

Forest Health Data Summaries for **Johnstown Flood National Memorial (2007 – 2024)**

Background

Forests are crucial resources in Johnstown Flood National Memorial (JOFL), providing an important backdrop for interpreting the historic lakebed, recreation opportunities for park visitors, habitat for countless animal and plant species, as well as protecting soil stability and stream health. The following forest health summaries are based on data collected in Eastern Rivers and Mountains Inventory and Monitoring Network (ERMN) long-term forest health monitoring plots between 2007 - 2024. There are 12 ERMN forest health monitoring plots in JOFL that are sampled on a 4-year cycle and were visited four times during this reporting period.

Within each forest plot, tree and stand measurements, including an assessment of deer browse impact, are made within fixed-area, circular plots, 15-m in radius. Tree regeneration data are collected in four 2-m radius circular microplots embedded within each plot. Plots are permanently marked and measured at the same location every cycle. For a more detailed description of our methods, refer to the [ERMN forest monitoring protocol](#).

This document provides data summaries and interpretations of trends in tree regeneration, deer browse impacts, forest structure, tree canopy composition, and invasive plants to help inform National Park Service (NPS) staff of forest health condition and trends.

Tree Regeneration and Deer Impacts

An abundant regeneration layer that is composed of tree seedlings and saplings of varying sizes is an important component of a healthy forest. Regeneration debt occurs when forests lack sufficient regeneration, or the species composition in the regeneration layer does not match the canopy. JOFL has a forest regeneration status of Probable Failure, meaning that the park is experiencing regeneration failure due to insufficient and declining tree regeneration ([Miller et al. 2023](#)).

On average, seedling and sapling abundance is declining within JOFL, with declines observed across all height classes except 30 – 100 cm (Figure 1). However, trends in seedling abundance and height class are not homogeneous across the park (Maps 1 and 2). Although the majority of the seedlings are in the smallest height class (5 - 15 cm in height), the increases in 30 – 100 cm height seedlings indicate that some seedlings are maturing. The regeneration stocking index, which quantifies whether native seedling and sapling densities are sufficient to restock a forest canopy, indicates that 25% of plots in JOFL are severely understocked, 42% are moderately stocked, and 33% are sufficiently stocked with enough seedlings and sapling to replace the canopy (Map 5).

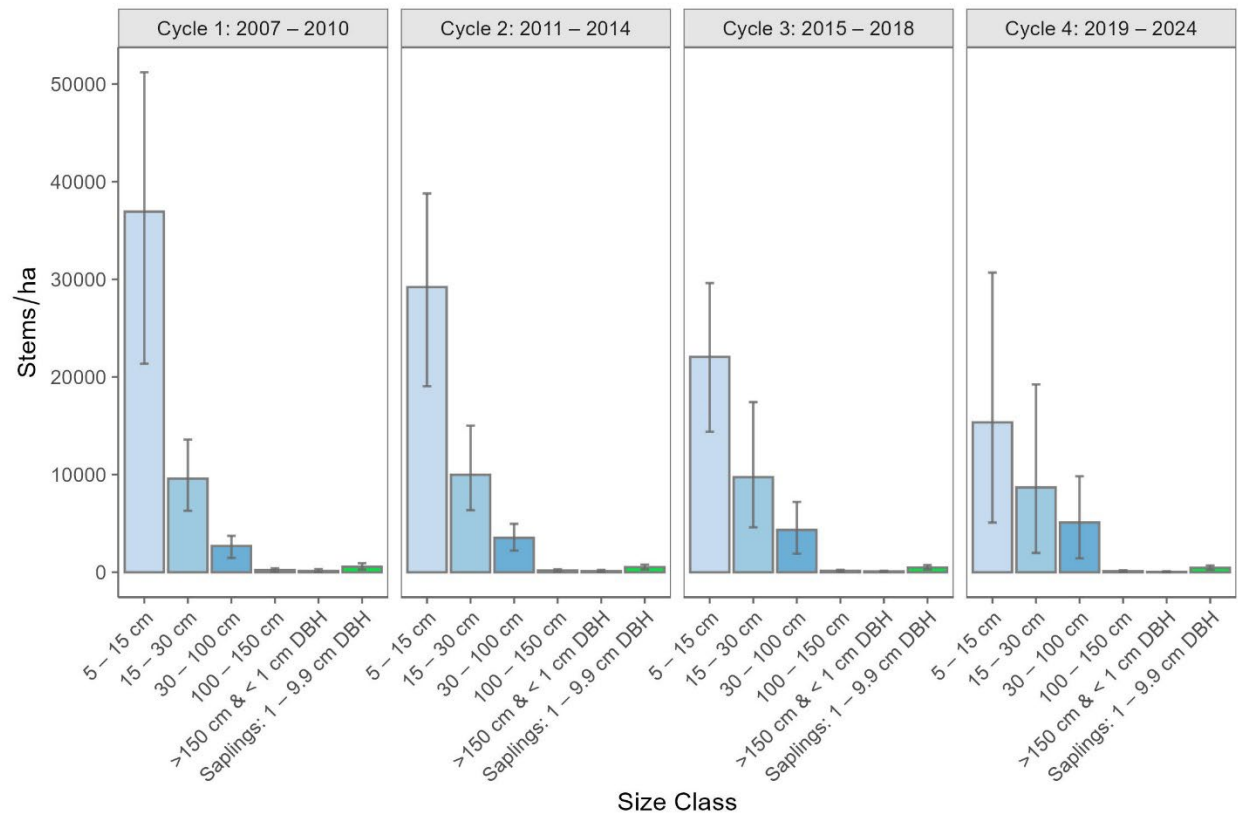


Figure 1. Trends in tree regeneration densities by height class in Johnstown Flood National Memorial, 2007 – 2024. Error bars are 95% bootstrapped confidence intervals to account for non-normal error.

In general, the seedling and sapling layers in JOFL are dominated by red maple (*Acer rubrum*) and black cherry (*Prunus serotina*), which is very similar to the dominant species in the forest canopy (compare Maps 3 and 4). Abundance of red maple seedlings and saplings has dramatically declined over the monitoring period (Figures 2 and 3), though there is little risk of red maple disappearing from the park's forest due to its tolerance of a wide range of environmental conditions. Black cherry saplings showed similar dramatic declines, but black cherry seedlings were relatively stable despite natural fluctuation. Notably, ash is common as seedlings and saplings in some sections of the park, though their future is uncertain due to threats from the emerald ash borer (*Agrilus planipennis*). Thus far, ash saplings have seen slight but steady increases, while ash seedlings peaked following emerald ash borer infestation when stressed trees produced an abundance of seeds.

Deer browse impacts are assessed on a scale of 1 – 5, with 1 representing unnaturally low impacts from deer exclusion and 5 representing severe impacts evidenced by a distinct browse line. Impacts of medium (3) or higher typically require management intervention to maintain adequate forest regeneration. In the most recent 4-year survey, many plots (50%) were rated as medium impact, with 17% of plots assigned low impacts and 33% of plots rated as high deer impacts (Map 6).

