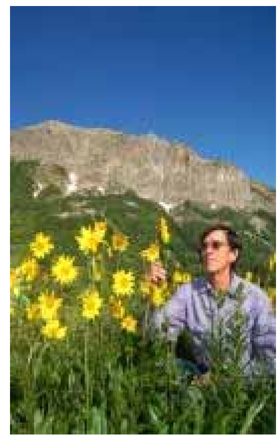
Project BudBurst
Timing is everything!

A National Citizen Science Network



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National Ecological Observatory Network

Caleb Slemmons & Sandra Henderson,
National Ecological Observatory Network

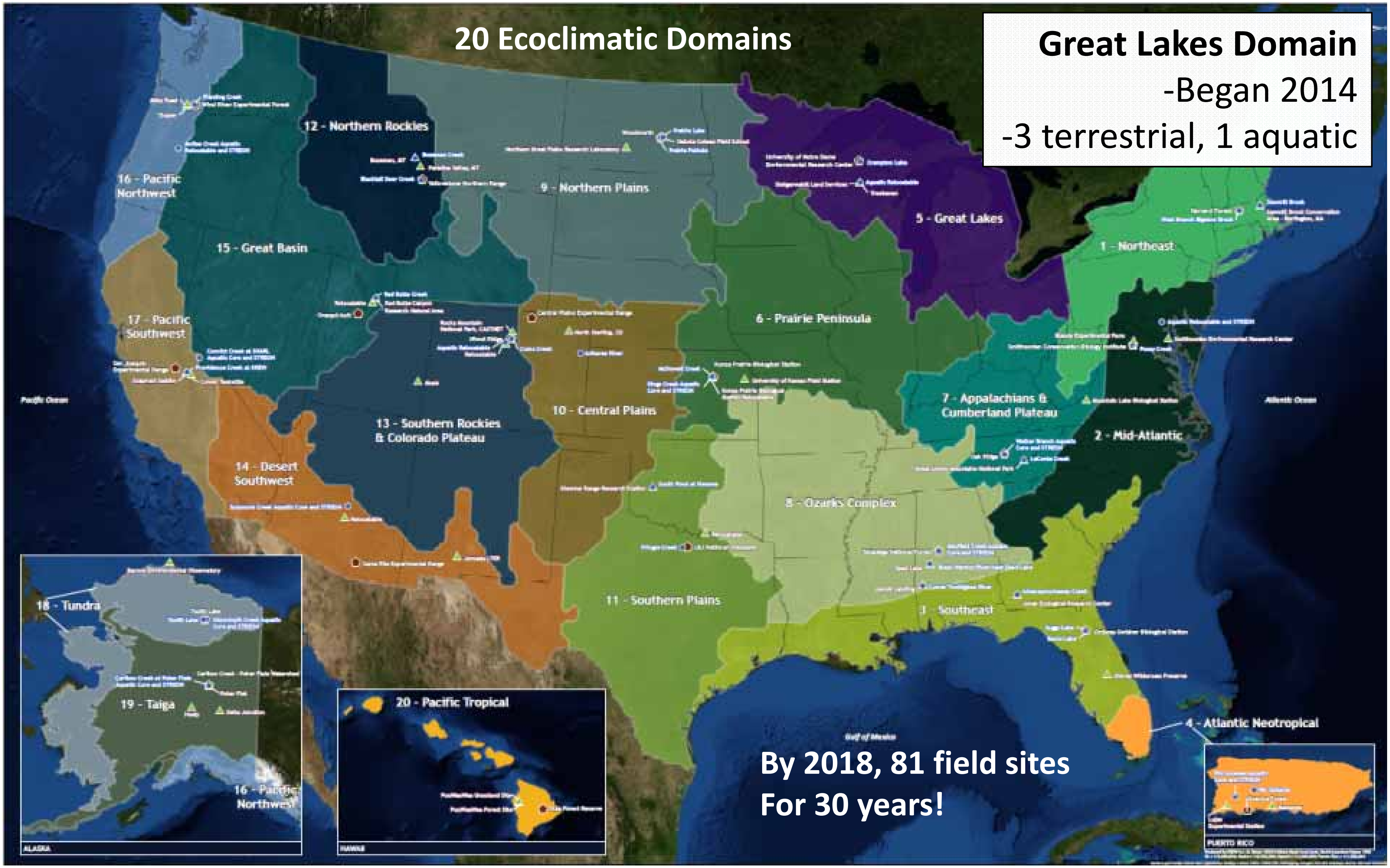
NSF

Overview

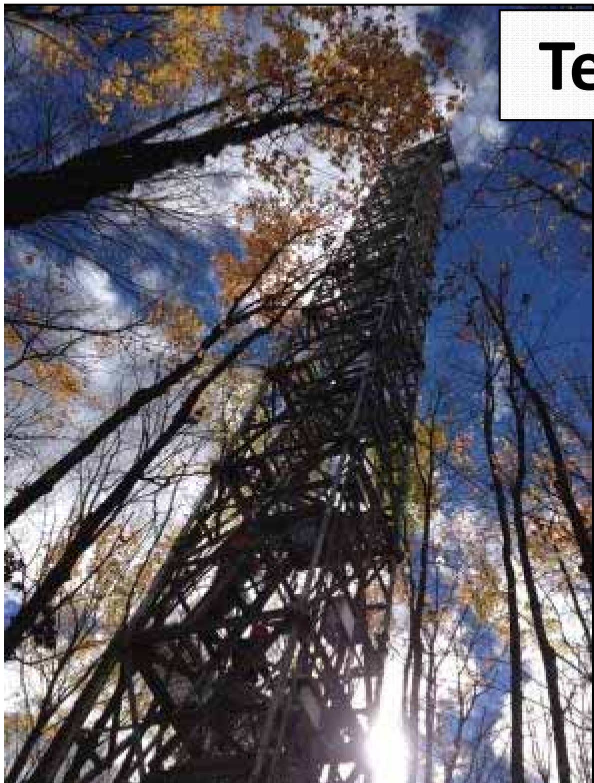
Project BudBurst
Timing is everything!

