UC Santa Cruz Arboretum Phenology Walk

Illustrations by Jazmin Gasca-Correa

Phenology is the timing of life cycle events, for example: when plants first bloom, birds migrate, and insects hatch. You will be collecting phenology data for several plants here in the UC Santa Cruz Arboretum Native Plant Garden.

Why is phenology important?

Timing of life cycle events can influence species interactions such as pollination and herbivory. For example if plants bloom before pollinating insects have hatched then plants cannot reproduce and pollinators will not have a food source. As humans we rely on phenology to know when to plant crops, to track high allergen times, and for cultural events such as cherry blossom festivals. Finally many species, plant and animal, have shifted their phenologies in response to climate change.

Why is the data YOU collect important?

The data you collect at the UC Santa Cruz Arboretum contributes to the USA-National Phenology Network's national database of phenology observations. The USA-NPN has standardized protocols for collecting data, so it can be used by scientists, land-managers, policy makers, or you to study phenology patterns. Also, UC Santa Cruz is a research institution, so the data you collect might be used for a research project right here!

Instructions

There are 6 species, with 3 individuals or plots (replicates) of each species, permanently marked for you to observe. Each individual plant or plot will have a sign labeled "Phenology Walk" with the name of the species and a number (1 through 3). The number designates which individual or plot of that species you are observing, since there are 3 of each species. To help you find your way maps are provided with marker numbers for each plant.

1) For each plant, find the datasheet that corresponds to that species. On that species' datasheet, find the row with the appropriate replicate number. The columns are the life cycle stages, or "phenophases", that you will be collecting data for. They generally describe leaves, flowers and fruit.

2) Flip to the page in this booklet that corresponds to your species. This describes how to observe each phenophase for that species. Based on these descriptions, fill in the information for each phenophase on that species' datasheet in the row that corresponds to the plant's replicate number.

For species that ask you to observe within a plot, limit your observations to the plants within the boundaries of the 4 stakes, which is the plot. If you have any doubts, circle the "?" on the datasheet.

Drop your datasheet in the dropbox provided—staff at the UC Santa Cruz Arboretum will enter your data into the USA-National Phenology Network's database.

If you have a smartphone or tablet: you can download the Nature's Notebook app and create an account. Join the UC Santa Cruz Arboretum group and record data using your device. The app automatically uploads your data to the USA-National Phenology Network's database. We recommend you only record data for the phenophases we describe in the booklet.

Thank you for your contribution!

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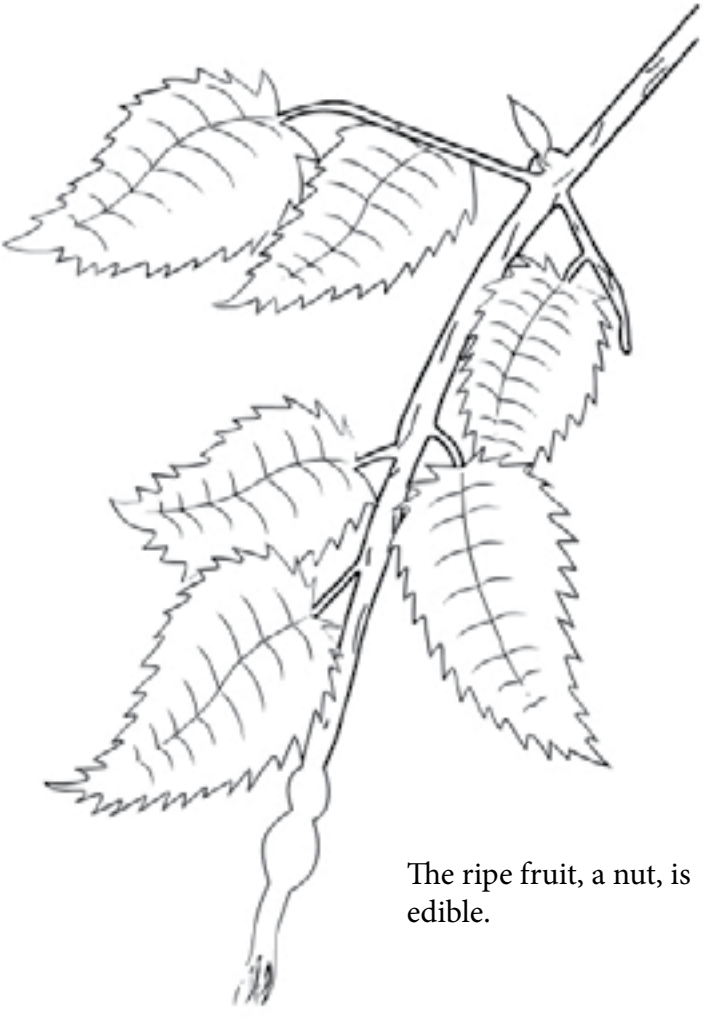
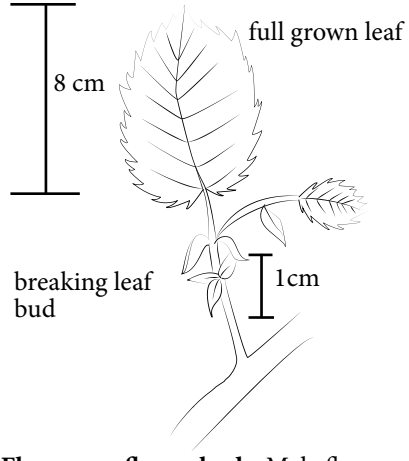
(Listed alphabetically)