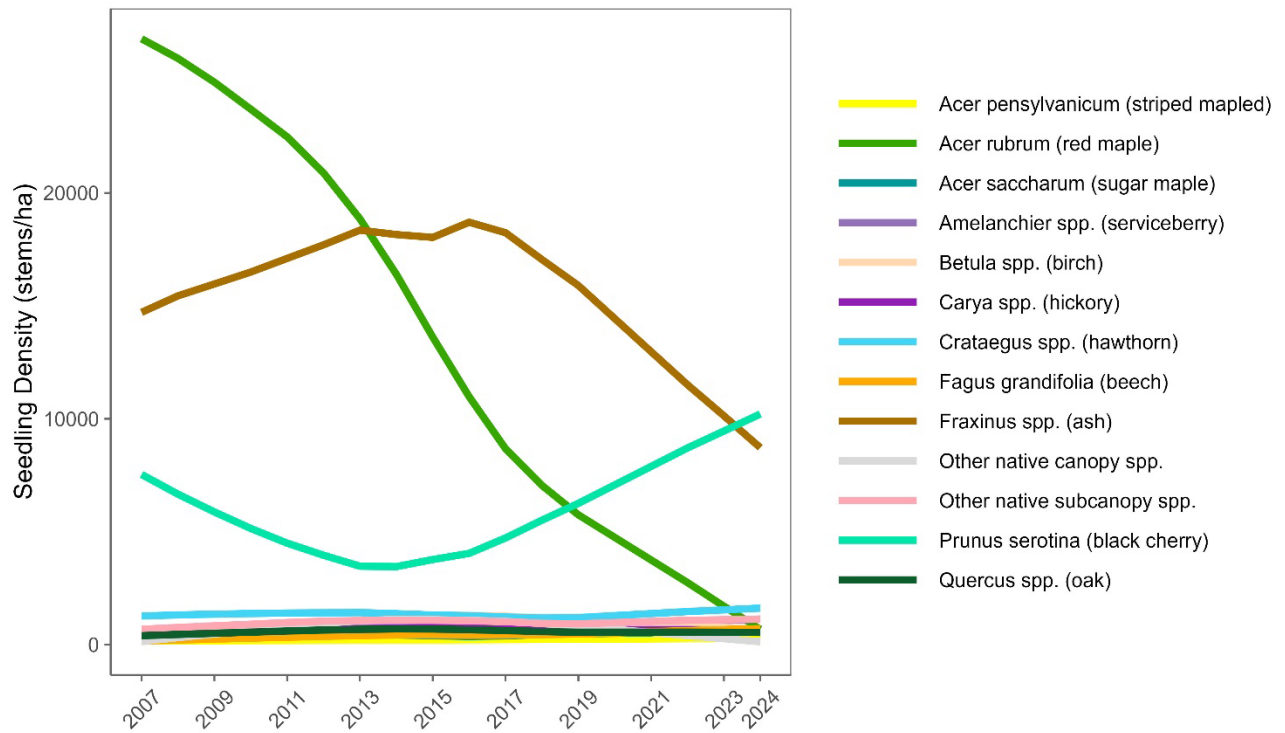


Figure 2. Trends in seedling density by species group and sample year in Johnstown Flood National Memorial. Local regression smoothing approximated a linear trend between consecutive sample events per panel.

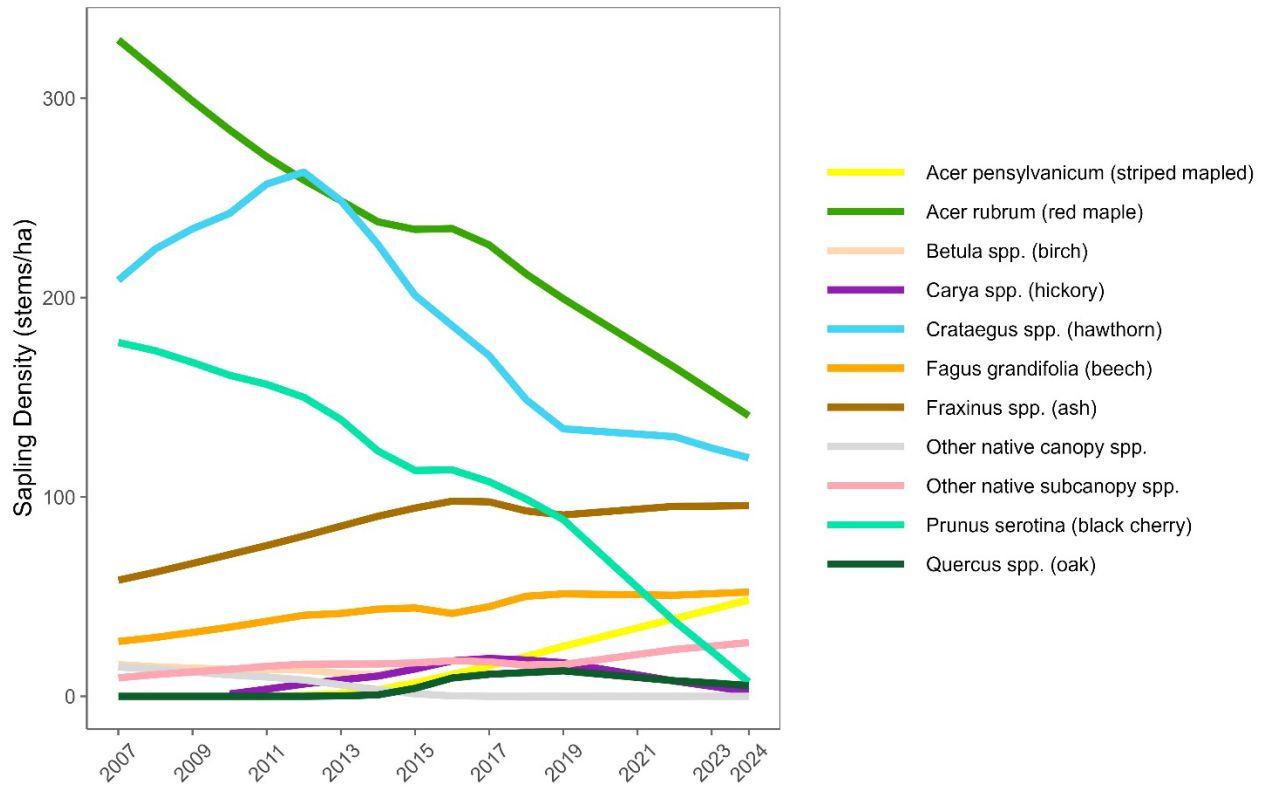


Figure 3. Trends in sapling density by species group and sample year in Johnstown Flood National Memorial. Local regression smoothing approximated a linear trend between consecutive sample events per panel.

Forest Structure and Canopy Composition

Based on tree cores collected near our plots, trees in JOFL are primarily 70 to 80 years old, with the oldest cored tree, a black cherry, originating nearly 95 years ago. Despite being young to middle-aged, the forests in JOFL have more complex older forest structure, such as large live trees, than surrounding forests sampled by the US Forest Service ([Miller et al. 2016](#)). Therefore, the protection and management of park forests has importance beyond the boundaries of the park. Canopy cover within monitoring plots has been increasingly or consistently high and stable, as expected in young and middle-aged forests (Map 7). The abundance of downed coarse woody debris (Map 10) is another important component of forest structure that provides wildlife habitat and nutrient cycling.

