Wild bee communities in non-crop land cover in the Maine (USA) wild blueberry production landscape

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• What wild bee species are found in the wild blueberry production landscape? • Do wild bee communities in this landscape differ by growing region? •

Background:

- Wild bees in the Maine wild blueberry (*Vaccinium angustifolium*) agroecosystem are not well studied outside of crop fields.
- We surveyed bees in wild blueberry and seven non-crop land cover types to increase predictive capability of the InVEST Crop Pollination model in this landscape.
- Wild bees respond to landscape context in other agricultural systems.

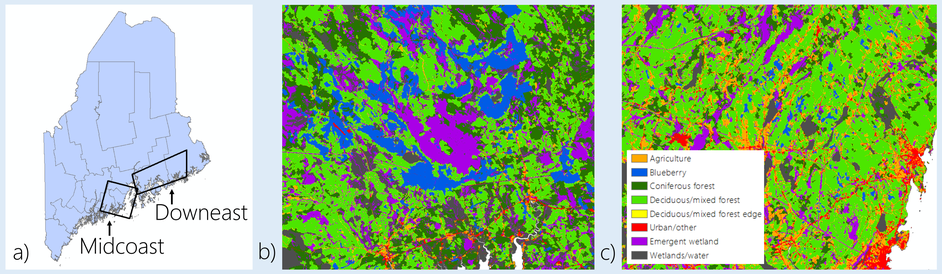

Figure 1: Study area. a) Growing regions, b) Downeast landscape, and c) Midcoast landscape.

Table 1: Landscape metrics in Maine wild blueberry growing regions, average value (min-max).

Growing region	Number of patches	Patch Size (LPI)*	Patch Shape (LSI)**	IJI***	% Deciduous****
Downeast (8 sites)	664.5 (453-857)	12.75 (5-24)	22 (17-26)	68.875 (61-78)	28.125% (11-35%)
Midcoast (16 sites)	664.6875 (476-846)	9.875 (5-13)	25.375 (22-28)	64.0625 (57-68)	46.125% (34-66%)

*Largest Patch Index: Percent of landscape comprised by the largest patch (Unitless); **Landscape Shape Index: Measure of shape complexity by total patch edge length (Unitless); ***Interspersion Juxtaposition Index: Measure of landscape complexity by patch adjacency (Unitless); ****Percent of Deciduous/mixed forest

Study Area:

- Maine's two blueberry growing regions differ in landscape context (Figure 1, Table 1).
- Downeast region: simple landscape structure dominated by large crop fields with more coniferous forest (Figure 1b, Table 1).
- Midcoast region: complex landscape structure including more urban and agricultural areas in a deciduous/mixed forest matrix (Figure 1c, Table 1).

Figure 2: Sampling methods. a) An urban bee bowl transect , b) Blooming shrub at a wetland site.

Sampling Methods:

- Early, mid-, and late summer surveys of bees and flowers in 2015
- Five sampling blocks, eight sites per block (one per cover type).
- Blue, yellow, and white bee bowls placed every 10 m along a 100 m transect
- 24 hour bowl sampling, 30 minutes hand netting
- Transect survey of flowering species, estimated patch size, and % bloom

Data Analysis:

- Bees identified to species; all specimens were verified by taxonomic experts
- Descriptive statistics calculated by study region and land cover type
- Regions and cover types compared with Non-metric Multidimensional Scaling (NMDS).

Results:

- We collected 1709 specimens in 119 species, 23 genera, and five families.
- Wild blueberry fields had the greatest bee abundance, followed by urban and forest edge cover types (Figure 3a).
- Forest edge habitat was the most diverse, followed by wild blueberry fields and emergent wetland (Figure 3b).
- NMDS created significantly distinct communities based on land cover type ($p<0.001$, $R^2=0.58$) (Figure 4a), but found no significant difference in communities based on region ($p=0.71$, $R^2=0.05$) (Figure 4b).

