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Anna N. Vo
Memphis Botanical Garden, anna.vo@membg.org

Lee E. Bridges
Overton Park Conservancy, ebridges@overtonpark.org

Allan Trently
Tennessee Department of Environment and Conservation, Allan.Trently@tn.gov

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The Tale of Two Forests: Oak Management in Memphis's Urban Forested Natural Areas

Management for oak (*Quercus* spp.) recruitment is difficult for many urban forested natural area managers (Piana et al., 2021a). A common theme in species composition of urban forested natural areas is dominance of oaks in the overstory with little to no oak regeneration (Pregitzer et al., 2019; Fahey et al., 2012). Developing urban silvicultural techniques that promote oak restoration that are also feasible at varying scales and socially acceptable has presented a challenge to managers (Piana et al., 2021b). The Memphis Botanic Garden and Overton Park Conservancy are combining their management and research efforts to improve understanding and management of oak recruitment in urban forested natural areas of the region.

Keywords

urban forested natural areas, practitioner notes, urban forests, urban ecology, oak recruitment, oak regeneration, urban silviculture

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CONTEXT

In 1961, eight years after the Memphis Botanic Garden was established, the Memphis Area Wildflower Society planted native plants in the understory of a four-acre treed area in what would become known as the Woodland. Five miles away and ten years later, the United States Supreme Court ruled in favor of the Citizens to Preserve Overton Park (CPOP v. Volpe 1971), preventing Interstate 40 from being built through 126 acres of woods that would become the Old Forest State Natural Area (Old Forest) in Overton Park (Figure 1). While both sites contain overstories dominated by mature oak (over two hundred years old), their understories consist of dense stands of non-native invasive species and native understory trees such as pawpaw (*Asimina triloba*) with little to no oak regeneration. Until recently, neither the Woodland nor the Old Forest had dedicated managers. However, when the respective managers realized they were both working to improve oak regeneration and establishment, a decision was made to combine efforts.

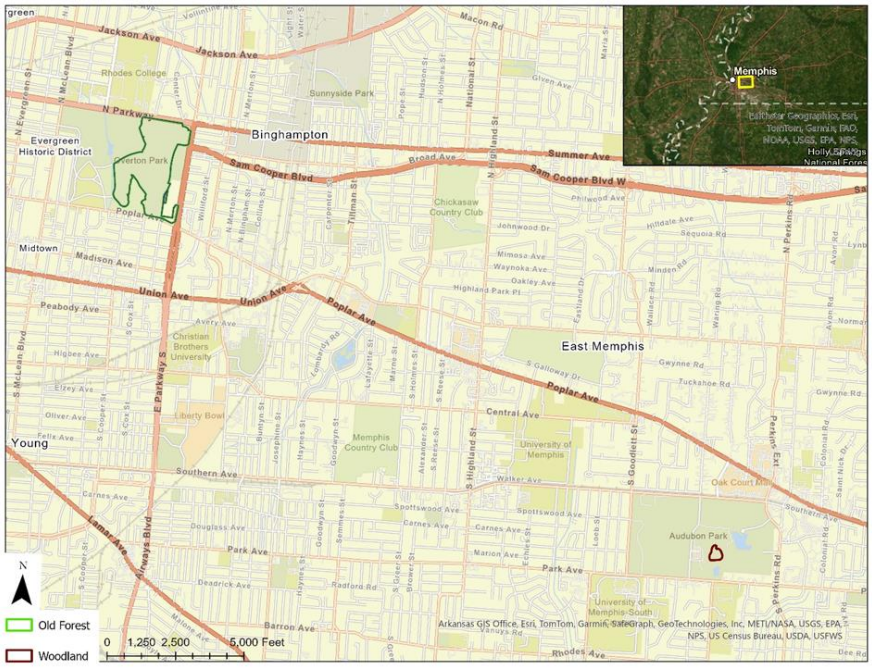

Figure 1. Location map of the Old Forest in Overton Park and the Woodland at Memphis Botanic Garden, Memphis, Shelby County, Tennessee. Coordinate system: WGS 1984 Web Mercator Auxiliary Sphere.

GOAL

The long-term goal of this project is the formation of a collaborative research and demonstration program to raise awareness about and share management strategies for oak regeneration and establishment in urban forested natural areas of the region. To meet this goal, multiple objectives were established. First, we sought to understand the causes of oak regeneration failure. Then, we developed management strategies to support oak regeneration, including reducing the abundance and impact of non-native invasive species and considering other overly abundant native species

for removal. Throughout these efforts, we engaged community stakeholders in both research and practice, which served our goal of growing a community of stewards and advocates.

