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Food habits of the Striped Owl *Asio clamator* in South-East Brazil

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ABSTRACT

The Striped Owl *Asio clamator* is a poorly known species ranging from southern Mexico to northern Argentina and Uruguay. Few quantitative data are reported on its food habits, particularly in Brazil. This study analyses the diet of this raptor, including prey biomass consumption and seasonality.

Field work was conducted in two localities in south-east Brazil, where savannah grassland (Cerrado biome) was the main vegetation cover. Samples of 87 pellets plus 6 pellet debris and 57 pellets plus 10 debris were collected respectively in the Reserve of Universidade Federal de São Carlos and the Ecological Station of Itirapina, roughly 30km apart. Pellet analysis for both localities yielded 478 prey individuals, including 48 species/morphospecies.

Vertebrates, mostly rodents and birds, were both by number and by biomass the bulk of the diet (83.4-86.7% and 99.4-99.5%, respectively). Invertebrates were represented only by insects. Unlike other owls of similar body mass, the Striped Owl (347-546g) seems to prey regularly on relatively larger prey (>100g), as sub-adults and juveniles of Spiny Rats, Cavies and Opossums. This can be partially explained by the larger and possibly stronger talons of this owl.

INTRODUCTION

The Striped Owl, *Asio* (=*Rhinoptynx*) *clamator* is a widespread mid-sized Neotropical species, ranging from southern Mexico through virtually all of Brazil except Amazonian forest, to northern Argentina and Uruguay (Voous 1989; Burton 1992; Del Hoyo *et al.* 1999; König *et al.* 1999). This owl occurs in open habitats with some shrub and tree cover, including savannahs, marshes, forest edges and agricultural fields (Voous 1989; Sick 1993; Del Hoyo *et al.* 1999). There are few ecological data available about this species (see Voous 1989 and Del Hoyo *et al.* 1999), apart from Oliveira (1980), Massoia (1988), Martínez *et al.* (1996), and Isacch *et al.* (2000). König *et al.* (1999) pointed out that its biology and behaviour need more study.

Diet studies from Argentina reported that this owl preyed mostly on rodents and birds (Massoia 1988; Isaach *et al.* 2000). In spite of being a relatively common species in Brazil (Sick 1993), virtually nothing is known about its food habits in this country. This study includes the first quantitative description of the food habits of the Striped Owl in Brazil, both by number and by estimated biomass of prey. The aim was to perform a quantitative analysis of the Striped Owl's diet in two localities in South-east Brazil, including estimates of prey biomass consumption.

STUDY AREA

The fieldwork was conducted in two localities approximately 30km apart in South-east Brazil, including the Preserve of the Universidade Federal de São Carlos - UFSCAR (21°58'S; 47°52'W; 300ha) and the Ecological Station of Itirapina - ESITI (22°15' S; 47°49' W; 2,300ha).

Both study sites are located in the southern part of the Cerrado biome and are covered mostly with grassland savannah and some gallery forest remnants. The UFSCAR area shows higher levels of disturbance, since it includes extensive areas of *Eucalyptus* plantation, whereas the ESITI is a reserve covered almost entirely by original grassland-savannah. The climate in the region is a transition between Cwa and Aw according to Koeppen's classification, rainy tropical with marked dry (April to September) and wet (October to March) seasons (Setzer 1966; Tolentino 1967). More detailed descriptions of the Cerrado biome can be found in Oliveira-Filho & Ratter (2002).

METHODS

Pellets and pellet debris were collected during 1992-1993 in UFSCAR and 2001-2003 in ESITI. This material was soaked in a 10% NaOH water solution for 4 hrs. (Marti 1987), and the contents were washed through a fine mesh screen and dried for storage. The identification of prey remains was performed by comparison with reference collections from the study sites that also provided data for biomass estimates. These collections of prey species are deposited in the Museum of Departamento de Biologia Evolutiva da Universidade Federal de São Carlos, and in the Departamento de Ecologia Instituto de Biociências, Universidade de São Paulo. Small mammal biomass was estimated through linear regression equations obtained per species according to procedures in Hamilton (1980), with mandible length (mm) being the independent variable (Y) and body mass the dependent one (X). Great individual body mass differences among individuals within species justified this procedure. For unidentified birds the same procedure was developed using humerus length (Morris & Burgis 1988). On the other hand, mean body mass found in the reference collection was used for identified birds, anura, lizards, bats, rabbits, insects and small mammals with broken mandibles.

