The Effects of Food Color and Feeder Spacing on Food Consumption by Ruby-throated Hummingbirds in Baton Rouge, Louisiana

**ABSTRACT** We tested whether hummingbirds prefer red-dyed food over clear food, and food consumption at single feeders in comparison to feeders in close proximity to one another. Our study included 144 feeders divided among 12 yards in College Town, Baton Rouge, LA. The feeders were mounted on X-bars or shepherd’s hooks to measure the effects of proximity on consumption, and were filled with either clear or red food to measure the effects of color on consumption. On average, hummingbirds consumed 4.163 g more clear food than red food, and 6.680 g less food from single feeders than from X-bar feeders. The results did not support our hypothesis that hummingbirds prefer brightly colored food, but did support the hypothesis that consumption at single feeders is lower than at grouped feeders due to a reduction in territoriality. Our study can be useful for homeowners who wish to attract more hummingbirds to their property for aesthetics or to improve the quality of their gardens; or for researchers who need to attract large numbers of hummingbirds for observational studies.

**KEY WORDS** *Archilochus colubris*, Baton Rouge, College Town, color preference, feeder spacing, ruby-throated hummingbird, territoriality.

This project was designed to give first-hand experience with hypothetical-deductive science to students studying natural resource ecology and management at Louisiana State University in Baton Rouge, LA. The purpose of this study was to determine the effects of food color and feeder spacing on food consumption by ruby-throated hummingbirds (*Archilochus colubris*). Ruby-throated hummingbirds (RTHB) are the only hummingbird species known to breed east of the Mississippi, and are facultative mutualists of many plants (Bertin 1982). A study exploring the relationship between RTHB and their food plants found that hummingbirds are important pollinators and can increase the spread of seed by up to 17% compared to pollination by only insects (Bertin 1982).

We examined the effects of food color on consumption because it is a commonly held belief that many of the flowers that hummingbirds feed on are red due to co-evolution with hummingbirds that have a preference for red food (Miller and Miller 1971). However, studies have yet to confirm that hummingbirds have a preference for any particular color (Grant 1966). We hypothesized that consumption at feeders filled with red food would be higher than at feeders filled with clear food because hummingbirds are more attracted to bright colors. I predicted that hummingbirds would make more visits to feeders filled with red food during the fall migration in Baton Rouge, LA.

Researchers have long known that ruby-throated hummingbirds exhibit territorial behaviors (Pitelka 1942). Ruby-throats will defend their territory, which often consists of a roost and sources of food and water, from hummingbirds of both sexes; and will go so far as to fight off other species, such as moths and bees, which may compete for food (Pitelka 1942). We hypothesized that consumption at feeders in close proximity would be higher than consumption at single feeders due to a reduction in territorial displays because hummingbirds will not be able to defend multiple feeders. I predicted that consumption at single feeders would be lower than consumption at grouped feeders because fewer hummingbirds would utilize the single feeders.

**STUDY AREA**

The study area was College Town, a neighborhood in Baton Rouge, LA, near the Louisiana State University campus. Baton Rouge is located in the Mississippi River Delta and has a sub-tropical climate. Ruby-throated hummingbirds pass through Louisiana between August and October on their annual migration to their breeding grounds along the Gulf of Mexico and in Central America (Willimont 1988). There were no hurricanes or major storms in Louisiana during the study period.

**METHODS**

The experimental design and materials for the study were provided by Mr. Luke Laborde, an instructor at Louisiana State University. Prior to the start of the study, L. Laborde obtained the consent of homeowners to place 144 hummingbird feeders in 12 yards and lots. To measure the effects of feeder spacing on consumption, half of the feeders were placed on X-bars made of re-bar. Each X-bar held 12 feeders in a 10 m2 area. There were 72 feeders hanging on X-bars in half of the yards, and 72 feeders hanging on single shepherd’s hooks in the other 6 yards. Adjacent yards were paired and the treatment (feeder spacing) was decided by coin flip. Food color and feeder size were alternated by factorial experimental design. Half of the feeders in each yard were 88.7 ml (3 oz.) Perky Pet feeders (small feeders) used to measure consumption. The rest of the feeders were 1419.53 ml (48 oz.) feeders, used as attractors but not for measurement. In single feeder yards, feeders were hung in pairs (2 large feeders or 2 small feeders) on hooks spaced <1 m apart, and each pair at least 10 m away from another pair. To measure the effects of food color on consumption, feeders were filled with either clear or red food. Food was prepared with 4 parts water to 1 part sugar, boiled, and separated into 3.78 L (1 gal.) containers. Half of the food was dyed with red food coloring. Food color was alternated in both large and small feeders. First placement (large or small, clear or red) was decided by coin flip for each yard. X-bars were oriented North – South, in line with the hummingbird migration route. Small feeders were placed on the N – S axis, with food color alternated and first placement decided by coin flip. Large feeders were on the E – W axis, with food color alternated and first placement determined by coin flip. All feeders were labeled with the yard number, food color, and feeder number (Laborde 2013).

