

*The  
USA National Phenology Network:  
A national science and monitoring  
program for understanding climate  
change*

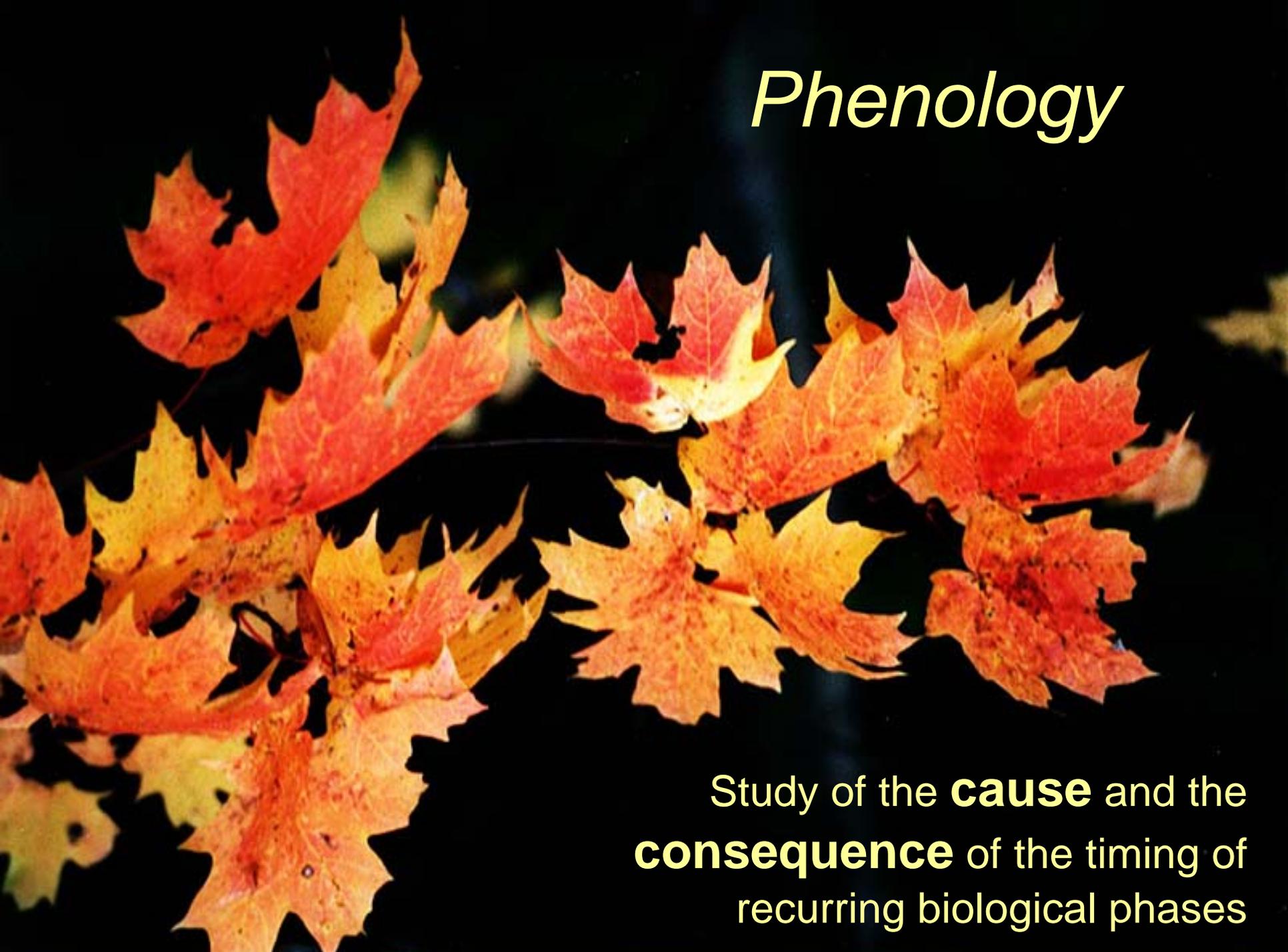
**Jake F. Weltzin**

**United States Geological Survey**

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

# Outline

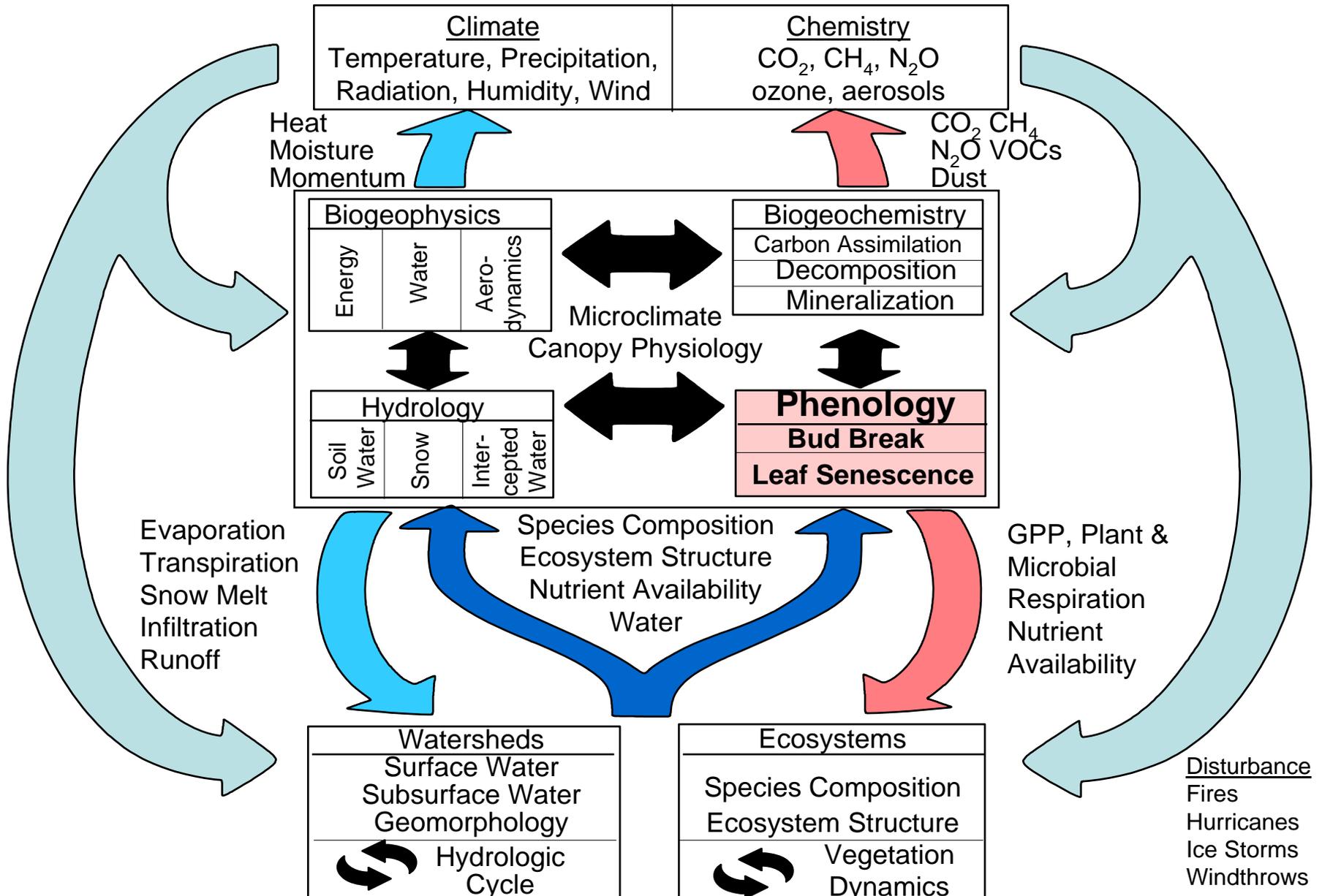
- Definitions
- Implications for natural ecological systems
- The National Phenology Network
- Plant, animal, & landscape monitoring programs



# *Phenology*

Study of the **cause** and the **consequence** of the timing of recurring biological phases

# Phenology and the biosphere





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



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# Changes in spring timing for many organisms

