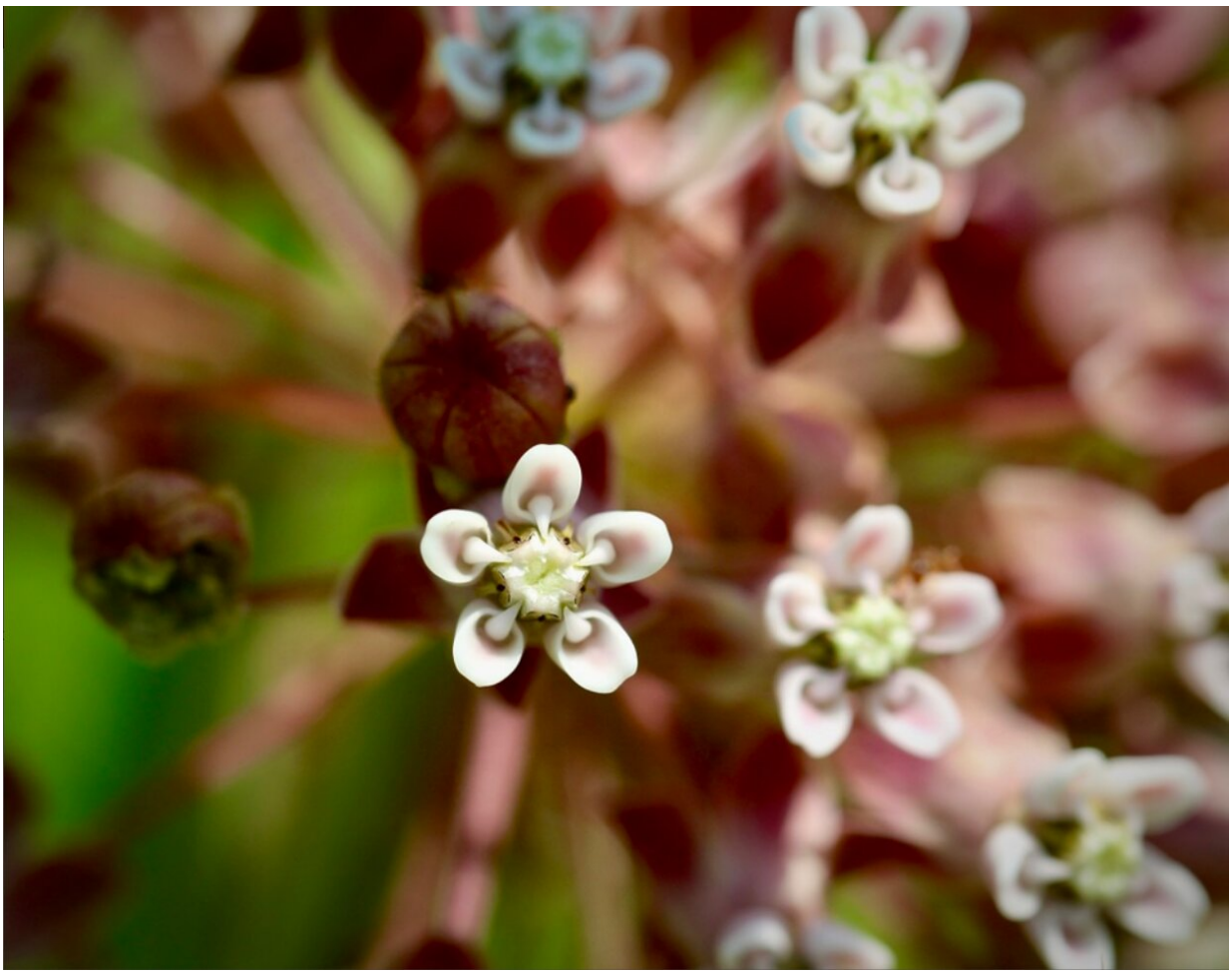
Citizen scientists from 200 years ago and today help shed light on climate change trends

July 6 2022, by Cristina Rojas



Citizen science observations across two centuries reveal a dramatic, climate-driven shift to earlier leaf out and flowering, which varies across settings, species and functional groups. Plants in urban areas, insect pollinated trees, and early-

season species show the greatest rate of advancement overall. This unprecedented comparison of historic-modern network observations illustrates how long-term monitoring and citizen science efforts are invaluable for ecological forecasting and discovery. Credit: Kerissa Fuccillo Battle

Nearly 200 years ago, a system of academies across New York set out to collect data on the state's climates and seasons. Equipped with thermometers, rain gauges and instructions for data collection, the schools' principals and teachers—and even a few students—recorded temperature measurements and observations: when the robins were first seen, when the red maples bloomed, when the strawberries ripened, when the wheat harvest began.

