

On foraging ecology of the Scops Owl (*Otus scops*) at the northern limit of its area

K potravnjej ekológii výrika lesného (Otus scops) na severnej hranici areálu

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The species is endangered at northern limit of its area and reasons are not known. In its diet were determined in total 884 food subjects belonging to 29 taxa. Markedly dominant were insects (97.9%), rare were spiders (0.5%), birds (0.8%) and small mammals (0.8%). The bush-cricket Tettigonia viridissima (87.6%) was the most important and preferred prey species. The analysis of the video-records and photographs taken at young's feeding has not resulted in finding any food preference associated with the young's age. Preferred foraging strategy was perching and flying onto twigs and leaves of trees and shrubs. Another observed foraging strategy was flying onto flying bush crickets, beetles and butterflies within a layer of 2–6 m above the ground and less frequently flying from a perch onto the ground layer and onto the soil surface. The parents provide their young in the nest mostly with undivided food subjects. In young less than four days in age, the parents tear larger food subjects and divide them in the nest hole. But already the young owls 4–5 days old mostly swallow whole prey items in size of T. viridissima – in spite of the fact that the prey frequently reaches 20–40% of the body length of the birds. The young owls were fed with a frequency of 1.4–11 feedings/ hour (n = 3 nests/ 11 nights), what is less compared to the generally recognized reports from the Mediterranean (5–18/ hour, n = 5 nests/ 5 nights).

Introduction

Slovakia is situated on the boundary separating the Pannonian and Carpathian regions (Pannonian and Carpathian bioregions according to the NATURA 2000), and also on the northern limit of distribution range of several species belonging to the Mediterranean and subtropical fauna. From the birds, there are primarily comprised insectivorous migratory species, e.g. *Lanius minor*, *Monticola saxatilis*, *Falco vespertinus*, *Otus scops*. These species are endangered, especially in Central Europe, and the lack of large insect species (>25 mm) may be a factor of their endangering (Arlettaz et al. 1991, Hagemeyer & Blair 1997).

Our single strictly migratory owl *Otus scops* prefers in its diet – across its whole distribution range – insects, primarily Orthoptera (Herrera & Hiraldo 1976, Cramp 1985, Streit & Kalotás 1991, Bavoux et al. 1993, Danko & Pačenovský 1995, Kellaer & Parrag 1996, Sárossy & Kristín 2003, Marchesi & Sergio 2005). It is breeding in the Pannonian hilly region of Slovakia (Randík 1963, Danko & Sárossy 2002), where especially this insect group is considerably endangered due to intensive farming, using pesticides and loss of diversity in case of both habitats and species (Sárossy et al. 2002, Šotnár 2007). The hitherto obtained knowledge has resulted in finding that the occupied Slovak territories together with their habitats are rich in species diversity in

case of insects and Orthoptera (Krištín & Sárossy 2002).

The aims of this work were i) contribute to knowledge about the diet composition of this species in Slovak breeding sites and make comparison with the data from other parts of the area, ii) identify the main preferred prey species which protection is worth of attention and iii) contribute to knowledge about feeding behaviour and frequency of young's feeding.

Methods

The food analysis was performed based on i) pellet analysis and analysis of food remains, ii) direct observations and analysis of video records iii) analysis of photos taken at feeding of young 1–28 days in age, in five nests (see the description of localities). The video records and photos were taken from a shelter situated at a safe distance (6–10 m) from the nest, to avoid the birds' disturbing and to ensure sufficient identification of the prey. Each locality covered minimally 2 ha within the territory. The field observations on each locality were carried out mainly in June – July, mostly for 3–4 hours, under rainless weather, primarily after the sunset (after 8:30 pm). Three localities also served for 11 nights for continual data assembling on young's feeding frequency, especially in June, at the birds' age of 4–28 days.

Prey species from food remains and pellets were identified using stereomicroscope. The abundance was calculated based on pair body parts (legs, mandibles, wings etc.) and impair body parts (heads, thorax, ovipositors), sexes were determined using egg content and numbers. For quantitative evaluation was used absolute (n) and relative dominance (n%) of prey items (n = 884).