Forest canopies in JOFL are strongly dominated by red maple and black cherry, which show typical slight increases in basal area with accompanying slight declines in tree density (Figures 4 and 5, Map 4). Black birch (*Betula lenta*) is a common and stable associate canopy tree, while white pine (*Pinus strobus*) is becoming more common in JOFL forests. Notably, mature ash trees (*Fraxinus* spp.) have been nearly eliminated by emerald ash borer during this period.

Aside from emerald ash borer's impact on ash trees, several other pests threaten JOFL's forests. American beech, which comprise a small fraction (<2%) of trees in JOFL, have been exposed to beech bark disease (caused by the combination of a scale insect and a fungus) for around two decades. However, the recently introduced beech leaf disease, caused by an invasive microscopic nematode (*Litylenchus crenatae* subsp. *mccannii*), is a more serious threat, causing mortality in saplings first, followed by canopy tree death. Spongy moths (*Lymantria dispar*), also known to occur in JOFL, typically cause defoliation on oaks and other trees, but are unlikely to cause widespread mortality in JOFL due to low abundance of oaks (<1% of total basal area).

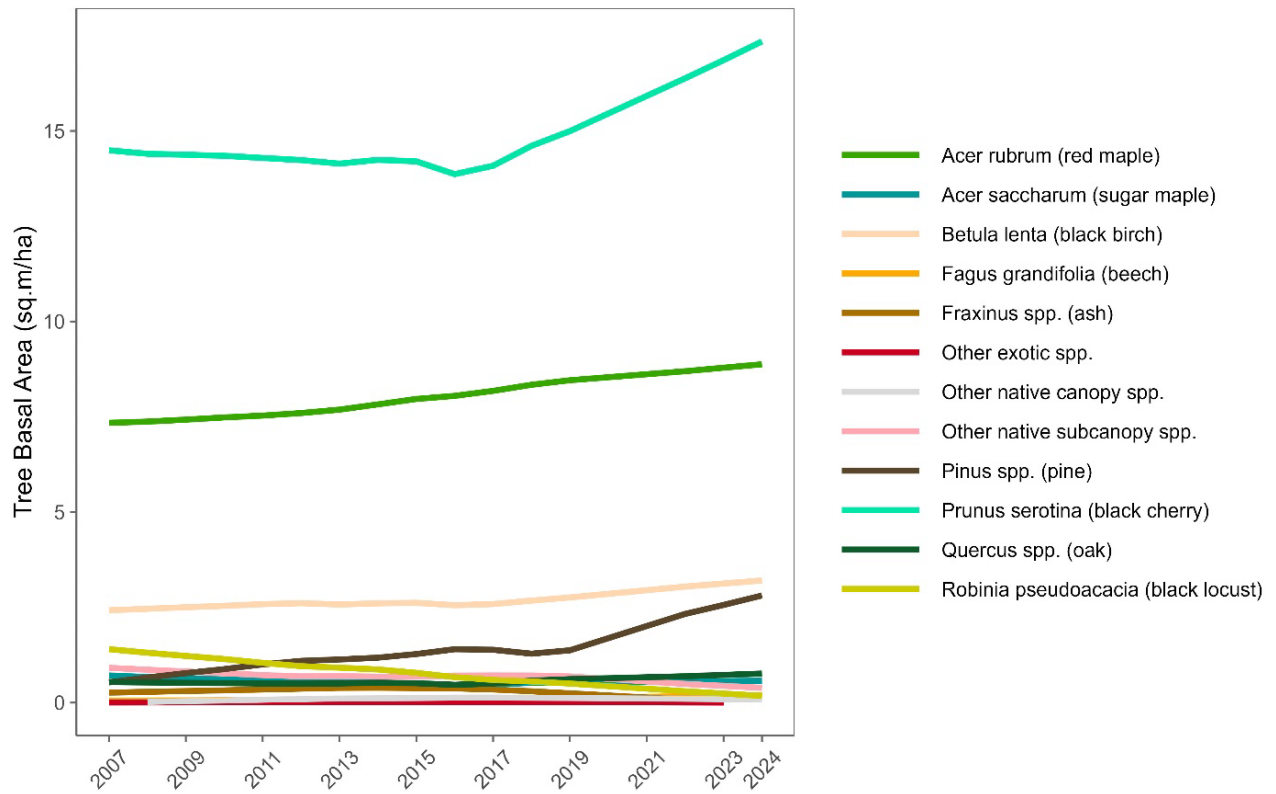


Figure 4. Trends in tree basal area by species group and sample year in Johnstown Flood National Memorial. Local regression smoothing approximated a linear trend between consecutive sample events per panel.

