

2010-2011 California Phenology Project Accomplishment Report

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I. Workshop: Scientific Framework for the California Phenology Project (CPP)

In November 2010, the California Phenology Project convened a group of scientists and the CPP core planning team in order to develop a scientifically based framework for network-wide phenology monitoring. The goals of the workshop were to solicit ideas and recommendations that would enable the CPP core planning team to achieve 6 objectives:

- (1) To identify how the CPP can best use plant phenology to monitor the response of natural resources to climate change across national parks and reserves in California,
- (2) For the approaches suggested in #1, to identify scientific questions or hypotheses that will be both interesting scientifically and relevant to resource managers,
- (3) To develop and to agree to a set of prioritized recommendations for alternative approaches to California plant phenological monitoring and for scientific questions to be addressed,
- (4) To define an initial scientific framework for the California Phenology Project based on #3 (e.g. how to organize the sampling effort across bioregions, landscapes, altitudinal gradients, communities, co-location with environmental monitoring stations etc.),
- (5) To identify criteria for selecting monitoring targets (species, guilds, habitats etc.) that are amenable to monitoring and vulnerable to climate change, and
- (6) To identify a clear plan of action with assignments (for those who have time and interest in participating) to move forward on project design and species/community selection and identify how to best engage university and other agency partners in the project and identify possible participants.

The outcomes of the workshop are summarized in a formal report, accessible on the CPP website: www.usanpn.org/cpp. The report includes a list of tractable ecological questions and their relevance to natural resource management, criteria for selecting species, measures of success, and a list of tasks and processes by which CPP species will be selected and the CPP's components will be implemented.

II. Species-selection for the 19 California NPS units

In early 2011, the CPP initiated a species-selection process to identify species for monitoring in each of the 19 California NPS units. The California NPS units were assigned to one of four biogeographic groups (Northern Coast, Southern Coast, Mountains, and Desert), and the species-selection process was carried out for each group.

The CPP consolidated floras for all California park units and calculated the frequencies of species' presence across all parks and biogeographic regions. The CPP also assembled floras from the UC- Natural Reserve System and summarized each species' presence across these management units as well. For each species in this preliminary list, species attribute information, including native vs. alien status, life form, and family, was obtained from the USDA PLANTS database. Finally, all dominant, characteristic, and/or indicator species for the NatureServe Ecological Systems in each bioregion were identified.

The CPP invited botanists, vegetation ecologists, NPS resource managers, and others with knowledge of the California flora to join species-selection workgroups, each focused on selecting species for one of the four biogeographic regions, and a species-selection webinar was held for each group. Prior to each webinar, the CPP distributed a preliminary list of candidate species for each bioregion, which included the 100 most frequently occurring species in each bioregion and *all* dominant, characteristic, and/or indicator species. Workgroup participants were asked to assess each candidate species based upon whether the species is well-suited to address CPP ecological questions of interest and a set of pre-determined CPP species-selection criteria. Both the ecological questions of interest and species-selection criteria were developed during the November CPP Scientific Framework workshop and can be found in the workshop report (available online at www.usanpn.org/cpp). Workgroup participants submitted a list of 8-10 suggested taxa prior to the webinar; the CPP collated workgroup responses and then distributed to each workgroup's members a summary of suggested taxa (for that region) prior to the webinar.

To facilitate discussion and eventual ranking of candidate species, the CPP summarized the workgroup suggestions at the beginning of each webinar and briefly reviewed the number of times a taxon was suggested by workgroup members, the attributes represented by the suggested species, and how each suggested species might be used to address CPP ecological questions and species-selection criteria. Workgroup participants were then asked to provide further justification for top-ranked candidate species, as well as justification for any additional species that may have been overlooked in the initial suggestions. Participants were also asked to identify candidate species that are the subject of other research projects underway in the parks, including federal Inventory and Monitoring Programs. Following the summary and subsequent discussion, the workgroup created a list of approximately 10 taxa to be considered for monitoring in each park, as well as approximately 5 relatively widespread taxa to be considered for monitoring across parks in each bioregion.

Following each webinar, a summary of the candidate species proposed during the webinar was distributed to the workgroup, providing an opportunity for workgroup participants to offer additional feedback on the ranked list of candidate species. Workgroup participants were also asked to provide supplementary information for each species, including known locations within each park; known pollinators, herbivores and dispersers; links to I&M activities or ongoing research efforts; and examples of representation in the primary literature.

The short list of highly-ranked candidate species was then further constrained by four practical criteria determined to be important in the field. The application of these criteria to each candidate species required detailed knowledge of the distribution, habitat, and abundance of focal taxa at each park, and therefore required scouting work and input from park staff. The four practical criteria were: *accessibility* (i.e., individuals of the candidate species must be right next to monitoring locations, particularly when we expect members of the public to be the primary observers); *abundance* (i.e., at least 5-15 healthy individuals of a given taxon must be present at a monitoring location to allow for sufficient replication); *ease of delineating a single individual* (sprawling, clonal species can be problematic since observers may not know how many stems to include when observing phenophases); and *ease of identifying phenophases* (some phenophases are difficult to identify for certain taxa).

Finally, a short list of top-ranked species that fulfilled the four practical criteria was sent to the National Coordinating Office of the USA National Phenology Network (USA-NPN). The NPN developed phenophase monitoring descriptions and species profiles (if they did not already exist) for species on the CPP short-list. As of August 2011, the NPN Nature's Notebook includes species profiles for 67 taxa that have been identified by the CPP as good candidates for phenological monitoring in California's National Parks and elsewhere (see the list of 67 species in **APPENDIX A**). In total, there are now 167 plant species in Nature's Notebook that are known to occur in California.

III. Spring and summer 2011 pilot park visits

In the spring and summer of 2011, the UCSB team visited each of the six pilot parks. During these visits, UCSB offered a menu of activities that included *phenology workshops*, which provided an introduction to the basic concepts and processes that comprise phenology and climate change, as well as hands-on training with NPN protocols and a tour and demonstration of the NPN website and Nature's Notebook; *brainstorming sessions with an interpretive focus* to discuss options for incorporating phenological monitoring into each park's current interpretive and education programs, to identify tools that the CPP can develop to facilitate monitoring in the parks, and to identify monitoring locations that would be best for interpretive and educational purposes; *brainstorming sessions with a resource management focus* to identify resource management issues at the park that could be informed by phenological data, to explore applications of phenological data to resource management issues, and to identify potential monitoring locations, given environmental gradients present and ongoing research or monitoring efforts in each park; and *scouting and setting up CPP monitoring sites*, in which the CPP team worked with park staff to scout potential CPP monitoring locations identified during brainstorming sessions and/or to set up CPP monitoring infrastructure at selected sites. A brief summary of the UCSB visits to each pilot park is included below.

