

The California Phenology Project

Tracking the effects of climate on plant phenology

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www.usanpn.org/cpp



TODAY'S WORKSHOP

- 8:30 - 9:00 – Introductions (round-robin)
- 9:00 – 10:00 – Introduction to phenology, its link to climate change, ecological consequences & a few case studies. (slides 1-42)
- 10:00 – 10:15 – *Break*
- 10:15 – 11:15 – California Phenology Project and Nature's Notebook: origin, design, infrastructure, & resources available (slides 43-99)
- 11:15 – 11:30 – *Break*
- 11:30 – 12:15 – Results to date, lessons learned, the mothership (the USA National Phenology Network), the app, Botany Crash Course (slides 100-145)
- 12:30 – 4:00 – *Drive to Alum Rock City Park* – Picnic lunch – hands-on phenological monitoring; selecting sites and plants for monitoring; planning future monitoring



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 & Cherry trees

Phenological mismatch: dutch-pied flycatcher

Long-term observational studies

- **The California Phenology Project: design and implementation**
- **The USA-NPN (Source of protocols and data repository)**
- **Crash course in botany**

What is phenology?



Spring wildflowers



Foliage color change



Migration patterns

*the study of recurring plant and animal life cycle stages
(phenophases)*

What is phenology?

And...to elaborate a bit....phenology may include the study of the recurring life cycle stages of an organism, population, and/or community



Plants



Animals

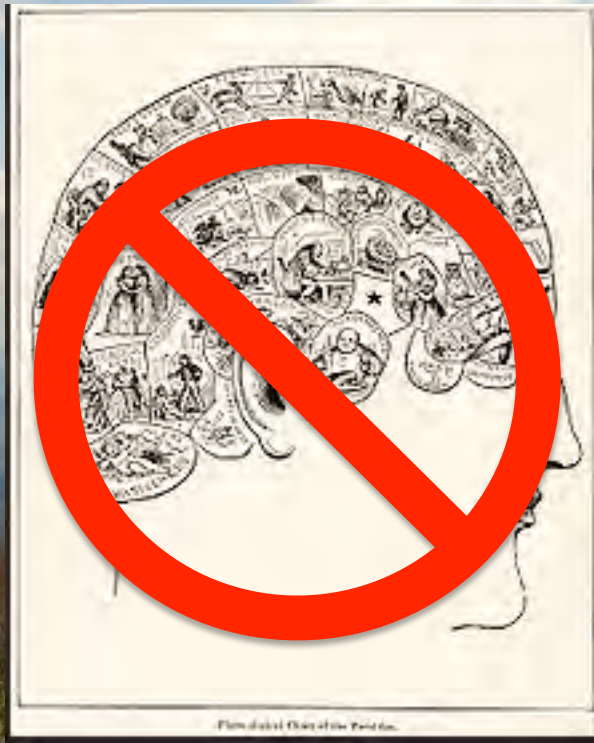


Fungi

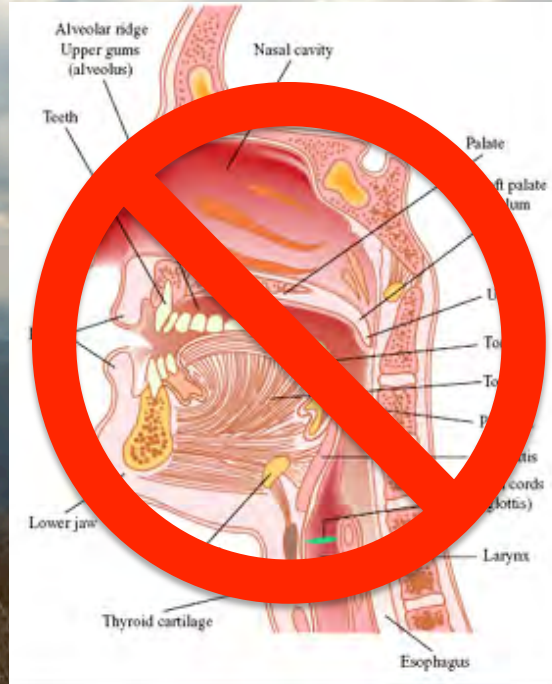


Microbes

Just to be clear...



phRenology -
a pseudoscience
focused on
measurements of the
human skull and size
of the brain



phOnology -
a branch of
linguistics concerned
with the organization
of sounds in
language

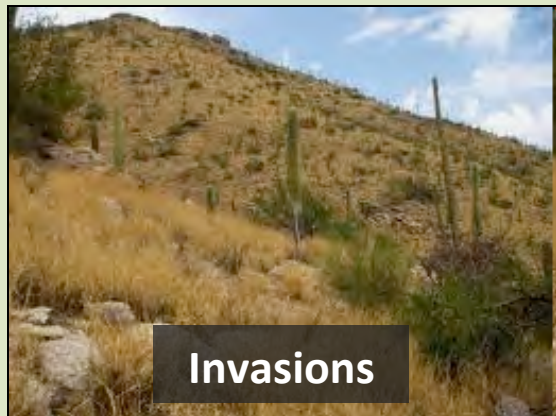
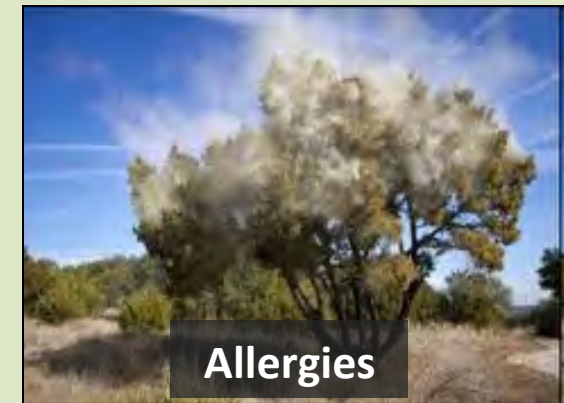
Why should we care?

Phenological monitoring meets multiple missions

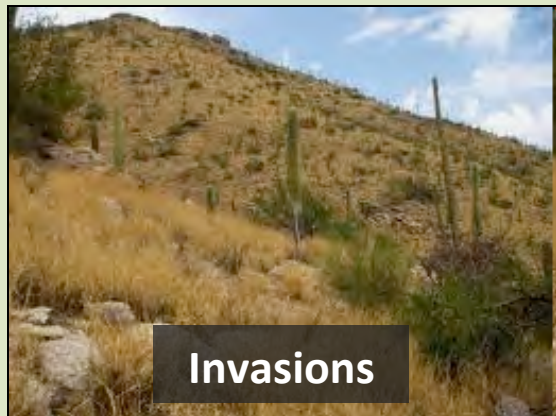
- Improves observational skills, increasing awareness and enjoyment of nature
- Provides a way to detect the effects of climate change on both native and exotic species
- Offers a way to assess and to share with students and visitors to natural areas the sensitivity of natural resources to the quality of the environment.
- Can be linked to ongoing research on phenological patterns throughout California
- Visitors can directly participate in authentic research at national parks and bring their skills back home.
- Provides a baseline assessment of the seasonal availability of botanical resources (new growth, pollen, flowers, fruits) on which pollinators, invertebrates, and vertebrates depend.
- The frequency and intensity of phenological monitoring are highly flexible, depending on the number of staff, educators, and volunteers available to participate.
- Other ideas (what motivates *you* to conduct phenological monitoring?)



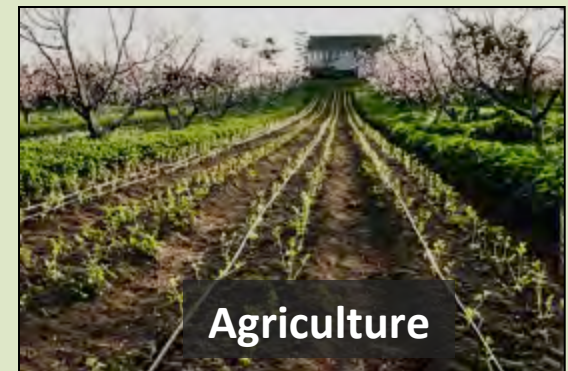
Phenology: current economic importance



Phenology: current economic importance

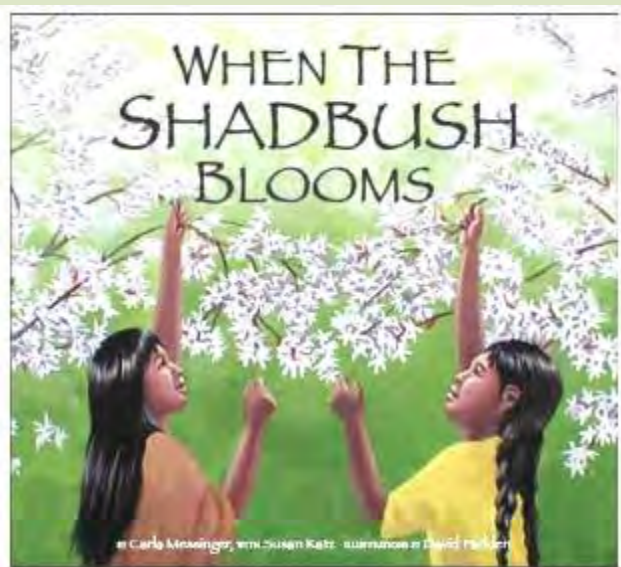


But the study of phenology is also an ancient activity



Phenological indicators used by fisherman:
plant phenophases can predict the best time to fish

Fisherman on the east coast of Canada would not fish for shad (*Alosa sapidissima*) until after the shadbush (*Amelanchier* spp.) flowered.



**Phenological indicators used by indigenous hunters:
plant phenophases used to predict the best time to hunt**

**Okanagan indians used blooming of mock-orange
(*Philadelphus lewisii*) as an indicator that marmots
were fat and ready to hunt.**



**Phenological indicators used by indigenous hunters:
plant phenophases used to predict the best time to hunt**

**Comox indians used oceanspray (*Holodiscus discolor*)
flowering as an indicator of the best time to dig for butter
clams (*Saxidomus gigantea*)**



Phenological Indicators used by indigenous people: **plant phenophases** observed to predict safe harvest times of **marine resources**

Coastal Pomo Indians stopped gathering clams and other shellfish when elderberry flowered. When there were ripe elderberries, they knew it was safe to harvest shellfish.



Phenological indicators used by indigenous hunters: plant phenophases used to predict the best time to hunt

The Nuu-Chah-Nulth tribe of Vancouver Island used the ripening of salmonberries (*Rubus spectabilis*) to predict the return of adult sockeye salmon (*Oncorhynchus keta*) to freshwater.



Bouchard & Kennedy, 1990. Clayoquot Sound Indian Land Use. Report prepared for MacMillan Bloedel Ltd.
Peacock, S. L. 1992 Piikani Ethnobotany: Traditional Plant Knowledge of the Piikani Peoples of the Northwest Plains. MS thesis, University of Calgary.

Phenological indicators used by indigenous hunters: plant phenophases used to predict the **best time to hunt**

The Blackfoot tribe of s. Alberta and Canada used the flowering of the buffalo bean (*Thermopsis rhombifolia*) to indicate that bison males (*Bison bison*) had eaten enough spring browse to be ready to hunt (their meat was sufficiently marbled with fat).



Phenological Indicators used by indigenous people: **plant phenophases at one location** can predict **harvest times for plants at another location**

The Tubatulabal tribe of Kern County (CA) used the ripening of coffeeberry fruits (*Rhamnus californica*) at low elevations to indicate that pinyon pine (*Pinus monophylla*) seeds in the mountains were ready to harvest.



M. KAT ANDERSON

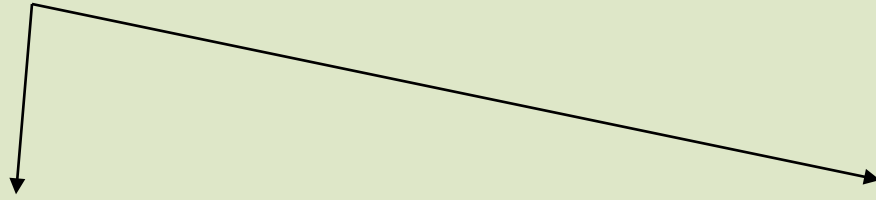
TENDING THE WILD

NATIVE AMERICAN KNOWLEDGE
AND THE MANAGEMENT OF
CALIFORNIA'S NATURAL RESOURCES



Phenology: biological importance

Plants & animals are dynamic over the seasons



Vegetative phenology

Reproductive phenology

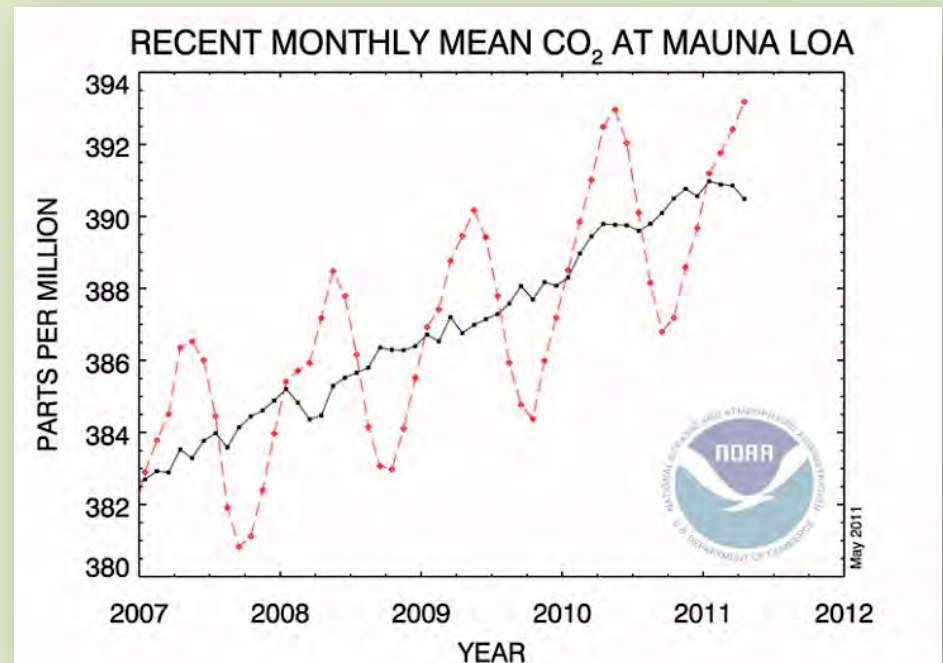


Phenology: biological importance

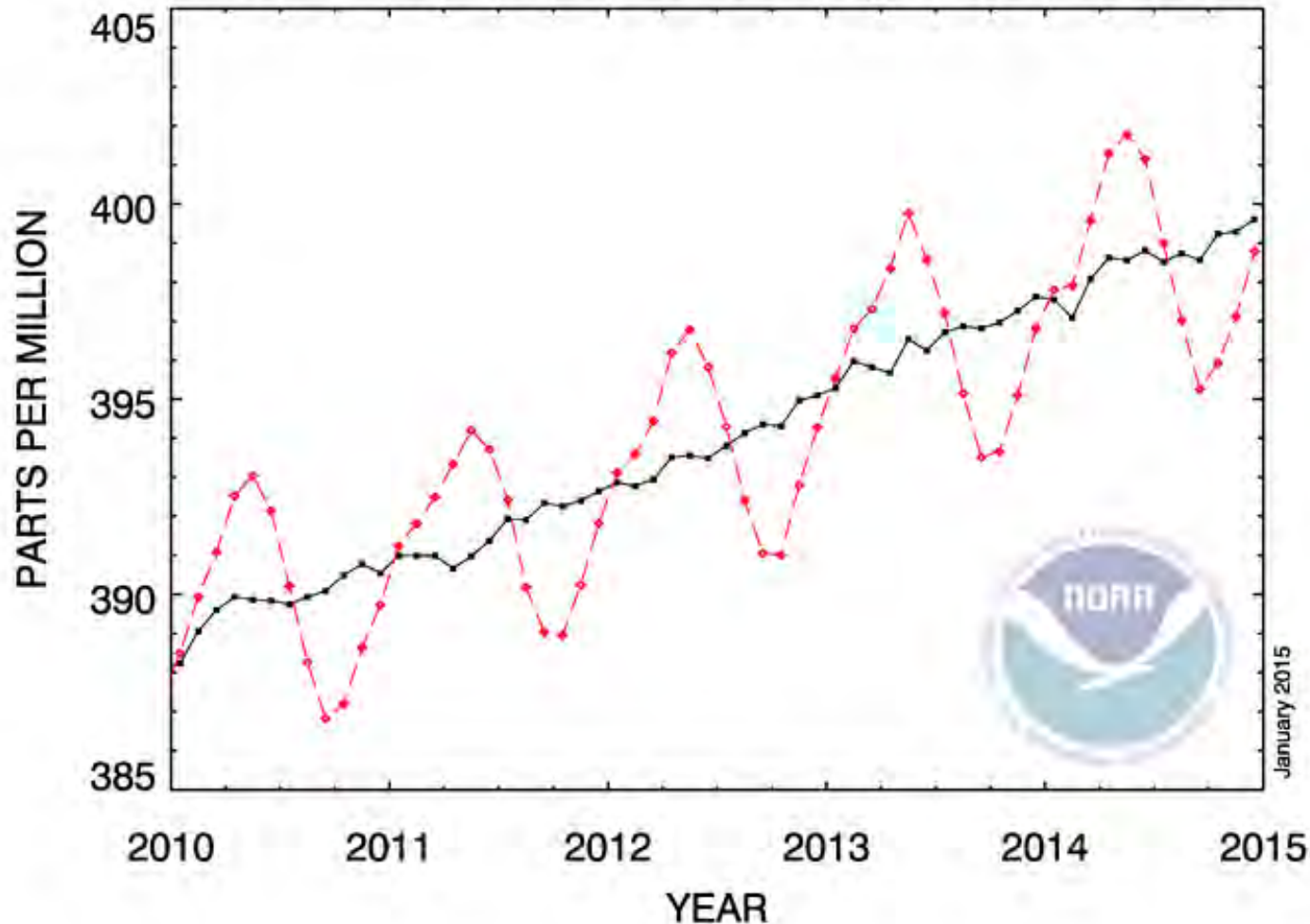
Plants & animals are dynamic over the seasons

Vegetative phenology:

- **Locally:** Leaves provide energy to the plant for reproduction & growth, food for herbivores, shade and protection for understory animals
- **Globally:** Influences global biogeochemical cycles (e.g., C-cycle)



RECENT MONTHLY MEAN CO₂ AT MAUNA LOA



The red line represents the monthly mean values. The black line represents the same, after correction for the average seasonal cycle. The average seasonal cycle is the moving average of 7 adjacent seasonal cycles centered on the month to be corrected.

Phenology: biological importance

Plants & animals are dynamic over the seasons

Reproductive phenology:

- Plant reproduction depends on flowers → fruits
- Many flowers provide nectar & pollen for pollinators
- Many plants provide fruits & seeds that are eaten by animals

The abundance of any of these resources for the animals that rely on them depends on their timing (onset), duration, and “intensity”



Coming up

- **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 & Cherry trees

Phenological mismatch: dutch-pied flycatcher

Long-term observational studies

The California Phenology Project: design and implementation



Visualizing phenology

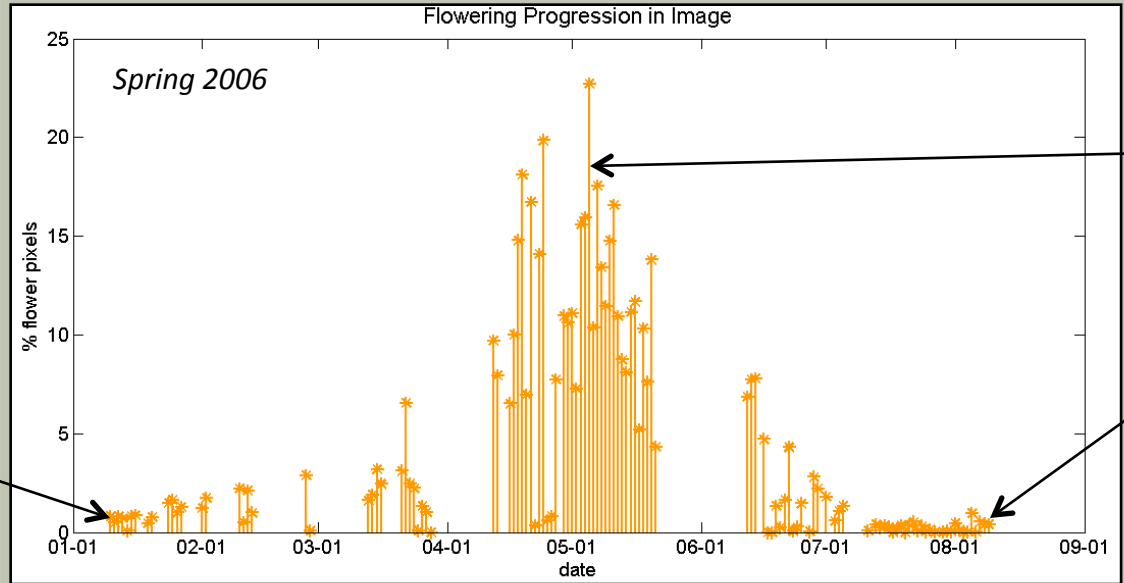


COPR ReserveVegetation4 / RoboCam View - 2006-01-10 11:54:00

Flowering time-lapse @ UCSB's Coal Oil Point Natural Reserve



Remote sensing:
webcam



First flower in population

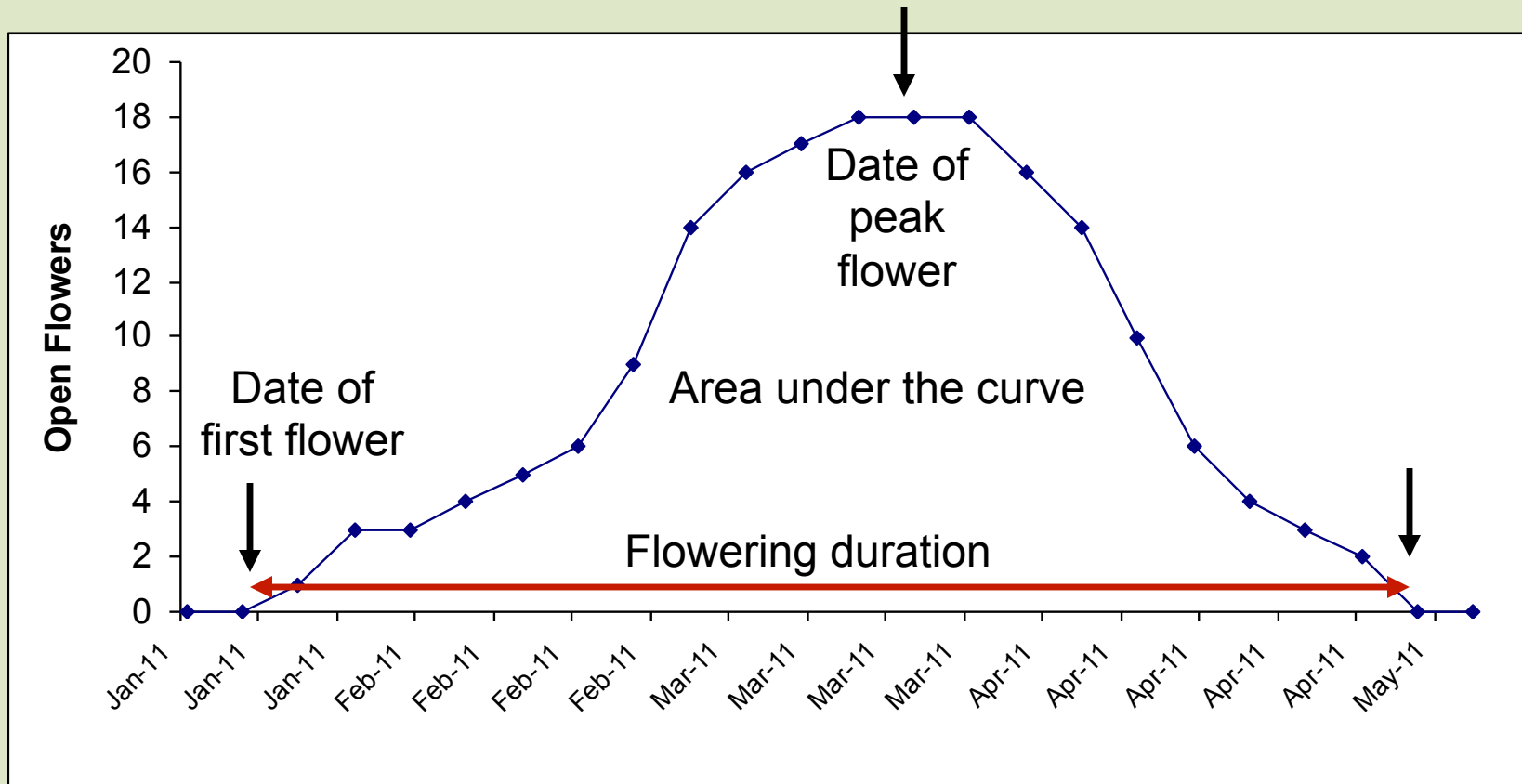
Peak flowering

Last flower in population

Visualizing phenology – teaching tool

Flowering curves

What quantitative information can you extract from this graph?
Why is the curve shaped this way?





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

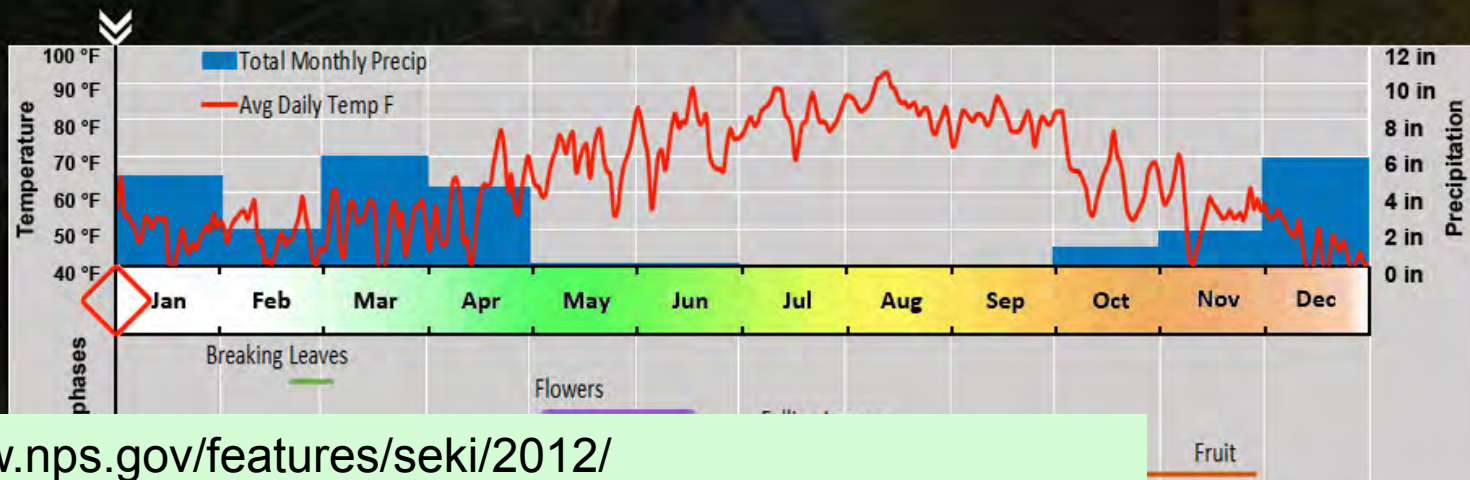


California Buckeye (*Aesculus californica*)

Click or tap image to enlarge



Date: 1.1.2012



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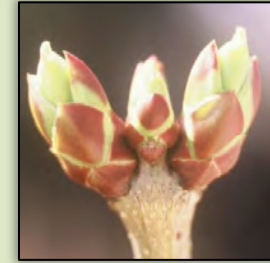
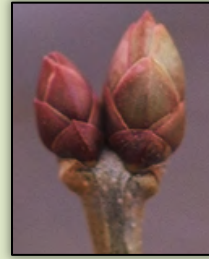
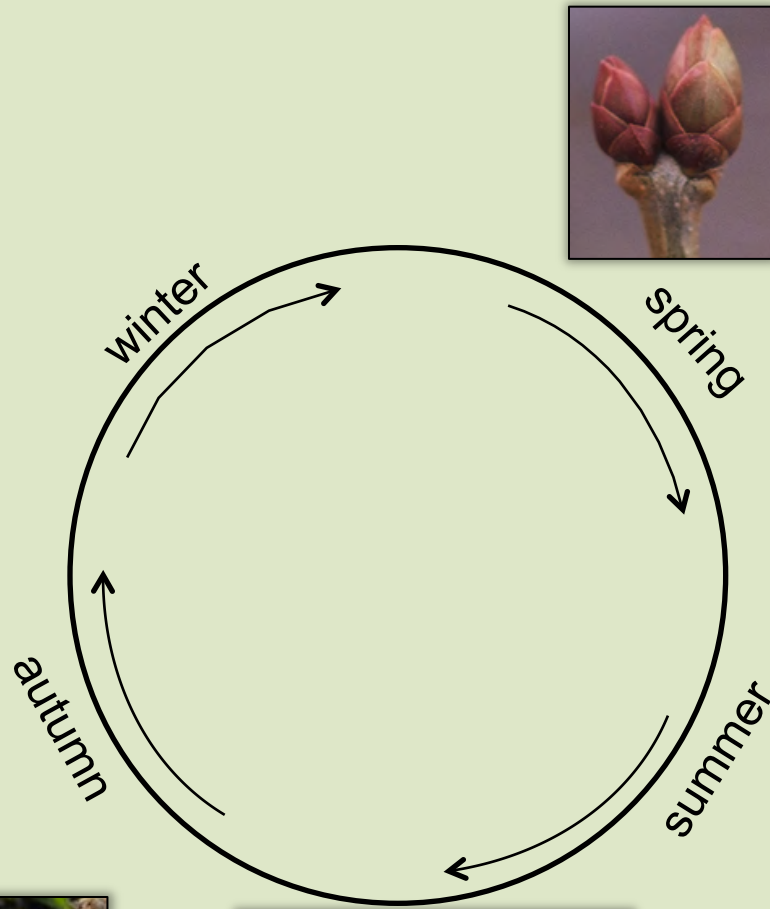
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Long-term observational studies

The California Phenology Project: design and implementation



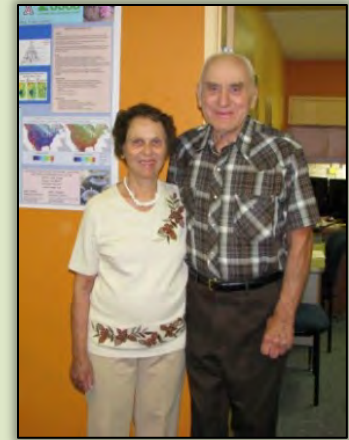
Case study: Lilac phenology network



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)



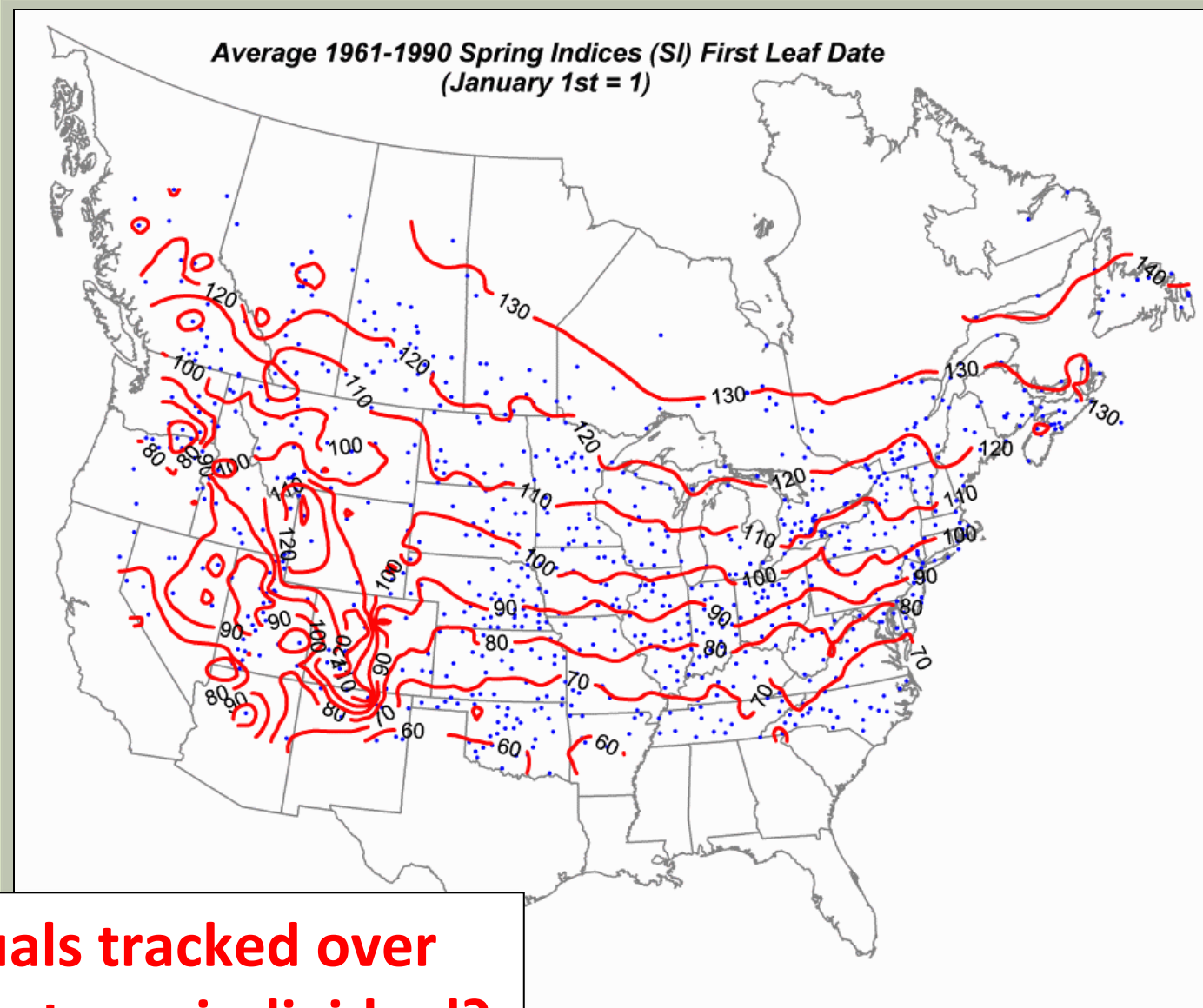
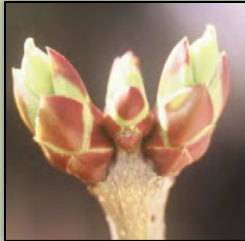
Joe Caprio
Montana St Univ

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.

