



Long-legged fly (Diptera: Dolichopodidae) communities in Ohio agroecosystems and assessing their role as biological control agents in vegetable crops

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ABSTRACT

Biological control is a vital ecosystem service provided by a diverse guild of predators in agroecosystems. Biodiversity is thought to be linked to ecosystem functioning through more efficient resource capture and niche partitioning. Understanding the factors that impact the diversity of these predators is therefore important to our understanding of how to enhance biocontrol services. Long-legged flies (Diptera: Dolichopodidae) are a particularly ubiquitous yet understudied group of insect predators that are common in all habitats in Ohio, including agricultural systems. Previous studies have shown that these flies are sensitive to environmental changes, at least in natural systems like grasslands and reed marshes. The goal of this study is to determine how field management and disturbance influences the community assemblage of Dolichopodidae found in agroecosystems. During the summer of 2013 and 2014, pan trapping was used to sample the dolichopodid community present in produce farms across northeast Ohio. Sweet corn, summer squash, and unmanaged old fields were sampled. Over 3,000 flies representing twelve dolichopodid genera were found. Analysis shows that overall dolichopodid abundance was actually higher in crop habitats than unmanaged habitats, and that the community within each habitat was different. Currently, a molecular gut content analysis is also being done to reveal the dietary composition of these flies. Identifying which factors are driving the diversity of this family of flies, as well as figuring out what they are eating, will help us understand how to maximize the biological control services being provided.

INTRODUCTION

- Sufficient biological control services are key to sustainable production in food systems
- It is hypothesized that greater predator biodiversity results in increased levels of biological control¹
- However, not all groups within a predator guild are well understood as far as their role in biological control
- If we want to maximize the biological control services being provided, we need to focus more on such groups
- The long-legged flies, or Dolichopodidae, are a great example of a predatory group that is highly abundant^{2,3}, yet largely ignored as a beneficial predator in agroecosystems
- We hypothesized that dolichopodids are abundant in Ohio vegetable crops and predators of important pests

Therefore, the objectives of this research are to:

1. Characterize dolichopodid abundance and diversity in vegetable crops grown in NE Ohio and compare to a reference habitat (unmanaged old fields)
2. Determine the dietary niche breadth of dolichopodids in vegetable crops and unmanaged systems, in order to assess their biological control potential

METHODS

- Flies sampled on produce farms across NE Ohio during the 2013 and 2014 growing season
- 14 farms sampled in 2013, 12 farms sampled in 2014
- 3 habitats sampled within each farm: sweet corn, summer squash, and an unmanaged old field
- Plastic yellow pan traps filled with soapy water used to collect flies
- 4 pan traps in each habitat, deployed for a 24-hour period once a month
- Flies dried and pinned for identification to genus level⁴
- GLMM used to compare abundance of the flies in different habitats at each sampling period
- NMDS and ANOSIM analyses used to compare dolichopodid community structure between sites and habitats



Fig. 1. Area of Ohio where sampling took place (above). Pan traps used for sampling long-legged flies (below).

RESULTS

- 3,012 total flies collected: 1,901 in 2013 and 1,111 in 2014
- 12 dolichopodid genera represented, the five most common shown in Fig. 2



Fig. 2. Microscope images of the five most abundant dolichopodid genera collected during the study. From left to right: *Chrysotus*, *Condyllostylus*, *Achradocera*, *Dolichopus*, and *Pelastoneurus*.

