


A preliminary look at the Bee and Syrphid Diversity in kitchen gardens St. Lawrence County, NY



Bumble bee on St. John's Wort
Agricultural site
Fleabane Daisy

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Aswini Pai, Dept. of Biology, St. Lawrence University

- Northeast USA and South Asia
- Plant Ecology, Ethnobotany (medicinal sps.)
- Agroecosystems – Pollinator diversity

Agroecosystems/Pollinator diversity

Overarching Goals -


- Teach and train undergraduates about pollinators and agricultural ecosystems
- Create baseline data and long term monitoring of the pollinators (bees and syrphids) in SLC
- Understand how agroecosystems influence/impact/interact with pollinators




Pollinators: Bees, Wasps, Bee flies, Hoverflies, Butterflies, Moths, Beetles, Bats, Birds, Primates, Possums, Rodents, even some Reptiles!

Introduction

- Vast diversity of wild bees (20,000 sps.)
 - N. York, adjoining Canada 350 sps.
- Key pollinators (temperate zone)
 - Pollen obligates
 - Flower constancy
- Wild bees: native, non-managed
 - Dominant pollinators
 - small fields, kitchen gardens
 - **60% - 90%** of flower visits
- Originally supplemented with European honey bees to control pollination/cultivation of introduced crops




Apis mellifera (Quintin 2010)




Kitchen garden site

Introduction (cont.)

- Agriculture threatened by “pollination crisis”
- Wild bee species more resilient
- Community dynamics / population composition largely unknown
- Wild bee diversity influenced by blooming, availability of floral resources such as wildflowers
- Most studies on large farms and orchards



Agricultural site





Augochloropsis spp. (Peters 2013)

Introduction (cont.)


Kitchen gardens

- Traditional agroforestry systems, culturally rooted
- Polycultures (multiple species), adapted to local microenvironment
- Variety of cultivation techniques
- Promote agrobiodiversity and genetic diversity
- Considered sustainable; small in size (0.5-3 acres)
- Composition influenced by local ecological and socioecon. conditions
- Food security to economically marginalized farmers and growers
- Well studied in tropics

Research Questions

- What genera / species of wild bees present in SLC?
- Is bee genus/sps. richness and abundance correlated to crop sps. richness?
- Is wild bee sps. diversity and abundance in kitchen gardens increased by surrounding floristic diversity/resources?
 - Significant difference in bee sps. richness inside vs. outside kitchen gardens?
- Trends in wild bee sps. diversity through summer?
 - Correspond to trends in floral resources?
- 2012 vs. 2015? (we have only 2 years of data)




Bombus spp. (Lobb 2012)


Andrena spp. (Reyes 2010)

Hypotheses

- Wild bee diversity greatest
 - In areas with greater floristic diversity
 - At point in summer when most flowers in bloom
- No significant difference in bee species richness found IN vs. OUT
- No difference 2015 vs. 2012




Common milkweed



Cow vetch


Study Area

- St. Lawrence County
 - Patchwork of forest and agricultural land
 - Temperate broadleaf / mixed forests, 4 seasons
 - USDA Hardiness Zone 3b
 - St. Lawrence River Watershed
 - Agricultural history: Ash, Livestock, Dairy
 - >1300 farms, 20% land



<http://www.landsat.com/st-lawrence-county-new-york-aerial-photography-2008.html>

Study area (cont.)




<http://www.landsat.com/st-lawrence-county-new-york-aerial-photography-2008.html>

Dairy farming in SLC

- Forage crops - Alfalfa (*Medicago sativa*), Soybean (*Glycine max*)
- Protein and fiber for livestock
- Mono cultures, some volunteer “weedy” species

Kitchen gardens in SLC

- Vegetables, ornamentals, herbs.
- Hobby farms, CSAs, farmer co-op, farmer’s market
- Polycultures
- Pollinated by domestic honey bees and native wild bees
- Reports of Colony Collapse Disorder (CCD)



12-22 Kitchen Garden Sites Sampled

Grasse River

Oswegatchie River

Bennetts

Barco

Terfield

Rocco

Dewar

S.S. Farm

Road

Birdshot

W.B.


