
Chapter 5
Introduction to plants
Plant lifestyles
Parts of a plant
Plant Communities
Plants and People


Introduction to Plants
a. surround us
b. feed us
c. aesthetic and functional backdrop of our lives
corylus


adiantum


rorippa


dodecatheon


cercis

Plant Lifestyles

a. all plants want warm and wet
   - optimal for their metabolism
   - aseasonal tropical rainforests are the "ideal"

b. not too many places in the world fit this ideal profile
   - most plants must be clever and make the best of their situation
   - plant lifestyles and their adaptations reflect this struggle

How is this Ductman's pipe uniquely adapted to life in its environment?

Woody Perennial Plants

a. trees
   - deciduous trees lose their leaves during the unfavorable season

- evergreen trees keep their leaves during the unfavorable season (hence, “forever green”)

b. shrubs

- generally have more than one stem
- usually reach a maximum of height of 15 feet

c. woody vines
   - piggyback on trees to attain higher heights and more sunlight exposure

Herbaceous (non woody) perennial plants

a. during favorable season, behave like woody perennial plants
b. hibernate during unfavorable season by moving carbon compounds and minerals to their roots and bulbs

c. at return of favorable season, jump start growth from energy and nutrients stored in their roots and bulbs

d. many plants that seem to produce swarms of species in CA follow this kind of lifestyle
e. have the advantage in stable, predictable environments

Annuals plants (persist only for a few quick months)

a. sprout from seedling in February
b. grow
c. die around October or November

d. many wild plants found in the hills are annual plants

e. their ability to produce numerous seeds becomes increasingly advantageous in uncertain and unpredictable environments

Plant anatomy

Plants grow by making stems

a. as stems elongate they produce successive leaves which are essential for photosynthesis
b. in some species stems are contracted and difficult to spot

c. in others, stem is elongate and easily visible

At the base of the stem resides the *bud*

a. a clump of tissue specialized to grow new stem, leaf or flower

b. surrounded and protected from weather extremes and predators by bracts
c. bracts are evolutionary modified leaves
d. often visible at the base of the leaf
e. easily seen during the dormant season on deciduous plants
f. when new stem begins to grow, bud bracts relax, which permits stem elongation to occur
g. thereafter, the bracts fall off

Leaf shape

a. simple (undivided)

b. compound (divided)

Arrangement along the stem

a. alternate

b. opposite

c. whorled

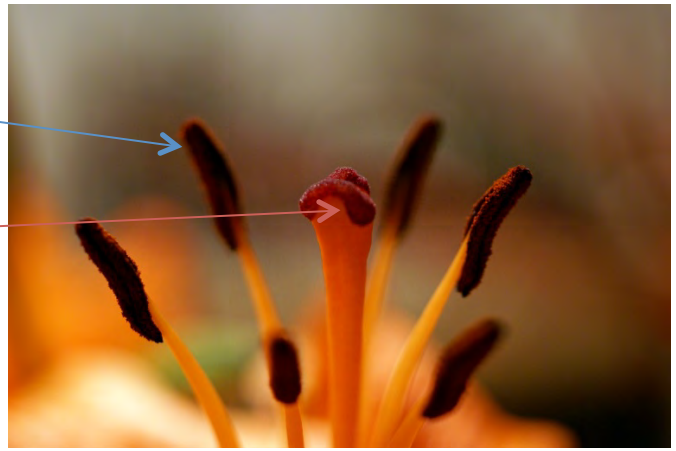
Flowers consists of four whorls of modified leaves

a. sepals (outermost whorl)
   - enclose and protect the other inner three whorls

b. petals
   - advertisement for potential pollinators
   - often lushly colored

b. stamens
   - male function
   - site of pollen production

c. pistils
   - female function
   - contains ovary (which will develop into the seed)



Pollination

a. mating with other individuals rather than yourself produces more fit offspring
b. most plants have developed methods to reduce chance of self-pollination

- animal pollination example
  - bees dive into the flower to drink the sweet nectar
  - pollen from the flower gets caught on their body
  - the bee will inadvertently transfer pollen from one flower to another as it moves from flower to flower

Main components of animal pollination

a. advertisement
   - visual cues like lushly colored sepals, petals, stamens
   - olfactory cues
     - fills Earth with fragrances

b. rewards
   - nectar
   - pollen
   - oil

Wind pollination is cheaper than animal pollination

a. no need for making sepals or petals
b. no need for producing nectar, pollens and oils

Seed Dispersal

a. external transport
   - caught on the furs or feathers of animals

- elaisome
  - oil rich body on certain types of plant seeds
  - ants gather the seeds
  - feed the elaiosome to their offspring
  - discard the seed, which may end up miles from where they found it

b. internal transport
   - fruits are enlarged ovaries containing seeds
   - animals ingest fruits
   - seed travels wherever animal moves
   - seed takes root wherever animal defecates

Plant communities of California

Nemophila

Every plant and animal in the world has:

a. a unique evolutionary heritage
b. a unique set of genes
c. a unique set of environmental tolerances

+

Every habitat can be parsed out into elements of:

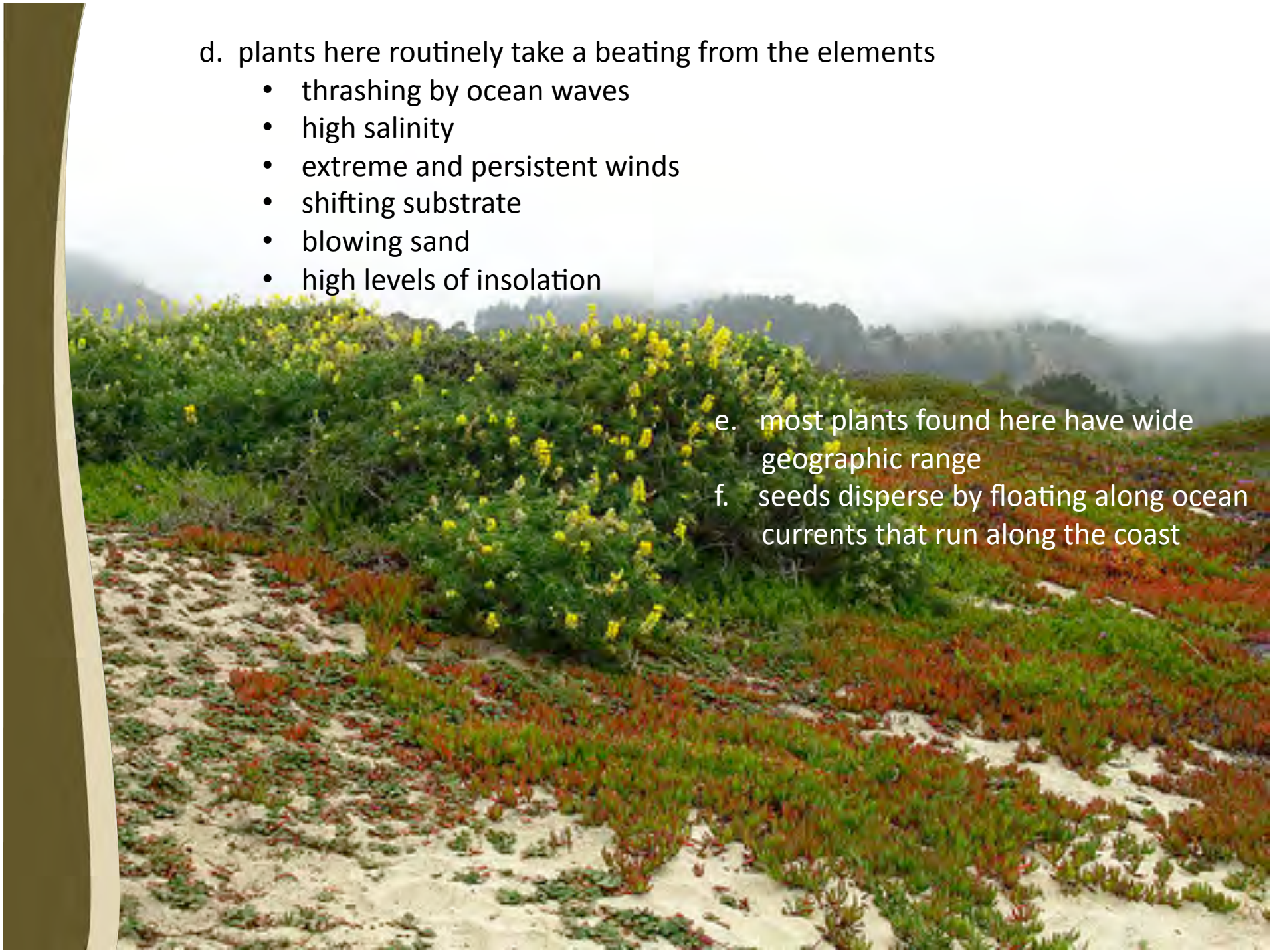
a. Climate
b. Geology
c. interactions between animals (especially elk, cattle, and people)
d. fire

→ The interaction of all these factors determine the distribution and composition of plant communities

Coastal strand

a. low spare, windswept carpet of plants occupying the sandy shore
b. includes immediately adjacent dunes and bluffs
c. composed primarily of annual or herbaceous perennial plants

d. plants here routinely take a beating from the elements
   - thrashing by ocean waves
   - high salinity
   - extreme and persistent winds
   - shifting substrate
   - blowing sand
   - high levels of insolation



e. most plants found here have wide geographic range

f. seeds disperse by floating along ocean currents that run along the coast

g. extremely prone to alteration by humans

- seawalls

- coastal homes

- introduction of European beach grass


Common species found in coastal strand
a. Sand verbena
semi-succulent leaves
© 1997 Christopher L. Christie


b. beach bur
silvery pubescence
© 2009 Dr. Mark S. Brunell


c. Beach evening primrose
prostrate, creeping position
Beatrice F. Howitt © California Academy of Sciences

Grassland

a. composed of mostly foreign European and Asian annual grasses
b. very little shrub or tree cover
c. occurrence throughout Coast Ranges and Sierra foothills intimately intertwined with history
   - woodlands, forests and chaparral cleared in the past for agriculture or pasture
   - this retarded the natural succession of grasslands to shrublands to woodland to forest
   - given time and the removal of livestock, most grasslands will eventually revert back to woodland or forest

General order of colonization

1. *Baccharis*
   (wind dispersed coyote brush)

bird dispersed poison oak

2. *Umbellularia* (California Bay)

Douglas fir

Example

- Golden Gate National Recreation Area
- used to be an area of expansive pasture for cattle ranches between 1860-1960
- since the land was purchased by National Park Service 1960s, it has been left ungrazed
- today, coastal sage scrub has almost completely covered the former grasslands
- Douglas fir trees and bay trees are also starting to invade (in part due to fire suppression)

A few areas where native CA grasses can still be found

a. native mixed woodlands along steep and wet slopes
   - protected from over-grazing
   - less competition for water

b. serpentine soil
   - low calcium: magnesium ratio
   - lack essential nutrients
   - contain toxic heavy metals
   - still, some species are exquisitely adapted to these conditions and thrive
   - as a place where exotic grasses generally cannot invade, serpentine is a stronghold for native grasses
   - serpentine soils usually have incredibly diverse displays of native grass and wildflower

Replacing exotic annual grasses with native grass plants would greatly increase biodiversity. Buts its challenging.

a. simply eliminating grazing would result in a surge of exotic annual plants, which would drown out the native grasses even more
b. car exhaust, which contains nitrogen, sometimes acts incidentally as fertilizer, which increases exotic grass populations

Salt Marsh

a. typically very flat, making it highly desirable to humans
b. 90% of the original Bay salt marshes have been converted for human use
    - most threatened plant community along CA coast
c. twice daily inundation by salt water interspersed with periods of extreme insolation
d. extremely low soil oxygen
e. high soil salinity
f. high rates of soil deposition
g. often seasonally flooded with fresh water from neighborhood creek channels

