

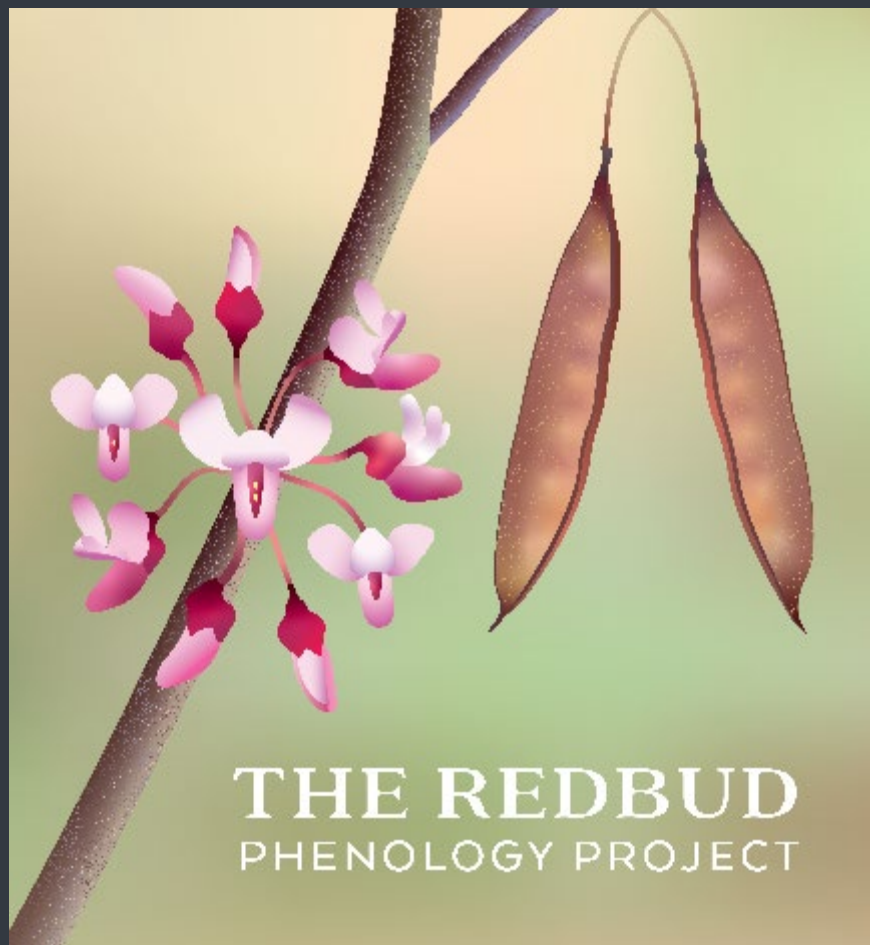


The Redbud Phenology Project Training Webinar

January 4th, 2024



Kickoff 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

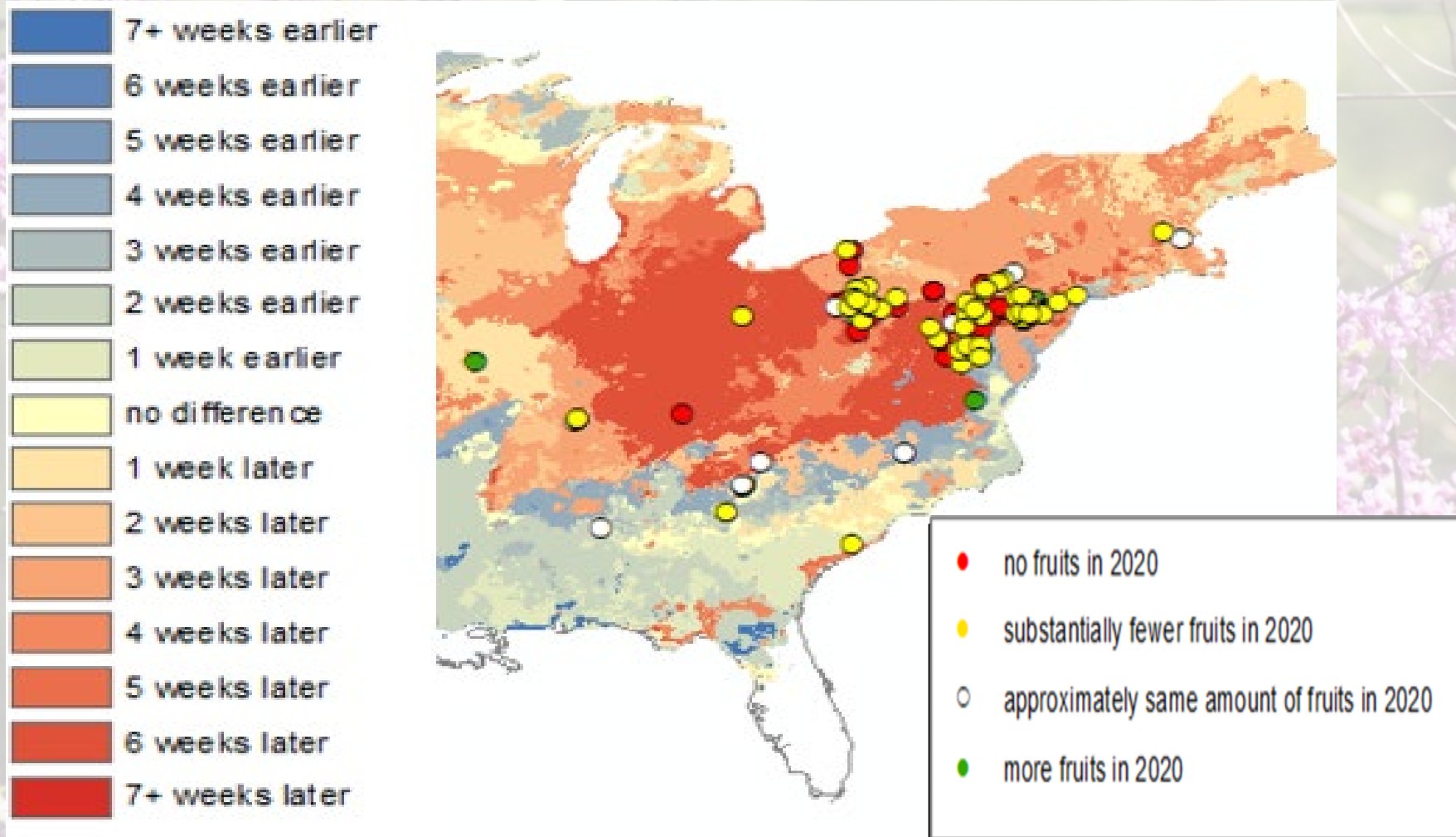
In the chat: Let us know where you're calling in from!

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



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

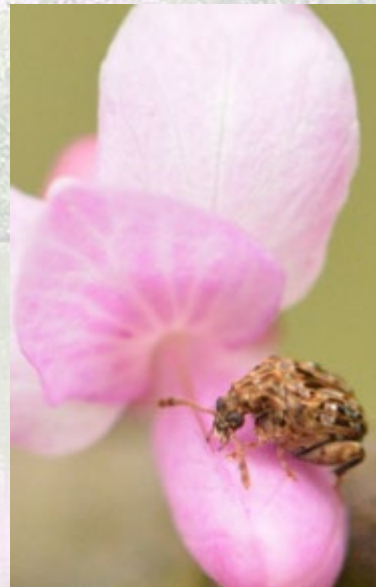
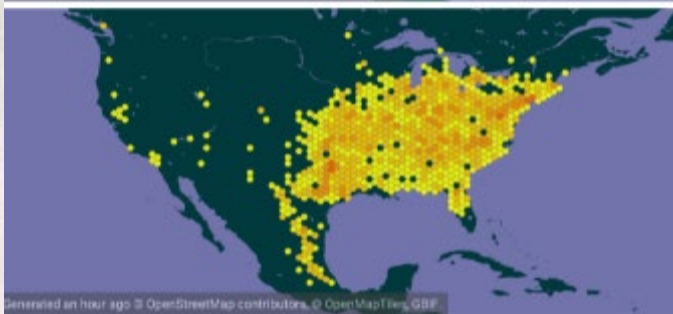
Late Spring Frost in 2020 Possibly Killed Reproductive Organs of Redbuds