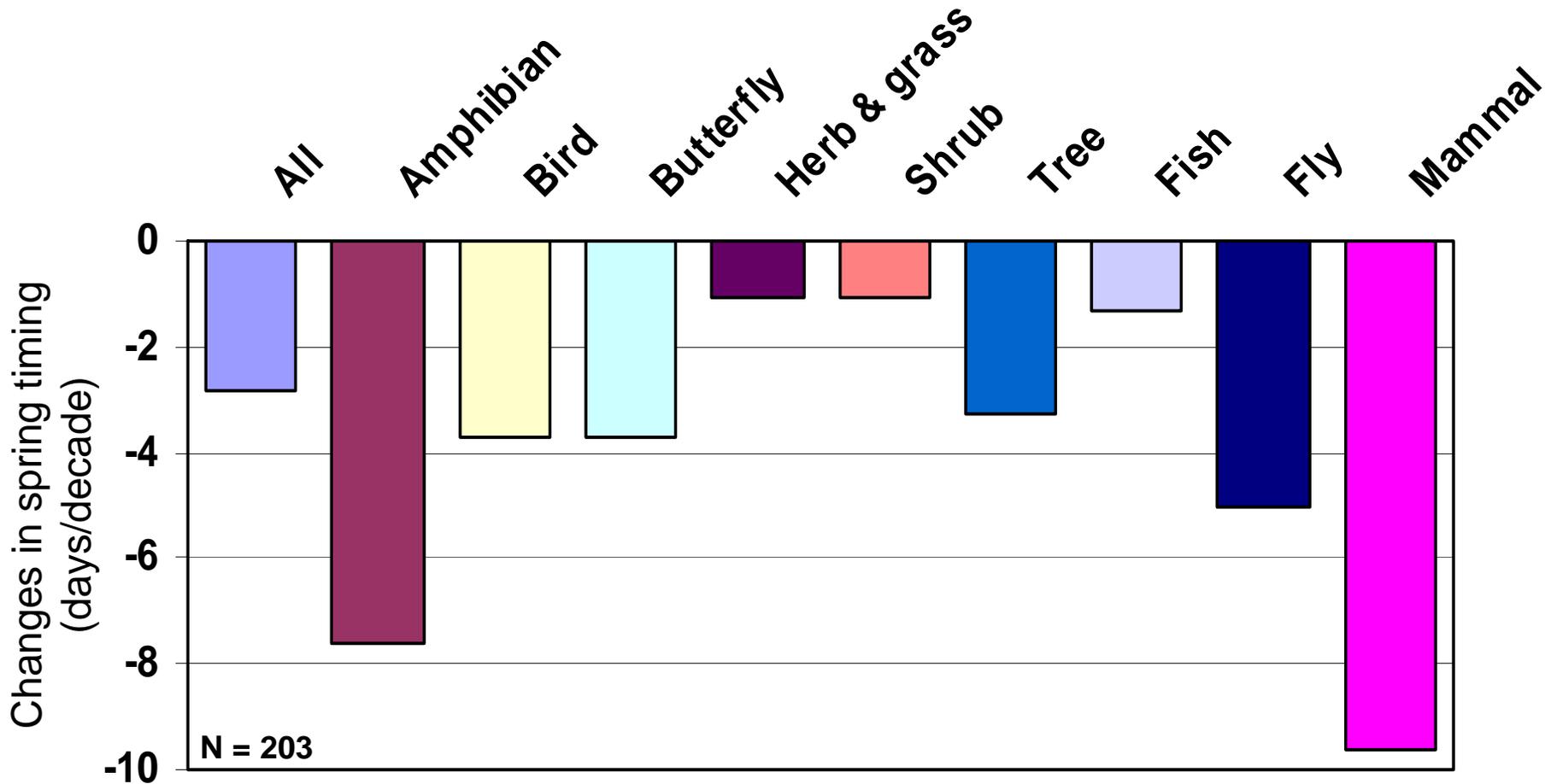


Camille Parmesan

## Parmesan and Yohe

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

# Differential response across species groups





**English Oak**

**EARLIER**

# A three-way mismatch



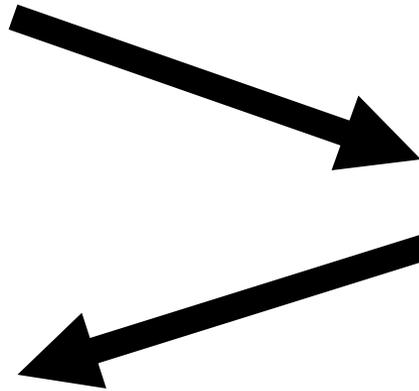
**Winter Moth**

**EARLIER**

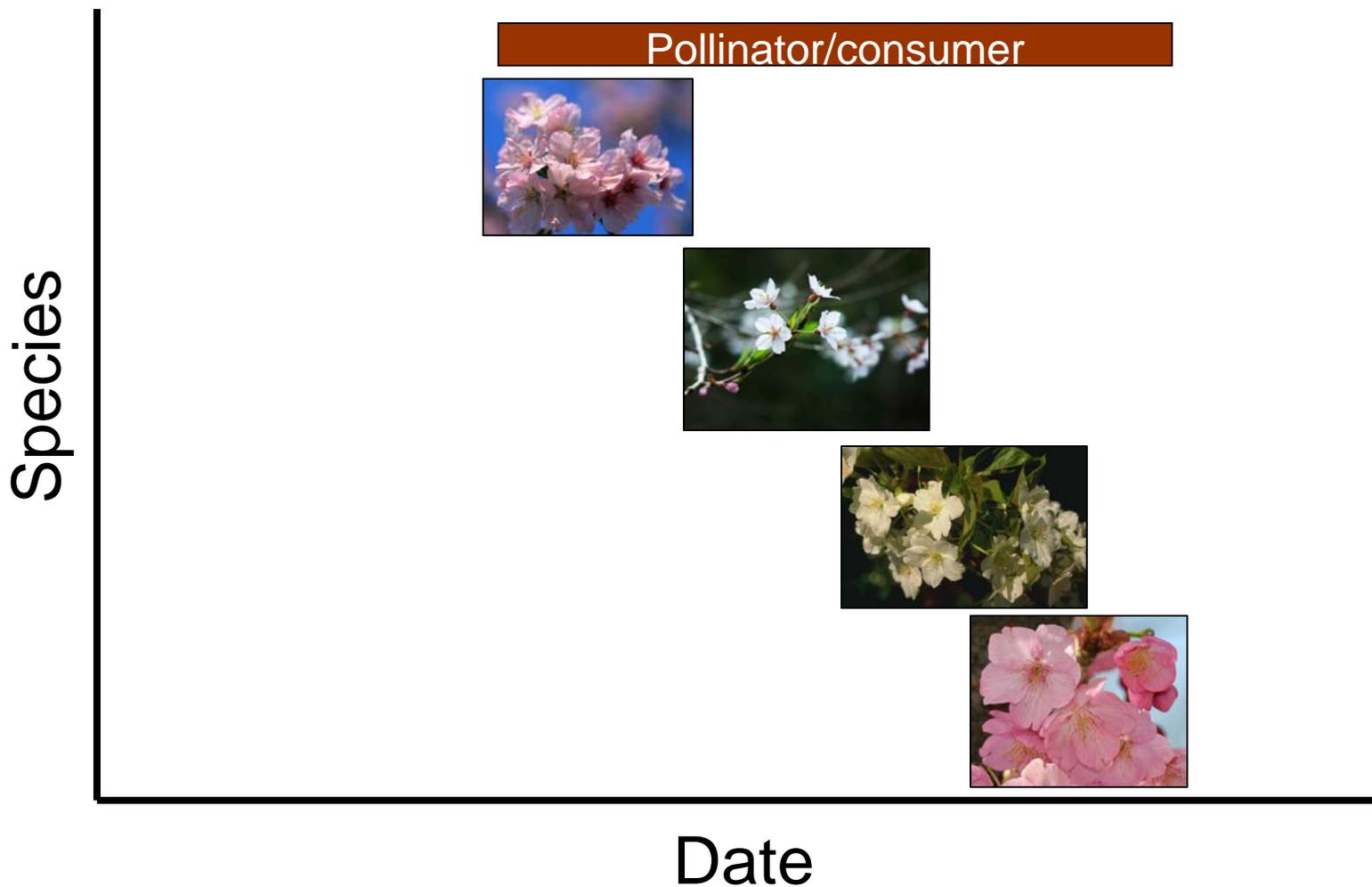