Corylus cornuta
(Hazelnut)



The ripe fruit, a nut, is edible.

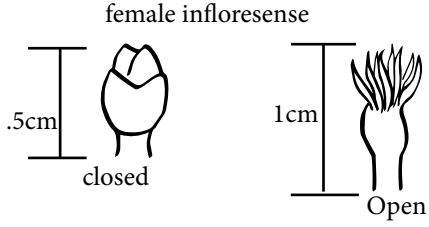
Tree can grow up to 8m

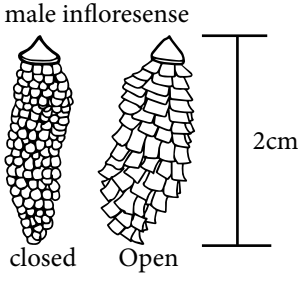


Breaking leaf buds: A leaf bud is broken when:
1) seperate leaves are visible, one or more individual leaves are coming out, AND
2) the leaf stalks (petioles) are not visible yet.
Estimate the number of breaking buds.

Colored leaves: Hazelnut trees drop thier leaves in the fall, and the leaves will turn yellow before they drop. Estimate the percentage of leaves that are colored yellow.

Flowers or flower buds: Male flowers hang in cylindrical clusters (catkins) from the branches. Female flowers are gray/brown buds, considered open when protruding red tufts (pistils) are visible. Estimate the number of male catkins and female flowers both open and unopened. Do not include dry/dead flowers

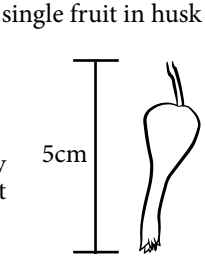


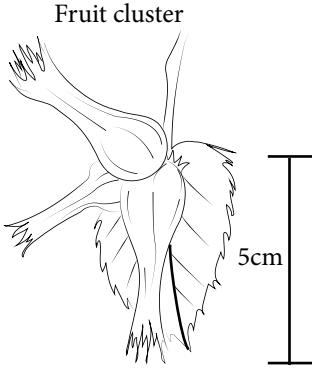


Open flowers: Male flowers are open when flower clusters are packed loosely together (with space between each individual) versus packed compactly and stiffly. Female flowers are open when protruding red tufts are visible. Estimate the percentage of male catkins and female flowers combined that are open. Do not include dry/dead flowers

%=#open flowers ÷ (#unopen+ #open flowers)

Pollen release: Gently shake the open male catkins, are yellow pollen grains released?



