

ORCHIDS AND HUMMINGBIRDS: SEX IN THE FAST LANE

Part 1 of Orchids and Their Pollinators

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PART BULLY, ALL SWAGGER, hummingbirds are tiny bundles of ego and attitude with no humility or fear. The smallest warm-blooded avian creatures, they hover like a helicopter, consume energy like a jet plane, and glitter in the sunlight like a precious jewel. It is fitting that this most magnificent evolutionary miracle should be a pollinator for the equally magnificent evolutionary miracle that is the orchid.



Booted Raquet-tail (*Ochreatus underwoodii*) male visiting *Comparettia falcata*, montane forest, Tandayapa Valley, Ecuador.

Hummingbirds are thought to have started their evolutionary path toward orchids after gobbling insects in mid-air. In the course of searching for insects and spiders inside flowers as well, they stumbled upon the delicious nectar set out to lure insect pollinators and so began their life as nectar feeders. Never looking back, they evolved the ability to hover efficiently to access the nectar bounty while the orchids evolved characteristics to make them even more irresistible to their new pollinators. A series of interlocking adaptations resulted in an incredibly fast, remarkably tiny little metabolic dynamo and some very distinctive-look-

ing flowers locked together in a mutually beneficial dance.

Hummingbirds (Trochilidae) are the predominant avian orchid pollinator. Birds are late-comers to the pollination game and only pollinate three percent of orchids. Nonetheless, with an estimated 35,000 orchid species, there are probably hundreds and hundreds of orchids that rely on hummingbirds for pollination. Most orchids that are hummingbird-pollinated are from high-elevation ecosystems in the tropical New World where insects are rare or unable to operate because of the cold. They are particularly common in the Andean regions where hummingbirds reach their greatest diversity. Hummingbirds are found only in the Americas with at least 330 species from Alaska to the tip of South America. The greatest numbers are found in the tropics with fewer than 20 species normally found in the United States and Canada.

Hummingbirds seem particularly attracted to many species of the genera *Elleanthus*, *Cochlioda*, and *Compartmentia*. Some species of *Masdevallia*, *Epidendrum*, *Encyclia*, *Cattleya*, *Sobralia*, and *Laelia* have also adapted to hummingbirds. In addition, the highly-specialized little birds are attracted to certain species of *Ada*, *Scaphyglottis* (syn. *Hexisea*), *Scelochilus*, *Cattleya* (syn. *Sophronitis*), and *Stenorrhynchos* as well as an assortment of other genera.

Ornithophily or How to Get a Bird to Love You

Van der Pijl and Dodson described the distinctive syndrome of flower features associated with bird pollination (ornithophily). They include the following characteristics that cluster together:

1. Vivid colors
2. Absence of odor because birds lack the sense of smell
3. Small or curved-back flower lip since birds do not need to land on flowers
4. Abundant nectar in medium-length, rather broad tubes with a capillary system
5. Tubular horizontal flowers, often hanging free, with space for hovering birds
6. Hard flower walls with protected organs because of hard bird beaks
7. No nectar guides since they are not necessary for birds

Stenorrhynchos speciosum is a perfect example of ornithophily in an orchid. (See picture on page 14.)

Although this syndrome is helpful for predicting a

likely pollinator for a flower, it is not a one-to-one relationship. Flowers often have several pollinators, and pollinators often go outside their preferred “syndrome” to get nectar. It is so risky to be in an exclusive pollinator-flower relationship that it is a rare occurrence in nature. What if your orchid is not in bloom when you visit? What if your habitat is damaged? What if another pollinator has gotten there first? It makes sense to be flexible. It is important not to underestimate the complexity and variability of flower-pollinator relationships. Nonetheless, hummingbirds and orchids seem to have developed a unique set of characteristics and a unique relationship.

