California Phenology (CAP TCN): Starting Year 3

Capturing California's flowers: Using digital images to investigate phenological change in a biodiversity hotspot

Building a record of flowering time

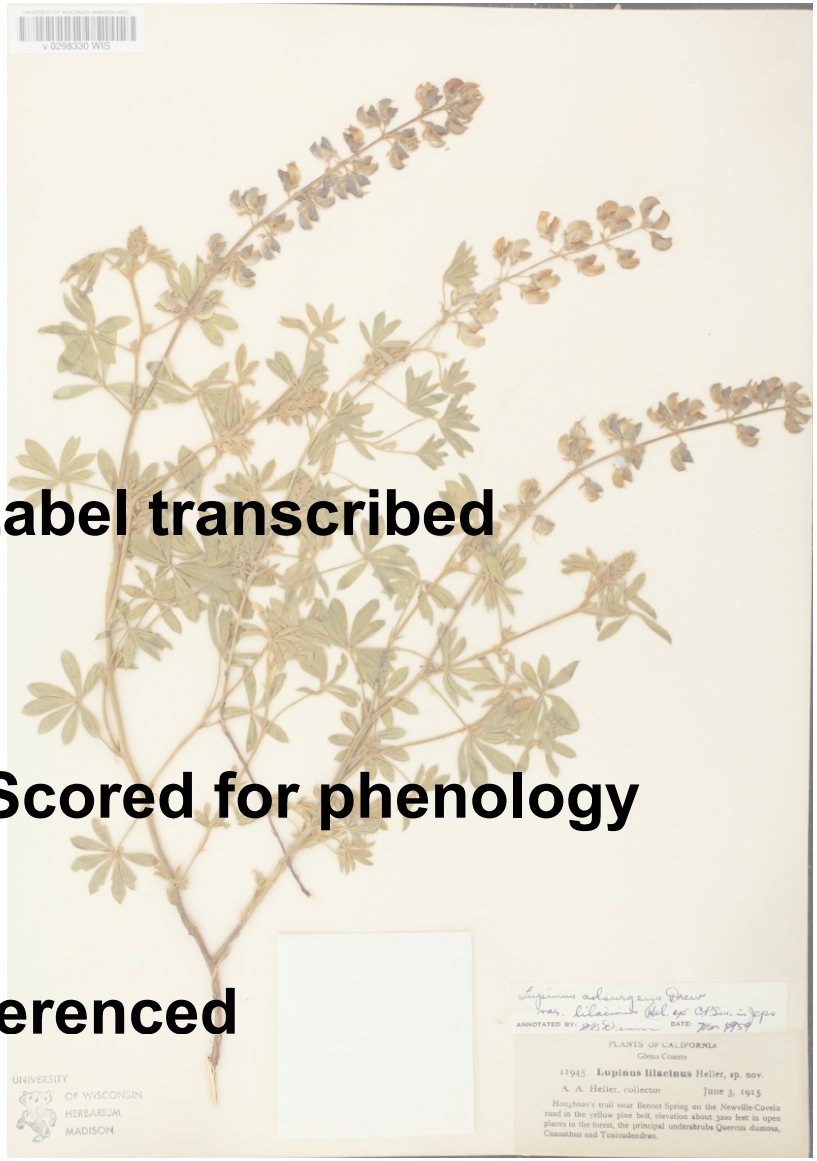
Goal: 904,200 specimens

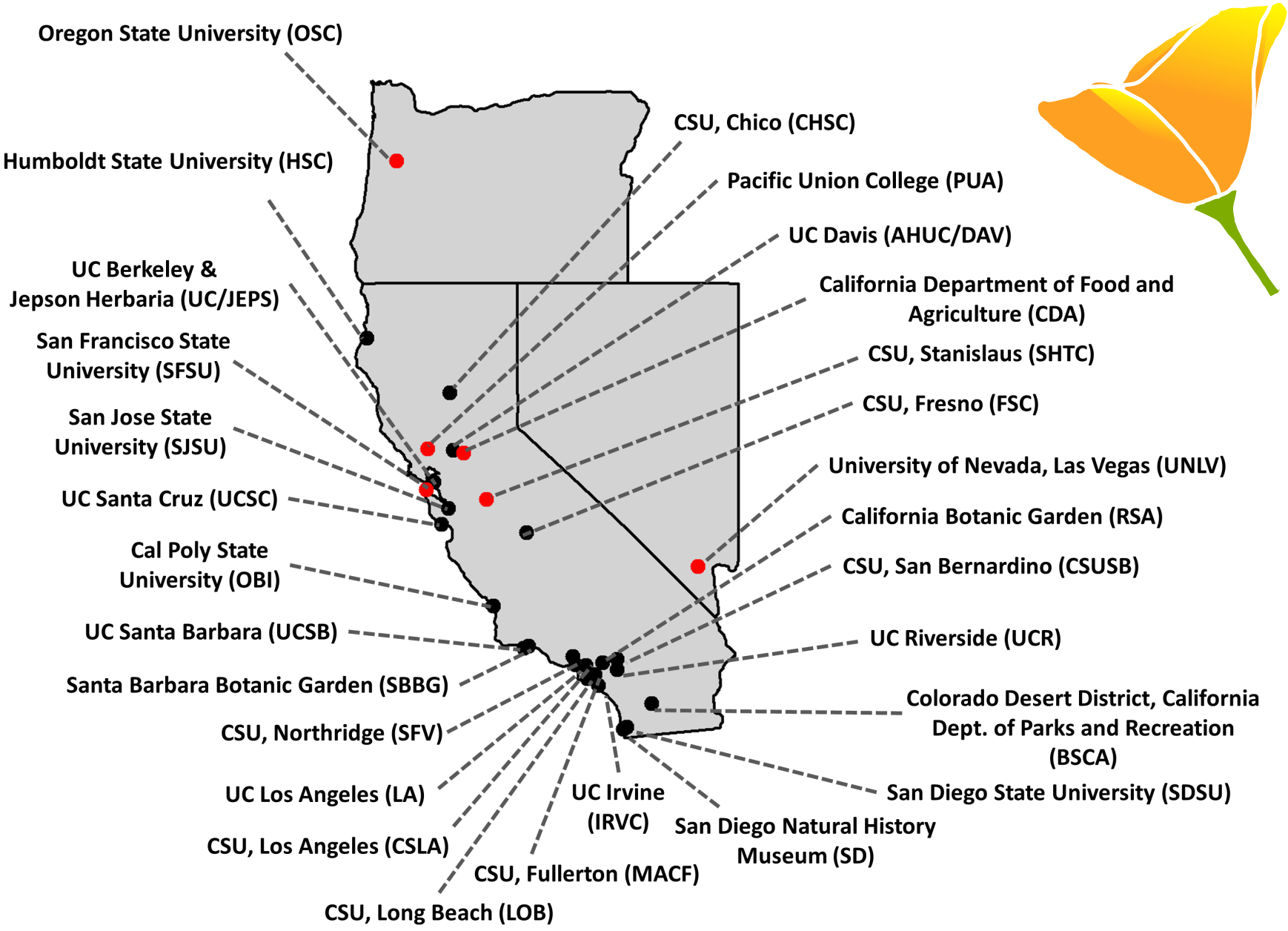
Imaged

Label transcribed

Scored for phenology

Georeferenced

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CSU, Chico (CHSC)
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California Department of Food and Agriculture (CDA)
CSU, Stanislaus (SHTC)
CSU, Fresno (FSC)
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California Botanic Garden (RSA)
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UC Riverside (UCR)
Colorado Desert District, California Dept. of Parks and Recreation (BSCA)
San Diego State University (SDSU)
San Diego Natural History Museum (SD)
UC Irvine (IRVC)
CSU, Fullerton (MACF)
CSU, Long Beach (LOB)
CSU, Los Angeles (CSLA)
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CSU, Northridge (SFV)
Santa Barbara Botanic Garden (SBBG)
UC Santa Barbara (UCSB)
Cal Poly State University (OBI)
UC Santa Cruz (UCSC)
San Jose State University (SJSU)
San Francisco State University (SFSU)
UC Berkeley & Jepson Herbaria (UC/JEPS)

Our first PEN

- Aaron Liston (OSU)
- Jon Rebman & Layla Hains (SD)
- Jason Cantley (SFSU)
- Andy Gardner (SHTC)
- Lloyd Stark (UNLV)
- Genevieve Walden (CDA)
- Aimee Wyrick (PUC)

Taking advantage of the digital world of Covid-19

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Welcome to the Consortium of California Herbaria Portal (CCH2)

CCH2 serves data from specimens housed in CCH member herbaria. The data included in this database represents all specimen records from partner institutions. The data served through this portal are currently growing due to the work of the **California Phenology Thematic Collections Network (CAP-TCN)**. This collaboration of 22 California universities, research stations, natural history collections, and botanical gardens aims to capture images, label data, and phenological (i.e., flowering time) data from nearly 1 million herbarium specimens by 2022. Data contained in the CCH2 portal will continue to grow even after this time through the activities of the CCH member institutions.

