

Final Report and Project Deliverables

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Introduction

A section of the Peterson prairie at the Agronomy Center of Research and Education (ACRE) was recently removed due to the construction of new grain bins. To help mitigate the loss of the section of the previous prairie, another prairie will be created in the front, Southeast section of ACRE near Highway 52. We partnered with the ACRE farm manager Rachel Stevens to help implement this new move. The new prairie will have designated trails, within, to allow people to traverse and explore the natural area. Furthermore, educational signage, benches, and picnic tables will be placed along the trails for enjoyment and rest. The specific deliverables that were created for this project are: a prairie species list, a GIS trail map for visitors, a GIS map for ACRE to use for designing the new prairie, five trail signs (24" x 18"), and a welcome sign (48" x 32"). Extensive background research was done for this project and the gathered information was incorporated into the Literature Review below. Through the employment of the knowledge gained on prairie ecosystems and the utilization of design and GIS software, the desired deliverables were successfully constructed.

Literature Review

Introduction

To effectively construct a prairie at the Agronomy Center of Research and Education Center (ACRE), the management, restoration, and further components of prairies needed to be researched and understood. Prairie ecosystems are beneficial in numerous ways: they positively affect pollinators, wildlife, humans, and soil health. Historically, across the United States, these native prairies have seen a drastic decrease in extent, but more recently, restoration efforts have been put in place to rebound their extent. Individuals have utilized various restoration practices, but many follow a general process while restoring a site. The restoration of a prairie is site-specific, so each step must be thoroughly examined. For prairies to thrive, prairie management is vital, and it starts even before the prairie is established. With continuous proper management, prairie plants will be able to establish themselves, native plants will flourish, and the environment will reap the benefits of the prairie ecosystem. Prairies are a beneficial ecosystem that are being restored across the United States, and through correct restoration practices and management practices, native prairies will prosper.

Benefits of a Prairie

With the creation of the new prairie, pollinators and wildlife will have a better quality of life due to increased habitat and food sources. According to Olynyk et al. (2021), the composition, diversity, and abundance of a bee community tend to be positively correlated with the accessibility of floral resources for gathering necessary sustenance. With more flowering plants being available for bees and other pollinators – due to the creation of the new prairie – the pollinators will be positively impacted in various ways. Local wildlife also benefits from the creation of a prairie, according to the National Parks Service (2020), since prairies have an abundance of native plants, they provide a unique range of habitat for wildlife species to utilize. Furthermore, the prairie would provide wildlife with food resources, shelter, and nesting and additional reproductive sites (“The Benefits of Prairie,” 2023). Visitors to ACRE will also reap benefits from the addition of this prairie, according to Jackson et al. (2021), by participating in outdoor activities, adolescents can increase their subjective well-being and build up a resilience to various stressors. Finally, through the creation of the prairie, the overall soil health will increase. With the deep-rooting prairie plants being utilized for the creation of the prairie, there will be an increase in soil stability, infiltration rates, and organic matter. Furthermore, the soil health would be positively affected due to a decrease in nutrient runoff and erosion brought about by the prairie (“The Benefits of Prairie,” 2023). With the creation of a new prairie, to mitigate the loss of an already established prairie, humans, pollinators, and wildlife will be able to have an increased experience at ACRE.

Historical Extent of the Prairies and Their Loss

Native prairies account for the largest vegetative provenance in North America, yet since the settlement of the land by the Europeans the extent of native prairies has drastically decreased (Samson et al., 1994). Now, native prairies face a threat as stress by overgrazing, agriculture, and recreation have led to a need for restoration efforts. Before European settlement, the Great Plains consisted of 162 million hectares of tallgrass prairies, mixed grass prairies, and shortgrass prairies (Samson et al., 1994). When European settlers arrived, a wide loss of prairie land occurred due to agriculture and many plots being plowed over. Not only did a large-scale cultivation occur to start growing crops, but the introduction of cattle greatly degraded prairies as they overgrazed in more concentrated tendencies compared to bison. Prairie dogs and bison were also slowly exterminated by settlers which further disrupted the prairie as they played a crucial role in aerating soil and sustainably grazing (Friesen, 2019). The introduction of homesteading within Indiana and Illinois in the early 1830s began the loss of the grasslands. Since then, the native prairie has declined by over 90% in the Great Plains (Samson et al., 1994).

