



Introduction to USA-NPN and *Nature's Notebook*

Nature's Notebook video series



USA **n p n**

National Phenology Network

Phenology: The
timing of seasonal
activities in plants
and animals

Photo: Brian F Powell



Enhance and support
scientific discovery
regarding species and
ecosystem responses to
changing climate and
environmental conditions

Photo: Brian F Powell

Inform decisions in
natural resource
conservation and
management, human
health, recreation, and
land use

Trees and Shrubs *Deciduous (with pollen)*

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.
y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).
Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.

nature's notebook

Species: *Quercus macrocarpa*
Common Name: bur oak
Nickname: bur oak 1
Site: Fulton, D.C. Booth National Fish
Year: 2017
Observer: null null

Do you see...	Date:	Time:	Date:	Time:	Date:	Time:	Date:	Time:
Breaking leaf buds	y	n	?		y	n	?	
Leaves	y	n	?		y	n	?	
Increasing leaf size	y	n	?		y	n	?	
Colored leaves	y	n	?		y	n	?	
Falling leaves	y	n	?		y	n	?	
Flowers or flower buds	y	n	?		y	n	?	
Open flowers	y	n	?		y	n	?	
Pollen release	y	n	?		y	n	?	
Fruits	y	n	?		y	n	?	
Ripe fruits	y	n	?		y	n	?	
Recent fruit or seed drop	y	n	?		y	n	?	
Check when data entered online:								
Comments:								

Plant Phenophase Datasheet

Taking the Pulse of Our Planet **nnpn**
More information: www.usanpn.org/how-observe

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Communicate and connect with individuals and partners to ensure that they have an improved understanding of the value of phenology and sustain long-term participation in monitoring phenology



nature's notebook

A project of the USA-NPN

Milkweed

Nearly 2,000
species of plants
and animals

Monarch

Do you see initial growth?	Y ☒ N ?
Do you see young leaves?	Y ☒ N ?
Do you see leaves?	☒ Y N ?
Do you see flowers or flower buds?	☒ Y N ? 3 to 10 ▼
Do you see open flowers?	☒ Y N ? 25-49% ▼
Do you see fruits?	☒ Y N ? Less than 3 ▼
Do you see ripe fruits?	Y ☒ N ? What value? ▼
Do you see recent fruit or seed drop?	Y ☒ N ? What value? ▼



Do you see or hear adults?	☒ Y N ? 1
Do you see adults feeding?	☒ Y N ? 1
Do you see flower visitation?	☒ Y N ? 1
Do you see migrating adults?	Y ☒ N ? How many?
Do you see mating?	Y ☒ N ? How many?
Do you see egg laying?	Y ☒ N ? How many?
Do you see eggs?	Y ☒ N ? How many?
Do you see caterpillars?	Y ☒ N ?
Do you see caterpillars feeding?	Y ☒ N ?
Do you see pupae?	Y ☒ N ? How many?
Do you see dead adults?	Y ☒ N ? How many?
Do you see dead caterpillars?	Y ☒ N ? How many?
Do you see individuals at a feeding station?	Y ☒ N ? How many?
Do you see individuals in a net?	Y ☒ N ? How many?
Do you see individuals in a trap?	Y ☒ N ? How many?

Photo: Lasclay via Unsplash, Public Domain



Photo: NPS, CC BY-NC-SA 4.0



Photo: Brian F Powell



USA

nnpn

National Phenology Network

[Observe with Nature's Notebook](#) [Explore Phenology Data](#) [Community](#) [What's Happening](#) [About](#)

Search

[Home](#) » [Observe with Nature's Notebook](#)

Become an Observer

Why should I observe?...



Discover changes in nature—you will be surprised at what you see when you watch carefully!



Learn how your data are being used to conserve plants and animals, manage invasive species, create allergy alerts, manage wildfire, and more.



Join a dedicated community of observers who are helping to make a difference.

How it works...



Choose a location that you can visit regularly



Pick which plants and/or animals that you want to observe from the list



Make weekly observations to record their seasonal changes

Once you're an observer, you can



Become a Certified Observer



Earn badges



Climb the Leaderboard

Ready to get started?

SIGN UP HERE

Get the *Nature's Notebook* mobile app







Milkweed #1

Do you see initial growth?	Y ☒ N ?	
Do you see young leaves?	Y ☒ N ?	
Do you see leaves?	☒ Y N ?	
Do you see flowers or flower buds?	☒ Y N ?	3 to 10 ▼
Do you see open flowers?	☒ Y N ?	25-49% ▼
Do you see fruits?	☒ Y N ?	Less than 3 ▼
Do you see ripe fruits?	Y ☒ N ?	What value? ▼
Do you see recent fruit or seed drop?	Y ☒ N ?	What value? ▼

Monarch

Do you see or hear adults?	☒ Y N ?	1
Do you see adults feeding?	☒ Y N ?	1
Do you see flower visitation?	☒ Y N ?	1
Do you see migrating adults?	Y ☒ N ?	How many?
Do you see mating?	Y ☒ N ?	How many?
Do you see egg laying?	Y ☒ N ?	How many?
Do you see eggs?	Y ☒ N ?	How many?
Do you see caterpillars?	Y ☒ N ?	
Do you see caterpillars feeding?	Y ☒ N ?	
Do you see pupae?	Y ☒ N ?	How many?
Do you see dead adults?	Y ☒ N ?	How many?
Do you see dead caterpillars?	Y ☒ N ?	How many?
Do you see individuals at a feeding station?	Y ☒ N ?	How many?
Do you see individuals in a net?	Y ☒ N ?	How many?
Do you see individuals in a trap?	Y ☒ N ?	How many?

