Coloration and Behavior

by Lauren M. Dembeck

On October 24, Reade Roberts led a colorful social evening discussion on pigmentation and behavior. With cichlid models in hand, he provided examples of how pigmentation and behavior are intertwined.

He opened the discussion with an example from Lake Malawi, where sympatric species of cichlids reside. The males often sport vivid pigmentation patterns, which females use as visual cues to choose mates, generally preferring bright, colorful males. In contrast, the females have modest pigmentation that helps them hide from predators. Interestingly, the males have yellow spots on their anal fins called egg spots. In these species, the females are mouth-brooders. After a female lays eggs, she collects them in her mouth; when she runs out of eggs to collect, she will nuzzle the egg spots of the male, whereupon he will fertilize the now mouth-brooded eggs.

There are many intriguing cases where pigmentation and behavior coalesce. Stick insects, the order *Phasmatodea*, are not only camouflaged, but also tend to move in a jittery manner as if blowing in the wind. Roberts also cited an example of a predatory cichlid, *Haplochromis livingstoni*, which utilizes blotchy coloration to mimic a decaying fish and lies motionless on the ocean floor until an unsuspecting prey comes in proximity. Perhaps the most fascinating are the organisms that can rapidly modify their body color such as octopi, cuttlefish, and squid. For example, the Indonesian Mimic Octopus, *Thaumoctopus mimicus*, shifts both its body color and behavior to mimic poisonous sea snakes, flounder, and even lionfish. A highlight of the evening was a video showing how squid chromatophores can rapidly expand and contract to change body color. The video - "Insane in the Chromatophores"- is of Woods Hole squid (*Loligo pealei*) skin responding to a musical stimulus. The researchers cut off the ear buds from an iPod and inserted the wires into the squid's dorsal fin nerve. When the iPod sends bass frequencies the nerves fire an action potential. This causes the muscles in the chromatophores (pictured from video) to contract creating a flashy and beautiful display. View the video at http://www.youtube.com/watch?v=G-OVrI9x8Zs.

Aggression is also associated with body coloration. In cichlids and other fish, bars or vertical stripes are associated with higher levels of aggression and territorial defense, whereas fish with horizontal stripes tend to school and do not fight over territories. Similarly, animals that are domesticated or selected for "tameness" also show associated changes in body pigmentation. One of the best known examples is the fox-farm experiment, which has continued for over 40 years. Russian geneticist Dmitry K. Belyaev began selecting foxes for tameness. As in many other domesticated species, he observed the emergence of diverse morphological features, including dwarf and giant breeds, curled tails like in pigs and dogs, floppy ears, and piebald coloration, and a spotted or blotchy loss of pigmentation.

Reade Roberts showing models of pigmented fish

Pigmentation differences are also associated with mating strategies and preferences. In a virtual game of rock-paper-scissors, the three color morphs of the side-blotched lizard (*Uta stansburiana*) exhibit differing levels of aggression and mating strategies. Orange-throated males are hyper-aggressive and maintain large harems of females; however, yellow-throated males utilize a sneaker strategy to win some of the orange morph females. In contrast, blue-throated males guard a single female and, hence, are able to ward off the sneaker male, but still risk losing females to the dominant orange morph.

Another example are mating preferences in the aposematic Heliconius butterflies. Color pattern morphs form a hybrid zone throughout Central and South America and mating preference may drive speciation. *H. cydno* and *H.pachinus* males use the color of patches on the wings to choose mates. This color preference segregates with forewing color in hybrids, indicating a genetic association between the loci responsible for preference and color pattern.

Body color and behavior are intimately linked. Natural and sexual selection have led to beautiful, clever, and sometimes, extreme phenotypes.