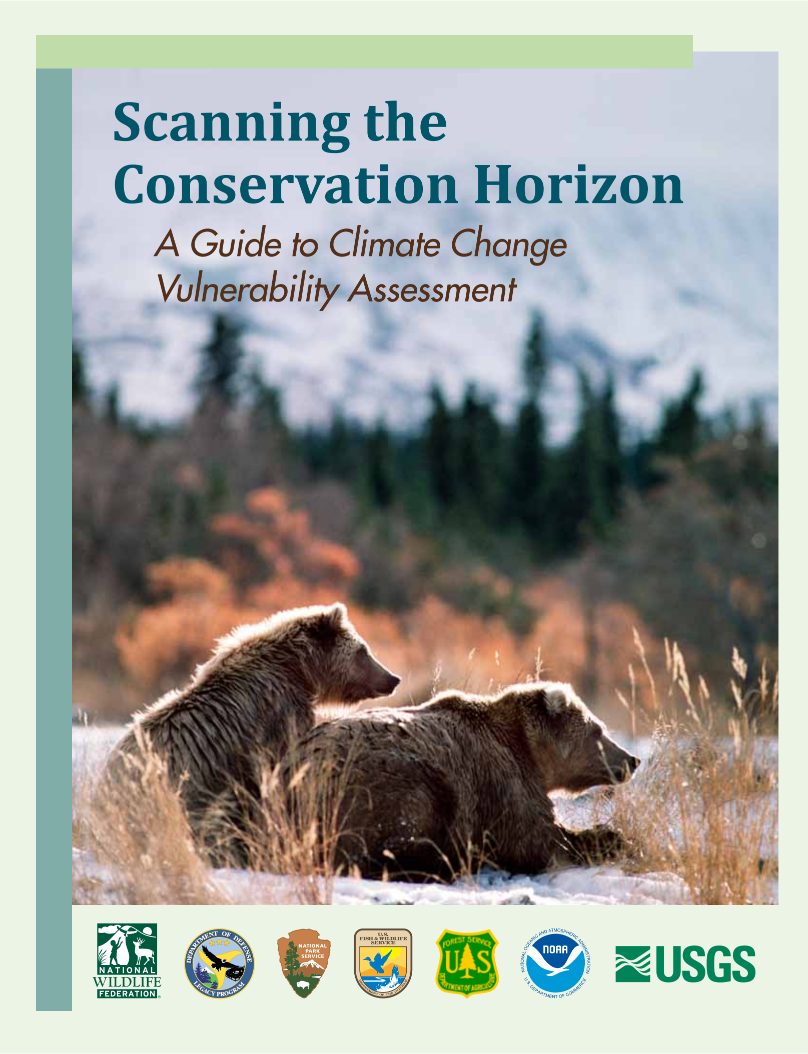
Introduction to Climate Change Vulnerability Assessments & Adaptation Planning