Leaves



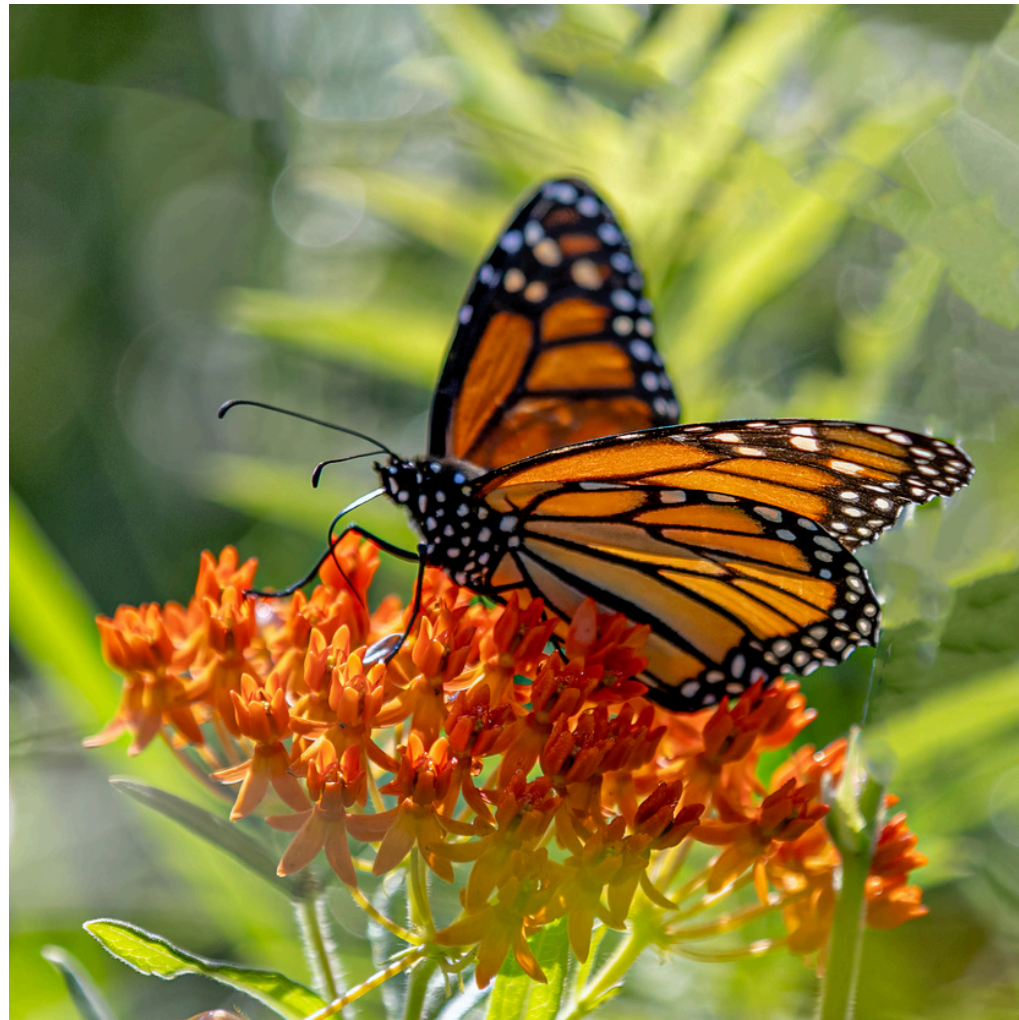
Flowers



Fruits



Feeding



Reproduction

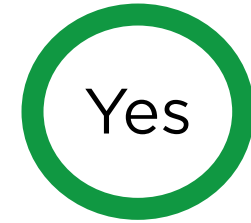


Development

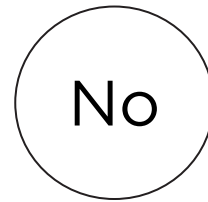


Common milkweed, *Asclepias syriaca*

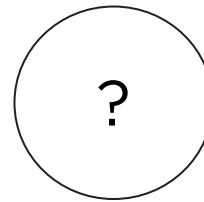
Do you see Fruits?



Yes



No



?

Phenophase Definition:

One or more fruits are visible on the plant.

For *Asclepias syriaca*, the fruit is large and pod-like and changes from green to tan or brown and splits open to expose seeds with fluff. Do not include empty fruits that have already dropped all of their seeds.



Common milkweed, *Asclepias syriaca*

Do you see Fruits?

Yes

No

?

How many fruits are present?

Less than 3

3 to 10

11 to 100

101 to 1,000

More than 1,000



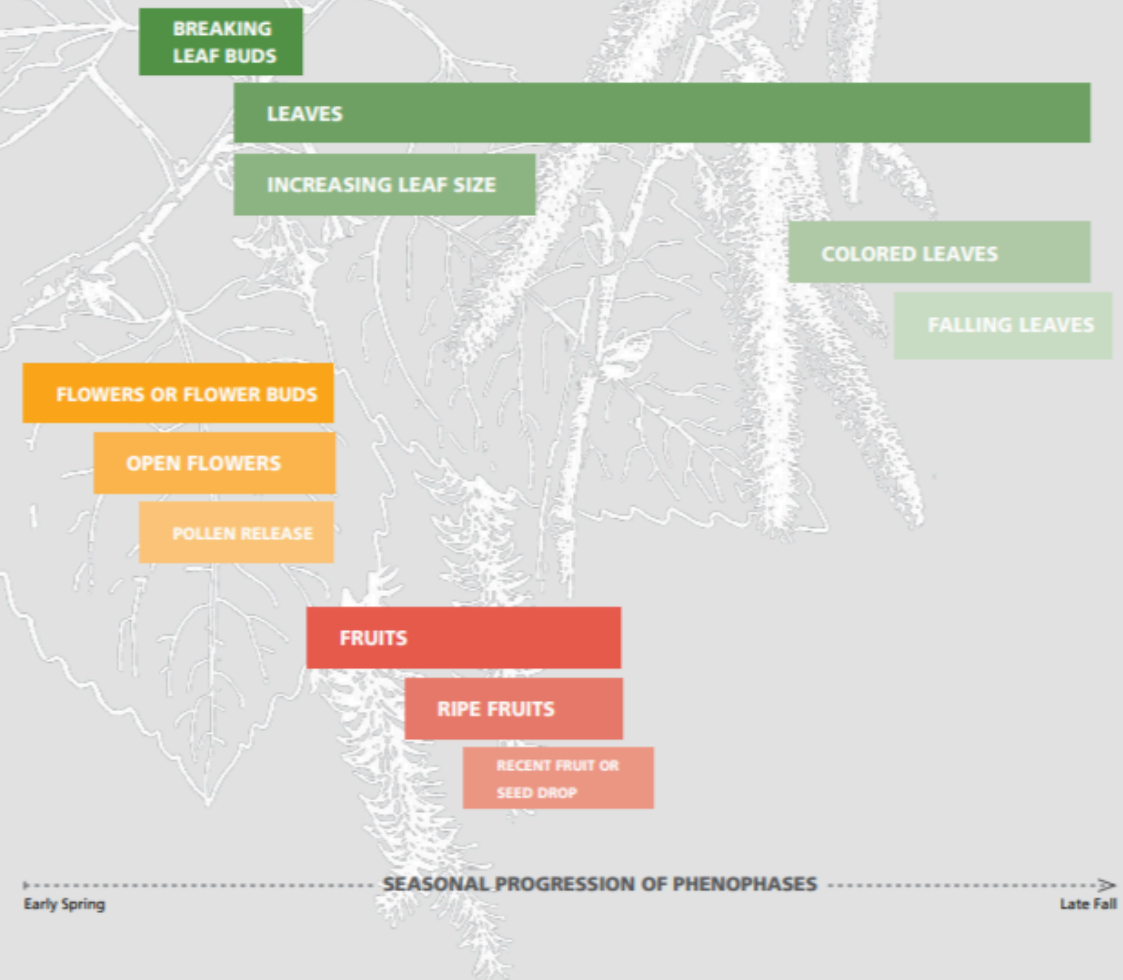
Training Resources Available

Red maple is widespread in the eastern US and one of the first trees to bloom in spring. It can be monoecious—that is, the separate male and female flowers are found on the same tree—or it can be dioecious—male flowers are found on separate trees from female flowers. Flowers are small and wind-pollinated, typically opening just before the leaf buds break. The fruits are winged samaras that ripen and drop later in spring or summer, spiralling like a helicopter rotor as they fall to the ground. In fall, these trees often create colorful displays of red leaves.

Phenological characteristics of note:

- scaled leaf and floral buds are separate
- male and female parts are in separate flowers
- flowers emerge before leaves
- fruit ripeness indicated by color change

An approximate phenological timeline for *Nature's Notebook* observations of *Acer rubrum* (red maple)



An overview of dormant and swelling leaf buds

What do they look like?

On these two pages we take a look at dormant and swelling leaf buds—buds that are resting or those beginning to swell just before buds break open. We will take a look at species that have bud scales to protect the embryonic leaves and those that do not have bud scales. Just for botanical reference—bud scales are also called cataphylls.

Those species whose buds have no bud scales—called naked buds—fall into two categories: those that tightly cover their embryonic leaves with tiny immature leaves (often in warm climates) and those that cover their embryonic leaves with immature leaves having dense hairs, parts of the plant stem or other leaf tissues (often in cold climates).

Although dormant or swelling leaf buds are not phases for which a *Nature's Notebook* participant would record observations, becoming familiar with the leaf buds of your observed species—and their subtle characteristics and activities—will enable you to make accurate observations when the buds become active after a dormant phase.

Buds with bud scales

Buds with scales that are overlapping (imbricate):

Images 1-7 show examples of species for which the dormant leaf bud has bud scales that have an imbricate structure—the scales overlap each other like the shingles on a roof. Image 1 shows a bud that is beginning to swell—with bud scales that have begun to shift and loosen around the enclosed embryonic tip.

Buds with a single scale:

Some species (like willows) only have a single bud scale that covers the embryonic leaves (Images 8-10). The buds in Image 10 have broken and have unfolded leaves—this image is included here so that one can see the position of the bud scales on the twig.

Buds with two scales that meet but do not overlap (valvate):

Some species have valvate buds (Images 11-12), where two bud scales meet tightly together and do not overlap each other.



×

Introduction

The Observer Certification...

Module 1: How to Observ...

Module 1: Learning Outco...

Lesson 1: What is Phenolo...

Lesson 2: Your Observ...

Lesson 3: Establish a ...

Lesson 4: Choose Pla...

Lesson 5: Set up Your ...

Lesson 6: Getting Org...

Lesson 7: Record Plant...

Lesson 8: Record Ani...

Lesson 9: Submitting ...

Lesson 10: More Oppo...

Module 1 Complete!

Module 2: Nature's Noteb...

Lesson 1: Using the Basic ...

Lesson 2: Advanced F...

