Purdue Natural Landscapes

Marissa Harless, Amanda Finley, Katelynn Angel,
Hannah Gruber, and Ethan Forestal

Introduction

Purdue University has been a member of Bee Campus USA since 2023. However, the location and quantity of pollinator plants on campus has not been documented. Recognizing this need, Purdue's Physical Facilities has identified the need for a comprehensive database detailing the pollinator plants that inhibit Purdue University's campus. Our project partner is Brooke Sammons, a landscape architect for Purdue Physical Facilities. Physical Facilities has expressed a need for a database of pollinator plants on Purdue's campus. The purpose of our project is to capture pollinator plants in a GIS map so plants can be located by flower color, season of bloom, and the pollinators they attract. This information will show how Purdue supports Bee Campus USA and be a resource for the public. Purdue Physical Facilities will be able to continue documenting plant data with this map to help conserve Purdue's status as a Bee Campus.

Background

A pollinator species is one that facilitates plant fertilization by carrying pollen from one plant to another, such as bees and moths. Many flowering plants rely completely on pollinator species for reproduction. An estimated seventy-five percent of plant species rely on another organism for pollination, and eighty percent of flowering plants rely on pollinators. When populations of pollinators decline, the health of their ecosystem similarly suffers. Native pollinators are of particular importance, as they are closely tied with native plants and are generally the most effective at facilitating the fertilization of those plants. An introduced species, even a pollinator species, has the potential to cause unforeseen ecological consequences. Because of the importance of native pollinator species, their preservation is essential to maintaining biodiversity, ensuring food security, and sustaining the aesthetic values of an environment.

Many pollinator populations have declined globally due to a variety of threats. Habitat fragmentation can reduce access between pollinators and plants; the plants they pollinate are oftentimes a food source for the pollinators, so this loss of access can harm pollinator populations. Impervious surfaces in urban areas, such as concrete, reduce nesting sites for pollinators and can similarly weaken a pollinator population. Pollinator populations have been significantly impacted by pesticide and insecticide use as well. Additionally, climate change has drastically impacted pollinators. For example, it is estimated that, for every Celcius degree that the Earth's climate warms, bee abundance declines by forty-one percent (Braman & Griffin, 2022). These threats to pollinators often work in conjunction, leading to massive global losses in pollinator numbers.

- **Biodiversity Value**

Pollinators play a large role in maintaining the biodiversity of ecosystems. Most flowering plants rely on them to some degree. Many fruit species of importance to humans, such as avocados and blueberries, are dependent on pollinators for fertilization. Additionally, pollinator populations indirectly support a wide range of other species. They support wildlife, such as birds, by facilitating fertilization which ensures that seeds and fruit are available as food (Mach & Potter, 2018). Pollinator species are also a source of food for a wide range of wildlife, further supporting the biodiversity of an ecosystem (Hopwood, 2023).

- **Coevolution and Food Security**

In many cases, pollinators and the plants they pollinate share close evolutionary ties. Some pollinators evolved specifically to pollinate certain plant species, or even a single species. For example, the yucca moth and yucca plant have coevolved, and now share a mutualistic ecological relationship (Pellmyr, 2003). Native pollinators have a particularly strong impact on plants native to their environment; the pollinators and pollinator-dependent plants share an evolutionary partnership by virtue of coming from the same environment. This is unlike nonnative pollinators, which run the risk of harming an ecosystem they are introduced to.

Because many plant species rely on pollinators for fertilization, the loss of these pollinators can be disastrous for the dependent plants. When pollinator populations dwindle, the plants that rely on them often decline as well. Evolution is a slow, gradual process; when pollinator populations decline relatively quickly, their niche may not be filled by another species. If the niche left behind is not filled, and dependent plants are unpollinated, there is a very real possibility that a cascade of population declines will occur. Many pollinator-dependent plants produce fruit that is valued by humans, so this cascade of declines could negatively affect human food security. Many fruits, nuts, and vegetables rely on pollinator activity to reproduce and thrive, and the decline of those pollinators can be disastrous for the survival of these food sources. Currently, bee population losses have stunted the yields of certain nuts, fruits, and vegetables.