- In both years, the dolichopodid community was dominated by *Chrysotus* and *Condyllostylus*, as shown in Fig. 3

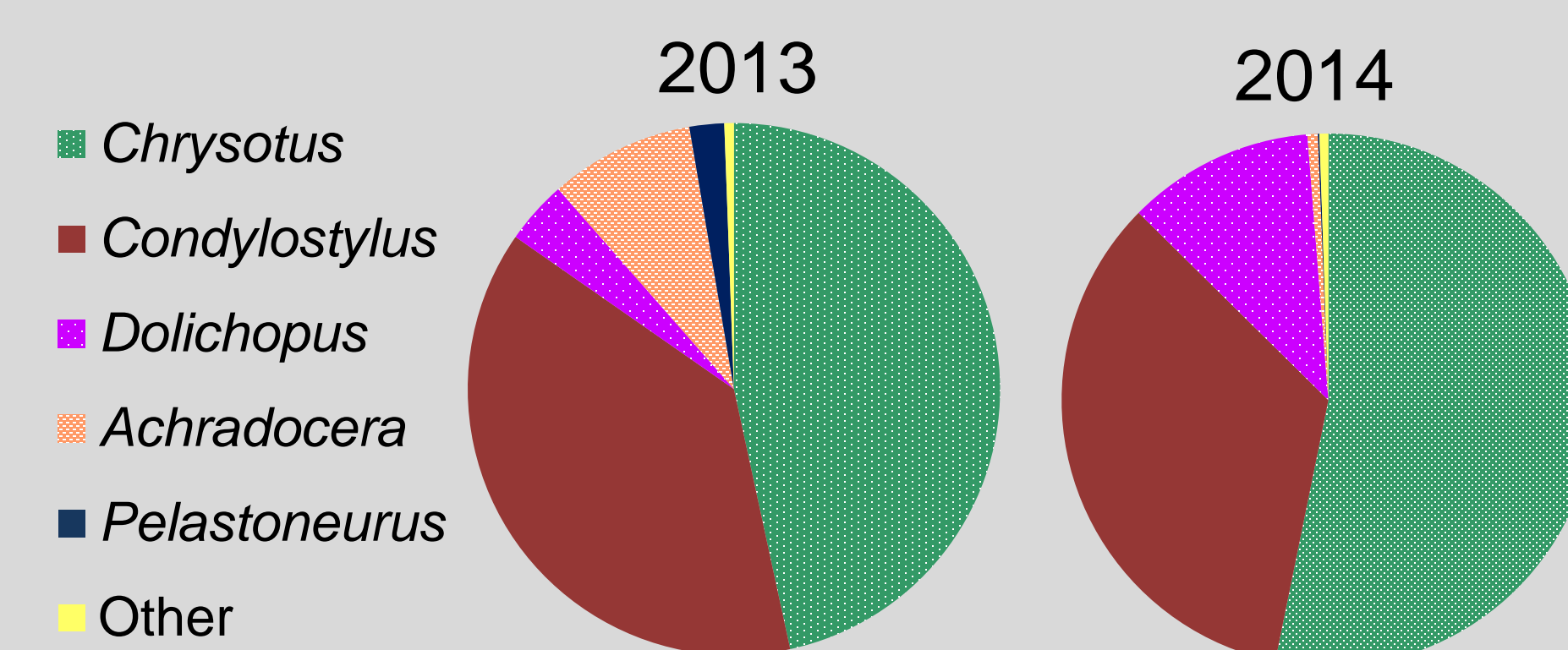


Fig. 3. Pie charts showing the proportion of the various dolichopodid genera caught each year. The seven rare genera are included in "other".

RESULTS (cont.)

- In all but one instance, the old field habitats actually had the lowest abundance of dolichopodids (Fig. 4)

