

## Sources of more information

U.S.A. National Phenology Network ([www.usanpn.org](http://www.usanpn.org)). You can learn how to join a nationwide citizen science project to monitor seasonal changes in plant and animal life. You can also find out what scientists are learning from phenological data collected through this network.

New York Phenology Project ([www.nyphenologyproject.org](http://www.nyphenologyproject.org)), a network of sites in New York State collecting phenological data.



1420 Taughannock Blvd. (NY Rt 89), Ithaca, New York 14850  
[www.priweb.org](http://www.priweb.org)  
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## How is climate change affecting plants and animals in autumn?



Milkweed pod. Photo: Sarah Nystrom,  
US Fish and Wildlife Service

A changing climate is altering the timing of seasonal events in nature such as flowers blooming in the spring, birds migrating, insects reproducing, fruits ripening, and leaves turning color. These events affect ecosystems, agriculture, and many human activities through changes in pollination, spread of diseases, changes in populations, release of allergens, predator-prey relationships, and much more.

The study of the timing of seasonal events is called **phenology**. Scientists have focused much of their attention on understanding springtime changes, but less on autumn. Recently, three researchers reviewed the latest scientific understanding of how climate change is affecting autumn.<sup>1</sup> This leaflet summarizes some of their and others' findings.

<sup>1</sup>Gallinat, A.S., R. B. Primack, and D. L. Wagner (2015) Autumn, the neglected season in climate change research, *Trends in Ecology & Evolution* Vol. 30, No. 3, 169-176.

**“Leaf senescence is, on average, delayed by increasing temperatures.”**



Photo: Judy Gallagher, CC BY 2.0 via Wikimedia Commons

Leaf senescence is the final stage of a leaf’s annual cycle, when leaf cells break down, including the structures called chloroplasts in which photosynthesis takes place. When photosynthesis stops, the leaves lose their green color and they turn the brilliant yellows, oranges, and reds that we admire. A study<sup>2</sup> has shown that in autumns preceded by hot summers, leaf senescence takes place later.

**“Invasive non-native plants can gain an advantage over native species by extending their growing seasons in autumn.”**

A 2012 study<sup>3</sup> of 43 native and 30 non-native plant species from deciduous forests in the eastern U.S. found that invasive species extend their fall growing season by an average of four weeks longer than native plants. The leaves of non-native species were able to function for weeks after the leaves of native plants had started to break down.

<sup>2</sup> A. Menzel et al. (2006) European phenological response to climate change matches the warming pattern, *Global Change Biology* Vol. 12, 1969–1976.

<sup>3</sup> Fridley, J.D. (2012) Extended leaf phenology and the autumn niche in deciduous forest invasions, *Nature* Vol. 485, 359–362.

**“Birds are shifting their autumn phenology in response to climate change, with short distance migrants generally delaying migration and some long-distance migrants leaving earlier.”**

Researchers have found a lot of variability in the autumnal responses to climate change of different species of birds.



Song Sparrow. Photo: Bill Thompson, USFish and Wildlife Service

**“Fruit ripening of native plants is the only autumn event of which we are aware to have advanced, on average, in response to warming temperatures.”**

Most of the autumn phenological events studied seem to be happening later, but fruits are ripening earlier. A study<sup>4</sup> from the Netherlands of 320 plant species showed that fruits were ripening on average 13 days earlier during the period 2001-2010 compared to the period 1940-1968, and 14 days earlier compared to the period 1894-1932. The date when fruit ripens seems to depend on spring temperatures.

<sup>4</sup> Van Vliet, A.H. et al. (2014) Observed climate-induced changes in plant phenology in the Netherlands, *Reg. Environ. Change* Vol. 14, 997–1008.