



# UC-NRS PHENOLOGY NETWORK – PROJECT DESCRIPTION

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## Background

Phenology is the study of seasonal or periodic biological events such as flowering, leaf-out, insect emergence, and animal migration. The phenological schedules of plants and animals across the seasons are dynamic and closely linked to climatic and ecological variables. Consequently, tracking the phenology of plants and animals is a compelling way in which to study how living systems function in response to seasonal climate variability and, over the long-term, to climate change. Given that phenological monitoring is easy to conduct and straightforward to teach, both professional and citizen scientists can contribute to regional and national efforts to track phenological changes.

Since 2007 the *USA National Phenology Network (USA-NPN)* has brought together scientists, citizen scientists, government agencies, non-profit groups, educators, and students of all ages to monitor the effects of climate change on plants and animals in the United States ([USA-NPN website](#)). 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. The USA-NPN's observation program (*Nature's Notebook*) and data management infrastructure assure standardized reporting of phenological data while tracking the participation of individual users. In addition, *Nature's Notebook* users can visualize geographic variation in phenological patterns and access data contributed by participants nationwide. The USA-NPN makes phenological data, models, and related information available to scientists, resource managers, and the public so that they may investigate phenological patterns within and across species.

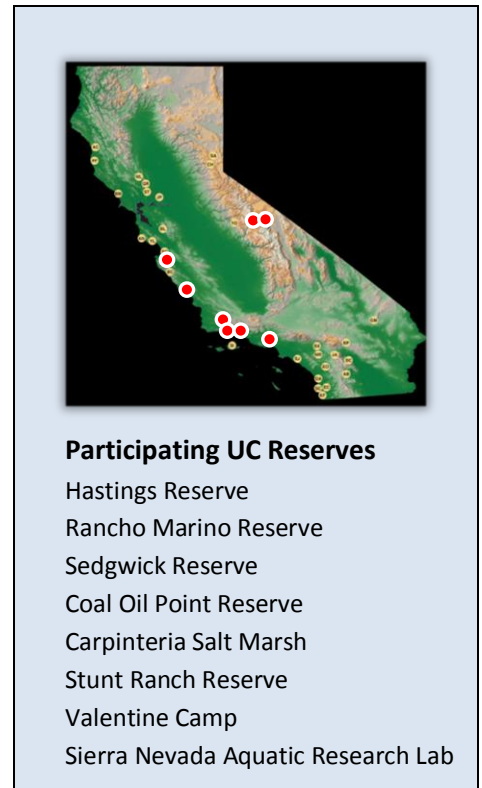
In California, where climate change is expected to alter the temporal patterns of temperature and precipitation, the inter-annual schedules of leaf-out, flowering, pollination, fruit production, and seed dispersal may be affected, along with the animals and ecosystem functions that depend on these processes. To track these important changes in the seasonal cycles of plants and animals, the *California Phenology Project (CPP)* was launched in 2010 to coordinate phenological monitoring across 19 of California's National Parks (links: [CPP website](#), [Project Brief](#), [Newsletter](#)). With funding from the National Park Service's Climate Change Response Program, the CPP's mission includes the design and implementation of long-term phenological monitoring of carefully selected, iconic, and ecologically informative plant species across California's diverse landscapes. The CPP's monitoring infrastructure and [phenological literacy resources](#) have been developed to encourage partnerships with other science and education networks across the state, including the University of California. Standardized phenological data from this project are contributed to the USA-NPN's database, where they are available to anyone for analysis, interpretation, and educational activities.

Despite the potential for phenological studies to detect early warning signs of the effects of climate change, and despite their applications to other science and education efforts, the CPP represents the first concerted effort among California researchers, educators, and institutions to conduct phenological research. **With seed funding from the UC Office of the President (UCOP), we are initiating the development of coordinated phenological monitoring and education programs across the University of California, beginning with eight natural reserves in the UC Natural Reserve System (UC-NRS).**

## UC-NRS Phenology Network

The world's largest university-operated system of natural reserves, the University of California Natural Reserve System provides an exceptional opportunity to create a geographically widespread and long-term phenological monitoring program that holds the promise of revealing links between the seasonal behavior of plants and animals and changing climatic conditions. Eight of the 37 UC Reserves have been selected for this pilot project (other reserves, locations, and partners are welcome to participate by contacting Brian Haggerty and Susan Mazer) and encompass a diverse range of ecosystems and plant communities, including coastal salt marsh and dunes; oak woodland; chaparral; coastal sage scrub; pinyon pine-juniper forest; and montane evergreen forest. Moreover, most of these reserves are highly accessible to researchers and local community members, and have a long history of visitation and educational programs assisted by enthusiastic amateur naturalists who are available — and eager — to be trained as citizen scientists.

Consequently, we have designed this project to leverage the available ecological resources, student communities, and volunteer groups offered by, and available to, the UC-NRS while minimizing the time investment required by NRS staff in order to ensure the program's success. The primary goals of the proposed project are to:



- 1) **Design an integrated phenological monitoring program among the eight pilot UC Reserves** while customizing its implementation within each reserve. CPP monitoring sites generally include 10-30 labeled and georeferenced plants of each of 4-6 species distributed across trails, demonstration gardens, or natural habitats, which are monitored up to two times per week. We will aim to select species at the Reserves that are already being monitored in California's National Parks and Recreation Areas in order to maximize the geographic sampling of these taxa.

Visit the [CPP species list](#) and download the [CPP species selection summary](#) to learn more.

- 2) **Create educational, training, and monitoring resources** that will be available online to UC faculty, public school educators, and informal science educators for integrating phenology and climate change education into current curricula and activities.

Visit [CPP Education](#) and [CPP Presentations](#) to learn more and to download available resources.

- 3) **Conduct one-day workshops at each pilot reserve** to teach local volunteers, docents, scientists, and informal science educators about the causal relationships between phenology and climate change, and how to participate in phenological monitoring and the UC-NRS Phenology Network. In the 1-2 days following a workshop, participants are invited to join Haggerty & Mazer in establishing monitoring sites at the reserve.



Brian Haggerty, Susan Mazer, and CPP post-doc Liz Matthews discussed project goals with UC-NRS reserve managers during the 2011 manager's meeting at Sedgwick Reserve. Training and coordinating workshops for reserves, their staff, and the public will be conducted during 2012 at each of the eight participating UC Natural Reserves.