America's Forests: challenges and opportunities

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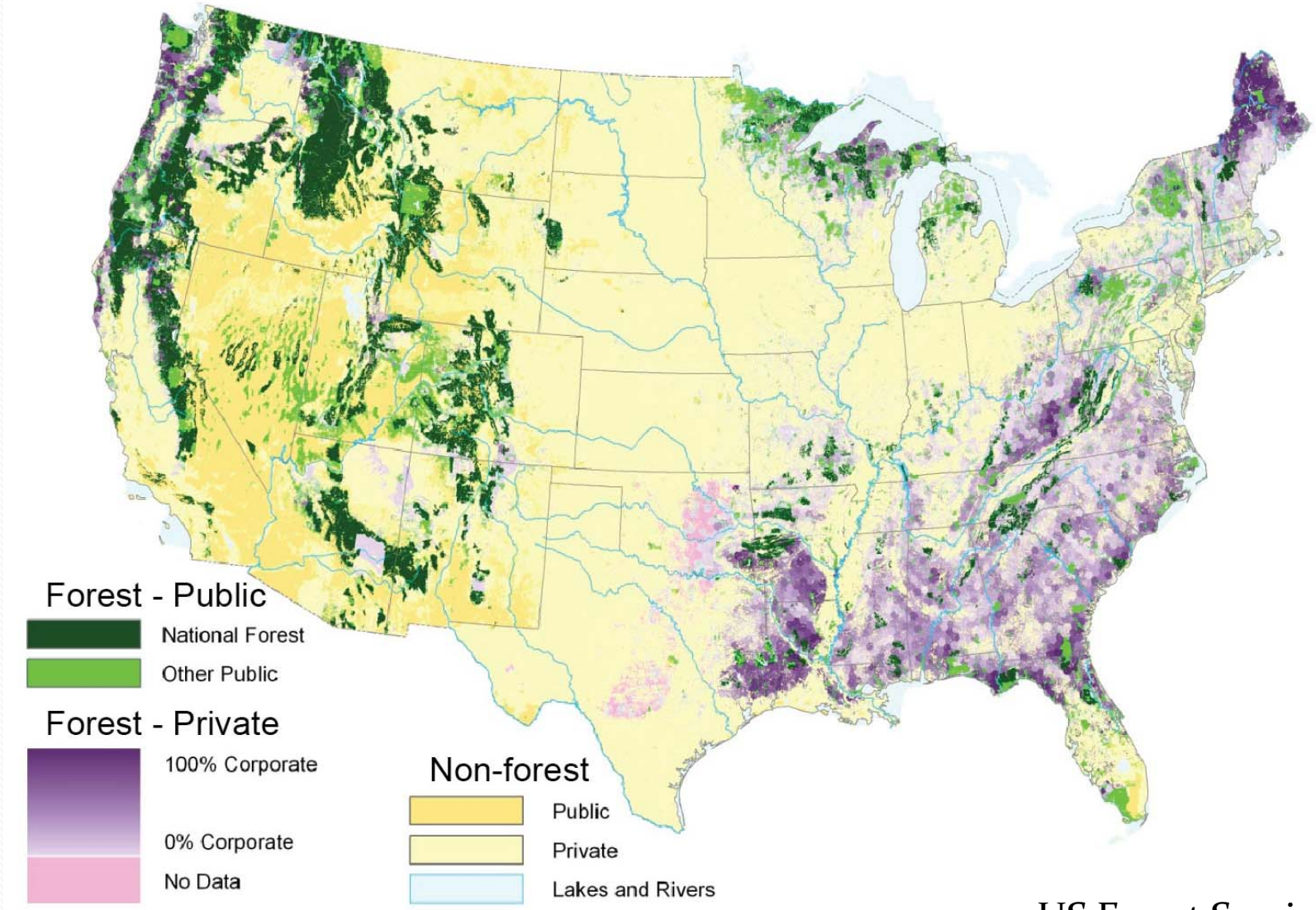
Context, Opportunities, Challenges

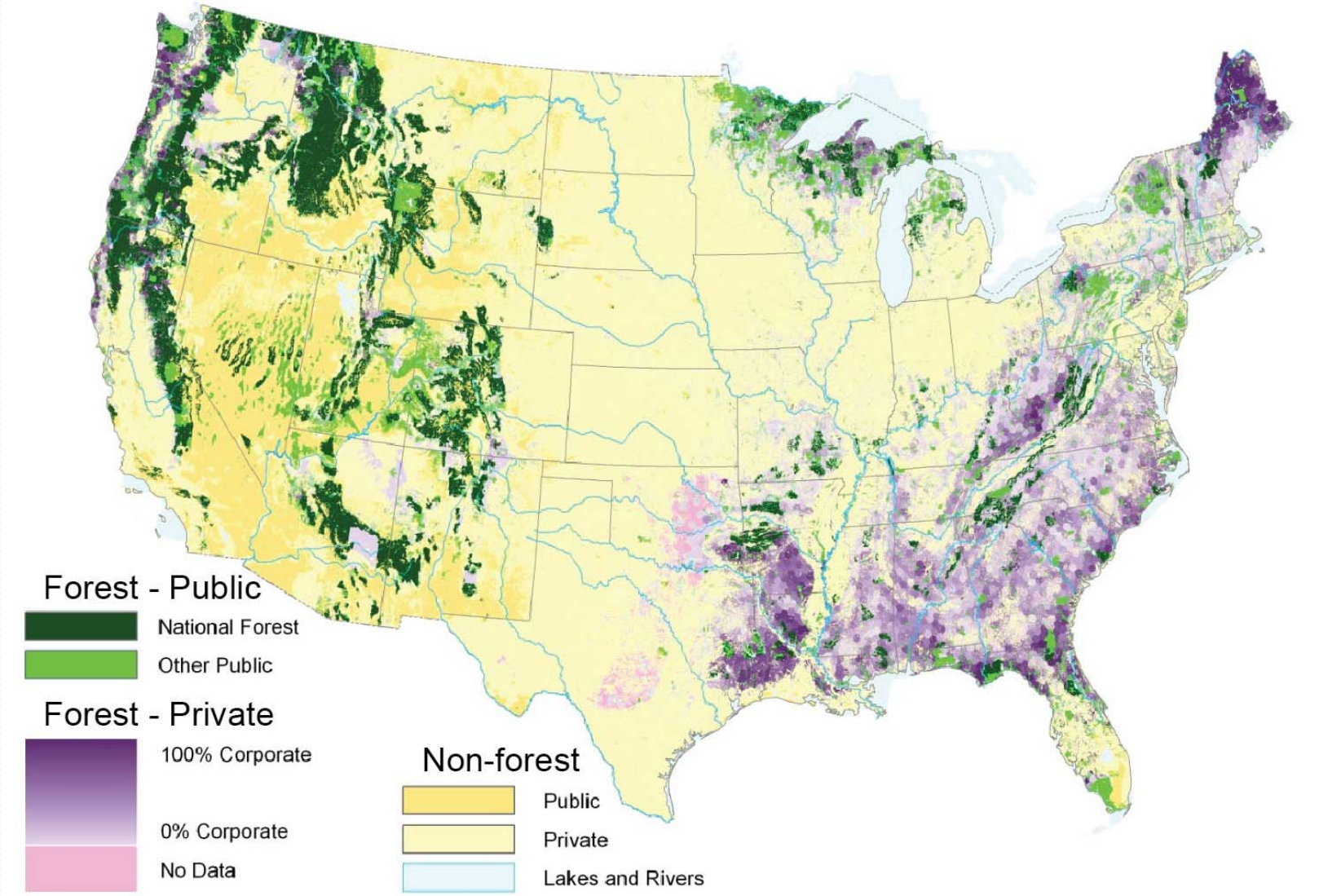
- Forests –
  - where are they, how productive,
  - what are they valued for, and
  - what are the threats currently
- Opportunities – new uses
- Challenges – economic growth, land use change, climate change.

Where are the Forests?



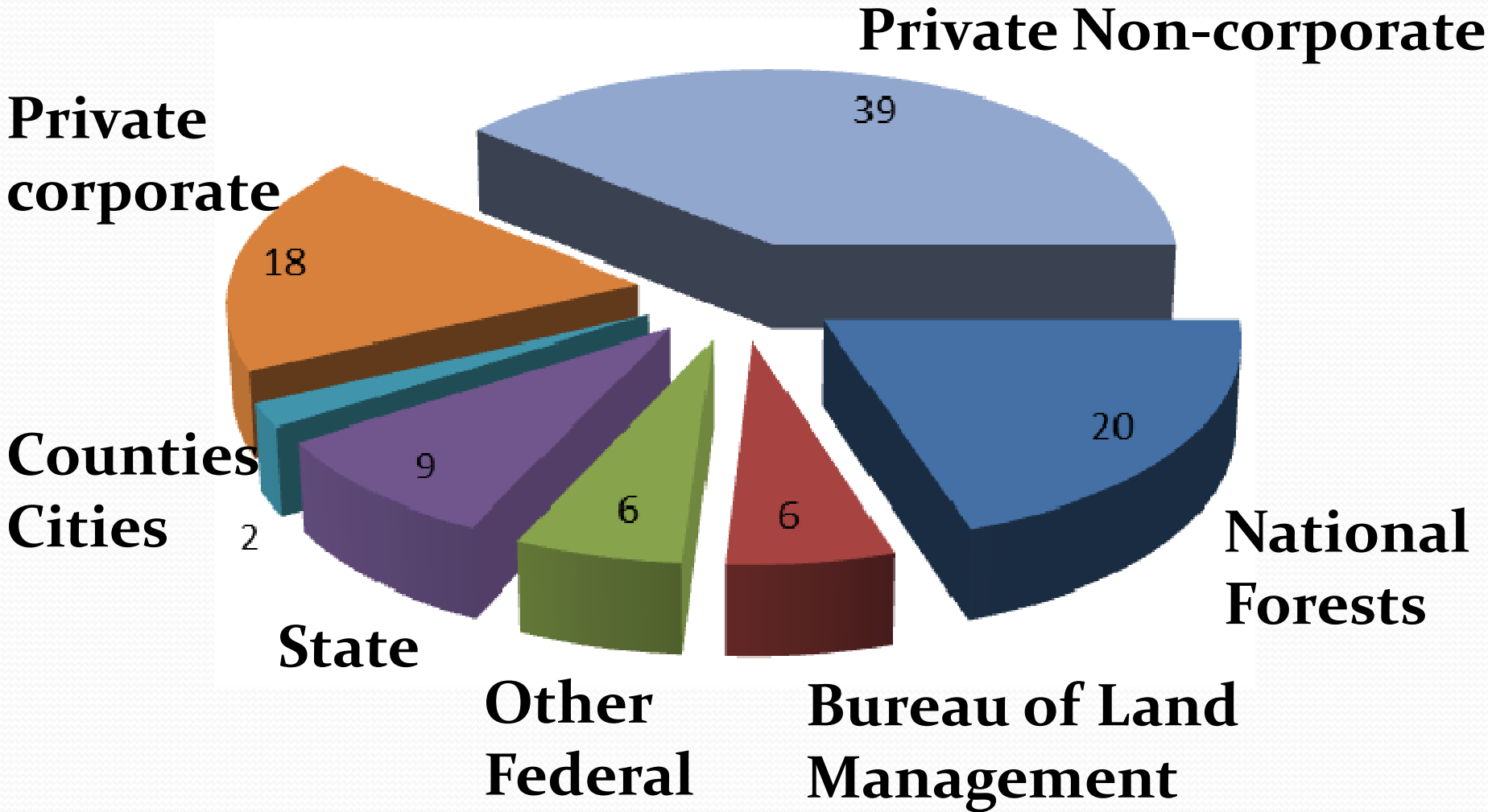
US Forest Service 2012

Who Manages Forest Land?



US Forest Service 2012

Forest Owners/Managers are Diverse

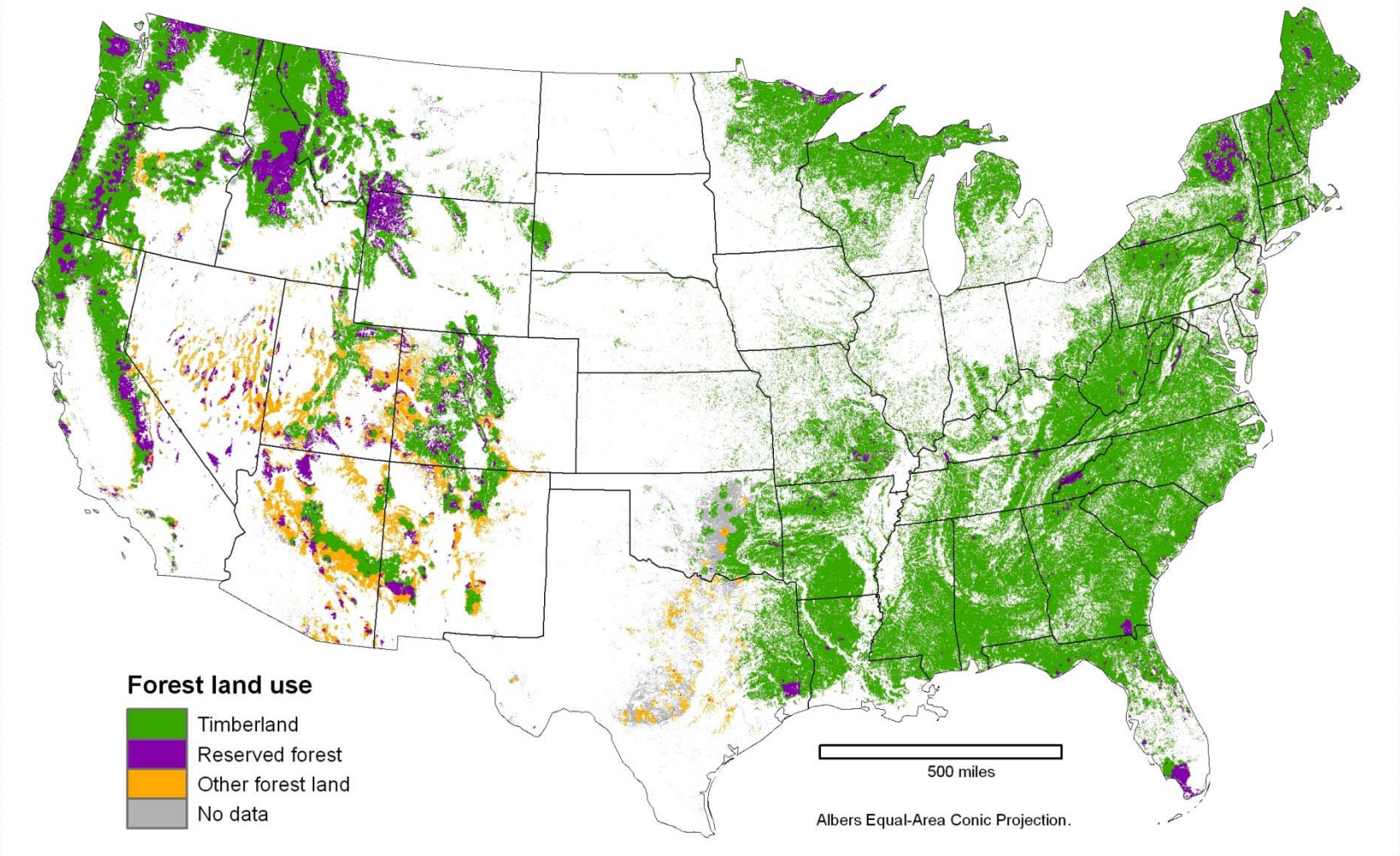


US Forest Service 2012

Ecosystem Services from Forests

- Wood products
- Watershed protection
- Wildlife habitat
- Recreation
- Hunting
- Aesthetics
- Bioenergy
- Home in the Woods
- Carbon sequestration
- Trees for Agroforestry
- Urban landscaping and forests

