21 Midwest

Carson, Wisconsin

Key Message 1

Agriculture

The Midwest is a major producer of a wide range of food and animal feed for national consumption and international trade. Increases in warm-season absolute humidity and precipitation have eroded soils, created favorable conditions for pests and pathogens, and degraded the quality of stored grain. Projected changes in precipitation, coupled with rising extreme temperatures before mid-century, will reduce Midwest agricultural productivity to levels of the 1980s without major technological advances.

Key Message 2

Forestry

Midwest forests provide numerous economic and ecological benefits, yet threats from a changing climate are interacting with existing stressors such as invasive species and pests to increase tree mortality and reduce forest productivity. Without adaptive actions, these interactions will result in the loss of economically and culturally important tree species such as paper birch and black ash and are expected to lead to the conversion of some forests to other forest types or even to non-forested ecosystems by the end of the century. Land managers are beginning to manage risk in forests by increasing diversity and selecting for tree species adapted to a range of projected conditions.

Key Message 3

Biodiversity and Ecosystems

The ecosystems of the Midwest support a diverse array of native species and provide people with essential services such as water purification, flood control, resource provision, crop pollination, and recreational opportunities. Species and ecosystems, including the important freshwater resources of the Great Lakes, are typically most at risk when climate stressors, like temperature increases, interact with land-use change, habitat loss, pollution, nutrient inputs, and nonnative invasive species. Restoration of natural systems, increases in the use of green infrastructure, and targeted conservation efforts, especially of wetland systems, can help protect people and nature from climate change impacts.

Key Message 4

Human Health

Climate change is expected to worsen existing health conditions and introduce new health threats by increasing the frequency and intensity of poor air quality days, extreme high temperature events, and heavy rainfalls; extending pollen seasons; and modifying the distribution of disease-carrying pests and insects. By mid-century, the region is projected to experience substantial, yet avoidable, loss of life, worsened health conditions, and economic impacts estimated in the billions of dollars as a result of these changes. Improved basic health services and increased public health measures—including surveillance and monitoring—can prevent or reduce these impacts.

Key Message 5

Transportation and Infrastructure

Storm water management systems, transportation networks, and other critical infrastructure are already experiencing impacts from changing precipitation patterns and elevated flood risks. Green infrastructure is reducing some of the negative impacts by using plants and open space to absorb storm water. The annual cost of adapting urban storm water systems to more frequent and severe storms is projected to exceed $500 million for the Midwest by the end of the century.

Key Message 6

Community Vulnerability and Adaptation

At-risk communities in the Midwest are becoming more vulnerable to climate change impacts such as flooding, drought, and increases in urban heat islands. Tribal nations are especially vulnerable because of their reliance on threatened natural resources for their cultural, subsistence, and economic needs. Integrating climate adaptation into planning processes offers an opportunity to better manage climate risks now. Developing knowledge for decision-making in cooperation with vulnerable communities and tribal nations will help to build adaptive capacity and increase resilience.

Executive Summary

The Midwest is home to over 60 million people, and its active economy represents 18% of the U.S. gross domestic product.[1] The region is probably best known for agricultural production. Increases in growing-season temperature in the Midwest are projected to be the largest contributing factor to declines in the productivity of U.S. agriculture.[2] Increases in humidity in spring through mid-century[3,4] are expected to increase rainfall, which will increase the potential for soil erosion[5,6] and further reduce planting-season workdays due to waterlogged soil.[7]

Forests are a defining characteristic of many landscapes within the Midwest, covering more than 91 million acres. However, a changing climate, including an increased frequency of late-growing-season drought conditions, is worsening the effects of invasive species, insect pests, and plant disease as trees experience periodic moisture stress. Impacts from human activities, such as logging, fire suppression, and agricultural expansion, have lowered the diversity of the Midwest's forests from the pre-Euro-American settlement period. Natural resource managers are taking steps to address these issues by increasing the diversity of trees and introducing species suitable for a changing climate.[8]

The Great Lakes play a central role in the Midwest and provide an abundant freshwater resource for water supplies, industry, shipping, fishing, and recreation, as well as a rich and diverse ecosystem. These important ecosystems are under stress from pollution, nutrient and sediment inputs from agricultural systems, and invasive species.[9,10] Lake surface temperatures are increasing,[11,12] lake ice cover is declining,[12,13,14] the seasonal stratification of temperatures in the lakes is occurring earlier in the year,[15] and summer evaporation rates are increasing.[13,16] Increasing storm impacts and declines in coastal water quality can put coastal communities at risk. While several coastal communities have expressed willingness to integrate climate action into planning efforts, access to useful climate information and limited human and financial resources constrain municipal action.

Land conversion, and a wide range of other stressors, has already greatly reduced biodiversity in many of the region's prairies, wetlands, forests, and freshwater systems. Species are already responding to changes that have

occurred over the last several decades,[17,18,19] and rapid climate change over the next century is expected to cause or further amplify stress in many species and ecological systems in the Midwest.[20,21,22] The loss of species and the degradation of ecosystems have the potential to reduce or eliminate essential ecological services such as flood control, water purification, and crop pollination, thus reducing the potential for society to successfully adapt to ongoing changes. However, understanding these relationships also highlights important climate adaptation strategies. For example, restoring systems like wetlands and forested floodplains and implementing agricultural best management strategies that increase vegetative cover (cover crops and riparian buffers) can help reduce flooding risks and protect water quality.[23,24,25]

Midwestern populations are already experiencing adverse health impacts from climate change, and these impacts are expected to worsen in the future.[26,27] In the absence of mitigation, ground-level ozone concentrations are projected to increase across most of the Midwest, resulting in an additional 200–550 premature deaths in the region per year by 2050.[28] Exposure to high temperatures impacts workers' health, safety, and productivity.[29] Currently, days over 100°F in Chicago are rare. However, they could become increasingly more common by late century in both the lower and higher scenarios (RCP4.5 and RCP8.5).

The Midwest also has vibrant manufacturing, retail, recreation/tourism, and service sectors. The region's highways, railroads, airports, and navigable rivers are major modes for commerce activity. Increasing precipitation, especially heavy rain events, has increased the overall flood risk, causing disruption to transportation and damage to property and infrastructure. Increasing use of green infrastructure (including nature-based approaches, such as wetland restoration, and innovations like permeable pavements) and better engineering practices are beginning to address these issues.

Conservation Practices Reduce Impact of Heavy Rains

Integrating strips of native prairie vegetation into row crops has been shown to reduce sediment and nutrient loss from fields, as well as improve biodiversity and the delivery of ecosystem services.[33] Iowa State University's STRIPS program is actively conducting research into this agricultural conservation practice.[34] The inset shows a close-up example of a prairie vegetation strip. *From Figure 21.2 (Photo credits: [main photo] Lynn Betts, [inset] Farnaz Kordbacheh)*.

Citizens and stakeholders value their health and the well-being of their communities—all of which are at risk from increased flooding, increased heat, and lower air and water quality under a changing climate.[30,31] To better prevent and respond to these impacts, scholars and practitioners highlight the need to engage in risk-driven approaches that not only focus on assessing vulnerabilities but also include effective planning and implementation of adaptation options.[32]

The photo shows Menominee Tribal Enterprises staff creating opportunity from adversity by replanting a forest opening caused by oak wilt disease with a diverse array of tree and understory plant species that are expected to fare better under future climate conditions. *From Figure 21.4 (Photo credit: Kristen Schmitt)*.