Unusual Adaptations

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EVOLUTION OF THE MIMIC OCTOPUS

The remarkable mimic octopus (*Thaumoctopus mimicus*) has an astonishing repertoire of defense mechanisms. Like many of its relatives, the octopus sometimes uses camouflage to expertly blend into its surroundings, such as the sandy seabed bottom. More unusual, however, is its mimicry of other species. *Thaumoctopus mimicus* can undulate across the ocean floor, gracefully extending all eight legs backward to take on the shape, motion, and speed of a flounder, even flattening its head and positioning its eyes prominently, like flatfishes. It can also impersonate a venomous sea snake or lionfish. What is most rare is its ability to suddenly display a bold pattern of colors that would seem to draw a predator's attention—a risky strategy.

"Even among a group of animals for which instant shape changes and apparent disappearing acts are par for the course, the protean abilities of *T. mimicus* stand out," write Christine L. Huffard, science and monitoring adviser for Conservation International Indonesia, and her colleagues in the September 2010 issue of the *Biological Journal of the Linnean Society*.

Scientists did not describe *T. mimicus*, which lives in the coastal waters off Indonesia, until 1998, and there is still much to be learned about the animal. Scientists do not know, for example, whether the octopus is toxic to predators. There is also conflicting research about whether its defense mechanisms are learned or inherited. Huffard and researchers at the California Academy of Sciences explored scenarios for the octopus's behavior and morphology.

They used DNA sequencing—both their own and that done by others—of *T. mimicus* and 36 related species to learn the order in which the defense traits evolved. The researchers had predicted that flatfish swimming was an exaptation, with the mimic octopus first developing the sinuous movement of its long limbs for locomotion and then, at some later point, using that movement for mimicry. Instead, they discovered that the ability to swim like a flatfish evolved along with the octopus's very long arms.

According to DNA sequence analysis, the traits evolved in the following order: First came the ability to quickly change from camouflage to bold brown and white stripes, presumably to confuse a predator if camouflage failed; second, the octopus simultaneously developed its lengthy arms and its flatfish swimming ability; and finally, it rolled all these traits together—transforming to a bold color pattern while swimming like a flatfish—when it hunts for food in the daylight or when resting.

By displaying conspicuous brown and white stripes, rather than using camouflage, the mimic octopus takes a risk. *Thaumoctopus mimicus* may be unpalatable, and it thus gives predators honest warning, the researchers suggest; or, because many flatfish are toxic, the octopus may have evolved to mimic them. Even if the mimicry is imperfect, it would give predators pause—just long enough for the octopus to beat a hasty retreat.

OYSTER ADHESION UNIQUE

As part of scientific efforts to restore the health of *Crassostrea virginica* oyster populations, researchers at Purdue University and the University of South Carolina analyzed the adhesive that oysters use to stick together to form a reef, a system that is little understood. They discovered that the "glue" is a unique material not found in other shellfish or even in oyster shells themselves. Their findings were published in the 15 September issue of the *Journal of the American Chemical Society*.

"Our results indicate that there is a chemically distinct adhesive material holding the oysters together," says Purdue chemist Jonathan Wilker. "The cement contains significantly more protein than the shell."

That said, there is less protein in the cement of the oyster than in the adhesive material of mussels and barnacles. These animals employ softer organic glue, while the oyster adhesive is made up primarily of cementlike calcium carbonate.

Considerable research has been devoted to understanding and restoring the Eastern oyster, an important species both ecologically and economically. Oysters filter water, help prevent erosion, protect coastlines, and provide habitat for other organisms—not to mention their culinary contribution. Historically, populations of *C. virginica*, the oyster common to the Atlantic seaboard, stretched for miles, with billions of oysters constituting a sturdy reef. But their numbers have been decimated by pollution, overharvesting, and disease. In the Chesapeake Bay, oysters have declined to just 2 percent of their legendary numbers in the 1800s.

The adhesion research has other benefits related to the development of new materials for surgical adhesives. In addition, by better understanding marine bioadhesion, researchers may find ways to keep the hulls of ships clear of fouling organisms that cause drag and contribute to higher fuel consumption.

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