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Foraging opportunism and feeding frequency in the red-footed falcon (*Falco vespertinus*) in Slovakia: case study from 2017

Potravný oportunizmus a frekvencia kŕmenia u sokola kobcovitého (*Falco vespertinus*) na Slovensku: prípadová štúdia z roku 2017

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Abstract: Foraging opportunism and feeding frequency are less studied parameters of behaviour in insectivorous falcons, many of which are endangered bird species. In this short study, prey composition and feeding frequency of red-footed falcon (*Falco vespertinus*) nestlings were studied using the method of camera recordings during seven days in July 2017 in southwestern Slovakia. Camera recording analyses of 2–3 chicks (14–26 days old) in three nests revealed a significant preference for insects (97%, n = 305 prey items), of which the Italian locust (*Calliptamus italicus*) was highly predominant (54%). We also found very high average chick feeding frequency (9.9 feedings per hour, n = 29 hours 22 min of regular observations), whereby the females fed their young ones more frequently (64.9%, n = 305 feedings) than the males (35.1%). Analyses of food composition in adverse weather conditions showed that unfavourable weather had a negative effect on chick feeding frequency, and in rainy weather the males fed significantly less than the females.

Abstrakt: Potravný oportunizmus a frekvencia kŕmenia sú málo študované parametre správania u hmyzožravých sokolov, ktoré často patria medzi ohrozené druhy vtáctva. V tejto krátkej práci sme študovali zloženie potravy a frekvenciu kŕmenia mláďat sokola kobcovitého (*Falco vespertinus*), a to pomocou kamerových záznamov počas 7 dní júla 2017 na juhozápadnom Slovensku. Analýzou snímkov 2 – 3 mláďat (starých 14 – 26 dní) v 3 hniezdach sme zistili jasnú preferenciu hmyzu (97 %, n = 305 objektov koristi), pričom dominoval koník ružovokrídly (*Calliptamus italicus*) (54 % celkovej abundancie koristi). Zistili sme vysokú priemernú frekvenciu kŕmenia mláďat (9,9 kŕmení/hod., n = 29 hod 22 min pravidelných pozorovaní), pričom samice kŕmili mláďatá častejšie (64,9 %, n = 305 kŕmení) ako samce (35,1 %). Analýzy zloženia potravy v odlišnom počasí ukázali, že daždivé počasie malo negatívny vplyv na frekvenciu kŕmenia mláďat a v daždivom počasí kŕmili samce signifikantne menej ako samice.

Key words: foraging strategies, falcons, insect outbreaks, entomophagy

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Introduction

Prey supply and its accessibility are the main factors affecting the diet composition of animals (Ontiveros & Pleguezuelos 2000). In predators, carnivores, raptors and owls it is known that they opportunistically prefer those prey species which occur in larger quantities or in population cycles (e.g. Korpimäki & Norrdahl 1991).

The red-footed falcon is one of the mostly insectivorous raptor species (Krištín 1992, White et al. 1994). It is classified as an endangered species as the size of its worldwide population has been estimated at 300,000–800,000 individuals (Ferguson-Lees & Christie 2001). In certain parts of their area of occurrence a strongly negative population trend, even by 30–40%, has been recorded. In Slovakia the situation is similar, and the decrease dates from the 1970s also as a consequence of the extinction of rooks' colonies and biotope changes following from unfavourable agricultural management (Danko & Chavko 2002, Slobodník et al. 2014), or as a result of the falcon population decline in the entire Pannonian Basin (Palatitz et al. 2009). However, there is some positive news from the last few years in Hungary, where in 2014 the number of pairs showed a rather significant increase, mainly due to a

large-scale nest-box programme implemented in the past decade (Palatitz 2015).

