An aerial photograph of a field station situated on a grassy hillside. Several small, modern-looking buildings with solar panels are scattered across the landscape. The background shows rolling green hills under a blue sky with scattered clouds.

NETWORKING FIELD STATIONS, RESERVES AND NATURAL HISTORY COLLECTIONS: AN OUTDOOR DIGITAL PARTNERSHIP IN THE AGE OF BIG DATA.

BECCA FENWICK (UCNRS, UCSC)*, DAVID ACKERLY (UCB), COLLIN BODE(UCB), KEVIN BROWNE (UCNRS, UCR), KELLY EASTERDAY (UCB), PEGGY FIEDLER (UCNRS, UCOP), MICHELLE KOO (BNHM, UCB), SCOTT SMITH (UCB)

BERKELEY NATURAL HISTORY MUSEUMS



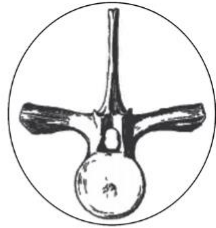
Wieslander Vegetation Map
Project (VTM)



Natural Reserve System
Field Station Data



Calphotos



VertNet



University and Jepson
Herbaria



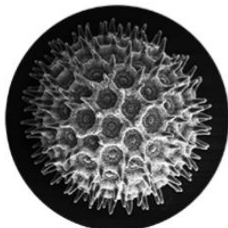
University Museum of
Paleontology



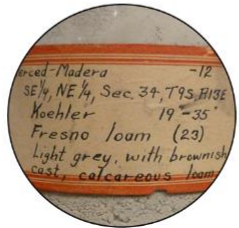
Essig Museum of
Entomology



Museum of Vertebrate Zoology



Pollen Core Data



Soil Database



Natural Reserve System
Environmental Sensor Array

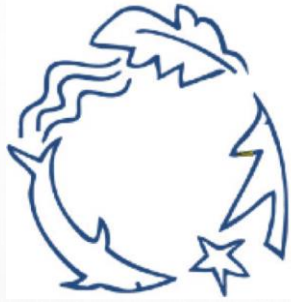


Climate Data

Joseph Grinnell and Annie Alexander saw rapid change in the land use of CA in the early 1900's and the Collection and the various museums date back to 1880 -1920, and continue to grow today.

Grinnell documented and collected mammals, birds, amphibians and reptiles in >700 locations across CA

- >100,000 specimens,
- 74,000 pages of field notes
- Standardized bird count data and habitat descriptions
- 10,000 images



