SCIENCE TO SUPPORT THE NATIONAL COHESIVE WILDLAND FIRE MANAGEMENT STRATEGY

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Timeline

- The Federal Land Assistance, Management and Enhancement Act (the FLAME Act) – November 2009
  - Called for a report to Congress containing a cohesive wildfire management strategy within one year
- Phase I: Completed in 2010
- Phase II: 2011 – 2012
- Phase III: 2013 – 2014
  - A. Regional Strategies
  - B. National Strategy
- Final Report to Congress: April 2014

Directed by the Wildland Fire Leadership Council (WFLC)

Phase I: Outline a Strategy

- Two principal teams
  - Cohesive Strategy Oversight Committee (CSOC): Agency and stakeholder representatives (22 official members)
  - Project Management Team (Agency staff and contractors)
    - Small "Science Group," mainly from Forest Service
- Products
  - A National Cohesive Wildland Fire Management Strategy
    - Three national goals
    - Guiding principles
    - Governance
    - Plan for a phased approach to more fully develop a strategy
    - Appendix A: Comparative Risk Assessment
  - Report to Congress

Cohesive Strategy National Goals

- Restore and maintain resilient landscapes

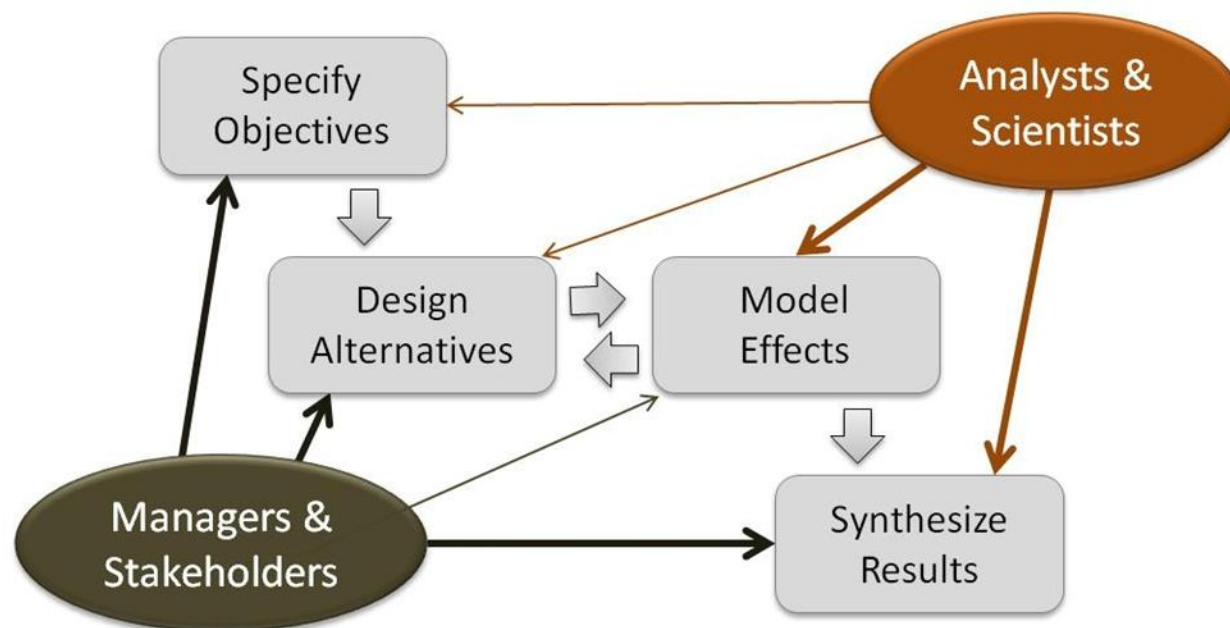- Fire adapted communities

- Response to wildfire

Phase II: Regional Assessments and Strategies
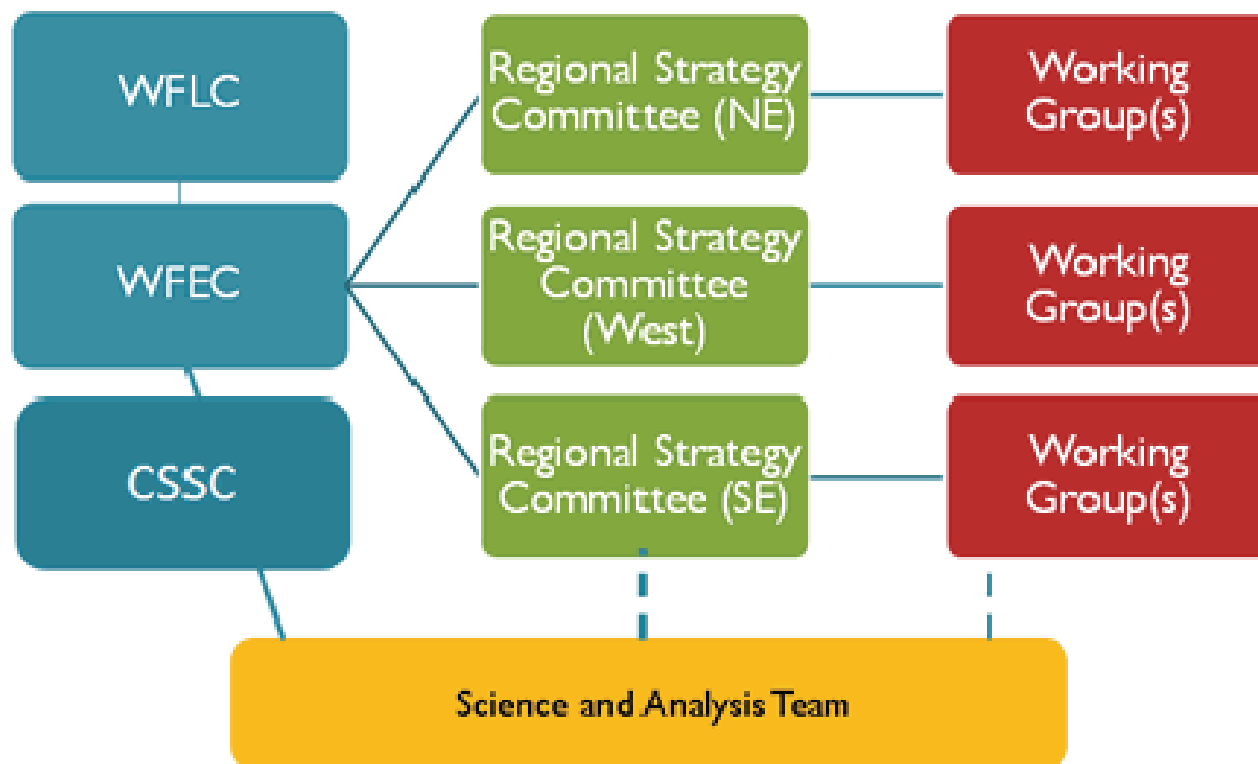
Phase II: Role of Science Team

- Support to Regional Strategy Committees
  - Guidance in structured decision analysis – application of the CRAFT risk assessment framework to development of regional strategies

Phase II Science Team Efforts

- Conceptual Modeling
  - Assemble credible scientific information, data, and pre-existing models
  - Develop conceptual frameworks linking actions and activities to managing risks
- Worked in Sub-teams on Specific Topics
  - Landscape resilience
  - Wildfire ignitions and preventions
  - Fuels management, wildfire extent and intensity
  - Wildfire response and suppression effectiveness
  - Fire adapted communities
  - Firefighter safety
  - Smoke management and impacts
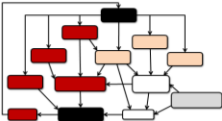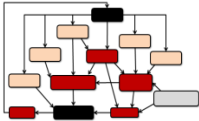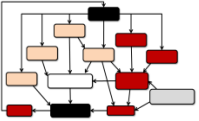 - Public acceptance and policy effectiveness

