Investigating Habitat-Related Differences in Home Range and Behavior in *Sceloporus consobrinus*

By

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Extensive studies of the life history traits of lizards have revealed that differences in habitat (Lima and Zollner 1996) and thermal regimes (Adolph and Porter 1993) affect the life histories of lizards, especially space usage and behavior. Alyssa Bangs and Sarah Tomke (previous graduate students) and I found that environmental temperature does not influence morphology of prairie lizards in Northwest Arkansas, and that isolated habitats in the Arkansas River Valley have distinct genetic populations (Tomke 2018). As a consequence of these findings, I initiated further research to better understand the spatial ecology of lizards in Central Arkansas and whether these different habitats differed enough in structure and thermal regime to cause a difference in space usage and behavioral responses to a simulated predator.

In the spring and summer of 2018 and 2019, several students and I placed transmitters on 26 lizards and repeatedly relocated them in order to record their coordinates as well as characterize the microhabitat and microclimate characteristics of the lizard's location at the time. I compared behavioral responses to a simulated predator among the habitats as well. The median home range sizes were 339.320 m^2 for the forested sites, 185.040m^2 for the mixed sites, and 240.589 m^2 for the rocky sites, these differences were not significantly different ($F = 2.58$, proportion of F-values > observed = 0.08). We also evaluated the behaviors of 240 individual lizards, and found that lizards differ by habitat in responses to a simulated predator ($F = 3.24$, proportion of F-values > observed = .0402).

Purposes/Objectives

Our objectives were to determine whether differences exist among habitats in lizard home range size and lizard behavioral responses. These habitat types include rocky habitats, forested habitats, and transitional habitats. Forested habitats include mixed oak (Quercus spp.), hickory (Carya spp.), and shortleaf pine (Pinus echinata) along with an understory of vines and shrubs.

Small dirt or paved paths produce breaks in the canopy that provide basking opportunities. Rocky habitats are comprised of anthropogenic outcroppings of rip-rap and concrete proximately located to other man-made structures such as roads, dams, reservoirs, and boat ramps. Rocky habitats have no forest canopy; the only shade is provided by the rocks which lizards use as refuge from the sun and predators. Forested habitats are generally shady and lizards actively seek out sun flecks for basking. Tomke (2018) examined the genetic structure of this species, and found that prairie lizards inhabit transitional sites that are either open forest with a rocky understory or forest edges adjacent to large openings. Bangs (2016) found that structural differences between rocky and forested sites resulted in drastically different thermal regimes. Rocky habitats exhibit higher average maximum temperatures and also heat up more rapidly after day break.

Introduction

One of us (C.K) has been studying lizards in rocky and forested habitats near Russellville since 2011. Surprisingly those lizards have not exhibited expected size differences that are associated with thermally different habitats (Smith and Ballinger 2001, Adolph and Porter 1993), while exhibiting distinct genetic populations around the Russellville area. Previous research has indicated that spatial ecology is influenced by habitat structure () and that geographically close but structurally different habitats result in different spatial ecologies for *Sceloporus* species (Refsnider et al. 2015). Consequentially, examining *S. consobrinus* populations around Russellville will help to confirm or deny whether this trend is consistent at the local scale.

In addition to spatial differences, one of us (F.K) was interested in the presence or absence of personality in this population of *S. consobrinus*. Personality in animals is indicated in part by the presence of repeatable behaviors (Dingemanse et al. 2002), and repeatability is a

measure of how much individuals differ from each other after taking into account all other factors that cause individuals to differ in behavioral responses. Personality in reptiles is an understudied facet of behavioral ecology and our research hoped to further our understanding of reptile behavior and the factors that may cause individuals to express different behavioral responses.

Methods

Study Sites: We used sites located along the shoreline of Lake Dardanelle, at Old Post Park, Bona Dea Nature Trail in Russellville, and Mount Nebo State Park. Lizards were captured in twenty-six sites in 2018 and 2019 (8 forest, 12 transitional, 6 rocky).

Methods: We used nooses to capture each lizard at each site. A small noose of dental floss was tied to the end of a stick. After capture, each lizard was measured, weighed, and given a unique identifier of different colored paint dots at the base of its tail. If the lizard was large enough, a R1600 radio transmitter (.45 grams) was placed on the lizard's pelvic girdle. Microclimate data was taken utilizing a sling psychrometer to measure relative humidity and temperature. Canopy cover was measured, when appropriate, with a densitometer, and the surface temperature of the lizards' location was taken with an infrared thermometer. Microhabitat data was taken upon each relocation. The dominate substrate was recorded and the habitat type was recorded as well.

We tracked lizards utilizing a Yagi 3-element antenna and recorded each relocation utilizing a Geo 7x GPS unit. GPS coordinates were corrected in Pathfinder and processed in Arc GIS 10.3.1. We utilized both minimum convex polygon estimates and kernel density estimates to calculate the home ranges of individual lizards.