Natural Reserve System

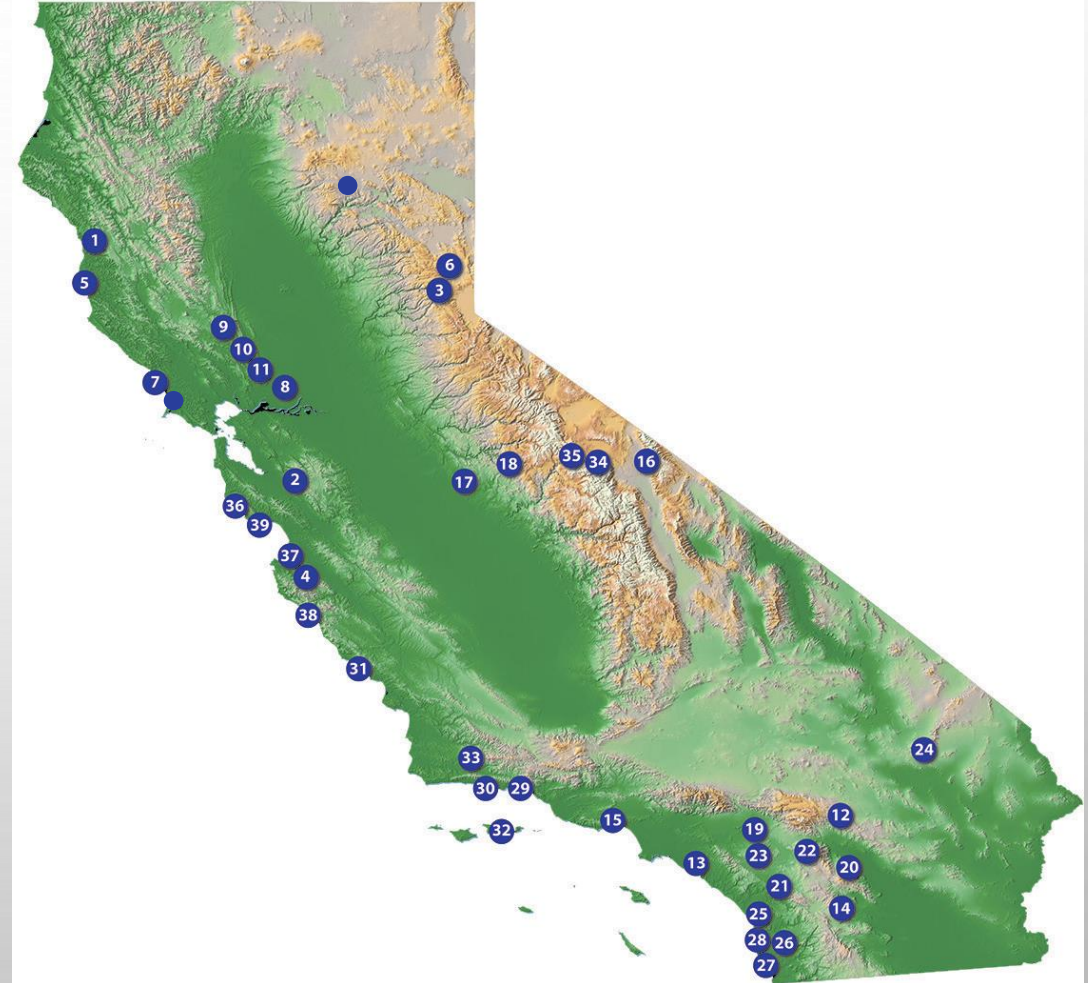
UNIVERSITY OF CALIFORNIA

Ken Norris, Bill Mayhew, and Mildred Mathias also saw rapid land use change in the late 1940's, the loss of study sites and loss of teaching locations in (southern CA)

Founded the NRS 1965 with 7 reserves

53 years later:

- 39 (soon to be 41) reserves
- Hastings Reservation: 81 yrs
- Merced Vernal Pools: ~15 yrs
- 9 UC campuses
- >756,000 acres
- All major CA ecosystems
- Broad range of partners; state agencies, federal agencies, non-profits, foundations, and private donors





