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Perch use by *Anolis polylepis* Peters, 1874 (Polychrotidae) in a tropical humid forest at the Piro Biological Station, Costa Rica

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Abstract. Individuals of a species use habitats on different ways for refuge, feeding, reproduction, or perching. We studied the variation on perch use between sex and age classes of *Anolis polylepis* at the Piro Biological Station, Costa Rica. Our results point to a similar perch use pattern between sex, but different between age classes, considering only the lowest and highest perches. Adult females and males use herbaceous and shrubby vegetation and avoid leaf litter. Juveniles use herbaceous vegetation and leaf litter, but avoid shrubby vegetation. We suggest that adult males use higher perches to defend territory. Conversely, juveniles use lower perches to avoid predators and foraging. Adult females use middle and high perches. This result is in contrast with previous studies on this species.

Keywords. *Anolis polylepis*, age classes, sex, perch use, Piro Biological Station.

Introduction

Habitat use in animals depends on their specialization, spatial scale, and other biotic and abiotic factors (Morris, 1987; Block and Morrison, 1998). Animals do not perch randomly, but select elements of the environment that better fit to their morphology and intra- and interspecific interactions (Rodriguez-Robles et al., 2005).

Resource acquisition is related to microhabitat use, since microhabitat quality and availability affect individuals differentially according to sex, seasonality, and period of the day (Rodriguez-Robles et al., 2005). Habitat use may differ between males and females, as well as between age classes, affecting differentially growth, foraging behavior, and reproductive success (Garshelis, 2000; Rodriguez-Robles et al., 2005). Perch use in *Anolis* lizards (Polychrotidae) vary greatly, both inter- and intraspecifically (Genet, 2002; Irschink et al. 2005).

Anolis polylepis is a medium-sized anole distributed along the Pacific slope of central and southern Costa Rica and western Panama from near the sea level to 1,615 m a.s.l. (Köhler, 2010). Sexual dimorphism in external morphology includes an extend dewlap coloration in males and a diamond stripe in the dorsum of females (Steffen, 2010). Polymorphic females differ in foraging behavior, diet, and perch height (Perry, 1996; Barquero and Arguedas, 2009;Steffen, 2010). Likewise, adult males use higher perches because they spend more time defending territories, while females and juveniles dedicate more time foraging in lower perches (Andrews, 1971; Hertz, 1974; Perry, 1996).

We analyzed how perch use varies between sex and age classes in *A. polylepis* in a tropical humid forest, at the Piro Biological Station, Osa Peninsula, Costa Rica. We predict that: 1) juveniles and adult females would perch on the leaf litter, and 2) adult males would use herbaceous vegetation.

Materials and Methods

Study area

This study was conducted at the Piro Biological Station (08°24' N; 83°20'' W) at the Osa Conservation Area, Osa Peninsula, Costa Rica. The area has a tropical humid forest (Holdridge, 1967) and vegetation that varies from a primary to secondary forest. Mean temperature is 25º C and relative humidity exceeds 90% at almost all year. Rainfall ranges from 2,500 to 6,000 mm, with a dry season from January to March, and a wet season from April to December (Kappelle, 2003).

Field methods

Sampling was conducted by one observer from 23 to 25 July 2012 in three 200-m long and 2-m width transects, randomly located at Piro (8° 24' 10 N, 83° 20' 20 W),

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Higuerón (8° 24' 16 N, 83° 20' 15 W), and Ocelote trails (8° 24' 15 N, 83° 20' 1 W). Each trail was at least 500 m distant from one another. Refuge hiking trails was used to sample on each trail in order to avoid recording the same lizard (Barquero and Arguedas, 2009). Sampling was made by Visual Encounter Survey (Crump and Scott, 1994) examining all vegetation at an interval of 5 min on each side of the transect, by slowly walking in a zig-zag pattern to avoid disturbing the lizards. Each transect was sampled from 10:00 to 13:00 h daily.

Perch type was classified according to height above the ground: leaf litter = 0 m, herbaceous vegetation = 0 - 1 m, and shrub vegetation > 1 m (Rand, 1964). Sex and age classes were identified by morphological characteristics, such as an extended dewlap coloration in males, a diamond stripe dorsal pattern in females (Steffen, 2010), and other characteristics like the presence of gular fan and individual size (size in females and males ranges from 41 to 57 mm and juveniles are below 41 mm; Savage, 2002).

The availability of herbaceous and shrubby vegetation was measured by counting them in randomized 2 m x 50 m quadrants along each transect. Leaf litter availability was estimated by measuring its proportion in quadrants of 1 m x 1 m randomly situated along transects (Alfaro, pers. comm.).

Statistical analyses

We used Manly et al.'s (1993) resource selection ratio index to identify which perches were used differentially according to sex and age classes, following the formula:

$$\alpha = \frac{pUi}{pNi}\left[\frac{1}{\sum(pUi/pNi)}\right]$$

where p_{Ui} is the proportion of the i category used relative to *U,* (U / u_i) and p_{Ni} is the proportion of units of *i* category relative to *N*. *U* is the total number of individuals and *N* is the total number of units in all habitat categories, i.e., perch type in our case (Montenegro and Acosta, 2008a).

We used the following criterion to identify which perches are preferred, used, or avoided (see Manly et al., 1993; Montenegro and Acosta, 2008a): Manly's $\alpha i > 0.33$ indicate preference, $\alpha i = 0.33$ indicates use, and $\alpha i < 0.33$ indicate avoidance of a specific perch type. We used this index because it is based on the concept of resource selection function, considering the resource units measured, such that the value for a unit is proportional to the probability being used (Manly et al., 1993). The major advantage of this method for determining habitat selection is that it provides confidence intervals to assess selectivity that consider multiple resources (Osborn, 2005).

