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Diet composition and spatial patterns of food caching in wintering Great Grey Shrikes (*Lanius excubitor*) in Bulgaria

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Abstract: Diet composition of the Great Grey Shrike (*Lanius excubitor*) was studied on the basis of cached prey, pellets and food remains collected beneath perches, from November to March for 5 years (1998–2002). The ratio of vertebrates and invertebrates (by numbers) was nearly 1:9. Pellet dimensions were on average 25.4 (±5.45) mm × 10.8 (±1.13) mm. A total of 104 caches were found, including 95 with *Gryllus campestris*. Most caches were fixed on plants (91.3%) and the rest on barbed wire. Stored prey items were placed at an average height of 1.05±0.29 m (range 0.57–1.9 m) above ground, most commonly in the middle part of the plants. Storage height was significantly correlated with plant height. Patterns of impaling were also studied – about half of the specimens of *G. campestris* were impaled through the forepart of the abdomen. A latitudinal cline in the proportion of vertebrates in the Great Grey Shrike diet during winter in Europe proved to be statistically significant.

Key words: Great Grey Shrike, *Lanius excubitor*, winter, diet composition, food caching, Bulgaria

INTRODUCTION

The Great Grey Shrike (*Lanius excubitor*) is widely distributed throughout the temperate zone of the Holarctic region (HARRIS & FRANKLIN 2000). In Europe the species shows a moderate decline, especially in the medium-latitudinal parts (LEFRANC 1997), and like most other shrike species (*Lanius* spp.), it is of conservation concern (VAN NIEUWENHUYSE 1999). Its food composition – diverse invertebrates (chiefly insects) and small vertebrates – is relatively well-studied, but mainly in Central, Western and Northern Europe (see compilations in CRAMP & PERRINS 1993, GLUTZ VON BLOTZHEIM & BAUER 1993).

In Bulgaria the Great Grey Shrike is an irregular breeder, but numerous during late autumn and winter in lowlands and hilly parts of the country. Foraging ecology of this species was not previously studied in Bulgaria and only sporadic data about

single stomach contents analyses and short notes on its diet have been published (summarized in NANKINOV & NIKOLOV 2003).

Here, we present data on food composition and some spatial patterns of food caching in the wintering population of Great Grey Shrikes in Bulgaria.

MATERIAL, STUDY SITES AND METHODS

A total of 201 prey items from caches (51.7%), pellets (43.3%) and food remains (5%) were identified. HERNÁNDEZ (1999) thought that among the three above-mentioned methods the best results could be achieved by pellet analysis. The data for the present study were collected during 5 years (1998–2002) from November to March (the main part of the material was from December–February). The following localities were studied (most being among the high fields of W Bulgaria):

(1) Western Bulgaria: the fields between Anton and Doushantsi villages (42º43'N, 24º19'E; altitude 750 m a.s.l.), Kambanite area (42º37'N, 23º23'E; 590 m a.s.l.), Koprivshtitsa (42º37'N, 24º23'E; 1000 m a.s.l.), Baykalsko village (42º27'N, 22º50'E; 800 m a.s.l.), Iskar reservoir (42º27'N, 23º34'E; 850 m a.s.l.) and Bezden village (42º53'N, 23º06'E; 600 m a.s.l.).

(2) Northern Bulgaria: the region of Yablanitsa (43º02'N, 24º07'E; 450 m a.s.l.).

Moderate continental climate and basin-like, low-mountain and hilly relief characterize all areas under study. The territories occupied by Great Grey Shrikes were mainly located in open terrain with patchy landscape: pastures (often with barbed wire fences) and arable land with lots of forest belts (including solitary bushes and trees), sometimes in proximity to large wooded areas or wetlands.

Like pellets and food remains, all caches were removed when found – for identification and to avoid double counting. We recorded how each cache was fixed, the height above ground, and total plant height. The collected material was preserved in 75% ethanol and subsequently analysed. For every pellet the minimum number of individuals of prey per taxon was estimated. A spring balance "Pesola" (±0.1 g) was used for weighing the pellets after being collected and dried. All percentages of the taxa found in the Great Grey Shrike food composition are based on number of individuals and not biomass. The statistical analyses were performed following FOWLER & COHEN (1996). All data are presented as mean ±SD.

