

Flying Jewels

Hummingbirds Are New World Treasures

by Leslie Forsberg

High atop the 25-foot flowering Bing

cherry tree in my Seattle backyard, a male Anna's hummingbird perches, feathers glimmering emerald and ruby in the sun, eyes scanning the air for rivals. I'm sitting on a lawn chair, watching him through a pair of binoculars, thrilled by the opportunity to observe one of these colorful birds at rest for several minutes.



This page: An Anna's hummingbird feeds her chicks, which are snug in a nest about the size of a golf ball. Opposite page: A rufous hummingbird seeks a sip of fuchsia nectar.

Suddenly he launches skyward, zooming to about 100 feet, then dives straight down, faster than my eyes can follow, emitting a piercing "chirp" sound right before he pulls out of the dive just a foot from the top of our 20-foot plum tree.

As he repeats his dive over and over, I spy a green-and-gray female in the plum tree, watching the dashing figure woo her with his extraordinary speed, which can reach 60 mph. And just in case that's not impressive enough, he orients himself toward the sun so that his head and neck feathers catch the solar rays in a brilliant magenta flash as he approaches her.

I'm reminded of a Mayan legend about the marriage of two hummingbirds that has been recounted by various hummingbird enthusiasts. As with most mythology, there are different versions, but I like this one: After making all the other birds, the creator used leftover items to fashion a plain gray hummingbird, endowing it with the gift of extraordinary flight, including the ability to hover, to compensate for its small size. Pleased with the result, the creator formed another hummingbird as a mate and announced that the birds would be married. Spiders spun webs for the hummingbirds' first nest, and other birds sang and offered some of their beautiful feathers to decorate the couple. When the sun arrived, it pledged that the hummingbirds' feathers would forever gleam with magic whenever the birds looked toward the sun.

The Spaniards who colonized Mayan lands and other parts of the Americas also became enchanted by hummingbirds, which are found only in the New World. Awed by the birds' vibrant garnet-, malachite- and sapphire-hued plumage, the Europeans called these creatures *joyas voladores*, "flying jewels." Earlier, Christopher Columbus had dubbed the aerobatic birds "flying marvels."

This tiny animal—Earth's smallest bird, ranging in weight from less than a U.S. dime (bee hummingbird) to about two U.S. half dollars (giant hummingbird)—has more unusual abilities than other avian species. Hummingbirds not only can hover—moving their wings in a figure-8 pattern—but also fly sideways, backward as well as forward, and even, briefly, upside down.

A hummingbird's wingbeat can range up to 100 strokes per second. Its heart rate may exceed 1,200 beats per minute. Hummingbirds have the highest metabolism of all birds, and must eat the equivalent





ALL CANADA PHOTOS / ALAMY (2)

Male Anna's hummingbirds such as the one approaching a flower, top, and male calliope hummingbirds such as the one on a branch, above, are known for their vibrant throat feathers. Anna's may stay in the same area year-round; calliope migrate about 5,600 miles round-trip each year.

of more than their weight in flower nectar and insects every day to survive. Some 8,000 plants throughout the Americas are dependent primarily on hummingbirds for pollination.

To survive at night via the energy reserves obtained while feeding during the day, a hummingbird slows its metabolism and heartbeat, reducing its heart rate to as few as 40 beats per minute.

Most of the known 338 species of hummingbirds live in remote tropical and subtropical regions of Central and South America, but more than 60 species breed in North America, according to the nonprofit Hummingbird Society, based in Sedona, Arizona. In addition to Anna's hummingbird (named for 19th century Italian duchess Anna

Massena), some of the most common species seen in the western United States and western Canada include black-chinned, broad-tailed, calliope, rufous, Allen's (named for 19th century San Francisco Bay-area bird-watcher Charles Allen) and Costa's (named for 19th century French marquis Louis Marie Pantaléon Costa).

Like many bird-watchers, I've long been fascinated by these creatures because of their beauty, their aerial abilities and their seeming willingness to interact with humans. Just a few weeks ago, a male Anna's buzzed right up to my husband, Eric, paused midair to hover just two feet away, and observed him with what appeared to be curiosity. Surprised and delighted, Eric locked gazes with the tiny creature for several moments before it zipped away.

Perhaps it was the same male I see courting a female. If he succeeds in impressing her, they'll have a brief dalliance before he flies off in search of his next conquest. Although the Mayan legend connotes long-term fidelity, hummingbirds don't form life pairs. Instead, the male may mate numerous times during the breeding season, approximately November/December to May/June, and the female also typically mates more than once, usually producing two broods, each with two chicks.