The Paleo Indians were the first to inhabit Tippecanoe County from 13,000 to 6,000 B.C (Robinson, n.d.). They lived in a time with ice age animals where they hunted mammoths, the giant ground sloth, and other large animals. They also relied on gathering wild plants to survive, which at the time was prospering as the land was fertile and consisted of native prairies. During the woodland period of 500 B.C. to 1000 A.D., intense cultivation and the modification of crops began (Robinson, n.d.). When the Mississippian culture started in 1000 A.D. to late 1500 A.D., large towns started to sprout with the creation of plazas and large platform mounds. In this period, large-scale agriculture began with extensive farming of corn, beans, and squash (Robinson, n.d.).

Prairie reconstruction in Indiana has occurred for many years dating back to the year 1987. Efforts of tallgrass prairie reconstruction occurred from 1990 to 2000 by institutions such as Taylor University and The Nature Conservancy. Indiana's first reconstructed prairie was in an eastern deciduous forest at Butler University. Reconstruction occurred to seek out a replacement for turf grass near newly built athletic fields (Rothrock et al., 2016). After the Conservation Reserve Program was implemented in 1985, farmers in Indiana turned to prairies to increase the soil health of their highly erodible lands (Rothrock et al., 2016). The goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce the loss of wildlife habitat (*Conservation Reserve Program*, n.d.). By 1994, the Indiana Natural Heritage Program created a report to reconstruct 770 ha of agricultural land leased in Depot boundaries – property owned by Newport Chemical Depot in Indiana. For a time, the Depot prairies were the largest prairie reconstruction in Indiana and resulted in fertile and rich soils that farmers could lease (Rothrock et al., 2016). Now, prairie reconstruction in Indiana remains a vital conservation practice that allows for the repurposing of land.

Prairie Restoration History and Best Practices

Prairie restoration or reconstruction is the rebuilding of prairies by planting prairie seeds in areas where prairies once existed but are now gone due to industrial, agricultural, commercial, or residential development. Prairie restoration is critical for managing and restoring the biodiversity of many species' groups such as plants, animals, and insects, and promoting self-sustaining native populations (Trowbridge et al., 2017). Prairies can provide environmental and agricultural benefits, such as improving aggregate stability, reducing soil erosion, limiting nutrient losses, filtering water and runoff, sequestering carbon, suppressing weeds, and improving soil quality. Prairies positively impact soil health by increasing organic matter content, expanding the diversity of the microbial community, and improving nutrient cycling (Chenhui et al., 2021).

While planning the restoration of a prairie there are different processes that an individual can follow. Restoration specialists follow a general process while restoring a site: site selection, plant selection, site preparation, planting time and method, and post-planting management (Diboll, n.d.). The first step to restoring a prairie is to select a site that is suitable to the type of prairie that you would like to restore; sometimes the site is already selected and the type of prairie that will be restored needs to be determined. The second step is plant selection; this will be determined by soil type and the range, this is determined by hardiness zones (USDA) and the native plant ranges that overlap with the site, that the site is in. The third step is site preparation, which is killing any unwanted species before planting. The fourth step is to determine the planting time and method, determined by the species being planted and if seeds or nursery crops are being planted. If a pre-made seed mix is selected, a person must ensure that all seeds in the mix are native and will thrive in the site's range; our team suggest that a unique seed mix is made for this site using the species list. Looking at the timing and needs of seeds is very important to consider as many seeds in this range need cold stratification to germinate. The fifth step is to determine the management of the prairie; so that the health of the prairie will be maintained for years to come (Diboll, n.d.).

There are a few different steps that are suggested when restoring a prairie. Some individuals suggest that a seed mix is selected based on range instead of picking out individual species (Smith, 2010). There are also different levels of monitoring suggested, based on the type of planting that is done on the site.

