

On bird communities in the natural spruce forests in the Veľká Fatra Mts. (C Slovakia)

K vtáčím spoločenstvám v prírodných smrekových lesoch vo Veľkej Fatre (stredné Slovensko)

Miroslav SANIGA

Institute of Forest Ecology SAS, Research station, 976 02 Staré Hory, Slovakia; uelsav@bb.sanet.sk

At present, European forests are more and more damaged by air pollution, and different disturbances and their long-term effect results in changes in species composition and in the structure of the vegetation components, thus having a secondary impact on animals (Brotans et al. 1998, Jadczyk 2009). Problems of the relationship between bird communities and the vegetation cover in different forest types and different countries have been studied by many authors (e.g. Ferry 1960, Short 1979, Wiens 1981, Verner & Larson 1989, Krištín 1990, 1993, Kropil 1992, Saniga 1995). Nevertheless, it is important to determine in detail the structure of bird assemblages in different primeval and relatively undamaged forest ecosystems in order to be able in the future to compare the structure of these communities in damaged biocoenoses with those in the natural forests (e.g. Korňan 2004). Some fragments of the non-affected primeval forests have been conserved at some less accessible sites in the spruce vegetation tier of the Veľká Fatra Mts. up to now. Therefore, the goal of this study was to analyse the composition of bird communities in three primeval forests.

Bird assemblages were investigated during breeding seasons (from the beginning of April to late June) in 2006–2008. Bird censuses were carried out using the strip transect method (Verner 1985). A singing male, pair of birds, family, feeding bird, and a bird defending nest area were considered as a pair (two individuals) during the spring season. One bird seen or heard was considered as one individual in this

period (Blondel et al. 1970). Breeding status was determined also by direct evidence on or near the study sites (nests, fledglings, feeding birds) or data from previous observations in the same habitats. Lengths of transects at the sites were as follows: Suchý vrch (700 m), Čierny kameň (1000 m), and Smrekovica (5000 m). The width of all transects was 50 m. A total of 30 field checks were made (10 evening investigations). Birds were generally counted twice per day (early in the morning from 3:00 to 9:00 CEST and later in the evening from 17:00 to 20:00 CEST, cf. Verner 1985). All checks were made under satisfactory weather conditions (stillness and no rain). Species with nocturnal activity (owls and *Caprimulgus europaeus*) were observed during night. Individuals outside the survey belt were also recorded but without the quantitative indices. I calculated following population characteristics: density (D); relative abundance (A%); Shannon-Weaver's (1949) equation was used for calculating the diversity index (H'); and index of equitability (E) was calculated according to Sheldon (1969).

Study sites represented primeval spruce forests (altitude ranging from 1100 to 1530 m a.s.l.) in the Veľká Fatra Mts. (E 18°50'–19°18', N 48°47'–49°19'). The main habitat features of three census sites are given in Table 1.

During spring season, altogether 46 species at a total density of 66.6 ind./ 10 ha formed the bird community in the natural spruce forests. *Fringilla coelebs* (A = 16.5%), and *Parus ater* (11.7%) were eudominant, with *Erithacus rubecula* (9.5%), *Prunella modularis* (8.6%),

Table 1. Features of the examined localities in Veľká Fatra Mts.
Tab. 1. Charakteristiky skúmaných lokalít vo Veľkej Fatre.

Site <i>Lokalita</i>	Group of forest types <i>Skupina lesných typov</i>	Tree composition <i>Drevinové zloženie</i>	Exposure <i>Expozícia</i>
Suchý vrch	<i>Fageto-Piceetum</i> 140-year-old	<i>Picea abies</i> 90% <i>Fagus sylvatica</i> 10%	E
Smrekovica	<i>Sorbeto-Piceetum</i> 200-year-old	<i>Picea abies</i> 90% <i>Sorbus aucuparia</i> 10%	SW and NE
Čierny kameň	<i>Fageto-Piceetum</i> 150-year-old	<i>Picea abies</i> 80% <i>Pinus mugo</i> 20%	NW

Regulus regulus (8.1%), and *Turdus torquatus* (6.6%) being dominant. The diversity index H' was 4.14 and the value of the equitability index E was 0.80. In total, 41 species were considered to nest in the primeval spruce forests. Individuals of *Accipiter nisus*, *Aegithalos caudatus*, *Sylvia curruca*, and *Coccothraustes coccothraustes* were observed several times in this type of habitat, but breeding has not apparent. Individuals of *Turdus iliacus* were present in the understudied habitat during April only and did not nest here (Table 2.).

