Comparative Photographic Study of Common Lesser Antillean Avian Nectarivore Bill Morphology in Dominica

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Abstract

Nectarivorous birds of the Lesser Antillean island of Dominica include the Purple-Throated Carib hummingbird (*Eulampis jugularis*), the Green-Throated Carib hummingbird (*Sericotes holosericeus*), the Antillean Crested hummingbird (*Orthorhyncus cristatus*), the Blue-Headed Hummingbird (*Cyanophaia bicolor*), and the Bananaquit (*Coereba flaveola*). My project was to photographically document bill morphology of nectarivores, and to test if a simple ratio of curvature to length would be enough to distinguish between the different nectar-feeding birds present at the Springfield Center for Environmental Protection, Teaching, Research and Education (SCEPTRE). In previous years it has been possible to observe Purple-Throated Caribs, Green-Throated Caribs, Antillean Crested Hummingbirds and Bananaquits at the field station, however no Antillean Crested were available for this study. Pictures of four hummingbird feeders with centimeter scale markings were taken with a Canon 40 Digital SLR camera with a 300x lens. Results revealed that based on a ratio of curvature to length alone, the Purple-Throated Carib hummingbird can be distinguished from the Green-Throated Carib and the Bananquit, however based on this ratio *C. flaveola* and *S. holosericeus* cannot be distinguished between one another. Further study is needed to include other species of nectar feeding birds not photographically captured for this study.

Introduction

Nectarivorous birds of the Lesser Antillean island of Dominica include the Purple-Throated Carib hummingbird (*Eulampis jugularis*), the Green-Throated Carib hummingbird (*Sericotes holosericeus*), the Antillean Crested hummingbird (*Orthorhyncus cristatus*), the Blue-Headed hummingbird (*Cyanophaia bicolor*), and the Bananaquit (*Coereba flaveola*). Studies of the Purple-Throated Carib hummingbird (*Eulampis jugularis*) have been carried out over the years to investigate the species' sexual dimorphism and the relation between beak morphology and the plants that provide nectar for the birds (Temeles, 2000). The *Eulampis jugularis* lives on the islands of St. Lucia and Dominica, and the sexually dimorphic bill morphology of this species has been studied (Temeles, 2003). Purple-Throated Caribs and Green-Throated Caribs share similar food sources and foraging habits, their diets including nectar and insects, and the two can often be seen contemporaneously (Evans, 1993). Bananaquits also feed on nectar and insects, but their diet includes various fruit juices and seeds of herbaceous plants (Evans, 1990). A comparative study of the morphology of nectar feeders will help to describe the differences between all the species that have evolved utilizing similar food sources on Dominica. My project was to photographically document bill morphology of nectarivores, and to test if a simple ratio of curvature to length would be enough to distinguish between the different nectar-feeding birds present at the Archbold Tropical Research and Education Centre (ATREC). In previous years it has been possible to

observe Purple-Throated Caribs, Green-Throated Caribs, Antillean Crested Hummingbirds and Bananaquits at the field station. Based on this information, Blue-Headed Hummingbirds were not included in my experimental design, although their incorporation would be possible in the habitats where they occur.

Methods

Four hummingbird feeders were marked with one-centimeter scales (Figure 1) in order to provide an in-picture frame of reference for scale.

