

*Phenology as a tool for science,
management and education in a
changing environment*

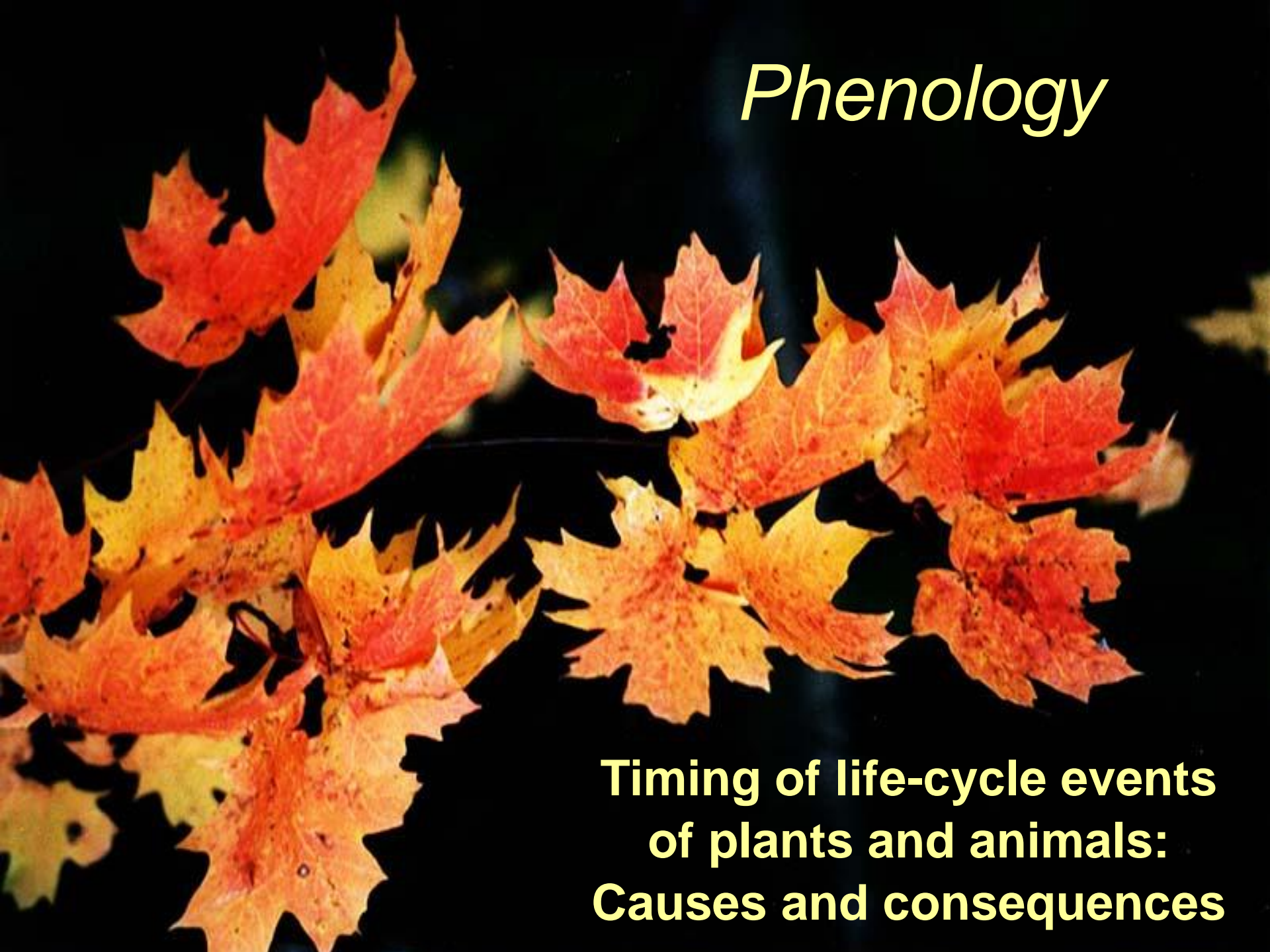
The USA National Phenology Network

Jake F. Weltzin

US Geological Survey

Outline

- **Why phenology is important**
 - **Science, Management, Education**
- **What is the USA-NPN?**
 - **Services & Partnerships**
- **Phenology monitoring**
- **Networking the networks**



Phenology

**Timing of life-cycle events
of plants and animals:
Causes and consequences**



“Phenology...is perhaps the simplest process in which to track changes in the ecology of species in response to climate change.” (IPCC 2007)





- Easy to observe
- Sensitive to environmental variation
- Scales from 'leaf to globe'
- Linked to most aspects of ecosystems



Changes in spring timing for many organisms



Camille Parmesan

Parmesan and Yohe

- Meta-analysis
- 677 species examined
- 16-132 years (med = 45)
- 62% advanced in timing

Earlier flight by butterflies



Art Shapiro

34 years (1972-2006)

