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Monitoring of colonies and provisioning of rooks with nest material as a potential tool for stabilizing colonies and increasing nesting opportunities in the countryside. Project report

Monitoring kolónií a poskytovanie hniezdneho materiálu havranovi čiernemu ako možný nástroj stabilizácie kolónií a zvýšenia hniezdnych príležitostí v krajine. Projektová správa

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Abstract: The rook is a species inhabiting open agricultural landscape whose non-active nests are also used by other bird species for nesting. It is the decline in rook colonies that has been posited as one of the reasons for decrease in the red-footed falcon (*Falco vespertinus*) population in Slovakia since the 1970s. During the period from 2012 till 2016, four monitorings of rook colonies were carried out in south-western Slovakia (Diakovce, Nitrianska Osada, Sokolce and Tvrdošovce). In the colony at Tvrdošovce, supporting activity involving provisioning of rooks with nest material was under way from 2014 until 2016. While the colonies at Diakovce and Nitrianska Osada have been showing a slight decrease in the number of nesting rooks, despite larger interannual differences the colony at Sokolce has been showing an upward trend. The size of the colony at Tvrdošovce has been stable since the beginning of the supporting activity. This activity had a statistically significant positive effect on the width of rook nests. In 74 cases in the studied rook colonies we have recorded nesting by three other bird species – Eurasian kestrel (*Falco tinnunculus*) 43.8%, western jackdaw (*Corvus monedula*) 39.7% and long-eared owl (*Asio otus*) 16.4%. In 2015 two female red-footed falcons were observed in the colony at Tvrdošovce.

Abstrakt: Havran čierny je druh otvorenej poľnohospodárskej krajiny, ktorého neaktívne hniezda sú využívané na hniezdenie aj inými druhmi vtákov. Úbytok havraních kolónii je totiž označovaný za jeden z dôvodov poklesu populácie sokola kobcovitého (*Falco vespertinus*) od 70. rokov minulého storočia na Slovensku. V priebehu rokov 2012 až 2016 bol realizovaný monitoring štyroch havraních kolónií (Diakovce, Nitrianska Osada, Sokolce a Tvrdošovce) na JZ Slovensku. V kolónii Tvrdošovce prebiehala od roku 2014 do roku 2016 podporná aktivita vo forme predkladania hniezdneho materiálu. Zatiaľ čo kolónie v Diakovciach a Nitrianskej Osade vykazovali mierny pokles v počte hniezdiacich havranov, kolónia Sokolce vykazuje aj napriek väčším medziročným rozdielom rastúci trend. Veľkosť kolónie Tvrdošovce bola od začiatku realizácie podporenej aktivity stabilná. Podporná aktivita mala preukazne pozitívny vplyv na šírku havraních hniezd. V 74 prípadoch bolo v sledovaných havraních kolóniách zaznamenané hniezdenie troch iných druhov vtákov – sokol myšiar (*Falco tinnunculus*) 43,8 %, kavka tmavá (*Corvus monedula*) 39,7 % a myšiarka ušatá (*Asio otus*) 16,4 %. V roku 2015 boli v kolónii Tvrdošovce pozorované dve samice sokola kobcovitého.

Key words: *Corvus frugilegus*, *Falco vespertinus*, supporting activity, conservation

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Introduction

Sufficient numbers of nesting opportunities together with increasing nesting success rate are among the oldest and the best known activities within conservation management (Møller 1994, Zasadil 2001). With a long-term perspective, in some species a gradual change in

preference of local or entire populations from nesting in the original, natural conditions to nesting in artificial conditions may be shown (Bartolotti 1994, Chavko et al. 2014, Kotymán et al. 2015). In increasing and improving the nesting conditions, emphasis is put on hollow-nesting birds or species nesting in nest boxes. Another form of support consists of nest material provision (Baxter et al. 1996, Horváth et al. 2015). However, some species do not build their own nests and use nests of other species for breeding (e.g. Strigiformes, *Falco* spp.). Support for a particular species nesting may thus become support for others which do not build their own nests.

The rook (*Corvus frugilegus*) is one of the most common species of corvids (Corvidae) in Slovakia (Mošanský & Trnka 2002) and in Europe (BirdLife International 2015). Its population trends in particular parts of the nesting area differ. While in Western Europe the populations are stable and locally increasing (Marchant & Gregory 1999, Schoppers 2004), in the agricultural parts of Central and Eastern Europe the species has been exposed to severe persecution in the last few decades (Orłowski & Czapulak 2007, Fehérvári et al. 2009, Palatitz et al. 2009, Vongrej & Szalay 2012).

