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COMMUNAL ROOSTING BEHAVIOR AND WINTER DIET OF THE WHITE-TAILED KITE (*ELANUS LEUCURUS*) IN AN AGRICULTURAL HABITAT ON THE ARGENTINE PAMPAS

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ABSTRACT.—Although the White-tailed Kite (*Elanus leucurus*) is widely distributed throughout the Americas, winter communal roosting has been recorded only in the Nearctic portion of its range. As a result, data on the food habits of the White-tailed Kite in South America during the nonbreeding season are scarce and, when available, limited to pellets from solitary individuals. Here, we report the communal roosting behavior and the winter diet of White-tailed Kites in an agricultural habitat on the Argentine pampas based on information gathered over three consecutive years (2006–2008). From May to July of each year, we observed an average of 11 (±SD = 2.8) kites roosting in a grove of *Eucalyptus viminalis*. Prior to roosting, kites gathered in a tall, dead, and leafless *Eucalyptus* tree before flying to more densely foliated trees where they spent the night. The diet of kites during winter was composed almost entirely of small mammals, mainly *Calomys* sp. and *Akodon azarae*. Because agricultural intensification in the Argentine pampas is ongoing, further studies are needed to gain a complete knowledge of White-tailed Kites in this habitat and of the effects of land-use changes on their foraging and other behavior.

KEY WORDS: *White-tailed Kite*; Elanus leucurus; *agricultural lands*; *Argentine pampas*; *communal roosting*; *winter diet*.

COMPORTAMIENTO DE DESCANSO COMUNAL Y DIETA INVERNAL DE *ELANUS LEUCURUS* EN UN HÁBITAT AGRÍCOLA DE LAS PAMPAS ARGENTINAS

RESUMEN.—Aunque *Elanus leucurus* es una especie de amplia distribución en las Américas, la congregación de individuos en áreas de descanso comunal durante el invierno se ha documentado sólo en la porción neártica de su distribución. Como resultado, los datos sobre los hábitos de alimentación de la especie en Sur América durante la época reproductiva son escasos y cuando están disponibles se limitan a egagrópilas de individuos solitarios. En este estudio documentamos el comportamiento de descanso comunal y la dieta invernal de individuos de esta especie en un ambiente agrícola de las pampas argentinas con base en información obtenida a lo largo de tres años consecutivos (2006–2008). Entre mayo y junio de cada año, observamos un promedio de 11 individuos (±DE = 2.8) descansando en un rodal de *Eucalyptus viminalis*. Los individuos se reunieron en árboles de *Eucalyptus* altos, muertos y sin hojas antes de percharse a descansar en árboles con follaje más denso en los que pasaron la noche. La dieta durante el invierno estuvo compuesta, casi en su totalidad, de pequeños mamíferos, principalmente *Calomys* sp. y *Akodon azarae*. Debido a que la actividad agrícola se está intensificando en las pampas argentinas, es necesario hacer más estudios para alcanzar un conocimiento completo de *E. leucurus* en este ambiente y de los efectos del cambio del uso de la tierra sobre el forrajeo y otros comportamientos.
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Several hypotheses on the value of communal roosting behavior have been proposed, including predation avoidance, information sharing, and thermoregulation (Beauchamp 1999). This behavior is taxonomically widespread among birds, including some diurnal birds of prey such as the White-tailed Kite (*Elanus leucurus*, hereafter ''kite''; Dunk 1995 and references therein). This small raptor's distributional range extends from the southwestern United States to Patagonia (Ferguson-Lees and Christie 2001, Figueroa et al. 2006), encompassing a variety of open habitats with some trees. In the northern portion of their range, wintering kites hunt alone during the day but return to communal roosts each night (Dunk 1995). However, this social behavior has been described only for North America, where several communal roosts of White-tailed Kites have been recorded (Longhurst 1959, Stendell and Myers 1973, Warner and Rudd 1975, Clark and Wheeler 1989), including mixed communal roosts comprising kites and other raptor species (Clark 2006). Though Central and South America represent a greater portion of the species' range, winter communal roosting has been suggested but never effectively documented in these regions (e.g., Meserve 1977).