The highest species richness was found in the bird assemblage of the spruce forest *Sorbeto-Piceetum* at the locality Smrekovica (45 species at a total density 75.3 ind./ 10 ha). Species *F. coelebs* (14.6%), *P. ater* (11.2%) and *E. rubecula* (11.2%) were eudominant, with *P. modularis* (8.1%), *R. regulus* (8.0%), and *T. torquatus* (6.6%) being dominant. Bird community of the natural spruce forest of the group of forest types *Fageto-Piccetum* at the locality Suchý vrch formed 44 species at a total density of 67.7 ind./ 10 ha. Species *F. coelebs* (17.7%), and *P. ater* (13.0%) were eudominant, with *E. rubecula* (8.9%), *P. modularis* (8.5%), *R. regulus* (7.6%), and *T. torquatus* (6.2%) being dominant. Forty-four species at a total density of 56.5 ind./ 10 ha formed the bird community in the natural spruce forest of the group of forest types *Fageto-Piccetum* at the locality Čierny kameň. Species *F. coelebs* (18.0%), and *P. ater* (11.0) were eudominant, with *P. modularis* (8.8%), *R. regulus* (8.8%), *E. rubecula* (8.1%), and *T. torquatus* (7.1%) being dominant.

Based on results obtained by dividing bird species into guilds and from the results of previous studies in the natural spruce forests in the Veľká Fatra Mts., it may be stated conclusively

that bird species of the studied vegetation tiers have displayed an optimum of their vertical occurrence. Species *Picoides tridactylus*, *R. regulus*, and *Loxia curvirostra* have an optimum occurrence in the natural spruce forests.

During previous spring studies of spruce forests in Slovakia, Turček (1956) reported assemblage consisting of 63 species at a total density of 128.6 ind./ 10 ha, with *P. ater*, *F. coelebs*, and *Turdus philomelos* being dominant. Whereas, for European spruce forest in general, Oelke (1980) found a density 25–45 bird pairs/ 10 ha, which highly corresponds with our findings. On the contrary, in the primeval mountain spruce forest in the Malá Fatra Mts only 13 breeding species at a low density of 23.5 ind./ 10 ha has been found (Randík 1981), with *F. coelebs*, *P. ater*, *Phylloscopus trochilus*, *Phylloscopus collybita*, *R. regulus*, and *E. rubecula* being dominant. In the primaeval beech-fir forest of the Malá Fatra Mts. were were found 52 breeding species with density 52–61 pairs/ 10 ha using mapping method (Korňan 2004). In the spruce natural forests in the Poľana Mts. (Slovakia), Krištín (1990, 1991, 1993) reported a bird assemblage consisting of 43 populations at a total density of 75.9 pairs/ 10 ha.

From the comparison of the results of the present study with data published previously, similarity of the species composition among the compared bird communities is obvious. Some species mentioned by Turček (1956) study (*Strix aluco*, *Asio otus*, *Streptopelia turtur*, *Picus viridis*, *Parus caeruleus*, *Parus major*, *Parus palustris*, *Certhia brachydactyla*, *Turdus pilaris*, and *Corvus corone*) were not observed to rise to the spruce natural forests in the Veľká Fatra Mts.

As for the substitution of the dominant species, the bird assemblages studied in natural

Table 2. The density (D – ind./ 10 ha), relative abundance (A%), diversity index (H'), and equitability index (E) for bird communities in natural spruce forests in the Veľká Fatra Mts., Slovakia in 2006–2008 (x – occurrence outside the strip belt).

