

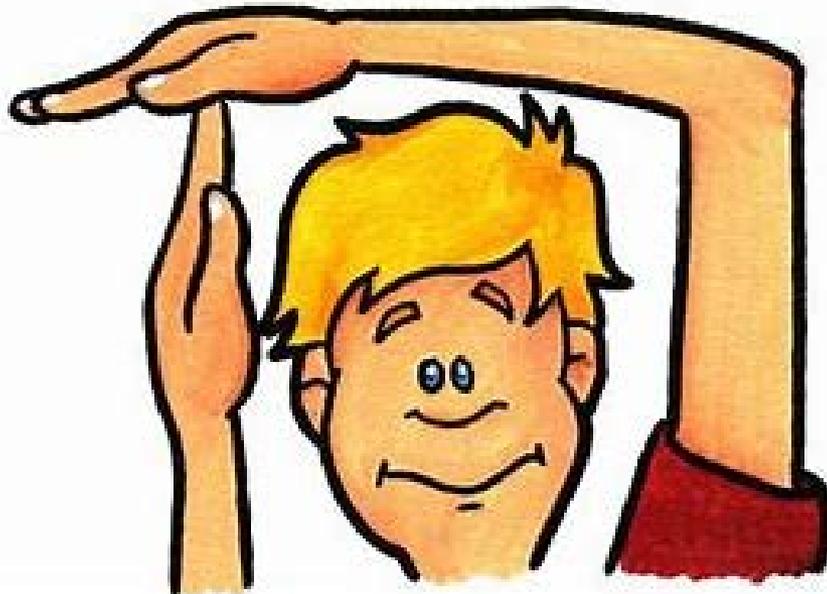


# GROUP EXERCISE





## BREAK TIME





# **Resources for Climate Change Adaptation**

## Intermountain Region – Climate Assessment Workshop

May 22, 2018



**Jessica Halofsky, PhD**  
Research Ecologist  
University of Washington – School of Environmental and Forest  
Sciences



# **Assessing and adapting to climate change**

## **Vulnerability assessment**

Evaluation of the degree to which organisms and systems are susceptible to the effects of climate change

## **Adaptation**

Adjustment in natural or human systems to mitigate harm, facilitate transitions, or exploit benefits of climate change



# Adaptation Partnership Goals

- Increase climate change awareness
- Assess vulnerability of natural resources
- **Develop adaptation strategies and tactics**





