

# Assessing Vulnerability & Developing Adaptation Strategies for Key Southern California Habitats

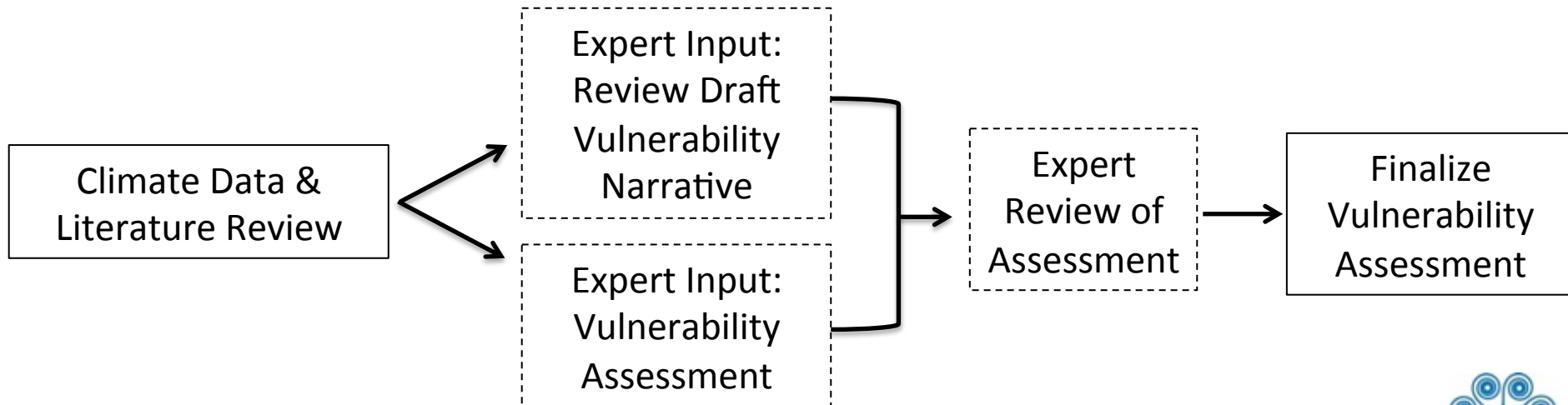
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# Vulnerability Assessment Methodology

1. Compile draft habitat vulnerability information and regional climate projections.
2. Distribute to 3-5 habitat experts; habitat experts complete online survey using provided information and review draft narrative.
3. Compile and review comments and scores from experts.
4. Finalize assessments.



Dashed lines indicate collaboration



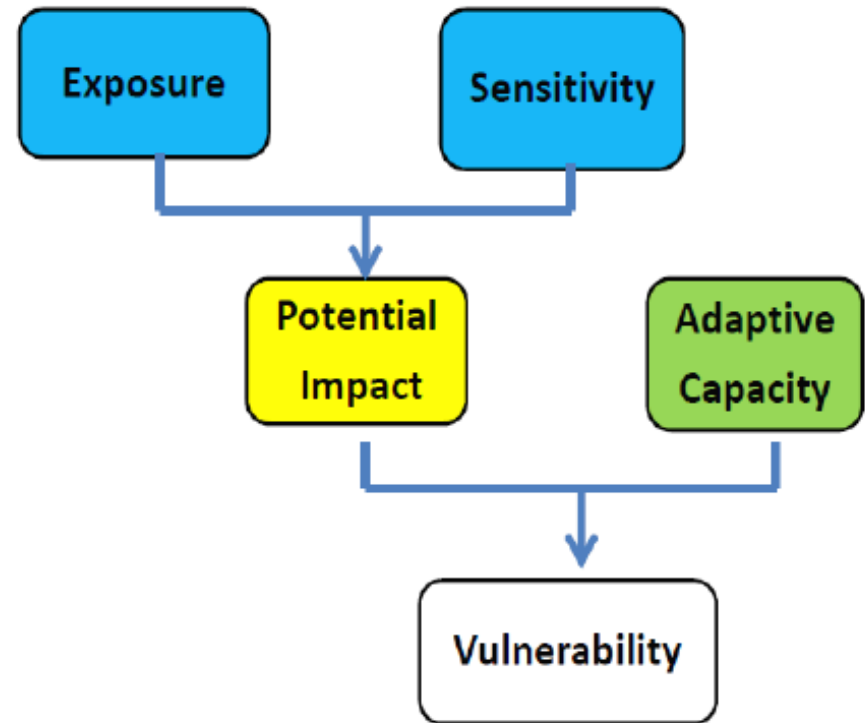
# Vulnerability Assessment

IPCC 2007

Vulnerability is....a function of the ***sensitivity*** of a particular resource to climate changes, its ***exposure*** to those changes, and its ***capacity to adapt*** to those changes.

