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The identity of Azara's description No. 18 "Gavilán mixto pintado" is a juvenile Harris's hawk (*Parabuteo unicinctus*)

Identita Azarovho opisu č. 18 „Gavilán mixto pintado" je juvenilný myšiak štvorfarebný (*Parabuteo unicinctus*)

Paul SMITH

Abstract: The classic ornithological work by Félix de Azara "Apuntamientos para la historia natural de los páxaros del Paraguay y Rio de la Plata" was one of the first descriptive texts dealing with the avifauna of the Southern Cone of South America. Azara's No. 18 "Gavilán mixto pintado" has long been misidentified as a juvenile great black hawk (*Buteogallus urubitinga* ((Gmelin, 1788)). However, there are clear inconsistencies in the description of the plumage coloration, shape and measurements which make that identification erroneous, and Azara's No. 18 can in fact be convincingly identified as the juvenile plumage of the Harris's hawk (*Parabuteo unicinctus* (Temminck, 1824)). The description by Azara contains numerous diagnostic characteristics for that species, and the measurements provided by him are inconsistent with those of the great black hawk, yet remarkably similar to those provided by the same author for the description of the adult No. 19 "Gavilán mixto obscuro y canela". No scientific names have apparently ever been based on Azara No. 18.

Abstrakt: Klasické ornitologické dielo Félixa de Azaru „Apuntamientos para la historia natural de los páxaros del Paraguay y Rio de la Plata" bolo jedným z prvých popisných textov zaoberajúcich sa avifaunou južného cípu Južnej Ameriky. Azarove číslo 18 – „Gavilán mixto pintado" je už dlho nesprávne identifikované ako juvenilný myšiak vodný (*Buteogallus urubitinga* (Gmelin, 1788)). Avšak v opise sfarbenia, tvaru a rozmerov sú zrejmé nezrovnalosti, ktoré spôsobujú, že toto určenie je nesprávne, a Azarove číslo 18 možno v skutočnosti presvedčivo identifikovať ako myšiaka štvorfarebného (*Parabuteo unicinctus* (Temminck, 1824)) v juvenilnom šate. Popis od Azara obsahuje množstvo diagnostických charakteristík tohto druhu a ním uvádzané rozmery sa nezhodujú s parametrami myšiaka vodného, avšak sú obzvlášť podobné tým, ktoré sú uvedené Azarom pre adultného jedinca č. 19 – „Gavilán mixto obscuro y canela". Z Azarovho č. 18 zrejme neboli nikdy odvodené žiadne vedecké mená druhov.

Key words: *Buteogallus urubitinga*, Gavilán mixto, Great Black Hawk, Paraguay

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Shortly after the publication of Azara's (1802, 1805a,b) key ornithological text "Apuntamientos para la historia natural de los páxaros del Paraguay y Rio de la Plata", the identity of his No. 18 Gavilán mixto pintado (Azara 1802) was proposed by Kaup (1847) to be a juvenile great black hawk (*Buteogallus urubitinga* (Gmelin, 1788)), though he did not provide any justification. This conclusion has since been repeated without question by all major reviewers of Azara's work (Hartlaub 1847, Berlepsch 1887, Laubmann 1939, Pereyra 1945), though Sonnini (in Azara 1809) had earlier correctly stated that the description was of a hitherto undescribed species. However, the description (both of the morphology and the behaviour) and measurements provided refer to a quite different bird, as Azara (1802) himself acknowledged, despite recognising a superficial similarity in plumage.

Azara described his No. 18 Gavilán mixto pintado as follows (my translation; the original text is included in Appendix 1):

"It has many things in common in its colours and their distribution with the previous species, and in what

Fig. 1. Juvenile of great black hawk (*Buteogallus urubitinga*) (a), juvenile of Harris's hawk (*Parabuteo unicinctus*) (b). Presidente Hayes Department, Paraguay.

Obr. 1. Juvenilný jedinec myšiaka vodného (*Buteogallus urubitinga*) (a), juvenilný jedinec myšiaka štvorfarebného (*Parabuteo unicinctus*) (b). Región Presidente Hayes, Paraguay.

I have observed of the customs of both of them; only that this one is much more scarce; it seems more active and it is much smaller.

Length 20 inches; tail 9 ½; wingspan 43. A cinnamon eyebrow, varied a little with dark, begins over the eyelid and goes to the side of the nape. From the rear edge of the eye there is a line thinner than the eyebrow, and it accompanies it below. The rest of the side of the head, and also part of the neck and sides of the nape, have the feathers of the aforementioned cinnamon with dark markings in the centres. The rest of the neck or nape is the same, but the dark dominates much more. The crown is dark brown, like the back and as far as the upper-tail coverts, which are white. The scapulars are also dark brown; but lifting up the feathers cinnamon cross lines are visible, and those of the rump are white. The coverts are dark with the edges cinnamon, and small cinnamon-white spots in the form of random, irregular lines. The tail has the base white, and the rest has even stripes of dark and grey, with the tip cinnamon-white. The upper side of the flight feathers and the outer coverts are like the tail. The foreneck to the venter is streaked with cinnamon-white and dark, because every feather has a large, pear-shaped spot of this colour. The white venter has a dark heart on every feather, and from the anus to the tail is cinnamon-white with strange dark markings in the form of an arrow. Legs are cinnamon with dark barring. The flight feathers and underside of the tail are barred dark and white; but on the outer part there is a large white spot from the base to the two-thirds. The underwing coverts are streaked with cinnamon-white and dark, and each of these has another of cinnamon next to it.

Flight feathers 24, the fourth longest. Tail 12 feathers in slight wedge-shape, the outermost 11 lines shorter. Leg 57. Tarsus 45, colour of straw feathered at the top, with flattened scales on the front and a triangular prism. Mid-toe 22, its nail 9, united by a membrane to the outermost until the last phalange. Bill 18, its membrane greenish-yellow, in which is the nostril, half outside: the tip is black, the rest clear blue, and the iris is dark cinnamon.

I killed an adult, whose upper mandible was so inclined to the right that its tip was deviated four lines from the lower, which was straight, it being impossible for them to unite".

Azara (1802) begins his description by noting the similarity in colour and pattern to his previous species, No. 17 Gavilán mixto chorreado, but highlights differences in behaviour and size. No. 17 refers to the juvenile great black hawk (*Buteogallus urubitinga*) (Fig. 1a), the morphologically similar adult of which is described later as No. 20 Gavilán mixto negro. However, the measurements provided for No. 18 are so different to these that it becomes impossible to rationalise them as belonging to the same species (Table 1). Azara (1802) No. 19 Gavilán mixto obscura y canela, on the other hand, has measurements which are remarkably similar to those of No. 18, and both of these descriptions in fact refer to the same species, Harris's hawk (*Parabuteo unicinctus*), with No. 19 featuring the adult and No. 18 the juvenile (first basic) plumage (Fig. 1b).

Whilst the morphometrics are clear enough to distinguish Harris's hawk from the much larger, much longer-

Tab. 1. Comparative measurements (mm) taken from Azara's descriptions (one inch = 25.6 mm; one line = 2.21 mm). In parentheses next to some of the major measurements provided by Azara are range measurements for the species given in the modern literature, taken from the following sources: total length (Thiollay 1994); tail (Ferguson-Lees & Christie 2001); wingspan (*Parabuteo unicintus*: Dwyer & Bednarz 2020; *Buteogallus urubitinga*: Van Dort 2020); tarsus (Blake 1979).

Tab. 1. Porovnanie rozmerov (mm) prevzatých z Azarových opisov (jeden palec = 25,6 mm; jedna čiara = 2,21 mm). V zátvorkách vedľa niektorých z hlavných rozmerov, uvedených Azarom, sú hraničné rozmery týchto druhov uvádzaných v modernej literatúre, prevzaté z nasledujúcich zdrojov: celková dĺžka (Thiollay 1994); dĺžka chvosta (Ferguson-Lees & Christie 2001); rozpätie krídel (*Parabuteo unicintus*: Dwyer & Bednarz 2020; *Buteogallus urubitinga*: Van Dort 2020); tarsus (Blake 1979).

	no. 18 gavilán mixto pintado (*Parabuteo u. unicinctus*; juvenile)	no. 19 gavilán mixto obscuro y canela (*Parabuteo u. unicinctus*; adult)	no. 17 gavilán mixto chorreado (*Buteogallus u. urubitinga*; juvenile)	no. 20 gavilán mixto negro (*Buteogallus u. urubitinga*; adult)
total length / celková dĺžka	512.0	512.0 (480–560)	614.4	601.6 (510–640)
tail / chvost	243.2	217.6 (228–265)	256.0	263.7 (230–270)
wingspan / rozpätie krídel	1100.8	1100.8 (1030–1190)	1305.6	1382.4 (1150–1370)
leg / noha	126.0	121.6	152.5	159.1
tarsus / behák	99.5	92.8 (80–92)	139.2	143.7 (114–128)
mid-toe / stredný prst	48.6	46.4	53.0	53.0 (49–52.5)
nail / pazúr	19.9	22.1	28.7	24.3
bill / zobák	39.8	35.4	46.4	42.0

legged and shorter-tailed great black hawk (Table 1), it is worth pointing out that the juveniles of both species do indeed show a superficial resemblance to each other in plumage colouration and pattern (Fig. 1). Nonetheless, the plumage description is also characteristic for Harris's hawk. The crucial difference in the ratio of tail length to total length indicate a rather long-tailed bird, the mention of white rump and upper-tail coverts (which are absent in the juvenile great black hawk), the cinnamon-edged wing coverts and the tail pattern with a pale cinnamon-white tip, are all characteristic of a juvenile Harris's hawk, and are not shared by the juvenile great black hawk.

To my knowledge no scientific names are based on Azara's (1802) description of No. 18 Gavilán mixto pintado.

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Appendix 1. Original text from Azara (1802).
Príloha 1. Pôvodný text od Azaru (1802).

NUM. XVIII
(GAVILÁN MIXTO) DEL PINTADO

Tiene bastante semejanza en las tintas y su distribución con el precedente, y lo que he observado de costumbres es lo mismo en ambos; solo que éste es mucho mas escaso: me parece mas activo; y es mucho menor.

Longitud 20 pulgadas: cola 9 ½: braza 43. Una ceja acanelada, variada muy poco de obscuro, principia sobre el tejadillo del ojo y va al costado del cogote. De lo postrero del ojo hace una tira mas angosta que la ceja, y la acompaña por debaxo. El resto del costado de la cabeza, y en seguida parte del cuello y del costado del cogote, tienen las plumas de dicha canela con manchitas obscuras en los centros. Lo mismo es el resto sobre el cuello ó pestorejo, pero domina mucho lo obscuro. Sobre la cabeza es de un pardo obscuro, como la espalda y hasta los timoneles, que son blancos. También es pardo obscuro el escapulario; pero elevando las plumas se ve tienen listones al través acanelados, y las de la rabadilla blancos. Las cobijas son obscuras con las borditas acaneladas y manchitas blancas acaneladas á manera de faxas mal seguidas al través, que se ven alborotándolas. La cola tiene raiz blanca, y lo demás á tiras casi iguales obscuras y aplomadas, con la puntita blanca acanelada. La barba superior dé los remos y las cobijas del trozo externo son como la cola. Lo anterior del cuello y hasta el vientre es jaspeado de canela blanquizca y obscuro, porque cada pluma tiene de este color una mancha grande en figura de pera. El vientre blanco con un corazón obscuro en cada pluma, y del ano á la cola blanco acanelado con raras manchas obscuras en figura de flecha. Las piernas acaneladas con tiras obscuras de través. Los remos y cola debaxo á tiras obscuras y blancas; pero en el trozo exterior hay una grande mancha blanca desde la raiz á los dos tercios. Las tapadas á tiras blancas acaneladas y obscuras, y cada una de éstas tiene pegada otra de canela.

Remos 24, el quarto mayor. Cola 12 plumas en escalerilla, la de afuera 11 líneas mas corta. Pierna 57. Tarso 45, color de paja poco vestido en lo alto, escamoso á tablas delante, y prismático triangular. Dedo medio 22, su uña 9, unido con membrana al exterior hasta la primera falange. Pico 18, su membrana amarilla verdosa, en que está el respiradero, la mitad fuera: la punta es negra, lo demás azul claro, y el iris acanelado obscuro.

Maté un adulto, cuya mandíbula superior se inclinaba tanto á la derecha, que su punta quedaba desviada quatro líneas de la inferior, que era recta, siendo imposible que ajustasen.

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Spatial distribution of four sympatric owl species in Carpathian montane forests

Priestorová distribúcia štyroch sympatrických druhov sov v karpatských horských lesoch

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Abstract: Knowledge about spatial distribution of owl species is important for inferring species coexistence mechanisms. In the present study, we explore spatial patterns of distribution and habitat selection of four owl species – Eurasian pygmy owl (*Glaucidium passerinum*), boreal owl (*Aegolius funereus*), tawny owl (*Strix aluco*) and Ural owl (*Strix uralensis*) – ranging in body mass from 50 g to 1300 g, with sympatric occurrence in temperate continuous montane forests in the Veľká Fatra Mts., Western Carpathians, central Slovakia. Locations of hooting owl males were surveyed between 2009–2015 in an area of 317 km^2. Spatial point pattern analysis was used for analysis of owl distribution. Random patterns of owls' spatial arrangement dominate at both intra- and interspecific levels within the studied area. Only intraspecific distribution of pygmy owls and interspecific distribution of Ural owls toward tawny owls exhibited positive associations. This discrepancy with other studies can be explained in terms of pygmy owls' preference for high-quality nest sites and/or spatial clustering in their prey distribution, and due to aggressive behaviour of dominant Ural owls toward subdominant tawny owls, respectively. Moreover, we found considerable overlap in habitat preferences between owl species, considering stand age, stand height, tree species richness, distance to open area, elevation, slope, percentage of coniferous tree species and position on hillslope, although pygmy owls were not registered in pure broadleaved stands, Ural owls were not registered in pure coniferous stands, and boreal and Ural owls were more common on slope summits and shoulders than tawny and pygmy owls. The observed patterns of spatial arrangement might suggest developed coexistence mechanisms in these owl species; differences between studies may indicate complex interactions between intra- and interspecific associations and habitat quality and quantity, food availability and owl species involved in those interactions on a landscape scale.

Abstrakt: Poznatky o priestorovej distribúcii rozličných druhov sov sú dôležité pre pochopenie mechanizmov spolužitia druhov. V tejto štúdii skúmame priestorový vzor distribúcie a výber habitatu u štyroch druhov sov – kuvička vrabčieho (*Glaucidium passerinum*), pôtika kapcavého (*Aegolius funereus*), sovy obyčajnej (*Strix aluco*) a sovy dlhochvostej (*Strix uralensis*), dosahujúcich hmotnosť od 50 do 1300 g, so sympatrickým výskytom v súvislých horských lesoch mierneho pásma v pohorí Veľká Fatra (Západné Karpaty, Slovensko). V rokoch 2009 – 2015 boli na území s rozlohou 317 km^2 mapované miesta výskytu teritoriálne sa ozývajúcich samcov sov. Pre analýzu distribúcie sov bola použitá priestorová bodová analýza. Náhodný charakter priestorovej distribúcie sov prevažoval na skúmanej ploche na vnútrodruhovej aj medzidruhovej úrovni. Pozitívna asociácia sa zistila len pri vnútrodruhovej distribúcii kuvičkov vrabčích a medzidruhovej distribúcii sov dlhochvostých voči sovám obyčajným. Táto nezhoda s inými štúdiani sa môže vysvetliť preferenciou kuvičkov k hniezdnym lokalitám vysokej kvality a/alebo v dôsledku priestorového zhlukovania koristi kuvičkov, a agresívnym správaním dominantnej sovy dlhochvostej voči subdominantnej sove obyčajnej. Navyše, našli sme významný prekryv v habitatových preferenciách – veku porastu, zastúpení drevín v poraste, vzdialenosti k otvoreným plochám, nadmorskej výške, sklone svahu, zastúpení ihličnanov a polohe vo svahu – medzi jednotlivými druhmi sov, avšak kuvičky vrabčie neboli registrované v čistých listnatých porastoch, sovy dlhochvosté neboli registrované v čistých ihličnatých porastoch, pôtiky kapcavé a sovy dlhochvosté boli bežnejšie v hrebeňovej a podhrebeňovej časti svahov ako kuvičky a sovy obyčajné. Pozorovaný vzorec priestorového rozmiestnenia môže naznačovať existenciu vyvinutých mechanizmov spolužitia týchto druhov sov; rozdiely medzi jednotlivými štúdiami môžu poukazovať na zložité vzťahy medzi vnútro- a medzidruhovými asociáciami a kvalitou či zastúpením habitatu, dostupnosťou potravy a druhmi sov zahrnutými v týchto interakciách na krajinnej priestorovej škále.

Key words: spatial arrangement, territoriality, habitat characteristics, point pattern analysis

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Introduction

Direct and indirect interactions between members of the same species or different species competing for a shared limited resource, expressed as competition, are determinants of population and community structure (Sih et al. 1985, Townsend et al. 2008). Requirements for resources are more similar at intraspecific than at interspecific level, resulting in stronger competition within species than among species (Connell 1983). Those interactions can be more marked when species act simultaneously as predator and competitor for other species at the same or similar trophic level, referred as intraguild predation (Polis et al. 1989, Sergio & Hiraldo 2008, Lourenço et al. 2014). Intraguild predation as an asymmetrical and size-based phenomenon can affect distribution, abundance and evolution of the species involved (Sih et al. 1985) through reduction of site occupancy, breeding success and survival of the species (Sergio & Hiraldo 2008, Lourenço et al. 2014). Individuals of the prey species respond to intraguild predation pressure through direct predator avoidance, i.e. spatial and/or temporal segregation, habitat-mediated avoidance, short-term behavioural avoidance (e.g. reduced vocal activity and escape to refugia after predator detection) and resource partitioning (Zuberogoitia et al. 2005, Sergio et al. 2007, Sergio & Hiraldo 2008, Holm et al. 2016, Jenkins et al. 2019). Predator avoidance must be an effective mechanism in any intraguild predation system to enable long-term coexistence of the intraguild prey with its predator (Sergio et al. 2007, Sergio & Hiraldo 2008). Non-overlapping patterns of spatial distribution develop among species at higher trophic levels, avoiding aggressive interactions between individuals (intra- and interspecifically), leading to territorial behaviour in predatory birds (Sergio et al. 2003, Vrh & Vrezec 2006). Territoriality in birds is more often displayed as acoustic communication than as aggressive interaction (König & Weick 2008). The dominant species has an advantage when occupying the most suitable localities within habitats, as large species are usually dominant in interspecific interactions, outcompeting smaller, subordinate ones, thus dictating their distribution pattern (Vrh & Vrezec 2006, Sergio et al. 2007, Sergio & Hiraldo 2008, Rebollo et al. 2017).

We studied four sympatric owl species: Ural owl (*Strix uralensis*), tawny owl (*Strix aluco*), boreal owl (*Aegolius funereus*, also known as Tengmalm's owl) and Eurasian pygmy owl (*Glaucidium passerinum*). The weight ranges of these owls are 47–83 g (pygmy owl), 90–194 g (boreal owl), 325–716 g (tawny owl) to 500–1300 g (Ural owl) (König & Weick 2008). Their body mass is positively associated with their competitiveness (e.g. Vrezec & Tome 2004a). Habitat and food preferences of these species overlap to a great extent, but pygmy owls show a high proportion of small birds in their diet (Mikkola 1983, Hagemeijer & Blair 1997, Marks et al. 1999, Obuch 2011, Kloubec, et al. 2015, Šotnár et al. 2015). Interspecific competition is size-related, i.e. heavier owl species prey upon smaller one(s) (e.g. Mikkola 1976), thus it can be assumed that the smaller the species, the larger the predation risk. Tawny owl and Ural owl pair-bonds last for life, while boreal owl pair-bonding is only seasonal, and pygmy owl pair-bonds sometimes last for more than one season. Tawny owls and Ural owls maintain the same territory for many years; the boreal owl is characterized as a sedentary species with irregular wanderings around breeding sites in central Europe (adult females and young birds are especially marked as nomadic; adult males are mostly sedentary) (Kämpfer-Lauenstein & Lederer 2010, Kloubec et al. 2015); pygmy owl males may use the same territory for up to seven years (König & Weick 2008). While there are some studies assessing patterns of sympatric occurrence of two or three of these species (e.g. Lundberg 1980, Hakkarainen & Korpimäki 1996, Vrezec & Tome 2004a, b, Suhonen et al. 2007, Kajtoch et al. 2015), we are aware of only one study dealing with all four owl species (Kajtoch et al. 2016); however, the sample size in the latter study did not allow all interspecific interactions to be assessed.

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Geographic differences in patterns of coexistence between owl species associated with intraguild predation can be found in the literature. Due to negative interactions, tawny owls select areas free of Ural owls in central Sweden (Lundberg 1980), in the Slovenian Dinaric Alps (Vrezec & Tome 2004a, b) and the Carpathian foothills in southern Poland (Kajtoch et al. 2015, 2016). No negative spatial interactions (segregation in habitat use) have been found between Ural owls and boreal owls despite their territories overlapping in central Finland (Hakkarainen & Korpimaki 1996), in the Dinaric Alps (Vrezec & Tome 2004a) and in Poland (Kajtoch et al. 2015, 2016). While spatial segregation has been observed between tawny owl and boreal owls in the Dinaric Alp forests (Vrezec & Tome 2004b), no such pattern between these two species was observed in the Polish Carpathian foothills (Kajtoch et al. 2015). Distribution of pygmy owls was not affected by that of Ural owls in the Polish Carpathians (Kajtoch et al. 2016).

Species dynamics are driven by spatial and temporal processes (Fletcher & Fortin 2018). For this reason, in order to better understand intra- and interspecific spacing behaviour, interactions, territoriality, interference competition and mechanisms of coexistence, we analysed patterns of spatial distribution of the four owl species (Eurasian pygmy owl, boreal owl, tawny owl, and Ural owl) living in sympatry in relatively well-preserved montane forests in part of the Western Carpathians (Veľká Fatra Mts. in Slovakia) using point pattern analysis (Baddeley et al. 2015, Fletcher & Fortin 2018). Studies considering the distribution of sympatric owl species from the spatially-explicit perspective are scarce. In addition, we examined the habitat characteristics at the locations of calling (hooting) males. To date there is a lack of data on the spatial patterns of these four owl species (Sergio & Hiraldo 2008, Kajtoch et al. 2016).

Material and methods

Study area

The studied area (48.944° N, 19.086° E; Fig. 1) is located in central Slovakia, in the Veľká Fatra Mts (Western Carpathians), within the Veľká Fatra National Park and Special Protection Area. The size of the studied area is 317 km^2; elevation ranges from ca. 500 m to 1596 m a.s.l. Parent rock consists predominantly of dolomites, limestones and marly limestones (Biely et al. 2002). The relief of the mountain range is quite rugged, with a large elevational range. The relief is characterized by deep valleys with steep slopes, gorges and outcropping rocks. Mean annual temperatures vary between 2.5 and 6.5 °C (Šťastný et al. 2002), and mean total annual precipitation ranges between 750 and 1250 mm (Faško & Šťastný 2002). Relatively well-preserved forest (e.g. Mikoláš et al. 2019) covers nearly 90% of the area. The upper tree line was lowered at some places in the past (especially during the Wallachian colonization) and now lies at ca. 1350 m a.s.l. in this area. Most forest stands have natural species composition (including European beech *Fagus sylvatica*, silver fir *Abies alba*, Norway spruce *Picea abies*, sycamore *Acer pseudoplatanus*, mountain ash *Fraxinus excelsior*, larch *Larix decidua*, Scotch pine *Pinus sylvestris*, lime *Tilia* spp., European hornbeam *Carpinus betulus*), but have been replaced in some places with pure Norway spruce plantations. Within the altitude range 500–1000 m a.s.l. mixed fir-beech forests predominate, spruce-beech-fir forests predominate from 900 to 1300 a.s.l., and mountain coniferous Norway spruce forests dominate from 1250 to 1550 a.s.l. Forest stands are thus mostly mixed, but there are also homogeneous coniferous and deciduous forests. The age of stands is in some places up to 200 years and many stands are more than 100 years old. The best-preserved, unmanaged forests are located mainly in the south-western part of the studied area, where there are several strictly-kept nature reserves. Commercially-managed forests predominate in other parts of the studied area. No human settlements are situated inside the study area.

Owl inventory

The owl inventory was carried out by means of acoustic monitoring of hooting males (advertising calls) from survey transects and points. The inventory of the area was performed gradually, in sections (i.e. valleys), from 2009 to 2015, and each valley was surveyed only once. The fact that this owl survey was done in different years should not affect the results, as most owl territories were found to be constant over the years (Kajtoch et al. 2015, Peri 2018a); however philopatry can be influenced by food availability (Korpimäki & Hakkarainen 2012). Surveys were conducted during the peak period of owl pre-breeding, breeding and post-breeding activities in spring and autumn, from the end of February to the end of April and from September to the beginning of November. In the evenings, we mapped especially at dusk and then ca. two hours after sunset. In the mornings, we started mapping about one hour before sunrise and continued until 9:00 a m. We did not map during

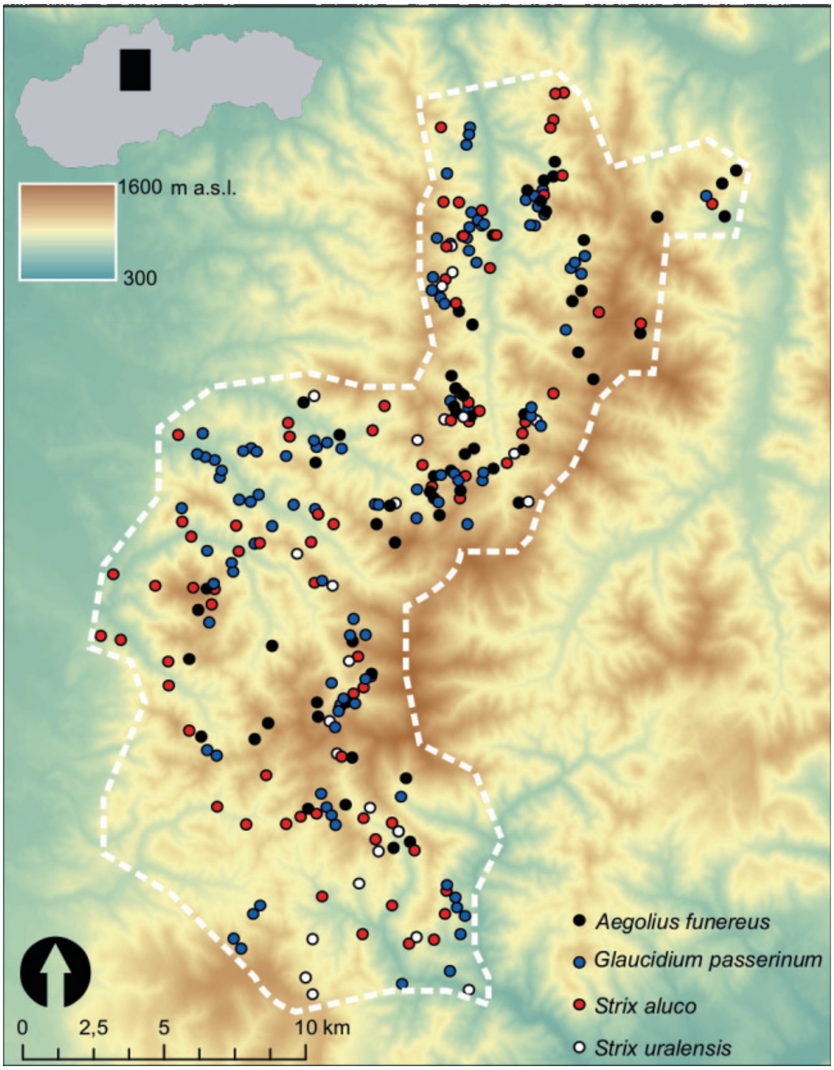

Fig. 1. Study area in the Veľká Fatra Mts with the registered four owl species.
Obr. 1. Študované územie vo Veľkej Fatre s registrovanými lokalitami výskytu štyroch druhov sov.

rain and strong winds. In total we carried out 71 evening or morning visits. We used a combination of transect and point-count methods. Survey points were spaced evenly in the landscape, in forest stands older than 40 years, all between 500–1000 m a.s.l. Each stop including listening lasted for 10–15 minutes. Pygmy owls were provoked by mouth-imitation of their territorial voice. The pygmy owl has different timing of activity compared to the other three species: it has crepuscular activity in the evening and early morning and it is considered as a conspicuous daytime hunter (Marks et al. 1999). For these reasons we provoked it to improve our chances of detecting it during its short periods of crepuscular activity lasting less than one hour in the evening and early morning. We did not use broadcasting of calls of the other three owl species as this could have drawn owls into otherwise unused areas as a reaction to call broadcasts (Kissling et al. 2010). Special emphasis was put on recording simultaneously hooting birds. Locations of calling owls were marked with GPS coordinates.

Habitat characteristics

We extracted the habitat characteristics of the forest stands in which calling owls were located from the Forestry Geographic Information System (LGIS 2020). The following parameters were extracted: elevation (m a.s.l.), stand age (years), slope (gradient, %), stand height (m), tree species richness (n), and proportion of coniferous tree species (%). Location of calling owl on hillslope was also assigned (0 – toeslope, 1 – footslope, 2 – backslope, 3 – shoulder and summit; after Schoeneberger et al. 2012). Distance to an open area was measured in Google Earth Pro (Google 2020). Open areas were defined as clear-cutted woodland, meadows, pastures, and rock outcrops, with a minimum area of 1 ha.

Data analysis

We used R 3.6.3 statistical software (R Core Team 2020) for analyses of the data.

To characterize intra- and interspecific spatial distributions of calling owls we calculated the nearest-neighbour distance between calling individuals using the "nndist" function in the R "spatstat" library (Baddeley & Turner 2005, Baddeley et al. 2015). For more details on the calculations, see Rebollo et al. (2017).

We also used the nearest-neighbour distance distribution function (G-function and multitype (or cumulative or cross-type) G-function) implemented in the "spatstat" library ("Gest" and "Gcross" functions) to analyse the spatial arrangement of four owl species, as it provides a better summary of information than that conveyed by mean nearest-neighbour distances. It allows determining of whether the distribution of individuals is random, regular or clustered. We used G-function as it summarises information at shorter range (Baddeley et al. 2015), and the studied owl species are very territorial during spring and autumn (König & Weick 2008). To test for statistical significance of spatial arrangement (using a hypothesis of complete spatial randomness), we generated an acceptance interval with significance level of 0.4% ($P \leq 0.004$) associated with simulation envelopes of the summary function ("alltypes" function, number of Monte Carlo permutations = 499). We used default edge effect correction. The acceptance interval is the range of values deemed to be not significantly different from the hypothesised value of the target quantity (Baddeley et al. 2015). True (or estimated or observed) values of the cross-type G-function curve above/below the theoretical cross-type G-function curve of a completely random point pattern indicate whether more/less points (i.e. owl individuals) were observed within a given radius than what would be expected under complete spatial randomness (aggregation/segregation).

We used analysis of variance (ANOVA) to test for association between species identity of calling owl and habitat characteristics (continuous variables). Because of unequal sample sizes we used one-way ANOVA applying Type III Sums of Squares. Tukey post-hoc testing was used to identify differences between the owl species when the habitat/environmental variable was identified as significant overall. ANOVA and Tukey tests were performed in the "car" package (Fox & Weisberg 2019). Association between species identity and position on hillslope location was assessed using ordinal logistic regression in the "MASS" library (Venables & Ripley 2002). McFadden's pseudo-R^2 was calculated using the "pscl" library (Jackman 2017). Pairwise post-hoc testing was performed using the "pairwiseOrdinalIndependence" function implemented in the "rcompanion" package (Mangiafico 2017) and relying on the "coin" package (Hothorn et al. 2017). The "ggplot2" package (Wickham et al. 2016) was used for plot visualization.

Results

Overview

Overall we registered 274 calling individuals of four owl species in the study area. The most abundant species was pygmy owl, followed by tawny owl and boreal owl, while the least numerous was Ural owl (Table 1). Density of owl species ranged from 0.85/10 km^2 (Ural owl) through 1.99/10 km^2 (boreal owl) and 2.49/10 km^2 (tawny owl) to 3.31/10 km^2 (pygmy owl).

Spatial arrangement of owls

Mean nearest-neighbour distance (NND) between calling owls was 460.4 ± 21.0 m (median = 356.1 m). Ural

Tab. 1. Mean intraspecific and interspecific nearest-neighbour distances (± standard error) between registered calling locations of Eurasian pygmy owl, boreal owl, tawny owl and Ural owl in the Veľká Fatra Mts.

