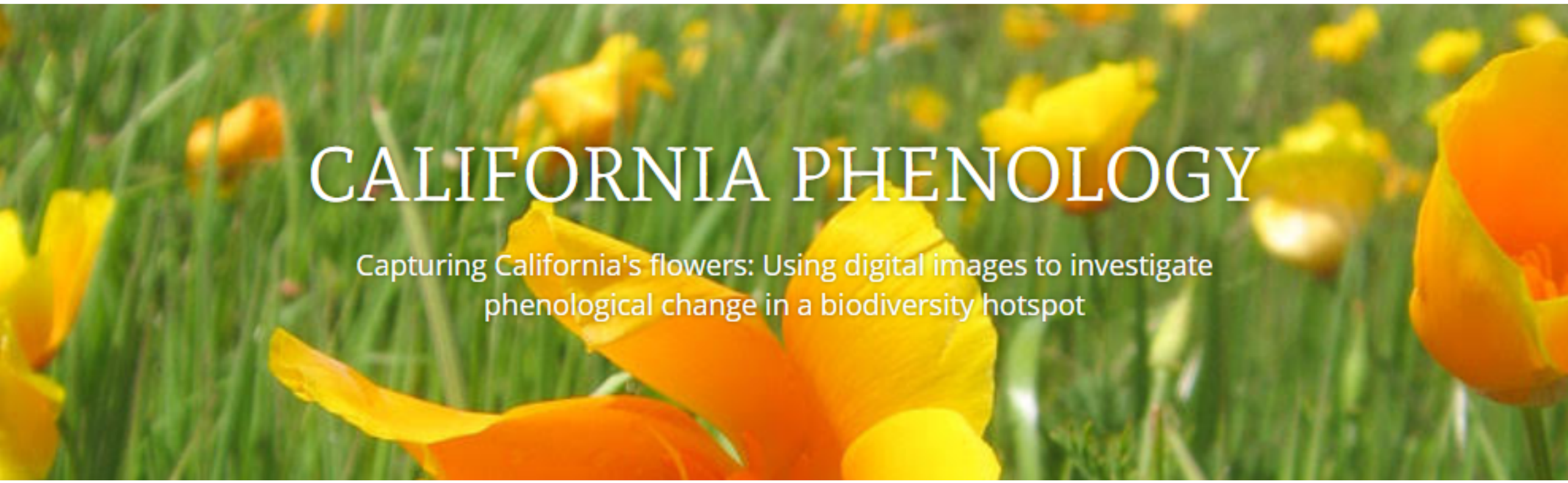


CALIFORNIA PHENOLOGY

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

Katie Pearson

Project manager, California Phenology (CAP) TCN

California Phenology (CAP) TCN

The University of California, Davis

University of California, Santa Barbara

Cal Poly San Luis Obispo

San José State University

UC

California State University, Fresno

California State University, San Bernardino

University of California, Berkeley

California State University, Chico

University of California, Riverside

Rancho Santa Ana Botanic Garden
California's Native Garden

University of California, Santa Cruz

California State University, Long Beach

Santa Barbara Botanic Garden

University of California, Los Angeles

California State University, Los Angeles

California State University, Northridge