The UCSB team visited Joshua Tree National Park (JOTR) in April 2011 and held two days of workshops and brainstorming sessions, which were attended by 17 NPS staff members. UCSB also led one full-day training workshop for the public, hosted by the Joshua Tree National Park Association's Desert Institute. Working with JOTR staff, the UCSB group set up four monitoring locations and labeled and georeferenced 141 individual plants representing five species. Species tagged at JOTR included: *Coleogyne ramosissima* (42 individuals); *Larrea tridentata* (27); *Prosopis glandulosa* (5); *Yucca brevifolia* (37); and *Yucca schidigera* (30). A map of all JOTR monitoring sites and tagged plants is available here: <http://maps.google.com/maps/ms?msid=214141007841125111618.0004a2164021216efb338&msa=0>

The UCSB team visited Santa Monica Mountains NRA (SAMO) in May 2011 and held three days of workshops and brainstorming sessions. Working with SAMO volunteers and staff from the Naturebridge campus at SAMO, UCSB set up three monitoring locations and labeled 123 plants. Species tagged during the May visit include: *Adenostoma fasciculatum* (33 individuals); *Baccharis pilularis* (11); *Eriogonum fasciculatum* (44); *Quercus agrifolia* (6); *Quercus lobata* (7); and *Sambucus nigra* ssp. *cerulea* (22). Two additional monitoring locations at Cheeseboro Canyon and Rancho Sierra Vista were established by SAMO intern, Crystal Anderson, in late summer 2011. A map of all SAMO monitoring sites and tagged plants is available here: <http://maps.google.com/maps/ms?msid=214141007841125111618.0004a5b0b718de13d0d98&msa=0>

The UCSB team visited Golden Gate National Recreation Area (GOGA) in June 2011 and held one workshop and brainstorming session, followed by three days of field work to set up monitoring infrastructure. Working with GOGA staff (including the CPP summer hire, Ruby Kwan) and staff from nearby NPS units (John Muir Historic Site), the UCSB team set up three monitoring locations and labeled 107 plants. Species tagged at these locations include: *Diplacus aurantiacus* (24 individuals), *Baccharis pilularis* (44), *Heracleum lanatum* (6), *Eschscholzia californica* (12), and *Quercus agrifolia* (1). Three additional monitoring sites were identified, and Ruby Kwan will coordinate future site set-up with Presidio Trust staff and volunteers; these sites will capture additional individuals of species not yet well-represented (e.g., *Quercus agrifolia* and *Heracleum lanatum*). A map of all GOGA monitoring sites and tagged plants is available here: <http://maps.google.com/maps/ms?msid=214141007841125111618.0004a5c819f05b808e710&msa=0>

The UCSB team visited Redwood National Park in June 2011 and held one workshop and brainstorming session, followed by three days of field work to scout and set up CPP monitoring infrastructure. During the visit, two monitoring sites were established and a third site was identified for future development by Steven Krause, a seasonal ranger at Redwood NP working with the CPP. By the end of the visit, 82 plants were labeled at two monitoring sites; tagged plant species include: *Lathyrus littoralis* (32 individuals), *Baccharis pilularis* (9), *Rhododendron macrophyllum* (18) and *Trillium ovatum* (23). A map of all REDW monitoring sites and tagged plants is available here:

<http://maps.google.com/maps/ms?msid=214141007841125111618.0004a626d66a4be5dd28b&msa=0>

The UCSB team visited Sequoia and Kings Canyon National Parks (SEKI) in July 2011. The UCSB team led a full day, mid-season training workshop for SEKI interpretive staff on the first day of the visit. On the second day, two brainstorming sessions were scheduled for permanent park staff and partners--the morning session focused on interpretive programs and the afternoon session focused on resource management issues. On the final day, the UCSB team and Sylvia Haultain scouted candidate monitoring locations that were identified in the brainstorming sessions the previous day; we expect a least two of these locations to be set up in fall 2011.

The UCSB team visited Lassen Volcanic National Park (LAVO) in July 2011 and held one workshop and brainstorming session. During the visit, the UCSB team worked with LAVO staff, staff from Lava Beds National Monument, and a group of volunteers to scout and set up monitoring infrastructure in the park. Five monitoring locations were established and 90 individuals tagged; species tagged at LAVO include *Arctostaphylos patula* (27), *Lupinus obtusilobus* (10), *Penstemon newberryi* (20), *Pinus contorta* (11), *Pinus ponderosa* (9), *Populus tremuloides* (12), and *Sambucus nigra* ssp. *cerulea* (1). Future monitoring locations and sites were also identified during this visit; most will be located at the southern part of the park, which was still covered in snow and inaccessible during the July visit. Future sites will capture *Wyethia mollis*, additional *Lupinus obtusilobus* (near lake margins), and *Heracleum lanatum*. A map of all LAVO monitoring sites and tagged plants is available here:

<http://maps.google.com/maps/ms?msid=214141007841125111618.0004a88925fe3f98aa794&msa=0>

As of August 2011, 574 plants have been tagged across five pilot parks and 57 CPP monitoring sites have been registered in Nature's Notebook. Following each park visit, UCSB produced a set of maps for each pilot park, documenting the CPP monitoring locations, sites, and tagged plants at a variety of spatial scales (**APPENDIX B**). UCSB also created a photo-sharing website with photos documenting species phenophases, monitoring sites, and park workshops and brainstorming sessions (<http://calpp.smugmug.com/>). Finally, with the help of collaborators at the USA-National Phenology Network, the CPP has also produced *draft* profiles for each CPP species currently being monitored at a pilot park (**APPENDIX C**).

During the summer of 2011, NPS staff members have also been actively developing materials for engaging park visitors in CPP monitoring. At Redwood NP, Steven Krause developed first-person perspective photographic images for all CPP-REDW monitoring locations, and at Golden Gate NRA, Ruby Kwan developed "kid-friendly" datasheets that include photos of each phenophase. See **APPENDIX D** for examples of these tools.

IV. Product Development and Future Directions

After a very successful first year, the CPP Core Planning Team scheduled a two-day meeting in September 2011 to review accomplishments to date and to outline a detailed work plan for the coming year. The major goals of this meeting were (1) to discuss scientific questions that the CPP can address with the monitoring infrastructure established in 2011 and how CPP data can inform resource management issues or goals in the parks, (2) to identify additional tools that the CPP should develop to facilitate monitoring efforts in all California NPS units, (3) to discuss future modifications to the monitoring infrastructure, and (4) to clarify the CPP's education and outreach goals and products. The CPP also reviewed the experiences of park staff and volunteers who participated in the first year of monitoring efforts, collecting feedback and creating a list of issues to address (e.g., problematic phenophase definitions, difficult-to-observe phenophases, information that is not clear on species profiles, etc.) The CPP will work with the NPN to revise monitoring protocols prior to the next growing season. The CPP will also begin work on a formal SOP document that will include protocols for site selection, species-specific information, sampling design, observation instructions, and more.

In fall 2011, the UCSB team will return to each of the pilot parks, as well as to additional participating parks (e.g. John Muir Historic Site and Yosemite National Park). The content of future park visits will vary from park to park, depending upon individual park needs and preferences, but may include additional infrastructure development, training workshops for park partners, and demonstration of outreach and educational activities.

