

# The times they are a-changing... Phenology and changing springs

Theresa Crimmins, Director  
and the USA-NPN team



[www.usanpn.org](http://www.usanpn.org)

# What is phenology?

Recurring plant and animal life-cycle stages and their timing and relationships with weather and climate



Photos: Brian F Powell

# Why phenology?

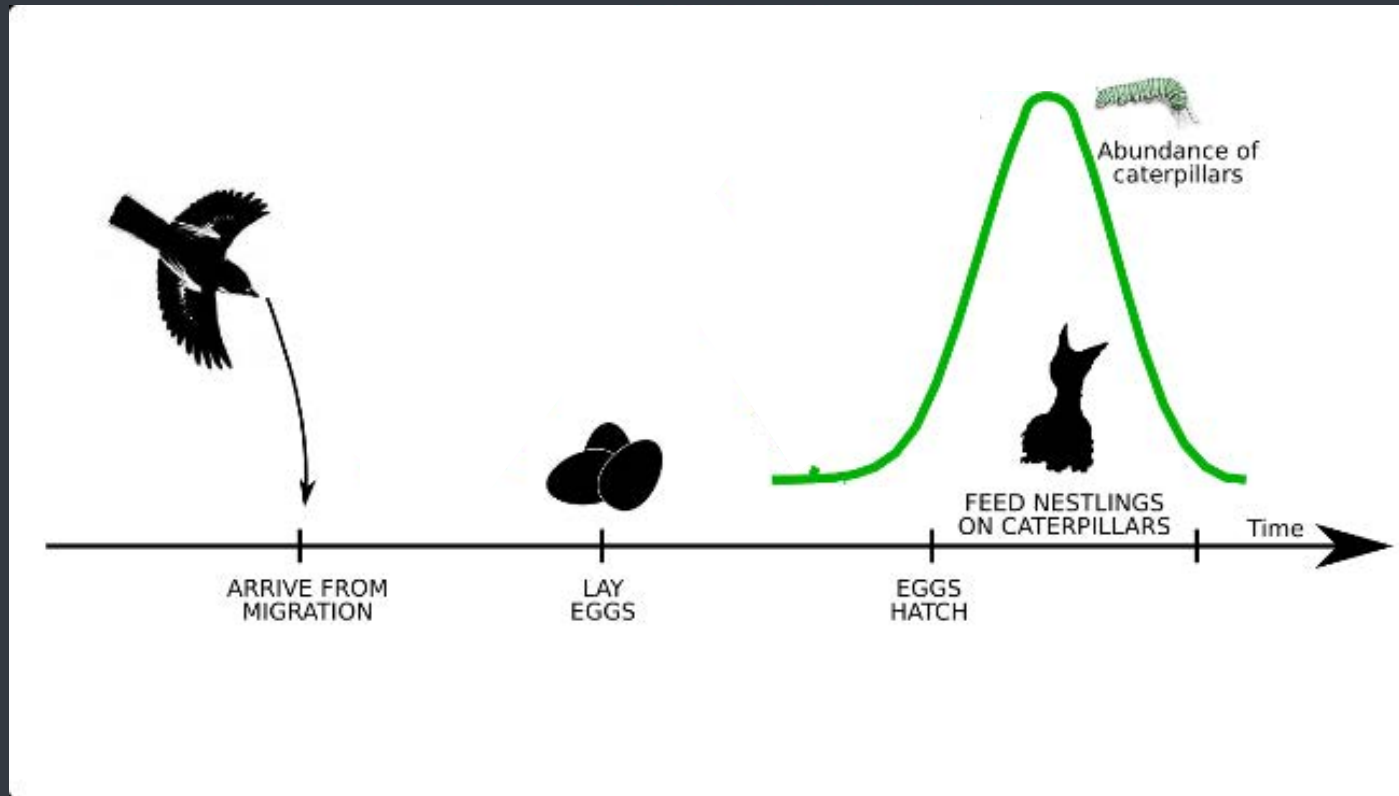


- Invasive species control
- Crop harvesting
- Pollination
- Cultural events
- etc...

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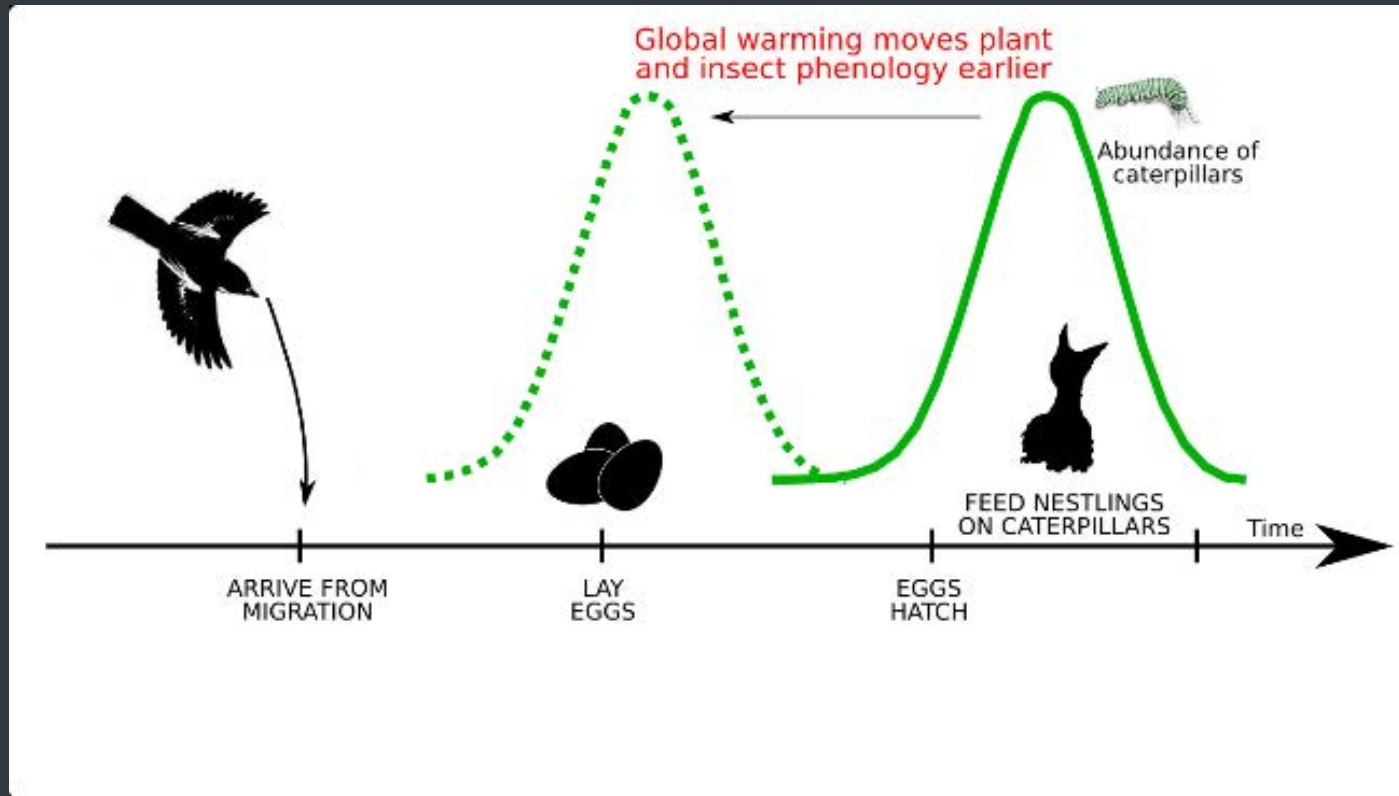


# Why phenology?



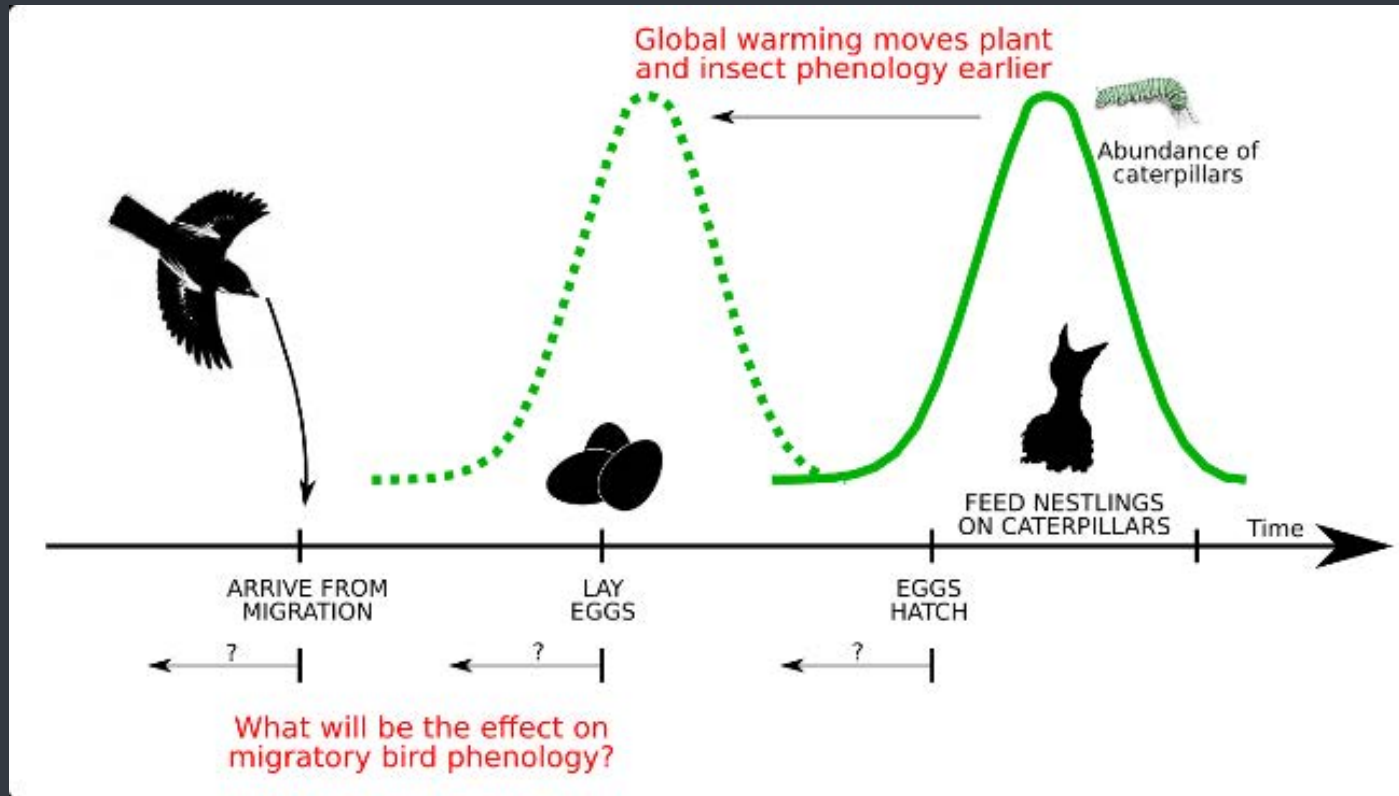
[nadiyah.org/phenology.html](http://nadiyah.org/phenology.html)

