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A REVIEW OF THE TROPHIC ECOLOGY OF THE BARN OWL IN ARGENTINA

M. ISABEL BELLOCQ
Departamento de Ciencias Biológicas, FCEN-Universidad de Buenos Aires, Ciudad Universitaria, Pab. 2, Buenos Aires 1428, Argentina

ABSTRACT.—I reviewed the literature on the trophic ecology of the Barn Owl (*Tyto alba*) in 40 areas of Argentina representing seven vegetation types in the species' range. Mammals (rodents, marsupials and bats) represented an average of 90.2 ± 13.6% (±SD) of the total prey found in pellets, and most mammalian prey were sigmodontine rodents (77.0 ± 19.6%). Birds were the most common secondary prey, and insects, reptiles and amphibians were negligible in the diet. The number of mammalian genera found in pellets (dietary richness) was similar among vegetation types but higher in subtropical than in temperate regions, showing a negative correlation with latitude. Mean weight of dominant prey species ranged from 12.6–326.0 g. Average food niche breadth (FNB) was similar in subtropical (4.07) and temperate (4.03) regions. Standardized FNB was 0.33 ± 0.16 and it was similar among vegetation types but lower in subtropical than in temperate regions. The diet of Barn Owls may reflect some human alterations to the habitat.

KEY WORDS: *Barn Owl*; Tyto alba; *diet*; *trophic ecology*; *Argentina*.

Un resumen de la ecologia trofica de *Tyto alba* en Argentina

RESUMEN.—Se revisó la literatura acerca de la ecología trófica de *Tyto alba* (lechuza del campanario) proveniente de 40 localidades de Argentina, que representan siete tipos de vegetación en el área de distribución de la especie. Los mamíferos (roedores, marsupiales, murciélagos) representaron un promedio de 90.2 ± 13.6% (±DE) del total de presas presentes en regurgitados y la mayoría de estos mamíferos eran roedores sigmodontinos (77.0 ± 19.6%). Las aves fueron la presa secundaria más común y los insectos, reptiles y anfibios tuvieron una representación insignificante en la dieta. El número de géneros de mamíferos representados en los regurgitados (riqueza) fue similar entre los distintos tipos de vegetación, pero mayor en regiones subtropicales que en templadas, presentando una correlación negativa con la latitud. El peso medio de la especie presa dominante en la dieta varió entre 12.6–326.0 g. La amplitud de nicho trófico (ANT) promedio fue similar entre regiones subtropicales (4.07) y templadas (4.03). La ANT estandarizada total fue 0.33 ± 0.16. La ANT estandarizada fue similar entre los tipos de vegetación, pero menor en regiones subtropicales que templadas. La dieta de *Tyto alba* puede reflejar algunas alteraciones antrópicas del hábitat.

[Traducción del autor]

Food is a major dimension of ecological niches (Schoener 1974). Competition for food resources, resulting in specialization and food partitioning, has been suggested as a primary mechanism allowing coexistence of species in assemblages of amphibians (Toft 1985), reptiles (Pianka 1973), birds (Lack 1946) and mammals (Dickman 1988). Descriptions of what animals eat are essential to identify energy paths through trophic webs and to understand how species divide food resources. Furthermore, knowledge of trophic ecology is fundamental to understand feeding strategies (selective and opportunistic behaviors) and niche dynamics. Raptors have frequently been used as predator models in studies of community ecology (e.g., Jaksić 1985, Marti et al. 1993), and the Barn Owl (*Tyto alba*) has been frequently included in major trophic studies of raptor assemblages (Marti et al. 1993 and references therein).

The Barn Owl is a common and widely distributed nocturnal predator that feeds primarily on small mammals. In Argentina, it is one of the most common and best-studied raptors. It occurs throughout the country and is particularly common in agrosystems, grasslands and open areas. Studies of the breeding biology have been conducted in temperate grasslands in the eastcentral part of the country (Fraga 1984, Nores and Gutiérrez 1986, Bellocq and Kravetz 1993). Two additional studies have focused on feeding strategies of breeding and nonbreeding Barn Owls, and prey selection on rodent species (Bellocq and Kravetz 1994, Bellocq 1998).

Food habits of the Barn Owl have been studied in numerous areas throughout its geographic range (Clark et al. 1978). Over 40 studies have described the food habits of Barn Owls in Argentina and several additional studies have been conducted in Chile (e.g., Jaksić and Yañez 1979, Iriarte et al. 1990). Here, I present a synthesis of the trophic ecology of the Barn Owl in Argentina based on a compilation and analysis of published information in 40 areas of the country.

MATERIALS AND METHODS

Habitat Descriptions. The diet of Barn Owls was studied in over 40 areas representing seven major vegetation types: subtropical rainforest, humid forest, the delta of the Paraná River, grasslands, savannas, and warm and cold semideserts (Table 1, Fig. 1).

Subtropical rainforests are characterized by warm and humid weather, with mean annual temperatures of 20–21°C and annual precipitation ranging from 1500–2000 mm. The vegetation has several strata and a high richness of species and life forms (e.g., epiphytes). The delta of the Paraná River has elements of the subtropical rainforest. However, I considered it as a separate region because it has distinct environmental characteristics and numerous endemisms. The vegetation physiognomy is dominated by pastures, willows and marshes in the lower zones, and by open shrublands and humid forests (where native species are common) in the upper zones.

Subtropical humid forests were originally xerophyllous and dominated by *Schinopsis balansae* and *Aspidosperma quebracho* in the upper canopy. There are typically one or two subcanopy tree strata followed by shrubs (e.g., *Prosopis ruscifolia, Acacia praecox, Castela coccinea*) and herbs (e.g. *Bromelia serra, Leptochloa virgata, Gomphrena pulchella*). The landscape has been widely modified by logging and by ranching.

