ORNITOLOGIA NEOTROPICAL 20: 137–141, 2009

DIETS OF TWO COEXISTING OWLS IN THE HIGH ANDES OF NORTHWESTERN ARGENTINA

Emiliano Donadio[1], Mariano L. Merino[2], & Maria J. Bolgeri[3]

[1]Program in Ecology & Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming 82071 USA. *E-mail:* emiliano@uwyo.edu

[2] División Zoología Vertebrados, Museo de La Plata / CICPBA, Paseo del Bosque s/n, La Plata (B1900FWA), Buenos Aires, Argentina.

[3] Wildlife Conservation Society, CEAN, Junín de los Andes (8371), Neuquén, Argentina.

Dieta de dos especies simpátricas de estrigiformes en los llanos de altura del noroeste Argentino.

Key words: *Bubo magellanicus*; *Tyto alba*, Argentina, trophic interactions, diet.

INTRODUCTION

The feeding habits of the Magellanic Horned Owl (*Bubo magellanicus*) and the Barn Owl (*Tyto alba*) are well known for the central and southern regions of Argentina (Pardiñas & Cirignoli 2002), but virtually no information is available for the Puna region in the high Andes of northwestern Argentina. Moreover, few studies have addressed the trophic interactions between coexisting populations of both owl species in arid and semiarid habitats of Argentina (Trejo *et al.* 2005) and Chile (Jaksic & Yáñez 1980, Iriarte *et al.* 1990).

Magellanic Horned Owl diet in the Puna was briefly described for Laguna de los Pozuelos, Jujuy province (Massoia 1994). There, Sigmodontinae rodents make up the bulk of the diet. Likewise, Barn Owl diet in the high Chilean Atacama Desert was composed mainly of small mammals including marsupials and rodents (Carmona & Rivadeneira 2006). No data are available on the diet and trophic interactions of coexisting Barn and Magellanic Horned Owls inhabiting the high Andes of Argentina and Chile. Where they coexist, both species prey mainly upon native rodents, with Barn Owls generally taking smaller-bodied rodents than Magellanic Horned Owls (Santibañez & Jaksic 1999, Trejo *et al.* 2005, Trejo 2006). Additionally, the latter occasionally include exotic lagomorphs, European hares (*Lepus europaeus*) and rabbits (*Oryctolagus cuniculus*), as part of their diet (Jaksic & Yáñez 1980, Iriarte *et al.* 1990, Donázar *et al.* 1997).

Herein, we (1) present the first available concurrent quantitative information on the diet of coexisting Magellanic Horned Owl and Barn Owl populations in the high Andes of the southern Neotropics, and (2) analyze their trophic relationships.

STUDY SITE AND METHODS

Between June and August 2004, we conducted fieldwork in two contiguous reserves located in the Andes range of San Juan province, northwestern Argentina: San Guillermo National Park (SGNP, 29°13'S–69°21'W) and San Guillermo Provincial Reserve (SGPR, 29°47'S–69°26'W). These reserves lie within one of the most ecologically intact areas of South America (Sanderson *et al.* 2002), and encompass c. 9500 km^2, ranging from 2100 to 5800 m a.s.l. The region is cold and dry, with average annual temperatures ranging from -5 to 5°C, and winter minimum temperatures reaching -24°C. Precipitation ranges from 20 to 400 mm per year. Low-elevation valleys (2000–3000 m) of shrub steppe, open plains or "llanos" (3000–4300 m) of sparsely vegetated grass steppe, and high-elevation deserts (> 4300 m) with virtually no vegetation, characterize the landscape (Cajal *et al.* 1981, Carrizo *et al.* 1997). In the area, available vertebrate prey for owls includes several species of Sigmodontinae and caviomorph rodents, birds, lizards and insects (Haene *et al.* 2001); European hares are present at very low densities (mean ± SE = 2.5 ± 0.6 individuals per km^2; Donadio *et al.* unpubl.).

We collected owl pellets between 3000 and 3500 m. Magellanic Horned Owl pellets were collected at three sites representing at least two territories; Barn Owl pellets were collected at five sites representing at least three different territories. Because pellet collection took place in winter, it was difficult to ascertain if collection sites corresponded to either roost or nesting sites. Also, we were unable to determine the relative age of pellets; therefore, our sample may not strictly represent the winter diet of the owls. Small mammal remains were identified using taxonomic keys for skulls and mandibles (Pearson 1995), and voucher specimens housed at the Museo de La Plata, La Plata, and the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires. Birds and reptiles were identified based on the presence of skulls, mandibles, and feathers.