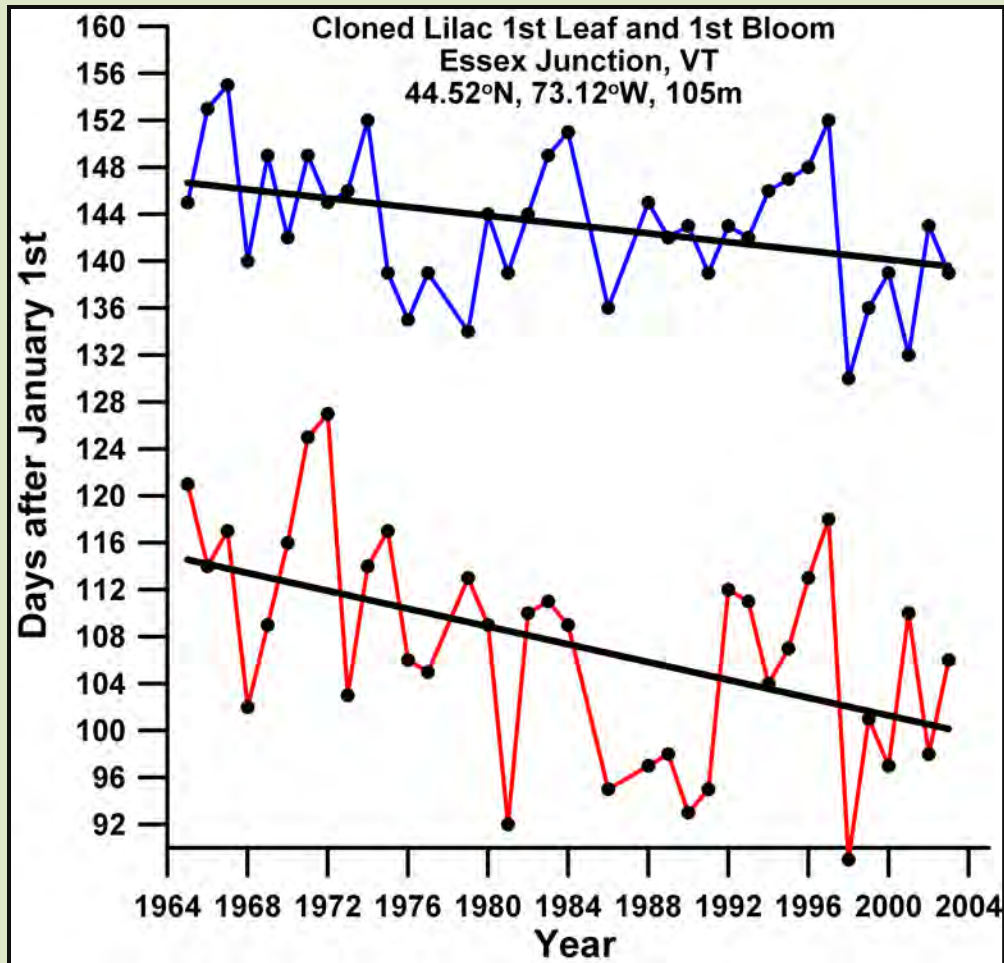


Case study: Lilac phenology network



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

Phenology is an indicator of environmental change



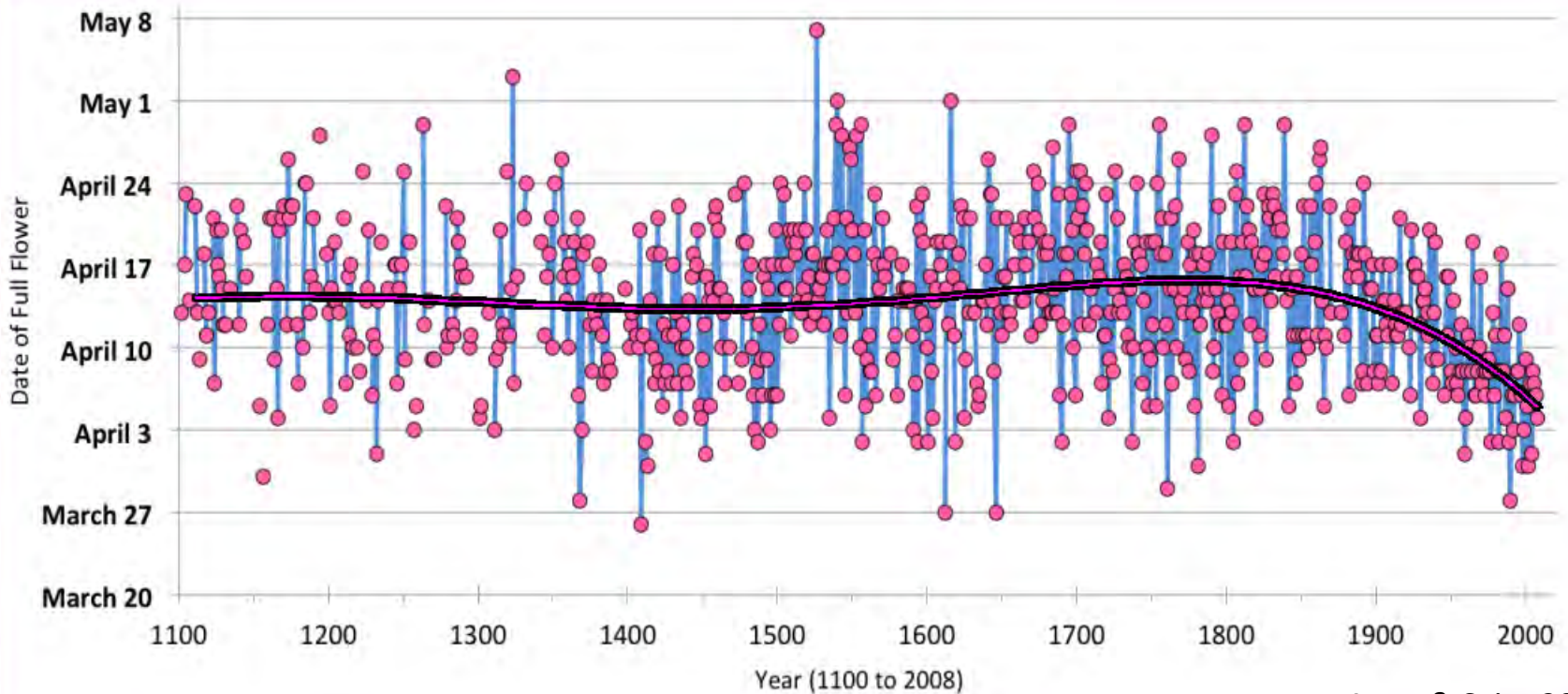
Phenology for one Lilac individual

Date of first flower

Date of first leaf

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

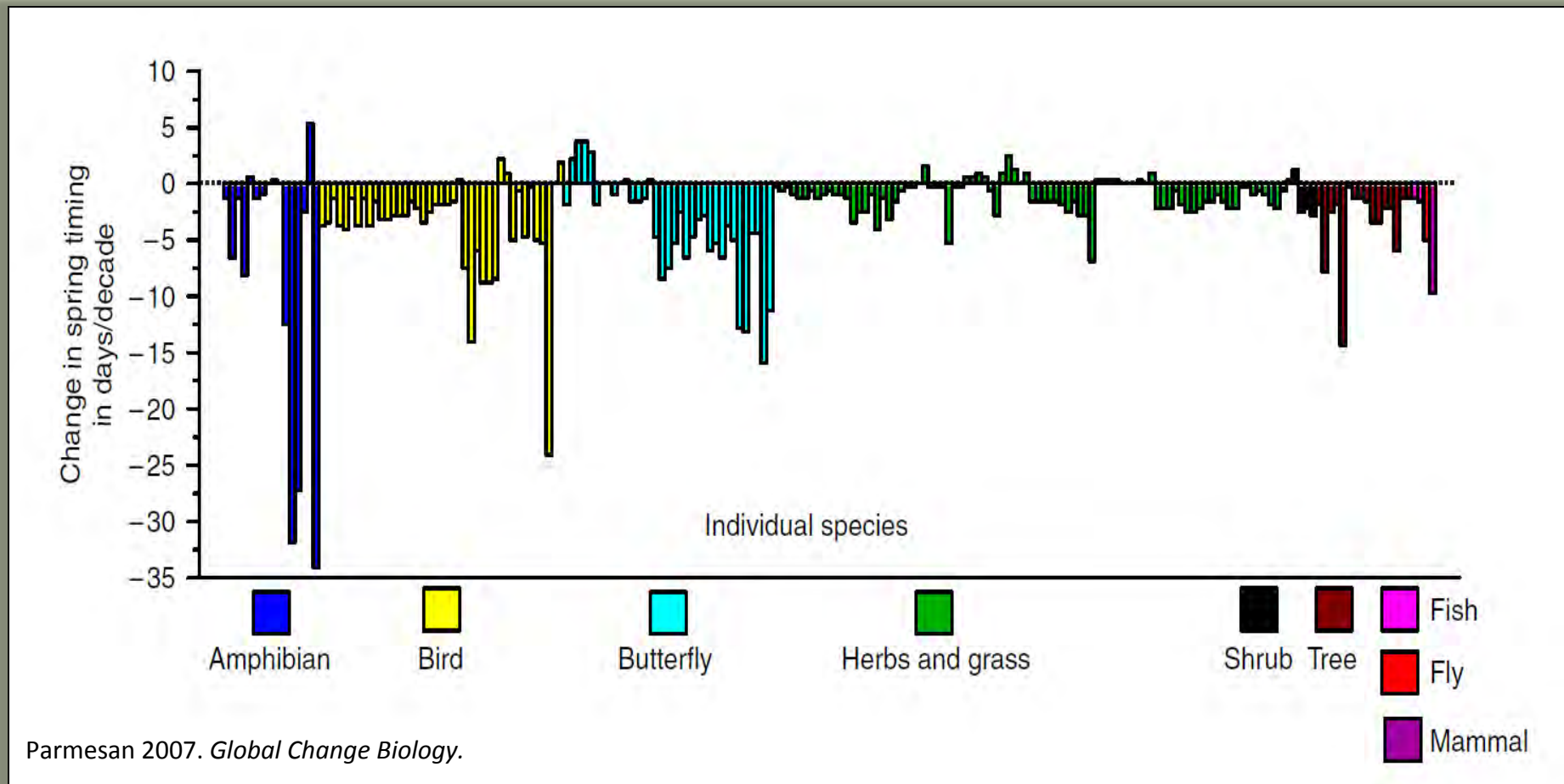
Twelve Centuries of Cherry Full Blossom Dates in Kyoto, Japan from Historical Records



Phenology as an indicator of climate change

Magnitude of phenological response varies across species

“Phenological mismatches” among interacting species occur when the response differs between them



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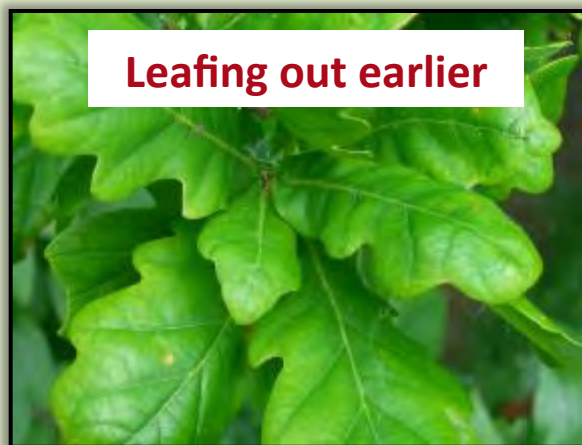
Phenological mismatch: dutch-pied flycatcher

Long-term observational studies

The California Phenology Project: design and implementation



“Phenological mismatches” may cause population crashes



Leafing out earlier

English oak



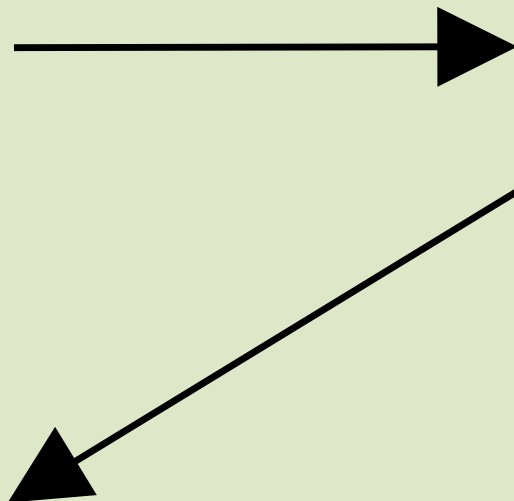
Emerging earlier

Winter moth



Pied flycatcher

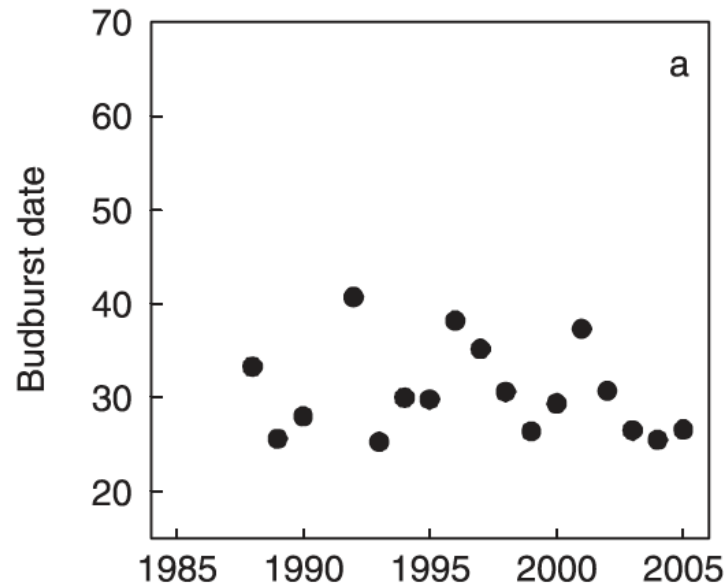
**Migrating the same time
each year**



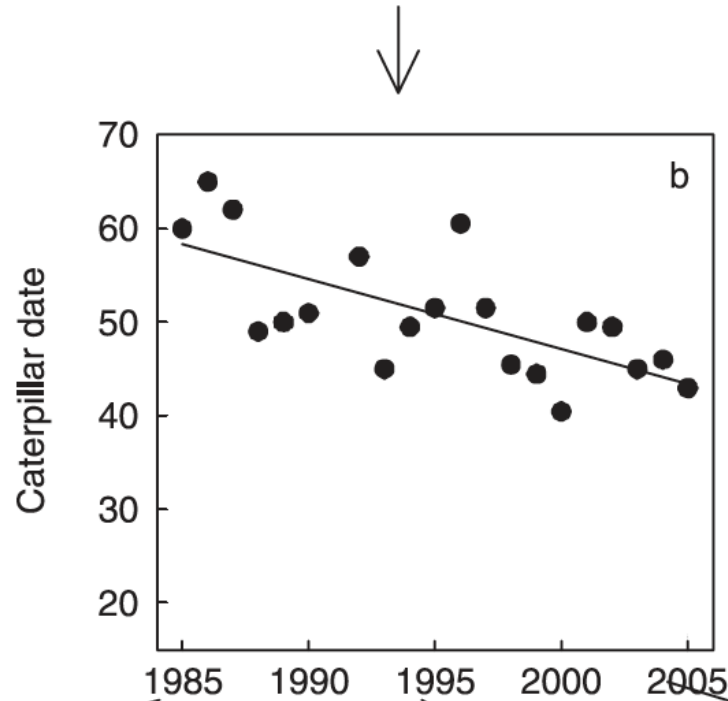
Bird populations have declined by 90% where food for nestlings is peaking earlier in the season and the birds' arrival and breeding events are now mistimed.

“Phenological mismatches” may affect multiple species

Leaf budburst of
Quercus robur



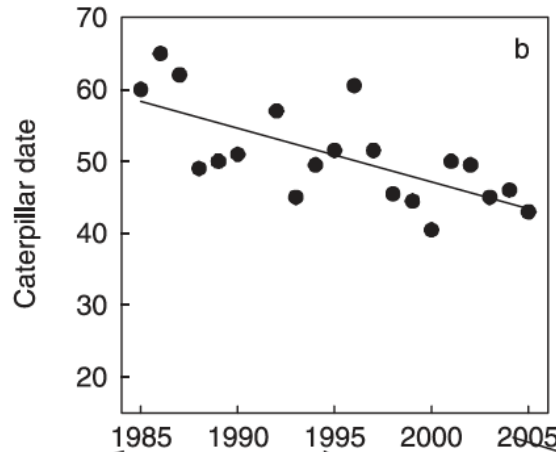
Caterpillar
hatch date
(winter moth
and oak leaf
roller, based on
appearance of
frass)



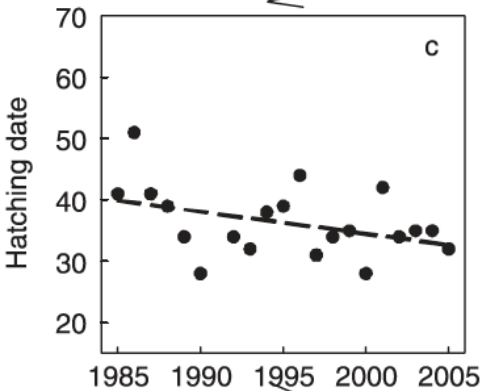
Both et al. 2009 J. Anim. Ecol.

“Phenological mismatches” may affect multiple species

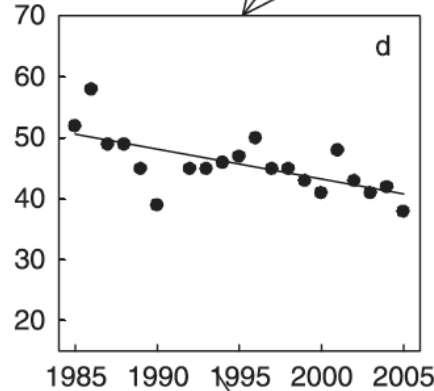
Caterpillar hatch date (winter moth and oak leaf roller, based on appearance of frass)



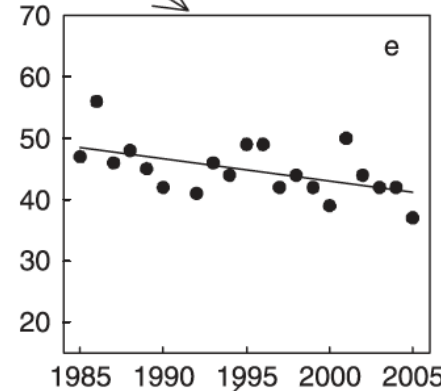
None of the bird species that depend on these caterpillars are accelerating their hatch dates as rapidly as the caterpillars



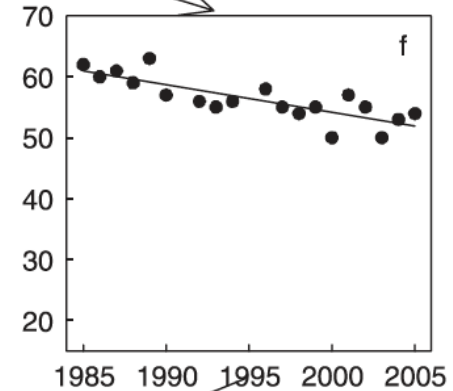
Coal tit hatch date



Blue tit hatch date



Great tit hatch date



Pied flycatcher (*Ficedula hypoleuca*) hatch date

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[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

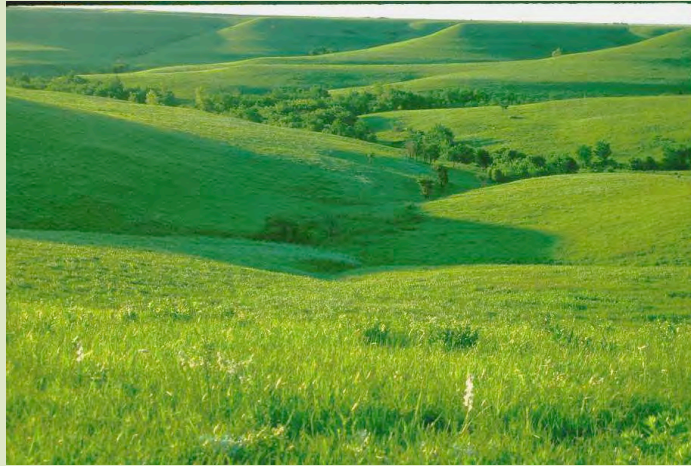
Gothic, CO

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

Phenophase recorded: Date of first flower

Climate records: Growing Degree Days, Precipitation ⁴⁰

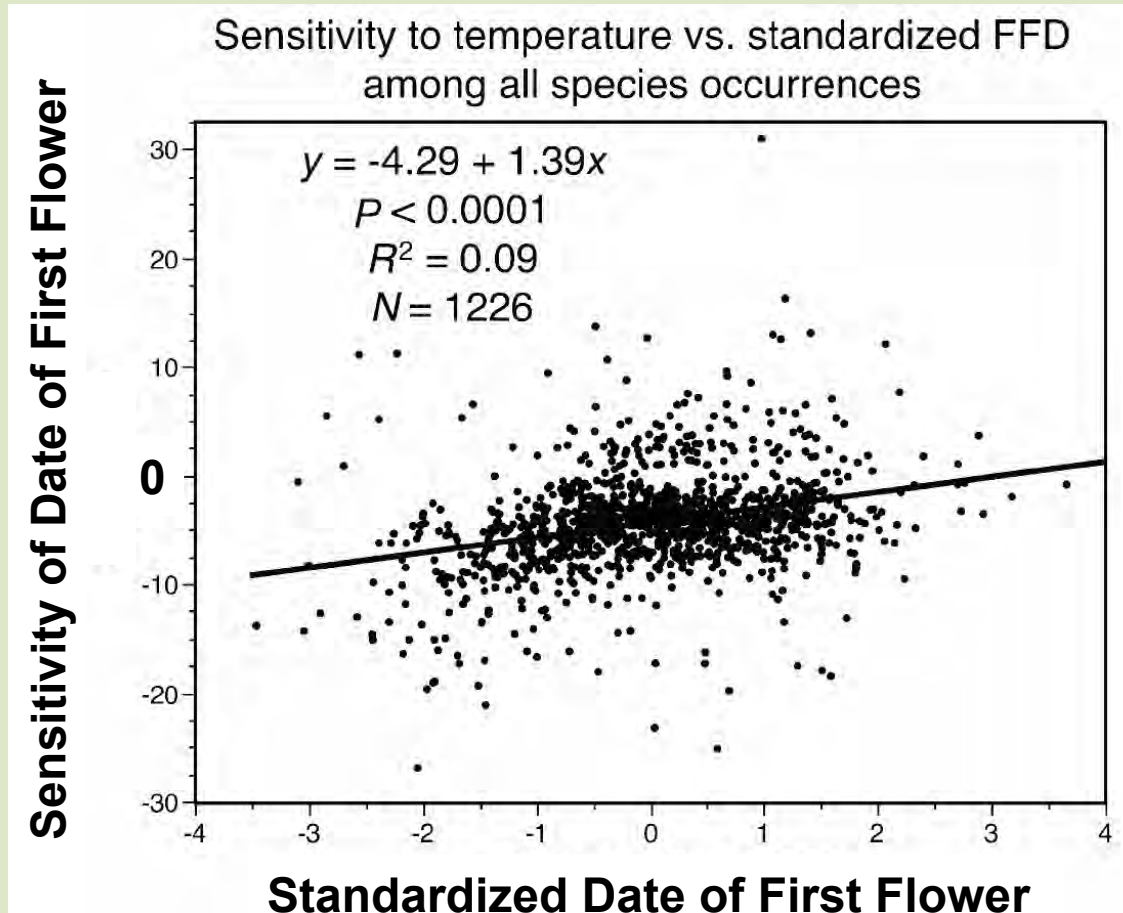
Long-term observational studies: sensitivity is related to FFD

Outcome variable of interest: **Phenological sensitivity**

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

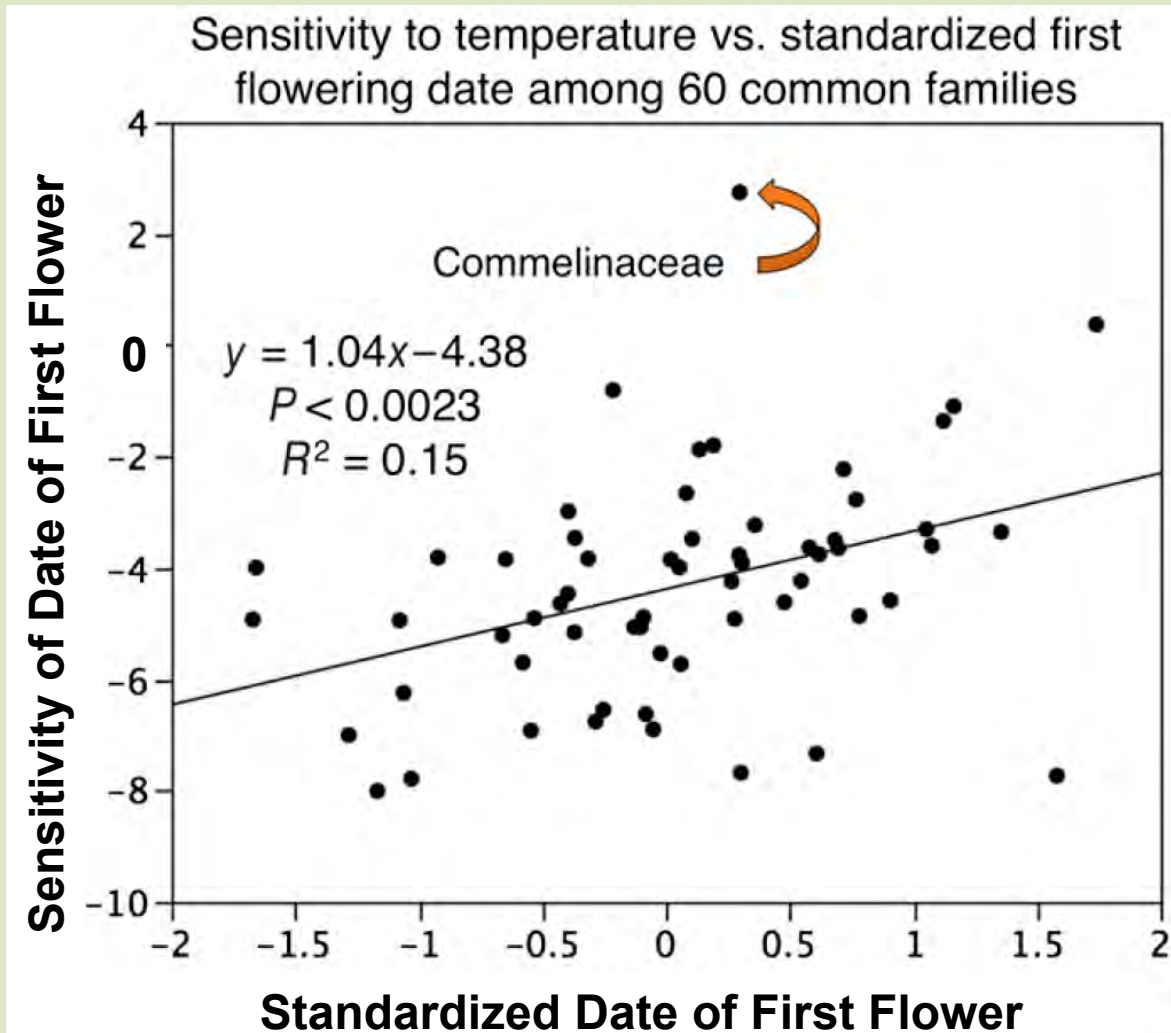
Variables standardized to account for variation among sites

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

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Long-term observational studies

- **The California Phenology Project: design and implementation**
- **The USA-NPN (Source of protocols and data repository)**
- **Results to date from the CPP (highlights from SAMO)**
- **Crash course in botany**

TODAY'S WORKSHOP

- **California Phenology Project and the USA-National Phenology Network: design, infrastructure, & resources available**

California Phenology Project

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

Selection of locations

Selection of species

Use of historical data

Tools: labels, maps, species profiles and data sheets

Nuts and bolts of collecting data

Examples of results after 2 years





CALIFORNIA PHENOLOGY PROJECT

Connect with the seasons

A coordinated scientific effort to assess the effects of climate change on California's landscapes



Establish a coordinated phenological monitoring network

Cover a large geographic area

Sample across key environmental gradients

Establish baseline of phenological data for long-term comparison



The California Phenology Project

Research-related activities

- Create a scientific framework
- Select high-priority focal species
- Track historical phenology using herbarium specimens

Training & outreach activities

- Workshops, public lectures

Educational activities

- Curriculum development
- Phenology Gardens
- K-12, College, Adult
- Professional development (educators)



The California Phenology Project: 7 pilot parks

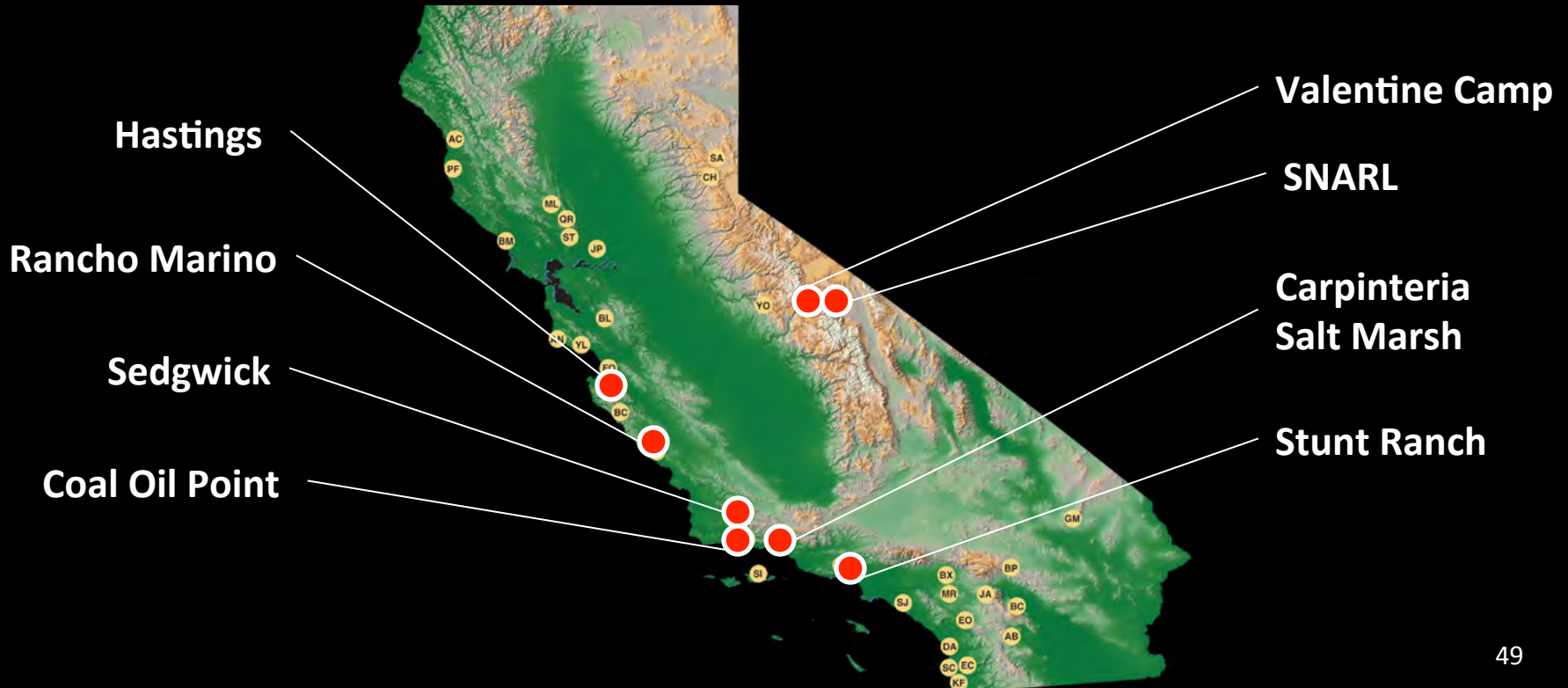


The California Phenology Project



University of California Natural Reserve System Phenology Network

- ✓ **8 of 39 UC Reserves**
- ✓ **First multi-reserve & multi-campus project in 48-year history of UC-NRS**



California Phenology Project: Goals

establish a coordinated phenological
monitoring network



- 1) address scientific questions,
- 2) guide resource management decisions, &
- 3) educate the public about phenology & climate change by engaging Citizen Scientists in genuine research experiences

California Phenology Project

- identify key scientific questions
- select focal species
- develop phenophase descriptions appropriate for California plant taxa
- identify and use historical datasets
- develop and test monitoring protocols, infrastructure, and tools in pilot parks
- develop outreach and education programs and partnerships to build a Citizen Science observer network

California Phenology Project

- **identify key scientific questions**
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CPP scientific questions

- In November 2010, the CPP convened an advisory panel made up of academic and agency scientists
- Goal: to create a scientific framework for CPP activities
 - Identify scientific questions
 - Develop guidelines for selecting focal plant species

Full Report of this meeting available at:

<https://www.usanpn.org/cpp/resources>

Scroll down to: “Scientific framework....”

CPP scientific questions

- How do iconic, widespread species respond to environmental variation and climate change?
- Which taxa or functional groups are most sensitive to climate change?
- Do communities or habitats differ in their general responses to climate change?
- Are relationships between plant and animal mutualists disrupted by climate change?

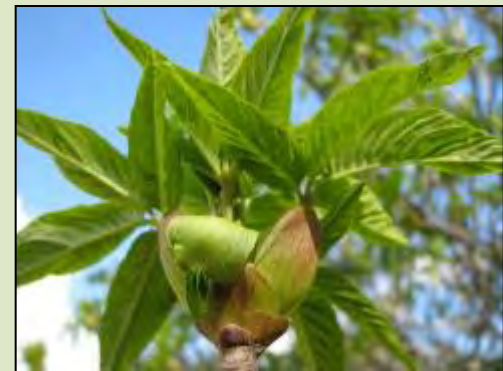


California Phenology Project

- identify key scientific questions
- **select focal species**
- develop phenophase descriptions appropriate for California plant taxa
- identify and use historical datasets
- develop and test monitoring protocols, infrastructure, and tools in pilot parks
- develop outreach and education programs and partnerships to build a Citizen Science observer network engaged in phenological monitoring

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
- benchmark species (e.g., species that are “first-responders” to spring warming or that are last-to-flower)
- known and accessible locations



CPP species selection

- >5,000 taxa in the California flora
 - Identified 75 high-priority species
 - 30 focal species currently monitored
- Many trade-offs among criteria that maximized scientific value vs. public engagement



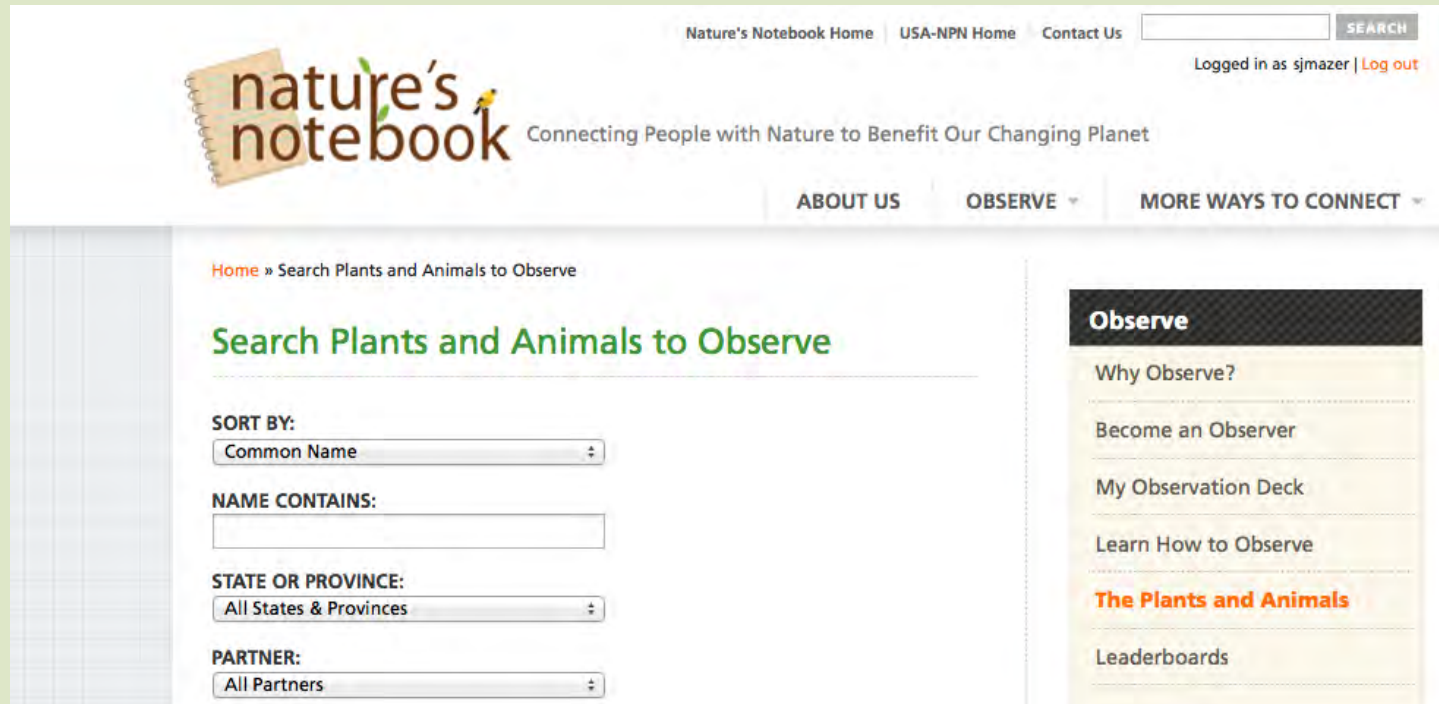
CPP focal species

- 30 native California species

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

- These 30 species are also targeted nationally by the NPN
- >340 USA-NPN plant species occur in CA

http://www.usanpn.org/species_search



The screenshot shows the 'Search Plants and Animals to Observe' page on the Nature's Notebook website. The page features a search form with the following fields:

- Sort By:** A dropdown menu currently set to 'Common Name'.
- Name Contains:** An empty text input field.
- State or Province:** A dropdown menu currently set to 'All States & Provinces'.
- Partner:** A dropdown menu currently set to 'All Partners'.

