

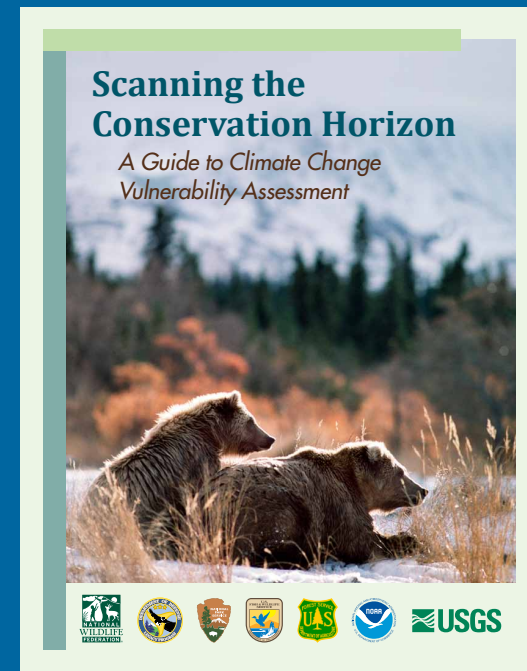
# Overview of vulnerability and adaptation: What it means, how it works and how you can do it

Lara Hansen, Ph.D.  
EcoAdapt



# Talk Goals

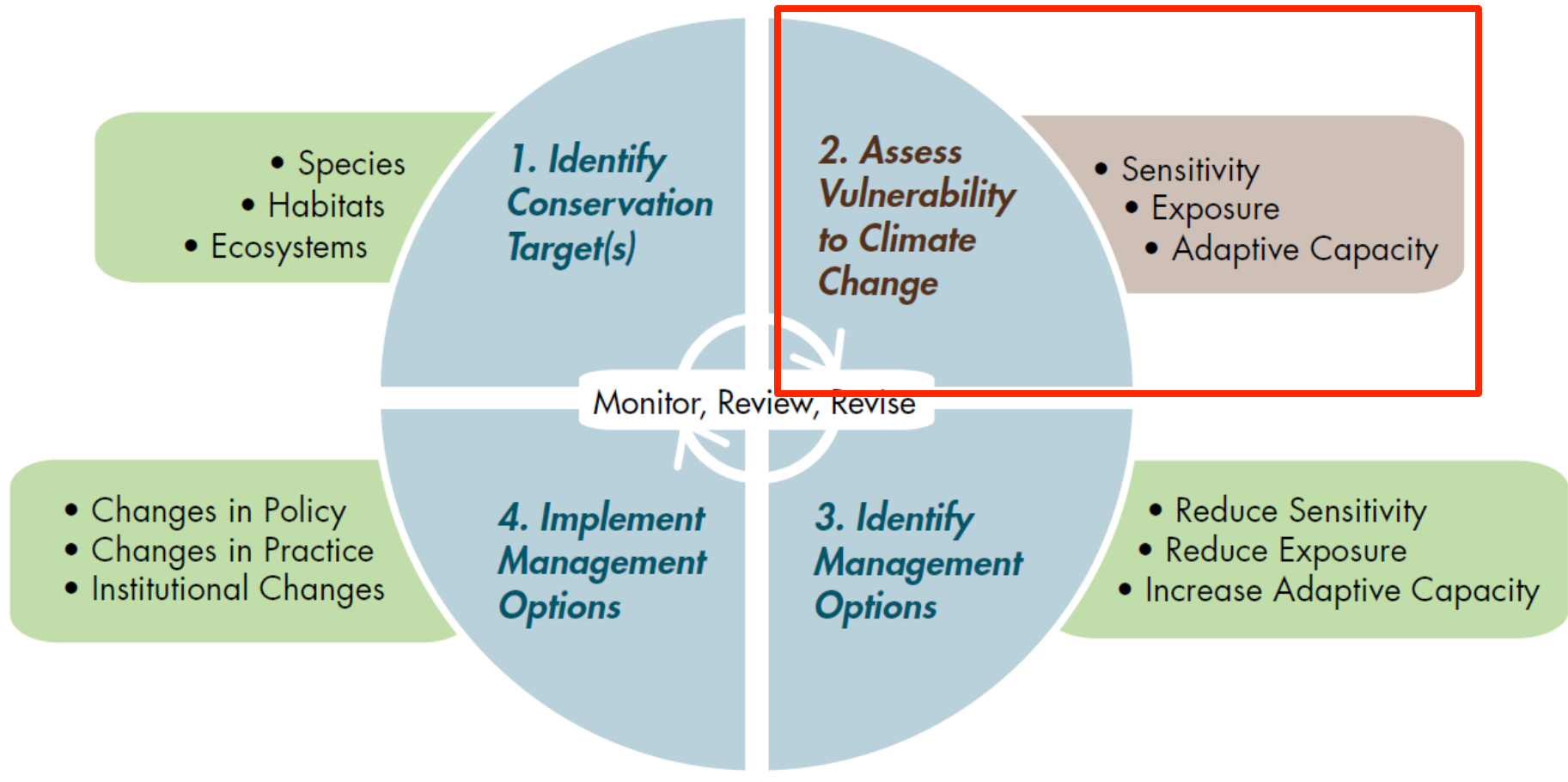
- Introduce climate change adaptation and the role of vulnerability assessment
- Unpack the concept of vulnerability
- Summarize key assessment steps
- What we'll be doing here!



