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FOOD OF THE LESSER KESTREL (*FALCO NAUMANNI*) IN ITS WINTER QUARTERS IN SOUTH AFRICA

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KEY WORDS: *Lesser Kestrel*; Falco naumanni; *winter quarters*; *South Africa*; *diet*; *Solifugae.*

The Lesser Kestrel (*Falco naumanni*) has undergone a drastic decline in this century in its breeding range in the southern Palearctic and is classified as RARE in the *Red Data Book* (del Hoyo et al. 1992, Tucker and Heath 1994). At present, 6000–10 000 breeding pairs occur in Europe (Gonzalez and Merino 1990). Recently, the greatest density of breeding Lesser Kestrels was reported in Spain, where an estimated 20 000–50 000 breeding pairs in 1980 had fallen to 4200–5100 by 1990 (Tucker and Heath 1994).

The Lesser Kestrel is migratory and most individuals winter in the grasslands of the Free State in South Africa (Siegfried and Skead 1971, del Hoyo et al. 1992). A drastic decline in wintering Lesser Kestrels was also noted in this province, where ca. 74 000 birds were recorded during the austral summer of 1966–67 (Siegfried and Skead 1971) and only 33 900 during the austral summer of 1992–93 (Roos and Roos 1986, Colahan 1993). Prey contaminated by pesticides and the destruction of natural habitats in the Lesser Kestrel's breeding range have been suggested as the main factors responsible for the decline (del Hoyo et al. 1992, Tucker and Heath 1994).

Food availability is one of the most important ultimate factors controlling any avian population and information on the diet of a declining species, such as the Lesser Kestrel, is therefore vital for conservation. Summer diet of the Lesser Kestrel has been investigated quantitatively in Spain, France, and Austria (Cramp and Simmons 1980, Bijlsma et al. 1988). The diet in winter has been examined through the analysis of stomach contents (An-

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derson et al. 1999, Kok et al. 2000). In this paper, I present data on the Lesser Kestrel diet as determined by analysis of pellets collected in South African grasslands.

METHODS

The food of the Lesser Kestrel was determined by analysis of pellets. Most pellets were collected between November 1997 and February 1998 from a traditional roosting site in a stand of large eucalyptus (*Eucalyptus* sp.) in Oosteinde, Bloemfontein, South Africa (29°10′S, 26°15′E). About 2000 Lesser Kestrels roosted there from late October 1997 to early March 1998. A few pellets were also collected in four other traditional roosting sites (in large eucalyptus) in the Free State: at Winburg (27°01′S, 28°30′E), 70 km NE of Bloemfontein (25 pellets collected on 22 November 1997), at Reddersburg (29°39′S, 26°10′E), 40 km S of Bloemfontein (100 pellets collected on 26 January 1998), at Edenburg (29°43′S, 25°55′E), 15 km SW of Edenburg (74 pellets collected on 5 January 1998), and at Trompsburg (30°02′S, 25°43′E), 23 km SW of Edenburg (85 pellets collected on 5 January 1998). The natural vegetation around Winburg is represented by the *Cymbopogon-Themeda* Veld, while the False Upper Karoo is the natural vegetation at the other sites. Most of the natural vegetation around all four sites has been, however, converted into cultivated fields.

The rainfall during November–December 1997 was much lower (50 mm), while during January–February 1998 much higher (420 mm) than long-term (40 yr) average for these periods (ca. 140 mm for November–December and ca. 170 mm for January–February).

Only fresh and compact pellets were collected in the middle and at the end of each month of the study. Each pellet was broken apart by hand and remains of prey items were identified mainly to the level of order. The following prey remains were isolated for identification: chelicerae of sun spiders (Solifugae), exoskeletons, jaws and elytrae of orthopterans (Orthoptera) and beetles (Coleoptera), cerci of earwigs (Dermaptera), heads and wings of termites (Isoptera), and hair of small mammals (Micromammalia).

Frequency of occurrence was calculated as the proportion of the total number of pellets examined containing a given taxon. Estimation of prey number and their wet biomass in the pellets was based on the following assumptions and calculations (wet biomass of prey × mean number of prey per pellet): sun spiders, 1.4 g × 8.5 in November–December, 1.4 g × 2.5 in January–February; orthopterans 1.4 g × 2; crickets (Orthoptera: Gryllidae), 1.4 g × 1; beetles, 0.7 g × 2; scarabaeids (Coleoptera: Scarabaeidae), 0.7 g × 2; ground beetles (Coleoptera: Carabidae), 0.3 g × 2; tenebrionids (Coleoptera: Tenebrionidae), 0.3 g × 2; termites, 0.1 g × 10; earwigs, 0.1 g × 2; dragonflies (Odonata), 1.0 g × 1; scolopendras (Chilopoda: Scolopendromorpha), 2.0 g × 1; small insectivorous mammals (Mammalia: Insectivora), 10 g × 1; small mammals, 20 g × 1.