For more information about the California Phenology TCN, visit the project website:

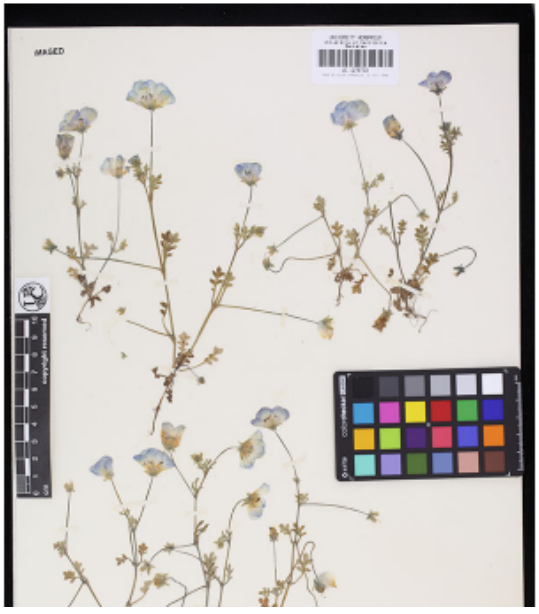
https://www.capturingcaliforniasflowers.org

For more information about the California Consortium of Herbaria (CCH) see:

http://ucjeps.berkeley.edu/consortium/about.html

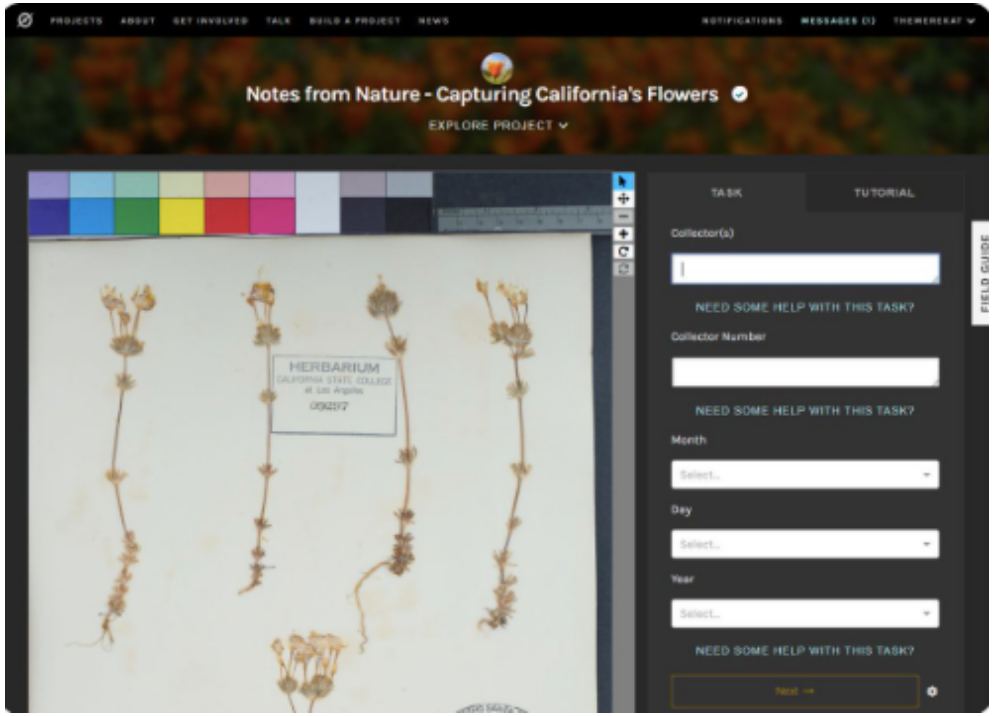
The California Phenology TCN is made possible by the National Science Foundation Award 1802312. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Special thanks to the National Park Service who provided funds for the initial setup of the CCH2 website and database (November 2016)

