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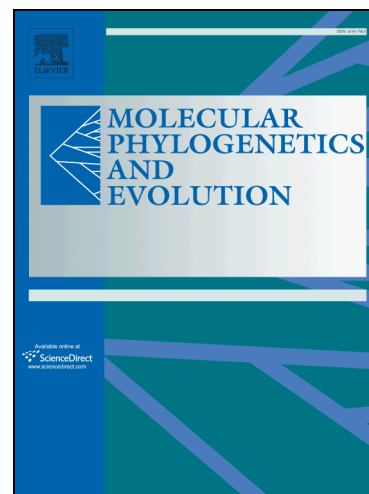
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The birth of aposematism: High phenotypic divergence and low genetic diversity in a young clade of poison frogs

Rebecca Dent Tarvin^{1,#,*}, Emily A Powell^{1,#}, Juan C Santos^{2,3}, Santiago R Ron⁴, and David C Cannatella¹

¹Department of Integrative Biology and Biodiversity Collections, University of Texas—Austin

²Department of Biology, Brigham Young University, Provo, UT

³Department of Biological Sciences, St. John's University, Queens, NY

⁴Museo de Zoología, Escuela de Biología, Pontificia Universidad Católica del Ecuador, Quito, Ecuador

#Authors contributed equally

*Corresponding author: E-mail: rdtarvin@gmail.com

Abstract

Rapid radiation coupled with low genetic divergence often hinders species delimitation and phylogeny estimation even if putative species are phenotypically distinct. Some aposematic species, such as poison frogs (Dendrobatidae), have high levels of intraspecific color polymorphism, which can lead to overestimation of species when phenotypic divergence primarily guides species delimitation. We explored this possibility in the youngest origin of aposematism (3–7 MYA) in poison frogs, *Epipedobates*, by comparing genetic divergence with color and acoustic divergence. We found low genetic divergence (2.6% in the 16S gene) despite substantial differences in color and acoustic signals. While chemical defense is inferred to have evolved in the ancestor of *Epipedobates*, aposematic coloration evolved at least twice or was lost once in *Epipedobates*, suggesting that it is evolutionarily labile. We inferred at least one event of introgression between two cryptically colored species with adjacent ranges (*E. boulengeri* and *E. machalilla*). We also find evidence for peripheral isolation resulting in phenotypic divergence and potentially speciation of the aposematic *E. tricolor* from the non-aposematic *E. machalilla*. However, we were unable to estimate a well-supported species tree or delimit species using multispecies coalescent models. We attribute this failure to factors associated with recent speciation including mitochondrial introgression, incomplete lineage sorting, and too few informative molecular characters. We suggest that species delimitation within young aposematic lineages such as *Epipedobates* will require genome-level molecular studies. We caution against relying solely on DNA barcoding for species delimitation or identification and highlight the value of phenotypic divergence and natural history in delimiting species.

Keywords: species delimitation; phenotypic divergence; introgression; warning signals; polymorphism; multispecies coalescent method

Abbreviations: bpp = Bayesian Posterior Probabilities, BP&P = Bayesian Phylogenetics and Phylogeography program, ML = Maximum Likelihood, ILS = Incomplete Lineage Sorting, TNHCFs = Texas Natural History Collections Field Series, MSC = MultiSpecies Coalescent, SNP = Single Nucleotide

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