900+

publications
2011-16

species of
native plants



2,100+



39

natural reserves
all major state ecosystems



147,000

students & researchers
visit each year



756,000
acres

world's largest
university reserve system



50

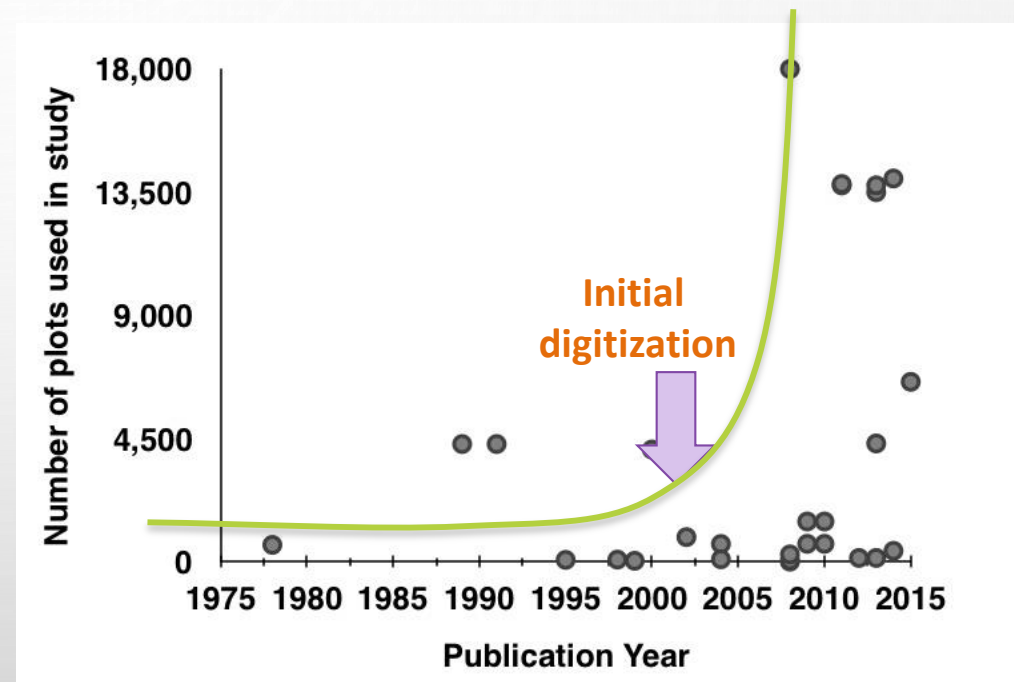
miles of protected
coastal shoreline

ARCHIVE COLLECTIONS AND ONGOING LISTS

- ECOLOGICAL OBSERVATIONS
- PLANT SPECIES LIST
- VERTEBRATE SPECIES LIST
- INVERT SPECIES LIST
- INSECT SPECIES LIST
- BIRD SURVEYS
- SOIL SAMPLES
- MICROSCOPE SLIDE COLLECTIONS
- POLLEN SPECIMENS
- GENOMIC SPECIMENS
- AGENCY REPORTS
- OLD GROWTH FOREST MONITORING
- ARCHEOLOGICAL COLLECTIONS
- LAND USE HISTORIES
- FIRE HISTORIES
- SOUNDSCAPE
- CLIMATE MONITORING NETWORK
- VEGETATION MAPS
- GEOLOGY MAPS
- TOPOGRAPHY DATA
- LIDAR MAPS
- STREAM GAUGE
- VIDEO DATA
- PHENOLOGY IMAGES
- AERIAL PHOTOS
- PUBLICATIONS

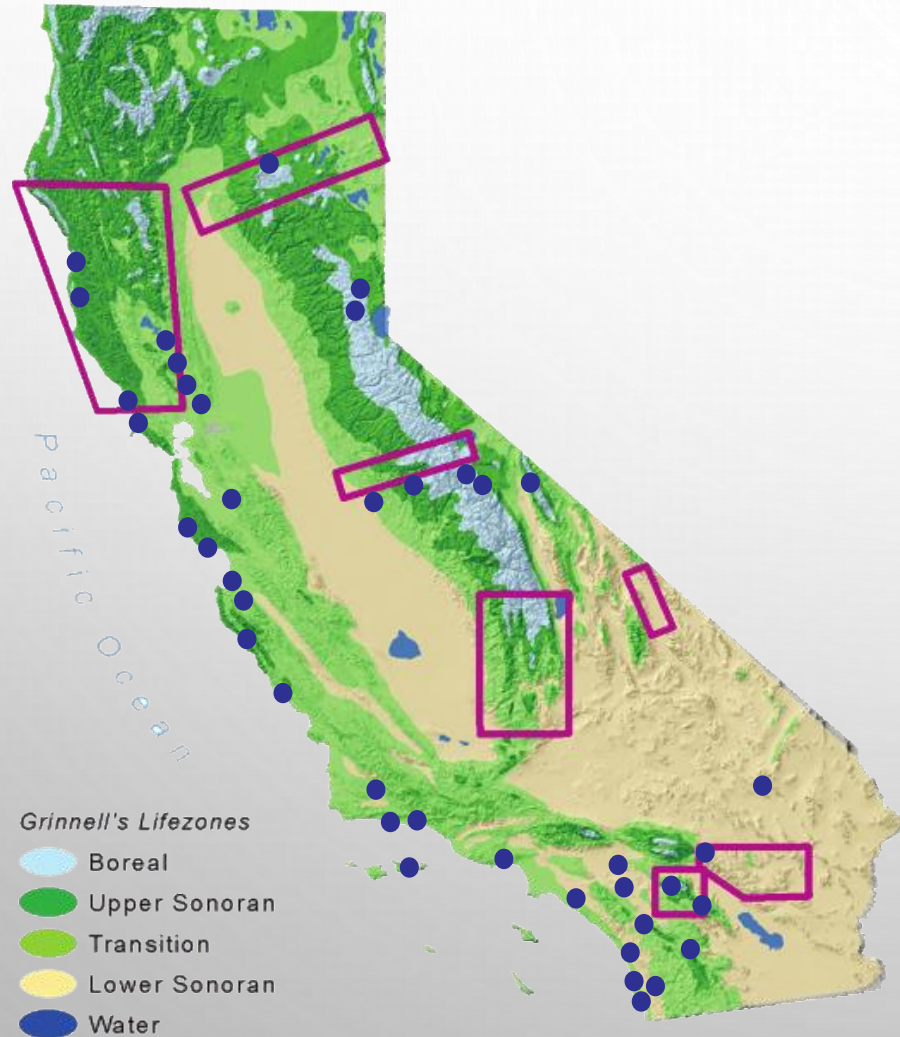
DIGITIZATION AND SHARING CREATES BENEFITS