Temperate grasslands have a moderate climate where annual precipitation varies from 600–1100 mm. The most common native grasses are *Stipa, Piptochaetium, Aristida, Melica, Briza, Bromus, Eragrostis* and *Poa*. These highly productive grasslands have gradually been converted to agriculture over the last two centuries. Currently, the natural plant community is composed of both native and introduced species (e.g., *Lolium, Briza,* and *Bromus*). Primary uses of the land are for cereal crops and livestock breeding.

Savannas have a moderate to dry climate with xerophyllous vegetation, where *Prosopis caldenia* is the most common tree species. Other tree species include *P. flexuosa, Geoffroea decorticans, Jordina rhombifolia, Schinus fasciculatus* and *Ximenia americana.* Savannas are open woodlands with some shrubs (e.g., *Condalia microphylla, Atamisquea emarginata, Ephedra triandra, Maytenus spinosus*) and diverse grasses (e.g., *Trichloris crinita, Elionurus muticus, Schizachyrium consanguineum, Setaria mendocina*). Deforestation and ranching has partially modified the natural vegetation.

Warm semideserts include the driest lands of Argentina where annual precipitation ranges from 80–200 mm Typically, they are dominated by thorn-scrub communities with shrubs such as *Larrea divaricata, L. cuneifolia, L nitida, Monttea aphylla* and *Bougainvillae spinosa.* Bromeliads are also common. The main human activity of the region is ranching. In cold semideserts, mean annual temperature ranges from 5.0–13.4°C and annual precipitation ranges from 155–500 mm. It is a steppe where common species such as *Malinum spinosum, Brachyclados caespitosus, Junellia tridens* and *Nassauvia glomerulosa* are adapted to a dry and windy climate. Further details on these vegetation types can be found in Ragonese (1968) and Cabrera (1971).

Data Analysis. Pellet analysis was used by all authors to study diets of Barn Owls. The objectives of the studies, however, were varied (Table 1). While some studies focused on feeding habits of the owls, others emphasized small mammal distributions and descriptions of new small mammal races (e.g., Contreras and Rossi 1981). I used the number of mammalian genera found in pellets to provide an estimate of dietary richness for each locality and I estimated the frequency and recorded the average weight (taken from Redford and Eisenberg, 1992) of the dominant prey species.

For each locality and prey type, data were summarized as the percent frequency of the total number of prey found in pellets. Because most publications provided more details on mammalian prey than on any other prey, I was also able to obtain frequency estimates of rodent families in the diets. Although there were relatively recent changes in small mammal taxonomy, I maintained the old taxonomy as it appeared in literature. As a result, I refer to Cricetidae (instead of Sigmodontinae) and Muridae (instead of Murinae). Marsupials, bats, birds, reptiles, amphibians and arthropods were considered different categories. Finally, I estimated the average percentage frequency for each prey category by vegetation type.

Food-niche breadth (FNB) was estimated for each locality following Marti's (1988) criteria. Thus, mammals (rodents, marsupials and bats) were categorized by genus whereas birds, reptiles, amphibians and insects (including other invertebrates) were catagorized by class. Levins' index was used to estimate food-niche breadth as $FNB = 1/\Sigma p_i^2$, where p_i is the proportion of item i in the diet Hurlbert's standardization was employed to allow meaningful comparisons, and it was calculated as $FNBs = (B_{obs} - B_{min})/(B_{max} - B_{min})$, where B_{obs} = FNB (as calculated above), $B_{min} = 1$ (minimum possible niche breadth) and $B_{max} = N$ (maximum possible niche breadth or total number of prey categories).

ANOVA or Kruskal-Wallis (H, when the data set did not reach homogeneity of variances even after transformation) tests were used to test for differences in FNBs and in the number of mammalian genera found in diet among vegetation types. Correlation and regression analyses were used to test for associations and explain spatial variations of food-niche parameters. All means are presented ± 1 SD.

Table 1. Major vegetation types, geographic location and emphasis of studies on the diet of Barn Owls (*Tyto alba*) in 40 localities in Argentina. Numbers preceeding localities correspond to numbers in Figure 1.

Major Vegetation Type	Geographic Location	Study Emphasis	Source
Subtropical rainforest	1. S.M. Tucumán, 26°50′S, 65°13′W	Mammalian prey	Soncini et al. 1985
	2. Teyú Cuaré, 27°15′S, 55°34′W	Mammalian prey	Massoia et al. 1988a
	3. Arroyo Yabebirí, 27°18′S, 55°32′W	Vertebrate prey	Massoia et al. 1989c
	4. Campo Ramón, 27°27′S, 55°08′W	Diet description	Massoia 1988b
	5. Los Helechos 27°27′S, 55°08′W	Mammalian prey	Massoia et al. 1989a
	6. Bonpland, 27°29′S, 55°29′W	Vertebrate prey	Massoia et al. 1989b
	7. Apóstoles, 27°54′S, 55°45′W	Mammalian prey	Massoia 1983
Subtropical humid forest	8. Ensenadita, 27°12′S, 58°21′W	Vertebrate prey	Massoia et al. 1988b
	9. Desaguadero, 27°14′S, 58°25′W	Mammalian prey	Massoia et al. 1990
		Avian prey	Morici 1990a
Delta forest	10. Islas del Ibicuy, 33°44′S, 59°10′W	Mammalian prey	Massoia 1983
	11. INTA-Delta, 34°09′S, 58°51′W	Mammalian prey	Massoia et al. 1989
Temperate grasslands	12. Córdoba, 31°28′S, 64°15′W	Feeding habits	Nores and Gutiérrez 1990
	13. Diego Gaynor, 34°18′S, 59°14′W	Seasonal variations	Bellocq 1990
	14. San Miguel, 34°30′S, 58°42′W	Vertebrate prey	Massoia 1989
		Avian prey	Morici 1990b
	15. Castelar, 34°39′S, 58°39′W	Mammalian prey	Massoia 1983
	16. Lobos, 35°12′S, 59°06′W	Seasonal variations	Faverín 1989
	17. Alta Italia, 35°20′S, 64°06′W	Diet description	Massoia and Vetrano 1988b
	18. Luán Toro, several localities	Mammalian prey	De Santis et al. 1988
	19. Saladillo, 35°35′S, 59°46′W	Mammalian prey	Massoia 1988c
	20. Mar del Tuyú, 36°34′S, 56°55′W	Mammalian prey	Massoia 1990
	21. Santa Rosa, several localities	Mammalian prey	De Santis et al. 1988
	22. Bajo Giuliani, 36°37′S, 64°17′W	Mammalian prey	De Santis et al. 1983
	23. Macachín, several localities	Mammalian prey	De Santis et al. 1988