Overall Conceptual Diagram
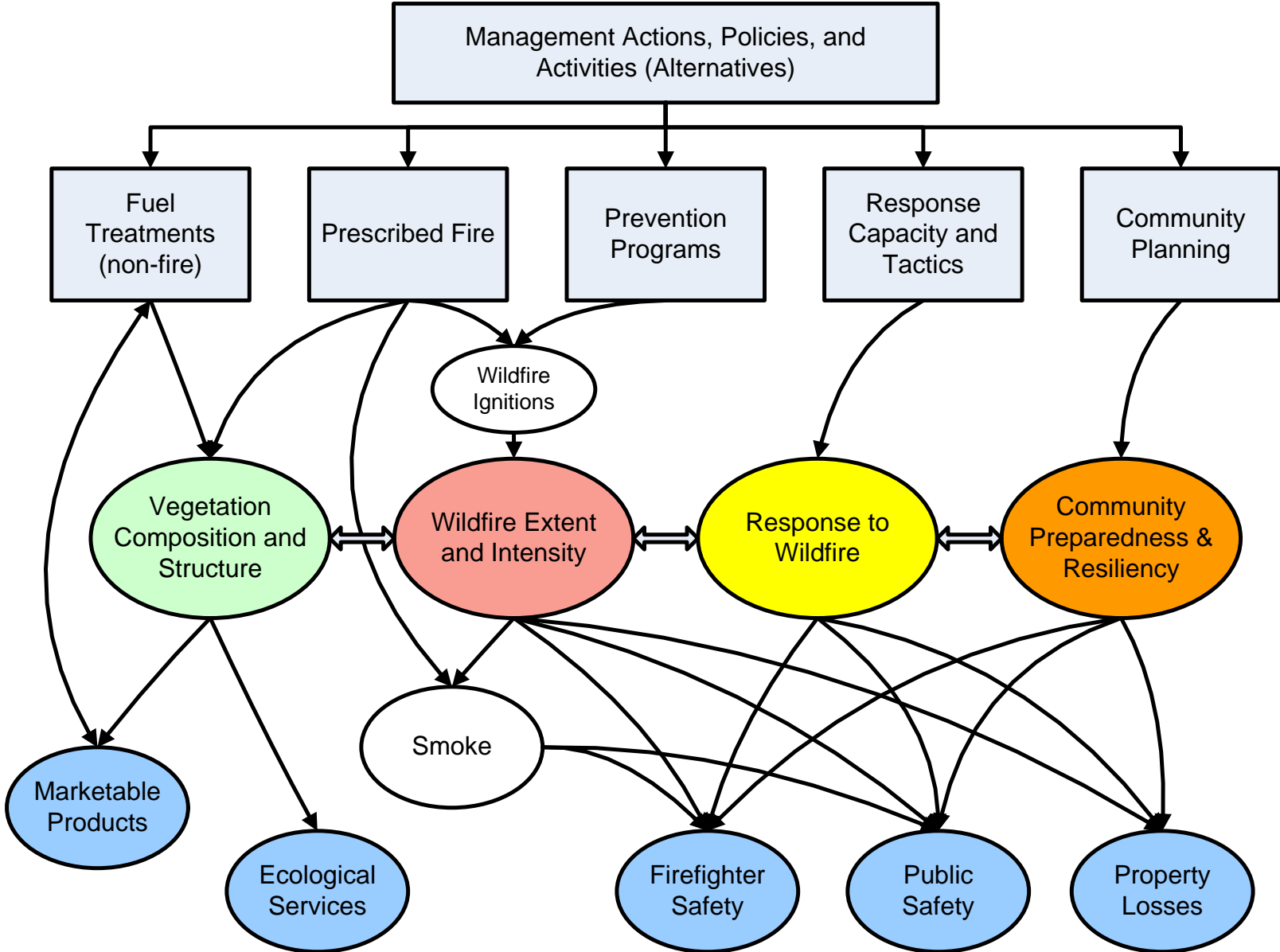
An Overview Conceptual Model of Firefighter Safety Related to Incidents
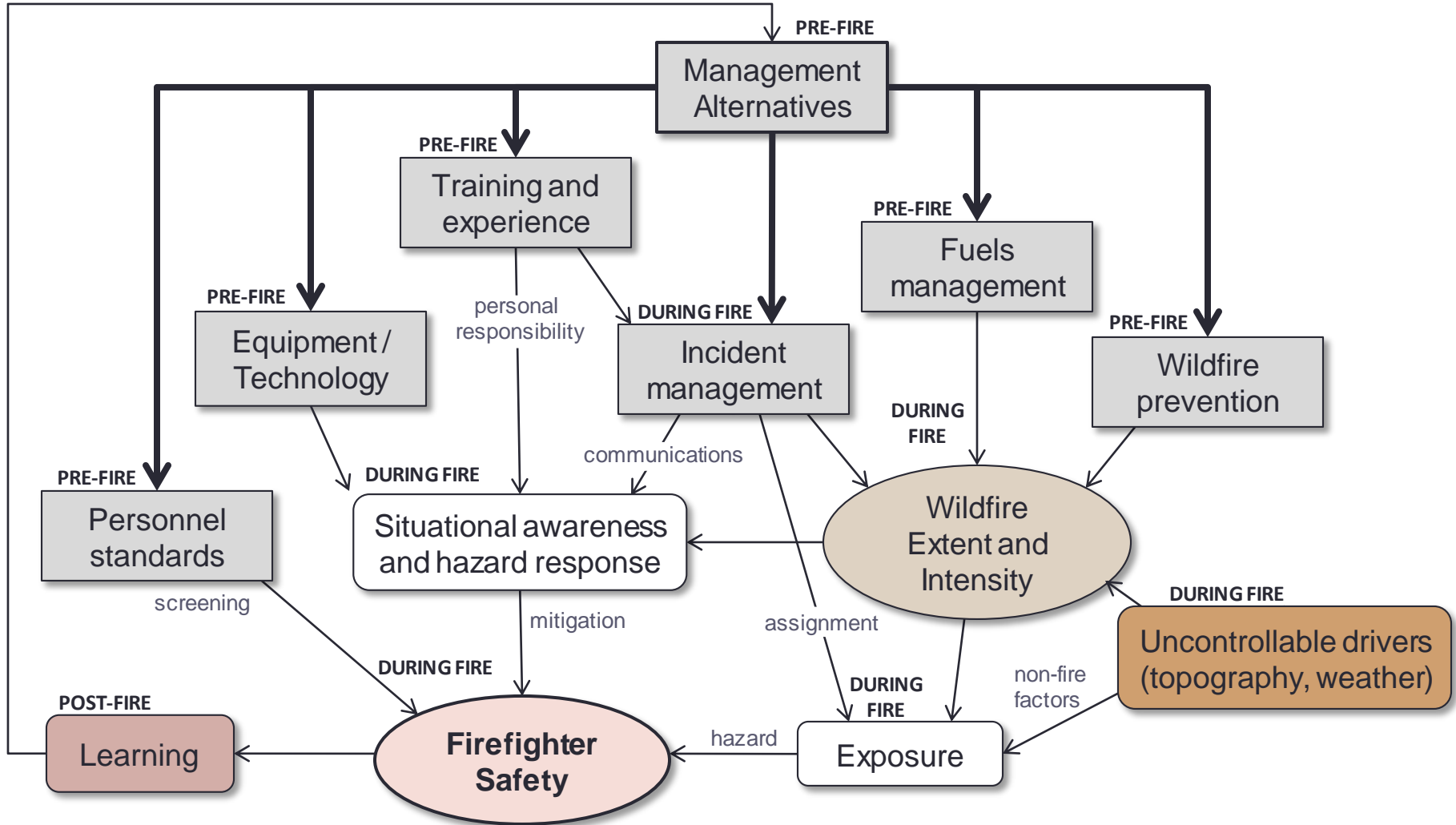
Pathways to reducing firefighter deaths and injuries

Strategic investment	Workforce emphasis	Incident management emphasis	Fire attribute emphasis
Position within Figure 2 shown by black and red:			
Standards, training, experience	X	X	
Technology, equipment	X	X	
Communications	X	X	
Health monitoring	X		
Personnel standards, screening efforts	X		
Incident learning	X	X	X
Fire behavior and weather modeling	X	X	X
Wildfire prevention efforts			X
Fuels reduction			X
Forest and disease management			X

Phase II Products

- Regional Assessments
  - Regional Conditions and Context
  - Policies and Regulations
  - Values
  - Trends and Uncertainties
  - Objectives and Actions
  - Actions and Activities
  - Barriers and Proposed Solutions
  - Management Scenarios and Areas to Explore for Reducing Risk
    - The Northeast's Areas to Explore for Reducing Risk
    - The Southeast's Management Scenarios
    - The West's Management Scenarios
- Science Team Report
  - Summarized Subteam Reports
  - Set Expectations for Phase III

Phase III: Regional and National Reports and Action Plans

The National Cohesive Wildland Fire Management Strategy: Phase III Western Regional Science-Based Risk Analysis Report

