USA National Phenology Network

nature's notebook
A project of the USA-NPN

The Redbud Phenology Project Training Webinar

December 2nd, 2025

ARIZONA

USGS science for a changing world

NSF

USDA

www.usanpn.org

Training Webinar Agenda

- Overview of the research
- What have we learned in the last three years?
- Overview of USA-NPN and *Nature's Notebook*
- How to get started with the Redbud campaign
- Training materials and other resources
- Q&A

In the chat: Let us know where you're calling in from!

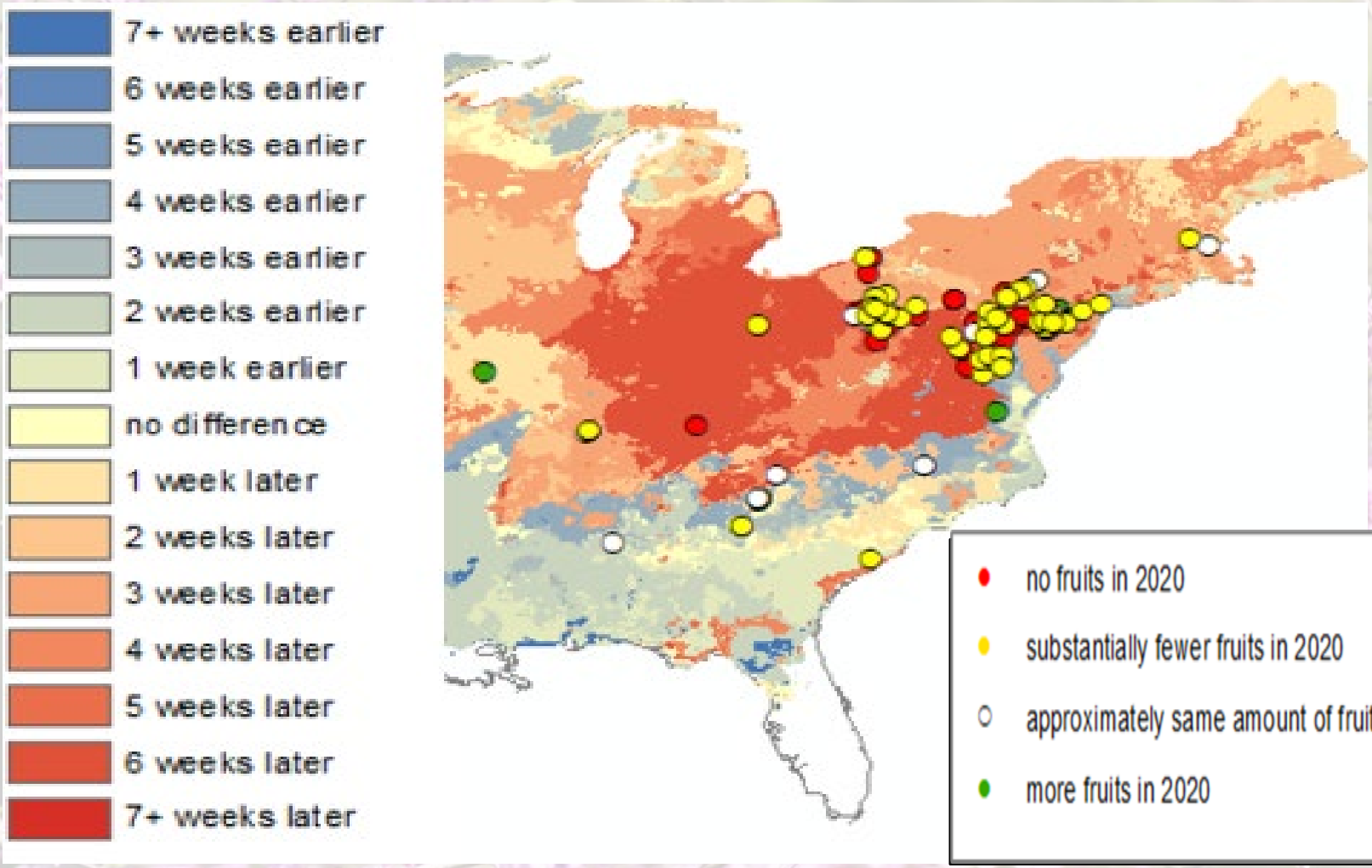
USA npn National Phenology Network

ARIZONA

Biology of Eastern North America Redbud, *Cercis canadensis* Linnaeus, 1753 (Fabaceae)

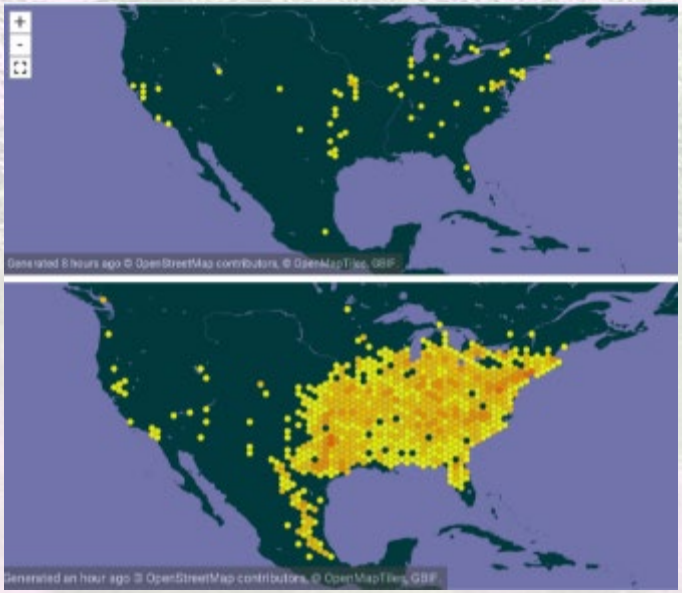
Branches of redbud at Nixon Park, Jacobus, PA. Note absence of seed pods.

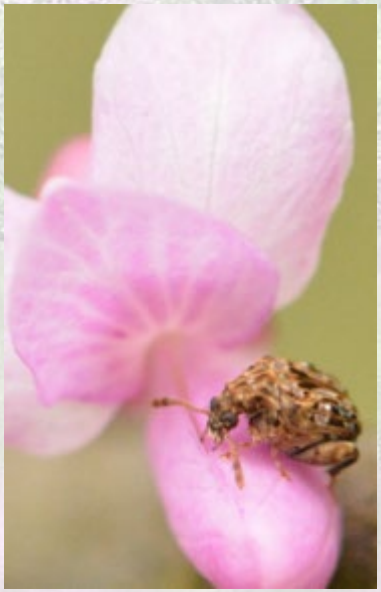
Late Spring Frost in 2020 Possibly Killed Reproductive Organs of Redbuds



Difference (in days) between the date of last frost in 2019 and 2020 (Data source: PRISM daily minimum temperature maps, Oregon State University). In 2020, the last freeze was over a month later than in 2019 in much of our study area.

Ongoing Project 1:
Co-writing the Chapter on Eastern Redbuds for the Updated USDA's *Silvics of North America*, with Seven Other Colleagues, Including Dr. Theresa Crimmins (USA-NPN)





- Economically important. Why? Small tree, flowers early, pretty flowers. Many cultivars and varieties
- Expanding geographical distribution in temperate zones, worldwide.
  - Potential for exporting pests to other parts of the world.

Ongoing Project 2: What Animals Eat Redbud Seedpods? Use Trail Cameras or Sit and Observe

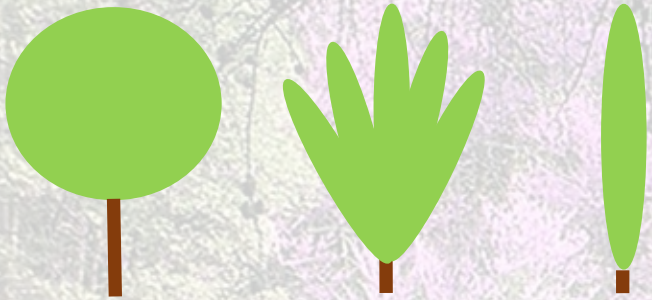
Want to help? Contact Jorge: blayj@psu.edu or blayj@si.edu


Ongoing Project 3:
Although Redbuds are Insect Pollinated,
We Are Trying to Exclude Wind Pollination

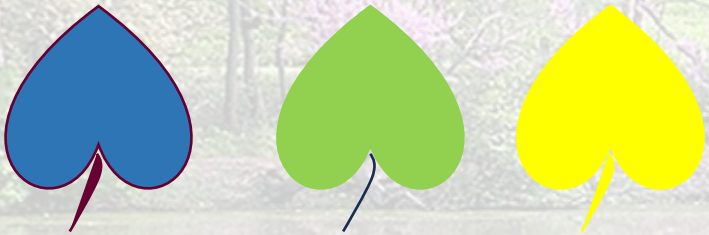
Ongoing Project 4:
Designing a Universal Recipe to Propagate Redbuds from Seeds

Some Axes of Variation in Eastern Redbud Varieties (the Hand of Nature) and Cultivars (the Hand of Humans), with examples

