Praying Mantises Play Top Gun

An ultrasonic ear and a knack for aerobatics enable some survival-driven insects to elude marauding bats

DARTING AND TWISTING THROUGH THE night sky, emitting radar-like pulses of ultrasound as it goes, a bat is an ace insect-snaring machine. No wonder that its prey have evolved spectacular countermeasures. Hearing the chirps of an approaching bat, moths fold their wings and suddenly drop groundward to shake their pursuers. Other insects such as green lacewings pull off related survival stunts. But the evasive maneuvers of the male praying mantis evoke something more than these marvelous behavioral innovations of capricious evolution: modern air war. In the words of neurobiologist David D. Yager of the University of Maryland, mantises employ nothing less than "the same strategy that Tom Cruise used in *Top Gun*."

At a meeting of the Acoustical Society of America in Baltimore last week, Yager described how flying male praying mantises—females of many species don't fly—rely on an ultrasonic ear as an "early warning system." Discovered 5 years ago by Ronald Hoy and Yager, then both at Cornell University, the ear, which resembles devices that warn a military pilot when enemy radar has locked onto his airplane, is buried in a groove on the underside of the abdomen. It is tuned to the humanly inaudible high-frequency chirps of bats scanning for food.

Within about a tenth of a second after the ear picks up either genuine or simulated bat chirps, the mantises begin a series of extraordinary aerobatic moves. They extend their forelimbs—ordinarily folded in "prayer"—into a Superman-like stretch. They flip up their abdomens. "That throws them into a stall," Yager says. Next, the insects slide into a steep roll. They finish with a "power dive," during which their air speed doubles from their cruising clip of about 2 meters per second.

Some insect-eating bats can flap through the air at up to 9 meters per second, but the slower mantises outmaneuver them with their evasive choreography. "We can show mathematically that mantises should be able to avoid most bat challenges," Yager says.

Even surprise can't necessarily overcome the mantis advantage. As a bat approaches to chomping distance, a mantis hears louder and louder chirps. In such tight spots, the mantis adds a spiral trajectory to the power dive. If a bat predator has enough right stuff to remain on the insect's tail, some mantises turn to their last tactical resort: Instead of pulling out of the dive, they execute crash landings. Small and sturdy, a mantis survives the impact, and the bat pursuer shows its wisdom and gives up the chase.

Yager, Michael May of Cornell University, and a team of assistants teased out the basic components of these maneuvers in two sets of studies. In one set, they tethered insects with string and wax to a tongue depressor and placed the bound insects in front of a fan, which served as an aerial equivalent of a treadmill. That arrangement allowed the scientists to watch how the insects changed their aerodynamic postures in response to electronically produced bat chirps. In another set of studies, carried out in an open atrium at Cornell, Yager and his colleagues observed and photographed the effects of these changes on mantises in free flight. The bats, again, were simulated: The investigators used a "batgun" to bombard the insects with ultrasonic chirps.

With the help of bat scientist M. Brock Fenton and assisting "bat people" from York University in Ontario, Yager and May were able to see whether the evasive maneuvers actually work in nature. Working in Pinery Provincial Park in southwestern Ontario, the group released a variety of captive mantises and waited for hungry bats to swoop in. The 250 mantises released included species that have ears sensitive to the local bats' echolocation frequencies together with species whose ears are tuned to the higher frequencies of other kinds of bats. Those mantises presumably were deaf to the airborne dangers in Pinery Park.

The releases drew a total of 11 bat attacks, six of them involving nonhearing mantises. "Bats caught five of them," Yager said. None of the five attacks on hearing mantises was successful—good evidence that the insects' aural countermeasures and tricky flying help them survive in hostile airspace. For an insect that was considered deaf before 1986, the praying mantis has quickly ascended to Top Gun status in the business of avoiding bats.

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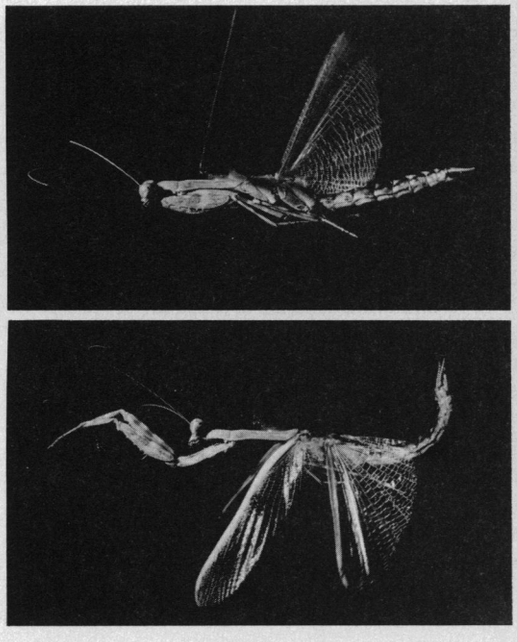

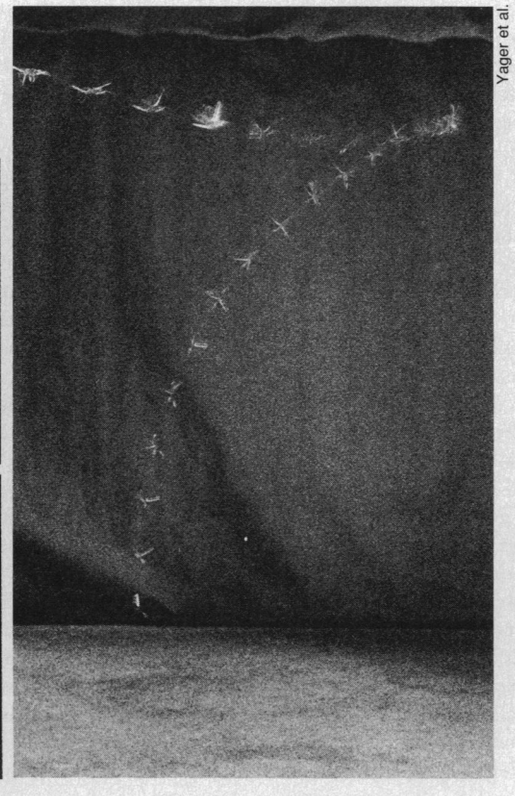

Yager et al.

Ace mantis. *From prayer position to Superman, triggering a spiral dive.*