California State University, Fullerton

Humboldt State University

theNAT
San Diego Natural History Museum

California State Parks

California Department of Parks and Recreation

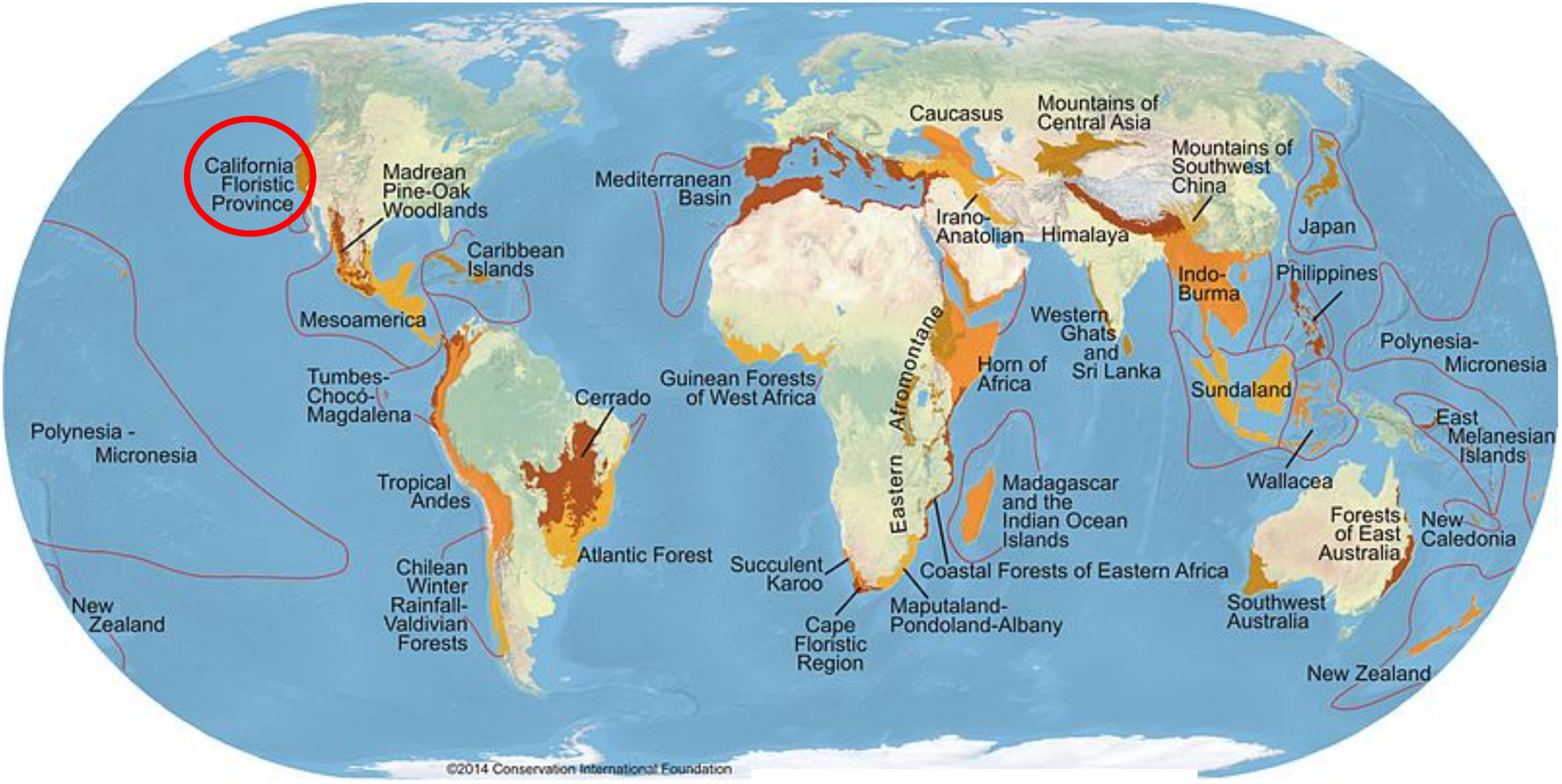
San Diego State University
Leadership Starts Here

Project Management

- Lead PI: Jenn Yost (Hoover Herbarium, Cal Poly, San Luis Obispo)
- Project manager: Katelin (Katie) Pearson
- Data manager: Jason Alexander
- Symbiota developer: Ed Gilbert

capturingcaliforniasflowers.org

Goals of CAP TCN



Conservation International (conservation.org) defines 35 biodiversity hotspots — extraordinary places that harbor vast numbers of plant and animal species found nowhere else. All are heavily threatened by habitat loss and degradation, making their conservation crucial to protecting nature for the benefit of all life on Earth.

