

# *The California Phenology Project*

## Tracking the effects of climate on plant phenology

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# Today's Webinar

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- **California Phenology Project: origin, geographic scope, and goals**
- **CPP design and implementation**
- **Progress to date**
- **Results: Links between CPP species' phenology and climatic variation**
- **The USA-NPN (how to become involved as a CPP partner)**

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- **California Phenology Project: origin and scope**

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Origin & funding – 2010: NPS Climate Change Response Program Grant

Selection of locations — 7 national parks with one permanent contact  
— coastal, montane, and desert regions

Selection of species — 30 woody or perennial species initially targeted

Tool creation: labels, maps, species profiles and data sheets

Dozens of workshops to train volunteers, educators, and park staff



# The California Phenology Project: 7 pilot parks



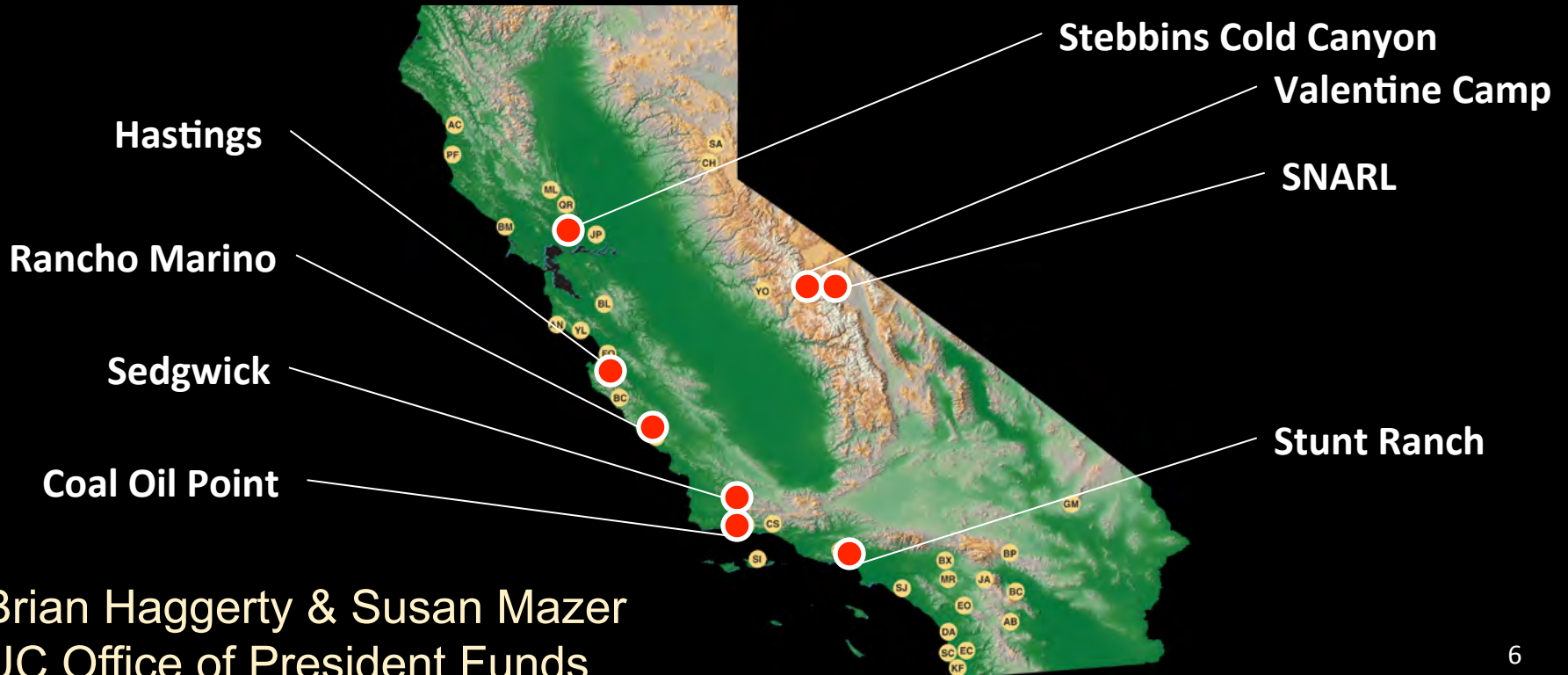
# The California Phenology Project at UC Natural Reserves



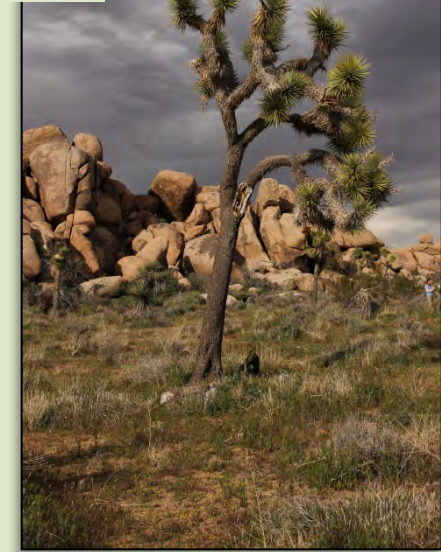
*University of California Natural Reserve System Phenology Network*

✓ **8 of 37 UC Reserves**

✓ **First multi-reserve & multi-campus project in 48-year history of UC-NRS**



# California Phenology Project: origin, scope, and goals



## ***Scientific goals:***

**Establish a phenological monitoring network using standardized protocol**

**Cover a large geographic area**

**Sample across environmental gradients**

**Establish a baseline of phenological data for long-term comparison**

**Begin to assess the effects of climate variability and climate change on the seasonal cycles of California taxa**

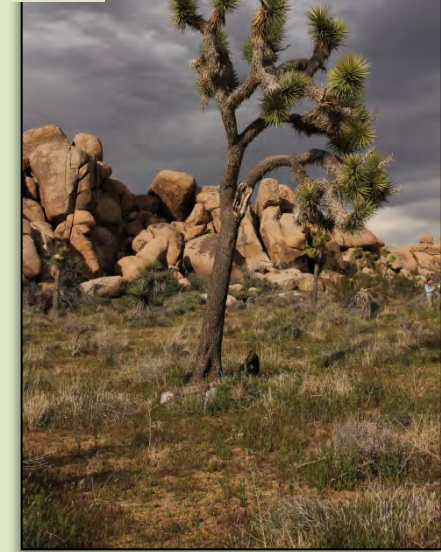


# California Phenology Project: origin, scope, and goals



## CALIFORNIA PHENOLOGY PROJECT

Connect with the seasons



### *Public relevance:*

**Guide resource management decisions**

**Education the public**

**Engage citizen scientists in genuine research**





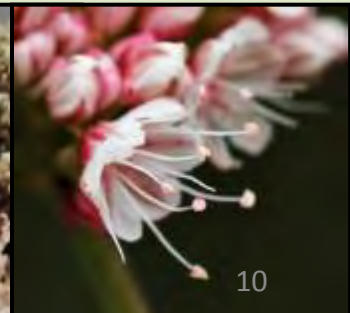
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# California Phenology Project: design and implementation

- Identify scientific questions
- Select species: 30 woody or perennial taxa initially targeted
- Revise phenophase descriptions for California plant taxa
- Develop monitoring protocols, infrastructure, and tools
- Develop outreach and education programs and partnerships
- Workshops, workshops, workshops....



# CPP scientific questions

- How do iconic, widespread species respond to environmental variation and climate change?
- Which taxa or life forms are most sensitive to climate change?
- Are phenophase onset dates more sensitive to winter temperature or precipitation?
- Do communities or habitats differ in their general responses to climate change?
- Are relationships between plant and animal mutualists disrupted by climate change?



# CPP species selection criteria

- dominant and/or indicator species
- widely distributed taxa
- species of management concern
- ease of identification
- proximity to other monitoring efforts
- species for which there are legacy data
- known and accessible locations



# CPP species selection

- >5,000 taxa in the California flora
  - Identified 75 high-priority species
  - 30 focal species currently monitored
  - >340 USA-NPN plant species occur in CA

<http://www.usanpn.org/cpp/meet-the-species>



# CPP species selection – one easy choice

## Joshua Tree (*Yucca brevifolia*)

- Iconic desert species, indicator for Mojave desert
- Ability to address scientific questions
- Proximity to other monitoring efforts
- Species of local management concern
- Ability to engage Citizen Scientists



# Targeted Species: Blue Oak

## *Quercus douglasii*



# Targeted Species: California Buckeye

## *Aesculus californica*





# Targeted Species: California buckwheat

## *Eriogonum fasciculatum*



# Targeted Species: Blue elderberry



# California Phenology Project: design and implementation

## Codes and Labels



# Discussion

- Examples of non-CPP species being monitored?
- Use of codes other than the CPP “standard”?

CPP-SEKI-FHVC1-AECA2

Unique Identifier: 447

4-letter **park** code

4-letter **location** plus **site**

4-letter species  
plus individual

CPP-**Sequoia&Kings Canyon**-**Foothill Visitor Center (Site 1)**-*Aesculus californica* (Ind 2)

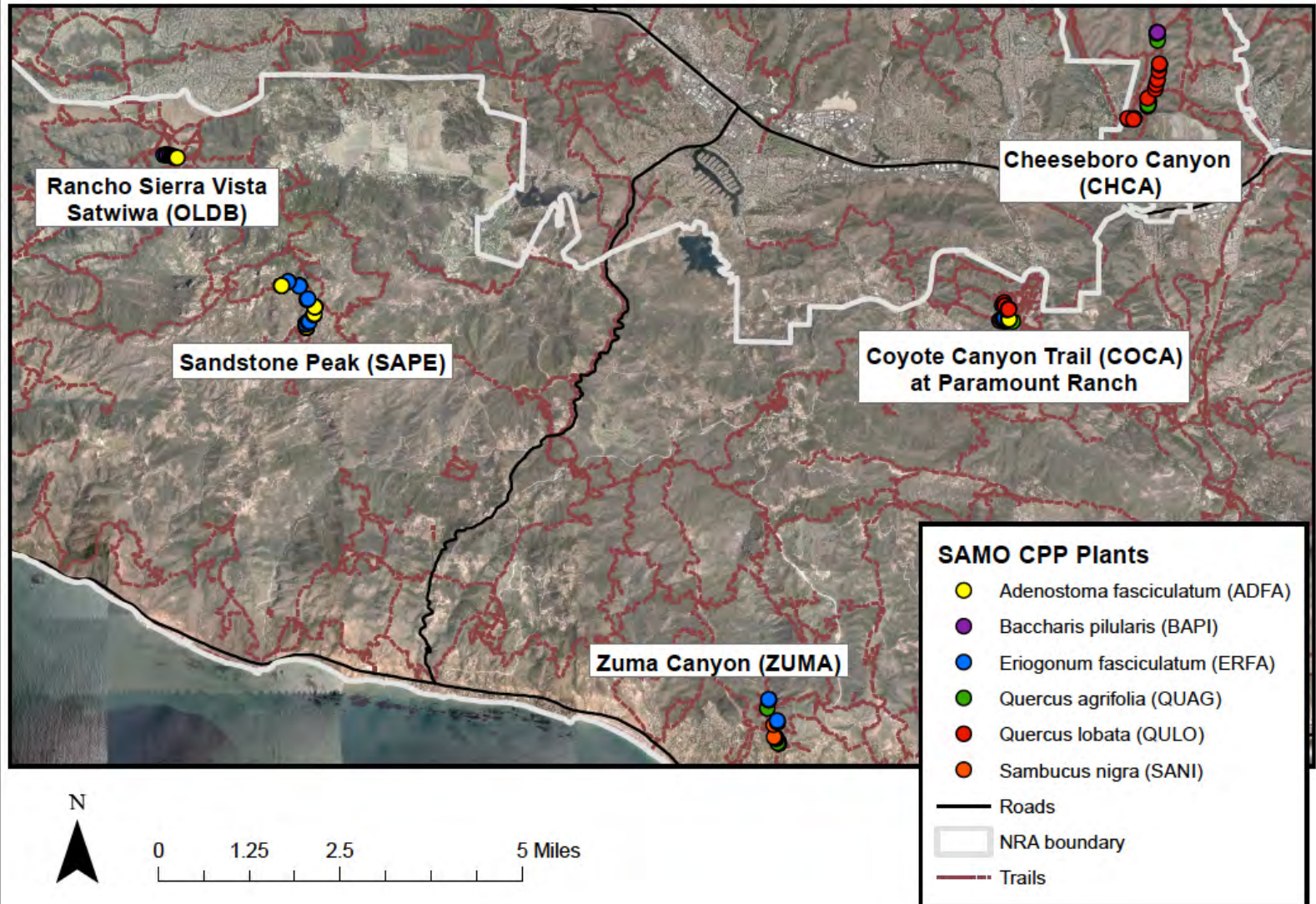
- Methods of training participants – Your experience



# California Phenology Project: design and implementation

## Static maps

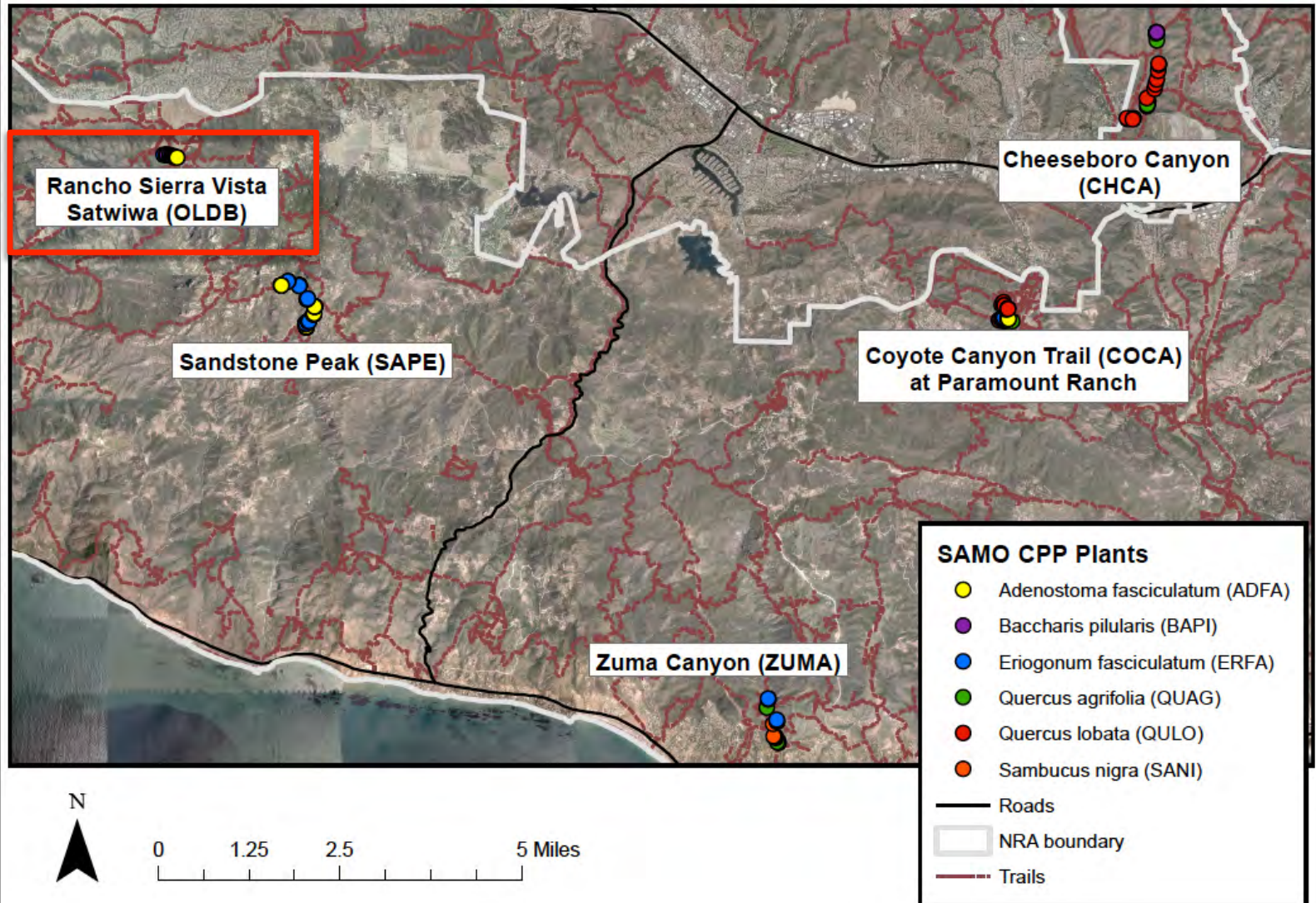
CPP Monitoring Locations at Santa Monica Mountains (SAMO)  
National Recreation Area



# California Phenology Project: design and implementation

## Static maps

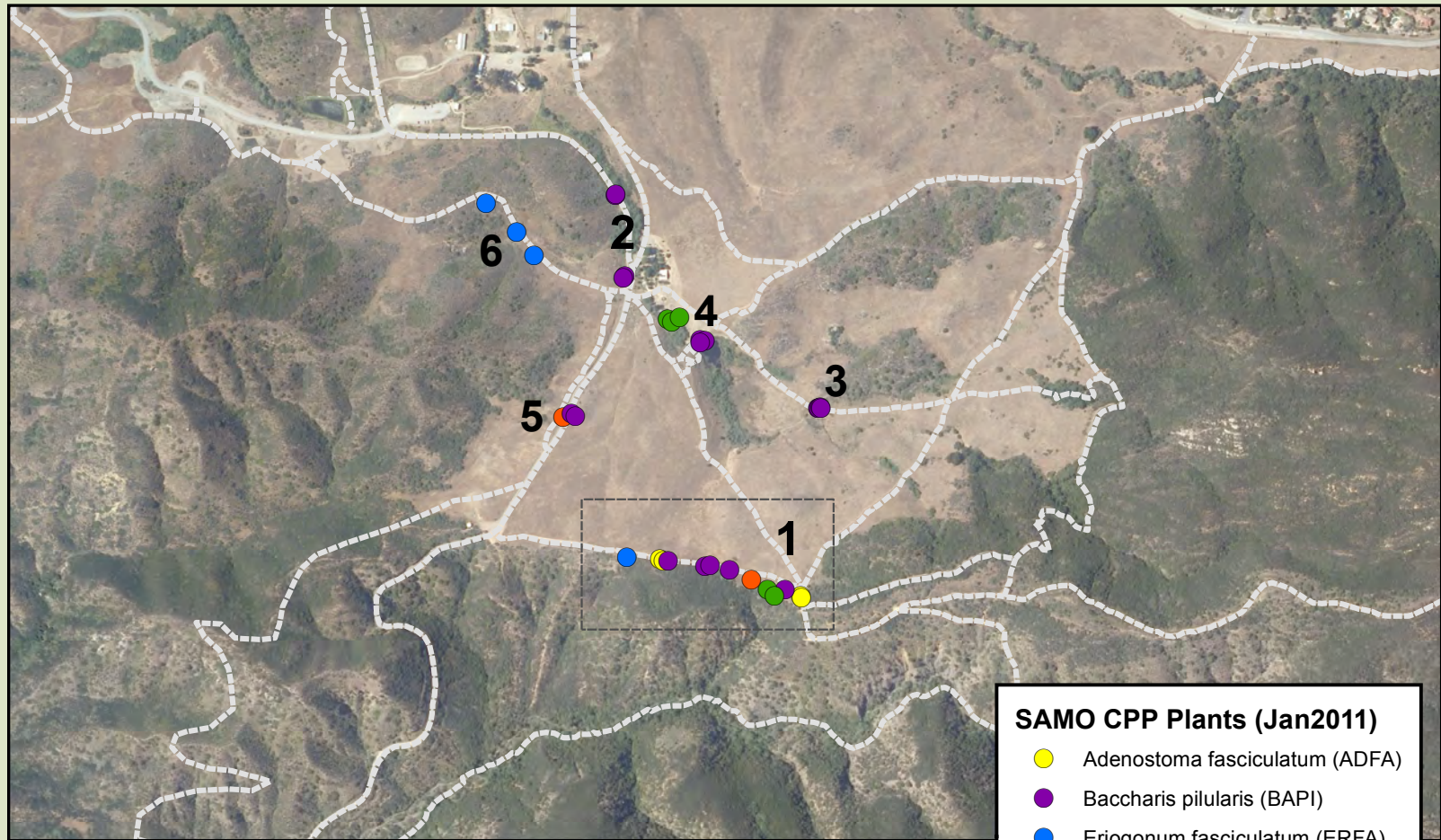
CPP Monitoring Locations at Santa Monica Mountains (SAMO)  
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# California Phenology Project: design and implementation