Purpose of a vulnerability assessment:

Identify what resources are ***most vulnerable*** and ***why***



$$V = E * S - AC$$



# Assessing Exposure

Climate Variables	Future Projections
Annual Temperature	↑
Precipitation	Shifts from snow to rain, drier summers/wetter winters
Snowpack	↓
Runoff	↑ winter runoff flood frequency  Earlier spring runoff = prolonged & lower summer flows
Climatic water deficit and drought	↑
Groundwater recharge	Variable
Wildfire	↑

**Measure of how much of a change in climate or other environmental factor a resource is likely to experience.**

Exposure: Low (1) to High (5)  
Confidence: Low (1) to High (3)



# Assessing Sensitivity



**Measure of whether and how a resource is likely to be affected by a given change in climate.**

## **Factors affecting habitat sensitivity:**

- Climate drivers
- Disturbance regimes
- Non-climate stressors

Sensitivity: Low (1) to High (5)  
Confidence: Low (1) to High (3)





# Assessing Adaptive Capacity

**Ability to accommodate or cope with climate change impacts with minimal disruption.**

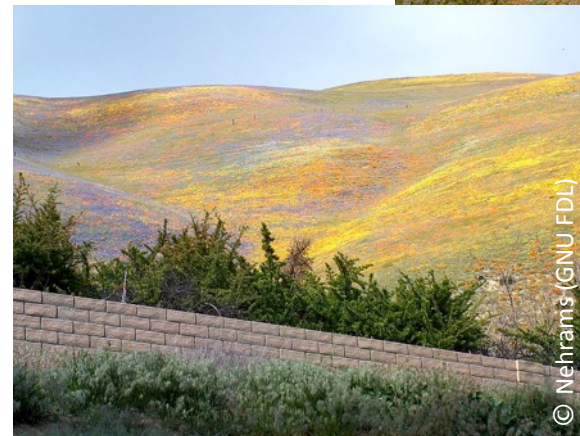
**Factors affecting habitat adaptive capacity:**





- Extent, integrity, continuity, landscape permeability
- Resistance and recovery
- Diversity
- Management potential













Adaptive Capacity: Low (1) to High (5)  
Confidence: Low (1) to High (3)



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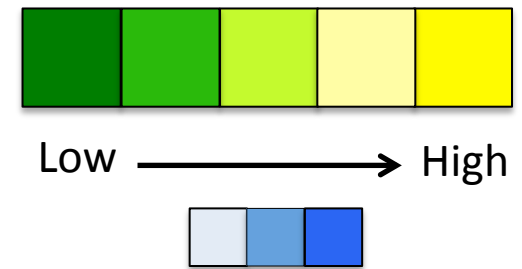


Overall Habitat Vulnerability	Exposure	Sensitivity	Adaptive Capacity
<p><b><u>ALLUVIAL SCRUB</u></b></p>  <p><b>MODERATE-HIGH</b> <i>High Confidence</i></p>	 <p><b>HIGH</b></p> <p>↑ Air temp, fire, drought</p> <p>△ Precip, stream flow</p> <p>↓ Soil moisture</p>	 <p><b>MODERATE-HIGH</b></p> <p>C: Precip, soil moisture, drought, low stream flows</p> <p>D: Flooding, fire</p> <p>NC: Invasives, dams/water diversions</p>	 <p><b>MODERATE</b></p> <p>- Degraded, lower continuity and diversity, site restrictions</p> <p>+ Resistance/recovery</p>

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<p><b><u>GRASSLANDS</u></b></p>  <p><b>MODERATE</b> <i>Moderate Confidence</i></p>	 <p><b>MODERATE-HIGH</b></p> <p>↑ Air temp, fire, drought</p> <p>△ Precip</p>	 <p><b>MODERATE</b></p> <p>C: Precip, soil moisture, drought, air temp</p> <p>D: Fire, herbivory</p> <p>NC: Invasives, land use conversion, grazing</p>	 <p><b>MODERATE</b></p> <p>- Degraded, lower continuity</p> <p>+ Higher extent, diversity, resistance &amp; recovery</p>
<p><b><u>CHAPARRAL</u></b></p>  <p><b>LOW-MODERATE</b> <i>Moderate Confidence</i></p>	 <p><b>LOW-MODERATE</b></p> <p>↑ Air temp, fire</p> <p>△ Precip</p>	 <p><b>LOW-MODERATE</b></p> <p>C: Drought</p> <p>D: Fire</p> <p>NC: Invasives, land use conversion</p>	 <p><b>MODERATE</b></p> <p>- Degraded, lower resistance</p> <p>+ Higher diversity, extent, continuity, and recovery potential</p>

