

Shifting Phenology in a Changing Climate

SYNOPSIS / MARCH 30, 2017 / BY JENNIFER HUSHAW

Phenology—the seasonal rhythms of plants and animals, especially the timing of natural cycles as related to weather and climate—is a sensitive indicator of climate with implications for global change, ecosystem processes, and land management (including forestry).

A warming climate will affect phenology, leading to a whole host of direct and downstream impacts. Here we reveal both recent and anticipated shifts in the phenology of boreal and temperate trees.

Background

WHY PHENOLOGY MATTERS

Phenology mediates many processes related to carbon, water, and nutrient cycling. By controlling timing and extent of leaf area, flowering, leaf fall, etc., it directly influences productivity, growth, evapotranspiration, runoff, decomposition, and mineralization. Globally, phenology also influences vegetation-related feedbacks to the climate system.

SEASONAL SIGNALS

Temperate and boreal trees undergo an annual cycle where dormancy is induced in the fall and released in the spring. These shifts are cued by: (1) degree of warming in spring, (2) onset of cold temperatures in fall, (3) degree and duration of winter chilling, (4) photoperiod (i.e. day length). Much of this process is mediated by temperature, but photoperiod and chilling are critical as well. Sensitivity to these may limit how certain species adapt to climate change.

VARIABLE SENSITIVITY TO SEASONAL CUES

The relative importance of these factors varies by species, genetic makeup, gene expression (i.e. phenotype), successional niche, and region of origin.

Phenology: An Indicator of Change

There is ample evidence of changes in the timing of **spring**, **autumn**, and the overall **growing season**, both globally and in the U.S, over the last several decades.

Climate Smart Land Network Bulletin Synopsis

Since the 1980's the U.S. growing season has increased by 10 days or more (compared to the long-term average), with big implications for ecosystem productivity, e.g. some research suggests that lengthening the growing season by 5-10 days may increase annual net primary productivity of forest systems by as much as 30%.

Phenology in a Warmer World

Climate change presents a mix of opportunities, challenges, and “it depends” situations with regard to shifting phenology, for example:

OPPORTUNITIES

- Longer growing season = increased productivity
- Many species are flexible & will take advantage
- Less frost damage (on average)

CHALLENGES

- Risk of more frost damage on range margins
- Invasive species will generally benefit
- Shifting phenology may change understory light conditions and affect seedling survival
- Some characteristics, e.g. sensitivity to photoperiod, are genetically controlled, which will limit ability of some species to adapt

IT DEPENDS...

- Milder winters may provide insufficient chilling, causing delays in spring phenology that reduce growth potential, but also risk of frost damage
- Variation in the sensitivity of different species will lead to changes in competitive advantage

Emerging Research & Questions

Current science reveals that phenological response to climate change is complex. Many factors determine how a particular species or site will respond, so it will be important to watch your own forest carefully and monitoring emerging research. See the full bulletin for an overview of remaining uncertainties and key questions.

Click on the sub-headings above to go directly to the corresponding section of the full bulletin, or read the complete bulletin online: <http://climatesmartnetwork.org/2017/03/shifting-phenology-in-a-changing-climate/>