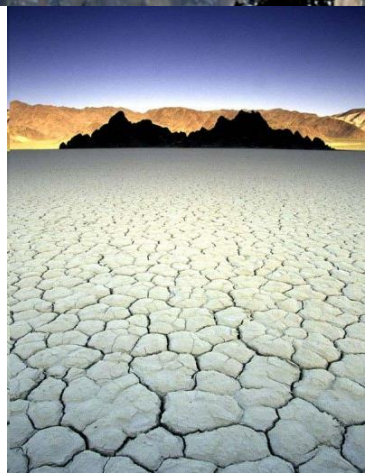

California Naturalist
University of California
California Naturalist
Discovery • Action • Stewardship
University of California
Agriculture and Natural Resources

A state of extremes:

Mt Whitney and Badwater in Death Valley are the highest and lowest points in the contiguous 48 states, respectively




Granite Spires of Yosemite


Oak Woodlands


Wildflowers of the Anza Borrego Desert
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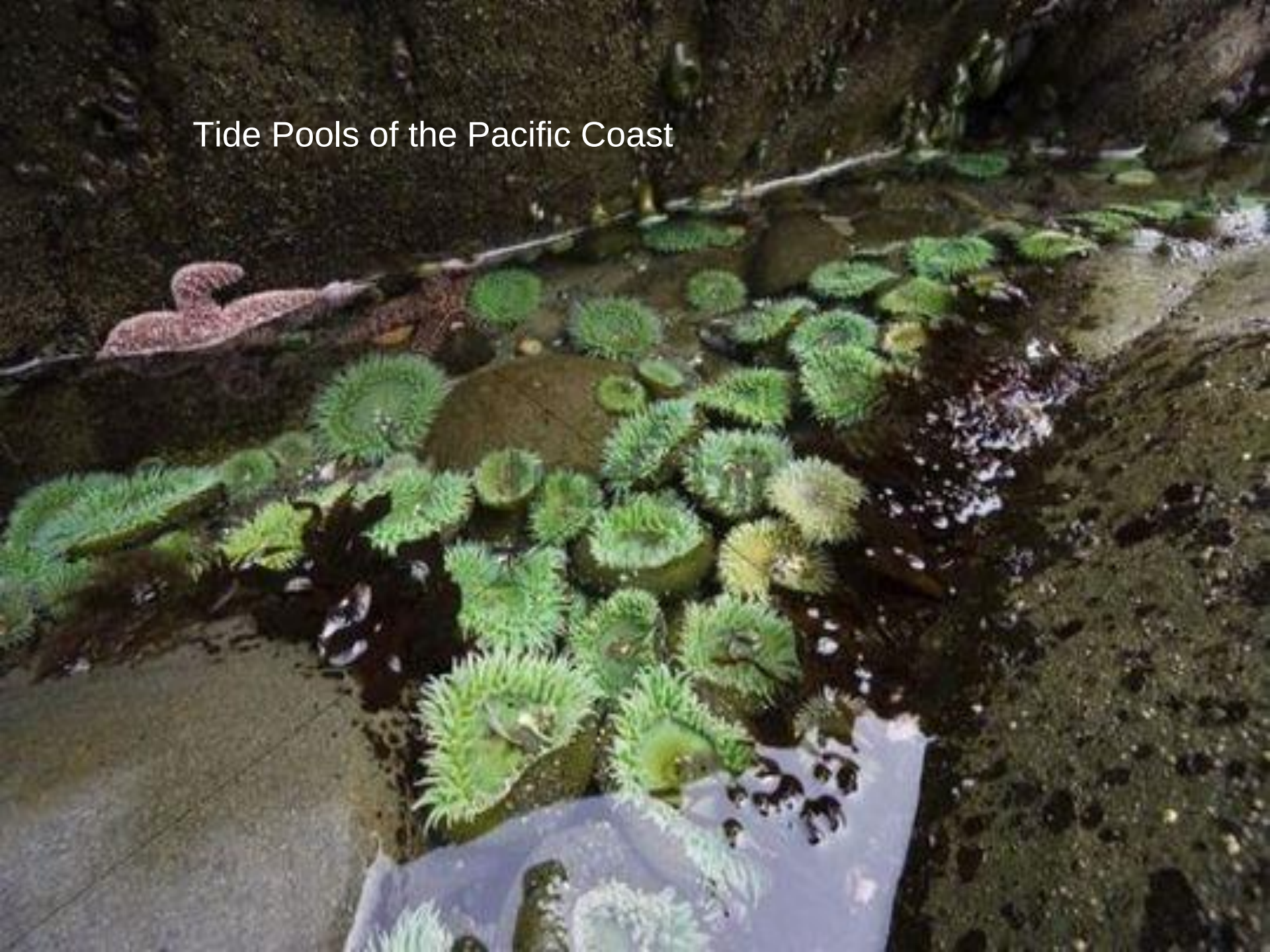
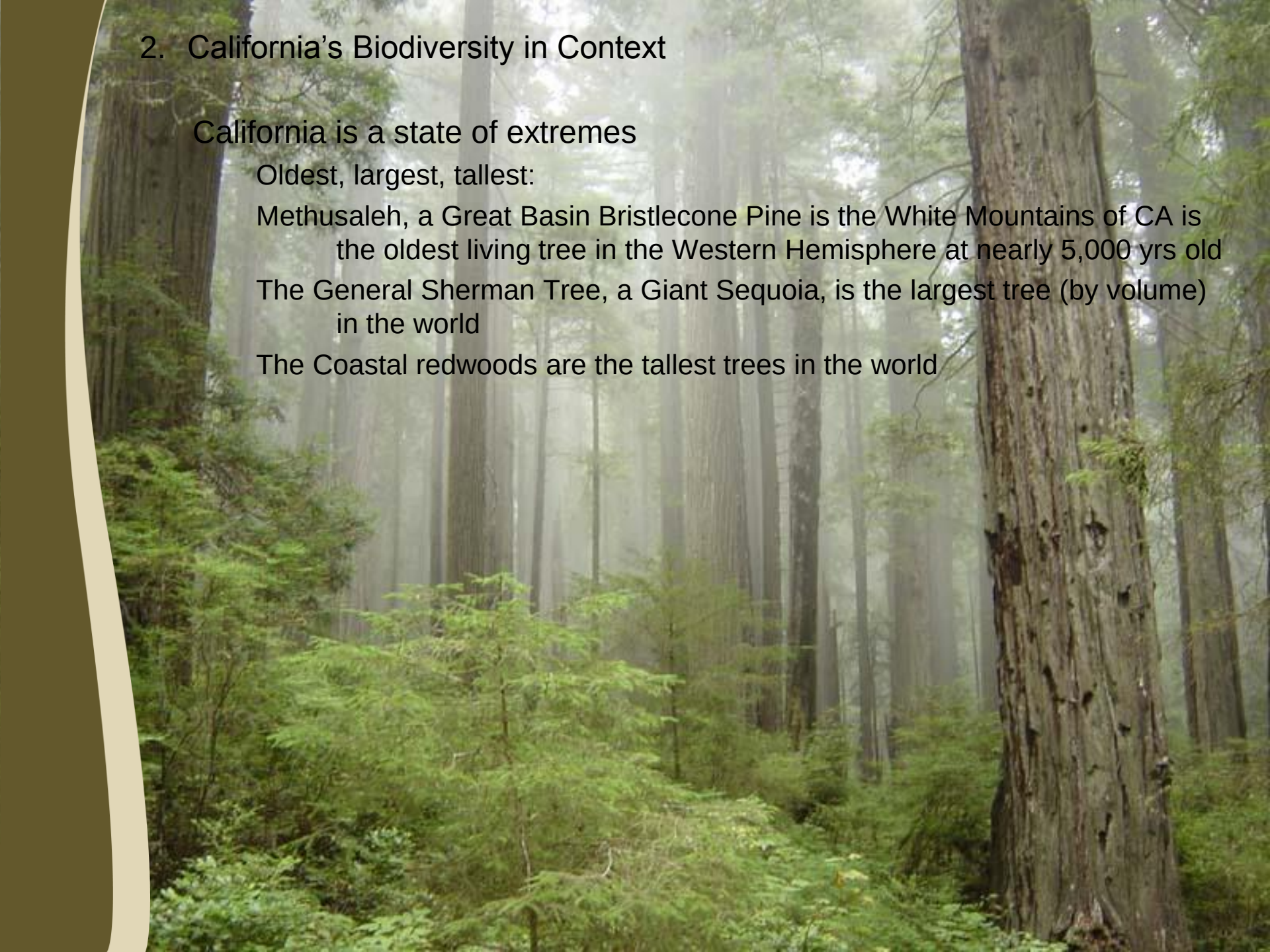

