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Seasonal changes of bird assemblages in a small urban wetland revealed by mist-netting

Sezónne zmeny vtáčích spoločenstiev malej mokrade v mestskom prostredí: analýza odchytov

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Abstract: *Seasonal differences of bird assemblages were studied using mist-netting method during four seasons (May, July, September, and December) in two years (2014 and 2021) in a secondary wetland habitat (7 mist-nets in willow grove, reed, and scrubland) in Zvolen town, central Slovakia. Altogether 54 species and 876 individuals of birds were captured during 24 days of eight trapping sessions (in 84 m of mist-nets at 7.3 ha study plot). The highest number of mist-netted species and individuals was found in July (36 species, 290 individuals), the lowest was in December (16 species, 153 individuals), pooled for both years. The most abundant species were breeding species* Sylvia atricapilla, Parus major, Cyanistes caeruleus *and* Turdus merula*. The characteristic reedbed birds included four* Acrocephalus *species*, Locustella luscinioides, Emberiza schoeniclus*, and scrubland species* Luscinia megarhynchos, Sylvia communis *and* Remiz pendulinus*. Seasonal differences in species number and abundance are discussed. Regular wintering was found in migratory species* Prunella modularis *and* Erithacus rubecula *north of the known winter quarters of their central European breeding populations. The site fidelity and between-season retraps were confirmed in 10 species and 54 individuals (18.5% of all mist-netted species and 6.2% of all individuals). Based on retrapped individuals, the resident species* P. major, C. caeruleus, Aegithalos caudatus *and* T. merula *were the most faithful to the site, whereas inter-seasonal retraps of migratory species were rare (e. g.* Sylvia atricapilla, Luscinia megarhynchos *and* Phylloscopus collybita*).*

Key words: *passerines, ringing, secondary habitats, monitoring, CES*

Introduction

Wetlands and reedbeds increase heterogeneity of the landscape, these habitats have a water retention role, and are important refuges of biodiversity (Gibbs 2000). They are located only seldom in urbanized environment, where together with the buildings and urban greenery are crucial elements and habitats for birds (Jokimäki et al. 2016). Birds are indicators of the state of biodiversity, and wetlands provide them with suitable habitats for survival during different times of the year in the process of global and climate change (Gibbs 2000, Robledano et al. 2010). Secondary wetlands can also increase the biodiversity in the landscape (Whited et al. 2000). In Slovakia, from an ornithological point of view there are some examples, e. g. Béter wetland near Lučenec (Kerestúr & Mojžiš 2008), or periodic wetlands in arable fields (Kaňuščák 2009). Similarly, wetland Kórea located in the industrial zone of Zvolen town and Lieskovec village in central Slovakia represents a regionally important refuge of biodiversity with mosaics of several habitats suitable for birds (Krištín et al. 2014).

Mist-netting and ringing of birds is one of the methods used to study the migratory status of birds, its fidelity to the locality, and it is a com-

Fig. 1. Study site, Kórea wetland in three seasonal aspects: a) May 12, 2021, b) July 8, 2021, c) December 14, 2021 (Photo by P. Kaňuch & A. Krištín).
Obr. 1. *Študovaná lokalita, mokraď Kórea v troch sezónnych aspektoch: a) 12.5. 2021, b) 8.7.2021, c) 14.12. 2021, (Foto P. Kaňuch & A. Krištín).*

plementary method of qualitative and quantitative research of several species (Silkey et al. 1999, Cepák et al. 2008, Šebestián 2008, Chytil 2009). Mist-netting has become an increasingly popular tool in long-term monitoring of bird populations, mainly passerines (Peach et al. 1996, 1998, Silkey et al. 1999, Balmer et al. 2004). However, this method is used mainly during the breeding season, spring and autumn migration (Olekšák et al. 2007, 2012, Trnka 2011, Krišovský et al. 2019), and only rare throughout the year (Neto 2003). Ringing data for the winter season from Central Europe are very limited (Csörgö et al. 2001, Cepák et al. 2008) and can improve the picture on the structure of wintering birds and the importance of the habitats in this unfavourable period. Furthermore, year-round ringing data can improve the knowledge on the site fidelity in the temperate zone (Csörgö et al. 2001, Krištín & Kaňuch 2016). Based on above mentioned issues, we monitored using a mist-netting method of 3-day bird trapping sessions in four seasons during two years at secondary small urban wetland Kórea: (i) number of species and their abundance; (ii) seasonal changes in species composition and (iii) changes between years; and (iv) site fidelity of particular species.

