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The Pawpaw: Small Tree, Big Impact

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With leaves and branches that deer avoid, and fruit that is loved by all, the pawpaw (*Asimina triloba*) is a fascinating native tree. It's the only local member of a large, mainly-tropical plant family (Annonaceae), and produces the largest edible fruit native to North America. Despite being a small, understory tree, unlikely to ever grow into the forest canopy, pawpaw is the most frequently observed sapling in the National Capital Region Network's (NCRN) forest monitoring plots. What do we know about the ecology of pawpaw in our region, and what could its dominance mean for our future forests?

Fruit

One of the most tasty late-season rewards for hikers and wildlife alike is the pawpaw fruit, which begins to ripen in late summer and peaks in September and October. The flavor of pawpaw fruit is often compared to bananas, but with hints of mango, vanilla, and citrus. The fruit has the ungainly appearance of a small green potato and may occur in clusters on the tree. In spite of pawpaw's prevalence in NCR forests, successfully foraging for its fruits can be a challenge. Pawpaw is self-incompatible, which means that pollen produced on a plant cannot pollinate flowers on the same plant. Instead, to produce fruit, a pawpaw flower must receive pollen from flowers on another tree, and sometimes this "other tree" is farther away than it may appear at first glance! Although pawpaws frequently grow in clusters (think pawpaw patch), the trees in a patch are often genetically identical and connected underground by roots (and thus, in biological terms, are a single plant). Nonetheless, pawpaw's pollinators (which include flies and beetles) inevitably pollinate some flowers, and fruit-hunters may eventually find a tree with fruit. The next hurdle for the human forager is determining if the fruits are ripe; lightly shaking a tree will dislodge any ripe fruits that have escaped the notice of local wildlife. Opossums, foxes, squirrels, raccoons, and birds are all known to enjoy pawpaw fruit.

NCR Parks with Many Pawpaws

While NCRN forest monitoring shows pawpaw to be the most common sapling in the region, some parks have many

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Copies of this and other issues are available at http://science.nature.nps.gov/im/units/ncrn

Photo: NPS/Nortrup

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more pawpaw saplings than others (Figure 1). Pawpaw is the most common sapling species in CHOH*, GWMP, HAFE, and NACE, and ranks as the second most common sapling species at ANTI, and MONO. This distribution is likely a reflection of the amount of preferred pawpaw habitat in each park, but may also be related to other ecological processes.

Habitat Expansion & Understory Domination

In recent decades, naturalists have noted the expansion of pawpaw from well-drained, lowland habitats into drier, upland forests. This phenomenon appears to be driven, at least in part, by patterns of deer browse. Deer find pawpaw foliage unpalatable and, therefore, avoid browsing pawpaw seedlings and saplings. Instead, they preferentially browse species such as spicebush (*Lindera benzoin*), oaks (*Quercus* spp.), red maple (*Acer rubrum*), and blackgum (*Nyssa sylvatica*). Deer avoidance of pawpaw is evident in NCRN forest data. Out of 2,480 saplings recorded in the most recent sampling period, 27% showed signs of deer browse. The browse rate is strikingly different for pawpaw (which represents 21% of all saplings) with less than 1% showing signs of deer browse and greater than 99% being browse-free!

This deer behavior benefits pawpaw in two ways. First, small pawpaws don't need to allocate energy to recovering from browse, and instead can put that energy towards growth and reproduction. Second, frequent deer browse on sapling and shrub species preferred by deer suppresses the growth of these species, clearing the way for pawpaw. As a result, we might expect to see pawpaw becoming more common in forest understories that are heavily impacted by deer browse (which describes most NCR forests). Indeed, NCRN's forest data show that pawpaw sapling density is increasing across the region, while the density of some deer-preferred species (e.g., red maple and black gum) is decreasing (Figure 2).

Another potential contributor to the success of pawpaw is the suppression of fires that were an important part of the disturbance regime in many eastern forests before European settlement. Pawpaw are not strongly fire-adapted (unlike other common canopy dominates, such as oaks), and they likely benefit from the lack of fire in contemporary forests.

