Studies on Neotropical Fauna and Environment
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713817190

Comparison of food habits and prey selection of the white-tailed kite, Elanus leucurus, between natural and disturbed areas in central Argentina

To cite this Article: , 'Comparison of food habits and prey selection of the white-tailed kite, Elanus leucurus, between natural and disturbed areas in central Argentina', Studies on Neotropical Fauna and Environment, 42:2, 85 - 91
To link to this article: DOI: 10.1080/01650520601050857
URL: http://dx.doi.org/10.1080/01650520601050857

Studies on Neotropical Fauna and Environment, August 2007; 42(2): 85–91

ORIGINAL ARTICLE

Comparison of food habits and prey selection of the white-tailed kite, *Elanus leucurus*, between natural and disturbed areas in central Argentina

JOSÉ HERNÁN SARASOLA[1,2], MIGUEL ANGEL SANTILLÁN[1] & MAXIMILIANO ADRIÁN GALMES[1]

[1]*Centro para el Estudio y Conservación de las Aves Rapaces en Argentina (CECARA), Universidad Nacional de La Pampa, Santa Rosa, La Pampa, Argentina, and* [2]*Department of Applied Biology, Estación Biológica de Doñana, Sevilla, Spain*

(Received 23 June 2005; accepted 5 October 2006)

Abstract
We studied the food habits of white-tailed kites (*Elanus leucurus*, Accipitridae) in central Argentina during austral spring and summer (November to March) and compared prey captured in two different habitat types. Diet was determined by analysing pellets and prey remains collected under nests and roost sites. During the same period small mammals were trapped using pit-fall traps in Parque Luro reserve with the aim of assessing prey selection by kites. In Parque Luro reserve (semiarid forest), tuco-tucos (*Ctenomys* sp., Rodentia) were the main prey in the white-tailed kite diet, accounting for 75% of the items and 91% of biomass. In agricultural fields, however, there was not a single main prey species, as measured either by number of prey items or by biomass, *Calomys* sp. (43%) and *Akodon azarae* (22%) being the main prey in this habitat. The analysis of prey availability in the Parque Luro reserve showed that tuco-tucos are a seasonally available prey, only captured in spring and summer. During these seasons, the consumption of tuco-tucos by white-tailed kites was disproportionately higher than the occurrence of tuco-tucos, indicating a preference for this species by kites. These results suggest that other prey attributes, such as conspicuousness and social behavior, could be key factors in prey selection by white-tailed kites.

Keywords: Agricultural habitats, food habits, prey selection, semiarid forests, tuco-tuco, white-tailed kite

Introduction

The white-tailed kite (*Elanus leucurus*) ranges throughout the Americas, inhabiting open grasslands, savannas, steppes and agricultural areas with at least some arborescent growth (Palmer, 1988). Regarding its food habits, the white-tailed kite is considered to be a small mammal specialist (Dunk, 1995). In North America white-tailed kites fed mainly on voles of genus *Microtus* (Hawbecker, 1940; Cunningham, 1955; Dixon et al., 1957; Stendell & Myers, 1973; Warner & Rudd, 1974), whereas in South America they preyed on a variety of small mammals, including *Akodon olivaceous*, *A. longipilis*, *Oryzomys longicaudatus* and *Octogon degus* in Chile (Meserve, 1977; Schlatter et al., 1980), *A. azarae* and *Calomys* spp. in agricultural areas of the Argentinean Pampas (Leveau et al., 2002) and *Mus musculus* in southern Brazil (Scheibler, 2004).

