Mystery of glowing shrimp deepens

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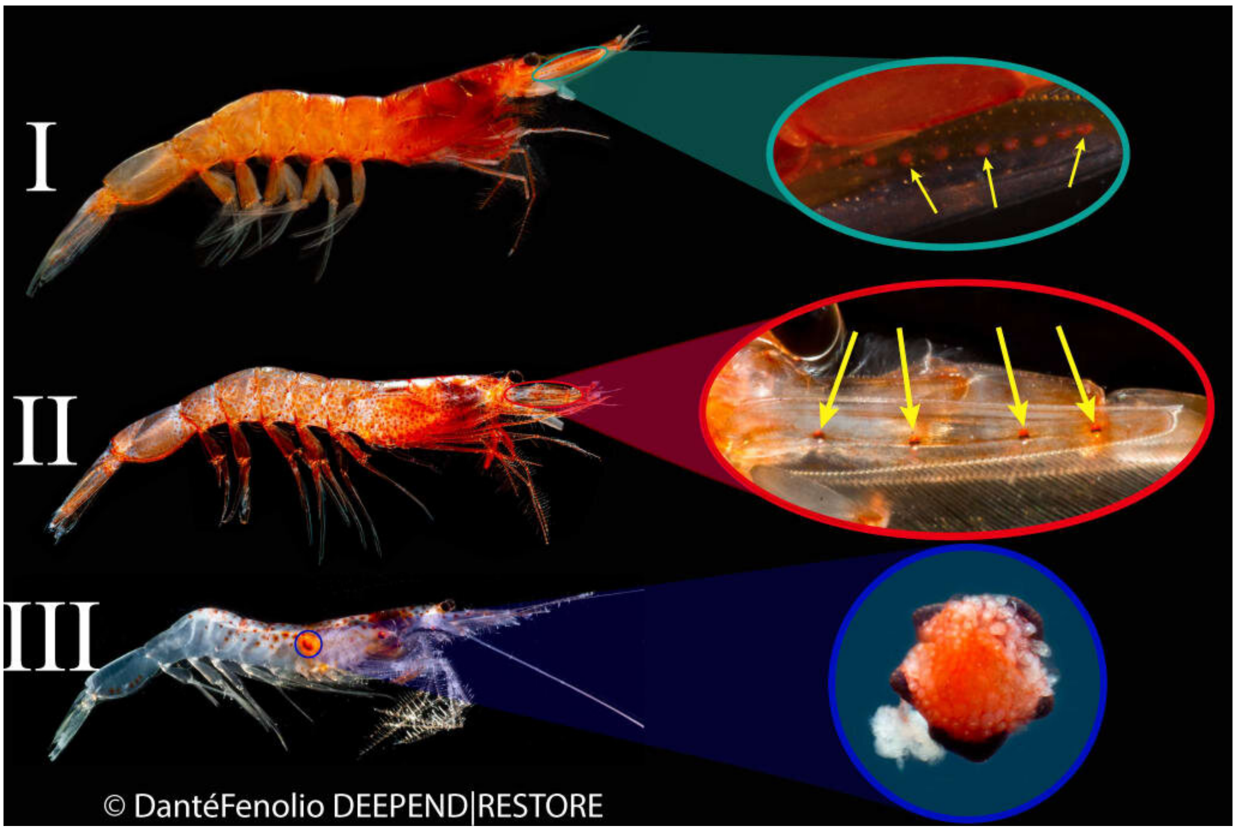

Many deep-sea shrimp glow but researchers have found the light organs in deep-sea shrimp may have evolved depending on depth and habitat.

FIU marine scientist Heather Bracken-Grissom and her graduate student Charles Golightly collaborated with a team of researchers to trace the evolutionary history of a family of deep-sea shrimp, the Sergestidae.

The shrimps' light organs, called photophores, vary in size, quantity and structure and some seem to be correlated with the habitat and depth at which they reside and vertically migrate within the water column. This research also revealed that the species that live in the deepest waters have evolved to have no photophores at all. This research begins to shine a light on how photophores have evolved, but many questions still remain.

"We have this one family of deep-sea shrimp, but they all have remarkable and unique variations of light organs. But why?," Bracken-Grissom said. "We wanted to understand why there was so much diversity. It was very cool to see that the organs might actually be adapted to the depth at which they are living, as well as the habitat."

Scientists believe the photophores play an important role in camouflage, helping the shrimp hide. As shrimp migrate to shallow waters, where downwelling light is present, the photophores turn on to mimic the light and help the shrimp camouflage themselves from predators. Recent evidence has also suggested these photophores may detect light.

The deep-sea shrimp from the Sergestidae family has three different variations of photophores—lensed, non-lensed and internal light organs called organs of Pesta.

The researchers employed a technique called ancestral state reconstruction to understand the evolutionary changes that led to so much photophore variation, including the lack of photophores in some species at deeper depths. As the name suggests, this involves running a statistical analysis that takes information from the living representatives to infer the type of light organs the ancestors had. Their analysis revealed the ancestor to all sergestids had internal light organs and the other types—lensed and unlensed—evolved once across the sergestid tree of life.

The team also compared the kind of photophores to data on depth and habitat. There were interesting and unique patterns. Species that spend their lives on the seafloor appear to all have lensed photophores, while those in shallower waters, where there's more sunlight, have the larger internal photophores or the non-lensed photophores. Species at the deepest, darkest depths of the ocean seem to have lost photophores altogether. After all, what good is light to disguise yourself if you live in a place with no light?

Even with this latest finding, photophores remain a mystery to scientists and in some ways, this new research creates new questions.

"We're just starting to understand that bioluminescence and light organs are used for a whole magnitude of things we just don't understand yet," Bracken-Grissom said. "We think there are other potential uses like recognizing each other."

The findings were published in *Invertebrate Systematics*.

More information: Charles Golightly et al, Tracing the evolution of bioluminescent light organs across the deep-sea shrimp family Sergestidae using a genomic skimming and phylogenetic approach, *Invertebrate Systematics* (2022). DOI: 10.1071/IS21013

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