

# Understanding & Communicating Climate Change Introducing the California Phenology Project



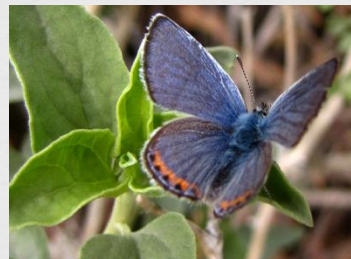
[www.usanpn.org/cpp](http://www.usanpn.org/cpp)

Dr. Angie Evenden, CA-CESU NPS Research Coordinator  
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# PHENOLOGY

**PHENOLOGY** is the study of recurring plant and animal life cycle stages or phenophases, such as leafing and flowering of plants, maturation of agricultural crops, emergence of insects and migration of birds.

- ❑ Many of these events are sensitive to climatic variation and change and are simple to observe and record
- ❑ “Phenology...is perhaps the simplest process in which to track changes in the ecology of species in response to climate change.” (IPCC 2007)





**California Poppy**  
 Scientific name: *Eschscholzia californica*  
 Plant family: Papaveraceae (Poppy family)

**IDENTIFYING CHARACTERISTICS**

**HABIT:** Herbaceous, sometimes with woody stem bases.

**PLANT SIZE:** Height 5 - 60 cm  
 Width 5 - 40 cm

**LEAVES:** Stems spreading from central base. Leaves sometime with bluish-green tint, finely lobed and concentrated at the base of flowering stems.

**FLOWERS:** Conspicuous, borne singly on tips of erect stems, 4 yellow-orange to golden petals each 20-60mm length. Interior base of petals generally darker orange than outer edges. Stamens <20, stigma lobes 4. Buds erect, conical with pointed tip, subtended by pinkish disc-like receptacle.

**FRUITS:** Cylindrical, elongating to 3-10cm during maturation (~3-4wks), often retaining remnants of stigma lobes at tip. Fruit maturity reflected in dryness of capsule; change in color from bluish-green to brown. Fruits split along vertical axis to dehisce seeds. Pinkish disc-like receptacle conspicuous at base of developing fruit.

**SEEDS:** Round to elliptical, brown to black, 1.5-2mm wide.

**HABITAT**  
 Well-drained soils with full sunlight, coastal dunes, open woodlands, montane meadows, 0-2500m. Commonly found in open sunny habitats, disturbed roadsides, parks, and gardens.

**LIFE HISTORY**  
**DURATION:** Typically annual, but can be perennial in optimal conditions.  
**FLOWERING TIME:** February - September, individual plants flower for 1-5 months.  
**POLLINATION:** Entomophilous - mostly bumblebees, also solitary bees and beetles.

**DISTRIBUTION**

**PHENOLOGY OF CALIFORNIA POPPY**

**APPROXIMATE TIMING OF PHENOPHASES**

In the Santa Barbara region, California Poppy seeds germinate with late-autumn rains and leaves develop throughout the winter. Leaf development slows and flowering begins as soils warm in the spring. Fruits mature through mid-summer, plants die by late summer.

**PHENOPHASE IDENTIFICATION**  
 Key terms to use with the Phenophase Quick-Guide

PLANT HABIT	FLORAL ARCHITECTURE
herbaceous	Solitary flowers

**PHENOPHASES TO OBSERVE**  
 First flower, last flower, first mature fruit, onset of leaf senescence, full leaf senescence

The flowers of California Poppy close up at night and during harsh weather. Take this into consideration when determining phenophases or quantifying floral display.

FLOWER BUD	FIRST FLOWER	MATURE FRUIT
	Stamens visible	splits open from middle of vertical axis pink receptacle

The genus *Eschscholzia* was named after Johann Friedrich Gustav von Eschscholtz, a naturalist and surgeon aboard a Russian ship that dropped anchor in the San Francisco Bay in 1815. He, like many others, was smitten with the wildflower-covered hills. He was also responsible for collecting specimens throughout his journey - a legacy which led his colleagues to name a group of closely-related species after him. When the scientific name of the genus was published formally, the "1" in Eschscholtz was inadvertently omitted. *Eschscholzia californica* was named California's state flower in 1903.

