DIET OF THE TAWNY OWL (*STRIX ALUCO*) IN THE KARST ENVIRONMENT NEAR ŠKOCJANSKE JAME (SW SLOVENIA)

PREHRANA LESNE SOVE *(STRIX ALUCO)* V KRAŠKEM PREDELU BLIZU ŠKOCJANSKIH JAM (JZ SLOVENIJA)

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Lovrenc Lipej & Miran Gjerkeš: Prehrana lesne sove (*Strix aluco)* v kraškem predelu blizu Škocjanskih jam (JZ Slovenija)

V kraškem predelu blizu Škocjanskih jam (jugozahodna Slovenija) smo raziskali prehrano lesne sove (*Strix aluco*). Njene izbljuvke smo pobirali na počivališču ob vhodu v jamo v obdobju 1992-1993. Najpomembnejša vrsta plena je bil polh (*Myoxus glis),* ki je sestavljal 37,7% celotnega plena in 83,5% biomase vsega plena. Žuželke so bile pomembna skupina nadomestnega plena. V članku podajamo tudi spremembe v prehrani v različnih letnih časih.

Ključne besede: lesna sova, *Strix aluco,* prehrana, polh, *Myoxus glis,* Slovenija, Kras, Škocjanske jame

Abstract UDC 598.88:591.13

Lovrenc Lipej & Miran Gjerkeš: Diet of the Tawny Owl (*Strix aluco*) in the karst environment near Škocjanske Jame (SW Slovenia)

The diet of the Tawny Owl *(Strix aluco*) was studied in karst area near Škocjanske Jame (Škocjan Caves) in the southwestern part of Slovenia. Pellets were collected during the 1992-1993 period in the cave entrance in the submediterranean forest belt. The dominant prey group was the Fat Dormouse *(Myoxus glis),* 37.7% by number and 83.5% by weight. Insects were the most important alternative prey. Seasonal variations in the diet are also discussed.

Key words: Tawny Owl, *Strix aluco,* diet, Fat Dormouse, *Myoxus glis*, Slovenia, Kras, Škocjanske Jame

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INTRODUCTION

The Tawny Owl (*Strix aluco*) feeds on a wide range of prey, mainly on small mammals but also on other vertebrates and invertebrates. The diet of this nocturnal raptor has been investigated extensively in most parts of Europe (Southern, 1954; Delmee *et al.*, 1982; Mikolla, 1983; Sara & Massa, 1985; Bochensky, 1990; Kirk, 1992;. Zalewski, 1994). Although the Tawny Owl (*Strix aluco)* is a common owl species throughout Slovenia (Geister, 1995), there is only a scarce number of studies on the diet of this nocturnal bird. Reports on its diet have come from the NE part of Slovenia (Janžekovič, 1986; Šorgo & Janžekovič, 1995) and from the Slovene part of Istria (Lipej, 1988).

This paper presents information about the diet of the Tawny Owl in the submediterranean karst environment near Škocjanske Jame, which are, as an internationally important site, listed in the UNESCO List of World Natural Heritage.

METHODS

Whole and partially broken pellets were collected in a rocky limestone habitat located near doline of Sokolak near Škocjanske Jame. They had accumulated under the nest in the cave entrance. In order to study the seasonal variation in the diet, samples were gathered 4 times in 1992 and once in 1993.

Pellets were broken by hand and all undigested prey remains were sorted and separated. Small mammals were identified from cranial remains by diagnostic features according to Kryštufek (1985, 1991). Birds were determined on the basis of skull remains and humeri, while insects and other invertebrates were identified as to order from chitinous fragments of wings, elitrae and heads. For the abundance assessment of mammal remains, the minimum number of individual prey was counted. The mean prey weight of small mammals for biomass calculations were obtained from Lipej (1988). The mean prey weight of birds (thrushes) and invertebrates was roughly estimated.

