NORTH-WESTERN JOURNAL OF ZOOLOGY 12 (1): 159-165 ©NwjZ, Oradea, Romania, 2016
Article No.: e151512 *http://biozoojournals.ro/nwjz/index.html*

Diet of *Dendropsophus branneri* (Cochran, 1948) (Anura: Hylidae) from a cocoa plantation in southern Bahia, Brazil

Indira Maria CASTRO[1], Raoni REBOUÇAS[1,2] and Mirco SOLÉ[1,3,*]

1. Programa de Pós-Graduação em Zoologia, Universidade Estadual de Santa Cruz, Rodovia Jorge Amado, Km. 16, Salobrinho, CEP: 45662-900 Ilhéus, Bahia, Brazil.
2. Programa de Pós-Graduação em Ciências Biológicas (Biologia Animal), Universidade Federal do Espirito Santo, Av. Fernando Ferrari, 514, Prédio Bárbara Weinberg, 29075-910 Vitória, Espirito Santo, Brazil.
3. Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz, Rodovia Jorge Amado, km. 16, Salobrinho, CEP: 45662-900 Ilhéus, Bahia, Brasil.
*Corresponding author, M. Solé, E-mail: msole@uesc.br

Received: 11. June 2015 / Accepted: 18. September 2015 / Available online: 30. May 2016 / Printed: June 2016

Abstract. In this study we analyze the diet of a population of *Dendropsophus branneri* from a cocoa plantation in southern Bahia, Brazil. Frogs were captured monthly from August 2010 to July 2011. Stomach contents were retrieved through stomach-flushing and later identified to order level. Our results show that *D. branneri* feeds mainly on arthropds, such as Diptera, larval Lepidoptera and Araneae. Based on the identified food items and the low number of prey per stomach we conclude that the studied population of *D. branneri* uses a "sit and wait" strategy. We further conclude that stomach flushing can be successfully applied to frogs from a size of 14.4mm.

Key words: trophic resources, stomach flushing, feeding habits, Hylidae, cabruca, Atlantic Rainforest.

Introduction

The Brazilian Atlantic Forest is a recognized biodiversity hotspot (Myers et al. 2000). Within this hotspot several amphibian "hotpoints" have been identified, such as the region of Santa Tereza in the State of Espirito Santo (Rödder et al. 2007) and recently the Serra Bonita Mountain in Southern Bahia (Dias et al. 2014). While most parts of the Atlantic Forest have suffered rapid reductions in their extension due to logging and transformation into pasture lands, southern Bahia still maintains some of the largest rainforest remnants in the northern part of this endangered forest, some of them representing the richest areas in tree diversity on the planet (Martini et al. 2007). Carnaval et al. (2009) identified three pleistocenic refuges in the Atlantic Forest of which the one in Bahia is by far the largest and the one with the largest genetic diversity.

Cocoa cultivation on a large scale was established in the southern Bahia region during the mid-nineteenth century. In the traditional planting system called "cabruca" the cocoa trees are set out in the shadow of thinned-out native forests or introduced trees such as Jackfruit tree (*Artocarpus heterophyllus*), Yellow mombin (*Spondias mombin*) and Mountain Immortelle (*Erythrina poeppigiana*) (Sambuichi et al. 2003). This system extends over an area larger than 70% of the remnants of the Atlantic Forest of southern Bahia (Araújo et al. 1998). Despite providing low-quality habitat for ferns, these "cabrucas" represent intermediate quality for birds and high quality for many species of bats, lizards and frogs (Faria et al. 2007).

While a large number of studies on bioacoustics (Forlani et al. 2013, Juncá et al. 2012, Mendes et al. 2013), taxonomy (Pimenta et al. 2007) and the description of new species (Caramaschi et al. 2013, Lourenço-de-Moraes et al. 2012, Napoli et al. 2011, Recorder et al. 2010) from southern Bahia have been published recently, only a few studies deal with the trophic interactions of amphibians and their environments (Rebouças et al. 2013, Solé et al. 2009).

Dendropsophus branneri (Cochran, 1948) is one of the smallest hylids from Brazil and can be found from the State of Maranhão southwards to the state of Rio de Janeiro (Baracho et al. 2014). As it shows a prolonged breeding season this, tree frog can easily be found in large numbers in temporary and permanent ponds.