We described owl diets as the percentage of frequency of occurrence (number of times a prey item occurred as percentage of the total number of prey items in all pellets), and percentage of prey biomass (body mass of a given prey item multiplied by the number of times this prey item occurred as a percentage of the total prey mass in all pellets). Trophic relationships between species were analyzed using (1) the arithmetic mean weight of mammalian prey (MWMP) with asymmetric confidence intervals, and (2) food niche overlap, calculated with the Pianka index (PI; values range between 0 an 1, from none to complete food overlap; Pianka 1973). We calculated MWMP as the arithmetic mean of the body masses only for mammal prey individuals found in the pellets. We estimated MWMP confidence intervals with log transformations of the data that are back-transformed (Fowler *et al.* 2003). We favored this approach because frequency distributions of body mass of mammalian prey were consistently skewed, and geometric means tend to underestimate mean weights of prey. We believe that arithmetic means provide more realistic estimates of the MWMP consumed by predators, while asymmetrical confidence intervals are consistent with skewed distributions (Fowler *et al.* 2003). Body masses of prey species were obtained from Redford & Eisenberg (1992). Food niche overlap was estimated using percentage of frequency of occurrence of the main prey items grouped into six categories (*Ctenomys*, *Abrocoma*, *Neotomys*, *Phyllotis*, *Abrothrix*, and *Eligmodontia*). To determine the probability that overlaps of the observed magnitude are greater or less than those that would be expected randomly, we ran 1000 Monte Carlo randomizations of proportions of different prey categories in each species' diet to simulate expected overlaps among the two species using the program EcoSim 7.0 (Gotelli & Entsminger 2006). The prey category "rodents unidentified" was dropped from all analyses. All skeleton remains recovered from pellets were housed at the Museo de Ciencias Naturales de La Plata, La Plata.

RESULTS AND DISCUSSION

Seventy-five and 392 prey items were identified in the pellets of the Magellanic Horned and Barn Owls, respectively. Magellanic Horned Owls consumed mainly rodents (90.6% of the total prey items), seldom preying upon birds, lizards, and invertebrates. Barn Owls consumed almost exclusively rodents, which represented 98.8% of the total prey items. Neither owl species consumed European hares. Diet overlap was relatively high between owls (PI observed = 0.888; PI expected = 0.442; *p* observed > expected = 0.054); however, Magellanic Horned Owls took, on average, larger prey species than Barn Owls [MWMP (95 % CI): *Bubo* = 65.2 (55.4–76.9) g, *Tyto* = 46.7 (44.2–49.3) g] (Table 1).

In the high Andes of northwestern Argentina, Magellanic Horned and Barn Owls preyed primarily on small native mammals. Sigmodontinae rodents were the prey consumed most frequently and the most important biomass component. This finding agrees with the only two previous reports available for Magellanic Horned Owls (Massoia 1994) and Barn Owls (Carmona & Rivadeneira 2006) from high altitude deserts, and descriptions of the diet of both owl species in other regions of the southern Neotropics (e.g. Jaksic & Yáñez 1980, Iriarte *et al.* 1990, Donázar *et al.* 1997, Trejo & Grigera 1998, Pillado & Trejo 2000). Unlike Barn Owls in the Atacama Desert, Barn Owls in SGNP and SGPR did not include birds, lizards, and invertebrates in their diet. These alternative prey items seemed to be abundant in our study area and could become important components of the diet during periods of rodent scarcity (Cerpa & Yáñez 1981, Carmona & Rivadeneira 2006).

Magellanic Horned and Barn Owls exhibited extensive overlap in their diets preying heavily upon *Phyllotis* spp., a medium-sized (57.7 g) sigmodontine rodent, and the most abundant rodent in the area (32.9 individuals/km^2; Cajal & Buenaventura 1998). Despite this extensive overlap, Magellanic Horned and Barn Owls showed a fine scale partitioning of the prey base, with the former taking more large-sized rodent species than the latter (Table 1). This observation is consistent with the hypothesis that Magellanic Horned and Barn Owls partition their prey based on size; in Chile and Argentina, Magellanic Horned Owls tend to take larger prey species (Jaksic & Yáñez 1980, Iriarte *et al.* 1990), and larger individuals within prey species (Santibañez & Jaksic 1999, Trejo 2006), than Barn Owls.

