September 7 Lecture Notes: Logistics and a few Plant Communities…

I. Field trip reminder and discussion

Friday Sept 14th - Sept 16th(next week!) Big Sur Coast Field Trip

Come prepared to botanize feverishly!

Departure Details:

- We will **depart SBCC at 7:30am SHARP!!**. Note this change of time from the syllabus!!
- ARRIVE NO LATER THAN 7:00am
- Be ready to leave by 7:25!!
- Bus and van will be in the parking lot immediately below the lab
- Consult gear list for "what to bring"!

II – VIII: Plant community overviews for future field trips

II. Plant communities

Ecosystem: All the organisms in a given area, along with the nonliving (abiotic) factors with which they interact.

Plant community: an assemblage of plant species growing together in a particular area.

Ecotone: A transition area between 2 or more ecosystems or plant communities.

A word of caution about the notion of "plant community" (you do not need to know for exams):

Plant communities are proposed as general, tidy, and convenient categorizations of plant assemblages. These categorizations are simultaneously useful and dangerous.

They are useful to the botanist, because they allow him/her to identify groups of plants and then discuss features common to the group. For example, Chaparral plant communities share features that make them very different than oak woodlands. Plant communities, as defined by humans, reflect our own species' propensity for categorization – which is an important component of logic and reasons.

Such categorizations are intellectually dangerous because nature often does not conform to the tidy categories that humans create. For example, imagine two groups of plants that exist some distamce apart from each other, but are assigned to a particular community (e.g., chaparral). Although the same community type, these two clusters of plants may vary in many important ways: the total number of different species present, actual height, density or other physical feature of the plants themselves, the ratio of different plant species in the community (e.g., if two species are present, do they exist in a 50:50 ratio or a 90:10 ratio – and does it matter to the botanist?), and the presence/abundance of plant species that are categorized in some other community type (For example, what if a chaparral community has 10% coverage by coast live oak trees (*Quercus agrifolia*) - is it still chaparral – or is it something slightly different…?!!). What about ecotones – which community(-ies) should they be classified under?!

With this disclaimer issued, we will whole-heartedly embrace the concept of "plant community" as a valid means of categorizing vegetation types. We do so while bearing in mind the common sense conclusion that nature often deviates from the simple categories assigned by humans, but this does not make the categories invalid or useless. While it is true that no two plant patches on Earth are identical, the features present may be similar enough to warrant placement in a mutual category.

There are **approximately 6,000 – 7,000 native and naturalized species of plants in California, and perhaps ~1500 in the SB region** (the numbers vary depending upon the source and the manner of counting/identifying individual species [i.e., “lumping” vs. “splitting”], here I pull from TJM2 for CA, and Smith 1998 for the SB region). This is an extremely high number of species, and owes in part to the diversity of physical environments in California and Santa Barbara.

As with the number of species, the number of different plant communities in California and SB identified by botanists varies, but Holland and Kiel (1995; California Vegetation) identify 16 different major communities, as listed below. Within each type, Holland and Kiel identify a number of different subcategories (the numbers in parentheses, below). *You do not need to memorize this list!*

Per botanical convention, the subcategories identified by Holland and Kiel are based upon the **dominant (i.e., most abundant) plant species** (or genera/groups of species) present in each community type. For example, one of the two subcategories of the *coastal coniferous forest communities* are the redwood forests (*Sequoia sempervirens*), and one of the *oak woodland community* subcategories is coast live oak woodland (*Quercus agrifolia*).

Dominant species: species that comprises most of the biomass in an ecosystem or plant community, and is therefore used to define that system/community.

