

Introduction to Vulnerability Assessments



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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

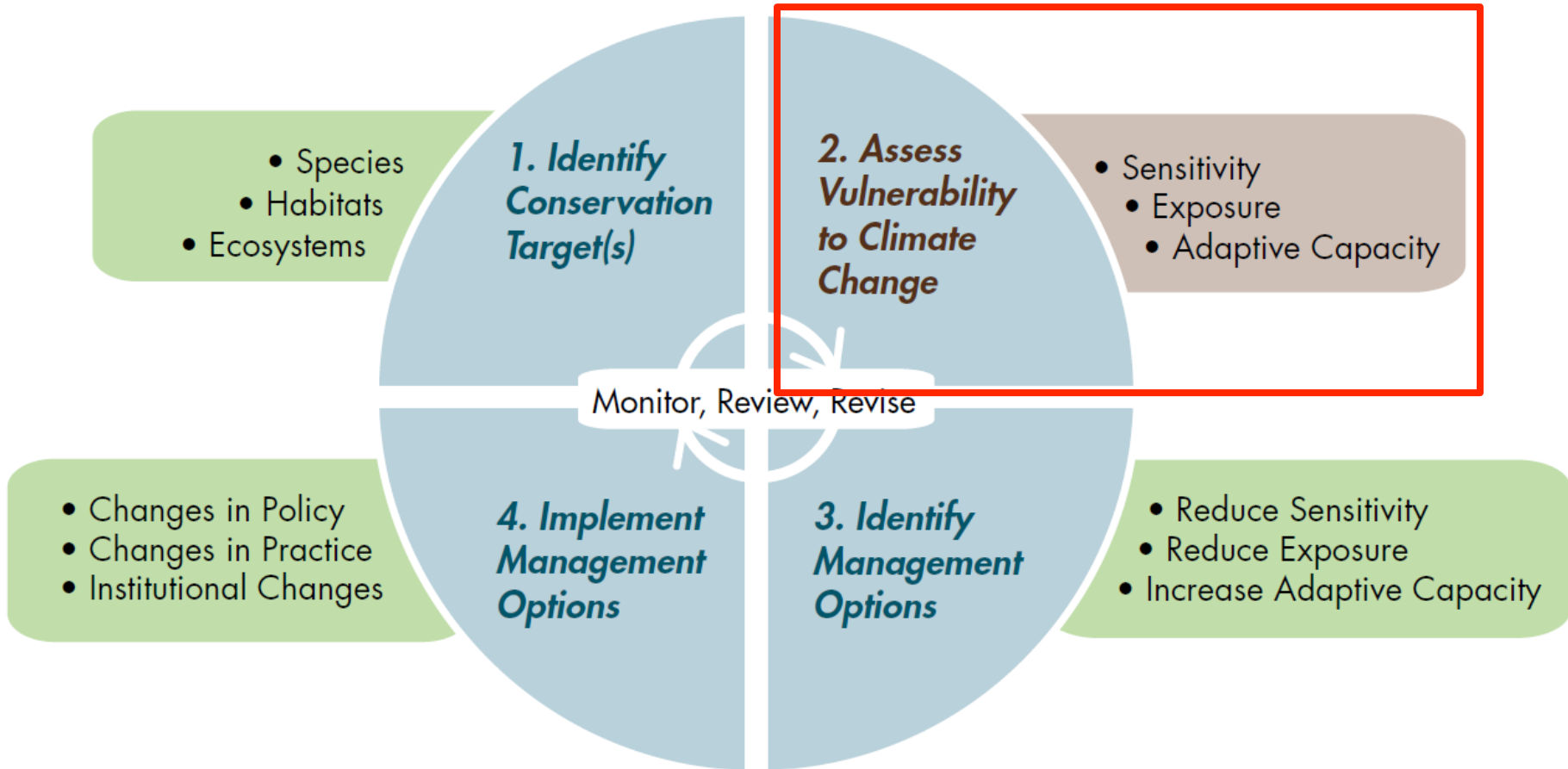
Scanning the Conservation Horizon

*A Guide to Climate Change
Vulnerability Assessment*



Adaptation Planning Framework

Overarching Conservation Goal(s)