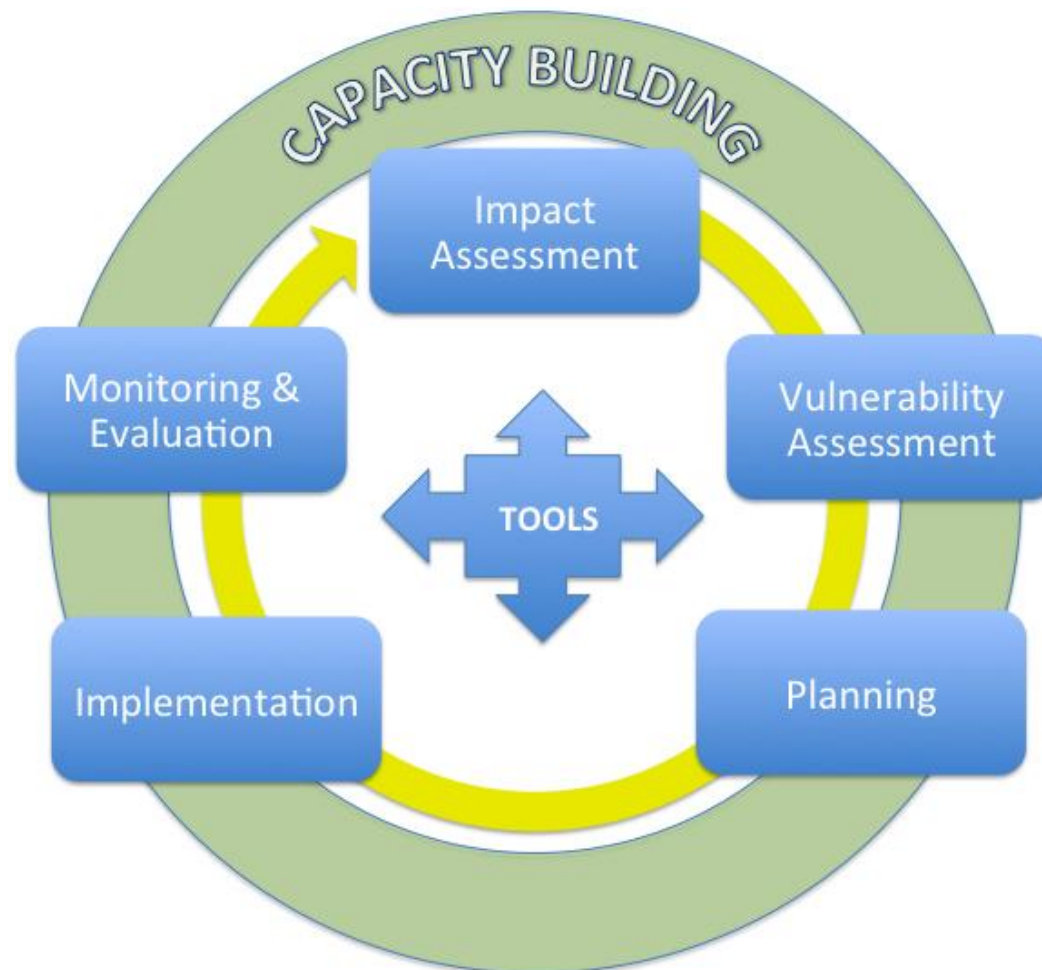


# Adaptation Planning Framework

## Overarching Conservation Goal(s)



# Adaptation Cycle



# Adaptation Ladder of Engagement



## 6. Sharing

**Sharing:** Internal capacity and resilience building are great, but for long-term success increases when we share and learn with others—supporting adaptation as part of our own workflow.

## 5. Integration

**Integration:** Adapting is not a one-time action. It is a process of integrating climate-savvy thinking into how work, so you can assess, anticipate, or respond to change as it happens.

## 4. Implementation

**Implementation:** It is not enough to have a plan—you have to put it into action. This may mean implementing new laws or processes, or adjusting existing activities.

## 3. Planning

**Planning:** Knowing your vulnerability should not result in paralysis. Rather it should inspire you to develop a strategy! Move from assessing the problem to identifying solutions.

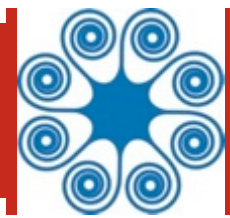
## 2. Assessment

**Assessment (or Taking Stock of the Situation):** Systematically assess how climate change might affect your work or other investments of time, effort and money.

