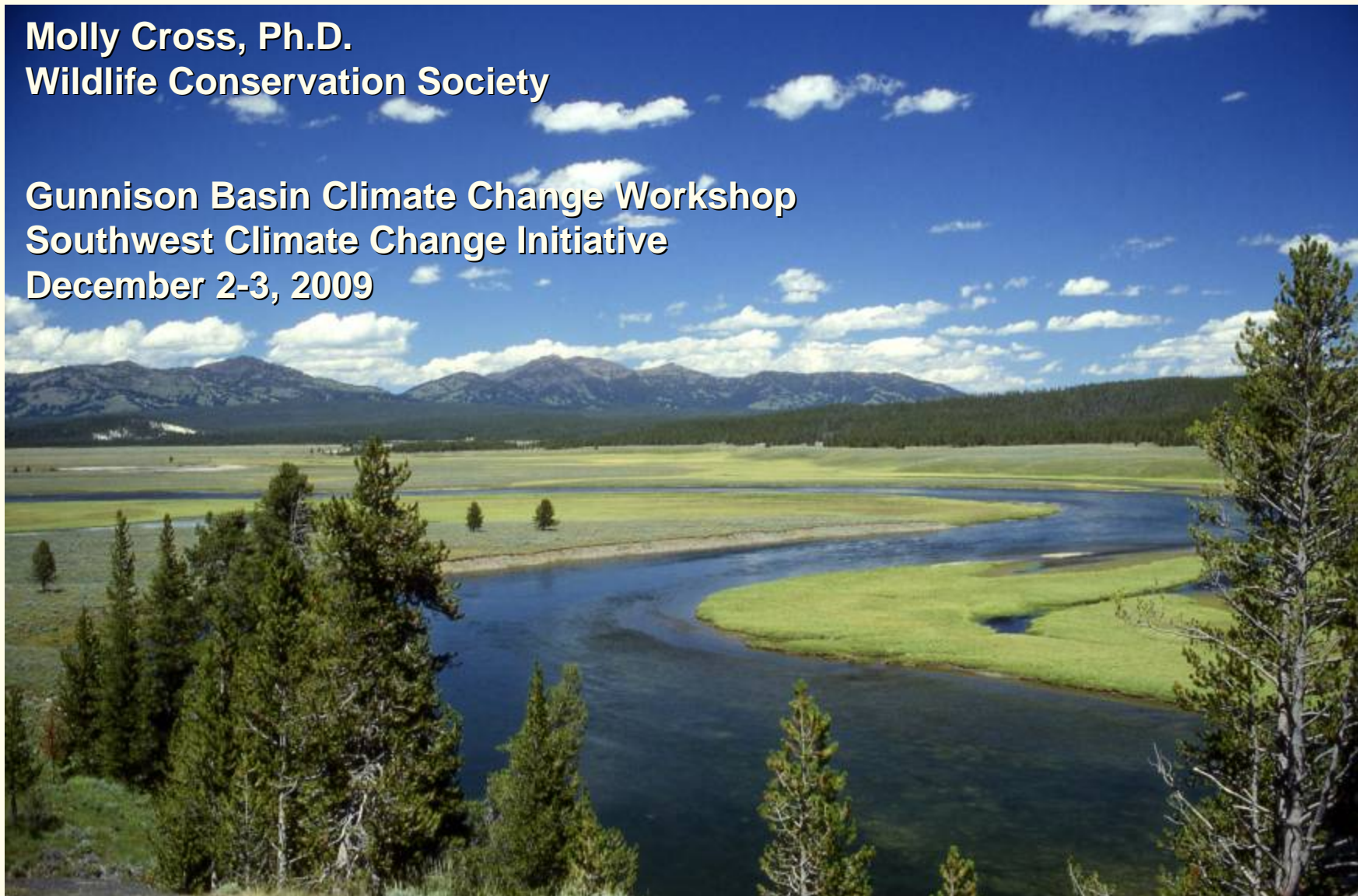




# Place-based climate change planning: Overcoming the paralysis of uncertainty

**Molly Cross, Ph.D.**  
**Wildlife Conservation Society**

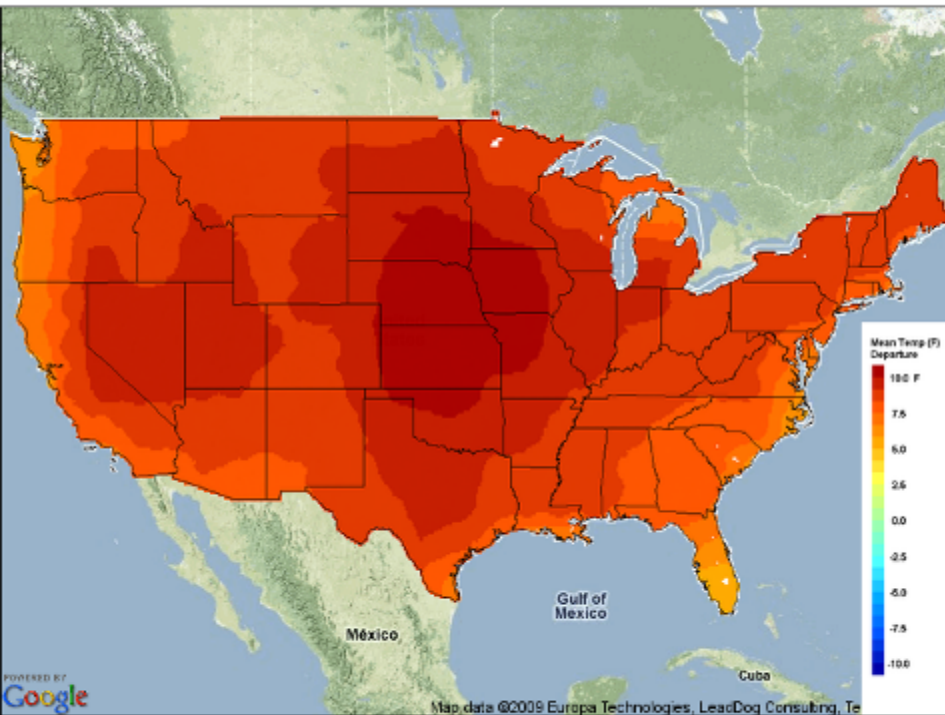
**Gunnison Basin Climate Change Workshop**  
**Southwest Climate Change Initiative**  
**December 2-3, 2009**



# Consequences of climate change

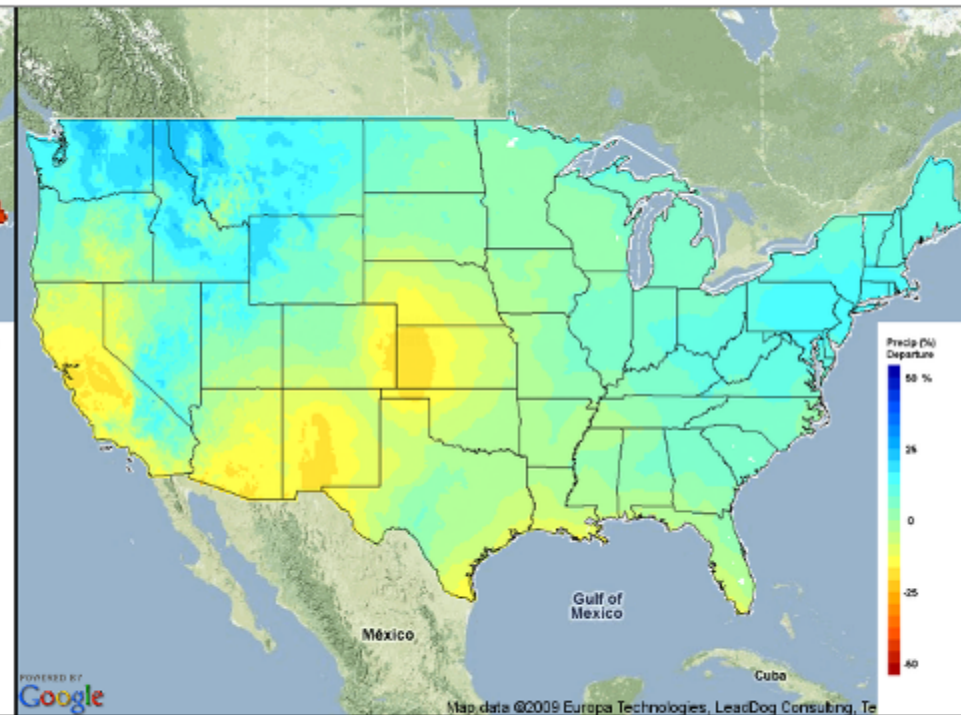
Change in Average Annual Temperature by 2100

Model: Ensemble Average, SRES emission scenario: A2



Change in Average Annual Precipitation by 2100

Model: Ensemble Average, SRES emission scenario: A2



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Google

Map data ©2009 Europa Technologies, LeadDog Consulting, Te

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Google

Map data ©2009 Europa Technologies, LeadDog Consulting, Te

Data Source: Base climate projections downloaded by Maurer, et al. (2007). We also acknowledge the following groups for providing the WCRP CMP3 multi-model dataset available: Program for Climate Model Diagnosis and Intercomparison, The WCRP's Working Group on Coupled Modeling, and the Office of Science, US Department of Energy

