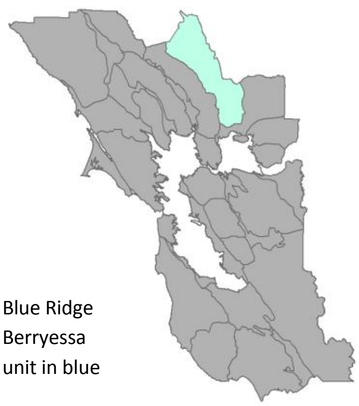
Climate Ready Vegetation Report

Blue Ridge Berryessa Landscape Unit

How is a changing climate going to impact vegetation native to the Bay Area?

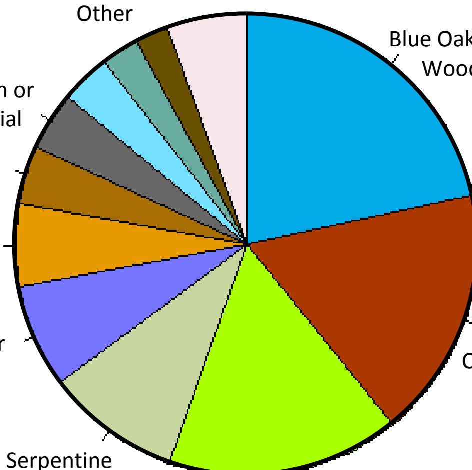
The San Francisco Bay Area's climate is already changing in ways that may impact which plants can grow where–the spatial pattern or distributions of native plant communities. From coastal redwood forests to stands of blue oaks in inland valleys, the diversity of local plant communities today reflects the region's steep climate gradients, complex topography, varied soils and history of ecological disturbance and human land use.



This report summarizes current conditions and potential climate change impacts for one of the Bay Area's 35 "landscape units" (as defined by the Bay Area Open Space Council's Conservation Lands Network). The last page provides links to additional information on Bay Area climate impacts, how scientists use computer models to estimate which plants may be resilient or vulnerable in the face of projected change, and recommendations for land managers.

Blue Ridge Berryessa: Current Natural Land Cover

The pie chart to the right shows land cover for the Blue Ridge Berryessa landscape unit, which is currently dominated by grasslands, mixed montane chaparral, and blue oak forests woodlands, with significant representation of serpentine leather-oak chaparral, chamise chaparral, blue oak and montane hardwoods.

