AUDUBON CANYON RANCH

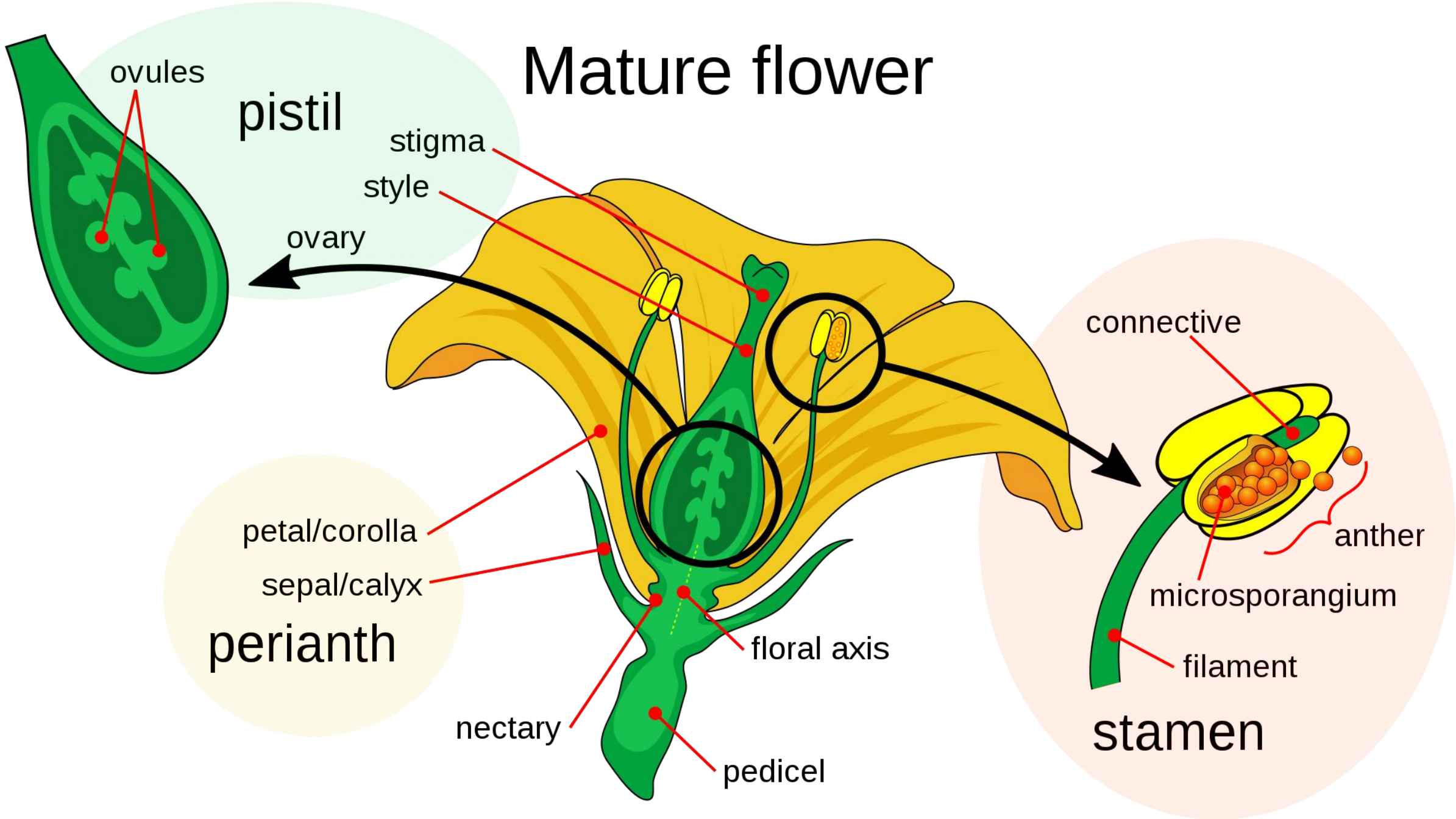
acr

conservation in action

Plant Communities

talk by Henry Inman, Resource Ecologist at Martin Griffin Preserve
April 2021

"A **plant community** is a collection or association[1][*page needed*] of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types."-English language wikipedia


Mature flower
ovules
pistil
stigma
style
ovary
petal/corolla
sepal/calyx
perianth
nectary
floral axis
pedicel
connective
anther
microsporangium
filament
stamen

