The Outside Story

Mosquitoes in the Rain

By Rachel Sargent Mirus

If you're a mosquito and it's a warm spring afternoon, you're out cruising the air currents on your tiny wings. But as you buzz around, the sun warming your exoskeleton, the clouds roll in, heralding a spring shower. Balls of water up to 50 times heavier than your body begin plummeting out of the sky. You're too slow to evade the giant drops; it's only a matter of time before one will hit you!

For tiny flying insects, such as mosquitoes and their relatives, rainfall is a completely different experience than it is for other animals. Their relative size to the raindrops makes it a potentially life-threatening situation. When drops hit a larger creature, they break apart in a splash, and the only result is a wet animal. But what happens to insects, when being hit by a raindrop is a full-body mid-air collision?

Andrew Dickerson, a researcher at the University of Tennessee, who investigates how liquids flow under different conditions, asked this question. He put mosquitoes in enclosures and dropped water on them at about half the speed of falling rain. He described this experiment as "the human equivalent of raindrops the size of Volkswagen Beetles falling from the sky."

Flying insects do have an advantage over humans when dealing with water: they are extremely water-repellent. They have wax-coated hairs on their bodies that make them more hydrophobic than their aquatic or terrestrial cousins. This means that when they are hit by water, it is more likely to slide or bounce off than it is to remain stuck to them. "It would be like us walking around with a coating of Teflon," Dickerson said.

Natural raindrops vary in weight and size, but usually come in around 4-100 mg, with a radius of 1-4 mm. Insects that weigh in at under 3 mg, including mosquitoes, blackflies, and fruit flies, are smaller than a raindrop. When one hits their body, it remains mostly spherical and doesn't break apart into a

classic crown-shaped splash. Instead, it gives the insect a solid push downwards. When this happens, they experience accelerations that are 100-400 times stronger than gravity. By comparison, the greatest acceleration humans can survive is 50 times gravity.

Small insects can shrug off these extreme accelerations because they have so little mass that the actual forces generated are also small. Additionally, smaller animals are proportionately stronger than their larger counterparts. If we imagine doubling the mass of a mosquito, that super-mosquito would be stronger, but it wouldn't double in strength relative to a normal-sized mosquito. While getting hit with balls of water 50 times our body weight sounds terrifying for a human, flying insects are actually better prepared to survive such an experience than we are.

Perhaps this is why Dickerson's mosquitoes didn't appear alarmed about water collisions. In his lab experiments, he never saw mosquitoes attempt evasive maneuvers before being struck by water drops. A mosquito's maximum flight speed is so much slower than the speed of a falling raindrop that Dickerson calculated they would rarely, if ever, succeed at avoiding such a collision even if they did try. Although, if they reacted quickly enough, they might turn a full body strike into a glancing blow.

He also never saw mosquitoes attempt to actively shed water after being hit, like how mammals shake to dry off more quickly. They didn't show any behavioral tricks to free themselves from the water. Instead, they relied on their natural water repellency to passively separate from a ball of rainwater.

Still, the intensity of the everyday experience of rain for insects is hard to imagine. A mosquito braving a raindrop collision is "like a Teflon-coated Hulk being hit by a car," said Dickerson. So next time you feel mildly inconvenienced by the rain, imagine instead that you're cruising the air as an insect. Each drop is a giant ball of water which can send you plummeting towards the earth. When one hits you, you tumble downwards at terrifying speeds before recovering and continuing your flight. Just another day in the rain.

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