



# Oh, the places bees go: RFID methods connect bumblebee foraging to resources in Wisconsin landscapes

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## Introduction & Background

Bees provide a vital ecosystem service that enhances the production of 70% of economically important crops<sup>1</sup>. However, declines in both managed and native bees due to agricultural intensification and land-use change threaten pollination services across the globe<sup>2,3</sup>. Conserving these essential organisms is crucial to establishing food security for an ever-growing population. To conserve bees, we must first understand how they respond to changes in the landscape - particularly in resource (e.g., food, nesting) abundance and distribution as this is likely to drive suitability of different landscapes for bee conservation initiatives. Changes in behavior such as foraging may be related to change in the landscape. For example, foraging behavior (e.g., foraging time) has previously been used as a metric to predict resource availability<sup>4,5</sup>.

### Goals:

1. Develop a relationship between bee foraging and landscape-level resource abundance, quality
2. Determine a method to quantify landscape suitability for bees
3. Assess potential foraging range of native bees

### We hypothesized that foraging time would be:

1. Greater in landscapes with limited resources (e.g. intense ag)
2. Reduced in landscapes abundant in resources (e.g. natural area)

Additionally, we predicted that bumblebee colonies would have increased growth and reproductive production in landscapes with greater resource availability.

## Methods

1. Place RFID tag on bee pronotum using super glue



2. Record foraging trips using RFID

- Unique ID for each tagged bee
- 105 bees tagged
- Colonies allowed to forage for 8 weeks in each landscape



3. Assess colony performance

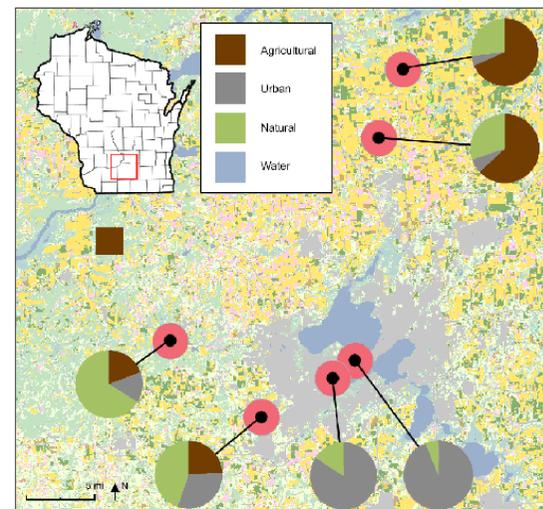
- Count number of queens, workers, brood cells, etc.
- Compute volume and mass gained
- Relate performance and foraging to landscape composition

## Literature Cited

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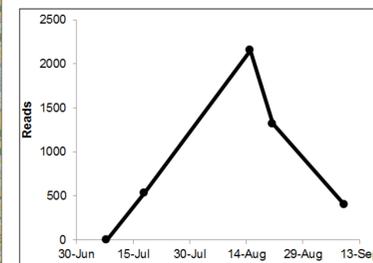
## Results - Foraging

### Colony locations and landcover type within 2km radius

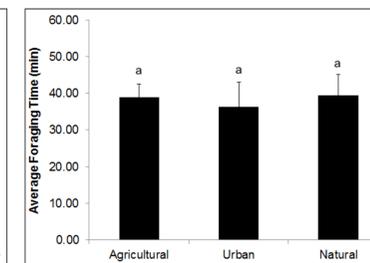


### 2014 pilot study yielded successful method for tagging and monitoring bees with RFID technology and assessing colony-level performance

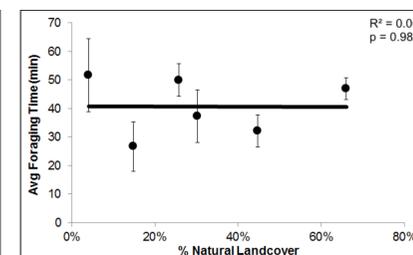
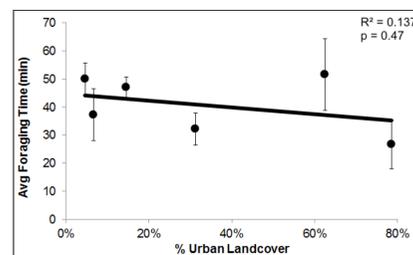
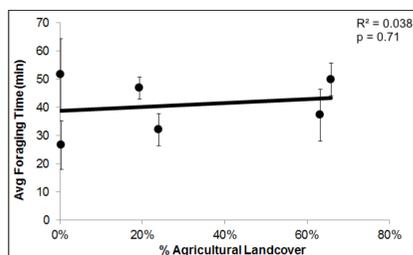
4,411 reads were recorded between July 7th and September 9th