Final Report of the Western Regional Strategy Committee November 2012
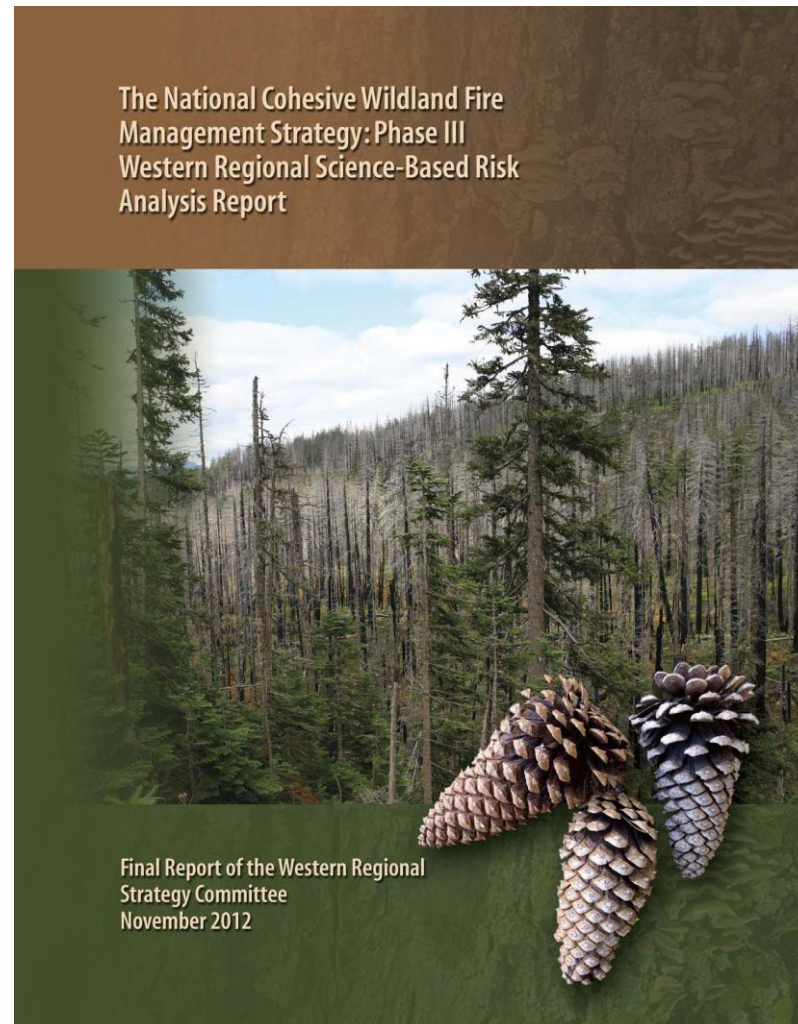
Phase III, Part 1: Original Charge to Science Team

The NSAT will develop analytical models* and interact with the RSCs and work groups to explore alternative management strategies (alternatives) for each region.
- Phase II Report, p. 46

*some assembly required

Data Assembly (Over 300 variables)

- Biophysical
  - Precipitation and Temperature
  - Terrain (elevation and slope)
  - Potential and Existing Vegetation
- Social and Economic
  - Demographic information (from census)
  - Urban influence (population and proximity)
  - Wildland-Urban interface
  - Land-use or other measures of economic activity

- Wildland Fire
  - Capacity (stations, equipment, and personnel)
  - Frequency and extent
  - Causes of ignitions
  - Human safety (injuries and fatalities)
  - Property loss

County-level Summaries and Maps

Urban Influence	Urban Influence based on population and location	Factor score, States= e.g. Small metropolitan area, Large metropolitan area. ???		• ERS typology codes
Urban Index	Average urbanness value calculated from Edwards and Hargrove product.	Index		
Natural Ignitions	Percent of known fires that were caused by natural ignitions.	Percentages, 6 bins (Low to High)		
Vegetation Cluster	Existing vegetation cluster based on LANDFIRE NVCS class information.	Classes; NE= 100s; SE= 200s; W= 300s		• LANDFIRE NVCS
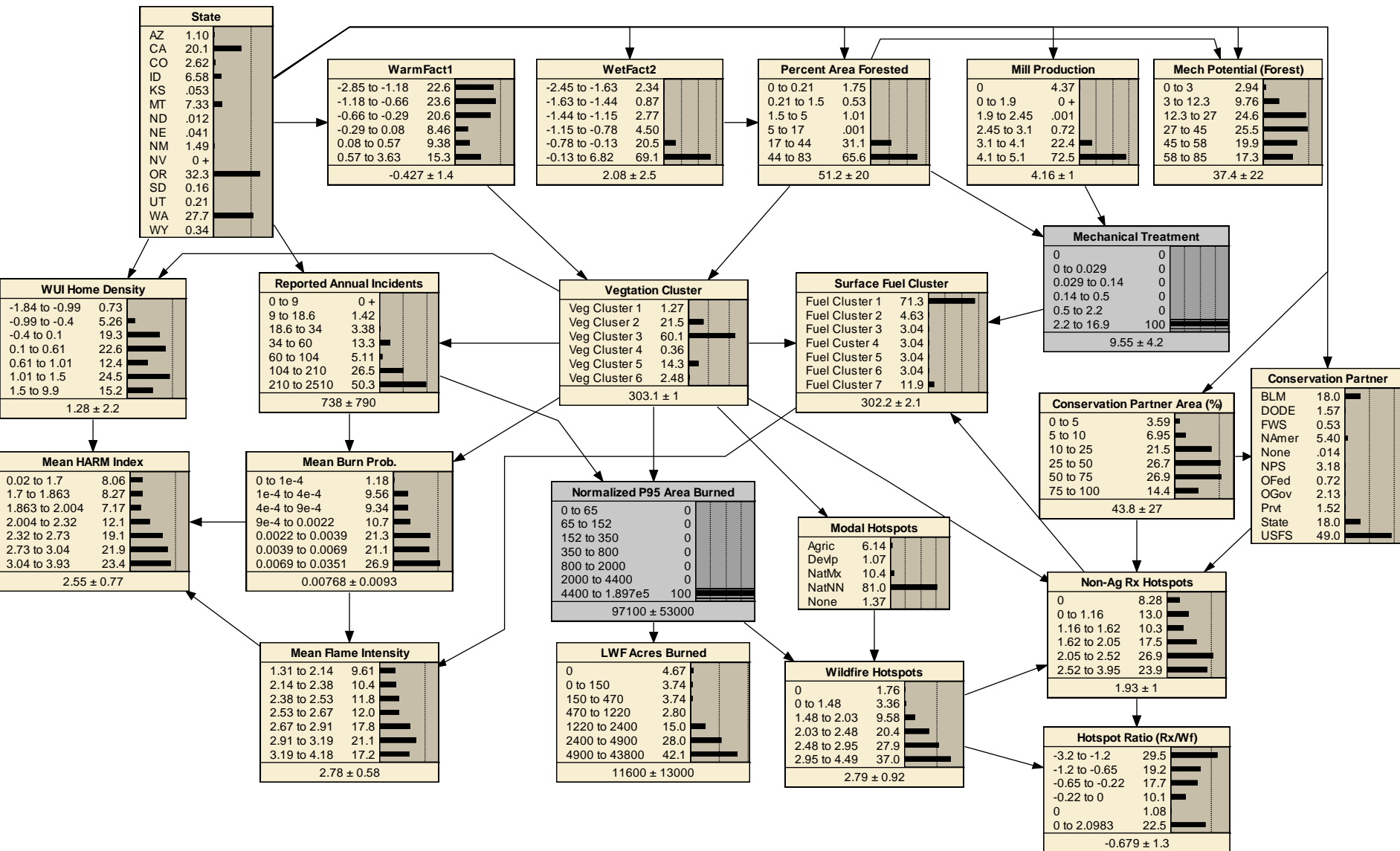
appropriate options. The outcome of more actively managing the landscapes in the West will have positive benefits for all three goals of the Cohesive Strategy. The middle lands are especially important, when considering the spatial extent of many large wildfires and rapid rates of spread that directly impact fire adapted communities, as well as the adverse impacts on private timber and grazing lands, natural resources, cultural and watershed resources that support these communities. A cohesive strategy must ensure that commitments to collaborative efforts and partnerships that have developed in treating areas outside of the WUI are maintained. Over time this alternative significantly reduces/modifies the impacts of wildfire, the level of required response, and helps to protect fire adapted communities.