Regression equations, coefficients of determination and statistical significance for each prey are listed below:

Birds (a combination of 21 species) X= length of humerus

(n = 21 individuals) $\log Y = 2.44(\log X) - 1.70$ $R^2 = 0.93$; $P < 0.001$

Mammals (X = length of mandible)

Gracilinanus sp (n = 7)	$\log Y = 3.61(\log X) - 3.12$	$R^2 = 0.98$; $P < 0.001$
Bolomys lasiurus (n = 286)	$\log Y = 4.40(\log X) - 3.32$	$R^2 = 0.79$; $P < 0.001$
Calomys tener (n = 119)	$\log Y = 4.23(\log X) - 2.88$	$R^2 = 0.75$; $P < 0.001$
Oligoryzomys nigripes (n = 33)	$\log Y = 3.73(\log X) - 2.41$	$R^2 = 0.87$; $P < 0.001$
Rattus rattus (n = 5)	$\log Y = 3.92(\log X) - 2.92$	$R^2 = 1.00$; $P < 0.001$
Mus musculus (n = 6)	$\log Y = 3.05(\log X) - 1.71$	$R^2 = 0.95$; $P < 0.001$

Measurements of owl's bill width at the commissural points were made with callipers. The dimensions of owl's talon included the first to third toes and their claws. Because museum specimens had curved talons, this measurement was made in the ventral portion of the foot with the use of string. All measured specimens were from the Museum of Zoology, Universidade de São Paulo, Brazil. The Kruskal-Wallis (*KW*) one-way analysis of variance (Siegel & Castellan Jr. 1988) was performed for comparisons of morphometry among owl species. A significant *KW* was followed by a multiple comparison test to determine between which of the samples significant differences occur (Siegel & Castellan Jr. 1988).

Seasonality in the diet was assessed by contingency tables using *G*-tests according to Zar (1999). All tests were performed by the statistical package BioEstat 2.0 (Ayres *et al.* 2000).

RESULTS & DISCUSSION

General diet analysis

Striped Owls displayed mostly nocturnal and crepuscular activities. All observations of active hunting individuals took place at night or just after sunset (Motta-Junior 1996), even though in the reproductive period hunting in daylight can also occur (Oliveira 1980). Active individuals were observed mostly in grassland-savannah and savannah-forest edges, which is in accordance with reports in Del Hoyo *et al.* (1999) and König *et al.* (1999). Pellets were collected in diurnal roosts. These were dense foliage shrubs at a grassland savannah in UFSCAR, and pine trees in a *Pinus* plantation inside a savannah in the ESITI.

The analysis of 144 pellets and 16 pellet debris for both areas yielded 478 prey individuals in approximately 48 species/morphospecies (Table 1).

Vertebrates were the main prey, both numerically (83.4-86.7%) and by biomass (99.4-99.5%). As in Argentina, rodents and birds were the main prey irrespective of the analysis by number (66.9-71.3%) or by biomass (85.0-91.2%).

Table 1. Diet of the Striped Owl in two localities, South-east Brazil, both by prey numbers and by estimated biomass consumed. The figures are in percentages.

