

## SCIENCE TAKE

# The Hummingbird as Warrior: Evolution of a Fierce and Furious Beak

Winsomely captured in poems and song, the birds are yielding new secrets about their astounding beaks and penchant for violence.



By **James Gorman**

Feb. 5, 2019

If you want to know what makes hummingbirds tick, it's best to avoid most poetry about them.

Bird-beam of the summer day,

— Whither on your sunny way?

Whither? Probably off to have a bloodcurdling fight, that's whither.

John Vance Cheney wrote that verse, but let's not point fingers. He has plenty of poetic company, all seduced by the color, beauty and teeny tininess of the hummingbird but failed to notice the ferocity burning in its rapidly beating heart.

The Aztecs weren't fooled. Their god of war, Huitzilopochtli, was a hummingbird. The Aztecs loved war, and they loved the beauty of the birds as well. It seems they didn't find any contradiction in the marriage of beauty and bloodthirsty aggression.

Scientists understood that aggression was a deep and pervasive part of hummingbird life. But they, too, have had their blind spots. The seemingly perfect match of nectar-bearing flowers to slender nectar-sipping beaks clearly showed that hummingbirds were shaped by co-evolution.

It seemed clear that, evolutionarily, plants were in charge. Their need for reliable pollinators produced flowers with a shape that demanded a long slender bill. Hummingbird evolution obliged.

But hummingbirds also heard the call of battle, which demanded a different evolutionary course. Some of those slender, delicate beaks have been reshaped into strong, sharp and dangerous weapons.

In a recent paper organizing and summing up 10 years of research, Alejandro Rico-Guevara and his colleagues at the University of California, Berkeley, shared evidence gathered by high-speed video about how the deadly beaks are deployed in male-to-male conflict.

Like the horns of bighorn sheep or the giant mandibles of stag beetles, hummingbird beaks are used to fight off rivals for mates. This is sexual selection, a narrow part of natural selection, in which the improvement of mating chances is the dominant force.

The males use their bills to stab other males, and to fence — feinting and parrying, sometimes knocking the other bird off a perch. Some hummingbirds even have hooked beaks, with serrations that look like shark's teeth. Dr. Rico-Guevara's high-speed video shows males tearing out another bird's feathers with those grippers.



The beak of a male tooth-billed hummingbird, found in the forests of Colombia, is adapted for battle. Kristiina Hurme

This is only one of several findings by Dr. Rico-Guevara and others that have recently changed the way hummingbirds are understood, including the unusual way they process sugar, the way they use their tongues in nectar drinking, and the evolution of bill shape.

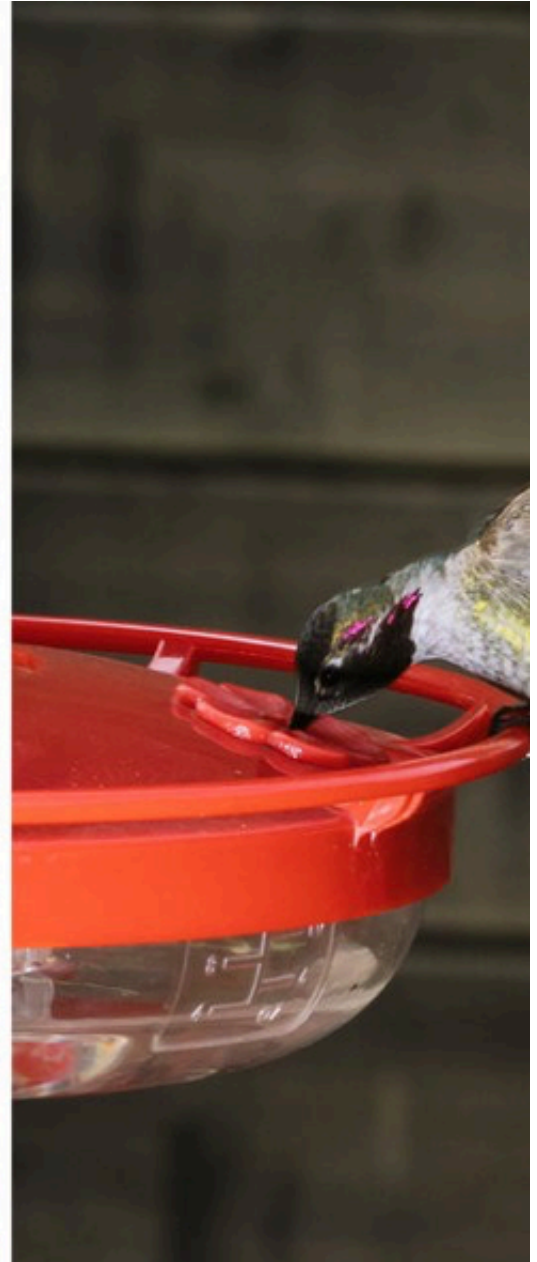
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Douglas Altshuler, an ornithologist at the University of British Columbia, in Vancouver, said that Dr. Rico-Guevara's thoroughness and attention to detail have pushed research on hummingbirds to new levels of excellence. "I think the body of work is great," he said.