- **NEON Overview**
- **NEON Education & Outreach**
- **Project BudBurst**
- **Partnerships, Additional Resources & Season Spotter**

A Continental Scale Observatory



Network of automated sensors



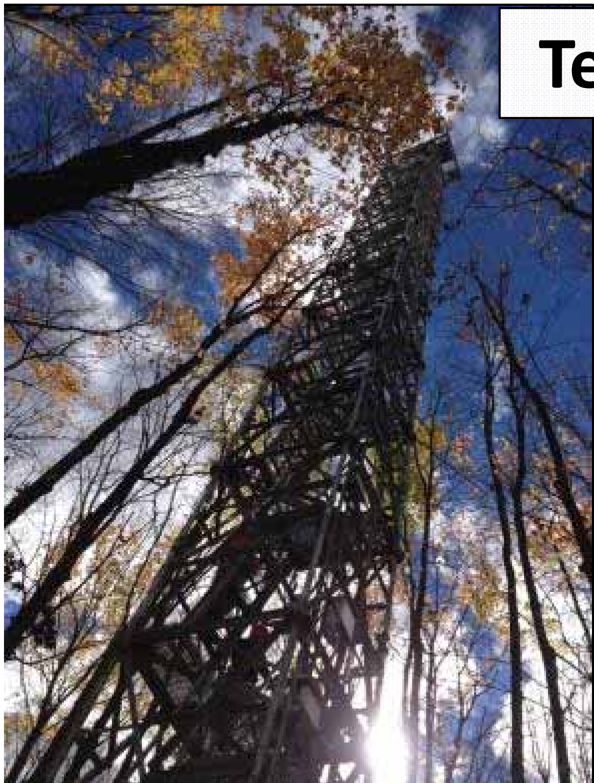
Terrestrial Instrument System

Airborne Observatory

Aquatic Instruments

Network of automated sensors

Terrestrial Instrument System



Instrumented in 2014

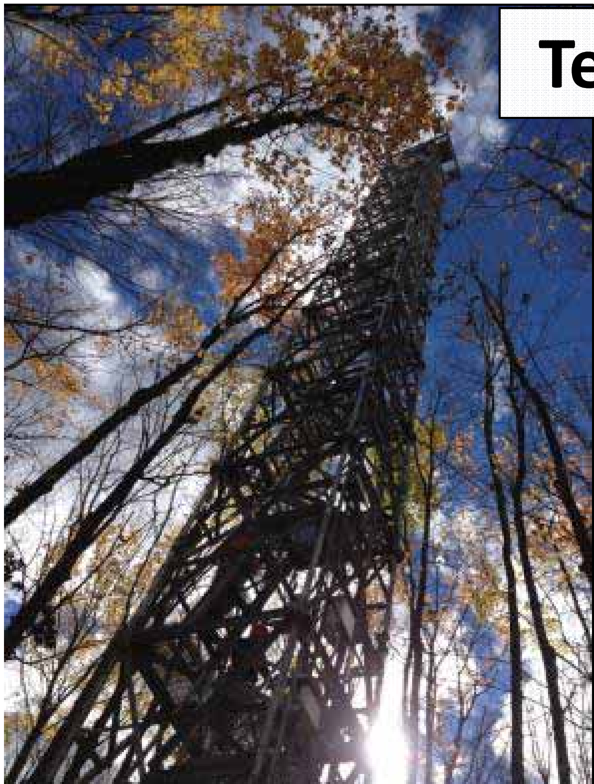
Airborne Observatory

First GL Flight 2016!

Aquatic Instruments

Network of automated sensors

Terrestrial Instrument System

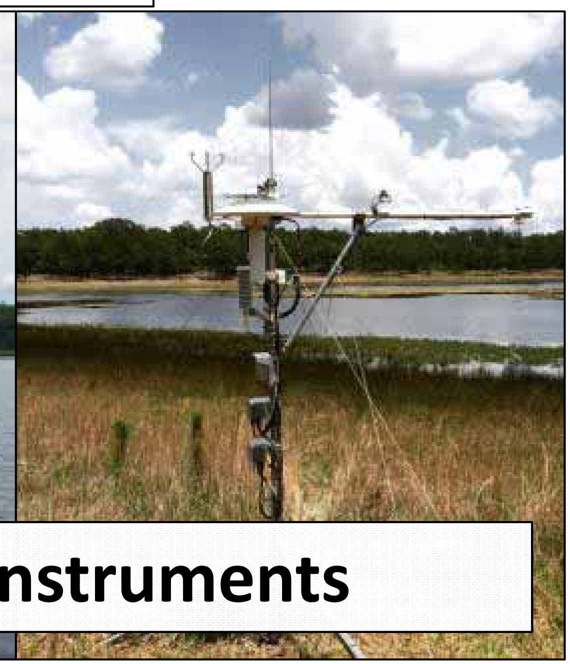


Instrumented in 2014

Airborne Observatory

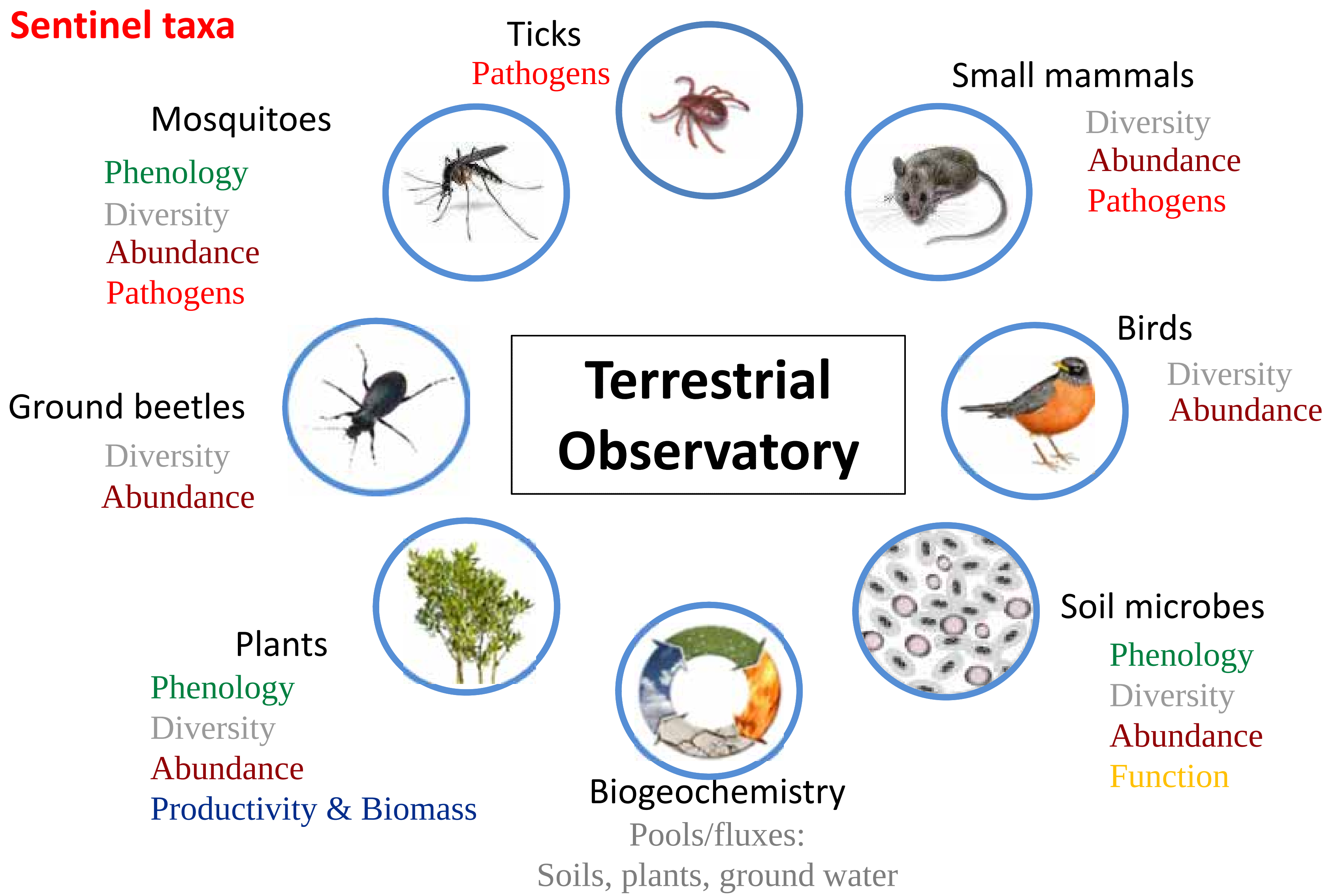
First GL Flight 2016!

