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de Albuquerque, Nelson Rufino; da Silva Costa-Urquiza, Arianna; Pereira Soares, Michelly; Saucedo Alves, Ledilene; Santiago Urquiza, Marcus Vinícius

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Nelson Rufino de Albuquerque[1,2], Arianna da Silva Costa-Urquiza[1], Michelly Pereira Soares[1], Ledilene Saucedo Alves[1] & Marcus Vinícius Santiago Urquiza[1]

[1]Laboratório de Zoologia, Universidade Federal de Mato Grosso do Sul – UFMS, Campus do Pantanal, Av. Rio Branco, 1270, Universitário, CEP 79304-902, Corumbá, MS, Brazil
[2]Corresponding author: Nelson Rufino de Albuquerque: e-mail: nelson_rufino@hotmail.com

ALBUQUERQUE, N.R., COSTA-URQUIZA, A.S., SOARES, M.P., ALVES, L.S. & URQUIZA, M.V.S. **Diet of two sit-and-wait lizards, *Phyllopezus pollicaris* (Spix, 1825) (Phyllodactylidae) and *Hemidactylus mabouia* (Moreau de Jonnès, 1818) (Gekkonidae) in a perianthropic area of Mato Grosso do Sul, western Brazil**. Biota Neotrop. 13(4): http://www.biotaneotropica.org.br/v13n4/en/abstract?short-communication+bn01913042013

Abstract: The dietary compositions of two sit-and-wait lizard species, *Hemidactylus mabouia* and *Phyllopezus pollicaris*, which co-occur over rocky substrate and vertical rock walls in a perianthropic area of western Brazil, were described. Both species showed a generalist feeding pattern, feeding mainly on insects. The most frequent prey items in the diet of *P. pollicaris* were Coleoptera, Araneae and Homoptera whereas the most important were Coleoptera and Homoptera, respectively. For *H. mabouia* the most frequent prey items were Araneae followed by Coleopterae and Hemiptera, whereas the most important items were *H. mabouia* followed by Formicidae and Hemiptera. Our identification into broader prey-types categories (i.e., order or family-level) suggests that some degree of food resource partitioning may occur, possibly through the occupation of different temporal niches.
Keywords: *food habits, Reptilia, Squamata, Pantanal, Mato Grosso do Sul.*

ALBUQUERQUE, N.R., COSTA-URQUIZA, A.S., SOARES, M.P., ALVES, L.S. & URQUIZA, M.V.S. **Dieta de dois lagartos senta-e-espera, *Phyllopezus pollicaris* (Spix, 1825) (Phyllodactylidae) e *Hemidactylus mabouia* (Moreau de Jonnès, 1818) (Gekkonidae) em uma área periantrópica do Mato Grosso do Sul, no oeste do Brasil**. Biota Neotrop. 13(4): http://www.biotaneotropica.org.br/v13n4/pt/abstract?short-communication+bn01913042013

Resumo: A composição da dieta de duas espécies de lagartos senta-e-espera, *Hemidactylus mabouia* e *Phyllopezus pollicaris*, que coocorrem sobre substratos rochosos e paredões rochosos em uma área periantrópica no oeste do Brasil, foi descrita. Ambas as espécies demonstraram um padrão de alimentação generalista, alimentando-se principalmente de insetos. As presas mais frequentes na dieta de *P. pollicaris* foram Coleoptera, Araneae e Homoptera enquanto que os itens mais importantes foram Coleoptera e Homoptera, respectivamente. Para *H. mabouia* as presas mais frequentes foram Araneae seguido de Coleoptera e Hemiptera, enquanto que os itens mais importantes foram *H. mabouia* seguido de Formicidae e Hemiptera. Nossas identificações de presas em categorias mais amplas (i.e., nível de ordem ou família) sugerem que certo grau de partição de recursos alimentares pode ocorrer, possivelmente através da ocupação de nichos temporais diferentes.
Palavras-chave: *hábitos alimentares, Reptilia, Squamata, Pantanal, Mato Grosso do Sul.*

