Effects of microhabitat on nectar robbing

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Abstract: *Diglossa plumbea*, the Slaty Flowerpiercer, specializes in nectar robbery of tubular flowers. Previous research suggests that *D. plumbea* forages more often on flowers found in dense vegetation (interior microhabitats) than on those on outside edges of vegetation patches (exterior microhabitats) because dense vegetation structure in the interior provides more perches. We hypothesized that the frequency of flower piercing should be influenced by the microhabitat of individual flowers and that flower piercing preference should be affected by the proximity and availability of perches to a flower. We found no significant effect of microhabitat (interior vs. exterior) on the number of flowers pierced in our study area. However, pierced flowers had significantly more surrounding perches than unpierced flowers and the distance to the nearest potential perch was shorter for pierced flowers than for unpierced. These findings suggest that vegetation structure is an important factor and may explain why flower morphotypes found most commonly in dense vegetation had a high proportion of pierced flowers.

Key Words: Diglossa plumbea, *hummingbird flowers, Slaty Flowerpiercer*

Introduction

Nectar robbing is a process by which birds extract nectar from a flower by piercing the base of its corolla. *Diglossa plumbea*, the Slaty Flowerpiercer, specializes in nectar robbery of tubular flowers that are pollinated by hummingbirds. Unlike hummingbirds, *D. plumbea* cannot hover; it must perch in order to access a flower's nectar.

Colwell et al. (1974) suggest that *D. plumbea* forages on flowers found in dense vegetational microhabitats (interior sites), rather than in microhabitats that are open and exposed (exterior sites). Vegetation structure provides perch space for *D. plumbea* while foraging (Colwell et al. 1974). Therefore, we predicted that the frequency of flower piercing should be influenced by the microhabitat of individual flowers, and that *D. plumbea* flower preference should be affected by the proximity and availability of perches to a flower.

Methods

We established twelve 20 m transects along both sides of the hiking trail through the early successional forest approximately 1 km East of the Estación Biológica Cuericí, Costa Rica. Within each transect, we counted all pierced and unpierced open flowers of every hummingbird-pollinated plant. We classified each plant's microhabitat as either interior (surrounded by vegetation and ≥ 3 m away from the trail) or exterior (not surrounded by vegetation, usually bordering on the trail). While collecting data, we observed two common hummingbird pollinated plants: red tubular flowers with a corolla length of approximately 20-30 mm which we will call the kissing stamen species (Species A) and *Hemichacna fruticosa* (Species B), family Scrophulariaceae, with large yellow flowers and a corolla length of 20-30 mm. Classification efforts were confined to these two species. We regressed pierced flowers against total flowers to correct the number of flowers pierced for the total number of flowers in an individual. We called the residuals the "piercing factor". The effects of species and location on piercing factor were analyzed using a 2-way ANOVA.

To analyze the proximity and availability of perching sites, we randomly selected seven individual plants of Species A that had one or more pierced flowers. For each plant, we noted the number of pierced flowers and for each pierced flower randomly selected an unpierced flower from the same plant. We then measured the diameter and proximity of all potential perches within a 10 cm radius of each pierced and unpierced flower pair. A potential perch was defined as any branch that had a diameter ≥ 2.5 mm. Data were analyzed using a paired t-test.

Results

We tested for the effect of transect by nesting flower species and microhabitat by transect. The effect was not significant so it was omitted from the model. There was no effect of microhabitat on the number of flowers pierced (2-way ANOVA, $F = 1.479$, $df = 1$, $P = 0.23$; Fig. 1). Species A had a significantly higher proportion of pierced flowers than Species B ($F = 47.86$, $df = 1$, $P < 0.001$; Fig. 2). There was no interaction of microhabitat and species on the proportion of flowers pierced (2-way ANOVA, $F = 0.29$; $df = 1$; $P = 0.59$). In Species A, pierced flowers had significantly more surrounding perches than unpierced flowers (paired-t test, $t = 1.979$, $P = 0.015$; Fig. 3) and distance to the nearest potential perch was shorter for pierced flowers than for unpierced (paired-t test, $t = 1.980$ $P = 0.033$; Fig. 4).

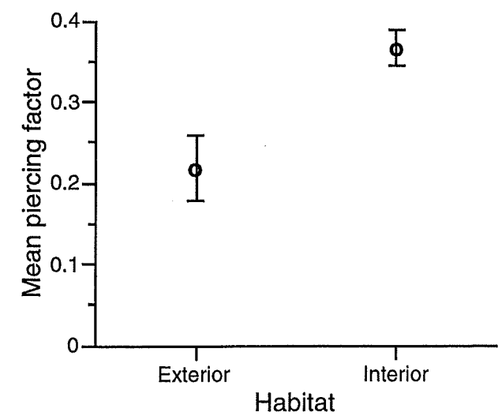

Fig. 1. Mean piercing factor (± 1 SE) by location in vegetation for two species of hummingbird pollinated flowers (n=150). There was no significant effect of location on piercing factor.