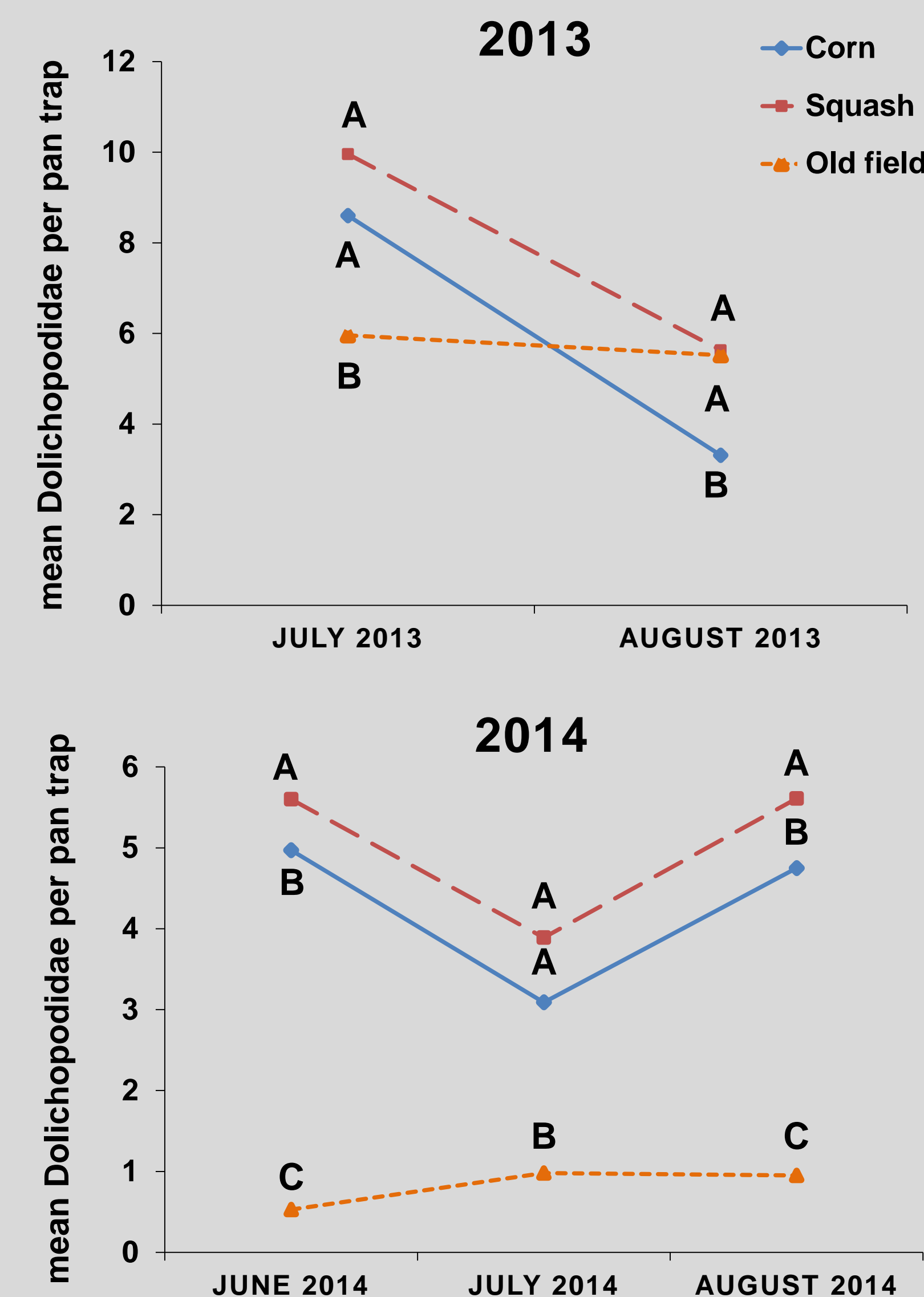


Fig. 4. Graphs showing the average number of flies per pan trap from the three different habitats at each sampling period. Letters indicate significant differences ($p < 0.05$) within each month between the three habitats.