Table 1. Continued.

DOMINANT VEGETATION TYPE	GEOGRAPHIC LOCATION	STUDY EMPHASIS	SOURCE
Savanna (*Prosopis*)	24. La Elenita, 36°17′S, 65°47′W	Mammalian prey	Tiranti 1988
	25. Toay y Loventué Districts	Mammalian prey	Justo and De Santis 1982
	26. Chacharramendi, several localities	Mammalian prey	De Santis et al. 1988
	27. Luan Cura Hué, 38°05′S, 64°33′W	Trophic ecology	Tiranti 1992
	28. Cuchillo Có, 38°20′S, 64°40′W	Trophic ecology	Tiranti 1992
	29. Anzoategui, several localities	Mammalian prey	De Santis et al. 1988
Warm semidesert	30. Humaita, 24°55′S, 65°31′W	Mammalian prey	Massoia 1988a
	31. Salinas del Bebedero, 33°39′S, 66°36′W	Mammalian prey	Massoia and Pardiñas 1988
	32. Los Ranqueles, 37°55′S, 65°24′W	Mammalian prey	Tiranti 1988
	33. Casa de Piedra, 38°12′S, 67°12′W	Avian prey	Montalvo et al. 1985
	34. Puelén, several localities	Mammalian prey	Noriega et al. 1993
	35. Villa Regina, 39°20′S, 67°06′W	Diet description	De Santis et al. 1988
	36. Laguna Blanca, 42°49′S, 15°08′W	Mammalian prey	Massoia and Vetrano 1988a
		Avian prey	De Santis and Pagnoni 1989
	37. Punta Este, 42°49′S, 19°09′W	Mammalian prey	Noriega et al. 1990
			De Santis and Pagnoni 1989
Cold semidesert	38. Junín de los Andes, 39°57′S, 71°05′W	Gradient in diet	Travaini et al. 1997
	39. Corintos river, 46°06′S, 71°31′W	Vertebrate prey	De Santis et al. 1983
	40. Trevelin, 46°06′S, 71°30′W	Feeding habits	De Santis et al. 1994

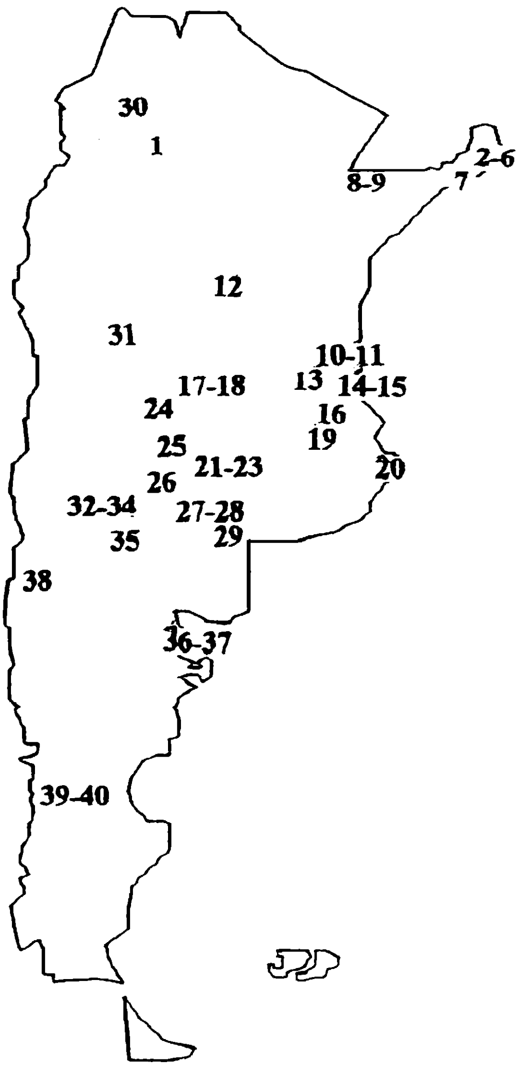

Figure 1. Geographical location of sites where the diet of Barn Owls was studied in Argentina. Numbers correspond to locations given in Table 1.

RESULTS AND DISCUSSION

Overall Diet. The Barn Owl is a specialist on small mammals (Dean 1975, Morton and Martin 1979, Jaksić et al. 1982, Lenton 1984, Marti 1988). Mammals were also the most common prey found in pellets in all areas of Argentina with the exception of San Miguel and Castelar where passerine birds were more abundant (Table 2). In Castelar, Córdoba, San Miguel and Ensenadita (urban or suburban areas), birds, Muridae and bats were unusually abundant in the diet. Mammals represented an average of 90.2 ± 13.6% (range = 36.3–100%) of the total prey found in pellets and most mammalian prey were cricetine (now sigmodontine) rodents (77.0 ± 19.6%, range = 27.5–100%). Barn Owls took a wide variety of mammalian species depending on the distribution and, presumably, the local availability of prey. The differential predation on rodent species in agrosystems reported by Bellocq and Kravetz (1994) may be attributed to habitat selection. There is evidence that Barn Owls feed selectively on large rodents when prey abundance is high during the breeding season, but not consistently during the nonbreeding season when rodent abundance is low (Bellocq 1998).

