Building a phenological monitoring network in California as a model for the nation

E. Matthews, S. Mazer, A. Evenden, K. Gerst, C. Brigham, J. Coles, S. Fritzke, B. Haggerty, S. Haultain, J. Hoines, S. Samuels, K. Thomas, F. Villalba and J. Weltzin.

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USA npn National Phenology Network

NATIONAL PARK SERVICE

UCSB Phenology Stewardship Program

UNIVERSITY OF CALIFORNIA Natural Reserve System

Outline

1. Background
2. Building a regional phenological monitoring network
   - Lessons learned
3. Successes
4. Future directions





The California Phenology Project

California Phenology Project: Goals

establish a coordinated phenological monitoring network, covering a large geographic area and sampling across key environmental gradients

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establish a coordinated phenological monitoring network, covering a large geographic area and sampling across key environmental gradients

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*

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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
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CPP scientific questions

- CPP convened a *Scientific Advisory Panel* that included academic and agency scientists
- Create a scientific framework for CPP activities
  - Identify scientific questions
  - Develop guidelines for selecting focal plant species

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?



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CPP species selection

- dominant species
- widely distributed taxa
- indicator species
- species of management concern
- ease of identification
- accessibility for monitoring across an abiotic or biotic gradient
- 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)
- ability to engage Citizen Scientists
- known and accessible locations

CPP species selection

- Working groups assessed species with respect to their ability to answer scientific questions and to fulfill species-selection criteria
- >5,000 taxa in the California flora
  - 75 high priority species
  - 30 focal species currently monitored
- Trade-offs between scientific and public engagement criteria

CPP species selection

Joshua Tree (*Yucca brevifolia)*

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

CPP species selection

Common yellow monkeyflower (*Mimulus guttatus)*

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

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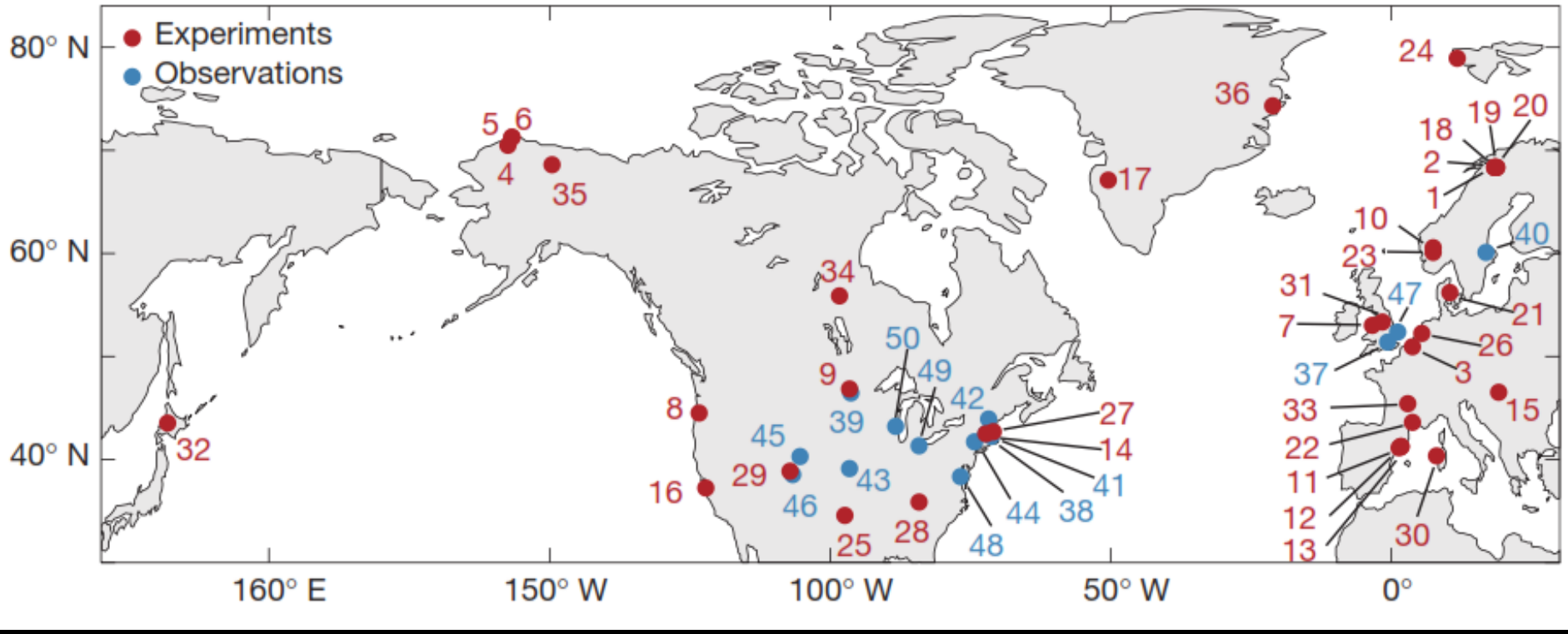
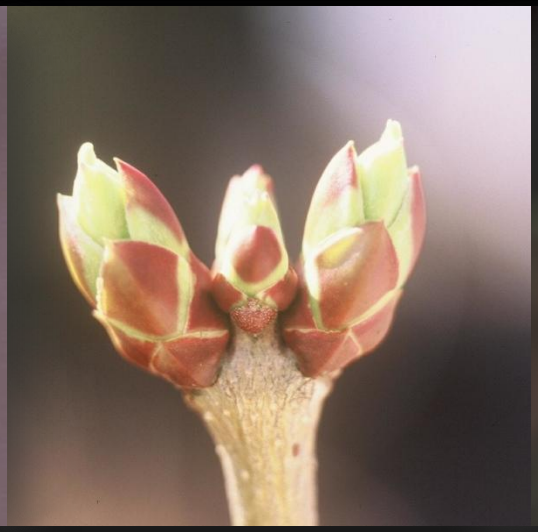
Phenophase descriptions



