Climate Change Adaptation Project

Caroline Lake Preserve

Working forests are an integral part of the Northwoods landscape, providing forest products, jobs, and environmental benefits to local communities. Climate change introduces new challenges to the integrity and productivity of these forests over the long term. The Nature Conservancy's Caroline Lake Preserve in northern Wisconsin provides a real-world example of how climate change adaptation can be incorporated into sustainable forest management. It is one of multiple adaptation efforts in the area that show how forest management actions can enhance the forest's ability to cope with changing conditions while meeting a variety of landowner goals.

CLIMATE CHANGE AND CAROLINE LAKE

Northern Wisconsin is already experiencing the effects of climate change, and many of these impacts are expected to increase in the future. A variety of factors that strongly influence the area's forests are anticipated to change, including seasonal temperatures, timing and type of precipitation, frequency and severity of natural disturbances, and the range of pests and diseases[1].

Potential climate change impacts on the Caroline Lake Preserve include:

- **Changes in the area's hydrology** due to warmer winter temperatures and changing precipitation patterns. Warming is expected to be greatest in winter, which may reduce the large amount of lake-effect snow, leading to changed seasonal conditions and increased potential for deer browsing on vegetation.
- **Reduced water levels or water levels that fluctuate greatly between seasons** as a result of changes in precipitation patterns, particularly in forested wetlands. These changes could increase stress on forests and reduce their ability to provide clean water and wildlife habitat.
- **Declines in habitat for many of the preserve's tree species**, such as black spruce and balsam fir. Some forest types, such as lowland conifers, may be at a particular disadvantage, especially if large hydrological changes also occur.
- **Increases in habitat for some of the preserve's trees species** such as red oak, white pine, and several other species that currently occur in parts of the preserve and are projected to fare better in the future. In many parts of the preserve, the diversity of tree species and forest habitats that are currently present enhances resilience to climate change.

Caroline Lake Preserve

SIZE: 1,044 acres
FOREST TYPES: A variety of upland and lowland types including northern hardwoods, aspen, and lowland conifers.

Caroline Lake forms the headwaters of the Bad River. Its clean, clear water contributes to the high water quality of the river and of the Kakagon/Bad River Sloughs—16,000 acres of wild rice, grasses, sedges, trees, streams, and open water located along the southern shore of Lake Superior. The Sloughs are the largest and healthiest fully-functioning freshwater estuarine system remaining in the entire upper Great Lakes region.

Current management focuses on transitioning the relatively young forest to mid- and late-successional forests in order to increase tree species and age diversity.

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A TEAM EFFORT

A variety of partners are helping to carry out this adaptation project:

- The **Northern Institute of Applied Climate Science (NIACS)** leads the Northwoods Climate Change Response Framework project, a collaborative effort that helps natural resource managers incorporate climate change considerations into forest management planning and decision making. This includes a vulnerability assessment[1] for northern Wisconsin that summarizes anticipated changes in northern Wisconsin forests, as well as a set of forest adaptation resources[2] that enables managers to identify climate change concerns and management actions that facilitate adaptation.
- **The Nature Conservancy (TNC)** has worked in Wisconsin since 1960, conserving more than 162,500 acres of forests, wetlands, prairies, lakes and streams. TNC's Caroline Lake Preserve is located in Ashland County and forms the headwaters of the Bad River, which empties into Lake Superior. The Preserve contains 1,044 acres of forest acquired from industrial ownership in 1997, and TNC has developed a management plan that provides for sustainable forest management and protection of natural processes, water quality, and biodiversity.
- The **Shared Landscapes Initiative (SLI)** is a forum for the forestry community in northern Wisconsin to discuss the effects of a changing climate on ecosystems, management responses, and cooperative activities across a variety of public and private organizations. The SLI is convening a set of adaptation projects across a variety of landownerships in the area surrounding Chequamegon Bay, including this effort at the Caroline Lake Preserve.

