IRCF REPTILES & AMPHIBIANS
CONSERVATION AND NATURAL HISTORY

Approach Distances and Escape Behavior of the San Salvador Curly-tailed Lizard, *Leiocephalus loxogrammus parnelli*

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Two subspecies of the Bahamian Curly-Tailed Lizard, *Leiocephalus loxogrammus*, are currently recognized. *Leiocephalus loxogrammus parnelli* is endemic to San Salvador (Figs. 1 & 2) and *L. l. loxogrammus* is endemic to Rum Cay (Henderson and Powell 2009). Little is known about the natural history of *L. l. parnelli* (Henderson and Powell 2009). Species of *Leiocephalus* are largely sit-and-wait predators that feed primarily on insects but also consume buds, flowers, and seeds (Schoener et al. 1982). The San Salvador Curly-tailed Lizard is largely xerophilic and is most frequently encountered in rocky areas but also occupies sandy beaches, human-populated sites, and more densely vegetated coastal habitats (Schwartz and Henderson 1991). These lizards are particularly abundant around ruins dating to the Loyalist Era after the American Revolution (Hillbrand et al. 2011).

Prey facing an approaching predator monitor predator distance and speed to assess risk and make decisions regarding appropriate defensive responses (Lima and Dill 1990). Ydenberg and Dill (1986) predicted that the distance at which escape behavior is initiated increases with predation risk and decreases with costs of fleeing or remaining in a refuge. Escape distance (distance fled before stopping) also is predicted to increase with risk and decrease with cost (e.g., Cooper and Pérez-Mellado 2004).

In previous studies of Curly-tailed lizards, Cooper (2007) found no significant effects of approach distance in Northern Curly-tailed Lizards (*Leiocephalus carinatus*) in Florida on distance fled or the probability of the individual entering a refuge. Nelson et al. (2001) recorded mean initial response distances in Hispaniolan Pale-bellied Curly-tailed Lizards (*L. semilineatus*) of 2.01 m and in Red-sided Curly-tailed Lizards (*L. schreibersii*) of 3.85 m. Gifford et al. (2008), in a study of two Hispaniolan species of *Leiocephalus*, found that populations in more open, especially coastal habitats had longer hindlimbs, faster sprint speeds, and longer approach distances.

During a five-day period in May 2013, we assessed approach and escape distances of *Leiocephalus loxogrammus parnelli* to test predictions that approach and escape distances would differ significantly based on size class. Based largely on conclusions by Stiller and McBrayer (2013), we predicted that juveniles would allow the closest approaches and exhibit the shortest escape distances.

Fig. 1. An adult female San Salvador Curly-tailed Lizard (*Leiocephalus loxogrammus parnelli*) from scrub habitat near Rocky Point. Photograph by Robert Powell.

Fig. 2. A juvenile San Salvador Curly-tailed Lizard (*Leiocephalus loxogrammus parnelli*) from "Watling's Castle." Photograph by Robert Powell.

Methods

We conducted our study near Watling's Castle (23°57'16.49"N, 74°32'46.53"W) on San Salvador Island (Fig. 3), Commonwealth of the Bahamas. Based on data collected during a concurrent study (Dlugolecki et al. 2015) and to reduce variable effects attributable to time of day, we limited approaches of lizards to morning peak-activity periods (0900–1130 h). Mean temperature during the study periods was 31.5 ± 0.8 °C.

We adapted methods used previously by Nelson et al. (2001) and Gifford et al. (2008). We approached lizards only if they had not reacted to our presence. The same person, moving at a standard speed of 0.8–1.0 m/sec, halted immediately when the focal individual initiated an escape. We then measured the distance to where the lizard had been and the distance it moved before stopping. For each approach, we recorded the size class of the individual (adult male, small adult of undetermined sex, juvenile), insolation (sun/shade) at the original location of the lizard, and microhabitat (rocks versus ground) for both the initial location and the site to which the individual moved. To avoid approaches to the same lizards, we did not approach animals in the same size class within 20 m of a previous observation.

We used StatView® 5.0 (SAS Institute Inc., Cary, North Carolina) for statistical tests; ANOVA to compare responses of lizards in the three size classes, t-tests for comparisons of any two size classes, and Kendall Correlation to examine relationships between approach and escape distances. All means are presented ± one SD. For all tests, $\alpha = 0.05$.