## Static maps

CPP SAMO Rancho Sierra Vista / Satwiwa Sites



### SAMO CPP Plants (Jan2011)

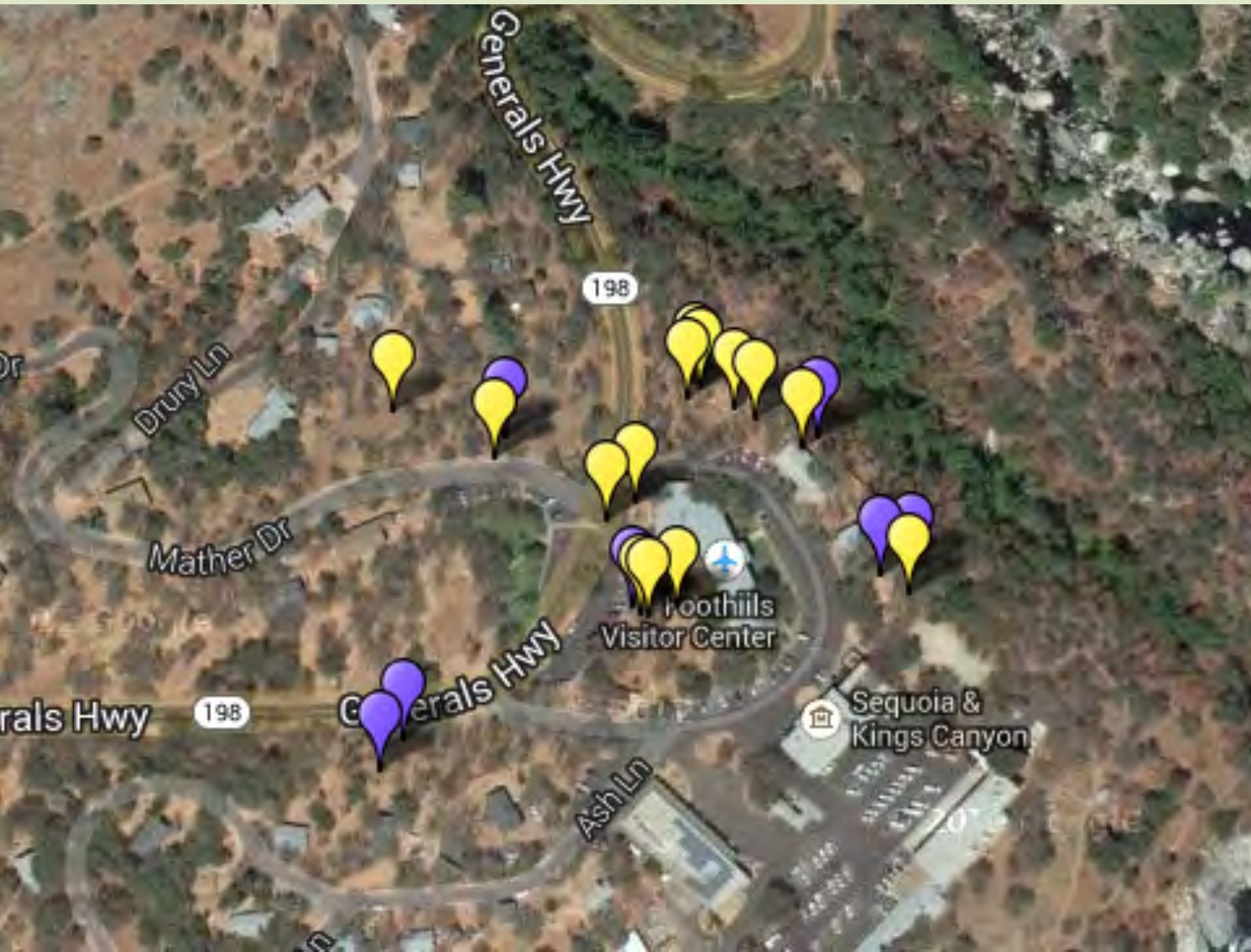
- *Adenostoma fasciculatum* (ADFA)
- *Baccharis pilularis* (BAPI)
- *Eriogonum fasciculatum* (ERFA)
- *Quercus agrifolia* (QUAG)
- *Sambucus nigra* (SANI)

----- Trails

# California Phenology Project: design and implementation

## Google maps

### Foothills Visitor Center



- SEKI-FHVC1-QUDO2 (#463)
- SEKI-FHVC1-QUDO3 (#461)
- SEKI-FHVC1-QUDO3 (#461)
- SEKI-FHVC1-QUDO4 (#460)
- SEKI-FHVC1-QUDO4 (#460)
- SEKI-FHVC1-QUDO5 (#459)
- SEKI-FHVC1-QUDO5 (#459)
- SEKI-FHVC1-QUDO6 (#458)
- SEKI-FHVC1-QUDO6 (#458)
- SEKI-FHVC1-AECA1 (#457)
- SEKI-FHVC1-AECA1 (#457)
- SEKI-FHVC1-AECA2 (#455)
- SEKI-FHVC1-AECA2 (#455)
- SEKI-FHVC1-AECA3 (#456)
- SEKI-FHVC1-AECA3 (#456)
- SEKI-FHVC1-QUDO7 (#454)
- SEKI-FHVC1-QUDO7 (#454)
- SEKI-FHVC2-QUDO1 (#453)
- SEKI-FHVC2-QUDO1 (#456)
- SEKI-FHVC2-QUDO2 (#452)
- SEKI-FHVC2-QUDO2 (#452)
- SEKI-FHVC2-QUDO3 (#451)
- SEKI-FHVC2-QUDO3 (#451)
- SEKI-FHVC2-QUDO4 (#449)
- SEKI-FHVC2-QUDO4 (#449)
- SEKI-FHVC2-QUDO5 (#448)
- SEKI-FHVC2-QUDO5 (#448)
- SEKI-FHVC2-AECA1 (#450)
- SEKI-FHVC2-AECA1 (#450)
- SEKI-FHVC3-AECA1 (#447)
- SEKI-FHVC3-AECA1 (#447)
- SEKI-FHVC3-QUDO1 (#444)
- SEKI-FHVC3-QUDO1 (#444)
- SEKI-FHVC3-QUDO2 (#443)
- SEKI-FHVC3-QUDO2 (#443)
- SEKI-FHVC4-AECA1 (#445)
- SEKI-FHVC4-AECA1 (#445)
- SEKI-FHVC4-AECA2 (#446)
- SEKI-FHVC4-AECA2 (#446)



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# Vital stats in a nutshell

- 30 species monitored
- 8 species monitored in multiple parks
- > 950 tagged monitored individuals
- > 763,000 observation records (2011-2014)
  - CPP observations account for ~20% of observations submitted to the USA-NPN database from 2010-2014

Thank  
you!



# CPP publications

National Park Service  
U.S. Department of the Interior



Natural Resource Stewardship and Science

## California Phenology Project (CPP) Plant Phenological Monitoring Protocol

*Version 1*

Natural Resource Report NPS/PWR/NRR—2014/763



National Park Service  
U.S. Department of the Interior



Natural Resource Stewardship and Science

## California Phenology Project

*Report on Pilot Phase Activities, 2010-2013*

Natural Resource Report NPS/PWRO/NRR—2013/743



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## *Baccharis pilularis* Coyotebrush



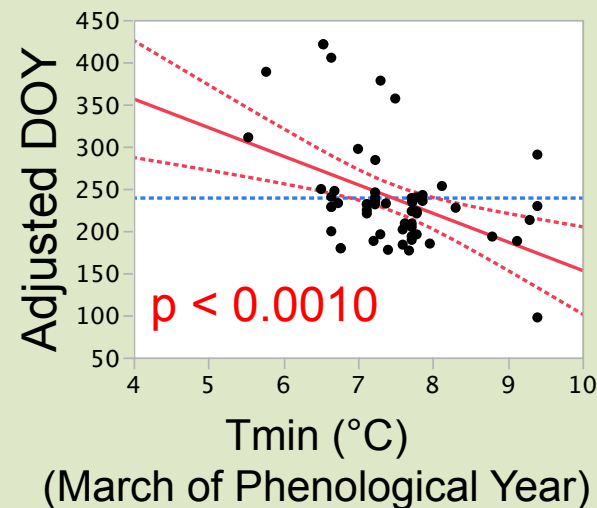
# Pilot parks where *B. pilularis* is monitored



# Effects of warmer temperatures & higher rainfall differs among months: all sites and years (2011-2013) pooled

## *Baccharis pilularis*: Flowers and Flower Buds

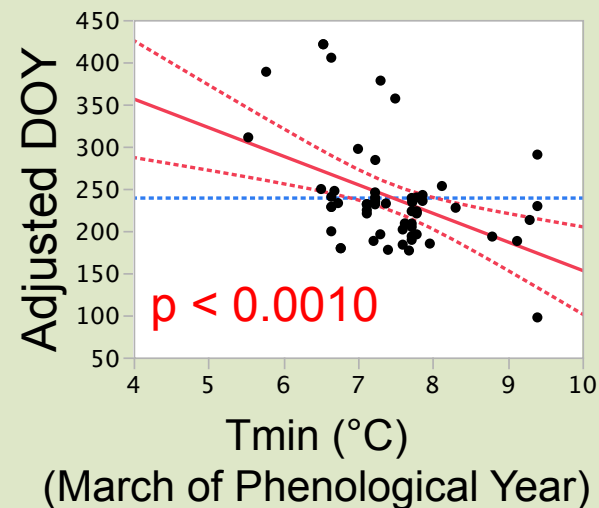
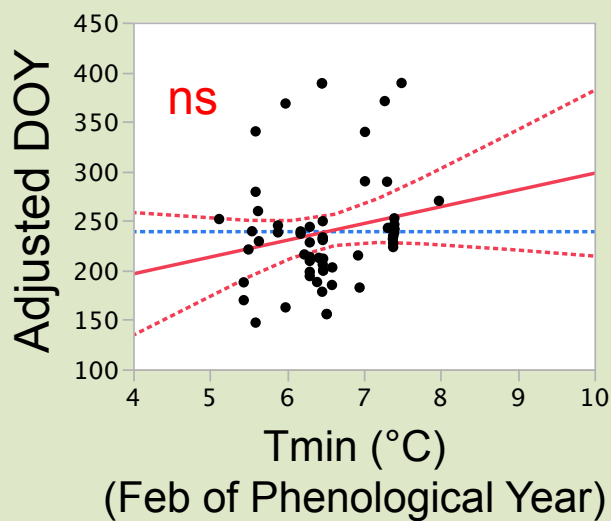
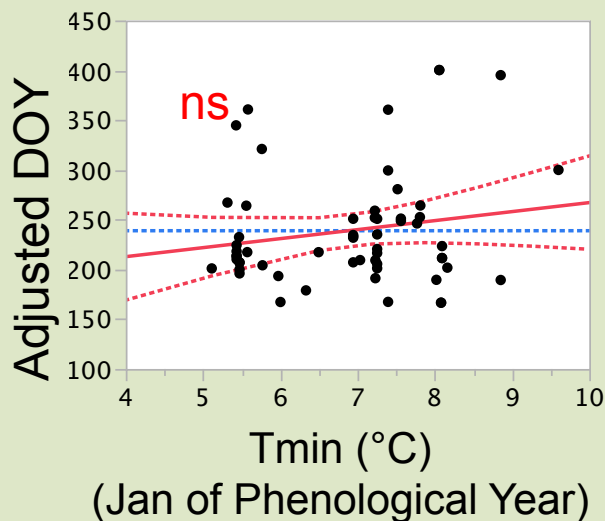
Each point represents the average minimum daily temperature of a site and the average Day of the Year (DOY) when flowers or flower buds appeared among the plants monitored at that site



At sites that experienced a warm March, Coyotebrush flowered *earlier* than at sites that experienced a cool March

# Effects of warmer temperatures & higher rainfall differs among months: all sites and years (2011-2013) pooled

## *Baccharis pilularis*: Flowers and Flower Buds



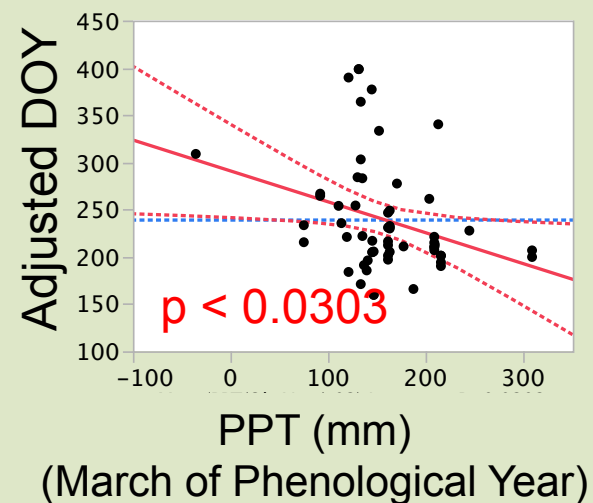
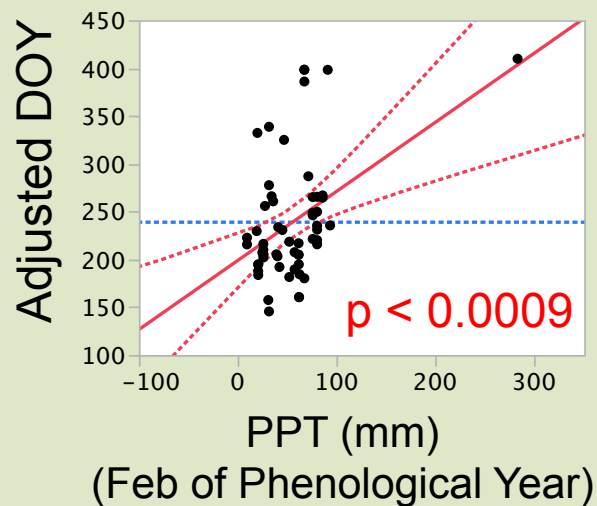
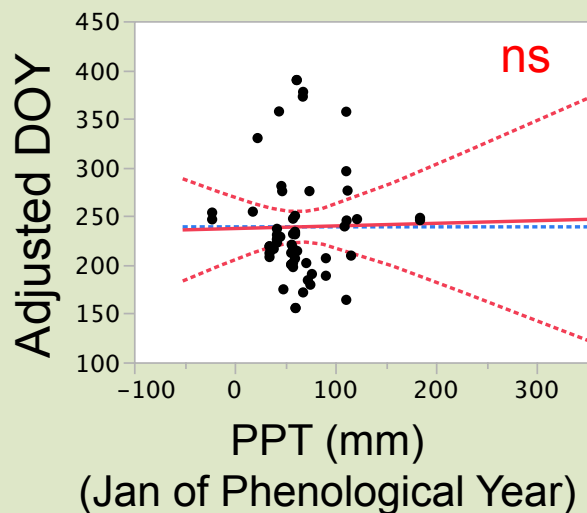
Temperatures in January and February did not influence the timing of the appearance of flowers or flower buds



# Effects of warmer temperatures & higher rainfall differs among months: all sites and years (2011-2013) pooled

## *Baccharis pilularis*: Flowers and Flower Buds

High rainfall in February vs. March had opposite effects on the timing of the appearance of flowers or flower buds



# Coyotebrush details

## *Baccharis pilularis* Coyotebrush

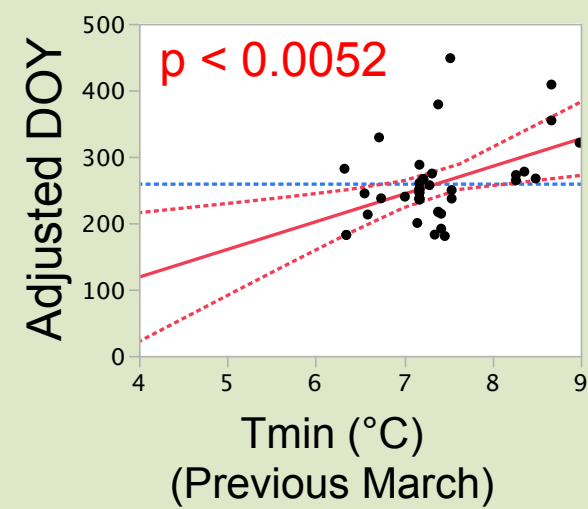
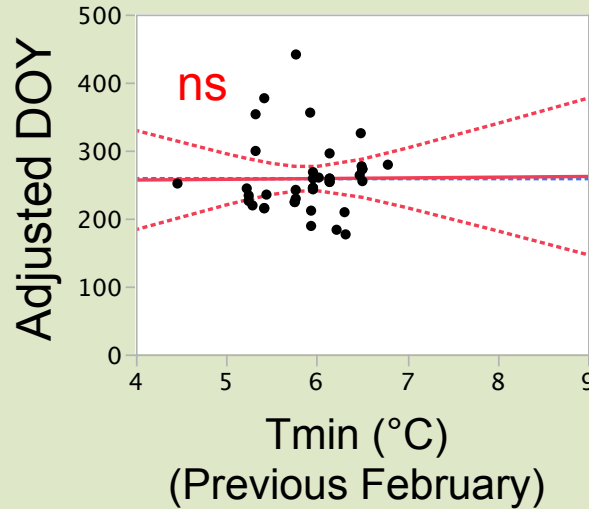
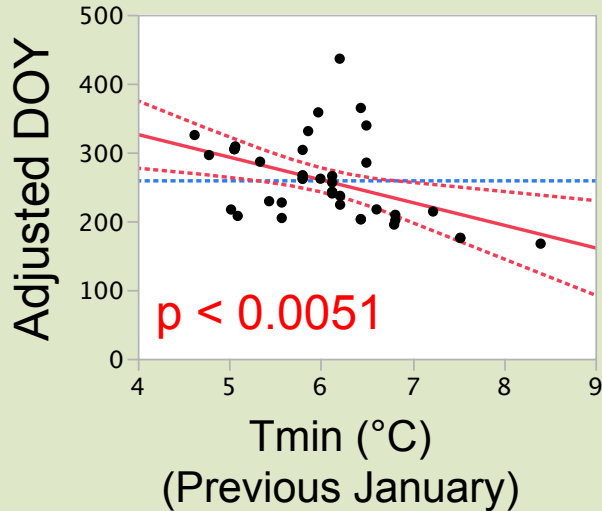
This is a species with separate sexes.

Do male and female phenophases  
respond differently?



