Big bees fly better in hotter temps than smaller ones do

October 28 2018

Honeybee (Apis mellifera) landing on a milk thistle flower (Silybum marianum). Credit: Fir0002/Flagstaffotos/ Wikipedia/GFDL v1.2

Arizona State University researchers have found that larger tropical stingless bee species fly better in hot conditions than smaller bees do. Larger size may help certain bee species better tolerate high body temperatures. The findings run contrary to the well-established temperature-size "rule," which suggests that ectotherms—insects that rely on the external environment to control their temperature—are larger in cold climates and smaller in hot ones. The research will be presented today at the American Physiological Society's (APS) Comparative Physiology: Complexity and Integration conference in New Orleans.

Insects fall into three categories:

- ectotherms (reliant on environmental temperatures for their own body temperature),
- poikilotherms (reliant on environmental temperatures but can control their own temperature—or thermoregulate—by sun- and shade-seeking or other behaviors), or
- endotherms (which can physiologically warm themselves).

"Bees fall along this entire range," explained lead author Meghan Duell, a graduate student at Arizona State University. "Most [insects] employ some means of behavioral thermoregulation. As body size increases, it's more likely that insects will be able to behaviorally and physiologically thermoregulate, especially in flying insects. Bigger bees, like bumblebees or the larger species in the work I'm presenting, are partially endothermic. They can warm themselves by shivering their flight muscles to produce heat but do not constantly physiologically regulate body temperature."

Excessive heat, such as that in the rainforests of Panama where the bees in this study originated from, can limit a bee's ability to fly. "If bees stop flying as often in hot temperatures, the amount of time they have to forage (and therefore pollinate flowering plants) decreases. This can mean they aren't able to collect enough food to maintain the colony," Duell said. "On a large enough scale, this negatively impacts the overall bee population and the plants they pollinate while collecting pollen and nectar for food."

Therefore, better flying performance is an advantage for bees in hot climates. Bees that are unable to fly in hot conditions ultimately end up walking from flower to flower, which is far less efficient than flying and means they are subject to even hotter temperatures on the surfaces of flowers and leaves.

In the new study, Duell and her collaborator, Jon F. Harrison, Ph.D., measured air and thorax temperatures of 10 species of stingless bees—which varied in body mass between 2 and 120 milligrams—to assess how well bees fly at high temperatures and the variations seen based on body size. The researchers also measured leaf and flower surface temperatures and air temperatures in sun and shade within the bees' native tropical forest canopy.

With the temperature-size rule in mind, the researchers were expecting the smaller bees to perform better in hot weather. Surprisingly, the opposite was true. Their findings showed that large bees seem to have adapted to the high temperatures and by using their ability to maintain their own heat. This flight performance advantage was also seen in cooler altitudes of the hot Panamanian rain forest.

"Essentially the bigger bees are exposed to higher temperatures—sometimes in excess of 10 degrees Celsius hotter than air temperature—because they produce a lot of heat while flying. That same heat producing ability gives them an advantage in cooler regions as well because they can be active earlier in the morning, later into the evening or on cooler days compared to smaller bees," Duell said.

Provided by American Physiological Society

Citation: Big bees fly better in hotter temps than smaller ones do (2018, October 28) retrieved 1 May 2024 from https://phys.org/news/2018-10-big-bees-hotter-temps-smaller.html