## 1. Awareness

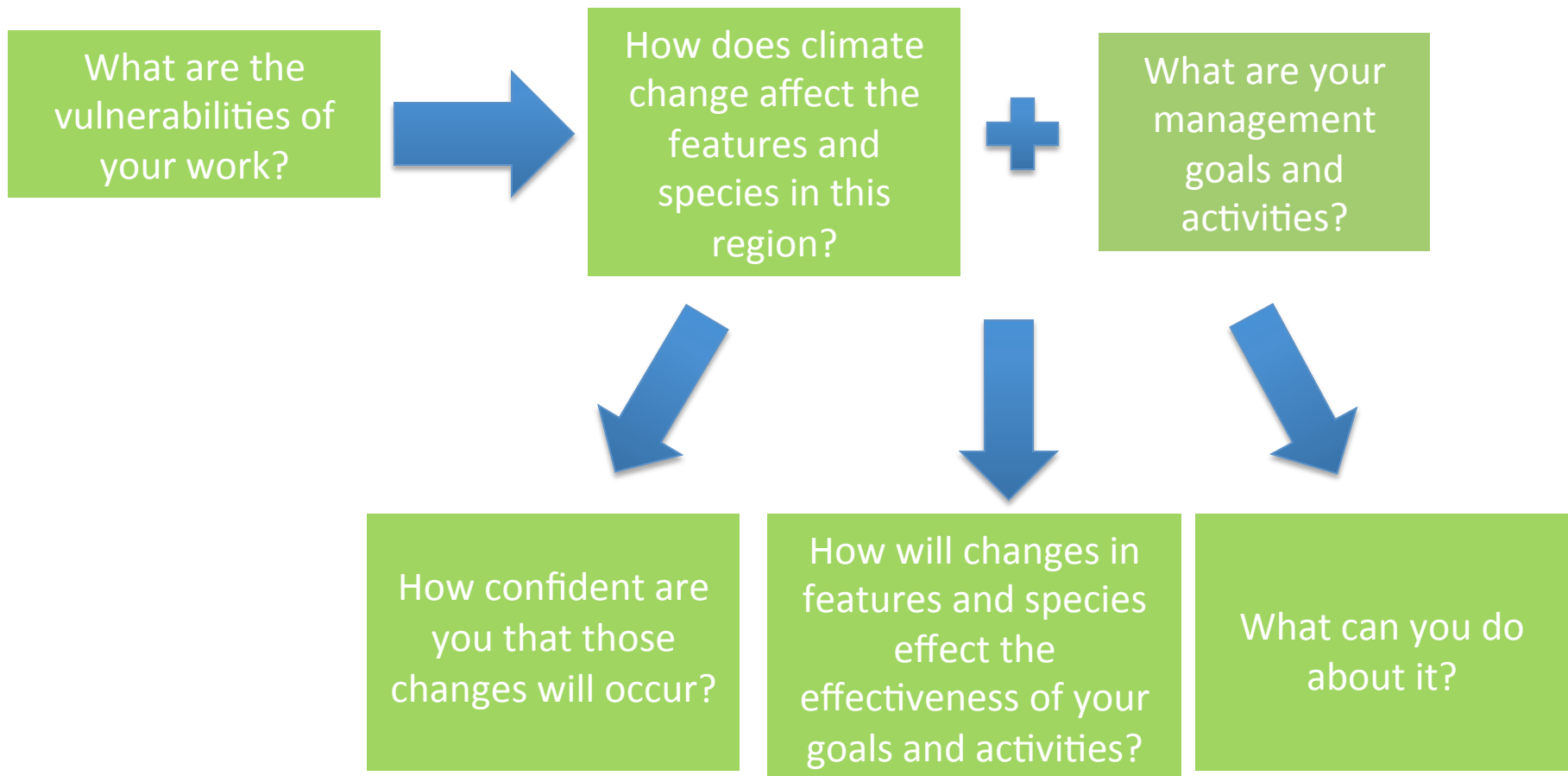
**Awareness:** Realizing that climate change affects your ability to meet your goals, either by altering the effectiveness of the tools you use to achieve your goal or by undermining your goal itself.

# Vulnerability Assessment Panel



Day 1: Recap what's happening, consider implications for features and species

Day 2: What does it all mean for management



# Defining Vulnerability

Climate change vulnerability refers to the extent to which a species, habitat, or ecosystem process is susceptible to harm from climate change impacts

- *What* things are most vulnerable
- *Why* they are vulnerable



# Why Assess Vulnerability?

## Vulnerability assessments **can help:**

- Prioritize species and systems for management actions
- Develop management strategies to address climate change
- Efficiently allocate resources



## What vulnerability assessments **cannot do:**

- Make a conservation or management decision for you





# Key Steps for Undertaking a Vulnerability Assessment

1. Determine objectives and scope
2. Gather relevant data and expertise
3. Assess the components of vulnerability
4. Apply assessment results in adaptation planning



# Steps 1 and 2

## 1. Determine objectives and scope

- Audience/user needs
- Goals and objectives
- Assessment targets (features, species, ecosystems, resources)
- 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