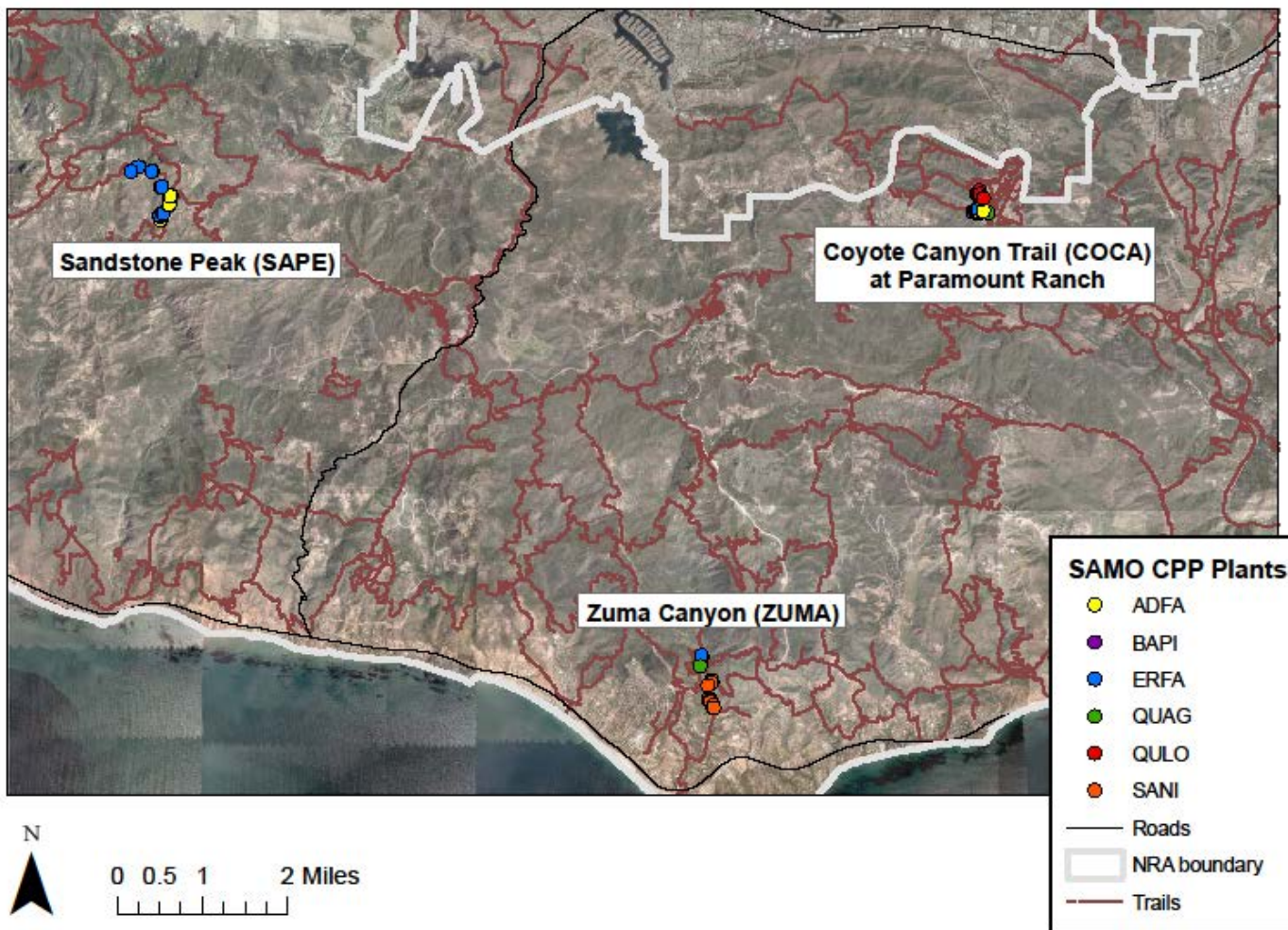
In the upcoming year, the CPP will also initiate new partnerships with organizations across California. In spring 2011, Susan Mazer and Brian Haggerty were awarded University of California Office of the President (UCOP) Research Opportunity Funds to design and implement parallel phenological monitoring programs in the UC Natural Reserve System. This award will fund work in seven UC natural reserves in 2011 and 2012. The CPP UCSB team will lead a phenology workshop for UC Natural Reserve System managers in October 2011. In September 2011, Angie Evenden and Liz Matthews attended the California Native Plant Society Conservation Symposium in San Diego, where they introduced symposium attendees to the CPP; there is great potential for a citizen science connection between the two groups, as well as potential for data sharing. Finally, the CPP has also been invited to deliver a presentation at a November workshop hosted by the Southern California Coastal Water Research Project (<http://www.sccwrp.org/>); this workshop aims to identify and developing strategies and tools for conservation in Southern California.