# Assessment and Adaptation Focus Areas

Vegetation and disturbance

Wildlife

Water resources

Aquatic species

Recreation

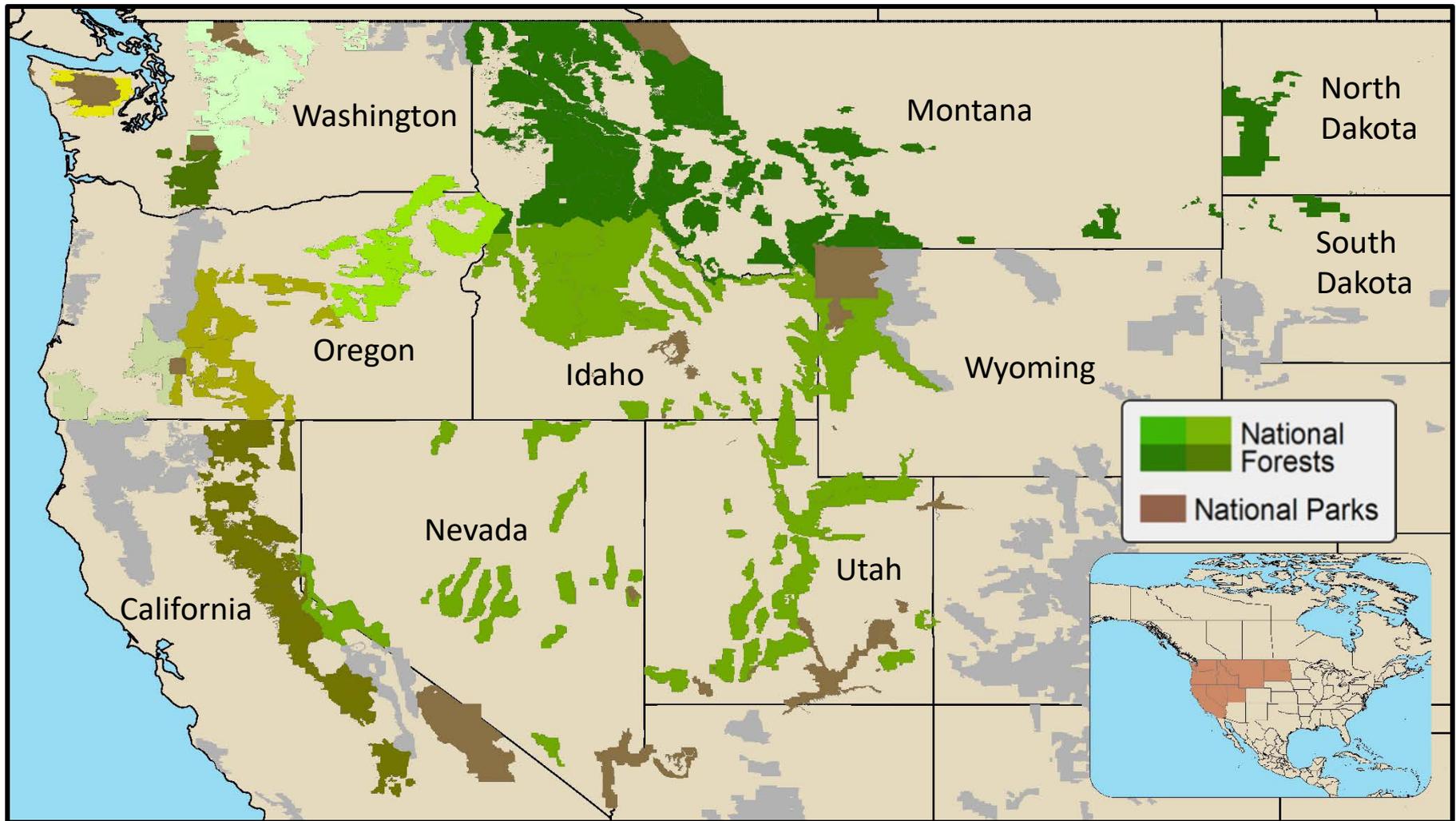
Infrastructure

Cultural resources

Ecosystem services



# We're making progress



Climate change vulnerability assessments completed or in progress

# We're making progress



Climate change vulnerability assessments completed or in progress

# Climate Change Adaptation Library

HOME WHAT WE DO WHO WE ARE ADAPTATION LIBRARY PROJECTS

## ADAPTATION PARTNERS

SCIENCE-MANAGEMENT PARTNERSHIPS FOCUSED  
ON CLIMATE CHANGE ADAPTATION IN THE  
WESTERN UNITED STATES

<http://adaptationpartners.org/library.php>

# Climate Change Adaptation Library

HOME WHAT WE DO WHO WE ARE ADAPTATION LIBRARY PROJECTS

## ADAPTATION PARTNERS

Over 500 adaptation options for vegetation, wildlife, water resources, fisheries, recreation, and ecosystem services.

<http://adaptationpartners.org/library.php>

# Chapter 14: Adapting to the Effects of Climate Change

Jessica E. Halofsky

The IAP made many contributions to the Adaptation Library!

## Introduction

Adapting to climate change, or adjusting to current or future climate and its effects (Noble et al. 2014), is critical to minimizing the risks associated with climate change impacts. Adaptation actions can vary from passive (e.g., a “wait and see” approach), to relatively simple (e.g., increasing harvest rotation age), to complex (e.g., managing forest structure and processes across large landscapes for a future range of conditions) (Spittlehouse and Stewart 2003). Many adaptation actions are complementary to other land management goals and actions, and most land managers already have the tools and knowledge to start addressing climate change. However, managers may need to make some adjustments, considering new issues, scale and location of implementation, timing, and prioritization of actions (Swanston et al. 2016). For example, it will be increasingly important to prioritize which management actions to take, and where to take those actions, based on the vulnerability of resources to climate change and the likelihood that actions in those places will be effective.

Federal land and water management agencies are required to consider climate change in planning and project analysis, and to begin preparing for the effects of climate change (Federal Register 2009, 2013; USDA FS 2012). The processes and tools for developing adaptation strategies and tactics have differed within and among Federal agencies (Halofsky et al. 2015). However, as outlined in Peterson et al. (2011b), key steps in the process include: (1) education on basic climate change science, integrated with knowledge of local resource conditions and issues (review); (2) evaluation of the sensitivity of specific natural resources to climate change (rank); (3) development and implementation of adaptation strategies and tactics (resolve); and (4) monitoring of the effectiveness of adaptation options (observe), with adjustments as needed.

The development of climate change adaptation strategies and tactics is conducted in the third (“resolve”) step. Adaptation strategies describe how adaptation options could be employed, but they are still broad and general in their application across ecosystems. Tactics are more specific adaptation responses and can provide prescriptive directions for actions to be applied on the ground. At the broadest level, climate change adaptation strategies can be differentiated into four types: (1) resistance, (2) resilience, (3) response, and (4) realignment strategies (Millar et al.