Goals of CAP TCN

1. Image, database, and georeference 904,200 specimens
   - 22 target families
     - Oldest records
     - Most diverse families
     - Most endemic and threatened families
   - 250 additional taxa

USA npn National Phenology Network

Goals of CAP TCN

2. Capture phenological data for all 900,000+ specimens
   - From images
   - From label data

Goals of CAP TCN

3. Manage data in centralized, standardized portal

Home | Search Collections | Map Search | Image Search | Browse Images | About CCH | Log In | New Account | Siten

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.

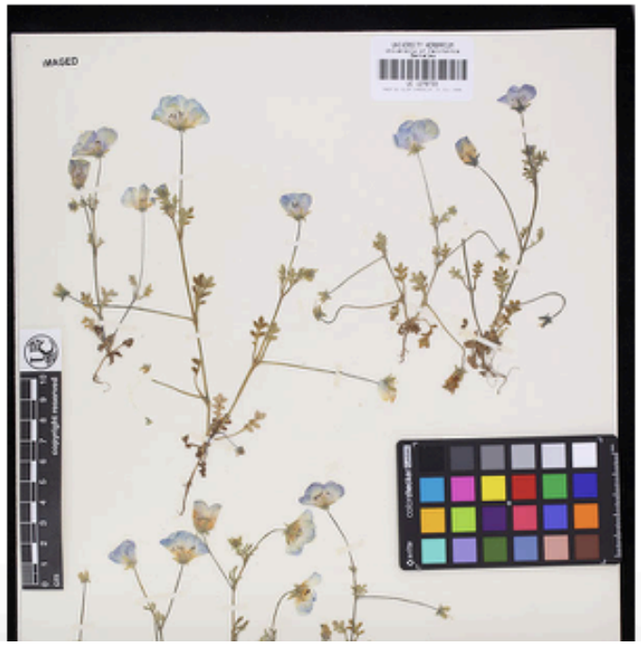
For more information about the California Phenology TCN, visit the project website:

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.



Specimen Details

Report a Problem

Species:	Acacia angustissima var. hirta
Collection Date:	June 2, 1989
Bar Code ID:	000027046
UUID:	ee815114-857c-4b75-8c51-63274085c594
Collectors:	Loran C. Anderson
Collector's Identifier:	12045
Flowers Present?:	True
Country:	United States
State or Province:	Florida
County or Parish:	Dixie
Plant Morphology Observations:	Filaments prominently white, perianth light green
Local Abundance Observations:	Frequent

View Image View JPEG
Download JPEG (1.59 MB)

BRITISH COLUMBIA
CONSERVATION DATA CENTRE
- Flora of British Columbia -

***ramineum* Lej.**

TY: Carnation Creek estuary, ca. 14 km NE of Bamfield

T: Dominant on tidal mud flats with Plantago maritima, Honkenya peploides, Spergularia, and Salicornia virginica; slope 1%; asp W

10U 353300 5419600 **NAD** 83

NG: 48°10'/125°00' **ELEV** 0 m

CTOR: G.W. Douglas, J.L. Penny & N. Alexander

COLL NO: 13298 **COLL. DATE:** 98-06-30

PLOT NO.: _____ **DET.:** GWD /98

NOTES: ca. 500 plants/ ha.; flowers reddish-tinged

PLANTS OF CONNECTICUT

Rubus flagellaris Willd.

Connecticut: Litchfield Co., Sharon
ob, Housatonic State Forest
petals - white; railing

Leslie J. Mehrhoff 8030 23 JUN 1983

TORREY HERBARIUM OF THE UNIVERSITY OF CONNECTICUT
CONNECTICUT STATE MUSEUM OF NATURAL HISTORY

SAN DIEGO MUSEUM OF NATURAL HISTORY
BAJA CALIFORNIA, MEXICO
SIERRA JUÁREZ

Lasthenia coronaria (Nutt.) Ornduff

Heads yellow.

