Monitoring Pollinator Habitat to Inform Management: A pilot of a single-summer phenological survey of nectar resources in a natural area

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Introduction

Pollinators provide crucial ecosystem services such as crop pollination and pest control (Isaacs et al. 2009). Global declines in pollinator populations have been observed (Potts et al. 2010), with habitat loss and fragmentation acting as primary drivers (Potts et al 2010; Kopek & Bird 2017). The Environmental Monitoring and Management Alliance (EMMA) is a partnership of researchers and land managers in the Hudson Valley dedicated to regionally-coordinated ecological monitoring that informs sustainable management practices and natural resource conservation. In partnership with Vassar College, we piloted a method to determine the availability of nectar resources for pollinators at the Vassar Farm and Ecological Preserve (VFEP). We created an inventory of flowering plants between June 2017 and the end of the growing season, and conducted a literature search to determine which pollinators visit the flowers found.

Goals

- To develop an inventory of the flowering plants on the VFEP as a pilot for the wider EMMA network
- To determine which flowers act as resources for native bees, butterflies and moths
- To determine whether any temporal gaps in these resources exist, and to use these gaps to inform 1) pollinator habitat restoration or 2) routine mowing of protected old field habitats

Methods

- Old field habitat at the Vassar Farm and Ecological Preserve (VFEP) was divided into sampling units (Figure 1).
- From 31 May until the end of the growing season in October, these units were checked weekly for open flowers via a meandering transect. Open flowers were identified and listed along with an estimate of their abundance, which was based on categories developed by the USA- National Phenology Network. Any new flower species encountered was photographed with a numeric tag that was matched to the recorded data.
- A literature search was conducted to determine which pollinators visit the flowers found. Using this data, we discerned a subset of species that provide nectar to native bees and to butterflies or moths, and that flowered for at least three weeks in numbers of at least 10,000.
- Nectar calendars were created to show the phenology of subsets of species available to native bees and to butterflies and moths (Figure 4).

Time Commitment for Land Managers

Project participants were able to cover an average of 3.13 acres per hour. Our most experienced participant was able to cover the VFEP's 48 acres of old field in approximately 12 hours. With three student assistants, the area could be covered in one day. However, all participants experienced a learning curve, with training occurring at an average rate of 2.64 acres per hour.
Data management took roughly 8 hours per week. However, we have streamlined the process by creating an Access database and a corresponding field datasheet in order to expedite data entry during future surveys.

Figure 1. Old field sampling units on the Vassar Farm and Ecological Preserve (VFEP).

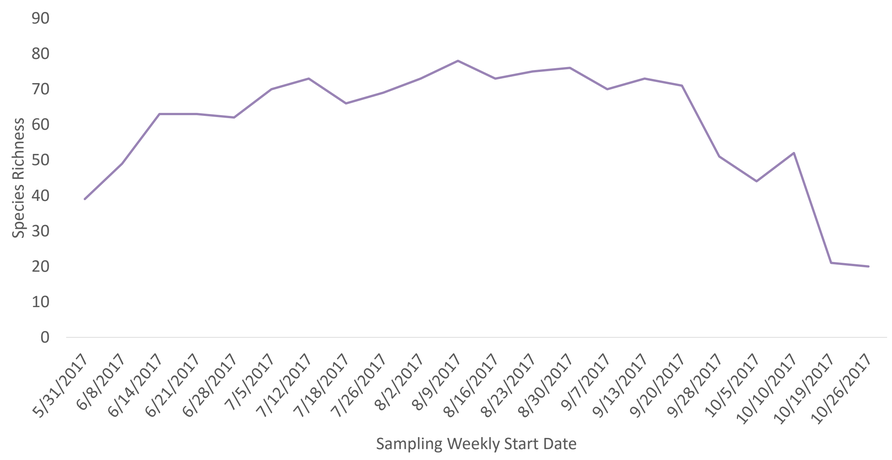

Figure 2. Species richness of all flowering plants observed on the VFEP between 31 May and 26 October 2017. Species richness is lower in May than during the rest of the growing season.

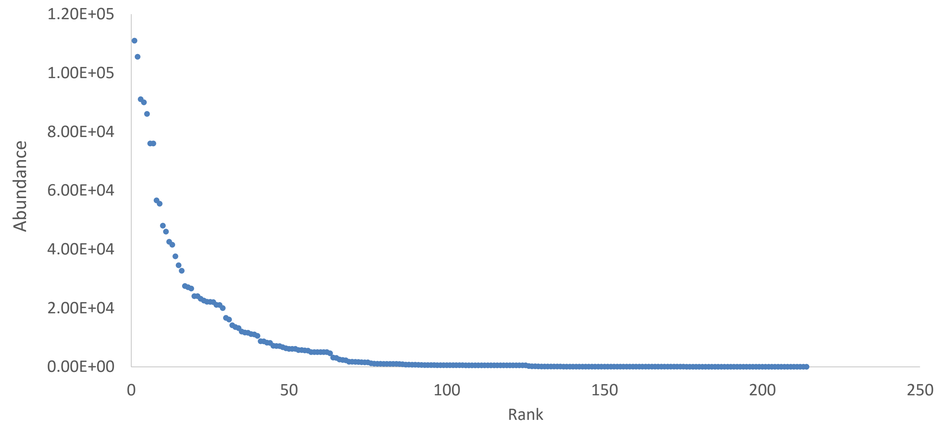

Figure 3. Rank-abundance of the flowering plant species observed on the VFEP between 31 May and 26 October 2017. Most species were observed in very small numbers and likely do not contribute significantly to the VFEP's floral resources.