In SGNP and SGPR, Magellanic Horned and Barn Owls did not consume European hares. Several studies in the semi-arid and arid habitats of Argentina and Chile show that introduced lagomorphs can be either important components in the diet of owls (particularly Magellanic Horned Owls; Jaksic & Yáñez 1980, Iriarte *et al.* 1990, Donázar *et al.* 1997) or not (Trejo & Grigera 1998, Pillado & Trejo 2000, Teta *et al.* 2001, Nabte *et al.* 2006). The absence of hares in the diet of owls could result from owls being unable to hunt such a large prey (Donázar *et al.* 1997, Trejo & Grigera 1998); however, this hypothesis fails to explain why owls did not take juvenile hares. In SGNP and SGPR our preliminary data suggest that hares exist at very low densities.

TABLE 1. Diets of the Magellanic Horned Owl and Barn Owl in the high llanos of northwestern Argentina, June–August 2004. FO (n/%) = frequency of occurrence (number/percentage) in the diet. % Biom = percentage of biomass in the diet. [1]Adult body mass from Redford and Eisenberg (1992); [2]percentage of biomass estimated only for mammalian prey.

		Magellanic Horned Owl			Barn Owl		
Prey item	Weight (g)[1]	FO (n)	FO (%)	Biom (%)[2]	FO (n)	FO (%)	Biom (%)[2]
Ctenomys spp.	360.0	3	4.0	26.7	2	0.5	4.6
Abrocoma cinerea complex	200.0	1	1.3	4.9	1	0.3	1.3
Neotomys ebriosus	64.5	2	2.7	3.2	52	13.3	21.3
Phyllotis cf. *xanthopygus*	57.5	40	53.3	56.9	146	37.2	53.4
Abrothrix spp.	24.0	0	0	0	70	17.9	10.7
Eligmodontia spp.	21.0	16	21.3	8.3	66	16.8	8.8
Rodents unidentified	-	6	8.0	-	50	12.8	-
Birds	-	1	1.3	-	3	0.8	-
Reptiles (lizards)	-	1	1.3	-	0	0.0	-
Invertebrates	-	5	6.7	-	2	0.5	-
Total prey items		75			392		
Total pellets		31			203		

Moreover, hares were rarely found in scats of mammalian carnivores (Walker *et al.* 2007) and pellets of diurnal raptors (Donadio *et al.* 2007). Consequently, we believe that in our study site hares are not sufficiently abundant to become prey for owls. Such speculation has still to be tested.

ACKNOWLEDGMENTS

A. Montañez and A. Carrizo, park rangers of SGNP, provided logistic support. A. Wurstten, M. Vitali, R. Palacios, and R. Batistella assisted with fieldwork. O. Vaccaro (Museo Argentino de Ciencias Naturales) and D. Verzi (Museo de La Plata) granted us access to mammal collections. M. C. Funes, J. N. Pauli, and G. Hayward kindly reviewed this manuscript for style and content. The Fulbright Commission, Lincoln Park Zoo, Rufford Small Grants, College of Art and Sciences (University of Wyoming, USA), Denver Zoological Foundation, and Idea Wild funded this work.

REFERENCES

Cajal, J. L., & S. M. Bonaventura. 1998. Densidad, biomasa y diversidad de mamíferos en la Puna y Cordillera Frontal. Pp. 191–211 *in* Cajal, J. L. (ed.). Bases para la conservación y manejo de la Puna y Cordillera Frontal de Argentina: El rol de las reservas de biosfera. UNESCO-FUCEMA, Buenos Aires,, Argentina.

Cajal, J. L., A. A. Reca, & J. C. Pujalte. 1981. La Reserva Provincial San Guillermo y sus asociaciones ambientales. Ministerio de Cultura y Educación de Argentina, Buenos Aires, Argentina.

Carmona, E. R., & M. M. Rivadeneira. 2006. Food habits of the Barn Owl *Tyto alba* in the National Reserve Pampa del Taramugal, Atacama Desert, North Chile. J. Nat. Hist. 40: 473–483.

Carrizo, R., A. Baldón, S. Cavallaro, & M. A. Dzendoletas. 1997. Estudio preliminar de las características geoambientales del área de reserva Laguna Bava, Provincia de La Rioja. CAC, Contribuciones Científicas, Buenos Aires, Argentina.