Seeing Red

Firstly, hummingbird-pollinated orchids tend to be brightly colored with vivid red predominating as well as pink, purple, orange, yellow and magenta. Showy bright colors are a visual reminder to us that pollination services are not easy for orchids to come by. Vigorous advertising is a must. Dodson reported hummingbirds visiting the light purple flowers of *Elleanthus capitatus*, the yellow flowers of *E. aureus*, and the orange or scarlet flowers of *E. aurantiacus*. The orchid-hummingbird photos in this article by Patricia and Michael Fogden strikingly illustrate these warm colors. It is thought that hummingbirds hatch without a color preference and learn to associate red, orange and other warm colors with food sources after being rewarded repeatedly with nectar from these color flowers in their early lives. Most insects cannot perceive the red end of the light spectrum and tend to leave the nectar in these flowers alone. For them, red is just another dark, blackish not particularly attractive color. Hummingbirds can see these flowers better than bees and can take advantage of them. Others suggest that being red prevents bees from robbing nectar because of their red-blindness.

Hummingbirds seem to so like red that Buchmann and Nabhan in *The Forgotten Pollinator* note that if you put on red lipstick, fill your pursed mouth with red wine, and stand where a feeder or magenta flowers have been outside, the hummers may feed right out of your mouth! I have more than once shared my cherry Slurpee® with a hummingbird. Nonetheless, hummingbirds have been seen feeding on small greenish flowers like those of the buckthorn and visiting plants of all sizes, colors and shapes and will frequently visit a feeder even without food coloring. The operative words are “tends to like” warm colors.

Hummingbirds pollinate orchids that lack fragrance—hummingbirds have little sense of smell, so orchids waste no fragrance on them. The warm colors

and lack of odor lessen these orchids’ appeal for insects like bees.

Dark Pollinia and Other Cryptic Tales

An interesting adaptation to hummingbird pollination is the development of dark, cryptic pollinia (masses of pollen which adhere together). With other flowers, loose, powdery pollen adheres to bird feathers. With orchids, sticky pollinia are deposited on hard bird beaks. Robert Dressler was struck by the high incidence of darker-colored orchid pollinia in hummingbird-pollinated orchids. Most orchid pollinia are yellow. However, Dressler noted that bright yellow would produce a sharp visual contrast with the color of the beak, and the bird would be stimulated to clean his beak. This tidy behavior would be a reproductive disaster for the orchid. Therefore, to avoid detection, half of all hummingbird-pollinated orchids evolved dark pollinia—blue, gray or brown—which most closely approaches the colors which predominate in hummer



Purple-throated Mountain-gem (*Lampornis calolaema*) feeding at a *Sobralia amabilis*, cloud forest, Costa Rica. Note the pollinarium stuck to the bird’s bill.

beaks and blend in more successfully. Purple-brown or lead-blue pollinia are observed in *Arpophyllum spicatum*, *Elleanthus capitatus*, and several other species of *Elleanthus*, *Scaphyglottis aurea*, *Isochilus major*, *Domingoa purpurea* (syn. *Nageliella purpurea*), *Cyrtochilum retusum*, *Sobralia amabilis*, and *Cattleya cernua*, among others.

In the subtribe *Sobraliinae*, there is a marked contrast between the pollinia of insect- and hummingbird-pollinated flowers. The pollinia in most species of bee-pollinated *Sobralia* are cream or pale yellow, but in the hummer-pollinated *Sobralia amabilis*, they are blue-gray. Similarly, since most species of *Elleanthus* are pollinated by hummingbirds, most of these species possess pollinia that are dark brown, purple-gray, puce or pink. However, those adapted to another pollinator



Coppery-headed Emerald (*Elvira cupreiceps*) visiting *Epidendrum radicans*. This orchid does not provide nectar but mimics flowers of *Asclepias curassavica* and *Lantana camara* which do. Cloud forest, Costa Rica.

like *Elleanthus caricoides* and *E. linifolius* have yellow pollinia and white flowers. Another third of hummingbird-pollinated orchids have cream or gray-white rather than yellow pollinia. These include *Ada aurantiaca*, *Broughtonia sanguinea*, *Guarianthe aurantiaca*, *Comparettia falcata*, *Prosthechea vitellina*, *Scaphyglottis imbricata*, *Ornithidium fulgens*, *Neocogniauxia monophylla*, *Rodriguezia lanceolata* (syn. *Rodriguezia secunda*), and *Odontoglossum sanguineum* (syn. *Symphyglossum sanguineum* and *Cochlioda sanguine*). These appear not to be as highly specialized for hummingbirds. Although they are not as well-adapted as the darker colors, they are still better adapted to avoid detection than yellow pollinia. It is thought that the suppression of the yellow-color pigment (leading to cream or gray-white) may be a first step in the evolution of blue-gray pollinia. In addition, *Broughtonia* and *Cattleya* both form natural hybrids with closely related allies which are bee-pollinated.