# Why phenology?



[nadhah.org/phenology.html](http://nadhah.org/phenology.html)

# Why phenology?



nadiah.org/phenology.html

# How is spring changing?



Yellow trout lily – 7d advanced  
Petrauski et al. (2019)



Blueberries – 3-4 weeks advanced  
Miller-Rushing and Primack (2008)



Brewer's sparrow  
3 weeks advanced  
Mayor et al. (2017)

# How is spring changing?



*Corydalis ambigua*



Kudo & Ida 2013



# How is spring changing?

## Georgia peach crop decimated after warm winter

Atlanta Journal-Constitution  
May 31, 2017



Photo: The Atlanta Journal-Constitution

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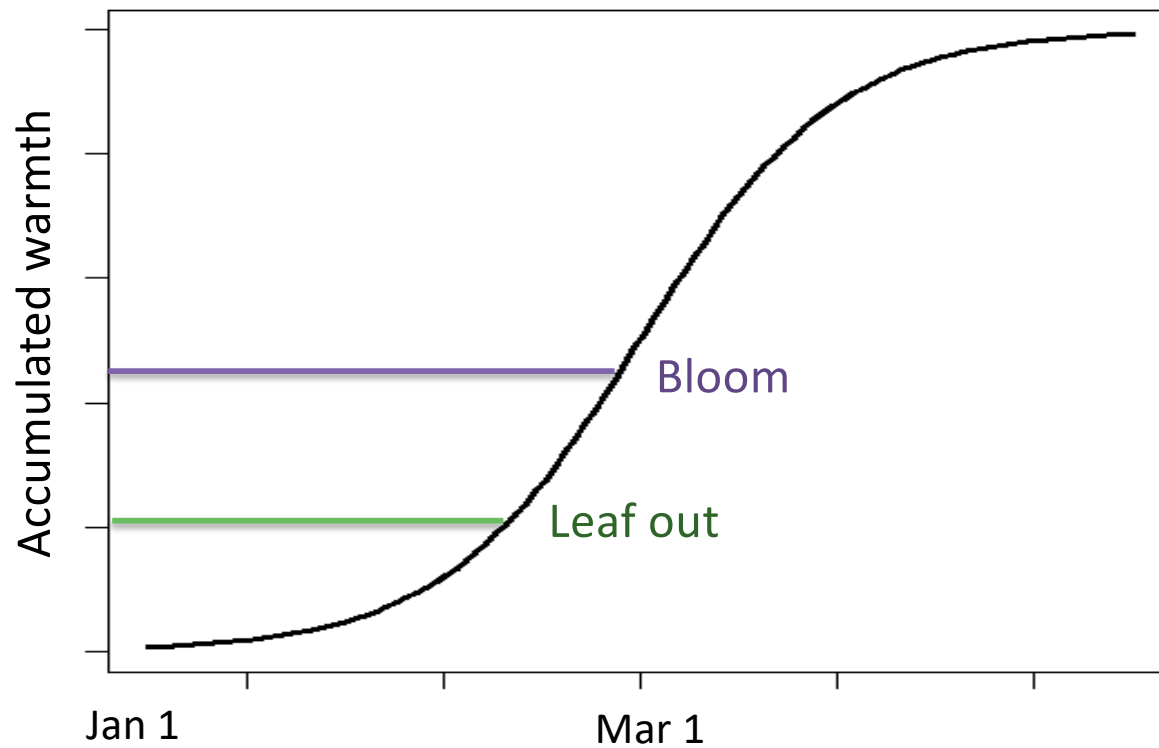
# How is spring changing?



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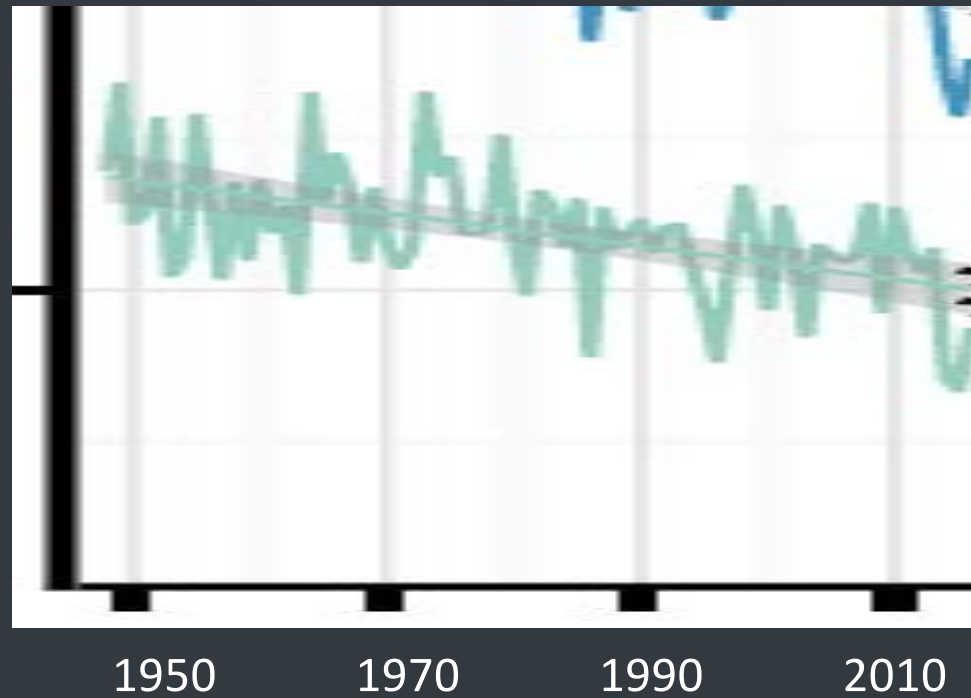


# Start of spring



# Start of spring

Day 50  
(Feb 19)