RESULTS

A total of 2050 pellets was collected from November 1997–February 1998. The Lesser Kestrel's diet during the non-breeding season was dominated by sun spiders. Orthopterans and beetles were also an important component, together forming 27.5% of the total number of prey items identified and 44.4% of the total wet biomass (Table 1, Fig 1). Orthoptera were mainly represented by grasshoppers (Orthoptera: Acrididae), while beetles mainly by scarabaeids. Other arthropod groups, such as earwigs, termites, cockroaches (Blattodea), dragonflies, and scolopendras constituted supplementary food (Table 1). Only a few vertebrate items represented by small mammals were found (Table 1) Three pellets contained small stones.

Sun spiders were especially numerous in the Lesser Kestrel's diet in November–December, being recorded in each pellet examined (Fig. 1a), and formed over 80% of the total wet biomass consumed (Fig. 1c) and over 70% of total prey items consumed (Fig. 1b). Out of 105 and 275 pellets selected randomly from November–December (100% of which contained sun spiders) and January–February (49% contained sun spiders), respectively, the mean number of sun spiders per pellet decreased significantly ($t = 4.10$, df = 26, $P = 0.005$) from November–December ($\bar{x} = 8.87$, SD = 25.34, range = 1–17, $N = 105$) to January–February ($\bar{x} = 1.40$, SD = 8.68, range = 0–10, $N = 275$).

The quantity of sun spiders consumed by the Lesser Kestrel in Bloemfontein, as reflected in the randomly-selected pellets containing sun spiders (Fig. 3), decreased as the wintering season progressed ($\chi^2 = 98.79$, $P < 0.01$, df = 3). In contrast, the proportion of pellets containing beetles significantly increased ($\chi^2 = 47.49$, $P < 0.01$, df = 3), and Orthopterans were more frequently found in pellets in January–February than in November–December ($\chi^2 = 43.22$, $P < 0.01$, df = 3; Fig. 1a). Similarly, the frequency with which other prey, such as earwigs, termites, small mammals etc., were taken increased toward the end of the wintering season ($\chi^2 = 11.86$, $P < 0.01$, df = 3; Fig. 1a)

Sun spiders were equally common at other localities in the Free State (Fig. 2), being found in almost every pellet collected ($\chi^2 = 3.49$, $P > 0.05$, df = 7). The contribution of orthopteran prey decreased southward, i.e., from wetter to drier areas ($\chi^2 = 23.28$, $P < 0.005$, df = 7), while the contribution of beetles and other prey groups to the falcon's diet (Fig. 3) was markedly different from site to site ($\chi^2 = 112.6$, $P < 0.001$, df = 7 and $\chi^2 = 21.86$, $P < 0.005$, df = 7 for beetles and other prey groups, respectively).

DISCUSSION

During the breeding season, beetles and grasshoppers constitute the bulk of the Lesser Kestrel diet, supplemented by a low frequency of large prey, such as small mammals, lizards (Sauria), bush crickets (Orthoptera. Tettigonidae), and mole crickets (Orthoptera: Gryllotalpidae) (Cramp and Simmons 1980, Bijlsma et al. 1988). In South Africa, these larger prey groups are replaced mainly by smaller sun spiders and termites, while vertebrate prey are taken only occasionally (Anderson et al. 1999, Kok et al. 2000).

Pellet analysis can underestimate the contribution of

Table 1. Food of Lesser Kestrels wintering near Bloemfontein, Free State, South Africa. Data are from pellets collected from November 1997 through February 1998.

	Frequency of Occurrence		Approximate Number of Prey		Approximate Wet Biomass of Prey	
Taxa	*N*	%	*N*	%	Grams	%
Arachnida						
Sollifugae	1695	82.6	11 558	68.3	16 180	75.0
Insecta						
Orthoptera Combined	1478	69.9	2815	16.6	3950	18.3
Gryllidae	141	6.9	141	0.8	200	0.9
Other Orthopterans	1337	63.0	2674	15.8	3750	17.4
Coleoptera	1033	50.4	2003	11.9	1175.5	5.5
Combined						
Scarabaeidae	550	26.8	1100	6.5	770	3.6
Cetoniinae	41	2.0	50	0.3	35	0.2
Carabidae	117	5.7	234	1.4	70	0.3
Tenebrionidae	45	2.2	60	0.4	20	0.1
Curculionidae	1	0.1	1	<0.1	0.3	<0.1
Unidentified Coleopterans	279	13.6	558	3.3	280	1.3
Dermaptera	35	1.7	70	0.4	7	<0.1
Isoptera	33	1.6	330	2.0	35	0.2
Blattodea	4	0.2	4	<0.1	1	<0.1
Odonata	2	0.1	2	<0.1	2	<0.1
Chilopoda						
Scolopendromorpha	21	1.0	30	0.2	60	0.3
Mammalia	7	0.3	7	<0.1	140	0.6
Micromammalia						
Insectivora	1	0.1	1	<0.1	10	<0.1
Small stones	3	0.2	20	0.1	10	<0.1
Total	2050		16 915	100	21 570	100

