Ecological and evolutionary determinism in Greater Antillean reptiles

Graham Reynolds*†[1] and Jonathan Losos[2]

[1]University of North Carolina Asheville (UNC Asheville) – 1 University Heights Asheville, NC 28804, USA, United States

[2]Washington University in St Louis (WashU) – Washington University in St. Louis, One Brookings Drive, St. Louis, MO 63130, United States

Abstract

Some of the most important insights into the ecological and evolutionary processes of diversification and speciation have come from studies of island adaptive radiations, yet relatively few studies have examined how these radiations initiate. We suggest that *Anolis sagrei* (Brown Anoles) is a candidate for understanding the origins of the Caribbean *Anolis* adaptive radiation and propose that detailed investigation of the morphological and genetic variation of this widespread species can help to provide considerable insight into how a colonizing anole species begins to undergo allopatric diversification, phenotypic divergence, and, potentially, speciation. To investigate the extent of diversification across *A. sagrei*, the most widespread species of anoles, we undertook a genetic and morphological analysis of representative populations across the entire native range of the species, encompassing 295 individuals from 95 locations. We find that at the broadest scale, populations colonizing areas with fewer closely related competitors tend to evolve larger body size and larger number of toepads, on average. Such a trend follows expectations for an ecological release scenario, whereby populations freed from competition with close relatives evolve towards different morphological and ecological optima. Further, colonization of islands can dramatically influence the evolutionary trajectories of organisms, with both deterministic and stochastic processes driving adaptation and diversification. Some island colonists evolve extremely large or small body sizes, presumably in response to unique ecological circumstances present on islands. One example of this phenomenon, the West Indian boas, includes both small ($<$ 90cm) and large (4m) species occurring on the Greater Antilles and Bahamas Platform, with some islands supporting pairs or trios of body-size divergent species. Here we show that small body size evolved repeatedly on separate islands in association with specialization in substrate use. Our results further suggest that microhabitat specialization is linked to increased rates of head shape diversification among specialists. Our findings show that ecological specialization following island colonization promotes morphological diversity through deterministic body size evolution and cranial morphological diversification that is contingent on island- and species-specific factors.

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*Speaker

†Corresponding author: greynold@unca.edu