RESULTS

Food composition

A total of 201 prey items were identified, belonging to 22 taxa (Table 1). The ratio of vertebrates and invertebrates in the Great Grey Shrike food was nearly 1:9 (Fig. 1). Insects comprised the main part of the diet and were the only invertebrates (Fig. 2). Among them orthopterans (Orthoptera) predominated – 64.4%, and crickets (Gryllidae) were 98.3% of all orthopterans. Beetles (Coleoptera) comprised 31.6%, Carabidae being the most numerous among them (86%). Heteroptera, Hymenoptera and Lepidoptera in the diet were rare (0.6–2.2%) in comparison to orthopterans and beetles.

Table 1. Diet composition of the Great Grey Shrike (*Lanius excubitor*) during winter in Bulgaria

PREY ITEMS	Kambanite area	Anton - Doushantsi	Koprivshtitsa	Baykalsko	Yablanitsa	Bezden	Iskar reservoir	TOTAL	
	n	n	n	n	n	n	n	n	%
INSECTA g. sp.		1						1	0.5
ORTHOPTERA									
Gryllidae									
Gryllus campestris	19	59	10	1	5	1		95	47.2
Gryllus sp.		11	8					19	9.4
Gryllotalpidae									
Gryllotalpa gryllotalpa		1						1	0.5
Acrididae									
Chorthippus parallelus			1					1	0.5
HETEROPTERA g. sp.					1			1	0.5
COLEOPTERA g. sp.		1			1			2	1.0
Carabidae g. sp.	1	21	5		7			34	16.9
Calathus sp.	4							4	2.0
Harpalus rufipes		1						1	0.5
Harpalus sp.	2	5			3			10	5.0
Scarabaeidae g. sp.		4						4	2.0
Geotrupes sp.			1					1	0.5
Pentodon sp.			1					1	0.5
HYMENOPTERA									
Formicidae g. sp.					4			4	2.0
LEPIDOPTERA g. sp.	1							1	0.5
INSECTA subtotal								180	89.5
REPTILIA									
Lacerta agilis		1						1	0.5
REPTILIA subtotal								1	0.5
RODENTIA g. sp.		6			1			7	3.5
Microtus subterraneus		3						3	1.5
Microtus ex gr. *arvalis*			1	1	1		1	4	2.0
Soricidae g. sp.					1			1	0.5
Micromammalia g. sp.	1	4						5	2.5
MAMMALIA subtotal								20	10.0
Plant remains		+							
TOTAL	28	118	27	2	24	1	1	201	100.0

n – number of specimens

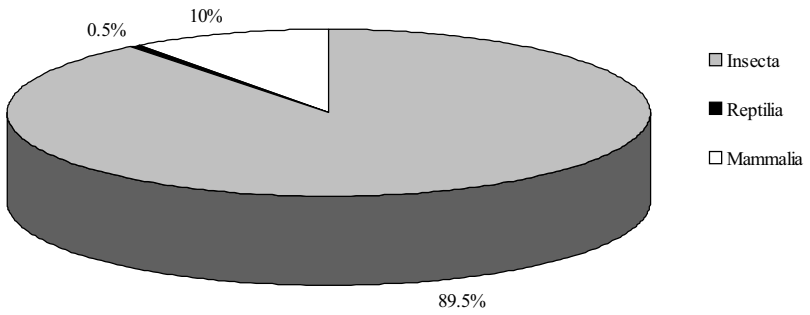

Fig. 1. Diet composition of the Great Grey Shrike (*Lanius excubitor*) during winter in Bulgaria (n=201 prey items)