Phenology Field Guide  
 for Coal Oil Point Natural Reserve  
 and the central California coast



This guide to observing seasonal changes in plant communities can be used in conjunction with phenological monitoring protocols established by the UCSB Phenology Stewardship Program and the USA National Phenology Network. Visit [www.usanpn.org](http://www.usanpn.org) to learn more.



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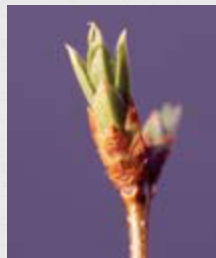
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Phenological Observation -  
 Opportunity to engage citizen  
 scientists and educate the  
 public about  
 climate change



# PHENOLOGY NETWORKS

- ❑ Organized to coordinate simultaneous monitoring of phenological events across wide geographic areas and to share information
- ❑ Observers rely on a common set of definitions and protocols in order to standardize observations across regions for many different species
- ❑ European phenology networks have long been active for agricultural applications
- ❑ United States – Lilac and Honeysuckle networks



**Phenological progression for the common Lilac, *Syringa vulgaris*.**  
Photos courtesy Mark Schwartz and the USA NPN.

# NPS California Phenology Project

**Project Initiated in 2010** – funded by the NPS Climate Change Response Program – 3 year pilot project

## **Collaborators:**

**USA National Phenology Network –Coordinating Office**

**UCSB - Phenology Stewardship Program**

**NPS Coordination Team**



## **PRIMARY GOAL:**

**Facilitate a California Phenology Network of parks and partners to develop, test and implement protocols for a scientifically rigorous phenology monitoring program that engages citizen scientists and provides for public education and outreach – **initial focus is on plants !****

# NATIONAL PHENOLOGY NETWORK

- ❑ Consortium of individuals and organizations that collect, share and use phenology data, models & related information
- ❑ Key goal is to detect and understand how plants, animals and landscapes respond to environmental variation and climate change
- ❑ Invites people of all ages and backgrounds to observe and record phenology

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

# UCSB Phenology Stewardship Program

## The Phenology Handbook

*A guide to phenological monitoring for students, teachers, families, and nature enthusiasts*



**Brian P Haggerty and Susan J Mazer**

University of California, Santa Barbara

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**Dr. Susan Mazer, PI**

**Dr. Liz Matthews, Project Post-Doc**

**UC Santa Barbara**

### Accomplishments:

- phenology handbook
- teacher training
- undergraduate training
- phenology trails
- phenology gardens in local schools
- after-school phenology program at a Boys & Girls' Club

# CA Phenology Project Objectives

- 1) **Identify scientific questions and target species for monitoring** with assistance from interested partners
- 2) Develop **plant species profiles and phenophase definitions** for target species
- 3) Develop, adapt and test USA-NPN **phenology monitoring protocols** for selected target species in six pilot parks
- 4) Develop, adapt, test and evaluate **education and outreach tools** that use phenology to engage citizens in observing and detecting effects of climate change
- 5) Identify and utilize **legacy data sets**
- 6) Create web-based phenological monitoring tool kit and project management website
- 7) **Cultivate partnerships and funding sources** for a sustainable California Phenology Network



# CA Pilot Phenology Parks



**Involves 19 California NPS Units (+ 1 in Nevada)**

**Six Pilot Parks for Protocol Testing:**

*Semi-arid bioregion*

Joshua Tree NP

*Coastal bioregion*

Redwood NP

Golden Gate NRA

Santa Monica NRA

*Mountain bioregion*

Sequoia & Kings Canyon NPs

Lassen Volcanic NP

# CPP Future Partners ??



**We expect to work with many partners:**

- CA Native Plant Society
- Theodore Payne Foundation
- park cooperating associations & institutes
- other agencies
- botanic gardens
- museums