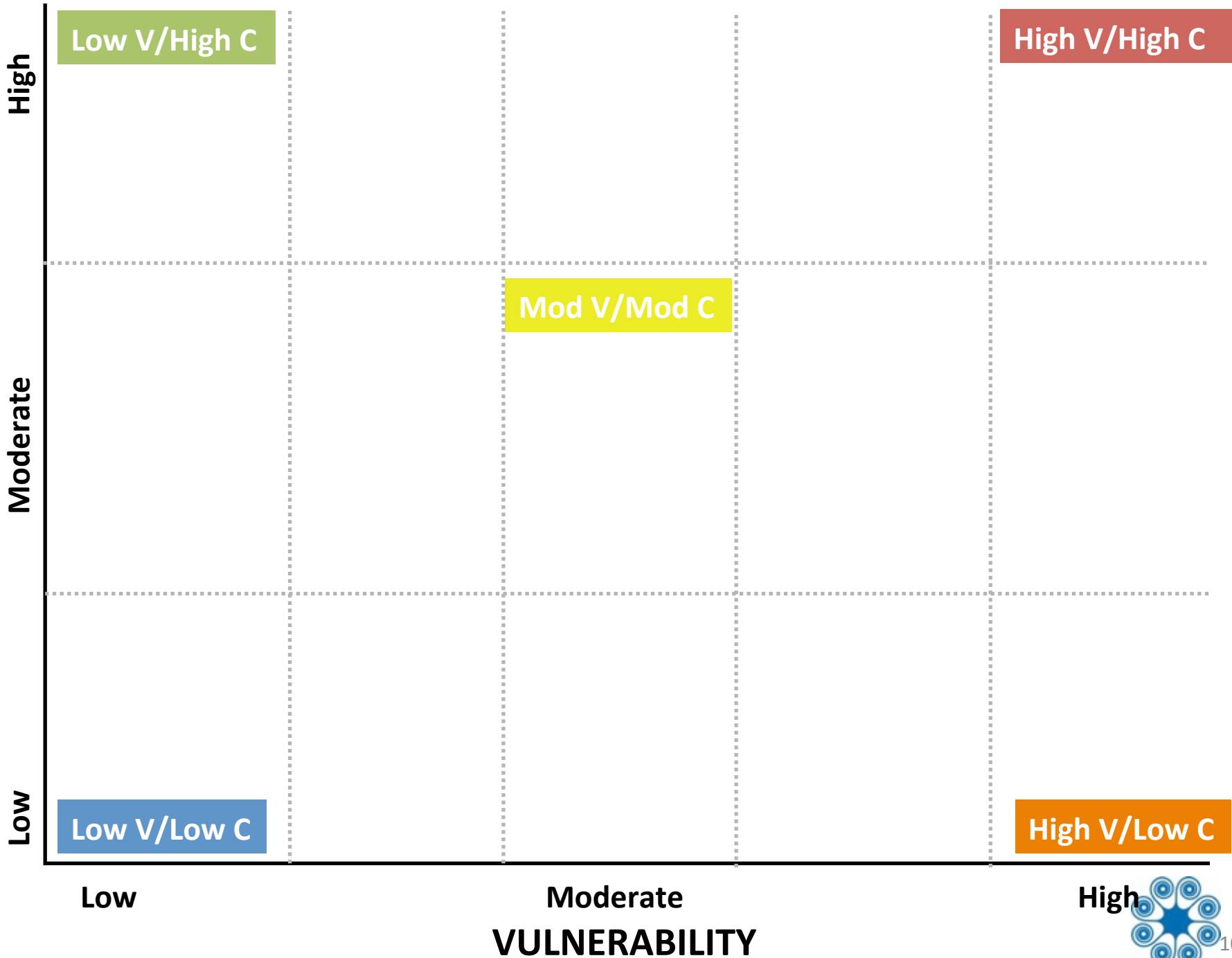


# Relative Vulnerability

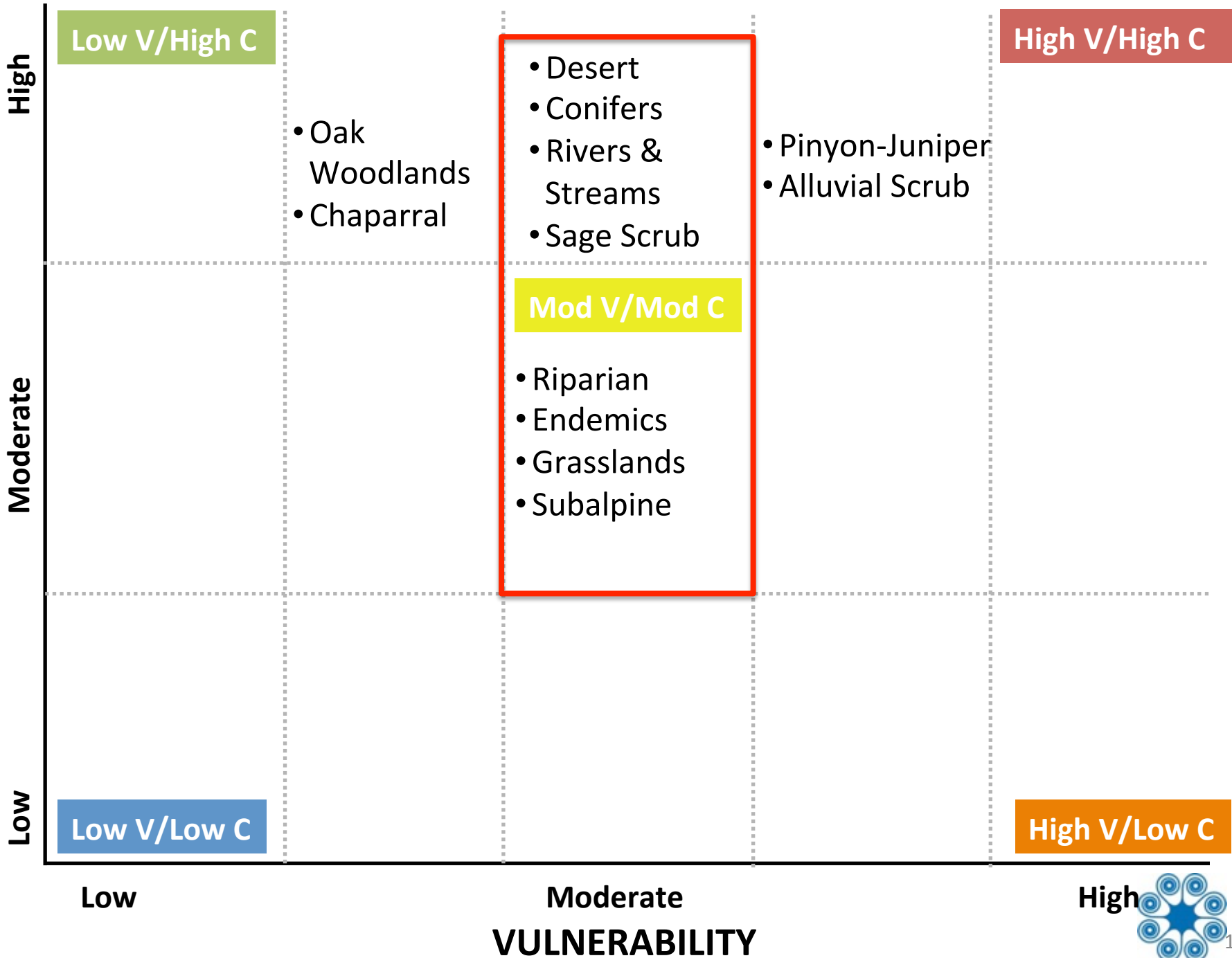


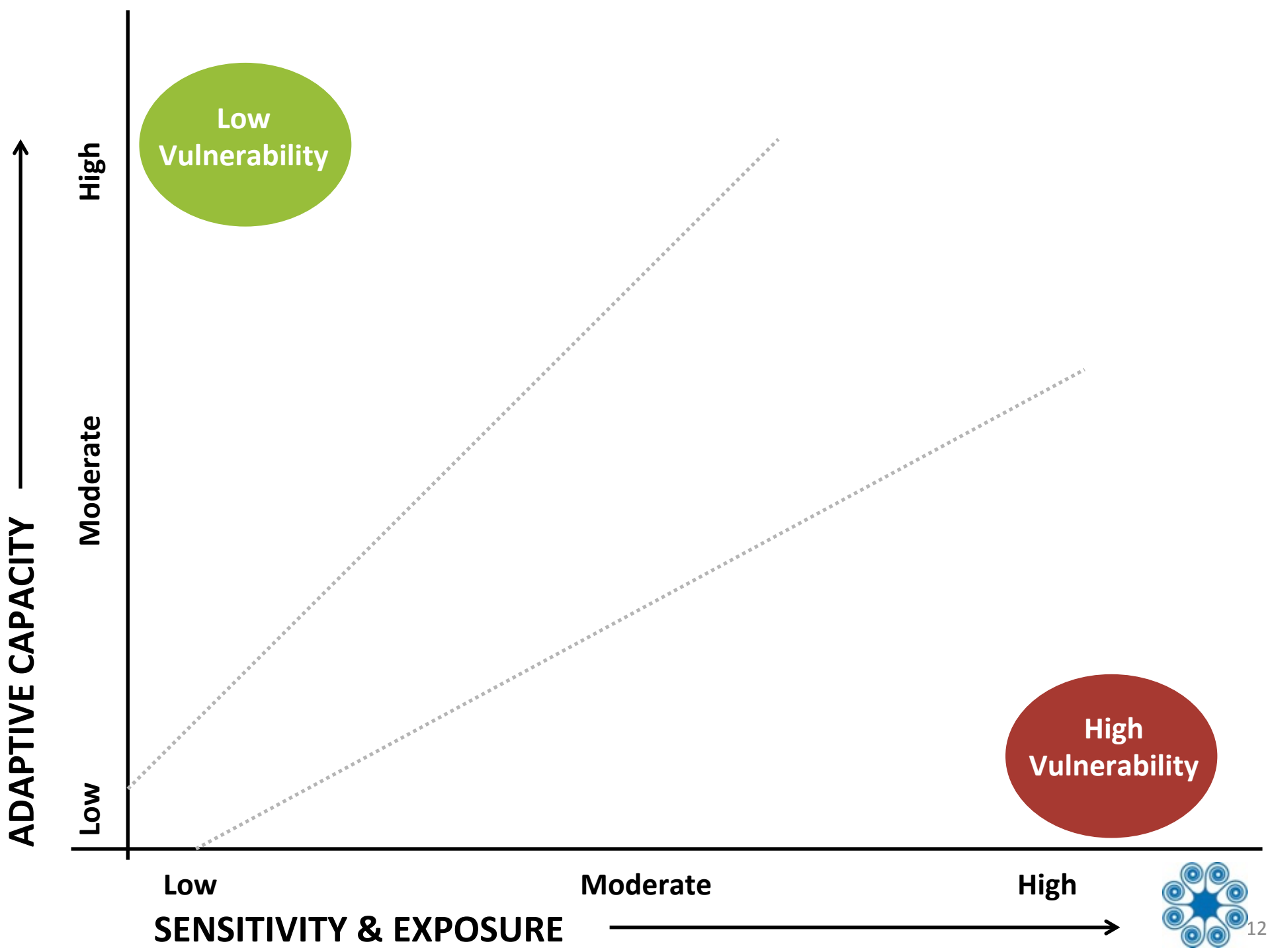
HABITAT	VULNERABILITY SCORE	CONFIDENCE SCORE
Pinyon-Juniper	Moderate-High	High
Alluvial Scrub	Moderate-High	High
Riparian	Moderate	Moderate
Desert	Moderate	High
River & Streams	Moderate	High
Endemics	Moderate	Moderate
Conifers	Moderate	High
Sage Scrub	Moderate	High
Grasslands	Moderate	Moderate
Subalpine	Moderate	Moderate
Oak Woodland	Low-Moderate	High
Chaparral	Low-Moderate	High