Wolkovich *et al* 2012

Phenophase descriptions

Phenophase descriptions

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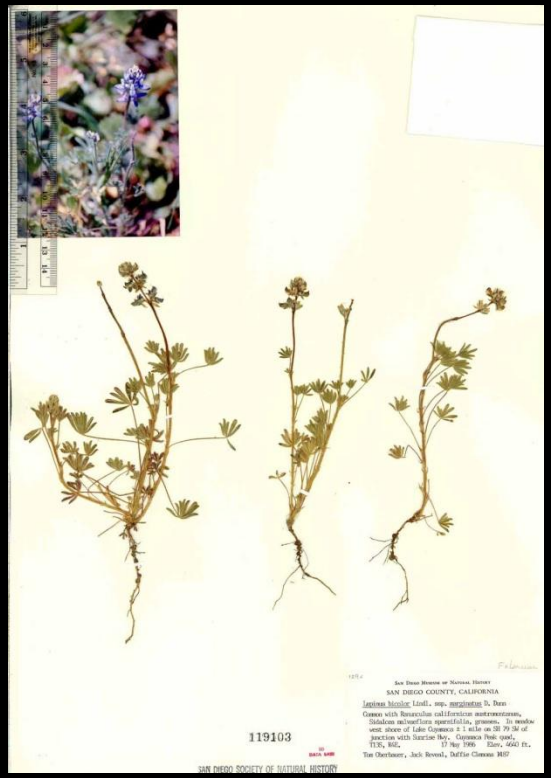
Historical datasets

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 → examined > 1500 specimens to date