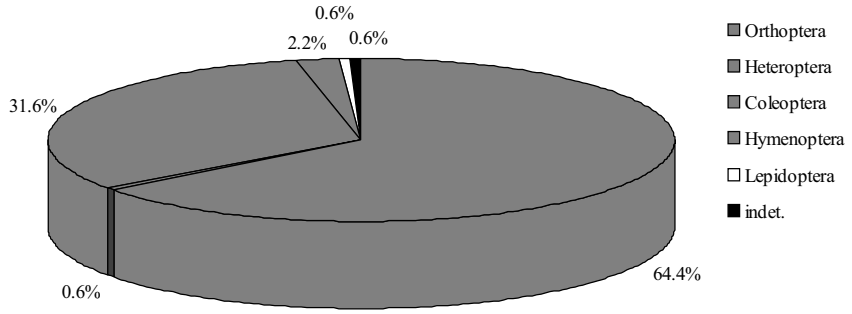

Fig. 2. Proportion of the main taxa of insects (Insecta) in the diet of the Great Grey Shrike (*Lanius excubitor*) during winter in Bulgaria (n=180 prey items)

Some plant remains (parts of twigs, 1–2 per pellet) were present in three of the pellets found in the region of Anton-Doushantsi. Their mean size was 11 mm × 0.8 mm (6–18 mm × 0.5–1.5 mm; n=3).

Pellets

Out of 19 pellets collected, the average dimensions of 12 intact ones were 25.4±5.45 mm × 10.8±1.13 mm (17.0–34.0 mm × 9.0–12.5 mm). The dry weight of 9 pellets was also measured: 0.43±0.19 g (range 0.2–0.8 g). The colour of pellets varied from grey, dark brown-black to black, depending on their composition: fur and bones of small mammals or chitinized insect remains.

Caches

Spatial distribution of caches. A total of 104 caches were found, with animals belonging to 9 taxa (Table 2), placed on a barbed wire and various plants. The latter were separated into three main groups: trees (in most cases they were small, bush-like, about 2 m high; the highest reached 4.2 m), bushes, and weeds (large herbs).

Table 2. Spatial distribution of prey items cached by the Great Grey Shrike (*Lanius excubitor*) during winter in Bulgaria

CACHED PREY LOCATION	Mean length of thorns/ twigs with stored prey [mm]	Insecta							Reptilia	Mammalia	TOTAL
		Orthoptera		Coleoptera							
		Chorthippus parallelus	*Gryllotalpa gryllotalpa*	*Gryllus campestris*	*Harpalus rufipes*	*Geotrupes* sp.	*Pentodon* sp.	Lepidoptera larva indet.	*Lacerta agilis*	*Microtus* ex gr. *arvalis*	
TREES (n=52)											
Alnus glutinosa	22.3±5.7 (n=6)	-	-	6	-	-	-	-	-	-	6
Populus sp.	12 (n=1)	-	-	1	-	-	-	-	-	-	1
Prunus cerasifera	22.7±15.5 (n=9)	1	-	23	1	1	-	-	-	1	27
Prunus spinosa	10.8±3.18 (n=2)	-	-	3	-	-	-	-	-	-	3
Pyrus pyraster	20 (n=1)	-		1	-	-	-	-	-	-	1
Salix sp.	34.3±26.0 (n=4)	-	1	12	-	-	-	-	-	-	13
? Dry fallen tree	-	-	-	-	-	-	-	-	-	1	1
BUSHES (n=13)											
Crataegus monogyna	14.0±7.1 (n=2)	-	-	6	-	-	-	-	-	-	6
Rosa sp.	-	-	-	4	-	-	-	-	1	-	5
Rubus sp.	22 (n=1)	-	-	2	-	-	-	-	-	-	2
WEEDS (n=30)											
Arctium lappa	-	-	-	4	-	-	-	-	-	-	4
Artemisia sp. *(?absyntium)*	-	-	-	4	-	-	-	-	-	-	4
Cichorium intybus	-	-	-	1	-	-	-	-	-	-	1
Cirsium vulgare	24.0±5.4 (n=15)	-	-	19	-	-	-	1	-	-	20
Pulicaria sp.	32 (n=1)	-	-	1	-	-	-	-	-	-	1
BARBED WIRE (n=9)		-	-	8	-	-	1	-	-	-	9
TOTAL	23.1±11.9 (n=42)	1	1	95	1	1	1	1	1	2	104