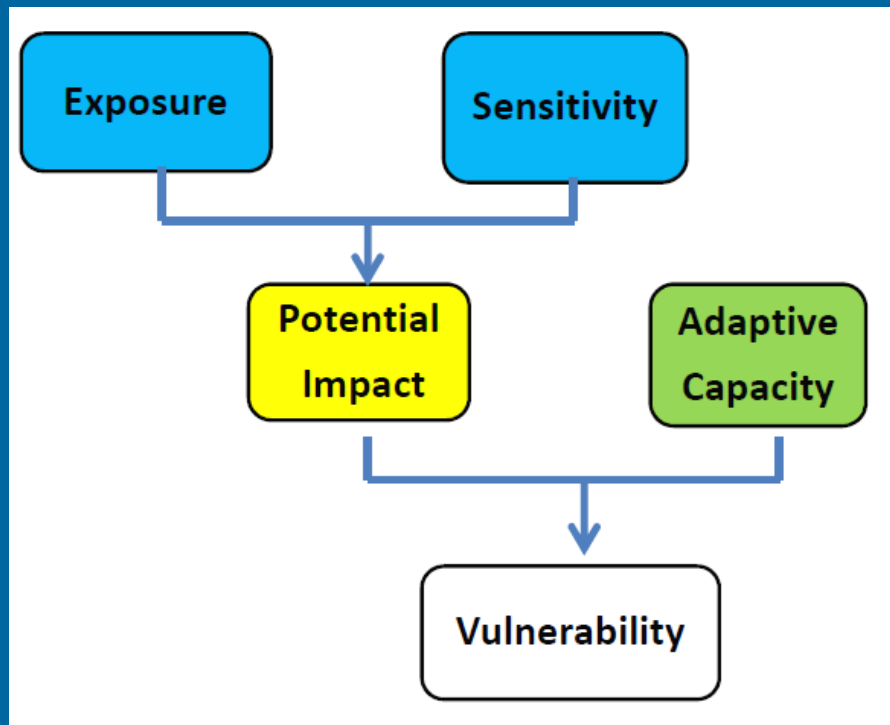
### Can find information through:

- Climate Change Sensitivity Database
- TACCIMO
- Data Basin

# Step 3

## 3. Assess components of vulnerability

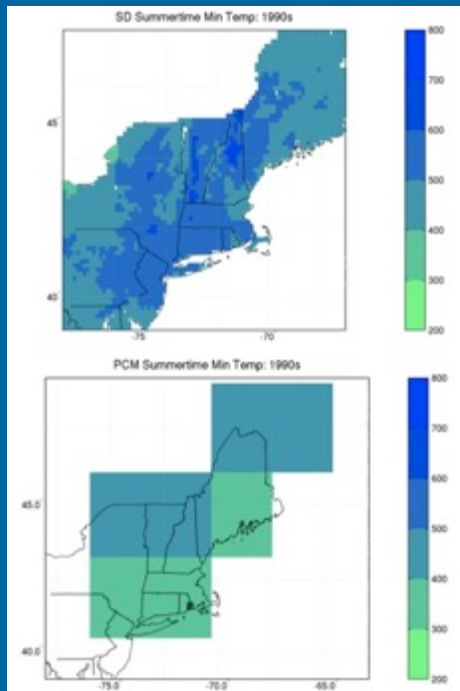
- Assess **sensitivity, exposure, and adaptive capacity**
- Estimate overall vulnerability
- Document confidence levels and uncertainties



$$V = \frac{E * S}{AC}$$

# Assessing Exposure

Measure of how much of a change in climate or other environmental factor a species or system is likely to experience



Factors to consider when assessing exposure:

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



# Exposure

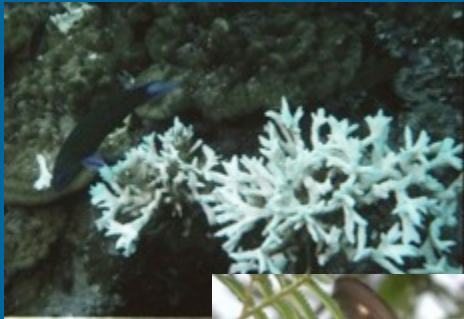
## Sunburn example:

- Where you are
  - tropics vs. poles
  - dense forest vs. open savannah
- When you're out
  - nocturnal vs. diurnal



# Assessing Sensitivity

Measure of whether and how a species or system is likely to be affected by a given change in climate or factors driven by 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