**The Nature  
Conservancy**  
Protecting nature. Preserving life.™

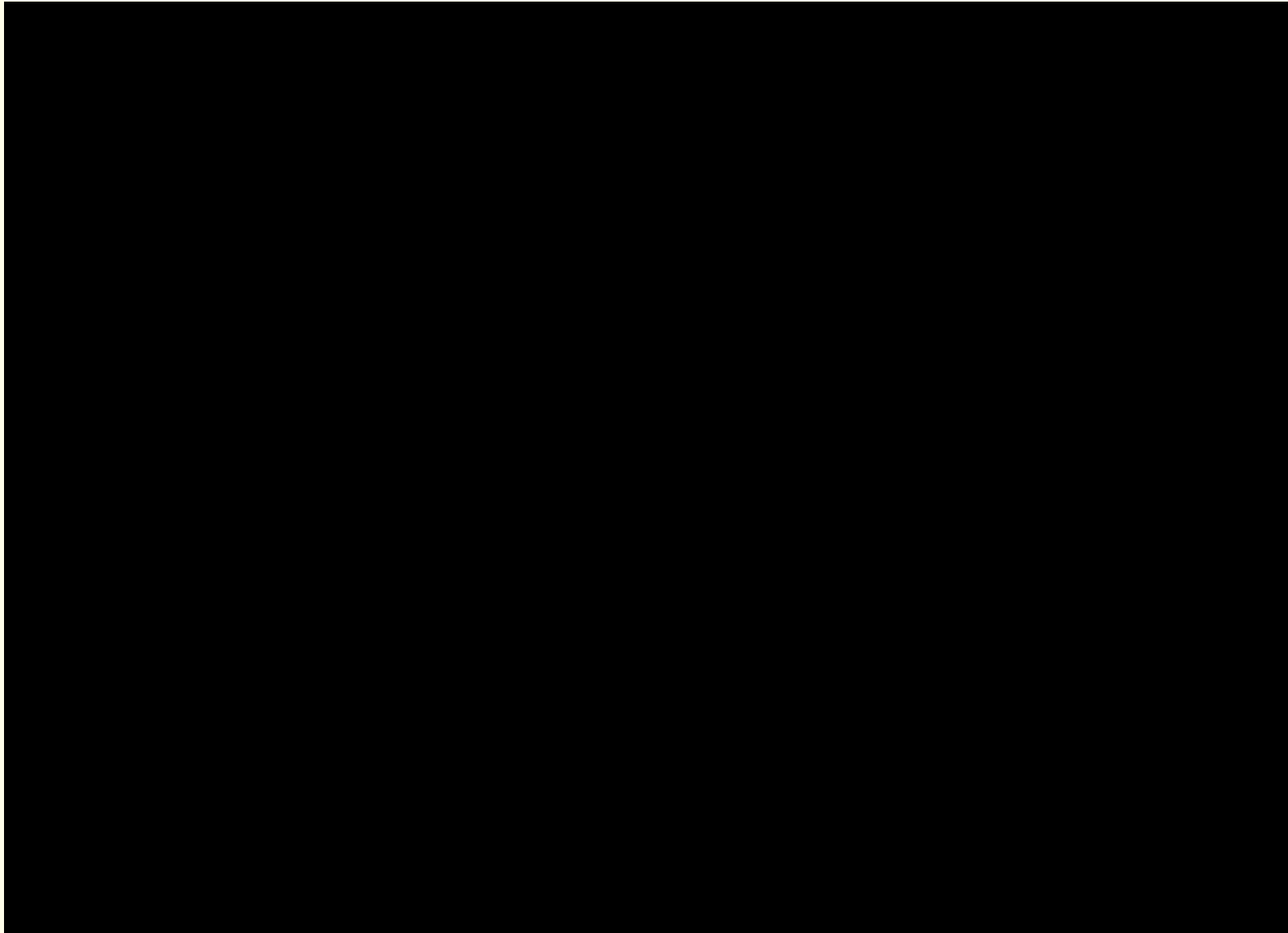
**Santa Clara  
University**

Data Source: Base climate projections downloaded by Maurer, et al. (2007). We also acknowledge the following groups for providing the WCRP CMP3 multi-model dataset available: Program for Climate Model Diagnosis and Intercomparison, The WCRP's Working Group on Coupled Modeling, and the Office of Science, US Department of Energy

**The Nature  
Conservancy**  
Protecting nature. Preserving life.™



# Adapt, move or go extinct?



# Climate change adaptation

**Adaptation** = actions that enable species or systems to better cope with or adjust to changing conditions.





# General principles of adaptation

- Reduce non-climate stressors
- Manage for ecological function and biodiversity
- Establish buffer zones and connectivity
- Implement “proactive” management strategies
- Increase monitoring and facilitate management under uncertainty

# Challenges facing natural resource management

How to make  
applicable to  
my system?

Where to begin?

Uncertainty?  
Complexity?

What to  
manage FOR?



J. Kastner



# Reframing management goals

Increase **RESISTANCE** to change

Promote **RESILIENCE** to change

Enable ecosystems to **RESPOND** to change

Determine when to consider **TRIAGE**  
(e.g., adjust priorities)

# Challenges facing natural resource management

How to make applicable to my system?

Where to begin?

Uncertainty?  
Complexity?

What to manage FOR?



J. Kastner



# Climate Change Adaptation Framework

**\*\* TAB #5 IN YOUR PARTICIPANT PACKET \*\***

**Combines concepts from:**

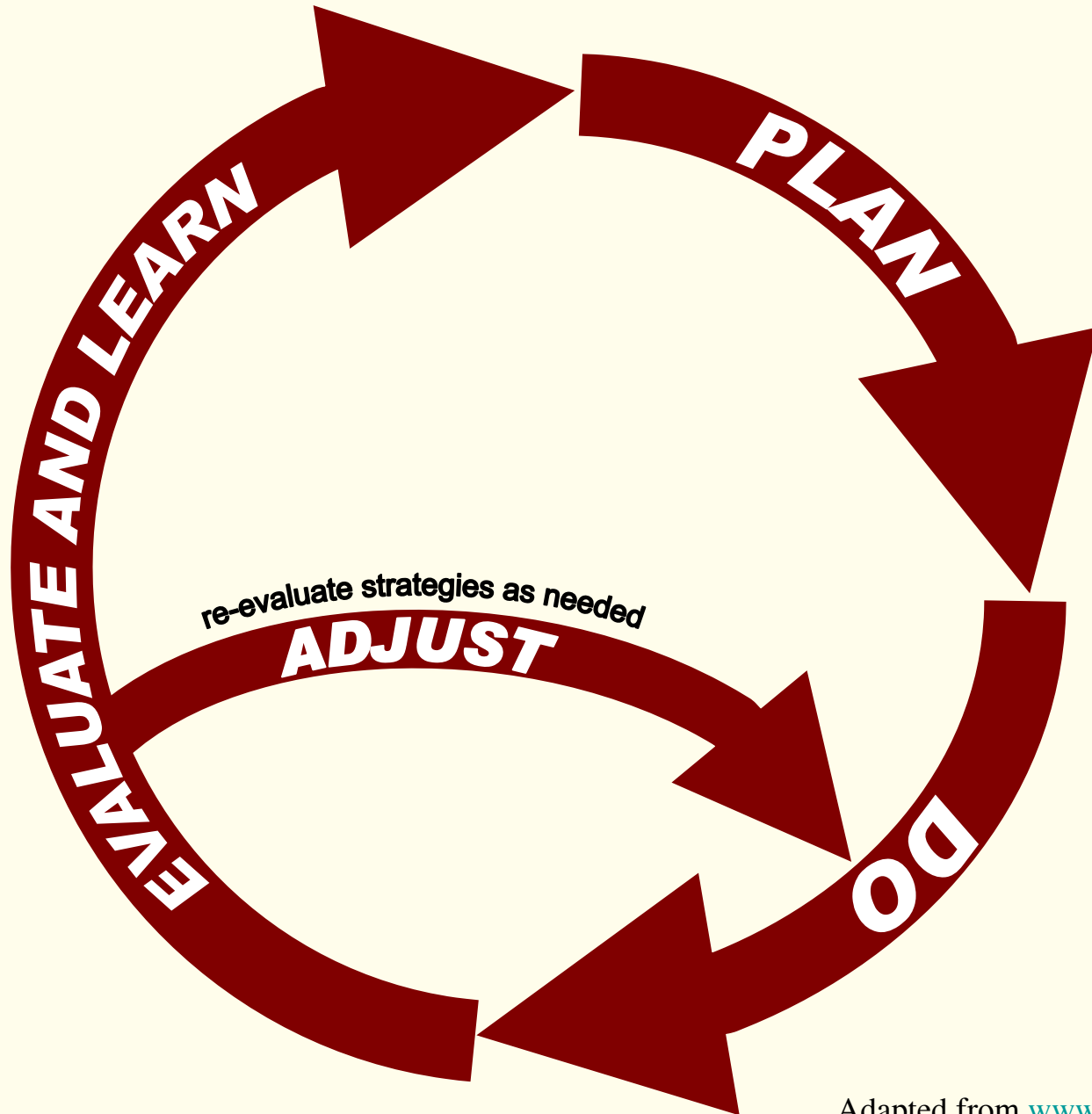
- 1) Climate change adaptation framework developed by the CLIMATE CHANGE AND WILDLIFE CONSERVATION WORKING GROUP**