n – number of specimens

Among trees, the Cherry Plum (*Prunus cerasifera*) and willows (*Salix* sp.) were most frequently used – 51.9 and 25%, respectively. The bushes of Common Hawthorn (*Crataegus monogyna*) and Dog Rose (*Rosa* sp.) held similar amounts of caches (46.2 and 38.5%, respectively). Among weeds, the Spear Thistle (*Cirsium vulgare*) was most commonly used for caching – 66.7%. The length of thorns/twigs used by Great Grey Shrikes as cache-holders was on average 23.1±11.9 mm (range 7.0–62.0 mm; n=42). Among caches, the Field Cricket (*Gryllus campestris*) was the most frequent prey – 91.3%. The other taxa were represented by 1–2 items each.

The Great Grey Shrike caches were placed at a height of 1.05±0.29 m (range 0.57–1.9 m; n=104). Most of them (94.2%) were located up to 1.5 m above ground (Fig. 3).

The stored prey was usually fixed in the middle parts of the plants – at 57.5±13.7% (range 31.4–93.0%; n=70) of their total height. As a main part of the caches, the Field Cricket showed similar results – 1.04±0.28 m (range 0.57–1.9 m;

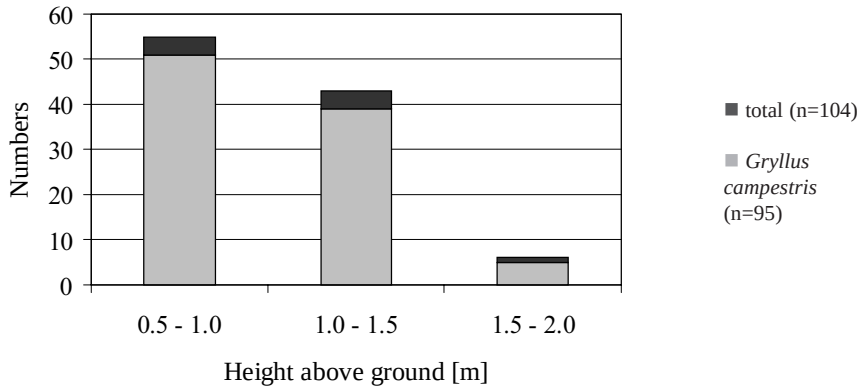

Fig. 3. Distribution of cached prey items of the Great Grey Shrike (*Lanius excubitor*) during winter in Bulgaria in relation to height above ground

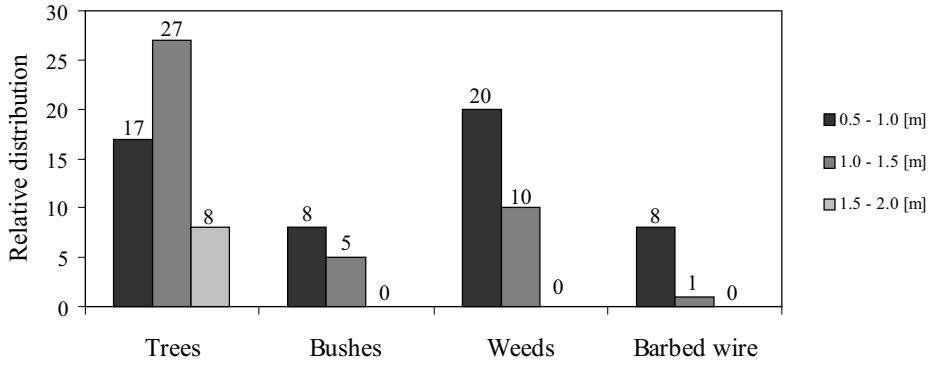

Fig. 4. Distribution of the cached prey items of the Great Grey Shrike (*Lanius excubitor*) during winter in Bulgaria in relation to height above ground and substrate (n=104)

n=95) above ground and 57.0±13.4% (range 31.4–92.5%; n=64) of the plants' total height. Storage height was significantly correlated with plant height (Pearson correlation r = 0.653, n=70, $P < 0.05$).

