

ANT ATTENDANCE ON APHIDS IN CORN LILY (*VERATRUM CALIFORNICA*)

BIOL 315 - Field Methods In Ecology Class - July 2002
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(left to right) John Crane, Neil Schanker and Janet Byron sample ants and aphids.

Abstract

We examined the relationship between the number of ants attending aphids and the number of aphids on leaves of corn lily (*Veratrum californica*) in Carmen Valley, California. We determined that a sample size of 22 would be adequate to detect an increase of one ant per 10 additional aphids on a leaf with an $\alpha = 0.05$ and a $\beta = 0.2$. However, in our preliminary data we observed that the number of ants per leaf increased by a factor of one per eight additional aphids on a leaf. We conclude that the number of ants attending aphids on leaves of corn lily is a positive function of the number of aphids per leaf.

Introduction

Ants tend aphids milking them for honeydew, their sugary excrement, and potentially providing protection from predators or parasites in return. Ants tend groups of aphids and may herd aphids into dense aggregations. We observed ants tending aphids on corn lily in Carmen Valley, CA in July 2002. We conjectured that the number of ants tending aphids on a leaf would be positively related to the number of aphids on that leaf. Our null hypothesis was that there is no relationship between ant and aphid numbers; our alternative hypothesis was that leaves with more aphids would be attended by a greater number of ants. We collected preliminary data of the relationship between ant and aphid abundance within leaves of corn lily to determine the sample size necessary to detect an increase of one ant for ten additional aphids per leaf with an $\alpha = 0.05$.

Study Site

Carmen Valley is located in the northern Sierra Nevada Mountains of California, in the western part of Sierra Valley, 10 miles east of Yuba Pass at 5,200 feet elevation. Carmen Valley is a narrow valley, lined on both sides by pine forests. Willow, grassland, sagebrush and wetter patches of sedge and corn lily characterize the meadow floor. The valley is currently undergoing a hydrological restoration to increase the hydroperiod of the meadow to rectify historic channeling and head-cutting of the stream caused by the construction of a rail line for logging.



Ants tend aphids on corn lily in Carmen Valley.

Methods

In order to test the hypothesis that ant and aphid numbers are related, we selected 10 leaves from corn lily plants for evaluation. Samples were taken on July 25, 2002, from approximately 1 pm to 2 pm. Leaves were selected based on whether ants and aphids were present; leaves with aphids but no ants were not evaluated. Leaves were all approximately the same size. We attempted to choose equal numbers of leaves with ants attending aphids on the upper and the lower surface of the leaf, and also to sample leaves from the sun and shade. For each leaf, two estimates of ant numbers were made by different observers and averaged. Observers counted ants from several feet away, and then approached the leaf to count aphids. Estimates of the abundance of winged (alate) aphids were made by two observers and averaged. We also obtained vouchers of ants and aphids and preserved them in 70% ethyl alcohol for future identification.

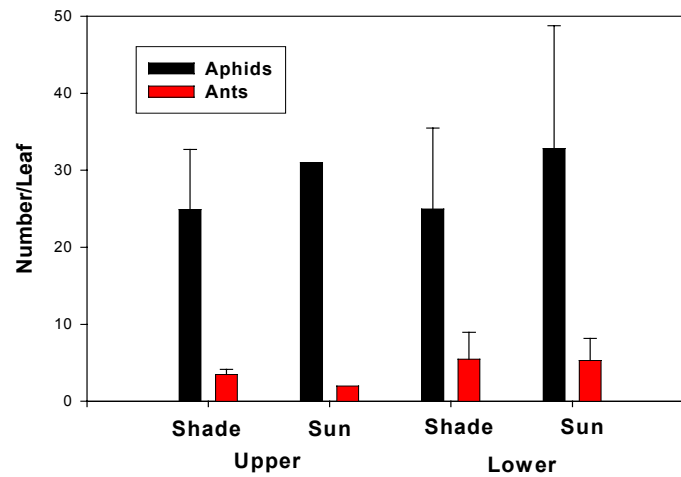
Our sampling method was efficient for determining the abundance of ants and aphids on leaves since it took only 45 minutes to assess 10 leaves. We experimented with using digital photography as a means of obtaining estimates of abundance. However, because of the limited depth of field on macro settings, photographs of whole leaves were not entirely in focus. Therefore, it was difficult to count aphids accurately. Continued experiments with photographic procedures indicated that adequate resolution and focus could be obtained if aphid clusters

within leaves were photographed separately, and abundance data pooled among photographs of the same leaf.

