College of Arts and Sciences, Department of Evolution, Ecology, and Organismal Biology

Patterns of Taxonomic and Ecological Diversity of a Non-bee Pollinator (Diptera: Syrphidae) in Ohio

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INTRODUCTION

- Insects respond quickly to their environment and can serve as environmental quality indicators.
- Hover flies (Diptera: Syrphidae) comprise >400 species in northeastern USA.[2]
- Nectar-feeding adult hover flies are pollinators.
- Predatory larvae (~1/3 of species) provide biological control of agricultural pests (Fig. 1).
- Larvae of other species decompose plant matter or are ant parasites (Fig. 1).

OBJECTIVES

- Conduct the first statewide survey of Ohio's hover flies since 1913.[1]
- Determine how landcover influences hover fly diversity and abundance.

HYPOTHESES

1. Hover fly abundance and diversity declines with developed landcover and increases with forest cover.
2. Larval diet affects habitat associations and distribution of species.

Larval Functional Groups

Table 1. Larval functional group classification based on diet and habitat

Function	Subfamily	Larval Habitat and Diet
Aquatic Decomposers	Eristalinae	Larvae live in wet environments; most feed on decaying organic debris. Some may live in sap trails, under bark, or rot-holes in trees.
Ant Nest Parasites	Microdontinae	Larvae parasitize ant nests and are predators of ant brood.
Soft-bodied Insect Predators	Syrphinae, Pipizinae	Primarily aphid predators and found in many habitats.

Figure 1. Hover fly larvae from the three larval functional groups. Left: aquatic decomposer larvae © Gene H CC BY 4.0. Middle: ant nest parasite larvae © Nikolai Vladimirov CC BY 4.0. Right: soft-bodied insect predator larvae © David McCorquodale CC BY 4.0.

Sample Sites

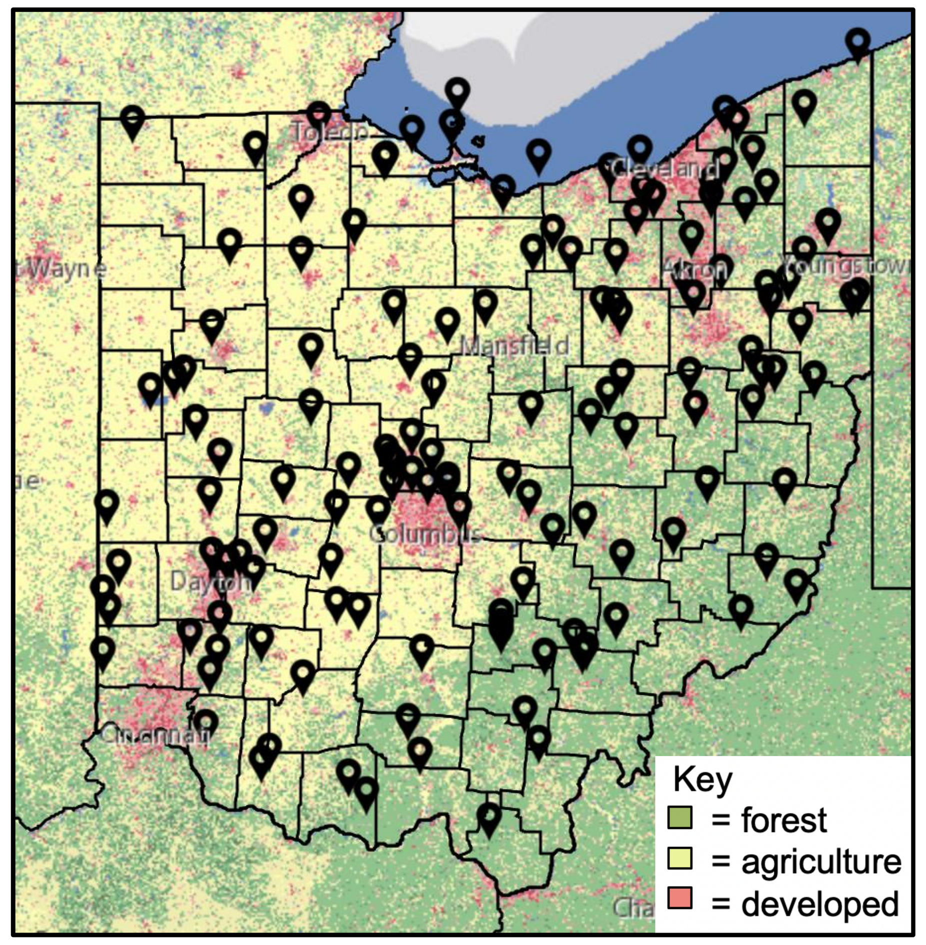

Figure 2. Sample sites and land cover classes based on the 2019 National Land Cover Database.[4]

METHODS

- Set bowl traps weekly, May-October 2020 at 142 sites (Fig. 2).
- Used ArcGIS to calculate the percent land cover in forest, agriculture, and developed within 500 m radius of each site (Fig. 2)
- Pinned and identified specimens to the lowest taxonomic level possible[2,3] and into larval functional groups (Table 1, Fig. 3).
- Calculated rarefied generic richness[7], made a genera accumulation curve[6], and calculated Shannon diversity.[5]
- Tested the association of landcover with the abundance, diversity, and rarefied richness.
- Tested the association of landcover with abundance, diversity, and rarefied richness using Spearman rank correlations.
- Tested presence of functional groups using logistic regression.

