

Ecological aspects of *Scinax argyreornatus* (Anura, Hylidae) from a cacao plantation in Espírito Santo state, southeastern Brazil

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ABSTRACT: We examined the gonads and stomach contents of 110 specimens of the hylid frog *Scinax argyreornatus* (snout-vent length range: 14.4-23.0 mm) from a cacao plantation in the municipality of Linhares, Espírito Santo state, southeastern Brazil. Females were significantly larger than males. The number of mature oocytes found in females varied from 94 to 197 (N = 15), and was positively related to female size. Isopods were the dominant prey in the diet of *S. argyreornatus*, which is somewhat unexpected considering this frog's scansorial habits and the fact that isopods are not usual items in the diets of most anurans.

RESUMO: Aspectos ecológicos de *Scinax argyreornatus* (Anura, Hylidae) em uma plantação de cacau no estado do Espírito Santo, sudeste do Brasil - Nós examinamos as gônadas e os conteúdos estomacais de 110 espécimes do anuro hílideo *Scinax argyreornatus* (amplitude de comprimento rostro-cloacal: 14,4-23,0 mm) em uma plantação de cacau no município de Linhares, estado do Espírito Santo, sudeste do Brasil. As fêmeas foram significativamente maiores do que os machos. O número de ovócitos maduros encontrados nas fêmeas variou de 94 a 197 (N = 15), e foi positivamente relacionado com o tamanho das fêmeas. Isópodos foram as presas dominantes na dieta de *S. argyreornatus*, o que é algo inesperado, considerando-se o hábito escansorial desta espécie e o fato de isópodos serem itens pouco comuns na dieta da maioria dos anuros.

Introduction

The small hylid frog *Scinax argyreornatus* (Miranda-Ribeiro, 1926) is endemic to the Brazilian Atlantic rainforest biome, occurring from the states of

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Bahia to São Paulo (Frost, 1985; Silvano & Pimenta, 2001). This species reproduces in temporary or semi-permanent pools on the floor of lowland forests, with calling activity extending from September through March (Carvalho-e-Silva & Carvalho-e-Silva, 1998). Current available information on the ecology and biology of *S. argyreornatus* consists of a few observations on its breeding behavior (Carvalho-e-Silva & Carvalho-e-Silva, 1998) and data on its advertisement call (Pombal *et al.*, 1995).

In the present study, we assess the clutch size and diet of *S. argyreornatus* collected in a cacao plantation within an Atlantic rainforest area of south-eastern Brazil.

Methods

Study area

The study site is located within a cacao plantation in the district of Povoação (19°25'20"S, 39°57'80"W), municipality of Linhares, state of Espírito Santo, southeastern Brazil. Annual temperatures in the Linhares region average 23.6° C and total annual rainfall averages about 1200 mm, with mean monthly totals ranging from 35 mm (in June) to 190 mm (in December) (World Meteorological Organization, 1996). During the rainy period (which usually extends from October to March, varying from year to year), temporary ponds form on the ground within the cacao plantation, allowing numerous anurans of several different species to reproduce.

Collecting methods and analyses

Fieldwork was carried out during three consecutive nights in October 2000, during the rainy season. Frogs were collected by hand between 20:00 and 22:00 h. Specimens were later killed in 10% alcohol, and transferred to 10% formalin. After a week, they were washed and preserved in 70% alcohol.

In the laboratory, we measured the snout-vent length (SVL) of the frogs with a caliper (0.1 mm precision), and weighed them in an electronic balance (0.1 g precision). After these procedures, frogs were dissected for verification of sex, examination of gonads and excision of stomachs. All stomachs were opened, and their contents were spread on a Petri dish for identification under a stereomicroscope. Prey items found were identified to Order, counted,

measured with a caliper (to the nearest 0.1 mm), and weighed in an electronic balance (precision of 0.1 mg). Frequency of occurrence (i.e. the number of stomachs containing a given prey type), percentage of the total number of prey, and percentage of the total prey mass were calculated for each prey category, in order to quantify its importance in the diet of *S. argyreornatus*. The effect of frog size on prey size was assessed by relating the length of the largest prey item found in each stomach to frog SVL, using simple regression analysis. We also counted the number of mature oocytes or eggs (when present) for each reproductive female, to estimate clutch size for *S. argyreornatus*. The relationship between number of mature oocytes and female SVL was tested using simple regression analysis.

Basic statistics shown throughout the text refer always to arithmetic mean plus one standard deviation.

Results

We collected a total of 110 specimens of *Scinax argyreornatus*, of which 94 were males and 16 were females. Males ranged in SVL from 14.4-20.8 mm (mean = 16.2 ± 1.0 mm) and in mass from 0.4-1.0g (mean = 0.5 ± 0.1 g). Females ranged in SVL from 18.1-23.0 mm (mean = 20.7 ± 1.0 mm), and in mass from 0.5-1.2g (mean = 1.0 ± 0.2 g). Females were significantly larger than males (ANOVA on SVL; $F_{1,108} = 264.2$, $p < 0.01$). Individuals were found mainly perched on herbaceous vegetation some 20-30 cm above ground, close to temporary ponds.