Results

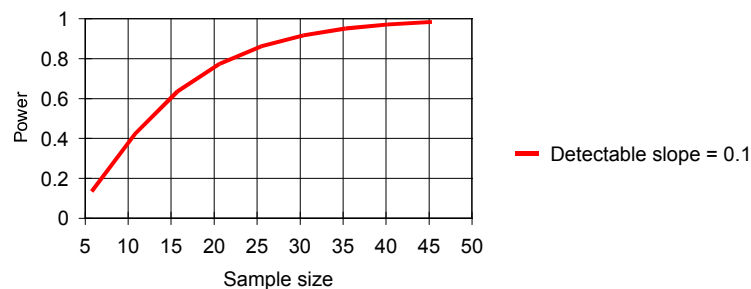
We found ant numbers to range between two and 11, while aphids numbers ranged between four and 59. The average number of aphids per leaf was 27.90 (sd = 17.05) and the average number of ants per leaf was 4.3 (sd = 3.20, Fig. 1). The ratios of numbers of aphids-to-ants ranged from 1.30 to 17.75. Half of the leaves sampled had aphids on the upper leaf surfaces and half on the lower surface. Four leaves were sampled in the shade and six in the sun.

Figure 1. Ant and aphid numbers on the upper and lower surfaces of corn lily leaves in the sun and shade



Given our desire to detect an increase of one ant of each 10 additional aphids with a power of 0.80 and a Type I error rate (α) of 0.05, the necessary sample size would be 22. (Fig. 2). If we sampled 34 leaves, we would obtain a type II error (β) of 0.06. This would give us equivalent type I and type II errors.

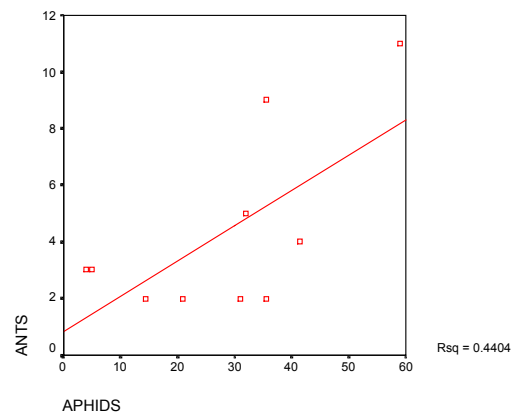
Fig. 2. Power as a function of sample size



alpha=0.05 lambda=0.1 sigma_x=17.05 sigma=2.70795

A regression analysis of the preliminary data suggests that the number of ants per leaf is a positive function of the number of aphids on that leaf ($F_{1,8} = 6.3$, $p = 0.036$, $R^2 = 0.44$, Fig. 3). No significant differences were found between leaves in sun and shade, or fronts and backs of leaves. About 44% of the variation in the number of ants per leaf was due to variation in the number of aphids per leaf.

Figure 3. Regression of ant numbers per leaf on aphid numbers per leaf (number of ants = 0.124 (number of aphids + 0.826))



Discussion

Based on our preliminary data, a sample size of 22 would be necessary to detect an increase of 1 ant per 10 aphids on a leaf (e.g., a regression slope of 0.1), with $\alpha = 0.05$, $\beta = 0.2$, and the estimated level of observational variability. However, from our preliminary data we observed an approximate increase of 1 ant per 8 additional aphids per leaf, a stronger relationship between ant and aphid numbers than we had hypothesized. Therefore, based our initial sample size of 10 leaves, we are able to conclude that the number of ants per leaf is positively related to the number of aphids per leaf. With minimal effort, future students could expand the sample size to confirm our preliminary results. Future studies might reexamine the relationship between ant and aphid numbers estimating the abundance of both wingless and winged aphids, and factors that might affect levels of ant activity such as proximity to ant nests, time of day, and temperature.