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Diet of *Aplastodiscus perviridis* Lutz 1950 (Anura, Hylidae) in subtemperate forests of southern Brazil

Dieta de *Aplastodiscus perviridis* Lutz 1950 (Anura, Hylidae) em florestas subtemperadas do sul do Brasil

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Abstract

Diet studies allow us to understand important questions about a species behavior in relation to resource use. *Aplastodiscus perviridis* Lutz 1950 is an arboreal anuran that occurs in southern and southeastern Brazil and western Argentina. In this study, we described and analyzed the diet composition of a population of *A. perviridis* in southern Brazil. We evaluated the diet by examining the gastrointestinal contents of 42 specimens, 12% of which had no gastrointestinal content, while 12 prey categories were registered. Acarina, Araneae, Coleoptera-adults and Lepidoptera-larvae were the prey categories with the largest relative importance values. The trophic niche breadth was lower than those recorded for other hylids, suggesting a more specialized character.

Keywords: prey, niche, behavior, Araucaria forest, predation.

Resumo

Estudos de dieta permitem compreender questões importantes sobre o comportamento de uma espécie em relação ao uso de recursos. *Aplastodiscus perviridis* Lutz 1950 é um anuro arbóreo que ocorre no sul e sudeste do Brasil e no oeste da Argentina. Neste estudo, descrevemos e analisamos a composição da dieta de uma população de *A. perviridis* no sul do Brasil. Avaliamos a dieta por meio de análise do conteúdo gastrointestinal de 42 espécimes, 12% dos quais estavam sem conteúdo gastrointestinal, enquanto, nos demais, foram registradas 12 categorias de presas. Acarina, Araneae, Coleoptera (adultos) e Lepidoptera (larvas) foram as categorias de presas com os maiores valores de importância relativa. A amplitude do nicho trófico foi menor que a registrada para outros hilídeos, sugerindo um caráter mais especializado.

Palavras-chave: presa, nicho, comportamento, floresta de Araucária, predação.

Introduction

Studies on feeding ecology provide basic information about the biology of a species, as well as its position in the food web (Begon *et al*., 2006). Despite a recent significant increase in studies on amphibian ecology in the Neotropics (Ximenez and Tozetti, 2015), the number of such studies is relatively low regarding the family Hylidae when considering the high diversity of the group.

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Diet composition of hylids range from generalist (Van Sluys and Rocha, 1998; Barbosa *et al*., 2014) to specialist trends (Parmelee, 1999). It may also vary according to morphological features (Toft, 1981), such as individual relative size and the size of prey that can be ingested (Muñoz-Guerrero *et al*., 2007). The species behaviour itself can also influence the diet, such as changes in prey consumption during the breeding season (Solé and Pelz, 2007). This may be related to either the duration of the reproductive period or the different distances to be traveled to the reproductive site (Duellman and Trueb, 1994; Solé and Pelz, 2007; Barbosa *et al*., 2014). Species with short breeding season, for example, tend to decrease prey consumption in the reproductive period (Solé and Pelz, 2007).

The arboreal anuran *Aplastodiscus perviridis* Lutz 1950 (Hylidae) occurs in southern and southeastern Brazil and far west of Argentina. It lives in transition areas between forests and open areas (edge) and has a short breeding season going from November to February (Kwet *et al*., 2010). This species has a specific reproductive behaviour, in which males display arrangement moves and calls to attract the female to an underground burrow constructed by the male itself (Haddad *et al*., 2005). In Rio Grande do Sul, this species occurs on the edge of native grassland areas with Araucaria Forest (with the presence of *Araucaria angustifolia*), using wetlands for breeding (Kwet *et al*., 2010). These grassland and forested areas, which are important for animal diversity in general, are under threat by human farming activities that convert natural areas into crops and apply agrochemicals (Bond-Buckup and Dreier, 2008).

