ARPHA Conference Abstracts 2: e37059
doi: 10.3897/aca.2.e37059

Conference Abstract

Evolution in Extremis: The When, How, and Why of Hawaiian Carabid Beetles

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Received: 11 Jun 2019 | Published: 12 Jun 2019

Citation: Liebherr J (2019) Evolution in Extremis: The When, How, and Why of Hawaiian Carabid Beetles. ARPHA Conference Abstracts 2: e37059. https://doi.org/10.3897/aca.2.e37059

Abstract

The Hawaiian Archipelago is the most isolated oceanic island system in the World, separated from the nearest source areas by more than 4000 km. Five independent colonization events have resulted in diversification of a native carabid beetle fauna in excess of 400 known species. This diverse assemblage is disharmonic, with the major radiations restricted to the platynine genus *Blackburnia* Sharp (139 species), the subgenus *Nesocidium* Sharp of *Bembidion* Latreille (21 species), and the moriomorphine genus *Mecyclothorax* Sharp (239 species). Biogeographical, ecological, and evolutionary attributes of these three radiations are compared in order to determine factors crucial to carabid beetle diversification in this most-isolated situation. Biogeographical attributes include the age of origin of the constituent radiation, the island likely colonized by its common ancestor, and the biological characteristics, where known, of the colonizing ancestors for each independent radiation. Ecological attributes include the amount of habitat specialization undergone during each radiation, taking into account the primordial habitat colonized and the subsequent pattern of occupation of different habitat types during diversification. Evolutionary attributes include brachyptery, body-size evolution, sexual selection, and the evolution of specialized body conformations. It is shown that ecological specialization—i.e., occupation of a diverse array of ecological zones and microhabitats—in concert with reduced dispersal ability brought on by evolution of brachyptery are positively associated with enhanced levels of diversification. Comparing sympatric island faunas, it is shown that the latter operates synergistically with body size, as the smaller-bodied *Mecyclothorax* beetles speciate much more rapidly than the larger-bodied

Blackburnia on Maui and Hawai'i Island. Nonetheless, small body size does not gaurantee high diversity, as *Bembidion* beetles attain body sizes similar to *Mecyclothorax* beetles. Age of origin of a radiation is a subsidiary criterion for diversification given that the *Mecyclothorax* radiation commenced only 1.2 Ma, whereas it is hypothesized that *Blackburnia* have been resident in the Hawaiian archipelago for upwards of 28 Ma. Thus especially for *Blackburnia* we are constrained in our ability to know all of the evolutionary products of the radiation due to extinction of presumably all or nearly all species that occupied the now-sunken islands northwest of the oldest high island of Kauai. We are fortunate to know of several extinct *Blackburnia* species discovered in lowland subfossil deposits in Kauai, and these species provide crucial information now regarding future patterns of extinction. Sexual selection can be demonstrated for the *Bembidion* subgenus *Nesocidium*, and is a likely explanation for genitalic evolution over parts of the *Mecyclothorax* radiation, but it is not a phenomenon pervasively associated with increased levels of speciation.

Keywords

biogeography, body size, cryptic species, dispersal, sexual selection, speciation, vicariance

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Presented at

19th ECM oral communication

Acknowledgements

I thank collaborators Dan A. Polhemus, Curtis P. Ewing, Arthur Medeiros, David Kavanaugh, Will Haines, and Paul Krushelnycky for sharing specimens and for their hard work in the field.

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Author contributions

The author served as primary investigator and senior author on all aspects of the reported research.

Conflicts of interest

The author reports no conflicts of interest for this research.