Similarly to other species of insectivorous falcons (e.g. *Falco naumanni*, *Falco amurensis*), the red-footed falcon opportunistically prefers mainly locally available species of Orthoptera and Coleoptera for its food (Haraszthy et al. 1994, Purger 1998, Kopij 2010, Pietersen & Symes 2010, Bounas & Sotiropoulos 2017). Their diet composition is also influenced by the local weather and types of habitats (Catry et al. 2012). It is assumed that the availability and capacity of foraging sources are the main conditions motivating them to occupy a nesting site, and they are also the main factors influencing breeding success (e.g. Korpimäki & Norrdahl 1991, Ontiveros & Pleguezuelos 2000). The food supply and prey availability are also important factors having an impact on the falcons' foraging activity (Rejt 2001) and chick feeding frequency in the nests (Rejt et al. 2000).

The objective of this study was to contribute to the knowledge about the red-footed falcons' prey, the feeding frequency of chicks and the parental role in chick feeding, during a short period over the course of seven days in various weather conditions. Furthermore, regarding the considerable increase in the number of nesting pairs in 2017 in the last and single site in Slovakia, we tried to explain this positive change in terms of the development of new conditions motivating the species to nest in the Special Protected Area (SPA) known as Sysľovské polia, where falcon pairs also gather from the wider surroundings, mainly from Austria (Dvorak et al. 2016) and probably also from Hungary (Palatitz et al. 2015).

Material and methods

Study area

Since 1993 the species' nesting site at the Sysľovské polia SPA near the Slovak-Austrian state border has been constantly monitored (Danko & Chavko 2002, Maderič 2005–2010, Chavko 2011–2016, Slobodník 2017). Since 2011 this has been the only known nesting site in Slovakia where this species still successfully breeds. In Hungary at a distance of about 5–6 km to the south there is an area of 800 ha of semi-natural grasslands (P. Szpakovsky in verb.). This locality is not only an important reproduction site for the great bustard (*Otis tarda*) but also the stronghold of many species of insects attractive for falcons, Orthoptera and Coleoptera in particular, so red-footed falcons regularly stay here during the migration period. Based on our observations we assume that the well-flying Orthoptera and Coleoptera species expand from there into the surrounding agricultural landscape and equally into the studied Sysľovské polia SPA.

Study species

The red-footed falcon is a facultatively colonial species that exploits rookeries, artificial nest-box colonies and solitary corvid nests for breeding. The number of

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Fig. 1. A typical biotope in the surroundings of the studied nests of the red-footed falcon, where the density of locusts in the narrow grass strips was low.
Obr. 1. Typický biotop okolo študovaných hniezd sokola kobcovitého, denzita koníkov v úzkych trávnatých pásoch bola nízka.

breeding pairs at the Slovakian study site is strongly fluctuating. In 2011 there was one pair nesting there (with 3 hatched nestlings); in 2012 there was not a single nest occupied in the whole territory of Slovakia; in 2013 one pair successfully bred there (4 nestlings); in 2014 three pairs bred successfully (11 fledglings); in 2015 one pair successfully bred there (4 nestlings); in 2016 there were 5 pairs breeding (with altogether 19 hatched nestlings); and in 2017 as many as 16 pairs bred there and hatched 41 nestlings (Slobodník et al. 2017). This population is breeding in the conditions of standard agricultural management at the borderline of two intensively-used agricultural management systems. Agrocenoses in Slovakia consist of large monocultures of maize, rapeseed and cereal crops (Fig. 1), whereas over the border in Austria the landscape is a mosaic of rather narrow strips of areas under cultivation with substantially higher diversity of crops.