The page also includes a navigation menu with 'ABOUT US', 'OBSERVE', and 'MORE WAYS TO CONNECT'. A sidebar on the right titled 'Observe' contains links for 'Why Observe?', 'Become an Observer', 'My Observation Deck', 'Learn How to Observe', 'The Plants and Animals' (highlighted in orange), and 'Leaderboards'. The top of the page shows the 'nature's notebook' logo and the tagline 'Connecting People with Nature to Benefit Our Changing Planet'.

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



CPP species selection – appealing but not viable

Common yellow monkeyflower (*Mimulus guttatus*)

- Widespread
- Widely studied
- But: Other yellow monkeyflower look-alikes
- But: Wetland habitats– remote and inaccessible in desert and Mediterranean ecoregions



Targeted Species: California Buckeye

Aesculus californica



Targeted Species: *Quercus agrifolia* (California live oak)



Trageted species: Coyotebrush

Baccharis pilularis



Targeted Species: California buckwheat

Eriogonum fasciculatum



Targeted Species: Blue elderberry



Benefits of monitoring CPP focal species



- Enjoy species-specific monitoring tools, including species profiles, are available for download on the CPP website;

- Species observed at new sites complement CPP data collected at the National Parks and UC Natural Reserves, collectively contributing to our understanding of how CA taxa respond to environmental & climatic variation; and,

- You benefit from the collective experiences of the CPP observer network.



California Phenology Project

- identify key scientific questions
- facilitate selection of focal species
- **develop phenophase descriptions appropriate for California plant taxa and life histories**
- identify and use historical datasets
- develop and test monitoring protocols, infrastructure, and tools in pilot parks
- develop outreach and education programs and partnerships to build a Citizen Science observer network engaged in phenological monitoring

Phenophase descriptions – no vegetative “buds” in most xerophytic woody species



California Phenology Project

- identify key scientific questions
- facilitate selection of focal species
- develop phenophase descriptions appropriate for California plant taxa
- **Identify and use historical datasets**
- develop and test monitoring protocols, infrastructure, and tools in pilot parks
- develop outreach and education programs and partnerships to build a Citizen Science observer network engaged in phenological monitoring

Historical datasets

Many potential sources of legacy data: naturalist journals, seed collection records, herbarium specimens, historical photographs



Miller-Rushing et al 2006

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)



Lupinus bicolor



Clarkia unguiculata



Trillium ovatum

California Phenology Project

- identify key scientific questions
- select focal species
- develop phenophase descriptions appropriate for California plant taxa
- identify and use historical datasets
- **develop and test monitoring protocols, infrastructure, and tools in pilot parks**
- develop outreach and education programs and partnerships to build a Citizen Science observer network engaged in phenological monitoring

TODAY'S WORKSHOP

- **California Phenology Project and the USA-National Phenology Network: design, infrastructure, & resources available**

California Phenology Project

- ✓ History and funding
- ✓ Selection of locations
- ✓ Selection of species
- ✓ Use of historical data

Tools: labels, maps, species profiles and data sheets

Nuts and bolts of collecting data

Examples of results after 2 years



CPP monitoring infrastructure: labels, maps, species profiles, and data sheets

Joshua
Tree NP



Redwood NP



Golden Gate



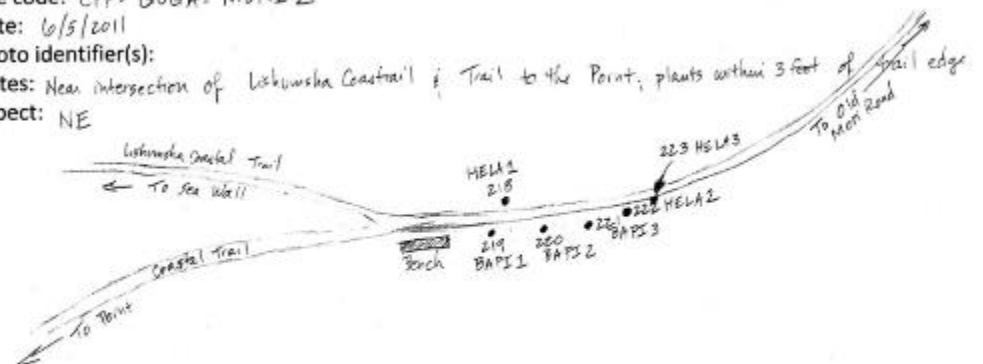
Site code: CPP-GOGA-MORI 2

Date: 6/5/2011

Photo identifier(s):

Notes: Near intersection of Lickwisha Coastal Trail & Trail to the Point; plants within 3 feet of trail edge

Aspect: NE



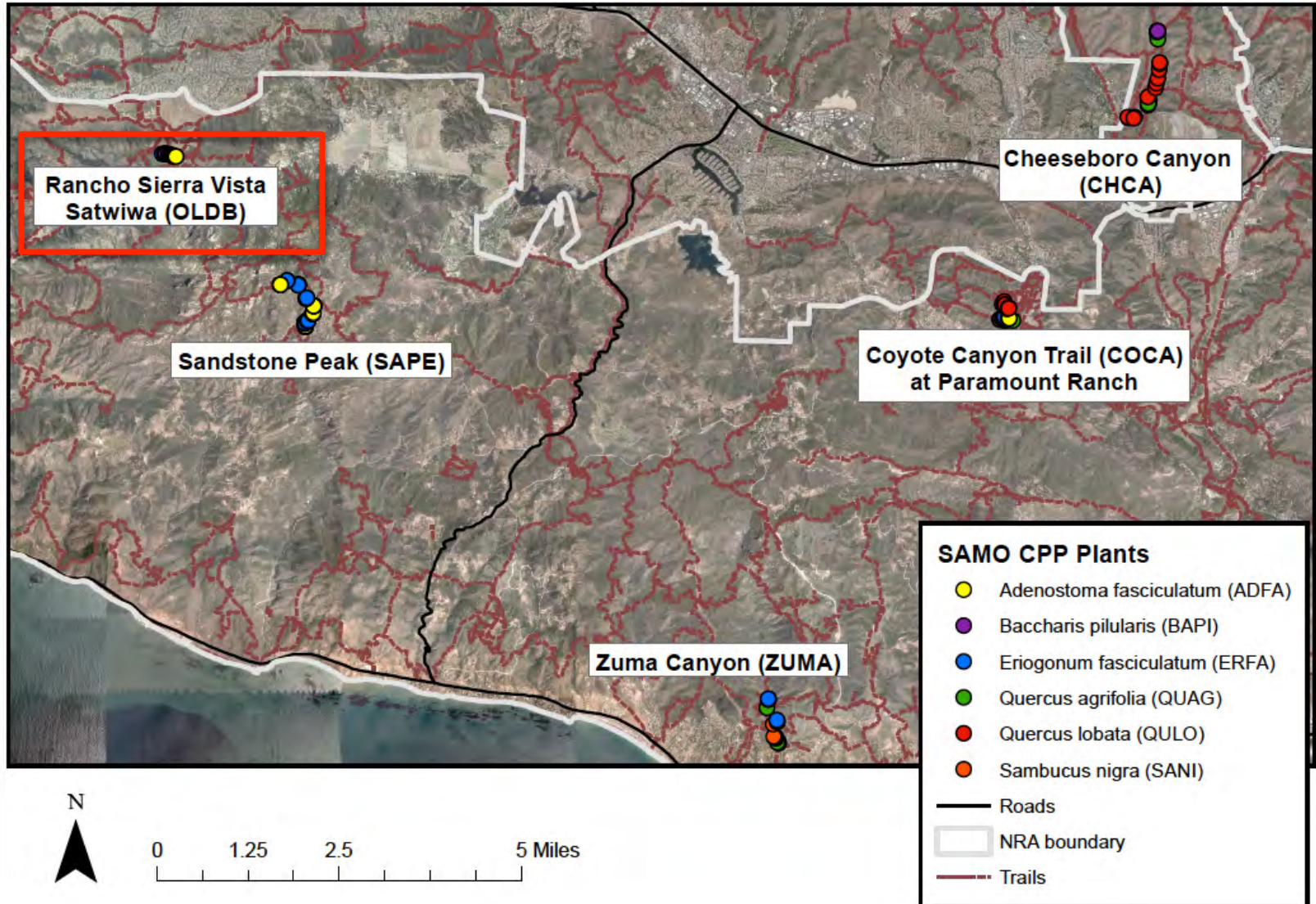
CPP monitoring infrastructure: labels, maps, species profiles, and data sheets



CPP monitoring infrastructure:

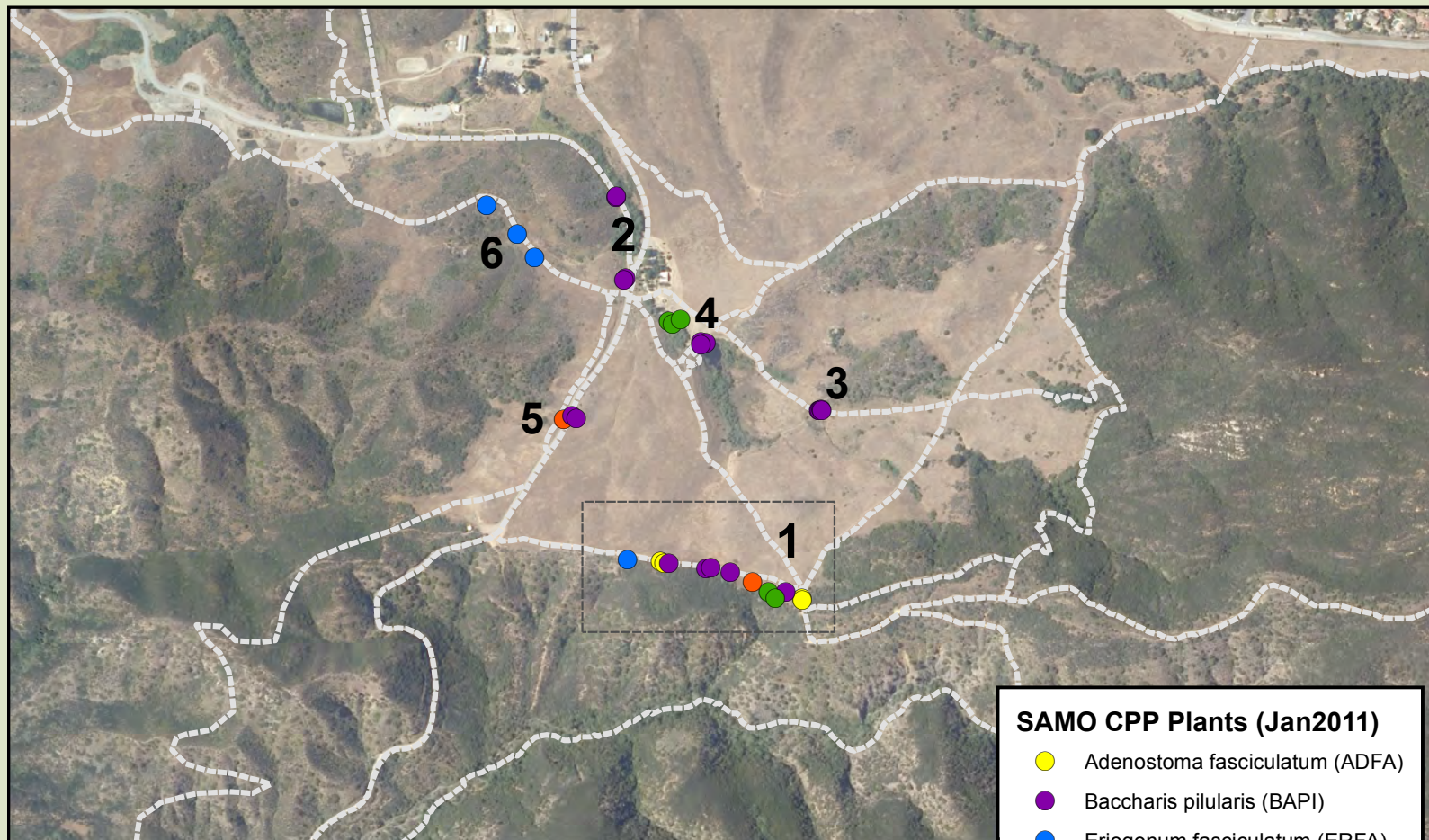
labels, **static maps**, species profiles, and data sheets

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



CPP monitoring infrastructure: labels, static maps, species profiles, and data sheets

CPP SAMO Rancho Sierra Vista / Satwiwa Sites



0 160 320 640 Meters

SAMO CPP Plants (Jan2011)

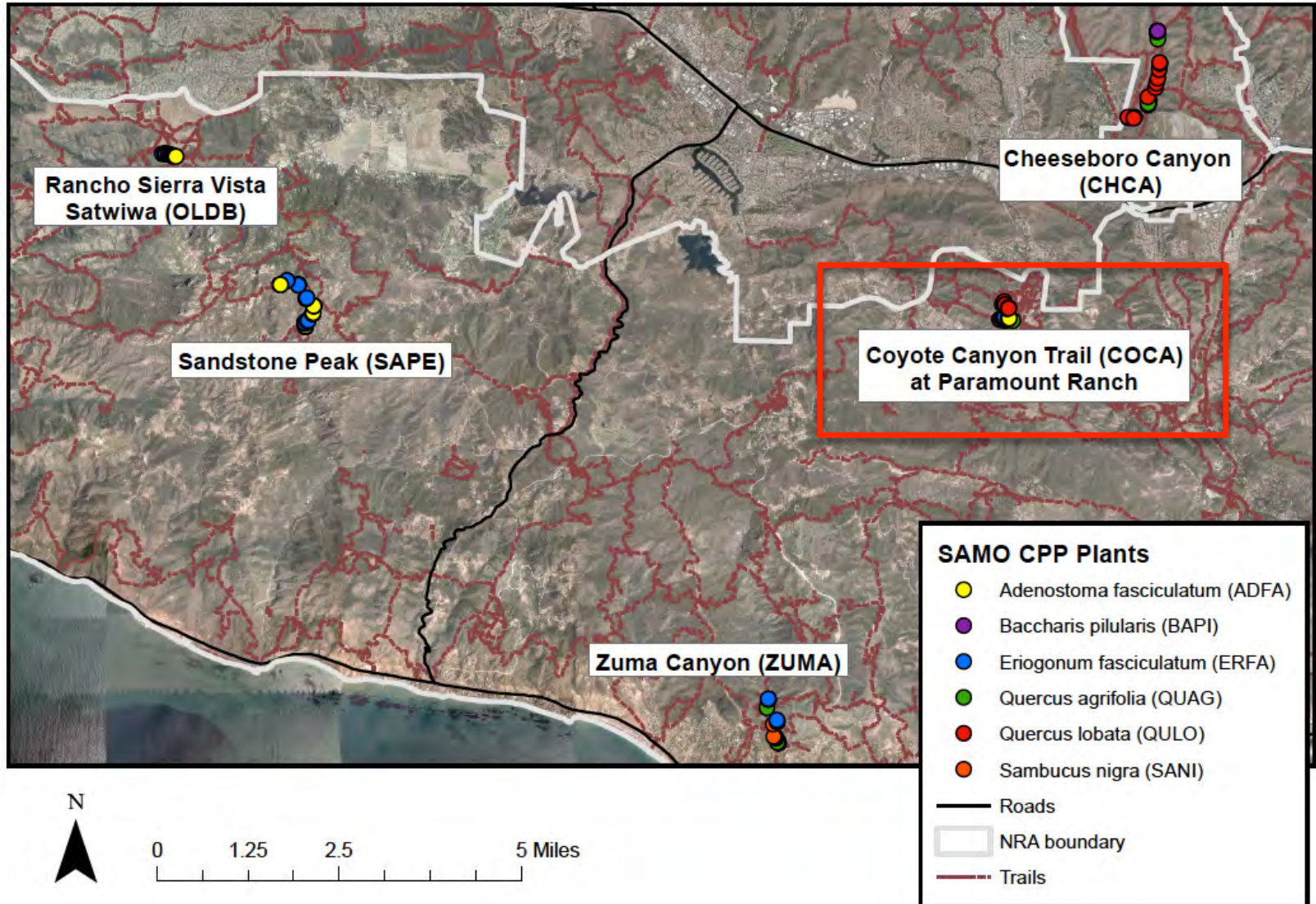
- Yellow: Adenostoma fasciculatum (ADFA)
- Purple: Baccharis pilularis (BAPI)
- Blue: Eriogonum fasciculatum (ERFA)
- Green: Quercus agrifolia (QUAG)
- Orange: Sambucus nigra (SANI)

--- Trails

CPP monitoring infrastructure:

labels, **static maps**, species profiles, and data sheets

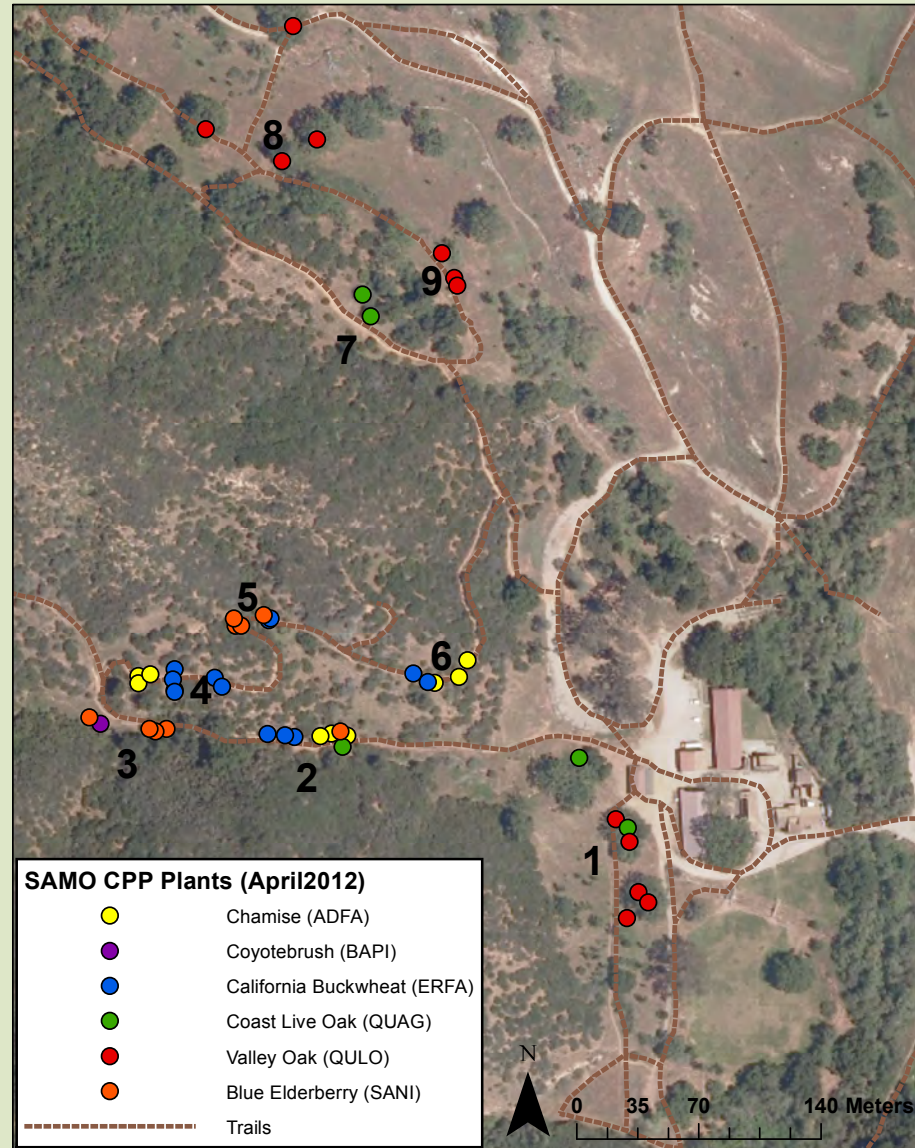
CPP Monitoring Locations at Santa Monica Mountains (SAMO)
National Recreation Area



CPP monitoring infrastructure:

labels, static maps, species profiles, and data sheets

CPP SAMO Paramount Ranch Monitoring Sites



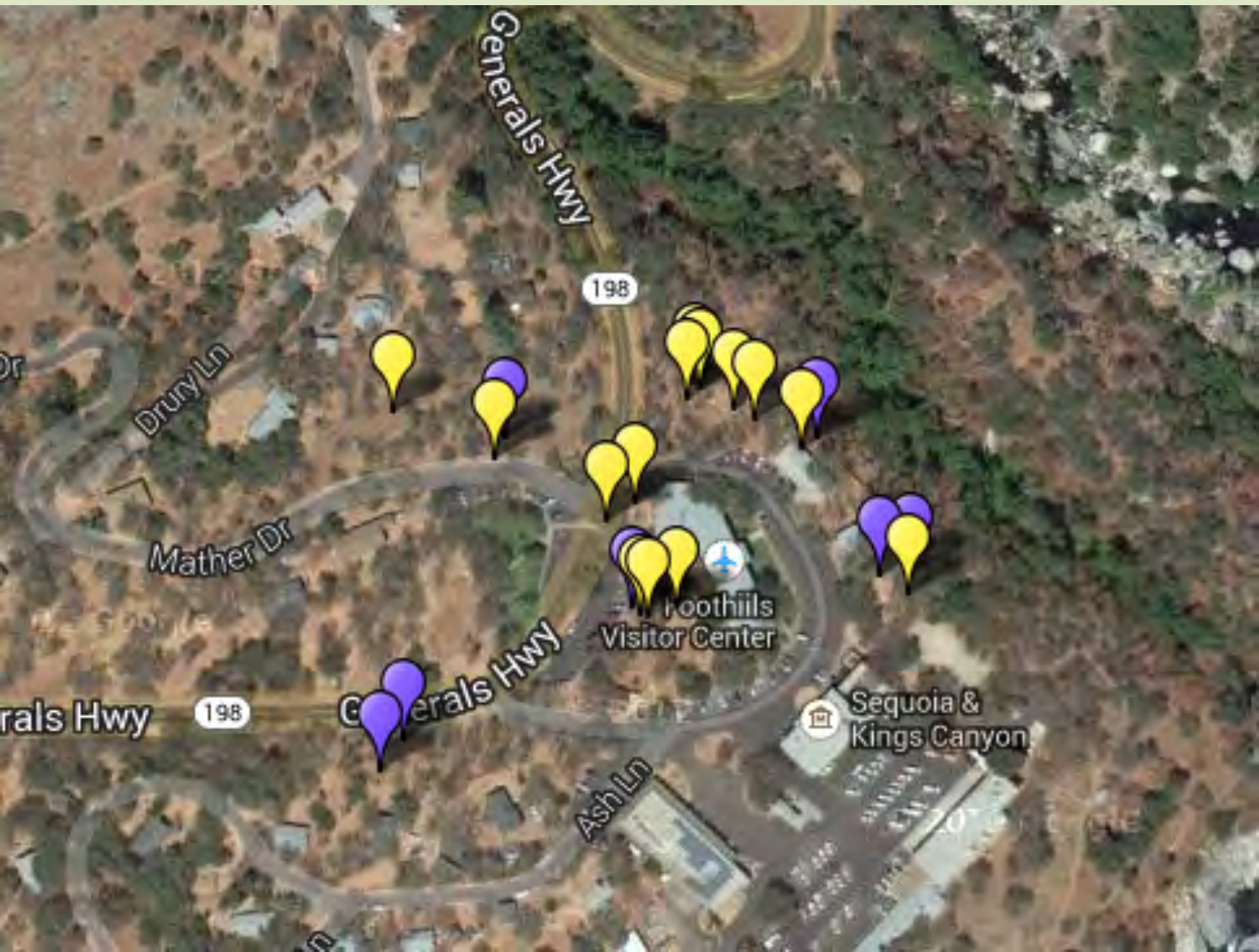
CPP monitoring infrastructure: labels, google maps, species profiles, and data sheets






















Foothills Visitor Center, SEKI



CPP monitoring infrastructure: labels, google maps, species profiles, and data

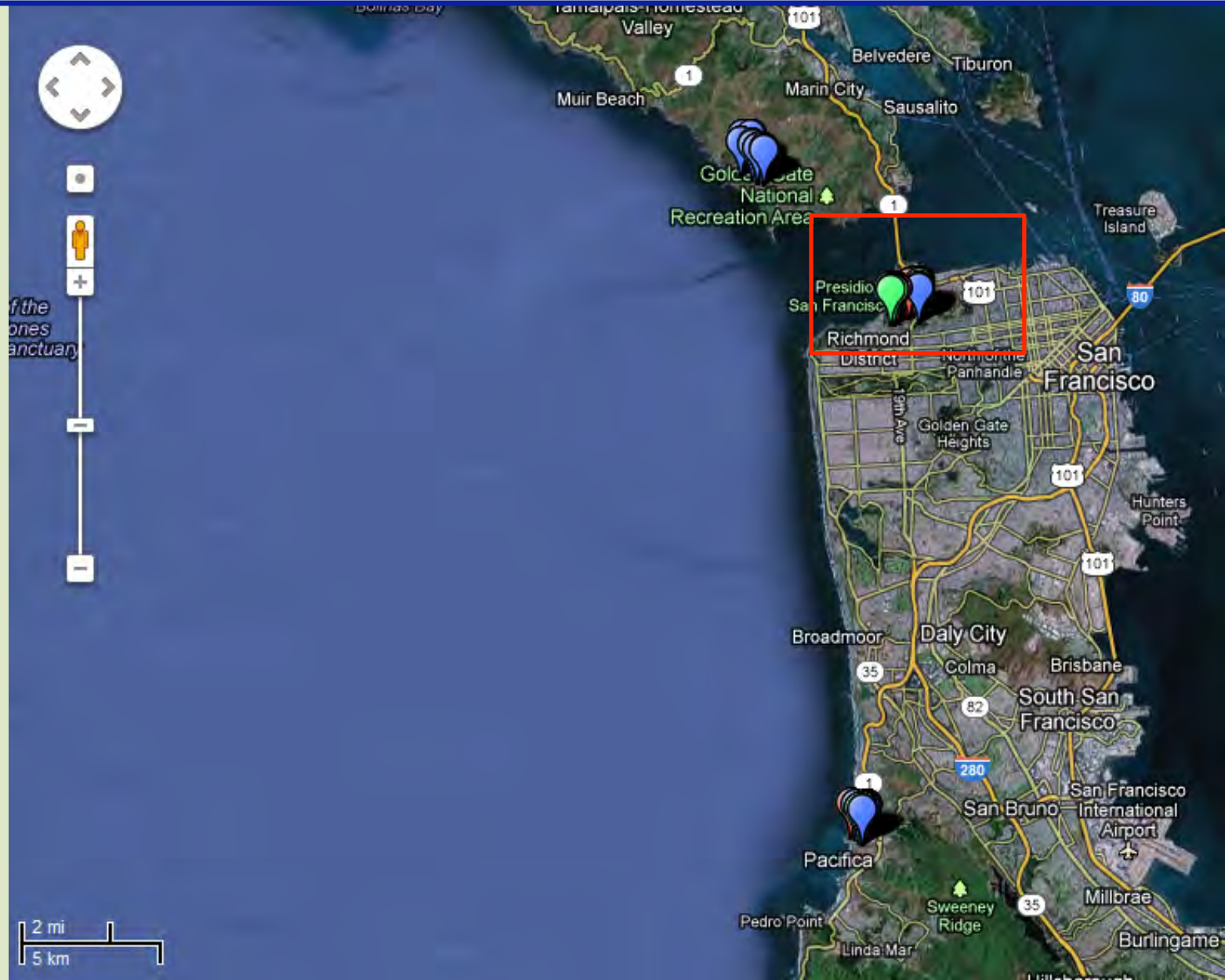
Foothills Visitor Center



-  SEKI-FHVC1-QUDO1 (#462)
SEKI-FHVC1-QUDO1 (#462)
-  SEKI-FHVC1-QUDO2 (#463)
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)
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-  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)
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-  SEKI-FHVC3-QUDO1 (#444)
SEKI-FHVC3-QUDO1 (#444)
-  SEKI-FHVC3-QUDO2 (#443)
SEKI-FHVC3-QUDO2 (#443)
-  SEKI-FHVC4-AECA1 (#445)
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SEKI-FHVC4-AECA2 (#446)

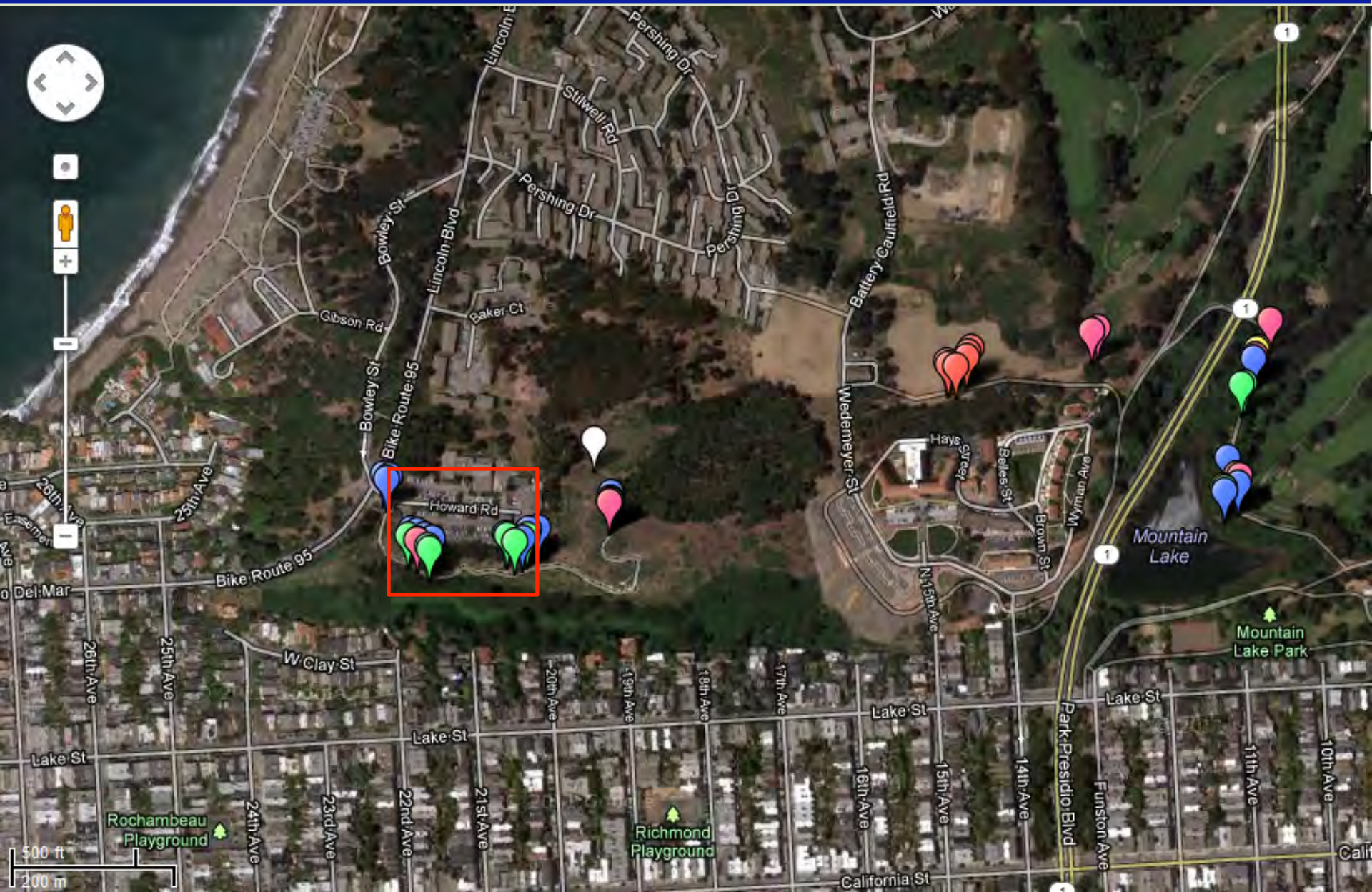
CPP monitoring infrastructure:

labels, google maps, species profiles, and data sheets



CPP monitoring infrastructure:

labels, google maps, species profiles, and data sheets



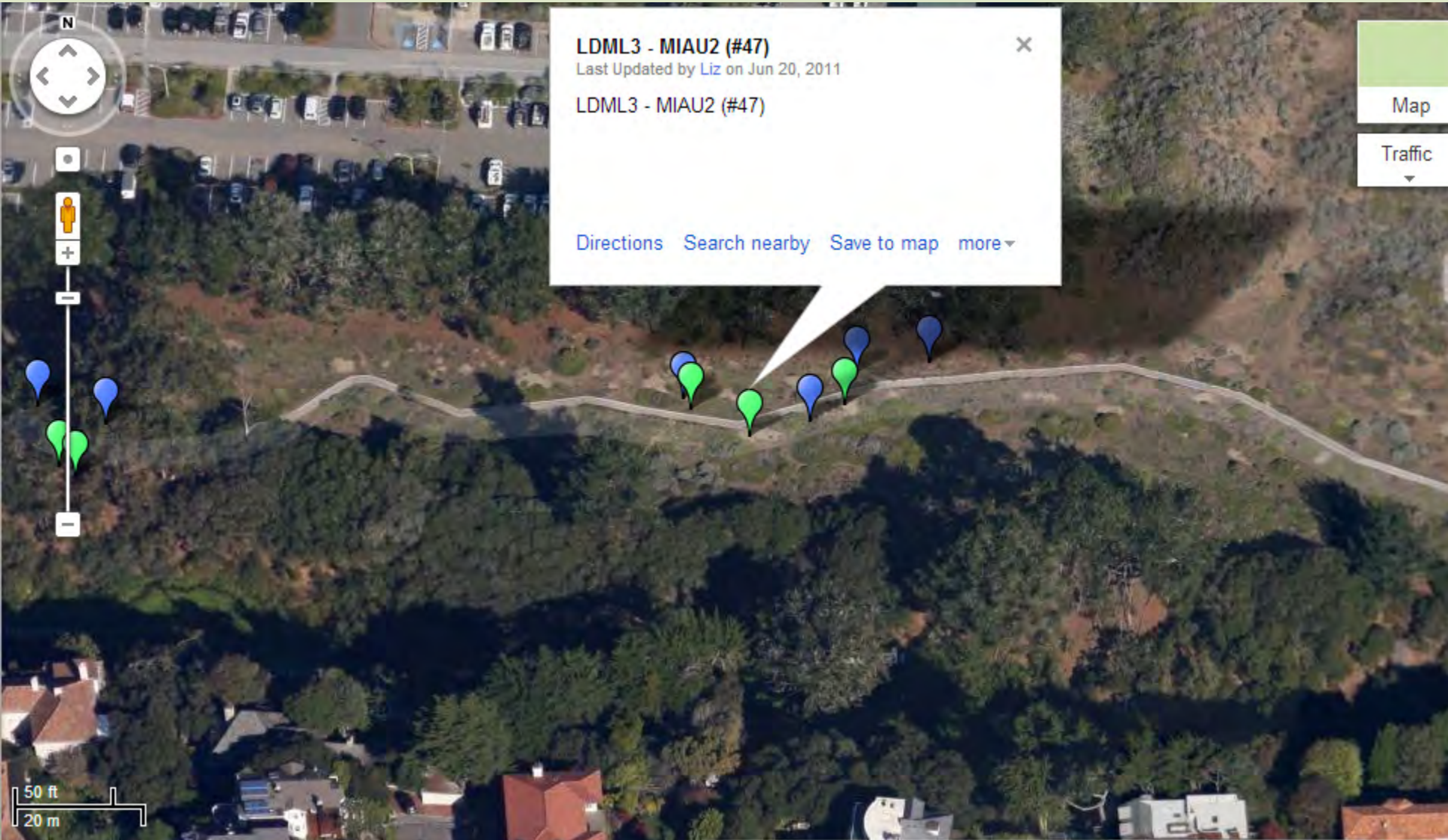
CPP monitoring infrastructure:

labels, google maps, species profiles, and data sheets



CPP monitoring infrastructure:

labels, google maps, species profiles, and data sheets



Building a Citizen Science network

- 30 species
 - perennials, evergreen shrubs and trees, deciduous shrubs and trees.
 - 8 are monitored in multiple parks
- > 950 tagged monitored individuals
- > 780,000 observation records (2011-2014)
 - CPP observations account for ~25% of observations submitted to the USA-NPN database from 2010-2014



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)

CPP species profiles

Download from the CPP website:
www.usanpn.org/cpp

California Phenology Project: species profile for Blue Oak (*Quercus douglasii*)



CPP site(s) where this species is monitored: Sequoia National Park and John Muir NHS



Photo credit: loarie (flickr)

What does this species look like?

This deciduous tree is short and straight. It grows from 6 to 20 m tall and has thin and flaky light grey bark. The waxy bluish-green leaves are 3 to 8 centimeters long with wavy margins. This species is monoecious, having male and female flowers separate, but on the same plant. Male flowers are yellow green hanging catkins, and female flowers are small and solitary, growing in the axis of leaves. This species is wind pollinated. The acorns are 2 to 3 centimeters long and take one year to mature.