Fifteen females had the ovaries totally developed, with mature oocytes. The smallest female containing mature oocytes measured 18.9 mm in SVL. The number of mature oocytes per female varied from 94 to 197 (mean = 130.1 ± 30.1), and was significantly related to frog SVL ($R^2 = 0.73$; $N = 15$; $p < 0.01$) (Fig. 1).

Of the 110 stomachs examined, 88 (80.0%) contained prey. Terrestrial isopods were the predominant food items in the diet of *S. argyreornatus*, followed by beetle larvae (Table 1). Orthopterans were important items in terms of relative mass, but not in frequency of occurrence or in numerical percentage (Table 1).

Individual prey items found in *S. argyreornatus* stomachs varied in length from 2.1 to 21.9 mm (mean = 4.8 ± 2.9 mm). There was a positive and significant relationship between prey size and frog SVL ($R^2 = 0.51$; $N = 70$; $p < 0.01$) (Fig. 2).

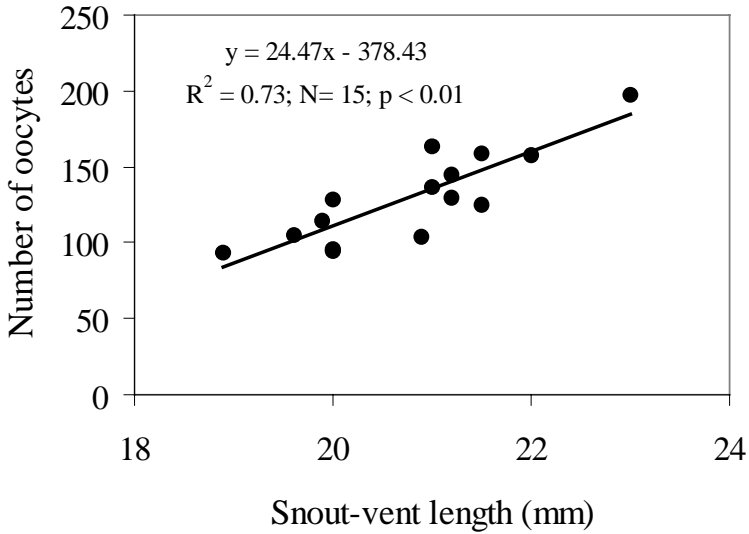


Fig. 1- Relationship between the number of oocytes and the snout-vent length of female *Scinax argyreornatus* from a cacao plantation in Linhares, southeastern Brazil.

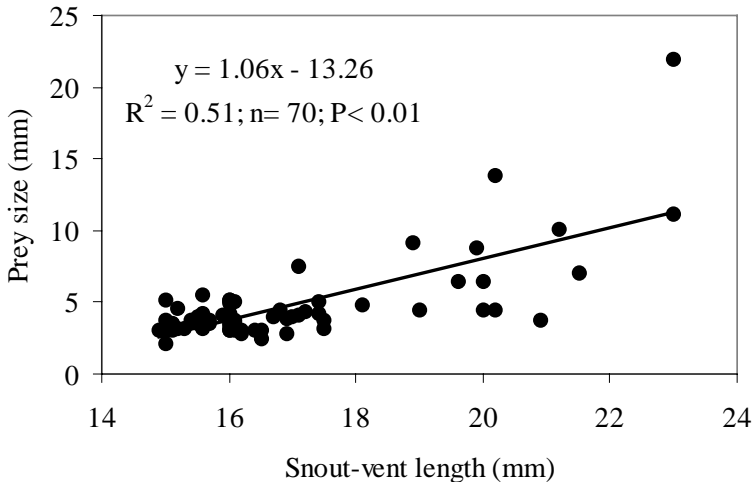


Fig. 2- Relationship between the length of the largest prey item ingested and the snout-vent length of *Scinax argyreornatus* from a cacao plantation in Linhares, southeastern Brazil.

Table 1- Representativeness (in absolute values and percentages) of each type of prey found in the stomachs of *Scinax argyreornatus* from a cacao plantation in south-eastern Brazil (number of stomachs with prey = 88). S = number of stomachs containing that prey type (frequency of occurrence); N = number of prey items found; M = mass of prey (mg).