# How is spring changing?

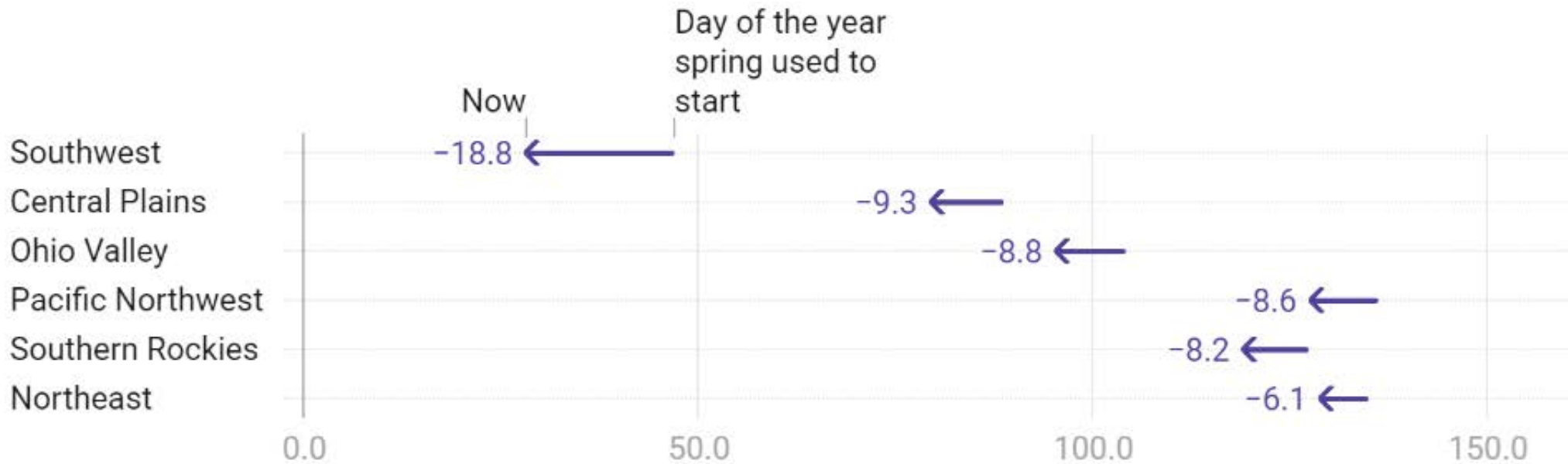
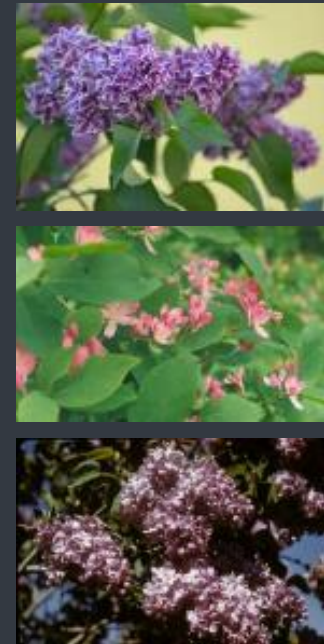
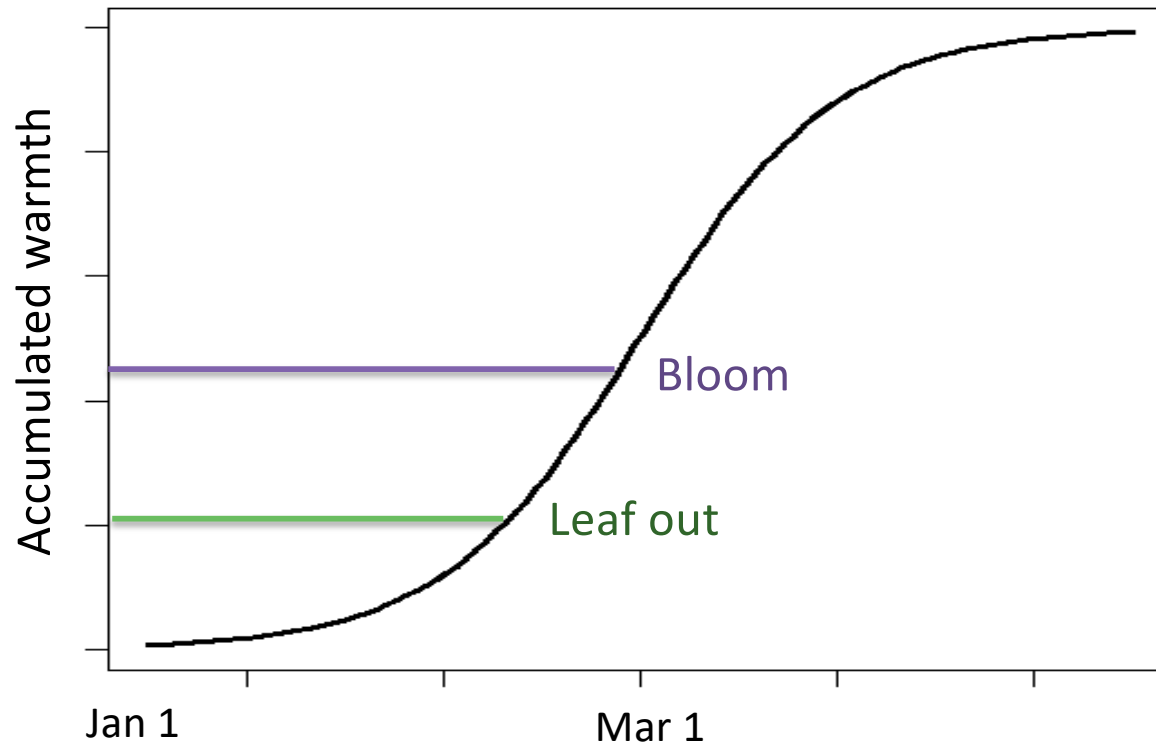


Chart: The Conversation, CC-BY-ND • Source: [Crimmins, T.M. and M.A. Crimmins. 2019](#) • [Get the data](#)

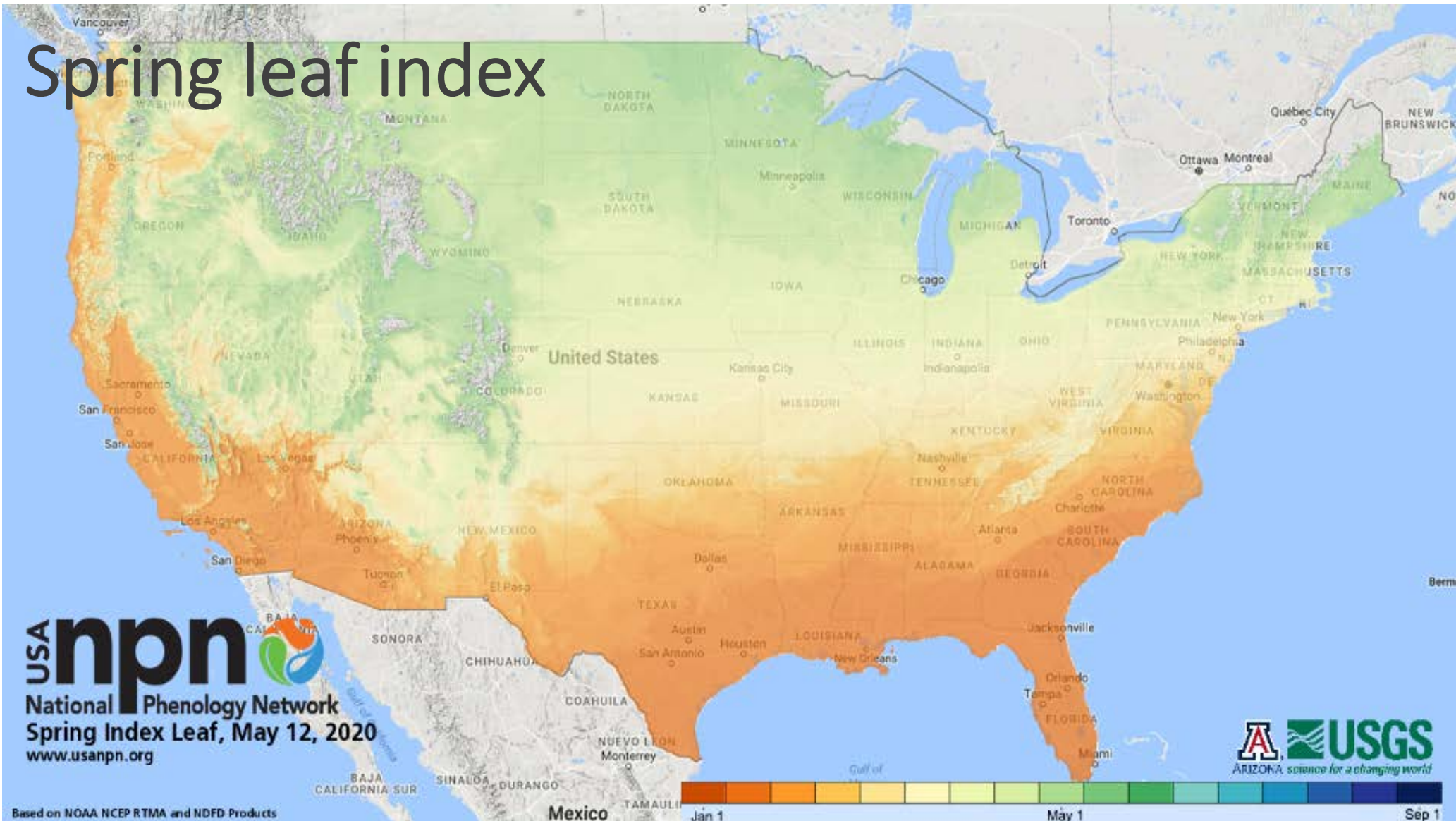
# Spring 2020: Spring Indices



Schwartz 1997 (book chapter)