Introduction

The lack of information on the ecology of introduced species of reptiles and their interactions with native biota has been one of the limiting factors for understanding the impacts produced and the subsequent management of these species (Rocha & Anjos 2007, Vitt & Caldwell 2009). *Phyllopezus pollicaris* (Spix, 1825) and *Hemidactylus mabouia* (Moreau de Jonnès, 1818) are two species of nocturnal, sit-and-wait lizards, differentiated from each other mainly by the presence of infradigital lamellae single in the first species. While *P. pollicaris* is found in both open formations and forested areas from the northeastern to the southeastern region of Brazil and northern Argentina and southeastern Paraguay, *H. mabouia* is cosmopolitan in distribution, occurring in Africa, Madagascar, and Americas (Vanzolini et al. 1980, Butterfield et al. 1993, Avila-Pires 1995). In South America, *H. mabouia* is considered an invasive species that was originally introduced either carried by ships used to transport slaves in the 19th century (Goeldi 1902, Vanzolini 1968) or via "natural rafts" (i.e., logs or masses of floating vegetation) (Kluge 1969). Regardless of the cause of its introduction, the range of *H. mabouia* in the Americas is still expanding (e.g., Franz et al. 1993, Meshaka Junior et al. 1994, Flaschendrager 1999, Fuenmayor et al. 2005).

Despite the fact that both species are nocturnal and sympatrically distributed over most of their range, aspects of their natural history (e.g., diet) were never studied among syntopic populations of these species. Previous studies have suggested that these two species are basically arthropods consumers that feed mainly on Araneae, Blattodea, Diptera, insect larvae and Isopoda (e.g., Bonfiglio et al. 2006, Rocha & Anjos 2007, Recoder et al. 2012, Iturriaga & Marrero 2013). Herein, we examined and compared the dietary composition of two syntopic populations of *P. pollicaris* and *H. mabouia* from a perianthropic area in western Brazil. We also reviewed all available published literature on dietary composition of these species for comparison with our own data.

Material and Methods

This study was conducted in a perianthropic area located in the city of Corumbá, Mato Grosso do Sul, known as Porto Marina Limoeiro (18° 59' 54.4" S, 57° 37' 51.6" W; 124 m a.s.l.). This area corresponds to a harbor located at the right margin of the Paraguay River, dominated by rocky substrate and vertical rock walls (Figure 1). Specimens of *Hemidactylus mabouia* and *Phyllopezus pollicaris* were manually captured in October 2009 and April-June 2010, between 17:00 and 22:00 hours with the aid of flashlights and plastic bags. Subsequently, the lizards were euthanized with a lethal dose of anesthetic Thiopentax 1g, fixed in 10% formalin and preserved in 70% alcohol. Stomach contents were collected from adult specimens, and stored in alcohol for later analysis.

Figure 1. Ecological distribution of *Phyllopezus pollicaris* (PP) and *Hemidactylus mabouia* (HM) in Porto Marina Limoeiro, Corumbá. Oval circles show the syntopic distribution of species on rocky substrate and rock walls.

Most stomach contents were identified to order level. Ants (Hymenoptera) were identified to family level. The volume of intact prey items was estimated by measuring the length and width of prey items and using the following formula $V = (\pi.length.width^2)/6$ and Importance Value Index (IVI) using the formula IVI = N% + V%/2 (De-Carvalho et al. 2008), where N is the number and V the volume of prey consumed, in percentage. An overall index of dietary niche overlap between the two species was estimated to determine whether the populations of *P. pollicaris* and *H. mabouia* partitioned food resources. A food utilization matrix was constructed with columns as prey categories, and the number of prey items per stomach represented the individual entries of the matrix. From this matrix, pairwise estimates of niche overlap (O_{jl}) were obtained using the Pianka index (Pianka 1973) (Equation 1):

