An aerial photograph of the California central coast, showing a gradient from the ocean to the mountains. The image captures a large bay with a sandy beach, surrounded by dense green forests and rolling hills. In the foreground, there are rocky cliffs and waves crashing against the shore. The background shows a vast expanse of the ocean meeting a hazy horizon under a clear sky.

**SEA TO SUMMIT GRADIENTS and the  
MARVELOUS MOSAIC OF NATURAL COMMUNITIES  
on CALIFORNIA'S CENTRAL COAST**

# **BIODIVERSITY RESULTS FROM:**

**Geology** – tectonics; origin and structure of rocks; soil characteristics like chemistry, texture, nutrients.

**Physiography** - physical patterns and variation of the landscape; topography, elevation, aspect... microclimates, and the geomorphic processes that influence the landscape.

**Climate** - seasonal patterns of precipitation and temperature, which reflect latitudinal variability, elevation or proximity to the coast, as well as landscape gradients and unpredictability.

**Ecological Process** – slow (or sudden!) biological change over time; evolutionary history; disturbance regime; adaptation and plasticity.

**Weirdness** – unexplainable things, mutations (weirdness is real).



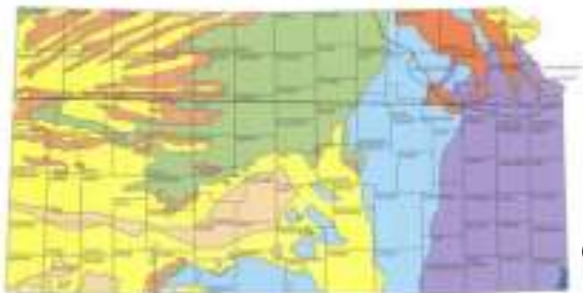
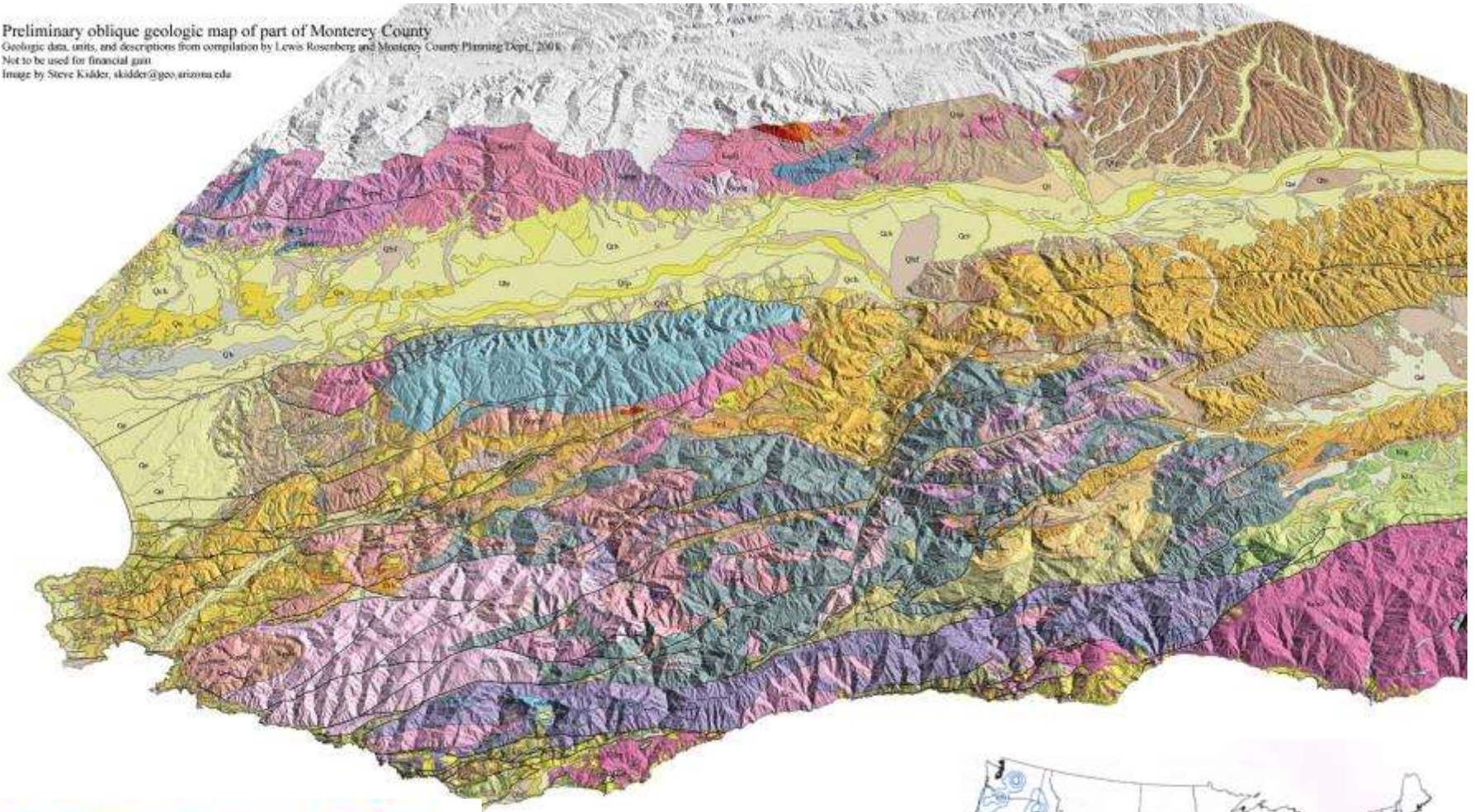
# Geologic Map of Big Sur and most of Monterey County

Preliminary oblique geologic map of part of Monterey County

Geologic data, units, and descriptions from compilation by Lewis Rosenberg and Monterey County Planning Dept., 2008.