EcoAdapt™
Meeting the challenges of climate change

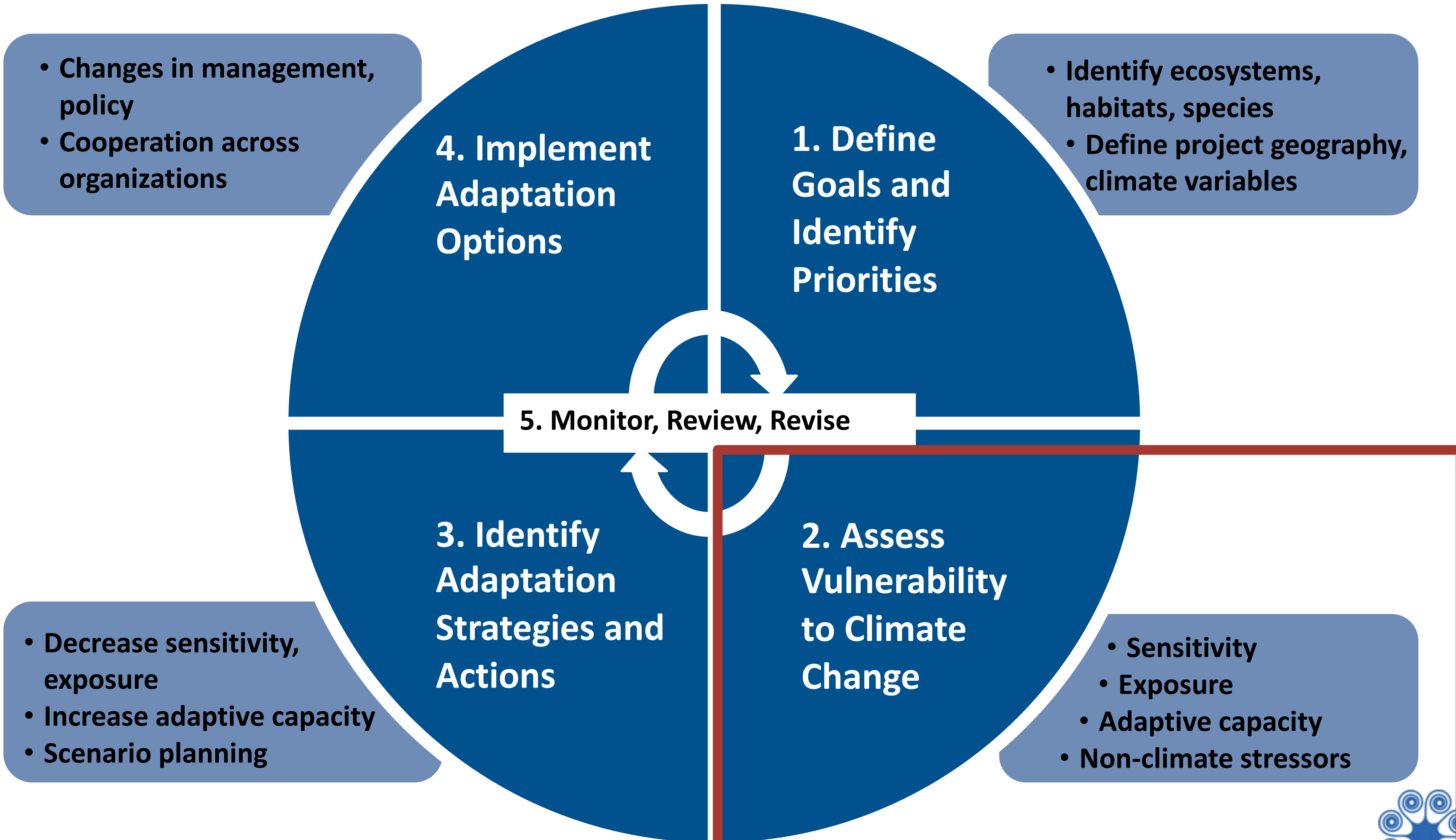
Jessi Kershner, Senior Scientist
EcoAdapt
jessi@ecoadapt.org

Talk Goals

- Introduce climate adaptation planning and the role of vulnerability assessments
- Unpack the concept of vulnerability
- Summarize key assessment steps
- Provide case studies of vulnerability to adaptation



