

# Drought, Floods, and Forests

Leslie Brandt

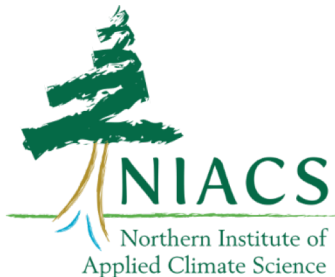
Northern Institute of Applied Climate Science

USDA Northern Forests Climate Hub

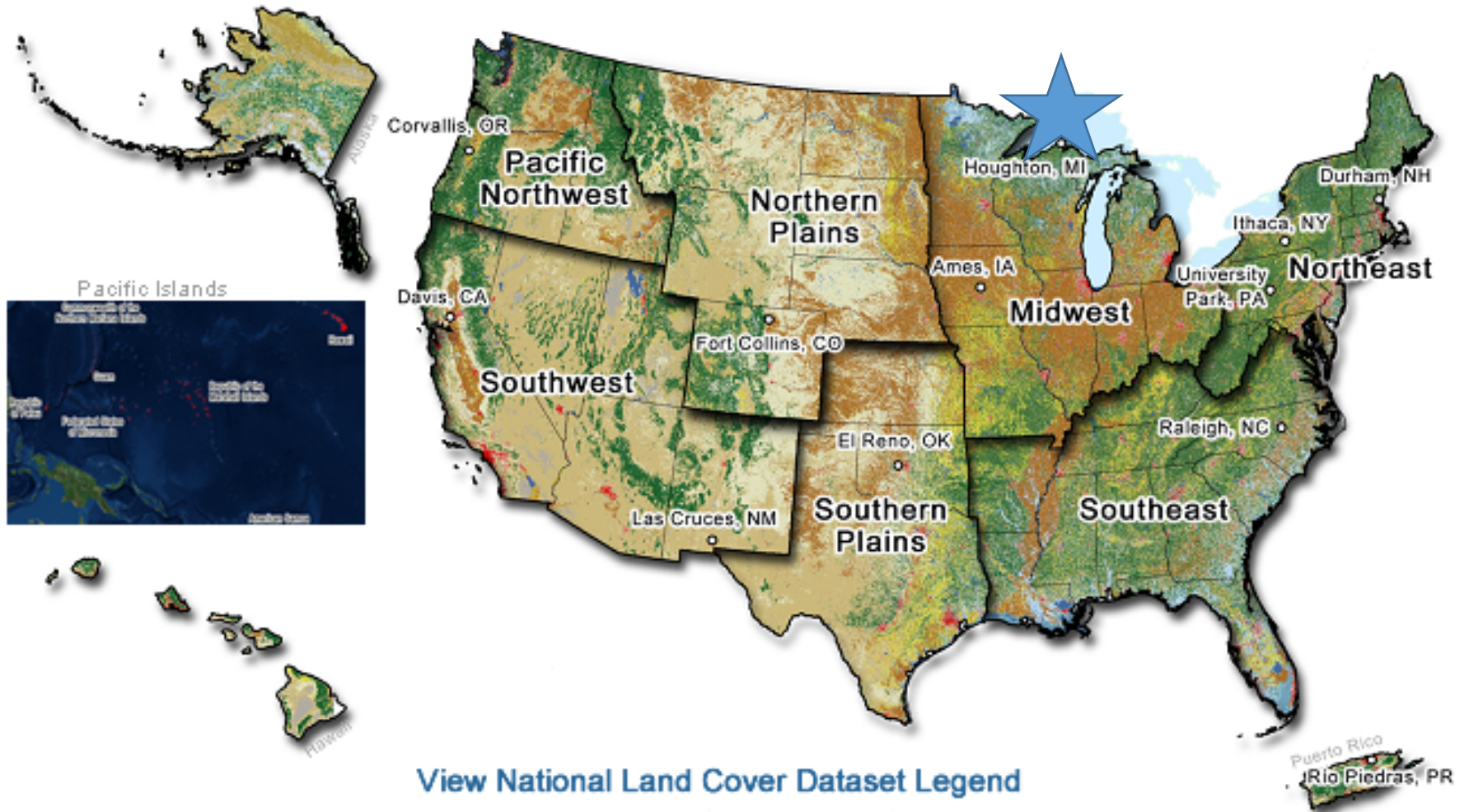