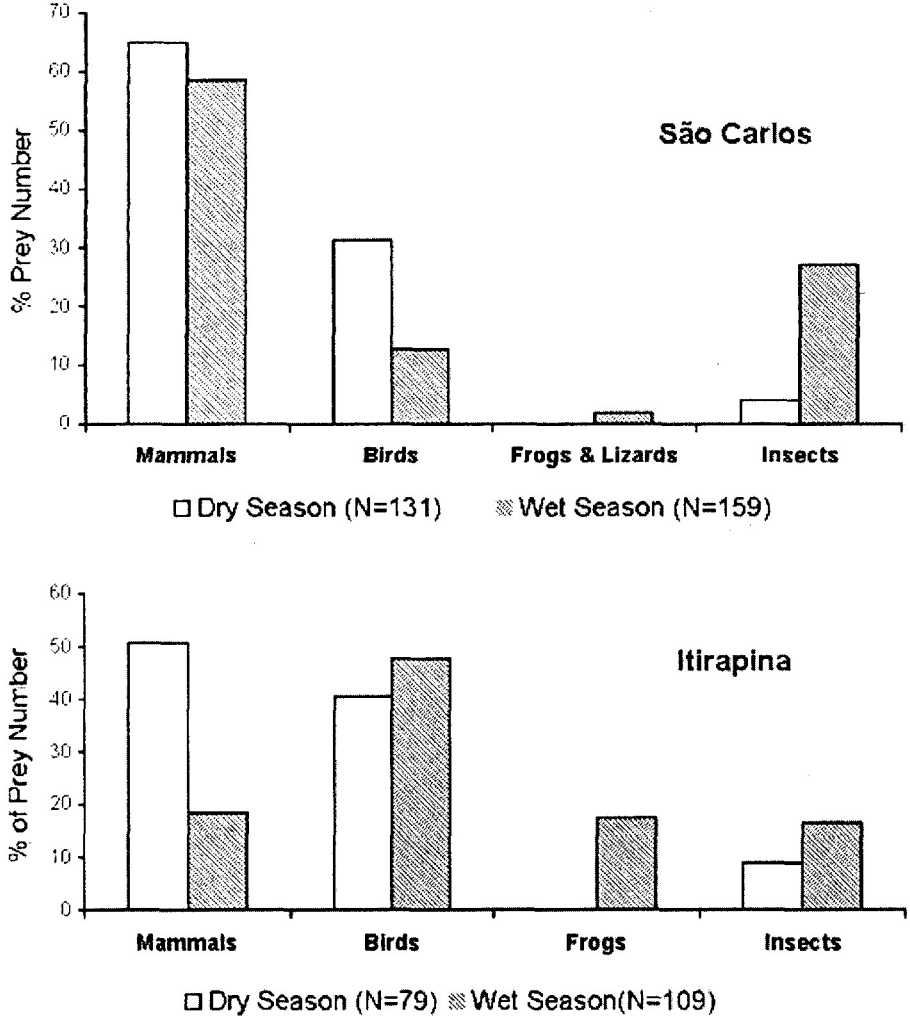
	SÃO CARLOS		ITIRAPINA	
Prey	*Number*	*Biomass*	*Number*	*Biomass*
OPOSSUMS				
Gracilinanus sp.	9.6	5.6	2.7	1.5
Didelphis albiventris juvenile	0.7	4.9		
BATS				
Artibeus lituratus	0.3	0.7		
Eumops glaucinus			2.1	2.1
Lasiurus sp			0.5	0.2
Molossus sp			2.1	1.6
Nyctinomops laticaudatus			1.1	0.3
Unidentified small Chiroptera	0.3	0.1	1.1	0.3
RABBITS				
Sylvilagus brasiliensis	0.3	2.3		
RODENTS				
Bolomys lasiurus	11.4	9.8	2.1	2.5
Calomys tener	5.2	2.0	7.4	3.1
Oligoryzomys nigripes	22.1	9.1	2.7	1.5
Oryzomys subflavus	1.4	2.9		
Holochilus cf. *brasiliensis*	1.0	1.4		
Rattus rattus	7.6	21.2	0.5	1.5
Mus musculus	0.7	0.3		
Cavia aperea	0.7	4.8		
Clyomys bishopi			9.6	44.5
BIRDS				
Crypturellus parvirostris	0.3	2.0		
Nothura maculosa	0.3	3.4		
Columba sp			1.1	8.1
Columbina talpacoti	5.2	7.9	3.2	3.7
Zenaida auriculata	0.7	3.0		
Cuculidae cf. *Coccyzus* sp			2.1	5.0
Melanopareia torquata			0.5	0.3
Pitangus sulphuratus	0.3	0.7		
Tyrannus sp			1.1	1.2
Unidentified Tyrannidae	2.1	3.5	3.2	1.9
Turdus sp	3.1	7.1	1.6	2.8
Passer domesticus	2.1	1.7	10.0	5.9
Tersina viridis	0.3	0.4		
Thraupis sayaca	0.7	0.7		
Volatinia jacarina	3.8	1.2	12.8	3.7
Sporophila cf. *caerulescens*	0.3	0.1		
Zonotrichia capensis	0.7	0.5		
Unidentified small Passerines	0.3	0.3	1.1	0.5
Unidentified Emberizidae			5.8	2.0
Other unidentified birds	1.0	1.0	2.1	3.1
FROGS				
Hylidae			4.3	0.9
Bufonidae			5.9	1.2
Unidentified Anura	0.3	0.1		
LIZARDS				
Ameiva ameiva	0.3	0.7		
Unidentified small Iguanidae	0.3	0.1		
SUBTOTAL VERTEBRATES	83.4	99.5	86.7	99.4
INSECTS				
Blattidae	0.7	tr	3.7	0.1
Mantidae	0.3	tr		
Tettigoniidae	12.1	0.4	0.5	tr
Other Orthoptera	1.7	tr	5.3	0.3
Scarabaeidae	1.7	0.1	3.7	0.2
SUBTOTAL INVERTEBRATES	16.5	0.5	13.3	0.6
TOTAL (INDIVIDUALS, GRAMS)	290	8,717.9	188	6,423.5
PELLETS (AND DEBRIS) ANALYSED	87 (6)		57 (10)	