Except for reproduction studies (Haddad and Prado, 2005; Haddad *et al*., 2005; Zina *et al*., 2007), distribution notes (Both *et al*., 2006), taxonomy (Garcia *et al*., 2001) and cell biology (Carvalho *et al*., 2009), studies on the genus *Aplastodiscus* are scarce, and there are no records on feeding behavior. Considering the importance of natural history studies and the limited available knowledge about this genus, the aim of this study was to contribute to filling these gaps, describing and analysing the diet composition of *A. perviridis* during the breeding season in areas associated to Araucaria moist forests in Rio Grande do Sul, Brazil.

Material and Methods

Study Site

We conducted the study in wet areas with shrubby vegetation associated with Araucaria moist forests in the municipalities of Garibaldi (29°16’28.8”S and 51°31’40.5”W), Farroupilha (29°12’48.2”S and 51°17’46.4”W) and São Francisco de Paula (29°25’29.6”S and 50°23’20.1”W) in southern Brazil. The climate is of the mesothermal type, humid subtemperate (cfb in Köppen classification), with annual rainfall of 1,412 mm and average annual temperature of 15.2° C, having mild summers and cold winters, with frequent frost formation (Maluf, 2000).

Data Collection

We collected the samples in February, September and November 2015, using the nocturnal visual search method (Crump and Scott Jr., 1994). We kept the captured animals in identified plastic bags and maintained them in a refrigerated container to reduce the physiological activities that accelerate digestion. We collected the samples under the collecting permit from the Federal Authority, SISBIO (permit # - 45861-1). After identification, we euthanized the specimens with topical anesthetic (lidocaine), fixed them in 10% formalin and preserved them in 70% ethanol. Afterwards, we dissected the animals to remove the gastrointestinal tract (stomach and intestine), which we maintained in 70% ethanol and screened by use of a stereomicroscope. We considered stomach and intestine contents as a single sample. We identified the extracted items (prey) mostly to the taxonomic level of order, except for hymenopterans, in which we differentiated Formicidae from non-Formicidae. When we found unidentifiable prey fragments, we grouped these under “other items”, of which we quantified only volume. For each identified item (prey category), wherever possible, we calculated the number, volume and frequency of occurrence in absolute and percentage values. We calculated volume by using the area (mm²) occupied by each item with graph paper support fixed to the bottom of the Petri dish, where we evenly spread each item, maintaining a regular height of 1 mm (Hellawell and Abel, 1971). To calculate the volume (V), we multiplied the value of the area occupied by each item by its height (1 mm) (Barbosa *et al*., 2014).

Data Analysis

We assessed the importance of each prey in the species’ diet using the Index of Relative Importance (IRI): IRI = (%N +%P) %FO, where %N is the relative abundance of each prey in the diet; %P is the mass percentage of each prey in the diet; and %FO is the relative frequency of occurrence of prey (Pinkas *et al*., 1971; Krebs, 1999). The higher the value of IRI, the greater is the importance of each prey in the diet.

We calculated the amplitude of trophic niche through Levins’ Trophic Niche Amplitude Index (B) (Krebs, 1999), defined by: $B = 1 / \Sigma p_i^2$, in which p is the proportion of individuals of a given resource i (taxon) found in the diet. To facilitate comparisons among species, we calculated the standardized Levins’ index (Bsta), which limits the index on a scale from 0 to 1 according to the following equation: Bsta = (B-1) / (n-1), where n is the number of resources (prey categories) recorded. Values near zero are assigned to specialized diet, while those closer to 1, to a generalist diet.

Results

We captured 42 males of *Aplastodiscus perviridis*, in Garibaldi, Farroupilha and São Francisco de Paula (five without gastrointestinal content, representing 12% of the total sample). Altogether, we found 98 food items classified into 12 categories (Table 1). According to IRI, the most important category in the diet was Acarina, followed by Araneae, Coleoptera-adults, Lepidoptera-larvae, Orthoptera, Hemiptera and Coleoptera-larvae (Table 1). Other groups, such as Lepidoptera-adult, non Formicidae, Formicidae, Pseudoscorpionida and Dermaptera, had little relevance in the diet of *A. perviridis*, presenting a value of IRI < 30.

The trophic niche breadth (Bsta) was 0.27. Plant material content had high frequency in the stomach/intestines of frogs (Table 1). However, we could not identify a relatively large proportion of items due to their high level of fragmentation (“other items”).