<u>Major CA plant communities (and subcategories – in parentheses), as identified by Holland and Kiel 1995</u>

Coastal sand dune and beach communities (3)*
Coastal scrub communities (4)*
Marine aquatic communities (3)*
Chaparral communities (11)*
Grassland communities (4)*
Closed-cone coniferous forest communities (~8)
Coastal coniferous forest communities (2)*
Mixed evergreen forest communities (3)*
Oak woodland communities (6)*
Montane coniferous forest communities (11)*
Alpine communities (3)*(for us in Bot123 - subalpine)
Desert woodland communities (7)*
Desert scrub communities (9)*
Riparian communities (5)*
Freshwater wetland communities (5)*
Anthropogenic communities (5)*

Needless to say, in Bot 123 we cannot explore the full range of plant communities above. **You do not need to memorize this list!** It is simply meant to give you an appreciation of the diversity of plant communities in California. We will, however, explore a fair number of these communities (categories are noted with an asterisk), and we’ll explore them in respectable detail!! You will learn the dominant species in many communities, and for 1-3 of them you and your lab partners will press and preserve 8-12 species.

<u>Plant communities are shaped by two general types of "forces", or factors</u>:

Biotic factor: A living component of an ecosystem that influences other living organisms.

<u>Four key biotic factors that shape plant communities and ecosystems</u>:

1) **production** (process of acquiring energy through carbon fixation, conducted by autotrophs ['producers'], usually via photosynthesis)
2) **consumption** (i.e., herbivory) (process of acquiring energy by consuming other organisms – conducted by heterotrophs, 'consumers')
3) **competition** (fight amongst organisms for limiting resources. Examples of limiting resources: space, water, light, nutrients, food, mates)
4) **disease** - abnormal condition affecting the body of an organism (often causing lower survival and reproduction)

Abiotic factor: A nonliving component of an ecosystem/plant community that influences living organisms

<u>Six key abiotic factors that shape plant communities and ecosystems</u>:

1) **Temperature/heat** – (life can exist within a range of temperatures, and near the extremes of this range many organisms cannot function.
   The basis for this temp. range: At low temps molecular processes slow to critically low rates and cells rupture when they freeze; at high temperatures proteins denature and/or organisms can dehydrate. High temps also cause water to evaporate out of soils.
2) **Humidity** - water vapor in air
3) **Precipitation** – atmospheric water that falls due to gravity (rain, snow, hail, etc.)
4) **Light** – (can be limiting because **production** via photosynthesis requires light
5) **Edaphic:** of, produced, or influenced by soil. **Soil** - Upper layer of earth that contains minerals (sand, silt, clay) and organic matter and into which plant roots penetrate. (note: this is a simplistic definition…soil science is complex).
6) **Physical disturbance** (wind, fire, storm events, etc. that kill/inhibit organisms)

*Items 1-3, (and some of items 6) are contained in **climate**.

Climate: Average patterns in temperature, humidity, precipitation, wind and other variables over long periods of time. (contrast with **<u>weather</u>** = short term conditions/events)

*Items 1-2 (and soil moisture) are greatly influenced by the **aspect** of a slope, and plant communities are greatly influenced by slope aspect!

Aspect: The direction that an object (e.g., a hill/mountain slope) faces (here, North vs South).

*Items 1-4, and 6 are influenced, in varying degrees, by the **elevation** of a location. Elevation has many interesting impacts upon climate, weather, and physical disturbance- we'll explore these as we move along through the semester. Elevation also correlates directly with important stresses such as UV exposure.

Elevation: The height of an object *attached to the Earth* above some fixed reference point, usually sea level.

--vs.--

Altitude: The height of an airborne object above some fixed reference point, usually sea level or the nearest Earth surface underneath the object.

III. Sand Dune Plant Communities

Sand: granules of finely divided (i.e., eroded) rock and mineral particles.
(FYI: sand = 0.0626-2mm; gravel = 2-64mm; silt: 0.002-0.0626mm; clay < 0.002mm)

There are many different types of sand. Most sand in temperate (i.e., non-tropical) regions contains high levels (typically 80%+) of quartz, because quartz is common in rock that is weathered to form sand, and because it is more durable than other minerals in rock and thus it takes longer to completely break down into silt or smaller particles. Quartz is a mineral constructed from silica molecules: SiO_2 (for you non-chemistry folks, this is one silicon atom bonded to two oxygen atoms – you don't need to know this…).
(Note that in Santa Barbara, the rock that is weathered to form sand is sandstone – thus it is rock that was formed when sands on an ancient seafloor accumulated and formed sedimentary rock. Thus, our sand is on (at least) its second life as sand!)