Small marsupials were taken by Barn Owls when available. They represented 23.8% of the total prey in Bonpland but, in Diego Gaynor, they were not found in pellets or in small mammal trapping conducted during several years using several different trapping methods. *Marmosa pusilla* was consistently found in pellets from the *Prosopis* savanna. Marsupials such as *Marmosa agilis* are abundant in the humid forest and Massoia (1983) suggested that they may be a preferred prey of Barn Owls in the delta of the Paraná River. Although marsupials such as *Lutreolina crassicaudata* occurred in almost all study areas, they were only occasionally found in pellets, presumably because of its large size and aggressive behavior. Other marsupials represented in diets included *Thylamys agilis, T. elegans* and *Monodelphis henseli.*

Birds were the most common secondary prey but the percent of birds found in pellets varied greatly among localities. The average percent of birds in the diet was 7.2 ± 12.8% (range = 0–63.7%). The following orders were identified in decreasing order: Passerifirmes, Columbiformes, Tinamiformes, Charadriiformes, Anseriformes and Gruiformes.

Bats were occasionally found and represented ≤56.6% of the diet. Bats most commonly taken included species of *Lasiurus, Molossus, Eumops, Myotis* and *Sturnira.*

Reptiles such as snakes and iguanas were only found in pellets from Diego Gaynor, Laguna Blanca, Punta Este and Luan Cura Hué. Amphibians were found in pellets from S.M. Tucumán (*Leptodactylus chaquensis*), Campo Ramón (Batrachia), Desaguadero (Batrachia), San Miguel (Leptodactylidae, Bufonidae, Ceratophrynidae), Alta Italia, Villa Regina (Batrachia), Trevelin (*Pleurodema bufonina*) and Junín de los Andes.

Arthropods were likely taken opportunistically and their role in fulfilling energetic requirements appeared to be negligible in Argentina. Insects were reported in the diet in five localities. In Lobos, 15% of the pellets collected year round contained remains of insects and the percent of pellets showing insects was higher in spring-summer (50.3%) than in fall-winter (1.8%) (Faverin 1989). Although 33.5% of the food items found in pellets in Diego Gaynor were arthropods, their contribution in terms of biomass (<1%) was negligible in comparison to that of vertebrates (Bellocq 1990). Massoia and Vetrano (1988a) identified spiders and insects (Carabidae, Scarabaeidae, Coccinellidae, Rutelidae, Gryllidae, Acridiidae, Mantidae, Mantispidae, Cicadidae, Blattidae) in pellets from Villa Regina which represented 9.5% of the total prey.

Food-niche Parameters. Dietary richness was negatively correlated with latitude. The number of mammalian genera found in pellets varied from 4–20 (Table 2) and was correlated with latitude ($r = -0.456$). I excluded from the analysis one outlier corresponding to Junín de los Andes. The coefficient of determination showed that latitude explained 18% of the variation in the number of mammalian genera found in pellets ($F = 7.862$, $P < 0.01$). Given that species richness is highly and negatively correlated with latitude (Rohde 1992), the spatial variation in dietary richness may be partially explained by differential availability of prey at the regional scale. This expected general pattern identified in southern regions of the Neotropics was not found among diets of raptor assemblages in northern latitudes (Marti et al. 1993).

I also expected to find an association between FNB and latitude, where declining FNB should be associated with increasing latitude. However, there was no significant correlation between FNB and latitude. Average FNB was 4.05 ± 1.40 ranging from 1.37 in Alta Italia to 7.49 in Saladillo and FNBs was 0.33 ± 0.16 ranging from 0.05 in Alta Italia to 0.69 in the Toay and Loventué Districts (Table 2). The dominant prey in the diet represented >30% of the total prey in 70% of the localities and >40% in 47% of the localities.

Mean weight of the dominant prey species varied from 12.6–326.0 g (Table 2). The overall geometric mean of prey weight of Barn Owls in temperate Neotropical regions was estimated to be 45.1 g (Marti et al. 1993). It was unusual for Barn Owls to take prey as heavy as *Holochilus brasilensis* (326 g) and *Scapteromys tumidus* (146 g) which were the primary prey found in two subtropical localities (Desaguadero and the Ibicuy Islands).

Comparison among Regions. The mean percent frequency of the dominant prey species in the diet was similar between subtropical (39.5 ± 15.0) and temperate (34.7 ± 10.2) localities ($F = 0.941$, $P > 0.05$). Although the primary prey species varied among localities, there was consistency within most regions (Table 2).

The number of mammalian genera found in diet was similar among vegetation types ($H = 1.110$, $P > 0.05$), but higher in subtropical (13.6 ± 4.3) than in temperate (8.8 ± 2.5) regions ($F = 19.008$, $P < 0.001$) (Table 3). In contrast, more classes and rodent families were represented in diets in temperate (3–4 classes and 4–6 rodent families) than in subtropical (2–3 classes and 3 rodent families) regions. This may be explained by the diversity of primary prey in the wild. Species diversity of Cricetine rodents is higher in subtropical than in temperate regions (Redford and Eisenberg 1992), and they represented over 60% of the diet of Barn Owls in natural regions of Argentina (Table 3). Barn Owls seem to prey on a wide variety of Cricetine species when available before exploring other prey taxa.

FNB was similar in subtropical (4.07 ± 1.22) and temperate (4.03 ± 1.51) regions of Argentina ($F = 0.005$, $P > 0.05$). Marti et al. (1993) obtained similar values for temperate and tropical regions of South America (Table 4). The average FNBs was 0.33 (Table 3). It was higher than any value estimated in the southern portion of the Barn Owl's range in the Neotropics (Table 4) but similar to the average value obtained from Marti's (1988) compilation of nine areas most of them from southern latitudes (FNBs = 0.27, $F = 0.27$, $P > 0.6$). My FNBs value was also similar to the mean value estimated from 19 areas around the world (FNBs = 0.26, $F = 0.96$, $P > 0.3$) (Marti 1988).