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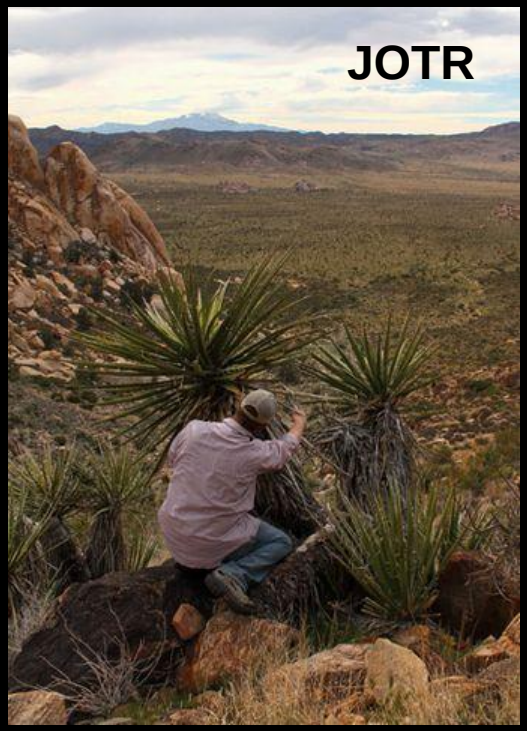
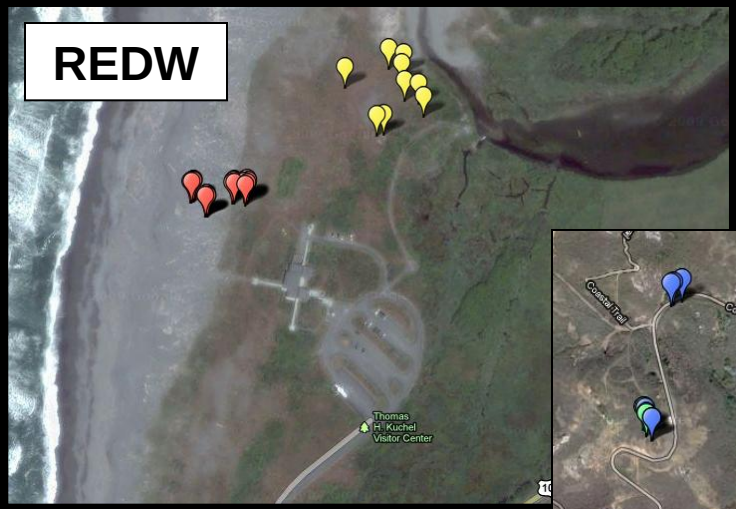
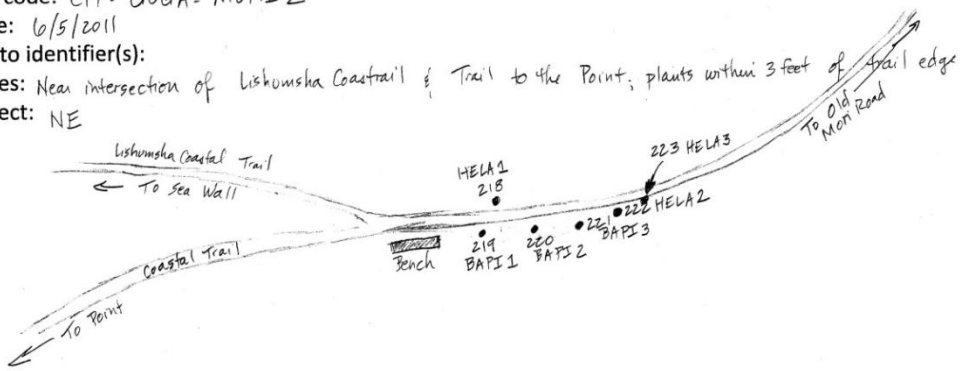
CPP: monitoring infrastructure