Not to be used for financial gain

Image by Steve Kidder, skidder@geo.arizona.edu



MoCo has:

- 2329 taxa of plants
- 142 families
- 20 endemic plants

Geologic map of Kansas



# Elkhorn Slough National Estuarine Reserve

A wetland of international importance!





*Salicornia pacifica*, pickleweed  
(Neal Kramer, California,  
©Neal Kramer)



[www.elkhornslough.org](http://www.elkhornslough.org)

**BABY OYSTERS PLANTED**  
ELKHORN SLOUGH  
KION 5/46  
SEE TO IMPROVE THE POPULATION BY DONATING OYSTERS  
JOHN ROLY

Junipero Serra Peak , 5862'  
Santa Lucia Range



San Benito Mtn = 5267'  
Mount Bielawski = 3233'

## SIERRAN DISJUNCTS...

Sugar pine, *Pinus lambertiana*

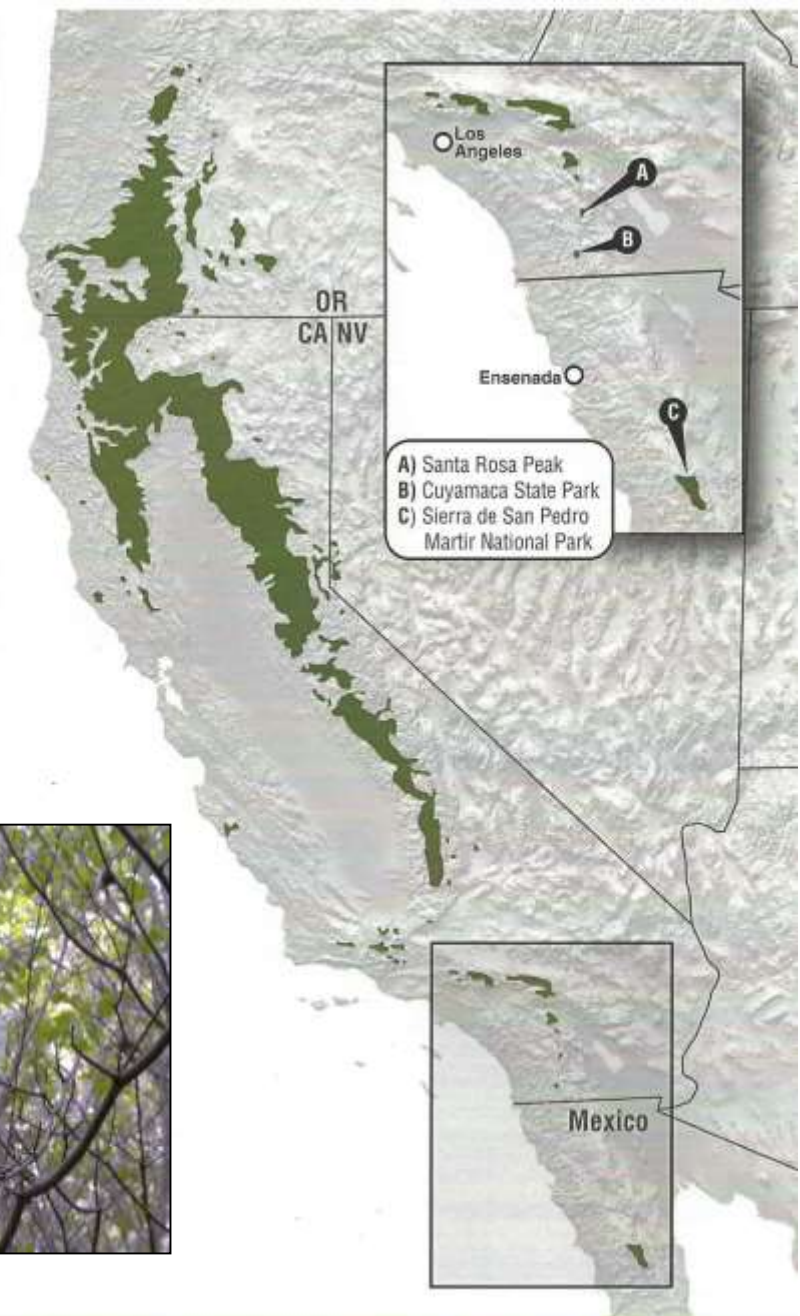
Incense cedar, *Calocedrus decurrens*

Bitterroot, *Lewisia rediviva*

Dogwood, *Cornus nuttallii*



*L.r. var. minor*



■ sugar pine (*Pinus lambertiana*) along the Pacific Slope\*

\* based on Little (1971), Griffin and Critchfield (1976), and Charlet (1996)



