Early bloomers: Statistical tool reveals climate change impacts on plants

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A Snowdrop flower (Galanthus angustifolius) in bloom. Scientists from Utah State University, McGill University, Harvard University, the University of Maryland, Rocky Mountain Biological Laboratory and Boston University announce a statistical estimator that extracts meaningful measures from current and historical phenological data and provides evidence of climate change impacts on plants. Credit: Karduelis, public domain, Wikimedia Commons

Early flowering, early fruiting: Anecdotal evidence of climate change is popping up as quickly as spring crocuses, but is it coincidence or confirmation of shifts in plant phenology caused by global warming?

"My mum reports her snowdrops are blooming earlier each spring in her English garden," says Utah State University scientist Will Pearse. "Are her observations, like those of thousands of citizen scientists across the world, indicating unpredictability in temperature, precipitation and other weather patterns?"

Until now, scientists had few tools to piece together disparate data into a collective, bigger picture. Now, Pearse and colleagues announce a statistical estimator that extracts meaningful measures of phenological change - that is, the timing of plants' reoccurring life history events - from scores of data collected by current and ancestral citizen scientists (Henry David Thoreau among the latter cohort), along a continuous record from herbaria plant collections stretching more than 200 years into the past. Their findings appear in the Nov. 6, 2017, online edition of *Nature Ecology & Evolution*.

Contributing authors include Charles Davis, Harvard University; David Inouye, University of Maryland and Colorado's Rocky Mountain Biological Laboratory; Richard Primack, Boston University; and T. Jonathan Davies of Canada's McGill University. The team's research was supported by the National Science Foundation and the USA National Phenology Network.

"Using this estimator, and providing three case studies, we demonstrate a method to resolve an ongoing debate about the relative timings of the onset and cessation of flowering that allows us to reliably place modern observations within the context of a vast wealth of historical data," says

Pearse, assistant professor in USU's Department of Biology and the USU Ecology Center and lead author of the paper. "This provides powerful evidence of climate change."

Utah State University phenologist Will Pearse is lead author on a paper published Nov. 6, 2017, in the early online edition of 'Nature Ecology & Evolution' discussing a statistical estimator that distills evidence of climate change effects on plants from centuries of plant data. Credit: Mary-Ann Muffoletto, USU

Davies says the estimator unlocks "dusty specimens" hidden away in

dried plant collections.

"Our work provides new insights into how human activities have altered today's climate by contrasting the time a flower bloomed in the past to observation in the present-day," he says.

Pearse says the new technique also unleashes the power, and emphasizes the value, of citizen science. He especially praises the efforts of the USA National Phenology Network.

"If you ever doubted the observations of an 'ordinary' observer, you can put those doubts to rest," he says. "Those bits of information, like my mum's vigilance and Thoreau's fervent environmentalism, contribute to invaluable scientific observation."

More information: Pearse, William D., Charles C. Davis, David W. Inouye, Richard B. Primack and T. Jonathan Davies. "A statistical estimator for determining the limits of contemporary and historic phenology," *Nature Ecology & Evolution*. 06 Nov 2017. DOI: 10.1038/s41559-017-0350-0

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