



# Southern California Chaparral and Sage Scrub Habitats

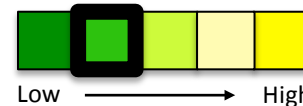
## Climate Change Adaptation Actions Summary

**An Important Note About this Document:** This document represents an initial effort to identify adaptation actions for chaparral and sage scrub habitats in southern California based on stakeholder input and existing information.<sup>1</sup> Specifically, the information presented below comprises stakeholder input during a two-day adaptation workshop, peer-review comments and revisions, and relevant examples from the literature or other similar efforts. The aim of this document is to expand understanding of possible adaptation actions for southern California chaparral and sage scrub habitats in response to climate change.



### Chaparral Habitat Vulnerability

**Low-Moderate Vulnerability**



The relative vulnerability of chaparral habitats in southern California was evaluated to be low-moderate by habitat experts due to low-moderate sensitivity to climate and non-climate stressors, low-moderate exposure to projected future climate changes, and moderate adaptive capacity. Drought is the key climate driver affecting chaparral habitats. Chaparral habitats are adapted to seasonal drought, but prolonged and/or more frequent drought or shifts in the onset of seasonal drought may contribute to plant dieback, shrub mortality, and/or altered community composition, including increased dead fine fuel load that may increase large fire events in the future by promoting the incidence of firebrands and spot fires. Many chaparral species are fire-adapted, but increasing fire frequencies linked with more human ignitions and increased drought can inhibit chaparral regeneration and facilitate type conversion to exotic grassland and/or degraded shrubland communities. Invasive and problematic species perpetuate shifting fire regimes, while land use conversion contributes to habitat loss and fragmentation and alters invasive species establishment and fire ignition rates. Chaparral habitats have experienced significant fragmentation; current and future habitat continuity and extent are threatened by development and land use conversion and a variety of other landscape barriers, such as transportation corridors, agricultural and grazing lands, and fuel clearance/vegetation treatments. Interacting climate and non-climate stressors may reduce the inherent resilience of chaparral habitats, but moderate species diversity may bolster habitat adaptive capacity in the face of climate change. Chaparral habitats provide a variety of ecosystem services including biodiversity and recreation.



### Sage Scrub Habitat Vulnerability

**Moderate Vulnerability**



The relative vulnerability of sage scrub habitats in southern California was evaluated to be moderate by habitat experts due to moderate sensitivity to climate and non-climate stressors, moderate exposure to projected future climate changes, and moderate adaptive capacity. Sage scrub habitat distribution and composition is largely determined by precipitation and

<sup>1</sup> Although chaparral and sage scrub habitat vulnerability were evaluated separately, these habitats were combined in the discussion of adaptation strategies.

temperature. Warming temperatures and shifts in rainfall timing and drought timing and severity may affect sage scrub germination, recruitment, and overall species composition. Although sage scrub habitats are adapted to wildfire, increasing fire frequencies as a result of more human ignitions prevent sage scrub recovery and seedbank regeneration, creating conditions favorable for invasive species establishment and potential vegetation type conversion to exotic annual grassland. Nitrogen deposition also enhances invasive species establishment. Land use conversion significantly threatens sage scrub habitat extent, continuity, and vulnerability to wildfire ignition, invasive species pressure, and other impacts. A majority of historic sage scrub habitat in southern California has been destroyed, and human activities such as land use conversion, agriculture, transportation, and grazing contribute to habitat fragmentation and loss, limiting sage scrub dispersal potential. Sage scrub habitats are drought-adapted and able to recover from disturbance, but non-climate stressors such as invasive species and nitrogen deposition undermine the natural resilience of this habitat. Sage scrub habitats exhibit moderate-high diversity and provide a variety of ecosystem services including biodiversity, recreation, and carbon sequestration.

## Adaptation Strategies and Actions

Table 1 presents a summary of possible adaptation strategies and actions for chaparral habitats, and consists of stakeholder input during an adaptation workshop as well as additional options from the literature or other similar efforts. Stakeholders identified ways in which current management actions could be modified to reduce habitat vulnerabilities as well as future management actions that are not currently implemented but could be considered for future implementation.