When monitoring this species, use the USA-NPN **deciduous trees and shrubs (with pollen)** datasheet.

Species facts!

- The CPP four letter code for this species is QUDO.
- Exhibits masting behavior; all individuals in a population will have synchronized episodic acorn productions. This is thought to satiate seed predators so that some acorns can survive to germinate the following year.
- Susceptible to Sudden Oak Death disease, a plant pathogen that can have a devastating impact on forests.



Photo credit: loarie (flickr)

Where is this species found?

- Endemic to California.
- Found on dry slopes, interior foothills, and woodland habitats.
- Covers the foothills surrounding the Central Valley of California.
- At elevations less than 1200 meters.



Photo credit: KQED Quest (flickr)

For more information about phenology and the California Phenology Project (CPP), please visit the CPP website (www.usanpn.org/cpp) and the USA-NPN website (www.usanpn.org)

California Phenology Project: species profile for Blue Oak (*Quercus douglasii*)



Breaking leaf buds



Leaves



Increasing leaf size



Colored leaves



Flowers or flower buds

The male inflorescence is a catkin which is initially compact and stiff, but eventually unfolds, lengthens, and hangs loosely from the branch. Female flowers are very small and petal-less, emerging from the growing stem at the point where a new leaf is attached.



Open flowers

The male flowers will open once the catkin has unfolded and is hanging loosely. Female flowers are open when the pistils are visible, but will be very difficult to see where they are out of reach.

When monitoring **flower or flower bud abundance** for this species, count each inflorescence as a single flowering structure!

When monitoring the **proportion of open flowers**, estimate the number of individual flowers that are open, not inflorescences! For big trees, estimate proportions of open flowers for a few branches and extrapolate for the rest of the tree.



Fruits

The fruit is an acorn that changes from green to yellowish-green to brown or dark brown.



Ripe fruits

The fruit is considered ripe when it is brown or dark brown.

Important Note: USA-NPN flower and fruit phenophases are nested. If you say "Y" to "open flowers" you should also have said "Y" to "flowers or flower buds" and if you say "Y" to "ripe fruits" you should also have said "Y" to "fruits"

Phenophases not pictured: **Falling leaves, Pollen release, Recent fruit or seed drop**

Using USA-NPN datasheets

Download from the CPP website:
www.usanpn.org/cpp

Trees and Shrubs *Deciduous (with pollen)*

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.

y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).

Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.



Species: Quercus douglasii

Common Name: blue oak

Nickname: _____

Site: _____

Year: _____

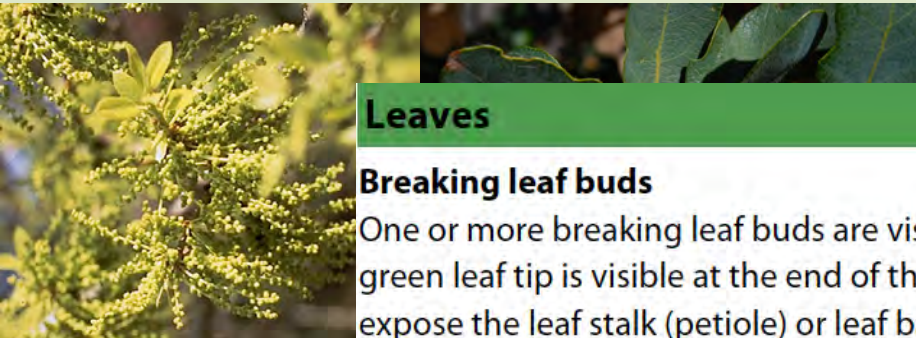
Observer: _____

	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Breaking leaf buds	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Increasing leaf size	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Colored leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Falling leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Flowers or flower buds	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Open flowers	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Pollen release	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Fruits	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Ripe fruits	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Recent fruit or seed drop	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Check when data entered online:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

Using USA-NPN datasheets

Download from the CPP
website:
www.usanpn.org/cpp



Leaves

Breaking leaf buds

One or more breaking leaf buds are visible on the plant. A leaf bud is considered "breaking" once a green leaf tip is visible at the end of the bud, but before the first leaf from the bud has unfolded to expose the leaf stalk (petiole) or leaf base.

How many buds are breaking?

Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Leaves

One or more live, unfolded leaves are visible on the plant. A leaf is considered "unfolded" once its entire length has emerged from the breaking bud so that the leaf stalk (petiole) or leaf base is visible at its point of attachment to the stem. Do not include fully dried or dead leaves.

What percentage of the canopy is full with leaves? Ignore dead branches in your estimate.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Increasing leaf size

A majority of leaves on the plant have not yet reached their full size and are still growing larger. Do not include new leaves that continue to emerge at the ends of elongating stems throughout the growing season.

What percentage of full size are most leaves?

Less than 25%; 25-49%; 50-74%; 75-94%; 95% or more;

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

Check when data entered online

Comments:

Using NPN datasheets: California Buckeye

California Phenology Project: species profile for California Buckeye (*Aesculus californica*)



CPP site(s) where this species is monitored: Sequoia National Park; John Muir National Historic Site

What does this species look like?

This deciduous species is a large shrub or tree, up to 12 meters tall. The leaves are palmate (the leaflets emerge from a single point) and made up of 5 to 7 leaflets, each 6 to 17 cm long. Flowers are white to pale rose-colored, with petals 12 to 18 millimeters long. The flowers are clustered in an erect inflorescence with many showy, ill-smelling flowers. Only the flowers at the tip of each inflorescence are fertile and produce fruit. Each fruit contains one large (2 to 5 cm) glossy brown seed.



Photo credit: Martin Jambom (flickr)

When monitoring this species, use the USA-NPN **deciduous trees and shrubs** datasheet.

Species facts!

- The CPP four letter code for this species is **AECA**.
- The bark, leaves, stems, fruit, and seeds of this plant contain toxic glycosidal compounds.
- Native Americans used the ground seeds to poison fish, but the seeds could also be used for food when leached of their poison and mashed.
- Although honeybees are the primary pollinator of buckeye, the nectar and pollen can be toxic to them.



Photo credit: randomtruth (flickr)

Where is this species found?

- This species is endemic to California.
- It is found in dry slopes, canyons, and the edges of streams.
- Found at elevations less than 1700 meters



Photo credit: James Gaither (flickr)

For more information about phenology and the California Phenology Project (CPP), please visit the CPP website (www.usanpn.org/cpp) and the USA-NPN website (www.usanpn.org)

California Phenology Project: species profile for California Buckeye (*Aesculus californica*)



Terrie Schweitzer

Breaking leaf buds

A leaf bud is considered "breaking" once a green leaf tip is visible at the tip of the bud, but before the first leaf from the bud has unfolded to expose the leaf stalk or base. Can you see the leaf tips emerging from the bud in this picture?



Eugene Zelenko

Leaves

Can you see the base of the leaflets? New leaflets may need to be bent backwards to see whether the petiole is visible.



Liz Matthews

Increasing leaf size



Cliff Hutson

Colored leaves



Devra

Flowers or flower buds

When monitoring flower or flower bud abundance for this species, count each inflorescence as a single flowering structure! For example, if there are two inflorescences with many flowers or buds each, then abundance should be recorded as 2.



Dawn Endico

Open flowers

Do you see the pollen-producing anthers protruding from the flowers? **Proportion of open flowers** should be recorded at the scale of individual flowers, not inflorescences (i.e. estimate the proportion of individual flowers that are open!).

Note: flower phenophases are nested; if you record Y for "open flowers" you should also record Y for "flowers or flower buds"



Eugene Zelenko

Fruits

The fruit is a large, leathery capsule that changes from green to tan or grayish-tan and splits open to release a large seed when ripe.



randomtruth

Ripe fruits

A fruit is considered ripe when it splits open. **Note:** fruit phenophases are nested; if you record Y for "ripe fruits" you should also record Y to "fruits"

Phenophases not pictured: Falling leaves, recent fruit or seed drop

CPP species profiles: California Buckeye

Trees and Shrubs *Deciduous*

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.

y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).

Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.



Species: Aesculus californica

Common Name: California buckeye

Nickname: _____

Site: _____

Year: _____

Observer: _____

No pollen release phenophase

	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Breaking leaf buds	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Increasing leaf size	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Colored leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Falling leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Flowers or flower buds	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Open flowers	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Fruits	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Ripe fruits	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Recent fruit or seed drop	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
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Comments:

CPP monitoring infrastructure:

labels, user-made maps, species profiles, and data sheets

Eriogonum fasciculatum

California buckwheat



CPP monitoring infrastructure:

labels, user-made maps, species profiles, and data sheets

California Phenology Project: species profile for Eastern Mojave Buckwheat (*Eriogonum fasciculatum*)



UCSB

CPP site(s) where this species is monitored: Santa Monica Mountains National Recreation Area, Joshua Tree National Park



Photo credit: Stan Shebs

What does this species look like?

This perennial shrub can be up to 2 meters tall and 3 meters wide. The leaves are clustered at branch nodes and are leathery in texture; some varieties have white fuzz below, whereas others are glabrous. Leaves are a grey-green color, and rolled along the edges. The small flowers are 2.5 to 3 millimeters diameter, white to pinkish in color, and arranged in a dense clusters.

When monitoring this species, use the USA-NPN *semi-deciduous trees and shrubs* datasheet.

Species facts!

- The CPP four letter code for this species is ERFA.
- This species was used by Native American groups to treat headaches, diarrhea, and wounds.
- This species is visited by a variety of butterflies, and is an important source of nectar for honeybees in dry areas.
- Can form associations with mycorrhizal fungi to aid in seedling survival and the colonization of new sites.



Photo credit: Brian Haggerty

Where is this species found?

- Found in dry slopes, washes, and canyons.
- A member of sagebrush scrub, desert scrub and coastal sage scrub plant communities.
- Found at elevations less than 2300 meters.
- In California, it is distributed in the Southern Sierra Nevada, Central West CA, Southwestern CA, East of Sierra Nevada, and Deserts.



Photo credit: wanderingname (Flickr)

For more information about phenology and the California Phenology Project (CPP), please visit the CPP website (www.usanpn.org/cpp) and the USA-NPN website (www.usanpn.org)

California Phenology Project: species profile for Eastern Mojave Buckwheat (*Eriogonum fasciculatum*)



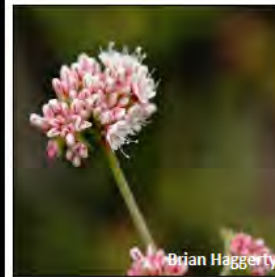
UCSB



Cait McHugh and Anjanette Garcia

Young leaves
Young leaves are generally thinner and lighter colored than mature leaves.

Similar to other species in Mediterranean and desert ecosystems, Buckwheat may respond to precipitation events with a flush of new leaf production. If water becomes unavailable after growth is initiated, however, then leaf expansion may be arrested, resulting in many small leaves on the plant. These responses to water availability (initiation of growth followed by arrested growth when the resources give out) can be confusing for observers. If you are unsure of what you are seeing, do not hesitate to circle? on the NPN datasheets. With more experience, you may be able to distinguish between newly produced young leaves vs. old, small leaves. As you observe this species throughout the year, take note of the differences between new and old leaves—color, texture, and size can all be used to identify young leaves!



Brian Haggerty

Flowers or flower buds

When monitoring flower or flower bud abundance for this species, count each inflorescence as a single flowering structure! For example, if there are two inflorescences with many flowers or buds each, then abundance should be recorded as <3.

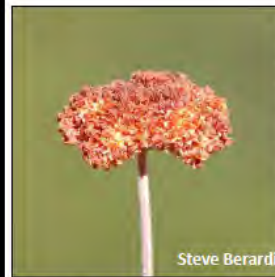


Brian Haggerty

Open flowers

You can see the pollen-producing anthers emerging from the flower in the photo to the left. Proportion of open flowers should be recorded at the scale of individual flowers, not inflorescences (i.e. estimate the proportion of individual flowers that are open!)

Note: flower phenophases are nested; if you record Y for "open flowers" you should also record Y for "flowers and flower buds"



Steve Berardi

Fruits

The fruit is tiny and capsule-like, partially enclosed in a spent flower base (calyx), with many such spent flower bases tightly clustered together. The spent flower base changes from green to light brown or rusty brown as it dries out.



Arnold Zane

Ripe fruits

A fruit is considered ripe when the spent flower base enclosing it has turned light brown or rusty brown.

Note: fruit phenophases are nested; if you record Y for "ripe fruits" you should also record Y to "fruits"

The green, pre-ripe fruit phenophase may be difficult to identify on this species. Remember you can circle? If you are unsure of what you are seeing!

Phenophases not pictured: Leaves, Recent fruit or seed drop

USA-NPN datasheets



Eriogonum fasciculatum California buckwheat

Trees and Shrubs *Semi-deciduous*

Trees and Shrubs *Semi-deciduous*



Species: Eriogonum fasciculatum
 Common Name: Eastern Mojave buckwheat
 Nickname: _____
 Site: _____
 Year: _____
 Observer: _____

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.

y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).

Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.

	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Young leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Flowers or flower buds	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Open flowers	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Fruits	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Ripe fruit	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Downed fruit or seed bank	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Check when data entered online	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

Using NPN datasheets

Leaves

Young leaves

One or more young, unfolded leaves are visible on the plant. A leaf is considered "young" and "unfolded" once its entire length has emerged from the breaking bud so that the leaf stalk (petiole) or leaf base is visible at its point of attachment to the stem, but before the leaf has reached full size or turned the darker green color or tougher texture of mature leaves on the plant. Do not include fully dried or dead leaves.

How many young leaves are present?

Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Leaves

One or more live, unfolded leaves are visible on the plant. A leaf is considered "unfolded" once its entire length has emerged from the breaking bud so that the leaf stalk (petiole) or leaf base is visible at its point of attachment to the stem. Do not include fully dried or dead leaves.

What percentage of the canopy is full with leaves? Ignore dead branches in your estimate.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Do you see

Young leaves

Leaves

Flowers

Open flowers

Fruit

Ripe fruit

Download full datasheet

Check when data entered online

Comments:

Young leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Leaves	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Flowers	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Open flowers	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Fruit	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Ripe fruit	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Download full datasheet	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Check when data entered online	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1
eat

CPP Focal Species at Alum Rock

1. *Sambucus nigra* (Blue Elderberry)
2. *Aesculus californica* (California buckeye)
3. *Quercus lobata* (Valley Oak)
4. *Quercus agrifolia* (California Live Oak)
5. *Diplacus aurantiacus* (Sticky Monkeyflower)
6. *Heteromeles arbutifolia* (Joshua Tree)

TODAY'S WORKSHOP

- **California Phenology Project and the USA-National Phenology Network: design, infrastructure, & resources available**

California Phenology Project

- ✓ History and funding
- ✓ Selection of locations
- ✓ Selection of species
- ✓ Use of historical data
- ✓ **Tools: labels, maps, species profiles and data sheets**

Nuts and bolts of collecting data

Examples of results after 2 years



CPP monitoring infrastructure:

labels, user-made maps, species profiles, and data sheets



Aesculus californica California Buckeye

Trees and Shrubs *Deciduous*

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.
y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).
Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.



nature's
notebook

Date: 7/29/13

Time: _____

Do you see...	y	n	?	_____
Breaking leaf buds	y	n	?	_____
Leaves	y	n	?	_____
Increasing leaf size	y	n	?	_____
Colored leaves	y	n	?	_____
Falling leaves	y	n	?	_____
Flowers or flower buds	y	n	?	_____
Open flowers	y	n	?	_____
Fruits	y	n	?	_____
Ripe fruits	y	n	?	_____
Recent fruit or seed drop	y	n	?	_____
Check when data entered online:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

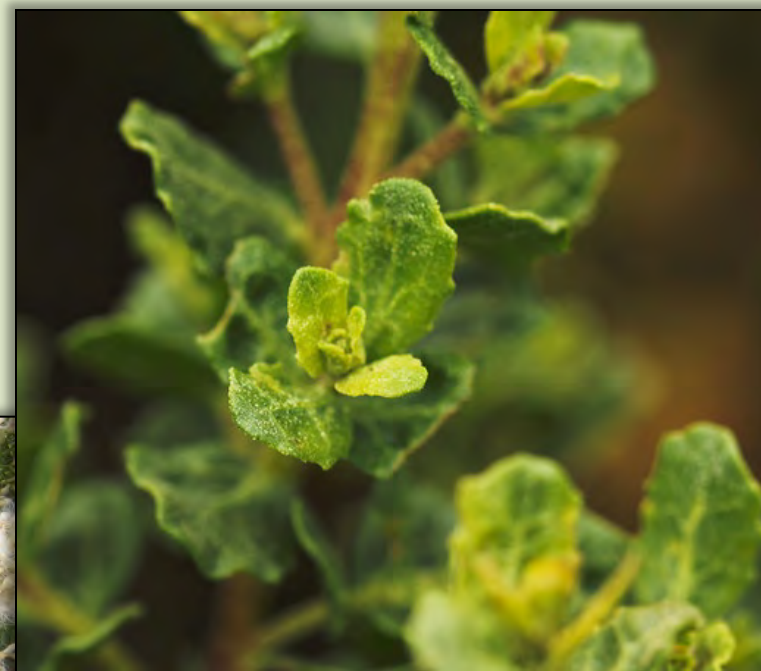
Phenophase transitions indicated by blue circles

TODAY'S WORKSHOP

- 8:30 - 9:00 – Introductions (round-robin)
- 9:00 – 10:00 – Introduction to phenology, its link to climate change, ecological consequences & a few case studies. (slides 1-42)
- 10:00 – 10:15 — *Break*
- 10:15 – 11:15 – California Phenology Project and Nature's Notebook: origin, design, infrastructure, & resources available (slides 43-99)
- 11:15 – 11:30 — *Break*
- 11:30 – 12:15 — Results to date, lessons learned, the mothership (the USA National Phenology Network), the app, Botany Crash Course (slides 100-145)
- 12:30 – 4:00 — *Drive to Alum Rock City Park* — Picnic lunch — hands-on phenological monitoring; selecting sites and plants for monitoring; planning future monitoring



Baccharis pilularis Coyotebrush



The California Phenology Project: 7 pilot parks

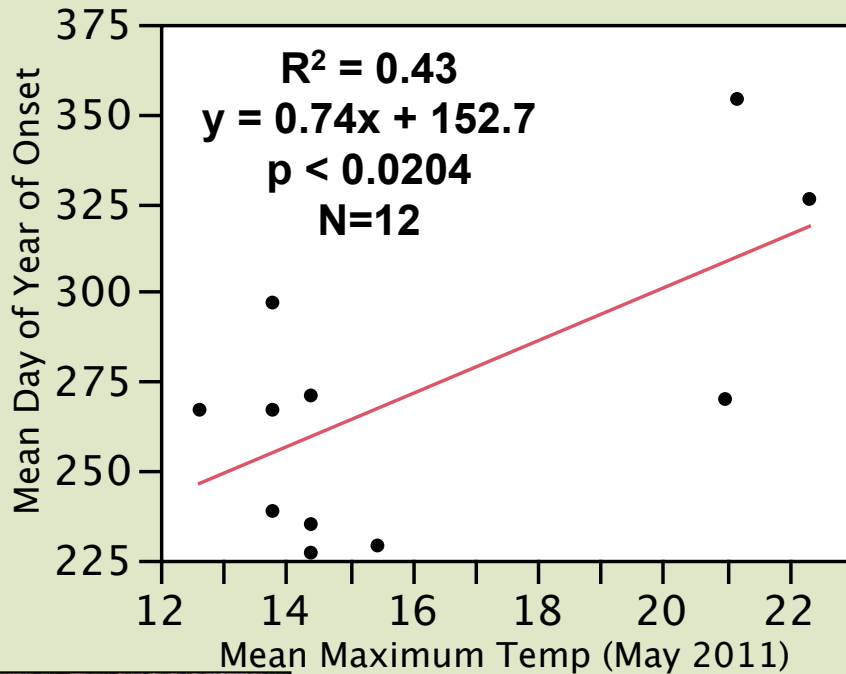


Baccharis pilularis: **Across California**, data points are site means (1-9 plants/site).

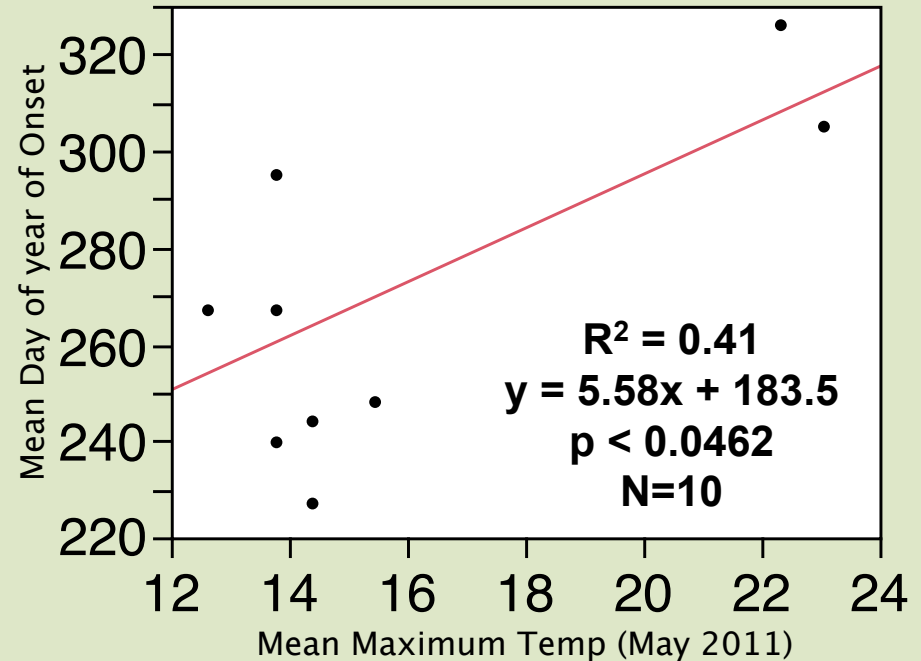
Climate data obtained from PRISM website: prismmap.nacse.org/nn/

Sites included: **GOGA**-(15 sites), **REDW**-(5 sites), **SAMO**-(8 sites)

2011: Onset of Fruits



2011: Onset of Ripe Fruits



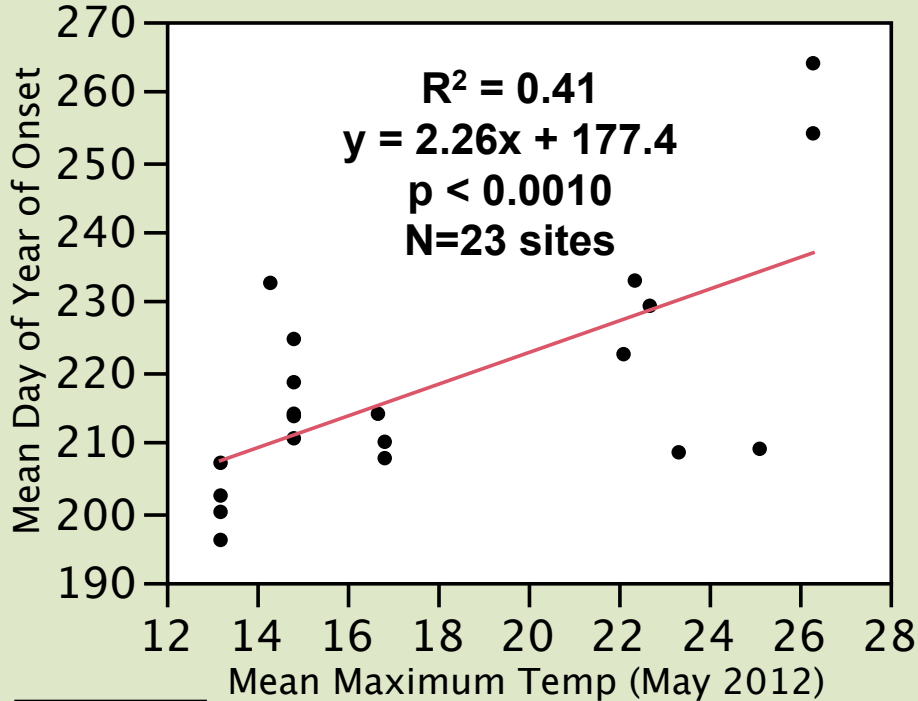
2011: Warmer **May**
maximum temperatures
also delayed phenology

Baccharis pilularis: **Across California**, data points are site means (1-9 plants/site).

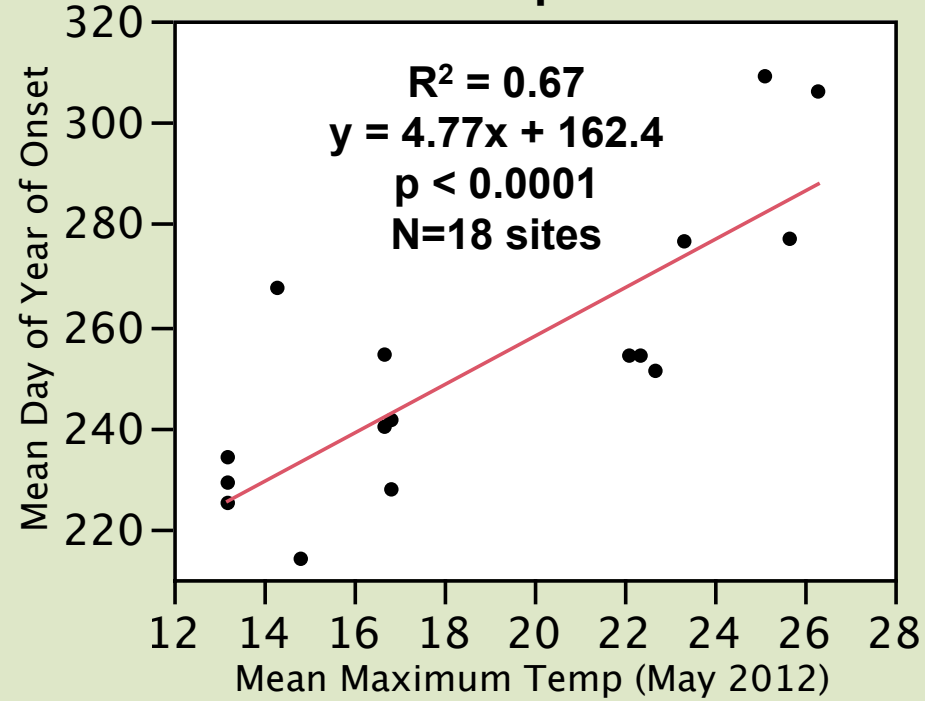
Climate data obtained from PRISM website: prismmap.nacse.org/nn/

Sites included: **GOGA**-(15 sites), **REDW**-(5 sites), **SAMO**-(8 sites)
(not all phenophases recorded at all sites)

2012: Onset of Flower Buds & Flowers



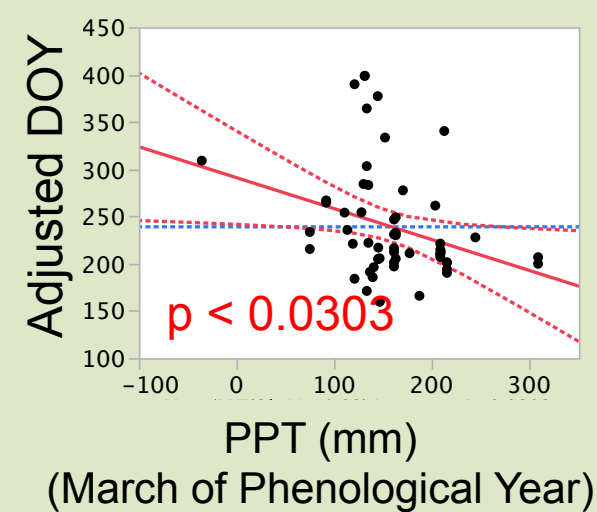
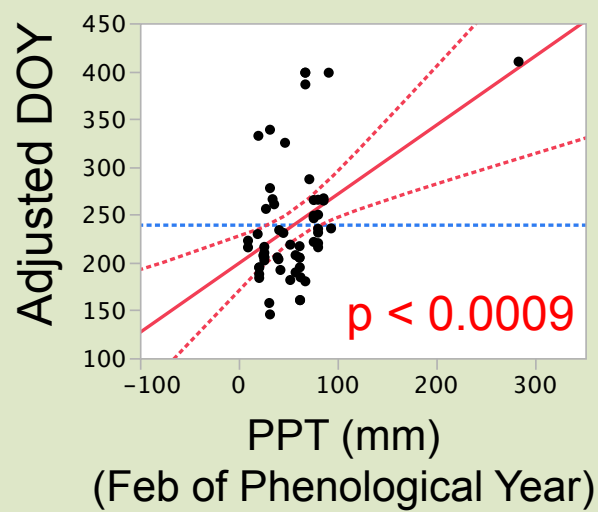
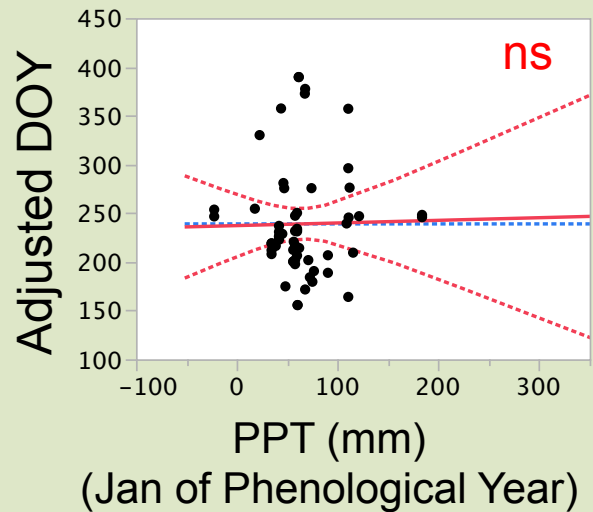
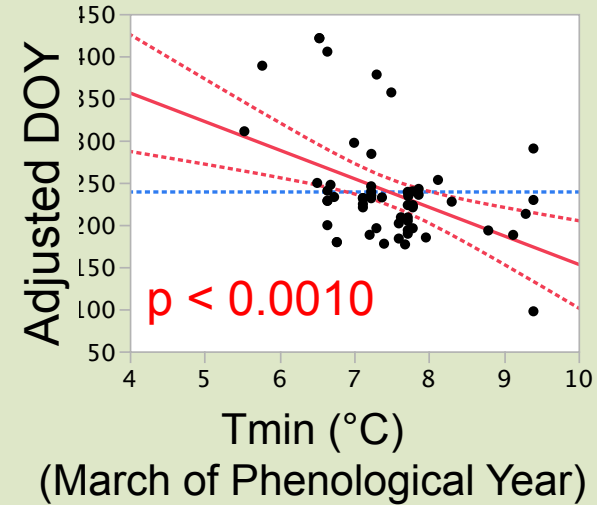
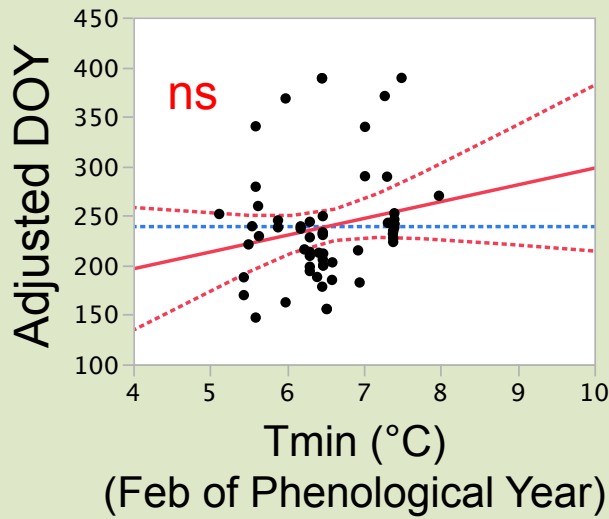
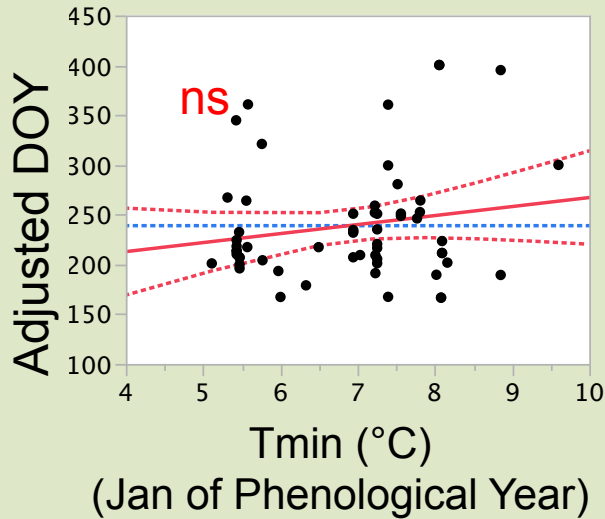
2012: Onset of Open Flowers



This pattern is also seen in 2012. Warmer May maximum temperatures *delayed* flowering

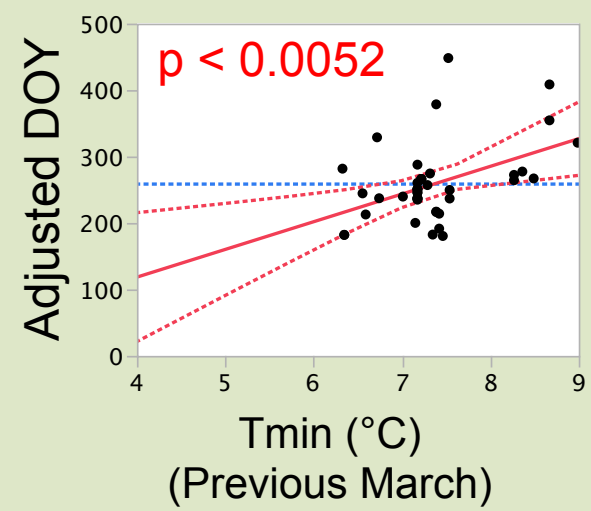
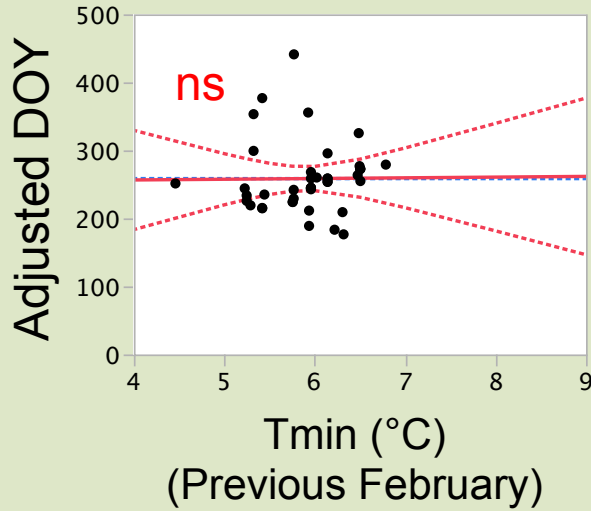
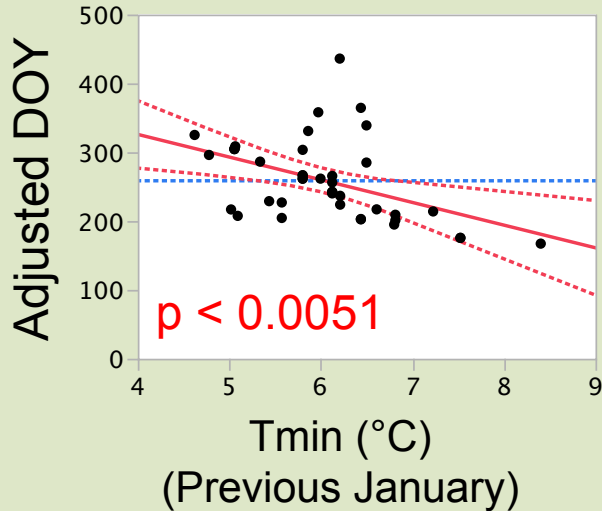
Effects of warmer temperatures & higher rainfall differs among months: all sites and years (2011-2013) pooled