(tr) – traces, less than 0.05 %.

Occurrence of exotic species associated with urban areas (*Passer domesticus, Rattus rattus*) in the diet at Itirapina indirectly suggested home range areas up to 1,260ha for the Striped Owl, since minimum distances from roost sites to urban areas were approximately 1.5-2km.

The consumption of several passerine bird species (Table 1), most of them arboreal (Sick 1993), and the scansorial *Oligoryzomys nigripes* and *Gracilinanus* sp. (Alho 1982; Alho & Villela 1984; Emmons 1997) suggest that Striped Owls can catch some of these prey directly in shrubs or trees.

Figure 1. Seasonality in the diet of the Striped Owl in two localities according to major prey groups, South-east Brazil (G= 42.83; df = 3; $p < 0.0001$ for São Carlos; and G= 37.11; df = 3; $p < 0.0001$ for Itirapina).



Seasonality

The consumption of major groups of food items was dependent on the season of the year in Itirapina and São Carlos (Figure 1). Insects and frogs were caught in higher proportions during the rainy season (both localities), whereas birds at São

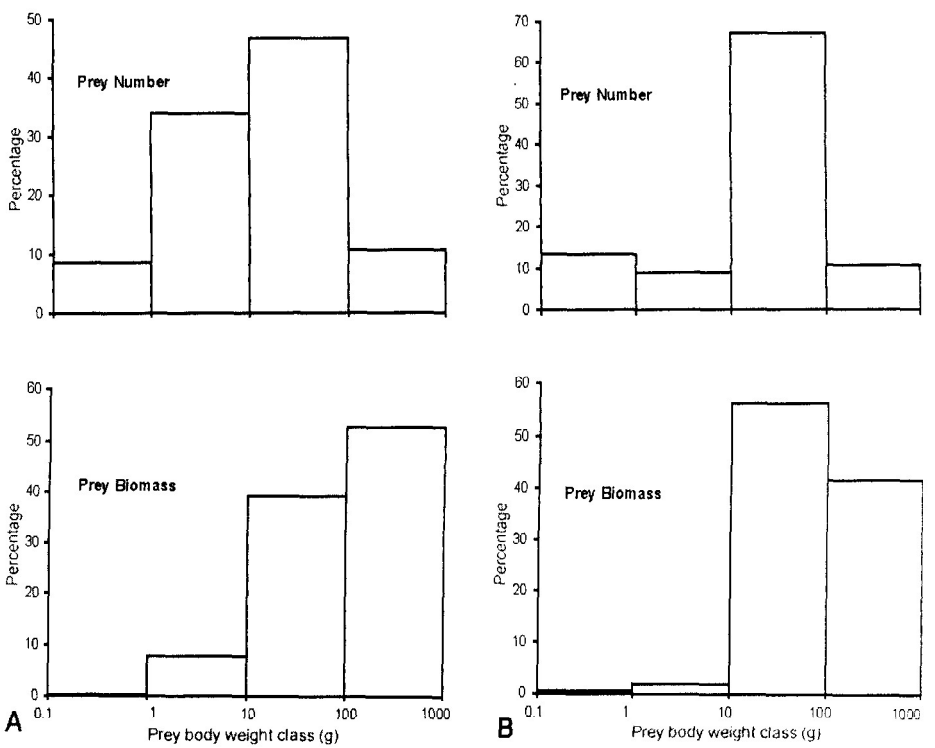
Carlos and small mammals at Itirapina were preyed on mostly in the dry season. On the other hand, birds and mammals in Itirapina and São Carlos, respectively, appear to be captured independently of the season (Figure 1). These patterns of predation are partially in accordance with the natural cycles of abundance of some of the prey in the Cerrado biome, such as insects, frogs and small mammals (Motta-Junior 1996; Colli *et al.* 2002), suggesting some temporal opportunism in the diet of the Striped Owl.