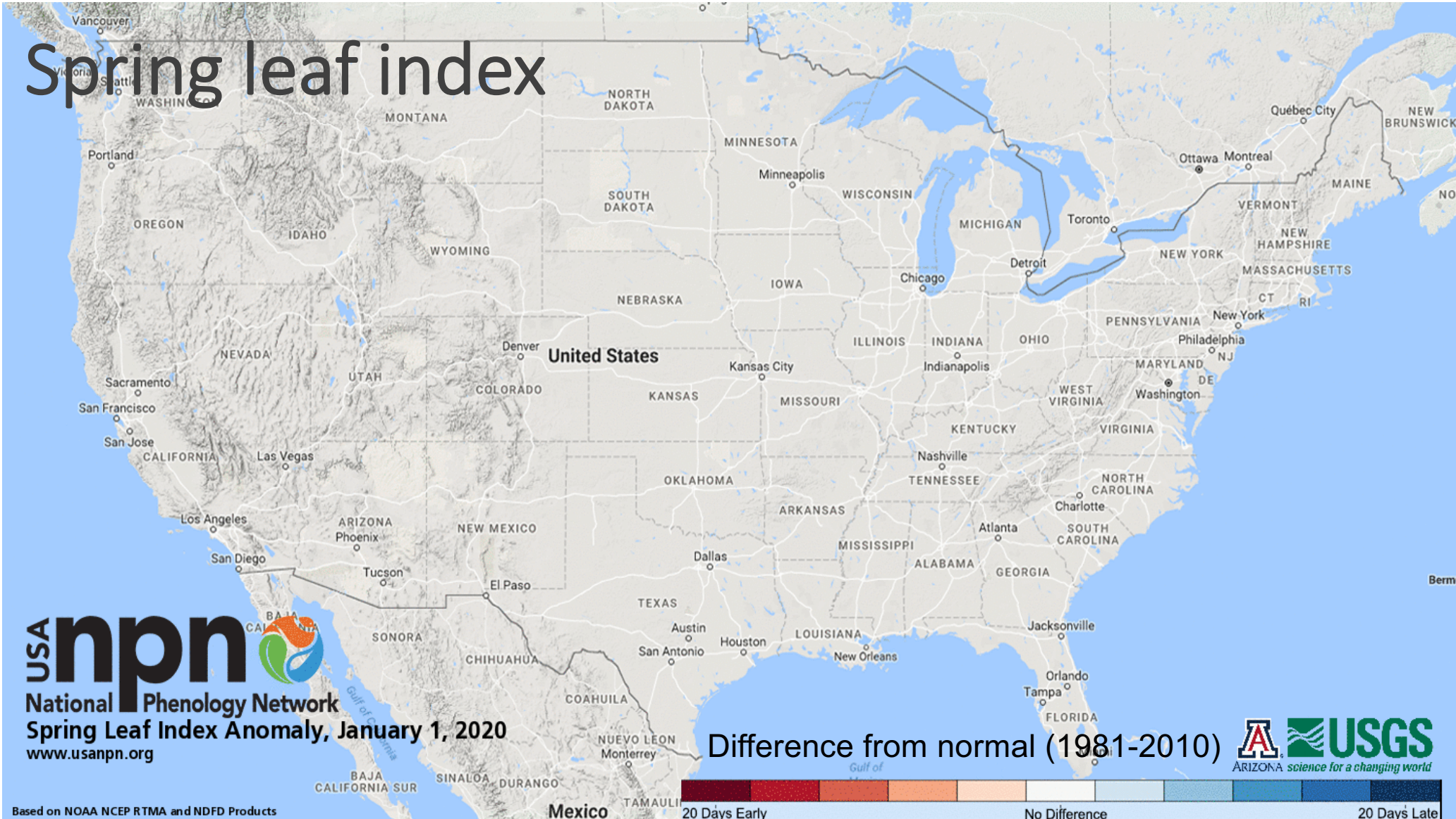
Schwartz et al. 2013 *Int J Climatol*

# Spring leaf index

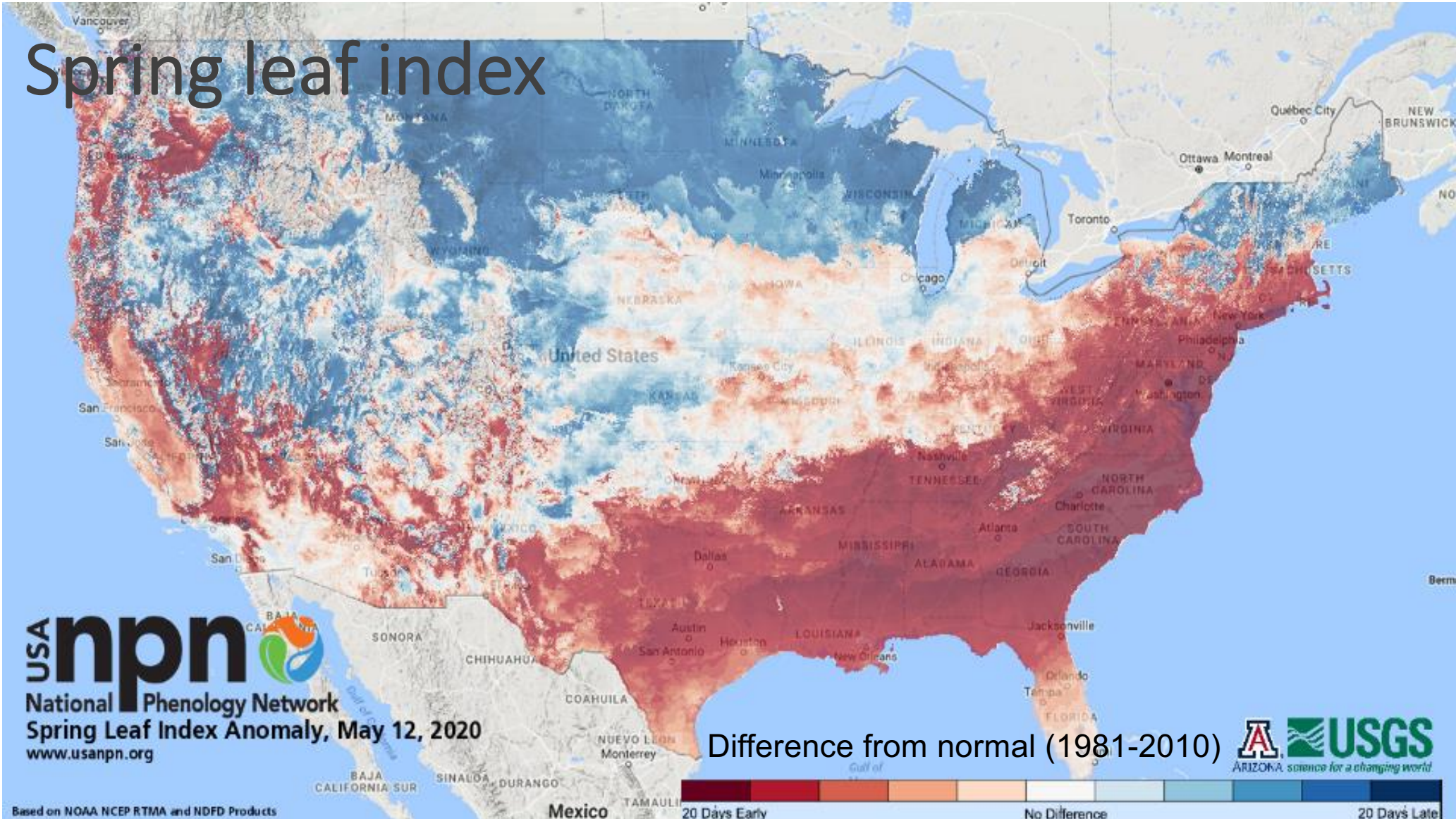




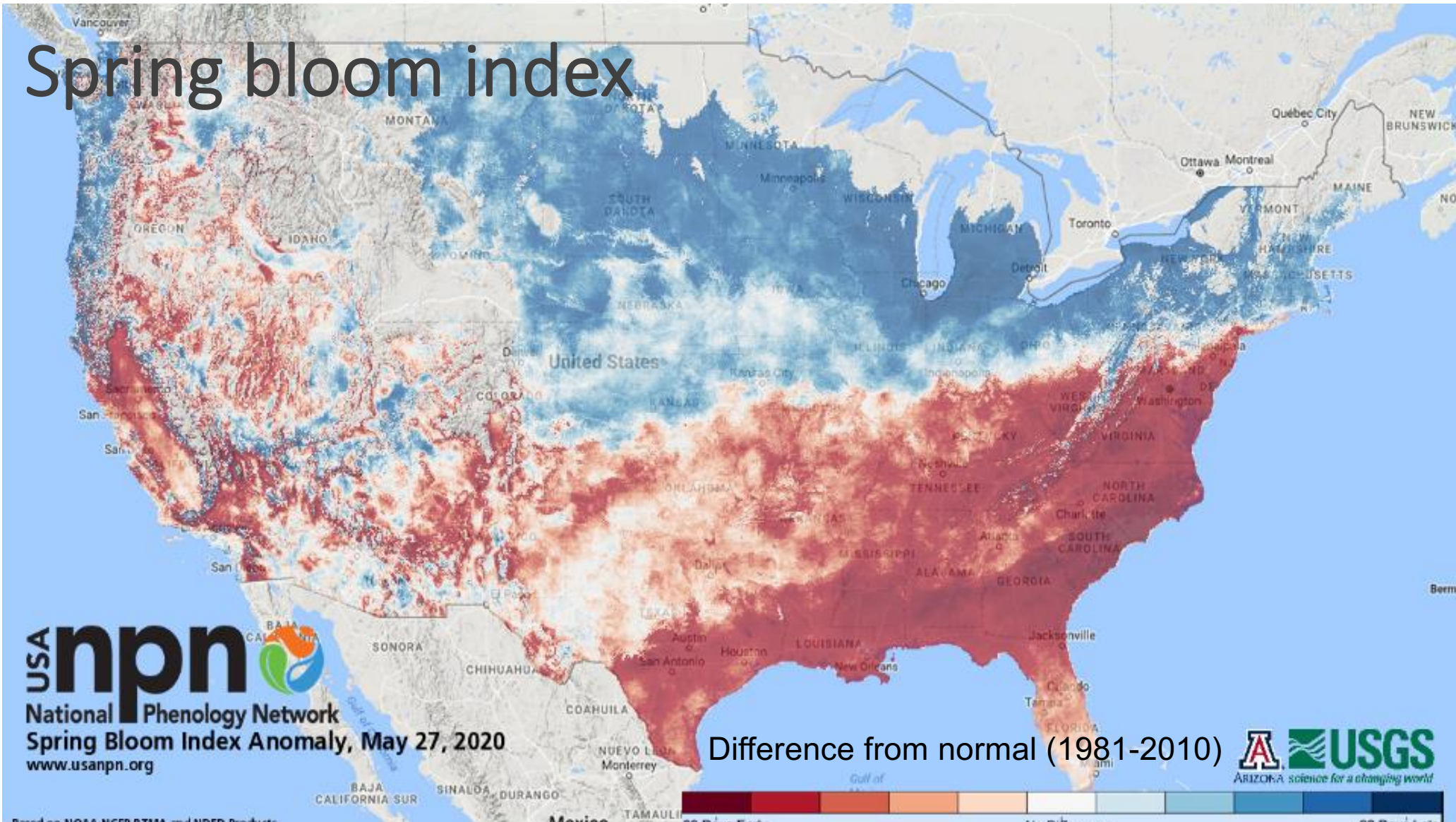
# Spring leaf index



# Spring leaf index



# Spring bloom index



Difference from normal (1981-2010)