STUDY AREA

Breeding site of the Tawny Owl is situated in the rocky habitat near the dolina of Sokolak (Fig. 1), which is covered with dense forest vegetation. The

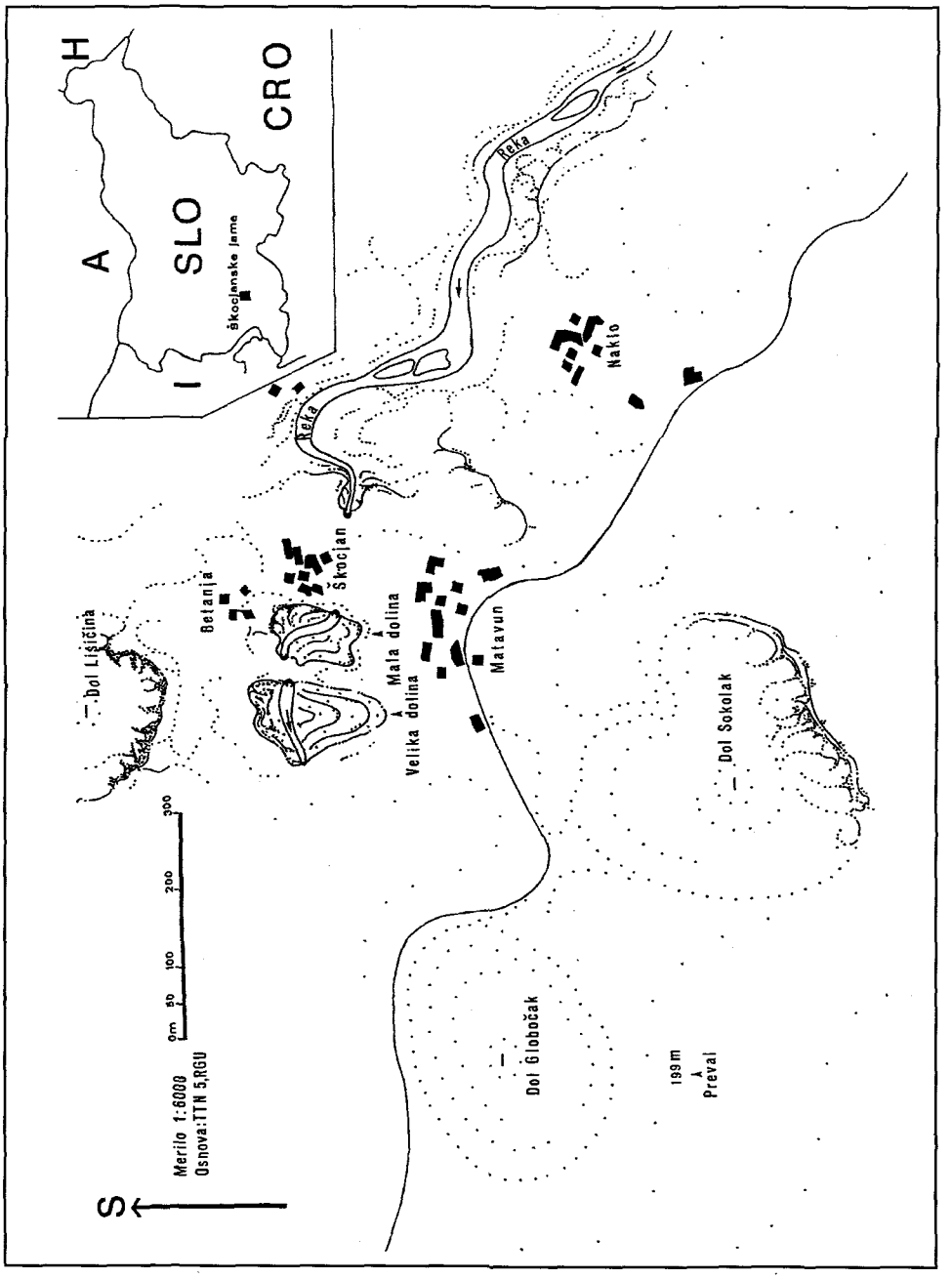

Fig. 1: The study area
Sl. 1: Zemljevid obravnavanega območja

owl's nest is oriented towards doline with a large field in its central part, surrounded by a forest belt. The study area is located in the submediterranean phytogeographic area according to M. Wraber's phytogeographical vegetational map of Slovenia. The background is typically karstic. The forest vegetation is constituted of thermophilous forest association *Ostryo-Quercetum pubescentis* and karst meadows in phase of succession (Kaligarič, pers. comm.).

