

Tracking the effects of climate change on wild plant life cycles: monitoring phenology in the field

Susan Mazer, PhD

Liz Matthews, PhD



This morning's presentation

- What is phenology?
- How is phenology related to climate and climate change?
 - Case studies
- California Phenology Project (CPP)
- USA National Phenology Network (USA-NPN)
- Incorporation of phenological monitoring into outdoor education programming
- Your creativity here: break-out sessions to invent and practice ways of introducing phenology to kids



OUTLINE

- Brief introduction to phenology
- The California Phenology Project (CPP)
- USA National Phenology Network (USA-NPN)
- Crash course in botany
- Nuts and bolts of phenological monitoring– *hands on practice outside!*



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Phenology is the science of the seasons



Spring wildflowers



Foliage color change



Migration patterns

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

Phenology is the science of the seasons



Spring wildflowers



Foliage color change



Migration patterns

Other examples?



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

Comox indians use 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 can predict harvest times of animals

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 people:
plant phenophases at one location can predict harvest
times for plants at another location

Wampanoag tribe of Cape Cod (Massachusetts) claimed that
the best time to plant corn was when the leaves of white
oak (*Quercus alba*) were the same size as the footprint of a
red squirrel (*Tamiasciurus hudsonicus*)



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California Phenology Project: Goals

establish a California-wide phenological monitoring network to monitor across a large geographic area and along key environmental gradients



allow the CPP and each park to:

- (1) address important scientific questions,
- (2) guide resource management decisions, and
- (3) engage and educate people of all backgrounds and ages about phenology and climate change research through Citizen Science!**



CPP: monitoring infrastructure

REDW



GOGA



CPP: monitoring infrastructure



Monitoring by Citizen Scientists

1. Visit and monitor labeled and mapped 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
(e.g., Plants in a schoolyard)
3. Visit and monitor unlabeled plants whose location you're familiar with
(e.g., the big tree at the corner)
4. Visit and monitor unlabeled plants one time, or opportunistically
(e.g., plants you encounter while hiking the Pacific Crest Trail)

CPP: outreach and education



California Phenology Project

www.usanpn.org/cpp

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



- About
- Meet the Species**
- Phenology in the Parks
- Education
- Participate
- Resources
- News

California Phenology Project

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 areas, and building upon existing monitoring protocols and programs of project collaborators. However, 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 get 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 learn more about the project partners who are currently spearheading this effort.



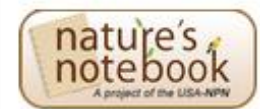
Recent news

Upcoming public workshops at Lassen Volcanic NP, Lava Beds NM, and more! Visit the **news** tab for details.

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Download the CPP **Fall Newsletter** and **Project Update**



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All Species

- [Aspen \(*Populus tremuloides*\)](#)
- [Beach Pea \(*Lathyrus littoralis*\)](#)
- [Blackbrush \(*Coleogyne ramosissima*\)](#)
- [Blue Elderberry \(*Sambucus nigra ssp. cerulea*\)](#)
- [Blue Oak \(*Quercus douglasii*\)](#)
- [California Buckeye \(*Aesculus californica*\)](#)
- [California Buckwheat \(*Eriogonum fasciculatum*\)](#)
- [California Live Oak \(*Quercus agrifolia*\)](#)
- [California Poppy \(*Eschscholzia californica*\)](#)
- [Chamise \(*Adenostoma fasciculatum*\)](#)
- [Coast Rhododendron \(*Rhododendron macrophyllum*\)](#)
- [Common Compassplant \(*Hesperaloe parviflora*\)](#)
- [Coyotebrush \(*Baccharis pilularis*\)](#)
- [Creosote \(*Larrea tridentata*\)](#)
- [Greenleaf Manzanita \(*Arctostaphylos patula*\)](#)
- [Honey Mesquite \(*Prosopis glandulosa*\)](#)
- [Joshua Tree \(*Yucca brevifolia*\)](#)
- [Lodgepole Pine \(*Pinus contorta*\)](#)
- [Mojave Yucca \(*Yucca schidigera*\)](#)
- [Mountain Pride \(*Penstemon newberryi*\)](#)
- [Pacific Trillium \(*Trillium ovatum*\)](#)
- [Ponderosa Pine \(*Pinus ponderosa*\)](#)
- [Red Elderberry \(*Sambucus racemosa*\)](#)
- [Satin Lupine \(*Lupinus obtusilobus*\)](#)
- [Sticky Monkeyflower \(*Diplacus aurantiacus*\)](#)
- [Valley Oak \(*Quercus lobata*\)](#)

