MIGHTY MITES: USING *RHINOSEIUS COLWELLI* TO DETERMINE HUMMINGBIRD FLOWER PREFERENCES IN *CENTROPOGON*

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Abstract. The mite *Rhinoseius colwelli* is dispersed among *Centropogon talamancensis* flowers on the beaks of hummingbirds. The number of mites per flower has been used as an index of hummingbird foraging frequency on that flower. Upon examination of *C. talamancensis* flowers, we found that larger patches of *C. talamancensis*, had more nectar mites per flower and that larger flowers (determined by corolla length) had larger mite colonies. Mite abundance per flower and patch density were uncorrelated. These data suggest that hummingbirds frequent larger patches and larger flowers more often, regardless of patch density.

Key Words: Centropogon talamancensis, *hummingbird mites, mutualism, nectar*

INTRODUCTION

Rhinoseius colwelli is a small, white mite (0.6 mm) that lives within the flowers of several species of plants such as *Centropogon talamancensis, C. valerii,* and two species of Bomarea at Cerro de la Muerte (Colwell 1983). *R. colwelli* is dependent upon the mutualism between hummingbirds and bird-pollinated flowers because they rely upon hummingbirds as a means of dispersal among flowers. While the hummingbird is feeding upon a flower, the nectar mites enter the nasal passages of the bird and are carried to another flower. At Cerro de la Muerte, mites have been found in the nasal passages of Green Violet-ear *(Colibri thalassinus)* and Fiery-throated *(Panterpe insignis)* hummingbirds (Colwell 1983).

Because nectar mites do not move between flowers on their own power and the hummingbirds do not ingest the mites (Colwell et al. 1974), the presence of nectar mites in an individual flower indicates previous hummingbird visits. Furthermore, the number of mites per flower can be taken to be an index of hummingbird foraging frequency on that flower (Colwell et al. 1974). We used this relationship between mite density and hummingbird visitation to assess hummingbird foraging activity on *Centropogon talamancensis.* Specifically, we hypothesized that (i) larger patches of *C. talamancensis*, both in terms of total area (m2) and total number of flowers, would have more nectar mites per flower, that (ii) patches of higher density would have higher mite densities than patches of low flower density, and that (iii) flowers with longer corollas would have larger mite colonies.

METHODS

We collected data on all *Centropogon talamancensis* patches that were visible from the trail above Cuerici Biological Station near Cerro de la Muerte. A total of 14 patches were sampled. In each plant, data were collected only on open flowers that were not yet wilted. For each *C. talamancensis* plant, we measured the total ground area (m2) of the bush. We then divided the patch into 0.25 m2 quadrats and randomly selected 20% of the quadrats for more intensive sampling. If there were less than five quadrats only one quadrat was sampled. In each quadrat sampled, we recorded the total number of healthy flowers and the average height of the flowers by measuring the height of the quadrat. We then removed each flower, one by one, recorded the corolla length, and then dissected the flower and counted all the nectar mites contained within.

We calculated the total number of flowers per plant by multiplying the average number of flowers per quadrat by the total number of quadrats. To estimate flower density on each plant, we calculated the average number of flowers per quadrat. We used linear regressions to analyze the relationships between mite densities and patch size, patch densities, and corolla lengths.

RESULTS

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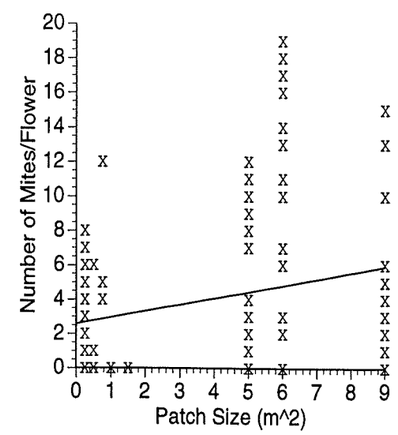

FIG. 1. Relationship between number of mites per flower and individual patch size (m^2).

DISCUSSION

Based upon Colwell's (1974) mite population index which can be used to determine hummingbird foraging frequency on particular flowers, our results revealed that hummingbird visitations increased with increasing patch area and total number of flowers. It is important to note, however, that Colwell's index is simply an index of hummingbird foraging frequency on a particular flower. Because mites may reproduce in flowers and the number of mites entering and leaving a flower during a particular hummingbird visit may be highly variable, this index cannot be used in a quantitative way to establish a relationship between number of mites and frequency of visits (Colwell 1974).

Although we found a significant increase in the number of mites per flower as patch area increased,

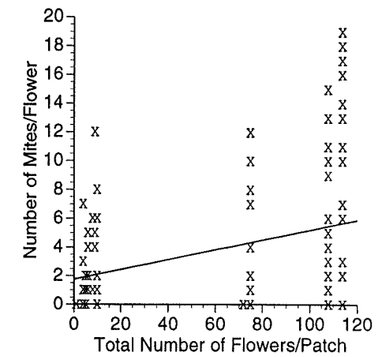

FIG. 2. Relationship between the number of mites per flower and the total number of flowers per patch.

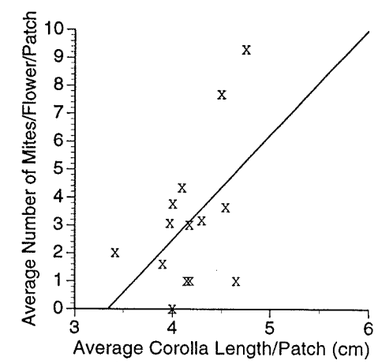

FIG. 3. Relationship between average number of mites per flower per patch and the average corolla length of flowers per patch.

there was a notable variance of the number of mites per flower within patches, especially in larger patches. This finding supports Colwell's observation that within *Centropogon* patches there exist distinct regions which are more preferred by hummingbirds. Specifically, Colwell et al. (1974) noted that hummingbirds prefer flowers on the upper and outer parts of the shrub. Because we randomly selected quadrats within patches and did not attempt to select particular quadrats which would represent each of the zones which Colwell established as preferred by hummingbirds, we are unable to quantify these variations within patches. However, this notable variance in the number of mites per flower in larger patches suggests that not only are hummingbirds visiting flowers in small patches less frequently than flowers in larger patches, but that there is little variation in flower preference within smaller patches. Because of this overall variation within patches, our ability to detect differences in mite density as a function of patch size was limited.

Contrary to our second hypothesis, we observed no positive correlation between increases in patch density and increases in the total number of mites per flower. While our intuition initially led us to believe that hummingbirds would prefer higher density patches since more flowers per area would enable them to expend less energy in traveling from one flower to another, it appears that hummingbirds may instead prefer larger patches with more flowers regardless of the density of these flowers. In fact, our results revealed a significant negative correlation between flower density per quadrat and patch size. This suggests that not only do larger patches appear to have lower flower densities, but that hummingbirds prefer these patches.

The positive relationship between average corolla length and mite density reveals that hummingbirds visit larger flowers more frequently than smaller flowers. Although we did not measure individual flower nectar quantities, we would predict that larger flowers are visited more frequently because of their ability to produce more nectar.

In summary, Colwell's mite index provided us with the means to assess how patch size, total number of flowers per patch, patch density, and flower size affect hummingbird foraging preferences. Because *Centropogon* relies upon hummingbirds as pollinators, those patches which are able to lure more potential pollinators may increase their chances for successful pollination. Thus, those patches with a relatively greater total area, greater number of total flowers, and larger flowers are more likely to be visited by pollinating hummingbirds.

Literature Cited

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