



Introduction to Vulnerability Assessments

Foundational Elements & Key Steps

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Talk Goals



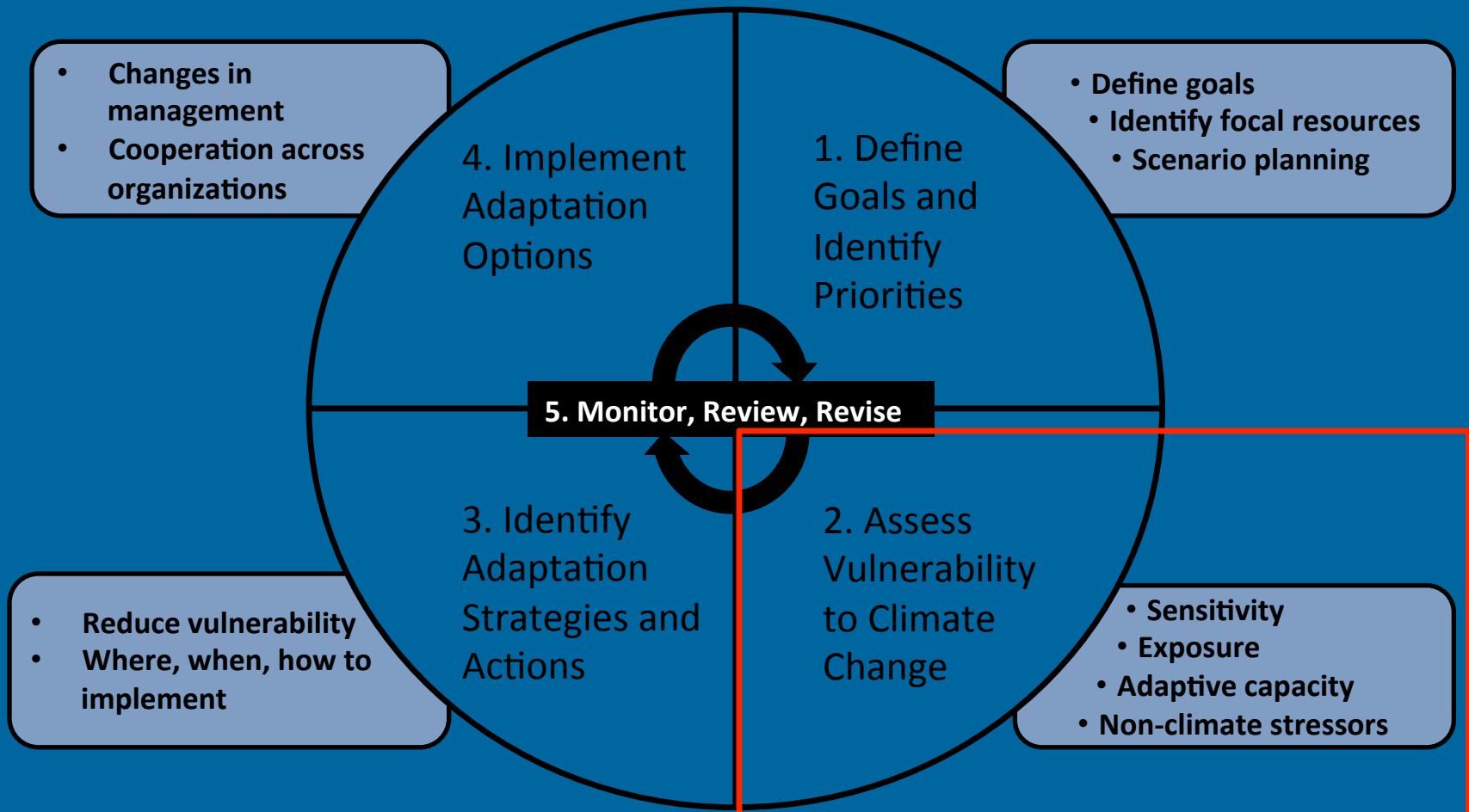
- Introduce climate adaptation planning and the role of vulnerability assessment
- Unpack the concept of vulnerability
- Summarize key assessment steps

