SEASONAL AND GEOGRAPHIC VARIATION IN THE DIET OF BARN OWLS (TYTO ALBA) IN TEMPERATE AGROECOSYSTEMS OF ARGENTINA

Carlos M. González-Fischer¹², Mariano Codesido¹², Pablo Teta³, & David Bilenca¹²

¹Grupo de Estudios sobre Biodiversidad, Genética y Evolución, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Intendente Güiraldes 2160, Ciudad Universitaria, Pabellón II, Cuarto piso, Buenos Aires (C1428EGA), Argentina. E-mail: cfsicher@ege.fcen.uba.ar
²Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Avenida Rivadavia 1917, (C1033AAJ) Buenos Aires, Argentina.

Resumen. – Variaciones estacionales y geográficas en la dieta de la Lechuza de Campanario (Tyto alba) en agroecosistemas templados de Argentina. – Estudiamos el nicho trófico de la Lechuza de Campanario (Tyto alba) en agroecosistemas templados del centro de Argentina, describiendo la variación estacional y geográfica en los hábitos dietarios de esta lechuza en cuatro distritos de la región Pampeana (Pampa Deprimida, Interior, Ondulada y Austral). Se identificaron 21,925 ítems presa de muestras frescas de egagrópilas coleccionadas durante el verano (n = 23) y el invierno (n = 26). Los mamíferos, en su mayoría roedores sigmodontinos, fueron los ítems mejor representados (91.9%), seguidos por anfibios (6.5%) y aves (1.6%). Los artrópodos también fueron ítems comunes, presentes en el 45% de las muestras. El consumo de artrópodos y anfibios fue mayor en verano que en invierno, sugiriendo que las variaciones estacionales en la abundancia de presas se reflejan en la dieta de la lechuza. No encontramos diferencias en la amplitud de nicho trófico entre los cuatro distritos estudiados, aunque este parámetro varió entre estaciones, siendo mayor durante el verano. Seis especies de roedores fueron comunes a todos los distritos: Calomys spp., Akodon azarae, Oligoryzomys flavescens, Mus musculus, Rattus spp. y Holochilus brasiliensis. Calomys spp. fue numericamente dominante

Abstract. – We studied the dietary niche of the Barn Owl (Tyto alba) in temperate agroecosystems of central Argentina by describing seasonal and geographic variation in the food habits of this owl in four districts of the Pampean region (Floodling, Inland, Rolling, and Southern Pampas). We identified 21,925 prey items from samples of fresh pellets collected in summer (n = 23) and winter (n = 26). Mammals, mostly sigmodontine rodents, were the main prey items (91.9%), followed by amphibians (6.5%) and birds (1.6%). Arthropods were also a common prey item (found in 45% of the samples). The consumption of arthropods and amphibians was higher in summer than in winter, indicating that seasonal changes in prey abundances are reflected in the Barn Owl diet. We found no differences in food-niche breadth among the four study districts, but food-niche breadth varied between seasons, being higher during summer. Six rodent species were common to all districts: Calomys spp., Akodon azarae, Oligoryzomys flavescens, Mus musculus, Rattus spp., and Holochilus brasiliensis. Calomys spp. was numerically dominant.
in 46 of the 49 samples, and together with A. azarae and O. flavescens comprised the bulk of the diet (> 80%). Predation on rodents may reflect population dynamics of the prey species with high predation rates when peaks in abundance of sigmodontine rodents occurred (autumn–winter). Accepted 2 May 2011.

Key words: Barn Owl, Tyto alba, Buenos Aires, Cricetidae, food-niche breadth, Pampean region, small mammals, Tytonidae.

INTRODUCTION

The Barn Owl (Tyto alba, Tytonidae) is a cosmopolitan strigiform that typically preys on small (< 200 g) mammals (Taylor 1994, Marks et al. 1999, Marti 2010). It prefers open habitats, including grasslands, deserts, marshes, and agricultural fields (Taylor 1994). Numerous studies have been conducted on the Barn Owl diet in Argentina, mostly focused in describing small mammal distributions (Bellocq 2000, Pardiñas & Cirignoli 2002 and references therein) or some aspect of predator-prey relationships (e.g., Bellocq 1998). In contrast, few studies have examined dietary responses at large scales (e.g., Leveau et al. 2006, Trejo & Lambertucci 2007). Leveau et al. (2006) explored geographic variation in diet along the coast of Buenos Aires province in east-central Argentina, showing that dietary parameters were strongly influenced by the composition of rodent assemblages in different phytogeographic units. However, no comprehensive large scale studies have included the agriculturally modified areas of the entire Pampean region of Buenos Aires province, and seasonal variation in the diet of the Barn Owl has not been considered in any regional study in southern South America.