Focus areas:

1. Provides for collaborative fuels and prescribed fire strategies for the restoration and maintenance of resilient forest and rangelands through active management.
   a. Employ a variety of vegetation management applications and treatments through mechanical treatments, grazing, prescribed fire and cultural fires, natural fires, and any other combination of tools that may be appropriate for a given geographic region or fuel type in the West. Management options and treatments are located to protect values at risk and implemented at a landscape scale, especially in areas with a history of large wildfire occurrence.
   b. Enable land owners/managers to develop and implement more appropriate actions to achieve healthy and resilient forest and rangeland landscapes.
   c. Emphasize vegetation treatment projects with a positive net revenue that will improve vegetative landscapes to the largest extent possible.
   d. Prioritize treatments geographically by existing forest and range conditions and by opportunities to stimulate local and regional economic activity.
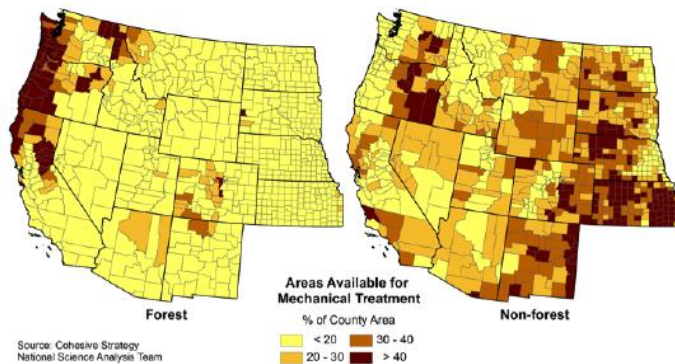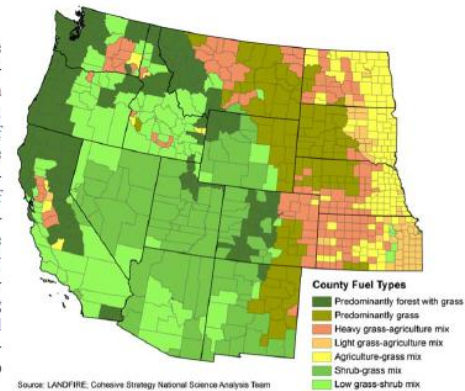
Source: Cohesive Strategy National Science Analysis Team

Figure 2. Areas Available for Mechanical Treatment
The percent of county area generally available for mechanical treatment - for forested (left) and non-forested (right) burnable fuels - based on legal or policy restrictions, slope, accessibility and land cover. The map does not reflect the availability of markets or capacity to plan and conduct treatments.

Fuels and Climate

The Surface Fuel Type map shows a spatial representation of fuels, categorized in seven broad surface fuel types, and grouped by proportion of area in each county. Diverse forest and rangeland vegetation types, with mosaics of complex fuel structures, characterize Western fuels. These environments are increasingly departed from historical conditions, and are experiencing declining forest and rangeland health conditions, that are resulting in a cumulative buildup of fuel loadings.
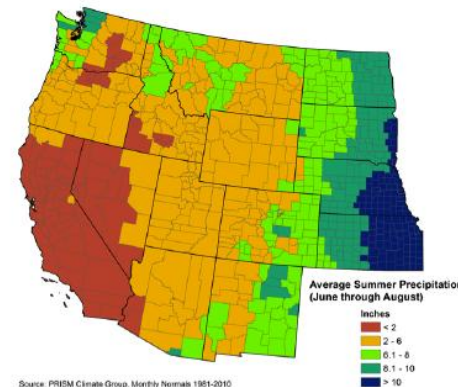
Source: LANDFIRE; Cohesive Strategy National Science Analysis Team

Figure 6. Surface Fuel Type
Source: LANDFIRE and Cohesive Strategy NSAT. Western counties categorized in seven broad surface fuel types, grouped by proportion of area in each county.

The Average Summer Precipitation Map, Figure 7, shows that much of the West tends to be dry and arid. Vegetative environments that occur in relatively warm and dry Western climates are highly conducive to fire ignitions and wildfires, with a high potential for intense fire behavior and spread. Wetter areas that experience high ignition frequencies and large fire occurrence may require additional focus, as growing conditions enable rapid growth with fuels accumulation, which may trigger the need for shorter management intervals.

A century of fire exclusion and lack of fuels management has resulted in many forest types seeing dramatic increases in tree density, with ladder fuels and increasing amounts of surface fuel loading and understory brush, that has led to an increased incidence and spread of uncharacteristically large and severe wildfires. This rapid escalation of severe wildfire behavior has resulted in increased wildfire suppression costs, greater fire severity, significant home and property losses, and increased threats to communities.

Abnormally large and long-duration fires have been prevalent in the past two decades due to a variety of factors, such as fuels accumulations and changing climatic conditions. Stressed forest or

Source: PRISM Climate Group, Monthly Normals 1981-2010

Figure 7. Average Summer Precipitation

20

Example pages from the Western regional report

Phase III, Part 2: New Science Team Tasks

- Assignment (January 2013): Explore various potential national policy options for achieving the national goals of the Cohesive Strategy

- Purpose: provide a broad strategic overview of the challenges and opportunities that could inform subsequent discussion and decision-making processes.

- Follow-up Assignment (June 2013): Use the information from the national analysis to suggest spatially explicit national priorities to be included in a national strategy.

General Approach

- Draw from multiple data sets spanning the range of biophysical, social, and economic factors in addition to wildland fire statistics.

- Use a mix of statistical and geospatial techniques to create a nationally consistent classification system.

- Match policy or management options to characteristics of each county.

- Blend options spatially and institutionally to create a national strategy (role of the larger CS governance).

