Tracking Phenology for Research, Management and Education in the Face of Climate Change

The USA National Phenology Network

Jake F. Weltzin

US Geological Survey

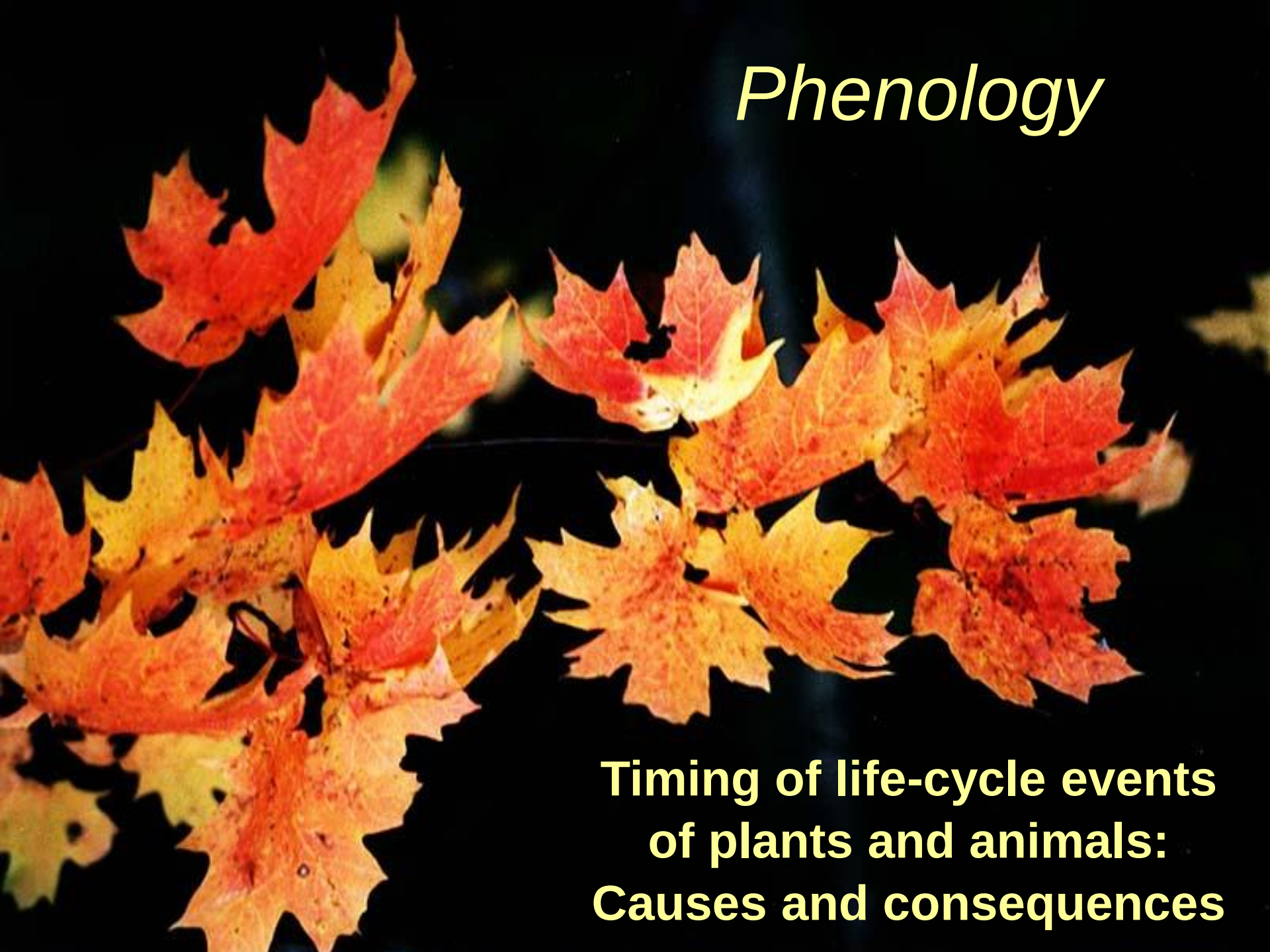
USA npn National Phenology Network

www.usanpn.org

USGS science for a changing world

Outline

- **Introduction to phenology**
- **Applications for phenology information**
- **Introduction to USA-NPN**
- **Phenology monitoring: Nature's Notebook**
- **Partnerships**



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

Art Shapiro's butterfly world

Butterfly population trends

- 34 years (1972-2006)
- 5,476 site-visits
- 83,000 records
- 159 butterfly species

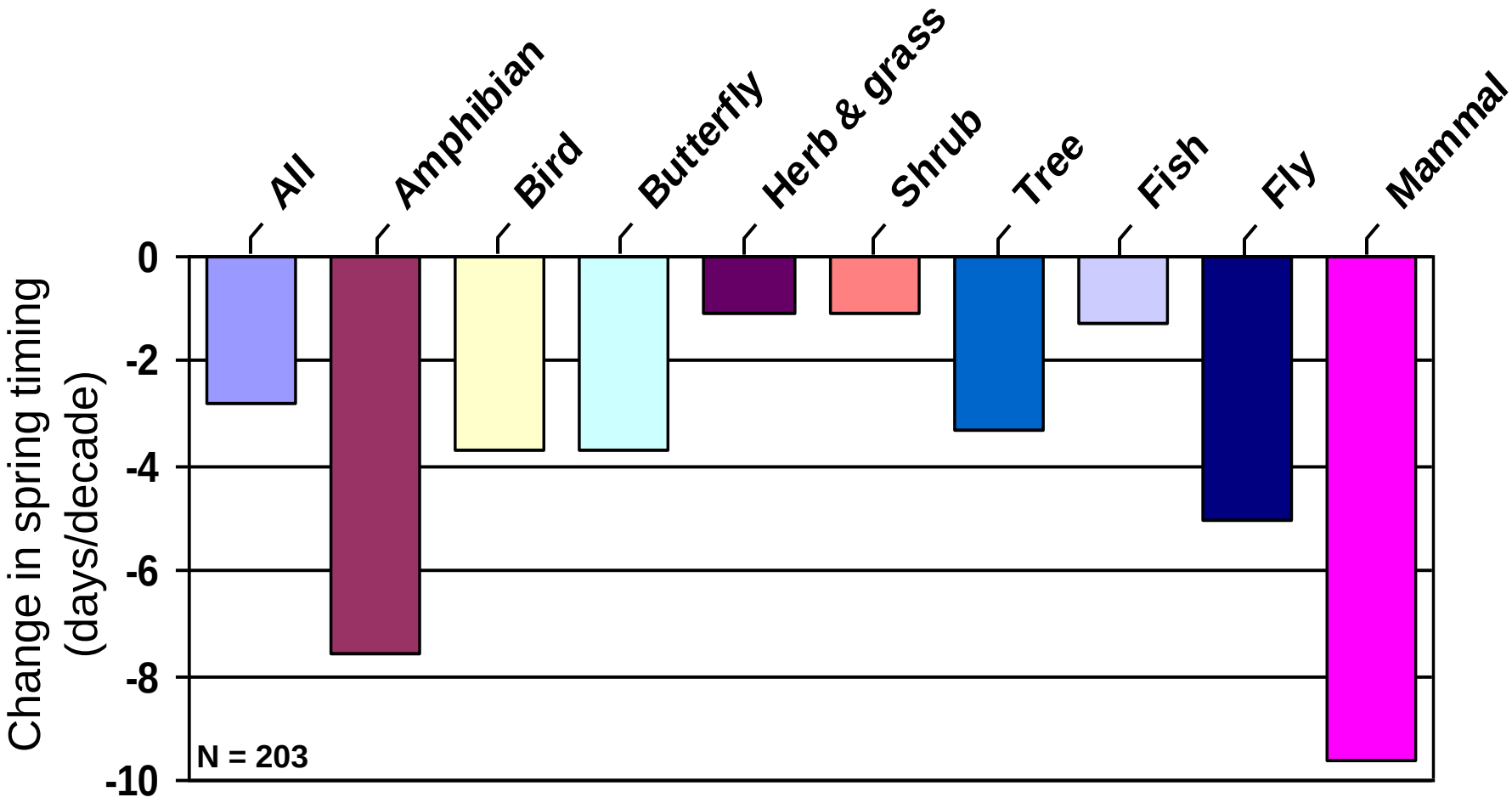
"23 species in Central Valley average 24 days earlier"