The differences in the mean height above ground between thorny and non-thorny plants (pooled data) were not significant (Mann-Whitney test, $P > 0.05$), also when data were treated within separate groups – trees (t-test = -1.88, df = 50, $P > 0.05$) and weeds ($t = 0.026$, df = 28, $P > 0.05$); all three species of bushes were thorny plants.

The distribution of all caches in relation to the place of location and height above ground is shown in Fig. 4. Most of the caches on bushes, weeds and barbed wire were fixed at 0.5–1.0 m, while those on trees at 1.0–1.5 m, which can be explained by the larger total height of the latter.

In four cases we found 2–3 caches on the same tree – twice on a small willow (two Field Crickets on each) and twice on Cherry Plums: with 3 items (2 × *G. campestris* and 1 × *Harpalus rufipes*) and 2 items of stored prey (*Geotrupes* sp. and *Chorthippus parallelus*). In the latter case both caches were impaled on the same thorn.

Patterns of prey fixation. Almost all insects among the stored prey were impaled through the abdominal region of their bodies – the Field Cricket (as the most numerous stored prey) was not an exception (Table 3). About half of cached crickets

Table 3. Impaling patterns of Field Cricket (*Gryllus campestris*) – the most frequent of the cached prey of the Great Grey Shrike (*Lanius excubitor*) – during winter in Bulgaria

Impaling patterns of *Gryllus campestris*	Number and % of individuals	
	n	%
Through the head	2	2.2
Between the thorax and head	4	4.4
Through the thorax	10	11.0
Between the thorax and abdomen	26	28.6
Through the abdomen (the forepart)	48	52.7
Through the left foreleg	1	1.1
TOTAL	91	100.0

(52.7%) were impaled through the forepart of the abdomen. Together with the cases of impaling between thorax and abdomen (28.6%) and through the thorax (11.0%), overall 92.3% of the Field Crickets were impaled through the thorax or abdomen. The rest (through the head, between head and thorax and through the left foreleg) comprised 7.7%. In 3 cases the crickets were not impaled, but wedged between a small twig and the main trunk; for 1 case we lack data.

The only reptile found cached, Sand Lizard (*Lacerta agilis*), was impaled laterally in the body foreparts, just behind the forelegs. Voles (*Microtus arvalis*) were also impaled in their foreparts – one was intact and impaled between one of the forelegs and throat; the head and forelegs of the other were missing and it was wedged in a fork.

DISCUSSION

Food composition

The Great Grey Shrike is often considered a raptor-like passerine (SCHÖN 1994a, 1996) and is known to prey upon vertebrates readily. The established ratio of vertebrates to invertebrates in its food composition during winter in Bulgaria is one of the few where the difference between these two groups is big (invertebrates predominated about 8.5 times). When compared to other studies in Europe (Table 4) it is obvious that, in general, going further north the proportion of vertebrates in its diet during winter gradually increases. This latitudinal cline was confirmed statistically (Fig. 5; linear regression $R^2 = 0.753$, $P < 0.001$). Most probably this could be

Table 4. Proportion of vertebrates and invertebrates in the diet of the Great Grey Shrike (*Lanius excubitor*) during winter in Europe

Approx. coordinates	Country	Ratio vertebrates : invertebrates	Material analysed	Source
~64ºN, ~24ºE	W Finland	100 : 0 %	pellets	HUHTALA et al. (1977)
60º17-20'N, 22º08-25'E	SW Finland	66.2 : 33.8 %	pellets	KARLSSON (1998)
58-59ºN, ~17ºE	S Sweden	79.9 : 20.1 %	pellets, caches	OLSSON (1986)
50º55'N, 34º49'E	Ukraine	62.6 : 37.4 %	pellets	KNYSH et al. (1991)
~50º30'N, ~12º47'E	E Germany	57.4 : 42.6 %	pellets	OESER (1974)
50º0-30'N, 5º40-50'E	S Belgium	32.5 : 67.5 %	pellets	BOCCA (1999)
~50N	W Germany	61.9 : 38.1 %	pellets, food remains	GRÜNWALD (1983) (cit. in CRAMP & PERRINS 1993)
~49º20'N, ~21º20'E	NE Slovakia	61.6 : 38.4 %	stomach contents	HROMADA & KRIŠTÍN (1996)
~49ºN, ~15ºE	S Czech Republic	56.8 : 43.2 %	pellets, food remains	BOHÁČ (1964) (cit. in CRAMP & PERRINS 1993)
~48ºN	S Germany	38.3 : 61.7 %	pellets	BAYER (1950) (cit. in MESTER 1965)
~47ºN	NW Switzerland	38.3 : 61.7 %	pellets	BASSIN et al. (1984) (cit. in OLSSON 1986)
42º27'-43º02'N, 22º50'-24º23'E	W Bulgaria	10.5 : 89.5 %	caches, pellets, food remains	Present study

