Prairie sites were given treatments with honey bee hives or no hives. Bumble bees were collected in eight Iowa prairies and honey bees (Apis mellifera) were kept on or near prairies. The presence of honey bee hives could be useful for informing both bee management and wild bee conservation decisions.

**Main Objective:** To determine if there is a difference between bumble bee viral levels at sites with and without honey bee hives, in order to study potential viral spillover between Apis species.

### ABSTRACT

**Populations of wild and managed pollinators are declining in North America, due in part to a loss of flowering resources. Tallgrass prairies can provide floral resources for managed honey bees (Apis mellifera), as well as wild bees such as bumble bees. However, if honey bees are kept on or near prairies, they could transfer harmful diseases to wild bees. Information is lacking on the potential for harmful diseases to wild bees. We quantified viral levels in honey bees and bumble bees at prairie sites with and without honey bee hives. Bumble bees from both site types showed low levels of all viruses measured, much lower than those of honey bees. However, bumble bees collected at sites with honey bee hives present had higher levels of deformed wing virus compared to bumble bees at sites with no hives present. These data suggest that the presence of honey bees in tallgrass prairie could increase exposure of wild bees to viruses. This study, along with future studies on direct effects of virus infection on bumble bee health, could be useful for informing both bee management and wild bee conservation decisions.**

### METHODS

**Prairie sites were given treatments of honey bee hives or no hives**

Bumble bees were collected in eight Iowa prairie sites in the Chichaqua Bottoms Greenbelt of Iowa, four with honey bee (Apis mellifera) colonies present at the site (HB+) and four with no honey bee colonies present (HB-).

Collecting bumble bees and honey bees

Collections were made in September to October in 2017 to catch male bumble bees, and in July to September 2018 to catch female bumble bees, based on bumble bee phenology. These bumble bees were from wild colonies, not managed colonies. Both honey bee foragers and honey bees from the hives were collected. Honey bee foragers are older honey bees with the role of foraging for pollen, water, and nectar, while honey bees from hives are typically younger nurse bees with the role of feeding brood.

Analysis for viral quantities

In 2017, 66 male B. impatiens bumble bees, as well as honey bees from hives at each HB+ site, were tested for deformed wing virus (DWV) quantities. In 2018, 75 female bumble bees of two different species (B. impatiens and B. griseocollis) were tested for quantities of three different viruses. Honey bee foragers and honey bees collected from hives were tested for the three viruses as well for comparison. To measure viral quantities, RNA was extracted from all bee samples by crushing a whole bee body in Tris-Cl, followed using qRNAasy, and standardizing to the same RNA concentration. Viruses were detected using qPCR methods and then previously published primers for deformed wing virus (DWV), lake Sinai virus (LSV), and Israeli acute paralysis virus (IAPV).

### RESULTS

**Chichaqua Bottoms Sites**

A map of the sites in Chichaqua Bottoms, Iowa. Yellow sites (HB) have hives while green sites (HB) do not.

### CONCLUSIONS

1. Honey bees from hives had higher DWV levels than foraging honey bees. For all three viruses tested in 2018, viral quantities were significantly higher in honey bees collected from hives than honey bees collected while foraging (Figure 2).

2. Honey bees from hives had higher DWV levels than bumble bees. In 2017, DWV viral quantities were significantly higher in honey bees collected from the hive than male B. impatiens bumble bees (p < 0.001). In 2018, viral quantities were higher in honey bees than in bumble bee species for viruses DWV and LSV (Figure 2). Forager honey bees did not differ from bumble bees in viral quantities, except for DWV, which was higher in honey bee foragers than B. griseocollis.

3. DWV quantities increased in bumble bees at sites with hive presence, but other viruses did not. DWV levels were higher in male and female bumble bees at sites with honey bee hive presence, but the viruses LSV and IAPV did not significantly differ between site types. Overall, the levels of viruses in bumble bees were low and it is uncertain how this exposure might impact bumble bee health. No deformed wings were observed on any bumble bees collected, so the bees were not affected in wing function by the quantities of deformed wing virus measured. These results suggest that while bumble bees may have elevated levels of DWV in the presence of honey bee hives, this pattern is not true for all viruses.

**Significance:** These results suggest that there may be some increased exposure of bumble bees to honey bee viruses when honey bee hives are present. However, this was not true for all viruses measured, and all viral levels were relatively low, so it is uncertain how this low level exposure might impact bumble bee populations. Other studies indicate that native bees may be exposed to honey bee viruses when foraging on floral resources shared with honey bees. In this study, there was not a strong trend of higher viral quantities in foraging honey bees than in bumble bees, so more work is needed to explain how viruses are transmitted in ecosystems.

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**Figure 1:** B. impatiens males with higher DWV levels in presence of honey bee colonies. T-test was used (p = .04). Photo by Amy Toth

**Figure 2:** Average virus starting quantity for three viruses compared between honey bee hive bees, honey bee foragers, and bumble bee species B. impatiens and B. griseocollis. Wilcoxon Rank Sum Test was used.

* denotes significantly different from hive collected honey bees, N.S. = not significant

N = 22 B. griseocollis, N = 16 B. impatiens, N = 20 hive honey bees, N = 16 forager honey bees

**Figure 3:** Average viral quantities in B. griseocollis females for IAPV, DWV, and LSV. There was not a significant difference in average IAPV quantity in sites with and without hives (p = 0.469). DWV levels were significantly higher in B. griseocollis at sites with hives present (p = 0.0491). LSV levels did not significantly differ between site types (p = 0.3132). Wilcoxon Rank Sum Test was used.

N = 10 B. griseocollis in hive presence, N = 12 B. griseocollis without hive presence

**Figure 4:** Mean viral starting quantity for three viruses compared between honey bee hive bees, honey bee foragers, and bumble bee species B. impatiens and B. griseocollis.