Sand on tropical beaches may originate from eroded volcanic rock (in which case the beach is typically a black sand beach), or as is usually the case may be from weathered coral and other calcium carbonate exoskeletons in marine animals (e.g., seashells, sea urchin tests & spines, etc…). Such sand is said to be "biogenic", because it originates from once-living organisms. In the latter case, beach sands are white, and the sand may be formed not by physical erosion but by predatory fish or urchins that ingest and pulverize corals or shells. I had a friend once (really, I did…!) who studied sand dynamics in Hawaii, and he estimated that perhaps most of the sand on Hawaii has passed though the gut of a fish! (Not sure if this is true…but it's a nice story…and he was my friend…).

Sand sources, sinks, and transport along the California coast

On California's coastal beaches, sand originates from erosion of sea cliffs (~10% of total) or inland (terrestrial) sources (~90%) and flows to the coast down creeks and rivers (CDFG 2002). Once at the coast, sand is transported parallel to (i.e., along) the shore by currents in a process known as **longshore transport**. In California, **longshore transport** is predominantly southward (and it is along the entire west coast of North America). Sand may move northward on small scales, and it moves on-off shore on a seasonal basis or in rip-currents. However, the general trend over long time scales is: a) terrestrial origination, followed by; b) southerly longshore transport in ocean currents. This is where our beach sand comes from. Where, ultimately, does all this sand end up (where does it go if not on a beach, or after it leaves a particular beach)? The most important **sinks** are deep submarine canyons, harbor entrances, and coastal dunes.

Rocky headlands and deep submarine canyons divide California's coastline into physically defined cells that do not import or export significant amounts of sand through longshore transport. These are called **beach compartments** or **littoral cells**. In general, the majority of sand grains in a particular cell either remain in that cell or exit through some sink – but they are not transferred alongshore to another cell. Prominent examples of littoral cell boundaries in our area are Pt. Conception, Pt. Mugu and an associated deepwater canyon, Pt. Dume, and the Palos Verdes Peninsula. In each cell, beaches towards the down-current (south or east, in our area…) will receive more total sand than beaches towards the up-current end of the littoral cell (north or west in our area). This is due to longshore transport of sand in that direction, in addition to the fact that more total creeks contribute sand to the longshore process as one moves toward the "down-current" end of a beach compartment. Thus, beaches are often wider near the down-current extent (in our area: southern or eastern) of beach compartments/littoral cells. The Guadalupe Dunes are a sand deposit at the southern extent of a littoral cell. Let's go there!!

Longshore transport: transportation of sediments (e.g., sand) along a coast at an angle to the shoreline. Driven by currents and wave action.

Dune formation, structure, and movement (here, wind-formed, or Aeolian):
(note: we diagrammed these processes in lecture – you should be able to as well for the final exam(s)! You should also be able to define the bolded terms.)

Sand dunes initially form when sand particles are blown by wind across a large and semi-flat surface, and then encounter a 3D object such as a log, tree, rock, etc. As the sand grains encounter the object, some lose their directional momentum and fall back to Earth due to gravity. As grains accumulate, the object becomes covered in sand and the dune begins to form. At some point, the dune itself becomes the 3D object that causes sand grains to lose their momentum. Sand grains continue to accumulate until, if conditions permit, a full dune develops. Sand grains typically move along the surface of the flat beach or dune by "bouncing" or "skipping" across when momentarily suspended in intermittently strong gusts of wind. This phenomenon is known as **saltation** (from the L: salt = leap). Hopefully we won't see *too much* of this on our field trip!

As winds continue to deposit sand on the **windward** side of a dune, the windward side maintains a "gentle" (i.e., not steep) slope and the dune grows taller. Eventually, the top forms a crest because more sand grains are deposited onto the windward side than on the **leeward** side. The leeward side remains at a steep angle until finally it becomes so unstable that the crest fails and sand cascades down the leeward side. For this reason, the leeward side of a dune is referred to as the **slip-face**. Sand cascades down the slip face when steepness of the slip-face exceeds ≈30-34°. This angle (≈**30-34°**) is known as the **angle of repose**.