The rook is social, tree-nesting bird (Kasprzykowski 2008). In Central Europe the occurrence of its nesting colonies is linked with patches of woodland in agricultural areas or urban zones (Czapulak & Betleja 2002). The occurrence of colonies is conditioned by sufficient extent of foraging biotopes, mainly meadows and pastures (Griffin & Thomas 2000, Kasprzykowski 2003, Gimona & Brewer 2006). The survival of rook colonies is also affected by their size. Orłowski & Czapulak (2007) stated that there is a greater probability for smaller colonies to become extinct. Due to a lack of social relations among individuals, small colonies are more likely to be abandoned (Józefik 1976). Distances between colonies also influence their abandonment or extinction. The more distant and more isolated colonies tend to be left more often (Griffin & Thomas 2000, Orłowski & Czapulak 2007). A landscape with a lack of forested areas may have not only insufficient nesting opportunities for rooks, but also a lack of nest material (Horváth et al. 2015). This risk is even greater when we realize that the old nests of rooks, or corvids in general, are used for nesting by other species, such as long-eared owls (*Asio otus*) (Garner & Milne 1998, Noga 2009), Eurasian kestrels (*Falco tinnunculus*) (Cavé 1968), or red-footed falcons (*Falco vespertinus*) (Slobodník et al. 2014, Horváth et al. 2015). Since 2012 the red-footed falcon, a species listed in the IUCN Red List of Threatened Species as NT – a Near Threatened species (BirdLife International 2016), has been nesting in only one locality in south-western Slovakia (Slobodník et al. 2016). It is precisely the decline in rook colonies, along with agricultural intensification, which is described as one of the reasons for the red-footed falcon population decrease in Slovakia since the 1970's (Gúgh et al. 2015). Horváth et al. (2015) carried out supporting activity in SE Hungary based on nest material provision near rook colonies. The result was positively shown in the parameters of rook nests. Due to the greater number of twigs used in the nest building, the nest durability increased, and thus also the nesting opportunities for other species, including the red-footed falcon.

Our objectives were: (i) to find out the effect of nest material provision on the size of nests and (ii) on the size of the rook colony in the locality of Tvrdošovce; (iii) to monitor the size of the rook colonies in 4 localities from 2012 till 2016; (iv) to monitor the use of rook nests by other species.

Material and methods

Study area

The study was carried out at four rook colonies in the Podunajská nížina lowland: Tvrdošovce (48.0993792N, 18.0330414E; 120 m a.s.l.), where two hectares of woodland and several meadows are situated in the immediate proximity of the colony; Diakovce (48.1365672N, 17.8080792E; 115 m a.s.l.), Sokolce (47.8489375N, 17.8222411E; 112 m a.s.l.) and Nitrianska osada (48.0454978N, 18.1495564E, 112 m a.s.l.) (Fig. 1). All the colonies are situated in small patches of woodland in the intensively-used agricultural land of southern Slovakia, where large fields of oilseed rape, maize and cereals with windbreaks of *Populus* sp. and *Robinia preudoaccacia* predominate. Except for the colony at Tvrdošovce, larger and more complex forest habitats are missing. Inhabited areas are in the vicinity of colonies (one colony within 300 metres of Tvrdošovce, one at the periphery of Diakovce, one at the periphery of Sokolce, and one within 50 metres of Nitrianska osada). The colonies are situated within or in the close vicinity of two Special Protected Areas: SPA Ostrovné lúky (SKCHVU019) and SPA Dolné Považie (SKCHVU005), where the red-footed falcon is listed as a Threatened bird species in Annex I. The colony at Tvrdošovce represents a historical nesting locality of the red-footed falcon.