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Coyotebrush (*Baccharis pilularis*)

Wed, 08/31/2011 - 17:40 — [lizmatthews03](#)



Baccharis pilularis is a shrub in the Aster family that can be up to three meters tall. The leaves are toothed, oval, and sticky. Coyotebrush is dioecious, meaning each plant has flowers with either all male parts or all female parts. The male flowers produce pollen and are yellowish, and the female flowers produce fruit and are white (see photos of male and female flowers on the CPP species profile). The CPP four letter code for this species is **BAPI**.

This species is currently being monitored at Santa Monica Mountains NRA, Redwood NP, and Golden Gate NRA.

Download the USA-NPN datasheet for *Baccharis pilularis* [here](#).

Download the CPP species profile for *Baccharis pilularis* [here](#).

For additional information about this species, visit these pages:

[Baccharis pilularis on the USA-NPN website](#)

[Baccharis pilularis on Calflora](#)

[Baccharis pilularis on USDA PLANTS](#)

[Golden Gate National Recreation Area](#) [Redwood National Park](#) [Santa Monica Mountains National Recreation Area](#)

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USA-NPN datasheets

Trees and Shrubs *Broadleaf evergreen (with pollen, no leaf buds)*

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.



Nickname: _____

Species: coyotebrush

Site: _____

Year: _____

Observer: _____

	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 ? ____
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:								

	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 ? ____
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"/>





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Coyotebrush (*Baccharis pilularis*)

Wed, 08/31/2011 - 17:40 — lizmatthews03



Baccharis pilularis is a shrub in the Aster family that can be up to three meters tall. The leaves are toothed, oval, and sticky. Coyotebrush is dioecious, meaning each plant has flowers with either all male parts or all female parts. The male flowers produce pollen and are yellowish, and the female flowers produce fruit and are white (see photos of male and female flowers on the CPP species profile). The CPP four letter code for this species is **BAPI**.

This species is currently being monitored at Santa Monica Mountains NRA, Redwood NP, and Golden Gate NRA.

Download the USA-NPN datasheet for *Baccharis pilularis* [here](#).

Download the CPP species profile for *Baccharis pilularis* [here](#).

For additional information about this species, visit these pages:

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CPP species profiles

California Phenology Project: monitoring guide 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.



Photo credit: Jerry Kirkhart (Flickr)



Photo credit: KQED QUEST (Flickr)

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.

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: monitoring guide 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.



Flowers or flower buds

When monitoring flower 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.

Miguel Viera



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



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.

Crystal Anderson



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**



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Education

The California Phenology Project is working at all levels to cultivate phenological and climate literacy. From elementary school classrooms to university labs, and from natural reserves to urban gardens, the CPP is developing and implementing a variety of educational, outreach, and scientific training resources.

Whether you're looking for a simple hands-on activity for the backyard or schoolyard, or you're in need of a guide to plan, install, and use a phenology garden for year-round scientific and educational activities, you'll find over 25 phenology-focused resources on our Education pages. These resources are designed by CPP scientists and educators for a variety of ages and scientific abilities.



To browse and download our resources, we suggest that you first identify your intended audience in the table below and then explore the appropriate resources.

We would value your feedback when you use these resources with your own audiences – so please let us know what works, what doesn't, and how you've integrated these resources with your programs.

X = Suitable for everyone within audience (X) = Suitable/adaptable for advanced groups
 A complete list of our resources is [available here](#).