Red admiral: 1 day/year

Field skipper: 1 day/year

Forister and Shapiro 2003 GCB

Response depends on the type of organism



Parmesan 2007 GCB

A three-way mismatch

EARLIER

English Oak

Winter Moth

EARLIER

SAME TIME EACH YEAR

Pied Flycatcher

Both et al. 2006 Nature

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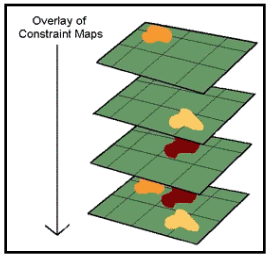
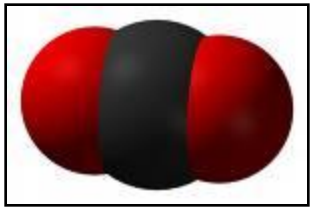
Impacts, vulnerability, decision-making, forecasting

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



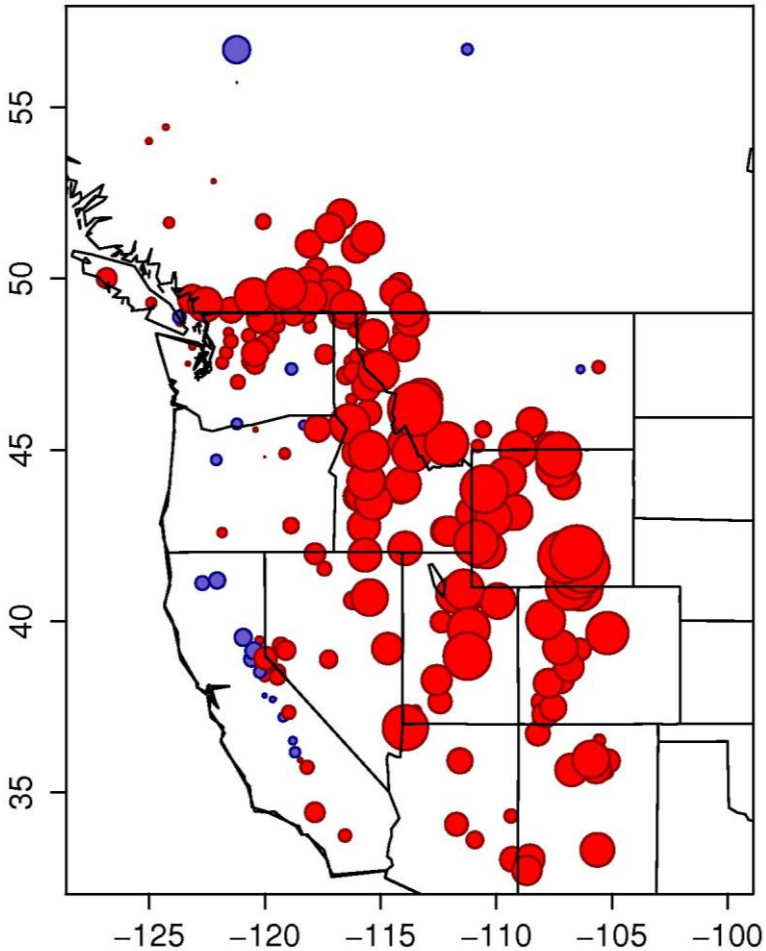


Predicting frequency of large forest fires

fires > 400 ha in SW US, 1970-2003, vs CT and vs SI

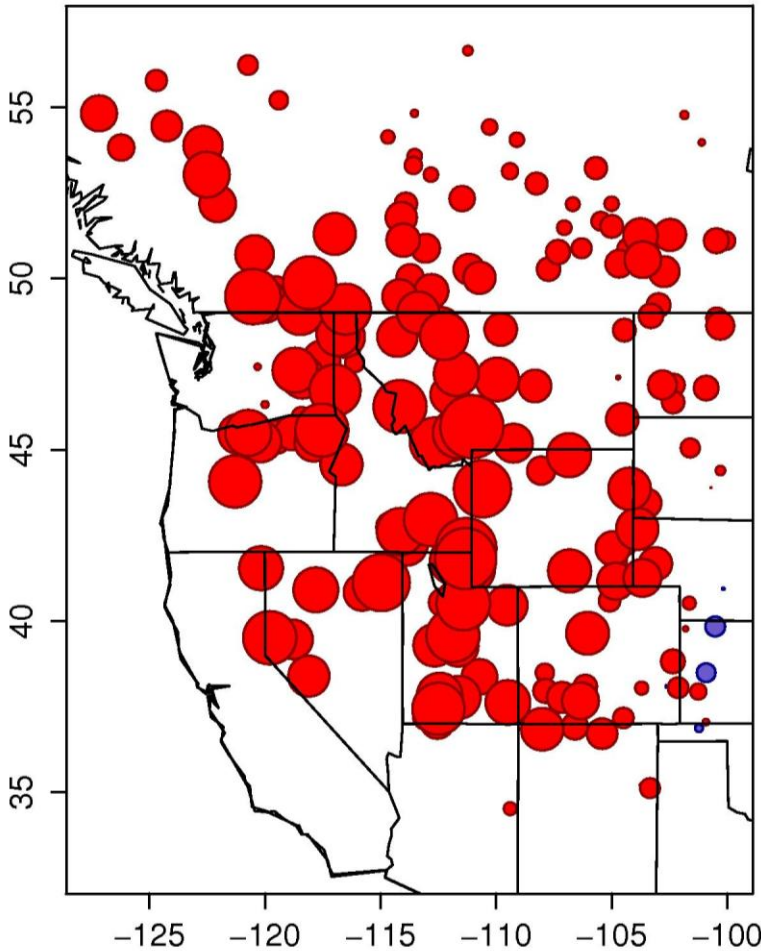
Streamflow

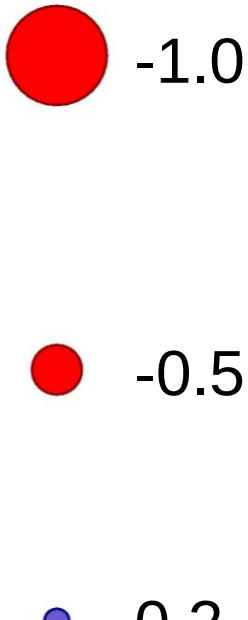
CT (center of mass)