Classification Tree for Landscape Classes

Landscape Classes

- A (gray)
- B (dark blue)
- C (light blue)
- D (brown)
- E (tan)
- F (yellow)
- G (orange)
- H (dark green)
- I (light green)
- J (red)
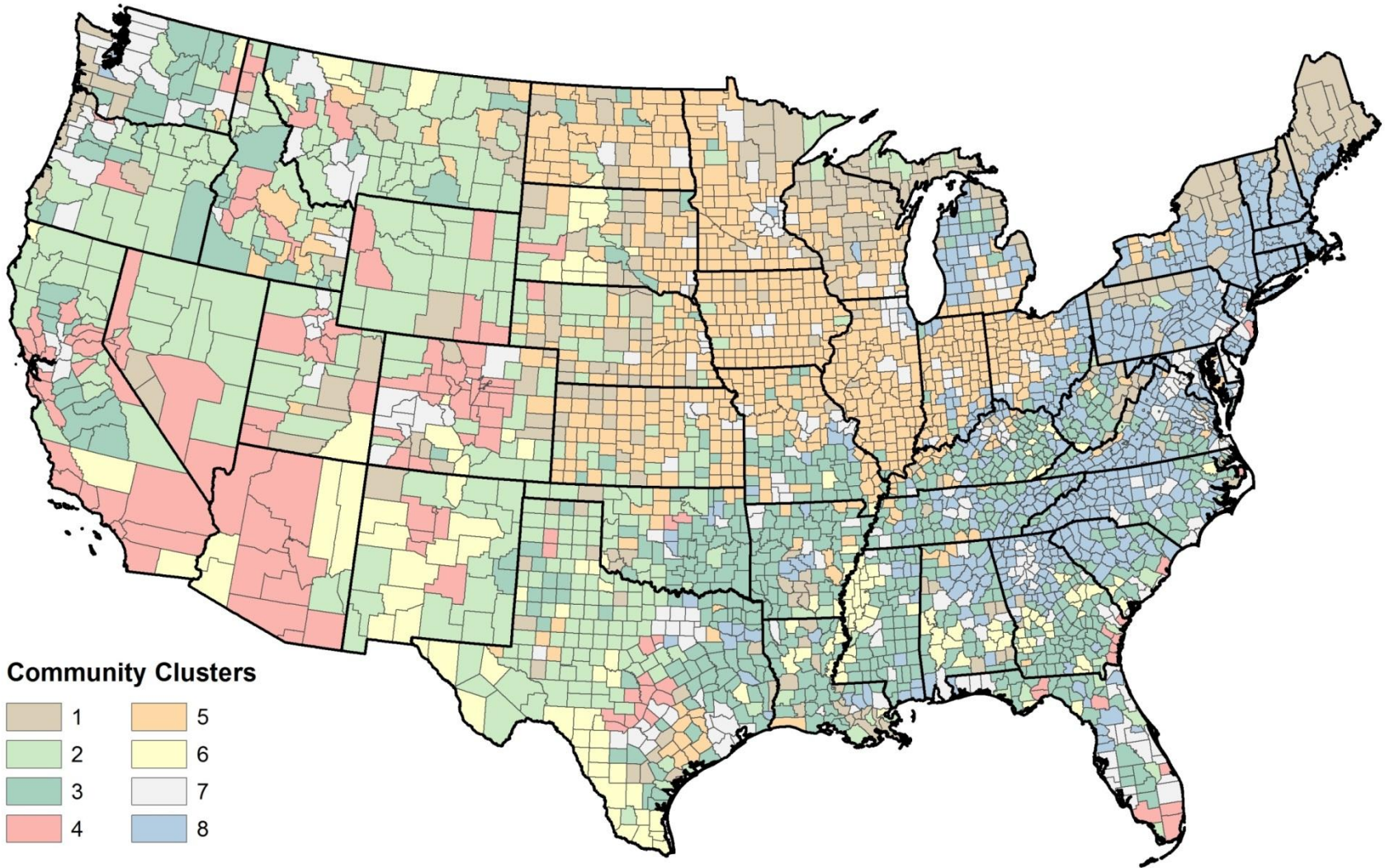- K (dark red)
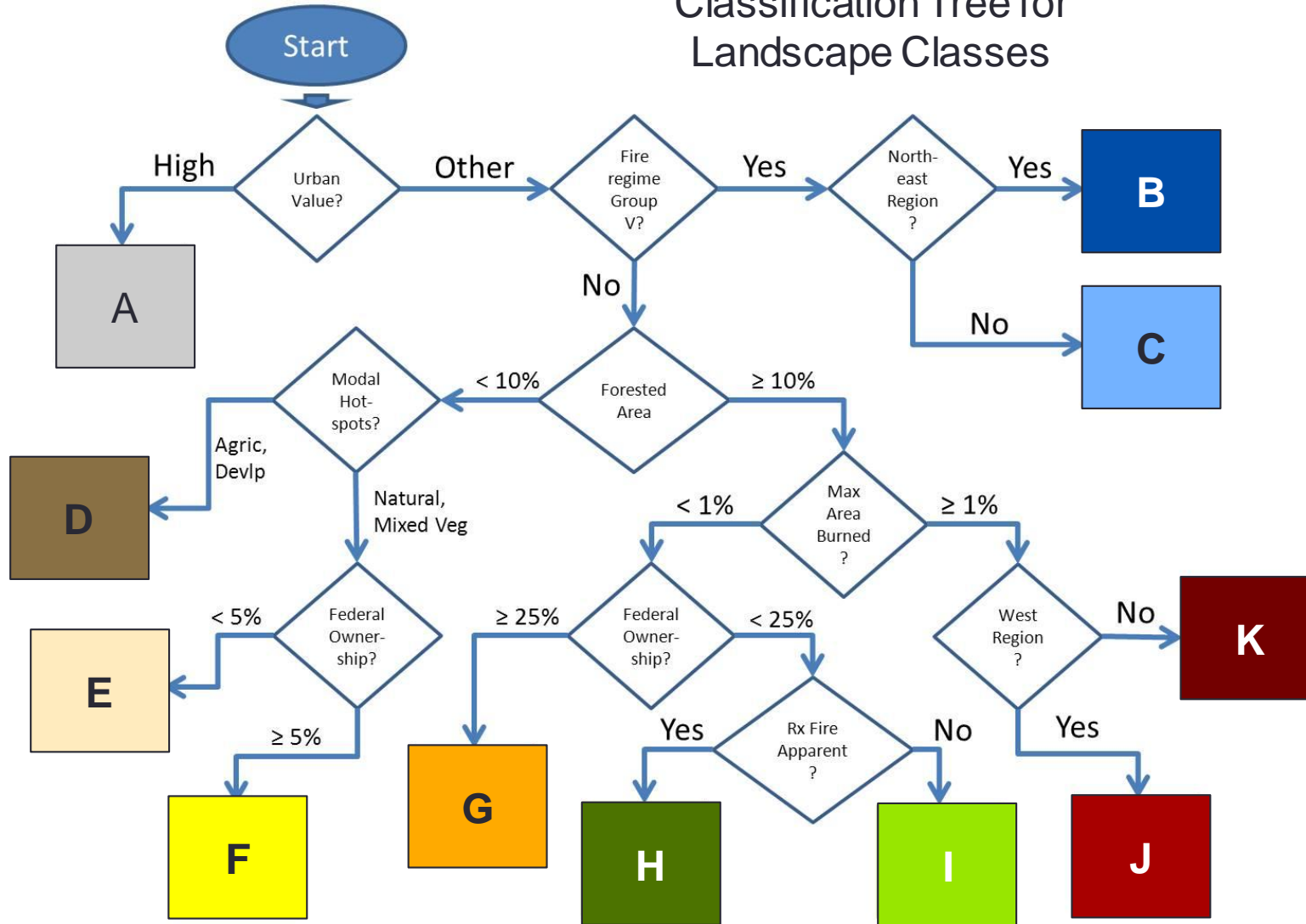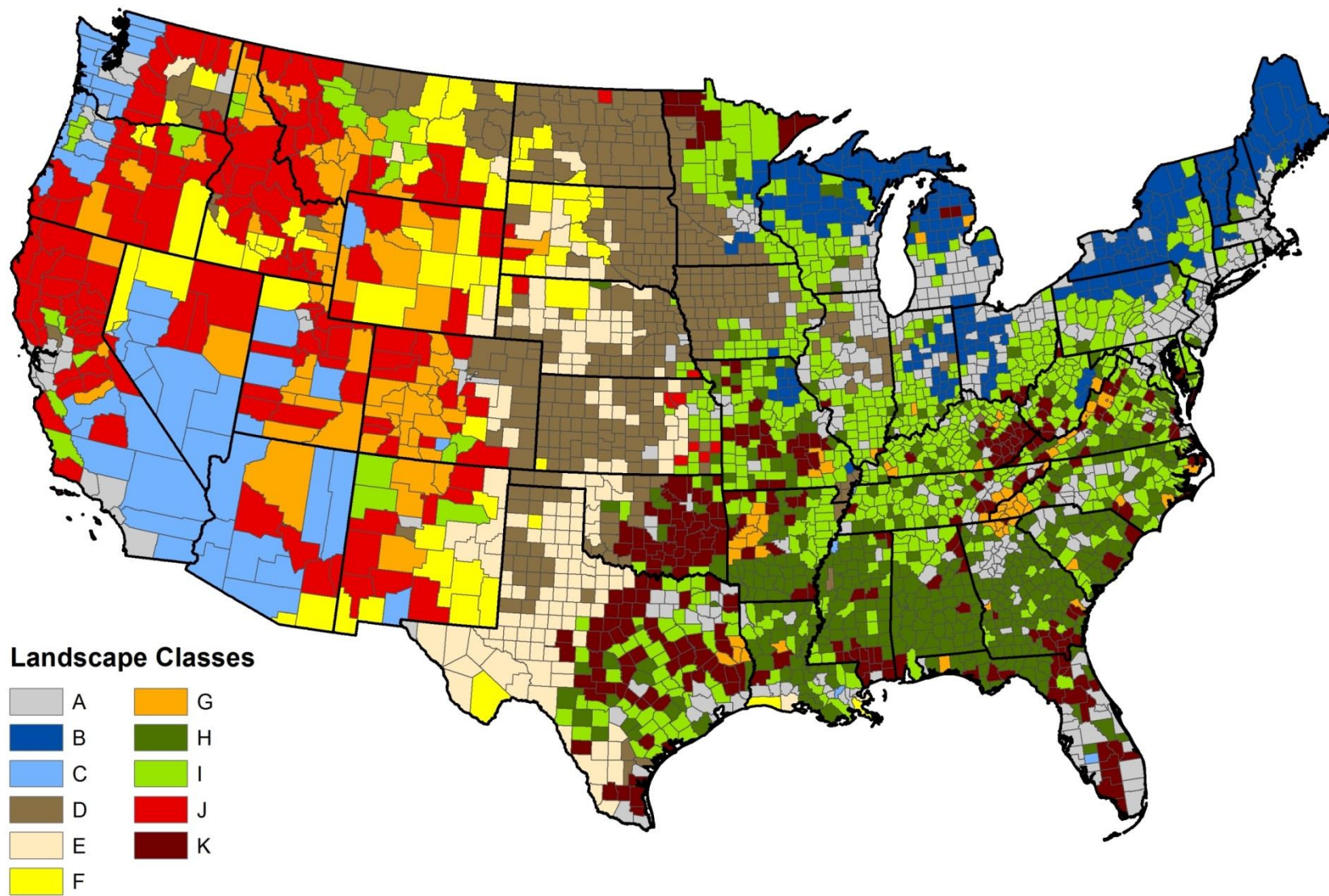
National

