

Inter-specific predation between two eco-morphologically similar *Anolis* lizards

Kamau Walker¹, Andrew C. Battles², James T. Stroud^{3,4}

¹Yale University, New Haven, CT

²University of Rhode Island, RI

³Washington University in St. Louis, St. Louis, MO

⁴Fairchild Tropical Botanic Garden, Coral Gables, FL

Email: jamesTstroud@gmail.com

Cuban brown anoles (*Anolis sagrei*) were first introduced to Miami in the 1950s (Kolbe et al. 2005). Since their initial establishment they have dispersed rapidly and are now present throughout south Florida (Kolbe et al. 2007). Puerto Rican crested anoles (*A. cristatellus*) were first introduced to the Pinecrest/South Miami neighborhood in south Florida in the 1970s (Salzburg 1984), on the Snapper Creek canal on Red Road in Pinecrest, approximately 1km from the Fairchild Tropical Botanic Gardens. Since introduction, *A. cristatellus* have spread radially from this point of initial establishment throughout Miami-Dade county (Kolbe et al. 2016).

Trunk-ground ecomorphs, of which *A. cristatellus* and *A. sagrei* are both categorised, are generalist insectivores, mainly consuming leaf-litter arthropods (Schoener 1968, Giery et al. 2013). However, intra-specific predation (i.e. cannibalism) of smaller individuals has been observed in both species (*A. sagrei*, Cates et al. 2014, JTS *pers. obs.*; *A. cristatellus*, Campbell et al. 2018), which suggests the consumption of vertebrates occurs, although possibly only opportunistically during seasonal periods when appropriate sized prey are available (e.g. during the emergence of hatchlings in mid-late Summer).

Here, we report the predation of an adult female Cuban brown anole (*A. sagrei*) by an adult male Puerto Rican crested anole (*A. cristatellus*) in the Fairchild Tropical Botanic Gardens, Miami FL USA (25.677°N, 80.276°W). On May 14th, 2018, at 1300h, an adult male *A. cristatellus* was caught by KW using a telescopic fishing pole (Cabelas Inc). Upon inspection, we noticed a prey item half-ingested in the mouth of the *A. cristatellus*. Following a gentle stomach massage, the prey item was fully regurgitated and determined to be a female *A. sagrei*. The prey item had been ingested head first. The female *A. sagrei* was an adult of reproductive size (i.e. >35mm svl; JC Lee 1989) and measured 42mm svl, while the male *A. cristatellus* measured 63mm svl (see Fig 1. for a size comparison photo with scale bar).

We then compared the size of the predated *A. sagrei* to a large data set of body sizes (snout-vent lengths) of *A. sagrei* within the community located in Fairchild Tropical Botanic Gardens (Fig 2). The comparison revealed that the female *A. sagrei* was not abnormally small, but rather only slightly smaller than the median body size. The size of the male *A. cristatellus* was similarly compared to a data set of body sizes (snout-vent length) of male *A. cristatellus* within the community (Fig 3). The captured *A. cristatellus* was also slightly below the median svl. Neither the *A. cristatellus* or *A. sagrei* were unusual in size. Therefore, predation upon other *A. sagrei* by *A. cristatellus* may be possible.



Figure 1. Size comparison of male *A. cristatellus* (top: larger lizard, 63mm svl) and ingested female *A. sagrei* (bottom: smaller lizard, 42mm svl). Digital calipers set to 50mm included for scale.

It was previously presumed that the relationship between adult *A. cristatellus* and *A. sagrei* in Miami FL was only agonistic and competitive (Salzburg 1984, Kolbe et al. 2016, Stroud 2018). However, this observation establishes the existence of a predatory relationship between *A. cristatellus* and *A. sagrei* that had not been previously observed. Predation is a much more powerful biotic interaction in driving changes in behavior and ecology, with the frequency of predation events not needed to be high for a behavioral response to be elicited by prey species. The extent to which this relationship is symmetrical (i.e. do large male *A. sagrei* predate small female *A. cristatellus*) is unclear and deserves further study.