# CPP Scientific Questions

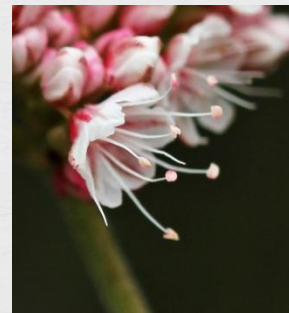
- How do iconic, widespread, and ecologically important species of the California flora respond to variation in climate?
- Which plant species in California are most sensitive to climate (and, by extension, to climate change)?
- Are relationships between inter-dependent plant and animal mutualists at risk due to climate change?
- How do particular communities or vegetation types differ in their phenological response to climate change?
- How do plant reproductive schedules respond to invasions of competitors or diseases?
- How do species respond to abiotic disturbance?
- What are the earliest indicators of spring?
- How are end-of-season phenological events and patterns affected by long-term climate change?
- Across all species and habitat types, are certain functional groups (e.g., winter annuals, perennial herbs, evergreen shrubs) more sensitive to climate and to climate change than others?

# CPP Species Selection Criteria

- Dominant species
- Widely distributed taxa
- Indicator species
- Species of local ecological or management concern
- Ease of identification
- Accessibility for monitoring across an abiotic or biotic gradient
- Proximity to other monitoring sites
- Species for which there are legacy data to which current phenological behavior can be compared
- Benchmark species
- Ability to engage citizen scientists
- Known accessible locations of multiple individuals in park units

# CPP Focal Taxa

- ❑ **The CPP selected 67 species as candidates for phenological monitoring in California**
  - These taxa are all now included on the National Phenology Network website
  - Search for plants that occur in California on the NPN website to see the full list!
- ❑ **More than 20 species have been tagged at CPP monitoring sites in the pilot parks (as of August 2011)**
  - For these taxa, the CPP has created species-specific plant profiles, which include phenophase photos and tips on monitoring each taxon, soon to be available on the CPP website



# CPP Taxa Tagged at Parks in 2011

## Joshua Tree:

*Larrea tridentata*  
*Coleogyne ramosissima*  
*Yucca brevifolia*  
*Yucca schidgera*  
*Prosopis glandulosa*

## Santa Monica:

*Quercus agrifolia*\*  
*Quercus lobata*  
*Adenostoma fasciculatum*\*  
*Eriogonum fasciculatum*  
*Sambucus nigra*\*  
*Baccharis pilularis*\*

## Golden Gate:

*Quercus agrifolia*\*  
*Baccharis pilularis*\*  
*Eschscholzia californica*  
*Mimulus aurantiacus*\*  
*Heracleum lanatum*\*

## Redwood:

*Baccharis pilularis*\*  
*Trillium ovatum*  
*Rhododendron macrophyllum*  
*Lathyrus littoralis*  
*Heracleum lanatum*\*  
*Sambucus racemosa*

## Lassen Volcanic:

*Arctostaphylos patula*  
*Lupinus obtusilobus*  
*Penstemon newberryi*  
*Pinus contorta*  
*Pinus ponderosa*  
*Populus tremuloides*  
*Sambucus nigra*\*



\* Denotes cross-park taxa

# Historical Data

- ❑ Historical data provide a point of reference, making only a few years of modern data very powerful
- ❑ Many non-traditional sources of data: herbarium specimens, seed collection databases, repeat photography, ranger journals, and more
- ❑ Search for historical data will continue through the fall/winter of 2011

Please let us know if you are aware of any historical data that might inform contemporary observations!