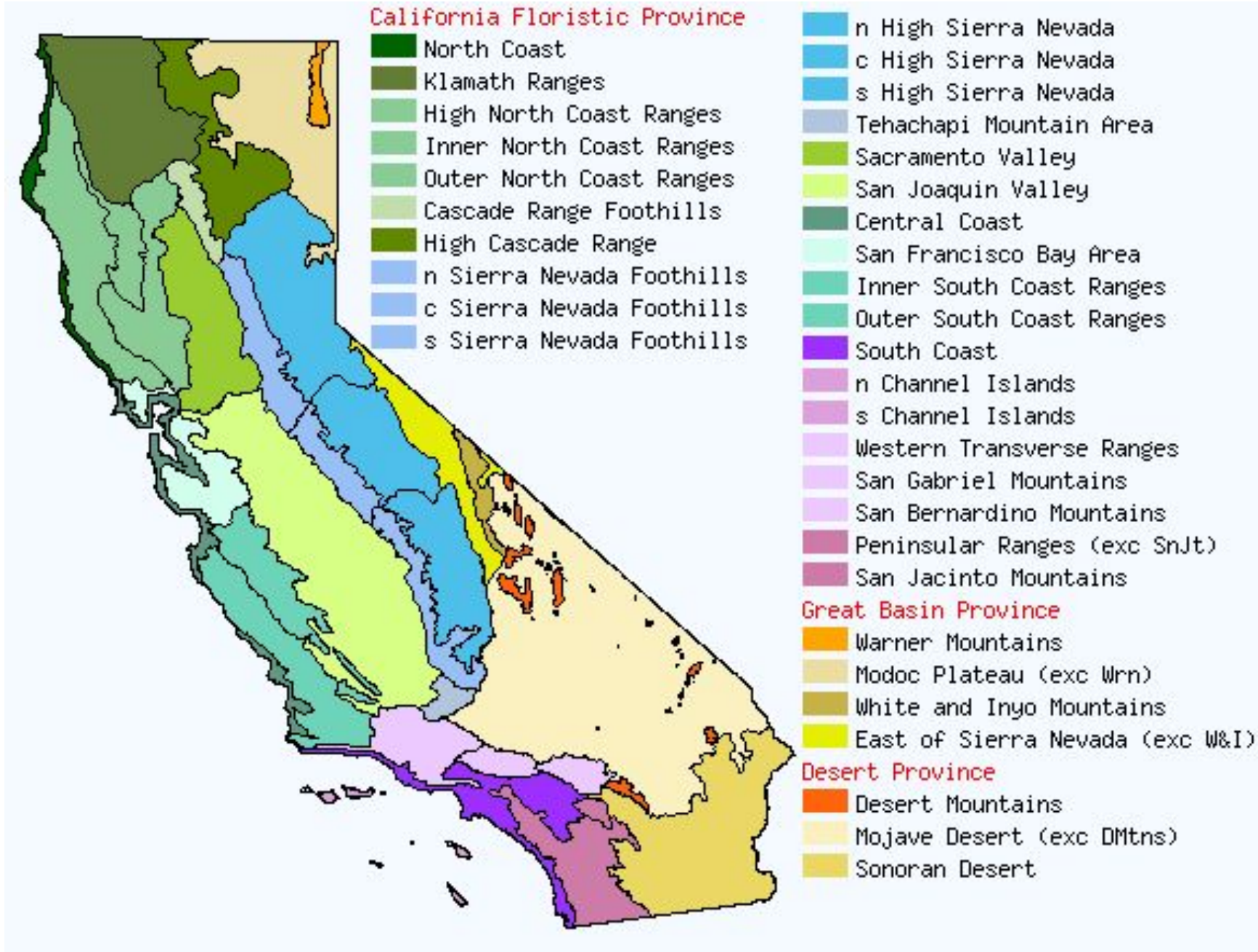

Stamen
Stigma

Blind Show and Tell – 20 min breakout

Take turns describing your plant, and the rest of the group can work together to figure out what the plant is.

What did you learn? whole group discussion

- What was difficult or unclear? Were some things easier to describe than others?



Jepson Flora Project, *Jepson eFlora*, https://ucjeps.berkeley.edu/eflora/

California Floristic Province

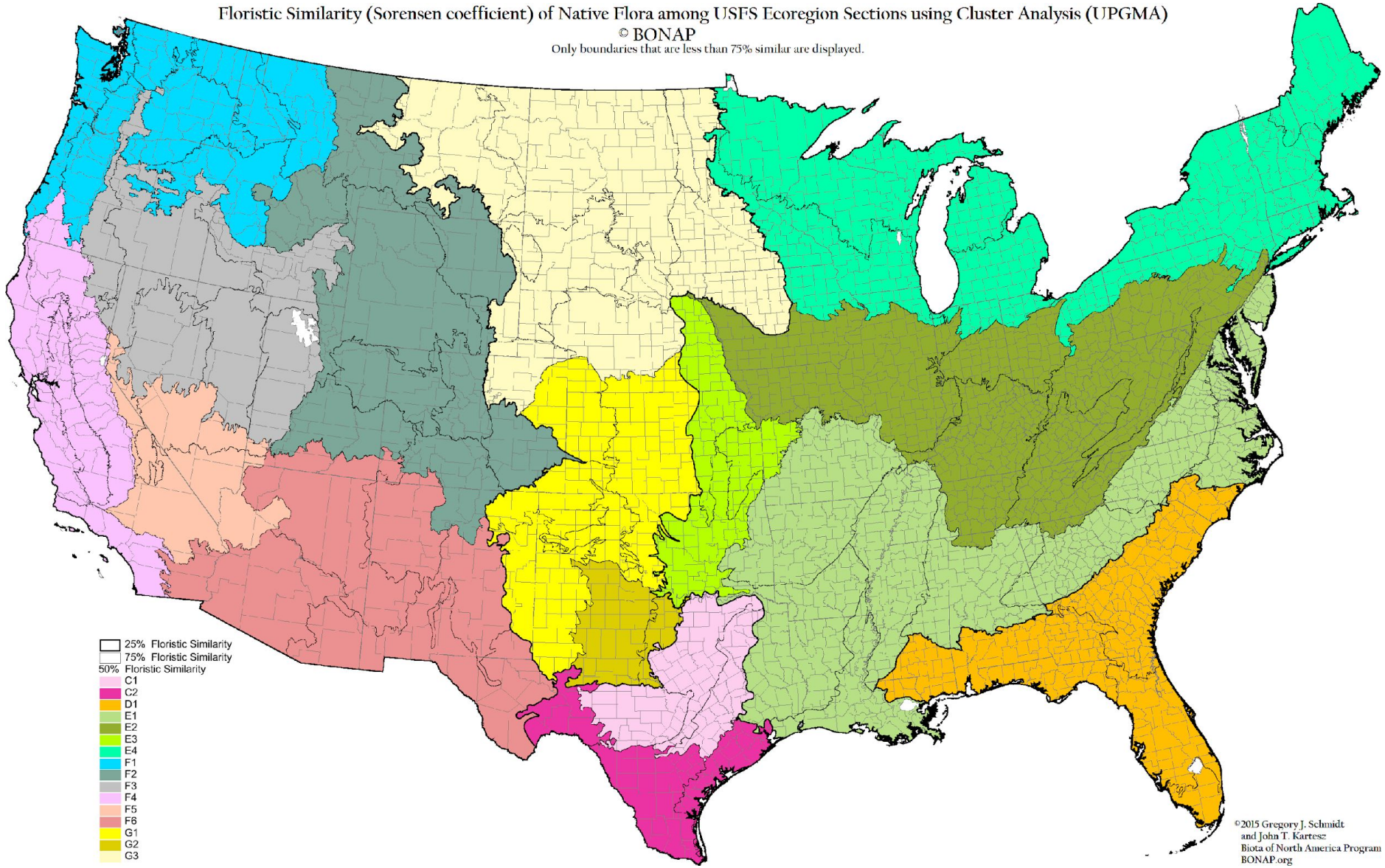
- A floristic province is a geographic area with a relatively uniform composition of plant species
- 42% of native vascular plants in the California Floristic Province are endemic (Madroño, 63(2):3-206 (2016). https://doi.org/10.3120/madr-63-02-3-206.1)
- One of only five areas in the world with a Mediterranean-type climate (http://www.biodiversityhotspots.org/xp/Hotspots/california_floristic)
- About 24.7% of the vegetation in this province remains in more or less pristine condition

File:CA floristic province.png. (2021, February 21). *Wikimedia Commons, the free media repository*. Retrieved 00:01, March 6, 2021 from https://commons.wikimedia.org/w/index.php?title=File:CA_floristic_province.png&oldid=534668525.

Floristic Similarity (Sorensen coefficient) of Native Flora among USFS Ecoregion Sections using Cluster Analysis (UPGMA)

© BONAP

Only boundaries that are less than 75% similar are displayed.



Ecological biogeography

- Why is a species confined to its present spatial range?
- What enables a species to live where it does, and what prevents it from expanding into other areas?
- What roles do soil, climate, latitude, topography, and interactions with other organisms play in limiting its distribution?

- (Source: Biogeography: An Ecological and Evolutionary Approach by C. Barry Cox, Peter D. Moore, and Richard J. Ladle)

10 minutes journaling

- Why is a species confined to its present spatial range?
- What enables a species to live where it does, and what prevents it from expanding into other areas?
- What roles do soil, climate, latitude, topography, and interactions with other organisms play in limiting its distribution?