	Intended Audience			
	'Formal' education settings (K-12)	'Informal' education settings	Public	College
Phenology Gardens Learn how to integrate phenology into garden design and planning, and then run our activities in them.	X	X	X	X
Hands-on interactive activities (outdoor/indoor) There's something for everyone here! Games, activities, lessons, and other creative ways of integrating phenology into new or existing programs.	X	X	X	X
Herbarium-based phenology activities Learn how to explore preserved plants in your own region to study phenology and climate change.	(X)	X	X	X
Computer-based data exercises Using real phenological data from a CPP research project, follow a step-by-step guide to process, analyze, and visualize the data in Microsoft Excel.	(X)	X	X	X
Annotated lectures Deliver a scripted presentation to your own audience.	(X)	X	X	X
Seminar modules Dive into the scientific literature with these guided discussion modules.		(X)	(X)	X

CPP: outreach and education

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



California Poppy Open Flower

© Br. Alfred Brousseau, Saint Mary's College



California Poppy Buds

© Jo-Ann Ordario, California Academy of Sciences

PHENOLOGY GARDENS

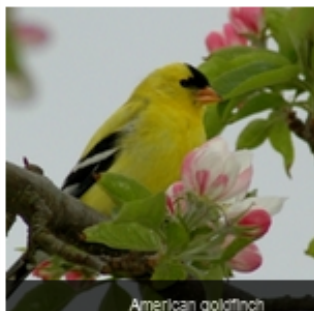
A PRACTICAL GUIDE FOR INTEGRATING PHENOLOGY INTO GARDEN PLANNING AND EDUCATION



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- **USA National Phenology Network (USA-NPN)**
- Crash course in botany
- Nuts and bolts of phenological monitoring– *hands on practice outside!*





American goldfinch
[View All Species](#)

Join Us!

We are looking for volunteers to help us monitor plant and animal species found across the United States. Click "Nature's Notebook" to join us!



Become a citizen scientist in Nature's Notebook today!

Visualization Tools



USA National Phenology Network

The USA National Phenology Network brings 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. The network harnesses the power of people and the Internet to collect and share information, providing researchers with far more data than they could collect alone.

[Learn more about us](#)

[USA-NPN News](#) [Phenology Feed](#) [Join the Conversation](#)

- ▶ Phenology 2012 Registration Open (Student Scholarships Available)
- ▶ Mobile Apps for iPhone and Android now available in app stores!
- ▶ Phenology on NPR's All Things Considered and The Diane Rehm Show
- ▶ Phenology Camera live at USGS Headquarters in Reston
- ▶ USA-NPN Co-organizing Citizen Science Conference in August
- ▶ Explore Local and Regional Phenology-Oriented Groups
- ▶ Phenology and USA-NPN highlighted in agency and White House reports

- ▶ Recent Media Reports
- ▶ Newsletter Archive
- ▶ Jobs, Fellowships and Volunteer Opportunities

What does observing lilacs right now have to do with the White House next year?



Geographic Affiliates



Explore local and regional phenology-oriented groups.

Top Observers This Week

1	Ellen@ME	54
2	Richard@CA	53
3	Steven@MN	30
4	Bridget@ME	29
5	Merrill@AK	27

[See all leaderboards.](#)

Countdown to One Million

Observations: 942,958

We are nearing the millionth observation record in our database. Help us get there!



Are you...?

- New to phenology?
- Ready to start observing?
- One of our partners?
- Interested in creating a partnership?
- An educator?
- Interested in finding data to use?
- A media outlet?

nature's notebook

a project of the USA-NPN



www.usanpn.org

- 500+ plant species
- 160+ animal species
- Core protocols

1 
Search plants & animals

2 
Learn how to observe

3 
Register yourself

4 
Start reporting

USA-NPN: Nature's Notebook

Standard protocols for plants, animals, and landscapes



Each life form is monitored for a different set of phenophases:

- Evergreens
- Cacti
- Conifers
- Deciduous
- Forbs
- Grasses
- Annual wildflowers



Using USA-NPN datasheets



Baccharis pilularis
Coyotebrush



Using USA-NPN datasheets



Baccharis pilularis Coyotebrush

Trees and Shrubs *Broadleaf evergreen
(with pollen, no leaf buds)*

	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time:	Time:	Time:	Time:	Time:	Time:
Young leaves	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 ?
Open flowers	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 ?
Fruits	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 ?
Recent fruit or seed drop	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"/>

Comments:

Using USA-NPN datasheets



Coyotebrush

(*Baccharis pilularis*)



Phenophase Definitions

Directions:

As you report on phenophase status (Y, N or ?) on the datasheets, refer to the definitions on this sheet to find out what you should look for, for each phenophase in each species. To report the intensity of the phenophase, choose the best answer to the question below the phenophase, if one is included. Feel free not to report on phenophases or intensity questions that seem too difficult or time-consuming.



