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Bee abundance as a function of floral abundance: potential bias of fluorescent pan traps

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Introduction

As one of the most productive pollinators in the world, bees have an essential role in maintaining our agricultural economy and natural ecosystems. Growing concern over the possible decline of pollinators and the effects of Colony Collapse Disorder (CCD) in honeybees has contributed to an increase in bee-related research. To survey bee communities, many researchers utilize the USDA Bee Inventory Plot protocol (Droege 2003) . The protocol instructs the simultaneous use of fluorescent pan traps and aerial netting because pan traps capture mainly smaller bees while netting captures mainly larger bees. Scientists have speculated, however, that pan traps have a selection bias at low floral abundance (Baum 2011, Cane 2000). The fluorescent color of the pan traps is thought to be extremely attractive to bees when there are few forbs in bloom. This study uses a regression analysis to compare the sampling rate of pan traps to aerial netting as a function of floral resources.

Question: Is there a correlation between the available floral resources and the ratio of net-collected to pan-collected bees?
Hypothesis: The ratio of netted bees to bowl-collected bees will increase as floral resources increase.

Methods

Surveyed 100m x 75m plots from 24 tallgrass prairies in Northeastern Illinois for a total of 72 surveys over the years 2010 and 2011.

Floral Survey:
Each survey included 35 1m^2 quadrat records for:
1. Blooming forb cover class
2. Number of blooming forb individuals

Bee Survey:
1. Aerial netting
   - 60 collection minutes
2. Pan traps
   - Set pans for 6 hours
   - UV fluorescent 3 oz. bowls: blue, yellow, white
   - 5 of each color at 0m and 1m height

We used the ratio of netted bees to bees collected in bowls (**net: bowl ratio)** as the dependent variable because net collection numbers provide a baseline of comparison for how bowl collections change with floral abundance.

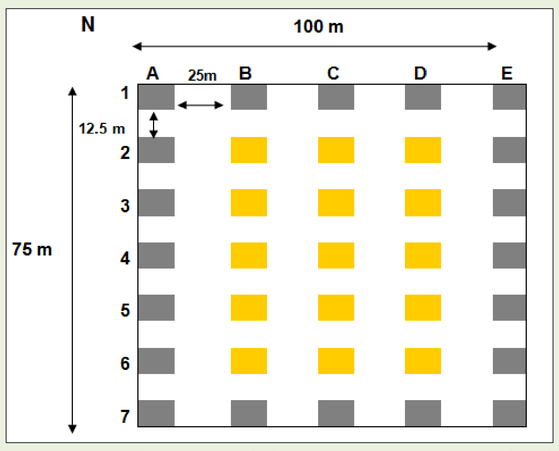

Figure 1: Schematic of the 75-m x 100-m study plot. The 35 boxes represent the location of vegetation surveys . The 15 orange boxes are where bee bowls should be placed

Figure 2: Aerial netting for bee survey

Figure 3: Fluorescent pan traps for bee survey

Results

Table 1: Summary of descriptive statistics for the data

Bowl-collected bees	Net-collected bees	Blooming forb cover	Number of blooming individuals
Avg. = 30	Avg. = 20	Avg. = 87	Avg. = 110
Max. = 133	Max. = 62	Max. = 257	Max. = 514

