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Owl breeding survey in the lower part of the Ipeľ River basin (S Slovakia), 2010–2016

Sovy hniezdiace v južnej časti Ipeľskej kotliny (južné Slovensko) v rokoch 2010 – 2016

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Abstract. *European farmland habitats face dramatic changes in biodiversity and birds serve as good indicators of such changes. Here I present results of a seven-year survey for a particular group of farmland birds, owls, for a region in southern Slovakia during 2010–2016. The ecological abundance of Scops-Owl, a focal owl species, was 3–5 breeding territories/40 km of the Ipeľ River. Approximately half (6/11) of Scops-Owl territories was located in old rural parks within villages, with the remaining territories being located in riverine woodland. A high availability of large trees and extensive grassland areas with low pesticide use appear to provide Scops-Owl with the most suitable breeding habitats within the study area. With an estimated median breeding population density of 4 (range: 1–7) pairs per ca. 80 km², Long-eared Owl breeding density in the study area belongs among Slovakia's highest. Most Long-eared Owl breeding territories were located in villages in various woodland structures, such as old manor and cemetery parks, street tree lines and windbreaks, with the remaining territories being located in similar structures, mainly hedgerows, but just outside the villages. Little Owl breeding distribution was limited to a single breeding core area, consisting of four breeding territories. The median breeding population density of Little Owl was 2 (range: 0–4) pairs per ca. 80 km², with the median ecological breeding density being 1 (range: 0–4) pair per ca. 4 km². Four Tawny Owl breeding territories were recorded, and two of these territories overlapped with those of Scops-Owl. Single breeding territories of Barn Owl and Eagle Owl were recorded. The current distribution of Barn Owl and mainly Little Owl emphasizes the importance of ruderal and non-productive farmland habitats and indicates important changes in trophic interactions in the region's farmland ecosystem.*

Key words*:* Otus scops*,* Athene noctua*,* Asio otus*, abundance, breeding habitat, farmland*

Introduction

Population trends of birds over the last decades indicate marked changes in biodiversity across different ecosystems in Europe (Donald et al. 2006, Sanderson et al. 2006, Gregory et al. 2007, Vickery et al. 2014). While the reasons of large-scale population changes are debated (e.g. Fuller et al. 1995; Evans et al. 2004; Newton 2004; Both et al. 2006), it is also clear that to elucidate this problem at the large spatial scale, refined data sets are needed for different spatial and temporal scales (e.g. Dunning et al. 1992; Peterson et al. 1998).

Farmland habitats not only represent a considerable area of Europe, but this ecosystem also is facing perhaps the most dramatic changes in biodiversity, mainly following a revolution in agricultural practice (Blaxter and Robertson 1995; Benton et al. 2003). Bird population declines are one of the most apparent manifestations of changes in ecosystem processes

and trophic interactions in farmland habitats (Matson et al. 1997; Tscharntke et al. 2005). The differences in past and current agricultural practices between eastern and western European countries offer one opportunity to address the causes of large-scale population changes in farmland birds (e.g. Báldi and Faragó 2007). For example, a study based on changes in food contents of Barn Owl *Tyto alba* revealed that despite a more recent implementation of the Common Agricultural Policy of the EU in eastern European countries, a temporal decline in a common farmland bird is surprisingly more pronounced in eastern than western European countries (Roulin 2014). This example underlines a complex nature of bird population changes taking place at the level of species, communities, and food webs. The last review on the trends of raptors and owls in Europe between 1970 and 2000 indicates that owl species associated with forest habitats, particularly in northern Europe, face relatively stable population trends (Burfield 2008). In contrast, owl species associated with open habitats, such as Barn Owl and Little Owl, show unfavourable trends – mainly in eastern and central Europe (Burfield 2008). Importantly, due to ongoing socioeconomic and land-use changes, these trends were predicted to be even more dramatic in eastern Europe (Burfield 2008).

Here I present results for a particular group of farmland birds for a farmland region in southern Slovakia. During a seven-year period, I investigated the distribution of owls in the Ipeľ River basin. The study area is dominated by open farmland and largely corresponds with the Poiplie Special Protection Area (SPA), which was identified as one of the most significant regions for Scops-Owl *Otus scops* in Slovakia. The main goal of this study was to establish the breeding distribution and abundance patterns of Scops-Owl and other owl species distributed within the study area.

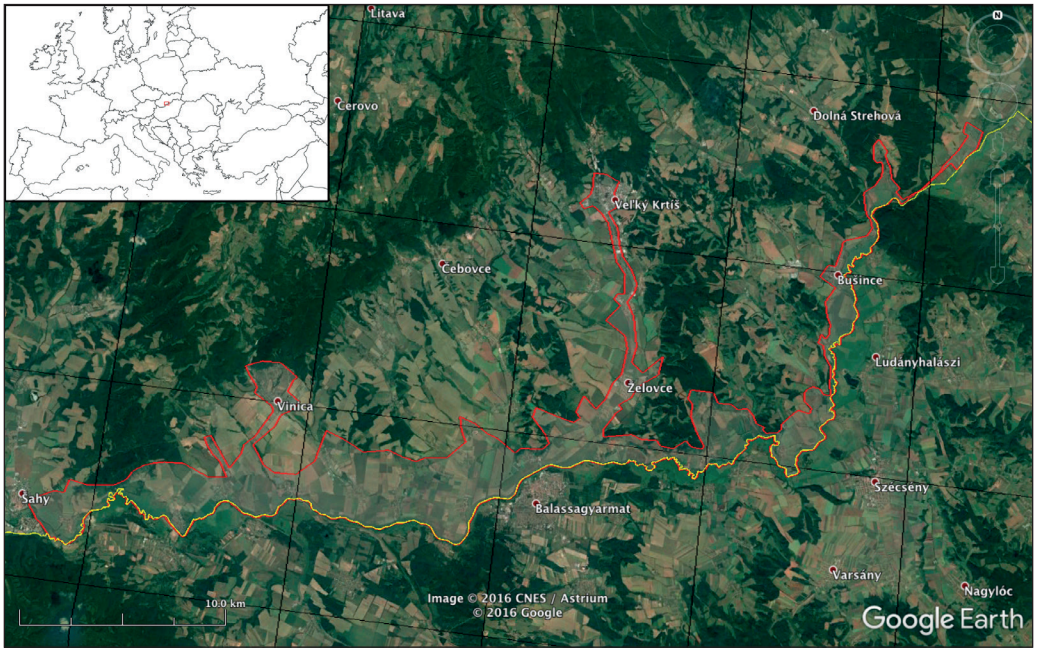

Fig. 1. Study area in the Ipeľ River basin (South Slovakia) where the breeding owl survey was conducted during 2010–2016. The borders of the whole study area (127 km^2) are marked with red line. Yellow line shows border between Slovakia and Hungary. Black lines correspond to a 10 × 10 km grid implemented by the European Bird Breeding Atlas.