Fully-formed sand dunes will continue to experience transfer of sand grains from the windward side to the slip-face for two reasons: 1) wind, and 2) avalanching of the crest when the slip-face angle is greater than the angle of repose (≈30-34°). In this manner, the grains can actually cycle from the upper surface of the windward side and/or crest to the bottom side of the slip-face, and over again in a manner that one researcher likens to the tread of a tank or bulldozer (http://science.nasa.gov/science-news/science-at-nasa/2002/06dec_dunes/). Eventually, as sand grains continue to be transferred the entire dune may actually migrate in the direction of the leeward side. How fast can dunes move? Some dunes can move faster than you might think! Individual storms can move dunes many meters in a single day, and the Chinese village of Longbaoshan is bracing for the arrival of a sand dune system that is advancing at ≈20m/year (http://news.bbc.co.uk/2/hi/asia-pacific/778325.stm).

Sand dune: a hill of sand formed by wind (or water).
Aeolian dune: a dune formed by wind (from the Greek god of wind, Aeolus)
Dune field: a large area covered in dunes
Unstabilized dune (aka active dune): a dune that has not been stabilized (e.g., by plants) and can migrate.
Stabilized dune: a dune that is "anchored" in place (typically by plants)
Blowout: area where sand has been removed by wind, often caused by removal of vegetation
Incipient dune: a newly forming "young" dune

Dune zones and ecology:
Coastal strand: ephemeral plant community immediately above the high tide line
Plant diversity and biomass lowest of all plant communities listed here

Foredune: a vegetated dune ridge that runs parallel to a shoreline.
Plants here are pioneer species.
Diversity is low.
Disturbance and salt stress are high
Nutrients are low
Plant adaptations: deep taproots, ability to grow when buried (e.g., *Ammophila arenaria*), succulent (i.e., thick) leaves and/or stems, trichomes, long horizontally growing stems (stabilize sand), sand armor (e.g., *Abronia* spp).

Hind dune: a dune that is inland from the foredune. Compared with foredunes:
Plant diversity here is higher
Biomass is higher
Disturbance and salt stress is lower
Soils are more developed

Slack: the trough between dunes

Wetland: land area saturated with water and supporting one of four characteristic ecosystems: marshes, swamps, bogs, and fens.
Marsh: Wetland plant community dominated by aquatic herbaceous plants, typically at edge of river, estuary, or lake – can be High diversity and very high productivity/biomass
Glade: depression that is close to the water table and therefore characterized by moist soil

<u>IV Riparian plant communities – more detail in the field</u>
Riparian: associated with flowing fresh water (e.g., creeks, rivers, streams). We'll discuss on the field trip.

V. Chaparral

NOTE: WE WILL DISCUSS CHAPARRAL ECOLOGY AND ADAPTATIONS AT GREAT LENGTH IN A FUTURE LECTURE, FOR NOW, LET'S FOCUS ON GENERAL CHARACTERISTICS

Chaparral: Dense thickets of short woody plants that are: 4-12 feet (or more) in height, fire resilient, drought tolerant, and have small sclerophyllous leaves.
(The term "chaparral" derives from the Spanish term "chaparro", which means "short".)

- Most widespread plant community in CA
- Covers ~5-9% of the total area of the state (estimates vary by source).
- Key factors (selective pressures) we'll discuss: drought, fire, and soil (to a lesser extent)

Characteristic of **Mediterranean climate:**

- Warm dry summers often with drought conditions, and cool wet winters.
- Five locations on planet Earth have Mediterranean climates: 1) Southern CA/Northern Baja, 2) Mediterranean Europe/Africa, 3) South Africa, 4) Southern and Western Australia, and 5) Chile.
- *(FYI, no need to know for exams: Occur between 30°-45° latitude on the western edge of continents)*

Drought: an extended period of water deficiency in a region. (Droughts are typically described as occurring over multi-year periods, but can occur on time scales of months or even weeks. Thus, it is reasonable to refer to dry & hot summers as drought-like or causing drought.