Phenology

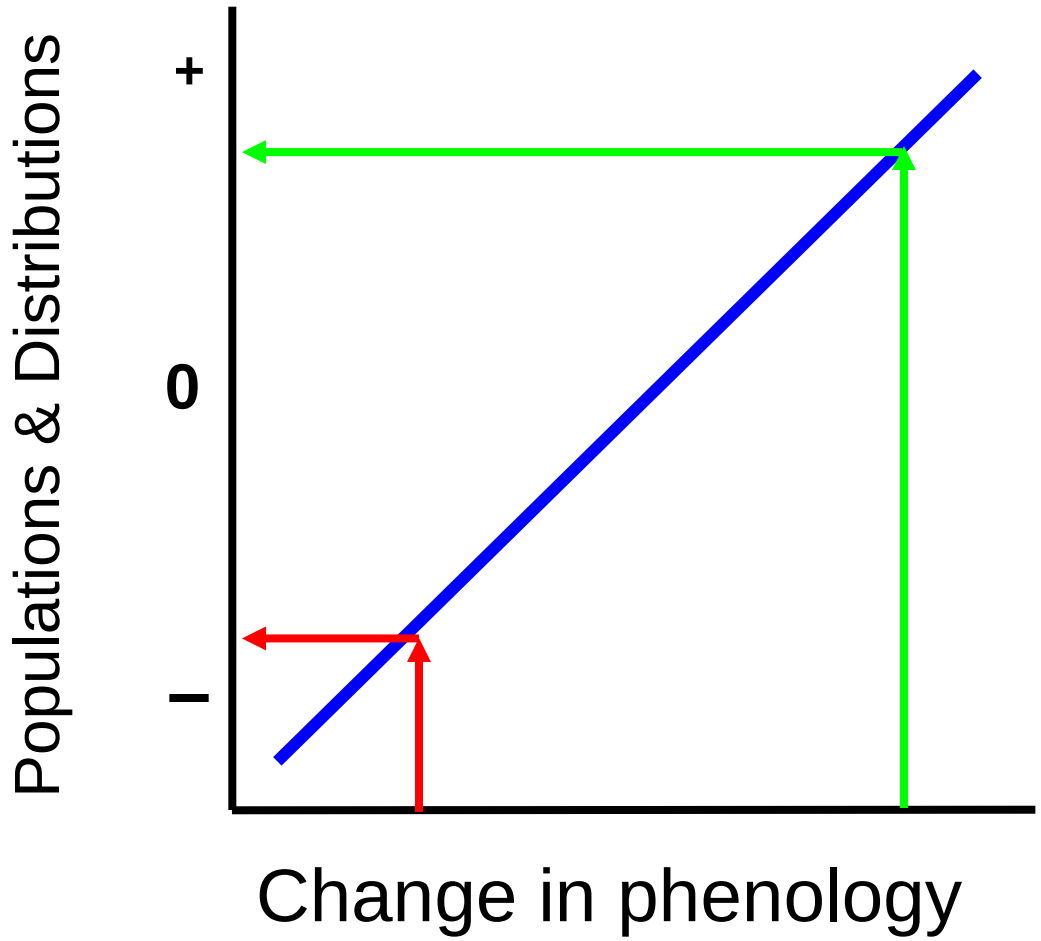
SI (lilac & honeysuckle)





Westerling, Schwartz & Betancourt, in prep.

Predicting vulnerability, invasions and distributions



Willis et al. 2008 PNAS
Moller et al. 2008 PNAS
Willis et al. 2010 PLOS Biology
Ozgul et al. 2010 Nature
Hulme 2011 New Phyt.

Determine timing of management activities

Courtesy Julio Betancourt

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USA npn National Phenology Network

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

Core functions

- Develop a national phenology information management system

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

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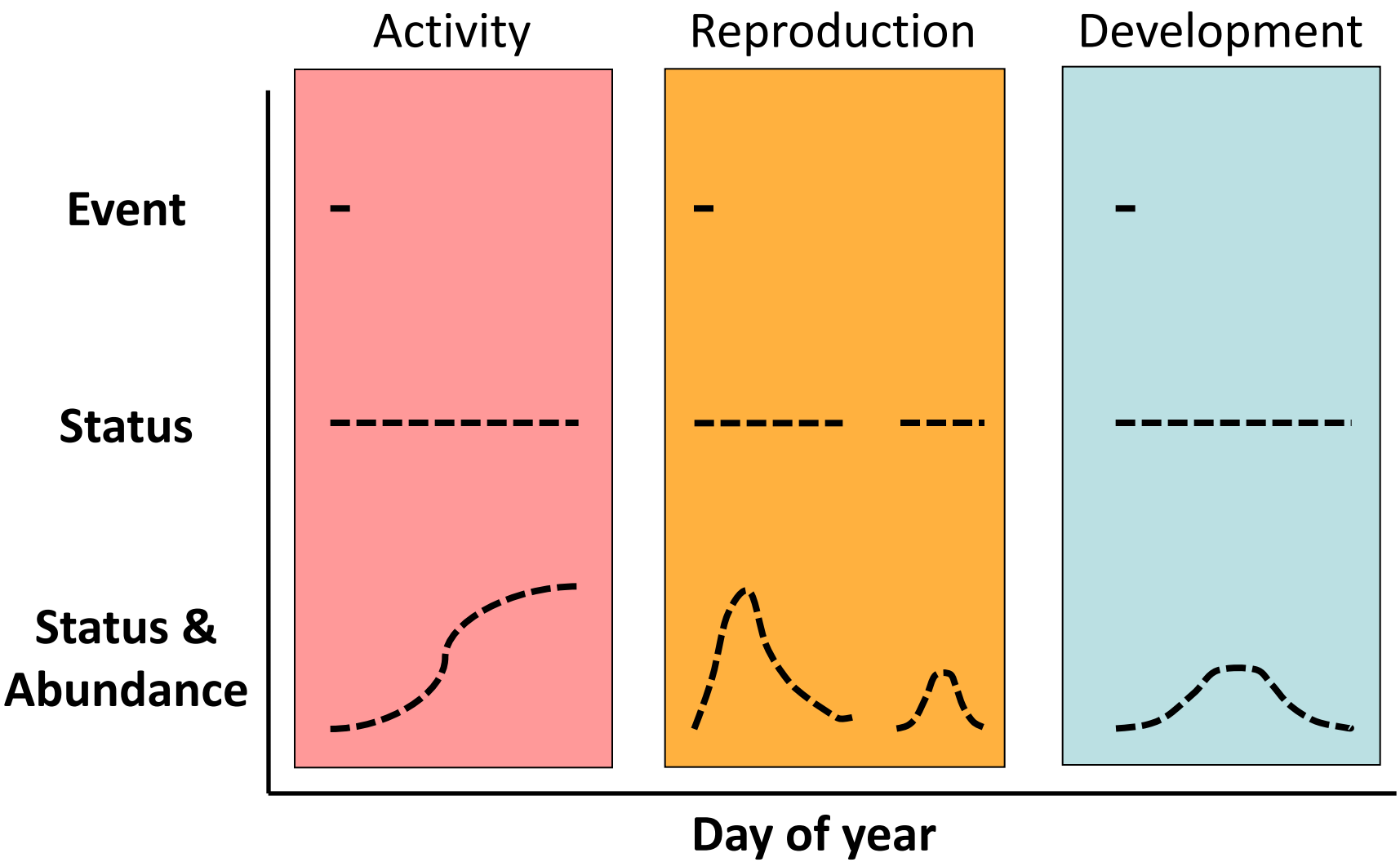
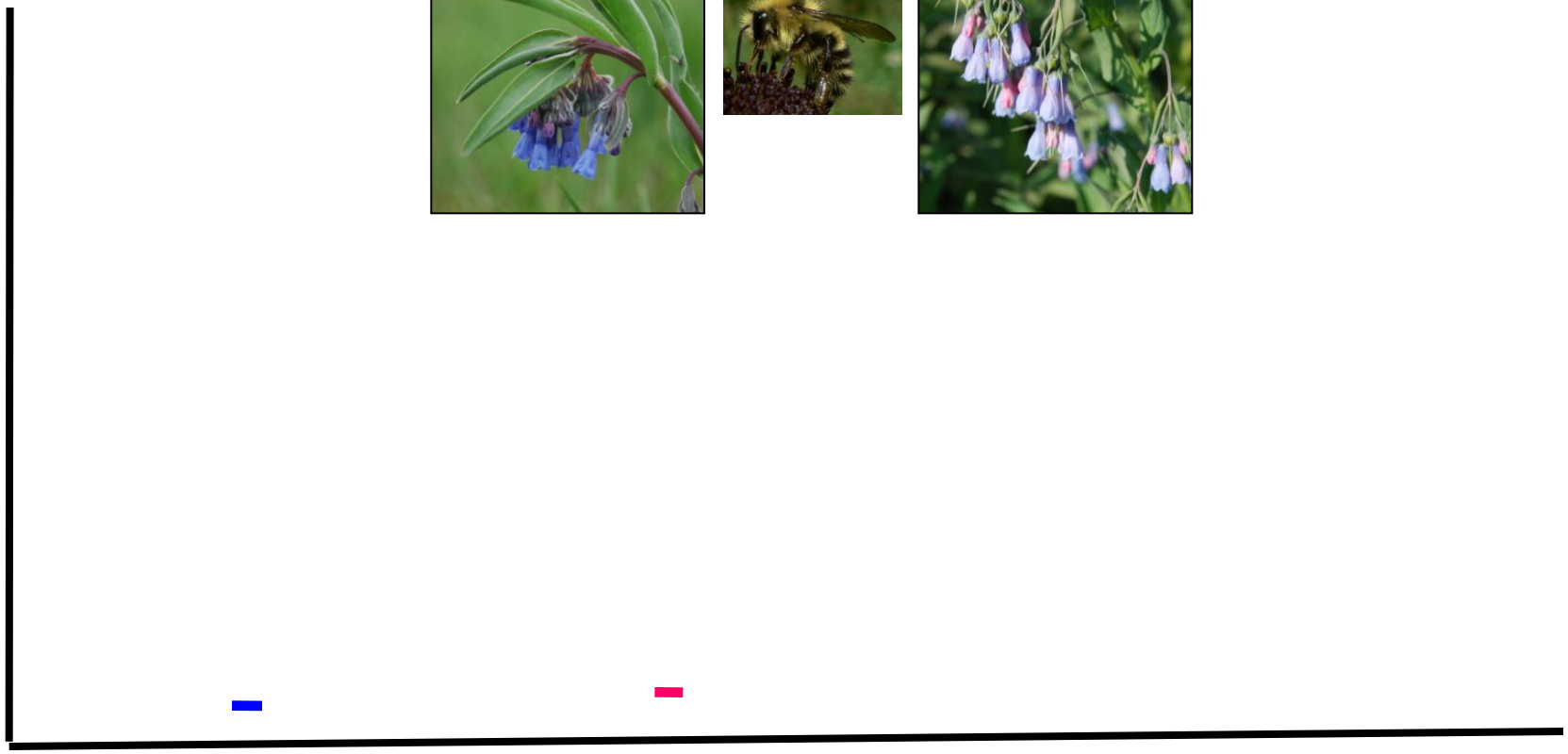
Phenology Monitoring Methods