	Date:	
Do you see...	Time:	
Young leaves	y n ? _____	y
Flowers or flower buds	y n ? _____	y
Open flowers	y n ? _____	y
Pollen release	y n ? _____	y
Fruits	y n ? _____	y
Ripe fruits	y n ? _____	y
Recent fruit or seed drop	y n ? _____	y
Check when data entered online:	<input type="checkbox"/>	

Do you see...

Young leaves

Flowers or flower buds

Open flowers

Pollen release

Fruits

Ripe fruits

Recent fruit or seed drop

Check when data entered online:

Comments:

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;

Flowers

Flowers or flower buds

One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds that are still developing, but do not include wilted or dried flowers.

How many flowers and flower buds are present? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), simply estimate the number of flower heads, spikes or catkins and not the number of individual flowers.

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

Open flowers

CPP species profiles

California Phenology Project: monitoring guide 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



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**.

Photo credit: stonebird (Flickr)

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.



Photo credit: Jerry Kirkhart (Flickr)



Photo credit: KQED QUEST (Flickr)

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.

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: monitoring guide 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.



Flowers or flower buds

When monitoring flower 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.

Miguel Viera



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



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.

Crystal Anderson



Steven Krause

Ripe fruits

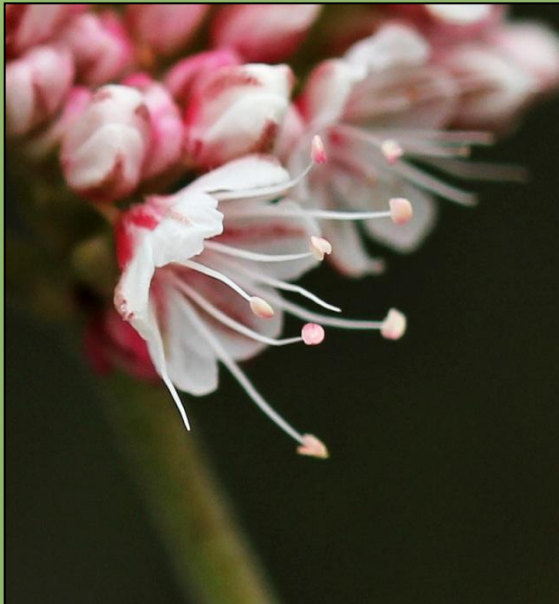
The fruit is considered ripe when it is tan or light brown.
Note: fruit phenophases are nested; if you record **Y** for "ripe fruits" you should also record **Y** to "fruits"

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

Using USA-NPN datasheets



Eriogonum fasciculatum
California buckwheat



Using USA-NPN datasheets



Eriogonum fasciculatum California buckwheat

Trees and Shrubs *Semi-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.



Nickname: _____
Species: Eastern Mojave buckwheat
Site: _____
Year: _____
Observer: _____

	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 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:

CPP species profiles

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



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



Photo credit: wanderingnome (Flickr)

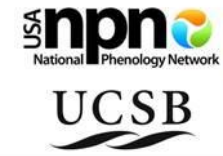
Where is this species found?

- 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.

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)

Version 2, March 2012

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



Cait McHugh and Anjaneta 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 to "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**

Version 2, March 2012

OUTLINE

- Brief introduction to phenology
- The California Phenology Project (CPP)
- USA National Phenology Network (USA-NPN)
- **Crash course in botany**
- Nuts and bolts of phenological monitoring– *hands on practice outside!*



Basic Botany Review

Vegetative structures

- Leaves and stems

Reproductive structures

- Flower buds, flowers, fruits & seeds

Pollination → Fertilization → Seeds & Fruits develop

Do you see...?