Tab. 1. Priemerné vnútrodruhové a medzidruhové vzdialenosti k najbližšiemu susedovi (± stredná chyba) medzi registrovanými volacími miestami kuvičkov vrabčích, pôtikov kapcavých, sov obyčajných a sov dlhochvostých vo Veľkej Fatre.

species / druh	n	mean nearest-neighbour distances ± standard error (m) / priemerná vzdialenosť k najbližšiemu susedovi			
		to / k *A. funereus*	to / k *G. passerinum*	to / k *S. aluco*	to / k *S. uralensis*
Aegolius funereus	63	951.7 ± 76.5	782.5 ± 76.7	851.3 ± 76.7	2209.2 ± 260.3
Glaucidium passerinum	105	1436.2 ± 127.9	592.9 ± 54.0	915.1 ± 62.8	1987.9 ± 137.4
Strix aluco	79	1398.9 ± 129.0	1088.3 ± 104.7	993.7 ± 77.9	2341.8 ± 222.6
Strix uralensis	27	1690.7 ± 337.0	1101.9 ± 172.3	858.5 ± 143.7	1452.2 ± 485.9

owls showed the longest mean intraspecific NND between calling individuals, followed by tawny, boreal and pygmy owls. The longest mean interspecific NND between calling individuals was found from tawny, boreal and pygmy owls to Ural owls (~2000–2350 m), followed by Ural, pygmy and tawny owls to boreal owls (~1430–1700 m); Ural and tawny owls to pygmy owls (~1100 m); pygmy, Ural and boreal owls to tawny owls; and lastly boreal owls to pygmy owls (~780–910 m) (Table 1).

Global spatial distribution of the owl community had a clustered pattern of distribution in radius up to 100 m and from ca. 300 m to 600 m (Fig. 2). However, the test of spatial arrangement of owl species using the multitype G-function showed that the observed functions fall within the simulation envelope ($P \leq 0.004$) for the whole distance range for most inter- and intraspecific associations (Fig. 3). This indicates that individual calling owls are similarly and randomly distributed around each other, that no attraction or repulsion between the birds was present. Only two exceptions were observed: intraspecific positive association among pygmy owls and interspecific positive association between Ural owls and tawny owls (Fig. 3). Individual pygmy owls were closer to each other than would be expected in a random pattern ($P \leq 0.004$) within a distance range from 0.3 to 1.0 km. Similarly, distribution of Ural owls toward tawny owls was aggregated within a range from 0.4 to 0.8 km; the opposite was not true however.

Habitat characteristics of owls' calling locations

We did not find statistically significant differences between the four owl species in terms of stand age, stand height, tree species richness or distance to open areas of their calling locations (P = 0.147–0.615). However, Ural owls called from locations up to ~300 m from open sites while the other species were registered also at greater distances. The elevation, slope, percentage of coniferous tree species and position on hillslope of calling owls differed statistically significantly between species, but species identity explained only 2–5% of variability in these characteristics (Fig. 4). Pygmy owls were observed in stands with the highest proportion of conifers. Ural owls were not registered in pure coniferous stands, and pygmy owls were not registered in pure broadleaf stands. Boreal and Ural owls were more common on slope summits and shoulders than tawny or pygmy owls.

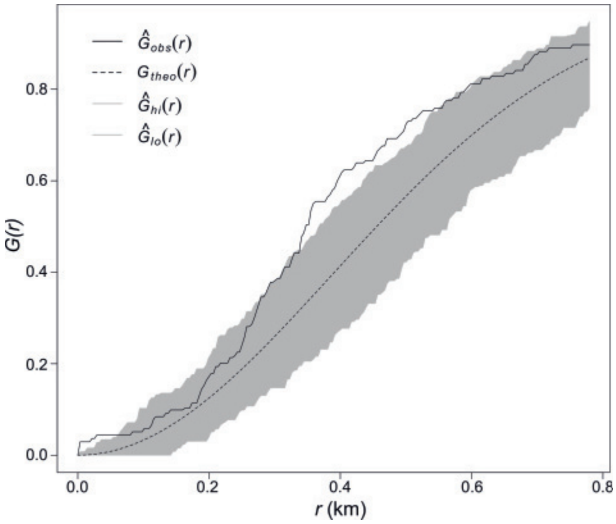

Fig. 2. Overall relationship between nearest-neighbour distance distribution function (*G(r)*) and distances between locations with registered owls (*r*; in km). Continuous line represents the observed function of species records; dashed line indicates theoretical null model expectations; and grey areas indicate the simulation envelopes generated from 499 Monte Carlo simulations under the null hypothesis of complete spatial randomness ($P \leq 0.004$). Arrangement of points within an area is considered as clustered if the observed function is above the simulation envelope, as regular if the function is below the envelope, and as random if it is inside the envelope.

Obr. 2. Celkový vzťah medzi distribučnou funkciou vzdialenosti najbližšieho suseda (*G(r)*) a vzdialenosťami medzi lokalitami so zaznamenanými sovami (*r*; v km). Súvislá čierna čiara predstavuje pozorovanú funkciu zaznamenaných jedincov sov, prerušovaná čiara predstavuje očakávaný teoretický nulový model a sivé plochy naznačujú simulované obaly vygenerované zo 499 Monte Carlo simulácií pri nulovej hypotéze úplnej priestorovej náhodnosti ($P \leq 0.004$). Umiestnenie zaznamennaých bodov v priestore je považované za zhlukovité, ak pozorovaná funkcia je pod obalmi, a ako náhodné, ak sa nachádza vo vnútri obalov.

Discussion

In the montane forests of the Veľká Fatra Mts, Western Carpathians, we found a random pattern of spatial arrangement of calling male owls for most intra- and interspecific associations within and between the four owl species, except for (i) intraspecific distribution of pygmy owls, where the calling males were closer than expected at distances from 0.3 km up to 1 km, and (ii) interspecific distribution of Ural owls toward tawny owls, where Ural owl males were closer to male tawny owls than expected at distances between 0.4 km to 0.8 km.

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We observed no or only subtle interspecific differences in habitat characteristics of calling owls' locations; their habitat requirements considerably overlapped. However, pygmy owls were not registered in pure broadleaf stands, which is in accordance with most published data on the great preference of this species for coniferous and mixed forests throughout Europe (Marks et al. 1999; Pačenovský 2002a, Henrioux et al. 2003,

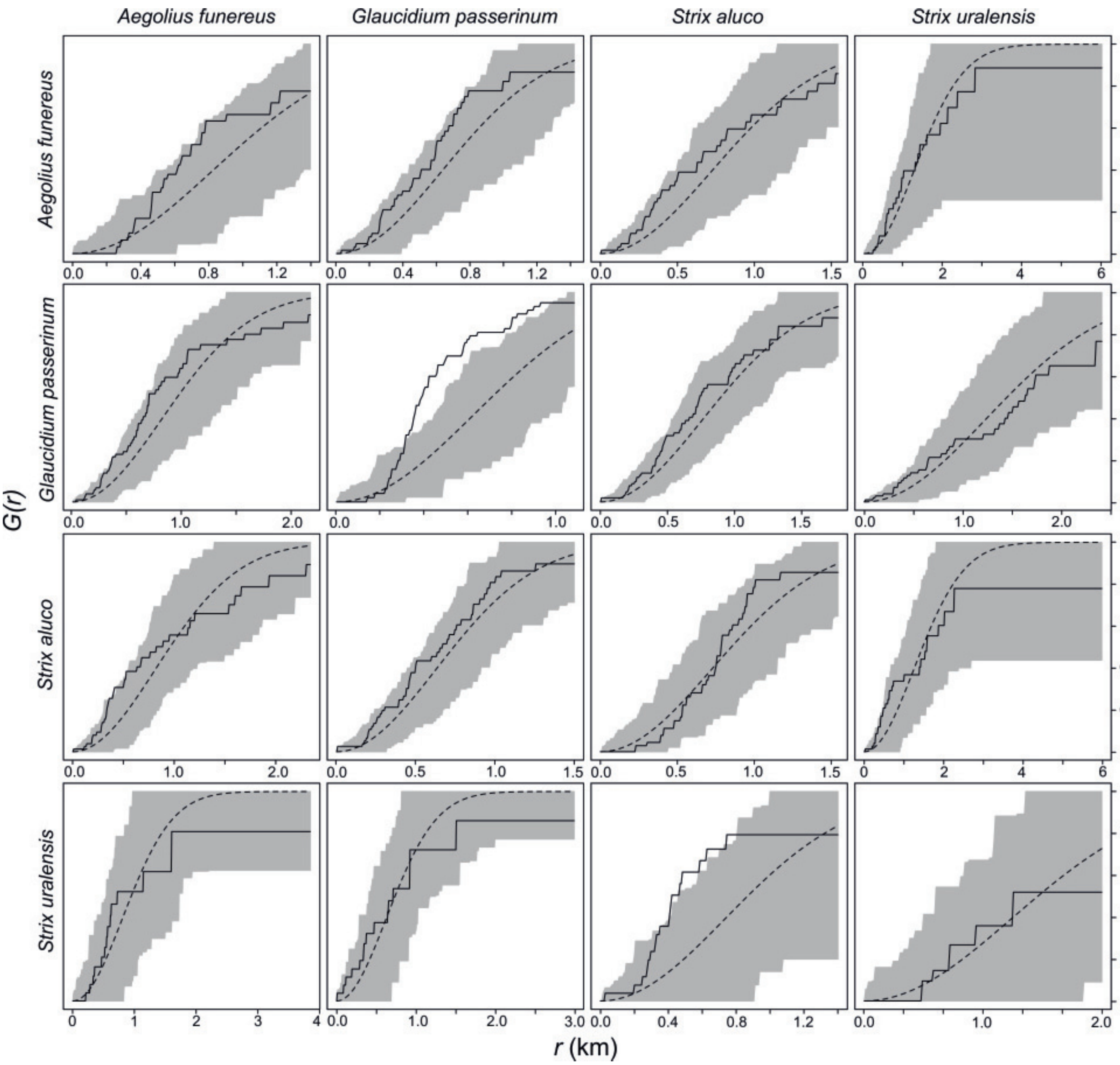

Fig. 3. Intra- and interspecific relationships between multitype (cross-type) nearest-neighbour distance distribution function (*G(r)*) and the distances between locations with registered owls (*r*; in km). Continuous line represents the observed function of species records, dashed line indicates theoretical null model expectations, and grey areas indicate the simulation envelopes generated from 499 Monte Carlo simulations under the null hypothesis of complete spatial randomness (P ≤ 0.004).

Obr. 3. Vnútro- a medzidruhové vzťahy medzi multitypovou (cross-type) distribučnou funkciou vzdialenosti najbližšieho suseda (*G(r)*) a vzdialenosťami medzi lokalitami so zaznamenanými sovami (*r*; v km). Súvislá čierna čiara predstavuje pozorovanú funkciu zaznamenaných jedincov sov, prerušovaná čiara predstavuje očakávaný teoretický nulový model a sivé plochy naznačujú simulované obaly vygenerované zo 499 Monte Carlo simulácií pri nulovej hypotéze úplnej priestorovej náhodnosti (P ≤ 0.004).

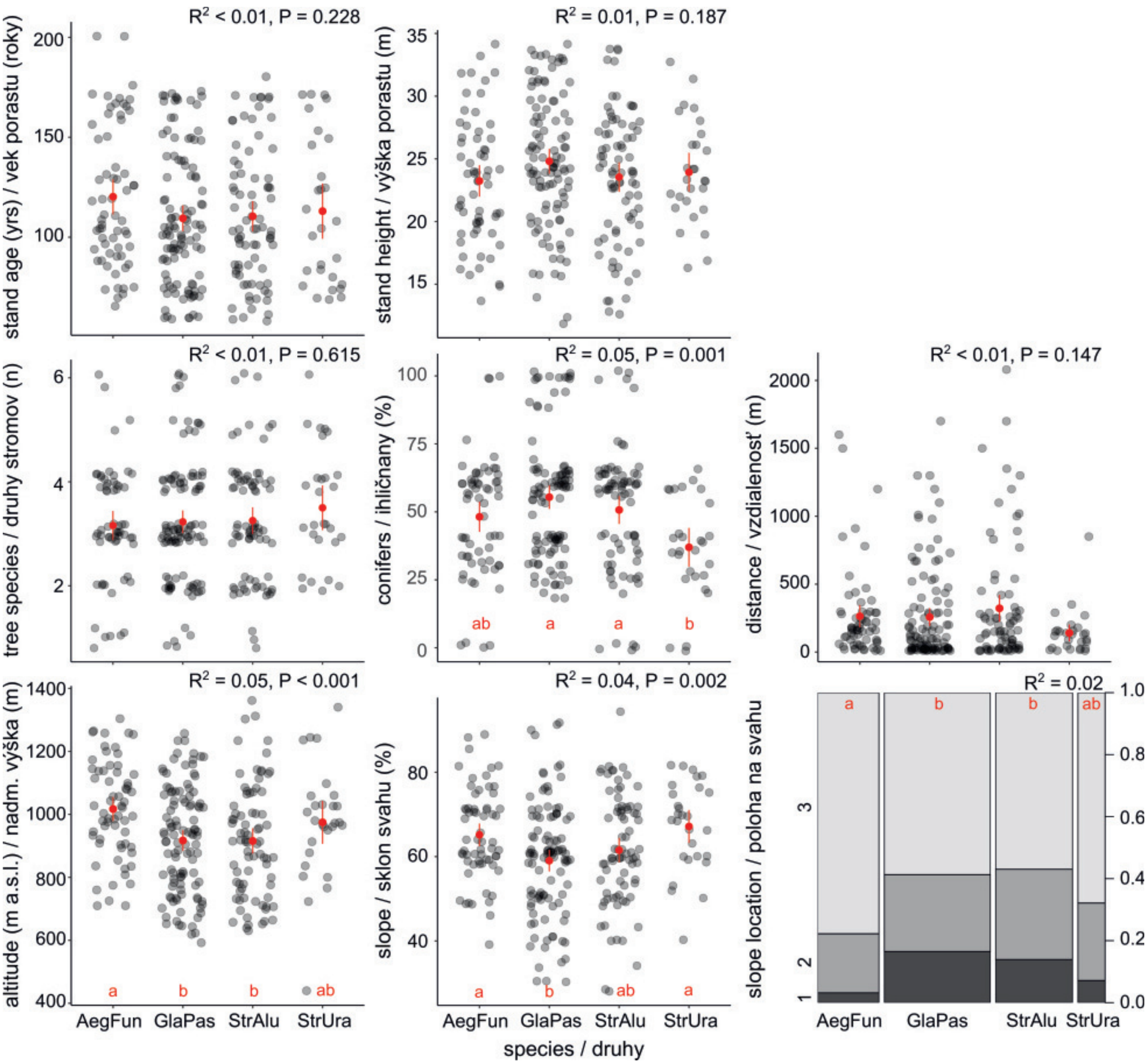

Fig. 4. Means and 95% confidence intervals of habitat characteristics assessed for locations of calling owls (AegFun = *Aegolius funereus*, GlaPas = *Glaucidium passerinum*, StrAlu = *Strix aluco*, StrUra = *Strix uralensis*) in the Veľká Fatra Mts: stand age (years), stand height (m), tree species richness (n), proportion of coniferous tree species (%), distance to closest open area (m), altitude (m a.s.l.), slope (gradient; %) and location of calling owl on hillslope (ordinal: 0 = toeslope, 1 = footslope, 2 = backslope, 3 = shoulder and summit). Points are jittered to minimise their overlapping.

Obr. 4. Priemery a 95%-né intervaly spoľahlivosti habitatových charakteristík zisťovaných pre stanovištia volajúcich sov (AegFun = *Aegolius funereus*, GlaPas = *Glaucidium passerinum*, StrAlu = *Strix aluco*, StrUra = *Strix uralensis*) vo Veľkej Fatre: vek porastu (roky), výška porastu (m), počet druhov stromov (n), zastúpenie ihličnatých drevín (%), vzdialenosť od najbližšej otvorenej plochy (m), nadmorská výška (m n. m.), sklon svahu (%), a poloha volajúcej sovy vo svahu (rádové kategórie: 0 = úpätie svahu, 1 = dolná tretina svahu, 2 = stredná časť svahu, 3 = horná tretina svahu a hrebeň). Body sú zobrazené tak, aby sa minimalizovalo ich prekrývanie.

Kloubec et al. 2015, Barbaro et al. 2016). Ural owls were not registered in pure coniferous stands in our study area, which is in accordance with the usual habitat selection of Ural owls in central Europe, where it is confined to deciduous forests, especially of European beech, in mountain areas (Marks et al. 1999, Kloubec et al. 2015). In most of its range in Slovakia the boreal owl inhabits old forests situated at the ends of valleys, neighbouring with open habitats such as meadows, grassy uplands and clearcuts (Pačenovský 2002b).

Our results appear to contradict the findings of other studies analyzing patterns of coexistence of at least two of the owl species investigated in our study. Negative association between sympatric Ural owls and tawny owls resulting in habitat displacement effect was observed in southern Poland (Kajtoch et al. 2015, 2016). These researchers found that tawny owls occupied forests with higher canopy compactness, sites located closer to forest boundaries and to built-up areas, as well as stands with a higher share of fir and spruce and a lower share of beech compared to sites occupied by the dominant Ural owls (Kajtoch et al. 2015). Similarly, competitive exclusion of tawny owls by Ural owls was observed in Slovenia, resulting in altitudinal segregation of the smaller and less competitive tawny owl to lower elevations than the Ural owl (Vrezec & Tome 2004b). These authors explained this pattern of distribution in terms of different reactions by both species to human presence, as well as their habitat structure: Ural owls avoided lower altitudes with the presence of human settlements. In their studied area, boreal owls did not show negative interactions with Ural owls, and they inhabited similar habitats (Vrezec & Tome 2004a). In contrast, the presence of Ural owls negatively affected the abundance of boreal owls in central Finland (Hakkarainen & Korpimäki 1996). On the other hand, due to negative interactions boreal owls and tawny owls were highly segregated with regard to habitat and space in the Slovenian study area (Vrezec & Tome 2004a). However, negative association between these two species was not found in submontane hilly areas in the Polish Carpathians and their surroundings, as the arrangement of boreal owl territories was random with respect to the tawny owl, and similarly the distribution of pygmy owl territories with respect to the Ural owl (Kajtoch et al. 2016). The authors explained this discrepancy in terms of the close proximity of boreal owls to Ural owls, which provided protection for the boreal owls, so the distance to tawny owls might be of secondary importance. Boreal owls, despite being the interspecific competitor and intraguild predator, did not affect the spatial arrangement of pygmy owls in Finland (Morosinotto et al. 2017).

Using spatial point pattern analysis, we did not detect any negative spatial associations within and between the four owl species. Habitat availability and quality might be responsible for discrepancies between studies in the observed spatial patterns of the owls' distribution. Thus more pronounced intra- and interspecific intraguild predation and competition can be expected in landscapes with lower availability of optimal nesting habitats and sites, and when food supply is limited (e.g. Hakkarainen & Korpimäki 1996, Dhondt 2010, Barbaro et al. 2016, Morosinotto et al. 2017, Baroni et al. 2020). The fragmented forests in submontane hilly areas of the Polish Carpathians were occupied by the Ural owl at relatively low densities (Kajtoch et al. 2015, 2016), so negative interactions between the two species, i.e. avoidance behaviour by tawny owls in response to Ural owls leading to decreased tawny owl density, were relatively weak there (Kajtoch et al. 2015, 2016). In the boreal forests of Finland, pygmy owls' avoidance of their conspecifics, when choosing their breeding site, decreased when food was abundant, suggesting that high food availability leads to weaker intraspecific density dependence, probably through decrease in territory size (Morosinotto et al. 2017). Food resources are scarcer in boreal forest ecosystems compared to more southern temperate environments, which is reflected in the pygmy owl's larger home range size at the northern edge of its area of occurrence (Morosinotto et al. 2017). In addition, the numbers of competitors and predators present within the area also affect habitat availability (Dhondt 2010). In a relatively stable bird community, due to coexistence mechanisms the effects of competition on populations are practically impossible to determine without an experiment in which one competing species is removed, and then the response of the other is observed (Newton 1998, 2007). Well-developed coexistence mechanisms in stable bird communities may also be responsible for low intraguild predation, assessed based on analysis of more than 68,000 tawny owl food items collected mostly in central Slovakia, where only nine instances of boreal owl and three of pygmy owl consumed by tawny owls were found (Obuch 2011).

As the Ural owl is known to prey on the tawny owl (Mikkola 1983), the attraction of the former to the latter should be regarded as a consequence of interference and aggressive behaviour of the dominant species toward the subdominant, i.e. aggressiveness of Ural owls towards tawny owls (Pačenovský 1995, Vrh & Vrezec 2006). This explanation may be supported by the random distribution of calling tawny owl locations in response to Ural owls, when due to their high density tawny owls cannot spatially avoid the Ural owls. The presence of calling pygmy owl males closer to conspecifics might be due to their preference for high-quality nest sites, and due to spatial clustering in the distribution of pygmy owl prey (Cornulier & Bretagnolle 2006). Voles, the most common prey of the four owl species (Obuch 2011), are clustered in small patches during decreasing phases of the population cycle (Hakkarainen et al. 1997), which might restrict the territory locations available to pygmy owls. In addition, stronger territoriality expressed by behavioural responses such as approaching neighbour conspecifics could explain the observed pattern of pygmy owl spatial aggregation. Clustering of calling owls cannot be interpreted as a sign of positive interaction, as facilitation cannot be expected from territorial birds during the breeding season (Newton 1998).

Assessed response variable is a factor which can influence the observed spatial distribution pattern of intraguild predators and competitors. We monitored the locations of calling owl males in the present study, similarly as Vrezec & Tome (2004a, b) and Kajtoch et al. (2015, 2016); locations of nests were surveyed for instance by Cornulier & Bretagnolle (2006), Morosinotto et al. (2017) and Rebollo et al. (2017). Level of territory defence behaviour by owls may differ in response to intruder location within the territory (Pačenovský 1995). Territorial behaviour of Ural owls towards tawny owls was confirmed using a playback experiment (Vrh & Vrezec 2006). Tawny owls vocalize more often in the peripheries than in the centre of their territory and home range (Sunde & Bølstad 2004, Burgos & Zuberogoitia 2018), and moreover their territories or home ranges can overlap (Burgos & Zuberogoitia 2018, Peri 2018b). On the other hand, boreal owl males usually utter their primary song from within 100 m, and frequently within 10 m of a suitable nest-cavity, but they may use several breeding sites during one season (Korpimäki & Hakkarainen 2012). It can be assumed therefore that the results of studies dealing with different response variables will vary. Moreover, studies assessing calling bird location as a response variable may be more inaccurate when disentangling spatial interactions between owls, compared to the studies analysing the positions of nests.

Another factor which could affect the results of studies using the location of calling owls as a response variable is the detected proportion of the population. Correct territory mapping requires that birds must be sufficiently vocal to allow the location of their vocalizations to be pinpointed (Mennill 2011). Vocal activity of owls depends on many factors, e.g. species (Zuberogoitia & Campos 1998), environmental factors (Ševčík et al. 2019, Zuberogoita et al. 2019), time of day and year (Zuberogoitia & Campos 1998, Zuberogoita & Martínez Climent 2000, Ševčík et al. 2019), population density (Zuberogoita & Martínez Climent 2000, Salvati et al. 2002, Zuberogoita et al. 2019), mating status (Korpimäki & Hakkarainen 2012), prey abundance (Ševčík et al. 2019), occurrence of conspecific or heterospecific competitors (Lourenço et al. 2013, but see Ševčík et al. 2019), number of researcher visits (Vrezec & Bertoncelj 2018, Zuberogoita et al. 2019) or vocal stimulation by playback (Zuberogoita & Martínez Climent 2000, Vrezec & Bertoncelj 2018). Playback broadcasting is recommended as a principal technique for owl monitoring (Zuberogoitia & Campos 1998, Zuberogoita et al. 2019), however the use of particular owl-call broadcasting may draw those owls into otherwise unused areas as a reaction to the call broadcasts (Kissling et al. 2010), or in a high-density population it can lead to overestimation of the abundance of calling males (Salvati et al. 2002), which could also obscure the interpretation of data.

To summarize, in the present study we describe the spatial arrangement of calling males of four owl species living in sympatry using point pattern analysis. Except for the intraspecific distribution of pygmy owls and the interspecific distribution of Ural owls compared to tawny owls exhibiting positive associations, most inter- and intraspecific associations had random spatial patterns, which might suggest the presence of developed coexistence mechanisms within these owl species living in sympatry, which is also supported by the high quality habitat within the study area. The habitat requirements of the four species broadly overlapped. Our results appear to be in discrepancy with other studies dealing with spatial distribution patterns of the same owl species. The differences between studies may be a result of complex interactions between intra- and interspecific associations, as well as varying habitat quality and quantity, food availability and the owl species involved in those interactions on a landscape scale (see Dhont 2010, Morosinotto et al. 2017).

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Changes in the Eurasian eagle-owl (*Bubo bubo*) population in Czechia and their association with legal protection

Vývoj populace výra velkého (*Bubo bubo*) a jeho souvislost s právní ochranou

Jan ANDRESKA & Dominik ANDRESKA

Abstract: The article deals with trends in the Eurasian eagle-owl (*Bubo bubo*) population in Czechia and the interplay between legal regulation of hunting and nature protection. In the early 20th century, the eagle-owl population in Bohemia decreased to an estimated 20 nesting pairs, and the population in Moravia and Silesia was subsequently estimated to be similarly low. In previous centuries, eagle-owls had been persecuted as pest animals; additionally, their chicks were picked from nests to be kept by hunters for the eagle-owl lure hunting method ("výrovka" in Czech), where they were used as live bait to attract corvids and birds of prey, which were subsequently killed by shooting. As soon as the state of the eagle-owl population was established in the 1900s, the effort to save the autochthonous eagle-owl population commenced. Nevertheless, when eagle-owls became legally protected from killing in the 1930s, the eagle-owl lure hunting method was not prohibited. The intensified use of this hunting method in the 1950s was accompanied by serious decline in the populations of birds of prey in the Czech countryside, when tens of thousands of Eurasian sparrowhawks (*Accipiter nisus*), northern goshawks (*Accipiter gentilis*), common buzzards (*Buteo buteo*) and rough-legged buzzards (*B. lagopus*) were killed on a yearly basis. The usage of eagle-owl chicks in lure hunting was criticised by ornithologists concerned with the conservation of birds of prey. The eagle-owl thus became a subject of more general debate on the role of predators in nature, and this debate (albeit regarding other predator species) has continued to the present-day. As the eagle-owl population has been growing steadily following the prohibition of its killing in the 1930s, its story may serve as an example of the need for effective legal protection of predators to ensure their survival in the intensively exploited central-European environment. The article examines the successful preserving of the eagle-owl in the Czech countryside, from its low point in the early 20th century towards today's stable and ever-increasing population, focusing on environmental, conservationist, legal and societal aspects of the issue.

Abstrakt: Předložená práce se zabývá vývojem populace výra velkého (*Bubo bubo*) v Česku a souvislostmi s právní úpravou myslivosti a ochrany přírody. Na počátku 20. století se početnost populace výra velkého v Čechách snížila na odhadovaných 20 hnízdních párů; populace na Moravě a Slezsku byla dodatečně odhadnuta jako srovnatelně malá. V předcházejících staletích byli výři systematicky pronásledováni myslivci jako škůdci myslivosti. Výřata byla zároveň myslivci vybírána z hnízd k chovu pro loveckou metodu zvanou výrovka, při které chovaný výr sloužil jako živé lákadlo pro dravce a krkavcovité pěvce (rovněž vnímané jako myslivosti škodící druhy), které bylo na výra možné nalákat a zastřelit. Proto se na začátku 20. století projevily snahy ornitologů o záchranu české výří populace. Právní ochrana výrů před přímým usmrcováním však byla zavedena až ve 30. letech; výrovka sama však zakázána nebyla. Masivní používání výrovky v 50. letech bylo doprovázeno významným poklesem početnosti jednotlivých druhů dravců v české přírodě, ze které každoročně odstřelem ubývaly desetitisíce krahujců (*Accipiter nisus*), jestřábů (*Accipiter gentilis*), kání obecných (*Buteo buteo*) a kání rousných (*B. lagopus*). Z tohoto důvodu začala být výrovka kritizována ornitologickou veřejností zabývajícími se ochranou dravců. Výr se tak stal předmětem obecnější diskuze o úloze predátorů v přírodě; debaty, která (ovšem ohledně jiných druhů) trvá dodnes. Vzhledem k tomu, že populace výra od zavedení ochrany ve 30. letech stále roste, může příběh její záchrany posloužit jako příklad nutnosti účinné právní ochrany predátorů v intenzivně využívané středoevropské krajině a přírodě. Předložený článek se zabývá úspěšnou záchranou výra v české přírodě, z pokraje vyhubení až ke dnešní stabilní a stále sílící populaci, a to z environmentálního, ochranářského, právního a společenského úhlu pohledu.

Key words: owls, lure hunting, nature conservation, Central Europe

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Introduction

Over the course of the 20th century, the understanding of the role of predators in ecosystems has evolved tremendously. Many species which used to be persecuted or were already exterminated in the territory of Czechia (the area within the borders of today's Czech Republic, divided historically into Bohemia, Moravia and Silesia) by the 1900s have since become protected by law and have started to return to the countryside of both Czechia and the broader central European region (Andreska et al 2007, Andreska & Andreska 2014a, 2014b, 2015, 2016, Andreska 2017a, 2017b). Examples of such species include the white-tailed eagle (Haliaeetus albicilla), the great cormorant (*Phalacrocorax carbo*) or the common raven (*Corvus corax*) among the birds, and the beaver (*Castor fiber*), the elk (*Alces alces*) or the grey wolf (Canis lupus) among the mammals. This evolution in thinking as well as law can be well demonstrated in the change of human approach towards the Eurasian eagle-owl (*Bubo bubo*) in Czechia (Andreska & Andreska 2018). In the early 20th century, the eagle-owl was perceived solely as a harmful predator and a pest to hunting, and was therefore systematically exterminated, its population reaching its all-time low of only 40 nesting pairs (estimated) (Loos 1906, Hudec 1983; see further). It has however since been acknowledged as a valuable example of living natural heritage, well worthy of strict legal protection (Andreska & Andreska 2018).

Accounts in the literature differ as to when legal protection of the eagle-owl was introduced in Czechia. While Hudec et al. (1983) suggest the year 1929, as does Jirsík (1935), Leiský (1962) proposes the year 1926 and Černý (1958) the year 1928. None of these authors mention the particular legal instrument which introduced the protection by either number or name. An additional topic emerged with deeper research into the work and data of Loos (1906), according to whom the autochthonous eagle-owl population was on the verge of extinction at the beginning of the 20th century. We therefore started wondering how a population which was allegedly almost exterminated by 1904 survived until the introduction of legal protection some 25 (!) years later, what the motivation for the introduction of such protection was, and how the development of legal protection has contributed to trends in the eagle-owl population until today.

To our knowledge, no research into the effects of legal protection on eagle-owl population trends (or of other species in the Czech countryside) covering any extended period of time has ever been conducted.

The size of the eagle-owl population in Czechia, on the other hand, has been surveyed at least ten times. Leaving aside Šír (1892), whose data has been challenged by many authors, it was primarily Loos (1906; only for Bohemia), then Jirsík (1944; only for parts of Czechia – see further), Sekera (1950), and since the 1970s four times by means of square grid mapping of breeding distribution (Šťastný et al. 1996, 2006; data from last mapping not yet published), the 1982 – 1985 winter mapping (Bejček et al. 1995), and a further three times in monitoring of bird species listed in Annex I of the Birds Directive (Hora et al. 2010, 2015, 2018).

Trends in the eagle-owl population have however not been studied in detail together with the development of the law on species protection in Czechia. Research into the effects of legal protection on bird species population trends was conducted by Voříšek et al (2008), but their study evaluated the population trends for all protected species, and the reference data used were those collected in the second (1985 – 1989) and third (2001 – 2003) square grid mapping studies of breeding distribution, so only a relatively short period of time was covered. We, on the other hand, intended to conduct a qualitative study covering a longer period of time (beginning in the late 19th century), and focusing especially on the time period when the eagle-owl was not yet fully protected.

There were two dimensions to historical eagle-owl persecution. Not only were eagle-owls exterminated as perceived pests, but eagle-owl chicks were also systematically picked from the nests to be used for a special hunting method called výrovka (výr = eagle-owl in Czech). The eagle-owl lure hunting method was a traditional method of extermination of birds considered as pests in hunting, primarily corvids (hooded crows *Corvus cornix*, carrion crows *C. corone*, Eurasian magpies *Pica pica*, jackdaws *Coloeus monedula*, jays *Garrulus glandarius*) and birds of prey (notably Euroasian sparrowhawks *Accipiter nisus*, northern goshawks *Accipiter gentilis*, common buzzards *Buteo buteo* and rough-legged buzzards *Buteo lagopus*), while other species were usually targeted indiscriminately (Andreska & Andreska 2017). The eagle-owl lure hunting method took advantage of the natural hostility of daylight birds (especially corvids and birds of prey) towards the eagle-owl as the apex nocturnal predator. If an eagle-owl is discovered in daylight by other birds, they alert the surroundings with screaming and start attacking it. A hunter using the eagle-owl lure method kept an eagle-owl in captivity and used it as bait in the open to lure corvids and birds of prey to attack it, and then shoot them with a shotgun (the term výrovka applies both to the name of the method and the location where such hunting took place, so it is also a common local toponym). This method was in fact probably used throughout Europe. The first record of it can be found as early as in the 13th century (Willemsen 1979). It was subsequently used in German-speaking countries (Willemsen 1979), and it is also well-known in France (Passerat 1906).