APPENDIX A: CPP CANDIDATE SPECIES INCLUDED IN THE NPN'S NATURE'S NOTEBOOK

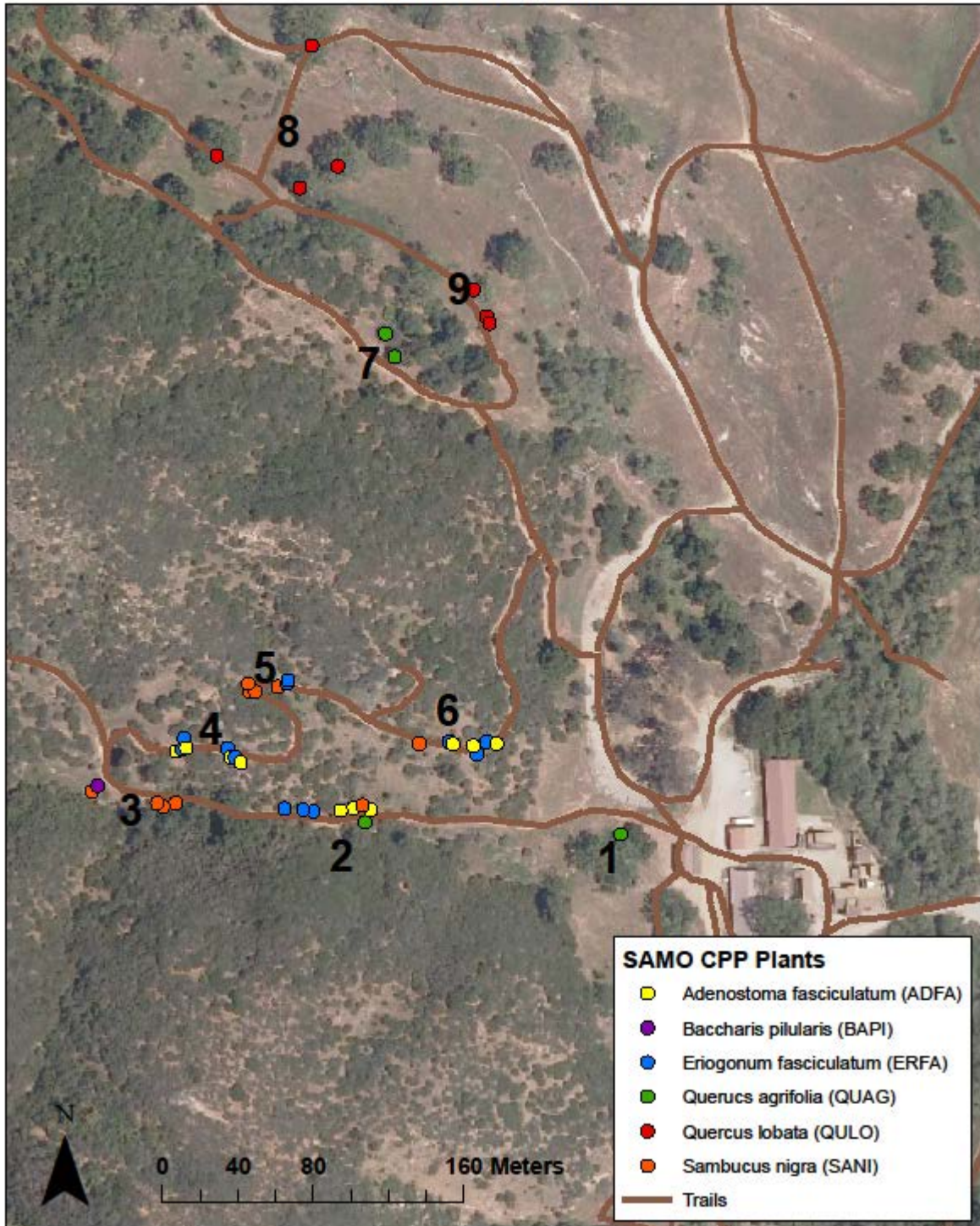
<i>Acer macrophyllum</i>	<i>Eschscholzia californica</i>	<i>Prunus emarginata</i>
<i>Achillea millefolium</i>	<i>Fouquieria splendens</i>	<i>Purshia tridentata</i>
<i>Adenostoma fasciculatum</i>	<i>Heracleum lanatum</i>	<i>Quercus agrifolia</i>
<i>Aesculus californica</i>	<i>Heteromeles arbutifolia</i>	<i>Quercus douglasii</i>
<i>Arctostaphylos patula</i>	<i>Holodiscus discolor</i>	<i>Quercus garryana</i>
<i>Artemisia tridentata</i>	<i>Larrea tridentata</i>	<i>Quercus kelloggii</i>
<i>Atriplex canescens</i>	<i>Lathyrus littoralis</i>	<i>Quercus lobata</i>
<i>Atriplex hymenelytra</i>	<i>Lessingia germanorum</i>	<i>Rhododendron macrophyllum</i>
<i>Baccharis pilularis</i>	<i>Lithophragma bolanderi</i>	<i>Rhododendron occidentale</i>
<i>Brassica tournefortii</i>	<i>Lupinus latifolius</i>	<i>Rubus spectabilis</i>
<i>Bromus madritensis</i>	<i>Lupinus obtusilobus</i>	<i>Salix lasiolepis</i>
<i>Bromus tectorum</i>	<i>Lupinus polyphyllus</i>	<i>Salvia columbariae</i>
<i>Cardamine californica</i>	<i>Malacothrix glabrata</i>	<i>Sambucus mexicana</i>
<i>Ceanothus cordulatus</i>	<i>Mimulus aurantiacus</i>	<i>Sambucus racemosa</i>
<i>Ceanothus cuneatus</i>	<i>Mimulus guttatus</i>	<i>Sisyrinchium bellum</i>
<i>Chrysothamnus nauseosus</i>	<i>Olnya tesota</i>	<i>Taraxacum officinale</i>
<i>Cirsium occidentale</i>	<i>Penstemon newberryi</i>	<i>Trillium ovatum</i>
<i>Cirsium vulgare</i>	<i>Pinus contorta</i>	<i>Wyethia mollis</i>
<i>Coleogyne ramosissima</i>	<i>Pinus longaeva</i>	<i>Yucca brevifolia</i>
<i>Cornus nuttallii</i>	<i>Pinus ponderosa</i>	<i>Yucca schidigera</i>
<i>Cornus sericea</i>	<i>Polemonium eximium</i>	<i>Yucca whipplei</i>
<i>Epilobium canuum</i>	<i>Populus tremuloides</i>	
<i>Eriogonum fasciculatum</i>	<i>Prosopis glandulosa</i>	

APPENDIX B: EXAMPLE MAPS FOR CPP MONITORING SITES-- SANTA MONICA MOUNTAINS NRA

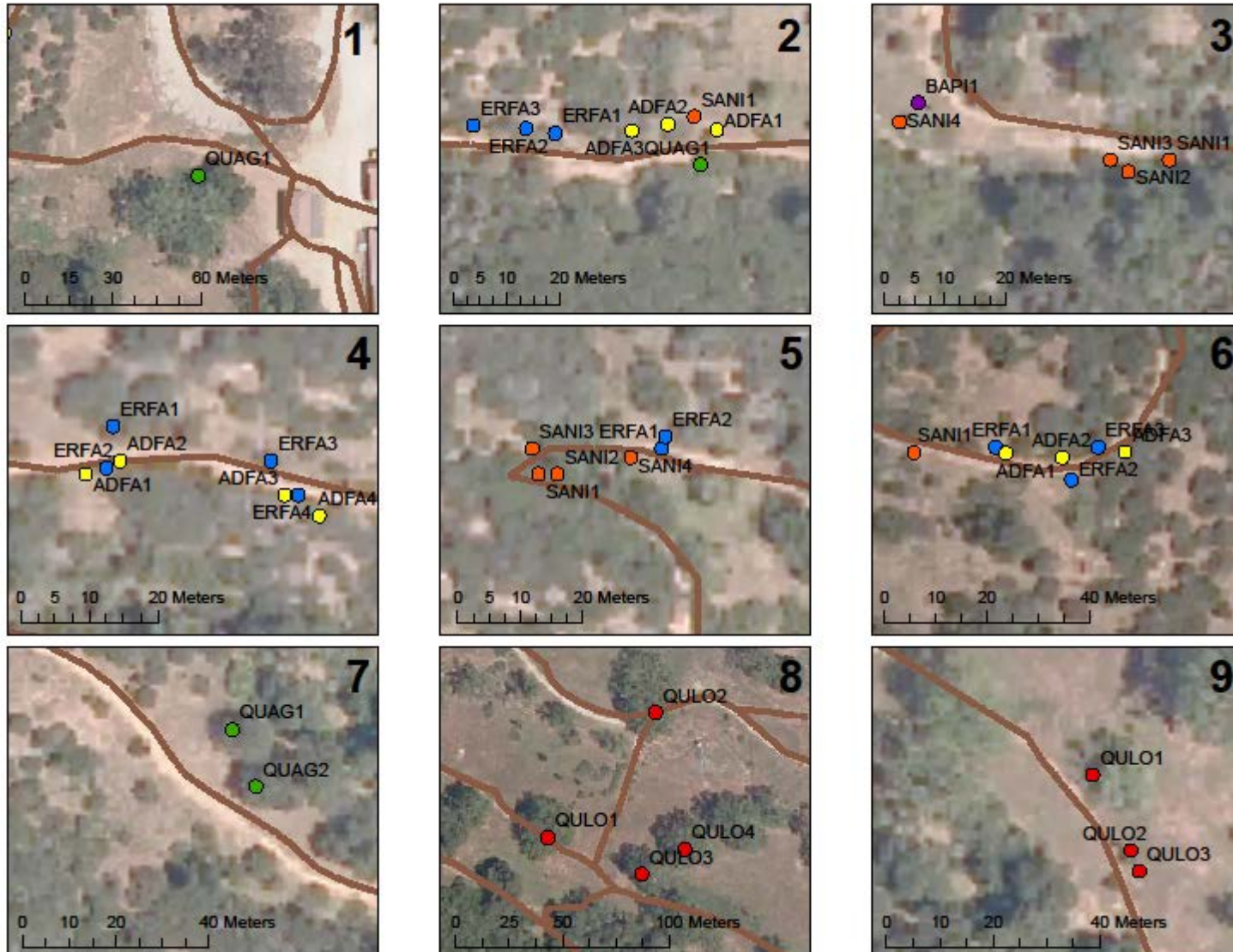
**CPP Monitoring locations at Santa Monica Mountains (SAMO)
National Recreation Area**