Figure 3. Hover flies. Top left: Syrphinae, Top right: Eristalinae. Bottom left: Pipizinae. Bottom right: Microdontinae. © MaLisa Spring all rights reserved.

RESULTS

- We collected 8,210 hover flies from 1,967 sampling events at 140 of 142 sites.
- With 44 genera, sampling approached the number of genera previously found in Ohio[1] (Fig. 4).
- 94% were soft-bodied insect predators (Fig. 5).
- 89% were in the genus *Toxomerus* (Syrphinae).
- Functional group presence was not related to the percent forest, developed land, nor agriculture in the surrounding landscape.
- Diversity and rarefied genera richness increased with forest cover ($R^2 = 0.089$, df = 141, $p < 0.05$, Fig. 6) and decreased with development ($R^2 = 0.127$, df = 141, $p < 0.05$)

Analysis of Sampling Effort

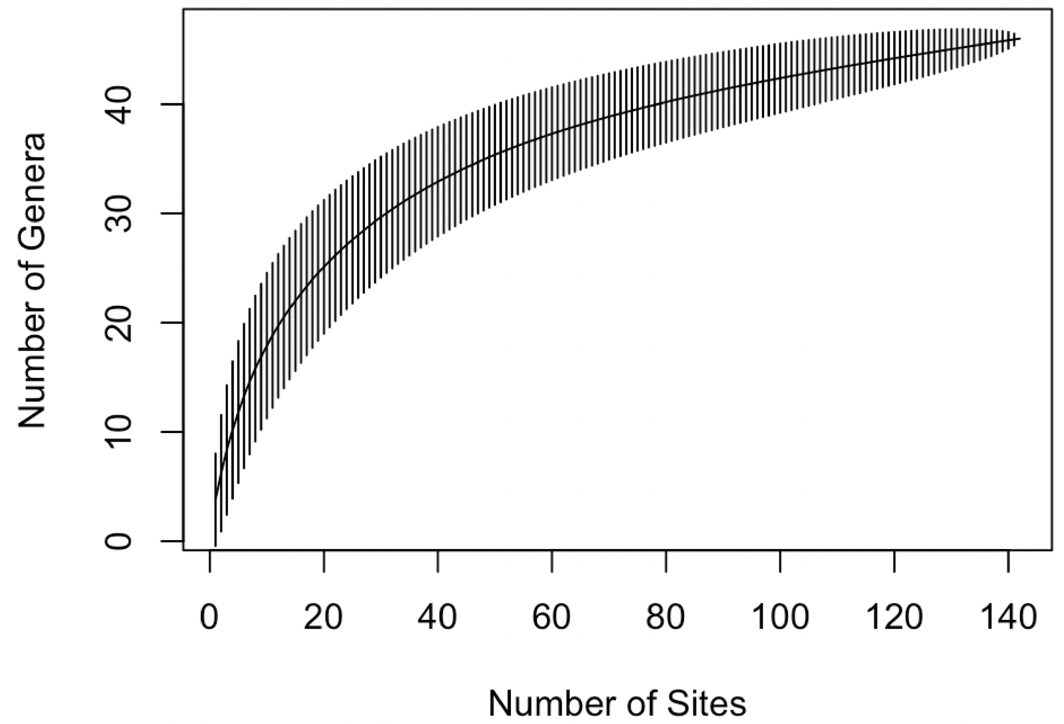

Figure 4. This genera accumulation curve shows the expected number of observed genera as a function of sampling effort. Vertical lines represent 95% confidence intervals.