Management Methods

Prairie management is a very important aspect of keeping a prairie alive and well. There are many aspects to prairie management, such as managing the start of the prairie if it is new and upkeep. When starting a new prairie, one must remove the existing growth in the location. There are a few ways to do this, but it is usually done by herbicide or physical removal. Using herbicides can become very costly when converting a large area (“Grass Removal Methods,” 2021). Once the prairie is cleared of grass, one can then think about transplanting plants or seeding new plants. While some prairie plants can be transplanted, others are difficult to

reestablish in new locations and would be better for seeding. Transplanting can be done with not only seedlings but also established adult plants (Fahselt, 2007). Prescribed burns are an excellent way to maintain a healthy prairie. It is recommended to burn them once every two or three years depending on the type of prairie. For example, with mesic prairies (prairies dominated by native grasses), one cannot wait much longer than 3 years before woody species begin to dominate (Gardner, 2010). In addition to prescribed burns, other management recommendations are mowing, pulling weeds, and selectively using herbicides for spot treatment. Mowing can be used to: control annual and biennial weeds in the first two years after seeding, control cool season grasses and weeds in the third year of establishment and beyond and prevent the growth of trees and shrubs. Herbicides and weed pulling can be used to eliminate unwanted plants and weeds in the prairie (Diboll, n.d.). Once the prairie is established, it is also important to ensure it stays full and diverse, this can be done by overseeding. Seeds can be harvested from other areas or bought and then broadcast heavily in the winter months, so they can begin growing in the spring (Helzer, 2014). By using these methods in a native prairie, we can ensure it stays healthy for years to come.

Conclusion

Through the creation of the new prairie at ACRE, ecological needs, and human experiences will be enhanced. While many steps will go into the restoration of this prairie, the new space will be rejuvenated and allow for a clearer learning experience for visitors. It is important to note that this prairie was on the eastern edge of the North American Tall Grass Prairie and the new prairie plot will represent a restored ecosystem that is reminiscent of that. The old prairie section at ACRE will be removed due to the construction of new grain bins, so new species as well as species from the past plot will be introduced in the new prairie to increase pollinator presence with a more diverse array of prairie plants. This diverse set of plants will improve soil health through the deep and fibrous root systems and provide a habitat for diverse wildlife. The new prairie plot will also feature a trail that includes benches, picnic tables, and signage to ensure an educational and immersive experience in the prairie. The educational signage will feature the historical context of prairies in Tiptecanoe County, and how native populations cared for the land long before it was used for modern agricultural practices. The restoration of this ecosystem will not only have many environmental benefits for soil health and biodiversity, but it will also be a way to bring awareness to the use of the land in the United States. It is important to understand that intense agriculture was not the first use of the land in the Midwest, and there were many more sustainable uses that preserved the prairie much better than we do now. Ultimately, the reconstruction of prairie land remains an important practice for environmental conservation in the Midwest, and repurposing this land will allow for a healthy ecosystem with ample learning opportunities for people in the community.

Goals and Objectives

The reason for removing the Peterson Prairie was understood when the projects were first allocated to their specific groups. But, throughout the semester, the goals for creating the new prairie were identified through many conversations among the group, and with Dr. Bowling and Mrs. Stevens. At first, it was known that a species list, a trail design, and possibly a few signs for the new prairie were needed. So, from this information, a few draft products were created, and after presenting these draft products to the class and professors, considerable changes were made. For example, the species list was only the common and scientific names to begin with, so we added average height, bloom time, bloom color, conservation status, pollinators attracted, ease of establishment, planting time, and years to establish, for each of the species. Furthermore, the draft signage was changed to include aspects such as a QR code to an informational Purdue Extension pdf, more images, and more educative text. After further conversing with Mrs. Stevens, it was decided to make six signs – in total – to highlight the different aspects of the prairie while providing education to its visitors. Through consulting Dr. Bowling, the sizing for the signs was determined, with the five informational signs being (24” x 18”) and the welcome sign being (48” x 32”). The Literature Review, along with additional research on prairies and common interpretive sign designs helped complete the project.