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

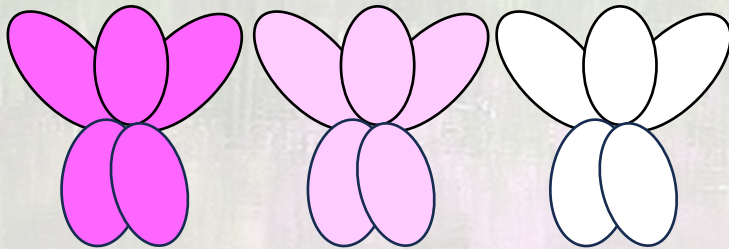
Canopy shape



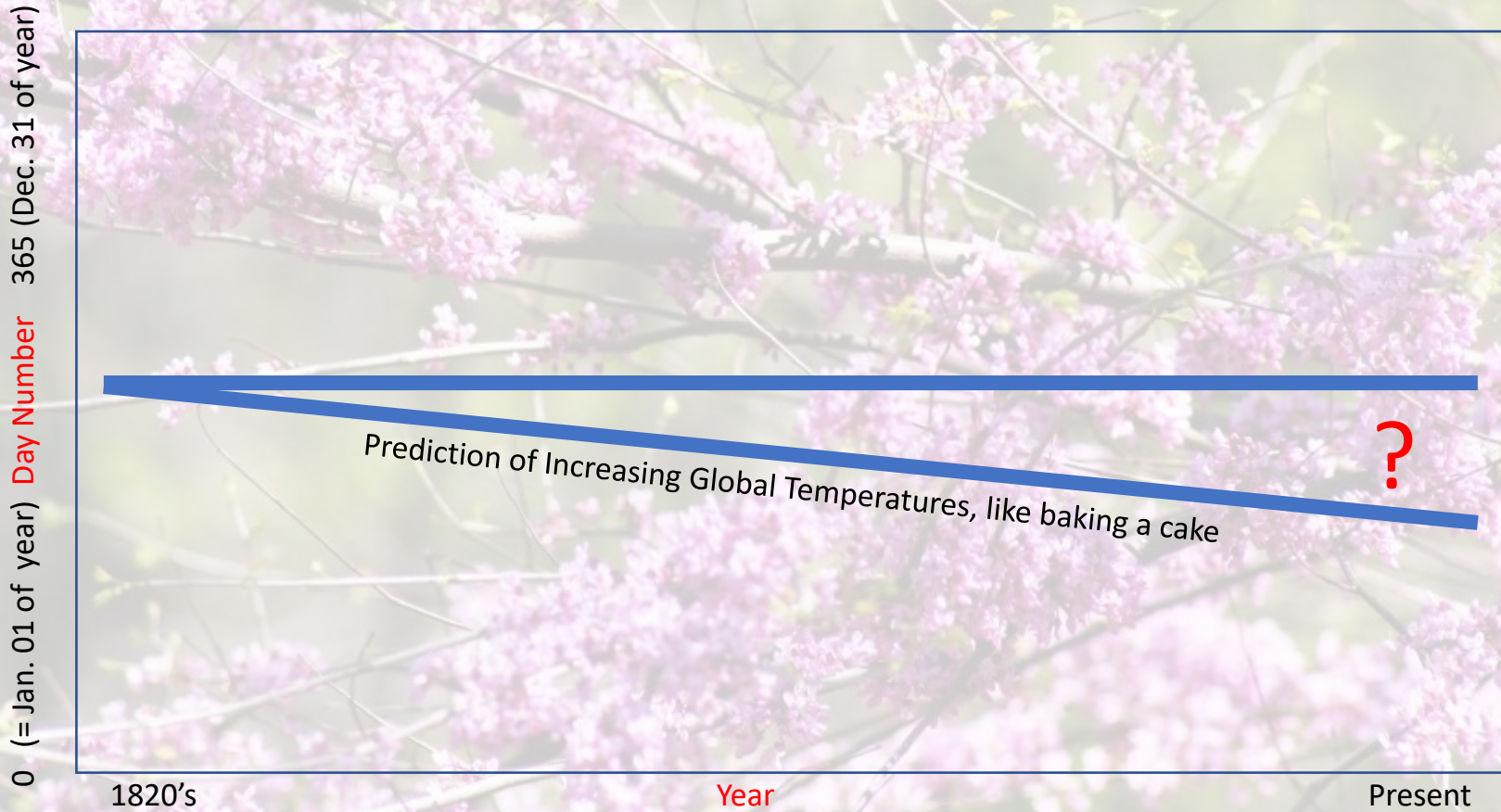
Leaf color



Flower color



Is Flowering & Fruiting Timing Changing with Increasing Global Temperatures?