# Sensitivity

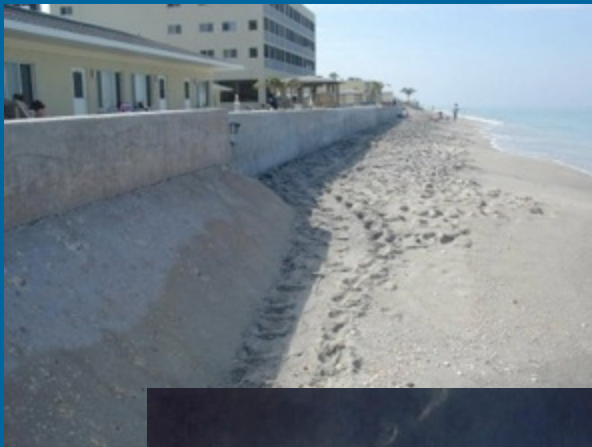
## Sunburn example:

- Skin with lower melanin levels is more sensitive to sunburn
- Chemical compounds can increase sensitivity (e.g. some antibiotics)



# Assessing Adaptive Capacity

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



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

- Intrinsic factors
  - “Plasticity”
  - Dispersal abilities
  - Evolutionary potential
- Extrinsic factors
  - Existence of barriers to habitat migration
  - Institutional capabilities

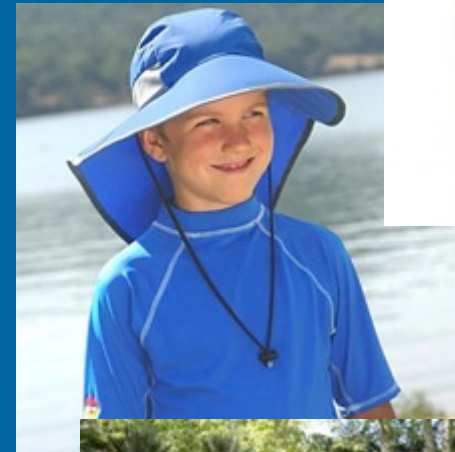




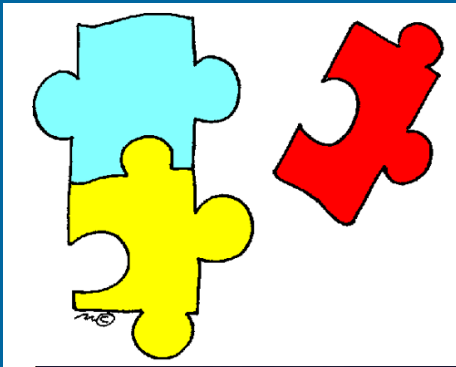
# Adaptive Capacity

## Sunburn example:

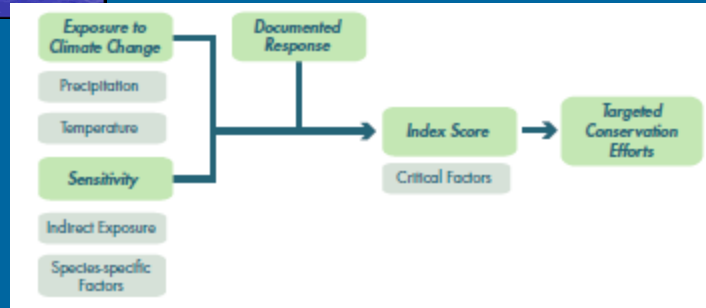
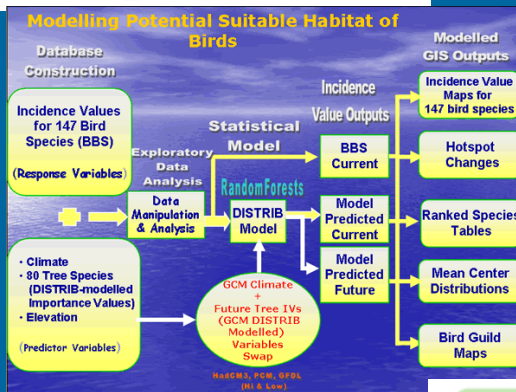
- Can be intrinsic (reduce sensitivity) or extrinsic (reduce exposure)
- For sunburn, extrinsic adaptations includes sunblock, protective clothes, shelter
- Intrinsic adaptations include UV-induced increase in melanin production (i.e., tanning )



# 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



# 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 predictions
- Ecological responses
- Management effectiveness

- Distinguish between uncertainty in trend vs. rate & magnitude

| 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                |

# Uncertainty in Vulnerability

(Should I take my umbrella?)