Module 2 Complete!

Module 3: Plant and Anim...

Module 3: Learning Outco...

Observer Certification Course

Introduction

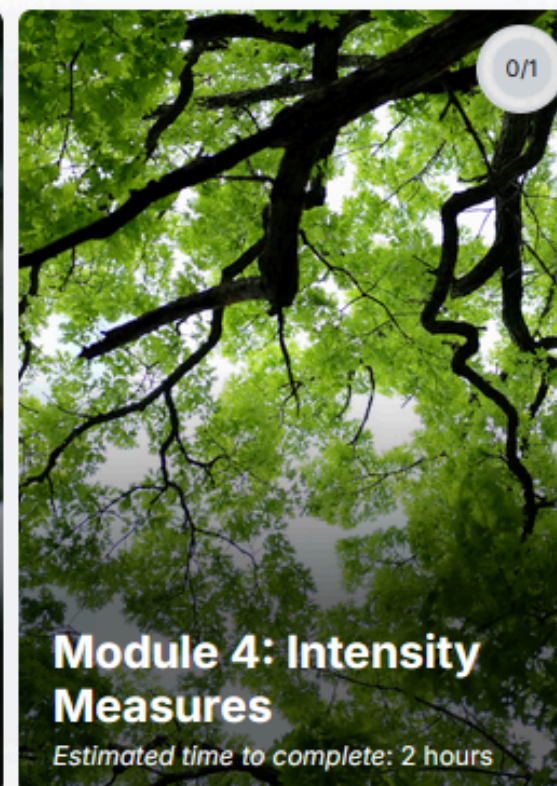
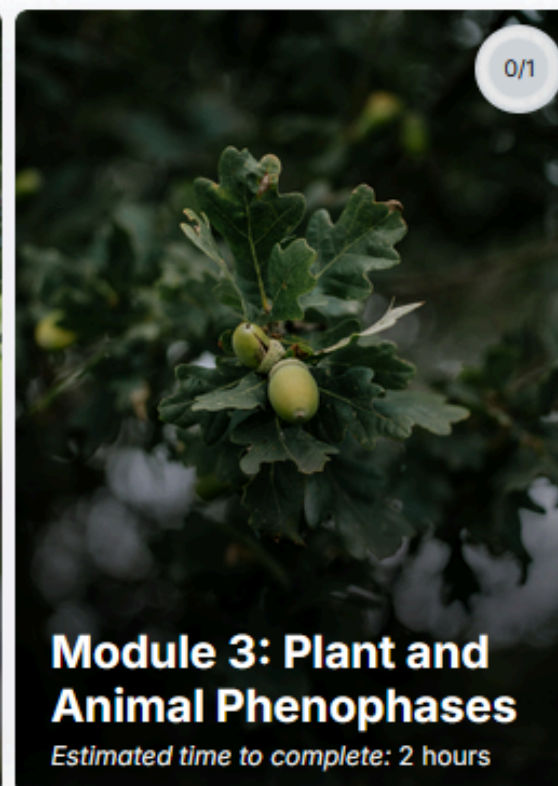
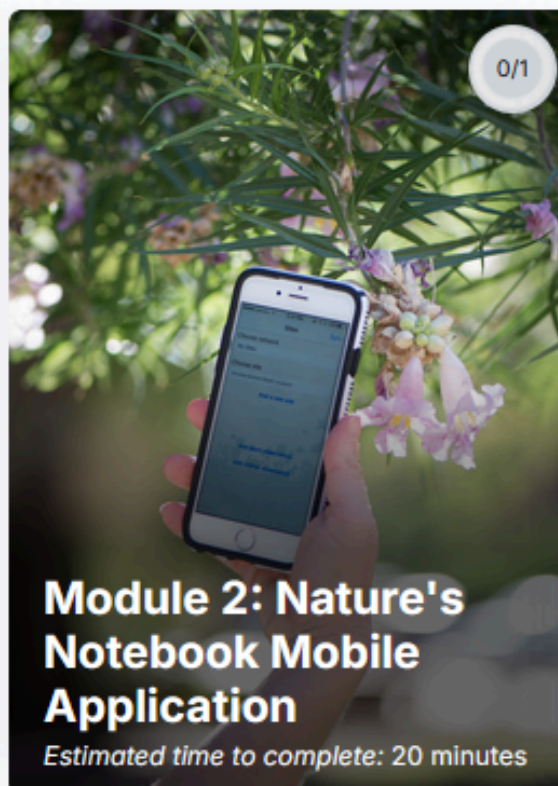
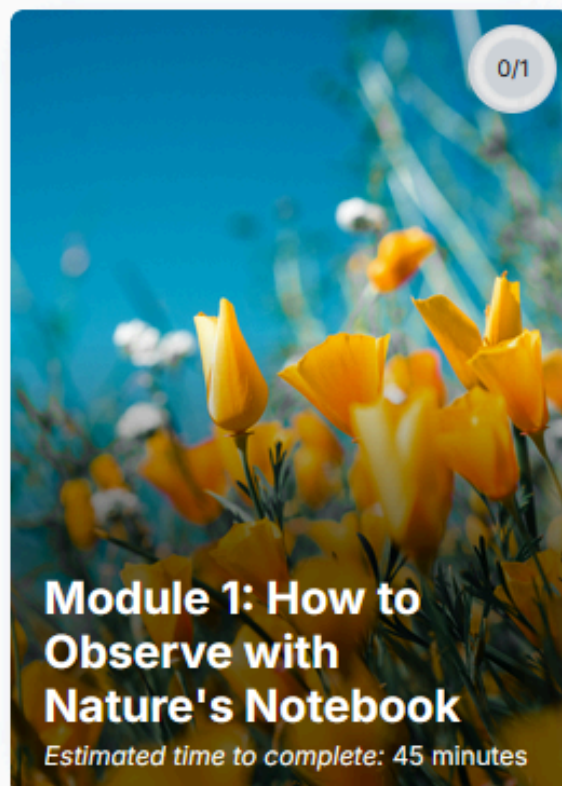
The Observer Certification Course provides an orientation to using *Nature's Notebook* to collect data on the timing of plant and animal life cycle events. The Course is our primary training resource and covers the basics on setting up sites, selecting plants and animals to observe, collecting data with the mobile app, an in-depth look at the plant and animal phenophases and intensity measures, and a chance to practice making observations.

Upon successful completion of the course, you will become an official Certified Observer. You will receive a completion certificate, a badge for your Observation Deck, and you will be tagged in the *Nature's Notebook* database as a Certified Observer.

The course consists of five learning modules that are broken into lessons with a quiz at the end of each lesson. You must answer each quiz question correctly to move to the next question and then on to the next lesson. You have an unlimited number of attempts to select the correct answer to each question.

You can return to the modules after completion to review the material at any time. In fact, we encourage you to review Modules 3 and 4 yearly to refresh your memory on the details of evaluating phenophases.

We hope that the Observer Certification Course helps you to become more confident with your *Nature's Notebook* observations. Thanks for participating!





Botany Primer

Understanding Botany for *Nature's Notebook*
USA-NPN Education & Engagement Series 2015-001 January 2015