# *Baccharis pilularis*: Effects of warmer monthly temperatures differ between male and female phenophases

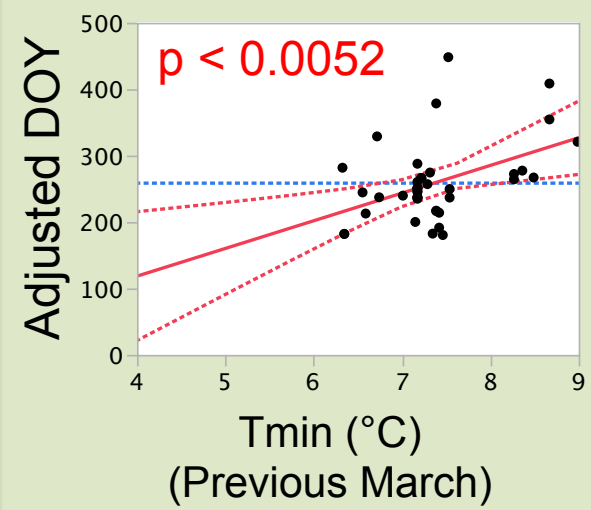
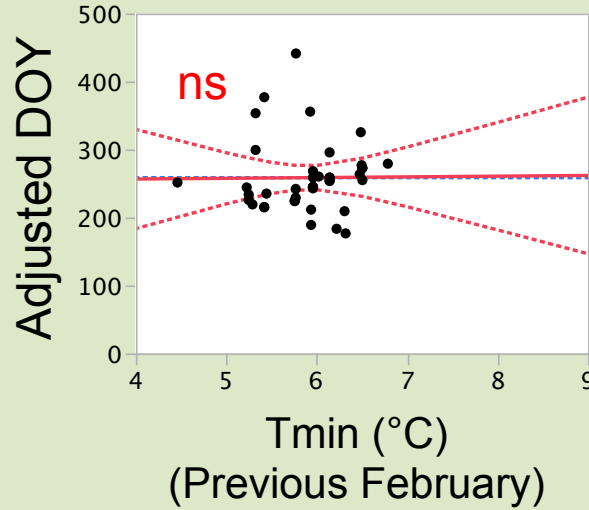
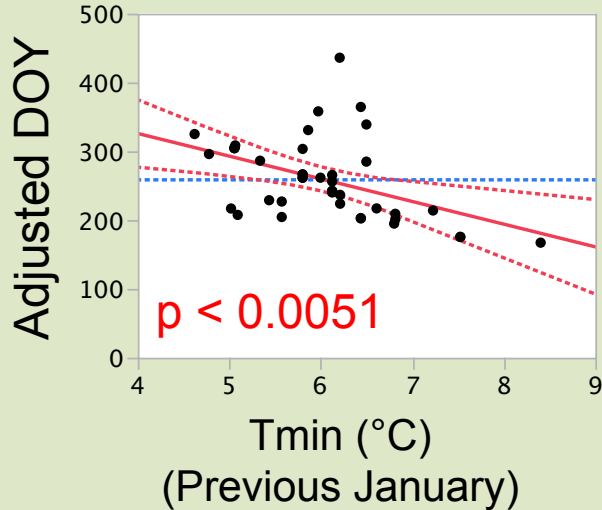
## A. Pollen Release



Sites where it is warm in March exhibit late pollen release

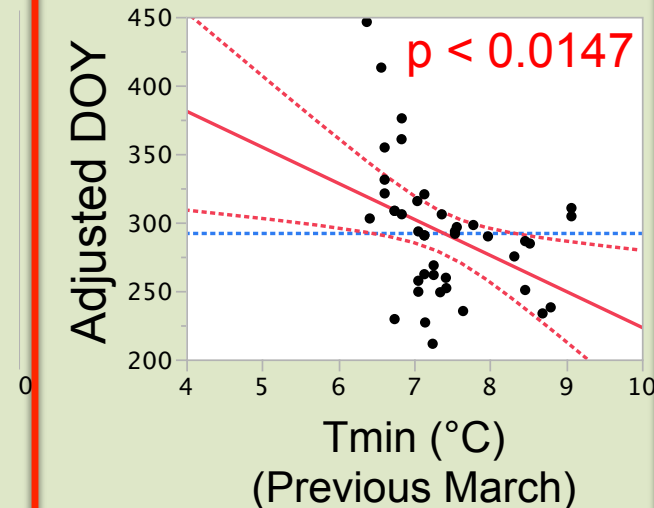
# *Baccharis pilularis*: Effects of warmer monthly temperatures differ between male and female phenophases

## A. Pollen Release



## B. Fruit

Sites where it is warm in March exhibit early fruit production

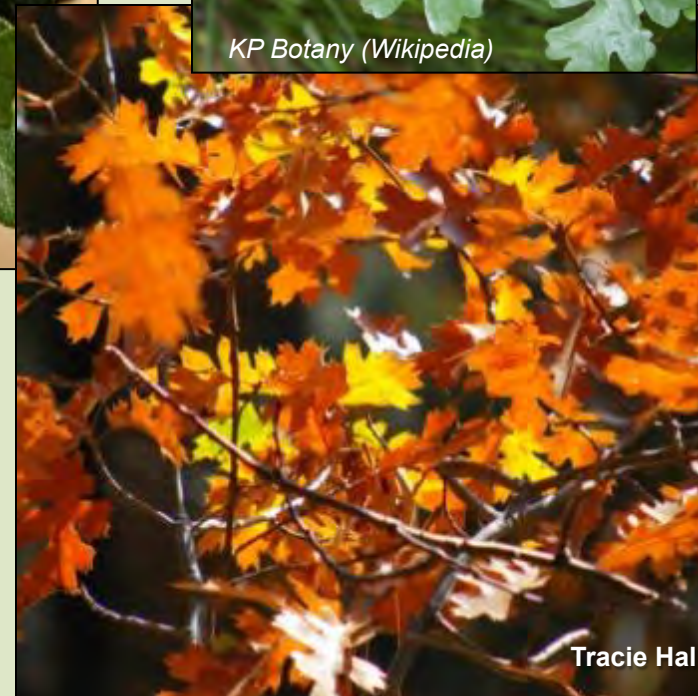


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  - *Quercus lobata*
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  - *Adenostoma fasciculatum*
- **The USA-NPN (how to become involved as a CPP partner)**

## *Quercus lobata* Valley Oak

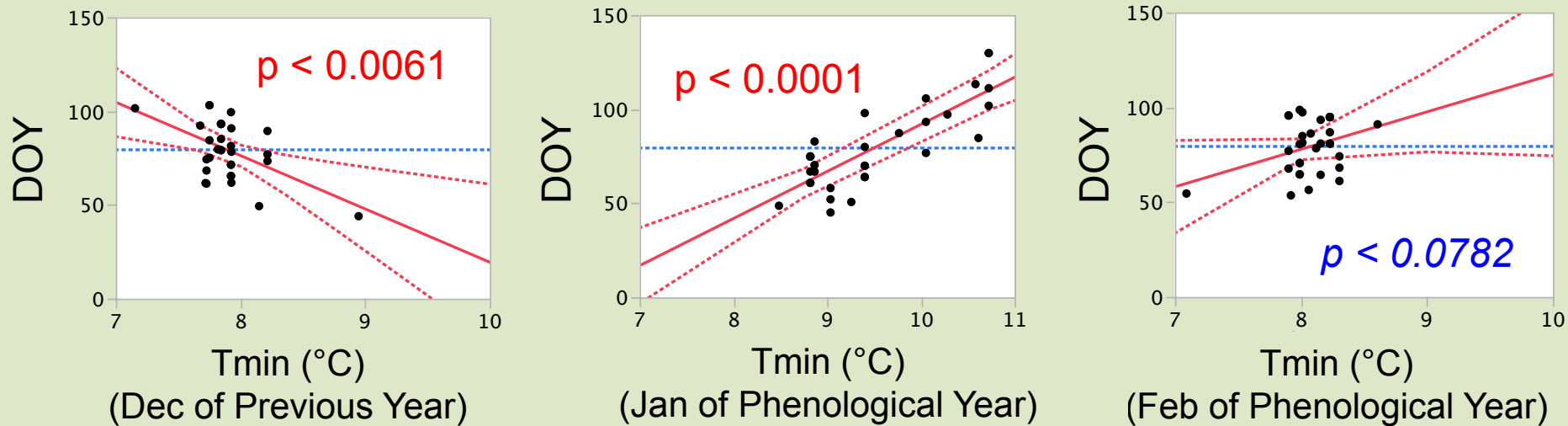


# Quercus lobata monitored in Santa Monica Mountains



# Effects of warmer temperatures among sites and years at Santa Monica Mtns NRA

## *Quercus lobata*: Breaking Leaf Buds



The effect of warm winter conditions on the onset of bud break differs among months.

A warm December accelerates bud break; a warm January delays bud break



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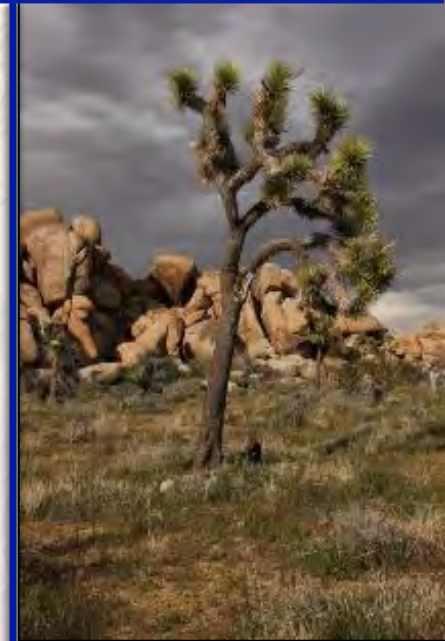
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## *Quercus douglasii* Blue Oak



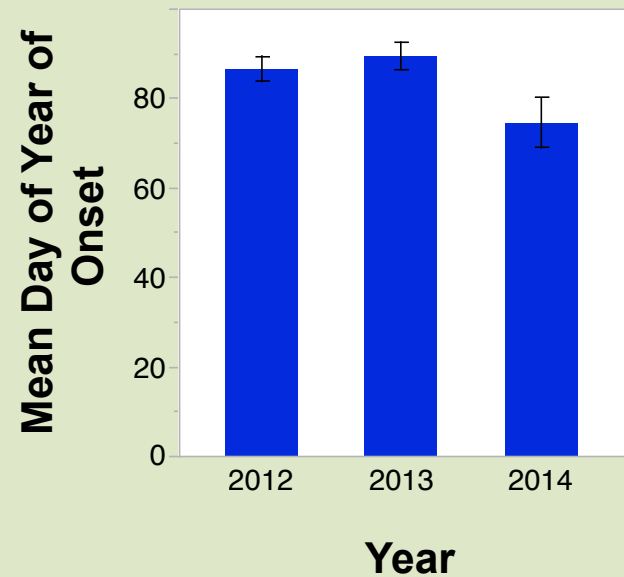
# The California Phenology Project: 7 pilot parks



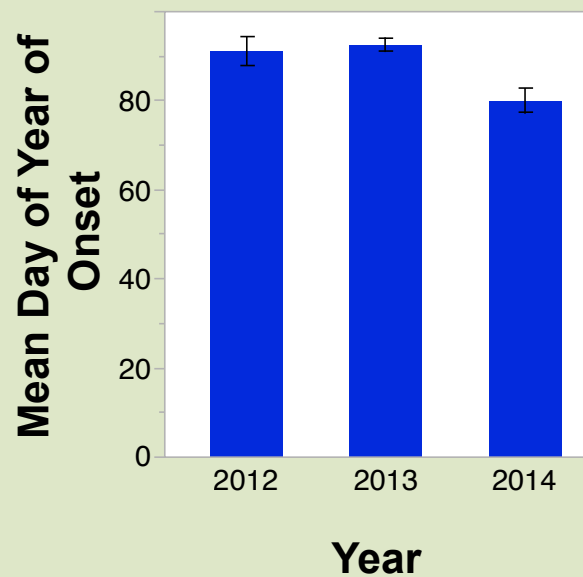
# Interannual variation in the onset of phenophases at Foothill Visitor Center, Sequoia and Kings Canyon NP

## *Quercus douglasii* (Blue Oak)

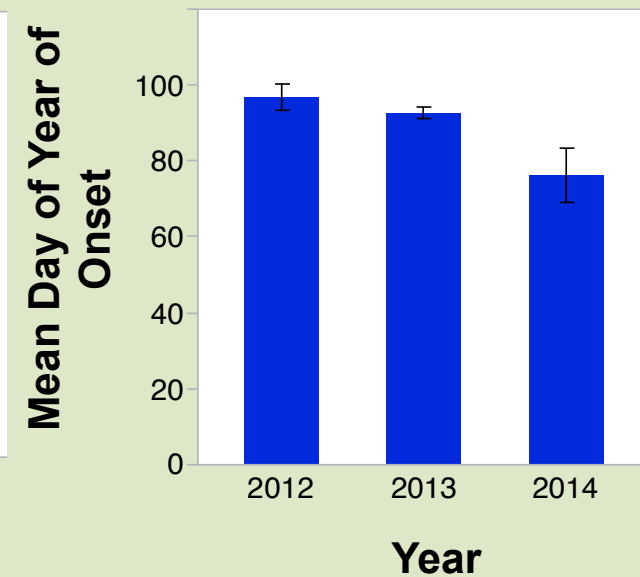
Flowers or Flower Buds



Open Flowers



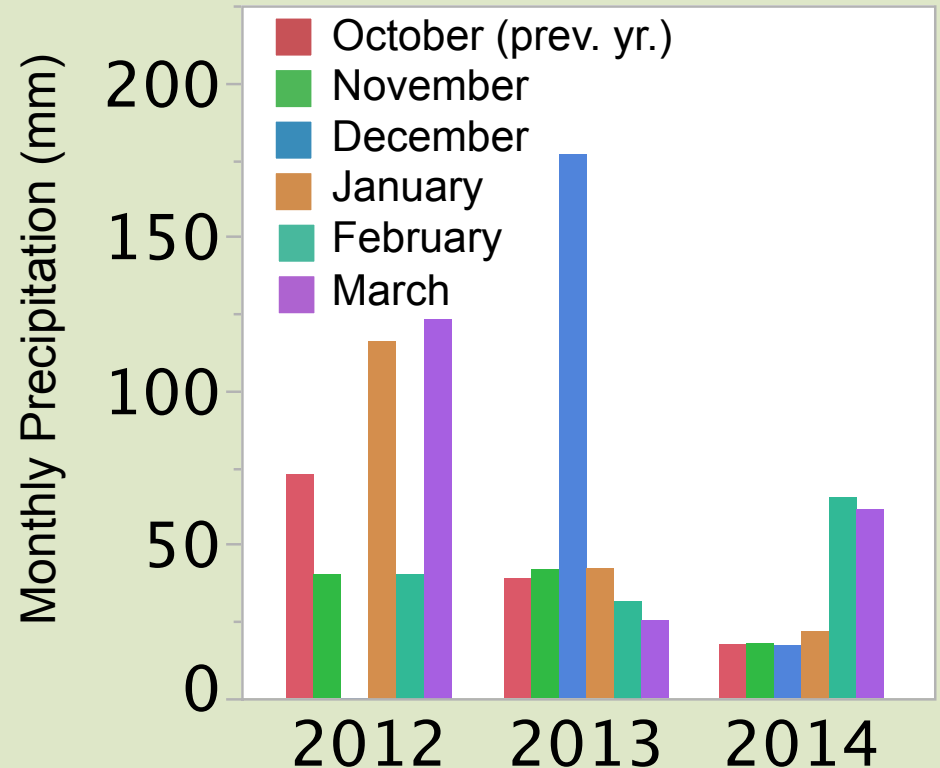
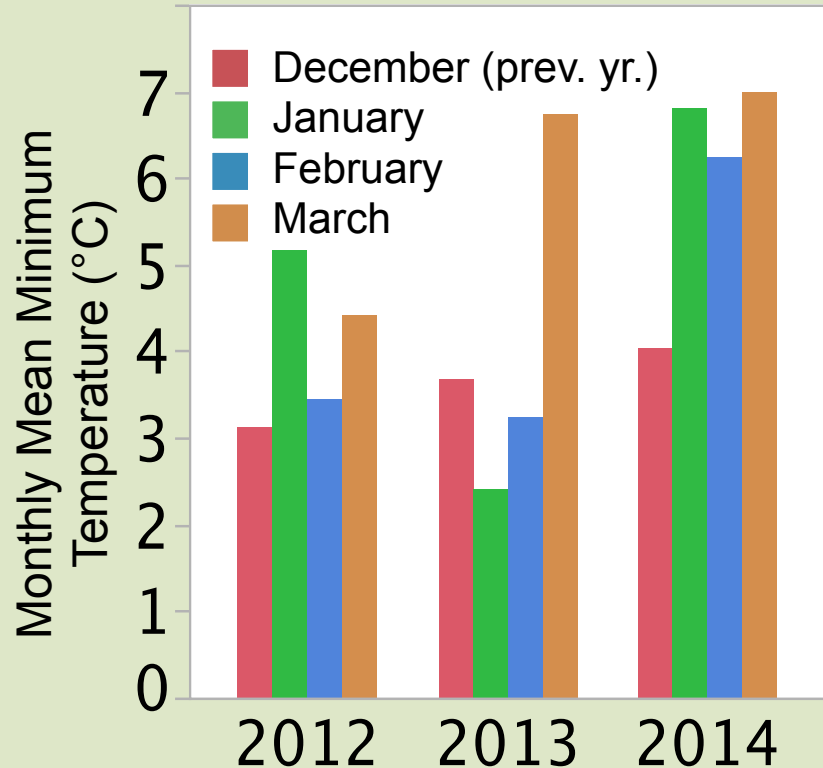
Pollen Release



All phenophases were advanced (earlier) in 2014

# Interannual variation in monthly climatic variables at Foothill Visitor Center, Sequoia and Kings Canyon NP

Winter 2014 was warmer and drier than Winters of 2012 and 2013



All phenophases were advanced (earlier) in the warmest, driest year

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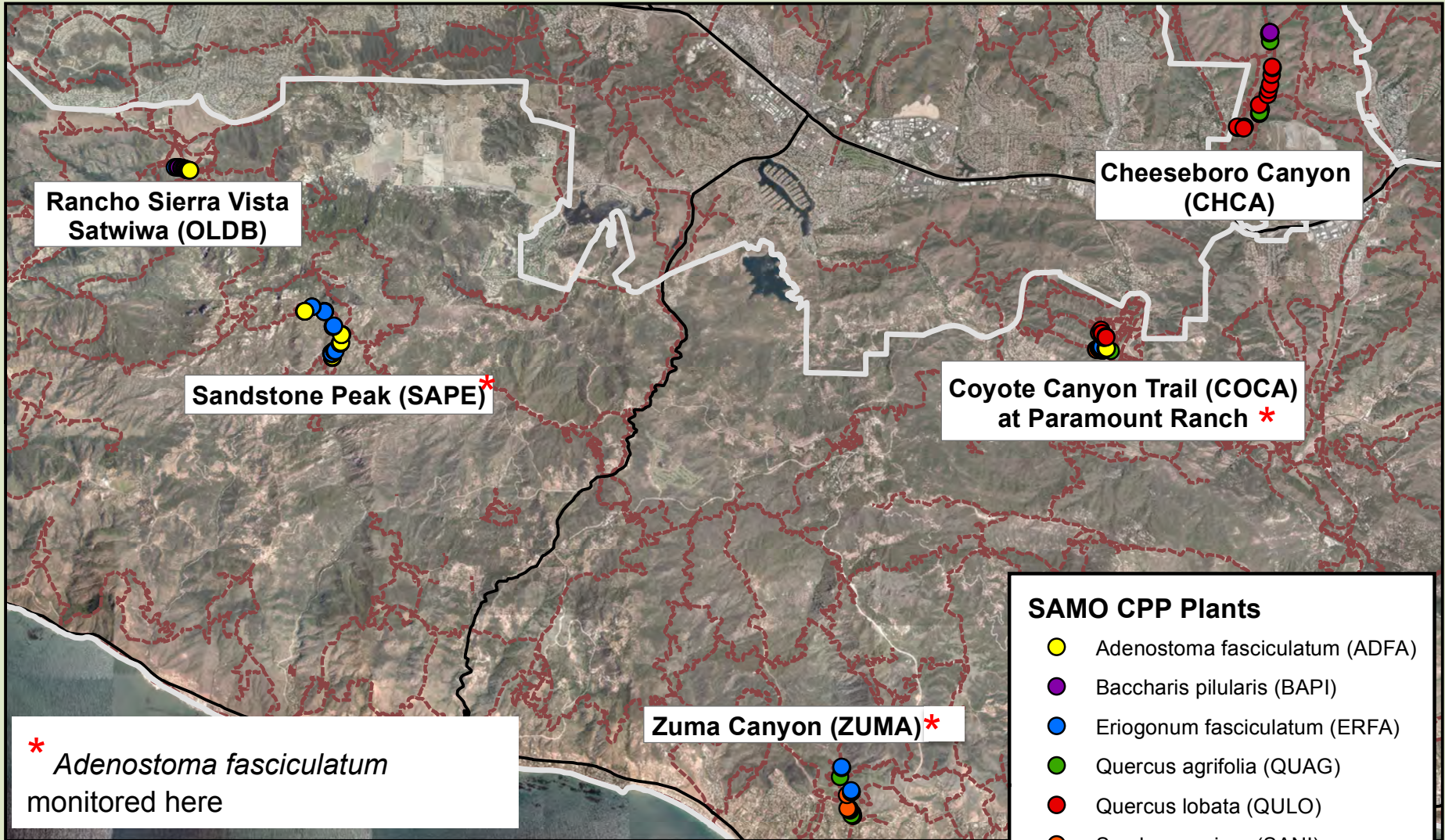
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# Targeted Species: Chamise