Prey size distribution

Numerically the most consumed prey size was between 10.1g and 100g for both populations of owls. Conversely, by biomass, prey weighing more than 100g yielded either the bulk (Itirapina, Fig. 1A) or a considerable portion of the diet (São Carlos, Fig 1B).

Although the Striped Owl captured great proportions of small-sized vertebrates, larger mammals and birds, like juveniles of *Sylvilagus brasiliensis, Cavia aperea, Didelphis albiventris* and *Nothura maculosa,* made the bulk of the diet by estimated biomass in São Carlos (Figure 1B). A similar result was found in Itirapina, but the bulk of the diet was represented by the Spiny Rat *Clyomys bishopi* and *Columba* spp. (Figure 1A). Larger prey weighing more than 200g like those listed above have been reported in previous studies (Voous 1989; Massoia 1988).

Figure 2. Prey size distribution in the diet of the Striped Owl in Itirapina (A) and São Carlos (B), both by number of prey and by biomass as a function of prey body weight class.



Unlike other owls of similar body mass, the Striped Owl seems to prey regularly on larger prey (>100g) relative to its body size. Voous (1989) has pointed out that greater talon length found in this species could be indicative of larger prey. Indeed its talons are larger than similar-sized sympatric owl species (Table 2).

Bill width seems to be inadequate as an explanation for the ingestion of larger prey, since this measure did not differ significantly among the three owl species in the study region ($KW = 4.52$; $p = 0.104$; Table 2). On the other hand, the larger ($KW = 12.83$; $p = 0.002$) and possibly stronger talons of the Striped Owl can partially explain why this owl preys on larger prey than other similar or even larger-sized owls (Table 2). Contrary to expectation, the larger Stygian Owl *Asio stygius* has smaller talons and preys on smaller vertebrate prey (Motta-Junior & Taddei 1992) ($KW = 31.50$; $p < 0.0001$; Table 2).

Further studies on the Striped Owl feeding ecology should focus on the possible prey selection of larger prey both between and within species.

Table 2. Measures of talon length and bill width of three sympatric and similar sized Brazilian owls. Additionally there are data on owl sizes and their mean prey size according to Motta-Junior (1996) and this study. Linear measurements and masses are in mm and g respectively.

Owl species	Range of body mass	Mean Talon length (n)	Mean Bill width (n)	Mean body mass of vertebrate prey (n)
Tyto alba	360-480	84.2±7.6 (12)	29.7±2.0 (12)	19.5±22.5 (512)
Asio clamator	347-546	94.8±5.0 (14)	31.0±1.4 (14)	39.4±53.5 (405)
Asio stygius	633-675	89.4±5.3 (7)	30.0±0.8 (7)	21.7±24.3 (348)

Multiple comparison tests:
- for talons: $p_{(A.clamator \times T.alba)} = 0.0004$; $p_{(A.clamator \times A.stygius)} = 0.075$; $p_{(T.alba \times A.stygius)} = 0.227$.
- for prey body mass: $p_{(A.clamator \times T.alba)} = 0.006$; $p_{(A.clamator \times A.stygius)} < 0.0001$; $p_{(T.alba \times A.stygius)} = 0.090$.

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