

Certificate in Native Plant Studies Final Report

Piedmontprairie.us: documenting a habitat hidden in plain sight

Bradley Saul

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Background and Purpose

Prairie plant communities were once widespread in the Piedmont region of the eastern United States. Recognition of the ecological and conservation value of these communities is growing. This certificate in native plant studies project is a website – piedmontprairie.us – which documents the natural history and flora of the Piedmont prairie habitat. The site describes ways for people to get involved in Piedmont prairie conservation, especially by conserving refugia on roadsides and Rights-of-Way (ROW). Additionally, the site includes a comprehensive bibliography of scientific literature relevant to the Piedmont prairie habitat and its flora.

The project is open-source and its content released under a CC BY-SA 4.0 license, so others may contribute and expand the knowledge base. The project’s source code is available at

GitHub: github.com/bsaul/piedmontprairie.us. This report includes the (current) text and references, as well as a detailed description of the website's technical specifications.

Methodology

Technology

The project website was built in the R Statistical Computing environment (R Core Team 2021) using the `blogdown` package (Xie, Hill, and Thomas 2017). The `blogdown` package itself uses (by default) Hugo, a static site generator written in the Go programming language, to generate HTML. For styling the site, the `ananke` Hugo theme was chosen as a basis from to create a custom theme. GitHub is used as a remote repository to keep and version track the project files, including the website's HTML, CSS, and JavaScript. Whenever I push changes to the GitHub repository, the website is automatically deployed by another service, netlify, thus making `piedmontprairie.us` available on the public web.

While these technologies require a certain amount of technical skill to set up, the approach has advantages over other website-building tools. For one, a static site simply consists only of HTML, CSS, and JavaScript files; there is no database or content management software such as Wordpress to maintain. Writing site content simply means editing text files on your computer using the straightforward Markdown markup language, as opposed to using a WSIWYG editor in a browser. Unlike free website hosts like `wix.com` or `wordpress.com`, the site's content and aesthetics are completely customizable. Like `wix.com` and `wordpress.com`, netlify (and similar services) offer a free level for sites with a small footprint like `piedmontprairie.us`.

The `blogdown` package provided the added benefit that content can be written using R Markdown, allowing for content to be generated from evaluated R code. For example, the list of references on `references.html` page is generated from the following code in the `references.Rmd` file:

```
sort(bibtex::read.bib("piedmontprairie.bib"))
```

where `piedmontprairie.bib` is a bibtex file containing all the Piedmont prairie references.

Site Content

The website contains the following content:

- a landing page featuring an attractive prairie landscape and navigation text.
- a Natural History page describing the origins and status of the habitat

- a section on the Flora of the Piedmont prairie
- a Blog section where interesting articles and field trip reports will be added over time
- a Get Involved page serving as a collection of links
- a Reference page displaying the Piedmont prairie bibliography

Note: any references to files below are in reference to the files available in the project's github repository.

Choosing feature species

Describing all the species potentially found in a Piedmont prairie was beyond the scope of this project. Instead, eight species were selected to highlight the habitat's beauty and diversity. The list include species widespread across the Eastern US, like wild quinine (*Parthenium integrifolium*) as well as those mostly endemic to the Piedmont like largeflower aster (*Symphotrichum grandiflorum*). These species were chosen from three sources: the NCBG Roadside Inventory (provided by Johnny Randall), species with more than ten observations in the iNaturalist North Carolina Piedmont Roadside Native Plants project, and discussions with Julie Tuttle. Additional species may be added in the future.

Images

Images used in the site were obtained from the North Carolina Botanical Garden, Rua Mordecai of the Piedmont Prairie partnership, iNaturalist, and Wikipedia. Image sources and licenses are collected in the `content/image-info.json` file and displayed as appropriate as an overlay on the image or, in the case of species' images, in the species image gallery.

iNaturalist maps

For each feature species, a map showing research grade iNaturalist observation was created using the `rinat` and `ggplot2` R packages (Barve and Hart 2021; Wickham 2016). The code used to generate the maps can be found in the `scripts/map_inaturalist.R` file.

Results

The project website can be found at piedmontprairie.us.

Discussion

This section includes the *text only* of the Natural History page. The text is current as of 2021-07-14; for the most recent text and other pages, visit piedmontprairie.us.

Natural History

A common myth is that colonizers of the Southeastern Piedmont reached a vast, unbroken forest. Some have claimed that a squirrel could cross the Piedmont from mountains to the coastal plain and “never have seen a flicker of sunshine on the ground” (J. T. Adams 2012; as quoted in Brown and others 2000). Recent academic literature refers to the pre-colonial Piedmont region as “Southern Forest” (e.g., Sanderson et al. 2008). Even in *Field Guide to the Piedmont*, author Michael Godfrey (2012) writes:

This is what I see in the Piedmont of 300 years ago: the canopy claims the direct sunlight completely by filling every gap with a broad-leaved parasol, cantilevered aloft. No part of the jade awning is within one hundred feet of the ground.

A more accurate biogeographic depiction of the historic Piedmont region is a mosaic of many habitats including forest, savanna, and what we now call the *Piedmont Prairie*.

The US Environmental Protection Agency defines the Piedmont Ecoregion as extending from near Montgomery, AL northeastward across Georgia, the Carolinas, and Virginia to Washington, DC. The Atlantic Seaboard Fall Line defines the region’s eastern border, and to the West, the Appalachian Mountains rise out of the Piedmont’s rolling hills.