Methods and material

Study site

Kórea Wetland (7.3 ha) is located in central Slovakia, within the cadastres of the town of Zvolen and the village of Lieskovec in Zvolenská kotlina Basin (N 48°34′24″, E 19°09′10″, 296 m a.s.l., Fig. 1). The wetland and marshes were cre-

ated by building a railroad yard in 1954, which created a dam for the outflow of rainwater and seepage water. In 67 years, the original grassland and field habitats succeeded to wetland, riparian willow forest, shrubs and rich littoral vegetation (for more detailed characteristics of the site, see Krištín et al. 2014).

Data sampling

The mist-netting method adapted for inter-seasonal comparisons of bird assemblages was used in 2014 and 2021. Altogether 84 m of mist-nets lines (5-field nets with mesh 16 × 16 mm) were installed and used consistently at the same seven locations (cf. Krištín et al. 2014). The mist-nets were installed in the reedbed vegetation (*Typha*, *Carex*, *Phragmites*) of the wetland (4 lines) and the scrub and willow trees understorey (3 lines). In total, we performed eight trapping sessions with bird ringing during windless and non-rainy weather in spring (22.–24.5.2014, 10.–12.5.2021), summer (23.–25.7.2014, 22.–24.7.2021), autumn (8.–10.9.2014, 6.–8.9.2021) and winter (9.– 11.12.2014, 12. – 14.12.2021) seasons. The trapping sessions always lasted three days in each season (from 15h in the first day up to 12h CET in the third day continual), but due to the length of the daylight, the trapping time varied in particular seasons (Table 1). No playback and no feeding sites were used to attract the birds.

Birds were banded by standard aluminium ornithological rings with unique codes. For each bird captured, we registered the date, species, age (first year bird 1Y and + 1Y, older than the first year) and sex. Site fidelity of species was measured as at least one recapture of already ringed bird individuals (retrap) in different session within a year. Retraps within one trapping session were not included in the species abundance.

Results and discussion

Number of species and their abundance

In total, we captured 54 species and 876 individuals of birds of them eight species of non-passerines (10 individuals). The number of mist-netted species was 44.2% of the total 122 species recorded at the site (Krištín et al. 2014, updated December 2021, see below). The highest number of captured species and individuals was found in July (24 and 29 species and 154 and 136 individuals in 2014 and 2021, respectively) and also in both years together (36 species, 290 individuals), i.e. after fledging of the young and during post-breeding dispersal of species (Table 2). On the other hand, after recalculating the time of bird capture per hour, the number of captured birds was the highest in September, i.e. during the autumn migration (Table 1). Altogether, 32 species were registered equally in May and September, while 31% more individuals were in September than in May. This could be explained by the higher number of first-year birds. As expected, the lowest number of species and individuals was found in December (16 species and 153 individuals in both years), when the mean daily temperatures were below −1 °C and the leaf cover of trees and shrubs absented (Neto 2003). Nevertheless, the hourly efficiency of bird capture in December was unexpectedly higher than in May, in both years (Table 1). It is probably due to higher number of wandering

Table 1. Trapping efficiency (bird/h), trapping period and mean daily temperature (https://www.meteoblue.com/sk) in four seasons in 2014 and 2021.
Tab. 1. *Efektivita odchytu vtákov (ex./hod), doba odchytu a priemerné denné teploty (https://www.meteoblue.com/sk) v 4 sezónach rokov 2014 a 2021.*

Year / *rok*	2014				2021			
Month/ *mesiac*	May	Jul	Sep	Dec	May	Jul	Sep	Dec
birds/h *vtákov/h*	3.8	5.5	6.5	4.8	3.1	4.9	5.1	4.8
trapping time / *doba odchytu* (h)	26	28	22	16	26	28	22	16
aver. temperature / *priem. teplot*a (°C)	16.8	23.5	16.0	-1.2	16.0	22.4	16.2	-2.1

tits and species, roosting in reeds and shrubs in this time (e. g. *Erithacus rubecula, Troglodytes troglodytes, Prunella modularis*).