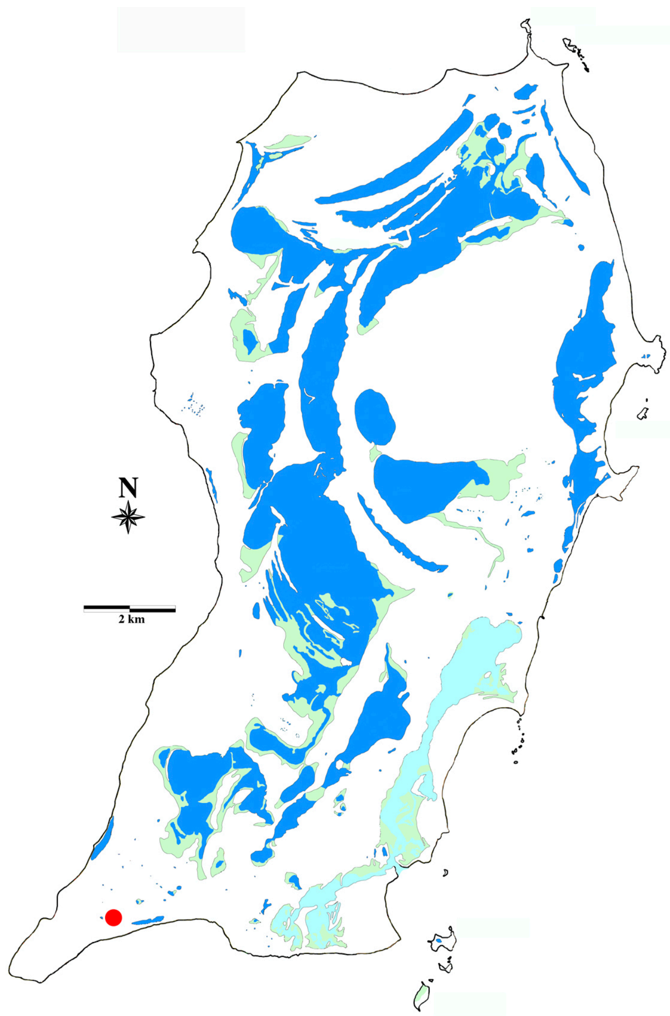

Fig. 3. Map of San Salvador showing lakes and ponds (dark blue), Pigeon Creek (a tidal creek; pale blue), wetlands (pale green), and the approximate location of "Watling's Castle" (red dot).

Results

We approached 46 individuals (5 adult males, 31 small adults, 10 juveniles). Insolation (F = 0.26, df = 2, P = 0.77), initial microhabitat (F = 0.30, df = 2, P = 0.74), and escape microhabitat (F = 0.19, df = 2, P = 0.83) did not differ significantly by size class, but approach distances (Fig. 4) varied significantly (F = 10.55, df = 2, P = 0.0002), with juveniles allowing the closest approaches (1.03 ± 0.21 m, 0.35–2.30 m), followed by small adults (1.45 ± 0.13 m, 0.38–3.50 m) and adult males (2.83 ± 0.32 m, 2.34–4.10 m). Differences in escape distances by size class (Fig. 5) approached significance (F = 2.52, df = 2, P = 0.09); however, those of adult males (0.73 ± 0.14 m, 0.40–1.10 m) and small adults (0.73 ± 0.07 m, 0.08–1.46 m) were significantly greater than those of juveniles (0.45 ± 0.06 m, 0.15–0.75 m) (t = 2.42 and 2.52, respectively; P = 0.02 for both). Approach and escape distances were not significantly correlated for all lizards (Z = -0.34, P = 0.74), adult males (Z = 0.94, P = 0.35), small adults (Z = -1.90, P = 0.058), or juveniles (Z = 0.19, P = 0.85).

