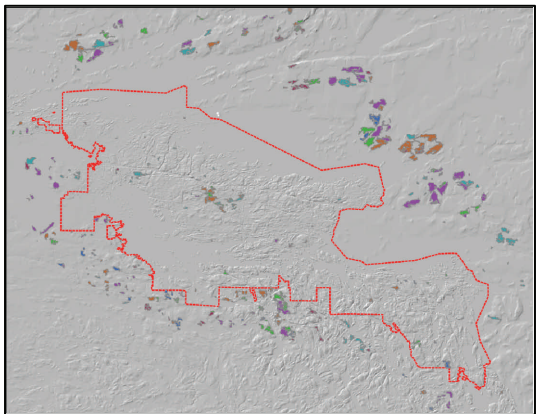
Great Lakes Network
Climate Change Resource Brief

Midwest Region
Inventory & Monitoring
National Park Service
U.S. Department of the Interior

Land Cover-Land Use Monitoring

Using Landsat satellite imagery, we are tracking *disturbances* such as *changes in forest cover* in areas as small as one hectare. High resolution aerial photography helps validate these disturbances and identify causal agents. If climate change models for the Midwest are accurate, more frequent and severe weather events, including extreme wind conditions, could increase the amount of dead woody material on the ground. Combined with the hotter and drier conditions that are also predicted, this increases the potential occurrence and severity of fires. Increased summer droughts, warmer winters, and longer growing seasons could cause a loss of vigor and increased mortality for many tree species and contribute to greater numbers of disease and insect vectors.



Satellite imagery is used to track large-scale disturbances such as fires and blowdown within and outside of park boundaries.

Water Quality Monitoring

Our water quality monitoring program tracks several metrics that can be influenced by climate change. Seasonal and year-to-year changes in *lake water levels and stream flow* reflect changes in ground water recharge/discharge and precipitation patterns. Algae, as measured by *chlorophyll*, are an indicator of temperature changes, length of snow and ice-free season, and nutrient enrichment. The anoxic zone (void of oxygen) in deeper waters may move up the water column or develop earlier in the season with earlier snow melt and ice-off and warmer weather. Changes in the amount of *dissolved organic carbon (DOC)* input from streams and their residence time in lakes affects water clarity which effects productivity. Changes in weather patterns may alter *nutrient* deposition rates to water bodies, resulting in eutrophication and changes in nutrient ratios and limitations.

Low water levels will present new challenges to boaters in addition to affecting water quality and the overall aquatic environment.

Vegetation Monitoring

The predicted changes in precipitation and temperature could affect tree species *densities and distributions*. Cedar and tamarack trees, both adapted to wet areas, are especially vulnerable when summer droughts occur. Species ranges will likely move north as temperatures rise, changing the habitats on which many animals, particularly birds, depend. Climate change may result in drier, more fire-prone forests. Our data will detect changes in *live and dead standing trees* and *down woody material* available for fire.

Persistent Contaminants Monitoring

We are monitoring levels and spatial patterns of six persistent, bioaccumulative, and toxic environmental contaminants. These chemicals are monitored in each park using either fish or bald eagles. One of the chemicals – mercury – is especially relevant, as mercury's global distribution is linked to energy production — a driver of climate change — and weather patterns, which are affected by climate change. The formation of *methylmercury*, the toxic form available to plants and animals, is mediated by water temperature, precipitation, dissolved organic carbon, and other factors.

Analyzing blood and feathers from young bald eagles (*Haliaeetus leucocephalus*) lends insight to contaminant levels in the surrounding area. Photo by Jim Spickler.

Phenology and Weather-Climate Monitoring

Weather stations in and around Great Lakes national parks are recording temperature, precipitation, and wind speed, among other things, which we will use to identify trends over time and look for correlations with trends seen in our other monitoring programs. In addition, we are developing a protocol to monitor phenology, or seasonal events such as leaf-out, ice-off, and flowering dates.

Contact Information

Bill Route, Network Coordinator, 2800 Lakeshore Drive East, Ste. D, Ashland, WI 54806. *Bill_Route@nps.gov*; (715) 682-0631 x 21

Carmen Thomson, Midwest Region Coordinator, 601 Riverfront Drive, Omaha, NE 68102. *Carmen_Thomson@nps.gov*; (402) 661-1876

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