nn.usanpn.org





Phenophase Primer for Flowering Plants

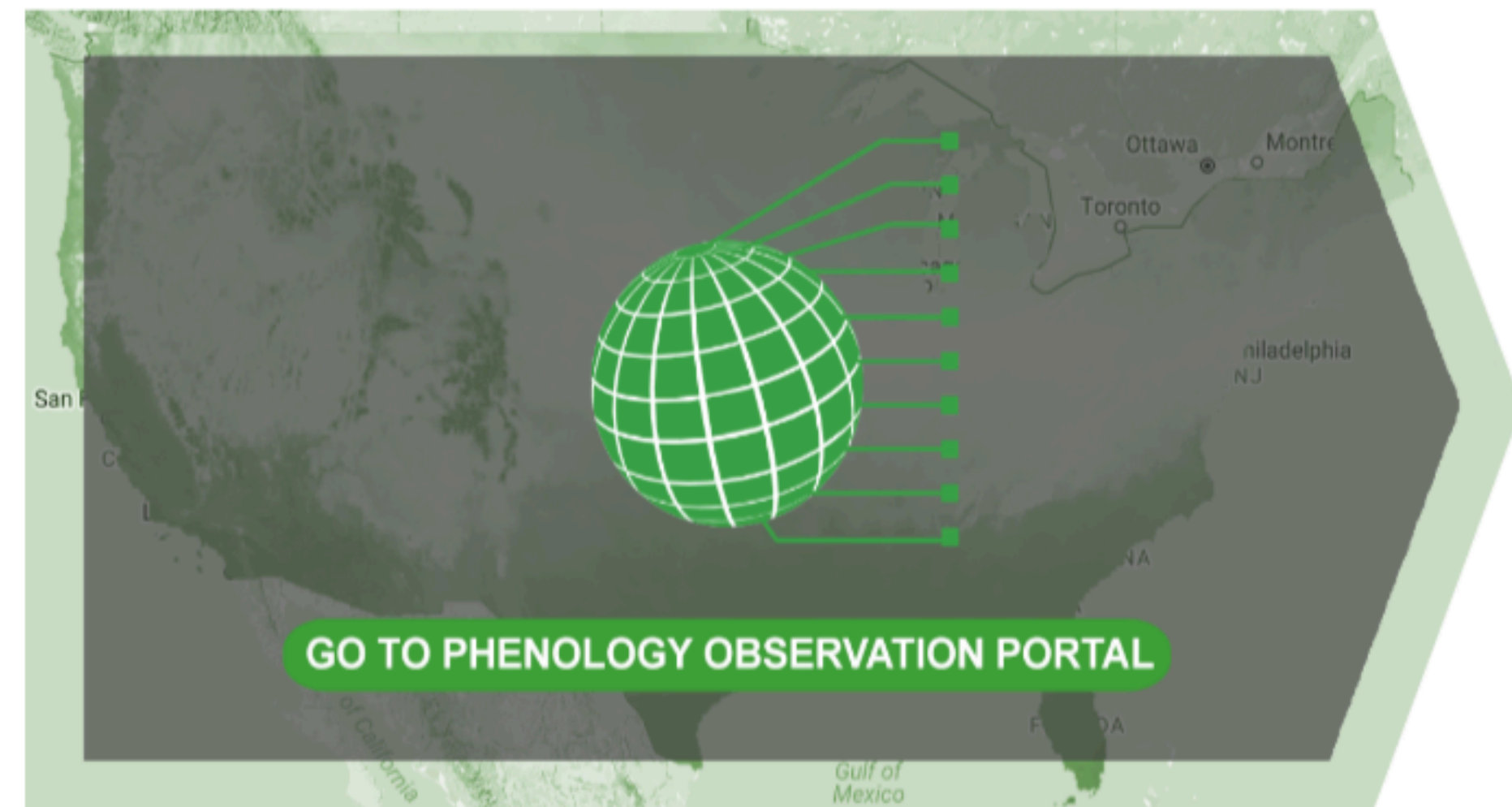
Understanding Plant Phenophases for *Nature's Notebook*

USA-NPN Education & Engagement Series 2024-001 December 2024



Observational Data

You are invited to use the Phenology Observation Portal to download customized datasets of observational data from the National Phenology Database, which includes phenology data collected via the *Nature's Notebook* phenology program (2009-present for the United States), and additional integrated datasets, such as historical lilac and honeysuckle data (1955-present). Filters are available to specify dates, regions, species and phenophases of interest.



Phenology Observation Portal



Get Started

Date Range

Locations

Species

Phenophases

Partner Groups

Source Datasets

Output Fields

Ancillary Data

Metadata

Help

Get Started!

Download customized datasets from the National Phenology Database using the filters in the menu at left to specify dates, locations, species, and phenophases of interest. Choose which data type you would like to download.

Status and Intensity

Individual Phenometrics

Site Phenometrics

Magnitude Phenometrics

Data Description

Status and Intensity Data: This data type includes phenophase status records of presence ("yes") or absence ("no") of the phenophase, as well as information about the degree to which the phenophase was expressed. Each row represents the status and intensity or abundance of one phenophase on one individual plant or on one animal species at a given site, on a single visit. See the Metadata window for more information.

Next

Your Download

Status and Intensity Dataset

Estimated Records:

Filters

☐ I have read and acknowledged the USA-NPN [data use](#) and [attribution](#) policies.

Download

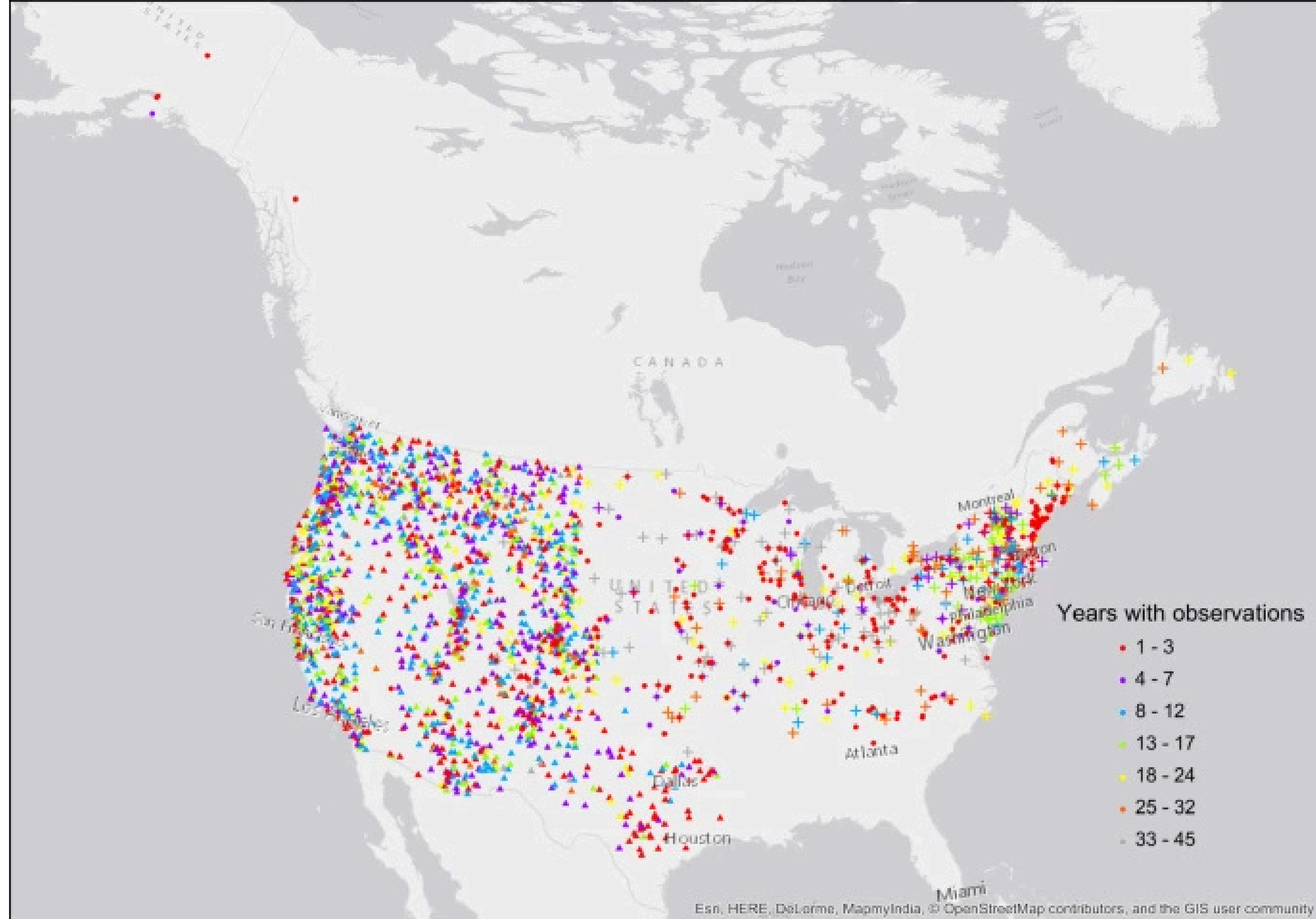
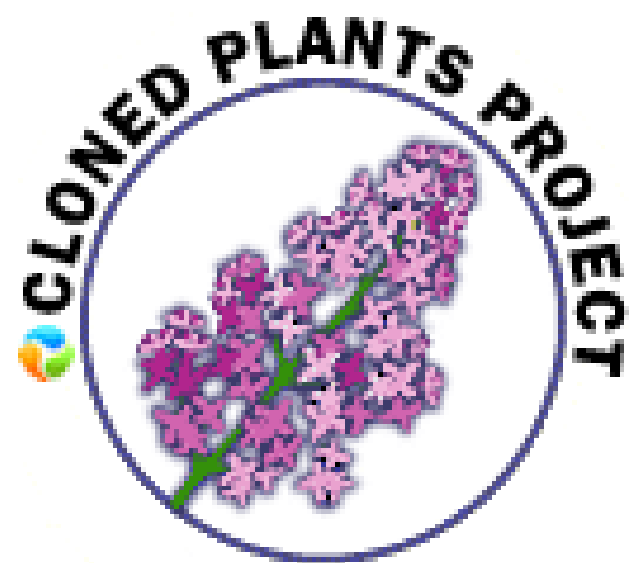