- In both years, there was a significant difference in community structure between the three habitat types; results from 2014 are shown in Fig. 5

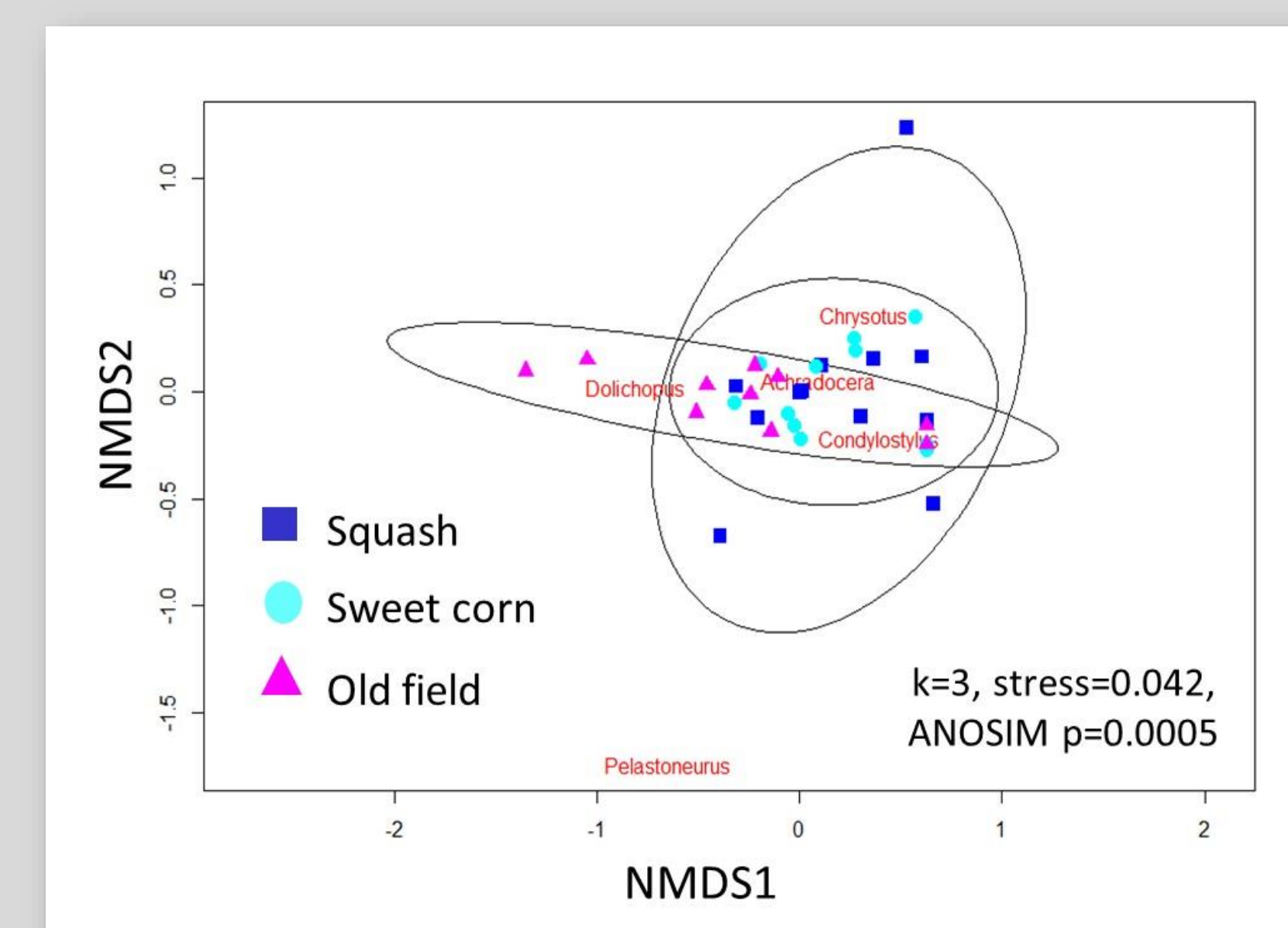


Fig. 5. NMDS plot showing the similarities between the dolichopodid communities at all of the study sites in 2014, based on the five most abundant genera and categorized by habitat.