Food availability seems to be one of the main limitations for breeding and non-breeding populations of white-tailed kites in North America (Dunk, 1995). For example, a close relationship between vole abundance (*Microtus californicus*) and the presence (Stendell & Myers, 1973; see Pearson, 1985 for a review) or abundance of white-tailed kites (Dunk & Cooper, 1994) has been found. Contrasting with this prey–predator relationship observed in North America, studies on white-tailed kites in other areas of their range have not detected a single small mammal species as the prevalent prey item. Schlatter et al. (1980), for example, did not observe a dominant prey (e.g. >50% of items) in any of the

Correspondence: J. H. Sarasola, Centro para el Estudio y Conservación de las Aves Rapaces en Argentina (CECARA), Facultad de Ciencias Exactas y Naturales, Universidad Nacional de La Pampa, Avda. Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina. Fax: +54 2954 432535. Email: sarasola@exactas.unlpam.edu.ar

ISSN 0165-0521 print/ISSN 1744-5140 online
DOI: 10.1080/01650520601050857

two different habitats, including agricultural lowlands, studied in central Chile. Also in agricultural areas of Argentina, the diet of white-tailed kites is composed of a variety of small mammals, but without a prevalence of a single rodent species (Leveau et al., 2002). Only Meserve (1977) and Scheibler (2004) observed the olivaceous grass mouse (*Akodon olivaceus*) and the house mouse (*Mus musculus*) reaching high occurrence of a single species in agricultural lowlands of central Chile and southern Brazil, respectively.

Although feeding ecology is one of the aspects of kite's biology receiving highest attention, knowledge of food habits of the white-tailed kite is scarce compared with the diversity of habitats in which they occur in southern South America. Furthermore, most studies were conducted in disturbed habitats while only one was performed in low-disturbed areas in Chile (Schlatter et al., 1980). Since the level of human disturbance (e.g. agricultural practices) may influence availability of rodent species affecting thus prey selection by this raptor (Schlatter et al., 1980), the determination of its diet in natural habitats is of special importance for the understanding of the environmental conditions required by white-tailed kites.

In this paper, we report new data on the food habits of the white-tailed kite in central Argentina. We compare prey consumed by kites in two areas of different land use: the natural reserve Parque Luro designated to protect the semiarid *Prosopis caldenia* forest habitat and agricultural fields that are comparable to the land use surrounding the reserve. We aim to examine differences in prey taken by kites in these two habitats that differ both in their ecological attributes and the level of human-induced disturbance that could affect prey populations. For Parque Luro we also evaluated prey selection of kites by assessing prey availability and comparing it with prey occurrence in the diet. Using published data from both North and South America, we calculated and summarized trophic parameters for the white-tailed kite and compared them with those obtained in our study areas in Argentina.

Material and methods

Study sites

Food habits of white-tailed kites were determined by analysing pellets and prey remains collected between November 2000 and January 2001 in the Parque Luro reserve (36°55′S, 64°16′W), La Pampa province, central Argentina. During November 2002 to March 2003, an additional sample of pellets was collected in agricultural areas near Uriburu town (36°30′S, 63°51′W) of La Pampa province. These sites were about 50–100 km away from the reserve. The landscape is flat in both areas, with elevations of 226 and 167 m a.s.l., respectively. The reserve (7604 ha) is dominated by a xerophytic forest of *Prosopis caldenia* (Leguminosae) which represents the characteristic vegetation of the Espinal biome in the semiarid pampas of Argentina (Cabrera, 1976). Grasses such as *Stipa* spp. (Poaceae) are the main herbaceous species of the lower stratum, and *Condalia microphylla*, *Lycium chilense*, *L. gilliesianum* (Solanaceae) and *Schinus fasciculatus* (Anacardiaceae) are the common shrub species where a middle stratum is present. The reserve is surrounded by farmland with wheat, sunflower, corn and soybean fields, and perennial (e.g. alfalfa) and annual pastures (e.g. oat). The climate is continental semiarid and is characterized by hot summers (maximum 42°C) and cold winters (minimum −13°C) with low humidity and low annual rainfall (500–600 mm), typically concentrated in spring and summer.

Diet analysis

In both study areas pellets were collected under nests and roost sites used by white-tailed kites. Pellets collected in Parque Luro reserve came from one pair, those collected in agricultural fields from at least three pairs. Pellets were hydrated, broken apart by hand and the remains of prey items were separated. Mammals were identified to species on the basis of skulls and dentaries, using reference collections and keys (Pearson, 1995). Insects were identified to family level using mandibles, heads, elytra and other parts. In order to estimate the minimum number of individual prey items in each sample, skulls of mammals and amphibians were counted; whole heads, feet, elytra and mandibles were used for insects. When only hairs, bones or feathers were found, these were counted as one individual and classified as unidentified.

