Hitchhikers in the rainforest: how human transportation models can help us understand interactions between hummingbirds, plants and flower mites

(Alwyn Gentry Award 2021, Association for Tropical Biology and Conservation)

By Laura Bizzarri

That the tropics are a hotspot of biodiversity is no secret for the readers of the OTS eCanopy newsletter. However, when the general public thinks about the tropics, they often picture charismatic organisms such as macaws, howler monkeys, jaguars, or tree boas. Smaller, less conspicuous organisms are often overlooked. My research focuses on a fascinating interaction, small flower mites that live in the flowers of hummingbird pollinated plants. Flower mites hitch rides on the beaks of hummingbirds to disperse to new host plants and find flowers, drink nectar, mate and reproduce. I started working on the ecology of hummingbird flower mites in the Fall of 2017, when I joined the lab of Dr. Carlos García-Robledo at the University of Connecticut to pursue a master's degree. I will admit that I had not applied to grad school with the goal of working with mites, but once Carlos and I got talking about these arthropods and how they interact with plants and hummingbirds, it wasn't hard for me to fall in love with this cool system. I was thrilled when the National Geographic Society awarded me an Early Career Grant. With the support of Nat Geo, I combined novel methods such as high-speed video recording and DNA Barcoding to study hummingbird flower mites and their interactions with hummingbirds and plants at La Selva Biological Station in Costa Rica.

Hummingbird-pollinated flowers host a group of nectar robbers, the hummingbird flower mites. Mites spend most of their life in flowers of their host plants. To disperse to new plants, mites hitch rides in the nares of the hummingbirds that pollinate their host plants. Illustration by Erin K. Kuprewicz.

Before the COVID-19 pandemic shut down entire countries worldwide, tropical biologists relied on airplane travel to reach a beautiful location for research, a much-needed vacation, to return home and visit our families, or attend amazing conferences such those held by the Association for Tropical Biology and Conservation (ATBC). Imagine if you had to take a plane every day to get food, find a partner or start a family. This is exactly what hummingbird flower mites experience throughout their lifetime. This analogy inspired me to adopt human transportation analyses to study transportation patterns in hummingbird flower mites. Transportation analyses can determine

how accessible are transportation hubs, such as a subway station, an airport or a hummingbird-pollinated flower (Rodrigue 2016).

My presentation on this transportation analysis of hummingbird-mite interactions was honored with the Alwyn Gentry Award – best talk by the Association for Tropical Biology and Conservation Conference (ATBC). My talk focused on the use of accessibility matrices developed for human transportation networks. I was able to adapt these methods to determine whether flower mites can access all their host plants by simply riding on a single hummingbird species.

Laura Bizzarri during field work at La Selva. Field work for this project included multiple steps, from locating and marking plants for video recordings and flower mite collections, to mist netting hummingbirds and collecting mites from hummingbird nares. Mite species were identified using DNA barcodes.
Photo credit: Mario Alberto Salazar Araya.

During my master's research I employed molecular methods, such as DNA barcoding, the use of a small fragment of an organism's DNA to identify or delineate species, to determine that there are at least 18 species of mites interacting with hummingbirds and hummingbird pollinated plants at La Selva. But to determine the accessibility of different host plants for each mite species I also needed to know what hummingbird species interact with each host plant species. I used GoPro cameras to take video recordings of hummingbirds visiting the mites' host plant species. I finally had all the pieces I needed to map out the dispersal routes of each mite species among its host plant species. The use of the accessibility matrices from human transportation geography allowed me to determine that 15 out of the 18 mite species that I found at La Selva can go directly from one host plant to another using a single hummingbird species. Only 3 mite species use host plants for which they have to stop at an intermediate host plant and use two different hummingbird species to move among the different plant species.

I feel incredibly lucky to continue my PhD research at La Selva. I will admit that the choice to carry out my field work at La Selva was mainly driven by my advisor. Carlos has been doing research at La Selva for over two decades, with a permanent field lab and long-term projects, but I honestly couldn't have thought of a better place to conduct my field work. I like to think of La Selva as a haven for researchers from all around the world to unleash their curiosity about the natural world and its workings. I personally have come to view La Selva as one of my 'happy places' on Earth. I would also like to acknowledge that the people I met at La Selva played a fundamental role in turning this place into my 'happy place'. I want to thank the Organization for Tropical Studies community, who made this project possible by providing funding and logistic support, and a safe space to unravel my scientific creativity.

If you would like to watch the lightning talk I gave at the 2021 Virtual ATBC conference, enjoy the video at this link: https://youtu.be/5GEZnVH3Hsw

Literature Cited

Rodrigue, J.-P. 2016. The Geography of Transport Systems. Taylor & Francis.