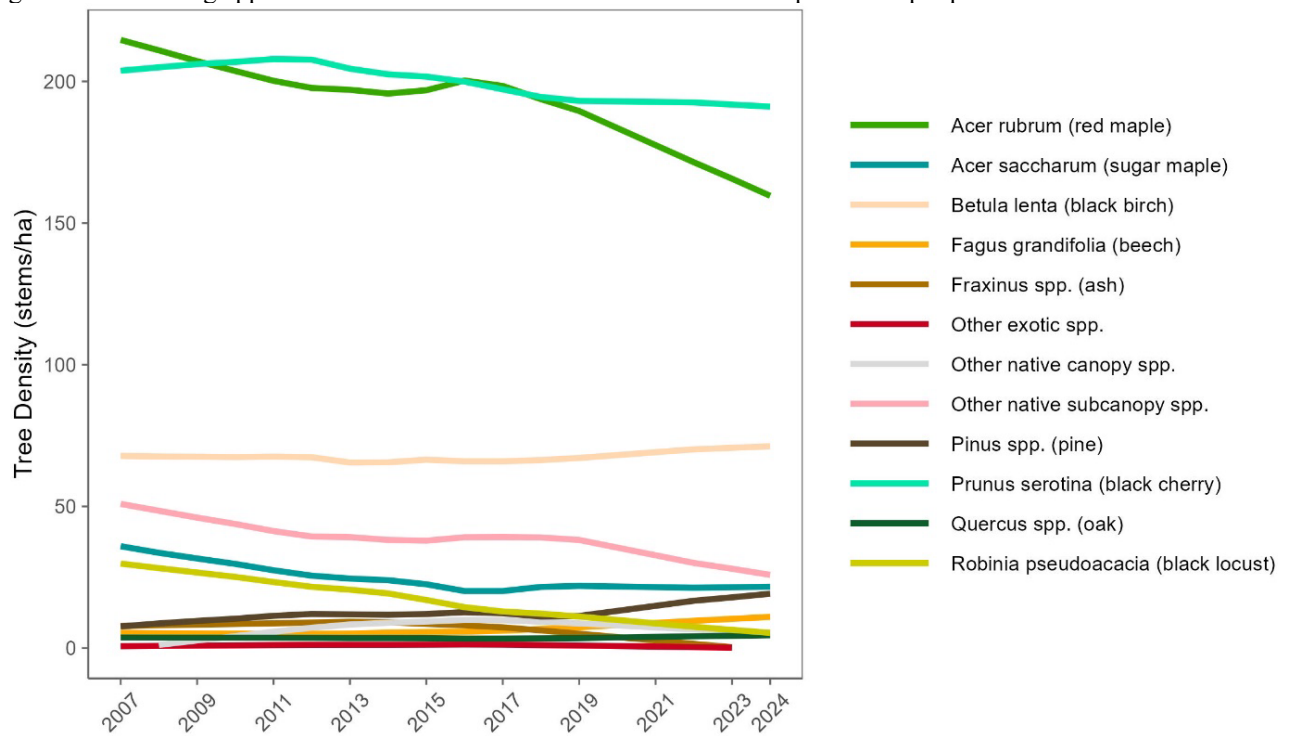


Figure 5. Trends in tree density by species group and sample year in Johnstown Flood National Memorial. Local regression smoothing approximated a linear trend between consecutive sample events per panel.

Invasive Species

Invasive plants can have dramatic impacts on forest health by altering forest structure and diversity, suppressing tree regeneration, altering nutrient cycling and disturbance regimes, and reducing native species diversity. In JOFL, invasive plants are not uniformly distributed throughout the park (Maps 8 and 9). Very few to no invasive plants were detected in forest plots in the Picnic Area, while exotic honeysuckles (*Lonicera* spp.), multiflora rose (*Rosa multiflora*) and privet (*Ligustrum* spp.) are common in other forested sections of the park. The increasing abundance of invasive shrubs in JOFL ([Miller et al. 2021](#)) highlights the importance of implementing strategic invasive plant management, especially to protect the high quality forests in the Picnic Area.

Conclusions

Forests are an important ecological and cultural resource in JOFL that provide under-represented and regionally significant forest habitat. Future management priorities could include forests impacted by storms or pests, where canopy gaps will increase light to the forest floor. Continued investment in invasive plant management, through early detection and rapid response, release of approved biological controls, and strategic invasive plant management in high priority habitats, will bolster forest resilience.

Author Contributions

This summary document, completed in December 2025, was written by Stephanie Perles, ERMN Plant Ecologist. Maps and figures were created by Hannah Cabell (ERMN Forest Crew Member) and Stephanie Perles. This document was adapted from materials developed by staff from the NPS Northeast Temperate and Mid-Atlantic Inventory and Monitoring Networks, including Kate Miller (NETN/MIDN Quantitative Ecologist), Camilla Seirup (former NETN/MIDN Forest Crew Leader), and Jamie Attanasio (NETN/MIDN Forest Crew Member).



Map 1. Native Canopy-Forming Tree Regeneration by Cycle

Trends in tree regeneration, including seedlings and saplings of native canopy-forming species, observed in forest plots during four monitoring cycles spanning 2007 - 2024. Plot-level regeneration stem densities range from 5,570 to 125,135 per hectare. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Regeneration densities

- Cycle 1: 2007 to 2010
- Cycle 2: 2011 to 2014
- Cycle 3: 2015 to 2018
- Cycle 4: 2019 to 2024

Plot number

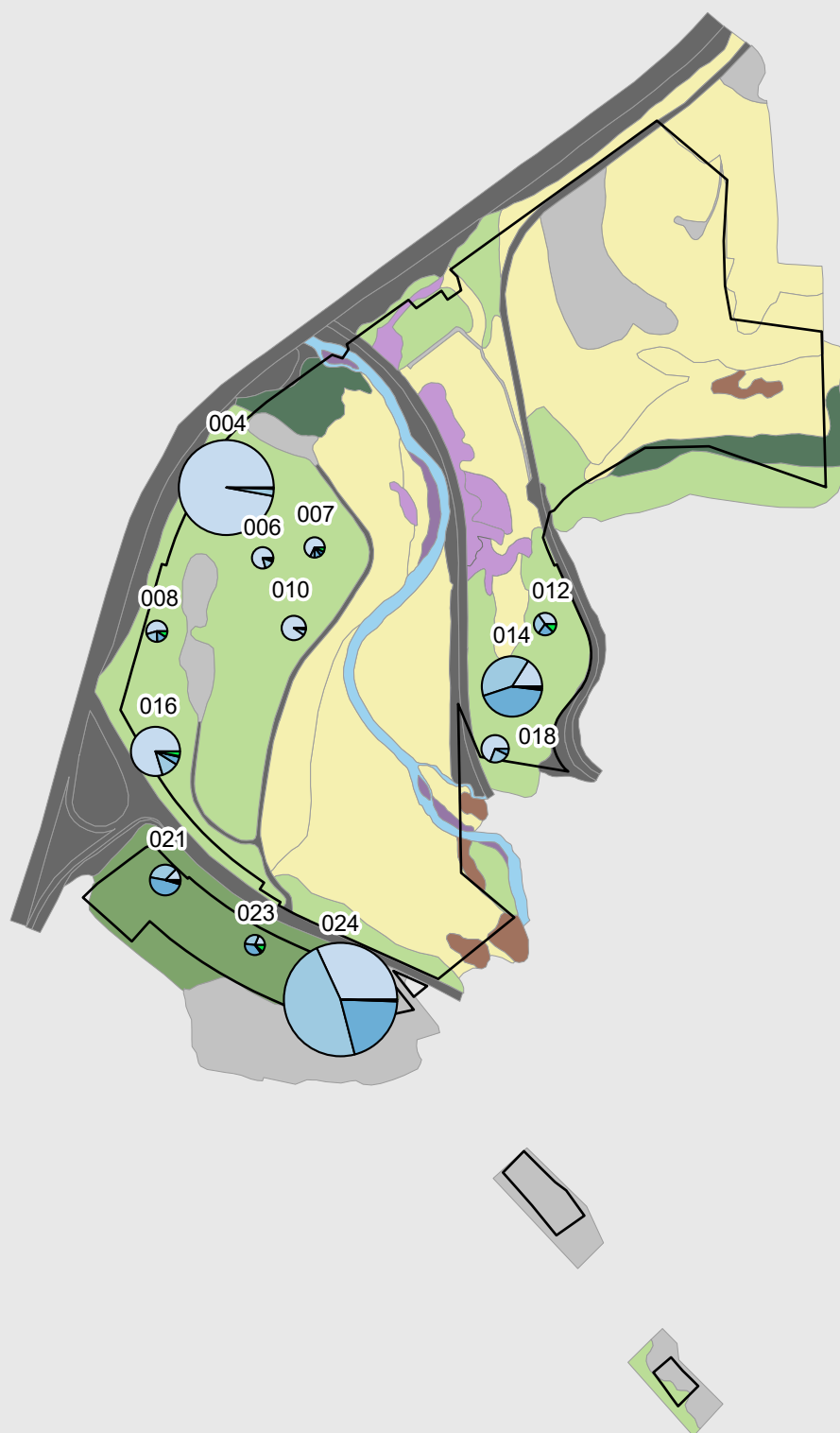


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Map 2. Native Canopy-Forming Tree Regeneration by Size Class