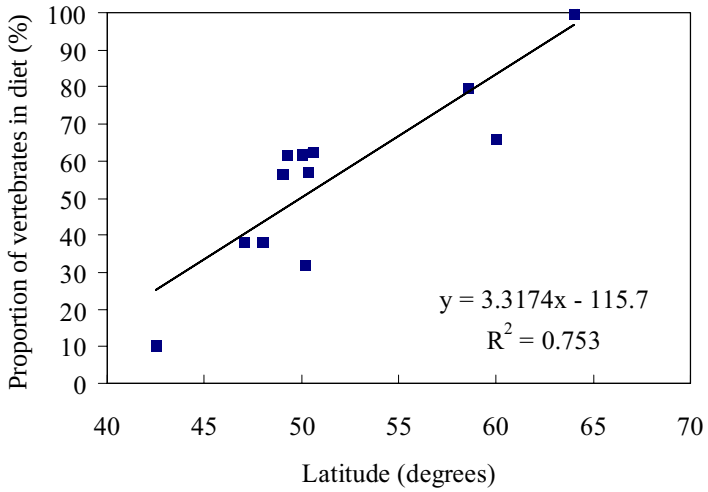

Fig. 5. Proportion of vertebrates in the Great Grey Shrike (*Lanius excubitor*) diet during winter versus latitude in Europe

explained with the more severe winters in the northern parts of the Great Grey Shrike wintering range. A comparison between studies in Northern and Central Europe revealed a higher vertebrate prey range in the north (KARLSSON 2002). A study in North America (43º30'N) showed that vertebrates comprised 36.1% of the winter diet of this species (ATKINSON & CADE 1993), which fits well into the above relationship described for Europe. HAENSEL & HEUER (1970, 1974), studying Great Grey Shrike pellets in NE Germany, found few vertebrates (7.3%) in its food composition during winter.

In SE Europe the southern border of the Great Grey Shrike wintering range passes through Bulgaria and Northern Greece (HANDRINOS & AKRIOTIS 1997, NANKINOV & NIKOLOV 2003). Due to the Mediterranean influence, severe and snow-rich winters rarely occur in the region. On sunny and warm days, when snow cover is lacking, lots of invertebrates are active. The present study showed that the Field Cricket is the most frequent prey of the wintering Great Grey Shrikes in Bulgaria. This species is distributed throughout the country – mainly in lowlands, but also in mountains up to 1800 m a.s.l. (BURESCH & PESCHEV 1957). Field Crickets spend most of the time close to their burrows, remaining in direct sunlight, so they are easy to catch (pers. obs.). Probably because of this, the Great Grey Shrike in Bulgaria rarely caches food and rarely preys upon vertebrates (in comparison to its Central and Northern European wintering grounds) because most of the time such a suitable and easily caught prey is available. Most probably this explains the smaller individual territories (21.25±13.1 ha; range 10–40 ha, n=4) of this species in Bulgaria, compared to those in Central (52–68 ha; SCHÖN 1994b) and Northern Europe (110–144 ha; OLSSON 1984b; KARLSSON 2001).

The optimal foraging theory is valid for the Great Grey Shrike – the birds preferred to hunt invertebrates when these were available rather than to adopt a hunting strategy that would optimise the encounter rate with vertebrates (KARLSSON 2001).

However, when rodents and shrews (Soricidae) could be caught, smaller and younger individuals of medium-sized species were preferred (HERNÁNDEZ 1995b). KARLSSON (2002) found increased prey diversity in conditions of lower prey availability.