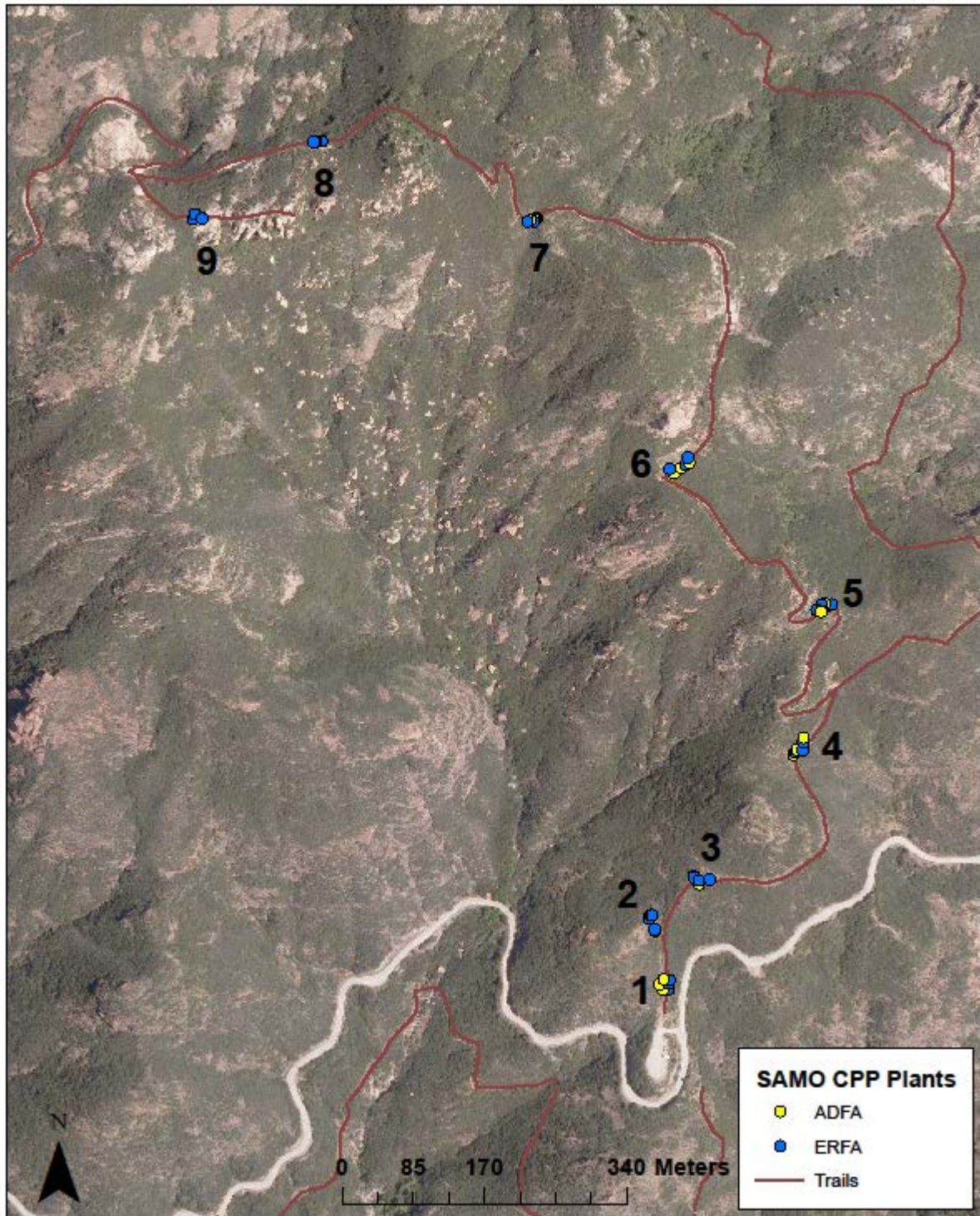
CPP SAMO Coyote Canyon at Paramount Ranch Monitoring Sites



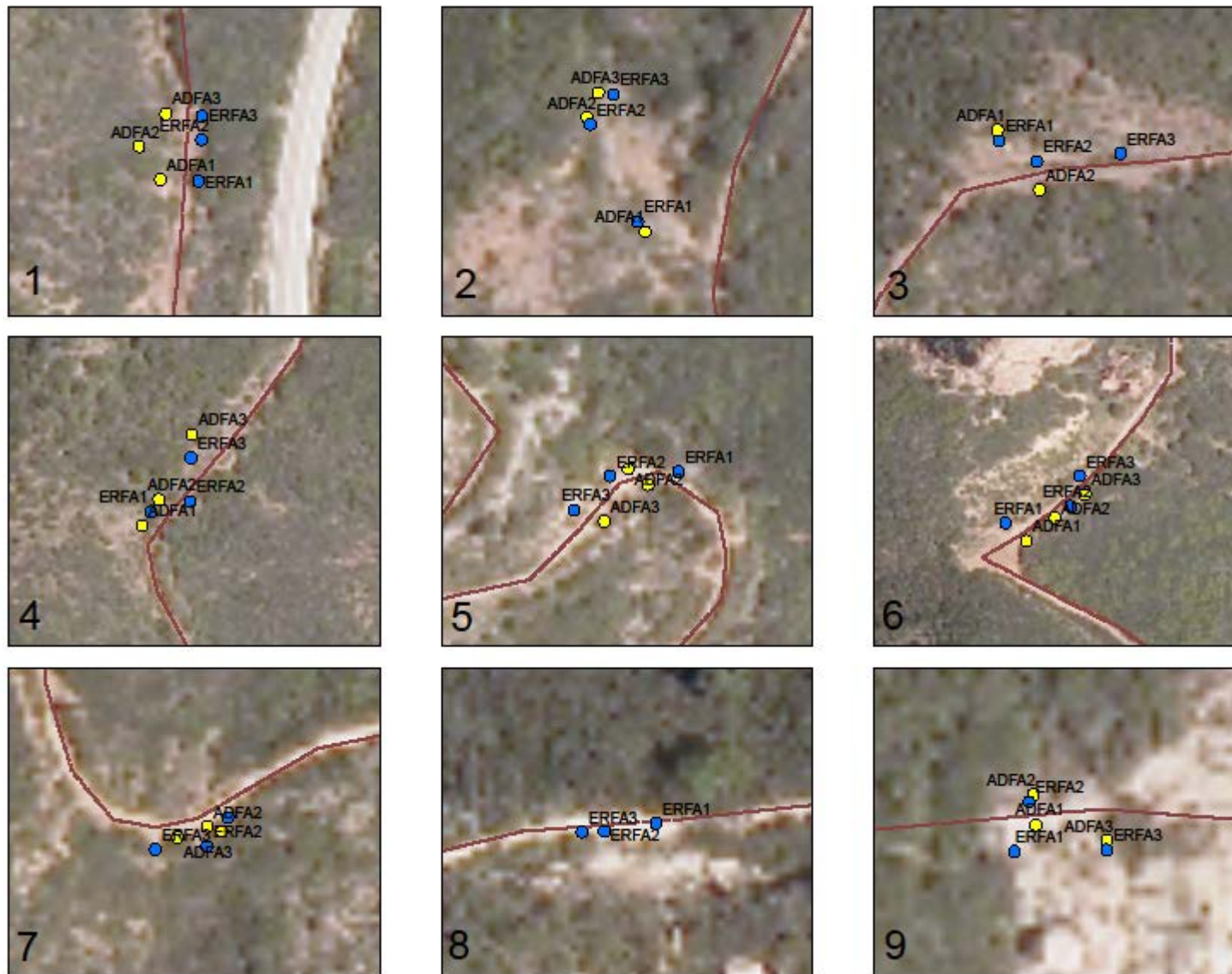
CPP SAMO Coyote Canyon Trail (COCA) at Paramount Ranch Monitoring Sites and Plants