Tide Pools of the Pacific Coast



2. California's Biodiversity in Context

California is a state of extremes

Oldest, largest, tallest:

Methusaleh, a Great Basin Bristlecone Pine is the White Mountains of CA is the oldest living tree in the Western Hemisphere at nearly 5,000 yrs old

The General Sherman Tree, a Giant Sequoia, is the largest tree (by volume) in the world

The Coastal redwoods are the tallest trees in the world

2. California's Biodiversity in Context

California is one of Earth's 25 biodiversity hotspots

- 30,000 species of insects
- 63 species of freshwater fish
- 46 species of amphibians
- 96 species of reptiles
- 563 species of birds
- 190 species of mammals
- more than 8,000 species of plants, many of which are found only in CA

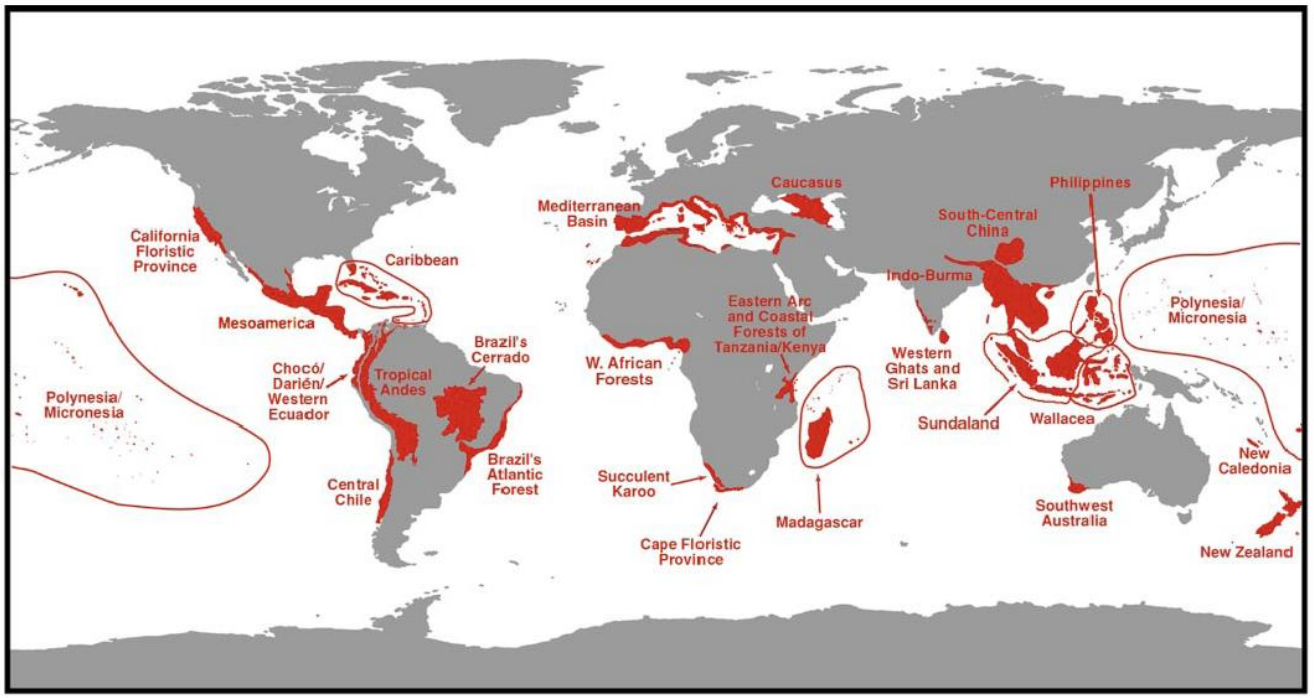


Figure 1 The 25 hotspots. The hotspot expanses comprise 30–3% of the red areas.

2. California's Biodiversity in Context

California has the largest number of endemic species out of all 50 states

- *geographic range* refers to the area within which a given species may be found
- *geographic range* is not static, as plants and animals are constantly probing the boundaries of their range to see if it can be expanded
- *endemic species* are those whose geographic range is naturally and exclusively restricted to a particular locality or region

  example: to say that blue oak is endemic to CA is to say that blue oak is found in CA and **nowhere else** in the world

Region	Area (km2)	Native genera	Native spp.	% spp endemic	Intr. Genera & spp.
California	411,000	878	4839	30	188/1023
California Floristic Province (CFP)	324,000	795	4452	47.7	
Alaska	1,479,000	355	1366	5.9	
Texas	751,000	1075	4196	9	
Japan	377,000	1098	4022	34	

Numbers of vascular plant taxa (sensu Ornduff et al.; circa 2005)

Examples of California endemics

Blue oak

Clarkia xantiana

34 Clarkia species are *endemic to California*

2. California's Biodiversity in Context

Why does California have such high levels of species diversity, endemism, and habitat diversity?

