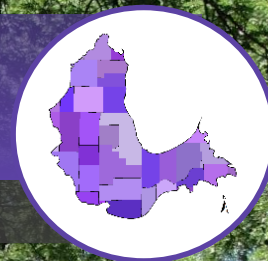


Chicago Wilderness Region

Urban Forest Vulnerability Assessment and Synthesis



SUMMARY AND HIGHLIGHTS

The urban forest of the Chicago Wilderness region can be viewed as two separate but interconnected entities: natural areas and developed sites. These areas are managed and maintained in vastly different ways and by different stakeholder groups.

Urban forests will experience local climate change impacts in the coming decades. A key step to understanding the potential impacts of climate change on the urban forest is to conduct vulnerability assessments.

As part of the Urban Forestry Climate Change Response Framework Chicago Wilderness pilot, more than 20 scientists and urban forestry professionals collaborated to assess the vulnerability of the region's forest to the likely range of climate change. Learn more other project activities at:

www.forestadaptation.org/urban

The climate has changed

Over the past century, the Chicago Wilderness region has warmed by about 1°F on average. Summer minimum temperatures increased by 2.5 °F (1.4 °C) on average across the region. Changes in summer maximum temperatures differed geographically, with increases around Chicago and several other areas directly adjacent to Lake Michigan and decreases in the far southern part of the region, away from the lake.

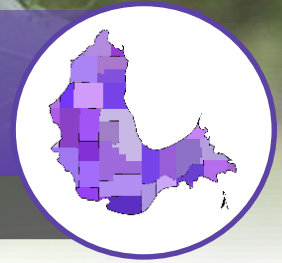
Precipitation has also increased across the region on average. Across the entire area, increases were greatest in the summer. Much of these summer increases have been from heavy storm events.

The Chicago Wilderness Region is getting warmer and wetter, with more intense precipitation events.



Chicago Wilderness Region

Urban Forest Vulnerability Assessment and Synthesis



SUMMARY AND HIGHLIGHTS

Global climate models can help us understand how climate may change in the future given changes in greenhouse gas emissions. In this assessment, we report climate projections for two global climate models under two contrasting greenhouse gas emissions scenarios (high and low) over the next century compared to the average over the last 30 years of the 20th century.

Temperatures will increase

All global climate models project that temperatures will increase in the Chicago Wilderness Region. Model projections suggest an increase in temperature over the next century across all seasons by 2 to 8 °F. Growing seasons will continue to lengthen due to warmer temperatures.

Evidence suggests that winter temperatures will increase in the area, even under low emissions, leading to changes in snow and soil frost.

Precipitation will change

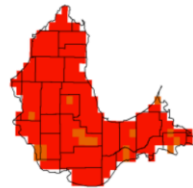
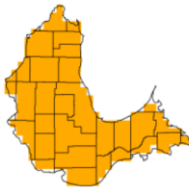
Precipitation is projected to increase in winter and spring. There is a difference in model projections for later in the growing season, but evidence seems to indicate there may be a decrease in precipitation in either summer or fall, depending on scenario. Even if the total annual amount of precipitation does not change substantially, some evidence suggests it may occur as heavier rain events interspersed among relatively drier periods

CHANGE IN MEAN TEMPERATURE

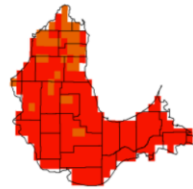
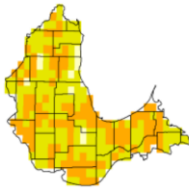
LOW emissions

HIGH emissions

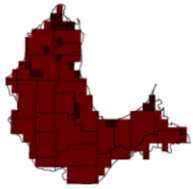
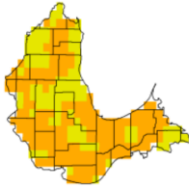
Winter
(Dec - Feb)



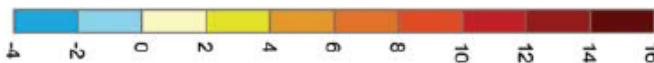
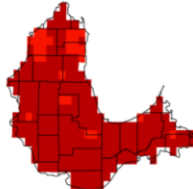
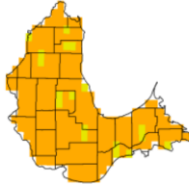
Spring
(Mar - May)



Summer
(Jun - Aug)



Fall
(Sep - Nov)