Discussion

Our predictions that juveniles would allow the closest approaches and exhibit the shortest escape distances were supported. We tried to standardize approach speed and directness of approach, two variables known to be positively correlated

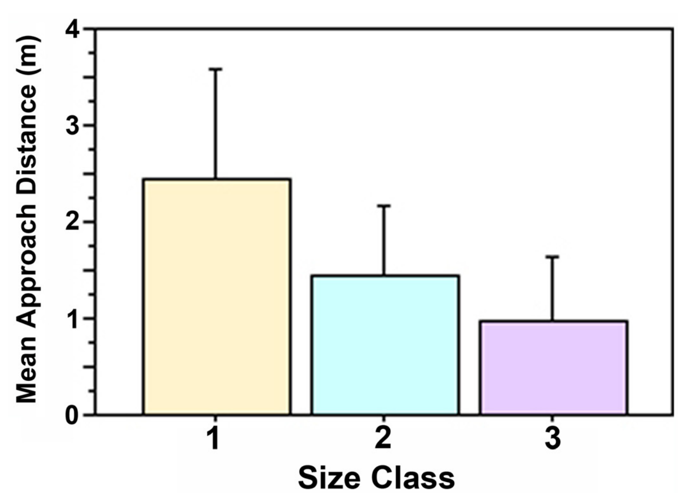

Fig. 4. Mean approach distances (± one SD) by San Salvador Curly-tailed Lizards (*Leiocephalus loxogrammus parnelli*). Size classes: Adult males (1), small adults (2), and juveniles (3).

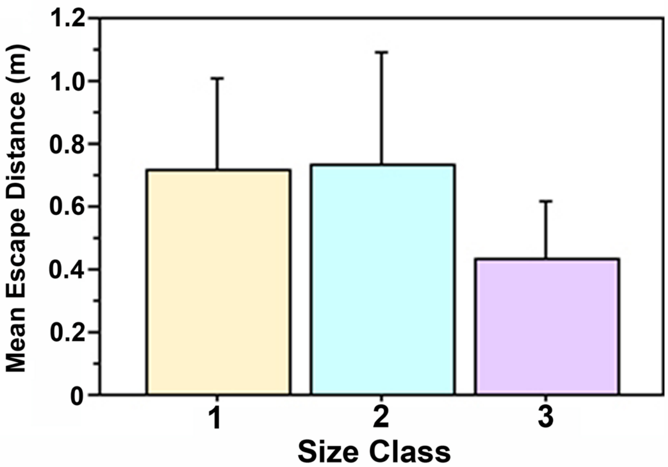

Fig. 5. Mean escape distances (± one SD) by San Salvador Curly-tailed Lizards (*Leiocephalus loxogrammus parnelli*). Size classes: Adult males (1), small adults (2), and juveniles (3).

with approach distance (Cooper 1997), but did not address distance from a refuge (Bulova 1994; Cooper 1997) or variation in visibility in open versus more sheltered microhabitats (e.g., Gifford et al. 2008). We also did not assess potential costs, such as lost opportunities to forage or engage in social interactions that might reduce approach distances (Cooper 1999; Cooper and Pérez-Mellado 2004). Regardless, we believe the shorter approach and escape distances by juveniles are largely attributable to smaller size, limited experience in risk assessment and predator recognition, and a greater reliance on crypsis (Stiller and McBrayer 2013 and references therein). Juveniles, which are slower than adults due to smaller size, likely rely more heavily on crypsis to decrease the likelihood of detection by a predator and are more likely to run shorter distances before reverting to crypsis; adults, in contrast, with greater sprint speeds, are more likely to flee more quickly when approached. Our data and assumptions are very similar to observations by Stiller and McBrayer (2013) for *Sceloporus woodi* in Florida. The inverse might also explain the greater approach distances for adult males. These are the largest and presumably fastest individuals in the population (Huey and Hertz 1982), are most likely to engage in behaviors that render them more visible to potential predators (Baird et al. 2003), and consequently appear to be most wary and to initiate flight at the greatest distance.

That no evident correlation existed between approach and escape distances in adult males and juveniles was somewhat surprising, but is probably best explained by substantial variation in small samples. However, for small adults, the negative correlation closely approached significance, suggesting that individuals who allowed closer approaches fled farther and vice-versa. This might be explained by closer approaches resulting in greater panic and consequent greater flight distances, and longer distances before flight was initiated resulting in shorter flights before reverting to a reliance on crypsis.

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