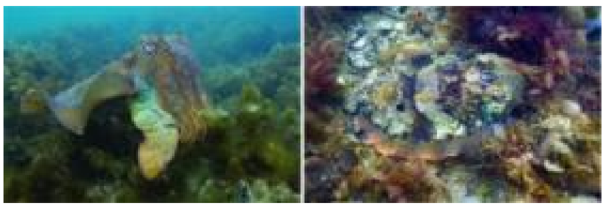
Now you see it, now you don't: Scientists unraveling the mystery of camouflage

January 15 2009



This pictture shows giant Australian cuttlefish, Sepia apama, in a conspicuous pattern while swimming, and then in a camouflaged pattern that combines "mottle" with "disruptive" coloration. Credit: Roger T. Hanlon

At Hogwarts, Harry Potter uses an invisibility cloak to hide from his enemies. In nature, animals like cuttlefish and chameleons use the awe-inspiring tricks of camouflage to hide from theirs.

Roger Hanlon, a senior scientist at the Marine Biological Laboratory (MBL), has spent 35 years studying animal camouflage, and in that time he has moved beyond awe at nature's disappearing tricks and discovered three broad classes of camouflage body patterns. He and his colleagues detail these three pattern classes, and how they achieve several mechanisms of visual deceit, in this week's issue of *Philosophical Transactions of the Royal Society B.* The issue is entirely devoted to camouflage.

"Camouflage is found throughout the animal kingdom, among big, small, wet, and dry animals, but it is probably one of the least-studied natural phenomena we know of," Hanlon says.

This is one of the first efforts to quantify camouflage body patterns. "No one has successfully quantified, for instance, what is exactly meant by 'background matching,' which is when an animal visually blends into its environment," Hanlon says.

Although Hanlon and colleagues have begun to compare camouflage tactics in many animals—large primates, amphibians, reptiles, fishes, insects—this week's analysis focuses on the cephalopods, which include squid, octopus, and cuttlefish. Remarkably, these soft-bellied mollusks are able to dynamically produce all three classes of camouflage body patterns (termed uniform, mottled, and disruptive).

"Cephalopods are the most changeable animal on earth for camouflage," Hanlon says. "There is no animal group that can equal it for speed or diversity of disguise. They have the widest range of patterns and they have the fastest change. Therefore, they are a good model to help unravel the general principles of camouflage."

Hanlon is developing a mathematical description of camouflage patterns that can be used comparatively across the animal kingdom to better understand this biological phenomenon. To accomplish this, his team developed a software program that measures the degree of contrast and granularity (spatial scale) in the light and dark patches on the animal's body. These two metrics allow them to broadly sort all kinds of photographs of animal camouflage into the three classes of body patterns.

Uniform and mottle patterns are what most people recognize as camouflage. The patterns function by resembling the background. Such background matching is not so simple, however. In cephalopods, there are few high-fidelity matches to the background. More commonly, there are varying qualities of match in terms of color, intensity, pattern or 3-dimensional texture of the skin. How to measure these in terms of visual perception by the predator is still a daunting task.

The patterns in the third class, disruptive coloration, tend to obscure the outline of the animal against certain backgrounds. While a predator might easily detect the pattern, it won't recognize it as prey. Disruptive coloration is a controversial camouflage mechanism among vision scientists. "It's a counterintuitive notion," Hanlon says. An extreme example is a panda bear in a tree. If viewed by looking up into the brightly lit sky, the bear's large-scale black and white patches may not be recognized as animal skin, but rather as disjunctive areas of shadow and bright light. "Viewed against the right background, that body pattern is just an odd jigsaw puzzle. The pieces don't connect into an animal," Hanlon says. His research marshals evidence that strongly supports the notion that disruptive coloration is a bona fide mechanism of camouflage.

As a next step, Hanlon and colleagues plan to quantify camouflage body patterns in fish. "We hope that other investigators will pick up this technique to describe and quantify camouflage patterns in other animal groups," he says.

"Visual predator-prey interactions are one of the most widespread phenomena known in natural selection," Hanlon says. "In terms of being an evolutionary force, camouflage is one of the great defenses."

Citation: R.T. Hanlon, C.-C. Chiao, L.M. Mäthger, A. Barbosa, K.C. Buresch and C. Chubb (2008). Cephalopod dynamic camouflage: bridging the continuum between background matching and disruptive coloration. Phil. Trans. R. Soc. B, doi:10.1098/rstb.20008.0270.

Source: Marine Biological Laboratory