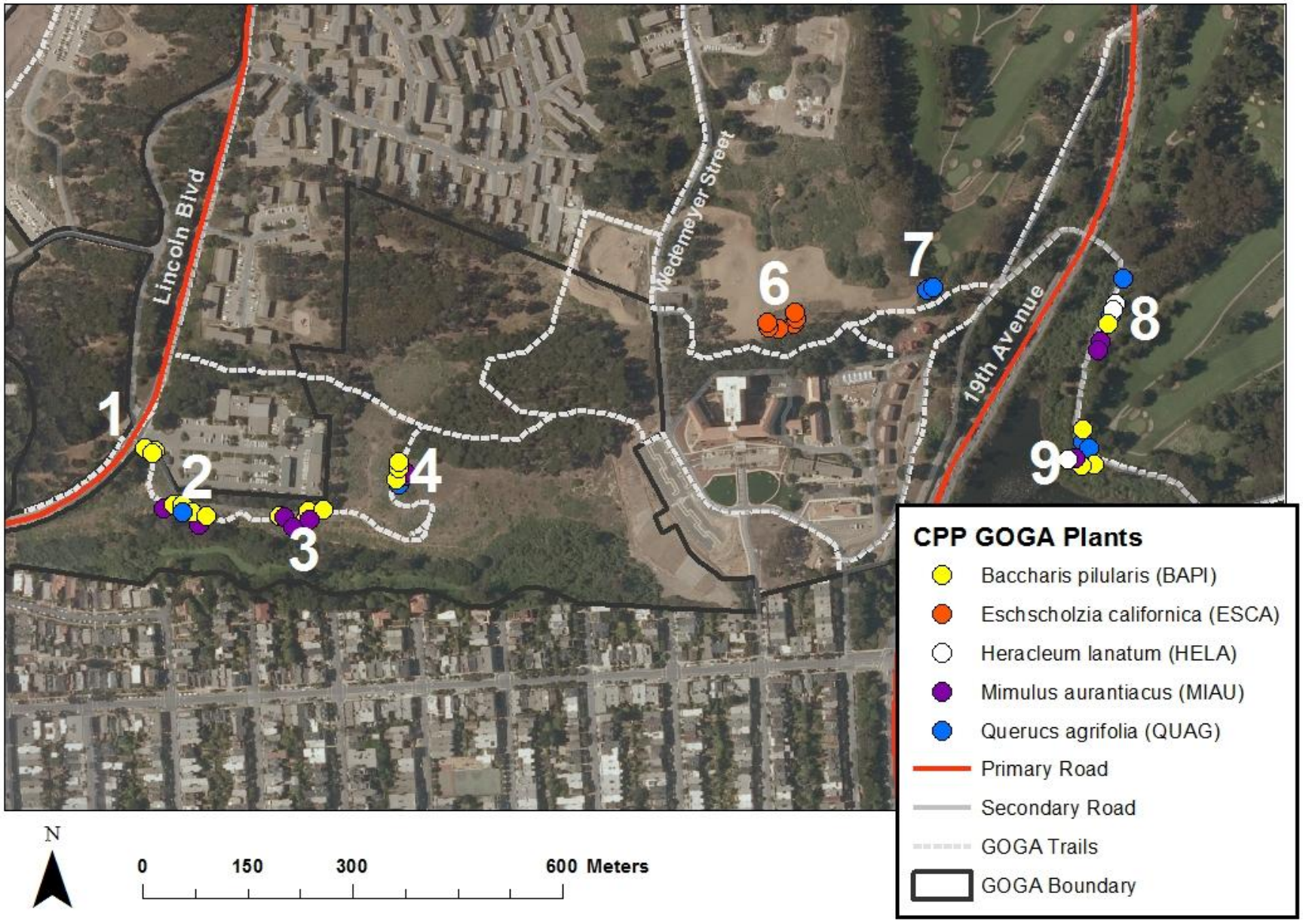


Site code: CPP- GOGA- MORI 2
Date: 6/5/2011
Photo identifier(s):
Notes: Near intersection of Lishumsha Coastrail & Trail to the Point; plants within 3 feet of trail edge
Aspect: NE