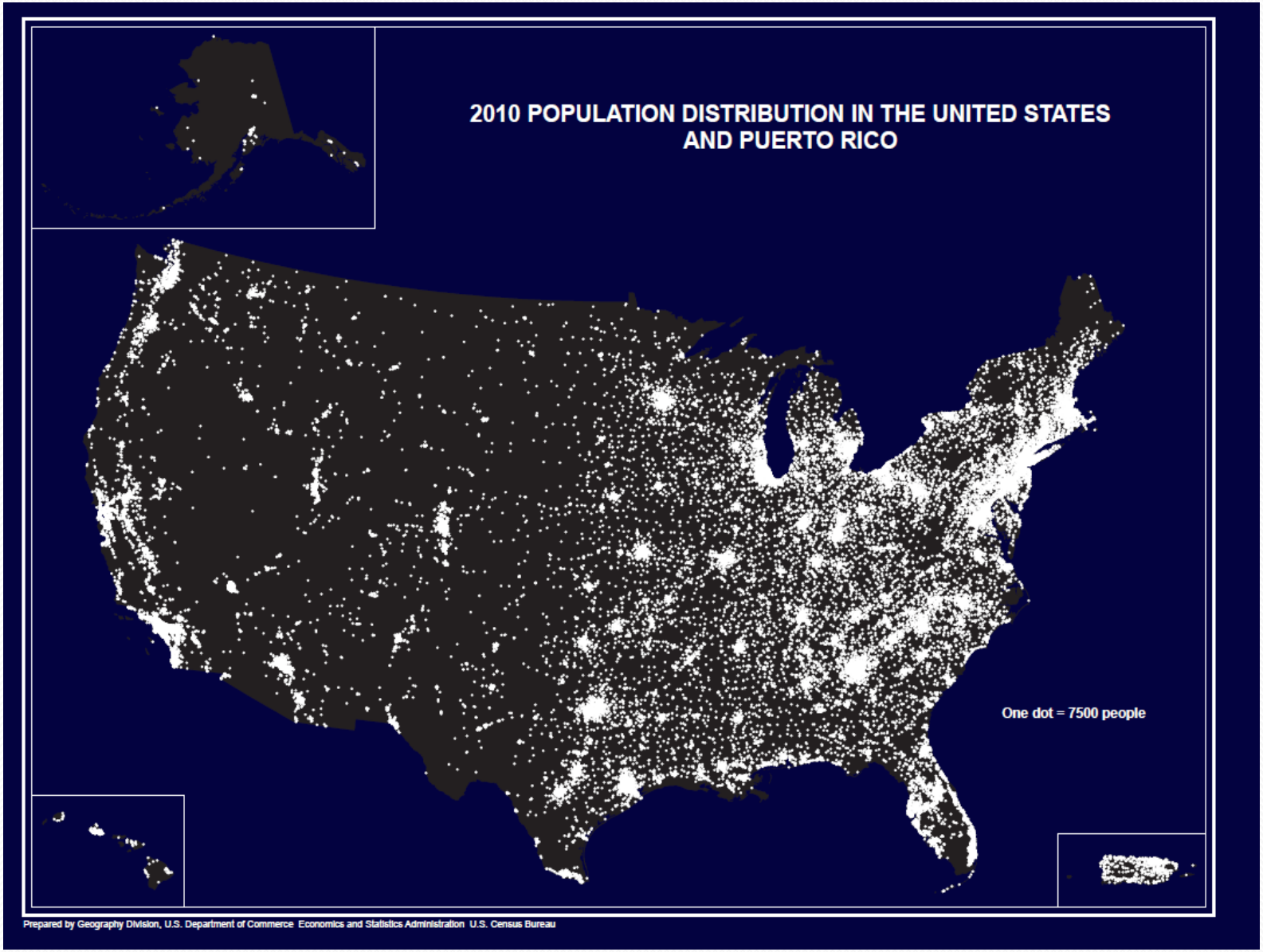
How Productive are Forests?



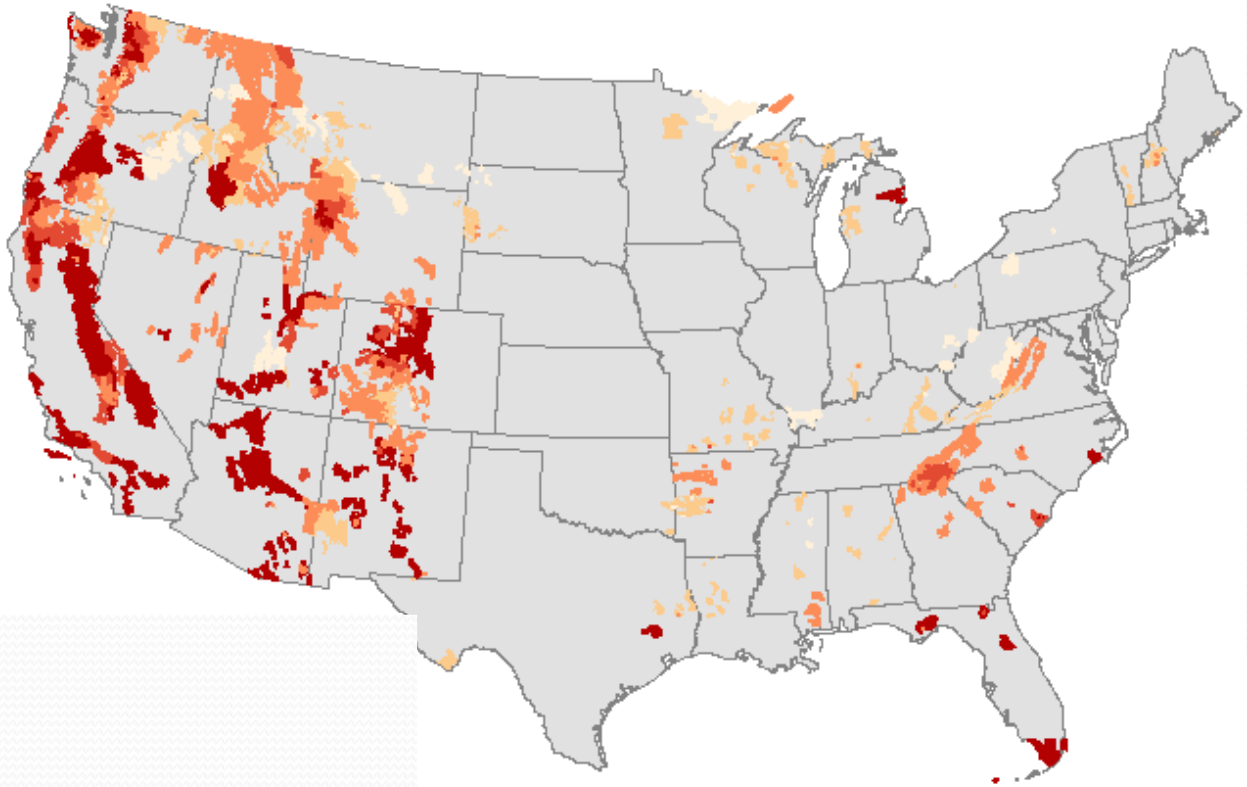
Timberland – produces 20 cu ft/year of industrial wood in natural stands
Reserved - land withdrawn from timber utilization

Forest Land Use, 2007, USFS 2012

People live in the most Productive Forests



Humans alter the extent and character of forest land



Housing growth in and near National Forest System and National Park System lands, 1940-2000

Radeloff et al 2010

Trends in total forest area underestimate threats to forests from fragmentation

1.1% net loss of total forest area

3.2% to 10.5% net losses of forest interior area (4.41 ha to 5,310 ha).

Widespread shift to more fragmented conditions, even in regions exhibiting small net changes in forest area.

Riitters and Wickham 2012

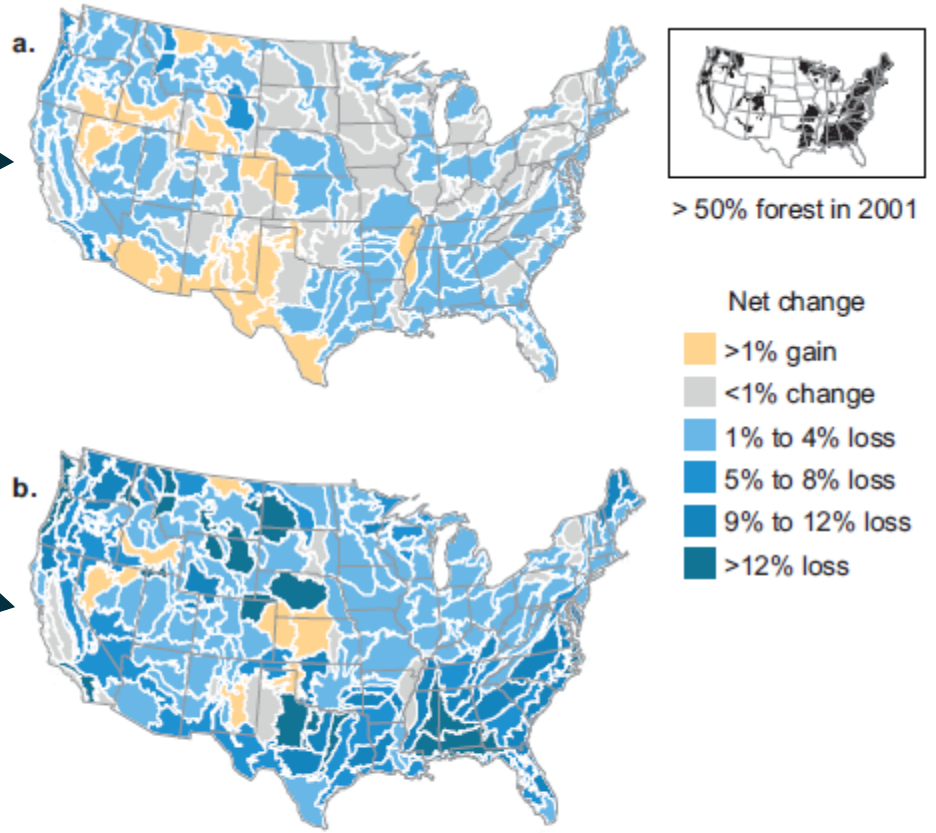


Figure 2 | Net change in forest area from 2001 to 2006. (a) All forest. (b) Forest interior in a 65.6-ha neighborhood. Ecological sections[44] are shaded and State boundaries are shown for comparison. In the inset map, forest-dominated ecological sections are those that contained more than 50% forest in 2001.