Our objectives were: 1) to provide new information on the niche dimension of the Barn Owl, and 2) to describe spatial and seasonal variation in its feeding habits in four districts of the Pampean region of central Argentina. To the best of our knowledge, the studied data base is larger than any other previously published for a South American country, encompassing an area of ~ 277,000 km².

METHODS

Study area. The Pampas included in Buenos Aires province (~ 33º–41º S, 57º–63º W) are classified into four ecological units or districts which can be distinguished according to differences in geomorphology, soils, drainage, physiography, and vegetation: the Rolling Pampa, the Southern Pampa, the Flooding Pampa, and the Inland Pampa (Soriano et al. 1992, Fig. 1). Mean annual temperature varies from 13ºC in the south to 17ºC in the north and mean annual precipitation varies from 600 mm in the southwest to 1200 mm in the northeast. The four units also have different land use patterns: in the Rolling Pampa, crops have replaced most of the native vegetation and crop fields cover about 70% of the land whereas in the Flooding Pampa grasslands or pastures remain (> 85%). The Southern and the Inland Pampas have a mixed production system with similar areas dedicated to crops and animal husbandry (48 and 45% for the Southern Pampa, and 27 and 47% for the Inland Pampa, respectively). In the Rolling, Inland, and Flooding Pampas summer crops (soybean Glycine max and maize Zea mays) are predominant, whereas in the Southern Pampa winter crops (i.e., wheat Triticum aestivum) prevail (INDEC 2006, Baldi & Paruelo 2008).

Small mammal assemblages of the Pampas are dominated by the native sigmodontine rodents Calomys laucha, C. musculinus, Akodon azarae, and Oligoryzomys flavescens (Pardiñas et al. 2010). Introduced rats and mice (i.e., Rattus norvegicus, R. rattus, and Mus musculus) are restricted mostly to pig and poultry farms and
the vicinities of human habitations cross the rural landscape (Gómez Villafañe & Busch 2007, Miño et al. 2007).

Field procedures and taxonomic identification. We collected fresh Barn Owl pellets during winter (July and August 2006–2007) and summer (January and February 2007–2008) from nest sites distributed in the four districts of the Pampean region included in Buenos Aires province (Fig. 1). Some areas, such as the eastern portion of the Rolling Pampa or the western portion of the Southern Pampa were not sampled. However, based on literature review (e.g., Pardiñas et al. 2010, Teta et al. 2010) and the relative environmental homogeneity within each unit (see Soriano et al. 1992) we made some conclusions extensive to these portions as well. Thus, with some confidence we think that the studied samples are coarsely
representative of the agriculturally modified areas of each district.

The pellets were soaked in water and broken up into small fragments manually. Sodium hydroxide (NaOH) solution was used to dissolve fur and feathers (following the method described by Longlan 1985) and the skeletal material recovered was washed in water and dried. Mammalian preys were identified to the lowest taxonomic level possible by examination of skulls and dentaries. Osseous remains were identified by comparison of voucher specimens deposited in museum collections and also by a literature review. Taxonomy followed Wilson & Reeder (2005) for rodents and marsupials and D’Elía et al. (2008) in the punctual case of the rodent genus Necromys. The number of bird specimens was identified by the number of skulls and femurs, and amphibians were counted by numbers of pelvic girdles. In addition, we also recorded the presence or absence of arthropods in each sample. Those samples with less than 100 prey items were excluded from statistical analyses, since they were considered as inadequate to determine ow’s diet (Love et al. 2000).