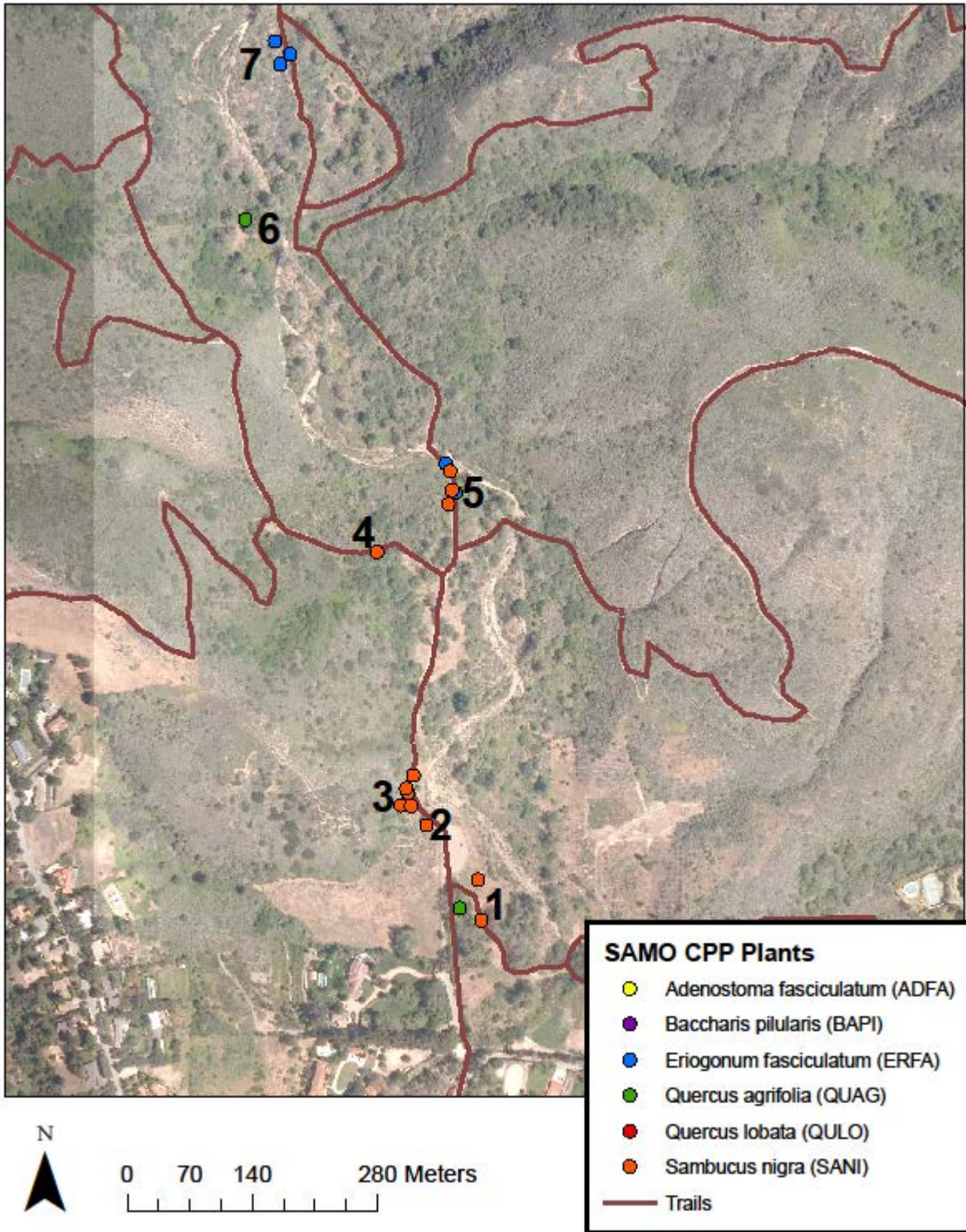
CPP SAMO Sandstone Peak Monitoring Sites



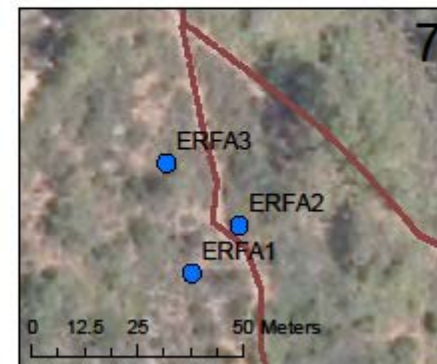
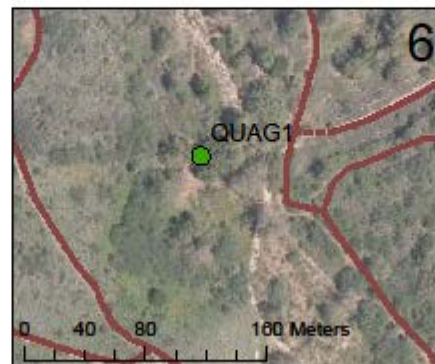
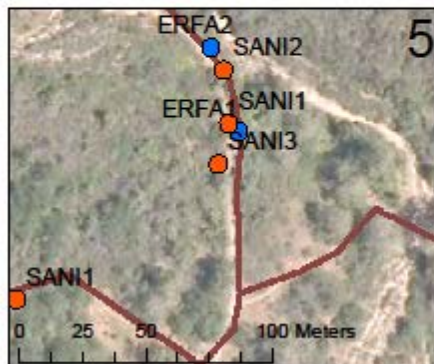
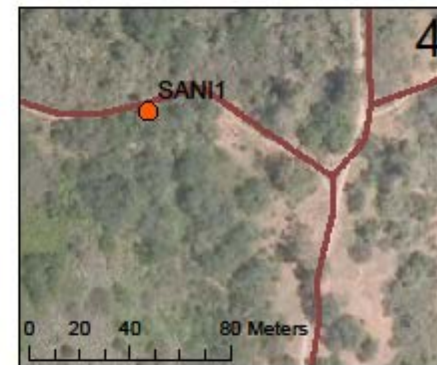
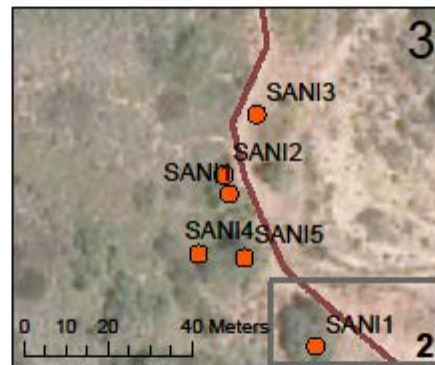
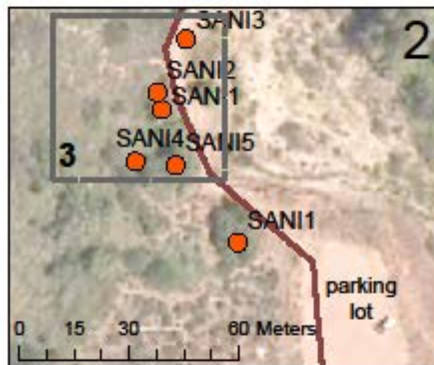
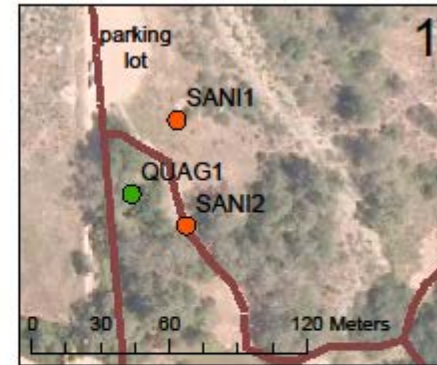
CPP SAMO Sandstone Peak (SAPE) Monitoring Sites and Plant