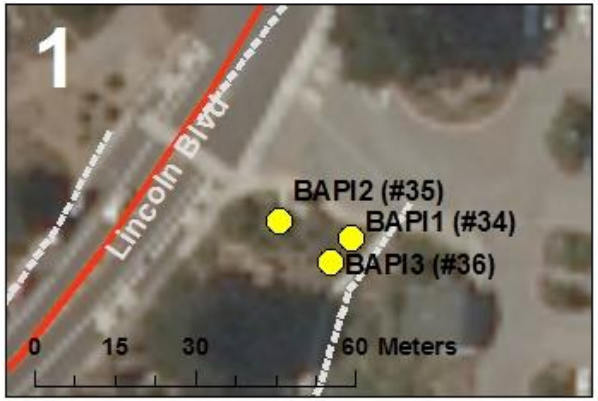


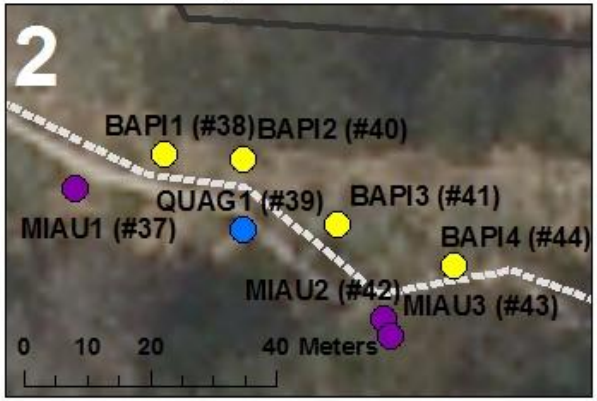
CPP: monitoring infrastructure

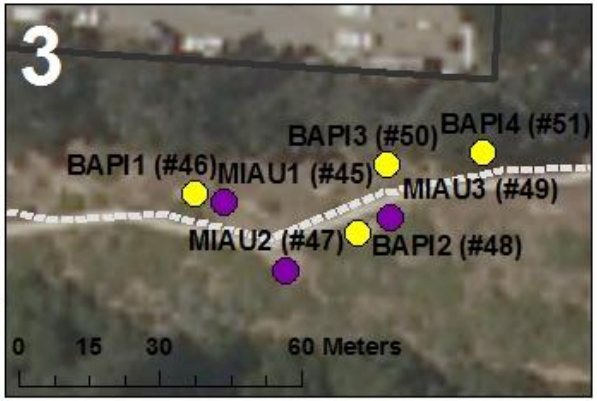
CPP GOGA (Presidio)
Lobos Dunes to Mountain Lake (LDML) Monitoring Sites

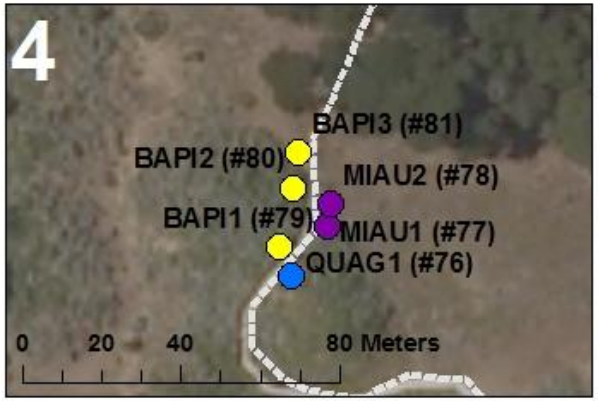


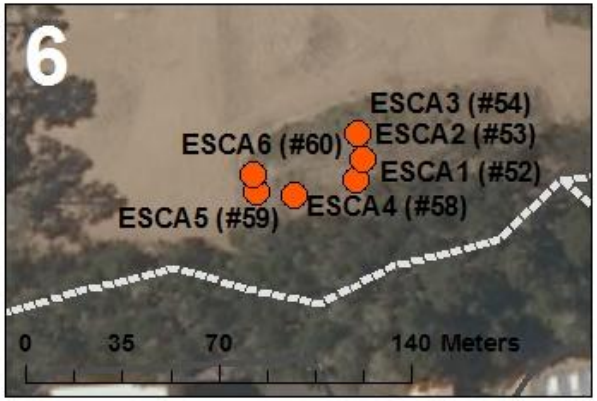
CPP GOGA (Presidio) Lobos Dunes to Mountain Lake (LDML) Monitoring Sites and Plants