$$O_{jk} = \frac{\sum_{i=1}^{n} P_{ij} P_{ik}}{\sqrt{\sum_{i=1}^{n} P_{ij^2} \sum P_{ik^2}}}$$

where P*ij* and P*ik* are the frequencies of each prey type consumed by the *j* and *k* species, respectively. Values closer to 1.0 indicate a higher degree of resource overlap, whereas values closer to 0.0 indicate more differences in prey use. To determine whether measured overlap values differed from what would be expected based on a random sampling of the species data, we performed a randomization analysis through the EcoSim 7.0 software (Gotelli & Entsminger 2001). All values of the original matrix were randomized 10000 times, and the niche breadth was retained for each species. Activity times were collated as 17:00-18:00, 18:01-19:00, 19:01-20:00, 20:01-21:00 and 21:01-22:00 hours to verify the activity of 88 *H. mabouia* and 45 *P. pollicaris* (some specimens were not collected). Specimens and respective stomach contents are deposited in the Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul (ZUFMS) (Appendix).

Results and Discussion

We collected 28 individuals of *Phyllopezus pollicaris* (11 males and 17 females) and 36 individuals of *Hemidactylus mabouia* (13 males and 23 females). The number of prey items per stomach ranged between one and eight, with 47.6% containing only a single prey item. Prey remains were all unidentifiable or well-digested in seven stomachs of *P. pollicaris* and 12 stomachs of *H. mabouia*, leaving 45 for detailed analyses of diet. Some preys were so fragmented by digestion that we could not estimate their volume.

Both species are basically arthropod consumers. Numerically, Coleoptera (F = 29.03%), Araneae (F = 19.35%) and Homoptera (F = 16.13%) dominated the diet for *P. pollicaris*; the most important items was Coleoptera (IVI = 85.74) and Homoptera (IVI = 9.32). For *H. mabouia* the most common food items were Araneae (F = 20.51%) followed by Coleoptera (F = 17.95%) and Hemiptera (F = 12.82%), whereas the most important items were *H. mabouia* (IVI = 26.58), Formicidae (IVI = 19.73) and Hemiptera (IVI = 8.65). One male *H. mabouia* had one juvenile of *H. mabouia* in the stomach (Table 1). The trophic niche overlap between the species was high (O_{jk} = 0.90). Randomizations with all data did not find a significant difference between measured (observed) and simulated (expected) overlaps

Table 1. Diet of *Hemidactylus mabouia* and *Phyllopezus pollicaris* from Porto Marina Limoeiro, Corumbá, MS. Values are presented in terms of number of prey items (N), frequency of occurrence in the stomachs (F), and prey volume (V) in mm³. Numbers in parenthesis are percentages. Only intact prey items were used to calculate the volume.

Prey categories		*Hemidactylus mabouia* (n = 24)							*Phyllopezus pollicaris* (n = 21)						
		N	(%)	F	(%)	V (mm³)	V (%)	IVI	N	(%)	F	(%)	V (mm³)	V (%)	IVI
REPTILIA															
H. mabouia		1	2.04	1	2.56	494.71	51.12	26.58	-	-	-	-	-	-	-
ARACHNIDA															
Araneae		8	16.33	8	20.51	6.12	0.63	8.48	7	15.91	6	19.35	-	-	-
Pseudoscorpionida		1	2.04	1	2.56	1.99	0.21	1.13	-	-	-	-	-	-	-
DIPLOPODA		2	4.08	1	2.56	6.89	0.71	2.40	1	2.27	1	3.23	-	-	-
INSECTA															
Coleoptera		7	14.29	7	17.95	10.28	1.06	7.68	11	25.00	9	29.03	81.72	89.76	85.74
Hemiptera		5	10.20	5	12.82	68.70	7.10	8.65	1	2.27	1	3.23	-	-	-
Homoptera		5	10.20	3	7.69	51.62	5.33	7.77	7	15.91	5	16.13	9.32	10.24	9.78
Hymenoptera	Formicidae	8	16.33	4	10.26	223.80	23.13	19.73	10	22.73	2	6.45	-	-	-
	Other	5	10.20	3	7.69	58.22	6.02	8.11	3	6.82	3	9.68	-	-	-
Lepidoptera		2	4.08	2	5.13	-	-	-	2	4.55	2	6.45	-	-	-
Lepidoptera larvae		2	4.08	1	2.56	-	-	-	-	-	-	-	-	-	-
Orthoptera		2	4.08	2	5.13	45.36	4.69	4.39	2	4.55	2	6.45	-	-	-
UNIDENTIFIED EGGS		1	2.04	1	2.56	-	-	-	-	-	-	-	-	-	-
Total		49	100	39	100	967.69	100		44	100	37	100	91.04	100	