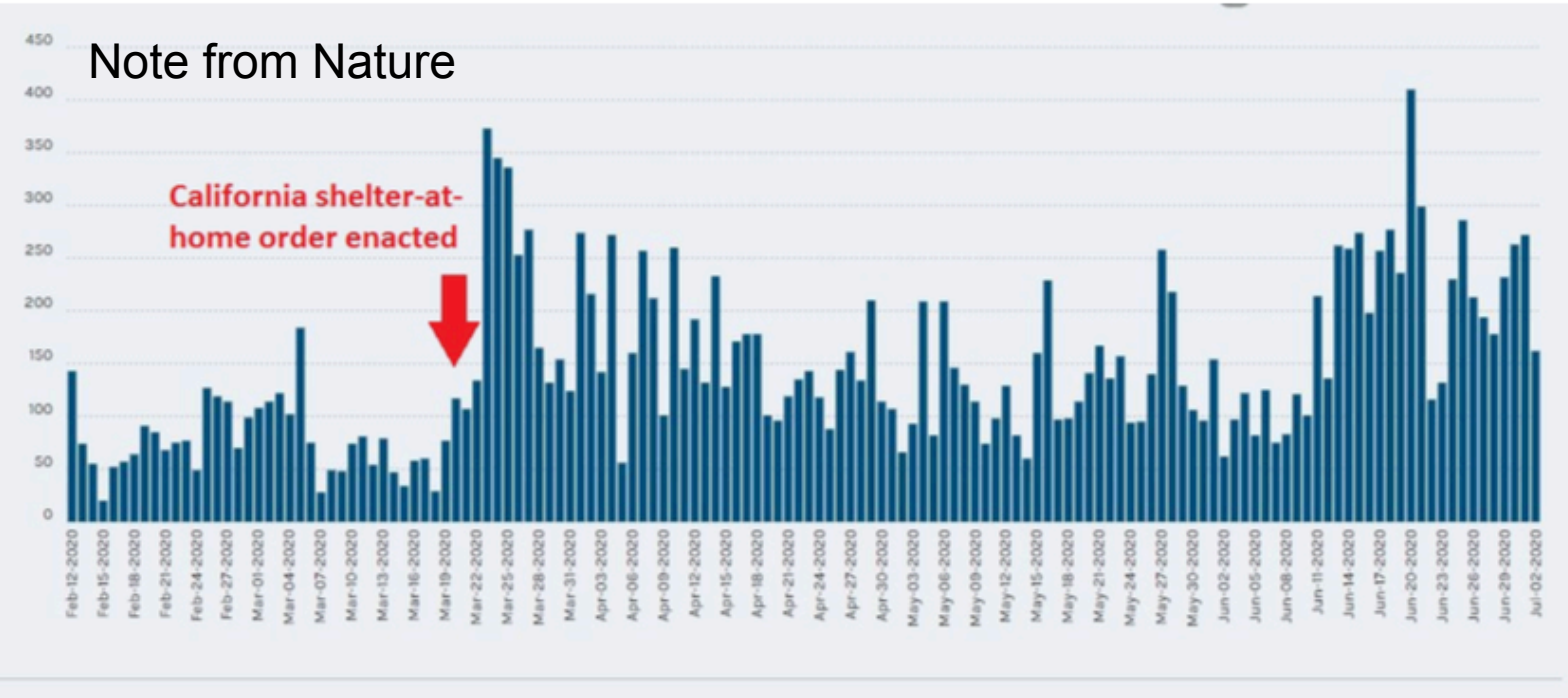


Notes From Nature

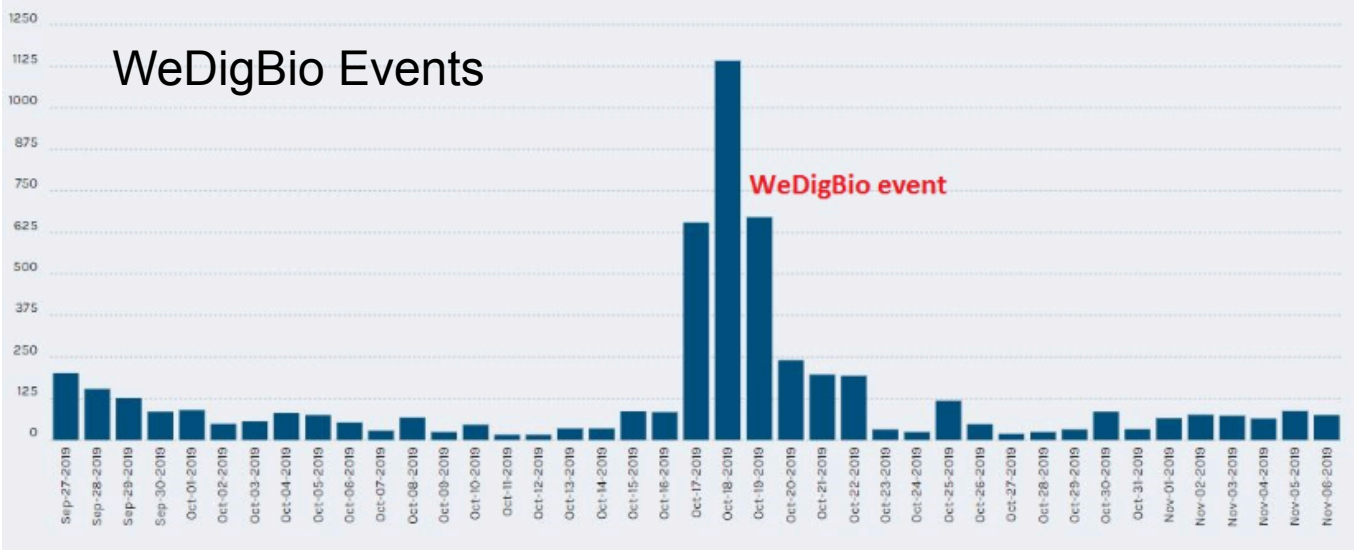
12,000 records transcribed by 500 volunteers