Apply these questions to the plant you chose

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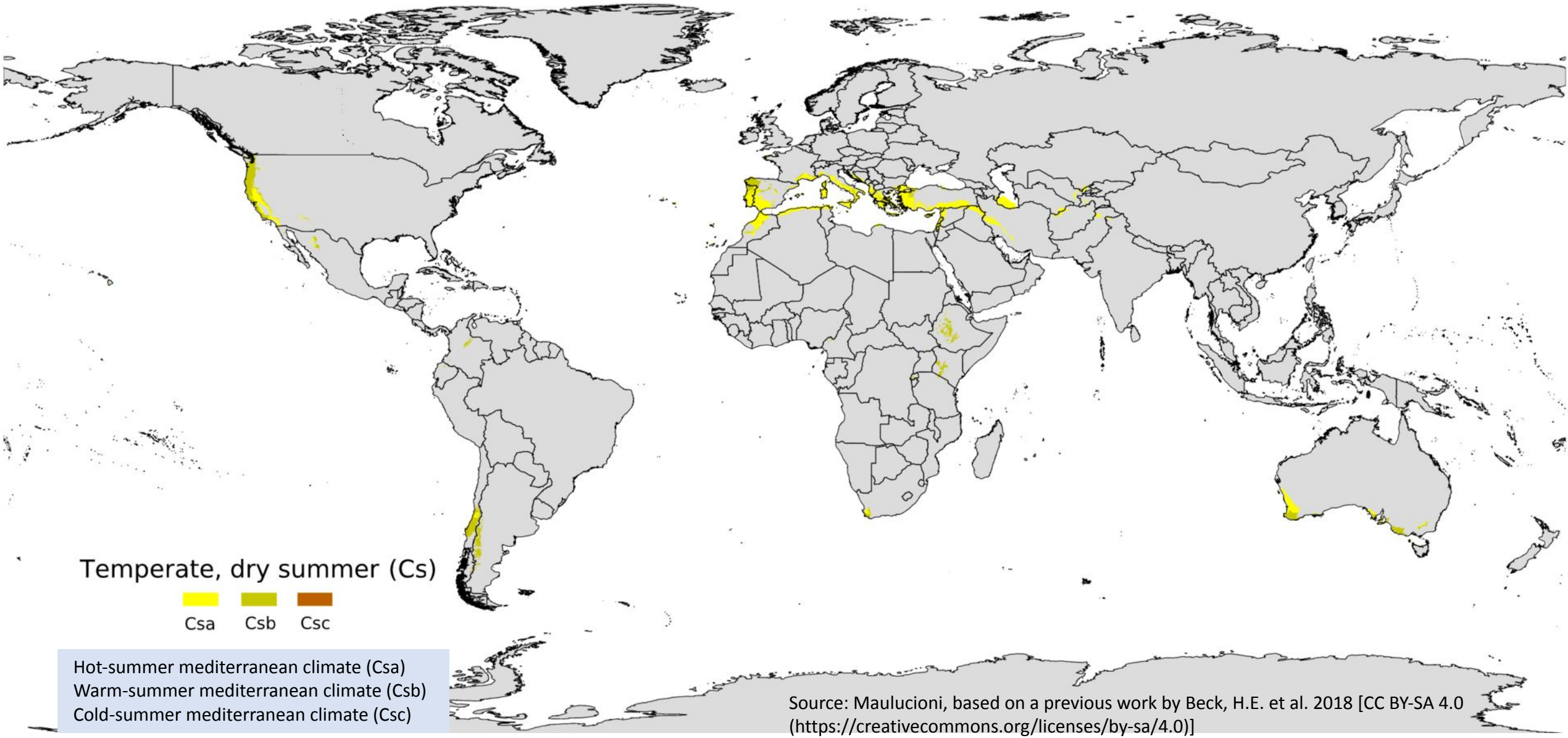
Mediterranean Climate

- Cool wet winters, hot dry summer
- Mediterranean regions represent only 2.2% of Earth's land surface, but 20% of all known vascular plants grown in Mediterranean regions

Source: **The California Naturalist Handbook**
by Adina Maya Merenlender, Deborah Stanger Edelman, and Greg de Nevers

Mediterranean Climate



Hot-summer mediterranean climate (Csa)
Warm-summer mediterranean climate (Csb)
Cold-summer mediterranean climate (Csc)

Why are Mediterranean climates on the western coasts of continents?

- https://www.youtube.com/watch?v=sI5EcAI-nnQ

California Floristic Province

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Mediterranean Climate

© 2018 Lindsay T. Cook

Danielle Carney

© 2019 Michelle Karle

Ian Brooker and David Kleinig

Temperate, dry summer (Cs)

Csa Csb Csc

Hot-summer mediterranean climate (Csa)
Warm-summer mediterranean climate (Csb)
Cold-summer mediterranean climate (Csc)

American Skunk Cabbage *(Lysichiton americanus)*

Native to California, invasive in Europe!

Source: European Commision https://ec.europa.eu/environment/nature/invasivealien/list/index_en.htm

Coastal Bush Lupine (*Lupinus arboreous)*

Native to California, invasive in the Mediterranean region, Australia, New Zealand, Southern South America …. And California!

Native to Central and Southern California and invasive in Northern California Dune habitat.

Small-flowered Fiddleneck (*Amsinckia menziesii*)

Native in California, invasive in Australia!

Source: https://www.fs.fed.us/psw/publications/beyers/psw_2010_beyers(montalvo)_NativePlantRecomm.Amsinckia.menziesii.pdf

Invasive Species Biology

- How do invasive species impact the places they grow?
- What is a weed?

© Getty Images/ M. Ralston

Flowering Plant Families – Global Number of Species

FAMILY	NUMBER OF SPECIES
Asteraceae (Sunflower family)	22,750
Orchidaceae (Orchid family)	21,950
Fabaceae (Pea family)	19,400
Rubiaceae (Madder family)	13,150
Poaceae (Grass family)	10,035
Lamiaceae (Mint family)	7,175
Euphorbiaceae (Spurge family)	5,735

Top 20 Plant Families in the Bay Area

Family	Number of Species	Family	Number of Species
1. Asteraceae (Sunflower)	280	11. Onagraceae (Evening Primrose)	47
2. Poaceae (Grass)	191	12. Rosaceae (Rose)	45
3. Fabaceae (Pea)	128	13. Polemoniaceae (Phlox)	44
4. Brassicaeae (Mustard)	86	14. Eriaceae (Heath)	41
5. Boraginaceae (Borage)	77	15. Orobanchaceae (Broomrape)	40
6. Cyperaceae (Sedge)	74	16. Ranunculaceae (Buttercup)	39
7. Plantaginaceae (Plantain)	57	17. Rhamnaceae (Buckthorn)	31
8. Apiaceae (Carrot)	54	18. Chenopodiaceae (Goosefoot)	31
9. Polygonaceae (Buckwheat)	51	19. Liliaceae (Lily)	27
10. Lamiacaea (Mint)	50	20. Juncaceae (Rush)	26

- What are the limiting factors in the environment?
- How are plants adapted to these limiting factors?
- What natural disturbances occur? What are the non-natural threats to the plant community?






