ORNITOLOGIA NEOTROPICAL 15: 65–70, 2004

SMALL MAMMALS IN THE DIET OF BARN OWLS (*TYTO ALBA*) IN AGROECOSYSTEMS OF SOUTHERN BRAZIL

Daniel Ricardo Scheibler[1] & Alexandre Uarth Christoff[2]

Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, Porto Alegre 91501-970, RS, Brazil.

Resumo. – Pequenos mamíferos na dieta da Coruja Suindara (*Tyto alba*) em agroecossistemas no sul do Brasil. – Nós estudamos a dieta da Coruja Suindara (*Tyto alba*) numa área agrícola no sul do Brasil (29°36'S, 52°11'W) a partir da análise de restos regurgitados. Os resultados claramente mostraram que a dieta da suindara reflete o impacto humano sobre seu hábitat. O camundongo cosmopolita Mus musculus foi o pequeno mamífero mais predado (81,9%) e o mais importante em termos da biomassa ingerida (69%). Este roedor, devido ao seu baixo peso, também é responsável pelo peso médio das presas de pequenos mamíferos na dieta da coruja relativamente baixo (19,6 g). Nos agroecossistemas da região sul do Brasil, a suindara provavelmente consome intensamente *Mus musculus* devido a grande abundância deste em campos de cultivo e locais de armazenagem de grãos.

Abstract. - We studied the diet of the Barn Owl (*Tyto alba*) in an agricultural area of southern Brazil (29°36'S, 52°11'W), based on analysis of regurgitated remains. The results clearly showed that the diet of the Barn Owl reflects the human impact on its habitat. The cosmopolitan house mouse (*Mus musculus*) was the most preyed upon small mammal (81.9%) and the most important in terms of the Barn Owl ingested biomass (69%). This rodent, due to its small size, is also responsible for the relatively low mean weight of small mammal prey in the owl diet (19.6 g). In southern Brazilian agroecosystems, the Barn Owl probably feeds mainly on mice due to their great abundance in crop fields and grain storage areas of the region. *Accepted 23 July 2003*.

Key words: Barn Owl, *Tyto alba*, predation, *Mus musculus*, agrosystems, Brazil.

INTRODUCTION

The Barn Owl (*Tyto alba*) is a nocturnal cosmopolitan owl often found near humans, and fields are its main hunting habitat (Fast & Ambrose 1976; Bellocq 1990, 2000). In general, this owl preys primarily on small mammals, and occasionally on other vertebrates and/or insects (Jaksiæ *et al.* 1982, Marti 1988, Bellocq 2000). Although the Barn Owl is widely studied on most of its geographic range, its ecology is poorly known in Brazil, where it had been only recently studied (Motta-Júnior & Talamoni 1996, González *et al.* 1999, Bonvicino & Bezerra 2003).

In this paper, we present a Barn Owl diet study in an agricultural area of southern Brazil, focusing mainly on small mammal prey.

[1]*Current address:* Departamento de Zoologia, Universidad Estadual Paulista, Rio Claro 13506-900, SP, Brazil.

[2]*Current address:* Departamento de Biologia & Museu de Ciências Naturais, Universidade Luterana do Brasil, Canoas 92420-280, RS, Brazil. *E-mail:* auchrist@ulbra.br

STUDY AREA AND METHODS

The study site is located in Venâncio Aires county, Rio Grande do Sul state, southern Brazil (29º36'S, 52º11'W; approx. 50 m elevation). The landscape is a mosaic of different habitats. It includes crop fields (approx. 70% of the total study area), ungrazed areas in different stages of ecological succession, small eucalyptus plantations and small swamps. It also includes some areas of native forest. The original distribution of deciduous seasonal forest (Instituto Brasileiro de Geografia e Estatística 1986) is quite reduced today, having been replaced by agrosystems. The region as a whole is constituted of a great number of small rural properties, averaging 10 ha. Agricultural practices are diversified. However, corn crops prevail. Frequently, those properties include barns used for grain storage, mainly for corn.

In November 1999, remains regurgitated by Barn Owls (mainly small mammals) were collected from six nests in a same barn. Because these remains had been regurgitated over a certain time interval, it was not possible to individualize regurgitated pellets, according to the normal procedure. Invertebrate remains such as insect parts probably did not stay preserved. Therefore, we analyzed only osteological remains. We also do not know when these remains were regurgitated nor if the six nests correspond to six different years.