# 2011 CPP Pilot Park Workshops

- ❑ Introduction to phenology, climate, and climate change
- ❑ Introduction to CPP, NPN, and CPP focal species
- ❑ Train park staff and partners in NPN monitoring protocols





# CPP NPS Brainstorming

**Discussions at every park covering a wide range of topics, including:**

- ❑ **Where to monitor? What are ideal locations for CPP monitoring sites?**
- ❑ **When will park staff and partners be able to monitor CPP sites-- all year? seasonally (spring/summer)?**
- ❑ **Who will be responsible for monitoring?**
- ❑ **How will we accomplish monitoring?**



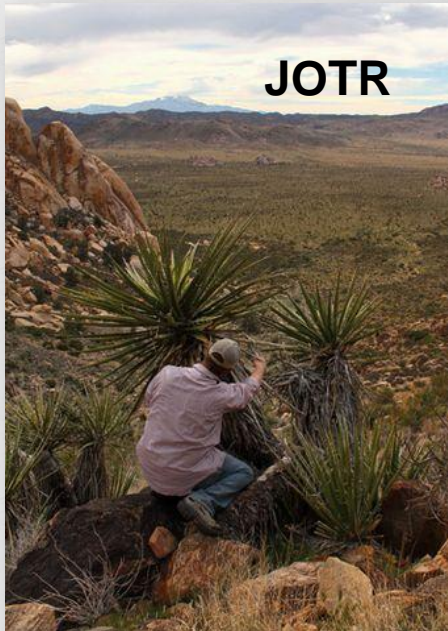
# CPP: Monitoring Infrastructure



- Go to [www.usanpn.org](http://www.usanpn.org)
  - 253+ plant species
  - 158+ animal species
  - Status monitoring
  - Core protocols
- Species on demand
- Abundance reporting
- User profiles



# CPP: Monitoring Infrastructure



**JOTR**



**REDW**



**GOGA**

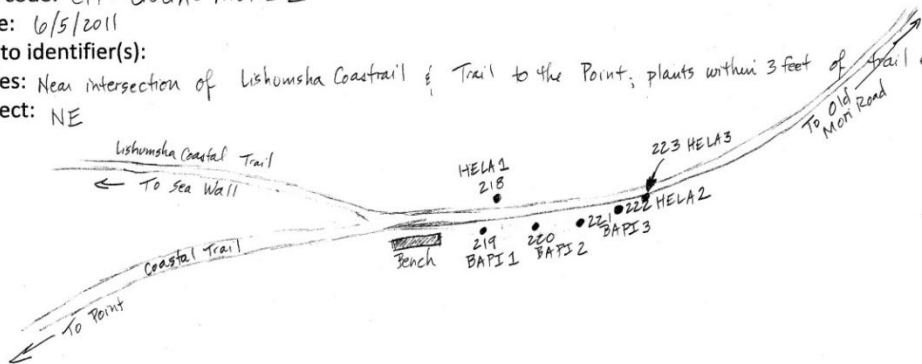
Site code: CPP-GOGA-MORI 2

Date: 6/5/2011

Photo identifier(s):