In some orchids like *Satyrium carneum*, pollinated by sunbirds, the pollinia has remained yellow, with very large, plate-like, extremely sticky viscidia that thwarts the bird's efforts to remove the yellow masses.

Drinking on the Job

Every orchid sexual encounter is a ménage à trios—an orchid which wants to deliver its pollen to another orchid and a pollinator that is seduced into being their delivery boy. The hummingbird, of course, has no interest in this love tryst but is bribed with nectar into doing their reproductive work. Orchids provide the copious, dilute nectar in a 25% solution that hummingbirds prefer in medium-length floral tubes, just the right length for a hummer bill. A hummingbird's diet consists of approximately 25% insects and 75% nectar. Hummingbirds have straight or curved needle-shaped



Half of all hummingbird-pollinated orchids evolved dark pollinia such as in *Arpophyllum spicatum*.

bills which are perfectly adapted for drinking nectar. During feeding, the tip of the bill opens, and the bifurcated tongue moves rapidly in and out. The lobes of the tongue form a thin lamina which is rolled lengthwise to form a slender tube. Nectar is held in this tube by capillary action until the tongue is withdrawn into the beak, and the nectar is squeezed out, sucked up, and swallowed. The outer half of the tongue has fringed edges to help pick up the nectar and catch insects inside of flowers.

When feeding on insects, the hummers pick them from leaves or snap them up in midair. Eldon Grieb, founding editor of *Birder's World* magazine, claims that hummingbirds have been captured on video flying fast toward insects and capturing them by opening their bills wide like nighthawks.

There are significant differences in the bills of North American and tropical hummers. In the United States and Canada, hummingbirds are forced to migrate during the cool weather to find nectar sources. Their bills are often quite straight to fit into the largest number of different shaped flowers that may be found on their



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Hummingbirds visiting the light purple flowers of *Elleanthus capitatus*.

which suggested that hummingbird bill size and shape was locked in an evolutionary arms war with flowers. It was much more complicated than just inserting a "straight or curved blade into a scabbard."

It seems that plants and birds have different agendas. The bird wants to get nectar. The flower wants to get pollinated. For the bird, a bill that fits exactly into the nectar chamber gets more nectar faster and more efficiently. For the flower, a slight mismatch forces the bill to struggle more and pick up more pollen. Temeles and Ewald found that if the flower is more curved than the bill, more pollen is deposited.

This has led to an evolutionary arms race. Selection favors a more curved tube enhancing pollination which then favors curvature of the beak to enhance feeding which in turn selects for even greater floral curvature and so on. In orchids, to enhance pollination success, a heavy callus or strong fold on the lip of the orchid bars entrance to the floral tube forcing the bird to push its beak against the column in a perfect position to receive the pollinia. *Comparettia falcata* perfectly illustrates this as the lip has a callus which partially closes the flo-



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Cyrtorchilum retusum has dark pollinia.

migratory route. Their search for nectar is called "traplining," feeding on flowers in bloom in a moving pattern along a migratory seasonal route. Having a beak that fits into a lot of different flowers is an advantage for the hummer.

Tropical hummingbirds, the pollinators of orchids, have sufficient food year-round so that they don't need to perform long migrations. They might travel a bit or go to different elevations, but they do not need to trapline. They sip nectar from curved tropical flowers, so they tend to have beaks that curve up or down in more dramatic ways; their beaks fit into specific flowers. Tropical hummingbirds don't need to be generalists like North American migratory hummers. They also find and defend specific territories for longer periods than do migratory hummers.