Studied sites

Čeláre, Kirt' (150 m a.s.l., Ipeľská kotlina Basin, quadrate of Databank of Slovak fauna, further DFS 7882) – an about 100-years-old park in the village surrounded by extensively managed (mown) wet meadows and fields on

banks of the Ipeľ River, with a high insect diversity. The nests in a plane tree and a willow tree were observed in years 2000–2002 (two and three nestlings, respectively in 2000 and 2001, in 2002 the nest predated, Sárossy & Krištín 2003).

Bakta, Zacharovce (240–247 m a.s.l., Rimavská kotlina Basin, DFS 7586) – an old isolated settlement with an orchard (> 60 years), managed extensively or without management, surrounded by fields, at a distance of about 700 m from the nearest community. The nest in a black walnut was studied in year 2002 (four nestlings, Sárossy & Krištín 2003).

Prestavky (317–320 m a.s.l., Žiarska kotlina Basin, DFS 7478) – a mixed forest with dominant poplar, hornbeam, cherry and maple (30–50 y.) adjacent to a mesophilous meadow and a sand quarry. The nest in a box with three young individuals was observed in July 13–15, 2006. The nest with four young birds in the same box was observed in July 3–5, 2008.



Fig. 1. Scops Owl female with the Great Green Bush-cricket (Piešťany, July 14, 2008, Photo by S. Harvančík).
Obr. 1. Samica výrka lesného s kobylkou zelenou (Piešťany, 14. 7. 2008, Foto: S. Harvančík).

Piešťany (164 m a.s.l., Trnavská pahorkatina Hills, DFS 7373) – a pasture with solitary poplars and willows at the edge of a floodplain forest by the dyke of the Váh River, the nest in a willow (3.5 m above the ground). The nest with 2–3 young birds was observed in July 13–15, 2008.

Bojnice (290 m a. s. l., Hornonitrianska kotlina basin, DFS 7277) – and lime-maple tree alley (70–80 years old) adjacent to an abandoned meadow, swimming pool and the Castle Bojnice. The nest with four young birds was observed in July 2008.

Other localities were studied for further knowledge on food supply and on control of size of breeding territories (Krištín & Sárosy 2002, Sárosy et al. 2002, Sárosy & Krištín 2003): Mlyňany (180–190 m a.s.l., DFS 7676), Melek (190–200 m a.s.l., DFS 7876), Horné Semerovce (134 m a.s.l., DFS 7879) Slovenské Ďarmoty (150–160 m a.s.l. DFS 7881), Valice (240–250 m a.s.l., DFS 7587).

Results

Diet composition

In the food we have identified in total 884 food objects belonging to 29 taxa. From this amount, there were markedly dominant (according to the number of consumed individuals) consumed insects (97.9%), rarely spiders (0.5%), birds (0.8%) and small mammals (0.8%, Table 1). The Great Green Bush-cricket *Tettigonia viridissima* (87.6%), belonging to the Orthoptera, was the most important and in all the studied localities preferred prey species. It has characteristic crepuscular to nocturnal stridulating and flying activities. We can declare that the presence and abundance of this species in the localities is a necessary condition for breeding presence of the Scops Owl (Fig. 1). In spite of the fact that the males of this species were expected to be preferred – due to their intensive acoustic callings activities, the video-analyses have resulted in up to 78% females identified, and analyses of the food residues from the nests confirmed up to 82% (based on comparison of the amount of

mandibles and calculating the number of eggs per one female individual) females. Also other species and groups of Orthoptera have an important role in the Scops Owl's diet – representing up to 3.9% of the total amount, and together with the mentioned species *T. viridissima* up to 91.5% total amount of the food! Important was a finding of Preying Mantis *Mantis religiosa* in two sites (n = 0.8%), stag beetle *Lucanus cervus* and the biggest Slovak carabide *Carabus coriaceus* in the food. Several insect groups found in the food also manifest, similar to *T. viridissima* crepuscular and night activities, either acoustic (tanner beetle *Prionus coriarius* – 2.5% in food), or flying (moths and hawkmoths from the families Noctuidae and Sphingidae, in total 1.6%). Vertebrates (young birds, dormouse, wood mouse, vole, Table 1) were only found as supplementary food components.

In the food remains found in the nests we also found a high number of ants from the genus *Formica*. We cannot explain the origin of the ants' occurrence there; the case was probably swarming and entering the nest substrate. There have been found only small differences in the diet composition between the Slovak localities.