Data analyses. Frequencies of samples containing arthropods were compared between seasons for each district using Fisher’s exact test (Zar 1996). Mean percentages of mammals, birds, and amphibians were compared among districts and seasons by means of two-way analyses of variance (ANOVAs, Zar 1996). Data transformation and Tukey’s multiple comparison tests were performed when necessary (Zar 1996). In addition, we compared the mean percentages of each of the six rodent species that were common to all districts. For each sample we computed the following dietary parameters (see Marti 1987): food-niche breadth (FNB = 1/∑pi²; where pi is the proportion of each class “i” in the diet), and standardized food-niche breadth (FNBst = [FNB – 1]/[n – 1]; where n is the total number of class categories) and small mammal species richness per site (S). Values for these parameters were compared among districts and seasons with separated two-way ANOVAs, and we analyze their relationship with latitude and longitude by means of separated linear regressions.

RESULTS

We analyzed samples from 49 sites, 23 from the summer and 26 from the winter (Fig. 1), identifying a total of 21,925 prey items: 91.9% mammals, 6.5% amphibians, and 1.6% birds. Mammals and birds were present in all samples, whereas amphibians and arthropods were present in 76% and 45% of the samples, respectively. The percentage of samples including arthropods increased from 12% in winter to 82% in summer (Fisher’s exact test; P < 0.001, Fig. 2). In contrast, the percentage of mammals in the diet decreased from 98% in winter to 81% in summer (ANOVA; F1,41 = 26.59, P < 0.001, Fig. 2). Amphibian percentages in owl’s pellets also varied seasonally and geographically, ranging from less than 1% in winter samples from the Southern Pampa to 17% in summer samples from the Inland Pampa (ANOVA, F1,41 = 37.29, P < 0.001 and F3,41 = 4.73, P = 0.006 for seasons and districts, respectively).

Of the 20,150 mammals identified, 20,113 (99.8%) were small mammals (< 150 g), including 9 rodent genera and one of marsupials (Table 1). Larger mammals (= 500 g) found in low frequencies included lagomorphs (Lepus europaeus), caviomorphs (Cavia aperea), and marsupials (Lutreolina crassicaudata).

We found no differences in the food-niche breadth indexes (FNB and FNBst) among the four studied districts. In comparison, food-niche breadth varied between seasons, being highest during summer (ANOVA, F1,41 = 13.16, P < 0.001; Table 2). In addition,
no trend was observed between FNB or FNBst and latitude or longitude.

Mean small mammal species richness per site (S) was lowest in the Inland Pampa and highest in the Rolling Pampa (ANOVA, \( F_{3,41} = 6.72, P < 0.001 \); Table 1). Six rodent species were common to all ecological districts: *Calomys* spp. (including *C. laucha* and *C. musculinus*), *A. azarae*, *O. flavescens*, *Mus musculus*, *Rattus* spp., and *Holocheilus brasiliensis* (Table 1). *Calomys* spp. were dominant in 46 of the 49 samples, and constituted the bulk of the sample along with *O. flavescens* and *A. azarae*. Mean percentage of both *O. flavescens* and *A. azarae* was lowest in the Southern Pampa and largest in the Flooding Pampa (ANOVA, \( F_{3,41} = 4.71, P = 0.006 \) and \( F_{3,41} = 7.19, P < 0.001 \) for *A. azarae* and *O. flavescens*, respectively). Moreover, the relative frequencies of *O. flavescens* in owl diets increased significantly from 10% in summer to 14% in winter (ANOVA, \( F_{1,41} = 5.74, P = 0.021 \)), replacing *A. azarae* as the second more abundant species in winter pellet samples. Relative abundances of *Calomys* spp. showed a marginal variation among districts, ranging from 62% in the Flooding Pampa to 81% in the Southern Pampa (ANOVA, \( F_{3,41} = 2.55, P = 0.069 \)). There was no significant variation among districts or between seasons in the presence of the other common species (Table 1).