When snow cover is present and the area is suitable, the Great Grey Shrikes frequently inhabit slopes with southern exposure. At such places the snow melts earlier and the opportunities for catching a greater variety of prey is increased (pers. obs.).

During the present study, a bird as prey of the Great Grey Shrike was not observed. They are difficult to catch and their proportion in the food composition of the study species increases parallel to the depth of snow cover and increased degree of winter harshness (LEIVO 1942, OLSSON 1984b, c). In Finland the percentage of birds in the Great Grey Shrike diet is higher in February (KARLSSON 1998). Numerous short notes (HARISSON 1961, STOKOE 1961, MESTER 1965, JOBSON 1967, KRIMMHOLZ 1984, NIKOLAEV 1998) or longer articles (OLSSON 1986, YOSEF 1989, LOREK et al. 2000, FUISZ & YOSEF 2001) have been published on birds that were attacked or taken by Great Grey Shrikes. In some cases single shrikes become specialists in catching certain bird species (ŠTANCLOVÁ 1983). Sometimes birds entangled in mist-nets are also attacked (NANKINOV & NIKOLOV 2003). For the Great Grey Shrike even acoustic luring of avian prey was recorded (ATKINSON 1997). According to a study on three species of shrikes in NW Spain, the majority of the attacks on birds did not involve the purpose of capture, and were probably caused by interference competition (HERNÁNDEZ 1993). Similar data for the Southern Grey Shrike (*Lanius meridionalis*) in Senegal were given by TYE (1984).

During late autumn and winter in Bulgaria (between 1992 and 2002) Great Grey Shrikes attacked a Green Woodpecker (*Picus viridis*), Skylark (*Alauda arvensis*), Fieldfare (*Turdus pilaris*), Redwing (*T. iliacus*) and small unidentified passerines (*Passer* or *Carduelis*). On the island of Vardim (Danube River, NE Bulgaria), in winter (February 12, 1998) and with deep snow-cover, a Great Grey Shrike caught a Great Tit (*Parus major*) and alighted on a bush nearby, wedging it about 2 m above ground (S. Marin, pers. comm.). Additional information on Great Grey Shrikes attacking birds in Bulgaria was summarized by NANKINOV & NIKOLOV (2003).

The plant remains (parts of twigs and buds) found in some of the pellets most probably served as gastroliths, supporting digestion.

Pellets

The established pellet dimensions are very similar to those given in a number of references. According to HUHTALA et al. (1977) the Great Grey Shrike pellets had the following dimensions: 27.5 × 12.0 × 9.5 mm (n=900; the largest sample of *L. excubitor* pellets found in the literature).

Similarly, the dry weight of pellets from Bulgaria is very close to that recorded in other parts of the Great Grey Shrike range: Ukraine (mean 0.54 g, range 0.15–1.25 g) and Belgium (0.55±0.21 g) (KNYSH et al. 1991, BOCCA 1999). GORBAN (2000) reported about weight of 2.5–4.3 g, but most probably these values concern fresh and/or not completely dry pellets.

Caches

Lots of studies on food storage by shrikes (*Lanius* spp.) have focussed on the ontogeny of impaling and wedging of prey (LORENZ & VON SAINT PAUL 1968, SMITH

1972, 1973, BUSBEE 1977). Others discussed this phenomenon in general (BEVEN & ENGLAND 1969). Still others dealt with the variety of prey cached (for the Western Palaearctic see compilation in CRAMP & PERRINS 1993) and its role (e.g., YOSEF & PINSHOW 1989). HERNÁNDEZ (1995a) contributed to revealing some of the temporal-spatial patterns of food caching in two sympatric shrike species in NW Iberia.

Spatial distribution of caches. Most of the prey items found stored (91.3%) were placed on natural substrate (plants), whereas the rest on barbed wire. While two thirds of all caches found in Bulgaria were on thorny plants, in Scandinavia the majority of Great Grey Shrikes stored prey on willows: 49% in Sweden (OLSSON 1984a, 1985) and 75% in Finland (KARLSSON 1997). In Belgium caches of this shrike species were found mainly in *Crataegus* bushes, at a height of 0.5–2 m above ground (BOCCA 1999).

