



Quantifying Ecological Benefits of Trees in the National Capital Region

Introduction

Trees provide a variety of ecological services that benefit humans and their surrounding environment. While trees can sequester carbon dioxide and produce oxygen, they also remove air pollution and mitigate storm water runoff. These ecological benefits can be highly valuable in densely populated, urban areas like those surrounding the parks of the National Capital Region. Quantifying these benefits can be crucial in demonstrating a forest's value and advocating for its preservation.

Using iTree Eco for Quantification

iTree Eco is a software application developed by the U.S. Forest Service, in collaboration with several professional arborist groups, to quantify benefits of trees based on field measurements. Drawing from reference research, iTree combines tree measurements with other data sets including local air pollution and weather. The result is a report of the forested land providing modeled estimates of environmental value. For the National Parks in the National Capital Region, tree species, within preexisting sample plots, are regularly monitored by the NPS's Inventory & Monitoring Forest Vegetation Monitoring Program, which provided input data for the iTree system. Entered data is processed then iTree generates a report that describes conferred ecological benefits including removal of airborne gasses and particulates, carbon stored organically in trees, carbon removed from atmosphere, breathable oxygen produced by trees, other gasses produced by trees, stormwater intercepted before reaching waterways, monetary benefits/value of eco-services, and tree size data based on diameter at breast height (DBH) and species.

This brief covers the ecological benefits from trees in eight parks: Antietam National Battlefield (ANTI), C&O Canal National Historical Park (CHOH), George Washington Memorial Parkway (GWMP), Harpers Ferry National Historical Park (HAFE), Manassas National Battlefield Park (MANA), National Capital Parks - East (NACE), Prince William Forest Park (PRWI), and Wolf Trap National Park for the Performing Arts (WOTR). Results for other parks in the region, Catocin Mountain Park, Monocacy National Battlefield, and Rock Creek Park can be found in the companion brief *Ecobenefits of National Capital Region Park Trees* (Ferguson 2017).

Results

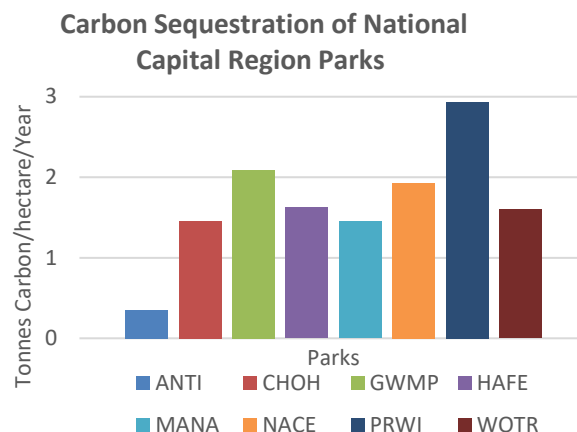
The parks featured in this work are of various sizes, in locations that are more or less urban and forested. iTree results were scaled (normalized) to match the size of the park and the amount of forested park land. Plot location provides iTree with the ability to estimate surrounding impacts (e.g. more pollution for an urban location and less from a rural site).

Table 1 Park Size and Percent Canopy Coverage

Park Unit	Area (km ²)	Tree Canopy
ANTI	13.2	22.33%
CHOH	84.4	71.57%
GWMP	21.5	60.21%
HAFE	15.0	69.70%
MANA	20.6	51.58%
NACE	46.0	62.99%
NAMA	4.4	12.82%
PRWI	50.8	89.50%
WOTR	0.5	58.22%