Assessing prey availability

Prey selection by white-tailed kite, considered as the diet composition in relation to the availability of prey (*sensu* Village, 1990), was evaluated only for the Parque Luro reserve. Simultaneously to pellet collection, we measured prey availability by setting three pit-fall traps (Corn, 1994) in an open forest of *Prosopis caldenia* with a grassland stratum and a reduced shrub layer (Sarasola et al., 2005). Traps were active throughout the year 2000 and visited once a month. Trapping results of small mammals were grouped by season for analysis (April to June=autumn, July to September=winter, October to December=spring, January to March=summer).

Data analysis

To evaluate prey selection, we performed a G test for homogeneity (Fowler & Cohen, 1986) comparing prey consumed by kites for the spring and summer seasons against the availability of small mammals during these seasons. To avoid low expected frequencies that would invalidate test requirements (Fowler & Cohen, 1986), prey types were considered as species/genus for *Akodon azarae*, *A. molinae*, *Calomys* sp. and *Ctenomys* sp. The remaining prey types, all of them occurring in low frequency during spring–summer seasons, were grouped together.

A comparative analysis of the diet of the white-tailed kites throughout the Americas was conducted by gathering information from published studies and reports. For each of these studies we calculated the Levin's 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 mammals or birds) for vertebrate prey, and order for invertebrate prey (Marti et al., 1993). To compare diet breadth between samples containing different numbers of prey categories, we calculated the standardized food niche breadth following Colwell and Futuyma (1971):

$$B_{sta} = (B_{obs} - B_{min})/(B_{max} - B_{min})$$

where $B_{min}=1$, the minimum niche breadth possible, and $B_{max}=N$ (number of prey categories identified in the sample). We also calculated the geometric mean weight of vertebrate prey (MWVP) consumed in a diet sample by multiplying the $\log_e$-transformed mean weight 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 compensates for the skewed distribution of prey sizes and the potential over- or underestimating of mean weight of prey from using mean weights for each prey type (Marti et al., 1993). The mass of the prey taken by white-tailed kites in our study areas was obtained from species collected in pit-fall traps and from Tiranti (1992) for rodent species that occurred in the diet of kites but that were not trapped during the study. We classified tuco-tucos (*Ctenomys* sp.) as juveniles or adults based on the size of skulls and by the width of the incisive teeth comparing them with incisive-width/mass regression provided by Pearson et al. (1968).

For studies conducted in North America, and when pertinent information was not given in the respective sources, weights of prey items were obtained from Marti (1974) and Steenhof (1983). Student's t tests were performed to examine differences between trophic parameters obtained for dietary studies conducted in South and North America. All the variables met the assumptions of normality (Kolmogorov–Smirnov test P values >0.20 for all the variables) and were suitable for parametric testing.

Results

Diet composition

A total of 147 pellets were analysed, 75 from Parque Luro reserve and 72 from agricultural areas. Seven species of small mammals were recorded in kite pellets collected in agricultural areas. Rodents constituted 90% of the prey items and more than 98% of the dietary biomass, with *Calomys* sp. and *Akodon azarae* being the main prey (Table I). Birds, amphibians and insects occurred in very low proportions. A total of six small mammal species was recorded in pellets and prey remains collected in Parque Luro reserve (Table I), with rodents accounting for 95% of the prey items and 99% of the dietary biomass. Tuco-tucos were the most important prey and all remains were from juveniles. The second most common prey was also *Akodon azarae*.

Prey availability in semiarid forests

We captured 152 rodents in pit-fall traps set in Parque Luro reserve, with four species accounting for almost 90% of the total sample: *Calomys* sp. (34.9%), *Akodon azarae* (24.3%), *Akodon molinae* (13.8%) and *Oligoryzomys flavescens* (14.5%). However, only the first three were captured in all seasons (Figure 1). The proportions of each species in the diet were significantly different from their availability in the field ($G=236.3$, df=4, $P<0.05$). The greatest deviation was recorded for *Ctenomys* sp., 70% of them juveniles, which were captured only during spring and summer, and in lower proportions than the other small mammals.