The precise extent of prairie-like habitat prior to European settlement is unknown, but ample historical evidence suggests open habitat was common. In a seminal monograph on historical vegetation patterns in the Southeast, Rostlund (1957) writes:

On a vegetation map of the ancient Southeast, if such a map could be constructed from the early records, there would be some areas in dark green color to show the dense and mature forests, other areas in light green to represent the open woodlands, and the map would be liberally flecked with yellow to indicate the scattered tracts of open country.

These “yellow flecks” would have included areas of Piedmont prairie.

Prairie origins

Factors that are thought to have contributed to the formation and maintenance of open habitat in the Piedmont include soil type, Native American land-use practices, fire, and grazing by large herbivores. These are briefly described here, though the relative contribution of each factor to sustain prairie probably varied depending on the specific region and the vegetation community.

Soil type Noss (2012) details many endemic plants and plant communities in the Southeast that survive in large part due to the specific soil characteristics where they are found. Indeed, the Southeast is one of the most species-rich regions in the world in terms of grassland biodiversity. Davis et al. (2002) associated several prairie remnant sites with characteristic clay soils common in the Piedmont. A dense clayey soil could impede tree root growth, especially during dry summers.

The Piedmont does have open habitats such as the Piedmont Hardpan Forest dependent on specific soil types. However, the degree to which edaphic (soil) factors maintained large tracts of open habitat historically is an open question. Since most of the Piedmont has been plowed in the past 400 years, where we find prairie remnants today may not be representative of Piedmont prairie's historic range and soils.

Indigenous Land Use A recent report by the North Carolina Natural Heritage program (Robinson 2020) found “that while edaphic conditions play a role in the distribution of prairie/savanna associated plants, it is the prevention of canopy closure through anthropogenic activity that is most closely associated with the distribution of these plants at the present time.” The Piedmont region was a long-thriving center of human activity prior to European settlement, supporting an extensive trade network and largely agricultural societies. Indeed, Dobbs (2009) argues that the trade routes left by the indigenous people (after disease had extensively depopulated the Piedmont) set the “initial conditions” upon which early Piedmont settlers built their society.

Early explorers and settlers of the Piedmont describe large open areas maintained by Native Americans. Brown and others (2000) cite several historic records of prairie-like regions of the Virginia Piedmont, including one Robert Beverley who described “large Spots of Meadows and Savanna's (*sic*), wherein are Hundreds of Acres without any Tree at all; but yield Reeds and Grass of incredible Height.”

Fire While many of the Piedmont habitat types today do not share the same dependence on fire as the Long Leaf Pine savannas of the Coastal Plain, remnants of fire-adapted habitats such as Post Oak savannas and prairies suggest fire was historically an important driver ecological patterns in the Piedmont. Prior to colonization, fires – both man-made and natural – occurred regularly in much of North America. Frost (1998) estimates a presettlement fire frequency of every 4-6 years for most of the Piedmont. Native Americans also used fire as a primary means to clear and open areas (Williams 2003).

Today, conservation-minded property managers use fire as a critical tool to maintain Piedmont Prairies. The following short video shows how fire is used at a small Piedmont Prairie patch at Sarah P. Duke Gardens in Durham, NC: <https://www.youtube.com/watch?v=DQkvMUNZsJk>.

Herbivory Historical evidence suggests American Bison (*Bison bison*) ranged widely across the American Southeast during at least the 16th and 17th centuries (Rostlund 1960). To have been successful, bison would have needed large tracts of open, grassy areas. Bison were a keystone species in the Tallgrass prairie of the midwestern plains, their grazing having had profound effects on the ecosystem (Knapp et al. 1999).

Were bison a keystone species in the Piedmont, maintaining and expanding prairie habitat? We don't know how long the bison's range extended over the Piedmont. But given the volume of herbaceous plants needed to sustain herds of bison, their effect must have be profound.

Biodiversity

From a distance, grasslands may appear to have little biodiversity, hosting only a few, highly abundant species. Close inspection tells a different story. In fact, grassland habitats can be among the most biodiverse places on earth (Wilson et al. 2012; Risser 1988). Tompkins et al. (2010) inventoried over 200 species on a single 2.8 hectare Piedmont prairie site.

Several rare or endangered species find refuge in Piedmont prairie habitats. Schweinitz's sunflower (*Helianthus schweinitzii*) is a federally listed endangered species and found only in the South/North Carolina Piedmont. Smooth purple coneflower (*Echinacea laevigata*) is another federally listed species that prefers open and sunny habitats.

Finding prairies today While ample evidence shows prairie and savanna habitats were once more widespread in the Piedmont, where can be the prairies be found today? Besides a handful of prairie sites managed for conservation (see map below), many of the best prairie habitats are hidden in plain sight! The regular mowing and removal of woody species makes

roadsides and other rights-of-way ideal refugia for prairie species in the Piedmont (N. Adams 2012).

Conservation

Awareness of the Piedmont prairie's conservation value has risen in recent years. While the Piedmont region is highly fragmented and development pressures are only increasing, there are positive signs of conservation of this habitat. A number of prairie demonstration and restoration sites have been created. Organizations such as the Southeastern Grasslands Initiative have spearheaded initiatives to identify, protect, and restore Piedmont prairie.

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