Defining Vulnerability

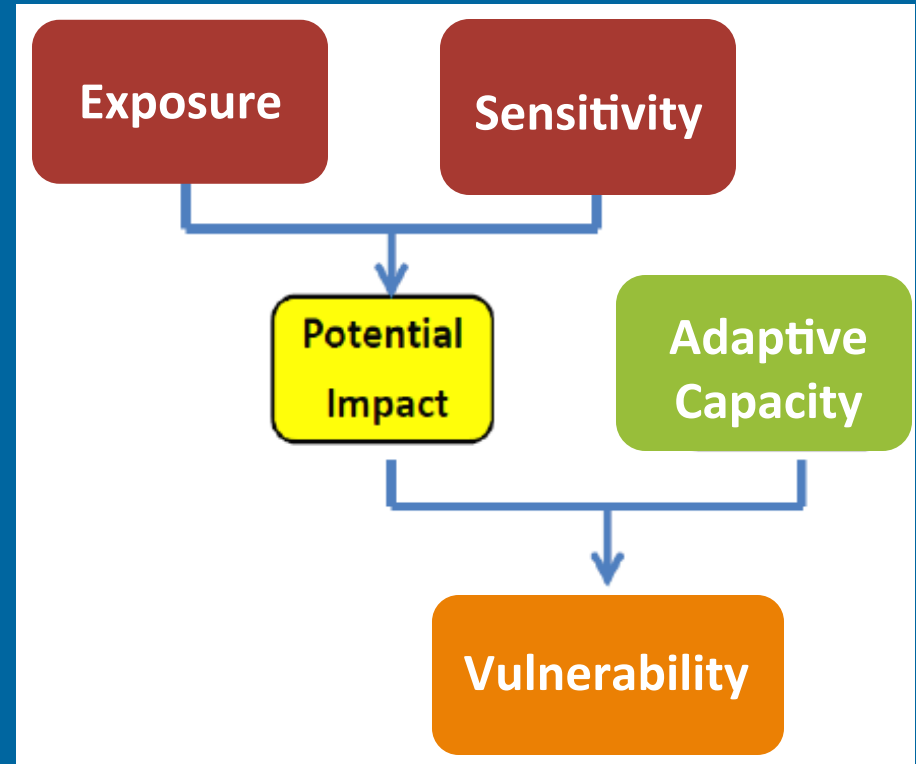
Climate change vulnerability refers to the degree to which a species, habitat, or ecosystem service is susceptible to, and unable to cope with adverse impacts of climate change



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



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



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**

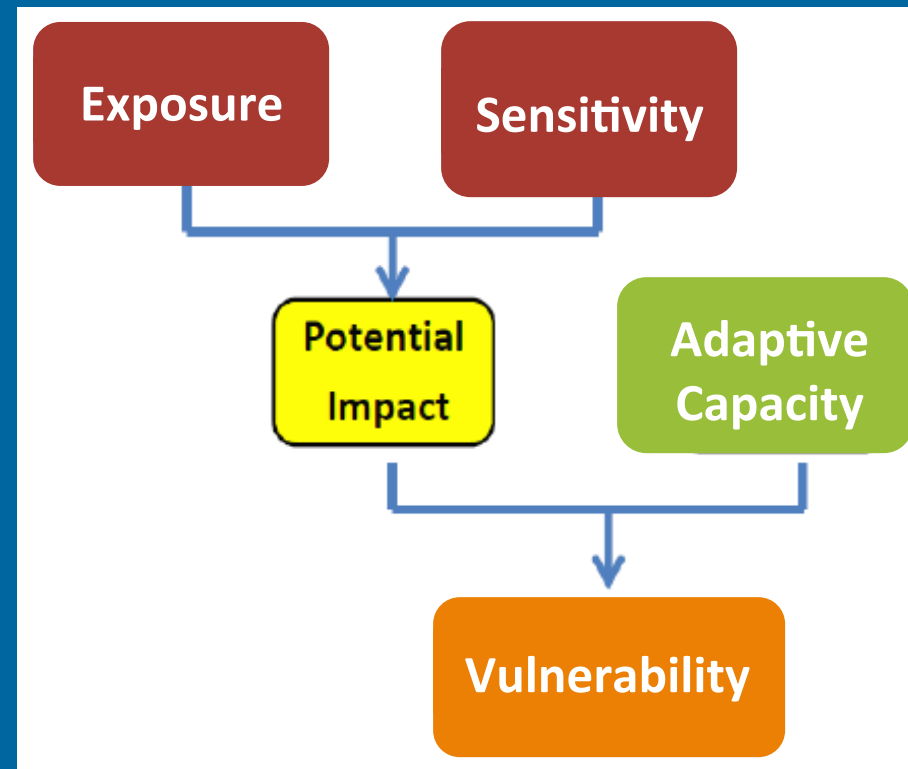
**Ability of a resource to
accommodate or cope with
climate impacts**