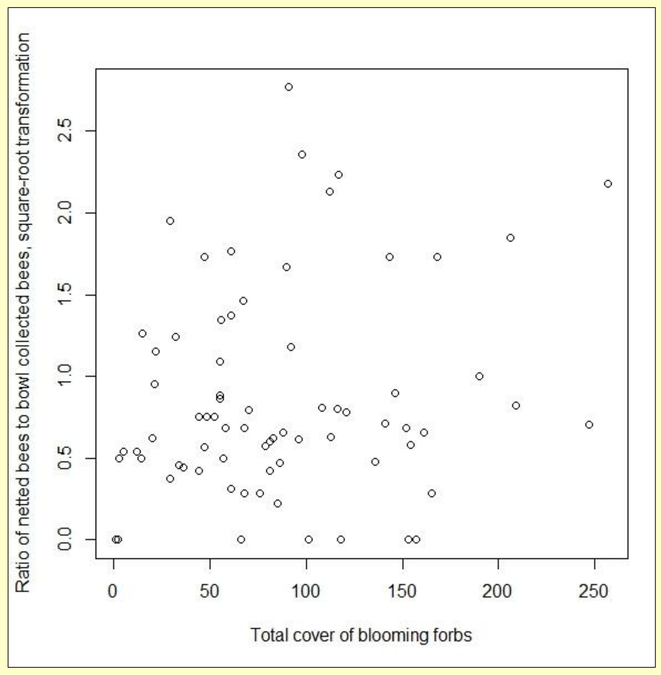

Figure 4: Net: bowl ratio as a function of blooming forb cover.

The ratio of netted bees: bowl-collected bees is not correlated with the total cover of blooming forbs ($p = 0.12$, adjusted $r^2 = 0.021$).

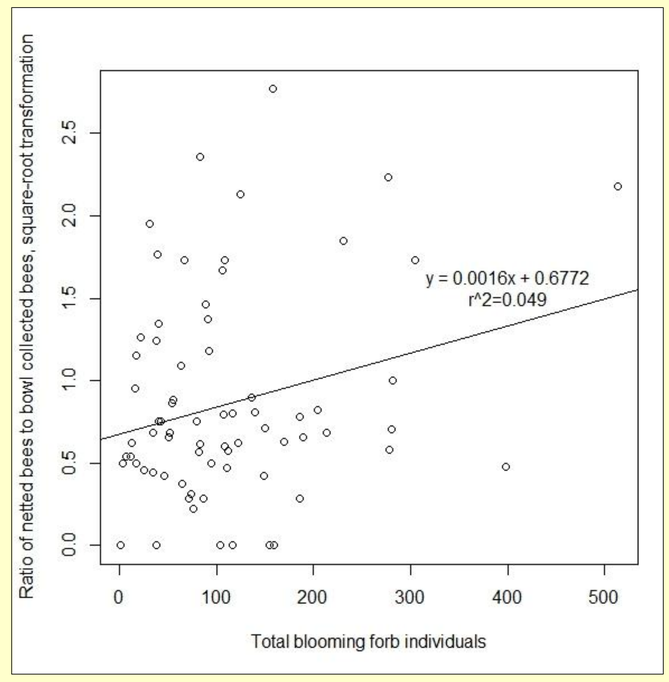

Figure 5: Net: bowl ratio as a function of the number of blooming individuals.

The ratio of netted bees: bowl-collected bees has a significant, weakly positive correlation with the number of individual blooming forbs ($p = 0.035$, adjusted $r^2 = 0.049$).

Discussion

The positive correlation between the net: bowl ratio and the number of individual blooming forbs could be the result of numerous factors. As my hypothesis predicted, it could be that pan traps are extremely attractive when floral abundance is low, such that the number of bowl-collected bees is disproportionately high compared to net-collected bees. When floral abundance is high pan traps may be less visible to bees, and therefore less attractive. Another possible explanation is that large and mainly net-collected bees, such as bumble bees, are more abundant at sites with more floral resources.

The reason no trend was observed as a function of cover is likely because our measure of cover included the leaves and steams of blooming forbs. Therefore cover class may not be a good indicator of floral resources for plants such as compass plant or rattlesnake master with high vegetative cover.

The potential bias of pan traps as a function of floral resources is important because the number of bees surveyed from pan traps may not accurately represent the abundance of bee populations. The results of this study and anecdotal evidence support the hypothesis that there is a selection bias of traps. However, the correlation was weak, and we cannot conclude that floral resources are the *cause* of the observed net/bowl collection trend without further research.

Suggestions for future research:
- Measure floral resources by the bloom cover, rather than whole plant cover of blooming forbs
- Include more study sites with high bloom cover to extend the upper threshold of the data
- Compare bee bowl collections to other surveying methods in addition to netting, i.e. observation, malaise traps

References:
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