In Argentina, FNBs was similar among natural regions ($H = 3.552$) (Table 3). However, the average FNBs was lower in subtropical (0.25 ± 0.04) than in temperate regions (0.35 ± 0.19, $F = 4.423$, $P < 0.05$). Marti et al. (1993) estimated a higher diet diversity in tropical than in temperate regions of South America.

Management Implications. Diets of Barn Owls may reflect opportunistic feeding because of the effects of human impacts on their habitat. For instance, the diet of Barn Owls changed after dam

Table 2. Number of pellets analyzed, total number of prey items, dominant prey found in pellets, percent frequency of dominant prey (relative to the total mammals found in pellets), number of identified genera of mammals, food niche breadth (FNB) and standardized FNB (FNBs) of the Barn Owl in seven major vegetation types of Argentina. Sources are listed in Table 1.

Vegetation Type & Locality	No. Pellets	Total Prey	Dominant Prey (mean weight, g)	% Frequency	No. of Genera	FNB	FNBs
Subtropical rainforest							
S.M. Tucumán	149	200	*Calomys* sp.	51.4	10	3.11	0.23
Teyú Cuaré	ca. 50	112	*O. eliurus* and *Necromys temchuki*	24.1	9	5.87	0.54
Arroyo Yabebirí	>1000	1905	*Oligoryzomys eliurus*	32.4	18	3.36	0.14
Campo Ramón	ca. 300	571	*Oligoryzomys eliurus*	37.5	20	4.93	0.17
Los Helechos	ca. 300	542	*Oligoryzomys eliurus*	33.3	20	4.27	0.16
Bonpland	—	454	*Oligoryzomys* sp.	48.0	17	3.69	0.17
Apóstoles	116	279	Akodontini	28.9	10	5.34	0.48
Subtropical humid forest							
Ensenadita	—	83	*Eumops bonariensis* (12.6)	57.5	9	2.98	0.22
Desaguadero	—	692	*Holochilus brasilensis* (326.0)	40.5	13	4.93	0.28
Delta River							
Islas del Ibicuy	1215	2367	*Scapteromys tumidus* (146.0)	24.5	13	4.55	0.30
INTA-Delta	—	91	*Oligoryzomys flavescens* (18.9)	65.9	11	1.71	0.07
Temperate grasslands							
Córdoba	262	496	*Rattus norvergicus*	23.8	10	3.87	0.32
Diego Gaynor	352	1409	*Calomys laucha* (12.6)	40.0	6	—	—
San Miguel	—	801	Passerine birds	—	9	4.35	0.33
Castelar	58	80	Passerine birds	—	8	2.01	0.14
Lobos	621	2203	*Akodon azarae* (28.3)	40.1	7	—	—
Alta Italia	134	347	*Calomys* sp.	94.3	8	1.37[a]	0.05
Luán Toro	—	784	*Calomys* sp.	49.7	8	3.01[a]	0.29
Saladillo	35	39	*Akodon azarae*	25.0	10	7.49[a]	0.65
Mar del Tuyú	80	110	*Ctenomys lujanensis*	30.8	8	5.67	0.58
Santa Rosa	—	273	*Calomys* sp.	41.7	10	3.62[a]	0.29
Bajo Giuliani	—	272	*Calomys* sp.	42.1	10	3.61[a]	0.29
Macachín	—	53	*Akodon molinae* (31.8)	41.5	7	3.80	0.56

Table 2. Continued.

Vegetation Type & Locality	No. Pellets	Total Prey	Dominant Prey (mean weight, g)	% Frequency	No. of Genera	FNB	FNBs
Savanna							
La Elenita	45	165	*Calomys* sp.	79.4	4	1.54[a]	0.18
Toay y Loventué	—	168	*Akodon azarae*	30.2	7	5.13	0.69
Chacharramendi	—	394	*Calomys* sp.	40.3	9	3.95[a]	0.37
Luan Cura Hué	96	440	*Akodon azarae*	23.2	12	4.94[a]	0.36
Cuchillo Có	110	157	*Calomys* sp.	52.3	8	2.84[a]	0.26
Anzoategui	—	57	*Akodon molinae*	24.5	7	3.51	0.42
Warm semidesert							
Humaita	—	125	*Calomys callosus* (30.9)	36.0	8	3.21	0.28
Salinas del Bebedero	65	100	*Ctenomys talarum* (157.0)	26.5	7	5.51	0.64
Los Ranqueles	71	217	*Eligmodontia typus* (20.6)	24.9	11	5.19[a]	0.42
Puelén	—	362	*Eligmodontia typus*	38.3	10	3.66[a]	0.30
Casa de Piedra	—	75	*Eligmodontia typus*	41.1	9	4.39[a]	0.42
Villa Regina	150	263	*Mus* sp.	34.7	10	5.31	0.36
Laguna Blanca	124	190	*Eligmodontia typus*	48.6	9	4.14	0.39
Punta Este	142	226	*Eligmodontia typus*	54.0	8	3.02	0.29
Cold semidesert							
Junín de los Andes	—	2447	*Reithrodon auritus* (74.0)	22.9	19	7.39	0.36
Corintos river	30	84	*Eligmodontia typus*	56.2	8	2.85	0.26
Trevelin	107	304	*Reithrodon auritus*	32.0	9	3.78	0.35

[a] After Tiranti (1992).

Table 3. Average percent frequency of the number of prey found in pellets of Barn Owls in seven vegetation types of Argentina.