RESULTS

A total of 321 prey specimens were recovered from 144 whole and some partially broken pellets during the period from 1992 to 1994. Five brown pellets also contained earthworms (Oligochaeta), sand grains and vegetable

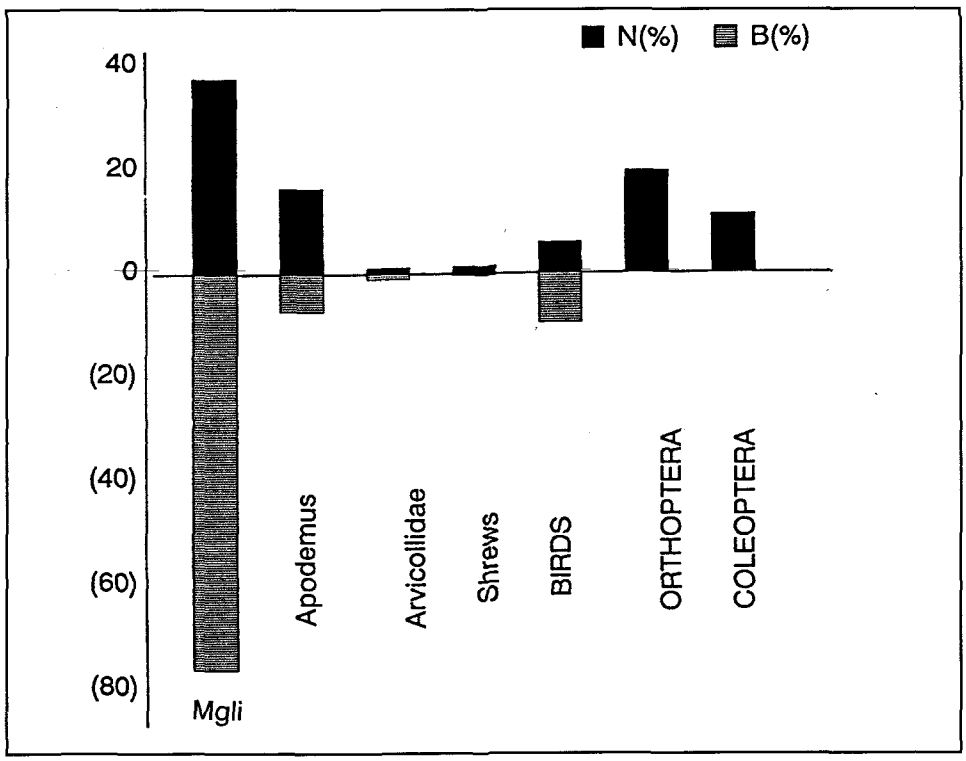

Fig. 2: The proportions of important prey groups in the diet of the Tawny Owl in terms of abundance (N) and biomass (B). Mgli is abbreviation for the Fat Dormouse (Myoxus glis).

*Sl. 2: Deleži najpomembnejših skupin v celotni abundanci (N) in biomasi (B) plena v prehrani lesne sove. Kratica Mgli označuje polha (*Myoxus glis*).*