She typically chooses a shrub or tree in which to build a golf ball-size, cup-shaped nest—using items ranging from spiderwebs to lichen—and lays white eggs, each about the size of a pea, which take two to three weeks to hatch.

The female feeds and watches over the chicks for approximately another 20 to 25 days before they leave the nest, and she continues to feed them for about

a week once they're out of the nest, before shoos them on to independence. The siblings might fly off together and remain companions through the fall before becoming sexually active at about the one-year mark.

Anna's, which may choose to stay year-round in the Northwest and various other locations, live for about six years. Some hummingbird species have been known to live up to 12 years; others live less than four.

Despite how intrigued humans are by hummingbirds, only 30 or so species have been studied in depth. One of the most referenced studies was done in 2008 by research biologist Chris Clark, who at the time was working on his Ph.D. in hummingbird tail anatomy at the University of California, Berkeley, and is now an assistant professor at the University of California, Riverside. While it was widely known that Anna's hummingbirds make high-pitched squeaky sounds when they're at rest, the volume of the shrill, high-pitched whistle-like blast that concludes their dives is startling. The chirp is four octaves above middle C, and audible for an incredible 100 yards. How, Clark wondered, could

such a tiny creature—only about 4 inches long and weighing about the same as a U.S. nickel—make such a loud noise, the loudest sound made by any hummingbird?

"I found a really old paper saying that hummingbirds made sounds with their tail feathers, but another paper said that their song on a perch is similar to their dive song," he says. "I fully expected to find that the sound was vocal, and I set up experiments to find out."

For his field site, he used Eastshore State Park, a waterfront park with shrubs, eucalyptus trees and sand dunes in the San Francisco area, and filmed the hummingbird's 60 mph dive by using a combination of high-speed and regular-speed cameras. Anna's hummingbirds reach speeds of about 400 body lengths per second and briefly hit 10 Gs when pulling up at the bottom of a dive, he says. "A fighter pilot would pass out at a similar acceleration, yet there's no effect on the hummingbirds; it's the fastest an animal has ever gone, relative to its size."

Like other hummingbirds, Anna's hummingbirds have tails with 10 feathers, but Clark noticed that the inner feathers were soft and aerodynamic-looking, while the outermost two feathers on each side

were stiffer, narrower and curved differently, in a shape unique to Anna's hummingbirds.

He conducted his experiment by first observing a male Anna's diving and making the sharp, high-pitched "chirp" sound at the bottom of the dive 10 times in a row. Then he caught the bird in a drawstring-curtain feeder trap and carefully trimmed the stiff tail feathers. This does not harm the bird, he says, and the feathers grow back in five weeks.

"The next day I came back with the male, which I'd designated with a small dab of nontoxic paint on his head, and with a female from our lab as an attractant," he says. "The male Anna's again dove 10 times in a row, but none of those times made a sound. So the sound was generated by the tail feathers, not through vocalization."

Clark's discovery prompted him to press on with additional research into the extraordinary sound. He eventually determined that the sound is generated by fluttering of the feathers, much like sound is created by the vibrating of a reed in a clarinet. The chirp is caused by a 60-millisecond flaring of the outer, irregularly shaped tail feathers in the air. The next feather in on each side acts as an amplifier, he says,

For More Information

There are many ways to learn more about hummingbirds and to participate in their protection, beginning with finding out when hummingbirds are typically in your area, and planting flowers that provide natural nectar, or putting out feeders (with a 4:1 water-to-sugar ratio and no food coloring), as well as choosing not to use pesticides. The nonprofit Hummingbird Society (hummingbirdsociety.org) in Arizona provides a wealth of information about hummingbirds, including beneficial plants, and hosts the annual Sedona Hummingbird Festival, which is August 2–4 this year. The society donates a portion of ticket revenues to conservation efforts in various parts of the world. Local Audubon chapters, nurseries and garden clubs are excellent sources of information specific to where you live.

Another resource is *Hummingbirds of North America: The Photographic Guide*, by Steve N.G. Howell, research associate at the Point Blue Conservation Science nonprofit in the Sonoma County, California, town of Petaluma. Another reference, *A Field Guide to Hummingbirds of North America*, was written by ornithologist Sheri Williamson, co-founder of the Southeastern Arizona Bird Observatory. And the beautifully illustrated picture book *The Amazing Hummingbird Story of “Red” Rufous*, by artist-and-writer duo Craig and Joy Johnson, of Whidbey Island, Washington (pugetsoundbackyardbirds.com), is a great way to engage children in learning about the life cycle of hummingbirds. —L.F.