- Increase in scope and scale of research
- Novel combinations of models and data create new knowledge
- New modeling approaches to predict future scenarios
- Technological improvements to foster collaboration



Kelly et al., 2017. "Geospatial Informatics Key to Recovering and Sharing Historical Ecological Data for Modern Use." *Photogrammetric Engineering & Remote Sensing*

GRINNELL RESURVEYS



- Partnership between Berkeley Natural History Museum, San Diego Natural History Museum, University of New Mexico, UC Berkeley & UC Santa Cruz
- Initial resurveys on Sierra Nevada Sites to examine distribution changes in relation to climate change
- Bird resurveys throughout coastal ranges of central and northern CA
- Current focus is resurveys of the CA deserts & the central valley

GRINNELL RESURVEYS

- >700 locations across CA
- >100,000 specimens
- 74,000 pages of field notes
- Standardization of bird count data and habitat descriptions
- 10,000 images

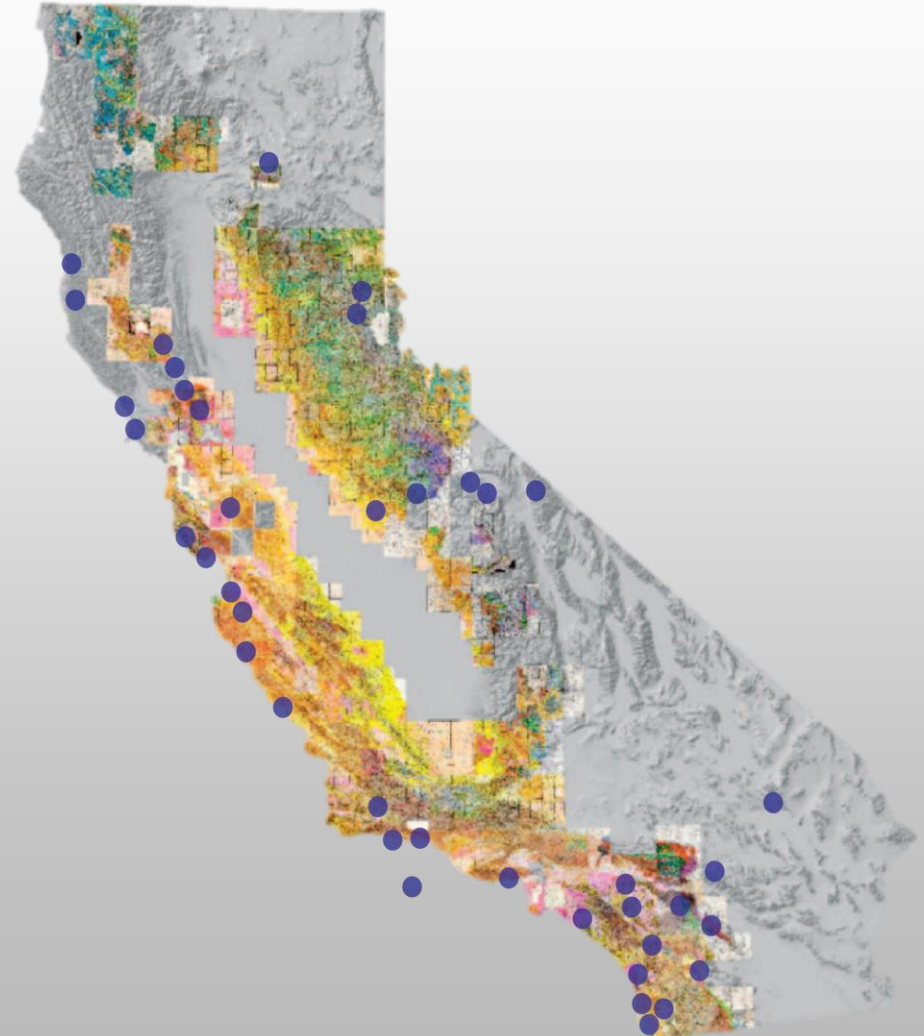




WEISLANDER VEGETATION TYPE MAPS

1920's and 1930's survey information:

- Detailed maps
 - Specimen collection
 - Vegetation samples
 - Photographs
-
- 3,500 landscape photos now georeferenced
 - Vegetation map polygons for dominant vegetation type in small areas
 - 18,000 plot data from tree and brush inventories
 - 23,000 digitized herbarium specimens





Thorne, James H., and Thuy N'goc Le. 2016. "California's Historic Legacy For Landscape Change, the Wieslander Vegetation Type Maps." *Madroño*

Using VTM Data

These are all examples of peer reviewed papers using the VTM data

Use of VTM data in publications

-  Maps
-  Plots
-  Photos
-  Maps & Plots



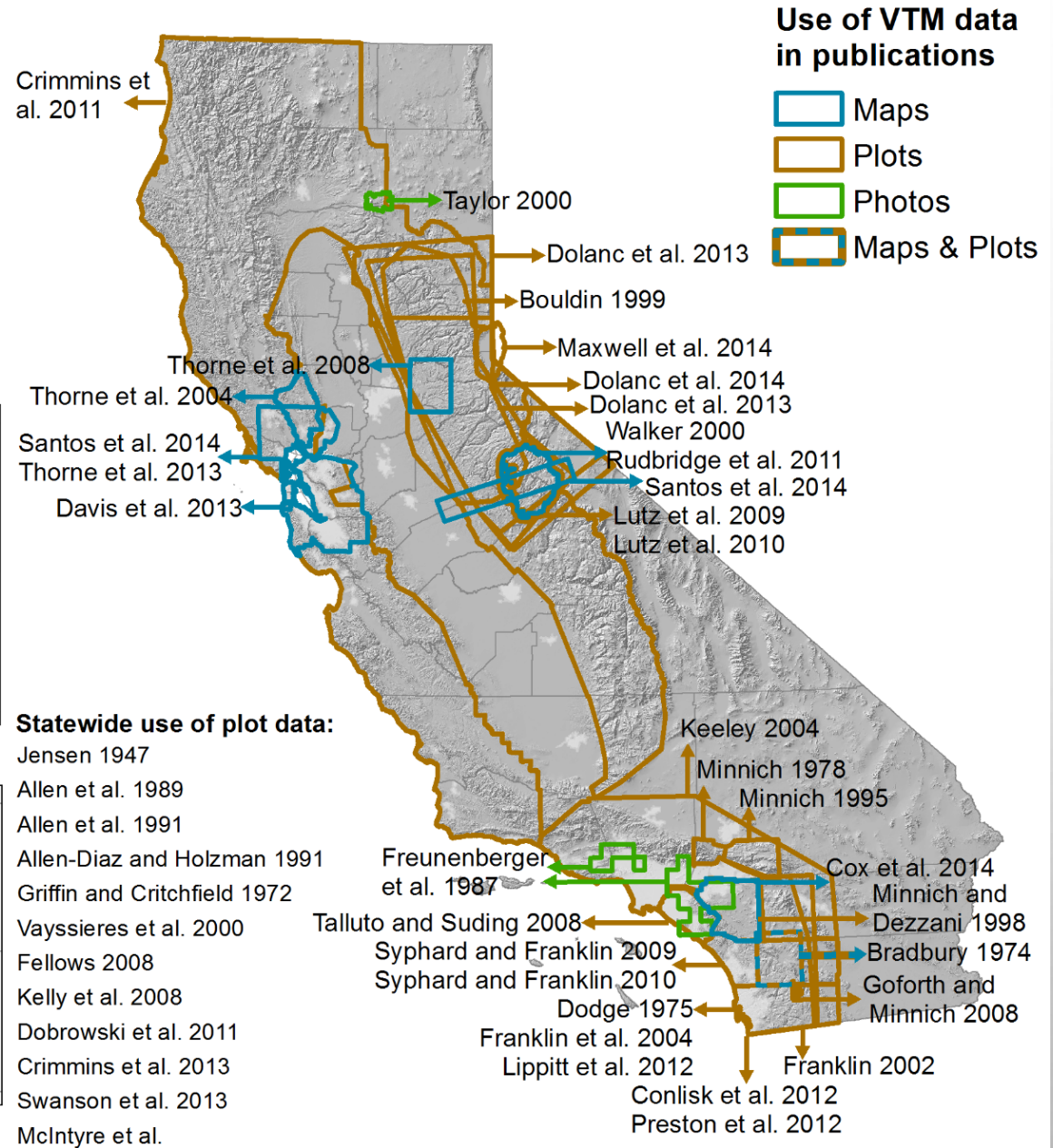
VTM vegetation maps

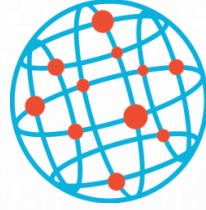


VTM georeferenced photographs



VTM vegetation plots



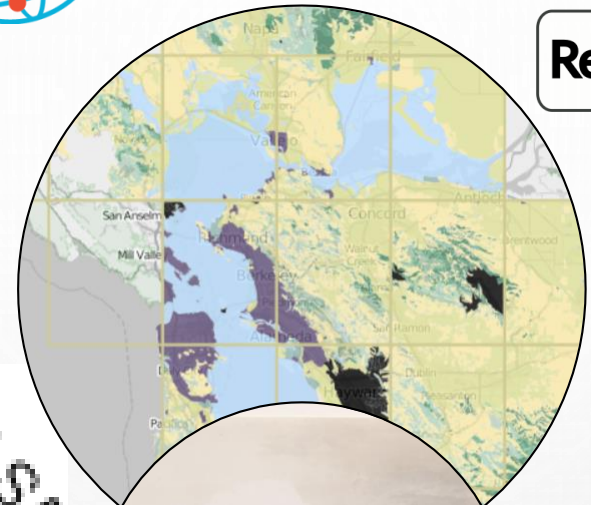


HOLOS

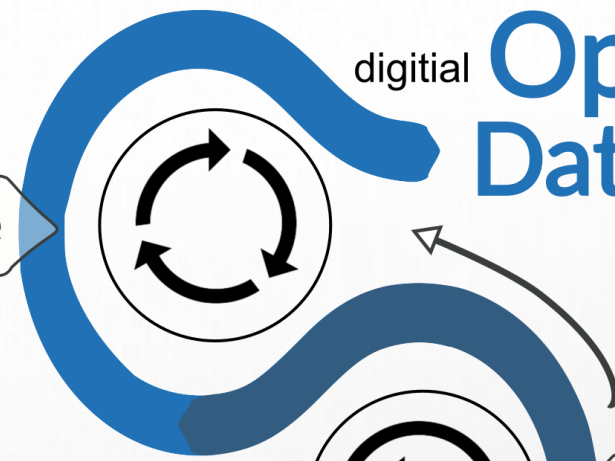
BERKELEY ECOINFORMATICS ENGINE

digital variety
Open Data
volume

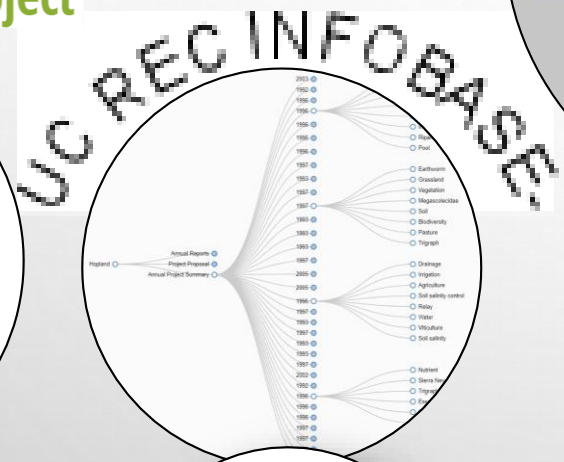
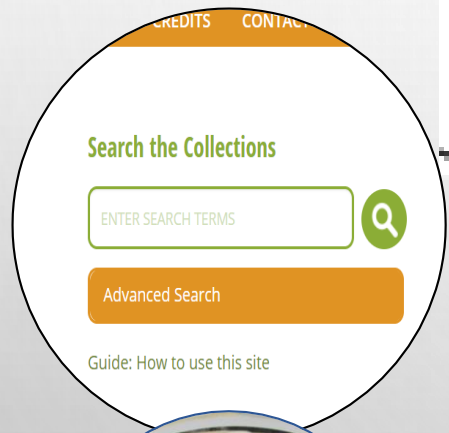
University of California Natural Reserve System
history & archive project