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

Aspect: NE

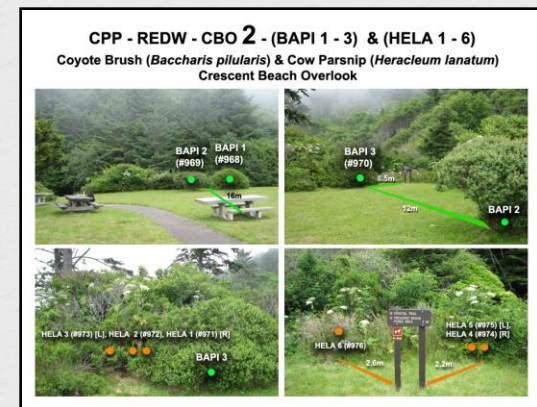
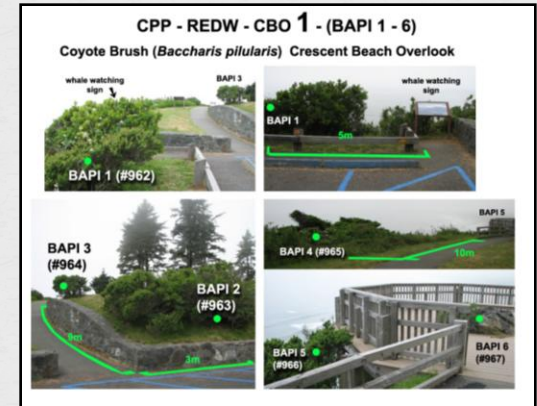
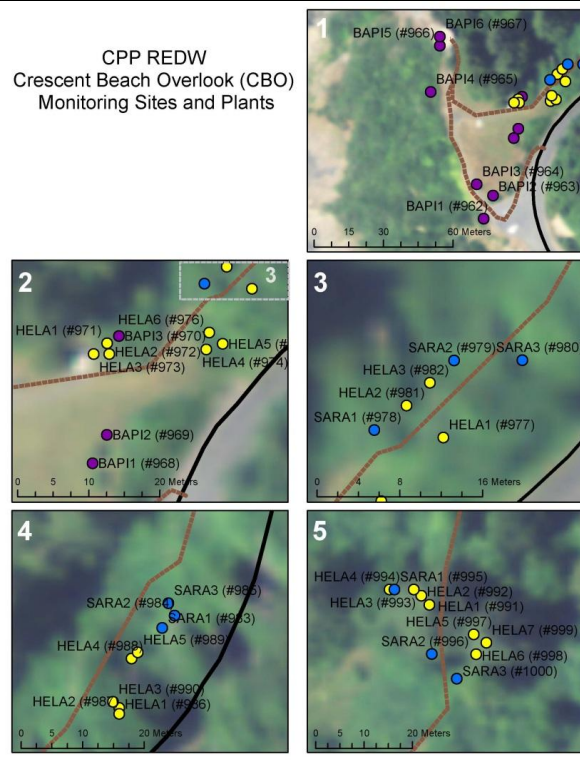


# CPP: Tools for Monitoring

CPP REDW Crescent Beach Overlook (CBO) Monitoring Sites



CPP REDW Crescent Beach Overlook (CBO) Monitoring Sites and Plants



# CPP: Tools for Monitoring

## California Phenology Project: monitoring guide for Blackbrush (*Coleogyne ramosissima*)



CPP site(s) where this species is monitored: Joshua Tree National Park



Photo credit: Stan Shebs

### What does this species look like?

This perennial desert shrub grows up to 2 meters tall with short, stiff, branched stems that are spine-like at the tip. The grey bark turns black with age or when wet and the small leaves are aromatic. The flowers lack petals but the thick sepals remain when flowers open. The sepals are yellow on the inside and reddish on the outside.

### Species facts!

- Member of the Rose family.
- *Coleogyne* is Greek for "sheathed fruit" and *ramosissima* is Latin for "many branched".
- Spiny stems protect it from browsing herbivores.
- Dependent on rodents for seed dispersal.
- Drought deciduous.
- Primarily wind pollinated.



Photo credit: Brewbooks (Flickr)

### Where is this species found?

- Mojave desert scrub and Pinyon-Juniper Woodland in the Upper Sonoran life zone.
- Association with Joshua Tree and Mojave Yucca.
- Dry well-drained sandy, or rocky soil.
- Mesas, open plains, and foothills.
- Elevations between 2500 and 7000 feet.



Photo credit: Brewbooks (Flickr)

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

## California Phenology Project: monitoring guide for Blackbrush (*Coleogyne ramosissima*)



### Phenophases to monitor:

#### 1. 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.



#### 2. Young leaves



One or more young unfolded leaves are visible on the plant. A leaf is considered "young" and "unfolded" once the leaf stalk (petiole) or leaf is visible, but before the leaf has reached full size or turned the darker green color of mature leaves on the plant. The leaf may need to be bent backwards to see whether the leaf stalk or leaf base is visible.

#### 3. Flowers



One or more fresh flowers or flower heads (inflorescences) are visible on the plant. Flower heads include many small flowers that usually do not open all at once. Do not include wilted or dried flowers that remain on the plant, or heads whose flowers have all wilted or dried.



not include wilted or dried flowers that remain on the plant.

#### 4. Open flowers

One or more open fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between unfolded or open flower parts. Do not include wilted or dried flowers that remain on the plant.

#### 5. Fruits

One or more fresh fruits are visible on the plant.

