Study of colorful crayfish challenges theories of bright coloration as adapted phenotype

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Credit: Zachary Graham

A pair of biologists, one with West Liberty University, the other with Arizona State University, both in the U.S., has found evidence that challenges theories surrounding bright coloration always functioning as

an adapted phenotype.

In their study, published in the journal *Proceedings of the Royal Society B: Biological Sciences*, Zackary Graham and Dylan Padilla Perez studied coloring and other attributes of hundreds of species of crayfish to understand why a creature that lives mostly in the mud at the bottom of rivers would have vibrant coloring.

Evolutionary theory suggests that accidental genetic mutations that offer some degree of advantage are preserved and passed on to future generations. Traits that serve little to no useful purpose but still require resources to maintain, on the other hand, tend to be phased out. But what happens when a genetic mutation does not serve a purpose but requires no resources to maintain? To learn more, they turned to the crayfish.

Crayfish (also known as crawfish and crawdads) are freshwater crustaceans that resemble small lobsters—there are more than 300 species in North America alone. They come in a variety of sizes and colors, and many of them spend most of their lives in the muddy bottoms of rivers or streams and only emerge at night.

Graham and Padilla Perez noted that some species, despite living in such conditions, still have vibrant coloring. The question is why. Most creatures with vibrant coloring use it to frighten predators or to attract a mate. Vibrantly colored crayfish do not appear to use their coloring for either purpose.

To determine why, the team undertook a study of the crayfish phylogenetic tree and compared coloring between species. They found that conspicuous coloring had evolved independently in more than 50 of the species on the tree.

They also found a correlation between the evolution of conspicuous

coloring and burrowing behavior and they suggest that tan coloring has evolved in many of the species due to pressure to blend in with their environment; they observed no examples of brightly colored crayfish maintaining their colors as they evolved to have more aquatic behaviors.

The researchers conclude that bright coloration evolved incidentally due to random mutations and was maintained because there was no evolutionary pressure for it to fade—until crayfish found a need to blend into the mud.

More information: Zackary A. Graham et al, Correlated evolution of conspicuous colouration and burrowing in crayfish, *Proceedings of the Royal Society B: Biological Sciences* (2024). DOI: 10.1098/rspb.2024.0632