Study of color and sugar concentration preferences in *Sericotes holosericeus* and *Coereba flaveola*

Audrey Holstead

Texas A&M University

Dr. Jim Woolley

Dr. Thomas E. Lacher, Jr.

Dr. Adrienne Brundage

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Abstract

There are multiple types of pollinating birds on the Island of Dominica. This includes hummingbirds and other pollinators, such as Bananaquits. At the Archbold Research Center, I conducted a study to test for color preference and sugar level preference. Five feeders of different colors were set out, each containing a 4:1 water to sugar ratio. After data were gathered for color preference, the feeders were taken down and 3 others (all red) were put up with sugar solutions that varied in concentration. One feeder had a concentration of 12%, another had 22.5%, and the third one had >30%. When testing for color, it was found that Green-throated Caribs prefer red feeders and avoid the 12% solution, but distribute relatively equally between the other two concentrations. Bananaquits will show a preference for yellow and pink feeders, while also showing a high preference for the >30% solution.

Introduction

Dominica is an island with many diverse habitats, but each one is dependent on pollinators for a vast number of the flora species on the island. Multiple species of birds are part of this, including *Sericotes holosericeus, Eulampis jugularis, Cyanophaia bicolor,* and *Orthorhyncus cristatus*, 3 species of hummingbird, and the Bananaquit, *Coereba flaveola* (Evans 1990).

Previous studies were done to test for color preference (Rice 2015) and sucrose concentration (Barrera 2002). Rice's study was done with colors ranging across the visible light light spectrum, including green and blue, whereas I have chosen colors specifically in the "warm

color" spectrum, which both species showed preference for over the purple, a "cool color". This is very similar to the use of only red and yellow feeders done in a series of experiments by F. Gary Stiles in 1976 to test for taste preference, color preference, and flower selection in different species of hummingbirds (Stiles 1976). Stiles test revealed that between red and yellow, red was more likely to be chosen, but the birds could be conditioned to alter this behavior. Barrera tested two levels of sugar concentration, with a 4:1 water to sugar ratio, and an 8:1 water to sugar ratio. This study will look at the standard 4:1 ratio suggested by most sources when setting up feeders, as well as a lower concentration level and a more saturated level. The study was intended to test for 3 different hummingbird species, but the territorial nature of *Sericotes holosericeus* caused the other species to be driven off. With both tests, I will be attempting to determine an ideal feeder color for different species of pollinators, as well as a preferred sugar concentration to attempt to encourage them to visit more often.

Materials and Methods

I began my tests by prepping five hummingbird feeders and sugar water. I selected five feeders of the same shape, cleaned and painted them each one of the selected colors (Figure 1).

Figure 1: The hummingbird feeders before being painted, with their selected color next to them.

After each one had dried, they were filled with a sugar solution that had a 4:1 ratio of water to sugar. The solution was tested with a refractometer and produced a 17% reading. The feeders were evenly spaced out about 1.5 feet from each other and tied to a bamboo pole. Bamboo tripods were assembled and the pole that the feeders were tied to was placed on them on the 2nd tier of the back portion of the Springfield property (Figure 2).

Figure 2: Feeders hanging from the bamboo stand and tripods.

The feeders were left for 24 hours to allow the birds to adjust to them. The following day, hour long observations were started in the morning, consistently starting at ~06:00. Afternoon observations were also started, however, starting time varied between 16:00-17:00 and the duration varied from one hour to two. Each day, the color order was randomly generated by putting the list in an online generator (Haarh, 1998).

For the second portion of the data collection, three sugar solutions were created with varying sugar levels. The solutions were tested with a refractometer and resulted in 12%, 22.5%, and >30% solutions. Each solution was placed in a red feeder, all being the same color and size to avoid discrepancy. The color feeders were taken off the bamboo stand and replaced with three red ones. The color red was selected because of the study done by Stiles, where he determined that hummingbirds have a natural preference for the color red (Stiles 1976). Observations were

restarted, beginning at the same times, and lengths were the same as when color variation was being tested. A third observation time was added at 13:00, and lasted one hour long. Each day, the order for the sugar concentrations was randomly generated with the same online generator (Haarh,1998).

Once all of the observation totals were completed and the data was tallied up, a Likelihood analysis was run on both data sets.

Results

Two species of nectar feeding birds visited the feeders: the Green-Throated Carib, *Sericotes holosericeus*, and the Bananaquit, *Coereba flaveola*. Shown below are Tables 1 and 2 with the number of visits to each feeder, based on species and test variable.

Species	Purple	Pink	Red	Orange	Yellow
Green-throated Carib	0	13	36	17	15
Bananaquit	10	17	10	12	20

Table 1: Number of visits to feeders that vary in color.

Species	12%	22.5%	>30%
Green-throated Carib	21	21	41
Bananaquit	3	15	14

Table 2: Number of visits to feeders that vary in sugar concentration.

A Likelihood analysis was run on both data sets. For the color analysis, the pink and purple totals had to be merged because of the inability to analyze a dataset containing 0.

Therefore, the analysis was a 2 species x 4 colors block. When the test was run, we received a result of $X^2(3) = 21.23$ and $p<0.001$.

For the sugar concentrations data, the same type of test was run. We had a 2 species x 3 concentrations block run. The test resulted with $X^2(2) = 5.72$ and $p= 0.057$.

Discussion

Based on my test results, there is a significant difference between the behaviors of *C. flaveola* and *S. holosericeus*. For color preference, the likelihood test produced a highly significant result for both species (Table 1). *S. holosericeus* will be highly likely to drink from the red feeders, whereas *C. flaveola* will tend to avoid the red and orange feeder, and are more likely to drink from the pink/purple feeders and the yellow feeder.

For the sugar variation test, the product was deemed marginally nonsignificant (Table 2). One issue that may be present with the sugar variations a lack of sufficient observation replicates. Due to the timeline of the trip, I was unable to sit for more than 2.5 days to observe the feeders. If a person were to look solely at the number of visits to the feeders, data trends indicate that *S. holosericeus* will tend to avoid the 12% solution, but have a relatively even distribution between the other two feeders with the amounts of visit. For *C. flaveola*, it's also very apparent that they tend to prefer the >30% solution, with 41 visits to that feeder, verses 21 at each of the other too feeders. However, because of the lack of data, the results were insignificant. If someone were to repeat this test, it would need to be for a longer period of time so that more data can be gathered and more accurate results can be obtained.

Coereba flaveola were not originally intended to be factored into the tests. However, because of how much of a pollination factor they also are on the island and how frequently they were coming into the feeders, I decided to determine preferences for them as well.

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