CPP SAMO Zuma Canyon Monitoring Sites






CPP SAMO Zuma Canyon (ZUMA) Monitoring Sites and Plants



APPENDIX C: EXAMPLE SPECIES PROFILES- JOSHUA TREE NATIONAL PARK

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)







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.

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
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.



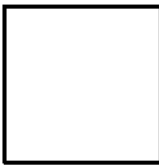
2. Young leaves
One or more young unfolded leaves are visible on the plant. A leaf is considered "young" and "unfolded" once the leaf stalk (petiole) or leaf is visible, but before the leaf has reached full size or turned the darker green color of mature leaves on the plant. The leaf may need to be bent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



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,

**California Phenology Project:
monitoring guide for
Creosote Bush
(*Larrea tridentata*)**

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




Photo credit: R.A. Howard, Smithsonian Institute

What does this species look like?
Creosote bush is a drought tolerant evergreen shrub growing up to 12 feet tall. The stems are generally flexible. The waxy small leaves are dark green and very resinous. After rainfall, these leaves emit a characteristic strong odor. Its yellow flowers have five petals and are bisexual, having both male and female parts.

Species facts!

- The oldest living plant is a Creosote bush in the Mojave Desert, estimated to be between 9,400 and 11,000 years old.
- The flowers are visited by over 120 bee species; 22 of these exclusively use Creosote pollen as their food source.
- Native Americans used a dry powder from the leaves as an antibacterial treatment for wounds and burns.





Photo credit: Sue in AZ (Wikipedia)

Where is this species found?




- Grows in gravelly and sandy soils that are well drained.
- Can tolerate a wide range of water availability and temperatures (5 to 120°F).
- Found in valley plains, mesas, arroyos, alluvial fans, and gentle slopes within the three Southwest deserts (Mojave, Sonoran and Chihuahuan).



*King Clone, the oldest known plant
Photo credit: Ktokied (Wikipedia)*

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
Creosote Bush
(*Larrea tridentata*)**

Phenophases to monitor:

1. Breaking leaf buds
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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
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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 xxxxxx

6. Ripe fruits
One or more ripe fruits are visible on the plant.
In this species a fruit is ripe when xxxxx

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: xx, xx, B. Haggerty x3, xxx

**California Phenology Project:
monitoring guide for
Honey Mesquite
(*Prosopis glandulosa*)**

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




Photo credit: Homer Price (Flickr)

What does this species look like?
This deciduous species is a thorny, nitrogen-fixing large shrub or medium-sized tree. It grows between 1.5 to 35 feet tall. The greenish-white to yellowish-white flowers develop simultaneously with the leaves. These flowers are grouped tightly on elongated spikes that are showy and droopy. Flowers are high in nectar and pollinated primarily by bees.

Species facts!

- Honey mesquite wood is used for fuel, furniture, flooring, utensils, and posts.
- The pods and seeds are eaten by wildlife.
- Native Americans ground the pods and seeds into meal to make bread, mush, and alcohol. Other plant parts were used to make black dye, rope, cement for pottery, and candy.




Photo credit: Melody Lytle

Where is this species found?

- Grows in warm desert shrub communities and grasslands.
- On plains, terraces, washes, and riparian sites.
- Grows in sites where plants have access to permanent underground water.
- Within California, this species occurs at elevations between 60 and 1090 meters.







Photo credit: Thomas Muller


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
Honey Mesquite
(*Prosopis glandulosa*)**






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. Leaves
One or more live unfolded leaves are visible on the plant. A leaf is considered "unfolded" once the leaf stalk (petiole) or leaf base is visible. New small leaves may need to be bent backwards to see whether the leaf stalk or leaf base is visible. Do not include dried or dead leaves.




3. 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.




4. 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.



5. 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.




6. Pollen release
One or more flowers on the plant release pollen when gently shaken or blown.




7. Fruits
One or more fresh fruits are visible on the plant.

In this species, a fruit is a xxx



8. Ripe fruits
One or more ripe fruits are visible on the plant.

In this species a fruit is ripe when xxx



9. 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.

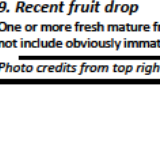


Photo credits from top right, clockwise:

California Phenology Project:
monitoring guide for
Joshua Tree
(*Yucca brevifolia*)

USA npn National Phenology Network
UCSB NATIONAL PARK SERVICE

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




Photo credit: Brian Haggerty

What does this species look like?
This species is tree-like with a thick trunk, growing up to 40 feet tall. The leaves are evergreen and linear, tapering to a sharp point. The creamy flowers are bell-shaped and found in tight clusters at the end of stalks. These flowers are monoecious; meaning they have separate male and female flowers on the same plant.

Species facts!

- A monocot in the Lily family.
- It has been proposed that the Shasta ground sloth was the main fruit disperser of Joshua Tree before they went extinct.
- Joshua Tree is pollinated by the Yucca moth, which fertilizes the flowers while laying its eggs inside the flowers. The larvae then hatch and feed on the seeds.
- Native Americans used the leaves for baskets and the seeds and flower buds for food.
- Joshua Tree got its name from Mormon pioneers.




Photo credit: Jack11_Poland (Wikipedia)

Where is this species found?

- Joshua Tree is an indicator species of the Mojave desert.
- It is found at elevations between 400 and 1800 meters.
- It is found on flat sites, mesas, bajadas, and gentle slopes.
- Prefers well-drained sandy and gravelly soil in alluvial fans adjacent to desert mountain ranges.





Photo credit: David Scriven

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)

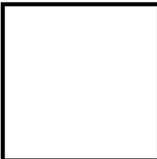
California Phenology Project:
monitoring guide for
Joshua Tree
(*Yucca brevifolia*)

USA npn National Phenology Network
UCSB NATIONAL PARK SERVICE

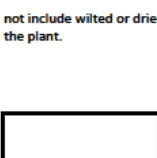

Phenophases to monitor:




1. 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.