Data collection

Diet composition and the prey items brought to the 14–26 day old fledglings were studied using camera recordings during the course of seven days from July 12 until July 31, 2017. These data were collected from three pairs not showing special signs of shyness and tolerating human presence (Appendix 1). Two of the pairs bred in nesting boxes (each having 3 fledglings) and one in the nest of a crow (having 2 fledglings). The camera pictures were taken using a remote trip or directly from a camouflaged shelter located 10–25m from the nest, not having an impact on the chick feedings. We used a Canon EOS 5D Mark III camera with an EF300 mm f/2.8L IS II USM + 2x III telephoto lens. All recordings were made in the time of most intensive feeding, in days of sunny and rainy weather. Prey species were identified from the collected photo-material. Insects which could be not identified (due to the picture quality, or not identifiable part of the prey's body) were classified as "other insects". Random camera pictures when we successfully recorded a female bird (11 times) and a male bird (4 times) bringing prey were also included in the overall number of prey items/samples. However, these random pictures were not included in the evaluation of the feeding frequency and role of the two sexes in chick feeding.

The chick feeding frequency was evaluated as the number of feedings by the male or the female per unit of time (Fig. 2–8). The diet composition was analysed in terms of the dominance of the prey items brought as the number of particular prey species also expressed as a percentage of the total number of prey items (N, N%).

Results

Prey composition in chicks

Insects, mostly Orthoptera and Coleoptera, represented as many as 97% of all prey individuals (Appendix 1). A highly dominant prey species (54%) was the Italian locust (*Calliptamus italicus*, Fig. 9), the increased abundance of which in the foraging territories was opportunistically used by falcons mainly during the sunny days. Less abundant prey species were also other species of Orthoptera and beetles (Coleoptera). Of the other identified Orthoptera species we found grasshoppers *Chorthippus biguttulus*/*brunneus*, *C. apricarius*, *C. oschei* and bush-crickets *Decticus verrucivorus* and *Platycleis grisea*. We failed to identify 115 individual insects at the species level. Vertebrates were represented in the diet only in low abundance (2.6%), with four field mice (*Apodemus* sp.), three common voles (*Microtus arvalis*), one unidentified rodent, and one European green lizard (*Lacerta viridis*) (Appendix 1). In most cases we observed that small ground mammals and also the lizard were caught and brought by the males, which passed them to the female birds near the nesting box or the nest (Fig. 10).

The parents feeding their nestlings removed the thorny parts in most cases, mostly the sharp ends of legs, from the caught grasshoppers (Fig. 11–13), though sometimes they gave an untreated piece of prey to the fledglings. Small ground mammals were mostly decapitated. It was interesting to observe an approximately 14 day old nestling swallowing a whole field mouse (Fig. 14 and 15).

In the morning hours, the chicks regurgitated the indigestible remains in the form of pellets, in which it was possible to see also the legs of Italian locusts (*C. italicus*) (Fig. 16). Using the camera, we recorded the first chick regurgitating a pellet on July 31, 2017 at 8:50 am, and the second chick then regurgitated two pellets (the first at 9:12 am and the second at 9:21 am).

Chick feeding frequency

In the observed periods of time in the course of 7 days in July 2017 (31 hours and 22 minutes of recordings, Appendix 1) we recorded overall 305 feedings of 14–26 day old chicks, which the males fed 107 times (35.1%) and the females 198 times (64.9%, Appendix 1). The