- 2) CONSERVATION ACTION PLANNING GUIDELINES FOR DEVELOPING STRATEGIES IN THE FACE OF CLIMATE**



# Climate Change Adaptation Framework



# Climate Change Adaptation Framework

Select conservation feature  
&  
Define management objectives

## FEATURE:

*Species*  
*Ecological process*  
*Ecosystem*

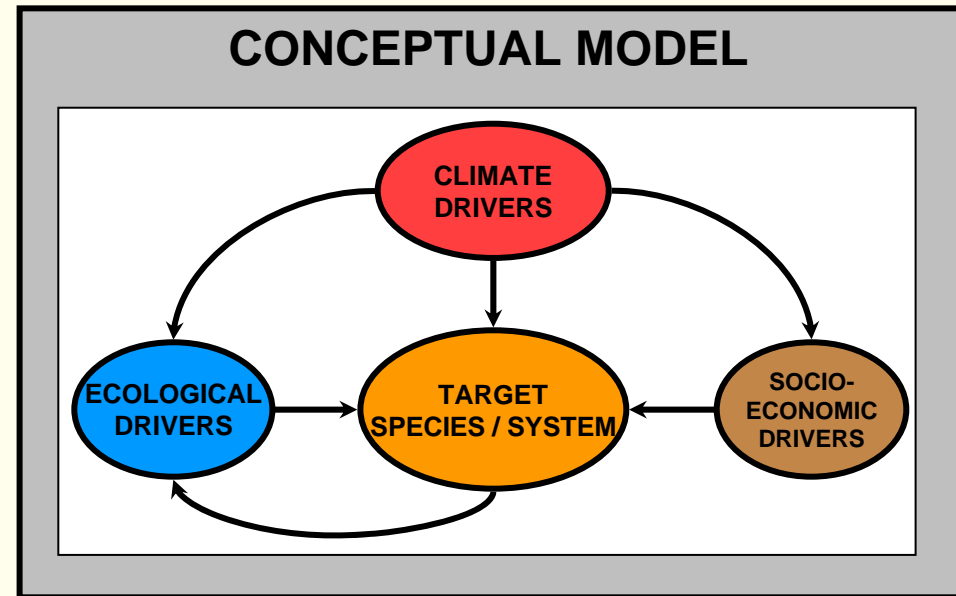
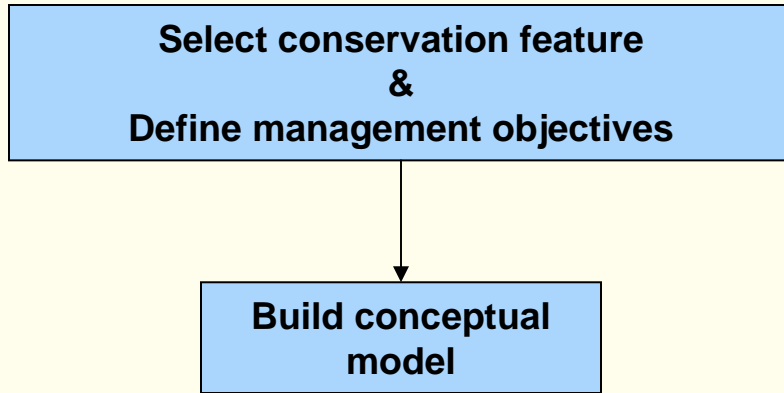
## OBJECTIVES:

*Current Objectives*

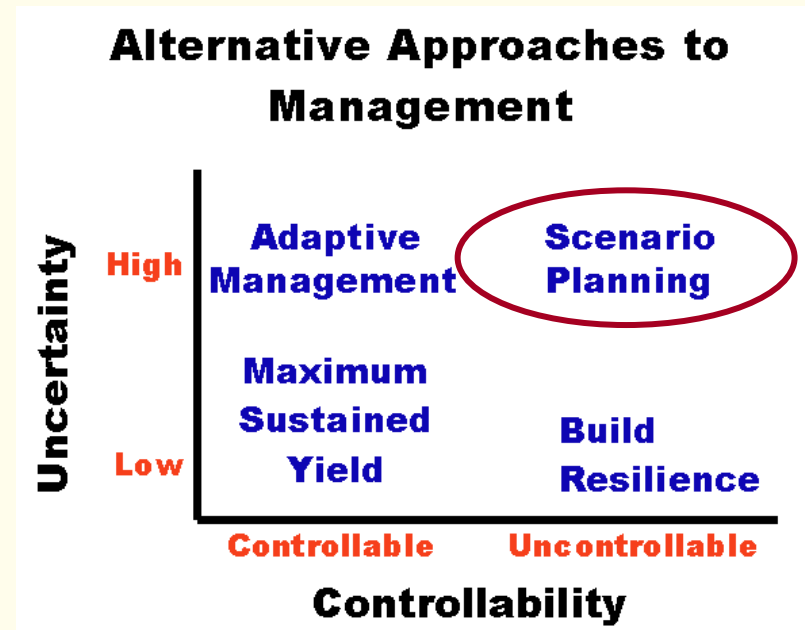
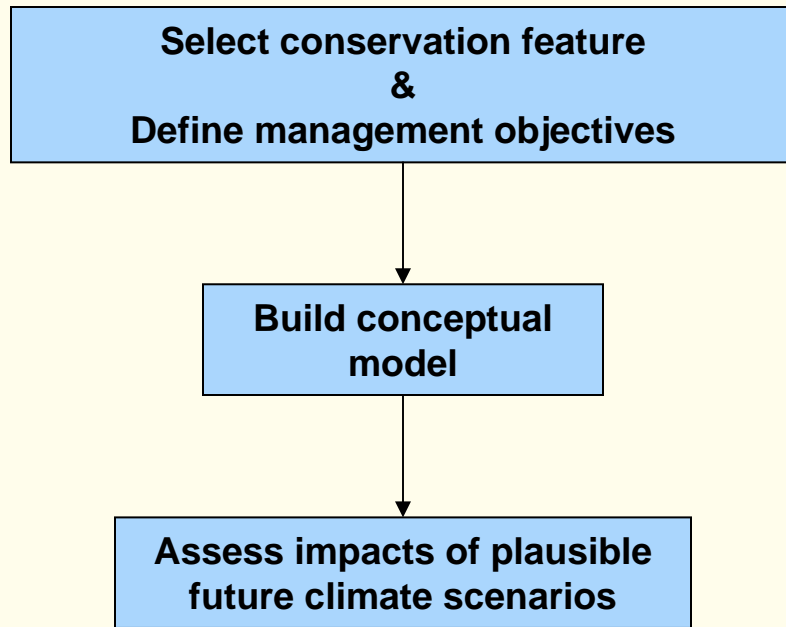
*or*

*Resistance*  
*Resilience*  
*Response*

# Climate Change Adaptation Framework

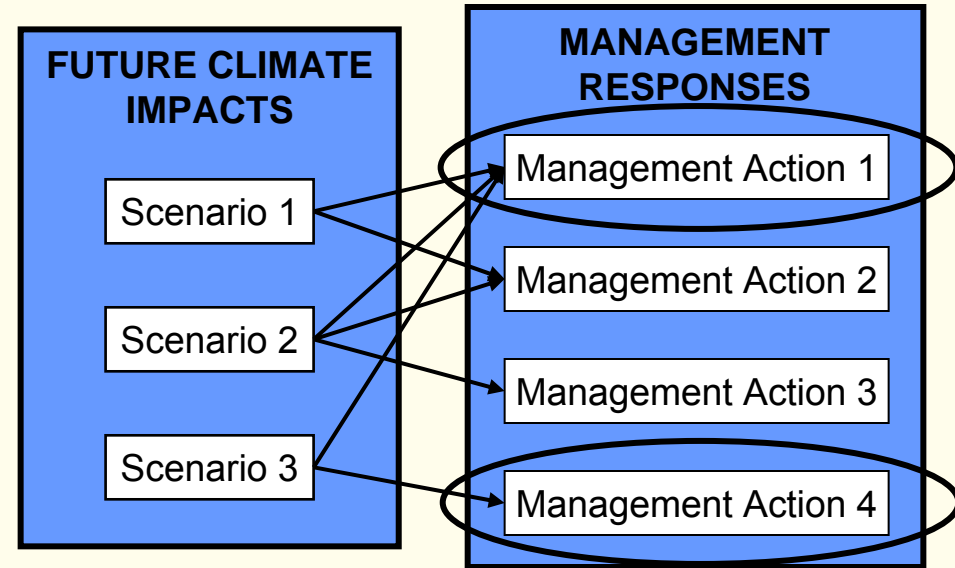
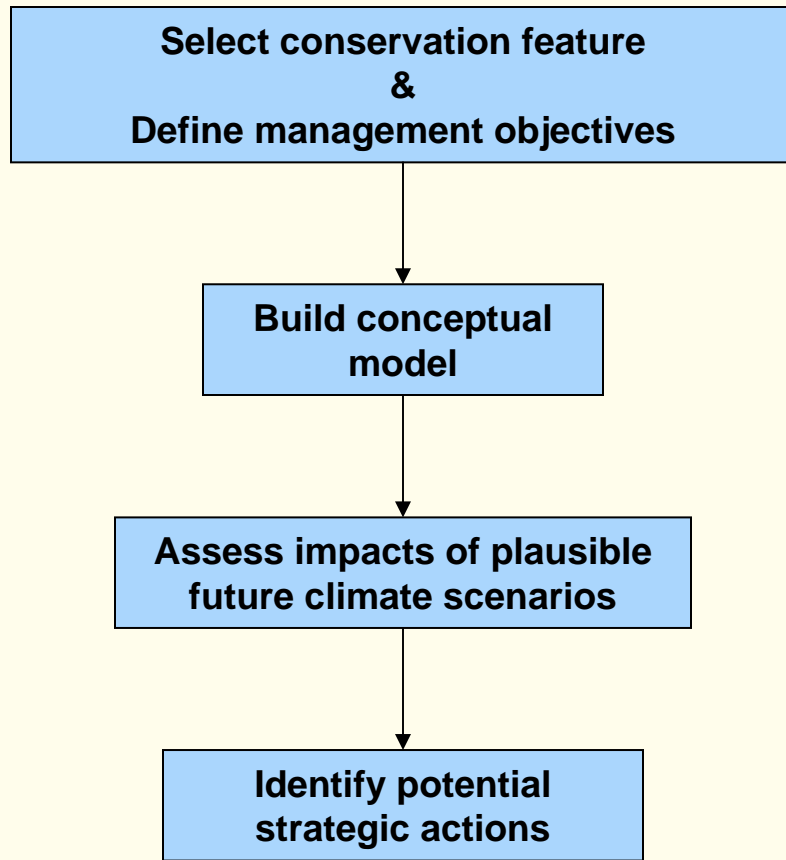