Adaptation strategies and actions are grouped according to one of five categories:

1. **Enhance Resistance.** These strategies can help to prevent the effects of climate change from reaching or affecting a resource.
2. **Promote Resilience.** These strategies can help a resource withstand the impacts of climate change by avoiding the effects of or recovering from changes.
3. **Facilitate Transition (or Response).** These strategies intentionally accommodate change and/or enable resources to adaptively respond to changing and new conditions.
4. **Increase Knowledge.** These strategies are aimed at gathering more information about climatic changes, impacts, or the effectiveness of management actions in addressing climate change.
5. **Engage Coordination.** These strategies may help coordinate efforts and/or capacity across landscapes and agencies.

**Table 1.** Summary of possible adaptation options for chaparral and sage scrub habitats.

Adaptation Category	Adaptation Strategy	Specific Adaptation Actions
Enhance resistance	Restore disturbed areas with native species to limit erosion and prevent establishment of non-native species	<ul style="list-style-type: none"> <li>• Remove non-native species as soon as they are detected<sup>2</sup></li> <li>• Immediately plant or seed with native species after disturbance<sup>2</sup></li> <li>• Water restored native plants to ensure establishment<sup>2</sup></li> <li>• Exclude off-highway vehicles (OHVs) from restored sites<sup>2</sup></li> </ul>
	Practice rapid, effective fire suppression to minimize fire frequency and restore appropriate fire return intervals	<ul style="list-style-type: none"> <li>• Minimize or eliminate fuels treatments that can damage shrublands<sup>2</sup></li> <li>• Practice effective types of fuels management in strategic locations, particularly around at-risk human communities or key resources<sup>2</sup></li> </ul>

<sup>2</sup> Denotes action identified by workshop participants.

Adaptation Category	Adaptation Strategy	Specific Adaptation Actions
Enhance resistance (con't)		<ul style="list-style-type: none"> <li>• Conduct patrols during high wind events for early detection of fire<sup>2</sup></li> <li>• Prevent fine fuel growth at road margins<sup>2</sup></li> <li>• Block sparks from igniting vegetation on roadsides<sup>2</sup></li> </ul>
	Increase public education and wildfire prevention efforts	<ul style="list-style-type: none"> <li>• Limit human activity and traffic in fire-prone areas to prevent ignitions<sup>2</sup></li> <li>• Move roadside power lines underground to reduce fire risk<sup>2</sup></li> <li>• Map ignition hotspots and reduce access to those areas<sup>2</sup></li> <li>• Increase fire prevention efforts<sup>3</sup> (education, law enforcement, elected officials)<sup>2</sup></li> <li>• Incorporate fire risk into land use planning (e.g., plan for defensible space, focus on the wildland-urban interface)<sup>2</sup></li> </ul>
Promote resilience	Promote occurrence and vigorous growth of native shrubs and other perennial species	<ul style="list-style-type: none"> <li>• Promote the occurrence and growth of early-season native species<sup>2</sup></li> <li>• Reduce grazing in July and August to encourage perennial growth<sup>2</sup></li> <li>• Revise grazing policies, and review and evaluate grazing allotment plans<sup>2</sup></li> <li>• Focus habitat restoration activities on sites that are less likely to experience very warm or dry conditions<sup>2</sup></li> </ul>
	Limit recreational use to decrease disturbance and risk of wildfire	<ul style="list-style-type: none"> <li>• Identify overused areas and limit recreational trails/roads and OHV use<sup>2</sup></li> <li>• Centralize recreation impacts to easy-access areas<sup>2</sup></li> <li>• Provide greater regulation and enforcement of recreational use and access restrictions<sup>2</sup></li> <li>• Create an education campaign for OHV users that emphasizes potential impacts<sup>2</sup></li> <li>• Improve public education and interpretive signage to increase understanding of impacts<sup>2</sup></li> <li>• Collaborate with law enforcement to regulate and enforce restrictions in highly impacted areas<sup>2</sup></li> </ul>
	Restore/manage habitat to reflect future climate conditions, not historical, while still benefitting native species and mirroring current ecological function	<ul style="list-style-type: none"> <li>• During restoration activities, focus resources on particularly resilient species and possibly incorporate species that are not currently on site (assisted migration)<sup>2</sup></li> <li>• Reseed/replant disturbed sites with species expected to do well under future climate conditions<sup>2</sup></li> <li>• Increase planning phase of restoration activities to buffer against years with unfavorable conditions<sup>2</sup></li> </ul>

<sup>3</sup> California Natural Resources Agency. (2009). *2009 California Climate Adaptation Strategy*. Retrieved from [http://resources.ca.gov/docs/climate/Statewide\\_Adaptation\\_Strategy.pdf](http://resources.ca.gov/docs/climate/Statewide_Adaptation_Strategy.pdf)