While studying the food caching of Red-backed Shrikes (*Lanius collurio*) and Southern Grey Shrikes in NW Spain, HERNÁNDEZ (1994) found that *Crataegus* and *Prunus* thorns (cylindrical and thin) seemed to allow a better attachment of impaled prey than those of *Rosa* and *Rubus* (laterally flattened and wide) and than twigs. The same author gave the following measurements of *Crataegus* and *Prunus* thorn length: 3.7±2.1 cm (n=48) and 3.7±1.7 cm (n=28) respectively, whereas the length of twigs was 2.5±1.7 cm (n=20). Long thorns, growing upwards and fairly vertical, were mainly used. All above-cited values of thorn/twig length appear to be larger than those measured in Bulgaria.

In Bulgaria the stored prey items of Great Grey Shrikes were found to be placed fairly low above ground – mainly up to 1.5 m (94.2%). Similar data were given by OLSSON (1985) for Sweden (about 73%). In Spain the cached food of the Southern Grey Shrike (considered as a subspecies of *L. excubitor* until recently: ISENMANN & BOUCHET 1993, ISENMANN & LEFRANC 1994, LEFRANC 1995) was placed significantly lower than that of Red-backed Shrikes (HERNÁNDEZ 1995). In the same study, about 44% of all prey items and most vertebrates cached were located in inner parts of shrubs.

During the present study, up to 2–3 caches were found on the same tree (4 cases), but their number can exceed 10 (CADE 1967, PARROTT 1980, YOSEF & PINSHOW 1989).

Patterns of cache fixation. Unlike in the present study, HERNÁNDEZ (1995) stated that most of the insects cached by *L. collurio* and *L. meridionalis* were impaled through the thorax. The large percentage of Field Crickets (almost 53%) found to be impaled through the forepart of the abdomen could be explained at least in two ways: (1) this part of their bodies is soft and easy to be impaled; and (2) the birds probably try to fix the prey in its middle part (usually most easy for handling). This may explain why only 2.2% of all crickets were impaled through the head – although it is larger and wider than thorax, strongly chitinized and is the endmost body part.

Both voles cached in this study were fixed in the forepart of their bodies; similar data were reported for most other vertebrates (HERNÁNDEZ 1994). One of them lacked the forepart of its body. According to OLSSON (1986) the Great Grey Shrike rarely eats all of a prey in the case of small mammals; the head and anterior part of the body were usually preferred. In general, invertebrates and reptiles were stored alive, whereas amphibians, birds, and small mammals were stored dead (HERNÁNDEZ 1994).

In Sweden most of the cached food, mainly vertebrates, were fixed in forks (54%) instead of being impaled (OLSSON 1985).

ULLRICH (1971) established that the Great Grey Shrike has developed a behaviour pattern as a safeguard against prey items becoming useless through freezing – it breaks up large prey and impales pieces of eatable size, which may also be eaten in a frozen state.

During the present study we did not observe other animals cleptoparasitizing any of the cached prey as previously reported by several researchers about Magpie (*Pica pica*), Jay (*Garrulus glandarius*) (KÜBEL & ULLRICH 1975, OLSSON 1985, KARLSSON 1997), but even mammals, such as the Red Fox (*Vulpes vulpes*) (OLSSON 1985).

Only once was the capture of a vole observed directly (17 November 2001, Yablanitsa region) – the shrike caught it in its beak, sat for a while on a nearby bush, and then flew away carrying the vole in its feet. The mode of prey transport was described by YOSEF (1993) for the Loggerhead Shrike (*L. ludovicianus*) in North America: small prey are transported in the beak, middle-sized prey in beak and then feet, and large (heavy) prey only in feet. Similar data for the Great Grey Shrike in Europe are quoted by LOREK et al. (2000). ULLRICH (1971) and DORKA (1975) showed that in comparison to the Woodchat Shrike (*L. senator*) and Red-backed Shrike, the Great Grey Shrike least frequently uses its feet when eating – it prefers to impale and wedge its prey.

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