USDA Forest Service

# Northern Institute of Applied Climate Science

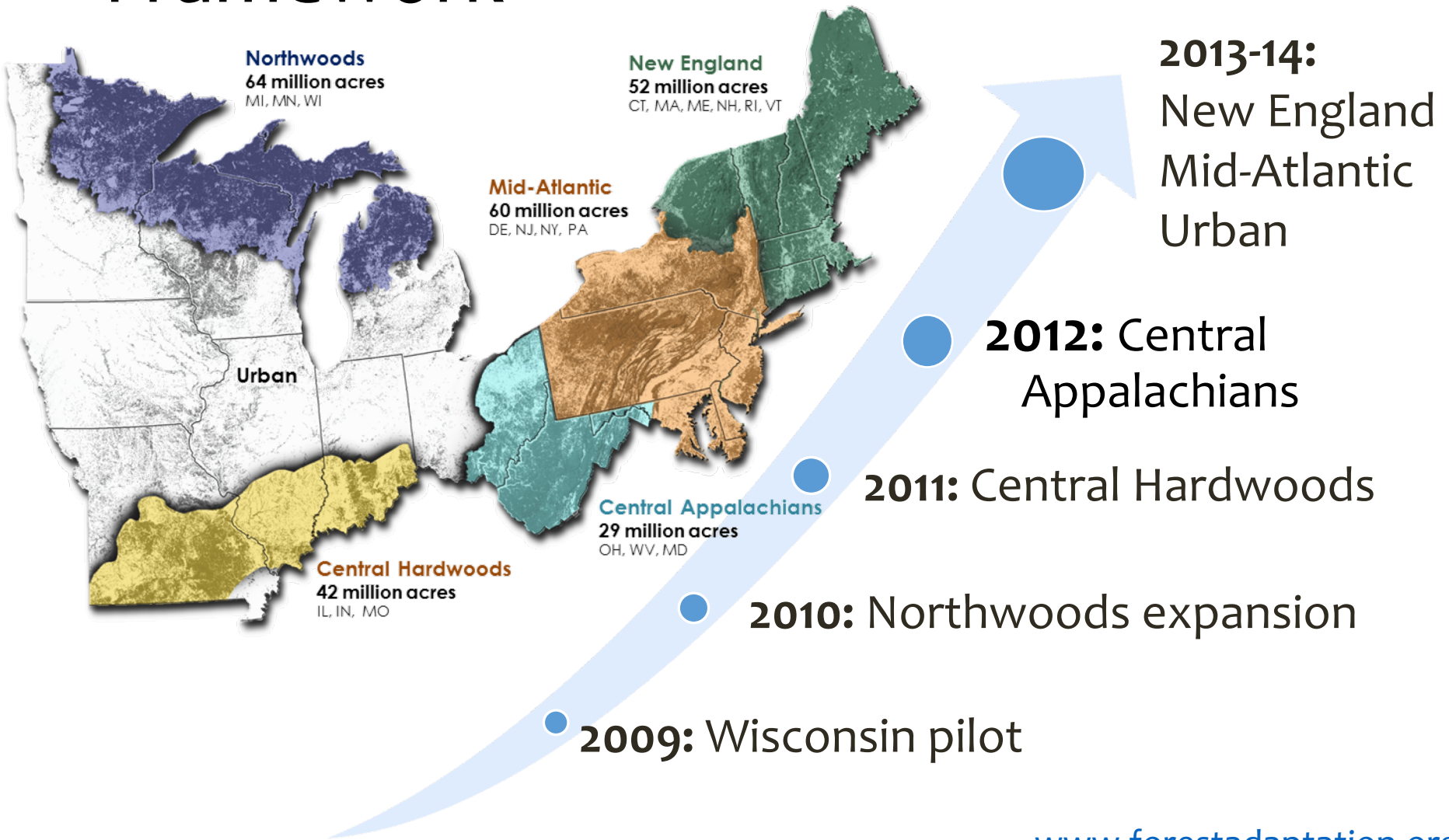
Chartered by USDA Forest Service, universities, non-profit, and tribal conservation organizations