CONCLUSIONS

Not only are dolichopodids present in these heavily disturbed systems, they seem to be thriving. It is therefore increasingly important that we understand the ecological impact they are having on agroecosystems, especially with respect to trophic interactions. We also found the community structure in these three habitats differed, which suggests variations among the genera in habitat preference and perhaps prey preference. These differences are particularly important as we look further into the biological control potential of these flies.

CURRENT WORK

- During the summer of 2014, 480 flies were caught live from six managed and six unmanaged habitats for a molecular gut content analysis (Fig. 6)
- Universal arthropod primers and next-generation sequencing⁵ are being used to identify the gut contents of these flies
- The results will reveal the dietary niche breadth of these flies and their role in biological control

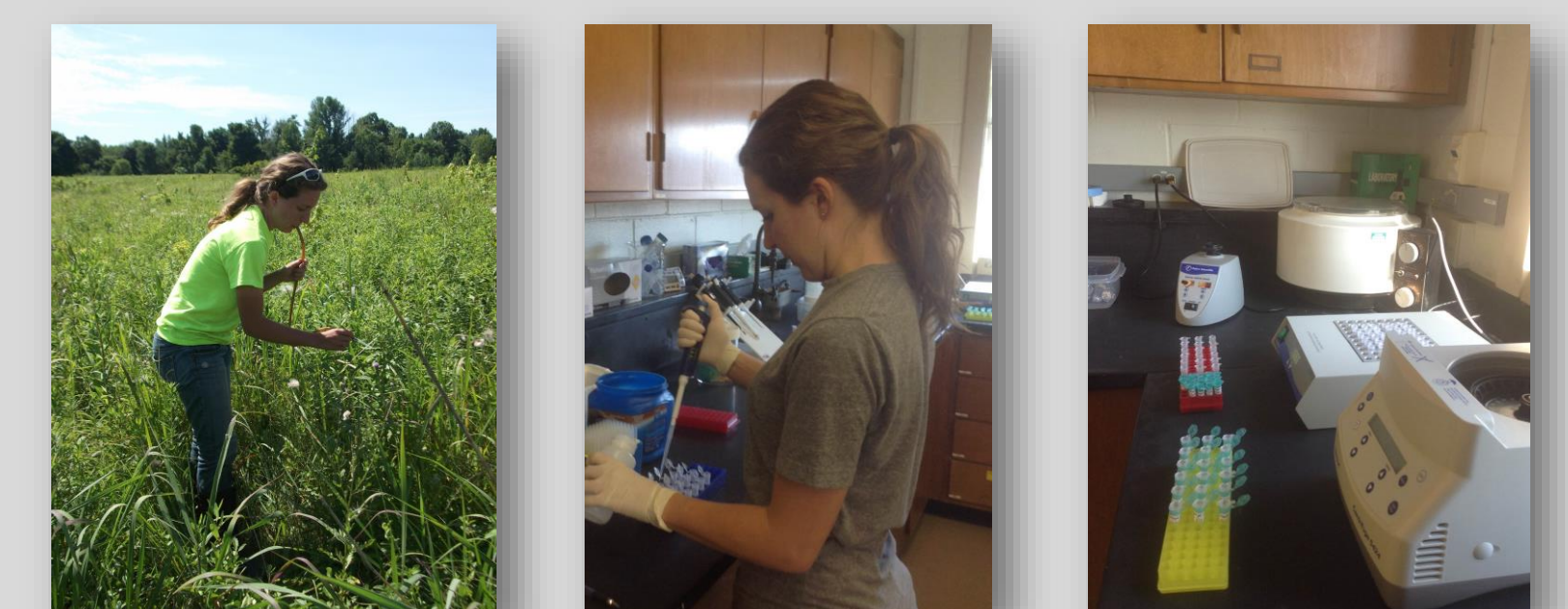


Fig. 6. Aspirating long-legged flies off of the foliage to be used in a molecular gut content analysis (left). DNA extractions of the fly specimens in the lab (middle, right).

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