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



Xianzhen Zhou

Summer
Bowen

Corinne Fahs



Ken Brown



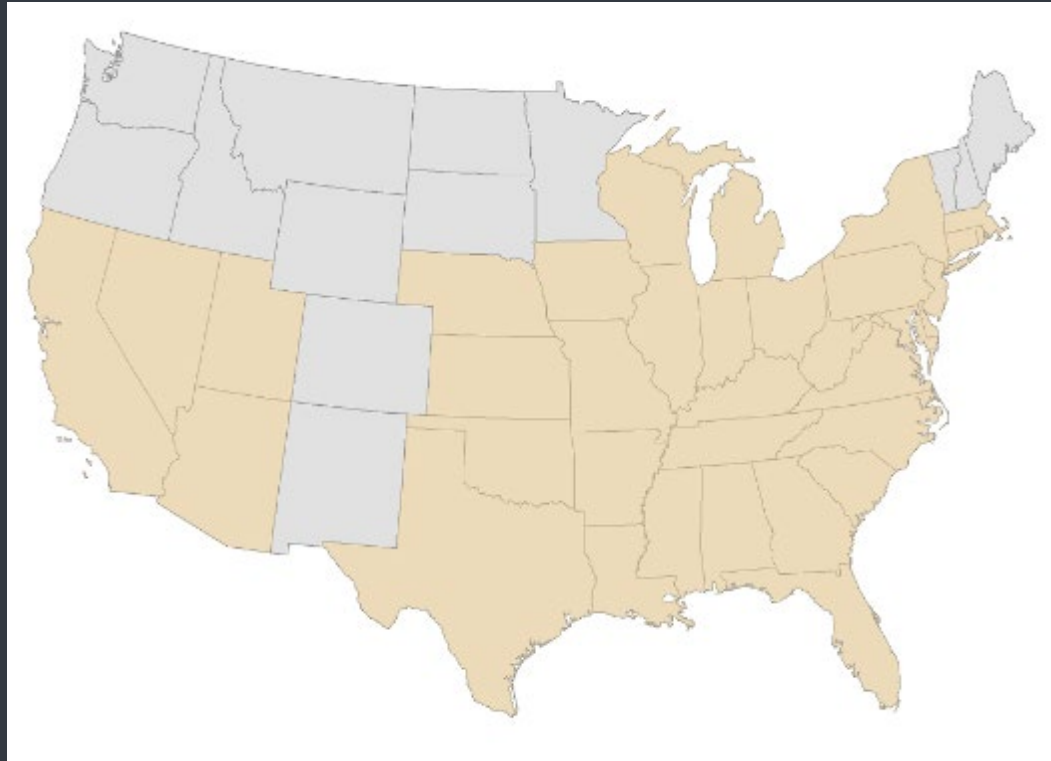
Redbuds: an icon of spring



Photo: MSU Extension/Gary Bachman



Eastern and western redbud natural ranges





Early spring bloomers



Photo: Dcrjsr



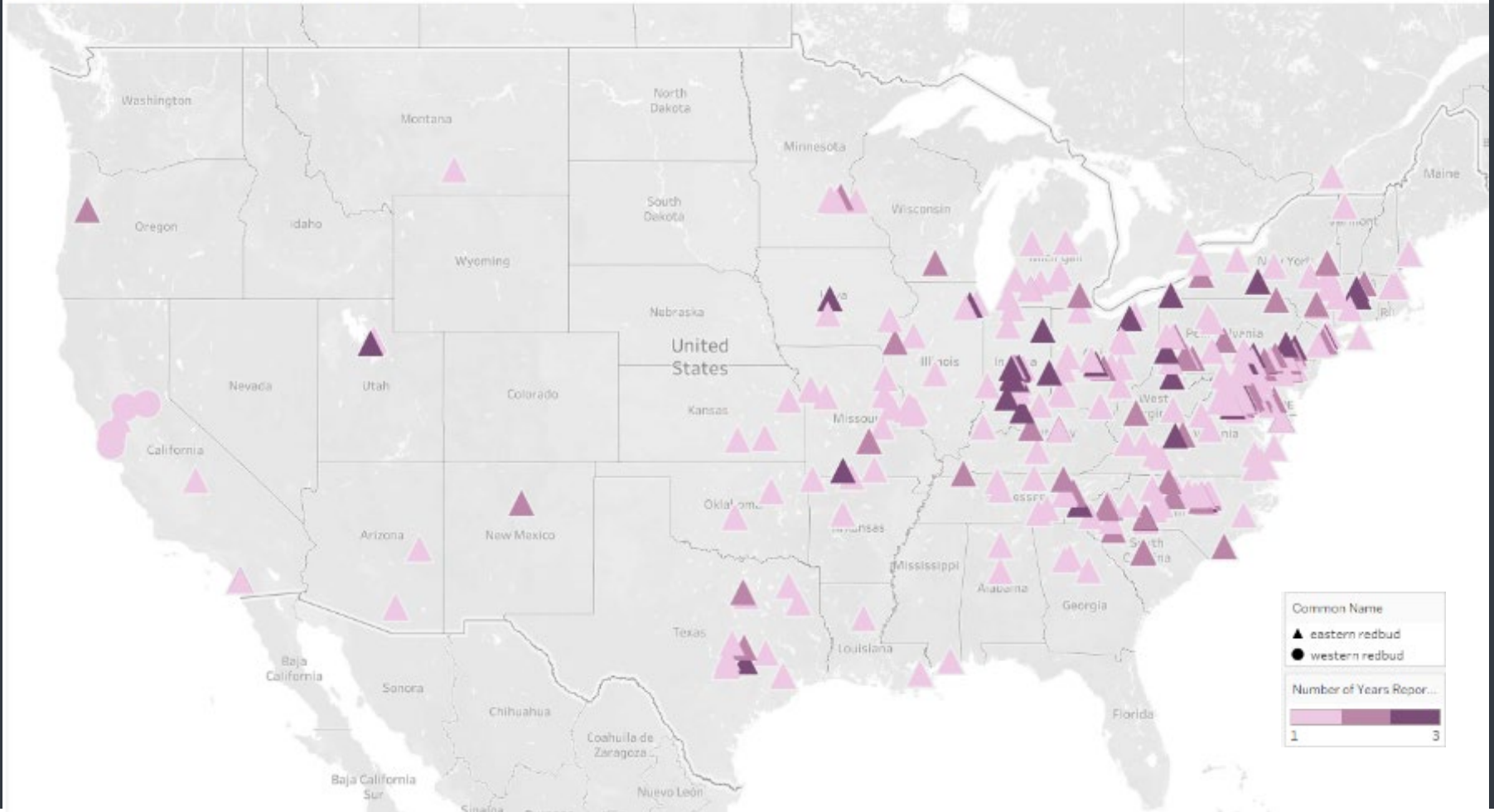
First the flowers buds, then the leaves



Photo: Sballal via Wikimedia Commons

Redbud open flower reports 2021-23

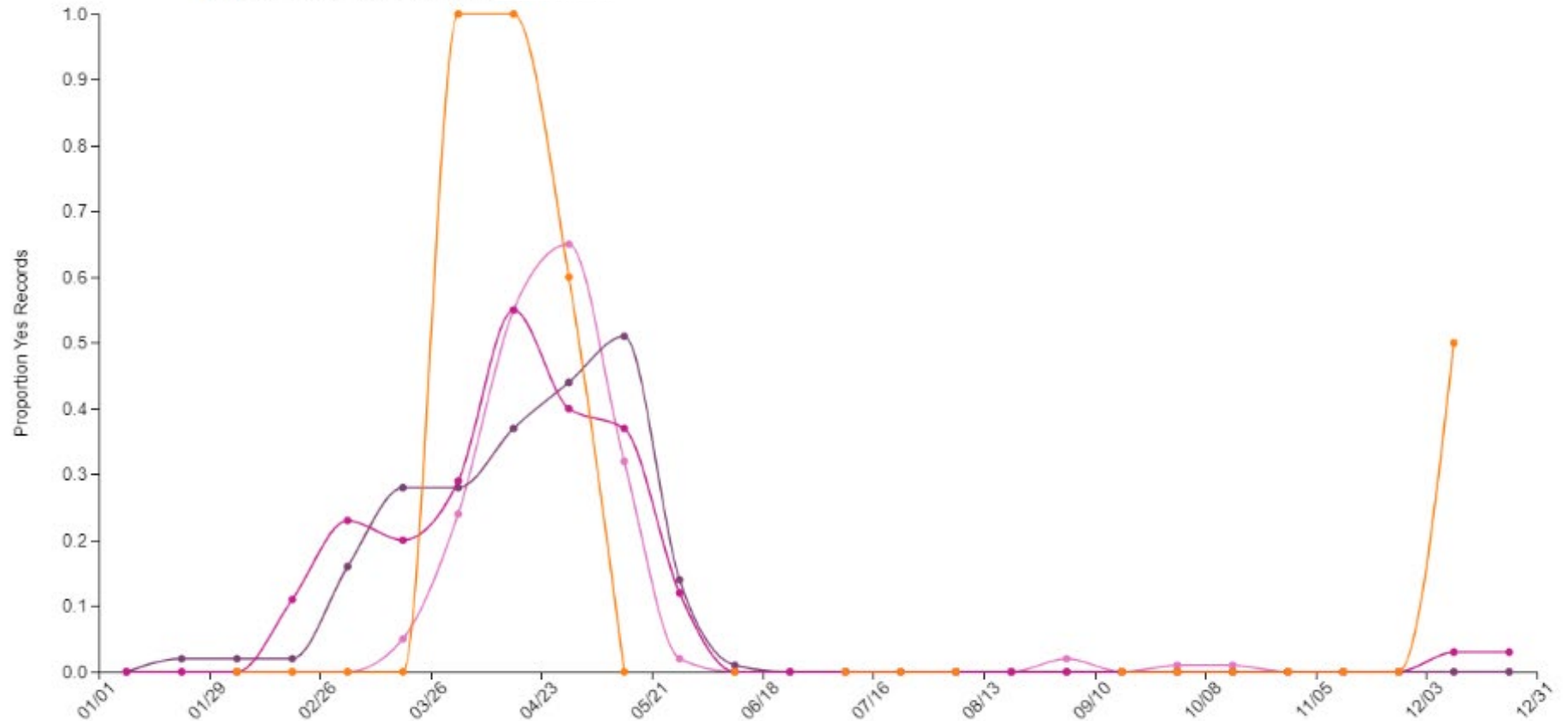
Eastern and Western Redbud Sites 2021-2023



Eastern redbud flowering reports 2021-23

Activity Curves

- 2021: Eastern redbud - Open flowers
- 2022: Eastern redbud - Open flowers
- 2023: Eastern redbud - Open flowers
- 2023: Western redbud - Open flowers



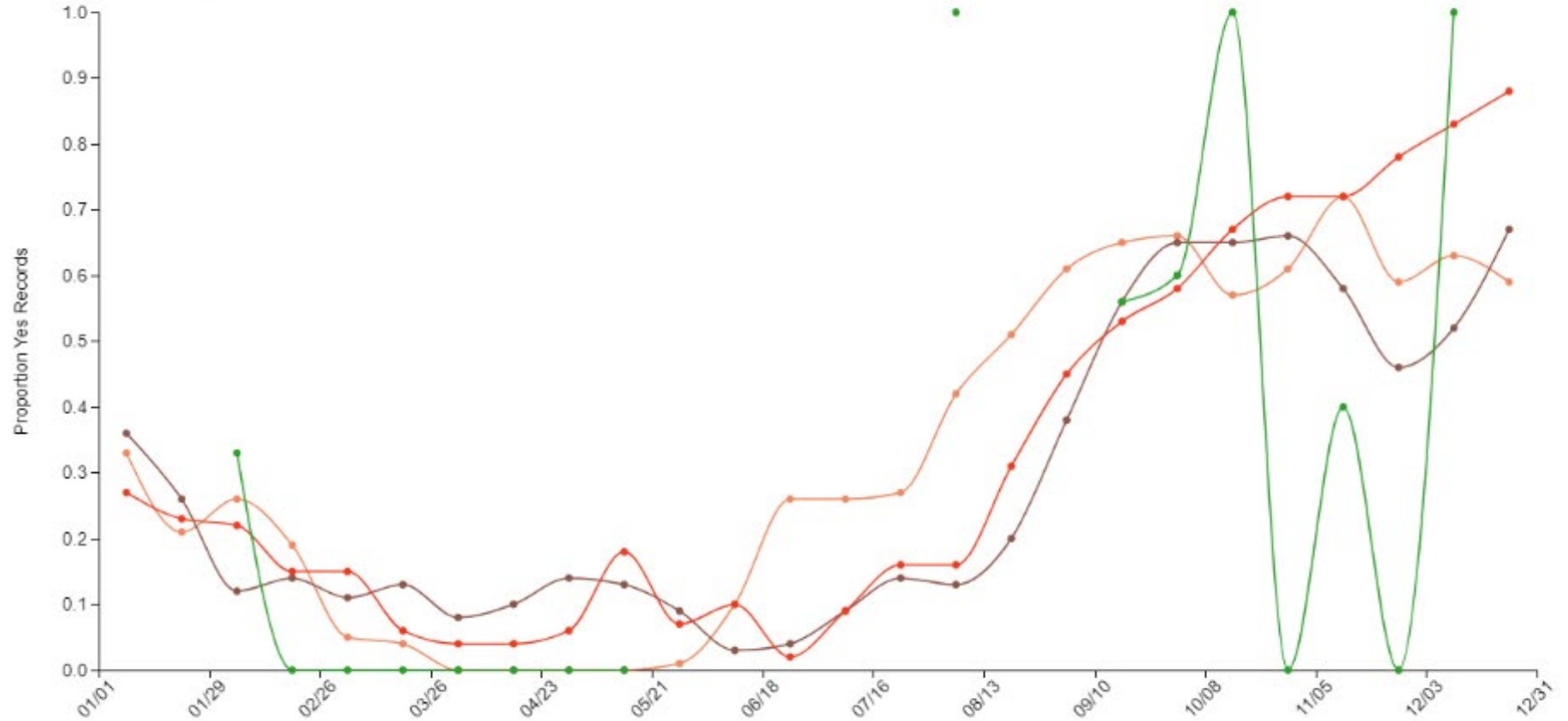
USA National Phenology Network www.usanpn.org

www.usanpn.org

Eastern redbud fruiting reports 2021-23

Activity Curves

- 2021: Eastern redbud - Ripe fruits
- 2022: Eastern redbud - Ripe fruits
- 2023: Eastern redbud - Ripe fruits
- 2023: Western redbud - Ripe fruits



USA National Phenology Network www.usanpn.org

www.usanpn.org

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



USA National Phenology Network



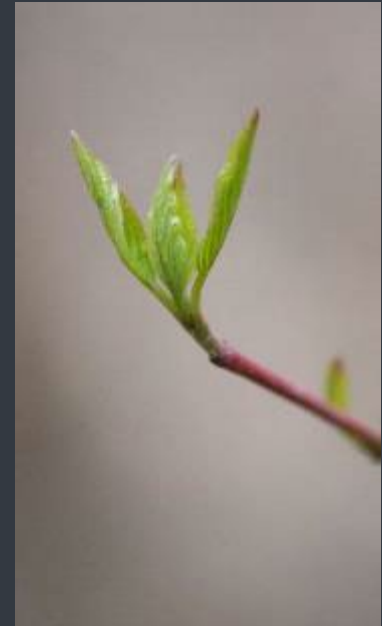
Collect • Store • Share
Phenology data and information

Why phenology?