Richard Prum, an ornithologist at Yale who studies the kind of evolution that produces extreme male characteristics, described the research as spectacular: “Love this guy, love his work.”

Dr. Rico-Guevara began his study of hummingbirds as an undergraduate at the National University of Colombia. His adviser was Gary Stiles, a leading expert on hummingbirds, under whose tutelage Dr. Rico-Guevara wrote an honors thesis on how hummingbirds hunt insects to supplement their diet of nectar, which is pure sugar.

At about the same time, Margaret A. Rubega, an evolutionary biologist at the University of Connecticut, published a paper in *Nature* on the way hummingbirds bend their bills to capture insects. One thing led to another, and Dr. Rico-Guevara ended up at UConn, doing his Ph.D. research with Dr. Rubega on hummingbird tongues.



Alejandro Rico-Guevara, an expert on hummingbirds, at the University of California, Berkeley, left; and an Anna's hummingbird at a feeder at Dr. Rico-Guevara's house. Peter Prato for The New York Times

The research on hummingbird tongues was groundbreaking. The dominant idea about how the birds suck up nectar was that the shape of the beak and the tongue produced capillary action, in which liquid rises against gravity because of mechanical forces.

This is what happens when a narrow tube is inserted into liquid, or when a brush soaks up paint even though only the tip is in the liquid.

Dr. Rico-Guevara and Dr. Rubega showed instead that the hummingbird's feeding method was completely different: As the forked tip of its tongue is withdrawn up the narrow bill, it traps nectar.

All hummingbirds fight, including females, but only a few species have weaponized bills. Dr. Rico-Guevara found that males wage their battles to claim the best mating territories.

In some species, males assemble in areas called leks, away from the flowers that they feed on. In a lek, each male has a territory, and the females shop around.

The territories vary quite a lot in size, but about 270 square feet is typical — the size of a very small New York City apartment. Central territories are the most prized, and a swordlike bill helps a male capture and keep that prime real estate.

In other hummingbird species with weaponized beaks, males set up mating territories right on the richest patches of flowers, again fighting off rivals. For them, Dr. Rico Guevara said, it doesn't really matter if they aren't the most efficient nectar-drinkers — “just don't let anybody else get to the flower.”

## Extremists with wings

Hummingbird research is a rich, growing field, delving into everything from aerodynamics to how the birds process sucrose.