Right and left upper maxillaries (hemimaxillas) of small mammals were identified using their morphological pattern, mainly from teeth, after comparison with rodents captured in the study area and specimens of the mammal collection of the Zoology Department of Universidade Federal do Rio Grande do Sul. For identification, we only used upper maxillaries because the distinction between remains of adults of two rodent species, *Akodon paranaensis* and *Necromys lasiurus* (=*Bolomys lasiurus*), due to the great molar tooth wear, was only possible based on the incisive foramen position. This structure is found only on the upper maxillaries. The rodents were also considered as juvenile and adult, based on the size of their maxillaries and molar tooth wear pattern.

In addition to the percentage frequency of prey, we calculated the mean weight of small mammals in the Barn Owl diet. This average was obtained by summing the products of the numbers of individual prey times their weight (g) and dividing by the total number of mammalian prey in the sample. This value was calculated for two different situations: 1) for better comparison with literature values, we considered all prey as adults; 2) to calculate it more accurately, we considered separately adult and juvenile animals. Based on the size of the maxillaries examined, we assumed mean weight of juveniles to be half that of adults. Dietary diversity in relation to the small mammal component was calculated using Shannon's information function (H'). The corresponding value of evenness was obtained by using Pielou's index (J'). Despite many of undetermined rodents were probably pertaining to identified species of the sample, they were not considered for the H' and J' calculation.

Weights of *A. paranaensis*, *Oligoryzomys nigripes* and *Holochilus brasiliensis* were obtained from specimens of the mammal collection of the Zoology Department of Universidade Federal do Rio Grande do Sul. The weight of black rats (*Rattus rattus*) was obtained from the mean of male and female weights given by Tamarin & Malecha (1972). The weight of *N. lasiurus* was provided by Alho *et al.* (1986). Those of the house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), *Cavia aperea*, *Molossus molossus* and *Tadarida brasiliensis* were arbitrarily estimated based on the midpoint of weight ranges reported by Nowak (1999), Silva (1994) and Mares *et al.* (1989). The

TABLE 1. Number of small mammal upper maxillaries (right and left) and biomass (g) of small mammal prey in the diet of Barn Owls of Venâncio Aires, state of Rio Grande do Sul, southern Brazil.

Prey species (adult weight)[1]	Number of upper maxillaries		Total (%)	Biomass supplied (%)		Total (%)
	Adults	Juveniles		Adults	Juveniles	
RODENTIA						
Akodon paranaensis (36)	26	42	68 (1.88)	936 (1.37)	756 (1.10)	1692 (2.47)
Brucepattersonius iheringi	5	1	6 (0.16)	-	-	-
Calomys sp.	10	2	12 (0.33)	-	-	-
Cavia aperea (500)	0	6	6 (0.16)	-	1500 (2.19)	1500 (2.19)
Holochilus brasiliensis (284)	3	23	26 (0.72)	852 (1.24)	3266 (4.77)	4118 (6.01)
Mus musculus (21)	1542	1422	2964 (81.92)	32382 (47.25)	14931 (21.78)	47313 (69.03)
Necromys lasiurus (42)	71	64	135 (3.73)	2982 (4.35)	1334 (1.95)	4316 (6.30)
Oligoryzomys nigripes (29)	94	98	192 (5.31)	2726 (3.98)	1421 (2.07)	4147 (6.05)
Oryzomys sp.	0	2	2 (0.06)	-	-	-
Rattus norvegicus (350)	0	1	1 (0.03)	-	175 (0.26)	175 (0.26)
Rattus rattus (92)	7	96	103 (2.84)	644 (0.94)	4416 (6.44)	5060 (7.38)
Unidentified rodents	-	-	49 (1.35)	-	-	-
MARSUPIALIA						
Monodelphis sp.	-	-	23 (0.64)	-	-	-
CHIROPTERA						
Molossus molossus (12)	2	0	2 (0.06)	24 (0.03)	-	24 (0.03)
Tadarida brasiliensis (16)	12	0	12 (0.33)	192 (0.28)	-	192 (0.28)
Unidentified	-	-	1 (0.03)	-	-	-
AVES	-	-	14 (0.39)	-	-	-
ANURA	-	-	2 (0.06)	-	-	-
Total	-	-	3618 (100)	-	-	68537 (100)

[1]Adult weight given in grams.

weight of *Brucepattersonius iheringi* was not available.

RESULTS

We identified 3602 upper maxillaries of small mammals (minimum number of specimens = 1801), and rodents represented the most important component of the owl diet (Table 1). We can roughly identify three groups of prey in relation to the degree of predation intensity. The first contained only one species, the introduced house mouse, the most consumed (81.92%) and important in terms of ingested biomass by Barn Owls; the second one was made of four species (*R. rattus*, *O. nigripes, N. lasiurus* and *A. paranaensis*) that together represented 13.8% of the small mammals eaten; and the third one involved several species, which counted for only 4.3% of the diet. The mean weight of juvenile and adult small mammal prey ± SD was 19.6 g ± 18.3 g. The mean weight of all small mammals considered as adults, H' and J' were in general smaller than in other regions studied (Table 2).