Baccharis pilularis: Flowers and Flower Buds

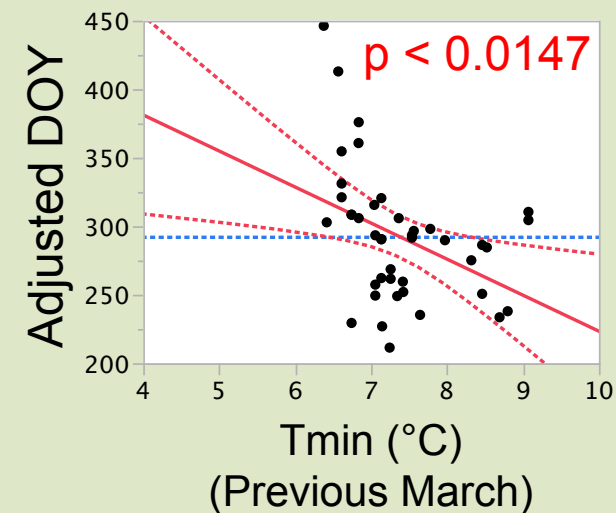
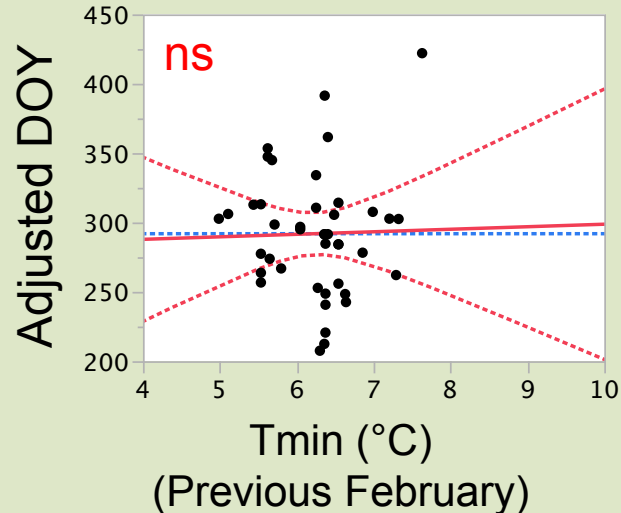
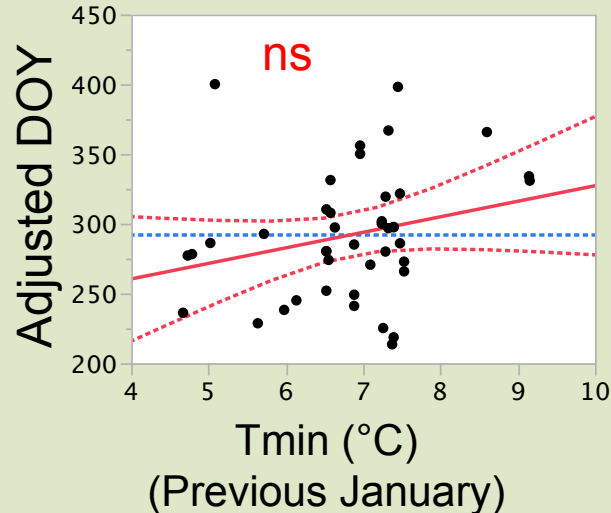


Baccharis pilularis: Effects of warmer temperatures & higher rainfall differs between male and female phenophases

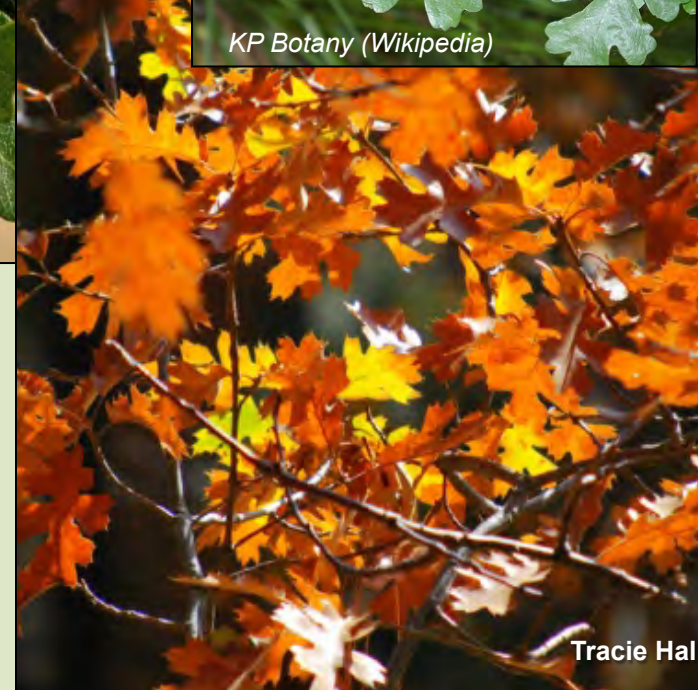
A. Pollen Release



B. Fruit



Quercus lobata Valley Oak

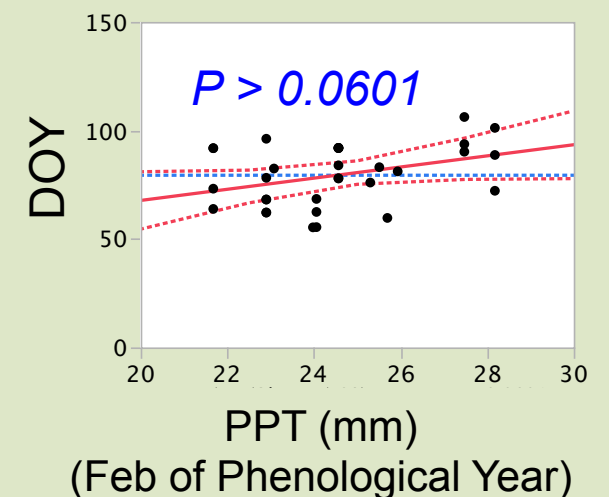
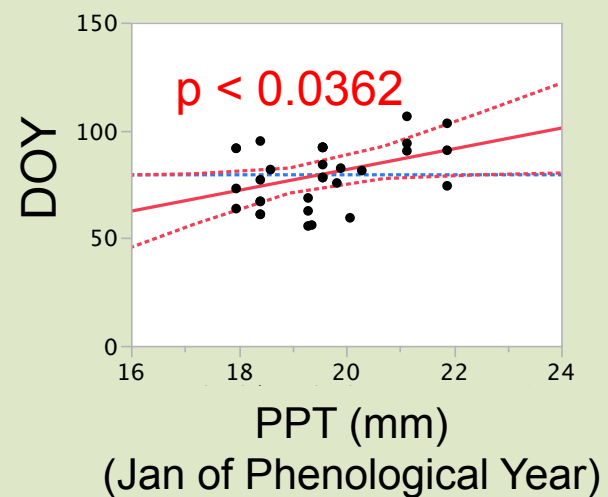
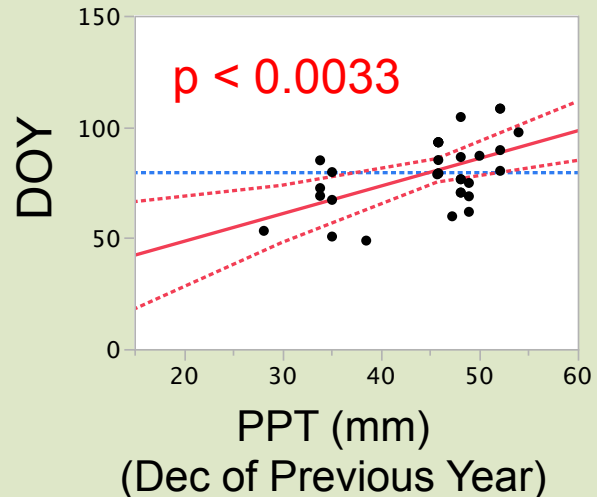
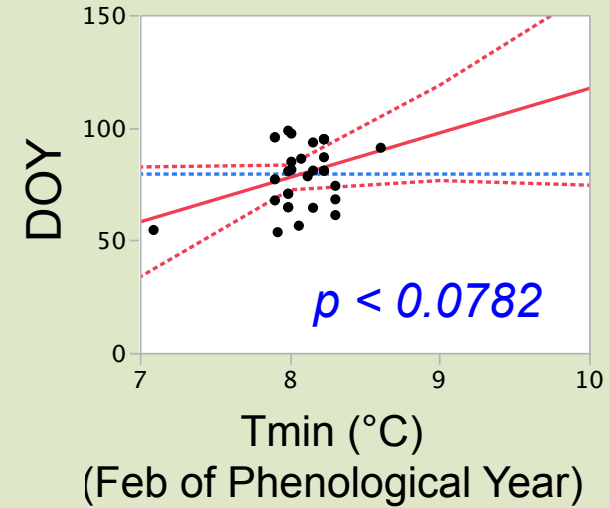
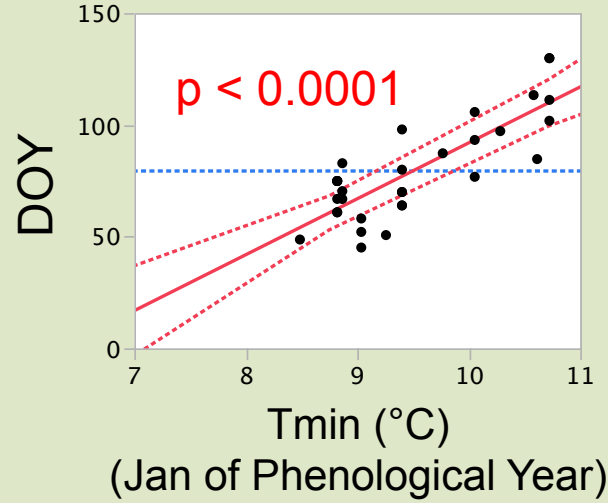
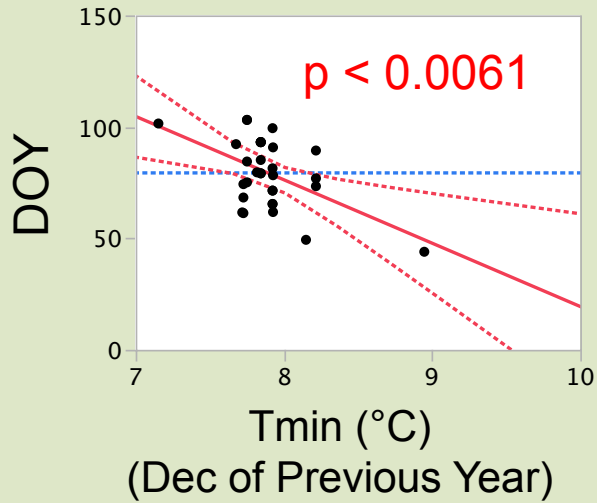


The California Phenology Project: 7 pilot parks



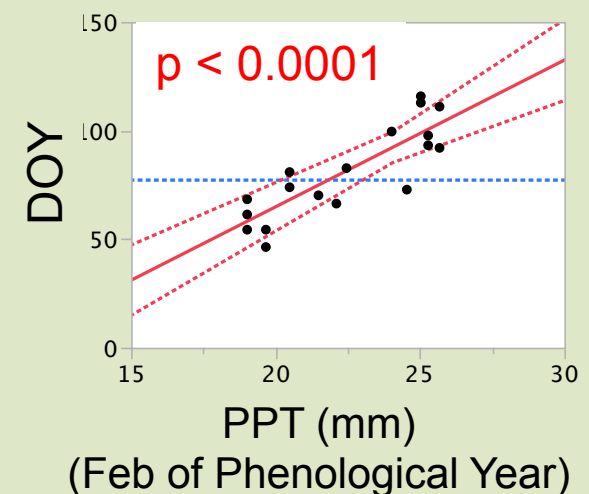
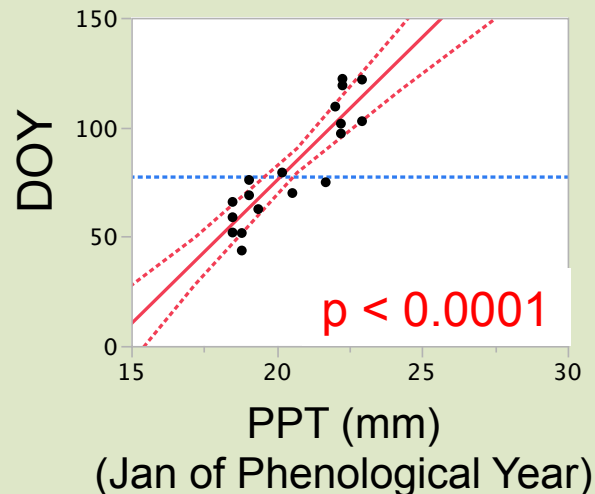
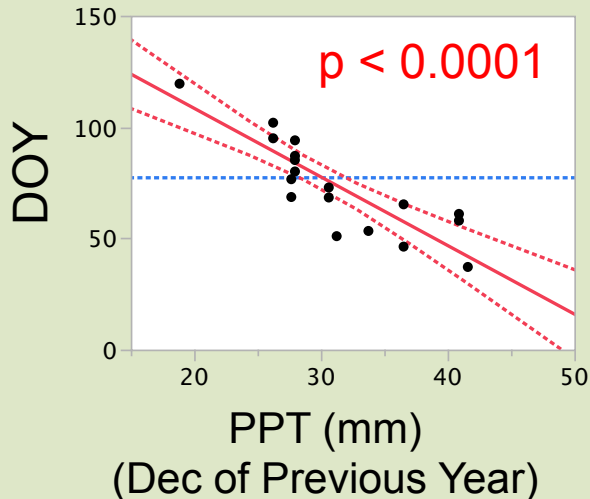
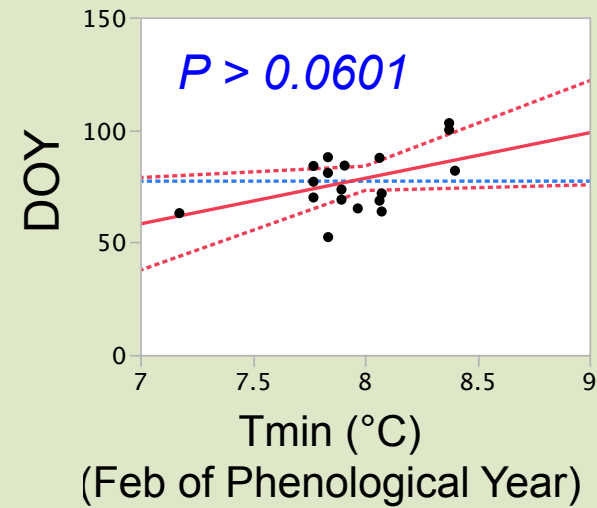
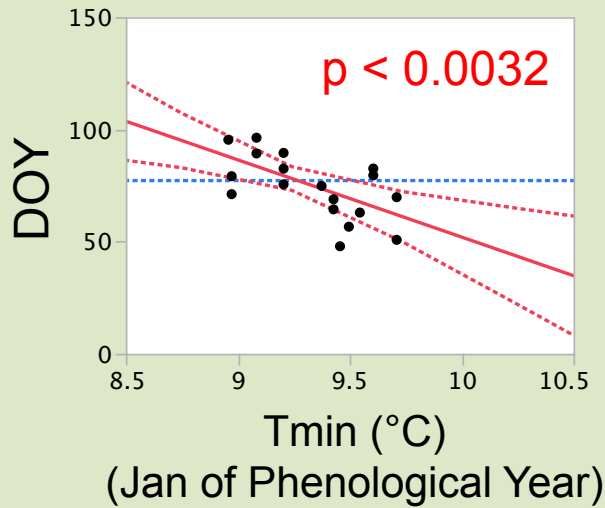
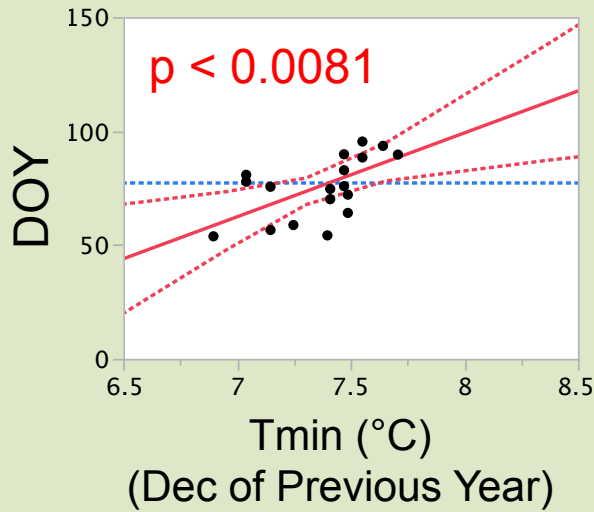
Effects of warmer temperatures & higher rainfall among sites and years at Santa Monica Mtns NRA

Quercus lobata: Breaking Leaf Buds



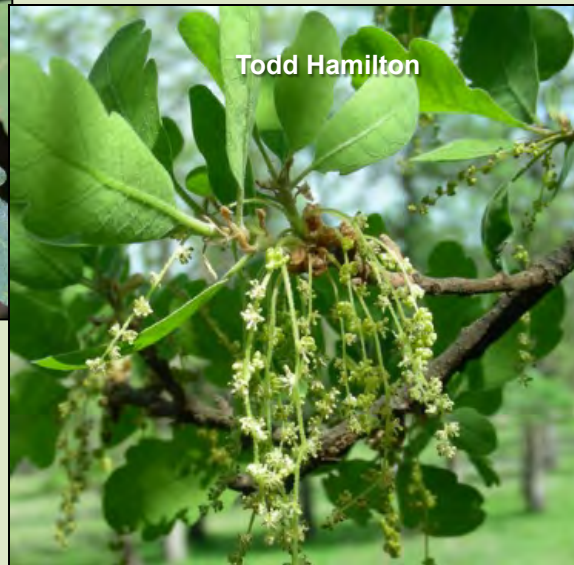
Effects of warmer temperatures & higher rainfall among sites and years at Santa Monica Mtns NRA

Quercus lobata: Flowers or Flower Buds



Quercus douglasii

Blue Oak



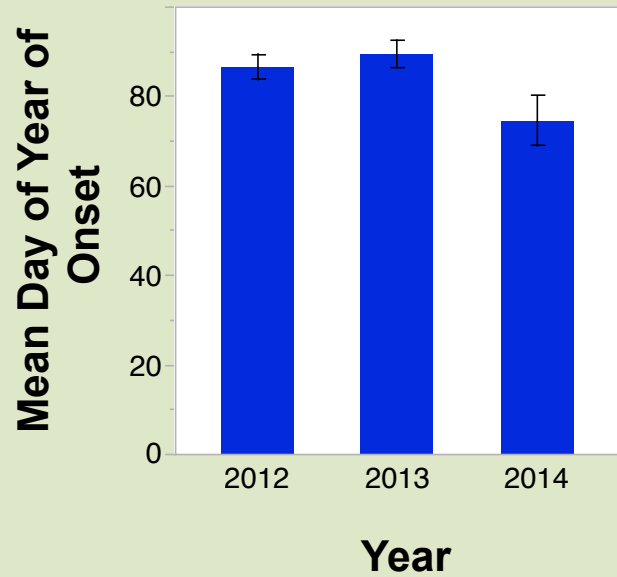
The California Phenology Project: 7 pilot parks



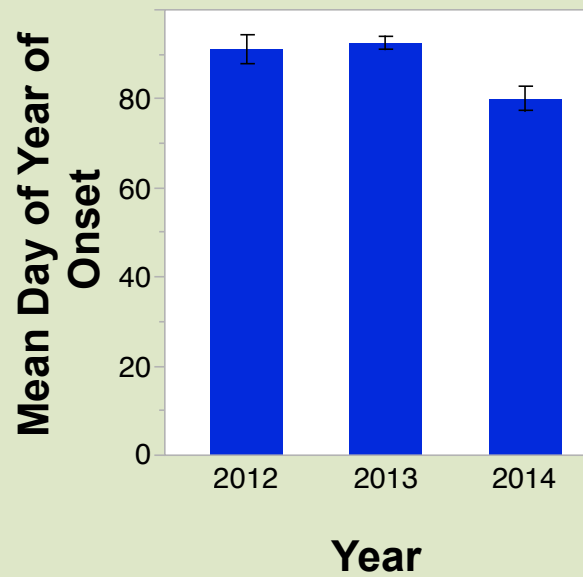
Interannual variation in the onset of phenophases at Foothill Visitors Center, Sequoia and Kings Canyon NP

Quercus douglasii (Blue Oak)

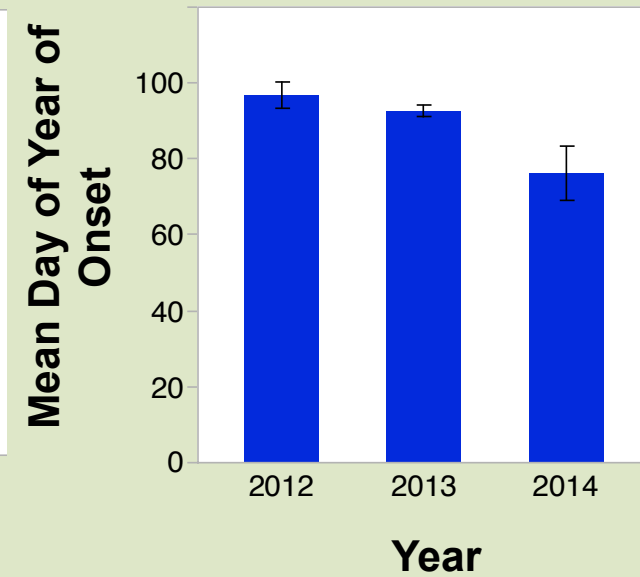
Flowers or Flower Buds



Open Flowers

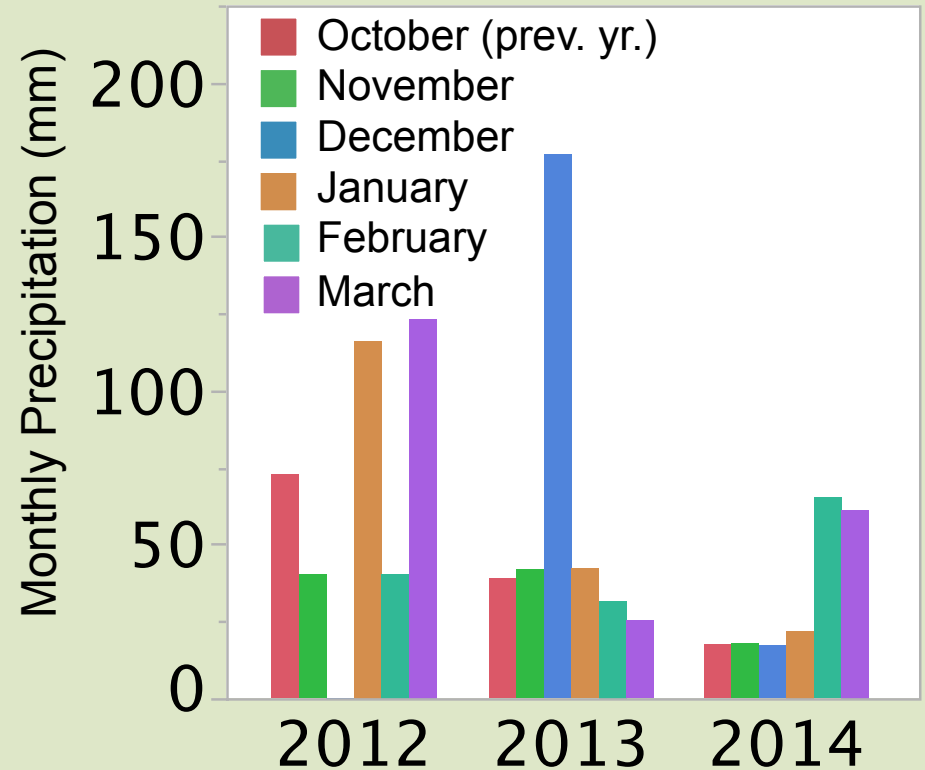
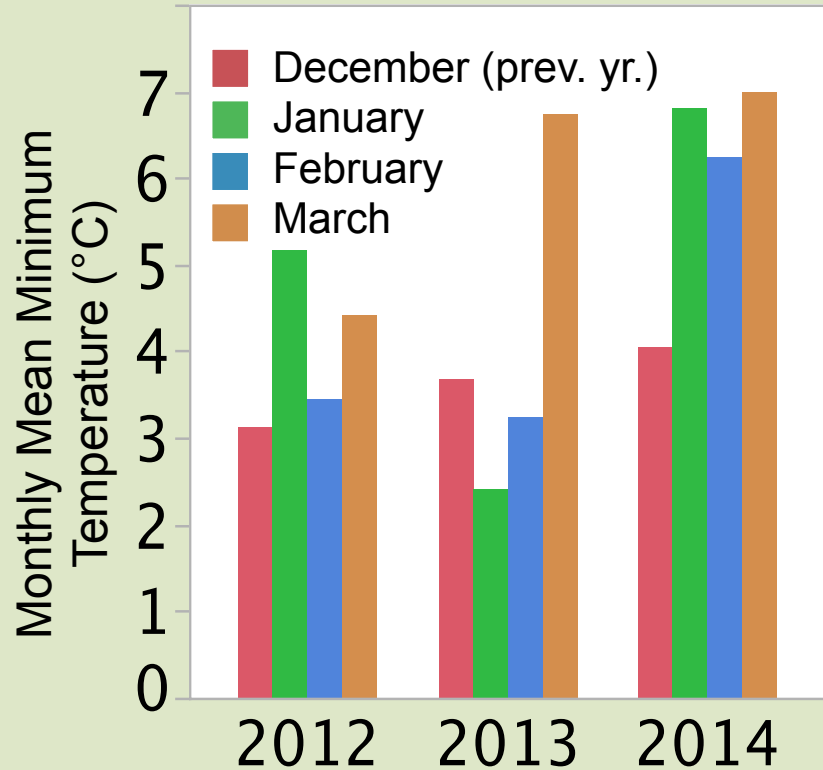


Pollen Release



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

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

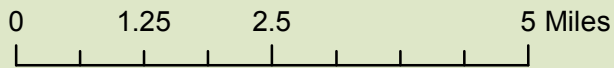
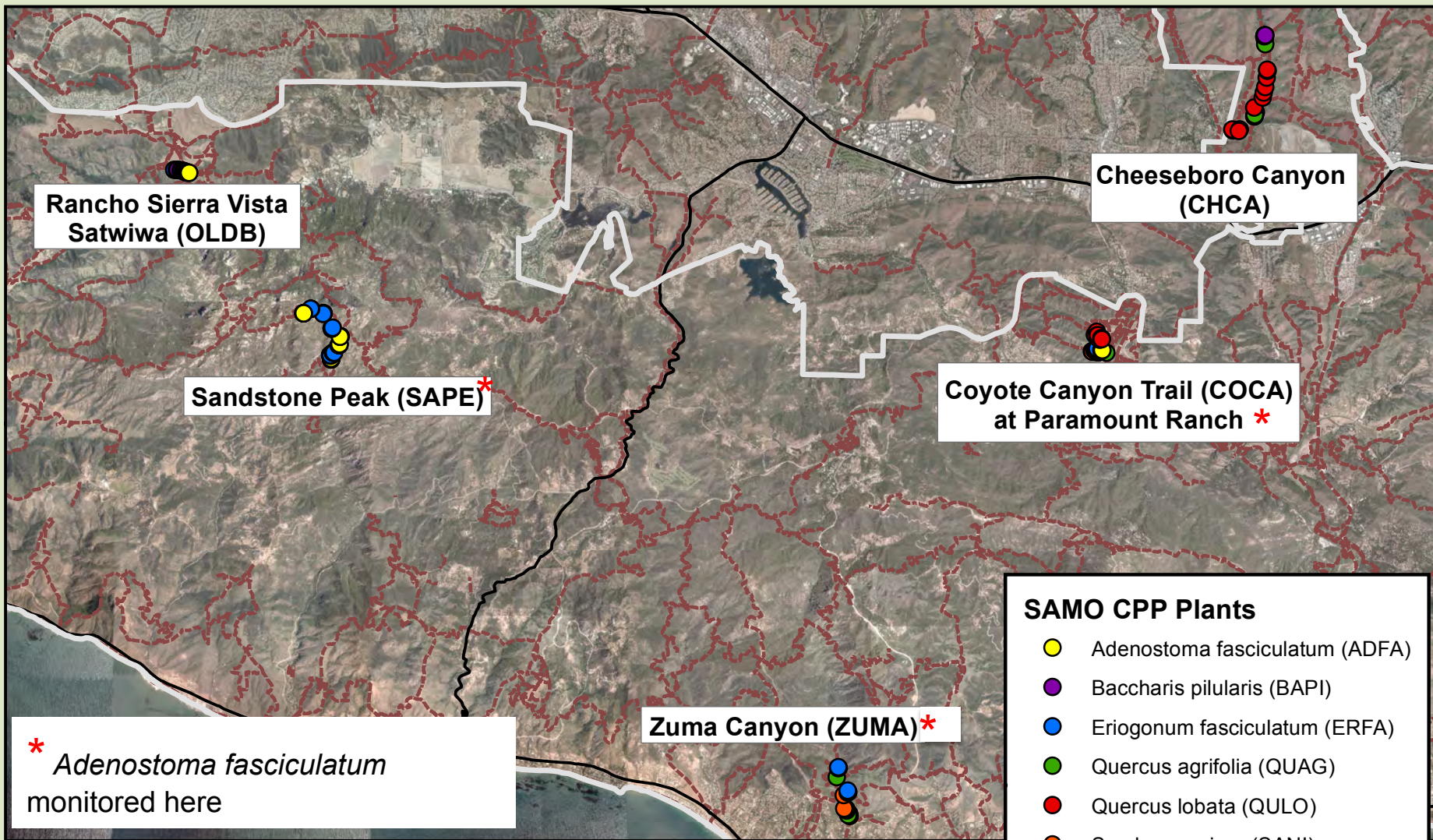


Targeted Species: Chamise

Adenostoma fasciculatum



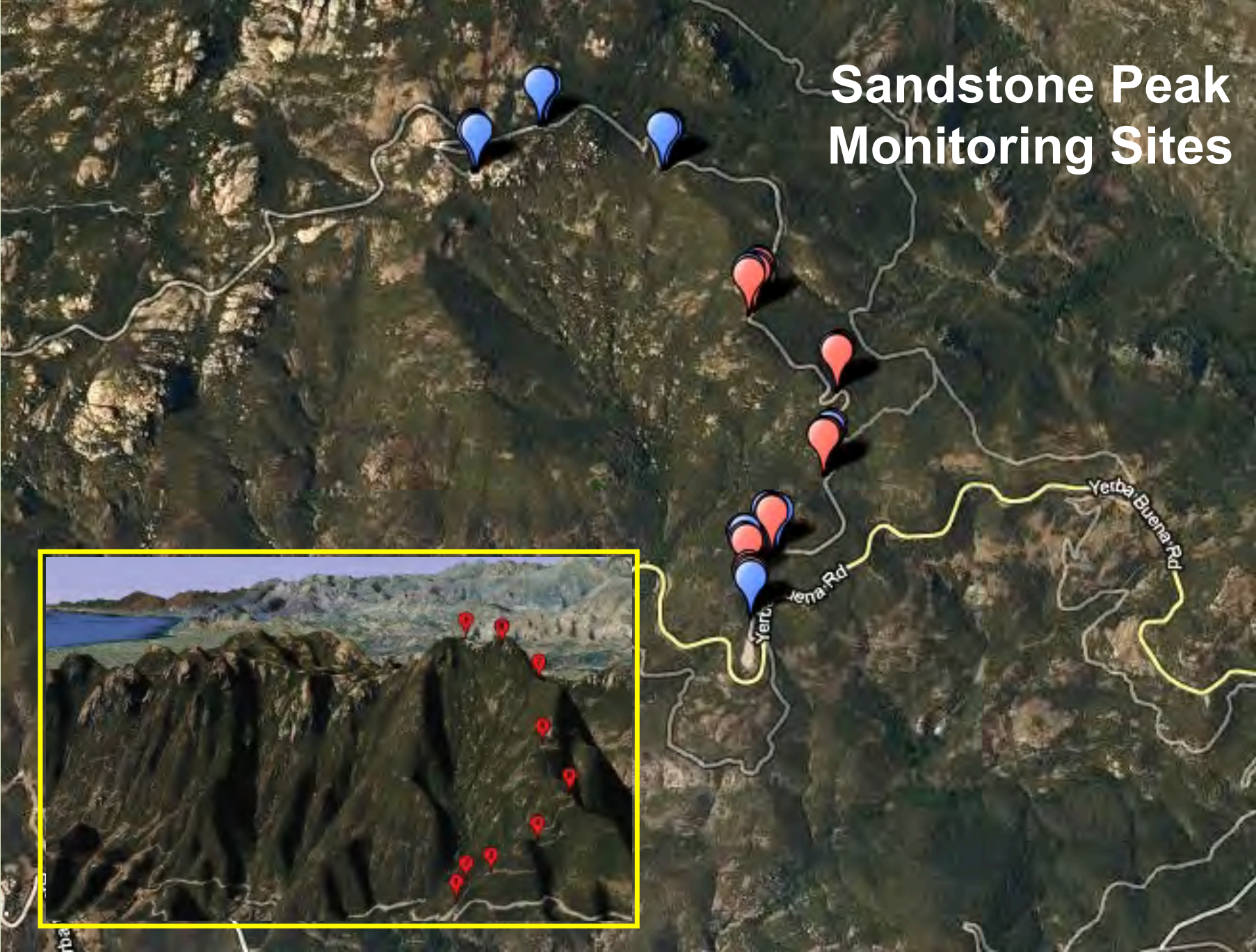
CPP Monitoring Locations at Santa Monica Mountains (SAMO) National Recreation Area



CPP SAMO Sandstone Peak Monitoring Sites



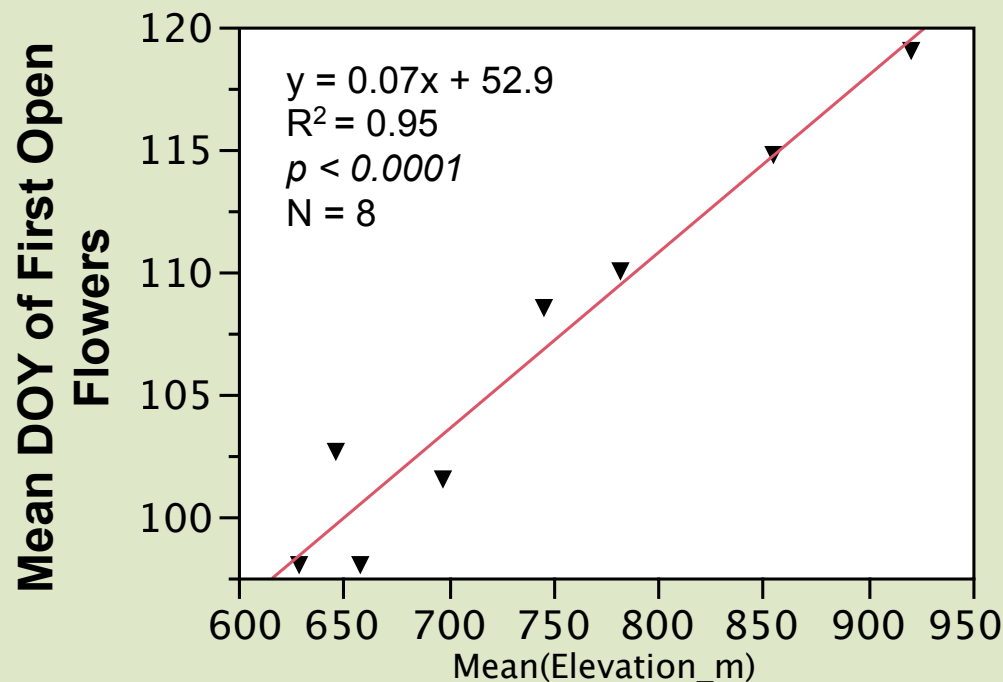
Sandstone Peak Monitoring Sites



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*

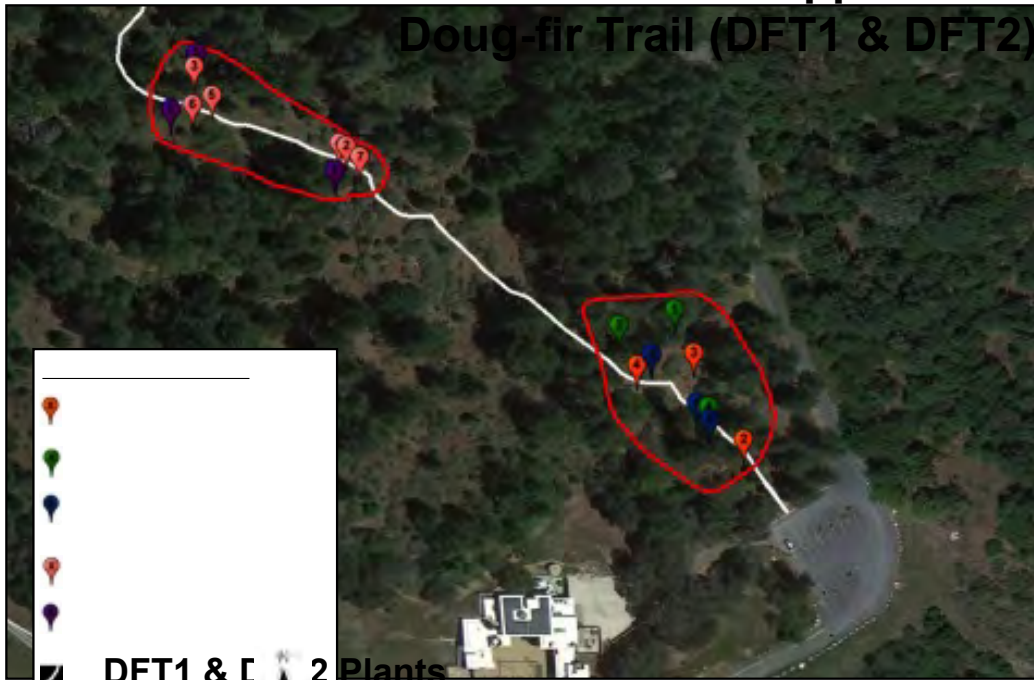




What have we learned?