# How are these maps being used?

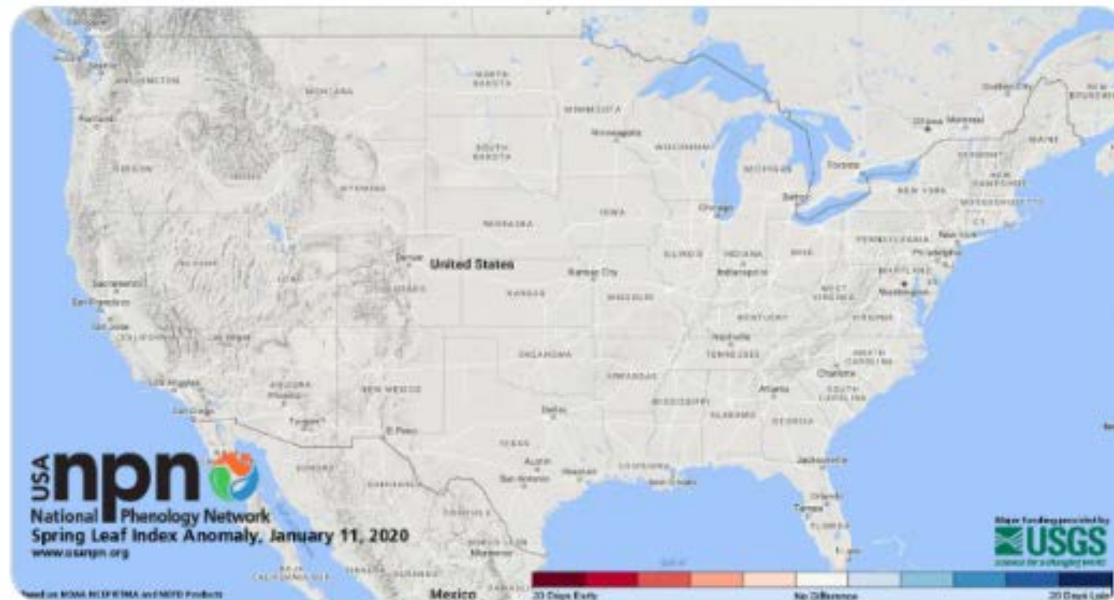
## Allergies start following weather patterns than usual

Pollen levels are high in the southwest area of the country.



Dennis Todey @dennistodey · Feb 5

This early progression on early dormancy break is concerning. [usanpn.org/news/spring](https://www.usanpn.org/news/spring). Hearing reports of #wheat and #pasture #greening in the Ohio area and other progress that is too early given chances of freeze still.



## Weather Means For...ry Blossoms

SHARE f t +

EXPLORING SPACE LECTURE SERIES  
RESERVE TICKETS  
AT THE MUSEUM IN WASHINGTON, DC  
Smithsonian National Air and Space Museum

[www.usanpn.org](http://www.usanpn.org)



# USA National Phenology Network



Collect • Store • Share  
Phenology data and information

Advance Science  
Inform Decisions

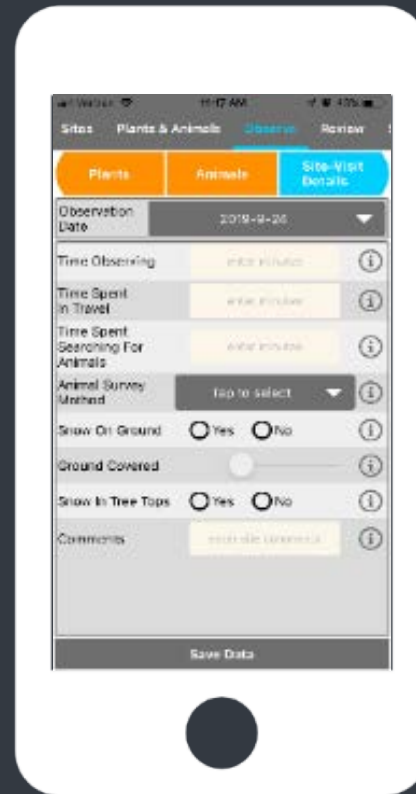
Communicate & Connect  
Create an Equitable and Inclusive  
Network

[www.usanpn.org](http://www.usanpn.org)



# Comprehensive community science program

- Standardized protocols for ~1,400 species of plants and animals (Denny et al. 2014)
- Extensive training materials & support
- Mobile apps



Denny et al. 2014 *Int J Biometeorol*

[www.usanpn.org](http://www.usanpn.org)



# We make it easy to observe phenology

Become an observer today in 3 steps

1 Join Nature's Notebook

2 Set up your account

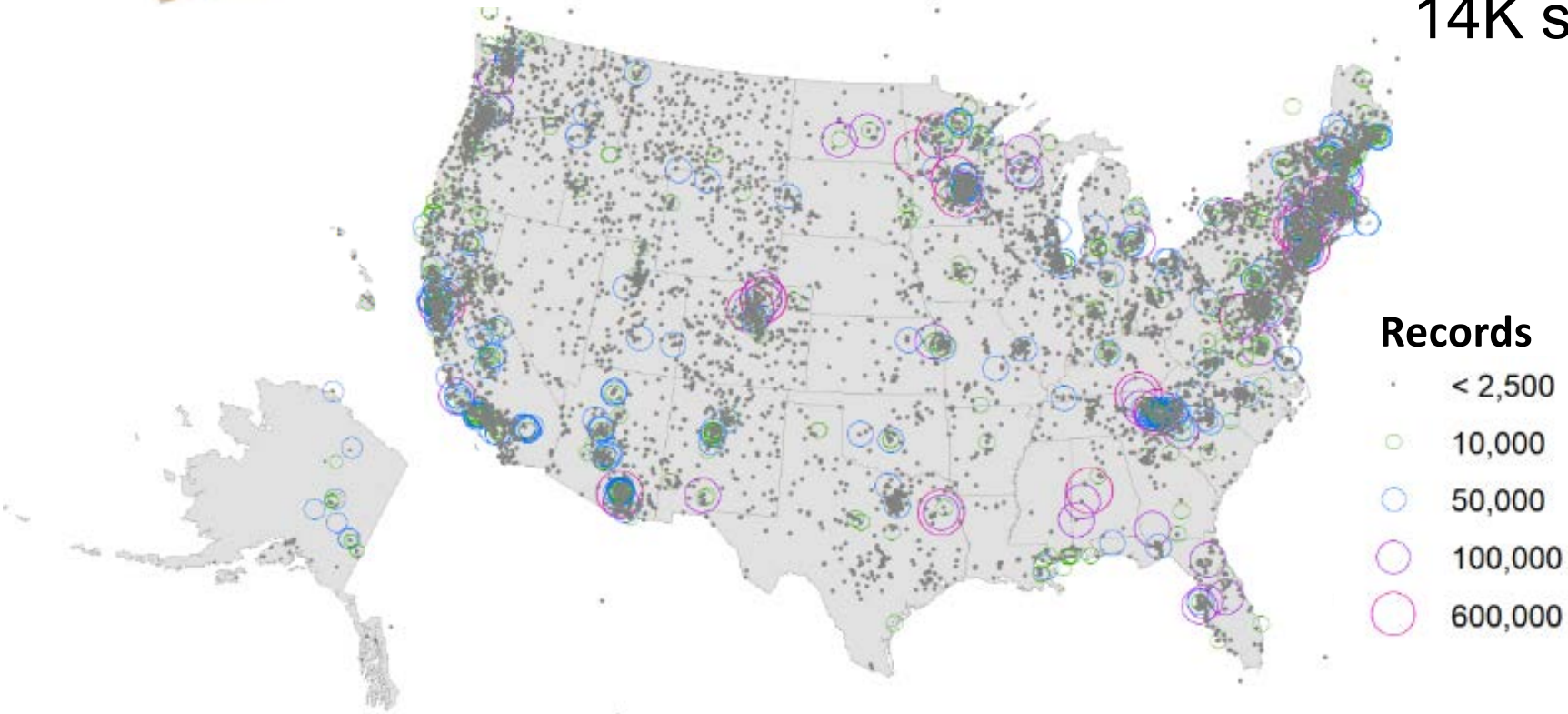
3 Start Observing

[www.usanpn.org](http://www.usanpn.org)





21M records  
18K observers  
14K sites



[www.usanpn.org](http://www.usanpn.org)