PREY	S	%S	N	%N	M	%M
INSECTA						
Blattodea	2	2.3	2	1.7	14.4	2.4
Coleoptera (adult)	2	2.3	2	1.7	35.2	6.0
Coleoptera (larvae)	22	25.0	22	18.6	56.1	9.5
Diptera	1	1.1	1	0.8	0.6	0.1
Hemiptera	1	1.1	1	0.8	2.1	0.4
Homoptera	1	1.1	1	0.8	1.2	0.2
Hymenoptera (ants)	4	4.5	6	5.1	18.9	3.2
Isoptera	1	1.1	1	0.8	0.9	0.2
Orthoptera	4	4.5	4	3.4	74.5	12.6
MYRIAPODA						
Chilopoda	1	1.1	1	0.8	13.9	2.4
ARACHNIDA						
Araneae	9	10.2	9	7.6	31.9	5.4
CRUSTACEA						
Isopoda	46	52.3	68	57.6	341.2	57.7
TOTAL	-	-	118	100.0	590.9	100.0

Discussion

Judging by our data, the clutch size of *S. argyreornatus* is equal to or smaller than those of other neotropical hylids (including congeners) of about the same size (e.g., Duellmann, 1978; Bastos & Haddad, 1996). Nevertheless, it was the most abundant anuran species observed during our study (pers. obs.). Although our data are from a single month, observations by one of us (R. L. Teixeira, unpubl. data) at another Atlantic rainforest area in Espírito Santo state suggest it is abundant there throughout the year. Thus, this frog's low fecundity does not prevent it from maintaining a dense population at our study area.

Scinax argyreornatus fed predominantly on terrestrial isopods, which is an unexpected finding, since isopods are typically found on the leaf litter and *S. argyreornatus* is scansorial, like most hylids. It should be noted, however, that the present study has been carried out during the breeding season of *S. argyreornatus*, which may explain the predominance of these terrestrial arthropods in its diet. Hirai & Matsui (2000, 2002) found that the semiarbooreal Japanese hylid *Hyla japonica*, which normally forages in trees or vegetation, takes prey on the ground during its breeding season. Thus, having to descend to ground level to breed on water bodies may affect the diet composition of semiarbooreal frogs (except for those whose reproductive strategy does not require them to leave the trees) during the reproductive period. Collections carried out outside the breeding season of *S. argyreornatus* would be useful to verify whether the diet of this species does vary seasonally or is actually based on isopods throughout the year.

Even assuming that the consumption of large quantities of isopods by *S. argyreornatus* may be a seasonal phenomenon, feeding heavily on those crustaceans is considered unusual among anurans (Van Sluys *et al.*, 2001). Indeed, no isopods were found in the stomachs of three sympatric small hylids (12 *Hyla bipunctata*, 11 *H. decipiens* and one *Scinax alter*; R. L. Teixeira, unpubl. data) collected with *S. argyreornatus* during the present study, and several other similar-sized neotropical hylids (including other species of *Scinax*) whose diets have been studied do not seem to prey on isopods to any significant degree, if at all (e.g. Duellmann, 1978; Van Sluys & Rocha, 1998). Isopods are generally unimportant items even in the diets of small terrestrial amphibians, including leaf-litter dwellers, in the neotropics (e. g., Toft, 1980, 1981; Vitt & Caldwell, 1994; Caldwell, 1996; Howard *et al.*, 1997; Caldwell & Vitt, 1999), with few exceptions such as the leptodactylid *Zachaenus parvulus* (Van Sluys *et al.*, 2001). Also, surveys of leaf-litter arthropod faunas of cacao plantations in Trinidad (Strickland, 1945, 1947) and of other Atlantic rainforest (*sensu stricto*) areas in southeastern Brazil (Lacerda *et al.*, 1998; Santos *et al.*, 1998) showed that isopods are never among the most abundant arthropods in those communities. Thus, it is possible that *S. argyreornatus* may be feeding selectively on isopods. It is also possible that isopods are abundant in that particular locality and may simply not be favored as food by other sympatric hylids. In any case, the high proportion (80%) of individuals with prey in their stomachs suggest that the studied population of *S. argyreornatus* may be in positive energy balance (see Huey *et al.*, 2001), which means that its feeding strategy may be efficient.

Although isopods were consumed by frogs of all sizes, there was a tendency

for larger frogs to consume larger prey, indicating some trophic ontogeny in prey size. Being gape-limited predators that swallow prey whole, frogs will tend to feed on prey as large as they can swallow, whenever they have the chance (Toft, 1985). Thus, a tendency of prey size to increase with frog size may be evident even in frog species for which the size difference between adults and juveniles is relatively slight, as is the case of *S. argyreornatus* and other small species studied elsewhere (Lima & Moreira, 1993).

Our study thus indicates that *S. argyreornatus* is a locally abundant frog species at Povoação, has a relatively small brood size, and feeds on a variety of arthropods but predominantly on isopods. However, more studies carried out outside that species' breeding season are needed to assess whether its high abundance and unusual feeding habits at the study area are dependent or not of the time of the year.

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