Monvero Dunes - BLM

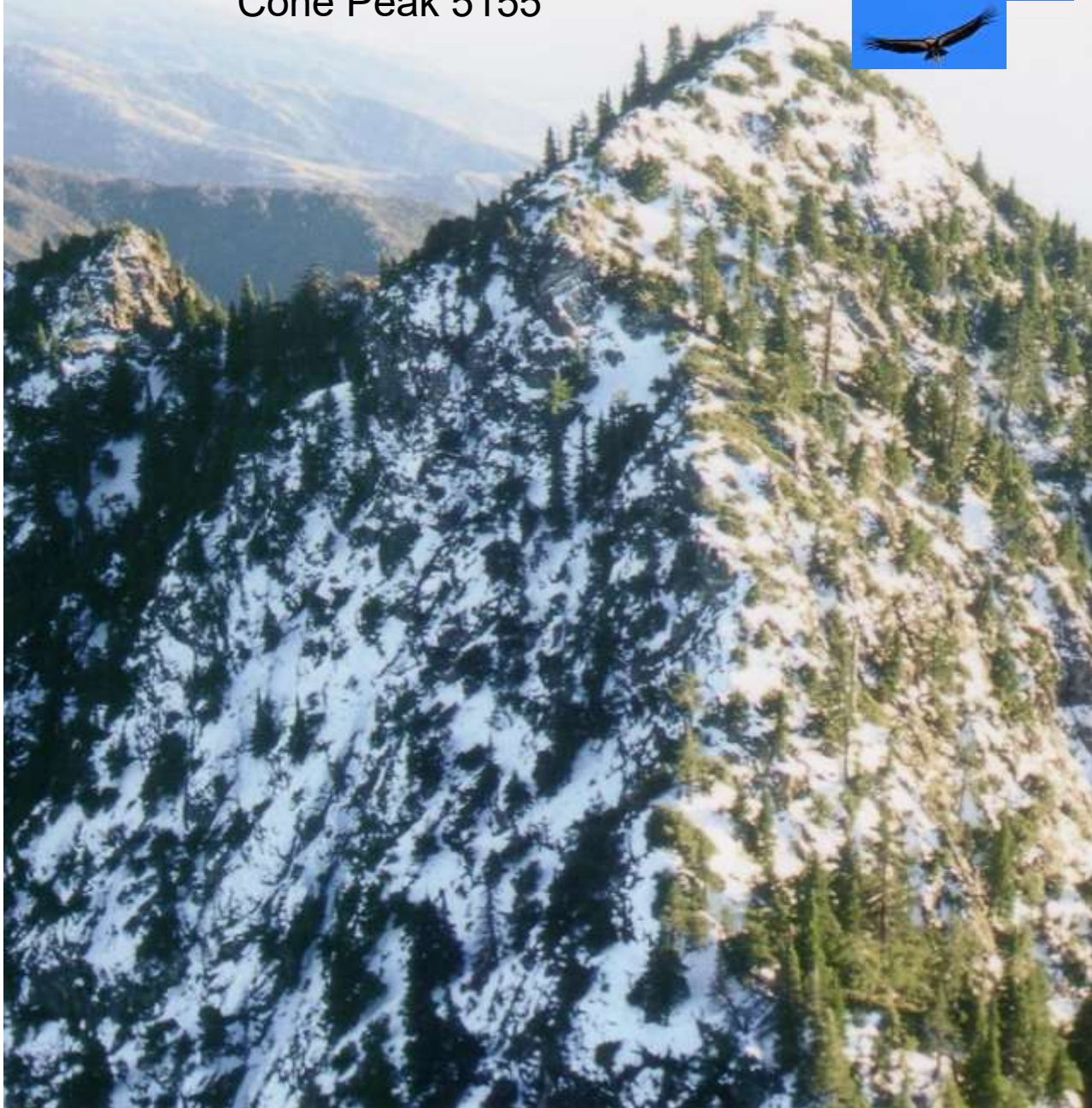


## Cone Peak 5155' - Cone Peak Gradient Research Natural Area, USFS

The geologic terrane within the RNA is varied, with outcrops of sedimentary, metamorphic (including marble and gneiss), and crystalline basement rocks. The area is geologically unique, containing the oldest (Pre-Cambrian) rocks known between the Transverse Ranges and the N. Cascades, a major thrust fault (the Sur-Nacimiento Fault), and the only charnockitic terrain described W. of the Continental Divide.



# Cone Peak 5155'



*Pinus lambertiana*



*Cycladenia humilis*



*Diplacus linearis*



*Malacothamnus palmeri* ssp. *lucianus*



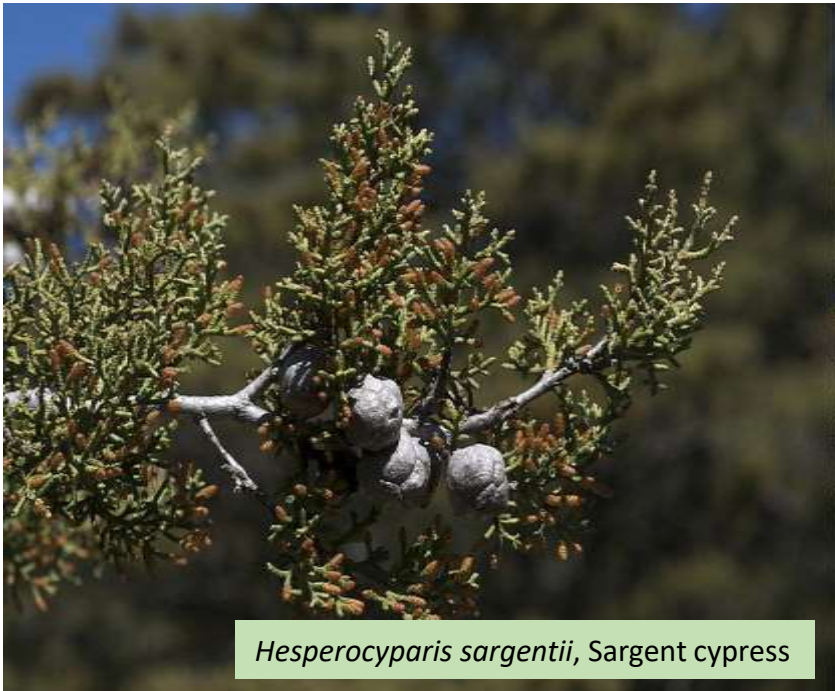
# Geography & Stable Climate = ecological refugium, with relictual species and high rates of endemism

Santa Lucia fir, *Abies bracteata*



Serpentine at Lion's Den, Silver Peak Wilderness Area  
Monterey Ranger District, Los Padres National Forest





*Hesperocyparis sargentii*, Sargent cypress



*Quercus durata*, leather oak



*Galium andrewsii* ssp. *gatense*,  
serpentine bedstraw,  
(John Doyen, Calflora)