“like the body of a guitar amplifies the sound produced by the string.”

Hummingbirds have also been studied by Bret Tobalske, director of the University of Montana’s Flight Lab field research station at Fort Missoula, and Doug Warrick, an associate professor of zoology at Oregon State University, who have collaborated on

several research projects. “Compared to any other birds, hummingbirds are masters of the air,” Tobalske says. “Flight is fascinating because it takes a great deal of energy; it’s a very costly activity. Hummingbirds are elite athletes.”

For some of the researchers’ experiments, frequently conducted in partner-

ship with scientists from other universities, as well, they used a flight chamber. They sprayed the chamber with a mist of olive oil whose microscopic droplets were so lightweight, they moved in accordance with how the air moved as a rufous hummingbird beat its wings. Using laser-lighting technology, the scientists were able to illuminate the moving droplets and capture images of them to “see” the air circulation around the bird.

“With lift or thrust, a bird gets acceleration and exerts force on the environment, forming vortices in the air. It’s like stirring tea with a spoon, creating patterns in the tea leaves,” Tobalske explains.

They discovered that hummingbirds can generate lift almost without interruption throughout the entire wing-beat cycle—downstroke, upstroke and transition—something that plays a key role in hummingbirds’ ability to hover and something that no other birds are known to do. The relative narrowness of a hummingbird’s wings may be one of the factors allowing the aerial achievement.

Scientists such as Warrick and Tobalske speculate that hummingbird flight abilities evolved to allow the birds to access

flower nectar, a significant and concentrated source of energy that 40 million years ago was largely untapped except by insects. “We don’t have a clear fossil record of hummingbird ancestry, so what was going on 40 million years ago will remain speculation, but flowering plants were dominating then, and the sheer number of nectar sources and the quantity of energy they offered made it likely birds would try to exploit it,” says Warrick.

“Most flowers have sufficient structure to allow insects to land, but birds would be too large and would have to hover at the flower while extracting nectar. Only small

birds have sufficient excess muscle power to allow them to hover, but when you’re small you can’t carry as much fuel—e.g., fat—and your metabolic rate is proportionally higher, so you need to eat more often and/or be more efficient in gathering the food. Thus, for birds seeking nourishment from floral nectar, the resulting natural-selection pressure favoring both small size and more efficient hovering might have been strong, and evolutionary change relatively rapid, with fewer generations of transitional forms. That may be one of the reasons we know little about hummingbird evolution. The oldest known fossil of a true

hummingbird, whose bone structure indicates it had the ability to hover like modern hummingbirds, dates to about 30 million years ago.”

Doug Altshuler, an assistant professor of zoology at the University of British Columbia in Vancouver, also has been involved in numerous hummingbird studies, including documenting the birds’ exceptional motor control and ability to keep up with a revolving feeder.

He’s also determined that to accelerate vertically—important when competing for food and when displaying desirability as a mate—hummingbirds increase the frequency and widen the sweep angle of their wingbeats. In a human, that would be the equivalent of increasing both the frequency and length of our strides to run faster, he says. That’s challenging: Increasing the length of each stride typically results in fewer strides. Increasing the number of strides typically results in shorter strides.

The Altshuler Lab at the University of British Columbia is now investigating what role vision plays in how hummingbirds control speed, height and transitions from hovering to other types of flight.

One of the studies I found most interesting was reported in 2012 by University of California, Berkeley biologists Victor Manuel Ortega-Jimenez and Robert Dudley, who demonstrated that Anna’s hummingbirds aren’t bothered by rain. They can hover extremely well even in heavy downpours. They do so by adopting a more horizontal body/tail position and by increasing the frequency of their wingbeats. This ability may account for their willingness to weather winter as well as savor summer in my Seattle backyard.

A network of amateur and professional bird-watchers is contributing to research on hummingbird migration patterns, such as the migrations of calliope and rufous hummingbirds, both renowned for cross-continental marathons that seem unthinkable for such tiny birds. Scientists are still trying to answer questions such as how high hummingbirds fly during migration, how they stay on course, and how many are typically blown off course by wind and other weather events.

The calliope—whose scientific name, *Stellula calliope*, comes from the Latin *stellula*, for “little star,” because the male has a bright red to deep pink throat patch on a white background, and from the name of the Greek muse Calliope—is the small-

est long-distance bird migrator on the planet, traveling approximately 2,800 miles each way between south-central Mexico and the northwestern United States or southwestern Canada.