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

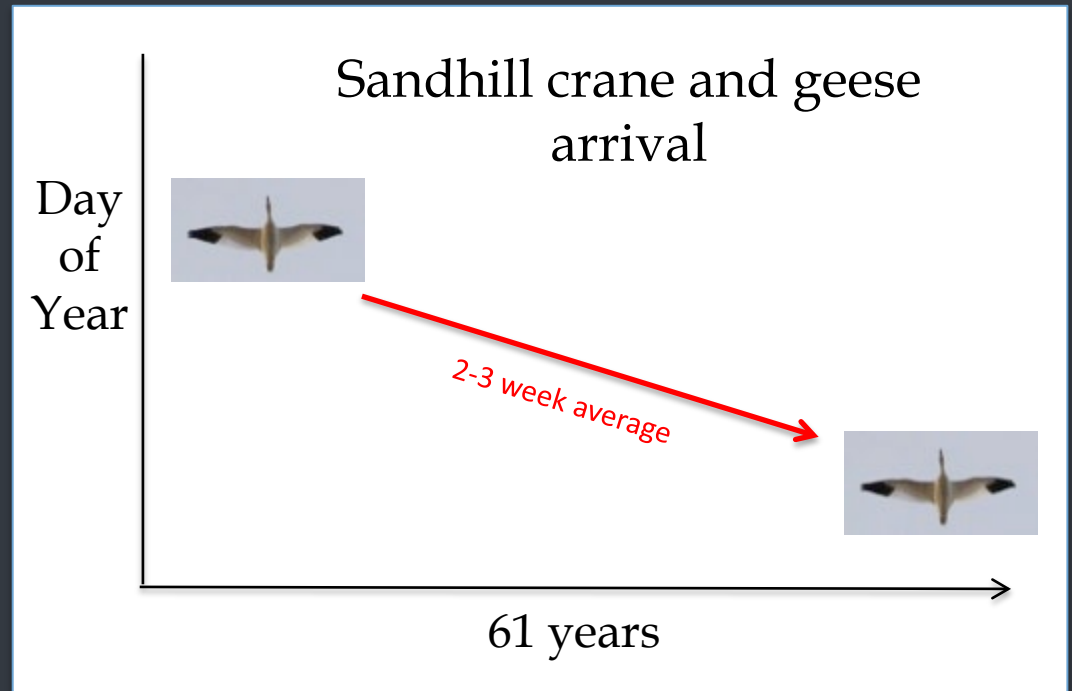


Photo: Journal Sentinel files

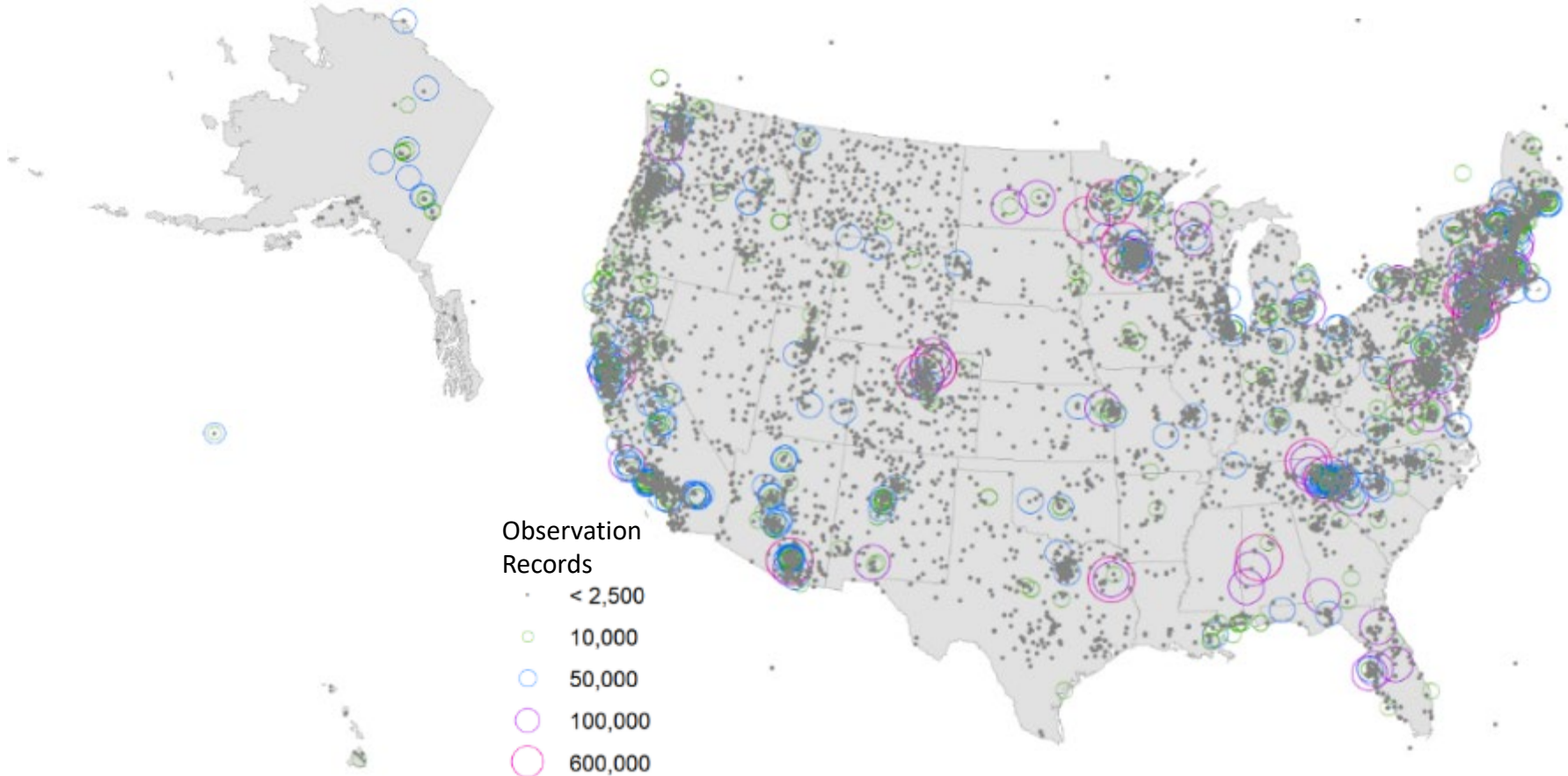
Bradley, N.L., et al. 1999, *PNAS*

How do you track plant and animal life cycles?

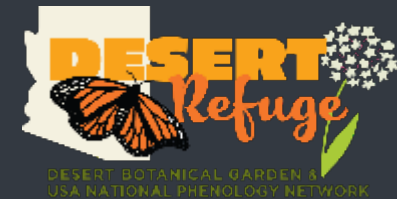
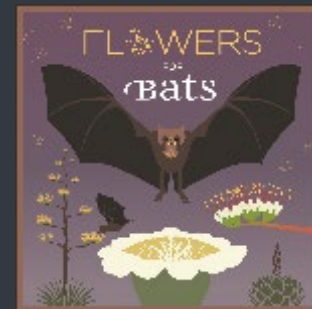
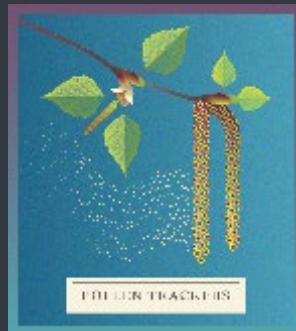
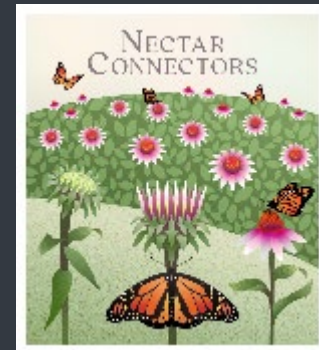
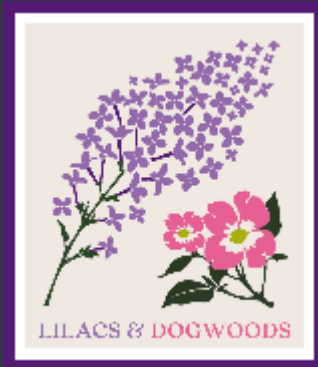