	Subtropical Rainforest	Subtropical Humid Forest	Delta River	Temperate Grasslands	Savanna	Warm Semidesert	Cold Semidesert
Mammalian orders and families							
Cricetidae	77.6 ± 8.5	60.8 ± 38.3	88.8 ± 6.4	70.3 ± 27.0	91.2 ± 7.7	72.3 ± 14.7	89.0 ± 4.4
Muridae	4.3 ± 4.8	0.2 ± 0.3	0.5 ± 0.8	5.6 ± 9.9	0	3.8 ± 10.9	3.3 ± 4.4
Caviidae	0.9 ± 0.6	0.9 ± 1.3	<0.1	1.7 ± 2.9	0.2 ± 0.5	2.2 ± 2.4	0.2 ± 0.3
Ctenomyidae	0	0	0	3.4 ± 8.3	1.6 ± 2.5	6.1 ± 8.6	1.2 ± 2.4
Leporidae	0	0	0	0.2 ± 0.7	0	0.7 ± 2.1	<0.1
Octodontidae	0	0	0	0	<0.1	<0.1	0
Echimyidae	0.2 ± 0.6	0	0	0	0	0	0
Marsupialia	9.0 ± 8.9	5.4 ± 0.8	8.9 ± 7.9	0.6 ± 0.8	5.5 ± 4.4	7.3 ± 7.2	0.3 ± 0.6
Chiroptera	0.9 ± 1.0	28.8 ± 39.2	6.2 ± 8.3	0.6 ± 1.2	0.2 ± 0.3	0.4 ± 1.1	0
Mammals	93.8 ± 5.4	96.3 ± 0.1	99.6 ± 0.6	78.0 ± 21.0	98.2 ± 1.8	91.3 ± 7.8	94.7 ± 1.3
Birds	3.2 ± 2.6	3.6 ± 0	0.4 ± 0.6	17.2 ± 21.5	1.6 ± 1.7	6.8 ± 7.3	2.6 ± 2.0
Reptiles	0	0	0	<0.1	<0.1	0.5 ± 0.9	0
Amphibians	1.2 ± 3.0	<0.1	0	0.7 ± 1.4	0	0.2 ± 0.5	0.7 ± 1.1
Sample size (localities)	7	2	2	12	6	8	3
Average number of mammalian genera	14.8 ± 5.0	11.0 ± 2.8	12.0 ± 1.4	8.4 ± 1.4	7.8 ± 2.6	9.0 ± 1.3	12.0 ± 6.1
Average FNBs	0.27 ± 0.17	0.25 ± 0.04	0.18 ± 0.16	0.35 ± 0.19	0.38 ± 0.17	0.38 ± 0.17	0.32 ± 0.05

Table 4. Food-niche breadth (FNB, based on proportion of species) and standardized food-niche breadth (FNBs) of the Barn Owl in regions of Europe, North America and South America. Source: Marti et al. (1993).

	FNB	FNBs
Europe		
Mediterranean	3.84	0.20
West	4.43	0.06
East	2.23	0.03
North America		
West	7.88	0.03
Midcentral	9.61	0.29
Eastcentral	1.96	—
Southeastern	3.04	—
South America		
Temperate	4.28	0.18
Tropical	4.61	0.38
Insular	3.20	0.19

construction on the Colorado River in Casa de Piedra. Montalvo et al. (1985) reported diet composition based on pellets collected in October 1979 and November 1983, prior to and after dam construction (also in Noriega et al. 1993). Prior to dam construction, the diet consisted of 97.3% mammals and 2.7% birds. After dam construction, it changed to 60.2% mammals and 39.8% birds. This change in diet may have been due to a change in the relative abundance of vertebrate populations or a higher vulnerability of birds due to increasing edge effect.

Barn Owls are predators of small mammal species considered harmful for agriculture and agroforestry. *Calomys laucha* and *Holochilus brasilensis* are known to damage crops and young tree plantations, respectively. Furthermore, *C. laucha, Oligoryzomys flavescens* and *Akodon azarae* can carry serious human diseases such as hantavirus pulmonary syndrome (Levis et al. 1995) and hemorrhagic fever (Kravetz et al. 1986). Increasing availability of roosting sites for raptorial birds in cropfields resulted in decreased short-term abundance of *C. laucha* (Bellocq and Kravetz 1990). Similar results were found after habitat enhancement for predators in pine plantations (Muñoz and Murúa 1990) and nest boxes have been a useful tool to increase productivity of Barn Owls in agrosystems of Argentina (Bellocq and Kravetz 1993).

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LITERATURE CITED

BELLOCQ, M.I. 1990. Composición y variación temporal de la dieta de *Tyto alba* en ecosistemas agrarios pampeanos, Argentina. *Vida Silvestre Neotropical* 2:32–35

———. 1998. Prey selection by breeding and non-breeding Barn Owls in Argentina. Auk 115:224–229.

——— AND F.O. KRAVETZ. 1990. Practical and theoretical implications of perch use for avian predators on rodent populations. *Ecosur* 16:61–67.

——— AND ———. 1993. Productividad de la lechuza del campanario (*Tyto alba*) en nidos artificiales en agrosistemas pampeanos. *Hornero* 13:277–282.

——— AND ———. 1994. Feeding strategy and predation of the Barn owl (*Tyto alba*) and the Burrowing Owl (*Speotyto cunicularia*) on rodent species, sex, and size, in agrosystems of central Argentina. *Ecología Austral* 4· 29–34.

CABRERA, A.L. 1971. Fitogeografía de la República Argentina. *Bol. Soc. Arg. Bot.* 19:1–42.

CLARK, J.R., D.G. SMITH AND L.H. KELSO. 1978. Working bibliography of owls of the world. Natl. Wildl. Fed Sci. Tech., Washington, DC U.S.A.

