DIET AND FORAGING OF THE ENDEMIC LIZARD *Cnemidophorus littoralis* (SQUAMATA, TEIIDAE) IN THE RESTINGA DE JURUBATIBA, MACAÉ, RJ

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ABSTRACT

We investigated the diet and foraging of the endemic teiid lizard *Cnemidophorus littoralis* in a restinga habitat in Jurubatiba, Macaé - RJ. The stomach contents were removed, analyzed and identified to the Order level. There was no relationship between *C. littoralis* morphological variables and number, length or volume of preys. Termites (48.7%) and larvae (35.5%) were the most important prey items which occurred in the examined lizards´ stomachs. The diet did not differ between males and females. *Cnemidophorus littoralis* is an active forager and predominantly consumes relatively sedentary prey or prey that is aggregated in the environment. We also found an intact and undigested hatchling of the crepuscular/nocturnal gekkonid lizard *Hemidactylus mabouia* in the stomach of an adult male of *C. littoralis*, which indicates that *C. littoralis* is a potential source of mortality for individuals of *H. mabouia* in the restinga de Jurubatiba.

Keywords: *Cnemidophorus littoralis*, Teiidae, Squamata, diet, restinga.

RESUMO

Dieta e forrageamento do lagarto endêmico *Cnemidophorus littoralis* (Squamata, Teiidae) da restinga de Jurubatiba, Macaé - RJ

Investigou-se a dieta e o forrageamento do lagarto endêmico *Cnemidophorus littoralis* na restinga de Jurubatiba, Macaé - RJ. Os conteúdos estomacais foram removidos, analisados e identificados no nível de Ordem. Não houve relação entre as variáveis morfológicas de *C. littoralis* e o número, tamanho e volume das presas. Cupins (48,7%) e larvas (35,5%) foram os itens de presas mais importantes nos estômagos dos lagartos examinados. A dieta não diferiu entre os machos e as fêmeas. *Cnemidophorus. littoralis* é um lagarto forrageador ativo e consome, predominantemente, presas relativamente sedentárias ou que ocorrem agregadas no ambiente. Foi encontrado também no estômago de um macho adulto de *C. littoralis* um jovem lagarto gekkonídeo crepuscular/noturno *Hemidactylus mabouia* intacto e não digerido, o que indica *C. littoralis* como uma fonte de mortalidade para indivíduos de *H. mabouia* na restinga de Jurubatiba.

Palavras-chave: *Cnemidophorus littoralis*, Teiidae, Squamata, dieta, restinga.

Different factors may affect the diet of lizards, including an ontogenetic shift in prey preferences, body size, sex and foraging tactic (Huey & Pianka, 1981; Pianka, 1986; Zaluar & Rocha, 2000). Moreover, the size of feeding structures can influence or at least, limit the type and size of prey that may be ingested. As a result, mouth size may affect diet composition which may result in differences between males and females and/or between the young and adults (Preest, 1994; Teixeira-Filho *et al.*, 2003).

Active foraging lizards tend to consume relatively sedentary prey or prey aggregated in the environment (Huey & Pianka, 1981; Magnusson *et al.*, 1985; Bergallo & Rocha, 1994). Teiid lizards, including the genus *Cnemidophorus*, are generally considered as typical active foragers (Pianka, 1970; Anderson & Karasov, 1981; Etheridge & Wit, 1993) and in general predominantly consume termites and larvae (Vitt, 1991; Teixeira-Filho *et al.,* 2003).

Cnemidophorus littoralis is a tropical bisexual lizard that is endemic to coastal sand dune habitats ("restingas") in Rio de Janeiro State, Brazil (Rocha *et al.*, 2000). It can be found in the restinga of Barra de Maricá northwards to the restinga of Grussaí in the north of Rio de Janeiro State (about 200 km of coast). Dietary data available for this species stems from the population of the restinga in Barra de Maricá, RJ (Teixeira-Filho *et al.*, 2003).

Cnemidophorus littoralis was recently described (Rocha *et al.*, 2000) and was recently included in the Official Threatened Checklist of Brazilian Fauna (IBAMA/ MMA/Fundação Biodiversitas/Conservation International Brazil, 2003), due to the intense degradation and loss of the habitats of this species.

One factor restricting development and implementation of conservation and managing plans for threatened species is the lack of information on many aspects of the biology/ecology of most of them.

As a result of the Restinga Expedition Project carried out in 1999-2000 along the Brazilian coast by the Departamento de Ecologia of the Universidade do Estado do Rio de Janeiro, a sample of *C. littoralis* was collected (at that time the species was still not described). We provide additional dietary data about the *C. littoralis* from the restinga in Jurubatiba, Macaé Municipality, RJ to broaden our understanding of the feeding ecology of this species.