Deliverable Description

1. **Prairie Species List:** This Google Sheets document includes a list of wildflower species that we believe would all be good candidates to be planted in prairie. We have included: the common name, scientific name, average height, bloom time, bloom color, conservation status, pollinators attracted, ease of establishment, planting time, and years to establish, for each of the species. Both the categories ease of establishment and planting time have information to the right of the table on the Google Sheet to provide further clarification on these categories.
2. **GIS Trail Map for Visitors:** This trail map was included in the welcome sign for the prairie so that visitors are aware of where to walk. The trail also includes areas designated for rest like benches and picnic tables and the locations of the signage. To open the trail map ArcGIS pro is needed. The projection is WGS84 web Mercator with a google satellite basemap. The version of ArcGis that I used for both the maps that were created was ArcGIS Pro 3.1 on windows 10.
3. **GIS Map for ACRE for Design Use:** This map includes the trail with a buffer of 60 inches which is the width of the trail and the area which will be mowed for the picnic tables. There is also a buffer of 5-meters for the road and a 10-meter buffer for the agricultural land. Mrs. Stevens could use this map to know where she should place signs, the welcome sign should be placed on the dot near the entrance and the rest could be chosen by Mrs. Stevens. However, we would recommend putting in the order of Prairie History, Native Prairie Plants, Prairie Pollinators, Using Fire to Manage Our Prairie, and How Our Prairie Benefits the Ecosystem. To open and edit this GIS map one ArcGis Pro is needed.
4. **Six Informational Signs:** The signs that were created have information on: prairie pollinators, native prairie plants, the use of prescribed fires on prairies, how prairies benefit the ecosystem, prairie history, and a welcome sign. When creating these signs, the reference age range was young adults and older.
 - a. **Prairie Pollinators:** This sign explains how pollinators are both beneficial to the health and success of prairies and benefited by the prairies not using harmful chemicals. It also displays some common pollinators to be found in prairies.
 - b. **Native Prairie Plants:** This sign explains both the environmental and visual benefit native plants have to prairies. It also displays examples of native plants that can be found in the prairie.
 - c. **Using Fire to Manage Our Prairie:** This sign includes information on prescribed fires such as why prescribed fires are used on prairies and the benefits

of utilizing a prescribed fire on a prairie. Overall, this sign was made to educate the visitors on prescribed fires since it is a management practice used on the ACRE prairies.

- d. **How Our Prairie Benefits the Ecosystem:** This sign includes information on the benefits that prairies bring to the ecosystem, and emphasizes the wildlife, pollinator, and soil health benefits. Overall, this sign was made to educate the visitors on why the prairie is important to the ecosystem and the benefits that prairies bring that may not be recognized by the visitors.
- e. **Prairie History:** This sign emphasizes the fact that agriculture was not the first use of the land at ACRE. It shines a light on the history of the land in Tippecanoe County and the importance of the ways that Native Americans preserved the land. There is also a section dedicated to North American prairie history since West Lafayette is on the Eastern edge of the North American Tall Grass Prairie.
- f. **ACRE Prairie Welcome Sign:** This sign is at the trailhead and welcomes visitors to the ACRE prairie. The sign shows a map of the trail layout. On this map, you can see where the picnic area, rest areas, and signage will be along the trail. It also covers some basic guidelines to follow during a visit such as the hours of operation, a reminder not to litter, and to respect the land.

