California Diversity, Species Distributions, and Climate Change

Overview

The range and distribution of plants on the landscape can be affected by a number of abiotic (nonliving) and biotic (living) factors. Abiotic factors include rainfall, temperature, sunlight, and geology (e.g., soils and topography). Biotic factors include seed dispersal, pollination, and natural enemies (e.g., herbivores and pathogens). Topography can be extremely important in determining plant range at the local level. For example, alpine regions can have completely different species than adjacent areas at a lower elevation. Latitude can play an important role, as well. Where a plant grows has important consequences for its morphology. For example, plants that grow in the desert have specific morphological adaptations, such as succulence or CAM photosynthesis, to cope with low precipitation, drought conditions and extreme high temperatures, In contrast, a plant growing in alpine habitats will have adaptations to cope with the extremes of that environment, such as deep taproots to penetrate poor soils and provide stability on steep talus slopes, or a compact cushion growth habit, which has been shown to increase local ambient temperatures and melt snow to provide a useable water source.

In this activity, you will access an online database of plant specimens that have been collected from different parts of California. You will map the range of five plant species and determine which factors might be responsible for their ranges.

Directions

1. Navigate to the Consortium of California Herbaria2 portal: cch2.org/portal
2. Under the menu bar select **Search Collections**. This shows you a list of all herbaria contributing their data and images to this portal.
3. Click the **Search >** radio button
4. In the next window, enter the name of the first species in the Species Data Table, ***Fouquieria splendens*** in the **Scientific Name Field** under **Taxonomic Criteria**. Click the **List Display** radio button.
5. This automatically opens to a list of records under the Occurrence Tab. Scroll through the records and examine those with images of specimens. Click on an image to enlarge it.
6. Examine the specimens and describe the plant. Is it short? Tall? A tree? An herb? What do the leaves look like? Are they smooth? Hairy? Light? Dark? Enter your answers in the Species Data Table.
7. Click on the Maps tab to view the distribution of collections made for each species. Under **Google Map**, click **Display Coordinates in Google Map** radio button. Record the general geographic distribution of each species. Does it occur southern California? Is it broadly distributed or is it endemic to the state? If broadly distributed, where else does it occur?
8. Use the Map of Vegetation Types in California (p. 3 of this document) to characterize the vegetation biome that the plant occurs in.
9. To collect more information about the abiotic factors of each species, navigate to calflora.org
10. Enter the taxon name in the **Plant Name** field, click the **Search** radio button. A results page displays a map of the species distribution (based on herbarium specimen collections and observations) as well as pictures and other information about the plant.
11. Click on **Plant Characteristics** next to the map to retrieve information about each plant.
12. Use the soils map (p. 4 of this document to characterize the soils that the plants grow on.
13. Repeat this procedure for the four other species.

14. In this last segment we will examine how climate change is likely to affect California and extrapolate the information we gather here to determine how these changes will affect native plant species. Navigate to cal-adapt.org
15. You are welcome to explore all climate tools on the site, but for this exercise we will examine Annual Averages, Extreme Heat Days and Warm Nights, Snowpack, Wildfire, Extended Drought Scenarios, and Maps of Projects Change. Each tool has a description on how to use and animations that will display projections of change.