In Czechia, the eagle-owl lure hunting method was very popular among hunters (Komárek 1941). Firstly, it proved to be very effective, especially for killing birds of prey. Using it, a single hunter was able to kill 12 falcons (*Falco peregrinus*), 11 hobbies (Falco subbuteo), 25 common buzzards, 27 northern goshawks, 23 Euroasian sparrowhawks, 18 common kestrels (Falco tinnunculus), 41 crows and 15 magpies in only two days (!) in autumn 1812, most likely at the time of migration (Andreska & Andresková 1993). However, where the lure method was used repeatedly, smarter corvids soon learned that the eagle-owl regularly appearing in the same place was accompanied by a hunter, so they proceeded with caution, whereas birds of prey, especially the ones only passing by along a migratory route, were often decimated (Andreska & Andreska, 2017). Secondly, one should also bear in mind that shooting at a flying target gives the hunter significant (and different kind of) satisfaction from the hunt, giving the eagle-owl lure method an additional attractiveness among hunters, who were very fond of it (Komárek 1941).

We may summarise people's attitude towards eagle-owls in Czechia in the past as a combination of three semi-opposing interests: to exterminate them as pests, to acquire their chicks to be used as bait in the lure hunting method, and then to give it legal protection as required for its preservation and recuperation of the population.

Material and methods

After compiling and assessing the available literature regarding the human approach towards the eagle-owl, its protection and estimates of its population size (see further), we focused on finding the available regulations and any more specific data on the population size, including data on killed specimens.

As for the literature, we started with Šťastný et al. (2006), Andreska & Andresková (1993) and Hudec (1983), and traced available sources as far back as possible. We then went through the historical issues of specialised "guild" magazines and journals, in order to establish how eagle-owls were perceived by the parties concerned, especially in the hunting and ornithology communities. We went through Myslivost and Stráž myslivosti (the official journals of the Czechoslovak/Czech hunters' association), Sylvia (the research journal of the Czechoslovak Society for Ornithology), and Ochrana přírody (the leading journal on nature protection). We mostly worked with archived journals stored either at the Antonín Švehla Library in Prague or at the National Museum of Agriculture's library in Ohrada, Hluboká nad Vltavou.

We also endeavoured to identify the legal instruments which set the regulatory basis for human conduct towards the eagle-owl. Prior to the emergence of conservation and nature protection legislation in the 20th century, the legal basis for utilization, protection (and sometimes legally-encouraged extermination) of particular animal species was set by legal instruments on hunting, forestry and agriculture; furthermore, these were often adopted in parallel to each other, rather than creating a unified framework (Andreska & Andreska 2020). Another challenging issue was that the historical regions making up Czechia (the lands of Bohemia, Moravia and Silesia) had different legal regulations on agriculture, forestry and hunting, so the relevant instruments had to be searched for in triplicate. Lastly, legal instruments regulating human conduct towards the eagle-owl were initially often instruments of sub-statutory legislation which were not published in the primary legal gazettes, but often in secondary (regional or theme-specific) and therefore less accessible official publications. We eventually discovered the majority of legal instruments applicable in Czechia in the archive of the Library of the Czech Parliament in Prague; some (see further) we did not find in the original, but they were found fully-transcribed in the Stráž myslivosti journal. After finding the relevant legal instruments and establishing successive series of applicable legislation in all three lands, we compared the regulations both in succession and synchronously in different lands, establishing in the end that the approaches in the different lands were actually very similar, with relevant protective norms being introduced more or less simultaneously (see further).

In the next step, we looked for reference data which would allow us to establish the effect of the adopted legal norms on eagle-owl population dynamics. As the data on eagle-owl population sizes were scarce (see above), we turned to other available sources of data collected more often, namely the hunting (kill) statistics. However, prior to 1918 Czechia was part of the Austro-Hungarian Empire and divided into three administratively independent units (Bohemia, Moravia and Silesia), with official (hunting and agricultural) statistics also being collected independently. We looked for statistics on killed specimens in the Třeboň office of the Czech State Archive, where historical statistics from the vast Schwarzenberg-owned domains in Southern Bohemia are assembled, but the data found there were incomplete and covered only a small area. We further searched in the Ústav pro hospodářskou úpravu lesů [Forest Management Institute] archive in Brandýs, but to little avail. We eventually discovered the raw statistics purely by chance in the archive of Kojetice village, in the form of yearly statistical sheets listing numbers of killed specimens of various animal and bird species per administrative unit and per specific year, beginning in 1874 (sheets for certain years were missing, though). The data from different yearly sheets were collected and put into charts (see further). We eventually found additional data in Schwenk (1985); there are still blank spots, presumably when the data for a particular species were not sent to Vienna and were therefore not published. We did not succeed in finding any statistics for the period after 1914; we presume that the collection ceased on the eve of WWI and was not resumed afterwards. Therefore, as of October 2020, we still do not have a continuous timeline of all eagle-owls reported killed in Czechia after 1914. The statistics on younglings picked from nests were not centrally collected at all; some incidental data are available from particular hunting domains (Andreska & Andreska 2018), but not at all enough to provide a comprehensive picture.

Results and discussion

Eagle-owls in Czechia in the early 20th century: people's attitudes towards them, the state of the eagle population, and their treatment in law

At the beginning of the 20th century, the autochthonous population of eagle-owls in Czechia was on the verge of extermination. By that time, eagle-owl has been persecuted for centuries as dangerous pest, labelled as such by textbooks and authorities on hunting of the time (see e.g. Rozmara 1912). Descriptions of its diet traditionally highlighted a high proportion of scrub hares (Lepus europaeus), common pheasants (Phasianus colchicus) and grey partridges (Perdix perdix) (Fleming 1724) which were (and still are) considered valuable game; this does not correspond to the scientific data on its diet available today (Havelková 2007, Obuch 2018). Over time, exaggerated assertions about the occasional predation of roes (Capreolus capreolus) (Rozmara 1912) were added to the superstitious legends surrounding the eagle-owl, firmly labelling it as an animal to be killed on sight in the eyes of most hunters. The persecution was in accordance with the 19th century perception of hunting and wildlife management, where the animals considered pests to hunting were systematically eliminated from ecosystems by hunters using all available means, and hunters were motivated by reward money paid per killed specimen (Andreska & Andresková 1993).

Systemic extermination of eagle-owls eventually led to the extinction of the species in most of Czechia, with surviving specimen isolated in handful of refugia (Loos 1906, Maxera 1932). The declining state of the eagle-owl population attracted attention of Kurt Loos who (1906) estimated the number of surviving nesting pairs in Bohemia in 1904 at 16 with others having been exterminated between 1896 and 1904 (he presented his data in the form of a complex table which lists recorded breeding in 32 nesting locations between 1895 and 1904, see also Fig. 1); Černý (1958) interpreted the table as "25 nesting pairs at most" whereas Hudec (1983) interpreted it as "only some 20 occupied nests in Bohemia", and further himself estimated "similar situation in Moravia" (presumably, as Hudec did not specify it, but most likely including Silesia). Loos's and Hudec's numbers combined together estimate the size of the eagle-owl population in Czechia in 1904 to consist of only some 40 nesting pairs.

At the same time, however, hundreds of specimen were yearly reported as killed in the Czech countryside between 1874 and 1914, per official statistics (Schwenk 1985, see also Fig. 1). Obviously, such high numbers do not correspond to the numbers reported by Loos (1906) – had the population been really so small, it would have not been able to produce enough offspring to be killed and reported in the statistics, even with possible (improbable though) influx of migrant birds from abroad. Either Loos or the statistics (or both) must therefore have been wrong.

As for reliability of Loos's data (his numbers appear to be undervalued), Loos in the foreword to his book describes in detail his method of data collection (general questionnaire published in forestry journals followed by some 300 direct request for reports from local hunting authorities in judicial-administrative districts, most of which were replied to), resulting in an overview he himself considers satisfactory, although he mentions the possibility that certain nests were omitted, too. In our opinion, his method of using data from local observers does not significantly differ from methods used today, and allowed for marginal error only; we conclude that the actual size of the population might have been bigger, but not significantly bigger.

As for the reliability of the statistics, the room for scepticism and criticism is wider. First of all, there was an obvious motivation to boost the numbers of the reported specimen killed, as reward money was paid to the reporting hunters. We speculate that talons (traditional evidence of killing pest birds) of other owls (presumably those of

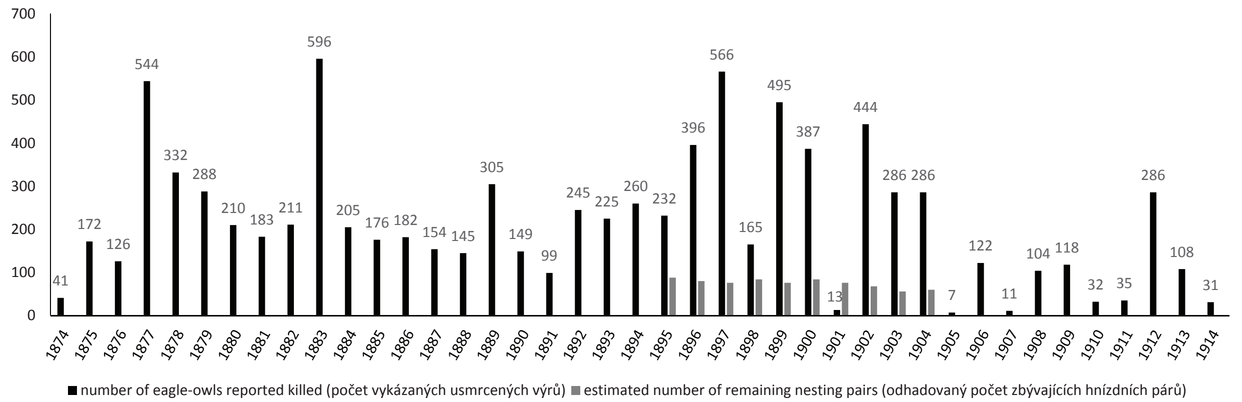

Fig. 1. Number of eagle-owls officially reported to be killed between 1874 and 1914 (Schwenk 1985, black columns) and population size estimates between 1895 and 1904 (Loos 1906, Hudec 1983, grey columns).
Obr. 1. Počet vykázaných usmrcených výrů v letech 1874 až 1914 podle oficiálních statistik (Schwenk 1985, černé sloupce) a odhady velikosti populace v letech 1895 až 1904 (Loos 1906, Hudec 1983, šedivé sloupce).

tawny owls (Strix aluco) which were abundant, no reward money was paid for them and since 1870 they were protected (Andreska & Andreska 2020) could have been intentionally presented by shooters when claiming money and accepted by the other side, which may have even colluded; Loos (1906) also suggested that tawny owls were misidentified as eagle-owls. The reliability of the statistics was criticised as early as in 1910 (Kněžourek 1910). A century later, however, it is for us utterly impossible to determine, to what degree the statistics were false (or falsified); it however seems safe to say that the actual number of killed eagle-owls was lower, but still, given the population size, presented a limiting factor to its survival.

Bearing in mind the above-mentioned critical considerations, the number of eagle-owls reported killed shows a steady decline after 1902 (the number reported in 1901 being inexplicably low, and the number in 1912 the only one which does not fit this trend; see Fig.1). This decline cannot in our opinion be explained by the lack of reporting, as the hunters were motivated to report their kills to receive the reward money. In our opinion, the decline was actually caused by the small number of eagle-owls being killed, which supports Loos' claim that the remnants of the eagle-owl population were in fact at the lowest point, although the population was probably bigger than he estimated in 1906.

As for the attitude of the law towards the eagle-owl in the early 20th century, the treatment of this species occurring in the Czech countryside was regulated by the law on hunting and agriculture. Laws on nature protection as we know it today did not yet exist, with only a set of three almost identical laws on protection of animals beneficial to agriculture adopted in 1870 (Act no. 39/1870 for Bohemia, Act no. 36/1870 for Moravia and Act no. 34/1870 for Silesia), providing protection for a limited number of animal species which were considered worthy of protection as they hunted pests (mice and insects). Among them, all species of owls in Czechia were to be protected (including their nests, eggs and young), with the single exception of the eagle-owl, which was to be further persecuted (Andreska & Andreska 2020).

The actual management of animals in the wild was for the most part entrusted to landowners; the performance of this management was then left to professional hunters employed by the landowners, and amateur hunters in the hunting districts they leased from the landowners on a contractual basis. This approach lasted well into the second half of the 20th century, and created understandable difficulties for nature protection, protection of eagle-owls included (Andreska & Andreska 2017, 2018). The eagle-owl lure hunting method, the other important factor for the survival of eagle-owls in the Czech countryside, had not been regulated by law at all at the time, and neither had the picking of eagle-owl chicks from nests for lure hunting (Andreska & Andreska 2017). In his book on eagle-owls Loos argued for protection and conservation of the species (Loos 1906), and similar concerns were also raised by Kněžourek (1910). Their suggestions, however, were not reflected in the revised Silesian act (no. 41/1909), nor in the revised Moravian act (no. 14/1913) on the protection of animals beneficial to agriculture, nor the revised Moravian hunting act (no. 4/1914).

The question then naturally arises as to how the extremely threatened eagle-owl population survived its low point. Loos (1906) reports that young eagle-owls were picked (on a yearly basis) from many of the eagle-owl nests he had obtained reports about. Maxera (1932) recalls that (around 1900) the nests with young eagle-owls in the forests of the Křivoklát estate were guarded by the estate owner's foresters so that they would not be picked by poachers (though we suspect that this was intended to ensure they could be picked and sold by the estate itself). Apparently not even the surviving nesting pairs were allowed to reproduce, further limiting the population dynamics of the species. On the other hand, however, we also suspect that it was precisely the demand for eagle-owl chicks to be kept for lure hunting (or more precisely the possibility to pick and sell the chicks to hunters for use in areas where eagle-owls were already exterminated, which made it impossible for local hunters to pick the young from nearby sources) which was the main reason why the last remaining nests were not destroyed and the population was not exterminated entirely. The breeding eagle-owl pairs were simply more valuable as a source of young birds which could be sold on a recurring basis. In this way isolated nesting pairs and sometimes small local populations survived.

Czechoslovakia (1918–1932): legal and societal development and its implications for eagle-owl protection and their population dynamic

Following the dissolution of the Austro-Hungarian Empire after its defeat in WWI, the independent state of Czechoslovakia was established in 1918. The legal system implemented in Czechoslovakia consisted in major part of the old laws applied during mperial times, as the young state was slow in adopting new laws to replace the old ones (Hácha et al. 1932). Because of this, the species protection law remained without any change until 1929, so the legally encouraged persecution of eagle-owls continued as well. We nevertheless do not have the kill statistics from that time to provide hard evidence of how many eagle-owls were (reported) killed after 1914.

During the winter of 1928/1929, extremely cold weather which lasted for two consecutive months took a grave toll on wildlife and also game, which drew attention to the necessity for more stringent legal protection of both (Andreska & Andreska 2018). This resulted in swift adoption of Act no. 98/1929 Coll. (the so-called "Minor hunting act"), which comprehensively amended the four parallel hunting laws still applicable in Czechoslovakia at the time (including the Bohemian, Moravian and Silesian parts [see above]) and prescribed a unified closed season for most of the hunted species throughout the whole country. Additionally, the 1929 Law allowed for alterations to the closed season as well as establishing protection for additional animal species by sub-statutory ordinances throughout Czechoslovakia (the three lands mentioned above, plus Slovakia).

Protection was soon given to two previously-unprotected bird species, in particular the peregrine falcon (*Falco peregrinus*) and the eagle-owl. The protection of both species was first adopted in Bohemia in 1930 (land-presidential ordinance no. 333.546 ai 1930, 27-942/4 ai 1930 of 11 July 1930) and Moravia-Silesia followed in 1931 (land-presidential ordinance no. 6.784/VI/15-31 of 20 November 1931).

The protection of the eagle-owl was not absolute however. While pursuing, capturing and killing of eagle-owls as well as collecting of their eggs and destroying their nests were expressly prohibited by all three decrees, an obvious (and clearly intentional) loophole remained: the picking of chicks from nests (for lure hunting) was omitted and therefore still allowed, so the practice continued unobstructed. In 1935 alone there were 12 eagle-owl advertisements in the Stráž myslivosti journal, with one of the sellers offering a young eagle-owl for 400 crowns (for comparison: one kilogram of bread cost 2 crowns, a litre of milk 1.5 crowns, one kilogram of butter 17 crowns at the time; Czechoslovak Statistical Office 1936).

The first public debate on the eagle-owl lure hunting method (1932)

The decrease in game numbers following the winter of 1928/1929 had another direct consequence. Under the pretence of protecting game (especially partridges and pheasants, which had been worst affected) and to ensure its quick resurgence to pre-1928 numbers, a campaign against all kinds of predators was intensified by hunters. The intensive killing of birds of prey using the eagle-owl lure hunting method especially attracted the attention of conservationists interested in bird protection, who soon opened a public debate on the issue (Musílek 1932, Andreska & Andreska 2018).

The debate was initiated in 1932 by Josef Musílek, the secretary of the Czechoslovak Society for Ornithology. In an open letter in the Stráž myslivosti journal (which also had an expert section on ornithology, as ornithologists of the time were often hunters and did not yet have their own journal, since the first scientific ornithological journal, the Sylvia, was initially issued in 1936), he called for prohibition of eagle-owl lure hunting and a more responsible attitude towards protection of birds of prey (Musílek 1932). The letter was accompanied by

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an editorial plea for readers' experience and opinions on eagle-owl lure hunting by the journal's editor Octavian Farský. Altogether, 17 respondents (experts and laymen alike) shared their views. An extensive answer was provided by Farský himself, in which he consistently criticised the hunting of birds of prey for alleged economic reasons, pointing out their role as predators of small rodents which were the real pests for agriculture (Farský had previously examined the usefulness of birds of prey and corvids for agriculture by analysis of the contents of their stomachs). Analysis of the responses showed that the respondents favoured maintaining the lure hunting method, both as an (allegedly) effective method of elimination of pest birds (especially crows and rough-legged buzzards) and as a traditional source of hunter's pleasure (Komárek 1941, Andreska & Andreska 2017). In a way, the 1932 debate foreshadowed the upcoming decades of clashing opinions on the ecological role of birds of prey (and predators altogether) in the wild, which has in a way continued until today (Andreska & Andreska 2018).

Developments in hunting law in German-occupied Czechia (1939–1945)

A higher level of legal protection, i.e. on the level of a legal regulation with nationwide application, was afforded to the eagle-owl by the governmental regulations on hunting (no. 127/1941 and no. 128/1941) in the later German-occupied Protectorate of Bohemia and Moravia (Böhmen und Mähren). The regulations unified the hunting law in the remnants of Bohemia, Moravia and Silesia, including species protection. The eagle-owl was still considered as game, but as no hunting season was prescribed for it, it was to be protected all year round.

Jirsík (1944) reported 75 nesting pairs of eagle-owls in Czechia. Among others he also used the method of correspondence inquiries, which was usual at that time. He described the state of the population at that time and noted the recent reoccupation of historically-used but abandoned nesting sites. In his research he had to deal with the reduction in the area of interest due to the incorporation of Czechia's borderlands (mainly Sudetenland) into the German Reich following the 1938 Munich Agreement. His data therefore only relate to the area of the remaining Protectorate, and have to be treated accordingly.

Additional strengthening of protection for eagle-owls was introduced by the Regulation of the Supreme Hunting Authority no. 37009-VI/4/1943 on the picking of eagle-owl chicks from nests, published in 1944. The 1944 Regulation was unusual among other hunting regulations of the time due to its extent and thoroughness.

First, in its introduction the 1944 Regulation specified the reasoning behind the stricter protection of the eagle-owl: "It has been pointed out that very often the chicks are picked from nests, that there is an uncontrolled trade in the eagle-owl, and that there is a risk to further preservation of this item of natural heritage. The demand for live eagle-owls is due to the abundant practice of eagle-owl lure hunting (...)." Second, it introduced stricter protection of eagle-owls by providing an authoritative interpretation of the provisions of the 1941 Regulations, which were to be applied further to eagle-owl protection. Primarily, from that time on the picking of chicks from nests required a permit from the Supreme Hunting Authority, and if any chicks were picked without such a permit, the perpetrator, even though otherwise legally entitled to engage in hunting, committed a fineable contravention; those not legally entitled to engage in hunting committed the misdemeanour of poaching, incurring much graver punishment. Furthermore, to prevent attempts to cover up picking without permits and subsequent falsifying of chicks' origins, the 1944 Regulation specified that no eagle-owls could be brought into the Protectorate from abroad.

Interestingly, the 1944 Regulation also addressed the apparent lack of scientific data on the eagle-owls surviving in the Protectorate (presumably to have a basis of data to take into account while issuing permits), by attaching a questionnaire on the presence of eagle-owl in all set hunting districts. These were to be obligatorily filled in by every person legally entitled to hunt in every hunting district, and this inquiry was to be conducted on a yearly basis. Furthermore, a second questionnaire was issued regarding eagle-owls already kept in captivity; the detailed information required about every specimen was to serve as the basis for the owners' permits and certificates. Every eagle-owl kept in captivity was also to be fitted with an individual numbered ring. To ensure compliance, the certificates were to be kept by both the owner and the hunting authorities, and any changes (e.g. in the eagle-owl's condition or in its ownership) were to be reported immediately. Last but not least, the Regulation also explained step-by-step the administrative procedure of applying for the picking permit and added guidelines for the picking itself.

Even though the 1944 Regulation did not intend to prohibit the eagle-owl lure hunting method, its apparent ultimate aims were firstly to ensure sustainable management of the eagle-owl in the wild as a rather peculiar natural resource, and secondly the creation of administratively controllable records of eagle-owls kept in captivity.

However, the data collected in the inquiries (the authors do not doubt it was collected, given the totalitarian nature of the Protectorate regime) was never published or made available in any way, and none of the later researchers (see further) were aware of them, otherwise they would undoubtedly have used them as reference data; the only available data are those from Jirsík (1944).

Post-war Czechoslovakia (1945–1958): societal and legal developments and their effects on eagle-owl protection and their population dynamic

Following the liberation and re-emergence of Czechoslovakia in 1945, unification of the legal systems in both parts of Czechoslovakia became one of the main aims of the new legislature (Kuklík 2009). This applied to all branches of law, including the law on hunting, and a new hunting act no. 225/1947 Coll. entered into force in 1948. Again, the eagle-owl was still considered as game (and a pest), however no hunting season was prescribed for it, and thus it was indirectly given year-round protection. An exception from this protection was granted for hunting inside of pheasantries, where otherwise protected raptor species including eagle-owls could be hunted freely without any special permits. Thus the unconditional prohibition of hunting eagle-owls was broken after just 15 years (Andreska & Andreska 2017). Additionally, the 1947 Act did not include any provisions on either the eagle-owl lure hunting method or on the picking of eagle-owl chicks from nests, thereby allowing both practices to continue without any restriction.

The provisions of the 1947 Act on hunting and their implications for eagle-owls were soon criticised by Slovak ornithologist and environmentalist Turček (1948). His insight was even more important as it came from Slovakia, where the eagle-owl was still abundant. He was especially concerned with the apparent loophole in the new legislation, as it did not explicitly prohibit picking of chicks and subsequent trading with them (Turček 1948). In the early 1950s, Sekera (1950, 1954) collected data on the numbers of eagle-owls by means of a questionnaire for the local hunting associations, and gathered data on 475 individual eagle-owls (not pairs) in Czechia. Influenced by the traditional hunters' approach, Sekera considered the rise in numbers to be an alarming consequence of too stringent protection, and advocated for its reduction. Notably, he was the first author to present figures for the whole territory of the state; still, his data came from the methodologically problematic questionnaire inquiry. Sekera's methods of data collection as well as the data themselves were subjected to hard criticism by Černý (1958), who dismissed Sekera's approach as naïve and his data as unreliable and exaggerated, especially when compared to data presented by Loos (1906) and Jirsík (1944). However, when put in the chart with the estimates and data collected prior to and after Sekera's inquiry, the latter's data do not seem that much out of line, as they more or less correspond to the overall population dynamic (see Fig. 2)

In 1951, ministerial decree no. 283/1951 implementing the 1947 Hunting Law was adopted. The eagle-owl was given a lot of attention, as the decree addressed both picking of eagle-owl chicks from nests as well as welfare of eagle-owls kept for lure hunting. It essentially followed the approach of the 1944 Regulation, as picking was now conditional upon obtaining a permit from the regional administrative office by a hunting manager who would keep one chick and obligatorily offer any others to the Czechoslovak Hunting Association, which would solely manage their trade, and the eagle-owls kept in captivity were subject to record-keeping and fitted with identification rings. We suggest though that the decree was adopted to regulate one of the last free-market areas in by then Socialist Czechoslovakia, rather than to ensure the sustainable management of eagle-owls in the wild.

The second debate on the eagle-owl lure hunting method and subsequent developments in eagle-owl protection (1958–1975)

The advent of people's hunting, allowed for by the 1947 Hunting Law and more generally also by wider societal changes following the Communists' taking power in February 1948, changed the overall approach towards hunting. Hunting as a free-time activity was now available to more people, especially from the social strata which were previously not eligible to take part, and hunting was classed as a form of agriculture rather than a free-time activity; this was also reflected in the preamble and provisions of the 1947 Hunting Act (Andreska & Andreska 2017). Both changes resulted in increasing demand for game, and by extension also in unrelenting pressure on predators, including birds of prey, which soon became an integral part of hunting management (Čabart 1952). Renewed, more intensive spread of the eagle-owl lure hunting method led both to massive extermination of common and rough-legged buzzards (both species were previously protected, but the 1947 Act abolished that protection) as well as to increased demand for eagle-owl chicks to be used as bait, resulting in turn in additional pressure on the eagle-owl population (Andreska & Andreska 2018).

The debate on lure hunting among the concerned public was reopened in 1958. In an article published in the Myslivost journal (the continuation of the original Stráž myslivosti under a new name, but with the same readership and impact), Čestmír Folk, Jiří Havlín and Karel Hudec, researchers at the Laboratory for Vertebrate Research of the Czechoslovak Academy of Sciences, criticised the in their opinion excessive elimination of buzzards. According to the data of the State Statistical Office, in 1950 alone some 12,000 common buzzards and 7,000 rough-legged buzzards were killed in Czechia (Folk et al. 1958); as for reliability of these numbers it should be pointed out that not all killed animals were reported to the authorities or appear in the statistics. Additionally, Folk et al. (1958) pointed out plentiful accounts of protected species of birds of prey being killed due to hunters' inability to accurately identify the bird species before taking their shot. In conclusion, the authors argued for redefining the list of pest animals as well for a new understanding of what makes an animal an actual pest in the wild, and further for prohibition of eagle-owl lure hunting as a method generally in conflict with traditional hunters' ethics (Folk et al. 1958).

The editors of the Myslivost journal themselves were the first to respond to the article in an attached note signed only as "Department of Hunting, Czechoslovak Hunting Association". In a rather hostile tone, the note defended the lure hunting method and (in response to the allegations of protected birds of prey being shot in error) stated bluntly: "Besides, our ornithologists are partially guilty too. For so long they paid no attention to the work of hunters, and only in some places did they cooperate with the hunters and educate them about birds of prey, their importance and how to identify them." This notion was just as despicable (as it tried to shift the burden of responsibility from the actual perpetrators to those pointing out the problem) as it was untrue, as there were several books which had been published on the topic. Obhlídal (1957) argued for better knowledge of birds of prey among hunters, including testing of their ability to identify birds in flight during the hunting license exams, and Jirsík (1941) highlighted the importance of birds of prey in the wild and argued for their stricter protection; the book also included a detailed manual for identification of birds of prey.

The debate about eagle-owl lure hunting and the protection of birds of prey, as well as more generally their role in the countryside, persisted for two more years on the pages of the Myslivost journal (Andreska & Andreska 2018). It was symptomatic for the change in course for subsequent developments in law and policy regarding this hunting method and the protection of birds of prey and eagle-owls in particular from legally-encouraged elimination towards legally-imposed conservation.

Soon after the conclusion of the debate on eagle-owl lure hunting, a new hunting act, no. 23/1962 Coll., was adopted. It took a strangely inconsistent approach towards the eagle-owl: on the one hand it was still considered as a pest which could be shot in any hunting district by any hunter, but at the same time the implementing decree no. 25/1962 Coll. no longer allowed the killing of eagle-owls in pheasantries and provided them with year-round protection, with the exception of picking chicks from nests to be kept for lure hunting. Thereby the de facto absolute prohibition on killing eagle-owls which had existed between 1930 and 1947 was reinstated. Killing of birds of prey using the lure method was prohibited by decree no. 4/1967 Coll. (though it was still allowed for killing corvids). Finally on 31 January 1975, by decree no. 10/1975 Coll., eagle-owl lure hunting was completely forbidden. The picking of eagle-owl younglings immediately declined (Honců 1985, see also Fig. 2). The first square grid mapping of breeding bird distribution in Czechia took place only shortly before, providing data on numbers with a reliability never previously achieved. According to the data collected, there were some 400–600 nesting pairs of eagle-owls, based on the 1973–1977 square grid mapping (Šťastný et al 1987).

Development of legal protection for eagle-owls and their population dynamics following the prohibition of the eagle-owl lure hunting method (1975–today)

The prohibition of eagle-owl lure hunting had an immediate impact on the practice of picking eagle-owl chicks from nests (Andreska & Andreska 2018). Even though picking itself was not prohibited, without the possibility of subsequent use for lure hunting, it made no more sense and the practice was abandoned over time (see Fig. no. 2). Whereas in 1973 and 1974 alike 19 eagle-owl chicks were picked, after the prohibition of lure hunting in 1975 the number of picked chicks dropped to two and remained around that figure until the practice was prohibited. Of course, unreported picking along with unreported killing might have been (and today still is) a factor affecting population dynamics, but we assume that the effects of picking have been marginal since the eagle-owl lure hunting method was finally prohibited.

The official statistics (ÚHÚL 2020) operate with the general word "kill" (quarry), but in fact the lost specimens could not have been killed (and reported), as killing was already prohibited at the time. Specimens reported as killed must therefore actually have been captured, either picked as chicks from nests or captured as adults, rather than killed. The changes in the law as of 1975, 1988 and 1992 are marked in Fig.2.

After the prohibition of eagle-owl lure hunting, the eagle-owl population in Czechia continued to grow steadily, doubling the number of occupied squares in the square grid map (Šťastný et al. 2006), with old abandoned nesting locations being retaken again. In the 1980s and 1990s it grew so big that previously-unknown nesting locations were also occupied (Kunstmüller 1996). According to the data collected in the second square grid mapping (1985 – 1989), there were some 600 – 950 nesting pairs in Czechia at that time (Šťastný et al. 2006), a significant rise compared to the 400 – 600 nesting couples reported from the 1973 – 1977 square grid mapping.

Finally in 1988, picking of eagle-owl chicks from nests was finally prohibited by another ministerial decree, no. 20/1988 Coll. The same decree on the other hand sparked the last flare-up of the conflict about the eagle-owl's role in nature, as it allowed capturing of eagle-owls present in pheasantries and hunting districts with established presence of capercaillie (*Tetrao urogallus*) and black grouse (*Lyrurus tetrix*; excessive hunting along with steady pressure on their habitats has brought these two species in Czechia to the verge of extinction as well; Šťastný et al. 2006). The captured eagle-owl was not to be harmed by the capturing mechanism and was to be handed over to a zoo within seven days after capture. The change in the law was readily accepted by the hunting community, with 22 eagle-owls reported captured between 1988 and 1991. The practice was prohibited in any case following the adoption of the new Nature Protection Act, no. 114/1992 Coll., as the eagle-owl was finally included among protected species listed in the implementing decree no. 395/1992 Coll., in the "endangered" category (the lowest level of protection of the three, which does not express how threatened the species is, neither is it derived from the IUCN categorization). That still means, among other things, that since the adoption of the 1992 Decree, it has been strictly forbidden to kill, capture or disturb eagle-owls (particularly during the breeding period), take their eggs in the wild, or destroy, damage or remove their nests. Both legal instruments have ensured the protection of the eagle-owl ever since, together with other instruments of international law (the Berne Convention on the Conservation of European Wildlife and Natural Habitats) and EU law (Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds, and its later versions).

Even though the eagle-owl is still listed as a game species under current hunting act no. 449/2001 Coll., its hunting is prohibited as a species protected under international and domestic law.