Cerpa, C., & J. Yáñez. 1981. Variación estacional de la dieta de *Tyto alba* (Gray 1929) en la zona mediterránea de Chile central. Bol. Mus. Nac. Hist.

Nat. 38:137–145.

Donadio, E., M. J. Bolgeri, & A. Wurstten. 2007. First quantitative data on the food habits of the Mountain Caracara. J. Raptor Res. 41: 328–330.

Donázar, J. A., A. Travaini, O. Ceballos, M. Delibes, & F. Hiraldo. 1997. Food habits of the Great Horned Owl in northwestern Argentine Patagonia: the role of introduced lagomorphs. J. Raptor Res. 31: 364–369.

Fowler, J., L. Cohen, & P. Jarvis. 2003. Practical statistics for field biology. John Wiley & Sons, Chichester, UK.

Gotelli, N. J., & G. L. Entsminger. 2006. EcoSim: null models software for ecology. Version 7. Acquired Intelligence Inc. & Kesey-Bear, Jericho, Vermont.

Haene, E., A. Montañez, A. Carrizo, G. Bodrati, J. Bono, G. Krauss, E. Mérida, C. Nardini, R. Rodríguez, J. Jones, & A. Pérez. 2001. Primer inventario de los animales vertebrados del Parque Nacional San Guillermo (Provincia de San Juan, República Argentina). Bol. Soc. Biol. Concepción 72: 59–67.

Iriarte, J. A., W. L. Franklin, & W. E. Johnson. 1990. Diet of sympatric raptors in southern Chile. J. Raptor Res. 24: 41–46.

Jaksic, F. M., & J. L. Yáñez. 1980. Differential utilization of prey resources by Great Horned Owls and Barn Owls in central Chile. Auk 97: 895–896.

Massoia, E. 1994. Analisis de regurgitados de *Bubo virginianus* de Laguna de Pozuelos, provincial de Jujuy. Biol. Cient. Asoc. Protec. Nat. 26: 13–16.

Nabte, M. J., S. L. Saba, & U. F. J. Pardiñas. 2006. Dieta del Búho magallánico (*Bubo magellanicus*) en el Desierto del Monte y la Patagonia Argentina. Ornitol. Neotrop. 17: 27–38.

Pardiñas, U. F. J., & S. Cirignoli. 2002. Bibliografía comentada sobre los análisis de egagrópilas de aves rapaces en Argentina. Ornitol. Neotrop. 13: 31–59.

Pearson, O. P. 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.

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

Pillado, M. S., & A. Trejo. 2000. Diet of the Barn Owl (*Tyto alba tuidara*) in northwestern Argentine Patagonia. J. Raptor Res. 34: 334–338.

Redford, K. H., & J. F. Eisenberg. 1992. Mammals of the Neotropics: The Southern Cone. Volume 2: Chile, Uruguay, Paraguay. Univ. of Chicago Press, Chicago, Illinois.

Sanderson, E. W., M. Jaiteh, M. A. Levy, K. H. Redford, A. V. Wannebo, & G. Woolmer. 2002. The human footprint and the last of the wild. Bioscience 52: 891–904.

Santibañez, D. P., & F. M. Jaksic. 1999. Prey size matters at the upper tail of the distribution: a case study in northcentral Chile. J. Raptor Res. 33: 170–172.

Teta, P., C. Panti, A. Andrade, & A. Pérez. 2001. Amplitud y composición de la dieta de *Bubo virginianus* (Aves: Strigiformes: Strigidae) en la Patagonia noroccidental argentina. Bol. Soc. Biol. Concepción 72: 125–132.

Trejo, A., & D. Grigera. 1998. Food habits of the Great Horned Owl (*Bubo virginianus*) in a Patagonian steppe in Argentina. J. Raptor Res. 32: 306–311.

Trejo, A. 2006. Segregation by size at the individual prey level between Barn and Magellanic Horned Owls in Argentina. J. Raptor Res. 40: 168–172.

Trejo, A., M. Kun, M. Sahores, & S. Seijas. 2005. Diet overlap and prey size of two owls in the forest-steppe ecotone of southern Argentina. Ornitol. Neotrop. 16: 539–546.

Walker, R. S., A. J. Novaro, P. Perovic, R. Palacios, E. Donadio, M. Lucherini, M. Pia, & S. López. 2007. Diets of three species of Andean carnivores in high-altitude deserts of Argentina. J. Mamm. 88: 519–525.

Accepted 6 January 2009.