Future Forest Canopy

What are the long-term implications of increasing pawpaw dominance in the forest understory? Although we don't have a firm answer to this question just yet, we do know that the mix of tree species in the forest understory influences the long-term trajectory of the forest canopy. Many factors determine which saplings ultimately become canopy trees, but trees that do not show up in the sapling layer will never join the forest canopy. Similarly, species that are more common in the sapling layer have more potential to be represented in the canopy than those with fewer saplings. If pawpaw continues to become more common in the sapling layer at the expense of other species, we might expect it to one day dominate the tree canopy as well.

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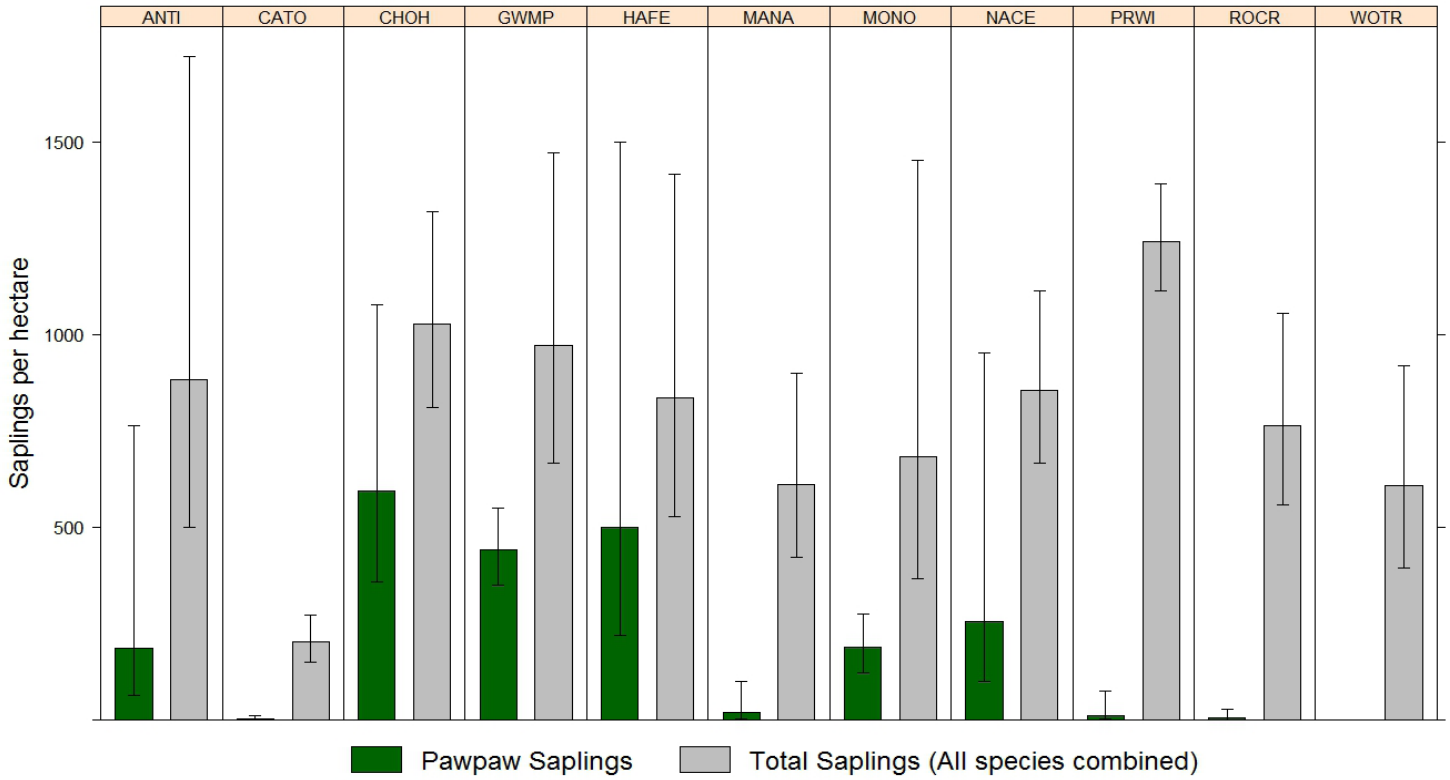
Figure 1. Sapling Density by Park: All Species versus Pawpaw



*Park acronyms on page 3

Stream Matters: Specific Conductance

What do snowstorms, urban development, and water pollution all have in common? They all can cause high rates of specific conductance in freshwater streams.

