Trading energy for safety, bees extend legs to stay stable in wind

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New research shows some bees brace themselves against wind and turbulence by extending their sturdy hind legs while flying. But this approach comes at a steep cost, increasing aerodynamic drag and the power required for flight by roughly 30 percent, and cutting into the bees' flight performance.

The findings are detailed in the Proceedings of the National Academy of Sciences.

"Wind is a universal part of life for all flying animals," says Stacey Combes, assistant professor of organismic and evolutionary biology in Harvard University's Faculty of Arts and Sciences. "Yet we know

remarkably little about how animals navigate windy conditions and unpredictable airflows, since most studies of animal flight have taken place in simplified environments, such as in still air or perfect laminar flows. Our work shows clearly that the effect of environmental turbulence on flight stability is an important and previously unrecognized determinant of flight performance."

Together with Robert Dudley of the University of California, Berkeley, and the Smithsonian Tropical Research Institute, Combes studied 10 species of wild orchid bees that fly at high speeds for tens of kilometers each day seeking food and other resources. Males of these species are especially motivated to collect aromatic scents in pouches on their oversized hind legs, which are then used in mating displays that attract females.

Because male orchid bees are so strongly attracted by scents, they will readily traverse severe conditions, such as those created when Combes and Dudley set up powerful air jets in the bees' Panamanian jungle habitats. Using high-speed video, the scientists measured the bees' maximum flight speed as they were buffeted by varying levels of environmental turbulence. In every case, the bees displayed a side-to-side rolling motion at high flight speeds, negotiating the turbulence by extending their rear legs while in flight.

"This increases the bees' moment of inertia and reduces rolling," Combes says, "much like a spinning ice skater who extends her arms to slow down."

This rolling increased with flight speed until the bees were rolled to one side or the other roughly 80 percent of the time, at which point the bees would become unstable and either crash to the ground or be blown from the airstream. Bees were able to reach higher speeds when flying in lower levels of turbulence, altered through the use of different types of

screens to deflect air flow in the air jet.

While Combes and Dudley only studied 10 species of euglossine bees, Combes says that this stabilizing behavior is likely to be seen across *Hymenoptera*, the order of insects that includes bees, wasps, ants, and sawflies, and that turbulent airflow may decrease the flight performance of many other flying insects as well.

Source: Harvard University (news : web)