*Arctostaphylos obispoensis*,  
bishop manzanita,  
(Chris Winchell, Calflora)





*Calochortus frimbriatus*,  
Weed's mariposa lily

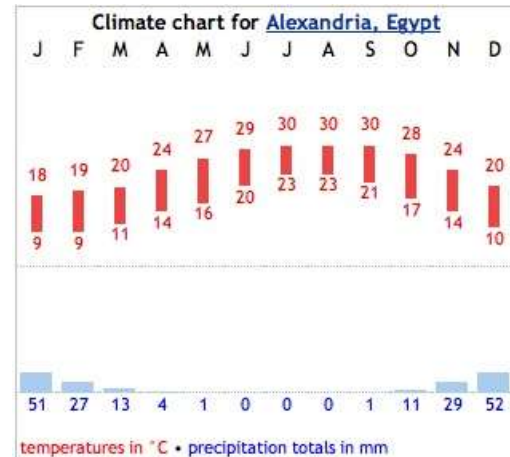
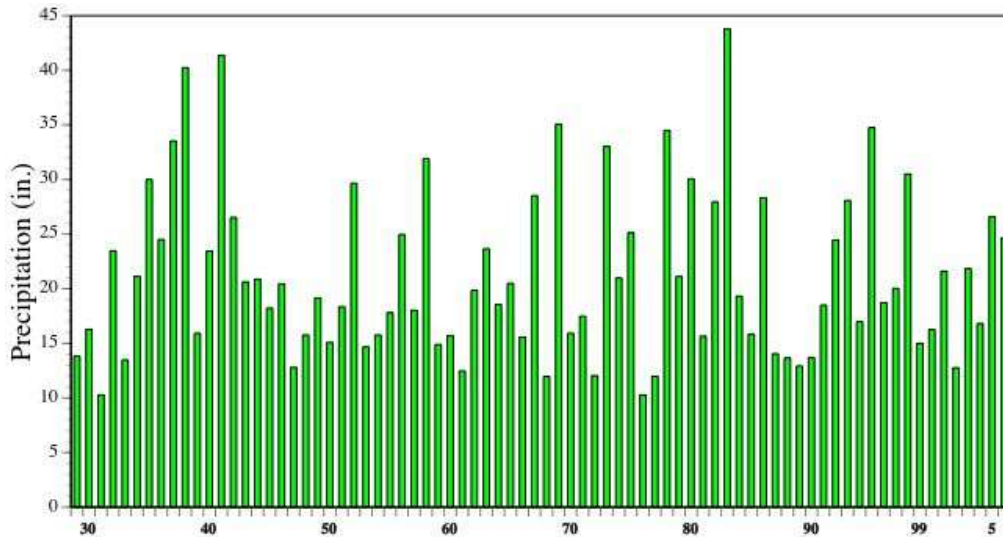
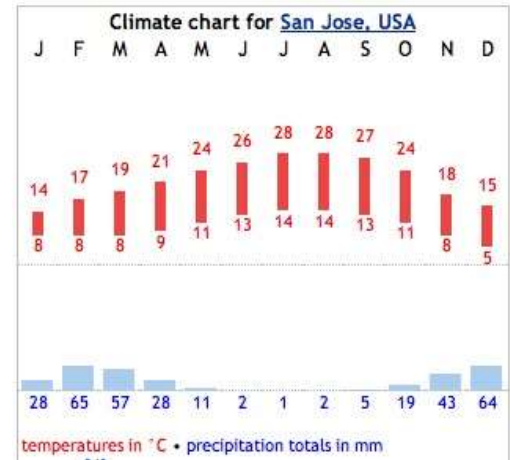
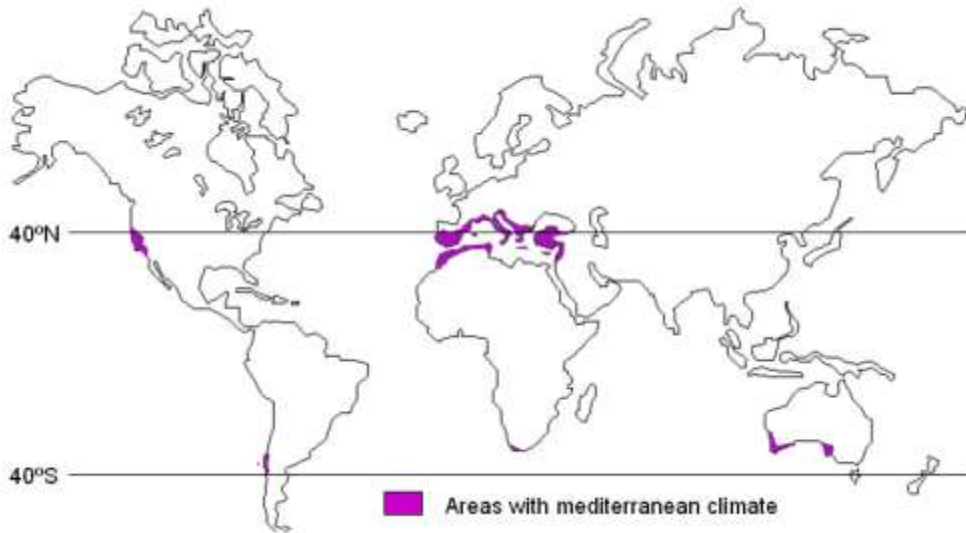
## Pico Blanco, limestone endemics

*Cheilanthes cooperae*,  
Mrs. Cooper's lip fern,  
(Susanna Danner, Calflora)





# Mediterranean Climate



Precipitation at UC Hastings Reserve

MEDITERRANEAN =

- Imbalance in moisture need and availability =
  - Seasonal Variability

&

- Annual Variability!!
  - Too much rain,  
or not enough....