For the past 10 years, specific conductance (S.C.) has been at higher than desirable levels in about three-quarters of NCR streams monitored by the Inventory & Monitoring (I&M) program.

While specific conductance itself does not directly effect aquatic life, an increase in S.C. can indicate high levels of pollutants toxic to aquatic life. Hence, S.C. serves is an indicator. Aquatic organisms are more likely to survive and be healthy in a stream where S.C. levels meet target ecological thresholds.

Photo: NPS/Nortrup

So what is going on in our streams? Not only are S.C. rates high, but in many streams rates are increasing. (Across the NCR, no stream has showed declining rates.)

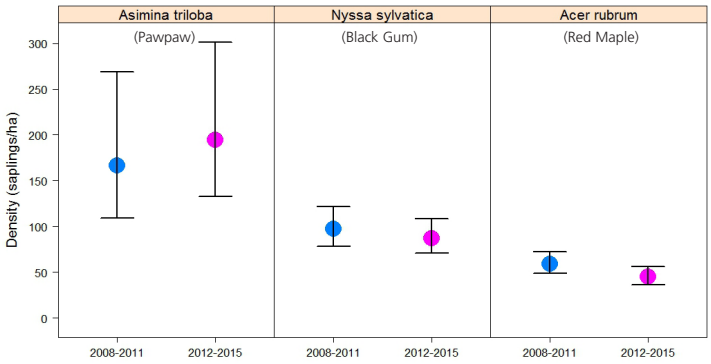
A new resource brief looking at specific conductance levels in NCR streams is now available at: http://science.nature.nps.gov/im/units/ncrn/assets/docs/RBs/NCRN_specific_conductance.pdf

Discharge of storm water into NCR watersheds can exacerbate issues with specific conductance.

PAWPAW from p2

Pawpaw is a small tree species (some might even consider it a tall shrub), growing to a maximum height of 15m— considerably shorter than the species that currently dominate NCR forest canopies. The five most common forest trees according to NCRN monitoring data include tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), Virginia pine (*Pinus virginiana*), and white oak (*Quercus alba*). All of these grow to 30m or more. If deer populations remain high, the forest canopy height may decline over time, particularly in areas where pawpaw is the only understory species available to replace dead or dying canopy trees. Or, perhaps the forest canopy would become patchier, with short patches dominated by pawpaw and tall patches dominated by other species that are represented in the sapling layer of the forest (American beech, for example, is deer-browse resistant and the second most common sapling in NCR forests).

Figure 2. Select Trends in Sapling Density



Interestingly, a similar phenomenon has been observed in over-browsed forests in central Pennsylvania. In these forests, the small, understory species striped-maple (*Acer pensylvanicum*) has become increasingly common in the forest understory over a 60-year observation period. At the same time, tree species that are capable of growing into the forest canopy have declined by 85% (Kain et al. 2011). Striped maple and American beech were found to make up 82% of all trees in the deer-browsed forests. The authors of this study speculate that these forests may experience unprecedented changes which will ultimately lead to a forest canopy dominated by only a few species that are resistant to deer browse. It is too early to tell if this is the future for NCR forests. For the time being, it is clear that deer-avoidance of pawpaw is contributing to its increased dominance in our understory, and while we may appreciate additional opportunities for fall fruit foraging, we hope it's not at the expense of losing our mighty tree canopy!

Citations

Kain, M., Battaglia, L., Royo, A., and W.P. Carson. 2011. Over-browsing in Pennsylvania creates a depauperate forest dominated by an understory tree: Results from a 60-year-old deer exclosure.