Chaparral plants have numerous adaptations to minimize heat stress and water loss during the warm, dry Mediterranean summers (or prolonged dry periods of **drought**)

- Deep roots
- Sclerophylls
- Leaf morphology: 1) Small leaves, 2) Lightly colored leaves, 3) Vertical orientation

Characteristic (generalization)	Chaparral ("hard chaparral")	Coastal sage scrub ("soft chaparral")
Vegetation height	$4\text{-}12^{+}$ feet	3-6 feet
Adaptation to fire	Resilience: Resprouting, reseeding from local sources	Resilience: Reseeding - local or outside sources (no resprouting)
Branches/plants	Woody, forming dense thicket that is often impassable, forming canopy	Mostly herbaceous or subshrubs (some woody shrubs), lower density often passable on foot, no canopy
Leaves	Sclerophyllous (e.g., *Ceanothus*) or thickened and small (e.g., *Adenostoma* [chamise]).	Thin, drought deciduous (*Salvia*, *Artemesia, Acmispon glaber* [deerweed], *Mimulus*), aromatic (e.g. *Salvia*, *Artemesia*)
Roots	Deep	Shallow (utilize fog

Fire is a major disturbance factor in chaparral communities. We'll discuss this in great detail later in the semester!!

<u>VI. Coastal sage scrub</u>

Coastal sage scrub: A plant community in Mediterranean climates in which the dominant plant species have the following general characteristics: short ($\leq$ 3-6' tall), soft leaves (non sclerophyllous), shallow roots, summer deciduous leaves, aromatic (e.g., *Artemesia californica*, *Salvia* spp., *Mimulus aurantiacus* – bush monkey flower (we did not press this species in lab)), and occur on lowlands, typically near the coast – but interior sage scrub communities exist as well!

Coastal sage scrub communities are often referred to as "soft chaparral" because they have many similarities with chaparral: they exist near chaparral communities, have similar abiotic factors shaping them (drought, fire, dry & nutrient poor soils), often form ecotones with chaparral that can be quite broad, and share a number of plant species.

The term "soft chaparral" underscores an important structural difference between the two: whereas mature chaparral communities tend to be impenetrable thickets of woody braches, coastal sage scrub plants are "softer" to the touch, less densely populated, and leaves are thin (non-sclerophyllous). In some circles, chaparral communities were referred to as "hard" chaparral to distinguish them from "soft" chaparral – but this nomenclature is on the way out and is seldom used (but you will hear it!).

{VIDEO: sage scrub communities: http://www.youtube.com/watch?v=BuxticCTj7k}

Chaparral and coastal sage scrub communities are shaped by similar abiotic factors, especially drought and fire. Their adaptations to these factors, however, can be different and further distinguish the two communities. (Study the comparative table in these notes).

Drought: an extended period of water deficiency in a region. (Droughts are typically described as occurring over multi-year periods, but can occur on time scales of months or even weeks. Thus, it is reasonable to refer to dry & hot summers as drought-like or causing drought.)

<u>Adaptation to drought</u>: Recall that Mediterranean habitats are characterized by cool & wet winters and warm & dry summers – often this means summer drought conditions. Some sage scrub species are often **drought deciduous**, meaning that they lose some or all of their leaves in during drought conditions (summer). Most photosynthesis occurs in winter and spring when soil moisture is highest. These thin leaves are more vulnerable to herbivory than the sclerophylls of chaparral, and the conventional wisdom is that these plants produce essential oils in defense of herbivory (recall *Artemisia californica*, *Salvia mellifera*, *Salvia leucophylla*)

Coastal sage scrub gets some relief from hot & dry summers due to cooler marine air temperatures and fog. The extent to which this is operative is variable among locations and across years, but it plays a part in the distribution of coastal sage scrub along the coast. It has been suggested that shallow roots assist with water absorption after fog/drizzle events.

<u>Adaptation to fire</u>: Unlike chaparral plants, which often recover from fire by sprouting from the roots (often from lignotubers / basal burls) or locally produced seeds (i.e., seeds produced by plants inside of a burn area), plants of the soft chaparral often rely upon seed delivered from <u>outside</u> of a burn area. Thus, these plants often have wind-mediated seed dispersal

mechanisms. (Note: some species, such as the sages, produce seeds that germinate in response to fire, as with *Ceanothus megacarpus* in chaparral, and are not wind dispersed.) The shallow and low-biomass root systems of coastal sage scrub make them unlikely to re-sprout from the roots after fire.