# USDA Climate Hubs



# Climate Change Response Framework



**2013-14:**  
New England  
Mid-Atlantic  
Urban

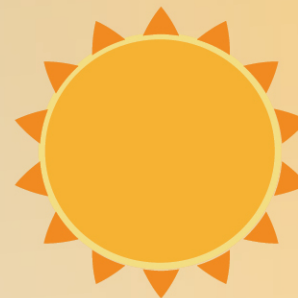
**2012:** Central  
Appalachians

**2011:** Central Hardwoods

**2010:** Northwoods expansion

**2009:** Wisconsin pilot

Impacts to forests



## Meteorological Drought

Decreased precipitation, increased temperature, and increased evapotranspiration

Meteorological drought affects human demands and values for water, exhibited as hydrologic, agricultural, and socio-economic drought.



*Hydrologic* - streamflows, water quality, and reservoir levels decrease.



*Socio-economic* - impacts increase to ecosystem services related to recreation, wildlife, and carbon sequestration.



*Agricultural* - productivity and crop survival decreases.



**Ecological drought** is a water deficiency that creates ecosystem vulnerability, and affects ecological and landscape characteristics, land and water use, and resource management.

Minor/Limited

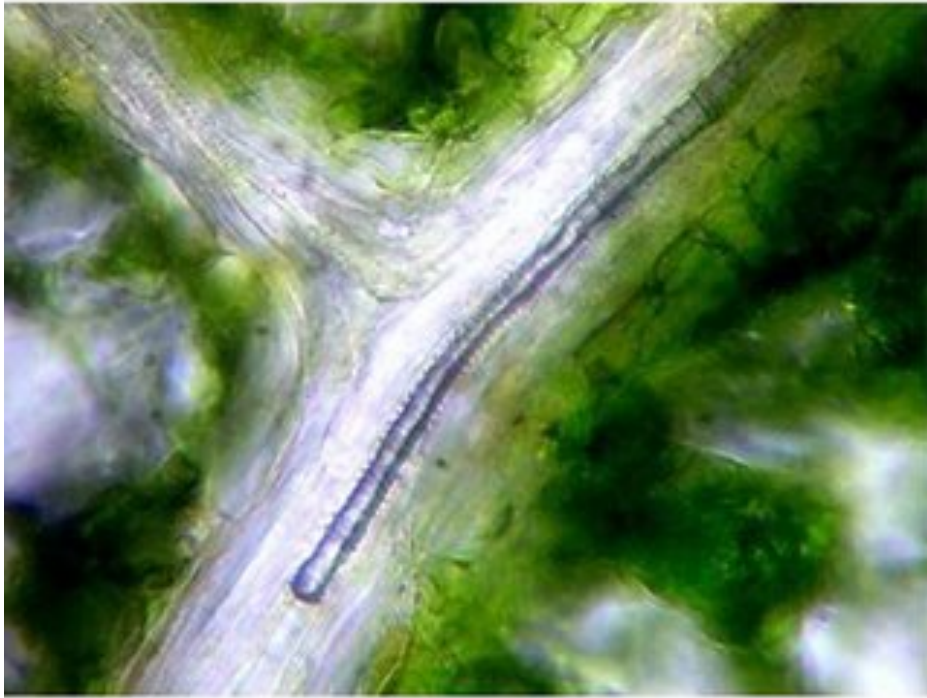