2007). The resistance strategy includes tactics that forestall impacts to protect highly valued resources. Resistance strategies are only a short-term solution but often describe the intensive and localized management of rare and isolated species (Heller and Zavaleta 2009). The resilience strategy includes tactics that improve the capacity of systems to return to desired conditions after disturbance. The response strategy employs tactics to facilitate transition of systems from current to new desired conditions. Finally, the realignment strategy uses restoration practices to ensure persistence of ecosystem processes and functions in a changing climate.

The Intermountain Adaptation Partnership (IAP) project incorporated all steps in the adaptation process. An initial kickoff meeting with leadership and managers from the U.S. Department of Agriculture Forest Service (USFS) Intermountain Region involved review of basic climate change information set in a local context. The initial meeting was followed by a vulnerability assessment process that evaluated potential effects of climate change on water and soils (Chapter 4), fish and aquatic habitat (Chapter 5), forest vegetation (Chapter 6), nonforest vegetation (Chapter 7), ecological disturbance (Chapter 8), terrestrial species (Chapter 9), outdoor recreation (Chapter 10), infrastructure (Chapter 11), cultural resources (Chapter 12), and ecosystem services (Chapter 13). Vulnerability assessments set the stage for hands-on development of adaptation options (the “resolve” step) by resource managers in a series of five workshops across the IAP region. Managers engaged in facilitated discussions and completed worksheets, adapted from Swanston and Janowiak (2012), identifying key climate change vulnerabilities and related adaptation strategies (overarching approaches for resource planning and management) and tactics (on-the-ground management actions). Participating land managers were encouraged to use the Climate Change Adaptation Library (<http://adaptationpartners.org/library.php>) for ideas on adaptation strategies and tactics, and to identify several types of strategies, including resilience, response, and realignment strategies. They also identified where tactics could be applied and opportunities for implementation of tactics, where applicable. This chapter describes adaptation strategies and tactics developed in the workshops for each of the 10 resource areas covered in the vulnerability assessment. This chapter covers only adaptation strategies and tactics considered high priority by resource managers and discussed in the workshops. It is thus not intended to be an exhaustive list of possible actions.

# **Vulnerabilities and adaptation**

## **WATER**

# Vulnerabilities and adaptation

## WATER

### Vulnerability

- Reduced water availability



# Vulnerabilities and adaptation

## WATER

### Vulnerability

- Reduced water availability



### Adaptation strategy

- Improve water conservation



# Vulnerabilities and adaptation

## WATER

### Vulnerability

- Reduced water availability



### Adaptation tactics

- Use drought-tolerant plants in landscaping
- Better manage livestock water improvements



# **Vulnerabilities and adaptation FISHERIES**

# Vulnerabilities and adaptation FISHERIES

## Vulnerability

- Warmer stream temperatures may favor nonnative species



# Vulnerabilities and adaptation FISHERIES

## Vulnerability

- Warmer stream temperatures may favor nonnative species



## Adaptation strategy

- Increase resilience of native fish species



# Vulnerabilities and adaptation FISHERIES

## Vulnerability

- Warmer stream temperatures may favor nonnative species



## Adaptation tactics

- Manage grazing
- Reconnect floodplains and side channels
- Conduct meadow restoration



# **Vulnerabilities and adaptation**

## **VEGETATION**

# Vulnerabilities and adaptation

## VEGETATION

### Vulnerability

- Wildfire will burn more area and over a longer fire season



# Vulnerabilities and adaptation

## VEGETATION

### Vulnerability

- Wildfire will burn more area and over a longer fire season

### Adaptation strategy

- Increase resilience of forest ecosystems to more frequent fire



# Vulnerabilities and adaptation

## VEGETATION

### Vulnerability

- Wildfire will burn more area and over a longer fire season

### Adaptation tactics

- Reduce stand densities
- Accelerate hazardous fuel treatments
- Manage for diversity



# **Vulnerabilities and adaptation**

## **WILDLIFE**

# Vulnerabilities and adaptation WILDLIFE

## Vulnerability

- Loss of late-seral ponderosa pine forest



# Vulnerabilities and adaptation WILDLIFE

## Vulnerability

- Loss of late-seral ponderosa pine forest

## Adaptation strategy

- Maintain current habitat, restore historical structure, and increase mosaic structure (including snags)



# Vulnerabilities and adaptation WILDLIFE

## Vulnerability

- Loss of late-seral ponderosa pine forest

## Adaptation tactics

- Conduct thinning and prescribed fire
- Manage grazing
- Plant ponderosa pine genotypes that will do well in the future



