

Evaluation of Family Trochilidae (Hummingbirds) Through Ecuador:
Importance, Threats, and Conservation

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Table of Contents

Introduction.....2

Importance of Hummingbirds in Ecuador.....4

Threats to Hummingbirds.....6

Conservation Efforts and Solutions to Support Hummingbird Populations.....8

Reference.....10

Introduction

Hummingbirds, family *Trochilidae*, belongs to the order *Apodiformes*, consisting of hummingbirds and swifts. Globally, hummingbirds are restricted to the Nearctic and Neotropical regions of the New World. The total range of family *Trochilidae* extends from Alaska and Labrador in northern Canada to Tierra del Fuego, the very tip of South America. Family *Trochilidae* consists of 328 species, distributed into 102 recognized genera (Camfield, 2004). While the total distribution ranges throughout the New World, most species of hummingbirds are tropical and sub-tropical birds and generally live between 10 degrees N and 25 degrees S latitude, with more than half of all species being found mainly in Brazil and Ecuador. This concentration of species leads to an increased importance to the conservation of suitable habitat through these two countries (Camfield, 2004).

Hummingbirds hold important ecosystem services as well as economic benefits to humans through areas with rich biodiversity. Hummingbirds are mostly nectivores, providing pollination of nectar producing flowers. These plant – pollinator relationships are very important for the survival of specific species that have co-evolved over time. Historically, hummingbirds were actively hunted in order to make jewelry and decorate clothing with their vibrant feathers. Hummingbirds have also been hunted to be sold in markets due to the belief that they can be used as aphrodisiacs, yet no scientific evidence has been found to support this claim. Aside from their feathers and meat, they were also captured to be put on display at zoos as well as collected by private citizens (Camfield, 2004). The largest benefit hummingbirds hold to humans is due to their aesthetic value, ecotourism has become a prominent industry

through Ecuador, providing large economic influence to the economy. Bird-watchers and photographers continuously flock to Ecuador in order to take advantage of the rich biodiversity.

Through Ecuador, disruption from numerous sources have led to a decline in total bird numbers, including human disturbances, climate change, and diseases. Hummingbirds have not been immune to this, showing a decline in total population in eastern Ecuador between 2008 and 2014 (Blake, et. al, 2015). This decline is mostly attributed to the effects of climate change, but other disturbances include forest fragmentation from deforestation, but efforts are in place to combat these disturbances.

Main efforts of wildlife conservation throughout Ecuador falls under the SNAP initiative. SNAP stands for Sistema Nacional de Areas Protegidas, or the National System of Protected Areas (NSPA). The goals of SNAP are categorized into three general objectives; 1) Conserve the biological diversity and the genetic resources contained within SNAP, 2) Offer sustainable use alternatives for natural resources and for the provision of goods and environmental services, and 3) contribute to the bettering of the quality of life of the local community. More specific objectives of the program are to protect representative samples of multiple types of ecosystems, protecting endemic species and those that are in danger of extinction, recover these species populations, and facilitate scientific research and environmental education. While SNAP is the main conservation organization in Ecuador, other research has been conducted in order to find what human interactions may effect hummingbird populations (SNAP, n.d.)

Importance of Hummingbirds in Ecuador

The main importance of protecting hummingbirds in Ecuador stems from their geographic range and small population numbers. With more than half of the total number of hummingbird species being found in Brazil and Ecuador, it is of extreme importance to protect their populations within these two countries in order to prevent possible extinction (Camfield, 2004). Of the 328 species of hummingbirds throughout the new world, 9 are currently listed as critically endangered, 11 as endangered, and 9 as vulnerable (Camfield, 2004). Multiple species of hummingbirds are endemic to Ecuador, including the Black-breasted Puffleg (*Eriocnemis nigrivestis*) and Violet-throated Metaltail (*Metallura baroni*). The Black-breasted Puffleg is listed as Critically Endangered by the IUCN, yet this can be mainly attributed to its restricted global distribution and small population size (Guevara, et. al, 2015). Confined to two small subpopulations on the north-western flanks of Pichincha volcano, and in the Toisan mountain range in the Imbabura province, the species has a total distribution of less than 70km². The total population of Black-breasted Pufflegs in these two subpopulations is estimated in the range of 250-999 individuals. Populations of hummingbirds are hard to determine due to their small size, it is impossible to attach any radio-signaling device to such a small bird, so estimates are mainly based on mist-netting and physical observations (Guevara, et. al, 2015). The Violet-throated Metaltail is listed by the IUCN as Endangered, one listing above Critically Endangered. This listing can also be attributed to the species restricted range and population size. A study in Bird Conservation International found that the Violet-throated Metaltail is actually tolerant of moderate human intervention in its habitat, as long as some brushy cover is maintained (Tinoco, et. al, 2009). While it is tolerant to human intervention, it is still restricted to an area of

less than 2,000km², causing concern for the longevity of the species, leading to the listing of Endangered (Tinoco, et. al, 2009). While the range of the Violet-throated Metaltail is more than 1,500km² larger than that of the Black-breasted Puffleg, it is restricted to the Western Cordillera of the Andes, an area much more vulnerable to human interaction and development.

Hummingbirds provides an important ecosystem service by facilitating pollination in nectar producing flowers. Some hummingbirds are reliant on specific species of flowers in order to feed as well as relying on multiple species, and vice-versa, many species of flowers rely on these pollinators for reproduction. This can lead to specialization between two co-evolved species. Lindberg and Olesen (2001) conducted a study to evaluate the fragility of this specialization, looking at the specific pollination of *Passiflora mixta* by its pollinating hummingbird, *Ensifera ensifera*. They were able to find that pollinators may be more buffered to extinction because they take advantage of multiple nectar sources, but in areas where local disappearance of the main pollinator has occurred, the plant may be in a 'living dead' state where no pollination is occurring, the plant is no longer able to reproduce (Lindberg, et. al, 2001). The presence of stable populations of hummingbirds is crucial to the survival of pollinating plants that may rely on hummingbirds.