Metadata and Technical Details

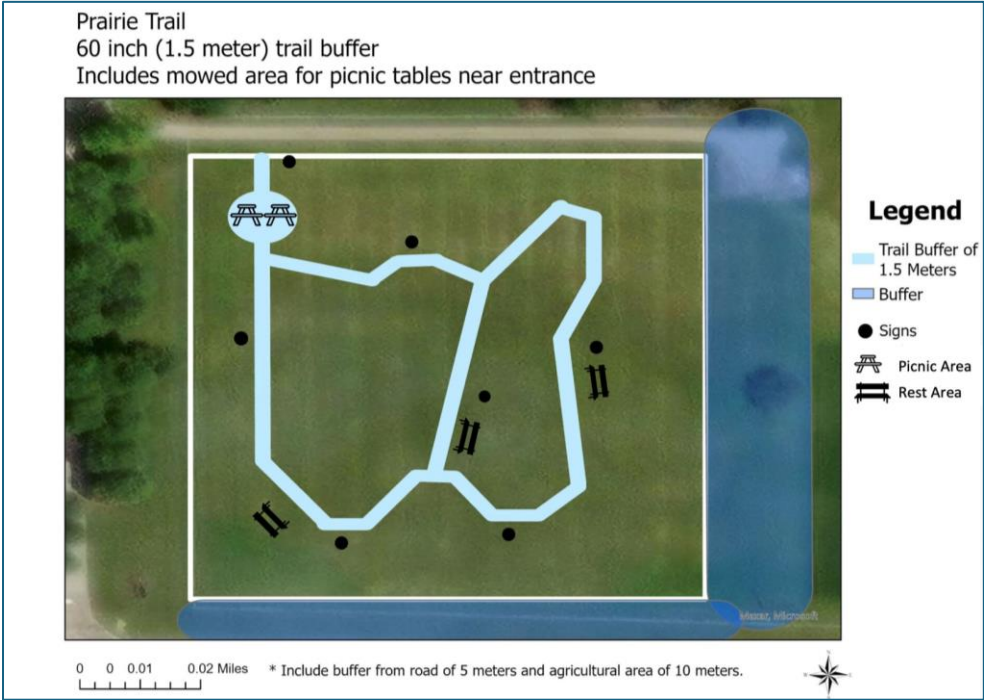
Links:	Software:	Size:	Contact Information:
Prairie Pollinators: https://www.canva.com/design/DAGAn7AM39g/f6c0n_acuTC6J2hDeceF2A/edit?utm_content=DAGAn7AM39g&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton	Canva	(24" x 18")	Name: Maddi Wilson Phone Number: (812) 756-1557 Email: wils1205@purdue.edu
Native Prairie Plants: https://www.canva.com/design/DAGBSN6anQE/dIX8C1HHdFZ-CKYOR47hoA/edit?utm_content=DAGBSN6anQE&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton	Canva	(24" x 18")	Name: Maddi Wilson Phone Number: (812) 756-1557 Email: wils1205@purdue.edu
Using Fire to Manage Our Prairie and How Our Prairie Benefits the Ecosystem: https://www.canva.com/design/DAGCCsYDsmU/91Duk6FcaZLBjUNLwonOw/edit?utm_content=DAGCCsYDsmU&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton	Canva	(24" x 18")	Name: Kyrstin Roberts Phone Number: (574) 870-8636 Email: rober577@purdue.edu
Prairie History: https://www.canva.com/design/DAGCD_0dF2Q/5H6213mez8cIOcbtkA934g/edit?utm_content=DAGCD_0dF2Q&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton	Canva	(24" x 18")	Name: Claire Wilson Phone Number: (636) 399-3368 Email: wils1153@purdue.edu

<p>ACRE Prairie Welcome Sign:</p> <p>https://www.canva.com/design/DAGClwskduQ/7FYv44exqF-ZM5DrgMQ-lg/edit?utm_content=DAGClwskduQ&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton</p>	<p>Canva</p>	<p>(48" x 32")</p>	<p>Name: Bailey Temple Phone Number: (260)-687-1113 Email: temple8@purdue.edu</p>
<p>Species List:</p> <p>https://docs.google.com/spreadsheets/d/1XJdoXvMogNbShtmQ0bYGbJ5mTkcC1tnhG0Wrl_iECSM/edit?usp=sharing</p>	<p>Google Sheets</p>	<p>N/A</p>	<p>Name: Emerson Lemberis Phone Number: (574) 279-5342 Email: elemberi@purdue.edu</p>
<p>ArcGIS Output (Prairie Design): 2024 ACRE GISOutput Editable.ppkx</p>	<p>ArcGIS Pro</p>	<p>N/A</p>	<p>Name: Emely Gramajo Phone Number: (630) 670-7252 Email: egramajo@purdue.edu</p>