Dunes and Coastal Strand

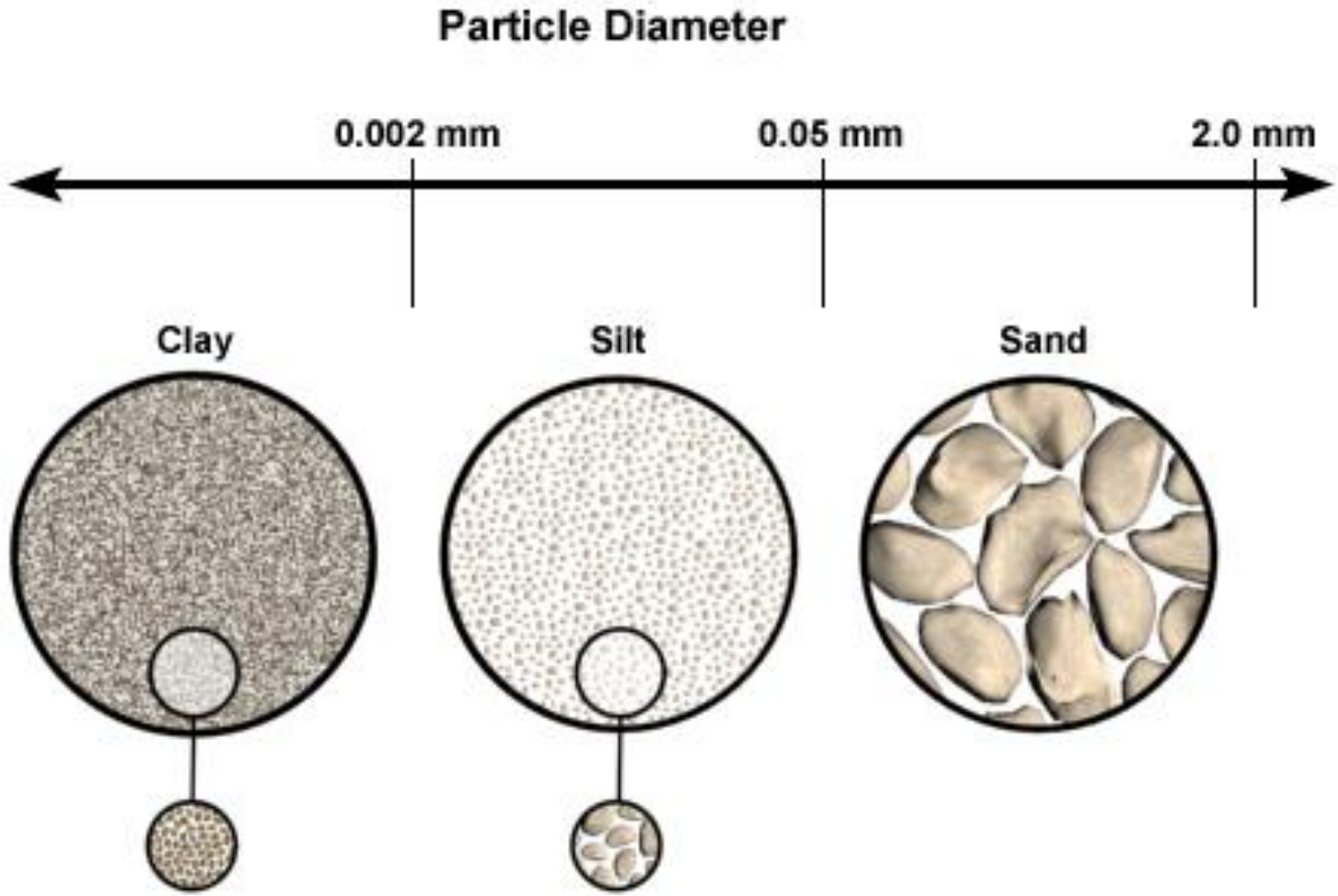
Source: **Ecosystems of California**
by Harold Mooney (Editor), Erika Zavaleta (Editor)

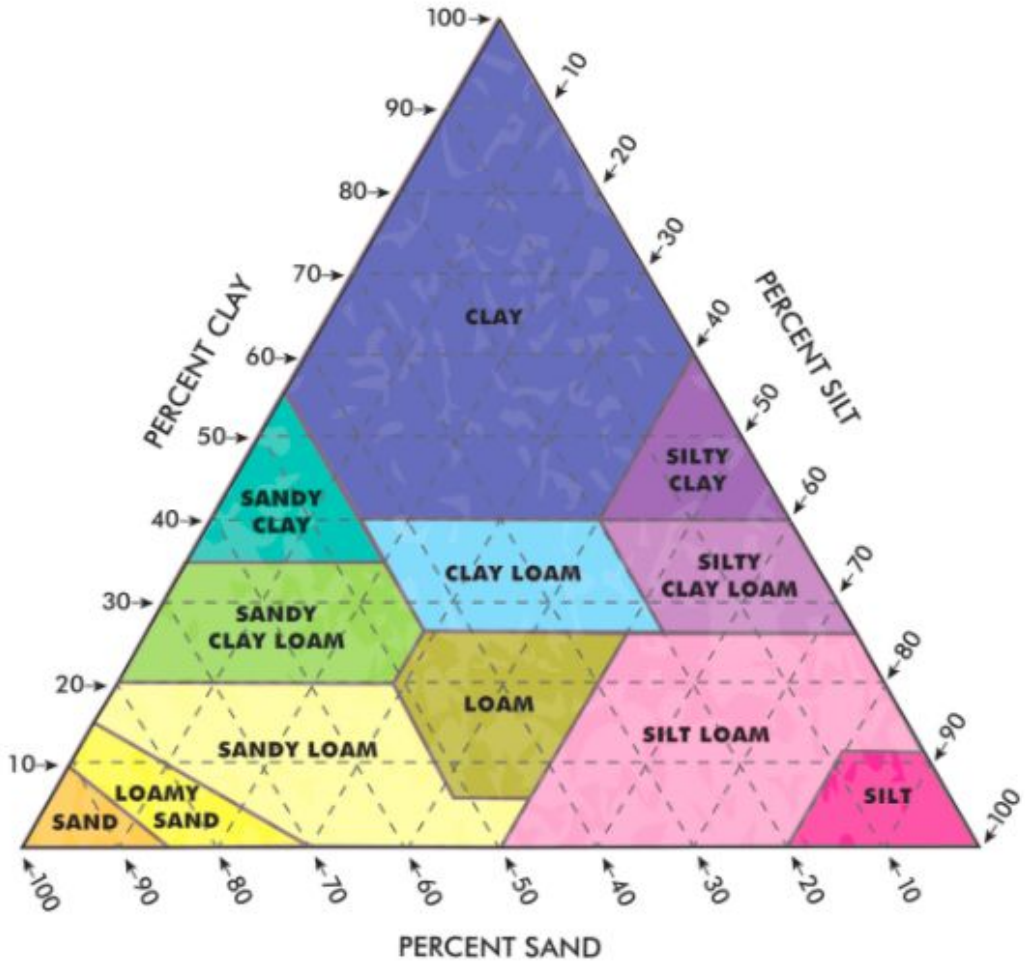
Dunes and Coastal Strand

Limiting Factors

- Sand is seasonally removed and replaced

- Because the soil is poorly developed and mostly sand, soil has low nutrient value, and water quickly drains and is inaccessible to plants