Vegetated areas

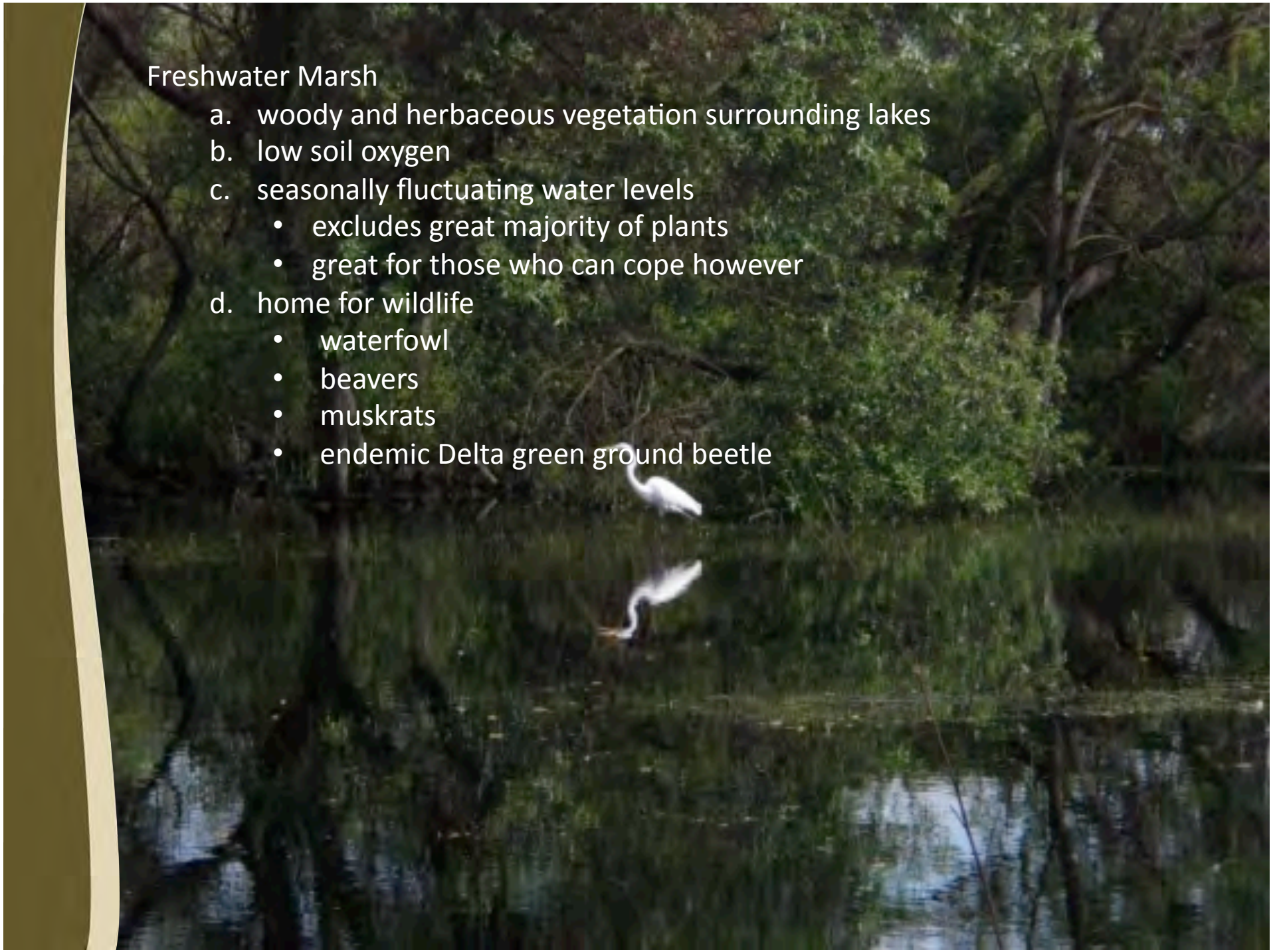
a. occupy higher elevations
b. perform primary production via communities of herbaceous plants
c. despite hardships, very high level of primary production

Bare mud flats

a. occupy slightly lower levels
b. abode for invertebrate consumers and decomposers
c. functions as nursery for fish too


Common salt marsh plants
a. *Frankenia salina*
© 2008 Jennifer Buck


b. Salicornia



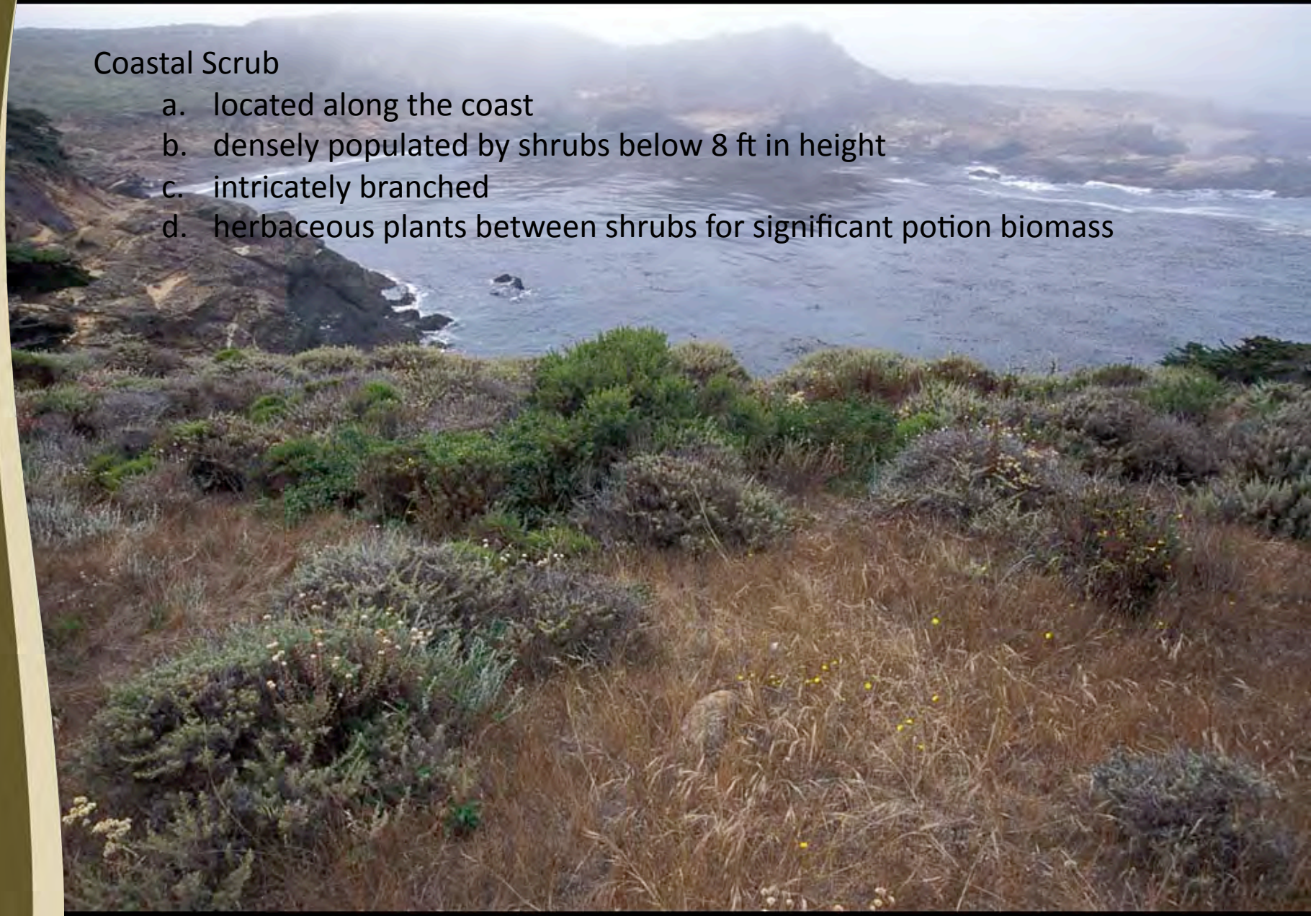
Freshwater Marsh

a. woody and herbaceous vegetation surrounding lakes
b. low soil oxygen
c. seasonally fluctuating water levels
    - excludes great majority of plants
    - great for those who can cope however
d. home for wildlife
    - waterfowl
    - beavers
    - muskrats
    - endemic Delta green ground beetle

