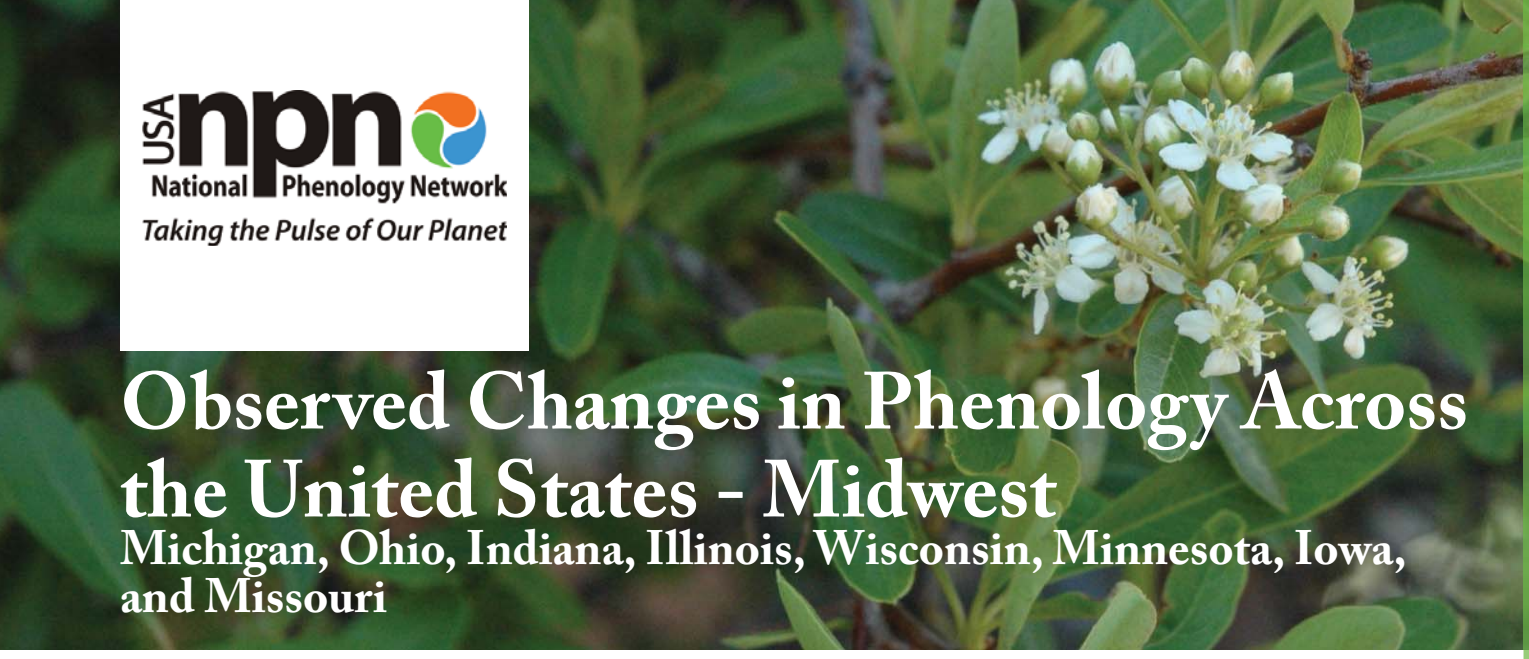
USA npn National Phenology Network
Taking the Pulse of Our Planet



Observed Changes in Phenology Across the United States - Midwest

Michigan, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, and Missouri

Background

Phenology — the seasonal timing of life cycle events in plants and animals such as flowering, hibernation, and migration — has been linked to shifts in the timing of allergy seasons, public visitation to National Parks, and cultural festivals. Change in phenology, recognized as a bio-indicator of climate change impacts, has also been linked to increased wildfire activity and pest outbreak, shifts in species distributions, spread of invasive species, and changes in carbon cycling in forests. Phenological information can and already is being used to identify species vulnerable to climate change, to generate computer models of carbon sequestration, to manage invasive species, to forecast seasonal allergens, and to track disease vectors, such as mosquitoes and ticks, in human population centers.

"Short-distance migratory birds in the Midwest appear to be more sensitive to temperature than long-distance migratory species."

This is one in a series of eight, geographic region-focused information sheets that summarizes documented changes in plant and animal phenology over the past century across the United States. This summary is based on long-term studies (10 years or more) published in the primary scientific literature since 2001. A forthcoming manuscript synthesizes the findings of the eight regional information sheets.

This information was developed in support of the U.S. Global Change Research Program's **National Climate Assessment,** and can be used to facilitate preparation for the cascading effects of ongoing climate change.

The Midwest

The midwestern U.S. has great expanses of both agricultural and forest lands with fragments of once extensive tall grass prairie ecosystems [1, 2]. The climate of this region is humid continental, characterized by mostly warm summers, but with cooler summers in the northern reaches. The Great Lakes are part of this region and influence climate patterns by generating lake-effect snow and moderating temperatures thereby protecting against frost. The Lakes also having a cooling effect on the surrounding area that can delay leaf out compared to inland areas. In the past century, there has been an increase in mean annual temperatures coupled with an increase in duration of the growing season [1, 2]. Precipitation events in the form of heavy summer downpours also are twice as frequent relative to earlier in the 20th century. In the next century, water levels of the Great Lakes are expected to drop between 0.25–0.4 m (0.8–1.3 ft.) [3].

Changes in Phenology - Highlights

Early spring species blooming even earlier

A 28-year dataset from Ohio shows that species that typically flower earlier in the growing season, such as crocus (*Crocus flavus*) and snowdrop (*Galanthus* sp.), exhibited the strongest shift in first flowering; a significant trend in warming temperatures also occurred during the period of record [4]. This is consistent with a number of recent studies, suggesting that late winter-early spring warming is a particularly important cue for typically early flowering species. In a Wisconsin study focused on the aggregated first bloom date for 53 plant species observed between 1962—1998, researchers determined that first bloom dates advanced at different rates depending on the attributes of the geophysical region within the state [5]. Researchers have also linked record-breaking spring temperatures in 2012 with earlier blooming in Wisconsin [6].

Walleye spawning earlier

In Minnesota, the sport fish species walleye (*Sander vitreus*) advanced its spawning date by 0.5 to 1.0 day for each 1-day decrease in ice-out date during much of the 20th century. Researchers suggested that walleye spawning may be a robust biological indicator of climate change impacts [7].

Short-distance migrants arriving earlier

A 22-year study of bird strikes in Chicago found that arrival of short-distance migrants correlated with warmer spring temperatures. Arrivals of long-distance migrants were more highly correlated with continental-scale climate patterns than with regional warming [8]. In a Minnesota study of 44 bird species over 40 years, 36% of species showed earlier arrival dates. Researchers linked this response to higher winter temperatures, particularly for short-distance migrants [9].

Case Study: Ecological Mismatch Between Wood Warblers and Their Food Sources

Under current climate change predictions, birds migrating between southern Illinois and northern Minnesota may have up to 20 fewer days to make the trip due to later spring arrival in southern Illinois and earlier spring arrival in Minnesota. Data sets from Minnesota (40 years) and Illinois (100 years) showed that, out of the eight wood warbler species examined, most species did not change their spring arrival times (six in Illinois; seven in Minnesota). Only one species, the yellow-rumped warbler (*Dendroica coronata,* pictured front), shifted its arrival time to earlier in both locations. If the remaining bird species do not similarly adjust their migration times, researchers suggest that they may miss optimal food foraging conditions in their breeding grounds and eventually experience declines in population size [10].

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