Growing Greener:

Eco-Structure For Climate Resilience

Chapter 3: Actions to Protect and Enhance the Health of Urban Forests

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NATIONAL WILDLIFE FEDERATION

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Introduction

Whether you live in the city overlooking a park, grew up with a backyard tree house, or have hiked in a national forest, you undoubtedly know exactly what poet Joyce Kilmer was feeling when he wrote, "I think that I shall never see a poem as lovely as a tree." Trees are a vital part of our natural world, health, economy, and culture.


Credit: Charlie Archambault

The ecological benefits of healthy trees, including the habitat, shelter, and food they provide for many birds and small wildlife, are widely known.

However, people living in urban areas may not immediately consider the ways in which healthy urban forests are **critical infrastructure** for *human* communities, too.

For starters, trees are central components of green infrastructure, which is a natural and cost-effective approach that many communities are using to reduce flooding, manage stormwater, improve water quality, and even reduce urban heat. Green infrastructure includes a mix of landscape features including tree canopies, open space, parks, and wetlands, as well as low impact development (LID) approaches, such as rain gardens, green roofs, and permeable paving. Additionally, planting and fostering healthy trees helps reduce carbon pollution because as trees grow, they absorb carbon dioxide from the air and store carbon in their trunks, roots, and foliage. Furthermore, communities are already experiencing the effects of climate change, including extreme flooding, heat waves, and drought, and green infrastructure can provide critical, natural protection from these impacts now and into the future.

Green infrastructure not only provides resilience to climate change, but can also help communities be more resilient to economic shocks since designing, installing, and maintaining green infrastructure projects, like green roofs and rain gardens, can lead to new local job opportunities. Additionally, green infrastructure often costs less to install and maintain when compared to conventional "grey" infrastructure, such as building underground storage tanks to manage stormwater, and buildings with vegetated roofs benefit from lower heating and cooler costs.[1] Green infrastructure also improves the health and quality of life for residents by improving access to green spaces, connecting people with nature, and by providing recreational opportunities.

[1]US EPA. *Reducing Urban Heat Islands: Compendium of Strategies.* Chapter on Green Roofs. URL: http://www.epa.gov/heatisland/resources/pdf/GreenRoofsCompendium.pdf (accessed 2 May 2013).

NWF partnered with King County, Washington, to help develop an on-line tool for landowners, called Urban and Community Forestry CPR - Climate Preparedness and Response (CPR).[2] Using CPR, landowners can view their own property using a Geographic Information System (GIS) tool. Once a property has been identified, the tool also quantifies and explains existing land and forest characteristics (e.g., total forest carbon stored at a particular site). Additionally, the website provides customized management recommendations through a Forest Health Assessment survey.

This guide is designed to help local governments, organizations, and others replicate the website and tool for their own communities, while also learning about the ways in which green infrastructure can provide natural protection from the impacts of climate change. The first section of this guide provides an overview of the ways in which climate change is impacting urban areas, and also describes how nature-based approaches, like enhancing and protecting the urban tree canopy, can help communities build resilience to climate impacts. The next section includes a case study of the King County Forest CPR development process, guidance for selecting data sources for the tool, and lessons learned from the King County project. Next, since climate change is impacting the survivability of urban trees, this guide also provides recommendations for integrating climate change considerations into the planning for and management of urban forests. This guide also includes a chapter about managing for pests in a changing climate, while the next section profiles National Wildlife Federation programs and resources that are designed to build healthy, resilient communities, including NWF's Certified Wildlife Habitat ® program. The last sections include regionally-specific resources and information to help enhance forestry health and subsequently increase the amount of carbon that urban trees are able to sequester.