prey species	N	N(%)	B(%)	W(g)
Myoxus glis	121	37.7	76.2	125
Muscardinus avellanarius	4	1.2	0.6	27.5
Apodemus agrarius	1	0.3	0.1	20.5
Apodemus flavicollis	16	5.0	2.8	35
Apodemus sylvaticus	8	2.5	1.0	24.5
Apodemus spp.	28	8.7	3.5	24.5
Rattus spp.	2	0.6	0.7	72
Pitymys liechtensteini	1	0.3	0.1	20
Chionomys nivalis	3	0.9	0.7	49
Talpa europea	8	2.5	3.8	95
Sorex minutus	1	0.3	< 0.1	4.5
Crocidura suaveolens	2	0.6	< 0.1	5
Crocidura leucodon	2	0.6	0.1	10
Myotis sp.	1	0.3	0.2	20
PASSERIFORMES	19	5.9	9.6	100
DIPLOPODA	1	0.3	< 0.1	1
ORTHOPTERA	65	19.6	> 0.1	1
COLEOPTERA	36	11.2	> 0.1	3
LEPIDOPTERA	1	0.3	> 0.1	1
sum	321	100	100	

*Table 1: The diet of the Tawny Owl (*Strix aluco*) at Sokolak near Škocjanske Jame. The columns represent the number of each prey group in the diet (N) and its percentage (N(%)), the percentage of each prey group in terms of biomass (B(%)) and the mean prey weight in grams of each prey group (W).*

Tabela 1: Prehrana lesne sove v Sokolaku pri Škocjanskih jamah. Kolone ponazarjajo število osebkov posamezne skupine plena (N) in njegov delež (N(%)), delež posamezne skupine v celotni biomasi plena in povprečno težo posamezne skupine plena v gramih (W).

prey species	winter 92	spring 92	summer 92	winter 93	summer 93
Myoxus glis	47 (50)	13 (24.5)	30 (47.6)	20 (50)	11 (15.5)
Muscardinus avellanarius		3 (5.7)		1 (1.6)	
Apodemus agrarius				1 (2.5)	
Apodemus flavicollis	4 (4.3)	3 (5.7)			9 (12.7)
Apodemus sylvaticus	1 (1.1)			2 (5.0)	5 (7.0)
Apodemus spp.	8 (8.5)	4 (7.5)	1 (1.6)	2 (5)	13 (18.3)
Rattus spp.		1 (1.9)		1 (2.5)	
Pitymys liechtensteini	1 (1.1)				
Chionomys nivalis	1 (1.1)	2 (3.8)			
Talpa europea	6 (6.4)	2 (3.8)			
Sorex minutus					1 (1.4)
Crocidura suaveolens	1 (1.1)	1 (1.9)			
Crocidura leucodon	2 (2.1)				
Myotis sp.		2 (3.8)			
PASSERIFORMES	5 (5.3)	7 (13.2)	2 (3.2)	2 (5.0)	3 (4.2)
DIPLOPODA		1 (1.9)			
ORTHOPTERA	7 (7.4)	3 (5.7)	29 (46.0)	10 (25.0)	16 (22.5)
COLEOPTERA	11 (11.8)	10 (18.9)	1 (1.6)	1 (2.5)	14 (19.7)
LEPIDOPTERA		1 (1.9)			
sum	94	53	63	40	71

Table 2: Seasonal variations in the diet of the Tawny Owl at Sokolak (near Škocjanske Jame). The proportions of each prey group are given in parentheses.

Tabela 2: Sezonske spremembe v prehrani lesne sove v Sokolaku pri Škocjanskih jamah. Deleži posameznih skupin plena so podani v oklepajih.

fibres. All brown pellets were found in the winter months, probably due to the wet conditions. Since we were not able to determine the accurate number of earthworms, this prey group was not taken in consideration. Small mammals were the main prey, constituiting 62% by abundance and 90.4% by biomass (Fig. 2). At least 13 species of small mammals were identified in the diet of the Tawny Owl. Among them the Fat Dormouse *(Myoxus glis)* was the dominant prey species, constituting 37.7% of the bird's total prey (Table 1). Other important mammal species were *Talpa europaea*, *Apodemus flavicollis* and *A. sylvaticus*. Only 4 specimens of woles were found in the Tawny Owl's pellets; three of *Chionomys nivalis* and one of *Pitymys liechtensteini*. Shrews were taken only rarely. Birds comprised 5.9% of total prey and 9.6% by weight (Fig. 2). The great majority of birds taken by the Owl were thrushes (family Turdidae). Numerically, invertebrates represented 31.4% of total prey. Proportion of invertebrates by weight was almost negligible. The predominant insect groups taken by the Tawny Owl were Orthoptera and Coleoptera. In the spring period the dominant Coleoptera were cockchafers (*Melolontha melolontha*). The prey taken by the Tawny Owl ranged from less than 1 g (insects and other invertebrates) to 125 g (*Glis Myoxus*).