Obr. 1. Študijná *plocha prieskumu sov v Ipeľskej kotline (južné Slovensko) počas rokov 2010–2016. Hranice* študijnej *plochy (127 km^2) sú označené* červenou čiarou. Žltá čiara *znázorňuje hranicu medzi Slovenskom a Maďarskom a* čierne čiary *vyznačujú sieť* štvorcov *(10 × 10 km), ktoré sú použité pre Európsky hniezdny atlas vtákov (EBBA).*

Material and Methods

The study area (127 km^2) was located in the Ipeľ River basin in southern Slovakia (centroid: 48°06'N 19°15'E), along Slovak–Hungarian borders, mostly along the Ipeľ River within the Veľký Krtíš district (Fig. 1). The study area was surveyed with different intensity, with the most intensively visited study area (ca. 80 km^2) chiefly corresponding with the Poiplie SPA (SKCHVU021 Poiplie). The Poiplie SPA is predominantly comprised of arable land (62%) and grassland (26%) and was designated in 2008 as a Natura 2000 site for the protection of fifteen wetland and farmland bird species. The region has a warm temperate climate and the annual precipitation rate between 550–600 mm. The actual regime of wetland habitats and the structure of wetland and farmland bird communities are highly dependent on spring precipitation rates and periodic Ipeľ River flooding (Mojžiš et al. 2011).

The owl surveys were conducted from March 2010 through August 2016. Totally, 42 to 72 visits per year were paid to 32 different sites (Table 1). Over the study period, each site was visited between 2 to 43 times (median = 14). The survey method was adopted to maximize the detection of Scops-Owl as the focal owl species for the study area. This means that the owl survey was most intensive during the period from mid April to mid August, which coincides with the breeding period of the species in Europe (Cramp 1985; Holt et al. 2016). In contrast, abundance indices may be underestimated for non-migratory owl species with an earlier and/or longer breeding season. The surveys were conducted under favourable weather, i.e. no rain and calm or light winds, from sunset until sunrise, but mostly between 22h00 and 02h00. The survey conducted each night followed a linear transect (road, river bank, flood embankment), with the length of each transect and the number of stops per transect depending on weather conditions, particularly, wind velocity. In order to obtain spatially more accurate information about the position of breeding territories, the acoustic monitoring of breeding distribution of Scops-Owl and other owls was conducted without the use of call stimulation method (i.e. playback recordings, whistle). In this way, it was possible to detect the position and breeding territories of spontaneously duetting pairs of Scops-Owls, identify potentially unmated territorial individuals, and reduce the possibility of recording non-territorial floaters.

In order to establish an index of relative breeding abundance, I estimated breeding densities when the quality and quantity of data permitted such calculations. The index of relative breeding abundance for Scops-Owl was calculated with respect to linear km of the Ipeľ River because all Scops-Owl breeding territories were located along or in the vicinity of this river.

Results

Over the study period of seven years (2010–2016), I detected the breeding occurrence of six owl species in the lower part of the Ipeľ River basin: Long-eared Owl *Asio otus*, Scops-Owl *Otus scops*, Little Owl *Athene noctua*, Tawny Owl *Strix aluco*, Barn Owl *Tyto alba*, and Eagle Owl *Bubo bubo*. Mainly based on systematic territory mapping surveys, I identified 20, 11, 8, 4, 1, and 1 unique territories for Long-eared Owl, Scops-Owl, Little Owl, Tawny Owl, Barn Owl, and Eagle Owl, respectively (Table 1 and 2; Fig. 2 and 3).

Scops-Owl

The yearly number of Scops-Owl territories fluctuated between 0 and 7 (median = 3) over the study period. While the majority (6/11) of territories was found to be occupied only during a single year, five territories were found to be occupied during multiple years (1, 1, and 3 territories were occupied during 4, 3, and 2 years, respectively). All the territories were identified based on spontaneous male calls (4/11 territories) or duetting males and females (7/11 territories). The species presence was most frequently detected during the period of May 21 to June 10 (Fig. 4) and between 23h01 and 24h00 (Fig. 5). After weighting the yearly

Table 1. Results of the breeding owl survey in the lower part of the Ipeľ River basin, South Slovakia, 2010–2016. The number of visits and the number of unique territories are shown for each site and owl species. The number in parentheses indicates the number of territories at the given site with duetting Scops-Owl *Otus scops* pairs.
Tab. 1. *Výsledky prieskumu hniezdneho rozšírenia sov v južnej* časti *Ipeľskej kotliny (južné Slovensko) počas rokov 2010 – 2016. V tabuľke sú uvedené počty návštev pre každú lokalitu a rok, ako aj počet teritórií pre každý druh a rok. Pre výrika lesného* Otus scops *sa v zátvorkách uvádza počet teritórií s duetujúcimi pármi.*

