California Phenology Project Species-Selection Process for the CA National Park Units

By Elizabeth M. Matthews

The California Phenology Project (CPP; www.usanpn.org/cpp) was initiated in 2010 with the primary goal of organizing and implementing an integrated phenological monitoring program across the state of California. The project is initially focused on six pilot parks, although future efforts will aim to expand the phenological monitoring program to include all CA NPS units and additional partners in California (e.g., UC Natural Reserve System, USFWS wildlife refuges, etc.). In early 2011, the CPP began a species-selection process to identify species for monitoring in each of the CA NPS units. This process was carried out in four biogeographic regions (Northern Coast, Southern Coast, Mountains, and Desert). This document summarizes the steps taken by the CPP to select focal species in each of these regions.

(1) Identify criteria for selection of species for phenological monitoring
   - The CPP species-selection criteria were developed during a full-day workshop held in Berkeley, California in November 2010. A full report describing the development of both ecological questions of interest and CPP species-selection criteria, as well as workshop participants, can be found here: http://www.usanpn.org/files/shared/files/SciAdvisory%20Workshop%20Nov%202010%20Summary%20Final%20Report.pdf

(2) Consolidate National Park floras to identify species present at each park and the frequency of species' presence across all CA parks and biogeographic regions. The combined flora can be found at the following URL: http://www.usanpn.org/cpp/resources.

(3) Identify all species that are dominant, characteristic, or indicator species for vegetation types or ecological systems found in the area of interest (e.g., biogeographic region, park unit, UC-reserve)
   - The CPP identified all species that were dominant, characteristic, or indicator species of Nature Serve Ecological Systems found within each CA bioregion (for more information about Nature Serve's Terrestrial Ecological Systems of the U.S., see http://www.natureserve.org/getData/USecologyData.jsp).

(4) Collect species attribute information, including nativity, life form, and family
   - The CPP gathered this information from the USDA PLANTS database.

(5) Compile initial list of species, including the most frequently occurring species and *all* dominant, characteristic, or indicator species for the area of interest
   - The CPP initial species lists included the 100 most frequent species and all dominant, characteristic, and indicator species in each bioregion; the four initial lists (including all four categories of species: most frequent, dominant, characteristic, and indicator) ranged in size from 136 species in the Mountain bioregion to 189 species for the Northern Coast bioregion.

(6) Distribute the initial candidate species list to a species-selection workgroup, composed of park staff, botanists, vegetation ecologists, and others with botanical expertise, to assess each species based on whether it is well-suited to address CPP ecological questions of interest and a set of pre-determined CPP species-selection criteria (developed during the November 2010 workshop described above). Species were valued for targeting if they addressed more than one (or many!) of the ecological questions and if they fulfilled more than one (or many!) of the species selection criteria. Individual workgroup participants provided responses to the CPP via email; participant responses were submitted in a spreadsheet format that included recommended species and justification information.

1. CPP focal ecological questions:
    i. How do iconic, widespread, and ecologically important species of the California flora respond to variation in climate (and, by extension, to alternative scenarios of climate change)?
    ii. Which plant species in California are most sensitive to climate (and, by extension, to climate change)?
    iii. Are relationships between inter-dependent plant and animal mutualists at risk due to climate change? For example, are pollinators and their floral resources tracking climate change at the same pace?
    iv. How do particular communities or vegetation types differ in their phenological response to climate change? Are some communities more buffered against climate change?
    v. How do species or populations behave at their range margins or at ecotones?
    vi. How do plant reproductive schedules respond to invasions of competitors or diseases?
    vii. How do species respond to abiotic disturbance?
    viii. What are the earliest indicators of spring?
    ix. How are end-of-season phenological events and patterns affected by long-term climate change?