The characteristic reedbed species captured at this secondary wetland site included four *Acrocephalus* species*, Locustella luscinioides* and *Emberiza schoeniclus,* and also scrubland species *Luscinia megarhynchos, Sylvia communis*, and so far *Remiz pendulinus*. However, may be probably due to secondary character of our study plot, these species are not among the most abundant species, as is the case with primary wetlands and fishponds (Šebestián 2008, Chytil 2009, Kerestúr & Mojžiš 2012). In southern Bohemia (Řežabinec), in southern Moravia (Nesyt pond) and in southern Slovakia (Kiarovský močiar) clearly dominated *Acrocephalus scirpaceus* a *A. schoenobaenus* (Šebestián 2008, Chytil 2009, Kerestúr & Mojžiš 2012).

Luscinia luscinia (1 ex., 8.9.2021), *Acrocephalus arundinaceus* (1 ex., 11.5.2021) belonged to rare mist-netted species of riparian stands occurring there only during migration period. During post-breeding dispersal were captured also *Phoenicurus phoenicurus* (2 ex., 23.7.2021) and *Ficedula albicollis* (2 ex., 24.7.2021), breeding in other habitats. Unexpected was also the mist-netting of six woodpecker species, especially *Picus canus*, which is species typical for beech forests. These species confirm the importance of the locality as an important stopover / roosting site for birds.

We found relatively high number of species, despite lower time-consuming sampling effort in a small area compared to similar but more long-term studies. For example, altogether, 19 210 birds of 52 species were mist-netted in reed stands in southern Moravia (Nesyt pond) in summer and autumn season within 6 years (360 days, 15.7. – 12.9.) in 150 m of mist-nets (Chytil 2009). Yearly it was 31–37 species (10 of them non-passerines) in S Moravia (in 60 days), and 42 and 47 species (eight of them non-passerines) at our locality (in 12 days) in 84 m of mist-nets. The higher bird species diversity in our locality than in reedbeds in southern Moravia can be explained by more diverse habitats as well as the coverage of four seasons (May to December) compared to the shorter mist-netting season in Moravia (July-September). To evaluate the habitat quality among different studies, we should compare only the same trapping periods with comparable trapping effort. For example, when we consider only May and July trapping sessions (summer period for CES method), we ringed 41 species (29 and 35 for particular years) and 468 individuals (252 and 216 for particular years) in our study site during six days. It is also higher species number but lower abundance in comparison to CES studies (but using 9 days trapping period) in similar habitats of study site Drienovec (SE Slovakia), i.e. 38 species and 1288 individuals in 178 m of nets in 2006 (Olekšák et al. 2007), or 32 species/ 826 ind. in 100 m of nets in three years (Kerestúr & Mojžiš 2012), or 20–31 species/ 151–615 ind. in 76 m of nets during 10 years (Krišovský et al. 2019).