**Pied Flycatcher**

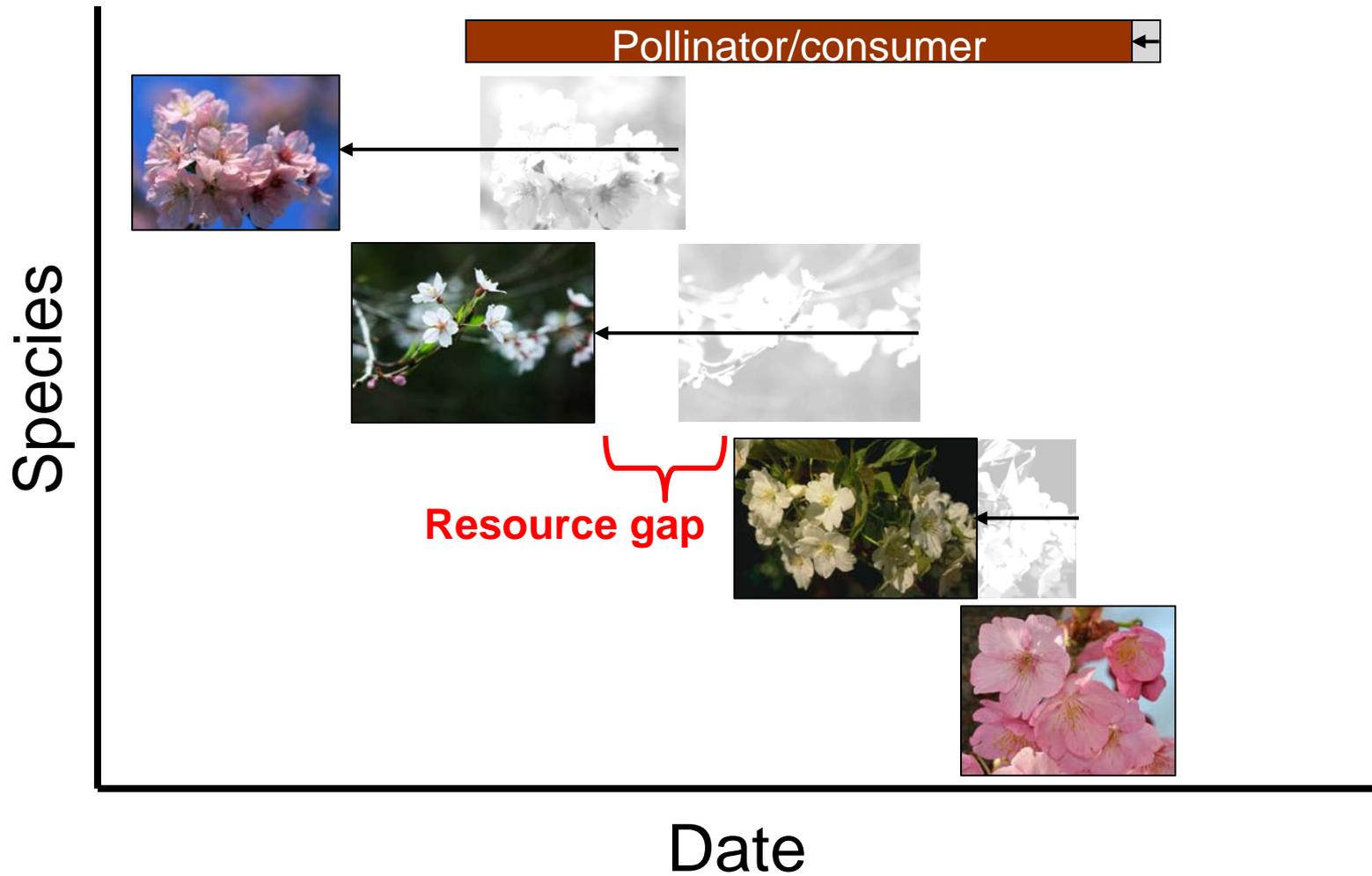
**SAME TIME  
EACH YEAR**



# Differential responses generate mismatches



# Differential responses generate mismatches



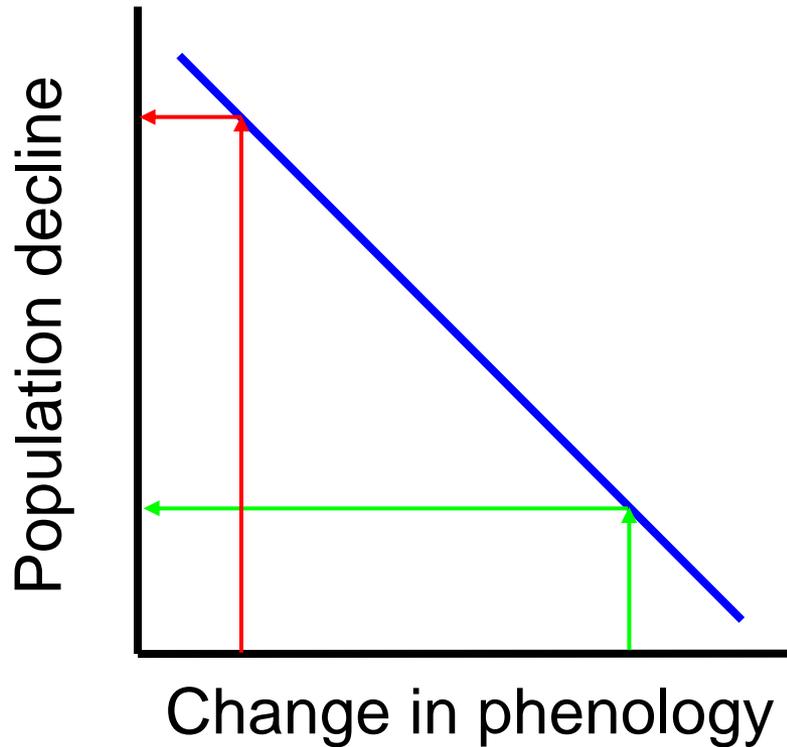
# Thoreau on Walden Pond



- Henry David Thoreau, Walden Pond, Concord, MA
  - 600 plant species, first flowering, 8 years, 1850s
- Richard Primack & Abe Miller-Rushing, Concord, MA
  - 43 plant species, first flowering, 4 years, 2004-2007
  - Average flowering date: 7 days earlier
  - Common plant flowering date: 21 days earlier
  - Culprit: rising winter and spring temperatures



# Local extinctions in Concord, MA



What's declining?