Adaptation Category	Adaptation Strategy	Specific Adaptation Actions
<b>Facilitate transition</b>	Identify vulnerable species and natural resources to inform protection efforts	<ul style="list-style-type: none"> <li>• Conduct spatial analysis to identify vulnerable species, incorporating levels of biodiversity, climate and non-climate threats, and functional diversity<sup>2</sup></li> <li>• Identify overused/impacted areas by conducting visitor counts during heavy use periods to inform development of regulation and/or education programs<sup>2</sup></li> </ul>
<b>Increase knowledge</b>	Determine risk of type-conversion from woody shrublands to exotic annual grasslands under projected climate scenarios, changes in fire regime, and management regimes	<ul style="list-style-type: none"> <li>• Determine historical pattern of type-conversion in southern California<sup>2</sup></li> <li>• Model impact of changes in climate and fire regime on risk and rate of type-conversion (risk of type-conversion and possible rate of conversion)<sup>2</sup></li> <li>• Model variability of past fire regime and climate and link with changes in percent cover of invasive species<sup>2</sup></li> <li>• Quantify ecosystem services provided by woody shrublands under past and future conditions (water flow, sedimentation, nitrogen absorption, carbon sequestration)<sup>2</sup></li> </ul>
<b>Engage coordination</b>	Limit recreational use to decrease disturbance and risk of wildfire	<ul style="list-style-type: none"> <li>• Collaborate with law enforcement to regulate and enforce restrictions in highly impacted areas<sup>2</sup></li> </ul>
	Coordinate with fire agencies and communities to reduce risk of wildfire	<ul style="list-style-type: none"> <li>• Educate fire agencies and communities about Best Management Practices for fuels treatments<sup>2</sup></li> <li>• Work with firefighters to determine most strategic locations for fuels management<sup>2</sup></li> <li>• Engage land use planners to reduce leapfrog development patterns and increase infill<sup>2</sup></li> </ul>

Table 2 identifies the key chaparral and sage scrub habitat vulnerabilities that may be reduced and/or addressed by various adaptation actions. These linkages are based on expert opinion.

Linking vulnerabilities to adaptation options can help managers decide which actions to implement and aid prioritization based on multiple factors (e.g., habitat type, observed or projected changes, ecosystem service). However, when selecting adaptation actions for implementation, it is also important to consider secondary effects on other resources, both positive and negative. For example, trail or road decommissioning may benefit aquatic systems by limiting erosion impacts but could also remove important access points to fire-prone areas. For more information about chaparral and sage scrub adaptation strategies and actions developed by participants during the workshop, including where and how to implement adaptation actions, implementation timeframe, collaborations and capacity required, and secondary effects on other resources (both positive and negative), please see the report *Climate Change Adaptation Strategies for Focal Habitats of Southern California*.

**Table 2.** Key vulnerabilities of chaparral and sage scrub habitats linked to specific adaptation actions; implementation of adaptation actions (central column) may help to directly reduce and/or address the impacts of identified climate and non-climate stressors and disturbance regimes (right columns). Actions highlighted in **red** represent adaptation strategies that enhance resistance, those highlighted in **orange** promote resilience, and those highlighted in **green** facilitate transition. Adaptation actions aimed at increasing knowledge and engaging coordination are not included in this table as they address vulnerability indirectly. Adaptation actions listed in this table include those identified by participants, in the scientific literature, and in other similar efforts.

