Over 100 bumble bee colonies estimated to forage in pumpkin fields on diversified farms

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Overview

Bombus impatiens, the Common Eastern Bumble Bee, is the most prevalent wild bee in the native bee community when assessing pollinator diversity on vegetable farms throughout Pennsylvania. Based on these results, we decided to further examine the population, and specifically to look at nesting habitat, which is a largely overlooked subject due to the difficultly in locating wild bee nests.

Focus: Here we examined foragers collected in pumpkin fields to determined how many colonies are pollinating and utilizing the crop. This will also allow us to estimate the number of nests in the agroecosystem and relate nest abundance to the surrounding landscape.

Why pumpkins? Pennsylvania ranks 6th in US pumpkin production. Pumpkin, and related Cucurbitaceae (squash, melon, cucumber, etc.) require cross-pollination for fruit set. We focused on these crops because Cucurbitaceae are particularly well suited for small-scale, diversified farming operations and are common on Pennsylvanian farms.

Example of pumpkin field site on a diversified farm in Pennsylvania.

Methods

- We used 20mL scintillation vials to individually collected 200 foraging bees
- Farms were located in north, central and SE Pennsylvania, separated by minimum 7km; 5 pumpkin fields and 1 mixed pumpkin and squash field
- Between 162-190 bees were successfully genotyped based on ten microsatellite markers which were used to assign full sibling families by likelihood with software COLONY 2.0.4.5 (Jinliang Wang, ZSL).
- Family number was used to estimate colony presence at each field

The Common Eastern Bumble Bee: *Bombus impatiens*

As social and generalist foragers bumble bees are beneficial pollinators in vegetable farms. In addition, they have several attributes which make them especially valuable native pollinators, particularly in northern latitudes:

- Long foraging ranges, relative to other native bees
- Long seasons (early spring to fall)
- Hardy- they can work in moderate rain and in cooler temperatures when other native bees typically retreat

Bombus impatiens, inside female pumpkin flower, *Cucurbita pepo*

Bombus impatiens, specifically, is recorded to have seasons from March to November, build large colonies, and thrive in a variety of habitats including agriculturally intensive and urban landscapes.

Results: number of colonies

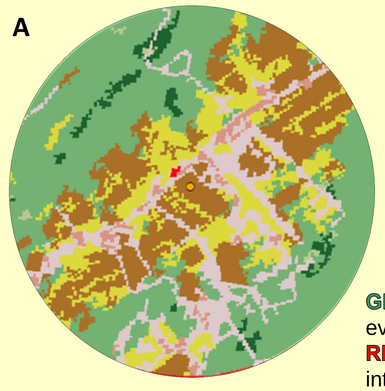
Farm code and county	Field size	Estimated number of colonies	Effective population size, Ne
HN, Center Co.	4 acres	167	1077
WY, Centre Co.	8 acres	149	698
RS, Centre Co.*	1 acre	128	340
BG, Lycoming Co.†	110m row	150	396
HB, Adams Co.	2 acres	145	453
SH, Chester Co.	4 acres	115	276

*Penn State University research farm; †Mixed pumpkin and squash field

To our knowledge, this is the first estimate of *Bombus* spp. colonies present on farms in eastern US agroecosystems. All sampled sites had greater than 100 colonies foraging on and utilizing pumpkin flowers. Although we did not measure pollination and foraging on other crops directly, we may reasonably assume that these bee populations are likely providing pollination services to pumpkin and other crops on the diversified farms included in this study.

Results: landscape effects

We regressed nest abundance at each site against the proportion of agricultural and forest land cover surrounding the field. This analysis was repeated at radii increasing every 250m up to 2000m. (*See figures A and B for example of landscape analysis).* Here we assume agricultural and forest land cover likely provide important nesting and floral habitat.



GREENS– Forest, (deciduous and evergreen), natural area
REDS – Developed (high, med, low intensity, impermeable)
PINK– Open Developed (permeable)
YELLOW & **BROWN** – Agricultural (pasture and cultivated)
BLUE – Orchard

Farm site: WY, Centre Co . **Figure A)** Land cover at 2000m radii around field, based on National Land Cover Database, 30m resolution (USGS); **Figure B)** Land cover at 500m radii, based on hand-digitized aerial maps created at 1:10m resolution [Figures A and B not to scale].

Landscape was significant ($p<0.05$) at larger scales (*see figure 3*). These initial results are based on data collected in year 1 (2011), and in year 2 (2012) we expanded our study sites to resample 5 of the 6 sites, plus add 8 sites. Future analysis will includes estimating nest density at each farm site and relating this to the surrounding landscape, which provides nesting habitat for these wild bees. Conclusions about native bee nest density will be valuable for growers that rely on native bee pollination services.

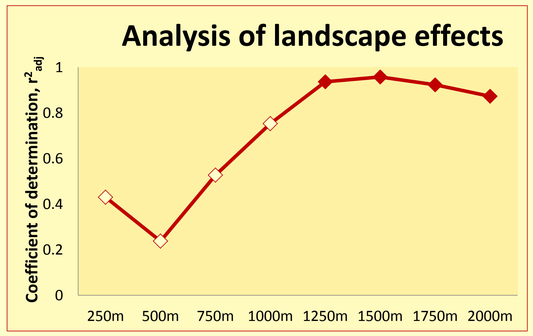


Figure 3 Regression coefficients of determination (r^2_{adj}) plotted against scale, filled symbols indicate significant regressions, $p<0.05$.

Acknowledgements

Assistance- Joyce Knoblett (USDA Bee Lab), Deb Grove (Genomics Core Facility, PSU), and many field assistants for helping to collect bumble bees. **Funding-** NE SARE for funding the important first year of this study. The second year of this project is supported by the Center for Pollinator Research at Penn State and USDA-NIFA pre-doctoral fellowship.

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