University of Vermont Extension
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# Climate Change in the Garden

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**What a changing climate means to gardens and landscapes**

Daily the news has articles relating to extreme weather and climate change. Whether or not you agree with all the predictions, if the climate does continue to get warmer and show extremes from one area to another, and one year to another, here are some impacts these may have on and in your own garden. It is important to look at "the big picture" and trends because, while one area or year may show one extreme, much of the world or a longer timeframe may show the opposite. Much information can be found from Cornell University (climatechange.cornell.edu/) or from a UMASS Boston lab (www.ecosystems.umb.edu/bace.html).

Do winters seem to be warmer lately? Perhaps this is from the fact that the average annual temperature in the Northeast has increased 1.5 degrees (F) since 1970, at a rate of 0.5 degrees per decade. Depending on the rate of air pollution, by the end this century, temperatures could increase from 3.5 to as much as 12.5 degrees.

The 2012 USDA hardiness zone map shows much of the country at least half a zone warmer (planthardiness.ars.usda.gov). A similar map (www.arborday.org/media/map_change.cfm) from the Arbor Day Foundation shows half of many areas a full zone warmer since 1990. A study by scientist Loarie and colleagues in the journal *Nature* in 2009 shows that, on the average globally, climate zones are moving northward about 3.8 feet per day. Over the past 40 to 50 years in Vermont, the facts from a talk on climate change and gardening (alanbetts.com) show that winters have warmed twice as fast as summer, with winter minimum temperatures increasing even faster.

We may have more need in the north to consider the AHS (American Horticulture Society) heat zone maps as well as cold hardiness maps when choosing plants. These, plus a map from Sunset publishing that groups regions by climate rather than just temperature, are online from the AHS (www.ahs.org/gardening-resources/gardening-maps). With an uncertain climate, such maps may become more an indicator of how far the weather in any year is from "normal", rather than an indication as in the past of what we could count on.

There may be more heat waves in summer and extremes over 100 degrees. By the end of the century, under a low emissions scenario, summers in northern New England may be similar to those now in Pennsylvania, and under a more severe scenario similar to those now in the Carolinas.

In addition to temperature changes, a changing climate is predicted to impact precipitation. By the end of the century, we may see 7 to 14 percent greater rain and snow, the higher figure under higher emissions. Yet, at the same time, projections are for more short-term droughts between rainy periods. Most of the higher precipitation in the last 50 years has come from the increasing frequency and intensity of downpours (alanbetts.com). The Northeast has led the country with a 67% increase in heavy precipitation. What this means for gardeners is for site preparation and plant choices that can handle such precipitation extremes. Along with hotter temperatures for gardening, the models point to more need to water in the future with less reliable water from rain.

Much of this precipitation increase is predicted to occur in winter, ranging from 11 to 30 percent more than now. More rain or mixed precipitation and less snow is predicted for winters, which will influence overwintering of perennials among other impacts. This loss could be one quarter to one half of our current snow-covered days. Snow is one of the best protections in winter for herbaceous perennials. Less snow may lead to more plant losses, and actually the ability to grow fewer perennials than now in areas with sufficient and reliable winter snow cover. Overall snow cover in the Northern hemisphere, particularly the far north, has declined each year since 1986 except one, with a steep decline since 2003 (Rutgers University snow lab).

The average growing season is increasing. This is seen in the bloom dates recorded for plants at the Arnold Arboretum in Boston, which are now blooming about eight days earlier than recorded there 100 years ago. Wildflowers in nearby Concord are blooming about 3 weeks earlier than in 1854 when Thoreau observed them (primacklab.blogspot.com/). Cornell researcher David Wolfe, in a 2005 article, reported that lilacs in the Northeast were blooming 4 days earlier than 50 years prior. The conservationist Aldo Leopold recorded bloom of 55 species at his Wisconsin farm, finding an advance of 6 days over a 50-year period. A researcher at Longwood Gardens near Philadelphia has shown that flowers in that area are blooming on average 1.5 days earlier per decade now, compared to 150 years ago. Similarly in Vermont, lilacs are blooming 1.5 days earlier with leaves out 3 days earlier, per decade (alanbetts.com). The longest record of flowering dates (1200 years, from researcher Yasuyuki Aono) shows that cherry trees in Japan are blooming earlier over the last 100 years.

Depending once again on emissions this century, by 2085, last spring frost may be one to three weeks earlier and the first fall frost one to three weeks later. The result would be a month or more increase in the growing season. This, coupled with higher temperatures, would mean many more plants could be grown successfully to flower and fruit in the north. Yet extreme frosts might impact early bloomers such as peaches.

On the other hand, we might lose some trees. Trees prevalent throughout the east coast such as oaks and pines would remain. Others adapted to cooler climates such as the sugar maple and American beech might shift further north. One map prediction (www.nrs.fs.fed.us/atlas/tree/tree_atlas.html) shows few maples left in New England by 2100. This U.S. Forest Service site lists 134 trees, and gives interactive maps showing current distributions, and possible changes with various climate scenarios. With warmer winters, some fruit varieties may no longer receive sufficient chilling hours (45 degrees or less).

Brilliant fall color of trees is a signature of the Northeast, especially the northern states. The best fall color comes from plenty of moisture, warm days, and cool nights. If nights become warmer, with drought periods during the growing season, the result would be less vibrant colors.

Of course pests currently in the warmer south may make their way north, and those already in the north would reproduce faster in most cases. Already in Alaska, British Columbia and Siberia, defoliating and wood-eating insects have increased with the longer summers recently. A study reported in fall 2013 in the journal *Nature Climate Change* found that, on average, crop diseases and pests in the Northern Hemisphere have moved north about 1.7 miles per year since 1960. More important is that fungal diseases are moving north about 4 miles per year. Breaking it down further, beetle and moth pests for instance are moving farther north an average 70 feet per day each season.

Some studies also point to a decrease in natural predators of insect pests with a more highly fluctuating climate, as many predict with climate change. Insects and their predators, such as birds, may get out of sync as will pollinators and the flowers they need for food. Not only pests, but new weeds and invasive species will move northward with a warmer climate.

Another interesting potential impact is on soils. Soil organic matter is second only to oceans in holding onto, or trapping (sometimes seen as "sequestering"), carbon and keeping it from entering the atmosphere. Higher temperatures would mean this soil organic matter breaks down faster, releasing carbon back into the atmosphere, making levels there even higher.

You can monitor climate change in your own garden or landscape as many have for years with "phenology" —the response of biological events such as insect and bud emergence to weather. A website from the University of Minnesota shows how to relate phenological events through the growing season to pests (www.entomology.umn.edu/cues/Web/049DegreeDays.pdf). In the extensive table there you'll see, for instance, that the Eastern tent caterpillar eggs hatch when red maples first bloom, white pine weevil adults emerge when Norway maples bloom, and bronze birch borer adults emerge when black locust are in full bloom.

Knowing when to watch for pests according to bloom dates is more accurate than calendar dates, as the latter can vary with the season. You can learn more about phenology, how it is being used to gauge climate change, and even how to participate in data collection, from the National Phenology Network (www.usanpn.org/). A manual from Cornell University gives directions on making your own observations (budbreak.org/downloads/BudBreak_manual.pdf).