Tab. 2. Densita (D – ex./ 10 ha), relatívna početnosť (A%), index diverzity (H') a index ekvitality (E) vtáčích spoločenstiev v prírodných smrekových lesoch vo Veľkej Fatre, Slovensko v rokoch 2006–2008 (x – výskyt mimo transektu).

Site / Lokalita Species / Druh	Suchý vrch		Čierny kameň		Smrekovica		Total	
	D	A	D	A	D	A	D	A
<i>Fringilla coelebs</i>	12.0	17.7	10.1	18.0	11.0	14.6	11.0	16.5
<i>Parus ater</i>	8.8	13.0	6.2	11.0	8.4	11.2	7.8	11.7
<i>Erithacus rubecula</i>	6.0	8.9	4.6	8.1	8.4	11.2	6.3	9.5
<i>Prunella modularis</i>	5.8	8.5	5.0	8.8	6.2	8.1	5.7	8.6
<i>Regulus regulus</i>	5.2	7.6	5.0	8.8	6.0	8.0	5.4	8.1
<i>Turdus torquatus</i>	4.2	6.2	4.0	7.1	5.0	6.6	4.4	6.6
<i>Certhia familiaris</i>	2.8	4.2	2.0	3.5	3.0	4.0	2.6	3.9
<i>Loxia curvirostra</i>	2.0	2.9	1.5	2.7	2.6	3.4	2.0	3.0
<i>Turdus viscivorus</i>	1.8	2.7	1.9	3.4	2.4	3.2	2.0	3.0
<i>Turdus philomelos</i>	1.8	2.7	2.0	3.5	2.4	3.2	2.0	3.0
<i>Parus cristatus</i>	1.6	2.4	1.4	2.5	2.0	2.7	1.7	2.5
<i>Troglodytes troglodytes</i>	1.2	1.8	1.0	1.8	1.6	2.1	1.3	2.0
<i>Carduelis spinus</i>	1.2	1.8	1.0	1.8	1.4	1.9	1.2	1.8
<i>Pyrrhula pyrrhula</i>	1.2	1.8	0.8	1.4	1.4	1.9	1.1	1.6
<i>Phylloscopus trochilus</i>	1.2	1.8	1.0	1.8	1.2	1.5	1.1	1.6
<i>Parus montanus</i>	1.2	1.8	1.0	1.8	1.0	1.3	1.1	1.6
<i>Phylloscopus collybita</i>	1.1	1.6	1.0	1.8	1.0	1.3	1.0	1.5
<i>Sitta europaea</i>	1.0	1.5	1.0	1.8	1.0	1.3	1.0	1.5
<i>Sylvia atricapilla</i>	1.0	1.5	0.8	1.4	1.2	1.5	1.0	1.5
<i>Picoides tridactylus</i>	0.8	1.2	0.8	1.4	1.0	1.3	0.9	1.4
<i>Bonasa bonasia</i>	0.6	0.9	0.5	0.9	0.7	0.9	0.6	0.9
<i>Anthus trivialis</i>	0.5	0.7	0.3	0.5	0.4	0.5	0.4	0.6
<i>Columba palumbus</i>	0.4	0.6	0.3	0.5	0.5	0.7	0.4	0.6
<i>Turdus merula</i>	0.4	0.6	0.4	0.7	0.4	0.5	0.4	0.6
<i>Phoenicurus phoenicurus</i>	0.4	0.6	0.4	0.7	0.4	0.5	0.4	0.6
<i>Nucifraga caryocatactes</i>	0.4	0.6	0.2	0.3	0.3	0.4	0.3	0.4
<i>Cuculus canorus</i>	0.3	0.4	0.4	0.7	0.2	0.3	0.3	0.4
<i>Scolopax rusticola</i>	0.2	0.3	0.2	0.3	0.5	0.7	0.3	0.4
<i>Regulus ignicapillus</i>	0.6	0.9	0.0		0.4	0.5	0.3	0.4
<i>Dryocopus martius</i>	0.2	0.3	0.2	0.3	0.4	0.5	0.3	0.4
<i>Tetrao urogallus</i>	0.2	0.3	0.1	0.2	0.3	0.4	0.2	0.3
<i>Glaucidium passerinum</i>	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3
<i>Dendrocopos leucotos</i>	0.2	0.3	0.1	0.2	0.2	0.3	0.2	0.3
<i>Aegolius funereus</i>	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3
<i>Parus palustris</i>	0.2	0.3	0.1	0.2	0.2	0.3	0.2	0.3
<i>Aegithalos caudatus</i>	0.2	0.3	0.1	0.2	0.2	0.3	0.2	0.3
<i>Coccothraustes coccothraustes</i>	0.1	0.1	0.1	0.2	0.3	0.4	0.2	0.3
<i>Tetrao urogallus</i>	0.2	0.3	0.1	0.2	0.2	0.3	0.2	0.3
<i>Ficedula albicollis</i>	0.1	0.1					0.1	0.2
<i>Sylvia curuca</i>			0.2	0.3	0.2	0.3	0.1	0.2
<i>Dendrocopos major</i>	0.1	0.1	0.1	0.2	0.2	0.3	0.1	0.2
<i>Muscicapa striata</i>	0.1	0.1	0.1	0.2	0.2	0.3	0.1	0.2
<i>Accipiter nisus</i>			0.1	0.2	0.1	0.1	0.1	0.2
<i>Garrulus glandarius</i>	x		x		0.2	0.3	0.1	0.2
<i>Turdus iliacus</i>	x				0.2	0.3	0.1	0.2
<i>Accipiter gentilis</i>	x		x		x		x	
Total / Spolu	67.7	100.0	56.5	100.0	75.3	100.0	66.6	100.0
Total species / Spolu druhov	44		43		45		46	
Diversity / Diverzita (H')	3.81		3.70		4.06		4.14	
Equitability / Vyrovnanosť (E)	0.73		0.71		0.76		0.80	