CPP at Pepperwood Preserve Doug-fir Trail (DFT1 & DFT2) Monitoring Sites



DFT1 & DFT2 Plants

Sucky Monkeyflower (MIAU)

Diplacus (née Mimulus) aurantiacus

California Bay Laurel (UMCA)

Umbellularia californica

Coast Live Oak (QUAG)

Quercus agrifolia

Coyotebrush (BAPI)

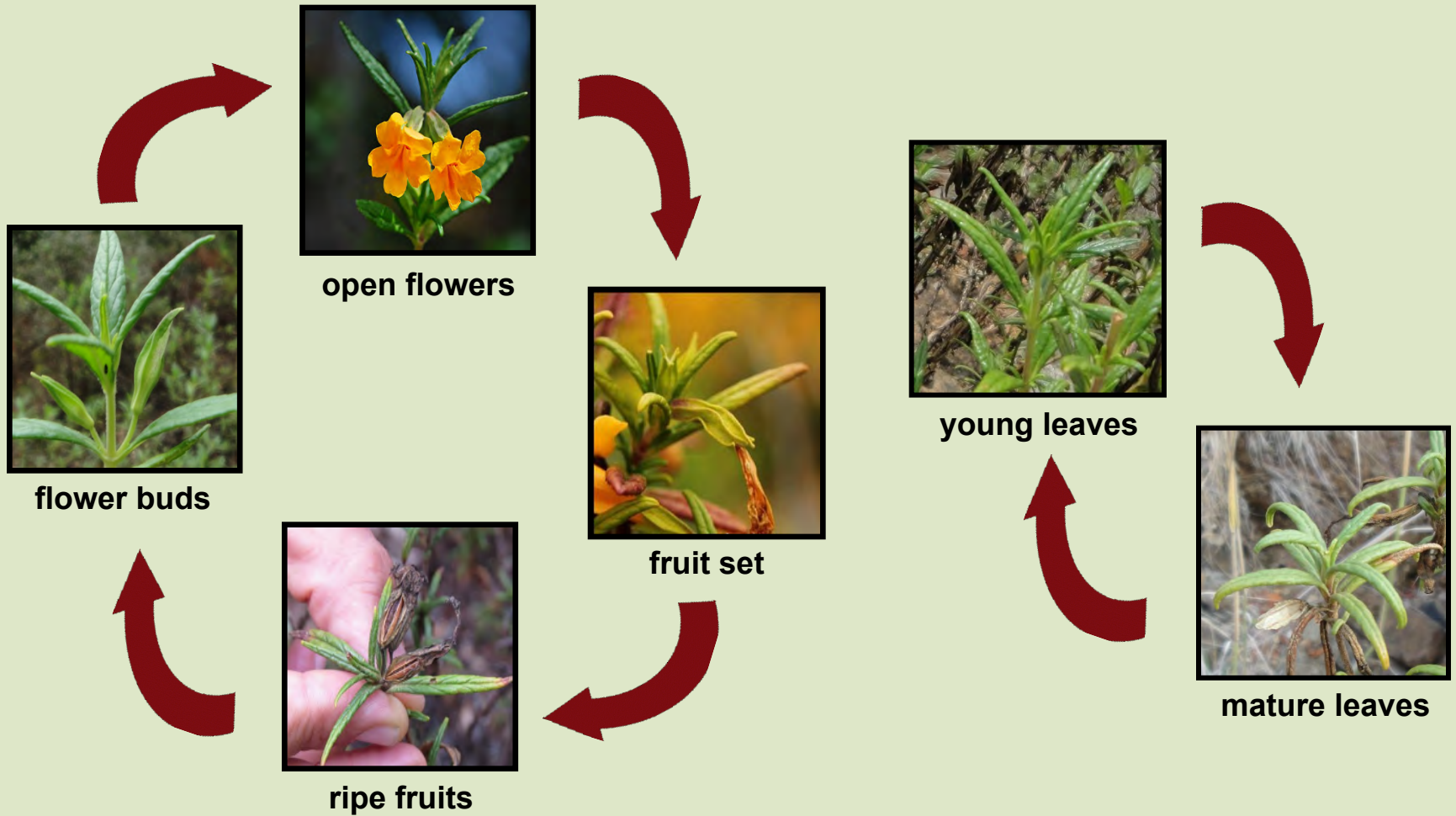
Baccharis pilularis

Poison Oak (TODI)

Toxicodendron diversilobum

Douglas-fir Trail

Sticky monkey flower (*Mimulus aurantiacus*)



California bay (*Umbellularia californica*)



California Phenology Project

- identify key scientific questions
- facilitate selection of focal species
- develop phenophase descriptions appropriate for California plant taxa
- identify historical datasets
- develop and refine monitoring protocols, infrastructure, and tools in pilot parks
- **develop outreach and education programs and partnerships to build a Citizen Science observer network engaged in phenological monitoring**

Building a Citizen Science network



Building a Citizen Science network

Adapting data sheets: one data sheet for all plants, per day

Date _____ Observer(s) _____ Check when data entered online

Coast live oak -- <i>Quercus agrifolia</i>		California poppy -- <i>Eschscholzia californica</i>						
Do you see...	QUAG 1	ESCA 1	ESCA 2	ESCA 3	ESCA 4	ESCA 5	ESCA 6	
Breaking leaf buds	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Young leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Flowers or flower buds	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Open flowers	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Pollen release	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Ripe fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Recent fruit or seed drop	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	
Comments								

Elderberry -- <i>Sambucus nigra ssp. cerulea</i>								
Do you see...	SANI 1	SANI 2	SANI 3	SANI 4	SANI 5	SANI 6	SANI 7	SANI 8
Breaking leaf buds	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Increasing leaf size	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Colored leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Falling leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Flowers or flower buds	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Open flowers	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Ripe fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Recent fruit or seed drop	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Comments								

Coyotebrush -- <i>Baccharis pilularis</i>				
Do you see...	BAPI 1	BAPI 2	BAPI 3	BAPI 4
Initial growth	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Flowers or flower buds	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Open flowers	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Ripe fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Recent fruit or seed drop	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Comments				

Sticky Monkeyflower -- <i>Diplacus aurantiacus</i>					
Do you see...	DIAU 1	DIAU 2	DIAU 3	DIAU 4	DIAU 5
Young leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Leaves	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Flowers or flower buds	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Open flowers	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Ripe fruits	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Recent fruit or seed drop	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____	Y N ? ____
Comments					



Sequence	
SANI 6	801
SANI 3	802
SANI 4	803
SANI 5	804
BAPI 3	805
BAPI 2	806
SANI 2	807
BAPI 4	816
SANI 1	808
BAPI 1	809
DIAU 1	811
DIAU 2	812
DIAU 3	810
QUAG 1	813
DIAU 5	815
DIAU 4	814
SANI 7	817
ESCA 1	820
ESCA 5	824
ESCA 4	823
ESCA 2	819
ESCA 3	821
ESCA 6	825
SANI 8	818



UCSB's
Coal Oil
Point
Natural
Reserve

California Phenology Project

www.usanpn.org/cpp

- Tools: maps, monitoring guides, species profiles, data sheets
- phenological education materials for formal and informal settings
- CPP documentation
- Powerpoint presentations
- CPP *DRAFT* Interpreters' Guide
- ***Instructions for joining the CPP listserv***



California Phenology Project

[View](#)

[Edit](#)

[Revisions](#)

[Track](#)

With funding from the National Park Service (NPS) Climate Change Response Program, the **California Phenology Project (CPP)** was launched in 2010 as a 3-year pilot project to develop and test protocols and to create tools and infrastructure to support long-term phenological monitoring and **public education** activities in California. A primary focus of the effort is how to recruit and engage California residents and visitors in the collection and interpretation of phenological data.

The CPP is initially focusing on **plants** in **seven pilot parks**, encompassing desert, coastal and mountain biomes, and building upon existing monitoring protocols and programs of project collaborators. In addition, new project products and infrastructure are being designed to support monitoring and educational activities for 18 California NPS units and parks in adjacent states.



Please explore our website to learn more about phenology, the origin and current activities of the CPP, where the CPP is currently monitoring plant phenology, and how to become involved. Also visit the **news tab for recent updates and upcoming events**.

Project collaborators include the National Park Service (NPS), the University of California, Santa Barbara (UCSB), and the National Coordinating Office of the **USA National Phenology Network (USA-NPN)**.

Visit our **cooperators and points of contact** page to **contact us directly** or to learn more about the project partners who are currently spearheading this effort.

Recent news

Check out new videos about CPP efforts at Lassen Volcanic NP ([video](#)) and John Muir NHS ([video](#)).

Download the DRAFT **CPP Interpretive Guide!**

Join us at a [CPP workshop](#) near you

Navigation

- ▼ [Create content](#)
 - [Page](#)
 - [Species](#)



TODAY'S WORKSHOP

- **California Phenology Project and the USA-National Phenology Network: design, infrastructure, & resources available**

USA National Phenology Network

What is it? Portal, consortium, database, toolkit

Nature's Notebook: interface with user

Target species

Alternative models for monitoring

On-line resources: data visualization tool and data sheets

PP



USA National Phenology Network (USA-NPN)

[USA-NPN Home](#) | [Nature's Notebook Home](#) | [Contact Us](#)

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The USA National Phenology Network

We bring 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.

[LEARN MORE ABOUT THE USA-NPN](#)

Our quarterly e-newsletter for partners covers new tools and research in the world of phenology.

SIGN UP FOR "THE CONNECTION"

FIRST NAME ▼

EMAIL ▼

[SIGNUP](#)

FOLLOW US:



What is the USA-NPN?

A collaborative monitoring network that brings together citizen scientists, government agencies, non-profit groups, educators, and students to monitor the impacts of climate change on plants and animals in the U.S.



nature's notebook

a project of the USA-NPN



www.nn.usanpn.org

- 650+ plant species
- 240+ animal species
- Core protocols



App Store > Education > Douglas Meredith



Free

Natures Notebook

Douglas Meredith >

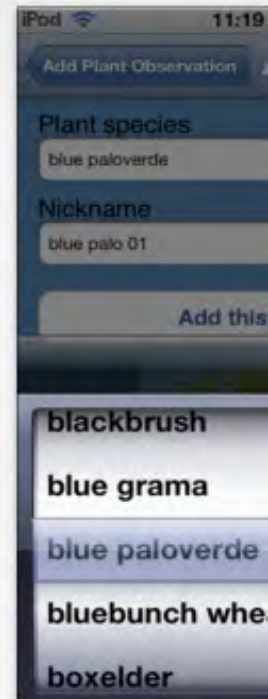
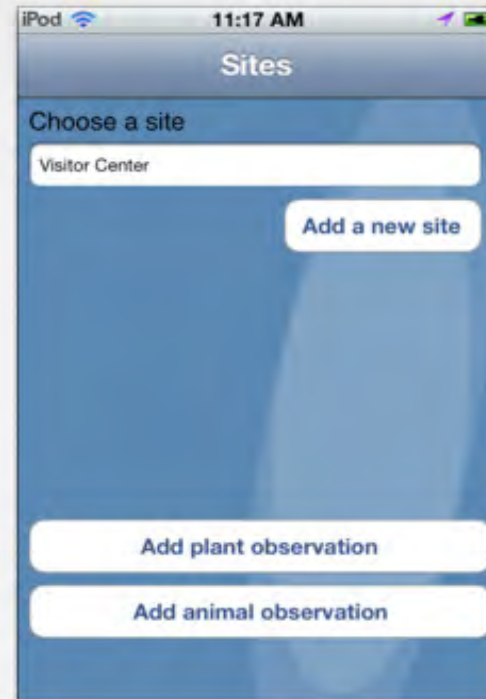
Details

Ratings and Reviews

Related

You MUST have your account completely set up online first to use the mobile apps!

iPhone Screenshots



No Ratings
Rated 4+

DEVELOPER WEBSITE >

© 2011 USA National Phenology Network

Description

Become an Observer | USA National Phenology Network

https://www.usanpn.org/nn/become-observer

Become an Observer | USA Nati...


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nature's notebook Connecting People with Nature to Benefit Our Changing Planet

ABOUT US | OBSERVE | MORE WAYS TO CONNECT

Home » Observe » Become an Observer

You're invited to experience plants or animals you see all the time in a brand new way by joining Nature's Notebook.



Become an Observer

When you participate in the program, you'll go outside to observe nature in your backyard or nearby area weekly and enter this information online.

Time commitment to...

Become an observer: About 10 minutes

Observe: About 2 minutes per individual plant or animal (*once you've familiarized yourself with the program and learned how to observe*)

Become an observer today in 3 steps:

- 1 Join Nature's Notebook**
 - All that's needed to join is your name and email address. No previous experience necessary. We don't give personal information away (Read our [Privacy Policy](#)).
- 2 Set up your account**
 - Choose your site, the location where you want to observe, such as your backyard.
 - Select species from our [Species List](#), identifying individual plants or animals you want to observe.
- 3 Start observing!**
 - Familiarize yourself with our guidelines for observing.
 - Print paper datasheets to take outside when you record observations.
 - Go outside, take observations of your plants or animals using your paper datasheets and enter them online afterward.

BECOME AN OBSERVER NOW

Nature's Notebook's home page: 3 steps

- 1) Register
- 2) Choose site and species
- 3) Start uploading data

You'll practice these steps shortly....



Connecting People with Nature to Benefit Our Changing Planet

[ABOUT US](#)[OBSERVE](#)[MORE WAYS TO CONNECT](#)[Home](#) » [Search Plants and Animals to Observe](#)

Search Plants and Animals to Observe

SORT BY:

Common Name

NAME CONTAINS:

STATE OR PROVINCE:

All States & Provinces

PARTNER:

All Partners

PLANT TYPE:

All Species

ANIMAL GROUP:

All Species

RESULTS TO DISPLAY:

 25
 50
 100
 All

ALL ANIMALS



Mammals



Fish

ALL PLANTS



Wildflowers & Forbs



Deciduous Trees & Shrubs

Observe

[Why Observe?](#)[Become an Observer](#)[My Observation Deck](#)[Learn How to Observe](#)[The Plants and Animals](#)[Leaderboards](#)

QUARTERLY E-NEWSLETTER

First Name *

Email *

SIGNUP

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



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



Connecting People with Nature to Benefit Our Changing Planet

[Home](#) » [Search Plants and Animals to Observe](#)

Search Plants and Animals to Observe

[Search Species Home](#)

SORT BY:

NAME CONTAINS:

STATE OR PROVINCE:

PARTNER:

PLANT TYPE:

ANIMAL GROUP:

RESULTS TO DISPLAY:

25 50 100 All

- [Quercus agrifolia \(California live oak\)](#)
- [Quercus douglasii \(blue oak\)](#)
- [Quercus garryana \(Oregon white oak\)](#)
- [Quercus kelloggii \(California black oak\)](#)
- [Quercus lobata \(valley oak\)](#)

Observe

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[Become an Observer](#)

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[Learn How to Observe](#)

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QUARTERLY E-NEWSLETTER

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NEWS AND EVENTS



Nature's Notebook

Join amateur and professional naturalists in regularly observing plants and animals to generate long-term data sets used for scientific discovery and decision-making.

GET STARTED WITH NATURE'S NOTEBOOK



TODAY'S WORKSHOP

- 8:30 - 9:00 – Introductions (round-robin)
- 9:00 – 10:00 – Phenology, climate change, ecological consequences & a few case studies.
- 10:00 – 10:15 — *Break*
- 10:15 – 11:15 – California Phenology Project and the USA-National Phenology Network: design, infrastructure, & resources available
- 11:15 – 11:30 — *Break*
- 11:30 – 12:15 — Practical guide to setting up monitoring: crash course in botany; best practices, lessons learned
- 12:30 – 4:00 — *Drive to Alum Rock City Park* — Picnic lunch — hands-on phenological monitoring; selecting sites and plants for monitoring; planning future monitoring



Basic Botany Review for minimalists

Vegetative structures

- Leaf buds
- Leaves & stems

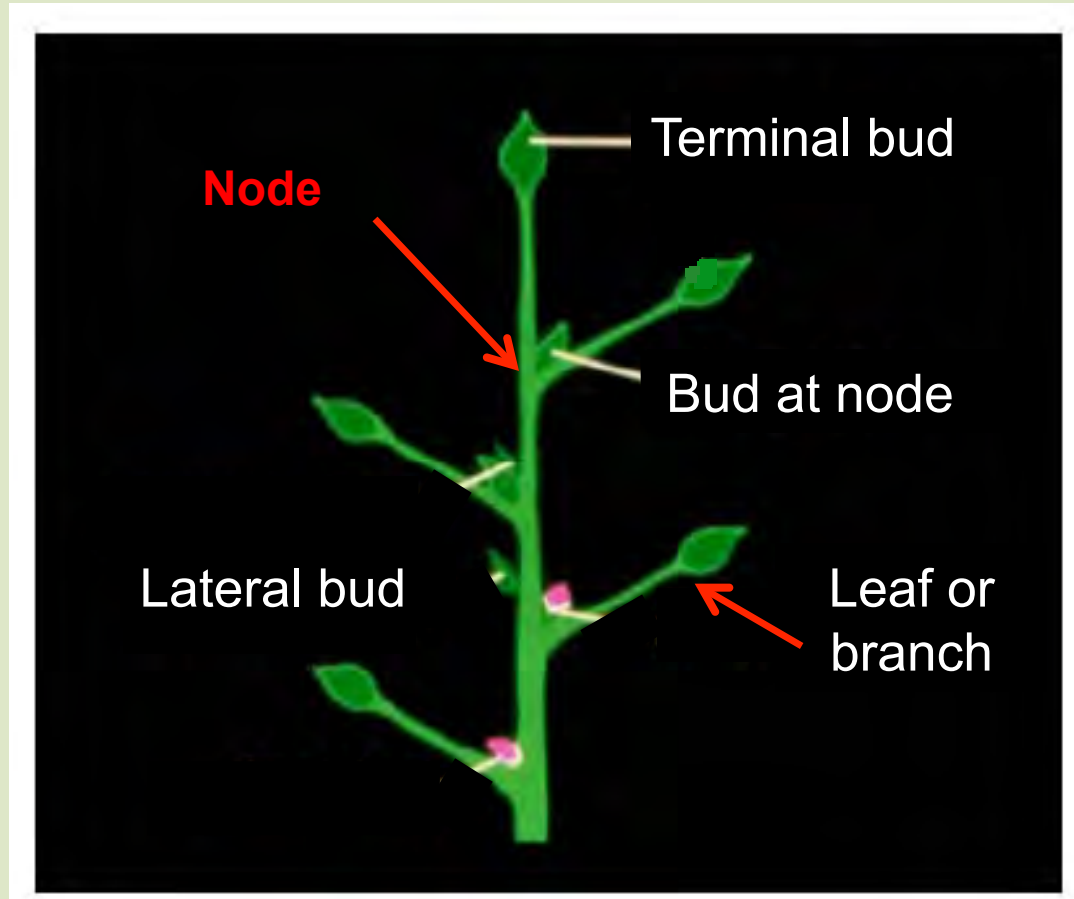
Reproductive structures

- 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



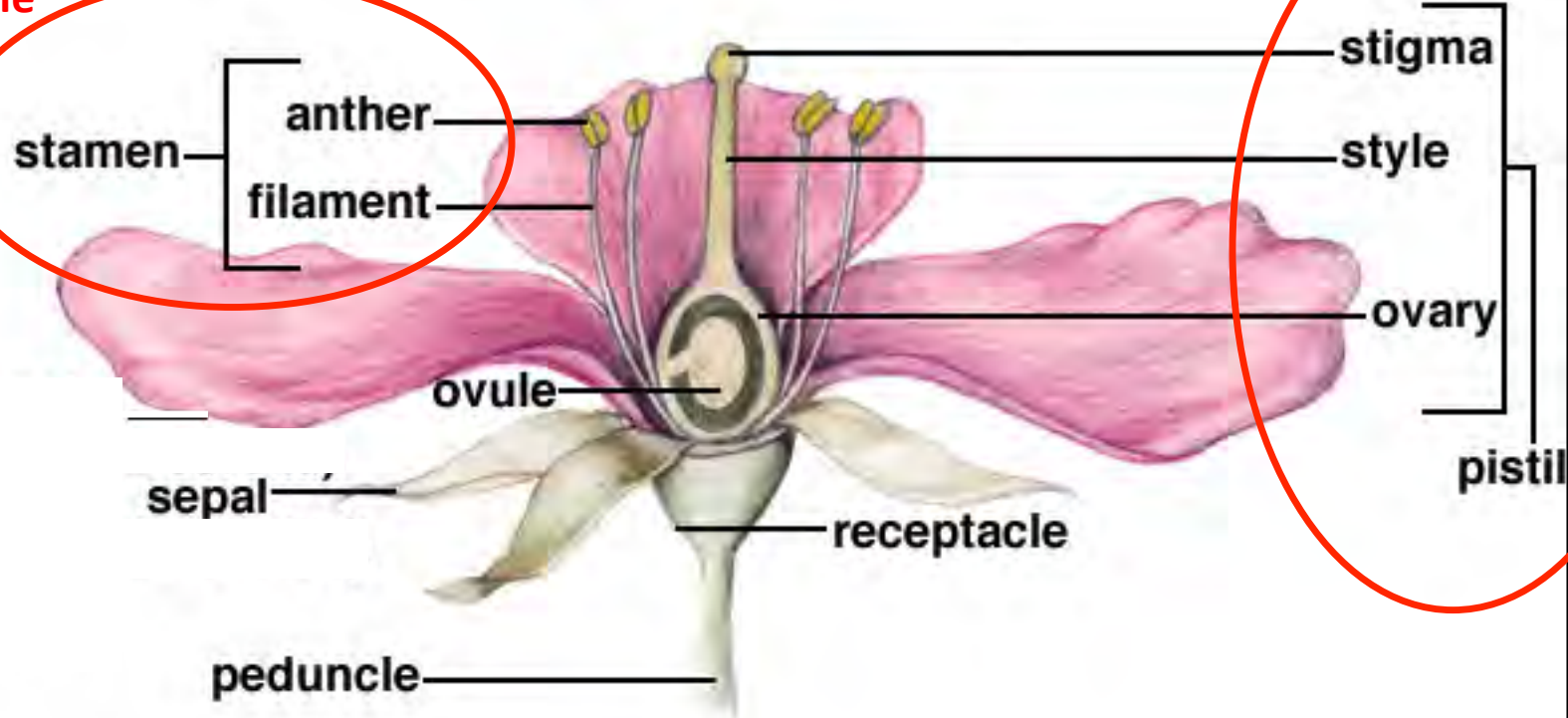
Buds may be found in several locations relative to leaves and stems. Generally, leaves ALWAYS have a bud in their axil, even though it may be very small

Reproductive structures: flower buds, flowers, fruits & seeds

Parts of a Flower

male

female



Pollination & fertilization

Vegetative structures: breaking leaf buds, expanding leaves, and full-sized leaves

Common Lilac



Red Elderberry



Pacific Rhododendron



Reproductive structures: flower buds, open flowers, and fruits

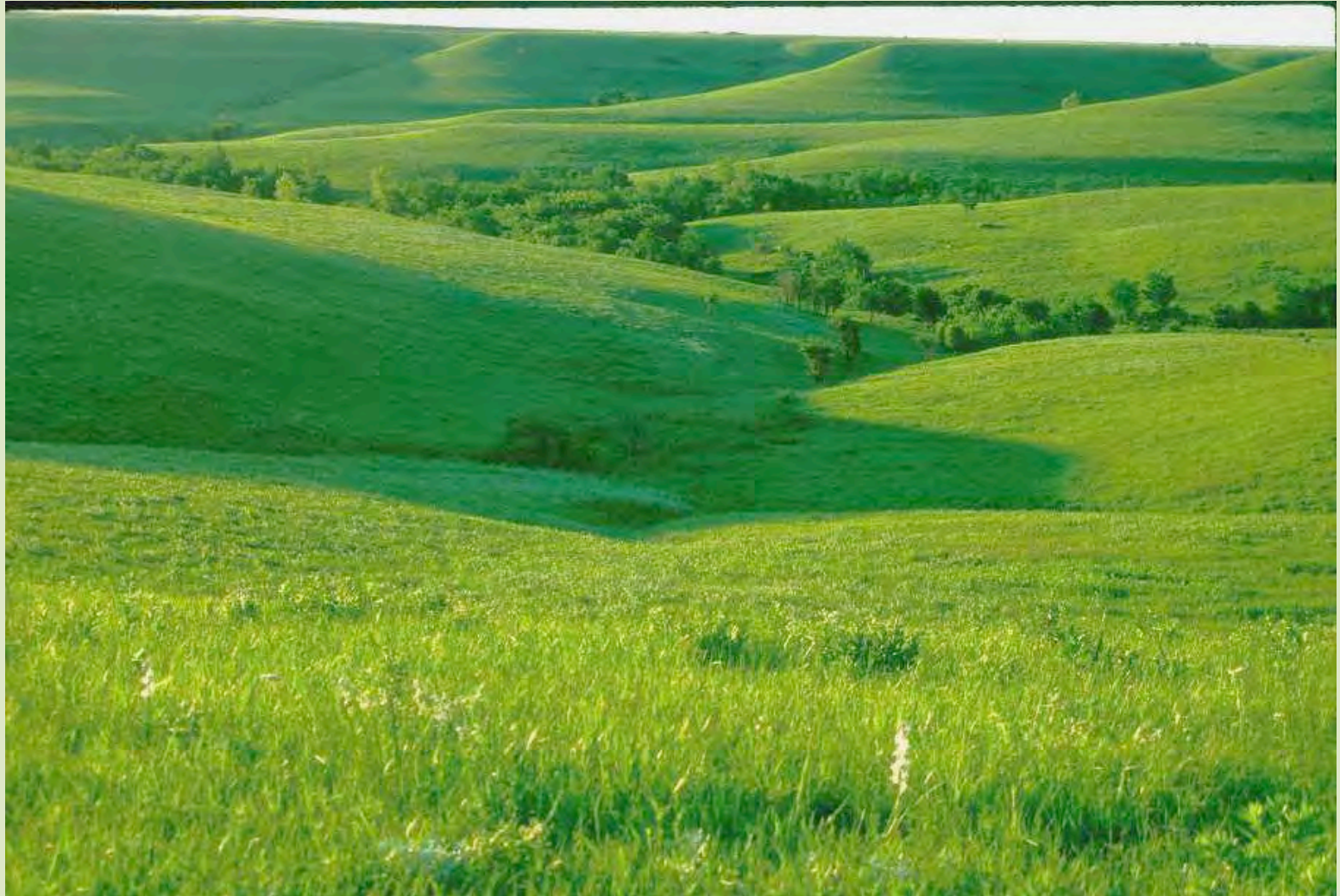
Joshua Tree



Red elderberry

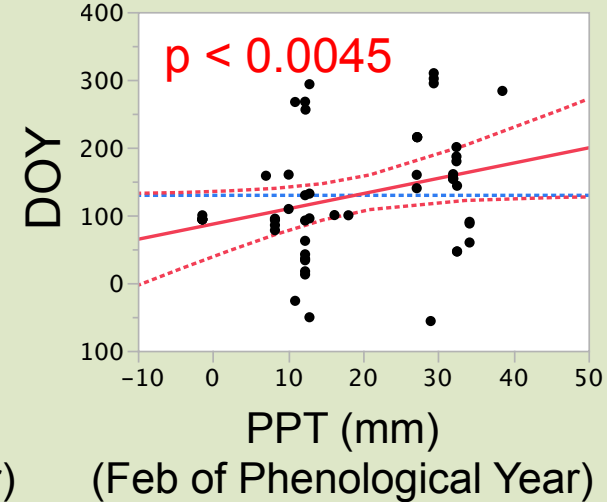
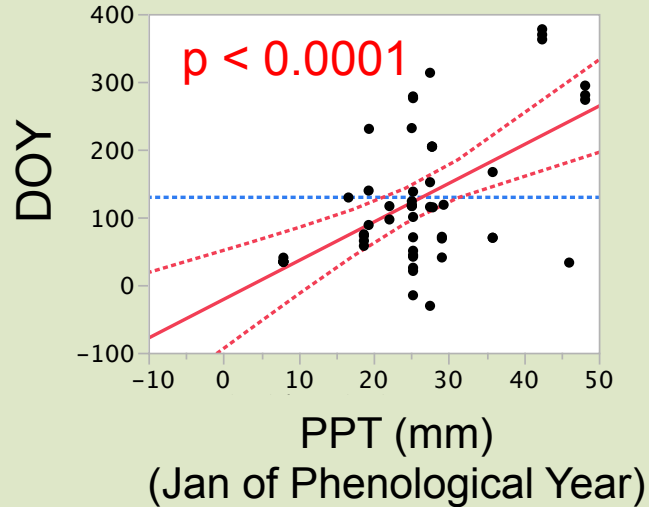
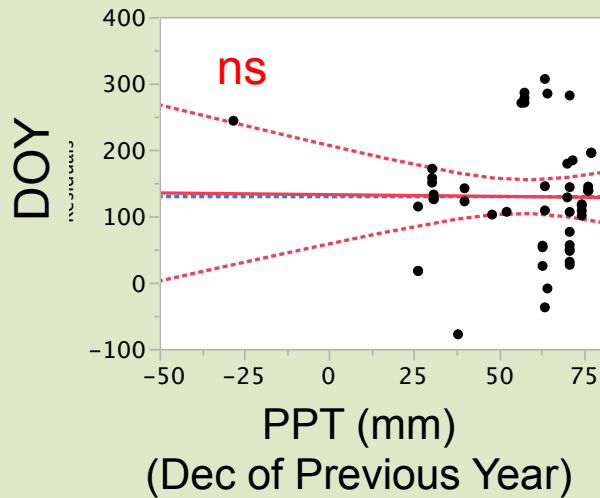
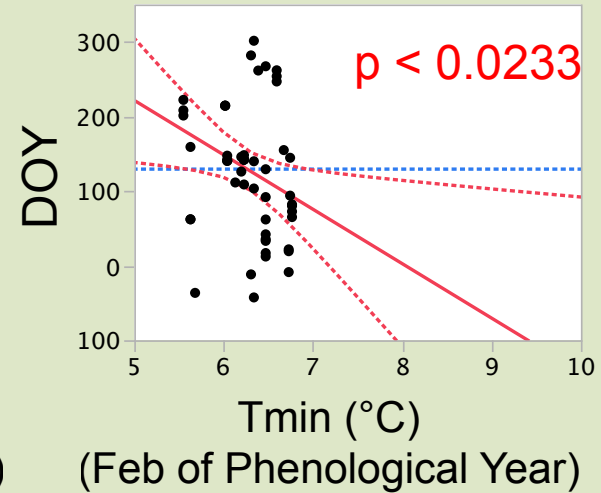
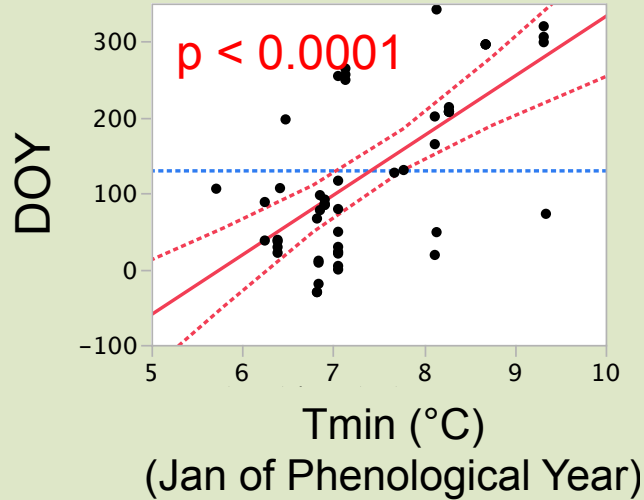
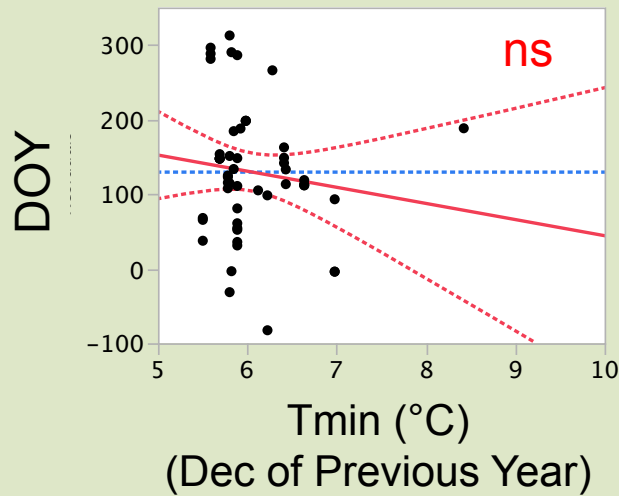


Let's Go Outside!!!