Climate Adaptation Framework

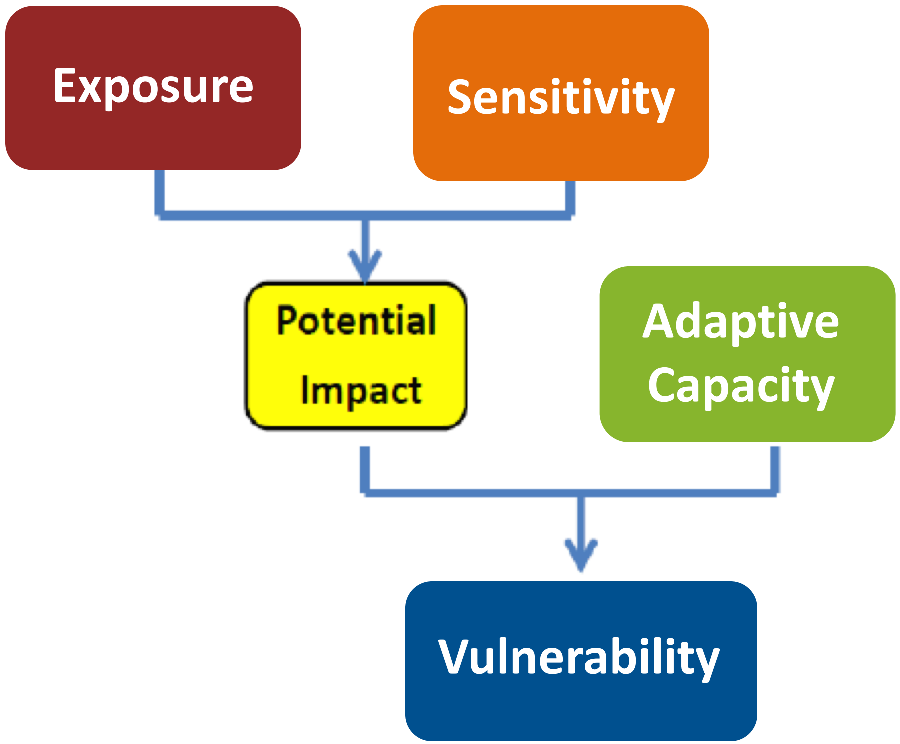


From Glick et al. 2011 *Scanning the Conservation Horizon*

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

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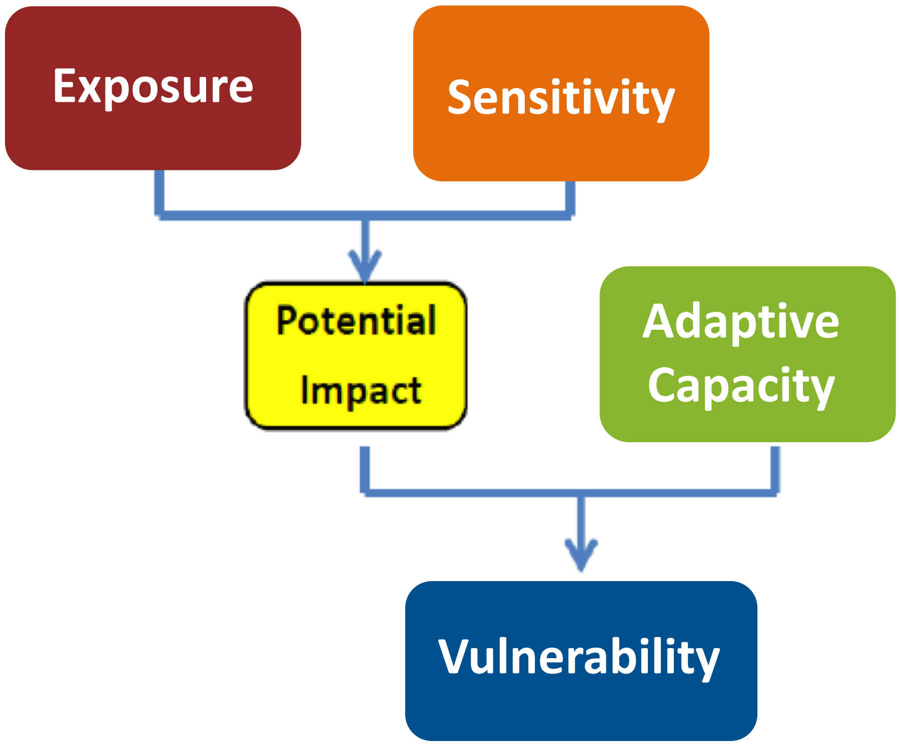


