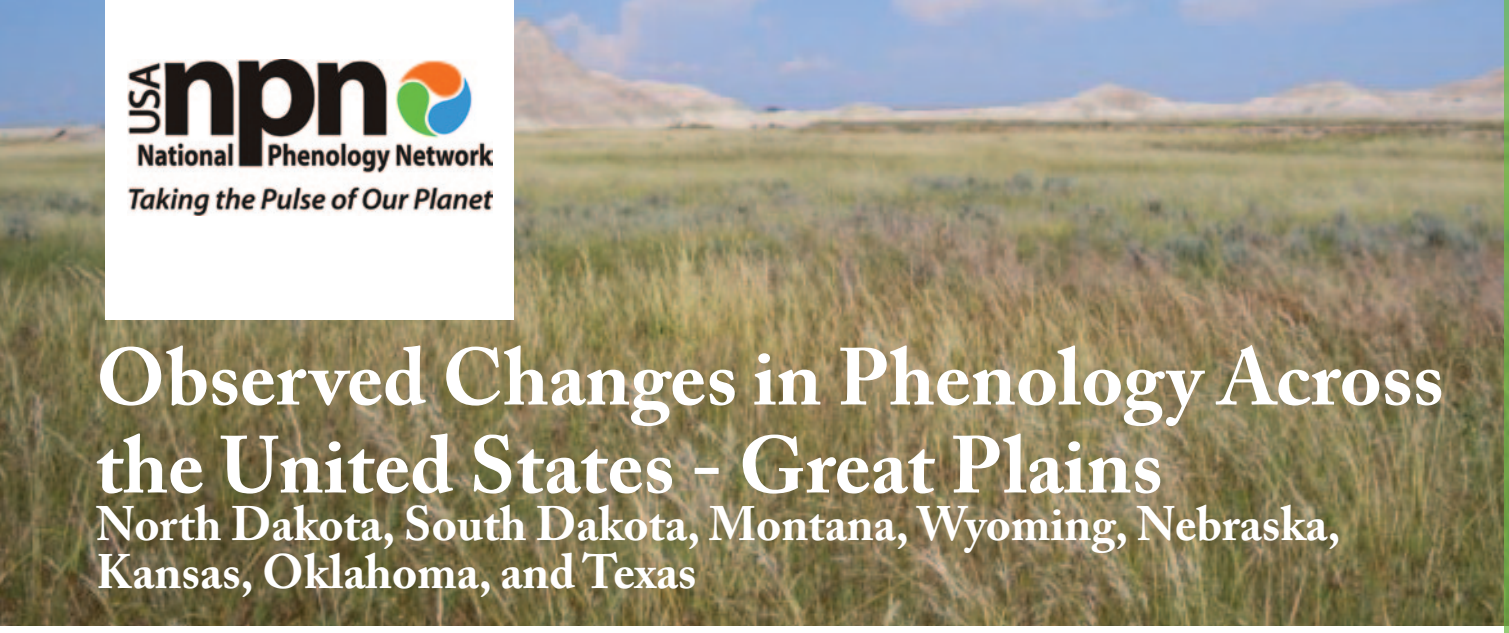
USA npn National Phenology Network
Taking the Pulse of Our Planet



Observed Changes in Phenology Across the United States - Great Plains

North Dakota, South Dakota, Montana, Wyoming, Nebraska, Kansas, Oklahoma, and Texas

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.

"Agricultural crops are blooming earlier across the Great Plains, yet natural plant populations are showing more variability, with some blooming earlier, some later, while others show no change."

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 Great Plains

The Great Plains region is dominated by warm- and cool-season grasslands, with deciduous tree cover in the far eastern reaches. Much of this region is used for farming and ranching [1, 2]. Climate in the Great Plains varies across its large geographical expanse and includes semi-arid steppe in the west, humid continental climate with cool summers in the north, humid continental with warm summers in the east, and subtropical patterns in the south (Texas). The Prairie Pothole region in the northern part of the Great Plains is critical for the production and migration of waterfowl [1, 2]. Mean annual temperatures have increased over the past century, especially in the winter and in the northern states, and since the 1970s has increased 0.83°C (1.5°F). Future temperatures are expected to increase, especially in the summer months in the central and southern areas of this region, and rainfall is projected to increase more in the north than in the south [1, 2].