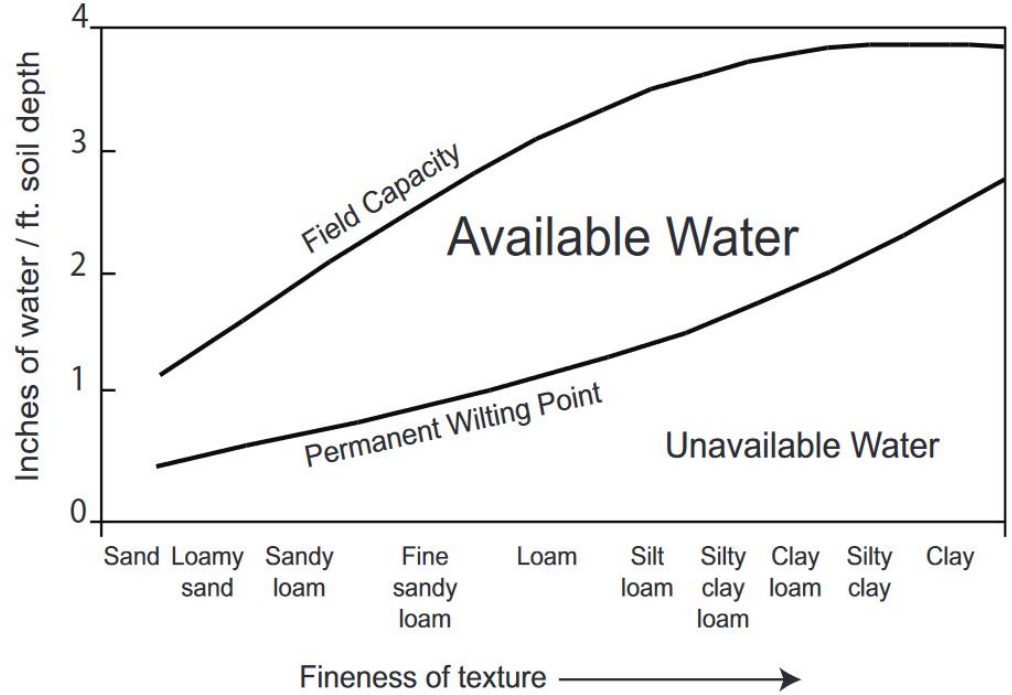
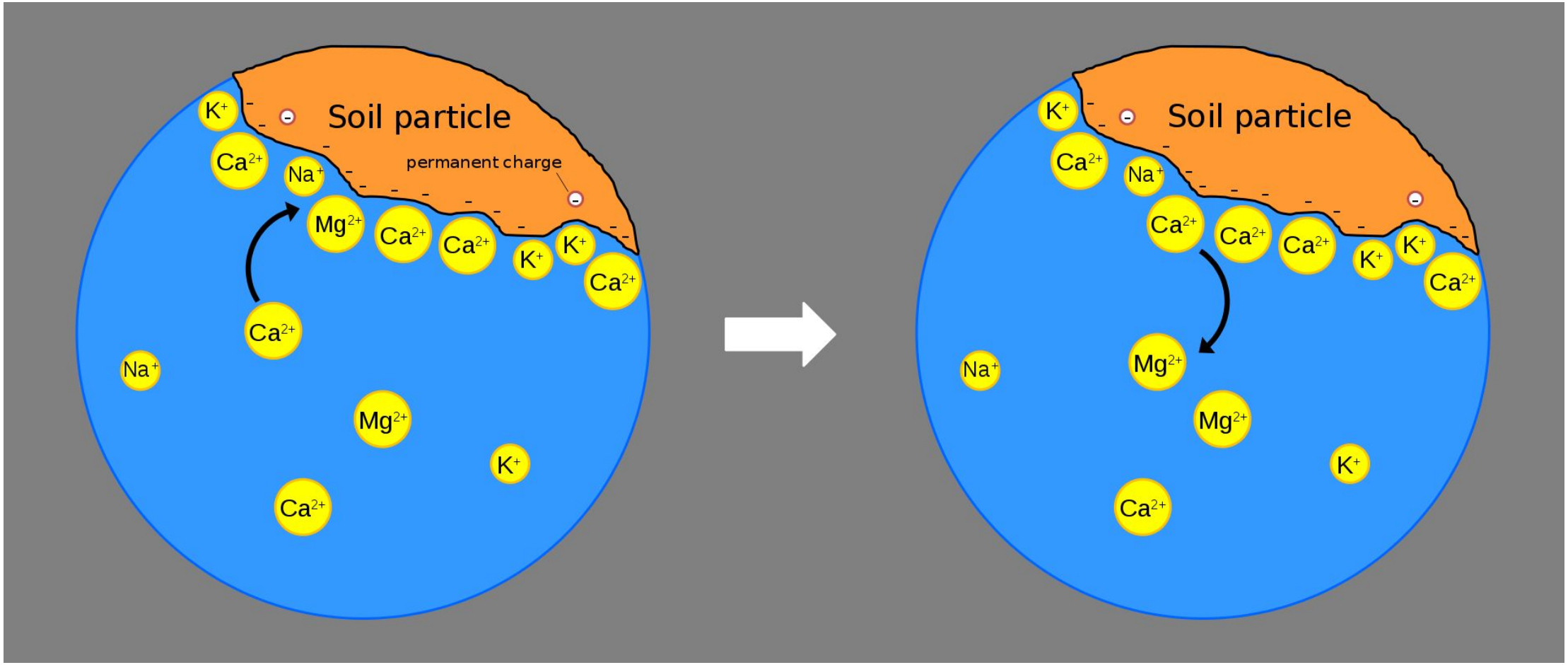


Figure 1. General relationship between soil moisture and texture. Ohio Agronomy Guide, 14th edition, Bulletin 472-05

Cation Exchange Capacity

A cation is an ion with a positive charge



- Clays and organic matter are negatively charged and can hold onto cations
- The most common soil cations (including their chemical symbol and charge) are: calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K+), ammonium (NH_4+), hydrogen (H^+) and sodium (Na^+).
- Soils without clays or organic matter will have deficiencies in these nutrients

For more information
http://nmsp.cals.cornell.edu/publications/factsheets/factsheet22.pdf
https://www.extension.purdue.edu/extmedia/ay/ay-238.html
Biogeochemistry: An Analysis of Global Change 4th Edition by W.H. Schlesinger (Author), Emily S. Bernhardt (Author)

Dunes and Coastal Strand

Limiting Factors

- Sand is seasonally removed and replaced
- Because the soil is poorly developed and mostly sand, soil has low nutrient value, and water quickly drains and is inaccessible to plants
  - Low availability of Nitrogen
  - Nutrient inputs may come in from offshore kelp washing up on the beach

Dunes and Coastal Strand

Limiting Factors

- Sand is seasonally removed and replaced
  - Difficult for plants to talk hold on the shifting sands of open beaches
  - Plants that find spots to colonize on dunes may help to stabilize the dunes, but may also end up buried or excavated by sand movement
- Because the soil is poorly developed and mostly sand, soil has low nutrient value, and water quickly drains and is inaccessible to plants
  - Low availability of Nitrogen
  - Nutrient inputs may come in from offshore kelp washing up on the beach

Dunes and Coastal Strand

Limiting Factors cont.