**DISCUSSION**

We present the first comprehensive study of the feeding habits of Barn Owls in the Pampas of Buenos Aires province, Central Argentina. Our results agree with those reported in other studies conducted in southern South America, showing rodents of the subfamily Sigmodontinae as the main prey item (e.g., Massoia 1983, Bellocq 2000). Arthropods are usually found in Barn Owl pellets, sometimes even in great numbers (up to 50% of prey samples).
<table>
<thead>
<tr>
<th>District/Season</th>
<th>Rolling Pampa</th>
<th>Inland Pampa</th>
<th>Flooding Pampa</th>
<th>Southern Pampa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
<td>Winter</td>
<td>Summer</td>
<td>Winter</td>
<td>Summer</td>
</tr>
<tr>
<td><em>Calomys</em> spp.</td>
<td>63.7 ± 3.0</td>
<td>74.8 ± 5.7</td>
<td>74.8 ± 5.8</td>
<td>73.0 ± 4.0</td>
</tr>
<tr>
<td></td>
<td>[57.0; 73.3]</td>
<td>[53.2; 87.1]</td>
<td>[40.1; 92.6]</td>
<td>[52.9; 85.3]</td>
</tr>
<tr>
<td><em>Oligoryzomys flavescens</em></td>
<td>20.7 ± 3.9</td>
<td>9.8 ± 1.9</td>
<td>13.1 ± 3.5</td>
<td>11.6 ± 2.2</td>
</tr>
<tr>
<td></td>
<td>[13; 32.6]</td>
<td>[2.8; 13.7]</td>
<td>[30; 32.3]</td>
<td>[3.3; 19.8]</td>
</tr>
<tr>
<td><em>Akodon azarae</em></td>
<td>10.8 ± 2.2</td>
<td>12.7 ± 4.2</td>
<td>11.7 ± 2.4</td>
<td>13.9 ± 2.1</td>
</tr>
<tr>
<td></td>
<td>[6.6; 16.9]</td>
<td>[6.1; 29.0]</td>
<td>[30; 27.2]</td>
<td>[5.9; 23.0]</td>
</tr>
<tr>
<td><em>Mus musculus</em></td>
<td>2.8 ± 2.6</td>
<td>0.9 ± 0.6</td>
<td>0.3 ± 0.1</td>
<td>0.9 ± 0.3</td>
</tr>
<tr>
<td></td>
<td>[0.0; 13.1]</td>
<td>[0.0; 3.0]</td>
<td>[0.0; 0.9]</td>
<td>[0.0; 2.7]</td>
</tr>
<tr>
<td><em>Holochilus brasiliensis</em></td>
<td>0.3 ± 0.2</td>
<td>0.7 ± 0.6</td>
<td>-</td>
<td>0.5 ± 0.2</td>
</tr>
<tr>
<td></td>
<td>[0.0; 1.2]</td>
<td>[0.0; 3.2]</td>
<td>[0.0; 1.6]</td>
<td>[0.0; 0.4]</td>
</tr>
<tr>
<td><em>Rattus</em> spp.</td>
<td>0.8 ± 0.4</td>
<td>0.04 ± 0.0</td>
<td>0.04 ± 0.0</td>
<td>0.1 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>[0.0; 2.5]</td>
<td>[0.0; 0.2]</td>
<td>[0.0; 0.4]</td>
<td>[0.0; 0.5]</td>
</tr>
<tr>
<td><em>Reithrodon auritus</em></td>
<td>-</td>
<td>-</td>
<td>0.5 ± 0.2</td>
<td>0.1 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>[0.0; 1.4]</td>
<td>[0.0; 0.4]</td>
<td>[0.0; 1.4]</td>
<td>[0.0; 0.4]</td>
</tr>
<tr>
<td><em>Necromys lasiurus</em></td>
<td>0.6 ± 0.3</td>
<td>0.8 ± 0.2</td>
<td>-</td>
<td>0.5 ± 0.2</td>
</tr>
<tr>
<td></td>
<td>[0.1; 1.9]</td>
<td>[0.4; 1.4]</td>
<td>[0.0; 0.4]</td>
<td>[0.0; 0.3]</td>
</tr>
<tr>
<td><em>Oxymycterus rufus</em></td>
<td>0.04 ± 0.0</td>
<td>-</td>
<td>0.1 ± 0.1</td>
<td>0.4 ± 0.4</td>
</tr>
<tr>
<td></td>
<td>[0.0; 0.2]</td>
<td>-</td>
<td>[0.0; 0.1]</td>
<td>[0.0; 0.3]</td>
</tr>
<tr>
<td><em>Monodelphis dimidiata</em></td>
<td>0.2 ± 0.1</td>
<td>0.3 ± 0.2</td>
<td>0.05 ± 0.0</td>
<td>0.1 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>[0.0; 0.6]</td>
<td>[0.0; 1.1]</td>
<td>[0.0; 0.3]</td>
<td>[0.0; 0.3]</td>
</tr>
<tr>
<td><em>Necromys obscurus</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.02 ± 0.0</td>
</tr>
<tr>
<td></td>
<td>[0.0; 0.6]</td>
<td>[0.0; 1.1]</td>
<td>[0.0; 0.3]</td>
<td>[0.0; 0.1]</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>2459</td>
<td>1803</td>
<td>3556</td>
<td>2563</td>
</tr>
<tr>
<td></td>
<td>[161; 1018]</td>
<td>[124; 743]</td>
<td>[148; 761]</td>
<td>[133; 1071]</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td>6.2 ± 0.66</td>
<td>6.0 ± 0.63</td>
<td>3.9 ± 0.20</td>
<td>4.6 ± 0.26</td>
</tr>
</tbody>
</table>

