



ARTICLE

Forest Regeneration 2023

Anacostia Park (<https://www.nps.gov/anac/>), Antietam National Battlefield (<https://www.nps.gov/anti/>), Baltimore-Washington Parkway (<https://www.nps.gov/bawal/>), Catoctin Mountain Park (<https://www.nps.gov/cato/>), Chesapeake & Ohio Canal National Historical Park (<https://www.nps.gov/choh/>), Fort Dupont Park (<https://www.nps.gov/fodu/>), Fort Foote Park (<https://www.nps.gov/fofo/>), Fort Washington Park (<https://www.nps.gov/fowal/>), George Washington Memorial Parkway (<https://www.nps.gov/gwmp/>), Glen Echo Park (<https://www.nps.gov/glec/>), Great Falls Park (<https://www.nps.gov/grfa/>), Greenbelt Park (<https://www.nps.gov/gree/>), Harpers Ferry National Historical Park (<https://www.nps.gov/hafe/>), Kenilworth Park & Aquatic Gardens (<https://www.nps.gov/keaq/>), Manassas National Battlefield Park (<https://www.nps.gov/mana/>), Monocacy National Battlefield (<https://www.nps.gov/mono/>), National Capital Parks-East (<https://www.nps.gov/nace/>), Oxon Cove Park & Oxon Hill Farm (<https://www.nps.gov/oxhi/>), Piscataway Park (<https://www.nps.gov/pisc/>), Prince William Forest Park (<https://www.nps.gov/prwi/>), Rock Creek Park (<https://www.nps.gov/rocr/>), Theodore Roosevelt Island (<https://www.nps.gov/this/>), Wolf Trap National Park for the Performing Arts (<https://www.nps.gov/wotr/>)

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◀▶ Growth of Box Elder Seedlings into Saplings at a Forest Plot at Rock Creek Park between 2018 and 2023



Left image

2018

Credit: NPS



Right image

2023

Credit: NPS

Overview

Forest regeneration in national parks of the National Capital Region (NCR) continues to show slow and steady improvement. While the stocking index remains relatively unchanged for most parks, seedling densities are increasing. Continued forest management efforts are important for preserving this progress and fully restoring regeneration in these forests for the future.

The Significance of Regeneration

Forests make up around three quarters of all landcover in national parks of the NCR. These protected forests (part of the Eastern Deciduous Forest ecosystem), have an ecological value [even greater](https://www.sciencedirect.com/science/article/pii/S0378112717319758?via%3Dihub) (<https://www.sciencedirect.com/science/article/pii/S0378112717319758?via%3Dihub>) than forests in the surrounding landscape due to their large area and high biodiversity. For these forests to regenerate, new tree seedlings and saplings must grow and fill out canopy gaps left when larger trees die. This process is crucial for sustaining forests as well as the wildlife that lives within them.

Threats to Regeneration

Due to high populations of white-tailed deer, combined with increases in invasive plants, forests in most eastern national parks have regeneration levels [too low to maintain forests in the long term](https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.2837) (<https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.2837>). Forest pests and pathogens and climate change pose additional threats. The sustained impacts of these stressors are significantly changed forest structure and conversion of forests to invasive shrub thickets.

The National Capital Region, Inventory & Monitoring Network (NCRN I&M) has been collecting forest data since 2006 to better assess these threats and forest conditions.

Gradual Improvements to the Stocking Index

Forest regeneration is slowly improving across the region, with the most recent improvements at Monocacy National Battlefield, in the western portion of the Chesapeake & Ohio Canal National Historical Park, at Manassas National Battlefield Park, and at Rock Creek Park when compared to [2022 forest regeneration data](https://www.nps.gov/articles/000/forest-regeneration-2022.htm) (<https://www.nps.gov/articles/000/forest-regeneration-2022.htm>) (Figure 1).

The Stocking Index is an important metric for measuring forest regeneration. The advantage of the stocking index is that it uses data across the entire park and takes into account all sizes of regenerating trees.

It calculates regeneration potential on a plot-by-plot basis based on the abundance and size of saplings and seedlings. Because they are more likely to survive and grow into mature trees, larger seedlings and saplings have more influence on the stocking index score.

A park is considered to have sufficient regeneration if the stocking index shows that 67% of its forest plots are adequately stocked with seedlings and small saplings. Since forest monitoring began in 2006, no NCR park has had more than 30% of their plots adequately stocked.

