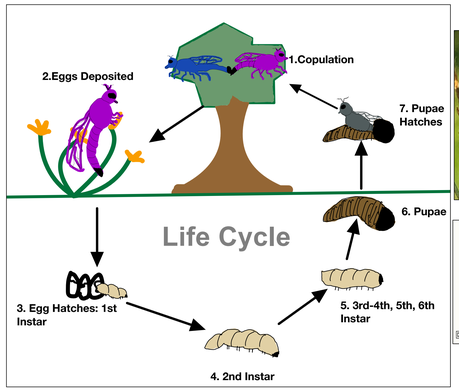
THE OHIO STATE UNIVERSITY College of Arts and Sciences, Department of Evolution, Ecology, and Organismal Biology

Diversity and Distribution of the Asilidae of Ohio

Vanessa Chilcoat (chilcoat.11@osu.edu), MaLisa Spring, and Dr. Karen Goodell

Introduction

- Insect declines associated with changing land use patterns risk loss of critical ecosystem services[1], such as pest control
- Asilidae are a family of predatory flies with 1,000 species in North America[2]
- Asilidae are important for pest management[3] (Fig 1)
- Asilidae are understudied in Ohio; the last published survey was 56 years ago[4]
- Studied biodiversity and habitat associations, providing data useful for conservation management



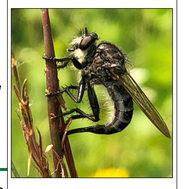


Figure 1. Left: Asilidae life cycle. Top right: Female *Efferia aestuans*, Bottom right *Holcocephala calva* consuming prey. Photo credit: MaLisa Spring

Objectives

I. Describe Asilidae diversity across Ohio

II. Determine the influence of landscape land use on diversity

Hypotheses

- Diversity will increase with area of natural habitat (grassland/shrubland/forest) because of higher prey abundance and diverse larval niches
- Diversity will decline with area of anthropogenically altered land (developed land and agriculture) because of pesticides, lower prey abundance, and soil disturbance

Literature Cited

1. Van der Sluijs, J. (2020). Current Opinion in Environmental Sustainability, 46, 39–42. https://doi.org/10.1016/j.cosust.2020.08.012
2. Finn, E. M. (2018, October). Common Name: Robber Flies. Featured Creatures. https://entnemdept.ufl.edu/creatures/beneficial/flies/robber_flies.htm
3. Mitton, J. (2020, March 26). Robber flies are fierce predators and resourceful lovers. Colorado Arts and Sciences Magazine.
4. Artigas, J. N. (1966). The Genus *Diogmites* (Robber Flies) in Eastern United States (Diptera: Asilidae).
5. Dewitz, J., and U.S. Geological Survey (2021) National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021): U.S. Geological Survey data release, doi:10.5066/P9KZCM54.
6. Barnes, J. K. (2008). Proceedings of the Entomological Society of Washington, 110(3), 701–732.
7. Fisher, E. (2001). Key to Species of *Machimus* (s.1.) of Eastern United States and Canada (east of Mississippi River).
8. Lindsay, K.G. and Marshall, S.A. (2019). Canadian Journal of Arthropod Identification 37: 91pp.
9. Martin, C. (1957). A Revision of the Leptogastrinae in the United States (Diptera: Asilidae).
10. McKnight, T. (2019). Bulletin of the American Museum of Natural History, 111, 343–386.
11. Wood, G. (n.d.). Key to the Asilid Genera of the Eastern U.S.
12. Wilcox, J. (2021). Bulletin of the Southern California Academy of Sciences, 210–214.
13. Baker, N. and Fischer, R. (1975). The Great Lakes Entomologist, vol 8 (2). https://scholar.valpo.edu/tgle/vol8/iss2/1
14. Warren, et al. (2021). The decline of butterflies in Europe: Problems, significance, and possible solutions. Proceedings of the National Academy of Sciences.

Asilidae Sampling Locations

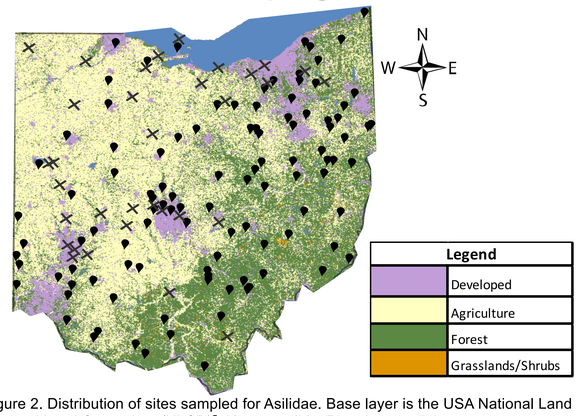


Figure 2. Distribution of sites sampled for Asilidae. Base layer is the USA National Land Use and Land Cover data (NLCD)[5]. X = no asilids, Pinpoints= asilids

Materials & Methods

- Volunteers set water bowl traps weekly at 149 sites in 2020 (Fig 2, 3)
- Pinned, labeled, and identified using available keys[6 -13]
- Calculated Shannon diversity and rarefied richness based on a sample size of 7 individuals in R-studio using rrarefy in the Vegan package
- Percent land cover in developed, agriculture, forest, and grassland/shrubland within 500 m of each site calculated using ArcGIS (Fig 2)
- Effect of land cover evaluated using generalized linear models with a log link function in JMPpro (v15)

Water Bowl Traps

Figure 3. Water bowl traps used in the Ohio Bee Survey, catching not only bees but also Asilidae (circled).