TABLE 1. Percentages of each micro-mammal species (Mean ± SE and [minimum; maximum]) and species richness per site (S) estimated from Barn Owl pellet samples collected in summer and winter from the four districts of the Pampean Region included in Buenos Aires province, Central Argentina. N = Total number of individuals [minimum; maximum] micro-mammal prey items per sample for each district.
TABLE 2. Food-niche breadth (FNB) and standardized food-niche breadth (FNBst) (Mean ± SE and [minimum; maximum]) estimated from Barn Owl pellet samples (taking classes as categories) collected in summer and winter from the four districts of the Pampean Region included in Buenos Aires province, Central Argentina.

<table>
<thead>
<tr>
<th>District/Season</th>
<th>Rolling Pampa</th>
<th>Inland Pampa</th>
<th>Flooding Pampa</th>
<th>Southern Pampa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Winter (N = 5)</td>
<td>Summer (N = 5)</td>
<td>Winter (N = 9)</td>
<td>Summer (N = 8)</td>
</tr>
<tr>
<td>FNB</td>
<td>1.07 ± 0.06</td>
<td>1.38 ± 0.32</td>
<td>1.06 ± 0.07</td>
<td>1.46 ± 0.32</td>
</tr>
<tr>
<td></td>
<td>[1.01; 1.41]</td>
<td>[1.05; 1.83]</td>
<td>[1.01; 1.23]</td>
<td>[1.07; 1.96]</td>
</tr>
<tr>
<td>FNBst</td>
<td>0.37 ± 0.32</td>
<td>0.88 ± 0.32</td>
<td>0.45 ± 0.25</td>
<td>0.95 ± 0.32</td>
</tr>
<tr>
<td></td>
<td>[0.01; 0.64]</td>
<td>[0.55; 1.33]</td>
<td>[0.01; 0.73]</td>
<td>[0.57; 1.46]</td>
</tr>
</tbody>
</table>
items). However, even in high percentages their contribution in terms of biomass is negligible (Bellocq 2000, Motta-Junior 2006). In fact, most studies regarding the diet of the Barn Owl are focused on small vertebrates, and generally arthropod data is either not registered at all or not included in the publications (Love et al. 2000). Dominance of small mammals in the diet at all districts explained the low values for food-niche breadth. The lower relative proportion of small mammals in summer and the higher consumption of arthropods and amphibians during this period compared with winter are consistent with seasonal changes in the abundance of each of these prey items in the environment (Mills et al. 1991, Busch & Kravetz 1992, Bilenca & Kravetz 1998, Attademo et al. 2005). Moreover, it is widely documented that birds, amphibians, arthropods, and bats have been reported as prey of the Barn Owl in some areas when preferred mammalian prey species declined (Bosè & Guidali 2001). In fact, field densities of rodents in Pampean agroecosystems are lower in spring and summer (Crespo et al. 1970, Mills et al. 1991). Our results are in agreement with previous studies showing that changes in prey availability are reflected in the diet of Barn Owls (Taylor 1994, Bellocq 1998, Love et al. 2000).

The relative consumption of amphibians by Barn Owls in this study is among the highest recorded for the Pampean region (Bellocq 2000, but see Fernández et al. 2010), even though they are lower than those reported for some tropical areas in South America (Delgado & Calderón 2007, Motta-Junior 2006). The higher proportion of amphibians in the diet recorded for the Inland Pampa could be related to the higher availability of habitats suitable for amphibians associated with wetland cover in this district (LART 2004).