CONTRERAS, J.R. AND M.I. ROSSI. 1981. Una nueva subespecie del ratón colilargo para la provincia de Mendoza: *Oligoryzomys flavescens occidentalis* (Mammalia, Rodentia, Cricetidae). *Historia Natural* (Argentina) 1 157–160.

DEAN, W.R.J. 1975. *Tyto alba* prey in southwest Africa and the northern cape. *Zool. Afr.* 10:217–219.

DE SANTIS, L.J.M. AND G.O. PAGNONI. 1989. Alimentación de *Tyto alba* (Aves: Tytonidae) en localidades costeras de la provincia del Chubut (República Argentina). *Neotropica* 35:43–49.

———, C.I. MONTALVO AND E.R. JUSTO. 1983. Mamíferos integrantes de la dieta de *Tyto alba* (Aves: Strigiformes, Tytonidae) en la provincia de La Pampa, Argentina. *Historia Natural* (Argentina) 3:187–188.

———, E. JUSTO, C. MONTALVO AND M. KIM. 1988. Mamíferos integrantes de la dieta de *Tyto alba tuidara* en la provincia de La Pampa, Argentina. Serie Suplementos No. 4:165–175, Universidad Nacional de La Pampa, Santa Rosa, Argentina.

———, L.J.M., N.G. BASSO, J.I. NORIEGA AND M.F. GROSSMAN. 1994. Explotación del recurso trófico por la lechuza de los campanarios (*Tyto alba*) en el oeste de Chubut, Argentina. *Stud. Neotropical Fauna Environ.* 29. 43–47.

DICKMAN, C.R. 1988. Body size, prey size, and community structure in insectivorous mammals. *Ecology* 69:569–580.

FAVERIN, C. 1989. Variación de la dieta de la lechuza del campanario (*Tyto alba*) en Lobos, provincia de Buenos Aires. Seminario de Licenciatura, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Mar del Plata, Argentina.

FRAGA, R.M. 1984. Casos de nidificación otoño-invernal en algunas rapaces (*Tyto alba, Asio clamator, Elanus leucurus*), en Lobos, Buenos Aires. *Hornero* 12:193–195.

IRIARTE, J.A., W.L. FRANKLIN AND W.E. JOHNSON. 1990. Diets of sympatric raptors in southern Chile. *J. Raptor Res.* 24:41–46.

JAKSIĆ, F.M. 1985. Toward raptor community ecology: behavior bases of assemblage structure. *J. Raptor Res.* 19:107–112.

——— AND J.L. YAÑEZ. 1979. The diet of the Barn Owl in central Chile and its relation to the availability of prey. *Auk* 96:619–621.

———, R.L. SEIB AND C.M. HERRERA. 1982. Predation by the Barn Owl in mediterranean habitats of Chile, Spain, and California. *Am. Midl. Nat.* 107:151–162.

JUSTO, E.R. AND L.J.M. DE SANTIS. 1982. Alimentación de *Tyto alba* en la provincia de La Pampa. I. *Neotrópica* 28:83–86.

KRAVETZ, F.O., R.E. PERCICH, G.A. ZULETA, M.A. CALLELO AND M.C. WEISSENBACHER. 1986. Distribution of Junín virus and its reservoirs. A tool for Argentine hemmorrhagic fever risk evaluation in nonendemic areas. *Interciencia* 11:185–188.

LACK, D. 1946. Competition for food by birds of prey. *J. Anim. Ecol.* 15:123–129.

LENTON, G.M. 1984. The feeding and breeding ecology of Barn Owls *Tyto alba* in peninsular Malaysia. *Ibis* 126:551–575.

LEVIS, S.C., A.M. BRIGGILER, M. CACASS, C.J. PETERS, K. KSIAZEK, J. CORTES, M.E. LAZARO, P.E. ROLLIN, E.P. PINHEIRO AND E. ENRIA. 1995. Emergence of hantavirus pulmonary syndrome in Argentina. *Am. J. Tropical Dis. Hygiene* 53:233.

MARTI, C.D. 1988. A long-term study of food-niche dynamics in the Common Barn-Owl: comparisons within and between populations. *Can. J. Zool.* 66:1803–1812.

———, E. KORPIMÄKI AND F.M. JAKSIĆ. 1993. Trophic structure of raptor communities: a three-continent comparison and synthesis. *Current Ornithology* 10:47–137.

MASSOIA, E. 1983. La alimentación de algunas aves del orden Strigiformes en la Argentina. *Hornero, Número extraordinario*:125–148.

———. 1988a. Análisis de regurgitados de *Tyto alba* de Humaita, departamento Cerrillos, provincia de Salta. Asociación para la Protección de la Naturaleza, Boletín Científico 5:6–10.

———. 1988b. Presas de *Tyto alba* en Campo Ramón, departamento Oberá, provincia de Misiones. Asociación para la Protección de la Naturaleza, Boletín Científico 7:4–16.

———. 1988c. Presas de *Tyto alba* en Saladillo, partido de Saladillo, provincia de Buenos Aires. Asociación para la Protección de la Naturaleza, Boletín Científico 6:10–14.

———. 1989. Animales depredados por *Tyto alba tuidara* en la ciudad de San Miguel, partido de General Sarmiento, provincia de Buenos Aires. Asociación para la Protección de la Naturaleza, Boletín Científico 15. 2–7.

———. 1990. Roedores depredados por *Tyto alba tuidara* en Mar del Tuyu, partido de General Lavalle, provincia de Buenos Aires. Asociación para la Protección de la Naturaleza, Boletín Científico 17:17–20.

——— AND U. PARDIÑAS. 1988. Algunos datos sobre la dieta mastofaunística de *Tyto alba* en Salinas del Bebedero, departamento Capital, provincia de San Luis. Asociación para la Protección de la Naturaleza, Boletín Científico 2:8–12.