There is no "normal"

Inherent unpredictability

-

compounded by  
climate change!



# SCLEROPHYLLOUS LEAVES



Coast live oak

**Sclerophyllous** leaves

provide an advantage in semi-arid areas for reducing evapotranspiration. They are reduced in size, small, hard, thick, and leathery. Often sclerophyllous leaves are hairy or have a waxy coating, and some species are summer or drought deciduous.

These adaptations allow the plants to survive the pronounced hot, dry season of the Mediterranean-type climate in which sclerophyllous vegetation is best developed.

- Chaparral
- Maquis, Garrigues (Mediterranean)
- Fynbos (South Africa)
- Matorral (Chile)
- Kwongn (SW Australia)



silk tassel



chamise



Carmel River floodplain, late 1930's. Red X is approximate location of Garland Ranch Regional Park Visitor Center today

# Salinas River



Salinas Valley



Pajaro River



Agricultural biodiversity

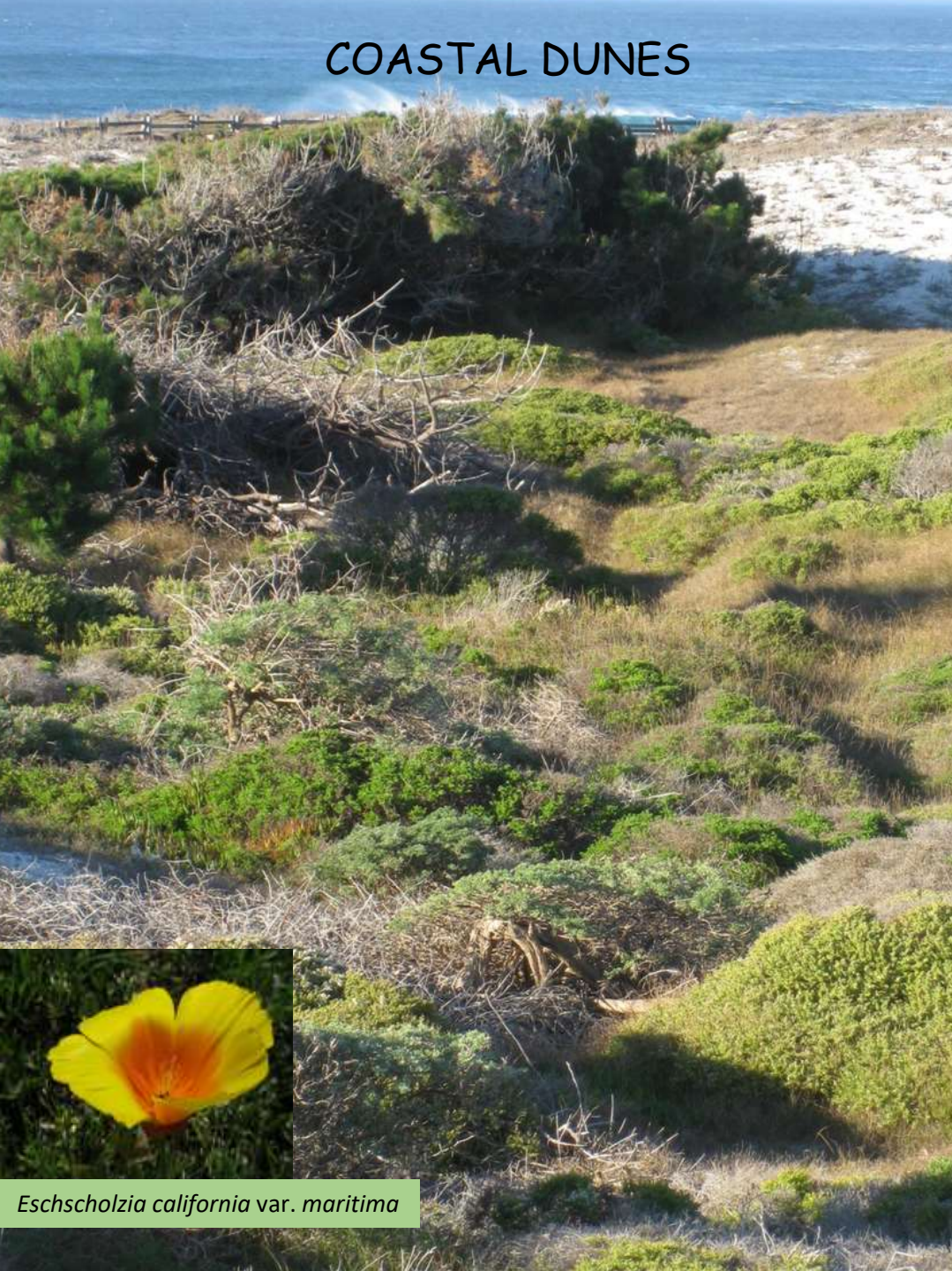
Cultural biodiversity





Salinas River National Wildlife Refuge, Martin Dunes, CEMEX  
January 31, 2005, Coastal Records Project

# COASTAL DUNES



*Lupinus tidestromii*, FE, SE



*Calystegia soldanella*



*E. menziesii* ssp. *menziesii* (blooms March/April, Asilomar)  
*E. menziesii* ssp. *yadonii* (blooms May/Sept, Marina)



*Castilleja latifolia*



*Eschscholzia californica* var. *maritima*




*Dudleya farinosa*



*Abronia latifolia*



A close-up photograph of purple flowers. The main focus is a single flower in full bloom, showing five petals with a light purple hue and a darker purple center. The center contains several stamens with bright blue anthers. To the left and above the main flower are other buds and partially open flowers, all in various stages of development. The background is a soft, out-of-focus green, suggesting a natural outdoor setting.