83,000 records

**“23 species in Central Valley
average 24 days earlier”**

Red admiral: 1 day/year



Fotolia

Field skipper: 1 day/year



Steve Scott



English Oak

EARLIER

**A three-way
mismatch**



Winter Moth

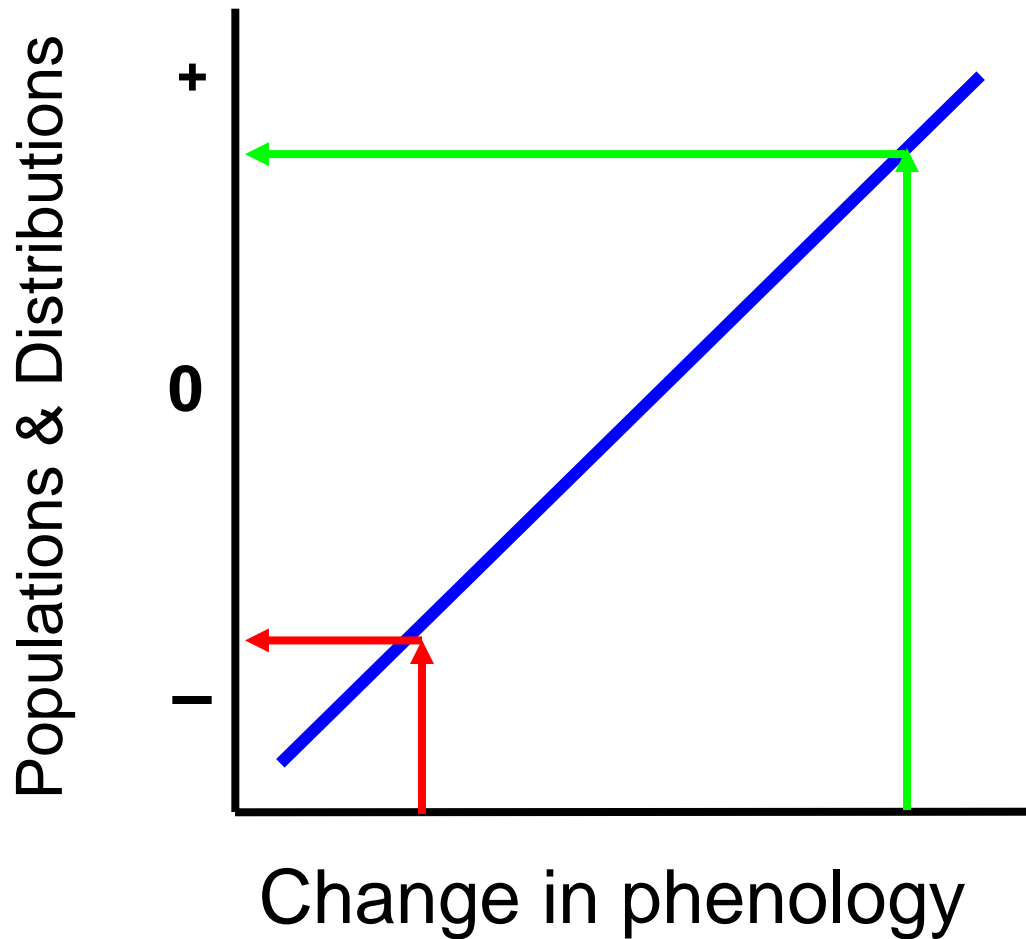
EARLIER



Pied Flycatcher

**SAME TIME
EACH YEAR**

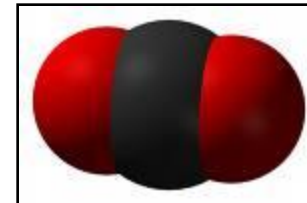
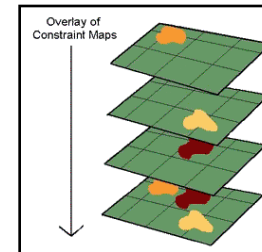
Predicting vulnerability, invasions and distributions



Willis et al. 2008 PNAS
Moller et al. 2008 PNAS
Willis et al. 2010 PLOS Biology
Hulme 2010 New Phyt.
Ozgul et al. 2010 Nature

Applications and decision-support tools

- Science
- Predictive services
- Health
- Resource mgmt
- Conservation
- Agriculture
- Ecosystem services
- Recreation



Pollen early warning systems



Phenology
Observations



Satellite Imagery



Predictive
Modeling



Allergen Alerts



Buffelgrass Phenology Reporter

WELCOME TO THE BUFFELGRASS GREENNESS REPORTER!

