

FORMIDABLE

Fliers

In search of food, fruit flies can cover extraordinary distances in a single flight.

By Lori Dajose (BS '15)

In 2005, an ultramarathon runner ran continuously 560 kilometers (350 miles) in 80 hours, without sleeping or stopping. This distance was roughly 324,000 times the runner's body length. Yet this extreme feat pales in comparison to the relative distances that fruit flies can travel in a single flight, according to new research from the laboratory of Michael Dickinson, the Esther M. and Abe M. Zarem Professor of Bioengineering and Aeronautics.

Fruit flies, Dickinson and his group discovered, can fly up to 15 kilometers (about 9 miles) in a single journey—6 million times their body length. To measure how flies disperse and interact with the wind, the team designed “release and recapture” experiments, releasing hundreds of thousands of flies on a dry lakebed in California's Mojave Desert, and luring them back into distant traps containing fermenting juice in order to measure the insects' flying speeds. Led by former postdoctoral scholar Kate Leitch, the group made several trips to Coyote Lake, with hundreds of thousands of the common lab fruit fly, *Drosophila melanogaster*, in tow.

Once onsite, the researchers set up 10 “odor traps” in a circular ring, each trap located along a 1-kilometer radius around the release site. The traps contained a tantalizing cocktail of fermenting apple juice and champagne

To watch a video about this research experiment, go to magazine.caltech.edu/post/flies

yeast, a combination that produces carbon dioxide and ethanol, which are irresistible to a fruit fly. The traps also each had a camera and were constructed with one-way valves so that the flies could crawl into the trap toward the cocktail but not back out. In addition, the researchers set up a weather station to measure the wind speed and direction at the release site throughout each experiment; this would indicate how the flies' flight was affected by the wind.

Before the release, group members first placed the traps and checked them over time, and found that although *D. melanogaster* are found at date farms within the Mojave, they are extremely rare at Coyote Lake, so the researchers could be confident that the flies they were catching were their own fruit flies.

At experiment time, the group drove the buckets of flies, which had been harvested from a fruit stand in the area and then raised in the lab, to the center of the circle of traps. The buckets contained plenty of sugar so that the insects would be fully energized for their flight; however, they contained no protein, giving the flies a strong drive to search for protein-rich food. The group estimated that the flies would not be able to smell the traps from the center of the ring, forcing them to disperse and search.

At a precise time, a researcher at the center of the circle opened up the buckets simultaneously and quickly released the flies.

"The person who stayed at the center of the ring to open the lids off of all the buckets witnessed quite a spectacle," says Leitch. "It was beautiful. There were so many flies—so many that you were overwhelmed by the whirring drone. A few of them would land on you, often crawling in your mouth, ears, and nose."

The researchers repeated these experiments under various wind conditions.

It took about 16 minutes for the first fruit flies to cover 1 kilometer to reach the traps, corresponding to a speed of approximately 1 meter per second. Previous studies from the lab showed that a fully fed fruit fly has the energy to fly continuously for up to three hours; extrapolating, the researchers concluded that *D. melanogaster* can fly roughly 12 to 15 kilometers in a single flight, even into a gentle breeze, and will go farther if aided by a tailwind. The fruit flies traveling approximately 6 million times their average body length is the equivalent of the average human covering just over 10,000 kilometers in a single journey—roughly the distance from the North Pole to the equator.

"The dispersal capability of these little fruit flies has been vastly underestimated. They can travel as far or farther than most migratory birds in a single flight. These flies are the standard laboratory model organism, but they are almost never studied outside of the laboratory and so we had little idea what their flight capabilities were," Dickinson says. 🍷

Read more about Kate Leitch's experiences at Coyote Lake on page 10.