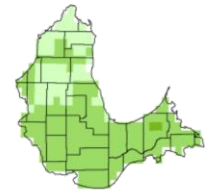
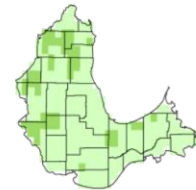


CHANGE IN PRECIPITATION

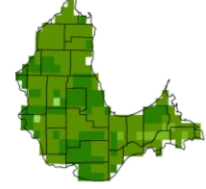
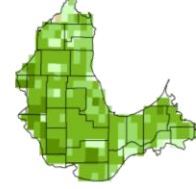
LOW emissions

HIGH emissions

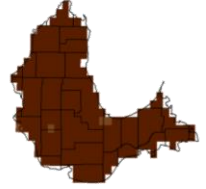
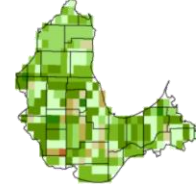
Winter
(Dec - Feb)



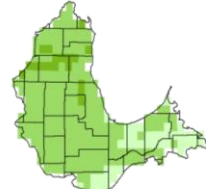
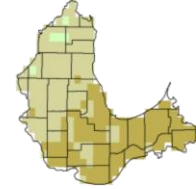
Spring
(Mar - May)



Summer
(Jun - Aug)



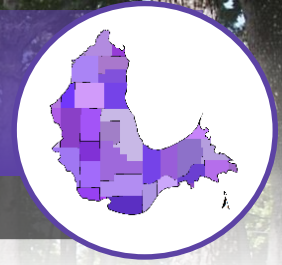
Fall
(Sep - Nov)



Projected difference in mean daily temperature and total seasonal precipitation at the end of the century (2070 through 2099) compared to 1971 through 2000 for two climate model-emissions scenario combinations.

Chicago Wilderness Region

Urban Forest Vulnerability Assessment and Synthesis



SUMMARY AND HIGHLIGHTS

The region's urban forest will experience both direct and indirect impacts from a changing climate

Information from tree species habitat suitability models, hundreds of scientific papers, and local urban forestry professionals' expertise were combined to assess the effects of climate change on the region's urban forest and trees.

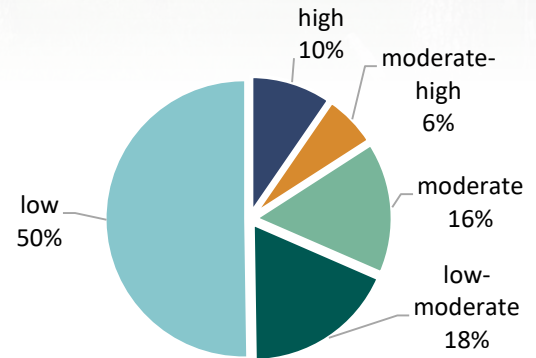
Hardiness zones and, more recently, heat zones are used to determine suitability for planting. We used downscaled climate model projections to estimate how heat and hardiness zones may change in the coming decades. Increases in temperature may lead to an increase of 1-2 hardiness zones and 2-4 heat zones.

There are many species not commonly planted in the area are likely to do well under future conditions. These can be considered as an alternative to invasive species or those that may be vulnerable.

We used habitat suitability models, projected changes in heat and hardiness zones, and assessments of species adaptability to stressors such as pests, flooding, wind, and temperature extremes to estimate the overall vulnerability of species commonly planted in the Chicago region as well as those recommended for planting.

Overall, half of all species in the region have low vulnerability, but many of the low vulnerability species are nonnative invasive or weedy species.

ⁱ invasive species



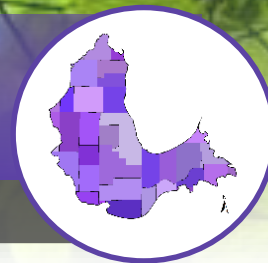
Percentage of trees in the region within each vulnerability category

	Low emissions				High emissions			
	1980 to 2009	2010 to 2039	2040 to 2069	2070 to 2099	1980 to 2009	2010 to 2039	2040 to 2069	2070 to 2099
Hardiness zone	5b-6a	5b-6a	6a-6b	6a-6b	5b-6a	6a-6b	6b-7a	7a-7b
Heat zone	4-5	5-6	5-6	5-6	4-5	6-7	7-8	8