# Climate Change Adaptation Framework

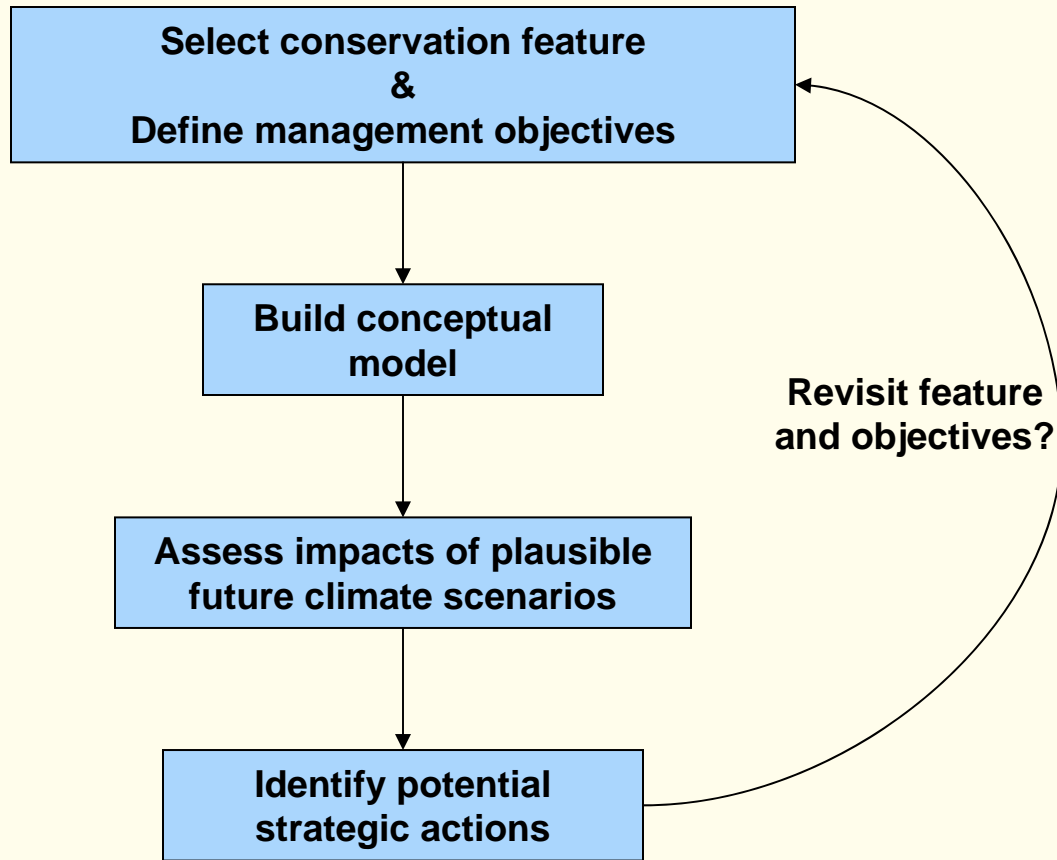


Peterson et al. 2004

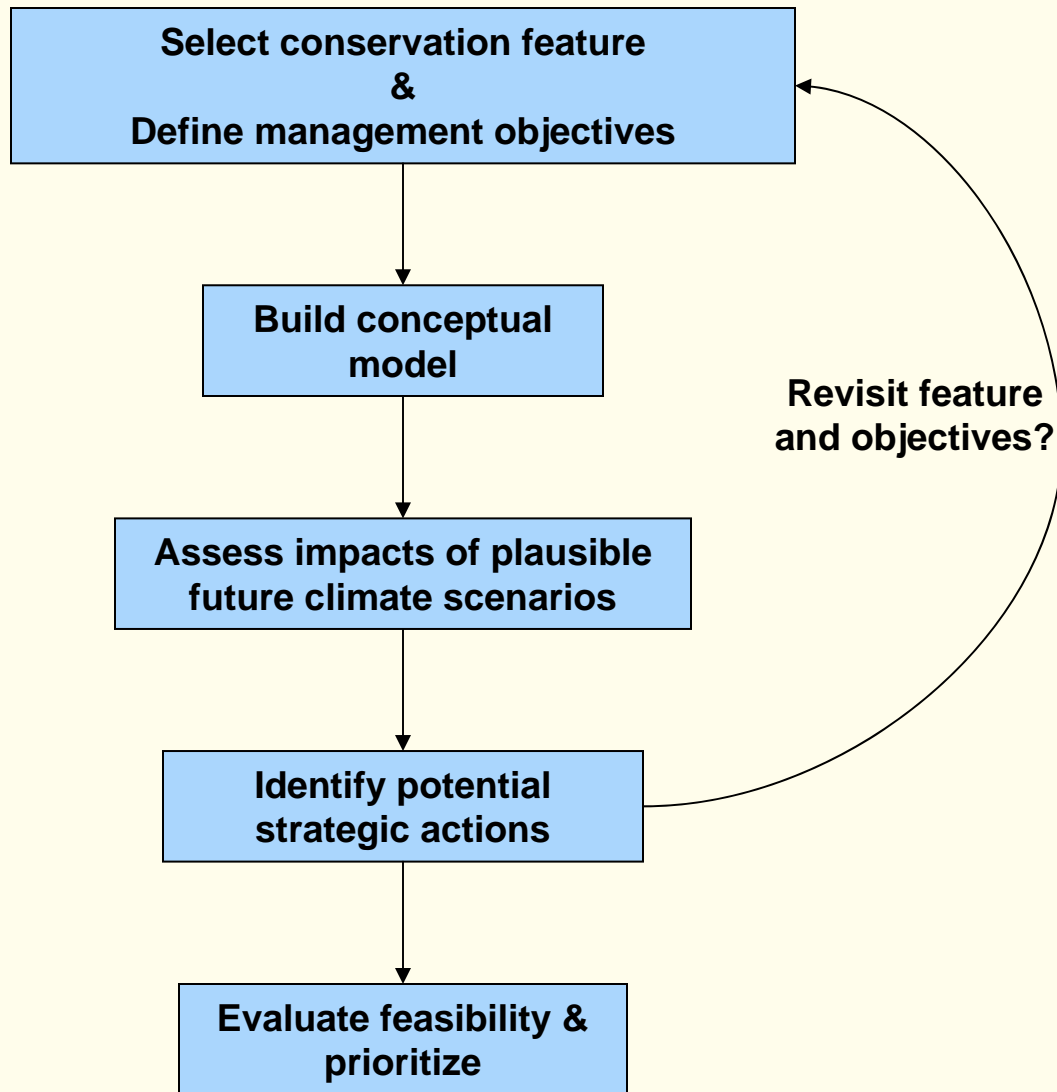
# Climate Change Adaptation Framework



# Climate Change Adaptation Framework



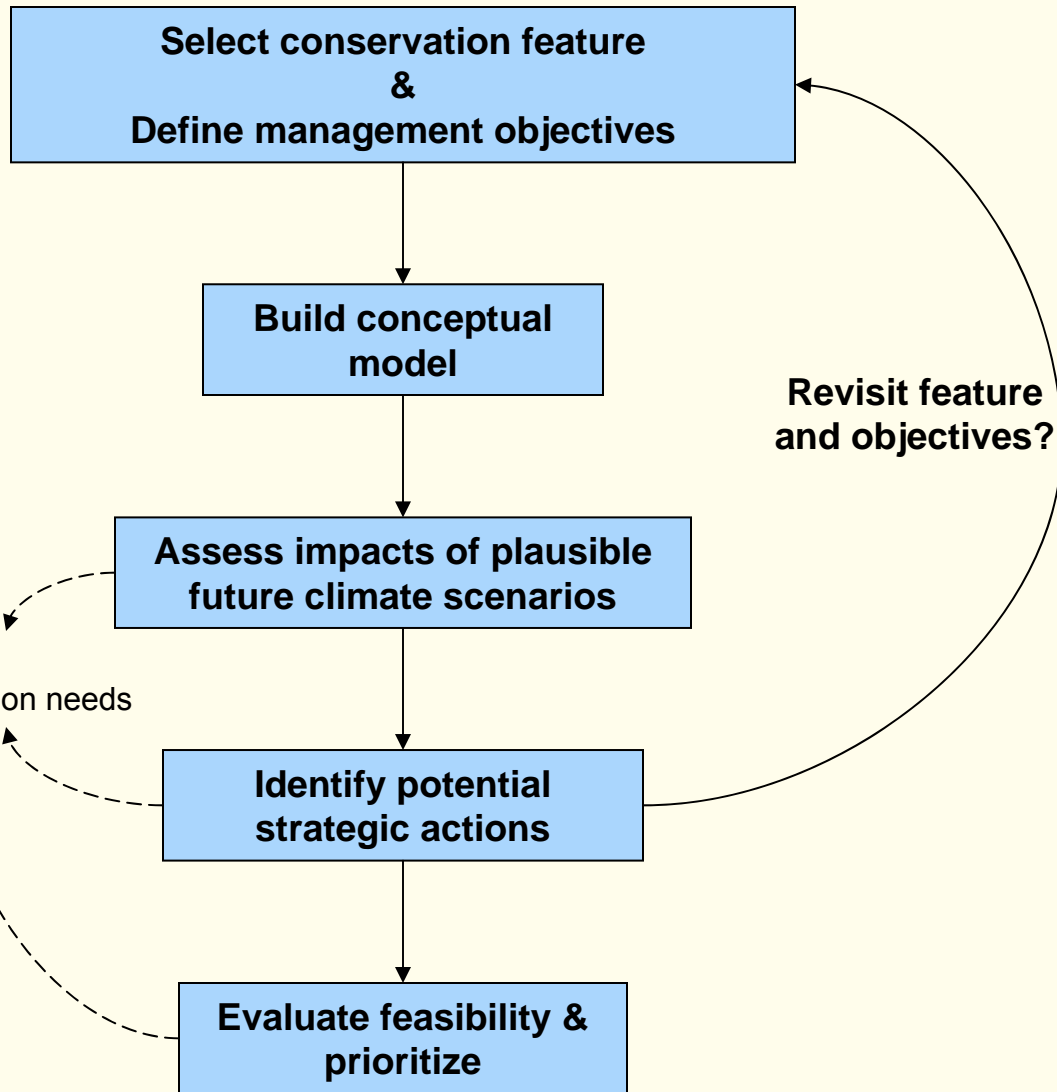
# Climate Change Adaptation Framework



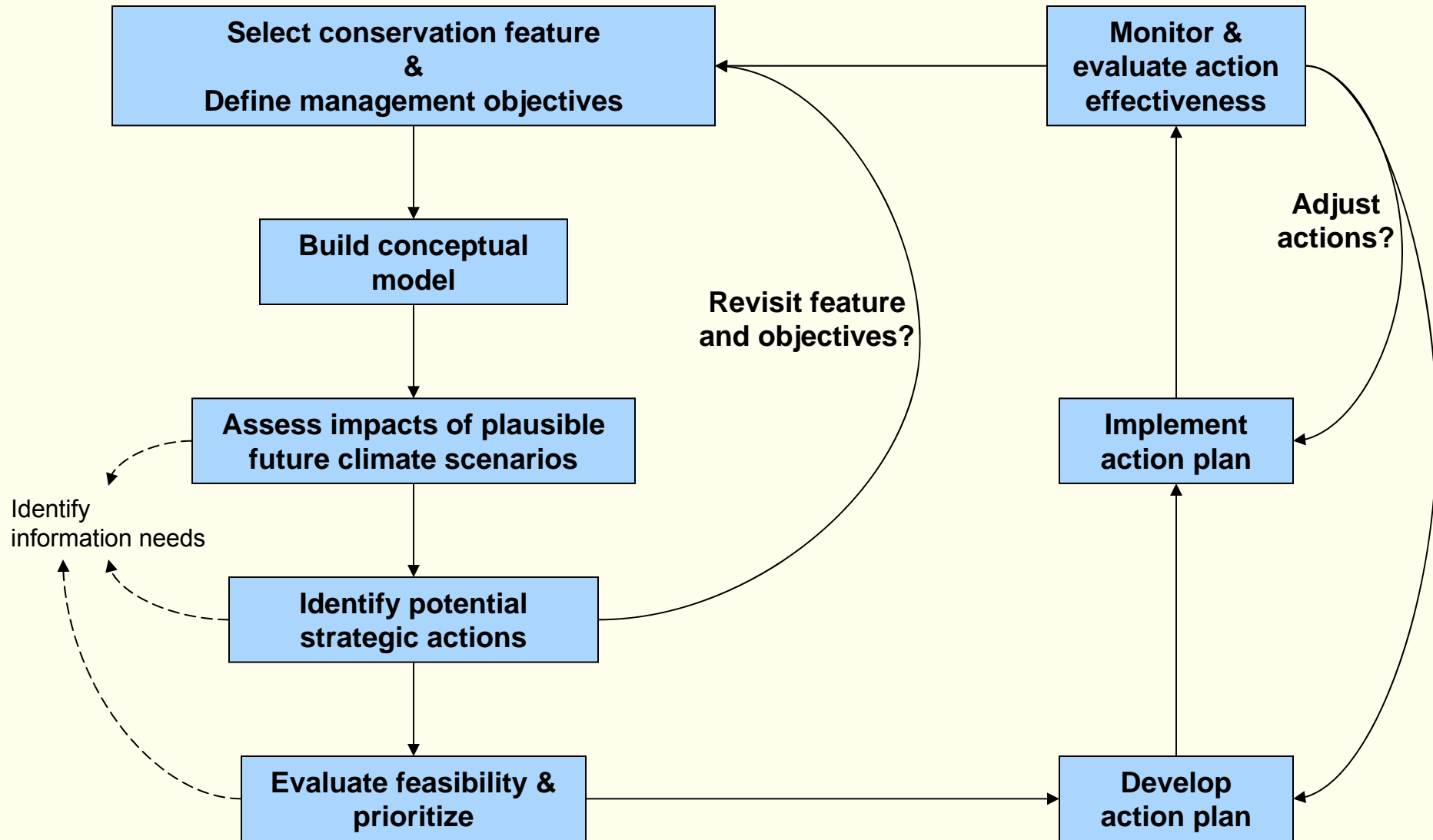
## EVALUATION FACTORS:

- How “robust” to climate change uncertainty
- Feasibility (economic, regulatory, social)
- Unintended consequences
- Synergistic positive effects