using diet proportion (P [observed < expected] = 1.00, and P [observed > = expected] = 1.00). Therefore, the observed mean (O_{jk} = 0.90; P > 0.0001) was greater than the expected mean value by chance.

Aside from these prey, some studies have found *H. mabouia* to consume a wide range of taxa including mollusks and gastropods (Rocha & Anjos 2007, see also Saenz 1996 who investigated the dietary habits of *H. turcicus* Linnaeus, 1758). We found that Pseudoscorpionida constituted a very small percentage (2.04%) of the total prey items consumed by *H. mabouia*. The study by Rocha & Anjos (2007) also reported Pseudoscorpionida and is the only previous study of *H. mabouia* diet to find pseudoscorpions. Cannibalism has been recorded in 18 species of lizards (Polis & Myers 1985), including in *H. mabouia* (Zamprogno & Teixeira 1998, Bonfiglio et al. 2006).

Anjos & Rocha (2008) presented a review of current knowledge of *H. mabouia*'s natural history and ecology. These authors noted differences in diet composition among populations living in natural environments and those that inhabit urban areas. Populations of *H. mabouia* in urban areas appear to feed mainly on winged species (see Bonfiglio et al. 2006), which tend to be attracted by artificial illumination.

Compared with other populations from Brazil, Coleoptera comprised substantial proportions by volume in diet of *P. pollicaris*. On the other hand, although ants are a typical component of geckos diet (e.g., Hibbitts et al. 2005, Carretero & Cascio 2010, Recoder et al. 2012, Iturriaga & Marrero 2013), including *P. pollicaris* (Dias & Lira-da-Silva 1998) we found that they represent only a small percentage of the total prey consumed by *P. pollicaris*. Table 2 presents a review of predation records of *P. pollicaris* and *H. mabouia* from the literature (including data from the present study). It shows that a total of 29 prey categories have been recorded in the diet of these lizards.

P. pollicaris and *H. mabouia* were observed on the rock walls as well as on the rocky substrate in syntopy but *P. pollicaris* was not present on the walls of house situated close to the rock walls (Figure 1). *H. mabouia* has been considered a perianthropic species in Brazil (Avila-Pires 1995, Feio & Caramaschi 2002), being most commonly associated with human habitations than *P. pollicaris*, which in turn seems to prefer rocky areas in natural habitats (Vanzolini 1978, Dixon & Soini 1986, but see also Vanzolini et al. 1980). According to Vanzolini (1978), *H. mabouia* can be found in environments very little disturbed, suggesting that it can colonize natural environments (Avila-Pires 1995). Vanzolini et al. (1980) stated that *P. pollicaris* is "well adapted to houses, inhabited or abandoned" (our translation). Thus, the syntopic distribution of *H. mabouia* and *P. pollicaris* was expected in natural environments.

