Habitat Description
In southern California, pinyon-juniper woodland habitats are typically found in mid- to high-elevation areas of the Mojave Desert, and in the San Jacinto and Santa Rosa Mountains (between 1,070 and 2,440 m). They are typically located on slopes above desert or Joshua Tree forests, where the climate is characterized by low precipitation, hot summers, and intense sunlight. Pinyon-juniper woodlands are characterized by an open overstory; the understory ranges from very dense to open.

Habitat Vulnerability

Pinyon-juniper woodlands are sensitive to drought, primarily due to low seedling recruitment and growth rates that may prevent habitat regeneration; dry conditions have been linked to tree mortality and range contraction. Moisture-stressed trees are more vulnerable to insects and disease, and anthropogenic stressors such as pollution can exacerbate the impacts of climate stressors. Human activity may contribute to increased fire ignitions, and more frequent and/or severe wildfires may not allow stand regeneration, resulting in the loss of large areas of habitat.

Projected Climate and Climate-Driven Changes | Potential Impacts on Pinyon-Juniper Woodlands
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**Increased temperature**
+2.5 to +9°C by 2100 | • Reduced growth, tree mortality, and range contraction
• Shifts toward increasingly dense, young-age stands
• Possible range shifts to the north and upward in elevation

**Changes in precipitation and soil moisture**
*Variable annual precipitation amount and seasonal pattern; decreased soil moisture* | • Decreased seedling survival when summer precipitation is low
• Tree mortality and habitat contraction during periods of low precipitation

**Increased drought**
*Longer, more severe droughts with drought years twice as likely to occur* | • Tree mortality, large-scale dieback, and/or range contraction
• Increased vulnerability to future drought events, as well as insects, pests, and disease

**Altered fire regimes**
*Increased fire size, frequency, and severity* | • Increased mortality and loss of seeds and/or seedlings from more frequent or severe fires
• Shift towards shrub- and grass-dominated ecosystems

Drivers of Pinyon-Juniper Woodlands
- **Climate sensitivities:** Precipitation, drought
- **Disturbance regimes:** Wildfire, insects
- **Non-climate sensitivities:** Pollution, fire suppression practices

Factors that enhance adaptive capacity:
+ Widespread habitat type in the western U.S.
+ Relatively extensive habitat remains, including connected patches for wildlife movement
+ Moderately-high species diversity, with varied woodland composition depending on location
+ Provides variety of ecosystem services: aesthetics, cultural values, recreation

Factors that undermine adaptive capacity:
- Species movement/dispersal limited by geologic features and grazing practices
- Very slow to recover from disturbance
- Pinyon species have shorter-lived seeds than juniper and depend on nurse plants for survival
- Previous injury or reduced growth due to stressors lowers resistance to future events
Adaptation Strategies for Pinyon-Juniper Woodlands

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

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<th>Adaptation Category</th>
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| Enhance Resistance   | Prevent stand-replacing wildfire | • Reduce fine fuels (exotic annual grasses)\(^1\)  
• Practice aggressive management of wildfire\(^1\) |
|                     | Ensure survival of seedlings after habitat restoration efforts | • Create barriers between restoration areas and sources of human ignition |
| Promote Resilience   | Maintain resources for wildlife | • Encourage the management of high producing pine nut stands to sustain production for wildlife and cultural use\(^2\) |
|                     | Increase survival and recovery from drought | • Manage stand density (e.g., thinning) to reduce competition among trees for water resources |
|                     | Promote understanding of habitat benefits | • Educate public and private land managers to recognize woodland diversity and possible management options\(^2\) |
| Facilitate Transition| Allow upslope migration of vegetation and wildlife | • Plan to protect continuous natural blocks to preserve corridors for migration and range shifts\(^1\) |
|                     | Establish local seed banks for long-term restoration projects | • Collect seed from trees in lower-elevation bands  
• Increase species and genetic diversity within seed collection |
| Increase Knowledge   | Monitor habitat extent and range shifts | • Map the upslope migration of pinyon-juniper habitat, as well as the potential invasion of desert scrub into current pinyon-juniper stands\(^1\) |
| Engage Collaboration | Work across jurisdictions | • Collaborate with tribes to protect pinyon-juniper woodlands for their cultural and historical value\(^3\) |

*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

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](http://ecoadapt.org/library).

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