Current buffelgrass greenness (07/21/2009) <-- Older Newer -->

TODAY'S BUFFELGRASS GREENNESS REPORTS

<-- Older Newer -->



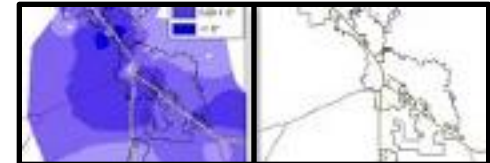
<http://java.arid.arizona.edu/bgpheno>



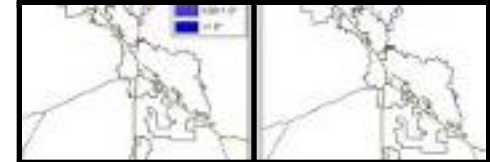
Phenology Model

Precip Green

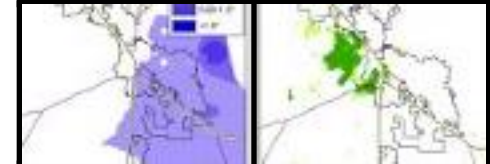
July 1



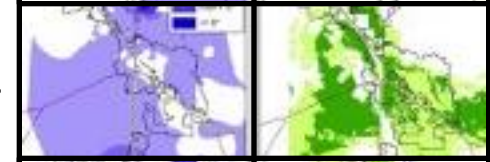
July 2



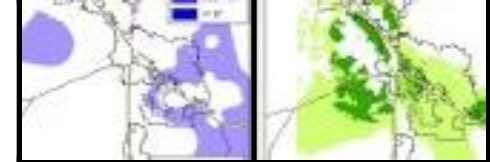
July 3



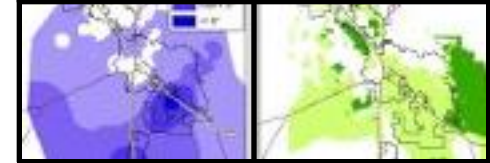
July 4



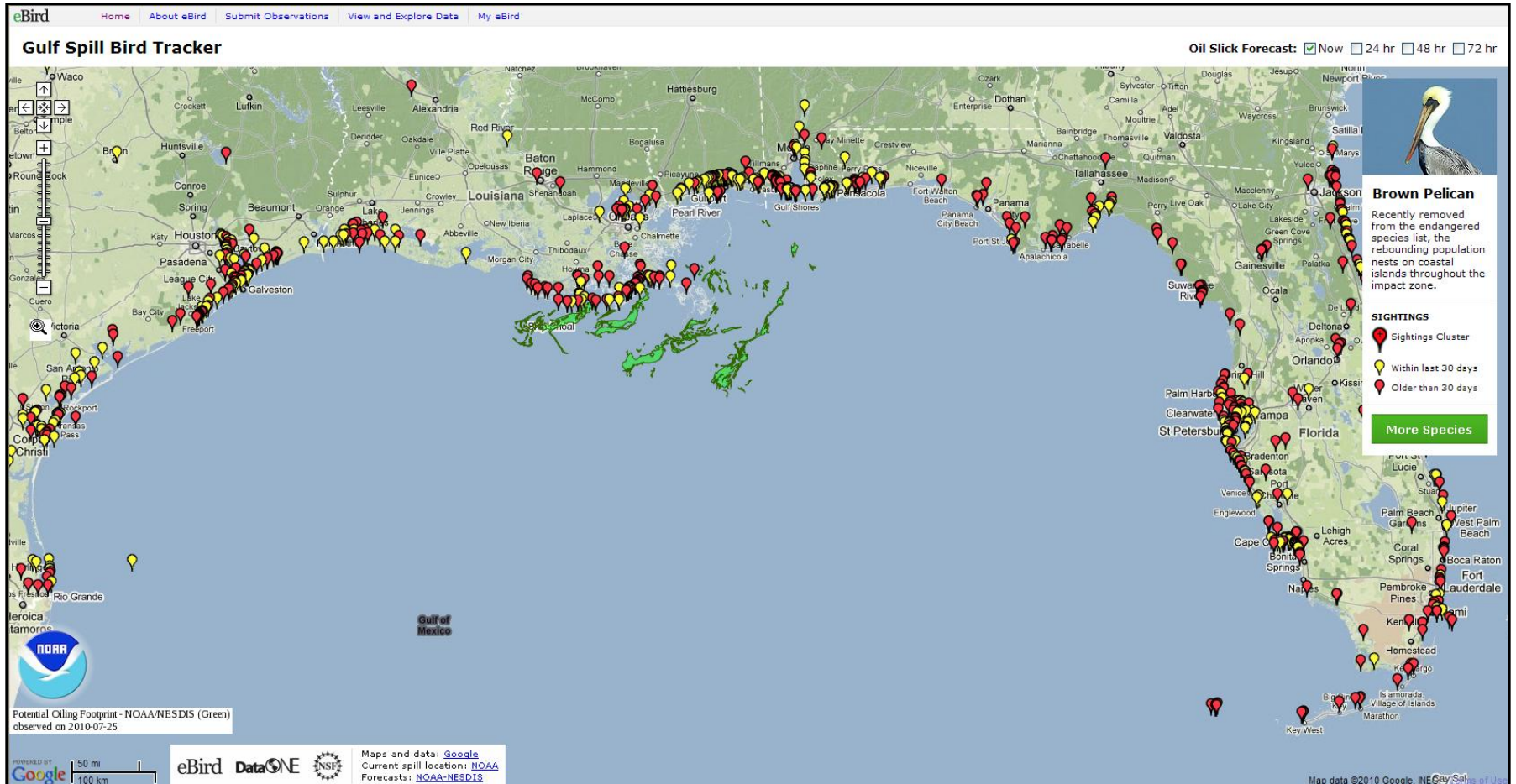
July 5



July 6



Disaster management



Education and outreach for K-Gray



Ross Franklin, AP



Steve Ringman, The Seattle Times

What is USA-NPN?

