



Oak Woodland Habitats

Climate Change Vulnerability, Adaptation Strategies, and Management Implications in Southern California National Forests



Photo by Noah Elhardt (Public Domain)

Habitat Description

Southern California contains primarily coastal oak woodlands and montane hardwoods, with coast live oak dominating the former, and black oak and canyon live oak dominating the latter. Many other species can co-occur with these dominants. Northern parts of the study area also contain blue oak and valley oak woodlands, which reach the southern end of their distribution in the study region. As dominant canopy species, oaks create favorable microclimates for diverse understory vegetation and provide habitat for many wildlife species.

Habitat Vulnerability

Sensitivity & Exposure

Shifts in precipitation and soil moisture may affect oak woodland distribution, composition, growth, and recruitment; these impacts may be compounded by shifts in temperature and drought patterns. Although adapted to wildfire, shifts in wildfire frequency and intensity may negatively affect oak recruitment and survival. Invasive plant species compete with oak seedlings for soil moisture, while invasive insects (e.g., gold-spotted oak borer) are contributing to high oak mortality within the region, and may expand with climate change. Land use conversion alters habitat extent and continuity, increases invasive species and wildfire risk, and eliminates potential refugia. Loss of oak canopy species would likely negatively affect the entire ecosystem.



Low-Moderate Vulnerability

Drivers of Oak Woodland Ecosystems

- Climate sensitivities: Precipitation, soil moisture, drought, air temperature
- Disturbance regimes: Wildfire, insects
- Non-climate sensitivities: Invasive & problematic species, land use conversion

Projected Climate and Climate-Driven Changes	Potential Impacts on Oak Woodland Habitats
Variable precipitation, reduced soil moisture, increased drought <i>Variable annual precipitation; increased climatic water deficit; increased drought frequency and length</i>	<ul style="list-style-type: none"> • Altered species distribution and species composition • Drier conditions: increased oak mortality, dieback, and habitat contraction; reduced recruitment due to enhanced variability in acorn production; reduced germination and seedling emergence • Altered disease vulnerability
Increasing temperatures and heat waves <i>+2.5 to +9°C by 2100; increased heat wave frequency and length</i>	<ul style="list-style-type: none"> • Reduced recruitment: altered pollination and acorn production; reduced germination and seedling survival with warmer conditions • Increased vulnerability to insects
Altered wildfire regimes <i>Increased fire size, frequency, and severity</i>	<ul style="list-style-type: none"> • Variable impacts depending on oak species, age, and size, burn timing, and other factors, but could increase mature oak damage and mortality and reduce tree mast and sapling recruitment • Reduction of germination sites via topsoil and leaf litter loss • Potential conversion to more fire-tolerant vegetation

Adaptive Capacity

Factors that enhance adaptive capacity:

- + Many species able to recover from disturbance and land use impacts if given time and space
- + Local/regional genetic diversity will contribute to spatially variable vulnerability
- + High endemism; provides key wildlife habitat
- + Provides a variety of ecosystem services: biodiversity, grazing, recreation, and air quality

Factors that undermine adaptive capacity:

- Habitat fragmentation may reduce resilience and migration potential in the face of climate change
- Migration unlikely to keep pace with climate change due to variable/declining recruitment, limited dispersal ability, and long generation time
- Only a few canopy-forming species; loss of any of these species would alter or eliminate this habitat

Adaptation Strategies for Oak Woodland Habitats



What kinds of adaptation options are there?

- Enhance Resistance* → Prevent climate change from affecting a resource
- Promote Resilience* → Help resources weather climate change impacts by avoiding the effects of or recovering from changes
- Facilitate Transition* → Accommodate change and/or enable resources to adaptively respond to variable conditions
- Increase Knowledge* → Gather information about climate impacts and/or management effectiveness in addressing climate change challenges
- Engage Collaboration* → Coordinate efforts and capacity across landscapes and agencies

Adaptation Category	Adaptation Strategy	Specific Management Actions
Enhance Resistance	Maintain oak woodland stands	<ul style="list-style-type: none"> • Practice oak seedling propagation • Reduce pests and pathogens, weeds, and chaparral adjacent to high value stands (can use physical removal or prescribed burns)
	Prevent invasive plant establishment	<ul style="list-style-type: none"> • Include invasive species prevention strategies in all projects • Implement early detection/rapid response for exotic species treatment
	Restore oak habitats to limit high severity fires and moisture stress	<ul style="list-style-type: none"> • Plant native bunch grasses within oak woodlands to reduce spread of invasive species • Fence priority oak areas or individual plants to exclude browsers
Promote Resilience	Change land use planning to preserve habitat and refugia	<ul style="list-style-type: none"> • Develop more habitat conservation plans that are used across all levels of planning for development and conservation within a particular area • Update current plans to incorporate climate change
	Plan for possible future habitat fragmentation due to drought or fire	<ul style="list-style-type: none"> • Obtain satellite imagery to map historical range of oak woodlands and chaparral and map “age” of chaparral based on “time since burn” • Consider climate change in post-fire or post-drought rehabilitation
Facilitate Transition	Identify and protect refugia	<ul style="list-style-type: none"> • Designate conservation easements • Monitor, evaluate, and promote stands that successfully regenerate
Increase Knowledge	Improve understanding of future species distribution to inform management	<ul style="list-style-type: none"> • Utilize species distribution models under current climate regime and future climate conditions to identify suitable areas in the future (major core areas and microrefugia)
Engage Collaboration	Engage the public	<ul style="list-style-type: none"> • Facilitate and build capacity in communities to protect/enhance/restore grasslands and oak woodlands • Enhance oak stewardship on private lands to improve oak resilience

*Actions presented are those evaluated as having higher effectiveness and/or feasibility.

Management Implications

This information can be used in a variety of ways:

- ✓ Forest Plan Revisions
- ✓ U.S. Forest Service Climate Change Performance Scorecard: Element 6 - “Assessing Vulnerability” and Element 7 - “Adaptation Actions”
- ✓ Bureau of Land Management Resource Management Plan Revisions

Resilient management requires implementing a variety of adaptation options



Further information and citations can be found in source reports, *Climate Change Vulnerability Assessment for Focal Habitats of Southern California* and *Climate Change Adaptation Strategies for Focal Habitats of Southern California*, available online at the EcoAdapt Library: <http://ecoadapt.org/library>.