Changes in Phenology - Highlights

Longer human allergy seasons

From Texas to Saskatchewan, the length of pollen season for ragweed (*Ambrosia* spp.), a common human allergen, has increased from 1995-2009 by as much as 16 days, with longer allergy seasons in the north. Researchers attributed this to regional warming that delayed the onset of first frost in autumn, effectively increasing the number of frost-free days [3].

Changes in duration of stay in migratory birds

Data collected in Texas between 1978 and 2005 showed a trend of later arrival, earlier departure, and shorter duration of stay for three species of winter-resident coastal birds. Summer residents showed greater variability in directional trends of arrival, departure and duration of stay. These changes in phenology were not correlated with warming summer and winter temperatures. However, climate change

impacts on the birds elsewhere along their migratory route may be contributing to these observed differences [4].

Snowmelt changes timing of egg laying

Between 1961 and 2002 in the mountains of Wyoming, egg-laying by American Pipits (*Anthus rubescens*) advanced by five days, and mean clutch size increased by 0.2 eggs; reproductive phenology was positively correlated with snowmelt, which occurred approximately seven days earlier over this same time period [5].

Agricultural crops advance in bloom time

Data from six locations throughout the Great Plains showed that winter wheat (var. Karkoff) is blooming six to 10 days earlier now than 70 years ago. Spring temperatures increased over this same period [6].

Case Study: Flowering Phenology Shifts in the Northern Great Plains Over a 100-Year Period

In North Dakota researchers examined first flowering dates (FFD) for 178 species of plants between 1910–1961 and between 2007—2010. They found that 41% of plants flowered unusually earlier or later between 2007—2010 compared to the 1910—1961 period. FFD and temperature were correlated, with greater deviations of flowering date in warmer years, compared to dates in the early part of the century, indicating that increases in temperatures were a likely mechanism for the observed shift in FFD. The species that showed a change in FFD were projected to show a continued response with increasing temperatures. Between the first and the last temperature periods of the study, temperatures increased 1.7°C (3.0°F) and the average growing season duration increased from 132 days to 154 days. However, the phenologies of >50% of all flowering species examined did not change. This suggests that, for some species, temperature may be less of a cue than other factors, such as precipitation [7, 8].

References

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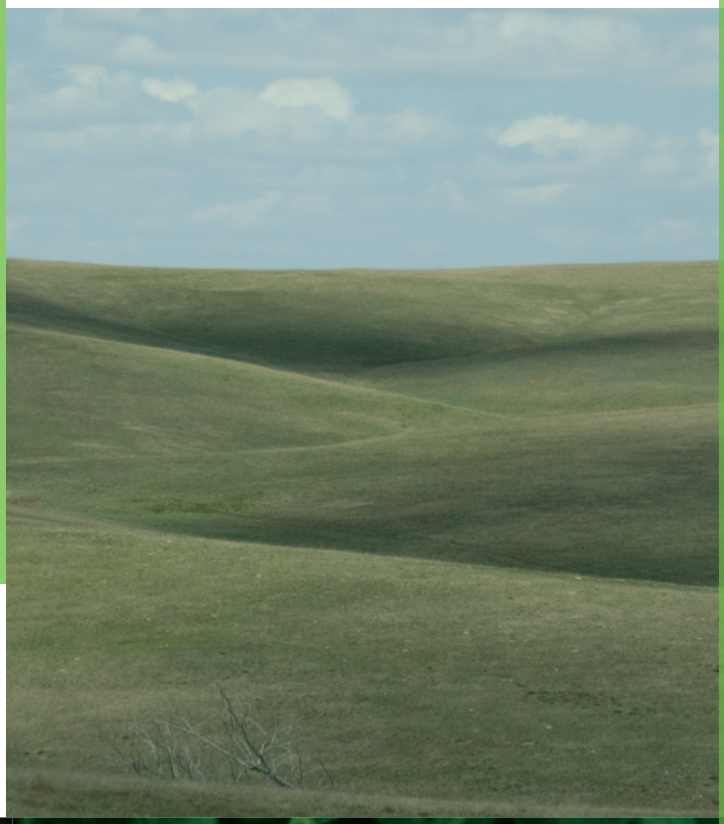

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