Scanning the Conservation Horizon

*A Guide to Climate Change
Vulnerability Assessment*



Climate-Smart Planning Process



Defining Vulnerability

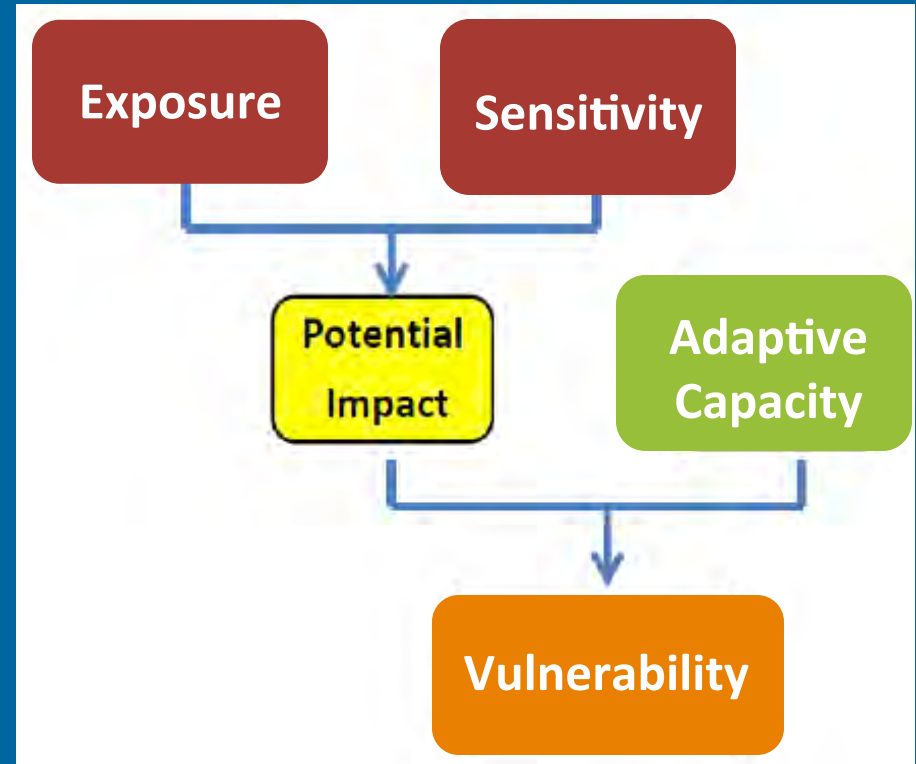
Climate change vulnerability refers to the degree to which a resource is susceptible to, and unable to cope with adverse impacts of climate change



Defining Vulnerability

IPCC 2007

Vulnerability is the degree to which a resource is susceptible to, and unable to cope with adverse impacts of climate change.



Defining Vulnerability

IPCC 2007

Vulnerability is the degree to which a resource is susceptible to, and unable to cope with adverse impacts of climate change.

Exposure

Degree of change a resource is likely to experience

+1°C vs. +5°C



Defining Vulnerability

IPCC 2007

Vulnerability is the degree to which a resource is susceptible to, and unable to cope with adverse impacts of climate change.

Sensitivity

Whether and how a resource reacts to climate change

E.g., does an increase in temperature matter?



Defining Vulnerability

IPCC 2007

Vulnerability is the degree to which a resource is susceptible to, and unable to cope with adverse impacts of climate change.

**Adaptive
Capacity**

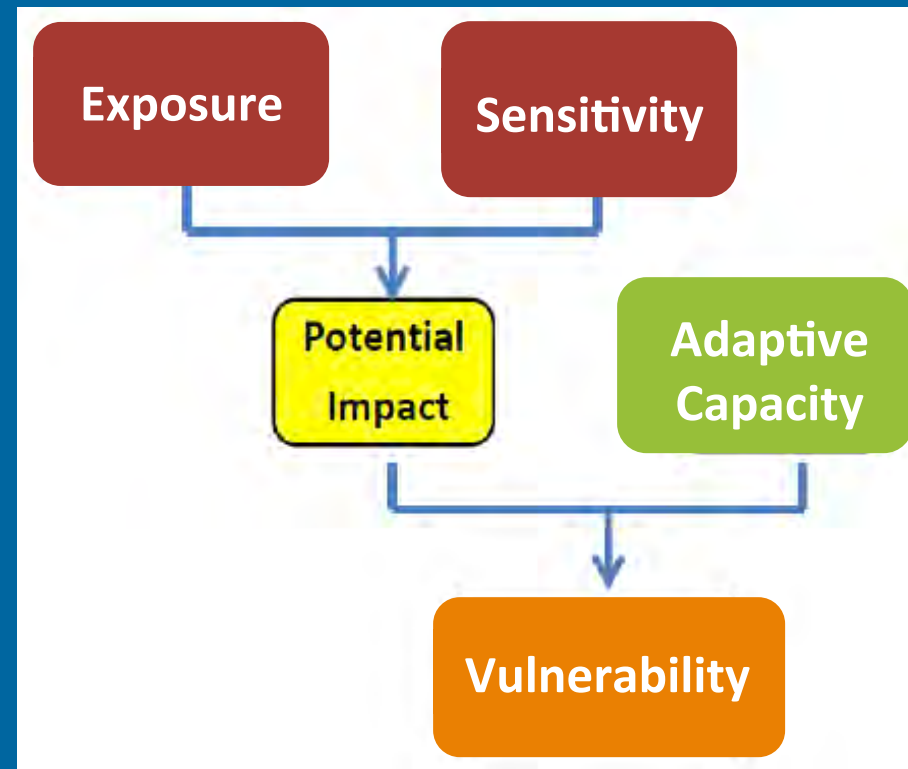
**Ability of a resource to
accommodate or cope with
climate impacts**