Prior to damming of the great rivers, Central valley periodically experienced flooding

a. formation of small shallow vernal pools along terraces and low spots of the Central Valley and its surrounding foothills
b. support unique flora of annual plants growing in concentric rings determined by water depth
c. during dry season, these basins dried up so that by end September, they were baked hardpans of dry cracked soil populated by humongous stands of tules (*Scirpus)*

d. controlling these rivers has led to arguably the greatest and most productive agricultural enterprise in human history, though it meant the loss of huge swathes of wetlands



Coastal Scrub

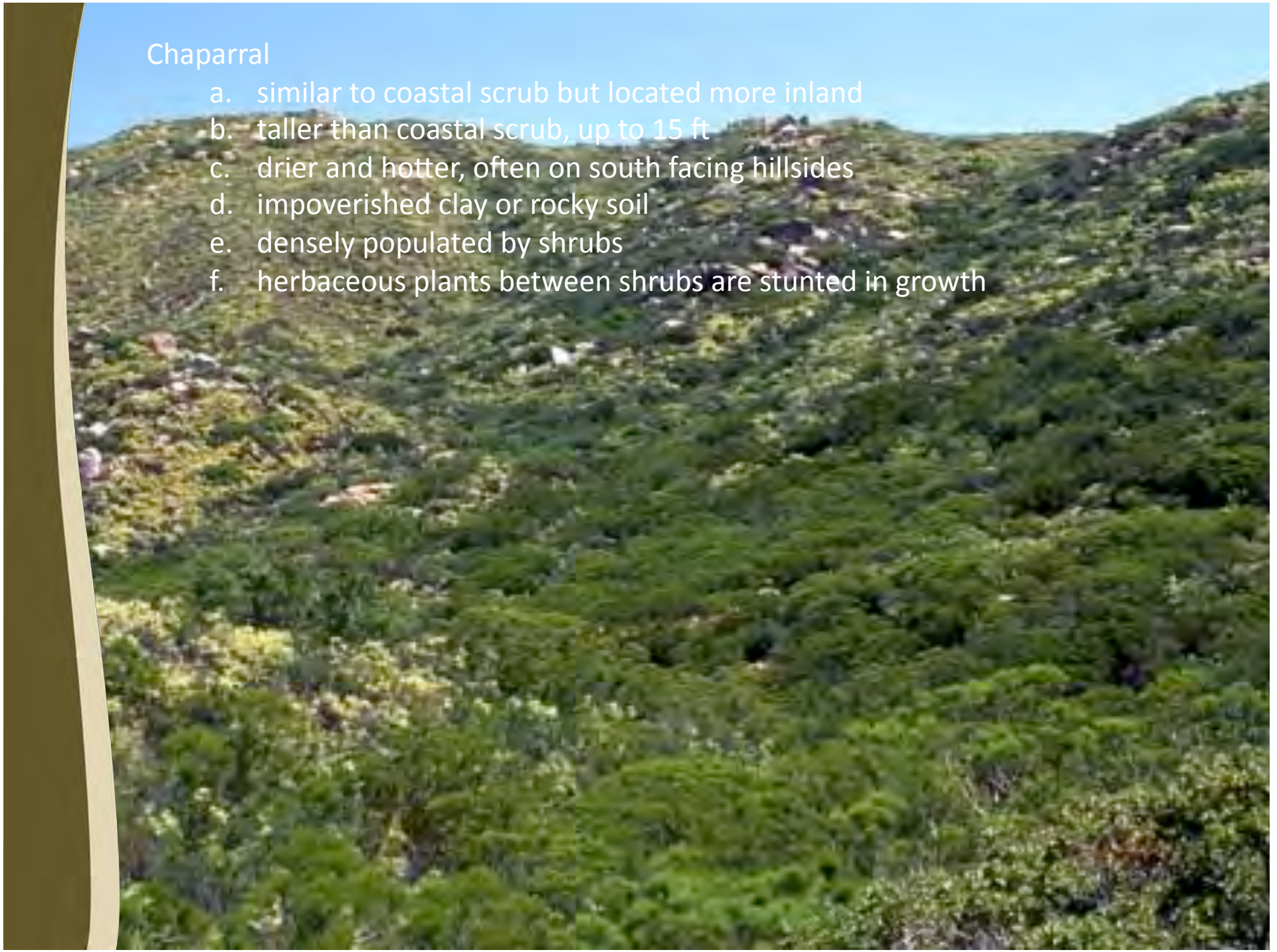
a. located along the coast
b. densely populated by shrubs below 8 ft in height
c. intricately branched
d. herbaceous plants between shrubs for significant potion biomass