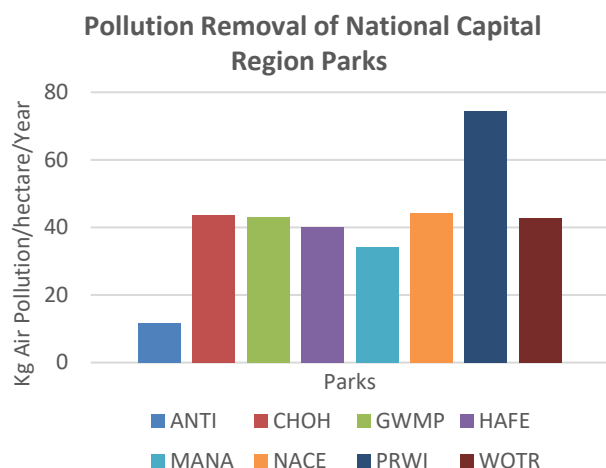
One of the most important services is carbon sequestration. This is the amount of carbon dioxide removed from the air, in this case by trees. Values are based on local carbon levels from 2013, tree diameter, and average growth for each genus of tree measured in the iTree program (see Figure 1).

Figure 1. Normalized Annual Carbon Sequestration by Trees in Eight National Capital Region National Parks.



iTree calculates air pollution removal for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter that is less than 2.5 microns in size. The values presented are combined totals for these air pollutants (see Figure 2). iTree references hourly local air pollution levels, documented in 2013, to determine air pollution removal levels. Removal rates are based on average measured values from peer-reviewed research found in the appendices of each iTree report.

Figure 2. Normalized annual air pollution removal values for trees in eight National Capital Region national parks.



Another important benefit, avoided runoff, is calculated by estimating the amount of rainfall that would be intercepted by the leaves of trees. Avoided runoff is the difference between annual local runoff with and without vegetation. Calculated values take into consideration estimates of the permeability of surrounding surfaces and percent canopy coverage (see Figure 3). MANA had an avoided runoff value of 0; this was due to an issue with data collection at the closest weather station.

Conclusions & Discussion

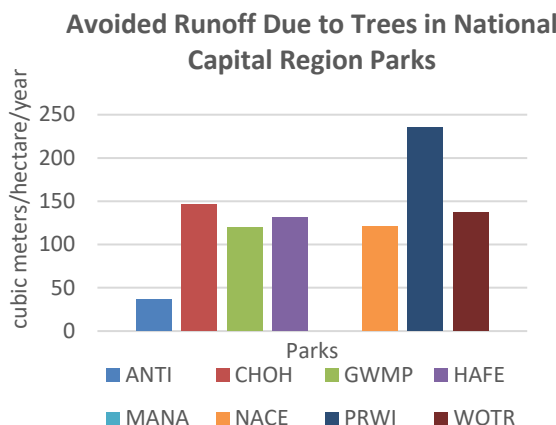
iTree Eco quickly estimates and values the ecological benefits for forests. Results give public lands managers the ability to quantify the benefits of particular trees and forests.

Parks located in urban environments have higher values for benefits such as air pollution removal and avoided runoff due to the higher air pollution levels and impervious surface area that occur in urban environments. At the beginning of each iTree project, the user must select a local weather station; this provides weather and pollution data that are used to calculate tree benefits. iTree's system is restricted to only one weather station per park, and can skew data for a

park such as CHOH which spans many different weather stations across geologic provinces. The percent canopy coverage heavily influences iTree output values. For example, PRWI had the highest percent canopy (89.5%) out of the eight parks; this likely explains its high values among the normalized graphs. ANTI had the lowest percent canopy (22.3%), which explains its lower ecological benefits values.

iTree Eco quantifies more benefits in addition to carbon sequestration, pollution removal, and avoided runoff. iTree reports provide extensive information that would allow users to compare ecological benefits between different species of trees. Conclusions drawn through future analysis of iTree Eco and national park data would further emphasize the importance and value of NPS lands in the National Capital Region.

Figure 3. Normalized Annual Avoided Runoff for Eight National Capital Region National Parks



Acknowledgements

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View of GWMP Trees from Arlington National Cemetery

Sources:

K. Ferguson. 2017. UERLA Resource Brief: Ecobenefits of National Capital Region Park Trees
 USDA Forest Service. (2018, January 18). i-Tree Eco User's Manual v6.0. Retrieved from
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