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 habitats or species for management actions
- Develop management strategies to address climate change
- Efficiently allocate resources

What vulnerability assessments **cannot do:**

- Make a conservation 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, ecosystem services)
- 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:

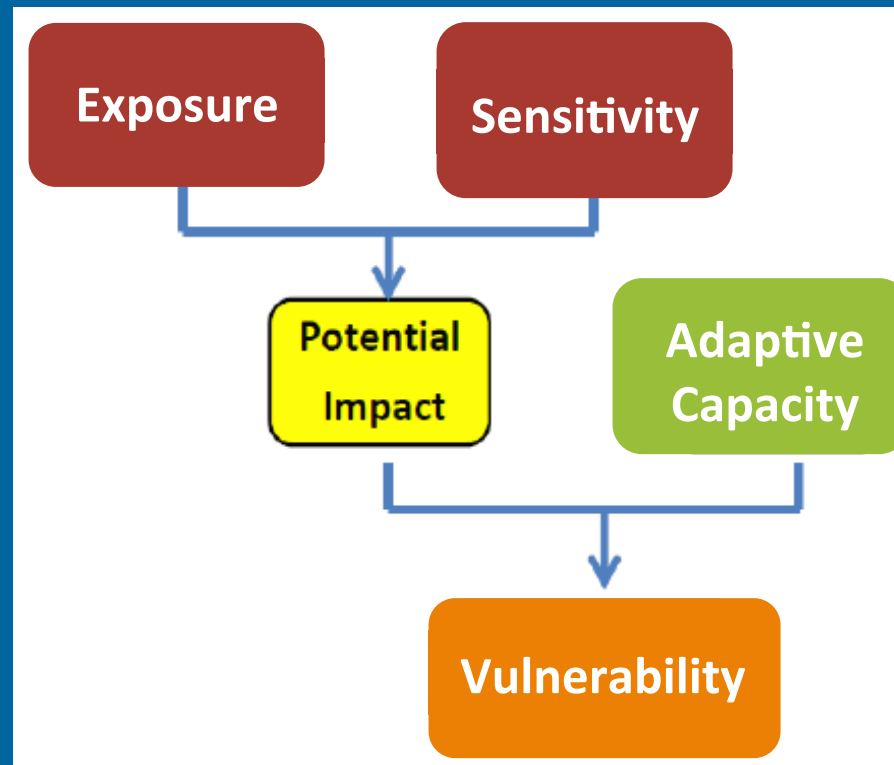
- Data Basin (piccc.databasin.org)
- Pacific RISA (pacificrisa.org)
- Climate Adaptation Knowledge Exchange (cakex.org)



Step 3

3. Assess components of vulnerability

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



Assessing Sensitivity

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



Sensitivity to sunburn:

- Amount of melanin in skin key physiological factor
 - Melanin absorbs UV rays, which cause sunburn
 - Skin with lower melanin levels is more sensitive to sunburn



Assessing Sensitivity

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

Sensitivity evaluations consider:

- Climate and climate-driven factors
- Disturbance regimes
- Non-climate stressors

- Species-specific considerations:
 - Dependencies
 - Life history



PHOTO: MICHAEL GINGERICH



Assessing Exposure

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

Exposure to sunburn:

- The amount of UV rays determines exposure
 - Strength of rays depends on latitude, season & weather
 - With enough exposure, most anybody can burn



Assessing Exposure

Climate Variable	Projected Future Trends
Air temperature	↑ 1-3°F by mid-century
Extreme heat events	↑ frequency and intensity
Precipitation	Variable
Drought	↑ risk, particularly in low- and mid-elevation leeward areas
Sea level rise	↑ overall, with variations in magnitude
Coastal inundation	↑ overall, with variations in magnitude
Wildfire	↑ if drought events increase