Planned for Fall, 2016

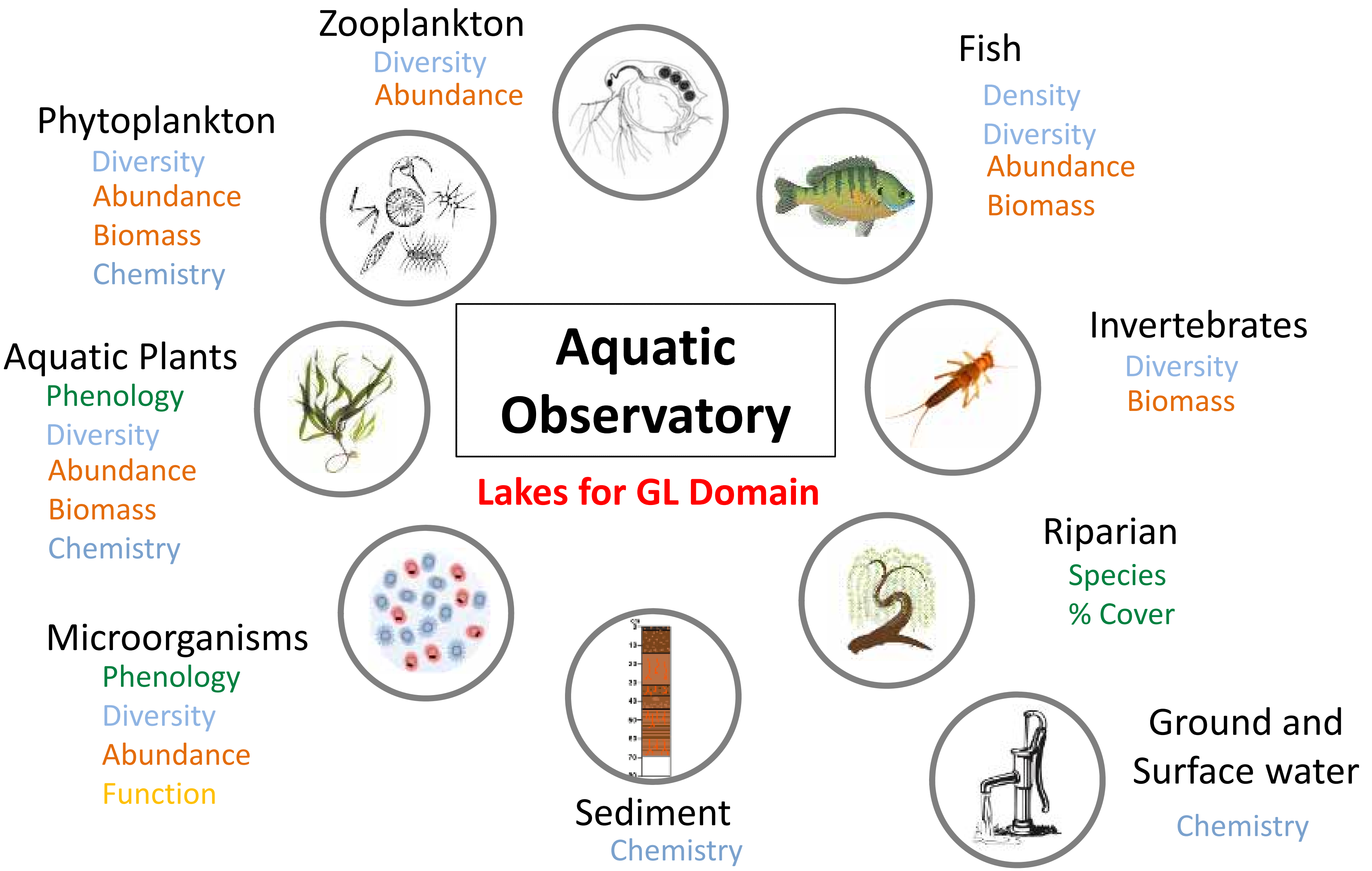


Aquatic Instruments

And on the ground sampling...



And "on the water" sampling…



NEON as a resource…

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Timing is everything!

NEON was designed to enable understanding and forecasting the effects of ***climate change, land use change***, and ***invasive species*** on continental-scale ecology by providing:

- **Physical Infrastructure**
- **Information Infrastructure**
  - **Data is free and will be publically available**

AND

- **Educational resources:** Programs and tools for engaging communities in scientific discovery

Project BudBurst:

a plant phenology citizen science program

- Started in 2007
- Co-managed by NEON and Chicago Botanic Garden

- Individuals from all walks of life
- Participants from all 50 US states
- Easy to contribute, numerous partners (USFWS, NPS, gardens etc.)

What is phenology?

Project BudBurst
Timing is everything!

Phenology: science that measures timing of life cycle events (*phenophases*)

Scientists who study phenology are interested in the timing of biological events as they relate to changes in season and climate.