Temeles and Ewald wrote an interesting article titled "Fitting the Bill" in *Natural History Magazine*

ral tube at the level of the anther and stigma, and the hummer, to get at nectar, is forced to guide its beak against the column where cryptic pollinia attach to the beak. Amazing thing, Nature!

Winging It

Becoming a nectar-feeder shaped hummingbird bodies. Nectar is not a rich enough food source to support a very large bird, so hummingbirds are, of necessity, very tiny. The Cuban Bee hummingbird weighs about six hundredths of an ounce (1.8 grams), the smallest warm-blooded creature. Even the largest hummingbird, South America's Giant hummingbird, weighs only six tenths of an ounce (17 grams).

On the other hand, hovering in front of an orchid requires a tremendously large expenditure of energy for the tiny bird. Hummingbirds consume relatively

more energy for their size than any other bird. They are always on the verge of starving to death and so have evolved into aggressive little dynamos that vigorously defend their nectar supply. They have even been observed chasing eagles and hawks.

Connie Toops, author of the brilliant book, *Hummingbirds, Jewels In Flight*, describes how hummingbirds have evolved powerful flight muscles and a specialized skeleton to enable them to hover. Her insights reveal a world of acrobatic, aerial magnificence, exquisitely designed to drink nectar and defend food supplies. Of the 9000 types of birds, only hummingbirds can hover as well fly forwards, backwards and upside down. In slow motion, hummingbirds have been captured flipping into a backward somersault, flying for a beat or two with the tail up and head down, rolling left or right and then turning upright again—all in just 1/5 of a second. To our eyes, this incredible speed looks like just a blur. Hummingbirds that weigh little more than a postage stamp can flap their wings up to 200 times a second and have been reported to fly over 27 miles per hour. It has been estimated that hummingbirds are subjected to 10 G's of force during the nose dives performed in mating rituals—which would cause even an experienced fighter pilot to black out! They can fly great distances; the ruby-throated hummingbird can fly nonstop at least 500 miles to cross the Gulf of Mexico.

All this aerial might burns tremendous fuel, and a hovering hummer requires ten times the energy of a marathon runner. If a man could exercise at this rate, he would have to sweat 100 lbs of perspiration an hour to cool his body! Hummingbird metabolic rates are double that of wrens and 25 times faster than chickens, the highest metabolic rate per unit of body weight in the avian world. To equal that metabolism, a human would need to eat double his body weight every day. Hummingbird researcher Crawford Greenewalt said that translates to our eating forty ten-pound bags of potatoes or 1000 quarter-pound hamburgers every single day! It is thought, unbelievably, that this consumption would raise our body temperatures to 750°F (398°C) and cause us to explode.

This dazzling aerial skill is made possible by their unique feather arrangement, internal wing structure, and amazingly strong flight muscles. Hummingbirds don't use their weak legs to spring up in the air, and they don't flap their wings up and down like most other birds. Instead, they form figure eight's with their wings, beating so rapidly back and forth that they lift their bodies into a vertical position like a swimmer treading water. On the forward stroke, the leading edge of the wing faces forward, and then the wing rotates at the shoulder so that the leading edge faces back. Unlike other birds which bend their wings, hummingbird



Green Violetear at *Elleanthus glaucophyllus* is found in the highlands from south-central Mexico to western Panama, Venezuela, Bolivia with seasonal visits to the U.S. and Canada.



Broughtonia sanguinea has gray-white pollinia rather than yellow.

wings remain rigid in flight. It is similar to your holding your arms out straight and using your thumb to make figure 8's. It takes only 1/500 second to complete the figure eight, so the hummingbird makes 500 figure 8's in just a second! Rapidly moving air above the wing creates less pressure than that below and creates lift on both the down stroke and upstroke as they rotate through 180 degrees. With lift on both the forward and return wing strokes, the little bird can hover like a helicopter with just a little balancing from the tail.