**Scale of Drought and Length of Time**

Major/Extended

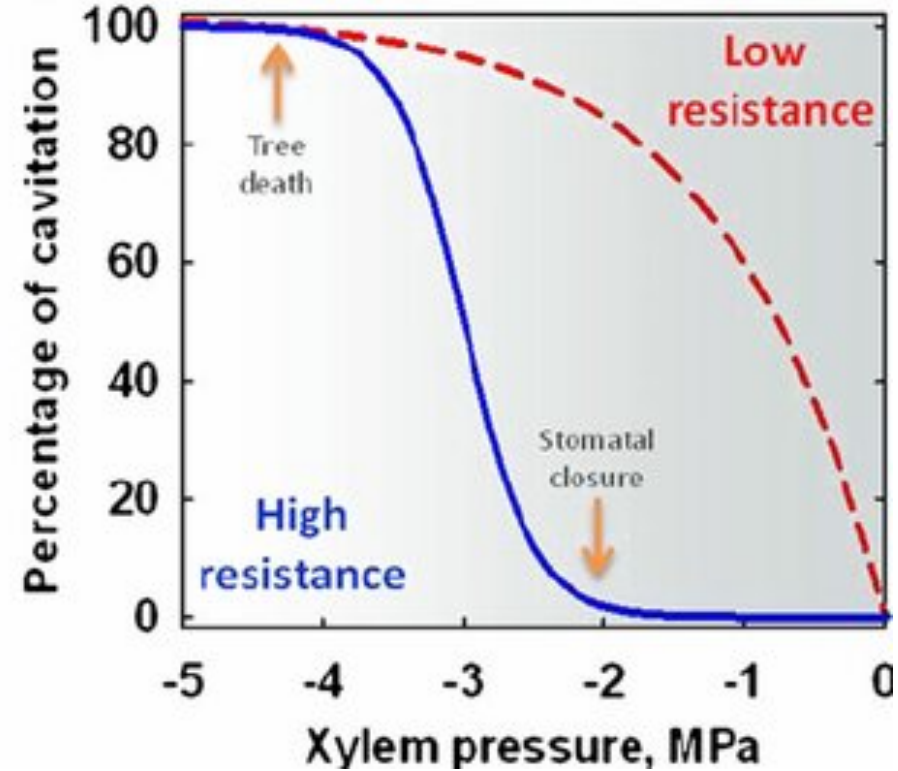


# Cavitation/embolism

**a**



**b**





# How bark beetles attack

*In drought conditions, native beetles can kill large numbers of trees in California's forests. Water plays a critical role in a tree's natural defense against the insects.*

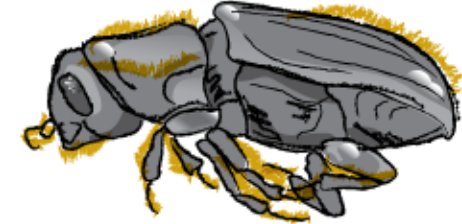
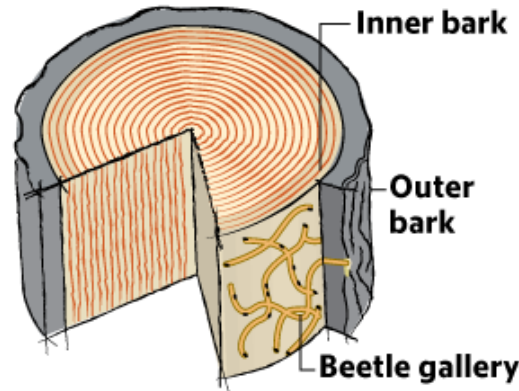
**1.** Bark beetles are small, hard-bodied insects that attack trees by boring through their outer bark. Attacking beetles release pheromones that attract other beetles, resulting in mass attacks that can spill over to nearby trees.



**Successful beetle attack**



**"Pitchout" tree defense**



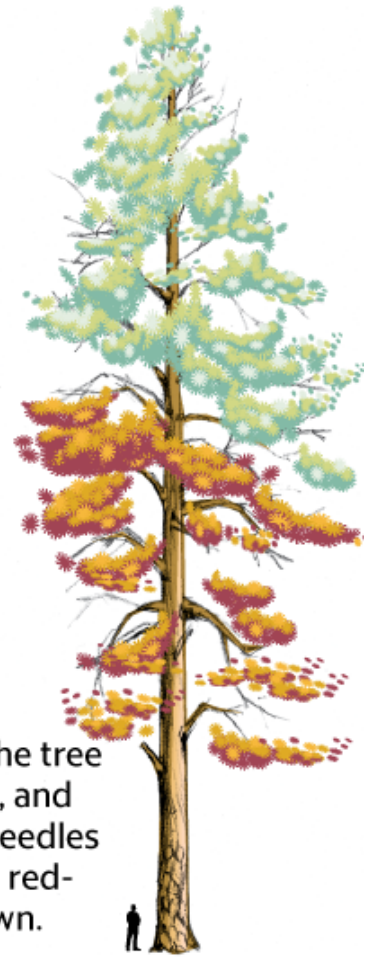
**The western pine beetle, one of several native bark beetles**

 **ACTUAL SIZE**

**2.** When bark beetles attack a tree, the tree releases a resinous pitch that drowns the beetles and pushes them out of the hole. When short on water, the tree can't produce enough pitch to ward off mass attacks.

