J Raptor Res. 38(2):178–181

TROPHIC RELATIONSHIPS BETWEEN WHITE-TAILED KITES (*ELANUS LEUCURUS*) AND BARN OWLS (*TYTO ALBA*) IN SOUTHERN BUENOS AIRES PROVINCE, ARGENTINA

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KEY WORDS: *Barn Owl*; Tyto alba; *White-tailed Kite*; Elanus leucurus; *diet*; *competition*; *trophic overlap.*

Similar species often partition resources along three dimensions: the habitat used for foraging, the kind of food eaten, and the time of day that foraging occurs (Cody 1968, Schoener 1974a, 1974b, Jaksic 1988). Time is considered to be the least important in niche partitioning (Schoener 1974a, 1974b). Moreover, Jaksic (1982) argued that time of activity was not adequate to separate niches of hawks and owls. On the other hand, Marti and Kochert (1995) studied the similarity in the diets of two generalistic raptors, Red-tailed Hawks (*Buteo jamaicensis*) and Great Horned Owls (*Bubo virginianus*), concluding that time of activity resulted in diet differences sufficient to separate the niches of these two raptors.

The diet of the Barn Owl (*Tyto alba*) has been studied intensively in some regions of Argentina (Bellocq 2000, Pardiñas and Cirignoli 2002). The White-tailed Kite (*Elanus leucurus*), on the other hand, is poorly known, and its biology in South America has been addressed by only a few contributions (e.g., Meserve 1977, Schlatter et al. 1980, Leveau et al. 2002).

White-tailed Kites are mainly diurnal, although also have been reported to be crepuscular (Jaksic et al. 1987, Mendelsohn and Jaksic 1989); Barn Owls are mostly nocturnal, but occasionally hunt during the day (del Hoyo et al. 1999). These two raptors, common in the Buenos Aires province (Narosky and Di Giacomo 1993), are well-known rodent predators (>90% of prey in most studies; Mendelsohn and Jaksic 1989, Bellocq 2000). Both species occupy similar habitat in sympatry (Narosky and Yzurieta 1987, Narosky and Di Giacomo 1993). Additionally, their body masses are very similar (White-tailed Kite $\bar{x}$ = 302.2 g and Barn Owl $\bar{x}$ = 307 g; Schlatter et al. 1980, Jaksic et al. 1992, respectively). Therefore, the period of hunting activity may be a key factor separating the niches of these two species. Here, we compare the small mammals consumed by White-tailed Kites and Barn Owls in a southern Buenos Aires area, Argentina, and examine the degree of dietary similarity to evaluate if activity periods separate niches of these species.

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METHODS

We collected data in Villa Cacique (37°40′S, 59°23′W; 210 m elevation), Benito Juárez county, Buenos Aires province, Argentina. This region is dominated by agroecosystems and introduced woodlands. The original vegetation (herbaceous steppe) has been reduced to small remnant patches in areas where agriculture is not feasible. The weather is temperate, with an annual mean temperature of 13.3°C and annual mean precipitation of 775 mm, concentrated during the summer (Jaureguy and Bernabé 1987).

We collected 77 fresh pellets and the remains of one prey from three pairs of White-tailed Kites. For Barn Owls, we examined 154 fresh pellets from two pairs. Both samples were collected under nests and roost sites from August–December 1998. Minimum number of prey were determined by skull remains in pellets and identified by comparison with reference material of Museo de La Plata mammal collections. Biomass of prey were estimated by multiplying the number of individuals of each prey species by the mean mass of these prey obtained from literature (Redford and Eisenberg 1992). To compare trophic resources between both raptors, we estimated a standardized niche breadth (Jaksic 2000). This index varies between 0 and 1, and permits comparison between species. Additionally, we used Pianka's index (Marti 1987) to measure trophic overlap. Values of this index vary between 0 (no overlap) and 1 (complete overlap). Finally, we estimated geometric mean prey mass (Marti 1987). This estimation is useful in the comparison of diets among raptors (Marti 1987).

To examine activity period and its relationship with prey consumption, we classified prey and prey percent biomass based on pellet data as available during nocturnal, diurnal, or both periods, based on literature (e.g., Dalby 1975, Massoia 1976, Pearson 1988, Nowak 1999, Pardiñas unpubl. data). We used a chi-squared test to compare the relative proportion of prey in the different periods of activity between species. Geometric mean prey mass was compared among raptors using a *t*-test, after log-transformation to normalize the data (Sokal and Rohlf 1981).