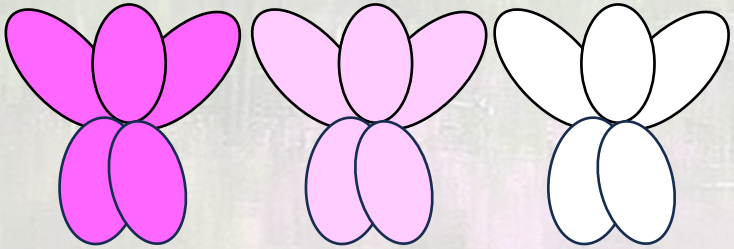
Canopy shape



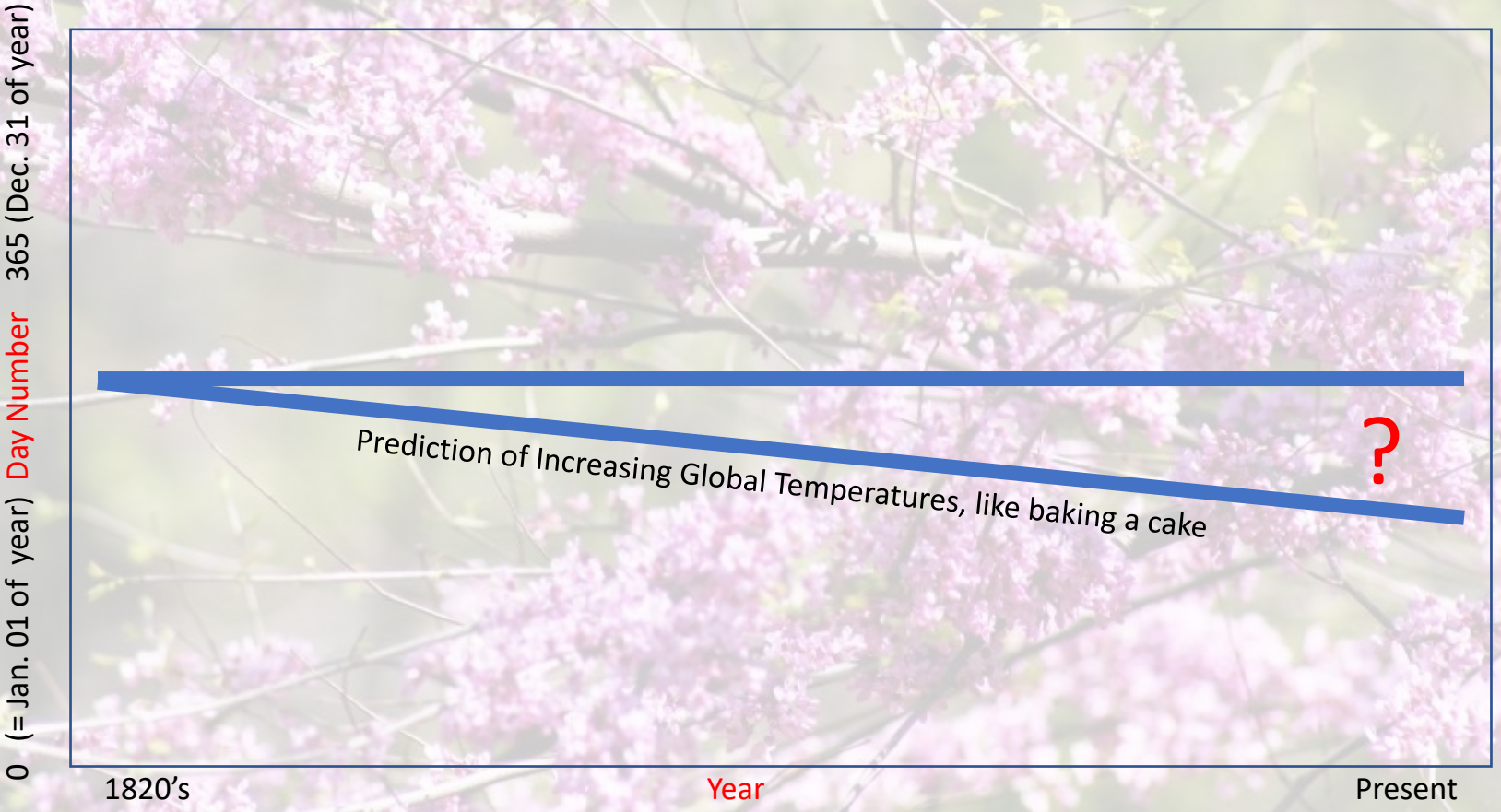
Leaf color



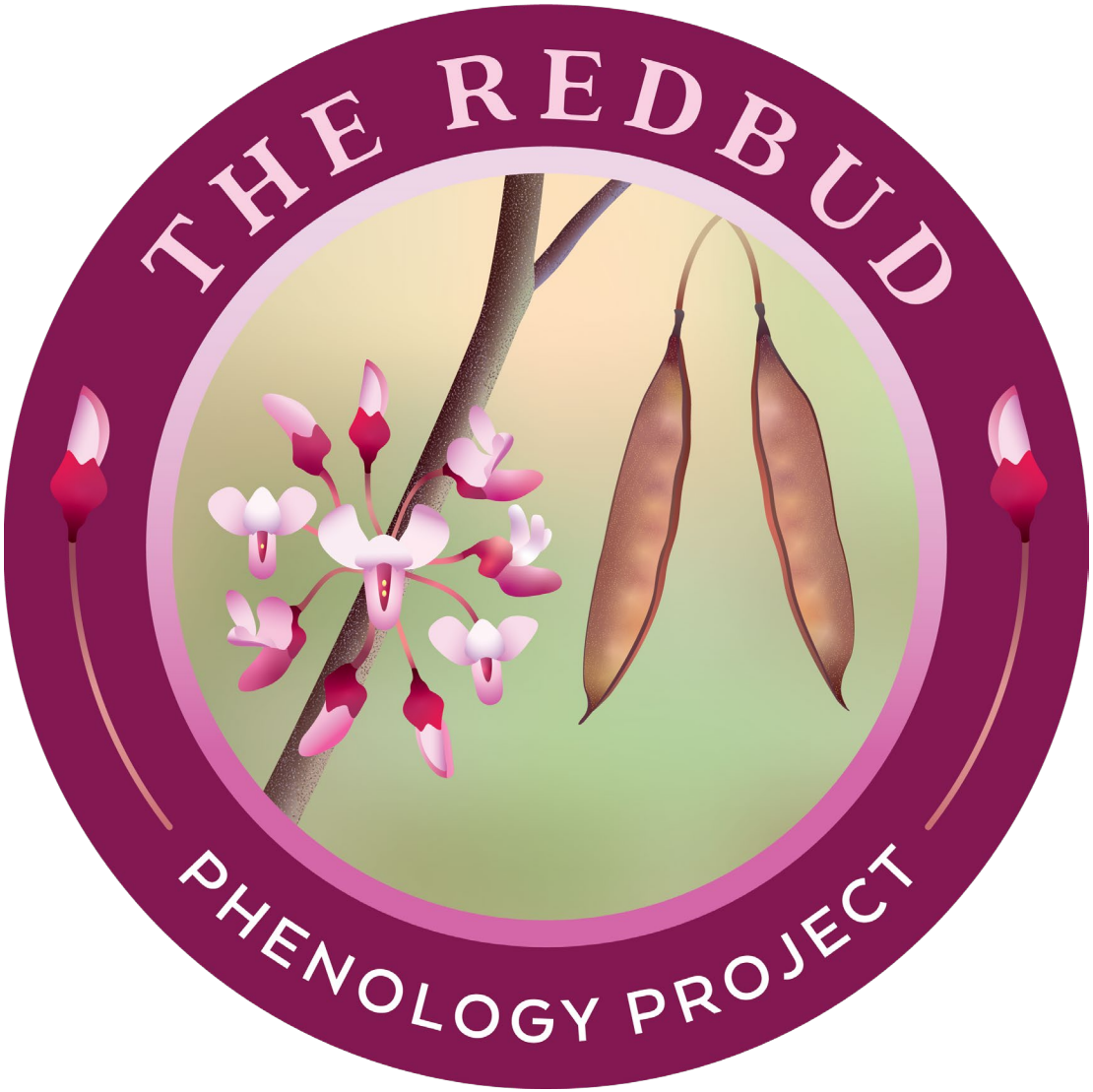
Flower color



Is Flowering & Fruiting Timing Changing with Increasing Global Temperatures?



Some of the Committed Citizen Scientists. Thanks for your help!



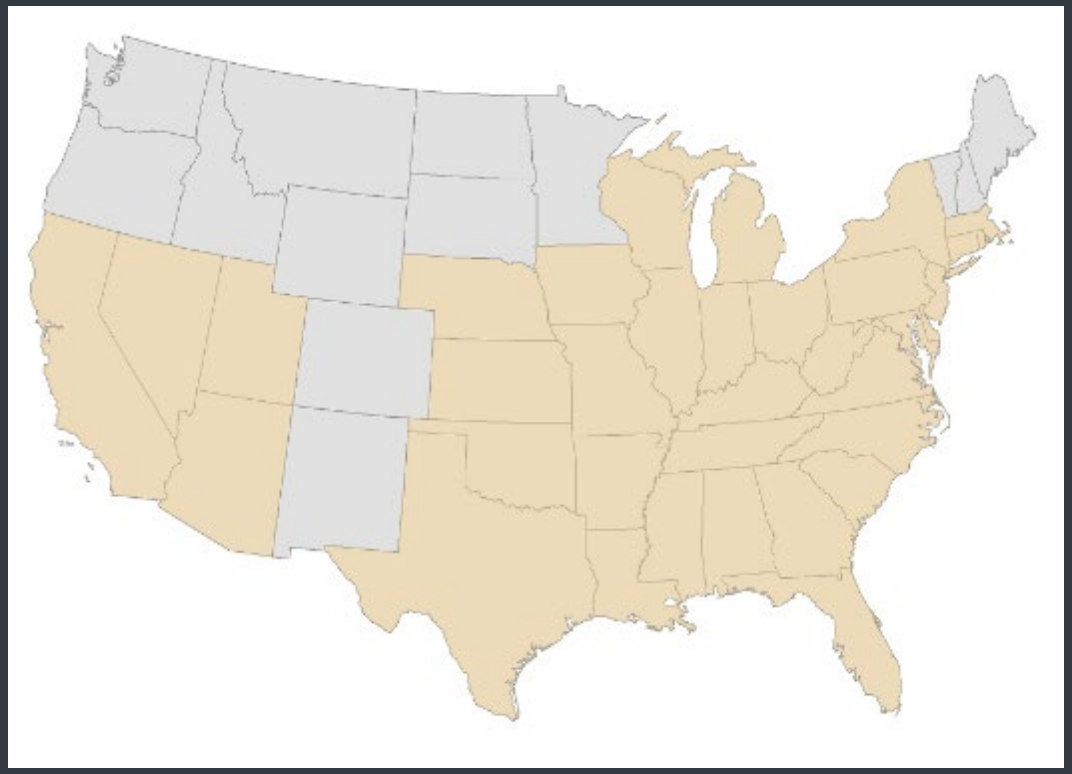
www.usanpn.org

USA npn National Phenology Network

ARIZONA

Early spring bloomers

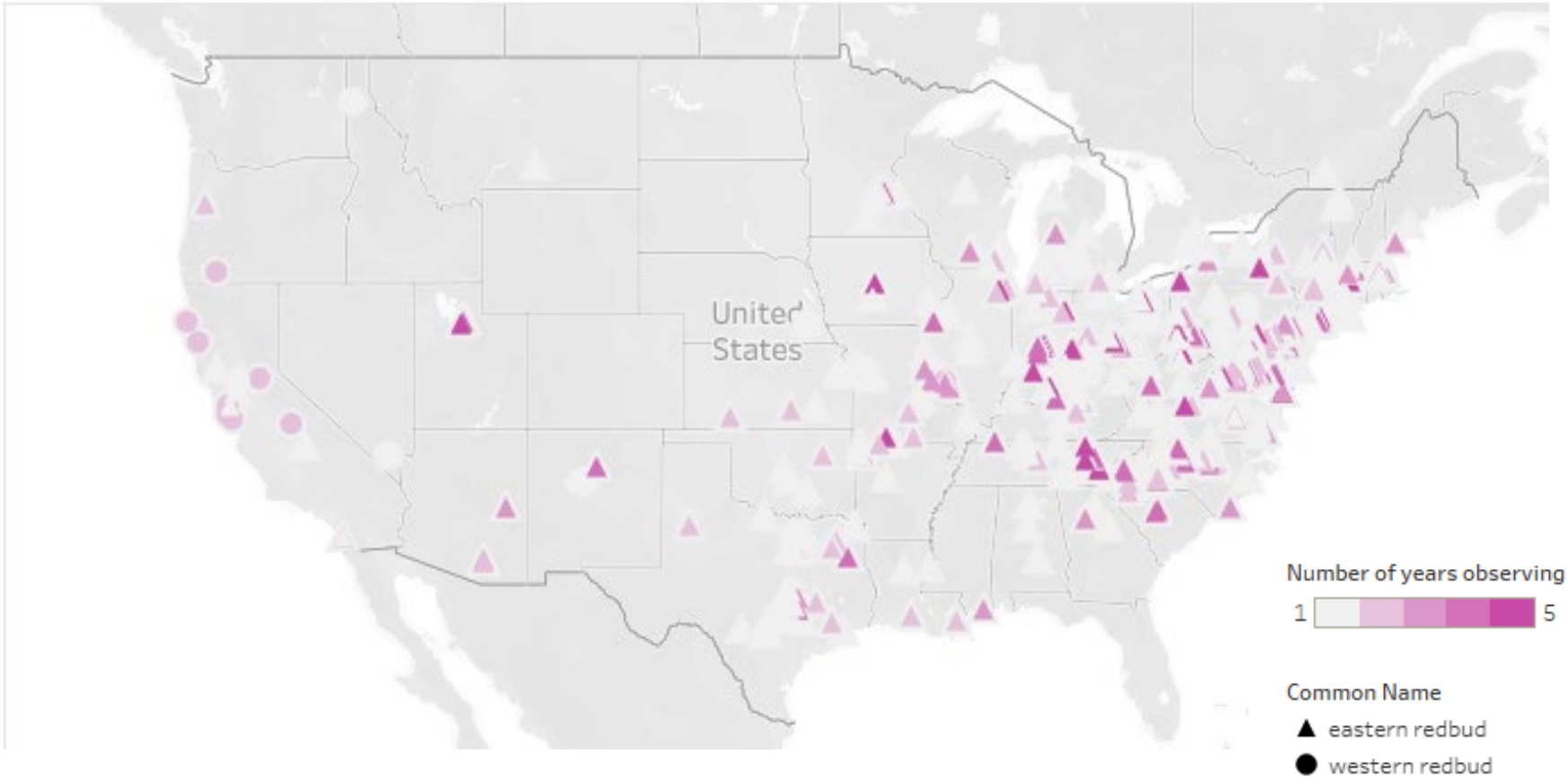
Eastern and western redbud natural ranges



First the flowers buds, then the leaves

Photo: Sballal via Wikimedia Commons

Eastern and Western Redbud Sites 2021-2025 (years of data collection)

