Southern California Endemic Habitats

Climate Change Vulnerability Assessment Summary

An Important Note About this Document: *This document represents an initial evaluation of vulnerability for endemic 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

Endemic habitats feature specialized and distinct vegetative communities that are adapted to harsh and unique conditions derived, in part, from parent soil material.[1-5] Endemic habitats are typically limited in distribution, occupying distinct areas within the southern California study area.[1] Endemic habitats considered in this assessment include: serpentine, gabbro, carbonate, pebble plains, and clay lens communities.

Habitat Vulnerability

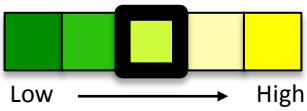
Moderate Vulnerability

Moderate Confidence

The relative vulnerability of endemic 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. Shifts in precipitation, moisture availability, and temperature may affect endemic habitat composition, survival, and vulnerability to non-climatic stressors. Endemic communities have variable responses to fire, but increasing fire frequencies are unlikely to benefit even the most fire-adapted communities due to slow recovery following disturbance. Endemic habitats face a variety of non-climatic stressors that reduce habitat resilience by increasing fragmentation and/or by exacerbating climate-driven changes; human population growth may increase the severity/extent of these stressors in the future. Unique soil requirements largely moderate endemic habitat distribution, species composition, and sensitivity to climate and non-climate stressors. Small, isolated populations, specific soil requirements, limited dispersal capacity, and several landscape barriers limit endemic habitat dispersal and recovery potential in the face of climate change, but specialized vegetation enhances habitat resistance. Endemic systems provide a variety of ecosystem services including biodiversity and recreation.

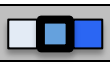
Sensitivity

Moderate Sensitivity



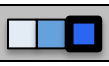
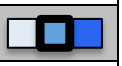
Endemic habitats are sensitive to several climate drivers, including drought, precipitation, soil moisture, and extreme high temperature events. In general, endemic habitats are adapted to harsh conditions (e.g., low moisture and nutrient availability) and are fairly resilient to fluctuations in precipitation and temperature due to historical exposure, although individual species resilience varies.[2] In addition, unique soil properties also control endemic species composition, distribution, and sensitivity to climate and non-climate drivers.[1,3-5] Endemic systems are sensitive to a variety of non-climate stressors that destroy, fragment, and/or degrade habitats, as well as exacerbate climate change impacts.[1,5] Human population growth in southern California will likely enhance many of these non-climate stressors, further increasing risk to endemic communities as development approaches national forest boundaries.

Habitat sensitivity factors and impacts*

CLIMATIC DRIVERS	Moderate Sensitivity  Moderate Confidence 
Precipitation & soil moisture	Endemic communities are largely adapted to water stress and unproductive soils,[2] but shifts in precipitation or soil moisture may result in: • Altered species composition, cover, richness, and fitness • Altered vulnerability to non-climate stressors (e.g., invasive species in serpentine habitats;[6-9] soil disturbance in pebble plains)[4,5]
Drought	Drought impacts are variable depending on drought length, seedbank persistence, dormancy cues, phenology and resilience of pollinators and mycorrhizae, soil microbes, and other factors. Increased drought may result in: • Increased mortality and reduced germination and recruitment for some habitats[10-12] • Altered invasive species pressure[9] and conifer and shrub encroachment patterns
Extreme high temperature events	Air temperature may influence plant survival or community composition. Increased air temperatures may cause: • Altered community composition or encroachment of other vegetative communities,[4] particularly if temperature changes drive snowpack shifts • Altered plant survival; many physiological heat tolerances are unknown
Snowpack†	In carbonate and serpentine communities, snowpack provides insulation and reduces wind desiccation.[13,14] In pebble plains communities, snowpack protects the clay-soil matrix and promotes frost heave in the root zone, helping prevent shrub and tree encroachment. Decreased snowpack may cause: • Higher exposure to wind and cold temperatures • Increased vulnerability to tree and shrub encroachment • Increased erosion

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

† Only some endemic habitats are sensitive to snowpack depth (i.e., pebble plains, serpentine, carbonate).