Note from Nature



WeDigBio Events



www.capturingcaliforniasflowers.org

Upcoming event:

DO YOU DIG PLANTS?

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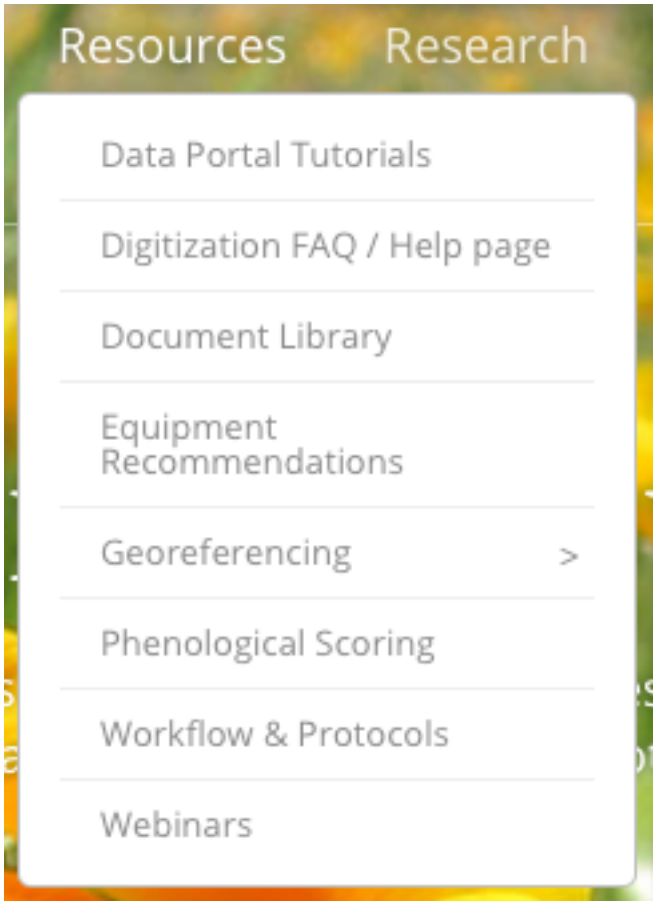

