Bat avoidance behaviour in insects

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Some insects have evolved audition and evasive behaviors in response to selective pressure from bats, and other insects were pre-adapted to detecting ultrasonic signals. Some bats have evolved in turn, improving the range or resolution of sonar signals and serendipitously making them less detectable by insects. In other words, there is a kind of evolutionary escalation going on between bats and insects (Miller and Surlykke, 2001).

Moths, as do crickets and most insects that display bat avoidance behaviors, have tympanic organs that display phonotactic and directional hearing; they fly away from the source of the sound and will only have the diving behavior considered above when the sound is too loud or when, in a natural setting, the bat would be presumably too close to simply fly away. It was found that the moths' responses vary according to ultrasound intensity, diving towards the ground if the pulse was of high amplitude, or flying directly away from the sound source if the sound amplitude was low.

Crickets are preyed on by bats during the night while they fly from one place to another. The cricket will steer itself away from the source of the sound within a very short time frame (40–80 ms). The response is evoked by brief ultrasonic pulses in the 20 to 100 kHz range, pulses within the range of bat ultrasonic echolocating calls (Fullard *et al*., 2005).

In praying mantids, ultrasound avoidance behaviors are non-directional turns or power dives that are very effective in preventing capture by bats. The mantis ear, located in the midline between the meta-thoracic (third) legs, comprises two tympana within an auditory chamber that enhances sensitivity (Yager *et al*., 1990). A bilaterally symmetrical pair of auditory interneurons, accurately track the ultrasonic calls during the early stages of a bat attack.

Arctiid moths use a very different, but highly effective defense against bats. They produce loud ultrasonic clicks in response to ultrasound (Surlykke and Filskov, 1997). Depending on the species of moth and its ecology, the clicks may work by startling the bat, by jamming its echolocation system, or by warning of distastefulness (aposematism).

Green lacewings (Chrysopidae) have sensitive ears on their wings. Ultrasound causes flying lacewings to fold their wings and drop, an effective maneuver for evading capture by bats. Some tettigoniids use a similar strategy, although other species respond much like crickets.

The evolutionary arms race continues between bats and their insect prey, and undiscovered strategies await to be revealed. An individual bat can modify at least some of its strategies through learning, whereas insect counterstrategies appear through the slower process of natural selection. Does this mean insect strategies lag behind those of their predators? Perhaps not. The variability of an individual insect's anti-bat behaviors might be a response to the predator's ability to learn. Perhaps the "evitability" of the prey's behavior makes learning by the predator less effective.

References

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