Plants and pollinators - Event

M. fusiformis

M. ciliata

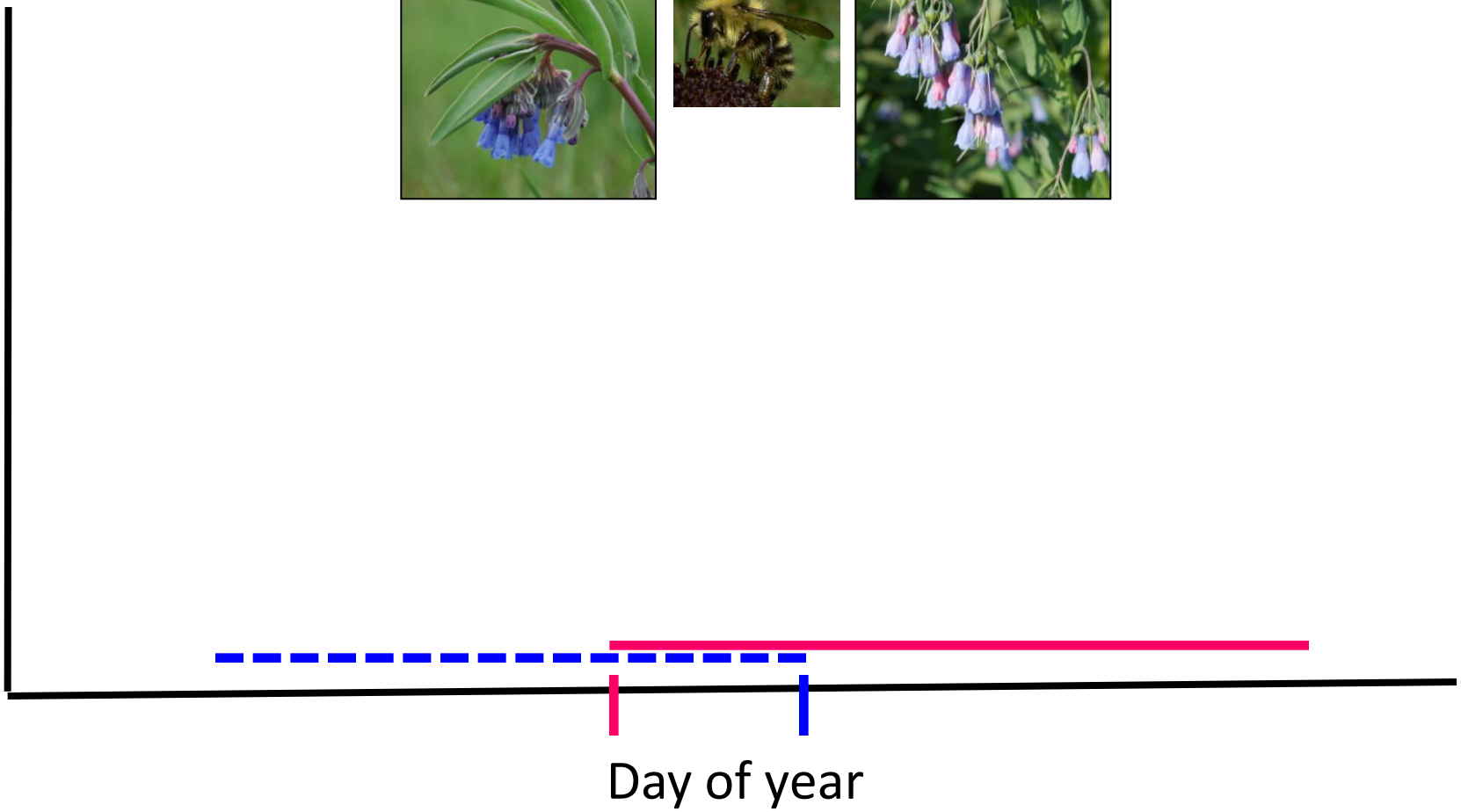


Miller-Rushing and Inouye. 2009. American Journal of Botany

Plants and pollinators - Status

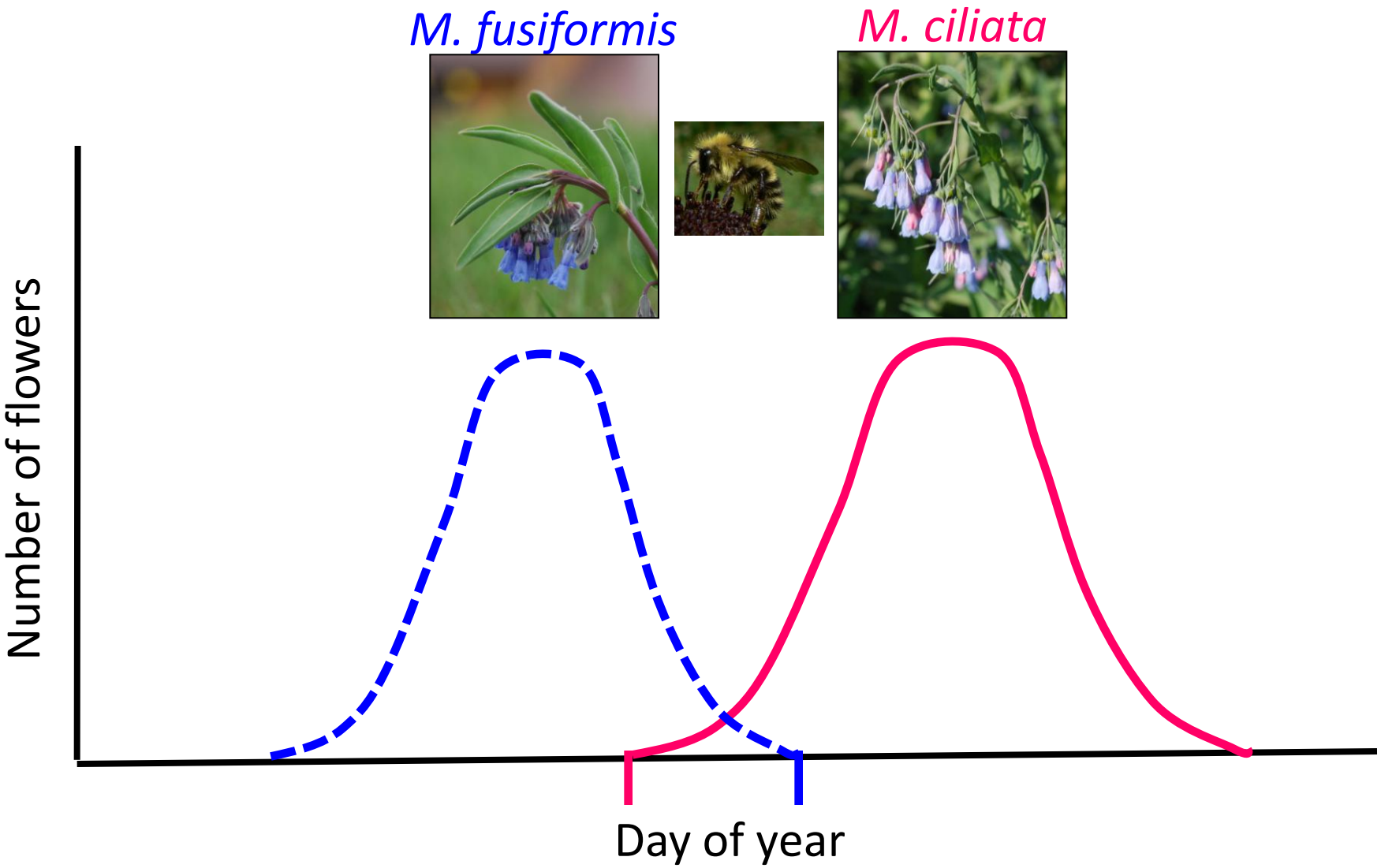
M. fusiformis

M. ciliata



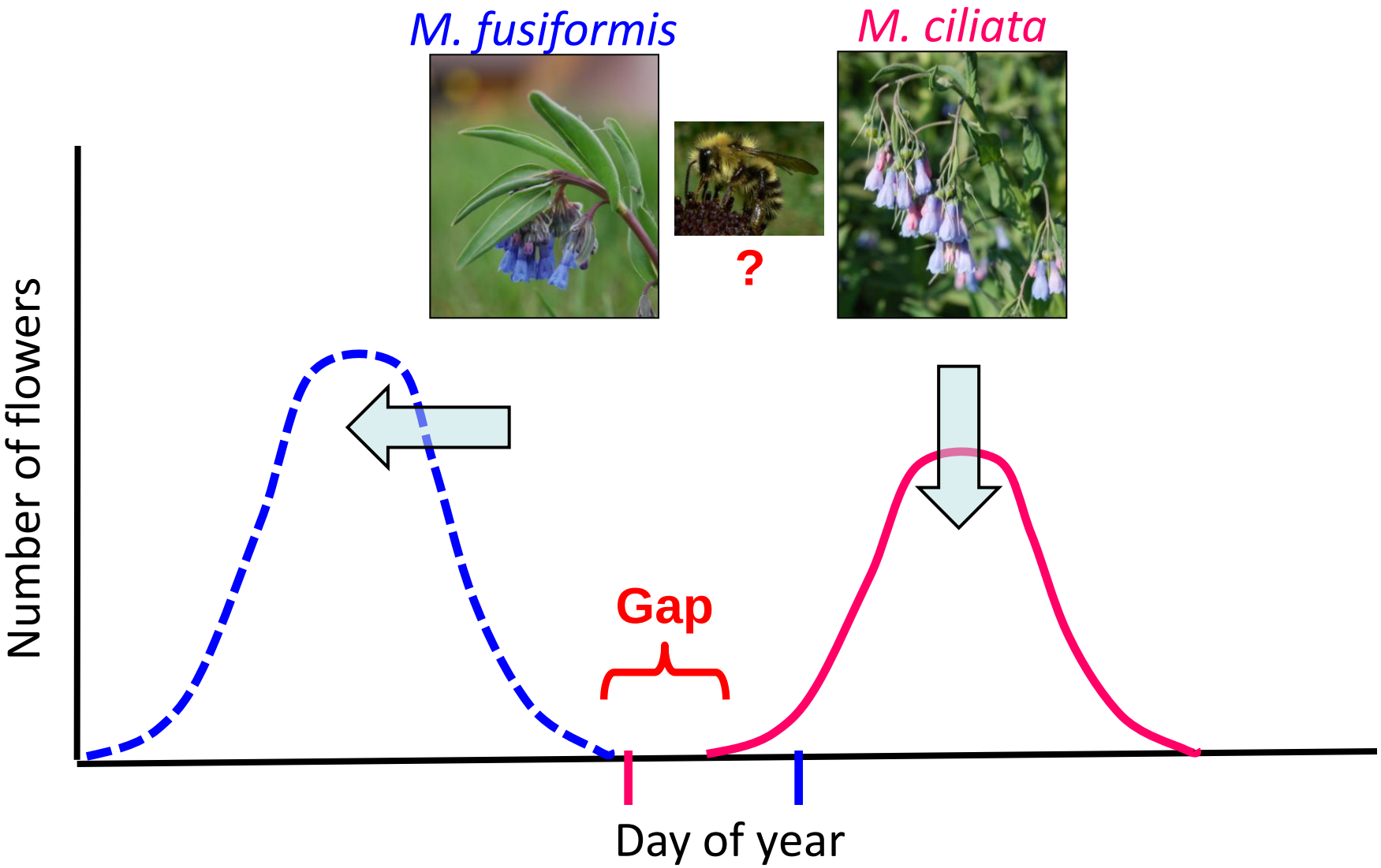
Miller-Rushing and Inouye. 2009. American Journal of Botany

Plants and pollinators - Status + Abundance



Miller-Rushing and Inouye. 2009. American Journal of Botany

Resource gaps for pollinators



Miller-Rushing and Inouye. 2009. American Journal of Botany

nature's notebook

a project of the USA-NPN

- Go to www.usanpn.org
  - 250 plant species
  - 160 animal species
  - Status + abundance
  - Core protocols

<u>Coming soon</u>

- 300 new plant species
- User profiles
- Shared sites

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

Real-time data now available

Overview

Data

Access Historical Data

Share Existing Data

Publications

Reports

Sponsors

THE UNIVERSITY OF ARIZONA.