Aldo Leopold – tracked phenology from 1938-'48

Migration

First pollen

Nesting

First leaf

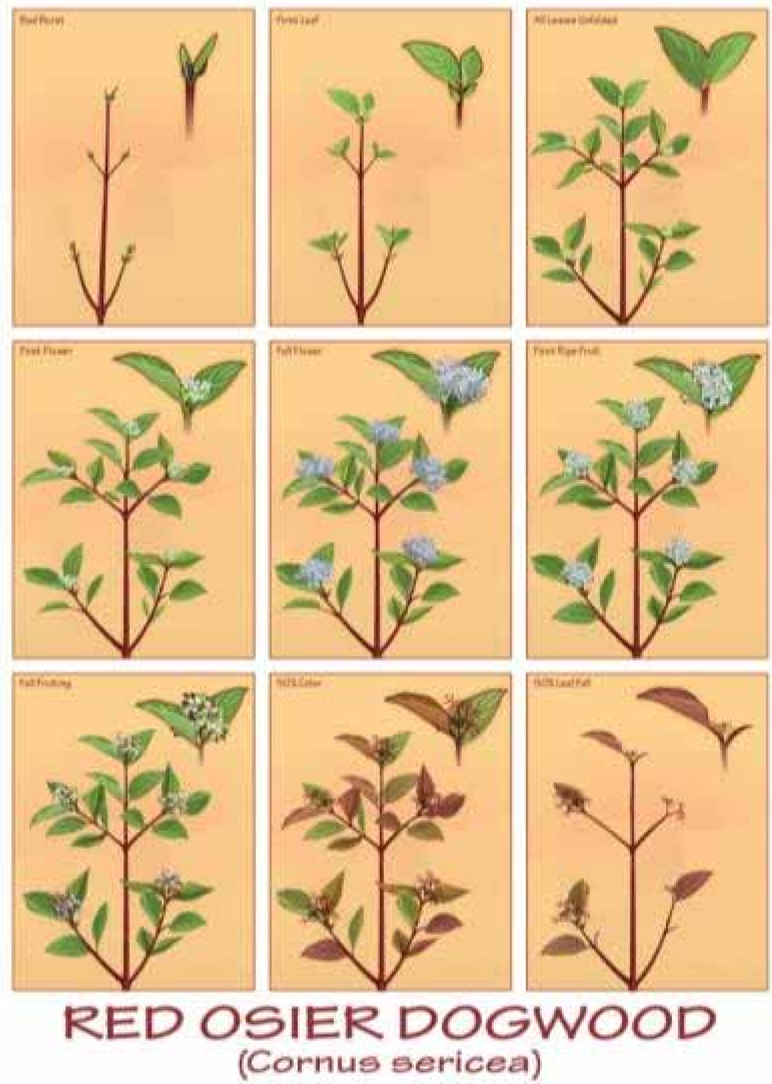
Photos courtesy of Wikipedia Commons, Paul Alaback,, and the US Fish and Wildlife Service

Phenophase Example

Project BudBurst
Timing is everything!

Phenophases of Red osier dogwood through the seasons

- A **phenophase** is a distinct event in the life cycle of a plant or animal
- Each stage is an example of a phenophase



A National Network of Citizen Science:

Project BudBurst
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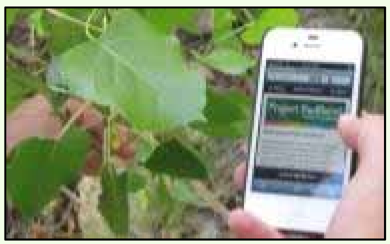
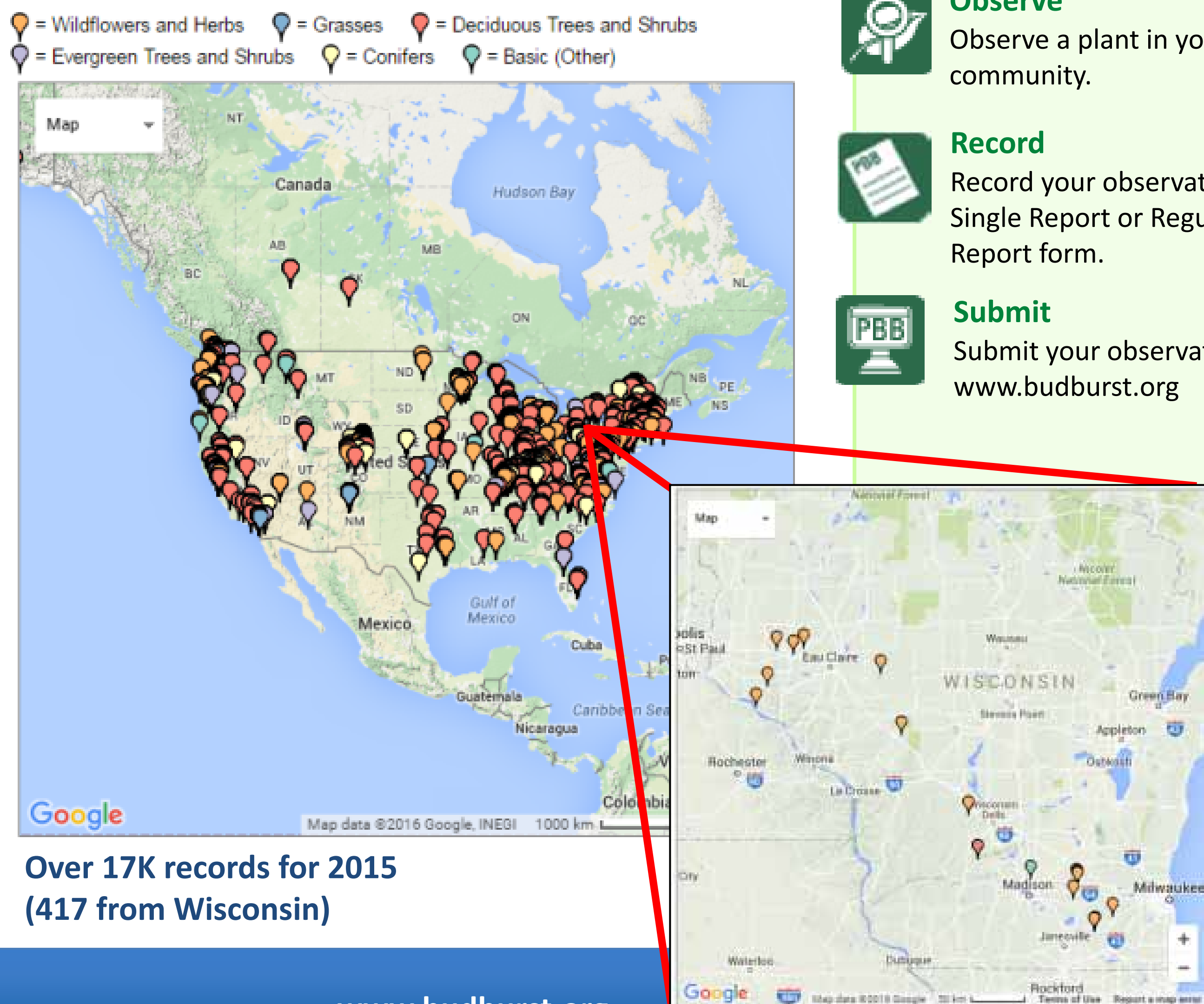
Online and Mobile Access





Over 17K records for 2015 (417 from Wisconsin)

Observe
Observe a plant in your community.