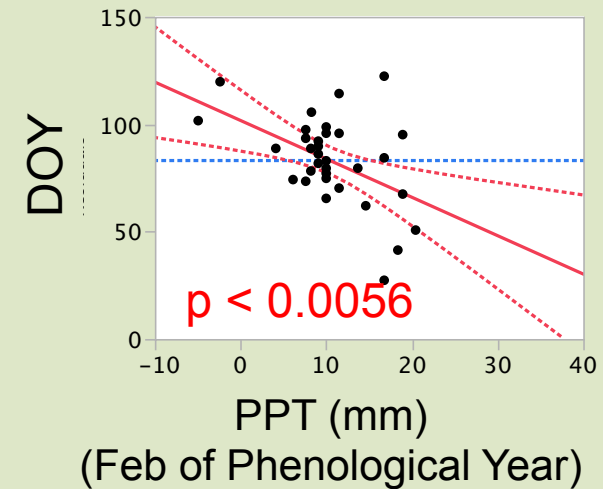
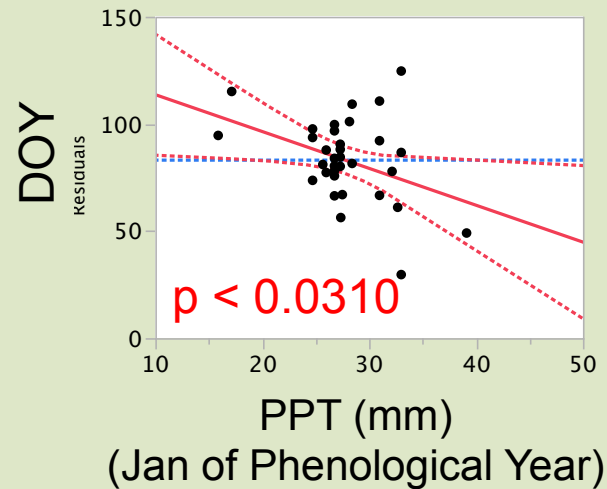
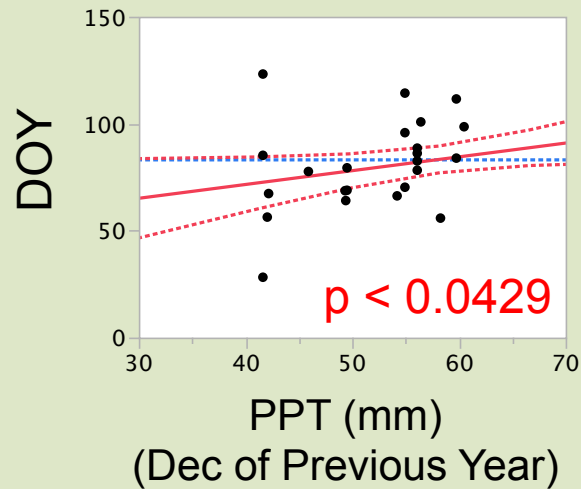
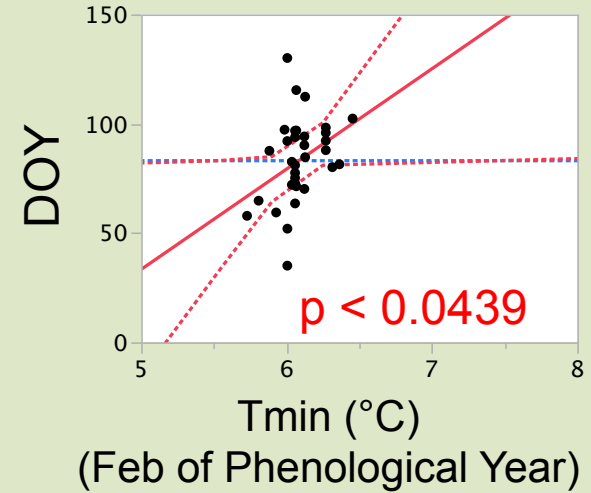
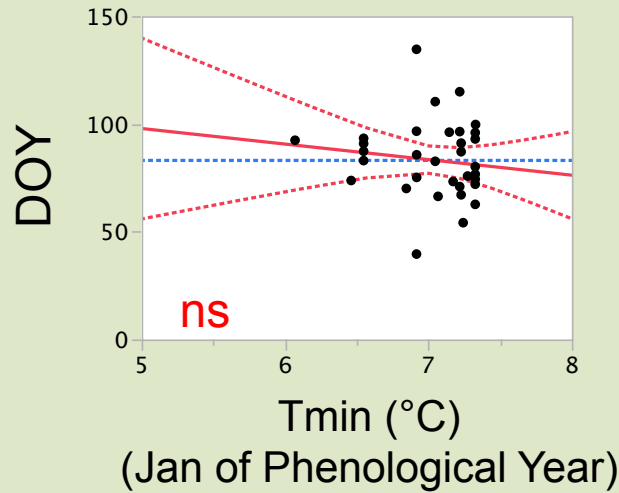
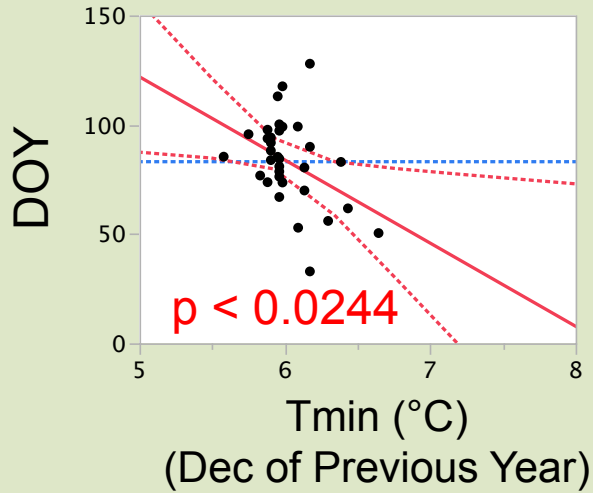


Extra slides below

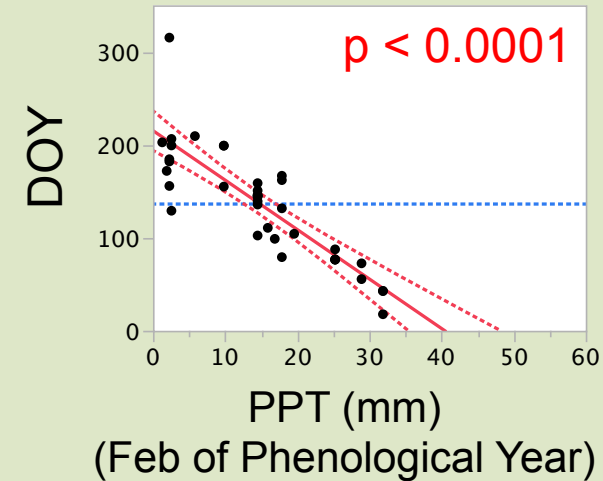
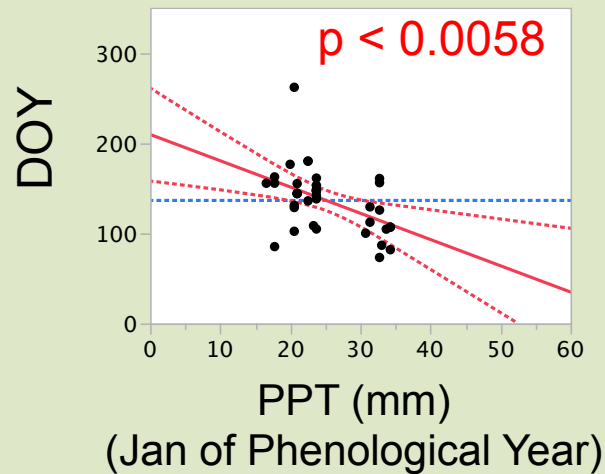
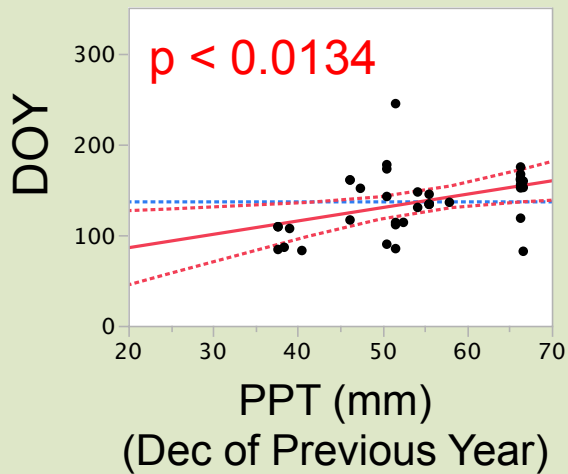
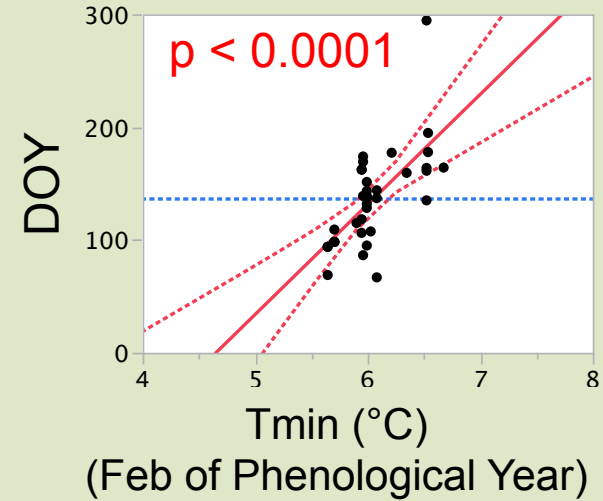
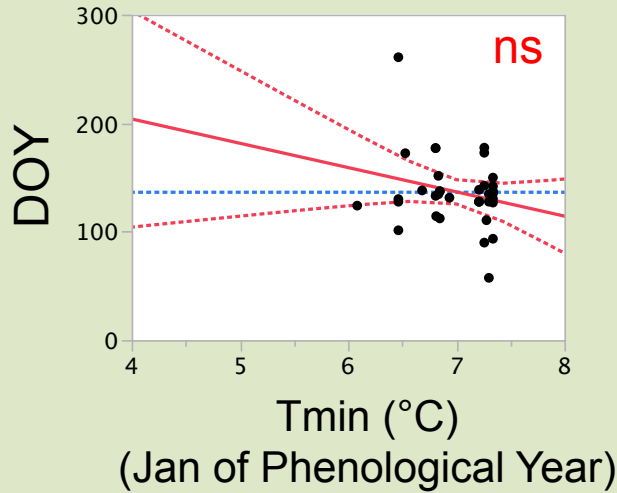
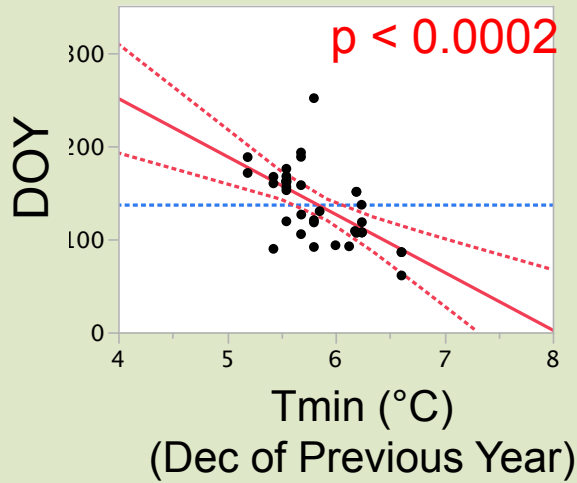
Eriogonum fasciculatum: Young leaves



Eriogonum fasciculatum: Flowers or flower buds



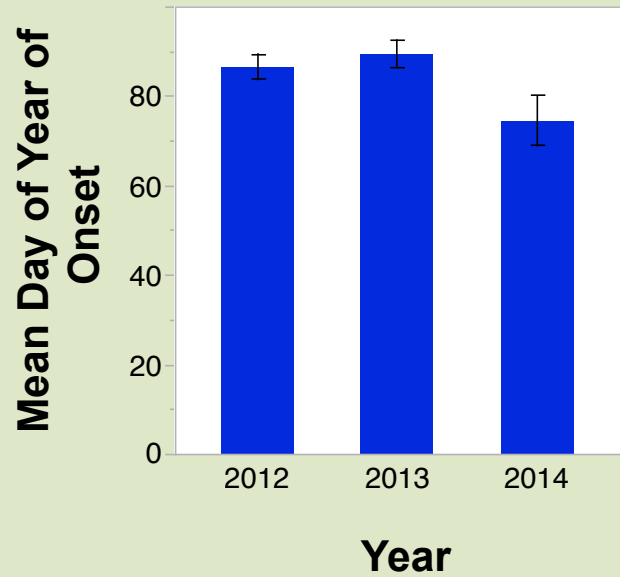
Eriogonum fasciculatum: Ripe fruits



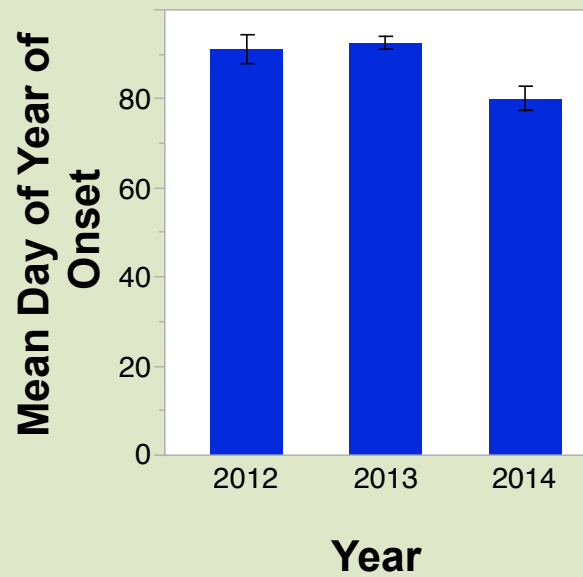
Interannual variation in the onset of phenophases at Foothill Visitors Center, Sequoia and Kings Canyon NP

Quercus douglasii (Blue Oak)

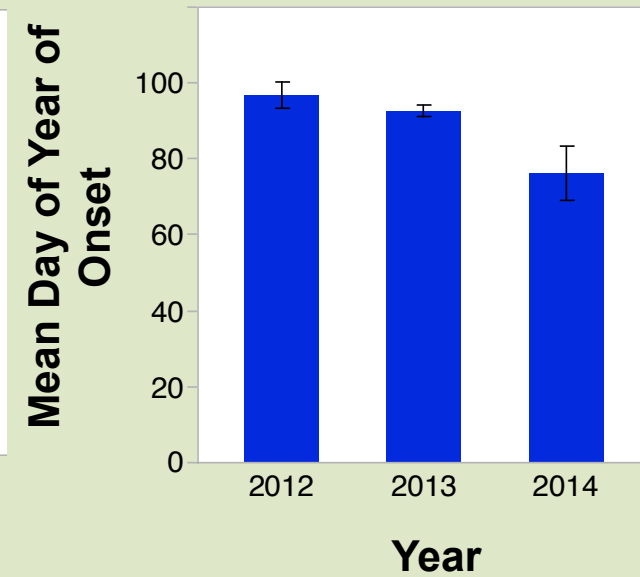
Flowers or Flower Buds



Open Flowers

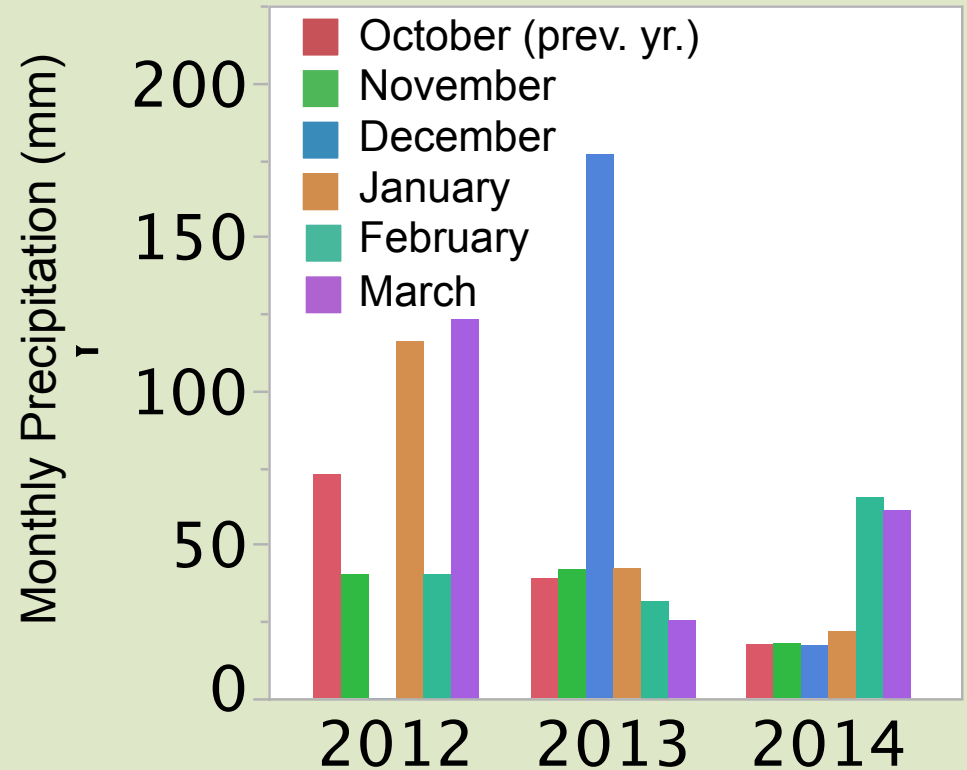
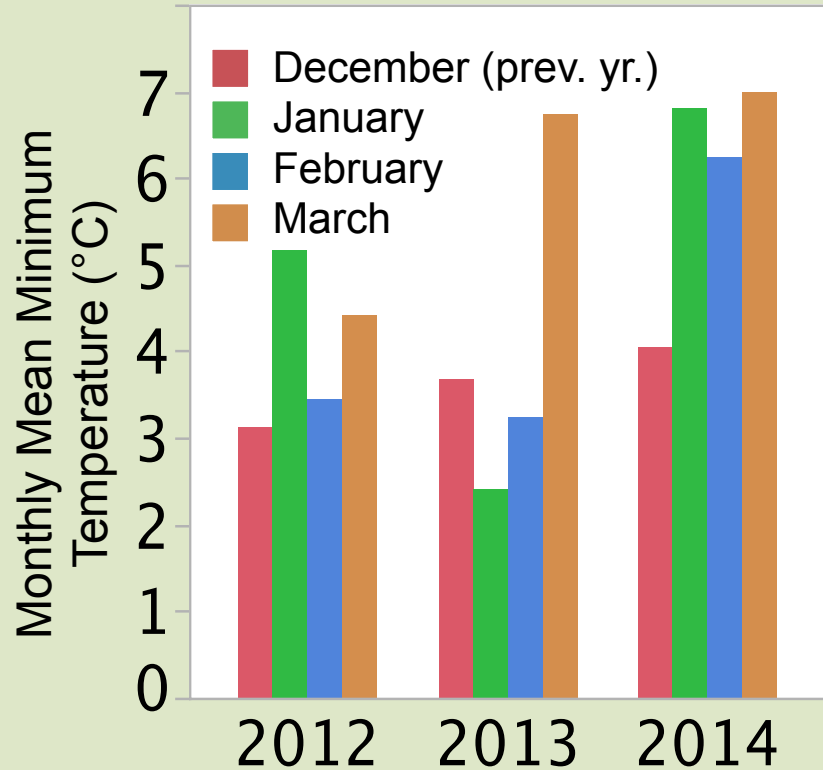


Pollen Release



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

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



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/nn/become-observer>
- <https://www.usanpn.org/nn/guidelines>
- <https://www.usanpn.org/nn/guidelines/shared-sites>



Phenological patterns are important, economically and biologically.



Questions/assignments for students....

Provide an example of the biological, agricultural, or economic importance of the phenology of any wild or cultivated species

Was plant phenology important to your parents or grandparents in ways that we currently overlook?

CPP: outreach and education

Phenology education materials available on the CPP website:

- Lesson plans for primary educators
- Activities for formal and informal education settings
- Undergraduate lecture series
- Readings and discussion questions for advanced undergraduate or graduate seminar in phenology

ETHNOPHENOLOGY

A hands-on nature exploration activity designed to engage participants in observing plant phenology while investigating how traditional cultures remedied health ailments with seasonally-available wild plants



"Ethnobotany" – the study of cultural uses of plants

"Phenology" – the study of seasonal plant and animal activities

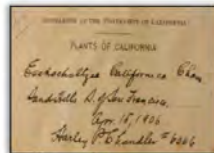


Planting Memories: Santa Barbara Edition

A memory matching game filled with plants that grow in our own backyard



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



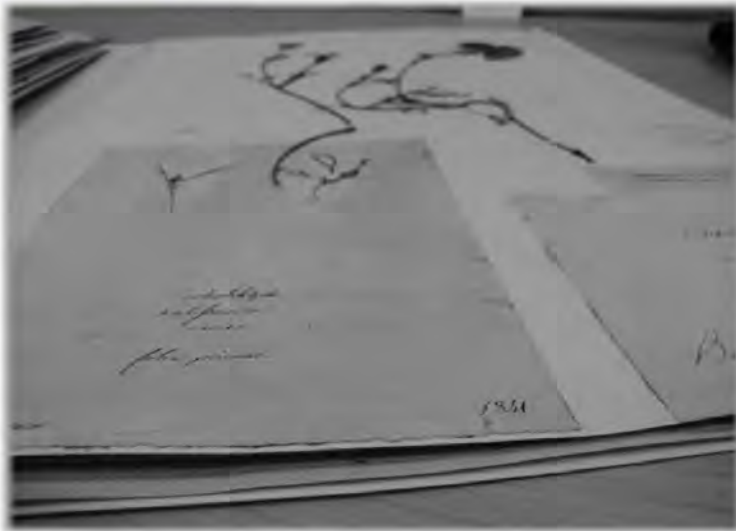
TABLE OF CONTENTS

- 2 BACKGROUND & INTRODUCTION
- 5 WHAT IS AN HERBARIUM? HOW IS IT USED?
- 12 HERBARIUM-BASED PHENOLOGICAL RESEARCH
 - ESTABLISHING AVERAGE ANNUAL PHENOPHASE WINDOWS
 - EXPLORING LONG-TERM TRENDS IN PHENOLOGY
- 15 METHODS FOR HERBARIUM-BASED PHENOLOGICAL RESEARCH
- 16 ADDITIONAL CONSIDERATIONS FOR RESEARCH & DATA ANALYSIS
- 19 REFERENCES & ADDITIONAL READING

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) or the USA National Phenology Network (www.usanpn.org/education).



BRIAN HAGGERTY, ALISA HOVE, AND SUSAN MAZER

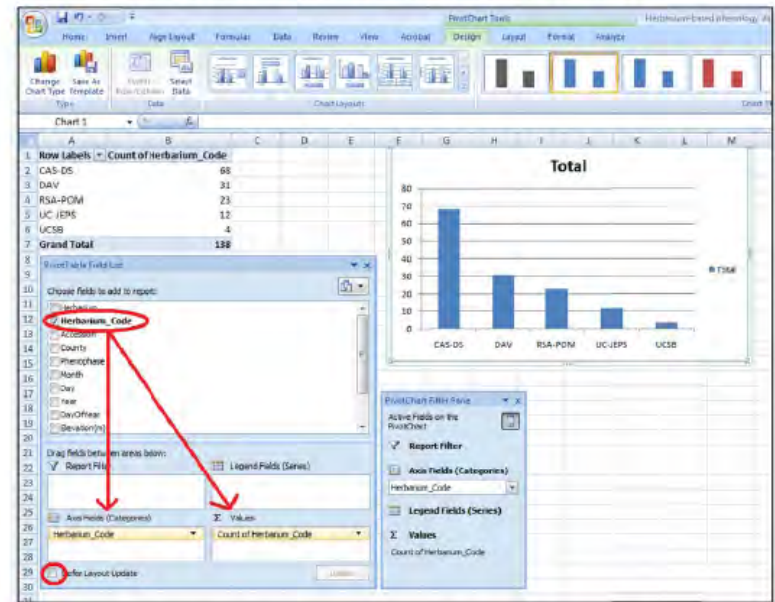
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Funding for the development of these materials was provided by the US Geological Survey and the USA National Phenology Network



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

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) or the USA National Phenology Network (www.usanpn.org/education).



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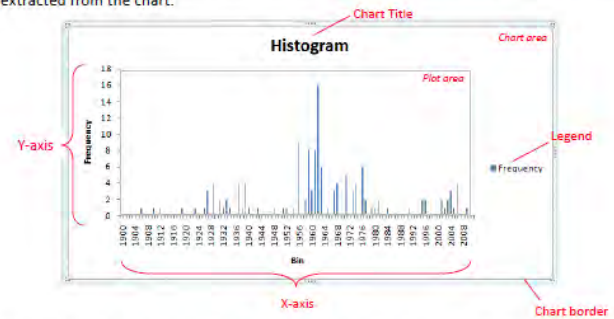
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Funding for the development of these materials was provided by the US Geological Survey and the USA National Phenology Network



FORMAT THE HISTOGRAM FOR INTERPRETATION, SHARING, AND PRESENTING

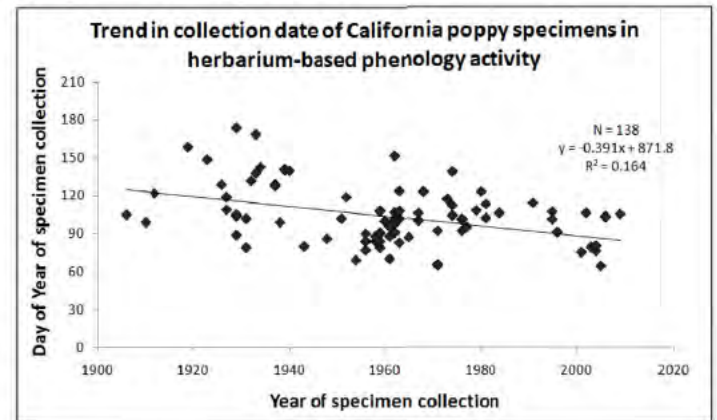
The histogram you produced is displayed in the default format. Though effective in visualizing the data, we should make a few brief formatting changes to make it appear cleaner while enhancing the information that can be extracted from the chart.



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 not centered on the X-axis. Format the

Finally, your scatter plot should appear similar to this:

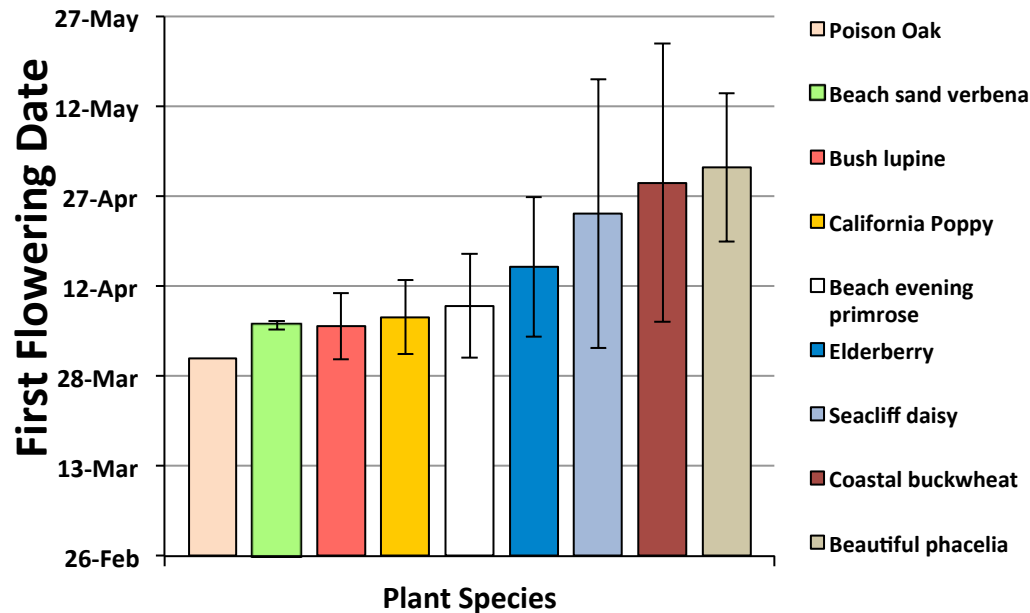


Visualizing phenology – teaching tool



Phenology at the community scale

UCSB's Coal Oil Point Natural Reserve



Onset of flowering more synchronous for early species

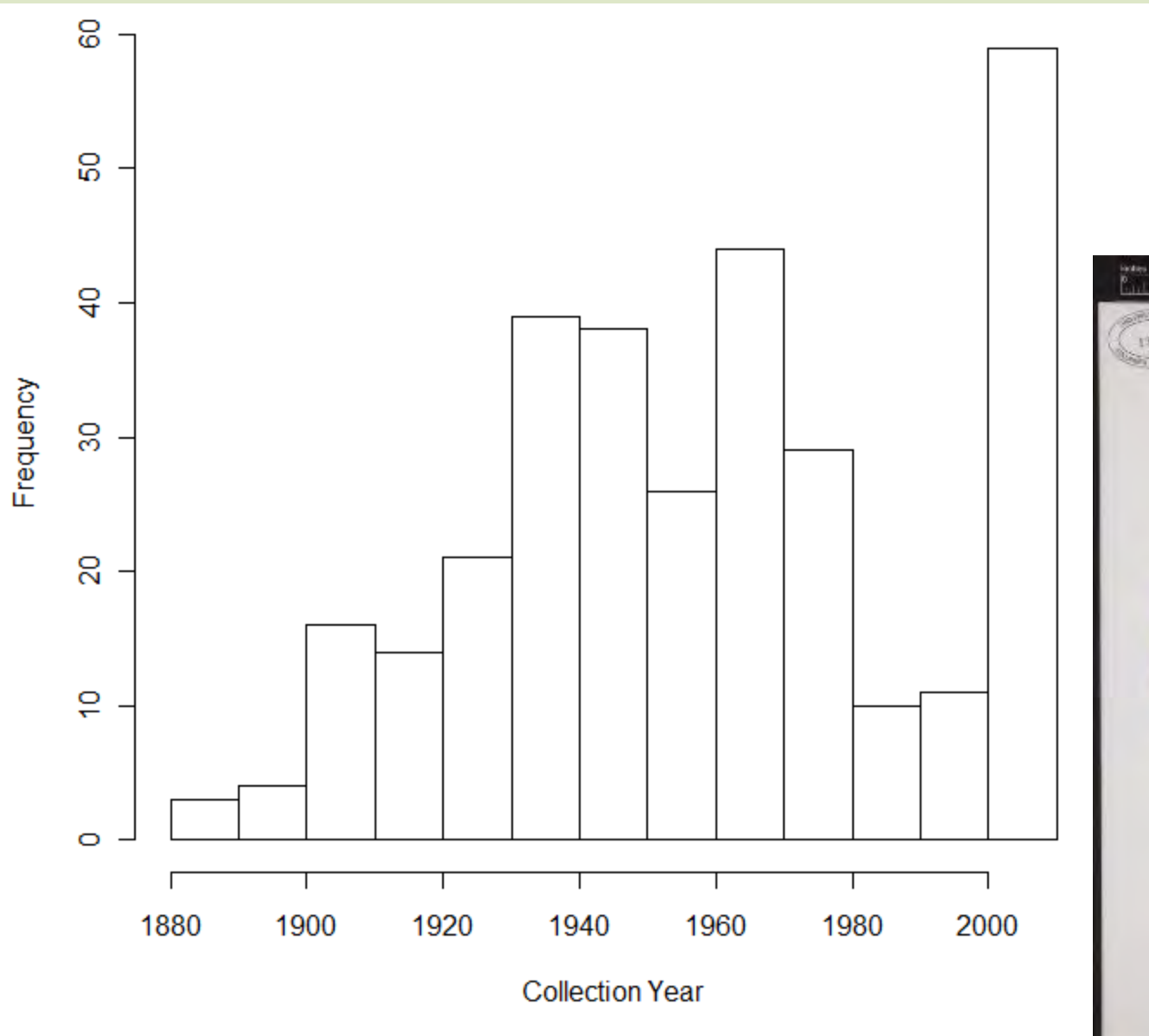
What does this mean for pollinators?

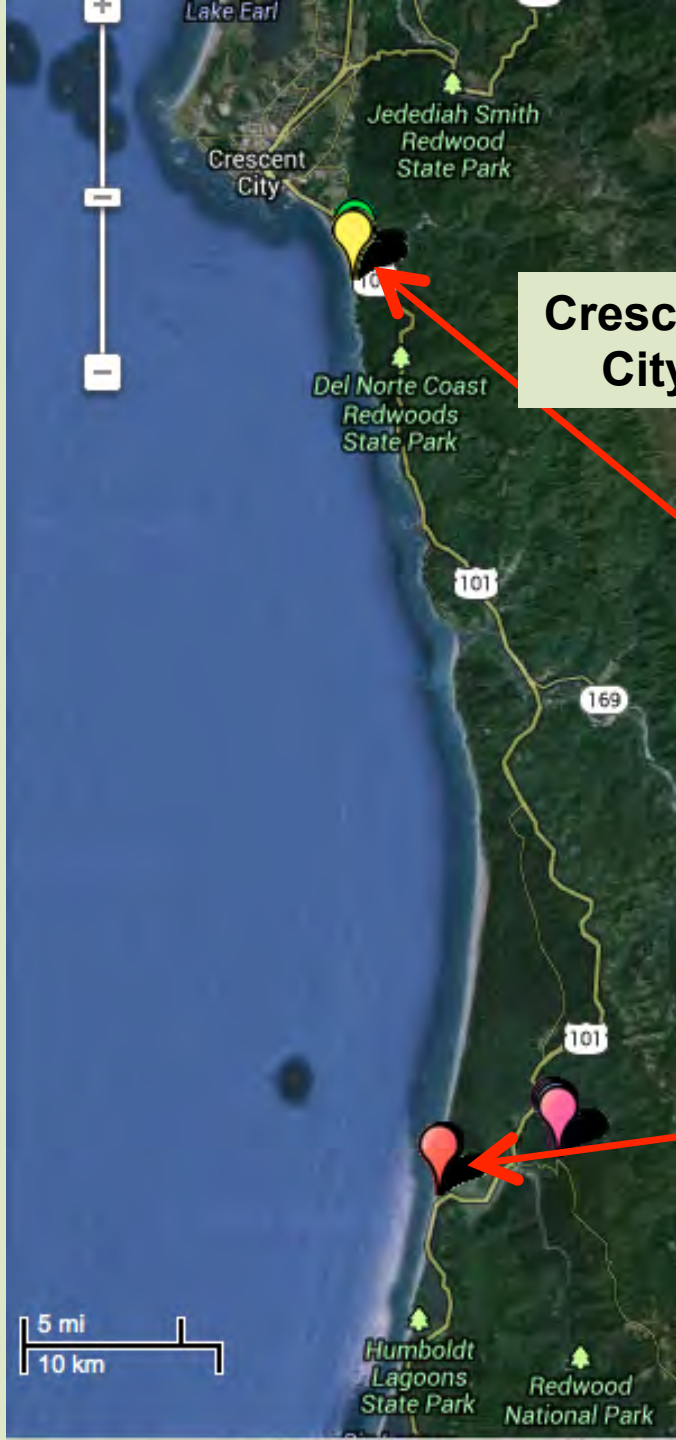
What does this mean for frugivores?

Pattern consistent across years?

Pattern consistent across habitats?

