

Predation Effects on Bumblebee Foraging Behavior

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Introduction

Several studies have illustrated that predation affects bees' foraging. The presence of predators may cause bees to select lower quality resources if high quality foods are associated with a higher predation risk, or to decrease the amount of time spent foraging (Jones and Dornhaus 2011). Other studies have shown that certain species of bees will decrease foraging efficiency in areas where they have previously been exposed to predation by searching the area for evidence of predators before beginning to forage (Ings and Chittka 2008). This study aims to determine how predation risk alters foraging behavior in the bumblebee *Bombus impatiens*. Because *B. impatiens* individuals have been observed to specialize as either pollen or nectar foragers, we examined how the presence of predators affected foraging choice between nectar and pollen.



Objectives

Does the risk of predation affect...:

- The amount of pollen and nectar foraged by the colony as a whole?
- The amount of time spent foraging nectar vs. pollen by individuals?



Bees foraging at pollen feeder



Bees foraging at nectar feeder

Methods

In this study three colonies were each given different predation treatments:

- Large pollen predation colony: foraged for three weeks with no predation, one week with predation only on pollen sources, followed by another week with no predation
- Small nectar predation colony: foraged for four weeks with predation on nectar sources, and one week with no predation
- Small pollen predation colony: foraged for four weeks with predation on pollen sources, and one week with no predation

Predation was simulated by grasping with forceps to mimic predator attack. All colonies had access to both pollen and nectar sources while foraging. Each individual bee was marked with number and color so that individual foraging behavior could be recorded. Foraging was measured using one minute scan sampling.