*Gilia tenuiflora* ssp. *arenaria* -  
slender-flowered gilia, sand gilia, FE, ST

**Vegetation**

**Dune Scrub**

**Coastal Prairie**

**Coastal Scrub**

**Monterey Cypress Forest**

**Monterey Pine Forest**

**Monterey Pine Forest**

**Monterey Pine Forest**

**Monterey Pine Forest**

**Monterey Pine Forest**

**Monterey Pine Forest**

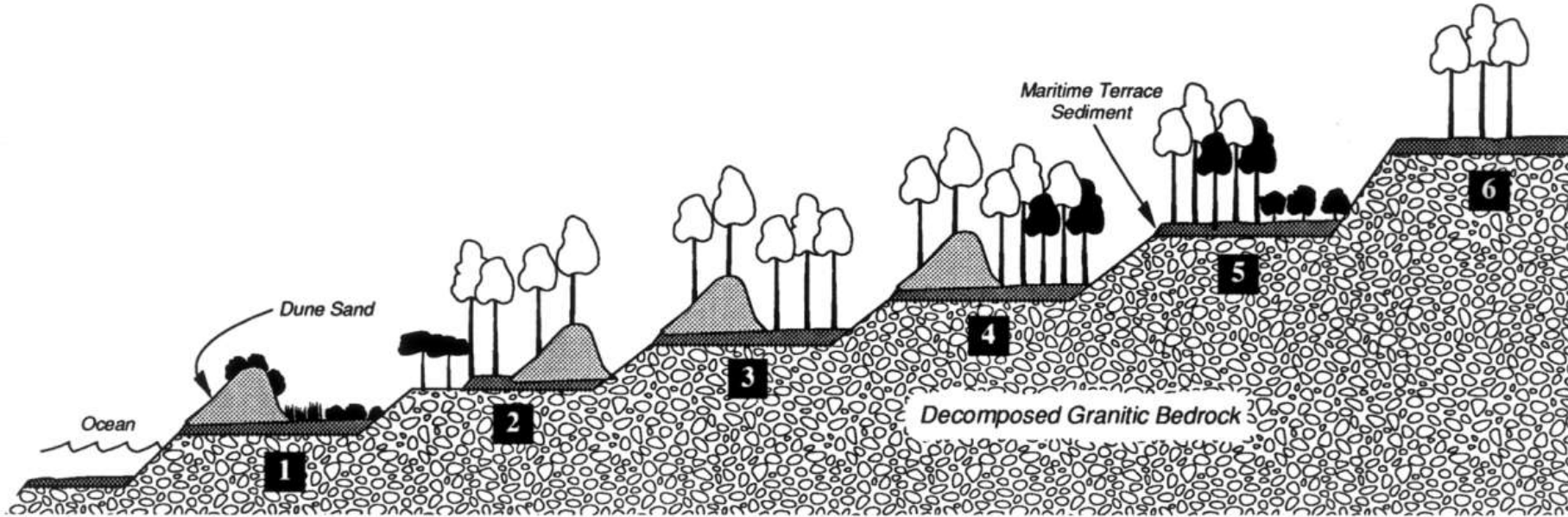
**Monterey Pine -  
Bishop Pine Forest**