	No. visits/year / Počet návštev/rok								No. territories/species / N teritórií/druhov					
Site / *Lokalita*	2010	2011	2012	2013	2014	2015	2016	∑	*Otus scops*	*Asio otus*	*Athene noctua*	*Strix aluco*	*Tyto alba*	*Bubo bubo*
Vyškovce nad Ipľom	0	0	0	0	0	0	2	2	0	0	1	0	0	0
Tešmak	5	2	3	2	4	4	2	22	0	2	0	0	0	0
PR Ryžovisko	2	2	2	2	2	3	2	15	0	1	0	1	0	0
PR Cúdenina	2	2	2	2	1	3	2	14	0	0	0	0	0	0
Ipeľské Predmostie	5	3	3	2	5	3	2	23	2 (2)	1	0	1	0	0
Veľká Ves nad Ipľom	1	1	1	3	2	2	1	11	1 (0)	0	0	0	0	0
Sečianky	0	0	0	0	1	0	1	2	0	1	0	0	0	0
Balog nad Ipľom	3	2	4	5	3	2	2	21	1 (1)	1	0	0	0	0
Kosihy nad Ipľom	2	0	2	5	3	2	2	16	2 (0)	1	0	0	0	0
Vinica	0	0	0	1	0	1	0	2	0	0	0	0	0	1
Veľká Čalomija	2	1	2	4	3	2	1	15	0	0	0	0	0	0
Malá Čalomija	0	0	0	2	2	2	0	6	0	1	0	0	0	0
Chrastince	0	0	1	2	3	3	2	11	1 (1)	1	1	0	0	0
Koláre	1	2	1	2	1	1	1	9	0	0	0	0	0	0
Iliašov	2	2	1	4	4	3	2	18	1 (1)	0	1	0	0	0
Slovenské Ďarmoty	1	1	0	1	1	1	0	5	0	1	0	0	0	0
Horné Podlužany	3	1	1	2	3	2	2	14	1 (0)	0	2	0	0	0
Záhorce	1	0	0	1	0	0	0	2	0	0	0	0	0	0
Želovce	2	0	0	1	1	1	0	5	0	1	0	0	0	0
Selešťany	3	3	2	4	5	3	1	21	0	1	0	0	0	0
Vrbovka	4	2	2	5	5	2	1	21	1 (1)	1	0	0	0	0
PR Kiarovský močiar	3	3	1	1	2	1	1	12	0	0	0	0	0	0
Kováčovce	3	3	2	2	3	3	1	17	0	3	0	0	0	0
Peťov	3	2	3	2	3	2	2	17	0	1	0	0	1	0
Kirť	4	3	1	2	3	2	1	16	1 (1)	1	0	1	0	0
Čeláry	3	2	1	2	1	1	1	11	0	0	0	0	0	0
Bušince	3	2	1	2	1	1	1	11	0	0	1	0	0	0
Muľa	2	2	2	2	1	3	2	14	0	1	0	0	0	0
Prieloh	1	1	0	0	2	0	1	5	0	1	0	0	0	0
Rároš	2	2	2	2	1	3	2	14	0	0	0	0	0	0
Dálovce	1	1	0	0	0	0	0	2	0	0	1	0	0	0
Veľký Krtíš	8	6	6	4	5	10	4	43	0	0	1	1	0	0
∑	72	51	46	69	71	66	42		11	20	8	4	1	1

Table 2. Temporal variation in the number of breeding territories detected for six owl species in the lower part of the Ipeľ River basin, South Slovakia, 2010–2016. The number in parentheses shows the number of Little Owl territories/home ranges after considering observations collected outside the breeding period.
Tab. 2. *Medziročná variabilita v počte registrovaných hniezdnych teritórií pre sovy južnej* časti *Ipeľskej kotliny (južné Slovensko) počas rokov 2010 – 2016. Hodnoty v zátvorkách znázorňujú počet teritórií / domovských okrskov po zohľadnení pozorovaní z mimohniezdneho obdobia.*

	No. Territories / *N teritórií*						
Species / *Druh*	2010	2011	2012	2013	2014	2015	2016
Otus scops	0	0	7	1	3	4	4
Athene noctua	2	2 (3)	0	1	4	1	2 (3)
Asio otus	5	1	2	4	4	7	1
Strix aluco	1	0	1	1	3	0	0
Tyto alba	0	1	1	0	0	0	0
Bubo bubo	0	0	0	1	0	0	0

number of detected Scops-Owl territories for survey effort (i.e. the yearly number of visits to the sites found positive for Scops-Owls between 2010 and 2016) and survey suitability (i.e. the yearly number of nocturnal trips during the period between May 21 and June 10), the number of territories peaked in 2012 and 2016 (Fig. 6). The owl territories were located in old rural and cemetery parks (n = 6) and riverine woodland in village outskirts (n = 5, Table 3).

Little Owl

Of eight territories detected during the study period within the study area or its immediate borders, two territories (Veľký Krtíš and Vyškovce nad Ipľom) were identified based on casual observations outside the period of systematic surveys as wells as outside the species' breeding period. Thus, I conservatively consider the sites for the two observations home ranges rather than breeding territories. The majority (9/14) of Little Owl observations was based on calling individu-