Purpose of a vulnerability assessment:

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

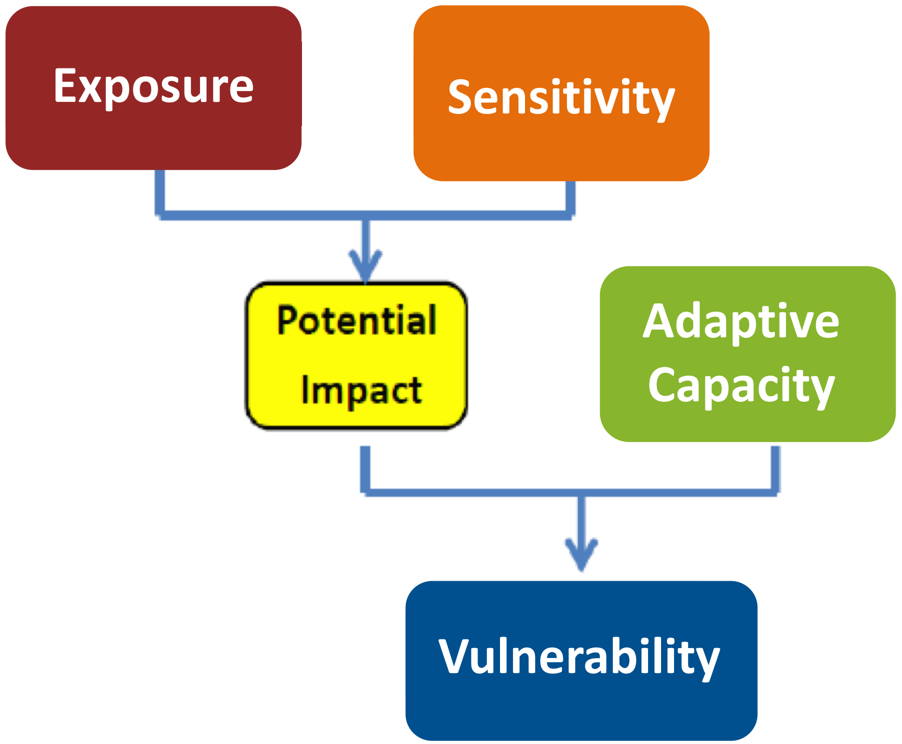
1. **Determine objectives and scope**
   - Audience/user needs
   - Assessment targets (species, habitats)
   - Scale (temporal and spatial)
2. **Gather relevant data and expertise**
   - Existing literature
   - Experts
   - Climate models

Can find information through:

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

Steps 3 and 4

3. **Assess components of vulnerability**



Assessing Exposure

Climate Variable	Projected Future Trends
Air temperature	↑ annual temperature, winter minimum, summer maximum
Precipitation	Variable
Climatic water deficit	↑
Recharge, runoff	Variable
Wildfire	↑ wildfire risk

Factors to consider when assessing exposure:

- Climate models
  - Shifts in temperature, precipitation
- Ecological response models
  - Climate related vegetation shifts
  - Hydrologic projections

Measure of how much of a change in climate 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:

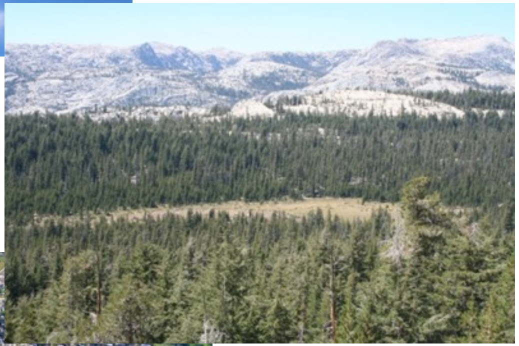
- Narrow environmental tolerances
- Specialized habitat or microhabitat requirements
- Impacts of non-climate stressors