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

Exposure evaluations consider:

- Climate and climate-driven changes
- Disturbance regimes

* Use climate models, ecological response models to help assess exposure



Assessing Adaptive Capacity

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

Adaptive capacity to sunburn:

- Can be intrinsic (reduce sensitivity) or extrinsic (reduce exposure)
 - Extrinsic adaptations include sunblock, protective clothes, shelter
 - Intrinsic adaptations include UV-induced increase in melanin production (i.e., tanning)

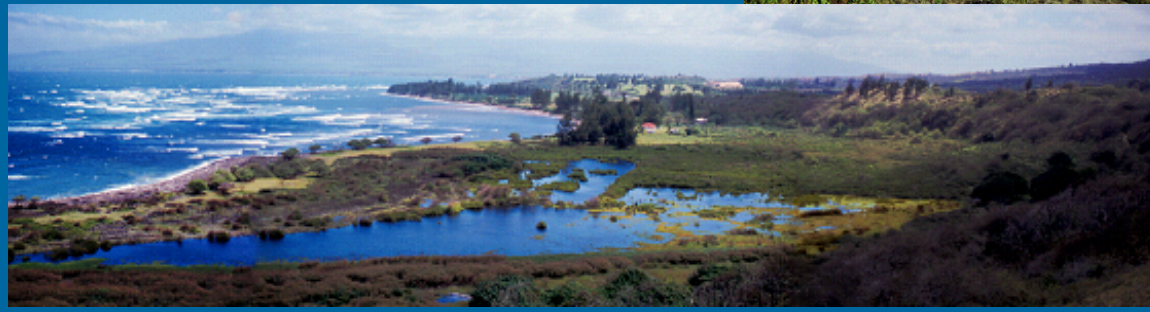
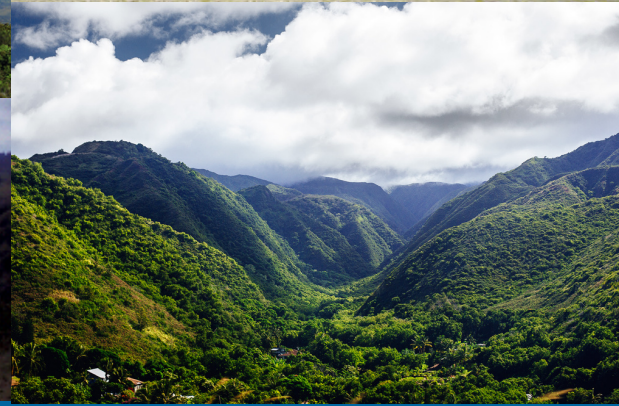


Assessing Adaptive Capacity

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

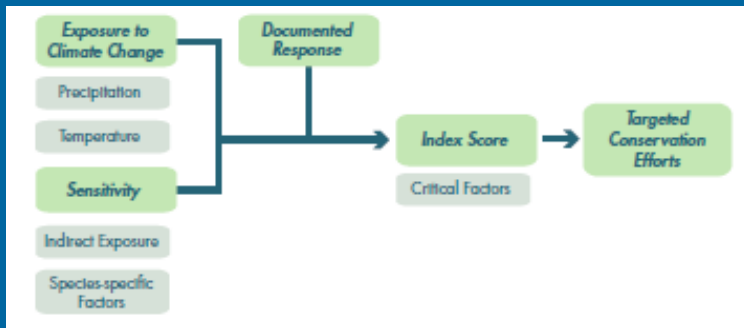
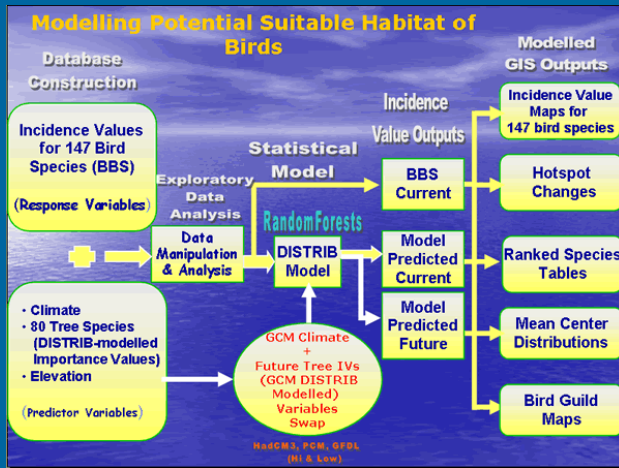
Adaptive capacity evaluations consider:

- Extent & integrity
- Dispersal barriers/isolation
- Resistance & recovery
- Diversity
- Management potential



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

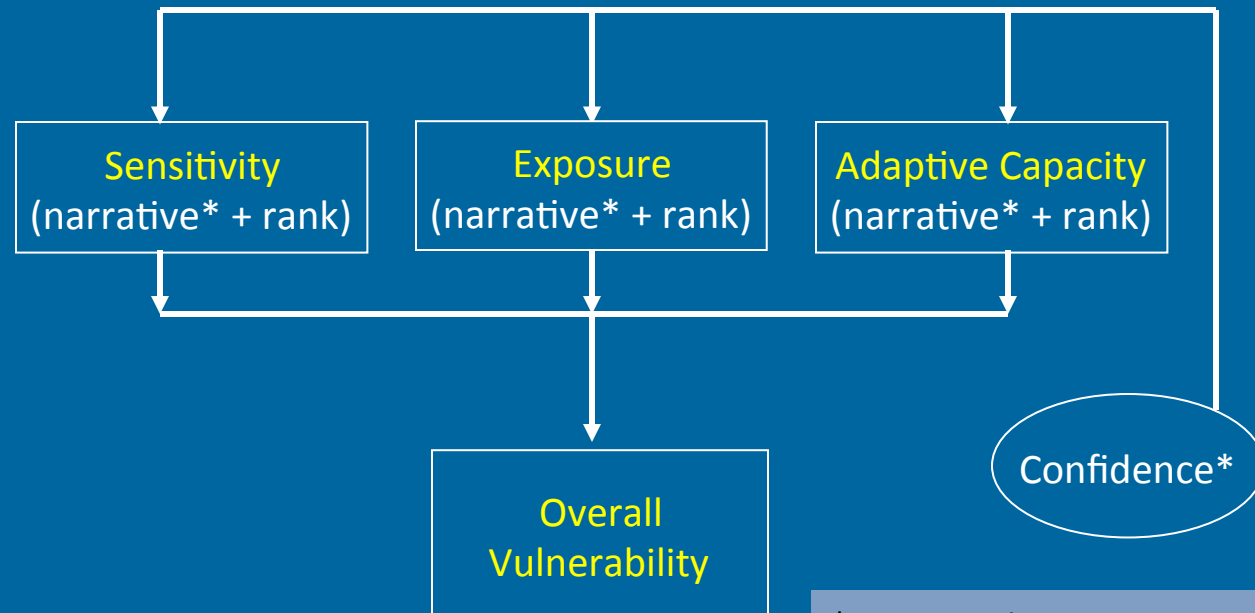


Vulnerability Assessment Process



Each vulnerability assessment includes:

- **Sensitivity**
 - Narrative describing key climate & non-climate sensitivities
 - Overall rank (e.g., Moderate)
 - Confidence evaluation (e.g., Low)
- **Exposure**
 - List of key climate exposure factors (e.g., increased temperature, drought)
 - Overall rank
 - Confidence evaluation
- **Adaptive Capacity**
 - Narrative describing +/- adaptive capacity factors
 - Overall rank
 - Confidence evaluation
- **Overall Vulnerability + Confidence**
 - Overall vulnerability rank
 - Overall confidence rank
- **Literature Cited**



*Documenting uncertainty

Example: Alluvial Scrub



Vulnerability:
Moderate-High
High Confidence



Exposure



HIGH (5)
High Confidence

Sensitivity



MODERATE-HIGH (4)
High Confidence

Adaptive Capacity



MODERATE (3)
High Confidence

- ↑ Air temperatures
- △ Precipitation
- ↑ Wildfire
- ↑ Drought

- Climate drivers:
- Water availability & timing
 - Temperature
- Disturbance regimes:
- Flooding
 - Wildfire
- Non-climate stressors:
- Invasive species
 - Dams & water diversions

- Fairly degraded
- Low continuity
- Site restrictions
- Low-moderate diversity
- + Moderate resistance and recovery
- + Moderate-high societal value



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
 - How is other uncertainty dealt with?



- 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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