Sample size adequacy was measured following two methods (Cherry 1996): N*pi and N*(1-pi), where N is the total number of observations and pi is the observed proportion used of *i* perch type. Sample size is adequate when both N*pi and N*(1-pi) is higher than 5. However, the N*(1-pi) test is more rigorous than N*pi (Cherry, 1996; Montenegro and Acosta 2008c). Thus, we have higher confidence to infer preference for habitats or resources when combining these two testes (Cherry, 1996; Montenegro and Acosta 2008c). Statistical analyses were conducted in HaviStat 1.0 (Montenegro and Acosta, 2008b).

Results

We observed 86 lizards in all perch types along the three trails (Piro: 9, Ocelote: 37, and Higueron: 40), 20 of them were adult males, 20 adult females, and 46 were juveniles. Individuals were recorded mostly on leaf litter and herbaceous vegetation, and less frequently on shrubby vegetation (Table 1).

Table 1. Number of adult males, females, and juveniles of *Anolis polypelis* observed on leaf litter, herbaceous, and shrubby vegetation.

	Life litter	Herbaceous vegetation	Shrub vegetation	
Adult males	1	17	2	
Adult females	1	16	3	
Juveniles	19	26	1	
Total	**21**	**59**	**6**	**86**

Males and females had a similar pattern of perch use. Males and females prefer herbaceous and shrubby vegetation ($\alpha i > 0.33$) and avoid perching on leaf litter ($\alpha i < 0.33$). Adults and juveniles differed in the use of the highest and lowest perches, but used medium perches similarly. Juveniles preferred leaf litter and avoided shrubby vegetation, while adults avoided

Table 2. Manly's Index of resource selection ratio for perch use in *Anolis polylepis.*

		Manly, 1993 (αi)			N-sample (Cherry, 1996)	
		Leaf litter	Herbaceous vegetation	Shrub vegetation	N * pi	N *(1-pi)
Potential Use x Independent variable category	**Perch type**	**72,5**	**44,2**	**70,5**		
Index X Dependent variables	Adult Males	0,1	0,5	0,4	Yes	Yes
	Adult Females	0	0,4	0,5	Yes	Yes
	Juveniles	0,5	0,4	0,1	No	Yes

1/(# independent variables or perch types)= 0.33

αi > 1/(# independent variables) indicate preference

αi < 1/(# independent variables) indicate avoid

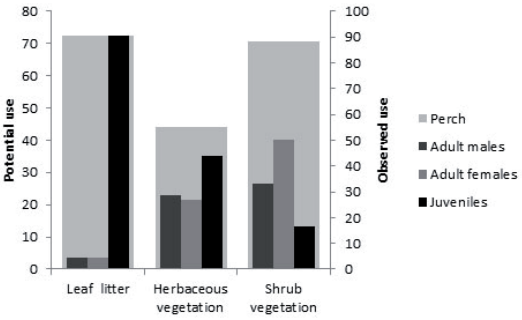

Figure 1. Perch use by sex and age classes in *Anolis polylepis.*

leaf litter and preferred shrubby vegetation. Both age classes preferred herbaceous vegetation. Sample size to test for perch use was appropriated for adult males and females, according to the two methods. However, for juveniles sample size was only adequate following one of the methods (Table 2; Fig. 1). Although we have higher confidence when inferring preference for perch use if data passes both tests, sample size for juveniles demonstrated to be adequate according to the more rigorous test.

Discussion

Our results suggest no difference in perch use between sex and age classes, considering that adult males and females perched on high and middle perches, similarly to juveniles. This, aspect differs from other studies, in which a variation in perch use between sex and age classes has been reported for *Anolis polylepis* and other polychrotids (Jenssen et al., 1998; Butler et al., 2000; Genet, 2002; Irschick et al., 2005). Differences in perch use may be related to changes in local climate, forest structure, interspecific competition, predation, food availability (Barquero and Arguedas, 2009), growth, foraging behavior, and reproductive success (Garshelis, 2000).

The preference of adult males for shrubby and herbaceous vegetation suggests that they use higher perches to achieve a better visibility when defending territory (Barquero and Arguedas, 2009). Females and juveniles usually spend more time foraging in low and less conspicuous perches to avoid predators (Andrews, 1971; Hertz, 1974; Perry, 1996). However, our results on perch use by females did not agree with these theoretical expectations. The brownish dorsum of *A. polylepis* may contribute to decrease predation risk, since it confounds with the background on lower perches, where light intensity is low (Barquero and Arguedas, 2009). However, these lizards usually change their skin on higher perches in order to avoid predators, since the white color of the molting make them less conspicuous, more similar to the dark background, specially the juveniles (Barquero and Arguedas, 2009).

There can be a slight change in habitat use between seasons in *A. polylepis* (Andrews, 1971). For example, males used lower perches during the dry season. Additionally, both males and females used a wider

variety of perches during the dry season (Barquero and Arguedas, 2009). This can partially explain perch use by adult males and females, although environmental factors that cause such variation remain illusive.

Our results indicate that adult females and males prefer herbaceous and shrubby vegetation, and avoid leaf litter, while juveniles prefer low and middle perches. We suggest that increased samplings should be obtained by conducting surveys in the morning and afternoon for a better representation of perch use by *A. polylepis*. Likewise, further studies should determine the actual factors that influence differential perch use between sex and age classes.

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