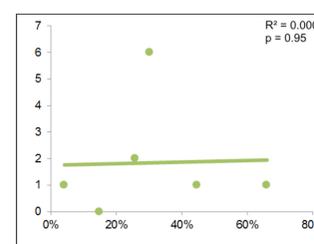
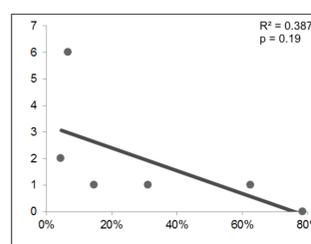
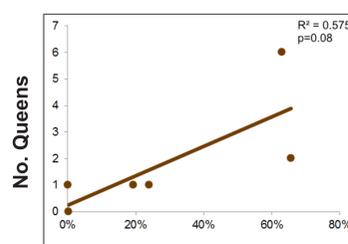
No significant differences in foraging time among different landscape types



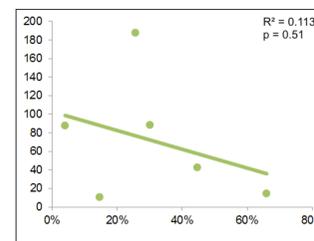
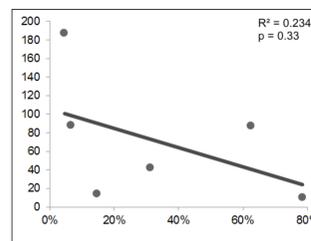
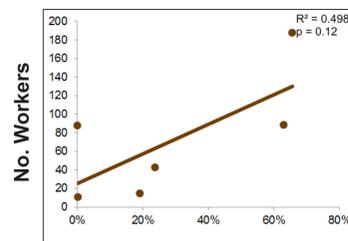
### Foraging time has no strong relationship with agricultural, urban, or natural land cover



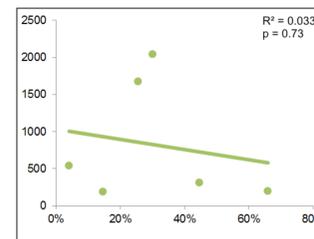
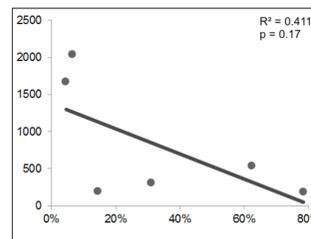
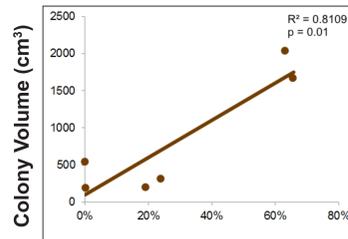
## Results - Colony Performance



Queen production increases with more agricultural land, but decreases with more urban land.



Worker production increases with more agricultural land, but decreases with more urban or natural land.



Colony volume increases with more agricultural land, but decreases with more urban land.

## Conclusions

1. Foraging time can be measured using RFID
  - Limited number of trips recorded as this was a pilot study
  - Successful method will allow for increased data collection
2. Variation in foraging not found to be related to landscape type
  - Collection of additional data necessary to confirm relationship
  - Expand assessment to include additional landscape types
3. Colony performance related to landscape type
  - Resource availability in each landscape may influence performance
  - Agricultural landscapes appear to increase colony performance
  - Natural landscapes have neutral or negative relationship (Data potentially confounded by bacterial infestation within "high natural land" colony)

## Future Directions

- Explicitly quantify resource availability within each landscape
- Develop empirical model between foraging time & resource abundance
- Inform predictive models of pollination service at farm level
- Expand assessment to additional landscape types (e.g., prairie)
- Further analysis to examine how landscape configuration (e.g., edge, connectivity) affects foraging and colony performance

## Impacts

- New protocol to easily determine how bees respond to landscape
- Method allows for easy testing of additional landscape types or bee species
- These and future data will inform predictive models of pollination services by empirically describing the suitability of various landscape types to native bees (as opposed to methods using "expert opinion")
- These data can help identify landscape attributes that affect colony performance and health
- Easier than assessing diversity and abundance of bee community as a proxy of community health

## Acknowledgements

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## Further Information



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