

Diet of *Athene cunicularia* (Molina, 1782) from a sandy coastal plain in southeast Brazil

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ABSTRACT: We analyzed the diet of the Burrowing Owl *Athene cunicularia* (Strigidae) on a sandy coastal plain to the north of Rio Doce, Linhares, state of Espírito Santo, southeast Brazil. This study was based on pellet analysis, prey found around the owl burrows in a pasture area, and stomach contents of five specimens found dead on the road. Samples were taken during the dry season (October 1996) and the rainy season (March 1997). We identified 24 food items, including arthropods and small vertebrates. Beetles were the most important prey in the diet, followed by amphibians, crustaceans (crabs), mammals (rodents and marsupials), birds, reptiles, and spiders. The frequency of occurrence of different prey types in the diet was not significantly different between dry and rainy seasons. The predominance of nocturnal prey suggests an increment in hunting activity of the Burrowing Owl starting around twilight hours.

Key words: Burrowing Owl, food habits, Strigidae.

RESUMO: **Dieta de *Athene cunicularia* em uma planície costeira do sudeste do Brasil.** Nós analisamos a dieta da coruja buraqueira *Athene cunicularia* (Strigidae) em pastagens da planície costeira ao norte do Rio Doce, Linhares, estado do Espírito Santo, sudeste do Brasil. O estudo foi baseado nas análises de pelotas, das presas encontradas no entorno das tocas e conteúdo estomacal de cinco exemplares encontrados atropelados. As amostras foram coletadas durante as estações seca (outubro de 1996) e chuvosa (março de 1997). Nós identificamos 25 itens alimentares, incluindo artrópodes e pequenos vertebrados. Besouros foram as presas mais importantes, seguidos por anfíbios, crustáceos (caranguejos), mamíferos (roedores e marsupiais), pássaros, répteis e aranhas. A frequência das presas na dieta não diferiu significativamente entre os períodos de seca e de chuva. A dominância

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de presas noturnas sugere um aumento da atividade de caça desta coruja durante o crepúsculo.

Palavras-chave: coruja-buraqueira, hábitos alimentares, Strigidae.

Introduction

The Burrowing Owl *Athene cucularia* (Molina, 1782) usually inhabits open habitats and lives in ground burrows abandoned by mammals or those eventually made by itself (Antas & Cavalcanti, 1988; Sick, 1997). This owl has broad geographic distribution, occurring from Canada to Tierra del Fuego (Sick, 1997). In Brazil, it is found mainly in fields, pastures, sandy coastal plains, and even gardens in urban areas (Antas & Cavalcanti, 1988; Sick, 1997). In North America, the Burrowing Owl comprises two subspecies (Korfanta *et al.*, 2005).

Some studies have found evidence that *A. cucularia* has a generalist diet, consisting of small arthropods and vertebrates (Bellocq, 1987, 1988; Martins & Egler, 1990; Silva-Porto & Cerqueira, 1990). Martins & Egler (1990) described several hunting tactics used by *A. cucularia*. Due to habitat loss and fragmentation from agriculture and urban development, owls often live in close proximity to humans, yet very little is known of habitat selection by the Burrowing Owl (Gervais *et al.*, 2003) or how its behavior is affected by the proximity to humans (Chipman, 2006).

We present information on the diet of *A. cucularia* inhabiting an area of pasture in southeast Brazil. The study was based on the analyses of regurgitated pellets and stomach contents of specimens found dead on the road.

Methods

Fieldwork was carried out by one of us (RLT) in a 14 ha pasture, located at Pontal do Ipiranga (ca. 19°12'S 39°43'W), municipality of Linhares, state of Espírito Santo, southeast Brazil. The area is low-lying, surrounded by swamps and covered with sparse herbaceous and grass vegetation. This pasture was originally covered with a typical Brazilian sandy coastal plain vegetation called Restinga, and is close to a major river: Rio Doce. The soil consists of sandy deposits of riverine and marine origin (Suguio *et al.*, 1982). The climate is hot and wet (Aw, according to Köppen, 1948), with the dry season occurring during the fall (March to May) and

winter (June to August), and the wet season during spring (September to November) and summer (December to February) (Moraes, 1974; Panoso *et al.*, 1978). Mean annual temperature during daylight hours varies from 22°C to 24°C, and mean annual precipitation varies from 1000 to 1250 mm (Nimer, 1989).

We collected regurgitated pellets, as well as prey remains found in an area of 3 m diameter around every burrow during the dry (October 1996, 58 burrows) and rainy season (March 1997, 56 burrows). Both regurgitated pellets and prey remains were labeled and put in a plastic bag. All items found were dealt as one sample per burrow. The owls' burrows were visited on three consecutive days between 8:00 and 12:00 h, 14:00 and 18:00 h, and between 19:00 and 23:00 h. The samples taken in March were made soon after a flood that occurred in the estuarine zone of Rio Doce, flooding the lowlands and isolating the area in February.