**3.** Once past the protective outer bark, the beetles feed on the moist inner bark – carving tracks, known as galleries, where they lay eggs. The hatching larva make more galleries, which cut off the tree's ability to transport nutrients.

**4.** The tree dies, and its needles turn red-brown.



Sources: U.S. Forest Service

The Sacramento Bee



# Flood After Fire



FEMA



Did you know wildfires dramatically alter the terrain and increase the risk of floods? Excessive amounts of rainfall can happen throughout the year. And properties directly affected by fires and those located below or downstream of burn areas are most at risk for flooding.

**1** During normal conditions, vegetation helps absorb rainwater.

**2** But after an intense wildfire, burned vegetation and charred soil form a water repellent layer, blocking water absorption.

**3** During the next rainfall, water bounces off of the soil.

**4** As a result, properties located below or downstream of the burn areas are at an increased risk for flooding.

## Degree of Land Slope

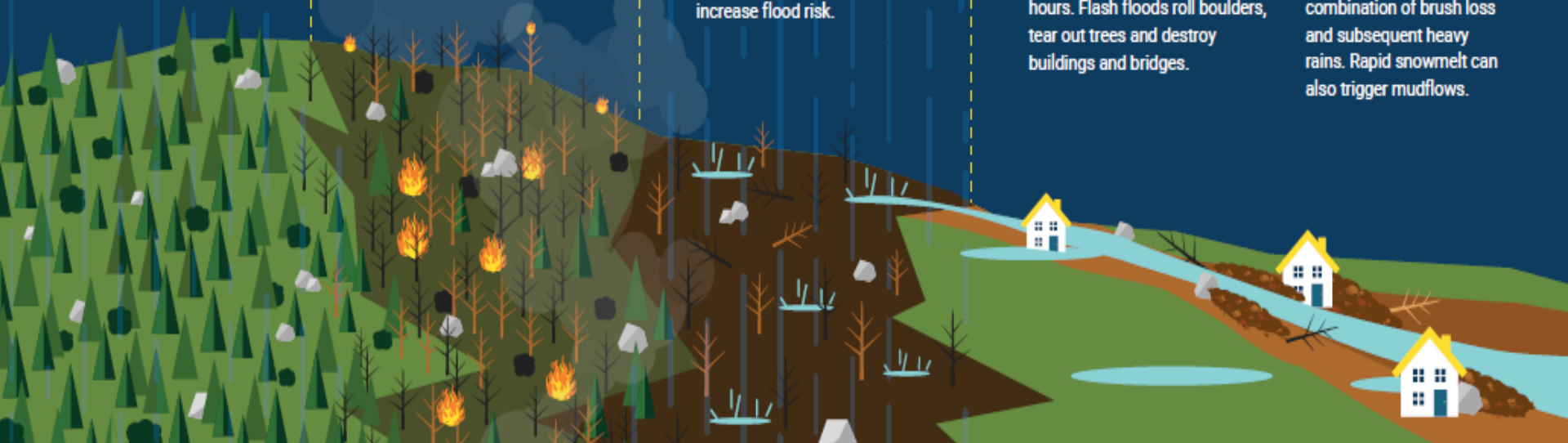
Higher degrees of land slope speed up water flow and increase flood risk.

## Flash Floods

Intense rainfall can flood low-lying areas in less than six hours. Flash floods roll boulders, tear out trees and destroy buildings and bridges.

## Mudflows

Rivers of liquid and flowing mud are caused by a combination of brush loss and subsequent heavy rains. Rapid snowmelt can also trigger mudflows.



Reduce your risk. The time to buy flood insurance is now. Contact your local insurance agent for more information or visit the National Flood Insurance Program at [FloodSmart.gov/wildfire](https://www.floodsmart.gov/wildfire).