Record
Record your observation on a Single Report or Regular Report form.

Submit
Submit your observation on www.budburst.org

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www.budburst.org

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Register, then learn

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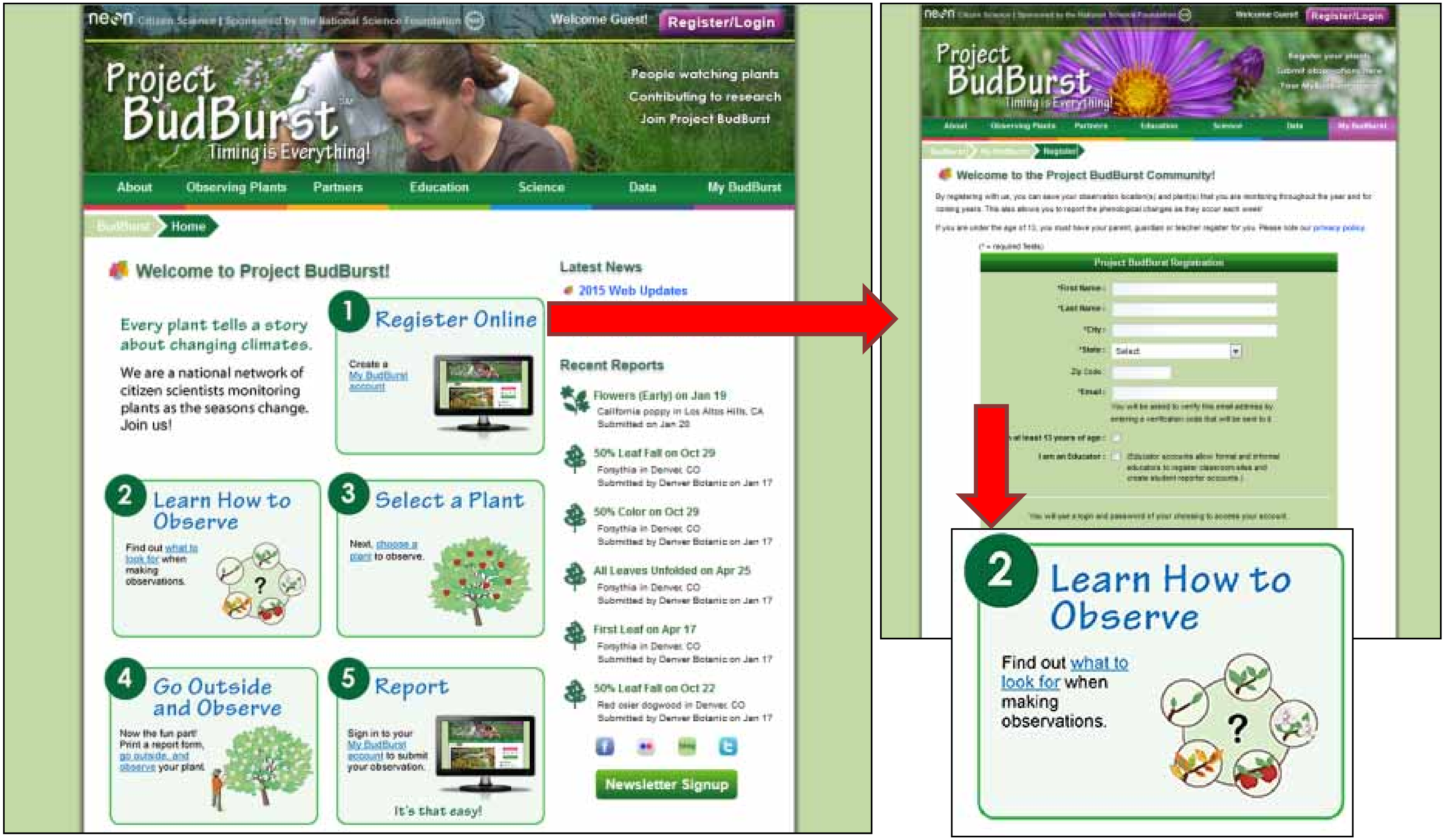
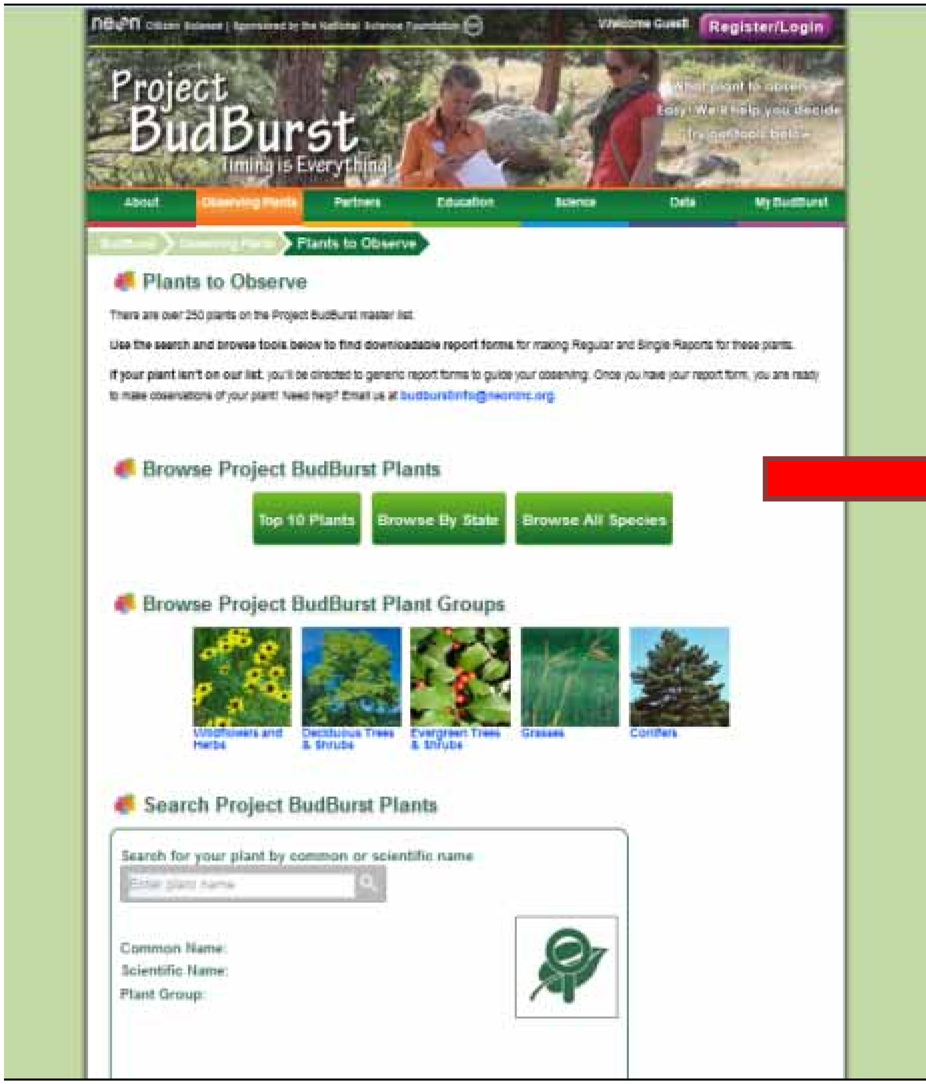
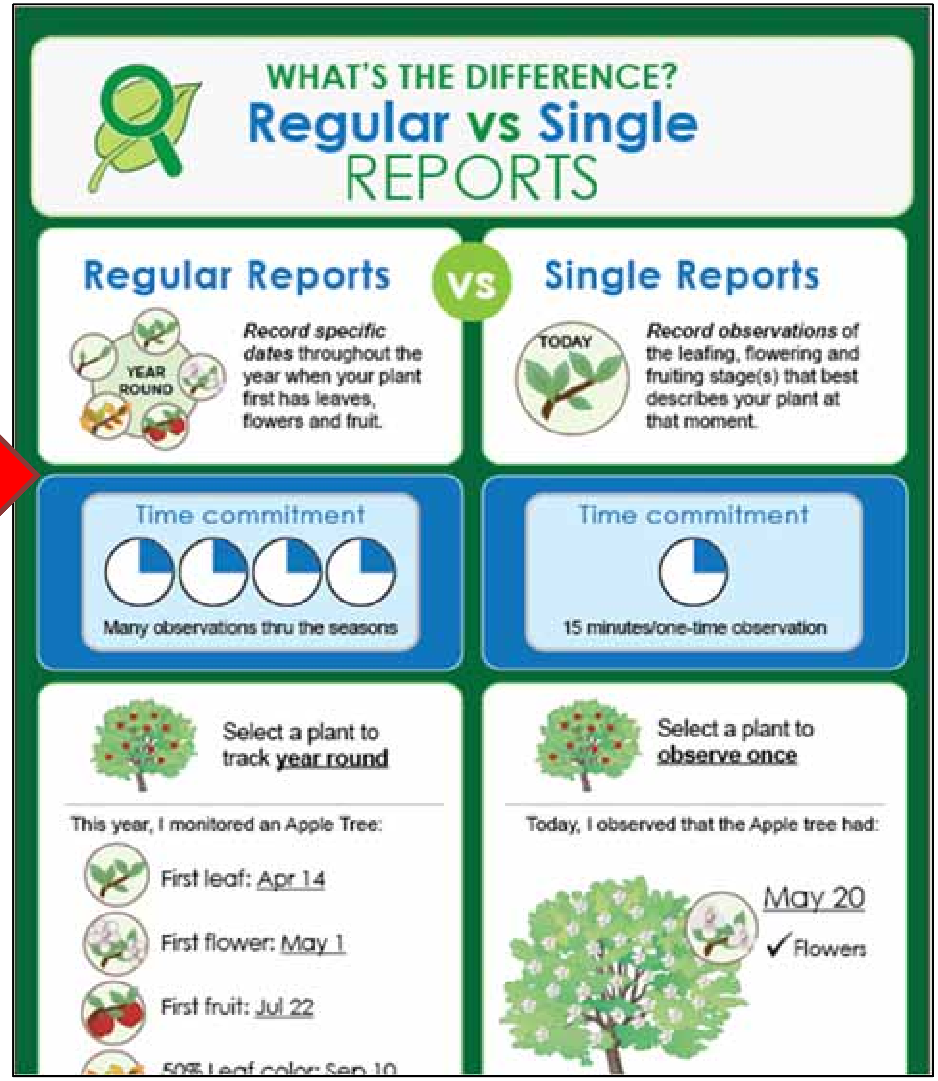


