Study shows surprising spread of spring leaf-out times

June 18 2014

This is a picture of *Rhodo Fargesii*. Credit: Richard Primack

Despite conventional wisdom among gardeners, foresters and botanists that woody plants all "leaf out" at about the same time each spring, a new study organized by a Boston University biologist found a surprisingly wide span of as much as three months in leaf-out times. Significantly,

observations the past two springs of 1,597 woody plants in eight botanical gardens in the U.S., Canada, Germany and China suggest that species differences in leaf-out times could impact the length of the growing season and the activities of birds, insect and other animals and therefore must be factored into climate-change model predictions.

"As species distribution and abundance shift due to climate change, interspecific differences in leaf-out timing may affect ecosystem processes such as carbon, water, and nutrient cycling," reported the study in the journal *New Phytologist*. "Our open-access leaf-out data provide a critical framework for monitoring and modelling such changes going forward."

While previous researchers observed leaf-out for a limited numbers of species in a single location, this study uniquely obtained observations of the same species from gardens around the world. Notably, the order of leafing out of species was almost the same in different gardens and with different climates, suggesting that leafing out time is a fixed character of a species, like the shape of its leaves or flowers; some species tend to leaf out early others late.

"Prior to this study, no one would have suspected that there was so much difference in the leafing out times of different species," says BU Prof. Richard Primack, who recruited colleagues from around the world for the study. "At the Arnold Arboretum in Boston, some gooseberry and honeysuckle shrubs start leafing out mid-March and early April, and evergreen rhododendrons and pine trees don't start leafing out until two to three months later in late May or even June. These differences are quite striking."

The study showed that shrubs leafed out on average 10 days before trees and deciduous plants leafed out on average 17 days before evergreens. And certain groups of plants—such as honeysuckles, willows, lilacs, and

apples—tended to leaf out early, while other groups—such as oak, beeches, honey locusts, and grapes—tended to leaf out late. As a result, forests will have flushes of new leaves over an extended period, which adds to the beauty of spring growth, but it also has implications for insect survival and for carbon dioxide absorption by forests.

"Leaf-out phenology affects a wide variety of ecosystem processes and ecological interactions and will take on added significance as leaf-out times increasingly shift in response to warming temperatures associated with climate change," the study said. "There is, however, relatively little information available on the factors affecting species differences in leaf out phenology."

Primack explained that as the climate warms, trees will tend to leaf out earlier in the spring, perhaps extending the growing season and affecting animal behavior. But this pattern will become complicated if the overall tree composition changes. For example, in eastern North America, maple and birch trees, which leaf out early, may be replaced gradually by more heat-tolerant oak trees, which tend to leaf out later in the spring.

The data was obtained by walking around each of the botanical gardens once a week and recording the appearance of first leafing out for all of the species. Leaf-out time was considered when the young leaves had emerged from their buds and their adult shape could be seen even though the leaves were still small.

Along with Primack, the team included Zoe Panchen (Carleton University), Birgit Nordt and Albert Dieter-Stevens (Berlin Botanical Garden), Elizabeth Ellwood (Florida State U.), Susanne Renner (U. of Munich), Charles Willis and Charles Davis (Harvard U.), Robert Fahey (Morton Arboretum), Alan Whittemore (U.S. National Arboretum), and Yanjun Du (Chinese Academy of Science, Beijing). Their next project will extend their observations to autumn to determine if there are also

major differences among species in when trees change color and drop their leaves at the end of the growing season.

Provided by Boston University Medical Center