Photo: Brian F Powell

Phenology Observation Portal



Get Started

Date Range

Locations

Species

Phenophases

Partner Groups

Source Datasets

Output Fields

Ancillary Data

Metadata

Help

Output Fields

Select which optional fields you would like to have appear in your data output file. Use tabs to add climate data fields, derived from Daymet, and view default fields.

Optional Fields

Climate Data Fields

Default Data Fields

☐ Select All

☐ Dataset ID

☐ ObservedBy Person ID

☐ Submission ID

☐ SubmittedBy Person ID

☐ Submission Datetime

☐ UpdatedBy Person ID

☐ Update Datetime

☐ Partner Group

☐ Site Name

☐ Species Functional Type

☐ Species Category

☐ Lifecycle Duration

☐ Growth Habit

☐ USDA PLANTS Symbol

☐ ITIS Number

☐ Plant Nickname

☐ Patch

☐ Protocol ID

☐ Phenophase Category

☐ Phenophase Name

☐ Phenophase Definition ID

☐ Species-Specific Info ID

☐ Observation Time

☐ Site Visit ID

☐ Observation Comments

Quality Control Fields

☐ Observed Status Conflict Flag

☐ Status Conflict Related Records

Set Optional Fields

Next

Your Download

Status and Intensity Dataset

Estimated Records: 43.5 M

Filters

☐

☐

☐

☐ I have read and acknowledged the USA-NPN [data use](#) and [attribution](#) policies.

Download

Phenology Visualization Tool

View

Edit

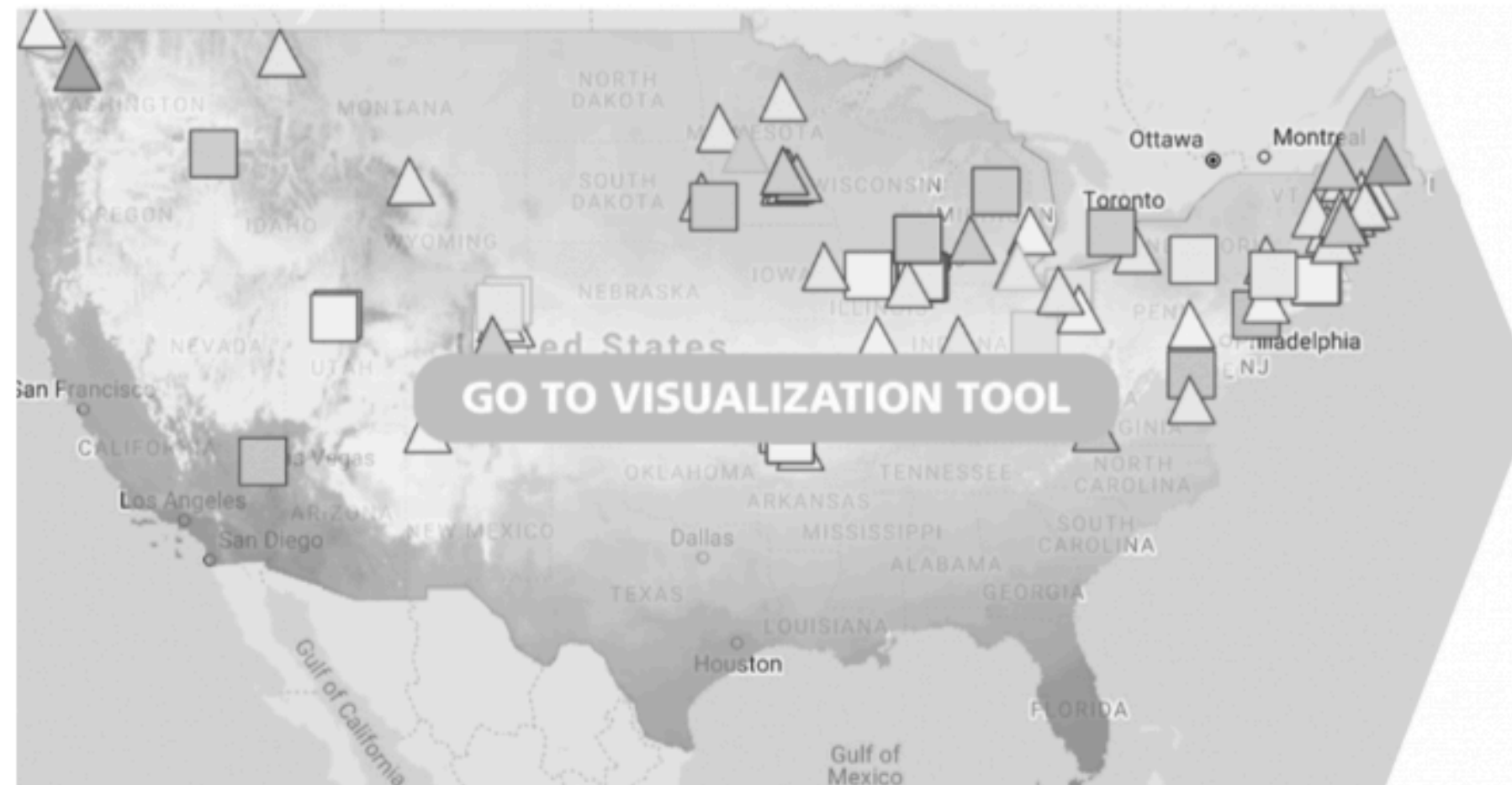
Export

Delete

Revisions

Explore the phenology data and maps made available by the USA-NPN. **Seasonal Stories** guide you through several examples of ways you can visualize the data. The **Data Explorer** lets you dive deep into the observational plant and animal data as well as the USA-NPN's phenology maps.

Want a little guidance on how to use the the tool? Watch our [Viz Tool Webinar recording](#).





Seasonal Stories
Quick access to curated visualizations



Data Explorer
Select data & create visualizations



Settings
Update application level settings



Visualization Tool

How fast is it warming up this year where I live?

This graph shows the heat accumulated across the year at a single location, and how that compares to previous years.

Please provide your zip code [See visualization](#)

Where did spring arrive early this year?

This map shows where spring leaf out arrived earlier or later compared to the long-term average.

[See visualization](#)

Do invasive shrubs leaf-out earlier than native shrubs?

This Phenology Calendar shows reports of initial shoot and leaf growth for invasive multiflora rose and native Northern spicebush in the Eastern U.S. in 2022.

[See visualization](#)

When is peak pollen release in oak trees in the Western U.S.?

This Activity Curve shows the timing of pollen release in plants in the *Quercus* genus in Western states from 2020 to 2022.

[See visualization](#)

How do winter temperatures correspond to leafing in the Soapberry family?

This Scatterplot graph shows how minimum winter temperatures relate to the onset of spring leafing in the Soapberry family, which includes maples and chestnuts.