**Exposure:** What is the likelihood of rain today?

**Sensitivity:** Will it be detrimental if I get wet? (cold, big meeting, will be out for a long time)

**Adaptive Capacity:** Can I get out of the rain? Can I bring a bag to put an umbrella just in case?

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

Scenario 2 = 50% chance of rain \* nature walk with school \* 1/shelters along the route = Medium (bring an umbrella?)

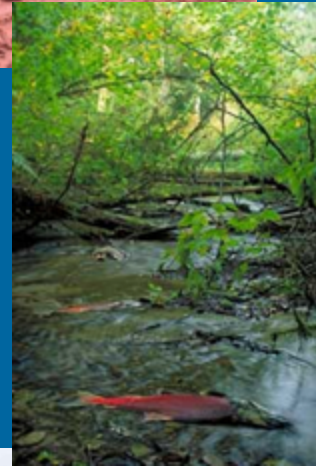
Scenario 3 = looks cloudy \* going to work \* 1/have a change of clothes & raincoat at the office = Low



# Step 4

## 4. Apply assessment results in adaptation planning

- **Reduce Sensitivity**
  - Example: Actively plant drought-tolerant species in an area projected to get drier
- **Reduce Exposure**
  - Example: Identify and protect cold-water refugia
- **Enhance Adaptive Capacity**
  - Example: Preventing invasive species that outcompete target species



# Vulnerability



## Adaptation Options

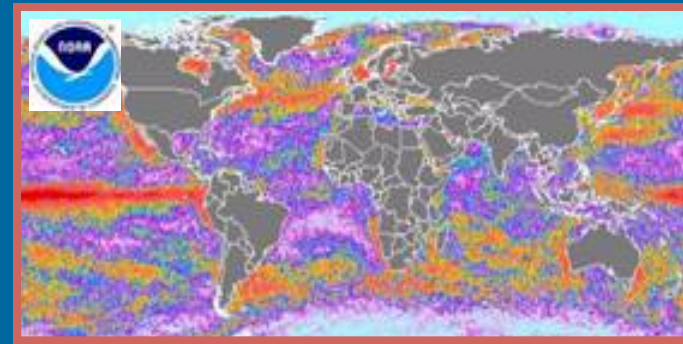


**Resistance**

**Resilience**

**Response**

# Tenets for a changing world



1. Protect adequate and appropriate space for a changing world

2. Reduce non-climate stressors exacerbated by or exacerbating the effects of climate change



3. Manage for uncertainty



4. Reduce the local and regional climate change

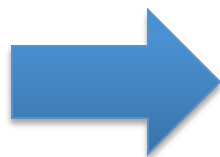
5. Reduce the rate and extent of global climate change



# Vulnerability Assessment Panel



What are your vulnerabilities?



What can you do to reduce your vulnerabilities?



What resources do you need to make this happen?

What partners do you need to make this happen?

How can you instigate implementation?





# Assessing your own vulnerability to an after lunch stupor

**Exposure:** Are others around you looking sleepy? Have you already started yawning?

**Sensitivity:** Did you eat too much at lunch? Have you had more or less coffee than usual? Is it really warm in this room?

**Adaptive Capacity:** Are you going to remain in your seat and slide into a torpor, or can you get up and energize yourself?

**Uncertainty:** Rate from 1 (Low) to 5 (High)

**Vulnerability** = yawning \* sugar crash \* 1/sedentary = High

# Energizer

Are you an OPTIMIST,  
PESSIMIST,  
or PRAGMATIST?