Breaking leaf buds

Leaves

Increasing leaf size

Flowers

Open flowers

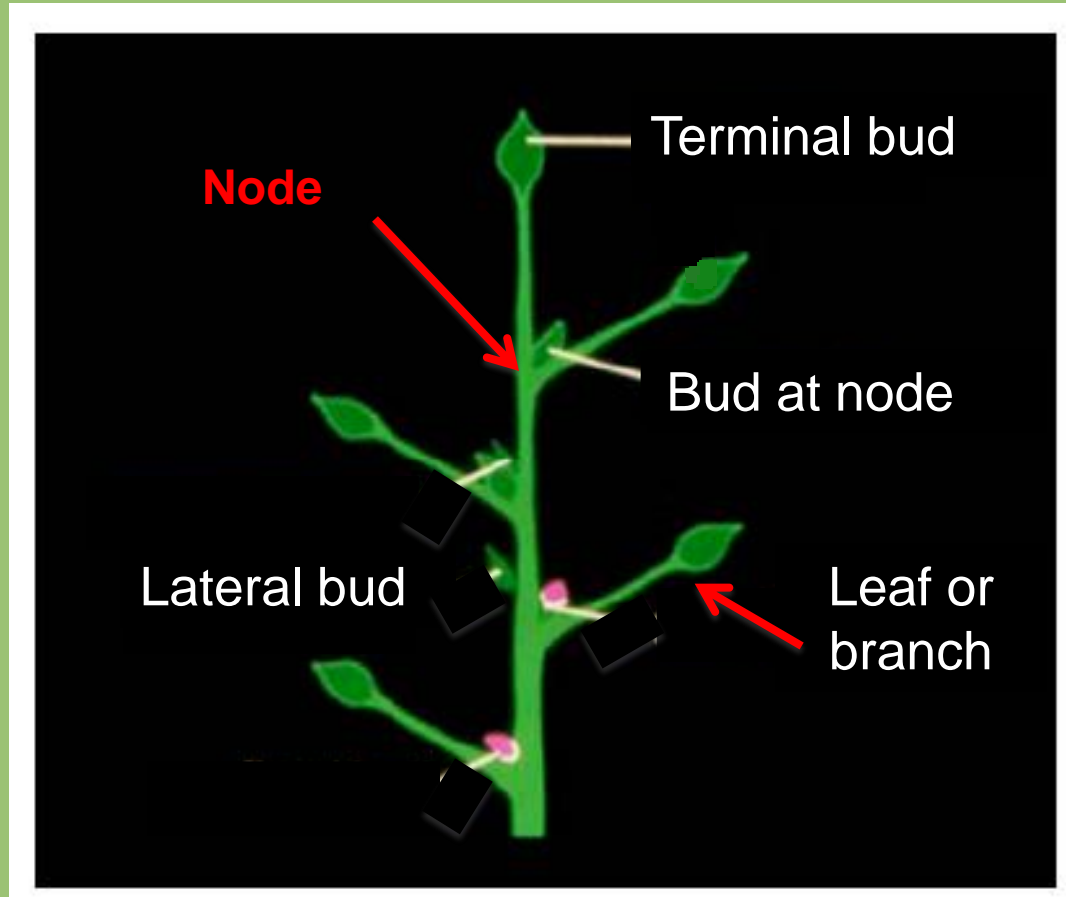
Pollen release

Fruits

Ripe fruits

Recent fruit drop

Basic Botany Review



Buds may be found in several locations. Leaves ALWAYS have a bud in their axil, even though it may be very small

