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Survival Tactics of Marine Animals in a Hypoxic, Low Oxygen Environment

Study of adaptations of the Atlantic mud crab to changes in estuarine oxygen levels

Hypoxia, or low amounts of oxygen, in coastal waters and estuaries has had significant effects on aquatic life. Because hypoxia occurs as a natural effect of aquatic respiration, it can fluctuate both seasonally and diurnally. Hypoxic conditions in the summer are influenced by temperature, pressure and salinity of the estuarine water. Some organisms have developed adaptations to cope with this oxygen deficiency. For example, the Atlantic mud crab, *Panopeus herbstii*, can increase the oxygen affinity of its hemocyanin, an oxygen carrying molecule. In order to better understand the mechanisms behind this adaptation, Bernard Akem, a visiting student from Northern Illinois University, joined the Burnett Lab at the College of Charleston as part of an undergraduate research program funded by the National Science Foundation (NSF).

Akem's project focused on the effects of prolonged hypoxia on the concentration and structural properties of the hemocyanin of mud crabs. Hemocyanin is the respiratory pigment used to transport oxygen in crustaceans and exists in two forms – hexamers and dodecamers. Akem hypothesized that there would be an increase in the hemocyanin concentration in response to hypoxia, and that there would be a shift toward the presence of more hexamers than dodecamers after exposure to hypoxia.

The experiment was conducted by exposing mud crabs to hypoxia or normoxia (full air saturation) for 2, 7, and 14 days and measuring the hemocyanin concentrations and the relative proportions of hexameric versus dodecameric hemocyanin in the two treatment groups.

Akem's study showed that the mud crab adapts to hypoxia by increasing the concentration of its hemocyanin. Higher levels of this respiratory pigment in *P. herbstii* allows more oxygen to be delivered to tissues when environmental oxygen is limited, not unlike the increase in hemoglobin when athletes train at high altitude. In addition, the mud crab adapts by increasing the relative amount of hexameric hemocyanin, the form that binds more tightly to oxygen. Akem's mentor Dr. Karen Burnett said, "Akem's data show that mud crabs do have some ability to adapt to prolonged hypoxia. However, it is not clear whether these adaptations can maintain the ability of this or other marine crabs to carry out normal activities, such as feeding, growth and reproduction, that are critical to long term survival of the species."

http://burnettl.people.cofc.edu/index.php
http://reu.cofc.edu/
https://www.youtube.com/watch?v=cqP4pXKuBds

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