Interseasonal differences

Ambient temperatures varied significantly between seasonal trappings, and the high temperature during midday in July, despite the longest sunshine, reduced the trapping efficiency (Table 1). Some species were mist-netted in only one season of the year (in both years). Only in May five species were mist-netted (*A. arundinaceus*, *Picus viridis*, *Sturnus vulgaris*, *Motacilla alba* and *R. pendulinus*). Two males of *A. arundinaceus* in both years sang at the site at least from May 2 to May 12. The species *P. viridis* occurs there throughout the year, and other three species nest in the locality but occur there only from March to October (Krištín et al. 2014). Exclusively in July, five another species were mist-netted (*Cuculus canorus*, *Jynx torquilla*, *Columba palumbus*, *P. phoenicurus*, *F. albicollis*), of them *C. canorus* and *J. torquilla* nested there, the other four were captured during post-breeding dispersal. Only in September, five different species were trapped during post-breeding dispersal (*P. canus*, *Dendrocopos syriacus*, *Hirundo rustica*) and migration (*Acrocephalus scirpaceus*, *Muscicapa striata*). December was a typical winter month (frost and snow in both years), characteristic by the specific occurrence and regular mist-netting of *P. modularis* in both

years. The capture of *Pyrrhula pyrrhula* and *Carduelis spinus* was also typical in December, as well as the abundant occurrence and mist-netting of *T. troglodytes* (Table 2). The importance of reedbeds and wetland vegetation for wintering of the hedge dwelling and ground foraging passerines as *T. troglodytes,* less *P. modularis* and *E. rubecula* is known from several other European countries (Hawthorn 1975, Csörgö et al. 2001, Cepák et al. 2008), but the origin of the birds is still unclear (Cepák et al. 2008). When the breeding populations *E. rubecula* from Central Europe (Slovakia, Czechia, Poland, Hungary) winter in southern and southwestern Europe along Mediterranean (Remisiewicz 2001, Cepák et al. 2008), we can expect only that the wintering individuals in our study site originate from breeding territories in northern and northeastern Europe (Korner-Nievergelt et al. 2014). In total, seven species were mist-netted only in December. Some of them are irregularly breeding on the site but were not caught during other seasons (*Fringilla coelebs*, *Dendrocopos medius*, *Carduelis carduelis*; Table 2). Year-round differences in species and their abundance revealed in our study are valuable because mist-nettings are done mostly during the breeding/vegetation period, and winter data are missing (Peach et al. 1996, 1998, Olekšák et al. 2012, Krišovský et al. 2019, Fulín et al. 2021).

Differences between years

In 2014, we mist-netted 42 species and 473 individuals; in 2021, altogether, 47 species and 403 individuals (Table 2). This was a slightly higher number of species (11%), but a lower abundance (15%) after seven years. In 2014 we caught eight different species compared to 2021 and vice versa 13 different species in 2021. The species *Locustella fluviatilis* was missing in 2021, while in 2014 it was regularly breeding at the site and mist-netted in May, July and September (Table 2). Its population trend has been strongly negative in the last decade in Europe (Keller et al. 2020), which may also explain its absence in the study site in 2021. On the other hand, in 2021 we captured more abundant two species *Saxicola rubicola* and *Phylloscopus trochilus*, but in this case, it is probably only an interannual variation (Table 2).

The most abundant species in both years were *Sylvia atricapilla*, *Parus major*, *Cyanistes caeruleus* and *Turdus merula*, which is similar at other sites with wetland and scrubland habitats in Slovakia, although only during the breeding or migration period (Olekšák et al. 2007, 2012, Krišovský et al. 2019, Fulín et al. 2021). After seven years, we found a strong decrease in abundance in *Acrocephalus palustris* (reflected in the number of mist-netting individuals and singing males), and there was also a decrease in numbers of *P. major* and *C. caeruleus* (Table 2). On the contrary, there was an increase in abundance and capture in species *Turdus philomelos* and *E. rubecula*. However, large population fluctuations in their population trends are registered in Europe (Voříšek et al. 2008, Keller et al. 2020).

The interannual variability in the number of species and their abundance is characteristic in long-term mist-netting (southern Moravia, Chytil 2009; Drienovec, Olekšák 2012, Krišovský et al. 2019) and is affected by several factors, e. g. weather (Gyurácz et al. 2003, Trnka 2003), habitat destruction, but also mortality due to climate and other human factors (Pearce-Higgins et al. 2015). However, longer time series are needed for understanding the effect of the factors influencing interannual variation in species composition and population trends of species.