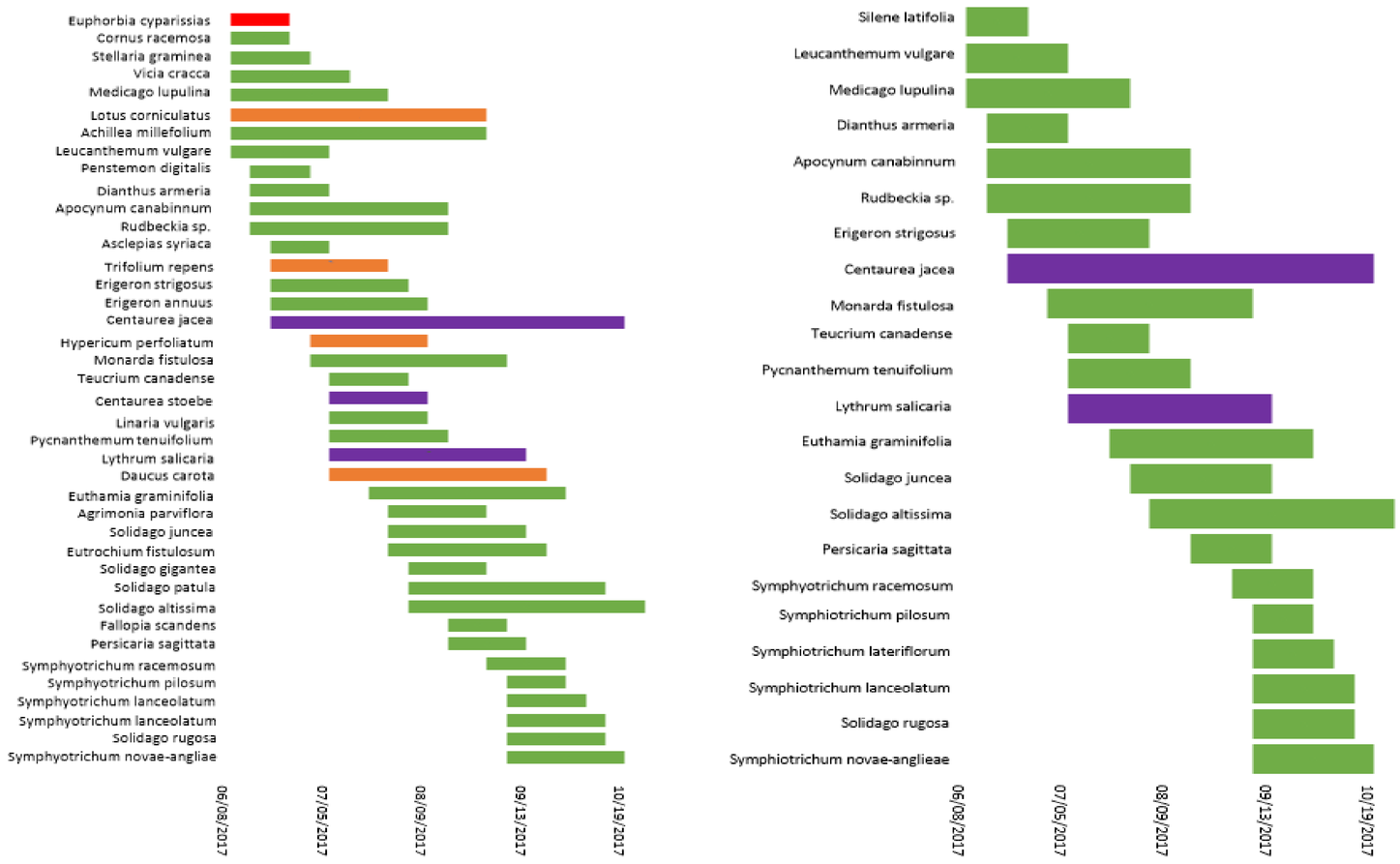

Figure 4. Nectar availability calendar for native bees (left) and *Lepidoptera* (right). Colors represent LH PRISM categories of invasiveness: Green = Native. Purple= Widespread invasive (Tier 4). Red = Established invasive (Tier 3). Orange = Species with low invasiveness rank, no known local occurrences, and/ or uncertainty about possible impacts (Excluded).