# Nature's Notebook engagement



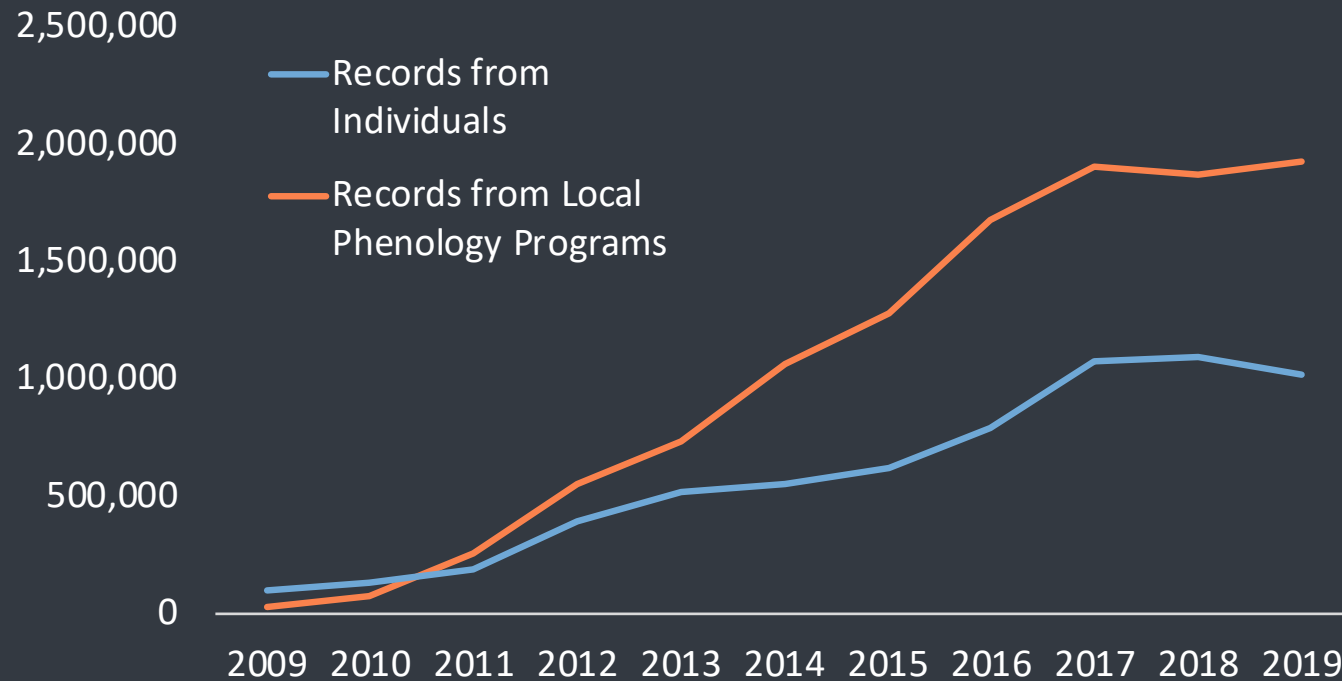
- 500+ partners contributing data
  - 53 NPS units
  - 24 USFWS units
  - 98 academic institutions
  - 2 Tribal Colleges and Universities
- Focus on diversity & inclusion, listening
- Formal training: >150 certified leaders



[www.usanpn.org](http://www.usanpn.org)



# Nature's Notebook engagement



[www.usanpn.org](http://www.usanpn.org)





# Signs of the Seasons: A New England Phenology Program

MENU ▾

Using their backyards as laboratories, participants in the *Signs of the Seasons* program help scientists document the local effects of global climate change.

Hundreds are trained to observe and record the phenology (seasonal changes) of common plants and



## Volunteer Trainings

Free 3-part webinar series! Watch the recordings.

[www.usanpn.org](http://www.usanpn.org)





Red maple (*Acer rubrum*)



Sugar maple (*Acer saccharum*)



American toad (*Anaxyrus americanus*)



Ruby-throated hummingbird (*Archilochus colubris*)



Common milkweed (*Asclepias syriaca*)



Rockweed (*Ascophyllum nodosum*)



Monarch butterfly (*Danaus plexippus*)



Forsythia (*Forsythia* sp.)



Wild strawberry (*Fragaria virginiana*)



Common loon (*Gavia immer*)



Wood frog (*Lithobates sylvaticus*)



Common reed (*Phragmites australis*)



Eastern white pine (*Pinus strobus*)



Spring peeper (*Pseudacris crucifer*)



Beach rose (*Rosa rugosa*)



Mountain ash (*Sorbus americana*)



Common lilac (*Syringa vulgaris*)



Common dandelion (*Taraxacum officinale*)



American robin (*Turdus migratorius*)



Gray treefrog (*Hyla versicolor*)



Lowbush blueberry (*Vaccinium angustifolium*)



2020: Sugar maple - Young leaves or needles



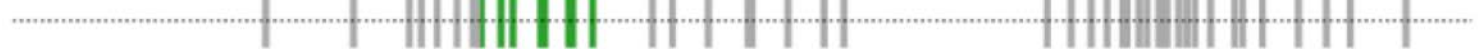
2019: Sugar maple - Young leaves or needles



2018: Sugar maple - Young leaves or needles



2017: Sugar maple - Young leaves or needles



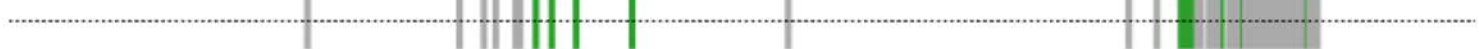
2016: Sugar maple - Young leaves or needles



2015: Sugar maple - Young leaves or needles



2014: Sugar maple - Young leaves or needles



2013: Sugar maple - Young leaves or needles



2012: Sugar maple - Young leaves or needles

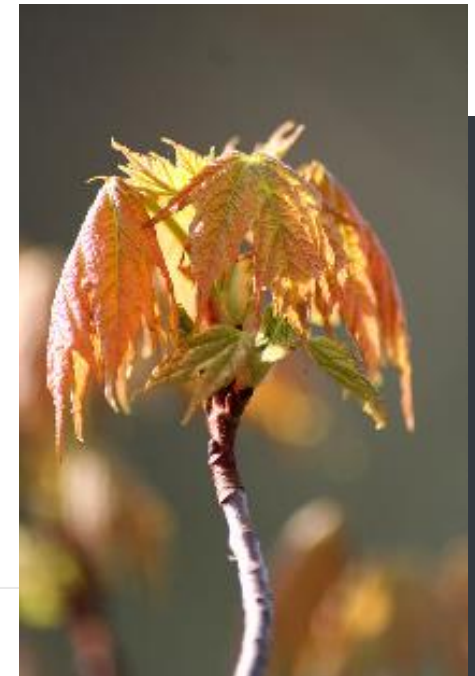


2011: Sugar maple - Young leaves or needles



January February March April May June July August September October November December

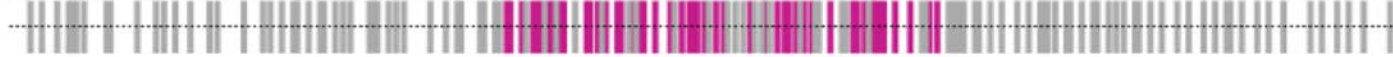
USA National Phenology Network [www.usanpn.org](http://www.usanpn.org)



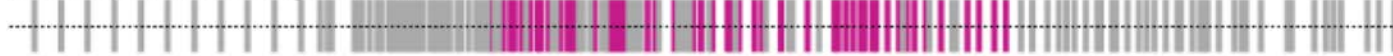
2020: Ruby-throated hummingbird - Active individuals



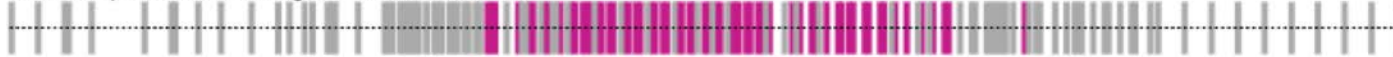
2019: Ruby-throated hummingbird - Active individuals



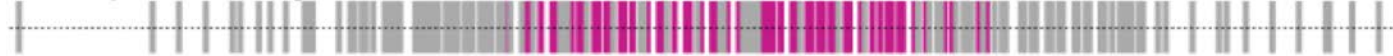
2018: Ruby-throated hummingbird - Active individuals



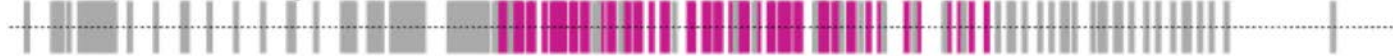
2017: Ruby-throated hummingbird - Active individuals



2016: Ruby-throated hummingbird - Active individuals



2015: Ruby-throated hummingbird - Active individuals



2014: Ruby-throated hummingbird - Active individuals



2013: Ruby-throated hummingbird - Active individuals



2012: Ruby-throated hummingbird - Active individuals

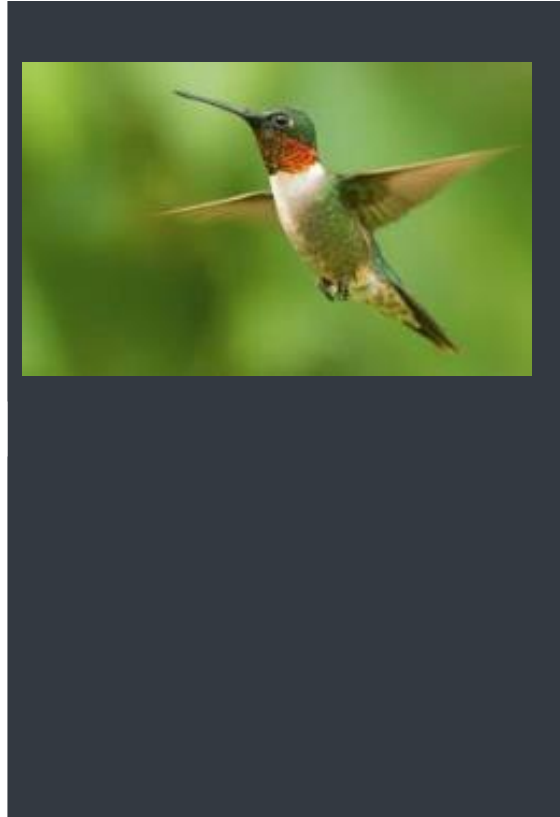


2011: Ruby-throated hummingbird - Active individuals



January February March April May June July August September October November December