**Monterey Pine Forest**

**Monterey Pine-  
Bishop Pine Forest**

**Pygmy Forest**

**Monterey Pine  
Forest**



**Terrace**

**Lighthouse**

**Ocean View**

**Peninsula  
College**

**Silvan**

**Monte Vista**

**Huckleberry**

**Elevation**

**10 - 40'**

**40 - 120'**

**140 - 220'**

**240 - 300'**

**320 - 540'**

**600 - 800**

**Soils**

**Active Dunes  
Antioch  
Various Soils**

**Sheridan  
Santa Ynez  
Baywood**

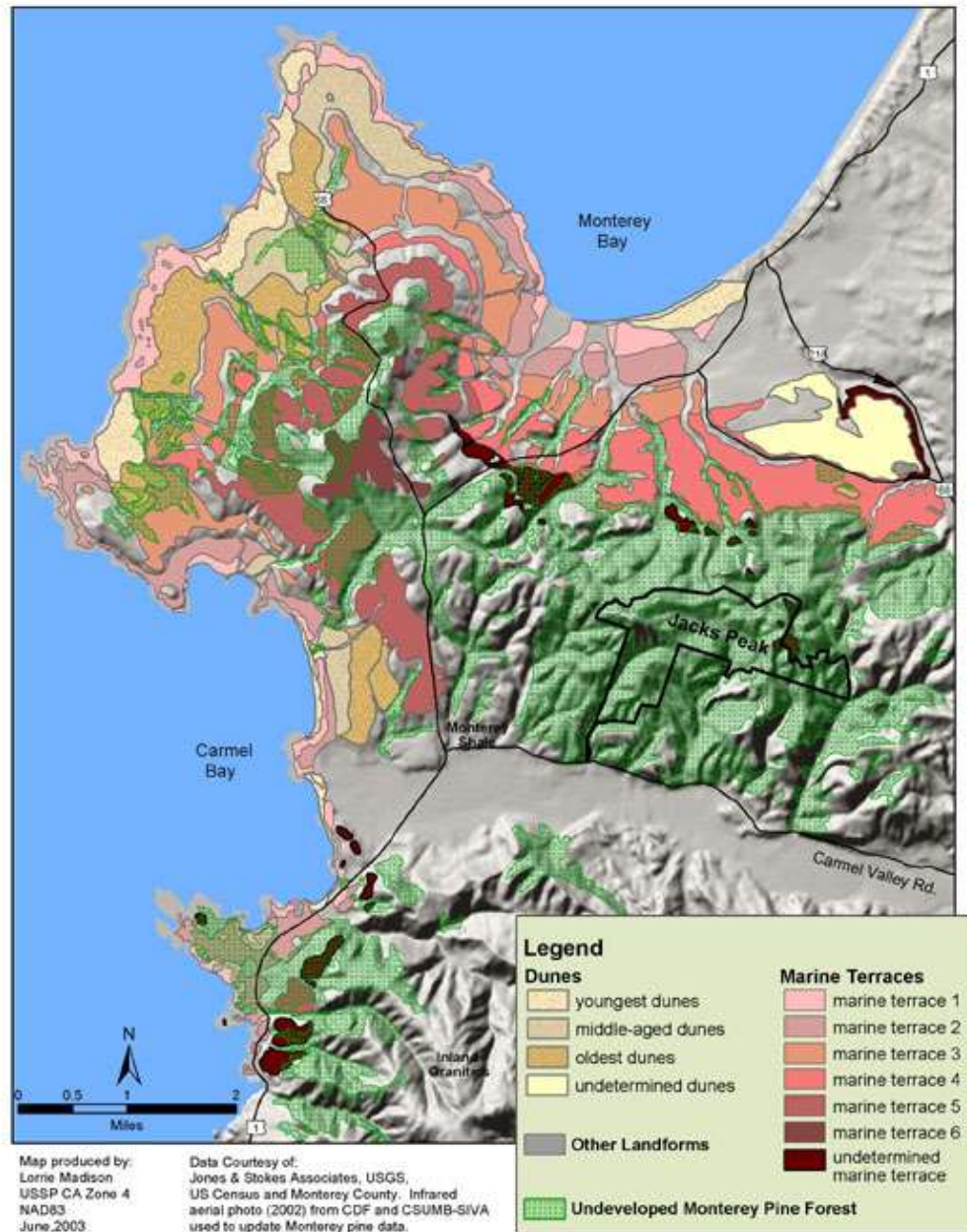
**Tangair/Oceano  
Narlon**

**Tangair/Arnold  
Narlon/Sunridge**

**Huckleberry/Narlon/  
Sunridge**

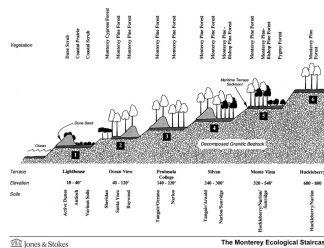
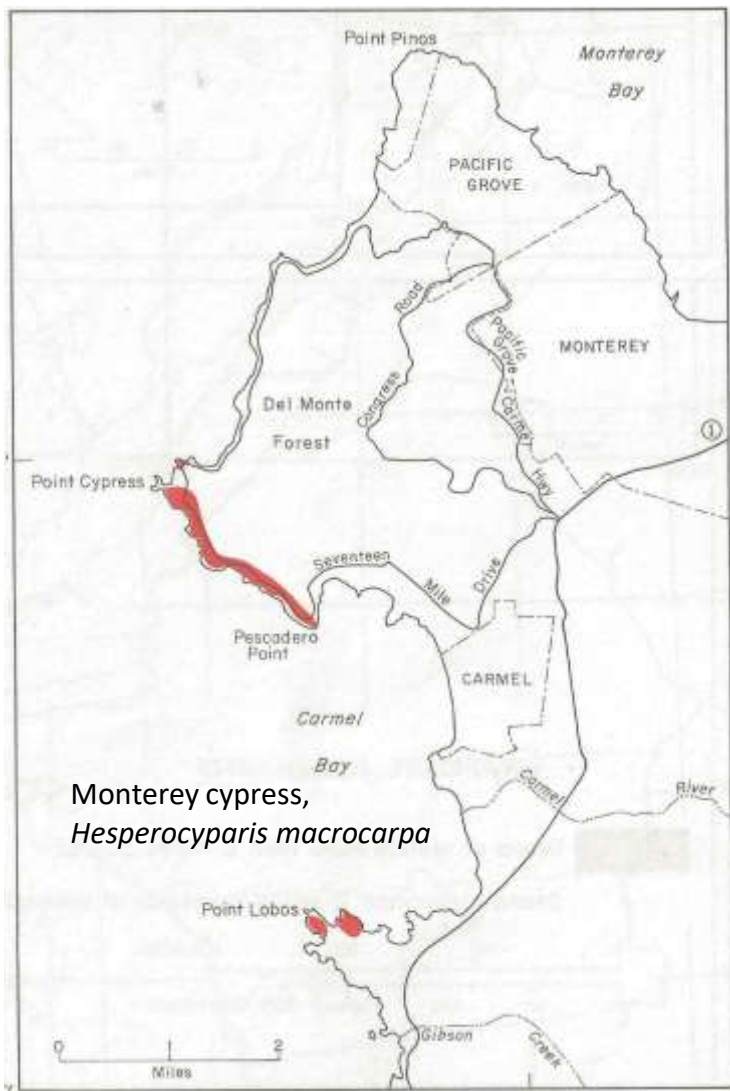
**Huckleberry/Narlon**

# Dunes and Marine Terraces of the Monterey Area



## Coastal Bluffs - Monterey Cypress







Gowen cypress and Maritime Chaparral on elevated marine terraces. Gowen cypress are “pygmy” trees, exhibiting phenotypic dwarfism on ancient, shallow, acidic and nutrient-poor soils. Shallow soils are usually underlain by hardpans that can perch watertables.





