Desert habitats are sensitive to climate drivers that exacerbate the already hot and dry conditions, enhancing vulnerability for many species that already exist close to their physiological limits. Climate drivers and disturbances (e.g., changes in precipitation, flooding, wildfire) have the potential to significantly alter species survival and composition. Slow-growing vegetation makes deserts particularly vulnerable to invasive grasses, which provide fine fuels for wildfire; ultimately, the cycle of invasive species and wildfire can cause type conversion to grasslands. Non-climate stressors have already disturbed and/or fragmented many desert habitats.

Habitat Description
There are three deserts in southern California: the Mojave Desert, the Colorado Desert (a subdivision of the larger Sonoran Desert), and the less well-known San Joaquin Desert, which historically and included much of the San Joaquin Valley, Carrizo Plain, and Cuyama Valley. These desert ecosystems contain the highest temperature extremes in the United States; topographical relief in these desert ecosystems ranges from 86 m below sea level in Death Valley up to 3300 m above sea level in the Panamint Range.

Projected Climate and Climate-Driven Changes

<table>
<thead>
<tr>
<th>Changes in precipitation, decreased soil moisture, and increased drought</th>
<th>Potential Impacts on Desert Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in timing and amounts of seasonal precipitation; longer, more severe droughts with droughts years twice as likely to occur</td>
<td>• Loss of critical water sources and associated microclimate refugia (e.g., palm oases) • Changes in plant phenology (e.g., germination, blooming) • Increase in drought-adapted vegetation, including succulents • Reduced seedling establishment, leading to older age classes</td>
</tr>
</tbody>
</table>

| Increasing temperatures & extreme heat events | Increasing evapotranspiration and loss of soil moisture | • Increased dependence of wildlife on underground thermal refugia, reducing opportunities to forage | • Damaged ability of plants to photosynthesize |
| +2.5 to +9°C by 2100; heat waves will occur more frequently, last longer, and feature hotter temperatures |

| Altered fire regimes | Altered species composition and population structure | Increased invasive annual grasses and associated increases in availability of fine fuels, leading to more fire | Direct mortality, reduced survival, and reduced reproductive success in wildlife (e.g., desert tortoises, western yellow bats) |
| Increased fire size, frequency, and severity |

Factors that enhance adaptive capacity:
+ High levels of biodiversity, including many rare, endemic, and threatened/endangered species
+ Species specifically adapted to drought and heat may be able to expand range
+ Limited habitat fragmentation compared to other habitat types
+ Valued for research potential

Factors that undermine adaptive capacity:
- Plant species are slow to recover from disturbance and exist close to physiological limits
- Habitat migration limited by anthropogenic and geological barriers
- Habitat may not be valued by the public, except for recreation opportunities and land use conversion (e.g., to agriculture, energy development).

Drivers of Desert Habitats
- Climate sensitivities: Precipitation, soil moisture, low stream flows, drought, extreme heat events
- Disturbance regimes: Wildfire, flooding
- Non-climate sensitivities: Invasive species
### What kinds of adaptation options are there?

<table>
<thead>
<tr>
<th>Adaptation Category</th>
<th>Adaptation Strategy</th>
<th>Specific Management Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhance Resistance</td>
<td>Design educational programs to address potential safety issues and limit non-climate stressors</td>
<td>- Communicate with the public about access to roads and recreation areas through signage, visitor centers, and brochures</td>
</tr>
</tbody>
</table>
|                     | Manage invasive species, including non-native grasses | - Remove non-native grasses around possible ignition sites
- Identify the species that may colonize sprayed areas and develop a plan |
|                     | Reduce possibility of severe wildfire | - Close access to roads and campgrounds during high fire hazard years or when site needs to recover; direct visitors to more resilient sites |
| Promote Resilience  | Protect and enhance seeps and springs, as well as the source aquifer(s) that supply them | - Discourage visitor use of springs in sensitive spring areas
- Protect a buffer zone for natural vegetation around spring sites to minimize effects of storm runoff |
| Facilitate Transition| Identify and protect desert refugia | - Prioritize land acquisition to target areas with potential refugia, such as seeps and springs, foothills, and dunes
- Protect desert refugia through varied strategies such as land acquisition, land use planning, and land transfers |
| Increase Knowledge  | Establish monitoring programs to detect changes over time | - Monitor desert biodiversity, including invertebrates and soil microbial communities |
| Engage Collaboration | Collaborate with decision-makers to create policies that support healthy ecosystems | - Identify current policies that could offer funding or logistical support for desert research and restoration projects |

*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

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

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