All this power requires mighty musculature and a specialized skeleton. The flight muscles account for 30% of the bird's weight, 50% more than other strong-flying birds. Our pectoral muscles make up just 5% of our weight. Chickens that can fly for only a brief time have small "white" flight muscles for quick movement. Hummers have "dark" red compact flight muscles for sustained motion. A proportionally longer and deeper sternum has a shallow depression at its junction with powerful coracoid bones that acts as a socket for the ball-shaped end of the short wing bones. The tapered compact wings, small size, light weight and whirring flight are perfect for advanced aerial maneuvers.



Coppery-headed Emerald (*Elvira cupreiceps*) feeding at *Ornithidium fulgens* (syn. *Maxillaria fulgens*) Monte Verde Cloud Forest, Costa Rica.



Ada aurantiaca has cream or gray-white pollinia.

Powerhouses with a large demand for oxygen, hummers have a supersized heart that can beat up to 1200 times a minute. Even at rest, the bird's heart rate is eight times faster than ours, and the bird can pant over 600 times a minute to get rid of all that excess heat.

Torpor

Connie Toops details the interesting phenomenon of hummingbird torpor. The tremendous energy expenditure of hovering to access nectar leaves the birds always on the edge of survival. They are particularly in danger of perishing from lack of food during sleep. If a bird consumes enough food during the day, it will have normal sleep. If not, they can conserve energy at night by entering a state of torpor, a kind of short-term hibernation. A hovering hummer is the equivalent of our running at 90 mph; a hummer in torpor is the equivalent of our walking briskly. Torpor uses as little as a fiftieth of waking and a fifth of sleeping energy levels. It has been recorded that the heart rate of a blue-throated hummingbird falls 92% in torpor from 480 beats per minute to 36. Body temperature drops from 105

degrees to a few degrees above the ambient temperature. Breathing becomes irregular and may appear to stop altogether. Torpor can last 8-14 hours. The bird gradually warms back up in the morning and can fly when he reaches 86°F (30°C).

There is a legendary tale of a grandfather who went for an outing with his grandson and found a "dead" bird hanging from a wire. He stuck it in his shirt pocket and later felt it moving in his pocket. Amazed, he found the bird had warmed up and flown out of his pocket. The ability of hummingbirds to enter a deathlike-trance and then reawaken led to many legends about their supernatural powers.

All the Colors of the Rainbow

When hummingbirds feed at orchids, it is hard to decide which is the more beautiful - the bird or the orchid. Hummingbirds really are "jewels in flight," their subgroups named things like sapphires, topazes, emeralds, brilliants, sungems, coronets, jewelfronts and mountain-gems. Other names suggest their jewel-like plumage—Ruby-throated, Amethyst-throated, Turquoise-throated Pufflegs, and Beryline.

Flashing vivid colors or zooming in dazzling flight displays, hummingbirds intimidate rivals and impress would-be mates. How do hummingbirds get those gorgeous colors in their gorget (the reflective patch of feathers at the throat of male birds) and crest plumage? Feathers that are dark brown and russet are pigmented. The iridescent feathers, however, are brilliantly colored by another means - not pigment but interference coloration that is the amplification of certain wavelengths of light by little layers of melanin.

Other birds' contour feathers are divided into hair-like barbules (small barbs fringing the feathers) arranged like a hook and pile of Velcro®, holding the feather covering together. Hummer feathers, which are iridescent only on the outer third, lack the hook and pile zipper. In its place, each barbule has stacks of microscopic plates about 1/10,000 to 4/10,000 of an inch. Each has an air layer sandwiched between thin films of dark-colored melanin. The rainbow of hummer colors comes from a minute difference in the thickness of melanin films and the spacing of the air between them. When light hits the feather, most light frequencies are eliminated, but certain frequencies are synchronized and strengthened as they bounce off the melanin layers. The beam of color can only be seen from a nar-

row angle and is intensified because the others appear black. Within the platelets, the melanin is sometimes pigmented which has an effect on the colors produced. So, simply, the platelets filled with tiny air bubbles partially reflect back light which causes brilliant reds, blues, and purples. The iridescent portion of the feather is flat and reflects light in only one direction.

