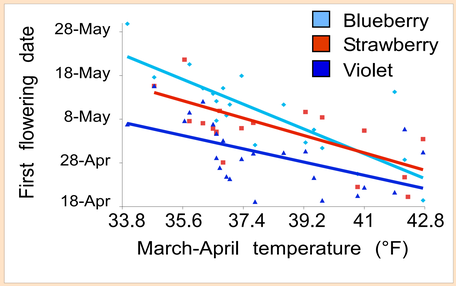
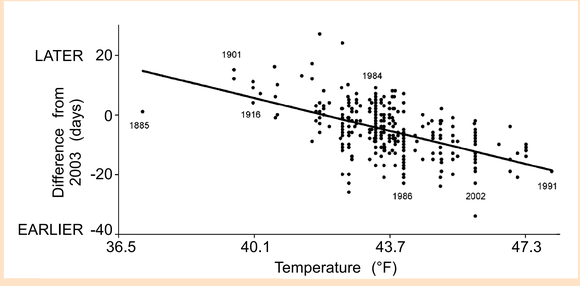
# How will local plants respond to climate change?

## Changes in flowering times

Plants in the Boston area have been flowering earlier and earlier in spring since about 1970[2,4,5]. Long-lived trees and shrubs growing in the Arnold Arboretum now bloom an average of eight days earlier than the same plants did in the early 20th century[1,3]. Similarly, lilacs, grapes and apple trees in New England now bloom two to eight days earlier than in 1965[5]. Many plants bloom in response to the average spring temperature, and years with warmer springs have earlier bloom dates[1,2,3]. **Average spring temperatures have been rising since about 1970, and plants have been blooming earlier since then.**



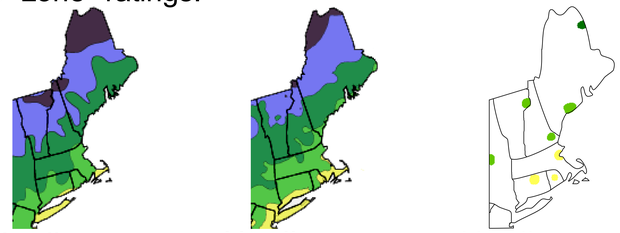

Wild strawberry, highbush blueberry and common blue violet flowers in Concord, MA start to bloom earlier in April in years with warmer springs (43°F), while in years with cooler springs (34°F) blooming begins toward the end of May[2].




Flowers of woody species at the Arnold Arboretum have bloomed earlier with increasing spring temperatures; most of the change in bloom date has happened since 1970[3].

## Shifts in hardiness zones

Warming has caused many places in New England to shift one hardiness zone warmer just since 1990[6], and future warming will cause more changes in hardiness zone ratings.




## Changes in growing season length

The growing season is the time between the last spring frost and the first frost the following winter. The timing of the frosts changes from year to year, but **the average growing season has increased by eight days** from 1900 to 2001[7].

| The future climate[7]: | Mid Century (2050) | End of Century (2085) |
|---|---|---|
| First leaves appear..... | 3-5* | 7-15 days earlier |
| First flowers bloom..... | 4-6 | 6-15 days earlier |
| First fall frost arrives..... | 1-16 | 6-20 days later |
| Last spring frost thaws.. | 8-14 | 16-23 days earlier |
| The growing season lasts... | 12-27 | 29-43 days longer |

*A range is given because the exact change in the length of the growing season will depend on carbon emission rates over time

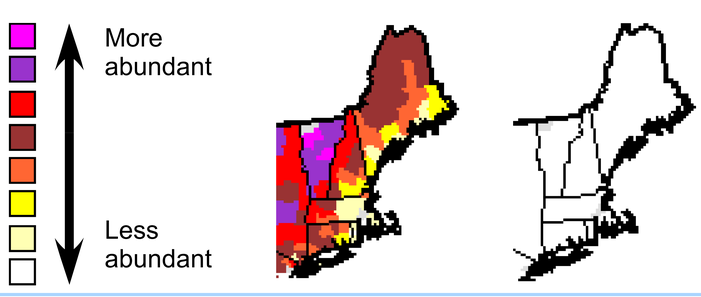
## Fall colors become less intense

Fall tree color displays depend on warm days and cool nights. When autumn nights are warmer, tree leaves produce fewer colorful pigments, and the colors are less dramatic. Summertime droughts, which are expected to increase, are also linked to less vibrant fall colors. **We can expect more muted fall colors as New England becomes warmer** and summer droughts become more common[8].

## Tree species shift ranges

As the climate warms, tree ranges will shift northward. Some of our native tree species, like oaks (*Quercus* sp.) and pines (*Pinus* sp.), are found all over the east coast, and they will continue to grow throughout New England. Other trees that we enjoy for their spectacular fall foliage, such as **Sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*), will shift northward into or near Canada**. Some species that do not live in New England now will move up the coast into the region[10].

**Range maps for Sugar Maple (*Acer saccharum*)[10]**




References:
[1] Miller-Rushing et al. 2006. American Journal of Botany 93(11):1667-1674.
[2] Miller-Rushing (personal communication)
[3] Primack et al. 2004. American Journal of Botany 91(8):1260-1264.
[4] Wake 2005. Indicators of climate change in the Northeast 2005. The Climate Change Research Center, University of New Hampshire.
[5] Wolfe et al. 2004. International Journal of Biometeorology 49(5):303-309.
[6] http:/ / www.arborday.org/ media/ zones.cfm
[7] Climate Change in the U.S. Northeast. 2006. Northeast Climate Impacts Assessment. Union of Concerned Scientists, Cambridge, MA.
[8] http:/ / www.na.fs.fed.us/ spfo/ pubs/ misc/ leaves/ leaves.html
[9] http:/ / creative commons.org
[10] http:/ / www.fs.fed.us/ ne/ deleware/ atlas/ web_atlas.html

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