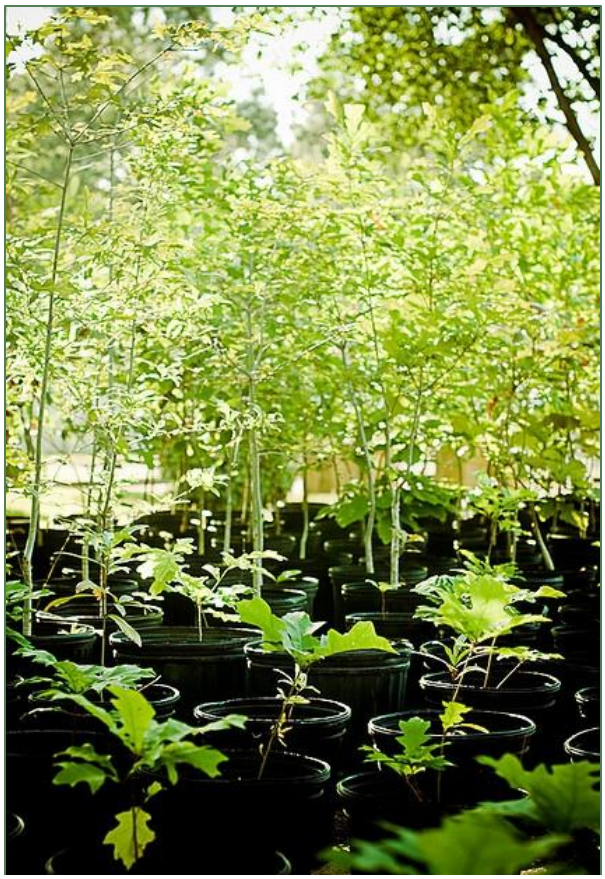
We have developed this guide to encourage cities and towns to recognize trees as critical, functional infrastructure –**"eco-structure"—**that is just as important as buildings and roads. We know that trees can survive and thrive in urban areas, while benefiting the humans that live there — we just need to place a premium on our trees and other green infrastructure and envision a greener, healthier future.

[2] Forestry CPR can be accessed here: http://gismaps.kingcounty.gov/ForestryCPR/

3. Actions to Protect and Enhance the Health of Urban Forests

Robust urban tree canopies can sequester carbon, provide habitat and food for wildlife, improve shade and cooling effects, and manage stormwater flooding (and reduce the urban heat island effect and air conditioning, thereby lowering GHG emissions associated with building energy use!). It has even been shown that, "people are willing to travel farther, visit more frequently, and pay more for goods and services in business districts with trees – on average 12 percent more."[3]

Although trees provide a number of ecological, social, and economic benefits, urban trees face a set of challenges that threaten their health, including poor soil quality and limited soil volume, flooding and poor drainage, invasive species and noxious weeds, development pressure, and others. Climate change exacerbates existing stressors and presents new challenges for urban foresters, property owners, and others working to protect and enhance urban tree canopies.



When trees are healthy, they are more likely to overcome a variety of stressors, and subsequently sequester more carbon. The Forestry CPR website identifies a number of general forestry practices that can help improve forest health and survival.

Since climate change is a key threat to forest health and survival, it is necessary to take climate change considerations into account when developing tree planting and management plans for urban areas. Fortunately, there are some relatively simple, lower-cost options that forest managers can take to help ensure forests can survive and thrive in a changing climate, described in the next section.

[3] Casey Trees. *Growing a Healthier DC: Greening Business Districts* URL: http://www.milliontreesnyc.org/downloads/pdf/28-Casey%20Tree%20BusinessBrief.pdf (Accessed 1 May 2013).

General Climate-Smart Recommendations

National Wildlife Federation has already been advising the "climate-smart" tree selection for a number of restoration projects in the Great Lakes Region. Building on that work and drawing from other resources, we have developed a set of climate-smart urban forestry practices relevant for communities across the country.

Understand Which Trees and Plants In Your Region Are Appropriate for a Changing Climate

Climate change is an important consideration for the selection of tree and plant species, given the inherent sensitivity of plants to climatic conditions. Choosing resilient species that can tolerate a wide range of conditions is a good strategy to prepare for climate change and help increase the survival of species over time. For example, from a strictly climate change perspective, ideal species to plant would be those able to thrive in both existing and future climates, as they will not require significant management in the near-term and have the greatest potential to persist over time.[4] Additionally, it is advisable to refrain from selecting tree species that are not suitable in the current climate and/or especially the future climate.[5] This is likely to be especially important when considering longer-lived species such as trees, which will be exposed to climate changes over periods of decades.[6] On the other hand, species with shorter life spans can be more easily substituted at some point in the future if they are unable to withstand future climatic conditions. Although there is some uncertainty regarding when and to what extent specific impacts will be felt in regions across the county, it is still possible to manage for change. For example, planting a wide diversity of species, including multiple age classes as well as plant types, improves the likelihood that some species will thrive, even if others do not.[7]

It also will be important to consider other functions that might help reduce exposure and enhance resilience to climate change. For example, plants that provide high shade value can help moderate water temperatures, enhancing refugia for target fish species in summer months when temperatures may push their thermal thresholds.[8]

When possible, priority should be places on planting species with greater adaptive capacity, eg., species on the northern edge of their range, to enhance survival rates as temperatures increase due to climate change. For example, Chicago is planting swamp white oaks and bald cypress, which are more resilient to increased temperatures.