Common on grassy steep north slope, San José, 6 km east of Tecate.

Near 32° 33½'N. 116° 34'W Elevation ca. 600 m.
Reid Moran 28481 10 May 1980

PLANTS OF THE HOPLAND FIELD STATION

University of California
Mendocino County

Rosa californica Cham. & Schldl.

Location: S-1, app .25mi SE of James Cabin.

Site: Edge of pond.

Elevation: 1,600 ft,

Date: 6-9-97

Plant Number: #2031

Collected by:
Kerry L. Heise

Notes in database: fl. present

Need for Phenological Standards

- Phenology is quantified (and stored!) differently according to research and institutional priorities
  - Description of methods may be difficult to find

Need for Phenological Standards

- Phenology is quantified (and stored!) differently according to research and institutional priorities
  - Description of methods may be difficult to find
- For most powerful phenological research, records must be aggregated.
- Non-standardized data is difficult to mine and analyze in a meaningful way.

Scoring Herbarium Specimens for Phenology Workshop, March 2016

David Baxter
Stanley Blum
Kjell Bolmgren
Richard Carter
Ellen Denny
Michael Denslow
Libby Ellwood
Amanda Gallinat
Edward Gilbert
Jillian Goodwin
Robert Guralnick
Marie Keatley
James Macklin
Staci Markos
Susan Mazer
Brent Mishler
Ashley Morris
Gil Nelson
Sarah Newman
Katie Pearson
Susanne Renner
Katja Seltmann
Pam Soltis
Tim Sparks
Patrick Sweeney
John Wieczorek
Charlie Willis
Jenn Yost

CAL POLY SAN LUIS OBISPO

University & Jepson Herbaria

UCSB

iDigBio Integrated Digitized Biocollections

Phenological scoring for angiosperms

First-order	Second-order	Third-order
Are 'reproductive structures' present? (yes/no/not scorable)	Are 'unopen flowers' present?	Mostly 'unopen flowers?' (or counts)
	Are 'open flowers' present?	Mostly 'open flowers?' (or counts)
		Mostly 'post-mature flowers'? (or counts)
	Are 'fruits' present?	Mostly 'immature fruits'? (or counts)
		Mostly 'mature fruits'? (or counts)
		Mostly 'post-mature fruits'? (or counts)

Yost et al. 2018, *APPS*

New Occurrence Record

Collector Info

Catalog Number ? | Other Cat. #s ? | Collector ? | Number ? | Date ? | Dupes? | Auto search

Associated Collectors ? | Verbatim Date ?

Exsiccati Title | Number

Latest Identification

Scientific Name ? | Author ?

ID Confidence ? Undefined | ID Qualifier ?

Family ?

Identified By ? | Date Identified ?

Misc

Habitat ?

Substrate ?

Associated Taxa ?

Description ?

Notes (Occurrence Remarks) ?

Life Stage ? | Sex ? | Individual Count ? | Sampling Protocol ? | Preparations ?

Phenology ? | Establishment Means ? | Cultivated

Life Stage ? | Sex ? | Individual Count ? | Sampling Protocol ? | Preparations ?

Phenology ? | Establishment Means ? | Cultivated

Unopen flower present:
- ❑ True
- ❑ False

Count open flowers present:

Reproductive structures present
- ❑ True
- ❑ False

<<

Open flower present:
- ❑ True
- ❑ False

<<

Percent open flowers present:

Other metric, open flowers:

Fruit present:
- ❑ True
- ❑ False

First-order	Second-order	Third-order

Life Stage ? | Sex ? | Individual Count ? | Sampling Protocol ? | Preparations ?

