Bee-friended mistletoe gets needed help

Small enough to ride on the head of a honeybee and sometimes mistaken for a fly, each drab bee of the genus *Hylaeus* in the United States tends to "literally go unnoticed, just another of the forgotten pollinators," observes bee expert Stephen L. Buchmann of the U.S. Department of Agriculture's Agricultural Research Service in Tucson.

Half a world away, however, other tiny bees of that genus are winning considerable respect for an amazing engineering feat: They can unlock the tightly sealed blooms of New Zealand's imperiled mistletoe.

These parasitic plants spend their lives in the limbs of trees. Lacking roots, they bore through bark and make themselves at home, gently siphoning off their water supply from their host.

Kelly

Bee videotaped wrestling open a mistletoe bud.

New Zealand's giant mistletoes, which can live a century and grow to 9 feet in height and width, produce large scarlet buds at Christmastime. The buds cannot open without outside help, however. Last year, Dave Kelly and Jenny J. Ladley of the University of Canterbury in Christchurch, New Zealand, described how the flowers' tough petals are sealed together in the floral equivalent of a childproof cap.

The researchers also observed some native birds that twist off the ends of the fingerlike buds during the roughly 5-day window when a flower is ripe. Severe predation by nonnative animals, including rats, ferrets, and cats, is cutting the population of such birds, leaving the future of New Zealand's mistletoes in jeopardy. If their flowers aren't opened and pollinated, the plants won't fruit 3 months later to produce seeds for a new generation.

In the Dec. 19–26 NATURE, the Canterbury researchers and their colleagues now report that native *Hylaeus* can wrestle ripe mistletoe buds open.

"They crawl all over the top, digging in and biting," Kelly observes. "Arching their backs, they push and pull and heave." Often, nothing happens. "But when they're successful, the flower explodes open, and they hit [pollen] pay dirt," explains Kelly, reached while he was videotaping the solitary bees in beech trees on the slopes of Mount Cook.

Most flowers, with their distinctive sizes and colors, "have evolved to be opened by only one or a small group of closely related pollinators"—usually either insects or birds, notes plant ecologist Thomas Hemmerly of Middle Tennessee State University in Murfreesboro. "For the same flower to be opened by both, that's novel," he says.

Adds Buchmann, this finding "helps get rid of the belief that there is an almost lock-and-key, one-to-one matching between a pollinator and its favorite blossom." However, "there remains a question of how fully [bees] are taking up the slack," cautions ecologist William F. Morris of Duke University in Durham, N.C.

The bees don't appear to be nearly as efficient as birds in opening mistletoe buds. "That difference," Morris says, "might tip the balance between a plant population that's viable over the long term or [one that's] declining."

In fact, for all the help that the bees offer in pollination, they can't disperse the seeds that develop in autumn. For that, Kelly says, "you've got to have a bird that will eat the fruit and move its seeds"—via feces—to another tree. This argues, he says, for controlling the native birds' predators. —*J. Raloff*

Robotic moth reveals key to insect flight

In Tom Wolfe's novel *The Right Stuff*, fighter pilots proved their mettle by "pushing the envelope" of each test plane's capabilities. Now, researchers have discovered that insects push the envelope every day, creating extra lift by finessing the laws of aerodynamics.

Whether on jumbo jets or bumblebees, wings create more lift as they increase pitch—their angle relative to flight direction. However, for insects to lift their weight, they would seemingly need to tilt their wings backward so far that the smooth flow of air would be ruined. The resulting turbulence should cause the bugs to stall and plummet. "According to developed theory, they couldn't generate enough lift," says Charles P. Ellington of the University of Cambridge in England.

Seeking an explanation for this apparent paradox, Ellington and his colleagues first tethered hawkmoths, *Manduca sexta*, inside a wind tunnel. By lacing the air with smoke, they could observe the flow around the insects' wings.

Inside the tunnel, the flapping moths increased the pitch of their wings during each downstroke. The scientists saw a spinning vortex of air whirl along the wing's leading edge, traveling from wing base to tip on each stroke. Instead of crashing when the pitch became steep at the end of a stroke, the moths started the next stroke a critical instant before the airflow became turbulent.

"Insects take advantage of stall taking a moment to develop," says Ellington.

To test this theory, the scientists built a robotic hawkmoth that released colored smoke from the front of its wings. The team describes its studies in the Dec. 19–26 NATURE.

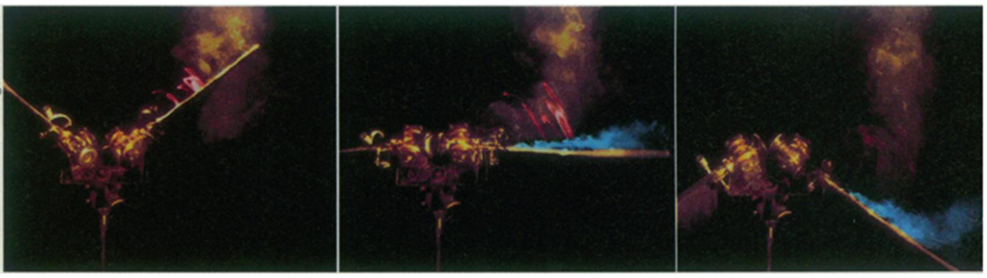
To correct for the difference in size—the robot is 10 times larger than the moth—the robot flaps at a lackadaisical one beat every 3 seconds. Moths move their wings 100 times faster. "It's lovely, you sit in a chair and watch the vortices," says Ellington.

He reports that spirals of air move along the robot's wings. When wing pitch reaches the angle at which the robot would be expected to stall, the vortices pull smoothly away from the wing, just as an upstroke begins.

"In effect, they've shown us how insects can fly," says biologist R. McNeill Alexander of the University of Leeds in England. He notes that theoretical studies had sliced the wing into two-dimensional sections and summed the lift from each part, ignoring airflow along the wing.

Though they see few immediate applications, entomologists are pleased by the findings. "We've been waiting 20 years for this," says Alexander. —*D. Vergano*

Ellington/NATURE



Inside a wind tunnel, the robotic hawkmoth injects blue smoke into the air flowing over its wings. The smoke, captured by vortices on the wing's leading edge, widens during the downstroke (left to right). The robot avoids stall at the end of the downstroke, where the blue smoke begins to separate from the wing, by quickly beginning an upstroke.