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WEAK SELECTION ON FLORAL CHARACTERS IN *JUSTICIA COMATA*

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Abstract: Spatial variation in selection pressures on floral traits has not been explored in many plant-pollinator systems. We observed two populations of *Justicia comata* that were visited by different potential pollinators. We predicted that the population visited by predominantly larger butterflies would exhibit different patterns of selection on floral traits than the population visited by smaller flying insects. We measured six floral characteristics and two fitness estimates on 24 plants at each site. A multiple regression showed only one significant trend; petal width was positively associated with one fitness estimate, at one site. We infer that petal width is under selection by pollinators at one site and that patterns of selection on petal width vary between the two sites.

Key Words: directional selection, pollination

INTRODUCTION

*Justicia comata (*Acanthaceae*)* flowers are common at the Palo Verde National Park in Costa Rica. *J. comata* have several floral visitors, including butterflies, hummingbirds, small bees and other insects. Observation of two distinct populations at Palo Verde showed that floral visitors at one site were dominated by larger butterflies and hummingbirds, while smaller flying insects were dominant at the other site. Because these visitors may be attracted by different flower traits, we hypothesized that *J. comata* may be experiencing different patterns of selection at the two sites. Our goal was to compare patterns of phenotypic selection on floral traits through estimates of seed production at the two sites.

Many floral traits affect pollinator attraction. We predicted that six traits would alter pollination success in this system: petal size, which affects the pollinator's ability to locate the flower; corolla width and length, which affect a pollinator's ability to gain access to nectar or pollen rewards; and the distance between the stigma and anthers, which may affect the morphological fit between the flower and visitor. Plant height and number of flowers per plant may both affect pollinator attraction. To estimate plant fitness, we chose the percentage of fruits developed (not aborted), and the mean number of viable seeds in successful fruits.

We predicted that smaller pollinators would select for narrower and shorter corollas, smaller stigma-anther distances,

shorter plants and smaller petals. Larger pollinators would select for larger flower traits.

METHODS

We sampled two *J. comata* populations in dry secondary forest at Palo Verde, one on El Pizote Trail and one between the airstrip and road, which were separated by approximately 2.5 km. We sampled 24 plants at each site and measured plant height, corolla length, corolla width, distance between stigma and anther, and petal width (diameter of flower face to the nearest cm) of 2 flowers per plant. For each plant we counted total flowers and haphazardly sampled 10 calyxes where the flower had fallen off; we identified ovary condition as an expanded or aborted fruit, and recorded expanded fruit per 10 calyxes as a fruit set ratio for the first fitness estimate. We haphazardly sampled 3 expanding fruits from each plant, counted seeds in each fruit, and averaged them to obtain an estimate of mean seeds per fruit per plant for the second fitness measurement. In all selection analyses, we estimated relative fitness for each plant by dividing each fitness estimate by the mean value per site. We made observations of floral visitors for 15 min at each site, recording the identity and activity of flower visitors.

We analyzed floral characteristics by site using a one-way MANOVA. A significant MANOVA was followed by univariate ANOVAs for each floral character, and correlation analysis among floral characteristics at each site. Finally, we assessed selection on floral characters through relative fitness estimates using a multiple regression at each site. Parameter estimates in the multiple regression represent direct selection on traits after accounting for selection on other traits in the analysis. We tested only for directional selection in the analyses; we could not test for non-linear patterns (e.g. disruptive selection) due to low sample size.

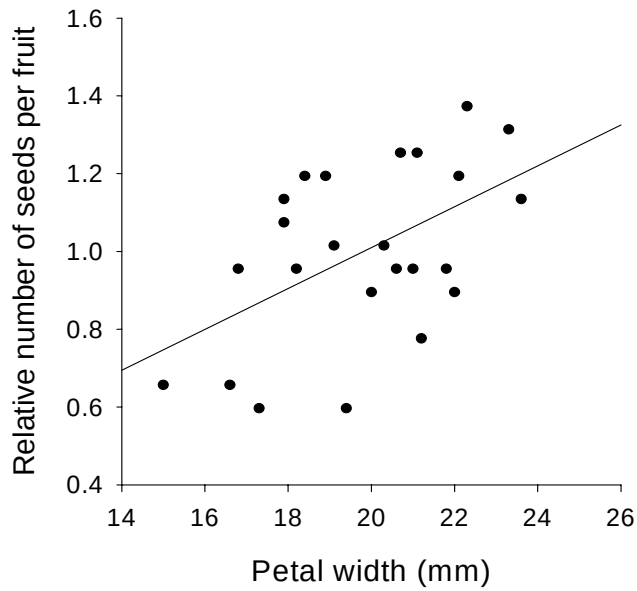

Figure 1. Regression of relative number of seeds per fruit on *J. comata* petal width at Site 1 (open habitat at Palo Verde National Park, Costa Rica, n = 24). Relative number of seeds per fruit is standardized to the mean for the population.

RESULTS

Plant characters were marginally different between the two sites (MANOVA, F = 2.18, df = 8, 36, P = 0.053). Plant height was 7.94% greater at Site 1 than at Site 2 (F = 13.31, df = 1, 44, P = 0.0007). No other floral characteristics were significantly different between sites

(in all cases, $F < 3.02$, df = 1, 44, $P > 0.09$).

Within Site 1, only corolla length and corolla width ($r = 0.52$, df = 23, $P = 0.0095$) and petal width and stigma-anther difference were correlated ($r = 0.71$, df = 23, $P = 0.0001$). There were no significant correlations between floral characteristics at Site 2 (in all cases, $r < 0.39$, $P > 0.06$). The only character to experience significant selection was petal width at Site 1, (regression between longer petals and number of seeds per fruit as the fitness estimate, $r^2 = 0.14$, df = 1, $P = 0.02$; Fig.1).

DISCUSSION

Our hypothesis that different pollinators drive selection was refuted, as floral traits did not differ between the two sites. Though we did not detect differences in selection between populations, pollinators may have driven weak directional selection toward larger petal width at Site 1. Increased petal width may attract more pollinators.

In contrast, petal width was not under significant selection at Site 2, which could be explained by at least three factors. First, smaller pollinators may not find larger petals more attractive. Second, Site 2 had been recently mowed, which may have introduced artifacts. Third, pollen supply may not limit seed production at Site 2, so that greater attractiveness of larger petals would not influence relative fitness.

This study did not fully assess the effects of petal width on fitness, so it would be useful to examine the heritability of petal width and assess experimentally how changes in petal width affect individual fitness.