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[4] Glick, Patty. Climate-Smart Habitat Restoration of the Clinton River Spillway, Michigan: Considerations for Project Engineering and Design. National Wildlife Federation. (under review)

[5] Ibid.

[6] Prasad, A.M., L.R. Iverson, S. Matthews, and M. Peters. 2007-ongoing. *A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States* [database]. URL: http://nrs.fs.fed.us/atlas/tree. Northern Research Station, USDA Forest Service, Delaware, OH.

[7] Ibid.

[8] Naiman, R.J., H. Decamps, and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 3: 209-212.

Included below is a set of questions, adapted from a set developed by a team in Chicago, to help guide tree and plant selection.[9]

- Would the current mix, or the selected tree species, hold up well under the projected climate impacts for the region, such as drier, hotter, wetter, and/or more extreme conditions? If they wouldn't, what changes in practices (eg., increased use of water, planting larger trees instead of seedlings) would be required in order to establish and maintain them?
- Which options would enable a great number of species to be incorporated into seed mixes, large-scale plantings, or urban forests? Are there ways to also increase within-species (genetic) diversity of plant materials by obtaining materials from a wider range of sources?
- Which species have higher drought tolerances, and could be substituted for species that are not likely to do well with increased drought? Based on site location, which trees and plants could withstand flooding, and even reduce flow rates/absorb more water? Are there trees and plants that can handle both drought and flooding well?
- Which invasive plant species will benefit from climate change and can be replaced with natives?

Develop A Climate-Smart Tree Species Planting List

As mentioned previously, we know that climate change is affecting the abundance and distribution of plants, and we know that hardiness zones are shifting northward. For these reasons, it is important to select tree species that will not only be able to withstand the already harsh urban conditions, but that can also survive and flourish in a changing climate.

For example, arborists in the City of Chicago have created a "climate ready," ranking factor that that is used in the City's tree species list, which they have based on the American Horticultural Society (AHS) heat intolerance map, which can be found here: http://www.ahs.org/publications/heat_zone_map.htm

Another example is from a restoration project that National Wildlife Federation is guiding along the Black River in Ohio, which includes the re-vegetation of stream sides. Using the US Forest Service Climate Change Tree Atlas[10] (A Spatial Database of 134 Tree Species of the Eastern USA), NWF developed a tree species list for the project, which includes tree species that have a better likelihood of survival over time, given the ways in which climate change will impact the region.

[9] Derby Lewis, A., Hall, K.R. and Hellmann, J.J. 2012. Advancing Adaptation in the City of Chicago: Climate Considerations for Management of Natural Areas and Green Spaces in the City of Chicago.

[10] The USFS Climate Change Tree Atlas can be found here: http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html#

Figure 3: Climate-Smart Tree Planting List for Lorain, Ohio (Black River Watershed). Source: National Wildlife Federation

Species Previously Used for Restoration	Scientific Name	Suitability in Historic Climate	Suitability in Future Climate	USFS Model Reliability
Black Walnut	*Juglans nigra*	Okay	Okay	Medium
Black Willow	*Salix nigra*	Okay	Okay	Low
Chokecherry	*Prunus virginiana*	Okay	Okay	Low
Eastern Cottonwood	*Populus deltoides*	Okay	Okay	Low
Eastern Redbud	*Cercis canadensis*	Okay	Okay	Medium
Eastern White Pine	*Pinus strobus*	Okay	Low	High
Flowering Dogwood*	*Cornus florida*	Okay	Okay	High
Northern Red Oak*	*Quercus rubra*	Okay	Okay	High
Pin Oak	*Quercus palustris*	Okay	Okay	Medium
Red Maple*	*Acer rubrum*	Okay	Okay	High
River Birch	*Betula nigra*	Okay	Okay	Low
Serviceberry	*Amelanchier spp.*	Okay	Okay	Medium
Shagbark Hickory	*Carya ovata*	Okay	Okay	Medium
Shortleaf Pine	*Pinus echinata*	Low	Okay	High
Silver Maple	*Acer saccharinum*	Okay	Okay	Medium
Slippery Elm*	*Ulmus rubra*	Okay	Okay	Medium
Swamp White Oak	*Quercus bicolor*	Okay	Okay	Low
Sycamore	*Platanus occidentalis*	Okay	Okay	Medium
Wild Plum	*Prunus americana*	Low	Low	Low
Yellow-Poplar	*Liriodendron tulipifera*	Okay	Okay	High
* Species Likely to fare best in both existing and future projected climate				

Integrate Climate Change Information into Pest and Invasive Species Management

In the urban forest, trees are already threatened by habitat loss and fragmentation, which can render them even more vulnerable to the impacts of climate change. At the same time, the impacts of climate change we are already experiencing, such as the urban heat island and stormwater flooding, further increase the vulnerability of urban trees. Without active monitoring and management, pests, disease, and invasive species can overwhelm even an otherwise healthy forest, and climate change may worsen some existing pest problems or allow for the proliferation of new pests.