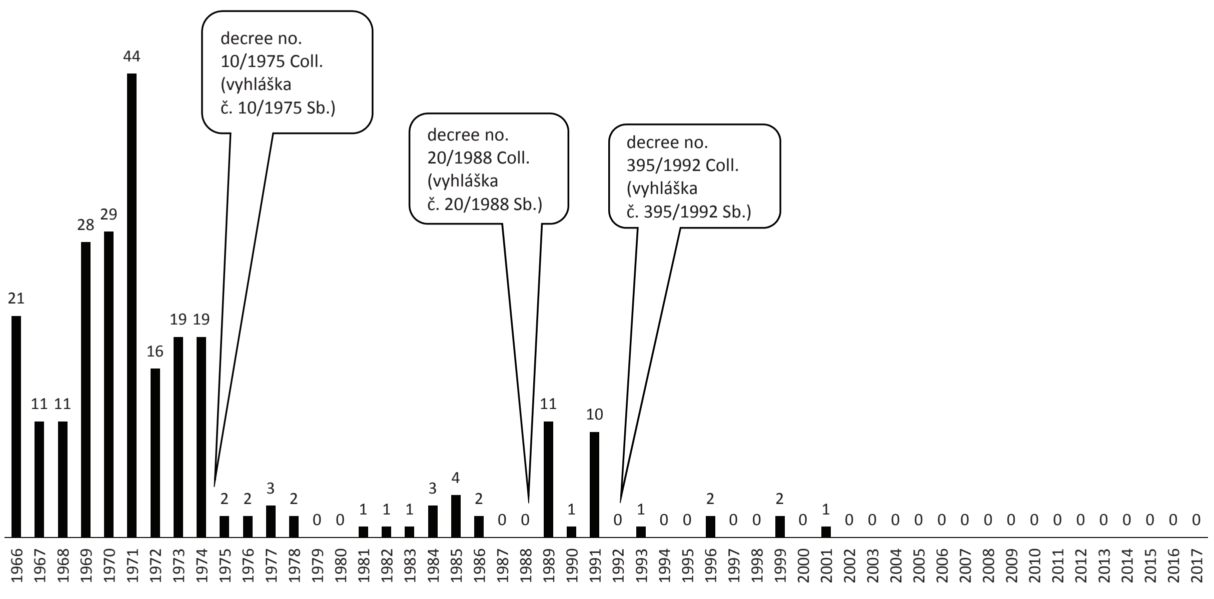

Fig. 2. Number of eagle-owls taken from the Czech countryside between 1966 and 2016 (ÚHÚL statistics sheets 2020).
Obr. 2. Počet výrů odebraných z české přírody v letech 1966 až 2017 (Ústav pro hospodářskou ústavu lesů 2020).

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According to the results of the third square grid mapping (2001–2003), the eagle-owl population remained at 600–900 nesting pairs (Šťastný et al. 2006). Subsequent inquiries indicate a slow decline in the eagle-owl population (Hora et al 2010, 2015 a 2018), albeit in the observed areas only. For example, local studies have shown that the eagle-owl population has been declining in the Jeseníky mountains (Suchý 2001), so the population dynamic is differentiated across the observed areas of Czechia. As for the current population (2020), the still unpublished data collected in the 2014–2017 square grid mapping estimated the eagle-owl population to be some 700–1000 nesting pairs (Bejček, 2020, in verb.), indicating a slow increase in overall numbers.

Other factors affecting the population dynamics

In our opinion, the contribution of legal protection to preservation of the Czech autochthonous eagle-owl population and its long-term positive dynamics is undeniable. However uncertain it may be to speculate about the eagle-owl population dynamic in the 20th century, it seems safe to say that without the imperfect protection established in 1930s, the population would not have achieved today's numbers.

At the same time, there were (and are) other factors which may also have influenced the population dynamics of the Czech eagle-owl population. In this subsection, we would like to address them and attempt to assess how they affect the long-term population dynamic.

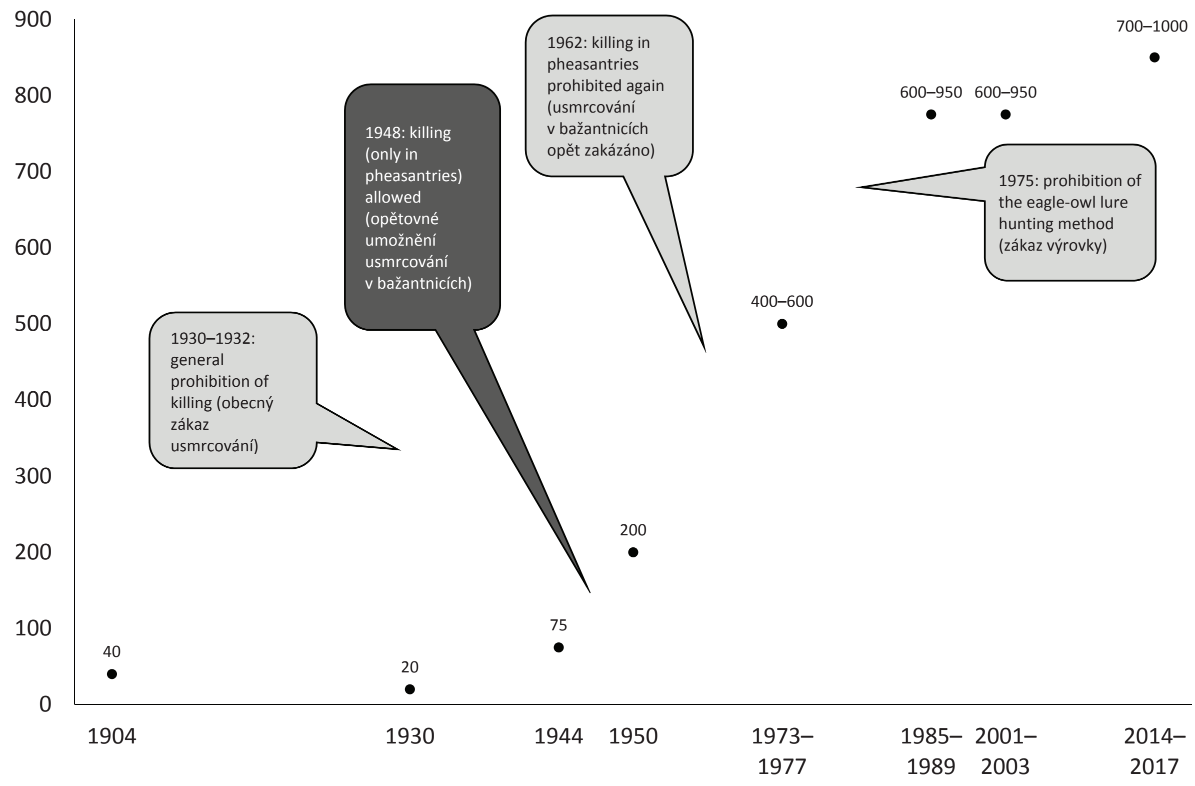

Fig. 3. Eagle-owl population in Czechia. Chart based on estimates for 1904 made by Loos (1906) and Hudec (1983), Jirsík (1930 and 1944) and Sekera (1950), and on data subsequently collected in square grid mapping operations (1973–1977, 1985–1989 and 2001–2003). The 2014-2017 figure represents an estimate of 700–1000 made by Bejček (2020) based on the results of their 4th square grid mapping. Number on y axis = number of breeding pairs.

Obr. 3. Vývoj populace výra velkého v Česku od počátku 20. století. Data v tabulce vychází z odhadů učiněných pro rok 1904 Loosem (1906) a Hudcem (1983) a dále Jirsíkem (1930 a 1944) a Sekerou (1950), a dále z výsledků prvního (1973–1977), druhého (1985–1989) a třetího (2001–2003) čtvercového mapování (Šťastný et al. 1987, 1996, 2006). Údaj pro roky 2014–2017 vychází z odhadu učiněného Bejčkem (2020) na základě dosud nepublikovaných výsledků čtvrtého čtvercového mapování (2014–2017). Čísla na ose y = počet hnízdních párů.

Nesting opportunities and lack thereof; nesting success rate

The eagle-owl prefers rock formations for nesting; usually rock boulders and cliff ledges, but also deserted (but occasionally even operational) mines (Kunstmüller 2013). There is limited availability of such places in the Czech countryside, and there are also parts of the landscape where such places are not available at all. Nevertheless, nesting in alternative places is possible, such as among windthrows or in nests originally built by other birds (e.g. white-tailed eagle or black stork *Ciconia nigra*; Šťastný et al. 2006) or in nestboxes originally meant for other bird species (in particular saker falcon *Falco cherrug*; Horal & Škorpíková 2011). In any case, eagle-owls show strong preference for particular nesting locations, and some nests have been known to be in continuous use for decades, maybe even centuries (Kněžourek 1910, Jirsík 1949, Sekera 1954, Cepák 2008). During the recent repopulating of Czechia, eagle-owl nesting pairs have first turned to old (established) nesting locations and only later, in the 1980s and 1990s, did they turned to previously unknown locations (Honců 1985, Kunstmüller 1996).

Altogether, the eagle-owl distribution area encompasses the whole territory of Czechia, with nesting opportunities throughout the countryside, but also including urban areas (there are at least two eagle-owl nests in Prague, one in the Prokop Valley and another in the Šárka Park). In our opinion, lack of nesting opportunities has never constituted a real limiting factor for growth of the eagle-owl population.

An important related factor, though, is the nesting success rate. In the Vysočina region, for example, the nesting success rate has decreased significantly since 2000, the primary reason being disturbance of nesting pairs in the time of breeding and rearing (Kunstmüller 2013). The same author lists unintentional disturbance by tourists (e.g. rock climbers) or due to forestry work, but also repeated (annual) deliberate destruction of eggs, nestlings and nesting locations as the most important factor for (un)successful breeding. As killing (even mere disturbance) is prohibited by the 1992 Nature Protection Act as well as the EU Birds Directive, we may only conclude that the mere existence of legal protection is insufficient in this context, especially when the law is not properly enforced; but this on the other hand is not an issue limited to nature protection alone. Nevertheless, the 1992 Act provides a basic legal framework allowing for punishment of such conduct by means of administrative or penal law, which can be viewed as a positive development. At any rate, disturbance is an increasingly important factor limiting nesting success rates and thereby the population dynamic as a whole, possibly even being the crucial factor behind the current stagnation in population growth. Confirmation of this hypothesis would however require a different kind of research from the kind we present in this article.

Food availability

Numerous food studies have been carried out for the eagle-owl. Obuch (2018) demonstrated that the eagle-owls' diet can vary significantly depending on local circumstances. Common vole (*Microtus arvalis*) and hare usually make up the majority of the diet. Locally, the share of brown rat (*Rattus norvegicus*) or hedgehog (*Erinaceus* sp.) may increase and become relevant as major food source too. This implies that the availability of food does not necessarily limit the abundance and population dynamics of the eagle-owl. Under optimal conditions, that is, when there is enough or surplus of available food (e.g. vole gradation), there may be a situation where a nesting pair is able to nurture four young (Kunstmüller 1996). We conclude that food availability is presently not a factor limiting the growth of the eagle-owl population in Czechia; however, we stress the need for educating stakeholders, especially hunters, on the composition of its diet, to eventually oust the traditional negative perception of the eagle-owl as a pest, which has unfortunately persisted to the present-day.

Anthropogenic bird mortality

Until it was completely banned, hunting with firearms and other means of persecution (of younglings and adults alike) had been the primary cause of bird mortality. Hunters were initially motivated by reward money paid for each specimen killed and also by the perceived need to eliminate eagle-owls as hunting competition; this need along with the mere power of tradition has resulted in the persecution of eagle-owls continuing even today. Nevertheless, large-scale hunting had to end because of legal restrictions and thus ceased to be a limiting factor for the increase in abundance of these owls (Honců 1985, Andreska & Andreska 2017, 2018). No detailed research into the causes of eagle-owl mortality has been conducted recently for the whole territory of Czechia, presumably due to the generally positive population dynamic. The results of a major study conducted recently (Šálek et al. 2018) into the causes of mortality of other, substantially more endangered owl species, the barn owl (*Tyto alba*) and little owl (*Athene noctua*), suggest that persecution, collision with vehicles (cars and trains), electrocution on power lines and confinement in buildings have become increasingly important as causes of mortality among these species. Of these, persecution, collision with vehicles or power lines, and electrocution by sitting on power lines or poles are known causes of mortality among eagle-owls in Czechia (Vaněk, Muláček, Kunstmüller in verb. 2020). Studies conducted in other European countries show that electrocution is the most significant cause of mortality among eagle-owls in Italy (Sergio et al 2004). Based on information shared with us by the National Wild Animal Rescue Stations Network [Národní síť záchranných stanic] (Nezmeškalová in verb. 2020), among the 512 eagle-owls admitted into the rescue stations between 2007 and 2019, the most common cause of injury was electrocution (94 cases), followed by collisions with cars (51) and trains (36); these data are however not absolutely accurate, as the cause of injury is not always determinable, and moreover not all dead or injured eagle-owls are admitted to rescue stations licensed with the Network. As we do not have similar historical data for comparison, we cannot determine the importance of these factors with certainty. Vehicle collisions were in our opinion not a factor until recently, as the amount of road traffic has only significantly increased since 1989; its prevalence as a cause of mortality is however now increasing.

To conclude: whereas intentional persecution (even though it still happens) has ceased to be a limiting factor for increase in the abundance of eagle-owls, the number of these owls killed by other anthropogenic means, especially electrocution and collision with vehicles, has been rising, and may become a limiting factor for eagle-owl population growth.

Conclusion

Comparison of the eagle-owl population in Czechia in the early 20th century (estimated at 40 nesting pairs by Loos 1906, Hudec 1983, but probably bigger in fact) with today's (much more accurate) estimates of 700–1000 nesting pairs (Bejček et al. in verb. 2020) reveals a significant increase in occurrence which has in our opinion been fundamentally promoted by the legal protection of eagle-owls, especially the prohibition of killing introduced in 1930–1931, as the eagle-owl population has grown steadily since then.

We eventually came to the conclusion that it was the (obviously problematic from today's point of view) eagle-owl lure hunting method (výrovka) which actually allowed the autochthonous eagle-owl population to survive the critical time between the end of the 19th century and the introduction of legal protection in the early 1930s. The opportunity to pick and sell young owls motivated the owners of land with hunting districts where the nests were located and the hunters administering those districts not to exterminate the last remaining nesting pairs. After the prohibition of killing and capturing adult eagle-owls, the issue of picking chicks to be kept for lure hunting (which caused a steady yearly decrease in young which would otherwise have matured and procreated) led to the continued existence of a loophole in the legal protection of eagle-owls, and it took more than 40 years from the first public debate on the eagle-owl lure hunting method until its prohibition in 1975. Even so, the eagle-owl population has nevertheless grown gradually but steadily the whole time. The legal protection of eagle-owls which was initiated in the 1930s was completed with the prohibition firstly of picking young owls from nests in 1988 and secondly of capturing adult owls (without explicit administrative permit, that is) in 1992, after more than 60 years, and more than 80 years since it was first suggested by Loos in 1906.

What is also worth pointing out in our opinion is the immediate temporal concurrence of the 1930s ordinances introducing the protection of eagle-owls from killing and the increase in the growth of the population.

The debate on the role of predators in the densely populated and intensively farmed Czech countryside is far from over (Andreska & Andreska 2014a, Havrlant 2018). Our research into the eagle-owl situation demonstrates (among other things) that the difference of opinions between the more traditionally thinking hunters and more environmentally-conscious conservationists has existed for a very long time. Although it has proved possible to overcome this almost trenchlike division in the specific case of the eagle-owl, it remains deeply rooted in the public debate about the role of predators in the Czech countryside to this day (Havrlant 2018). The recent debate on the presence of wolves in the Czech countryside in particular, and the extremely conservative stance of the hunters' lobby towards it, suggests that the conservationists' struggle to convince the concerned parties about the importance (and legitimacy) of predators' presence will not be easily won. Our case study on the eagle-owl shows in our opinion that through a combination of enforced legal protective measures and longstanding educational efforts by conservationists and environmentalists, such change is eventually possible.

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Diet of the lesser kestrel *Falco naumanni* at post-breeding roosts in southern Albania

Potrava sokola bielopazúrového *Falco naumanni* na pohniezdnych nocľažiskách v južnom Albánsku

Anton KRIŠTÍN, Tomáš BĚLKA, David HORAL & Taulant BINO

Abstract: The lesser kestrel is an insectivorous and migratory falcon species, frequently using communal roosts in the post-breeding period in southern Europe. Using pellet analysis from two post-breeding roosting sites in southern Albania collected in August 2017, we identified 1539 prey items belonging to approximately 58 prey species, 20 families and 7 orders in 110 pellets from two sites. Invertebrates made up the major part of the diet spectrum (PNI = 99.8 %, PFI = 100 %). Invertebrate prey body size varied between 8 and 62 mm (mean 28.1 mm). Bush-crickets (Tettigoniidae) and locusts (Acrididae) were the most abundant and frequent prey groups (PNI = 33 % resp. 48.6 % and PFI = 97 % resp. 94 %). Within the bush-cricket family we could identify the species of genera *Tettigonia*, *Decticus*, *Platycleis*, *Isophya* and *Metrioptera*. The species of genera *Calliptamus*, *Stenobothrus* and *Locusta* belonged among the locust species identified in the food. Birds and mammals were found in pellets only occasionally. The prey composition was rather similar at both studied sites, while locusts (Acrididae) were more abundant at the Jorgucat site and bush-crickets (Tettigonioidea) at the Mollas site in the same time. Prey groups Scarabeidae beetles and other beetles (Coleoptera other) were more abundant and frequent at Mollas than at Jorgucat, and spiders were more frequent at Jorgucat. These results suggest that the high abundance of orthopterans and beetles in the food supply in certain localities is the main reason for selection and stable occupancy of these massive communal roosting sites by lesser kestrels in Albania.

Abstrakt: Sokol bielopazúrový je hmyzožravý a sťahovavý druh sokola, ktorý často tvorí veľmi početné nocľažiská v južnej Európe v pohniezdnom období. Celkom 1539 objektov potravy patriacich asi do 58 druhov, 20 čeľadí a 7 radov bolo metódou analýzy vývržkov determinovaných v 110 vývržkoch zbieraných na dvoch lokalitách južného Albánska v auguste 2017. Bezstavovce reprezentovali hlavnú časť potravného spektra (PNI = 99,8 %, PFI = 100 %). Veľkosť tela koristi bezstavovcov varírovala medzi 8 a 62 mm (priemer 28,1 mm). Kobylky (Tettigoniidae) a koníky (Acrididae) boli najpočetnejšími a najfrekventovanejšími skupinami koristi (PNI = 33 % resp. 48,6 % a PFI = 97 % resp. 94 %). V rámci kobyliek sa identifikovali druhy rodov *Tettigonia*, *Decticus*, *Platycleis*, *Isophya* a *Metrioptera*. Druhy rodov *Calliptamus*, *Stenobothrus* a *Locusta* patrili k identifikovaným koníkom v potrave. Vtáky a cicavce boli zistené v potrave len výnimočne. Zloženie potravy na oboch lokalitách bolo podobné, pričom koníky (Acrididae) boli v rovnakom čase početnejšie v lokalite Jorgucat a kobylky (Tettigonioidea) na lokalite Mollas. Chrobáky čeľade Scarabeidae a ostatné Coleoptera (Coleoptera other) boli početnejšie a frekventovanejšie v lokalite Mollas ako Jorgucat, pavúky boli frekventovanejšie v Jorgucat. Výsledky ukazujú, že vysoká početnosť Orthoptera a Coleoptera v potravnej ponuke na lokalitách je hlavným dôvodom pre výber a stabilné osídľovanie týchto masových zhromaždísk sokolov v Albánsku.

Key words: lesser kestrel, foraging, insectivores, communal roosting, agriculture

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Introduction

Raptors are top predators in agroecosystems, and their presence, abundance and foraging strategies are important aspects of knowing the hierarchy of patterns in the food webs, especially in traditional farming areas (Kleijn et al. 2009). Their prey species spectrum reflects the structure of food supply, potential of foraging territories as well as the surrounding environment (Tulis et al. 2017). Many papers have focused on the diet composition and foraging ecology of small falcons, predominantly the myopha-

Fig. 1. Mollas study site with lesser kestrel roosting sites in poplars in the village centre (left) and foraging territories in its surroundings (right).
Obr. 1. Lokalita Mollas s nocoviskami sokola bielopazúrového na topoľoch v centre obce (vľavo) a potravné teritóriá v okolí obce (vpravo).

gous Eurasian kestrel *Falco tinnunculus* (e.g. Korpimäki 1986, Riegert et al. 2009), and insectivorous species like the red footed falcon *Falco vespertinus* (Purger 1998, Szövényi 2015, Tulis et al. 2017). The diet of the lesser kestrel has been studied extensively during the breeding period in several countries within its European range (e.g. Pérez-Granados 2010 in Spain, Kopij & Liven-Schulman 2012 in Israel, Bounas & Sotiropoulos 2017 in Greece, Di Maggio et al. 2018 in Sicily). There are also studies focusing on the post breeding/pre-migration period, e.g. in France Lepley et al. (2000), in Sicily Sarà et al. (2014), in Greece Bounas & Sotiropoulos (2017) and on winter grounds in South Africa (e.g. Kok et al. 2000), which highlight the importance of orthopteran insects in the diet across the entire species range. Generally, the birds feed mainly on large (~30 mm) insects (Orthoptera, Coleoptera) while their diet can be supplemented with smaller prey items (Kok et al. 2000) and small mammals and lizards during breeding (Parr et al. 1997).

In this paper we describe the diet composition of lesser kestrels based on our study of pellets collected in a rural area in South Albania, which holds a decreasing breeding population, but a large congregation of lesser kestrels before the autumn migration (Minias et al. 2009).

We aimed to investigate the lesser kestrel's diet composition in two different roosting sites (lowland and mountainous) within the same pre-migration period. Since prey abundance and availability are mostly habitat specific and thus subject to temporal changes, this study provides the information on the species' diet composition and feeding strategies specifically in the post-breeding time. This information can lead to the identification of important areas as roosting and foraging sites and can serve as a reference point for conservation managers and policy makers in order to develop targeted conservation strategies for the species (De Frutos & Olea 2008).

Material and methods

Studied species

The lesser kestrel is small migratory falcon that breeds in the southern Palaearctic region (in southernmost Europe, Asia and N Africa), with its wintering grounds located in sub-Saharan Africa (Del Hoyo et al. 1994, Cramp & Simmons 1997). It resembles the Eurasian kestrel, but their foraging strategies are different, the former being mostly insectivorous and the latter mostly myophagous (Cramp & Simmons 1997). In the IUCN Red List of Birds, it was classified as Vulnerable in 1994–2011, but owing to recent evidence indicating a stable or slightly positive population trend overall during the last three generations, it has subsequently been downlisted and is now in the category of Least Concern (Bird Life International 2017, birdlife.org).

The species often does not migrate directly to the African winter grounds but exhibits a post-breeding/ pre-migratory behaviour that lasts several weeks (Newton 2008). It is one of the most gregarious falcon species, usually tending to gather in flocks during that period. The birds must build up the appropriate fat reserves before the autumn migration (Sarà et al. 2019), so pre-migratory ar-

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Fig. 2. Jorgucat study site with lesser kestrel roosting sites in poplars NW of the village (left) and surroundings of the village (right).
Obr. 2. Lokalita Jorgucat s nocoviskami sokola bielopazúrového na topoľoch na SZ obce (vľavo) a okolie obce (vpravo).

eas are of great importance and have been highlighted in several studies (Minias et al. 2009, De Frutos et al. 2010, Sarà et al. 2014). In that time (July–August) the birds can form mass aggregations of individuals in small areas. This can make them vulnerable to a variety of localized threats which may possibly affect numerous breeding populations (Bounas & Sotiropoulos 2017). Once common in the Balkans and central Europe, the species underwent a serious decline which led to the extinction of several national populations (e.g. in Bulgaria, Czech Republic, Serbia, Slovakia, Slovenia and Ukraine) (Danko et al. 2002, Inigo & Barov 2010). Currently Albania is still among the most important pre-migration areas in southeastern Europe (Minias et al. 2009), though the species has not been recorded as breeding in the country at least since 2016 (Bino et al. 2016). On the other hand, neighbouring Greece hosts 5400–7100 pairs (representing 18 % of the total European breeding population), Northern Macedonia 500–800 pairs or Kosovo 80–120 pairs (BirdLife International 2017).

Study area

The pellets of the lesser kestrels were collected at two communal roosts traditional for the post-breeding period in southern Albania, 65 km away from each other:

1. Mollas village, Kolonjë municipality, Korçë county, N 40° 25', E 20° 40', 980 m a.s.l., Fig 1. Three full-grown poplars (*Populus* × *canadensis*) in the village centre were used as a roosting site. Approximately 350 birds roosted there on August 1, 2017 (estimated during morning fly-off).

2. Jorgucat (Jergucat) village, Dropull municipality, Gjirokastër county, N 39° 56', E 20° 16', 230 m a.s.l. Fig. 2. Four full-grown poplars (*Populus* x *canadensis*) at the NW edge of the village were used as a roosting site. The number of roosting birds was estimated on August 1, 2017 evening arrival and on August 2, 2017 morning fly-off at approx. 3300 birds. This roosting site in Jorgucat was discovered in mid-July 2008 by Minias et al. (2009), who estimated the number of roosting birds as 4000–6000, and it has been regularly occupied since then (T. Bino, unpublished data).

The roosting sites are located in villages surrounded by traditional agricultural landscape, steppic grasslands and pastures, where we found great abundance of grasshoppers of the genus *Calliptamus* (Fig. 1, 2). The Mollas site is located within mountainous country, while the second site Jorgucat is surrounded by hills and lowland.

Data collection and analysis

Fresh pellets regurgitated by the roosting birds were collected on August 1 and 3, 2017, in early morning on both days. Only unbroken fresh pellets were collected and stored dry in separate plastic bags to avoid mixing, and then analysed in a laboratory. The invertebrates in pellets were identified using a microscope (Nikon) with 6–50x magnification. Each sample was processed on a Petri dish by separating paired and unpaired prey body parts (e.g. heads, mandibles, legs) to make an estimation of the numbers of individuals for each sample (Rosenberg & Cooper 1990, Nuhlíčková et al. 2016). The volume of the pellets varied between 900 and 2900 mm^3 with the mean at 1330 mm^3, mostly corresponding to between 5 and 60 % of plant material originated from the bodies (metabolic tract) of the consumed phytophagous insects (mostly Acrididae, Tettigoniidae and Scarabeidae).

We identified prey remnants to the highest possible taxonomic level using a comparative collection of arthropods (cf. Pechacek & Krištín 2004). The prey items were identified and body sizes were determined according to Chinery (1987) and other references relevant to particular invertebrate groups (e.g. Giljarov 1964). The diet composition was estimated as relative numerical items (PNI) and relative frequency items (PFI) of prey species in any pellet for each separate site.

Results

After analysing 110 pellets from the two sites we recorded 1539 prey items belonging to approx. 58 prey species, 20 families and 7 orders (Tab. 1). Invertebrates made up the major part of the diet spectrum (PNI = 99.8 %, PFI = 100 %). Body size of invertebrate prey varied between 8 and 62 mm (mean 28.1 mm), with ants (Formicidae) representing the smallest prey items, then centipedes (*Scolopendra* sp.), bush-crickets, locusts and scarabeid beetles, and one passerine bird and one unidentified small mammal the largest ones. Bush-crickets (Tettigoniidae) and locusts (Acrididae) were the most abundant and frequent prey groups (PNI = 33 % resp. 48.6 % and PFI = 97 % resp. 94 %, Fig. 3, 4, Tab 1.). Among the bush-crickets we could identify the species of genera *Decticus*, *Platycleis*, *Tettigonia*, *Isophya* and *Metrioptera*. The species of genera *Calliptamus*, *Stenobothrus* and *Locusta* belonged among the identified locust species in the food samples (Tab. 1). The prey composition was rather similar at both studied sites, and while locusts (Acrididae) were more abundant at Jorgucat and bush-crickets (Tettigonioidea) at Mollas, their frequency was very similar at both sites (Fig. 3, 4). Beetles (Scarabeidae and other Coleoptera) were more abundant and frequent at Mollas than at Jorgucat, whereas spiders were more frequent at Jorgucat. Ants (Formicidae) were found relatively frequently in the pellets, but due to their small body size it was not clear if they were primary or only secondary prey items. Bush-crickets *Decticus* sp. were more frequently found at Jorgucat, while some locust species were found only at Jorgucat (*Calliptamus* sp., *Stenobothrus* sp.), showing the differences in food supply between the sites. Birds and mammals were found in pellets only rarely at the Jorgucat site.

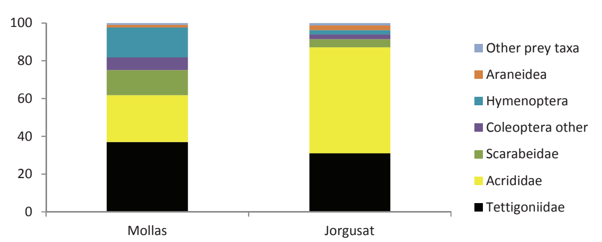

Fig. 3. Relative abundance (N %) of 7 main prey groups in the *Falco naumanni* diet composition at two post-breeding roosting sites in S Albania.
Obr. 3. Relatívna početnosť (N %) 7 hlavných skupín potravy druhu *Falco naumanni* na 2 pohniezdnych nocoviskách v J Albánsku.

Discussion

Variations in the lesser kestrel diet composition

We have presented the first data on the qualitative and quantitative structure of the lesser kestrels' dietary spectrum at post-breeding roosting sites in Albania, where we found great abundance and frequency of bush-crickets (Tettigoniidae) and locusts (Acrididae), but fewer scarab beetles among their food. Reviewing the literature on the food spectra of lesser kestrels in different areas of their range, we can generally see rather high prevalence of orthopteran insects and beetles (Coleoptera) in their diet, e.g. in France (Lepley et al. 2000), Spain (Granados 2010), Is-

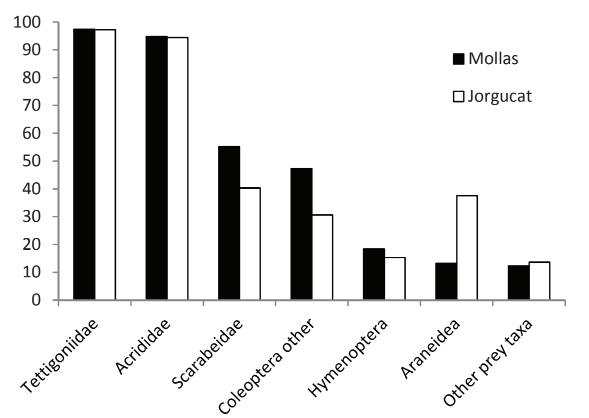

Fig. 4. Relative frequency (F %) of 7 main prey groups in the *Falco naumanni* diet composition at two post-breeding roosting sites in S Albania.
Obr. 4. Relatívna frekvencia (F %) 7 hlavných skupín potravy druhu *Falco naumanni* na 2 pohniezdnych nocoviskách v J Albánsku.

Tab. 1. Diet composition of the lesser kestrel F. naumanni at two post-breeding roosting sites in S Albania in August 2017 (N = number of prey items, N % relative abundance of prey items, F % = relative frequency of prey items; g.sp. = unidentified genus and species, sp. = unidentified species).
Tab. 1. Zloženie potravy sokola bielopazúrového F. naumanni na 2 pohniezdnych nocoviskách v J Albánsku (N = počet objektov potravy, N % = relatívna početnosť jedincov koristi, F % = relatívna frekvencia koristi; g.sp. = neurčený rod a druh, sp. = neurčený druh).

	Mollas				**Jorgucat**				**Mollas + Jorgucat**			
	N	**N %**	**F**	**F %**	**N**	**N %**	**F**	**F %**	**N**	**N %**	**F**	**F %**
prey taxa / druh koristi	**N = 347**		**F = 38**		**N=1192**		**F = 72**		**N=1539**		**n = 110**	
Chilopoda												
Scolopendra sp.	1	0	1	3	2	0	2	3	3	0	3	3
Araneidea g.sp.	5	1	5	13	28	2	27	38	33	2	32	29
Lycosidae g.sp.					2	0	2	3	2	0	2	2
Orthoptera												
Tettigoniidae g.sp. < 30 mm	77	22	37	97	186	16	70	97	263	17	99	90
Tettigoniidae g.sp. > 40 mm					4	0	3	4	4	0	3	3
Tettigonia sp.	2	1	2	5	9	1	9	13	11	1	11	10
Isophya sp.	3	1	2	5					3	0	2	2
Platycleis sp.					8	1	7	10	8	1	6	5
Decticus sp.	46	13	18	47	156	13	58	81	202	13	33	30
Metrioptera sp.					7	1	5	7	7	0	5	5
Gryllidae g.sp.					16	1	15	21	16	1	15	14
Acrididae g.sp.	80	23	36	95	575	48	68	94	655	43	96	87
Locusta migratoria	6	2	6	16	7	1	7	10	13	1	13	12
Calliptamus sp.					67	6	35	49	67	4	35	32
Stenobothrus sp.					8	1	3	4	8	1	3	3
Dermaptera g.sp.					1	0	1	1	1	0	1	1
Heteroptera g.sp.	3	1	2	5	6	1	6	8	9	1	8	7
Coleoptera g.sp.	12	3	10	26	10	1	10	14	22	1	20	18
Carabidae g.sp.	8	2	7	18	6	1	6	8	14	1	13	12
Carabus sp.	1	0	1	3					1	0	1	1
Curculionidae g.sp.					2	0	2	3	2	0	2	2
Elateridae g.sp.					3	0	3	4	3	0	3	3
Scarabeidae g.sp. < 20 mm	38	11	19	50	29	2	26	36	67	4	45	41
Scarabeidae g.sp. > 20 mm					2	0	1	1	2	0	1	1
Cetonia aurata					14	1	14	19	14	1	14	13
Cetonia aeruginosa					1	0	1	1	1	0	1	1
Geotrupes sp.	8	2	8	21	4	0	4	6	12	1	12	11
Anisoplia segetum					1	0	1	1	1	0	1	1
Tenebrionidae g.sp.	2	1	2	5	5	0	4	6	7	0	6	5
Buprestidae g.sp.					3	0	3	4	3	0	3	3
Hymenoptera												
Formicidae g.sp.	55	16	7	18	26	2	10	14	81	5	64	58
Apidae g.sp.					1	0	1	1	1	0	1	1
Mammalia g.sp.					1	0	1	1	1	0	1	1
Soricidae g.sp.					1	0	1	1	1	0	1	1
Aves												
Passeriformes g.sp.					1	0	1	1	1	0	1	1
total / spolu	**347**				**1192**				**1539**			

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Fig. 5. Lesser kestrel preys mostly on large invertebrates in the vicinity of post-breeding roosts (above: centipede *Scolopendra* sp., bottom: bush-cricket *Tettigonia* sp.).
Obr. 5. Sokol bielopazúrový loví v okolí pohniezdnych nocovísk hlavne veľké druhy bezstavovcov (hore: stonožka *Scolopendra* sp., dole: kobylka *Tettigonia* sp.).

rael (Kopij & Liven-Schulman, 2012), in Greece (Bounas & Sotiropoulos 2017) and Sicily (Di Maggio et al. 2018). Although local habitat conditions and land use can shape the species diet differently (Parr et al. 1997, Pérez-Granados 2010), our results generally conform with those from all the above studies and countries.