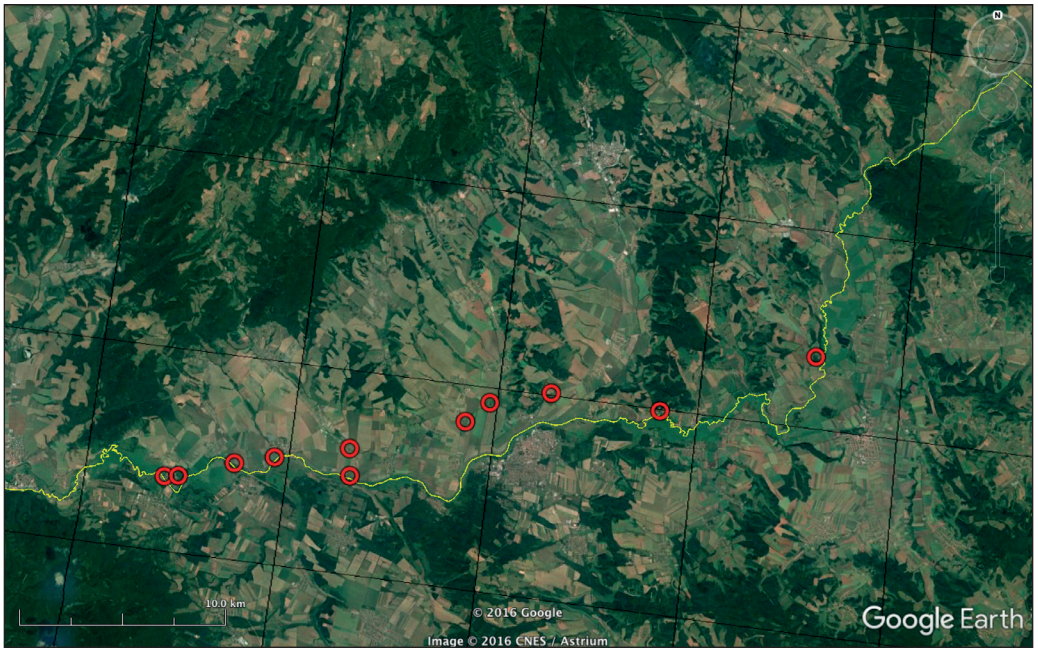

Fig. 2. Breeding distribution of Scops-Owl *Otus scops* in the Ipeľ River basin (South Slovakia), 2010–2016. Each circle indicates the position of breeding territories based on spontaneous calls of Scops-Owl. The position of breeding territories with duetting males and females were determined by taking mid-points.
Obr. 2. *Hniezdne rozšírenie výrika lesného* Otus scops *v Ipeľskej kotline (južné Slovensko) počas rokov 2010 – 2016. Každý krúžok znázorňuje polohu hniezdneho teritória, ktorá bola určená na základe registrácie spontánneho volania sov. V prípade duetujúcich párov bola poloha hniezdneho teritória určená ako stredná poloha duetujúcich vtákov.*

als, with the rest of observations being based on visual observations of adult or juvenile birds. I identified 0 to 4 (median = 2) breeding territories per year over the seven years study period. Little Owls at 5 of 8 territories/home ranges were observed only during a single year (Malé Dálovce: 2010; Veľký Krtíš: 2011; Chrastince: 2014; Bušince: 2016; Vyškovce nad Ipľom: 2016), two territories were occupied during two years (Horné Podlužany-1: 2011, 2014; Horné Podlužany-2: 2014, 2016), and one territory during five years (Iliašov: 2010, 2011, 2013, 2014, 2015). The latter three territories and the territory detected in Chrastince may in fact represent only two extended territories (nearest neighbour distances: Iliašov–Chrastince = 1.3 km; Horné Podlužany-1–Horné Podlužany-2 = 0.7 km; Iliašov–Horné Podlužany-1 = 4.5 km). Little Owls were most frequently detected in the first decade of June (Fig. 4) and during the period of time between 20h01 and 22h00 and between 00h01 and 01h00 (Fig. 5). Half (4/8) of all territories/home ranges was detected immediately next to Roma settlements, three territories/home ranges were located within farms and farmhouses, and a single territory/home range was located near a collective farm (Table 3).

Long-eared Owl

Even though the survey period was not entirely suitable for this species, with twenty unique breeding territories, Long-eared Owl was found to be the most abundant owl breeding species for the study region. The yearly number of Long-eared Owl territories ranged between 1 and 7 (median = 4). These numbers can only be considered conservative surrogates of the species' breeding abundance, as they are predominantly based on nestling squeaking calls (n = 22), and

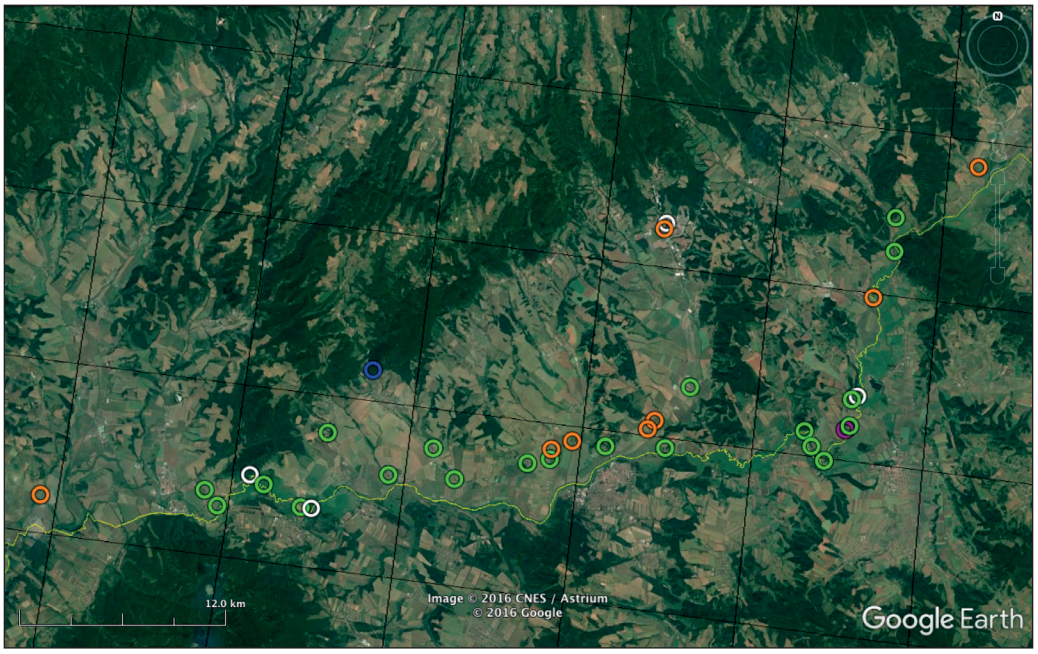

Fig. 3. Breeding distribution of Long-eared Owl (green), Little Owl (orange), Tawny Owl (white), Barn Owl (purple), and Eagle Owl (blue) in the Ipeľ River basin (South Slovakia), 2010–2016. Each circle denotes the position of breeding territories based on spontaneous calls and/or visual observations for all owl species. Two of eight positions for Little Owl were interpreted as home ranges rather than breeding territories (see Results).