DISCUSSION

In the studied agrosystems of southern Brazil, results clearly showed that the diet of Barn Owls reflects the human impact on its habitat. House mouse is often found inhabiting crop fields (NewSome 1969, Fleharty & Navo 1983; Mills *et al.* 1991, 1992), and stored cereals are important reproduction and feeding places for mice (Southern & Laurie 1946, Southwick 1958, Rowe *et al.* 1963). According to some rodent trapping data, the house mouse is the most abundant rodent found in crop fields of the study area (in October 2001, we found 81.1 mice per ha in corn fields). Black rats are also common in grain storage places, and the main native rodent prey of Barn Owls (*O. nigripes*, *N. lasiurus* and *A. paranaensis*) are also often found in the agrarian habitats of the study region, especially in recently abandoned crop fields. *Necromys lasiurus* can be found near or in human habitations of rural areas (Alho *et al.* 1986). Therefore, crop fields and grain storage places provide favorable conditions for Barn Owls in southern Brazil, mainly because mice are frequently found in such habitats. Likewise, the diet of Barn Owls may be a reflex of human intervention on habitat of Argentina (Bellocq 2000, Pardiñas *et al.* 2000) and North America (Clark & Bunck 1991).

Trophic ecology parameters of Barn Owls in the agrosystems of southern Brazil are also mainly influenced by the extremely high incidence of mice in their diet. Because of this, values of such parameters are in general smaller in southern Brazil than in other regions (Table 2). Jaksiæ *et al.* (1982) suggested that in Spain, unlike Chile and the California mediterranean habitats, Barn Owls are forced to use smaller mammalian prey, as well as more invertebrates, due to the reduced abundance of larger-sized small mammal prey. So, preying on small-sized prey is the only option for Barn Owls in Spain. On the contrary, in central Chile, and probably in the northwestern Argentine Patagonia (see Pillado & Trejo 2000), Barn Owls have a larger range of prey size, but it is apparently more profitable for owls to select larger prey. In the agrosystems of southern Brazil, unlike the Spanish mediterranean region, there is a high incidence of smaller-sized small mammals in the owl diet that cannot be explained by the absence of medium or larger-sized small mammals. Prey considerably larger than house mice (e.g., *A. paranaensis*, *N. lasiurus* and *C. aperea*) are common in the southern Brazilian study area (pers. observ.). Similarly, in the cerrado of central Brazil, Barn Owls can also benefit from larger rodent prey, but they prey heavily on small ones (Motta-Júnior & Talamoni 1996). The ecological success of Barn

TABLE 2. Quantitative parameters of Barn Owl trophic ecology in different parts of its geographical range. The Shannon's index and the Pielou's index were calculated in relation to the small mammal component of the diet.

Region	Mean weight of small mammal prey (g)	Mean weight of vertebrate prey, including small mammals (g)[1]	Shannon's index (H')	Pielous's index (J')	References
Central Chile	70.7 ± 52.3*	-	1.93	0.78	Herrera & Jaksic (1980)
Southern Spain	21.2 ± 24.0*	-	1.41	0.61	Herrera & Jaksic (1980)
California	68.2 ± 1.3**	-	1.99	-	Jaksic et al. (1982)
Colorado	45.9 ± 1.7**	-	1.86	-	Jaksic et al. (1982)
Southern Wisconsin	-	33.5 ± 1.4**	-	-	Jaksic (1983)
Southern Spain	-	23.6 ± 2.1**	-	-	Jaksic (1983)
Central Chile	-	109.0 ± 6.5**	-	-	Jaksic (1983)
Argentine pampas	16.9***	-	-	-	Bellocq (1990)
Argentine Patagonia	46.1****	-	-	-	Pillado & Trejo (2000)
Southern Brazil	27.4 ± 32.7*	-	0.75	0.28	This study

*Standard deviation, **Twice standard error, ***Only mean weight, ****Only geometric mean weight.

Owls throughout the world is certainly dependent on the great plasticity of their feeding habits.

ACKNOWLEDGMENTS

We thank Edwin O'Neill Willis and Tadeu Artur de Melo Júnior for reviewing the manuscript and providing valuable comments. We also thank Marta Elena Fabián for identification of the bats.

REFERENCES

Alho, C. J. R., L. A. Pereira, & A. C. Paula. 1986. Patterns of habitat utilization by small mammal populations in cerrado biome of central Brazil. Mammalia 50: 447–460.