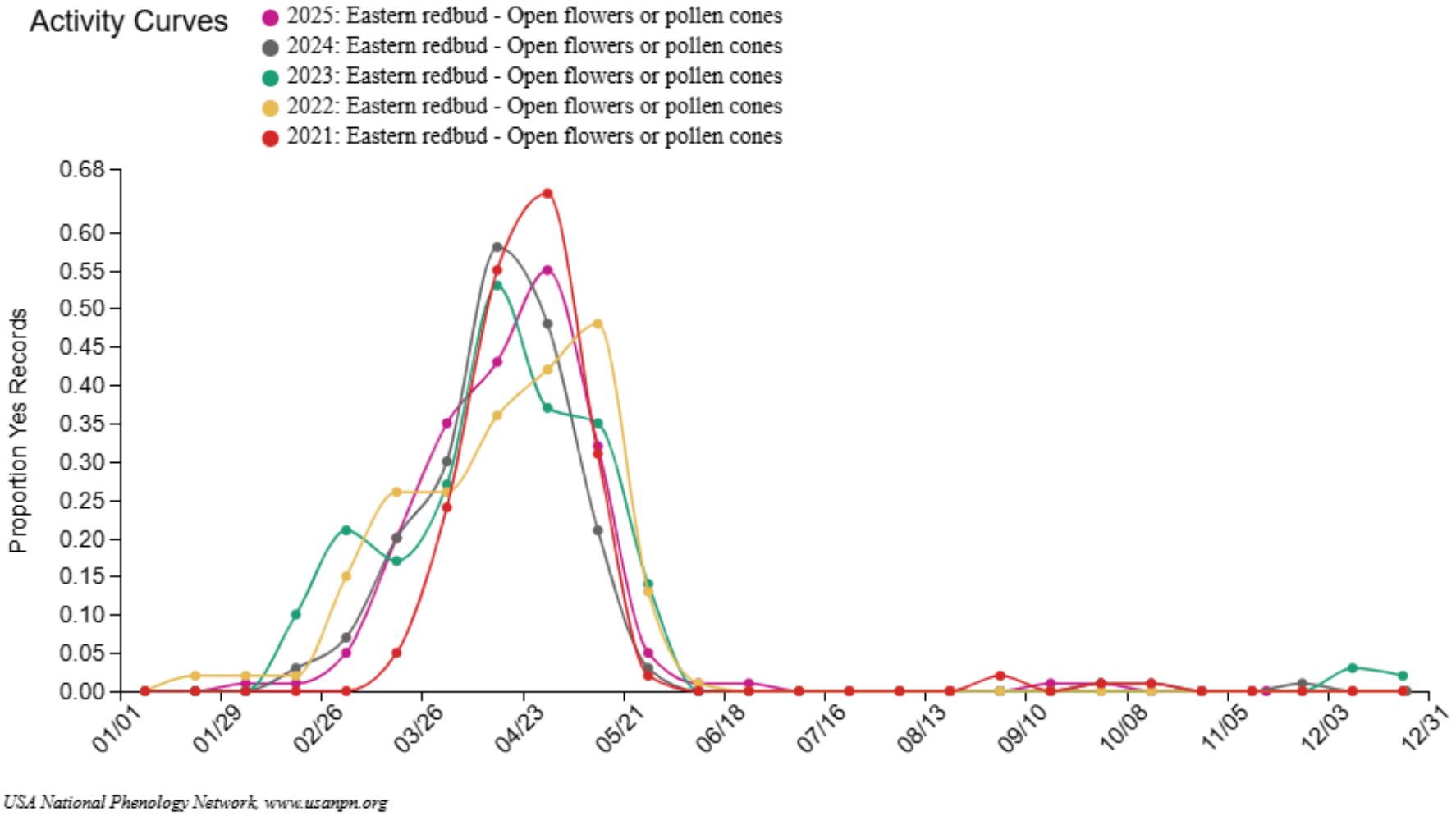


www.usanpn.org

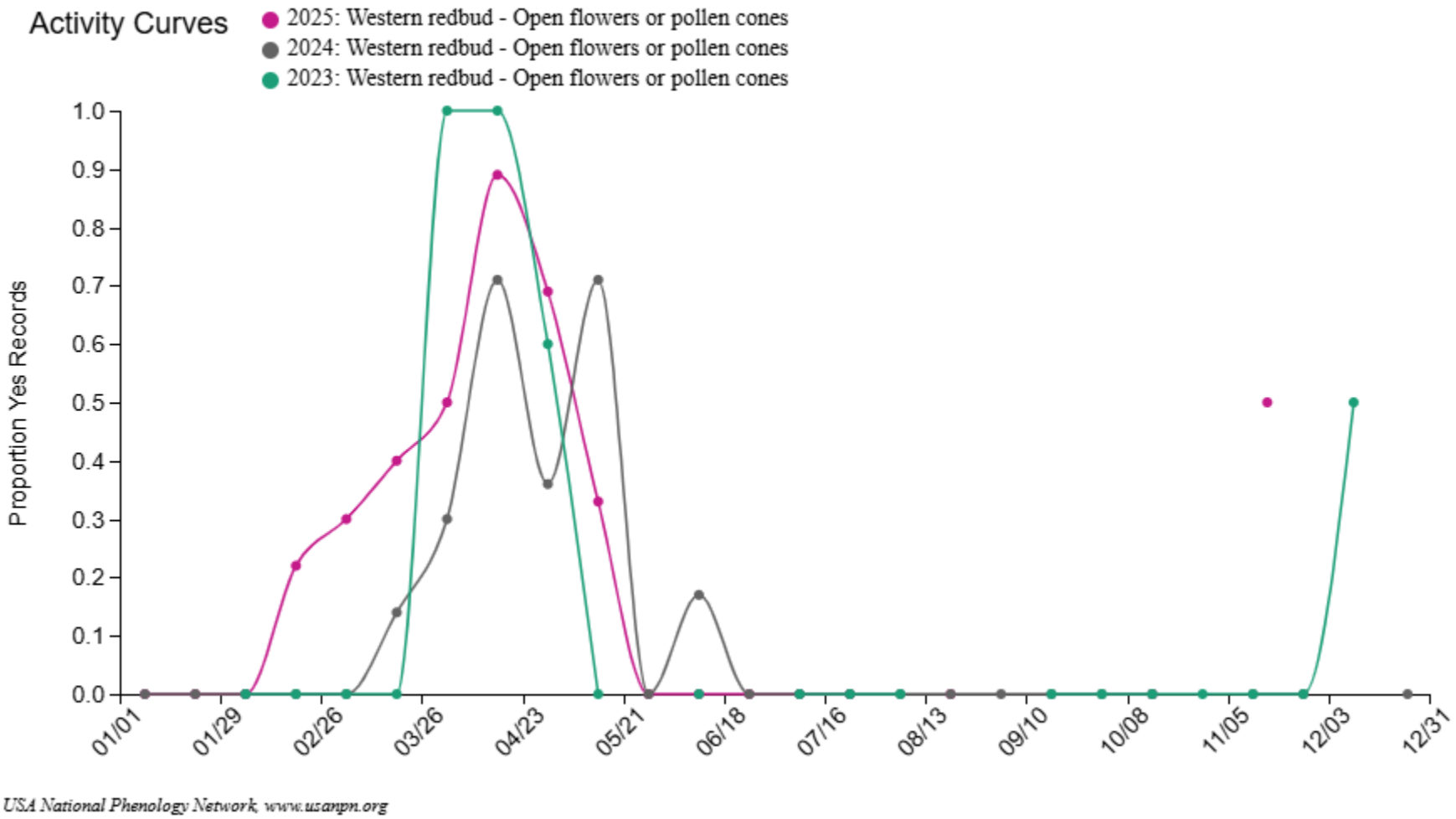
USA npn National Phenology Network

ARIZONA

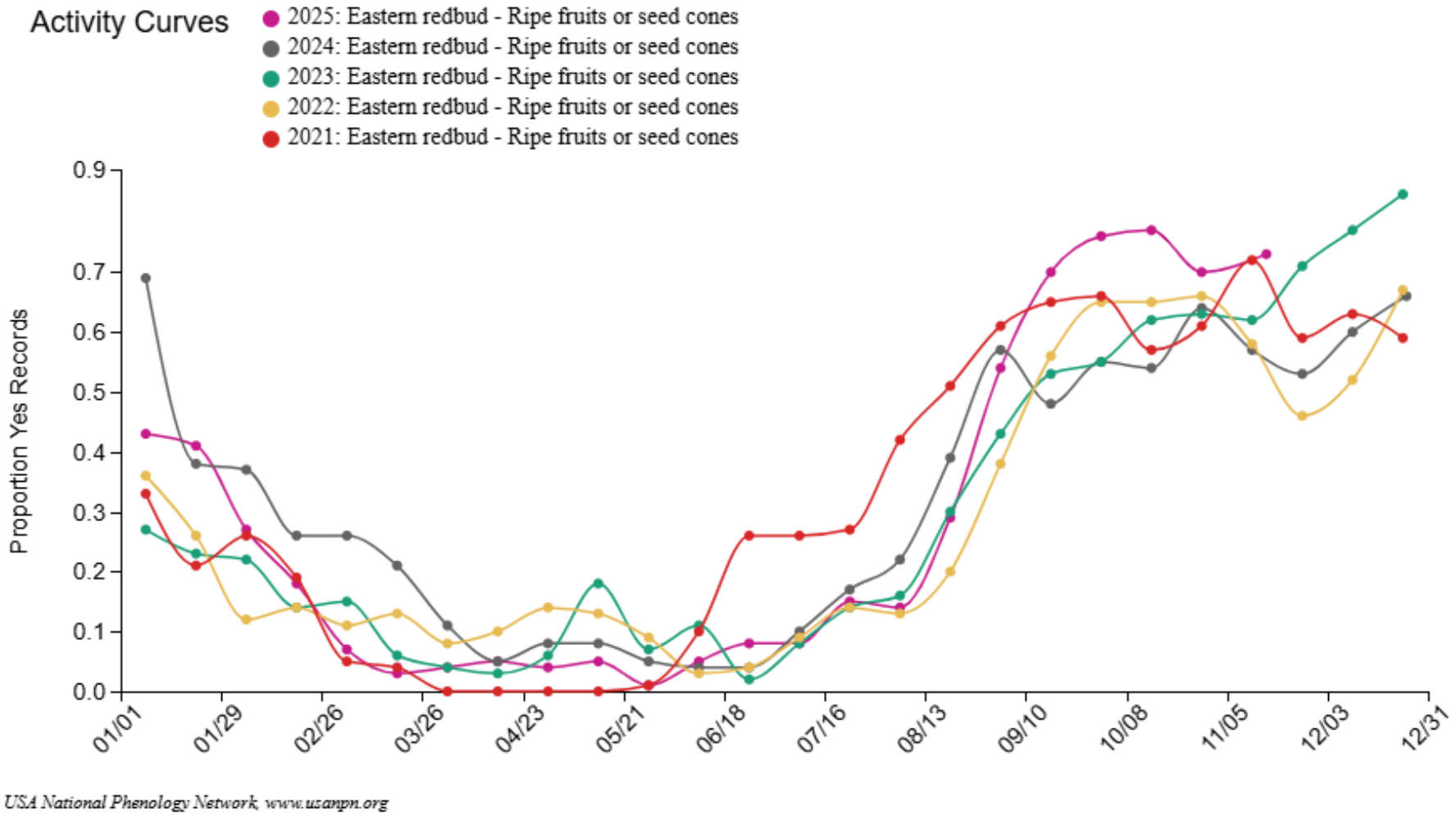
Eastern redbud flowering reports 2021-25



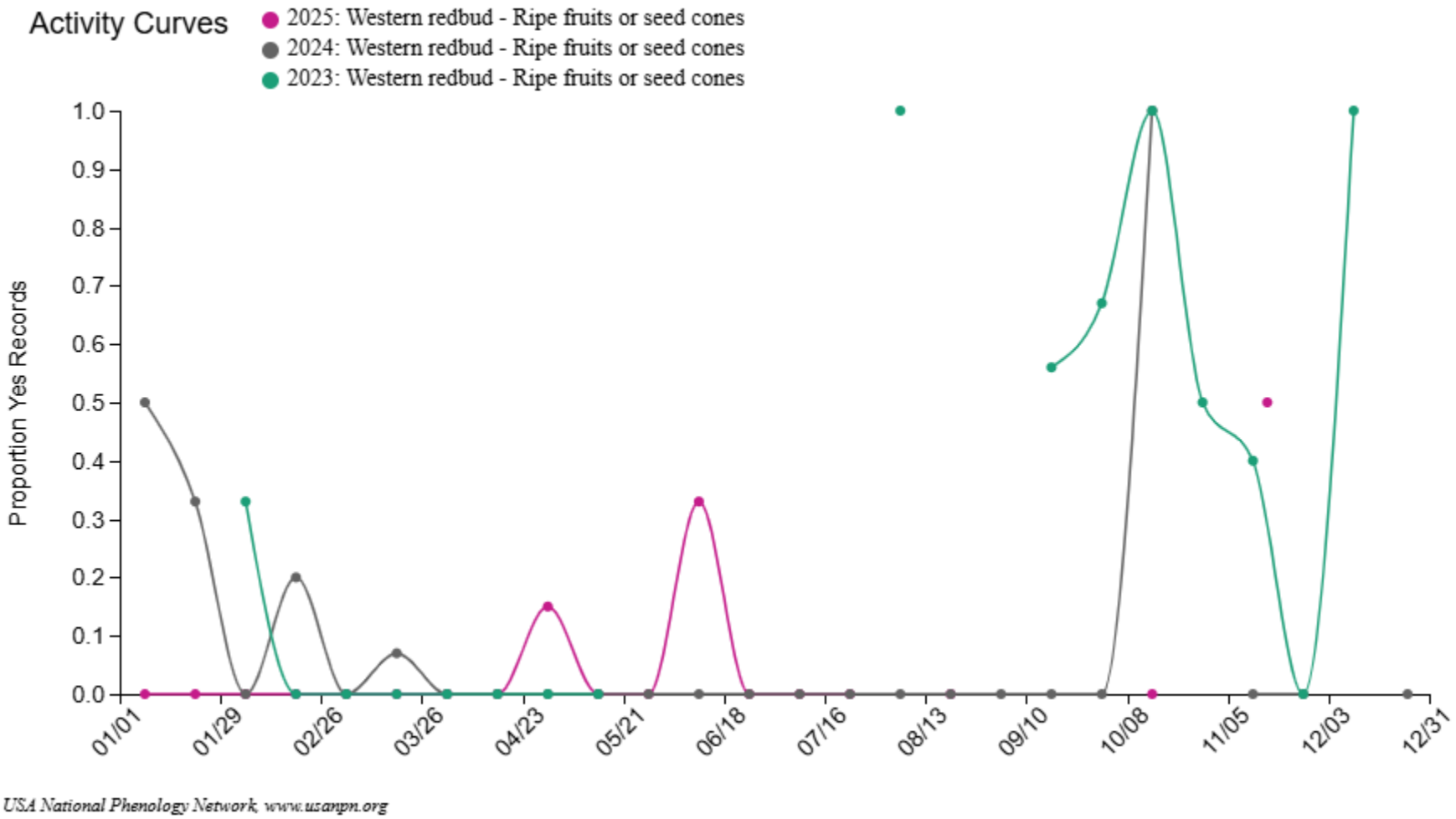
Western redbud flowering reports 2021-25