Park Acronyms

ANTI = Antietam National Battlefield
CATO = Catoctin Mountain Park
CHOH = Chesapeake & Ohio Canal National Historical Park
GWMP = George Washington Memorial Parkway
HAFE = Harpers Ferry National Historical Park
MANA = Manassas National Battlefield Park
MONO = Monocacy National Battlefield
NACE = National Capital Parks - East
NAMA = National Mall and Memorial Parks
PRWI = Prince William Forest Park
ROCR = Rock Creek Park
WOTR = Wolf Trap National Park for the Performing Arts

Interns Communicate Climate Change for NCR Parks

This year, the National Capital Region hosted seven climate change communications interns through a partnership between NPS UERLA (Urban Ecology Research Learning Alliance) and George Masion University Climate Change Communications Center. These interns came from universities across the country from Washington state to Washington, DC and they tackled two main themes. One team focused on regional sea level rise; the second team created climate change communication products specifically for George Washington Memorial Parkway (GWMP). Both teams benefited from the guidance of national, regional, and park employees.

The 3Cs (climate change communication) interns move fast during their 10 week internship. Between June 6 and August 12, the interns created climate change communication products unique to the GWMP for the park website including:

- a climate change landing page
- several NPS articles
- a fun and factual interpretive guide based on the park's namesake
- an infographic highlighting the unexpected consequences of climate change

The interns also made sea level rise products for two parks and the region including:

- an engaging educational sea level rise video with complementary lesson guide
- two park briefs communicating sea level rise at GWMP and Fort Washington Park (NACE-FOWA)

Next year keen, clever, creative young people could be creating materials for you to use in your park. Calls for park proposals will be announced in the fall but ideas for Climate Change Communication Interns will be welcomed at any time!

Photo: NPS

3C Interns from left to right: Siti Mohd-Khairi, Madison (Maddie) O'Beirne, Danielle (Dani) Hupper, and Nicholas (Nickie) Mitch. Not pictured: Sam Sheline, Mauricio Antunano, and Gavin Klein.

For more information about how you can have 3C interns in your park, please contact Ann Gallagher by NPS email or at 240-461-6171.

Thanks

Many thanks to the more than two dozen people who helped these young people thrive! Special thanks to Richard Moorer and Chip Johnston. Richard provided the interns with the guidance to identify park experts and to help the interns navigate GWMP by kayak, bike, and car! Chip volunteered to help make sense of sea level rise in the area by speaking on camera of his personal knowledge as Dockmaster at Belle Haven Marina in GWMP.

Drawing on the experience of several Natural Resource Stewardship and Science Divisions including the Water Resource Division, Climate Change Response Program, and Inventory & Monitoring Division ensured scientific accuracy. Guidance from regional Interpretation and Education staff, Communications staff, park biologists and rangers, and fellow interns strengthened the NPS graphic identity and message in the products. And, support from park permitting and visual information specialists guaranteed that interns captured especially effective images.

Managing Animal Behavior

Park staff who serve as first responders to potentially dangerous human-wildlife interactions are the target audience for a new document slated to come out before the end of the calendar year. "Managing Individual Animal Behavior" is intended to provide guidance in responding to specific situations and management contexts and assist with decisions on how best to proceed in difficult circumstances. The document is under preparation by the Biological Resource Division's Kirsten Leong who has chaired the Managing Animal Behavior workgroup since 2013.

The report will summarize:

- background information on animal behavior and learning and implications for behavior change in wildlife in parks
- a process to help guide management of animal behavior
- overarching principles for managing human-wildlife interactions that may affect animal behavior
- more specific guidance for bears, herbivores, and mesocarnivores, the three groups of animal that are often involved in human-wildlife interactions

For more information contact Kirsten Leong by NPS email or at 970-267-2191.

Photo: NPS/Milton

Mark Khosravi, Fairfax County Park Authority Education Specialist, handles a viper during a 2016 snake handling safety session at PRWI.

Exotic Plant Management News: New Team Lead

Alex Voznitza is the new Team Leader for the National Capital Region's Exotic Plant Management Team (EPMT).