- varied topography
  - leads to huge variation in climate
  - mountains, valleys, and deserts form geographic barriers which effectively isolate natural communities and engender higher rates of speciation
- varied soil types

California has 10 distinct bioregions, while most other states have relatively homogenous ecosystems

Minnesota has only three bioregions for instance

2. California's Biodiversity in Context

Topography and Climate

The North Coast Range can be thought of as a wall blocking the flow of air off of the Pacific toward the Central Valley

However, there is a gap in this wall at the Golden Gate, which is the first place that wind can push through the Coast Range to reach the Central Valley. This gap allows cool, moist Pacific air to rush inland daily, bringing moisture and lowering temperature everywhere it penetrates

Contrast this with the imposing wall of hills further down south between Monterey and Morro Bay along the Big Sur coast. This range of hills effectively blocks the flow of cool, moist Pacific air inland

at 6pm, July:

55 degrees

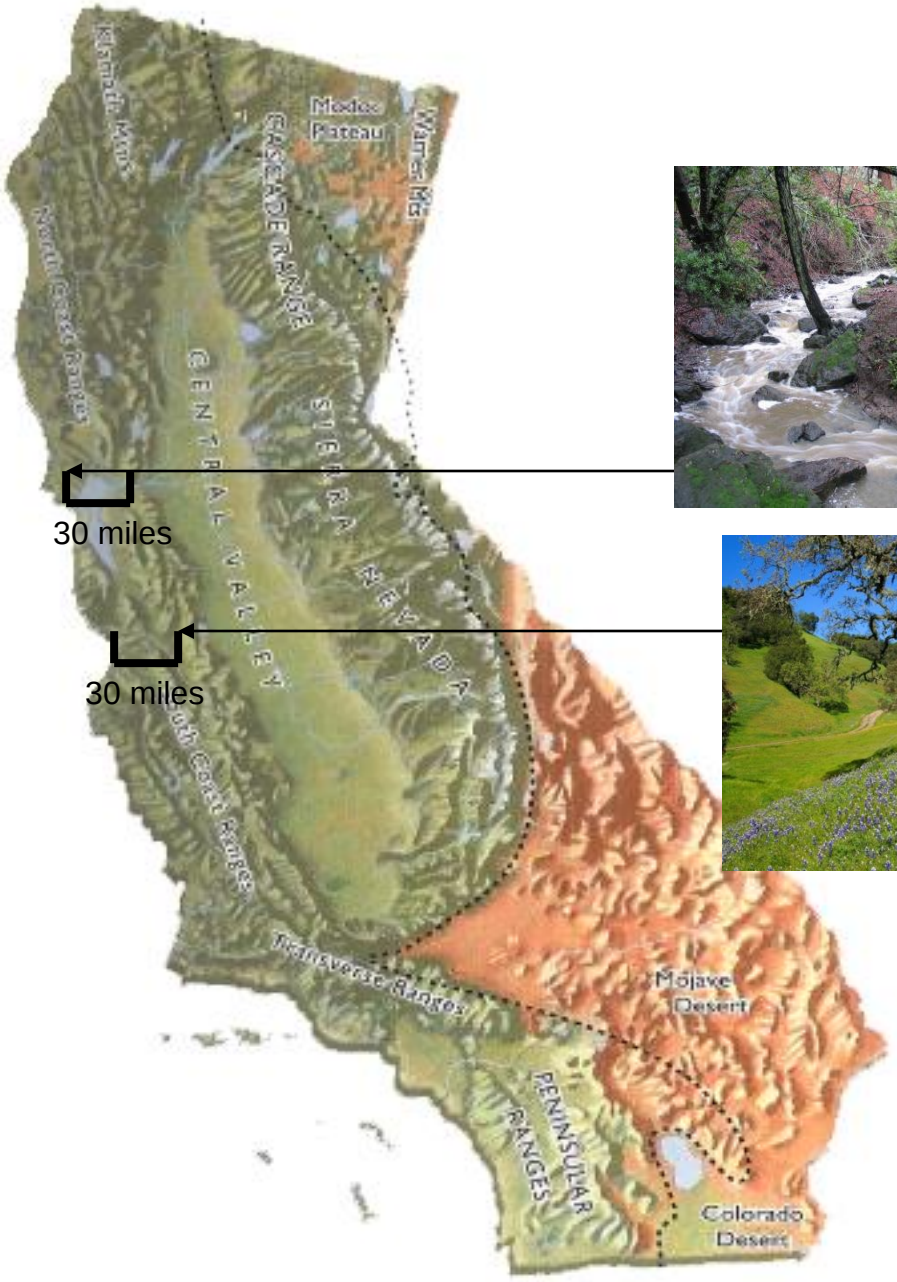
relative humidity 80%

30 miles

82 degrees

relative humidity 17%

30 miles



2. California's Biodiversity in Context

Topography plays a huge role in determining whether a plant or animal can occur in a certain place or not

- *Aspect* refers to the direction a hill faces
  - in the Northern Hemisphere, the sun shines from the south
    - north facing slopes are cooler
    - south facing slopes are hotter

55 degrees

relative humidity 80%

- In coastal CA, cool moist north-facing slopes tend towards redwoods and Douglas firs, while hot dry south-facing slopes field oaks or chaparral