Eastern redbud fruiting reports 2021-25



Western redbud fruiting reports 2021-25



Questions about redbud phenology

1. Does the timing of redbud flowering vary by location or elevation?

2. Is there a cycle to abundant years of redbud fruiting?

3. Has the timing of redbud flowering and fruiting advanced in recent years?

Photo: Julie Makin, wildflower.org

Join The Redbud Phenology Project, a *Nature's Notebook* Campaign

nature's notebook

A project of the USA-NPN

www.usanpn.org

USA npn National Phenology Network

ARIZONA

USA National Phenology Network

Collect • Store • Share
Phenology data and information

www.usanpn.org

USA npn National Phenology Network

ARIZONA

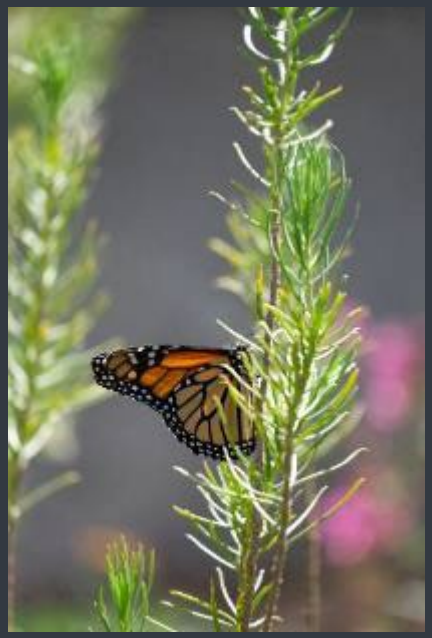
Why phenology?

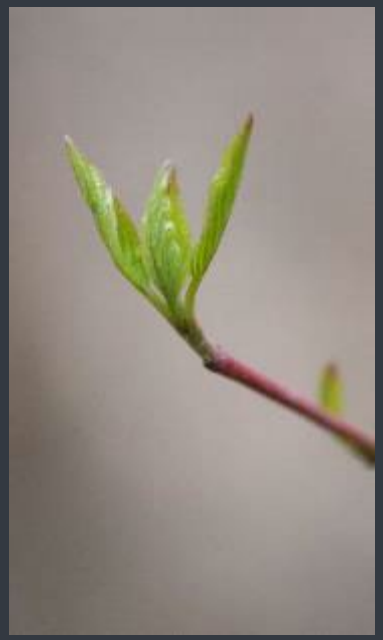
USA npn National Phenology Network

ARIZONA

Phenology as an indicator

"Phenology…is perhaps the simplest process in which to track changes in the ecology of species in response to climate change." (Intergovernmental Panel on Climate Change 2007)



The importance of long-term records

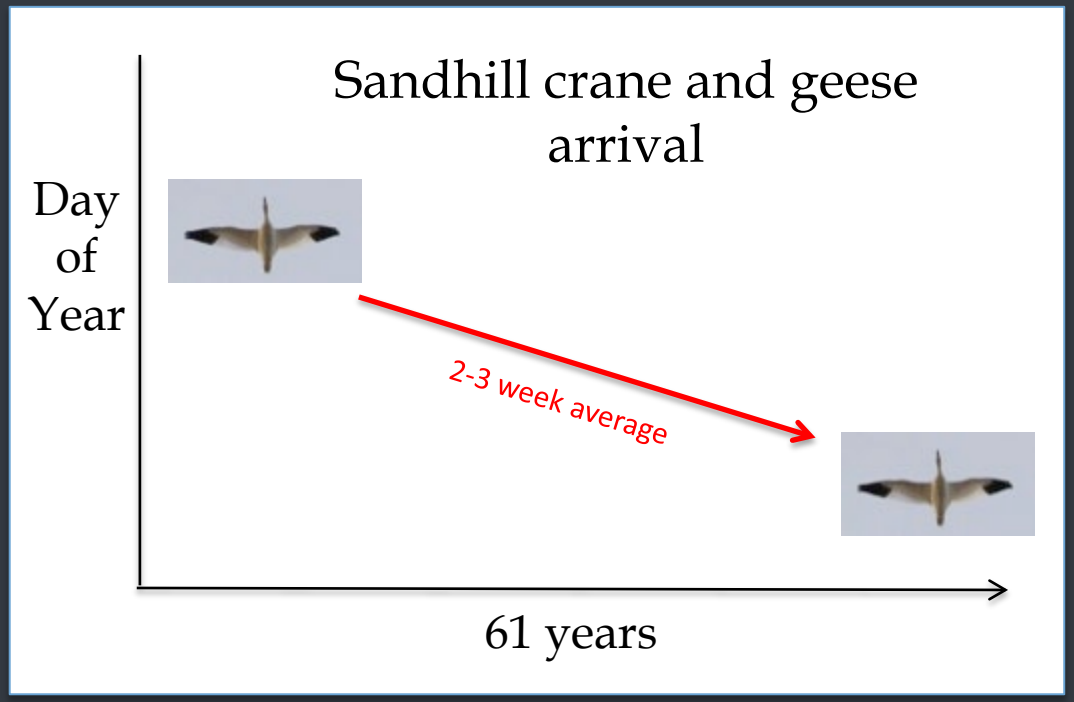


Photo: Journal Sentinel files

Bradley, N.L., et al. 1999, *PNAS*

How do you track plant and animal life cycles?

