

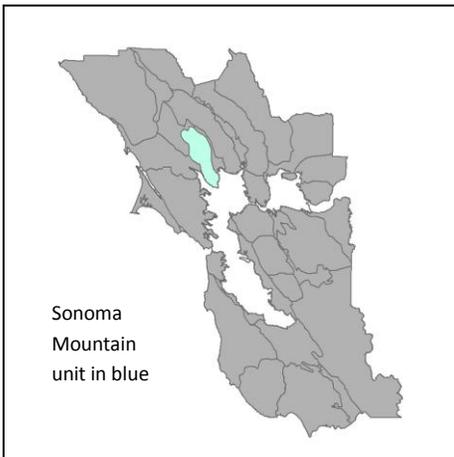


Climate Ready Vegetation Report

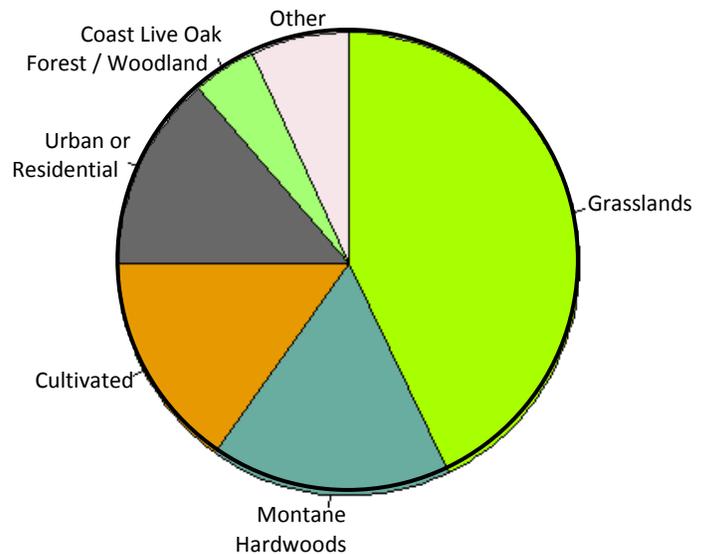
Sonoma Mountain Landscape Unit

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.



Sonoma Mountain: Current Natural Land Cover

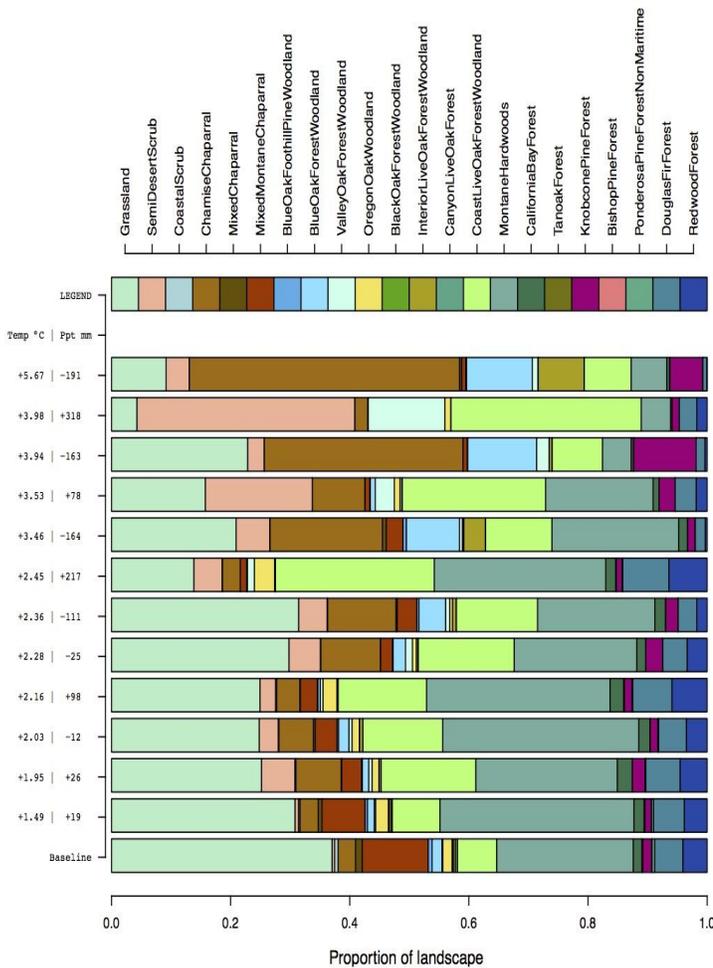
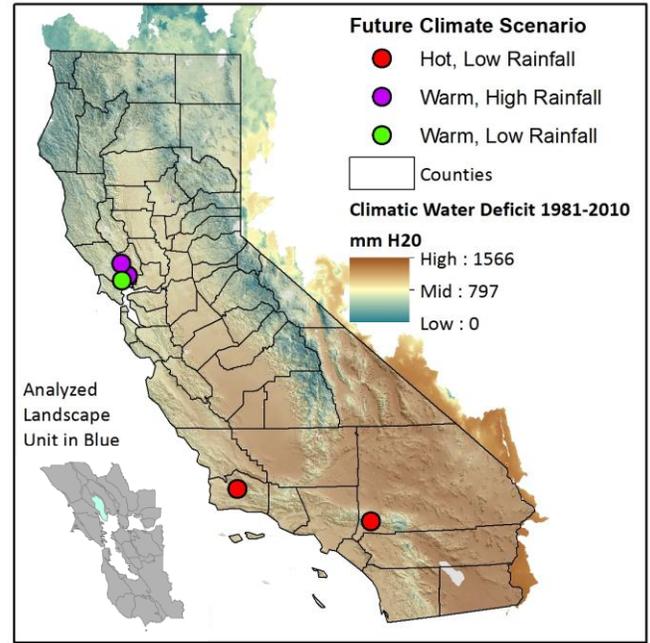
The pie chart to the right shows land cover for Sonoma Mountain landscape unit, which is currently dominated by grasslands, montane hardwoods, with significant representation of coast live oak.

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 Sonoma Mountain unit. There are a variety of analogs for mid-century climates for this landscape unit ranging from southern Sonoma to Santa Barbara and San Bernardino 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 Sonoma Mountain look like?

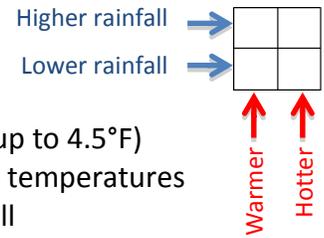
Potential changes in vegetation suitability across a wide range of future climate scenarios are arranged here in order of increasing temperature (bottom to top). As temperatures warm, intensifying the summer dry season, future conditions for the Sonoma Mountain may favor the expansion of drought adapted 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 Sonoma Mountain?

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		California Bay		Sensitive to hot, dry summers, but responds positively to warmer winters; the balance of these two makes projections uncertain. Bay regenerates vigorously from seed and seems to be expanding in many North Bay woodlands.
		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.
Likely Stable		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.
		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.
		Douglas-fir		Establishes in grasslands, shrublands and oak woodlands, and in the absence of fire invades and overtops oak woodlands. It responds positively to modest winter warming, but is sensitive to drier summers and reduced rainfall.
		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		Buckbrush		Buckbrush is an obligate seeder, depending on wildfire for regeneration. Seeds persist for some time in the seed bank. It would probably be able to persist anywhere there is chaparral, if it can get there.
		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.)
		Oregon Oak		Near the southern limit of distribution along the California coast. Declining suitability is projected under all future climate scenarios, due to drier summers and warmer winters. Recruitment failure has been observed in some populations, though causes are uncertain.

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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