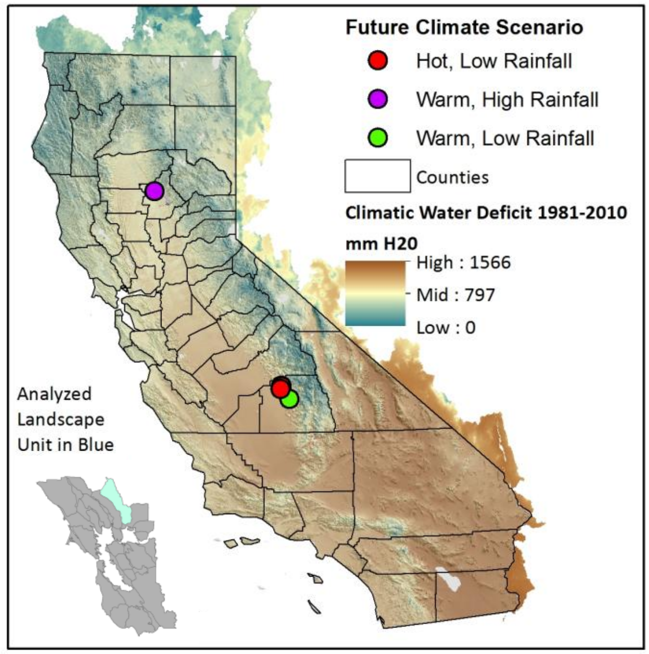


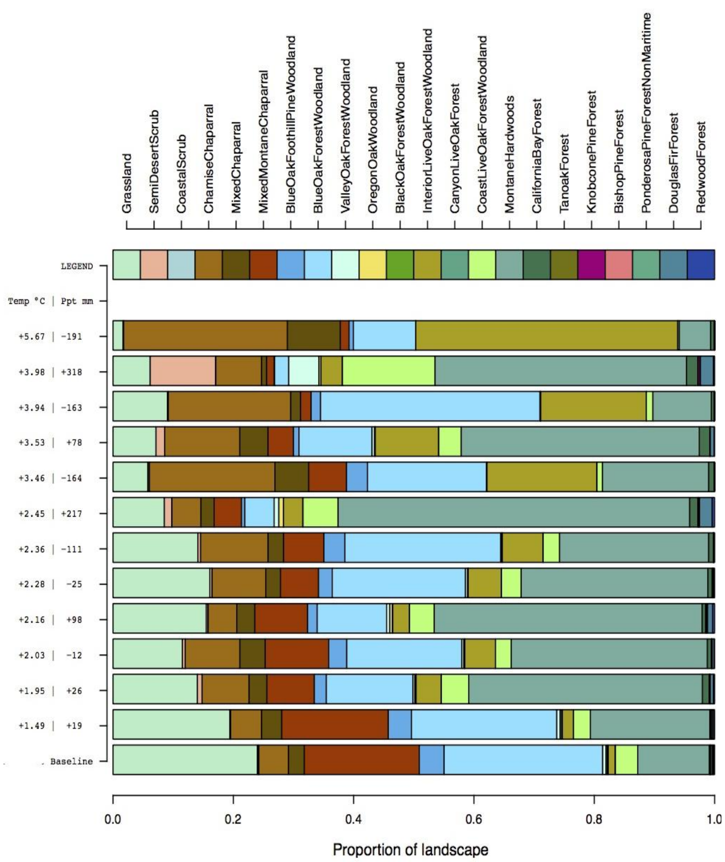
What will the Bay Area climate be like in the future and how might it effect vegetation?

By the end of the 21st century, average temperatures in the Bay Area are likely to rise at least 3-4°F, and possibly as much as 8°F, depending on the trajectory of greenhouse gas emissions. Rising temperatures will intensify the summer dry season, while also moderating the occasional winter frost. Changes in rainfall and the duration and intensity of future droughts are hard to predict. Warming temperatures and changes in rainfall may also lead to an increase in wildfire. These changes will in turn impact local vegetation in ways that can eventually lead to shifts in the distribution of native plant communities. On the next page you can visualize climate change by thinking about what locations in California already experience the climate that is projected for this landscape unit in the future.

Understanding potential climate change using “climate analogs”

A “climate analog” is a place that today has the climate (including temperature, rainfall, and soil moisture) that most closely matches what is projected for a place of interest in the future. This map is colored to show the relative aridity (climatic water deficit or CWD) of soils, with blue less arid and brown more arid. Colored dots show “climate analogs” for the Blue Ridge Berryessa unit. There are a variety of analogs for mid-century climates for this landscape unit ranging from Butte to Tulare counties, as shown in the map to the right. Shifts in climate of this magnitude could cause vegetation to change along trends shown in the stacked bar chart below.



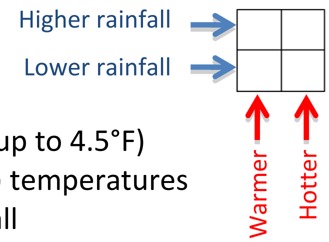


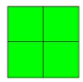
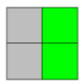
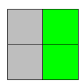
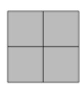
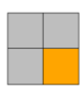
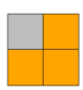
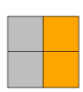
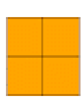
The lowest bar in this stacked chart represents current land cover. As you move up the stack future temperatures increase and the relative area of climate suitability for each vegetation type is shown.

What might the future vegetation of the Blue Ridge Berryessa look like?

Potential changes in vegetation suitability across a wide range of future climate scenarios are arranged here in order of increasing temperature (bottom to top). As temperatures warm, intensifying the summer dry season, future conditions for the Blue Ridge Berryessa will probably favor the expansion of drought adapted vegetation such as chaparral and possibly evergreen live oaks as well. These changes may occur slowly over many decades (or even centuries!), as long-lived trees eventually die off, and are replaced by other species. Major disturbance events, such as fire or drought-related tree mortality, may speed up these transitions. Seed dispersal, the way a plant produces and spreads its seeds, will be a key factor that may limit the expansion of well-adapted species or favor invasive weeds as conditions change, particularly after a major disturbance.