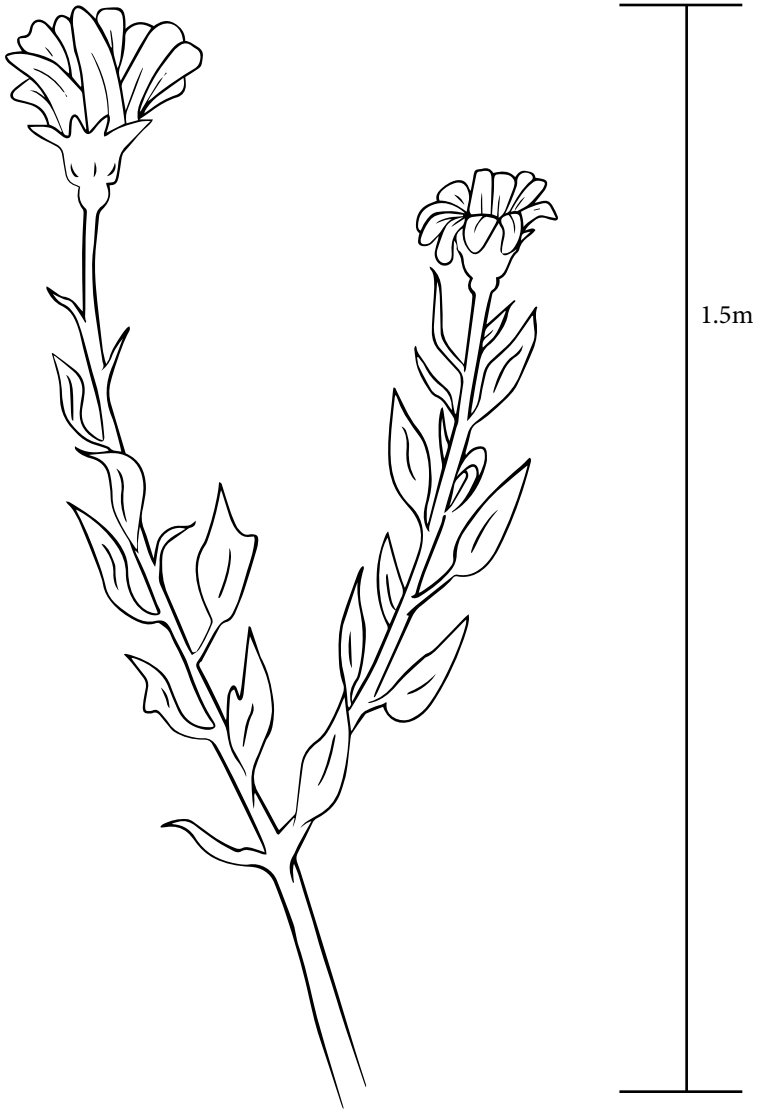


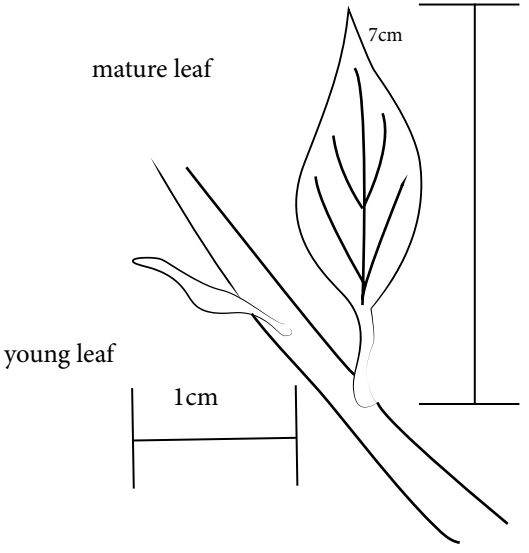
Fruits: Estimate the number of fruits, both unripe (husks are fuzzy and green) and ripe (husks and nut are brown).