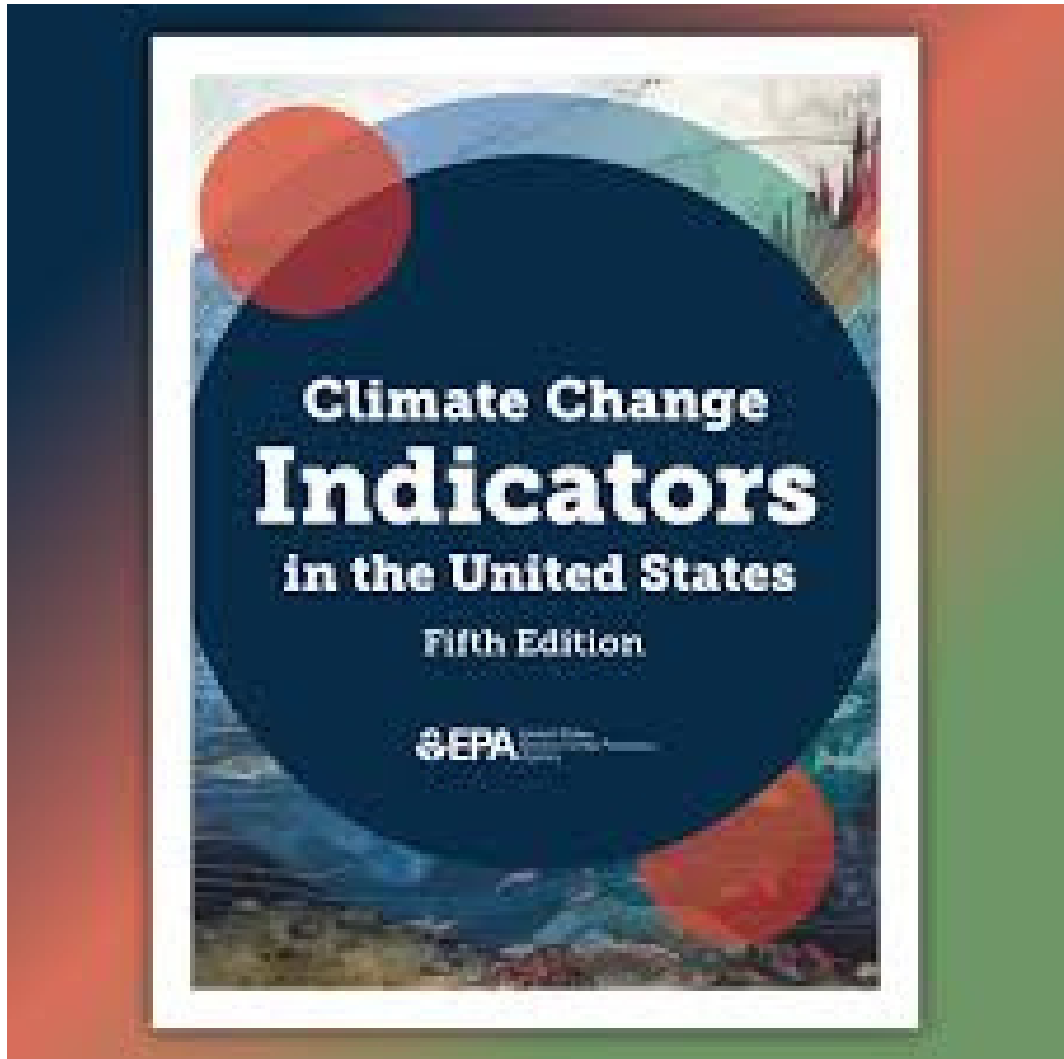
[See visualization](#)

Can the USA-NPN's Spring Index predict flowering in dogwoods?

This map shows the Spring First Bloom Index overlaid with observations of open flowers in flowering dogwoods.

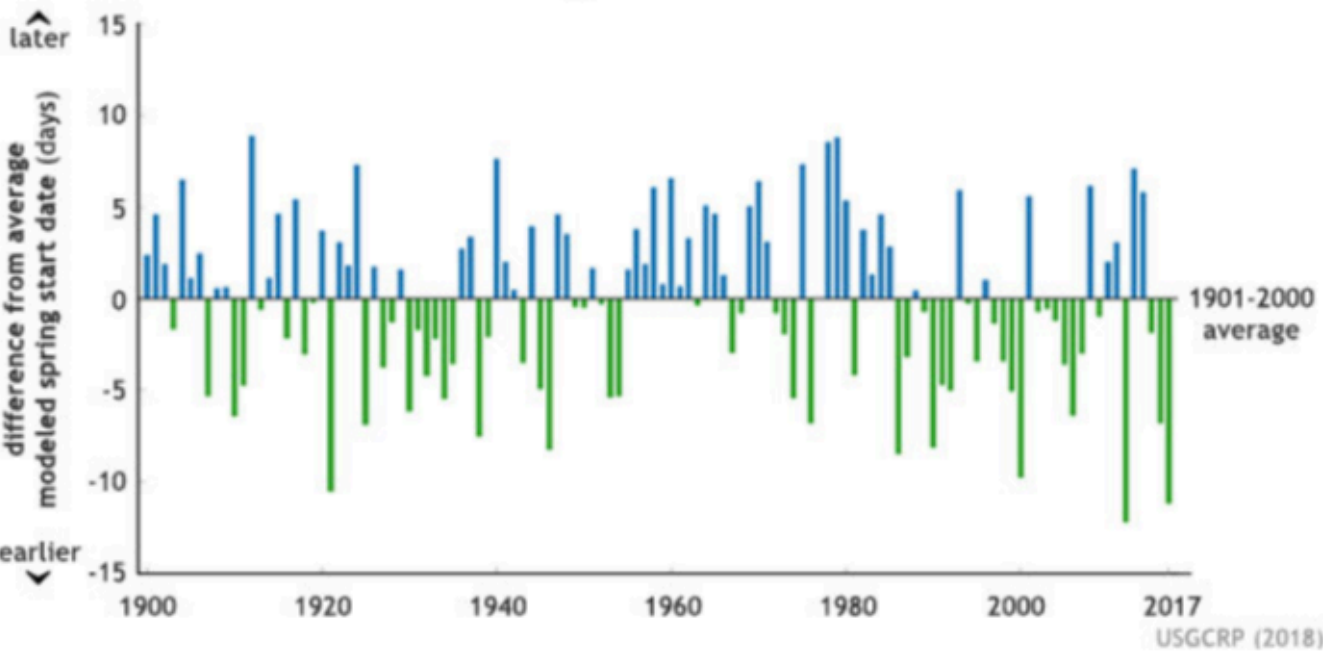
[See visualization](#)





GlobalChange.gov
U.S. Global Change Research Program

Annual Start of Spring for the Contiguous United States



On average, the start of spring has been occurring earlier since 1984 due to global warming. The earliest start of spring occurred in 2012 as warming temperatures allow plants to sprout earlier in the year.

ARTICLE

Distinct latitudinal patterns of shifting spring phenology across the Appalachian Trail Corridor

Jordon C. Tourville✉, Georgia L. D. Murray, Sarah J. Nelson

First published: 28 August 2024 | <https://doi.org/10.1002/ecy.4403> | Citations: 4

Journal of Economic Entomology, 117(3), 2024, 1185–1191
<https://doi.org/10.1093/jee/toae056>
Advance Access Publication Date: 28 March 2024
Short Communication



ENTOMOLOGICAL
SOCIETY OF AMERICA
SHARING INSECT SCIENCE GLOBALLY

OXFORD

Short Communication

Observation of key phenological stages of hemlock woolly adelgid (Hemiptera: Adelgidae): using citizen science as a tool to inform research and management

Nicholas J. Dietschler^{1,2,*}, Tonya D. Bittner^{1,*}, Marshall Bigler Lefebvre^{1,3}, Jasmine Schmidt¹, Carrie S. Jubb^{4,*}, Aryanna James⁴, Scott M. Salom^{4,*}, Mark C. Whitmore¹

nature plants

Article

Contrasting age-dependent leaf acclimation strategies drive vegetation greening across deciduous broadleaf forests in mid- to high latitudes

nature ecology & evolution

Article

Phenological divergence between plants and animals under climate change

<https://doi.org/10.1038/s41559-024-02096-2>

nature cities

Article

Artificial light at night outweighs temperature in lengthening urban growing seasons

ARTICLE

Distinct latitudinal patterns of shifting spring phenology across the Appalachian Trail Corridor

Jordon C. Tourville✉, Georgia L. D. Murray, Sarah J. Nelson

First published: 28 August 2024 | <https://doi.org/10.1002/ecy.4403> | Citations: 4

- Improve invasive species management¹
- Warmer winters affect timing of spring leaf out in plants²
- Daytime temperatures - rather than nighttime - trigger leafing in temperate plants³
- Springs are arriving earlier⁴ and the growing season is getting longer than in the past⁵
- and more!