General trophic parameters

The standardized diet niche breadth (B_{sta}) was highly variable among studies of white-tailed kite food habits throughout the continent ($n=17$; Table II). The mean value ($\pm$SD) for this parameter was 0.27 ± 0.22, while the mean prey weight calculated for all studies together was 30 ± 11.9 g. Although studies conducted in North America

Table I. Spectrum of prey items recorded in pellets of white-tailed kites from spring–summer seasons in the Parque Luro reserve and in agricultural habitats, La Pampa province, central Argentina.

		Agricultural habitat			Semiarid forest		
Prey item	Weight (g)	*N*	*N*%	*B*%	*N*	*N*%	*B*%
Rodents							
Galea musteloides	90	–	–	–	1	1.2	1.7
Reithrodon auritus	74	3	3.4	14.0	–	–	–
Calomys sp.	16	38	43.2	38.3	2	2.4	0.6
Oligoryzomys flavescens	22	6	6.8	8.3	3	3.7	1.2
Akodon molinae	38	3	3.4	7.2	2	2.4	1.4
Akodon azarae	22	20	22.7	27.7	9	11.0	3.7
Eligmodontia typus	17	1	1.1	1.1	–	–	–
Ctenomys sp.	80*	–	–	–	61	74.4	91.4
Non-identified rodents		7	8.0	–	–	–	–
Marsupials							
Thylamys pusilla	20	1	1.1	1.4	–	–	–
Birds							
Non-identified Passeriformes		3	3.4	–	1	1.2	–
Amphibians							
Bufo arenarum	31	1	1.1	2.0	–	–	–
Insects							
Tettigoniidae		1	1.1	–	–	–	–
Cicadidae		–	–	–	2	2.4	–
Formicidae		–	–	–	1	1.2	–
Scarabaeidae		4	5.0	–	–	–	–
Total prey items		88			82		
MWVP (g)		13.5			61.0		
Levin's index of trophic niche breadth		4.00			1.76		
Standardized niche breadth (B_{sta})		0.33			0.11		

N=number of prey items; *N*%=percentage of number of prey; *B*%=relative biomass. *Weight for juvenile tuco-tuco (*Ctenomys* sp.).

showed lower B_{sta} and higher MWVP values than those from South America (B_{sta}=0.21 vs. 0.34 and MWVP=31.4 vs. 27.9, respectively), these geographic differences for trophic parameters were not statistically significant (B_{sta}: $t=-1.22$, $P=0.24$, df=15; MWVP: $t=0.59$, P value=0.55, df=15).

Discussion

Habitat type influences the diet of white-tailed kites

Although in both study areas in La Pampa province rodents made up almost the total sample of prey consumed by white-tailed kites, a comparative

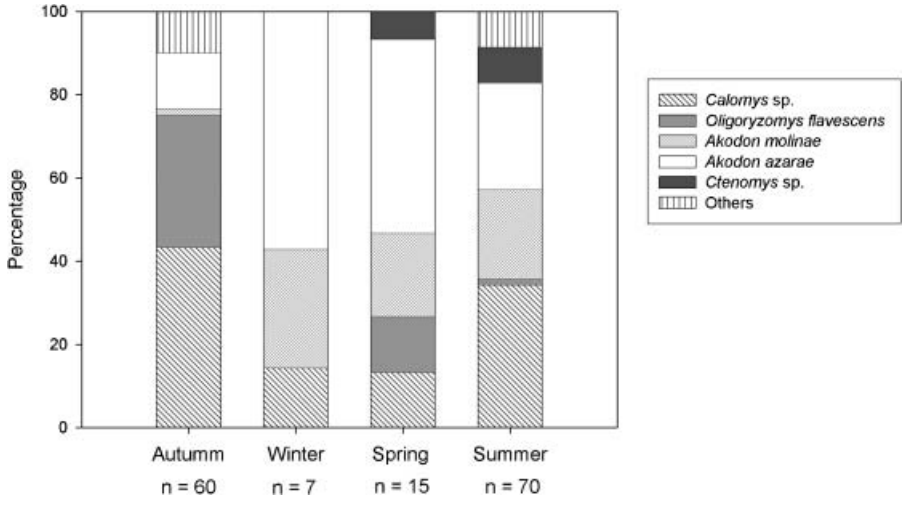

Figure 1. Seasonal availability of small mammals in Parque Luro reserve study area. Those species that occurred in small percentages during autumn and summer (*Graomys griseoflavus*, *Thylamys pusilla* and *Galea musteloides*) were grouped as Others.