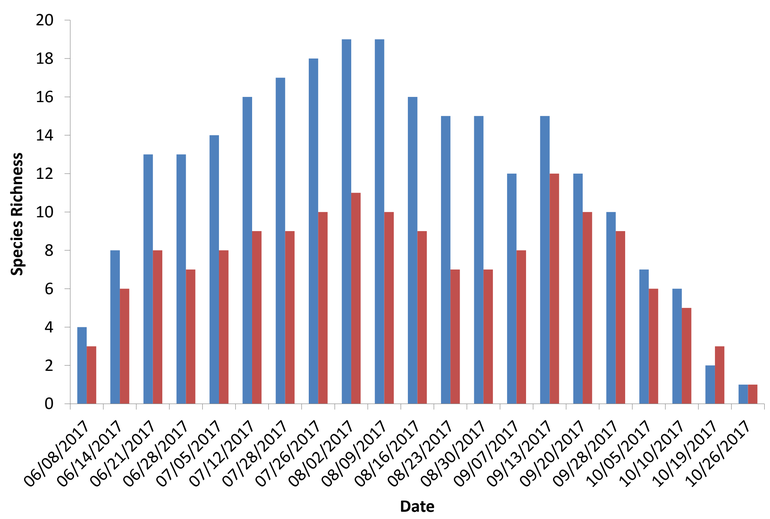

Figure 5. Species richness of top pollinator plants which service native bees (blue) and butterflies and moths (red). Although there is no critical temporal gap in flowering plant availability during the sampling period, richness of nectar resources for butterflies and moths is generally lower than that for native bees.

Results

- A total of 227 flowering plant species were identified on the VFEP during the sampling period.
- As the majority of species found were extremely low in abundance (Figure 3), is it likely that relatively few of the most abundant species contribute significantly to nectar resources on the VFEP.
- Overall species richness (Figure 2) was relatively low at the end of May, well into the growing season when pollinators have likely been active for months. This may indicate a temporal gap in flower availability in the late spring.
- Overall, there tend to be more species in flower that support native bees than butterflies at any given point in the season. This may be justification for restoration efforts to increase nectar availability for Lepidoptera on the VFEP. Several species that support lepidopterans are currently established in relatively small populations (Table 2); it is possible that the VFEP could augment these populations as part of such an effort.
- While the top pollinator plant species were largely native, it was found that a few Lower Hudson PRISM-listed invasive flowers contribute to the VFEP's nectar resources for both native bees and native lepidopterans (Figure 4).

Future Directions

- In order to explore the decline in species richness at the beginning of the sampling period, we will extend the sampling period into early spring to understand the nectar resources available to pollinators throughout the entire period of their activity. We intend to follow up during the spring of 2018 to complete this portion of the calendar.
- We aim to assess and increase the accuracy of our identifications by collecting voucher specimens for each species found. These specimens will be digitized and stored in Vassar College's herbarium.
- While a literature search provided guidelines for which pollinators visit each flower species observed, we should corroborate those findings with pollinator visitation observations and collection on the VFEP. Further investigation would augment our understanding of the community structure on the VFEP, particularly if observed visitation differs from what has been previously reported.
- This pilot study is intended to be adopted across the greater Hudson Valley region. The inclusion of other preserves in the study would allow us to develop an understanding of nectar resources available to pollinators on a regional scale.

Table 1. Potential *Lepidoptera* habitat restoration species. These native species were found in relatively low abundance on the VFEP; their population sizes could be augmented as part of a restoration effort.

Common Name	Scientific Name	Common Name	Scientific Name
Arrow-leaved aster	Symphyotrichum urophyllum	**Flat-topped Aster**	Doellingeria umbellata
Blackberry	Rubus allegheniensis	**Grey Goldenrod**	Solidago nemoralis
Butterflyweed	Asclepias tuberosa	**Heart-leaved aster**	Symphyotrichum cordifolium
Blue Vervain	Verbena hastata	**Hog Peanut**	Amphicarpa bracteata
Boneset	Eupatorium perfoliatum	**Large-leaved aster**	Eurybia macrophylla
Bristly dewberry	Rubus hispidus	**New York ironweed**	Vernonia noveboracensis
Bushy Aster	Symphyotrichum dumosum	**Showy goldenrod**	Solidago speciosa
Canada goldenrod	Solidago canadensis	**Small sundrop**	Oenothera perennis
Canada meadow lily	Lilium canadense	**Spiked lobelia**	Lobelia spicata
Common blue-eyed grass	Sisyrinchium montanum	**Spotted Joe Pye weed**	Eutrochium maculatum
Common cinquefoil	Potentilla simplex	**Sundrop**	Oenothera fructicosa
Common fleabane	Erigeron philadelphicus	**Swamp milkweed**	Asclepias incarnata
Common Morning Glory	Ipomoea purpurea	**Swamp smartweed**	Persicaria hydropiperoides
Common self-heal	Prunella vulgaris	**Swamp Thistle**	Cirsium muticum
Common Yellow Oxalis	Oxalis stricta	**Tall Thistle**	Cirsium altissimum
Crooked-stemmed aster	Symphyotrichum prenanthoides	**Trumpetweed**	Eutrochium fistulosum
Culver's root	Veronicastrum virginicum	**White Snake Root**	Ageratina altissima
Devil's beggartick	Bidens frondosa	**White Vervain**	Verbena urticifolia
Field thistle	Cirsium discolor		

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