Websites for more information:
www.sharedlandscapes.org
www.climateframework.org

Shared Landscapes INITIATIVE

NIACS Northern Institute of Applied Climate Science

The Nature Conservancy
Protecting nature. Preserving life.™

NORTHWOODS CLIMATE CHANGE RESPONSE FRAMEWORK

INCORPORATING CLIMATE CHANGE INTO FOREST MANAGEMENT

A team of scientists and forest managers from TNC, NIACS, and the Wisconsin Department of Natural Resources used the Adaptation Workbook from *Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers*[2] to evaluate the potential climate change impacts on the Caroline Lake Preserve (see previous page) and develop a variety of actions to enhance forest resilience to climate change under a wide range of future conditions.

STAND	CURRENT MANAGEMENT	POSSIBLE ADAPTATION ACTIONS
Shoreline Buffer	▪ No harvest reserve area	▪ Promote tree species that are expected to fare better under climate change, such as red oak or white pine, through timber stand improvement harvests ▪ Plant white pine to enhance long-lived conifer component and provide shading of the lake.
Lowland Conifer	▪ No harvest reserve area	▪ Maintain as no harvest reserve area. ▪ Increase monitoring to detect hydrological changes in peatland systems; revisit planned management if changes are observed.
Upland Conifer	▪ Promote long-lived conifers	▪ Promote long-lived conifers, with additional emphasis on species that are expected to fare better under climate change, such as white pine.
Lowland Hardwoods	▪ No harvest reserve area	▪ Diversify stands through thinning, group selection, or other techniques. ▪ Monitor natural regeneration of desired species. If inadequate, consider experimental plantings of swamp white oak or bur oak.
Upland Hardwoods	▪ Use single-tree or group selection methods to maintain species composition/diversity and increase structural diversity	▪ Diversify tree species and age classes by increasing gap sizes in harvested areas. ▪ Promote red oak in areas where natural regeneration is occurring by using large group selection or shelterwood harvests. ▪ Promote white pine and other species that are expected to fare better under climate change; release of advance regeneration or plant seedlings when possible. ▪ Convert a portion of one stand to a red oak forest where natural regeneration is present. ▪ Reserve high-quality pockets of hemlock to serve as refugia for that species

NEXT STEPS

Climate change considerations will be fully integrated into forest conservation and management at the Caroline Lake Preserve. Future activities include:

- Selected adaptation actions will be **incorporated into a revised forest management plan**. This plan will also meet the requirements of the Managed Forest Law and maintain the preserve as a working forest.
- A **new comprehensive forest inventory** will characterize current forest conditions and establish a baseline from which the effectiveness of adaptation actions can be measured.
- A set of **monitoring metrics will be developed** to evaluate the effectiveness of adaptation actions.
- TNC and other project participants will provide feedback to **improve adaptation resources and identify additional land manager needs** such as scientific information, communication efforts, or new tools and resources.
- NIACS and TNC will **communicate the outcomes and lessons** from this project to a wide variety of land owners, resources managers, and others.

REFERENCES

[1]Swanston, C., M. Janowiak, L. Iverson, L. Parker, D. Mladenoff, L. Brandt, P. Butler, M. St. Pierre, A. Prasad, S. Matthews, M. Peters, D. Higgins, and A. Dorland. 2011. *Ecosystem Vulnerability assessment and Synthesis: A Report from the Climate Change Response Framework Project in Northern Wisconsin*. Gen. Tech. Rep. NRS-82. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station, 142 p. www.nrs.fs.fed.us/pubs/38255

[2]Swanston, C. and M. Janowiak (editors). *Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers.* 2012. Gen. Tech. Rep. NRS-87. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station, 121 p. www.nrs.fs.fed.us/pubs/40543

For more information, visit www.sharedlandscapes.org or contact Maria Janowiak (mjanowiak02@fs.fed.us) or Matt Dallman (mdallman@tnc.org).