asters, bladderworts,  
buttercups, dogwoods, lilies,  
mints, orchids, violets

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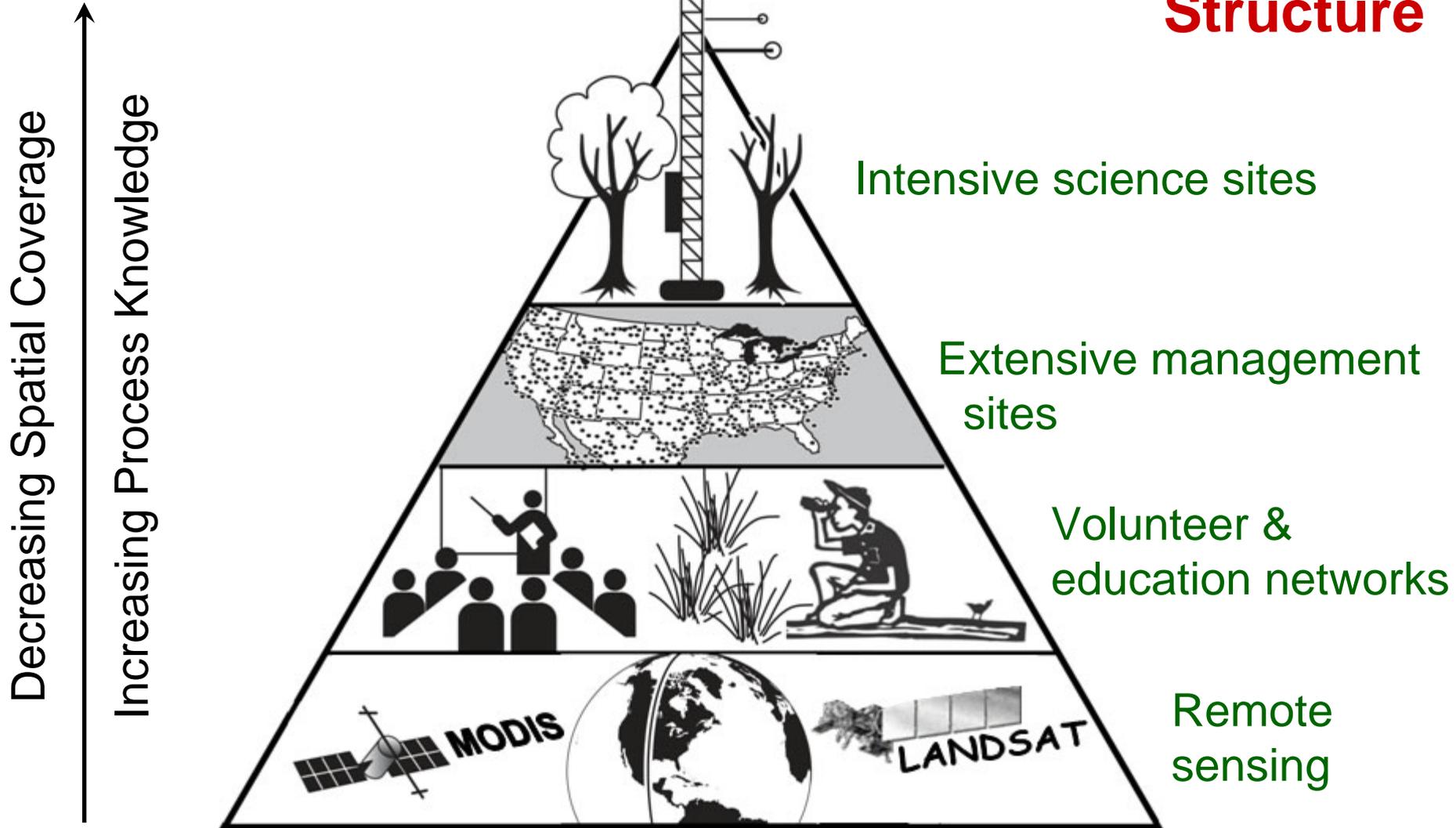
*A new data resource—a national network of integrated phenological observations across space and time*

- *Understand how plants, animals and landscapes respond to environmental variation*
- *Develop tools and techniques for human adaptation to climate change*



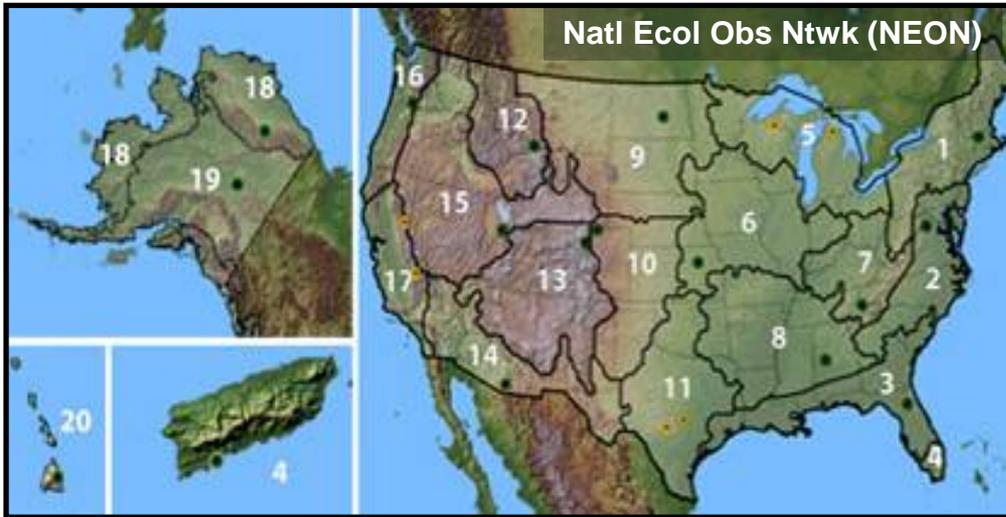
- Cooperate with agencies, NGOs, academia, public
- Standardize collection of phenology observations
- Incorporate historical data
- Provide online data entry, downloading, visualization
- Educate public
- Incorporate new technologies – e.g., remote sensing