Management Activity	Adaptation Actions	Climate Stressors		Disturbance Regimes	Non-Climate Stressors		
		✓	✓		✓	✓	✓
Habitat Management & Restoration Activities	Remove non-native species as soon as they are detected	✓	✓	✓	✓		✓
	Immediately plant or seed with native species after disturbance			✓	✓		
	Water restored native plants to ensure establishment		✓		✓		
	Promote the occurrence and growth of early-season native species		✓		✓		
	Focus habitat restoration activities on sites that are less likely to experience very warm or dry conditions	✓	✓				
	During restoration activities, focus resources on particularly resilient species and possibly incorporate species that are not currently on site (assisted migration)	✓	✓	✓			
	Reseed/replant disturbed sites with species expected to do well under future climate conditions	✓	✓	✓			
	Increase planning phase of restoration activities to buffer against years with unfavorable conditions	✓	✓				
	Conduct spatial analysis to identify vulnerable species, incorporating levels of biodiversity, climate and non-climate threats, and functional diversity	✓	✓	✓	✓	✓	✓
Fire Management Activities	Minimize or eliminate fuels treatments that can damage shrublands			✓		✓	
	Practice effective types of fuels management in strategic locations, particularly around at-risk human communities or key resources			✓		✓	
	Conduct patrols during high wind events for early detection of fire			✓			
	Prevent fine fuel growth at road margins			✓			
	Block sparks from igniting vegetation on roadsides			✓			
	Limit human activity and traffic in fire-prone areas to prevent ignitions			✓			
	Move roadside power lines underground to reduce fire risk			✓			
	Map ignition hotspots and reduce access to those areas			✓			
	Increase fire prevention efforts (education, law enforcement, elected officials)			✓			
Grazing Activities	Reduce grazing in July and August to encourage perennial growth		✓				
	Revise grazing policies, and review and evaluate grazing allotment plans		✓				
Recreation Management Activities	Exclude off-highway vehicles (OHVs) from restored sites			✓	✓		
	Identify overused areas and limit recreational trails/roads and OHV use			✓	✓		
	Centralize recreation impacts to easy-access areas			✓	✓		
	Provide greater regulation and enforcement of recreational use and access restrictions			✓	✓		
	Create an education campaign for OHV users that emphasizes potential impacts			✓	✓		
	Improve public education and interpretive signage to increase understanding of impacts			✓	✓		
	Identify overused/impacted areas by conducting visitor counts during heavy use periods to inform development of regulation and/or education programs			✓	✓		

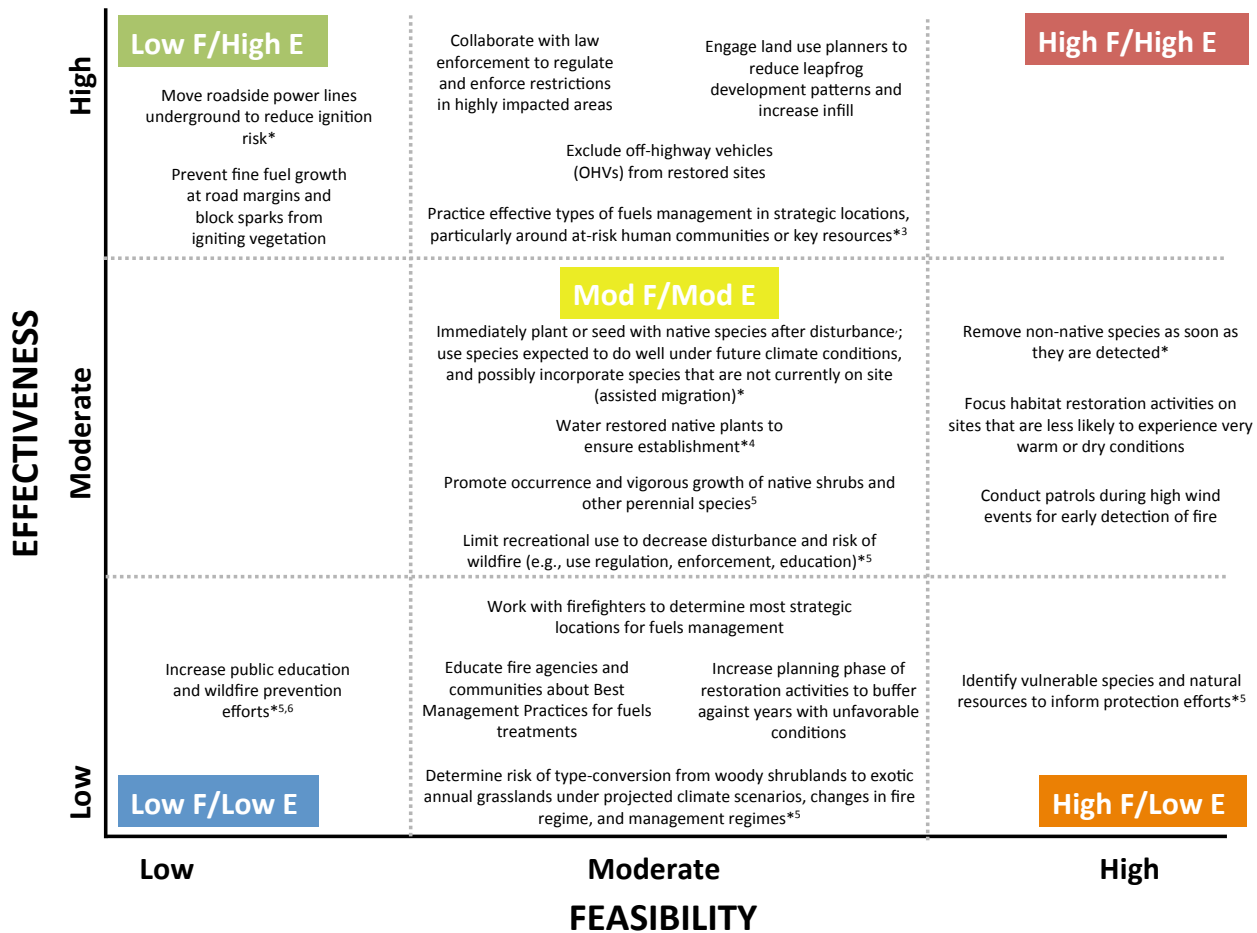
In addition to directly reducing some vulnerabilities (Table 2), some adaptation actions may indirectly address other vulnerabilities. For example, mitigating human-caused ignitions may help reduce the potential of invasive species establishment, which occurs more commonly in disturbed chaparral and sage scrub stands.