After our field trip on chaparral and coastal sage scrub, you should be able to compare and contrast the important similarities and differences between chaparral ("hard chaparral") and coastal sage scrub ("soft chaparral"). The comparative table contained in these notes is something you might see on exams!

<u>Coastal sage scrub conservation</u>. most coastal sage scrub has been lost to development in southern California, primarily because flat land near the coast is highly desirable for human developments.

Allelopathy: The inhibition of one species of plant by chemicals produced by another species of plant.

VII. Coast Redwood Communities (*Sequoia sempervirens*)

Forest: Plant community dominated by closely spaced trees, such that their crowns (the uppermost layer of vegetation) overlap and form a contiguous canopy. Dense canopies prevent direct sunlight from striking the ground, thus forest understories often are very low and open.

Woodland: Plant community dominated by trees that are more widely spaced than in a forest, such that the canopy is incomplete in places and therefore allows direct sunlight to penetrate to the ground. Woodland understories are often taller and more developed than in forests.

Savannah: Grassland plant community with trees that are sufficiently spaced such that the canopy is not closed. Understory dominated by grasses.

Canopy: The upper layer of vegetation formed by the crown(s) of plants. In forest ecology, the term canopy also refers to this top layer as a habitat layer and includes resident organisms (e.g., canopy birds, epiphytic plants, arboreal mammals, etc.).

Understory: The layer of vegetation underneath the canopy.

Epiphyte: A plant that grows on another plant non-parasitically. (Ex from lecture: ferns and mosses in redwood canopies.)

Fog drip: a type of precipitation that forms when fog droplets condense on the needles or leaves of trees or other objects, and drip to the ground.

Coast redwoods are the tallest living organisms on Earth, and they occur only near the coast. These facts are explained by **fog drip**, which coast redwoods depend upon for up to 34% of the annual water supply to trees (this is vastly reduced when trees are cut down and replaced by shorter trees). Indeed, the height of these trees is not a coincidence, but rather it is an adaptation for generating fog drip. (Remember during the first lecture when I told you that everything in biology makes more sense through the lens of natural selection…?).

Did we watch? Coastal fog in SF video:
http://www.slate.com/blogs/bad_astronomy/2013/09/11/time_lapse_video_adrift_features_stunning_footage_of_a_foggy_san_francisco.html
Music to cue to video (music at 0:01 to video 0:00)
https://www.youtube.com/watch?v=mrojrDCI02k

Forest biologists are still making important discoveries about forest canopies, and it is clear that the canopy is more than a physical feature of forests. Certain organisms live exclusively in the canopy, and this part of the forest has a fascinating and unique ecology.

{VIDEO: Redwood forest canopy: http://www.youtube.com/watch?v=9-8OCecOmEQ}

In a mature and/or old growth forest the canopy can block sunlight from hitting the forest floor and therefore the **understory** is often very sparse and comprised of small herbaceous plants, mosses, ferns etc. A low understory is typical of a forest with a dense canopy, and result from slow growth in low light levels. This forest structure – relatively few and large individual trees with a low understory - reflects the climax community structure in old growth redwood (and other coniferous) forests.

This low understory is thought to be critical for the successful hunting of animals such as the spotted owl (*Strix occidentalis*), which is often viewed as an **indicator species** for old growth forest health in the Pacific Northwest of North America. During the logging crisis/debates of the 80's/90's and into the 2000's, environmentalists and/or many scientists have pointed to the decline of spotted owls as evidence that old growth coniferous plant communities/ecosystems are degraded or heavily altered – and may not function as they once did (more on Wednesday).

Indicator species: A species whose presence, absence, or relative well-being in a given environment is indicative of the health of an ecosystem as a whole.

Old growth coniferous forests are also characterized by something that is more-or-less invisible to us as we walk through them – the networks of mycorrhizal fungi that connect living trees.
https://www.youtube.com/watch?v=iSGPNm3bFmQ
In your free time, watch this video and think (in the context of the scientific method and natural selection) about whether or not the trees are really "communicating"? What do you think?