# USA-NPN Conceptual Structure



Adapted from CENR-OSTP

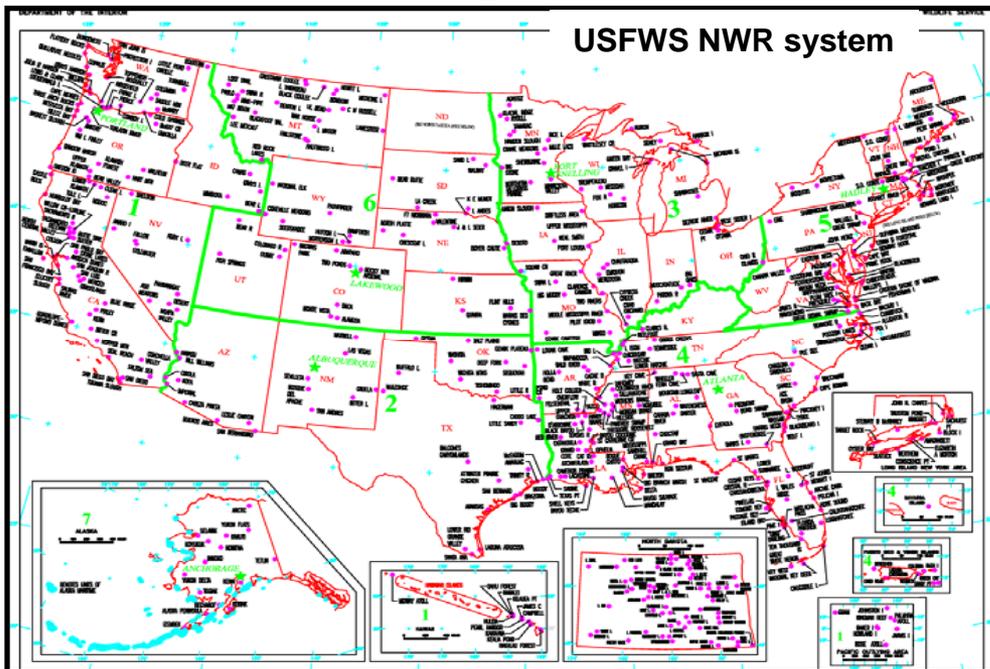
# Intensive science networks



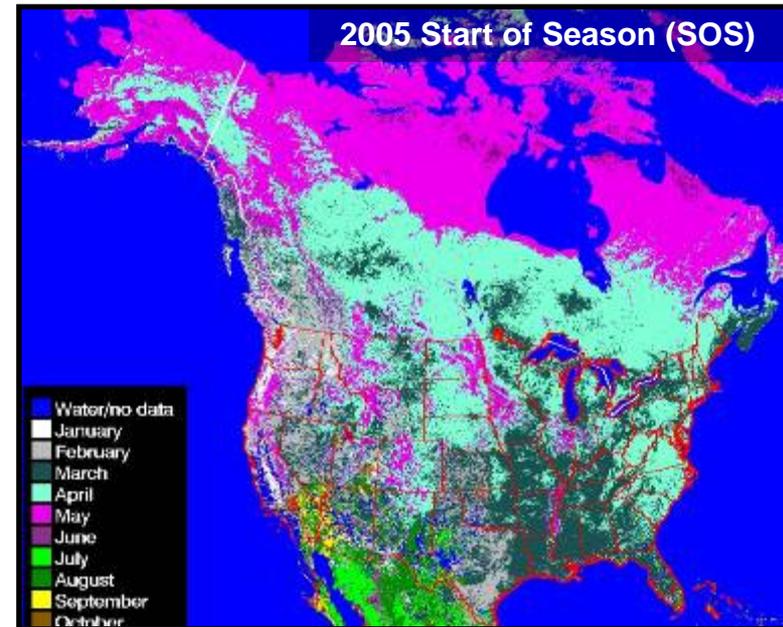
# Volunteers



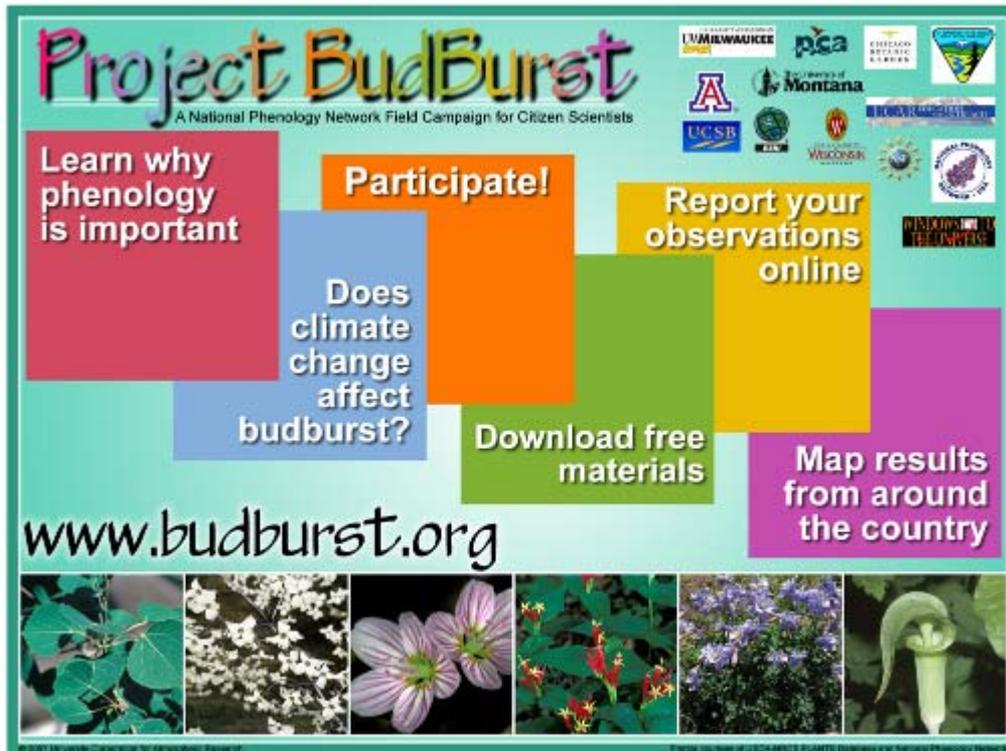
# Extensive management networks



# Remote sensing



# Education, outreach and citizen science



**Project BudBurst**  
A National Phenology Network Field Campaign for Citizen Scientists

Learn why phenology is important

Participate!

Report your observations online

Does climate change affect budburst?

Download free materials

Map results from around the country

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

Logos: ILMILWAUCKER, pca, UNIVERSITY OF MONTANA, UCSB, Wisconsin, UNIVERSITY OF CALIFORNIA, UNIVERSITY OF MICHIGAN, UNIVERSITY OF TEXAS AT AUSTIN, UNIVERSITY OF WISCONSIN, UNIVERSITY OF CALIFORNIA, UNIVERSITY OF MICHIGAN, UNIVERSITY OF TEXAS AT AUSTIN, UNIVERSITY OF WISCONSIN

Images: A collage of six photographs showing various plants and flowers, including a green leafy plant, white blossoms, pink flowers, red flowers, purple flowers, and a white flower with a green center.

- Engage public in GC data collection and analysis
- Education programs and modules (K - gray)
- Live for 2008 on Feb 15
- Enormous interest (AP, Science, NPR, Sunset: 200+ news articles)
- Source of legacy datasets
- Portal to detailed data collection protocols



# The NPN partnership model

**Science (Conservation, species interactions, climate change impacts, modeling)**

**Regional phenology networks (NE-RPN, MAP, SE-RPN)**

**Education, Outreach, Citizen Science (Project BudBurst, Phenology 101)**

**NCO Core Programs**  
*Plant phenology*  