**Data Collection**

The feeders were placed during the week of 19 August 2013, and the experiment was conducted from 26 August to 28 September. Students were divided into 7 teams of 5 students. Teams went to the study area every three days and weighed each feeder before refilling it with the same color food. All food was replaced every 6 days. Each team was assigned two days on which to weigh the feeders and replace the food. Data collection lasted approximately one hour, and took place between 0600 and 0700 hours each refill day. We collected 12 data points for each of the 72 small feeders.

**Data Analysis**

Data analysis was conducted using R Studio (RStudio, Inc., http://www.rstudio.com, accessed 14 Oct 2013). ANOVA was used to test for differences in consumption based on feeder spacing, food color, and spacing/color interaction. The best fit model was selected using Akaike Information Criterion (AIC), with the lowest AIC representing the best fit to the data. A parameter estimate confirmed the fit. A post hoc test with linear analysis was performed on both color and spacing to determine the impact of each factor on consumption. A random variable (time) was included in the analysis.

**RESULTS**

The model that best fit the data was feeder spacing + food color + time (Appendix: Table 1). On average, hummingbirds consumed 4.163 g more clear food than red food (*P* = 0.008, Table 2). Hummingbirds consumed an average of 6.680 g less food from single feeders than from X-bar feeders (*P* < 0.001, Table 3).

**DISCUSSION**

We found that ruby-throated hummingbirds are most attracted to feeders filled with clear food and feeders placed in close proximity to one another. We rejected our hypothesis that hummingbirds prefer brightly colored food. However, the results did support the hypothesis that consumption at single feeders would be lower than at grouped feeders, presumably because of a reduction in territoriality. Our results are in line with those of a study from the 1970s which concluded that the location, not color, of the food source is the most important factor in determining feeder preference by ruby-throated hummingbirds (Miller and Miller 1971). K. Grant proposed in the 1960s that a possible explanation for hummingbirds feeding predominantly on red-flowered plants is a type of Mullerian mimicry, in which it is beneficial for both the plants and the hummingbirds if potential food sources can be identified quickly by a common color (Grant 1966). Red likely became the color of choice simply because it is the most obvious color against a green background and would be easy for hummingbirds to identify (Miller and Miller 1971). In future repeats of this study, I would recommend including the findings of R. S. Miller and R. E. Miller in the experimental design by collecting data on consumption by location. It is possible that the location of the feeders was another random variable that might have influenced our results, and that we did not take into consideration.

**MANAGEMENT IMPLICATIONS**

Our study can be useful for homeowners who wish to attract more hummingbirds to their property for aesthetics or to improve the quality of their gardens. These results may also assist researchers who need to attract large numbers of hummingbirds for observational studies.

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**LITERATURE CITED**

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**APPENDIX**

Table 1. Comparison of models using AIC to determine the best fit for the data collected on food consumption by ruby-throated hummingbirds during the fall migration through Baton Rouge, LA, between 26 August and 28 September, 2013. “Stand” represents the feeder spacing, either single or in close proximity on an X-bar apparatus. “Color” represents the color of the hummingbird food, either clear or red. Model 3 had the lowest AIC and was the most parsimonious.

|  |  |  |
| --- | --- | --- |
| Models |  |  |
| Object | Y ~ (1 | Time ) |  |
| 1 | Y ~ Stand + (1 | Time ) |  |
| 2 | Y ~ Color + (1 | Time ) |  |
| 3 | Y ~ Stand + Color + (1 | Time ) |  |
| 4 | Y ~ Stand + Color + Stand \* Color + (1 | Time ) |  |
|  | Df | AIC |
| Object | 3 | 7918.8 |
| 1 | 4 | 7902.8 |
| 2 | 4 | 7913.9 |
| 3 | 5 | 7897.7 |
| 4 | 6 | 7898.4 |

Table 2. Post Hoc test of the variable “color” on food consumption by ruby-throated hummingbirds during the fall migration through Baton Rouge, LA, between 26 August and 28 September, 2013. The linear hypothesis states that consumption at feeders filled with clear food was 4.163 g more than consumption at feeders filled with red food.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | z value | Pr (> | z | ) |
| R – C == 0 | 4.163 | 1.561 | 2.667 | 0.008 |

Table 3. Post Hoc test of the impact of the variable “stand” on food consumption by ruby-throated hummingbirds during the fall migration through Baton Rouge, LA, between 26 August and 28 September, 2013. The linear hypothesis states that consumption at single feeders was 6.680 g less than consumption at feeders on an X-bar.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | z value | Pr (> | z | ) |
| X – S == 0 | -6.680 | 1.561 | -4.280 | < 0.001 |