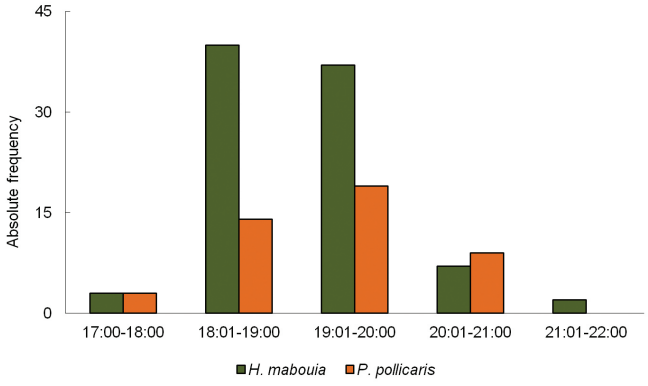

Figure 2. Records of *Hemidactylus mabouia* and *Phyllopezus pollicaris* from Porto Marina Limoeiro, Corumbá, MS between 17:00 and 22:00 hours. Values are presented in terms of class intervals.

There were differences in the activities of the species. The periods of peak activity were between 18:01-19:00 hours for *H. mabouia* (44.9% n = 40) and 19:01-20:00 hours for *P. pollicaris* (42.2% n = 19). It seems likely, therefore, that at night feeding activity decreases to *H. mabouia* and increases to *P. pollicaris* (Figure 2).

Composition of the diet of *H. mabouia* and *P. pollicaris* at the Porto Marina Limoeiro revealed prey types identified to the taxonomic level of order or family. Accordingly, it is possible that both species of lizards have fed on different species of insects belonging to the same

Table 2. Summary of studies of diet in *Phyllopezus pollicaris* and *Hemidactylis mabouia* including this study.

Prey categories		*H. mabouia*	*P. pollicaris*	Reference
REPTILIA				
H. mabouia		X	-	This study, Bonfiglio et al. (2006)
Lizard skin			X	Recoder et al. (2012)
Lizard eggs			X	Werneck et al. (2009)
Gecko skin		X		Iturriaga & Marrero (2013)
ARACHNIDA				
Acari		X		Bonfiglio et al. (2006)
Aranea		X	X	This study, Dias & Lira-da-Silva (1998), Bonfiglio et al. (2006), Rocha & Anjos (2007), Werneck et al. (2009), Recoder et al. (2012), Iturriaga & Marrero (2013)
Pseudoscorpionida		X	-	This study, Rocha & Anjos (2007),
Scorpionida			X	Recoder et al. (2012)
CRUSTACEA				
Amphipoda		X		Bonfiglio et al. (2006)
Isopoda		X		Bonfiglio et al. (2006), Rocha & Anjos (2007), Iturriaga & Marrero (2013)
GASTROPODA		X		Rocha & Anjos (2007)
CHILOPODA		X		Iturriaga & Marrero (2013)
DIPLOPODA		X	X	This study, Recoder et al. (2012)
INSECTA				
Apterygota			X	Recoder et al. (2012)
Blatoddea/Blattaria		X	X	Bonfiglio et al. (2006), Rocha & Anjos (2007), Werneck et al. (2009), Recoder et al. (2012), Iturriaga & Marrero (2013)
Coleoptera		X	X	This study, Rodrigues (1986), Dias & Lira-da-Silva (1998), Bonfiglio et al. (2006), Rocha & Anjos (2007), Werneck et al. (2009), Recoder et al. (2012)
Collembola		X		Bonfiglio et al. (2006), Rocha & Anjos (2007)
Dermaptera		X	X	Bonfiglio et al. (2006), Rocha & Anjos (2007)
Diptera		X		Bonfiglio et al. (2006), Rocha & Anjos (2007), Recoder et al. (2012), Iturriaga & Marrero (2013)
Hemiptera		X	X	This study, Bonfiglio et al. (2006), Rocha & Anjos (2007), Recoder et al. (2012)
Hymenoptera	Formicidae	X	X	This study, Rodrigues (1986), Dias & Lira-da-Silva (1998), Bonfiglio et al. (2006), Rocha & Anjos (2007), Werneck et al. (2009), Recoder et al. (2012)
	Other	X	X	This study, Dias & Lira-da-Silva (1998), Bonfiglio et al. (2006), Werneck et al. (2009), Iturriaga & Marrero (2013)
Insecta larvae		X	X	Rocha & Anjos (2007), Werneck et al. (2009)
Isoptera		X	X	Rodrigues (1986), Bonfiglio et al. (2006), Rocha & Anjos (2007), Recoder et al. (2012)
Lepidoptera		X	X	This study, Bonfiglio et al. (2006), Rocha & Anjos (2007), Iturriaga & Marrero (2013)
Lepidoptera larvae		X	X	This study, Bonfiglio et al. (2006), Recoder et al. (2012), Iturriaga & Marrero (2013)
Mantodea			X	Recoder et al. (2012)
Neuroptera		X		Bonfiglio et al. (2006), Rocha & Anjos (2007)
Orthoptera		X	X	This study, Rodrigues (1986), Dias & Lira-da-Silva (1998), Bonfiglio et al. (2006), Rocha & Anjos (2007), Werneck et al. (2009), Recoder et al. (2012), Iturriaga & Marrero (2013)
Psocoptera		X		Bonfiglio et al. (2006), Rocha & Anjos (2007), Iturriaga & Marrero (2013)