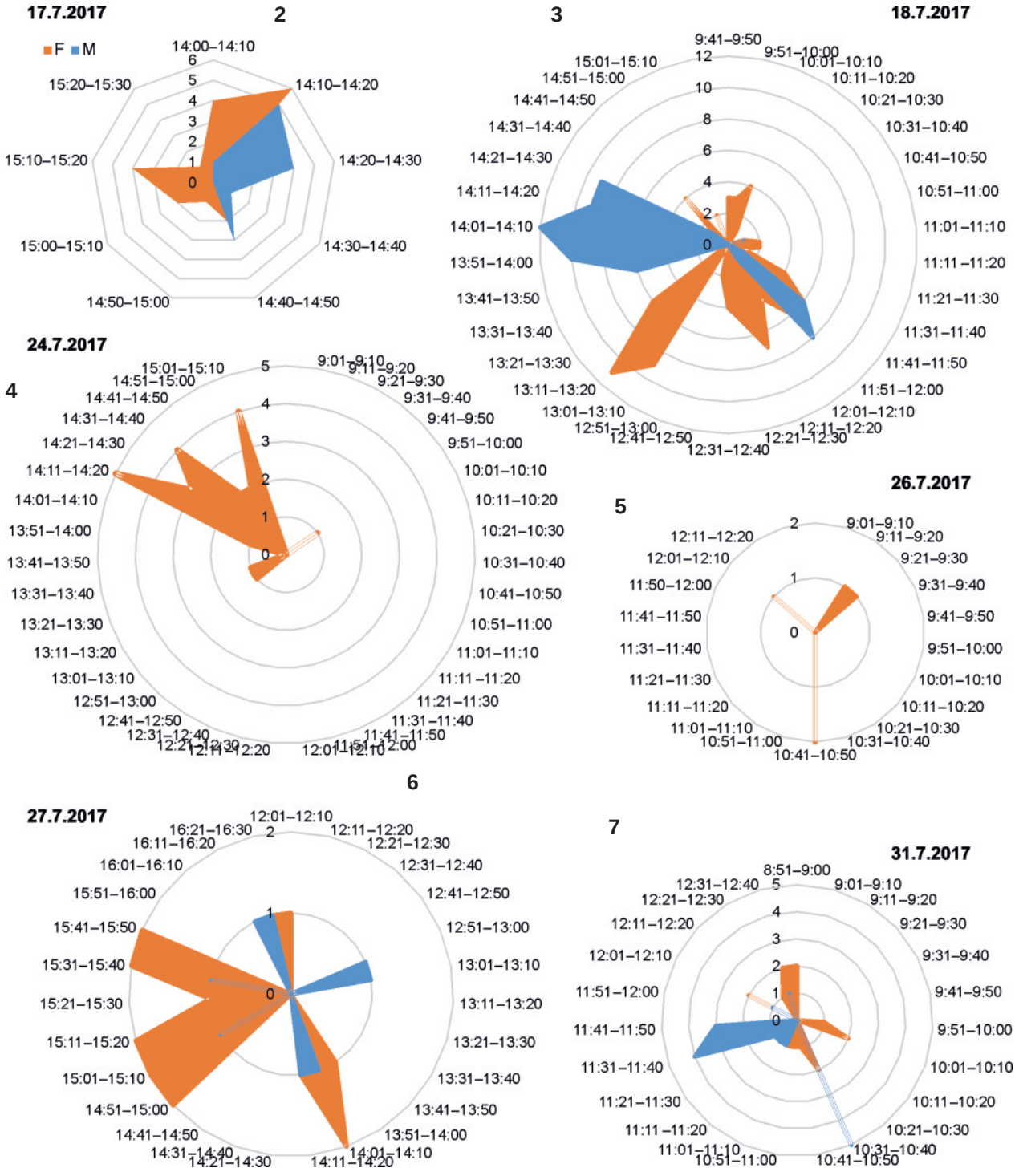

Fig. 2–7. Feeding frequency of 3 chicks (14 days old, nest No. 1, 02:00 pm – 03:30 pm, partly cloudy weather, 30°C) (2); feeding frequency of 3 chicks (15 days old, nest No. 1, 9:10 am – 03:10 pm, sunny weather, 32°C maximum) (3); feeding frequency of 3 chicks (21 days old, nest No. 1, 9:00 am – 03:20 pm, showers and rain, 26°C maximum) (4); feeding frequency of two chicks (14 days old, nest No. 2, 9:20 am – 01:30 pm, showers and rain, 24°C maximum), feeding frequency by the female – 4 times, by the