Table II. Mean weight of vertebrate prey (MWVP), standardized diet niche breadth (B_{sta}) and proportion (%) of main prey for food studies of the white-tailed kite in California, Chile, Brazil and Argentina [studies listed twice correspond to those reporting data for two different locations or during different seasons (breeding and winter) in the same area].

Source	Country	Habitat type	MWVP (g)	Main prey	B_{sta}	Proportion of main prey (%)
Hawbecker (1940)	California	Agriculture	48.6	*Microtus californicus*	0.04	91.1
Hawbecker (1940)	California	Agriculture	41.2	*Microtus californicus*	0.00	100.0
Bond (1942)	California	Orchard and adjacent areas	20.1	*Mus musculus*	0.20	83.8
Stoner (1947)	California	Wetlands	39.4	*Microtus californicus*	0.05	95.6
Cunningham (1955)	California	Grassland	24.0	*Mus musculus*	0.27	55.5
Dixon et al. (1957)	California	Orchard and adjacent areas	30.3	*Microtus californicus*	0.14	66.3
Waian & Stendell (1970)	California	Agriculture	25.0	*Microtus californicus*	0.41	47.4
Stendell & Myers (1973)	California	Grassland	39.5	*Microtus* spp.	0.06	85.7
Warner & Rudd (1974)	California	Shrubland (winter)	30.0	*Microtus californicus*	0.45	63.0
Warner & Rudd (1974)	California	Shrubland (breeding)	25.6	*Mus musculus*	0.54	52.0
Meserve (1977)	Chile	Agriculture	27.0	*Akodon olivaceus*	0.15	76.5
Schlatter et al. (1980)	Chile	Agriculture	18.9	*Akodon olivaceus*	0.70	35.2
Schlatter et al. (1980)	Chile	Shrubland	34.8	*Oligoryzomys longicaudatus*	0.66	37.1
Leveau et al. (2002)	Argentina	Agriculture	22.9	*Akodon azarae*	0.35	36.3
Scheibler (2004)	Brazil	Agriculture	16.75	*Mus musculus*	0.12	66.9
This study	Argentina	Agriculture	13.5	*Calomys* sp.	0.33	43.2
This study	Argentina	Semiarid forest	61.0	*Ctenomys* sp.	0.11	74.4

analysis among sites revealed differences in prey species composition, as well as the MWVP and B_{sta} values. Considering the prey species spectrum our results on the diet of kites for agricultural habitats of La Pampa province were more similar to those of Leveau et al. (2002) in the same habitat type but located 100 km away than to those obtained from the nearby semiarid forest, resulting thus in more similar diets when the type of land use and level of habitat alteration are similar. In addition, we have found a similar relation for MWVP to that observed by Schlatter et al. (1980) in Chile when comparing high- vs. less-disturbed habitats. In Chile, the most rewarding prey in terms of MWVP was in the less disturbed habitat, in accordance with our finding of a higher MWVP in Parque Luro reserve than in agricultural habitats. However, these results should be considered with caution because pellets collected in Parque Luro reserve presumably came from only one pair of white-tailed kites and might be due to individual preferences or specializations for hunting tuco-tucos.