Adult male hummingbirds have the most brilliantly glowing feathers as females gain some advantage by blending into the surroundings. Back feathers of males and females often have a green iridescence since the platelets are concave instead of flat and reflect less intense colors across a wider area.

Some of the feathers are modified to produce sound during courtship to further entice females. Jamaican Streamertail males have two six-inch trailing feathers which are curved near the end and scalloped along the inner edge. During courtship, the prominent tail produces a soft hum and is proudly displayed. Similarly, the inside edge of the stiff, curved tail feathers of the male Anna's hummingbird produces a sound during courtship dives and then further impress females with a popping sound as they come out of the dive. Females seem to find this irresistible.

Making Babies

At courtship time, males and females establish separate territories. The female visits his territory, risking the attack of the territorial male, and leads him to her territory where he tries to impress with his aerial skill. The brief act of copulation lasts five seconds, after which he is done with all his parental duties and returns to his territory. Males and females lead separate lives except for this brief but important exchange.

Hummingbirds lay the smallest bird eggs in the world, just half an inch long and half the size of a jellybean. Cup-shaped nests are made of fine plant material loosely woven with spider webs and disguised with bits of lichen and moss. The spider web makes the nest stretchy to accommodate the growing birds. After two weeks, the two tiny eggs hatch and produce two miniscule, nearly-bald, close-eyed little birds. In *The Secret Life of Hummingbirds*, Arizona-Sonora Desert Museum Head Keeper Karen Krebs is quoted as saying they "look like brown raisins with huge heads and eyes." Ornithologist Skutch describes them as "ugly, unpromising little grubs." The mother regurgitates insects into their throats gradually providing more nectar as the fledglings age.

Although adults are hard to catch, the little nestlings can fall victim to jays, snakes, squirrels, cats, mice, ants. They have even been eaten by roadrunners, frogs,

praying mantises, and shrikes. If they survive this dangerous period, hummingbirds can live for up to 12 years.

Other Bird Orchid Pollinators

Although hummingbirds are the main avian orchid pollinator, there are credible reports of other birds that pollinate orchids. For instance, Johnson proved that sunbirds are the primary pollinator for at least three species of South African *Satyrium* species—*Satyrium carneum*, *S. coriifolium*, and *S. princeps*. Johnson asserts these are the only African orchid species which are thought to be bird-pollinated. (For a time, *Disa ferruginea* was thought to be an example of ornithophily, but recent work shows it is exclusively pollinated by butterflies.) Most satyriums are dull-colored, strong-scented and moth-pollinated. However, the three *Satyrium* that are bird-pollinated exhibit the typical bird-pollination syndrome—vivid colors, lack of scent, robust perching stems, and long spurs containing copi-



©Michael & Patricia Fogden
Magenta-throated Woodstar (*Calliphlox bryantae*) male visiting *Stenorrhyncos speciosum*. Cloud Forest, Costa Rica. Note the orchid pollinia stuck to the bill.

ous quantities of dilute nectar. The sunbirds insert their bills into the labellum chamber and suck nectar from the spurs with their tongues. The column overarches the entrance to the lip, and pollinaria get stuck to the upper mandible of the bill. Unlike many other orchids pollinated by hummingbirds, these orchids do not have the dark pollinia described by Dressler. Instead, they have very large, unusually adhesive plate-like viscidia which prevent the removal of the pollinaria firmly attached to the bill. Rubbing against a branch does little to dislodge the pollinaria. Small viscidia, on the other hand, are associated with moth pollination. Orchid pollination by sunbirds has also been reported for *Dendrobium* species in southeast Asia.

In the Indian Ocean, on Réunion of the Mascarene Archipelago, three species of *Angraecum* have evolved to be bird-pollinated. Most of the angraecums display typical sphingophilous (moth-pollinated) syndrome—

strong evening scent, white, nectar-rich long spurs. Only *Angraecum striatum*, *A. bracteosum*, and *A. cadetii* are unscented with short, wide spurs and attract the bird-pollinator *Zosterops borbonicus* (White-eye) during the day. These flowers are unusual for bird-pollinated flowers in that they are white. The bills of the birds exactly match the flower entrance diameter and are perfect for extracting nectar and effecting pollination.