Services & partnerships

Evolution of USA-NPN

Ecological Impacts of Climate Change

Report from a
NEON Science Workshop



August 24–25, 2004
Tucson, Arizona

neon
National Ecological Observatory Network

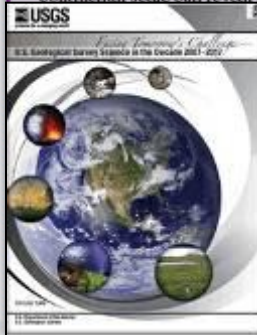
American Institute
of Biological Sciences

IBRCS
Infrastructure for Biology at Regional to Continental Scales
A component network of IBIS



A National Phenology Network

Phenology is the study of the times of recurring natural biological phenomena, especially in relation to climate. It is recording when the first robin arrives in the spring, or when the lilacs bloom. Records of shifts in phenology, or seasonal timing of flower development or other vegetation changes, animal migrations, hibernations, and the seasonal activity of cold-blooded animals, do more than simply provide powerful indicators of climate variability and change. Variations in phenology have consequences for individuals and can scale up to broader ecological dynamics. Spatially replicated phenological studies at the continental scale can reveal much about the ecology and



s, and ecosystems (Post, and spore production influence of pollinators to arrive at natural productivity. Large-scale change can be detected with a This type of information will be useful for natural resource management and for developing appropriate responses to climate change. This type of information will be useful for natural resource management and for developing appropriate responses to climate change. This type of information will be useful for natural resource management and for developing appropriate responses to climate change.



USA National Phenology Network
National Coordinating Office

Strategic Plan 2010-2015
September 2009



USA National Phenology Network Strategic Plan 2010-2015
September 2009

Page 1



IPCC WGII AR5, AR6
Whitehouse, OSTP, USGCRP
National Climate Assessment
DOI - CSC, LCC, Working Groups
USGS - CEN, NCCWSC
Many stakeholders



A new data resource—a national network of integrated phenological observations across space and time

Key Goal

Understand how plants, animals and landscapes respond to environmental variation and climate change