MATERIAL AND METHODS

Study area

The study was carried out in March, 1999 and January, 2000 at the restinga de Jurubatiba (22° 17' S, 41° 41' W), Macaé, Rio de Janeiro State, Brazil. Restingas are coastal sand dune habitats covered by herbaceous and shrubby vegetation (Suguio & Tessler, 1984). The climate of the study area is seasonal with a mean annual temperature of 22.6 °C and a mean annual rainfall of 1,164 mm (Pereira & Araújo, 2000). The most represented plant families in Restinga de Jurubatiba are: Leguminosae, Myrtaceae, Orchidaceae, Bromeliaceae, Rubiaceae and Asteraceae (Pereira & Araújo, 2000).

Data analysis

Lizards (N = 31) were collected with rubber bands and air rifles. Each lizard had its snout-vent length (mm) and jaw width (mm) measured with a Vernier caliper (to the nearest 0.1 mm) and was immediately fixed in 10% formalin. In the laboratory, the contents of the stomach were analyzed and each prey item was identified to Order under a stereomicroscope. All prey were measured for width and length using a Vernier caliper (to the nearest 0.1 mm) and their volume (in mm^3) was calculated using the elipsoid formula: $4/3\pi$ (length/2) $(width/2)^2$ (Vitt, 1991). To estimate the index of relative importance (I_x) of each prey category we calculated their numeric, volumetric and frequency percentages, summed these values and divided by three (Howard *et al.*,1999). We related the lizard´s jaw width (JW) and snout-vent length (SVL) to the number of prey and to mean length (mm) and volume (mm^3) of the five largest prey using regression analyses (Zar, 1999). Because number, length and volume of food items were heavily skewed towards small values, these variables were log transformed prior to analysis so that distributions approached normality. Differences in the mean number and volume of prey consumed between adult males and females were tested by t-test (Zar, 1999).

To estimate the relative movement rate of *C. littoralis* during activity at the study site, we recorded time (in seconds) moving and time motionless for each lizard using a stopwatch. We observed ten different individuals following each for the maximum observation time of 10 min (totalling 5,493 s of observation).

RESULTS AND DISCUSSION

The mean SVL of lizards collected was 61.0 ± 8.7 mm (range 37.4 – 76.1, N = 31). Adult

females measured 60.7 ± 3.7 mm (range 52.0 – 66.0, N = 11), adult males measured 64.4 ± 7.1 mm (range 49.4 – 76.1, N = 17) and juveniles measured 42.3 ± 5.3 mm (range 37.4 – 48.0, N = 3).

Cnemidophorus littoralis consumed 18 different prey types consisting of 562 items (as shown in Table 1). Out of the 31 lizards examined, one female and one male had empty stomachs (9.1% among females; 5.9% among males and 6.4% of all lizards). Termites (68.0%), larvae (61.0%) and cockroaches (22.6%) were the most frequent items found in the stomachs (Table 1). The most important prey (by number) were termites (67.3%), followed by larvae (13.3%) (Table 1). Volumetrically, the most important prey were larvae (32.1%), cockroaches (11.2%) and termites (10.9%) (Table 1). One juvenile of the Gekkonid lizard *Hemidactylus mabouia* (SVL = 24.7 mm) was found in the stomach of an adult male (SVL = 60.1 mm). The Importance index showed that termites and larvae were the most important prey (Table 1).

Morphological variables of *C. littoralis* did not affect the number (JW: $F_{1,23}$ = 0.122, P = 0.730; SVL: $F_{1,26}$ = 1.952, P = 0.174), mean length (JW: $F_{1,18}$ = 0.020, P = 0.890; SVL: $F_{1,21}$ = 0.434, P = 0.517) or mean volume ($F_{1,18}$ = 0.146, P = 0.706; SVL: $F_{1,21}$ = 1.231, P = 0.280) of prey consumed by *C. littoralis* in Jurubatiba. Diets of adult males and females did not differ either in number (t = 1.205, df = 25, P = 0.239) or in volume (t = 0.390, df = 20, P = 0.700) of prey consumed.

Cnemidophorus littoralis moved most of the time (moving: 80%, $\bar{x}$ = 439.0 ± 98.7 sec, N = 10; motionless: 20%, $\bar{x}$ = 110.3 ± 61.1 sec, N = 10), similar to other active foraging lizards and

TABLE 1
Absolute values and proportions (%) of number, volume (in mm³), frequency and index of importance (Ix) of each prey category in the diet of *Cnemidophorus littoralis* in the *restinga* in Jurubatiba, Rio de Janeiro State, Brazil.