Questions

1. Which abiotic factors best explain the current distribution of each of these five plant species?

2. For each species, what morphological features lend to their ability to persist in their environment?

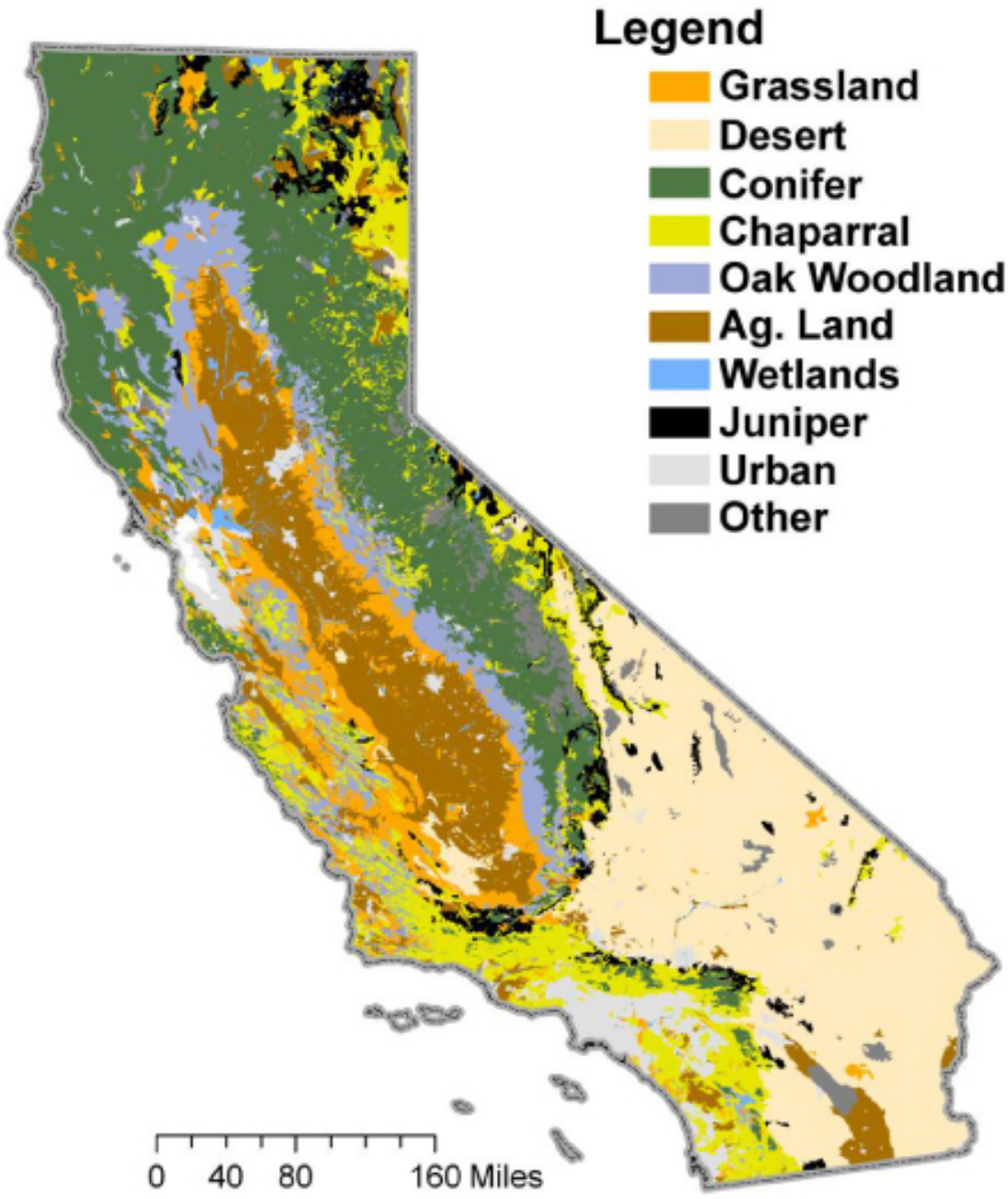
3. How might the morphology (physical characteristics) of these plants be related to the characteristics of their range (e.g., temperature, precipitation, and/or elevation)?

4. Using the climate tools, hypothesize how climate change may influence the geographic distribution of each of these species. Will their range expand? Decrease?