The pellets were put on a petri dish and dissociated in 70% ethanol. Prey items were identified to the lowest taxonomic level possible. To evaluate the relative importance of each prey type, we compared the frequency, the number of pellets found, and the number of burrows sampled. We also analyzed stomach contents of five *A. cunicularia* found dead on the road near our study site. Differences in the diet between the dry and rainy seasons were assessed using the Spearman rank correlation coefficient (r_s) and t-tests (t_s), after applying the modifications of Fritz (1974), who suggested to tie prey items having the same proportion.

Results

The analysis of regurgitated pellets and prey remains found around the burrows revealed 24 food items (Table 1). Beetles (Coleoptera) were the most important food item during both dry and rainy seasons. Other important food items were Amphibia (78.1% in the dry season and 35.7% in the wet season) and Orthoptera (48.3% in the dry season and 36.2% in the wet season). A positive and significant correlation was obtained between the diets of dry and rainy seasons ($r_s = 0.98$, $t_s = 11.02$, $p = 0.0001$).

Beetles of the families Scarabeidae and Hydrophilidae were the most common insects in the diet of *A. cunicularia*, followed by Saltatoria (e.g., Acrididae and Tettigoniidae) (Table 1). Other insect orders (e.g., Hymenoptera and Lepidoptera) and Araneae were infrequent in both seasons. The freshwater shrimp *Trichodactylus fluviatilis* was the only crustacean found, mostly in the dry season (Table 1).

Table 1. Frequency of food items found in regurgitated pellets and in prey remains around the burrows of *Athene cunicularia* during the dry (n = 58) and rainy (n = 56) seasons in Linhares, Espírito Santo, southeast Brazil.

Food Item	Activity period	Frequency of occurrence		Total
		Dry season	Rainy season	
Crustacea				
Trichodactylidae				
<i>Trichodactylus fluviatilis</i>	nocturnal	18.9	1.8	10.5
Insecta				
Coleoptera				
Scarabaeidae	nocturnal	100	92.8	96.5
Hydrophilidae	?	43.1	5.4	24.5
Cerambycidae	?	1.7	–	0.9
Curculionidae	?	3.4	–	1.7
Orthoptera				
Acridae	diurnal	43.1	28.6	35.9
Tettigoniidae	nocturnal	12.0	3.6	7.9
Hymenoptera				
Formicidae	diurnal	6.9	–	3.5
Lepidoptera				
Saturniidae				
<i>Rothschildia aurota</i>	nocturnal	1.7	–	0.9
Araneae				
Orthognatha	nocturnal	1.7	–	0.9
Pisces				
Callichthyidae	nocturnal	–	1.8	0.9
unidentified	–	–	1.8	0.9
Amphibia				
Bufonidae				
<i>Chaunus granulatus</i>	nocturnal	1.7	–	0.9
Leptodactylidae				
<i>Leptodactylus ocellatus</i>	nocturnal	8.6	–	4.4
Unidentified	–	65.5	35.7	50.9
Reptilia				
Serpentes				
Colubridae				
<i>Chironius</i> sp.	diurnal	1.7	–	0.9
<i>Philodryas patagoniensis</i>	diurnal	–	3.6	1.7
unidentified	–	1.7	1.8	1.7
Lacertilia				
Anguidae				
<i>Ophiodes striatus</i>	nocturnal	1.7	–	0.9
Scincidae				
<i>Mabuya</i> sp.	diurnal	1.7	1.8	1.7
Aves				
Strigidae				
<i>Athene cunicularia</i>	nocturnal	–	12.5	6.1
unidentified	–	6.9	8.9	7.9
Mammalia				
Rodentia				
Cricetidae	nocturnal	13.8	23.2	18.4
Didelphimorphia				
Didelphidae	nocturnal	1.7	–	0.9

Among anurans, we identified two species: *Leptodactylus ocellatus* (Leptodactylidae) and *Chaunus granulatus* (Bufonidae), both more common during the rainy season. Reptiles were uncommon and were represented by two lizards (*Mabuya* sp. and *Ophiodes striatus*) and two snakes (*Chironius* sp. and *Philodryas patagoniensis*) (Table 1). In addition, we found a few dead individuals of the house-gecko (*Hemidactylus mabouia*) around the burrows, but we did not include them as a food item because they had apparently been killed but not ingested and were all intact.

Feathers were recorded in 6.9% of the samples during the rainy season and 8.9% during the dry season. We found eggshell remains around the burrows, but we do not know whether *A. cunicularia* preys on other birds' eggs or the eggshells came from their offspring. We observed remains of *A. cunicularia* around the burrows during the rainy season, representing 12.5%, and suggesting cannibalism during this season. The bones and feathers found around the burrows suggest that they belonged to the young of that year. We found mammal remains, such as skin, bones and teeth, belonging mostly to rodents and marsupials in 15.5% of the samples.

In the stomach contents of five individuals found dead on the road we obtained the following food items: Coleoptera (Scarabeidae) (100%), Orthoptera (Acrididae) (60%), and birds (20%).