Locations of Indigenous Populations of Monterey Pine



Guadalupe Island,  
Rick Hawley



*Potentilla hickmanii*, FE, SE



*Piperia yadonii*, FE



*Rosa pinetorum*

Virdette Brumm & Robertson Parkman

# Monterey pine plantation in New Zealand



New Zealand Forestry



Northern/Lucian Coastal Scrub  
Looking south towards Big Sur





*Artemisia californica*

*Toxicodendron diversilobum,*



*Eriophyllum staechadifolium*



*Baccharis pilularis*



*Salvia mellifera*



# Maritime Chaparral



*Arctostaphylos hookeri*, Hooker's



*A. cruzensis*, Arroyo de la Cruz



*A. edmundsii*, Little Sur



*A. pajaroensis*,  
Pajaro manzanita



*A. pumila*, sandmat manzanita





*Ceanothus (cuneatus var.) rigidus*,  
Monterey ceanothus



*Ceanothus dentatus*, dwarf ceanothus



Fort Ord



*Xerophyllum tenax*, bear-grass (Melanthiaceae)  
Fort Ord National Monument



# Valley Grasslands, Coastal Prairie Grasslands, Annual Grasslands



*Monolopia lanceolata*





# VERNAL POOLS



*Microseris paludosa*,  
marsh scorzonella

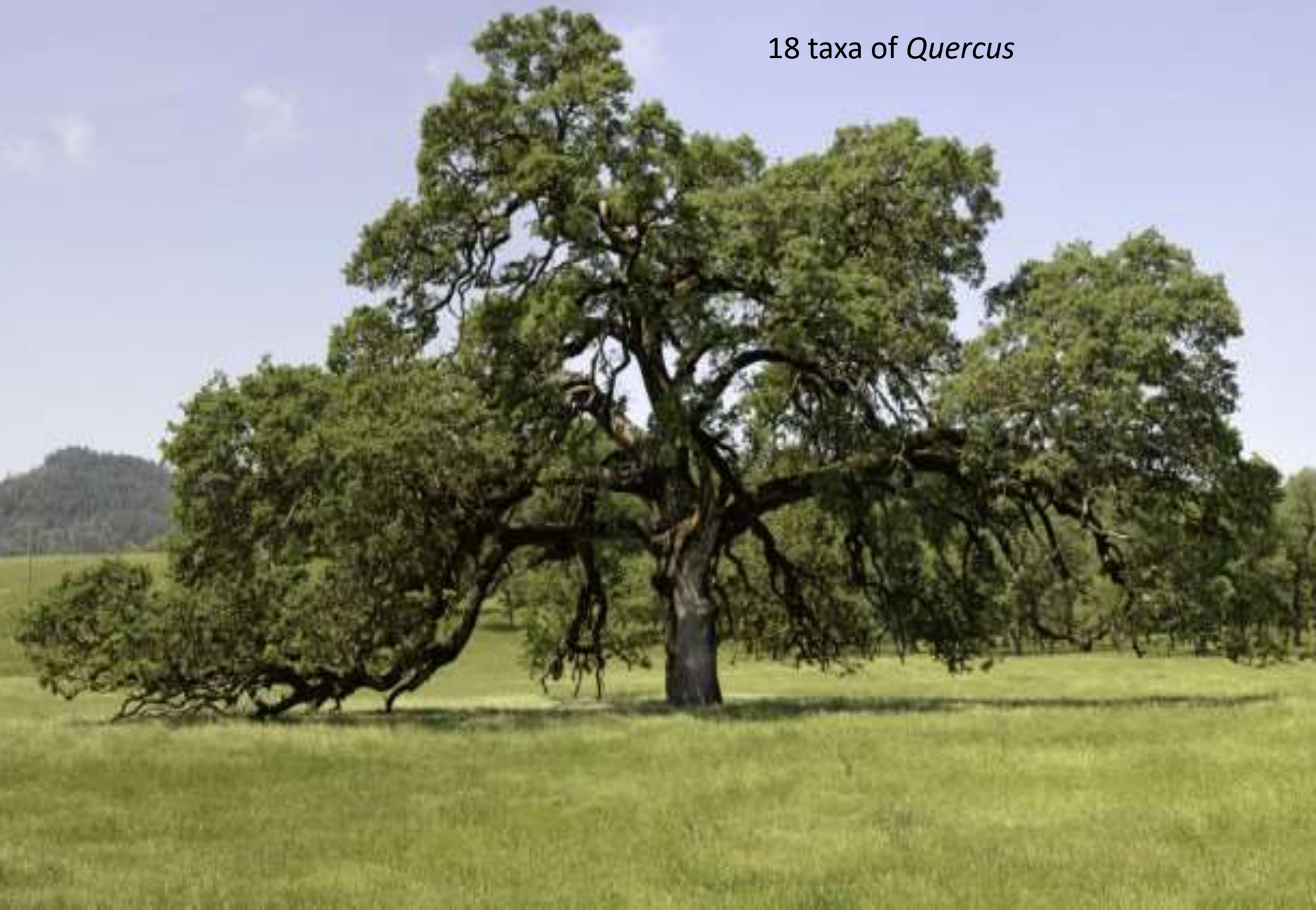


*Agrostis acuna-vernalis*,  
vernal pool bent grass

# Oak Woodlands



18 taxa of *Quercus*







*Trillium ovatum*



*Iris douglasiana*



*Viola ocellata*



*Clintonia andrewsiana*



*Pedicularis dudleyi*,  
Dudley's lousewort, CR

*Fire is an ecosystem process*



*Basin Complex Fire, June-July 2008  
Photo by Tom O'Neil*

40 years of fire in the Ventana Wilderness, with 4 lightning fires.  
GreenInfo Network, from Bay Nature Magazine, Oct/Dec 2009.  
The 2016 Soberanes Fire was a result of an illegal campfire.



Coast Ridge 2008







European animals and settlers from 1775 on... with their different agricultural and social practices, and “new” methods of animal and resource stewardship.



# Torrey pine, *Pinus torreyana*



- The rarest pine in the U.S.
- Endemic to San Diego County (once only 100 trees ... 3000+ trees today) and Santa Rosa Island (var. *insularis*).... but,
- Naturalized and recruiting aggressively at CSUMB and in Marina!!