The only available data on diet of *Dendropsophus* cf. *branneri* is from 28 individuals collected at a temporary pond in a semi-deciduous rainforest in Pernambuco State (Santos et al. 2004). Despite this, nothing is known about the diet of this small frog and its position in the trophic web of the Atlantic Rainforest biome. Thus we want to describe the diet of *D. branneri* and correlate morphometric aspects of frogs with the ingested prey volume as well as assess the trophic niche amplitude of the species.

Material and methods

We studied a population of *Dendropsophus branneri* (Fig. 1) at a temporary pond inside a 5 ha large "cabruca" on the Campus of the Universidade Estadual de Santa Cruz (14° 47'45'' S and 39° 10'20'' W), Ilhéus, Bahia, Brazil (Fig. 2). With annual average temperatures ranging between 22 °C and 25 °C and rainfall of 1.299 mm per year, this region shows a typical tropical hot and humid climate without a well-defined dry season (Sambuichi et al., 2003).

Frogs were captured manually from 18:00 to 20:00 during 27 nights in the months of August 2010 and July 2011 at their reproductive site. After capturing they were transferred to the nearby laboratory of "Vertebrate Zoology" at the Universidade Estadual de Santa Cruz, located about 300 m from the pond, where they were weighted with a digital electronic scale with an accuracy of 0.1 g and had their snout-vent length (SVL) measured with a digital caliper with an accuracy of 0.1 mm. After that, a stomach flushing procedure was performed on the frogs, following the methodology described in Solé et al. (2005). After the procedure the frogs were released at the pond where they were originally captured. Between sampling nights a minimum interval of three days without collecting frogs was established in order to allow frogs to feed normally. The retrieved stomach contents were stored in microcentrifuge tubes containing 70% ethanol and analyzed with the use of a stereo microscope. Invertebrates were identified to order level following Triplehorn and Johnson (2011), except for Hymenoptera, that were categorized as "ants" or "no ants".

The length and width of well preserved food items were measured using a digital caliper with a precision of 0.1 mm in order to calculate the approximate volume. We measured highly chitinized body parts of partially digested invertebrates as elytra in beetles or prosoma in spiders and applied the regression formulas proposed by Hirai and Matsui (2001) to estimate the original length of prey. Later the estimated original volume (V) was calculated using the formula for ellipsoid bodies (Dunhan 1983): $V=4\pi/3 \cdot L/2 \cdot (W/2)^2$, where V = volume, L = length and W = width of prey.

The index of relative importance (IRI) was calculated to reduce bias in the description of diet as suggested by Pinkas et al. (1971): $IRI_t = (PO_t) \cdot (PI_t + PV_t)$, where PO_t is the percentage of occurrence (100x the number of stomachs containing t item/total number of stomachs), PI_t represents the percentage of individuals (100x the total number of individuals of t in all stomachs/total number of individuals of all taxa in all stomachs), and PV_t is the volumetric percentage (100x the total volume of individuals of t present in all stomachs/total volume of all taxa in all stomachs).

We used a Pearson correlation test ($p < 0.05$) to analyze the correlation between body mass, SVL and mouth width with volume of ingested preys. Niche breadth was calculated using the index proposed by Levins (1968): $B_A = (1/\sum p_j^2) -1/ n_j - 1$, where *BA* = Levins' index, with an interval of 0 to 1; *pj* = proportion of individuals found using the resource *j*, n_j = number of individuals using the resource *j*. All analyzes were performed with R 3.01 software (R Core Team 2015).

Figure 1 Male *D. branneri* calling in a "cabruca", Ilhéus, Bahia, Brazil.

Figure 2 Pond located in a "cabruca" of the Campus of Universidade Estadual de Santa Cruz, Ilhéus, Bahia, Brazil, where frogs were sampled.

Results

Out of 170 individuals that were submitted to the flushing procedure 100 revealed stomach contents. The average length of the studied frogs measured was 18.3 mm (SD = 1.6, min = 14.4mm, max = 23.6mm). Mouth width was on average 5.86 mm (SD = 0.58, min = 4.6mm, max = 7.7mm) and mean body mass was 0.448 g (SD = 0.19, min = 0.228g, max = 2.028g).

