Vulnerability Assessment Results

Golden Gate Biosphere Network Adaptation Project

Images: NPS, Alison Taggart-Barone
Vulnerability Assessment Results

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Climate change vulnerability refers to the degree to which a resource is susceptible to and/or unable to cope with the adverse impacts of climate change.
Purpose of a vulnerability assessment:
Identify *which* resources are most vulnerable and *why*

- Exposure
- Sensitivity
- Adaptive Capacity

*Relative Vulnerability*

Vulnerability
(V = E*S – AC)

Figure adapted from Glick et al. 2011
**Exposure** is a measure of how much change in climate that resource is likely to experience.

**Factors affecting exposure**

- Direction and magnitude of change in climate stressors and disturbance regimes
- Degree of uncertainty associated with projected changes

Image: Justine Belson, U.S. Fish and Wildlife Service
Sensitivity is a measure of whether and how a resource is likely to be affected by a given change in climate factors.

Factors affecting sensitivity:
- Climate stressors
- Disturbance regimes
- Non-climate stressors
Adaptive Capacity is a measure of a resource’s ability to accommodate or cope with climate change impacts with minimal disruption.

Factors affecting adaptive capacity:
- **Extent and integrity**
- **Connectivity**
- **Resistance and recovery**
- **Diversity**
- **Public, societal, and cultural value**
- **Management potential**
- **Plasticity**

Image: Justine Belson, U.S. Fish and Wildlife Service
Why Assess Vulnerability?

Vulnerability assessments cannot...

Make a management decision for you
What Did We Do?

- Review of scientific literature
- Expert Assessment
- Vulnerability assessment two-day virtual workshop
- Vulnerability assessment worksheets for ecosystems and species
- 21 total assessments
### Vulnerability Assessments

#### 10 ecosystems

<table>
<thead>
<tr>
<th>Open oak woodlands/savannas*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal redwood forests*</td>
</tr>
<tr>
<td>Maritime chaparral</td>
</tr>
<tr>
<td>Freshwater marshes</td>
</tr>
<tr>
<td>Coastal prairie*</td>
</tr>
<tr>
<td>Coastal scrub</td>
</tr>
<tr>
<td>Mixed evergreen forests</td>
</tr>
<tr>
<td>Riparian forests/woodlands*</td>
</tr>
<tr>
<td>Coastal dunes*</td>
</tr>
<tr>
<td>Tidal marshes*</td>
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</tbody>
</table>

#### 11 species

<table>
<thead>
<tr>
<th>Mountain lion</th>
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<tbody>
<tr>
<td>Belted kingfisher</td>
</tr>
<tr>
<td>San Francisco common yellowthroat</td>
</tr>
<tr>
<td>Sanderlings</td>
</tr>
<tr>
<td>California black oak</td>
</tr>
<tr>
<td>Western leatherwood</td>
</tr>
<tr>
<td>Serpentine endemic rare plants</td>
</tr>
<tr>
<td>California red-legged frog</td>
</tr>
<tr>
<td>Coho and steelhead*</td>
</tr>
<tr>
<td>Mission blue butterfly*</td>
</tr>
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<td>San Bruno elfin butterfly*</td>
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**Vulnerability Results: Coastal Redwood Forests**

### Impact (Sensitivity + Exposure)

**High Impact**
- Precipitation amount/timing
- Drought
- Soil moisture
- Coastal fog
- Air temperature
- Altered stream flow
- Decreased redwood growth and seedling recruitment
- Increased evaporative demand and water stress
- Increased erosion and sedimentation
- *Wildfire regimes*
- *Non-climate stressors*: historic timber harvest, fire exclusion and suppression, invasive species, non-native pathogens, recreational use, dams and water diversions

### Adaptive Capacity

**Moderate AC**
- Public value and societal support
- Resistance to disturbances
- Relatively diverse species composition and habitat structure of old-growth forests
- Low structural complexity and associated biodiversity of young forests
- Fragmentation and loss of connectivity
Vulnerability Results: *Coho and steelhead*

### Impact (Sensitivity + Exposure)

**High Impact**

*Moderate Confidence*

- Freshwater temperature
- Air temperature/heat waves
- Precipitation amount/timing
- Altered streamflow
- Drought
- Sea level rise

- Increase in pathogens and algal blooms
- Disturbance and destruction of incubating eggs
- Barriers to spawning migration
- Reduction in habitat
- Decline water quality
- *Non-climate stressors:* dams and diversions, timber harvesting, development, livestock grazing and agriculture, pollution, invasive species, fire exclusion and suppression, hatchery production

### Adaptive Capacity

**Low AC**

*High Confidence*

- ▲ Juvenile steelhead may benefit from higher temperatures
- ▲ Flexibility and varied life history - steelhead
- ▲ Strong public support and interest and high societal value

- ▼ Endangered with limited distribution/extirpation
- ▼ Influx of contaminants
- ▼ Existing barriers – impacts on migration and spawning
## Relative Vulnerability: Ecosystems

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Vulnerability Score</th>
<th>Confidence Score</th>
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<tbody>
<tr>
<td>Open oak woodlands/savannas</td>
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Relative Vulnerability: Ecosystems

- **Low Vulnerability**
  - Open oak woodlands/savannas
  - Maritime chaparral
  - Coastal prairie

- **High Vulnerability**
  - Coastal scrub
  - Mixed evergreen forest
  - Coastal redwood forests
  - Coastal Dunes
  - Riparian forests/woodlands
  - Freshwater marshes
  - Tidal marshes
  - High Vulnerability

Ecosystems are classified based on their sensitivity, exposure, and adaptive capacity.
### Relative Vulnerability: Species

<table>
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Relative Vulnerability: Species

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  - SF common yellowthroat
  - CA black oak
  - Sanderlings
  - Mountain lion
  - Serpentine endemic rare plants
  - Western leatherwood

- **High Vulnerability**
  - Coho and steelhead
  - Mission blue butterfly
  - San Bruno elfin butterfly
  - CA red-legged frog

Sensitivity & Exposure
Vulnerability Assessment Trends Overall

**Climate Stressors**
- Freshwater temperature
- Soil moisture/drought
- Air temperature/heat waves
- Altered streamflow
- Sea level rise

**Disturbance Regimes**
- Wildfire
- Extreme storms and flooding

**Non-Climate Stressors**
- Residential/commercial development
- Fire exclusion/suppression
- Roads, highways, and trails
- Invasive/problematic species
- Dams & water diversions
- Pollution/poisons
Vulnerability Assessment Trends Overall

Adaptive Capacity Factors

▲ Public value and societal support

▲ Ability and capacity of managers to manage/cope with climate impacts

▲ Diverse species composition and habitat structure

▲ Resistance to/dependent on disturbances

▲ Potential to serve as refugia
Vulnerability Assessment Trends Overall

Adaptive Capacity Factors

- Endangered or threatened
- Influx of pollutants
- Existing barriers to dispersal (natural and manmade) – urban development & land conversion
- Conflicts or competing interests
- Isolated species populations
- Fragmented ecosystems
Questions?

Image: *Dirca occidentalis* (Western Leatherwood), Plant Image Library; USFWS, Joelle Belmonte