New Opportunity – Bioenergy

Potential Forestry Biomass Resources

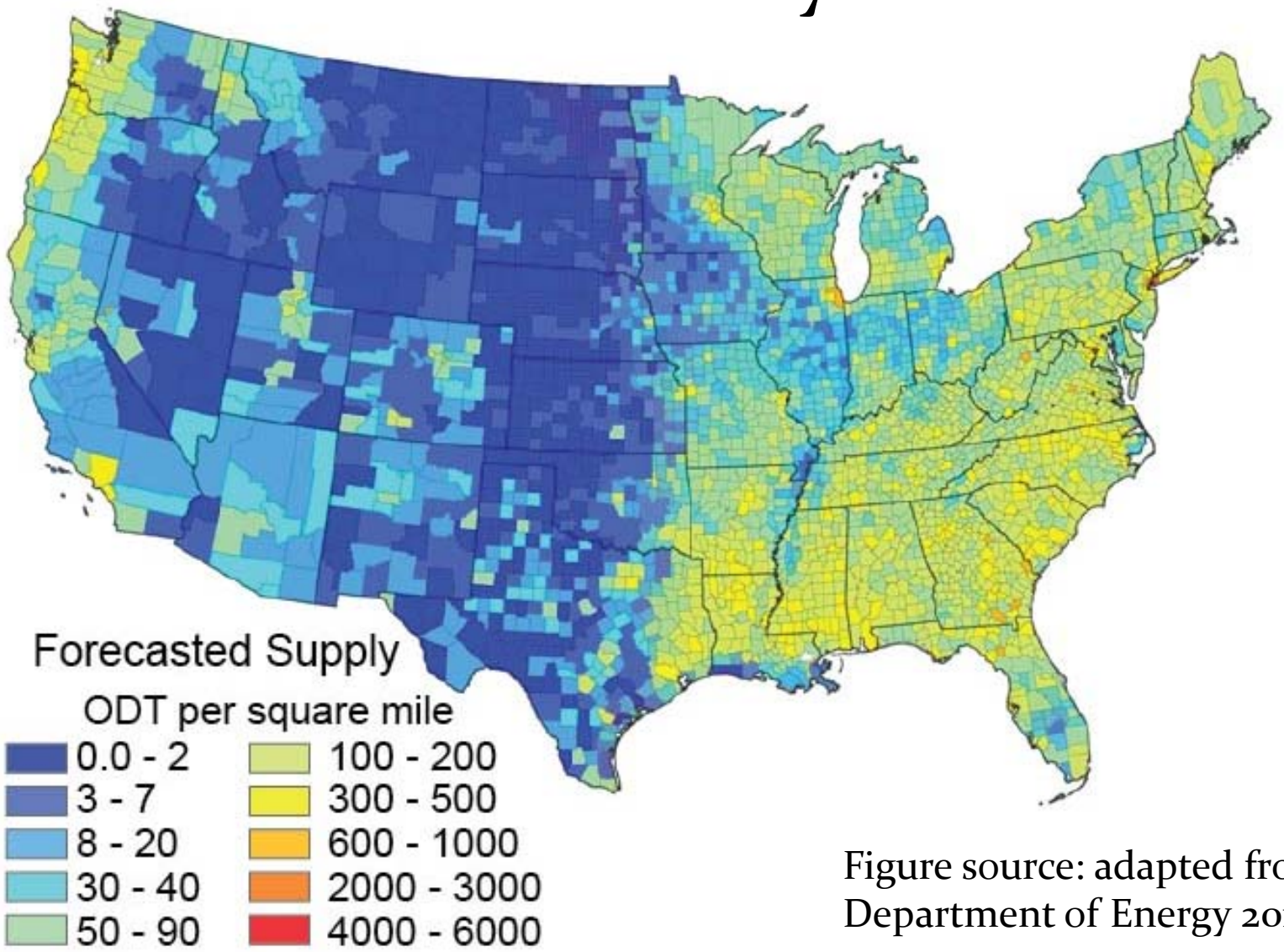


Figure source: adapted from U.S. Department of Energy 2011

Carbon Sequestration

New Ecosystem Service

Presently

U.S. *forests and associated wood products* currently absorb and store the equivalent of

about 16% of all carbon dioxide (CO_2)

emitted by fossil fuel burning in the U.S. each year.

National Climate Assessment 2013

Where is the Potential High for Carbon Management?

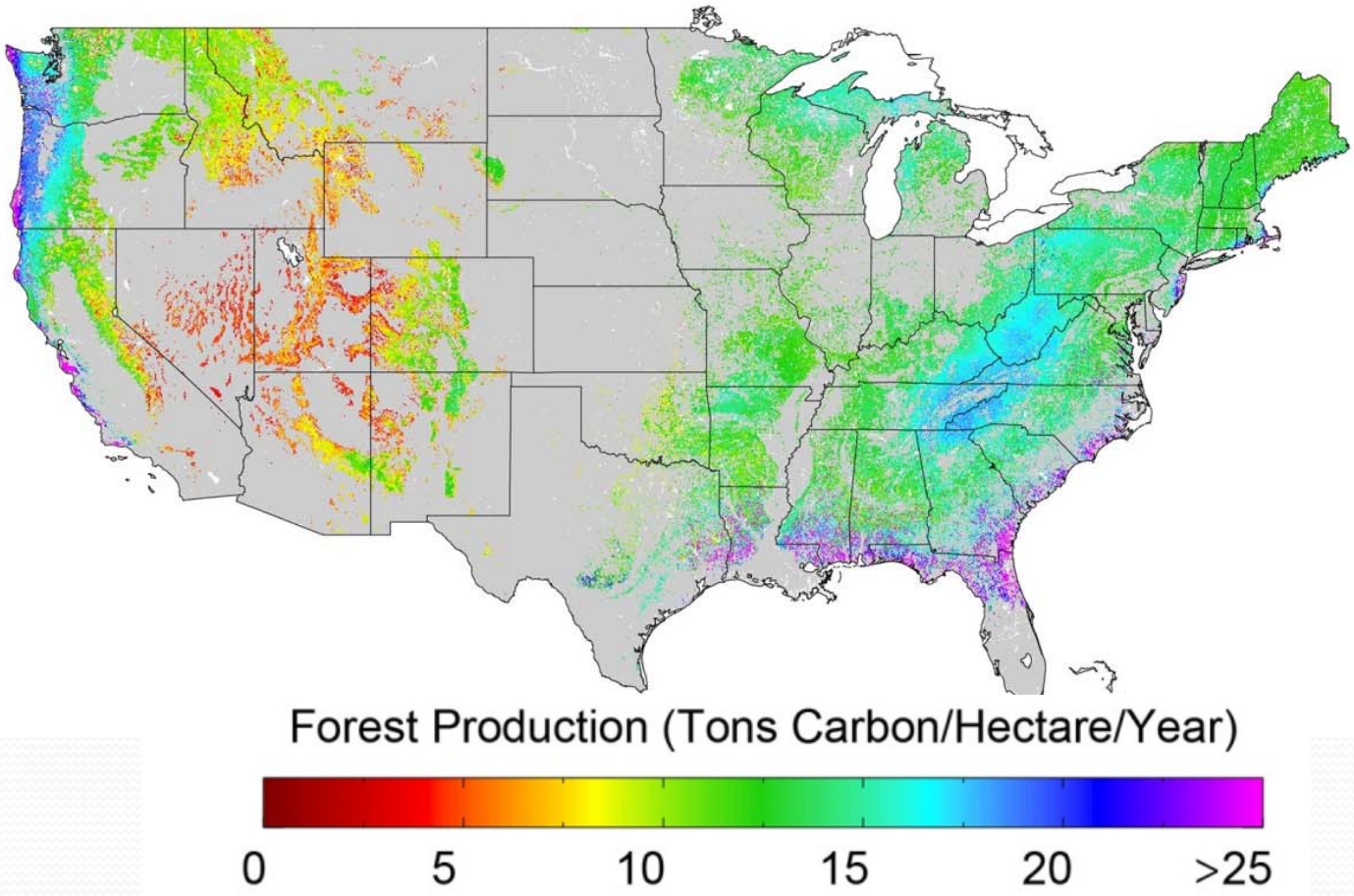


Figure source: adapted from Running et al. 2004, NPP.

Challenges and Opportunities

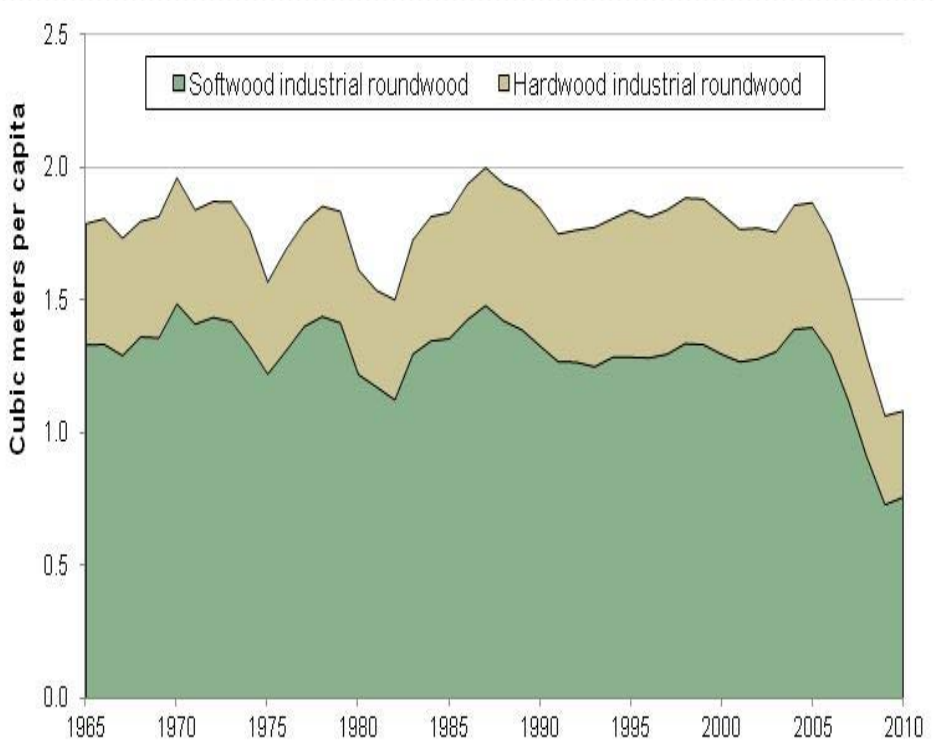
- Short-term
- Longer-term

Short-term

High demand for housing up to 2005.

In 2006, an abrupt drop in the U.S. housing market, a decline in home values, housing related financial instruments, followed by a global financial crisis in 2008.

Great Recession



Roundwood equivalent of U.S. forest product consumption (including imports)

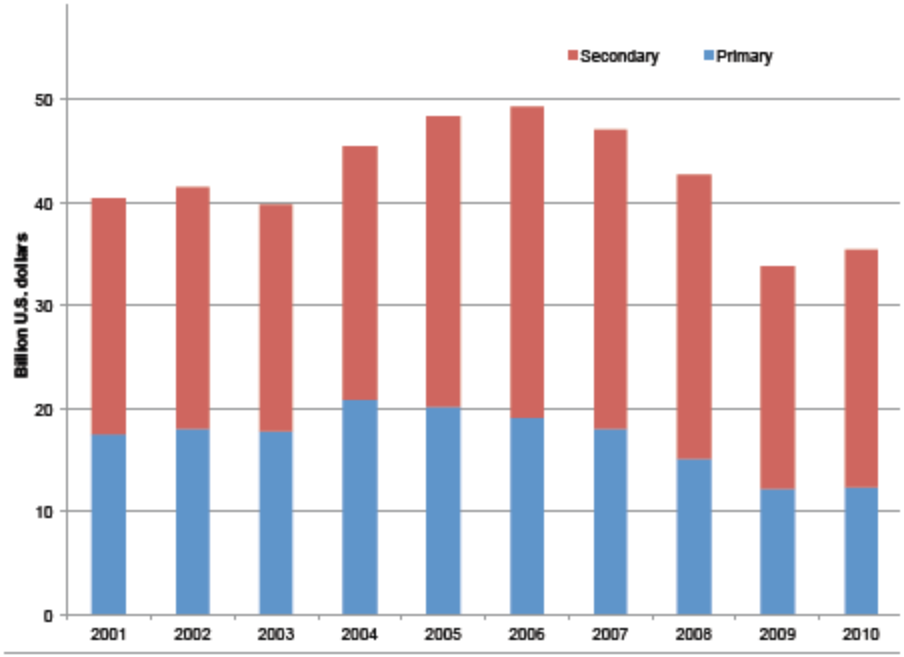
USDA Forest Service 2012

Great Recession – the West

Value of industry outputs fell 31%, $49 billion in 2006 to 34 billion in 2009.

Employment in the Rocky Mountain States down 22%.

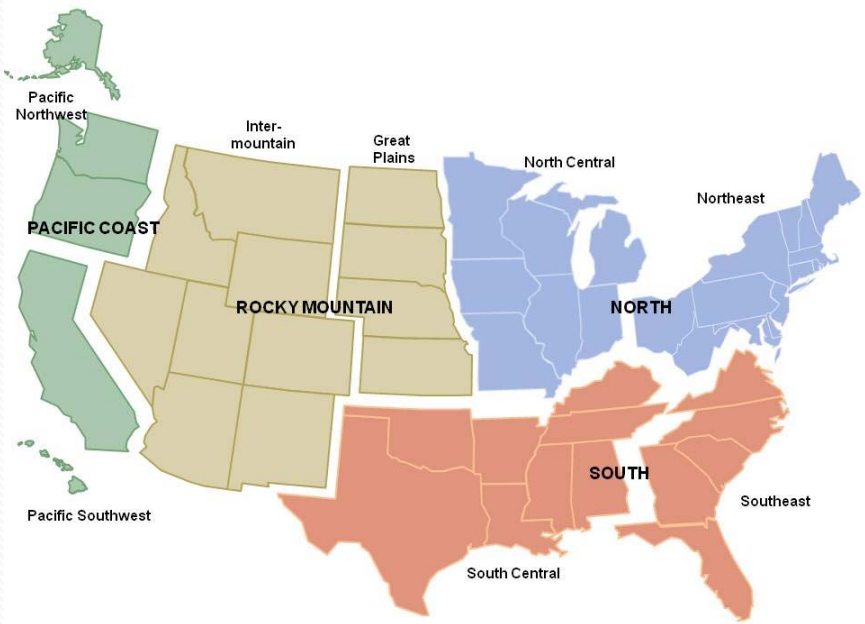
Figure 1. Sales value of the primary and secondary forest products industry in the western states



Demand for wood products was greatest in California and the Southwest, particularly the urban areas of Los Angeles, Las Vegas, Phoenix, and San Diego, where the housing collapse was the greatest.