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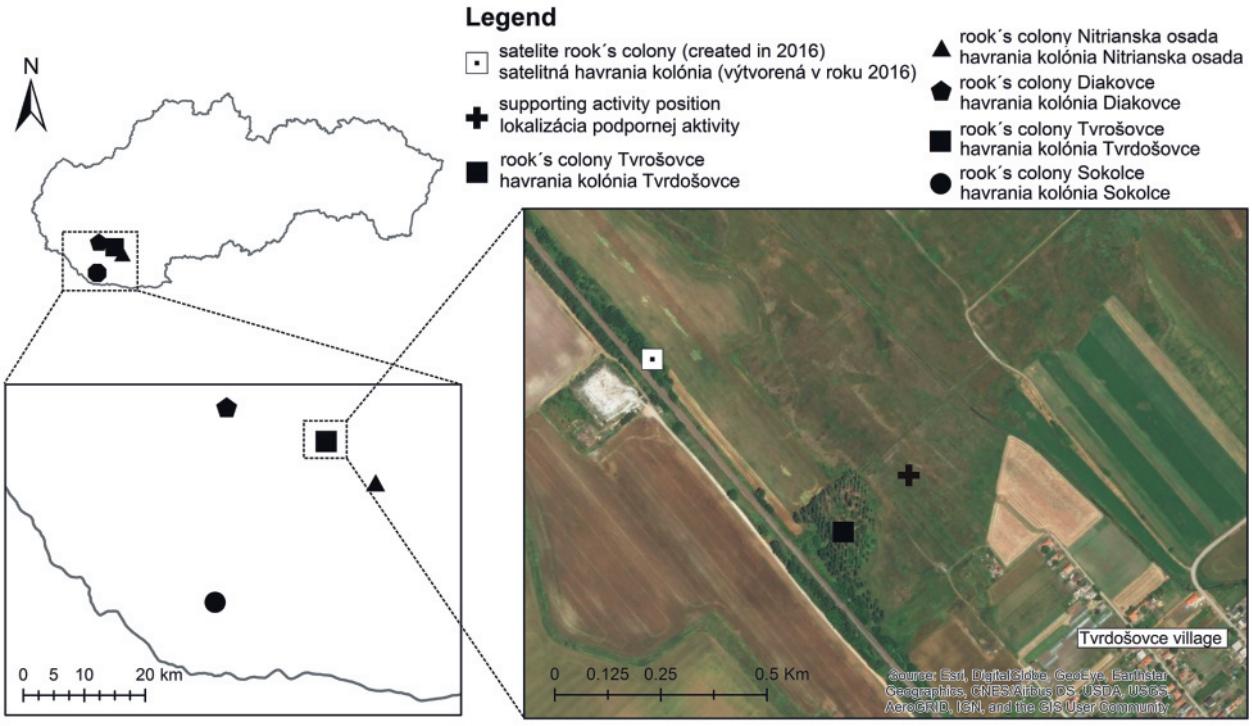

Fig. 1. Localisation of rook colonies in SW Slovakia, with a detailed view of the supported colony at Tvrdošovce.
Obr. 1. Lokalizácia kolónií havrana čierneho na JZ Slovensku s detailným pohľadom na podporovanú kolóniu v Tvrdošovciach.

Supporting activity

Nest material was provisioned in the immediate vicinity of the nesting colony at Tvrdošovce. The material used consisted of twigs of vine and branches from vineyards. The vine cuttings were processed to 15 cm up to 35 cm long pieces and then distributed in the open space next to the colony (30–50 m from its outer margin). The supporting activity was carried out in 2014 (small support, cca 10 m^3 – three supplies of nest material). In 2015 and 2016 bigger support was carried out – cca 25–30 m^3, seven supplies of nest material in 2015 and 10 supplies in 2016. In all cases the support was under way from February till March. In 2016 support of the rook colony was also carried out in April.

Impact of supporting activities on parameters of nests

Two nest parameters (height, defined as the maximum distance from the base up to the upper edge of the nest; and width, defined as the greatest outer distance between the nest edges) were observed in the colony at Tvrdošovce before carrying out the supporting activity: first check (N = 24 nests) in September 2013 and second check (N= 33 nests) in September 2016 after three years of nest material provisioning. In order to compare the results of the supporting activity, at the same time we took measurements of the nests in the rook colony at Sokolce (first check N = 21 nests, second check N = 22 nests), where no supporting activity had been carried out.

The measured nests were located at approximately the same height (5–15 m from the ground); for each checking they were selected randomly. The same person performed all the measurements with a gauge to 1 cm.

Monitoring of rook colony size and nesting of other species

Monitoring of the size of the four observed colonies was carried out in March and April from 2012 till 2016. Particular colonies were counted using a monocular from a sufficient distance so that the birds would not be disturbed. Each colony was counted several times, and then we used the highest number of nests recorded in April to

determine the number of nests for each season. The number of other species nesting in the rook nests was observed in the particular colonies in May.