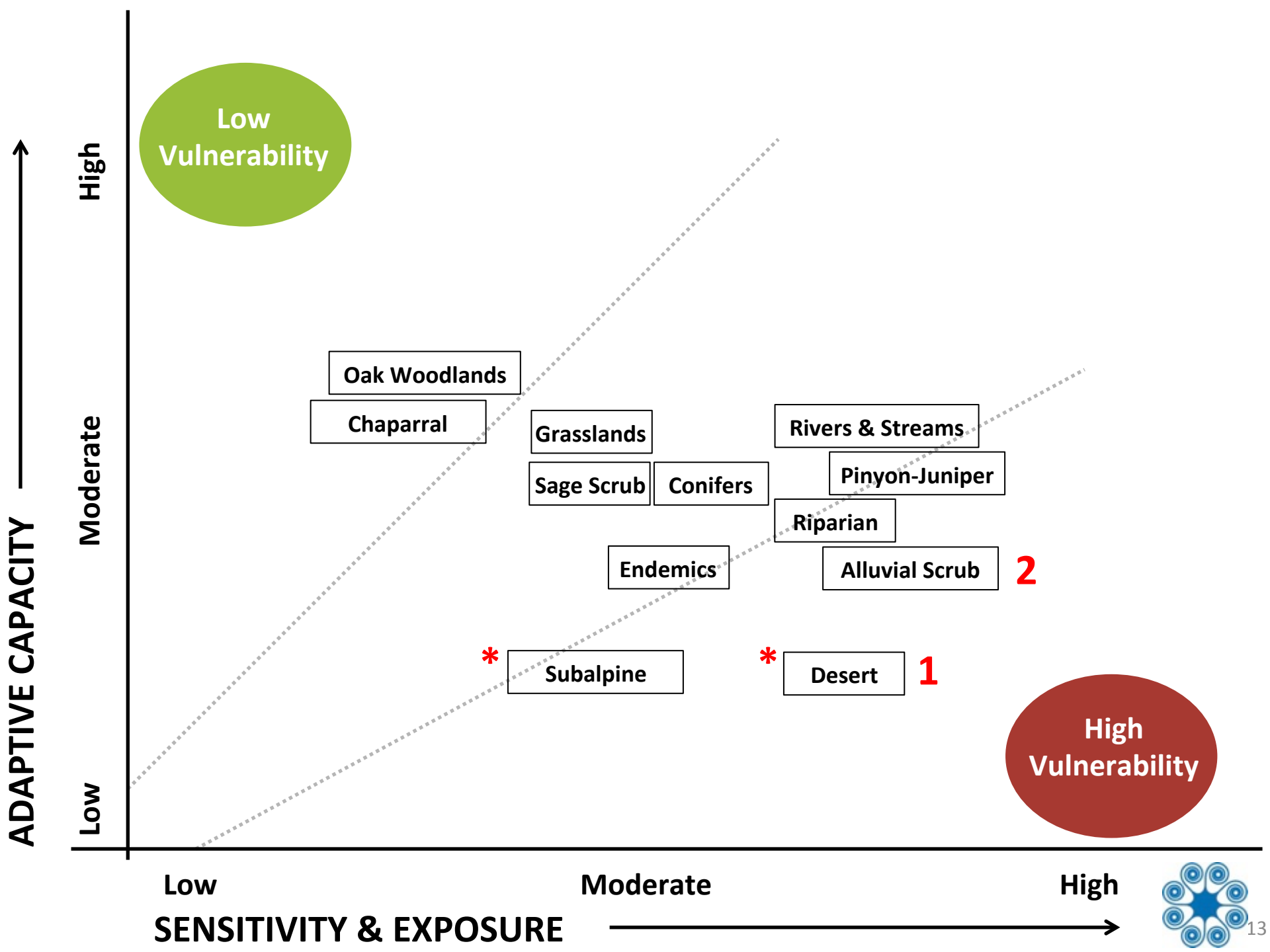
**CONFIDENCE**



**CONFIDENCE**







# Vulnerability Assessment Trends



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## Climate Stressors and Disturbance Regimes

- Precipitation variability
- Drought
- Soil moisture
- Wildfire

## Non-Climate Stressors

- Invasive species
- Land use conversion

## Adaptive Capacity

- + Decent species diversity
- + Provide many ecosystem services
- Fragmented and currently degraded





