Use of food resources and electivities in diet of an anuran assemblage from the quaternary sand dunes of the São Francisco River, Bahia.

Roberta P. Damasceno[1,2] (rpdama@ufba.br) & Pedro L. B da Rocha[1,2]
[1]Universidade de São Paulo, [2]Universidade Federal da Bahia.

Introduction

Investigations about resource use are a starting point to the assessment of factors that organize biological communities (Toft 1985; Underwood 1997). Suitable descriptions of patterns of resource use must incorporate data of resource availability (Lawlor 1980) and, in particular for ectoterms, such descriptions must explore ontogenetic variations in resource use (Lima e Magnusson 1998). Historical constraints must be assessed as a factor that governs resource use patterns, as well as ecological interactions (Losos 1996). The peculiar fauna of squamates from the dunes of the middle São Francisco River (Bahia, Brazil) is the object of a series of ecological and evolutionary studies and the discovery of an anuran terrestrial assemblage that is syntopic to and more abundant than the squamate fauna, already studied (Rocha e Rodrigues, submitted), in a locality of the dunes motivated the present study.

Objectives

This paper intends to: (1) describe food use and electivities in diet of the terrestrial anurans of the dunes of Ibiraba; (2) test premises about the quality of the estimates of food use and food availability used here; (3) assess ontogenetic variations in the diet of anurans; (4) assess evidence of adaptation in anurans' diet to the challenges of a semi-arid environment of the dunes and (5) discuss the impact that anurans can cause on the Squamata syntopic assemblage already studied.

Material e Methods

Anurans were collected with pitfall trap grids (Heyer *et al.* 1994) during five field campaigns. All anurans were sexed and snout-vent length (SVL) was measured. Diet analyses were made with data of stomach contents and percent mass contribution (from now on, "% mass") was used to index diet. Estimates of diet and food availability were made with individuals collected on the same days (20 sampled days) in different traps: three individuals of each species per day to estimate species diet and total diet (Winemiller e Pianka 1990) to estimate food availability (nine individuals per day, three individuals per species). Estimates of diet and availability were calculated as de average of % mass of each food category in the diet of the individuals. Food categories that showed % mass equal to or higher than 20 were considered important in diet. Electivities were calculated as the difference between diet % mass and available % mass for each food category: differences bigger than or equal to 20 were considered positive electivities and less than or equal to -20, negative electivities. This procedure was made in order to avoid spurious results of high positive electivities for rare food categories or food categories consumed in high quantities by few animals. The comparison of diet of anurans caught with pitfall traps and that of actively collected animals, on the same days, assessed the quality of the estimate of diet used here. Two estimates of food availability, one based on total diet (described above) and other based on arthropods collected with pitfall traps were compared and their differences and biases were discussed. The widest linear dimension of all prey items was measured. Ontogenetic variation was investigated by regressing: (1) food electivities by SVL, to assess variation in electivities for types of food during anuran growth; (2) the biggest linear dimension of the biggest prey item consumed by SVL, to investigate ontogenetic changes in the sizes of prey eaten and, when variation in type and size was detected, (3) partials of food electivities and SVL (removed the effect of prey sizes), to elucidate if variation in food types is an epiphenomenon of changes in food size. As diet is a multidimensional variable and events of prey items consume are not independent (Manly et al. 1993, Lima et al. 1997), food electivities were reduced in one dimension by non-metric multidimensional scaling (NMDS) with Manhattan distance and random starting configurations (statistical package - Ginkgo 1.4.1, VegAna). The lines (objects) of the NMDS matrix were the individuals, the columns (variables) were food categories, and cells contained electivity values. Evidences of adaptation in diet were assessed by comparing the diet of anuran populations from the dunes and that of allopatric populations or of phylogenetically related species. The assessment of the impact caused by anurans on the syntopic squamates was made comparing their habits.

Results

The three most abundant anuran species at the dunes of Ibiraba are *Pleurodema diplolistris*, *Bufo granulosus*, and *Physalaemus albifrons* and they comprise approximately 97% of all anurans collected at Ibiraba. Other