Around 50 bird families have been reported visiting flowers, and only three major avian groups are involved in a specialized nectar diet:

- Hummingbirds in the new world (Trochilidae)
- Sunbirds (Nectariniidae) in Old World primarily Africa
- Honeyeaters (Meliphagidae) in Australasia

Reports of pollination by honeyeaters are mostly anecdotal. The study on Réunion is the first time a bird species outside these three groups has been observed to pollinate orchids.



Scintillant hummingbird (*Selasphorus scintilla*) female feeding at and pollinating *Elleanthus glaucophyllus*, Monte Verde Cloud Forest, Costa Rica.

Conservation Concerns and Threats to Hummingbirds

Sometimes, being very beautiful can be a distinct threat to survival. As soon as colonists landed in North America, they were dazzled and utterly captivated by the hummingbird's jewel-like plumage. By the 1800's, there was great demand in Europe for these gorgeous feathers for jewelry, hats, fans and dresses. Millions of preserved skins were shipped in barrels from Columbia and Brazil to the fashion houses in London and Paris, and collectors bought stuffed birds to display. It was an age of hummingbird slaughter, and some that were in European stuffed-bird collections are now extinct. The Turquoise-throated Puffleg, an extinct endemic species from Ecuador, is now known only from museum specimens.

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By 1990, 29 species of hummingbirds were classified as endangered including the Cuban Bee hummingbird, the world's smallest bird. Most species are now protected by CITES. The most threatened species is thought to be the Hook-billed Hermit from eastern Brazil down to only 50 individuals. The lowland forest-dwelling species are under tremendous pressure from human intrusion. Other endangered species include the Honduran Emerald, Juan Fernandez Firecrown, Scissor-tailed hummingbird, the Chilean Woodstar, Sapphire-bellied hummingbird, and the Black-Breasted Puffleg.

The major threat to the birds is the loss of habitat. Most endangered are the tropical residents which include most of the orchid-pollinators. Some have a restricted habitat like the Marvelous Spatuletail which lives in just one Peruvian valley. Even in Costa Rica, progressive in terms of habitat conservation, more than half the native forest land has been cut since 1940. The clearing of land for farming or harvesting of old-growth forest for timber leads to the loss of hummingbird flowers such as bromeliads, vines, heliconia and orchids. The new plantings such as banana, citrus, cacao have different flowers, not particularly suited for the little birds.

Conservation practices in Latin America affect North America since the birds of the Western United States migrate to Mexico. For example, the Ruby-throats winter from southern Mexico into Panama and can survive near plantations but cannot survive when the forests are replaced with cattle pastures or row-crops like cotton. The destruction of forests also decreases woodland specialists like the Blue-capped hummer or Hook-billed Hermit and increases the number of generalists such as the Fork-tailed Emeralds,

Bull-bellied, Beryline and Rufous-tailed hummers.

Widespread use of pesticides and fungicides exacerbate the problems as many that are banned in the United States are still used in Latin America. For example, Diazinon has been linked to the deaths of two dozen bird species including hummingbirds.

In the United States, outlook is good and populations remain stable as hummingbird feeders, a national obsession, provide additional food sources for the birds.

Attracting Hummingbirds to Your Garden with a Feeder

Hummingbird feeders have become an important resource to migrating hummingbirds. Lately, it has been reported that hummingbirds that migrated to Mexico have added Baton Rouge, Louisiana and many

areas along the western and northern Gulf Coast to their regular flight route for the first time because of the large number of feeders there. More birds have been reported on the East Coast of the United States in winter for the same reason.

It is fun and easy to attract these birds with feeders. Many feeders have flower patterns or are red, but it is thought that it is the sugar which attracts them. Some still insist that red color or ribbons add to feeder success. The commercial feeders are of two types. One is an inverted-bottle type that lowers into a reservoir with feeding holes. The other is a container with holes in its cover through which the hummer reaches the fluid. You can even make your own out of a small vial, test tube or jar.

