To survive, tiger moths are bright for birds, click for bats

September 17 2008, By Krishna Ramanujan

The virgin tiger moth, Grammia virgo, has evolved warning signals to remind predators of its noxious taste. It is conspicuously colored to deter birds during the day and sound producing to deter bats at night. Image: Marie Louise Nydam

(PhysOrg.com) -- If you ate a spoiled hamburger from a fast-food restaurant, chances are you would be reminded of the experience every time you saw the chain's logo.

Similarly, some tiger moths taste noxious to birds and bats. And to remind these predators not to come back for seconds, the moths have evolved bright coloring and clicking sounds as warning signals.

A study by Cornell researchers, published in the Sept. 4 issue of *Nature*,

is one of the first to show that these "multimodal" signals -- those that use two different senses -- evolved independently as a response to a specific predator. That means that the bright coloring on some species of tiger moths are a visual signal of noxious taste to visually oriented birds, and the clicking sounds communicate the same message to acoustically oriented and nocturnal bats.

Different tiger moth species have the ability to display both or only one of these signals, but, the researchers discovered, there is no correlation between the two.

"We're interested in the evolution of these signals," said co-author Marie Nydam, a Cornell graduate student in ecology and evolutionary biology (EEB) who did the genetic analysis. John Ratcliffe, a former Cornell EEB postdoctoral researcher who is now at the University of Southern Denmark, is the paper's lead author.

"Most researchers focus on a single warning signal and a single sense," but this paper differs because it examines two signals directed toward two senses, Nydam added.

Evolutionary biologists have two main hypotheses for how these multimodal signals evolved, Nydam said. A single predator hypothesis proposes that two signals "might work together against a single predator," providing insurance that a predator is amply warned. A second hypothesis suggests that prey with multiple signals have different predators, and each signal has evolved to target a specific threat.

The researchers classified 26 species of tiger moths found at a site in southeastern Ontario, Canada, where both bats and birds live. Moth species were classified based on four characteristics: the date they emerged and whether they were active at night or during the day, were conspicuously colored and made ultrasonic clicks.

The timing of moth activity is important because foraging by nocturnal bats peaks from early July to mid-August. Birds, however, feed all year, with a slight plateau between early June and early July.

The researchers found that conspicuously white and brightly colored tiger moth species are more likely to fly during the day. During spring (when most bats are still hibernating), tiger moths do not produce clicks. Similarly, tiger moths that emerge later in the summer, when bats are prevalent, are more likely to defend themselves acoustically. Nocturnal moths also blend in more with their surroundings.

Provided by Cornell University