Daily pollinator activity patterns vary strongly between plants

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buzzdetect
github

Background

- Phenological aspects of plant-pollinator systems are well-studied at the seasonal scale. For example: floral phenology as a driver of community dynamics,[1] the influence of climate change on pollination phenology,[2] and temporal niche partitioning.[3,4]
- These same ecological concepts at the seasonal scale can often be applied at the scale of individual days.[4-7]
- However, there is a comparative lack of research on the daily patterns of plant-pollinator interactions, possibly due to the labor required for sufficient temporal resolution.
- Advances in machine learning enable passive monitoring, facilitating high-replication, high-resolution studies.

Goal: characterize the daily pattern of foraging in a broad diversity of flowers.

Methods

Passive Acoustic Monitoring

- Sony ICD-PX370 MP3 recorders were deployed in patches of blooming flowers.
- Patches were only recorded if there was no other species of flower within recording range, roughly one meter.
- Flowers were monitored opportunistically when blooms were available. Sample size varied between flowers depending on the size of the patch.

Analysis

- Recordings were analyzed with the machine learning tool buzzdetect (QR code top right), which detects the buzz of insect flight in audio.
- Exploratory data analysis in R: peak foraging time, duration of foraging, peak activity level.

Results

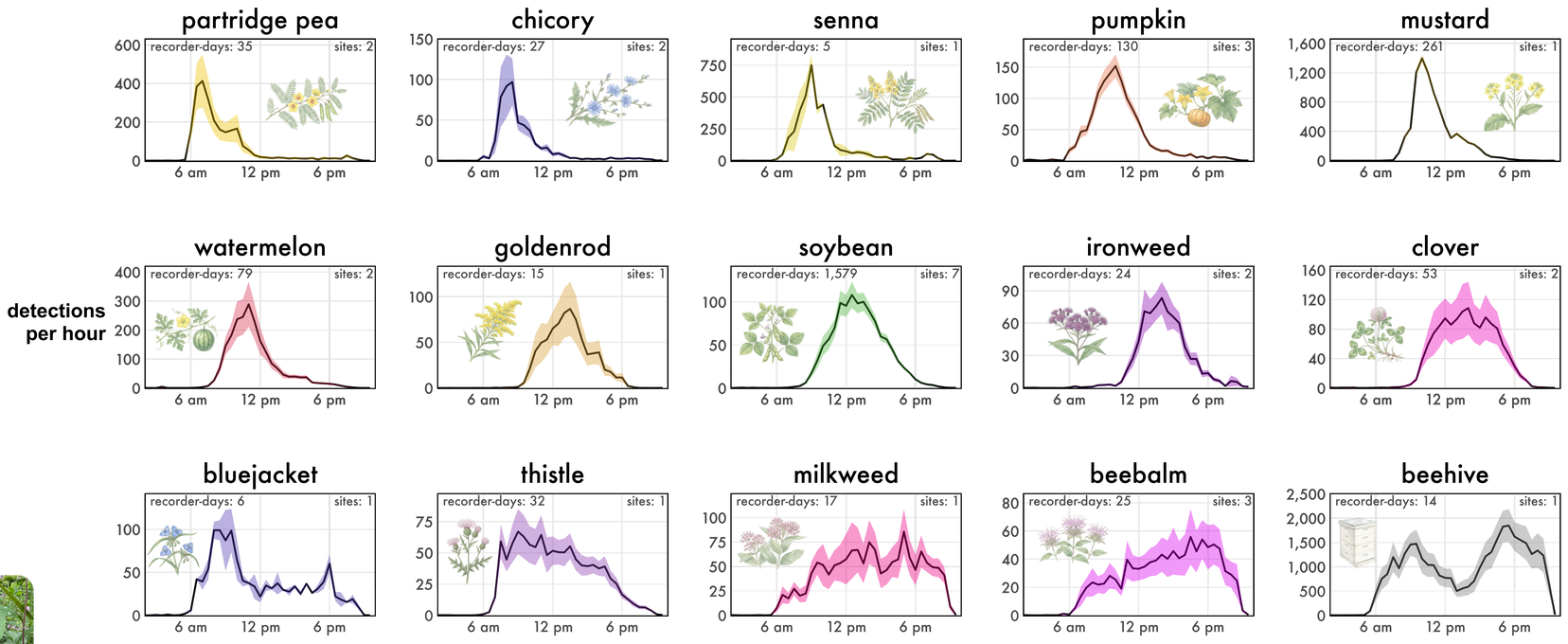

Figure 1. Daily patterns of pollinator activity at various flowers. Detections from multiple recorders across multiple dates have been averaged together in 30-minute bins and displayed as detections per hour. The colored area displays ±SE. The data volume (as recorder-days) and number of independent sites for each flower are displayed at the top of each panel. Differences in colors are for aesthetic purposes.

- Median peak foraging time varied from ~7:30 AM (partridge pea) to ~3:45 PM (beebalm).
- Median duration of foraging ranged from ~4 hours (chicory) to ~11 hours (beebalm).
- Average peak detection rate (detections/hour) varied from ~1,400 (mustard) to ~60 (thistle).
- Activity patterns were not clearly correlated with phylogeny; legumes showed both brief, early foraging (partridge pea) and longer, later activity (soybean, clover).

Discussion

- Previously published daily trends corroborate our results for pumpkin,[8,9] mustard,[10,11] watermelon,[12,13] and soybean.[14]
- To our knowledge, the daily trends for the other flowers in our dataset have not been previously published.
- Daily patterns of floral resource production are probably significant drivers of foraging,[15-17] but are understudied.
- Experiments should be designed carefully to avoid confounding results with time-of-day effects.
- Seed mixes for pollinator plantings should comprise flowers with different foraging times to provision pollinators throughout the day. In an agricultural setting, pollinator plantings with trends similar to the crop may be preferred in order to draw pollinators to the crop field, increasing pollination.

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