The long-term

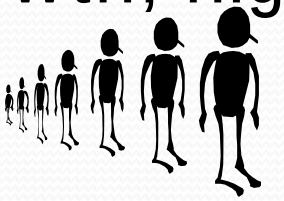
- US Forest Service RPA Assessment explores natural resource production on all forest and rangelands – 50 years into the future

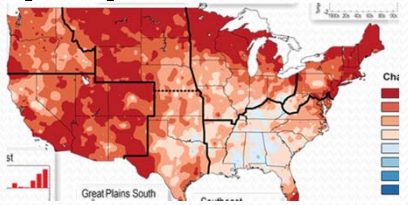


2010 RPA Scenarios

RPA scenario characteristics:

- A2: moderate economic growth, high population growth, warmest





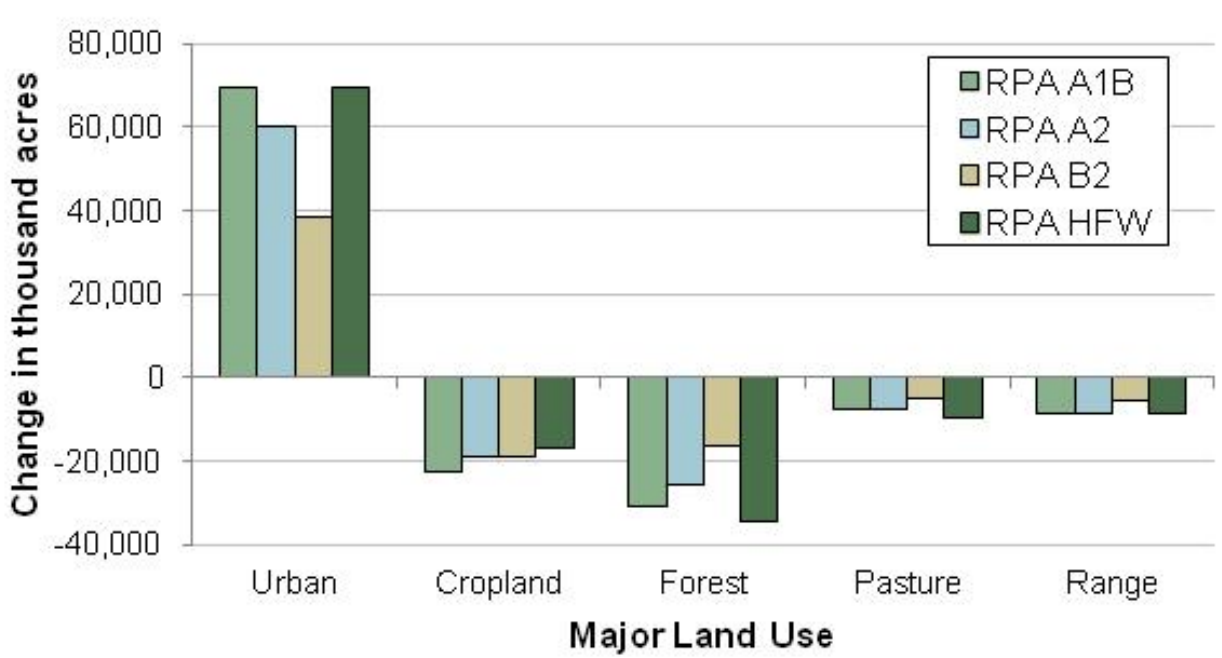
- A1B: high economic growth, moderate population growth, mid-range warm

- B2: moderate economic growth, low population growth, lowest warming

Forestland area declines by 2060

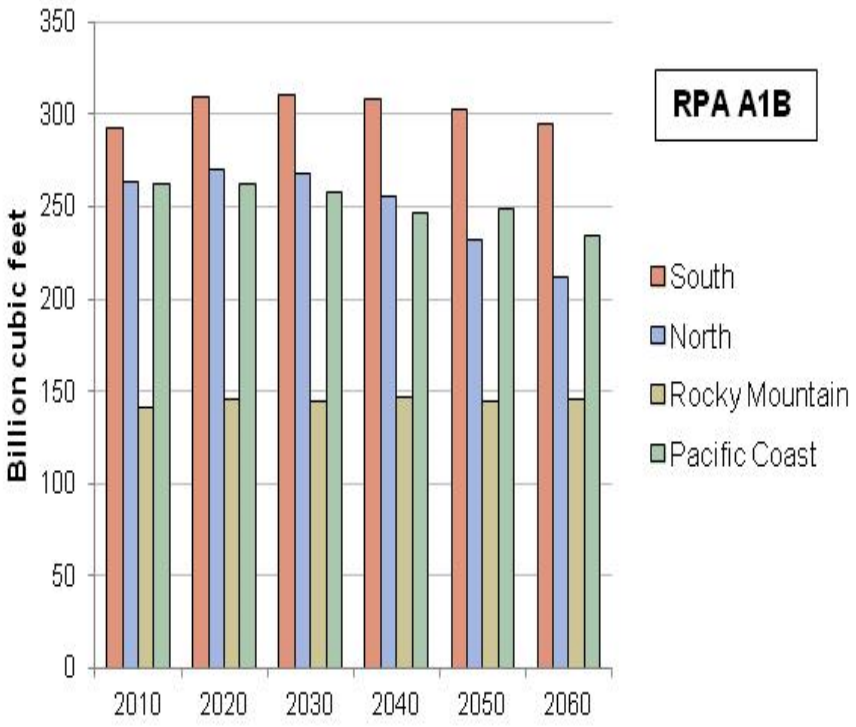
Area of forest land use declines in all scenarios, as do rangeland, cropland and pasture use areas.

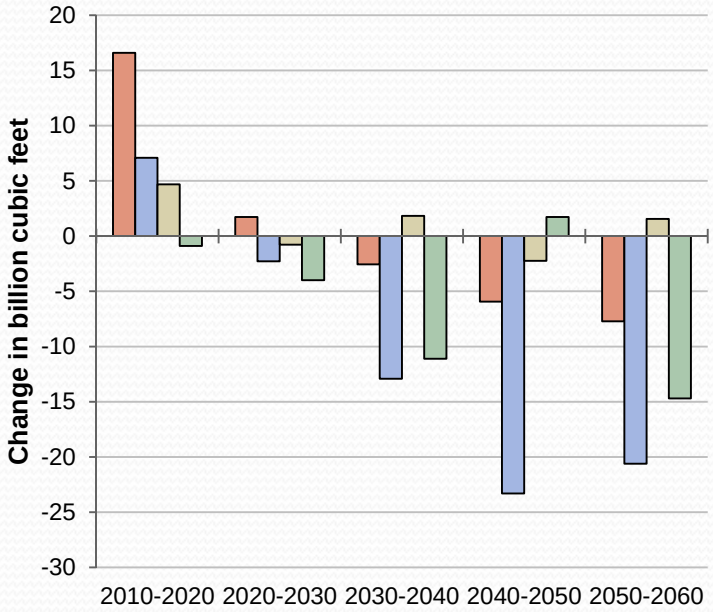
Area of urban/developed land use increases across all scenarios.



Non-federal land use change by RPA scenario 2010-2060, conterminous United States

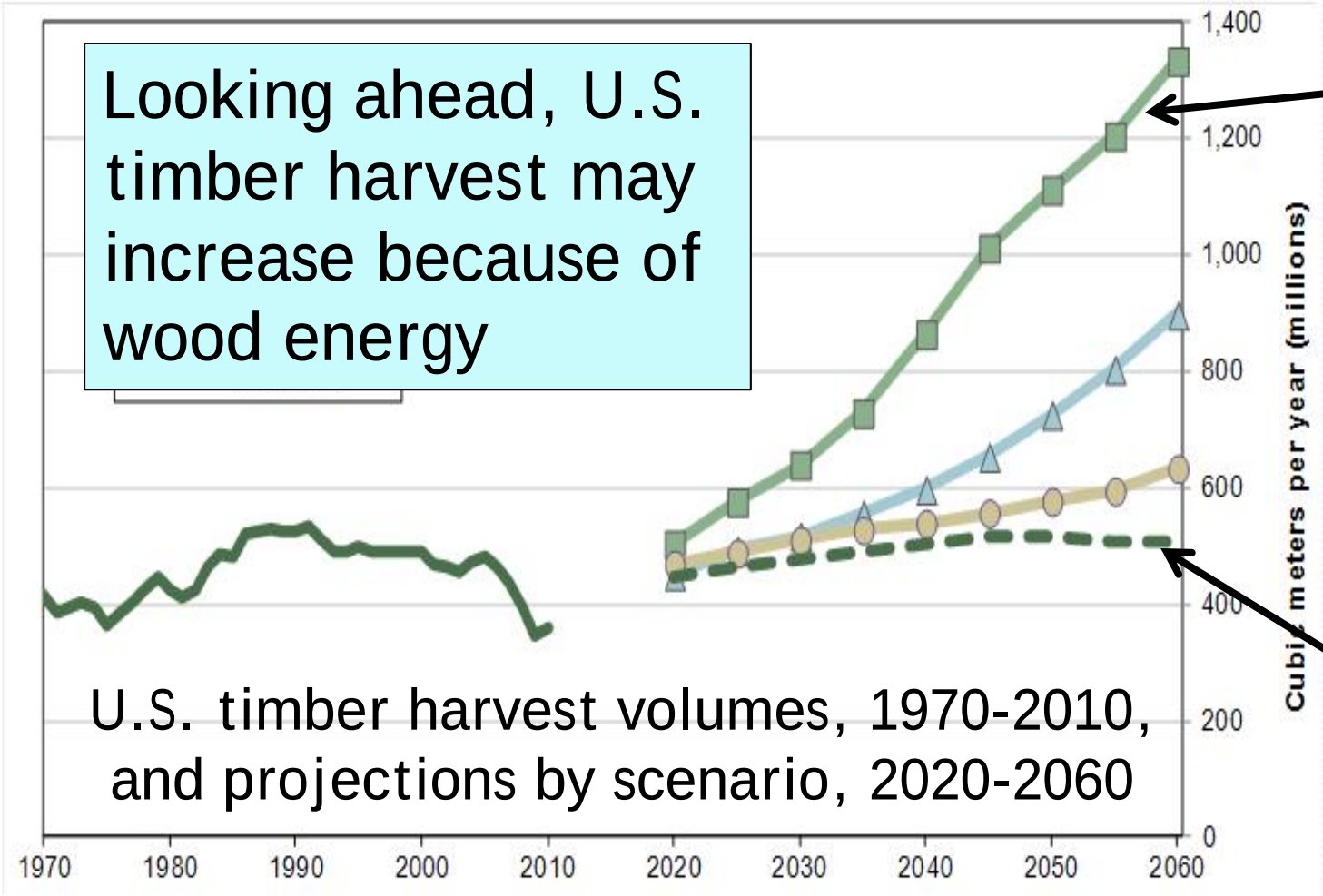
Forest Inventory Trends





Projected growing stock inventories (left) and projected change in growing stock inventories (right) for the conterminous United States by RPA region, 2010-2060.

Forest Products

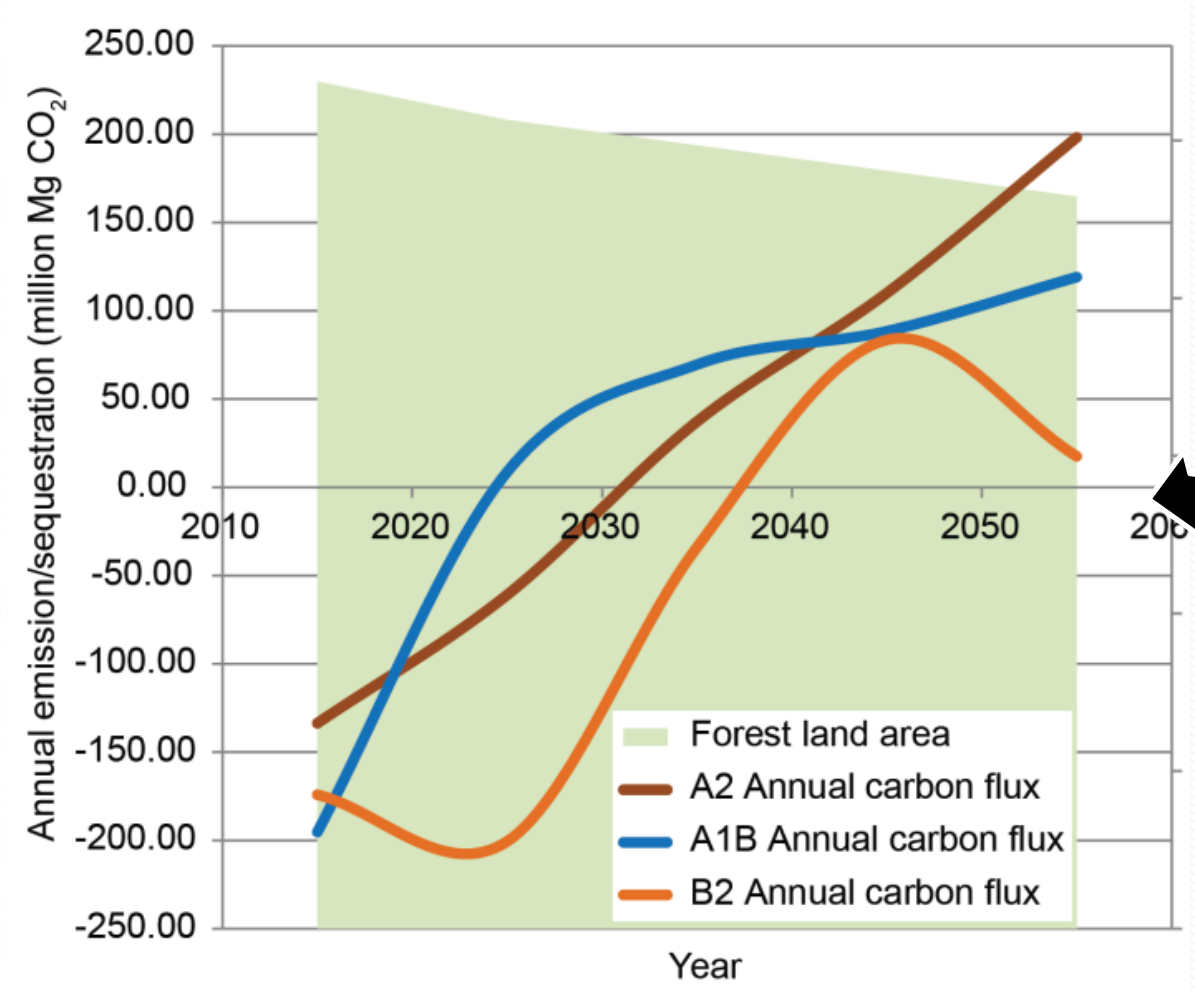


U.S. timber harvest volumes, 1970-2010, and projections by scenario, 2020-2060

Assumes a very high demand for wood energy

Assumes a demand for wood energy similar to present demand

U.S. Forests – area and inventory declines



SINK to SOURCE – 2020s to 2030s

Short term and Long term

- Short term influences are overlain on longer term trends, can have an influence on the direction of longer-term trends.
- Future economic assumptions can have large influences on the use of forest lands.

Effects of Climate Change, US Forests

- Increased flooding, erosion, movement of sediment into streams by
  - 1) higher precipitation intensity in some regions (South),
  - 2) higher rain:snow ratios in mountainous regions (West),
  - 3) higher area burned (western dry forests).

