

**Investigators' Annual Report to
Grand Teton National Park
2023**

Project Title: For everything there was a season –Phenology shifts in the Tetons

Research Permit: GRTE-2020-SCI-0007

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ABSTRACT:

Climate change is widely known to affect plant phenology, but little is known about how these impacts manifest in the widespread sagebrush ecosystem of the Western US which supports a number of wildlife species of concern. Shifts in plant phenology can trigger consequences for the plants themselves as well as the communities of consumers that depend upon them. We assembled historical observations of first flowering dates for 51 species collected in the 1970 and 80s in a montane sagebrush community in the Greater Yellowstone Ecosystem and compared these to contemporary phenological observations targeting the same species and locations (2016-2019). We also assembled regional climate data (average spring temperature, day of spring snowmelt, and growing degree days) and tested the relationship between first flowering time and these variables for each species. We observed the largest change in phenology in early spring flowers, which as a group bloomed on average 17 days earlier, and as much as 36 days earlier, in the contemporary data set. Mid-summer flowers bloomed on average 10 days earlier, nonnative species 15 days earlier, and berry-producing shrubs 5 days earlier, while late summer flowering plants did not shift. The greatest correlates of early spring and mid-summer flowering were average spring temperature and day of snowmelt, which was 21 days earlier, on average, in 2016-2019 relative to the 1973-1978. The shifts in flowering phenology that we observed could indicate developing asynchronies or novel synchronies of these plant resources and wildlife species of conservation concern including: Greater sage-grouse, whose nesting success is tied to availability of spring forbs; grizzly bears -- which rely heavily on berries for their fall diet; and pollinators. This underscores the importance of maintaining a diverse portfolio of native plants in terms of species composition, genetics, phenological responsiveness to climatic cues, and ecological importance to key wildlife and pollinator species. Redundancy within ecological niches may also be important considering that species roles in the community may shift as climate change affects them differently. These considerations are particularly relevant to restoration and habitat-enhancement projects in sagebrush communities across western North America.

Research Results and Future Directions:

The latest results of this research were published in *Ecological Applications* in March 2022 and have been shared with Grand Teton National Park. This publication serves as the best available research report and may be shared internally and with the public. The publication is attached and available here: <https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/eap.2583>

The principal investigator of this work, Trevor Bloom, has resigned from his role with The Nature Conservancy to serve as the Forest Botanist for the Bridger-Teton National Forest. The Nature Conservancy will continue to lead research and citizen science in Grand Teton National Park under the direction of Charlotte Cadow and Corinna Riginos. They will submit a new research permit under their name as a continuation of this project.

Future work will include continued phenology observations as a partnership between The Nature Conservancy and Grand Teton National Park and expansion of the successful citizen science project, Wildflower Watch explained in more detail in the Citizen Science and Outreach section below. As of spring 2023, Wildflower Watch has also been adopted by the Interpretive Program at Grand Teton National Park under the direction of Lee Rademaker and his staff.

Wildflower Watch: Citizen Science and Outreach

As a complement to the research program, we also aim to increase overall science literacy and awareness of climate change through continued outreach efforts. The reputation of Frank Craighead, a renowned biologist in the Greater Yellowstone Ecosystem and long-time resident of the Tetons, and the accessibility of our field sites, lend this project perfectly for citizen science and community engagement in climate change research. Citizen science, which engages non-professional scientists in one or more stages of scientific research, has made substantial contributions to scientific understanding and conservation management (McKinney et al., 2012) and is an effective form of science outreach.

In spring 2018 we launched Wildflower Watch, a citizen science project where volunteers collect phenology observations on approximately a dozen wildflower species in several locations in Jackson Hole. We expanded partnerships to include more volunteers from diverse backgrounds and created a total of five phenology walks in Jackson Hole – Blacktail Butte, The Murie Ranch, Kelly Elementary, and Cache Creek. We published a booklet of instructions using photos, diagrams, maps of collection sites, and step by step instructions for making field observations (Supplementary Materials: Wildflower Watch handout). We utilize the Nature's Notebook application, and all citizen science data is automatically uploaded to the USA National Phenology Network database.

Since 2017, I have watched Wildflower Watch blossom from an idea back in 2017, to a program that has reached more than 1,000 volunteers and has yielded over 19,000 observations in five locations across the state. All data is automatically uploaded to the USA National Phenological Network (USANPN) database using the Nature's Notebook application. One of the greatest advances is that Wildflower Watch is now a daily ranger-led program in Grand Teton National Park in the Interpretive and Education Departments. This led to a huge increase in participation with over 400 volunteers donating over 700 volunteer hours in 2023 alone.

2023 at a Glance

- In 2023, we hosted more than 400 volunteers and recorded 720 volunteer hours at these sites.
- Due to our program's expansion, our committed volunteers recorded a record 11,946 observations in the Nature's Notebook phenology database, compared to 1,943 in 2022!
- Spring and summer across Wyoming featured frequent rain showers and the abundant moisture led to a vibrant array of flowers and grasses in the meadows and forests across the state.
- We held our first Wildflower Watch on the Paul Stock trails in Cody, where spring arrives a bit earlier. This site was monitored by dedicated volunteers associated with the Draper Museum of Natural History.
- We now have four locations in the Greater Yellowstone Ecosystem: Blacktail Butte, Murie Ranch, Heart Mountain Ranch Preserve and the Paul Stock Nature Trail.

This is a huge increase in participation since 2017 and demonstrates a large public interest in citizen science. We partnered with educational organizations including the Teton Science Schools and Kelly Elementary to bring hundreds of students of all ages into the field to participate as citizen scientists. Preliminary examinations indicate that our citizen scientists are accurately collecting phenology data on target taxa that do not greatly differ from the

observations of our primary researchers. Our efforts have proven the feasibility of a successful citizen science project in the Tetons, and I look forward to The Nature Conservancy and Grand Teton National Park growing the Wildflower Watch program into the future.

Restoration and Continued Outreach

We are working closely with key partners to expand the utility of our research to inform restoration of federal lands. At Grand Teton National Park, we are communicating with Vegetation Ecologists, Laura Jones, Erik Kramer and Jasmine Cutter to better address their priorities. Specifically, we are working to inform when and where to collect seeds (at the key phenophase) for native plants to then be reseeded elsewhere in the park, including the long-term Kelly Hayfields/Antelope Flats Habitat Restoration project.

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Additional Materials:

[Flowering time advances since the 1970s in a sagebrush steppe community: Implications for management and restoration.](#) Ecological Applications. March 2023

[For Everything There Was a Season video series.](#)

www.Nature.org/WildflowerWatch