species were not included in the analyses. Estimates of food use and availability used here were considered suitable. There was no difference between the % mass of food categories in the diets of *Pleurodema diplolistris* collected with pitfall traps and with transect active sampling. As expected, availability of millipedes (arthropods with toxins) was underestimated by total diet, and ants were underestimated by pitfall captures. Ants and bugs were the important food categories in the diet of all three species. *Bufo granulosus* showed positive electivity for ants and this is a very recurrent pattern in the diet of the Genus. *Physalaemus albifrons* had positive electivity for beetles and negative electivity for ants, a very distinct pattern if compared to the diet of many species of this Genus. *Pleurodema diplolistris* showed no food electivities. The NMDS-ordination of food electivities showed high values of stress for the Leptodactylidae, but Mantel tests revealed that the configurations in one dimension represented a great part of original distances between objects, for all three species. The ordination also revealed a negative linear relationship between the electivities of ants and bugs for all species, but no species changed the types of prey it consumed during ontogeny and this was not a spurious result of a narrow range of anurans' size analyzed. *B. granulosus* and *P. diplolistris* ate bigger preys as they grew. Neither sex, nor days of capture seems to explain the inverse linear relationship between ants and bugs electivities in diet of all species. There was no evidence of adaptation in *B. granulosus* diet and insufficient data precluded this analysis with *P. diplolistris*' diet. Apomorphies registered in *P. albifrons*' diet does not seem to be explained by ecological contemporary interactions with local herpetofauna components. Anurans do not seem to cause a big impact on Squamata syntopic species, because, in general, anurans and squamates show divergent food electivities and/or activity times. Moreover, most of this divergent pattern has probably evolved before the establishment of the current assemblage. Coincident positive electivities for ants of *B. granulosus* and the tropidurid *Tropidurus psammonastes* can be an indicative of contemporary competitive interactions between them, principally because they are very abundant at the dunes. But evidence of limiting resources is necessary to raise this hypothesis because divergent activity times preclude interference competition, although ants are very abundant at the dunes.

Conclusions

I. Ants and beetles are the most important food in diet of the three species of anurans;

II. *Bufo granulosus* showed positive electivity for ants; *Physalaemus albifrons* had positive electivity for beetles and negative electivity for ants; *Pleurodema diplolistris* showed no food electivities;

III. Estimates of food use and availability that were used here were considered suitable;

IV. The NMDS-ordination of food electivities showed a gradient of inverse variation between electivities for ants and beetles for all species;

V. No species changed the types of prey it consumed during ontogeny and this was not a spurious result of a narrow range of anurans size analyzed;

VI. *B. granulosus* and *P. diplolistris* ate bigger preys as they grew;

VII. There was no evidence of adaptation in *B. granulosus*' diet and insufficient available data precluded this analysis with *P. diplolistris*' diet;

VIII. Apomorphies registered in *P. albifrons*' diet does not seem to be explained by ecological contemporary interactions with local herpetofauna components;

IX. Anurans do not seem to cause a big impact on Squamata syntopic species;

X. The positive electivity for ants of *B. granulosus* and the syntopic tropidurid *Tropidurus psammonastes* can indicate contemporary competitive interactions between them, although this hypothesis seems unlikely.

References

HEYER, W.R. *et al.* (Eds.) **Measuring and monitoring biological diversity** Standard methods for amphibians. Washington: Smithsonian Institution Press, 1994. 364 p.

LAWLOR, L.R. Overlap, similarity, and competition coefficients. *Ecology*, v.61, n.2, p.245-251, 1980.

LIMA, A.C. *et al*. Diet of the turtle *Phrynops rufipes* in Central Amazônia. *Copeia*, n.1, p.216-219, 1997.

LIMA, A.P.; MAGNUSSON, W.E. Partitioning seasonal time: interactions among size, foraging activity and diet in leaf-litter frogs. *Oecologia*, v.116, p.259-266, 1998.

LOSOS, J.B. Phylogenetic perspectives on community ecology. *Ecology*, v.77, n.5, p.1344-1354, 1996.

MANLY, B.F. *et al*. **Resource selection by animals** Statistical design and analysis for field studies. Londres: Chapman & Hall, 1993. 177 p.

ROCHA, P.L.B.; RODRIGUES, M.T. (submetido). Electivities and resource use by an assemblage of lizards endemic to the "Brazilian Little Sahara".

TOFT, C.A. Resource partitioning in amphibians and reptiles. *Copeia*, n.1, p.1-21, 1985.

UNDERWOOD, A.J. **Experiments in ecology**: their logic design and interpretation using analysis of variance. Cambridge University Press, 1997. 504 p.

WINEMILLER, K.O.; PIANKA, E.R. Organization in natural assemblages of desert lizards and tropical fishes. *Ecological Monographs*, v.60, n.1, p.27-55, 1990.

(We are indebted to Fundação O Boticário de Apoio à Natureza, CADCT/SEPLANTEC, CNPq, CAPES and FAPESB for financial support.)