Defining Vulnerability

IPCC 2007

Vulnerability is the degree to which a resource is susceptible to, and unable to cope with adverse impacts of climate change.



Purpose of a vulnerability assessment:

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

$$V = (E * S) - AC$$



Why Assess Vulnerability?

Vulnerability assessments **can help:**

- Prioritize the focus of management actions
- Develop strategies to address climate change
- Efficiently allocate resources

What vulnerability assessments **cannot do:**

- Make a management decision for you

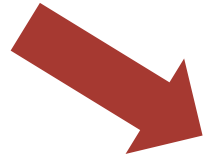


Vulnerability Assessment Steps

Step 1
Determine
objectives & scope



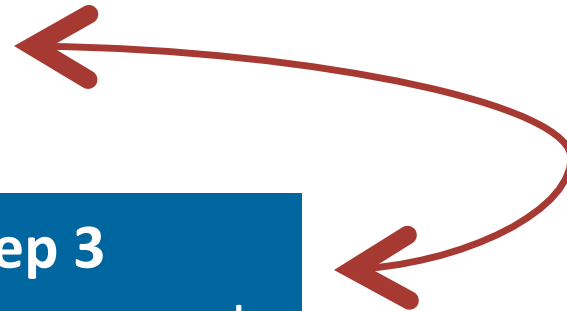
Step 2
Gather relevant
data & expertise



Step 3
Assess components
of vulnerability



Step 4
Apply results of
vulnerability assessment
in adaptation planning



Steps 1 and 2

1. Determine objectives and scope

- Audience/user needs
- Goals and objectives
- Assessment targets (species, habitats)
- Scale (temporal and spatial)
- Appropriate approach (no “one size fits all”)

2. Gather relevant data and expertise

- Review existing literature
- Reach out to experts
- Obtain/develop climate and ecological response projections

Can find information through:

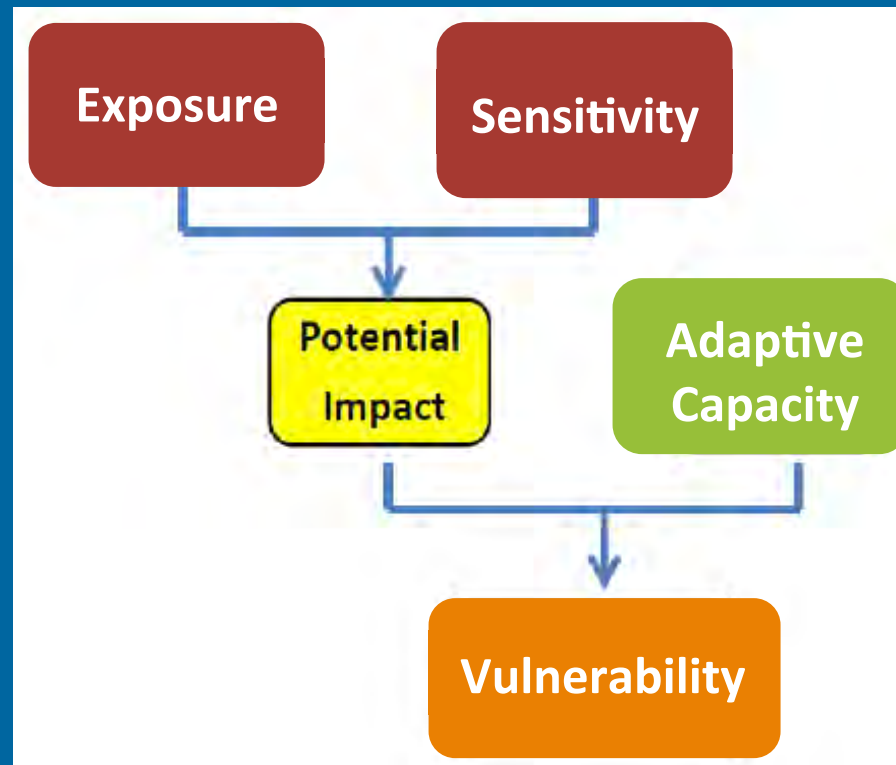
- Data Basin (databasin.org)
- California Climate Commons (climate.calcommons.org)
- Climate Adaptation Knowledge Exchange (cakex.org)