Diet composition tends to be biased as a result of the choice of study period, reflecting the actual food supply in the surrounding foraging habitats. Significant differences have been found between the breeding and pre-migrating periods at the same study sites, e.g. in Israel or Greece, when the composition of prey in the diet of lesser kestrels during pre-migration was found to be more homogeneous, suggesting a feeding strategy which shows a specialist predator–prey relationship regarding Orthoptera (Kopij & Liven-Schulman 2012, Bounas & Sotiropoulos 2017). In Greece, crickets (Gryllidae), bush-crickets (Tettigoniidae) and scarab beetles dominate during breeding in May-June, while locusts (Acrididae) are more common in the premigratory period in August, when the pre-migration diet breadth is much narrower than in the breeding season (Bounas & Sotiropoulos 2017). In Israel, significant month-by-month variations in the proportions of the main prey groups have been recorded. From February to April the lesser kestrel fed mainly on beetles there, while from May to July it fed mainly on Orthoptera and Solifugae (Kopij & Liven-Schulman 2012). Relatively high incidence (9 %) of vertebrates (mammals 4 %, reptiles 3.5 %, birds 1.8 %) besides the most abundant orthopteran insects and beetles was found during eight breeding periods in Sicily (Di Maggio et al. 2018). In the winter grounds (South Africa), during the austral summer over a 12 year period, the prey groups Isoptera, Solifugae and Chilopoda formed the staple food. The birds consumed large quantities of small-sized prey, mainly termites (Isoptera), early in the austral summer there, while larger-sized food items, mostly grasshoppers (Acrididae), dominated at the end of the non-breeding season (Kok et al.2000).

Conclusions

As we expected, invertebrates, especially orthopteran insects, accounted for the major part of the lesser kestrel diet at both of our study sites in Albania. Predominance of bush-crickets and locusts together with high frequency of scarabeid beetles in the study area suggest that the lesser kestrel finds the major part of its food items in well-preserved and traditionally-managed agricultural land. Based on general knowledge of insectivorous falcon habitats, we can state that this species prefers hunting in grasslands and fallow lands; it has a neutral attitude towards alfalfa and cereal fields, and it avoids hunting in intertilled crops, over water surfaces, woods and artificial surfaces (Tella et al. 1998, Palatitz et al. 2011, Sarà et al. 2014).

This study presents the first data on the diet composition of the lesser kestrel at post-breeding roosting sites in Albania. The results suggest that the great abundance of orthopteran insects in the food supply in the kestrels' foraging territory is the main reason for their selection and stable occupancy of the massive communal roosting sites in Albania. Effective protection of roosting sites in pre-migratory areas and maintenance of orthopteran (grasshopper and bush-cricket) populations there appear crucial for preserving this threatened migratory raptor along its African–Eurasian flyway.

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Comparison of orbital asymmetries among some raptor species: "when size does not matter"

Porovnanie orbitálnej asymetrie vybraných druhov dravcov: keď na veľkosti nezáleží

Pere M. PARÉS-CASANOVA & Jordina SALAS-BOSCH

Abstract: A sample of 73 dry, well-preserved skulls was studied, representing various species of raptors with different foraging strategies. The sample included *Accipiter nisus* (n=15), *Buteo buteo* (n=13), *Gyps fulvus* (n=24) and *Neophron percnopterus* (n=5), *Bubo bubo* (n=16) and *Tyto alba* (n= 2). Geometric morphometric methods were used to detect orbital asymmetries. On digital pictures of each skull side, a set of 16 semi-landmarks and two landmarks were located in order to describe the orbital ring. The variables were analysed based on Generalized Procrustes analysis. The morphometric data showed that the orbital asymmetry of raptors differed significatively between species, although directional asymmetry (e.g. left orbita systematically more developed than the right) appeared not to be correlated with orbital size. This indicates that larger orbitas do not lead to greater asymmetry. Differences between species should rather be explained by their foraging strategies and degree of visual obstruction in their natural environment.

Abstrakt: Študovaná bola vzorka 73 suchých, dobre zachovaných lebiek rôznych druhov dravých vtákov s rozdielnymi potravovými stratégiami – *Accipiter nisus* (n=15), *Buteo buteo* (n=13), *Gyps fulvus* (n=24), *Neophron percnopterus* (n=5), *Bubo bubo* (n=16) a *Tyto alba* (n=12). Na zaznamenanie asymetrie v orbitálnej oblasti boli použité geometrické morfometrické metódy. Na popísanie orbitálneho prstenca boli použité dva morfometrické body a 16 pomocných bodov (semi-landmarkov) lokalizovaných na digitálnych fotografiách oboch strán lebiek. Namerané premenné boli analyzované za pomoci generalizovanej prokrustovej analýzy. Morfometrické údaje ukazujú, že orbitálna asymetria sa medzi jednotlivými druhmi preukazne líši, ale javí sa, že priestorová asymetria (napr. ľavá orbita systematicky viac vyvinutá než pravá) nekoreluje s orbitálnou veľkosťou. To naznačuje, že zväčšovanie orbity nevedie k väčšej asymetrii. Rozdiely medzi druhmi tak môžu byť vysvetlené skôr ich potravovými stratégiami a množstvom prekážok vo výhľade v ich prirodzenom prostredí.

Key words: Accipitriformes; directional asymmetry; fluctuating asymmetry; orbital shape; Strigiformes; vision

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Introduction

Bilateral symmetry is a subject of widespread interest, and structures with such symmetry are particularly considered when these consist of two mirror copies on opposite sides of the body (Klingenberg et al. 2002). Two forms of bilateral symmetry are commonly distinguished: matching symmetry, where the two mirror images are considered separated parts of the structure (Torcida et al. 2016) (e.g. gonads), and object symmetry, where the two mirror images are located on each side of an axis (plane) named the median or sagittal axis (median plane in three dimensions), which also defines the whole structure (Torcida et al. 2016) (e.g. skull). Vertebrate sensory systems are generally based on bilaterally symmetrical sense organs. Lateral biases due to brain lateralization (such as preferences in the use of a limb, or of a visual hemifield in animals with laterally placed eyes) usually occur at population level, with most individuals showing similar direction of bias (Vallortigara 2006). Left and right orbital rings are connected mirror images of each other, while the axis of symmetry passes through the entire skull, constituting a clear example of matching symmetry. Biological asymmetrical forms generally fall into one of two broad categories: when laterality is fixed (most individuals asymmetrical towards the same side, known as directional asymmetry, DA) or when there are random differences between sides (fluctuating asymmetry, FA) (Auffray et al. 1999).

The term "raptor" has historically been applied to a diversity of bird species which were originally grouped together principally for hunting and feeding on other animals, possessing strong, hooked bills and sharply-curved talons (Mitkus et al. 2016) (Pecsics et al. 2019). Raptors can be insectivores, piscivores, avivores, mammalivores or scavengers, as well as generalist or highly specialized hunters (Pecsics et al. 2019). The raptors also include species which may be primarily nocturnal, diurnal or crepuscular in their activity (Pecsics et al. 2019). So there appear to be major differences in raptors' visual abilities (Beckwith-Cohen et al. 2015). The sensory systems of these birds exhibit a high degree of variation which appears subtly tuned to the perceptual challenges posed by the conduct of specific tasks, especially hunting and foraging, and hence visual capacities are seen as a vital part of each species' ecology (O'Rourke et al. 2010, Pecsics et al. 2019). An important source of variation in vision arises from the position of the eyes within the skull (Sun et al. 2018). The location of the eyes in the bird's skull and the range of each eye's visual field (the monocular field) combine to determine the size of the total visual field about the head, the width of the blind sector behind the head, the range of the binocular field, and the extent to which they see by each eye alone. As a result, the overall visual field and the degree of binocular vision overlap.

The osseous orbit in raptors is a spherical-shaped cavum, formed mainly by the frontal, zygomatic and maxillary facial bones. Its function is to protect and accommodate the eye, as well as the relevant muscles and nerves. The complexity of eye orbit shape means that if studies are conducted on the basis of linear measurement and derived indices, limited information about the regional variability of orbit shape can be obtained. Compared with traditional descriptive observations and linear measurements, geometric morphometry (GM) analyses can provide more information about shapes (Sun et al. 2018). GM focuses on methods which capture the geometry of morphological structures and preserve this information throughout the analyses (Bookstein 1991). Using GM, powerful morphometric analyses can be performed, and more subtle shape differences can be visualized. GM techniques are also useful for the study of intraspecific morphological variation, such as the symmetry between bilateral structures (Sun et al. 2018). This widely-used technique allows the quantification and description of the morphological variations within a set of specimens. Additionally, GM analyses enable size and shape to be assessed independently.

Sight adaptations are a conspicuous feature of raptor evolution. Although different species have differing visual capacities and although there are some documented size and shape asymmetries in birds (Aparicio & Bonal 2002) (Pecsics et al. 2018), little is known about differences across species and the degree or the direction of these asymmetries (Güntürkün et al. 2000). Visual lateralization is achieved based on the developmental and anatomical asymmetry of the visual nervous system as well as the cerebral nervous system (Yoo et al. 2017). These asymmetric variations in the nervous system might also generate, or be associated with, the asymmetric morphology of eyes (Yoo et al. 2017). However, our knowledge on whether such internal asymmetric variation is also reflected in the orbita remains limited, despite its anatomical relevance. For this reason we investigated possible orbital size and shape asymmetries and allometric relations among different raptor species with different foraging strategies, some of which are primarily diurnally active (i.e. the Accipitriformes) and others nocturnal (i.e. the Strigiformes). Non-random asymmetric orbital variation was expected to be associated with asymmetric development related to visual lateralization, rather than the selection of bilateral symmetry.

Material and methods

A sample of 73 dry, well-preserved skulls was studied, housed in the osteological collection of the Museu de Zoologia in Barcelona (Catalonia). The specimens came from various species of Accipitriformes (*Accipiter nisus* n = 15, *Buteo buteo* n = 13, *Gyps fulvus* n = 12 and *Neophron percnopterus* n = 5) and Strigiformes (*Bubo bubo* n = 16 and *Tyto alba* n = 12). Bones showing evidence of trauma, malformation or other pathology were first excluded.

A lateral picture of each side was taken with a digital camera. Digital images of skulls were taken with a Nikon D1500 digital camera equipped with an 18 – 105 mm Nikon DX telephoto lens. The photographic record was composed using a standardized and homologous skull position for all specimens (lateral aspect), in order to cancel out differences in the disposition of the anatomical structures. Each specimen was placed in the centre of the optical field, with the lateral aspect oriented parallel to the image plane, and including a ruler for calibration purposes.

The bony orbit is a complex conical structure containing the eye and its appendages (Samour & Naldo 2007).

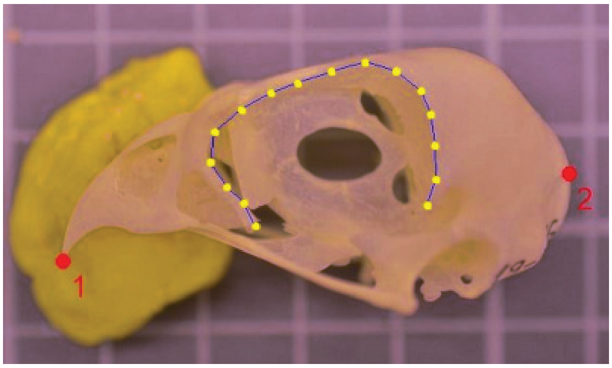

Fig. 1. Position of landmarks (2) and semi-landmarks (16). The landmarks were located on both right and left sides of each orbita. The skull in the image corresponds to an *Accipiter nisus.*
Obr. 1. Pozícia morfometrických bodov (2) a pomocných morfometrických bodov – semi-landmarkov (16). Morfometrické body boli umiestené na pravej aj ľavej očnici. Lebka na obrázku patrí druhu *Accipiter nisus*.

It is made up of many bones which are penetrated by several soft tissue structures (Samour & Naldo 2007). Representing its shape by setting landmarks (discrete anatomical points) can leave out important aspects of its curvature, so orbital outlines were described as two sets of 16 semi-landmarks and 2 landmarks (anterior and posterior) (Figure 1). Unlike landmarks, semi-landmarks are discrete points which are first obtained as coordinates on an initial curve, and then transformed into equidistant discrete points (Gunz & Mitteroecker 2013). This adjustment process was done using the TPS software package (Rohlf 2015), which equalized the distances over the curves. The digitalization of images was performed by a colleague in two separate independent sessions. Ulterior Generalized Procrustes Analysis removed information about location, orientation and rotation from the raw coordinates, and standardized each specimen to unit centroid size (CS), a dimensionless size-measure computed as the square root of the summed squared Euclidean distances from each landmark to the specimen centroid (Webster & Sheets 2010), and resultant shapes were extracted.

The covar matrix of Procrustes coordinates for size and shape was then analysed using two-way mixed-model ANOVA. “Side” effect was interpreted as DA and “side*individual” effect as FA. Wilcoxon W paired testing assessed size differences between sides. Regression was performed using individual asymmetric coefficients as dependent variables, and CS (log transformed) as independent variable. Canonical Variate Analysis (CVA) was done for asymmetric components using Mahalanobis distances and 10,000 permutation rounds. The MorphoJ v. 1.07a (Klingenberg 2011) and PAST v. 2.17c (Hammer, Harper, and Ryan 2001) packages were used. Confidence level was stablished at 95 %.

Results

Procrustes ANOVAs revealed measurement errors of 0.10 % for size and 2.93 % for shape (Table 1). Directional asymmetry was clearly greater than fluctuating asymmetry (Table 1), with left orbitas usually bigger than right ones ($W = 7635$, $p < 0.0001$). CVA revealed that statistical asymmetries were different among all species ($p < 0.01$) (Figure 2). The multivariate regressions of Procrustes coordinates (dependant variables) on size (Log CS – in-

Table 1. Results of Procrustes ANOVA for size (above) and shape (bottom), with a significative effect of “side” (directional asymmetry) and “side*individual” effect (fluctuating asymmetry) for size and shape. Sums of squares (SS) and mean squares (MS) are in units of Procrustes distances (dimensionless).
Tab 1. Výsledky prokrustovej analýzy veľkosti (hore) a tvaru (dole) so signifikantným efektom “tvaru” (priestorová asymetria) a “individuálneho tvaru” (fluktuujúca asymetria) veľkosti a tvaru. Sumy štvorcov (SS) a priemer štvorcov (MS) sú v jednotkách prokrustových vzdialeností (bezrozmerné).

effect / efekt	SS	MS	df	F	p		
individual / jedinec	276 622.40	3 841.98	72	239.20	< 0.0001		
side / tvar	230.34	230.34	1	14.34	0.0003		
side*individual / tvar*jedinec	1 156.43	16.06	72	3.60	< 0.0001		
error / chyba	647.16	4.46	145				
effect / efekt	**SS**	**MS**	**df**	**F**	**p**	**Pillai**	**p**
individual / jedinec	8.050	0.0030	2 304	17.28	< 0.0001	20.07	< 0.0001
side / tvar	0.025	0.0007	32	3.66	< 0.0001	0.65	0.0041
side*individual / tvar*jedinec	0.470	0.0002	2 304	1.51	< 0.0001	13.01	< 0.0001
error / chyba	0.620	0.0001	4 640				

dependent variables) revealed non-significant influence of allometry, specifically isometry ($p = 0.252$), with only 1.76 % of orbital asymmetry explained by orbital size.

Discussion

The lateralized brain, in which each hemisphere carries out different functions, is ubiquitous among vertebrates (Vallortigara 2006, Siniscalchi et al. 2014). Birds, mammals and reptiles have been shown to be lateralized (Bonati et al. 2008). This is particularly evident in the visual system, in which the different use of the eyes (i.e. visual lateralization) involves the use of a specific eye to observe specific kinds of stimuli and their processing with the correspondending contralateral hemisphere (Bonati et al. 2008). Functional asymmetry between the left and right eye is the widespread norm across the animal taxa (Yoo et al. 2017). Increased visual asymmetry appears to enhance cognitive ability, behavioural performance, and thus also the biological fitness of individuals (Yoo et al. 2017). This is reinforced by the differing specialization of the left and right sides of the brain, which may increase efficiency in many vertebrates. For instance, there is evidence that most toads, chickens and fish react faster when a predator approaches from the left (Vallortigara 2006).

The morphometric data obtained in this study show a lateral bias (directional asymmetry) among raptors, both diurnal and nocturnal, with different species having differing orbital asymmetry. Orbital size also showed directional asymmetry, with the left orbita typically being larger than the right. Major use of the left eye would reflect the main role of the right hemisphere in control of vision during hunting or foraging.

The detected allometry indicates that larger orbitas exhibit the same degree of directional asymmetry. Differences between species could be explained in terms of visual strategies. The skull morphology reflects foraging habits rather than diet or prey preference (Pecsics et al. 2019). It appears that predators searching for fast-moving prey (such as *Accipiter nisus*, *Buteo buteo* and *Bubo bubo*) have larger directional asymmetries than species that do not engage in prey pursuit, which have smaller eye movements (such as *Gyps fulvus* and *Neophron percnopterus*, which eat carrion, or *Tyto alba* being an “acoustic location” predator). Ultimately, the eyes as such are closely related to diet choice and feeding behaviours (Beckwith-Cohen et al. 2015), so each hunting or foraging strategy explains different visual traits (visual fields, degree of eye movement, orbit convergence) relevant to gathering visual information (O’Rourke et al. 2010), as well as the degree of visual obstruction in the environment (e.g. open or enclosed habitats) (O’Rourke et al. 2010). The location of the eyes in a bird’s skull appears to have no relationship with asymmetry.

One practical conclusion of our research is that in comparative biometrical studies of raptor skulls, bilateral characters (orbitas at least) should not be examined consistently on only one side, in order to avoid bias. Looking ahead, it would be interesting to study whether or how these asymmetries function in live animals, to confirm whether structures located on the left eye attend predominantly to predatory actions.

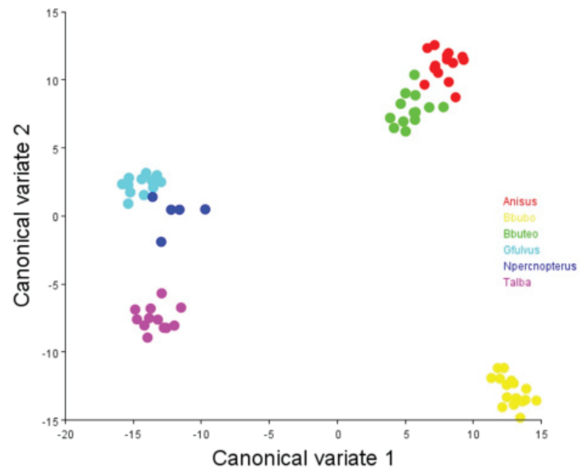

Fig. 1. Canonical Variate Analysis of the asymmetric component for different raptor species (*Accipiter nisus* n = 15, *Bubo bubo* n = 16, *Buteo buteo* n = 13, *Gyps fulvus* n = 12 and *Neophron percnopterus* n = 5, and *Tyto alba* n = 12), revealing statistical differences between all species. It appears that predators searching for fast-moving prey (such as *Accipiter nisus*, *Buteo buteo* and *Bubo bubo*) have larger directional asymmetries than species which do not engage in prey pursuit, which have smaller eye movements (such *Gyps fulvus* and *Neophron percnopterus*, which eat carrion, or *Tyto alba*, being an “acoustic location” predator).

Obr. 1. Kanonická variačná analýza asymetrických komponentov rôznych druhov dravých vtákov (*Accipiter nisus* n = 15, *Bubo bubo* n = 16, *Buteo buteo* n = 13, *Gyps fulvus* n = 12 and *Neophron percnopterus* n = 5, and *Tyto alba* n = 12) odhaľujúca preukazné rozdiely medzi všetkými druhmi. Javí sa, že druhy dravcov loviace rýchlo sa pohybujúcu korisť (napr. *Accipiter nisus*, *Buteo buteo* a *Bubo bubo*) sa vyznačujú väčšou smerovou asymetriou než druhy, ktoré neprenasledujú korisť a majú menší pohyb očí (ako *Gyps fulvus* a *Neophron percnopterus* ktoré sa živia kadávermi, alebo *Tyto alba* ktorá sa pri love orientuje sluchom).

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Age of maturity and exceptionally distant natal dispersal of over 500 km by a male lesser spotted eagle *Clanga pomarina*

Vek dospelosti samca orla krikľavého *Clanga pomarina* a jeho mimoriadne veľký, viac ako 500 km, hniezdny rozptyl

Bernd-Ulrich MEYBURG, Hinrich MATTHES & Grzegorz Maciorowski

Abstract: According to previous studies using colour rings, lesser spotted eagles *Clanga pomarina* have established breeding territories up to 249 km from their natal site. A colour-ringed lesser spotted eagle nestling from NE Poland settled 540 km further west in NE Germany. This male was discovered at the age of six and nested there for several years. This finding is all the more remarkable because the bird was a male, which in large eagles typically settle nearer to their natal sites than females. They apparently reproduce successfully for the first time later than females, normally at the age of five.

Abstrakt: Na základe predchádzajúcich štúdií využívajúcich značenie farebnými krúžkami je známe, že orly krikľavé *Clanga pomarina* obsadzujú hniezdne teritóriá do vzdialenosti 249 km od hniezda, kde sa vyliahli. Farebne označený orol krikľavý vyliahnutý v SV Poľsku obsadil teritórium 540 km na západe v SV Nemecku. Tento samec bol objavený vo veku šiestich rokov a na tom mieste hniezdil už viacero rokov. Toto zistenie je o to zaujímavejšie, že sa jedná o samca, pretože samce veľkých orlov sa obyčajne usadzujú bližšie k miestu ich vyliahnutia, než samice. Okrem toho sa samce zjavne prvýkrát rozmnožujú neskôr než samice, obyčajne vo veku piatich rokov.

Key words: age of maturity, distant settling, ringing, lesser spotted eagle, *Clanga pomarina*

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Introduction

Natal dispersal, i.e. the movement of wandering individuals from their natal area to their first breeding locations, hereafter "dispersal" (Ronce 2007), can be considered one of the most intriguing ecological processes, one that has stimulated the scientific curiosity of several generations of researchers. Dispersal behaviour is a fundamental animal feature and a major determinant of their basic living patterns and processes. Natal dispersal in birds is generally sex biased, with females settling further from their natal sites than males in large raptor species (e. g. Whitfield et al. 2009, Millsap et al. 2014). However, good empirical data on natal dispersal patterns are still needed (Walters 2000), especially for lesser spotted eagles *Clanga pomarina*. These eagles, like many other birds of prey, exhibit a high degree of philopatry. They usually breed not very far from where they were reared (Danko et al. 1996, Meyburg et al. 2006, 2020). According to previous information from ringed birds in Slovakia, lesser spotted eagles settled to breed between 0.13 km and 249 km (median 21.7 km, n = 15) from their natal areas (Danko & Maderič 2008, Dravecký et al. 2013.). The furthest natal dispersal reported so far was achieved by a male which bred 249 km west of where it hatched in Slovakia.

In Germany, settlement could be investigated in 28 cases through the use of readable rings in the federal state of Mecklenburg-Western Pomerania. It took place between 8 and 105 km, on average 44 km from the natal area, with 16 males settling on average 37 km and 12 females on average 53 km from their natal area (C. Rohde pers. comm.).

Method

We marked a male lesser spotted eagle nestling (age ~7 weeks) on July 22, 2010, in the southern part of the Augustów Forest (NE Poland, 53° 45' N / 23° 02'E) with two readable metal rings (Blue-yellow BUY / 55) and a metal ring (BN4628) of the Polish Ringing Station.

Results

In 2016, at the age of six, the eagle was first detected as a territory-holder and breeding bird at an eyrie (53°34' N / 14°10' E) 17 km east of the town of Pasewalk in the extreme north-east of Mecklenburg-Western Pomerania (Germany) in the district of Pomerania-Greifswald near the Polish border. The bird was clearly identified by its two colour rings, an identification confirmed by photographs taken by Michael Heiss and observations by other birdwatchers who read the rings.

The eagle's settlement location was 540 km west of its natal nest, in a densely wooded region of the southern Ueckermünder Heide area, the eastern part of which is in Poland and is known as Puszcza Wkrzańska. This forest area is crossed by the rivers Uecker, Randow and Zarow, and there are numerous protected wetlands, especially in the area bordering on Poland.

During 2016–2020 successful breeding by this eagle was only recorded in 2017 (one fledgling). In 2019 breeding was disturbed by logging operations, and in 2020 a new eyrie was built and used.

Discussion

This long-distance settlement, more than twice the distance previously described in the literature (Dravecký et al. 2008a, 2013), and near the margins of the breeding range of this species, is especially remarkable because the marked individual was a male. Normally, large raptor males are particularly faithful to the area where they were raised, while females sometimes breed further away. On average, female golden eagles (*Aquila chrysaetos*) in North America dispersed about 50% further than males (Murphy et al. 2019). The distance (9–124 km) at which satellite-tracked individuals bred was considerably shorter than for the lesser spotted eagle. For males of the osprey (Pandion haliaetus), which have about the same size as the lesser spotted eagle, the settlement distance of males was 4–23 km (median 23 km, n = 37) and for females 17–278 km (median = 115 km, n = 54) (Schmidt et al. 2006).

Very few data exist on the age of first successful breeding for lesser spotted eagles. One female successfully raised a fledgling at the age of four years (Meyburg et al. 2008), as did a four-year-old male in Slovakia (Dravecký et al. 2008a). Two males fitted with transmitters as nestlings in Germany behaved very differently from one another (Meyburg et al. in prep.). One male appeared in a previously unoccupied territory at the age of two, but first raised an offspring only at the age of five, and again when seven years old. The other was a floater until the age of seven, when it occupied a territory and raised offspring (Meyburg et al. in prep.).

Fig. 1. The young eagle on 22 July 2010 at the nest in Poland.
Obr. 1. Mladý orol na hniezde v Poľsku 22. júla 2010.

At the age of two, a male was registered for the first time at the release site (hacking station) of a lesser spotted eagle conservation project in Germany some 70 km north of Berlin (Meyburg et al. 2008, 2017), where the bird had been released two years before. When three years old, this male occupied a territory and mated with an unmarked female close to the hacking station where young second-hatched eagles ("Abels") were being released as part of a conservation project (Meyburg et al. 2008, 2017). Normally only one chick is reared and fledges in the nest because of the so called "Cain and Abel" conflict or "cainism" (Meyburg 1974). The following year, the couple adopted a young eagle after fledging which had been reared and released into the wild as part of this management project. It was only when the male was five years old that the pair raised their own offspring. This male was originally translocated from Latvia to Germany, together with 50 other second-hatched eagles, within the framework of a population support programme in which second-hatched young fledging extremely rarely from their own nest due to cainism (Meyburg 1984) are taken from the nest, reared in captivity, and then released into the wild. Up to 2020 119 second-hatched eagles from Germany, Latvia and Poland were released to the wild by means of fostering and hacking (Meyburg et al. in prep.). Thanks to identification ringing, the survival of these released young eagles could be proven in several cases, up to their own successful breeding (Meyburg et al. in prep.).

Although relevant details are known in only a few cases, it seems that male lesser spotted eagles normally reproduce with success for the first time later than females.

For decades we have marked lesser spotted eagles using plastic colour rings first and later readable metal rings for nestlings and adult birds. As part of the satellite telemetry project in Germany since 1992, which also involves marking and tracking released young second-hatched birds, we started by marked lesser spotted eagles using plastic colour rings for some years. As a result of satellite telemetry, several of the tagged adult lesser spotted eagles could be observed for years, and some of them could also be photographed. We have documented several cases in which the colour plastic rings have been lost or removed by the eagles, including the case of a young eagle which got rid of its ring during the post-fledging period, prior to independence (Meyburg et al. in prep.). Dravecký et al. (2013) also reported some cases of plastic colour rings which had been removed by the birds or otherwise lost. Because of this, for many years now we have only used metal rings etched with readable characters (Meyburg et al. in prep.), such as those being used for a reintroduced tree-breeding population of peregrine falcons (*Falco peregrinus*) in northern Germany, for white-tailed sea eagles (*Haliaeetus albicilla*) and other raptor species. As the oldest adult lesser spotted eagle in the telemetry project was already 24 years old when it was captured and marked with a transmitter (Meyburg et al. in prep.), it is important for us that the identification rings last for decades.

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Fig. 2. The male lesser spotted eagle as a breeder in Germany, 14. June 2018.
Obr. 2. Samec orla krikľavého hniezdiaci v Nemecku 14. júna 2018.

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Fig. 3. A second-hatched male from Latvia with readable ring KN, which had been translocated, raised and released in Germany, reappeared for the first time back at the release site at the age of two.
Obr. 3. Samec z Lotyšska, ktorý bol druhým vyliahnutým mláďaťom na hniezde s čitateľným krúžkom KN. Bol prenesený a vypustený v Nemecku a prvýkrát pozorovaný na mieste vypustenia vo veku dvoch rokov.

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Summary of raptor and owl ringing in Slovakia in the period from 2012 to 2019

Prehľad krúžkovania dravcov a sov na Slovensku v rokoch 2012 – 2019

Roman SLOBODNÍK & Michal JENČO

Abstract: Between 2012 and 2019, 6523 raptors and owls (30 species) were ringed in Slovakia. The most abundant was the common kestrel (2811 individuals), then the western marsh harrier (664) and saker falcon (517). The proportion of nestlings among all the ringed individuals was 84.4%. In the given period, 340 recoveries of raptors and owls (23 species) were recorded in the ringing station database. This number included 160 recoveries of individuals colour-marked and also recovered in our territory. There were 83 recoveries of birds ringed in Slovakia and resighted abroad. The last 97 recoveries were of individuals ringed abroad and recovered in Slovakia. In summary, most of the recoveries (of all types) were of Eastern imperial eagle (62 recoveries), then red-footed falcon (51) and common kestrel (43). Most of the recovery circumstances were ring reading (44% in total), recaptures (15%) and findings of bird cadavers. Regarding raptors or owls, collisions with vehicles (5%) and electrocutions (5%) were frequent causes of their deaths.

Abstrakt: V rokoch 2012 – 2019 bolo na Slovensku okrúžkovaných 6523 dravcov a sov (30 druhov). Najpočetnejšie boli krúžkované sokol myšiar – 2811 jedincov, kaňa močiana – 664 a sokol rároh – 517. Podiel mláďat zo všetkých okrúžkovaných jedincov predstavuje 84,4 %. V spomínanom období bolo v databáze krúžkovacej stanice zaevidovaných 340 spätných hlásení dravcov a sov (23 druhov). 160 spätných hlásení sa týkalo jedinca označeného a zároveň aj nájdeného na našom území. 83 hlásení predstavovali vtáky označené na Slovensku a zaznamenané v zahraničí. 97 hlásení reprezentujú jedince označené v zahraničí a nájdené na Slovensku. V sumárnom počte bolo najviac hlásení (všetky typy) získaných u orla kráľovského (62 hlásení), nasleduje sokol kobcovitý (51) a sokol myšiar (43). Väčšina okolností týchto hlásení tvoria odčítania krúžkov (spoločne takmer 44 %), nasledujú kontrolné odchyty (15 %) a nálezy uhynutých jedincov. Častou príčinou sú v prípade dravcov a sov kolízie s dopravnými prostriedkami (5 %) a úhyny následkom elektrického prúdu (5 %).

Key words: birds of prey, owls, ringing data, recoveries, Slovakia

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Introduction

This report on the results of raptor and owl ringing follows on from articles published regularly in the Slovak Raptor Journal in the past (Slobodník & Slobodník 2012 being the latest). In comparison to those articles, this report presents partial changes from the viewpoint of the evaluation of collected data according to the annual overview of the Czech Bird Ringing Centre in Prague (Klvaňa & Cepák 2020 being the latest). In that period, ringing was perfomed based on the decisions of the Ministry for Environment of the Slovak Republic permitting exemptions from the requirements of Law No. 543/2002 Coll. on nature and landscape protection. One exemption (Decision No. 269/132/05-5.1) authorises the ringing of all bird species except for certain selected ones, specifically some owls and raptors. Another exemption (Decision No. 664/297/05-5.1 pil) enables members of the Raptor Protection of Slovakia organization to research raptors and owls and to ring them. Since 2019, a new exemption (Decision No. 3320/2019-6.3 of 8 April 2019) has been in force.