Site fidelity of species

In both studied years, we confirmed site fidelity and repeatedly inter-seasonal occurrence in 10 species and 54 individuals (18.5% of all mist-netted species and 6.2% of all individuals). None of ringed birds in 2014 was retrapped after seven years. Based on the number of retrapped species among four seasons of 2021, four resident and abundant species were most faithful to the site (most frequently retrapped): *P. major* (17 retraps), *C. caerulues* (13), *Aegithalos caudatus* (9), *T. merula* (7), the other six species were retrapped only 1–2 times (Table 3). Inter-seasonal retraps of migratory species were rare (*S. atricapilla* 2, *L. megarhynchos* and *P. collybita* 1).

Table 2. Number of ringed birds in mist nets (84 m in 7 lines) at Korea wetland (Zvolen) in four seasons of years 2014 and 2021.
Tab. 2. *Počet krúžkovaných vtákov odchytených do 84 m sietí 7 línií na močiari Kórea (Zvolen) v 4 sezónach 2014 a 2021.*

Dátum/ Date	2014						2021					
Druh/ Species	May	Jul	Sep	Dec	Σ	n%	May	Jul	Sep	Dec	Σ	n%
Columba palumbus								1			1	0.25
Cuculus canorus		1			1	0.20						
Picus viridis	1				1	0.20						
Picus canus									1		1	0.25
Dendrocopos syriacus			1		1	0.20						
Dendrocopos major				1	1	0.20		1		1	2	0.50
Dendrocopos medius				1	1	0.20						
Jynx torquilla		1			1	0.20						
Hirundo rustica			4		4	0.80						
Troglodytes troglodytes			1	4	5	1.10				8	8	1.99
Prunella modularis				4	4	0.80				4	4	0.99
Motacilla alba							4				4	0.99
Erithacus rubecula	1	4	7	7	19	4.00	1	3	12	8	24	5.96
Luscinia megarhynchos	4	3			7	1.50	5	5	1		11	2.73
Luscinia luscinia									1		1	0.25
Phoenicurus ochruros		1	1		2	0.40	1	2			3	0.74
Phoenicurus phoenicurus								2			2	0.50
Turdus merula	13	13	10	4	40	8.50	7	10	5	5	27	6.70
Turdus pilaris		5	6		11	2.30		4			4	0.99
Turdus philomelos	1	7	4		12	2.50	3	8	15		26	6.45
Ficedula albicollis								2			2	0.50
Acrocephalus schoenobaenus	3		3		6	1.30	2	1			3	0.74
Acrocephalus palustris	9	9	2		20	4.20	1	1			2	0.50
Acrocephalus scirpaceus			1		1	0.20						
Acrocephalus arundinaceus							1				1	0.25
Locustella luscinioides		2			2	0.40	2	4			6	1.49
Locustella fluviatilis	2	2	2		6	1.30						
Sylvia curruca	1	2			3	0.60	3		2		5	1.24
Sylvia communis	7	6	3		16	3.40		5	1		6	1.49
Sylvia borin	1	1			2	0.40			1		1	0.25
Sylvia atricapilla	18	44	19		81	17.10	14	22	34		70	17.37
Phylloscopus collybita	1	5	17		23	4.90	6	10	9		25	6.20
Phylloscopus trochilus								2	3		5	1.24
Saxicola rubicola							2	2	1		5	1.24
Muscicapa striata			1		1	0.20			1		1	0.25
Aegithalos caudatus		2	6	10	18	3.80	4	1		10	15	3.72
Remiz pendulinus	2				2	0.40	1				1	0.25
Parus major	17	32	17	13	79	16.70	8	18	8	11	45	11.17
Cyanistes caeruleus		9	15	26	50	10.60	2	4	7	13	26	6.45
Poecile palustris			8	1	9	1.90	2	1	1	4	8	1.99
Sitta europaea			1		1	0.20	2	2	2		6	1.49
Lanius collurio	2	1			3	0.60		2			2	0.50
Pica pica									1		1	0.25
Garrulus glandarius		1			1	0.20	2				2	0.50
Sturnus vulgaris	4				4	0.80	1				1	0.25
Fringilla coelebs										1	1	0.25
Passer montanus	3	1	15		19	4.00	1	19	1	1	22	5.46
Serinus serinus	1				1	0.20		1	1		2	0.50
Carduelis chloris	1	1			2	0.40			3		3	0.74