Results

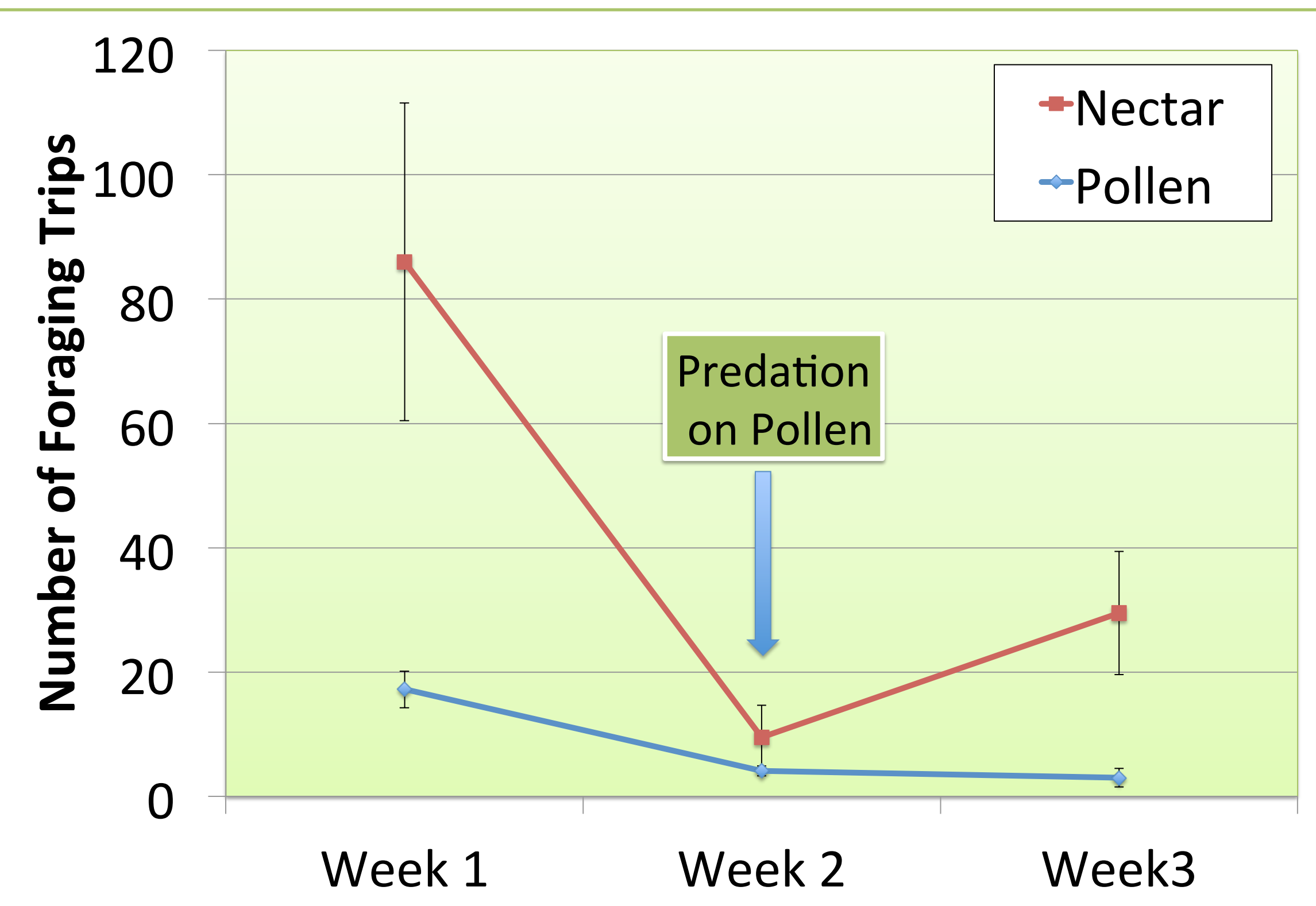


Figure 1: Repeated measures ANOVA on nectar and pollen foraging in large colony with predation on pollen. Foraging decreased sharply at both feeders week 2, suggesting that factors other than predation may have reduced foraging activity ($F_{2,11} = 29.73$ $P < 0.001$). However, foraging resumed at the nectar feeder in week 3, but not at the pollen feeder, suggesting a lingering fear of predation effect on the pollen feeder (feeder x week interaction $F = 13.8$ $P = 0.003$).

	Nectar	Pollen
Nectar Predation	1285	360
Pollen Predation	1392	220

Table 1: The number of nectar and pollen visits significantly differs as expected for feeder specific predation: Relatively more pollen visits when predation is at nectar, and more nectar visits when predation is on pollen ($\chi^2_2 P < 0.01$).