Vose et al. 2012

Effects of Climate Change, US Forests

- Increased drought
  - exacerbate insects, fire, and invasive species,
  - leading to higher tree mortality,
  - slow regeneration in some species, and altered species assemblages.

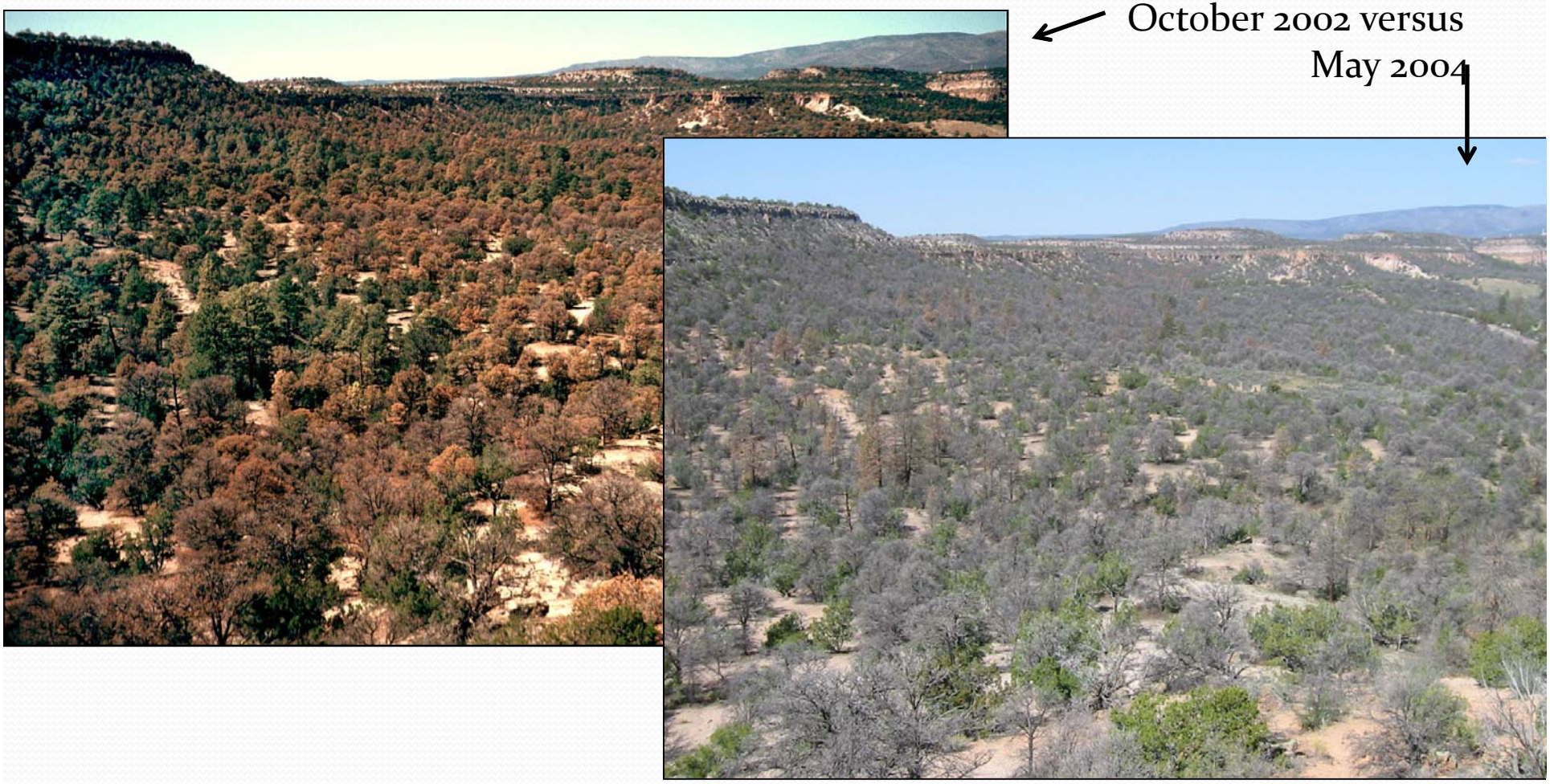
Vose et al. 2012

Effects of Climate Change, US Forests

- Wildfire increases, area burned doubling by mid-21st century.
- Insect infestations expand, possibly more area/yr than wildfire.
- Invasive species more widespread, especially in areas of increased disturbance and in dry forest ecosystems.

Vose et al. 2012

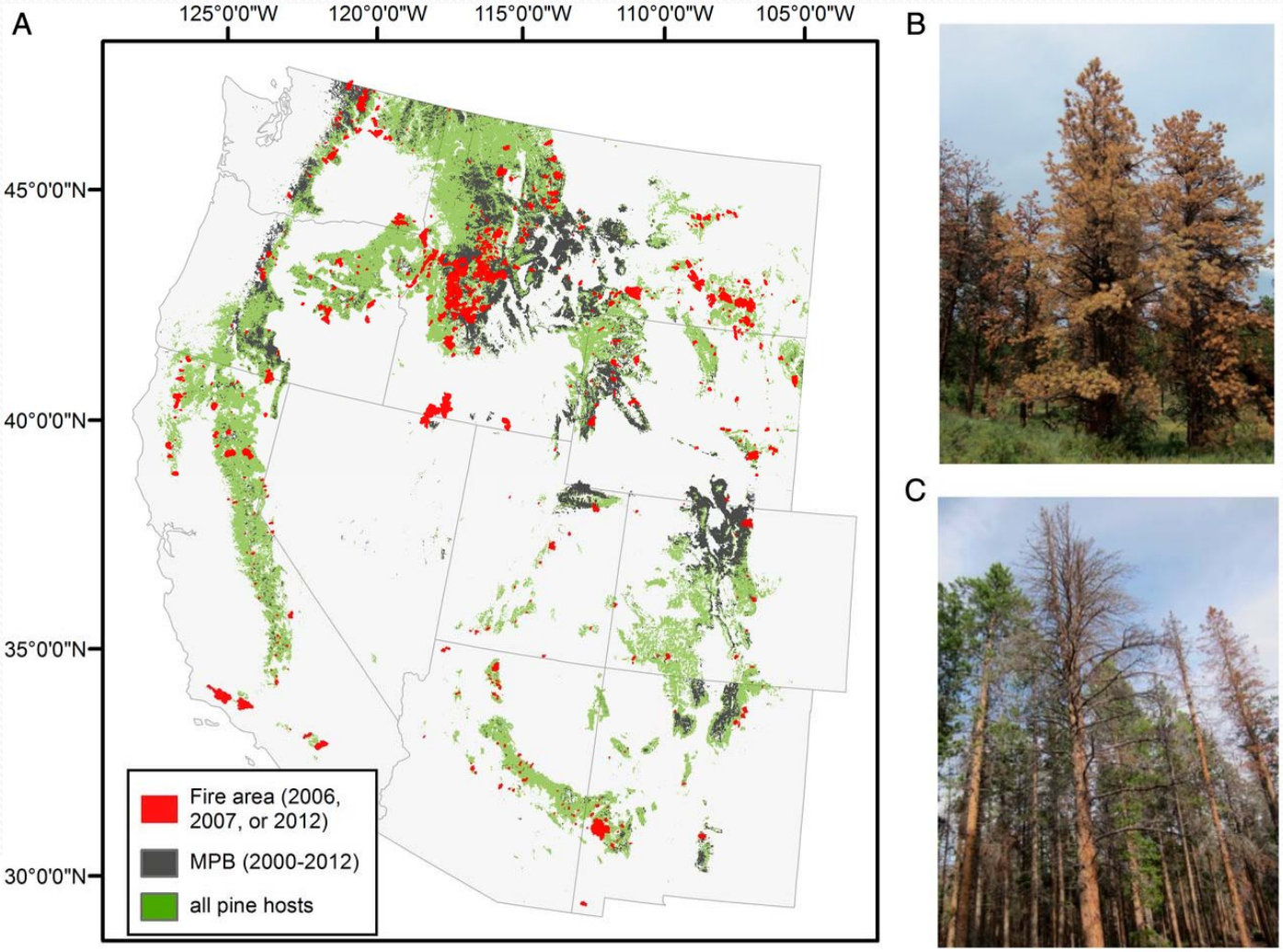
Drought- and beetle induced tree die-off in northern New Mexico



Breshears et al. Front Ecol Environ 2009

Near Los Alamos, NM
Photo: Craig D. Allen

Major wildland fires in 2006, 2007, and 2012 that intersect MPB hosts and cumulative MBP infestation in 2000–2013 across the western United States.



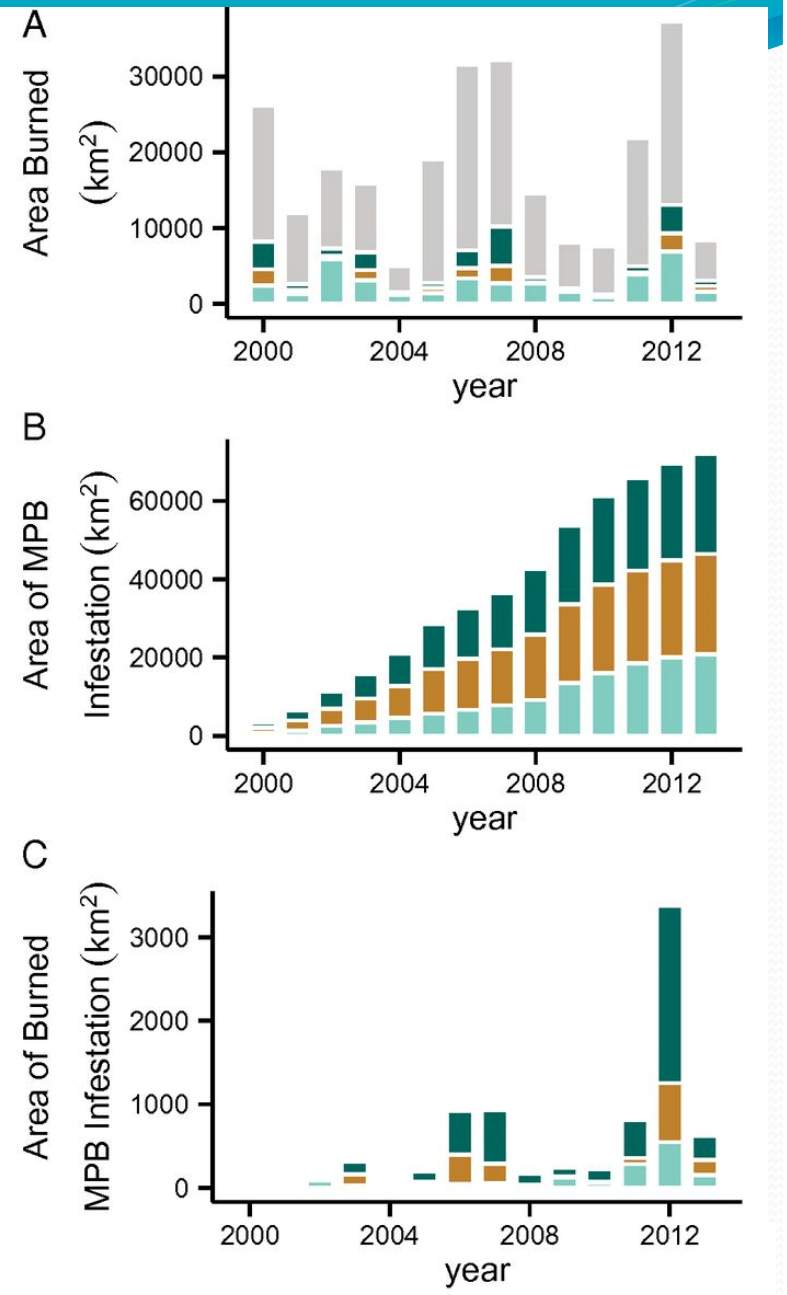
Sarah J. Hart et al. PNAS 2015;112:4375-4380

PNAS

Annual area burned by wildfires across the western United States

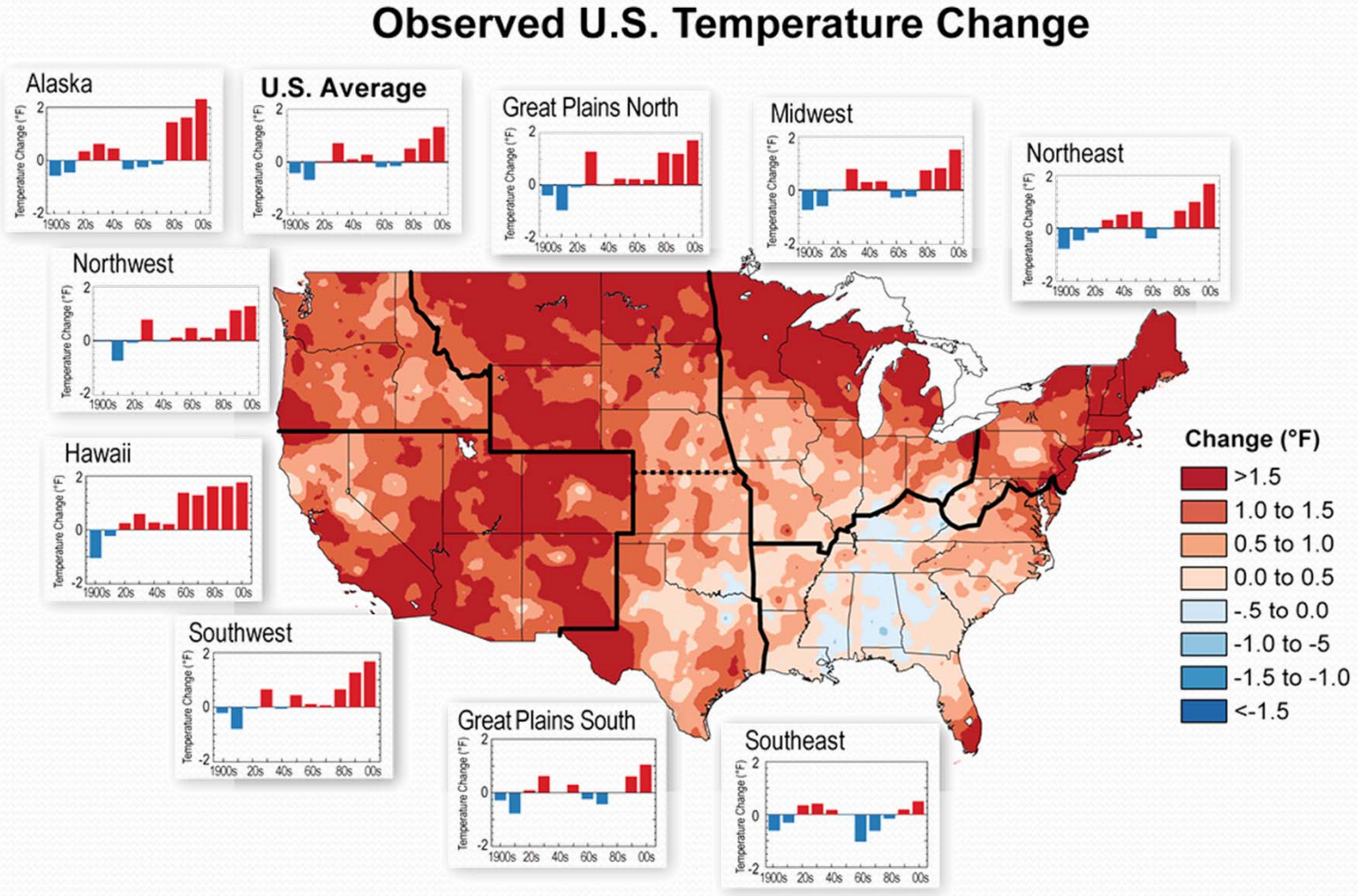
Cumulative area infested by MPBs (2002–2013) across the western United States