*Animal phenology*  
*Land surface phenology*

**Agency programs (NWR, NPS, Heritage, CEN, NCCWSC)**

**Specialized networks (Monarch Watch, Hummingbird Network, ARMI, BBS)**

**Ecological Observatory Networks (NEON, LTER, Ameriflux)**

**Phenology Gardens/Canopy-Cam Network**

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# Plant Phenology Program



- 220 plant species
  - Useful for applications in research, health, agriculture, recreation, conservation, invasive species...
- Sampling protocols
  - Tiered levels of involvement
  - Consistent with international standards
  - Accommodate issues of scaling, taxonomic differences, historical data

# Wildlife Phenology Program



- Build partnerships
  - government, academic, conservation, and education organizations
- Develop and vet list of species and monitoring protocols
- Incorporate historical datasets
- Integrate observations of plants, animals & landscapes
- ID opportunities for early success

# National PhenoCam Network

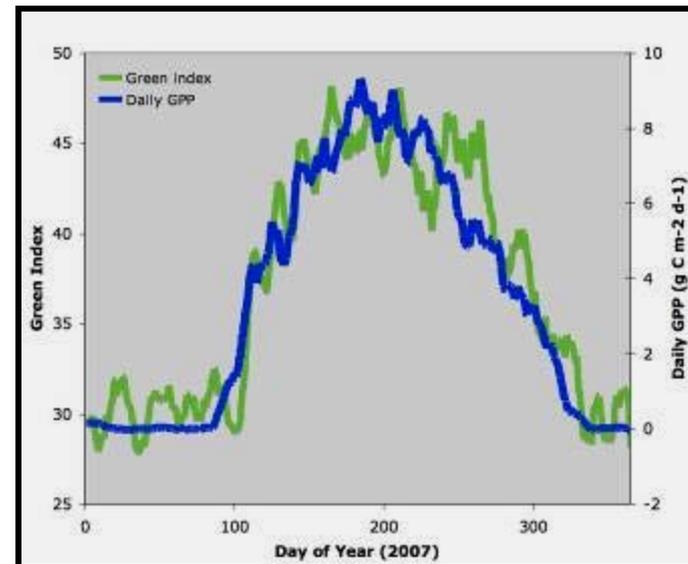
*A canopy phenology monitoring network for the United States*

Latest image -  
15 June 2007

Bartlett Expt'l Forest, NH



Green index predicts GPP



Richardson in prep.

1 April 2007



15 April 2007



1 May 2007



15 May 2007



1 June 2007



# Remote Sensing Working Group

Pieter Beck, Jess Brown, Kirsten de Beurs, Geoff Henebry, John Kimball, Liang Liang, Jeff Morissette, Wim van Leeuwen, Xiaoyang Zhang, others

