Unique "cave animal" research focuses on eye degeneration

Dr. Meredith Protas' research at Dominican University of California, examining the genetic basis of eye and pigment loss in cave-dwelling crustaceans, could eventually provide important insight into eye degeneration in humans.

Protas is one of only a few researchers nationwide focusing on the genetic basis of eye and pigmentation differences in the isopod cave crustacean, *Asellus aquaticus*. Collected from Slovenia, the crustacean has both surface dwelling and cave dwelling populations with extreme morphological differences in eye size, pigmentation, and appendage length. Her goal is to investigate the genetics and developmental biology behind these morphological differences, and to understand how and why these characteristics evolved.

Protas, who joined Dominican's Department of Natural Sciences and Mathematics in 2014, began studying the invertebrate *Asellus aquaticus* as a post doc at UC Berkeley. She received her doctorate in genetics from Harvard Medical School, where she studied the genetic basis of morphological evolution in the vertebrate cavefish, and while doing so "became hooked on studying cave animals."

"Most people who study cave biology in a genetic manner study the species of cave fish I was working on in graduate school. I wanted to develop another system to study the genetic basis of cave characteristics, so I picked this unique species from Slovenia."

Asellus aquaticus is unique, in that one species has two forms. The surface form has pigment and eyes; the cave form is unpigmented and does not have eyes. Protas and her Dominican students are investigating the genetics and developmental biology behind these morphological differences in order to understand how and why these characteristics evolved, and how certain cave-related traits are gained and lost.

"Cave animals are one group with immense potential to address the mechanisms of evolutionary change," Protas said. "Similar morphological alterations, such as enhancement of sensory systems and the loss of eyes and pigmentation, have evolved multiple times in many different species."

The cave animals are bred and maintained in Protas' Dominican lab, living off dead and decaying leaves and stored in incubators kept at 12 degrees Celsius. Master's student Hafasa Mojaddidi is assisting on work studying the animal's embryos – comparing the embryos of the surface animals and the cave animals in order to determine when genetic changes occur.

Protas is also working on studies with a collaborator in Slovenia on research that examines different cave populations, asking whether the same or different genetic changes are responsible for similar characteristics, like eye and pigment loss. Earlier research conducted by Protas has supported the prediction that significant morphological change can be mediated through one or a few genes.

"Our goal is to develop an invertebrate model to study cave evolution so that, in combination with a previously established vertebrate cave system, we can address whether multiple species utilize similar or different mechanisms to achieve the same unique characteristics."

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