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



Assessing Vulnerability

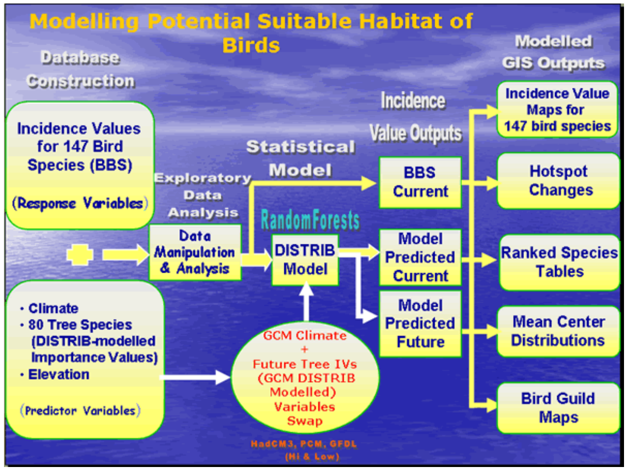
(Should I take my umbrella?)

Exposure: What is the likelihood of rain today?

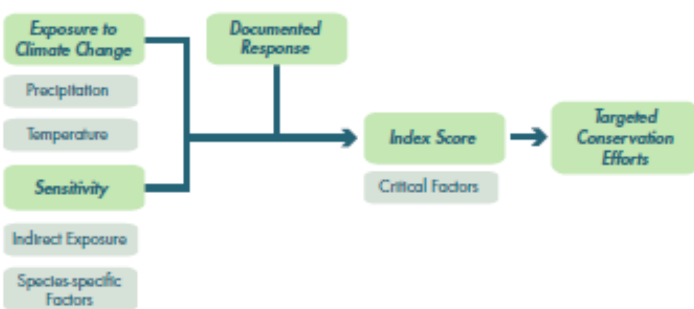
Sensitivity: Will it be detrimental if I get wet?

Adaptive Capacity: Can I get out of the rain?

Putting the Pieces Together: How to Assess Vulnerability Components



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



A Note About 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

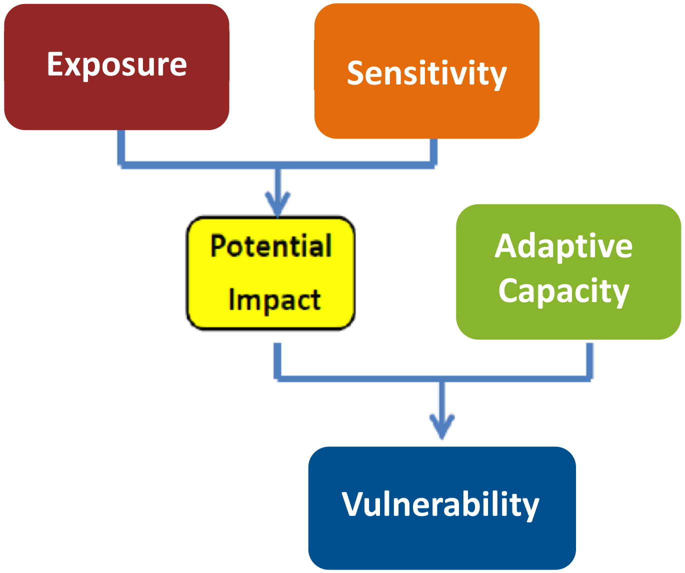
Likelihood Scale	
Terminology	**Likelihood of the Occurrence/Outcome**
Virtually certain	>99 percent probability of occurrence
Very likely	>90 percent probability
Likely	>66 percent probability
About as likely as not	33 to 66 percent probability
Unlikely	<33 percent probability
Very unlikely	<10 percent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