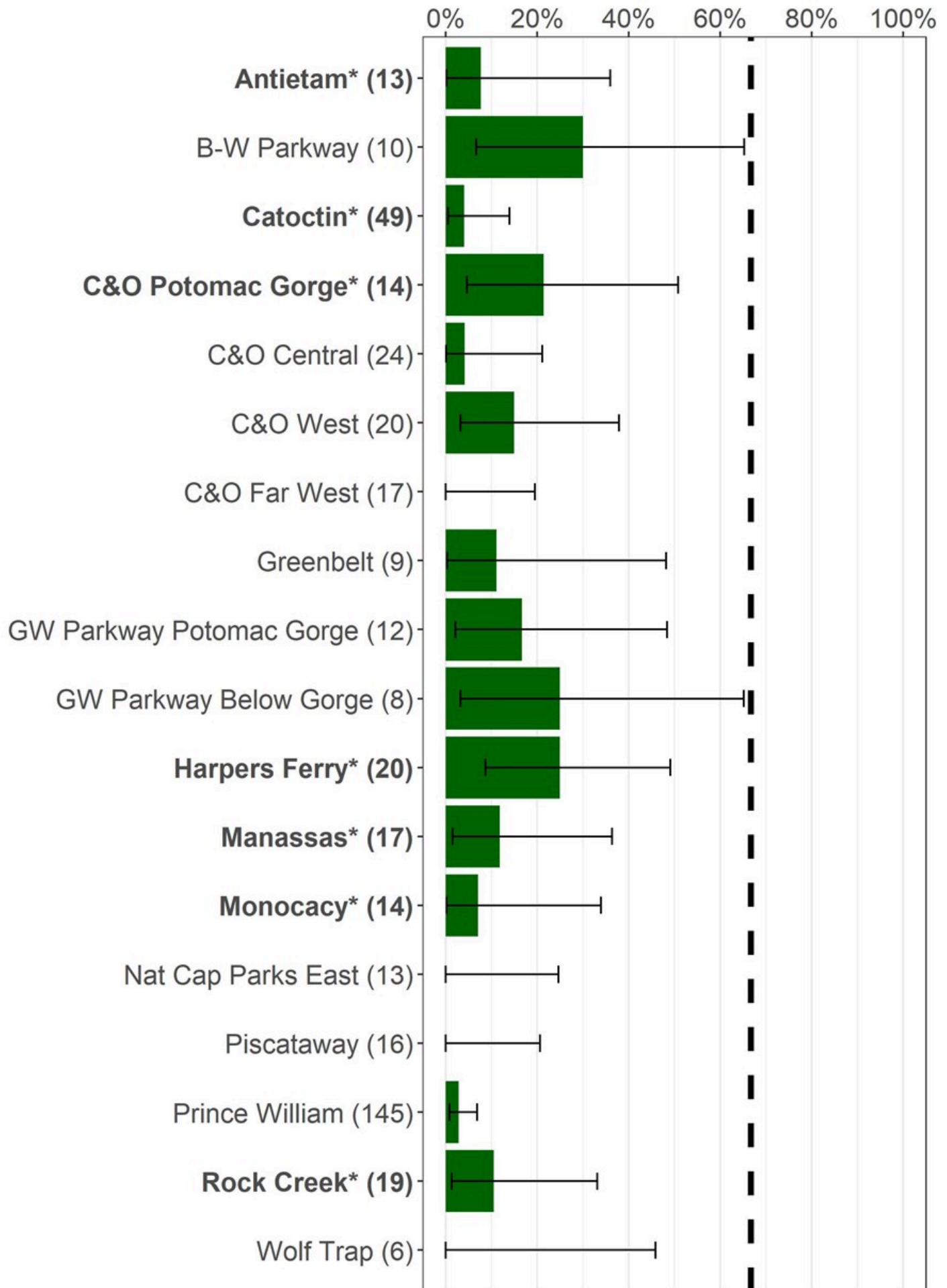


Figure 1. Stocking Index 2019-2023. For a park or smaller distinct park area to have healthy regenerative capacity, 67% of plots must be adequately stocked (dashed line). The number of NCRN forest monitoring plots is listed in parenthesis after each park name. Asterisks show parks managing deer. T-shaped error bars indicate 95% confidence intervals.

NPS

Narrative Description of Figure 1

Positive Change in Seedling Density

There was a general increase in seedling density in most parks (Figure 2). This trend is consistent with previous years. But while seedling density is improving in the region, it does not guarantee future regeneration in these forests. It takes many years for seedlings to grow into saplings and resilient mature trees, and they are vulnerable to many threats along the way.