# Products and Applications

## Adaptation Ladder of Engagement®

7 Sharing

6 Evaluation

5 Integration

4 Implementation

3 Planning

2 Assessment

1 Awareness

brought to you by **EcoAdapt™**

- Vulnerability Assessment Report
  - Methodology
  - Climate Impacts Synthesis
  - Individual Habitat Summaries
  - In-depth Habitat Syntheses
- Habitat Vulnerability and Adaptation Strategy Briefings

*Thank you habitat experts!*



# Applying Vulnerability Information in Management Operations

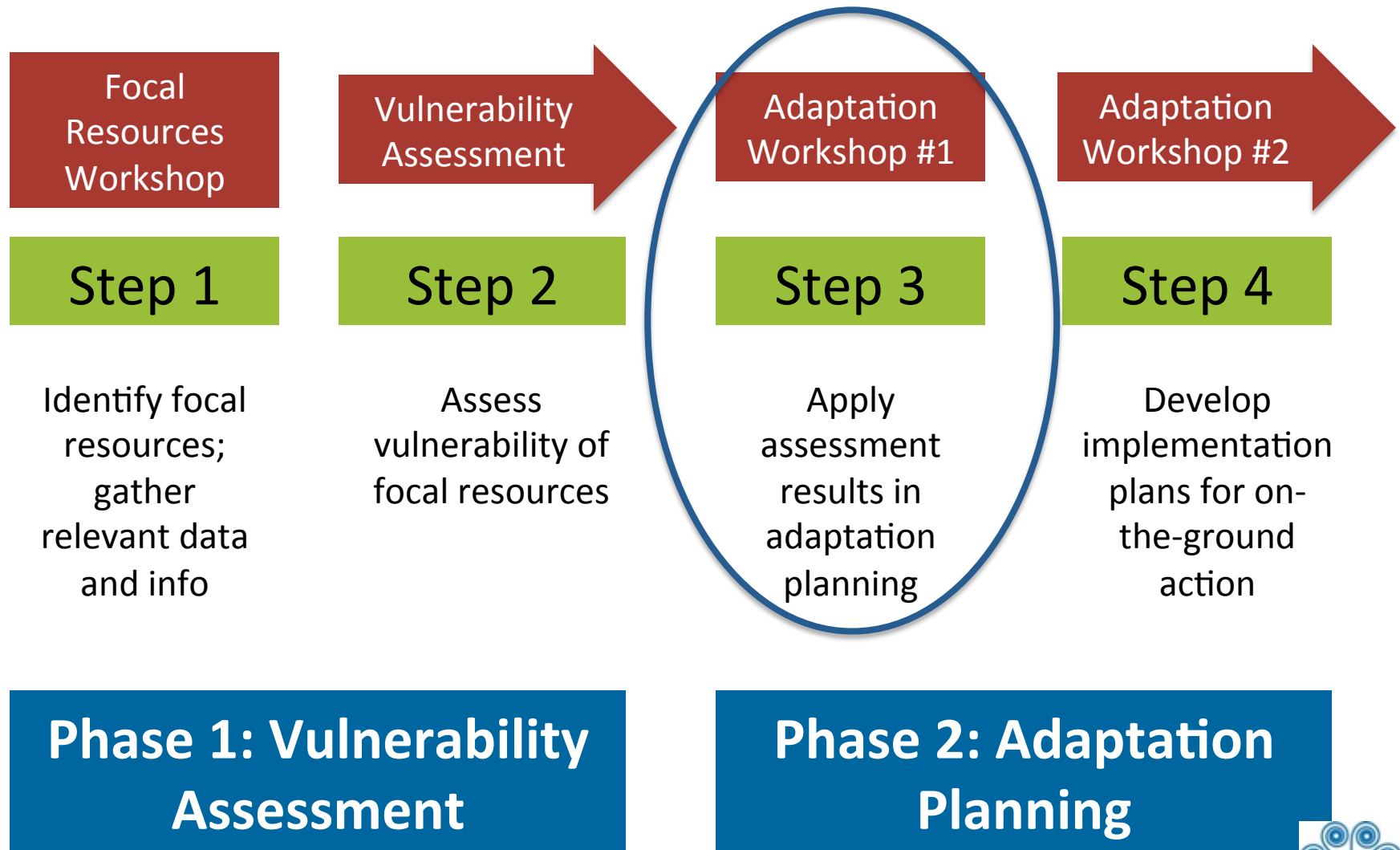
- **Management Assessments**
  - Forest Plan Assessments, Proposed Actions, Watershed Assessments
- **Resource Management Strategies**
  - Conservation strategies, Fire Management Plan, Travel Management Plan, etc.
- **Monitoring Plans**
  - Provides knowledge gaps where monitoring could be implemented