The White-tailed Kite is a small-mammal specialist, feeding upon a variety of rodent species. Composition and diversity of consumed prey usually varies locally, according to the availability of accessible prey (Dunk 1995), but kites may also specialize on the most energetically rewarding prey species available (Schlatter et al. 1980, Sarasola et al. 2007). Although the biology of this raptor has received little attention in the southern portion of its range, there are several studies on White-tailed Kite trophic habits and hunting behavior in Chile (Meserve 1977, Schlatter et al. 1980, Jaksic et al. 1987, Mendelsohn and Jaksic 1989, Gonzalez-Acuña et al. 2009), Brazil (Scheibler 2004, 2007) and Argentina (Leveau et al. 2002, Sarasola et al. 2007). However, possibly due to the lack of reports of winter communal roosts for the species, little is known about the food habits of White-tailed Kites during winter. Meserve (1977) and Gonzalez-Acuña et al. (2009) reported seasonal diets of White-tailed Kites from central and southern Chile, respectively, but in both cases the winter diet was derived from a small sample of pellets from a few individuals. Furthermore, none of these authors reported winter communal aggregations for the populations they studied.

We here provide the first description of roosting behavior and roost site characteristics of White-tailed Kites in southern South America. In addition, we also examine the food habits of kites sharing a communal winter roost, providing the first detailed report of the winter diet of this species in this region.

METHODS

Study Area. Field observations on White-tailed Kites and pellet collections were carried out in El Remanso ranch (36°08.25′S, 63°50.85′W) near the town of Colonia Barón in northeastern La Pampa province, central Argentina. The area is dominated by agricultural lands devoted to field crops and cattle ranching, as well as annual and perennial pastures. The most common summer crops are soybean, sunflower, and corn. In winter, crop fields are almost entirely devoted to wheat. The climate is subhumid, with a mean annual rainfall of ca. 700 mm and a mean annual temperature of 15°C.

Sample Collection and Analysis. Observations on roosting behavior of White-tailed Kites were conducted from May to July (austral winter) from 2006 to 2008. The roost was located in a group of six trees within a larger stand (980 m in length × 50 m in width) of *Eucalyptus viminalis*. Every time we visited the site, we looked for fresh, whole regurgitated pellets beneath roost trees. A total of 630 pellets was collected beneath kite roosting trees during the study period: 193, 235, and 202 pellets in the 2006, 2007, and 2008 winter seasons, respectively. Pellets collected were hydrated, broken apart by hand, and separated by prey item for identification (Marti et al. 2007). Mammals were identified to species on the basis of skulls and dentaries, using keys (Pearson 1995) and reference collections located at the CECARA, University of La Pampa. Insects were identified to family level by mandibles, heads, elytras, and other parts using reference collections also located at the CECARA, University of La Pampa. To estimate the minimum number of individual prey items in each sample, we counted skulls of mammals and birds; we used whole heads, feet, elytras, and mandibles for insects. When only hairs, bones, or feathers were found, these were counted as one individual and classified as unidentified.

For each sample of pellets belonging to the same winter season, we calculated the Levins' index of trophic niche breadth (Levins 1968) as follows:

$$B = 1/\Sigma p_i^2$$

where p_i is the proportion of prey in different categories. These categories were considered as species, genus, or order (in the case of unidentified birds) for vertebrate prey, and family for invertebrate prey (Marti et al. 1993). To compare diet breadth among samples containing different numbers of prey categories, we calculated the standardized food-niche breadth following Colwell and Futuyma (1971):

$$\text{Bsta} = \text{Bobs} - \text{Bmin}/\text{Bmax} - \text{Bmin}$$

where Bmin = 1, the minimum niche breadth possible, and Bmax = n (number of prey categories identified in the sample). We also calculated the geometric mean mass of vertebrate prey (MWVP) consumed in a diet sample by multiplying the log-transformed mean mass of each prey type by the number of that prey in the sample, summing these products, dividing by the total number of prey, and back-transforming this sum. This procedure partially compensated for the skewed distribution of prey sizes and the potential to over- or underestimate mean prey mass (Marti et al. 1993). Sources of the mass values assigned to each prey item are given in Sarasola et al. (2007). To assess differences in prey frequency in the diet of kites, we performed chi-square tests (Zar 1999). For this purpose, prey species with absolute frequencies <5 for some of the years were grouped in a single category.