# Climate Change Adaptation Framework



# Climate Change Adaptation Framework



# Climate Change Adaptation Framework

## Planning phase

## Implementation phase

Select conservation feature  
&  
Define management objectives

Build conceptual  
model

Assess impacts of plausible  
future climate scenarios

Identify potential  
strategic actions

Evaluate feasibility &  
prioritize

Monitor &  
evaluate action  
effectiveness

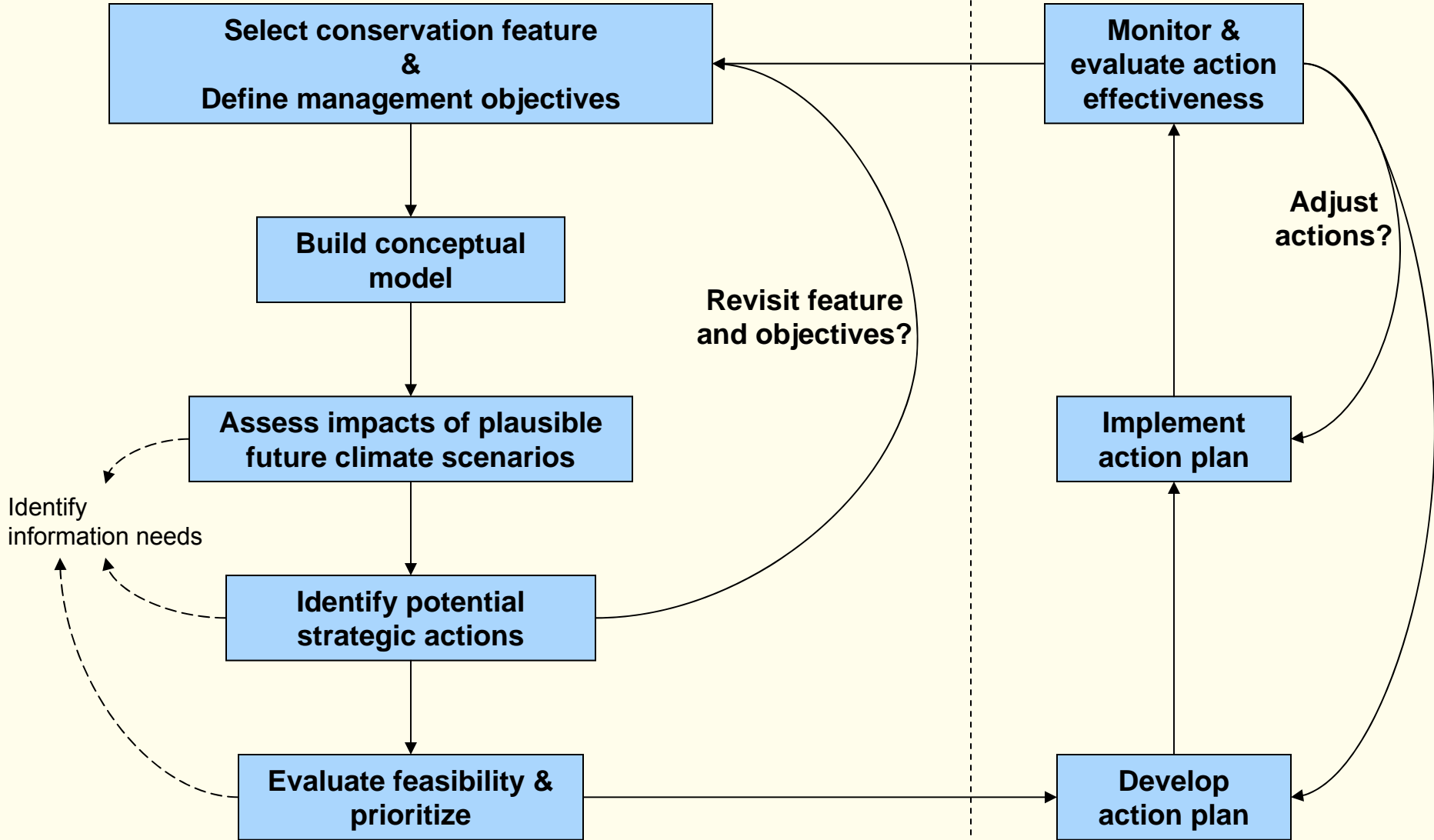
Implement  
action plan

Develop  
action plan

Revisit feature  
and objectives?