Although more observations are needed to determine the relative frequency of such a predation event, it is possible that the uncovering of this relationship between *A. cristatellus* and *A. sagrei* could be important in explaining observed ecological shifts of *A. sagrei* when coexisting with *A. cristatellus* (Salzburg 1984, Kolbe et al. 2016, Stroud 2018). Specifically, when sympatric with *A. cristatellus* in Miami FL, *A. sagrei* perch lower and are more frequently

found on the ground than when allopatric (Stroud 2018). As *A. cristatellus* continues to disperse throughout Miami, new sympatric communities of *A. cristatellus* and *A. sagrei* are forming where previously only *A. sagrei* occurred. These novel communities may be especially important in understanding how rapid the nature of this intraguild relationship is, or if it only presents after prolonged sympatry. Similarly, further effort should be afforded to understanding the full extent of intraguild predation between all members of sympatric anoles (in both natural and non-native communities). Although studies of anole diet and trophic ecology were pioneered in the 1960's and 1970's (e.g. Schoener 1967, 1968, Roughgarden 1972, 1974, Lister 1976), little development has been made to understand the ecological and evolutionary importance of diet in anoles past just recording diet contents. This topic is considered particularly valuable to future anole research.

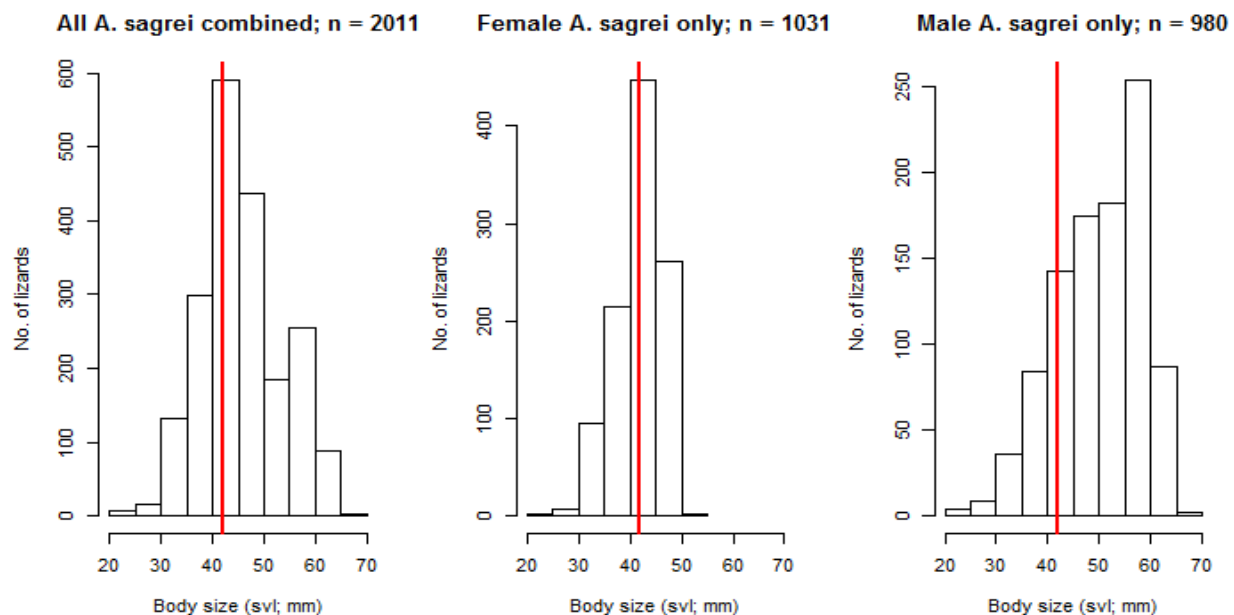


Figure 2. Size comparison between the ingested *A. sagrei* (red line) and other *A. sagrei* present within the same community (left: all individuals combined; middle: females only; right: males only). The histograms represent the distribution of body sizes for each class, red line indicates the size (svl) of the predated female *A. sagrei* in this observation. 30.48% of all *A. sagrei* are equal or smaller than the predated female, however 41.51% of all females are smaller or equal compared to only 18.88% of males. Those percentages indicate the proportion of individuals which are assumed to be vulnerable to an equal sized predatory *A. cristatellus*.