Common coastal scrub plants
a. Coyote brush
© 2002 Lynn Watson


b. Coastal sage
© 2002 Lynn Watson

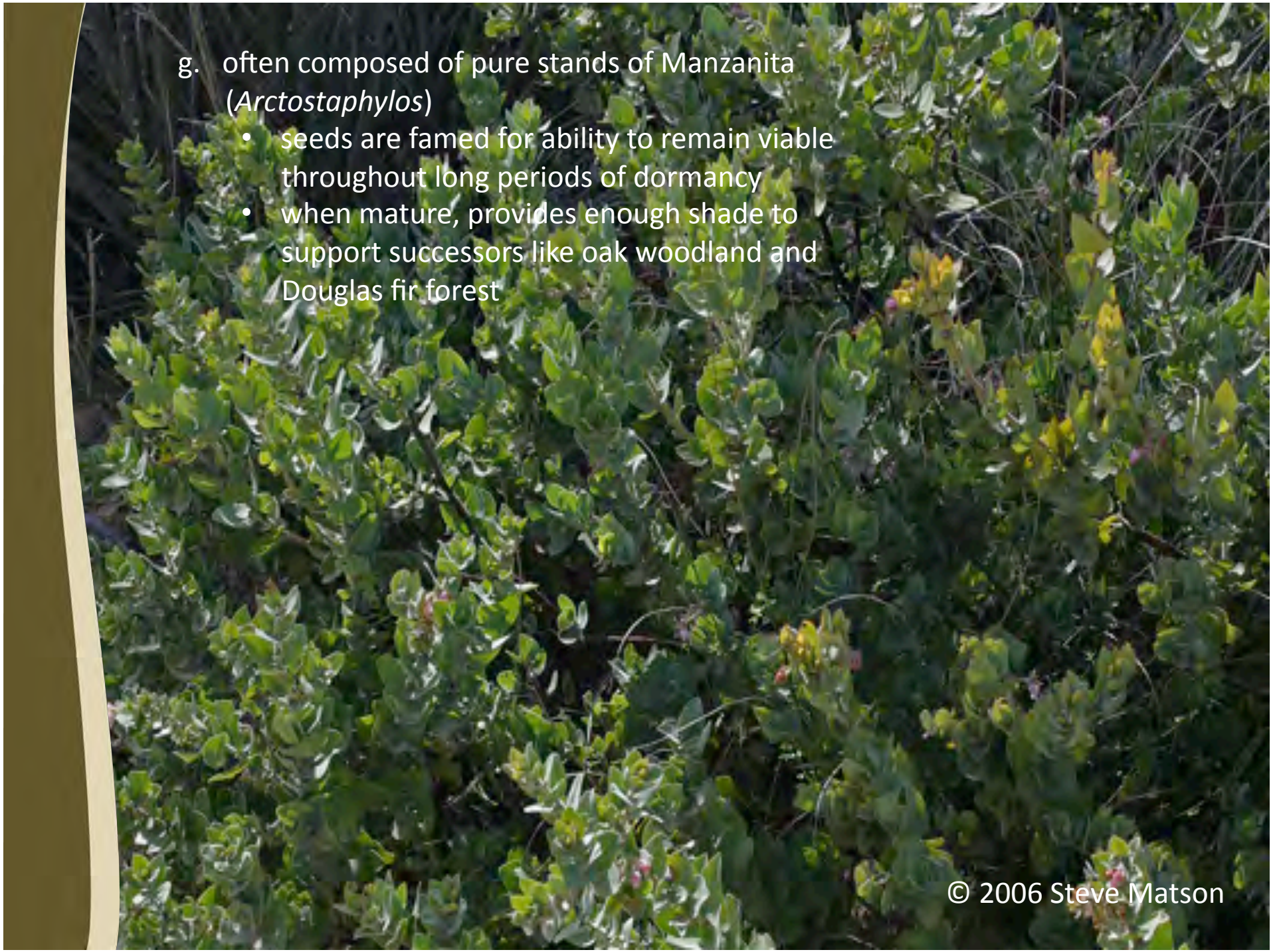

c. *Rubus ursinus* (California blackberry)
© 2005 Doreen L. Smith


d. Sticky monkey flower



Chaparral

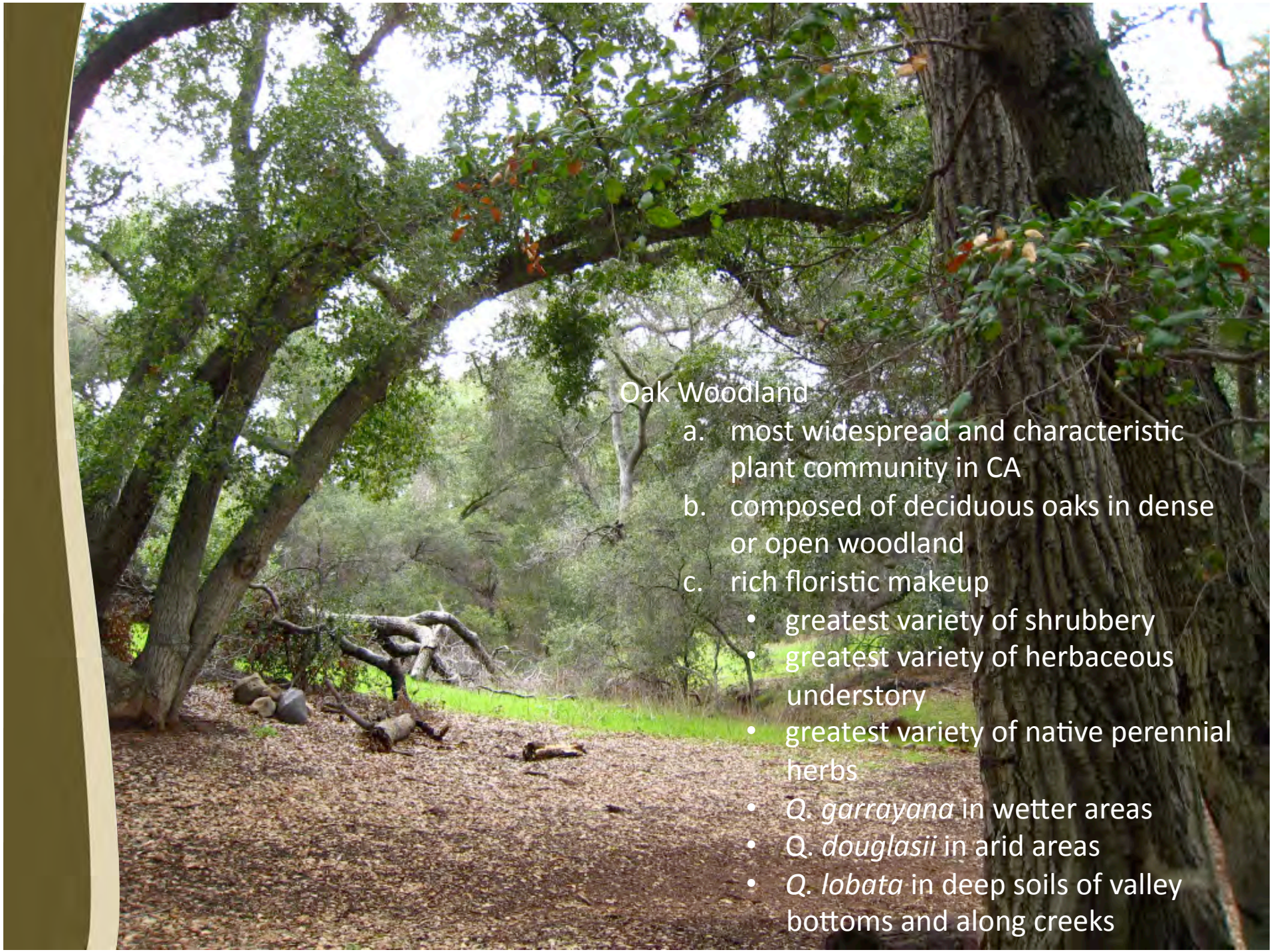
a. similar to coastal scrub but located more inland
b. taller than coastal scrub, up to 15 ft
c. drier and hotter, often on south facing hillsides
d. impoverished clay or rocky soil
e. densely populated by shrubs
f. herbaceous plants between shrubs are stunted in growth


g. often composed of pure stands of Manzanita (*Arctostaphylos*)
• seeds are famed for ability to remain viable throughout long periods of dormancy
• when mature, provides enough shade to support successors like oak woodland and Douglas fir forest
© 2006 Steve Matson