Results and discussion

In the period from 2012 to 2019, 6523 raptors and owls were ringed in Slovakia (an average of 815 individuals per year), which represented 1.4% of all the birds ringed in Slovakia (462 451 individuals) in the given period (Jenčo & Repel 2019, Bird Ringing Centre Database). Of the total number, raptors (Accipitriformes and Falconiformes orders) outnumbered the owls with 85.9% (5600 individuals, 20 species). Owls (Strigiformes order) represented only 14.15% (923 individuals, 10 species). Common kestrel (*Falco tinnunculus*) with 2811 individuals, western marsh harrier (*Circus aeruginosus*) with 664 and saker falcon (*Falco cherrug*) with 517 were the most abundant raptors. Among the owls, it was long-eared owl (*Asio otus*) – 316 individuals, barn owl (*Tyto alba*) – 186 and tawny owl (*Strix aluco*) – 180 which were most commonly ringed (Table 1). As far as the ringing itself is concerned, we may observe several trends. The least individuals were ringed in 2013 (only 453), while in 2019 it was the most – 1222. The ringing of raptors and owls is obviously on the uptrend, which we may see mainly in the number of ringed common kestrels representing 43.1% (Fig. 2). Among the remaining species, numbers of ringed individuals (e.g. *A. heliaca, F. cherrug, C. aeruginosus* or *B. bubo*) remained stable. Another group comprised species in which the number of ringed individuals is on a downward trend (e.g. *C. pomarina, B. buteo*).

The proportion of nestlings was 84.4% (5506 individuals), increasing continuously through the observed period. While in 2012 chicks represented 67.5%, in 2019 it was as much as 92.9% (Fig. 2). In comparison with other bird groups (orders, families) ringed in Slovakia, the proportion of chicks is higher (Jenčo & Repel 2019) as this is a long-term specialization of the ringers focusing on raptors and owls not only in Slovakia (e.g. Slobodník & Šnírer 2001) but also in Europe (e.g. Saurola 2012, Saurola et al. 2013).

Accipitriformes order

For a long time, the European honey buzzard (*Pernis apivorus*) has belonged among the species in our country to which not much attention is paid (Danko et al. 2002), which is reflected in the low number of ringed individuals (e.g. Slobodník & Slobodník, 2012). During the eight years of this study, four of them saw not a single individual ringed, even though considering its abundance this buzzard does not belong among the critically-endangered species (Danko et al. 2002). By contrast, the single black kite chick ringed in 2016 is not surprising, considering that this species is not abundant in Slovakia

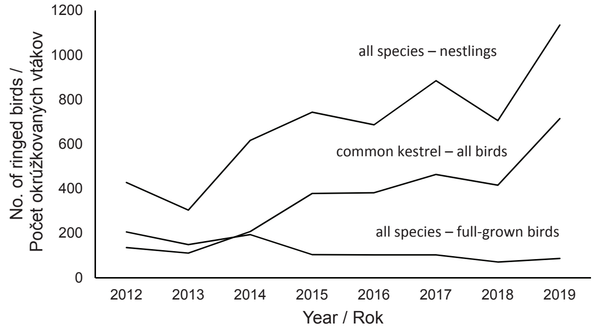

Fig. 1. Developments in ringing of all raptors and owls in Slovakia, especially the common kestrel (2012–2019).
Obr. 1. Vývoj krúžkovania všetkých dravcov a sov a špeciálne sokola myšiara na Slovensku (2012 – 2019).

(Danko et al 2002) and its nestlings have rarely been ringed here even in the past (e.g. Slobodník 2007, Slobodník et al. 2009). Ringing of red kite chicks (*Milvus milvus*) would be welcome, since their number has been increasing recently, not only in western Slovakia but also in the Czech Republic (Knott et al. 2009). In addition to ringing, in central Europe numerous monitorings of individuals have been recently under way by means of trasnmitters (Literák et al. 2019), which could lead to even more ringing activities in the future. In spite of the fact that their population in the central European region is growing, the numbers of ringed white-tailed eagles are not getting any bigger (Bělka & Horal 2009). This is mainly due to the great height at which they build their nests and the absence of a larger number of ringers working at such heights. As far as the western marsh harrier is concerned, we have recorded increased numbers of their nestlings being ringing, mainly thanks to the colour-ringing programme implemented mostly in eastern Slovakia (Jenčo & Repel 2018). In the case of the remaining two harrier species, only small numbers of chicks (Montagu's harrier, *Circus pygargus*) or individuals in the late autumn or winter period (hen harrier, *Circus cyaneus*) have been ringed, while the specialization from the past has declined (Danko 2000, Slobodník 2008). It would be possible to carry out captures of nesting individuals focused on determining fidelity and philopatry rates (Poprach et al. 2016), which would contribute to a higher number of ringed individuals. The numbers of ringed northern goshawks are decreasing compared to the past (Slobodník 2007, 2008). In 2019 there was not even a single individual ringed in Slovakia, which may be attributed to its population decrease due to the West Nile virus (Hubálek et al. 2018). The number of ringed Eurasian sparrowhawks is connected mainly to the captures of songbirds during their autumn migration or on feeders. In comparison to the recent past, the chicks have not been ringed (Slobodník 2007). The situation is similar with the common buzzard, regarding which the numbers of ringed birds are very low. In 2019 there was not even a single chick ringed in Slovakia, though it is one of the most abundant raptor species in this country (Danko et al. 2002). In the last five years no rough-legged buzzard has been ringed in our territory (Table 1). The absence of this ringing is connected to a certain extent to the absence of hen harrier ringing (Danko 2000). The ringing of chicks of lesser spotted eagles in the study period is closely related to the LIFE09 Project NAT/SK/000396 Conservation of *Aquila pomarina* in Slovakia (Dravecký et al. 2015a). After completing the project in 2014, significant decrease in ringed individuals occurred, mostly in the areas which had been monitored for a long time (Dravecký et al. 2015b). With the next two eagle species the numbers of ringed individuals remained relatively stable despite the increasing abundance of both species (Bagyura et al. 2002, Chavko et al. 2013, Korňan 2015).

Falconiformes order

The common kestrel was the most frequently ringed raptor species in the study period as well as in the past (e.g. Slobodník & Slobodník 2010). In this species, nestlings ringed in their nest (or a nesting box) highly predominate. They have been ringed within the colour-ringing programme implemented mainly in the western Slovakia (Jenčo & Repel 2018). After several individuals ringed in 2002, 2004, 2005 and 2009 (Slobodník 2007, 2008, Slobodník & Slobodník 2010), there has been a significant increase in the number of ringed red-footed falcons. This species has been ringed annually since 2016 and the numbers are closely connected with its increasing population in Slovakia (Slobodník et al. 2017), which replicates the growing population trend in central Europe, and mainly in Hungary thanks to the LIFE 05 NAT/H/000122 and LIFE11 NAT/HU/000926 projects (Palatitz et al. 2015). In 2019, both of these falcon species were ringed in the historically highest numbers. We connect these 2019 numbers with the abundance of common vole in central Europe, mainly in Moravia and south-western Slovakia (Tulis 2019), which also manifested itself in the number of individuals ringed in the Czech Republic (Klvaňa & Cepák 2020). The Eurasian hobby has been ringed in Slovakia sporadically, compared to the past, when much attention had been paid to it mainly in eastern Slovakia (Lipták 2007), as shown in the number of ringed individuals (Slobodník et al. 2009). Even though its population is low, the saker falcon belongs among the species ringed numerously (Chavko et al. 2019, 2020). By contrast, in the case of the peregrine falcon the number of ringed individuals has not increased, despite the population and area trend in Slovakia getting higher (Chavko 2002). In Slovakia since 2018, every chick of both the big falcon species has also been ringed with colour rings (Jenčo & Repel 2018).

Strigiformes order

There has been a dramatic decrease in the barn owl population in central Europe (e.g. Mátics et al. 2017, Šálek et al. 2019) and also in Slovakia; several hundreds of pairs known from the turn of the millennium have dropped to the current few individuals (Danko et al. 2002, Bacsa & Riflik 2020). The number of ringed chicks confirms this condition too. In 2002, 170 individuals were ringed, of which 142 chicks (Slobodník 2007). The last known two chicks were ringed in 2010 in the district of Lučenec (Slobodník & Slobodník 2011). Subsequently, no nesting was recorded in Slovakia until 2017 when five chicks were ringed in the district of Nové Zámky (Table 1). In addition to them, in cooperation with several groups in the Czech Republic and Slovakia, individuals captured and reared have been released. In 2019 the population increased to six known pairs, of which all the chicks were ringed (Bacsa & Riflik 2020). As with the common kestrel and red-footed falcon, we assume the increase in the number of breeding pairs is connected to the increased diet supply, mostly of common vole (Tulis et al. 2019). The Eurasian scops owl has been rarely ringed in Slovakia (Table 1). In the past it was ringed in small numbers and irregularly in the district of Piešťany and Prievidza (Slobodník 2008, Slobodník & Slobodník 2010). It is possible to increase captures of this species, mainly during spring migration, by means of birdcall reproduction (Klvaňa & Cepák 2020, Lučan 2019). Due to its late application, the effect of this method could not be shown in the number of ringed individuals. The Eurasian eagle-owl population in Slovakia went through certain local changes: while in the north of Slovakia it decreased noticeably (Flajs 2019), in the west of the country (Ponitrie) it appears to be stable (Šnírer et al. 2018), and in the east it is considered a new avifauna element (Hrtan 2010, Mihók & Lipták 2010). Compared to the past the numbers of ringed chicks in total (Table 1) are rather even (Slobodník 2007). The Eurasian pygmy owl belongs among the rarely ringed species (Table 1) and even in the past the number of its ringed individuals was not high (Slobodník 2007). It is similar in the case of the little owl, though its abundance (Dobrý 2009), and mainly the fact that it is able to breed in

Table 1. Summary of raptors and owls ringed in Slovakia in 2012-2019 (pull. – young, f.g. – full-grown, A - bird ringed and recovered in Slovakia, Z – bird ringed in Slovakia recovered abroad, C - bird ringed abroad recovered in Slovakia).
Tab 1. Súhrnné výsledky krúžkovania dravcov a sov na Slovensku v rokoch 2012–2019 (pull. – mláďatá, f.g. – plne vyvinuté, A – vták označený aj nájdený na Slovensku, Z – vták označený na Slovensku a nájdený v zahraničí, C – vták označený v zahraničí a nájdený na Slovensku).

year / rok	2012		2013		2014		2015		2016		2017		2018		2019		2012 – 2019	recoveries nálezy (2012–2019)		
species / druh	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull.**	**f.g.**	**pull. + f.g.**	**A**	**Z**	**C**
Pernis apivorus	2	0	0	0	0	4	0	0	0	6	0	0	0	0	0	0	12	0	0	0
Milvus migrans	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0
Milvus milvus	3	0	3	0	2	0	4	0	3	0	1	0	0	0	3	0	19	1	2	1
Haliaeetus albicilla	5	1	0	0	3	0	10	0	12	0	3	0	3	0	8	0	45	5	12	12
Circus aeruginosus	30	2	34	3	101	8	114	1	75	1	120	0	100	0	75	0	664	8	4	0
Circus cyaneus	0	3	0	0	0	1	0	0	0	1	0	1	0	0	0	0	6	0	0	0
Circus pygargus	0	0	0	0	0	1	0	1	0	0	3	0	3	0	0	0	8	0	1	0
Accipiter gentilis	0	3	2	6	11	16	0	0	3	6	3	2	2	3	0	0	57	3	0	1
Accipiter nisus	0	24	0	25	0	13	0	16	0	11	0	6	0	9	1	16	121	10	0	0
Buteo buteo	1	50	3	23	9	49	1	29	1	13	0	30	2	7	0	14	232	5	1	8
Buteo lagopus	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Clanga pomarina	83	0	77	2	71	0	25	0	19	0	34	1	18	2	19	0	351	15	9	4
Aquila heliaca	31	0	23	0	28	0	24	0	35	0	20	3	14	0	32	0	210	14	18	30
Aquila chrysaetos	18	0	9	0	16	0	21	0	20	0	18	0	7	0	16	0	125	8	3	2
Falco tinnunculus	89	47	75	36	179	29	366	13	363	19	442	22	400	16	704	11	2811	28	6	9
Falco vespertinus	0	0	0	0	0	0	0	0	16	0	41	0	41	0	73	0	171	31	5	15
Falco columbarius	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Falco subbuteo	0	0	0	2	0	1	0	0	0	0	2	1	0	1	4	1	12	1	0	0
Falco cherrug	77	0	37	1	64	0	65	0	71	0	71	0	72	0	59	0	517	9	10	5
Falco peregrinus	43	2	17	0	32	0	50	0	20	0	37	0	14	1	16	0	232	3	4	6
Tyto alba	0	5	0	14	0	9	0	19	0	25	5	16	0	22	48	23	186	2	1	3
Otus scops	0	0	0	0	3	1	0	0	0	0	1	0	0	0	0	1	6	0	1	0
Bubo bubo	6	0	16	0	17	1	24	1	18	1	44	3	16	1	22	0	170	6	5	0
Glaucidium passerinum	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	2	6	0	0	0
Athene noctua	0	0	0	0	0	1	0	5	0	1	0	0	0	1	0	5	13	0	0	0
Strix aluco	33	6	6	3	59	10	8	3	3	3	12	2	4	3	19	6	180	3	0	0
Strix uralensis	0	0	0	1	11	0	0	1	0	1	10	2	2	0	2	1	31	1	0	0
Asio otus	7	56	2	25	11	44	32	13	27	14	18	14	8	5	34	6	316	7	0	0
Asio flammeus	0	2	0	2	0	5	0	1	0	0	0	0	0	0	0	0	10	0	0	1
Aegolius funereus	0	1	0	2	0	0	0	1	0	0	0	0	0	0	0	1	5	0	0	0
total / spolu	**428**	**206**	**304**	**149**	**617**	**194**	**744**	**104**	**687**	**103**	**885**	**103**	**706**	**71**	**1135**	**87**	**6 523**	**160**	**83**	**97**

nesting boxes made by people (e.g. Poprach et al. 2018), facilitates the possible specialisation and has led to a higher number of ringed individuals. It also helps preventing the species from becoming locally extinct, as has happened in the greater part of the Czech Republic (Šálek et al. 2019). In both Strix and Asio species, the numbers of ringed birds are far lower than in the past, as this activity has been performed less frequently mostly in eastern and western Slovakia (Danko 2000, Lengyel 2006, Slobodník 2007, Slobodník & Slobodník 2011). The ringing of boreal owls happened only coincidentally during ringing focused on other species, though we may find inspiration to increase the numbers due to the re-emergence of this specialisation, for instance in the Czech Republic (Klvaňa & Cepák 2018).

List of selected recoveries (2012 – 2019)

In the period from 2012 to 2019, the ringing station database recorded 340 recoveries of raptors and owls (Table 1), from which there was at least one recovery in each of the 23 species recorded. The total proportion of recoveries was as follows: 160 recoveries were of an individual both ringed and recovered in our territory (i.e. Recovery Type A, Jenčo et al. 2017). Then there were 83 recoveries of birds ringed in Slovakia and resighted abroad (Type Z, 16 countries in total, Table 2), of which the most were recovered in the surrounding countries: Hungary (36 recoveries), the Czech Republic (18) and Austria (8). The other 97 individuals were ringed abroad and recovered in Slovakia (Type C, 9 countries in total, Table 3), most of them ringed in Hungary (74), then Finland (7) and Poland (5). In summary, most of the recoveries (of all types) were of eastern imperial eagle (62 recoveries), then red-footed falcon (51) and common kestrel (43). After assessing only the individuals ringed in Slovakia (Type A and Z), the order is as follows: red-footed falcon (36), common kestrel (34), and eastern imperial eagle (32).

Most of the circumstances of these recoveries were ring readings (almost 44% in total), in which cases colour rings (26%) prevailed over aluminium ones (17%). Then there were recaptures (15%) and findings of cadavers. Raptors and owls frequently die due to collisions with vehicles or by electrocution (Table 4).

The most distant recoveries of individuals with Slovakian rings were of lesser spotted eagles in Botswana (7 582 km) and Lebanon (2 148 km), and a black kite in Norway (1 621 km). Regarding birds ringed abroad at the greatest distance and then recovered in Slovakia, there was a recovery of a short-eared owl from Norway and common kestrels (5) and common buzzards (2) ringed as nestlings in Finland.

All the species for which there was at least one successful recovery (n = 23) between 2012 and 2019 are listed in the selected recoveries.

Table 2. Recoveries (2012 – 2019) of raptors and owls ringed in Slovakia and recovered abroad (Z) and recoveries of raptors and owls ringed abroad and recovered in Slovakia (C).
Tab. 2. Spätné hlásenia dravcov a sov okrúžkovaných na Slovensku (2012 – 2019) a nájdených v zahraničí (Z) a hlásenia dravcov a sov okrúžkovaných v zahraničí a nájdených na Slovensku (C).

country / krajina	Z	C
Albania	1	
Austria	8	4
Botswana	1	
Czech republic	18	3
Estonia		1
Findland		7
France	2	
Germany	2	1
Greece	1	
Hungary	36	74
Italy	5	
Lebanon	1	
Norway	1	1
Poland	2	5
Romania	1	
Serbia		1
Spain	1	
Turkey	1	
Ukraine	2	
total / spolu	**83**	**97**

For every recovery of a particular species, we state:
N – total number of recoveries recorded between 2012 and 2019, divided according to the distance (S = 0 – 10 km, M = 11 – 100 km, L > 100 km)
C – number of recoveries with rings from foreign centres recorded in the territory of Slovakia (station code and number of data in brackets)
Z – number of recoveries with rings from N. MUSEUM SLOVAKIA recorded abroad (country code and number of data in brackets)

A selected recovery is given as follows:
1st line: station code, ring type and number (sex and age when ringed given in brackets), date of ringing, locality (district), country, name of the ringer (in the case of a ring from N. MUSEUM SLOVAKIA), rounded coordinates of the ringing locality
2nd line: date of recovery, locality (district or region), country, name of the finder, rounded coordinates of the recovery locality

Table 3. Circumstances of recoveries (2012–2019) of raptors and owls ringed in Slovakia (A – bird recovered in Slovakia, Z – bird recovered abroad).
Tab. 3. Okolnosti nálezu spätných hlásení (2012 – 2019) dravcov a sov krúžkovaných na Slovensku (A – vták nájdený na Slovensku, Z – vták nájdený v zahraničí).

recovery circumstates / okolnosti nálezu	A	Z	A + Z	%
alive and probably healthy, colour ring read in field / živý, číslo farebného krúžku odčítané	52	12	64	26.3
alive and probably healthy, metal ring read in field / živý, číslo hliníkového krúžku odčítané	23	19	42	17.3
caught and released by ringer / chytený a pustený krúžkovateľom	23	14	37	15.2
found dead / nájdený uhynutý	21	13	34	14
electrocuted / usmrtený elektrickým prúdom	7	5	12	4.9
found / nájdený bez bližších údajov	4	5	9	3.7
dead on road / nájdený mŕtvy na ceste	6	2	8	3.3
shot / zastrelený		5	5	2.1
entered building / nájdený vo vnútri stavby	3	2	5	2.1
ring only found / nájdený iba krúžok	4		4	1.6
dead, aircraft casualty / nájdený mŕtvy po zrážke s lietadlom	4		4	1.6
poisoned, poison not identified / otrávený neznámou látkou	1	2	3	1.2
found at or in nest-box / nájdený v búdke	2		2	0.8
hit wires / náraz do elektrického vedenia		2	2	0.8
general trauma, injured / prirodzené poranenie	1	1	2	0.8
sick / choroba	2		2	0.8
recovery caused by the ring on the bird / nájdený v dôsledku označenia	1		1	0.4
trapped because it was ringed / chytený v dôsledku označenia		1	1	0.4
poisoned, poison identified / otrávený známou látkou	1		1	0.4
dead on railway / nájdený mŕtvy na železnici	1		1	0.4
hit glass / náraz na sklo	1		1	0.4
vital infection / infekcia	1		1	0.4
violent weather / nepriaznivé počasie	1		1	0.4
unknown / neznáme	1		1	0.4
total / spolu	**160**	**83**	**243**	**100**

3rd line: recovery circumstances code, distance between the ringing and recovery locality, time elapsed (= period from the ringing date to the recovery date) in y (year), m (month), d (day) format.

Sex
M – male
F – female
N – unknown

Age
1 – pullus
2 – full-grown
3 – hatched during calendar year of ringing
4 – hatched before calendar year of ringing, exact year unknown
5 – hatched during previous calendar year
6 – hatched before previous calendar year, exact year

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Abbreviations used for the individual ringing centres (local name of the centre, English name for the country):
AUW – WIEN, Austria
CZP – PRAHA, Czech Republic
DER – RADOLFZELL, Germany
EEM – MATSALU, Estonia
HGB – BUDAPEST, Hungary
PLG – GDANSK, Poland
SFH – HELSINKI, Finland
SKB – BRATISLAVA, Slovakia

Code for circumstances of find
00 – found
01 – found dead
02 – ring only found
10 – shot
20 – caught and released by ringer
26 – trapped because it was ringed
27 – found at or in nest-box
28, 29 – alive and probably healthy, metal ring read in the field
35 – electrocuted
37 – poisoned, poison identified
38 – poisoned, poison not identified
40 – dead on road
41 – dead on railway
42 – aircraft casualty
43 – hit wires
44 – hit glass
46 – entered building
50 – general trauma, injured
53 – vital infection
58 – sick
78 – violent weather
81, 82, 87 – alive and probably healthy, colour mark (ring) read in the field
99 – unknown

Black kite (*Milvus migrans*)
N = 1 (S 0, M 0, L 1) Z 1 (Norway 1)

SKB D5608	(1N)	01.07.2016	Michalovce [Slovakia], Vladimír Pečeňák	N48°31’	E22°05’
		02.06.2019	Systad, G.H./Univ. i Bergen (RG)	N59°37’	E5°46’
			26; 1 621 km; 2r, 11m, 0d		

In the given period, we recorded one significant species recovery. That recovery from Norway is unique proof of one individual moving to a location more than 1500 kilometres distant. Relocation of chicks and settling at a great distance is not a rare phenomenon with this species, as confirmed by a chick from the Czech Republic nesting in Ukraine (Cepák et al. 2008). Coincidentally, this very individual was the only example ringed in the study period.

Red kite (*Milvus milvus*)
N = 4 (S 1, M 0, L 3) A 1, Z 2 (Hungary 1, Greece 1), C1 (DEH 1)

DEH EA198407	(1N)	07.06.2015	Sachsen Anhalt [Germany], Hiddensee	N51°01’	E12°07’
		11.03.2019	Skalica [Slovakia], Štefan Bílek	N48°47’	E17°06’
			38; 434 km; 3r, 9m, 3d		
SKB D6161	(1F)	24.06.2017	Vranov nad Topľou [Slovakia], Vladimír Pečeňák	N48°53’	E21°46’
		21.09.2017	Tolna [Hungary], Gubacsi Mihály	N46°31’	E18°52’
			01; 343 km; 2m, 28d		
SKB D5607	(1N)	15.06.2016	Humenné [Slovakia], Vladimír Pečeňák	N48°57’	E21°51’
		18.11.2016	Messolonghi lagoons wetlands [Greece], I. Literák	N38°23’	E21°12’
			01; 1 176 km; 5m, 3d		

Nowadays in Europe, many individuals of this species have been marked not only with a ring but also with a satellite transmitter, which has produced many new items of knowledge from the viewpoint of the observed population (Literák et al. 2018). The presence of a chick from Slovakia in Crete was out of the ordinary, considering the nature and direction of migration of individuals coming from central Europe (Cepák et al. 2008, Panter et al. 2020).

White-tailed eagle (*Haliaeetus albicilla*)
N = 29 (S 1, M 10, L 18) A 5, Z 13 (Hungary 12, Slovakia 1), C 11 (HGB 10, PLG 1)

PLG AX3424	(1N)	11.05.2015	Podkarpackie [Poland], Janusz Wójciak	N50°21’	E21°55’
		01.04.2016	Šaľa [Slovakia], Lengyel Jozef	N48°06’	E17°58’
			38; 381 km; 10m, 21d		
CZP LX672	(1N)	14.05.2018	Žďár nad Sázavou [Czechia], J. Čejka	N49°32’	E15°53’
		24.06.2019	Malacky [Slovakia], Radovan Václav	N48°16’	E17°01’
			81; 164 km; 1r, 1m, 10d		
HGB E493	(1N)	16.05.2012	Heves [Hungary], Tihanyi Gábor	N47°27’	E20°26’
		15.08.2017	Trebišov [Slovakia], Ervín Hrtan ml.	N48°34’	E21°45’
			81; 159 km; 5r, 2m, 29d		
HGB H0043	(1N)	08.05.2015	Jász-Nagykun-Szolnok [Hungary], Tihanyi Gábor	N47°19’	E20°46’
		06.10.2017	Trebišov [Slovakia], Ervín Hrtan ml.	N48°33’	E21°40’
			28; 152 km; 2r, 4m, 29d		
HGB H0153	(1N)	11.05.2014	Jász-Nagykun-Szolnok [Hungary], Monoki Ákos	N47°10’	E20°15’
		06.10.2017	Trebišov [Slovakia], Ervín Hrtan ml.	N48°33’	E21°40’
			28; 188 km; 3r, 4m, 26d		
HGB H0165	(1F)	18.05.2015	Jász-Nagykun-Szolnok [Hungary], Monoki Ákos	N47°27’	E20°11’
		24.10.2018	Šaľa [Slovakia], Jozef Chavko	N48°00’	E17°57’
			38; 178 km; 3r, 5m, 7d		
HGB H0338	(1F)	11.05.2017	Hajdu-Bihar [Hungary], Tihanyi Gábor	N47°40’	E21°08’
		31.08.2017	Trebišov [Slovakia], Jaroslav Kizek	N48°37’	E21°44’
			28; 114 km; 3m, 20d		
SKB SK410	(1N)	23.04.2016	Dunajská Streda [Slovakia], Jozef Chavko	N47°52’	E17°34’
		21.01.2017	Dunajská Streda [Slovakia], Andrej Somora	N47°52’	E17°34’
			81; -- km; 8m, 29d		
		25.03.2018	Šaľa [Slovakia], Tomáš Veselovský	N48°00’	E17°57’
			37; 32 km; 1r, 11m, 0d		
SKB SK203	(1N)	25.04.2015	Dunajská Streda [Slovakia], Jozef Chavko	N47°50’	E17°37’
		28.01.2019	Hajdu-Bihar [Hungary], Kádár Ferenc	N47°37’	E21°01’
			28; 255 km; 3r, 9m, 4d		
SKB A1582	(1N)	28.04.2012	Dunajská Streda [Slovakia], Jozef Chavko	N47°52’	E17°34’
		04.03.2013	Hajdu-Bihar [Hungary], János Tar	N47°42’	E21°07’
			28; 266 km; 10m, 5d		
SKB A2032	(1N)	14.05.2017	Rožňava [Slovakia], Mihók Jozef	N48°35’	E20°45’
		30.12.2017	Hajdu-Bihar [Hungary], Tihanyi Gábor	N47°37’	E21°01’
			28; 111 km; 7m, 16d		
SKB A3407	(1N)	24.05.2015	Košice - okolie [Slovakia], Mihók Jozef	N48°31’	E21°09’
		20.01.2018	Hajdu-Bihar [Hungary], Kocsis Zsuzsanna	N47°37’	E21°01’
			28; 102 km; 2r, 7m, 28d		
SKB A3410	(1N)	28.05.2016	Rožňava [Slovakia], Mihók Jozef	N48°35’	E20°45’
		10.02.2017	Jász-Nagykun-Szolnok [Hungary], Kiss Ádám	N47°22’	E20°46’
			35; 137 km; 8m, 14d		
SKB A78	(1N)	24.05.2014	Michalovce [Slovakia], Mihók Jozef	N48°32’	E21°57’
		31.01.2016	Hajdu-Bihar [Hungary], Tihanyi Gábor	N47°40’	E20°58’
			28; 119 km; 1r, 8m, 8d		
		02.01.2017	Hajdu-Bihar [Hungary], Tar János	N47°40’	E21°07’
			28; 113 km; 2r, 7m, 10d		
SKB SK203	(1N)	25.04.2015	Dunajská Streda [Slovakia], Jozef Chavko	N47°50’	E17°37’
		19.02.2018	Hajdu-Bihar [Hungary], Tihanyi Gábor	N47°37’	E21°01’
			28; 255 km; 2r, 9m, 26d		
SKB SK5	(1N)	29.04.2017	Levice [Slovakia], Ladislav Šnírer	N48°12’	E18°39’
		28.10.2017	Pest [Hungary], Hencz Péter	N47°07’	E19°06’
			28; 126 km; 5m, 29d		
SKB A3401	(2N)	19.05.2012	Rožňava [Slovakia], Mihok Jozef	N48°34’	E20°45’
		26.01.2014	Hajdu-Bihar [Hungary], Tihanyi Gábor	N47°37’	E21°01’
			28; 107 km; 1r, 8m, 8d		

With the growing population of this species in central Europe in the recent period, it is typical to read live individuals, mostly at their foraging sites, which brings up the possibility of taking pictures, mainly in Hungary (Horváth 2009). Ring reading is more likely to occur thanks to the colour-ringing programme which has been implemented lately throughout most of Europe (Beran & Cepák 2010). The individuals read were largely young and juvenile individuals, as it is typical for them to roam over greater distances compared to the breeding individuals (Cepák et al.2008). Young individuals may move more than a hundred kilometres away from their place of hatching, and rather early in life as shown by the individual from Hungary (HGB H0338). Power lines (SKB A3410, Gális et al. 2019, Klvaňa & Cepák 2020) or illegally-laid poisons (SKB SK 410 and HGB H0165, Klvaňa & Cepák 2015, Krone et al. 2017) continue to pose a great danger to this species.

Western marsh harrier (*Circus aeruginosus*)
N = 12 (S 4, M 4, L 4) A 8, Z 4 (Albania 1, Czech Republic 1, Italy 2)

SKB E2796	(1N)	05.07.2012	Prievidza [Slovakia], Vladimír Slobodník	N48°45’	E18°38’
		03.09.2012	Žďár nad Sázavou [Czechia], Absollín Jan	N49°17’	E16°09’
			10; 190 km; 1m, 29d		
SKB D6036	(1N)	07.07.2015	Rožňava [Slovakia], Milan Olekšák	N48°35’	E20°45’
		17.04.2019	Košice - okolie [Slovakia], Radovan Václav	N48°36’	E20°54’
			81; 12 km; 3r, 9m, 10d		
SKB D6544	(1N)	29.06.2017	Košice - okolie [Slovakia], Milan Olekšák	N48°37’	E20°53’
		03.05.2019	Lezha [Albania], Marjo Zaka	N41°48’	E19°38’
			00; 763 km; 1r, 10m, 3d		
SKB D6017	(1N)	27.06.2015	Košice - okolie [Slovakia], Milan Olekšák	N48°37’	E20°53’
		17.05.2019	Rožňava [Slovakia], Milan Olekšák	N48°37’	E20°30’
			81; 28 km; 3r, 10m, 19d		
SKB D6078	(1N)	16.06.2016	Košice - okolie [Slovakia], Milan Olekšák	N48°31’	E21°09’
		11.06.2017	Košice - okolie [Slovakia], Milan Olekšák	N48°31’	E21°09’
			29; -- km; 11m, 25d		
SKB D5698	(1N)	22.06.2015	Košice - okolie [Slovakia], Milan Olekšák	N48°31’	E21°09’
		02.09.2015	Košice - okolie [Slovakia], Milan Olekšák	N48°36’	E20°54’
			58; 21 km; 2m, 11d		
SKB D6042	(1N)	07.07.2015	Košice - okolie [Slovakia], Milan Olekšák	N48°37’	E20°53’
		17.07.2019	Košice - okolie [Slovakia], Radovan Václav	N48°32’	E21°08’
			81; 21 km; 4r, 10d		
SKB D3571	(1N)	01.07.2006	Nitra [Slovakia], Kaňuščák Pavel	N48°22’	E18°00’
		03.02.2014	Sardinia [Italy], Melas Manuel	N39°06’	E8°31’
			01; 1 279 km; 7r, 7m, 4d		
SKB D6524	(1N)	25.06.2017	Košice - okolie [Slovakia], Milan Olekšák	N48°37’	E20°53’
		10.05.2018	Ascoli Piceno and Macerata [Italy], Italy BRC	N42°53’	E13°54’
			28; 835 km; 10m, 14d		

Thanks to the focus on this species in eastern Slovakia, in the study period we recorded valuable data confirming the strong philopatry within it (Cepák et al. 2008). The find of a dead individual from Sardinia (Agostini & Logozzo 2000) supported the theory of species migration across the Mediterranean Sea. Late return to Europe (closer to the place of hatching) was confirmed by the bird coming back from its first migration observed as early as the beginning of May in eastern Italy (Brown & Amadon 1968). There are noteworthy data from Albania suggesting the species migration of our nesting population takes place occasionally even in a south-easterly direction (Brown & Amadon 1968).