Seedlings 2009-2023

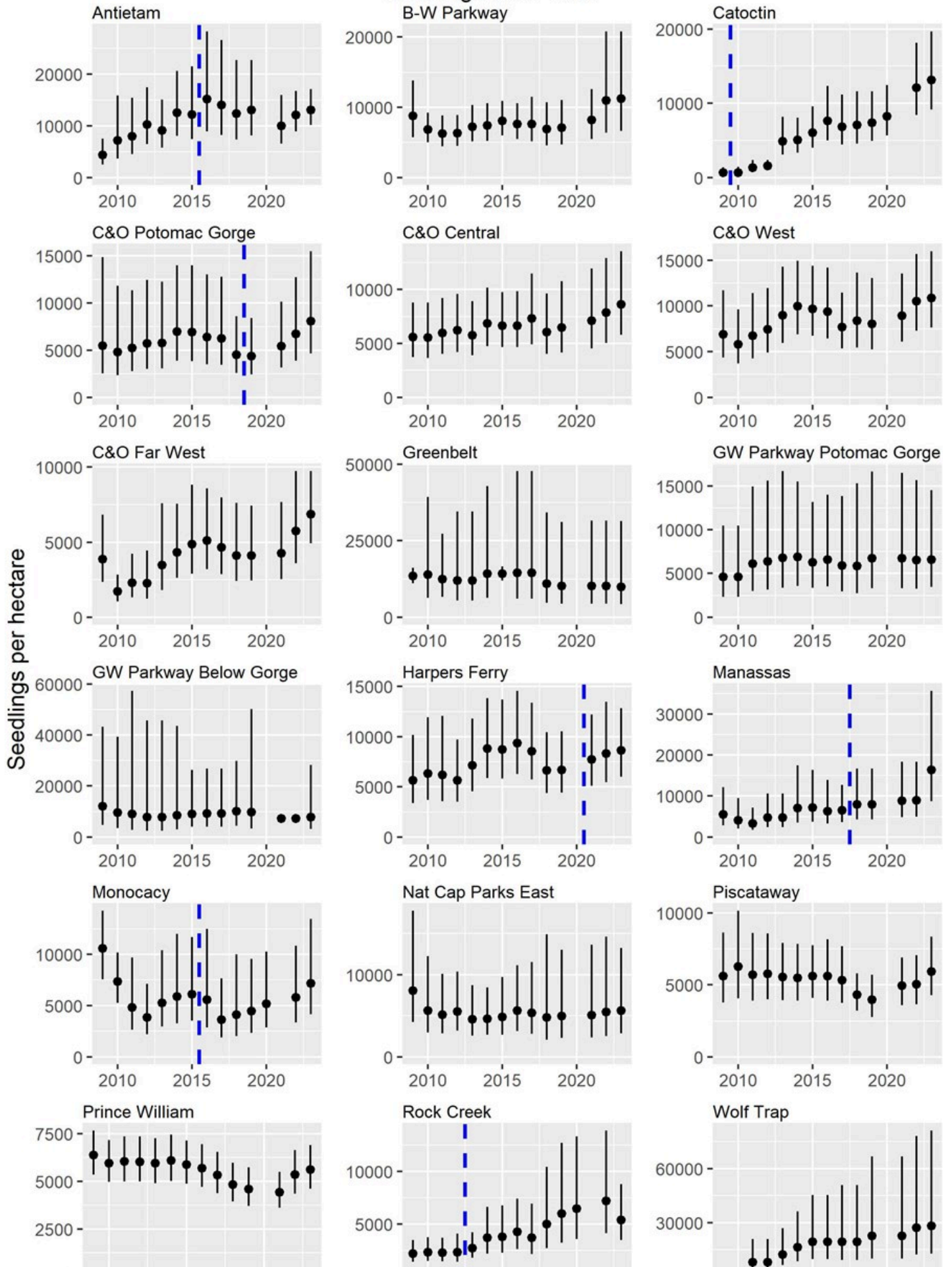




Figure 2. Change in seedlings per hectare 2009-2023 in parks and smaller distinct park areas. Each circle represents the average seedling data of the last visit to each plot (a complete sample of all plots at the park). Vertical lines are 95% confidence intervals. Dashed blue vertical lines indicate the year a park began deer population management. The y-axis varies from park to park due to a large variance in number of seedlings and the size of confidence intervals.

NPS

Narrative Description of Figure 2

Implications of Stocking Index and Seedling Density

Together, the stocking index and seedling measures help to give a comprehensive view of the current state of regeneration. Most parks managing deer populations show improvements in seedling densities, but the stocking index remains largely unchanged.