© 2006 Steve Matson

Mixed Evergreen Forest

a. composite of densely packed oaks, bay, Douglas fir, madrone, tan oak, and others
b. usually can stump sprout after fire
c. adapted to arid environment
   - sclerophyllous leaves: leathery hard, short internodes, marginal spines
   - waxy coating
   - reduced number of stomata
   - stomata located along leaf underside



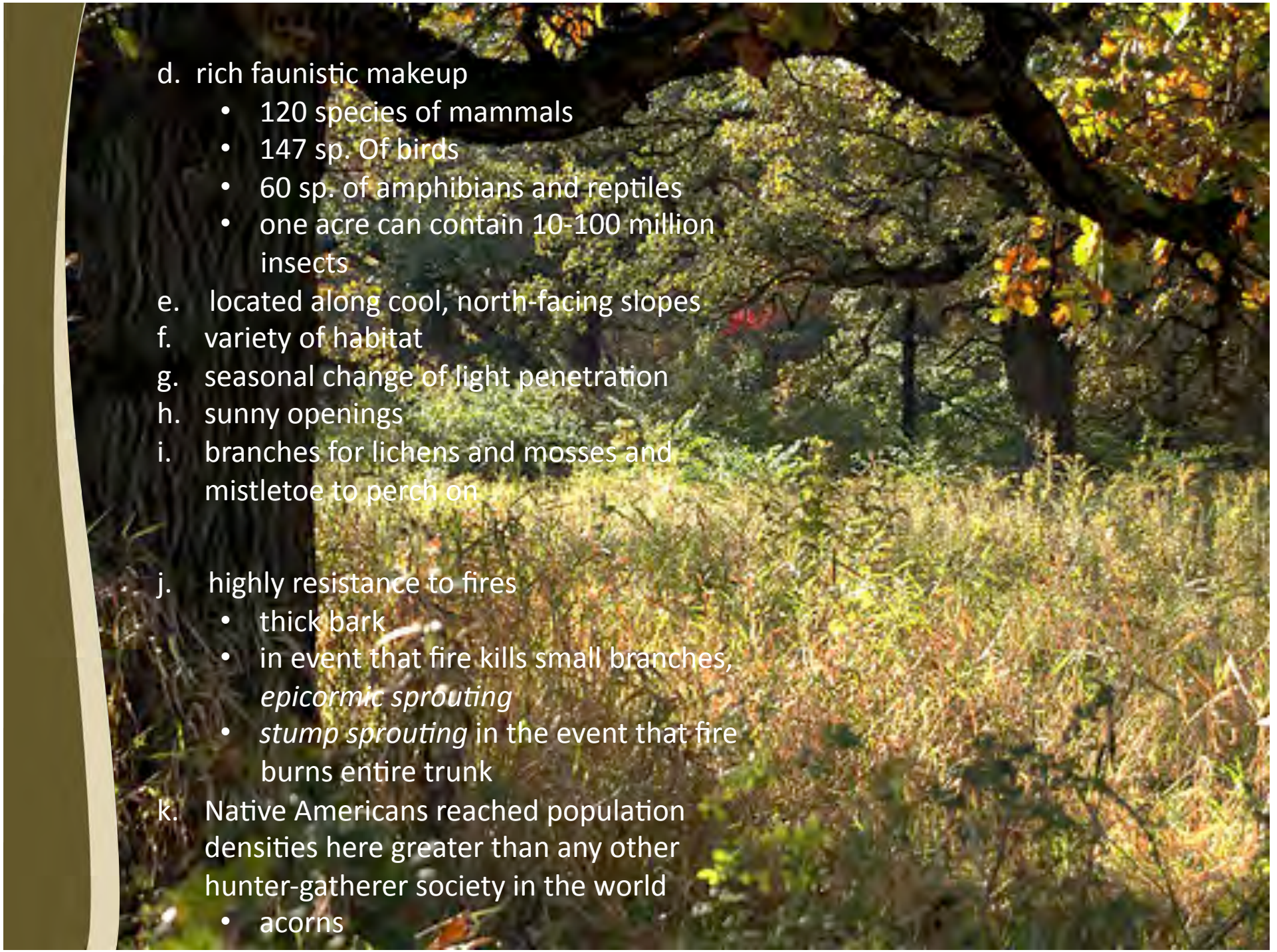
Oak Woodland

a. most widespread and characteristic plant community in CA
b. composed of deciduous oaks in dense or open woodland
c. rich floristic makeup
   - greatest variety of shrubbery
   - greatest variety of herbaceous understory
   - greatest variety of native perennial herbs
   - *Q. garrayana* in wetter areas
   - Q. *douglasii* in arid areas
   - *Q. lobata* in deep soils of valley bottoms and along creeks

- *Quercus garryana*


• *Quercus douglasii* (blue oak)


• *Q. lobata*
© Br. Alfred Brousseau, Saint Mary's College



d. rich faunistic makeup
   - 120 species of mammals
   - 147 sp. Of birds
   - 60 sp. of amphibians and reptiles
   - one acre can contain 10-100 million insects

e. located along cool, north-facing slopes
f. variety of habitat
g. seasonal change of light penetration
h. sunny openings
i. branches for lichens and mosses and mistletoe to perch on