- **Aesthetic Value**

The healthy, biodiverse ecosystems that pollinators support have aesthetic value to humans as well. Balanced, diverse green spaces have positive health and mood-boosting effects (Deng et al., 2020). Urban spaces for pollinators, such as bee gardens, also have positive aesthetic and reproductive effects on nearby crops (Langeletto et al., 2018). By assisting the reproduction of certain plants, many of which bear edible fruit, they support diverse plant life. This diverse plant life has positive effects on human observers, such as increased relaxation and decreased stress. The effect is particularly pronounced in urban settings, where abundant plant life is less common and more distinct from its surroundings. The edible fruits produced indirectly by pollinator activity is also a boon for humans. Once again, native pollinators are preferable. They are far less likely to disrupt the balance and cycles of native plants.

- **Conservation Strategies**

With massive declines in pollinator populations already underway, many conservation strategies have been developed. Many of these strategies involve creating new habitat for pollinators, especially bees. Bee gardens are a viable strategy, although they are generally small. Creating a bee-friendly habitat, even in a backyard, at least provides pollinators with a habitat that is not likely to be destroyed or seriously disrupted. Community bee gardens are also effective, and can sometimes be larger than those created in a backyard or similar setting. Educating the public on the benefits of pollinators is hugely beneficial, as it may make people less likely to harm bees and other pollinators often treated with hostility (Hall et al., 2020). Herbicides and pesticides contribute to the decline of insect pollinator populations, so limiting their use is also encouraged. This is especially true in the case of a garden, which will most likely attract bees.

Strategies to address climate change are also helpful for pollinators, as rising temperatures are harmful to pollinator populations. Unfortunately, since mitigating climate change is a global, gargantuan task, strategies for tackling this threat to pollinators will take tremendous time and resources. On a smaller scale, tactics such as bee gardens and reducing pesticide or herbicide use are efficient and low-effort.

Goals & Objectives

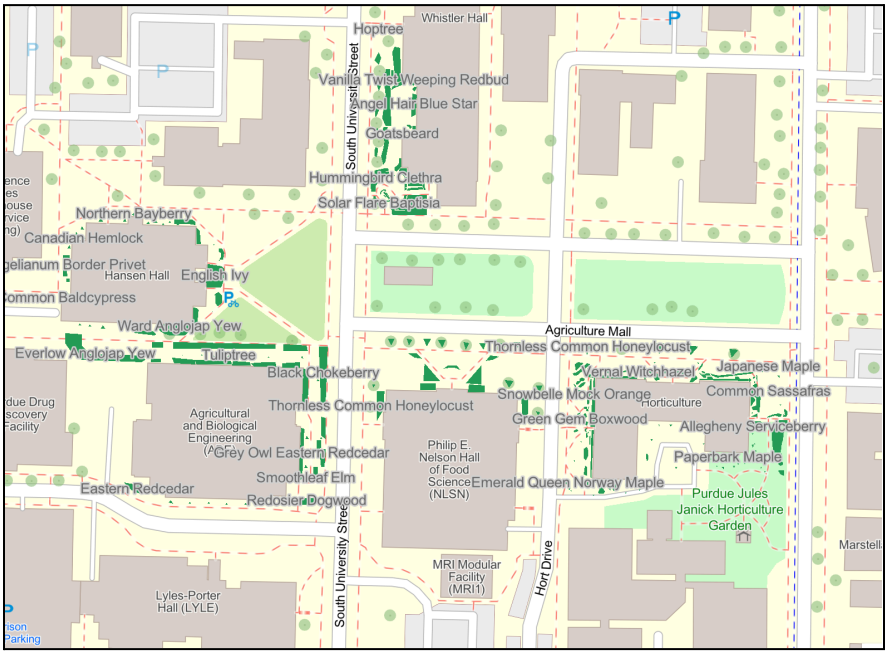
Originally, our goals were more focused around maintenance needs rather than on pollinator specifics, but as we met with our project partner and learned more about the wants of the project, we were able to shift focus. Ultimately, we had three major goals that guided our project: analyze campus plans and illustrations from Purdue Physical Facilities; create a GIS map of pollinator-attracting plants around five buildings on Agricultural Mall; create a resource to support the maintenance and upkeep of pollinator attracting plants to conserve Bee Campus status. Moreover, the GIS map will facilitate Purdue Physical Facilities in ongoing documentation efforts, ensuring the continuous monitoring and conservation of Purdue's status as a Bee Campus. By regularly updating and expanding the database with new plant data, Purdue can actively contribute to the preservation of pollinator habitats and biodiversity within its campus environment. To achieve these goals, we had to research the plants we found on the Physical Facilities planting plans and detail their scientific name, common name, plant type, bloom period, and bloom color.