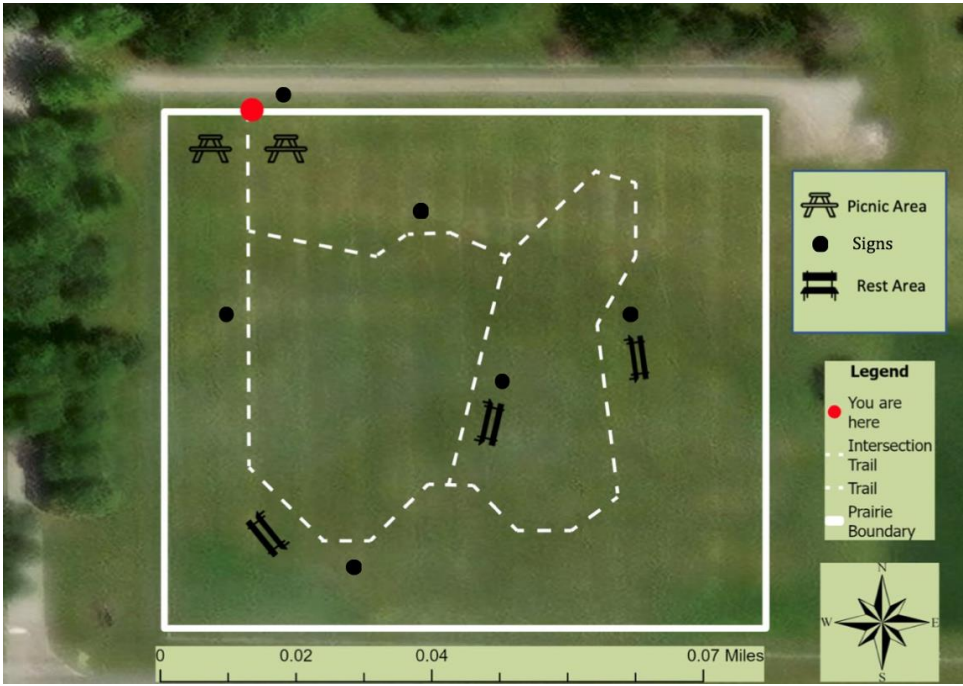
Future Work

With the created species list and GIS map, ACRE will be able to begin building the new prairie in the fall of 2024 or spring of 2025. Before planting, the prairie must be prepped with sod removal. Various methods, indicated in the Literature Review, can be utilized to determine which method will be the most efficient way to remove the sod. Next, ACRE management can utilize the species list and GIS maps to decide where each plant species will be planted. Additionally, ACRE management will begin production of the six signs designed for the new prairie. If further changes to the sign are needed before printing, editing links to each of the signs are included in this report for easy access. The signs will be printed at GLgraphixs and be mounted on wooden sign frames that must still be built. The wooden sign frames will be the same design as already existing signs at ACRE, so the building of them should not be an issue.

Appendix



Map 1. Prairie trail map used as an aid for Mrs. Stevens so that she can know where to place the trials, buffer, rest areas, picnic areas, and signage.



Map 2. The prairie trail map was created for the welcome sign so that visitors know where to walk.



Image 1. Welcome Sign displaying trail layout map and basic guidelines to follow during the visit.