Some pests and invasive species that may not be a threat now may become more problematic as the climate changes, so it is important to anticipate this kind of shift. A team in Chicago recommends that, "to anticipate these effects, one should anticipate if current species could emerge in a locality of interest. It is also possible that pests could arrive from distant locales or that non-native species that arrive with some frequency could begin to successfully establish if conditions were to change…[11]" More information regional information about pests can be found in Chapter 4.

[11] Derby Lewis, A., Hall, K.R. and Hellmann, J.J. 2012. Advancing Adaptation in the City of Chicago: Climate Considerations for Management of Natural Areas and Green Spaces in the City of Chicago.

Included below is a set of questions, adapted from a set developed by a team in Chicago, to help guide tree and plant selection.[12]

- Which invasive species or pest species require the most attention under current conditions, and are these likely to continue to be a problem in the future under continued climate change?
- Is it likely that warmer temperatures will favor new invasive species, such as those that currently pose a problem in more southern regions? Such species could be targets for early detection and early management to prevent or slow establishment.
- How will climate change affect the efficacy of current control measures? Will the current frequency of control be sufficient? For example, species that are currently controlled by hand-pulling may require more intensive measures if their abundance or growth rate increases due to climate change.
- Are there elements of invasive or pest control that are sensitive to the length of the growing season, or the presence/absence of frozen or wet ground (eg., prescribed burning, mowing, vegetation planting)? Can control methods be modified to account for these changes?

Additional Resources for Pests and Invasive Species Management:

Invasive plants are a threat to native species throughout the country. Some species may out-compete native plants, while others may act as parasites and directly harm desired trees. The U.S. Forest Service website offers resources and tools to inform the public and offer management methods. http://www.fs.fed.us/ccrc/topics/invasive-plants/

The US Forest Service offers data and services to address common pests and diseases. A list can be found here: http://www.na.fs.fed.us/fhp/id/index.shtm

Transform Yards and Vacant Properties into Wildlife gardens

Wildlife conservation efforts in the Unites States have largely focused on creating large intact landscapes for wildlife to survive and thrive with little effort targeted at the urban/suburban environment. Likewise, very few people living in these urban and suburban areas consider their lawns and gardens as wildlife conservation areas able to sustain our declining plants and animals. However, through National Wildlife Federation's Certified Wildlife Habitat ® program, people have an opportunity to help improve the status of wildlife that is struggling in urban and suburban areas.

Landowners can design a Certified Wildlife Habitat® in a way that not only provides habitat for wildlife, but also helps reduce the impacts that climate change has on people and wildlife. Networks of Certified Wildlife Habitats® can help restore wildlife in cities and suburbs, sequester carbon, reduce the urban heat island effect, and help manage flooding and drought.

[12] Derby Lewis, A., Hall, K.R. and Hellmann, J.J. 2012. Advancing Adaptation in the City of Chicago: Climate Considerations for Management of Natural Areas and Green Spaces in the City of Chicago.

Understand, Analyze, and Leverage the Benefits of Urban Trees

Robust urban tree canopies can reduce carbon pollution, provide habitat and food for wildlife, improve shade and cooling effects, and manage stormwater flooding. At the same time, trees can help reduce the urban heat island effect and air conditioning, thereby lowering GHG emissions associated with building energy use. If people are more familiar with the full range of benefits provided by trees, they may be more likely to help keep them healthy and protected. Plus, urban trees can help communities meet local policy goals, like those identified in sustainability plans and climate action plans.

Some resources to evaluate the benefits of urban trees included the following:

- The City of Arcata, CA, was the first municipality in the country to contract for the sale of forest carbon offsets. The forestry project will be registered and verified according to the rigorous Climate Action Reserve[13] protocols. The revenue from this sale will be used to decrease logging activities and allow tree stands to reach an older age. Learn more about forestry carbon credits here: http://www.governing.com/topics/energy-env/col-turning-forests-carbon-banks.html
- Developed by the USDA Forest Service, iTree is a series of forestry analysis and benefits assessment tools that helps users quantify the ecosystem services and values from trees. iTree can be accessed here: http://itreetools.org/

[13] The Climate Action Reserve is a carbon offset registry for North America that helps to ensure the environmental integrity and financial benefit of greenhouse gas emissions reduction projects. More information can be found here: http://www.climateactionreserve.org/