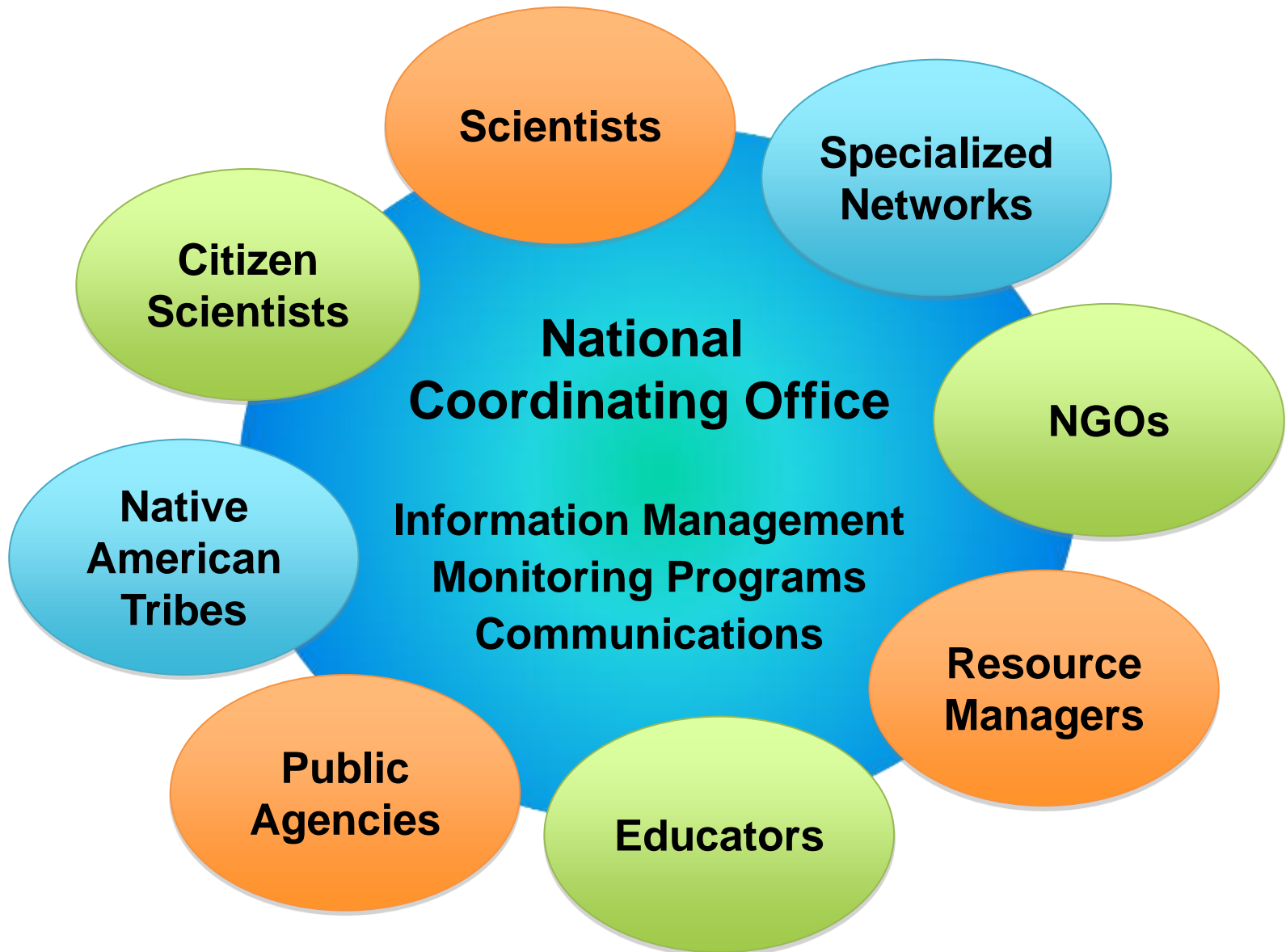
USA-NPN in a nutshell

- A national biological science and monitoring program
- Agencies, NGOs, academia, the public
- Standard protocols for plants, animals & landscapes
- Facilitate scaling from 'leaf to globe'
- Integrate with other monitoring networks
- Business to Business and Business to Customer

Core functions

- Develop a national phenology information management system
- Develop a national phenology monitoring system
- Develop partnerships for implementation
- Conduct and facilitate education and outreach
- Facilitate phenology science and research
- Facilitate development of decision support tools

