Climate Change Vulnerability and Adaptation Strategies for Natural Communities

Piloting methods in the Mojave and Sonoran deserts

https://connect.natureserve.org/publications/hccvi

Advisory Committee

Focal Natural Communities

1. Great Basin Pinyon-Juniper Woodland
2. Mojave Mid-Elevation (Joshua Tree-Blackbrush) Mixed Desert Scrub
3. Sonora-Mojave Creosotebush-White Bursage Desert Scrub
4. Sonoran Paloverde-Mixed Cacti Desert Scrub
5. Apacherian-Chihuahuan Semi-Desert Grassland and Steppe
6. Sonora-Mojave Mixed Salt Desert Scrub
7. North American Warm Desert Active and Stabilized Dune
8. North American Warm Desert Riparian Woodland and Shrubland and Stream
9. Sonora-Mojave Desert Springs and Seeps
10. North American Warm Desert Mesquite Bosque

See type descriptions on http://www.natureserve.org/explorer/

HCCVI Flow Chart

Climate Trends → Exposure → Sensitivity

Adaptive Capacity

Climate Envelope Modeling

Direct Climate Change Effects on Natural Communities

HCCVI Flow Chart

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Current Climate Envelope

Direct Climate Change Effects on Natural Communities

Climate Envelope Shift

12% overlap between 2010 & 2060
### Tabular Summary

<table>
<thead>
<tr>
<th>Variable (Month, 2050 forecast)</th>
<th>% of Area with Value ≥ 2 std dev departure</th>
<th>Mean Departure from Baseline (°C, Precip in Inches)</th>
<th>Min</th>
<th>Max</th>
<th>std</th>
</tr>
</thead>
<tbody>
<tr>
<td>January Min Temp</td>
<td>3.7%</td>
<td>5.9</td>
<td>5.3</td>
<td>7.1</td>
<td>0.3</td>
</tr>
<tr>
<td>May Min Temp</td>
<td>6.2%</td>
<td>4.8</td>
<td>4.3</td>
<td>5.6</td>
<td>0.4</td>
</tr>
<tr>
<td>June Min Temp</td>
<td>57.2%</td>
<td>5.7</td>
<td>4.4</td>
<td>8.4</td>
<td>0.6</td>
</tr>
<tr>
<td>June Max Temp</td>
<td>17.1%</td>
<td>6.2</td>
<td>5.2</td>
<td>9.1</td>
<td>0.4</td>
</tr>
<tr>
<td>July Min Temp</td>
<td>56.4%</td>
<td>6.4</td>
<td>4.9</td>
<td>9.0</td>
<td>0.6</td>
</tr>
<tr>
<td>July Max Temp</td>
<td>91.1%</td>
<td>5.5</td>
<td>3.9</td>
<td>8.7</td>
<td>0.6</td>
</tr>
<tr>
<td>August Min Temp</td>
<td>95.9%</td>
<td>6.9</td>
<td>5.1</td>
<td>9.6</td>
<td>0.6</td>
</tr>
<tr>
<td>August Max Temp</td>
<td>98.8%</td>
<td>5.9</td>
<td>4.3</td>
<td>8.6</td>
<td>0.6</td>
</tr>
<tr>
<td>August Tot. Precip</td>
<td>11.3%</td>
<td>0.9</td>
<td>0.3</td>
<td>3.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Sept. Min Temp</td>
<td>91.6%</td>
<td>6.6</td>
<td>4.6</td>
<td>8.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Sept. Max Temp</td>
<td>7.1%</td>
<td>7.1</td>
<td>5.6</td>
<td>7.5</td>
<td>0.3</td>
</tr>
<tr>
<td>October Max Temp</td>
<td>4.7%</td>
<td>7.2</td>
<td>6.6</td>
<td>8.5</td>
<td>0.3</td>
</tr>
<tr>
<td>October Min Temp</td>
<td>81.3%</td>
<td>6.5</td>
<td>4.9</td>
<td>8.3</td>
<td>0.4</td>
</tr>
<tr>
<td>November Min Temp</td>
<td>8.3%</td>
<td>5.4</td>
<td>4.3</td>
<td>7.1</td>
<td>0.6</td>
</tr>
<tr>
<td>December Min Temp</td>
<td>0.2%</td>
<td>5.3</td>
<td>4.3</td>
<td>6.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

### Indirect Climate Change Effects on Natural Communities

#### Invasive Species

[Map showing potential abundance of invasive annual grasses]

#### Biophysical Variability

[Map showing unique isobioclimates]
Adaptive Capacity of Natural Communities

**Diversity within Functional Species Groups**

- **Environmental Response** (e.g., drought tolerance)
- **Pollinators** (bats, bees, etc.)
- **Trophic levels** – predator/grazer
- **Roles in geochemical processes**

That is a “keystone” species! (assessed CC vuln. individually)

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**Linking Vulnerability Assessment to Adaptation Strategy**

<table>
<thead>
<tr>
<th>Build conceptual model</th>
<th>Assess climate change impacts</th>
<th>Identify future climate scenarios</th>
<th>Vulnerability Assessment</th>
<th>Implement action plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate actions</td>
<td>Adaptation Strategy</td>
<td>Develop action plan</td>
<td>Monitor and evaluate action plan efficacy</td>
<td></td>
</tr>
</tbody>
</table>

Cross et al. 2012

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**Summary Table**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Direct Effects</th>
<th>climate sensitivity</th>
<th>climate impact</th>
<th>climate stress</th>
<th>climate forecast</th>
<th>Indirect effects</th>
<th>Resilience</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>North American Warm Desert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desert Scrub</td>
<td>Moderate</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Mojave Mixed Salt Desert</td>
<td>Moderate</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sonora</td>
<td>Moderate</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

| 5 types = High Vulnerability |
| 10 types = Moderate Vulnerability |

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**Climate Change Strategy Options**

**RESISTANCE**

- **Low vulnerability**
  - Maintain the status quo, e.g., fire prevention to preclude fire in certain desert types

**RESILIENCE**

- **Moderate – High vulnerability**
  - Allow temporary changes in structure and function, e.g., riparian/streams to facilitate changes in future state, e.g., restore/maintain type

**RESPONSE**

- **Very High vulnerability**
  - Actively or passively facilitate changes, e.g., experimentally minimize obvious biodiversity loss

Adapted from Millar et al. 2007, Ecological Applications and USFS Climate Change Resource Center
Adaptation Strategies

• “No-regrets” actions to take within the next 5 years. (mostly resistance and resilience strategies; invest in targeted monitoring networks)

• “Anticipate Actions” over the coming 5-15 years. (mostly resilience strategies)

• “Wait and Watch” or potential actions to anticipate over the 15-30 year timeframe, with indicators to monitor and inform those future decisions. (mostly resilience, some transformation strategies; much prioritized research)

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Report: https://connect.natureserve.org/publications/hccvi