General attributes of each landscape class

Landscape Class		Percent Area Forested	Area Burned (2002-2011)	Historical Fire Frequency	Index of Prescribed Fire Activity	Federal Ownership	Average Urban Value	Natural Landscape (%)	Natural-Mixed Landscape (%)	Counties
A	Urban Developed Built	High	Moderate	Low	Moderate	Moderate	Very High	Low	Low	470
B	Cool, Wet Northern Forests	Very High	Low	Low	Moderate	Moderate	High	Low	High	220
C	Historically Infrequent Fire (Western)	Low	High	Low	Low	Very High	Low	Very High	Low	54
D	Agriculture and Grasslands	Low	Low	Very High	Low	Low	Low	Low	Low	409
E	Private Rangelands and Prairies	Low	High	Very High	Low	Low	Low	High	High	159
F	Public Rangelands and Prairies	Low	High	Low	Low	High	Low	Very High	Low	68
G	Public Forest Lands, High Fire Potential	High	Low	Low	Low	Very High	Low	Very High	Low	131
H	Eastern Forests with Ongoing Prescribed Fire	Very High	Low	High	Very High	Low	High	Low	Very High	459
I	Private Fragmented Forests with Less Prescribed Fire	High	Low	High	Low	Low	High	Low	High	715
J	Western Public Lands with Recent Large Fires	High	Very High	High	Low	Very High	Low	Very High	Low	150
K	Eastern Mixed Forests with Recent Large Fires	High	Very High	High	Low	Low	High	Low	Very High	274

○ Low   ◎ Moderate   ◒ High   ● Very High

Community Clusters

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

Basic Conceptual Model: Risk results from the intersection of wildfires, homes and communities, and socioeconomic resources.

Process is to group counties with similar characteristics using statistical cluster analysis

- Begin with six variables:
  - Ignition density (max annual fires per unit area)
  - Area burned (max annual area burned, normalized)
  - WUI Area Factor Score
  - WUI Home Density factor score
  - Demographic Advantage factor score
  - Demographic Stress factor score
- Cluster counties into eight "community clusters" using statistical methods

National

General attributes of each community cluster

Intersection of Community Clusters with Landscape Resiliency Classes

Resiliency Classes	Community Clusters								Grand Total
	1	2	3	4	5	6	7	8	
A	8	3	31	30	71	4	129	194	470
B	68	5	6		78	1	6	56	220
C	15	5	6	12		9	7		54
D	56	38	29	2	265	5	14		409
E	22	76	7	3	28	22	1		159
F	2	32	6	8	12	7	1		68
G	18	24	28	12	4	8	20	17	131
H	29	8	189	8	30	54	42	99	459
I	62	18	145	7	207	24	60	192	715
J		69	24	38	7	4	8		150
K		40	135	13	15	16	17	38	274
Grand Total	280	318	606	133	717	154	305	596	3109

Summary sheets have been prepared for each combination of community cluster and resiliency class

Available online at http://cohesivefire.nemac.org/

Home » National Characterization » Combinations » 8I

8I

These eastern areas experience a higher amount of demographic stress due to the rural nature of the "bedroom communities" in the Wildland Urban Interface (WUI) area. There are many people in the WUI and higher ignitions due to the higher population.

Example of a Typical County — Berkeley County, West Virginia: Berkeley County includes the commuter towns of Harpers Ferry and Martinsburg.

Policy Options and Opportunities

Vegetation and Fuels
There may be an active forest products industry nearby, which could support fuel treatments.

Homes, Communities and Values at Risk
Individual homeowners can be proactive on home defensive actions.

Human-Caused Ignitions
Human caused ignitions are a problem in these counties. Reduce accidental and human-caused ignitions through enforcement or outreach.

Effective and Efficient Wildfire Response
Response organizations continue to protect structures, treat fuels and target ignitions as local conditions apply.

National Priorities	
Vegetation and Fuels	Low
Homes, Communities and Values at Risk	Moderate
Human-Caused Ignitions	High

Effective and Efficient Response: There is moderate risk of large wildfires, less potential for resource benefits.

National Challenges	Management Options
Vegetation and Fuels	Prescribed Fire: Expand or maintain in areas of current use Prescribed Fire: Expand into areas of limited current use Prescribed Fire: Utilize on a limited basis Manage wildfires for resource objectives: In forested systems Manage wildfires for resource objectives: In non-forested systems Manage wildfires for resource objectives: In areas where increased awareness of community risk is necessary. Non-fire Treatments: Supported by forest products industry Non-fire Fuels Treatments: In non-forest areas Non-fire Fuels Treatment: In areas with limited economic markets Fuels Treatments as a precursor to prescribed fire or managed wildfire.
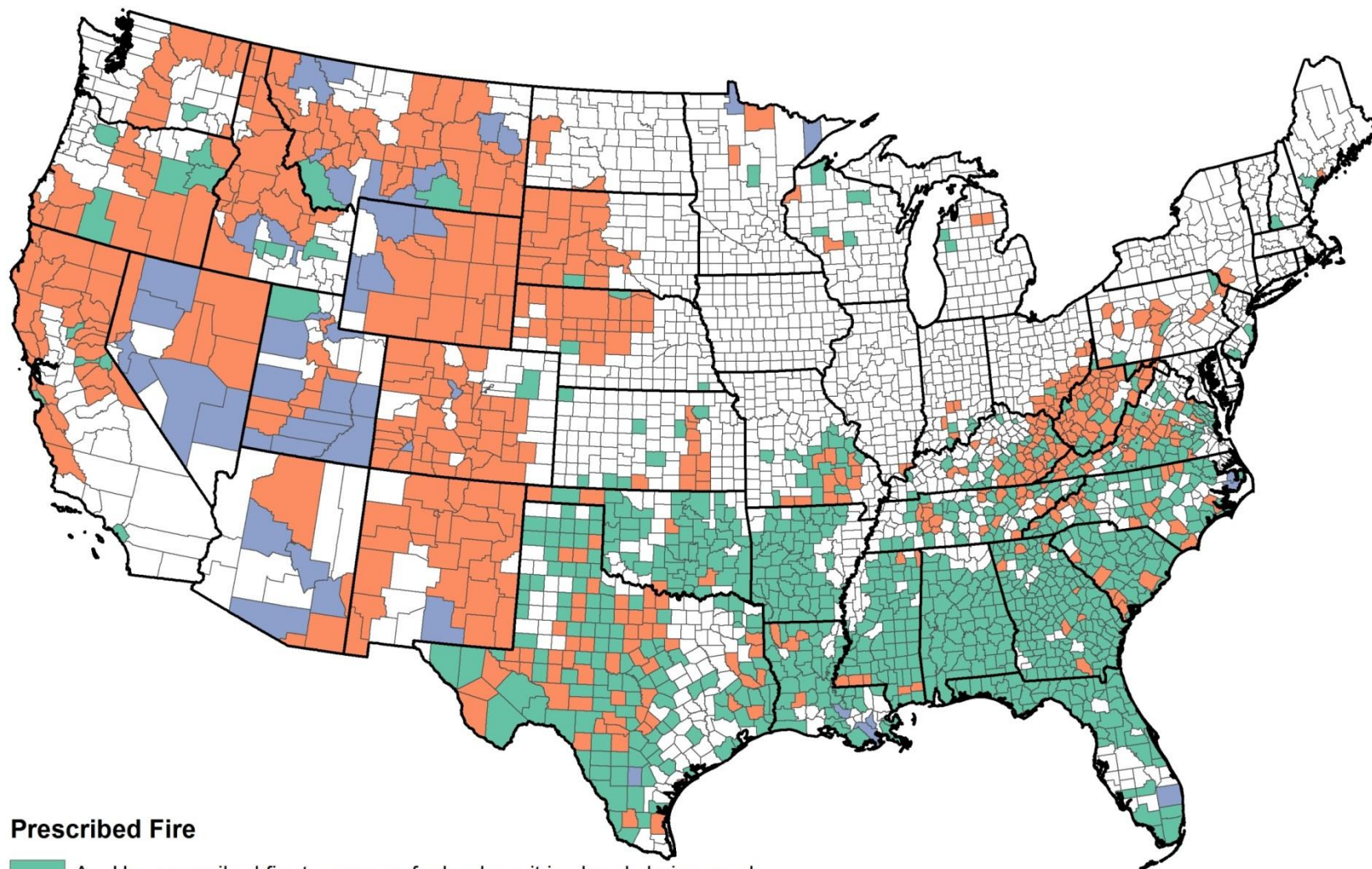
Prescribed Fire

- A – Use prescribed fire to manage fuels where it is already being used
- B – Consider expanding use of prescribed fire
- C – Consider prescribed fire, but on a limited basis