termite alates and scolopendras to the Lesser Kestrel's diet, if the hard body parts (heads, wings) are not well preserved in pellets. Anderson et al. (1999) and Kok et al (2000) showed a much higher proportion of these prey groups than I found in the diet of the Lesser Kestrels wintering in the Bloemfontein area. The prevalence of sun spiders in Lesser Kestrel diet in November–December found in this study may partly be the result of below average rainfall during the study period, but my findings need further confirmation, as pellets were collected during one non-breeding season and none were examined from an 'average' year. Under dry conditions, as those recorded in November–December 1997, mass alate termite flights that normally take place in mid-summer are delayed (pers. observ.). Hence these insects, that are typically an important component of Lesser Kestrel diet (Anderson et al. 1999, Kok et al. 2000) constituted a small proportion of the Lesser Kestrel diet in this study On the basis of pellet analysis, Van Zyl (1993) showed a summer peak of sun spiders and winter peak of orthopterans in the diet of Eurasian Kestrels (*Falco tinnunculus*) in South Africa.

The importance of orthopterans in the diet of the Lesser Kestrel increases southward in the Free State. This probably reflects relative abundance of orthopterans in this province, with a much higher density in semiarid Karoo than in wetter *Cymbopogon-Themeda* grasslands near Winburg. Due to low rainfall, population growth of orthopterans in November–December 1997 was probably slower than normal. Such dry weather could be, however, beneficial to sun spiders, as their greatest population density is in arid areas of Namaqualand (Northern Cape, South Africa) and southern Namibia (Lawrence 1955, Warton 1981). High proportion of sun spiders in the Lesser Kes-

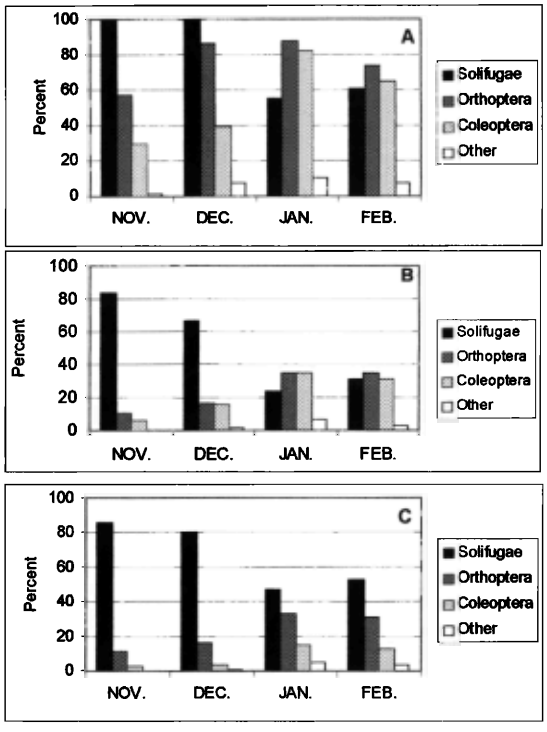

Figure 1. Monthly changes in percent of main prey groups in Lesser Kestrel diet wintering in Bloemfontein area, South Africa. A—frequency of occurrence in 2050 pellets, B—number of prey (total number of prey items = 16 915), and C—wet biomass of prey (total wet biomass = 21 570 g).

trel's diet may also be partly attributed to their rapid, mouse-like movements, which may attract the attention of Lesser Kestrels hunting from a high vantage point.

According to McCann (1994), Lesser Kestrels generally move up to 33 km from their roosting sites while foraging. About 2000 birds were present each evening at the Bloemfontein roost during the austral summer 1997–98. Assuming that each bird produces two pellets per day (Bijlsma et al. 1988, McCann 1994), I estimated that during the study period, the flock consumed ca. 2 400 000 sun spiders in an area of ca. 1500 km^2. This demonstrates how common sun spiders are in dry grasslands, and how important they can be in feeding Lesser Kestrels during prolonged droughts.