Table 2. Continuation
Tab. 2. *Pokračovanie*

Dátum/ Date	2014						2021					
Druh/ Species	May	Jul	Sep	Dec	Σ	n%	May	Jul	Sep	Dec	Σ	n%
Carduelis carduelis				5	5	1.10		1			1	0.25
Carduelis spinus										3	3	0.74
Pyrrhula pyrrhula				1	1	0.20				5	5	1.24
C. coccothraustes	3	1			4	0.80	1	1			2	0.50
Emberiza citrinella										2	2	0.50
Emberiza schoeniclus	3				3	0.60	4	1			5	1.24
Spolu ex./ total ind.	98	154	144	77	473	100	80	136	111	76	403	100
Spolu druhov/ total species	21	24	22	12	42		25	29	22	14	47	

The number of retraps (species and individuals) increased as expected from spring to winter during both studied years, and the number of first-year individuals increased from July to September, with a slightly decrease in December (Fig. 2). The highest proportion of first-year individuals reached 78–79% in September in both years, which is similar to the long-term study in southern Moravia in July-September (81%, Chytil 2009).

In 2014, we confirmed inter-seasonal site fidelity in six species and 36 individuals, three species (3 ind.) of them were retrapped in July, five species (11 ind.) in September and four species (22 ind.) in December, with only one individual (*Passer montanus* M +1Y) caught twice between three seasons (May-July-September, Table 3) and confirmed a longer stay at the site. In 2021 we retrapped inter-seasonally nine species and 18 individuals, of them after 72 days in July three species (3 individuals), in September five species (7 individuals) and in December four species (8 individuals), while no individual was caught more than once among the seasons (Table 3).

Conclusions

Results of the monitoring and the species diversity (54 ringed bird species in 24 days in 84 m of mist-nets) of this secondary wetland habitat showed its regional importance for breeding, migration and roosting of birds. However, long time series are needed to explain the factors influencing varia-

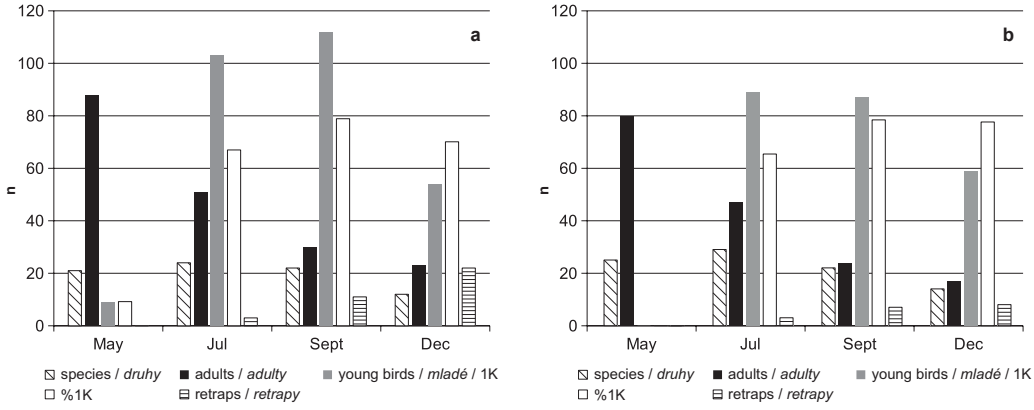

Fig. 2. Number of caught species, adults, young birds (i.e. up to 1-yr old), % of young birds (% 1K) and number of retraps (only from previous trapping sessions) in four seasons in 2014 (a) and 2021 (b).
Obr. 2. *Počet odchytených druhov, adultov, mladých vtákov (t.j. do jedného roka), % mladých (% 1K) a počet retrapov (len z predošlých sezón) v 4 ročných obdobiach v r. 2014 (a) a 2021 (b).*