5. How will each species respond to shifts in climate? Are they likely to migrate, adapt, or go extinct?

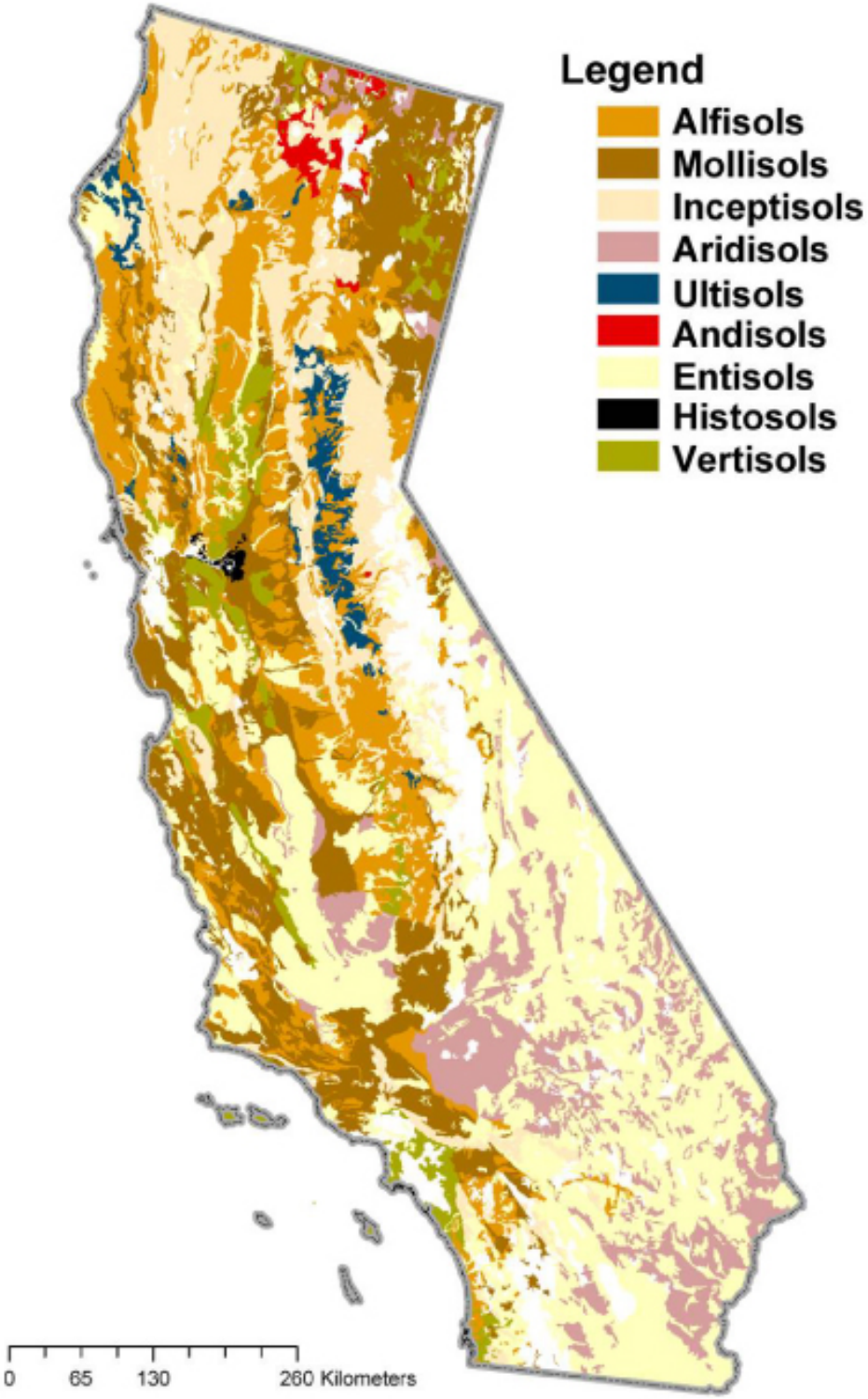
6. Which climatic variable might have the most impact on each species? Are these the same or are they different for each species?

Map of Vegetation Types in California
(Source: https://civilizedape.weebly.com/biomes-of-california.html)



Map of Soil Orders in California

(Source: https://casoilresource.lawr.ucdavis.edu/projects/pedology-and-soil-survey/gis-and-digital-soil-survey-projects/)



Species Data Table

Species	Perennial or Annual?	Morphological Description	Geographic Range	California Endemic?	Vegetation Biome	Elevational Range	Soils	Temperature Range	Precipitation
Fouquieria splendens									
Calochortus obispoensis									
Arctostaphylos glandulosa var. *gabrielensis*									

Eriogonum kennedyi var. *alpigenum*									
Nama demissa									