- **Distinguish between uncertainty in trend vs. rate & magnitude**

Steps 3 and 4

3. **Assess components of vulnerability**

4. **Apply assessment results in adaptation planning**






Defining Adaptation

Climate change adaptation refers to natural or human adjustments in an ecosystem in response to changing climate conditions




Adaptation strategies attempt to reduce the negative effects of or respond to climate change

Applying Vulnerability Assessment Results in Adaptation Planning

Vulnerability =

Exposure * Sensitivity

- Adaptive Capacity

↓ **Exposure**

↓ **Sensitivity**

↑ **Adaptive capacity**

Applying Vulnerability Assessment Results in Adaptation Planning

Vulnerability =

Exposure * Sensitivity

- Adaptive Capacity

↓ Exposure

Example: Protect resources and infrastructure from flood damage

Applying Vulnerability Assessment Results in Adaptation Planning

Vulnerability =

Exposure * Sensitivity

- Adaptive Capacity

↓ Sensitivity

Example: Reduce or eliminate invasive species that outcompete native species

Applying Vulnerability Assessment Results in Adaptation Planning

Vulnerability =

Exposure * Sensitivity

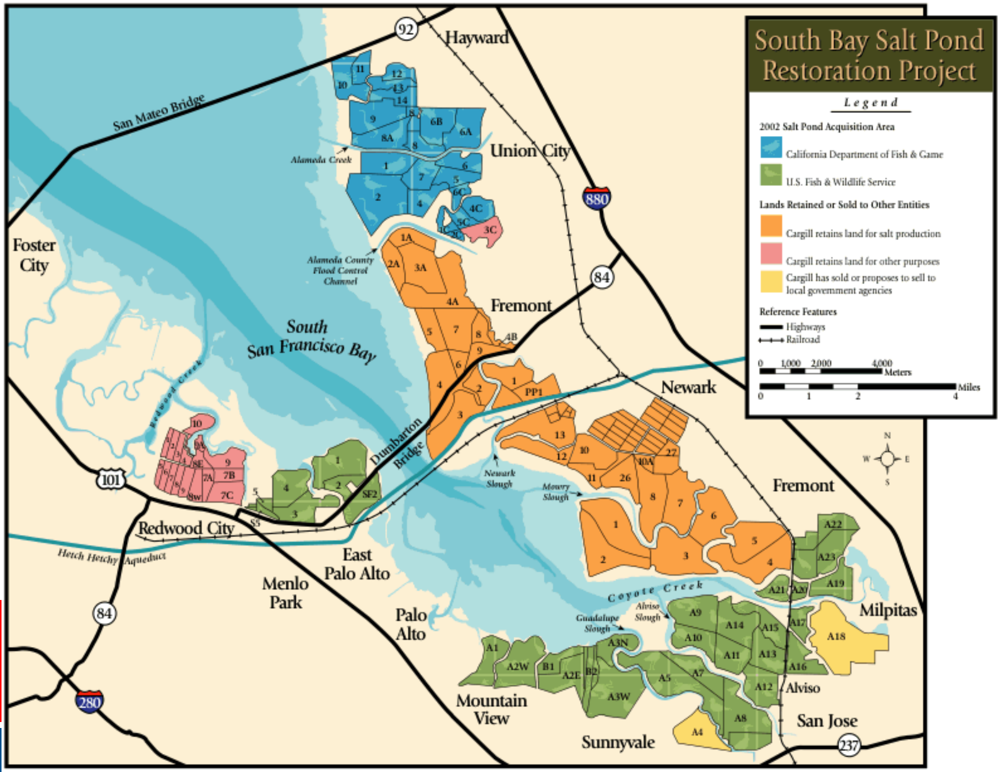
- Adaptive Capacity

↑ Adaptive capacity

Example: Adjust recreation timing or route of access

Moving from Vulnerability to Adaptation: Case Studies

Restoring coastal areas to reduce vulnerability



SLR, flooding, erosion

Actions

- Create, restore, or enhance habitats
- Maintain/improve flood protection
- Phased, adaptive management approach