Ripe fruits: Ripe fruits have brown husks and nuts. Estimate the percentage of fruits that are ripe:
% = #ripe ÷ (#ripe + #unripe)

Encelia californica (California brittlebush)

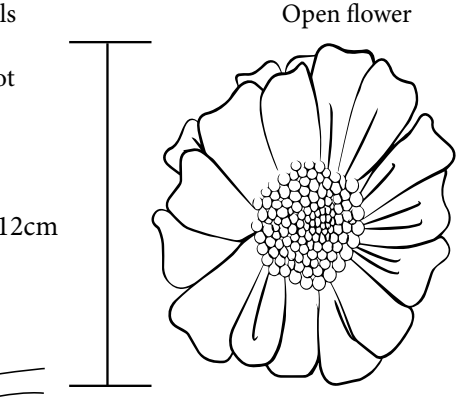
California bush sunflower.

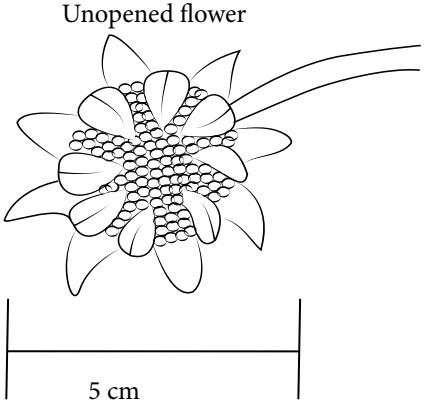




Young leaves: The leaf stalk is present, but when compared to the mature leaves, they are:
1) Lighter in color, or
2)Smaller, or
3) Less tough

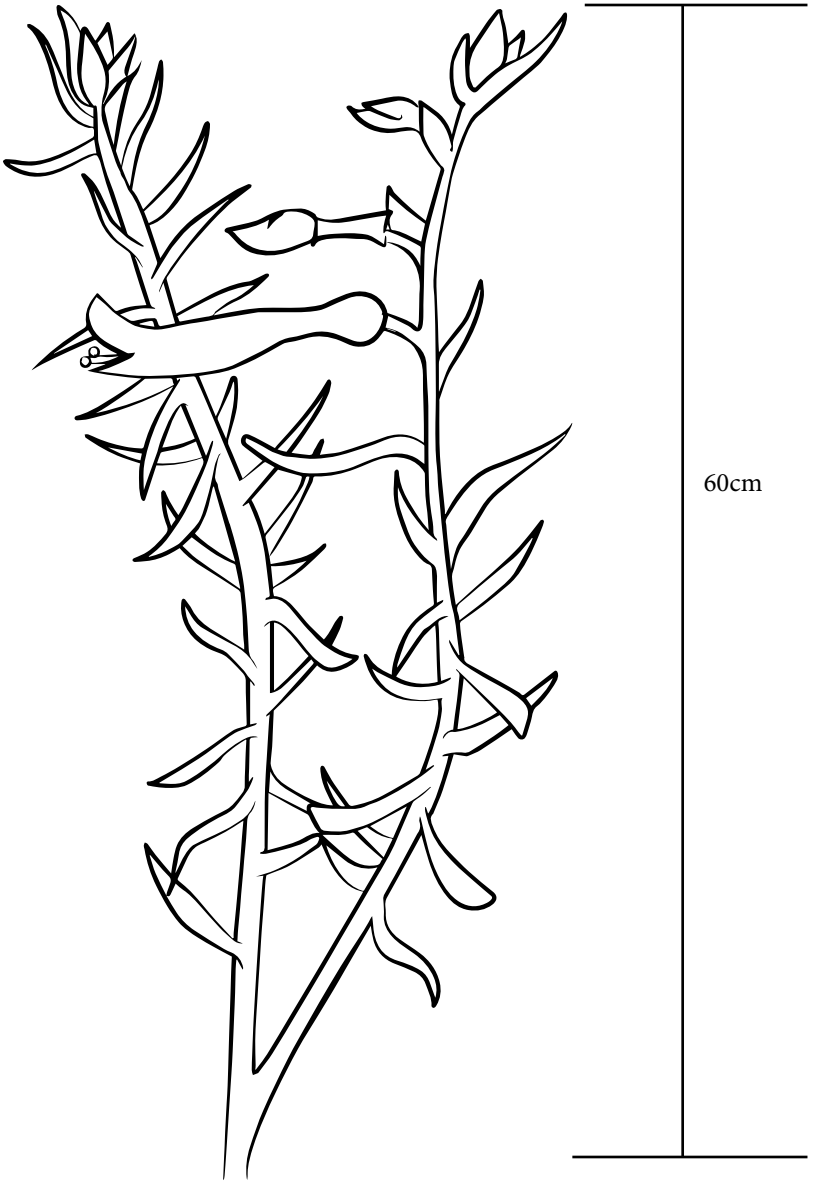
Flowers: Estimate the number of flower heads on the plant. Include unopen (base of the flower is green, but yellow petals are not visible yet) and open (yellow petals are visible) flower heads. Do not include dry/dead flower heads.