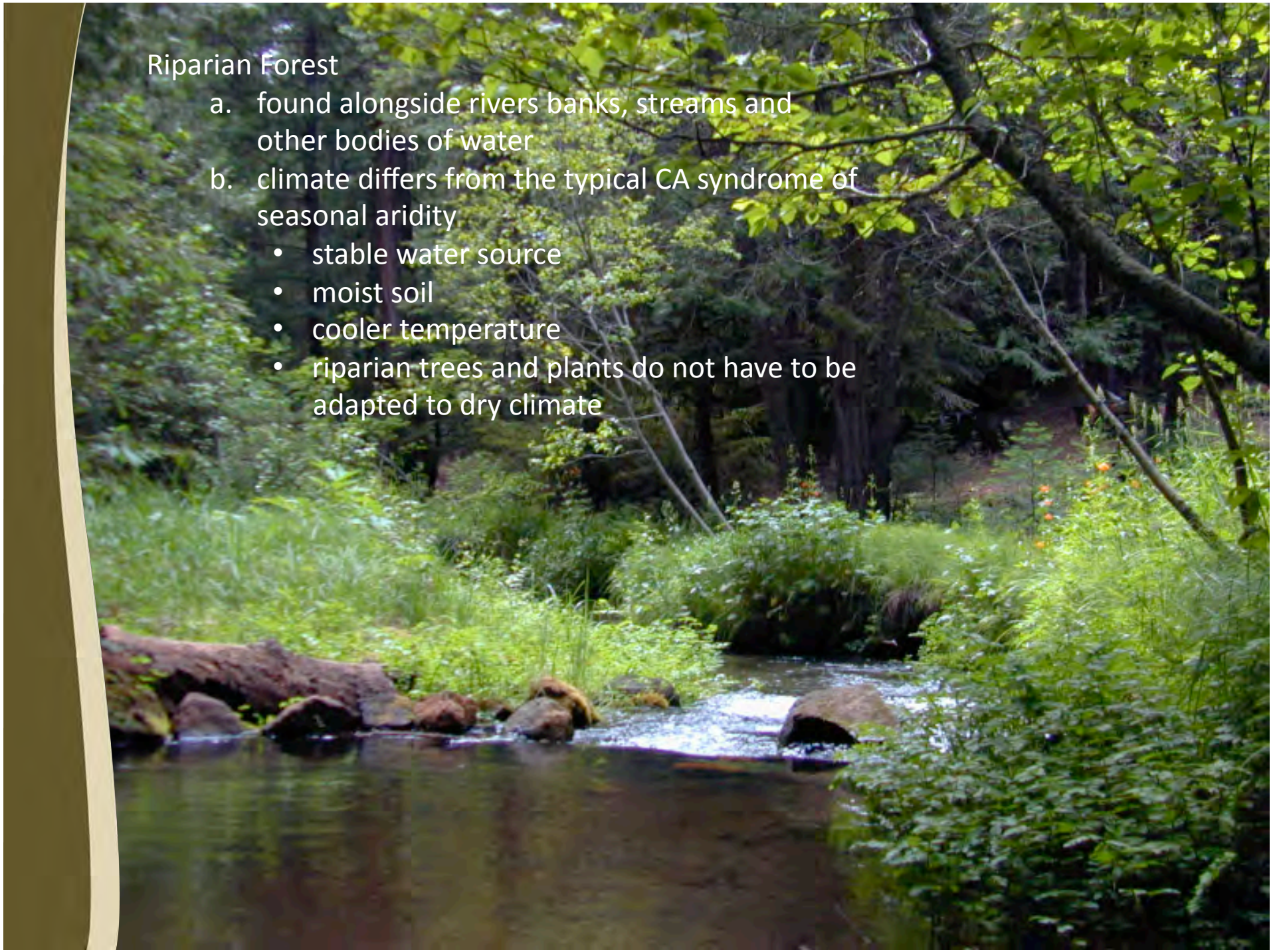
j. highly resistance to fires
   - thick bark
   - in event that fire kills small branches, *epicormic sprouting*
   - *stump sprouting* in the event that fire burns entire trunk

k. Native Americans reached population densities here greater than any other hunter-gatherer society in the world
   - acorns

Oak Woodlands in Peril:

a. Sudden Oak Death (SOD)
   - caused by *Phytophthora ramorum*, a fungus like water mold
   - induces bark cankers in trees that can girdle and even kill them
   - since its first appearance in CA back in 1995, SOD has killed hundreds of thousands of a California oaks.
   - prefers coastal and wetter habitat over hotter, drier habitats more inland of the state

b. firewood as an important vector for spread of several invasive species
   - ex. Gold spotted oak borer
     - has been killing thousands of oaks in the mountains of central San Diego country over the last few years
     - new firewood harvest regulations are needed



Riparian Forest

a. found alongside rivers banks, streams and other bodies of water
b. climate differs from the typical CA syndrome of seasonal aridity
   - stable water source
   - moist soil
   - cooler temperature
   - riparian trees and plants do not have to be adapted to dry climate


