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Assessing Biodiversity and Climate Resiliency of Trees in a Flood Plain Buyout

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Introduction

Urban forests are a common way to integrate nature into heavily populated areas. Urban forests provide a range of benefits to communities, including economic, social, and cultural benefits (Hirokawa 2010). For instance, trees provide opportunities for individuals to engage with the environment, reduce stress, and increase property values. Trees also contribute to ecosystem services by removing air pollutants, providing habitat for wildlife, and mitigating storm water runoff. Yet, each year many urban trees succumb to a variety of pests and diseases as well as weather-related conditions associated with climate change, such as drought and increased temperatures. To reduce these risks, urban forests should be biodiverse. A healthy, biodiverse urban forest is able to respond to and bounce back from environmental change while continuing to deliver important services to the urban environment (Nowak 2007). As the impacts of climate change become more apparent, it is important to assess vulnerabilities in urban forests in order to identify, mitigate, and manage weaknesses. This information is essential to increasing urban forest resilience strategies in future urban forest management plans.

Purpose

The purpose of this research is to assess the biodiversity and the climate resiliency of trees in an urban forest in Arlington, Texas, that was part of a program for environmental mitigation of a floodplain.

Methods

Heavy flooding from 2010's Tropical Storm Hermine prompted the City of Arlington, Texas, to acquire residential properties near Rush Creek. The city removed homes and converted the area to a park. To assess the biodiversity and climate resiliency of the area's trees, we collected the following data: tree location, tree diameter (DBH), species, and tree condition. We collected tree data using Trimble DA2 Catalyst GNSS System connected to ESRI Field Maps, a DBH measuring tape, Nikon Forestry Pro II Laser Rangefinder, and through visual observation methods. Tree DBH was measured using a measuring tape designed to record the diameter of the tree at 1.37 m from the base. Geographic coordinates were taken as close to the tree as possible with an accuracy within 5 cm. The height of the tree was measured with the rangefinder. Visual observations were made to identify the tree species, estimate canopy cover, and tree health. After collecting the field data, we organized it within a spreadsheet for further analysis. First, we analyzed the data using the Simpson's and Shannon's Biodiversity Indexes to calculate the urban forest's species evenness and richness, respectively. The results were used to determine the biodiversity of the urban forest. Next, we identified and selected native Texas trees for further analysis. To assess the adaptability and capability of the urban forest to respond to future climate conditions, we compared the native trees to two Representative Concentration Pathway (RCP) models (i.e., 4.5 and 8.5; *Ecoregional vulnerability assessments (evas) summaries version 4*). Finally, we used ArcGIS Pro version 3.0 to visualize the urban forest's biodiversity and climate resiliency.