National Challenges	Management Options
Homes, Communities, & Values At Risk	Focus on home defensive actions Focus on combination of home and community actions Adjust building and construction codes, municipal areas Adjust building and construction codes, non-municipal areas
Human-Caused Ignitions	Reduce accidental human-caused ignitions Reduce human-caused incendiary ignitions (e.g., arson)
Effective and Efficient Wildfire Response	Prepare for large, long-duration wildfires Protect structures and target landscape fuels Protect structures and target prevention of ignitions
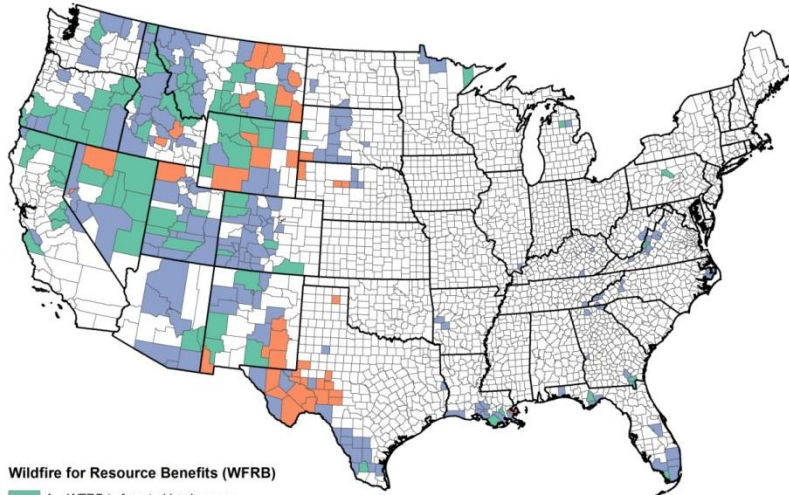
Wildfire for Resource Benefits (WFRB)

- A – WFRB in forested landscapes
- B – WFRB in non-forested landscapes
- C – WFRB, but with more conflicts with communities
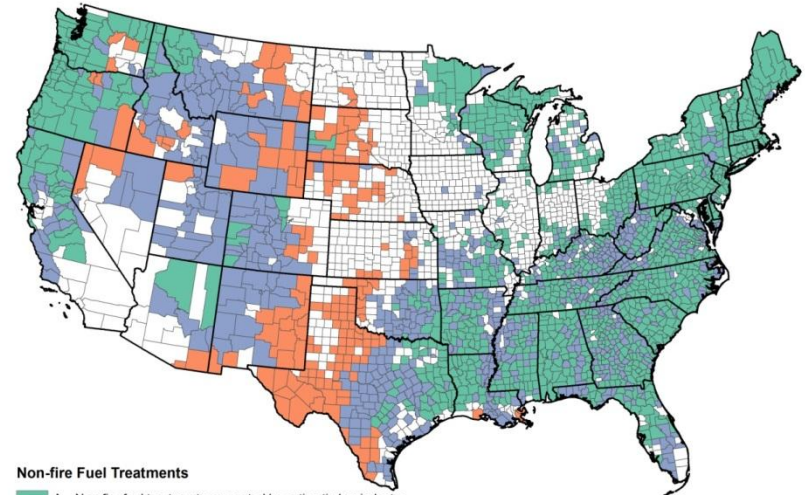
Non-fire Fuel Treatments

- A – Non-fire fuel treatments supported by active timber industry.
- B – Non-fire fuel treatments in non-forested areas supported by grazing or mowing.
- C – Non-fire fuel treatments are preferred option but supporting markets are weak.
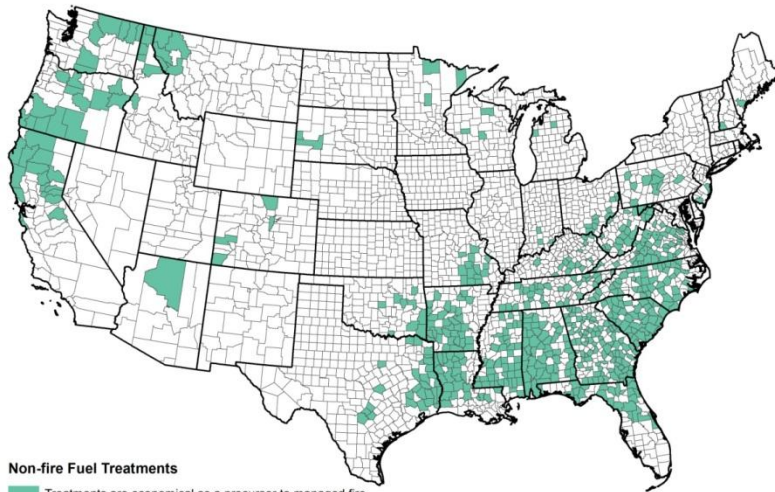
Non-fire Fuel Treatments

- Treatments are economical as a precursor to managed fire.
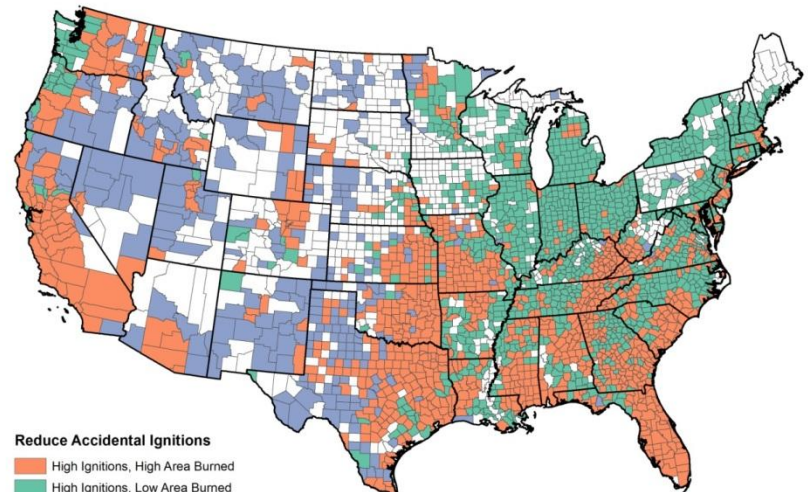
Reduce Accidental Ignitions

- High Ignitions, High Area Burned
- High Ignitions, Low Area Burned
- Low Ignitions, High Area Burned
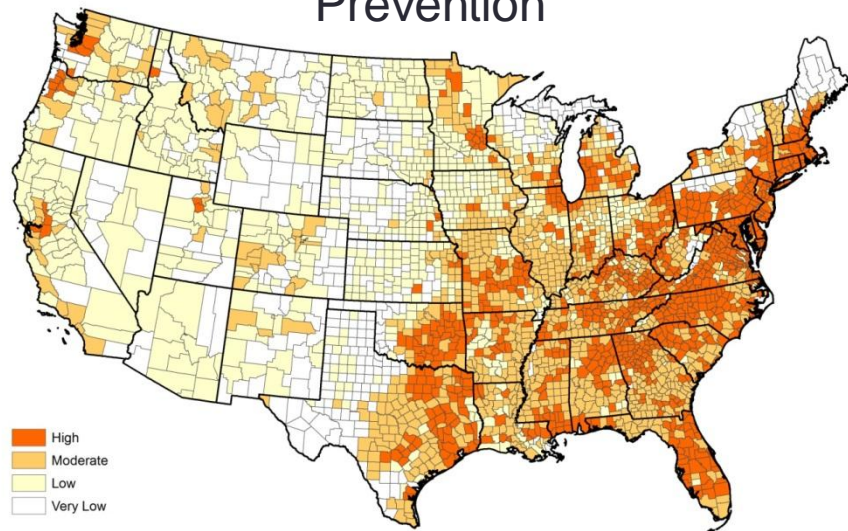- Low Ignitions, Low Area Burned