## *Adenostoma fasciculatum*



# CPP Monitoring Locations at Santa Monica Mountains (SAMO) National Recreation Area

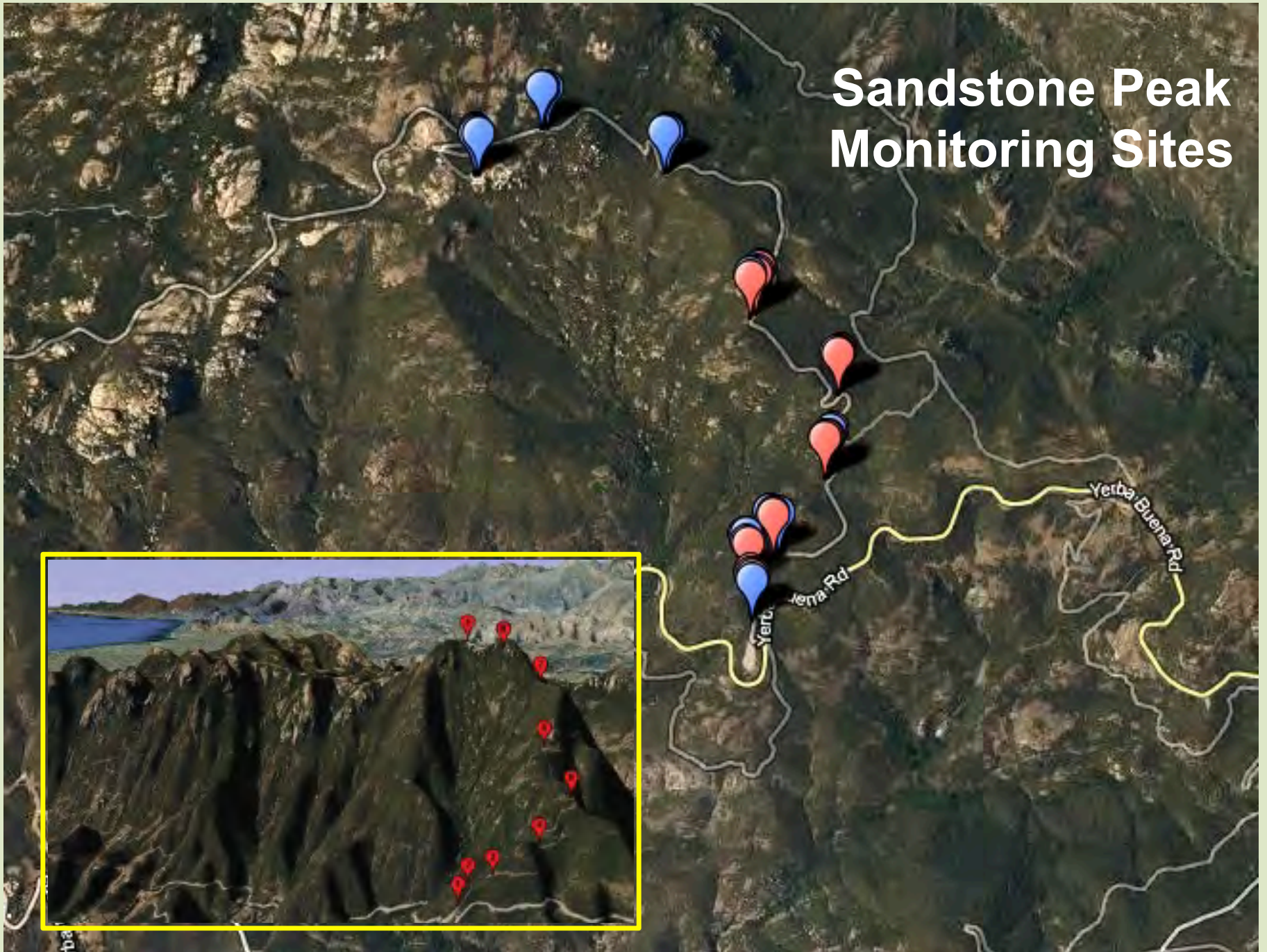




# CPP SAMO Sandstone Peak Monitoring Sites



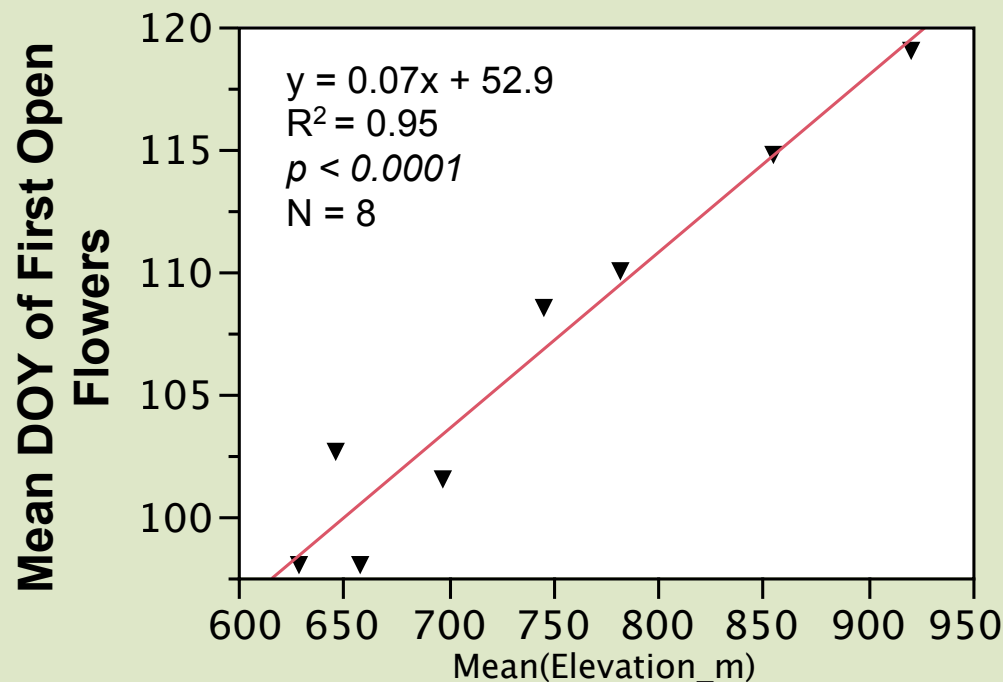
# Sandstone Peak Monitoring Sites



# Adenostoma fasciculatum – 2013, Sandstone Peak only

(*site means* [1-7 plants/site] by phenophase and by year, N=8 sites)

## Open flowers



### Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	403.53387	403.534	109.9380
Error	6	22.02336	3.671	
C. Total	7	425.55722		

**Prob > F**  
<.0001\*

### Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	52.908723	5.161373	10.25	<.0001*
Mean(Elevation_m)	0.0722919	0.006895	10.49	<.0001*



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# How to get involved as a CPP partner

---

- What does it mean to be part of the CPP?
- Are you:
  - Monitoring CPP species?
  - Monitoring at CPP established sites?
  - Using the CPP protocol or education materials?
  - or...*
  - Interested in joining the effort?

# How to get involved as a CPP partner

---

- Monitor at established sites in parks, reserves, or other protected areas
- Or, start your own site or network of sites nested within the CPP in *Nature's Notebook*
  - contact the USA-NPN coordinating office and we will create a new CPP group.
- To join a group of CPP sites and submit CPP data, add your group to your *Nature's Notebook* account



### Teachable Moments

Students in my classes benefit from the outstanding opportunity *Nature's Notebook* provides to share their data on plant and animal life cycles with a national audience.

- Dr. Heidi Steltzer, Fort Lewis College, Durango, CO

Log in successful for katgersz.

[View](#) | 
 [Edit](#) | 
 [Track](#)

## TRACKING Seasonal CHANGES IN PLANTS AND ANIMALS

Congratulations! Thank you for helping us collect more than 100 million records!

100% towards our goal

[GO TO YOUR OBSERVATION DECK](#)



**Phenology** refers to key seasonal changes in plants and animals from year to year—such as flowering, emergence of insects and migration of birds—especially their timing and relationship with weather and climate.

### How your data are being used

Observing nature is fun. But it also serves a greater purpose. Your observations of plants or animals inform scientific discovery and decision-making:



- Scientists use your data in groundbreaking research.
- Land managers use them to make better-informed decisions about natural resources in their care.
- Decision-makers use them to determine policy.

[Read about examples >](#)

[Attend a webinar to learn more >](#)

### Join a featured campaign



[See all campaigns >](#)

[Search all plants and animals >](#)

### HOW TO PARTICIPATE IN THE PROGRAM

Become an observer in 3 steps:

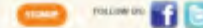
- 1 Join the program
- 2 Set up your account
- 3 Go outside and observe!

[BECOME AN OBSERVER](#)

### QUARTERLY E-NEWSLETTER

First Name \*

Email \*



Nature's Notebook Quarterly keeps you up to date on the world of phenology.



### FEATURED OBSERVER PHOTO



[Submit Your Photo](#)



Connecting People with Nature to Benefit Our Changing Planet

MY OBSERVATION DECK

ABOUT US

OBSERVE ▾

MORE WAYS TO CONNECT ▾

1 Join Nature's Notebook

2 Set up your account

3 Start observing!

katgerst

View

Edit

OAuth Authorizations

OAuth Consumers

Contact

Track page visits

File browser

**Partner Groups:**

- California Phenology Project
- Lassen Volcanic NP
- Lava Beds NM
- Santa Monica Mountains NRA
- Joshua Tree NP
- Yosemite NP
- Sequoia and Kings Canyon NP
- Golden Gate NRA
- John Muir NHS
- Redwood National Park
- Pima County Extension
- Coal Oil Point Natural Reserve
- Valentine Eastern Sierra Reserve
- Kenneth S. Norris Rancho Marino Reserve
- Sedgwick Reserve

**PARTICIPANT INFORMATION**

**First Name**

Kathy

**Last Name**

Gerst

**City**

Tucson

**State**

AZ

**HISTORY**

**Blog**

[View recent blog entries](#)

**Member for**

5 years 8 months



#### Partner Groups

- A.T. Seasons
- Arbor Day Foundation
- Audubon
- Belwin
- BLM Arcata Field Office
- Botanic Gardens and Arboretums
- Brazos Bend State Park
- Buffelgrass Monitoring Network, Tucson
- California Phenology Project
- Crazy Trees
- Chicago Park District
- City of Roanoke
- Clover Environmental Education
- Colleges and Universities
- Cooperative Extension
- Crosby Farm Regional Park
- Duke Farms
- Environmental Volunteers
- Florida Bluebird Society
- Foothill College Nature
- Great Barrington Phenology Trail
- Great Basin Bird Observatory
- Great Sunflower Project
- Hurricane Island
- Jug Bay Wetlands Sanctuary
- Juniper Pollen Project
- K-12 Schools
- Knock on Wood
- Knoxville Zoo Classroom Pollinator Project
- Laguna de Santa Rosa
- Land Trusts and Conservancies
- LTER
- MCI Framingham
- Minnesota Phenology Network
- Monarch Watch
- Mt. St. Helens Institute
- Murrieta Phenology Watch
- National Park Service
- Natural History Institute
- NatureBridge

- Brazos Bend State Park
- Buffelgrass Monitoring Network, Tucson
- California Phenology Project
  - ACR's Bouverie Preserve Pheno-Team
  - Coulee Ranch
  - CSU Monterey Bay
  - Don Edwards NWR
  - Death Valley NP
  - Golden Gate NRA
  - John Muir NHS
  - Joshua Tree NP
  - Lassen Volcanic NP
  - Lava Beds NM
  - Pepperwood Preserve
  - Redwood National Park
  - Santa Clara County Parks
  - Santa Monica Mountains NRA
  - Sequoia and Kings Canyon NP
- UCNRS
  - Coal Oil Point Natural Reserve
  - Kenneth S. Norris Rancho Marino Reserve
  - Sedgwick Reserve
  - Stebbins Cold Canyon Reserve
  - Valentine Eastern Sierra Reserve
- Ventura College
- Yosemite NP

Join a group, to observe at a shared site.

Very important!!

# Download summarized data: a new tool

**USA npn**  
National Phenology Network *Taking the Pulse of Our Planet*

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## DOWNLOAD PHENOLOGY DATA

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Download customized datasets from the National Phenology Database using the filters below to specify dates, regions, species and phenophases of interest.

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### Metadata & Documentation

- + [USA-NPN Protocols and Plant and Animal Phenophase Definitions](#)
- + [Documentation of Nature's Notebook User Interfaces](#)
- + [Dataset Comments field holds links to metadata for integrated datasets.](#)
- + [Quality Assurance and Quality Control Documentation](#)
- + [Documentation of data download via web service](#)
- + [National Park Service Protocols](#)

Data Type  
 Summarized Data  Raw Data

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- Data Dashboard
- Phenology Visualization Tool
- Download Phenology Data**
- Data Search Tools
- Share Existing Data

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Downloading and Summarizing Data Part 1: The Data Download Tool

Downloading and Summarizing Data Part 2: Summarizing and Graphing Data

HOW ARE YOU USING USA-NPN

www.usanpn.org/results/data

# Coming soon: personalized phenology calendars!



Connecting People with Nature to Benefit Our Changing Planet

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[Logout](#)

[MY OBSERVATION DECK](#)

[ABOUT US](#)

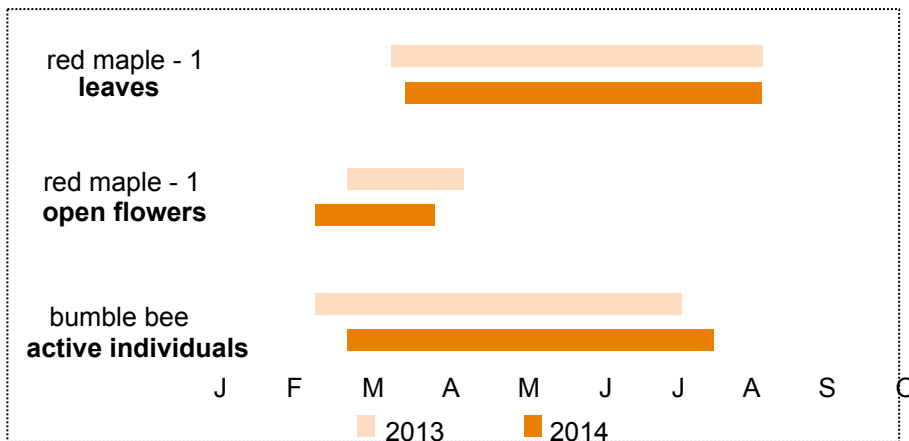
[OBSERVE](#)

[MORE WAYS TO CONNECT](#)

[Home](#) » [Observation Deck](#)

## erinposthumus's Observation Deck

Erinposthumus's [My Phenology Calendar](#)  [Earn Badges](#)



### Observations

[CUSTOMIZE MY CALENDAR](#)

Enter your observations below or via smartphone. You can edit the sites, plants or animals you've selected anytime.

### Observe

[Why Observe?](#)

[Become an Observer](#)

[My Observation Deck](#)

[Learn How To Observe](#)

[The Plants and Animals](#)

[Leaderboards](#)

### MY ACCOUNT

You are currently logged in as **erinposthumus**

[MY ACCOUNT DETAILS](#)

### Sites

NCO

[Nature's Notebook Training \(P\)](#)  
[Tanque Verde Guest Ranch](#)  
[Tucson Festival of Books 2013](#)

### My Plants & Animals

[quaking aspen-1](#)  
[devil's-tongue-1](#)  
[quaking aspen-2](#)  
[quaking aspen-3](#)

### Details for this Organism

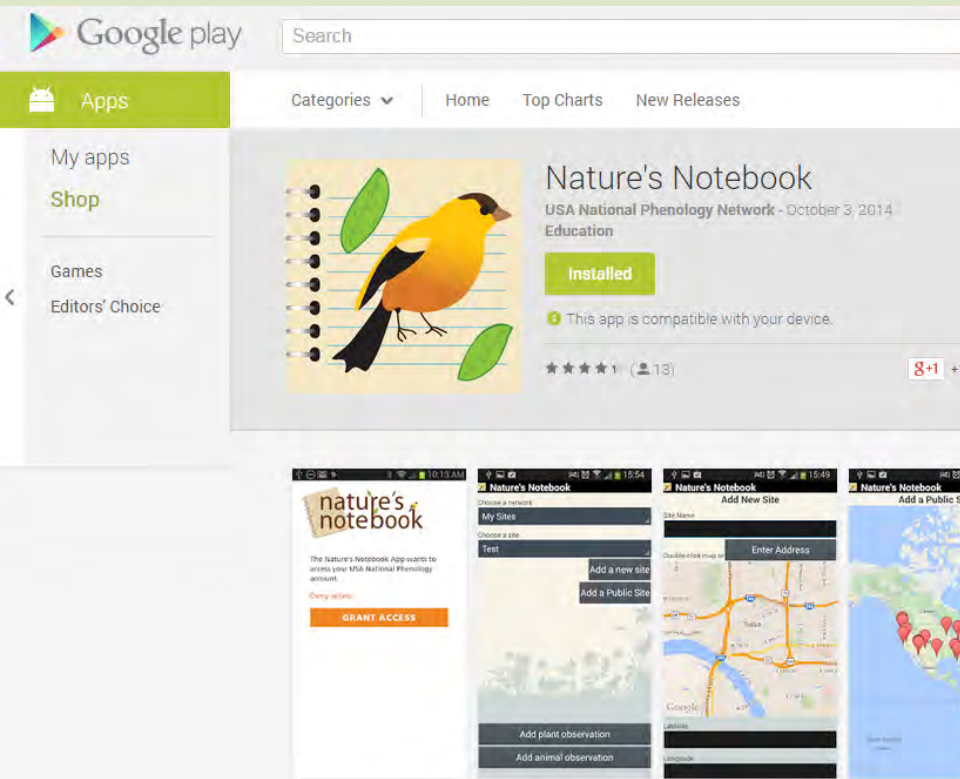
**quaking aspen-1**  
quaking aspen (*Populus tremuloides*)

Patch? No  
18/1/13 Unknown

### Enter Observations



# Use mobile apps to collect data



Google play

Search

Categories Home Top Charts New Releases

My apps Shop Games Editors' Choice

**Nature's Notebook**  
USA National Phenology Network - October 3, 2014  
Education

Installed

This app is compatible with your device.

★★★★☆ (13)

g+1

nature's notebook

The Nature's Notebook App wants to access your USA National Phenology account.

GRANT ACCESS

Nature's Notebook

My Sites

Observed Date

Text

Add a new site

Add a Public Site

Add plant observation

Add animal observation

Nature's Notebook

Add New Site

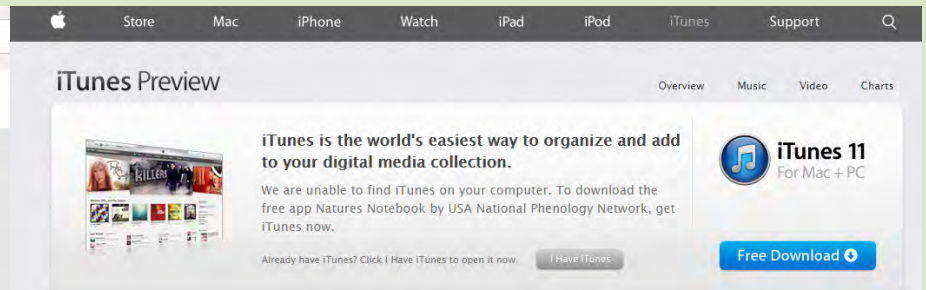
Site Name

Double-click map or

Enter Address

Nature's Notebook

Add a Public Site



Store Mac iPhone Watch iPad iPod iTunes Support

iTunes Preview

Overview Music Video Charts

iTunes is the world's easiest way to organize and add to your digital media collection.