An important consideration is the ease of cleaning and filling; the use of bottle brushes and pipe cleaners can make cleaning easier. Add vinegar to hot water to remove mold. You can add a tiny bit of Clorox to the water for tough stains, but be sure to rinse thoroughly. Although plastic doesn't break, glass is easier to clean.

Purchase a smaller feeder that holds enough liquid for a day or two; if the food sits too long, it can spoil. If you get a larger feeder, only fill it up part-way until you are sure that the contents will be consumed in a day or two.

It is best to put the feeder near flowers that attract hummers or where they have been seen feeding. Hummers have good flower memory and remember where flowers were the last time they visited. Put feeders in the shade and protect them from the wind to prevent spoilage and spilling. You can suspend the feeder from a garden stake or wire although sometimes the feeders have suction cups to attach directly to a window for a good view.

You can buy a commercial solution for your feeder or make your own. Add one part sugar to four parts water and boil for one to two minutes. Cool and store in the refrigerator. Flower nectar contains sucrose, glucose and fructose, but mainly sucrose. Studies have shown that sucrose is the preferred sugar. Boiling prevents spoilage. Do not leave the solution in the feeder for more than 48 hours when the temperature exceeds 60°F. Never use honey or artificial sweetener.

In North America, migrant species come in warmer weather. In the South, they arrive usually in January or February and in the North as late as April or May. You can leave feeders up until the birds leave. Males usually leave several weeks before the females and juveniles. Hummers are year-round residents on the West Coast, Southwest and a few places in the Southeast. In these

areas, the feeders save lives. In severe weather, you may have to warm sugar water to avoid freezing!

Bees, ants, and wasps can be a problem at a feeder. Connie Toops says the best method to exclude ants is to put an ant mote, commercially available, between the feeder support and the feeder to block ant access. You can also have some success blocking pests by putting Vaseline® or Tanglefoot® (sticky stuff sold in garden stores) on the wire or stake holding the feeder. Some wrap a strip of insect-repellent-soaked cloth around the stake. Others suggest putting Vicks on the feeding holes—hummers can't smell it, but bees hate it. You can also try placing salad oil around the hole but not inside it. Avoid getting any of these products in your sugar solution. It is easiest to get a feeder with screen-like covering over the feeder holes—bee guards.



Western Emerald (*Chlorostilbon melanorhynchus*) male feeding at an orchid in montane forest, Tandayapa Valley, west slope of Andes, NW Ecuador

Why Hummingbirds May Not Visit Your Home

Perhaps you are not looking when the birds visit your feeder. You have to be patient since sometimes it takes a while for the birds to discover you and your feeder. It is possible that your solution may be spoiled or that you have left your feeder empty for so long that birds have lost interest. It may be the breeding season, and they may have left to breed in other areas or may be still away on migration. There may be so many flowers and shrubs in your area that your habitat is too rich for them to need a feeder. On the other hand, perhaps you have too few shrubs and flowers to attract the bird. In that case, you might want to plant a hummingbird garden.

Planting a Hummingbird Garden

Hummingbirds love the nectar and insects in flowers. To create a hummingbird habitat, have a succession of flowers that will bloom at different times so you will always have something in bloom. Even if the hummingbirds are not attracted to a flower, an insect may be there that the bird can eat for dinner. Create different areas of sun and shade, and plant a variety of trees, shrubs and flowers in the garden. Hummingbirds spend 60% of their time perching and will appreciate a variety of places to rest.

It is thought that trumpet-shaped blossoms in red, orange or yellow are of particular attraction to the birds. Try to include vines of honeysuckle, morning glory, and Trumpet Creeper. Plant perennials like lilies, phlox, hibiscus, azaleas and mimosas. In addition, you will have success with plants like begonia, foxglove, geranium, gladiolas, hollyhock, impatiens, Indian paintbrush, lantana, nasturtium, nicotiana, petunia, red salvia, shrimp plant, and sweet William. Hummingbirds are very sensitive to pesticides and herbicides which should be avoided.

Hummingbirds and orchids have developed a mutually beneficial relationship that adds beauty and diversity to the natural world. Of all the pollinators, hummingbirds are surely the most beloved and treasured of all.*

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