Monarch abundance over an urban gradient

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Background

Butterflies serve as an important group of pollinators and are indicators of a healthy ecosystem (Clark et al. 2007). The monarch butterfly (*Danaus plexippus)* is unique among all others; they are the only butterfly known to make an annual migration. Unfortunately, monarch populations have declined by approximately 80-90% within the last 2 decades. Much of their decline has been linked to the loss of milkweed, an estimated 58% of milkweed has been lost over the last 15 years. (Pleasants and Oberhauser, 2013). Monarchs will only lay their eggs on milkweed because once hatched, the larvae feed exclusively on their host plant (Lemoine, 2015). We looked at the presence of monarch eggs and larvae on *Asclepias syriaca* (common milkweed) at sites that spanned an urban gradient.

Hypothesis

1. There will be less evidence of monarchs in highly urbanized areas due to a higher amount of habitat fragmentation and disturbance.
2. Monarch abundance will be greater in areas with higher milkweed densities.

Methods

- We modified methods from protocols used by the Monarch Larvae Monitoring Project (mlmp.org) for milkweed density and monarch monitoring.
- We identified 9 total sites to monitor (fig. 1).
- At each site we tagged 100 *Asclepias syriaca* stems.
- Tagged plants were monitored for eggs and larvae over the course of 5 weeks.
- Monitoring was completed at each site on 3 separate occasions.

Top left: monitoring for eggs and larvae at Midewin National Tallgrass Prairie in Wilmington, IL. This site was located in the southern rural transect.
Top right: a monarch egg located on the adaxial surface of an *A. syriaca* leaf.
Bottom left: monitoring for eggs and larvae at Big Rock Forest Preserve in Big Rock, IL. This site was located in the western rural transect.

Bottom right: monitoring at our site located in the southern urban transect.

Acknowledgements

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Study organisms

Danaus plexippus

Asclepias syriaca

Site locations

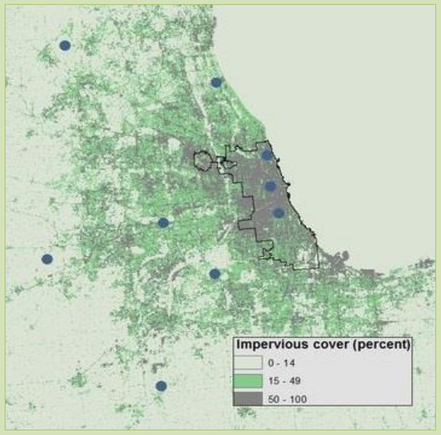


Fig. 1 Locations of the 9 populations of *A. syriaca* spanning 3 gradient categories along north, west, and south transects throughout the Chicago area.

Results

- ANOVA results show no statistical difference (p = 0.201) in mean number of eggs and larvae found at sites spanning gradients (fig. 2).
- A moderate negative correlation (r = -0.61) was found between milkweed density and monarch abundance (fig. 3).
- Proportion of larvae found was 0.1 at rural sites, 0.1135 at suburban sites, and 0.1167 at urban sites. Overall, the percentage of larvae found was 11.09% (fig. 4).

Boone Creek, rural site (left) and Skokie, suburban site (right).

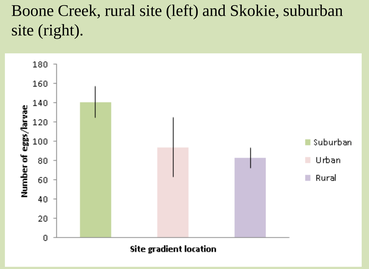


Fig. 2 Mean number of eggs and larvae found at sites spanning suburban, urban, and rural gradients.

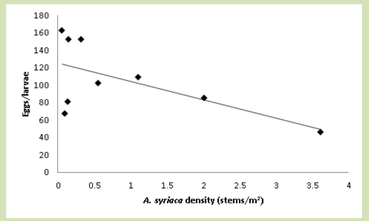


Fig. 3 Number of eggs and larvae at each site correlated to the milkweed density at each site respectively.