- > 25,000 active observers
- > 18,500 active sites
- > 34 million records



Nature's Notebook data collection campaigns



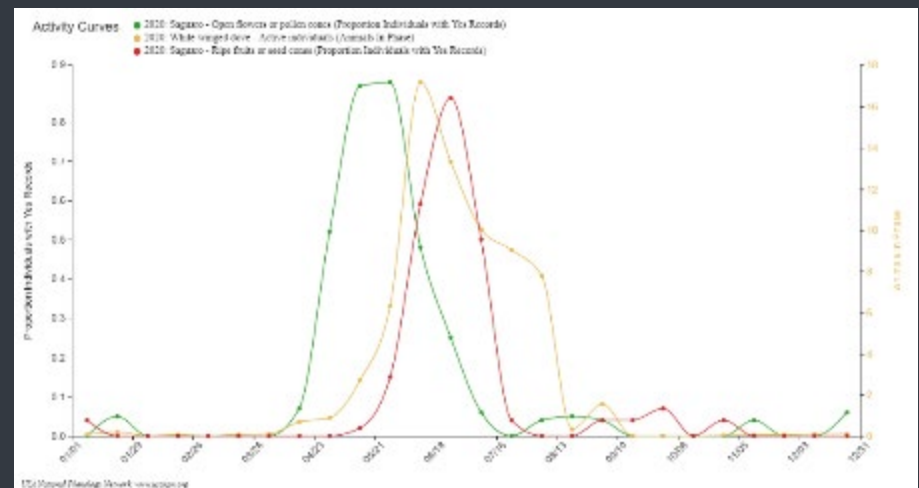
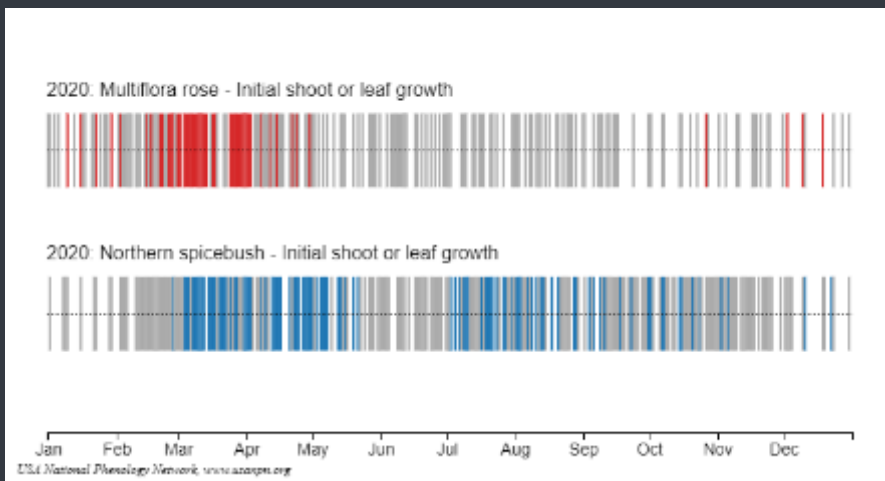
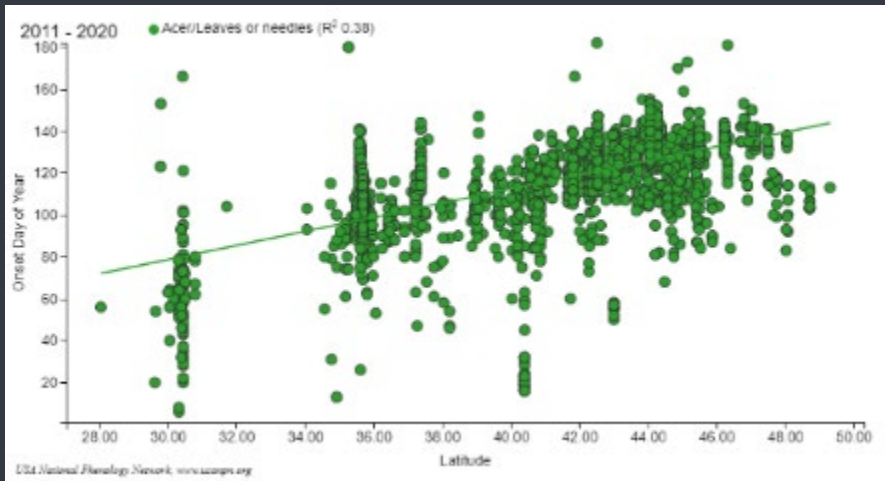
www.usanpn.org/nn/campaigns

www.usanpn.org

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



Explore how your data are used

SCIENTIFIC REPORTS

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

Received: 17 February 2017
Revised: 13 November 2017
Accepted: 14 November 2017
Aaren F. Huxford



Ecological Indicators
Volume 109, February 2020, 105745



Flowering phenology indicates plant flammability in a dominant shrub species

Emery, Nathan ¹ & Kooly Roth ², Alexandria Lynn Pivovarov ³

Ecological Solutions and Evidence

FROM PRACTICE AND EDITOR'S CHOICE

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

Robert V. Taylor , Wieteke Holthuijzen, A

ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

Article |  Open Access  

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

Laurie E. F. Herrer, 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 Fagn, Eli S. Bridge, Phillip B. Chilson

News & Publications



Precise, local predictions of grassland bird nest timing

May 06, 2022

[Publication Summary](#)

Grasslands are among the most disturbed ecosystems globally. In the areas that remain, managers must balance practices such as mowing and burning that maintain natural systems while avoiding nesting periods for grassland birds. The authors of this study used information about nest survival from scientific literature as well as climate information and the USA-NPN's Spring Bloom Index to develop models to predict the expected nest departure timing for 26 grassland bird species. This information can provide more localized information about nesting timing to better time management actions to avoid this critical period.



Creating a better forecast for invasive emerald ash borer

May 15, 2022

[Publication Summary](#)

Ash trees are in decline, and the main culprit is emerald ash borer (EAB), an invasive pest that has killed millions of ash trees in the United States. Knowing where and when to expect EAB emergence gives managers an advantage in controlling this pest, helping them to know when to take actions to control the pest. In this article, Taylor et al. evaluated a model that predicts activity of EAB, taking into account both phenology and locations that have suitable climate for this pest. They used observations of EAB, including those from Nature's Notebook, to test their model and found that it correctly estimated over 95% of presence records and predicted dates of adult EAB emergence within 7 days. This paper demonstrates how your observations can be used in the realm of invasive species, helping to improve management and ultimately conserve the unique ecosystems that we care about.



Phenology can support real-time, locally-relevant pollen alerts

Nov 04, 2022

[Publication Summary](#)

Pollen alerts give allergy sufferers the potential to reduce their exposure and the negative health impacts that result. An emerging data source for alerts is observations of flowering phenology, which can be highly correlated with the presence of airborne pollen. The authors of a new study compared data from National Allergy Bureau stations on daily pollen concentrations to flowering and pollen cone data from Nature's Notebook. They found that the strength of the relationship between open flowers and pollen cones and pollen concentration varied by the type of plant, with the best agreement for Oaks (*Quercus*) and walnuts (*Juglans*). More specific data on the timing of open flowers and pollen release, like those that you collect in Nature's Notebook, could lead to create real-time pollen alerts with local specificity.

[SEE ALL](#)