Adjust  
actions?

Identify  
information needs



# Climate Change Adaptation Framework

## Planning phase

## Implementation phase

Select conservation feature & Define management objectives

Build conceptual model

Assess impacts of plausible future climate scenarios

Identify potential strategic actions

Evaluate feasibility & prioritize

Monitor & evaluate action effectiveness

Implement action plan

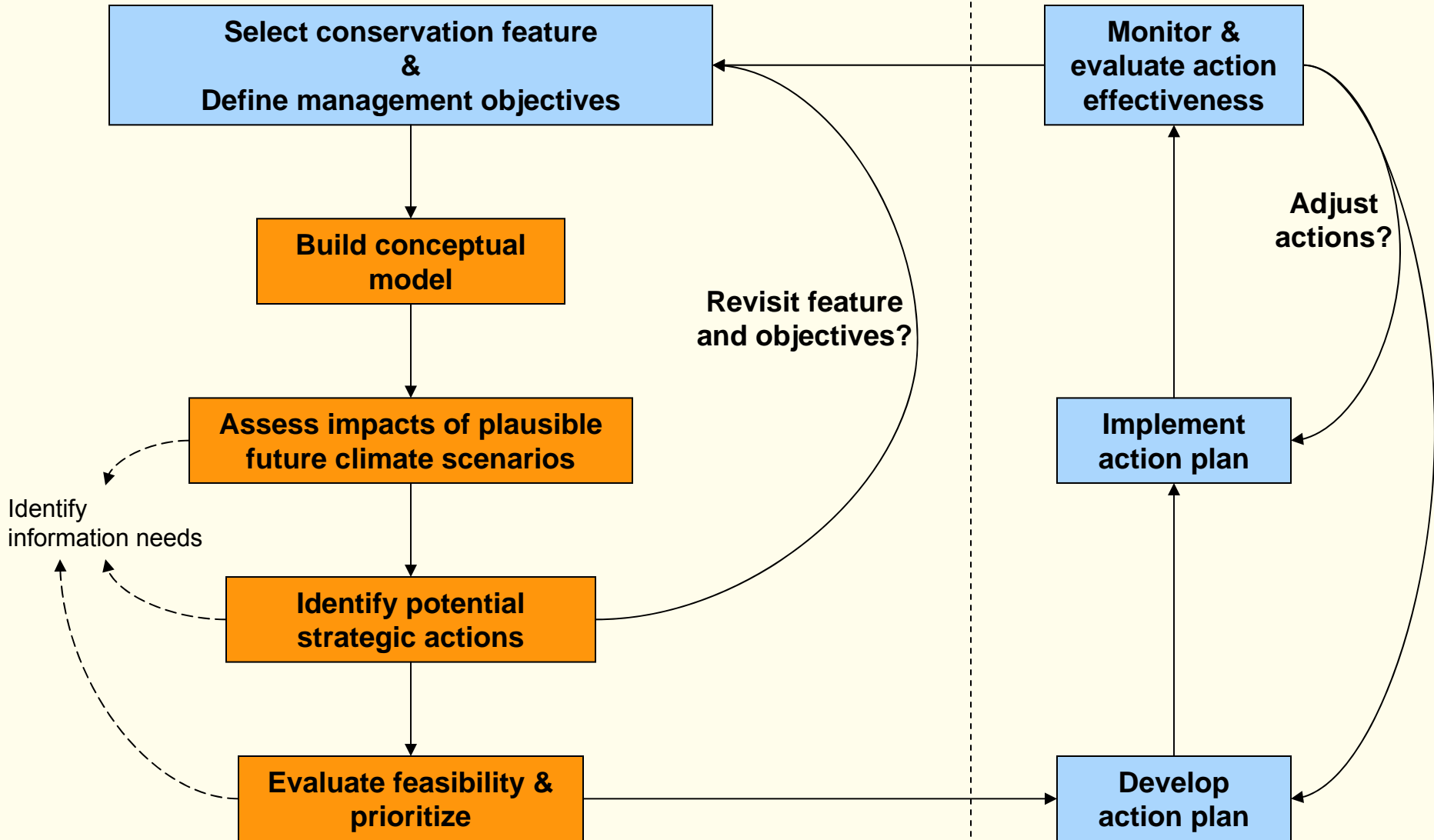
Develop action plan

Revisit feature and objectives?

Adjust actions?

Identify information needs

 = steps we will walk through during workshop



# A real world example

## Greater Yellowstone Ecosystem





# Select feature and define management objective

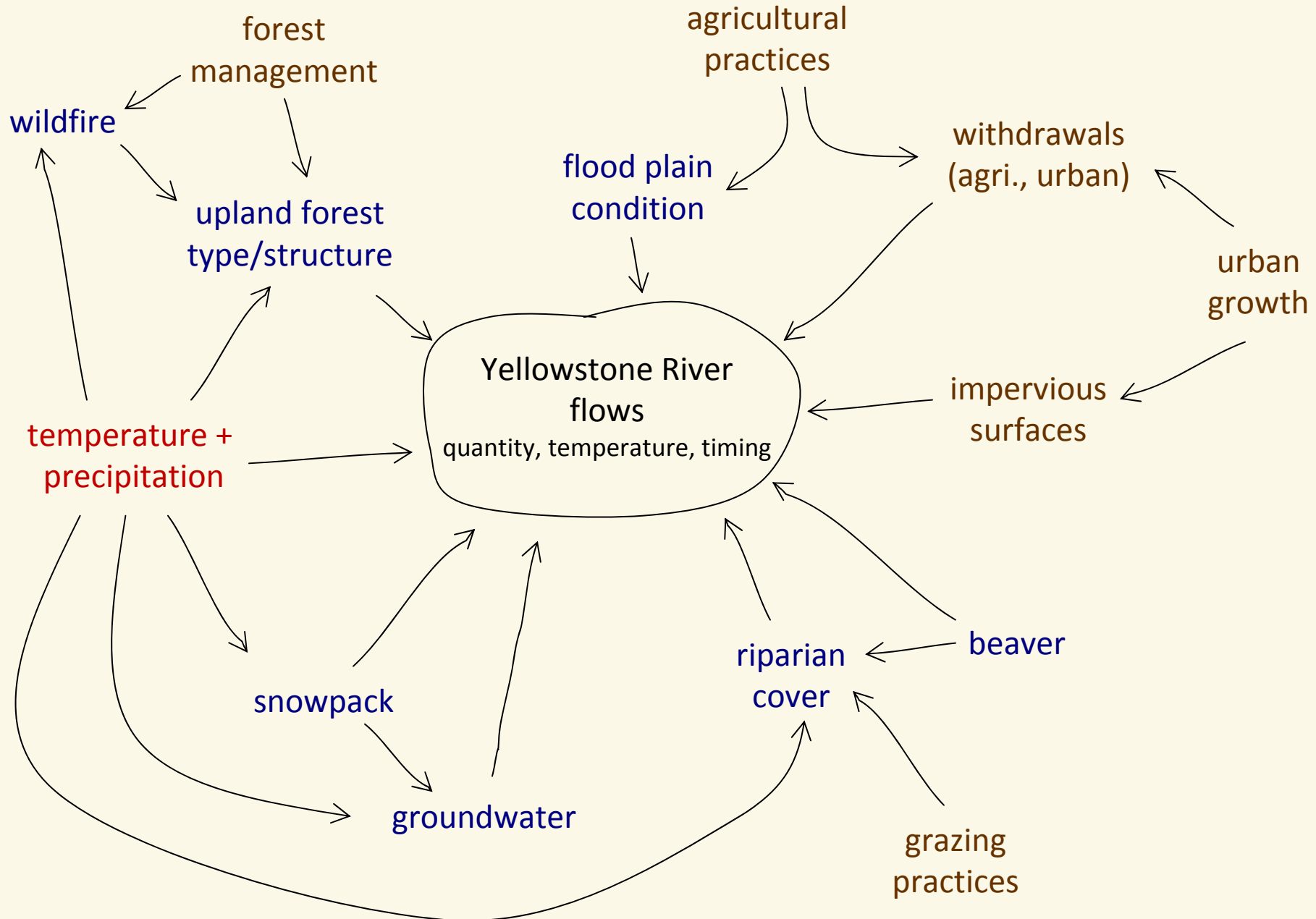
**Yellowstone River flows  
(ecological process)**