The items with the highest relative frequencies of occurrence in stomachs were Diptera (F% = 14.96), followed by Araneae (F% = 11.02) and larval Lepidoptera (F% = 11.02). The items that made up for the largest volumes were larval Lepidoptera (V = 228.68 mm^3, V% = 53.89), Araneae (V = 100.65 mm^3, V% = 23.72) and Diptera (V = 69.21

Table 1 Prey consumed by *D. branneri* (N=170) in a "cabruca" area in southern Bahia Brazil (*N* = number of items from all stomachs; *N%* = percentage of each item from all stomachs; *F* = number of stomachs from which each item was retrieved; *F%* = percentage of occurrence of each item from all stomachs; *V* = total volume of item from all stomachs; *V%* = volumetric percentage per item; *IRI* = Index of Relative Importance).

Prey category	*N*	*N%*	*F*	*F%*	*V*	*V%*	*IRI*
Arachnida							
Acari	4	2.78	2	1.57	0.01	0	0.01
Araneae	17	11.81	14	11.02	100.65	23.72	153.84
Insecta							
Blattaria	2	1.39	2	1.57	12.46	2.94	5.12
Diptera	27	18.75	19	14.96	69.21	16.31	296.81
Hemiptera	9	6.25	8	6.3	9.44	2.22	41.59
Hymenoptera (Formicidae)	7	4.84	7	5.51	0.51	0.12	26.91
Hymenoptera (non Formicidae)	4	2.78	3	2.36	2.07	0.49	7.05
Lepidoptera	1	0.69	1	0.79	0.26	0.06	0.61
Lepidoptera (larvae)	16	11.11	14	11.02	228.68	53.89	176.34
Orthoptera	3	2.08	3	2.36	1.35	0.32	5.24
Not identified animal content	26	18.06	26	20.47	--	--	--
Not identified plant content	17	11.81	17	13.39	--	--	--
Skin	11	7.64	11	8.66	--	--	--
Total	144	100	127	100	424.36	100	713.52

mm³, V% = 16.31).

The Index of Relative Importance (IRI) revealed that the most important diet elements were Diptera (IRI = 296.81), Lepidoptera (IRI = 176.34), Araneae (IRI = 153.8) and Hemiptera (IRI = 41.59) (Table 1).

We did not find a significant positive correlation between frog body mass and ingested volume (t = 0.8333, p = 0.2042) (Fig. 3) nor between SVL and ingested volume (t = 0.508, p = 0.3068) (Fig. 4) or between mouth width and volume of the largest ingested prey per frog (t = 0.7971, p = 0.2145) (Fig. 5). We calculated a niche breadth (B_A) for *D. branneri* of 0.491 and an average of 1.5 items per stomach.

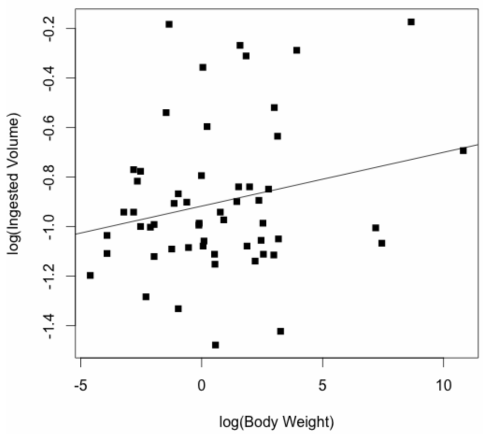

Figure 3 Relation between frog body mass and ingested prey volume per individual (R^2 = 0.034).

Discussion

On one hand most research on amphibians undertaken in Brazil deals with taxonomical issues, but studies on behavioral ecology such as assessment of trophic niches used by frogs also comprise a large part of the scientific efforts performed in this country (Campos et al. 2014). On the other hand there is a short-come of approaches focusing on habitat use, dispersal ability and home range of frogs. This applies especially to hylid frogs, of which a large majority are seldom encountered by researchers outside their breeding territories. We know virtually nothing about what these frogs do when they are not calling and reproducing at ponds or rivulets. They may be feeding high up in the trees or hiding in swamps or may even use the marginal vegetation of their breeding ponds as feeding grounds. But approaches in this direction require individual marking of frogs which are time expensive and involve costly material as elastomer tags (Molina-Zuluaga et al. 2014), radio-transmitter (Pizzato et al. 2014) or methodologies that despite having been successfully employed during decades are now regarded as controversial, such as toe clipping (Guimarães et al. 2014). This lack of life history data trammels studies that aim to find the position tree frogs occupy in tropical