2. CPP species-selection criteria:
    i. ***dominant species,*** representing the most common or "characteristic" local or regional vegetation type (e.g., coast live oak, redwood trees, giant sequoias)
    ii. ***widely distributed taxa*** (e.g., taxa that occur in the largest number of National Parks (and UC reserves) within biogeographic regions (coastal, montane, or arid) and across biogeographic regions (including more than one of the following: coastal, montane, or arid).
    iii. ***indicator species*** for habitats, or transitions between habitats, of particular interest (e.g., desert scrub, vernal pools, bogs, maritime chaparral, oak woodland, pinyon pine-juniper, riparian, snowmelt edges, evergreen forest)
    iv. ***species of local ecological or management concern,*** including keystone or highly charismatic taxa, and/or species involved in highly inter-dependent plant-animal interactions (e.g., Joshua Trees, fall-deciduous taxa that change leaf color; locally endangered species; highly invasive species; critical food sources for endangered pollinators or butterfly larvae)
    v. ***ease of identification*** – it's important that each selected species and its phenophases are relatively easy to identify (especially when closely related and morphologically similar taxa are sympatric with the target species)
    vi. ***accessibility for monitoring across an abiotic or biotic gradient*** (e.g., elevation; aspect; soil moisture; gradients of invasive species abundance; gradients of disturbance, such as across a wildfire boundary; gradients of coastal fog)
    vii. ***proximity to other monitoring efforts*** (e.g., co-location with I & M plots that provide demographic and abundance information or proximity to meteorological stations)
    viii. ***species for which there are legacy data*** to which current phenological behavior can be compared (e.g., Clausen, Keck & Heisey data, PhD dissertations, published primary literature, etc.)
    ix. ***benchmark species*** (e.g., species that are "first-responders" to spring warming; species that are last-to-flower; species that provide dramatic spring flowering or fall foliage displays)
    x. ***ability to engage Citizen Scientists*** (e.g., species that are easy to propagate or cultivate for use in native plant or school gardens; species whose phenological activity occurs at different periods throughout the year, allowing for interaction with Citizen Scientists in many seasons; etc.)
    xi. ***known and accessible locations*** of multiple individuals in park/unit

(7) Compile species recommended by workgroup participants, facilitate species ranking by workgroup participants, and provide opportunities for feedback and comment on ranked list for each CA bioregion

1. The CPP Core Team hosted a webinar for each biogeographic region to discuss and adjust preliminary species rankings (which were developed prior to each webinar by workgroup participants). Prior to each webinar, the CPP asked participants to submit a list of their top candidates for CPP monitoring, along with justification for each suggested taxon, based upon materials described above (initial species lists, focal ecological questions, and species-selection criteria). During the webinars, the workgroup reviewed the preliminary ranking, in which species were ranked by the number of times a species was proposed as a candidate prior to the webinar. The workgroup also discussed additional justification for proposed species and proposed additional taxa that were not included in the preliminary rankings. Based on these discussions, the workgroup adjusted the preliminary species rankings and identified a short list (5-15 taxa) of high-priority species for monitoring in each of the California parks.
2. Following each webinar, both the short list of high-priority species (5-15 taxa) and an annotated list of *all* species suggested and discussed by the workgroup were distributed to workgroup participants via email for a second round of comments and suggested ranking adjustments.

(8) Constrain short list of highly ranked species by practical criteria determined to be important in the field; many of these criteria require detailed knowledge of the distribution, habit, and abundance of focal taxa in the area of interest (and therefore may require some on the ground scouting work!)

1. Following the species-selection webinars and subsequent email communications, the CPP assessed the short list of high priority species based on the practical criteria described below; this was accomplished during multi-day visits by the CPP Core Team to each of the pilot parks, with assistance from park staff that were knowledgeable of the ecology, distribution, and abundance of high priority taxa.
2. Practical criteria, determined to be important in the field for engaging park staff and visitors in regular and routine monitoring, included:
    i. **accessibility** (i.e., adjacent to the phenology trails or other monitoring locations): this is especially important when members of the public will be involved in the data-collection,
    ii. **abundance:** if 5-15 healthy individuals of a given taxon could not be located along a 1-mile trail, then we generally don't want to sample the taxon on that trail because replication is a problem; also, as plants die in the future, it will be hard to replace them
    iii. **ease of delineating a single individual**: many shrubs and long-lived perennials become so sprawling and grow so clonally that it's hard to determine when one individual ends and another begins; the CPP is initially avoiding such individuals because it's hard for someone monitoring them to know how many stems or ramets to include when recording phenophases. The CPP is developing monitoring protocols that can support monitoring clonal species (e.g. patch monitoring protocols)
    iv. **ease of identifying phenophases**: some phenophases are difficult to identify for certain taxa (e.g., the % of the canopy that's full and the % of full-sized leaves); this issue can also be minimized by eliminating some of the phenophases for particular taxa

(9) Work with the National Coordinating Office of the USA National Phenology Network (USA-NPN) to develop phenophase monitoring descriptions (if they did not already exist) and species profiles for all high-priority CPP species that are not already included in the USA-NPN Nature's Notebook

1. As of October 2011, there are over 60 species included in Nature's Notebook that have been identified by the CPP as high-priority species for phenological monitoring in California
2. The NPN and CPP are also creating species profiles/monitoring guides for each of the CPP species monitored at the pilot parks; these profiles include secondary phenophase descriptions (i.e. species-specific descriptions of each phenophase, as opposed to the generic phenophase definitions included on

all USA-NPN datasheets, and practical pointers for monitoring each phenophase in the field), as well as phenophase photos and a general description of the taxon. The CPP species profiles are useful models for other parks and partners who are interested in creating species-specific monitoring guides for taxa not currently targeted by the CPP.

For more information about the California Phenology Project and the CPP species-selection process, please contact:

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