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



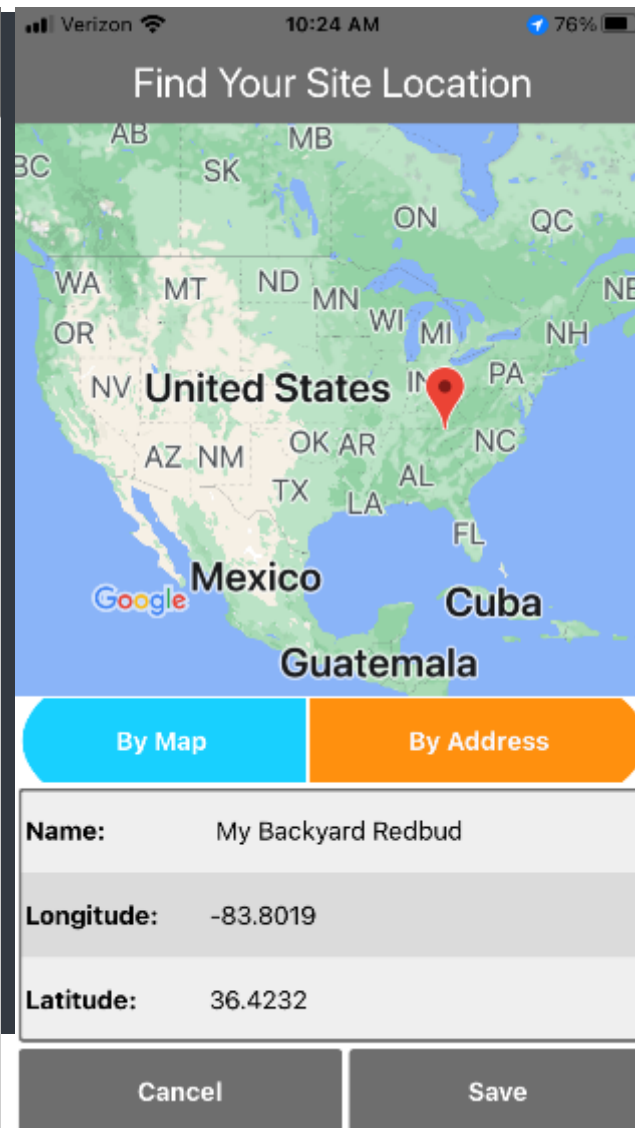
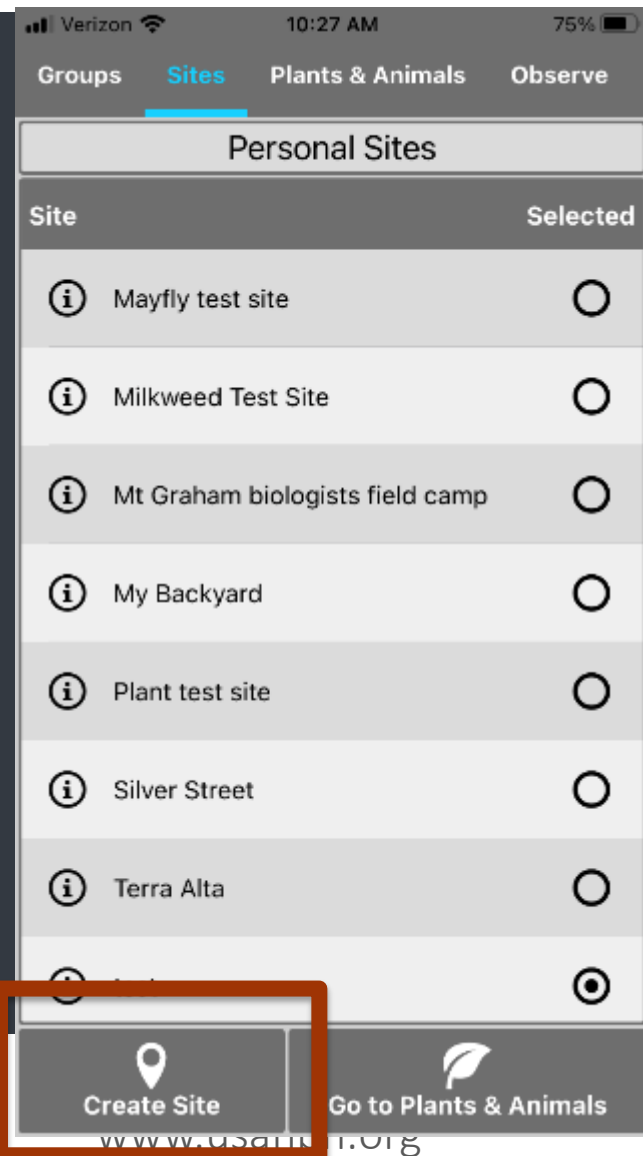
Download the
Nature's Notebook
app

A screenshot of a mobile app registration screen. At the top, the status bar shows 'Verizon', signal strength, Wi-Fi, '10:22 AM', and '76%' battery. The app logo 'nature's notebook' is displayed, with a small bird icon. A button labeled 'MY OBSERVATION DECK' is in the top right. The registration form includes:

- Username ***: A text input field with a note: 'Spaces are allowed; punctuation is not allowed except for periods, hyphens, apostrophes, and underscores.'
- E-mail address ***: A text input field with a note: 'Your email address will not be publicly viewable or distributed outside USA-NPN.'
- Confirm e-mail address ***: A text input field with a note: 'Please re-type your e-mail address to confirm it is accurate.'
- Password strength:**: A progress bar with a red indicator.

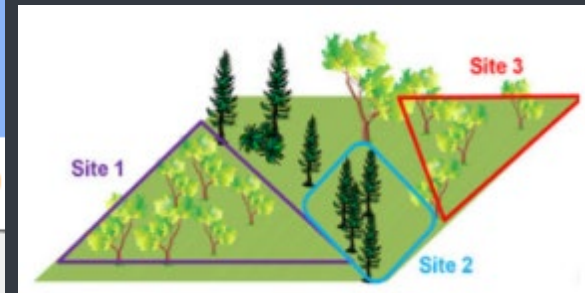
A 'Back' button is at the bottom.

2. Add a Personal Site

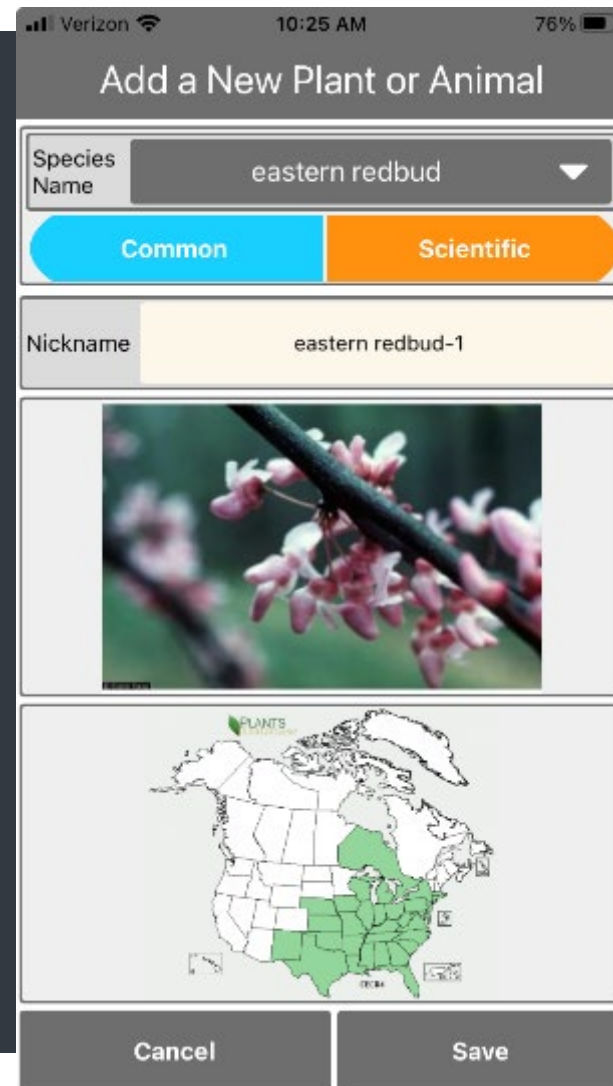
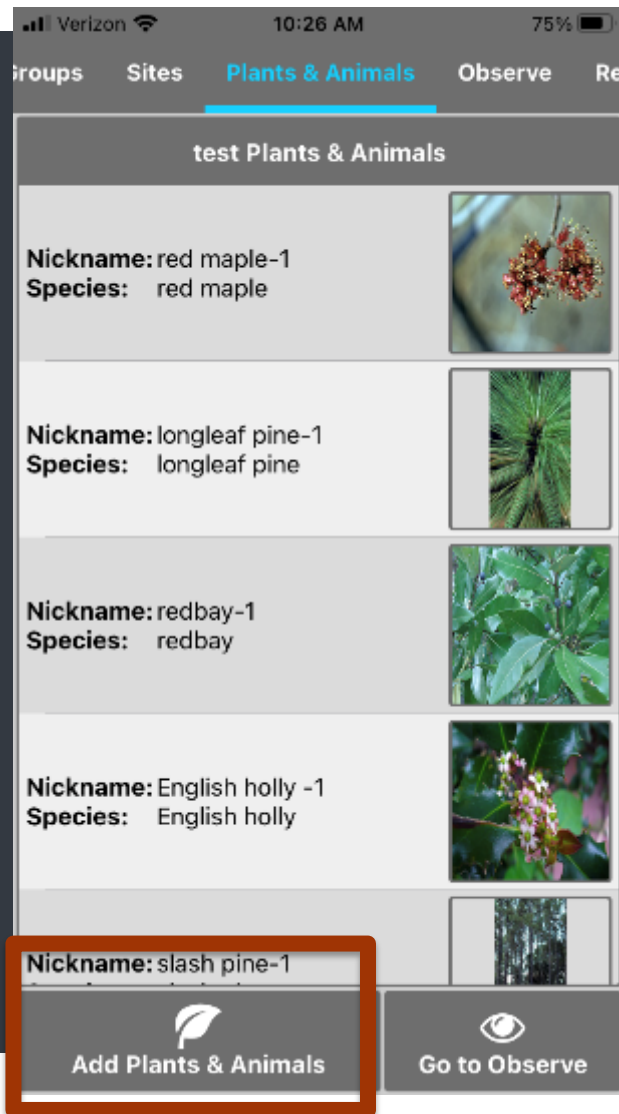


Select a site that is:

- Convenient
- Representative
- Uniform Habitat
- Appropriate Size

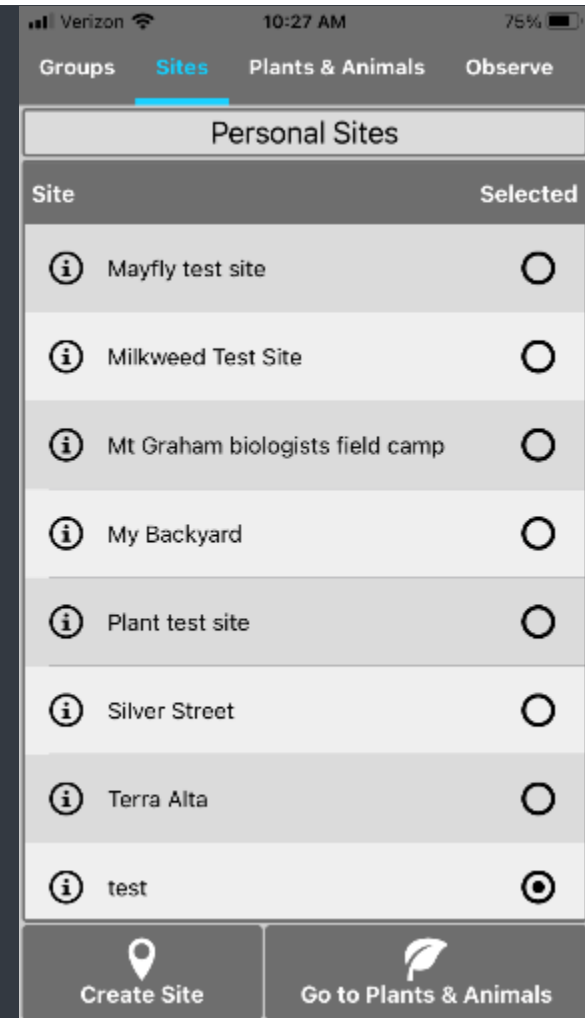


3. Add a redbud to your site



Already a *Nature's Notebook* observer?

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



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

Observe with Nature's Notebook | Explore Phenology Data | Community | What's Happening | About

Home | Observation Deck

Add or Edit Plants

← Observation Deck

Select the site where your plant or animal is located. Site: [Add a new site](#)

To add a plant, from the list of [available plants](#), start typing its common or scientific name in the "Plant Species" box, and select from the list of possible matches.

Your plants:

[Add new plant](#)

MEXICAN REDBUD AT CORNER

* Plant Species

* Nickname

Patch?

Shade status

Wild?

Watered?

Fertilized?

Gender?

Planting date:

Delete?

Dead?

Plant Image

Comments

4. Record data on your redbud

Verizon 10:26 AM 75%

Sites Plants & Animals **Observe** Review

Plants Animals Site-Visit Details

Observation Date 2023-1-4 : 10:24

eastern redbud-1

Mark All Phenophases As No

Breaking leaf buds Y N ? ⓘ

Leaves Y N ? ⓘ

Increasing leaf size Y N ? ⓘ

Colored leaves Y N ? ⓘ

Save Data Next Plant





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

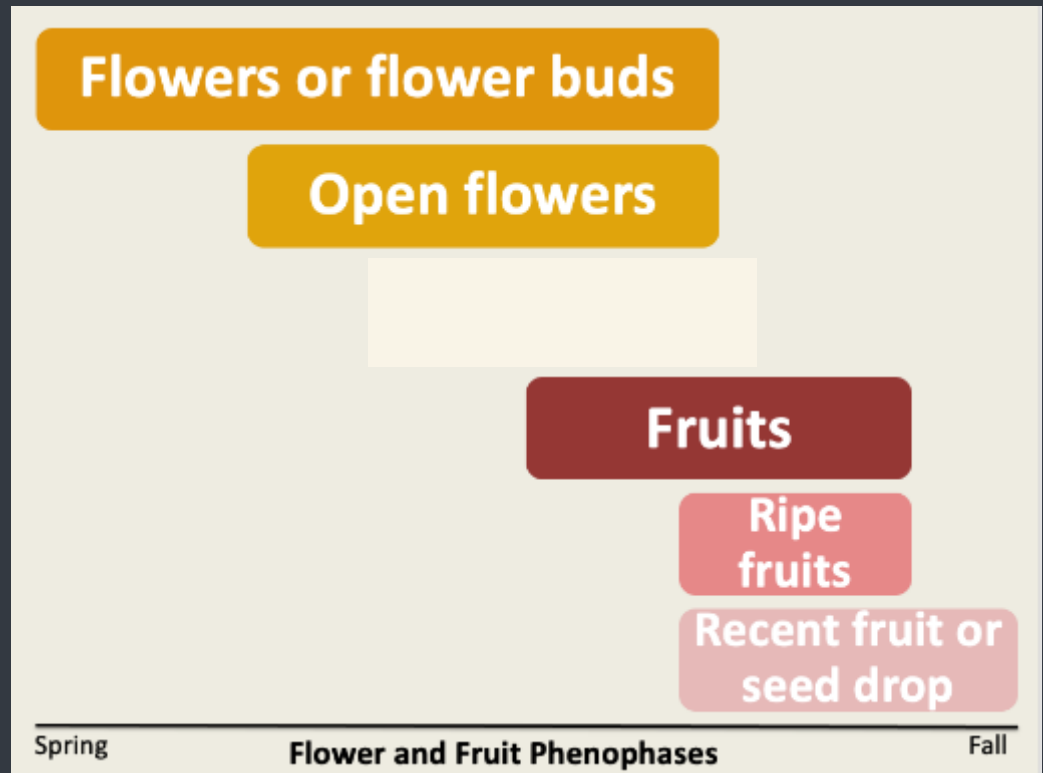
Eastern Redbud Datasheet

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 ? ____

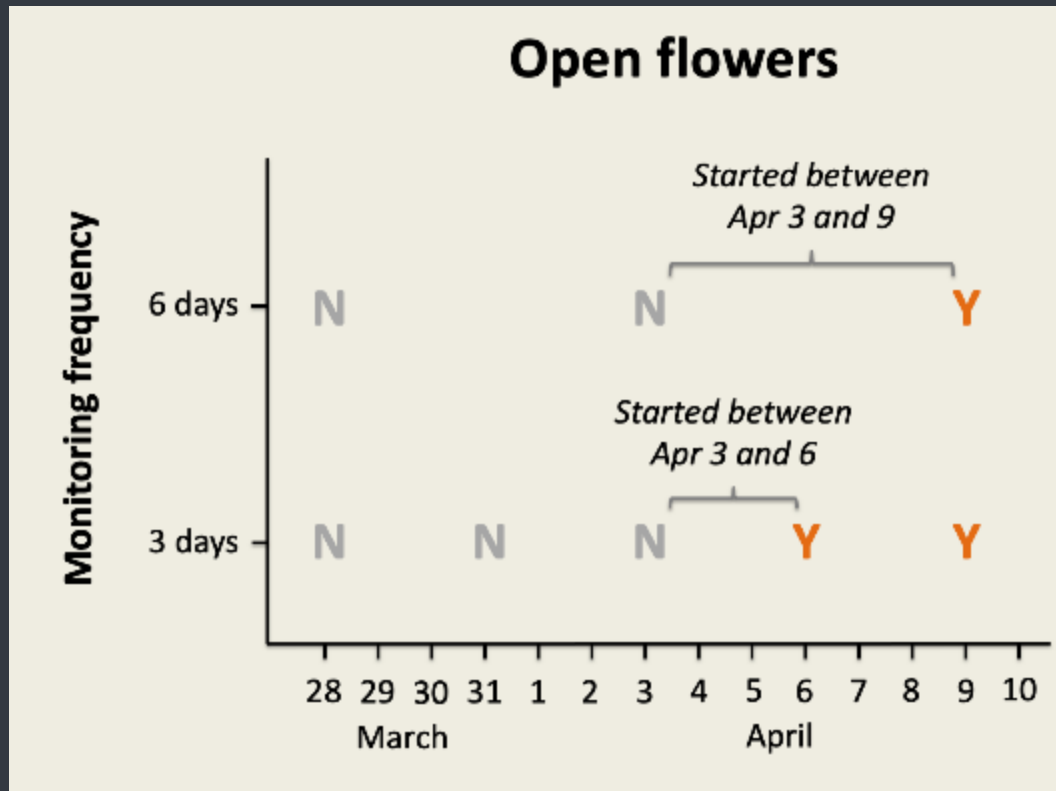
Phenophase	Definition	Photo (click to enlarge)
Flowers or flower buds	One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds or inflorescences that are swelling or expanding, but do not include those that are tightly closed and not actively growing (dormant). 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 <i>Cercis canadensis</i> , 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 <i>Cercis canadensis</i> , 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.	