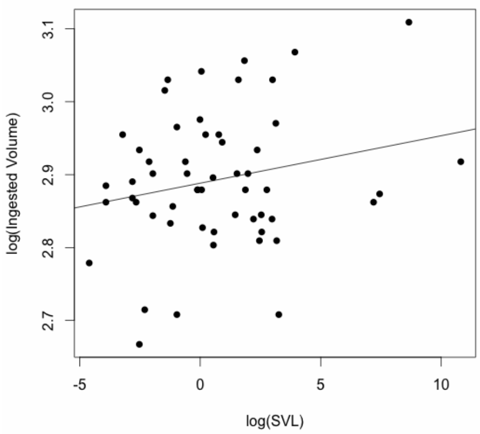

Figure 4 Relation between snout-vent length (SVL) and ingested prey volume per individual (R^2 = 0.108).

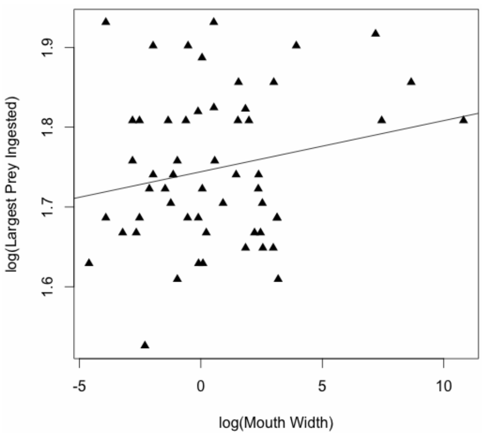

Figure 5 Relation between mouth length of *D. branneri* and volume of the largest retrieved prey item (R^2 = 0.126).

environments, as no accurate assessment of available potential prey is possible. This is the main reason why most diet studies on tree frogs do not provide an assessment of available prey (Solé & Pelz 2007). This tendency is not restricted to Brazil, it applies also to diet studies on tree frogs performed all over the world (Kovács et al. 2007; Mahan & Jhonson 2007; Luría-Manzano & Gutiérrez-Mayen 2014). The few studies that provide such kinds of data mostly sample the environment that surrounds the breeding localities (Lopez et al. 2009), but they can't guarantee that frogs were actually feeding at these places before they were captured for diet analysis. Most studies that include an assessment of potential prey availability are performed with species that inhabit leaf litter or are fossorial as most leptodactylids, bufonids and eleutherodactylids that can be easily found actively feeding on the ground (Heise-Pavlov & Longway 2011), but exceptions exist (Maneyro & Rosa 2004).

Foraging habits in amphibians are influenced by several factors as prey availability and competition (Duellman & Trueb 1986; Sucea et al. 2014; Pop et al. 2015). Adult anurans generally prey on arthropods and their feeding behaviors are mostly described as a "sit and wait" or an "active foraging" strategy (Ovaska 1991). The strategy of most species may lie somewhere in-between the continuum between these two strategies (Caldart et al. 2012). Toft (1980, 1981) distinguishes two patterns in the diet of amphibians: Those that feed on arthropods with strongly chitinized bodies and slow movements as ants, termites and mites called "ant specialists" and those that ingest a varied spectrum of less chitinized arthropods such as spiders and grasshoppers called "non-ant specialists".

We found Diptera, larval Lepidoptera and Araneae to be the prey categories with the highest relative frequency and the largest IRI in the diet of *Dendropsophus branneri*. Our results are very similar to those, registered by Santos et al. (2004), for 28 individuals of *D.* cf. *branneri* from a semideciduous forest in the state of Pernambuco, which revealed Diptera and larval Lepidoptera as the most frequent prey in the stomachs. Dipterans were also the most consumed prey by other two very small hylid frogs, *Dendropsophus nanus* and *D. sanborni* from three ponds in São Paulo State (Menin et al. 2005) and a lake in Corrientes, Argentina (Macale et al. 2008).

Araneae were the most frequent prey in 15 stomachs of *D. minutus* sampled by (Van Sluys & Rocha 1998) in Serra Norte, Carajás, while Araneae and larval Diptera showed the largest IRI in a study performed by Randall and Bolaños (2012) in La Selva, Costa Rica with stomach contents of 135 *D. phlebodes*. In this same study, 60 stomachs of *D. ebraccatus* were also examined revealing Lepidoptera, larval Diptera and Araneae as principal prey.