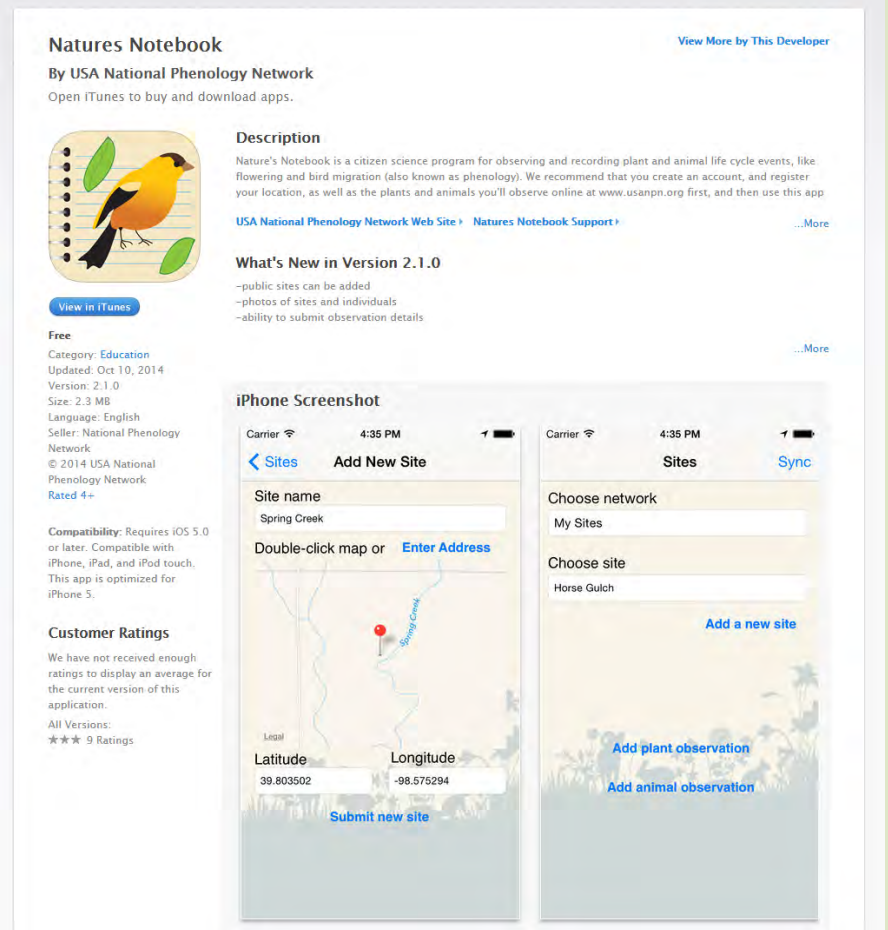
We are unable to find iTunes on your computer. To download the free app Nature's Notebook by USA National Phenology Network, get iTunes now.

Already have iTunes? Click I Have iTunes to open it now.

I Have iTunes

Free Download

iTunes 11  
For Mac + PC



Natures Notebook

By USA National Phenology Network

Open iTunes to buy and download apps.

View More by This Developer

Description

Nature's Notebook is a citizen science program for observing and recording plant and animal life cycle events, like flowering and bird migration (also known as phenology). We recommend that you create an account, and register your location, as well as the plants and animals you'll observe online at [www.usanpn.org](http://www.usanpn.org) first, and then use this app

[USA National Phenology Network Web Site](#) [Natures Notebook Support](#) ...More

What's New in Version 2.1.0

- public sites can be added
- photos of sites and individuals
- ability to submit observation details

...More

Free

Category: Education  
Updated: Oct 10, 2014  
Version: 2.1.0  
Size: 2.3 MB  
Language: English  
Seller: National Phenology Network  
© 2014 USA National Phenology Network  
Rated 4+

Compatibility: Requires iOS 5.0 or later. Compatible with iPhone, iPad, and iPod touch. This app is optimized for iPhone 5.

Customer Ratings

We have not received enough ratings to display an average for the current version of this application.

All Versions:  
★★★★ 9 Ratings

iPhone Screenshot

Carrier 4:35 PM

< Sites Add New Site

Site name  
Spring Creek

Double-click map or [Enter Address](#)

Latitude Longitude  
39.803502 -98.575294

Submit new site

Carrier 4:35 PM

Sites Sync

Choose network  
My Sites

Choose site  
Horse Gulch

[Add a new site](#)

[Add plant observation](#)

[Add animal observation](#)

Set up your account on your computer, and then use the mobile app outdoors.

# CPP: Next steps

---

- *For you:*
  - Let us know what you are doing, or thinking of doing
  - Add your group to the CPP network of sites
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  - Contact Susan Mazer, Kathy Gerst, or Angie Evenden
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  - [katgerst@email.arizona.edu](mailto:katgerst@email.arizona.edu)
  - [angela\\_evenden@nps.gov](mailto:angela_evenden@nps.gov)
- *For us:*
  - Revamp CPP website to include partners
  - Phone call meetings with all site leaders

# Discussion

---

- Has anyone made their own resources (maps, instructions, data sheets, games, etc.) that they'd like to share?
- Would you like them to be mounted on the CPP website?
- Examples of success in keeping volunteers motivated



Extra (unnecessary) slides below



# Future landscape of the CPP

---

- What does it mean to be part of the CPP?
- Are you:
  - Monitoring CPP species?
  - Monitoring at CPP established sites?
  - Using the CPP protocol or education materials?  
*or...*
  - Interested in joining the effort?

# How to get involved as a CPP partner

---

- Monitor at existing sites
- Start your own site or network of sites nested within the CPP
- Adding site or network to the CPP in *Nature's Notebook*
  - If you have not yet established site, or it is not yet nested in CPP, contact NCO.
  - If the site you want to join is already established...



### Teachable Moments

Students in my classes benefit from the outstanding opportunity *Nature's Notebook* provides to share their data on plant and animal life cycles with a national audience.

- Dr. Heidi Steltzer, Fort Lewis College, Durango, CO

Log in successful for katgersz.

View Edit Track

## TRACKING Seasonal CHANGES IN PLANTS AND ANIMALS

Congratulations! Thank you for helping us collect more than 600

100% towards our goal

GO TO YOUR OBSERVATION DECK



**Phenology** refers to key seasonal changes in plants and animals from year to year—such as flowering, emergence of insects and migration of birds—especially their timing and relationship with weather and climate.

### How your data are being used

Observing nature is fun. But it also serves a greater purpose. Your observations of plants or animals inform scientific discovery and decision-making:



- Scientists use your data in groundbreaking research.
- Land managers use them to make better-informed decisions about natural resources in their care.
- Decision-makers use them to determine policy.

[Read about examples >](#)

[Attend a webinar to learn more >](#)

### Join a featured campaign



[See all campaigns >](#)

[Search all plants and animals >](#)

### HOW TO PARTICIPATE IN THE PROGRAM

Become an observer in 3 steps:

- 1 Join the program
- 2 Set up your account
- 3 Go outside and observe!

BECOME AN OBSERVER

### QUARTERLY E-NEWSLETTER

First Name \*

Email \*

Subscribe

FOLLOW US



Nature's Notebook Quarterly keeps you up to date on the world of phenology.

Nature's Notebook mobile apps for **Android** and **iPhone**.

### FEATURED OBSERVER PHOTO



Submit Your Photo



Connecting People with Nature to Benefit Our Changing Planet

MY OBSERVATION DECK

ABOUT US OBSERVE MORE WAYS TO CONNECT

1 Join Nature's Notebook 2 Set up your account 3 Start observing!

katgerst

View Edit OAuth Authorizations OAuth Consumers Contact Track page visits File browser

Partner Groups:

- California Phenology Project
- Lassen Volcanic NP
- Lava Beds NM
- Santa Monica Mountains NRA
- Joshua Tree NP
- Yosemite NP
- Sequoia and Kings Canyon NP
- Golden Gate NRA
- John Muir NHS
- Redwood National Park
- Pima County Extension
- Coal Oil Point Natural Reserve
- Valentine Eastern Sierra Reserve
- Kenneth S. Norris Rancho Marino Reserve
- Sedgwick Reserve

PARTICIPANT INFORMATION

First Name

Kathy

Last Name

Gerst

City

Tucson

State

AZ

HISTORY

Blog

[View recent blog entries](#)

Member for

5 years 8 months

#### Partner Groups

- A.T. Seasons
- Arbor Day Foundation
- Audubon
- Belwin
- BLM Arcata Field Office
- Botanic Gardens and Arboretums
- Brazos Bend State Park
- Buffelgrass Monitoring Network, Tucson
- California Phenology Project
- Crazy Trees
- Chicago Park District
- City of Roanoke
- Clover Environmental Education
- Colleges and Universities
- Cooperative Extension
- Crosby Farm Regional Park
- Duke Farms
- Environmental Volunteers
- Florida Bluebird Society
- Foothill College Nature
- Great Barrington Phenology Trail
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- Casey Trees

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**SAVE**

**CANCEL ACCOUNT**

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- [Quality Assurance and Quality Control Documentation](#)
- [Documentation of data download via web service](#)
- [National Park Service Protocols](#)

Data type  
 Summarized Data  Raw Data

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HOW ARE YOU USING USA-NPN

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---

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  - [angela\\_evenden@nps.gov](mailto:angela_evenden@nps.gov)
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---

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- ✓ [angela\\_evenden@nps.gov](mailto:angela_evenden@nps.gov)

App Store > Education > Douglas Meredith



Free

# Natures Notebook

Douglas Meredith >

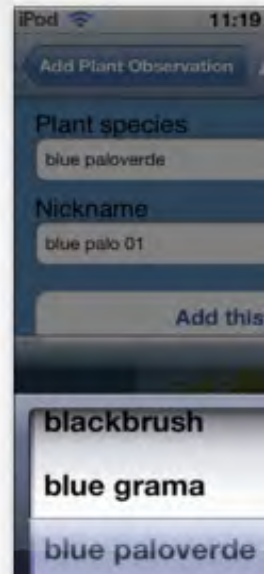
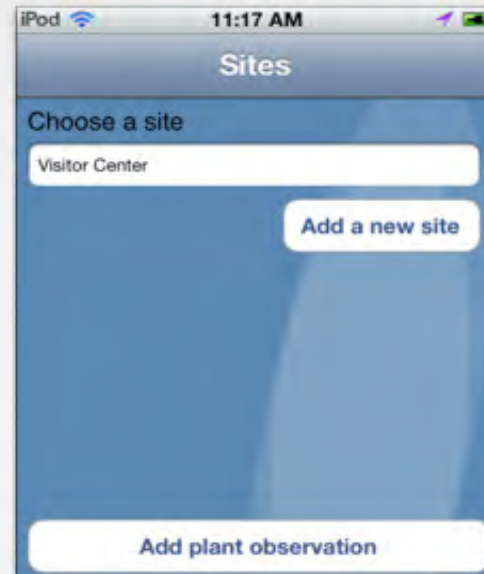
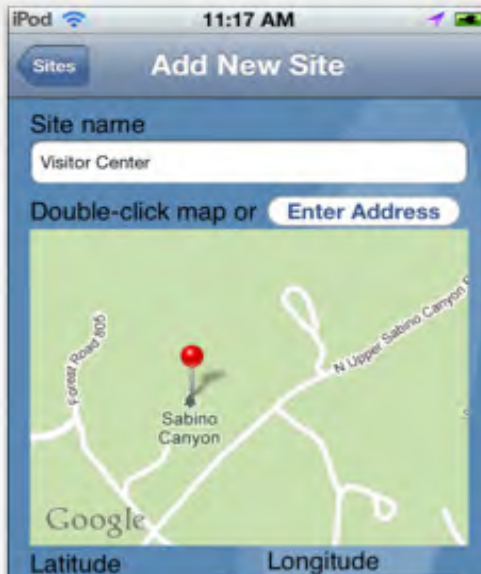
Details

Ratings and Reviews

Related

Set up your account on your computer, and then use the mobile app outdoors.

## iPhone Screenshots



No Ratings  
Rated 4+

DEVELOPER WEBSITE >

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**Question:** Has anyone in the webinar had trouble setting up their Nature's Notebook account or using the app?

Description

# 2014: Vital stats in a nutshell

<b>network</b>	<b># records</b>
California Phenology Project.....	1586
Coulee Ranch.....	1989
Don Edwards NWR.....	1461
Golden Gate NRA.....	2860
John Muir NHS.....	17005
Joshua Tree NP.....	20258
Kenneth S. Norris Rancho Marino Reserve.....	3995
Pepperwood Preserve.....	14696
Redwood National Park.....	1617
Santa Clara County Parks.....	2269
Santa Monica Mountains NRA.....	101832
Sedgwick Reserve.....	14310
Sequoia and Kings Canyon NP.....	26103
Stebbins Cold Canyon Reserve.....	4628
Valentine Eastern Sierra Reserve.....	384
Yosemite NP.....	1036
<b>Grand Total.....</b>	<b>216029</b>

Thank  
you!



# Alternative Models for Monitoring

---

1. Visit and monitor labeled and mapped individual plants: each plant is visited frequently when it is phenologically active  
(e.g., CPP plants in National Parks)
2. Visit and monitor labeled (unmapped) plants whenever it's convenient at a location with which you're familiar  
(e.g., plants in a campus courtyard or on-campus reserve)
3. Visit and monitor unlabeled plants one time, or opportunistically  
(e.g., plants you encounter while hiking the Pacific Crest Trail or taking students on an annual field trip)

**Question:** which of these models have you used?

# Today's Webinar

---

- CPP design and implementation
- Summary of CPP goals
- Summary of CPP progress to date
- **Links between California native species' phenology and climatic variation**
  - *Baccharis pilularis*
  - *Quercus lobata*
  - *Quercus douglasii*
  - *Eriogonum fasciculatum*
  - *Sambucus nigra*
- **Crash course in botany: tips for teaching volunteers**
- **The USA-NPN (how to become involved as an NPN partner)**

# Basic Botany Review for minimalists

## Vegetative structures

- Leaf buds
- Leaves & stems

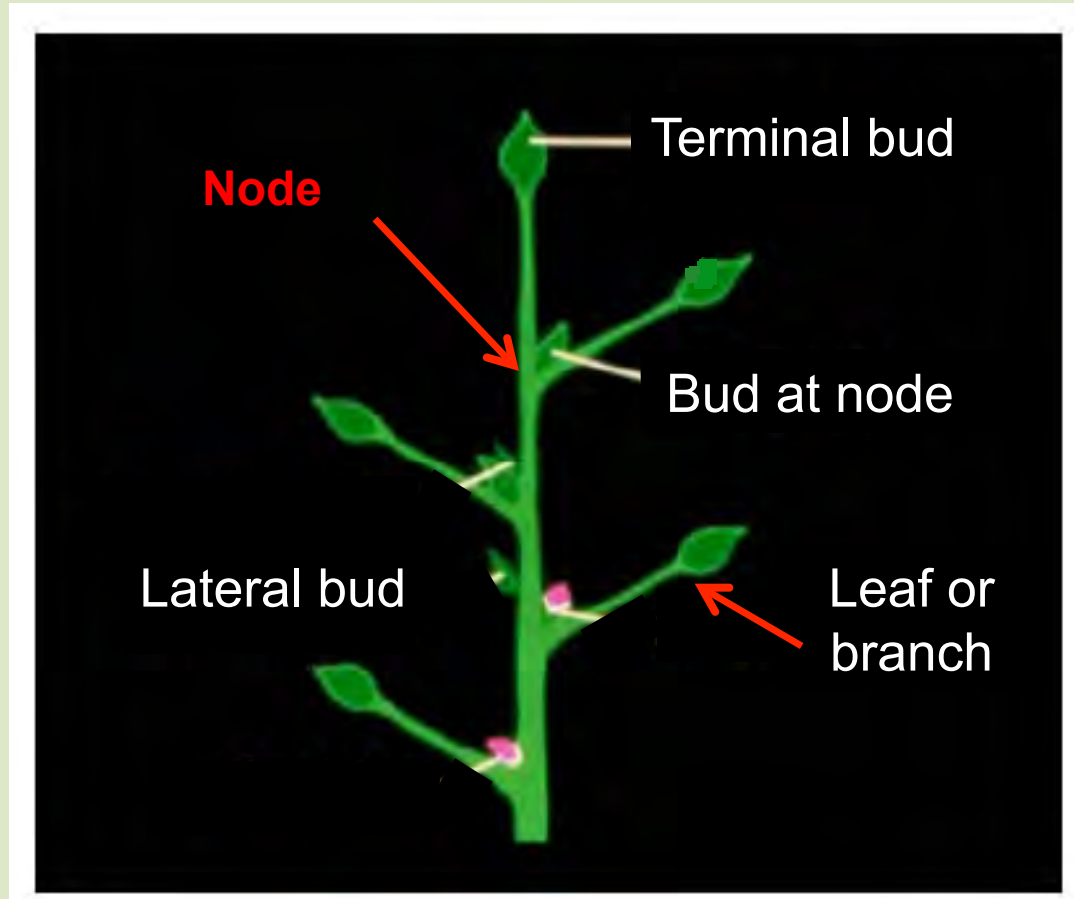
## Reproductive structures

- Flower buds
- Flowers
- Fruits & seeds

Do you see...
Breaking leaf buds
Leaves
Increasing leaf size
Colored leaves
Falling leaves
Flowers or flower buds
Open flowers
Pollen release
Fruits
Ripe fruits
Recent fruit or seed drop

*Pollination → Fertilization → Seeds & Fruits develop*

# Basic Botany Review for minimalists

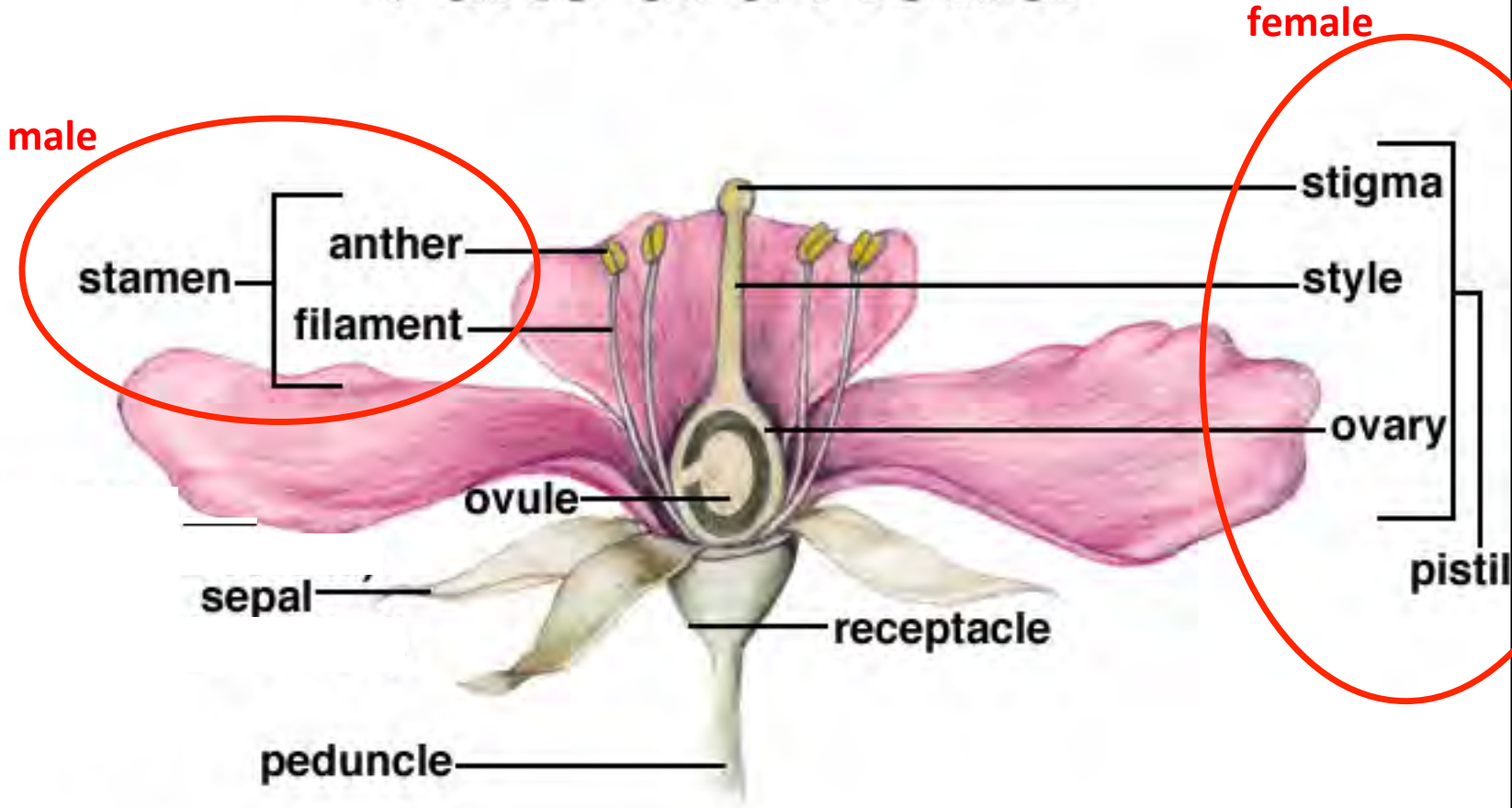


**Buds may be found in several locations relative to leaves and stems. Generally, leaves ALWAYS have a bud in their axil, even though it may be very small**



