

Many smaller animals clean themselves to survive, study finds

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Credit: Lilla Frerichs/public domain

Going without a shower for a few days might make you feel gross, but for small animals like bees and houseflies, keeping clean is a matter of life or death.

A mosquito flying through the fog of the early morning may find its wings so weighed down by [water droplets](#) that it can no longer search for food. A honeybee can easily pick up five times its body weight in pollen over the course of a day.

"It's all relative," said Guillermo Amador, a doctoral student at Georgia Institute of Technology. "To us, a particle of dust doesn't mean anything, but if a mosquito accumulates too many of them it gets too heavy to fly."

Amador is the coauthor of a recent study that examines the dangers of getting dirty in the natural world, as well as different strategies animals have developed to keep themselves clean.

The results could lead to new self-cleaning technologies to keep solar panels and remote camera sensors dust-free.

The study, published in the *Journal of Experimental Biology*, was inspired by Amador's previous work on the function of eyelashes. Together with his adviser, David Hu, a mechanical engineer at Georgia Tech, Amador discovered that the length and thickness of an animal's eyelashes are designed to reduce airflow over the eye while not interfering with the ability to see.

The eyelash study was such a success that the two decided to keep looking at the role of hair in biological systems.

The original plan was to study the function of the hairs between the eyes of insects. However, the researchers quickly found that no one had quantified how much hair insects have, or how it compares with the hair on mammals.

"The first result we stumbled on is that these animals, especially insects, have a lot of hair," Amador said.

The researchers examined 17 mammals and 10 insects and found that the two hairiest were the hair streak butterfly and the luna moth, which each have nearly 10 billion hairs. That's an order of magnitude of more total body hair than a beaver or sea otter. A human head has about 100,000 hairs.

They also discovered that honeybees and gray squirrels have the same number of hairs on their body - 3 million - even though the bee is three orders of magnitude smaller in mass.

The research team is not entirely sure why insects are so hairy. One thought is that their densely packed hairs create a water-repellent surface. Water beads up and rolls off. Scientists also have found that these hairs serve as sensors, detecting air currents and when the animal has been touched.

But with more hair comes more surface area, and

more places for particles to stick. That makes a furry animal's job of staying particle-free more challenging. Amador and Hu calculated that the surface area of a honeybee is equal to the area of a slice of bread. A cat has the [surface area](#) of a pingpong table.

To find out how small insects keep themselves clean, the scientists made super-slow-motion videos of pollen-covered honeybees and fruit flies grooming themselves. While watching these videos, they noticed that pollen was flying off the honeybees at extremely high speeds.

Further examination revealed that the bees were using their legs to bend hairs on their body. When the hairs were released, they snapped back to their upright state. The force of that action flicked the pollen off their bodies.

A colleague, Andrew Dickerson, discovered that mosquitoes can flutter their wings at high speeds to remove water, an action similar to the shaking of a wet dog. He also observed that these animals often fall deliberately, which can also remove water droplets.

We can picture mammals like dogs and cats using their tongues to keep themselves clean, but it turns out flies do that too, Amador said. When you see a housefly rubbing its arms together soon after landing, it is actually rubbing its arms over its body and then using its tongue to lick particles off its hands.

Stick insects and beetles have been observed wiping body parts on the ground to remove particles, much like most of us do when we step in dog feces. Ants secrete chemicals with antibiotic properties, and when bacteria land on cicadas, the [insects](#) can pop them like water balloons using sharp points on their wings.

Amador said one of the biggest take-aways of the study for engineers is the idea that hairiness may actually improve cleanliness.

"Traditionally when we want to keep something clean we make it really smooth so nothing will stick to it," he said. "But in biology that is not the case.

We see these animals that want to maintain cleanliness actually make themselves hairier."

He suggests that putting hair-like structures around surfaces we want to protect may prevent accumulation of particles, just like it does in the animal world.

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