Southern California Chaparral Habitats

Climate Change Vulnerability Assessment Summary

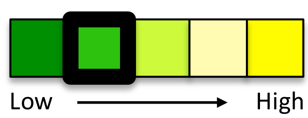
An Important Note About this Document: *This document represents an initial evaluation of vulnerability for chaparral habitats based on expert input and existing information. Specifically, the information presented below comprises habitat expert vulnerability assessment survey results and comments, peer-review comments and revisions, and relevant references from the literature. The aim of this document is to expand understanding of habitat vulnerability to changing climate conditions, and to provide a foundation for developing appropriate adaptation responses.*

Habitat Description

Chaparral ecosystems in southern California harbor high floristic diversity and provide critical habitat for a variety of wildlife species.[1] Chaparral is characterized by semi-arid shrub-dominated assemblages of sclerophyllous (i.e., hard-leaved) plants with adaptations to counter seasonal drought.[2] Dominant chaparral species can be categorized by mode of regeneration following fire: seedling recruitment, resprouting, or a combination of both strategies, termed facultative-seeding. Obligate seeders accumulate seed stores that require fire for germination. Obligate resprouters can recruit from seed during fire-free intervals, but seeds are killed by fire, requiring these plants to resprout from underground root structures or burls following burns. Facultative seeders use a combination of vegetative resprouting and seed germination.[3,4]

Habitat Vulnerability

Low-Moderate Vulnerability



High Confidence

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 increasing the frequency of firebrands and spot fires. Many chaparral species are fire-adapted, but increasing fire frequencies linked with increased human ignitions and drought can inhibit chaparral regeneration and facilitate type conversion to exotic grassland 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, agriculture, grazing, 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, recreation, and carbon sequestration.

Sensitivity

Low-Moderate Sensitivity

Low → High

High Confidence

Drought is the key climate driver affecting chaparral habitats, although chaparral distribution and species composition is influenced by moisture and temperature (particularly winter minimum temperatures).[2,4,5] Obligate seeders are typically associated with drier areas and have higher cavitation resistance (i.e., resistance of xylem to collapse), enabling survival during times of high water stress.[5,7] Obligate resprouters are associated with more mesic areas, and typically have deeper root systems, allowing enhanced access to water during drought periods.[8-10] Although adapted to wildfire, chaparral is negatively impacted by shorter fire return intervals.[11] Invasive species and land-use conversion can perpetuate shifting fire regimes,[2,12] and land-use conversion also fragments habitat, undermining migration in response to climate change.[13]

Habitat sensitivity factors and impacts[*]

CLIMATIC DRIVERS	Low-Moderate Sensitivity — High Confidence
Drought	Chaparral features several adaptations to accommodate seasonal drought,[2,14] but shifts in drought frequency, timing, and severity may result in: • Increased dieback and mortality;[15] obligate seeding and shallow-rooted seeding species may experience higher mortality[7,15] • Altered community composition[4,15,16] and potential novel germination patterns via canopy dieback[17] • Potential chaparral range shifts[15] • Elevated fire risk[18] by expanding length of peak ignition season[16,19] • Impaired post-fire recovery:[16,20] obligate seeders may fare better than obligate resprouting species in burned areas experiencing drought[16]
DISTURBANCE REGIMES	Low Sensitivity — High Confidence
Wildfire	Wildfire resets chaparral succession and increases biodiversity.[3] Recovery is typically rapid,[2,16,21] beginning with obligate seeding species[22] and followed by obligate resprouters.[3] However, fires are becoming more frequent due to enhanced increased human ignitions and enhanced drought conditions.[2,18,23-26] Altered fire regimes may cause: • Impaired regeneration, leading to shifts in composition and structure;[11,27] obligate seeding species are unlikely to have time to accumulate adequate seedbanks,[2] and obligate sprouters may experience high resprout

[*] Factors presented are those ranked highest by habitat experts. A full list of evaluated factors can be found in the Chaparral Habitats Climate Change Vulnerability Assessment Synthesis.

	mortality[11,28] • Potential type conversion to exotic grassland or degraded shrubland systems[28,29-31]
NON-CLIMATE STRESSORS	Moderate-High Sensitivity & Exposure; High Confidence
Invasive & problematic species	*Bromus* spp., *Centaurea* spp, and other invasive plants alter fire regimes in chaparral systems and compete for key resources.[2,30,31] Chaparral is at risk for invasion after canopy disturbance,[30,32] and invasives can be introduced along transportation corridors or in conjunction with human land use. Nitrogen deposition may enhance invasion.[30,32]
Land-use conversion	Human population growth and land use has contributed to significant chaparral habitat loss and fragmentation, limiting dispersal and the ability of this habitat to track changes in climate.[13] Development also alters fire ignition and invasive species establishment rates, particularly when human population growth extends into previously isolated stands and/or expands the wildland-urban interface.[12,19,24,33]