# Reproductive structures: flower buds, flowers, fruits & seeds

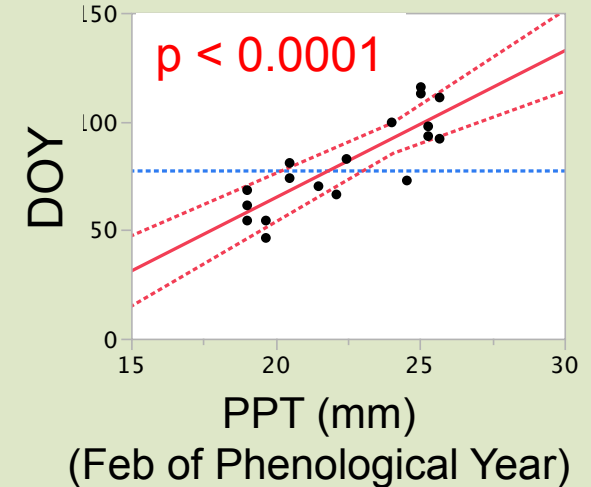
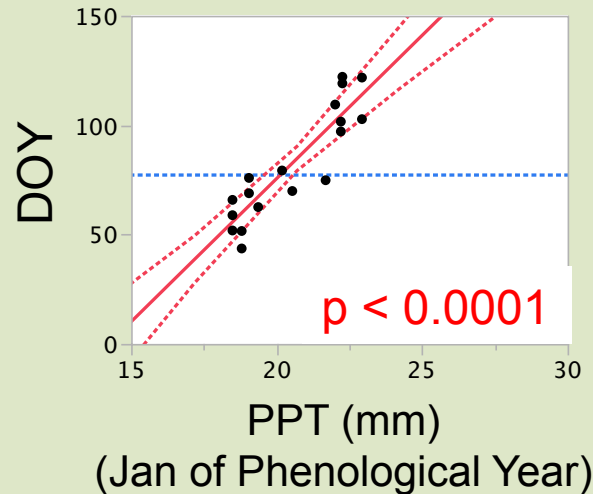
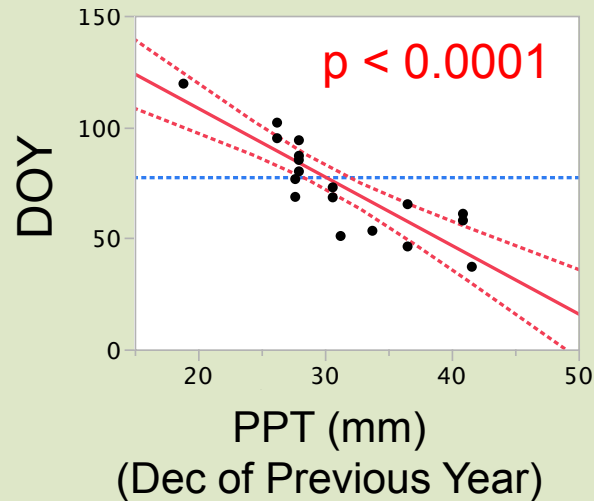
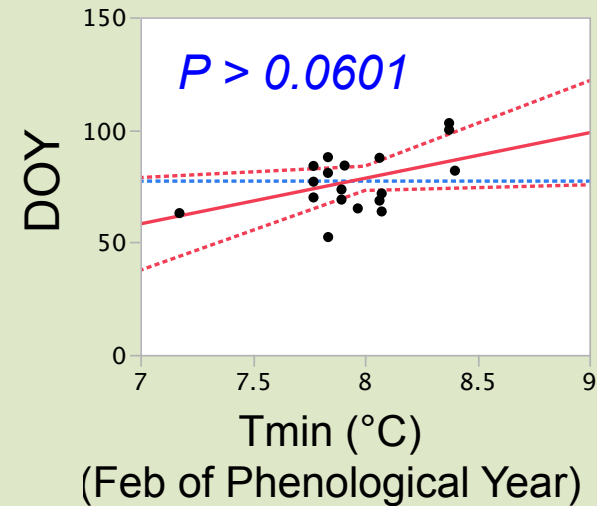
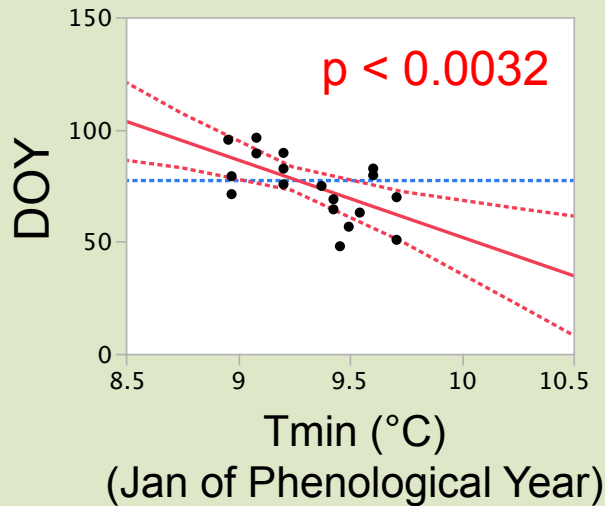
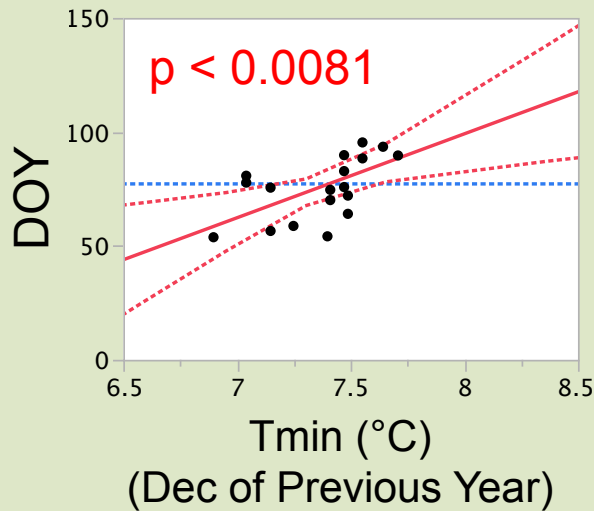
## Parts of a Flower



Pollination & fertilization

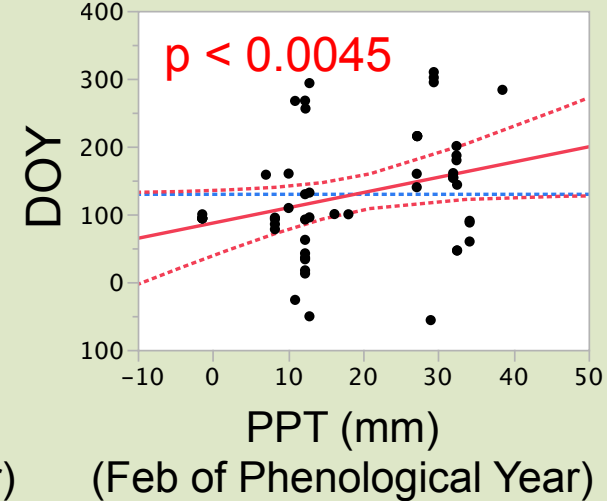
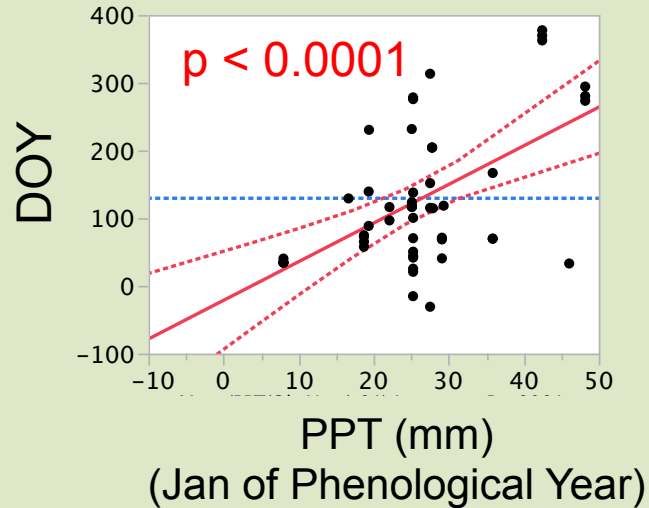
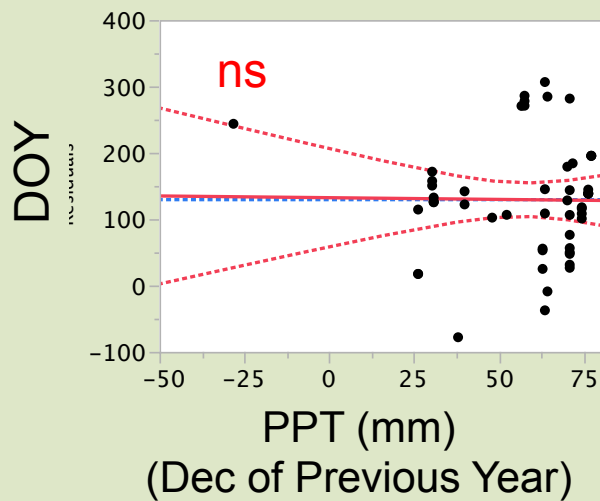
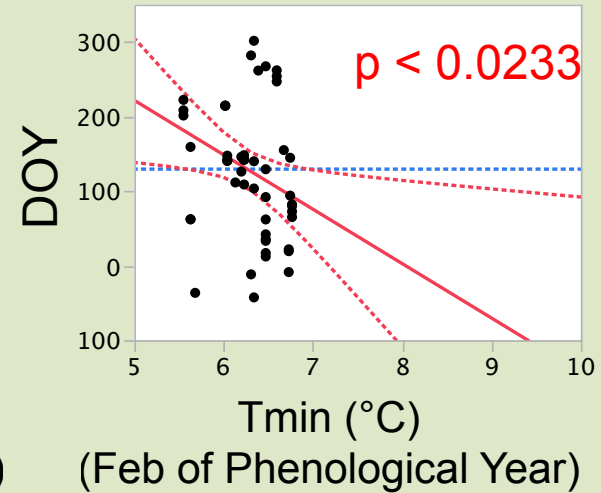
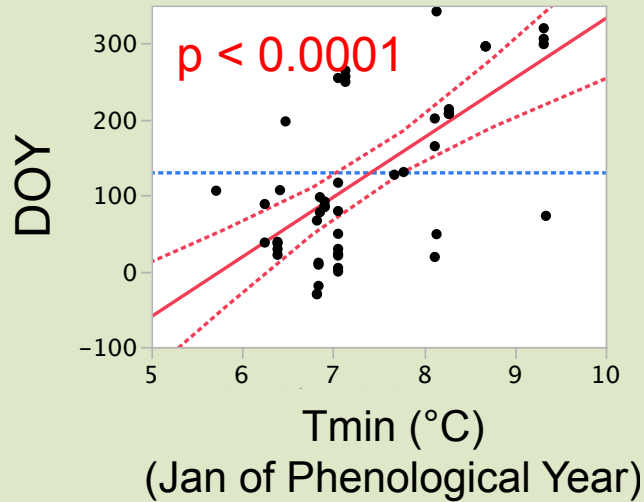
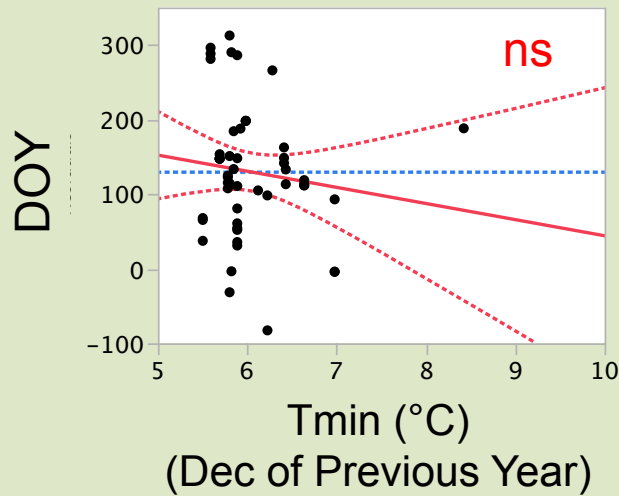
# Effects of warmer temperatures & higher rainfall among sites and years at Santa Monica Mtns NRA

## *Quercus lobata*: Flowers or Flower Buds

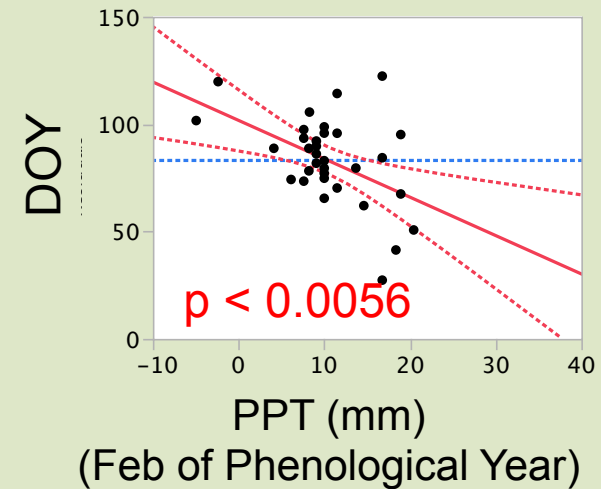
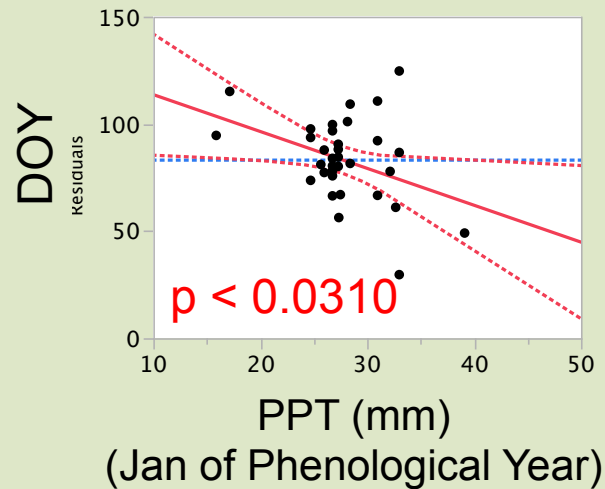
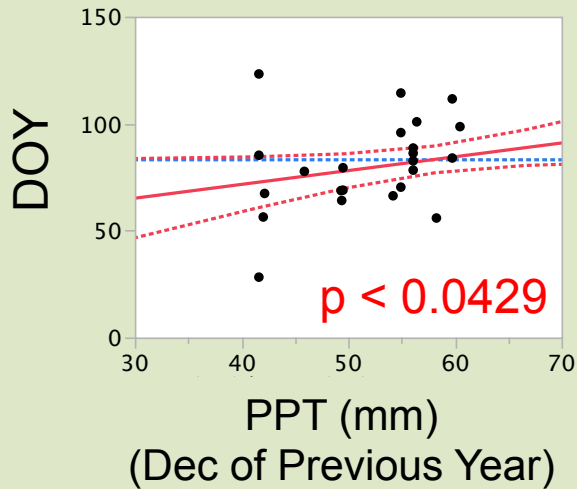
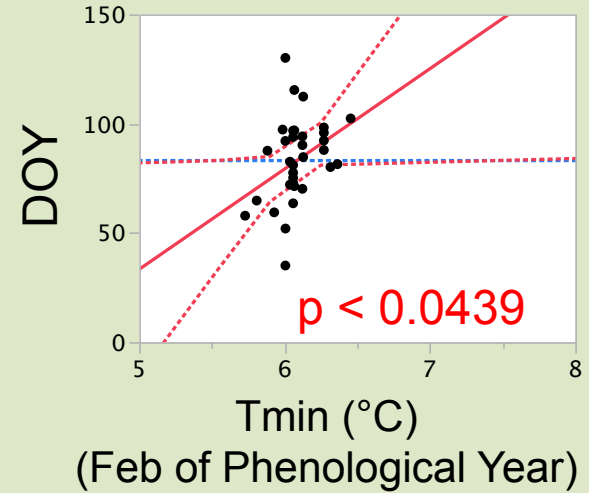
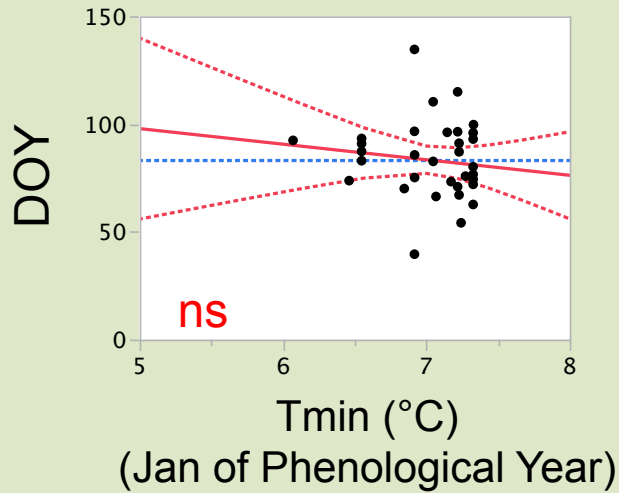
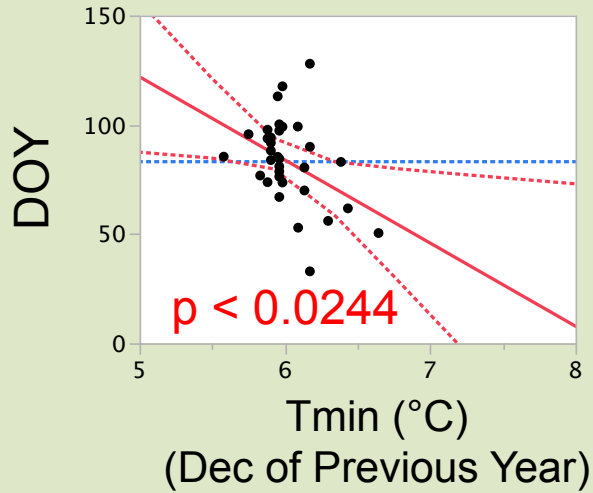


