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Structural habitat use by the Many-scaled Anole, *Anolis polylepis* (Squamata: Polychrotidae)

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Abstract. Lizards of the genus *Anolis* are commonly used as models for several ecological studies. Nevertheless, some aspects of their ecology have not been studied and information reported previously for several species must be reanalyzed. The aim of this study is to examine the structural habitat use in a population of the Many-scaled Anole, *Anolis polylepis*, with the purpose of comparing our results with the information reported previously for this species. Most of the captured individuals were on stems and we did not find any differences in the structural habitat use among sex/age classes. We found differences for perch height among individuals shedding their skin regarding those that are not. We also detected differences among our results and the information reported previously for this species. Such differences could be due to intrinsic factors of each population, such as the proportion of individuals that were molting their skin in a specific time. More studies with greater sample sizes and to a longer term are required to clearly understand the influence of these factors in the habitat use of *A. polylepis* and other anoline lizards.

Keywords. *Anolis polylepis*, lizard, ecology, habitat use, structural habitat.

INTRODUCTION

The genus *Anolis* includes species of neotropical, diurnal and mostly arboreal lizards (Pough et al., 2001). Due to the great diversity presented in the genus and high densities that many species reach in some sites, these lizards are commonly used as models for several ecological studies (Losos, 1994; Irschick et al., 1997). In this way, it has been possible to identify for many species the relationship between morphological characteristics and habitat use. For example, for the tail, an important organ of balance in these species (Ballinger, 1973), it has been observed that individuals with longer tails use narrower perches (Irschick et al., 1997).

However, a lot of ecological characteristics remain unknown and information reported previously for several species must be reanalyzed (Vitt et al., 2002; Vitt and Zani, 2005). For many species is still needed to determine if the use of structural habitat (i.e., perch diameter and perch height) varies in time or space and if so, which are possible causes for such variations (Rand, 1964; Irschick et al., 1997; Savage, 2002). It has neither been investigated if structural habitat reported for a particular species is affected by intrinsic factors of the population studied; for example, a high proportion of individuals with malformations or physical damages.

In spite of this lack of information, several ecological aspects of anoline lizards have been identified. Frequently, it has been reported that intrasexual differences in habitat use are present in *Anolis* species (Jenssen et al., 1998; Butler et al., 2000; Irschick et al., 2005). Such differences have been explained as a result of the different roles that each sex has in the environment. In *Anolis polylepis*, a Central American polychrotid lizard, adult males use higher perches than adult females because they spend more time defending their territories, so they need to achieve a better visibility of their territory. Females and juveniles, on the other hand, dedicate more time than males looking for food, so they use lower and less conspicuous perches to avoid predators (Andrews, 1971; Hertz, 1974; Perry, 1996).

It has been demonstrated that in *A. polylepis* there is a slight change in structural habitat use between seasons (Andrews, 1971). Males use lower perches during dry season than in the rainy one and both males and females select a greater diversity of perch types during dry season. Although some explanations have been proposed, environmental factors that cause such variation are still ignored.

The aim of this study is to examine structural habitat use in a population of the Many-scaled Anole, *Anolis polylepis*, in southwestern Costa Rica, with the purpose of comparing our results to the information reported previously for this species. Also, we will analyze possible factors that affect the use of structural habitat in this species.

MATERIALS AND METHODS

Anolis polylepis is a common lizard found in low and middle elevations throughout South Pacific of Costa Rica, usually in habitats with humid and shady conditions (Andrews, 1971; Socci et al., 2005). This species has a brown dorsal coloration, a medium body size (males bigger than females), and a smooth skin that is molted regularly. Males reach sexual maturity at 45 mm of snout-vent length, while females do this at 41 mm (Savage, 2002). *A. polylepis* uses perches up to 3 m above the ground, although individuals are located between 1 and 1.5 m on average (Andrews, 1971).

Study site

We carried out this study during part of the rainy season (October and November) of 2006, in the Golfito National Wildlife Refuge (08°38’ N, 83°09’ W), Puntarenas province, Costa Rica. The refuge includes a mountain range that forms a very irregular coast, rains are abundant and constant almost the entire year, and it presents a very humid tropical forest (Boza, 1996). We collected data in a secondary forest, with a dense understory dominated by herbaceous plants and some woody bushes, and a relatively closed canopy with some epiphytes.

Field techniques

We used the refuge hiking trails and every day we sampled a different area to avoid registration of the same lizards. We followed the activity cycle of lizards during the morning, from 7:00 to 11:30, and the afternoon, from 2:00 to 5:00, so sampling effort accounted for a total of 7.5 hr/individual/day. We searched for lizards examining all vegetation using the visual encounter survey technique (Crump and Scott, 1994). We registered the following data for each individual captured: sex/age class (adult male, adult female and juvenile), snout-vent length (SVL), and type (stem, tree trunk and leaf), height and diameter of the perch used in the moment of observation (see Rand, 1964). We also registered data that we considered relevant, such as presence of physical damages and ecdysis.

Statistical analysis.