-there are high speed winds on the coast

- high speed winds can desiccate plants

-there may be high amounts of solar radiation

-high salinity in soil and aerosols

-upper 20-100 cm of soil on dunes an be very dry, with moister being held in deeper soil

Limiting Factors	Adaptations
High solar radiation, high speed winds	Partial closure of stomata to avoid losing water
Limited Water availability	Succulence
Shifting sand	Trailing stems
Moisture held in deeper soil	Large taproots
High solar radiation	Dense hair or thick wax on leaves, which give the leaves a pale color


A

Dunes and Coastal Strand

Threats and Disturbances

- Many dune areas have been developed

THE GREAT SAND BANK

1 The Sunset District encroaches on the remaining sand dunes in 1928, just south of Golden Gate Park. Below, native dune vegetation in a photograph taken about two decades earlier.

2

Mile Rocks
Seal Rocks
Black Pt.
U.S. Reserve
SAN FRANCISCO
Rincon Pt.
Steamboat Pt.
MISSION BAY
Pt. of Rocks
Point San Quentin
Bernal Heights
Hunter's Point
Visitacion Valley

Dunes and Coastal Strand

Threats and Disturbances

- Many dune areas have been developed
- European beach grass
  - Produces dense, vertical rhizomes and tillers that promote vertical growth on dunes
    - This creates steep foredunes
    - Dunes stabilized by European dune grass tend to be formed parallel to the coast, whereas dunes stabilized by native dune grass tend to be formed perpendicular to the coast
  - In contrast to native American dune grass which increase lateral spread
  - Forms a dense cover that outcompetes native species


© Dave Ingram

Coastal Scrub

FIGURE 22.1 Distribution of coastal sage scrub in California. Data from U.S. Geological Survey, Gap Analysis Program (GAP). Map: Parker Welch, Center

Coastal Scrub

Limiting factors

- winter rainy season and prolonged summer drought
- often on steep, south facing slopes
- soils often have high clay content
    - soils are relatively nutrient rich, but water is less available

Limiting Factors	Adaptations
High clay content in soils which holds water close to the surface	Shallow root systems
High winds	Plants less than 2 meters tall, soft stems
Wet winter, dry summer	Seasonally dimorphic leaves
Regular fire	Nitrogen-fixing plants
Regular fire	Able to resprout after a fire
Regular fire	Long-lasting seeds that germinate after a fire
Large herbivores, deer	Aromatic leaves

Coastal Scrub Disturbances

- As of 1981, 10-15% of coastal sage scrub remained
- Limited by urbanization and land use change
- Invasive annual grasses

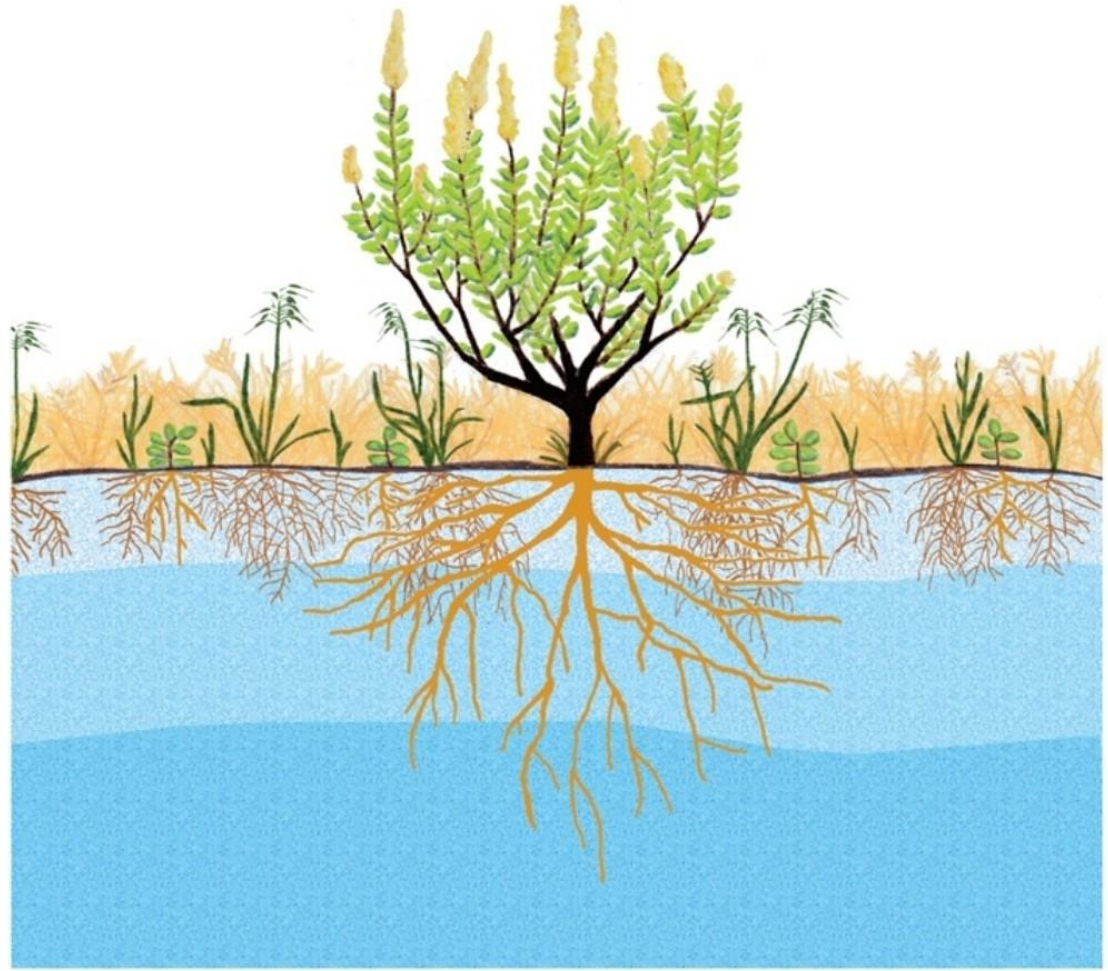


FIGURE 22.6 Root profiles of native shrubs (light brown) and exotic annual grasses (darker brown). Roots of establishing shrubs occupy the same shallow layers as roots of exotic annual grasses and place them in direct competition for water and nutrients. Exotic annual grasses also contribute to a significant litter layer aboveground, with multiple potential effects on establishing shrub seedlings including shading of shrub seedlings and greater soil moisture retention for deeper-rooted, mature shrubs. Illustration: Julie E. Larson.