USA npn National Phenology Network

ARIZONA

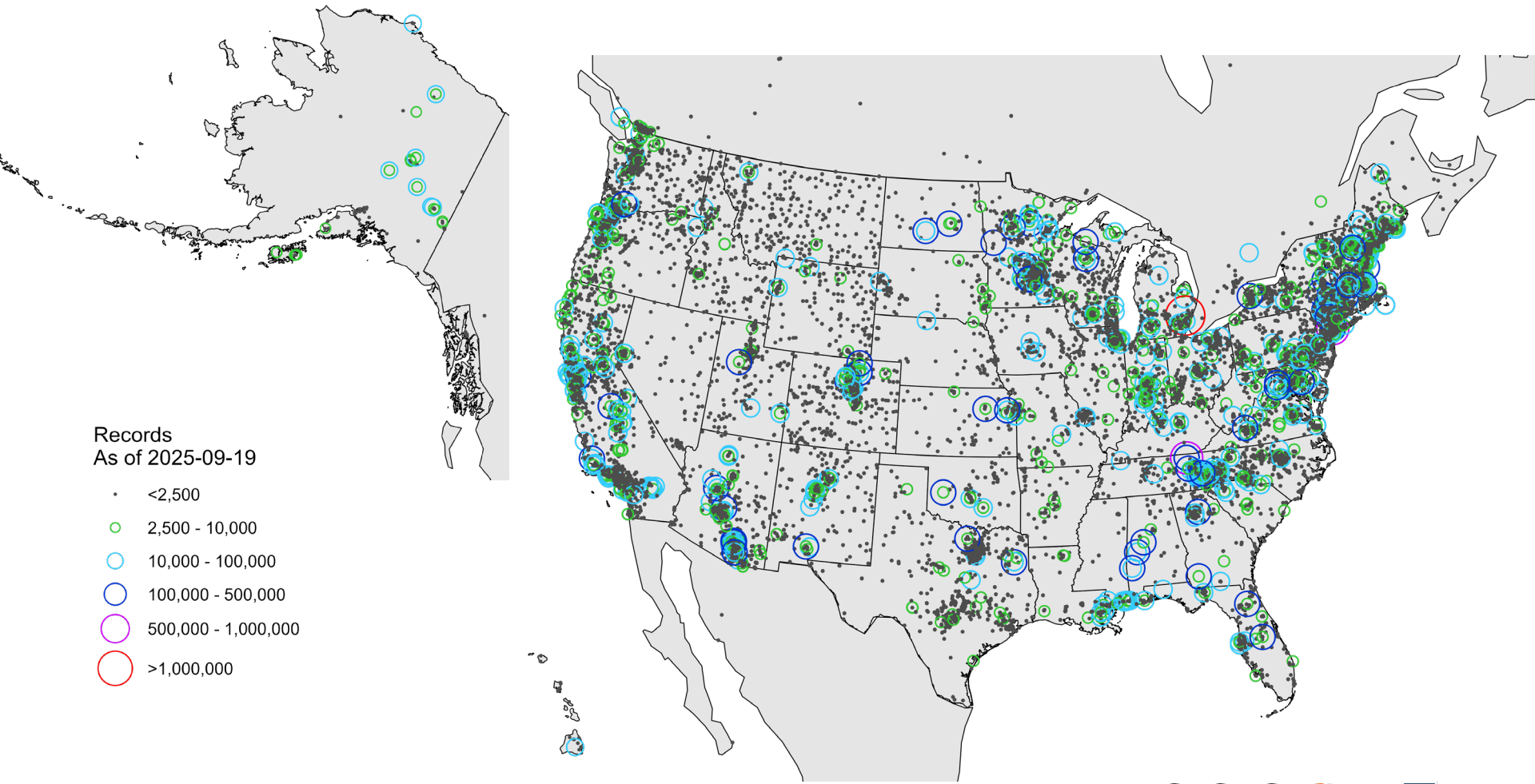
nature's notebook

A project of the USA-NPN

> 32,000 active observers

> 22,000 active sites

> 44 million records

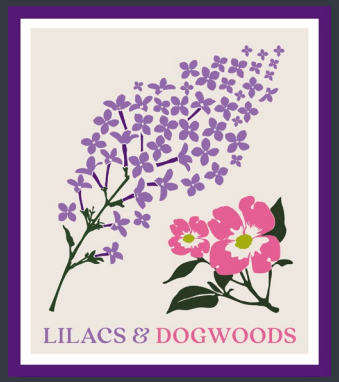


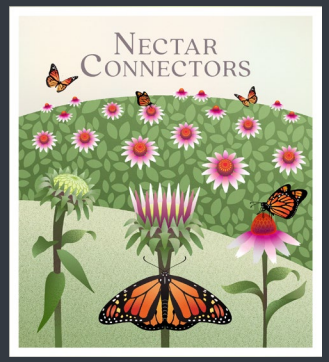
www.usanpn.org

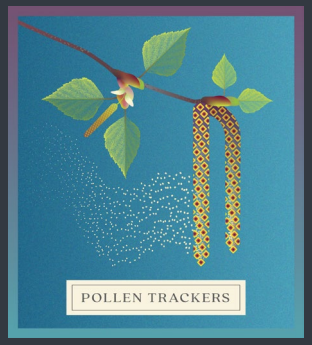
USA npn National Phenology Network

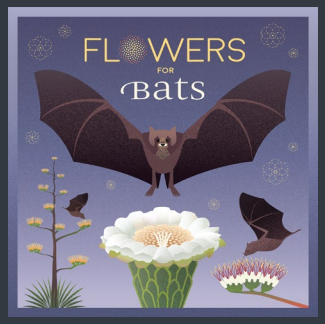
ARIZONA

Nature's Notebook data collection campaigns







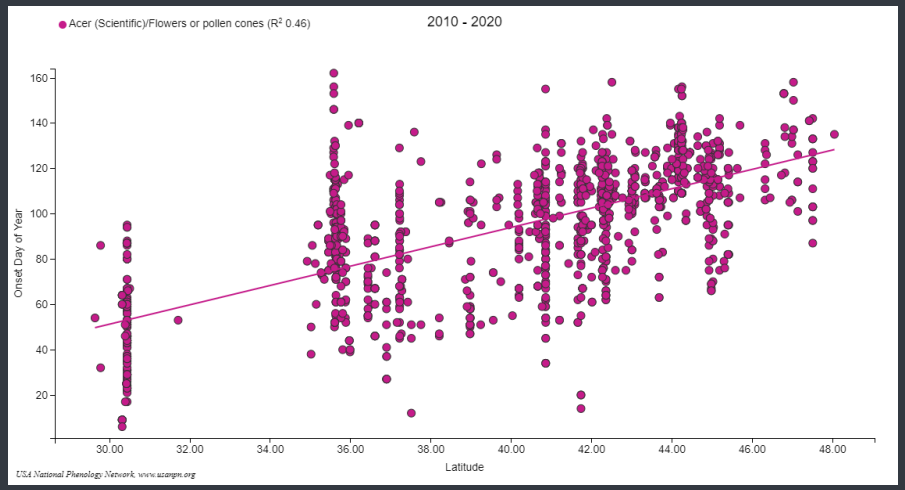


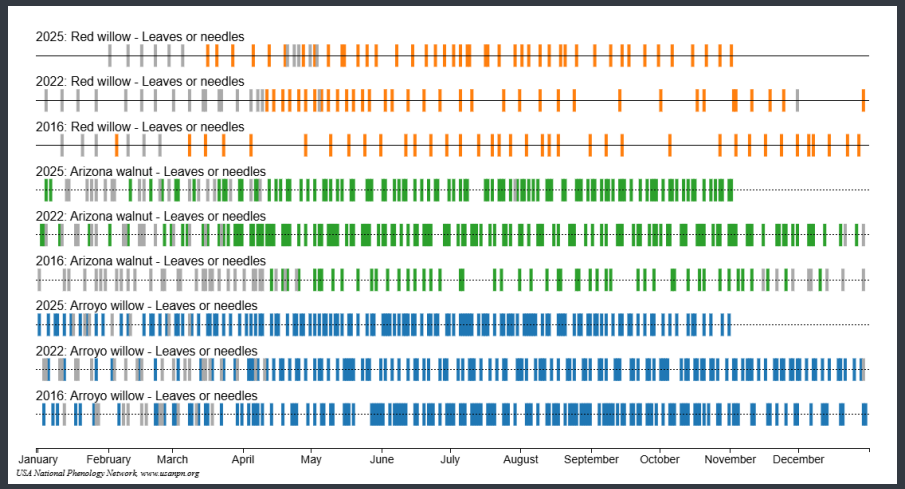
www.usanpn.org/nn/campaigns

USA npn National Phenology Network

ARIZONA

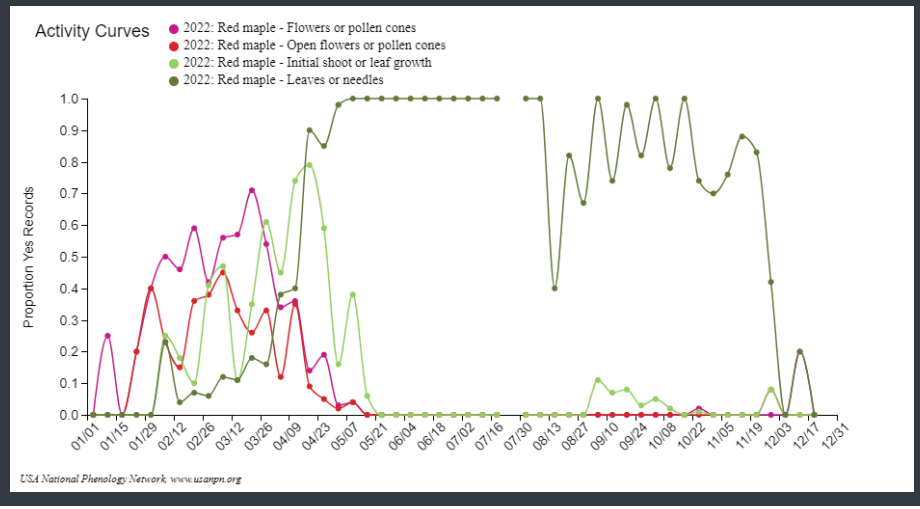
Explore the data with our Visualization Tool





- Seasonal Stories give you quick access to curated visualizations
- Data Explorer lets you select data and create visualizations

data.usanpn.org/vis-tool



USA National Phenology Network

ARIZONA

Explore how your data are used

SCIENTIFIC REPORTS

OPEN *Asclepias Syriaca* (Common Milkweed) flowering date shift in response to climate change

Ecological Indicators
Volume 109, February 2020, 105745

Flowering phenology indicates plant flammability in a dominant shrub species

Ecological Solutions and Evidence

FROM PRACTICE AND EDITOR'S CHOI

Using phenology data to improve control of invasive plant species: A case study on Midway Atoll NWR

Robert V. Taylor, Wieteke Holthuijzen,

ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

Article | Open Access

The primacy of bears as seed dispersers in salmon-bearing ecosystems

Laurie E. F. Harrer, Taal Levi

ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

Article | Open Access

Novel measures of continental-scale avian migration phenology related to proximate environmental cues

Jeffrey F. Kelly, Kyle G. Horton, Phillip M. Stepanian, Kirsten M. de Beurs, Todd Fagin, Eli S. Bridge, Phillip B. Chilson

News & Publications

Nature's Notebook data reveal earlier spring activity under warmer conditions

Wed, Nov 05, 2025

Publication Summary

Results from many small-scale studies have shown that warming temperatures are causing plants to leaf-out and flower earlier than they have in the past. However, it has been difficult to know whether these patterns hold true for a wide variety of plant species at a continental scale. To answer this question, researchers used thousands of observations of plants in the eastern U.S. that were submitted to Nature's Notebook, mainly by volunteers. They found that leaf-out and flowering occurred earlier with warmer temperatures, but the effects varied among species and locations. Invasive species, shrub species, and species at southern latitudes were more sensitive to warming temperatures than other species. These patterns were similar to results from analyses of data collected by professionals and consistent with results from previous scientific studies, demonstrating the value of Nature's Notebook observations.

Community scientists document a large diversity of plants in urban areas

Mon, Sep 15, 2025

Publication Summary

As the world becomes increasingly urban, it will become more important to maintain diverse plant communities in and around cities. A diverse plant community provides many benefits to people and wildlife inhabiting urban areas. In many cities, we have incomplete information about plant species and distributions. So, researchers gathered data from published scientific papers, unpublished reports, and observations submitted to community science programs like USA-NPN's Nature's Notebook to see whether combining information from all these sources provided a more complete picture of urban plant biodiversity. They compiled more than 171,000 observations of plants in the Chicago, Illinois area and documented more than 2,200 plant species. Community science programs contributed more observations of more plant species in more diverse locations than scientific studies or reports. However, professional scientists documented a significant number of native species with limited distributions that were not observed by community scientists. In all, the study highlighted the value in combining different types of data to better characterize and manage plant communities in urban areas.

Extreme weather events affect when plants flower and when insects are active

Wed, Jul 09, 2025

Publication Summary

As the climate changes, there has been a significant increase in the frequency of extreme weather events like heat waves, droughts, and hurricanes. We know that increases in average temperatures affect the timing of plant and animal activities, but the effects of extreme weather events are largely unknown. To address this knowledge gap, researchers used millions of photos of plants, butterflies, and moths that were submitted to iNaturalist between 2016 and 2022 to evaluate the effects of extreme heat, cold, dry, or wet conditions on the timing of plant flowering and adult insect activity. The results showed that the onset and duration of plant and animal activities were impacted by extreme events and not just changes in average climate conditions. However, the effects of extreme weather were complex, often differing between plants and animals and varying regionally. Results from this study can help us predict how plant and insect populations will respond to extreme weather events, which are likely to occur more often with climate change.

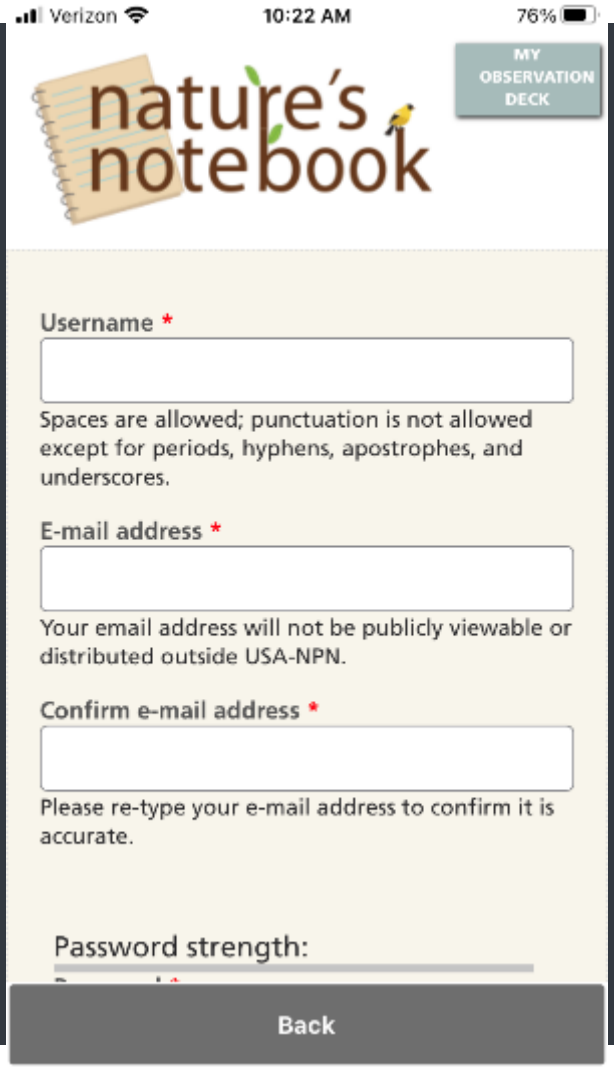
www.usanpn.org

Steps for getting started

1. Create a *Nature's Notebook* account
2. Add a Personal Site
3. Add a redbud to your site
4. Record data on your redbud
5. Sign up for campaign emails