At Rock Creek Park in 2023, the stocking index did increase while seedling density decreased. This is due to one plot where many box elders shot up from seedlings into saplings, disappearing from the seedling ranks and bumping up the Stocking Index.

Monocacy National Battlefield, and the western reaches of C&O Canal also saw increases to the Stocking Index. This is attributed to an increase in large Pawpaw at one plot in each park.

Meanwhile, many of the new seedlings at Manassas National Battlefield Park are ashes, likely doomed by the now naturalized [emerald ash borer](https://www.nps.gov/articles/000/ash-tree-update-2022.htm) (<https://www.nps.gov/articles/000/ash-tree-update-2022.htm>). Some other emerging seedlings are non-canopy species (e.g., pawpaw) that will be unable to fill canopy gaps.

It is important to note that neither the stocking index nor measures of seedling density consider tree species composition. Native canopy species and non-natives or non-canopy species are equally considered in both measures. Other ways to measure forest regeneration that take into consideration factors like native/non-native status were used in a 2023 analysis of forest data from 39 northeastern national parks [published in Ecological Applications](https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.2837) (<https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.2837>).

Parks Taking Action

Some parks are planning and implementing integrated forest management tactics that may help to mitigate the significant threats to regeneration in the region. Catocin Mountain Park, which has been removing invasive plants and reducing deer populations for over a decade, plans to expand their work into an area they've cleared of Japanese barberry and other brambles and [plant more than 5,000 native trees](https://www.nps.gov/cato/learn/news/inflation-reduction-act-to-invest-446-000-in-forest-restoration-at-catoctin-mountain-park.htm) (<https://www.nps.gov/cato/learn/news/inflation-reduction-act-to-invest-446-000-in-forest-restoration-at-catoctin-mountain-park.htm>).

George Washington Memorial Parkway is developing an Urban Forest Management Plan for their park with researchers at Virginia Tech University, and in 2023 Rock Creek Park worked with the Rock Creek Conservancy to design a Forest Resilience Framework to help manage forest resources and fundraise for management support.

Overall, low regeneration levels remain a cause for concern in the region. Significant and sustained effort is needed to help restore NCR forests for the long term.

Further Reading

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- Schmit JP, Matthews ER, Brolis A. 2020. [Effects of culling white-tailed deer on tree regeneration and Microstegium vimineum, an invasive grass \(https://irma.nps.gov/DataStore/Reference/Profile/2273890\)](https://irma.nps.gov/DataStore/Reference/Profile/2273890). Forest Ecology and Management. 463(118015).
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- Schmit, JP and M. Nortrup. 2020. [Stiltgrass and Tree Seedling Recovery \(https://www.nps.gov/articles/000/stiltgrass-and-tree-seedling-recovery.htm\)](https://www.nps.gov/articles/000/stiltgrass-and-tree-seedling-recovery.htm).
- Schmit JP, Matthews E, Brolis A. 2023. [Trends in woody forest vegetation in Prince William Forest Park, 2006–2017 \(https://doi.org/10.36967/2296913\)](https://doi.org/10.36967/2296913). Natural Resource Report. NPS/NCRN/NRR—2023/2495. National Park Service. Fort Collins, Colorado.

Learn More about the National Park Service's Inventory & Monitoring Efforts

To help protect natural resources ranging from bird populations to forest health to water quality, National Park Service scientists perform ecological Inventory & Monitoring (I&M) work in parks across the country. The [National Capital Region Network, Inventory & Monitoring program \(https://www.nps.gov/im/ncrn/index.htm\)](https://www.nps.gov/im/ncrn/index.htm) (NCRN I&M) serves national parks in the greater Washington, DC area. To learn more about NCRN I&M forest monitoring, you can visit [the NCRN forest monitoring webpage \(https://www.nps.gov/im/ncrn/forest.htm\)](https://www.nps.gov/im/ncrn/forest.htm).



anacostia park

antietam national battlefield

baltimore-washington parkway

catoctin mountain park

chesapeake & ohio canal national historical park

fort dupont park

fort foote park

fort washington park

george washington memorial parkway

glen echo park

great falls park

greenbelt park

harpers ferry national historical park

kenilworth park & aquatic gardens

manassas national battlefield park

monocacy national battlefield

national capital parks-east

oxon cove park & oxon hill farm

piscataway park

prince william forest park

rock creek park

theodore roosevelt island

wolf trap national park for the performing arts

resilient forest management

resilient forests

forest regeneration

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trees

saplings

seedlings

stocking index

eastern deciduous forest

forest

deer management

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