Sweetcorn

Arvin


Buckeye

Methods

- 12 -22 kitchen gardens, SLC, 4X -5X
- Flower counts →cultivated, wild
- Pan traps → detergent water
- Pinning (Droege 2010)
- Identification → dichotomous keys
 - All specimens to genus level
 - Two replicates to species
 - Early, Late Summer
- Statistical analyses
 - ANOVA
 - Correlation (Spearman's rank)





Pan trap



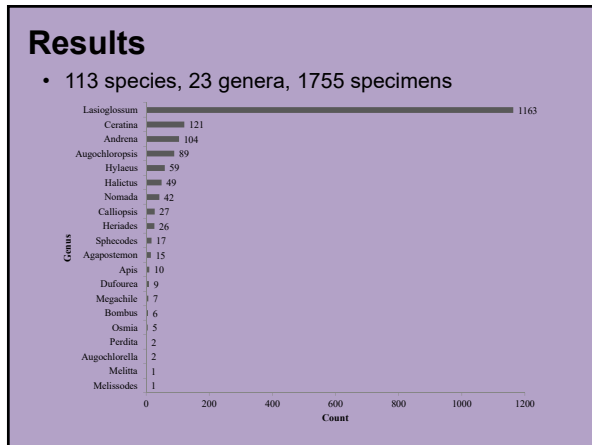
Pinned specimens

Identification





A-coloration
 B-patterns/banding of abdominal terga
 C-width of head and facial fovea
 D-wing venation
 E-propodeal triangle
 F-hair color
 G-facial markings
 H-body markings and coloration

Genus: Packer *et al.* 2007
 Species: Bug Guide, Discover Life, Michener 2007




Lasioglossum



(Kavanagh 2014)

Solitary, ground-nesting, pollinates sunflowers, sweet potatoes, cucumbers, melons, asparagus, the Fabaceae, strawberries


Augochloropsis



(McCulloch 2008)

Solitary, ground-nesting, pollinates apples, broccoli, cantaloupe, carrots, strawberries, grapes

Nomada



(LHG Creative 2014)

Solitary/communal, wood-nesting, generalists, pollinates blueberries, strawberries,

Results: Bees

Forage Farms

- significant difference in bee sps. richness and abundance between forage crops farms ↓ and kitchen gardens ↑



!!!!Preliminary Results!!!!

Results: Bees

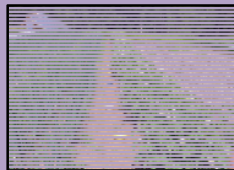
Kitchen Gardens only

Total bee abundance

- No sig. diff. ($p > 0.05$)
 - Among sites
 - Early vs. Late summer
 - IN vs. OUT

Bee sps. richness

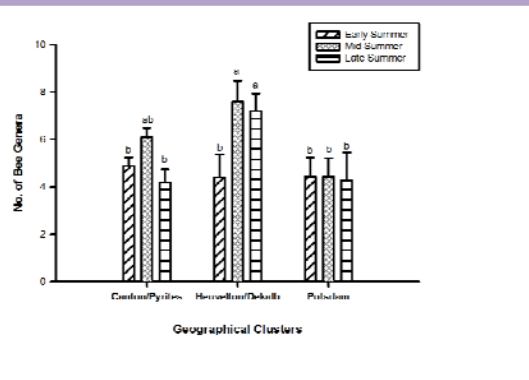
- No sig. diff. ($p > 0.05$)
 - IN vs. OUT
- Sig. diff.
 - Early vs. Late summer ($p = 0.008$)



Inside of agricultural site



Outside of agricultural site



Results (Cont.)

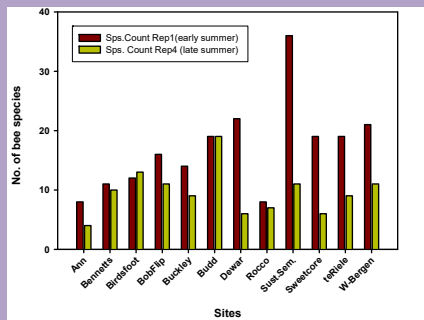


Figure 4. Bee species richness during early and late summer found at twelve kitchen garden sites in St. Lawrence County. Error bars not shown because data is sourced only from two replicates (two periods of sampling).