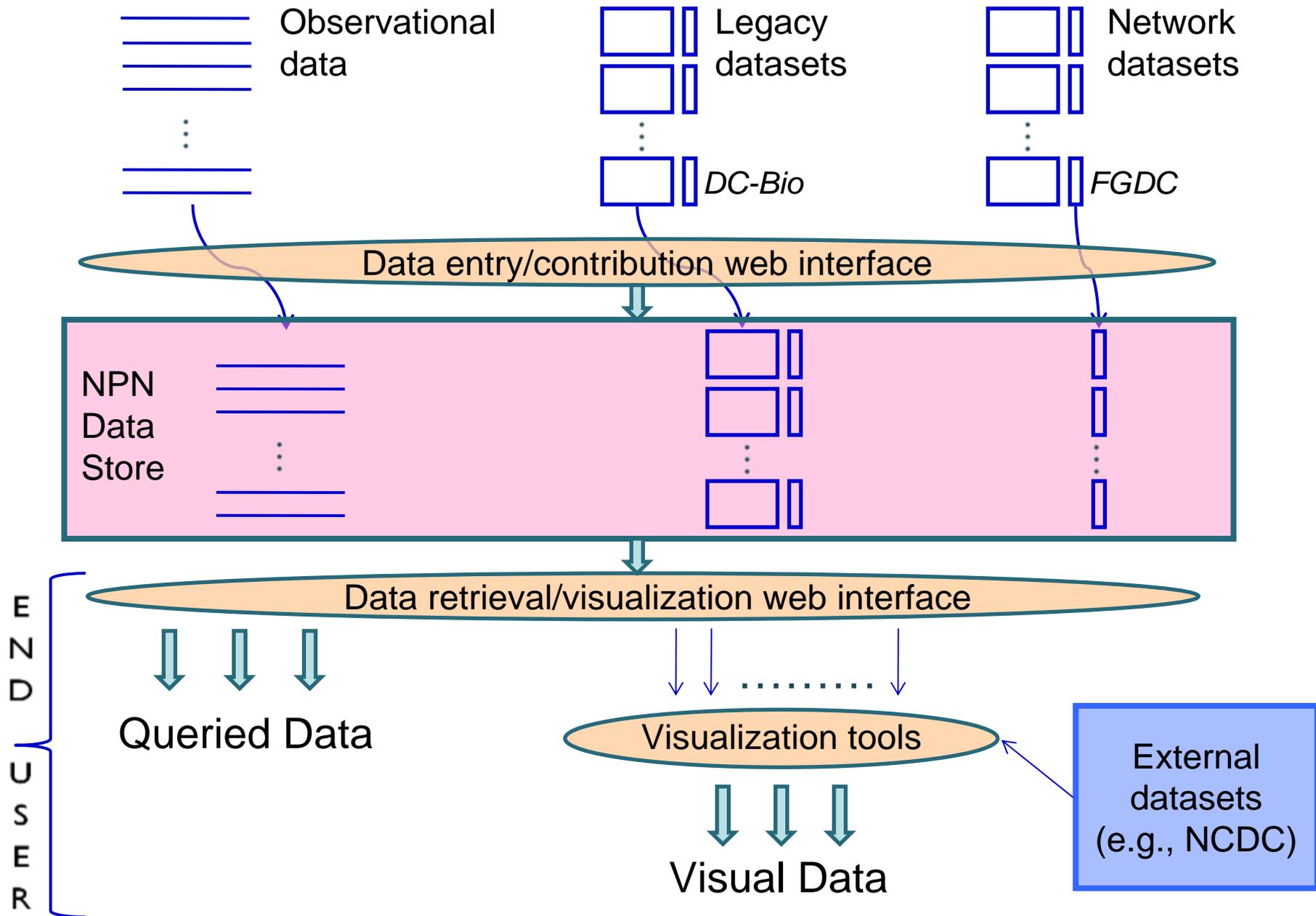
- Governance: Geoff Henebry, Chair; Wim van Leeuwen, Vice-Chair
- Phenology Special Session at 2008 AGU Fall Meeting
- Develop LSP workshop for ESA 2009
- Land Surface Phenology Variable Intercomparison Project
- Submitted: NASA Terrestrial Ecology Proposal

*“Assessing the Impacts and Consequences of Global Change on Shifts in Phenology: A scoping study to design a NASA campaign”*

## **USA-NPN RSWG progress, cont.**

- Update Friedl et al. (2006) ESDR white paper
- Review/revise LSP content on USA-NPN website
- Prepare LSP articles for Encyclopedia of Earth
- Develop gallery of LSP “eye-candy” for public and media
- Produce suite of “standard” products for naïve technical users (e.g., NEON, NPS, BLM, USFWS)
- Develop teaching modules/outreach products and funding possibilities
- Develop guide to LSP terminology
- Develop National LSP Coordinator position description

# Data Management Plan





- ABOUT NPN
- PARTICIPATE
- PRODUCTS
- SUBMIT DATA
- DOWNLOAD DATA
- ARCHIVE
- LOG IN

- About NPN
- Participate
- Products
- Submit Data
- Download Data
- Archive
- Log in

Partners

[more...](#)

## A National Phenology Network

Phenology is the study of periodic plant and animal life cycle events and how these are influenced by seasonal and interannual variations in climate. Examples include the timing of leafing and flowering, agricultural crop stages, insect emergence, and animal migration. All of these events are sensitive measures of climatic variation and change, are relatively simple to record and understand, and are vital to both the scientific and public interest.

Phenology can be used as a predictor for a variety of processes and variables of importance at local to global scales. Phenology modulates the abundance and diversity of organisms, their inter-specific interactions, their ecological functions, and their effects on fluxes in water, energy, and chemical elements at various scales. Phenological data and models are useful in agriculture, drought monitoring, and wildfire risk assessment, as well as management of invasive species, pests, and infectious diseases. **Integration of spatially-extensive phenological data and models with both short and long-term climatic forecasts offer a powerful agent for human adaptation to ongoing and future climate change.** To fully utilize the value in phenological data, however, a new data resource is required – a *large-scale network of integrated phenological observations, linked with other relevant data sources, and the tools to analyze these data at multiple scales.*

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

## News, Views & Announcements

- [Project Budburst live: 2008](#)
- [NPN teams up with Monarch Watch for 2008](#)
- [Recent Media Reports](#)
- [News & Views Archives](#)

## Upcoming events

[NPN/ASPRS \(Southwest US Region\) Symposium](#)  
(130 days)  
 [more](#)

## What's in the News?

["Natural Rhythms and ..."](#)