Feeding behaviour

Based on analysis of video-records and photos taken at young's feeding at five nests, we have not found food preferences associated with the young's age. Practically all the food subjects were delivered by the parents since the earliest youth.

The Scops Owl prefers foraging by flying from a stand (perching) onto twigs and leaves of woody plants and shrubs (bush-cricket *T. viridissima*, *Phaneroptera falcata*, young bird individuals; 58% from 134 observations). Another strategy is flying onto flying crickets (Tettigoniidae), beetles (tanner beetles *P. coriarius*) and butterflies (Noctuidae, Sphingidae) in the layer 2–6 m above the ground (29%), less frequently by flying from the foraging stage onto the ground layer and soil surface (small mammals, bush-cricket *Pholidoptera griseoptera*; 13%). The parents mostly supply their young

Table 1. Diet composition of Scops Owl *Otus scops* in Slovakia and Italy (n = number of individuals; sp. = the taxon was not identified more); Italian data by Marchesi & Sergio (2005).

Tab. 1. Zloženie potravy výrieka lesného *Otus scops* na Slovensku a v Taliansku (n = počet jedincov; sp. = taxón nebol presnejšie identifikovaný); údaje z Talianska podľa Marchesi & Sergio (2005).

Site / Lokalita	Kirt'	Bakta	Prestavky	Prestavky	Piešťany	Bojnice	Slovakia	Italy				
Date / Dátum	2001	2002	2006	2006	2008	2008	2008	2008				
Method / Metóda	video	video	nest	video	photo	nest	photo	nest				
Prey species / Druh koristi							Total		Total			
	n	n%	n	n%	n	n%	n	n%	n	n%		
Araneidea									4	0.8		
<i>Araneus</i> sp.					1		1	2	4	0.5		
Orthoptera									343	68.1		
<i>Tettigonia viridissima</i>	66	41	50	16	23	438	10	127	771	87.6		
<i>Pholidoptera griseoptera</i>		1					4		5	0.6		
<i>Phaneroptera falcata</i>		1							1	0.1		
<i>Decticus verrucivorus</i>		2				3		2	7	0.8		
<i>Gryllotalpa gryllotalpa</i>	2	1				1			4	0.5		
Acrididae	2	1	4			2		6	15	1.7		
Mantodea												
<i>Mantis religiosa</i>			3			1		3	7	0.8		
Coleoptera	1					1		3	5	0.6		
Cerambycidae						1			1	0.1		
<i>Prionus coriarius</i>	2		8			8		4	22	2.5		
<i>Lucanus cervus</i>	1								1	0.1		
<i>Carabus</i> sp.								4	4	0.5		
Curculionidae						2			2	0.2		
Lepidoptera												
Noctuidae	3	2					2	1	8	0.9		
<i>Autographa gamma</i>					1				1	0.1		
Sphingidae	2	1		1					4	0.5		
Sphingidae Larva				1					1	0.1		
Hemiptera												
Pentatomidae								2	2	0.2		
Hymenoptera												
<i>Camponotus</i> sp.			1			2			3	0.3		
Diptera												
Syrphidae			1						1	0.1		
Other Insecta										13	2.6	
Aves (Passeriformes)	1		1	1		1		1	5	0.6		
Sylvidae					1				1	0.1		
<i>Carduelis carduelis</i>						1			1	0.1		
Mammalia (Rodentia)				1		1		1	3	0.3		
<i>Muscardinus avellanarius</i>	1								1	0.1		
<i>Apodemus</i> sp.	1								1	0.1		
<i>Microtus</i> sp.	1	1	1						3	0.3		
Total / Spolu	83	51	69	20	25	463	17	156	884	100	504	100

in the nest with undivided food; if the young is younger than four days, the parents tear and separate larger subjects in the nest hole. Small vertebrates are torn to pieces. Especially up to the young's age of four days, the parents move away sharp and strongly sclerotised parts of the prey's bodies, for example ovipositors, legs and wings which has also been confirmed with findings of food remains in the nests.

In the observed nests we found the following young's feeding frequencies: the three 15–18 day old nestlings at locality Kirt' were fed with

a frequency of 1.4–4.1 feedings/ hour from 9:30 pm – 5:30 am; the four 25–28 day old nestlings at the locality Bakta obtained their food at a frequency of 4–11 feedings/ hour from 9:30 pm – 3:00am, and four 4 day old nestlings at the locality Piešťany were fed 24 times between 9:15 pm – 2:30 am (< 6 feedings/ hour).