USA National Phenology Network, www.usanpn.org

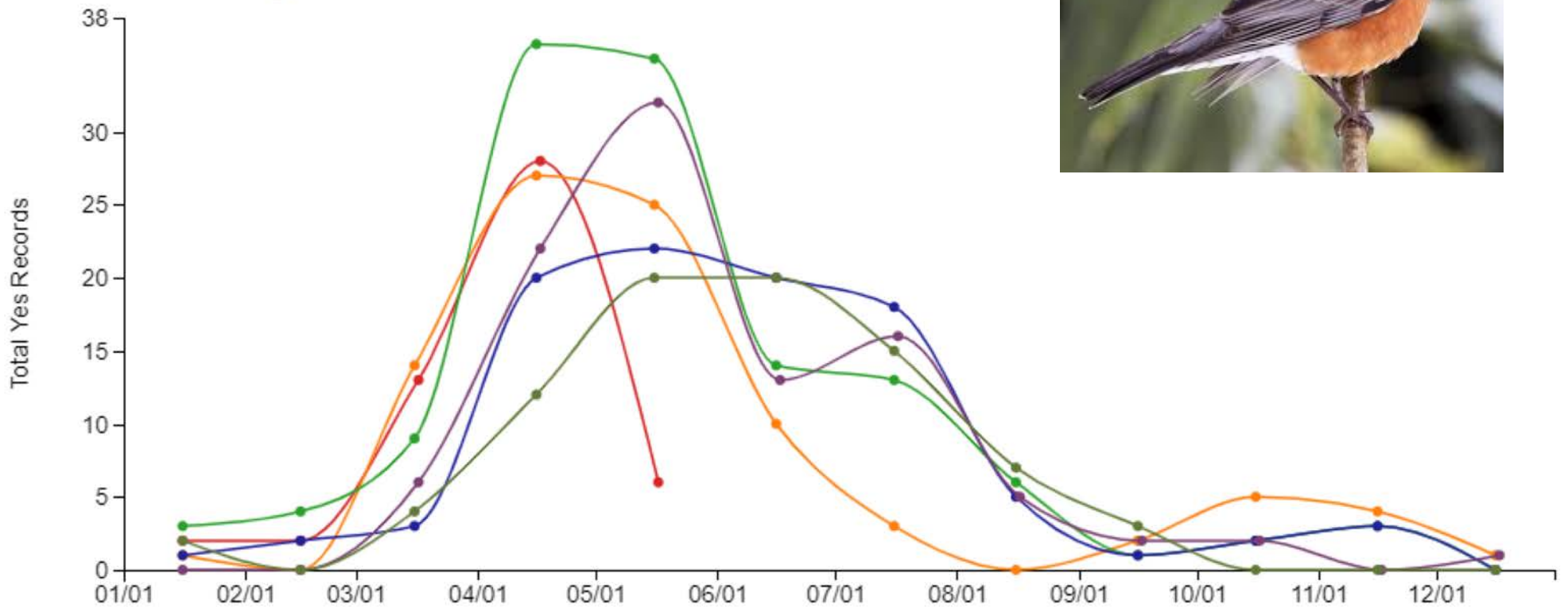


**JSGS**  
r a changing world

**USA npn**  
National Phenology Network

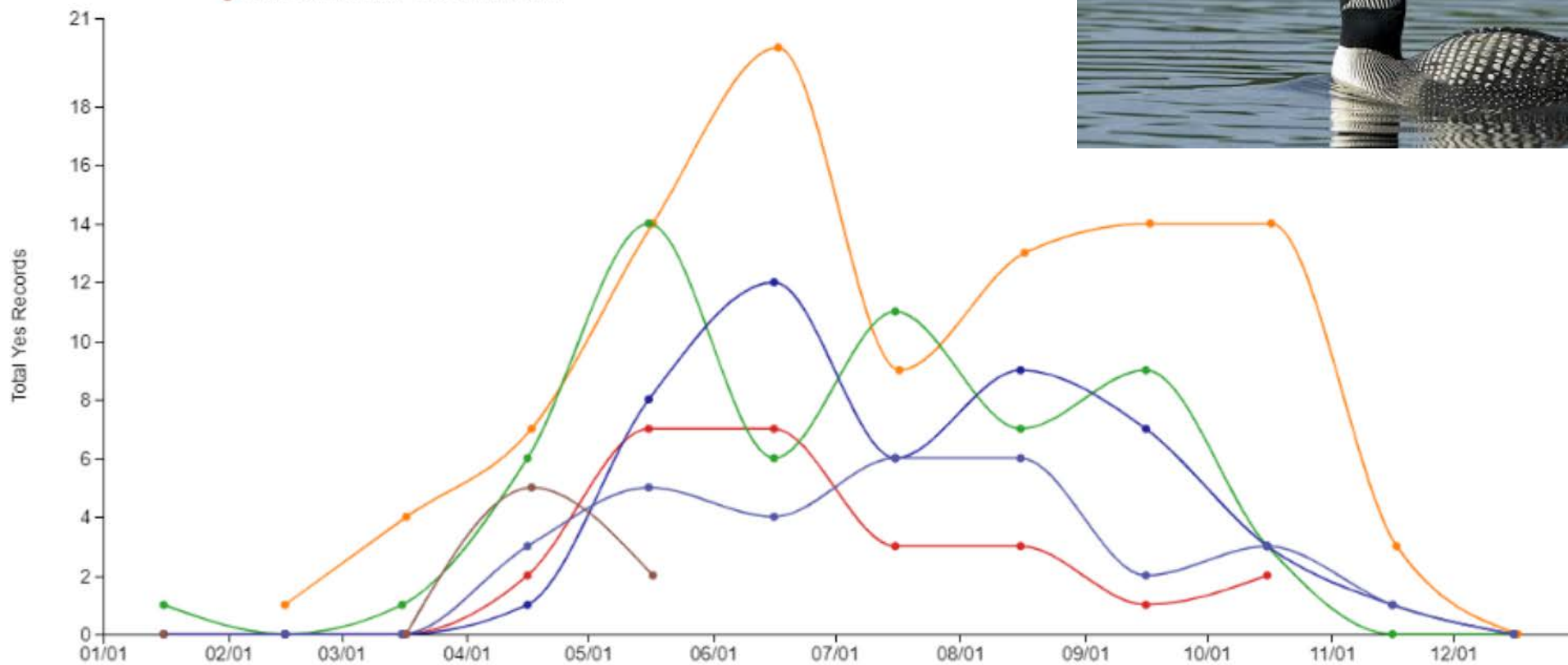
## Activity Curves

- 2020: American robin - Active individuals
- 2019: American robin - Active individuals
- 2018: American robin - Active individuals
- 2017: American robin - Active individuals
- 2016: American robin - Active individuals
- 2015: American robin - Active individuals



### Activity Curves

- 2015: Common loon - Active individuals
- 2016: Common loon - Active individuals
- 2017: Common loon - Active individuals
- 2018: Common loon - Active individuals
- 2019: Common loon - Active individuals
- 2020: Common loon - Active individuals





# Data access

- [github.com/usa-npn/](https://github.com/usa-npn/)
- R package
- APIs
- Online data access
- Visualization tool

## Phenology Observation Portal



**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**

**Your Download**

**Filters** [Eye icon] [Refresh icon] [Close icon]

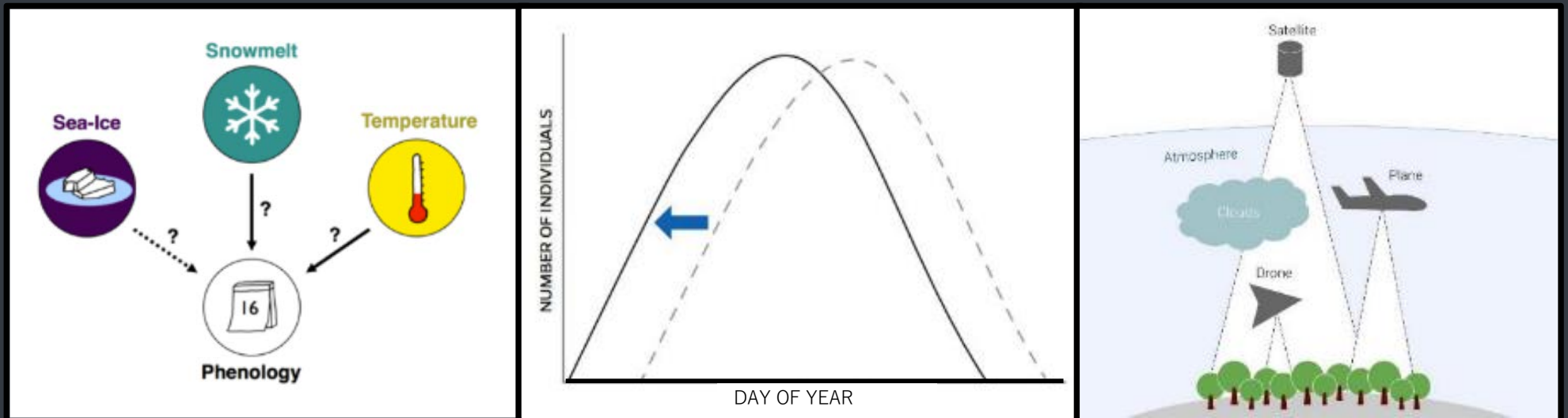
[data.usanpn.org/observations/get-started](https://data.usanpn.org/observations/get-started)