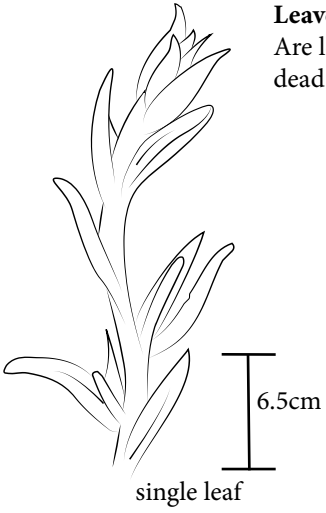




Epilobium canum
(Hummingbird Trumpet)

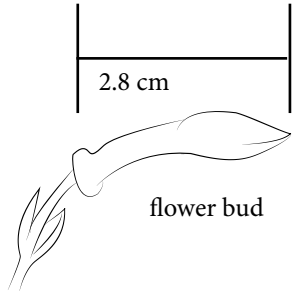
Also referred to as California fuchsia. Blooms in late summer/early fall. Attracts hummingbirds.





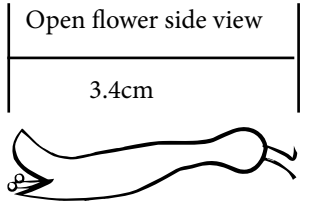
single leaf

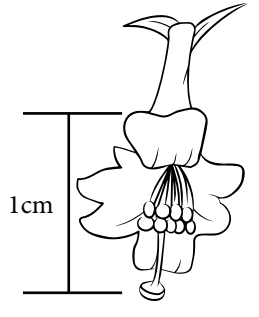
Leaves: Leaves are light green or gray. Are leaves present? (Do not include dry/ dead leaves)



Flowers: Flowers are red and tubular with 8 petal lobes. Estimate the number of buds and open flowers within the plot. (Do not include dry/dead flowers).

Open flowers: Flowers are open when reproductive parts are visible. Estimate the **Percentage of flowers that are open:**
% = #open flowers ÷ (#buds + #open flowers)