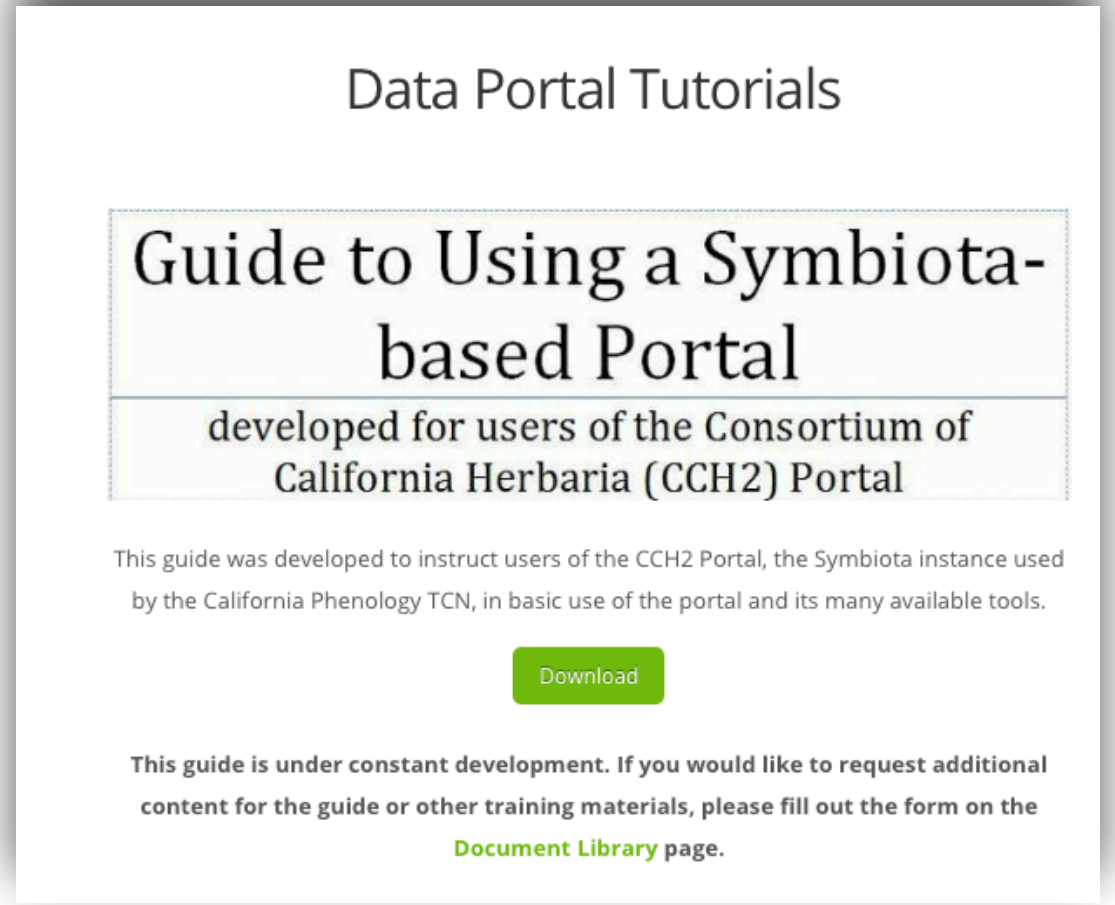

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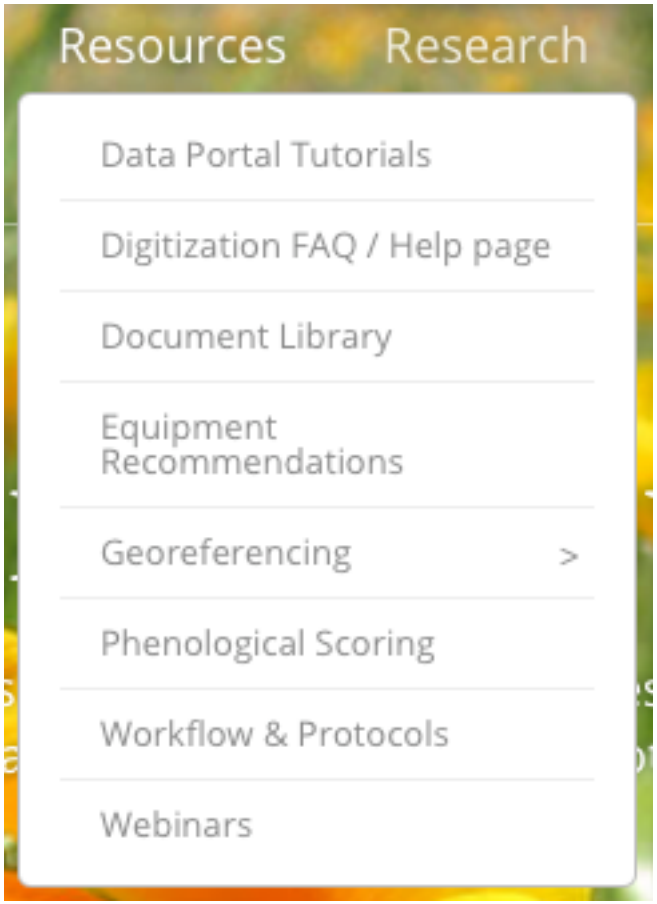
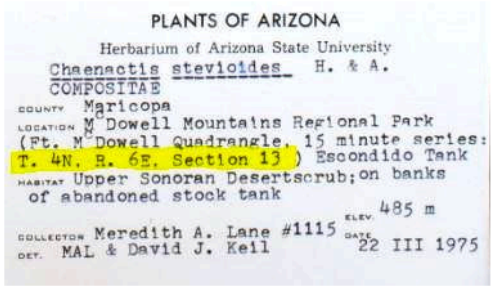


What do T, R, and sec. mean on a label?

5/5/2020 0 Comments

Problem

A label has T#N or T#S, R#W or R#E, and a section (sec.) value on it, like in the example below. What does this mean, and how do I enter this information in CCH2?
How do I georeference a specimen with TRS information?