**To maintain  
Yellowstone  
cutthroat trout**

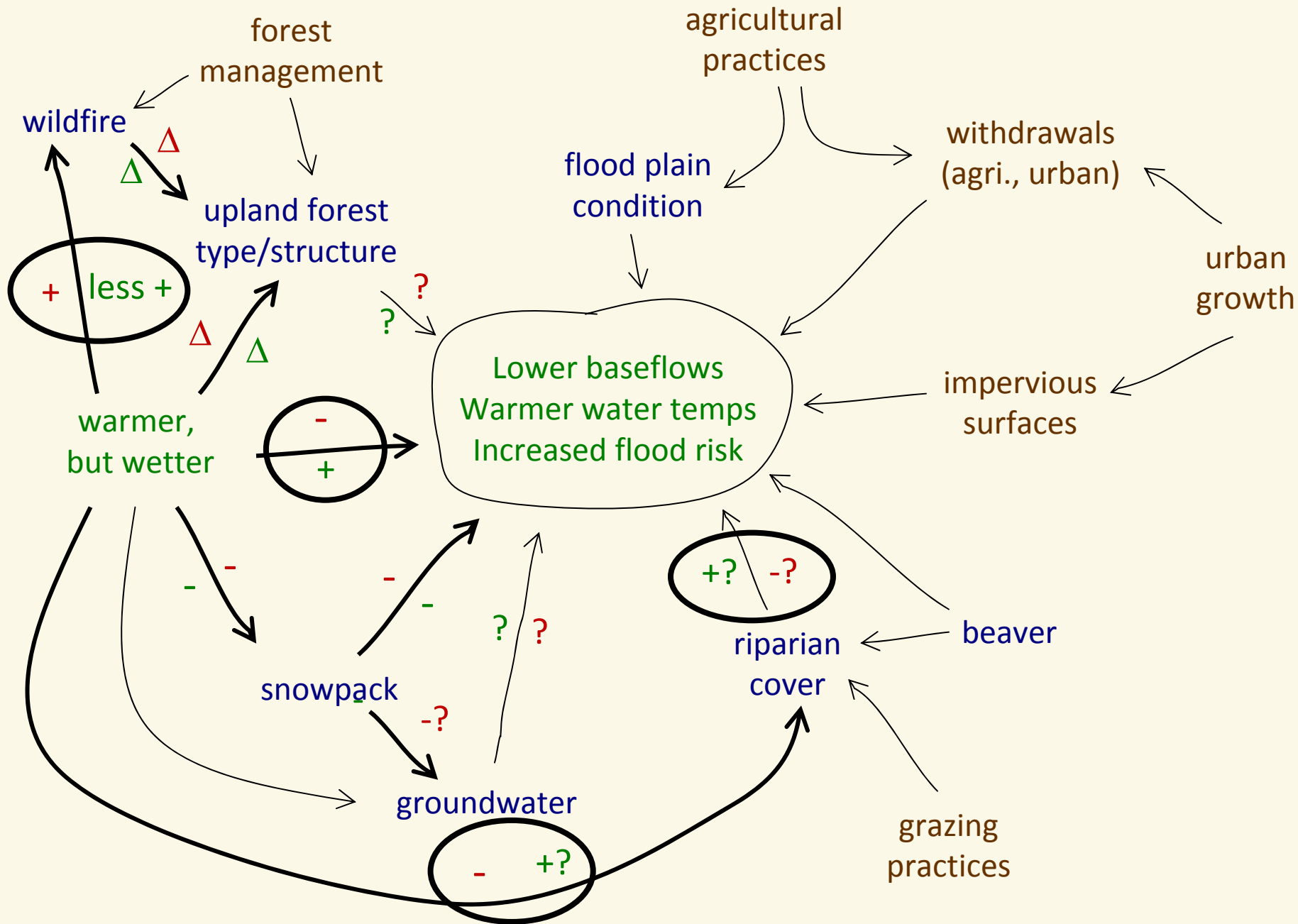


# Build conceptual model

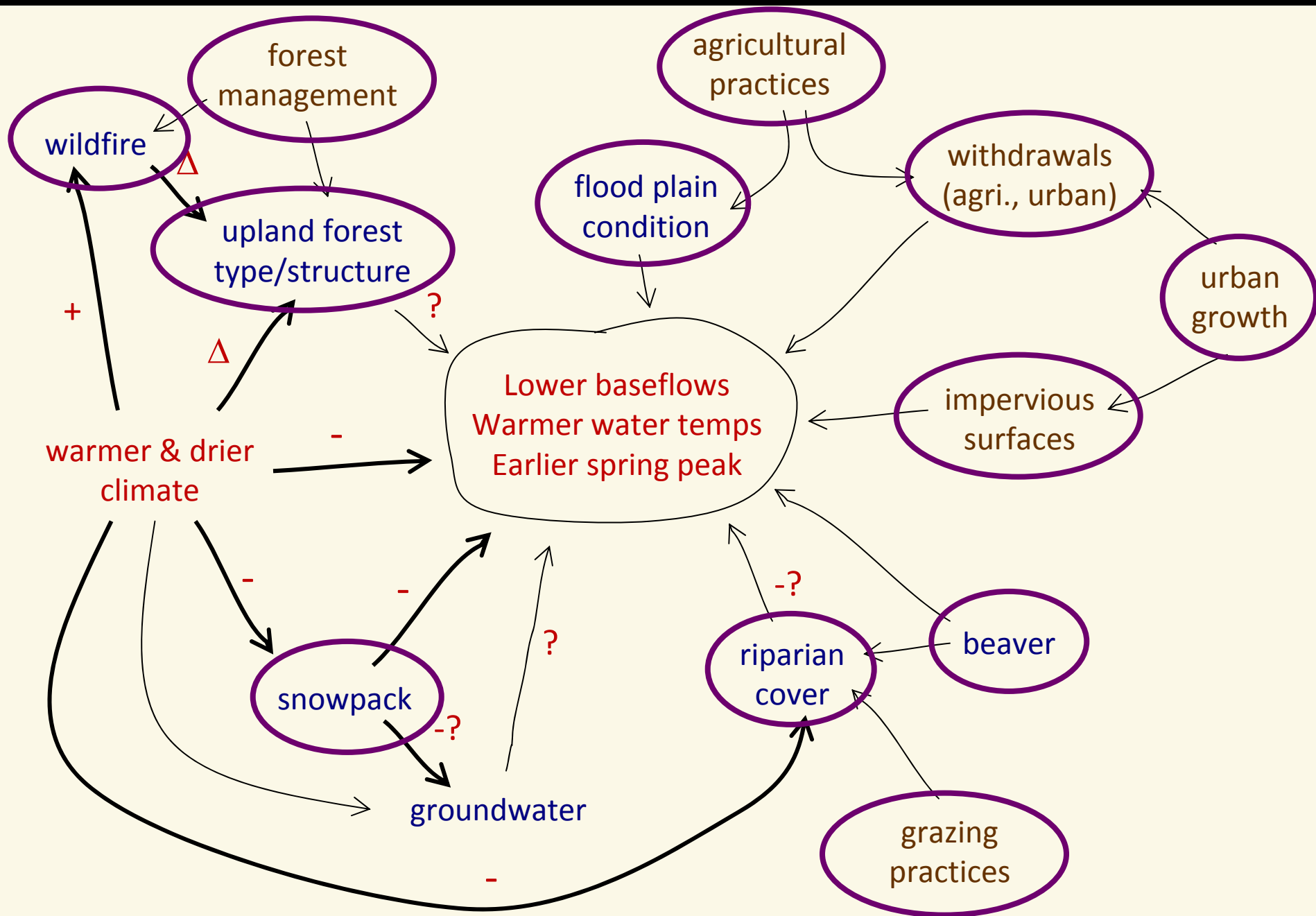




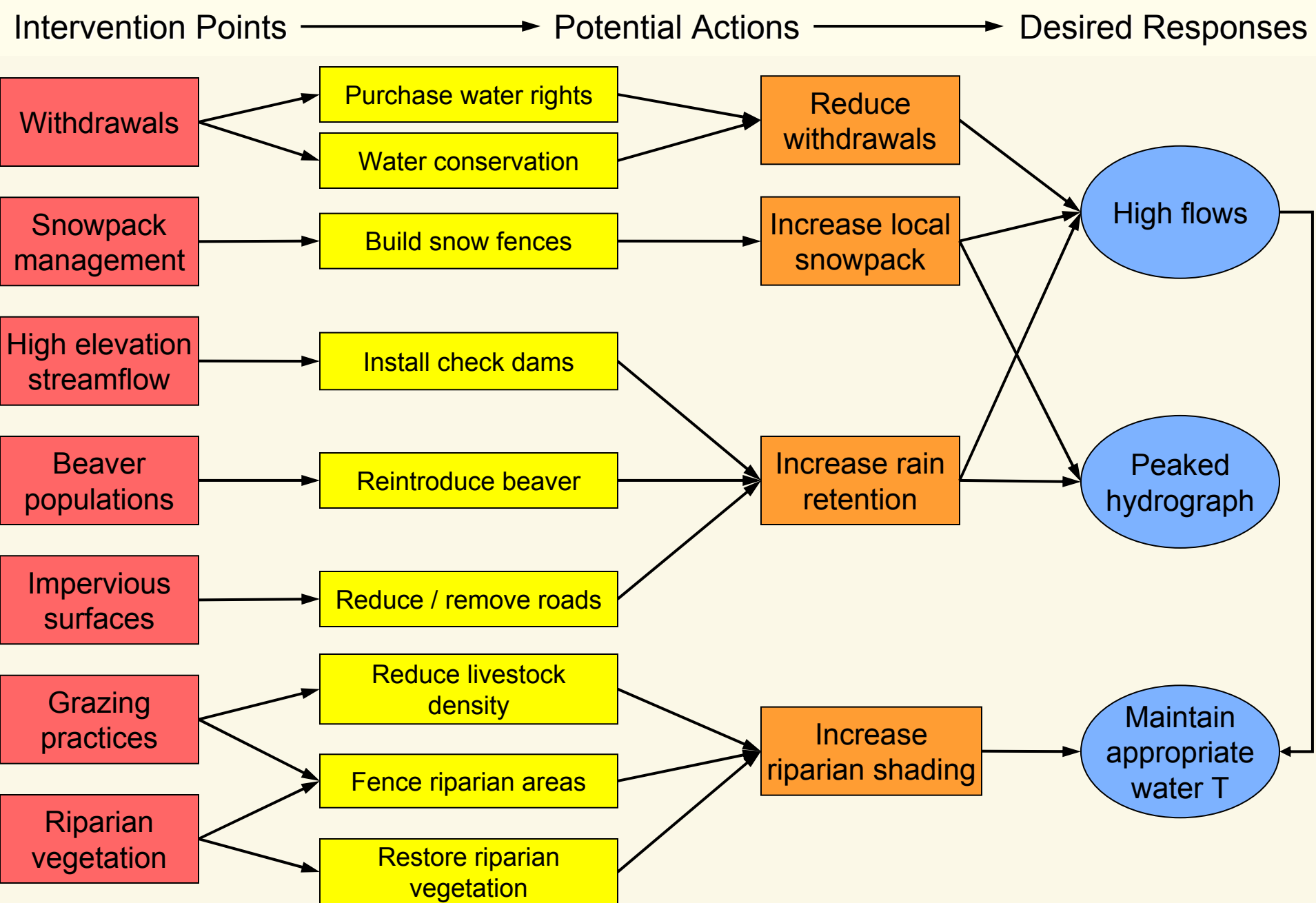
# Alternate climate scenario: Warmer & wetter



# Identify intervention points




# Potential actions for initial climate scenario

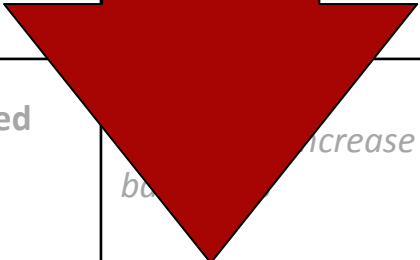


# Example evaluation

	<i>Building snow fences</i>	<i>Installing check dams</i>	<i>Reintroducing beaver</i>
<b>Feasibility</b>			
Economic	<i>Inexpensive</i>	<i>Moderately expensive, but not prohibitive</i>	<i>Relatively inexpensive</i>
Regulatory	<i>Might not be allowed in upper watershed, which falls within Yellowstone National Park</i>	<i>Might not be allowed in upper watershed</i>	<i>Not prohibited in a National Park</i>
Social	<i>Little conflict with downstream users</i>	<i>May conflict with downstream users</i>	<i>Potential conflict will vary among locations</i>
<b>Synergies with other management objectives</b>	<i>Delays timing of peak flow plus increases base flows</i>		<i>May improve status of riparian systems</i>
<b>Potential unintended consequences</b>	<i>No effects on fish passage</i>	<i>May increase siltation; prevents fish passage</i>	<i>Might not release enough water for scouring flows; populations might need to be heavily managed; might prevent fish passage</i>
<b>Potential for removal or modification</b>	<i>High</i>	<i>Becomes more difficult over time; has enduring effects</i>	<i>Difficult, especially over time; has enduring effects</i>