Obr. 3. *Hniezdne rozšírenie myšiarky ušatej* Asio otus (zelená), *kuvika obyčajného* Athene noctua (oranžová), *sovy obyčajnej* Strix aluco (biela), *plamienky driemavej* Tyto alba (fialová), *a výra skalného* Bubo bubo (modrá) *v Ipeľskej kotline (južné Slovensko) počas rokov 2010 – 2016. Každý krúžok znázorňuje polohu hniezdneho teritória, ktorá bola určená na základe registrácie spontánneho volania a / alebo vizuálnej registrácie sov. Dve pozície (Veľký Krtíš, Vyškovce nad Ipľom) pre kuvika obyčajného znázorňujú domovské okrsky a nie hniezdne teritóriá (viď Výsledky).*

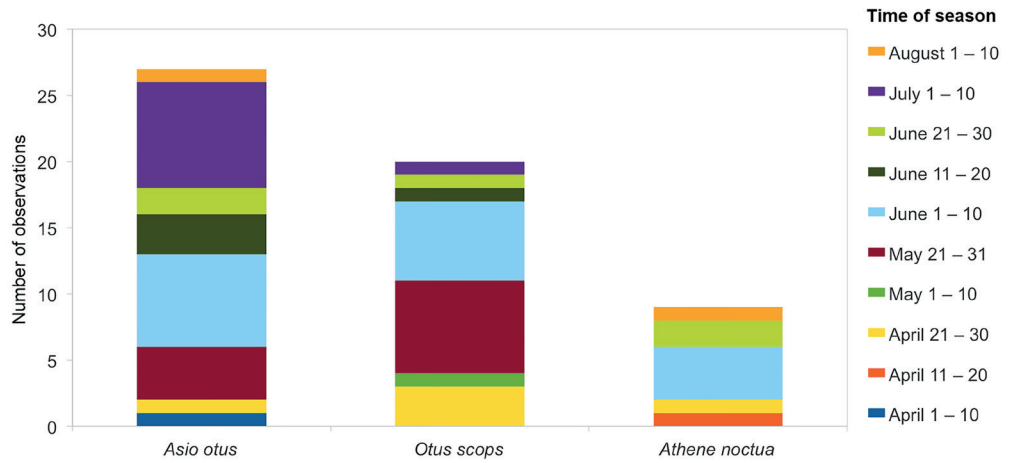

Fig. 4. Owl occurrence with respect to the time of season for three most common owl species in the Ipeľ River basin (South Slovakia), 2010-2016.
Obr. 4. *Regitrácia sov v závislosti od obdobia sezóny pre tri najbežnejšie druhy sov v Ipeľskej kotline (južné Slovensko) počas rokov 2010 – 2016.*

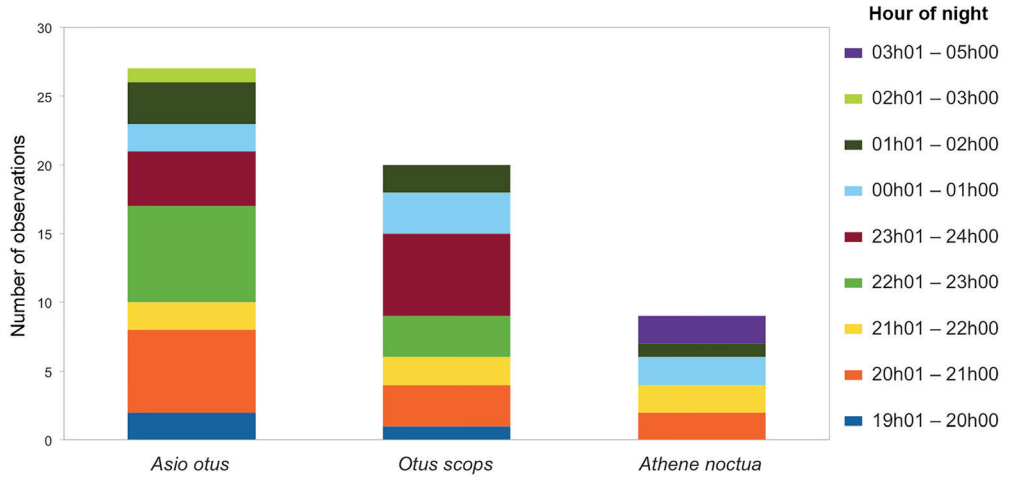

Fig. 5. Owl occurrence with respect to the hour of night for three most common owl species in the Ipeľ River basin (South Slovakia), 2010-2016.
Obr. 5. *Registrácia sov v závislosti od* času *noci pre tri najbežnejšie druhy sov v Ipeľskej kotline (južné Slovensko) počas rokov 2010 – 2016.*

not on male hooting (n = 5). The species was detected mostly during the first decades of June and July (Fig. 4) and during the periods of time between 20h01 and 21h00 and 22h01 and 23h00 (Fig. 5). The results revealed two peaks in the breeding activity of Long-eared Owls in terms of the timing of nestling calling, namely, the first decades of June and July (nest numbers with calling nestlings: May 21–31 = 4, June 1–10 = 8, June 11–20 = 2, June 21–30 = 1, July 1–10 = 7). I did not detect multiple breeding attempts at the same breeding territory during any year. The majority (14/20) of Long-eared Owl territories were located in rural woodland within villages, represented by old parks (n = 7), cemeteries (n = 4), and windbreaks along

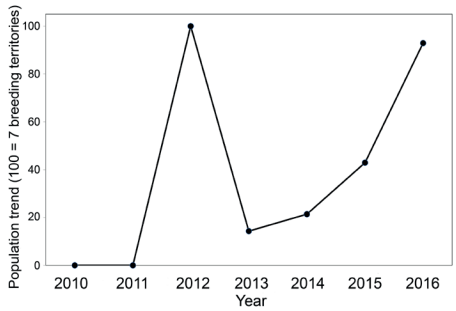

Fig. 6. Population trend for Scops-Owl *Otus scops* in the Ipeľ River basin (South Slovakia), 2010–2016. The population trend was determined by weighting the yearly number of breeding territories for survey effort and survey suitability (see Results).
Obr. 6. *Populačný trend výrika lesného* Otus scops *v Ipeľskej kotline (južné Slovensko) počas rokov 2010 – 2016. Populačný trend bol určený na základe váženia ročného počtu hniezdnych teritórií vzhľadom na intenzitu a vhodnosť prieskumu (viď Výsledky).*

football playgrounds (n = 3); the remaining (6/20) territories were detected in hedgerows located in village outskirts (Table 3).

Tawny Owl

Similarly as for Long-eared Owl, Tawny Owl territories were detected mainly based on nestling squeaking calls. Totally, four different territories were identified within the study region. During the study period, 0 to 3 (median = 1) territories were detected during individual years. Nests with calling nestlings were detected in late May and early June (May 28, June 9) and in the beginning of July (July 4 and 7). Similarly as for Long-eared Owl, I did not detect multiple breeding attempts at the same breeding territory during any year. The nests with calling nestlings were located in rural old parks (n = 3) and in an allotment garden located on a woodland margin (n = 1; Table 3).

