

CLIMATE IMPACTS – CENTRAL HARDWOODS

From the Adaptation Workbook: www.adaptationworkbook.org/explore-impacts

This area covers 42 million acres of southern Missouri, Illinois, and Indiana within Ecological Province 223 (Central Interior Broadleaf Forest) of the National Hierarchical Framework of Ecological Units. Provinces are broad geographic areas that share similar coarse features, such as climate, glacial history, and vegetation types, a mosaic of natural communities characterized by oak-hickory forests, woodlands and savannas.

The climate impacts and community vulnerability described in this document are excerpted from: L. Brandt, H. He, and others. 2014. [Central Hardwoods Ecosystem Vulnerability Assessment and Synthesis](#). USDA Forest Service Northern Research Station.

Summary of Climate Impacts (details and citations on subsequent pages):

Central Hardwoods region temperatures will increase across all seasons between 2 °F and 7 °F by the end of the century.

Precipitation in the Central Hardwoods region is projected to increase in winter and spring by 2 to 5 inches for the two seasons combined.

Hydrologic model projections indicate that soil moisture, runoff, and streamflow may increase in the Central Hardwoods region during the spring as precipitation increases.

Snow in the Central Hardwoods region will decrease, with subsequent decreases in soil frost.

The Central Hardwoods region's growing season will increase by 20 to 70 days by the end of the century.

Intense precipitation events will continue to become more frequent in the Central Hardwoods region.

The Central Hardwoods region soil moisture patterns will change, with drier soil conditions later in the growing season.

Climate conditions will increase fire risks in the Central Hardwoods region by the end of the century

Many invasive species, insect pests, and pathogens in the Central Hardwoods region will increase or become more damaging.

Southern species in the Central Hardwoods region will be favored by climate change.

Suitable habitat for northern species in the Central Hardwoods region will decline.

Low-diversity systems in the Central Hardwoods region are at greater risk from climate change.

Species in fragmented landscapes in the Central Hardwoods region will have less opportunity to migrate in response to climate change.

Fire-adapted systems in the Central Hardwoods region will be more resilient to climate change

Table 17.—Vulnerability determinations by natural community type. See Appendix 10 for a description of the relative ratings.

Community Type	Potential Impacts	Adaptive Capacity	Vulnerability	Evidence	Agreement
Dry-mesic upland forest	Moderate	High	Low-Moderate	Medium	Medium-High
Mesic upland forest	Negative	Low	High	Medium	Medium-High
Mesic bottomland forest	Moderate	Moderate	Moderate	Limited -Medium	Medium
Wet bottomland forest	Moderate-Negative	Moderate	Moderate-High	Limited-Medium	Medium
Flatwoods	Moderate- Positive	Moderate	Low-Moderate	Limited-Medium	Medium
Closed woodland	Positive	High	Low	Limited	Medium
Open woodland	Positive	High	Low	Limited-Medium	Medium
Barrens and savanna	Positive	Moderate	Low	Medium	Medium-High
Glade	Moderate- Positive	Moderate	Low-Moderate	Medium	Medium-High

Central Hardwoods region temperatures will increase across all seasons between 2 °F and 7 °F by the end of the century.

All global climate models project that temperatures will increase with continued increases in atmospheric greenhouse gas concentrations.

Precipitation in the Central Hardwoods region is projected to increase in winter and spring by 2 to 5 inches for the two seasons combined.

The vast majority of model projections for the Central Hardwoods Region are in agreement that there will be an increase in precipitation in winter and spring.

Hydrologic model projections indicate that soil moisture, runoff, and streamflow may increase in the Central Hardwoods region during the spring as precipitation increases.

Hydrologic modeling based on a range of climate models and scenarios suggests an increase in soil moisture, runoff, and streamflow throughout the next century. The magnitude or frequency of flooding could potentially increase in the winter and spring due to increases in total runoff and peak streamflow during those time periods.

Snow in the Central Hardwoods region will decrease, with subsequent decreases in soil frost.

The Central Hardwoods Region is already experiencing a decline in snowfall, depth, and cover. Decreased snowfall and increased snowmelt from higher temperatures are projected to decrease the amount of snow on the ground in the region, and may make some locations snow-free in some years. In recent years, this reduction in snow cover has led to an increase in soil frost from decreased snow insulation. However, as temperatures increase in the coming decades, this pattern is projected to reverse, and far southern Illinois and Indiana may no longer experience freezing soil conditions by the end of the century.

The Central Hardwoods region's growing season will increase by 20 to 70 days by the end of the century.

Evidence at both global and local scales indicates that growing seasons have been getting longer, and this trend is projected to become even more pronounced over the next century. As seasons shift so that spring arrives earlier and fall extends later into the year, phenology may shift for plant species that rely on temperature as a cue for the timing of leaf-out, reproductive maturation, and other developmental processes. Longer growing seasons could also result in greater growth and productivity of trees and other vegetation, but only if balanced by available water and nutrients.