1. Create a *Nature's Notebook* account

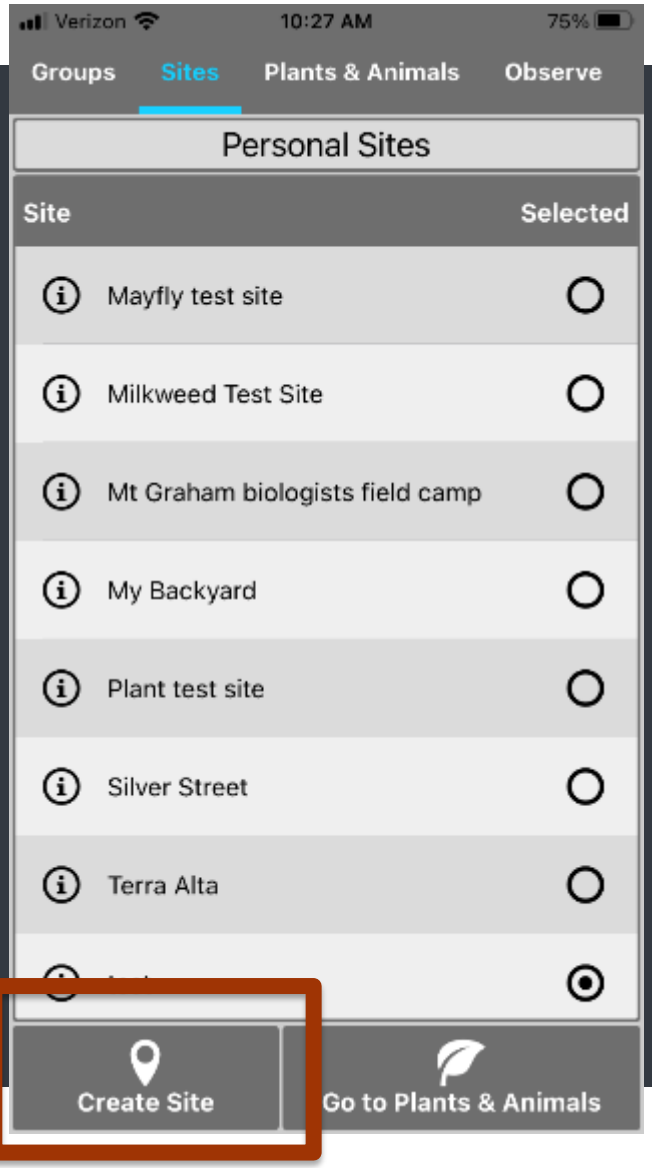
Download the *Nature's Notebook* app

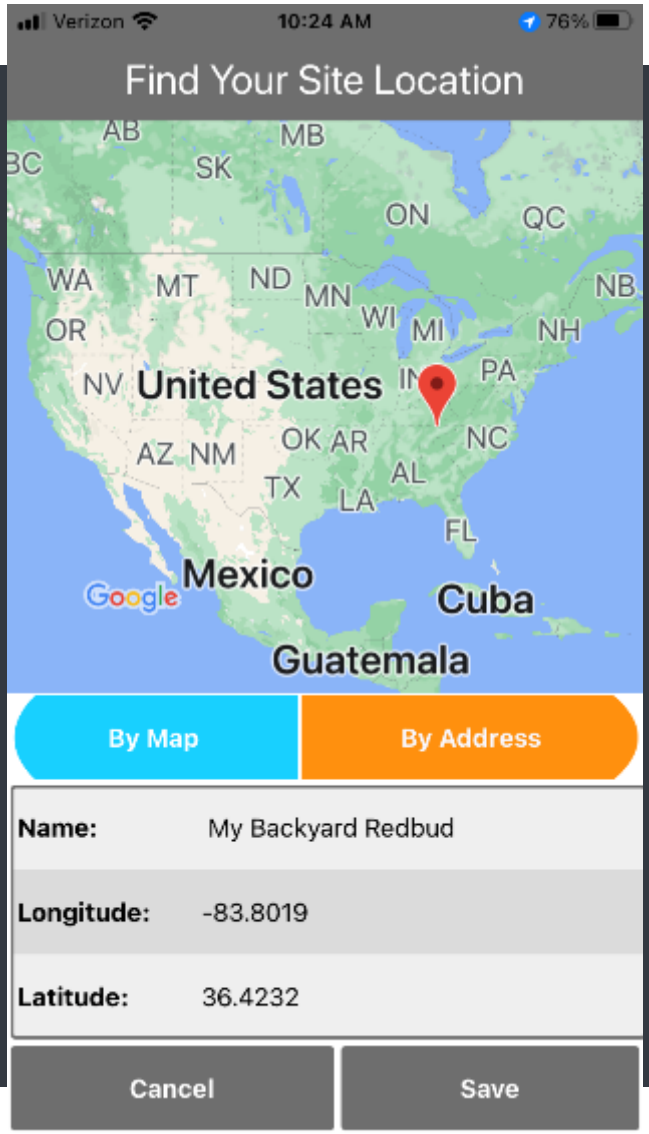


USA npn National Phenology Network

ARIZONA

2. Add a Personal Site

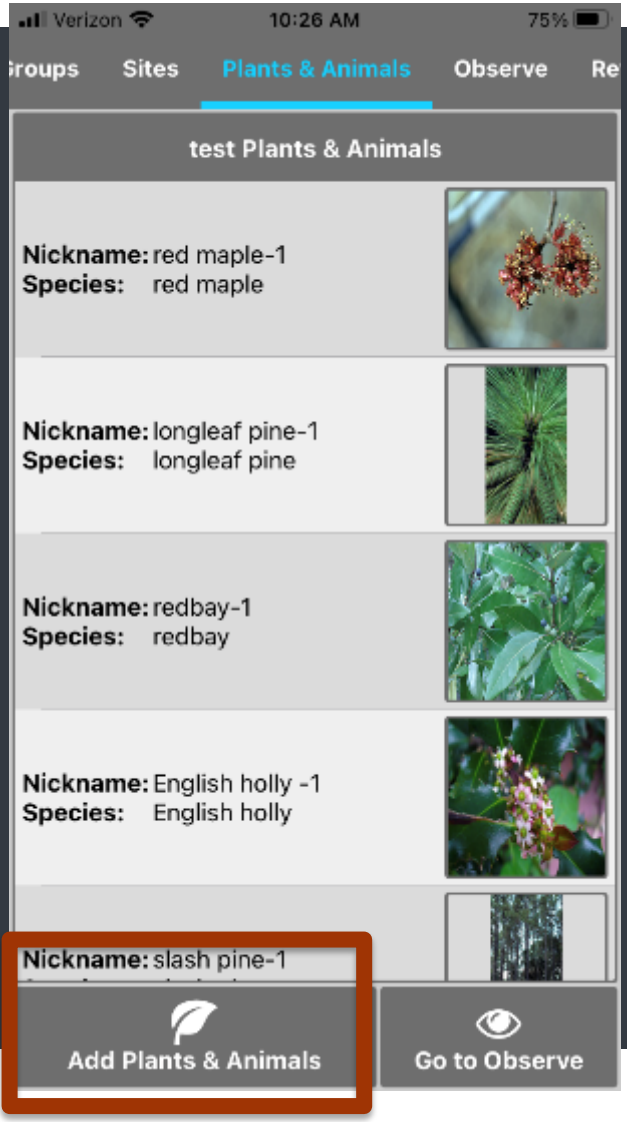




USA npn National Phenology Network

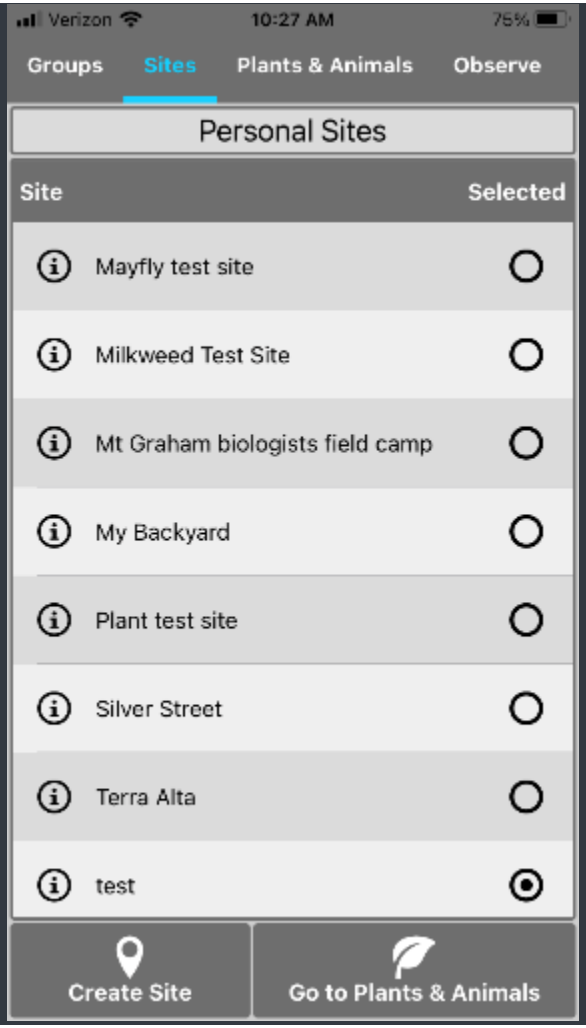
ARIZONA

3. Add a redbud to your site



Already a *Nature's Notebook* observer?

- Add redbud to your existing site
- Or make a new site for your redbud



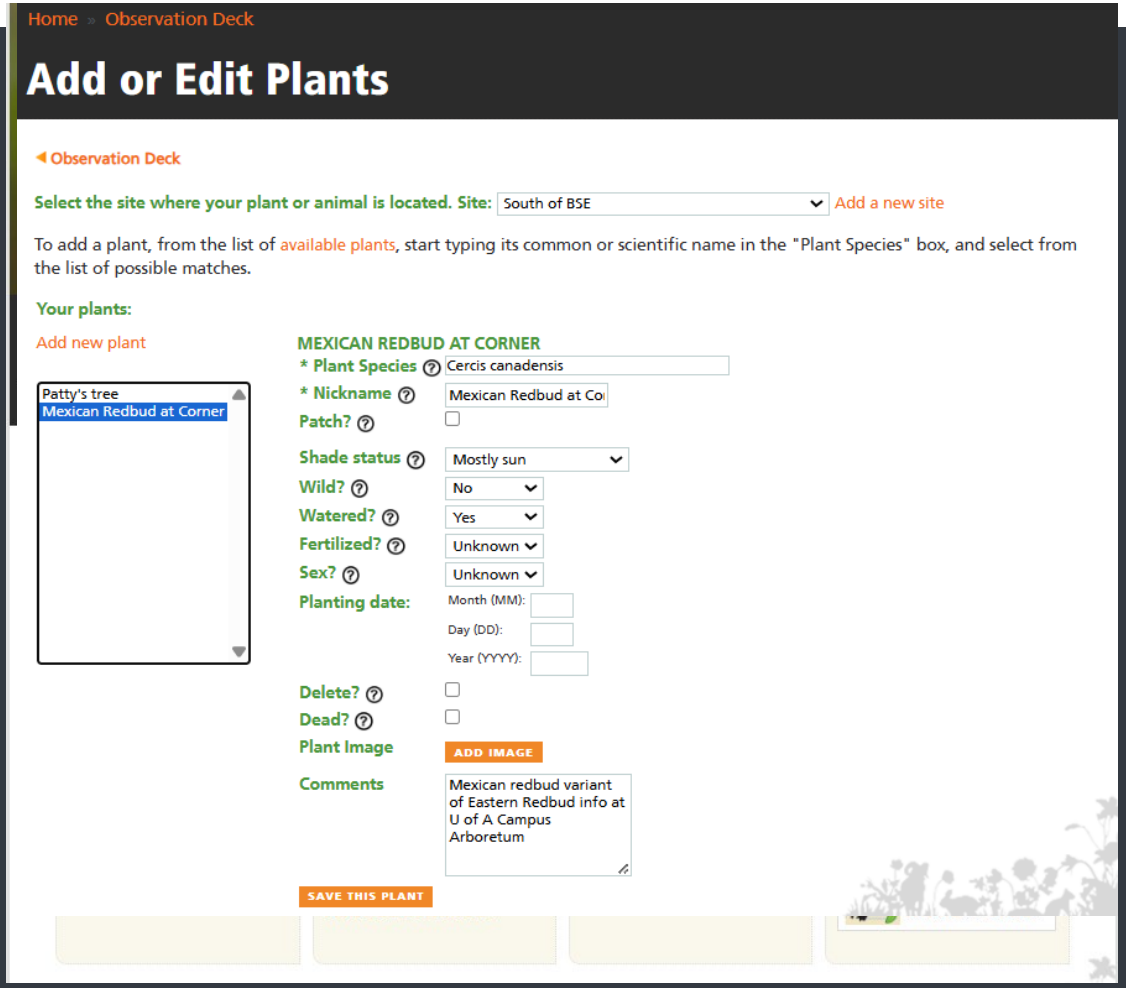
USA npn National Phenology Network

Arizona

Optional: provide some more details

Login to your Observation Deck to add details about your:

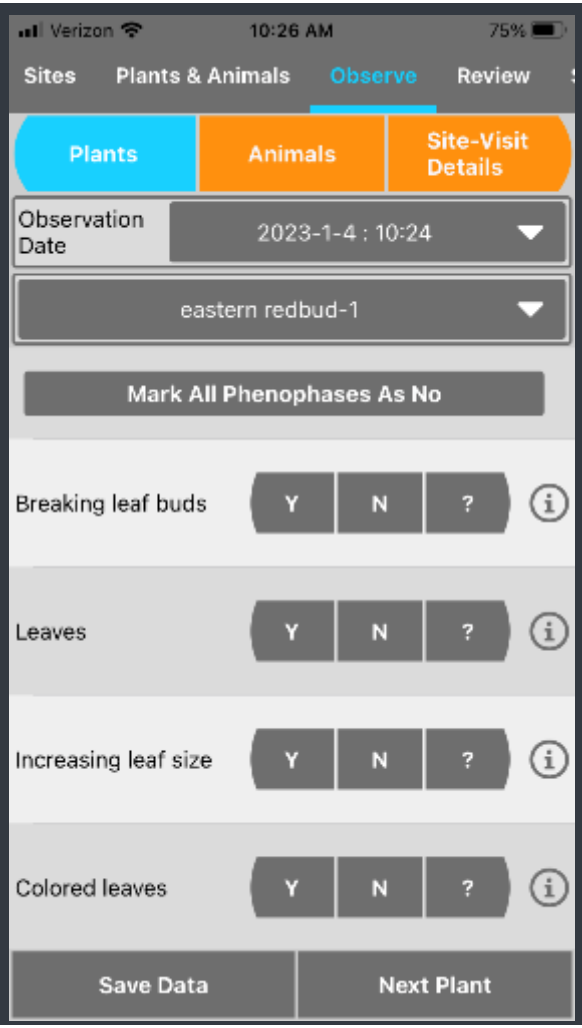
- Site
- Redbud
- Add cultivar or variety if you know it



USA npn National Phenology Network

ARIZONA

4. Record data on your redbud



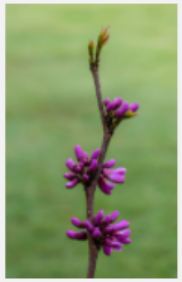
Eastern Redbud Datasheet

Do you see...	
Breaking leaf buds	y n ? ____
Leaves	y n ? ____
Increasing leaf size	y n ? ____
Colored leaves	y n ? ____
Falling leaves	y n ? ____
Flowers or flower buds	y n ? ____
Open flowers	y n ? ____
Fruits	y n ? ____
Ripe fruits	y n ? ____
Recent fruit or seed drop	y n ? ____

4. Record data on your redbud

Eastern Redbud Datasheet

Do you see...	
Breaking leaf buds	y n ? ____
Leaves	y n ? ____
Increasing leaf size	y n ? ____
Colored leaves	y n ? ____
Falling leaves	y n ? ____
Flowers or flower buds	y n ? ____
Open flowers	y n ? ____
Fruits	y n ? ____
Ripe fruits	y n ? ____
Recent fruit or seed drop	y n ? ____