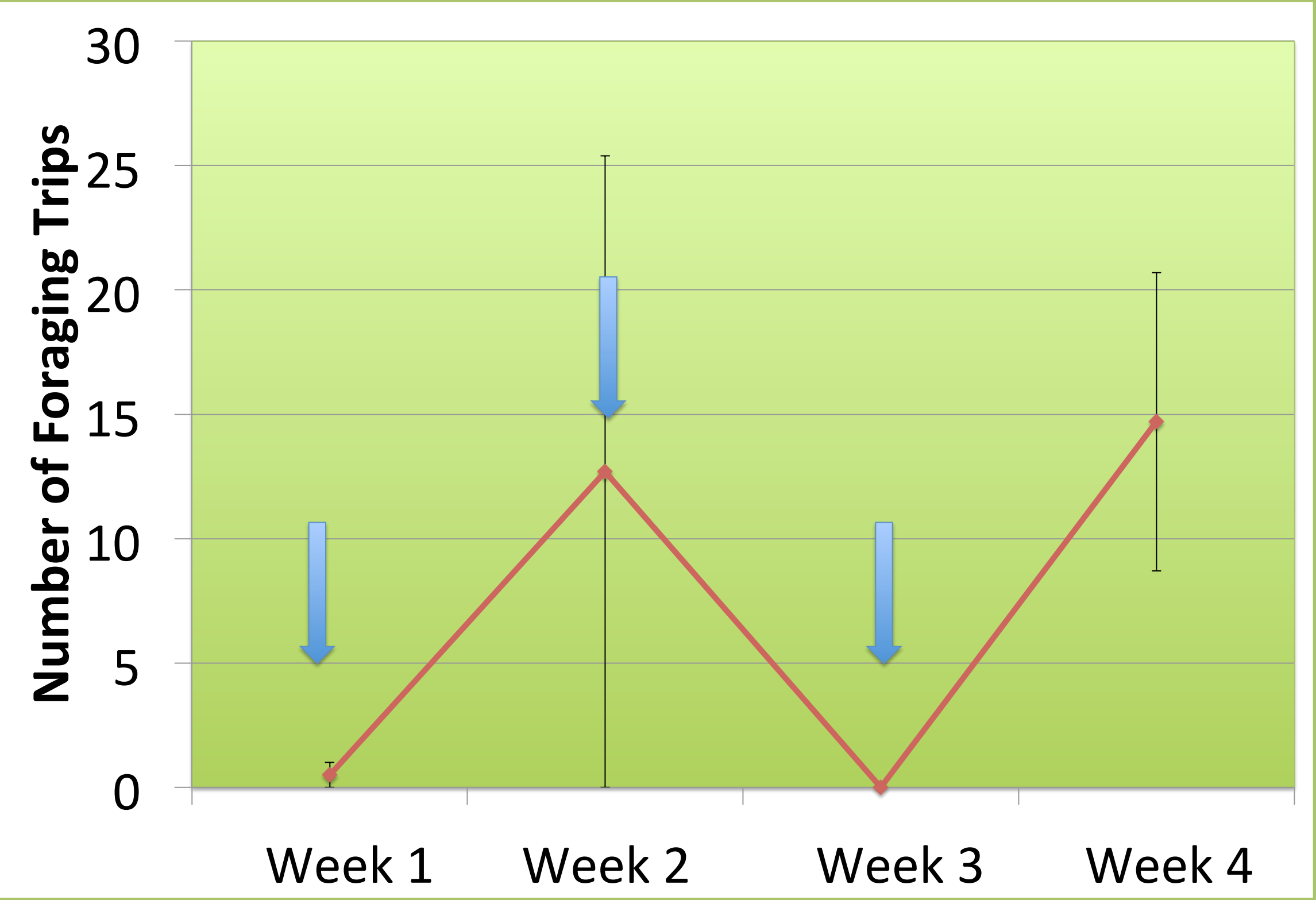


Figure 3: repeated measures ANOVA showing pollen trips by the most active foragers in small pollen predation colony, both during and after predation treatments. $F(3,9)=1.02$, $p=0.43$, vertical bars denote standard error. Arrows indicate where predation is present.



Figure 4: repeated measures ANOVA of nectar trips by the most active foragers in small nectar predation colony, both during and after predation treatments. $F(3,9)=1.14$, $p=0.38$, vertical bars denote standard error. Arrows indicate where predation is present.

In the large colony feeding sharply declined at both feeders, suggesting that another factor than predation was at work. However, nectar sharply rebounded in week 3, while pollen did not, suggesting an effect of predation on decreasing pollen foraging. Overall differences in foraging between the small nectar predation and small pollen predation colonies were as expected, but there was no significant difference between before- and after-predation foraging in the small colonies.



Conclusion

Overall the data suggest that predation influences foraging choice in *B. impatiens*, although other factors are likely at work, especially in the small colonies. In addition to the data shown here, several behavioral changes were observed that were not measured or analyzed. Many bees would wave one arm in the air while foraging nectar, a behavior not observed in colonies where there was no predation at nectar dishes. Several individuals also spent more time flying around nectar or pollen sources before landing to forage when predation was present, which could be a response to predation, as other species have been observed spending more time searching for predators around nutrient sources when exposed to predation. Future studies should examine these behavioral changes in more detail to determine if they are a significant response to predation.

References

Ings, T. C., Chittka, L. (2008). Speed Accuracy Tradeoffs and False Alarms in Bee Response to Cryptic Predators. *Current Biology* 18, 1520-1524.

Jones, E. I., Dornhaus, A. (2011). Predation Risk Makes Bees Reject Rewarding Flowers and Reduce Foraging Activity. *Behav Ecol Sociobiol* 65, 1505-1511.