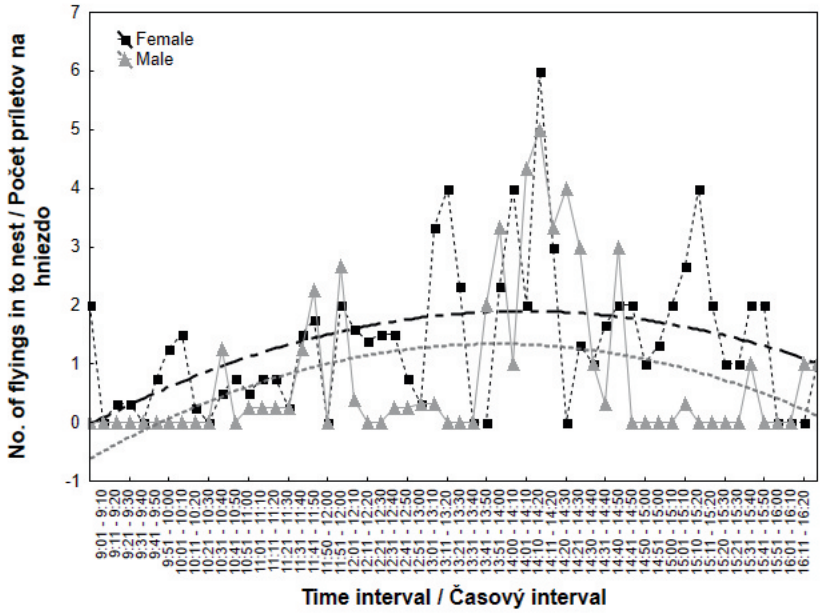

Fig. 8. Feeding frequency of 14 – 26 day old chicks in the course of one day (mean values of all the recorded feedings between July 17 and 31, 2017, from 09:00 am until 04:20 pm with the trend curve).
Obr. 8. Frekvencia kŕmenia 14–26 dní starých mláďat v priebehu dňa (priemery všetkých zaznamenaných kŕmení medzi 17. a 31. júlom 2017, v čase 9:00 až 16:20 hod. s trendovou krivkou).

average feeding frequency during the regular camera recordings (29 hours 22 minutes, n = 290 feedings) was 9.9 times per hour. The chick feeding frequency strongly depended on the age of the chicks and the local weather (Fig. 2–7). Overall the highest frequency was in warm sunny weather, reflecting the highest prey supply. In that time the feeding frequency varied between 4.2 and 16.2 times per hour by the females and 4 and 10.5 times per hour by the males. The food availability declined with increasing rainfall and wind force, and decreasing temperature. All in all, the feeding frequency by the females was only 1.1 up to 4.6 times per hour and by the males only 1.8 times per hour or not at all during the rainy weather (Appendix 1). The males brought food to the chicks only rarely and the low feeding frequency was compensated by their bringing bigger prey items (rodents). In the worst weather (on July 27) during the recordings lasting 7.5 hours, the lowest mean feeding frequency was found (by females every 22.2 minutes and by males every 53.8 minutes, Appendix 1, Fig. 5). By contrast, the highest feeding frequency was found in the sunny weather with high prey supply (on 18 July, when the female fed her chicks on average every 3.7 minutes and the male every 5.7 minutes, Appendix 1, Fig. 2). In tropical sunny weather (on July 31 between 8:30 am and 01:15 pm) with the maximum temperature up to 34°C, the average feeding frequency was lower than expected (by the female every 14.2 minutes and by the male every 15 minutes, Appendix 1, Fig. 6). Using the analysis of all the recorded feeding frequencies and with the expression of the daily trend curve (from 09:00 am until 04:20 pm) it follows that the highest feeding frequency by females was from 02:00 pm until 02:20 pm, from 01:00 pm until 01:30 pm, and from 03:00 pm until 03:20 pm, and by males it was from 02:01 pm until 02:30 pm, and 01:41 pm until 02:00 pm (Fig. 8). The females were more active even in the afternoon hours.