Step 3

3. Assess components of vulnerability

- Assess sensitivity, exposure, and adaptive capacity
- Estimate overall vulnerability
- Document confidence levels and uncertainties



Assessing Exposure

Climate Variable	Projected Future Trends
Air temperature	↑ 1-2°C by mid-century (annual)
Extreme heat events	↑ frequency
Precipitation	Variable
Drought	↑ frequency; ↑ risk of multi-year drought
Snowpack	↓ annual depth
Timing of snowmelt	Shift ~10-30 days earlier by 2100
Wildfire	↑ total area burned

Factors to consider when assessing exposure:

- **Climate models**
 - Shifts in temperature, precipitation
 - Increasing availability of finer scale data (e.g., downscaling)
- **Ecological response models**
 - Sea level inundation
 - Climate related vegetation shifts
 - Hydrologic projections

Measure of how much of a change in climate or other environmental factor(s) a resource is likely to experience

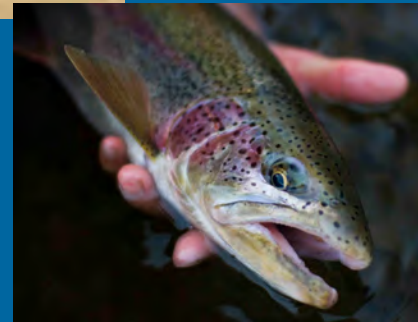


Assessing Sensitivity

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

Factors affecting sensitivity of species, habitats, ecosystems:

- Specialized habitat or microhabitat requirements
- Narrow environmental tolerances or physiological thresholds
- Dependence on interactions with other species



Assessing Adaptive Capacity

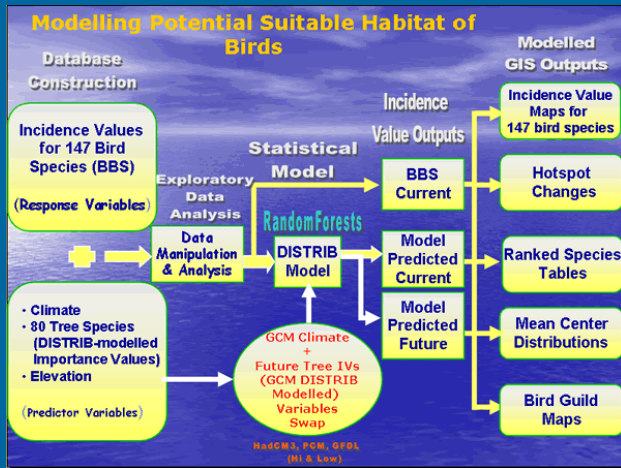
Ability of a resource to accommodate or cope with climate change impacts with minimal disruption

Factors that can influence amount of adaptive capacity of your species or habitat:

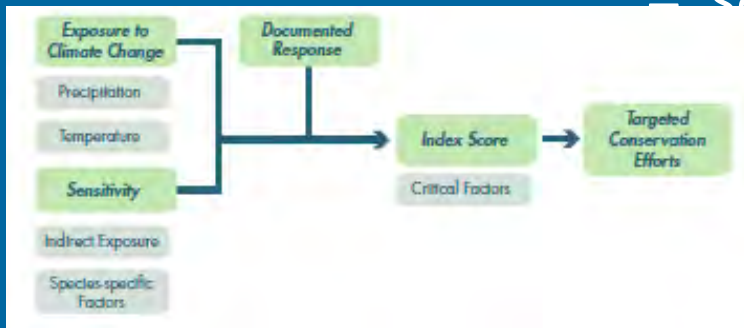
- **Intrinsic factors**
 - “Plasticity”
 - Ability to resist or recover from stressors
- **Extrinsic factors**
 - Barriers to dispersal/migration
 - Institutional capabilities



Putting the Pieces Together: How to Assess Vulnerability Components



- Detailed modeling efforts
 - In-house or commissioned
- Vulnerability indices
 - e.g., NatureServe Index
- Expert elicitation
 - Supplement and/or supplant modeling
- Scenario planning



Assessing Vulnerability

(Should I take my umbrella?)



Exposure: What is the likelihood of rain today?



Sensitivity: Will it be detrimental if I get wet?