4. Record data on your redbud

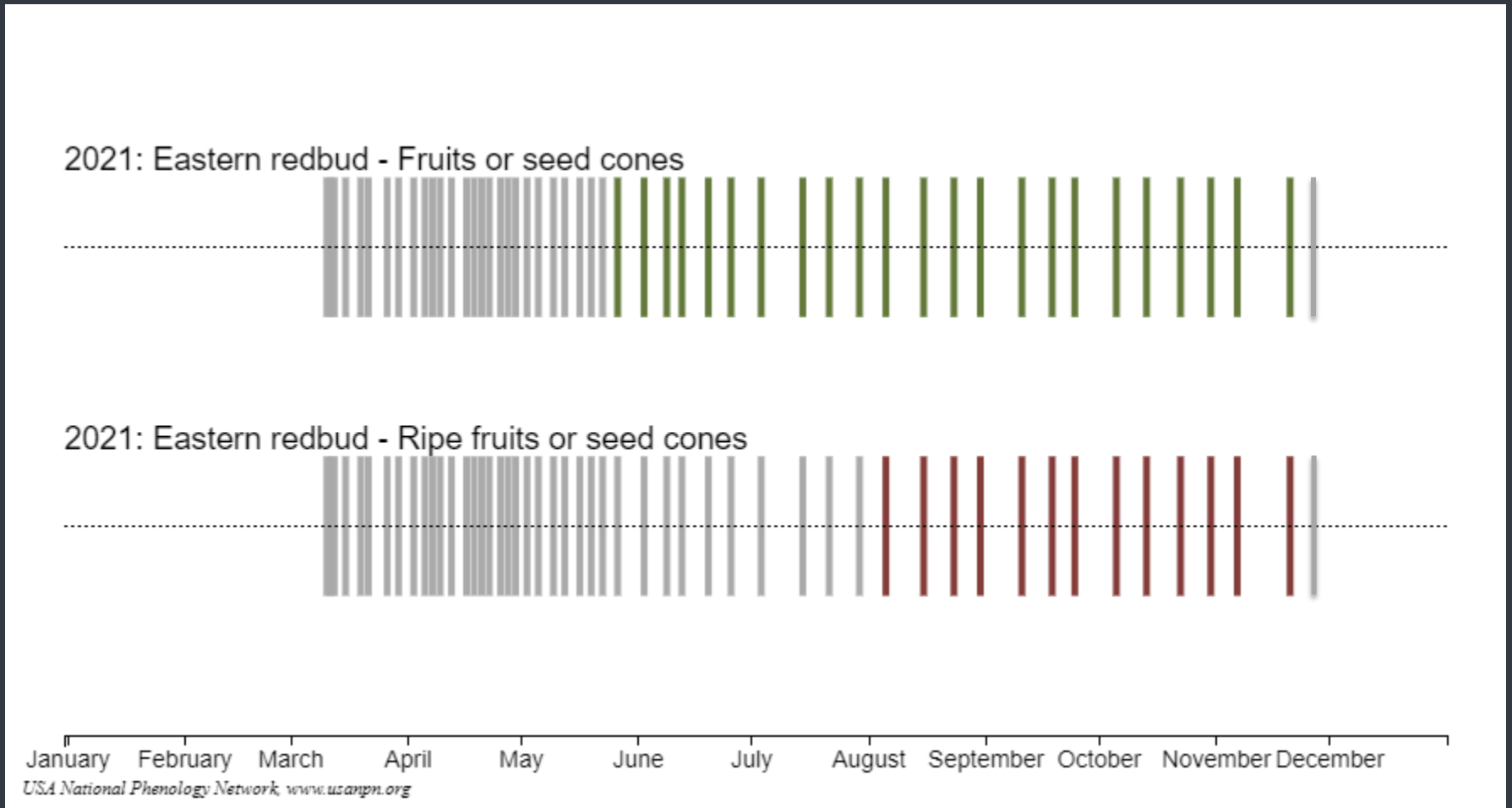
Do you see...	
Breaking leaf buds	y n ? ____
Leaves	y n ? ____
Increasing leaf size	y n ? ____
Colored leaves	y n ? ____
Falling leaves	y n ? ____
Flowers or flower buds	y n ? ____
Open flowers	y n ? ____
Fruits	y n ? ____
Ripe fruits	y n ? ____
Recent fruit or seed drop	y n ? ____



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?

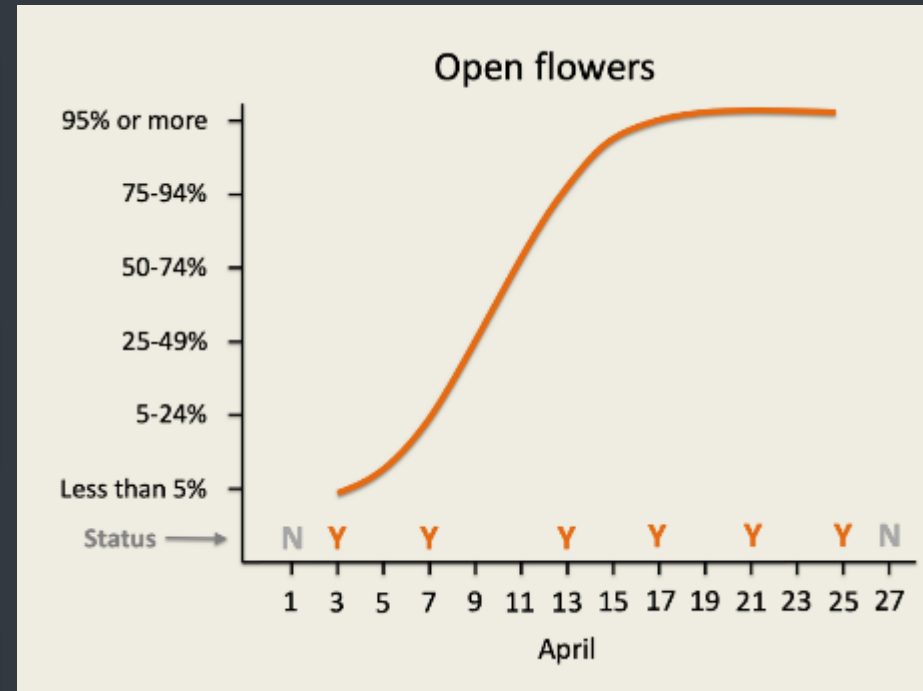
Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

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;



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 2024

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



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

Observe with Nature's Notebook | Explore Phenology Data | Community | What's Happening | About





Welcome back, erinposthumus!

Observations | Learning | Visualization | My Programs | Badges

Access the learning resources available to you.

- OBSERVER CERTIFICATION COURSE**
In this course you will learn how to get started with Nature's Notebook, an in-depth look at the plant and animal phenophases and intensity measures, and a chance to practice making observations.
- FREQUENTLY ASKED QUESTIONS**
Answers to questions about selecting sites, species, and individual plants, making observations, entering data, and more.
- BOTANY PRIMER**
An in-depth, photo-rich guide to understanding basic botany to help you observe with Nature's Notebook.
- PHENOPHASE PRIMER**
An in-depth, photo-rich guide to understanding life cycle stages (phenophases) that you will observe with Nature's Notebook.
- GLOSSARY**
Definitions used on the USA-NPN website and field in plant and animal data.




Nature's Notebook How-to Observe Module - Lesson 1: What is phenology?

Lesson 1: What is phenology?

Phenology is the study of the timing of life cycle events in plants and animals, their recurrence, and relationship to the environment. The word comes from the Greek root word *phaino*, which means to show or appear.

Phenology is nature's calendar—when cherry trees bloom, when a robin builds its nest and when leaves turn color in the fall.

Phenology is pollinators visiting open flowers to aid in reproduction, elk making mating calls, and a tadpole turning into a frog.



Course Outline

The Nature's Notebook How-to Observe Module

Nature's Notebook How-to Module Learning Outcomes

- Lesson 1: What is Phenology and Why Monitor It?
 - Lesson 1: What is Phenology and Why Monitor It? - Learning Objectives
 - Lesson 1: What is phenology?
 - Lesson 1: What is Phenology Video
 - Lesson 1: Summary
 - Lesson 1: Quiz
- Lesson 2: Create a Nature's Notebook Account
- Lesson 3: Establish a Site Outdoors for Monitoring
- Lesson 4: Choose Plant and Animal Species for Observation
- Lesson 5: Set up Your Sites and Species in Nature's Notebook Online

Training materials and resources

Phenophase Definitions

Eastern Redbud

(*Cercis canadensis*)



Phenophase Definitions

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 "broken" when the green leaf tip is visible at the end of the bud, but before the first leaf from the bud has exposed 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" when the length of the leaf has emerged from a breaking bud, stem node or growing stem tip, so that the leaf 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 estimate of 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 the 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 to 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.

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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?

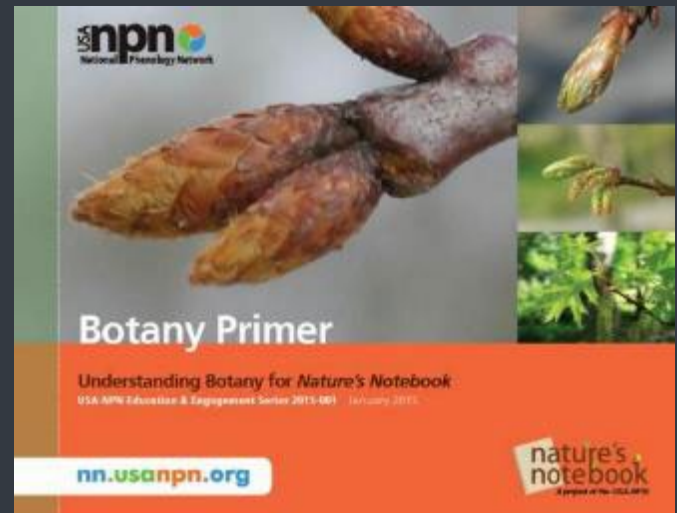
Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000

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.

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Linked from your Observation Deck

Local Phenology Programs



Participate as part of a group of observers

Contact
erin@usanpn.org for more info!



Resources available:

- Online Certification Course – starts Spring 2024!
- 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?

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