Annual area burned by wildfires and infested by MPBs (2002–2013)



Sarah J. Hart et al. PNAS 2015;112:4375-4380

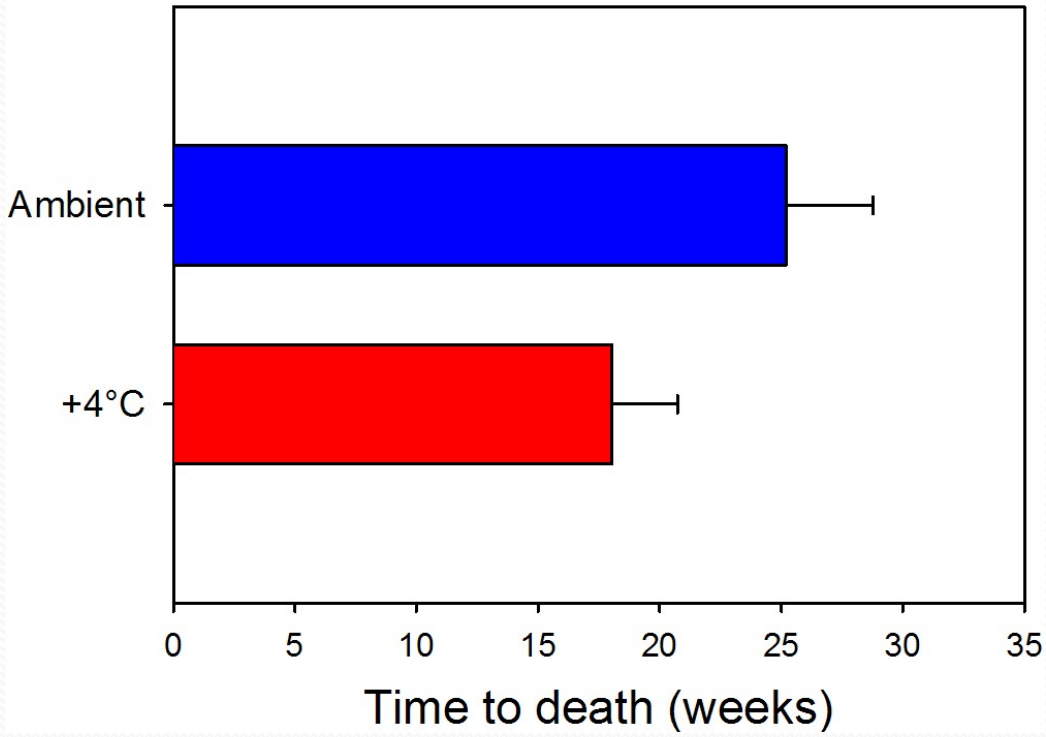
Warming Temperatures



Change over 1991-2011 compared to the 1901-1960 average

Trees die faster during drought when temperatures are warmer

	Watered	No Water
Ambient Temp.		
+4°C		



Adams et al. 2009

How will Managers make these Decisions under Climate Change?

Through every day decisions:

Selecting forest management
Deciding to plant seedlings or not
Identifying new opportunities
Investing in infrastructure
Decisions to harvest
Decisions to sell land

Incorporating Climate Change Adaptation into Forest Management

1. ***Resistance***: maintain values and ecosystem services in their present condition

Millar et al 2007, Joyce et al. 2008, Peterson et al. 2012

Protecting and Sustaining Forests - Reducing Wildfire Risk

Effectiveness of Forest Management in Reducing Wildfire Risk

Incorporating Climate Change Adaptation into Forest Management

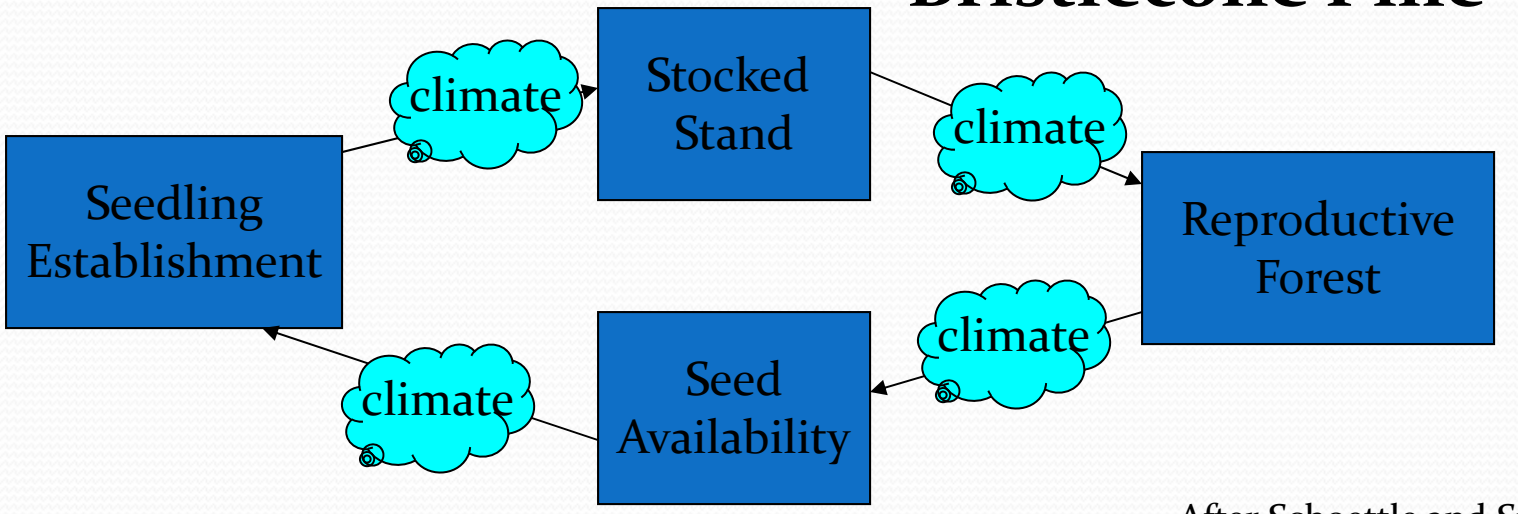
1. ***Resistance***: maintain values and ecosystem services in their present condition
2. ***Resilience***: **enhance capacity of ecosystems to withstand or absorb effects without loss of key processes or functions**

Millar et al 2007, Joyce et al. 2008, Peterson et al. 2012

Using fire/vegetation management to encourage regeneration response to current climate where advanced regeneration is evident.

White Pine Blister Rust

Bristlecone Pine



After Schoettle and Sniezko 2007

Incorporating Climate Change Adaptation into Forest Management

1. ***Resistance***: maintain values and ecosystem services in their present condition
2. ***Resilience***: enhance capacity of ecosystems to withstand or absorb effects without loss of key processes or functions
3. ***Response***: **assist transitions to future states by mitigating or minimizing disruptive outcomes**

Millar et al 2007, Joyce et al. 2008, Peterson et al. 2012

Adaptive Silviculture for Climate Change

- Forest managers need robust, operational examples of how to integrate climate change adaptation into silvicultural planning and on-the-ground actions that can…
  - Foster resilience to the impacts of climate change and/or
  - Enable adaptation to uncertain futures

Adaptive Silviculture for Climate Change (ASCC): A National Network

PROJECT GOALS

Compare key variables among 4 adaptation treatments in several forest types across the United States

- Forest growth and productivity
- Overstory and understory species composition
- Forest health and/or tree vigor

Treatments

Resistance

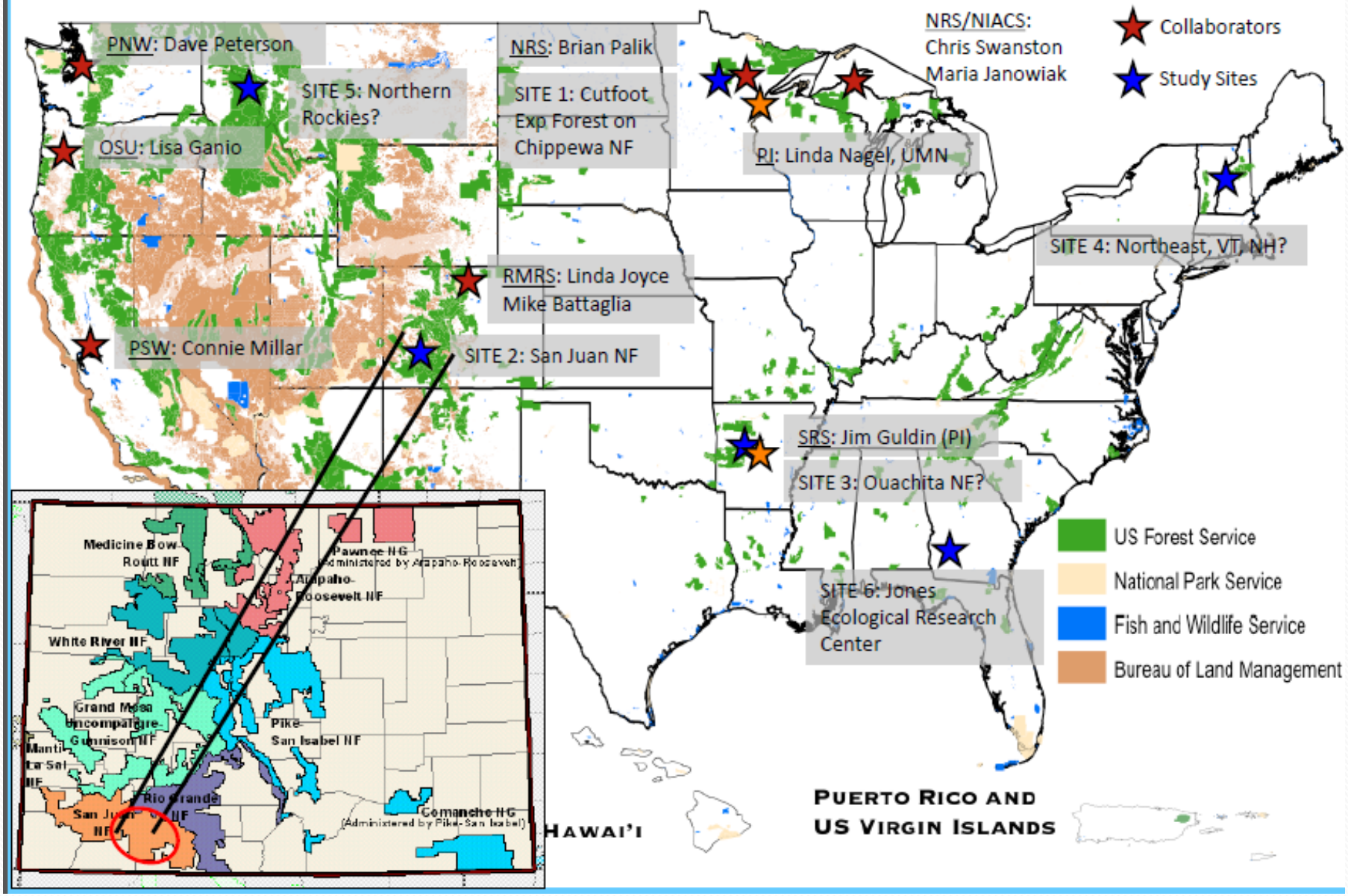
Resilience

Transition

No Action

Sensu Millar et al 2007

ADAPTIVE SILVICULTURE FOR CLIMATE CHANGE (ASCC)