Two other important considerations when selecting adaptation actions for implementation include feasibility (action capable of being implemented) and effectiveness (action reduces vulnerability). An adaptation action with high feasibility has no obvious barriers and a high likelihood of implementation whereas an action with low feasibility has obvious and/or significant barriers to implementation that may be difficult to overcome. An adaptation action with high effectiveness is very likely to reduce associated vulnerabilities (listed in Table 2) and may benefit additional management goals or resources whereas an action with low effectiveness is unlikely to reduce vulnerability and may have negative impacts on other resources.

Figure 1 plots adaptation actions listed in Table 1 according to feasibility and effectiveness. This figure can help managers prioritize actions for implementation (e.g., actions with high feasibility and high effectiveness), better target management efforts toward specific challenges (e.g., actions with low or moderate feasibility but high effectiveness), and/or evaluate whether to proceed with implementation (e.g., actions with high feasibility but low effectiveness). For the latter two purposes, managers may consider the following questions:

- **Low or Moderate Feasibility/High Effectiveness Actions:** What steps can be taken to increase the likelihood of this action being implemented in the future?
  - *Example:* Would improving public outreach and education or enhancing public/private collaboration facilitate the removal of dikes or recharge basins with the goal of restoring fluvial processes?
- **High Feasibility/Low or Moderate Effectiveness Actions:** Does this action still make sense given projected climate changes and impacts?
  - *Example:* If conditions are projected to become drier, should grazing continue in areas with drought-sensitive vegetation?

Alternatively, there may be some actions that do not reduce vulnerability directly but could provide important information, tools, or support to address vulnerability down the line. For example, actions aimed at increasing knowledge through monitoring or modeling could provide key information for future restoration activities (e.g., creating detailed species genetic profiles to select genetically and ecologically suitable plant species for future conditions). Managers may want to weigh the costs and benefits of implementing actions with the timeframe required to reduce vulnerability directly. Additionally, actions focused on coordination and collaboration may not directly address vulnerabilities, but these remain important steps toward better planning and management.



**Figure 1.** Chaparral and sage scrub adaptation actions plotted according to implementation feasibility (action capable of being implemented) and effectiveness (action reduces vulnerability). Those actions having high feasibility and effectiveness appear in the upper right corner and low feasibility and effectiveness in the bottom left corner. An asterisk (\*) denotes adaptation actions evaluated for feasibility and effectiveness by workshop participants, although in some cases the ranking was shifted based on expert opinion. All other adaptation action evaluations are based on expert opinion.

### Recommended Citation

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This document is available online at the EcoAdapt website (<http://ecoadapt.org/programs/adaptation-consultations/socal>).

<sup>4</sup> Workshop participants noted that this action might not be as effective during severe fire weather.

<sup>5</sup> Workshop participants noted that this action might become less feasible and effective due to climate change.

<sup>6</sup> This adaptation strategy includes several specific adaptation actions (Table 1).

<sup>7</sup> Workshop participants noted that the feasibility and effectiveness of this action could increase given political and societal support.