We acknowledge that determination of raptor diets with the analysis of pellets, especially for kites, involves some inherent biases. Specifically, Falconiforms typically digest bone to a greater extent than do owls (Marti 1987, Andrews 1990). Here we offer a preliminary comparison of the diets of these two raptors in the southern Buenos Aires province. We also suggest that additional data should be collected to evaluate the biases of using pellets

Table 1. Percent frequency and biomass of small mammals consumed by White-tailed Kite (N = 109 prey) and Barn Owl (N = 448 prey) in Villa Cacique, Buenos Aires, Argentina.

Prey	Prey Mass (g)[a]	White-tailed Kite		Barn Owl	
		Percent Frequency	Percent Biomass	Percent Frequency	Percent Biomass
Calomys sp.	14	24.8	11.0	57.1	23.6
Akodon azarae	28	37.6	33.4	25.4	21.0
Oxymycterus rufus	76	8.3	19.9	3.3	7.5
Oligoryzomys flavescens	19	5.5	3.3	4.0	2.2
Holochilus brasiliensis	326	0.0	0.0	2.2	21.4
Reithrodon auritus	79.5	0.0	0.0	2.9	6.8
Necromys benefactus	31	14.7	14.4	1.6	1.4
Mus domesticus	14	0.9	0.4	1.1	0.5
Rattus sp.	320	0.0	0.0	1.1	10.5
Cavia aperea (juvenile)	250	1.8	14.5	0.7	4.9
Monodelphis dimidiata	15	6.4	3.1	0.2	0.1
Chiroptera	11	0.0	0.0	0.2	0.1
		100.0	100.0	100.0	100.0

[a] From Redford and Eisenberg (1992).

to assess the diet of White-tailed Kites relative to using this technique for Barn Owls.

Results and Discussion

For White-tailed Kites, seven taxa of cricetid rodents accounted for more than 90% of 109 individuals consumed, followed by the marsupial (*Monodelphis dimidiata*; 6.4%; Table 1). The most common species taken were *Akodon azarae, Calomys* sp., and *Necromys benefactus* (Table 1). Prey mass varied between 14 g (*Calomys* sp., *Mus domesticus*) and 250 g (*Cavia aperea*; juvenile; Table 1). *Akodon azarae, Oxymycterus rufus, C. aperea,* and *N. benefactus,* in that order, accounted for 82% of the biomass of prey (Table 1).

For Barn Owls, 10 taxa of cricetid rodents were identified from the 448 individuals consumed. *Monodelphis dimidiata* and an unidentified bat were also recorded (Table 1). The most commonly taken species were *Calomys* sp. and *A. azarae,* representing more than 80% of the prey consumed (Table 1). Prey mass varied between 11 g (Chiroptera) and 326 g (*Holochilus brasiliensis*; Table 1). *Calomys* sp., *A. azarae,* and *H. brasiliensis* accounted for 66% of the biomass of prey, in that order of importance (Table 1).

Standardized niche breadths were 0.45 and 0.14 for White-tailed Kites and Barn Owls, respectively. The greater breadth for White-tailed Kites was due to the inclusion of *A. azarae, Calomys* sp., and *N. benefactus,* while Barn Owls preyed mainly on *Calomys* sp. (Table 1).

Pianka's index was 0.80, indicating a substantial trophic overlap between the two raptors. Simeone (1995), who studied the diet of White-tailed Kites and Barn Owls in Chile, also found overlap values ranging from 0.87–0.96. In our study, the high trophic overlap might be related to several factors acting singly or in combination. (1) both raptors share the same hunting habitats, mainly harvested wheat fields and pasture fields (L. Leveau and C. Leveau unpubl. data); (2) the prey resources (small mammals) may be very abundant and, therefore, easily available to both raptors; and (3) these resources (small mammals) are available both during the day and night, the activity periods of hawks and owls, respectively. According to Jaksic (1982), diurnal and nocturnal raptors could share the same trophic resources by extending their hunting activities to crepuscular hr, "sharing" the prey of that activity period.

Prey frequencies and percent of prey biomass differed significantly in relation to period of activity (Fig. 1; χ^2 = 135.15 and 133.27, respectively; df = 2; $P < 0.001$). White-tailed Kites consumed a larger proportion of diurnal mammals, such as *M. dimidiata, N. benefactus,* and *O. rufus* (Fig. 1a). On other hand, Barn Owls consumed more rodents that were exclusively nocturnal, such as *Calomys* sp., *H. brasiliensis,* and *R. auritus* (Fig. 1a). Prey biomass showed a similar trend (Fig. 1b).