APPROACH

The current approach takes advantage of the opportunities provided by each site. The Woodland, at four acres and with controlled access, allows for the implementation of management techniques that may be infeasible at larger scales and that may receive high levels of public scrutiny from the 800,000 annual visitors to the Old Forest. In contrast, the Old Forest, at 126 acres and directly adjacent to academic institutions, presents sufficient space and opportunity for the implementation of research projects.

A cursory examination of the Woodland understory revealed a high prevalence of non-native invasive plants as well as dense layers of pawpaw, boxelder (*Acer negundo*), and cherry laurel (*Prunus caroliniana*). Therefore, the main objective of management has been increasing understory light levels through the removal of non-native and native understory trees (Figures 2 & 3). Volunteers are removing invasive species such as privet (*Ligustrum sinense*), mahonia (*Mahonia bealei*), and honeysuckle (*Lonicera japonica*) through mechanical methods with supplemental chemical control provided by Memphis Botanic Garden staff. The dense native understory is being thinned by hand, and then herbicide is applied to the stumps to minimize resprouting, foliage removed to minimize visual impact, and downed stems left intact to serve as nurse logs on the forest floor. The next steps will involve volunteers monitoring for oak germinants and, where natural regeneration is unsuccessful, planting a variety of oak species either grown from local seed sources or obtained from regional nurseries.

Figure 2. The Woodland (a) before and (b) after removal of multiflora rose (*Rosa mutliflora*).

Figure 3. The Woodland (a) before and (b) after removal of white mulberry (*Morus alba*).

To better understand oak regeneration failure in the Old Forest, research plots were established in which acorns were placed within seed predator exclosures, i.e., excluding squirrels and blue jays, or within seed predator–accessible areas (Figure 4). Early results suggest that the majority of the acorns within predator exclosures germinated while over 99% of the acorns in accessible areas were removed by seed predators. While some of the removed seeds may have been secondarily dispersed, these preliminary findings are consistent with high seed predation rates observed in other urban forested natural areas (Labatore et al. 2016; Overdyck et al. 2013). These results also suggest that planting may be required to establish advanced regeneration rather than relying on natural regeneration. Future research will evaluate oak seedling growth and survival in response to light and competition levels.

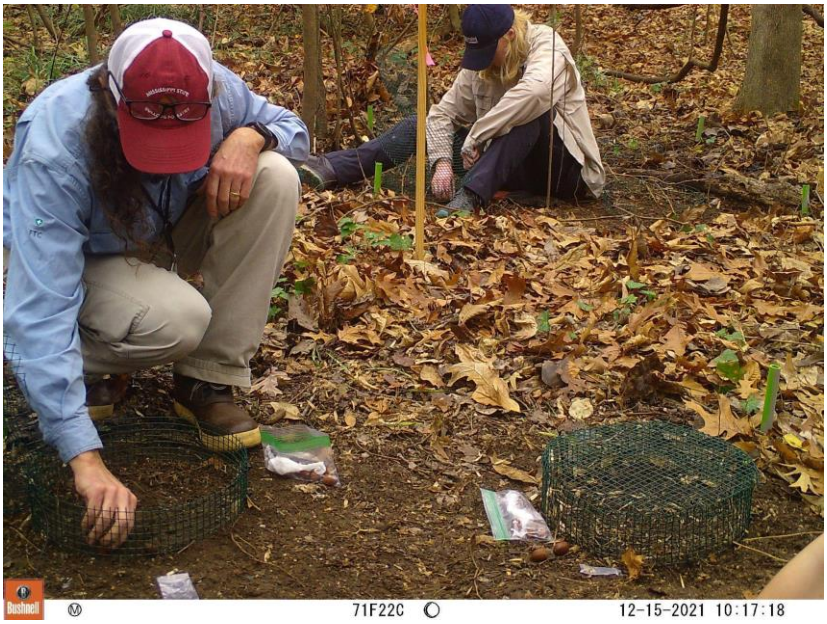

Figure 4. Seed predation research in the Old Forest.