Montagu’s harrier (*Circus pygargus*)
N = 1 (S 0, M 1, L 0) A 0, Z 1 (Czech Republic 1)

SKB H15402	(1N)	11.07.2009	Nitra [Slovakia], Kaňuščák Pavel	N48°22’	E18°00’
		06.08.2016	Uherské Hradiště [Czechia], Jaroslav Křižka	N48°58’	E17°38’
			20; 72 km; 7r, 26d		

The information about the relocation of a chick from western Slovakia to a nesting site in the Czech Republic is unique and valuable. We know of similar movements also from the Czech Republic, where individuals coming from a greater distance, i.e. Germany, have been settling (Cepák & Klvaňa 2017).

Northern goshawk (*Accipiter gentilis*)
N = 4 (S 3, M 1, L 0) A 3, C 1 (HGB 1)

HGB 535293	(1N)	27.05.2016	Pest [Hungary], Feldhoffer Attila	N47°38’	E19°05’
		30.08.2018	Nitra [Slovakia], Vladimír Fiala	N48°11’	E18°01’
			01; 99 km; 2r, 3m, 3d		
SKB E3282	(4M)	23.02.2010	Rožňava [Slovakia], Milan Olekšák	N48°37’	E20°29’
		11.02.2015	Rožňava [Slovakia], Milan Olekšák	N48°39’	E20°31’
			44; 5 km; 4r, 11m, 18d		

The occurrence of an adult individual at a distance of almost a hundred kilometres from the place of hatching (central Hungary) is rare (Cepák et al. 2008). The find of an individual from eastern Slovakia confirms that panes of glass represent a significant mortality factor for the species (Loss et al. 2014).

Eurasian sparrowhawk (*Accipiter nisus*)
N = 10 (S 10, M 0, L 0) A 10

SKB K314	(8M)	31.01.2012	Zvolen [Slovakia], Anton Krištín	N48°36’	E19°06’
		23.02.2013	Zvolen [Slovakia], Jozef Blaško	N48°37’	E19°07’
			46; 4 km; 1r, 23d		
SKB K5834	(5M)	12.01.2014	Rožňava [Slovakia], Milan Olekšák	N48°37’	E20°29’
		12.02.2015	Rožňava [Slovakia], Milan Olekšák	N48°37’	E20°29’
			20; -- km; 1r, 1m, 0d		
SKB K4544	(6M)	07.03.2010	Rožňava [Slovakia], Milan Olekšák	N48°37’	E20°29’
		11.02.2012	Rožňava [Slovakia], Olekšák Milan	N48°37’	E20°29’
			20; -- km; 1r, 11m, 5d		

The occurrence of three individuals confirms their fidelity towards their winter territories. One of the individuals was found dead inside a building, which is often a consequence of hunting songbirds in an urbanized environment (Newton et al. 1999).

Common buzzard (*Buteo buteo*)
N = 14 (S 4, M 5, L 5) A 5, Z 1 (Czech Republic 1), C 8 (DER 1, HGB 3, RSB 1, SFH 2, CZP 1)

SFH D270816	(1N)	28.06.2011	South Karelia [Finland], Tapio Solonen	N61°00’	E27°28’
		15.02.2012	Trebišov [Slovakia], Jaroslav Varga	N48°28’	E22°02’
			01; 1 434 km; 7m, 18d		
SFH D275471	(1N)	15.06.2011	Keuruu [Finland], Tarno Myntii	N62°19’	E24°37’
		24.12.2012	Trebišov [Slovakia], Balla Miloš	N48°37’	E21°44’
			20; 1 533 km; 1r, 6m, 10d		
DER JC51031	(2N)	31.12.2009	Niederösterreich [Austria], Karl Pauler	N48°16’	E16°26’
		24.04.2012	Senica [Slovakia], Jureček Rudolf	N48°34’	E17°13’
			40; 66 km; 2r, 3m, 23d		
HGB LY02214	(3F)	27.10.2013	Veszprém [Hungary], Széplaki Imre	N47°01’	E17°37’
		29.08.2014	Dunajská Streda [Slovakia], Pecsuk Péter	N48°00’	E17°28’
			43; 110 km; 10m, 1d		
HGB LY02280	(8F)	17.03.2013	Fejér [Hungary], Bérces János	N47°23’	E18°28’
		22.08.2015	Nové Zámky [Slovakia], Kostrová Adriána	N47°59’	E18°09’
			35; 70 km; 2r, 5m, 5d		
HGB 535231	(1F)	24.05.2014	Pest [Hungary], Feldhoffer Attila	N47°37’	E18°53’
		14.09.2015	Nové Zámky [Slovakia], Mária Jarosíková	N47°46’	E18°37’
			35; 26 km; 1r, 3m, 21d		

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RSB 504856	(2N)	28.02.2000	Vojvodina [Serbia], Kristian Barna	N45°54’	E20°04’
		24.01.2014	Michalovce [Slovakia], Miro Demko	N48°34’	E22°03’
			40; 330 km; 13r, 10m, 26d		
CZP C158317	(3F)	25.11.2018	Uherské Hradiště [Czechia], Jaroslav Křižka	N48°58’	E17°33’
		20.12.2018	Pezinok [Slovakia], Jaroslav Praženka	N48°14’	E17°12’
			28; 85 km; 25d		
SKB D3708	(1N)	29.05.2007	Prievidza [Slovakia], Karol Šotnár	N48°49’	E18°34’
		12.03.2012	Prostějov [Czechia], Ernst martin	N49°21’	E17°11’
			01; 116 km; 4r, 9m, 14d		
SKB D2414	(3F)	12.10.2004	Liptovský Mikuláš [Slovakia], Bohumil Murin	N49°08’	E19°50’
		26.03.2015	Liptovský Mikuláš [Slovakia], Viera Kacerová	N49°06’	E19°48’
			40; 6 km; 10r, 5m, 12d		
SKB D3100	(4F)	27.09.2005	Prievidza [Slovakia], Vladimír Slobodník	N48°43’	E18°23’
		02.04.2013	Prievidza [Slovakia], Ing. Suchomil	N48°43’	E18°23’
			01; -- km; 7r, 6m, 4d		

The occurrence of chicks ringed in Finland confirms migration of the Scandinavian population also to central Europe (Saurola et al. 2013). The find of a dead individual in the Czech Republic at a distance of more than a hundred kilometres is proof of relocation of a minority of chicks to more distant locations (SKB D3708, Cepák et al. 2008). When we consider the circumstances of the finds, risk factors are electricity pylons, power lines and road traffic (Gális et al. 2019, Janss 2000, Škorpíková et al. 2019, Vergara 2010).

Lesser spotted eagle (*Clanga pomarina*)

N = 28 (S 7, M 12, L 9) A 15, Z 9 (Botswana 1, Hungary 5, Lebanon 1, Poland 1, Turkey 1), C 4 (EEM 1, HGB 1, PLG 2)

PLG BA02717	(1N)	13.07.2001	Podkarpackie [Poland], Marian Stój	N49°23’	E21°46’
		12.04.2018	Medzilaborce [Slovakia], Martin Šepeľa	N49°17’	E21°52’
			40; 13 km; 16r, 8m, 29d		
PLG BA03992	(1N)	06.07.2012	Podkarpackie [Poland], Marian Stój	N49°16’	E22°04’
		08.06.2013	Bardejov [Slovakia], Igor Bilák	N49°27’	E21°19’
			81; 57 km; 11m, 2d		
PLG BN4628	(1N)	10.07.2010	Nadleśnictwo Augustów [Poland], G. Maciorowski	N53°45’	E23°04’
		25.04.2019	Lučenec [Slovakia], Marian Mojžiš	N53°45’	E23°04’
			81; -- km; 8r, 9m, 15d		
HGB KS0176	(1N)	20.07.2015	Borsod-Abaúj-Zemplén [Hungary], Béres István	N48°19’	E20°19’
		12.08.2017	Trebišov [Slovakia], Balla Miloš	N48°27’	E22°05’
			81; 131 km; 2r, 23d		
EEM R12398	(1N)	22.07.2011	Sagaste parish [Estonia], Ain Nurmla	N57°55’	E26°19’
		01.06.2012	Michalovce [Slovakia], Hrtan Ervín	N48°31’	E21°52’
			81; 1 086 km; 10m, 10d		
SKB BL1520	(1N)	10.07.2015	Košice - okolie [Slovakia], Miroslav Dravecký	N48°36’	E20°54’
		23.06.2019	Borsod-Abaúj-Zemplén [Hungary], Majercsák B.	N48°13’	E21°23’
			81; 56 km; 3r, 11m, 13d		
SKB BL1293	(1N)	19.07.2013	Tvrdošín [Slovakia], Dušan Karaska	N49°22’	E19°35’
		15.05.2015	Tvrdošín [Slovakia], Suchánek Oldøich	N49°27’	E19°37’
			81; 8 km; 1r, 9m, 25d		
SKB BL1514	(1N)	14.07.2014	Revúca [Slovakia], Miroslav Dravecký	N48°40’	E20°08’
		20.06.2017	Martin [Slovakia], Milan Zihlavnik	N48°58’	E18°46’
			81; 106 km; 2r, 11m, 6d		
SKB BL157	(1N)	30.06.2004	Rožňava [Slovakia], Miroslav Dravecký	N48°35’	E20°40’
		15.05.2012	Rožňava [Slovakia], Štefan Emódi	N48°36’	E20°45’
			02; 6 km; 7r, 10m, 14d		
SKB BL1735	(1N)	16.07.2015	Michalovce [Slovakia], Štefan Danko	N48°51’	E21°52’
		26.07.2018	Trebišov [Slovakia], Hrtan ml. Ervín	N48°37’	E21°44’
			81; 28 km; 3r, 10d		

SKB BL381	(1M)	10.07.2005	Prievidza [Slovakia], Karol Šotnár	N48°55’	E18°34’
		12.07.2016	Prievidza [Slovakia], Šotnár Karol	N48°49’	E18°34’
			28; 11 km; 11r, 2d		
SKB BL383	(1M)	10.07.2005	Prievidza [Slovakia], Karol Šotnár	N48°45’	E18°33’
		10.07.2017	Martin [Slovakia], Kicko Ján	N49°01’	E18°47’
			81; 34 km; 12r, 0d		
SKB BL388	(1M)	18.07.2005	Prievidza [Slovakia], Karol Šotnár	N48°41’	E18°36’
		22.04.2016	Partizánske [Slovakia], Harvančík Stanislav	N48°36’	E18°21’
			81; 21 km; 10r, 9m, 4d		
		04.04.2017	Partizánske [Slovakia], Rastislav Petrovič	N48°38’	E18°21’
			28; 20 km; 11r, 8m, 16d		
SKB BL1120	(1N)	09.07.2011	Rožňava [Slovakia], Miroslav Dravecký	N48°47’	E20°25’
		24.05.2016	Rožňava [Slovakia], Milan Olekšák	N48°37’	E20°29’
			29; 19 km; 4r, 10m, 15d		
SKB BL834	(1N)	03.07.2009	Rožňava [Slovakia], Miroslav Dravecký	N48°35’	E20°40’
		21.05.2016	Košice - okolie [Slovakia], Milan Olekšák	N48°35’	E20°48’
			29; 10 km; 6r, 10m, 18d		
SKB BL834	(1N)	03.07.2009	Rožňava [Slovakia], Miroslav Dravecký	N48°35’	E20°40’
		04.06.2016	Košice - okolie [Slovakia], Milan Olekšák	N48°35’	E20°48’
			29; 10 km; 6r, 11m, 1d		
SKB BL1676	(1N)	14.07.2017	Medzilaborce [Slovakia], Boris Maderič	N49°20’	E21°52’
		24.07.2019	Sobrance [Slovakia], Štefan Danko	N48°44’	E22°13’
			81; 72 km; 2r, 9d		
SKB BL1109	(1N)	12.07.2012	Dolný Kubín [Slovakia], Dušan Karaska	N49°15’	E19°30’
		17.01.2015	Savute, Chobe NP [Botswana], Blair Gavin	S18°46’	E24°25’
			28; 7 582 km; 2r, 6m, 5d		
SKB BL1115	(1N)	13.07.2013	Námestovo [Slovakia], Dušan Karaska	N49°25’	E19°25’
		03.11.2015	Azqej [Lebanon], Ireneusz Kaluga	N34°25’	E35°58’
			10; 2 148 km; 2r, 3m, 21d		
SKB BL1179	(1N)	03.07.2012	Liptovský Mikuláš [Slovakia], Ján Kicko	N49°03’	E19°36’
		27.10.2013	Györ-Mosin-Sopron [Hungary], Miklós Váczi	N47°37’	E16°49’
			35; 260 km; 1r, 3m, 24d		
SKB BL1207	(1N)	09.07.2011	Prešov [Slovakia], Pavol Kaňuch	N49°02’	E21°22’
		25.06.2014	Borsod-Abaúj-Zemplén [Hungary], Papp Gábor	N48°17’	E21°34’
			28; 84 km; 2r, 11m, 16d		
SKB BL1270	(1N)	29.06.2014	Stropkov [Slovakia], Boris Maderič	N49°11’	E21°39’
		07.06.2015	Szabolcs-Szatmár-Bereg [Hungary], Balazs Istvan	N48°07’	E21°26’
			81; 119 km; 11m, 8d		
SKB BL1520	(1N)	10.07.2015	Košice - okolie [Slovakia], Miroslav Dravecký	N48°36’	E20°54’
		09.07.2017	Borsod-Abaúj-Zemplén [Hungary], Papp Gábor	N48°13’	E21°23’
			81; 56 km; 1r, 11m, 29d		
SKB BL166	(1M)	23.07.2014	Prievidza [Slovakia], Vladimír Slobodník	N48°46’	E18°41’
		01.01.2015	Konya [Turkey], Ilker Özbahar	N37°52’	E32°28’
			10; 1 643 km; 5m, 9d		
SKB BL1713	(1N)	05.07.2016	Martin [Slovakia], Ján Kicko (5038)	N48°59’	E18°58’
		15.06.2019	Lubelskie [Poland], Wojciech Miczajka	N50°19’	E23°01’
			81; 327 km; 2r, 11m, 9d		

There is proof of this species’ longevity in the chick from Poland recovered in eastern Slovakia (PLG BA02717), or the individuals from Horná Nitra (SKB BL381, SKB BL383 and SKB BL388). Lesser spotted eagles may live even longer in the wild; the record is 26 years (Kasparson 1966). The individuals ringed in our territory confirm the quite strong philopatry of the species (Cepák et al. 2008, Danko et al. 2008). The shootings in Turkey and Lebanon (SKB BL166 and SKB BL1115) and their wintering in sub-Saharan Africa (SKB BL1109, Meyburg et al. 2000, Meyburg & Meyburg 2008) document the well-known path through the Middle East. From the viewpoint of the circumstances of the recoveries, ring readings predominate thanks to the already-mentioned colour-ringing programme (Dravecký et al. 2008, Dravecký et al. 2013).

Eastern imperial eagle (*Aquila heliaca*)
N = 62 (S 8, M 32, L 22) A 13, Z 19 (Austria 3, Czech Republic 3, Hungary 9, Italy 1, Romania 1, Slovakia 1, Spain 1), C 30 (DER 1, HGB 29)

HGB A395	(1N)	04.07.2013	Heves [Hungary], Horváth Márton	N47°53’	E19°53’
		22.03.2018	Nitra [Slovakia], Stanislav Kováč	N48°12’	E18°08’
			37; 135 km; 4r, 8m, 17d		
HGB A495	(1N)	18.06.2014	Békés [Hungary], Fatér Imre	N46°40’	E20°40’
		28.10.2015	Trebišov [Slovakia], Ervin Hrtan	N48°37’	E21°43’
			28; 229 km; 1r, 4m, 10d		
HGB A505	(1N)	17.06.2014	Heves [Hungary], Horváth Márton	N47°46’	E20°07’
		14.01.2018	Partizánske [Slovakia], Stanislav Harvančík	N48°38’	E18°13’
			38; 172 km; 3r, 6m, 28d		
HGB AAA1774	(1N)	20.06.2016	Békés [Hungary], Fatér Imre	N47°00’	E20°52’
		01.04.2017	Martin [Slovakia], Miroslav Švábik	N48°55’	E18°59’
			81; 256 km; 9m, 11d		
HGB AAA1801	(1N)	08.06.2016	Heves [Hungary], Horváth Márton	N47°37’	E20°07’
		12.02.2017	Malacky [Slovakia], Václav Radovan	N48°17’	E16°56’
			81; 249 km; 8m, 5d		
HGB AAA1865	(1N)	16.06.2016	Borsod-Abaúj-Zemplén [Hungary], Horváth Márton	N48°04’	E20°55’
		22.07.2018	Trnava [Slovakia], Chavko Jozef	N48°24’	E17°41’
			81; 242 km; 2r, 1m, 5d		
HGB AAA2294	(1N)	14.06.2018	Heves [Hungary], Horváth Márton	N47°40’	E20°23’
		06.10.2018	Trebišov [Slovakia], Mihók Jozef	N48°37’	E21°44’
			81; 146 km; 3m, 22d		
HGB AAA2320	(1N)	21.06.2018	Csongrád [Hungary], Horváth Márton	N46°19’	E20°25’
		18.10.2018	Trebišov [Slovakia], Balla Miloš	N48°33’	E21°40’
			81; 266 km; 3m, 27d		
HGB A219	(1N)	14.06.2012	Heves [Hungary], Horváth Márton	N47°46’	E19°41’
		19.05.2019	Hlohovec [Slovakia], Chavko Jozef	N48°24’	E17°43’
			74; 161 km; 6r, 11m, 3d		
DER RL1213	(1N)	05.07.2016	Burgenland [Austria], Matthias Schmidt	N47°43’	E16°56’
		25.03.2019	Senica [Slovakia], Jozef Chavko	N48°34’	E16°59’
			85; 95 km; 2r, 8m, 19d		
SKB A2820	(1N)	30.06.2012	Michalovce [Slovakia], Štefan Danko	N48°42’	E21°46’
		14.08.2013	Břeclav [Czechia], Mráz Jakub	N48°51’	E16°28’
			01; 387 km; 1r, 1m, 14d		
SKB SK190	(1N)	15.06.2016	Michalovce [Slovakia], Štefan Danko	N48°45’	E21°59’
		08.02.2019	Fejér [Hungary], Klébert Antal	N47°16’	E18°49’
			43; 287 km; 2r, 7m, 24d		
SKB SK200	(3M)	05.07.2017	Michalovce [Slovakia], Štefan Danko	N48°40’	E21°48’
		19.04.2019	Arad [Romania], Zsolt Hegyeli	N46°24’	E21°18’
			38; 255 km; 1r, 9m, 13d		
SKB A836	(1N)	01.07.2005	Trebišov [Slovakia], Štefan Danko	N48°37’	E21°44’
		17.03.2013	Piešťany [Slovakia], Kubica Erich	N48°31’	E17°48’
			38; 290 km; 7r, 8m, 15d		
SKB SK10	(1N)	23.06.2014	Levice [Slovakia], Ladislav Šnírer	N48°12’	E18°39’
		10.04.2017	Nové Mesto nad Váhom [Slovakia], Czech BRC	N49°01’	E17°38’
			01; 116 km; 2r, 9m, 17d		
SKB A1589	(1N)	08.06.2012	Topoľčany [Slovakia], Jozef Chavko	N48°27’	E18°09’
		20.05.2013	Niederösterreich [Austria], Josef Geier	N48°32’	E16°46’
			38; 102 km; 11m, 11d		
SKB SK145	(1N)	27.06.2014	Nové Mesto nad Váhom [Slovakia], Jozef Chavko	N48°38’	E17°57’
		18.10.2014	Huesca [Spain], José Antonio Sesé	N42°34’	W0°31’
			81; 1 584 km; 3m, 21d		
SKB SK183	(1N)	28.06.2014	Sobrance [Slovakia], Štefan Danko	N48°41’	E22°06’
		12.01.2015	Békés [Hungary], Gábor Balogh	N46°23’	E20°40’
			00; 276 km; 6m, 15d		

SKB SK217	(1N)	23.06.2016	Piešťany [Slovakia], Jozef Chavko	N48°34'	E17°44'
		02.01.2017	Bács-Kiskun [Hungary], Fabó Ferenc	N46°46'	E19°07'
			28; 227 km; 6m, 10d		
SKB SK402	(1N)	19.06.2015	Topoľčany [Slovakia], Jozef Chavko	N48°31'	E18°13'
		29.11.2015	Tolna [Hungary], Orosz Zoltán	N46°45'	E19°06'
			28; 207 km; 5m, 10d		
SKB SK403	(1N)	19.06.2015	Topoľčany [Slovakia], Jozef Chavko	N48°27'	E18°09'
		20.12.2015	Bács-Kiskun [Hungary], Molnár Péter	N46°46'	E19°07'
			28; 202 km; 6m, 1d		
SKB SK505	(1M)	20.06.2016	Topoľčany [Slovakia], Ladislav Šnírer	N48°31'	E18°13'
		20.10.2016	Niederösterreich [Austria], Richard Katzinger	N48°37'	E16°52'
			28; 101 km; 4m, 0d		
SKB SK534	(1N)	30.06.2016	Malacky [Slovakia], Jozef Chavko	N48°16'	E17°01'
		20.09.2016	Sicilia (including islands to W & N) [Italy], Italy BRC	N37°57'	E13°25'
			43; 1 185 km; 2m, 21d		
SKB SK001	(1N)	05.06.2000	Košice - okolie [Slovakia], Mihók Jozef	N48°36'	E20°54'
		24.08.2019	Heves [Hungary], Kovács András	N47°33'	E20°19'
			28; 120 km; 19r, 2m, 18d		
SKB A1606	(1N)	28.06.2013	Topoľčany [Slovakia], Jozef Chavko	N48°33'	E17°59'
		18.12.2019	Hodonín [Czechia], Martin Tomešek	N48°53'	E17°30'
			10; 51 km; 6r, 5m, 20d		

When we consider longevity, the data from the ring reading of almost 20-year-old eagles (SKB SK01), belonging among the oldest in this region, are unique (Klvaňa & Cepák 2020). Power lines (SKB SK 534), illegal poisoning (e.g. HGB A395, HGB A505) or shooting (SKB 1606) continue to represent limiting factors for this species. All these factors are considered high-risk in the whole species area (European Commission 2018, Heredia 1996, Horváth et al. 2006). The recoveries of breeding individuals in the territory of Slovakia coming from abroad (DER RL1213, Meyburg 2016) are also interesting, which we were able to find by means of satellite telemetry. Thanks to the targeted work of birdwatchers in eastern Slovakia, ring readings predominate in the recovery circumstances in comparison with the past, when the movements of eastern imperial eagles were documented mostly through findings of injured or dead individuals (Cepák et al. 2008). We may consider the reading of a juvenile by means of a phototrap at a foraging site in Spain unique (SKB SK145), since it is the first observation of a live eastern imperial eagle in the Iberian Peninsula. In the past, this species was frequently recorded when found dead wearing a ring (Slobodník & Slobodník 2011).

Golden eagle (*Aquila chrysaetos*)

N = 13 (S 0, M 8, L 5) A 8, Z 3 (Czech Republic 2, Hungary 1), C 2 (PLG 2)

PLG AX2513	(1M)	19.06.2012	Malopołskie [Poland], Marian Stój	N49°23'	E20°13'
		09.03.2018	Čadca [Slovakia], Robert Kruzsyk, Jan Kornan	N49°26'	E18°47'
			28; 104 km; 5r, 8m, 19d		
PLG AX2694	(1N)	28.05.2014	Podkarpackie [Poland], Marian Stój	N49°32'	E21°40'
		23.10.2015	Michalovce [Slovakia], Harčár Matúš	N48°46'	E21°53'
			35; 87 km; 1r, 4m, 26d		
SKB SK43	(1F)	10.06.2016	Bytča [Slovakia], Ján Korňan	N49°13'	E18°33'
		15.03.2017	Baranya [Hungary], Hidegh Tamás	N46°15'	E18°00'
			01; 333 km; 9m, 4d		
SKB A1503	(1M)	19.06.2012	Žilina [Slovakia], Ján Korňan	N49°13'	E18°45'
		05.05.2016	Uherské Hradiště [Czechia], Horal David	N49°06'	E17°37'
			01; 84 km; 3r, 10m, 15d		
SKB A1495	(1M)	16.06.2011	Žilina [Slovakia], Ján Korňan	N49°13'	E18°45'
		01.12.2015	Hodonín [Czechia], M. Hráček	N48°52'	E17°16'
			35; 113 km; 4r, 5m, 15d		
SKB SK68	(1F)	28.06.2014	Stará Ľubovňa [Slovakia], Ladislav Šimák	N49°13'	E20°44'
		12.01.2019	Púchov [Slovakia], Marián Jamrich	N49°06'	E18°19'
			28; 177 km; 4r, 6m, 15d		

SKB SK14	(1F)	14.06.2014	Žilina [Slovakia], Ján Korňan	N49°13’	E18°45’
		20.02.2019	Martin [Slovakia], Juraj Žiak	N49°04’	E19°03’
			28; 28 km; 4r, 8m, 7d		
SKB SK160	(1N)	24.06.2016	Ružomberok [Slovakia], Metod Macek	N49°08’	E19°22’
		02.04.2019	Púchov [Slovakia], Ľubo Ondráško	N49°03’	E18°20’
			81; 76 km; 2r, 9m, 7d		
SKB A1416	(1M)	26.06.2011	Považská Bystrica [Slovakia], Ladislav Šnírer	N49°07’	E18°27’
		15.09.2013	Trenčín [Slovakia], Tomáš Praženec	N48°49’	E18°07’
			01; 41 km; 2r, 2m, 20d		
SKB A1461	(1N)	30.07.2012	Sabinov [Slovakia], Ladislav Šimák	N49°06’	E21°05’
		09.08.2013	Prievidza [Slovakia], Juraj Schweigert	N48°55’	E18°40’
			01; 178 km; 1r, 9d		
SKB A1490	(1F)	16.06.2011	Žilina [Slovakia], Ján Korňan	N49°13’	E18°45’
		03.01.2017	Zvolen [Slovakia], CHKO Poľana	N48°34’	E19°04’
			01; 76 km; 5r, 6m, 19d		
SKB A3212	(1N)	21.06.2012	Levoča [Slovakia], Miroslav Dravecký	N49°01’	E20°35’
		15.10.2015	Sabinov [Slovakia], p. Varga	N49°07’	E21°10’
			01; 45 km; 3r, 3m, 23d		
SKB SK2	(1M)	26.06.2015	Bánovce nad Bebravou [Slovakia], Ladislav Šnírer	N48°45’	E18°24’
		13.02.2018	Púchov [Slovakia], Ľubo Ondráško	N49°02’	E18°20’
			28; 32 km; 2r, 7m, 19d		

As far as recovery circumstances are concerned, several eagles were identified by means of ring reading at their foraging sites (e.g. SKB SK14). There is an assumption that many individuals found dead with no details (code 01) died due to so-called bird criminality (shooting, poisioning). This factor and the one related to power lines (PLG AX2694, SKB SK43) belong among the most serious negative factors considered for the species (Kropil 2002). The recovery of a chick in southern Hungary documents the roaming way of life of young individuals, which is typical not only for our birds but also for the northern populations of the species (PLG AX2694, Cepák et al. 2008, Haraszthy & Schmidt 1986).

Common kestrel (*Falco tinnunculus*)
N = 43 (S 18, M 13, L 12) A 28, Z 6 (Austria 1, Czech Republic 4, Hungary 1), C 9 (CZP 1, HGB 3, SFH 5)

SFH S411722	(1N)	13.06.2019	Häme [Finland], Tapani Vähämäki	N60°50’	E23°13’
		23.10.2019	Michalovce [Slovakia], Miloš Balla	N48°31’	E22°08’
			43; 1 370 km; 4m, 10d		
SFH S338409	(1N)	10.06.2011	Turku-Pori [Finland], Jari Valkama	N62°01’	E22°22’
		18.05.2019	Poltár [Slovakia], Oleksandr Sas	N48°24’	E19°53’
			02; 1 522 km; 7r, 11m, 7d		
SFH S233618	(1N)	15.07.2004	Kuopio [Finland], Hannu Lehtoranta	N63°22’	E29°07’
		14.04.2016	Ružomberok [Slovakia], Metod Macek	N49°01’	E19°16’
			40; 1 703 km; 11r, 8m, 29d		
SFH S324111	(1N)	20.06.2010	Kymi [Finland], Matti Jousinen	N61°08’	E28°37’
		30.08.2012	Lučenec [Slovakia], Igor Ostrihoň	N48°23’	E19°36’
			01; 1 528 km; 2r, 2m, 10d		
SFH S343475	(1N)	18.06.2013	Kymi [Finland], Matti Jousinen	N61°12’	E28°52’
		08.09.2013	Košice - okolie [Slovakia], Krišovský Peter	N48°36’	E20°54’
			20; 1 486 km; 2m, 21d		
HGB HA16270	(1N)	22.06.2013	Veszprém [Hungary], Barta Zoltán	N47°13’	E17°55’
		21.02.2015	Trebišov [Slovakia], Hapl Ervín	N48°25’	E22°04’
			35; 338 km; 1r, 8m, 0d		
HGB HA9700	(3N)	01.07.2012	Jász-Nagykun-Szolnok [Hungary], Morandini Pál	N47°34’	E20°56’
		26.07.2012	Košice - okolie [Slovakia], Fulín Miroslav	N48°34’	E21°15’
			11; 114 km; 25d		
HGB HA30775	(1N)	02.06.2017	Bács-Kiskun [Hungary], Nyúl Mihály	N46°40’	E19°30’
		25.12.2018	Kežmarok [Slovakia], Juraj Ksiazek	N49°04’	E20°26’
			40; 275 km; 1r, 6m, 23d		

CZP ES53184	(1N)	11.06.2019	Břeclav [Czechia], Vladislav Hájek	N48°45'	E16°58'
		16.07.2019	Bratislava I [Slovakia], Ján Dragúň	N48°09'	E17°06'
			41; 66 km; 1m, 4d		
SKB H21657	(1N)	06.06.2016	Prievidza [Slovakia], Vladimír Slobodník	N48°43'	E18°37'
		18.09.2016	Vyškov [Czechia], Jiří Bartl	N49°10'	E16°55'
			20; 134 km; 3m, 12d		
SKB H23610	(1N)	10.07.2017	Nové Zámky [Slovakia], Roman Slobodnik	N48°05'	E18°02'
		13.09.2017	Opava [Czechia], František Gazda	N49°46'	E17°42'
			20; 189 km; 2m, 4d		
SKB H20732	(1N)	05.06.2014	Prievidza [Slovakia], Vladimír Slobodník	N48°42'	E18°32'
		15.08.2016	Ilava [Slovakia], Jozef Baránek	N48°57'	E18°10'
			81; 37 km; 2r, 2m, 10d		
SKB H20742	(1N)	05.06.2014	Prievidza [Slovakia], Vladimír Slobodník	N48°44'	E18°35'
		14.05.2017	Levice [Slovakia], Eva Števková	N48°12'	E18°39'
			81; 59 km; 2r, 11m, 8d		
SKB H20772	(1N)	16.06.2014	Dunajská Streda [Slovakia], Vladimír Slobodník	N48°03'	E17°27'
		15.12.2014	Levice [Slovakia], Kršák Gustáv	N48°02'	E18°38'
			35; 89 km; 5m, 29d		
SKB H21055	(1N)	11.06.2015	Prievidza [Slovakia], Vladimír Slobodník	N48°42'	E18°44'
		22.05.2017	Prievidza [Slovakia], Roman Slobodník	N48°42'	E18°44'
			28; -- km; 1r, 11m, 10d		
		06.05.2018	Prievidza [Slovakia], Andrea Mlynarčíková	N48°42'	E18°44'
			28; -- km; 2r, 10m, 25d		
SKB H21466	(1N)	02.06.2015	Nové Zámky [Slovakia], Roman Slobodnik	N48°05'	E18°02'
		03.07.2017	Nové Zámky [Slovakia], Lengyel Jozef	N48°05'	E18°02'
			81; -- km; 2r, 1m, 1d		
SKB H21698	(1N)	20.06.2016	Prievidza [Slovakia], Vladimír Slobodník	N48°51'	E18°40'
		01.06.2018	Martin [Slovakia], Miroslav Švabik	N49°00'	E18°58'
			02; 28 km; 1r, 11m, 10d		
SKB H18038	(1N)	04.06.2014	Dunajská Streda [Slovakia], Roman Slobodnik	N48°03'	E17°27'
		12.06.2018	Dunajská Streda [Slovakia], Roman Slobodník	N48°03'	E17°27'
			20; -- km; 4r, 8d		
SKB H21058	(1N)	11.06.2015	Prievidza [Slovakia], Vladimír Slobodník	N48°46'	E18°44'
		29.09.2017	Prievidza [Slovakia], Vladimir Slobodnik	N48°38'	E18°32'
			35; 20 km; 2r, 3m, 19d		
SKB H21231	(1N)	23.06.2015	Sabinov [Slovakia], Miroslav Fulín	N49°06'	E21°05'
		01.10.2018	Sabinov [Slovakia], Miroslav Fulín	N49°11'	E20°54'
			20; 16 km; 3r, 3m, 8d		
SKB H26329	(1N)	11.06.2019	Bratislava V [Slovakia], Roman Slobodnik	N48°01'	E17°08'
		05.08.2019	Niederösterreich [Austria], Dr. Franz Ziegler	N48°45'	E15°11'
			00; 166 km; 1m, 24d		
SKB H23794	(1N)	17.06.2018	Prievidza [Slovakia], Vladimír Slobodník	N48°47'	E18°34'
		10.01.2019	Turčianske Teplice [Slovakia], Radovan Reťkovský	N48°47'	E18°50'
			00; 19 km; 6m, 24d		
SKB H26107	(1N)	07.06.2019	Prievidza [Slovakia], Vladimír Slobodník	N48°53'	E18°36'
		26.08.2019	Uherské Hradiště [Czechia], Jaroslav Křižka	N48°59'	E17°37'
			20; 72 km; 2m, 19d		
SKB H23624	(1N)	10.07.2017	Dunajská Streda [Slovakia], Roman Slobodnik	N48°03'	E17°27'
		15.06.2019	Trnava [Slovakia], Roman Slobodnik	N48°21'	E17°42'
			27; 38 km; 1r, 11m, 4d		
SKB H26143	(1N)	16.06.2019	Prievidza [Slovakia], Vladimír Slobodník	N48°44'	E18°37'
		26.09.2019	Uherské Hradiště [Czechia], Jaroslav Křižka	N48°57'	E17°38'
			20; 76 km; 3m, 10d		
SKB H21583	(1N)	06.07.2015	Komárno [Slovakia], Roman Slobodnik	N47°50'	E17°52'
		25.01.2018	Pest [Hungary], László Galambos	N47°16'	E19°15'
			01; 121 km; 2r, 6m, 20d		

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The increased ringing activity in central and western Slovakia confirmed the complex migration manners of this species (Adriaensen et al. 1997, Holte et al. 2016). Some of the chicks leave their nest localities rather early (e.g. CZP ES53184 or SKB H26329), while a minority of them migrates in westerly or north-westerly direction (recoveries in the Czech Republic) and some individuals migrate to the south (the recovery in Hungary). At the same time, the birds from Hungary may come to our territory during their post-breeding dispersal (HGB HA9700). The chicks of the Scandinavian population are almost entirely migratory, the proof of which are five individuals from Finland (Saurola et al. 2013). The high number of ringed individuals also presents us with a varied mosaic of circumstances. Ring reading confirms their high fidelity (SKB G 25901) or philopatry (e.g. SKB H21055, SKB H21466), which is typical not only for this species (Cepák et al. 2008, Riegert & Fuchs 2011) but also for the whole Falco order (Steenhof & Peterson 2009). Finds of ringed individuals after collisions with vehicles (cars, train, planes), illegal shooting or collisions with power lines confirm their negative impact on the population (Cepák et al. 2008, Gális et al. 2019, Škorpíková et al. 2019). The find of a ring from a common kestrel in the nest of a Eurasian eagle-owl in central Europe (SKB H21698) is interesting, as the species can be found regularly in the diet of the eagle-owl, though not in high numbers (Obuch & Karaska 2010, Sándor & Ionescu 2009).