Relative Abundance of Functional Groups

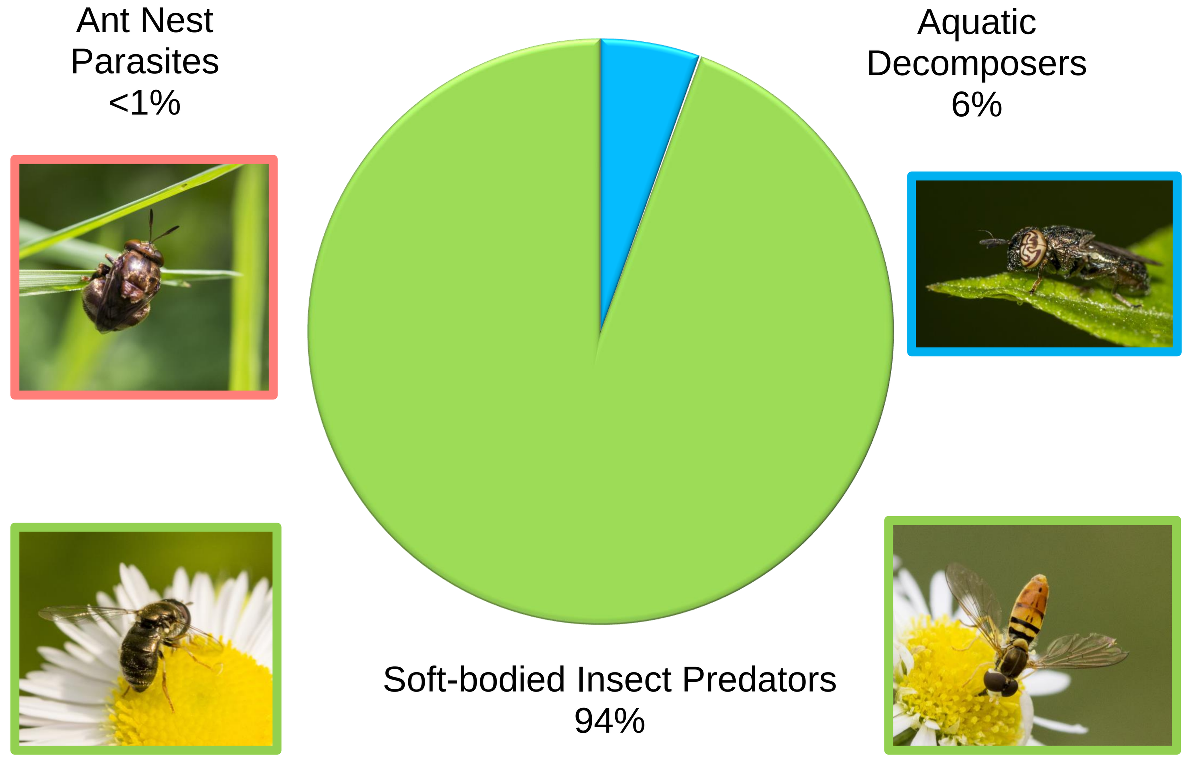

Figure 5. Abundances of each functional group. © MaLisa Spring all rights reserved.

Landcover Analysis

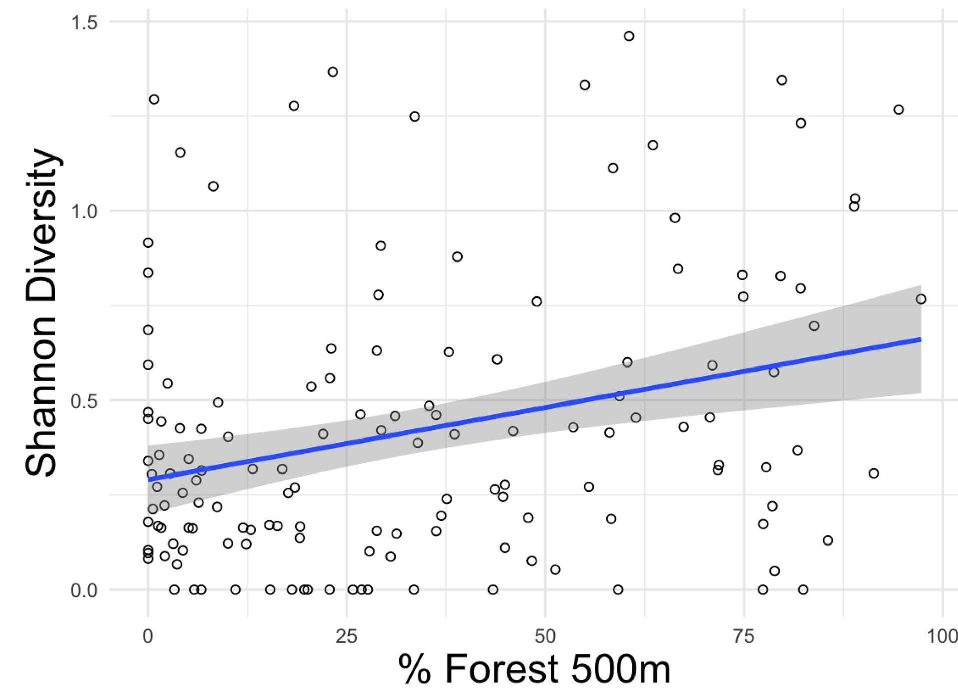

Figure 6. Shannon diversity plotted against percent forest cover within a 500m radius of each site. Significant, non-parametric correlation with a p-value <0.05. Line shows fit with 95% confidence region. Rank correlation shows the degree of association between % forest and Shannon diversity.

DISCUSSION

- Hover fly diversity is similar to that in 1913, but taxonomic revision makes comparison difficult.[1]
- Abundant, widespread taxa with predatory larvae suggest value in biological control services.
- Forested landscapes may have a diversity of habitats to support many different hover fly genera, while developed landscapes have fewer.
- Functional group presence was unrelated to forest, agriculture, or developed landcover, but may reflect poor representation of some groups.
- Different sampling methods could increase the representation of rare functional groups.
- Larger hover fly species may escape bowl traps, resulting in higher abundance of small hover fly species.

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