Common Species with Low Vulnerability	Common Species with High Vulnerability	New or Rare Species with Low Vulnerability
Amur Honeysuckle ⁱ	Balsam Fir	American Elm Cultivars ('Accolade', 'Discovery', 'Frontier', 'Triumph')
Black Locust	Black Cherry	Chestnut Oak
Black Oak	Douglas Fir	Chinese Juniper
Boxelder	Eastern Hemlock	Common Persimmon
Bur Oak	Gray Birch	Kousa Dogwood
European and Glossy Buckthorn ⁱ	Jack Pine	Scholar Tree
Freeman Maple	Paper Birch	Shantung Maple
Ginkgo	Quaking Aspen	Sunset Maple
Littleleaf Linden	White Pine	Willow Oak
Northern Hackberry	White Spruce	Yellowwood

Chicago Wilderness Region

Urban Forest Vulnerability Assessment and Synthesis



SUMMARY AND HIGHLIGHTS

Vulnerability Case Studies

Climate change will not affect all communities in the landscape in the same way. Some communities may be more vulnerable than others if they lack biodiversity, are in areas susceptible to climate change impacts, or lack the resources to adapt.

Vulnerability is the susceptibility of a system to the adverse effects of climate change. It is a function of potential climate change impacts and the adaptive capacity of the system. A system is vulnerable if it is at risk for no longer being recognizable as that community type, or if the system is anticipated to suffer substantial declines in health or productivity.

We developed a process for municipalities, park districts, and forest preserve districts to assess their vulnerability to climate change based on impacts and adaptive capacity. Ten case studies were developed in the Chicago Wilderness region using this approach. Most of the variation in vulnerability among communities was in adaptive capacity. In general, communities that had urban forests with high species, genetic, and age class diversity and had sufficient organizational, technical, social, and economic resources were less vulnerable to climate change impacts.

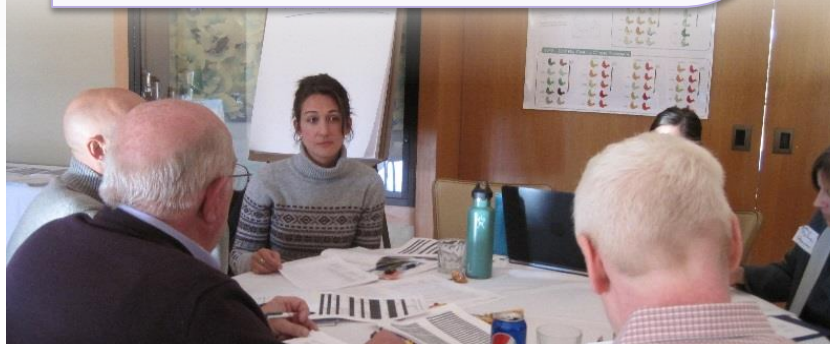
This process can be used by communities to help identify potential areas where they may wish to develop adaptation strategies.

What can managers do?

Confronting the challenge of climate change presents opportunities for land managers to plan ahead, foster resilient landscapes, and ensure that the benefits that forests provide are sustained into the future.

Climate change impacts will vary across the landscape. Examples of characteristics that make systems more adaptable include high species diversity, landscape connectivity, and the ability to bounce back following a disturbance, such as a drought, flood, or fire. Managers can use scientific information from the assessment and other sources to better understand which places may be most vulnerable.

Resources are available to help forest managers and planners incorporate climate change considerations into forest management. A set of Forest Adaptation Resources is available at www.forestadaptation.org.



More information

Leslie Brandt

Northern Institute of Applied Climate Science & USDA Forest Service
lbrandt@fs.fed.us

www.forestadaptation.org/urban

Citation: Brandt, Leslie A.; Derby Lewis, Abigail; Scott, Lydia; Darling, Lindsay; Fahey, Robert T.; Iverson, Louis; Nowak, David J.; Bodine, Allison R.; Bell, Andrew; Still, Shannon; Butler, Patricia R.; Dierich, Andrea; Handler, Stephen D.; Janowiak, Maria K.; Matthews, Stephen N.; Miesbauer, Jason W.; Peters, Matthew; Prasad, Anantha; Shannon, P. Danielle; Stotz, Douglas; Swanston, Christopher W. 2017. Chicago Wilderness region urban forest vulnerability assessment and synthesis: a report from the Urban Forestry Climate Change Response Framework Chicago Wilderness pilot project. Gen. Tech. Rep. NRS-168. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. Nn 142. <https://doi.org/10.2737/NRS-168>.

The Climate Change Response Framework is a core forest adaptation effort of the USDA Northern Forests Climate Hub