Lima et al. (2010) conducted a study at the same pond as our study, on the diet of two species of *Phyllomedusa*: *P. rohdei* and *P. burmeisteri*. For the 60 analyzed stomachs of *P. rohdei* they found larval Lepidoptera, Orthoptera and Araneae to hold the largest IRI values, while the 77 *P. burmeisteri* that revealed stomach contents had fed on larval Lepidoptera, Araneae and Coleoptera. These two hylid species are much larger than *D. branneri* and consequently also have larger mouths. The importance of Orthoptera and Coleoptera for their diets may be related to the generally larger size of the representatives of these arthropod orders, thus representing prey too large for the small *D. branneri* mouth. Other studies (Labanick 1976; Lopez et al. 2009; Moreno-Barbosa & Hoyos-Hoyos 2014; Solé & Pelz 2007; Vaz-Silva et al. 2005) also revealed Diptera, Lepidoptera and Araneae as frequent items in the diet of hylid frogs, but we can not affirm that they showed a preference for these items because available prey in the environment was not assessed.

Diet of adult frogs is usually composed of arthropods, but plant parts are also frequently retrieved from stomachs (Solé & Rödder 2009). We retrieved vegetable parts from 13.39% of the flushed stomachs. In most cases this vegetable part of diet is interpreted as accidentally ingested by the frog while capturing arthropod prey, but due to the absence of ethological studies covering the whole food ingestion process we can not rule out that frogs may ingest leaves or fruits on purpose, as already suggested for other species (Das 1996; Silva & Britto-Pereira 2006).

Based on the identified food items and the low number of prey per stomach we conclude that the studied population of *D. branneri* uses a "sit-and-wait" strategy. Although eating ants, they do not represent a high IRI value, suggesting that they are "non ant specialists" (Toft 1980), ingesting few items per time unit and a larger variety of soft-chitinized prey as Diptera, Araneae and larval Lepidoptera.

Our study showed once again that stomach-flushing is an efficient method to study the diet of amphibians, as showed by Zheng-Ju et al. (2007). So far, this approach has never been applied in studies targeting frogs with a SVL under 19 mm. The smallest species studied by Solé et al. (2005) were *Dendropsophus minutus* (SVL 21-28 mm) and *Physalaemus lisei* (SVL 21-33 mm). Dietl et al. (2009) applied the method to individuals of the species *Ischnocnema henselii* with a SVL of 20-35 mm), while Caldart et al. (2012) studied the diet of juveniles of the species *Crossodactylus schmidti* with SVL ranging from 19.04 to 23.91 mm. In our study we could show that stomach flushing can be successfully applied to frogs with a SVL of 14.4 mm.

Acknowledgements. We thank Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) for issuing the permanent research license n° 13708-1, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for funding during fieldwork, Ivelin Mollov, Aníbal Ramadan, Rodolfo Mariano, Leonny Santos and Greicilane Bonfim for comments on the manuscript and help during invertebrate identification.

References

Araújo, M., Alger, K., Rocha, R., Mesquita, C.A.B. (1998): A Mata Atlântica do sul da Bahia: situação atual, ações e perspectivas. Reserva da Biosfera da Mata Atlântica – MAB – UNESCO 8: 1-36.

Baracho, E.B.O., Silva, J.S., Nascimento, B.H.M., Fonseca, E.M.F., Magalhães, F.M. (2014): *Dendropsophus branneri* (Cochran, 1948) (Anura: Hylidae) as prey to invertebrates in northeastern Brazil. Herpetology Notes 7: 17-19.

Caldart, V.M., Iop, S., Bertaso, T.R.N., Cechin, S.Z. (2012): Feeding Ecology of *Crossodactylus schmidti* (Anura: Hylodidae) in Southern Brazil. Zoological Studies 51(4): 484-493.

Campos, F.S., Brito, D., Solé, M. (2014): Diversity patterns, research trends and mismatches of the investigative efforts to amphibian conservation in Brazil. Anais da Academia Brasileira de Ciências 86: 1873-1886.

Caramaschi, U., Orrico, V.G.D., Faivovich, J., Dias, I.R., Solé, M. (2013): A New Species of *Allophryne* (Anura: Allophrynidae) from the Atlantic Rain Forest Biome of Eastern Brazil. Herpetologica 69: 480-491.