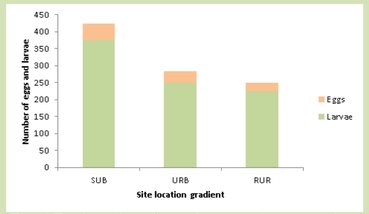
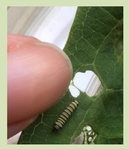
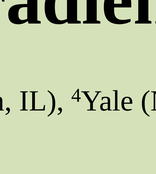


Fig. 4 Total number of eggs in comparison to total number of larvae found along gradient.



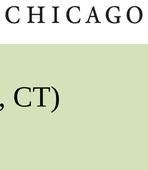
Discussion

- No significant difference was found across the gradient, hypothesis 1 stated urban areas would have significantly less monarchs. These results could be attributed to many factors, such as during the beginning of our data collection the weather was unusually cool and wet. We experienced flooding at one of our sites. That same site also contained maroon colored milkweed on one of our visits, this coincided with us finding only 2 eggs out of all 100 monitored plants. One site was located across the road from an agricultural field, therefore herbicide and pesticide drift could have deterred monarchs from the area.
- A negative correlation between abundance of monarchs and milkweed density was surprising, hypothesis 2 stated there would be a positive correlation. This could be a result of more predators and herbivore competitors being found in places of high vegetative density simply because it is easier to move from plant to plant. Since the higher density sites tended to be within the urban gradient, the negative correlation could be due to a higher amount of disturbance. High disturbance has been correlated with a reduction in native biodiversity, including butterflies (Clark et al. 2007).
- The percentage of larvae verses eggs we found was 11.09%. Monarch larvae have a fairly low survivability with approximately 12% reaching the 5th instar growth stage (Borkin 1982), this seems consistent with what we observed.



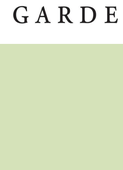
Maroon milkweed at Midewin

Urban site partially mowed



Flooding at Midewin

Tussock moth can defoliate milkweed



Crab spider, a stealthy predator

Conclusion

To get a better grasp on whether or not monarch abundance varies along an urban gradient, and to what extent, the study should be a larger magnitude in both time and number of sites. Our data was shared with the Monarch Larvae Monitoring Project (mlmp.org) to help their large scale effort in monitoring for monarchs.
Also, a large scale study of this type could provide useful information on how climate change will affect monarch and milkweed range by using the heat island effect as a proxy.

Future Work

- I plan to test leaf tissue samples from our sites for the levels of cardenolides (the toxin present in milkweed) to find out if monarchs have a preference in oviposition based on toxin levels.
- I also plan to test the nutrient levels in leaf tissues and soils from the site with the maroon colored milkweed. I suspect a nutrient deficiency could be the reason for the change in color.

References

1. Borkin SS. 1982. Notes on shifting distribution patterns and survival of immature *Danaus plexippus* (Lepidoptera: Danaidae) on the food plant *Asclepias syriaca.* Great Lakes Entomologist 15:199. **2.** Clark PJ, Reed JM, Chew FS. 2007. Effects of urbanization on butterfly species richness, guild structure, and rarity. Urban Ecosystems 10:321. **3.** Lemoine NP. 2015. Climate Change May Alter Breeding Ground Distributions of Eastern Migratory Monarchs (*Danaus plexippus*) via Range Expansion of *Asclepias* Host Plants. PLOS One 10. **4.** Pleasants JM and Oberhauser KS. 2013. Milkweed loss in agricultural fields because of herbicide use: Effect on the monarch butterfly population. Insect Conservation and Diversity 6:135. **5.** Monarch Larva Monitoring Project [Internet]; c2015 [cited 2015 08/05]. Available from: http://www.mlmp.org/ .