order. As noted by Luiselli (2006, 2008), identification of stomach contents into broader prey-type categories (e.g., order-level) may suggest an apparent partitioning of food resources by either lizards or snakes. Our identification into taxonomic categories suggests that some degree of trophic resource partitioning may occur at the order or family level though the results may also reflect a greater ease of capture of some prey types. The apparent evidence of resource portioning between the species studied may be due to the occupation of different temporal niches. However, the data are still insufficient to determine whether this occupation is seasonal.

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Appendix

Hemidactylus mabouia

Brazil, Mato Grosso do Sul, Corumbá, Porto Marina Limoeiro: ZUFMS-REP 1164, ZUFMS-REP 1165, ZUFMS-REP 1166, ZUFMS-REP 1167, ZUFMS-REP 1168 ZUFMS-REP 1169, ZUFMS-REP 1170, ZUFMS-REP 1141, ZUFMS-REP 1142, ZUFMS-REP 1143, ZUFMS-REP 1144, ZUFMS-REP 1145, ZUFMS-REP 1146, ZUFMS-REP 1147, ZUFMS-REP 1148, ZUFMS-REP 1149, ZUFMS-REP 1150, ZUFMS-REP 1151, ZUFMS-REP 1152, ZUFMS-REP 1153, ZUFMS-REP 1154, ZUFMS-REP 1155, ZUFMS-REP 1156, ZUFMS-REP 1157, ZUFMS-REP 1158, ZUFMS-REP 1159, ZUFMS-REP 1160, ZUFMS-REP 2196, ZUFMS-REP 2197, ZUFMS-REP 2198, ZUFMS-REP 2200, ZUFMS-REP 2201, ZUFMS-REP 2202, ZUFMS-REP 2203, ZUFMS-REP 2204, ZUFMS-REP 2206.

Phyllopezus pollicaris

Brazil, Mato Grosso do Sul, Corumbá, Porto Marina Limoeiro: ZUFMS-REP 1174, ZUFMS-REP 1175, ZUFMS-REP 1176, ZUFMS-REP 1178, ZUFMS-REP 1179, ZUFMS-REP 1180, ZUFMS-REP 1181, ZUFMS-REP 1182, ZUFMS-REP 1183, ZUFMS-REP 1185, ZUFMS-REP 1186, ZUFMS-REP 1187, ZUFMS-REP 1188, ZUFMS-REP 1189, ZUFMS-REP 1190, ZUFMS-REP 1191, ZUFMS-REP 1192, ZUFMS-REP 1193, ZUFMS-REP 1194, ZUFMS-REP 1195, ZUFMS-REP 1196, ZUFMS-REP 1197, ZUFMS-REP 1198, ZUFMS-REP 1199, ZUFMS-REP 1200, ZUFMS-REP 2192, ZUFMS-REP 2194, ZUFMS-REP 2195.