Carnaval, A.C., Hickerson, M.J., Haddad, C.F.B., Rodrigues, M.T., Moritz, C. (2009): Stability predicts genetic diversity in the Brazilian Atlantic forest hotspot. Science 323: 785-789.

Das, I. (1996): Folivory and seasonal changes in diet in *Rana hexadactyla* (Anura, Ranidae). Journal of Zoology 238: 785-794.

Dias, I.R., Medeiros, T.T., Nova, M.V., Solé, M. (2014): Amphibians of Serra Bonita, southern Bahia: a new hotpoint within Brazil's Atlantic Forest hotspot. Zookeys 449: 105-130.

Dietl, J., Engels, W., Solé, M. (2009): Diet and feeding behaviour of the leaf-litter frog *Ischnocnema henselii* (Anura: Brachycephalidae) in *Araucaria* rain forests on the Serra Geral of Rio Grande do Sul, Brazil. Journal of Natural History 43(23-24): 1473-1483.

Duellman, W.E., Trueb, L. (1986): Biology of Amphibians: Mcgraw-Hill, New York.

Dunhan, A.E. (1983): Realized niche overlap, resource abundance and intensity of interspecific competition. pp. 261-280. In: Huey, R.B., Pianka, E.R, Schoener, T.W. (eds.), Lizard Ecology: Studies of a Model Organism. Harvard University Press.

Faria, D., Paciencia, M.L.B., Dixo, M., Laps, R.R., Baumgarten, J. (2007): Ferns, frogs, lizards, birds and bats in forest fragments and shade cacao plantations in two contrasting landscapes in the Atlantic forest, Brazil. Biodiversity Conservation 16(8): 2335-2357.

Forlani, M.C., Mendes, C.V.d.M., Dias, I.R., Tonini, J.F.R., Sá, R.O.d. (2013): The Advertisement Calls and Distribution of Two Sympatric Species of *Chiasmocleis* (Méhely 1904) (Anura, Microhylidae, Gastrophryninae) from the Atlantic Forest. South American Journal of Herpetology 8(1): 46-51.

Guimarães, M., Corrêa, D.T., Filho, S.S., Oliveira, T.A., Doherty, P.F., Sawaya, R. J. (2014): One step forward: contrasting the effects of toe clipping and PIT tagging on frog survival and recapture probability. Ecology and Evolution 4(8): 1480-1490.

Heise-Pavlov, S.R., Longway, L.J. (2011): Diet and dietary selectivity of Cane Toads (*Rhinella marina*) in restoration sites: a case study in Far North Queensland, Australia. Ecological Management and Restoration 12: 230-233.

Hirai, T., Matsui, M. (2001): Attempts to estimate the original size of partly digested prey recovered from stomachs of Japanese anurans. Herpetological Journal 32(1): 14-16.

Juncá, F.A., Rohr, L.D., Lourenço-de-Morais, R., Santos, F.J.M., Potazio, A.S., Merces, E.A., Solé, M. (2012): Advertisement call of species of the genus *Frostius* Cannatella 1986 (Anura: Bufonidae). Acta Herpetologica 7: 189-201.

Kovács, É-H., Sas, I., Covaciu-Marcov, S-D., Hartel, T., Cupsa, D., Groza, M. (2007): Seasonal variation in the diet of a population of *Hyla arborea* from Romania. Amphibia-Reptilia 28: 485-491.

Labanick, G.M. (1976): Prey Availability, Consumption and selection in the Cricket Frog, *Acris crepitans* (Amphibia, Anura, Hylidae). Journal of Herpetology 10(4): 293-298.

Levins, R. (1968): Evolution in Changing Environments: Some Theoretical Explorations. Princeton, New Jersey: Princeton University Press.

Lima, J.E.P., Rödder, D., Solé, M. (2010): Diet of two sympatric *Phyllomedusa* (Anura: Hylidae) species from a cacao plantation in southern Bahia, Brazil. North-Western Journal of Zoology 6(1): 13-24.

Lopez, J.A., Scarabotti, P.A., Medrano, M.C., Ghirardi, R. (2009): Is the red-spotted green frog *Hypsiboas punctatus* (Anura: Hylidae) selecting its preys? The importance of prey availability. Revista de Biología Tropical 57(3): 847-857.