The largest benefit hummingbirds provide to the people of Ecuador is attributed to the ecotourism industry. People from all over the world come to Ecuador in order to witness the rich biodiversity present there, being considered a global diversity hotspot. Numerous bird watching lodges are located throughout Ecuador in order to facilitate tourists accessing the multiple ecosystems taken advantage of by hummingbirds (Camfield, 2004).

Threats to Hummingbirds

The biggest threats to hummingbird populations in Ecuador can be divided along the Andes. While the biggest threats present in western Ecuador include forest fragmentation, ranching, and human development, the biggest threats to habitats in eastern Ecuador are mainly attributed to climate change and oil expansion. Blake and Loiselle (2015) conducted a study to determine the cause of declines in overall bird numbers through eastern Ecuador. Their study site was restricted to Tiputini Biodiversity Station, adjacent to Yasuni National Park, an area known to have effects from oil expansion. While they did find hummingbird populations in the area have declined, the study was conducted in an area of within an expanse of largely undisturbed Amazonian rainforest with little increase in human activity, showing no evidence that habitat loss or alteration have cause the decline. Concluding that the specific mechanism for the decline is unknown, the study shows that a reduced reproductive success combined with reduced survival associated with climate change (Blake, et. al, 2015).

In western Ecuador, the expansion of human development has led to major forest fragmentation. Many hummingbirds, including the Violet-throated Metaltail, is under increasing pressure from human activities such as road construction, cattle ranching, burning and wood extraction (Tinoco, et. al, 2009). Habitat requirements are extremely important for the survival of a species, habitat fragmentation highly limits and may negate any possible habitat that a hummingbird may use. The Black-breasted Puffleg has also been effected by habitat fragmentation, within the distribution range of the species, once pristine habitat has been heavily effected by humans, specifically the expansion of agricultural operations and human-induced burning of grasslands and forests (Guevara, et. al, 2015) While migrating, the Black-

breasted Puffleg was shown to avoid forest borders during migration in order to reduce stress. Needing deep, interior forests in order to have little migrational stress makes it extremely difficult for the Black-breasted Puffleg to successfully migrate.

Another concern for the survival in hummingbirds through Ecuador is the prevalence of diseases such as blood parasites. These parasites can be very harmful to the host organism, in eastern Ecuador, a study showed that all the sampled species had been infected, and several species that had the highest infection rate correlated to the sharpest decrease in population sizes (Blake, et. al, 2015) A study conducted in the northern Andes documented the first sequences of haemosporidians, a family of protozoa mainly linked to malaria, present in hummingbirds. Setting out to evaluate the prevalence of blood parasites in areas of rich avian diversity, researchers identified 11 species of hummingbirds in the northern Andes that had been infected by haemosporidians (Harrigan, et. al, 2014). With the correlation of infection rates and population decline, it is necessary to consider the effects on hummingbird populations that the spread of haemosporidians.

Conservation Efforts and Solutions to Support Hummingbird Populations

The main efforts being put forth in order to help conserve suitable habitat is through SNAP, Sistema Nacional de Areas Protegidas, or the national system of protected areas. SNAP covers all four regions of Ecuador (Galapagos, Costa, Sierra, and Oriente) and is comprised of 51 natural reserves across the country. These reserves protect approximately 20% of the entire area of Ecuador. These reserves are categorized by the size and main objective of the reserve. The main categories that help with the conservation of hummingbirds includes National Parks, Biological Reserve, Flora and Fauna Production Reserves, and Wildlife Refuges. National Parks are large areas (>10,000 hectares) that is mainly concerned with scenery and complete ecosystem and species conservation. These areas remain little effected by human activities and facilitates research, environmental monitoring, and development of tourism that supports the conservation of the area. There are 11 national parks through Ecuador, including the Galapagos, Cotopaxi, Cajas, and Yasuni. Biological Reserves are large areas mainly concerned with the conservation of whole ecosystems and their species. These areas have very restricted access to humans in order to preserve the habitats, yet is still used for research. Flora and Fauna Production Reserves are less concerned with the management of habitats and wildlife. These areas are medium in size (5,000-10,000 hectares) and used for environmental education, ecosystem restoration, and ecotourism. Wildlife Refuges are smaller reserves (<5,000 hectares) with the main conservation goals directed towards endangered species and their specific habitats. In order to protect these endangered species, these refuges have very restricted usage. These reserves help preserve the needed habitat for hummingbird populations to survive (SNAP, n.d.).

While these nature reserves help protect species and habitats, it is impossible to completely protect all possible habitats that hummingbirds may utilize. Recently, nectar feeders have become a popular tool for private nature reserves in neotropical areas to attract hummingbirds close to their patrons. There has been little research into whether these artificial feeders affect flower visitation of hummingbirds, so Brockmeyer and Schaefer (2012) conducted a study to observe the effects of these feeders in the immediate area. It is important to understand the effects of these feeders on the flora populations and hummingbird behavior because most of these private nature preserves harbor incredible biodiversity and are extremely important to endemic species. Their study found that visitation rates of hummingbirds were higher within 5m of a feeder than at 100m, 500m, and 1.5km away, showing that these feeders may facilitate visitation of hummingbirds. Due to the fact that the visitation rates at 100m and 500m were unchanged from the rates at 1.5km, it can be concluded that these feeders do not draw hummingbirds away from the surrounding area, increasing visitation within an immediate area without reducing plant reproduction in the surrounding area. These feeders can be utilized to increase visitation within areas of rich biodiversity without affecting the surrounding area.

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