Adaptation Case Studies using Science-Management Partnerships

Pacific Northwest: Olympic National Forest and National Park,

North Cascadia Adaptation Partnership (2 NF, 2 NP),

Blue Mountains National Forests

Northern Rockies Adaptation Partnership

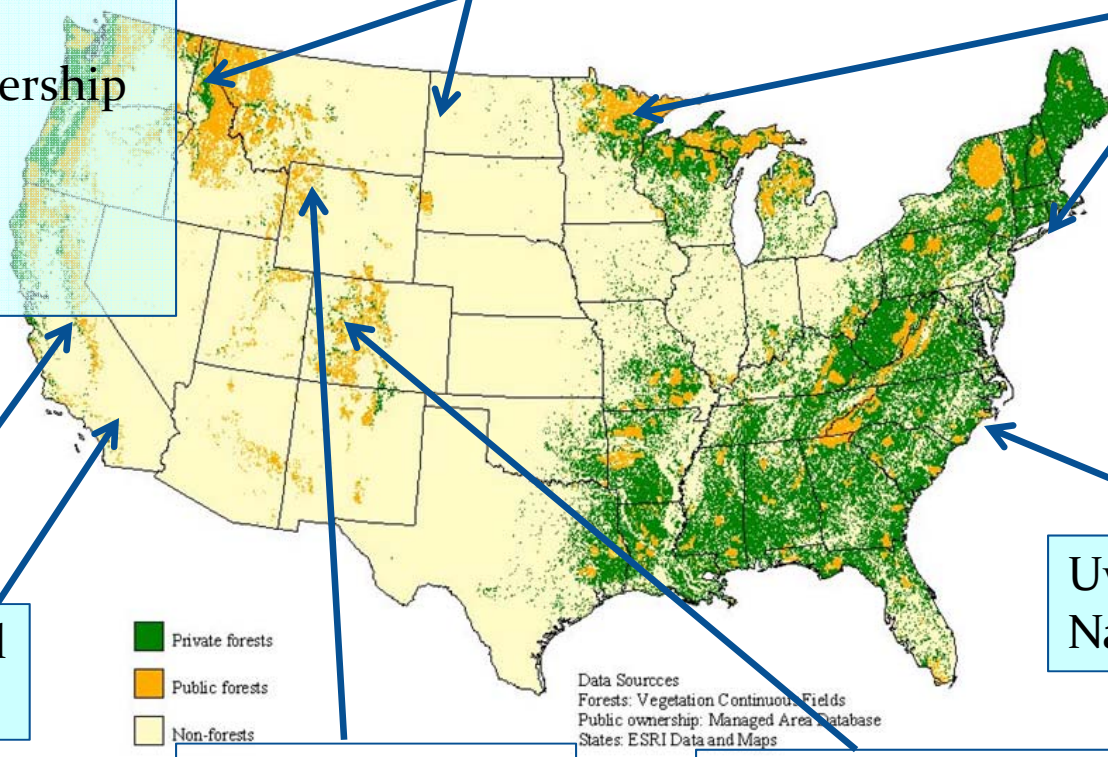
Northern and Northeast United States – over 30 on the ground projects

Watershed vulnerability assessments on 11 National Forests across the US

Inyo National Forest

Tahoe National Forest

Uwharrie National Forest



Shoshone National Forest

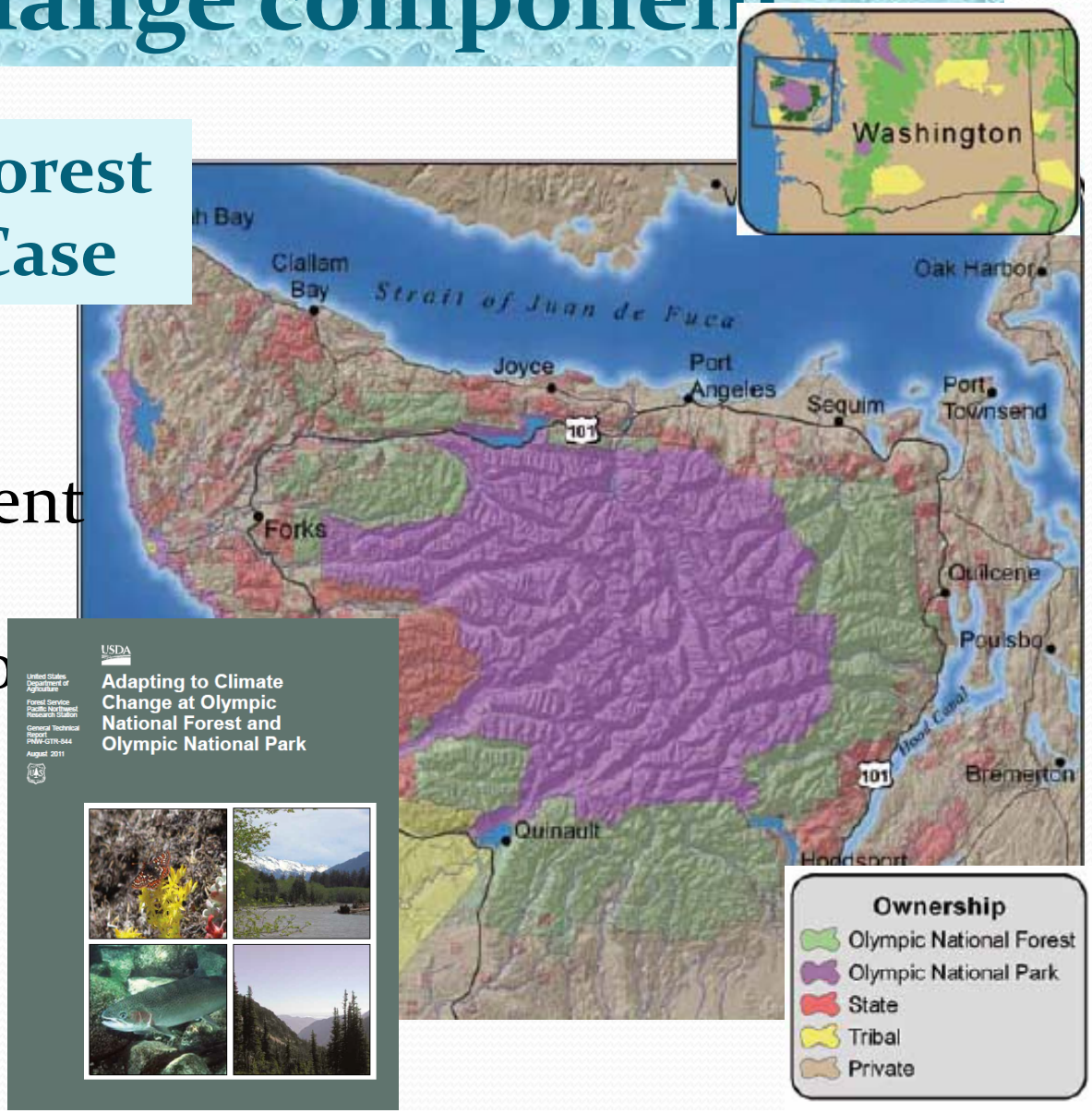
Gunnison Basin (led by TNC)

Current Tools that Assess Risk: add the climate change component

Olympic National Forest and National Park Case Study

Place-based vulnerability assessment and science management worksho to facilitate climate change adaptation planning.

Halofsky et al. 2011, PNW-GTR-844

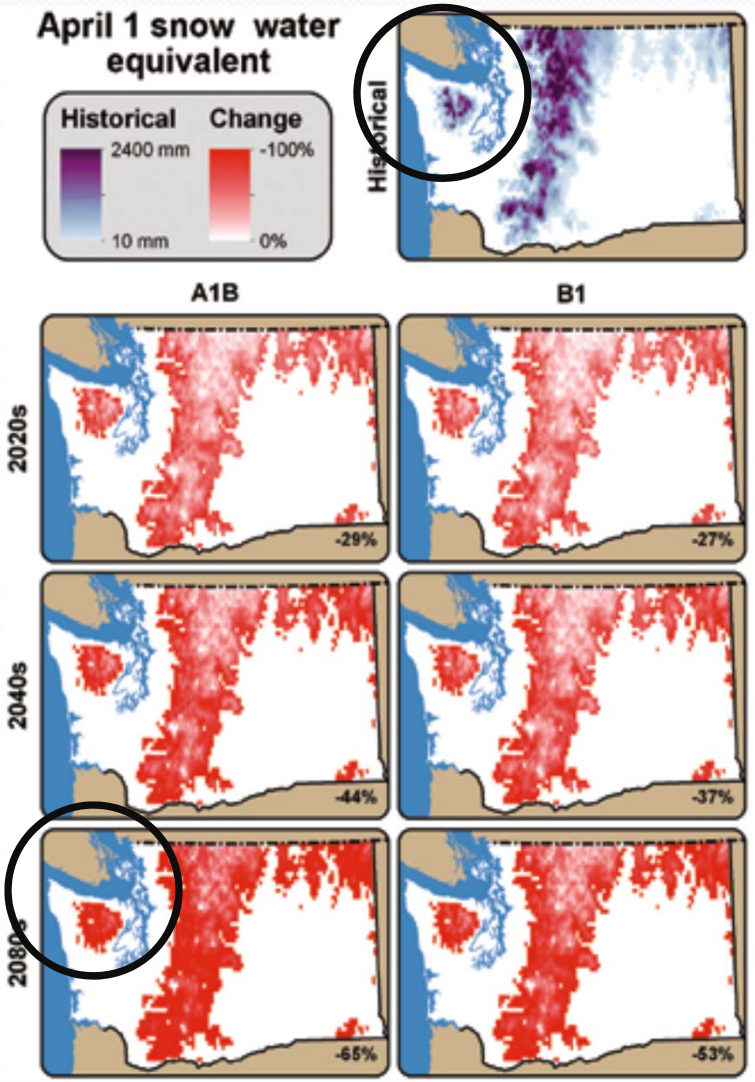


Climate change impacts on hydrology

Two Forest-level workshops

First workshop focused on climate change impacts on hydrology:

- Snowmelt-dominant watersheds
  decreases in flooding
- Transient watersheds -
  increased flood frequency
- Rain-dominant watersheds -
  small increases in flood frequency



Halofsky et al 2011

Adaptation: Adding Climate Change to Road Management

Second forest-level workshop focused on Adaptation

- **Aquatic risk quantified in the <u>current</u> Road Management Strategy**; add climate change influence.
- **Riparian zone proximity** - Assign a higher hazard rating if in projected flood hazard corridor.
- **Upslope hazard** – consider amount of area upslope that is in transient snow zone or rain-on-snow zone.

Projected increases in 20-year floods on the Olympic Peninsula.

Climate Change Response Framework

Northern Institute of Applied Climate Science

Cross-boundary approach

Partnerships

Integrated set of tools and actions

Demonstration Projects

http://climateframework.org/framework-components/forest-adaptation-resources

Adaptation Workbook -

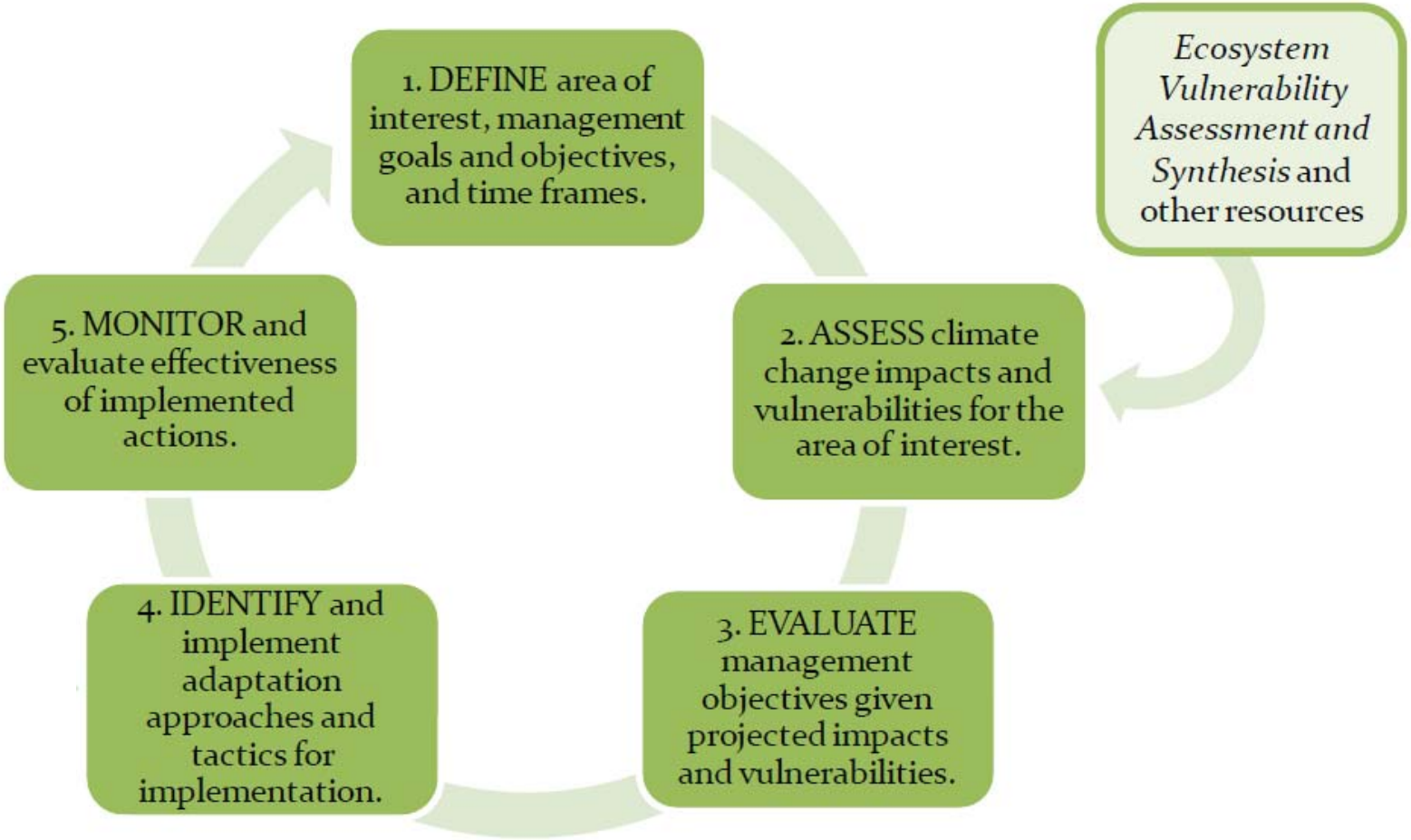


Figure 7.—The Adaptation Workbook presents a five-step process (dark green rectangles) that can be used to incorporate climate change as a management consideration and help ecosystems adapt to the anticipated effects of climate change. Additional resources (light green rectangles) provide information and tools that support the process.