We used the program STATISTICA 7 (StatSoft Inc., 2004) for all statistical analyses. We did a *G* test to compare the total number of individuals found on each perch type. Since perch height and perch diameter did not fit a normal distribution, we transformed these variables using base-10 logarithms. We used these transformed variables to carry out Two-Way Analysis of Variance to compare perch height and perch diameter of individuals on each sex/age class and ecdysis state. Since no juveniles with damaged tail were found, we excluded these ones and performed Two-Way Analysis of Variance to compare perch height and perch diameter of males and females with and without damages on the tail. For perch diameter, we excluded individuals found on leaves for all tests.

RESULTS

We captured a total of 47 individuals, 66% of which were adult males, 19% adult females and 15% juvenile (Table 1). Most of these individuals were found on stems than in other perch types ($G = 64.68$, df = 1, $P < 0.001$) (Table 1). This result contrasts with the information reported previously for *A. polylepis*, since it has been mentioned that a high proportion of individuals perch on leaves (Andrews, 1971; Hertz, 1974).

Also, several authors have reported that adult males of *A. polylepis* use higher and thicker perches than adult females and juveniles (Table 2).

However, we did not find differences among sex/age classes for perch height nor for perch diameter (Table 3). When we checked individuals for physical damages, only nine

Table 1. Number of adult males, adult females and juveniles of *Anolis polylepis* found on each perch type.

	Perch type			
Sex/Age class	Leaf	Stem	Tree trunk	Total
Adult males	1	28	2	31
Adult females	1	7	1	9
Juveniles	0	7	0	7
Total	2	42	3	47

Table 2. Mean perch height and mean perch diameter ± Standard Deviation reported for sex/age classes of *Anolis polylepis* in different studies. Sample size is in parenthesis.

Adult males	Adult females	Juveniles	Source
Perch height (cm)			
92 (68)	49 (86)		Andrews, 1971[1]
155 ± 56 (24)	53 ± 46 (18)		Hertz, 1974
89 ± 61 (32)	38 ± 43 (38)	16 ± 23 (78)	Perry, 1996
51 ± 29 (27)		31 ± 25 (53)	Frenkel, unpubl. data
94 ± 51 (31)	63 ± 45 (9)	159 ± 135 (7)	This study
Perch diameter (cm)			
2.65 ± 4.34 (24)	1.24 ± 1.43 (18)		Hertz, 1974
2 ± 2 (31)	4 ± 3 (9)	2 ± 1 (7)	This study

[1] Standard Deviation not reported.

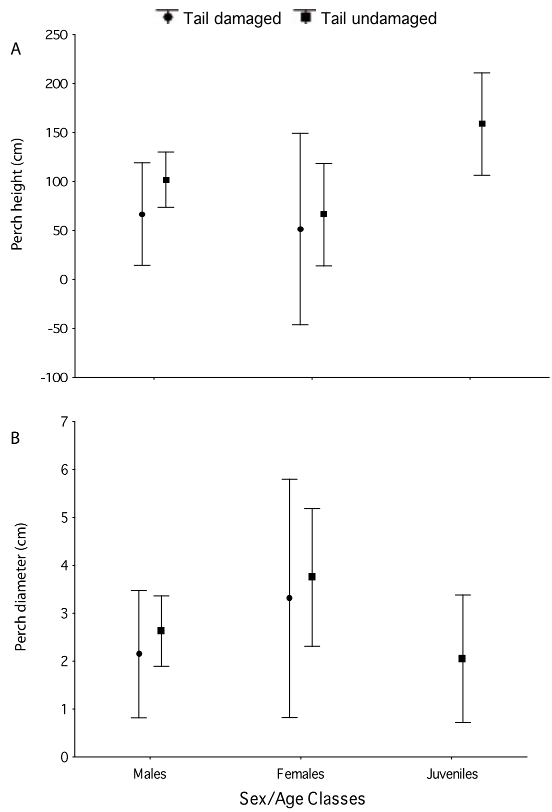

Fig. 1. Means of perch height (A) and perch diameter (B) for individuals of *Anolis polylepis* with damaged and undamaged tails. Lines indicate Standard Error.

Table 3. Results obtained using Analysis of Variance to test the effect of factors on perch height and perch diameter of *Anolis polylepis*.

	Factor					
	With or without ecdysis			Tail damaged or undamaged[1]		
Effect	F	df	*P*	F	df	*P*
Perch height						
Age/Sex Classes	0.828	2	0.444	1.430	1	0.240
Factor	11.174	1	0.002	0.411	1	0.525
Classes*Factor	0.597	2	0.555	0.344	1	0.561
Perch diameter						
Age/Sex Classes	0.411	2	0.666	3.114	1	0.087
Factor	0.969	1	0.331	0.041	1	0.840
Classes*Factor	1.075	2	0.351	0.209	1	0.651

[1] Juveniles are not accounted in this analysis.

