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Date:

Physiological Trade-offs: The potential cost of immunity in crustaceans
The immune response of shrimp against bacteria may impair its ability to escape predators

Many commercially-valued crustacean species, including the Atlantic brown shrimp, *Farfantepenaeus aztecus*, live in an environment where they face daily obstacles that threaten their survival. One common example is bacterial infection, which activates a response from the shrimp's immune system. Despite its effectiveness, researchers are discovering that this immune defense may come with its own drawbacks. Gaining knowledge of what may indirectly pose a hindrance to the shrimp's activity levels could be crucial in terms of fisheries and aquaculture management.

Alessandra Jimenez-Yap, an undergraduate student from Whitworth University and a summer intern with Dr. Karen Burnett of the College of Charleston (CofC), has been investigating the details of this trade-off in brown shrimp juveniles that are caught off the coast of South Carolina. The immune system in shrimp responds to infection by collecting the bacteria into the gills, which blocks blood flow and reduces oxygen uptake. Jimenez-Yap's research aims to figure out whether or not this condition of "internal hypoxia" affects the brown shrimp's primary escape behavior in response to predators (also known as tail-flipping).

The bacteria in question is *Vibrio campbellii (V. campbellii)* an opportunistic pathogen or disease-causing agent, commonly found in aquatic environments and maybe even in the shrimp themselves. Past studies have shown low, stable levels of *Vibrio*-type bacteria in a related shrimp species.

In Hollings Marine Laboratory, Jimenez-Yap introduces to the shrimp a concentrated yet sublethal dose of *V. campbellii.* via injection in order to spark an immune response. After several hours, infected shrimp and controls are induced to perform tail-flipping until fatigue. Tail-flipping is by itself an anaerobic activity, but oxygen is required to recover from fatigue. In order to investigate the details of how this behavior may be affected by the physiological trade-off of immune defense, the shrimp is tail-flipped twice with recovery time in between performances.

Investigating the costs associated with fighting infection is a major step towards understanding how these organisms survive in the face of various obstacles and trade-offs within their natural environment. "It is important to keep in mind that crustaceans must overcome multiple barriers in a constant fight to survive and thrive", says Dr. Karen Burnett, whose lab is focused on researching the mechanisms by which how such obstacles have a cumulative effect on crustaceans that can lead to changes in organism-level responses.

Jimenez's current study is funded by the National Science Foundation (NSF) and is part of the Research Experience for Undergraduates (REU) program hosted by CofC. Jimenez is one of ten selected students conducting scientific investigations pertaining to marine organism resilience and response to environmental change.

Overall, results from Jimenez's study may contribute to the general knowledge of what (and how) daily environmental factors ultimately affect shrimp survival and, on a grander scale, shrimp population dynamics. Both the immune system and tail-flipping activity of shrimp are vital, yet consequences of one may impact the other. Investigating potential relationships between the two can help determine whether immunity can have unexpected consequences for the survival of crustaceans.

For more information on this project and the NSF REU program, go to http://reu.cofc.edu/ and the CofC REU blog Web site: http://www.blogreu.wordpress.com/. Check out this youtube video for more information on Jimenez-Yap's project: https://www.youtube.com/watch?v=8fO_O-EJcZ4.

Jimenez-Yap tagging brown shrimp in wet lab. ©Alessandra J.

Atlantic brown shrimp in treatment tank. ©Alessandra J.

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