Forest Plan Assessment

5.0 Threatened, Endangered, Proposed and Candidate Species and Potential Species of Conservation Concern

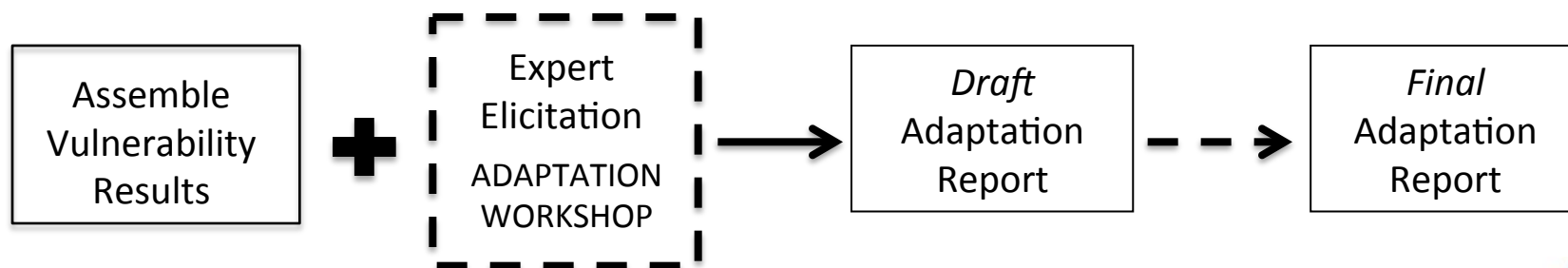


# Project Methodology



# Adaptation Planning Checklist

- ❑ Assemble vulnerability assessment results
- ❑ Collaboratively identify adaptation strategies and/or options for reducing resource vulnerabilities
- ❑ Synthesize adaptation strategies into final adaptation report



# Defining Adaptation

**Adaptation** refers to efforts to reduce the negative effects of or respond to climate change



**Adaptation actions** explicitly incorporate climate considerations, and aim to alleviate the impacts of climate change by increasing resilience and/or decreasing vulnerability





# Vulnerability



**Resistance**



**Resilience**



**Transition**

**Increase Knowledge**

**Engage Coordination**



# Adaptation Planning Workshop

1. Reviewed draft vulnerability assessment findings
2. Evaluated and revised current management actions based on potential climate vulnerabilities



3. Identified possible new management actions that address vulnerabilities
4. Evaluated current monitoring indicators in the context of climate change





# Current Adaptation Example: Chaparral & Sage Scrub

**Current Management Goal: Create habitat by restoring five acres per year of chaparral/sage scrub**

**Potential vulnerabilities:**

- Decreased seed germination due to drought/temperature increases
- Death of plants due to drought, competition with xeriscape plants, herbivory due to loss of other food sources
- Changes in species composition and reductions in species diversity; future type conversion
- Increased growth of invasive plants and/or changes in composition

Current Management Action	Current Effectiveness	Current Feasibility	Action Helps Address Vulnerabilities?	Continue to Implement Given Climate Vulnerabilities?	Where/How to Implement	Other Resource Considerations
Remove weeds	Moderate	High	Yes – invasive weed control, prevents weed expansion, reduces weed seed bank for natural plant germination in good years	Yes	<b>Where:</b> Weed areas that currently have some coastal sage scrub to enhance rather than restore from ground up <b>How:</b> Continue or increase weed control	<b>Other resources action benefits:</b> Clearing weeds will decrease impact on habitat <b>Other resources with potential conflicts:</b> None identified
Install native plants and seeds	Moderate	High	Yes – reduces fragmentation, and erosion, increases soil moisture and species diversity; creates seed bank for germination	Yes	<b>Where:</b> Select restoration areas that are less likely to dry out/less likely to suffer from heat (slopes, along coast, in canyons) <b>How:</b> Increase species in plantings that are hardy; focus on longer scale restoration (but possibly less intensively)	<b>Other resources action benefits:</b> California gnatcatcher, cactus wren, rare plant species <b>Other resources with potential conflicts:</b> Water use
Water plants to ensure establishment	Moderate	Moderate	Yes – helps to ensure success and establishment of native species	Maybe	<b>Where:</b> North slopes or shaded areas to maintain soil moisture <b>How:</b> Continuing to water may not be feasible or effective	<b>Other resources action benefits:</b> Helps habitat restoration <b>Other resources with potential conflicts:</b> None



# Future Adaptation Example: Conifer & Subalpine

## Management Goal: Maintain and/or enhance biodiversity of shifting communities and species

Adaptation Action	Effectiveness	Feasibility	Timeframe	Where/How to Implement	Collaboration & Capacity
Facilitate migration of co-adapted species	High	Moderate	Mid	<p><b>Where:</b> Vegetation transition zones – at lower and upper elevational limits</p> <p><b>How:</b> Identify species associations where one of several co-adapted species is limiting the migration rate of all, and move the limiting species (e.g., Cleveland NF – bring/reintroduce pinyon from escarpment up to top of Mt. Laguna)</p>	<p><b>External collaboration:</b> Scientists, researchers, ecologists, entomologists; state and county parks, CDFW, USFWS, BLM, other land managers</p> <p><b>Internal collaboration:</b> GIS, consulting biologists involved in planning (habitat conservation plans), etc.</p> <p><b>Capacity needed:</b> Monitoring for movement (GIS models); funding for studies, surveys, and analyses; niche analysis and risk analysis (pay local experts to identify likely assemblages and impacts on other species and assemblages, other vegetation/communities); identify/use surrogate species to indicate habitat shift</p>