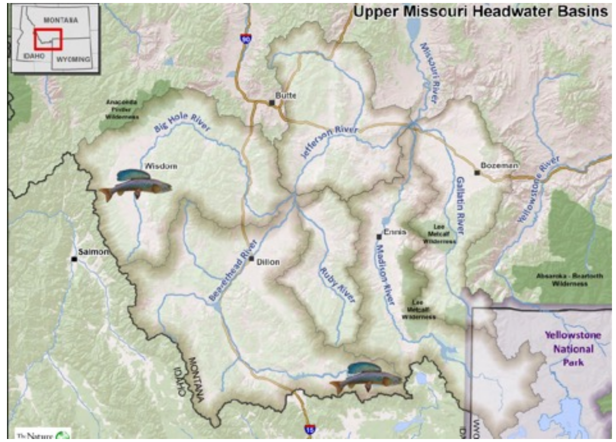
Restoring coastal areas to reduce vulnerability

South Bay Salt Pond Adaptive Management Plan

APPENDIX 3. Adaptive Management Summary Table

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Sediment Dynamics Project Objective 1 (Preserve existing estuarine habitat areas)	No significant decrease in South Bay intertidal and subtidal habitats (south of San Bruno shoal), including restored pond mudflat, intertidal mudflat, subtidal shallow and subtidal channel areas.	▪ Area of restored mudflat. ▪ Area of outboard mudflat. ▪ Area of subtidal shallows and channel. Methods: Bathymetry and LiDAR surveys will be performed periodically, initially every 3–5 years and then less frequently if data suggest slower rates of changes over time.	▪ Change in tidal mudflat and subtidal shallows expected to vary at the pond complex scales. Areas will be estimated and reported on the pond complex scale. ▪ Changes in South Bay need to be placed within system-wide (San Francisco Estuary) context to assess influence of external factors.	▪ Change in tidal mudflat & subtidal shallow: 10–20 years, assuming significant tidal habitat restoration continues beyond Phase 1. ▪ Subtidal channel change: 0–5 years.	▪ Outboard mudflat decreases greater than the range of natural variability + observational variability/error.	▪ Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning (such as plankton, benthic, fish or bird diversity or abundance) in the South Bay? ▪ Development of a 2- and 3-D South Bay tidal habitats evolution model.	▪ Convene study session to review and interpret findings to assess if observed changes are due to restoration actions or system-wide changes in the sediment budget (*e.g.*, effects of sea level rise). ▪ Study biological effects of loss of mudflat, subtidal shallows, and/or subtidal channel habitat. ▪ Adjust restoration phasing and design to reduce net loss of tidal mudflats. Potential actions include remove bayfront levees to increase wind fetch and sustain tidal mudflat, phase breaching to match demand and supply, and/or breach only high-elevation ponds to limit sediment demand ▪ Reconsider movement up staircase
Algal composition and abundance	▪ Nuisance and invasive species of algae are not released from the Project Area to the Bay. ▪ Algal blooms do not cause low DO within managed ponds	Algal species – visual observations of macrophytes and plankton tows Chlorophyll-a Sediment oxygen demand (SOD)	Ponds (visual), Bay (plankton tows) Ponds	Annually Annually	▪ Nuisance macrophytes are observed ▪ Harmful exotic species of phytoplankton are characterized in Bay	▪ Does pond configuration affect algal composition and abundance? ▪ Do harmful exotic species of algae persist in the Bay?	▪ Alter pond configuration ▪ Introduce artificial shading ▪ Stop progression towards Alternative C

Installing beaver mimicry structures



Decreased late summer flows, increased stream temperatures

Actions

- Identify high-flow potential basins resilient to climate change (i.e., temperature and discharge)
- Prioritize high-flow basins for whole-system restoration
- Install beaver mimicry structures as primary restoration approach

Questions?

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