Both in the breeding season (Cramp and Simmons 1980, Bijlsma et al. 1988) and in the non-breeding season (Anderson et al. 1999, Kok et al. 2000) Lesser Kestrels prey extensively on arthropods, which are largely crepuscular or nocturnal (e.g., sun spiders, crickets, earwigs, scolopendras, scarabaeids, termite alate, and mole crickets *Gryllotalpa* spp.; Scholtz and Holm 1985, Bijlsma et al. 1988). Hence, it seems likely that Lesser Kestrels are to some extent crepuscular, or even nocturnal, in their foraging. Many birds at Bloemfontein were observed arriving at the roosting site up to a few hours after sunset. This foraging habit of wintering Lesser Kestrels has not been previously reported (Brown et al. 1982).

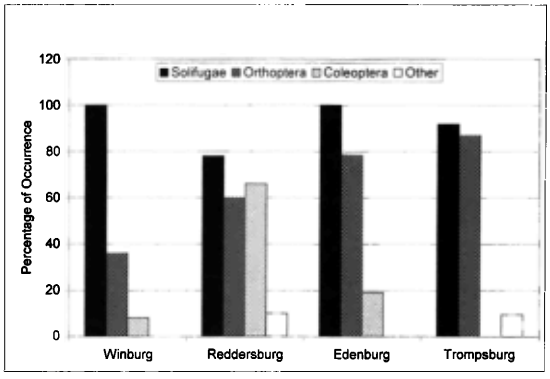

Figure 2. Food of wintering Lesser Kestrels in different localities in the Free State. Bars indicate percentage of occurrence of given prey groups at Winburg (N = 25 pellets), Reddersburg (N = 100 pellets), Edenburg (N = 74 pellets), and Trompsburg (N = 85 pellets).

RESUMEN.—Presentamos los datos sobre la dieta del cernícalo menor (*Falco naumanni*), basados en el análisis de egagrópilas. Las egagrópilas (N = 2050) fueron colectadas en sitios de percha en el Free State, Sudáfrica, donde los cernícalos forrajean in pastizales y campos cultivados. La mayoría de egagrópilas fueron colectadas de una sola percha en Bloemfontein. Solifugae (Arañas sol) constituyeron el grueso de la dieta, pero Orthoptera (principalmente Acrididae) y Coleoptera (principalmente Scarabaeidae) fueron también componentes importantes. Otros grupos de artrópodos tales como Isoptera, Der-

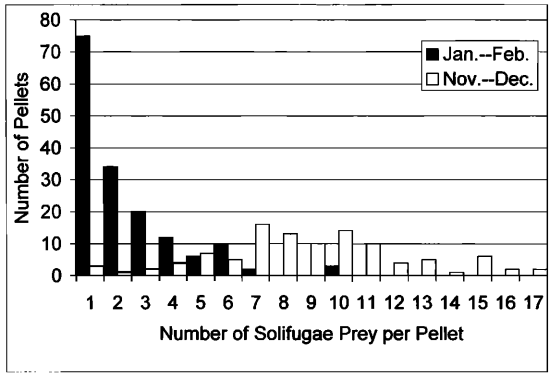

Figure 3. Number of sun spiders per Lesser Kestrel pellet in dry months (November–December 1997; 50 mm of rainfall) compared to wet months (January–February 1998; 420 mm of rainfall) near Bloemfontein, South Africa.

maptera, Blattodea, Odonata y Scolopendromorpha complementaron la dieta. Solamente unos pocos roedores pequeños fueron registrados. La proporción de los principales grupos de presa fue similar a lo largo de Free State, pero cambio marcadamente en la estación invernal. Con la progresión del verano austral, la proporción de Solifugae decreció, mientras que los otros grupos de presa aumentaron. La gran proporción de presas crepusculares y nocturnas en la dieta del cernícalo sugiere que este es al menos parcialmente crepuscular en sus hábitos de forrajeo.

[Traducción de César Márquez]

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RED-SHOULDERED HAWK FEEDS ON CARRION

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KEY WORDS: *Red-shouldered Hawk*; Buteo lineatus; *feeding*; *carrion.*

At 0804 H on 1 June 1999 at Avon Park Air Force Range, Highlands County, Florida, I observed an adult Red-shouldered Hawk (*Buteo lineatus*) drop off a fence post about 65 m away and land on the grassy shoulder of a paved road. The hawk picked up an object in its talons, flew back to a fence post, and began manipulating the item. Through Zeiss 10 × 25 binoculars, I identified the prey as a Common Nighthawk (*Chordeiles minor*), with conspicuous white bars on the long, blackish wings. The nighthawk remains appeared to consist solely of feathers

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