Reusable



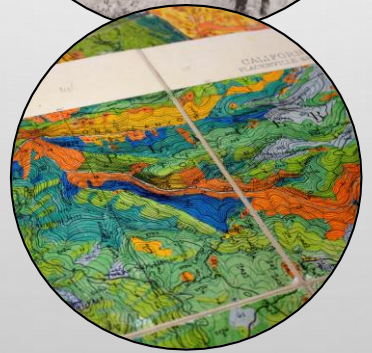
Interoperable



Accessible



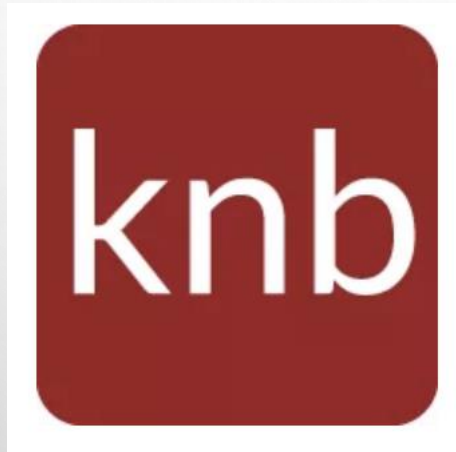
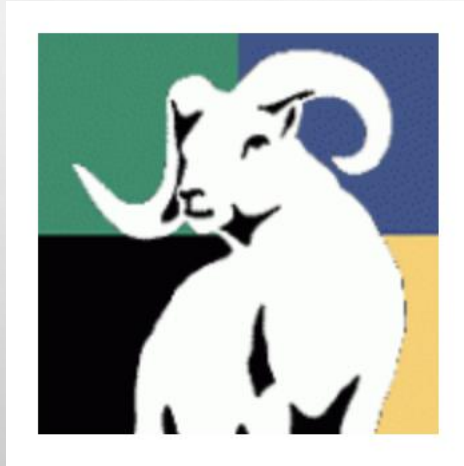
Findable



Dark Data
analog closed unstructured

<http://archives.nrs.ucsb.edu/> <http://igis.ucanr.edu/Infobase/InfobaseExplorer/> <http://vtm.berkeley.edu>

CURRENT AND FUTURE METADATA



UNIVERSITY
OF
CALIFORNIA



dash



CURRENT AND FUTURE RESEARCH DATA



Dendra
A cloud-based, multi-organizational system aggregating and storing time series environmental data

UCNRS STATIONS Units: Metric

Search weather stations

Angelo South Meadow
Coordinates: 39.739167°, -123.630833°
Elevation: 383.7 m
Dashboard

Anza Borrego
Coordinates: 33.2574°, -116.4073°
Elevation: 249.9 m
Dashboard

BigCreek Gatehouse
Coordinates: 36.070833°, -121.598611°
Elevation: 27.4 m
Dashboard

BigCreek Highlands
Coordinates: 36.06611°, -121.5611°
Elevation: 752.9 m
Dashboard

Reserve Mapper
Discover natural history observations, specimens, and photos associated with reserves, parks, and special districts.