Services for stakeholders and partners

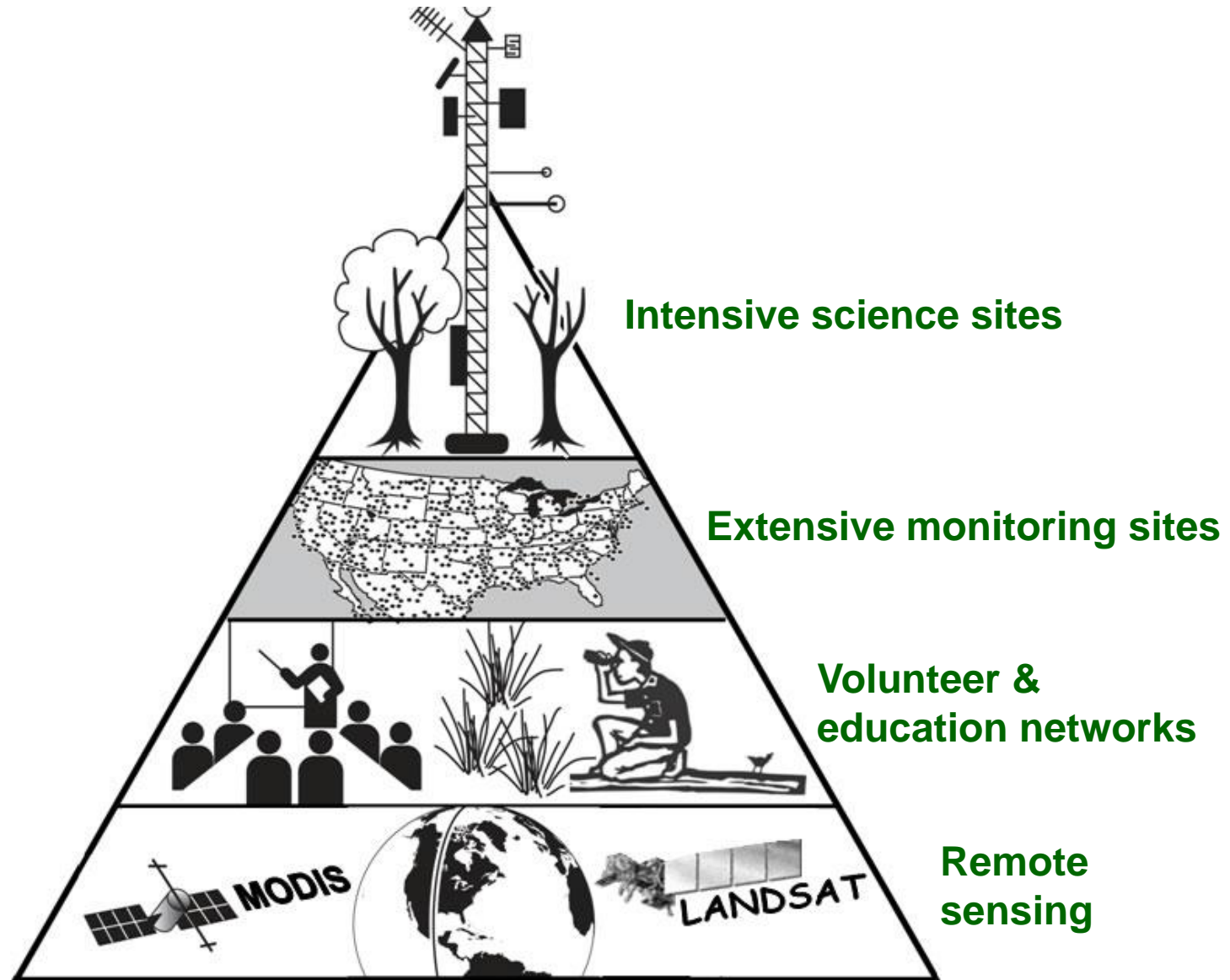


Key sponsors and collaborators...

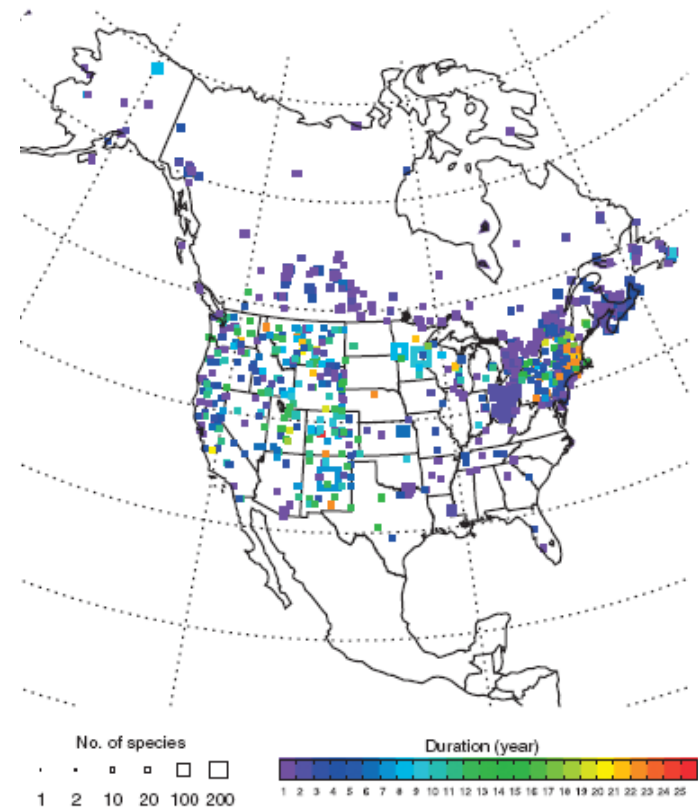
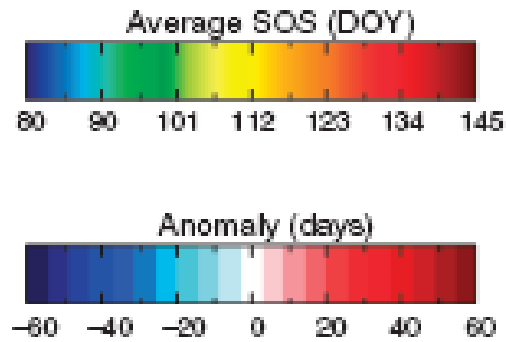
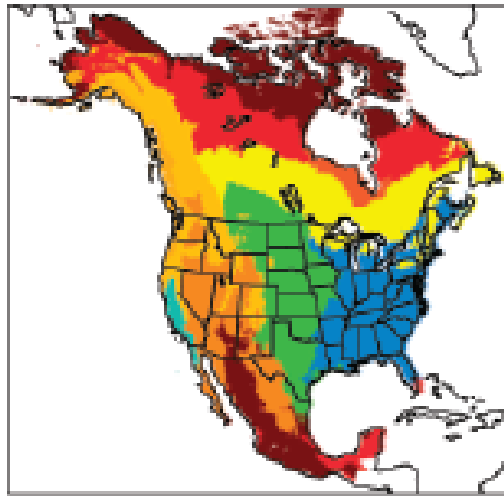