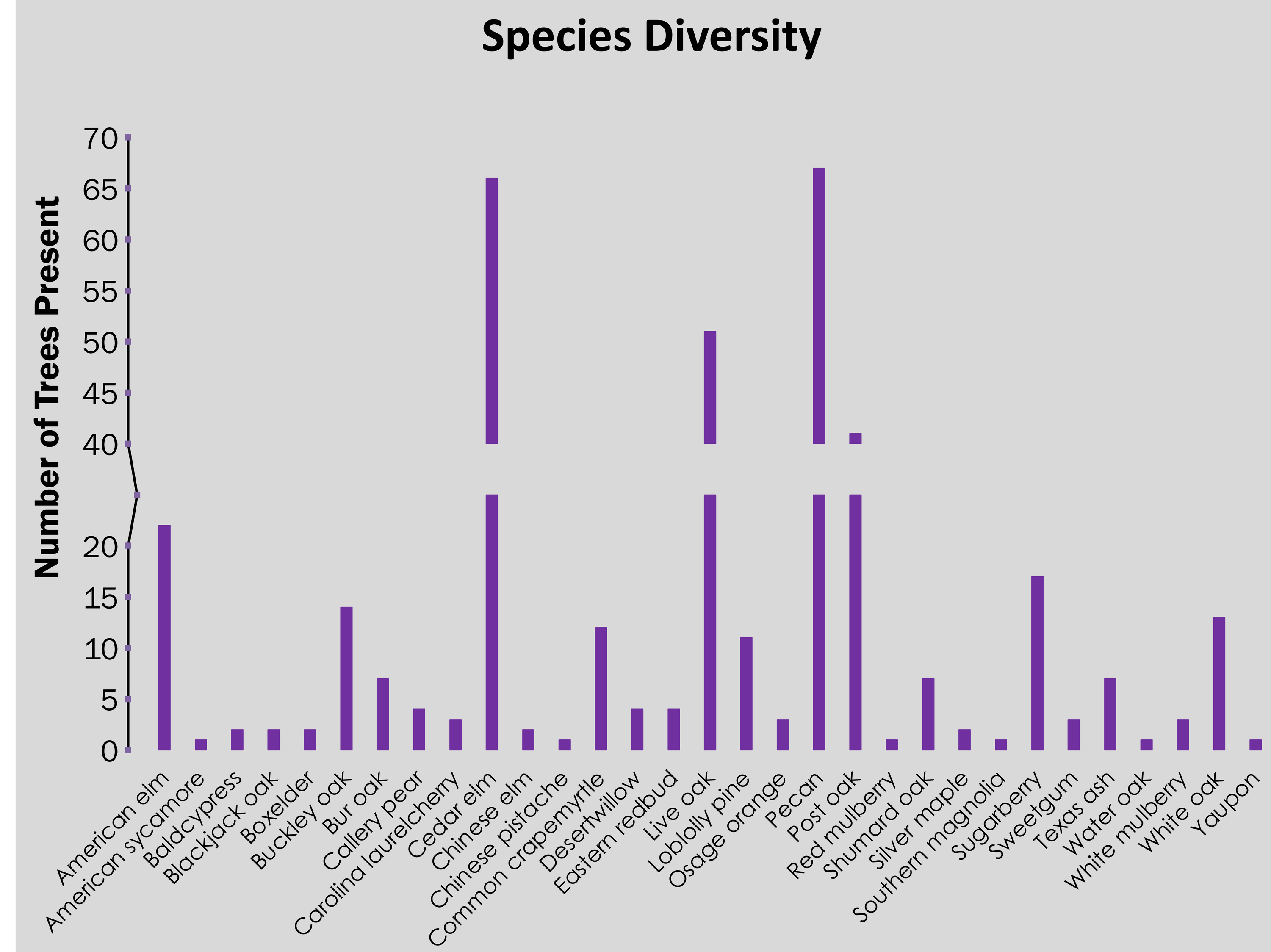
Results

Legend
Park · Buyout Parcel · American elm · Cedar elm · Live oak · Pecan · Post oak · Others

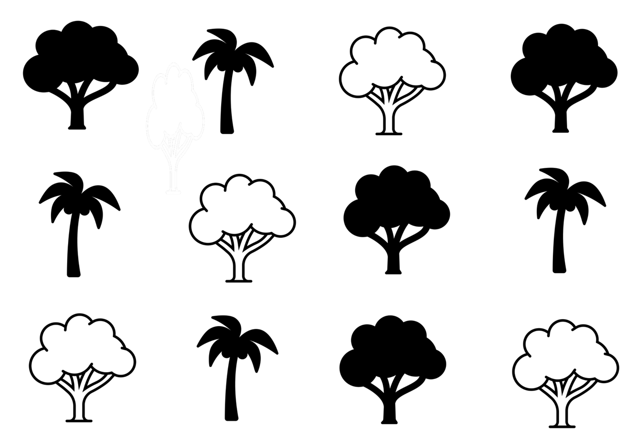
Figure 1. General Park Overview
The map displays the park area, buyout parcels, and the location of trees in the buyout parcels. The five most abundant trees species present are represented by different colors, and the remaining species are grouped together in the other category.

Legend
Park · Buyout Parcel · Good · Fia only · Fair · New habitat · Poor · Very Poor

Figure 2. Tree Capability
The map displays the capability of tree species native to the Arlington area. The capability of each tree to adapt to changing environmental conditions is categorized by fair, good, new habitat (habitat is no longer suitable), poor, very poor, or FIA (suitable under conditions).