82 degrees

relative humidity 17%

2. California's Biodiversity in Context

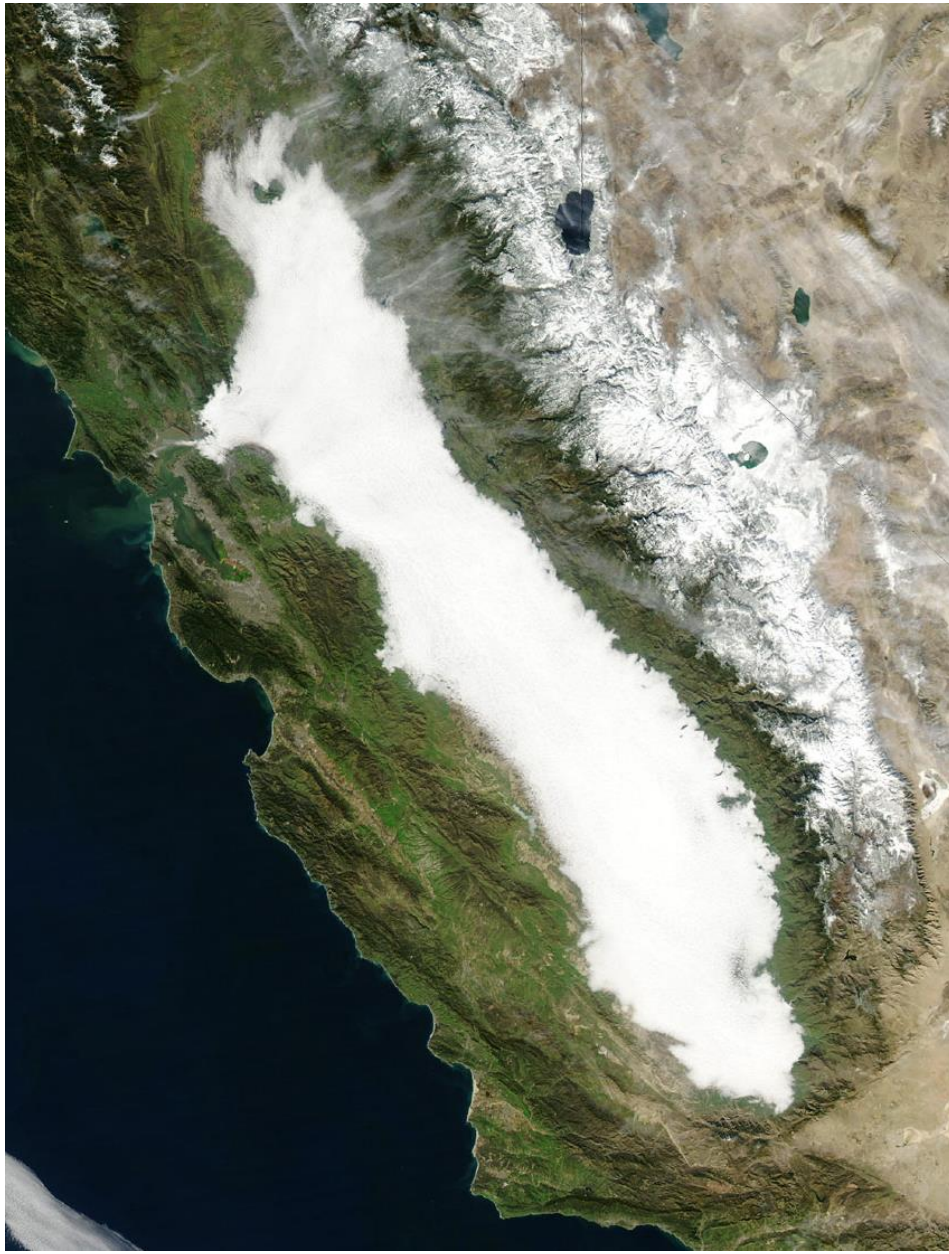
Topography plays a huge role in determining whether a plant or animal can occur in a certain place or not

- *Slope* is a measure of steepness
  - at one extreme is 0 degrees, or a flat terrain
  - at the other extreme is 90 degrees, or purely vertical terrain
  - most hills vary between 15% and 30% slope
- Plant communities will differ depending on where on the slope a plant occurs
  - soil at the bottom of the hill tends to be richer and softer because it has collected soils washed off the hills by landslides and streams
  - soil on the slopes tends to be shallower and rockier

2. California's Biodiversity in Context

Air flow up and down hills varies with the landscape

- Warm air rises
- Cold air sinks
- During the day, warm air moves up and over valley walls
- At night, cool air flows down the valley walls and pools at the bottom
- Tule fog forms when cold mountain air flows down the sides of the Central Valley and fills it to the "brim"