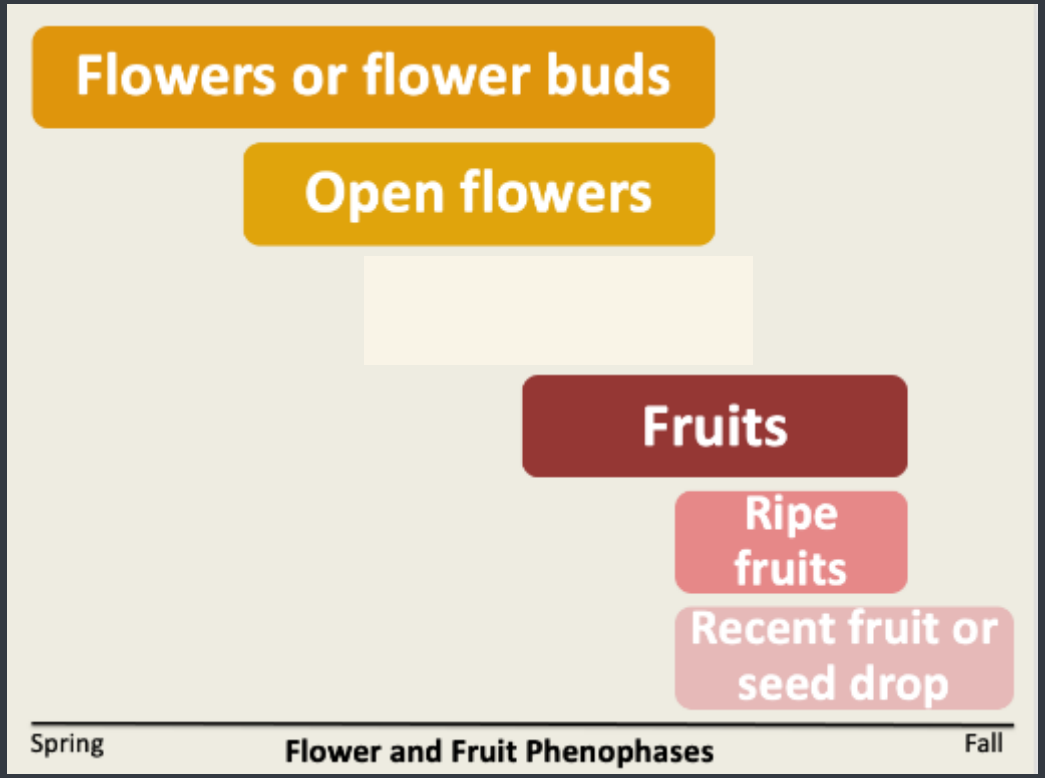
Phenophase	**Definition**	**Photo** (click to enlarge)
Flowers or flower buds	One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds or inflorescences that are swelling or expanding, but do not include those that are tightly closed and not actively growing (dormant). Also do not include wilted or dried flowers.	
Open flowers	One or more open, fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between or within unfolded or open flower parts (petals, floral tubes or sepals). Do not include wilted or dried flowers.	
Fruits	One or more fruits are visible on the plant. For *Cercis canadensis*, the fruit is a pod that changes from green to purplish to dark brown and, over time, splits open to expose the seeds. Do not include empty pods that have already dropped all of their seeds.	
Ripe fruits	One or more ripe fruits are visible on the plant. For *Cercis canadensis*, a fruit is considered ripe when it has turned dark brown. Do not include empty pods that have already dropped all of their seeds.	
Recent fruit or seed drop	One or more mature fruits or seeds have dropped or been removed from the plant since your last visit. Do not include obviously immature fruits that have dropped before ripening, such as in a heavy rain or wind, or empty fruits that had long ago dropped all of their seeds but remained on the plant.	

www.usanpn.org

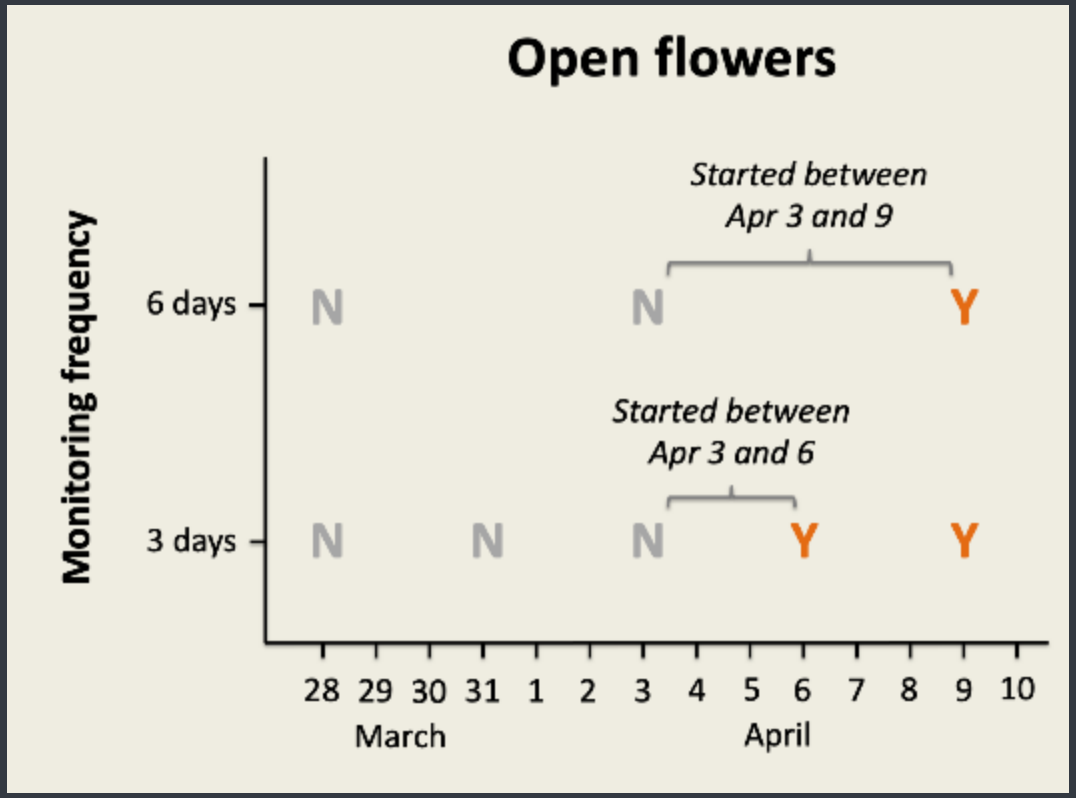
4. Record data on your redbud

Eastern Redbud Datasheet

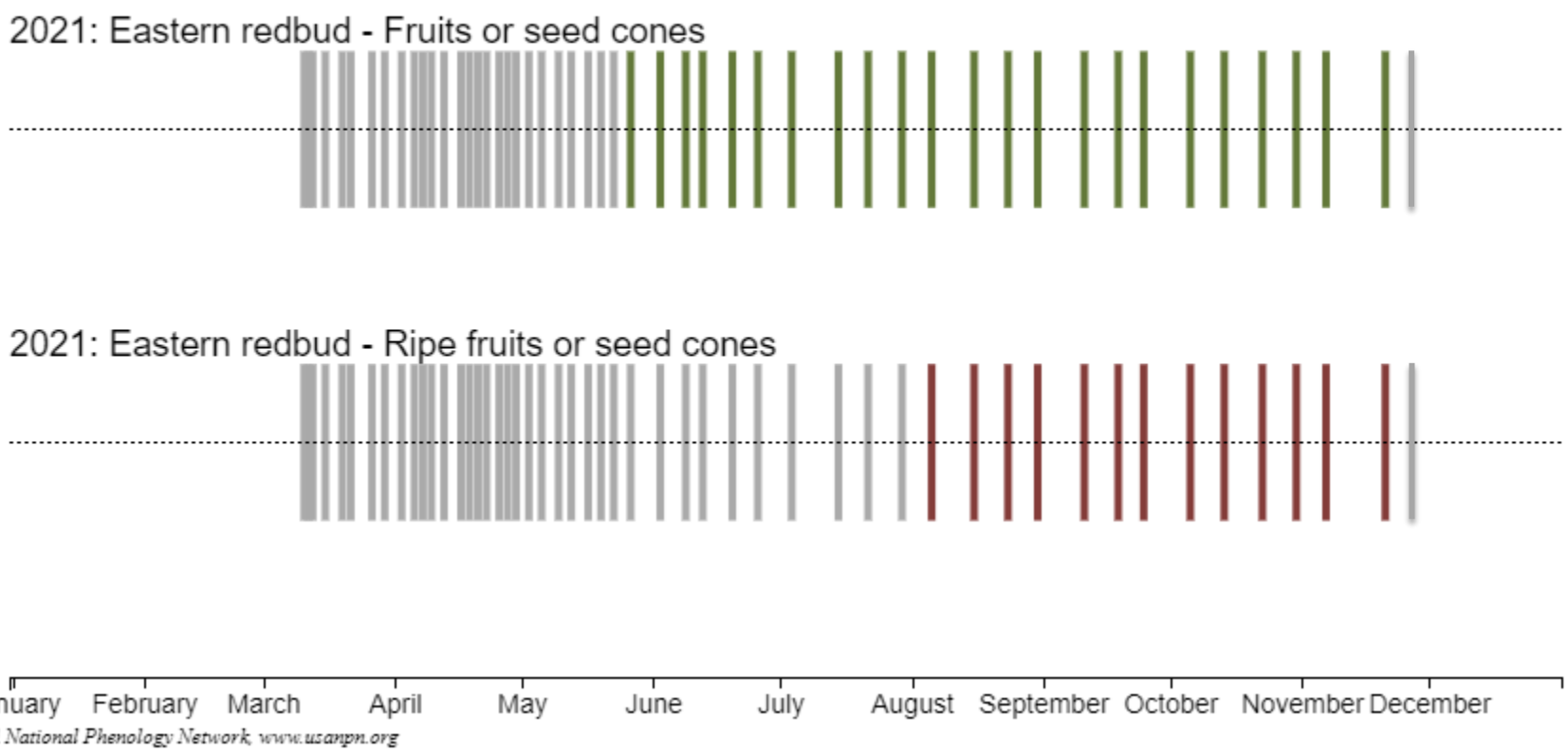
Do you see...	
Breaking leaf buds	y n ? ____
Leaves	y n ? ____
Increasing leaf size	y n ? ____
Colored leaves	y n ? ____
Falling leaves	y n ? ____
Flowers or flower buds	y n ? ____
Open flowers	y n ? ____
Fruits	y n ? ____
Ripe fruits	y n ? ____
Recent fruit or seed drop	y n ? ____



4. Record data on your redbud



4. Record data on your redbud



4. Record data on your redbud

Flowers

Flowers or flower buds

One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds or inflorescences that are swelling or expanding, but do not include those that are tightly closed and not actively growing (dormant). Also do not include wilted or dried flowers.

How many flowers and flower buds are present? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), simply estimate the number of flower heads, spikes or catkins and not the number of individual flowers.

Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Open flowers

One or more open, fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between or within unfolded or open flower parts (petals, floral tubes or sepals). Do not include wilted or dried flowers.

What percentage of all fresh flowers (buds plus unopened plus open) on the plant are open? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), estimate the percentage of all individual flowers that are open.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Fruits

Fruits

One or more fruits are visible on the plant. For Cercis canadensis, the fruit is a pod that changes from green to purplish to dark brown and, over time, splits open to expose the seeds. Do not include empty pods that have already dropped all of their seeds.

How many fruits are present?

Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

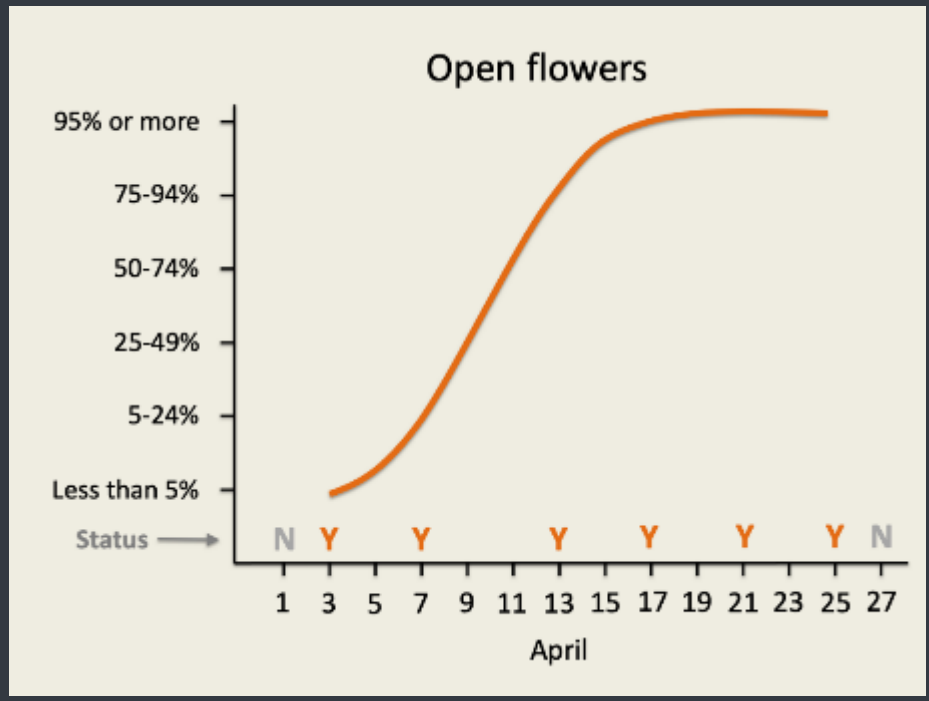
Ripe fruits

One or more ripe fruits are visible on the plant. For Cercis canadensis, a fruit is considered ripe when it has turned dark brown. Do not include empty pods that have already dropped all of their seeds.