Statistical analyses

The Mann-Whitney U test was used to compare differences in height and width of rook nests between the first and second check (measuring) in each locality with supporting activity, and also in the locality before it. Linear regression analysis was performed to describe the trend in changing numbers of rook nests between the study years in particular colonies. The R software v.3.2.5 (R Core Team 2016) was used to evaluate all analyses.

Results

Supporting activity

The results show a significant positive effect of the supporting activity on the width of rook nests (Mann-Whitney U test: $N_1 = 24$, $N_2 = 33$, $Z = -2.41$, $P = 0.01$) (Fig. 2A) in the locality of Tvrdošovce. The median of nest width after the supporting activity was 5 cm bigger (median: 35 cm) than before the supporting activity. We also found a positive effect on the height of rook nests, where the median of nest height after the supporting activity was 10 cm bigger (median: 40 cm) than before; however this result was not significant (Mann-Whitney U test: $N_1 = 24$, $N_2 = 33$, $Z = -1.84$, $P = 0.07$) (Fig. 2B). In the locality of Sokolce, where the supporting activity was not carried out, we observed no significant effect on width (Mann-Whitney U test: $N_1 = 21$, $N_2 = 22$, $Z = 0.01$, $P = 0.99$), where median of nest width was actually 4 cm smaller than at the first check (first check median: 30 cm), or on height (Mann-Whitney U test: $N_1 = 21$, $N_2 = 22$, $Z = 0.01$, $P = 0.09$), where the median of nest height (30 cm) was the same at both checks (Fig. 2C and Fig. 2D).

Monitoring of rook colonies

Interannual changes in the size of the observed colonies do not show a common trend (Fig. 3). Only the colony at Diakovce showed a significant gradual decrease ($R^2 = 0.97$, $P = 0.003$) in the number of nests (32% decrease was recorded between 2012 and 2016). In contrast though, the colony at Sokolce showed considerable interannual differences in the number of nests in comparison with 2012; the trend is rising and the amplitude is decreasing ($R^2 = 0.29$, $P = 0.35$). The colony at Nitrianska Osada is one with a rather balanced number of nests, but with a statistically non-significantly decreasing trend ($R^2 = 0.61$, $P = 0.12$). The colony at Tvrdošovce, where the supporting activities have been

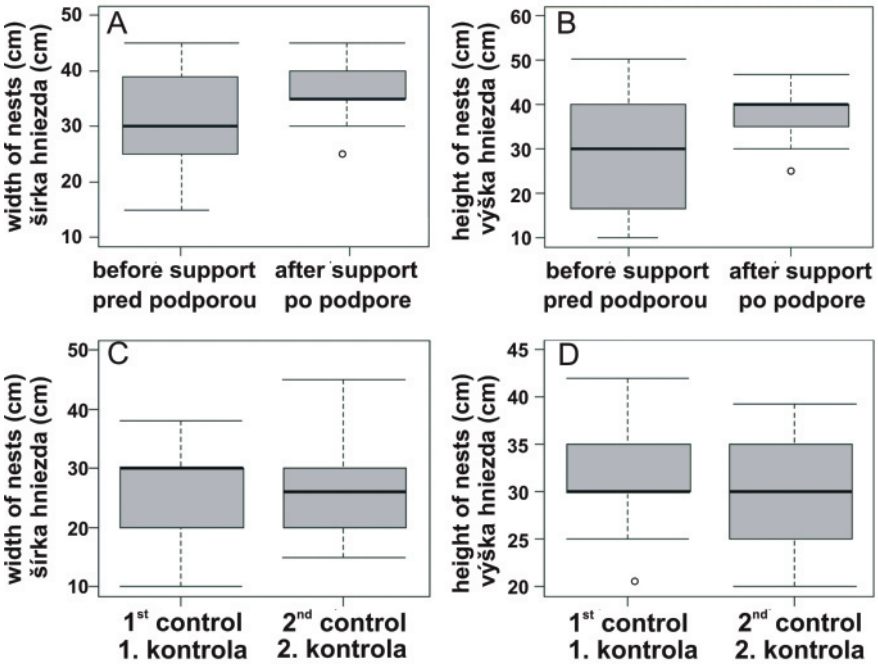

Fig. 2. Effect of supporting activity on parameters of rook nests; differences in width (A) and height (B) of rook nests between two checks when supporting activity was carried out after the first check; and differences in width (C) and height (D) of rook nests between two checks when supporting activity was not carried out; Median ± 25%–75% quartiles; Whisker: Min–Max, circles: outliers).