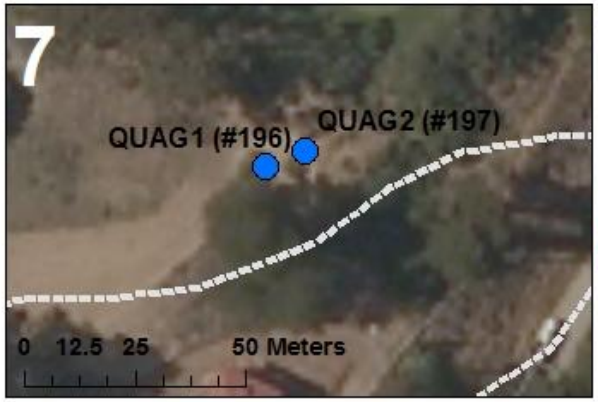


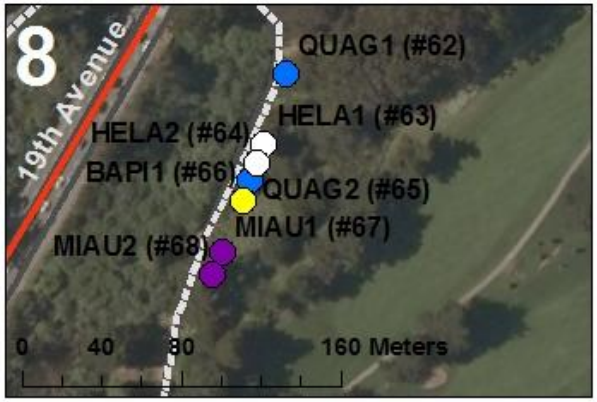


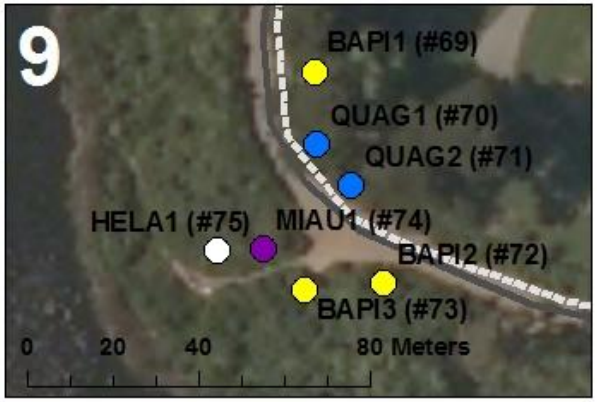


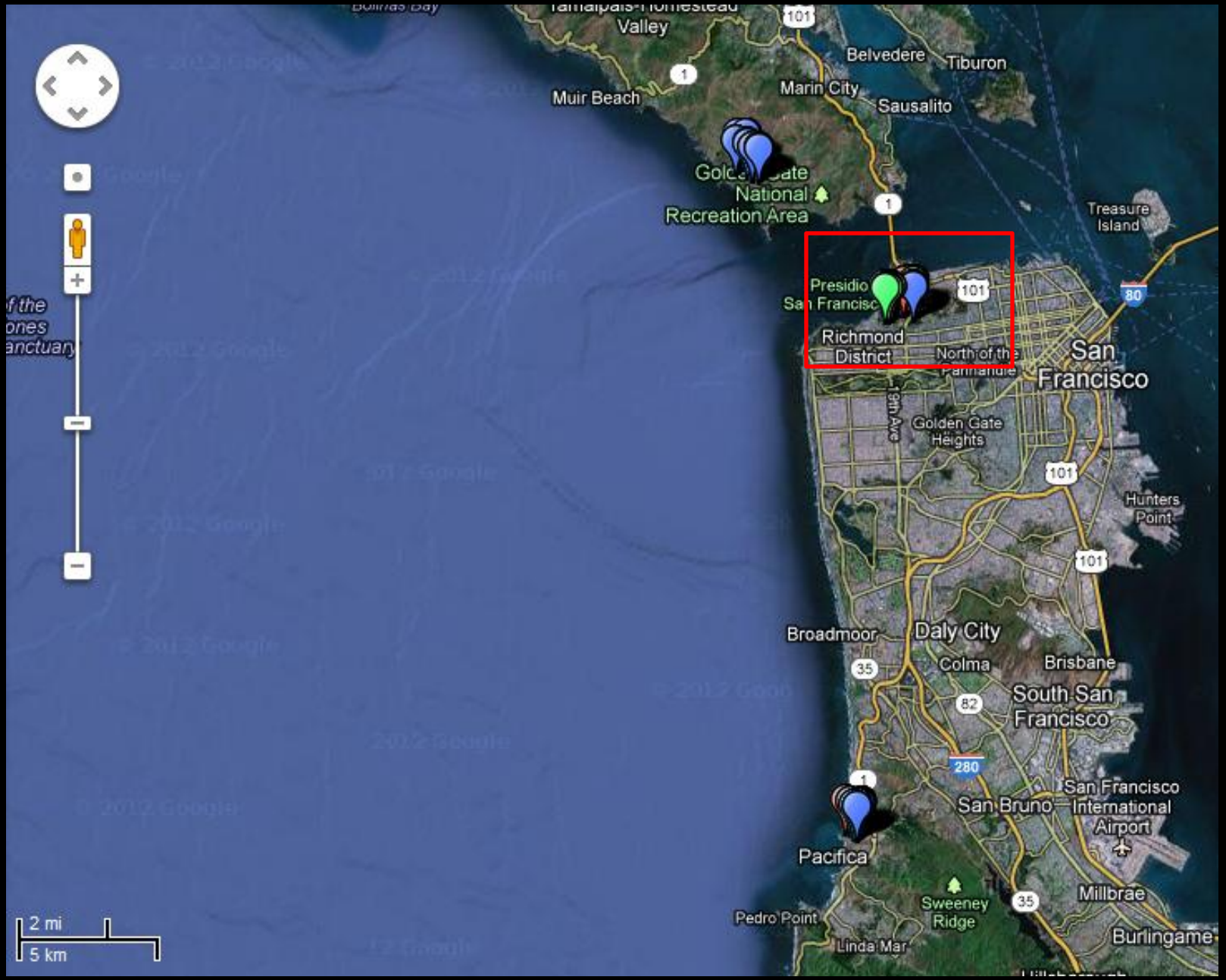








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Broadmoor
Daly City
Colma
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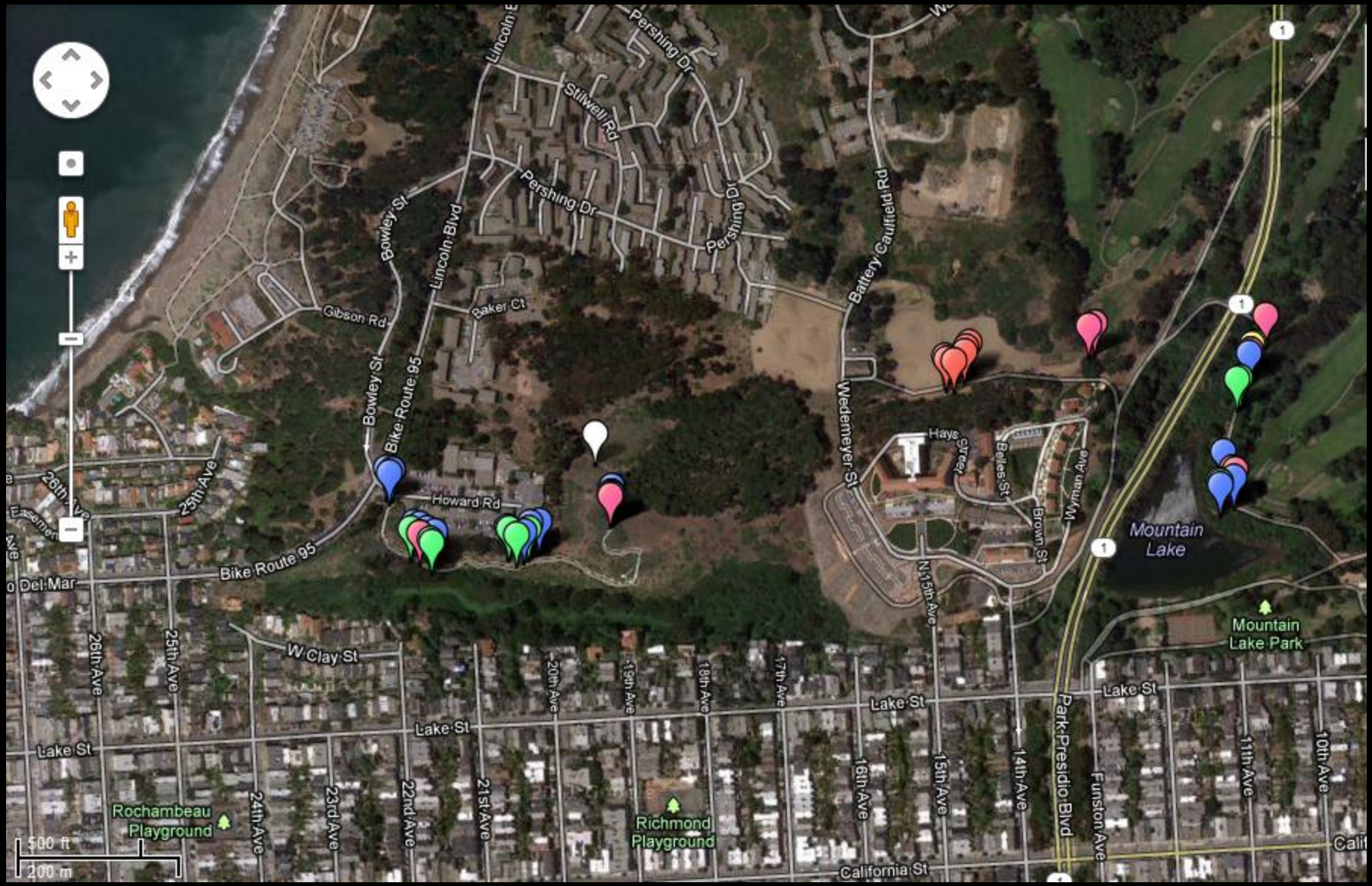
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Baker Ct
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Howard Rd
Battery Caulfield Rd
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Brown St
Mountain Lake
Mountain Lake Park
Del Mar
W Clay St
Lake St
26th Ave
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22nd Ave
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17th Ave
16th Ave
15th Ave
14th Ave
11th Ave
10th Ave
N 15th Ave
Park Presidio Blvd
Funston Ave
California St
Rochambeau Playground
Richmond Playground
500 ft
200 m

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)

Version 2, March 2012

California Phenology Project: monitoring guide for Coyotebrush (*Baccharis pilularis*)

Brian Haggerty

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

Crystal Anderson

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

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

Crystal Anderson

Miguel Viera

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.

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"*

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***

Version 2, March 2012

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Building a Citizen Science network

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Building a Citizen Science network

- conducted >30 workshops to recruit and train **>** 500 CPP observers
  - >70 listserv subscribers
  - many individuals or organizations adding data on USA-NPN's *Nature's Notebook*
- developed partnerships with education organizations (e.g. Naturebridge; New Leaf Collaborative; local schools) and conservation organizations (e.g., California Native Plant Society; Friends of Alhambra Creek; PRBO Conservation Science)
- collected lots of data!!

Future directions

- Data analysis
- Continue growing the observer network and reaching out to new partners
- Expand the network of sites
- Pursue additional funding to support the CPP network

California Phenology Project

www.usanpn.org/cpp

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UCSB collaborators: phenology@eemb.ucsb.edu

California Buckeye phenophases

CPP: focal species

- 30 CPP species with profiles
  http://www.usanpn.org/cpp/meet-the-species
- >100 USA-NPN plant species occur in CA
  http://www.usanpn.org/species_search