RESULTS

Roosting Behavior. We recorded White-tailed Kites roosting on 17 occasions in May 2006 (five records), July 2007 (eight records), and June-July 2008 (four records), which corresponded to the late austral fall and early winter seasons. However, we were able to record the total number of kites at the roost and their behavior on only 15 occasions. The mean number of kites (±SD) observed at the roost was 11 ± 2.8 individuals (range = 7–15 kites, n = 15). All the individuals observed at the roost were adult birds. Kites arrived at the roosting area in small groups of 2–7 individuals. The first kites arrived at the roost site 16 ± 8 min after sunset. Prior to roosting, some birds perched in a dead, leafless *Eucalyptus* tree located 100 m away from the roost. They remained in the pre-roost tree for an average of 25 ± 9 min before they flew to the roost 42 ± 6 min after sunset. The roost site consisted of a group of six leafy *Eucalyptus* trees that were at the end of an elongated tree stand (about 1 km long) planted for shelter belt and windbreak purposes.

Food Habits. We identified 1062 prey items. The diet of the White-tailed Kites was composed mainly of small mammals, with eight rodent species recorded as prey (Table 1). Rodents constituted 93–100% of the diet by number and nearly 100% by mass (Fig. 1). Other vertebrate (birds, 0.01% of total prey) and invertebrate (insects, 0.01%) prey were consumed only occasionally and in low numbers. Overall, the most abundant prey item was *Calomys* sp. (67%), followed by *Akodon azarae* (23%), *Eligmodontia typus*, and *Oligoryzomys flavescens* (2% each of the total number of prey item). Despite the prevalence of *Calomys* sp. in the diet in all three years, we found significant differences in rodent prey frequency among years (χ^2 = 84.6, df = 4, P < 0.01). These differences were mainly due to variation in the proportion of *Calomys* sp. and *Akodon azarae* in 2008 compared with previous seasons (Table 1). In addition, the standardized food-niche breadth (Bsta) was higher in 2008 than in previous seasons (Table 2). No differences in prey frequency were found between 2006 and 2007 (χ^2 = 0.2, df = 2, P = 0.88). The MWVP and the number of prey/pellet were similar for all three seasons, with values ranging from 17.0 to 18.4 g and 1.63 to 1.76 prey/pellet, respectively (Table 2).

DISCUSSION

Communal roosting behavior of White-tailed Kites observed in La Pampa province was similar to that described by Clark and Wheeler (1989) for California. In both studies, the roosting behavior of kites included individuals gathering in conspicuous pre-roosting sites before flying to the roost, such as in a bare, leafless tree (our study) or in plowed fields on the ground in their study. However, despite several records of White-tailed Kites roosting communally in North America, none have provided further information on the behavior of roosting kites. The proximate causes and functions of roosting may be numerous. Because the White-tailed Kite is a conspicuous bird in both size and color, we believe that gathering at very conspicuous sites may serve as a signaling function, either attracting conspecifics or, alternatively, deterring potential predators.

The number of kites observed at this roost was low compared to previous reports for North America, where the size of roosts ranged from 10–20 to more than 100 individuals (Clark and Wheeler 1989). Assuming that each roost site represents all of the individuals in a surrounding area, the number of birds at a roost site might reflect the local population density.

Table 1. Winter diet composition and trophic parameters for White-tailed Kites in agricultural lands of La Pampa province, Argentina (n = number of prey, Pr = proportions of prey by number, Pm = proportions of prey by mass).

	WINTER SEASON								
	2006			2007			2008		
	n	Pr	Pm	n	Pr	Pm	n	Pr	Pm
Rodents									
Calomys sp.	223	0.71	0.67	315	0.76	0.72	178	0.53	0.46
Akodon azarae	42	0.13	0.17	65	0.16	0.20	139	0.42	0.49
Akodon molinae	3	0.01	0.02	1	<0.01	0.01	—	—	—
Oligoryzomys flavescens	5	0.02	0.02	3	0.01	0.01	11	0.03	0.04
Ctenomys sp.	2	0.01	0.03	1	<0.01	0.01	—	—	—
Eligmodontia typus	4	0.01	0.01	22	0.05	0.05	—	—	—
Galea musteloides	2	0.01	0.03	—	—	—	—	—	—
Mus musculus	2	0.01	0.01	1	<0.01	<0.01	6	0.02	0.01
Unidentified rodents	15	0.05	—	4	0.01	—	—	—	—
Birds									
Passeriformes	6	0.02	—	—	—	—	—	—	—
Insects									
Lepidoptera	1	<0.01	<0.01	—	—	—	—	—	—
Acrididae	1	<0.01	<0.01	—	—	—	—	—	—
Coleopterae	—	—	—	1	<0.01	<0.01	—	—	—
Formicidae	7	0.02	<0.01	1	<0.01	<0.01	—	—	—
Gryllidae	1	<0.01	<0.01	—	—	—	—	—	—

Because kites rely on prey species that fluctuate seasonally and yearly, their population density may be modulated by prey abundance and/or the amount of suitable hunting habitat. Although the Argentine pampas have been highly modified, kites are well adapted to agricultural habitats and previous studies in this habitat have shown that increases in the percentage of arable farmland did not affect the relative abundance of kites (Filloy and Bellocq 2007). Thus, differences between the numbers of kites observed at our roost site and those observed in North America may simply be due to a naturally lower density of kites in the Argentine pampas. Unfortunately, actual data on local population density are not available to test such speculation.