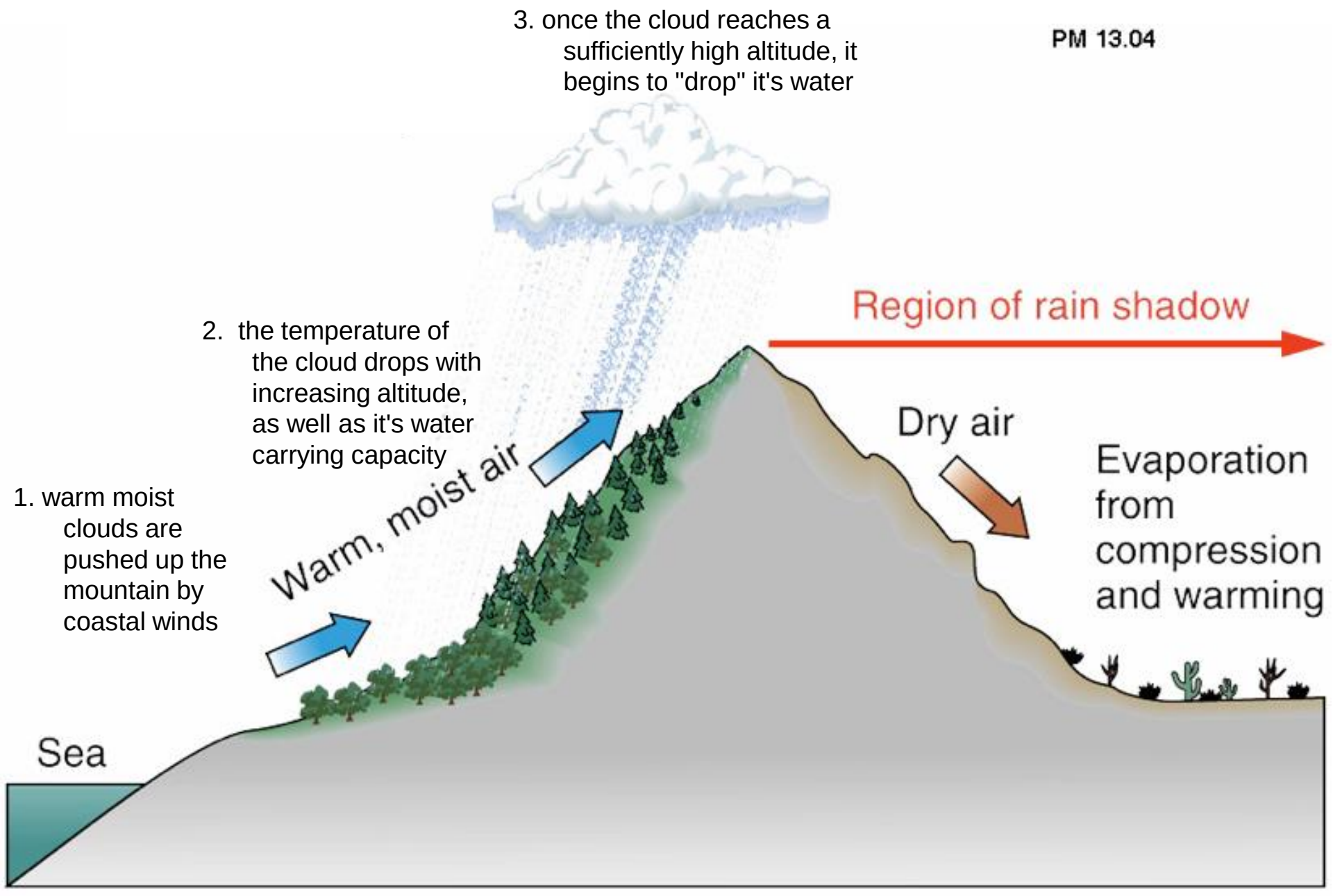


2. California's Biodiversity in Context

Topography has determining influence on temperature and rainfall

- It is not the averages but the extremes of temperature and rainfall which determine a species' geographic range
- a plant may do fine in 35 degree weather, but if the temperature dips below 32 degrees (freezing point), the plant will perish
- even if the temperature dips below freezing once every 20 years in a specific valley, that plant's geographic range will not include that site
- every 6 or 7 years, we may hear in the news of how a cold snap has killed off an entire crop of oranges or grapefruits in California or Florida. Citrus growers push the limits of temperature tolerance in the trees they cultivate, and periodically they pay the price for that transgression

2. California's Biodiversity in Context



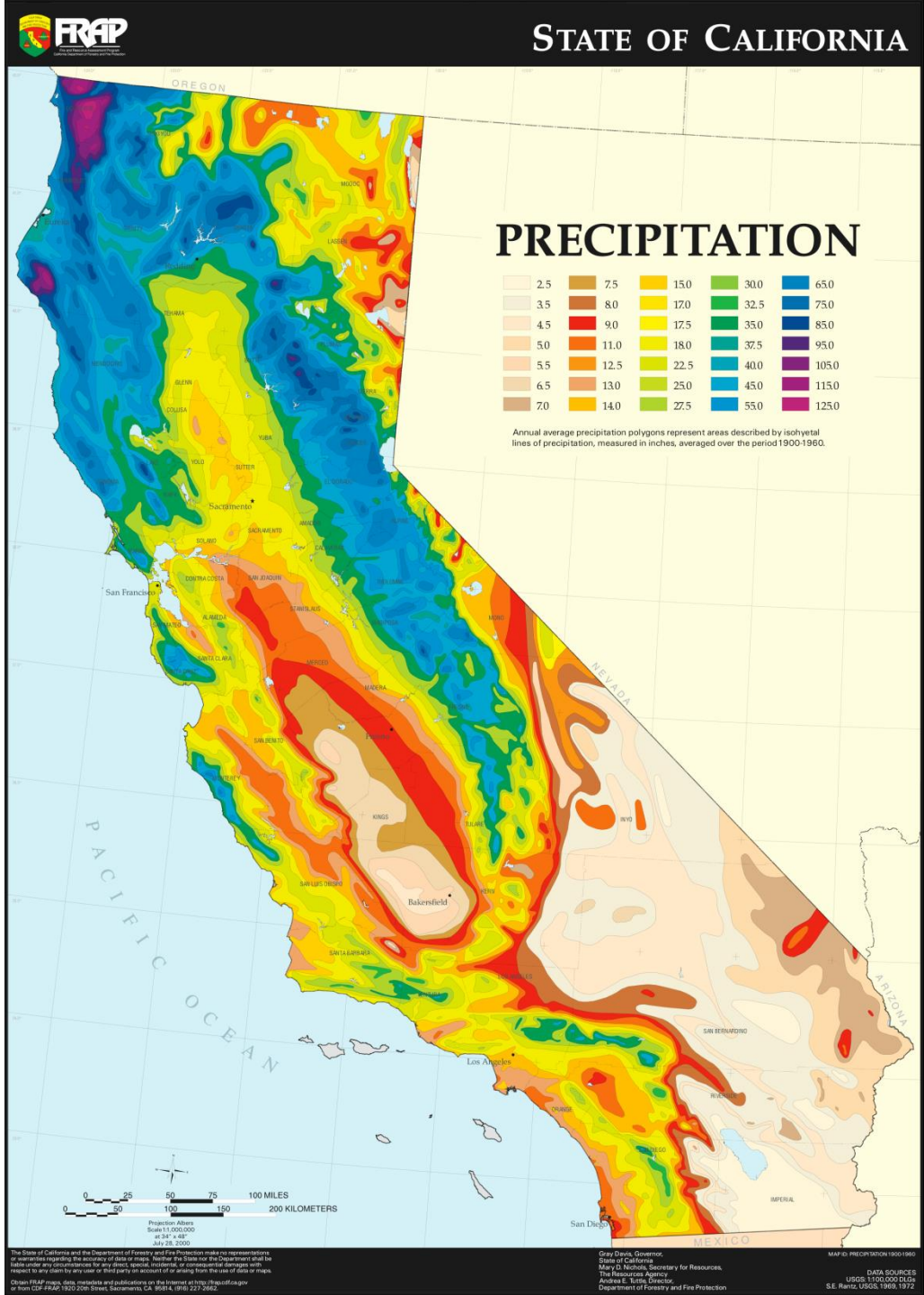
2. California's Biodiversity in Context

Rainfall

- How much rainfall occurs depends on how high of a mountain the cloud has passed
  - clouds passing over low topography San Francisco only produce 20 inches of annual rainfall
  - the same clouds passing over Mount Tamalpais on the other hand are driven up 2,000 or more feet and consequently Kentfield has 60 inches of annual rainfall
  - naturally, plant communities that grow in these two areas can be quite different

varied topography is one factor which contributes to CA's varied rainfall

- Mountain ranges along north coast and central coast–*orographic effect*
- Extent of *Orographic precipitation* varies with elevation and size of the mountain range–high Cascades and Sierra Nevada receive high precipitation, central valley only moderate amounts, and eastern and southern deserts receive very little



2. California's biodiversity in context

In addition to varied topography, varied soil also plays a definitive role in shaping California's bewildering biodiversity

- Soils have different chemical compositions and physical structures depending on their parent materials and how and where they were formed
  - Granite, which most of the Sierra Nevada is formed with, makes very different soil than the volcanic soil of Mt Shasta, and both of these differ chemically and physically from the serpentine soils of the Klamath Range