Discussion

Our analyses show that *A. cunicularia* has a broad prey spectrum, which includes insects, crustaceans, amphibians, reptiles, birds, and small mammals. This owl can be trophically classified as generalist predator, corroborating other studies conducted in South America (Bellocq, 1987; 1988; Martins & Egler, 1990; Schlatter *et al.*, 1980; Silva-Porto & Cerqueira, 1990; but see Motta-Júnior, 2006 and Motta-Júnior & Alho, 2000, who found a more specialized diet), and in North America (Jaksic & Marti, 1981; Tyler, 1983).

We have not found relevant differences in the diet of the Burrowing Owl between the dry and rainy seasons. Silva-Porto & Cerqueira (1990) found substantial seasonal change in the diet of this owl, which was related to prey availability in different microhabitats on a coastal plain in Maricá, Rio de Janeiro. Differences in the diets of owl populations at distinct sites have been explained mainly by environmental heterogeneity (Jaksic & Marti, 1981)

Silva-Porto & Cerqueira (1990) found predominately spiders,

grasshoppers, and hymenopterans in the diet of *A. cunicularia* in Maricá, Rio de Janeiro. In São Paulo, Martins & Egler (1990) found rodents (80%), insects (Choleoptera, Orthoptera, Homoptera, 65%), and lizards (5%) in 20 pellets examined. Zilio (2006) found the dominance of Orthoptera (49.8%) and Coleoptera (22.4%) in the diet of the Burrowing Owl from Rio Grande do Sul. Results from different localities indicate opportunism of *A. cunicularia*, whose hunting strategy focuses on the most abundant and accessible prey. The adaptation of this owl to exploit different prey types may be the main element that explains the success of this species in occupying disturbed areas.

The major frequency of anurans, aquatic insects, and the freshwater shrimp *Trichodactylus fluviatilis* in the diet of *A. cunicularia* during the dry season may be a response to the low water level in the floodplains around our study site. Several authors have reported the presence of these food items in the diet of *A. cunicularia* from different regions. Gallardo (1963) noted the presence of *C. granulatus* in the diet of the Burrowing Owl from Argentina. *Chaunus granulatus* appears to be the most predated toad, which could be related to its small size, as well as the reduced development of its parotoid glands, when compared to other sympatric toads (Cardoso & Sazima, 1977). Silva-Porto & Cerqueira (1990) found the crabs *Ocypode quadrata* and *Chasmagnathus granulata* in regurgitated pellets of *A. cunicularia* from the coastal plain of Maricá, Rio de Janeiro, while Soares *et al.* (1992) found 21 individuals of unidentified Ocypodidae crabs in the coastal plain of Joaquina, Santa Catarina Island, south Brazil.

In the coastal plain of Maricá, Rio de Janeiro, Rocha (1993) observed predation on the lizard *Liolaemus lutzae* by *A. cunicularia*. At the same site, Silva-Porto & Cerqueira (1990) found *Hemidactylus mabouia*, as well as iguanids, teiids, and other lizard species in the diet of the Burrowing Owl. In Campinas, São Paulo, Martins & Egler (1990) found an unidentified lizard in the regurgitate pellets. Predation on lizards or other reptiles showed low frequency in most studies dealing with the diet of the Burrowing Owl, proving that it preys only opportunistically on these types of prey. Lizards and other reptiles may be difficult to catch because they may have a high escape capacity.

There is evidence that the Burrowing Owl preys on other bird nests (Sick, 1997). The eggshell remains we found in the vicinity of some burrows could be the result of predation, but the frequency was too low, and could represent eggs of the owl itself. Cannibalism has been reported for 21 bird families and 37 species including Strigiformes (Stanback & Koenig, 1992), most commonly in the Burrowing Owl (Earhart & Johnson, 1970). As the

bodies we found around some the burrows appeared to be of young, they could have died during the flood that occurred in February, but they had beak marks on them. Cannibalism of the young has been attributed to social pathology, disturbances caused by man, captive situations, and the decrease of food availability (Stanback & Koenig, 1992).

Mammals were uncommon in the diet of *A. cucularia* at our study site. Small mammals, such as rodents, marsupials, and bats have been identified in regurgitated pellets in several owl species (Gillette & Kimbrough, 1970; Ruschi, 1979; Sick, 1997), including *A. cucularia* (Motta-Júnior & Bueno, 2004). Martins & Egler (1990) recorded the predominance of rodents in the diet of *A. cucularia* in a pasture area in São Paulo, southeastern Brazil.

In relation to the period of hunting activity, *A. cucularia* has been considered to be diurnal (Sick, 1997), twilight (Martins & Egler, 1990), diurnal-twilight (Jaksic & Braker, 1983), or twilight-nocturnal predator (Antas & Cavalcanti, 1988; Motta-Júnior & Bueno, 2004). Preferential hunting activity probably varies in different regions depending on prey availability. Most prey ingested by *A. cucularia* at our study site was nocturnal (Table 1), suggesting that this owl shows an increasing hunting activity at twilight, opportunistically hunting during the day.

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