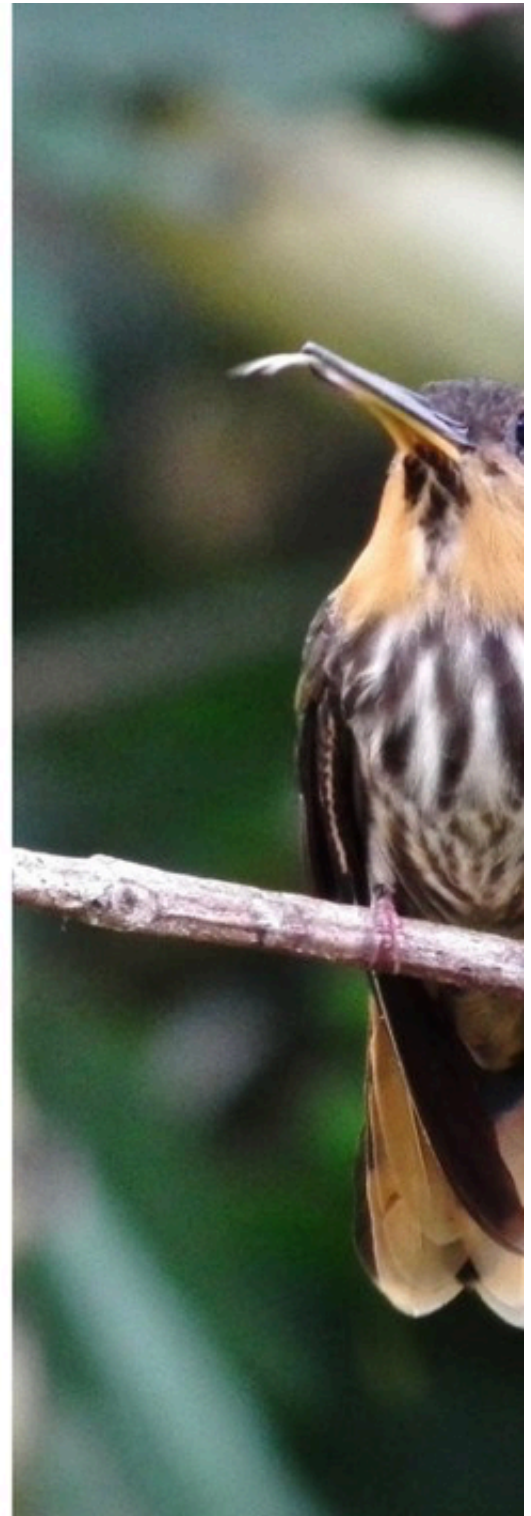
“In things that you can measure in any animal, like metabolism, they're extreme,” said Dr. Altshuler. “Another way they're extreme is in terms of their specialization.”

Hummingbirds also offer “opportunities to explore the limits of physiology,” Dr. Rico-Guevara said. They have the highest metabolic rate among vertebrates, and they specialize in hovering, “the most expensive form of locomotion in nature.”

Hovering, coincidentally, is a form of flight that is of intense interest to the designers of flying robots. “Everybody wants to replicate hummingbird flight,” he said.

The birds are also great to use in experiments, said Chris Clark, a biologist at the University of California, Riverside, who has collaborated with Dr. Rico-Guevara in studies of hummingbird flight.

The birds will fly readily to feeders. The presence of humans does not put them off. And, “they fly really well in wind tunnels and cages.”



Posters on the wall of the flight lab in Dr. Rico-Guevara's lab, left, and a male saw-billed hermit hummingbird, whose forked tongue is visible. Peter Prato for The New York Times, left; Kristiina Hurme



Hummingbird behavior is also of interest because they have been shown to be excellent learners. Dr. Clark said there is speculation that because they live on the edge in terms of their energy budget, they may require a great memory for where the food sources are.

In listing multiple areas of interest for studying hummingbirds, Dr. Rico-Guevara conceded that he's attracted to them for another reason.

“What has kept me attached to them is their incredible personality,” he said. “They are very bold. They come to you to explore what you are doing. They are inquisitive.”

He can only hope that in his science, “My curiosity would match their curiosity.”

And he does have some poetic company. Not all poets got stuck on the beauty of the birds. D.H. Lawrence, in “Humming-Bird” imagines an ancient one at the dawn of creation.

Probably he was big

As mosses, and little lizards, they say, were once big.

Probably he was a jabbing, terrifying monster.



A black-throated mango and a lesser violetear doing battle at Finca el Colibrí Gorriazul, a coffee farm in Colombia. Christian Irian

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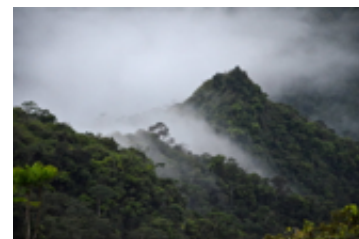
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### **Correction: Feb. 5, 2019**

*A picture credit on an earlier version of this article, using information provided by a source, misspelled the given name of a photographer. He is Christian Irian, not Cristian.*

James Gorman is a science writer at large and the host and writer of the video series "ScienceTake." He joined The Times in 1993 and is the author of several books, including "How to Build a Dinosaur," written with the paleontologist Jack Horner.

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