- Soil type shapes the composition of plant communities
  - for instance, serpentine soils are conducive to the growth of leather oak
  - Geologists looking for serpentine soils can use the presence of leather oak as a good first indication of serpentine soils

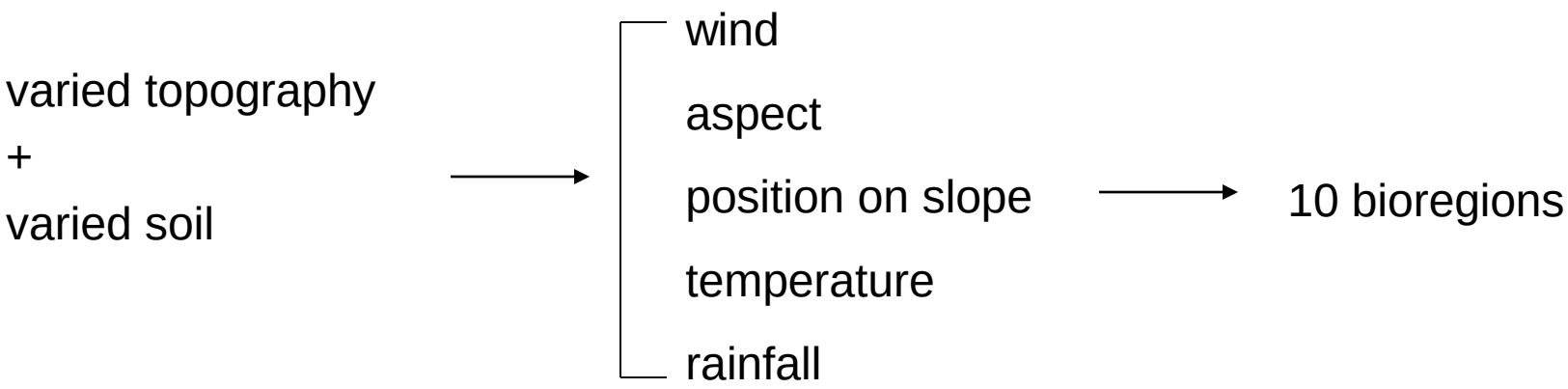
Granite

Volcanic soil

Serpentine soil

2. California's Biodiversity in Context

In summary




a wealth of
biodiversity

2. California's Biodiversity in Context

The Biodiversity Crisis

Biodiversity is the diversity of life found at all hierarchical levels

-from the tiniest mosses to the giant redwoods
-includes all the different genetic stocks of unique salmon runs

2. California's Biodiversity in Context

The global rate of species extinction exceeds the background extinction rate prior to the emergence of modern humanity

If the current rate of biodiversity loss continues, we will experience the most extreme mass extinction event since the K-T extinction event that ended the age of the dinosaurs

2. California's Biodiversity in Context

Land-use change is the primary driver of habitat loss and ecosystem degradation-it greatly exacerbates most of the other threats to the environment

- Accelerated rates of land-use change can be attributed to geometric growth of human population, which has increased sixfold since the 1800s
  - For example, with introduction of grazing and agriculture, the Great Plains of North America have lost more than 96% of its tallgrass praire, 82% of the eastern mixed grasslands and 25 percent of its shortgrass prairie
  - 465 grass species of the Great Plains are now classified as a conservation concern and endemic songbird and nesting bird species in these grasslands have declined by 50 and 75 percent, respectively.
- Overall, the human footprint is detectable across 83 percent of the land area in the world, excluding Antarctica

2. California's Biodiversity in Context

Synergistic effects between habitat loss, habitat fragmentation, and climate change can compound the effects of habitat loss on biodiversity

Researchers are figuring out whether or not species will be able to shift their distributions or evolve new adaptations fast enough to accommodate global warming

Numerous studies such as the UC Berkeley Grinell Project have documented the historical movement of species in response to climate change, but habitat loss and currently unprecedented speed of climate change could make these historical processes of adaptation less applicable today

2. California's Biodiversity in Context

The continuing loss of species and degradation of ecosystems threatens our economy

- Many of our medicines and advances in agriculture and public health depend upon the study of wild species and their habitats
- We have categorized and named less than1% of all Earth's biodiversity, and of that 1%, we have only ventured beyond a superficial description of anatomy into biochemistry and genetics in a handful of these
  - from a strictly economic standpoint, it would seem unwise indeed to continue pushing to extinction countless numbers of species who may yet provide the innovations we need to advance our science and technology

2. California's Biodiversity in Context

The continuing loss of species and degradation of ecosystems threatens the integrity of vital ecosystem functions which make all life on this planet possible

These ecosystem services

1) maintain air quality, soil production and nutrient cycling
2) moderate the climate
3) provide freshwater, fish and game and pollination services
4) detoxify and breakdown pollutants and waste
5) control parasites and diseases

One study, led by Dr Robert Costanza estimated that the earth's biosphere provides 16 to 54 trillion US dollars worth services annually-free of charge. That's more GDP than the world today commands!

From a strictly economic standpoint, the continued destruction of these free services is lunacy- a plebiscite tantamount to global suicide

2. California's Biodiversity

The continuing disenfranchisement of biodiversity robs us of opportunities for personal inspiration, recreation, exploration, cultural enrichment, and making great memories with our friends and families

2. California's Biodiversity in Context

Let's orient ourselves!

Where are we on this map?

Please break out into small groups and try to answer these questions

1. What watershed do you live in?
2. What stream is closest to your house?
3. Does it have water in it all year long or just seasonally? If seasonally, when does it go dry?
4. What is the name of the nearest mountain range?
5. What kind trees, plants and insects live in your community?
6. Describe where you live, both in terms of natural elements and human/social elements. What was here 100 years ago?

3. The Role of Naturalists

"To be a Naturalist is better than to be a King."

Charles William Beebe, Journal, 31 December, 1893

3. The Role of Naturalists

What is a naturalist?

- Today we define naturalists quite simply as people who observe the natural world, report back to their fellow humans, and work together to use those observations to make sense of the world. The aggregate of these observations over the ages, and the conclusions derived thereof, constitute what we refer to today as knowledge.

- Humans have always been naturalists by necessity: we have had to observe, measure, speculate and communicate about the world in order to survive

  - Every human culture on Earth has explored its given space, both in terms of geography, cosmology and biodiversity, in astonishing detail and accuracy
  - Indigenous people have lived, and in some areas still do live, as part of the ecosystem relying on observing, knowing, harvesting and teaching about nature for survival- they are the quintessential naturalists

3. The Role of Naturalists

Why be a naturalist?

