

Maintenance of color dimorphism in *Dahlia* spp. flowers

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**Abstract:** Frequency dependent selection may promote polymorphism within a species by increasing the fitness of less abundant morphs. We hypothesized that pollinators maintain the color dimorphism in *Dahlia* spp. flowers at Estación Biológica Cuerici, Costa Rica through frequency dependent choice. We observed pollinator visitations to white and purple flowers. Where white flowers were locally less abundant, we found that they were visited more frequently than purple flowers. Thus, frequency dependent selection by pollinators may be maintaining color dimorphism in *Dahlia* spp. flowers.

**Key Words:** frequency-dependent selection, pollination

## INTRODUCTION

Differences in pollinator behavior may maintain flower color polymorphism within a plant population (Capaldi, et al. 1992). We hypothesized that frequency-dependent selection by pollinators promotes the persistence of a dimorphism in a *Dahlia* spp. population, i.e. that pollinators always prefer the less abundant morph.

*Dahlia* flowers inhabiting the forest edge near the Estación Biológica Cuerici, Costa Rica have either purple or white heads, but purple heads are more abundant than white. We observed bees, butterflies, beetles and flies visiting flower heads of both colors. It is unlikely that flower color is environmentally determined since both morphs occur in close proximity within patches. We assumed that reproductive success of *Dahlias* increases with the frequency of pollination visits.

## METHODS

We conducted our study along the initial (most disturbed) portion of the lower part of the main trail loop at the Estación Biológica Cuerici. Our study had an observational and an experimental component. We conducted field observations in three 5 x 3 m plots containing various proportions of white and purple *Dahlias* (Table 1). Plots were spaced at least 10 meters apart. At each plot we observed visitations by pollina-

tors for ten 10-min. periods on 28 and 29 January between the 07:00 and 16:00. We counted visitations as the number of potential pollinators landing on each flower head.

In order to create plots with a greater range of proportions of white and purple flowers, we made experimental plots with cut flowers in a small grassy area by the trail. Purple was generally more abundant in observational plots. We set up 5 different proportions in the experimental plot types (Table 1). We observed these plots for 2 periods of 10 min. each, recording visitation to white and purple flowers. We collected new flowers for the plots midway through the experiment to ensure freshness.

We standardized the experimental visitation rate by multiplying it by the ratio of the mean number of observational plot visits to the mean number of experimental plot visits. We examined the relationship between this standardized number of visits per white flower to the proportion of white flowers using a linear regression.

## RESULTS

Purple flowers were nearly twice as abundant as white flowers in our observational plots (Table 1). The number of visits per white flower increased as the proportion of white flowers decreased (Fig. 1;  $r^2 = 0.22$ ,  $df = 22$ ,  $P = 0.02$ ). The slope for the experimental data was not significantly different from zero (Fig. 1;  $r^2 = 0.08$ ,  $df = 11$ ,  $P = 0.37$ ).

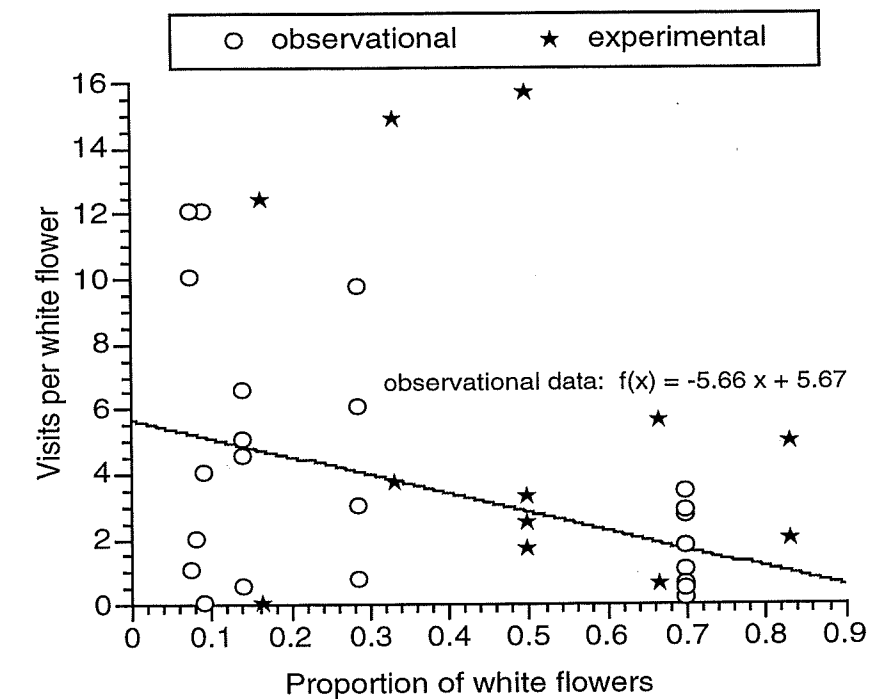


FIG. 1. The number of visits per white *Dahlia* spp. flower vs. proportion of white flowers in a plot. The slope was significantly different from zero for the observational data ( $r^2 = 0.22$ ,  $df = 22$ ,  $P = 0.02$ ) but not for the experimental data ( $r^2 = 0.08$ ,  $df = 11$ ,  $P = 0.37$ ). Observational data are from three 5 x 3 m plots at the Cuerici Preserve, Costa Rica. Experimental data are from five plots with cut *Dahlia* spp. flowers. Experimental data were standardized to observational visitation rate (see text).

However, both lines (observational data and experimental data) had negative slopes: as the proportion of white flowers in a patch increased, the number of visits per white flower decreased, although the trend was significant for only the observational data.

## DISCUSSION

Purple *Dahlia* flowers were twice as abundant as white flowers in the plots we observed, but we found that when white

flowers were proportionally less abundant, they received more visits per flower. This trend was only significant for the observational data, but we have more confidence in the observational data, because in the experimental plots, patch size was smaller and cut flowers were shorter than under natural conditions. Furthermore, experimental plots were novel resources in the area and many pollinators may not have had time to locate them. The significant trend we found in the observational data could explain the

TABLE 1. The number of white and purple *Dahlia* spp. flowers in observational (5 x 3m plots) and experimental plots at Cuerici Preserve, Costa Rica.

Plot Number	Number of purple flowers	Number of white flowers
Observational 1	10	4
Observational 2	3	7
Observational 3	10	1
Experimental 1	5	1
Experimental 2	1	5
Experimental 3	2	4
Experimental 4	4	2
Experimental 5	3	3

persistence of the less common white morph in the population. This inference is based on the assumption that higher visitation rate by pollinators is correlated with reproductive success. We conclude that frequency-dependent selection is probably operating in this system, through pollinator choice.

## LITERATURE CITED

- Capaldi, E. A., M. Puterbaugh, N. Greig, J. Bower, L. Schmoetzer, and N. Simmons. 1992. OTS 92-1. Issue Cerro FP. Pp. 85-88.