male – 0 times (5); feeding frequency of 3 chicks (22 days old, nest No. 3, 9:05 am – 04:22 pm, showers and rain, 25°C maximum) (6); feeding frequency of 3 chicks (26 days old, nest No. 3, 08:30 am – 01:15 pm, sunny weather, light breeze, 34°C maximum) (7).
Obr. 2 – 7. Frekvencia kŕmenia 3 mláďat (14 dní starých, búdka č. 1, 14:00 – 15:30 hod., polooblačno, 30 °C) (2); frekvencia kŕmenia 3 mláďat (15 dní starých, hniezdo č. 1, 9:10 – 15:10 hod., slnečno, max. 32 °C) (3); frekvencia kŕmenia 3 mláďat (21 dní starých, hniezdo č. 1, 9:00 – 15:20 hod., prehánky a dážď, max. 26 °C) (4); frekvencia kŕmenia 2 mláďat (14 dní starých, hniezdo č. 2, 9:20 – 12:30 hod., dážď a prehánky, max. 24 °C), frekvencia kŕmenia samice 4 krát samca 0 krát (5); frekvencia kŕmenia 3 mláďat (22 dní starých, hniezdo č. 3, 9:05 – 16:22 hod., prehánky a dážď, vietor, max. 25 °C) (6); frekvencia kŕmenia 3 mláďat (26 dní starých, hniezdo č. 3, 8:30 – 13:15 hod., slnečno, slabý vietor, max. 34 °C) (7).

Discussion

It is known that myophagous raptors opportunistically use gradations and increased occurrence of their preferred mouse prey in their population cycles (Korpimäki & Norrdahl 1991, Ontiveros & Pleguezuelos 2000). Data on the foraging opportunism of the so-called insectivorous falcons (e.g. *Falco amurensis*, *Falco naumanni*) are only rarely collected, mainly in their wintering areas (Kopij 2010, Pietersen & Symes 2010). In our study area in southwestern Slovakia, we confirmed this foraging opportunism even among red-footed falcons, namely by their high preference for Italian locusts in 2017. It is not entirely clear where this grasshopper occurred in such high density, thus representing an important foraging source for the nesting falcons. In that time the surrounding areas of large monoculture blocks without suitable grass vegetation (Fig. 1) did not provide an appropriate environment, and in the sunny weather the falcons hunted their prey (also the locusts) in the air, from which they descended directly to the nest with the caught prey. We assume that the Italian locusts migrated into the Slovakian foraging territories of the falcons from the grasslands located in Hungary and Austria (2–6 km away), where they occurred in large numbers (own unpublished results).

The study biotope at the nesting site of red-footed falcons in the Sysľovské polia SPA represents a typical agricultural landscape under intensive cultivation, which is why it is still uncertain what the motivation of the falcons was for increasing the number of nesting pairs just in this area. In the Slovakian part of the study area no environmentally friendly cultivation system is used, while in the neighbouring Austria the fields are divided in a mosaic way and there are still some grass strips and fallow land left, and in Hungary there is well-preserved large-scale semi-natural grassland. In particular we also have to consider the increasing numbers in the breeding population in Hungary (Palatitz et al. 2015) and suitable food supply in the entire breeding area in particular years. For example, in the red-footed falcon study area, Vásárhelyi Plain (SE Hungary) the potential and preferred food of this falcon was studied. There was very high orthopteran diversity in its food supply with great abundance of the Italian locust, both in the food supply and food composition (Szövényi 2015). This could also be one of the factors explaining why these falcons breed regularly there. At our study site we studied the food composition of the red-footed falcon in five different years (between 1998 and 2016) using food remnants analysis, where orthopterans and beetles were found to be the dominant prey group (Tulis et al. 2017). In another study carried out in our study area on the food supply for this falcon, high preference for orthopterans in its food was documented, but the Italian locust was not the dominant species in the food supply (Krištín et al. 2017).

In general, our study area may be evaluated as standardly managed and used with no preferable food supply, in comparison to the other historical nesting sites in Slovakia (Krištín et al. 2017). It is not known how the falcons evaluate the indicators and potential of successful breeding in the upcoming breeding season. Previous analyses of the diet composition, and this study

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Fig. 9. Italian locust (*Calliptamus italicus*), the predominant species in the diet of red-footed falcons in 2017.
Obr. 9. Koník ružovokrídly (*Calliptamus italicus*) eudominantný druh v potrave sokolov kobcovitých v roku 2017.

