lowlands up to the dwarf-pine zone (Kocian 1998, Kropil 2002a, Imbeau et al. 2003). Other three species *Parus major*, *Phylloscopus collybita* and *Sturnus vulgaris* were dominant in more than 50% of the plots. *Parus major* and *Sturnus vulgaris* are typical species that reach the highest population densities in lowlands, especially in floodplain forests and swamps (Krištín 2002, Kropil 2002b). *Parus major* breeds in forests up to the spruce vegetation zone, but its population density strongly decreases with elevation. *Sturnus vulgaris* reaches the highest population densities in forest edges and fragments surrounded by grasslands and fields (Kropil 2002b). It avoids continuous forests and higher altitudes above 1100 m a.s.l. *Phylloscopus collybita* prefers mature forests and is an interior-edge generalist (Imbeau et al. 2003). It was found to be dominant also in a primeval mountain mixed forest (Korňan 2004) and in young stands (Lešo 2003a). Dominance of other species reflects specific ecological conditions. For instance, the high population densities of *Anas platyrhynchos* in an alder forest result from high water level in spring that creates suitable breeding conditions for this species (Korňan 2009a). *Hippolais icterina*, *Luscinia megarhynchos* and *Passer montanus* are classified as edge species or species with affinity to edge (Imbeau et al. 2003, Korňan 2009b). The edge position of a census plot or a small size of the forest patch can explain their dominance status. Dominance status of other species is difficult to explain, but it may rather result from a complex factorial model as discussed in the previous part.

Studies in floodplain forests along the Morava River and its tributaries by relative quantitative methods

Kalivodová et al. (1996) studied bird assemblages of the floodplain forests of the lower stream of the Morava River. The analysis of wetland forests was based on the quantitative survey of five one-hectare plots and two 700 and 500 m long and 50 m wide belt transects censused during the breeding season in the period 1990–95. The authors applied the time quadrat and belt transect method to estimate breeding bird densities. Only pooled means from all samples and all years from the period 1990–95 were presented. Therefore, these results are difficult to compare with the current study from the methodological aspect. The authors detected 86 bird species in forests, out of this number 73 species were listed as breeders.

Bauer (1991) compared the structure of bird assemblages of wetland forest occurring along the Dyje River before and after the construction of a flooding regulation plant. The four hectare study area was censused for 20 years by an unspecified quantitative method. The twenty year period was divided into two 10 year parts. In the first period 1967–76, mean values of the assemblage at the time of periodic spring flooding were described, while in the second period 1977–86, the bird assemblage present immediately after the construction of a river management plant was characterised. In the first 10 year period, altogether 27 nesters were recorded, whereas only 24 species in the second one. The author found that bird species dependent on surface water during the spring floods disappeared or declined in numbers after the construction. Estimates of breeding bird densities are probably very biased and overestimated; therefore they were not compared with the rest of cited studies. The data were presented in

ind./ha. In order to compare the density values with other studies, we recalculated the number to pairs/10 ha. To illustrate the extremely high densities, we present the total assemblage density and the density of dominant species. The total mean breeding bird density in the first period was 2420 p/10 ha (484 ex./ha). A little lower density of 1980 p/10 ha (396 ex./ha) was given for the second period. The density of dominant species ranged in the interval 570–140 p/10 ha (114–28 ex./ha) in the first period. In the second period, the densities of dominants were in the interval 300–100 p/10 ha (60–20 ex./ha). Such extreme densities are incomparable with the rest of analyzed studies.

Hubálek (1997) studied a wetland forest of the association *Querceto-Ulmetum medioeuropaeum* in the floodplain area of the Dyje River between the town of Stará Břeclav and the village of Ladná in the period 1986–95. The author used the belt transect method with the belt width of 50–100 m. In the 10 year period, he detected altogether 73 bird species. The mean species richness per year was 59.2 species, range 55–66 species. These high values indicate much higher species richness of the assemblage in comparison to the assemblage in the Dolný les reserve. The higher richness was probably caused by larger sample size. The length of the belt transect was 6 150 m creating the sampled area of 30.75 ha. The Hubálek's data could not be analysed by the rarefaction techniques to eliminate the effect of area because the author presented combined data for woodland and open habitats. The total mean assemblage density was 143.36 p/10 ha, range 130.7–164.4 p/10 ha, which is a little lower compared to the presented results. The mean value of the Shannon species diversity index was 3.40 nats, range 3.29–3.49 nats. The evenness index based on the Shannon diversity measure reached the mean value 0.83, range 0.81–0.86. The assemblage in the Dolný les reserve had slightly lower values of species diversity (mean 3.14 nats) and higher values of evenness (mean 0.89). *Fringilla coelebs*, *Ficedula albicollis*, *Sylvia atricapilla*, *Erithacus rubecula*, *Phylloscopus collybita* and *Sitta europaea* were dominants in the Hubálek's study. *F. coelebs*, *S. atricapilla* and *P. collybita* were also dominants in the Dolný les assemblage, while *F. albicollis* and *E. rubecula* belonged to subdominat species.

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