<b>Robustness to increased rather than decreased precipitation</b>	<i>Would still increase baseflows</i>	<i>Would still increase baseflows, but higher risk of blowouts during high flow events</i>	<i>Would still increase baseflows, but higher risk of blowouts during high flow events</i>

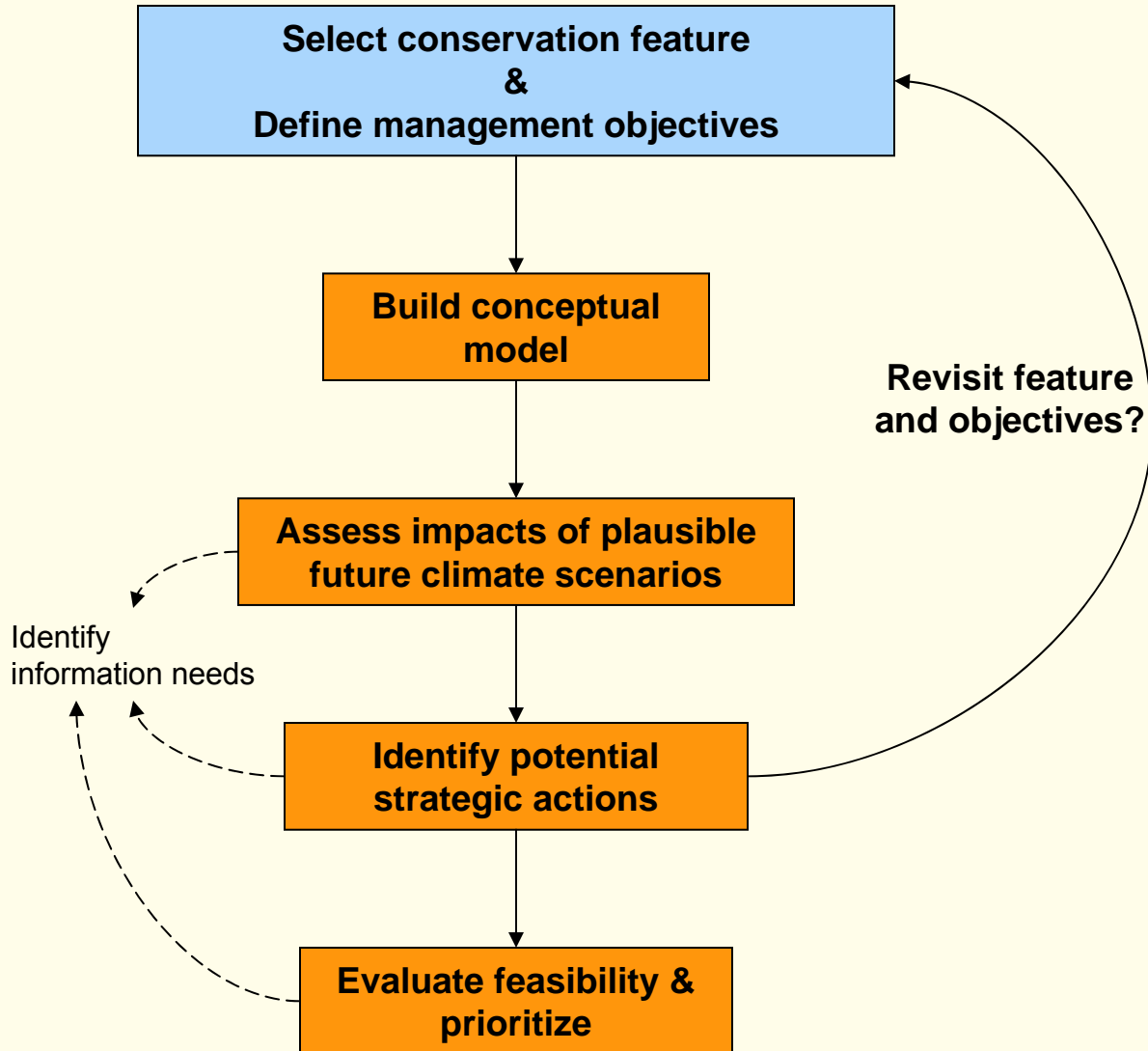
# Example evaluation

	<i>Building snow fences</i>	<i>Installing check dams</i>	<i>Reintroducing beaver</i>
<b>Feasibility</b>			
Economic			
Regulatory			
Social	<i>May conflict with upstream users</i>	<i>May conflict with downstream users</i>	<i>Potential conflict will vary among locations</i>
<b>Synergies with other management objectives</b>	<i>May increase peak flow and decrease base flows</i>		<i>May improve status of riparian systems</i>
<b>Potential unintended consequences</b>	<i>May reduce fish passage</i>	<i>May increase siltation; prevents fish passage</i>	<i>Might not release enough water for scouring flows; populations might need to be heavily managed; might prevent fish passage</i>
<b>Potential for removal or modification</b>		<i>Becomes more difficult over time; has enduring effects</i>	<i>Difficult, especially over time; has enduring effects</i>
<b>Robustness to increased rather than decreased precipitation</b>	<i>Would still increase baseflows</i>	<i>Would still increase baseflows, but higher risk of blowouts during high flow events</i>	<i>Would still increase baseflows, but higher risk of blowouts during high flow events</i>

**Tradeoffs across evaluation factors**




# Goal for breakout sessions





# Conservation features for this workshop

## 1. Gunnison sage grouse



## 2. Gunnison headwaters



## 3. Alpine ecosystem



# Questions?