——— AND A.S. VETRANO. 1988a. Análisis de regurgitados de *Tyto alba* de Villa Regina, General Roca, provincia de Río Negro. Asociación para la Protección de la Naturaleza, Boletín Científico 3:10–20.

——— AND ———. 1988b. Análisis de regurgitados de *Tyto alba* de Alta Italia, departamento Realicó, provincia de La Pampa. Asociación para la Protección de la Naturaleza, Boletín Científico 3:4–10.

———, J.C. CHEBEZ AND S. HEINONEN FORTABAT. 1988a. Depredación de mamíferos por *Tyto alba tuidara* en Teyú Cuaré, departamento San Ignacio, provincia de Misiones. Asociación para la Protección de la Naturaleza, Boletín Científico 8:7–13.

———, ——— AND ———. 1988b. Presas de *Tyto alba tuidara* en Ensenadita, departamento de San Cosme, provincia de Corrientes. Asociación para la Protección de la Naturaleza, Boletín Científico 12:8–14.

———, ——— AND ———. 1989a. Análisis de regurgitados de *Tyto alba tuidara* de Los Helechos, departamento Oberá, provincia de Misiones. Asociación para la Protección de la Naturaleza, Boletín Científico 14· 16–22.

———, ——— AND ———. 1989b. Mamíferos y aves depredados por *Tyto alba tuidara* en Bonpland, departamento Candelaria, provincia de Misiones. Asociación para la Protección de la Naturaleza, Boletín Científico 15:19–24.

———, ——— AND ———. 1989c. Mamíferos y aves depredados por *Tyto alba tuidara* en el Arroyo Yabebirí, departamento Candelaria, provincia de Misiones. Asociación para la Protección de la Naturaleza, Boletín Científico 15:8–13.

———, ——— AND ———. 1990. Mamíferos depredados por *Tyto alba tuidara* en Desaguadero, departamento Capital, provincia de Corrientes. Asociación para la Protección de la Naturaleza, Boletín Científico 18:14–17.

———, S.I. TIRANTI AND M.P. TORRES. 1989. La depredación de pequeños mamíferos por *Tyto alba* en Canal 6, delta bonaerense, partido de Campana, provincia de Buenos Aires. Asociación para la Protección de la Naturaleza, Boletín Científico 13:14–19.

MONTALVO, C.I., E.R. JUSTO AND L.J.M. DE SANTIS. 1985. Alimentación de *Tyto alba* (Strigiformes, Tytonidae) en la provincia de La Pampa. II. *Neotrópica* 30:250–252.

MORICI, A. 1990a. Aves depredadas por *Tyto alba tuidara* en Desaguadero, departamento Capital, provincia de Corrientes. Asociación para la Protección de la Naturaleza, Boletín Científico 18:18–19.

———. 1990b. Aves depredadas por *Tyto alba tuidara* en San Miguel, partido de General Sarmiento, Prov. de Buenos Aires. Asociación para la Protección de la Naturaleza, Boletín Científico 17:5–8.

MORTON, S.R. AND A.A. MARTIN. 1979. Feeding ecology of the Barn Owl, *Tyto alba,* in arid southern Australia. *Aust. Wildl. Res.* 6:191–204.

MUÑOZ, A. AND R. MURÚA. 1990. Control of small mammals in a pine plantation by modification of the habitat of predators (*Tyto alba,* Strigiforme, and *Pseudalopex* sp., Canidae). *Acta Oecologica* 11:251–261.

NORES, A.I. AND M. GUTIÉRREZ. 1986. Nidificación de *Tyto alba* en Córdoba, Argentina. *Hornero* 12:242–249.

——— AND ———. 1990. Dieta de la lechuza del campanario (*Tyto alba*) en Córdoba, Argentina. *Hornero* 13:129–132.

NORIEGA, J.I., L.J.M. DE SANTIS AND G.O. PAGNONI. 1990. Passeriformes presentes en egagrópilas de *Tyto alba* (Aves: Tytonidae) para la localidad de Laguna Blanca (provincia del Chubut, Argetina). *Neotrópica* 36:33–34

———, E.R. JUSTO AND L.J.M. DE SANTIS. 1993. Birds present in pellets of *Tyto alba* (Strigiformes, Tytonidae) from Casa de Piedra, Argentina. *J. Raptor Res.* 27:37–38.

PIANKA, E.R. 1973. The structure of lizard communities. *Ann. Rev. Ecol. Syst.* 4:53–74.

RAGONESE, A.E. 1968. Vegetación y ganadería de la República Argentina. INTA, Buenos Aires, Argentina

REDFORD, K.H. AND J.F. EISENBERG. 1992. Mammals of the Neotropics: the Southern Cone. University of Chicago Press, Chicago, IL U.S.A.

ROHDE, K. 1992. Latitudinal gradient in species diversity. the search for the primary cause. *Oikos* 65:514–527.

SCHOENER, T.W. 1974. Resource partitioning in ecological communities. *Science* 185:27–39.

SONCINI, R., H. SALAS AND L. MARCUS. 1985. Alimentación de la lechuza de los campanarios (*Tyto alba*) en San Miguel de Tucumán. *Historia Natural* 5:49–54.

TIRANTI, S.I. 1988. Análisis de regurgitados de *Tyto alba* en la provincia de La Pampa. Asociación para la Protección de la Naturaleza, Boletín Científico 11:8–12.

———. 1992. Barn Owl prey in southern La Pampa, Argentina. *J. Raptor Res.* 26:89–92.

TOFT, C.A. 1985. Resource partitioning in amphibians and reptiles. *Copeia* 1:1–21.

TRAVAINI, A., J.A. DONAZAR, O. CEBALLOS, A. RODRIGUEZ, F. HIRALDO AND M. DELIBES. 1997. Food habits of Barn Owls along an elevational gradient in Andean Argentine Patagonia. *J. Raptor Res.* 31:59–64.

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