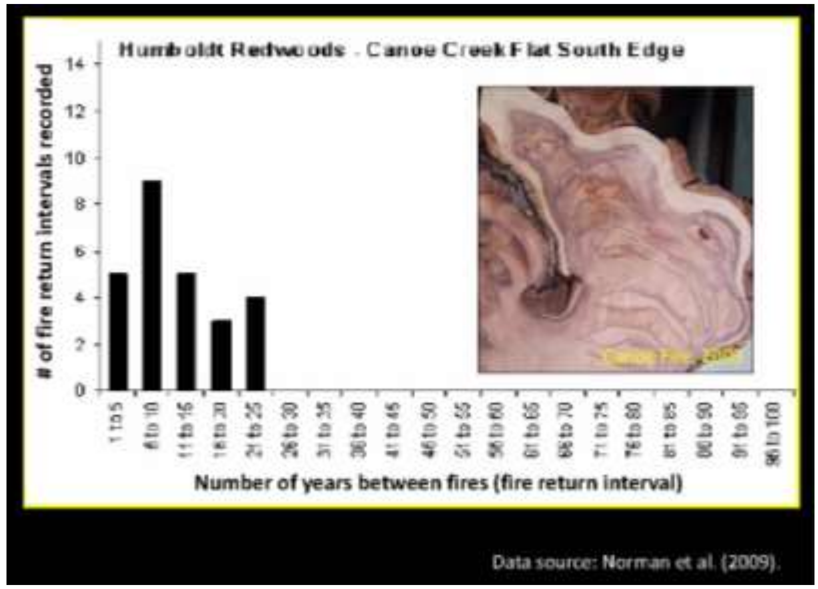
Fire in coast redwood forests

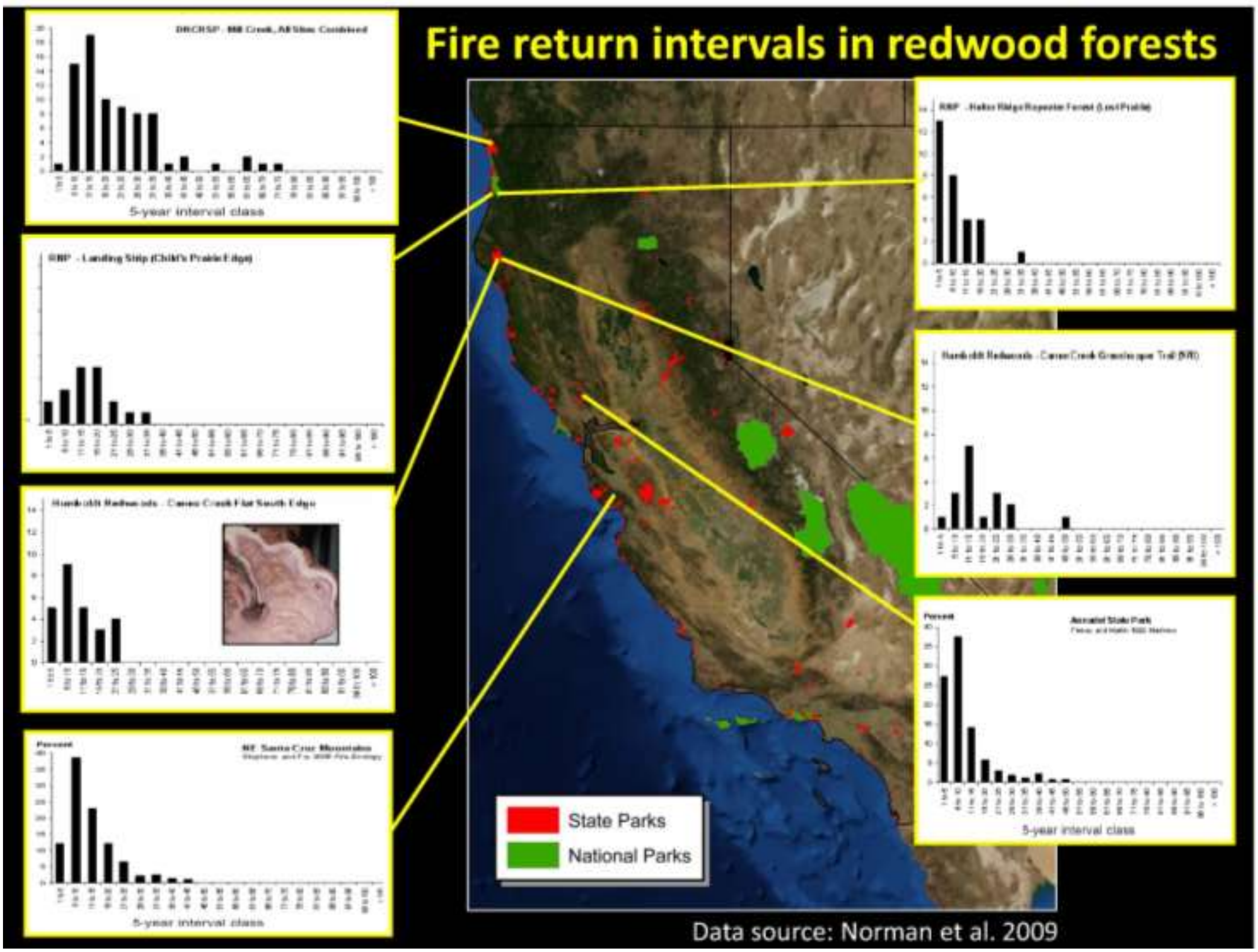
Fire Return Interval (FRI; or, fire interval): The time between fires in an area (any author/speaker should always define the area for which the FRI is being reported).