Select a plant…make observations





Regular or Single Reports

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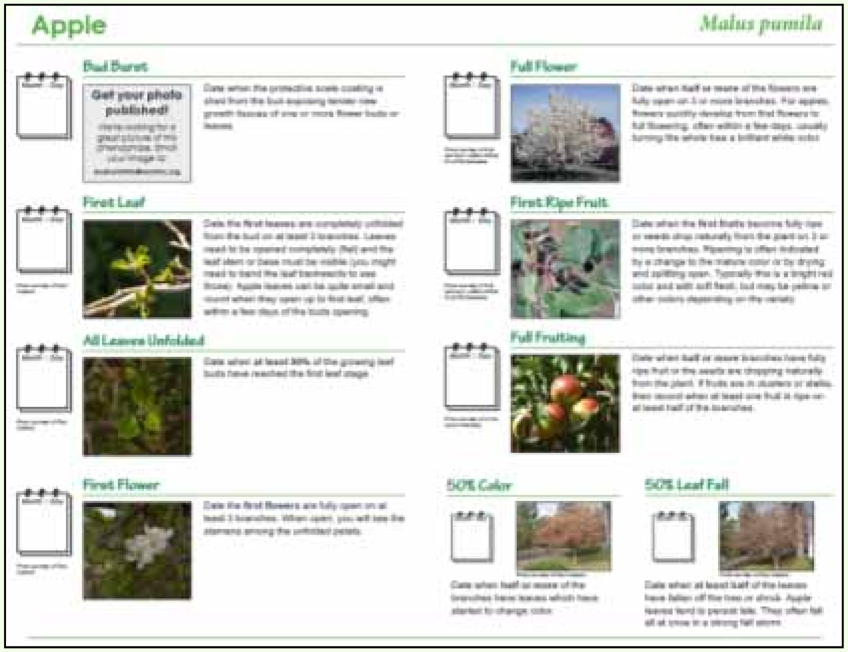
Timing is everything!