Table 3. Birds retrapped among four seasons in 2014 and 2021; the number of days (D) by retrap and months (Mo) of capture and recapture; M = male, F = female for species where sex was determined.
Tab. 3. *Vtáky retrapované medzi 4 sezónami v r. 2014 a 2021; uvedený je počet dní (D) pri retrape a mesiace (Mo) medzi odchytmi; M = samec, F = samica, pri číslach bez označenia pohlavia, sa pohlavie neurčilo.*

Druh / *species*	D (Mo)														
	2014							2021							
	47 (7-9)	72 (5-7)	90 (9-12)	109 (5-9)	136 (7-12)	197 (5-12)	Σ	46 (7-9)	72 (5-7)	96 (9-12)	107 (5-9)	141 (7-12)	198 (5-12)	Σ	Σ2014 a 2021
P. major	2M, 3F	1F		1M	2M, 1F	2M	7M, 5F	2M, 1F				1M	1F	3M, 2F	17
C. caeruleus	1M, 1F		4		4		10	1F		1F		1F		3	13
A. caudatus			6		1		7						1M, 1F	2	9
T. merula	1F	1M			1F	1F	4	1F				1F	1M	3	7
S. atricapilla	1M						1		1M					1	2
Pas. montanus		1M		1M			2								2
P. palustris											1F			1	1
E. rubecula								1F						1	1
L. megarhynchos									1M					1	1
P. collybita									1F					1	1
Σ	9	3	10	2	9	3	36	6	3	1	1	3	4	18	54

tion in population sizes and population trends of particular species. Shrub vegetation and reedbeds with the remnants of willow growths in the vicinity of an urbanized industrial zone and railway is supporting the heterogeneity of landscape, and conservation of such habitats is necessary for the maintenance of bird diversity (Dmowski & Kozakiewicz 1990, Machtans et al. 1996).

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Súhrn

Sezónne rozdiely v spoločenstvách vtákov boli študované pomocou metódy odchytu do sietí pravidelne počas štyroch ročných období (máj, júl, september a december) v dvoch rokoch (2014 a 2021) na sekundárnej mokradi (7,3 ha), so zvyškom vŕbového lesíka a krovinami vo Zvolene. Celkom 54 druhov a 876 jedincov vtákov bolo krúžkovaných počas 24 dní ôsmich odchytových akcií (v 84 m sietí). Najvyšší počet druhov a jedincov bol odchytený v júli (36 druhov, 290 jedincov), najmenej v decembri (16 druhov, 153 jedincov), súhrnne za oba roky. Najpočetnejšími druhmi boli hniezdiace druhy *Sylvia atricapilla*, *Parus major*, *Cyanistes caeruleus* a *Turdus merula*. Medzi charakteristické trstinové vtáky patrili štyri druhy *Acrocephalus*, *Locustella luscinioides*, *Emberiza schoeniclus* a tiež krovinové druhy *Luscinia megarhynchos*, *Sylvia communis* a *Remiz pendulinus*. Sezónne rozdiely v počte a početnosti druhov sú analyzované a diskutované. Pravidelné zimovanie bolo zistené u sťahovavých druhov *Prunella modularis* a *Erithacus rubecula* severne od známych zimovísk ich stredoeurópskych hniezdnych populácií. Vernosť lokalite a medzisezónne retrapy boli potvrdené u 10 druhov a 54 jedincov (18,5 % všetkých odchytených druhov a 6,2 % všetkých jedincov). Na základe opätovne odchytených jedincov boli lokalite naj-

vernejšie rezidentné druhy *P. major*, *C. caeruleus*, *Aegithalos caudatus* a *T. merula*, pričom medzisezónne retrapy sťahovavých druhov boli zriedkavé (napr. *S. atricapilla*, *L. megarhynchos* a *Phylloscopus collybita*).

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