About 3 inches long and weighing approximately the same as a penny, the calliope is also the smallest bird that breeds north of Mexico. It breeds in mountainous areas ranging from western Canada to California and Nevada, and as far east as Montana and Wyoming. The female often chooses to nest in a pine tree, where she crafts the nursery from materials such as bark and spider silk in a design

that looks somewhat like a pinecone.

Rufous hummingbirds—weighing less than a nickel and named for their glowing ember-colored feathers—fly 3,000 miles or so each way during their migration. Overwintering in Central America and Mexico, they travel as far north as Alaska each spring. Often described as pugnacious in defending their territory, they primarily breed in Alaska, western Canada, Washington, Oregon, Idaho and Montana, and may choose a tree in a yard, park or woodland.

Volunteer hummingbird-bander Kate McLaughlin, who lives in the town of

Chenega Bay on Evans Island, about 50 miles east of Seward, Alaska, is among the hundreds who are adding to the research on hummingbird migration patterns. She's occasionally been surprised by where the birds have traveled. On a cool, damp morning in June 2010, she was catching and banding hummingbirds visiting her feeders on the island. "Lots of them already had bands, and with a quick glance I could tell by the unique letter-number series that they were ones I'd previously banded," she says. "But I looked closely, three or four times, at the band on one female rufous because I realized it wasn't one of mine."

Every bird is accounted for on a data sheet, and the number is turned in to the U.S. Geological Survey's North American Bird Banding Laboratory, at the Patuxent Wildlife Research Center in Maryland, which manages a massive online database. But McLaughlin took a more personal approach to identifying the bird. "I went to our bird-banders' online discussion group [made up of USGS-certified hummingbird banders] and said, 'I just recovered this bird—whose is it?' In less than 24 hours I got an email from bander Fred Dietrich in Tallahassee, Florida, who said he had banded her there in January."

McLaughlin was ecstatic. She had just recorded the longest-ever documented migration route of any hummingbird species—some 3,500 miles in distance. The record still stands today.

While calliope and rufous hummingbirds migrate long distances, substantially depending for survival on flowers blooming along the way, hummingbirds that stay in one place can also face challenges, especially when that one place is a small region. If the birds' habitat is lost, the species may become extinct.

Seventeen hummingbird species are listed as endangered and eight are listed as critically endangered by the International Union for Conservation of Nature. Many of the endangered and critically endangered species have extremely small known ranges.

"None of the species that breeds in the United States is on the risk list, but species scattered throughout Mexico and Central and South America are endangered," says Ross Hawkins, executive director and founder of The Hummingbird Society.

In 2007, the society began supporting Juan Fernández Islands Conservancy/

Oikonos Ecosystem Knowledge efforts to help save the critically endangered Juan Fernández firecrown hummingbird, which lives only on 19-square-mile Robinson Crusoe Island, in the Juan Fernández Archipelago, about 400 miles west of Valparaíso, Chile. Invasive elm-leaf blackberry, eucalyptus and maqui trees have been displacing the native evergreen Chilean myrtle trees in which most of the hummingbirds nest. Domestic and feral cats have also been depleting the population of firecrowns.

Scientific censuses done in 2005 and 2006 by Oikonos—a nonprofit organization that studies and protects imperiled ecosystems by fostering collaborations—indicated the number of firecrowns was likely only 2,300 to 3,300. “Just 100 miles from Robinson Crusoe Island, a subspecies of the firecrown went extinct a century ago,” Hawkins notes.

The society raised \$25,000 to go toward conservation measures such as restoring critical habitat. It will take more fundraising and more than a decade before all the nesting areas are free of invasive species and replanted with native plants, and before the cat problem is better controlled (to prevent future problems, residents are now required to register their cats, and encouraged to spay and neuter them), Hawkins says, but 30 nests were counted last year in a study area where significant invasive plant control has already been done—an 18.5 percent increase in active firecrown nests in that area since 2008.

Hawkins observes that while nature’s whirring-winged bird with its dazzling array of colors is every bit a wild creature, many species also seem at home among humans, who are enthralled by the sight of a female rufous sitting in a nest atop a porch light or several Anna’s males bickering over a feeder, their wings beating faster than the human eye can record.

“The ability of these little guys to form a relationship with us is very different from other wild birds,” Hawkins says. “If you approach a goldfinch, it will fly away. A hummingbird is just as likely to fly right up to your face and stare at you.”

Perhaps, he says, there’s something to the belief among certain Southwest Indians that hummingbirds are messengers between worlds. Hummingbirds certainly communicate important things to humankind about our world ... including the power, grace and beauty that can be found in a very small being. ■

Writer Leslie Forsberg lives in Seattle.