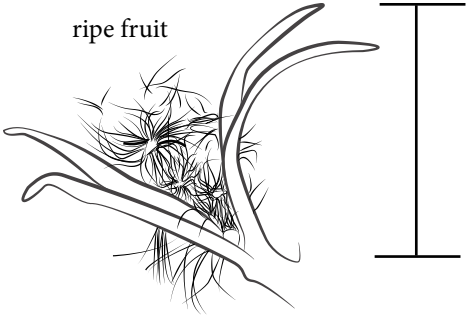




open flower front view

unripe fruit

ripe fruit

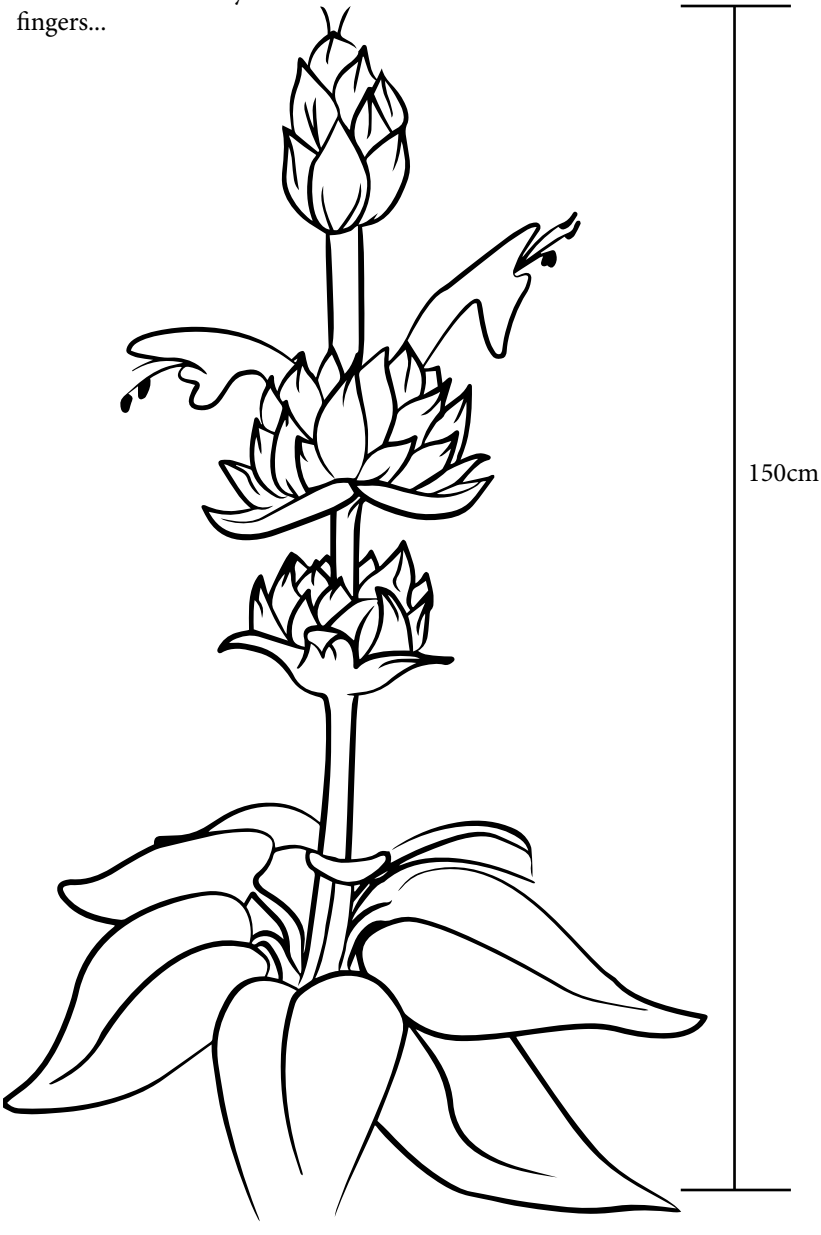


Fruits: Estimate the number of unripe and ripe fruits within the plot. Unripe fruits are green to dark red, linear in shape and hard.

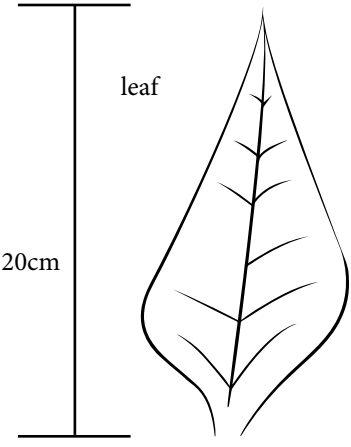
Ripe fruits: Ripe fruits are tan or light brown and have split open to expose seeds with fluff.

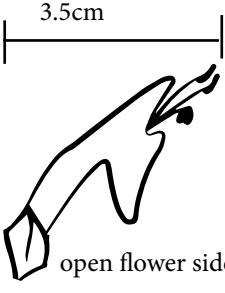
Salvia spathacea
(Hummingbird Sage)

Hummingbird sage is a member of mint family; rub the leaves and smell your fingers...