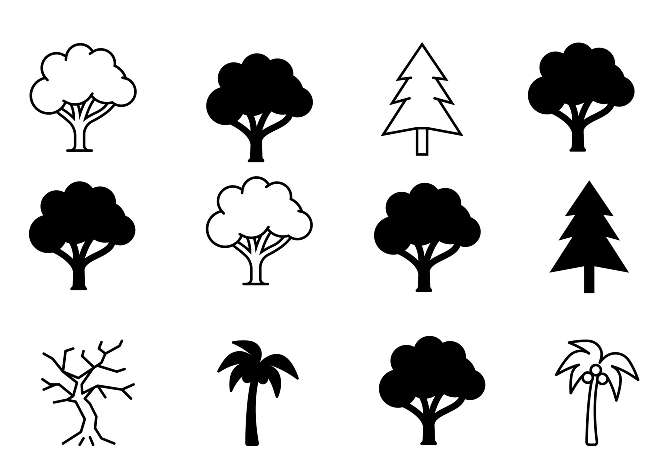


Species Evenness: The number of present individuals that belong to each species in a specific environment



Shannon's Index
E value: 0.769

Species Richness: The variety of different species present in a specific environment

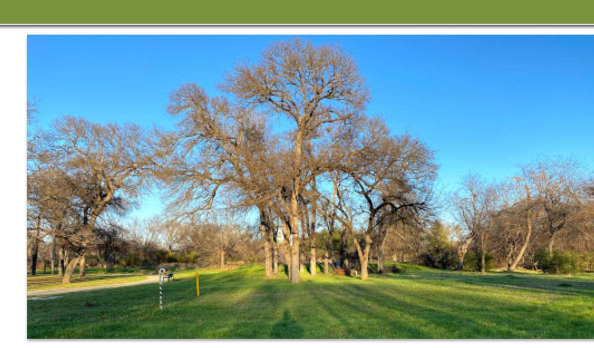


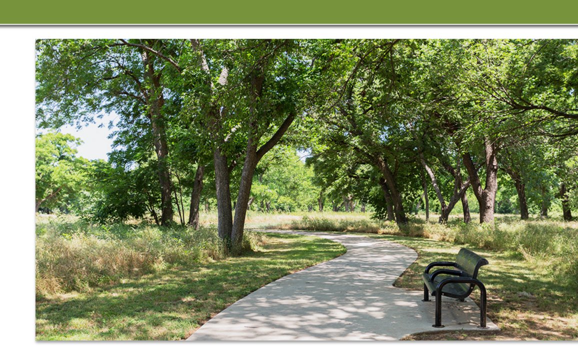
Simpson's Index
D value: 0.104

Legend
Park · Buyout Parcel

Figure 3. Clarence Foster Park
The map displays a real world view of Clarence Foster park. The overlays demonstrate the buyout parcel, park area, and trees in the areas.

Clarence Foster Park





Discussion and Conclusions

As climate change continues to alter temperature and precipitation patterns, it is crucial to identify well preforming tree species in an environment to develop sustainable urban forests that are resilient to climate change. We found that the urban forest has a high species richness but low species evenness. The values for the Simpson's and Shannon's Biodiversity Indexes indicate that the urban forest is diverse but there is an uneven distribution of species. For example, the area has over 30 species of trees, but a few tree species (i.e., cedar elm, pecan, and live oak) dominate the area while many other species recorded only have one tree (Figure1). This uneven distribution may lead to lower biodiversity in this area via a loss of species with low numbers. When we compared tree species to the different climate scenarios, we found that the RCP 4.5 scenario would impact 40% of the area's native trees, and under RCP 8.5 conditions that number increased to 60%. The performance of specific tree species under the different climate change scenarios show which species will be able to survive under changing environmental conditions. Of the trees native to Texas, *Celtis occidentalis* (hackberry), *Quercus stellata* (post oak), *Maclura pomifera* (Osage orange), and *Quercus virginiana* (live oak) had the best adaptability and performed the best under both RCP conditions (Figure 2). Based on these findings, we suggest that environmental managers invest in and plant a mix of these species to improve the climate resiliency of the area's urban forest and enhance its ability to deliver important services to the surrounding community.

References

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