Mean Fire Return Interval (MFRI; or, mean fire interval): Arithmetic average of all fire intervals determined, in years, in a designated area during a specified time period.

Dendrochronology: the science or technique of dating events, environmental change, and archaeological artifacts by using the characteristic patterns of annual growth rings in timber and tree trunks

Fire is frequent in redwood forests and helps to maintain the low understory (a structural feature of the climax community). Fire scars are common on old redwood trees, and the scars they leave within the growth rings allow for dendrochronological study of fire return intervals. Recent studies indicate fire return intervals (and mean fire return intervals) of less than 30 years in many areas! Remember that these trees live for 1,000-2,000 years, and so old trees are likely to have survived numerous wildfires. Recall the following slides from lecture, the lower of which showed a latitudinal gradient in fire return intervals.





Redwood trees themselves are resistant to fire due to their thick bark. Redwood trees are also resilient to fire and other disturbances (flooding is a common disturbance in redwood forests) by sprouting from nodes that occur where root/stem tissue connect. This is an important means of asexual reproduction in redwoods. Often times the mother tree dies and the daughter tree (or trees) remain(s) for many additional centuries. Often times the daughter trees form a ring around the original location of the mother plant – thus forming circular rings of mature redwood trees.

Quite often, these nodes are present in **burls** that form near the base of the tree. Burls can function like lignotubers, burl from a developmental standpoint they are different (note that the term "burl" is often used to refer to objects that are actually lignotubers - but this is technically incorrect).

Burl: a deformed woody growth in trees, caused by infection or physical injury that disrupts the normally concentric growth of the vascular cambium. Burls often contain dormant buds, and may be either above or below ground. (compare to lignotuber – previous lecture's notes).

Human activities are drastically changing fire behavior in coniferous forests. We will discuss this at lenth prior to, and during, our field trip to the Sierra Nevada Mtns and Yosemite NP.

VIII. Plant presses and herbarium specimens – see syllabus

Plant communities we'll emphasize on our field trip

1) **Riparian**
2) **Chaparral** (notes provided here, but detailed in-class lecture exploration deferred to our Oct 2 lecture and Oct 9 field trip)
3) **Coastal Sage Scrub**
4) **Forest** (coast redwood)
5) **Woodland** (oak, various species)
6) **Savannah** (oak, various species)
7) **Sand dune** (many communities within – see notes below)