[www.usanpn.org](https://www.usanpn.org)



# Scientific uses of USA-NPN data & products

>80 peer-reviewed publications



[www.usanpn.org/publications](http://www.usanpn.org/publications)

[www.usanpn.org](http://www.usanpn.org)



# Understanding fundamental relationships



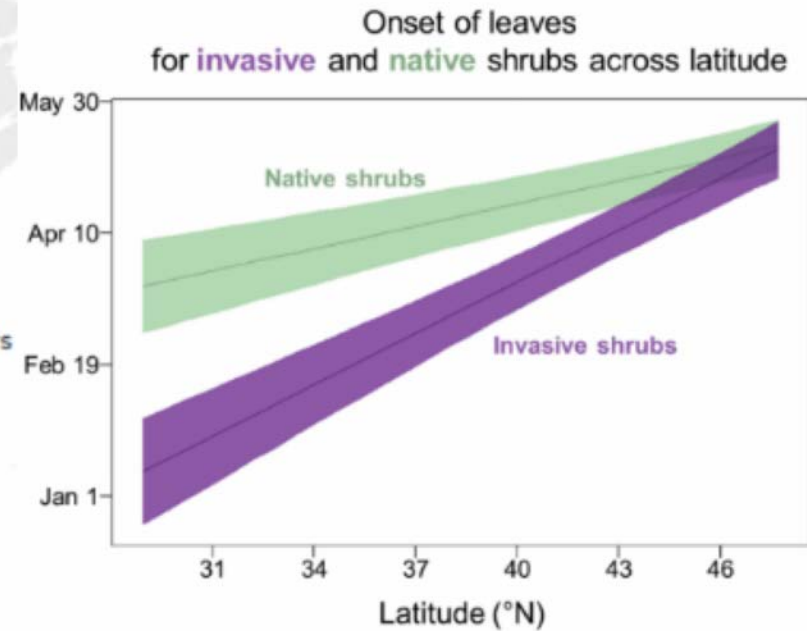
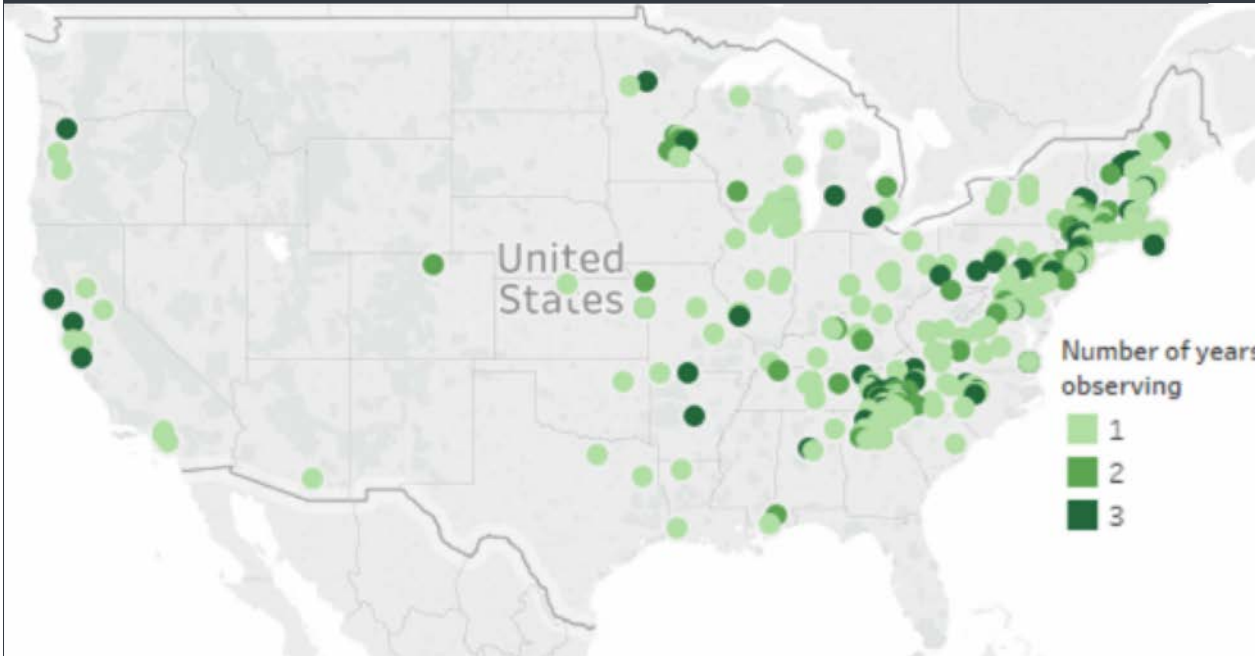
Li et al. 2019 *Nature Ecology & Evolution*

NSF-SAVI 1321595

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# Disentangling relationships



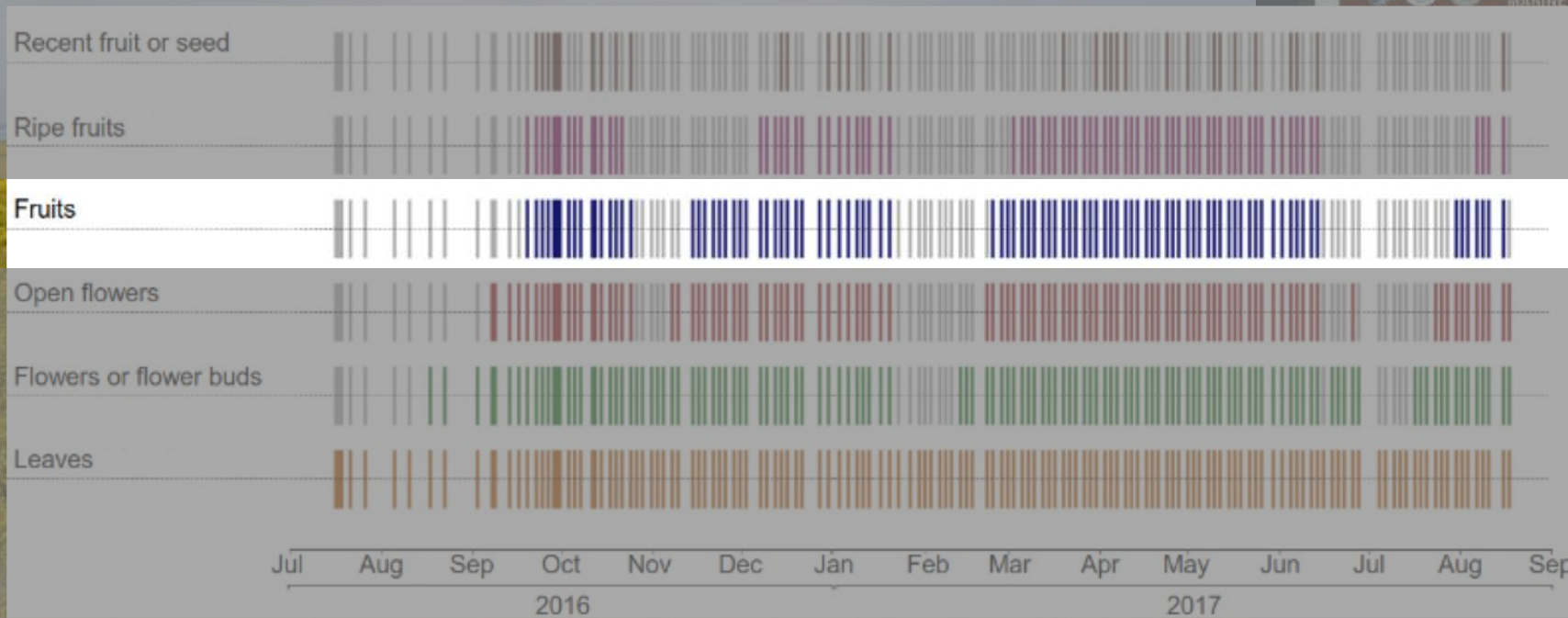
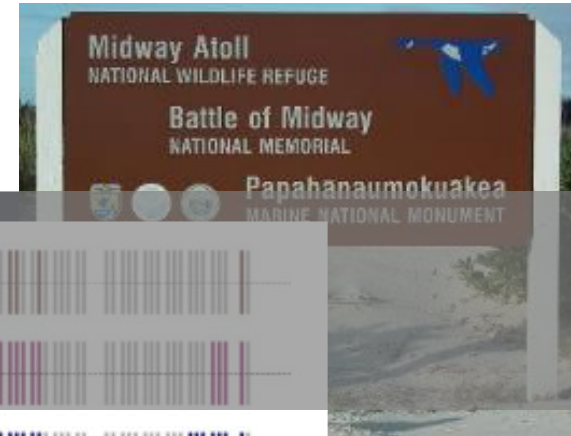
Maynard-Bean et al., in review *Front Ecol Environ*

NSF DDIG-1701740

[www.usanpn.org](http://www.usanpn.org)



# Partnering with USFWS: When to treat invasive plants?



Taylor et al., in press,  
*Ecological Solutions and Evidence*

[www.usanpn.org](http://www.usanpn.org)



# Join us!

- Observe using *Nature's Notebook*
- Discover patterns using phenology data
- Explore maps and forecasts
- Sign up for newsletters to stay informed



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Thank you!

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[@TheresaCrimmins](https://twitter.com/TheresaCrimmins)

and the entire USA-NPN team



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