Barn Owl and Eagle Owl

A single territory of Barn Owl was detected in Peťov in an old manor house. The pair was detected in May 2011, with a nest located in a hollow of the house's wooden ceiling. Based on the wear of the nest entrance and the quantity of pellets underneath, the nest served as a nesting site several years before 2011. The nest and food pellets were inspected in the house also in June 2012, confirming the continuing occupancy of the nest based on the accumulation of fresh food pellets. A single Eagle Owl territory was detected based on male hooting in April 2013. The presumed nesting site for the territorial male was an abandoned quarry (Table 3).

Table 3. Breeding habitat types associated with owl species surveyed in the Ipeľ River basin, South Slovakia, 2010–2016.
Tab. 3. *Typy hniezdnych biotopov pre sovy zaregistrované v Ipeľskej kotline (južné Slovensko) počas rokov 2010 – 2016. Typ hniezdneho habitatu: 1 – staré vidiecke a cintorínske parky, 2 – brehové porasty drevín, 3 – rómske osídlenia, 4 – gazdovstvá, gazdovské dvory, 5 – družstvá, 6 – vidiecke lesíky v obciach, 7 – vidiecke lesíky mimo obcí, 8 – staré vidiecke parky, 9 – záhradkárska osada, 10 – stará vidiecka budova, 11 – kameňolom.*

Breeding habitat type / *Typ hniezdneho habitatu*	Sites / *Lokality*
Otus scops	
Old rural and cemetery parks[1]	Ipeľské Predmostie-1, Kosihy nad Ipľom-1, Chrastince, Iliašov, Horné Podlužany, Kirť
Riverine woodland[2]	Balog nad Ipľom, Ipeľské Predmostie-2, Vrbovka, Veľká Ves nad Ipľom, Kosihy nad Ipľom-2
Athene noctua	
Roma settlements[3]	Iliašov, Chrastince, Bušince, Malé Dálovce
Farms, farmhouses[4]	Horné Podlužany-1, Horné Podlužany-2, Veľký Krtíš
Collective farms[5]	Vyškovce nad Ipľom
Asio otus	
Rural woodland within villages[6]	Tešmak, Ipeľské Predmostie, Sečianky, Balog nad Ipľom, Kosihy nad Ipľom, Malá Čalomija Chrastince, Slovenské Ďarmoty, Želovce, Selešťany, Kováčovce 1, Peťov, Kirť, Muľa
Rural woodland outside villages[7]	Tešmak, Ryžovisko, Vrbovka, Kováčovce 2, Kováčovce 3, Prieloh
Strix aluco	
Old rural parks[8]	Veľký Krtíš, Kirť, Ipeľské Predmostie
Allotment garden[9]	Ryžovisko
Tyto alba	
Old rural building[10]	Peťov
Bubo bubo	
Quarry[11]	Vinica

Discussion

This study reports the results of the first systematic longitudinal breeding Scops-Owl survey for a specific region in southern Slovakia from 2010 through 2016. In addition, this study provides a glimpse at the distribution, abundance and habitat associations of five other owl species breeding in the study area.

During the seven years study period, at least one breeding territory of Scops-Owl was detected for five of seven years in the lower part of the Ipeľ River basin. The yearly number of occupied territories fluctuated between zero and seven, with the median number of three territories. No Scops-Owl territory was detected in 2010, when the season from March to June was exceptionally wet (2–3 fold higher precipitation than the average) and included flooding, and in 2011, when the season was relatively dry and warm. It is hard to speculate whether Scops-Owl absence in 2011 can be a consequence of the unfavourable season 2010 or lower survey efficiency at the beginning of the study period. The latter case is feasible because from 2012, I modified the survey method in that I monitored potential sites in the whole study area within the two nights following the detection of any calling Scops-Owl. This approach was highly effective in detecting occupied Scops-Owl territories because the calling activity of this migratory owl species was found to be highly synchronous within the study region. This survey's modification was important because the occurrence and intensity of calling activity of this species was not steady even during the most suitable period of the season (i.e. from May through early June) or favourable weather conditions (e.g. Scops-Owls were detected to call at temperatures below 10° C). Consequently, based on the median yearly number of occupied territories and on the number of territories that were occupied during several years, this study suggests that the current population of Scops-Owls within the study area comprises three to five Scops-Owls territories. Taking into account only the section of the Ipeľ River with Scops-Owl territories, the species' yearly ecological abundance is estimated to be 3–5 breeding territories/40 km of the river. While this value is approximately half of that found by Zuna-Kratky et al. (2000) for the Morava River in SW Slovakia (11 calling individuals/45 km river during September 3–17), it must be noted that the estimate for the Ipeľ River corresponds to the number of unique breeding territories, and not to the number of calling individuals outside the breeding period, potentially involving fledged birds. Similarly, it is hard to compare the results of this study with other Scops-Owls surveys from the Ipeľ River basin or other Slovakia's regions. For example, Randík (1959) reports the results of the Scops-Owls survey for three years (1955–1957) for a lower course of the Hron River before its confluence with the Danube River. During three years, including nine nocturnal visits, Randík (1959) detected 44 calling individuals for a region of ca. 60.5 km^2. Unfortunately, as the author pooled together the number of calling individuals from all years, it is not possible to determine the actual breeding abundance of the species for any of the studied Hron River sections. Moreover, another shortcoming of the Scops-Owl surveys based on stimulation calls, such as the one by Randík (1959), is that it is only hardly possible to distinguish between territorial pairs, unmated territorial males, and non-territorial floaters. In contrast to the results obtained by call stimulation, duetting Scops-Owl pairs are readily detectable in surveys based on spontaneously calling owls. The latter technique, employed together with surveying the same territories repeatedly, not only enables to separate pairs from unmated territorial individuals and floaters, but also to estimate the suitability of potential breeding habitat patches. This is because paired individuals and re-occupied territories are likely to be associated with higher quality breeding habitat (e.g. Shields 1984; Aebischer et al. 1995; Clark and Shutler 1999; Bayne and Hobson 2001).