Alex was born and raised in Poland and moved to the United States in 2002. She graduated from Western Michigan University in 2013 with Bachelors of Science, and worked at Katmai National Park and Preserve as a Student Conservation Association intern. After leaving Alaska, Alex worked with a private ecosystem restoration company focused on restoring meadows and wetlands in the suburbs of Chicago.

Alex began her work with the NCR EPMT in 2014 as a crew member. She stepped up to a leadership position as a squad leader in 2015, and began as Team Lead in August 2016.

Photo: NPS

Alex considers a noxious giant hogweed plant (*Heracleum mantegazzianum*).

Former EPMT Team Lead Ryan Tietjen accepted a job with the Bureau of Land Management, Eastern States earlier in the year.

Other EPMT News

Team Liaison Mark Frey is currently serving a 90-day detail as Chief of Resources at Mount Rainier National Park. He will return to the NCR in late October 2016. In the meantime, Liz Matthews, Botanist with the Inventory & Monitoring program, is serving as Team Liaison until Mark's return.

Wavyleaf Basketgrass and Beech Bark Disease: New Pest Briefs

New "IPM Pest Briefs" on wavyleaf basketgrass and beech bark disease are now available. Contact IPM Coordinator Jil Swearingen by NPS email for copies.

Neither of these pests has been detected in any NCRN I&M forest vegetation monitoring plots. However, wavyleaf basketgrass has been found in several parks outside of I&M plots and has been treated by the NCR Exotic Plant Management Team.

Please keep an eye out for either one of these invaders!

I&M Fall Field Schedule

For specific field dates contact Megan Nortrup by NPS email or check the "NCRN I&M Activities" calendar which has been shared with NCR natural resource staff through BisonConnect gmail.

The calendar shares dates when I&M field staff will be working in specific parks. You and your interns and volunteers are welcome to join us in the field to learn about how NCRN I&M monitors natural resources in your park.

September, October, and November 2016	Marsh Elevation (SET)	Water (quarterly)
Antietam National Battlefield		X
Catoctin Mountain Park		X
Chesapeake & Ohio Canal NHP		
George Washington Memorial Parkway	X	X
Harpers Ferry NHP		X
Manassas National Battlefield Park		X
Monocacy National Battlefield		X
National Capital Parks - East	X	X
Prince William Forest Park		X
Rock Creek Park		X

The NCRN Forest Vegetation Monitoring Crew really gets into its job! Here, crew member Allen Dupre crouches inside a monster silver maple tree at the C&O Canal. The tree is inside one of I&M's monitoring plots. In 2012 it measured 171 cm diameter at breast height (dbh) and in 2016, it came in at 175 cm dbh. That's bigger than our standard tape measure!!

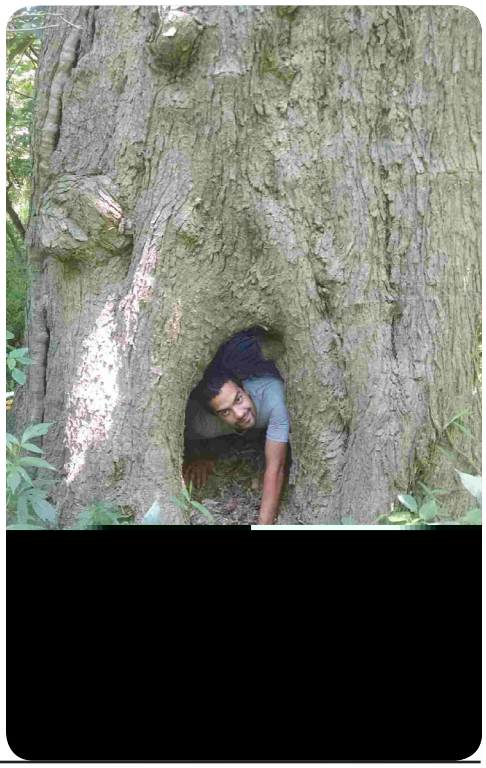


Photo: NPS/Brolis