Common species found in our surveys include :

- *Bombus ternarius*, Maine's most common bumblebee (331 specimens)
- *Lasioglossum cressonii*, a common cavity nesting small sweat bee (108 specimens)
- *Lasioglossum leucocomum*, almost all from blueberry fields (67 specimens) (Fig. 5)
- *Augochlorella aurata*, a common bright green sweat bee (110 specimens) (Figure 5)

Interesting specimens we collected are:

- An aggregation of *Agapostemon virescens* at one urban site (89 specimens)
- *Megachile inermis* and *Megachile rotundata* (Figure 5) (4 specimens each) exclusive to edge habitat
- *Anthidium manicatum* (1 specimen) and *Anthidium oblongatum* (Figure 5) (15 specimens) exclusive to one growing region
- *Calliopsis andreniformis* (6) and *Andrena miserabilis* (16) exclusive to urban land cover
- The generalist *Andrena nivalis* (Figure 5) was the only bee collected in all eight cover types. (28 specimens)
- Two state records: *Andrena personata* and *Lasioglossum platyparium*

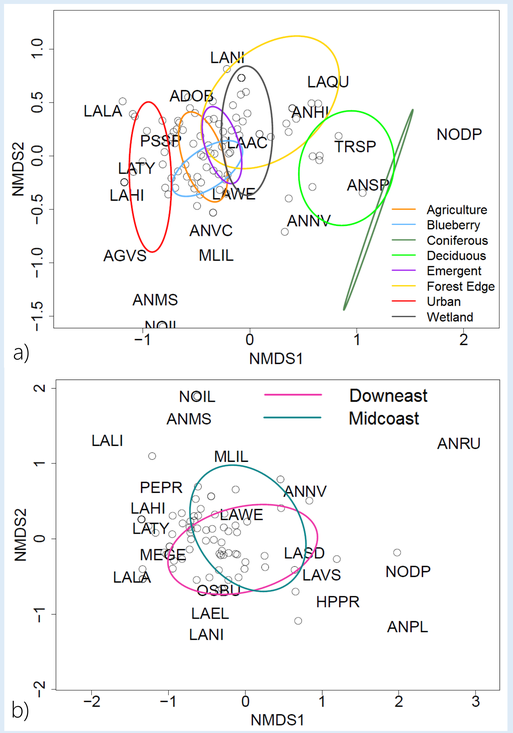

Figure 4: NMDS results. Bee community grouped by a) Land cover type and b) Growing region.

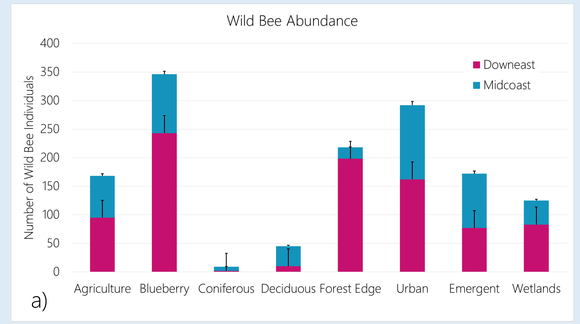

Figure 3: Community composition with standard error. a) Bee abundance and b) Bee diversity by land cover type.

Figure 5. Bees collected in samples (L-R)*: L.leucocomum*, *M.rotundata*, *A.nivalis*, *A. aurata*, and *A. oblongatum*. All photos © Laurence Packer via Discover Life.

Conclusions and Next Steps:

- Wild bees do not differ by growing region when pooled across land cover types.
- Bee communities differ by land cover type within growing regions.
- Land cover patch size differs among cover types between regions.
- Future analyses: explore relationships of landscape characteristics (patch size, patch shape, patch density, and cover type composition) and bee communities
- Does bee community composition reflect limits in foraging distance related to land cover patch size?
- Incorporate these data into the InVEST Crop Pollination model for Maine wild blueberry.

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