**Independent of winter temperature, high winter rainfall delays flowering**

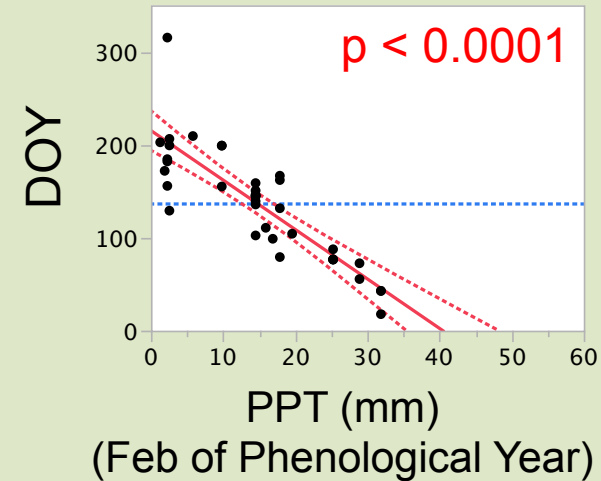
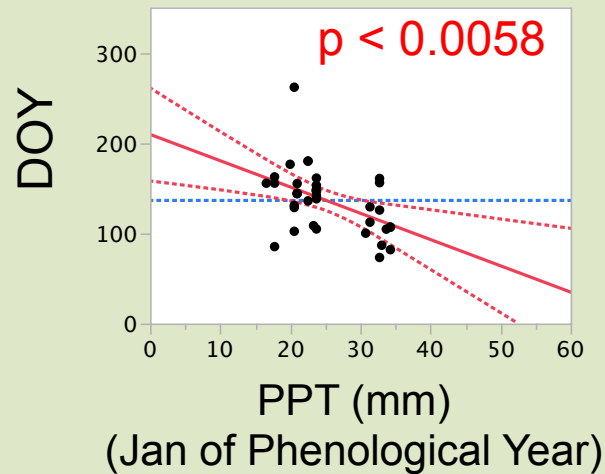
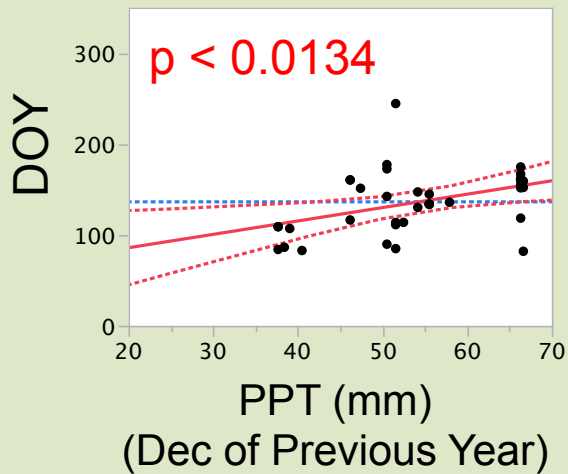
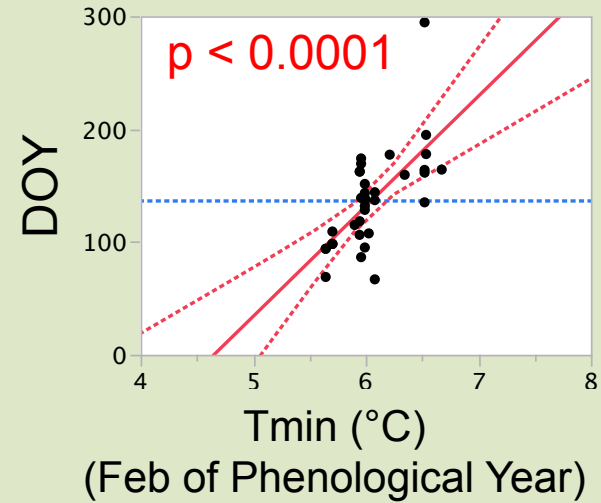
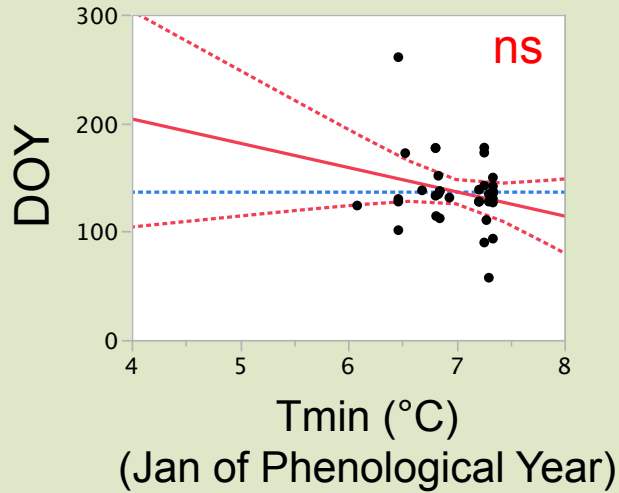
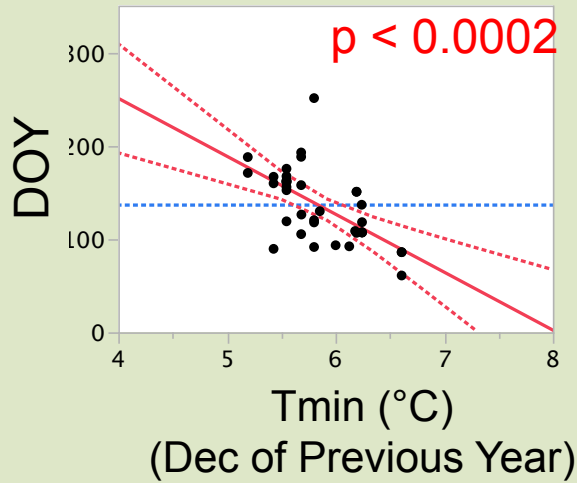
# *Eriogonum fasciculatum*: Young leaves



# *Eriogonum fasciculatum*: Flowers or flower buds



## *Eriogonum fasciculatum*: Ripe fruits

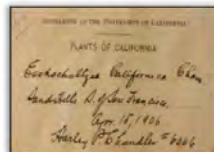


# TODAY'S WORKSHOP

- 4:30 – 5:00 – Practice and group discussion
- <http://www.usanpn.org>
- [https://www.usanpn.org/natures\\_notebook](https://www.usanpn.org/natures_notebook)
- <https://www.usanpn.org/nn/become-observer>
- <https://www.usanpn.org/nn/guidelines>
- <https://www.usanpn.org/nn/guidelines/shared-sites>



# A PRIMER ON HERBARIUM-BASED PHENOLOGICAL RESEARCH



BRIAN HAGGERTY, ALISA HOVE, AND SUSAN MAZER

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Funding for the development of these materials was provided by the US Geological Survey and the USA National Phenology Network



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- 15 METHODS FOR HERBARIUM-BASED PHENOLOGICAL RESEARCH
- 16 ADDITIONAL CONSIDERATIONS FOR RESEARCH & DATA ANALYSIS
- 19 REFERENCES & ADDITIONAL READING

# Visualizing phenology



COPR ReserveVegetation4 / RoboCam View - 2006-01-10 11:54:00





Phenology... "is the study of how changes in weather and climate affect the timing of plant and animal life cycle events."

Home

2011

2012

Live Webcam

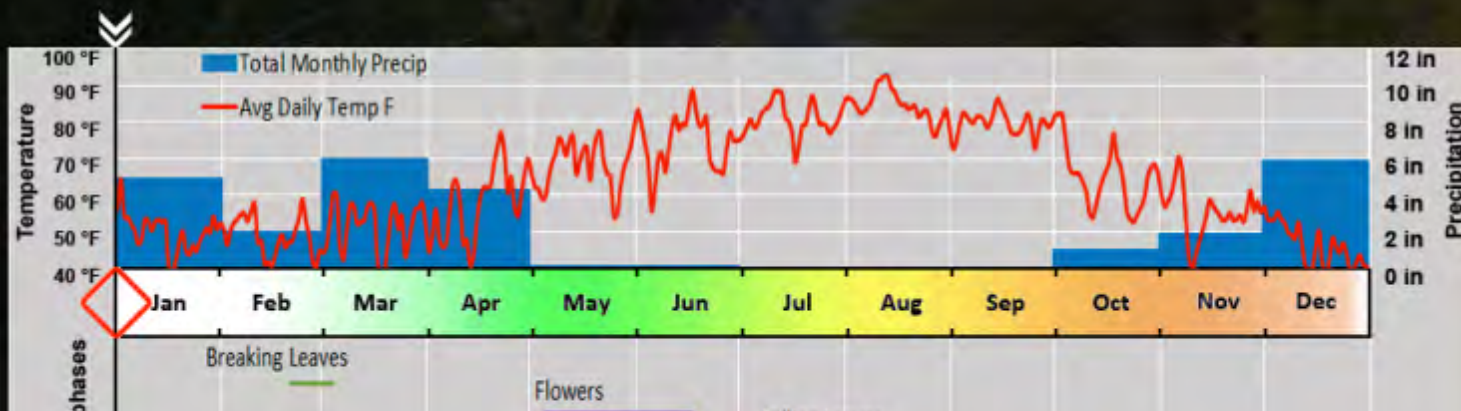


## California Buckeye (*Aesculus californica*)

Click or tap image to enlarge



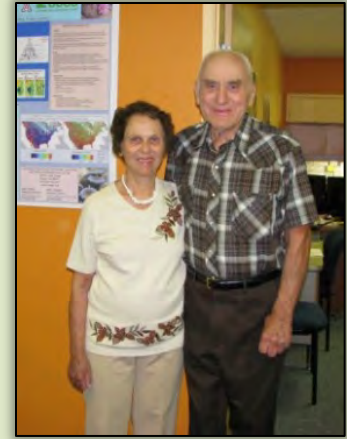
Date: 1.1.2012



# Case study: Lilac phenology network

**USA's first coordinated phenological monitoring effort**

**1950's – present: >3500 citizen scientists monitored lilac plants in backyards and gardens** (many National Weather Service Co-Op members)



**Joe Caprio**  
*Montana St Univ*

Lilac data have been used:

- ✓ To show the effects of elevation and latitude on the onset of spring
- ✓ To generate predictive maps for safe sowing dates
- ✓ To assess climate change throughout the U.S.



# TODAY'S WORKSHOP

- **Phenology, climate change, ecological consequences of phenological change, & a few case studies.**
- ✓ Introduction to phenology: ways to introduce the topic
- ✓ Significance of phenology: why should we care?
- ✓ Visualizing phenology: time lapse photography, quantitative figures

## **Links between phenology and climate change: Case studies**

Clonal lilac: national and individual plant scales

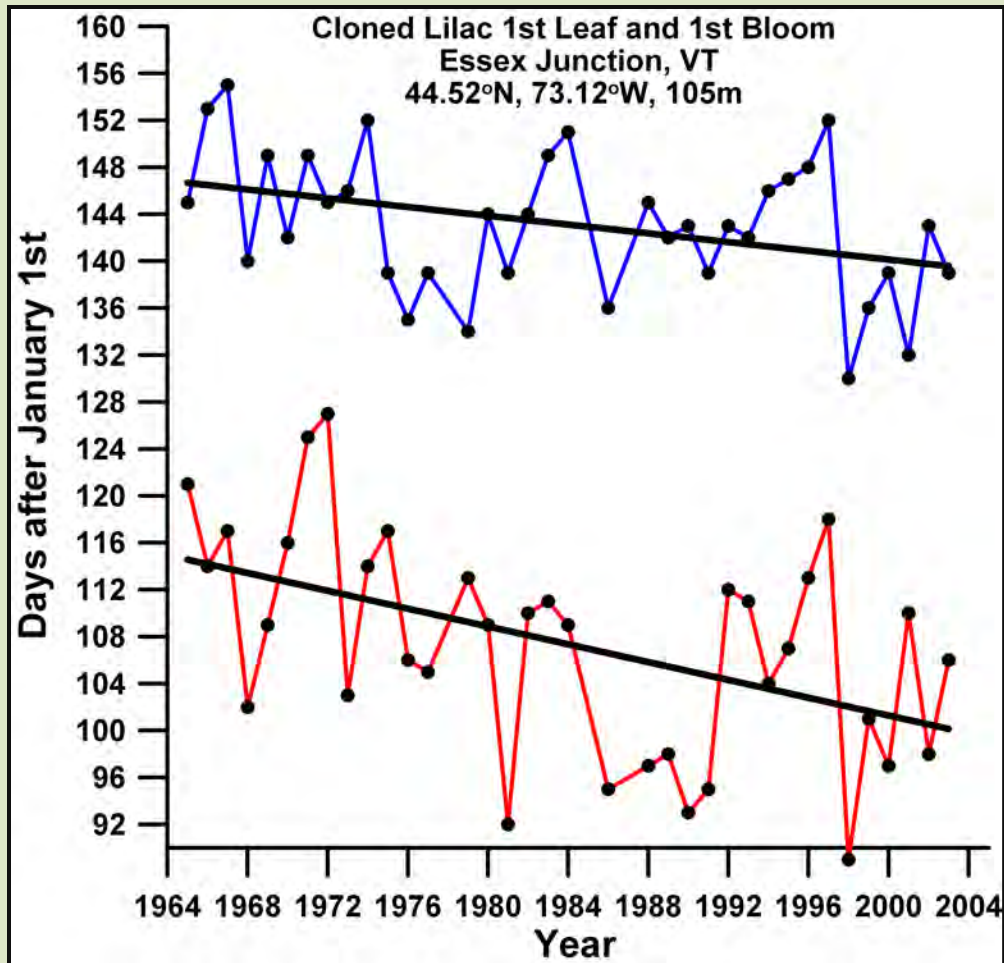
Phenological mismatch: dutch-pied flycatcher

Long-term observational studies

The California Phenology Project: design and implementation



# Phenology is an indicator of environmental change



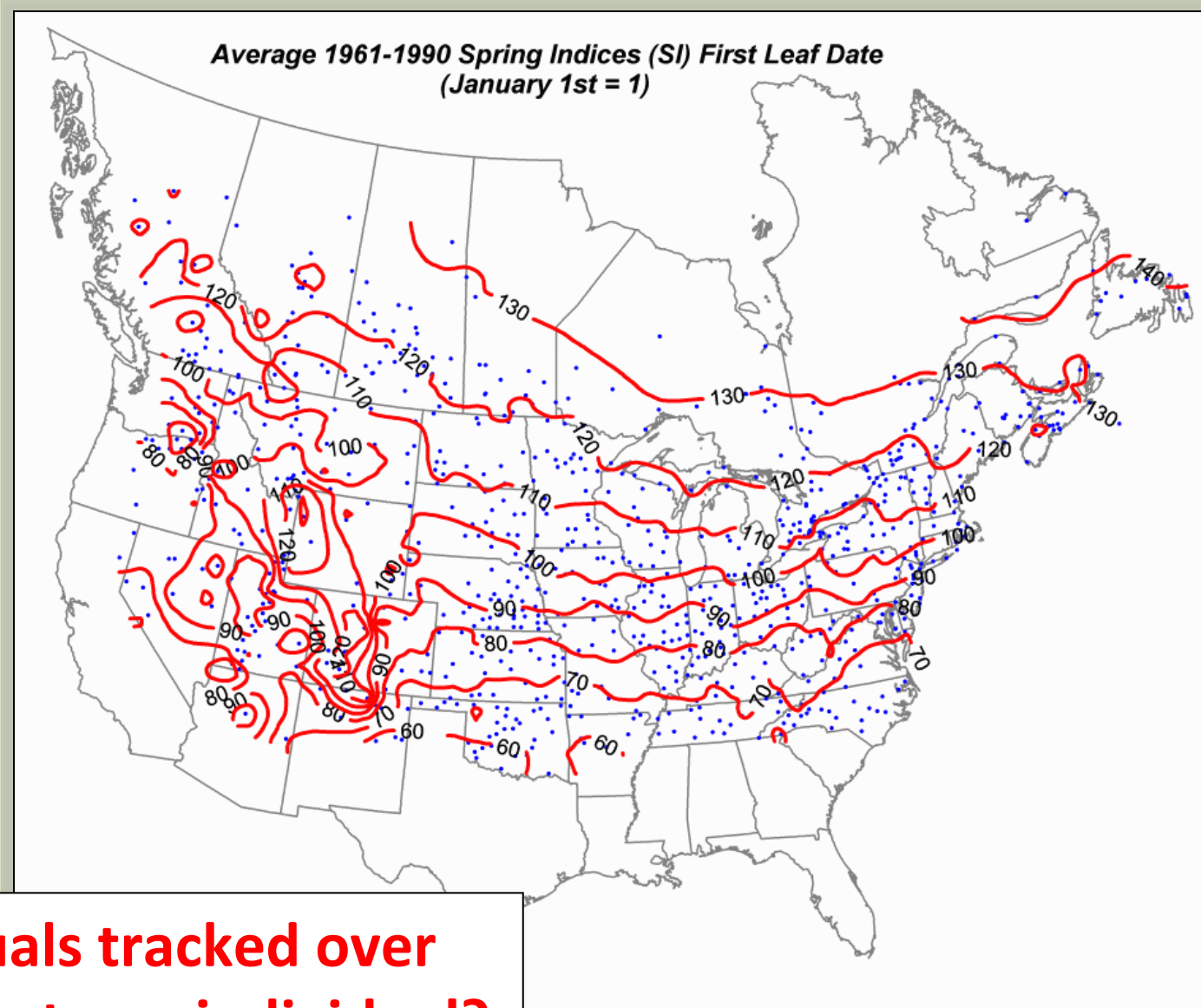
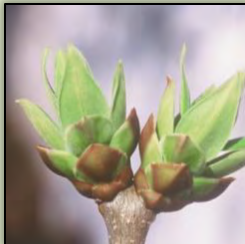
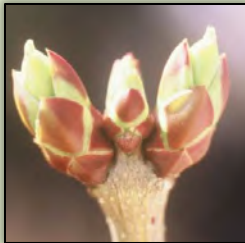
*Phenology for one Lilac individual*

Date of first flower

Date of first leaf

Phenological events in this lilac have advanced as the climate has warmed

# Case study: Lilac phenology network



**Many individuals tracked over time... what about one individual?**

# “Phenological mismatches” may cause population crashes



**Leafing out earlier**

**English oak**



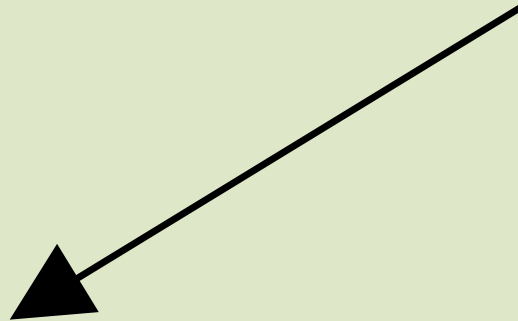
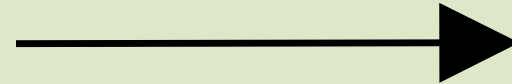
**Emerging earlier**

**Winter moth**



**Pied flycatcher**

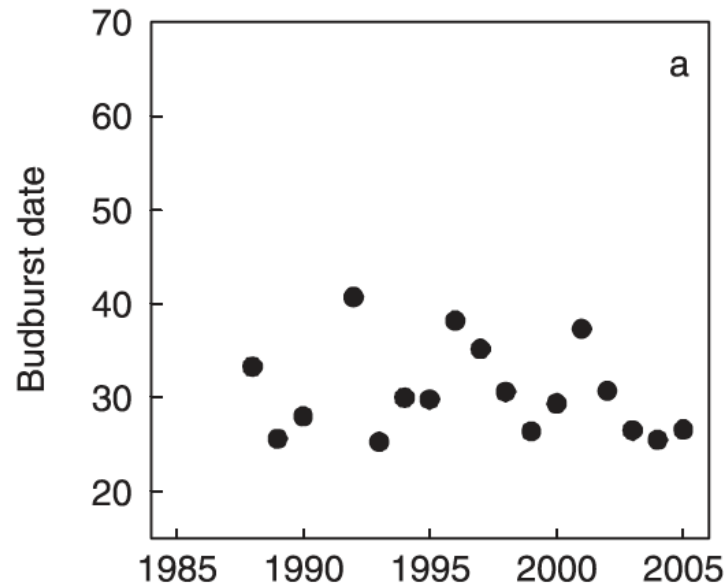
**Migrating the same time  
each year**



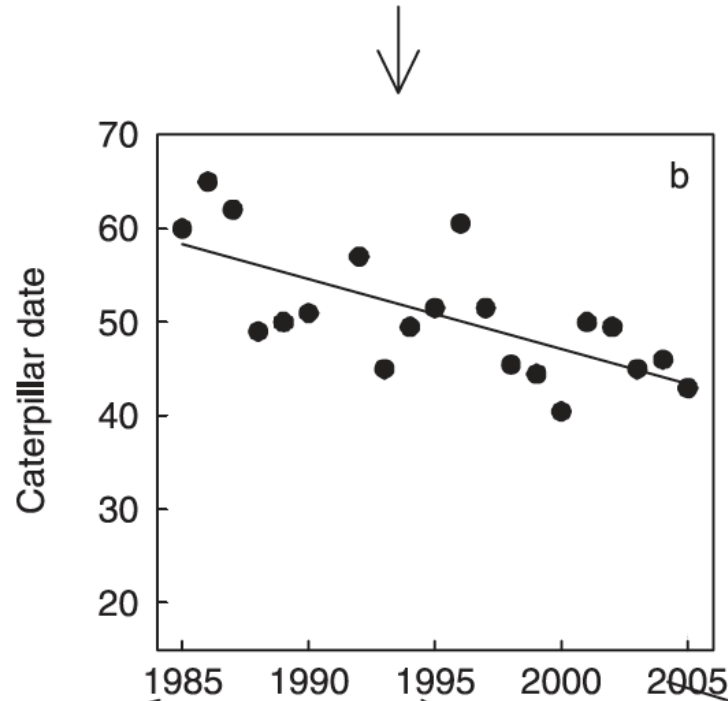
**Bird populations have declined by 90% where food for nestlings is peaking earlier in the season and the birds' arrival and breeding events are now mistimed.**

# “Phenological mismatches” may affect multiple species

Leaf budburst of  
*Quercus robur*



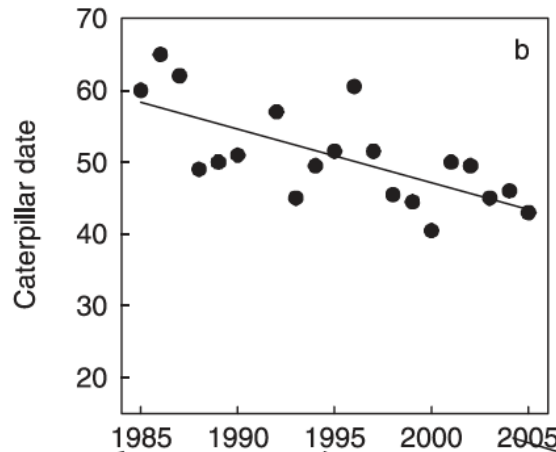
Caterpillar  
hatch date  
(winter moth  
and oak leaf  
roller, based on  
appearance of  
frass)



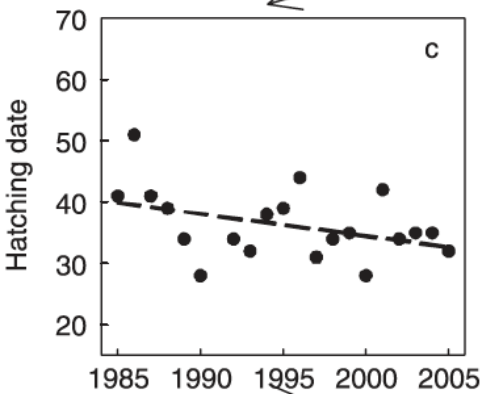
Both et al. 2009 J. Anim. Ecol.