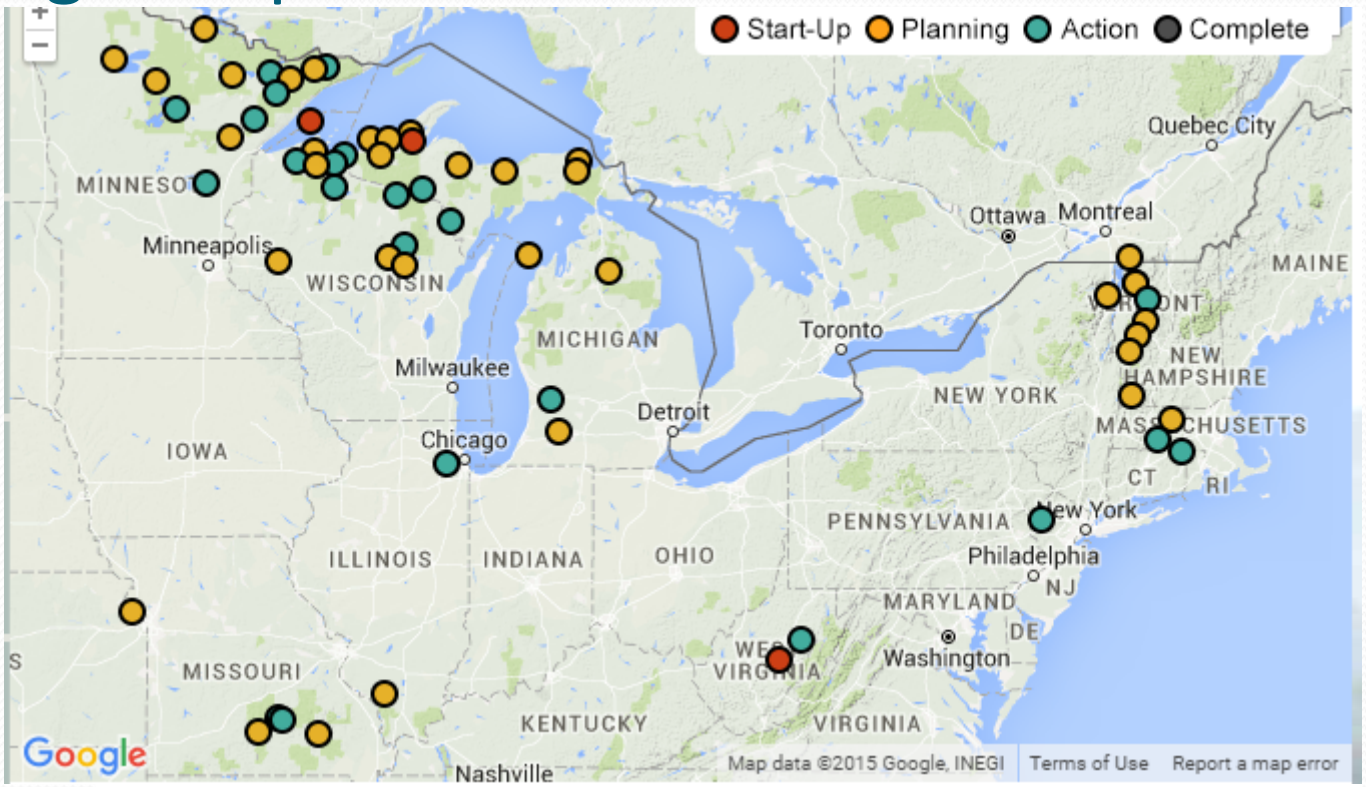
Swanston and Janowiak 2012

Demonstration Projects

Climate Change Response Framework

Landowner types:

- Federal
- State
- County
- Municipal
- NGO
- Tribal
- Private



Demonstration Projects

Demonstration projects are real-world examples of how managers have integrated climate considerations into forest management planning and activities. These projects use the partnerships and resources developed through the Framework to test new ideas and actions for responding to changing conditions. Demonstrations come in all shapes and sizes, showing a variety of adaptation actions that also achieve forest management goals.

Project	State	Landowner Type	Status	
- Any -	- Any -	- Any -	- Any -	Reset

http://climateframework.o

Challenges and Opportunities

- Challenges
  - Forest area losses, increased fragmentation
  - Economic returns on forests
  - Increasing disturbances
- Opportunities
  - New considerations for forest products
  - Science-management partnerships
  - Adaptive management
  - Experiments with adaptation

Questions

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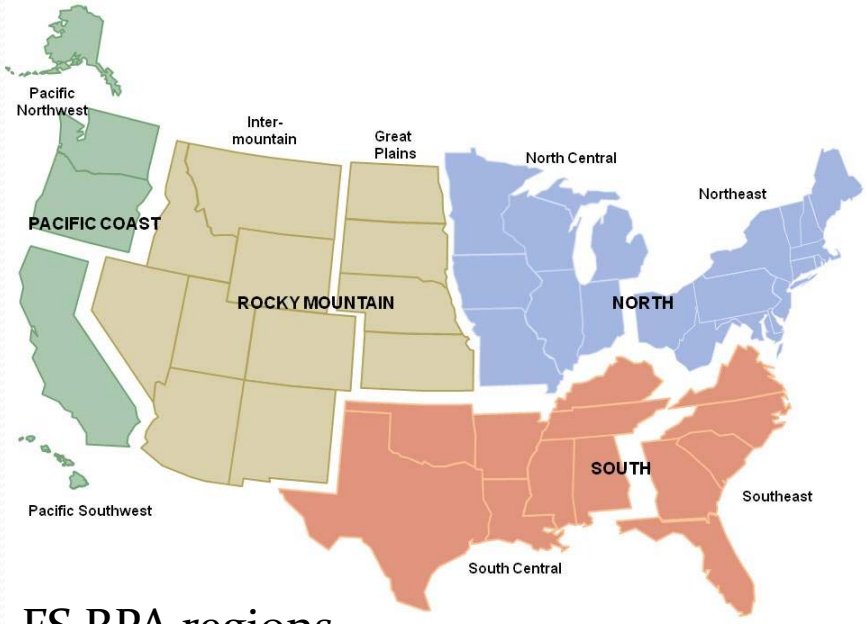
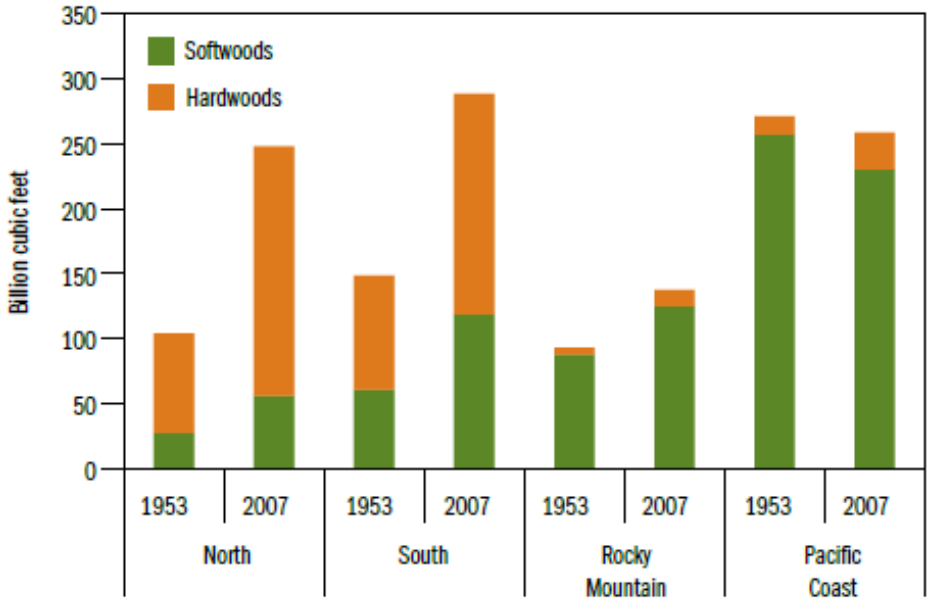
Growing-stock volume and volume of wood: 1953 and 2007



FS RPA regions



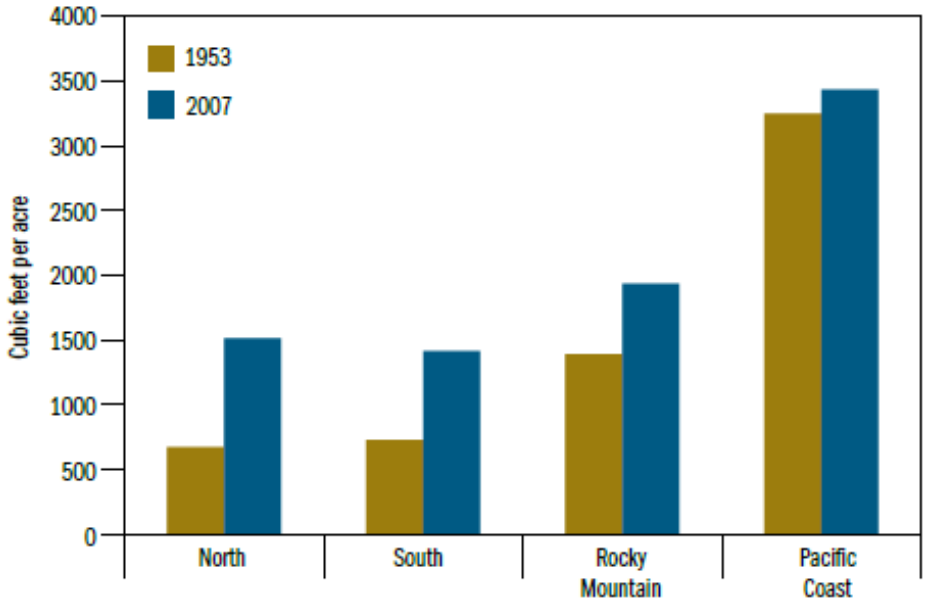
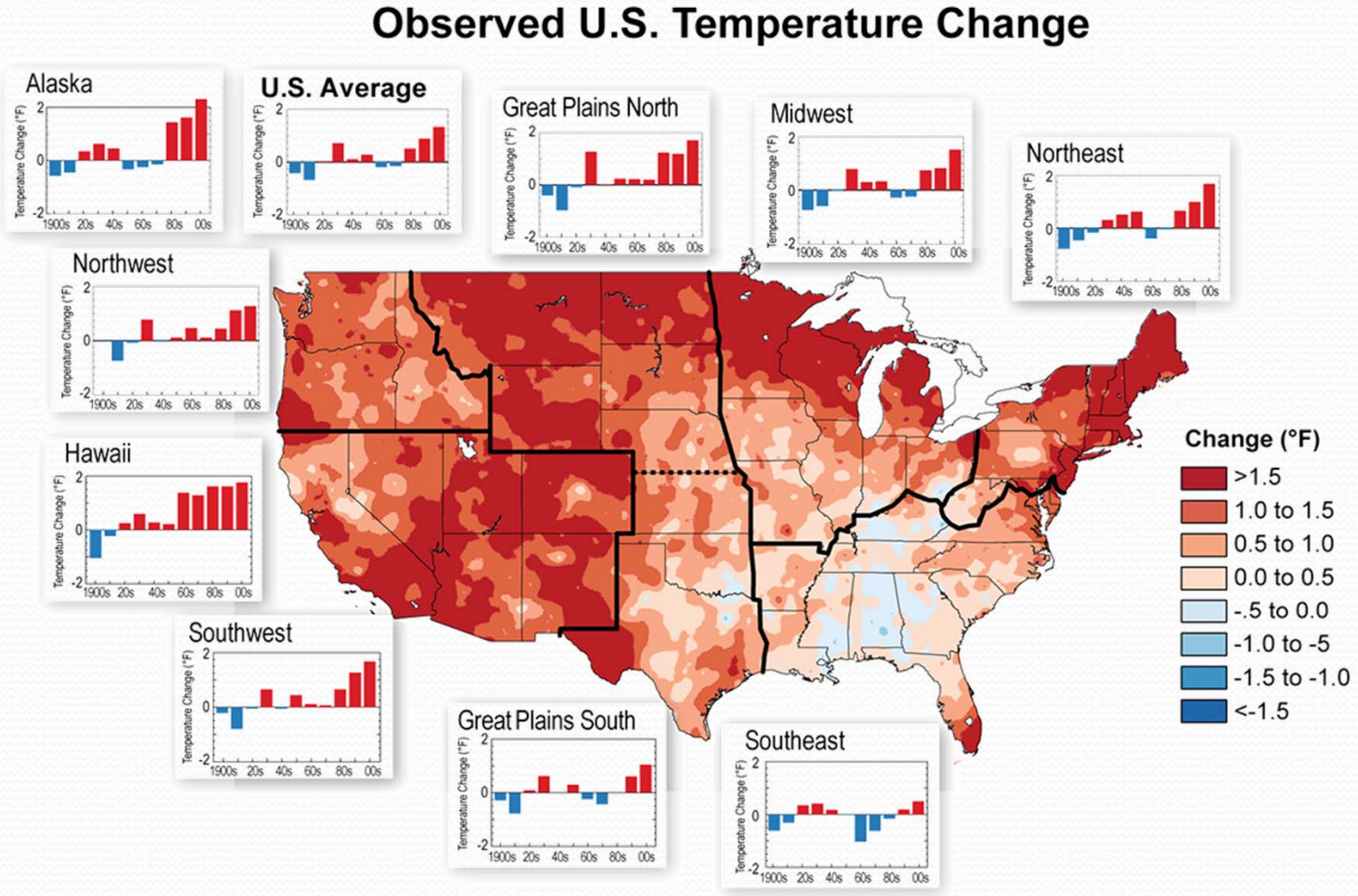


Figure 5b.1. Growing-stock volume and volume per acre by region, 1953 and 2007.

Change is Apparent Across the Nation



Change over 1991-2011 compared to the 1901-1960 average

Climate Change Response Framework

Northern Institute for Applied Climate Science

Adjusting silvicultural prescriptions to a changing climate

Chequamegon-Nicolet National Forest: Aspen Stands on the Park Falls District

Start-Up | Planning | **Action** | Complete

The stands in this adaptation project are marked for timber harvest.

The Chequamegon-Nicolet National Forest, like much of northern Wisconsin and the Northwoods, contains a large amount of aspen forest. This boreal forest type, which has substantial ecological and economic importance to the region, may be especially vulnerable to a changing climate.

This adaptation project evaluated the potential effects of a changing climate on two aspen stands, which led to adjustments to the silvicultural prescriptions. These changes are intended to help these stands adapt to anticipated changes, as well as provide a real-world example of how forest management can enhance adaptation to climate change.

http://climateframework.org/node/218