Phenology monitoring

Multi-tiered monitoring



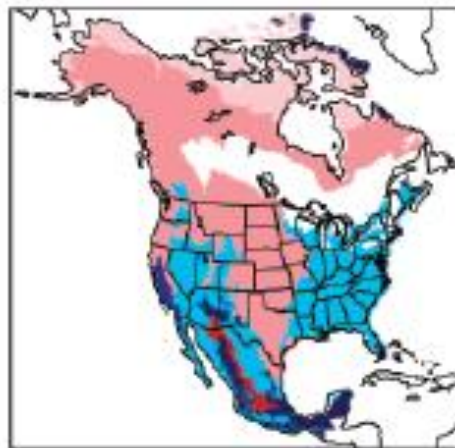
Estimating start of season (SOS)



PAT



Gaussian



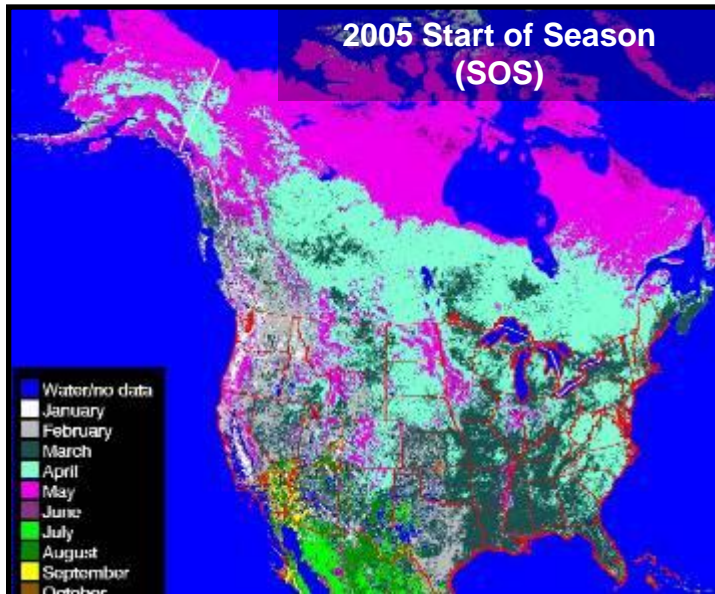
Midpoint_{cluster}



Organizing remote sensing of phenology



- Standardization
- Validation
- Integration across products and scales
- Research into utility and accuracy of products





nature's notebook

a project of the USA-NPN

- Go to www.usanpn.org
 - 253+ plant species
 - 58+ animal species
 - Core protocols