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Fig. 10. Vertebrates were preyed on mostly by males, which passed them mostly to the females. This type of prey was usually decapitated.
Obr. 10. Stavovce lovili väčšinou samce, od nich ich v prevažnej väčšine prípadov prevzali samice. Tento typ koristi bol obvykle dekapitovaný.

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Fig. 11–13. A male removes the spiky parts of a grasshopper's hind legs. Sometimes also the wings were removed as well.
Obr. 11 – 13. Samec odstraňuje z koristi pichľavé časti zadných končatín; niekedy boli odstraňované aj krídla.

likewise, point out the importance of climate, but also the crucial function of sufficient amounts of insects in the food supply. That elicits the question why all the other historical nesting sites in Slovakia have been abandoned, especially the nesting site in the Dolné Považie SPA near the village of Tvrdošovce, where red-footed falcons nested in the rooks' colony until 2011 (Slobodník et al. 2014). Nesting at this locality has not been restored despite the suitable conditions from the last breeding attempts in 2011 at this site (still existing opportunity of nesting in the rooks' colony, suitable habitat composition, plenty of installed nest boxes, no anthropic disturbance, and wide prey species spectrum and abundance of orthopterans (Krištín et al. 2017)). This situation is surprising in view of the occupation of the nesting site and the increase in the number of nesting pairs in the Sysľovské polia SPA.

The method of the study of food composition and feeding frequency by means of camera recordings makes it possible to determine, relatively accurately and objectively, the frequency of prey being delivered in the exact time sequence (Nuhlíčková et al. 2016). From the results it follows that the Italian locusts played an important role as a food source in the studied period, and even had positive impact on the breeding success. The results of the variable chick feeding frequency confirm the important positive impact of sunny weather on the prey sources availability, and subsequently on the chick feeding frequency itself. Cold and rainy weather significantly reduced the moving activity of insects and birds, with negative impact on the falcons' prey hunting success, which has been documented in several insectivorous species (Radford & Du Plessis 2003, Elkins 2004). For example, using camera recordings it was found that females of the great tit (*Parus major*) significantly reduced their feeding rate during all rain intensities, while the male feeding frequency did not significantly change (Radford et al. 2001). As we show, we found just the opposite result, when red-footed falcon males nearly stopped their chick feeding activity during rainy days.

The results of the food analyses in 2017 confirm the major share of insects in the diet from 1998–2016 (Tulis et al. 2017). From the results of nest lining collections, 477 prey items were identified in the diet of *Falco vespertinus* from the Sysľovské polia SPA at that time (12 species of vertebrates and 24 species of invertebrates). Invertebrates represented 78.4% (15 species of Coleoptera and 7 species of Orthoptera), while vertebrates accounted for 21.6% of the diet (7 mammal species, 3 species of birds, 1 reptile and 1 amphibian) and at this time through the analysis of camera recordings we have found as many as 97% of insects (e.g. 6 Orthoptera species and 4 species of vertebrates).

The mechanisms of Orthoptera species movements in the agrocenoses should be the subject of further studies, because it is unclear how and whence they expan-

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Fig. 14–15. This chick (14 days old) was able to swallow an adult field mouse whole.
Obr. 14 – 15. Mláďa (14 dní staré) dokázalo zhltnúť dospelú ryšavku.

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Fig. 16. This chick (24 days old) regurgitates a pellet in which we can see the red femur of an Italian locust (*Calliptamus italicus*).
Obr. 16. Mláďa (24 dní staré) vyvrhuje vývržok, na ktorom je vidieť červený femur koníka ružovokrídleho (*Calliptamus italicus*).

ded into the surroundings of the nests in our study, considering that in the narrow grass strips near the nests (within 100 metres, see Fig. 1) there was no such prey density which would correspond to the great abundance of the prey brought in by the parents (Krištín et al. 2017), and in the case of the Italian locust *C. italicus* practically only the bigger females were delivered to the nestlings.

