# **Backyard Pollinators Research Project**

**Background Worksheet**

We will observe insect pollinators in backyards, on campus, or anywhere you can find flowers, and describe plant-pollinator networks. Our class data will again contribute to a growing national database that will provide the largest non-agricultural pollination study available to date.

Ground beetles, in particular, are some of the most critical and understudied plant pollinators. Students will learn how and why NEON samples ground beetles, develop an appreciation of the ecosystem services provided by these often overlooked arthropods, and evaluate how the assemblages of pollinators from their sites relate to the broader North American landscape.

**Introduction**

All insects, including pollinators, are declining globally (Kluser et al. 2007), and urbanization and habitat fragmentation have contributed to their decline (Cunninghma 2000). More than 75% of wildflowers in tropical and temperate regions depend on pollinating animals (Ollertin et al. 2011), so pollinators are critical to the maintenance of pollination, a regulating ecosystem service. How can we understand where and how declines in pollinator populations are occurring?

Studying biodiversity – including whether insects or other taxa are declining – requires long term ecological monitoring at broad spatial scales. The National Ecological Observatory Network (NEON) is methodically collecting lots of environmental data from its 81 field sites and makes its datasets available to researchers and the public. The goal of the NEON data collection is to characterize and quantify how ecosystems across the United States are changing, using the long term, large scale approach. This is increasingly common in environmental science fields such as ecoinformatics and biostatistics.

One of the insects groups that NEON studies is ground beetles (Carabidae). NEON designed ground beetle sampling protocols explicitly because of their unique importance to ecosystems; they have broad ranges, are present in diverse habitats, and ~ 3000 species are known to occur in NEON field sites. They are critical pollinators, widely estimated to visit the majority of flowering plants, but not agricultural crops so they are not targeted for research. Ground beetles can be considered sentinel species for urbanization research (Niemela and Kotze 2009) and have been widely used as model organisms in landscape ecology (Kotze et al. 2011). This makes ground beetle pollination observations well suited to evaluate this ecosystem across land use gradients.

**Questions**

1. **What does it mean to be considered a “sentinel species” or a “model organism”?**
2. **In the context of the above statement that used those terms, what are some research questions that observations of ground beetles could help to answer?**

**Methods**

This project uses standardized timed focal floral observations of plant and insect pollinator functional groups to measure pollination and build plant-pollinator interaction networks. We will use direct observations of pollinating insect visitation rates to construct and analyze the plant pollinator network (Forup et al. 2008). Pollinating insects will be identified using functional morphospecies groupings accepted in the field (as done in Winfree et al. 2007 and Geslin et al. 2013). Direct observation is an appropriate, effective method for sampling pollinators such as native bees at taxonomic levels above species (Prendergast et al. 2020). We will also score flower abundance in the plots (Popic et al. 2013), as research has shown a positive correlation between pollinator abundance and bloom counts (Angelella et al. 2019). We will also record plant cover data, adapting NEON protocols as part of their plant presence and percent cover protocols. The plant and insect observations will be used to assess whether pollination events and interaction networks are different across landscapes.

**Research Questions**

Previous research has indicated urbanization is associated with reduced ecosystem function (Eigenbrod et al. 2011, Thompson et al 2017) and plant-pollinator interactions than more rural or natural areas (Geslin et al. 2013). Yet no study to date has used large-scale observational gradients and naturally occurring (non-agricultural) plant species to assess this question.

We hypothesize (1) Plant-pollinator interaction network structure will be simpler in more urban landscapes. (2) Fewer pollination events will be observed in more urban landscapes. (3) Fewer ground beetles will be observed in pitfall samples in more urban landscapes.

**Question**

1. **What is another research question that could be addressed using this data? What is your hypothesis?**