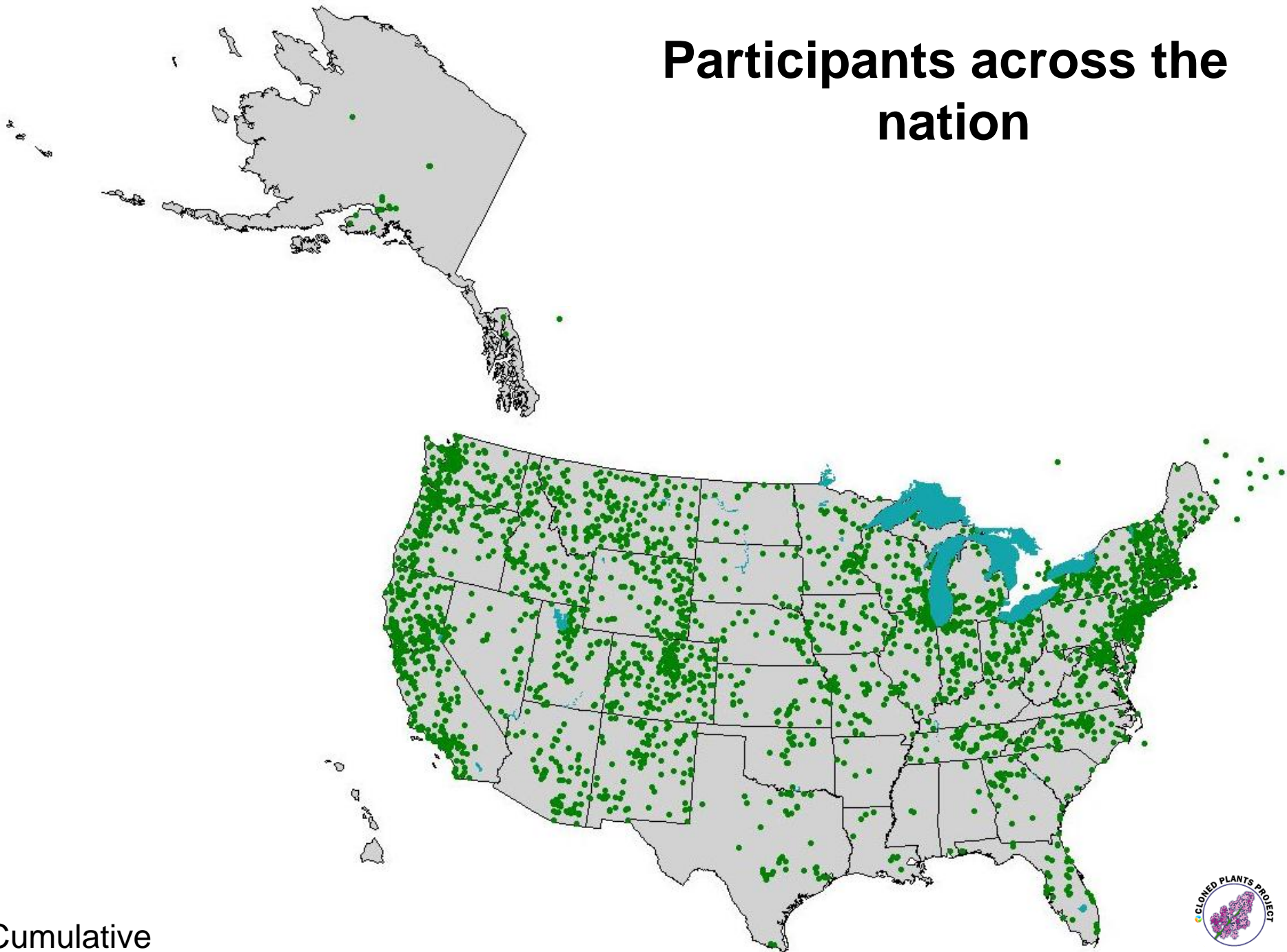
Coming soon

- Species on demand
- Abundance reporting
- User profiles



Metadata: method used, effort reporting, condition of site & organism

Participants across the nation



Cumulative

Real-time data now available

Share Existing Data

Access Historical Data


Publications

Maps



[Home](#) > [Download Data](#)


Download Data

Download contemporary phenology  data from the USA-NPN's Nature's Notebook program.

Please include the following acknowledgement in all publications using USA-NPN data. This can be done either in the main text or the Acknowledgements section.

“Data were provided by the USA National Phenology Network and the many participants who contribute to its Nature's Notebook program.”

Upon publication of manuscripts that use USA-NPN data, please provide bibliographic information to nco@usanpn.org.

Please cite the USA-NPN data sets following the citation given in the metadata , for example:

Citation: USA National Phenology Network. 2010. Plant Phenology Data for the United States, 2009. Tucson, Arizona, USA: USA-NPN. Data set accessed YYYY-MM-DD at <http://www.usanpn.org/results/data>.

This Data Attribution Policy (v1.0) was approved by NCO staff on 8-19-10.

[Download 2009 Data Set - Definitions Excluded](#) - 14.5MB

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March 2, 2009 - December 31, 2009

FGDC Metadata: [HTML](#) or [XML](#)

[Download 2010 Plant Data Set - Definitions Excluded](#)- ~8.0MB

[Download 2010 Plant Data Set - Definitions Included](#) - ~20.0MB


January 1, 2010 - today

FGDC Metadata: [HTML](#) or [XML](#)



E. Denny

Networking the Networks

- What Pete Murdoch said!
- Progressive data management, sharing, integration
 - Open-source
 - Web-services
 - Crosswalk-algorithms for data and metadata
- Crosswalk protocols and standards 
- Co-location and resource sharing
- 3 Cs: Communication, coordination, collaboration

USGCRP National Climate Assessment Ecosystems Interagency Working Group (EcoIWG)

Workshop: "Monitoring climate change and its impacts:
sources for indicators, detection, and attribution"

- (1) identify and suggest ways to prioritize indicators for monitoring
- (2) identify existing observation and monitoring networks that are collecting or could collect data on these indicators
- (3) identify the needs, gaps, and challenges associated with collecting data on these indicators
- (4) develop a framework to implement existing network to collect indicator information [sic]

Goal: Effective and efficient design of integrated monitoring networks to detect the effects of and responses to climate change in US ecosystems and their biodiversity



USA National Phenology Network

The USA National Phenology Network brings together citizen scientists, government agencies, non-profit groups, educators and students of all ages to monitor the impacts of climate change on plants and animals in the United States. The network harnesses the power of people and the Internet to collect and share information, providing researchers with far more data than they could collect alone.

[Learn more about us](#)

What is phenology?

Phenology refers to recurring plant and animal life cycle stages, or phenophases, such as leafing and flowering, maturation of agricultural plants, emergence of insects, and migration of birds. Many of these events are sensitive to climatic variation and change, and are simple to observe and record. As an USA-NPN observer, you can help scientists identify and understand environmental trends so we can better adapt to climate change.

[Why is phenology important?](#)

[USA-NPN News](#)

[Phenology Feed](#)

[Join the Conversation](#)

- ▶ [Introducing the USA-NPN Video](#)
- ▶ ["How to Observe" Handbook for Nature's Notebook](#)

www.usanpn.org



Are you...?

- New to phenology?
- Ready to start observing?
- One of our partners?
- Interested in creating a partnership?
- An educator?



western columbine

[View All Species](#)

Join Us!

We are looking for volunteers to help us monitor plant and animal species found across the United States. Click "Observe" to join us!

[Observe](#)

Sponsors