Discussion

Our analysis of perch availability and proximity provides support for the hypothesis that nectar robbing flowerpiercers prefer flowers in dense vegetation because of greater perch availability and closer perch proximity (Colwell 1974).

The lack of statistical difference in piercing factor between our microhabitat cat-

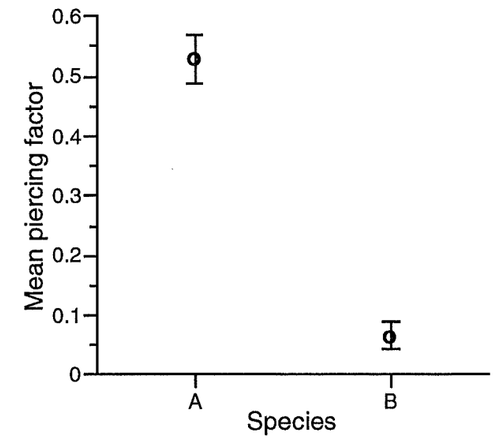

Fig. 2. Mean piercing factor (± 1 SE) of flowers on two species of hummingbird pollinated flowers (n = 150). Species A had a significantly higher piercing factor than Species B, *H. fruticosa*.

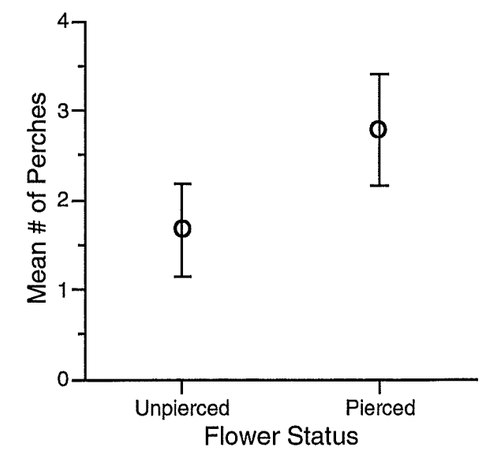

Fig. 3. Mean number (± 1 SE) of potential perches (branches of diameter greater than 2.5mm) within 10 cm of a flower of Species A was significantly greater for pierced flowers than non-pierced flowers (n = 17).

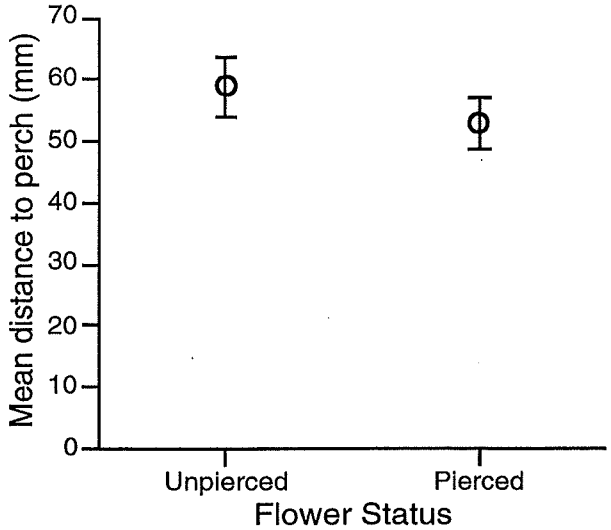

Fig. 4. Mean distance(± 1 SE) to the nearest potential perch on Species A was significantly shorter for pierced flowers than non-pierced (n = 17).

egories stands in clear contrast to our perch analysis and may be attributable more to our system of microhabitat classification than to the biology of *D. plumbea*. The species of a flower explained much of the variance in piercing factors across flowers. Species A grows in more dense vegetation (personal observation), providing *D. plumbea* with greater perch availability, while Species B is found in more exposed microhabitats and its flowers are usually on influroscences extending above the surrounding vegetation and as a result, it is less pierced. Our findings illustrate both a direct effect of perch availability and proximity on piercing and a possible indirect effect of these parameters on flower species preference.

Literature Cited

Colwell, R. K. 1974. Competition for the nectar of *Centropogon valerii* by the hummingbird *Colibri thalossinus* and the flowerpiercer *D. plumbea* and its evolutionary significance. Condor 76: 447-489.