Tree regeneration, including seedlings and saplings of native canopy-forming species, by size class observed in forest plots during the last census (2019 - 2024). Plot-level regeneration stem densities range from 5,371 to 111,011 per hectare. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Regeneration densities

- Seedlings 5 to 15 cm
- Seedlings 15 to 30 cm
- Seedlings 30 to 100 cm
- Seedlings 100 to 150 cm
- Seedlings > 150 cm
- Saplings

Plot number

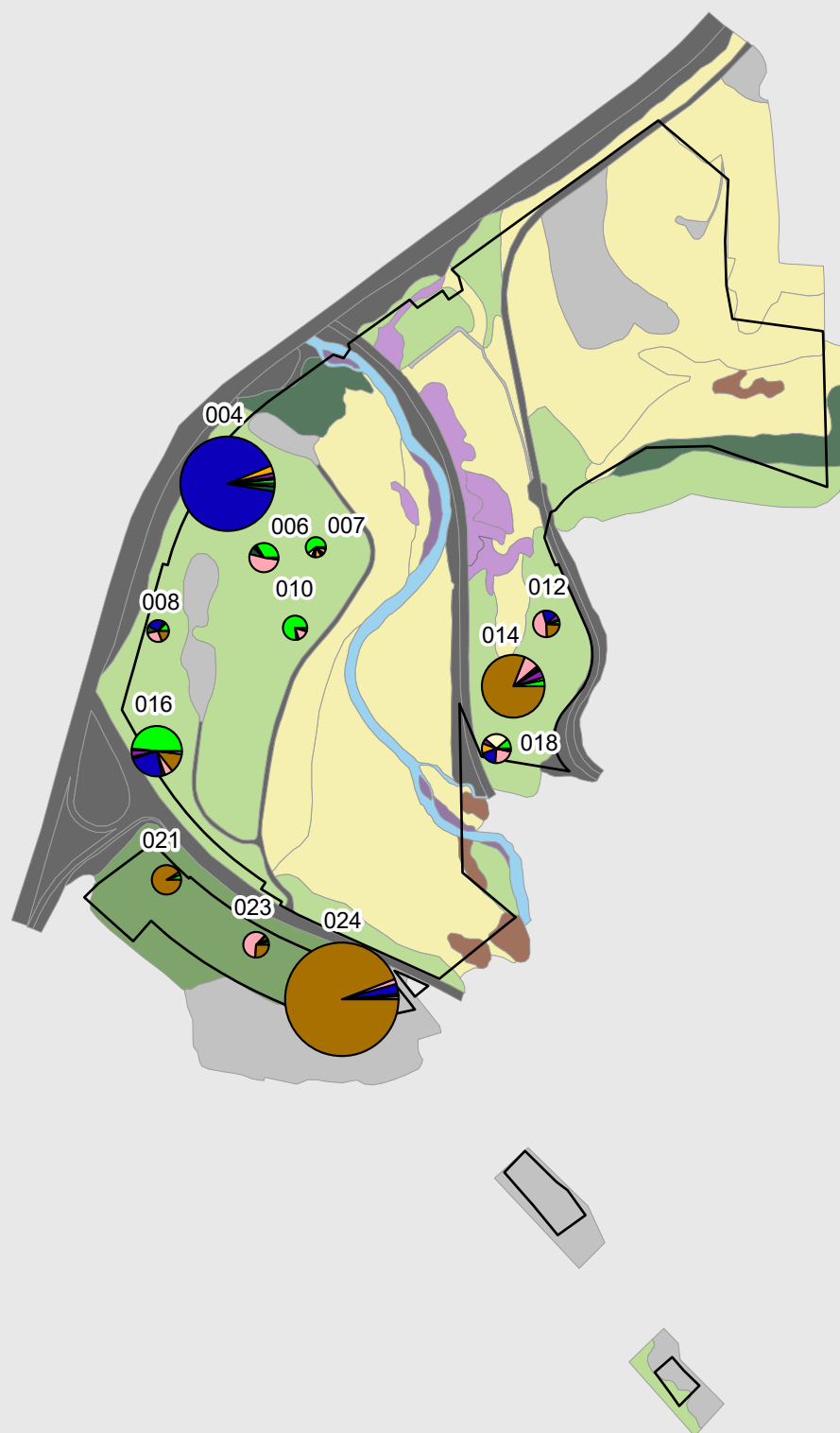


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Map 3. Tree Regeneration Composition

Tree regeneration, including seedlings and saplings, by species group observed in forest plots during the last census (2019 - 2024). Pie size is proportional to plot-level regeneration density. Plot-level regeneration stem densities range from 7,560 to 112,602 per hectare. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Tree regeneration composition

- Acer spp. (Maple)
- Betula spp. (Birch)
- Carya spp. (Hickory)
- Fagus grandifolia (Beech)
- Fraxinus spp. (Ash)
- Liriodendron tulipifera (Tulip poplar)
- Magnolia spp. (Magnolia)
- Pinus spp. (Pine)
- Prunus spp. (Cherry)
- Quercus spp. (Oak)
- Ulmus spp. (Elm)
- Other native canopy species
- Other native subcanopy
- Exotic species