At the time, the data helped farmers better understand the geographical and annual variation in the growing season and figure out when best to plant their crops. Two centuries later, a Portland State alum is using that same data to shed light on the effects of a changing climate and urbanization on the nature of our seasons.

Kerissa Fuccillo Battle, Ph.D. has led a multi-disciplinary team to compare the historical dataset with observations from a modern network that similarly collected data across New York State from 2009 to 2017. The group's findings evaluating changes in plant phenology—earlier leaf out and flowering—between time periods were published this spring in the *Journal of Ecology*.

"This study really resets the clock for biological response to climate change in North America," Battle said. "The dataset provides phenology and temperature data that extend further back in time than any previously known dataset for the region, extending to years prior to or at the beginning of recent human-caused climate change."

Battle and her co-researchers found that the majority of the 36 trees, shrubs and forbs in the analyzable dataset flowered and leafed out earlier in contemporary years than in the early to mid-19th century, coinciding with a warming trend in January to April temperatures.

On average, plants flowered 10.5 days earlier and leafed out 19 days earlier in the contemporary period. Plants in urban areas advanced more rapidly than their rural counterparts overall, and insect-pollinated trees advanced more rapidly than wind-pollinated trees. The greatest rates of temperature sensitivity and change between time periods for flowering are seen in early-season species, particularly trees. Changes in the timing of leaf-out are the most advanced for trees and shrubs in urban areas.

The accelerated timing poses risks for some species' survival, Battle said. Red maple, for example, is one of the most critical early-season food sources for native bee pollinators. If the red maple leafs out too early and those blossoms get frozen, then the bees that emerge and rely on that food source are going to be impacted. The cycle then continues for the organisms that rely on those bees, and so forth.

Knowing which species are more phenologically sensitive can also help inform conservation and management efforts, Battle said.

"Having a baseline now in the face of such rapid change is really critical," she said. "The comparative dataset allows us to really see the trajectory in a way that we wouldn't if we didn't have the past to look at. We wouldn't really know what that baseline was, how steep the curve is in terms of how the species is shifting, how sensitive it is and what we can expect."

Battle said the use of citizen and community scientists then and now has allowed for many more data points to be collected over a large geographic area than would be possible with only trained scientists. And

as she learned while leading phenology work with PSU undergraduates and other volunteer observers, it's not something you need extensive training to be able to do well.

The discovery of the historical dataset was something out of Battle's wildest dreams—and it all started with a natural history book.

Each year from about 1826 to 1863, academies reported their observations back to the New York State Board of Regents, who then summarized them in their annual report. Some of the early data made it into a volume of the Natural History of New York series. In 2014, Conrad Vispo, a natural history enthusiast and wildlife ecologist who amassed a collection of volumes through the years, came across the data and began to follow the trail of the Regents' reports.

"I started to dig into it thinking, 'Oh there's something in here that could be interesting,' not realizing how many observations there were," he said.

Vispo worked with his colleagues at Hawthorne Valley Farmscape Ecology Program, a small research and outreach program in Columbia County, New York, to begin to digitize the dataset with the intent of making it accessible to the public.

He then reached out to Battle, whose nonprofit Community Greenways Collaborative manages the New York Phenology Project, to partner on exploring how the historical dataset might be paired with more modern records for research. The New York Phenology Project, started by Battle in 2012, enlists the help of volunteer citizen scientists to collect data on the timing of seasonal changes in plants and pollinators in much the same way that the academies did.

"This paper is a testament to people who are engaged right now in citizen science not being able to know the full reach of their efforts," said Anna

Duhon, the cultural research and outreach coordinator at the Hawthorne Valley Farmscape Ecology Program. "Those people in the 1800s who were out there looking at those apple blossoms and dutifully recording it down had no idea that we would have the new relevance that came with climate change and the new need for that data to have a place comparatively with the citizen science data work that we're collecting now on phenology."

Vispo said the datasets and the ongoing citizen science projects offer a fun way to get people thinking about climate change.

"You're doing something that gets people engaged with the environment that you're trying to encourage them to save."

Get involved

You, too, can help generate long-term datasets by documenting what's happening on the ground in your own backyard. The U.S. National Phenology Network hosts Nature's Notebook, a platform suitable for people of nearly all ages and skill levels to track seasonal activity in plants and animals. The phenology observations contributed through the Nature's Notebook platform are increasingly valuable for supporting scientific discovery and understanding of organismal response to changing climate conditions. Become an observer in three steps.

More information: Kerissa Fuccillo Battle et al, Citizen science across two centuries reveals phenological change among plant species and functional groups in the Northeastern US, *Journal of Ecology* (2022). DOI: 10.1111/1365-2745.13926

Provided by Portland State University