Geometric mean of prey body mass for White-tailed Kites (25.27 ± 3.26 g) was greater than that of Barn Owls (21.57 ± 2.8 g; t = 2.15, df = 555, P = 0.032). White-tailed Kites ate rodents that were heavier (*N. benefactus* 31 g and *O. rufus* 76 g), than the most frequent prey taken by Barn Owls (*Calomys* sp. 14 g; Table 1). While both raptors have almost the same body mass, White-tailed Kite seemed to be more effective at capturing larger rodents or, alternatively, prey such as *N. benefactus* and *O. rufus* could be more abundant during the day. *Oxymycterus rufus* shows peaks of activity between 0800–1000 H and 1400–1900 H in southern Buenos Aires province

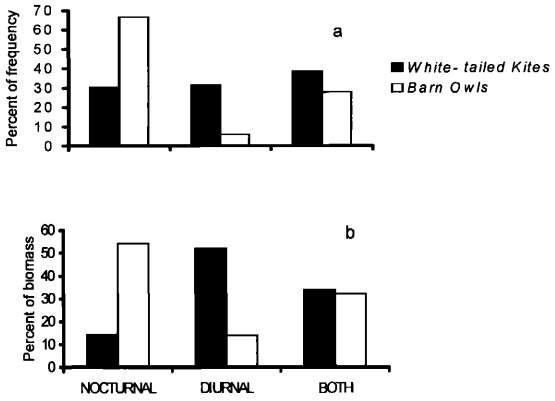

Figure 1. Distribution of prey frequency (a) and prey biomass (b) based on activity periods of rodents consumed by White-tailed Kites and Barn Owls in Villa Cacique.

(U. Pardiñas unpubl. data). This pattern of diurnal activity could explain the low abundance of this species in several analyses of the Barn Owl diet (Pardiñas 1999).

Although both raptors will select their prey in accordance to their period of activity, a trophic overlap of 80% suggests potential competition for food when in short supply (Simeone 1995). If prey were in ample supply, then the large trophic overlap may be interpreted as opportunistic convergence on abundant resources. However, the diurnal hunting activity of White-tailed Kites and the nocturnal activity of Barn Owls probably results in the avoidance of interference interactions (Case and Gilpin 1974, Marti and Kochert 1995, Simeone 1995). Similarly, White-tailed Kites nest in trees (de la Peña 1992), while Barn Owls nest mainly in cavities of buildings (de la Peña 1994), in this way avoiding competition for nest sites. The dietary similarity of these two species in the southern part of the Buenos Aires province might indicate that both raptors are dietary counterparts, consuming the same trophic resources alternatively during the day and night (Jaksic et al. 1981, Jaksic 1983, Simeone 1995).

RESUMEN.—Se compararon los mamíferos ingeridos por dos conocidos especialistas en el consumo de roedores, el milano blanco (*Elanus leucurus*) y la lechuza de campanario (*Tyto alba*), en el sur de la provincia de Buenos Aires, Argentina. Ambas rapaces depredaron casi exclusivamente sobre roedores cricétidos. Los valores de amplitud de nicho trófico estandarizado para el milano blanco y la lechuza de campanario fueron de 0.45 y 0.14, respectivamente. El solapamiento trófico entre las dos rapaces, basado en el índice de Pianka, fue del 80%. Los roedores de actividad diurna fueron más frecuentes y aportaron mayor biomasa en la dieta del milano blanco. El mismo patrón fue observado en la dieta de la lechuza de campanario, pero en relación con roedores fundamentalmente nocturnos. El peso promedio de las presas fue significativamente mayor en la dieta del milano que en la de la lechuza. El alto grado de solapamiento trófico podría estar indicando potencial competencia entre las dos especies.

[Traducción de los autores]

ACKNOWLEDGMENTS

P. Timo, J. Valero, D. Retondo, A. Leveau, C. Leveau, and R. Schlatter helped in many ways. M.I. Bellocq and F. Jaksic, three anonymous referees, and the editor gave critical comments on the manuscript. We really appreciate the improvements in English usage made by James Roper through the Association of Field Ornithologists' program of editorial assistance. This research was supported by a scholarship from the Fundación Antorchas (LML and CML) and funds from the Consejo Nacional de Investigaciones Científicas y Técnicas (UFJP).

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Received 6 May 2003; accepted 27 November 2003

J. Raptor Res. 38(2):181–186

RELATIVE ABUNDANCE AND DIVERSITY OF WINTER RAPTORS IN SPOKANE COUNTY, EASTERN WASHINGTON

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KEY WORDS: *Red-tailed Hawk*; Buteo jamaicensis; *Rough-legged Hawk*; Buteo lagopus; *relative abundance*; *roadside survey*; *sympatry*; *winter distribution.*

For years, biologists, falconers, and bird-watchers have recognized the high density of raptors in eastern Washington during the winter. Discussions with observers throughout the region indicate this zone of high abundance may extend from eastern Washington, east to the

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