Seasonal variations in the diet were not very obvious (Fig. 3). The Fat Dormouse was dominant in all sample collections, except in the summer 1993, when Wood Mice of the genus *Apodemus* were taken in higher proportion. The proportion of the Fat Dormouse ranged from 15.5% to 50% of total prey and from 53.6% to 93.7% by weight. The invertebrates were preyed most often in the summer period, particularly grasshopers and cockchafers.

DISCUSSION

In the greatest part of Europe, the Tawny Owl feeds principally on small vertebrates (summarized in Mikolla, 1983). In rural areas the dominant prey species are mostly small rodents, especially voles (Arvicollidae) and mice (Muridae) (summarized in Mikkola, 1983), while in urban and suburban areas birds prevail in its diet (Manganaro *et al.*, 1990; Zalewski, 1994). In our study, the Fat Dormouse was taken by owls throughout the year. The proportion of this species ranged from 15.5% to 50% of total prey and from 54% to 94% by weight. We should point out that we used the mean prey weight of 125g from Lipej (1988). This mean weight is probably overestimated, and for this reason we should rather determine the prey weight from mandible lenght *versus* weight ratio. However, even if such corrections were made, the importance of the Fat Dormouse in the diet of the Tawny Owl would be still great.

High proportions of the Fat Dormouse were recorded also for the Eagle Owl (*Bubo bubo*) from the Slovene part of Istria - 36.4% of the total prey number (Lipej, 1988) and from Karst Edge near Črni kal - 33.3% of the total

prey number (Lipej, 1995). The Fat Dormouse was found also in the pellets and in the nest of the Golden Eagle *(Aquilla chrysaetos)* in Istria (Lipej & Gjerkeš, not published). Šorgo and Janžekovič (1995) reported that the Fat Dormouse represented 12.4% by number and 29.4% by weight in the Tawny Owl's diet from the Pohorje Mountais. However, in other European countries the Fat Dormouse was always recorded in negligible proportions (> 1%) in the diet of European owls (Mikolla, 1983).

The high proportion of the Fat Dormouse in the diet of the Tawny Owl is probably reflected in the high abundance of this species in the owl's hunting territory. The population density of the Fat Dormouse was assessed to be very high in the area around Divaška Jama (B. Kryštufek, personal communication). On the other hand, this tree-living species was probably easier to catch than other species. Since we did not practice any trapping sampling of this arboreal species, we are not able to evaluate the hunting pressure of the Tawny Owl on these mammals. On the other hand, we still lack a simple and relatively exact technique for the assessment of the Fat Dormouse's density.

Generally, the voles of the genus *Microtus* represent the most common prey of owls throughout Europe (summarized in Mikolla, 1983). However, microtines are considered to be rare in the study area (Kryštufek, 1991), as it was reported also for the Istrian region (Lipej & Gjerkeš, 1994). Only two microtine species were preyed by the Tawny Owl. *Pitymys liectensteini* is a fossorial vole, inhabiting open habitats. *Chionomys nivalis* is considered a rock-dwelling species (Kryštufek, 1991) and yet less vulnerable to owl predation.

In Istria, shrews are the most important prey group in the diets of the Tawny and Barn Owls (*Tyto alba*) (Lipej, 1988; Lipej & Gjerkeš, 1994). At the studied site, shrews were rarely taken by the Tawny Owl. The dominant White Toothed Shrews of the genus *Crocidura* inhabit mainly open habitats (Kryštufek, 1991). The presence of the non-forest species in the diet, such as shrews of the genus *Crocidura*, moles and the vole *Pitymys liechtensteini,* indicate that the Tawny Owl hunts also in open habitats like those in dolines. Probably, the Tawny Owl would catch more shrews if the density of the Fat Dormouse declined.