Deliverables

1. **Purdue Bee Campus ArcGIS Online Map**:

The Purdue Bee Campus map is available on Purdue's ArcGIS Online platform. The map shows the location of pollinator plants on Purdue's campus and contains information specific to each plant and its attractiveness to pollinators.

Our project highlights Purdue University's commitment to supporting Bee Campus USA initiatives and how the institution consistently meets the yearly requirements set forth by the program. These requirements encompass a spectrum of initiatives aimed at enhancing pollinator habitats, minimizing pesticide usage, integrating pollinator-conscious practices into campus operations, and hosting educational events to raise awareness about the crucial role of pollinators. Through documentation and implementation of sustainable practices, Purdue's commitment to upholding this initiative can be better shown. Through using Geographic Information Systems (GIS) technology, we have effectively mapped and managed habitats to support pollinator populations, aligning seamlessly with Bee Campus USA's goals. Purdue University's dedication to promoting biodiversity and preserving ecosystems not only reinforces its status as a leader in academia but also underscores its pivotal role in fostering a sustainable future for generations to come.



2. **Purdue Bee Campus Map Tutorial**: This map tutorial details how to map new plants on the Purdue Bee Campus map. It is available in our shared folder of materials.

3. **ArcGIS Field Maps set up**: The Purdue Bee Campus map is also accessible on the ArcGIS Field Maps mobile application. We created a second layer, called Purdue Natural Landscapes, for collecting information about pollinator landscapes on-site. With the ArcGIS Field Maps app, points can be created to capture information about the health of landscapes. Points can include photos of the area and notes about what is observed. Purdue Physical Facilities can use Field Maps to monitor the health of landscapes and determine what plants to add. The points created in Field Maps automatically sync with the Purdue Bee Campus map and can be viewed and edited on ArcGIS Online.

4. **Plant List Google Sheets**: Our plant list details the information we researched about the plants included on the Purdue Bee Campus map, including scientific name, attracted pollinators, bloom time, and bloom color. This resource can be used as a reference when mapping the same plants in other areas of campus, and may be added to by anyone.

Technical Details

Software used:

- ArcGIS Online
- ArcGIS Field Maps app

Other resources:

- 🗀 Planting plans

Conclusions

Having concluded work on our project this semester, there are a few things we would suggest moving forward. Reflecting on our project, we acknowledge that there may be different ways to improve/expand on our projects deliverables and objectives. To ensure our projects continued relevance and accessibility, integrated our project into the Bee Campus Purdue webpage would be beneficial. We also recognize the potential to enhance our project by using the existing campus resources, such as incorporating it into the Arboretum map or integrating audio files to enrich the user experience. Finally, we see an opportunity to contribute to campus infrastructure through initiatives like rain garden improvements which align with our broader natural landscape goals of environmental sustainability and ecosystem preservation.

Pollinators, especially native pollinators, are essential for a healthy planet. They contribute to human food security by propagating food-bearing plants important to humanity. Their activities are foundational to balanced, biodiverse landscapes. Without them, an ecological cascade of decline will most likely ensue. It is critical that pollinator population decline be addressed, or the ecosystems of the entire world will suffer.

Appendices

Plant list

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