spruce forests of the Veľká Fatra Mts. were not too much different from those in other mountains of Central Europe (Oelke 1980, Kropil 1992, Krištín 1991, 1993). Differences appear when comparing bird assemblages from the West Carpathians with those of Scandinavian coniferous forest (e.g. Haila et al. 1987), these differences being due to the geographic distribution of some species (e.g. *Fringilla montifringilla*, *T. iliacus*).

Súhrn

V prírodných smrekových lesoch vo Veľkej Fatre sa skúmalo kvalitatívno-quantitatívne zloženie vtáčích spoločenstiev v hniezdom období (apríl – jún) v rokoch 2006–2008. Na troch výskumných plochách sa študovali vtáče spoločenstvá použitím pásovej transektovej metódy. Na všetkých troch skúmaných lokalitách sa zistilo 46 druhov s hustotou 66,6 jedincov/

10 ha. Eudominantné boli *Fringilla coelebs* (14,6%), *Parus ater* (11,2%) a *Erethacus rubecula* (11,2%), dominantné *Prunella modularis* (8,1%), *Regulus regulus* (8,0%), a *Turdus torquatus* (6,6%). Najrozmanitejšie vtáčie spoločenstvo bolo zistené v prírodnom smrekovom lese skupiny lesných typov *Sorbeto-Piceetum* na lokalite Smrekovica (45 druhov s denzitou 75,3 jedincov/ 10 ha). Na lokalite Suchý vrch pozostávalo vtáčie spoločenstvo prírodného smrekového lesa skupiny lesných typov *Fageto-Piceetum* zo 44 druhov s hustotou 67,7 jedincov/ 10 ha. Druhovo i početne najchudobnejšie vtáčie spoločenstvo prírodného smrekového lesa sa zistilo na lokalite Čierny kameň v skupine lesných typov *Fageto-Piceetum* (43 druhov s denzitou 56,5 jedincov/ 10 ha). Potvrdili sa počty druhov známe z relevantných štúdií v smrekových pralesoch, rozdiely boli zistené viac v denzitách a v dominanciách niektorých druhov. Rozdiely vyplývali najviac z použitej metodiky a rozdielných geografických podmienok.