Plot number

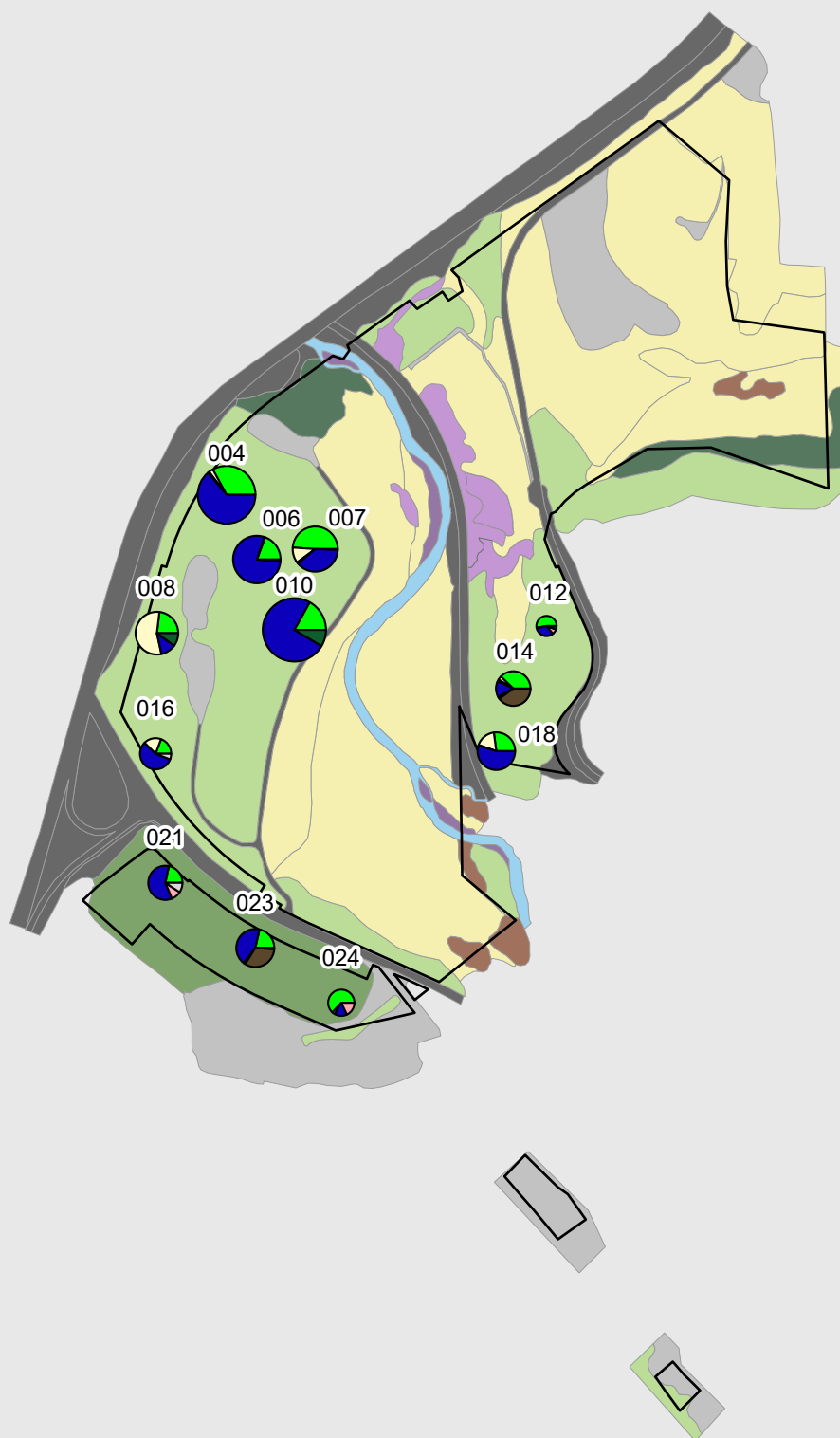


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Map 4. Tree Canopy Composition

Tree composition, by species group, observed in forest plots sampled in the most recent census (2019-2024). Pie size is proportional to plot-level tree basal area. Total basal area ranges from 14.5 to 51.2 m²/ha. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Tree regeneration composition

- Acer spp. (Maple)
- Betula spp. (Birch)
- Carya spp. (Hickory)
- Fagus grandifolia (Beech)
- Fraxinus spp. (Ash)
- Liriodendron tulipifera (Tulip poplar)
- Magnolia spp. (Magnolia)
- Pinus spp. (Pine)
- Prunus spp. (Cherry)
- Quercus spp. (Oak)
- Ulmus spp. (Elm)
- Other native canopy species
- Other native subcanopy
- Exotic species

Plot number



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Map 5. Tree Regeneration Stocking Index

Regeneration stocking index for the most recent census (2019-2024) quantifies whether regeneration is sufficient to restock a forest canopy given deer browse impacts. This index is a weighted sum of native canopy-forming tree seedling and sapling and is reported as a plot-wide average from four microplots. Index values range from 18.25 to 204.75 Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Stocking index

- < 30: Severely understocked, regeneration is insufficient to replace the forest canopy.
- 30 - 100: Moderately stocked regeneration, sufficient for areas with low deer impacts.
- 100 - 200: Sufficient regeneration to replace forest canopy in areas with moderate (or fewer) deer impacts.
- > 200: Sufficient regeneration to replace forest canopy in areas with high (or fewer) deer impacts.

Plot number



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Map 6. Index of Deer Browse Impacts

Index of deer browse impacts observed in forest plots in the most recent census (2019-2024). Each plot is sampled on a 4-year cycle, with one quarter of the plots sampled every year. Deer browse impacts are assessed on a scale of 1-5, with 1 representing no impact and 5 representing severe impacts. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Deer browse impact

- 2) Low impact: Deer-preferred (DP) species abundant and of varying heights.
- 3) Medium impact: DP species present, but mostly under 30 cm tall. DP herbs present but stunted and flowering is uncommon.
- 4) High impact: DP species are rare to absent. Non-preferred and browse-resilient vegetation (e.g. beech) limited in height by deer browse. DP herbs absent or severely stunted.

Plot number

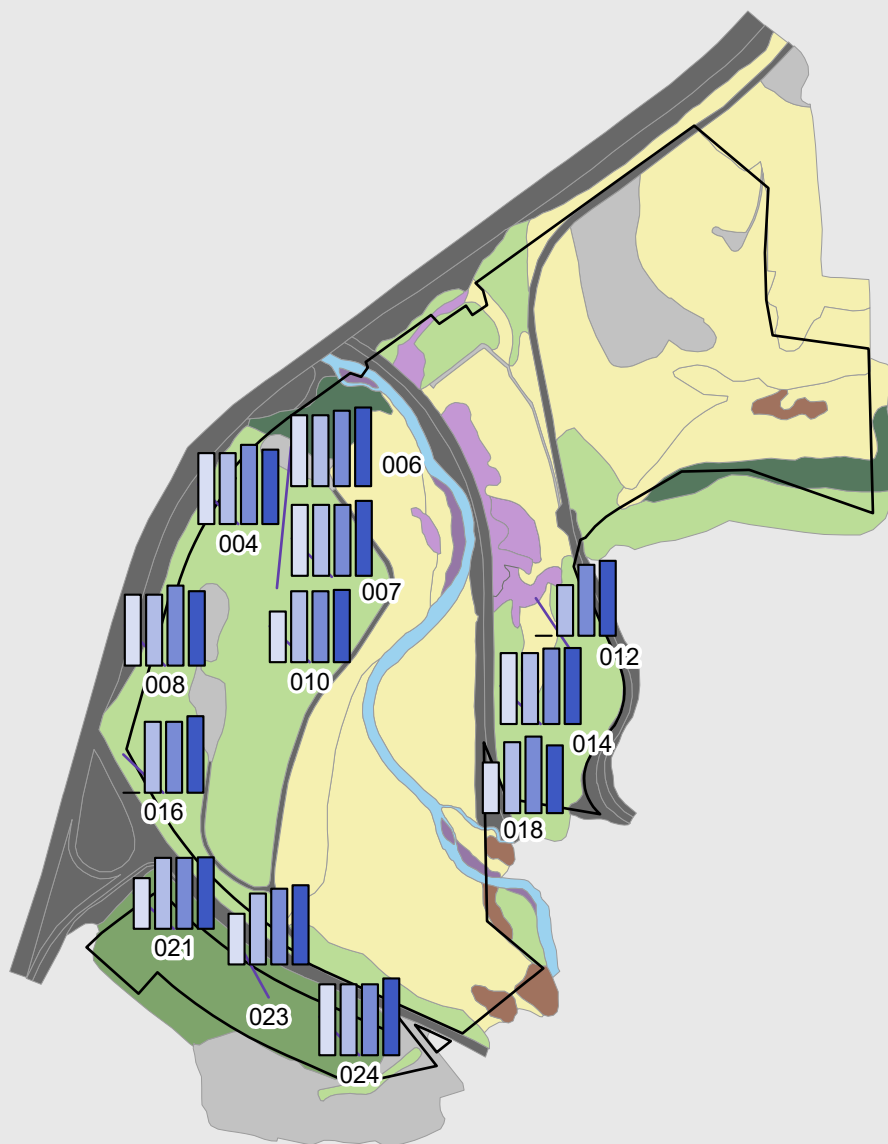


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Map 7. % Canopy Cover by Cycle