Discussion

Some items consumed by *Aplastodiscus perviridis* were also recorded in the diet of other frog species of the Hylidae family. Coleoptera-adult prey also showed high importance to *Boana leptolineata* (BRAUN AND BRAUN, 1977) in a habitat that is similar to that of this study (Barbosa *et al*., 2014). A high consumption of Araneae was also recorded for *Boana pulchella* (DUMÉRIL AND BIBRON, 1841) in coastal areas of Rio Grande do Sul and Uruguay (Da Rosa *et al*., 2011; Oliveira, 2014). Moreover, the presence of Acarina was also identified in the diet of *Boana raniceps* (COPE, 1862) in Pantanal (Sabagh *et al*., 2010) and of *B. pulchella* in Uruguay (Da Rosa *et al*., 2011). It is worth reminding that, in terms of biomass, it is believed that this prey category may not be of much importance, as mentioned in other studies on Neotropical hylids (Muñoz-Guerrero *et al*., 2007; Antoniazzi *et al*., 2013).

Table 1. Prey categories consumed by *Aplastodiscus perviridis* in Araucaria Forest in Rio Grande do Sul, southern Brazil. FO = frequency of occurrence of each prey category; IRI = Index of relative importance; N = number of individuals; V = total volume of prey (mm^3); (%) = percentage related to total.

Prey categories	N	N%	V	V%	FO	FO%	IRI
Acarina	44	44.9	4.9	0.05	11	29.7	1336.5
Aranae	16	16.3	627.2	7	10	27	630.2
Coleoptera-adults	9	9.2	1045	11.6	7	18.9	394.1
Lepidoptera-larvae	5	5.1	1520.2	16.9	5	13.5	297.9
Orthoptera	4	4.1	739	8.2	4	10.8	133.2
Hemiptera	4	4.1	608	6.8	4	10.8	117.4
Coleoptera-larvae	5	5.1	300	3.3	4	10.8	91.3
Lepidoptera-adults	3	3.1	48	0.5	3	8.1	29.2
Hymenoptera							
Non Formicidae	2	2	109	1.2	2	5.4	17.6
Formicidae	4	4.1	31	0.3	2	5.4	23.9
Pseudoscorpionida	1	1	30	0.3	1	2.7	3.7
Dermaptera	1	1	14	0.2	1	2.7	3.2
Plant Material	--	--	824	9.2	23	62.2	--
Other items	--	--	3073	34.2	28	75.7	--

The presence of larvae in the diet (Lepidoptera and Coleoptera-larvae), which are not very movable prey, suggests that *A. perviridis* individuals make an active search for them. In addition, when not vocalizing, *A. perviridis* probably uses the same shelter as the Coleoptera-larvae (*e.g.* fallen trunks, decomposing material) (Haddad and Prado, 2005; Haddad *et al*., 2005), which would increase the probability of encountering this prey. The number of prey that could not be identified due the advanced digestion degree (Other items) does not compromise the conclusions of this work, since this category is distributed in many of the individuals, besides being common in diet works (Siqueira *et al*., 2006), mainly in intestinal contents (Santana and Juncá, 2007; Moser *et al*., 2017).

There is a tendency in hylids with short reproductive period to reduce the ingestion of prey, prioritizing reproduction over foraging (Duellman and Trueb, 1994; Solé and Pelz, 2007). However, even *A. perviridis* having a short reproductive period, it does not seem to reduce foraging during reproduction, because the average amount of prey in the gastrointestinal tract was similar to that observed in another hylids with long-reproductive period, such as *B. pulchella* (Oliveira, 2014).

The trophic niche breadth of the studied populations of *A. perviridis* was smaller than that of *B. leptolineata*, Bsta = 0.51 (Barbosa *et al*., 2014) and *B. raniceps,* Bsta = 0.64 (Sabagh *et al*., 2010) and similar to that of *B. pulchella*, Bsta = 0.31 (Oliveira, 2014) from Brazil. This suggests that *A. perviridis* was more specialized in the use of food resources during the study period.

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