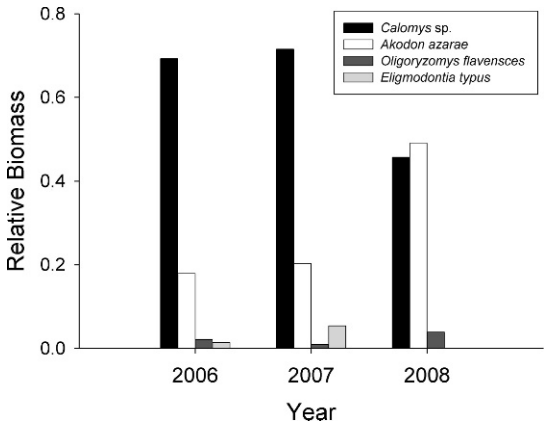

Figure 1. Variations in the relative mass of rodent prey in the winter diet of White-tailed Kites in the Argentine pampas for 2006, 2007, and 2008. Only the four most abundant prey species are shown.

Kites roosted in a grove of *Eucalyptus viminalis*, an exotic tree species. These groves are common in

Table 2. Winter diet parameters for White-tailed Kites in agricultural lands of La Pampa province, Argentina.

PARAMETER	YEAR		
	2006	2007	2008
Number of prey	314	414	334
Number of pellets	193	235	202
Number of prey/pellet	1.63	1.76	1.65
Levins' index	1.9	1.6	2.2
Standardized food niche (Bsta)	0.07	0.07	0.40
Mean weight vertebrate prey (g)	17.7	17.0	18.4

agricultural lands in Argentina and often used by other roosting birds of prey. For example, Swainson's Hawks (*Buteo swainsoni*) have been recorded using these groves during the nonbreeding season (Sarasola and Negro 2006), when large flocks of thousands of individuals congregate in South America. In fact, the same grove used by kites in winter was later occupied by Swainson's Hawks that roosted in it during the 2006–2008 austral summers (C. Solaro unpubl. data). The effects of these new structural elements on kite ecology may be similar to those reported for Swainson's Hawks in the pampas of Argentina (Sarasola and Negro 2006), a region that lacked trees before settlement by European colonizers (Zalba et al. 2000, Zalba and Villamil 2002). Such new landscape features could play an important role in the ecology of communally roosting species, either by changing their roosting behavior or by favoring the colonization of open areas such as the Argentine pampas when these groves became available. For example, the Afro-European species in this genus, the Black-winged Kite (*Elanus caeruleus*), is suspected to have colonized the Iberian Peninsula from Africa when dehesas (open areas with scattered trees in a matrix of cereal crops) became available (Balbontín et al. 2008).

The winter diet of the White-tailed Kites we studied was composed almost exclusively of small mammals, with sigmodontine rodents such as *Calomys* sp. and *Akodon azarae* most prevalent in frequency and biomass. These species are also the most abundant in the local rodent community (Bilenca et al. 2007), which suggests that kites may capture them opportunistically during the winter. In addition, *Akodon azarae* and *Calomys* sp. were also important in the diet of White-tailed Kites in an agricultural habitat of the Pampas region during the spring and summer seasons (Leveau et al. 2002, Sarasola et al. 2007). However, food-niche breadth in this winter study was narrower than that observed during spring and summer due to a higher numerical contribution of these rodent prey species. These differences, however, have little effect on other trophic parameters, such as the mean mass of vertebrate prey, which was similar to or slightly higher than that observed during the breeding season (see review in Sarasola et al. 2007). Differences in prey frequencies among the winter seasons examined may reflect changes in prey availability either due to climatic variability or to changes in land-use types in the area. Nevertheless, further studies are needed to improve our knowledge on the feeding behavior of this species during winter, as well as on the effects of the ongoing process of agricultural intensification on the ecology of White-tailed Kites in the Argentine pampas.

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