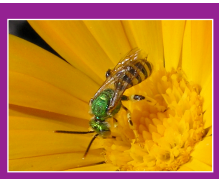

Wild Bee Diversity in Brooklyn Community Gardens

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Introduction: The global decline of pollinators has been accompanied by dramatic losses of commercial honey bees due to Colony Collapse Disorder. As a result, conserving wild pollinators has become more important. Wild bees (non-*Apis*) represent an ecologically- and economically-important component of the global pollinator community. Although research on the conservation of wild bees has advanced in agricultural settings, little is known about their status in urban environments. As cities move toward "greener" living systems, maintaining an abundant and diverse bee community will be essential for maintaining healthy and productive plants in parks, gardens, and sites of urban agriculture. This research represents the first year of a two-year study examining bee diversity in community gardens throughout Brooklyn, NY.

Research Questions:

1. What is the community composition of wild bees in Brooklyn, NY?
2. Does bee diversity differ among the community gardens?
3. What factors may explain variation in bee diversity?

Table 1. Study sites and bee diversity. Bees were collected from community gardens located in various Brooklyn neighborhoods. Bee diversity varied among the study sites.

Garden Name	Location	Latitude	Longitude	Diversity Index*
Warren/St. Mark's	Park Slope	40.680668	-73.979476	2.51
Greene Acres	Bedford-Stuyvesant	40.688089	-73.957225	2.46
Carlton Bears	Fort Greene	40.685712	-73.971558	2.20
Hollenback	Clinton Hill	40.685234	-73.965404	2.06
Lafayette Bears	Boerum Hill	40.685855	-73.978962	2.05
Pacific Bears	Park Slope	40.682999	-73.977216	1.92
Walt Shamel	Bedford-Stuyvesant	40.677366	-73.953772	1.84
Clifton Place	Clinton Hill	40.687655	-73.962486	1.79
Classon Fulgate	Clinton Hill	40.684000	-73.959211	1.65
East NY Farms	East New York	40.664667	-73.886988	1.58

* As measured by Shannon Diversity Index. Higher numbers indicate higher diversity.

Methods: Ten community garden study sites were established throughout Brooklyn, NY during the summer of 2009 **(Table 1)**. The gardens varied in several key characteristics that may influence bee diversity, including: patch size, isolation from other green spaces, and floral diversity. Bees were monitored on a biweekly basis from June-September using three pairs of yellow and blue pan traps deployed for 48 hours. All bees were identified to species or grouped by morphospecies. Several measures of diversity - community evenness, total bee abundance standardized by capture rate, and diversity indices - were quantified. These measures were used to investigate the structure of the Brooklyn bee community, and compare bee diversity among the gardens and their respective environmental characteristics.

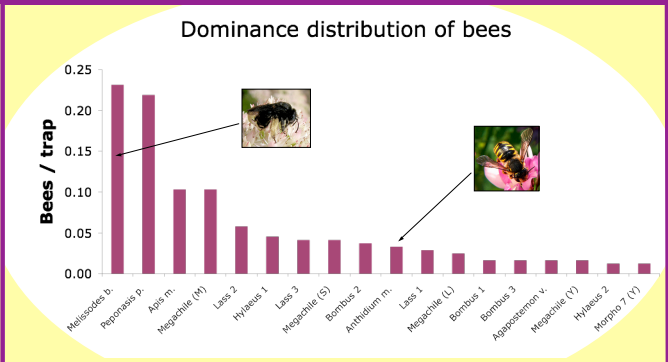

Fig. 1. The Brooklyn bee community exhibited a skewed dominance structure. Bees representing < 1% of total are not shown.

Results: 270 bees comprising 30 species were collected during the 2009 field season. The dominance distribution of the bee community was highly skewed (**Fig. 1**), as the top six species accounted for nearly 70% of the total bees captured. Bee activity varied significantly among gardens. Average capture rates ranged from 2.2 to 0.58 bees per trap **(Fig. 2)**. Bee diversity, measured by the Shannon Diversity Index, also varied among the gardens (**Table 1**). A positive linear relationship between garden size and bee diversity was found ($F=7.86$, $P=0.026$) when the largest garden (East NY Farms) was excluded **(Fig. 3**, dotted line**)**. When East NY Farms was included in the analysis, a curvilinear relationship was found (**Fig. 3**, solid line) as bee diversity was lower at this location. Preliminary analyses suggest that floral diversity mediates the relationship between garden size and bee diversity (data not shown).

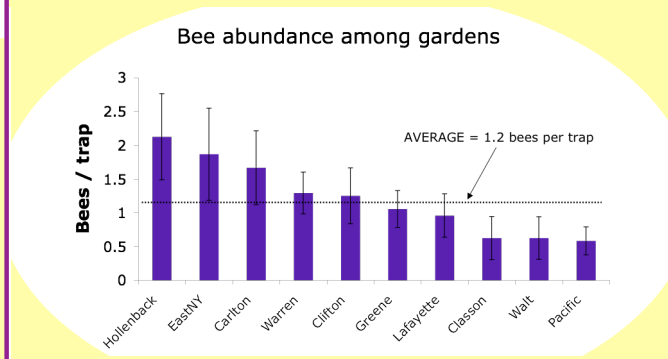

Fig. 2. Significant differences in bee abundance (mean +/- SE) were found among the gardens.

Conclusions: The structure of the Brooklyn bee community was typical of insect communities in highly disturbed habitats: low species richness and relatively few species dominating in abundance. In general, moderately large sunny gardens generated more bee captures and higher bee diversity. Large gardens tended to have more floral resources and provide more available nesting habitat, as most wild bees are solitary soil nesters. However, East NY Farms, the largest garden, had high bee abundance but low diversity. This garden was more "farm-like", had a managed honey bee colony, and had more crop plants and fewer wildflowers. Competition from honey bees and fewer alternative floral provisions may account for the decline in diversity at this location. We suggest that community gardens provide ample soil nesting sites and numerous alternative floral provisions (in addition to crops) to sustain bee diversity at the garden level.

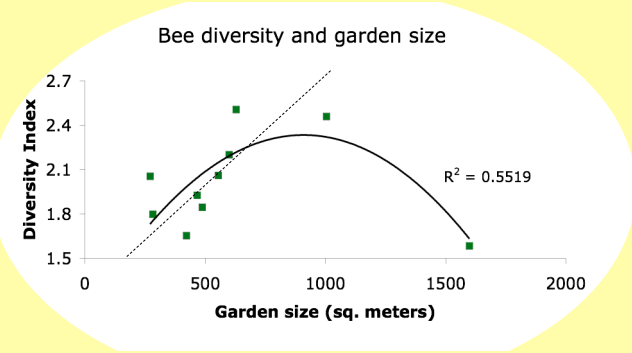

Fig. 3. A relationship between garden size and bee diversity was found.

Future considerations:

1. Include more large garden sites, to verify relationship between garden size and bee diversity.
2. Provide more detailed assessment of floral resources beyond floral diversity (e.g., area of wildflowers vs. crops).
3. Quantify additional landscape variables, such as degree of isolation from other habitat patches, that may influence bee diversity in gardens.

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