Lourenço-de-Moraes, R., Solé, M., Toledo, L.F. (2012): A new species of *Adelophryne* Hoogmoed and Lescure 1984 (Amphibia: Anura: Eleutherodactylidae) from the Atlantic forest of southern Bahia, Brazil. Zootaxa 3441: 59-68.

Luría-Manzano, R., Gutiérrez-Mayen, G. (2014): Reproduction and diet of *Hyla euphorbiacea* (Anura: Hylidae) on a pine-oak forest of southeastern Puebla, Mexico. Vertebrate Zoology 64(2): 207-213.

Macale, D., Vignoli, L., Carpaneto, G.M. (2008): Food selection strategy during the reproductive period in three syntopic hylid species from a subtropical wetland of north-east Argentina. Herpetological Journal 18: 49-58.

Mahan, R.D., Jhonson, J.R. (2007): Diet of the Gray Treefrog (*Hyla versicolor*) in relation to foraging site location. Journal of Herpetology 41(1): 16-23.

Maneyro, R., Da Rosa, I. (2004): temporal and spatial changes in the diet of *Hyla pulchella* Duméril and Bibron, 1841 (Anura: Hylidae) in Southern Uruguay. Phyllomedusa 3(2): 101-114.

Martini, A.M.Z., Fiaschi, P., Amorim, A.M., Paixão, J.L.d. (2007): A hot-point within a hot-spot: a high diversity site in Brazil's Atlantic Forest. Biodiversity Conservation 16: 3111-3128.

Mendes, C.V.d.M., Marciano-Jr, E., Ruas, D.S., Oliveira, R.M., Solé, M. (2013): Advertisement call of *Scinax strigilatus* (Spix, 1824) (Anura: Hylidae) from southern Bahia, Brazil. Zootaxa 3647: 499-500.

Menin, M., Rossa-Feres, D.C., Giaretta, A.A. (2005): Resource use and coexistence of two syntopic hylid frogs (Anura, Hylidae). Revista Brasileira De Zoologia 22(1): 61-72.

Molina-Zuluaga, C., Restrepo, A., Flechas, S.V., Daza, J.M. (2014): Short-term population dynamics of three frog species in the Northern Andes, Colombia. South American Journal of Herpetology 9(3): 200-206.

Moreno-Barbosa, S.E., Hoyos-Hoyos, J. M. (2014): Ontogeny of the diet in Anurans (Amphibia) collected at La Vieja River Basin in the Departamento of Quindio (Colombia). Caldasia 36(2): 365-372.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A.B., Kent, J. (2000): Biodiversity hotspots for conservation priorities. Nature 403: 853-858.

Napoli, M.F., Caramaschi, U., Cruz, C.A.G.d., Dias, I.R. (2011): A new species of flea-toad, genus *Brachycephalus* Fitzinger (Amphibia: Anura: Brachycephalidae), from the Atlantic Rainforest of southern Bahia, Brazi. Zootaxa 2739: 33-40.

Ovaska, K. (1991): Diet of the Frog *Eleutherodactylus johnstonei* (Leptodactylidae) in Barbados, West Indies. Journal of Herpetology 25(4): 486-488.

Pimenta, B.V.S., Faivovich, J., Pombal Jr, J.P. (2007): On the identity of *Hyla strigilata* Spix, 1824 (Anura: Hylidae): redescription and holotype designation for a 'ghost' taxon. Zootaxa 1441: 35-49.

Pinkas, E.R., Oliphant, M.S., Iverson, Z.L. (1971): Food habits of albacore bluefin, tuna and bonito in Califorina waters. California Department of Fish and Game Bulletin 152: 1-350.

Pizzato, L., Both, C., Shine, R. (2014): Quantifying Anuran Microhabitat Use to Infer the Potential for Parasite Transmission between Invasive Cane Toads and Two Species of Australian Native Frogs. Plos One 9(9): 1-11.

Pop, A.N., Sas-Kovács, I., Boariu, E., Covaciu-Marcov, S.D. (2015): Species or environment? Who has more influence on the feeding of two syntopic newt species (Amphibia) from Carpathian Mountains in unusual conditions? Biharean Biologist 9(1): 72-75.

Randall, J., Bolaños, F. (2012): Use of food and spatial resources by two frogs of the genus *Dendropsophus* (Anura: Hylidae) from La Selva, Cosa Rica. Phyllomedusa 11(1): 51-62.

R Core Team. (2015): R: A language and environment for statistical computing. Vienna, Austria. Retrieved from http://www.R-project.org/.