Acknowledgements

I thank volunteers who trapped insects, Cheyenne Helton for help with ArcGIS, and undergraduate students for pinning specimens. This work was funded by an OBCP grant through the ODNR to Dr. Karen Goodell and MaLisa Spring, and an Arts and Sciences Undergraduate Research Scholarship to Vanessa Chilcoat.

Results

- 1705 specimens collected from 143 sites (76% of sites) representing 11 genera and 25 species, 88% *Atomosia* (Table 1)
- The collector's curve, while decelerating, did not reach an asymptote, suggesting that we missed some diversity in our sampling (Fig 4)
- Shannon diversity was negatively related to % cropland; at sites with >50% cropland, diversity was minimal (Fig 5)
- Rarefied richness was positively related to forest; in sites with >40% forest >3 species were predicted in a sample of 7 individuals (Fig 6)

Record of Specimens

Table 1. displays the genus and abundance of specimens, increasing in size while moving down column. Shaded red is <15 mm, and shaded gray is >15 mm.

Genus	Abundance
Eudioctria	2
Atomosia	1504
Cerotainia	8
Heteropogon	2
Psilonyx	1
Laphria	110
Machimus	35
Diogmites	1
Efferia	31
Promachus	3

Completeness of Sampling

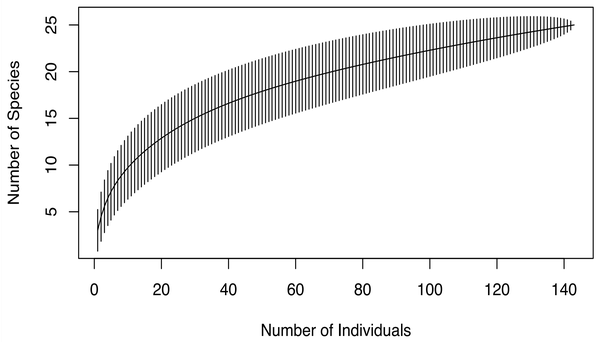


Figure 4. Species accumulation curve showing mean change in species richness as the number of individuals sampled increases. For complete samples, the curve asymptotes at the expected number of species. Error bars represent the standard deviation around the site mean predicted species richness.

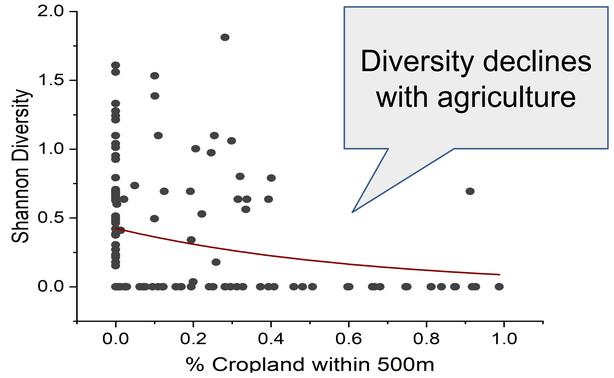


Figure 5. General linear model of Shannon index as a function of agriculture within 500 m of each site. The line represents the predicted diversity from the best fit model (Chi-square = 9.282, P = 0.0023).

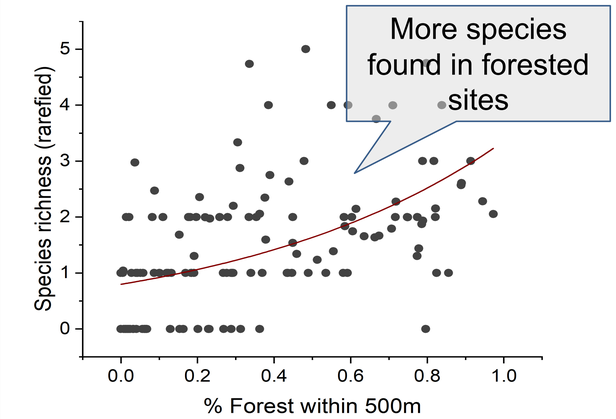


Figure 6. General linear model of rarefied richness as of function of percent forest within 500 m of each site. The line represents the predicted diversity from the best fit model (Chi-square = 49.648, P< 0.0001).

Discussion

- Unexpectedly, more species are found in forested landscapes, perhaps because of higher habitat heterogeneity
- We found fewer species than previous Ohio studies, likely due to biases of our sampling method for small and low-foraging species
- Shannon diversity was lower primarily in agricultural sites because the dominance of Atomosia puella lowered evenness, potentially reflecting its tolerance of agricultural disturbance
- Further research is needed to clarify species diversity declines in croplands, but pesticides, habitat degradation, and disturbance could all play a role[14]
- This study indicates key habitat for asilids and provides a baseline for future conservation efforts