Phenology ? | Establishment Means ? | Cultivated

Unopen flower present:
- ❑ True
- ❑ False

Count open flowers present: **12**

Reproductive structures present
- ☑ True
- ❑ False

<<

Open flower present:
- ☑ True
- ❑ False

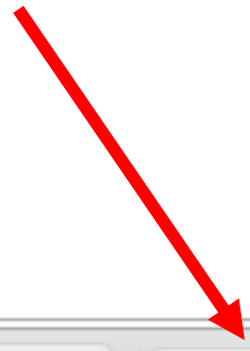
<<

Percent open flowers present:

Other metric, open flowers:

Fruit present:
- ❑ True
- ❑ False

First-order	Second-order	Third-order



Robert F. Hoover Herbarium, Cal Poly State University (OBI)

Home >> Collection Management >> Public Display >> **Editor**

|< << | 6 of 133 | >> >|

Occurrence Data | Determination History | Images | Linked Resources | Admin | Attributes

Collector Info

Catalog Number ?	Other Cat. #s ?	Collector ?	Number ?	Date ?
	80342	Jenn Yost	s.n.	2014-11-11

Dupes?

Auto search

Associated Collectors ?	Verbatim Date ?
Matt Ritter et al.	11/11/2014

Attribute Scoring Editor

Filter

Taxon: Eschscholtzia minutiflora

Phenology (ver 1.0)

Load Images

Target Specimens: 12

Action Panel - Phenology (ver 1.0)

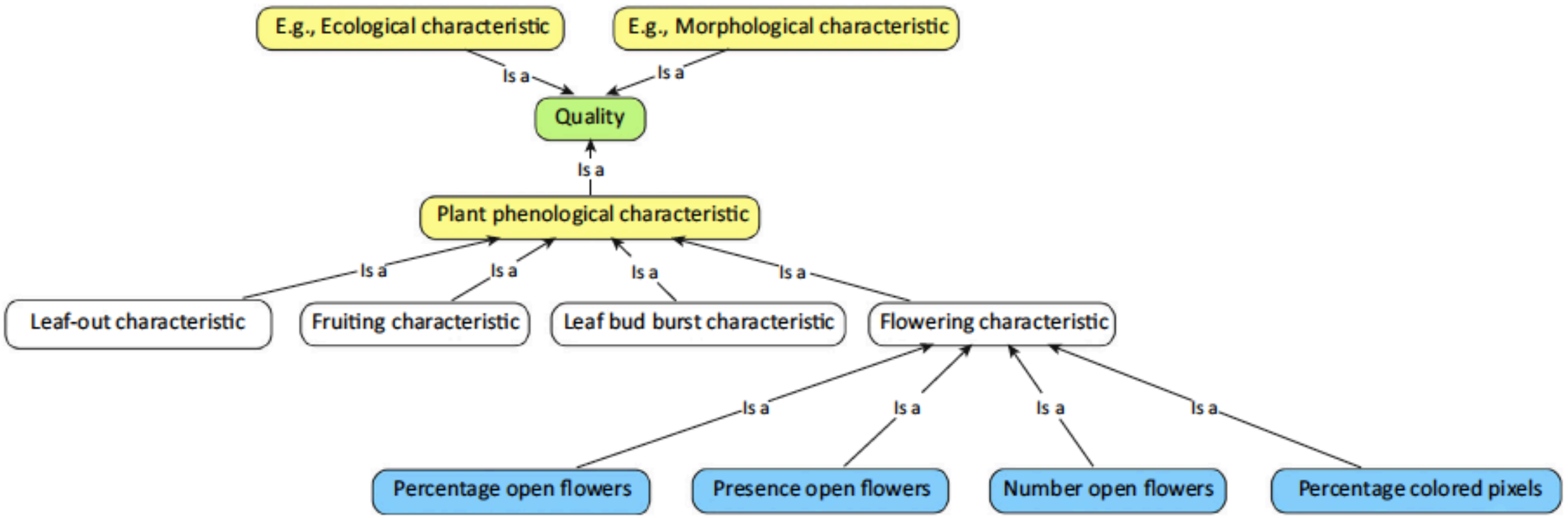
- (•) Reproductive
  - [x] Flowering
    - ( ) Mostly buds
    - ( ) Mostly open
    - ( ) Mostly old
  - [ ] Fruiting
  - [ ] Budding
- ( ) Sterile
- ( ) Not scorable