Intense precipitation events will continue to become more frequent in the Central Hardwoods region.

Heavy precipitation events have already been increasing in number and severity in the area, and some models suggest an increase over the next century.

The Central Hardwoods region soil moisture patterns will change, with drier soil conditions later in the growing season.

Due to projected decreases in precipitation during summer or fall and increases in temperature throughout the year, some evidence suggests a slight decrease in surface soil moisture in the Central Hardwoods Region over the next century. In addition, total soil moisture is projected to increase during winter and spring and decrease in the late summer and autumn. Even if there are increases in precipitation in the summer, as a few models suggest, increases in evapotranspiration are projected to lead to lower soil water availability. Even a slight decrease in soil moisture could lead to dramatic declines in tree species, especially broadleaf species. However, model projections vary, and at least one study in Illinois suggests that increases in summer precipitation may be sufficient to offset increases in evapotranspiration.

Climate conditions will increase fire risks in the Central Hardwoods region by the end of the century

At a global scale, the scientific consensus is that fire risk will increase by 10 to 30 percent due to higher summer temperatures and occasional increased periods of droughts. Projections for the central United States show low agreement among climate models on changes in fire probability in the near term, but the majority of models project an increase in wildfire probability by the end of the century. Fire seasons in the southeastern United States could nearly double in length and increase in severity. In addition to the direct effects of temperature and precipitation, increases in fuel loads from pest-induced mortality could also increase fire risk, but

the precise relationship between these two factors can be complex. The extensive fragmentation of forests by roads, agriculture, and other land uses in much of the Central Hardwoods may limit the scale of individual fires even as fire risk increases.

Many invasive species, insect pests, and pathogens in the Central Hardwoods region will increase or become more damaging.

A warming climate is allowing some invasive plant species, insect pests, and pathogens to survive farther north than they had previously. One particular emerging threat to the region is the southern pine beetle, which attacks shortleaf and other pines. Oak decline, a disease complex brought about by drought and other stressors, is expected to become a larger problem in the red oak group as droughts become longer and more widespread. Some drought- and fire-tolerant invasive plants, such as sericea lespedeza, may also benefit from projected climate changes. In addition, a warming climate may make conditions more favorable for invasive species that are currently invading from south of the area, such as kudzu.

Southern species in the Central Hardwoods region will be favored by climate change.

Model results suggest an increase in suitable habitat for many species at or near the northern extent of their current range, including shortleaf pine, post oak, and blackjack oak. In addition, habitat may become favorable to species not currently found in the assessment area, such as loblolly pine. However, habitat fragmentation and the limited dispersal ability of seeds are expected to hinder the northward movement of the more southerly species despite the increase in habitat suitability. Most species can be expected to migrate more slowly than their habitats will shift. Indeed, in a simulation for five species, only a maximum of 15 percent of newly suitable habitat would have much of a chance of getting colonized over 100 years.

Suitable habitat for northern species in the Central Hardwoods region will decline.

Results from climate impact models suggest a decline in suitable habitat for northern species such as sugar maple, white ash, and American beech when compared with habitat suitability under current climates. These northern species may be able to persist in some southern portions of their range if potential new competitors from farther south are unable to colonize these areas, although they are expected to have reduced vigor and be under greater stress.

Low-diversity systems in the Central Hardwoods region are at greater risk from climate change.

Species-rich communities have exhibited greater resilience to extreme environmental conditions and greater potential to recover from disturbance. Conversely, ecosystems that have low species diversity or low functional diversity (where multiple species occupy the same niche) may be less resilient to climate change, its associated stressors, or both. Genetic diversity within species is also critical for the ability of populations to adapt to climate change, because species with high genetic variation tend to have more individuals that can withstand a wide range of environmental stressors

Species in fragmented landscapes in the Central Hardwoods region will have less opportunity to migrate in response to climate change.

Habitat fragmentation can hinder the ability of species to migrate to more suitable habitat on the landscape, especially if the surrounding area is not forested. Modeling results in this assessment and elsewhere indicate that trees would need to migrate at rates of hundreds of feet to several miles per year to keep pace with the changes in climate that are projected to occur over the next century. Species in community types that tend to be more rare and fragmented may be at a particular disadvantage.

Fire-adapted systems in the Central Hardwoods region will be more resilient to climate change

In general, fire-adapted systems that have a more open structure and composition are less prone to high-severity wildfire. Frequent low-severity fire has also been shown to promote many species projected to do well under future climate projections, such as shortleaf pine and many oak species. Fire-suppressed systems, on the other hand, tend to have heavy encroachment of woody species in the understory that reduce regeneration potential for these fire-adapted trees. In addition, fire-suppressed systems can be more vulnerable to insect attack. Since the mid-1900s, lack of fire has led to at least a temporary increase in sugar maple in the eastern portion of the assessment area, and this species is not projected to fare well under projected climate change. However, it is important to note that effects of fire on species regeneration and disturbances can vary by site, species, and burn regime.