Trends in tree canopy cover in forest plots from 2007-2024. Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Canopy cover ranges from 63% to 99%. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

% Canopy cover

- Cycle 1: 2007 to 2010
- Cycle 2: 2011 to 2014
- Cycle 3: 2015 to 2018
- Cycle 4: 2019 to 2024

Plot number

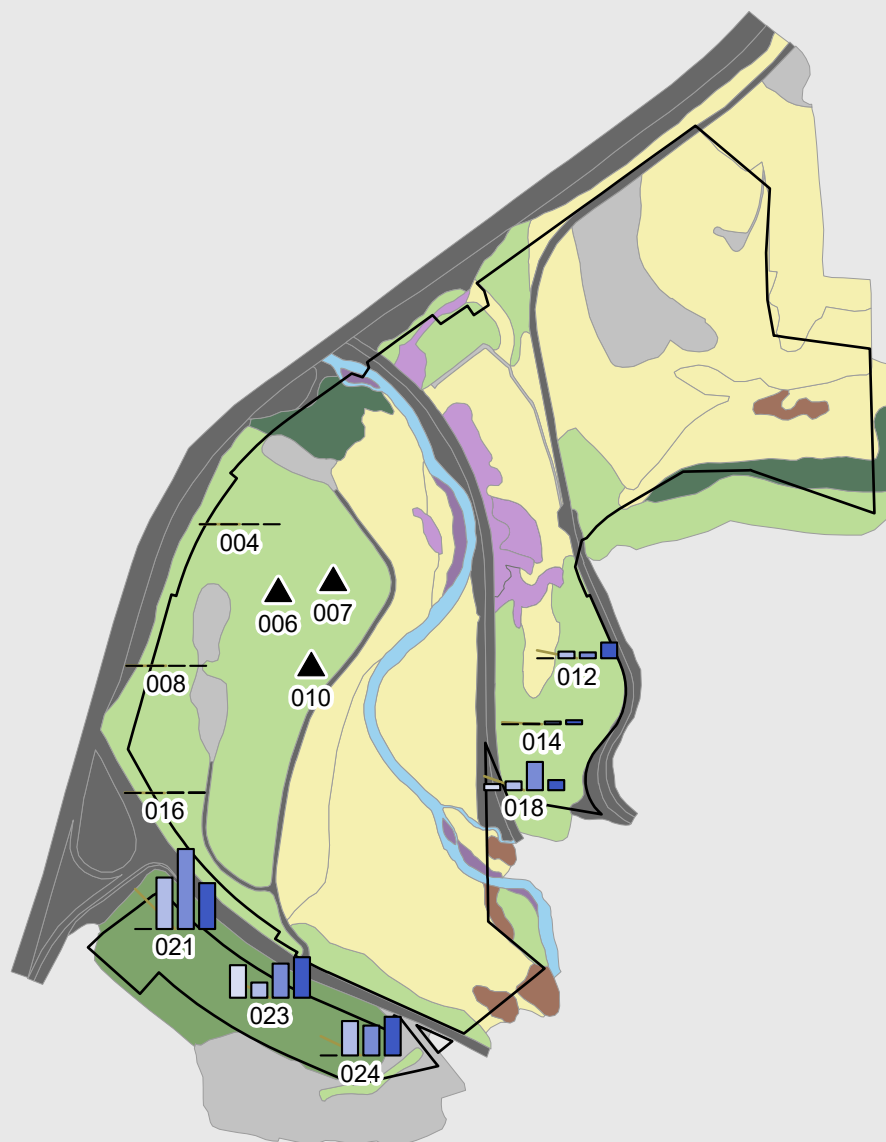


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Map 8. Invasive % Cover by Cycle

Trends in percent cover of invasive species observed in quadrats in forest plots sampled from 2007-2024. Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Average invasive cover per plot ranges from 0.008 to 38.5%. Cover exceeding 100% indicates multiple invasive species were overlapping within the quadrats. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

% Canopy cover

- Cycle 1: 2007 to 2010
- Cycle 2: 2011 to 2014
- Cycle 3: 2015 to 2018
- Cycle 4: 2019 to 2024
- No invasive spp. present