What are the potential native plant winners and losers for Blue Ridge Berryessa?

The color shows the projected response of vegetation to future climate. Red: Dramatic Decline - 25% less than current Orange: Moderate Decline - 25-75% less than current Gray: Relative Stability - 75-125% current Green: Increase - 125% more than current	The four squares represent different climate futures: combinations of warmer (up to 4.5°F) vs. hotter (+4.5°F or more) temperatures and lower vs. higher rainfall 

Possibly Expanding		Baccharis		Aggressive invader of grasslands in the absence of fire or grazing, and spreads rapidly in wet years. Models project expansion in interior regions of the Bay Area, especially under higher rainfall future scenarios.
		Toyon		Widespread in many different habitats and soil types, from coastal bluffs to interior chaparral and edges of woodland. Wide niche suggests it will be persistent in the face of climate change, but sensitivity of local populations is not known.
Likely Stable		Chamise Chaparral		Occupies hot, dry, steep slopes, and favorable conditions are projected to expand throughout the Bay Area under future climates. Seed dispersal and establishment may limit expansion. For existing chaparral stands, succession to oak woodland can happen over time in the absence of fire.
		Coast Live Oak		Reaches its northern range limit in the Bay Area, and may persist or even expand under warmer climates. While it is sensitive to warmer summers, it may be favored by increasing winter temperatures.
		Interior Live Oak		Models disagree on future projections for Interior Live Oak. It appears to be sensitive to warmer winter temperatures, and may decline in southern parts of the region, while staying stable or expanding in the north and in interior ranges.
Possibly Declining		Black Oak		Endemic to California and southern Oregon. Declines in climate suitability are predicted under all scenarios, due to warmer winters and drier summers. Native Americans promoted black oak for acorn harvesting.
		Blue Oak		Models disagree on the fate of Blue Oak. Native range includes very hot and dry locations, but it may be negatively impacted by warmer winters near the coast and loss of groundwater. Recruitment failure has been observed in parts of California, possibly due to competition with grasses and impacts of grazing.
		Grassland		Widespread across Bay Area climate gradients, usually maintained by grazing, mowing, and/or fire. Vulnerable to shrub invasion. Climate change and N-deposition are expected to alter species composition, but impacts on overall distribution and amount of grassland more likely depend on management strategies.

Priorities for biodiversity conservation

Land protection is more critical than ever to protect biodiversity in the face of climate change. Plants and animals need large, well-connected areas of natural and working landscapes. The landscape itself has a strong influence on local climate diversity and resilience. Rugged terrain creates variable conditions, including cold air pools in valley bottoms, hot dry south-facing slopes, and mesic north-facing slopes. Conserving a range of conditions via our Conservation Lands Network will enhance the resilience of living systems' in the face of climate change. Cool and moist locations can serve as "climate refugia". Enhanced connectivity between protected areas could provide important migration pathways for plants and animals adapting to climate change. For species of concern, including those that only occur in California, protecting both current populations and locations where they can live in the future may be critical to long-term survival. Co-benefits of land protection include water supply, water quality, reduced carbon emissions, and higher land values and quality of life for neighboring communities.

How to learn more

- To access a companion summary report of management implications based on this vegetation modeling see http://www.pepperwoodpreserve.org/tbc3/our-work/climate-ready

- For details on the vegetation modeling summarized here, see http://www.pepperwoodpreserve.org/tbc3/our-work/vegetation-impacts or for the peer reviewed research paper see Ackerly et al. 2015, "A Geographic Mosaic of Climate Change Impacts on Terrestrial Vegetation: Which Areas Are Most at Risk?", *PLOS ONE*, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130629

- For more information about current vegetation types and distribution, conservation goals, land use and climate in landscape units and other areas of interest, see the Conservation Lands Network report and Explorer Tool http://www.bayarealands.org

- For more information about projected climate change and impacts on watershed hydrology used for the vegetation modeling, check out the USGS Basin Characterization Model: http://climate.calcommons.org/article/featured-dataset-california-basin-characterization-model

- For more information about California conservation in an era of changing climate see Chornesky, E. A. et al. 2015, "Adapting California's ecosystems to a changing climate", *BioScience*, http://bioscience.oxfordjournals.org/content/early/2015/02/06/biosci.biu233.abstract

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