Trillium ovatum (Melianthiaceae)





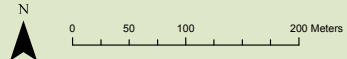
CPP REDW Crescent Beach Overlook (CBO) Monitoring Sites



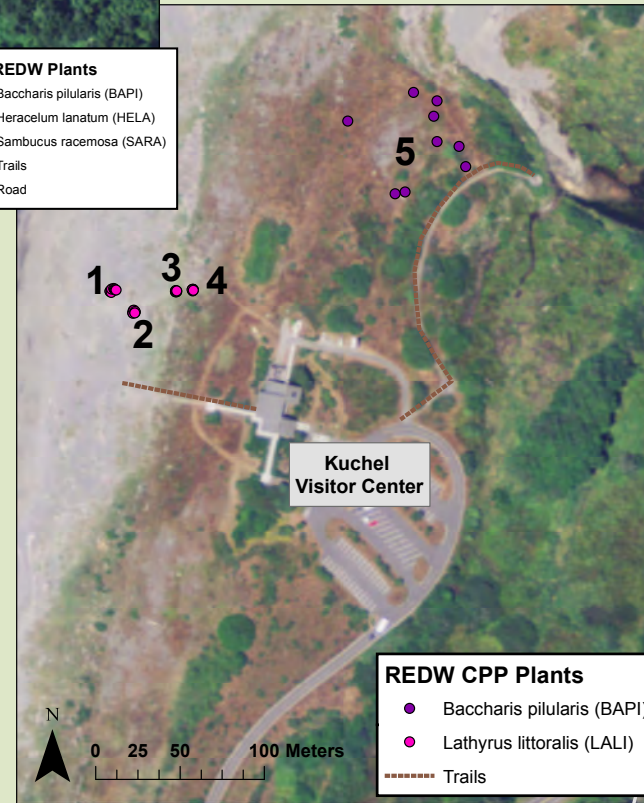
CPP REDW Plants

- Baccharis pilularis (BAPI)
- Heracelum lanatum (HELA)
- Sambucus racemosa (SARA)

----- Trails
 ——— Road



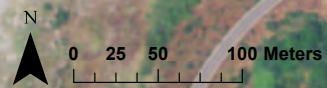
Kuchel Visitor Center (KVC) Monitoring Sites



REDW CPP Plants

- Baccharis pilularis (BAPI)
- Lathyrus littoralis (LALI)

----- Trails



Crescent City

Kuchel Visitor Center

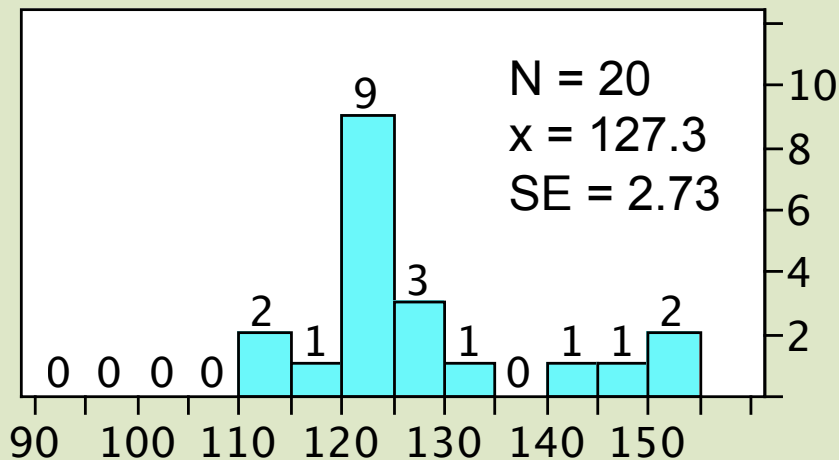
Lathyrus littoralis– Redwood National Park,
Kuchel Visitor Center, individual plants



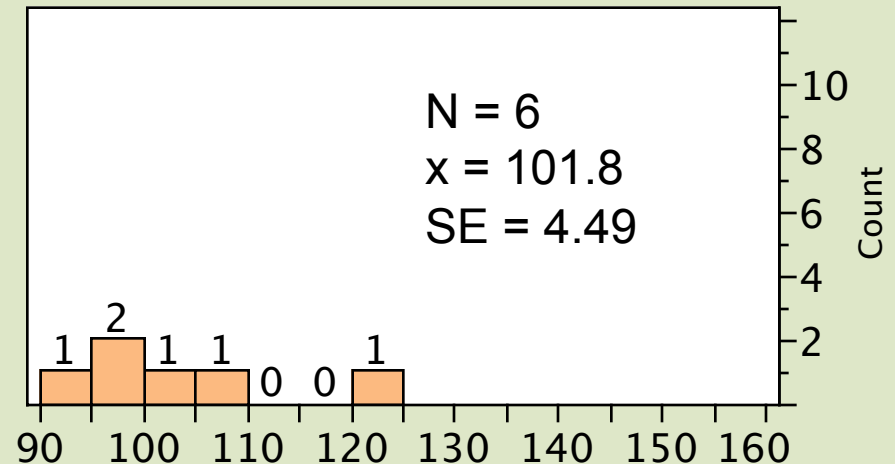
Silky Beach Pea

Lathyrus littoralis– Redwood National Park, Kuchel Visitor Center, individual plants

2012 and 2013: Flowers and Flower buds



2012: Flowers and Flower buds

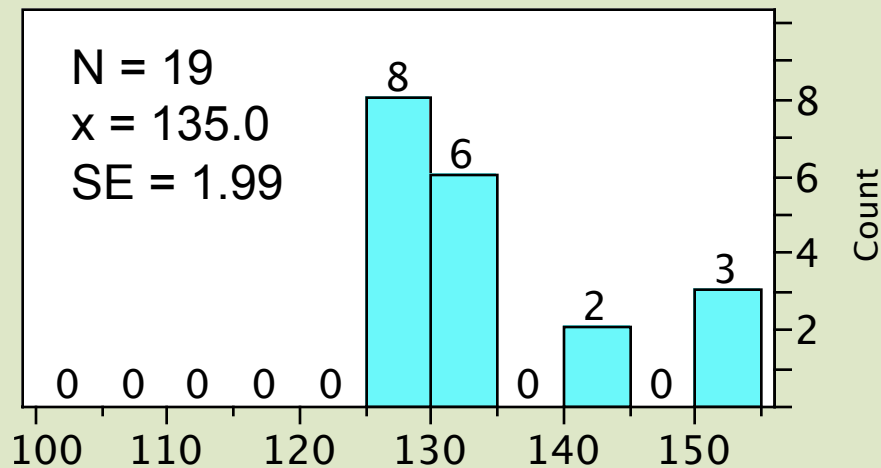


2013: Flowers and Flower buds

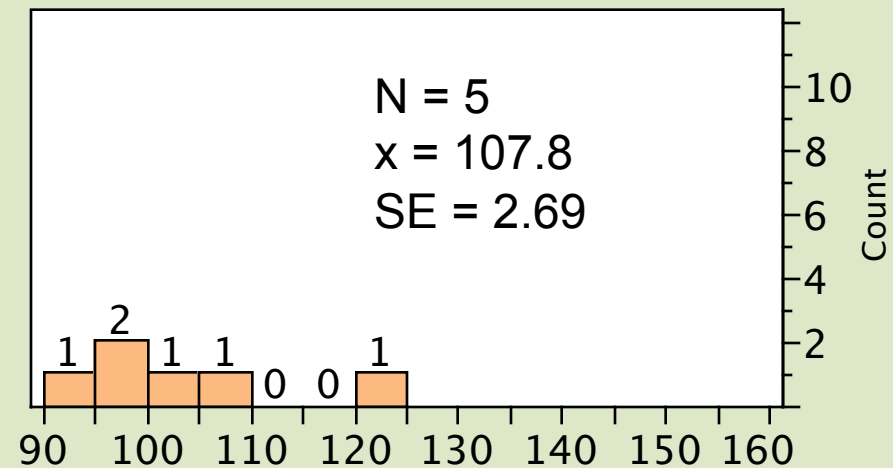
Flowering in 2013 is advanced relative to 2012

Lathyrus littoralis– Redwood National Park, Kuchel Visitor Center, individual plants

2012 and 2013: Open Flowers



2012: Open Flowers



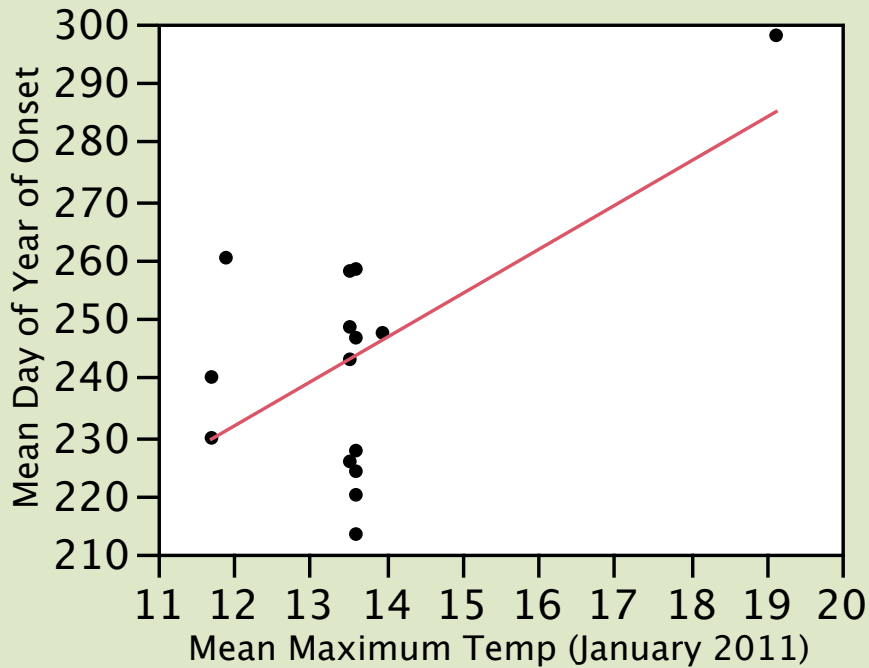
2013: Open Flowers

Flowering in 2013 is advanced relative to 2012

Baccharis pilularis: data points are mean values of sites (each site represented by 1-9 plants)

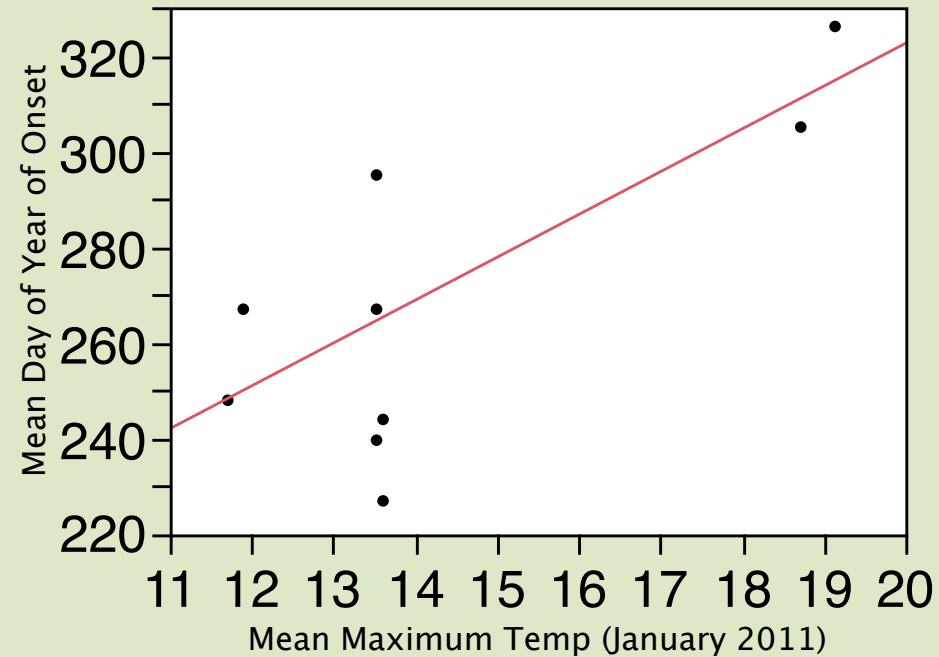
Sites included: **GOGA-LDML**1, 2, 3, 4, 8, 9; **GOGA-MORI**1,2,3,4,5,6; **GOGA-OLBU**1, 2, 3; **REDW-CBO**1, 2; **REDW-CBO**1,2; KVC5; **SAMO-CHCA**2, 8, 10, **SAMO-PARA**3, 8; **SAMO-RSVS**1, **SAMO-ZUMA**2, 4

2011: Onset of Open flowers



$R^2 = 0.35$
 $y = 7.48x + 141.8$
 $p < 0.0160$
N=16 sites

2011: Onset of Ripe Fruits

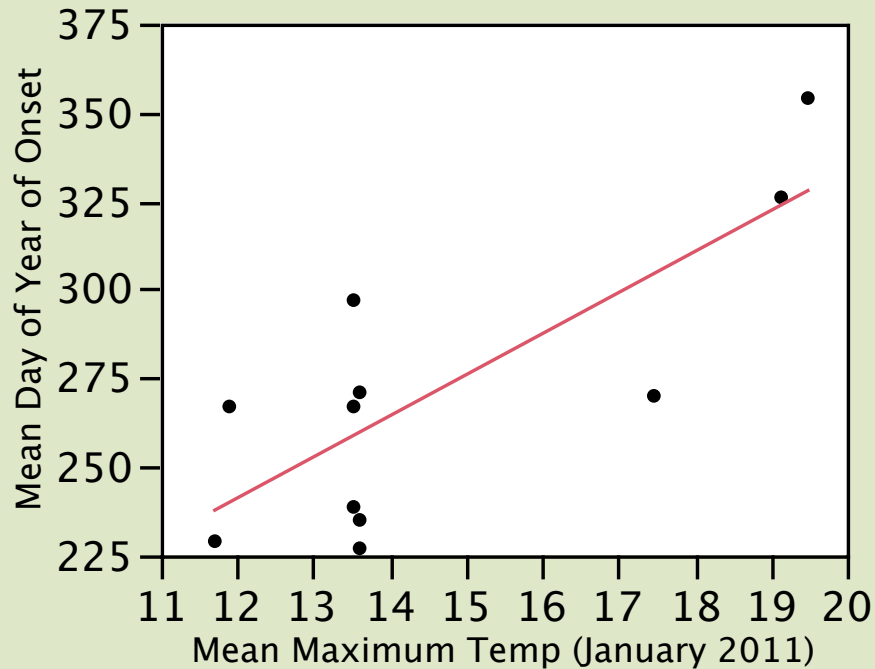


$R^2 = 0.49$
 $y = 8.94x + 143.8$
 $p < 0.0239$
N=10 sites

Baccharis pilularis: data points are mean values of sites (each site represented by 1-9 plants)

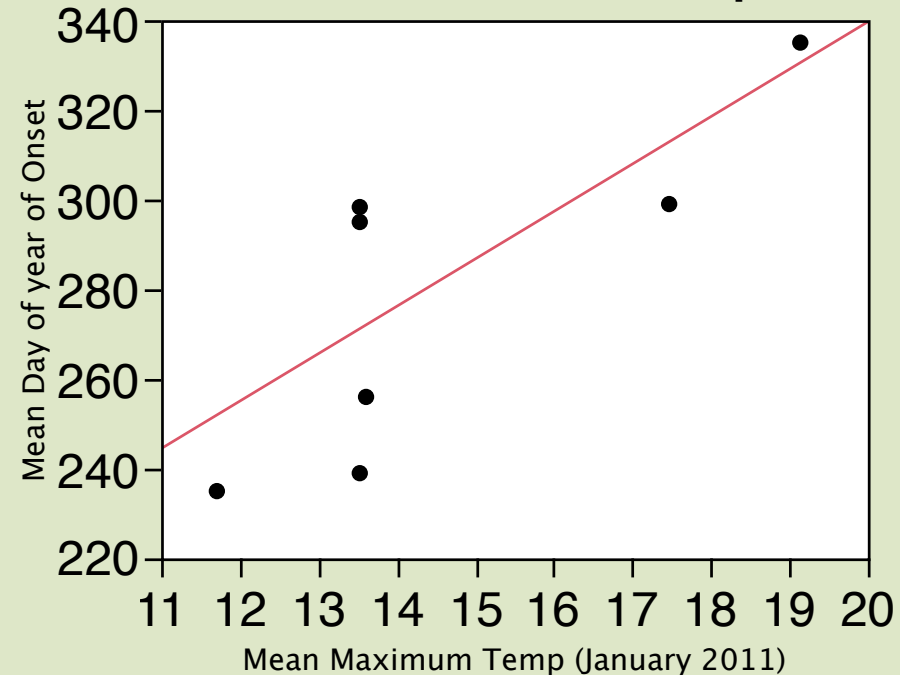
Sites included: **GOGA-LDML**1, 2, 3, 4, 8, 9; **GOGA-MORI**1,2,3,4,5,6; **GOGA-OLBU**1, 2, 3; **REDW-CBO**1, 2; **REDW-CBO**1,2; **KVC**5; **SAMO-CHCA**2, 8, 10, **SAMO-PARA**3, 8; **SAMO-RSVS**1, **SAMO-ZUMA**2, 4

2011: Onset of Fruits



$R^2 = 0.61$
 $y = 11.58x + 102.1$
 $p < 0.0027$
N=12 sites

2011: Onset of Fruit Drop

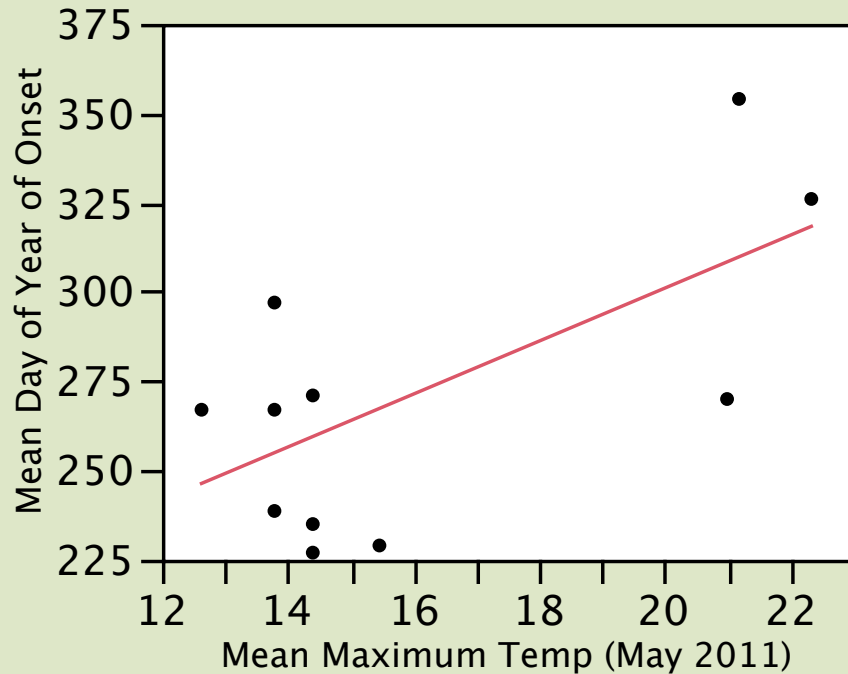


$R^2 = 0.57$
 $y = 10.57x + 128.17$
 $p < 0.0313$
N=8 sites

Baccharis pilularis: data points are mean values of sites (each site represented by 1-9 plants)

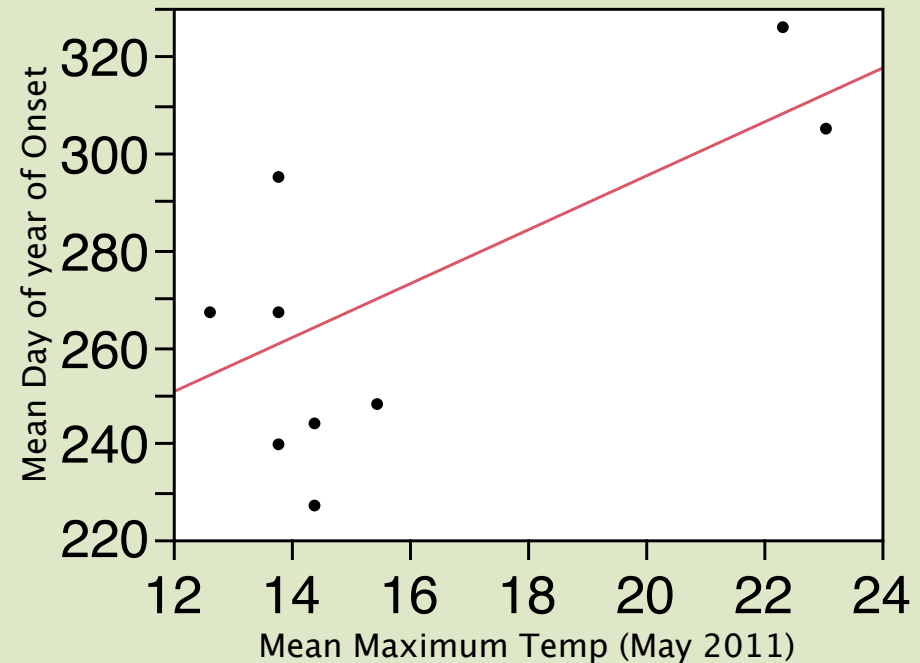
Sites included: **GOGA-LDML**1, 2, 3, 4, 8, 9; **GOGA-MORI**1,2,3,4,5,6; **GOGA-OLBU**1, 2, 3; **REDW-CBO**1, 2; **REDW-CBO**1,2; KVC5; **SAMO-CHCA**2, 8, 10, **SAMO-PARA**3, 8; **SAMO-RSVS**1, **SAMO-ZUMA**2, 4

2011: Onset of Fruits



$R^2 = 0.43$
 $y = 0.742x + 152.7$
 $p < 0.0204$
 $N=12$

2011: Onset of Ripe Fruits

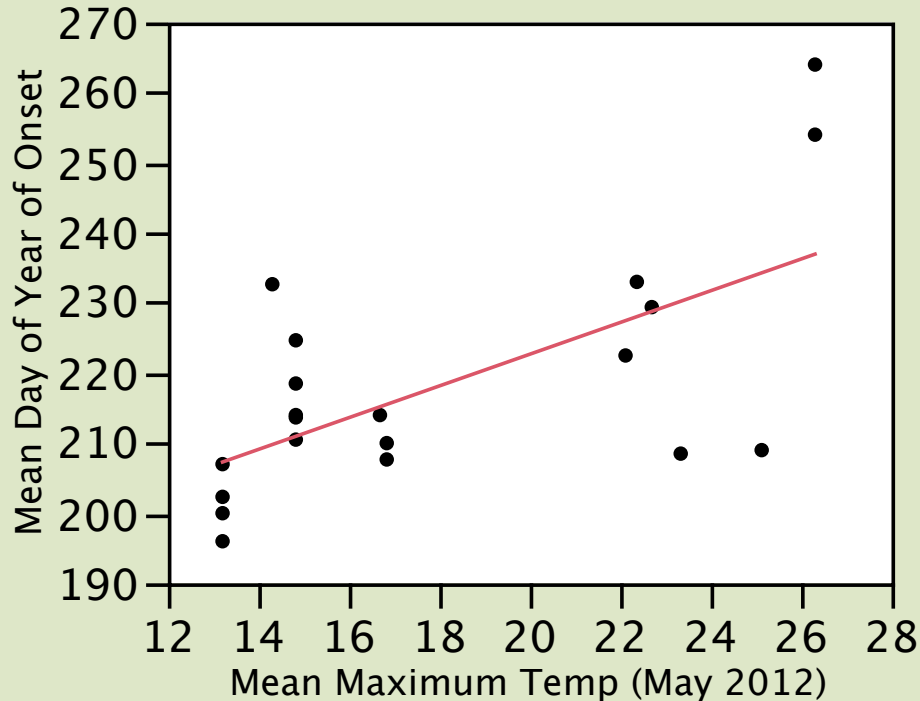


$R^2 = 0.41$
 $y = 5.58x + 183.5$
 $p < 0.0462$
 $N=10$

Baccharis pilularis: data points are mean values of sites (each site represented by 1-9 plants)

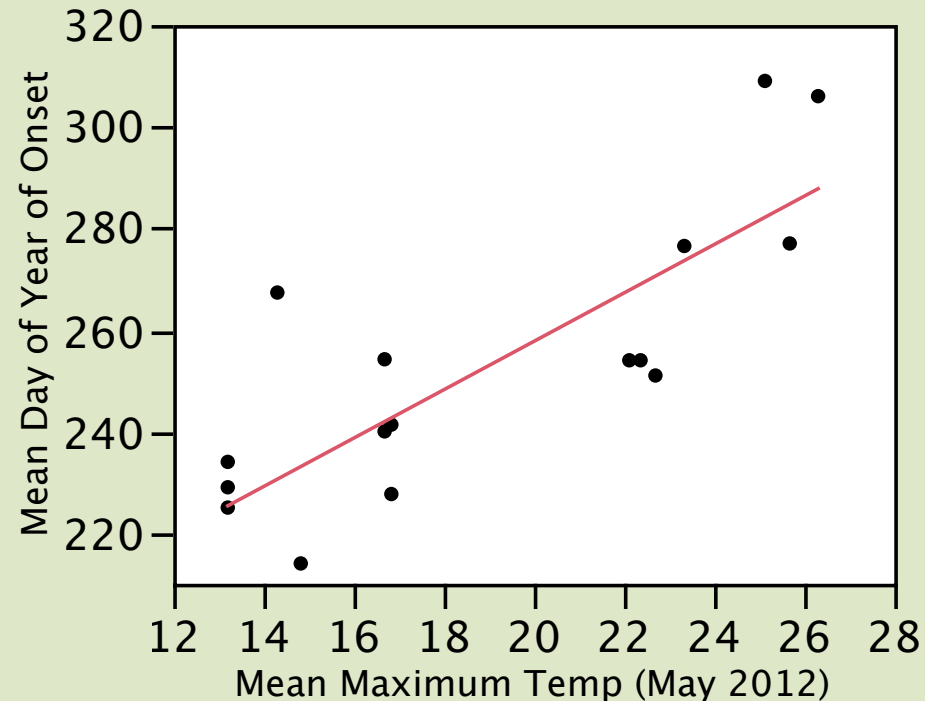
Sites included: **GOGA-LDML**1, 2, 3, 4, 8, 9; **GOGA-MORI**1,2,3,4,5,6; **GOGA-OLBU**1, 2, 3; **REDW-CBO**1, 2; **REDW-CBO**1,2; **KVC**5; **SAMO-CHCA**2, 8, 10, **SAMO-PARA**3, 8; **SAMO-RSVS**1, **SAMO-ZUMA**2, 4

2012: Onset of Flower Buds and Flowers



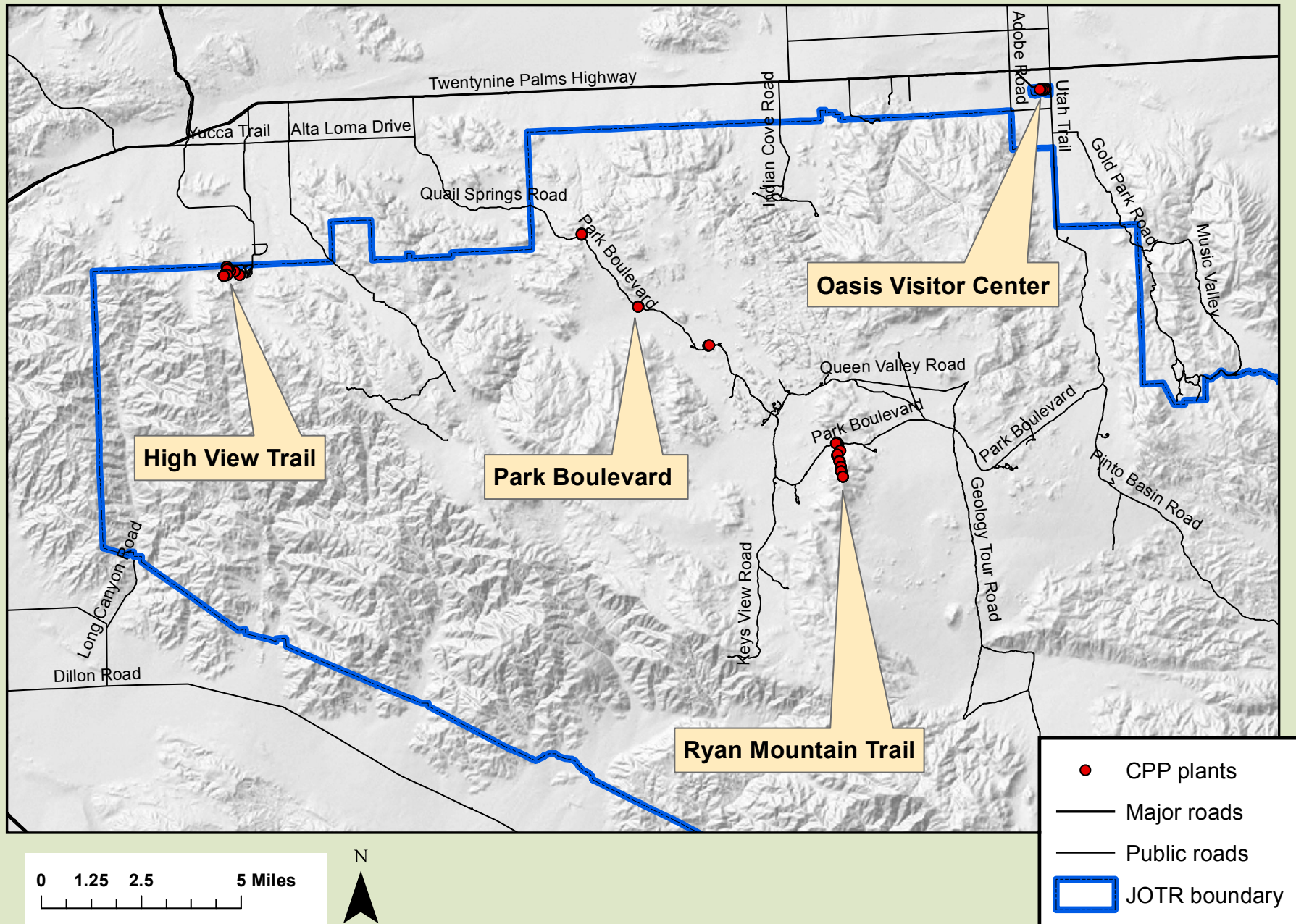
$$R^2 = 0.41$$
$$y = 2.26x + 177.4$$
$$p < 0.0010$$
$$N=23 \text{ sites}$$

2012: Onset of Open Flowers



$$R^2 = 0.67$$
$$y = 4.77x + 162.4$$
$$p < 0.0001$$
$$N=18 \text{ sites}$$

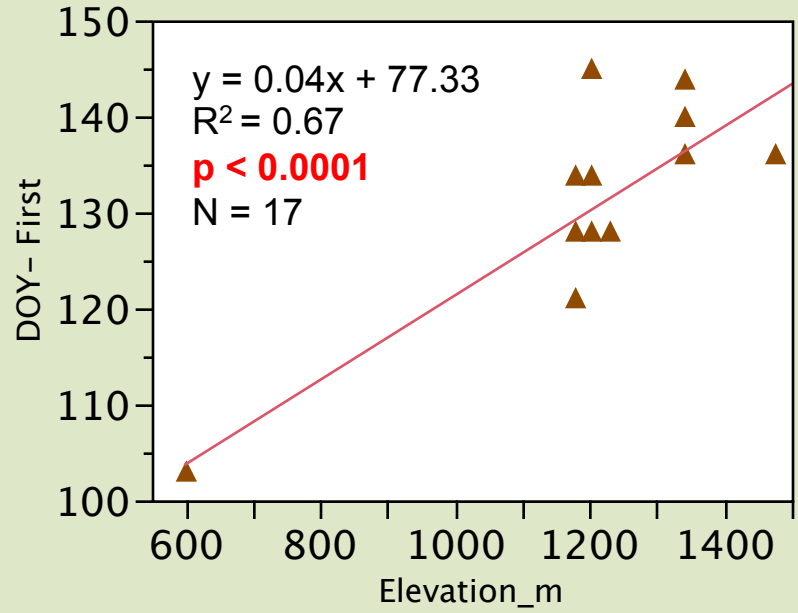
CPP Monitoring Locations at Joshua Tree NP



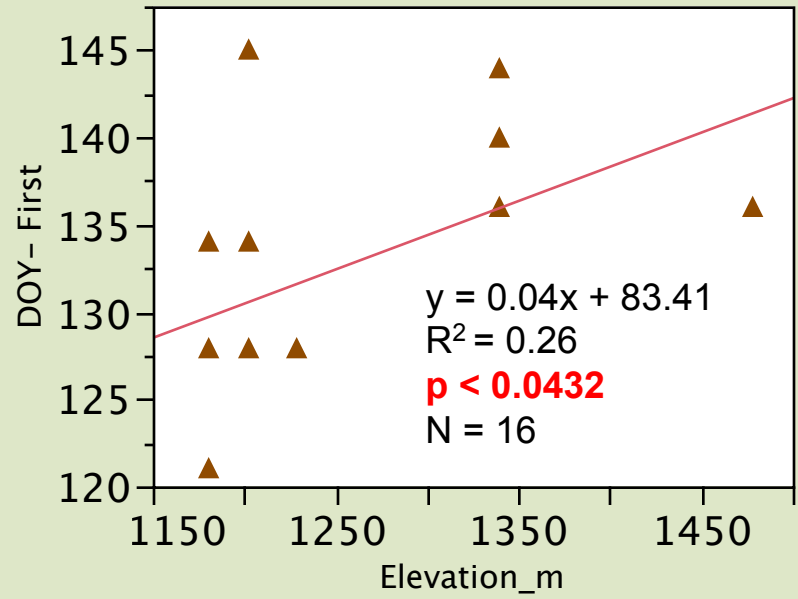
Larrea tridentata – JOTR only, data points are individual plants

2011 and 2012 pooled; all individuals considered separately:
Plants flower later at higher elevation

Open flowers



Open Flowers

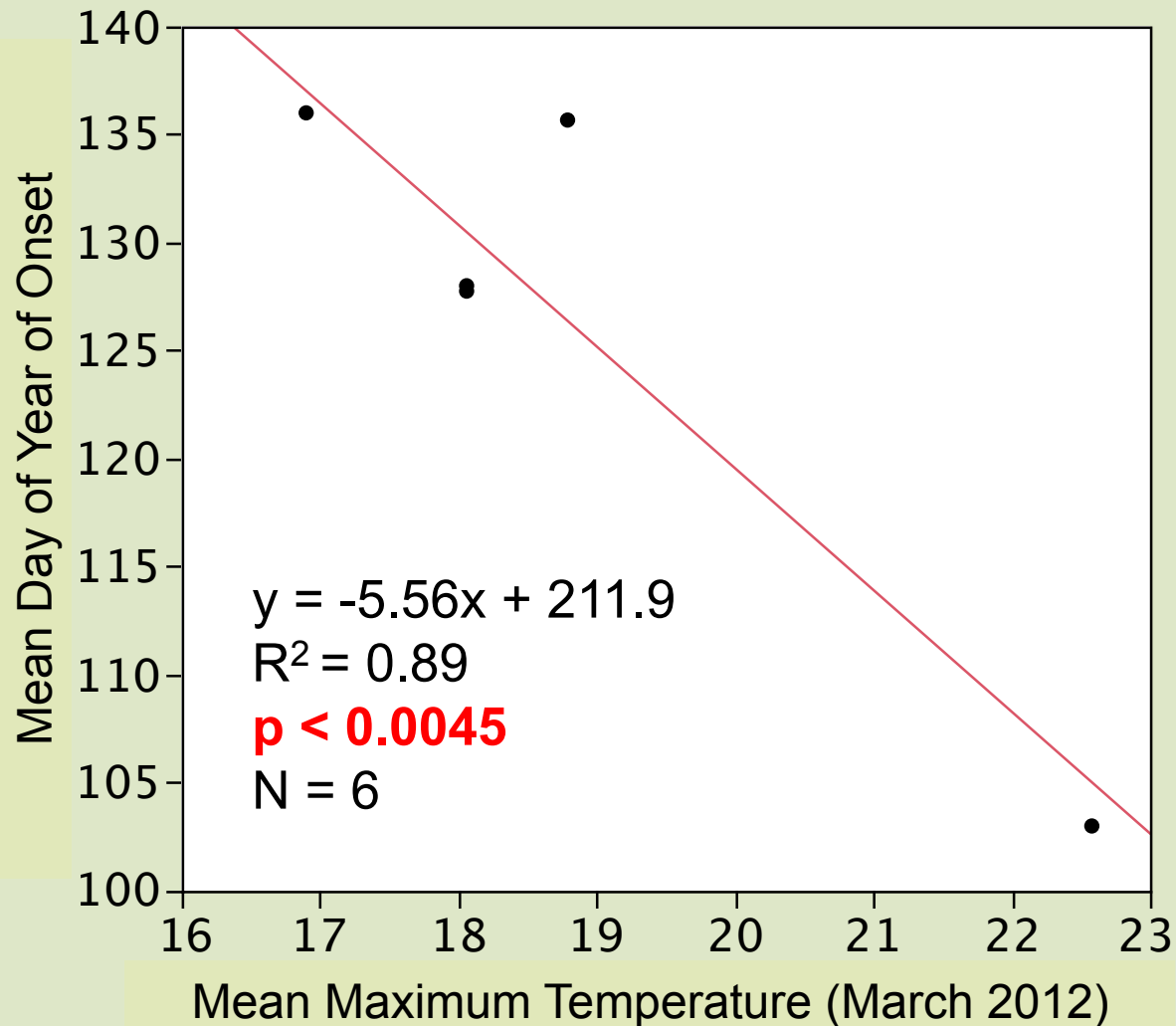


After the exclusion of the
one individual at 602'
elevation

Larrea tridentata – 2012, JOTR only,

Site Means (1-4 plants/site); Locations: PABO, RYAN, OAVC

Plants flower earlier at sites with higher March temperatures



Targeted Species: Live Oak phenophases



Using NPN datasheets

Baccharis pilularis Coyotebrush



CPP species profiles: Coyotebrush

California Phenology Project: species profile for Coyotebrush (*Baccharis pilularis*)



CPP site(s) where this species is monitored: Golden Gate National Recreation Area, Redwood National Park, Santa Monica Mountains National Recreation Area



Photo credit: stonebird (Flickr)

What does this species look like?

This shrub can be up to three meters tall. The leaves are toothed, oval, and sticky. Coyotebrush is dioecious, meaning that each plant either produces flowers with only male parts or with only female parts. The male flowers produce yellow pollen and appear yellowish from a distance, and the female flowers produce fruit and are white. The flower heads appear round and disc-like.

When monitoring this species, use the USA-NPN broadleaf evergreen (with pollen, no leaf buds) trees and shrubs datasheet.

Species facts!

- The CPP four letter code for this species is BAPI.
- BAPI is a member of the sunflower family (Asteraceae).
- This species arrives as a secondary pioneer species after fire or grazing.
- *Baccharis* derives from the Greek word "bakkaris", referring to plants with fragrant roots, and *pilularis* refers to sticky globs on the flower buds.
- Native Americans used the heated leaves to reduce swelling, and the wood to make arrow shafts and houses.
- This species is an important nectar source for wasps, flies, and butterflies.



Insect gall (note: do not confuse galls for flower buds on this species!)

Photo credit: Jess Gambel

Where is this species found?

- Found in many habitats including coastal bluffs and oak woodlands.
- Found from 0 to 750 meters elevation, but occasionally up to 1500 meters.
- This species is occasionally found on serpentine soil.



Photo credit: Jerry Kirkhart (Flickr)

For more information about phenology and the California Phenology Project (CPP), please visit the CPP website (www.usanpn.org/cpp) and the USA-NPN website (www.usanpn.org)

California Phenology Project: species profile for Coyotebrush (*Baccharis pilularis*)



Young leaves
Young leaves are generally thinner and lighter colored than mature leaves.

Brian Haggerty



Crystal Anderson

The flowers pictured to the left have only male parts (anthers) and will not produce fruit.



Crystal Anderson

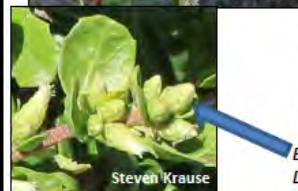
The flowers pictured to the right have only female parts and will produce fruit. Each flower may produce a single seed.



Miguel Viera

Flowers or flower buds

When monitoring flower and flower bud abundance for this species, count each inflorescence as a single flowering structure! For example, if there are two inflorescences with many flowers or buds each, then abundance should be recorded as <3.



Steven Krause

BAPI flower buds; Do not mistake for a gall (pictured on the front)



Steven Krause

Open flowers

Can you see the anthers or stigma? Proportion of open flowers should be recorded at the scale of individual flowers, not inflorescences (i.e. count individual flowers!).

Note: USA-NPN flower phenophases are nested; if you record Y for "open flowers" you should also record Y for "flowers or flower buds"



Crystal Anderson

Fruits

The fruit is a tiny, one-seeded capsule tipped with a tuft of white hairs. Fruits are grouped in a seed head and change from yellow-green to tan or light brown as they ripen. When fully dry, the fruits are blown from the plant.



Steven Krause

Ripe fruits

The fruit is considered ripe when it is tan or light brown.

Note: fruit phenophases are nested; if you record Y for "ripe fruits" you should also record Y to "fruits"

Phenophases not pictured: Pollen release, Recent fruit or seed drop