Source: 1: Gerst et al. 2021, *Ecological Solutions and Evidence*, Chapman et al. 2014, *Global Change Biology*; 2: Fu et al. 2015, *Global Change Biology*, Mazer et al. 2015 *Ecosphere*; 3: Piao et al. 2015 *Nature Communications*; 4: Allstadt et al. 2015 *Environmental Research Letters*



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.



Trees damaged by late season frosts can see negative impacts for years

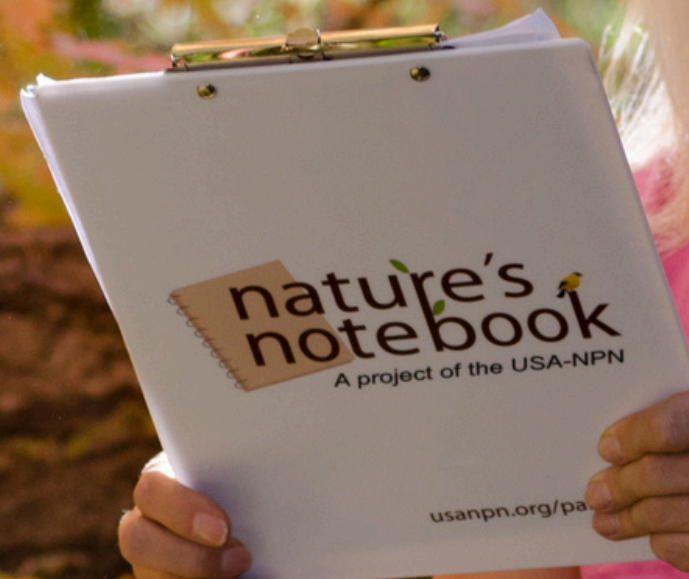
Fri, May 09, 2025

Publication Summary

Many trees in the Northern Hemisphere are leafing out earlier as the climate warms. But with leaves emerging earlier in the season, there is an increased risk of damage from a late spring frost. Researchers used experimental and observational data – including thousands of records from Nature's Notebook – to evaluate the effects of late spring frosts on hundreds of tree species. The results indicated that late spring frosts have both short-term and long-term effects on tree growth and phenology. In the short-term, late spring frosts damage young leaves and limit tree growth that year. But more notably, late spring frost events also limit the amount of resources a tree can store that year, which results in delayed leaf emergence and reduced productivity the next calendar year. These results illustrate that the effects of extreme climate events on plant phenology and productivity may extend months, or years, into the future. The results may also help scientists generate more accurate predictions of how forests will respond to future climate change.

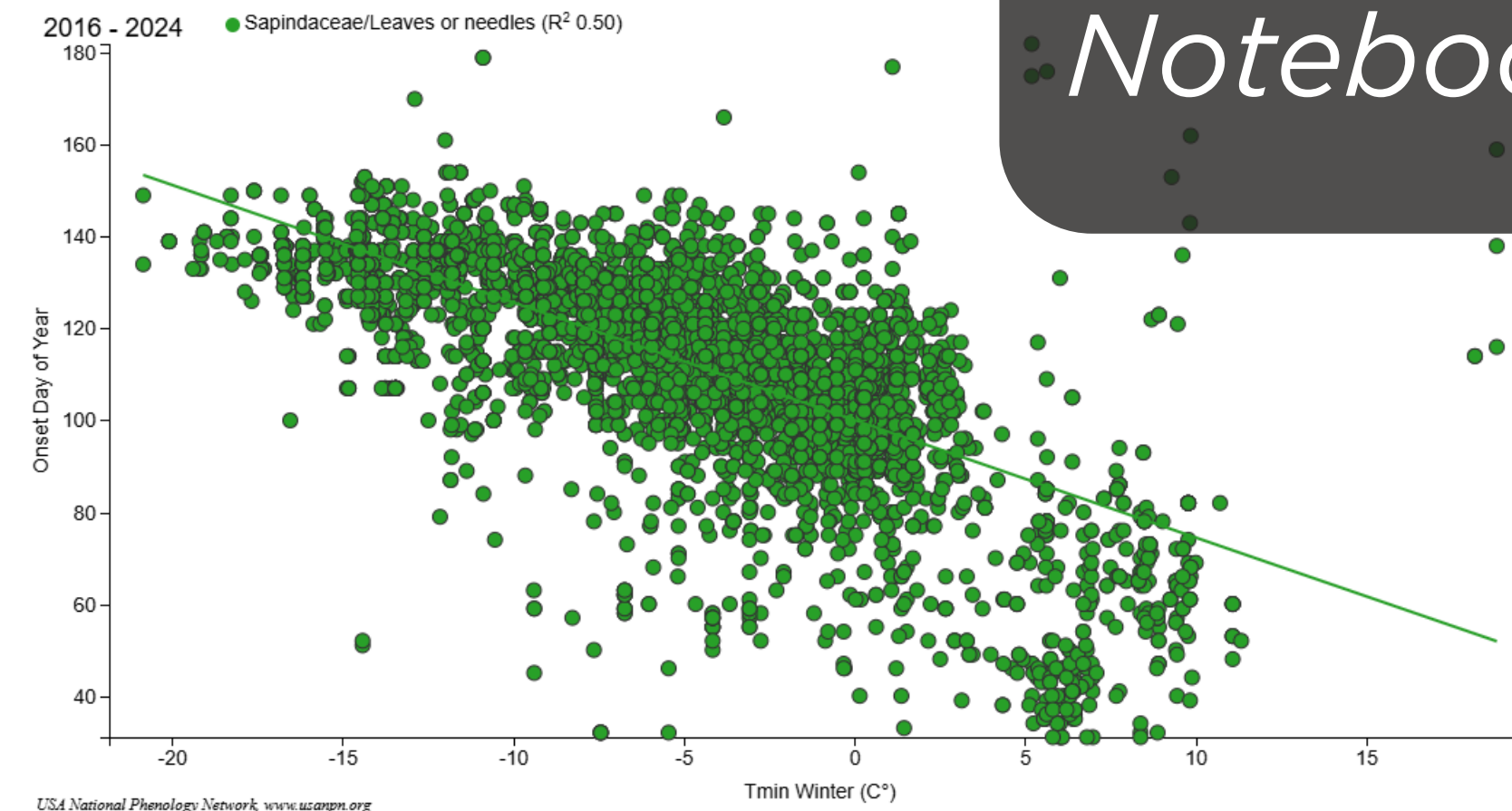
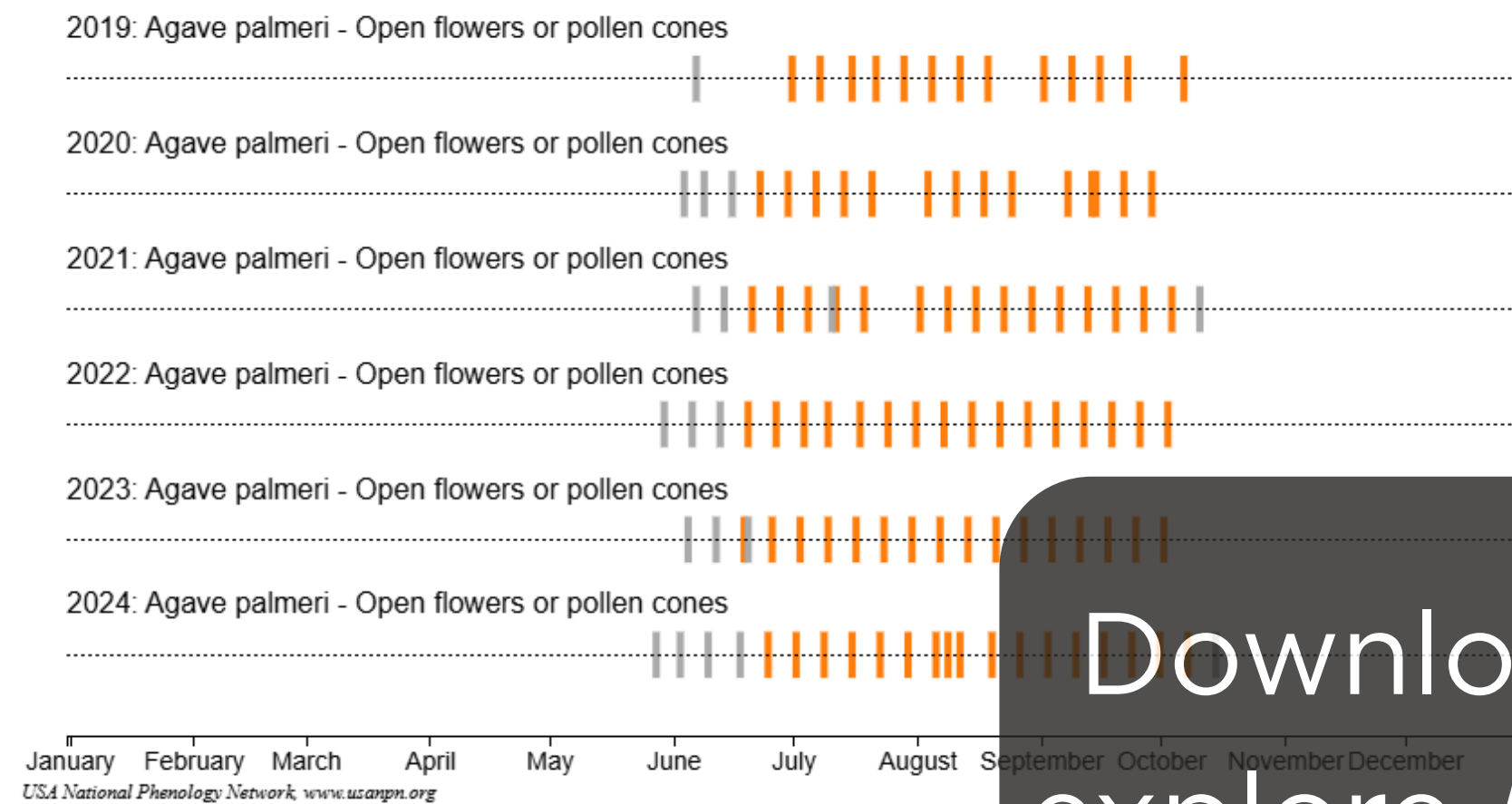
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Become a
backyard
observer in
*Nature's
Notebook*