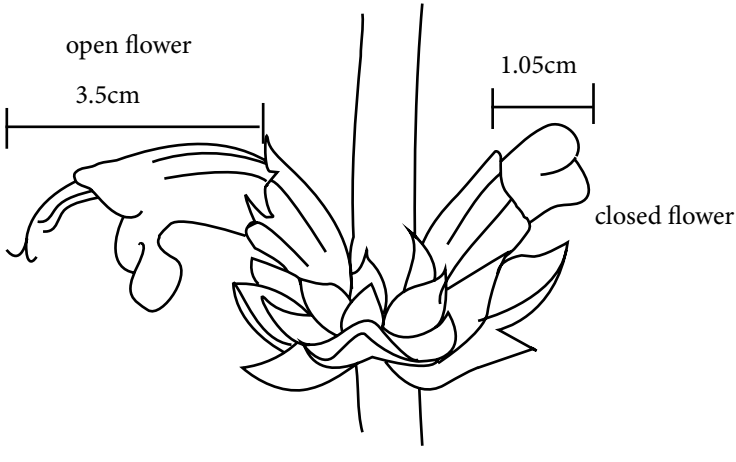
Leaves: Are leaves present? (Do not include dry/dead leaves)





Flowers: Flowers are dark pink, tubular, and bilaterally symmetrical. Flowers are in bud if:
1) Pink petals are visible, protruding from brown/green, hairy, sticky calyx (petals are **NOT** hairy or sticky), and
2) reproductive parts are not visible, not protruding from petals.
Estimate the number of buds and open flowers within the plot. (Do not include dry/dead flowers).

Open flowers: Flowers are open when reproductive parts are visible. Estimate the percentage of flowers that are open:
% = #open flowers ÷ (#buds + #open flowers)

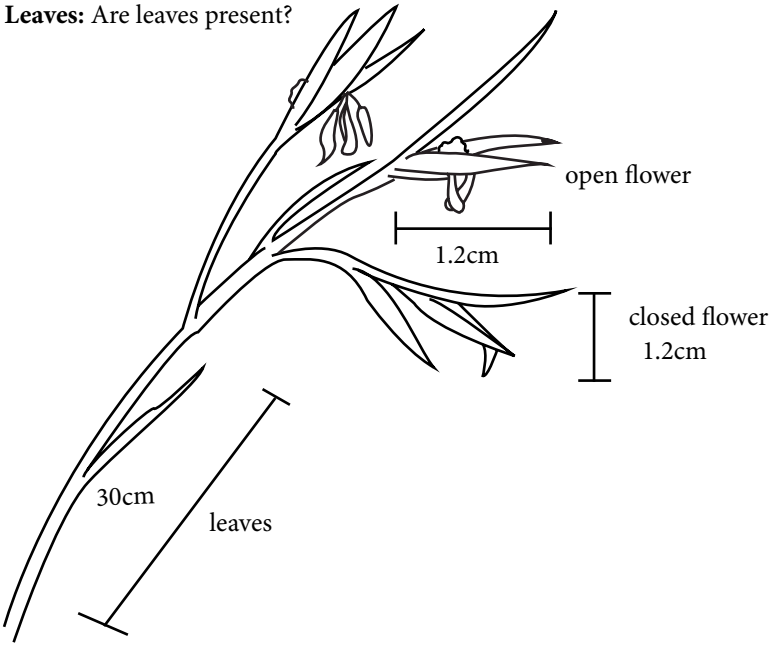


Stipa pulchra

(formerly *Nassella pulchra*; Purple needlegrass)

California's state grass

Leaves: Are leaves present?

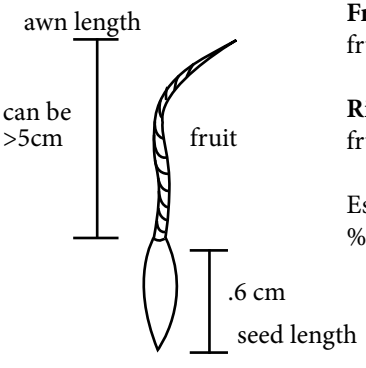


Flower heads: How many flower heads (spikelets) are present within the plot?

Open flowers: Flowers are open when reproductive parts hang out of the spikelet.

Are open flowers present?

Pollen release: Gently shake the open flowers, is pollen released from the reproductive parts?



Fruits: Estimate the number of unripe and ripe fruits within the plot. Unripe fruits are green.

Ripe fruits: Fruit is purple. Squeeze the fruit, ripe fruits are hard or fall off the plant when touched.