Plot number

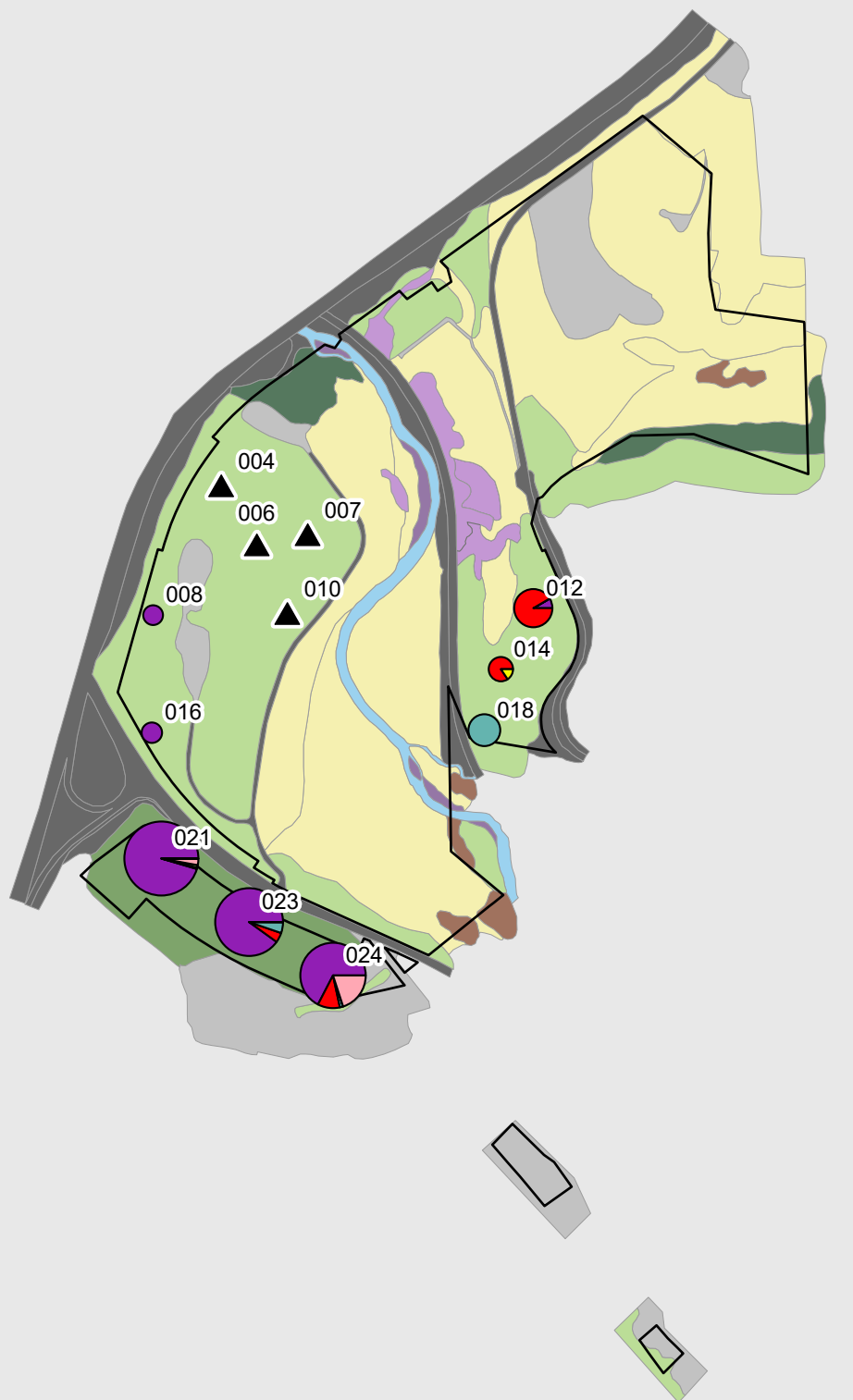


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Map 9. Invasive % Cover by Species

Percent cover of invasive plant species observed in quadrats in forest plots sampled in the most recent census (2019-2024). The top 10 species or genera are displayed individually; less common species are grouped as 'Other invasive spp.'. Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to total invasive cover (range: 0.01 to 22.1%). Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Invasive species

- Alliaria petiolata* (Garlic Mustard)
- Anthoxanthum odoratum* (Sweet Vernal Grass)
- Berberis thunbergii* (Japanese Barberry)
- Celastrus orbiculatus* (Asiatic Bittersweet)
- Elaeagnus umbellata* (Autumn Olive)
- Hesperis matronalis* (Dame's Rocket)
- Lonicera exotic* (Exotic Honeysuckle)
- Ligustrum* spp. (Privet)
- Microstegium vimineum* (Japanese Stiltgrass)
- Persicaria* spp. (Smartweeds)
- Reynoutria* spp. (Knotweeds)
- Rosa multiflora* (Multiflora Rose)
- Other invasive spp.
- No invasive spp. present

Plot number

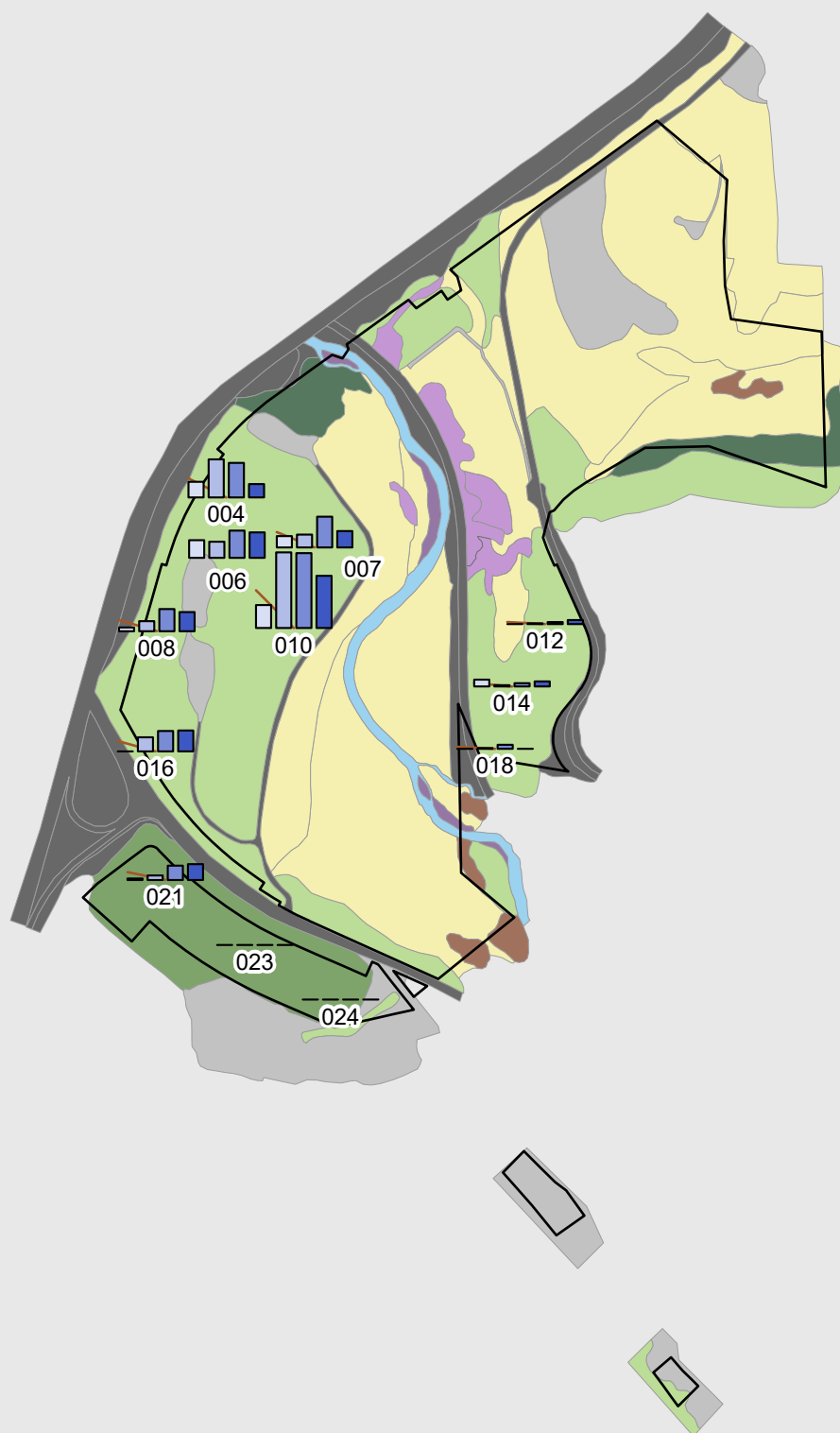


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Map 10. Coarse Woody Debris by Cycle

Trends in coarse woody debris (CWD) volume observed in plots sampled from 2007-2024. Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. CWD volume ranges from 0.8 to 85.3 m³/ha. Reporting Date: 12/15/2025.



Vegetation types

- Deciduous forest
- Conifer forest
- Successional forest
- Mixed forest
- Floodplain forest/wetland
- Open field
- Open wetland
- Developed land
- Transportation corridor
- Park Boundary

Regeneration densities

- Cycle 1: 2007 to 2010
- Cycle 2: 2011 to 2014
- Cycle 3: 2015 to 2018
- Cycle 4: 2019 to 2024

Plot number



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