Common plants found in riparian forests
• *Acer*
© 2005 Louis-M. Landry

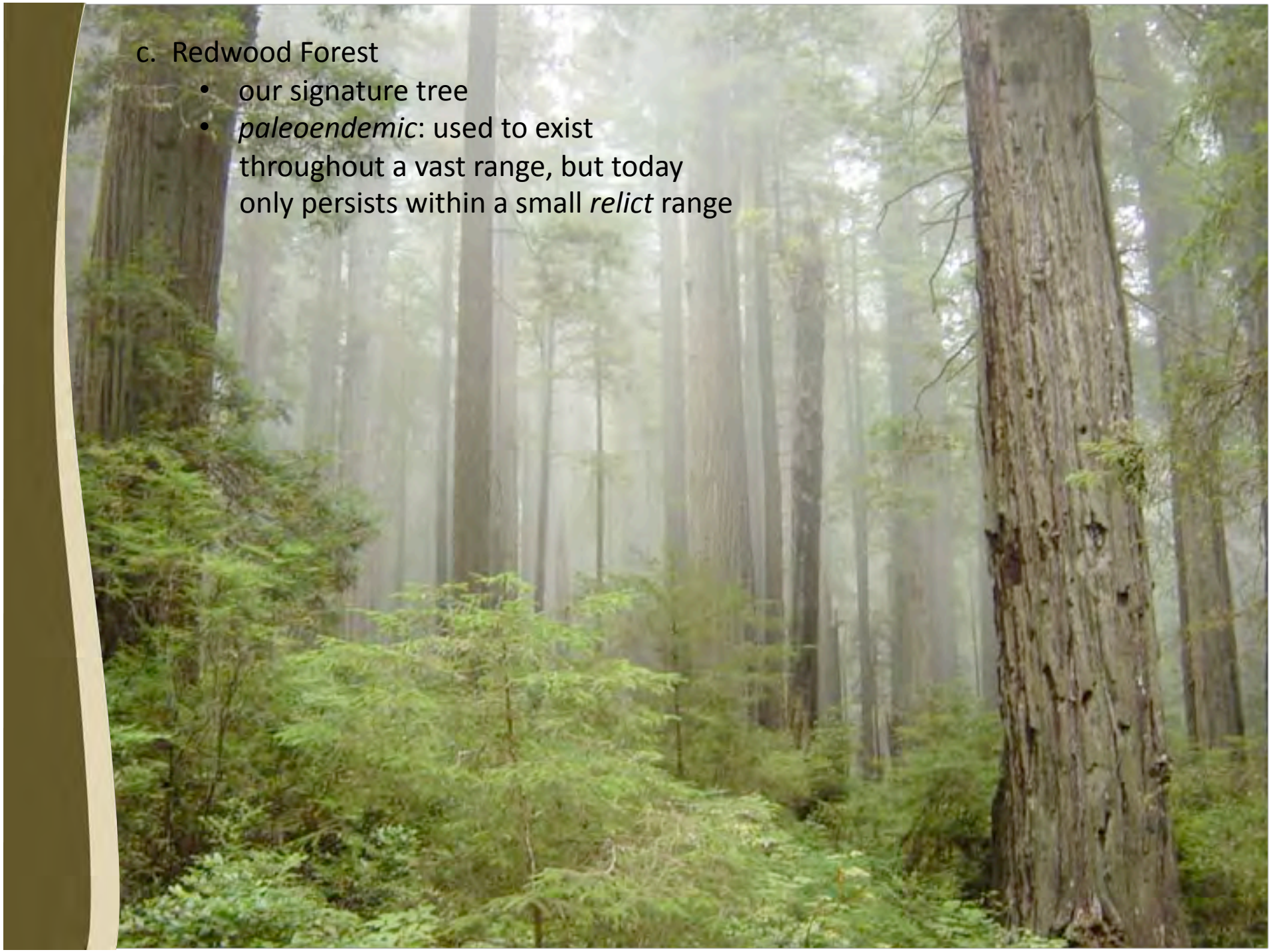

• *Alnus*
© 2009 Sandra Smith

Coniferous Forest

Several types

a. Douglas Fir (*Pseudotsuga menziesii*) Forest
   - most typical coniferous forest in CA
   - in coastal CA, Douglas Fir shares dominance with coast redwood (*Sequoia sempervirens*)
   - in especially dry habits, Douglas Fir is shares dominance with knobcone pine (*Pinus attenuate*)
   - always trying to invade its neighboring plant communities

b. Closed Cone Pine Forest: phoenixes rising from ash
   - produces cones that are tightly closed, persisting on branches for many years
   - when a fire comes along, this tree *wants* to get immolated
   - possesses flammable chemicals in its needles and bark to help the fire along
   - the fire causes the cones to open and release their stored seeds
   - this leads to even aged strands of trees over large patches of landscape



c. Redwood Forest
   - our signature tree
   - *paleoendemic*: used to exist throughout a vast range, but today only persists within a small *relict* range

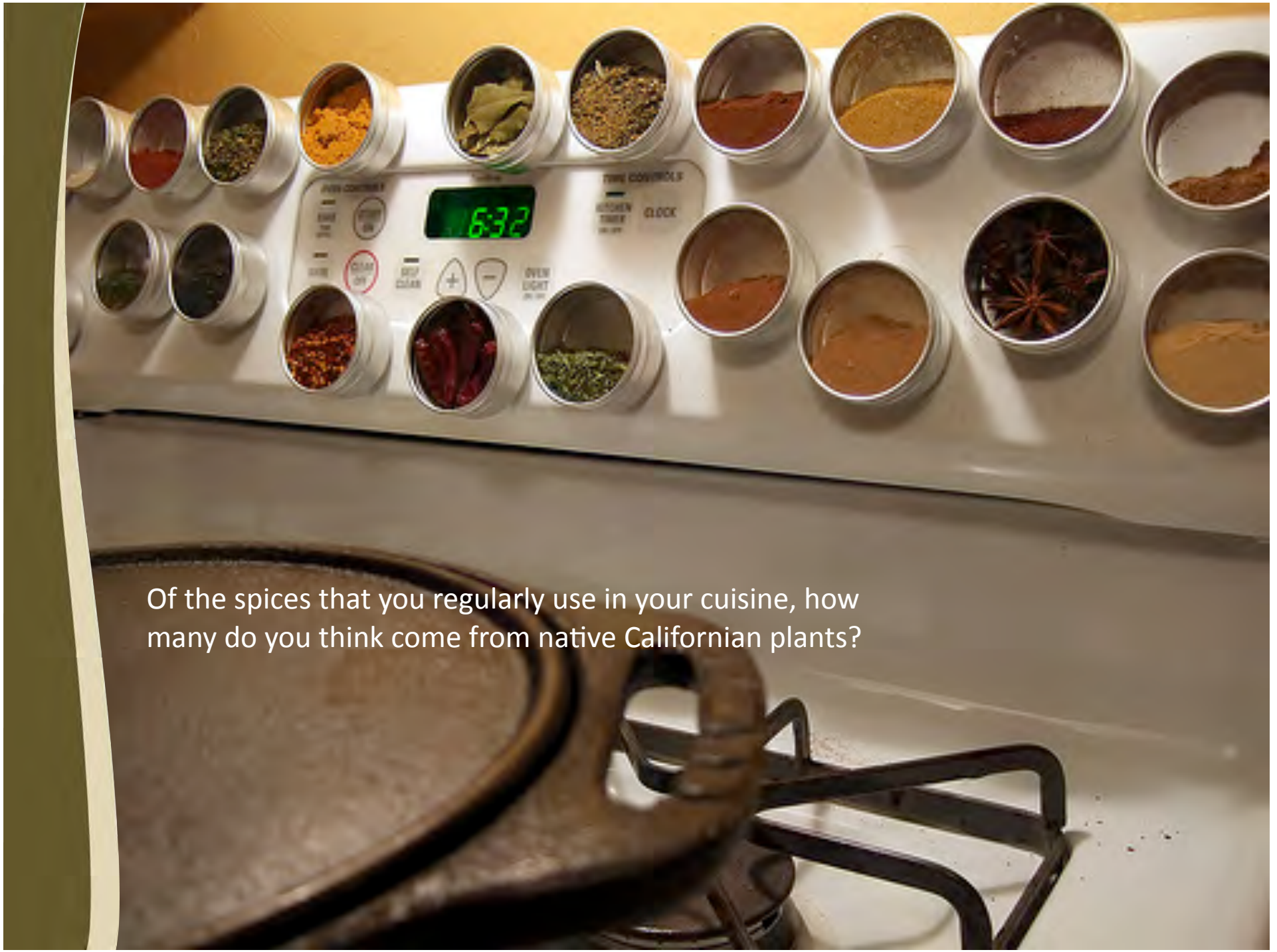
People and Plants

a. humans have since time immemorial used plants for
   - food
   - medicine
   - fiber
   - shelter
   - warmth
   - tools

b. humans move plants from one place to another
   b. sentimental reasons
      - Chinese workers brought tree-of-heaven (*Ailanthus altissima*) seeds to CA to remind them of China
      - Tree-of heaven is now widespread in CA, with clusters of such trees often designating sites of former Chinese habitation

- economic reasons
  - what would CA cuisine be like without avocados, the seeds of which have been imported from Mexico?
  - *Eucalyptus* trees imported from Australia for ornament under the mistaken notion that they could be grown for lumber have now become noxious weeds along our cost that exclude native CA plants

Much of the composition of CA's flora actually has derived from the human propensity, either intentionally or accidentally, of moving plants around



Of the spices that you regularly use in your cuisine, how many do you think come from native Californian plants?