Prey selection in semiarid forests

Tuco-tucos occurred in the diet of kites in much higher proportion than expected according to their proportion in pit-fall traps. Assuming that our sampling of small mammals in Parque Luro reserve reflects the true abundances of the species we can conclude that, in the better preserved habitat, white-tailed kites preyed selectively on *Ctenomys* sp., one of the less frequently recorded rodent species. Thereby the kites seemed to focus on young tuco-tucos, probably because adults are too heavy (153 g) to be lifted by the birds, but also because adults appeared to be even less abundant than juveniles during spring and summer. However, these conclusions must be considered with caution because the pellets studied revealed the diet of just one pair during a short period of time. So, our results might just be a case of individual specialization on one type of prey. Since *Ctenomys* specimens were not recorded in pitfall traps during autumn and winter it would be interesting to know whether white-tailed kites continue to hunt this rodent species or whether they shift their diet preferences to other small mammals during the other seasons of the year, restricting such a prey-selective behavior to a certain part of the year only. Similarly, kites preyed exclusively on juveniles of another large rodent species, the degu (*Octodon degus*), in Chile (Schlatter et al. 1980), but as that study did not provide information on the availability of potential prey it may be that predation on young degus was merely reflecting their abundance in the field.

By selecting to prey on tuco-tucos, white-tailed kites were foraging more efficiently in the forest than in agricultural areas. Assuming equal proportions of successful hunts in both habitat types, they obtained only 1600 g of prey in 83 attacks (number of prey taken without insects; Table I) in the agricultural fields but more than 5000 g in 79 attacks in the semiarid forest. High occurrence of juvenile *Ctenomys* has also been recorded in the diet of American kestrels (*Falco sparverius*) during the breeding season in the same study area (Sarasola et al., 2003), but kestrels, due to the lower body weight, probably prey on smaller tuco-tucos than kites. These data on the prevalence of tuco-tucos in

the diet of raptor species in this habitat could be evidence of a key role this rodent plays in the population dynamic and guild structure of avian predators during their breeding season in semiarid forest of central Argentina.

Common features of small mammals preyed upon throughout the Americas

A review of dietary information on white-tailed kites characterizes this raptor as a small rodent specialist with similar mean values of MWVP and B_{sta} for North and South America. In most of the studies from North America, all of them from California, *Microtus californicus* constituted the main, sometimes almost the only prey of white-tailed kites. Interestingly, *Microtus californicus* and *Ctenomys* sp. are social species (Pearson et al., 1968; Redford & Eisenberg, 1992), a trait that might make them more vulnerable to predation due to spatial predictability of the social groups that are settled in an area and remain there for a variable time. In addition, *Ctenomys* sp. which are subterraneous might be relatively easy to detect by the conspicuousness of their burrows. However, whether white-tailed kites exhibit a general preference for semifossorial or subterraneous and socially organized small rodents over their whole geographic range, or whether this is just a coincidence should be elucidated by further studies on the hunting behavior of white-tailed kites.

Acknowledgments

We thank Laura Bragagnolo, Verónica Salvador and Marcos Reyes for field assistance and help in pellet analysis, and Sergio Tiranti for assisting in rodent identification. We appreciate the improvements in English expression made by the editor Anne Zillikens and by Stacy Small through the Association of Field Ornithologists' program of editorial assistance. We are indebted to C. De Francesco, M. Goldstein, P. Meserve, O. Pearson and A. Pearson for reviewing and improving an early draft of this article. We also thank A. Zillikens and one anonymous referee for providing helpful comments on an early draft of the manuscript. The Dirección de Recursos Naturales, government of La Pampa made this work possible by giving permission to carry out fieldwork and rodent trapping in Parque Luro reserve. J.H.S. received a scholarship from Consejo Nacional de Investigaciones Científicas y Técnicas de Argentina (CONICET).

References

Bond RM. 1942. White-tailed kites feeding on house mice. Condor 44:231–232.

Cabrera AL. 1976. Regiones fitogeográficas argentinas. In: Kugler WF, editor. Enciclopedia Argentina de agricultura y jardinería. 2nd ed. Buenos Aires: Editorial Acme. p. 1–85.

Colwell RK, Futuyma DJ. 1971. On the measurement of niche breadth and overlap. Ecology 52:267–276.

Corn PS. 1994. Straight-line drift fences and pitfall traps. In: Heyer WR, Donelly MA, McDiarmid RW, Hayek LC, Foster MS, editors. Measuring and monitoring biological diversity: standard methods for amphibians. Washington: Smithsonian Institution Press. p. 109–117.