DISTURBANCE REGIMES	Moderate Sensitivity  High Confidence 
Wildfire	Endemic habitats vary in their sensitivity to wildfire: carbonate communities are fairly fire-intolerant,[5] serpentine species are adapted to periodic fire,[3,5,15] and gabbro communities depend on fire for regeneration.[5] Many communities are slow to recover from fire.[4,5] Altered fire regimes could cause: • Shifts in species composition, enhanced mortality, more frequent regeneration failures, or potential type conversion to other systems[4,5,15]
NON-CLIMATE STRESSORS	Moderate Sensitivity & Exposure  Moderate Confidence 
Serpentine communities	• Invasive species: atmospheric nitrogen (N) deposition reduces natural resilience to invasion;[6,16] enhanced N deposition and elevated water availability increase invasion success over time, while disturbance increases short-term invasive success[7] • Off-road vehicles: may increase trampling and disturbance[17,18] • Grazing, energy and mining: historical stressors (less prevalent today)[5,8]
Carbonate communities	• Energy production and mining: limestone, sand/gravel, and calcium-carbonate mining may destroy or fragment habitat, alter local microclimates, cause direct mortality or undesirable edge effects, and affect plant phenology through light pollution[12] • Many other human activities may alter and fragment habitat, increase soil compaction and erosion, alter surface/soil hydrology and affect plant vigor and fitness[1,5,12]
Gabbro communities	• Mining and land-use conversion: may degrade or extirpate gabbro species[1,4]
Pebble plains communities	• Recreation: may cause trampling, uprooting, sedimentation, and soil loss[1,5] • OHV and illegal vehicle use: ruts alter surface hydrology and cause soil compaction, remove the clay matrix, destroy vegetation, and invert seedbanks,[5] especially when soils are saturated • Roads: alter natural sheet water flow, generate dust that disrupts photosynthesis and reproduction, facilitate invasive species establishment,[5] and provide access points for unauthorized vehicles • Invasive species: alter ecological functioning,[1] compete for moisture and nutrients, and increase surface organics • Fire suppression: saline water and personnel camps/vehicles harm plants[1]

Exposure[‡]

Moderate Exposure

Under future climate conditions, endemic habitats are likely to be exposed to precipitation changes and increased wildfire. The scientific literature projects that roughly 66% of endemic

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

plant taxa in California will likely experience significant range reductions (>80%) by 2100.[19] Projections indicate that endemic plant diversity may shift toward more coastal and/or northern locations in California by the end of the century, although some species may exhibit southward movement as they attempt to colonize the coastal mountains of southern California.[19] In addition, topographical refugia may also be present at the local scale.[14] Migration to refugia will be limited by spatial isolation, soil specificity, limited dispersal capacity, and the severity and interaction of various climate changes.[2,14,19]

Projected climate and climate-driven changes for Southern California

CLIMATIC DRIVERS	PROJECTED CHANGE
Precipitation & snowpack	Variable annual precipitation volume and timing, with wetter winters and drier summers; reduced snowpack (-42%) and earlier snowmelt by mid-century
Soil moisture & drought	Increased climatic water deficit; longer and more severe droughts with drought years twice as likely to occur
Wildfire	Increased fire size, frequency, and severity
Air temperature & extreme heat events	+2.5 to +9°C by 2100; heat waves, particularly humid nighttime heat events, will occur more frequently, last longer, and feature hotter temperatures

Adaptive Capacity[§]

Moderate Adaptive Capacity

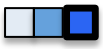
Small and isolated populations, unique soil requirements, limited dispersal capacity, and several landscape barriers may inhibit the ability of endemic habitats to track shifts in climate. Although endemic vegetation is adapted to fairly harsh conditions, these species are typically slow to recover from disturbance. Endemic habitats harbor high biodiversity, but also many threatened and endangered species, which may be more sensitive to climate change due to limited distribution.[1,2,5,19,20] A majority of serpentine, carbonate, and pebble plains habitats occur on national forest land, while the majority of gabbro outcrops occur on non-federal land.[1]

Habitat adaptive capacity factors and characteristics[**]

FACTORS	HABITAT CHARACTERISTICS
Habitat extent, integrity, & continuity Low-Moderate  Moderate Confidence	- Small and disjunct populations[1-5] are vulnerable to extirpation[19,20] - Limited dispersal distances (average 10-100 m; rare >1 km),[2,11] make it unlikely that endemic species will keep pace with climate change[19] - Many endemics have low productivity, recover slowly from

[§] 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
	disturbance, and are outcompeted on all but the most unique and harsh soil types[1,4,5]
Landscape permeability Moderate  Moderate Confidence 	- There are several barriers to endemic habitat/species dispersal, including energy production and mining, transportation corridors, land-use conversion, grazing, and geologic features - Dispersal is also limited by specific soil requirements[2]
Resistance & recovery Low-Moderate  Moderate Confidence 	+ Vegetation is adapted to unique and harsh conditions - Recovery is slow and limited
Habitat diversity Moderate-High  Moderate Confidence 	+/- Collective diversity amongst all endemic habitats is high; diversity within a given endemic association is lower + High endemism; harbor many threatened and endangered plant and animal species[21]
Management potential Low-Moderate  High Confidence 	+ Moderate societal value: valued for recreational opportunities, scenic quality, biodiversity, habitat provisioning, and endemism + Endemic habitats provide a variety of ecosystem services: biodiversity, water supply/quality/sediment transport, recreation, carbon sequestration, nitrogen retention, air quality, public health, fire regime controls, and flood and erosion protection - Some habitats valued for economic potential (e.g., mining), which may threaten habitat persistence

Recommended Citation

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

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