RESOURCES

Staff salaries for the two site managers are funded directly by their respective nonprofits, Memphis Botanic Garden and Overton Park Conservancy. Additional funding and support for invasive species removal equipment and native oak seedlings has been provided by the Tennessee Division of Forestry. Undergraduate research interns are provided through an Urban Forestry Fellowship established at Rhodes College. Both managers leverage dozens of volunteers from the West Tennessee Urban Forestry Council and the community to assist with research and management.

KEY RESULTS

- Key results of the collaboration: Research can inform management while management can produce new research questions. For example, anecdotal observations of high levels of pawpaw, boxelder, and cherry laurel in the Woodland understory prompted the Old Forest manager to undertake an observational study. The results of this study indicated that these three species accounted for 76% of the existing saplings and for 90% of the increased density of the Old Forest understory trees over the past three decades. Further research on cherry laurel in the Old Forest revealed that high densities of cherry laurel were associated with reduced native plant abundance. These findings prompted the Woodland manager to undertake increased cherry laurel control efforts.
- Early results from management efforts at the Woodland: Increased understory light levels have been observed. Removal of non-native and dense native species is opening the canopy and appears to be increasing native plant diversity in the understory. Effects on oak regeneration are unclear at this early stage.

- Early results from the research efforts at the Old Forest: Oak germination and establishment appear to be inhibited by high levels of seed predation, suggesting that planting will be required to establish a population of advanced oak regeneration.

LONG-TERM EXPECTED OUTCOMES

- Monitoring the effects of sub-canopy thinnings in the Woodland is expected to improve management efforts and determine appropriate light levels to maximize oak regeneration, establishment, and survival while minimizing non-native species spread.
- Enrichment and edge plantings using a variety of native species in the Woodland are expected to provide guidance for managers of similar sites in the region to maximize native biodiversity.
- Future research in the Old Forest on overly abundant native species such as cherry laurel is expected to shed light on the impacts these species have on oak regeneration and establishment.
- Further research in the Old Forest on seedling survival and growth in both naturally forming canopy gaps and adjacent closed canopy forest is expected to improve restoration strategies at this and similar sites.

OPEN QUESTIONS

The Memphis Botanic Garden has been actively removing overly abundant native tree species, especially pawpaw and boxelder, in small, controlled areas with minimal concern expressed from stakeholders, while attempts at thinning of excessively dense patches of native pawpaw in the Old Forest have not been well received. Differing levels of public engagement and perceptions of authority in the two spaces may have some relevance to the disparate levels of acceptance of this activity. Regardless, developing a definition and management approach to "native invasive species" and communicating this concept with the public will likely remain a challenge unique to each urban forested natural area.

Public concern over the use of herbicides leads managers to pursue alternative methods and techniques of invasive species control. For example, managers in the Old Forest found greater public acceptance of basal bark application when using long-handled four-inch foam rollers rather than backpack sprayers. Also, the Woodland found effective control of invasive forbs using 30% vinegar concentrate mixed with a tablespoon of soap and one cup of Epsom salt per gallon. However, the long-term ecological effects of these alternative treatments remain unclear.

New and challenging invasive species are constantly being discovered at both sites. For example, Italium arum (*Arum italicum*) is abundant in both systems. Attempts to control with non-selective herbicides appear unsuccessful without a high percentage of surfactant in the tank mix, which raises concerns over the health of native herpetofauna. However, digging the plant from the ground often results in accidental distribution of the abundant bulblets and potentially the unintentional spread of the species. The Woodland is experimenting with repeated manual cutting of all photosynthetic material to drain the plants' energy reserves, which may be effective for small areas but is potentially infeasible for larger sites. The Old Forest is experimenting with

the use of a weed torch in conjunction with limited herbicide applications. Best practices around control of particularly tenacious species would be helpful to urban forested natural area managers.

Whether using natural or artificial regeneration, the need to match a species to its site is critical in urban forested natural areas. In both the Woodland and the Old Forest, an emphasis from stakeholders has been to use hyper-local sources, i.e., seedlings grown from seeds collected in the forest. However, the need to maximize resilience to climate change by increasing genetic diversity is also recognized. Clarity on balancing these competing interests would be helpful to urban forested natural area managers.

CONTACT AND ADDITIONAL RESOURCES

Anna N. Vo
Memphis Botanic Garden, anna.vo@membg.org

Lee E. Bridges
Overton Park Conservancy, ebridges@overtonpark.org

Allan Trently
Tennessee Department of Environment and Conservation, Allan.Trently@tn.gov

Plant names were retrieved from the USDA Plants Database (USDA, 2024).

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