# “Phenological mismatches” may affect multiple species

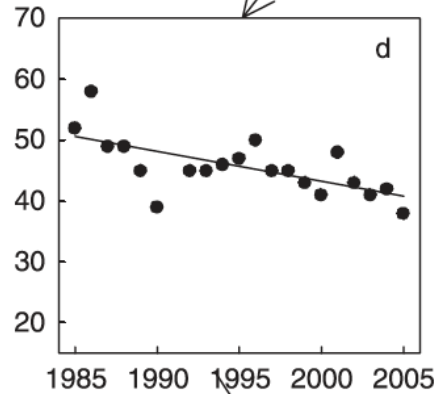
**Caterpillar hatch date (winter moth and oak leaf roller, based on appearance of frass)**



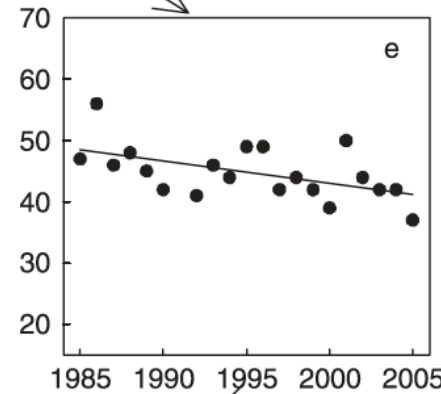
**None of the bird species that depend on these caterpillars are accelerating their hatch dates as rapidly as the caterpillars**



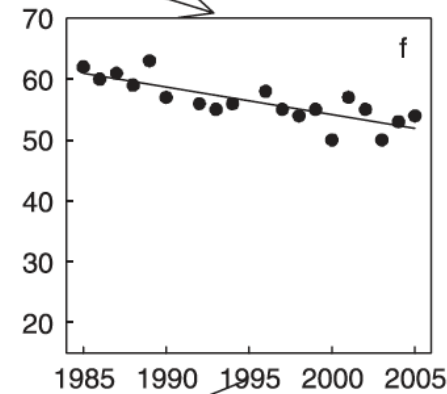
**Coal tit hatch date**



**Blue tit hatch date**



**Great tit hatch date**



**Pied flycatcher (*Ficedula hypoleuca*) hatch date**



# TODAY'S WORKSHOP

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- ✓ Visualizing phenology: time lapse photography, quantitative figures

## **Links between phenology and climate change: Case studies**

Clonal lilac: national and individual plant scales

Phenological mismatch: dutch-pied flycatcher

[Long-term observational studies](#)

The California Phenology Project: design and implementation



# Long-term observational studies

## North American and European Sites:

Mohonk, NY

Harvard Forest, MA

Gothic, CO

Chinnor, UK

Konza Prairie, KS

Fargo, ND

Washington, DC



1226 species occurrences (1031 unique species in 119 families)

All species observed for 8-35 years, depending on site

Phenophases recorded: Date of first leaf, Date of first flower

Climate records: Growing Degree Days, Precipitation <sup>98</sup>

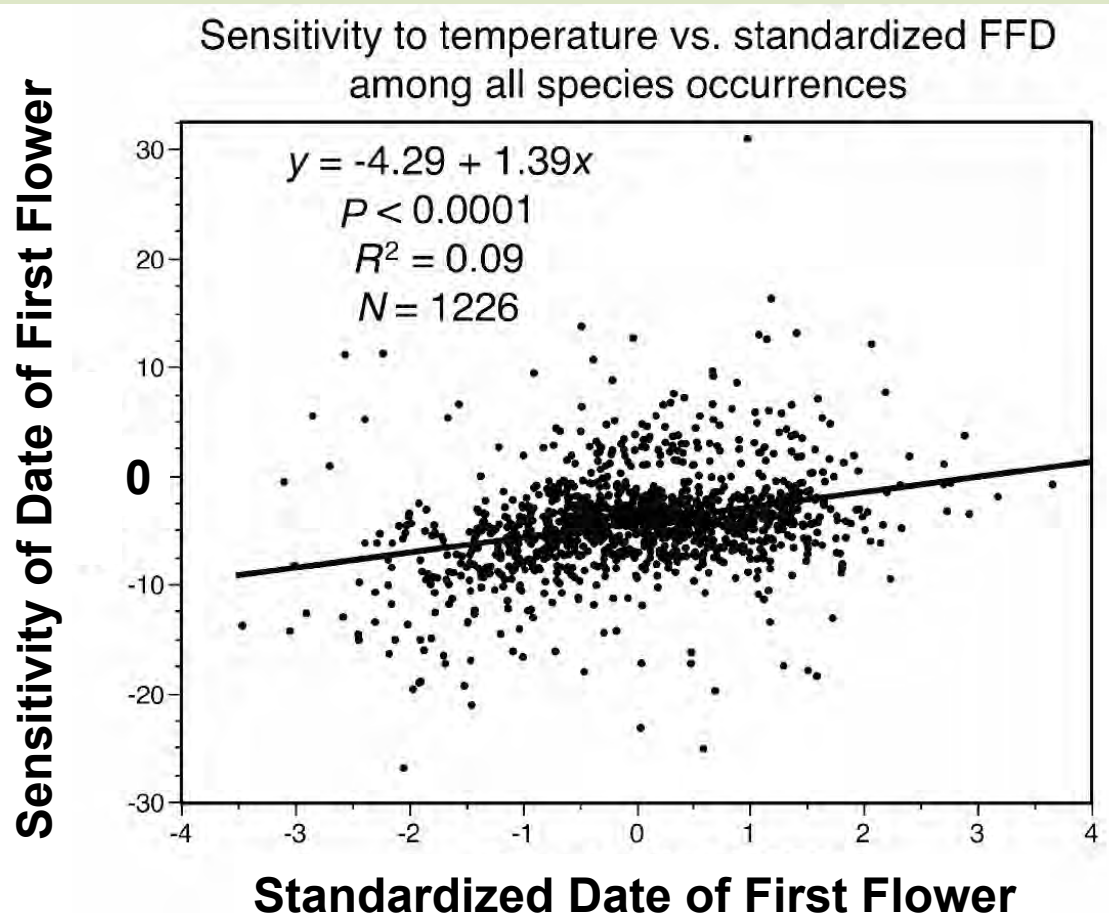
# Long-term observational studies: sensitivity is related to FFD

Outcome variable of interest: **Phenological sensitivity**

= Change in Date of First Flower/Interannual increase in Temperature

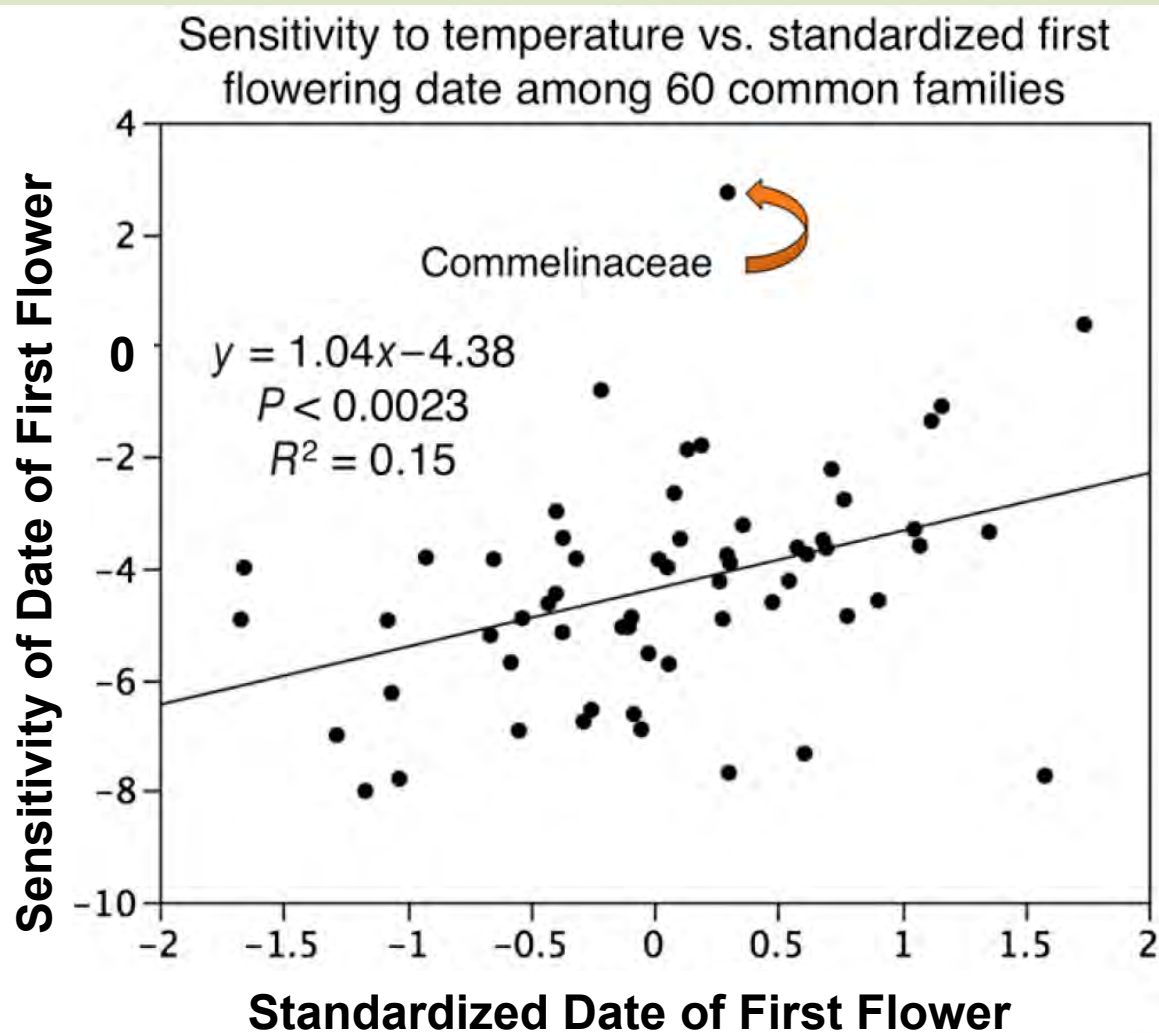
Variables standardized to account for variation among sites

Values < 0 = advancement of Flowering Date



**Species that flower early show greatest advancement in Date of First Flower**

# Long-term observational studies



**Families that flower early show greatest advancement in Date of First Flower**

# Historical datasets

- UCSB herbarium project: to date, undergraduate students have examined > 4000 specimens
- See “Skeletons in the Closet” lab activity & “Primer for herbarium research” documents ([www.usanpn.org/cpp/education](http://www.usanpn.org/cpp/education))



*Lupinus bicolor*



*Clarkia unguiculata*

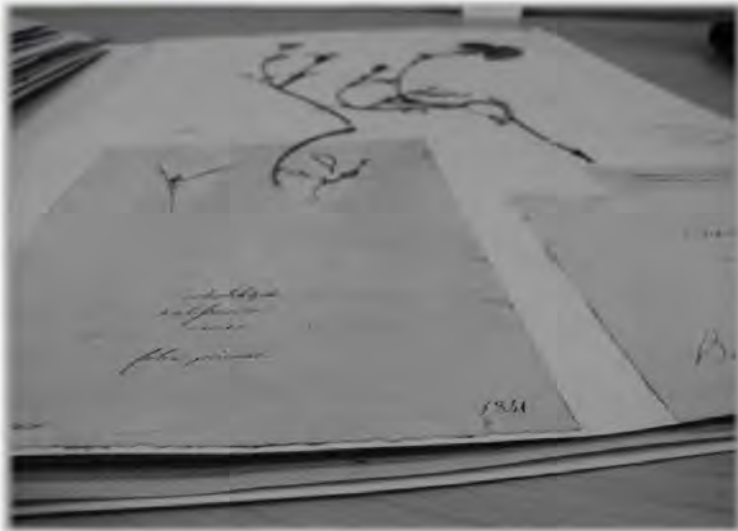


*Trillium ovatum*

# SKELETONS IN THE CLOSET

## PRESERVED PLANTS REVEAL PHENOLOGICAL RESPONSES TO CLIMATE CHANGE

This exercise will guide you through the basic processes of exploring long-term phenological data sets. Using a data set derived from herbarium specimens collected from 1906-2009, you'll be guided step-by-step through the processes of organizing, summarizing, visualizing, and analyzing the data using Microsoft Excel. Discussion questions and suggestions for continued learning are included for each section. For more background on herbaria and how they've been used to study phenology, read our *Primer on herbarium-based phenological research*, available on the Education section of the California Phenology Project website ([www.usanpn.org/cpp/education](http://www.usanpn.org/cpp/education)) or the USA National Phenology Network ([www.usanpn.org/education](http://www.usanpn.org/education)).



BRIAN HAGGERTY, ALISA HOVE, AND SUSAN MAZER

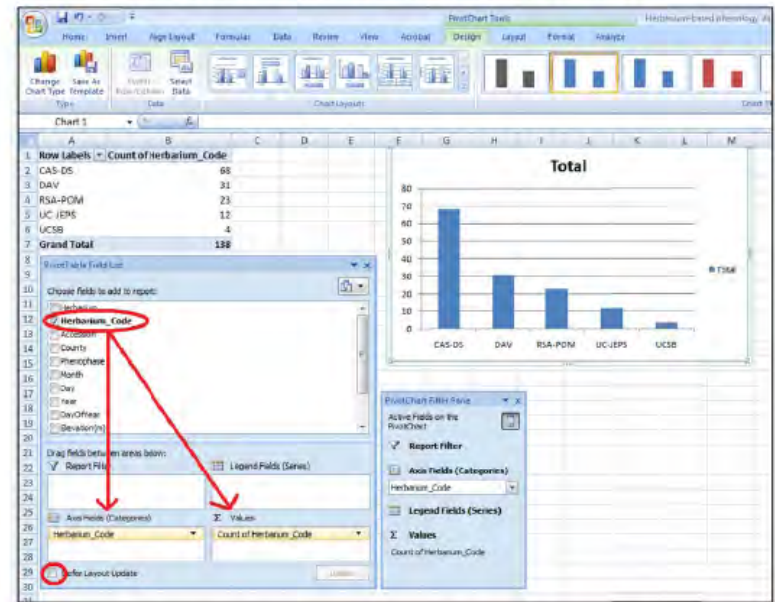
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Funding for the development of these materials was provided by the US Geological Survey and the USA National Phenology Network



A new worksheet will appear – it looks a bit complicated, but don't be intimidated! Provide a new name for the worksheet, such as "PivotCharts". Arrange the pop-up windows so you can see each of them (see below for example), and then focus on the "PivotTable Field List" window. Be sure that the box in the bottom-left corner called "Defer layout update" is un-checked.

Check the box at "Herbarium\_Code", and then grab the Herbarium\_Code name and drag it to the "Axis Fields (Categories)" and the "Values" windows. The table should automatically fill in, and so should the chart. These are your PivotTable and PivotChart. Notice that the Grand Total is 138, indicating that your filtered data have, in fact, been left behind in your new "Filtered data for analyses" worksheet. Play with the other categories of data as follows in order to explore the PivotChart function.



Select and drag Month into the "Axis Fields" window with Herbarium. Determine the most frequently-represented month of collections in each herbarium.

With Month and Herbarium in the "Axis Fields" window, change their positions so Month is above Herbarium. How does this change the table and chart?

What happens when you move herbarium to the "Legend Fields (Series)" window?

Now un-check Herbarium and Month, and instead check County. Which county is represented most in the data set? Where is that county located?

# SKELETONS IN THE CLOSET

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BRIAN HAGGERTY, ALISA HOVE, AND SUSAN MAZER

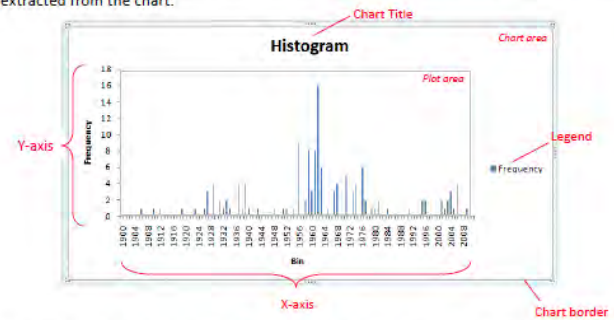
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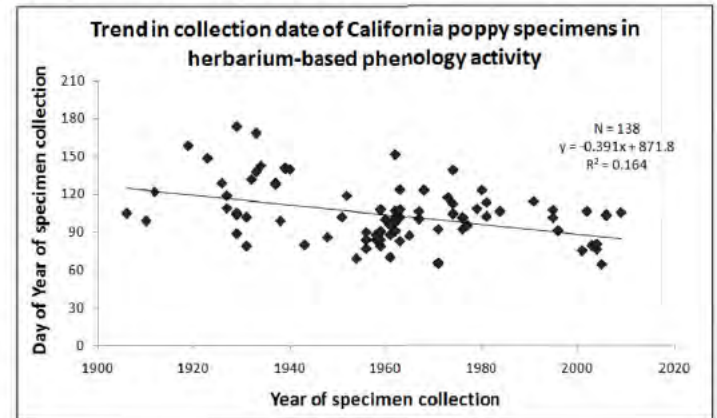
### FORMAT THE HISTOGRAM FOR INTERPRETATION, SHARING, AND PRESENTING

The histogram you produced is displayed in the default format. Though effective in visualizing the data, we should make a few brief formatting changes to make it appear cleaner while enhancing the information that can be extracted from the chart.



The area of the histogram with the vertical bars (bounded by a gray box) is called the "plot area", and it essentially has a white background. Notice that the chart is titled "Histogram". Format the

Finally, your scatter plot should appear similar to this:



# Historical datasets

---

**Question:** Does anyone in the webinar have access to other historical data sets?

- Photographs
- Naturalist notes
- Someone's home garden records
- Diaries
- Date of availability of home-made products (e.g., jams, pickles...)
- Other?