Report observations

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Timing is everything!

Then submit!

Partner Power!

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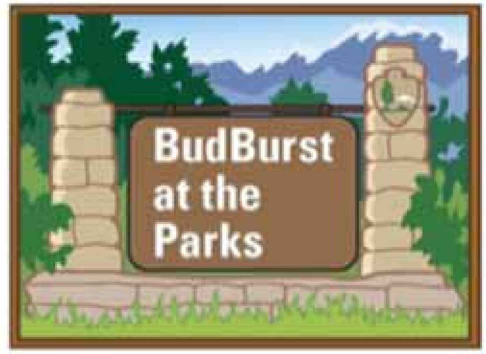

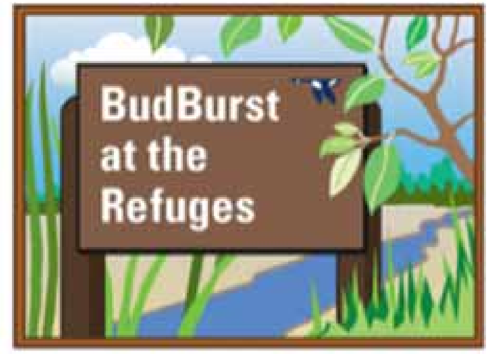

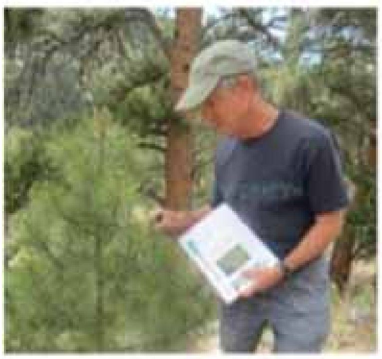

- Trempealeau NWR,
- Community Partners – Mequon Nature Preserve & Riveredge Nature Center (Saukville, WI)

These observations matter!

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Timing is everything!

At the interface of science and education, Citizen Science…

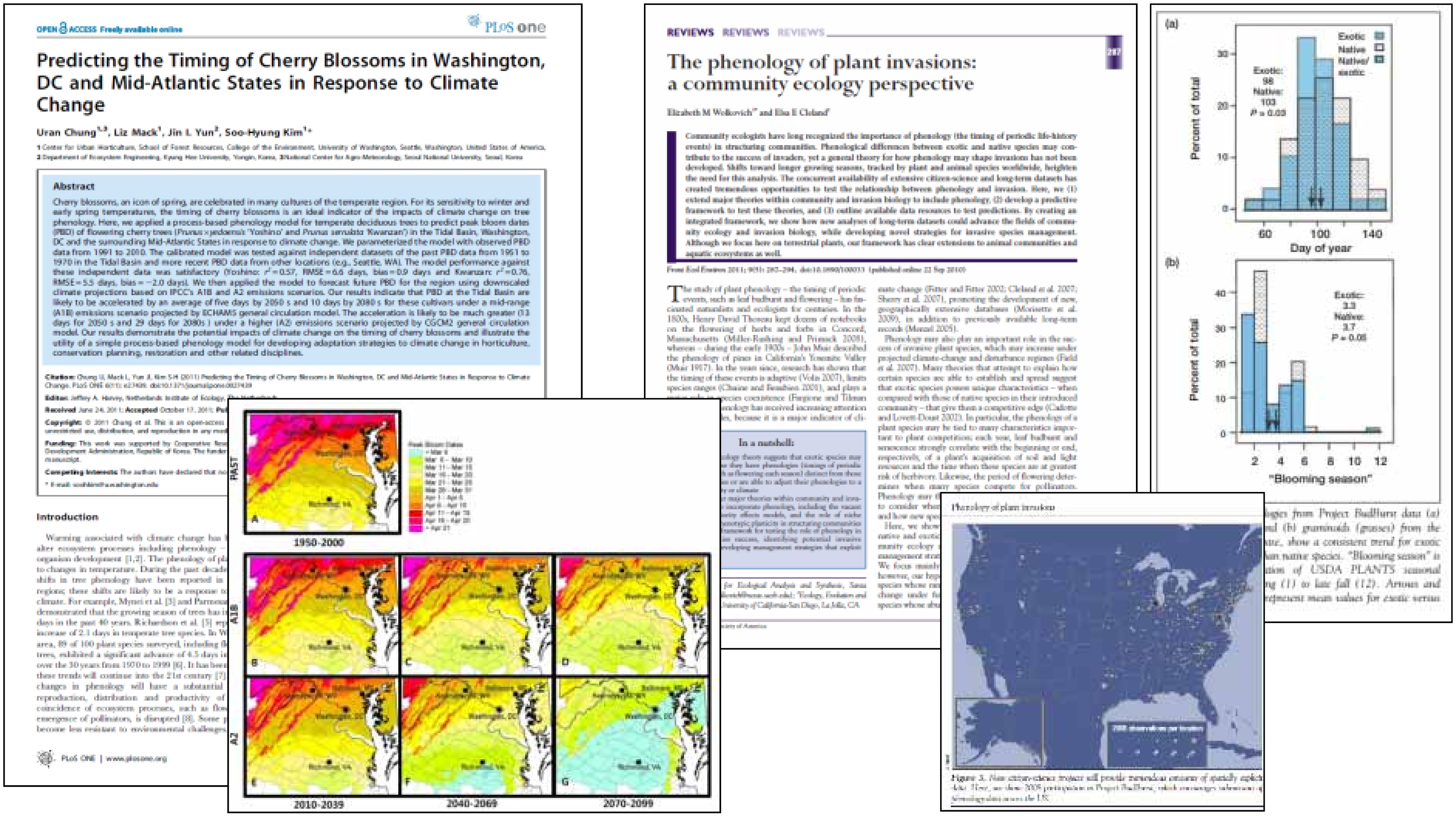
All data available through website (2007-'15)

Over 23k participants to date

- Makes science real by providing authentic research experiences
- Advances scientific learning through hands-on learning
- Can promote a sense of 'ownership' of plants/data

Scientific Application

Project BudBurst™
Timing is everything!