Considering the published Scops-Owls observations for the study area of the Ipeľ River basin (Randík 1959; Harvančík et al. 1991; Sárossy 2001), I have detected the presence of the species for both previously

reported sites (Slovenské Ďarmoty – Horné Podlužany, Kirť). Yet, it is not clear if the site reported by Harvančík et al. (1991) refers to the same site as the one reported by Randík (1959). Interestingly, in terms of re-occupancy frequency, neither of the two sites currently appears to belong among the most suitable breeding habitats within the study area. While one reason for this may be vegetation succession followed by tree cutting for the old rural park at the site Horné Podlužany, heightened interspecific interactions with other owls or mammal predators may be a potential reason in the case of the old rural park at the site Kirť (c.f. Sárossy et al. 2002, Sárossy and Krištín 2003).

In my survey, I have detected nine previously unreported Scops-Owls territories for the Ipeľ River basin. Approximately half (6/11) of all territories were located in old rural parks within villages, with the remaining territories being located in riverine woodland near villages (Table 3). All territories were characterized by the presence of woodland patches with sparsely distributed large, predominantly black poplar *Populus nigra* trees and the mosaic of grasslands, agricultural fields, and gardens. Based on the territory re-occupancy frequency, the most suitable Scops-Owls breeding habitat appears to be located at the site Ipeľské Predmostie, where two different territories were occupied during four and three different years, respectively. This site is exceptional in the abundance of large trees that are retained in the inundation area of the Ipeľ River, forming a green protection belt around the village. Moreover, an extensive area of grassland communities comprising of marshes and mowed and grazed meadows stretches on both sides of the Ipeľ River around the Ipeľské Predmostie village. All of these grasslands habitats are protected under national, EU or international legislation – Ipeľské hony Nature Reserve, Cúdenina Nature Reserve, Duna-Ipoly National Park, Poiplie Special Protection Area, Ipoly völgye Special Protection Area, Poiplie Ramsar Site, and Ipoly Valley Ramsar Site. Therefore, it appears that the combination of a high availability of large trees and the mosaic of extensive grassland communities with low pesticide use provide Scops-Owl with the most suitable nesting and foraging habitats within the study area. Since most Scops-Owls territories were located in a largely agricultural landscape, it is possible that the probability of territory occupancy at these sites depends not only on nesting habitat suitability, but also on agricultural land use in a particular year. The latter effect would not be surprising because the Scops-Owl's main diet is comprised of large insects associated with low-level agricultural practices (Krištín and Sárossy 2002, Šotnár et al. 2008, Latková et al. 2012).

While the focal species of this study was Scops-Owl, I gathered information on breeding distribution and abundance of other owls in the study area. My results suggest that Long-eared Owl is the most common owl for the study area. Over the period of seven years, a yearly median of five breeding territories was detected and nests with nestlings were detected in most villages surveyed (Fig. 3). This species also was recorded most frequently in grassland habitats around villages where it was found hunting during nocturnal surveys. Since some territories might have been undetected every year, mainly those with nests containing young during early May and late July (see Fig. 4), the yearly breeding abundance of Long-eared Owl may be underestimated in this study. While the median breeding population density of 4 (range: 1–7) pairs per ca. 80 km^2 for the period 2010–2016 belongs among the highest densities of Long-eared Owl in Slovakia (Kropil 2002), it is still below the species' average density of 10–20 pairs per 100 km^2 reported for Central Europe (Cramp 1985; Olsen 1999). Most (14/20) breeding territories were located in woodland structures, such as old manor and cemetery parks, street tree lines and windbreaks, within villages, with the remaining territories being located in similar structures, mainly hedgerows, just outside the villages. Long-eared Owl territories were mostly located near larger patches of dense tree stands within the predominantly open study area.

The results of this study for the Ipeľ River basin are in line with recent findings by Mojžiš

and Kerestúr (2013) about the decline in the abundance of Little Owl for the Lučenecká kotlina basin. The authors reported 4–6 Little Owl pairs per ca. 400 km^2 during the years 2011 and 2012, with all territories being detected in active collective farms. In this study, during the seven years period, I detected five Little Owl breeding territories within the main study area of about 80 km^2. In addition, I have detected three other Little Owl territories (Veľký Krtíš, Vyškovce nad Ipľom, Malé Dálovce) just outside the main study area. Restricting the territories only to the main study area, the median breeding population density of Little Owl during 2010–2016 in the Ipeľ River basin is 2 (range: 0–4) breeding pairs per ca. 80 km^2. Hence, this density estimate corresponds with that reported by Mojžiš and Kerestúr (2013) for the Lučenecká kotlina basin. Furthermore, restricting the area only to four closely adjacent territories (Záhorce, Horné Podlužany-1, 2, Iliašov, Chrastince), the median ecological breeding density of Little Owl for the same period is 1 (range: 0–4) breeding pair per ca. 4 km^2. This estimate roughly corresponds with average Little Owl densities of 0.3–0.5 pairs per 1 km^2 for Central Europe (Cramp 1985). Though systematic survey of Little Owl has not been conducted in the Ipeľ River basin, the species was widely distributed in the study region between 1980 and 1999 (Pačenovský 2002). Consequently, this study corroborates results from other regions, suggesting that it is mainly a contraction of the former breeding range into few core areas, rather than decreases in ecological breeding density, that is associated with the population decline of this species in Central Europe (Jakobsen 2006; Żmihorski et al. 2006; Nieuwenhuyse et al. 2008; Šálek and Schröpfer 2008; Šálek 2014). In fact, two recently abandoned Little Owl territories, namely the Cerina site in Slovenské Ďarmoty (Krištín in litt.) and the old manor house in Selešťany (Václav in litt.), are located just outside the borders of the current species' core area.