We also found that the mean feeding frequency of fledglings (9.9 feedings per hour, n = 29 hours and 22 minutes) of the red-footed falcon as an insectivorous species was significantly higher than of the myophagous species Eurasian kestrel (*Falco tinnunculus*), in the case of which 1–2.8 feedings per hour were found on average (Rejt et al. 2000). On the other hand, one might suggest that one big prey item (e.g. a rodent) covers the nutritional demands of chicks much more than small prey such as insects, and that these insectivorous falcons need to feed the chicks with higher frequency.

Thus the feeding frequency of the red-footed falcon approximates to the feeding frequency of insectivorous songbirds, considering the brood number (Smith et al. 1988). These big differences together with the role of the parents in the feeding of their young need to be studied more specifically and to be verified based on a larger data set.

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Appendix 1. Chick (14–26 days old) feeding frequency by parents (male – M and female – F) and food composition during 7 days in July 2017 in three nests (F and M 1–3). CI – *Calliptamus italicus*, OO – other Orthoptera, C – Coleoptera g.sp., OI – other insects, MA – *Microtus arvalis*, A – *Apodemus* sp., OR – other rodents, LV – *Lacerta viridis*, * – random sampling.

Appendix 1. Frekvencia kŕmenia mláďat (14–26 dní starých) rodičmi (samec – M a samica – F) a zloženie potravy počas 7 júlových dní 2017 na 3 hniezdach (F a M 1 – 3). CI – *Calliptamus italicus*, IR – iné rovnokrídlovce, C – Coleoptera g.sp., IH – iný hmyz, MA – *Microtus arvalis*, A – *Apodemus* sp., IHd – iné hlodavce, LV – *Lacerta viridis*, * – náhodné pozorovania.[1] – slnečno, [2] – polooblačno, [3] – zamračené, dážď, [4] – zamračené, veterno.

parents / rodičia	**No. of feedings / n kŕmení**	**mean feeding frequency / priem. frekv. kŕmenia**	**date / dátum**	**sampling time (CET) / vzorkovací čas (SEČ)**	**weather / počasie**	**food composition / zloženie potravy**							
						CI	**OO / IR**	**C**	**OI / IH**	**MA**	**A**	**OR / IHd**	**LV**
F	11*		12.7.2017	10:00–12:00	sunny[1]	2	3	2	4				
M	4*		12.7.2017	10:00–12:00	sunny	2				1		1	
F1	20	4.5 min	17.7.2017	14:00–15:30	partly cloudy[2]	16			4				
M1	14	6.9 min	17.7.2017	14:00–15:30	partly cloudy	8			5		1		
F1	97	3.7 min	18.7.2017	9:10–15:10	sunny	66	2		29				
M1	63	5.7 min	18.7.2017	9:10–15:10	sunny	45			15	2			1
F1	29	13.1 min	24.7.2017	9:00–15:20	cloudy, rain[3]	6	1		22				
M1	0	0	24.7.2017	9:00–15:20	cloudy, rain								
F2	4	52.5 min	26.7.2017	9:00–12:30	cloudy, rain				1		3		
M2	0	0	26.7.2017	9:00–12:30	cloudy, rain								
F3	17	22.2 min	27.7.2017	9:05–16:22	cloudy, wind[4]	3	1	1	12				
M3	7	53.8 min	27.7.2017	9:05–16:22	cloudy, wind	3		1	3				
F3	20	14.2 min	31.7.2017	8:30–13:15	sunny	10	3		7				
M3	19	15.0 min	31.7.2017	8:30–13:15	sunny	4	2		13				
∑	**305**		**7 days**	**31 h 32 min**		**165**	**12**	**4**	**115**	**3**	**4**	**1**	**1**