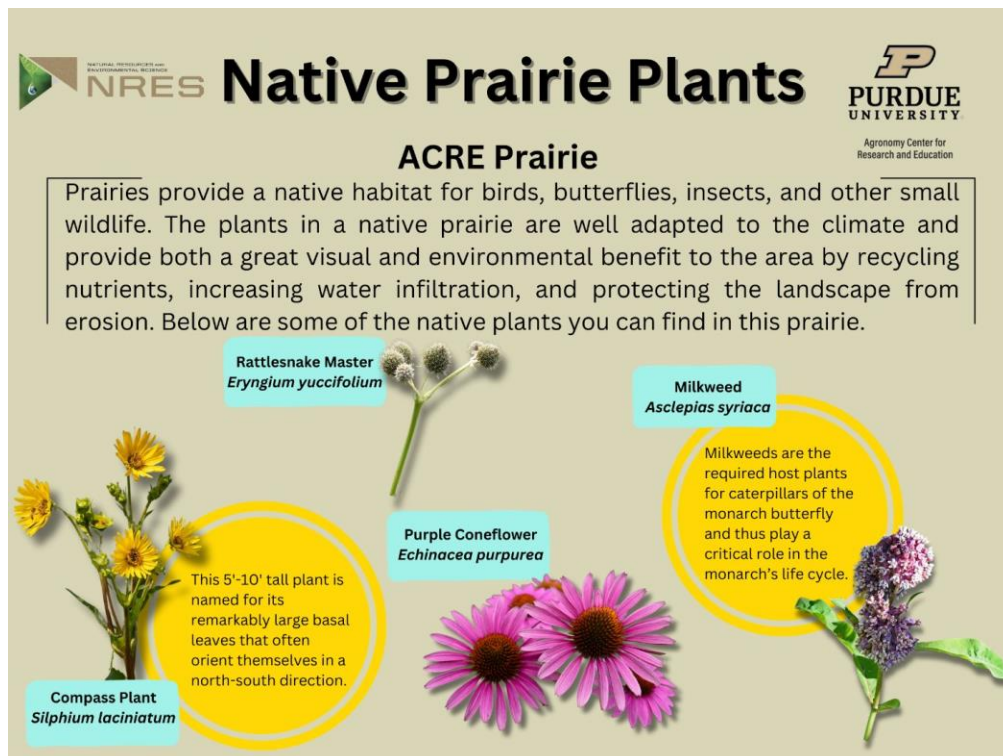


Image 2. Sign displaying information on native prairie plants that can be found in the prairie.

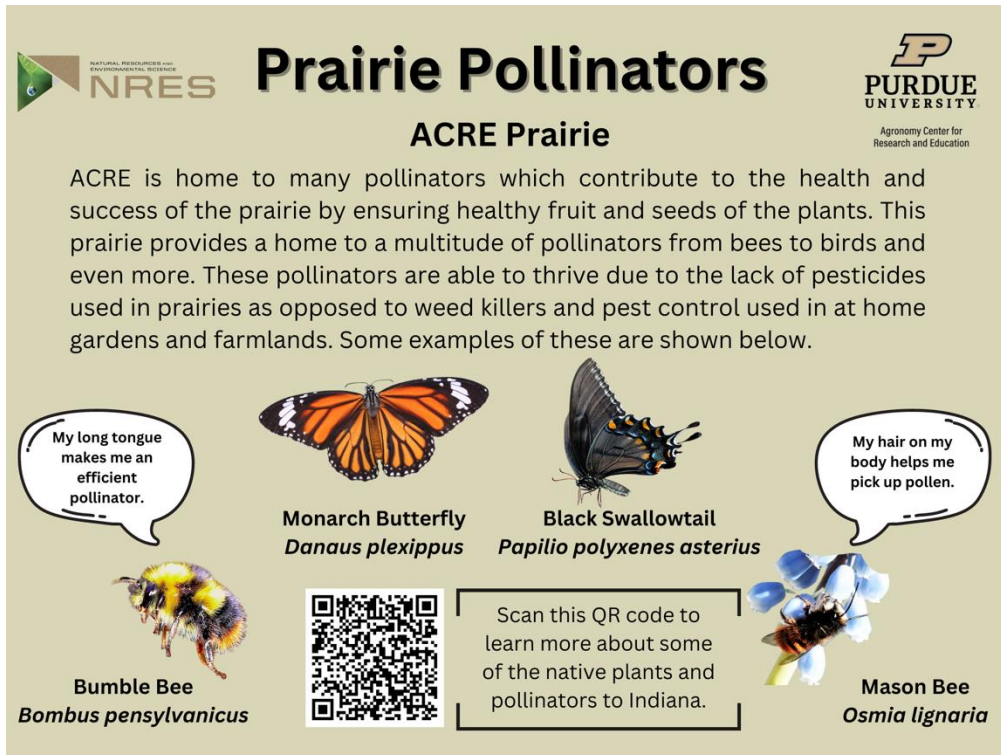


Image 3. The sign displays common pollinators often found in native prairies and their benefit.