Red-footed falcon (*Falco vespertinus*)
N = 51 (S 31, M 2, L 18) A 31, Z 5 (Austria 1, Czech Republic 3, France 1), C 15 (HGB 15)

HGB 363371	(1N)	12.07.2016	Györ-Mosin-Sopron [Hungary], Miklós Váczi	N47°37’	E16°49’
		30.04.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 54 km; 1r, 9m, 17d		
HGB HA17579	(1N)	07.07.2017	Hajdu-Bihar [Hungary], Tóth Pál János	N47°16’	E21°25’
		03.06.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 331 km; 10m, 26d		
HGB HA18147	(1N)	02.07.2014	Csongrád [Hungary], Solt Szabolcs	N46°38’	E20°15’
		04.08.2015	Košice - okolie [Slovakia], Mihók Jozef	N48°37’	E21°15’
			81; 232 km; 1r, 1m, 2d		
HGB HA18222	(1N)	05.07.2014	Csongrád [Hungary], Solt Szabolcs	N46°25’	E20°19’
		27.06.2017	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 301 km; 2r, 11m, 22d		
		25.04.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 301 km; 3r, 9m, 20d		
HGB HA18343	(1N)	10.07.2014	Csongrád [Hungary], Solt Szabolcs	N46°25’	E20°19’
		04.08.2015	Košice - okolie [Slovakia], Mihók Jozef	N48°37’	E21°15’
			81; 255 km; 1r, 24d		
HGB HA23287	(1N)	20.07.2017	Jász-Nagykun-Szolnok [Hungary], Palatitz Péter	N47°22’	E20°00’
		05.09.2017	Zvolen [Slovakia], Stanislav Ondruš	N48°37’	E19°07’
			42; 154 km; 1m, 16d		
HGB HA26742	(3N)	18.07.2016	Bács-Kiskun [Hungary], Sápi Tamás	N46°46’	E19°13’
		18.08.2016	Brezno [Slovakia], Stanislav Ondrus	N48°51’	E19°53’
			01; 237 km; 1m, 0d		
HGB HA27211	(1N)	13.07.2017	Csongrád [Hungary], Solt Szabolcs	N46°25’	E20°19’
		04.06.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 301 km; 10m, 21d		
HGB HA30968	(1N)	09.07.2017	Borsod-Abaúj-Zemplén [Hungary], N. Seres Mihály	N47°46’	E20°53’
		04.06.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 281 km; 10m, 25d		
HGB HA8381	(1N)	10.07.2012	Borsod-Abaúj-Zemplén [Hungary], N. Seres Mihály	N47°49’	E20°53’
		10.09.2012	Trebišov [Slovakia], Hrtan Ervín	N48°37’	E21°40’
			81; 107 km; 2m, 1d		
HGB HA17579	(1N)	07.07.2017	Hajdu-Bihar [Hungary], Tóth Pál János	N47°16’	E21°25’
		01.06.2019	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; 332 km; 1r, 10m, 24d		

HGB HA34645	(1N)	12.07.2019	Csongrád [Hungary], Domján András	N46°33’	E20°03’
		21.08.2019	Bratislava V [Slovakia], Jozef Chavko	N48°00’	E17°09’
			81; 272 km; 1m, 9d		
HGB HA26694	(1N)	10.07.2017	Bács-Kiskun [Hungary], Sápi Tamás	N46°46’	E19°13’
		28.08.2019	Bratislava V [Slovakia], Jozef Chavko	N48°01’	E17°08’
			81; 209 km; 2r, 1m, 18d		
		29.08.2019	Bratislava V [Slovakia], Chavko Jozef	N48°02’	E17°08’
			81; 211 km; 2r, 1m, 19d		
SKB K6501	(1N)	08.07.2016	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		15.07.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 2r, 6d		
SKB K6503	(1N)	08.07.2016	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		28.06.2017	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 11m, 20d		
		29.04.2018	Bratislava V [Slovakia], Chavko Jozef	N48°02’	E17°07’
			28; -- km; 1r, 9m, 20d		
		28.08.2019	Bratislava V [Slovakia], Jozef Chavko	N48°01’	E17°08’
			81; -- km; 3r, 1m, 19d		
SKB K6504	(1N)	19.07.2016	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		02.06.2017	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 10m, 13d		
SKB K6508	(1N)	19.07.2016	Bratislava V [Slovakia], Roman Slobodnik	N48°08’	E17°07’
		29.04.2018	Bratislava V [Slovakia], Chavko Jozef	N48°02’	E17°07’
			81; -- km; 1r, 9m, 9d		
SKB K6511	(1N)	19.07.2016	Bratislava V [Slovakia], Roman Slobodnik	N48°08’	E17°07’
		02.06.2017	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 10m, 13d		
SKB K6512	(1N)	03.08.2016	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		27.06.2017	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 10m, 23d		
SKB K6533	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		03.07.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 11m, 21d		
SKB K6535	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		05.06.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			28; -- km; 10m, 23d		
		30.07.2018	Bratislava V [Slovakia], Karol Csáky	N48°08’	E17°07’
			42; 10 km; 1r, 17d		
SKB K6540	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		03.05.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			28; -- km; 9m, 21d		
SKB K6544	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		08.06.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 10m, 26d		
SKB K6545	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		15.07.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 1r, 2d		
		02.07.2019	Bratislava V [Slovakia], Jozef Chavko	N48°01’	E17°06’
			81; 4 km; 1r, 11m, 19d		
SKB K6546	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		02.07.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 11m, 20d		
SKB K6552	(1N)	19.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		30.05.2018	Bratislava V [Slovakia], Jozef Chavko	N48°03’	E17°08’
			81; -- km; 10m, 10d		
		28.08.2019	Bratislava V [Slovakia], Jozef Chavko	N48°01’	E17°08’
			81; 4 km; 2r, 1m, 9d		

SKB K6181	(1N)	04.07.2018	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		02.07.2019	Bratislava V [Slovakia], Jozef Chavko	N48°01’	E17°06’
			81; 4 km; 11m, 28d		
SKB K6191	(1N)	10.07.2018	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		05.07.2019	Bratislava V [Slovakia], Jozef Chavko	N48°01’	E17°05’
			81; 4 km; 11m, 25d		
SKB K6180	(1N)	04.07.2018	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		11.08.2019	Uherské Hradiště [Czechia], Jaroslav Křižka N48°58’	E17°36’	
			20; 108 km; 1r, 1m, 7d		
SKB K7618	(1N)	02.07.2019	Bratislava V [Slovakia], Roman Slobodnik	N48°01’	E17°07’
		10.08.2019	Vyškov [Czechia], Robert Doležal	N49°15’	E17°01’
			20; 137 km; 1m, 8d		
SKB K7622	(1N)	02.07.2019	Bratislava V [Slovakia], Roman Slobodnik	N48°01’	E17°07’
		24.09.2019	Olomouc [Czechia], Ondřej Boháč	N49°36’	E17°10’
			81; 176 km; 2m, 23d		
SKB K6547	(1N)	12.07.2017	Bratislava V [Slovakia], Roman Slobodnik	N48°03’	E17°08’
		15.09.2017	Creuse [France], Guillaume Paulus	N43°32’	E4°52’
			28; 1 073 km; 2m, 4d		
SKB K7617	(1N)	02.07.2019	Bratislava V [Slovakia], Roman Slobodnik	N48°01’	E17°07’
		27.08.2019	Niederösterreich [Austria], Rainer Praschak	N48°35’	E16°53’
			81; 66 km; 1m, 25d		

Recoveries of red-footed falcons were rather unusual in the past (Cepák et al. 2008, Slobodník & Slobodník 2011). The individuals ringed in Hungary and then re-sighted in our territory are proof not only of the nesting of chicks from abroad in our territory (HGB HA18222 more than three hundred kilometres from their place of hatching), but also the post-breeding dispersal of juveniles in our territory (e.g. HGB HA23287). The post-breeding dispersal of our individuals was recorded in the Czech Republic (SKB K7622) and Austria (SKB K7617), and the most distant was the recovery of an individual photographed in France (SKB K6547), more than a thousand kilometres from its hatching place). These movements are typical for this species; they fly from their nests in the Carpathian Basin to northern or western Europe (Palatitz et al. 2009). A total of 20 readings of 15 individuals confirms the species' philopatry to the last known nesting colony (Slobodník et al. 2017). A minority of these individuals has been returning repeatedly (e.g. SKB K6503, a chick from 2017 which came back in the years from 2017 to 2019). Individuals from other places in Slovakia were recorded in eastern and central Slovakia, in which cases some of the places belonged among the traditional stops during spring or autumun migrations (Noga et al. 2017). Apart from ring reading, collisions with aircraft were recorded as a recovery circumstance (SKB K653, HGB HA23287). These are very common for this species as it hunts for its prey in areas with low vegetation (Fehérvári et al. 2009).

Eurasian hobby (*Falco subbuteo*)
N = 1 (S 1, M 0, L 0) A 1

SKB K4601	(4N)	24.08.2013	Košice - okolie [Slovakia], Miroslav Fulín	N48°31’	E21°09’
		03.09.2016	Košice - okolie [Slovakia], Milan Olekšák	N48°31’	E21°09’
			20; -- km; 3r, 10d		

Saker falcon (*Falco cherrug*)
N = 24 (S 2, M 14, L 7) A 9, Z 10 (Austria 4, Germany 2, Hungary 3, Italy 1), C 5 (AUW 2, HGB 3)

AUW G000327	(1N)	16.05.2018	Niederösterreich [Austria], Zink Richard	N48°01’	E16°45’
		26.02.2019	Trnava [Slovakia], Jozef Chavko	N48°29’	E17°40’
			35; 86 km; 9m, 12d		
		25.07.2018	Trnava [Slovakia], Jozef Chavko	N48°18’	E17°37’
			35; 72 km; 2m, 9d		
HGB LY03758	(1F)	03.06.2016	Heves [Hungary], Szitta Tamás	N47°47’	E20°20’
		28.03.2019	Trebišov [Slovakia], Ladislav Molnár, Ján Lipták	N48°36’	E21°38’
			38; 131 km; 2r, 9m, 23d		

HGB LY02469	(1M)	28.05.2013	Heves [Hungary], Szitta Tamás	N47°42’	E20°25’
		26.05.2016	Košice - okolie [Slovakia], Mihók Jozef	N48°34’	E21°07’
			81; 109 km; 2r, 11m, 28d		
HGB LY2398	(1M)	23.05.2014	Fejér [Hungary], Klébert Antal	N46°55’	E18°19’
		21.07.2016	Galanta [Slovakia], Deák Gábor	N48°10’	E17°40’
			35; 147 km; 2r, 1m, 29d		
SKB D5830	(1N)	07.05.2016	Trnava [Slovakia], Jozef Chavko	N48°22’	E17°40’
		07.01.2017	Dunajská Streda [Slovakia], Jozef Chavko	N48°04’	E17°26’
			35; 37 km; 8m, 1d		
SKB D5556	(1N)	12.05.2014	Nitra [Slovakia], Jozef Chavko	N48°12’	E18°03’
		26.04.2015	Bratislava V [Slovakia], Jozef Chavko	N48°08’	E17°07’
			42; 71 km; 11m, 14d		
SKB D5580	(1N)	29.05.2014	Senec [Slovakia], Jozef Chavko	N48°08’	E17°20’
		04.07.2015	Bratislava V [Slovakia], Jozef Chavko	N48°08’	E17°07’
			78; 17 km; 1r, 1m, 5d		
SKB D5806	(1N)	17.05.2015	Dunajská Streda [Slovakia], Jozef Chavko	N48°02’	E17°32’
		11.08.2015	Dunajská Streda [Slovakia], Jozef Chavko	N48°05’	E17°26’
			35; 9 km; 2m, 25d		
SKB D6674	(1N)	17.05.2019	Senec [Slovakia], Jozef Chavko	N48°12’	E17°31’
		30.07.2019	Bratislava II [Slovakia], Jozef Chavko	N48°09’	E17°13’
			42; 23 km; 2m, 13d		
SKB D4585	(1N)	12.05.2012	Dunajská Streda [Slovakia], Jozef Chavko	N48°02’	E17°32’
		16.03.2014	Györ-Mosin-Sopron [Hungary], Bagyura János	N47°55’	E17°08’
			20; 32 km; 1r, 10m, 3d		
SKB D4622	(1N)	22.05.2011	Senec [Slovakia], Jozef Chavko	N48°11’	E17°27’
		05.03.2012	Bari [Italy], Vincenzo Constantini	N40°47’	E16°55’
			50; 823 km; 9m, 14d		
SKB D4643	(1N)	25.05.2011	Malacky [Slovakia], Jozef Chavko	N48°26’	E16°58’
		26.02.2016	Niederösterreich [Austria], Austria BRC	N48°37’	E16°49’
			20; 23 km; 4r, 9m, 3d		
SKB D5093	(1N)	12.05.2012	Dunajská Streda [Slovakia], Jozef Chavko	N48°02’	E17°32’
		26.02.2015	Niederösterreich [Austria], Rainer Raab	N48°31’	E16°53’
			20; 72 km; 2r, 9m, 15d		
SKB D5534	(1N)	09.05.2014	Piešťany [Slovakia], Jozef Chavko	N48°32’	E17°39’
		01.03.2017	Lower-Austria [Austria], Peter Spakovszky	N48°37’	E16°49’
			20; 62 km; 2r, 9m, 22d		
SKB D5927	(1N)	07.05.2017	Trnava [Slovakia], Jozef Chavko	N48°18’	E17°39’
		05.03.2018	Györ-Mosin-Sopron [Hungary], Horváth Gyula	N47°43’	E17°40’
			01; 63 km; 9m, 28d		
SKB D6115	(1N)	12.05.2018	Senec [Slovakia], Jozef Chavko	N48°08’	E17°20’
		09.10.2018	Baden-Württemberg [Germany], Martin Grimm	N49°28’	E8°33’
			81; 660 km; 4m, 28d		
		10.10.2018	Baden-Württemberg [Germany], Volker Schmidt	N49°28’	E8°33’
			81; 660 km; 4m, 29d		
SKB D6625	(1N)	03.06.2018	Nové Zámky [Slovakia], Jozef Chavko	N48°02’	E18°11’
		17.10.2018	Csongrád [Hungary], Balogh Gábor	N46°17’	E20°43’
			35; 273 km; 4m, 14d		

Thanks to colour ringing, as in the case of the red-footed falcon, the number of recoveries has increased significantly in the course of the last few years (Jenčo & Repel 2018). This colour-ringing programme records information mostly in cases of chicks settling near their place of hatching (e.g. SKB D6130, SKB D6163, SKB D5839). In addition to this, we were able to identify a young saker falcon even in Germany, where the species does not nest (Kovács et al. 2014). The recoveries of individuals in Austria and Hungary and the recovery of an injured individual in Italy document the movement of individuals within the area of central Europe, which was known already in the past (Cepák et al. 2008). It works the same vice versa: chicks coming from the neighbouring countries appear in our territory (Slobodník & Slobodník 2008). Power lines continue to be a significant mortality factor for this species (European Commission 2018, Kovíce et al. 2014, Nemček et al. 2014, Gális et al. 2019). One individual in eastern Slovakia was poisoned (HGB LY03758), which is proof that poisoning still goes on in some form in Slovakia (Chavko 2010, Molnar 2004, Ragyova et al. 2009).

Peregrine falcon (*Falco peregrinus*)
N = 13 (S 1, M 3, L 9) A 3, Z 4 (Czech Republic 1, France 1, Hungary 1, Ukraine 1), C 6 (HGB 6)

HGB LY908	(1F)	29.05.2009	Komárom-Esztergom [Hungary], Prommer Mátyás	N47°42’	E18°28’
		15.03.2013	Trnava [Slovakia], Jozef Chavko	N48°30’	E17°19’
			81; 123 km; 3r, 9m, 16d		
HGB LY940	(1F)	23.05.2011	Veszprém [Hungary], Prommer Mátyás	N47°21’	E17°49’
		17.09.2012	Malacky [Slovakia], Jozef Chavko	N48°28’	E17°16’
			81; 131 km; 1r, 3m, 26d		
HGB LY01585	(1N)	17.04.2019	Pest [Hungary], Kazi Róbert	N47°57’	E18°56’
		29.12.2019	Dunajská Streda [Slovakia], Soňa Votavová	N48°05’	E17°32’
			20; 105 km; 8m, 12d		
HGB LY01811	(1N)	16.05.2014	Fejér [Hungary], Staudinger István	N47°16’	E18°11’
		22.04.2019	Malacky [Slovakia], Jozef Chavko	N48°15’	E17°07’
			81; 136 km; 4r, 11m, 6d		
HGB LY04124	(1N)	15.05.2017	Veszprém [Hungary], Szinai Péter	N47°07’	E17°22’
		13.03.2019	Trnava [Slovakia], Jozef Chavko	N48°29’	E17°23’
			81; 152 km; 1r, 9m, 27d		
HGB LY02891	(1F)	08.05.2017	Fejér [Hungary], Klébert Antal	N47°22’	E18°15’
		02.06.2019	Pezinok [Slovakia], Jozef Chavko	N48°27’	E17°19’
			81; 140 km; 2r, 24d		
SKB D2484	(1F)	04.05.2007	Trnava [Slovakia], Jozef Chavko	N48°30’	E17°25’
		07.12.2012	Levice [Slovakia], Jozef Chavko	N48°04’	E18°56’
			01; 123 km; 5r, 7m, 4d		
SKB D5801	(1F)	16.05.2015	Malacky [Slovakia], Jozef Chavko	N48°30’	E17°18’
		01.05.2017	Skalica [Slovakia], Norbert Sommer	N48°49’	E17°13’
			01; 35 km; 1r, 11m, 15d		
SKB E1302	(1M)	05.05.2008	Rožňava [Slovakia], Štefan Matis	N48°34’	E20°31’
		12.06.2015	Rožňava [Slovakia], Milan Olekšák	N48°34’	E20°28’
			41; 4 km; 7r, 1m, 6d		
SKB D3013	(1N)	28.05.2015	Rožňava [Slovakia], Miroslav Dravecký	N48°37’	E20°29’
		15.02.2016	Borsod-Abaúj-Zemplén [Hungary], Bereczky Attila	N48°04’	E20°48’
			46; 66 km; 8m, 19d		
SKB D3982	(1F)	09.05.2015	Partizánske [Slovakia], Ladislav Šnírer	N48°40’	E18°22’
		20.08.2018	Bas-Rhin [France], Guillaume Glaser	N48°57’	E7°46’
			00; 777 km; 3r, 3m, 11d		
SKB E4811	(3N)	31.07.2018	Michalovce [Slovakia], Jenčo Michal	N48°45’	E21°54’
		02.08.2018	Zakarpatska o. [Ukraine], Bohdan Demesh	N48°10’	E23°18’
			01; 120 km; 2d		
SKB D2339	(1N)	12.05.2007	Bánovce nad Bebravou [Slovakia], Ladislav Šnírer	N48°52’	E18°19’
		25.04.2012	Přerov [Czechia], Josef Chytil	N49°29’	E17°32’
			40; 90 km; 4r, 11m, 14d		

Peregrine falcons do not belong among the species for which numerous recoveries are typical (Cepák et al. 2008, Sobodník & Slobodník 2011). The recoveries of chicks ringed in Hungary are interesting, which then settled down at nesting sites in south-western Slovakia (HGB LY02891, HGB LY04124, HGB LY01811, Chavko 2018). The recovery of an individual in eastern France is the most distant instance of an individual from Slovakia. Individuals ringed in Slovakia flying farther to the west are becoming more common (Cepák et al. 2008). With regard to the recovery circumstances, collisions with vehicles were frequently recorded (SKB D2339, SKB E1302). By contrast, deaths caused by collisions with power lines, occurring abroad, were not recorded in the study period (Demeter et al. 2004).

Barn owl (*Tyto alba*)
N = 6 (S 2, M 2, L 2) A 2, Z 1 (Czech republic 1), C 3 (HGB 3)

HGB RE09409	(3N)	14.11.2018	Nové Zámky [Hungary], Árvay Márton	N47°34’	E18°47’
		17.01.2019	Nové Zámky [Slovakia], Jozef Lengyel	N47°59’	E18°16’
			46; 61 km; 2m, 3d		
HGB 449700	(1N)	15.06.2015	Tolna [Hungary], Nagy Sándor	N46°31’	E18°07’
		12.04.2017	Galanta [Slovakia], Kristián Bacsa	N48°12’	E17°38’
			01; 190 km; 1r, 9m, 27d		
HGB RE6160	(1N)	26.05.2017	Veszprém [Hungary], Klein Ákos, Dr.	N47°12’	E17°10’
		06.04.2018	Komárno [Slovakia], Zsolt Riflik	N47°53’	E17°54’
			01; 94 km; 10m, 10d		
SKB E5454	(3N)	17.08.2018	Komárno [Slovakia], Roman Slobodnik	N47°52’	E17°55’
		25.09.2019	Znojmo [Czechia], Karel Poprach	N48°46’	E16°08’
			20; 166 km; 1r, 1m, 8d		
SKB E5441	(3N)	17.08.2018	Komárno [Slovakia], Roman Slobodnik	N47°52’	E17°55’
		20.08.2019	Dunajská Streda [Slovakia], Roman Slobodnik	N47°54’	E17°48’
			20; 9 km; 1r, 2d		
SKB E2696	(3N)	24.09.2015	Komárno [Slovakia], Vladimír Šrank	N48°47’	E18°34’
		16.06.2018	Komárno [Slovakia], Katka Béresová	N47°49’	E17°59’
			40; -- km ; 2r, 8m, 22d		

Recoveries of ringed individuals in the study period were limited to those released within the restitution programme in the Žitný ostrov (Rye Island) area (SKB E2696, SKB E5441, SKB E5454), which are proof of the success of this activity (Bacsa 2018). The recovery of an individual released as a juvenile in autumn 2018 and recovered as a nesting female in Moravia in 2019 is very interesting, as this individual hatched in this particular area (SKB E5454). Another of the released birds settled only nine kilometres from its hatching place (SKB E5441). Individuals from the Hungarian population which were already recorded here in the initial phase of nesting or creating pairs (HGB 449700 and HGB RE6160) may continue to naturally strengthen the population. Currently, collisions with vehicles are critical for the species (SKB E2696), to the extent that they might cause local extinction of the population (Cepák et al. 2008, Marti et al. 2020).

Eurasian scops owl (*Otus scops*)
N = 1 (S 0, M 0, L 1) Z 1 (Czech Republic 1)

SKB K3667	(1N)	15.07.2017	Prievidza [Slovakia], Karol Šotnár	N48°47’	E18°34’
		20.05.2018	Břeclav [Czechia], Robert Doležal	N48°54’	E16°40’
			20; 140 km; 10m, 4d		

This is the first recovery of an Eurasian scops owl abroad recorded in the database (Cepák & Klvaňa 2019). The recovery may signify that the Eurasian scops owl is settling down in Moravia, though we cannot rule out a late return to the locality in which it was born.

Eurasian eagle-owl (*Bubo bubo*)
N = 9 (S 2, M 6, L 1) A 6, Z 5 (Hungary 3, Poland 1, Ukraine 1)

SKB B1110	(1N)	02.05.2014	Topoľčany [Slovakia], Ladislav Šnírer	N48°31’	E18°16’
		18.05.2017	Zlaté Moravce [Slovakia], Tomáš Veselovský	N48°22’	E18°25’
			40; 19 km; 3r, 16d		
SKB B1120	(1N)	28.06.2014	Hlohovec [Slovakia], Ladislav Šnírer	N48°29’	E17°52’
		05.03.2015	Nitra [Slovakia], Viktor Mlynek	N48°12’	E18°04’
			46; 35 km; 8m, 6d		
SKB B436	(1N)	14.05.2008	Košice - okolie [Slovakia], Štefan Matis	N48°42’	E20°57’
		04.09.2016	Liptovský Mikuláš [Slovakia], Vrlík Peter	N49°03’	E19°59’
			01; 81 km; 8r, 3m, 21d		

SKB B442	(1N)	15.06.2008	Košice - okolie [Slovakia], Štefan Matis	N48°36’	E20°54’
		05.09.2013	Humenné [Slovakia], Anna Macková	N48°55’	E21°52’
			01; 78 km; 5r, 2m, 20d		
SKB B800	(1N)	06.05.2013	Tvrdošín [Slovakia], Oldřich Suchánek	N49°23’	E19°36’
		16.01.2019	Volynska O. [Ukraine], BRC Ukraine	N51°06’	E23°31’
			00; 338 km; 5r, 8m, 11d		
SKB B55	(1N)	23.05.2009	Tvrdošín [Slovakia], Dušan Karaska	N49°23’	E19°36’
		24.10.2012	[Poland], Pawel Armatys	N49°32’	E19°55’
			01; 30 km; 3r, 5m, 2d		
SKB B891	(1N)	03.06.2013	Košice - okolie [Slovakia], Mihók Jozef	N48°40’	E21°27’
		16.09.2017	Borsod-Abaúj-Zemplén [Hungary], Firmánszky Gábor	N48°19’	E21°13’
			01; 44 km; 4r, 3m, 13d		
SKB B876	(1N)	13.05.2012	Košice - okolie [Slovakia], Jozef Mihók	N48°34’	E21°22’
		14.06.2018	Borsod-Abaúj-Zemplén [Hungary], Serfőző József	N48°29’	E21°16’
			01; 11 km; 6r, 1m, 1d		
SKB B398	(1N)	06.05.2015	Košice - okolie [Slovakia], Mihók Jozef	N48°34’	E21°22’
		31.10.2018	Borsod-Abaúj-Zemplén [Hungary], Schwartz Vince	N48°20’	E21°30’
			46; 28 km; 3r, 5m, 26d		

Recoveries of ringed individuals reproduce the items of knowledge on the central European population which we already know (Cepák et al. 2008). Flights over shorter distances confirm the roaming behaviour of fledglings, except for the individual flying to north-eastern Ukraine (SKB B800), which was the first one ringed in Slovakia and recovered in that country, and at the same time it was the most distant recovery of a Eurasian eagle-owl ringed in our country (Cepák et al. 2008). Finds linked with road traffic (SKB B1110) confirm the high mortality of this species due to vehicles, although paradoxically there were no finds of ringed individuals dead or injured due to power lines in the study period (Cepák et al. 2008, European Commission 2018, Valkama & Saurola 2005).

Tawny owl (*Strix aluco*)
N = 3 (S 1, M 2, L 0) A 3

SKB D4294	(1N)	05.05.2012	Prievidza [Slovakia], Karol Šotnár	N48°45’	E18°38’
		22.06.2013	Partizánske [Slovakia], Rudolf Holzer	N48°34’	E18°24’
			46; 27 km; 1r, 1m, 17d		
SKB D4313	(1N)	06.05.2012	Žilina [Slovakia], Karol Šotnár	N49°11’	E18°40’
		11.10.2015	Prievidza [Slovakia], Pavol Bielik	N48°53’	E18°38’
			01; 32 km; 3r, 5m, 5d		
SKB D6401	(1N)	01.07.2018	Komárno [Slovakia], Roman Slobodník	N47°49’	E17°59’
		21.08.2018	Komárno [Slovakia], Roman Slobodník	N47°49’	E17°59’
			40; -- km; 1m, 20d		

Finds of ringed owls which died in a chimney or due to collision with vegicles document the mortality factors which currently predominate (Santos et al. 2013, Silva et al. 2012).

Ural owl (*Strix uralensis*)
N = 1 (S 0, M 1, L 0) A 1

SKB C2036	(1N)	29.05.2004	Tvrdošín [Slovakia], Dušan Karaska	N49°21’	E19°47’
		20.09.2012	Námestovo [Slovakia], Dušan Karaska	N49°26’	E19°33’
			58; 19 km; 8r, 3m, 22d		

Long-eared owl (*Asio otus*)
N = 7 (S 6, M 0, L 1) A 7

SKB E4059	(2N)	28.09.2017	Košice - okolie [Slovakia], Peter Ďurian	N48°36’	E20°54’
		08.03.2018	Senec [Slovakia], Rudo Jureček	N48°13’	E17°16’
			40; 273 km; 5m, 8d		

SKB E2999	(2N)	18.08.2010	Košice - okolie [Slovakia], Peter Pjenčák	N48°36’	E20°54’
		30.10.2012	Košice - okolie [Slovakia], Peter Pjenčák	N48°36’	E20°54’
			20; -- km; 2r, 2m, 12d		
SKB E2962	(3F)	27.11.2014	Šaľa [Slovakia], Roman Slobodník	N48°12’	E17°56’
		19.01.2016	Šaľa [Slovakia], Roman Slobodník	N48°12’	E17°56’
			20; -- km; 1r, 1m, 22d		
SKB E4010	(2N)	05.11.2011	Košice - okolie [Slovakia], Peter Pjenčák	N48°36’	E20°54’
		28.03.2014	Košice - okolie [Slovakia], Pjenčák Peter	N48°36’	E20°54’
			20; -- km; 2r, 4m, 21d		
SKB E4035	(2N)	24.09.2014	Košice - okolie [Slovakia], Peter Pjenčák	N48°36’	E20°54’
		16.09.2017	Košice - okolie [Slovakia], Pjenčák Peter	N48°36’	E20°54’
			20; -- km; 2r, 11m, 22d		

The year-on-year increase in recaptures is valuable from the viewpoint of knowing the migration strategies of the species, as these relations have not been sufficiently clarified so far (Rumbutis 1990, Tome 2011, Zvářal & Sviečka 2009). In one case, fidelity to the wintering site was confirmed in two successive winters (SKB E2962). This species of owl is endangered by collisions with vehiclers as well (SKB E4059, Cepák 2008).

Short-eared owl (*Asio flammeus*)
N = 1 (S 0, M 0, L 1) C 1 (NOS 1)

N0S 4250252	(1N)	28.06.2011	Finnmark [Norway], Karl-Birger Strann	N69°01’	E22°56’
		22.04.2012	Košice - okolie [Slovakia], Peter Ďurian	N48°36’	E20°54’
			20; 2 271 km; 9m, 25d		

The recapture of a chick hatched in Norway during the summer migration is a valuable find. It is difficult to interpret this occurrence due to the species’ low philopatry, as in the common vole gradation period these owls often use the local diet supply and nest in various places, which contributes to their ambiguous migration behaviour (Arroyo & Bretagnolle 1999, Calladine et al. 2011, Tunka 2014)

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