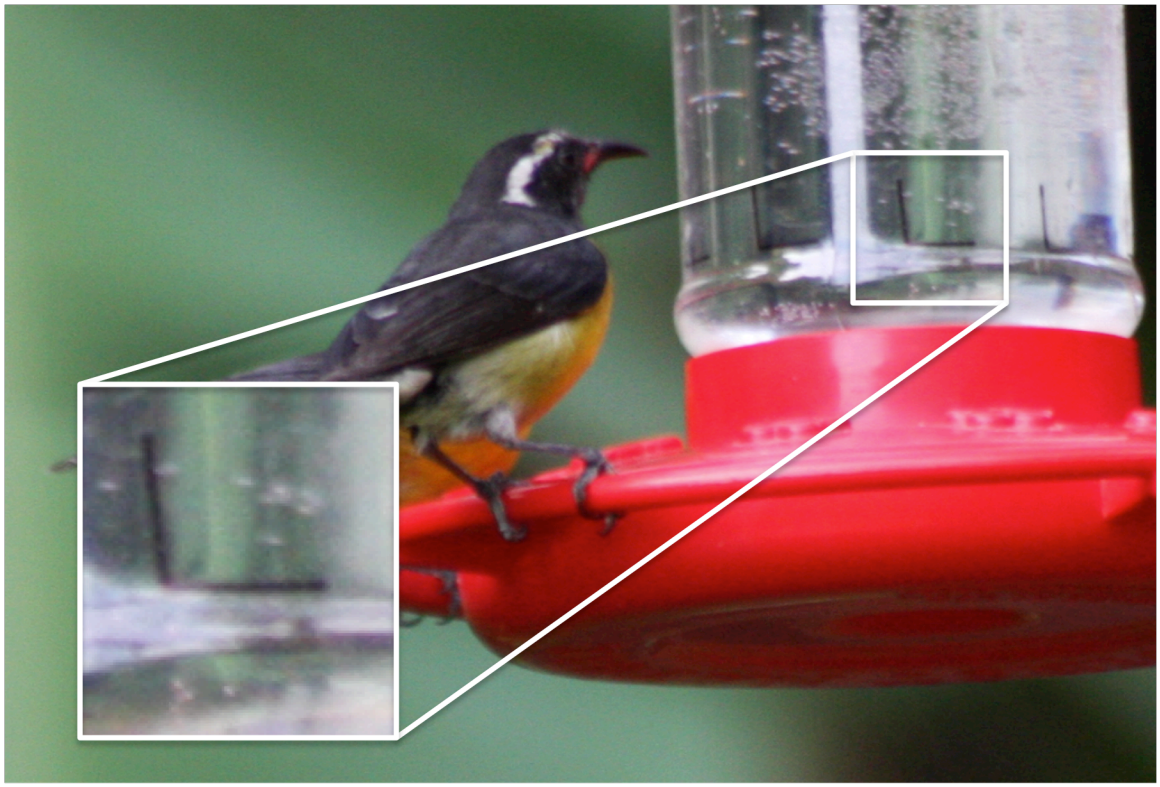

Figure 1

Bananaquits visit one of the hummingbirds. Centimeter scale provides in picture reference for size.

The four hummingbird feeders were suspended 1.5 to 2 meters high off the ground by rope strung across three trees spanning 10 meters across. From a vantage point at the relative center, pictures were captured with a Canon 40 Digital SLR camera with a 300x zoom lens. Photographs were then analyzed in Adobe Photoshop CS6 by first measuring the centimeter scale and recording the number of pixels. Next, five equally spaced landmarks were assigned to the bill of the bird, the first at the tip of the bill, and the last at the base, where bill meets feathers (Figure 2, 3, 4).

Figure 2
Green-Throated Carib (*Sericotes holosericeus*). Markers for measurement shown.

Figure 3
Bananaquit (*Coereba flaveola)*. Markers for measurement shown.