Naturalists are generalists in the best sense, cross-disciplinary, with knowledge of the *system as a whole*, not just the pieces

In the 18th and 19th centuries, before the formal fields of ecology, entomology, geology, zoology and others emerged, it was naturalists who commanded these sciences

Their work and collected specimens were instrumental to the creation of most natural history museums, including the California Academy of Sciences

Today, naturalists can contribute to science through their observations of rare or even new species. There are only so many scientists in California- more eyes and ears are needed in the field if we are to fully discover and explore all of our state's biodiversity

tralia
Darlyne Murawski

NATIONAL GEOGRAPHIC

3. The Role of Naturalists

Naturalists form the key link between the everyday and the academic

3. The Role of Naturalists

A quick stop to pay our respects to the great ones, whose observations and conclusions about nature changed the field of science…..

Charles Darwin (1809-1882)

- articulated ***evolution***, the greatest and most elegant explanatory tool of the biological sciences ever yet proposed

John Muir (1838-1914)

- wrote brilliant essays that changed our views on nature and deeply inspired readership to protect the environment
- possessed the ***two key qualities*** vital to any naturalist
    1. the power of careful observation
    2. the ability to communicate and inspire others
- fought to prevent the damming of Hetch Hetchy Valley
- pushed for the designation of Yosemite Valley, Sequoia & Kings Canyon, Grand Canyon, Mt Rainier as national parks
- founded the Sierra Club
- though he only had a few college classes in geology and botany, he was among the first people to recognize that Yosemite Valley had been carved out by receding glaciers, a conclusion he arrived at through his keen observation skills and intimacy with the area

3. The Role of Naturalists

Rachel Carson (1907-1964)

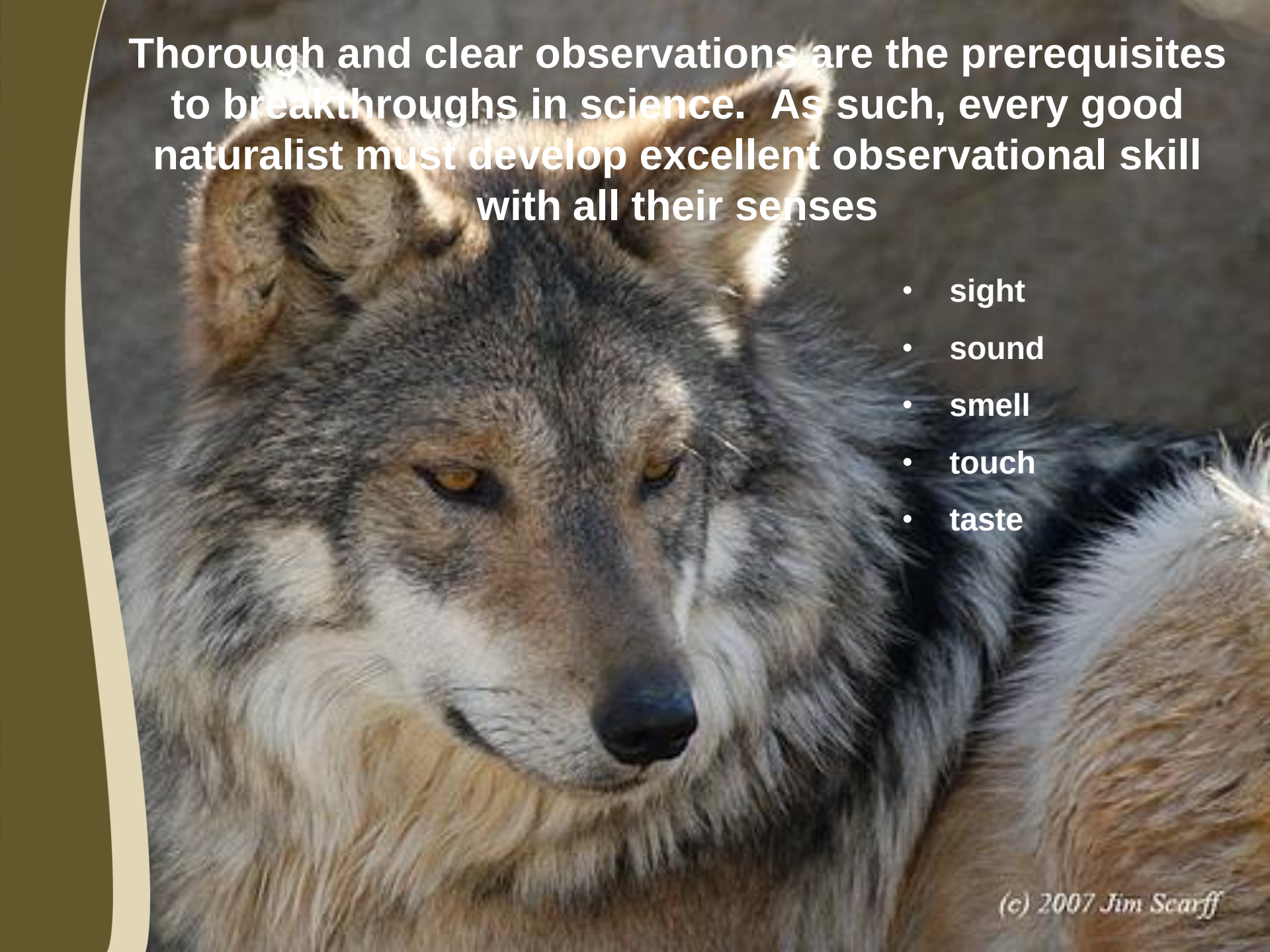
Her famous book ***Silent Spring*** brought attention to the damage caused by widespread pesticide use and ultimately influenced public policy

These three early explorers set the stage for modern environmentalism

Its up to you to take environmentalism to the next level!