UWM UNIVERSITY of WISCONSIN MILWAUKEE

Home › Download Data

Download Data

Download contemporary phenology data from the USA-NPN's Nature's Notebook program. FGDC metadata are available in web page or XML formats for the suite of six data sets below.

By downloading these data sets you acknowledge that you have read and agreed to both the USA-NPN Data Use **and** Data Attribution **policies.**

Download 2009 Plant Data Set - Definitions Excluded - 17MB
Download 2009 Plant Data Set - Definitions Included - 44MB
March 2, 2009 - December 31, 2009

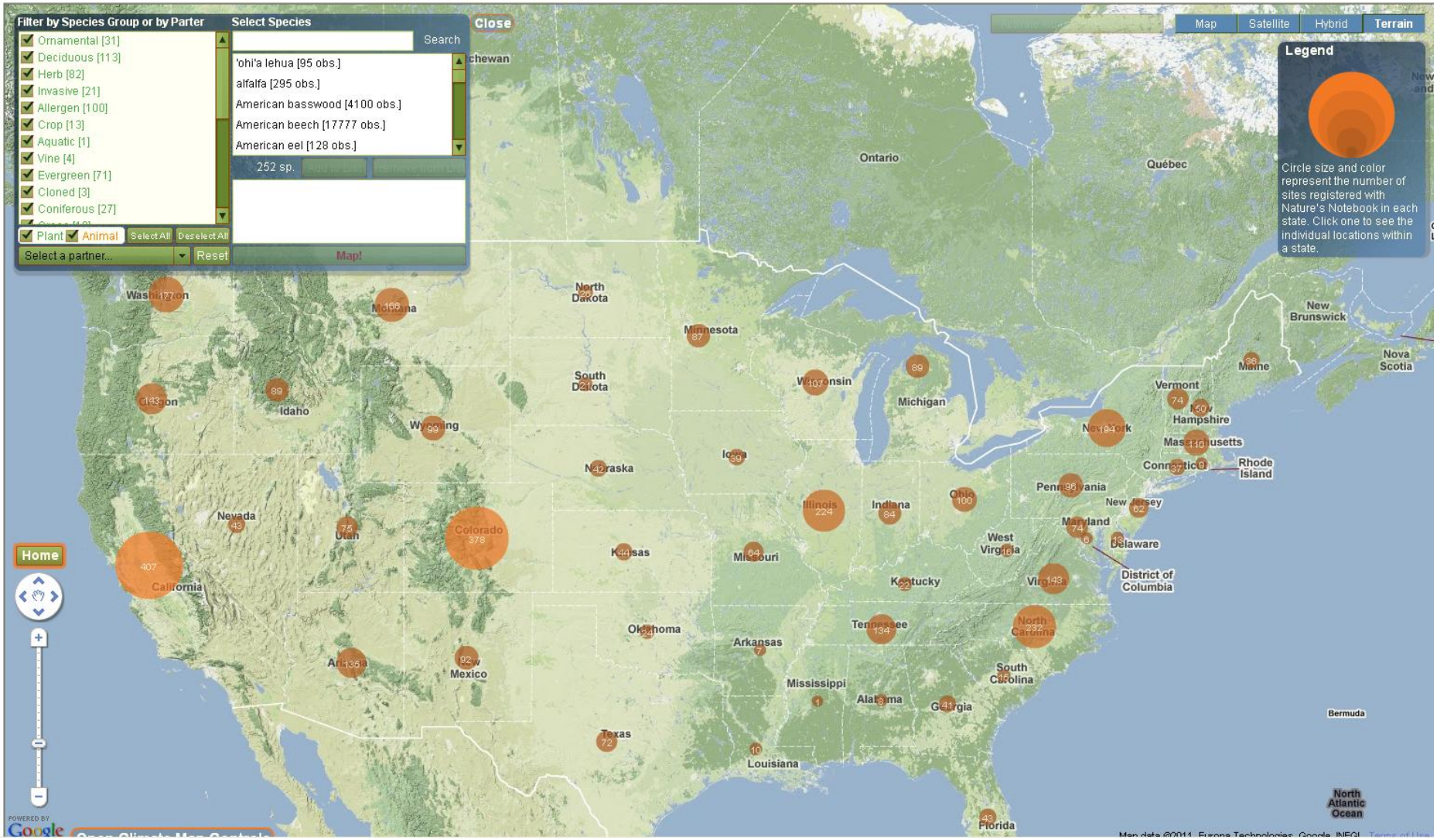
Download 2010-11 Plant Data Set - Definitions Excluded- ~16MB
Download 2010-11 Plant Data Set - Definitions Included - ~43MB
January 1, 2010 - today

Download 2010-11 Animal Data Set - Definitions Excluded - ~2MB
Download 2010-11 Animal Data Set - Definitions Included - ~3MB
January 1, 2010 - today