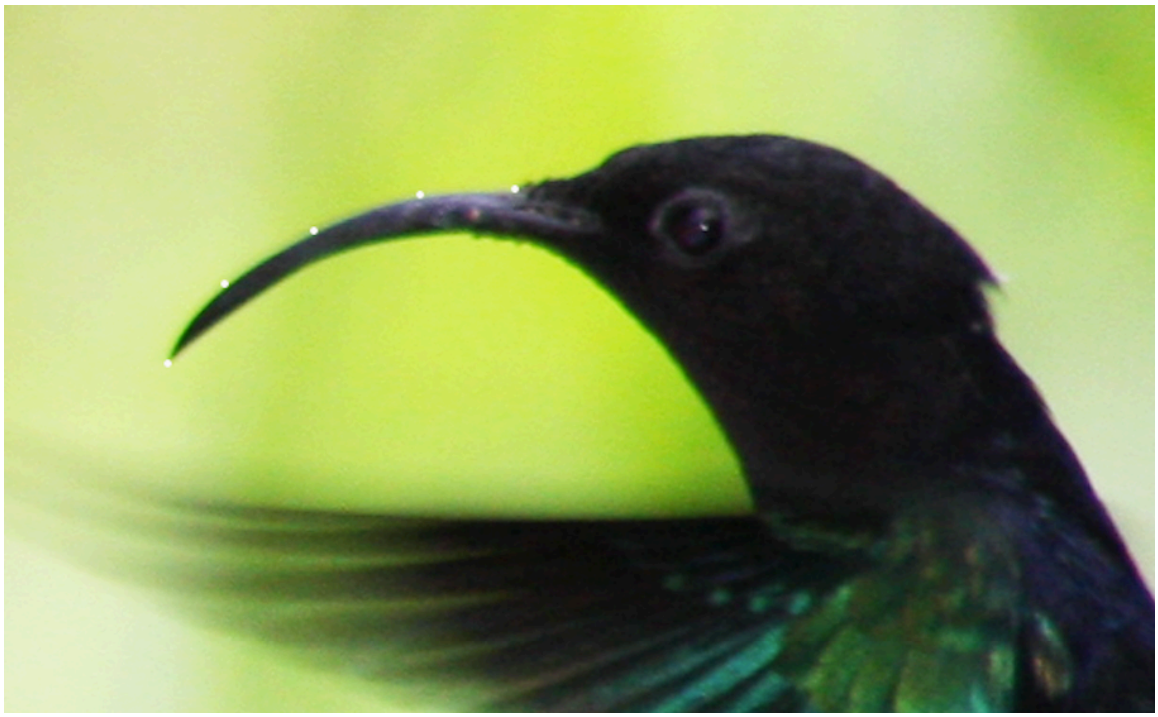

Figure 4
Purple-Throated Carib (*Eulampis jugularis)*. Markers for measurement shown.

The sum of the measurements between these markers served as the measure for total bill length. The ratio of the actual bill length (sum of the four segments as described above) divided by the straight-line length from the base of the bill to the tip served as the estimate of the bill curvature. All records were stored in Microsoft Excel, and exported to IBM SPSS Statistical Package Version 20.0 for statistical analysis.

Results

A total of 12 Purple-Throated Hummingbirds, 19 Green-Throated Hummingbirds, and 46 Bananaquits were observed in this study. These 77 individuals were successfully photographed, and the ratio was calculated for individuals. No Antillean-Crested or Blue-headed hummingbird individuals were documented.

The average straight-line length of Bananaquit bills was 1.164 cm, and the average ratio of curvature to length was calculated at 1.020 (range 1.010 to 1.039). The average straight-line length of the Green-Throated Carib hummingbirds was 2.261, and the average ratio was 1.021 (range 1.013 to 1.037). The average straight-line length of the Purple-Throated Carib hummingbirds was 2.191, and the average ratio of curvature to length was 1.056 (range 1.028 to 1.114).

Table 1

ANOVA results. Test for significant mean curvature ratio among the three species. There was a highly significant difference.

ANOVA

Ratio

	Sum of Squares	df	Mean Square	F	Sig.

Between Groups	.013	2	.006	54.235	.000
Within Groups	.009	74	.000		
Total	.022	76			

Table 2

Tukey test for pairwise comparisons among means. Species 2, the Purple-Throated Carib, had a significantly different ratio of curvature compared to the other two species.

Ratio

	SpeciesN	N	Subset for alpha = 0.05	
			1	2
Tukey HSD[a,b]	3.00	46	1.02052	
	1.00	19	1.02121	
	2.00	12		1.05625
	Sig.		.979	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 19.023.

b. The group sizes are unequal. The harmonic mean of the group sizes is used.

Type I error levels are not guaranteed.

Discussion

A univariate analysis of variance (ANOVA) with mean ratio as the dependent variable and species type as the independent variable was run. This test showed extremely high significance, 0.000 among groups, so a Tukey test of which groups was run to examine differences between mean ratios for the three species.

Although group sizes were different, the analysis of variation of the mean ratio sizes for each species revealed that Green-Throated Hummingbirds and Bananaquits could not be distinguished by their ratio of bill curvature alone (Table 2). As they are birds of different orders and possess very different average straight-line bill length, this is a good example of convergent evolution, by which both species have reached a very similar ratio of curvature to length due to feeding habits.

The analysis however did show that the Purple-Throated Carib could be distinguished from the other two study species by the ratio alone. Thus a photogrammatic tool can be used to distinguish between Purple-Throated Carib hummingbirds and Green-Throated Carib hummingbirds, even in poor light.

Further study including comparisons of Lesser Antillean Hummingbirds and Blue-Throated Hummingbirds could reveal more interesting details about the morphology of nectar-feeders on Dominica.

Conclusion

The identification of a Purple-Throated Carib as opposed to Green-Throated Carib or Bananaquit is possible based entirely upon the ratio of curvature to length established here. Distinguishing between Green-Throated Caribs and Bananaquits based on this ratio

is not possible. By simply calculating the ratio of curvature to length, a photographic subject can be identified as *E. jugularis* or not.

Acknowledgements

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