What percentage of all fruits (unripe plus ripe) on the plant are ripe?

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Optional!



USA npn National Phenology Network

ARIZONA

4. Record data on your redbud

Earn your Redbud Phenology Project badge!

Observe your redbud at least once a week in 6 separate weeks in 2026

See it on your Observation Deck

5. Sign up for campaign emails

Sign up for the Redbud Phenology Project messages

You will receive the Redbud Phenology Project campaign messages several times during the season with results, observation tips, and more.
Photo: Thom Pennington

* Email

* First Name

Zip Code

Sign Up

www.usanpn.org

USA npn National Phenology Network

ARIZONA

Test your skills!

Photo: MSU Extension/Gary Bachman

Test your skills!

Photo: JD McGreg, Wikimedia Commons, CCA-SA-3.0

A few things to remember about redbuds…

- Redbud trees may not flower until several years old
- Do not count winter flower buds until they swell
- Look for reproductive parts of flowers to know when they are open

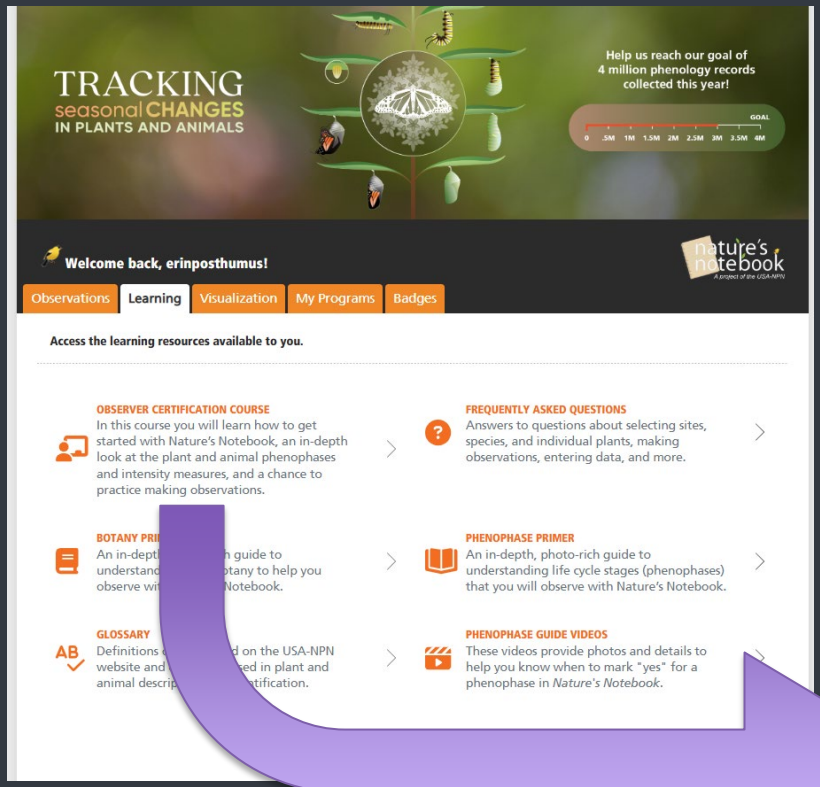
Photo Credit: AwkwardBotany.com

A few things to remember about redbuds…

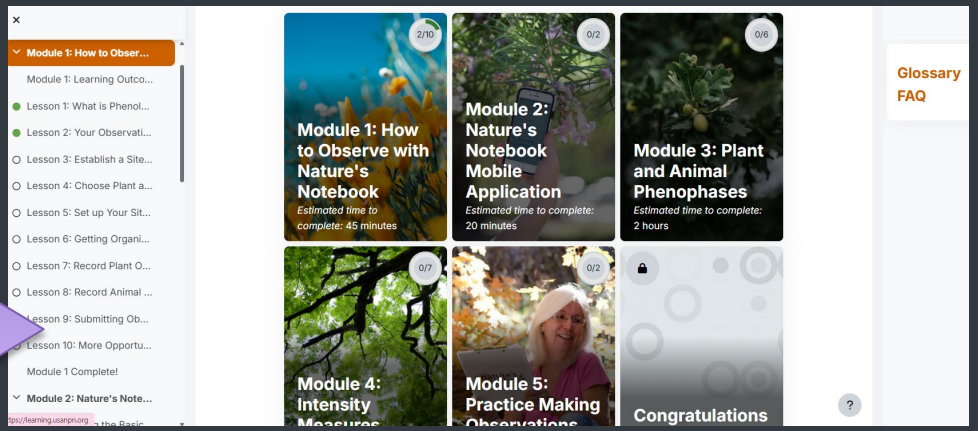
- Redbuds may hold onto empty seed pods all winter – you should stop counting "Yes" to ripe fruits once pods have released seeds
- If recording leaf phenophases, note that young leaves may appear red – this is not "colored leaves" that occurs in late summer/autumn
- Consider selecting 2-3 individual trees at your site if you have them available

Photo Credit: Wendy VanDyk Evans, Bugwood.org

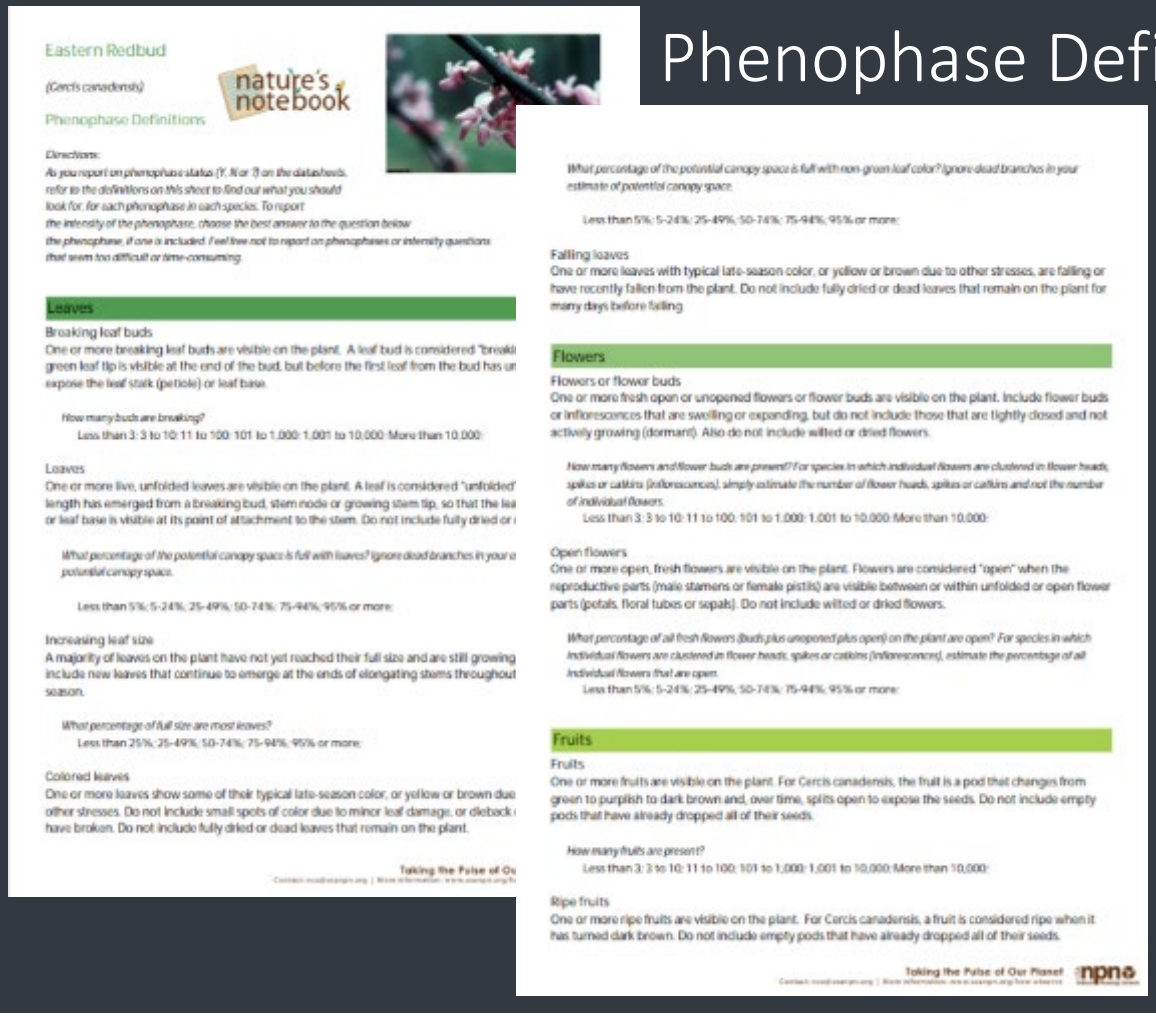
Training materials and resources



Free online Observer Certification Course



Training materials and resources


Eastern Redbud

(Cercis canadensis)

Phenophase Definitions

nature's notebook

Directions:
As you report on phenophase status (Y, N or ?) on the datasheets, refer to the definitions on this sheet to find out what you should look for, for each phenophase in each species. To report the intensity of the phenophase, choose the best answer to the question below the phenophase, if one is included. Feel free not to report on phenophases or intensity questions that seem too difficult or time-consuming.

Leaves

Breaking leaf buds
One or more breaking leaf buds are visible on the plant. A leaf bud is considered "breaki green leaf tip is visible at the end of the bud, but before the first leaf from the bud has ur expose the leaf stalk (petiole) or leaf base.

How many buds are breaking?
Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Leaves
One or more live, unfolded leaves are visible on the plant. A leaf is considered "unfolded" length has emerged from a breaking bud, stem node or growing stem tip, so that the lea or leaf base is visible at its point of attachment to the stem. Do not include fully dried or

What percentage of the potential canopy space is full with leaves? Ignore dead branches in your potential canopy space.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Increasing leaf size
A majority of leaves on the plant have not yet reached their full size and are still growing include new leaves that continue to emerge at the ends of elongating stems throughout season.

What percentage of full size are most leaves?
Less than 25%; 25-49%; 50-74%; 75-94%; 95% or more;

Colored leaves
One or more leaves show some of their typical late-season color, or yellow or brown due other stresses. Do not include small spots of color due to minor leaf damage, or dieback have broken. Do not include fully dried or dead leaves that remain on the plant.

Taking the Pulse of Ou

What percentage of the potential canopy space is full with non-green leaf color? Ignore dead branches in your estimate of potential canopy space.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Falling leaves
One or more leaves with typical late-season color, or yellow or brown due to other stresses, are falling or have recently fallen from the plant. Do not include fully dried or dead leaves that remain on the plant for many days before falling.

Flowers

Flowers or flower buds
One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds or inflorescences that are swelling or expanding, but do not include those that are tightly closed and not actively growing (dormant). Also do not include wilted or dried flowers.

How many flowers and flower buds are present? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), simply estimate the number of flower heads, spikes or catkins and not the number of individual flowers.
Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Open flowers
One or more open, fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between or within unfolded or open flower parts (petals, floral tubes or sepals). Do not include wilted or dried flowers.

What percentage of all fresh flowers (buds plus unopened plus open) on the plant are open? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), estimate the percentage of all individual flowers that are open.
Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Fruits

Fruits
One or more fruits are visible on the plant. For Cercis canadensis, the fruit is a pod that changes from green to purplish to dark brown and, over time, splits open to expose the seeds. Do not include empty pods that have already dropped all of their seeds.

How many fruits are present?
Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Ripe fruits
One or more ripe fruits are visible on the plant. For Cercis canadensis, a fruit is considered ripe when it has turned dark brown. Do not include empty pods that have already dropped all of their seeds.

Taking the Pulse of Our Planet

Phenophase Definitions

Linked from your Observation Deck

USA npn National Phenology Network

ARIZONA

Local Phenology Programs

Participate as part of a group of observers

Contact erin@usanpn.org for more info!

Resources available:

- Online Leader Certification Course – starts January 2026!
- Program Planning Resources
- Volunteer recruitment and retention strategies
- Community of Practice

Recap – Join the redbud campaign

- Create a *Nature's Notebook* account
- Add a site and individual redbud(s)
- Record observations (at least once per week if possible)
- Take advantage of training materials
- Sign up for redbud campaign messages

Questions?

Need help getting started?

Erin Posthumus
erin@usanpn.org

Dr. Jorge Santiago-Blay
blayj@psu.edu,
blayjorge@gmail.com

USA npn National Phenology Network

ARIZONA