The relative abundance of Calomys spp. was higher that reported in several previous studies (e.g., Bellocq 2000, Leveau et al. 2006). Ecological, paleontological and genetic studies have associated the dominance of Calomys spp. with anthropogenic disturbance and intensification of the agriculture in the Pampean region (Kravetz et al. 1986, Bilenca & Kravetz 1995, Pardiñas 1999, Chiappero et al. 2002a, 2002b, Bilenca et al. 2007, González-Irig et al. 2007) and Patagonia (Pardiñas et al. 2000). High consumption of one or two micromammalian species by Barn Owls is a frequent situation in agricultural regions through the world (Marti 1988, 2010; Love et al. 2000, Keene 2009).

The relative abundances of other common sigmodontine species found in our study partially differ from those found in previous studies for coastal Buenos Aires province (Leveau et al. 2006). In particular, Leveau et al. (2006) found that O. flavescens and A. azarae were the dominant prey species in the Flooding Pampa, whereas in our study Calomys spp. were the most common prey species in all districts, including the Flooding Pampa (Table 1). However, the relative abundances of A. azarae and O. flavescens in our study were significantly higher in the Flooding Pampa than in the other districts. The only sites in which A. azarae or O. flavescens were the dominant prey species belonged to the Flooding Pampa and were the closest to those reported by Leveau et al. (2006). Thus, as has been previously indicated by Pardiñas (1999), it seems that A. azarae and O. flavescens are still the dominant species towards the eastern part of the Flooding Pampas near to the coast, where the low terrain and soil restrictions prevent the expansion of agriculture, and keeps the abundances of Calomys spp. at lower levels.

Barn Owls specialize on small mammals throughout their range and the variety of small prey taken appears to vary with availability and environmental and geographical features (Taylor 1994, Bellocq 1998, Love et al. 2000, Marti 2010). Accordingly, species
richness was high toward the Rolling Pampas and lower at the Inland Pampa, following the general trends of small mammal richness in the Pampean region (see Pardiñas et al. 2010). The predation on rodents that we observed may have been a reflection of the population dynamics of the prey species. In fact, we recorded the highest predation rates when peaks in abundance of sigmodontine occurred (autumn–winter; see Mills et al. 1991, Busch & Kravetz 1992, Bilenca & Kravetz 1998).

Taking into account the recent changes observed in the Pampean biota related to different land use and landscape structure, such as the case of amphibians (Attademo et al. 2005) and birds (Codesido et al. 2008, Schrag et al. 2009, Codesido et al. in press), analysis of owl pellets is a promising tool for evaluating the composition of small mammal assemblages in short-term periods (Love et al. 2000). In this context, a large regional database such as ours is the first step toward making future contributions of this kind.

ACKNOWLEDGMENTS

We would like to thank L. and C. Leveau, L. Solari, and J. Tregoning for their assistance during fieldwork. This study was funded by the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET - Argentina), the Universidad de Buenos Aires (grants UBACyT X282 and X406), and the Instituto Nacional de Tecnología Agropecuaria (INTA n Argentina; PNECO 1302). We are grateful to M. Busch, J. Jacob, U. F. J. Pardiñas, and J. Polop for their comments on an early version of the manuscript.

REFERENCES


Codesido, M., C. M. Gonzalez-Fischer, & D. N. Bilenca. In press. Distributional changes of
landbird species in agroecosystems of central Argentina. Condor 113: ––.


González-Ittig, R. E., J. L. Patton, & C. N. Garde-

INDEC. 2006. Censo Nacional Agropecuario 2002: Resultados Generales. Instituto Nacional de Estadística y Censos de la República Argen-
tina, Buenos Aires, Argentina.


Leveau, L. M., P. Tera, R. Boglaschewsky, & U. F. J. Pardiñas. 2006. Feeding habits of the Barn Owl (*Tyto alba*) along a longitudinal–litudinal gra-


book of the birds of the world. Volume 5: Barn owls to hummingbirds. Lynx Edicions, Barce-
lona, Spain.


Massoia, E. 1983 La alimentación de algunas aves del Orden Strigiformes en la Argentina. Hor-


Motta-Junior, J. C. 2006. Relações tróficas entre cinco Strigiformes simpátricas na região central do Estado de São Paulo, Brasil. Rev. Bras. Orni-
BARN OWL DIET IN AGROECOSYSTEMS