Thorough and clear observations are the prerequisites to breakthroughs in science. As such, every good naturalist must develop excellent observational skill with all their senses

- **sight**
- **sound**
- **smell**
- **touch**
- **taste**



3. The Role of Naturalists

Becoming a Naturalist

1. Observe the world around you with all your senses (at least when its safe to do so)
   - Start out in your backyard, and gradually expand the range of your explorations
   - observe every bird that sings in your yard, every tree planted in your neighborhood park, every bug eating your rose bushes
2. Record your observations in a naturalist journal
   - a tool to sharpen your skills of observation and interpretation
   - a way of spending some time to yourself to reflect on your own experiences
     - Your experiences are valuable. Treasure them!
     - It matters not if a plant or insect has been classified fifty years ago and indexed neatly away- that plant or insect is still new to ***you***
   - a resource for other naturalists who may wish to build on your discoveries
     - Meriweather Lewis had such an exacting journal that we may today accurately retrace the progress of his first transcontinental expedition

3. The Role of Naturalists

Grinnell Method: used by UC Berkeley students and professional naturalists for over a century

Field Notebook

- this is what you actually take to the field to record your observations
- it should be spiral or hard bound
- record ***detailed*** observations
- put up an "Observation checklist" on the first or last page that you routinely refer to
  - I. Time & Date (use 24-hour clock format, ie military time)
  - II. Location (w/ arrival and departure time)
  - III. Route traveled
  - IV. Weather (include temperature, wind, precipitation type, cloud cover, etc)
  - V. Habitat / Vegetation type (woodland, grassland, wetland, etc)
  - VI. Species, rocks, or other natural things seen or events seen
  - VII. General observations & comments
  - VIII. Drawings, maps, photos (with digital photo number)

Field Journal

- a place to rewrite your field observations in a format that is easy for you and others to read
- each field day should have a separate journal entry with written descriptions, a species account and a catalog of collected specimens

3. The Role of Naturalists

Written description

- this is a general account of the day's events including where you went, what you saw and any additional thoughts or comments
- begin each page with the location of that entry, and underline it with a wavy line
- write in full sentences and narrate what you observed- tell a story
- only write on one side of the sheet, and use the opposite side for sketches, maps, or photos (taped onto the paper)
- underline species names, using straight lines for scientific names and wavy lines for common names
- compile a species list at the end of this written description. It is helpful to have different categories here (birds, plants in flower, rocks, etc)

Species account

- this is an account of specific natural observations of interests
- title the page with the name of the species (scientific name)

Catalog

- this is a record of any specimens that you collect
- title each page "Catalog"
- label or tag each specimen you collect with the following information
    I. catalogue number
    II. date collected
    III. collection location
    IV. collector's name
    V. identification

3. The Role of Naturalists

Other Journal Points

duration: each journal cover one year

margins: 3 cm from the left side and from the top of the sheet

date each entry in the space to the left of the page margin

put your name and the year in the upper left hand corner of each page

number all pages

for numbers use numerals instead of words

avoid abbreviations

use water-resistant ink pens such as Micron pens

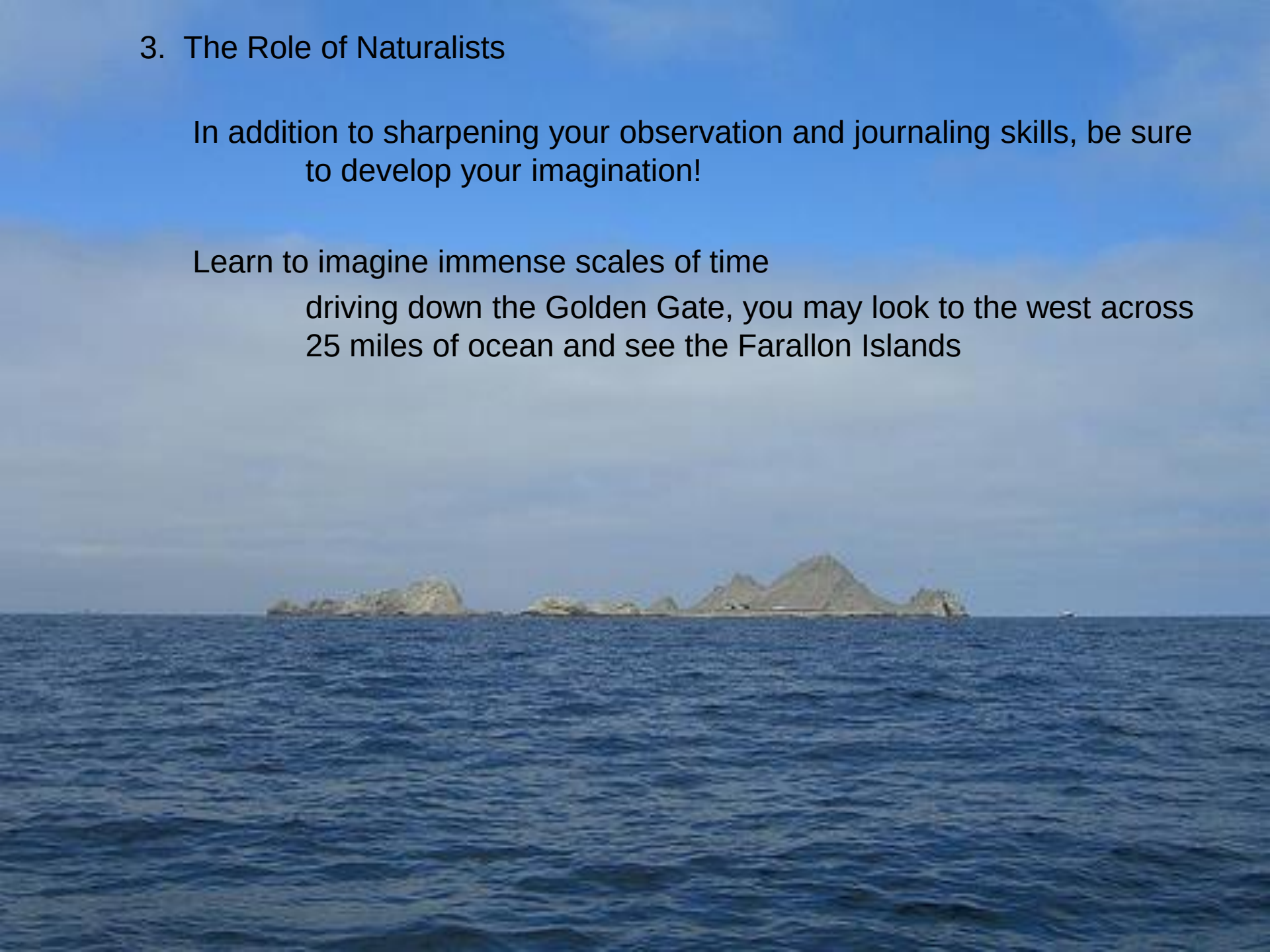
use bound journal with acid-free archival paper

3. The Role of Naturalists

In addition to sharpening your observation and journaling skills, be sure to develop your imagination!

Learn to imagine immense scales of time

driving down the Golden Gate, you may look to the west across 25 miles of ocean and see the Farallon Islands



3. The Role of Naturalists

But 35 million years ago, you would have seen a forest of avocado trees!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