Acknowledgements

This work was founded from the grants of VEGA 2/0130/08 and 2/0110/09.

References

BLONDEL J., FERRY C. & FROCHOT B. 1970: La méthode des indices ponctuels d'abondance (I.P.A.) ou des relevés d'avifaune par "stations écoute". — *Alauda* **38**: 55–71.

BROTONS L., MAGRANS M., FERRUS L., NADAL J. 1998: Direct and indirect effects of pollution on the foraging behaviour of forest passerines during the breeding season. — *Can. J. Zool.* **76**: 556–565.

FERRY C. 1960: L'avifaune nidificatrice d'un taillis sous futaie de Querceto-Carpinetum scilletosum. — *Alauda* **28**: 93–123.

HAILA Y., HANSKI I. K. & RAIVIO S. 1987: Breeding bird distribution in fragmented coniferous taiga in southern Finland. — *Ornis Fennica* **64**: 90–106.

JADCZYK P. 2009: Natural effects of large area forest decline in the Western Sudeten. — *Environ. Protect. Engineering* **35**: 49–56.

KORŇAN M. 2004: Structure of the breeding bird assemblage of a primaeval beech-fir forest in the Šrámková Natio-

nal Nature Reserve, the Malá Fatra Mts. — *Biologia, Bratislava* **59**: 219–231.

KRIŠTÍN A. 1990: Breeding bird communities in natural and cultivated spruce forests in Poľana Mountains. — Pp. 299–302. In: ŠTASTNÝ K. & BEJČEK V. (eds.): Bird Census and Atlas studies. Proc. Xth Int. Conf. On Bird Census and Atlas Work, Prague.

KRIŠTÍN A. 1991: Vtáčie spoločenstvá charakteristických biotopov Poľany. — *Stredné Slovensko* **10**: 165–182.

KRIŠTÍN A. 1993: Brutornithozöosen der Fichten- und Buchenwälder des Poľana Gebirges (SR) und Oberfrankens (BRD). — *Der Falke* **40**: 6–9.

KROPIĽ R. 1992: Predbežné výsledky výskumu produkcie vtáčích spoločenstiev prírodných lesov na Slovensku. — Pp. 300–306. In: VANÍK K. (ed.): Les-drevo-ekológia. Zvolen.

OELKE H. 1980: The bird structure of the European spruce forest biome – as regarded from breeding bird censuses. — Pp. 201–209. In: OELKE H. (ed.): Bird census work and nature conservation. Göttingen.

RANDÍK A. 1981: Rozbor ornitocenóz štátnej prírodnej rezervácie Rozsutec. — Pp. 952–1015. In: JANÍK M. & ŠTOLLMANN A. (eds.): Rozsutec – štátna prírodná rezervácia. Osveta, Martin.

SANIGA M. 1995: Breeding bird communities of the fir-beech to the dwarfed-pine vegetation tiers in the Veľká Fatra and Malá Fatra mountains. — *Biologia, Bratislava* **52**: 185–193.

SHANNON C. E. & WEAVER W. 1949: The mathematical theory of communication. — University of Illinois Press, Urbana.

SHELDON A. L. 1969: Equitability indices: Dependence on the species count. — *Ecology* **50**: 466–467.

SHORT J. J. 1979: Patterns of alpha-diversity and abundance in breeding bird communities across North America. — *Condor* **81**: 21–27.

TURČEK F. J. 1956: On the bird population of the spruce forest community in Slovakia. — *Ibis* **98**: 24–33.

VERNER J. 1985: Assessment of counting techniques. — *Curr. Ornithol.* **2**: 247–302.

VERNER J. & LARSON T. A. 1989: Richness of breeding bird species in mixed-conifer forests of the Sierra Nevada, California. — *Auk* **106**: 447–463.

WIENS J. A. 1981: Scale problems in avian censusing. — *Studies in Avian Biol.* **6**: 513–521.

Došlo: 17. 1. 2009
Prijaté: 28. 10. 2009