Rebouças, R., Castro, I.M., Solé, M. (2013): Diet of *Haddadus binotatus* (Spix, 1824) (Anura: Craugastoridae) in Brazilian Atlantic Rainforest, Bahia state. North-Western Journal of Zoology 9(2): 293-299.

Recorder, R.S., Teixeira Jr, M., Cassimiro, J., Camacho, A., Rodrigues, M.T. (2010): A new species of *Dendrophryniscus* (Amphibia, Anura, Bufonidae) from the Atlantic Rainforest of southern Bahia, Brazil. Zootaxa 2642: 36-44.

Rödder, D., Teixeira, R.L., Dantas, R.B., Pertel, W., Guarneire, G.J. (2007): Anuran hotspots: the municipality of Santa Teresa, Espírito Santo, southeastern Brazil. Salamandra 43(2): 91-110.

Sambuichi, R.H.R., Vidal, D.B., Piasenti, F.B., Jardim, J.G., Viana, T.G., Menezes, A.A., Baligar, V.C. (2003): Cabruca agroforests in southern Bahia, Brazil: tree component, management practices and tree species conservation. Biodiversity and Conservation 21: 1055-1077.

Santos, E.M., Almeida, A.V., & Vasconcelos, S.D. (2004): Feeding habits of six anuran (Amphibia: Anura) species in a rainforest fragment in Northeastern Brazil. Iheringia (Série Zoologia) 94(4): 433-438.

Silva, H.R.d., Britto-Pereira, M.C. (2006): How much fruit do fruit-eating frogs eat? An investigation on the diet of *Xenohyla truncata* (Lissamphibia: Anura: Hylidae). Journal of Zoology 270: 692-698.

Solé, M., Beckmann, O., Pelz, B., Kwet, A., Engels, W. (2005): Stomach-flushing for diet analysis in anurans: an improved protocol evaluated in a case study in *Araucaria* forests, southern Brazil. Studies on Neotropical Fauna and Environment 40(1): 23-28.

Solé, M., Dias, I.R., Marciano-Jr, E.A.S., Branco, S.M.J., Cavalcante, K.P., Rödder, D. (2009): Diet of *Leptodactylus ocellatus* (Anura: Leptodactylidae) from a cacao plantation in southern Bahia, Brazil. Herpetology Notes 2: 9-15.

Solé, M., Pelz, B. (2007): Do male tree frogs feed during the breeding season? Stomach flushing of five syntopic hylid species in Rio Grande do Sul, Brazil. Journal of Natural History 41(41-44): 2757-2763.

Solé, M., Rödder, D. (2009): Dietary Assessments of adult amphibians. In C. Kenneth Dodd Jr (Ed.), Amphibian Ecology and Conservation. Oxford: Oxford University Press.

Sucea, F., Cicort-Lucaciu, A.S., Covaci, R.F., Dimancea, N. (2014): Note on the diet of two newt species in Jiului Gorge National Park, Romania. Herpetologica Romanica 8: 11-27.

Toft, C.A. (1980): Feeding Ecology of Thirteen Syntopic Species of Anurans in a Seasonal Tropical Environment. Oecologia 45(1): 131-141.

Toft, C.A. (1981): Feeding Ecology of Panamanian litter anurans: Patterns in diet and foraging mode. Journal of Herpetology 15: 139-144.

Triplehorn, C.A., Johnson, N.F. (2011): Borror an DeLong's introduction to the study of insects. Cengage Learning, Boston.

Van Sluys, M., Rocha, C.F.D.d. (1998): Feeding habits and microhabitat utilization by two syntopic Brazilian Amazonian frogs (*Hyla minuta* and *Pseudopaludicola* sp. (gr. *falcipes*). Revista Brasileira de Biologia 58(4): 559-562.

Vaz-Silva, W., Frota, J.G., Prates-Júnior, P.H., & Silva, J.S.B. (2005): Dieta de *Lysapsus laevis* Parker, 1935 (Anura: Hylidae) do médio Rio Tapajós, Pará, Brasil. Comunicação do Museu de Ciência e Tecnologia da PUCRS 18(1): 3-12.

Zheng-Ju, W., Yi-Ming, Li., Yang-Ping, W. (2007): A comparison of stomach flush and stomach dissection in diet analysis of four frog species. Acta Zoologica Sinica 53(2): 364-372.