# **Vulnerabilities and adaptation**

## **WINTER RECREATION**

# Vulnerabilities and adaptation

## WINTER RECREATION

### Vulnerability

- Shorter winters with less snow, and wetter or icier snow



# Vulnerabilities and adaptation

## WINTER RECREATION

### Vulnerability

- Shorter winters with less snow, and wetter or icier snow

### Adaptation strategy

- Increase recreation management flexibility



# Vulnerabilities and adaptation

## WINTER RECREATION

### Vulnerability

- Shorter winters with less snow, and wetter or icier snow



### Adaptation tactics

- Expand facilities in areas where concentrated use increases
- Develop options for diversifying snow-based recreation



# **Vulnerabilities and adaptation**

## **CULTURAL RESOURCES**

# Vulnerabilities and adaptation

## CULTURAL RESOURCES

### Vulnerability

- Fire will increase erosion and loss of vegetation, which may increase damage to cultural resources



# Vulnerabilities and adaptation

## CULTURAL RESOURCES

### Vulnerability

- Fire will increase erosion and loss of vegetation, which may increase damage to cultural resources



### Adaptation strategy

- Develop pre- and post-disturbance strategies to protect cultural resources



# Vulnerabilities and adaptation

## CULTURAL RESOURCES

### Vulnerability

- Fire will increase erosion and loss of vegetation, which may increase damage to cultural resources



### Adaptation tactics

- Increase the use of prescribed fire or other vegetation manipulation
- Inventory, map, and rate fire risk for cultural resources



# **Vulnerabilities and adaptation**

## **ECOSYSTEM SERVICES**

# Vulnerabilities and adaptation

## ECOSYSTEM SERVICES

### Vulnerability

- Pollinators and their habitat may be sensitive to climate change



# Vulnerabilities and adaptation

## ECOSYSTEM SERVICES

### Vulnerability

- Pollinators and their habitat may be sensitive to climate change

### Adaptation strategy

- Enhance pollinator habitat



# Vulnerabilities and adaptation

## ECOSYSTEM SERVICES

### Vulnerability

- Pollinators and their habitat may be sensitive to climate change



### Adaptation tactics

- Use pollinator-friendly best management practices and seed mixes
- Establish a reserve of native seed mixes





# National Compendium for Climate Change Adaptation Actions

Northern Institute of  
Applied Climate Science  
*Climate Change  
Response Framework*

+

Adaptation Partners  
*Climate Change  
Adaptation Library*

=

*National Compendium  
for Climate Change  
Adaptation Actions*



# National Compendium for Climate Change Adaptation Actions

- A searchable online database with a user-friendly interface
- Will allow for searches by:
  - Resource area (e.g., water, forests, wildlife)
  - Region (broad geographic and/or Forest Service)
  - Climate change effect
  - Keywords
- Will include peer-reviewed citations for adaptation approaches



[Home](#)

compendium



**Resource Area**

- Any -

**Region**

- Any -

**Climate Change Effect**

Changing patterns of herbivory

[Filter Results](#)

[Reset Filters](#)

Maintain or improve the ability of forests to resist pests and pathogens

**Resource Area:** Forest **Source:** Adaptation Workbook

Manage herbivory to promote regeneration of desired species

**Resource Area:** Forest **Source:** Adaptation Workbook

Reduce competition for moisture, nutrients, and light

**Resource Area:** Urban **Source:** Adaptation Workbook

Plus Key Word Search!

[Search](#)

**Navigation**

▷ [Add content](#)



[Home](#)

## Conduct education and outreach with involved parties

[View](#) [Edit](#)

**Sensitivity:**

Hydrologic regime shifts with climate change will include lower summer flows and higher more frequent winter peak flows

**Strategy:**

Increase communication and collaboration

**Approach:**

Conduct education and outreach with involved parties

**Tactics:**

- Collaborate with watershed councils.
- Collaborate with recreation specialists/managers
- Increase communication networks for safety and awareness

**Source:**

Adaptation Partners

**Geography:**

Northwest/Rockies/Plains

Plus citations

### Navigation

▷ [Add content](#)



**National Compendium for Climate Change  
Adaptation Actions:**

**<https://www.fs.usda.gov/ccrc/>**

**Climate Change Adaptation Library:**

**<http://adaptationpartners.org/>**

**Climate Change Response Framework:**

**[www.forestadaptation.org/far](http://www.forestadaptation.org/far)**



**Jessica Halofsky**  
Research Ecologist  
Seattle, Washington  
jhalo@uw.edu  
541-231-9732



<http://adaptationpartners.org/>