Birds were of minor importance in its diet. The most common prey were species of the thrush family (fam. Turdidae). It seems that these birds are preyed in the vicinity of the Tawny Owl's breeding site, where these birds breed as well. On one ocassion in winter 1993, we found a dropping of the Tawny Owl. From feather remains we identified *Tichodroma muraria*, a bird regularly wintering in the area.

The majority of small mamals preyed by the Tawny Owl are considered forest species (i.e. *Myoxus glis*, *Apodemus flavicollis, A. sylvaticus*). It is evident that the Tawny Owl caught its prey in the forest belt which surrounds the breeding site, as previously confirmed by other authors (Southern, 1954; 1970;

Mikolla, 1983; Bochensky, 1990). Other species, such as moles and shrews, were caught in the doline of Sokolak.

Insects were frequently taken by the owl as an alternative prey. According to the optimal foraging theory, which predicts that a predator should maximize the difference between the energy spent for catching and the energy obtained (Pianka, 1974; Stephen & Krebs, 1986), insects are not a convenient prey group. They are probably preyed by the owl because of reduced availability of the main prey - the Fat Dormouse. On the other hand, invertebrates were preyed mostly in summer period, when the dense vegetation cover reduces the availability of ground small mammals, as previously suggested by various authors (Southern, 1954; Shrubb, 1980).

PREHRANA LESNE SOVE (*STRIX ALUCO*) V KRAŠKEM PREDELU BLIZU ŠKOCJANSKIH JAM (JZ SLOVENIJA)

Povzetek

Čeprav je lesna sova ena izmed najpogostejših slovenskih sov, je bilo opravljenih presenetljivo malo ekoloških in bioloških raziskav o tje ptici. V tem prispevku podajava rezultate preiskave sovjih izbljuvkov iz Sokolaka pri Škocjanskih jamah, kjer lesna sova redno gnezdi. Počivališče lesne sove sva odkrila v skalnem biotopu, ki ga obdaja submediteranski gozd črnega gabra in hrasta puhovca *Ostryo-Querceto pubescentis.* Na dnu doline se odpirajo travišča in manjša polja.

Preiskava izbljuvkov lesne sove je pokazala, da je polh (*Myoxus glis*) najpomembnejša vrsta plena. Njegov delež je v letih 1992-1993 znašal od 15.5% do 50% celotnega plena. Od drugih vrst malih sesalcev so bile plenjene predvsem gozdne miši (rod *Apodemus)* in krti (*Talpa europea)* Delež rovk in voluharic je bil presenetljivo majhen. Od drugih vretenčarjev je lesna sova občasno plenila tudi ptice. Žuželke so bile pomembna skupina nadomestnega plena. Še posebej v poletnem obdobju so bili pogosto plenjeni ravnokrilci in hrošči, predvsem majski hrošči *(Melolontha melolontha).* V petih rjavih izbljuvkih smo našli ostanke deževnikov, ki pa jih zaradi praktičnih razlogov (neprimerljivosti metode z drugimi metodami štetja plena) nismo vključili v obravnavo.

O vlogi polha v prehranjevalni verigi evropskih gozdov skorajda ni podatkov. Edini primerljivi deleži polha v prehrani lesne sove so znani s Pohorja (Šorgo & Janžekovič, 1995), sicer pa je, sklicujoč se na razpoložljive podatke v literaturi, delež te vrste povsod v Evropi neznaten. Polh je pomembna vrsta plena tudi v prehrani velike uharice in planinskega orla iz podobnih habitatov v Istri.

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Tawny Owl (Strix aluco) *(Photo by T. Makovec)*
Lesna sova (Strix aluco) *(Foto T. Makovec)*