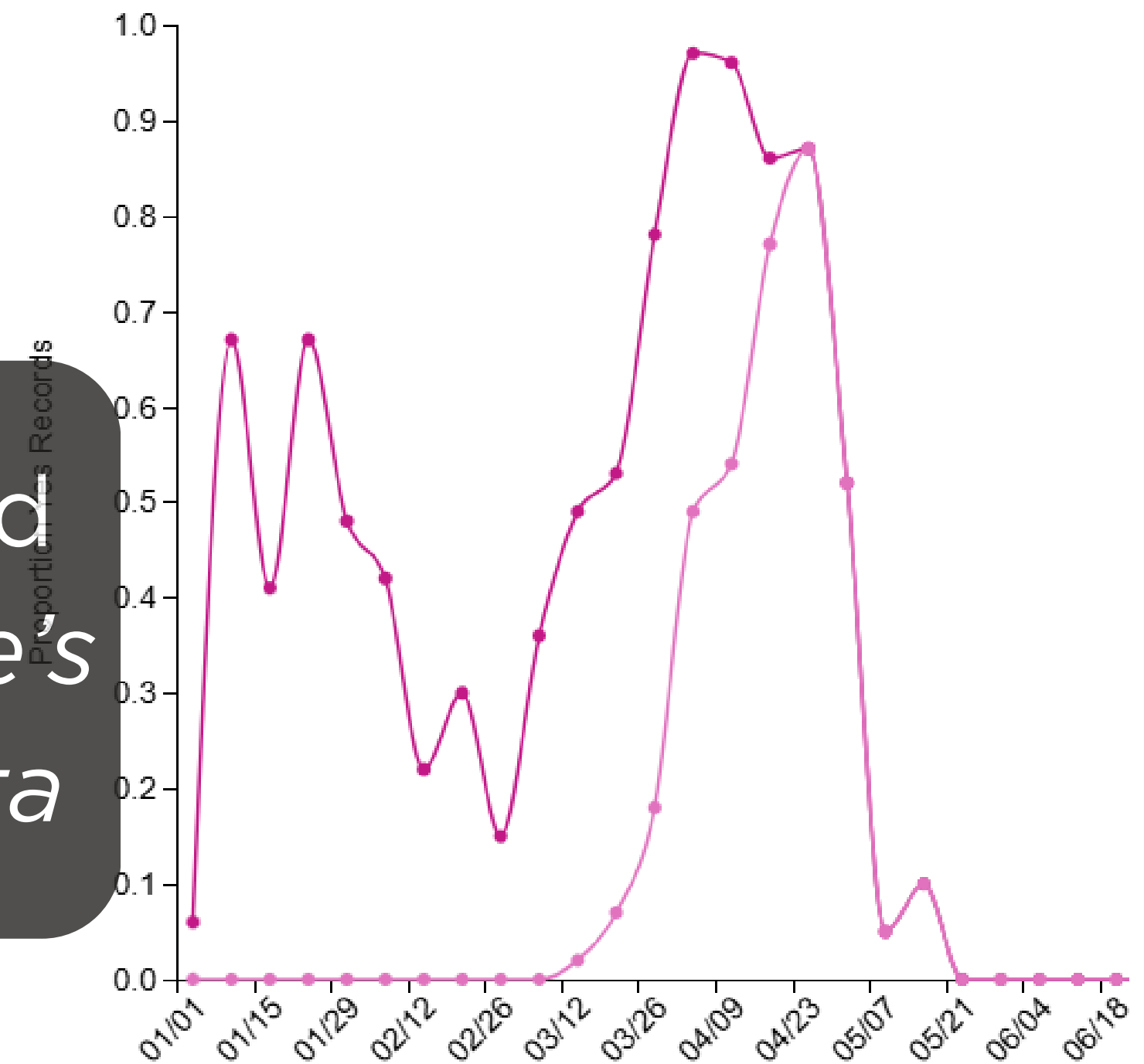
A photograph of three people in a field. On the left, a man in a blue cap and light blue shirt is seen from the back. In the center, an older man with a white beard and a green jacket with 'Ka Nai OCC' on it is looking at a plant. On the right, a woman with blonde hair and sunglasses on her head is also looking at the plant. They are surrounded by dry, brushy vegetation under bright sunlight.

Start a Local Phenology Program



Activity Curves

- 2025: Eastern redbud - Flowers or pollen cones
- 2025: Eastern redbud - Open flowers or pollen cones



Download and
explore *Nature's
Notebook data*



Learn more at

usannpn.org



References (in order cited)

Rosemartin, A, Denny, E, Weltzin, J et al. 2015. Lilac and honeysuckle phenology data 1956–2014. *Nature Scientific Data*. doi.org/10.1038/sdata.2015.38

Gerst, KL, Crimmins, TM, Posthumus, EE, et al. 2021. The USA National Phenology Network's Buffelgrass Green-up Forecast map products. *Ecological Solutions and Evidence* e12109. doi.org/10.1002/2688-8319.12109

Chapman, DS, Haynes, T, Beal, S, et al. 2014. Phenology predicts the native and invasive range limits of common ragweed. *Global Change Biology* 20(1):192–202.doi.org/10.1111/gcb.12380.

Fu, Y, Piao, S, Vitasse, Y, et al. 2015. Increased heat requirement for leaf flushing in temperate woody species over 1980–2012: effects of chilling, precipitation and insolation. *Global Change Biology*. doi.org/10.1111/gcb.12863

Mazer, SJ, Gerst, KL, Matthews, ER, et al. 2015. Species-specific phenological responses to winter temperature and precipitation in a water-limited ecosystem. *Ecosphere* 6 (6). doi.org/10.1890/ES14-00433.1

Piao, S, Tan, J, Chen, A, et al. 2015. Leaf onset in the northern hemisphere triggered by daytime temperature. *Nature Communications* 6. doi.org/10.1038/ncomms7911

Allstadt, AJ, Vavrus, SL, Heglund, PJ, et al. 2015. Spring plant phenology and false springs in the conterminous US during the 21st century. *Environmental Research Letters* 10. doi.org/10.1088/1748-9326/10/10/104008

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