Adaptive Capacity: Can I get out of the rain?



Assessing Vulnerability

(Should I take my umbrella?)



Exposure: What is the likelihood of rain today?

Sensitivity: Will it be detrimental if I get wet?

Adaptive Capacity: Can I get out of the rain?

Scenario 1: (80% chance of rain*job interview) - will be walking = **High Vulnerability** (bring an umbrella!)

VS.

Scenario 2: (looks cloudy*normal work day) - have a change of clothes at the office = **Low Vulnerability**

Step 4

4. Apply assessment results in adaptation planning

- **Reduce Sensitivity**
 - Example: Reducing or eliminating invasive species that outcompete native species
- **Reduce Exposure**
 - Example: Protecting resources and infrastructure from flood damage
- **Enhance Adaptive Capacity**
 - Example: Adjusting recreation timing or route of access



Addressing Uncertainty



- Natural resource management has always faced uncertainty
 - Anxiety about uncertainty often leads to “analysis paralysis”
 - Don’t deny it, embrace it



- Document where/why there is uncertainty

- Three types of uncertainty

- Climate projections
- Ecological responses
- Management effectiveness

Likelihood Scale	
Terminology	Likelihood of the Occurrence/Outcome
Virtually certain	>99 percent probability of occurrence
Very likely	>90 percent probability
Likely	>66 percent probability
About as likely as not	33 to 66 percent probability
Unlikely	<33 percent probability
Very unlikely	<10 percent probability
Exceptionally unlikely	<1 percent probability

- Distinguish between uncertainty in trend vs. rate & magnitude

Questions?



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EcoAdapt



Habitat Vulnerability Assessment

1. Define your habitat. Consider things such as:

- Elevational range
- Dominant species
- Location in region (e.g., foothills of Sierras)

Example: High-elevation shrubland and semi-barren habitats above the trade wind inversion layer. Currently above 7,000 ft. and above the clouds most of the time. Habitat vegetation dominated by pūkiawe, 'ōhelo, māmane, pilo, deschampsia, and bracken fern, and is being invaded by non-native grasses and conifers in subalpine areas. Alpine dominated by silversword in the vegetation community.

Habitat Vulnerability Assessment

2. Evaluate sensitivity to:

- Climate and climate-driven factors (e.g., temperature, snowpack, soil moisture)
- Disturbance regimes (e.g., flooding, fire, drought)
- Non-climate stressors (e.g., land use conversion, dams, fire suppression practices, invasive species)

Habitat Vulnerability Assessment

- 3. Evaluate habitat adaptive capacity by considering:**
- Extent, Integrity, Continuity
 - Landscape Permeability & Barriers to Movement
 - Ability to resist or recover quickly from stressors
 - Physical, Component Species, Functional Group Diversity
 - Societal value and our ability to manage climate impacts
 - Ecosystem services

Habitat Vulnerability Posters!

Sensitivity

- 1-3 key climate sensitivities (4-5 score) and bullet point for each on how it impacts habitat
- 1-3 key disturbance regimes (4- 5 score) and how it impacts habitat
- 1-3 key non-climate sensitivities (4-5 score) with higher exposure (4-5 score) and bullet point for each on how it impacts habitat

Adaptive Capacity

- Identify factors that contribute positively (+) or negatively (-) to adaptive capacity
- For example:
 - + structural integrity (score 4-5)
 - highly isolated (score 1-2)
 - + able to recover quickly (score 4-5)
 - low societal value (score 1-2)
 - + high ability to manage (score 4-5)

ROCKY SHORELINES - SENSITIVITY

① KEY CLIMATE SENSITIVITIES

SEA LEVEL RISE - low-lying areas

INCREASED WAVE ACTIVITY FROM ↑ STORMS

- erosion
- inundation

② KEY DISTURBANCE REGIMES

SEA LEVEL RISE
erosion, inundation

③ NON-CLIMATE SENSITIVITIES

RESIDENTIAL / COMMERCIAL
DEVELOPMENT

ROADS / HWYS / TRAILS

RECREATION

POLLUTION & POISONS

- weakens health of ecosystem

↑ erosion

ROCKY SHORELINES - ADAPTIVE CAPACITY

FACTORS

⊕ STRUCTURAL / FUNCTIONAL INTEGRITY

⊖ HABITAT ISOLATION

⊕ ABLE TO RECOVER QUICKLY FROM STRESSORS

⊖ LOW SOCIETAL SUPPORT

⊕ MODERATELY HIGH SOCIAL VALUE

⊖ LOW LIKELIHOOD FOR MANAGING CLIMATE IMPACTS DUE TO COMPETING INTERESTS