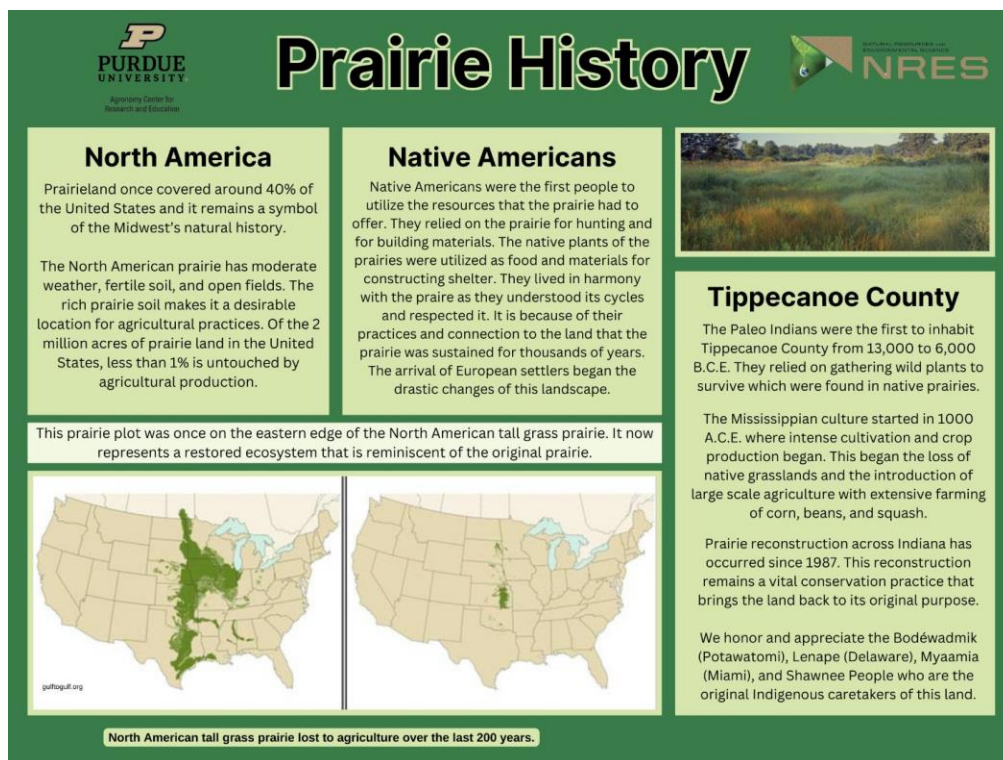


Image 4. Sign displaying the history of prairies in North America and Tippecanoe County.

Using Fire to Manage Our Prairie

What is a Prescribed Fire?

A prescribed fire refers to a controlled application of fire that is used to meet management goals.


These burns can also be called “controlled burns” and “prescribed burns.”

Why are Prescribed Fires Used?

Prescribed fires are utilized for numerous reasons, such as reducing hazardous fuel loads near developed areas, restoring natural woodlands, managing landscapes, and for research objectives.

Benefits of a Prescribed Fire

- Allows grassland habitat to persist by eliminating trees and shrub species.
- Reduces the spread of plant diseases.
- Increases plant diversity by opening up space for grasses and wildflowers.
- Releases nutrients tied up in dead organic material.










Image 5. Sign depicting information on prescribed fires and how they are a beneficial management tool for prairies.

How Our Prairie Benefits the Ecosystem

Wildlife

Prairies often have nutrient-rich soils that support a diverse array of plant life, including grasses and wildflowers. This plant life provides an abundance of food for animals, such as deer, mice, and ground squirrels.

The dense vegetation also serves as a shelter from harsh weather conditions and a possible hiding spot from onlooking predators.

Overall, prairies offer a unique combination of resources, space, and environmental conditions that make them attractive habitats for a diverse array of animals.

Pollinators

With the abundance of flowering species of plants, prairies provide pollinators with multiple sources of essential pollen and nectar.

Furthermore, the lack of pesticide utilization on prairies makes the habitat more hospitable for pollinators. By avoiding these harmful substances, pollinators do not face the negative consequences to their behavior, reproduction, and overall health.

Since pollinators are necessary for plant fertilization, it is important that they have a suitable habitat to utilize.

Soil Health

The diverse array of plants that inhabit a prairie are beneficial for the health of our soils.

This is because prairie plants:

- require little maintenance,
- are long lasting, and
- do not need fertilizers or pesticides to thrive.


Additionally, prairie plants have root systems that:


- penetrate deep into the soil profile,
- are drought resistant,
- prevent erosion, and
- promote water infiltration.



Indiana prairies are my home!

Prairie Deer Mouse
(Peromyscus maniculatus bairdii)









Image 6. Sign depicting information on how prairie ecosystems benefit the ecosystem with an emphasis on benefits to wildlife, pollinators, and soil health.

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