## Management Goal: Improve stand resilience

Track and manage groundwater extraction both on and off the forest to prevent drawdown and promote forest resilience in the face of drought and higher temperatures	Moderate – High	Low	Long	<p><b>Where:</b> Watersheds in and adjacent to coniferous forest; focus on transition zones first and more mesic sites with highest chance of improving condition</p> <p><b>How:</b> Identify status of water rights; engage with landowners; monitor groundwater levels to quantify change; target acquisitions in areas where protecting groundwater is a priority</p>	<p><b>External collaboration:</b> State Water Resources Control Board, state, legislators, NGOs, Office of General Counsel</p> <p><b>Internal collaboration:</b> Hydrologists, silviculturists, lawyers</p> <p><b>Capacity needed:</b> Data, political and public will, legal/policy change, funding</p>
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# Compiled Adaptation Strategies Example: Alluvial Scrub



Adaptation Category	Adaptation Strategy	Specific Adaptation Actions
<b>Enhance resistance</b>	Restore native species to disturbed areas	<ul style="list-style-type: none"> <li>• <i>Restore habitat with native species that are tolerant of disturbed conditions</i></li> <li>• Build up a reserve of seeds and plants that are tolerant of disturbed conditions</li> </ul>
	Restore fluvial processes to streams that support alluvial scrub vegetation	<ul style="list-style-type: none"> <li>• <i>Remove dikes, mining operations, and recharge basins that obstruct the migration ability of streams and sediment deposition areas</i></li> <li>• Require undeveloped buffers along streams</li> <li>• <i>Raise roads out of washes</i></li> </ul>
<b>Promote resilience</b>	Maintain and/or restore the natural and historical characteristics of a watershed	<ul style="list-style-type: none"> <li>• Designate critical habitat where the most sensitive species are found, and in areas where the home ranges of several species overlap</li> </ul>
	Improve ability to confidently source plants for alluvial scrub restoration	<ul style="list-style-type: none"> <li>• <i>Conduct a common garden experiment which includes plants from across the species' range in order to understand the level of adaptive variation within the population</i></li> </ul>
<b>Facilitate transition</b>	Identify and protect refugia	<ul style="list-style-type: none"> <li>• Protect areas that may be buffered from the effects of climate change, including microhabitats that may provide cooler temperatures or maintain higher soil moisture during periods of drought</li> </ul>
	Improve habitat restoration tools to support the ability of plants and animals to respond to changing climate conditions	<ul style="list-style-type: none"> <li>• Work on developing habitat restoration techniques that will be successful under future climate conditions</li> <li>• Use species distribution modeling to improve understanding and acceptance of facilitated migration for plant species</li> </ul>
<b>Increase knowledge</b>	Maintain the natural and historical characteristics of a watershed	<ul style="list-style-type: none"> <li>• Research historical ranges of flora and fauna</li> <li>• <i>Compile information on species ecology, range, and genetics to create detailed profiles</i></li> </ul>
	Map species distributions to understand potential habitat loss or gain and improve restoration	<ul style="list-style-type: none"> <li>• <i>Develop species distribution models (SDMs) under four different climate scenarios; include additional factors that could contribute to species shifts (e.g., water deficits)</i></li> <li>• Use joint species distribution modeling to look at multiple species within a habitat or community simultaneously, incorporating multiple threats</li> <li>• <i>Survey the vegetation and environment to aid in the design of a plant palette with species suited for various positions within an alluvial fan or watercourse, then update survey as habitat suitability changes under future climate conditions</i></li> </ul>
<b>Engage coordination</b>	Work across jurisdictions	<ul style="list-style-type: none"> <li>• Coordinate invasive species management, funding, and support between agencies</li> <li>• Communicate about projects and coordinate on-the-ground activities</li> <li>• Align budgets and program work priorities with adjacent lands</li> </ul>

# Products and Applications

Adaptation Ladder of Engagement®

7 Sharing

6 Evaluation

5 Integration

4 Implementation

3 Planning

2 Assessment

1 Awareness

brought to you by EcoAdapt™

- Adaptation Report
  - Methodology
  - Individual Adaptation Summaries
    - Compiled actions, actions linked with vulnerabilities, F/E figures
  - In-depth Adaptation Sections
  - Monitoring Indicators
- Habitat Vulnerability and Adaptation Briefs



# Applying Adaptation Strategies in Management Operations

- **Planning Documents**
  - Forest Plan Objectives, Standards & Guidelines, Actions & Management Approaches
- **Resource Management Strategies**
  - Conservation strategies, Fire Management Plan, Travel Management Plan, etc.
- **Project Design and Implementation**



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**“If available and needed to support restoration activities, projects should use native seed species appropriate for the ecological unit...Consider the effects of climate change in selecting appropriate seed.”**

**“Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, non-native species.”**



# Products and Applications

- Full syntheses/reports (complete literature review)
  - Forest Plan Assessments, Proposed Actions
  - Sierra Nevada, Nez Perce-Clearwater NF
- Summaries and Briefs
  - Washington SWAP climate watch list
  - Gulf of the Farallones
- Project-level efforts
  - Point Blue evaluation of meadow restoration activities (what to do, where based on climate vulnerability info)



# Acknowledgements



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**A big thank you to our habitat experts!**