Cunningham JD. 1955. Notes on food habits of the white-tailed kite in southern California. Condor 57:371.

Dixon JB, Dixon RE, Dixon JE. 1957. Natural history of the white-tailed kite in San Diego County, California. Condor 59:156–165.

Dunk JR. 1995. White-tailed kite (*Elanus leucurus*). In: Pole A, Gill F, editors. The birds of North America no. 178. Philadelphia: The Academy of Natural Sciences; Washington: The American Ornithologists' Union. (No. 178, DOI: 10.2173/bna.178)

Dunk JR, Cooper RJ. 1994. Territory-size regulation in black-shouldered kites. Auk 111:588–595.

Fowler J, Cohen L. 1986. Statistics for ornithologists. Hertfordshire, UK: British Trust for Ornithologists. 150 p.

Hawbecker AC. 1940. The nesting of the white-tailed kite in southern Santa Cruz County, California. Condor 42:106–111.

Leveau LM, Leveau CM, Pardiñas FJ. 2002. Dieta del milano blanco (*Elanus leucurus*) en Argentina. Ornitol Neotrop 13:307–311.

Levins R. 1968. Evolution in changing environments. Princeton (NJ): Princeton University Press. 120 p.

Marti CD. 1974. Feeding ecology of four sympatric owls. Condor 76:45–61.

Marti CD, Korpimäki E, Jaksic FM. 1993. Trophic structure of raptor communities: a three-continent comparison and synthesis. Current Ornithol 10:47–137.

Meserve PL. 1977. Food habits of a white-tailed kite population in central Chile. Condor 79:263–265.

Palmer R, editor. 1988. Handbook of North American birds. Volume 4. New Haven (CT): Yale University Press. 433 p.

Pearson O. 1985. Predation. In: Tamarin RH, editor. Biology of New World *Microtus*. Boston: American Society of Mammalogists. p. 535–566. (Special publication; 8).

Pearson O. 1995. Annotated keys for identifying small mammals living in or near Nahuel Huapi National Park or Lanín National Park, southern Argentina. Mastozool Neotrop 2:99–148.

Pearson O, Binsztein N, Boiry L, Busch C, Di Piace M, Gallopin G, Penchaszadeh P, Piantanida M. 1968. Estructura social, distribución espacial y composición por edades de una población de tuco-tucos (*Ctenomys talarum*). Invest Zool Chil 13:47–80.

Redford KH, Eisenberg JF. 1992. Mammals of the Neotropics. Volume 2, The Southern Cone. Chicago: Chicago University Press. 430 p.

Sarasola JH, Bragagnolo LA, Sosa RA. 2005. Changes in woody plant structure in fire-disturbed caldén forest of the Parque Luro Reserve, Argentina. Nat Area J 25:374–380.

Sarasola JH, Santillan M, Galmes MA. 2003. Food habits and foraging ecology of American kestrels in the semiarid forest of central Argentina. J Raptor Res 37:236–247.

Scheibler DR. 2004. Geographic variation in the size of mammalian prey taken by White-tailed Kites in the Americas. J Field Ornithol 75:218–222.

Schlatter RP, Toro B, Yañez JL, Jaksic FM. 1980. Prey of the white-tailed kite in central Chile and its relation to the hunting habitat. Condor 97:186–190.

Stendell RC, Myers P. 1973. White-tailed kite predation on a fluctuating vole population. Condor 75:359–360.

Steenhof K. 1983. Prey weights for computing percent biomass in raptor diets. Raptor Res 17:15–27.

Stoner EA. 1947. Food of white-tailed kites on the Suisun Marsh. Condor 49:84–85.

Tiranti SI. 1992. Barn owl prey in southern La Pampa, Argentina. J Raptor Res 26:89–92.

Village A. 1990. The kestrel. London: T&AD Poyser. 352 p.

Waian LB, Stendell RC. 1970. The white-tailed kite in California with observations of the Santa Barbara population. Calif Fish Game 56:188–198.

Warner JS, Rudd RL. 1974. Hunting by the white-tailed kite (*Elanus leucurus*). Condor 76:226–230.