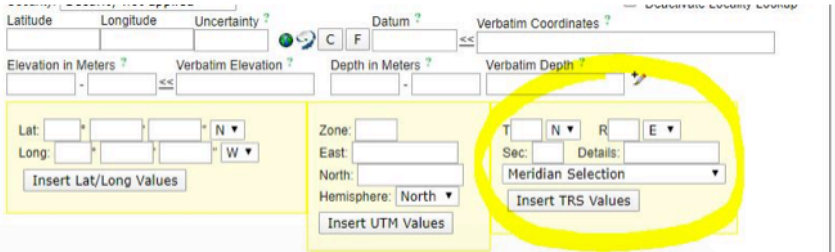
PLANTS OF ARIZONA
Herbarium of Arizona State University
Chaenactis stevioides H. & A.
COMPOSITAE
COUNTY Maricopa
LOCATION M Dowell Mountains Regional Park
(Ft. M Dowell Quadrangle, 15 minute series:
T. 4N. R. 6E. Section 13) Escondido Tank
HABITAT Upper Sonoran Desertscrub; on banks
of abandoned stock tank
ELEV. 485 m
COLLECTOR Meredith A. Lane #1115 DATE 22 III 1975
DET. MAL & David J. Keil

Our Solution

The letters and numbers you're seeing, like in the above example, are called township, range, and section coordinates, which are part of the U.S. Public Land Survey System, a system of defining locations that dates back to the 1700s. (Read more about it here: https://en.wikipedia.org/wiki/Public_Land_Survey_System)

The T value is the "township", which designates a 6-mile by 6-mile squares. The R value is the "range", which measures the distance east or west of the meridian. The section or "sec." is a numbered square within the township, measuring 1-mile by 1-mile.

In CCH2, you can enter TRS coordinates as they are, and you can convert them into a latitude, longitude, and error radius using GeoLocate. To do so, click the F button on the occurrence editor to open the formatting tools. A box in which you can enter TRS data is on the right (circled below).



Georeferencing in CCH2 Training Course

How to use this course

The purpose of this course is to provide a modular learning resource for georeferencing in the herbarium data portal, CCH2. Each module consists of learning objectives, a training video, and a quick quiz.

Module 1: What is georeferencing?

Learning objectives

Upon completion of this module, you should be able to:

- Understand the basic practice of georeferencing and why it is important
- Define the terms: **occurrence**, **locality**, **uncertainty/error**, **geodetic datum**
- Identify different types of coordinate systems you may encounter when georeferencing U.S. specimen records, including **decimal degrees**; **degrees, minutes, seconds**; **UTMs**; and **township, range, section**.

Resources Research

- Data Portal Tutorials
- Digitization FAQ / Help page
- Document Library
- Equipment Recommendations
- Georeferencing >
- Phenological Scoring
- Workflow & Protocols
- Webinars

Georeferencing in CCH2 Training Course

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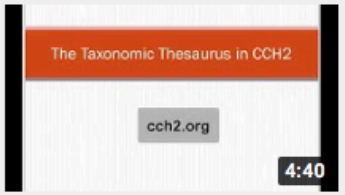

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Exploring Plant Phenology Using Herbarium Specimens

An undergraduate research course developed by the California Phenology Network

We're published! You can also find our materials on
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In this course, students will design and conduct original research to examine the effect of climate on plant phenological events (e.g., flowering) using herbarium specimen data. Students will augment existing specimen records with phenological and georeference data in the CCH2 data portal. They will then visualize, clean, and analyze herbarium specimen data and climate data using Excel and R code (through RStudio). Each student will present their research as a scientific report, poster, and/or a lightning talk. During weekly class meetings, important topics and guidance regarding the research process will be discussed.

Download Syllabus & List of Materials

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Course overview

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Course overview

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Delphinium spp. flowering influenced by regionally-specific temperature

Ryan Vosbigian[1], Tadeo Ramirez Parada[2], Katelin Pearson[3], & Jennifer Yost[3]

[1]Natural Resources and Environmental Sciences, California Polytechnic State University, San Luis Obispo;
[2]Biological Sciences, University of California, Santa Barbara;
[3]Biological Sciences, California Polytechnic State University, San Luis Obispo

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Introduction

- The species in the genus of *Delphinium*, common name larkspurs, are annuals within the buttercup family and that have distinct often brightly colored flowers
- They are found throughout much of California in a variety of habitats and plant communities
- Herbarium specimens provide an abundant resource for phenological research, because there are specimens from all across the country from the past century and a half (Willis et al. 2017)
- We used larkspur species to study the phenology, or timing, of flowering in response to regional specific baseline temperature and anomaly (or difference) from the baseline temperature
- We used minimum temperature, because plants have been shown to respond more to minimum temperature than averages or maximum (Abu-Asab et al. 2001)

Research Questions

- Does regional baseline minimum temperature influence flowering date?
- Does anomaly from regional baseline minimum temperature influence flowering date?
- Does baseline temperature affect sensitivity to annual anomalies from the historical norms?