Berkeley Natural History Museums ReserveMapper Map Table Statistics

Select University of California Natural Reserve
-- Select a Zoom Layer --

Query Type
 Occurrence Calphotos

Search Any Term
e.g: species, locality terms

Search by Taxonomy
SPECIES taxonomic name

Year Collected
YYYY to YYYY

Darwin Core Terms
InstitutionCode collectionCode

-- Basis of Record --
PRESERVED_SPECIMEN
FOSSIL_SPECIMEN
LIVING_SPECIMEN

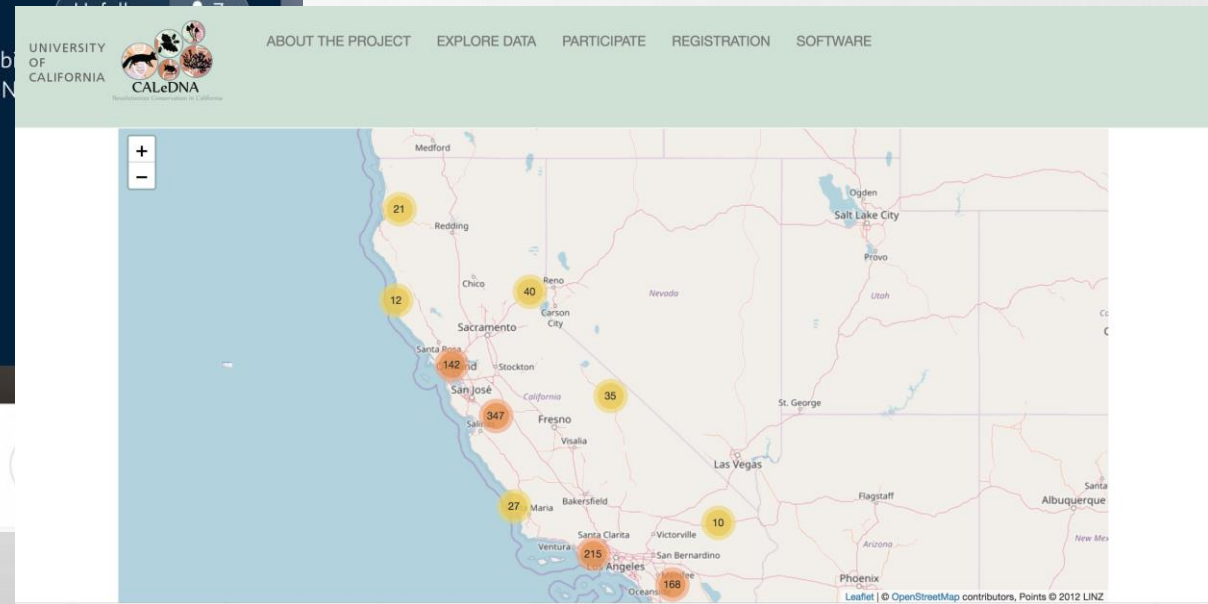
Q Search Clear Download

This site was made possible by a grant from the University of California Division of Agriculture and Natural Resources. Species occurrence data are harvested from the Global Biodiversity Information Facility and includes data from Berkeley

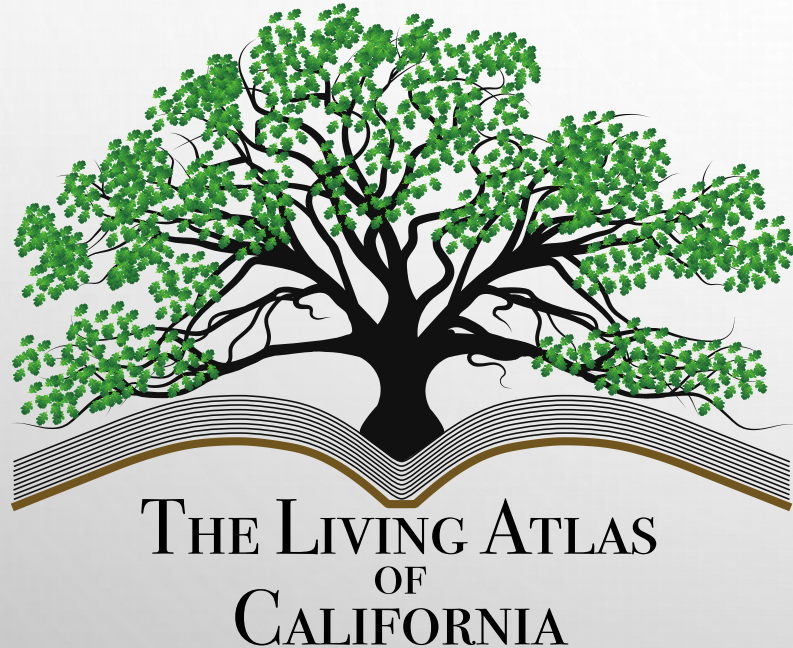
CURRENT AND FUTURE RESEARCH DATA

The image shows the iNaturalist website interface. At the top, the iNaturalist logo is on the left, followed by navigation links: "Explore", "Your Observations", "Community", and "More". On the right, there are icons for a location pin, a mail icon with "0", a speech bubble with "0", and a profile icon. Below the header is a large banner image of a person in a blue cap and khaki pants looking at a small object in their hands. To the right of the image is a dark blue sidebar with the text "About Keeping watch on b reserves of the UCN Read More >" and an "Edit Project" button. Below the banner is a white bar with the text "UC Natural Reserve System" and a small logo. At the bottom, there is a statistics bar with the following data:

Overview	31,975 OBSERVATIONS	3,721 SPECIES	1,734 IDENTIFIERS	2,171 OBSERVERS
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THE FUTURE?



Digital portal and online exploration tool for environmental and natural history information

- Providing access to environmental and conservation information for research, government, and the public
- Supporting all protected lands in CA
- Communicating the environmental state of the state