Estimate the percentage of ripe fruits:
% = #ripe ÷ (#ripe + #unripe)

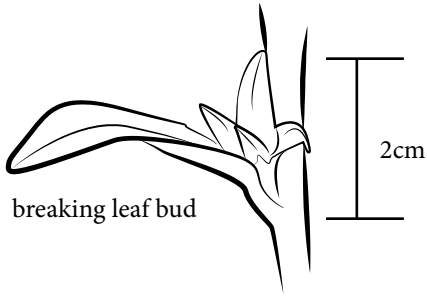
Vaccinium ovatum

(California huckleberry)

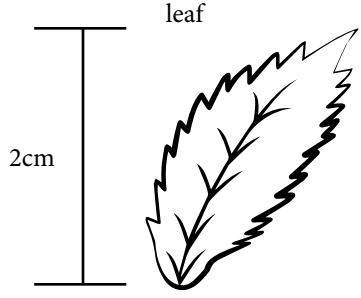
Related to blueberries and cranberries, edible.

Tree can grow up to 150cm.

Breaking leaf buds: Breaking leaf buds are often at the tips of the branches. The green leaf tip is visible on the end of the bud, but the leaf stalk (petiole) is not visible yet. Estimate the number of breaking buds.



Young leaves: The leaf stalk is present, but when compared to mature leaves they are:
1) Lighter in color, or
2) smaller, or
3)less tough.
Estimate the number of young leaves.

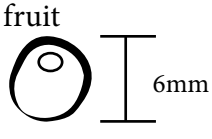


Flowers: Flowers are white with pink and bell shaped, hanging downward. Flowers are in bud if:
1)white/pink petals are visible, and
2) reproductive parts are not visible, not protruding from the inside flower bell.
Estimate the number of flowers.

closed flower

Open flower

Open flowers: Flowers are open when the bottom of the "bell" is open to expose the reproductive parts. Flowers are not yet open when the bottom of the "bell" is closed.



Fruits: Fruits are shaped similarly to a blueberry, they are green to red (unripe) to deep purplish-black (ripe). Estimate the number of fruits.

Ripe fruits: Ripe fruits are completely deep purplish black. Estimate the percentage of fruits that are ripe:
% = #ripe ÷ (#ripe + #unripe)

FAQ

Q: What is the USA-National Phenology Network?
A: The USA-NPN is an organization that develops standardized protocols for collecting phenology data. Then, researchers, students, volunteers and citizen scientists use these protocols to collect phenology data all across the USA. This data is managed by the USA-NPN and is used by researchers, land managers, and policy makers. Also, all the data is available to the public. Visit https://www.usanpn.org for more information.

Q: Why is it important to monitor the same individuals and plots from year to year?
A: By monitoring the same individuals and plots from year to year we can assume that any phenological changes we observe are due to environmental change over time, and NOT due to the location or genetics of the plants.

Q: Why monitor multiple individuals for each species?
A: Scientists require replication to ensure results are consistent. This also accounts for differences due to the locations of the plants.

Q: Why monitor species year round, even when they are dead or dormant?
A: This is important information too! It provides information about the length of the growing season, like whether plants are dying earlier in the season, or if the dormancy period is longer.

FAQ (cont)

Q: I am using the Nature's Notebook app and see that some phenophases are not included in the booklet and datasheets provided by the UC Santa Cruz Arboretum. Why are some phenophases included, but not others?
A: We only included the phenophases that we thought were unambiguous and simplest to record data for. However, if you want to record all the phenophases in your Nature's Notebook account, please feel free to do so.

Q: I also want to observe phenology outside the UC Santa Cruz Arboretum and still contribute to the USA-National Phenology Network. How can I do this?
A: Create a Nature's Notebook account, visit:
https://www.usanpn.org/natures_notebook
Using Nature's Notebook you can create your own "Sites" in which to observe phenology, and choose from a wide-variety of plants and animals to observe. For example you can observe anything from plants in your garden, to wildlife at a local open-space, to birds at your bird feeder. All of this data is valuable for scientists, land managers, and policy makers.