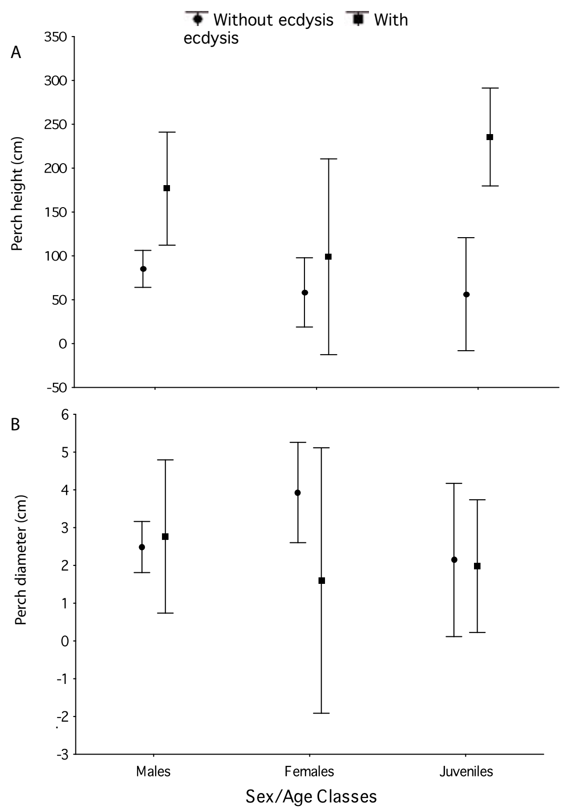

Fig. 2. Means of perch height (A) and perch diameter (B) for individuals of *Anolis polylepis* with and without ecdysis. Lines indicate Standard Error.

of them presented some kind of damage on the tail. We did not find significant differences for perch height (Fig. 1A) or perch diameter (Fig. 1B) when we considered sex/age classes, individuals with and without damages on the tail, and the interaction between class and damage on tail (Table 3).

We also found eight individuals that were shedding their skin. We did not find significant differences for perch height (Fig. 2A) when we considered sex/age classes or the interaction between class and presence of ecdysis (Table 3). However, we did find that individuals with presence of ecdysis perched higher than those that were not shedding their skin (Table 3). For perch diameter (Fig. 2B), we did not find significant differences for any of the effects tested (Table 3).

DISCUSSION

Studies about the ecology of mainland anoline species usually take into account one or just a few populations (Talbot, 1979; Jenssen et al., 1998; Vitt et al., 2005; Irschick et al., 2005), and only in some cases results generated have been compared with information reported in other studies (Irschick et al., 1997). Nevertheless, to achieve an integral knowledge of the ecology of an organism it is necessary to examine all information generated previously and determine if spatial or seasonal variations occur. In this study we compared structural habitat use of one population of *A. polylepis* with the information reported for populations along the distribution range of this species in Costa Rica, and we found differences in perch height and perch type.

Variations in habitat use among populations of different *Anolis* species has been reported previously (Pacala and Roughgarden, 1982; Losos et al., 1993; Vitt et al., 2002). Explanations that have been mentioned to explain these interpopulational differences are variations in climatic régime, forest structure, interspecific competition, predation, and food availability. However, intrinsic factors of each population could play an equally important role for habitat use of adult males, adult females and juveniles.

One of these factors is the proportion of individuals in the population shedding their skin in a given moment. Our data suggest that individuals in this stage use higher perches than those that are not. This was particularly notorious for juveniles, which presented a perch height way more above of the mean reported in other studies (Table 1). When considering juveniles with and without presence of ecdysis separately, mean perch height was greater for individuals shedding their skin than the one reported in other studies and did not differ for those not shedding (Fig. 2A).

A possible explanation for these differences involves coloration of this species and light microhabitat differences. Individuals of *A. polylepis* have a brown dorsal coloration which allows them to remain unobserved in low perches near the ground, where intensity of illumination is low. However, shed in these lizards is white, so they become conspicuous close to a dark background. It is possible that, in order to avoid predators, individuals presenting ecdysis tend to use higher perches than those of the rest of the population. By using higher perches, they are located in a brighter environment than if they remained close to the ground, reducing their conspicuousness. Although we did not measured environmental illumination for *A. polylepis*, it has been proved that this factor affects behavior of *Anolis* species (Fleishman and Persons, 2001; Leal and Fleishman, 2002; Macedonia et al., 2003), so our hypothesis deserves more attention.

Because the time to complete ecdysis in anoline lizards is short, we could assume that this factor would only affect habitat use in *A. polylepis* at short term. However, continuous presence of juveniles along the year and a quick growth rate (Andrews, 1991) indicates that in this species the proportion of individuals shedding in a given moment could be high (17% in this study). Hence, the effect of these individuals on structural habitat of one population of *A. polylepis* could be high.

Other intrinsic factors of each population could also affect habitat use of *A. polylepis*. Although our data do not reflect it, individuals with damaged tail could be affected in their movements due to the importance of this organ for keeping balance in these lizards. Studies with greater sample sizes, more sampling time, and a larger geographical range will help to elucidate the influence of these and other factors in basic ecological aspects of anoline lizards. However, our data show that structural habitat use in *A. polylepis* is affected by presence of individuals shedding, generating different information than reported previously for this species. This suggests that intrinsic factors deserve more attention and must be taken into account for ecomorphological studies in anoline lizards.

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