Notes:

Status: ----------

Save and Next

Plant Phenology Ontology



Trends in Ecology & Evolution

The Plant Phenology Ontology: A New Informatics Resource for Large-Scale Integration of Plant Phenology Data

Brian J. Stucky[1], Rob Guralnick[1], John Deck[2], Ellen G. Denny[3], Kjell Bolmgren[4] and Ramona Walls[5]*

[1] Florida Museum of Natural History, University of Florida, Gainesville, FL, United States, [2] Berkeley Natural History Museums, University of California, Berkeley, Berkeley, CA, United States, [3] USA National Phenology Network, The University of Arizona, Tucson, AZ, United States, [4] Unit for Field-based Forest Research, Swedish University of Agricultural Sciences, Lammhult, Sweden, [5] CyVerse, The University of Arizona, Tucson, AZ, United States

Frontiers in Plant Science

Darwin Core: MeasurementOrFact

MeasurementOrFact

measurementID | measurementType | measurementValue | measurementAccuracy | measurementUnit | measurementDeterminedBy | measurementDeterminedDate | measurementMethod | measurementRemarks

eMoF term	NEVP value	example
measurementID	version 4 UUID	urn:uuid:…
occurrenceID	version 4 UUID (usually)	urn:uuid:…
measurementType	NEVP vocabulary term (NEVP SKOS concept 'reproductive condition')	reproductive condition
measurementTypeID	NEVP SKOS Concept URI	http://purl.org/nevp/vocabulary/reproductive-phenology#01
measurementValue	NEVP vocabulary term (NEVP SKOS prefLabel) or value	flowering: mostly open
measurementValueID	NEVP SKOS Concept URI or empty	http://purl.org/nevp/vocabulary/reproductive-phenology#09
measurementDeterminedDate	ISO 8601 formatted date	12/31/17
measurementDeterminedBy	verbatim determiner name	John Doe
measurementMethod	textual description of scoring method	Phenological state determined by human from image(s) of herbarium specimen. Symbiota database GUID for image is provided in ac:providerManagedID.
measurementRemarks		Many reproductive units damaged by herbivory. Reviewed.

Advisory Committee

- Kjell Bolmgren (Swedish National Phenology Network)
- Katharine Gerst (USA-NPN)
- Gil Nelson (iDigBio)
- Patrick Sweeney (Yale, NEVP)
- James Macklin (AppleCore, Agri-food Canada)
- Liz Matthews (US National Park Service)
- Ramona Wals (Plant Phenology Ontology, Cyverse)
- Ed Gilbert (Symbiota, SEINet)
- John Wieczorek (Darwin Core)

Questions for This Workshop

- What metadata is created with machine learning?
- What data is worth keeping from machine learning with the specimen record, **if any**?
  - How can we (and should we) store multiple scorings of a specimen?
  - Can/should we indicate our confidence in scorings?
- Is it important for us to record that something was scored by a person now for the machine learning community?
  - From image
  - From physical specimen
  - From label text
- Are there other data that we (herbaria) need to record for the computer learning community that we aren't anticipating?
  - E.g., label says it is in flower, but specimen itself is not in flower (or has lost its flowers)
- What is the relationship between machine learning scorings and the Plant Phenology Ontology?

Acknowledgements

- iDigBio – Gil Nelson, Pam Soltis, Jillian Goodwin
- NSF – ADBC Funding to CAP TCN: Award number 1802301
- Plant Phenology Ontology - Ramona Walls, Rob Guralnick, Brian Stucky