Items	Number	%	Volume	%	Frequency	%	I_x
Isoptera	378	(67.3)	815.7	(10.8)	21	(68.0)	48.7
Larvae	75	(13.3)	2416.0	(32.1)	19	(61.0)	35.5
Coleoptera Lv	35	(6.2)	186.1	(2.5)	6	(19.0)	9.2
Neuroptera Lv	8	(1.4)	293.2	(3.9)	4	(13.0)	6.1
Lepidoptera Lv	29	(5.2)	1923.2	(25.6)	15	(48.0)	26.3
Unidentified Larvae	3	(0.5)	13.6	(0.2)	3	(9.0)	3.2
Coleoptera	7	(1.2)	154.8	(2.1)	4	(13.0)	5.4
Homoptera	2	(0.4)	29.9	(0.4)	2	(6.4)	2.4
Hemiptera	7	(1.2)	225.5	(3.0)	3	(9.0)	4.4
Diptera	2	(0.4)	0.5	(0.0)	2	(6.4)	2.3
Orthoptera	6	(1.1)	88.7	(1.2)	5	(16.1)	6.1
Blattaria	14	(2.5)	840.4	(11.2)	7	(22.6)	12.1
Hymenoptera Formicidae	4	(0.7)	2.5	(0.0)	3	(9.0)	3.2
Neuroptera	2	(0.4)	289.8	(3.8)	1	(3.2)	2.5
Isopoda	8	(1.4)	67.8	(0.9)	4	(13.0)	5.1
Pseudoscorpionida	1	(0.2)	0.6	(0.0)	1	(3.2)	1.1
Araneae	17	(3.0)	41.7	(0.5)	5	(16.1)	6.5
Ooteca	1	(0.2)	4.7	(0.1)	1	(3.2)	1.1
Pupe	7	(1.2)	495.7	(6.6)	4	(13.0)	6.9
Cocoon	1	(0.2)	7.1	(0.1)	1	(3.2)	1.1
Plant Material	3	(0.5)	10.4	(0.1)	3	(9.0)	3.2
Vertebrata	1	(0.2)	177.0	(2.3)	1	(3.2)	1.9
Unidentified arthropod remains	-	-	2850.1	(24.6)	-	-	-
Total	562	-	7519.0	-	-	-	-

ate prey that are relatively sedentary or that occur aggregated in the environment (Vitt, 1991; Zaluar & Rocha, 2000; Dias, 2002; Teixeira-Filho *et al.*, 2003). Larvae and termites were predominant in the diet. Termites were the most important prey in terms of number, contributing to 67.3% of the items consumed. Termites and larvae are frequent items in the diet of other Brazilian active foraging lizards (Magnusson *et al.*, 1985; Zaluar & Rocha, 2000; Teixeira-Filho *et al.*, 2003).

The lack of relationship between the number, length or volume of prey and morphological variables of *C. littoralis* may result from the predominance of termites in its diet. These prey are characterized by their small sizes and small size variation. A similar trend was found by Teixeira-Filho *et al.* (2003) for *C. littoralis* in the restinga de Maricá. The diet of *C. littoralis* in the restinga de Jurubatiba was similar to that usually found in other *Cnemidophorus* species in Brazil *(e.g*. Vitt, 1995; Teixeira-Filho *et al.*, 2003). Teiids, as actively foraging lizards, constantly tongue-flick while foraging to chemically detect and recognize prey before attacking (Cooper, 1990). This behaviour makes it easy to locate the prey with low mobility that is hidden inside the litter and under the surface of the ground.

We also found an intact and undigested hatchling of the crepuscular/nocturnal gekkonid lizard *Hemidactylus mabouia* in the stomach of an adult male of *C. littoralis*. In Brazil, other active foraging lizards species are known to prey on vertebrates (*Cnemidophorus lemniscatus* - Magnusson & Silva, 1993; *Kentropyx striatus* -Vitt & Carvalho, 1992; *Ameiva ameiva* Zaluar & Rocha, 2000). However, in the genus *Cnemidophorus* in Brazil, only *C. lemniscatus* was previously reported eating hatchlings of sympatric lizards (Magnusson & Silva, 1993). In restinga habitats, *H. mabouia* was previously found in the diet of the tropidurid lizard *Tropidurus torquatus* (Araújo, 1991) and of the colubrid snakes *Oxyrhopus guibei* (Colubridae) and *Thamnodynastes cf. strigilis* (Colubridae) (Vrcibradic & Rocha, 1998). This is the first record of *H. mabouia* in the diet of *Cnemidophorus littoralis* and shows that the gekkonid may be an occasional component of the *C. littoralis* diet. It also indicates this teiid lizard as a potential source of mortality of individuals of the sympatric *H. mabouia* in the restinga in Jurubatiba.

We conclude that *Cnemidophorus littoralis* in the restinga de Jurubatiba is an active foraging lizard and predominantly consumes larvae and termites and that small lizards may also be eaten.

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