Obr. 2. Vplyv podpornej aktivity na parametre hniezda havrana čierneho; rozdiely v šírke(A) a výške (B) hniezd havrana čierneho medzi dvoma kontrolami – podporná aktivita bola realizovaná po prvej kontrole; rozdiely v šírke (C) a výške (D) hniezd havrana čierneho medzi dvoma kontrolami – podporná aktivita nebola realizovaná; Medián ± 25 % – 75 % kvartily; Whisker: Min. – Max., krúžky: odľahlé hodnoty).

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carried out since 2014, does not show any increasing trend in the number of nests. On the contrary, since the start of the supporting activity the number of nests has shown a slight, non-significant decrease ($R^2 = 0.48$, $P = 0.19$).

Other bird species using rooks' nests

During the period of study, we recorded 73 cases of nesting by three other species in rooks nests (Tab. 1). Of the three species the nests were most frequently used by Eurasian kestrels (43.8%). Old rooks nests also represented a nesting opportunity for western jackdaws (*Corvus monedula*) (39.7%) and long-eared owls (16.4%). In 2015, we recorded adult female red-footed falcons in the colony at Tvrdošovce, inhabiting the south-western margin of the rook colony. Three occurrences were recorded from 22 May to 29 June involving two female birds which were found here on 22 May. Later on there was only one female bird which inclined to rooks' nests.

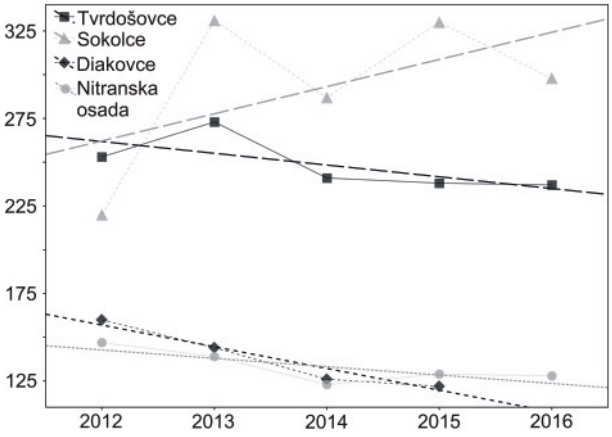

Fig. 3. Changing numbers of rook nests from 2012 to 2016 in particular colonies.
Obr. 3. Zmeny v počte havraních hniezd počas rokov 2012 až 2016 na jednotlivých lokalitách.

Discussion

The results of our study indicate that the supporting activity had a positive impact on the width of nests. The result being non-significant in the case of nest height could be caused by the smaller sample of compared nests. Horváth et al. (2015) did not study the width of nests, but in contrast to our results they did not record a significant impact of the supporting activity on the height of nests. From their results it is evident that the provisioned material was used to build each nest in the supported colony, where the rooks used the twigs with a significantly larger diameter for building nests. The authors presume that the rooks needed less time for building and that they could use more of their energy to choose a partner or to protect their nests. Whether the nests will have greater durability, being more robust thanks to the supporting activity, and thus will be less degraded by weather conditions cannot be determined now. In any case the number of nests in the colony at Tvrdošovce has remained constant, (linear regression showt a non-significant slightly decreasing trend) since the beginning of the supporting activity. In contrast, from 2014 in the control colony (Sokolce), where the supporting activity had not been carried out, the number of nests increased but their size did not change. Furthermore, their size was conditioned by accessibility of the foraging biotopes such as meadows, pastures and spring corn in the surroundings of the colony (Kasprzykowski 2003). Griffin & Thomas (2000) add that not only the accessibility of foraging biotopes but also the competition from neighbouring colonies has a significant impact on colony size. Increasing numbers of nests within a 6 km distance from a colony negatively influences its size. Orłowski & Czapulak (2007) illustrated how large colonies are situated at greater distances from each other.