Behavioral responses were taken by approaching each lizard and measuring how close they allowed the observer to approach before initiating an escape maneuver. The initial distance to the lizard was recorded, as well as how close we got to the lizard before it initiated flight. Flight was considered initiated when the lizard moved at least one body length. This was considered the flight initiation distance. The distance the lizard fled was also recorded, allowing us to measure the intensity of the response. We also measured the initial distance to the lizard, in order to control for initial approach distance. We utilized the R statistical package (R team 2019) to conduct all statistical analyses. We utilized a function provided by Dr. Bradley Carlson of Wabash College (Crawfordsville, IN)

Results and Discussion

The median minimum convex polygon home range sizes were 339.320 m^2 for the forested sites, 185.040m^2 for the mixed sites, and 240.589 m^2 for the rocky sites, these differences were not significantly different (F = 2.58, proportion of F-values > observed = 0.08). The median kernel density estimators were 1406.585 m^2 in the forested habitats, 855.09 m^2 in the mixed habitats, and 1140.00 m^2 in the rocky habitats and were significantly different (F = 2.94, proportion of F-values > observed = 0.044) (Figure 1). Although the KDEs showed significant differences in home range size across the home range sizes, it should be noted that this methodology has been observed to be an over-estimate of home range sizes in herpetofauna (Row and Blouin-Demers 2006).

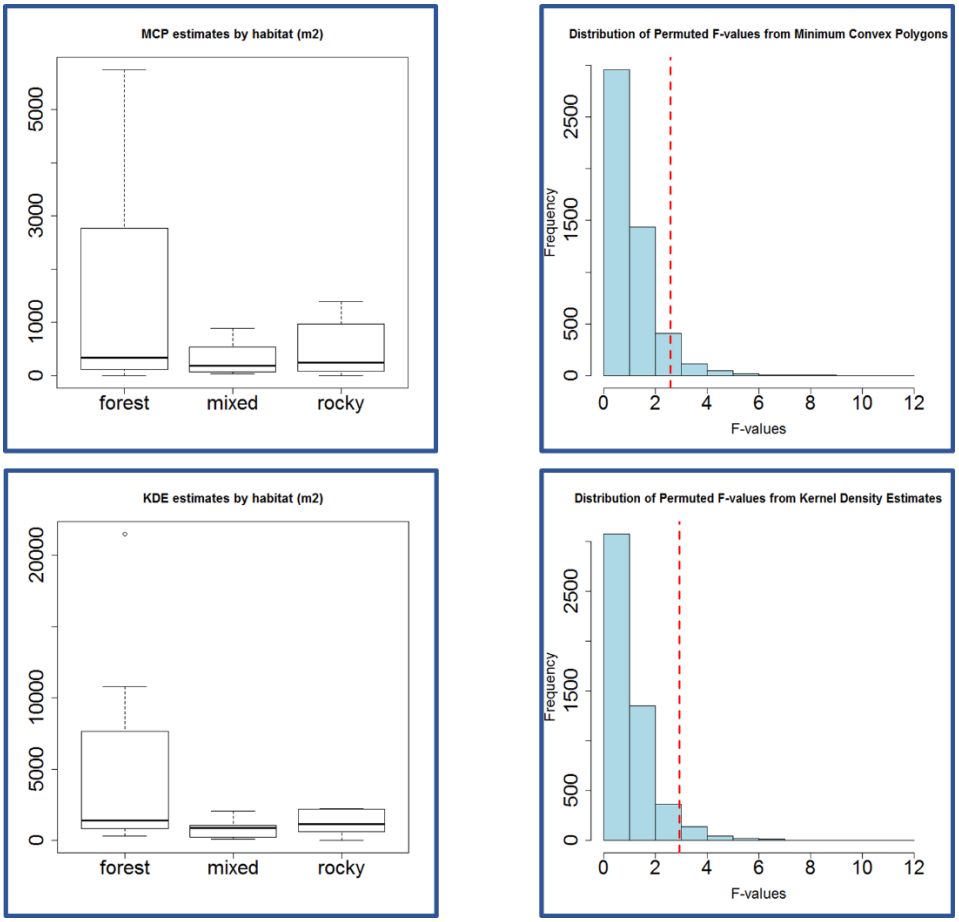

Figure 1: Boxplots of the differences in home range estimates and histograms of the F-values calculated from the permuted ANOVA values. The red lines indicate the observed F-value from each test.

We evaluated the behaviors of 240 individual lizards, and found that lizards differ by habitat in responses to a simulated predator ($F = 3.24$, proportion of F-values > observed = .0402). We also observed that the lizards do not show repeatability among individuals in FIDs when controlling for microclimate variables and microhabitat variables (repeatability = .2020). This indicates that lizards in the Arkansas River Valley do not exhibit individual personality differences and that the behavioral responses found in these populations do not differ among habitats nor among individuals.

We explored the effects that substrate type has on lizard behavioral responses and found that substrate type does have a strong relationship with FID (Kruskal-Wallis chi-squared = 33.642, df = 7, p-value = <.001). This indicates that lizards alter their behavioral responses as a result of the substrate types that they are inhabiting. Some substrate types were open, such as the pavement found on city trails, while others were more sheltered, such as the leaf litter in a forested habitat. This may have affected the visibility of the observer to the lizards, which allowed them to flee earlier in response to an observer's approach. Overall the lack of individual behavior differences or behavioral differences among habitats indicates that *S. consobrinus* inhabiting the Arkansas River Valley exhibit homogenous behavioral responses to a simulated predator.

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