Coastal Scrub Disturbances

- As of 1981, 10-15% of coastal sage scrub remained
- Limited by urbanization and land use change
- Invasive annual grasses
- Many grasses were introduced for grazing, much of the land use change is conversion of the land for grazing
- Human generated N from cars is deposited in soil, which increases exotic grass productivity
  - Increased Nitrogen in soils was shown in one study to kill 100% of California sagebrush plants
- Altered fire regime

Chaparral

Limiting Factors

- drier and hotter than coastal scrub
- low nutrient soils often shallow and rocky
- fire regime that completely burns vegetation at least once a century

Chamise

Manzanita

Small, hard leaves

Geophytes and bunchgrasses store a portion of their energy underground and are able to resprout after a fire

Bloomeria crocea

Bromus carinatus


Chlorogalum pomeridianum

Chaparral

Adaptations to Fire

- serotinous pines and cypress
    - resin seals pines shut but melts away with heat
- postfire annuals
-suffrutescent shrubs
    - woody stem at base, the rest of the plant is vegetative and dies back annually

Chaparral Disturbances

-climate change may lead to increased instances of extreme events such as droughts and heat waves

-changed fire regimes

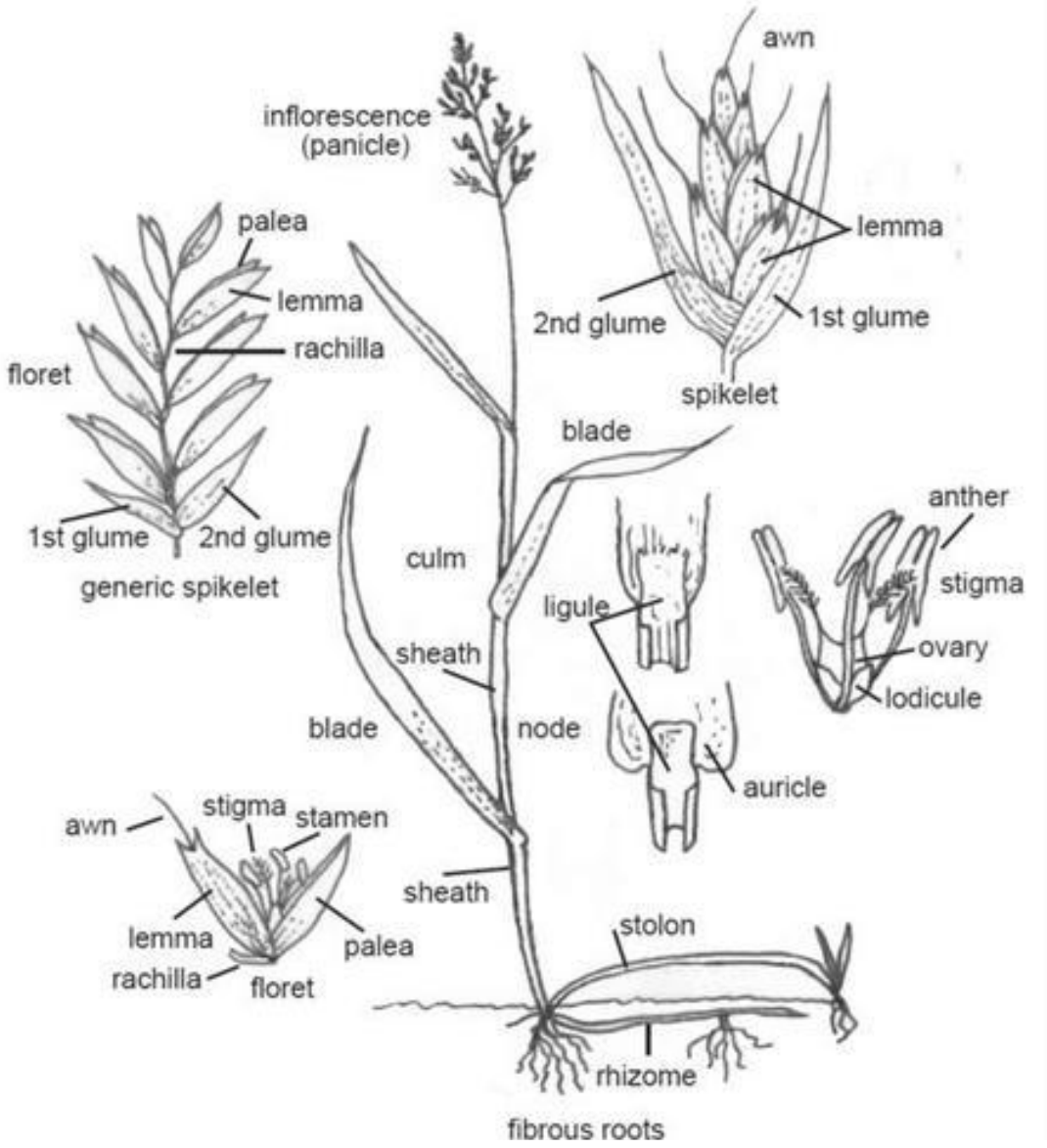
-chaparral stands are adapted to fire-return intervals greater than 15-20 years, however shorter intervals are becoming more common due to anthropogenic ignitions and fuels from annual nonnative grasses

Grasslands

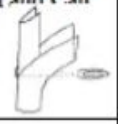
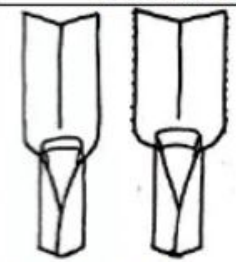
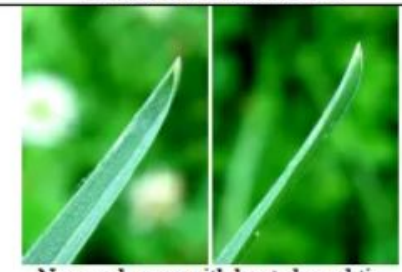
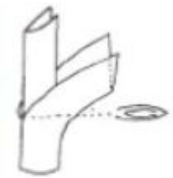
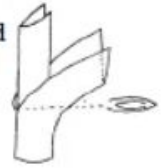
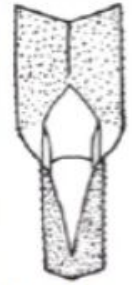
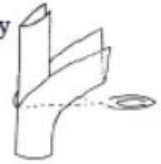
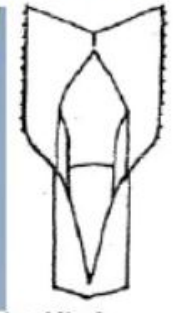
FIGURE 23.1 Distribution of grasslands in California. Additional grassland not shown here occurs in the understory of oak savannas and woodlands in much of the state (see Chapter 25, “Oak Woodlands”). Data from U.S. Geological Survey, Gap Analysis Program (GAP). Map: P. Welch, Center for Integrated

Grass Dissection!

“How wonderful must be the temper of the elastic leaves of grasses and sedges to make curves so perfect and fine …And what fine painting and tinting there is on the glumes and pales, stamens and feathery pistils.” – John Muir “My First Summer in the Sierra”



Characteristics of Forage and Pasture Grasses Found in the Northeast U.S.

