USA npn National Phenology Network
Taking the Pulse of Our Planet

Observed Changes in Phenology Across the United States - Northeast

Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, West Virginia, New Jersey, Delaware, Maryland, and the District of Columbia

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.

"Increasing temperatures are affecting the phenologies of iconic and economically important Northeastern species, such timing of sap flow in sugar maple and the timing of flowering in cherry trees in Washington, D.C."

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 Northeast

The Northeast is characterized forest cover, extensive shorelines, mountainous terrain, and high-density human populations [1, 2]. Most of the region's climate is classified as humid continental, although southernmost areas are more subtropical. Mean temperatures in this region are expected to increase 1.4 – 2.2˚C (2.5 to 4˚F) in winter and 0.8 – 1.9˚C (1.5 to 3.5˚F) in summer over the next several decades, which will increase the number of days over 32˚C (90˚F), extend the duration of the growing season, and increase the number of large rainfall events [1, 2]. Changes such as these could affect iconic northeastern species such as the sugar maple (*Acer saccharum*), the migration of songbirds in the spring and fall, and the timing of the Cherry Blossom Festival in Washington, DC. [9, 10].

Changes in Phenology - Highlights

Birds, bees, and frogs active earlier in the spring

Across the Northeast, native bees have appeared in spring an average of 10 days earlier over the last 130 years (1880 to 2010). Most of this advance occurred in the last 40 years, paralleling trends in warming over this same period. Bee pollinated plants also showed a trend of earlier blooming, helping preserve synchrony in timing between the observed plant species and their insect pollinators [3]. In upstate New York, on average, birds are now arriving earlier in the spring; however, there is substantial interspecific variation: some species are arriving earlier, others are arriving later, and still others have not shown changes in arrival time [4-6]. Compared to the early 1900s, short-distance migrants are now arriving 12 days earlier in the spring while long-distance migrants are arriving only four days earlier [4]. Other studies corroborate earlier arrival of short-distance migrants relative to long-distance migrants and raise the concern that long-distance migrants may experience trophic mismatch with food sources whose phenology is now earlier in possible response to increases in temperature [7]. Four of six frog species called 10 to 13 days earlier in springtime than they did in the early 20th century [8].

Many plant species bloom earlier

Cherry tree cultivars in Washington, DC, now bloom an

average of seven days earlier relative to the 1970s [9]. Peak bloom dates of cultivated cherries are projected to advance five to 13 days by mid-century, and 10 to 29 days by the end of the century [10]. On average, invasive plant species tracked warming climates more closely than native species, blooming an average of 11 days earlier now than in the mid-1800s [11]. Population sizes of plants that do not track changes in temperature are more likely to decline as temperatures warm [12]. Using 30 years of data, researchers generated projections of sugar maple sap flow production. Results showed a decrease in the number of optimal sap flow days and earlier sap flow by the mid-21st century. Shifting the tapping window to an earlier date could offset this change should the duration of sap flow remain the same. However, some future projections suggest decreasing durations in the future [13].

Changes in landscape phenology related to several factors

Elevation and proximity to urban environments influence spring 'green-up' and autumn 'brown-down' in some mid-Atlantic forests. Delays in autumns affect growing season length more than earlier springs [14].

Case study: Flowers Bloom Earlier Today Than in Thoreau's Time

Henry David Thoreau, followed by other citizens of Concord, Mass., made observations of the first flowering date for many plant species starting in 1852. Researchers compared these unique data to their own observations made between 2004—2006 [15]. Flowering species bloomed an average of seven days earlier than in Thoreau's time. Some species, such as highbush blueberry (*Vaccinium corymbosum*) and wood sorrel (*Oxalis stricta,* formerly, *O. europaea*), flowered as much as 21 and 32 days earlier, respectively. When climate patterns over the same period were examined, mean temperature in January emerged as the variable most closely related to flowering. Colder January temperatures resulted in later flowering times, with increasing winter temperatures resulting in earlier flowering [15]. Newer research found similar blooming patterns when compared to observations during the record-breaking warm springs of 2010 and 2012 [16].

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