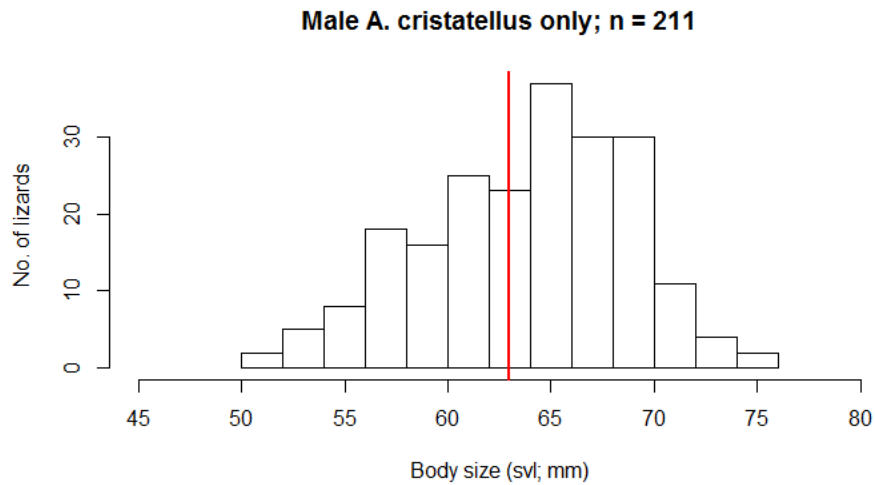


Figure 3. Size comparison of captured male *A. cristatellus* (red line) among all mature male *A. cristatellus* sampled in Fairchild Tropical Botanic Gardens. This histogram shows the distribution of sizes of mature *A. cristatellus* males and highlights that the individual from this observations was typical. This is restricted only to adult males, i.e. those >50mm svl. 60.19% of *A. cristatellus* males are larger than the male in this observation (and therefore it is likely that even larger *A. sagrei* may be predated than the female from this observation).

References

- Cates C.D., Delaney, D.M., Buckelew, A.M., Delaney, D.M., Durso, A.M., French, S.S., Reedy, A.M., Warner, D.A. 2014. *Anolis sagrei*. Cannibalism. *Herpetological Review*, 45:491.
- Kolbe, J.J., Glor, R.E., Schettino, L.R., Lara, A.C., Larson, A. and Losos, J.B., 2004. Genetic variation increases during biological invasion by a Cuban lizard. *Nature*, 431(7005), p.177.
- Kolbe, J.J., Larson, A. and Losos, J.B., 2007. Differential admixture shapes morphological variation among invasive populations of the lizard *Anolis sagrei*. *Molecular Ecology*, 16(8), pp.1579-1591.
- Kolbe, J.J., VanMiddlesworth, P., Battles, A.C., Stroud, J.T., Buffum, B., Forman, R.T. and Losos, J.B., 2016. Determinants of spread in an urban landscape by an introduced lizard. *Landscape Ecology*, 31(8), pp.1795-1813.
- Giery, S.T., Lemoine, N.P., Hammerschlag-Peyer, C.M., Abbey-Lee, R.N. and Layman, C.A., 2013. Bidirectional trophic linkages couple canopy and understory food webs. *Functional Ecology*, 27(6), pp.1436-1441.
- Lee, J.C., Clayton, D., Eisenstein, S. and Perez, I., 1989. The reproductive cycle of *Anolis sagrei* in southern Florida. *Copeia*, pp.930-937.

- Lister, B.C., 1976. The nature of niche expansion in West Indian *Anolis* lizards I: ecological consequences of reduced competition. *Evolution*, 30(4), pp.659-676.
- Roughgarden, J., 1972. Evolution of niche width. *The American Naturalist*, 106(952), pp.683-718.
- Roughgarden, J., 1974. Niche width: biogeographic patterns among *Anolis* lizard populations. *The American Naturalist*, 108(962), pp.429-442.
- Salzburg, M.A., 1984. *Anolis sagrei* and *Anolis cristatellus* in southern Florida: a case study in interspecific competition. *Ecology*, 65(1), pp.14-19.
- Schoener, T.W., 1967. The ecological significance of sexual dimorphism in size in the lizard *Anolis conspersus*. *Science*, 155(3761), pp.474-477.
- Schoener, T.W., 1968. The *Anolis* lizards of Bimini: resource partitioning in a complex fauna. *Ecology*, 49(4), pp.704-726.
- Stroud, J.T. 2018. Using introduced species of *Anolis* lizards to test adaptive radiation theory. *Ph.D. Dissertation*, Florida International University.