Species	Growth Habit	Seedhead	Leaf Characteristics	Other Characteristics
Bluegrass (*Poa* spp.) **Kentucky** – *P. pratensis* **Canada** – *P. compressa* Short, low growing perennial grasses; they form a dense sod spreading by short rhizomes; Ky BG is dark green and Can BG is blue-green Leaves fold in bud shoot 	 Many short rhizomes	 Panicle with very small seed	 Kentucky Canada Truncate ligules  Midrib has two grooves and is translucent in light	 Narrow leaves with boat shaped tip Leaves fold in bud shoot
Annual bluegrass *Poa annua* An annual often found near gates and laneways where soil is compacted P. annua spp. *reptans* is a subspecies that is stoloniferous.	 An annual bunchgrass	 Small, short panicles	 Pointed ligule  crinkled leaves	  Leaves have boat shaped tip and double grooved, translucent midrib when held in light; leaves folded in the bud shoot
Roughstalk bluegrass *Poa trivialis* Creeping perennial Prefers shady, moist areas Leaves folded in bud shoot 	 Spreads by stolons; forms dense patches	 Loose, green panicle	  Pointed ligule; rough surface	 Folded in bud shoot and leaf blades fold
Orchardgrass *Dactylis glomerata* Tall growing bunchgrass; Long leaves that are lighter green compared to other grasses; Leaves strongly folded in bud shoot 	 Prolific tillering grass	 Panicle seed head with ball-like clumps	  Long, pointed ligule, no auricle	 Leaves strongly folded

Grasslands

- Grow in a wide diversity of soils and precipitations
- Often grow interspersed with other plant communities
- Interior grasslands are dominated by forbs
- Coastal grasslands grow interspersed with woody species and forbs

Grassland Disturbances

- Fire and grazing
  - Natural disturbances that remove thatch and create space for forbs and legumes to grow

Grassland Disturbances

- Fire and grazing
  - Natural disturbances that remove thatch and create space for forbs and legumes to grow
- Livestock
  - Soil compaction

Salt Marsh

Limiting Factors

- plants are twice daily inundated

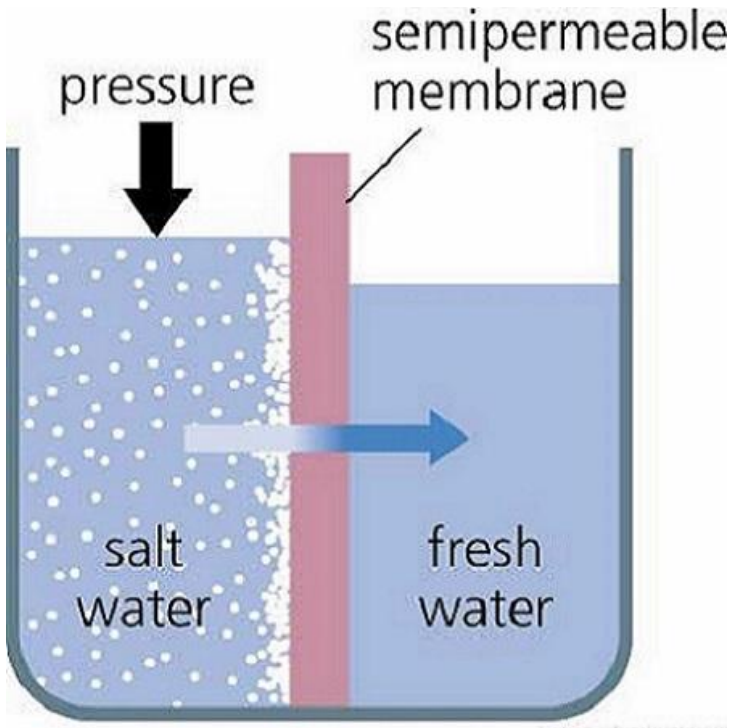
-high salinity and low oxygen

Salt Marsh Adaptations

- Reduce water loss with succulent stems and small, waxy, grey leaves
- Ability to sequester salt in the tips of stems
  - Pickleweed
- Ability to expel salt from the plant
  - Distichlis spicata

Salt is stored in the segments at the tip of the plant, which turn red and drop off when they fill with salt

Salt accumulation requires lots of internal storage of water. Water will move from an area containing less salt to an area containing more salt, towards equilibrium.



Coniferous Forest – Redwood Forest

Limiting Factors

- Redwoods are a remnant species whose ancient range included areas with wet summer months

- Redwoods now are limited to a narrow coastal strip from Monterey county to Oregon, and create their own local microclimate that enables them to have moisture year round

-low light levels at the forest floor

- fog is a major source of water

Coniferous Forest – Redwood Forest

Plant Adaptations

- understory plants shade tolerant

-redwood sorrel photosynthesizes best in low light but can be stressed in full light. Their leaves fold up to reduce incoming light during passing sun flecks.

- no annuals in the full shade because there is not enough light for plants to grow from seed to seeding in one year

Coniferous Forest – Redwood Forest

Plant Adaptations

- redwood needles can directly take up a small fraction of their summer daily water requirement from fog

-many understory species in the redwood forest are also able to directly absorb fog water, rain, and dew through their leaves

Desert

Limiting Factors

- very high and very low temperatures
- low rainful
- lack of water leads to salty soils
    - rapid evaporation leaves salt at the soil surface which doesn’t leach down into the soil without rain
- often extreme winds

Desert

Plant Adaptations

- Adaptations to lack of water
  - escape, annuals that avoid the dry season as seeds
  - Tissue succulence
  - Deciduousness
  - Waxy stems or leaves
  - Light colored hairs, spines, or salt crystals reflect light
  - Parallel orientation to the incoming light
  - Leaves that are fewer, small and narrow
    - High surface-to-volume ratio helps the leaves stay below lethal temperatures

Desert

Plant Adaptations

- Adaptations to lack of water
  - Different photosynthetic pathways
    - CAM photosynthesis is adapted to dry conditions, as leave stomates are shut during the day and open at night for CO2 uptake

Graph showing night time CO2 absorption by *Opuntia ficus-indica*

CO2 absorbed umol m2 s-1

0.5
0.4
0.3
0.2
0.1
0
-0.1

Starts at 03:40 AM

Finishes at 08:35AM

tm

19:05:00 19:20:00 19:35:00 19:50:00 20:05:00 20:20:00 20:35:00 20:50:00 21:05:00 21:20:00 21:35:00 21:50:00 22:05:00 22:20:00 22:35:00 22:50:00 23:05:00 23:20:00 23:35:00 23:50:00 00:05:00 00:20:00 00:35:00 00:50:00 01:05:00 01:20:00 01:35:00 01:50:00 02:05:00 02:20:00 02:35:00 02:50:00 03:05:00 03:20:00 03:35:00 03:50:00 04:05:00 04:20:00 04:35:00 04:50:00 05:05:00 05:20:00 05:35:00 05:50:00 06:05:00 06:20:00 06:35:00 06:50:00 07:05:00 07:20:00 07:35:00 07:50:00 08:05:00 08:20:00 08:35:00 08:50:00 09:05:00 09:20:00

Axis Title

Desert

Plant Adaptations

- Desert plants tend to grow wide rather than tall
- Wide shapes can intercept rain and create shad which prevents evaporation
- Light is not a limiting factor, so desert plants don’t need to grow upwards to compete for light like trees in a forest might

Desert

Plant Adaptations

- Creosote bush plants secrete allelopathic compounds to keep other plants at a distance, creating an evenly spaced pattern and less competition for water