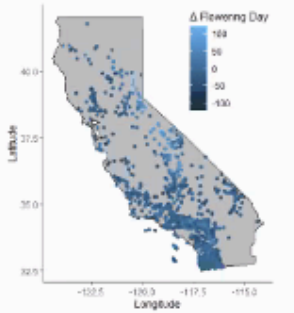


Figure 1: Map of specimens used in analyses including flowering date as a gradient of blue

Methods

- We used specimens from the Consortium of California Herbaria Portal (CCH2)
- We georeferenced specimens within the Robert F. Hoover Herbarium using text from specimen labels by approximating location and specifying an error radius
- Phenological scoring involved a binary system of classification, where we scored whether the characteristic of interest, flowers, were present or absent

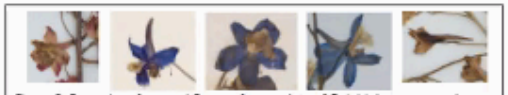


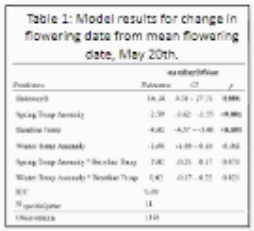
Figure 2: Examples of opened flowers for a variety of *Delphinium* spp. specimens

- Extracted data for all 10,967 Delphinium specimens in the CCH2 in California, removing specimens that were missing location, were not flowering, and had at least 25 specimens per species, which narrowed the final dataset 1398 specimens consisting 13% of the original dataset
- Matched temperature data from the PRISM Climate Group for each specimen
- To analyze the data, we used a mixed effects model, with *lme4* (Bates et al. 2015), modeling the deviation in days from mean flowering date with random effects for specific epithet
- We included fixed effects for baseline temperature, spring temperature anomaly, and winter temperature anomaly, and including interactions for baseline temperature against spring temperature anomaly and winter temperature anomaly.

Results

- For every 1 Celsius increase in regional baseline temperature, the day of flowering advanced by 4.0 days
- An increase in 1 Celsius in spring minimum temperature anomaly was associated with an advance by 2.6 days flowering (Fig. 3)
- No association found between flowering day and winter temperature anomaly (Fig. 4)
- No association found between flowering day and interactions between baseline temperature and temperature anomalies (Table 1)

Table 1: Model results for change in flowering date from mean flowering date, May 20th.



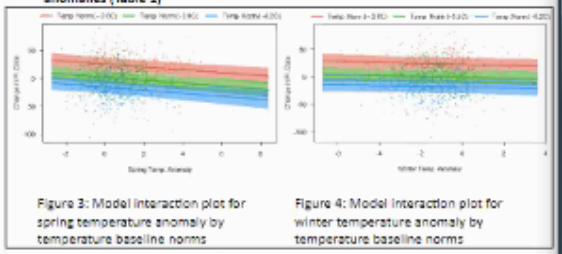


Figure 3: Model interaction plot for spring temperature anomaly by temperature baseline norms

Figure 4: Model interaction plot for winter temperature anomaly by temperature baseline norms

Discussion

- *Delphinium* plants did flower earlier in areas with warmer baseline temperatures and with warmer spring minimum temperatures
- Winter minimum temperature did not have an effect on flowering date after adjusting for baseline temperature and spring temperature, which is likely because winter weather and spring weather are not independent and there are complex associations in weather
- Larkspurs are affected more by spring minimum temperature than winter minimum temperature, which could be because the mean flowering date is relatively late in spring, May 20th
- Because the interaction between baseline temperature and winter and spring anomalies were not significant, we did not find evidence for the taxa having different sensitivities to annual differences in temperature
- Like other studies using a variety of species over a large latitudinal gradient, such as with Park and colleagues (2019), we found that there is a large amount of variation in flowering time by species and by regionally-specific weather

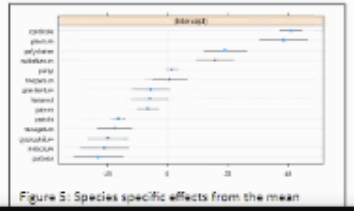


Figure 5: Species specific effects from the mean

Year 3: Here we come!

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