E. Denny

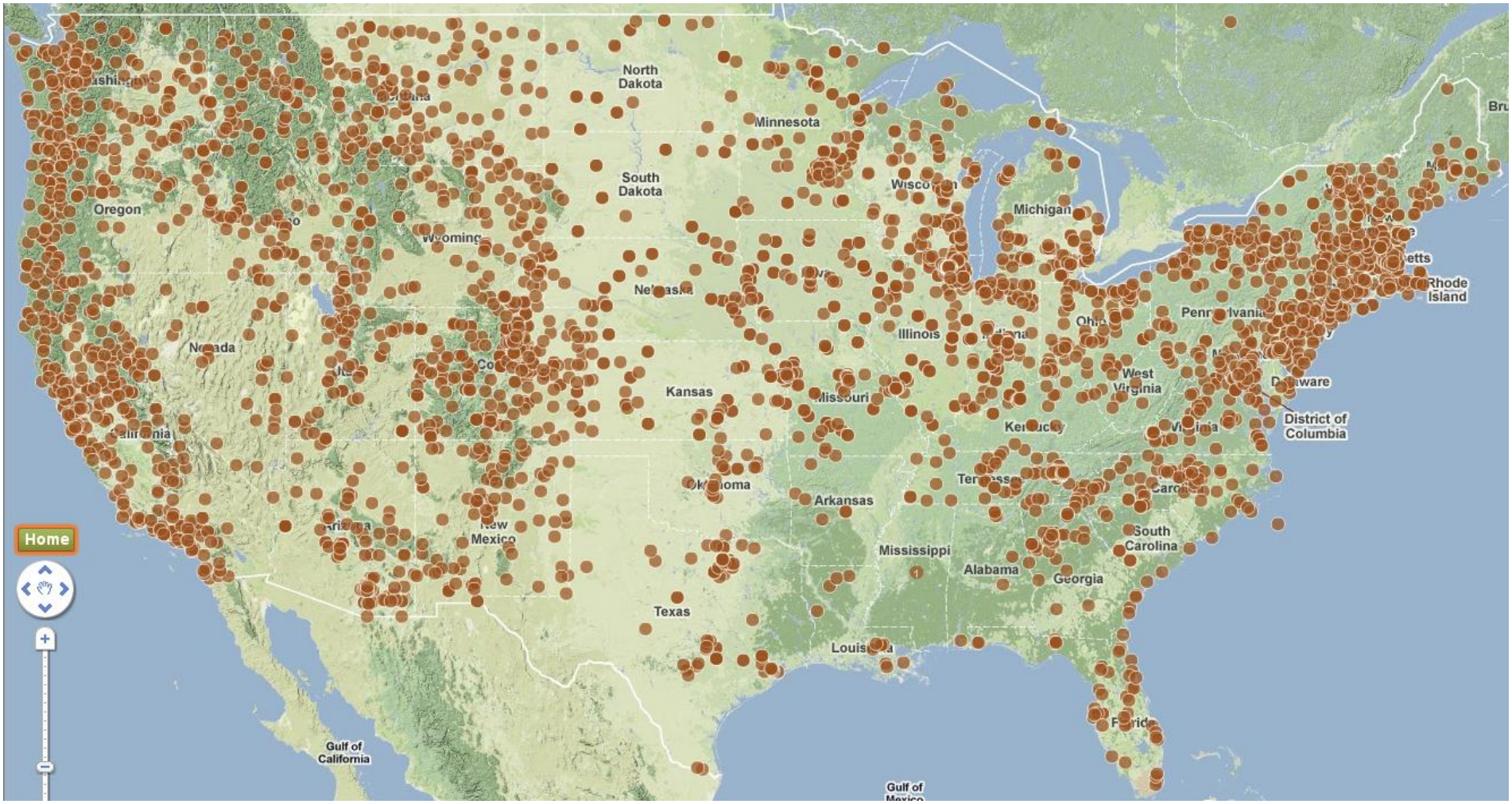
www.usanpn.org/results/data

Real-time visualization tools



http://www.usanpn.org/results/visualizations

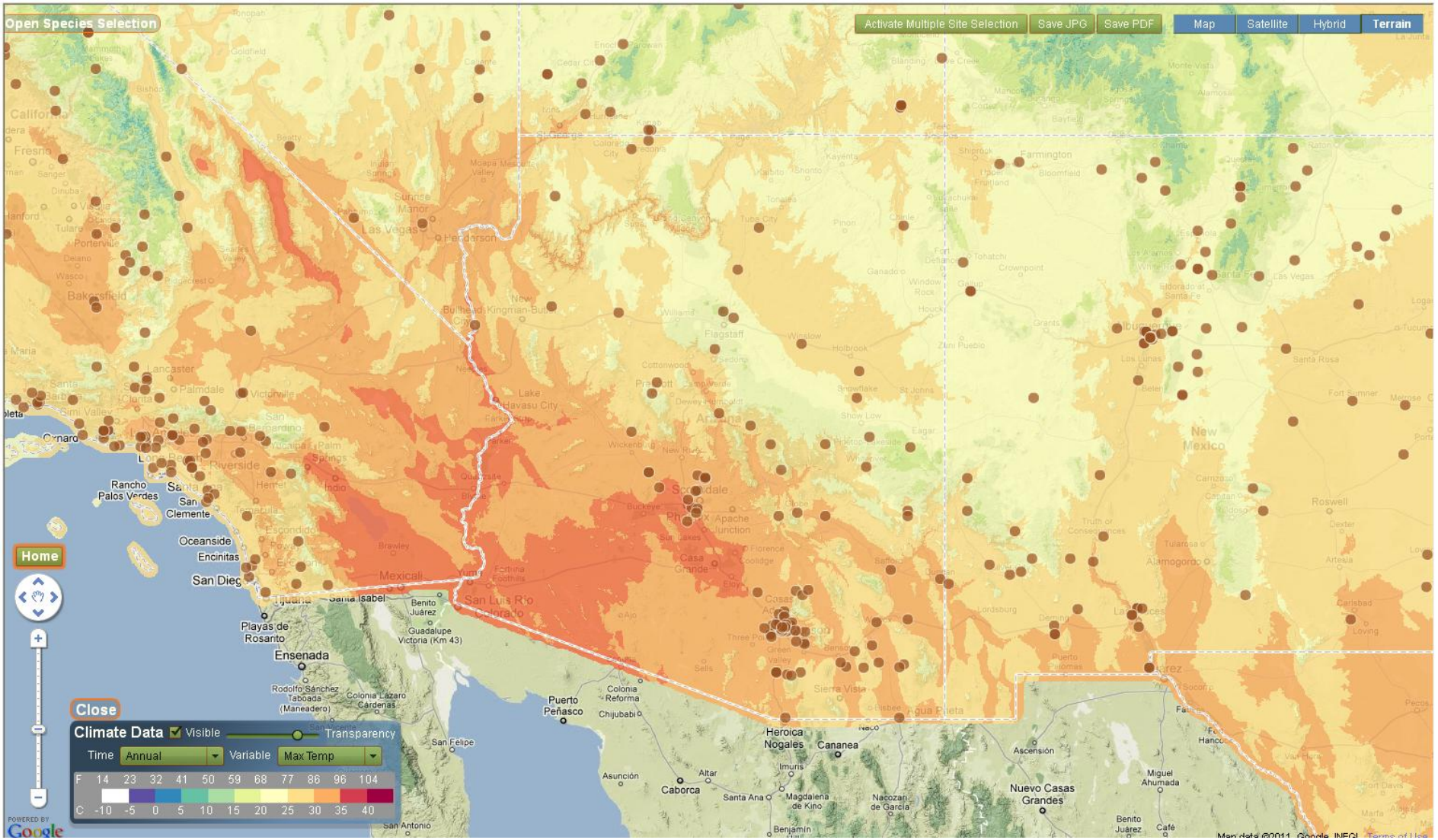
Nationally distributed observation sites