Discussion

Quantitative studies of the diet composition were only carried out on a small number of

works and nests. The Orthoptera represented in Central France 46.8% (Bavoux et al. 1993), in the Swiss Alps 67.4% (Arlettaz et al. 1991) and in the Italian Alps up to 78.6% (Marchesi & Sergio 2005, Table 1). Our results confirm key role of orthopterans (91.3%) and the low value of vertebrates (1.6%) in the diet, in spite of differences in the population density of the Scops Owl between the compared European countries (Slovakia < 0.2 pairs/ 100 km², Italia 52–64 p/ 100 km², Marchesi & Sergio 2005). It turns evident that the bush-crickets represent the key food component also for a species in extinction – the critically endangered Seychelles Scops Owl *Otus insularis*, in the diet of which Orthoptera represent 64% (Currie et al. 2003).

In the Scops Owl's diet in Central Europe were primarily identified larger Orthoptera species (> 25 mm long), especially *T. viridissima*, *Platycleis albopunctata*, in smaller amounts *Decticus verrucivorus*, *Gryllus campestris*, *Gryllotalpa gryllotalpa*, *Metrioptera* sp., *Meconema thalassinum*, *P. griseoptera*, *Barbitistes* sp. (Heller & Arlettaz 1994, Keller & Parrag 1996, Marchesi & Sergio 2005), *P. falcata* and *Leptophyes albovittata* (Danko & Pačenovský 1995), rarely *Oedipoda coerulea*, *Stenobothrus* sp. (Novák 1961). Vertebrates were identified only very rarely in these papers (n < 0.5%).

In the Italian Alps, a very high frequency of feeding the young in the nests has been found (13.2 ± 2.2 feedings/ hour (5–18, n = 5 nights/ 5 nests, Marchesi & Sergio 2005). The feeding frequency in the Slovak nests was substantially lower – probably reflecting more difficult accessibility of the prey. At an age of 4–5 days, the young in Slovak localities were able to swallow whole subjects in a size of *T. viridissima* in spite of the fact that the prey frequently reaches up to 20–40% of the length of the bird bodies (similar fact observed Kadochnikov 1963).

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Súhrn

Druh žije dnes na Slovensku a na severnej hranici areálu v izolovaných pároch, čím sa stáva ohrozeným. V práci sa analyzovala potrava ako jeden z významných faktorov prežívania druhov. V potrave mláďat bolo determinovaných celkom 884 objektov potravy patriacich do 29 taxónov. Z toho vysoko dominantne (počtom z konzumovaných jedincov) bol konzumovaný hmyz (Insecta 97,9%), ojedinele pavúky (Araneidea 0,5%), vtáky (Aves 0,8%) a drobné cicavce (Mammalia 0,8%). Jednoznačne najdôležitejším a na všetkých lokalitách preferovaným druhom potravy boli na sledovaných lokalitách kobyľky zelené *Tettigonia viridissima* (87,6%), patriace do rovnokrídlovcov (Orthoptera). Na základe analýzy videozáznamov a fotografií pri kŕmení mláďat neboli zistené nejaké potravné preferencie súvisiace s vekom mláďat. Výrik preferuje lov z posedu náletom na konáriky a listy drevín a krov. Ďalšou lovnou stratégiou je nálet na lietajúce kobyľky, chrobáky a motýle v etáži okolo 2–6 m vo vzduchu a menej z posedu náletom na prízemnú etáž a povrch pôdy. Mláďatám nosia rodičia potravu k hniezdu väčšinou celú, mláďatám do 4 dní hlavne väčšie potravné objekty trhajú a rozdeľujú v hniezdnej dutine. Stavovce sú mláďatám trhané. Vo veku 4–5 dní mláďatá už korist' vo veľkosti kobyľky zelenej *T. viridissima* prehlávajú celú, hoci korist' dosahuje často až 20–40% dĺžky tela mláďat. Mláďatá boli kŕmené vo frekvencii kŕmenia 1,4–11 kŕmení/ hodinu (n = 3 hniezda/ 11 nocí), čo je menej ako v známych štúdiách v Mediteráne (5–18/ h, n = 5 hniezd/ 5 nocí).

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