Tab. 1. Number of another bird species nesting in rooks nests. x = data not collected; T = Tvrdošovce, S = Sokolce, D = Diakovce, N = Nitrianska Osada.
Tab. 1. Počet ostatných druhov hniezdiacich v hniezdach havrana čierneho. x = údaje neboli zisťované; T = Tvrdošovce, S = Sokolce, D = Diakovce, N = Nitrianska Osada.

year / rok	**2012**				**2013**				**2014**				**2015**				**2016**				**∑**
colony / kolónia	**T**	**S**	**D**	**N**	**T**	**S**	**D**	**N**	**T**	**S**	**D**	**N**	**T**	**S**	**D**	**N**	**T**	**S**	**D**	**N**	
Corvus monedula	1	x	x	0	1	x	x	0	1	x	x	0	1	7	4	0	1	8	5	0	29
Falco tinnunculus	2	x	x	1	3	x	x	1	3	x	x	1	3	3	3	1	4	3	3	1	32
Asio otus	1	x	x	0	2	x	x	0	2	x	x	0	2	1	1	0	2	0	1	0	12
∑	4	x	x	1	6	x	x	1	6	x	x	1	6	11	8	1	7	11	9	1	73

The size of colonies has an impact on their own survival. Big colonies, thanks to their mutual active nest protection, are exposed to smaller predation risk (Brown & Brown 2001). Józefik (1976) says that small rook colonies are even more prone to leaving, as there is a lack of social interaction among individuals. The fact that the larger colonies are more resistant to leaving has also been found in other species living in colonies, such as grey heron (*Ardea cinerea*) or purple heron (*Ardea purpurea*) (Barbraud et al. 2003).

When comparing the interannual changes in the size of colonies in south-western Slovakia, we see that the localities do not show a common trend. We may observe that the increased amount of nest material does not lead to the rook colony's extension. The abundance of rooks and the size of the colonies themselves differ both between particular Europe countries (Marchant & Gregory 1999, Schoppers 2004, Kaľavský 2011) and between particular regions of the same country. Whilst in the western part of Poland a decrease in rook population is coming about (Czapulak & Betleja 2002), in the eastern part its density is increasing (Jakubiec 2005). The interannual changes in relation to the overall trend can also be seen at the local level. Individual colonies may show quite dynamic interannual changes as a whole (similar to the locality of Sokolce) and also changes accompanied by increasing or decreasing abundance in particular parts of colonies, while in total the number of nests for the given locality is more or less stable (Kaľavský 2011, Klejdus 2013). We may note a similar situation in the locality of Tvrdošovce, considering that in 2016 a small satellite colony (8 nests) emerged cca 10 metres from the original colony (Fig. 1). Such trends may be observed mainly in relation to resettlement of rooks from rural areas to urban residential areas (Haraszthy 1998), which is typical for Slovakia too (Mošanský & Trnka 2002).

Intensification of agriculture (Schoppers, 2004) connected with the use of pesticides (Malmberg 1973), or the pursuit and persecution of the species by humans (Fehérvári et al. 2009, Palatitz et al. 2009) are considered as the primary factors significantly impacting the size of rook populations. However, both factors are features of the environmental policies applied in particular countries. But these parameters were not studied in our research. As we deal with the colonies situated in south-western Slovakia, where agricultural production is considerably intensified, we anticipate the same impact of this factor on all the colonies studied. Anyhow, since 2015 in the study area the shooting of corvids has been legally banned, which may have a positive impact on their abundance in the future. Schoppers (2004) described the legislative protection and species support minimizing their persecution as positive factors influencing the stabilization and renewal of the rook population. It was precisely the shooting out of colonies which led to the decrease in the species abundance in south-western Slovakia in the past (Vongrej & Szalay 2012), and why they progressively moved into urban residential areas (Kaľavský 2011). Subsequently, the decline of rook colonies was identified as one of the reasons for red-footed falcon population decrease in Slovakia (Gúgh et al. 2015).

Building of more robust nests and stabilisation of rook colonies as a consequence of provisioning of nest material may have a secondary positive impact on other species using the nests of corvids for breeding, due to the longer duration of abandoned or inactive rook nests. A sufficient number of old rook nests in agricultural areas supports nesting by species such as the Eurasian kestrel and long-eared owl, at least in the period before rooks begin their building activities. In contrast, the red-footed falcon does not choose its place for breeding until May or June, when the nidification period of rooks is almost over (Literák 2008). Palatitz et al. (2015) identified the stabilization of existing rook colonies as one of the elements leading to preservation of the red-footed falcon population in the countryside.

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