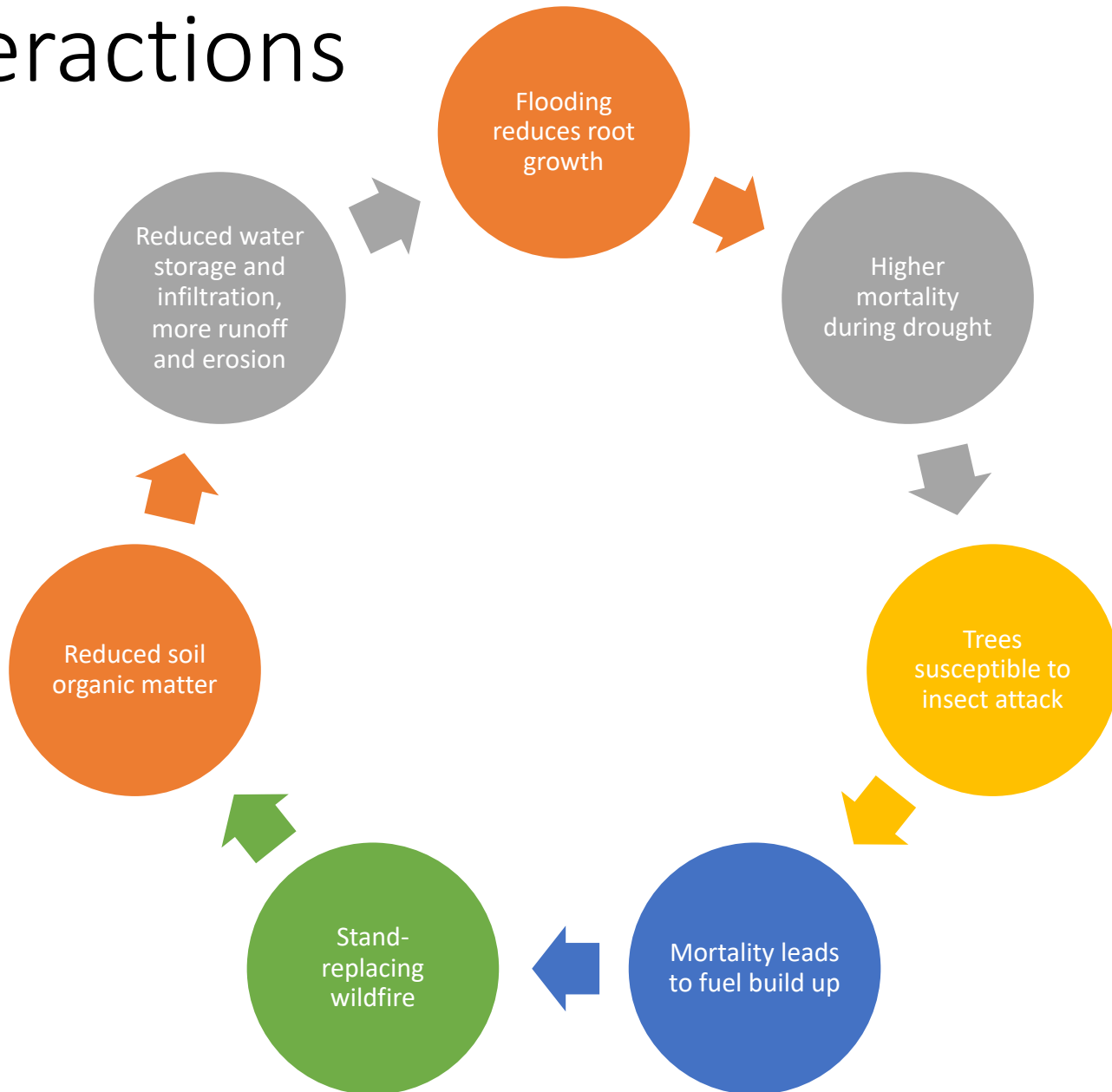






These prairie grasses (foreground) and trees (background) were killed by the excessive water resulting from the long-term flooding of the Mississippi River in the summer of 1993. (*Photograph courtesy of U.S. Fish and Wildlife Service.*)

# Interactions



# Management Responses



# Thinning to Reduce Competition during Drought



# Building Soil Organic Matter in Uplands

Slow, Spread and Sink water into uplands



Photo courtesy Bryan Hummell, EPA

# Restoring Wetlands and Hydrology



# Selecting species adapted to both extremes



Post Oak

# up-sizing culverts



# Information needs

- Better metric for “ecological drought”. Existing indices focus on agriculture or hydrology, not forests
- Better detection and early warning for hyper-local events that affect people (fire and flood)
- Long-term planning:
  - Hydrologic projections under multiple climate scenarios at the level of stream reaches.
  - Spatially-explicit vulnerability assessments