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

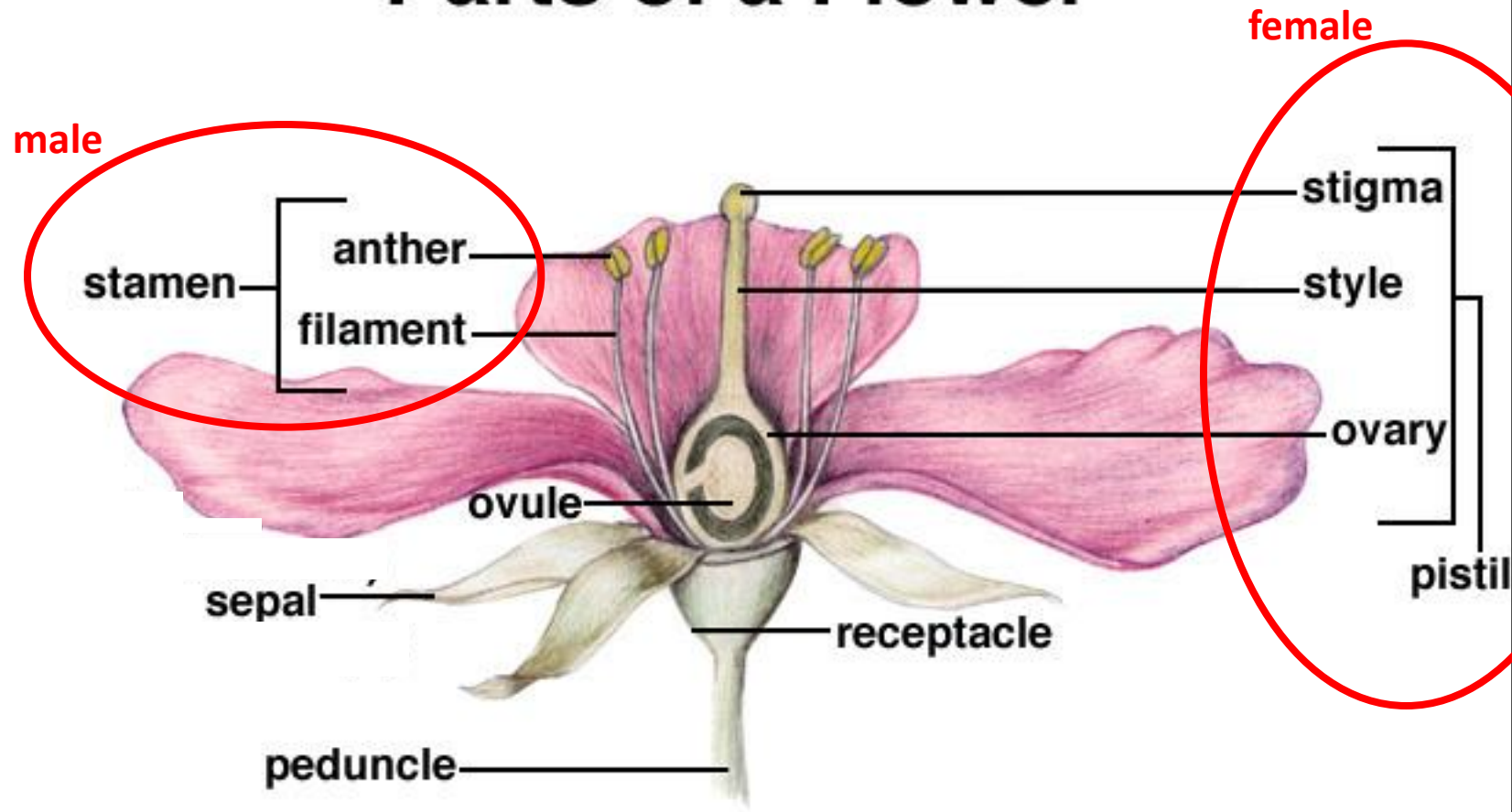


Reproductive structures: flower buds, open flowers, and fruits



Reproductive structures: flower buds, flowers, fruits & seeds

Parts of a Flower



Pollination & fertilization

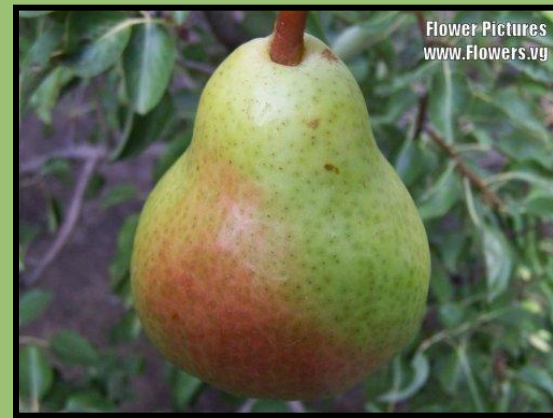
Reproductive structures: flower buds, flowers, fruits & seeds



The elegant Clarkia: *Clarkia unguiculata*



→
pear



→
orange



→
eggplant



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