Intriguingly, Little Owl breeding occurrence (i.e. occurrence of calling individuals or juveniles) within the study area was predominantly (4/6 breeding territories) associated with Roma settlements (Malé Dálovce, Bušince, Iliašov, Chrastince). The remaining two territories were located at solitary family farms/farmhouses (Horné Podlužany-1, 2). Despite the fact that the species' nesting habitat was associated with collective farms in the past, no breeding territory was detected for this type of breeding habitat during the study period. I can only speculate about the reasons behind the species-habitat associations detected. One possibility is a higher availability of permanent ruderal and uncropped low vegetation areas within farmland, which can play an important role in the persistence and abundance of Little Owl prey (rodents, small birds) in summer and mainly winter periods (c.f. Fulller et al. 2004). The breeding distribution of Long-eared Owl does not indicate that small vertebrate prey availability is so highly spatially heterogeneous within the study area during the summer season, thus pointing to the crucial importance of ruderal habitats during the winter season. In the future, it would be fruitful to monitor Long-eared Owl distribution during the winter period to see whether the species' winter distribution (winter roost sites) corresponds with Little Owl breeding occurrence and how it depends on winter conditions. Interestingly, within the study area, the current core area of Lesser Grey Shrike *Lanius minor* highly overlaps with the core area of Little Owl – and also of Scops-Owl. This may not be surprising because the abundance of large insects, the main diet for Lesser-grey Shrike, Little- and Scops-Owl, also is higher in ruderal, fallow and rural areas with low intensity farmland management (e.g. Giralt et al. 2008; Latková et al. 2012; Šálek et al. 2016).

Tawny Owl, Barn Owl and Eagle Owl territories also were detected within the study area between 2010 and 2016. While Tawny Owl and Eagle Owl do not represent typical representatives of an open farmland landscape, the current breeding distribution of Barn Owl within the study area adds to the evidence about a population decline in this species throughout Slovakia (Sárossy 2002) and Europe (Burfield 2008). As suggested by Roulin (2014), the population changes in Barn Owl can be used as an indica-

tor of large-scale changes in the abundance of farmland small vertebrates, especially birds, such as House Sparrow *Passer domesticus*. Consequently, the current breeding distribution of Barn Owl, but also of Little Owl, suggests an important deterioration of the farmland ecosystem in terms of farmland bird diversity and abundance within the study area. This is consistent with recent data for the study area, suggesting a strong population decline over the last two decades in farmland birds, such as Crested Lark, Common Quail, or Lesser Grey Shrike (Mojžiš et al. 2011). A similar joint population decline of Barn Owl and Little Owl has been reported for a farmland region in East Poland (Kitowski and Stasiak 2013). Therefore, this work confirms the assertion by Burfield (2008) that raptors and owls associated with open habitats such as arable farmland are likely to further decline in eastern Europe in the coming years.

During the study period, I detected three breeding territories of Tawny Owl within the main study area. Tawny Owl territories were located in old parks or in an allotment garden near denser woodland. Interestingly, Tawny Owls shared their territories with Scops-Owls in 2/3 (Ipeľské Predmostie, Kirť) sites, and for one site (Ipeľské Predmostie) simultaneously calling individuals of both species were detected during one survey visit (June 12, 2014). Another Tawny Owl territory was detected about 3 km from the Scops-Owl territory in Ipeľské Predmostie. Therefore, it appears that the breeding occurrence of Tawny Owl does not negatively affect the breeding occurrence of Scops-Owl at its prime breeding site.

To conclude, this study reveals a great importance of the mosaic of old-growth woodland stands within open farmland and the availability of natural grassland areas for the breeding occurrence of Scops-Owl. Long-eared Owl is the most common owl in the study area, depending primarily on old rural parks and woodland structures surrounded by farmland and grassland areas. The distribution of both resident owl species, Barn Owl and Little Owl, is currently contracted to a single site or core area, respectively. The current distribution of Little Owl in the study area emphasizes the importance of ruderal and non-productive farmland habitats and indicates the existence of profound changes in trophic interactions in the region's farmland ecosystem.

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Súhrn

Vtáky slúžia ako vhodné indikátory zmien biodiverzity aj v ekosystémoch poľnohospodárskej krajiny. V tejto práci prezentujem výsledky sedemročného mapovania sov ako špecifickej skupiny vtákov poľnohospodárskej krajiny pre vybrané územie na juhu Slovenska. V období rokov 2010–2016 pre južnú časť Ipeľskej kotliny predstavovala stredná početnosť výrika lesného *Otus scops* 3 hniezdne teritóriá (rozsah: 0 – 7) a ekologická početnosť 3 – 5 hniezdnych teritórií na 40 km toku Ipľa. Približne polovica (6/11) hniezdnych teritórií výrika sa nachádzala v starých, zväčša parkovitých, porastoch na území obcí, pričom zvyšné teritóriá sa nachádzali v pobrežných porastoch Ipľa. Biotopy s dostatkom starých vysokokmenných porastov uprostred rozsiahlych trávnych porastov s nízkou aplikáciou pesticídov predstavovala pre výrika v danom území najvhodnejší hniezdny biotop. Myšiarka ušatá *Asio otus* predstavovala najbežnejšie hniezdiacu sovu, pričom jej súčasné stredné hniezdne hustoty 4 páry (rozsah: 1 – 7) na 80 km^2 patria medzi najvyššie na Slovensku. Väčšina myšiarok hniezdila v obciach v rôznych stromových zoskupeniach, akými boli staré parky pri kaštieľoch a cintorínoch, ako aj líniové porasty pozdĺž ulíc a vetrolamy. Počas celého obdobia sledovania bolo zistených iba šesť hniezdnych teritórií kuvika obyčajného *Athene noctua*, pričom na základe opakovaných registrácií sa na sledovanom území nachádza pravdepodobne jediné jadrové územie jeho hniezdneho

výskytu. Stredná početnosť hniezdnych teritórií kuvika sa pohybovala na úrovni 2 párov (rozsah: 0 – 4) na území 80 km^2, pričom pre jadrovú plochu bola táto početnosť 1 pár (rozsah: 0 – 4 párov) na území 4 km^2. Celkovo boli identifikované štyri hniezdne teritóriá sovy obyčajnej *Strix aluco*, pričom dve z týchto teritórií sa prekrývali s teritóriami výrika lesného. Jediné hniezdne teritórium bolo zistené pre plamienku driemavú *Tyto alba* aj výra skalného *Bubo bubo*. Súčasné rozšírenie plamienky a najmä kuvika zvýrazňujú význam ruderálnych biotopov a neproduktívnych plôch v poľnohospodárskej krajine, pričom stavy týchto sov poukazujú na závažné zmeny v trofických vzťahoch ekosystému sledovanej poľnohospodárskej krajiny.

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