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

Bellocq, M. I. 2000. A review of the trophic ecology of the Barn Owl in Argentina. J. Raptor Res. 34: 108–119.

Bonvicino, C. R., & A. M. R. Bezerra. 2003. Use of regurgitated pellets of Barn Owls (*Tyto alba*) for inventorying small mammals in the cerrado of central Brazil. Stud. Neotrop. Fauna Environ. 38: 1–5.

Clark, D. R., Jr., & C. M. Bunck. 1991. Trends in North American small mammals found in Common Barn-Owl (*Tyto alba*) dietary studies. Can. J. Zool. 69: 3093–3102.

Fast, S. J., & H. W. Ambrose. 1976. Prey preference and hunting habitat selection in the Barn Owl. Am. Midl. Nat. 96: 503–507.

Fleharty, E. D., & K. W. Navo. 1983. Irrigated cornfields as habitat for small mammals in the sandsage prairie region of western Kansas. J. Mammal. 64: 367–379.

González, E. M., S. J. Claramunt, & A. M. Saralegui. 1999. Mamíferos hallados en egagrópilas de *Tyto alba* (Aves, Strigiformes, Tytonidae) en Bagé, Rio Grande do Sul, Brasil. Iheringia Sér. Zool. 86: 117–120.

Instituto Brasileiro de Geografia e Estatística. 1986. Levantamento de recursos naturais, folha SH.22 Porto Alegre e parte das folhas SH.21 Uruguaiana e SI.22 Lagoa Mirim. Fundação Instituto Brasileiro de Geografia e Estatística, Rio de Janeiro, Brazil.

Herrera, C. M., & F. M. Jaksiæ. 1980. Feeding ecology of the Barn Owl in central Chile and

southern Spain: A comparative study. Auk 97: 760–767.

Jaksiæ, F. M. 1983. The trophic structure of sympatric assemblages of diurnal and nocturnal birds of prey. Am. Midl. Nat. 109: 152–162.

Jaksiæ, F. M., R. L. Seib, & C. M. Herrera. 1982. Predation by the Barn Owl (*Tyto alba*) in mediterranean habitats of Chile, Spain and California: A comparative approach. Am. Midl. Nat. 107: 151–162.

Mares, M. A., R. A. Ojeda, & R. M. Barquez. 1989. Guide of the mammals of Salta Province, Argentina. Univ. of Oklahoma Press, Norman, Oklahoma.

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.

Mills, J. N., B. A. Ellis, K. T. Mckee, J. I. Maiztegui, & J. E. Childs. 1991. Habitat associations and relative densities of rodent populations in cultivated areas of central Argentina. J. Mammal. 72: 470–479.

Mills, J. N., B. A. Ellis, K. T. Mckee, J. I. Maiztegui, & J. E. Childs. 1992. Reproductive characteristics of rodent assemblages in cultivated regions of central Argentina. J. Mammal. 73: 515–526.

Motta-Júnior, J. C., & S. A. Talamoni. 1996. Biomassa de presas consumidas por *Tyto alba* (Strigiformes: Tytonidae) durante a estação reprodutiva no Distrito Federal. Ararajuba 4: 38–41.

Newsome, A. E. 1969. A population study of house-mice temporarily inhabiting a south Australian wheatfield. J. Anim. Ecol. 38: 341–359.

Nowak, R. M. 1999. Walker's mammals of the world. The Johns Hopkins Univ. Press, Baltimore, Maryland.

Pardiñas, U. F. J., G. J. Moreira, C. M. Garcia-Esponda, & L. J. M. De Santis. 2000. Deterioro ambiental y micromamíferos durante el Holoceno en el nordeste de la estepa patagónica (Argentina). Rev. Chil. Hist. Nat. 73: 9–21.

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

Rowe, F. P., E. J. Taylor, & A. H. J. Chudley. 1963. The numbers and movements of house-mice (*Mus musculus* L.) in the vicinity of four corn-ricks. J. Anim. Ecol. 32: 87–97.

Silva, F. 1994. Mamíferos silvestres – Rio Grande do Sul. Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil.

Southern, H. N., & E. M. O. Laurie. 1946. The house-mouse (*Mus musculus*) in corn ricks. J. Anim. Ecol. 15: 134–149.

Southwick, C. H. 1958. Population characteristics of house-mice living in English corn ricks: Density relationships. Proc. Zool. Soc. Lond. Ser. B 131: 163–175.

Tamarin, R. H., & S. R. Malecha. 1972. Reproductive parameters in *Rattus rattus* and *Rattus exulans* of Hawaii, 1968 to 1970. J. Mammal. 53: 513–528.