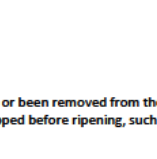
2. Open flowers
One or more open fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between unfolded or open flower parts. Do not include wilted or dried flowers that remain on the plant.

3. Fruits
One or more fresh fruits are visible on the plant.
In this species, the fruit is a capsule that changes from fleshy green to leathery tan, grayish-brown or brown. Sometimes the skin cracks, and the fruit drops from the plant.






4. Ripe fruits
One or more ripe fruits are visible on the plant.
In this species a fruit is ripe when it is leathery tan, grayish-brown or brown.



5. 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 right, clockwise: B. Haggerty, xx, B. Haggerty

**California Phenology Project:
monitoring guide for
Mojave Yucca
(*Yucca schidigera*)**

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




Photo credit: Stan Shebs

What does this species look like?
This is a small evergreen plant that grows up to 5 meters tall with a grayish-brown trunk. Its leaves are long, pointy, and very rigid. The leaves are arranged in a spiral on top of the basal trunk. They have coarse fibers along the leaf margins. The flowers are 3 to 5 centimeters long, white, and bell-shaped. They are arranged in dense clusters at the end of a central stalk. The flowers are bisexual; meaning each has both male and female reproductive parts.

Species facts!

- A monocot in the Lily family.
- Mojave Yucca was used extensively by Native Americans who utilized the seeds for flour, the leaf fibers for rope and cloth, and the roots for soap.
- This species is pollinated by the Yucca moth, which fertilizes the flowers while laying its eggs inside the flowers. The larvae then hatch and feed on the seeds.
- Occasionally hybridizes with Banana Yucca.




Photo credit: Nyenyec (Wikipedia)







Photo credit: Comroguet (Flickr)

Where is this species found?

- Distributed within the Mojave and Sonoran deserts.
- Typically found on well drained soil on rocky slopes and on Creosote flats.
- Found at elevations between 300 and 1200 meters.

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
Mojave Yucca
(*Yucca schidigera*)**

Phenophases to monitor:

<div style="border: 1px solid black; height: 80px; width: 100%;"></div> <p>1. 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.</p>	<div style="border: 1px solid black; height: 80px; width: 100%;"></div> <p>2. 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.</p>
<div style="border: 1px solid black; height: 80px; width: 100%;"></div> <p>4. Fruits One or more fresh fruits are visible on the plant. <i>In this species, the fruit is a capsule, sometimes constricted, that changes from fleshy green to leathery tan, grayish-brown or brown, and drop from the plant.</i></p>	<div style="border: 1px solid black; height: 80px; width: 100%;"></div> <p>5. Ripe fruits One or more ripe fruits are visible on the plant. <i>In this species a fruit is considered ripe when it is leathery tan, grayish-brown or brown.</i></p>

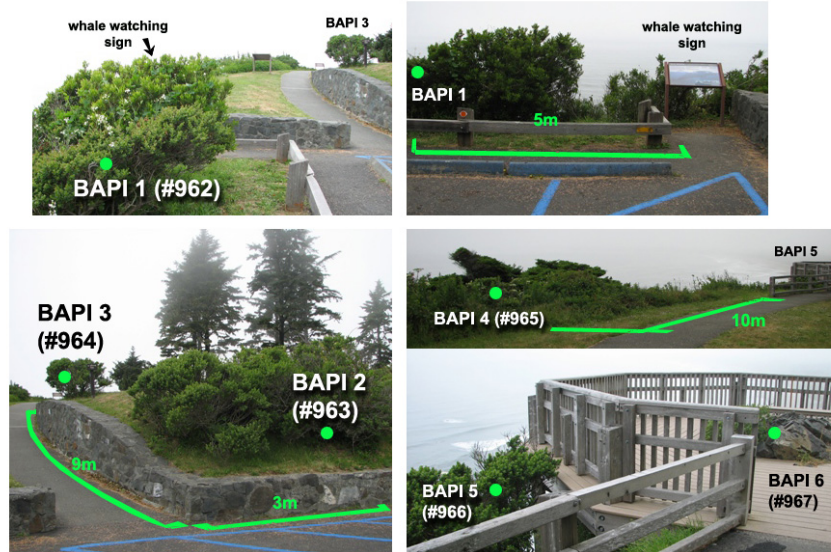
6. Recent fruit drop
One or more fresh mature fruits or seeds have dropped or been removed from the plant since your last visit. Do not include obviously immature fruits that have dropped before ripening, such as in a heavy rain or wind.

Photo credits from top right, clockwise:

APPENDIX E: EXAMPLE TOOLS DEVELOPED BY NPS SEASONAL STAFF

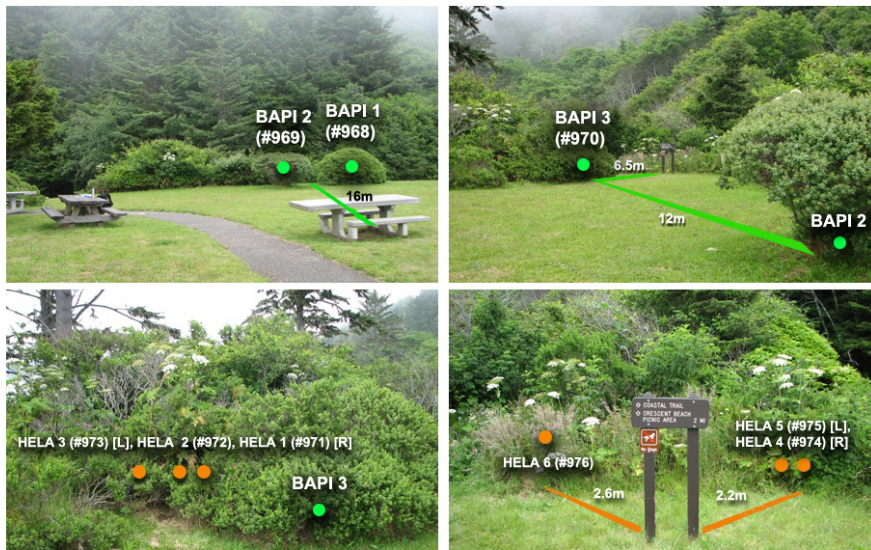
CPP - REDW - CBO 1 - (BAPI 1 - 6)

Coyote Brush (*Baccharis pilularis*) Crescent Beach Overlook



CPP - REDW - CBO 2 - (BAPI 1 - 3) & (HELA 1 - 6)

Coyote Brush (*Baccharis pilularis*) & Cow Parsnip (*Heracleum lanatum*) Crescent Beach Overlook



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)

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

Young leaves	Y or N	_____
Fresh flower	Y or N	_____
Fresh fruit	Y or N	_____
Ripe fruit	Y or N	_____

Plant Number _____

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

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

Young leaves	Y or N	_____
Fresh flower	Y or N	_____
Fresh fruit	Y or N	_____
Ripe fruit	Y or N	_____

Plant Number _____

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

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

Young leaves	Y or N	_____
Fresh flower	Y or N	_____
Fresh fruit	Y or N	_____
Ripe fruit	Y or N	_____

Plant Number _____

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

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

Young leaves	Y or N	_____
Fresh flower	Y or N	_____
Fresh fruit	Y or N	_____
Ripe fruit	Y or N	_____