Results: Floral Community

Species Richness

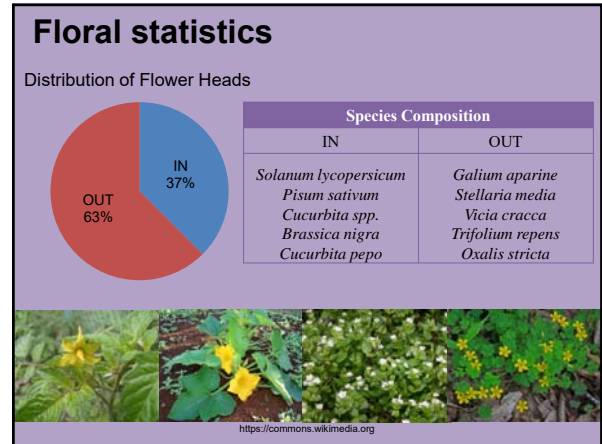
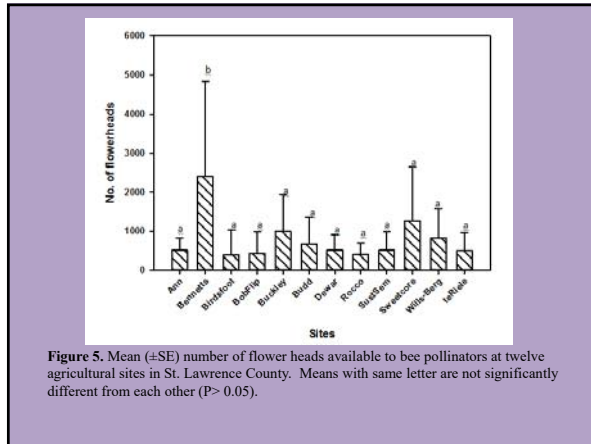
- Sig. diff.
 - Among sites ($p < 0.001$)
 - Early vs. Late ($p < 0.01$)
- No sig. diff.
 - IN vs. OUT
- Site x Location Interaction

Floral Abundance

- Sig. diff.
 - Among sites ($p < 0.001$)
- No sig. diff.
 - Early vs. Late
 - Throughout summer*



Flowering garlic



Results (Cont.)

Table 1. Spearman's Rank Correlation (r) of bee community and floristic variables sampled at 12 kitchen garden sites in St. Lawrence County, NY during early summer. Significant correlations ($r > 0.50$, $p < 0.05$) are indicated in bold.

| | No. Bee Species | Total No. Bees | No. Bee Genera | No. Flower Sp. (IN) | No. Flower Sp. (OUT) | Total No. Flower Heads |
|------------------------|-----------------------|------------------------|----------------|---------------------|----------------------|------------------------|
| No. Bee Species | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total No. Bees | 0.837 0.001 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| No. Bee Genera | 0.380 | 0.305 | 1.000 | 0.000 | 0.000 | 0.000 |
| No. Flower Sp. (IN) | -0.535 | -0.633 0.027 | -0.155 | 1.000 | 0.000 | 0.000 |
| No. Flower Sp. (OUT) | -0.264 | -0.095 | 0.325 | 0.386 | 1.000 | 0.000 |
| Total No. Flower Heads | 0.413 | 0.567 | 0.039 | -0.136 | 0.269 | 1.000 |
| | 0.182 | 0.054 | 0.903 | 0.674 | 0.398 | 0.000 |

Conclusions + Discussion

- 20 (+) genera, 113 (+) species; *Lasiglossum* predominates
- No sig. diff ($p > 0.05$) in bee abundance among sites, Early vs. Late, or IN vs. OUT
- Greater bee species richness Early vs. Late
- Variation in bee species composition over summer

Bumble bee on St. John's Wort Agricultural site

Conclusions + Discussion (Cont.)

- Higher flower counts, diversity outside at some sites
 - bee visits to kitchen gardens incidental
 - Importance of natural habitat
- Factors beyond floristic resources: Nesting sites / limited mobility
- More species, fewer genera 2015 vs. 2012
- Kitchen gardens important
- St. Lawrence County a conservation model as small farms rise?

Ground nesting *Andrena* (Jones 2006)

Peponapis "squash bees" (USDA 2008)

Future Directions

- Complete species ID
- Conduct analysis on complete dataset
- Quantify nectar and pollen availability
- Quantify additional habitat parameters
 - Nesting site availability
 - Landscaped, ornamental gardens
- Extend sampling season
- Farmer interviews – calendar, sps. selection, techniques, land use

Landscaped / ornamental garden (denverwaterblog.org)

Bee covered in pollen (Flickr CC)

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