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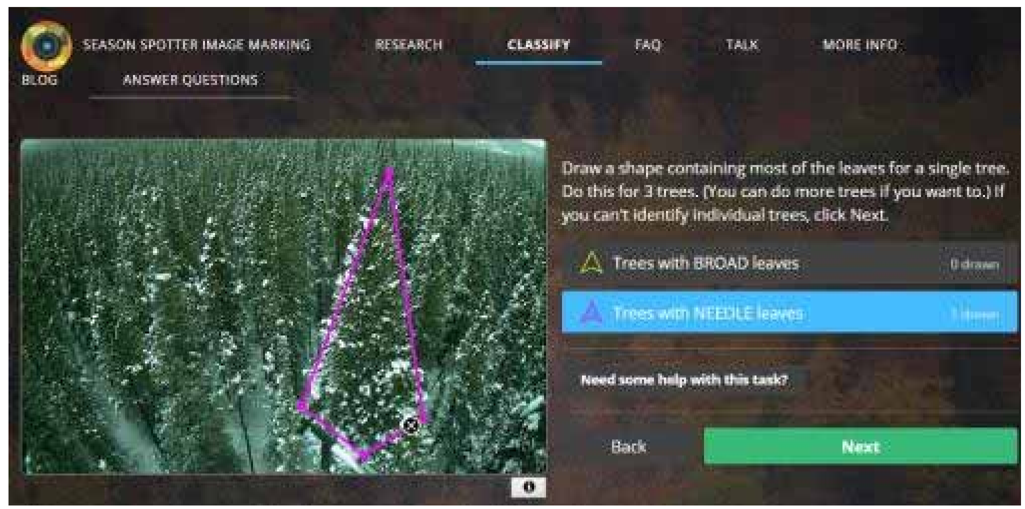
Season Spotter

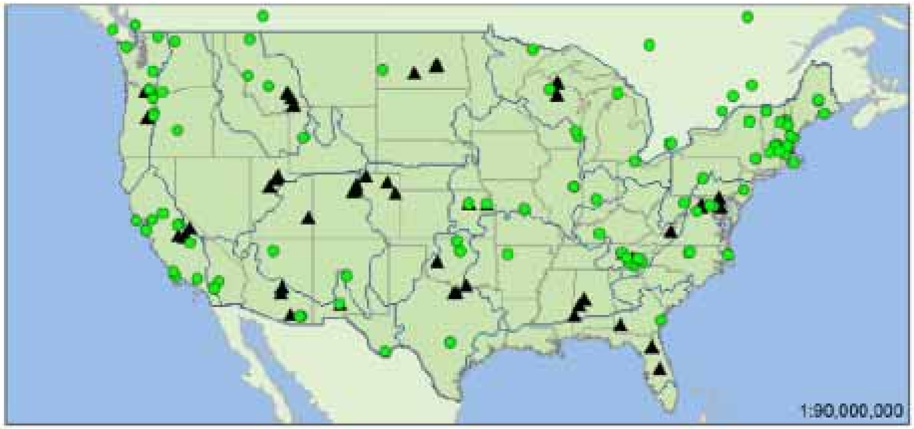
Willow Creek Tower Phenocam in Northern WI



A collaboration between Harvard University, NEON Inc., Boston University, Washington University, and University of New Hampshire

A phenocam network

SEASON SPOTTER



US Phenocam Network

- Uses Zooniverse platform for crowdsourcing
- Very simple, no registration required (though ~75% of classifications are from registered users)
- Minimal time commitment

- 2 types, classifications & image marking
- Chat section to interact w/researchers
- “Need some help” tips and location for each image

Image classification for Bitter Root Valley, Montana

A phenocam network

SEASON SPOTTER

- **Over 105K classifications and ~7K participants (in 8 months!)**
- **Possible synergies with PBB, value added**

Application

Using phenocams to monitor our changing Earth: toward a global phenocam network

Tim B Brown[1*], Kevin R Hultine[2], Heidi Steltzer[3], Ellen G Denny[4], Michael W Denslow[4], Joel Granados[5], Sandra Henderson[6], David Moore[8], Shin Nagai[9], Michael SanClements[7], Arturo Sánchez-Azofeifa[10], Oliver Sonnentag[11], David Tazik[7], and Andrew D Richardson[12]

Rapid changes to the biosphere are altering ecological processes worldwide. Developing informed policies for mitigating the impacts of environmental change requires an exponential increase in the quantity, diversity, and resolution of field-collected data, which, in turn, necessitates greater reliance on innovative technologies to monitor ecological processes across local to global scales. Automated digital time-lapse cameras – "phenocams" – can monitor vegetation status and environmental changes over long periods of time. Phenocams are ideal for documenting changes in phenology, snow cover, fire frequency, and other disturbance events. However, effective monitoring of global environmental change with phenocams requires adoption of data standards. New continental-scale ecological research networks, such as the US National Ecological Observatory Network (NEON) and the European Union's Integrated Carbon Observation System (ICOS), can serve as templates for developing rigorous data standards and extending the utility of phenocam data through standardized ground-truthing. Open-source tools for analysis, visualization, and collaboration will make phenocam data more widely usable.

Front Ecol Environ 2016; 14(2): 84–93, doi:10.1002/fee.1222

Understanding and adapting to global environmental change is one of the major challenges of the 21st century. Among the most visible outcomes of alterations in environmental properties and processes are shifts in phenology (the seasonal activity of plants and animals). Climate-driven changes in plant phenology, for instance, can have ecosystem-wide impacts, ranging from altered carbon budgets and productivity (Ciais et al. 2013) to effects on pollinators (Bellard et al. 2012) and crop yields (Lobell et al. 2011). However, quantifying such changes over large areas at appropriate timescales is challenging, even with satellite remote-sensing products.

Repeat photography has been used to detect and document changing landscapes since the earliest days of photography. Collections of photographs acquired from fixed locations have largely framed our understanding of global change processes, including desertification, glacial retreat, and alterations in land cover and land use (Webb 2010). Until recently, ground-based collection of time-series image data over long periods was expensive and technically challenging, but advancements in imaging and communication technologies are enabling continuous, widespread monitoring of the environment.

As high-quality, low-cost digital cameras have become more widely available, interest in applying these tools to ecological studies has expanded. "Near-surface remote sensing" utilizes data from automated ground-based sensors to augment conventional remote-sensing data, and to help bridge the gap between satellite monitoring and traditional

In a nutshell:

- Automated digital time-lapse cameras (phenocams) are powerful tools for recording and understanding ecological responses to global environmental change
- Documenting such changes in the environment is critical for informed decision making and to reduce or counteract negative outcomes
- Advances in digital imaging, computing, and networking technologies provide new opportunities for phenological monitoring, and the availability of low-cost, easy-to-use camera hardware brings the goal of developing a global environmental monitoring network within reach of most researchers
- Standardization of practices and metadata recording will improve the utility of phenocams and facilitate their integration with other monitoring methods

[1]Australian National University, Canberra, Australia [*](tim@time-science.com); [2]Department of Research, Conservation and Collections, Desert Botanical Garden, Phoenix,

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Go to zooniverse.org

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To learn more about Project BudBurst

Visit budburst.org

Thank you!