Improving aquaculture and identifying impact of climate change by researching crab molting

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The exoskeleton of a crab provides many benefits for the animal, including structural support and protection from predators and injury. The downside of having an exoskeleton is that it restricts the crab's growth, requiring the crab to molt, explains Don Mykles, a professor in the Department of Biology and leader of the CSU "Crab Lab." Molting is the process of shedding a crab's existing exoskeleton to make room for a new one.

This process is fundamental to the crab's biology—all other processes and activities revolve around molting. The decision of when to molt is important to the survival of individual crabs as they are more vulnerable to predators and competitors while undergoing this transformation.

Observing this process, Mykles and his team are asking, "How does an animal pull this off? How does an animal weigh environmental conditions and internal cues to make the decision to molt?"

Mykles will seek to answer this question as the leader of a five-investigator team at four universities awarded a $1.2 million National Science Foundation (NSF) grant. The researchers will use DNA and peptide sequencing to identify genes and proteins essential for the activation and repression of the molting process. They use a tropical species, the blackback land crab, as a model organism.

Stress and crowding are factors that can override internal cues that alert the crab that they need more room to grow inside of the exoskeleton. The crab can weigh hundreds, even thousands, of cues in its nervous system and then, when it is time, hormones will be secreted from the molting gland, initiating the physiological changes that prepare the crab to shed its exoskeleton.

The functions of the molting gland, both in committing the crab to molt and in repressing molting, are controlled by signaling genes. These signaling genes can serve as markers for environmental stressors, such as increased temperature, an observed impact of climate change.

Crustaceans are important components of many marine environments, existing in a middle trophic layer. Many fish and marine mammals feed on crustaceans. Information about their vulnerabilities during the molt cycle will inform fishery practices, as well as anticipate the adverse effects of environmental changes.

Understanding the key regulators of molting will also be useful in aquaculture, allowing for the molt cycle to be accelerated to produce rapidly growing strains of commercially-raised shrimp, lobsters, and crabs. These crustaceans can provide an abundant and high-quality source of protein for human consumption.

The research project will also involve an educational component. In collaboration with the College of Natural Sciences Education and Outreach Center, Mykles' team will develop lessons for middle- and high-school science teachers that translate the work being done here at CSU into sixth- to 12th-grade classrooms. The lessons will allow students to observe the molting process of another crustacean, the cherry shrimp. "It's very important to have open-ended discovery. This is how science works. We make observations and we construct a hypothesis about what's going on," said Mykles. "We've got to get more students

interested in science so that students learn how science is actually done."

Provided by Colorado State University

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