Exposure[†]

Low-Moderate Exposure

Low → High

High Confidence

Under future climate conditions, chaparral habitats will likely be exposed to increased wildfire, increased drought, and precipitation changes. Shifts in precipitation and temperature can alter chaparral distribution,[13,34] phenology,[35] and fire risk by altering relative herbaceous cover.[36] Fire will interact with land-use change, population growth,[12,19,26,37] and changing Santa Ana wind patterns to create spatially variable risk.[38,39] Chaparral habitat area is projected to decline in southern California by the end of the century, largely due to grassland expansion.[34] Obligate seeding species, particularly those with limited distribution, will likely experience larger habitat contractions by late century than obligate resprouting species.[13] However, many species will maintain 50% or more of current distribution by mid-century, with the exception of chamise, which is projected to experience an 82% reduction in suitable habitat area relative to current distribution during the same time period.[40] Experts believe that chaparral refugia areas from changing climate conditions may include canyons, north-facing slopes, more mesic areas, heterogeneously complex areas, areas with deeper soils, and/or areas isolated from human ignitions and exotic species.

Projected climate and climate-driven changes for Southern California

CLIMATIC DRIVERS	PROJECTED CHANGE
Precipitation	Variable annual precipitation volume and timing, with wetter winters and drier summers; increased climatic water deficit
Drought	Longer, more severe droughts with drought years twice as likely to occur
Wildfire	Increased fire size, frequency, and severity

[†] Relevant references for regional climate projections can be found in the Southern California Climate Overview (http://ecoadapt.org/programs/adaptation-consultations/socal).

Adaptive Capacity[‡]

Moderate Adaptive Capacity

Low → High

High Confidence

Chaparral habitats are incredibly diverse and span a range of geographic areas within the study region.[1,2] However, human population growth and associated development and land use have altered overall chaparral extent, continuity, and structural/functional integrity.[41,42] Although this habitat is fairly resilient to most climate stressors and can recover if given sufficient time, simultaneous exposure to multiple climate and non-climate stressors reduces overall habitat resilience in the face of climate change.[19]

Habitat adaptive capacity factors and characteristics[§]

FACTORS	HABITAT CHARACTERISTICS
Habitat extent, integrity, & continuity Moderate High Confidence	+ Chaparral occurs in many areas of southern California (coastal, inland, montane zones)[43] - Chaparral habitat connectivity and integrity is affected by extensive development, human population growth, and associated infrastructure,[41,42] with most severe impacts occurring in the wildland-urban interface[12,33] + Chaparral in southern California has experienced high levels of collaborative conservation planning[41,42]
Landscape permeability Moderate High Confidence	- There are several significant barriers to chaparral habitat/species dispersal, including land-use conversion, agriculture, grazing, transportation corridors, and fuel clearance/vegetation treatments - These barriers have become increasingly common, particularly near human communities, and may facilitate invasive species establishment
Resistance & recovery Low-Moderate Moderate Confidence	+ With the exception of too frequent fire and intense drought, chaparral is fairly resilient to climate stressors and recovers from disturbance if given sufficient time[31] - Many chaparral species are slow-growing, have limited dispersal potential, and are exposed to multiple stressors, which may undermine their ability to adapt or migrate in response to climate change[19]

‡ Please note that the color scheme for adaptive capacity has been inverted, as those factors receiving a rank of "High" enhance adaptive capacity while those factors receiving a rank of "Low" undermine adaptive capacity.

§ Characteristics with a green plus sign contribute positively to habitat adaptive capacity, while characteristics with a red minus sign contribute negatively to habitat adaptive capacity.

FACTORS	HABITAT CHARACTERISTICS
Habitat diversity Moderate-High High Confidence	+ High species diversity: chaparral is floristically diverse and hosts many endemic plants and native animals;[2] species composition varies widely between different geographic areas[1] - Functional group diversity is lower than interior chaparral communities (e.g., Arizona)[20]
Management potential Moderate Moderate Confidence	+ Moderate societal value: valued for recreation, watershed protection, environmental stability, slope stabilization, wildlife habitat, and aesthetics + Chaparral habitats provide a variety of ecosystem services: biodiversity, water supply/quality/sediment transport, fire regime controls, recreation, carbon sequestration, air quality, nitrogen retention, public health, and flood and erosion protection

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