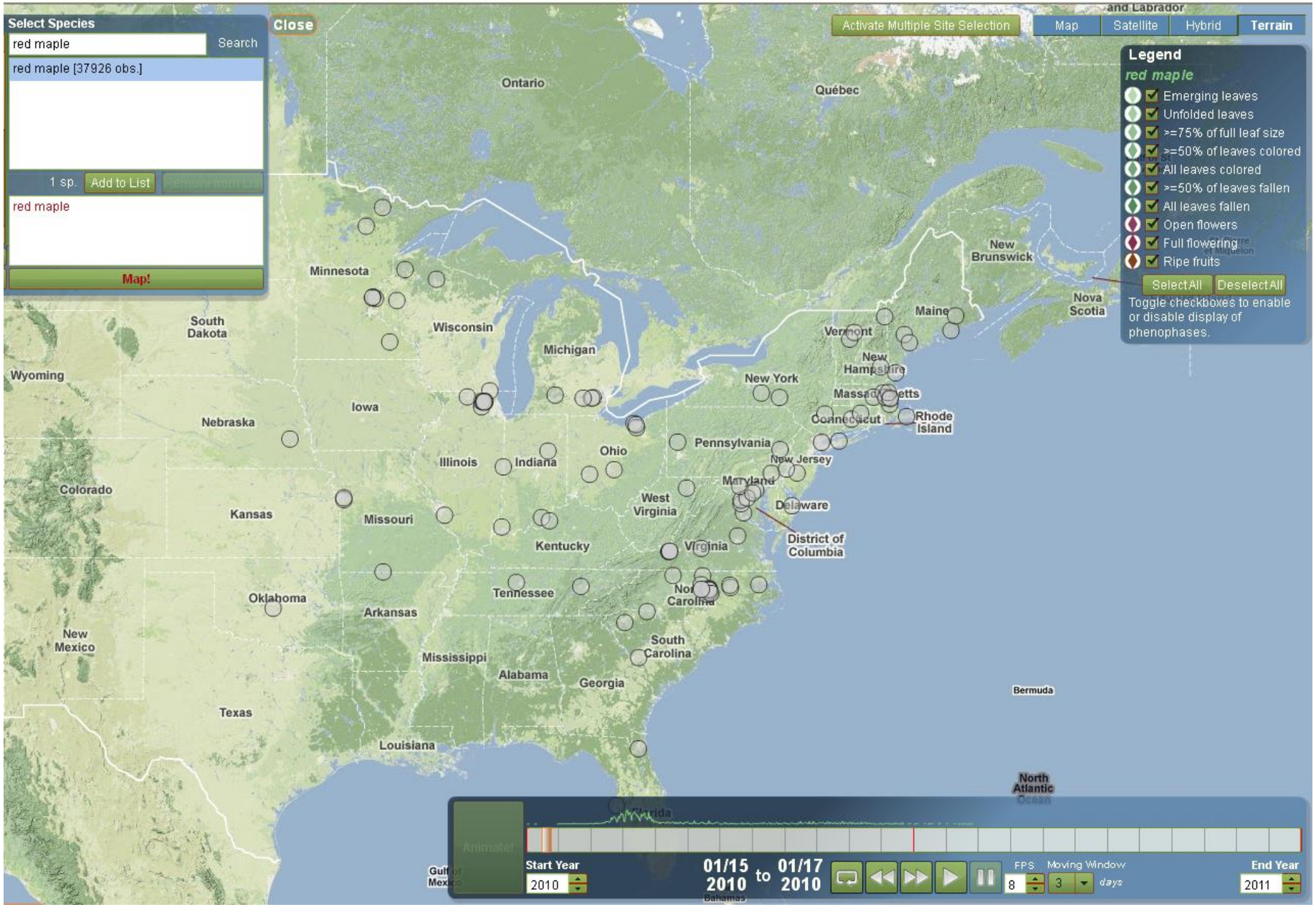
3160 observers at 4412 sites observing 5459 organisms

418731 records from 76304 observations

Integration with climatological data



Species-specific queries and animations



Data exploration and comparison

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Key sponsors and collaborators…

USGS science for a changing world

National Park Service

U.S. Fish & Wildlife Service

NSF

UWM University of Wisconsin Milwaukee

The Wildlife Society

NASA

NatureServe

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

U.S. Department of the Interior Bureau of Land Management

LTER

Forest Service U.S. Department of Agriculture

North American Pollinator Protection Campaign

esa

UCSB Phenology Stewardship Program

AMC

The Wilderness Society

Monarch Watch

Florida Bluebird Society

CoCoRaHS

United States Environmental Protection Agency

HBN

Arizona-Sonora Desert Museum

The Great Sunflower Project

science for citizens .net

The Cornell Lab of Ornithology

neon

Clean Air Cool Planet

EFTA

AmeriFlux

Oak Ridge National Laboratory

Hummingbird Monitoring Network Protect the Joy

your garden show

picture post

Freshwater Society

Project BudBurst www.budburst.org

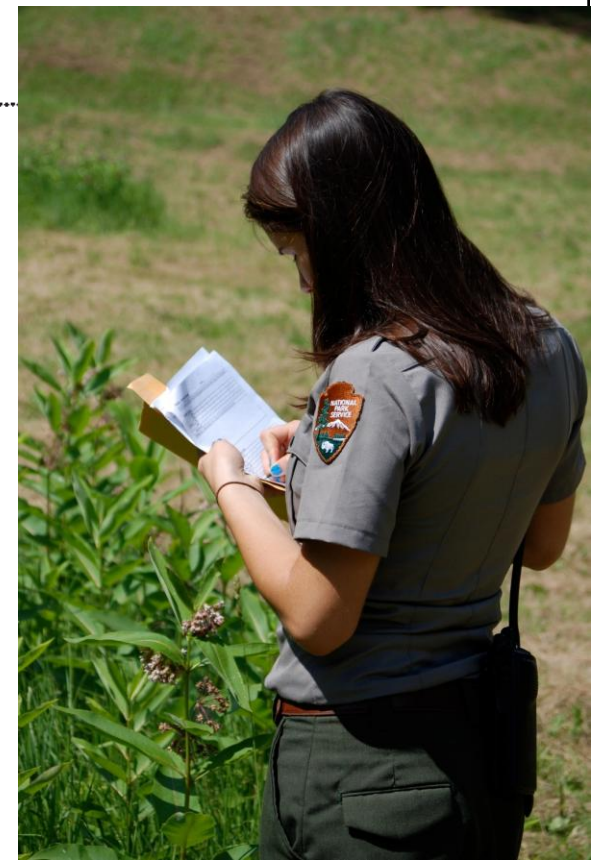
ESIP Federation

Arbor Day Foundation

The New York Botanical Garden

Observing the Rhythms of Nature

Monitoring Phenology in the Northeast Temperate Network



- Link I & M, Research Learning Centers, staff and volunteers
- Monitor phenology at 13 NPS units
- Test and evaluate multiple methods
- Develop SOPs and full NPS Protocol
- Expand to include regional partners

The California Phenology Project

Tracking nature's pulse to assess climate change response across California landscapes and national parks.

- Develop framework for network
- Monitoring at all 19 NPS units
- Formalize species selection process
- Collaboration to develop protocols
- Education and outreach tools
- Engage volunteers in data collection
- Ensure data stewardship
- Document legacy phenology datasets
- Expand to include regional partners

Tomorrow!

UCSB Phenology Stewardship Program

USGS science for a changing world

USA npn National Phenology Network

NATIONAL PARK SERVICE

USA npn National Phenology Network

Taking the Pulse of Our Planet

Log In

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 "Natures Notebook" to join us!

nature's notebook
A project of the USA-NPN

Visualization Tools

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

USA-NPN News | Phenology Feed | Join the Conversation

- Dynamic Visualizations Now Available
- Leaderboards See Top Observers & Top Species Observed
- Explore Local and Regional Phenology-Oriented Groups
- Live phenology data now available
- Phenology and USA-NPN highlighted in agency and White House reports

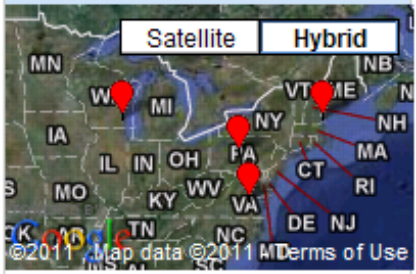
- Recent Media Reports

www.usanpn.org

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. More.

Geographic Affiliates



Explore local and regional phenology-oriented groups.

Top Observers This Week

1	Christopher@MN	324
2	Kelly@KY	44
3	Kathleen@AZ	40
4	nancy@OH	24
5	Lisa@MO	24

See all leaderboards.