*In this species, a fruit is a crescent shaped tiny capsule that changes from green to reddish brown and drops from the plant.*



#### 6. Ripe fruits

One or more ripe fruits are visible on the plant.

*In this species a fruit is ripe when it is reddish brown.*

#### 7. Recent fruit drop

One or more fresh mature fruits or seeds have dropped or been removed from the plant since your last visit. Do not include obviously immature fruits that have dropped before ripening, such as in a heavy rain or wind.

Photo credits from top left, clockwise: B. Haggerty x4,

# CPP: Tools for Monitoring

**Species:** Coast Live Oak (*Quercus agrifolia*)

**Group Name:** \_\_\_\_\_

**Site:** Lobos Dunes-Mountain Lake (LDML)

**Subsite (#):** \_\_\_\_\_

## Phenophases



**Young leaves:** A leaf is considered young once the leaf stalk (petiole) or leaf base is visible, but before the leaf has reached full size or turned the darker green color of mature leaves on the plant.

**Fresh flower:** The flowers of the oak tree are pendulous strands of catkins (think of a strand of beads).

**Fresh fruit:** Look inbetween the leaf stalk and the main stem (the leaf armpit) to find *fresh* fruits developing.

**Ripe fruit:** The ripe fruits of the oak are acorns.

## Plant Number \_\_\_\_\_

Do you see...? (Circle Y or N)

Young leaves	<b>Y or N</b>
Fresh flower	<b>Y or N</b>
Fresh fruit	<b>Y or N</b>
Ripe fruit	<b>Y or N</b>

How many do you see?  
Less than 3 (<3); 3 to 10; More than 10 (>10)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Plant Number \_\_\_\_\_

Do you see...? (Circle Y or N)

Young leaves	<b>Y or N</b>
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Young leaves	<b>Y or N</b>
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Do you see...? (Circle Y or N)

Young leaves	<b>Y or N</b>
Fresh flower	<b>Y or N</b>
Fresh fruit	<b>Y or N</b>
Ripe fruit	<b>Y or N</b>

How many do you see?  
Less than 3 (<3); 3 to 10; More than 10 (>10)

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# Anticipated Project Outcomes

- ❑ **Framework for Plant Phenology Monitoring for ALL California NPS Units**
  - target species w/supporting profiles & phenophase definitions
  - documented monitoring, data management & outreach protocols
  - implementation plan for extending monitoring to all CA NPS units
- ❑ **An engaged phenology network with multiple partners in CA**
- ❑ **Detailed monitoring protocols following NPS Inventory & Monitoring Program conventions for target species in pilot parks**
- ❑ **Evaluation of outreach tools including measures of efficacy and data quality of each approach**
- ❑ **A wide variety of educational and training materials for NPS park phenology monitoring programs**
  - project briefs, podcasts, articles, how-to manuals
  - training video for those joining the project at a later date
- ❑ **CA Phenology Network Webpage (tiered to USA-NPN)**

# CPP-CNPS Collaboration ??

- How do we best collaborate?
- Determine level of CNPS interest in CPP?
- January Conference – dedicated session on phenology/CPP ?
- Article on CPP for CNPS newsletter ?
- IDEAS .....





# CPP Project Coordination Team

## *UCSB - Phenology Stewardship Program:*

**Dr. Susan Mazer, Dr. Liz Matthews, Brian Haggerty**

## *USA NPN – National Coordinating Office:*

**Dr. Jake Weltzin, Dr. Kathy Gerst, and others**

## *NPS Project Coordination Team :*

**Dr. Angie Evenden, CA-CESU (lead)**

**Dr. Christy Brigham – Santa Monica Mountains NRA**

**Sylvia Haultain – Sequoia & Kings Canyon NPs**

**Josh Hoines– Joshua Tree NP**

**Stassia Samuels – Redwood NP**

**Janet Coles – Lassen Volcanic NP**

**Sue Fritzke –Golden Gate NRA**

**Ben Becker – Point Reyes NS**



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

Please contact us!

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