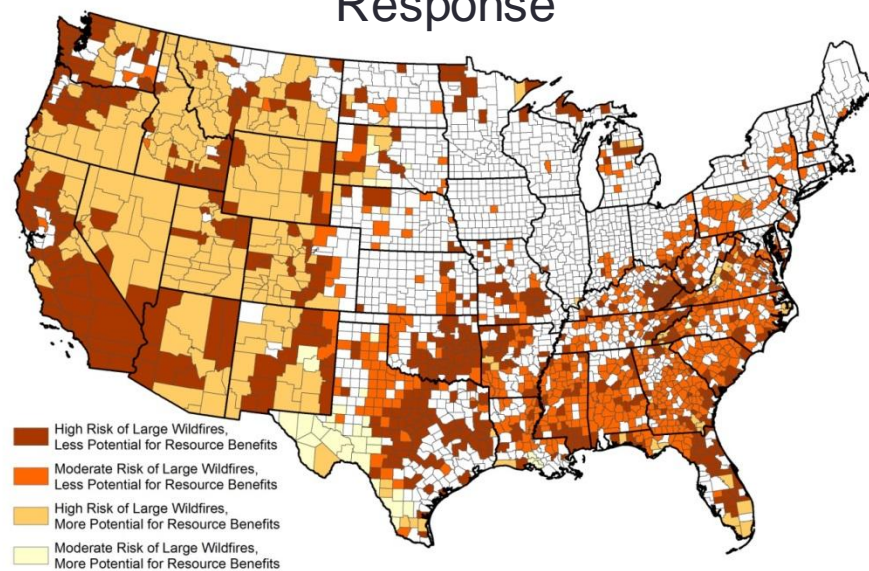# Spatial Prioritization

Fuels management
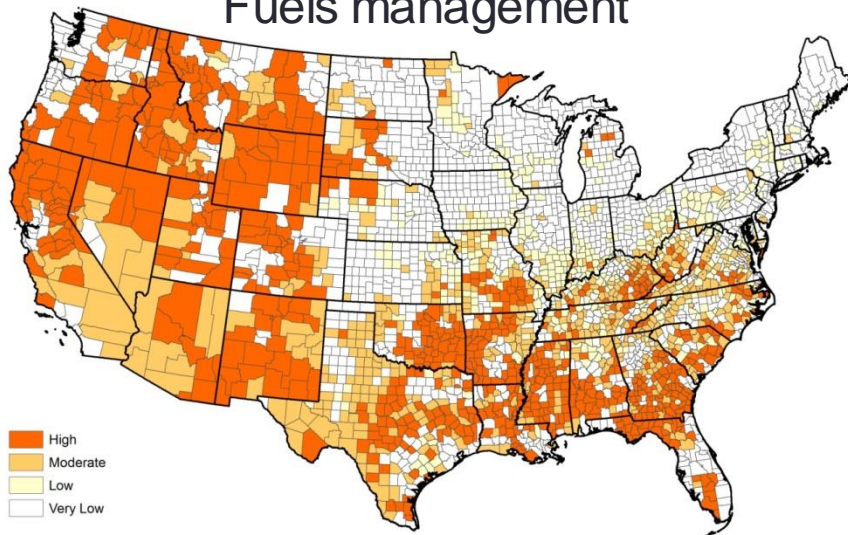
Community action
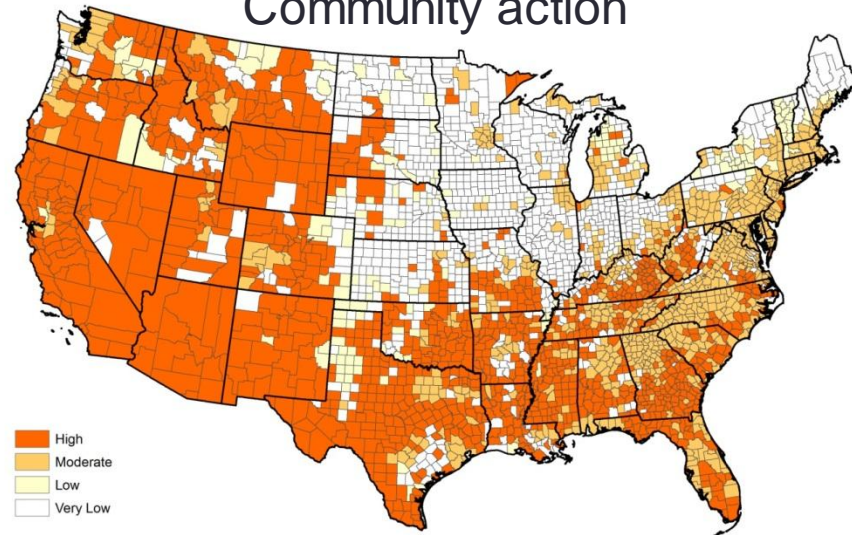
Prevention

Response

The National Strategy Document

- Approved by WFEC in November 2013

- Reviewed by OMB

- Approved by USDOI and USDA Secretaries

- Presented to Congress in April 2014

The National Strategy

The Final Phase in the Development
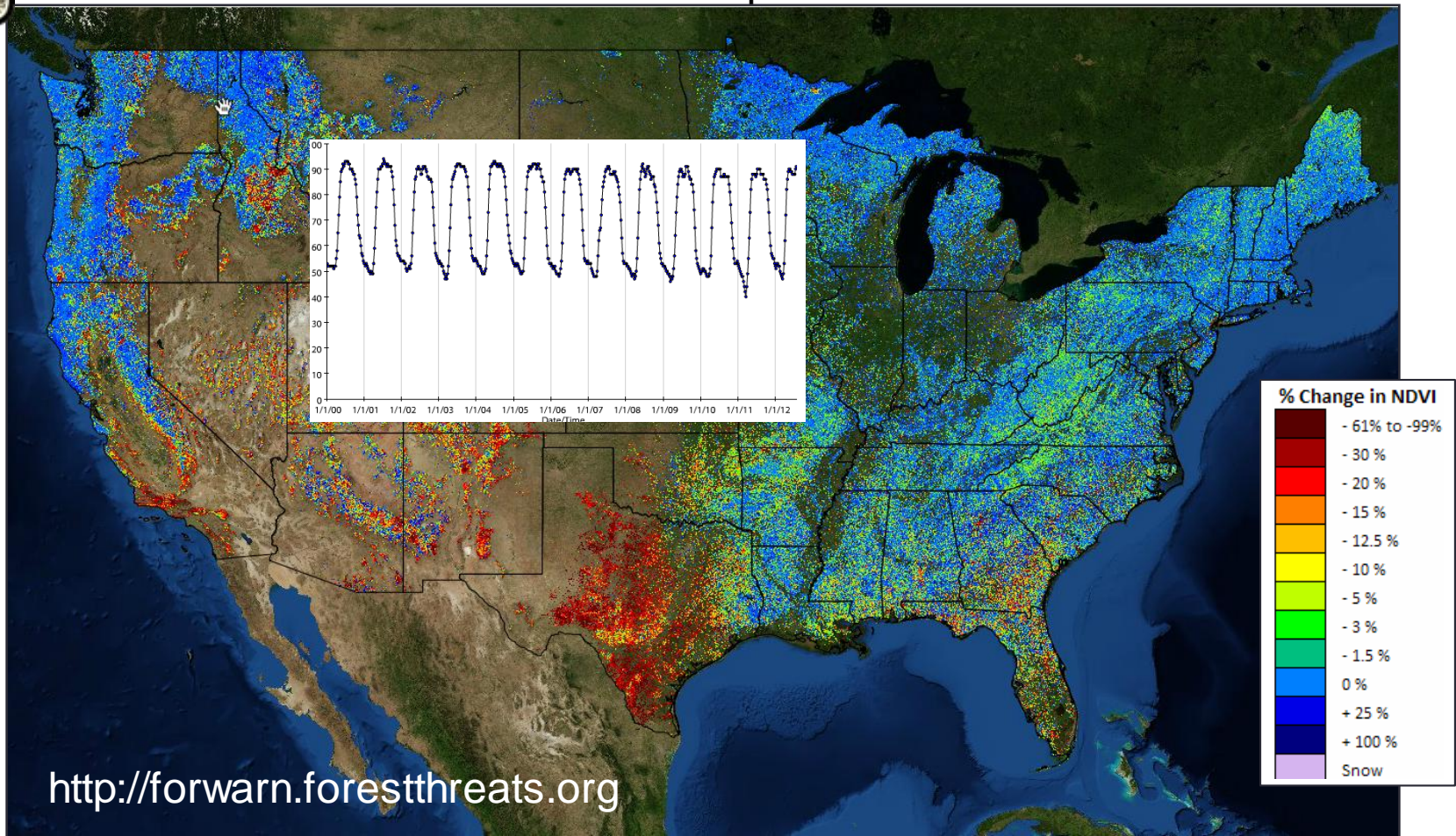of the National Cohesive Wildland Fire Management Strategy

Wildland Fire Executive Council (WFEC) Recommendation
to the Wildland Fire Leadership Council – *November 15, 2013*

What's next for Science Team?

- Complete, review, and publish report on national analysis.
- Continue to work with various agencies and regional planning teams to use the assembled information and data.
- Shift analytical attention to measuring outcomes.

- Normalized Difference Vegetation Index (NDVI) from MODIS
- 46 periods per year (8-day intervals)
- 2000 to present
- 232 meter resolution
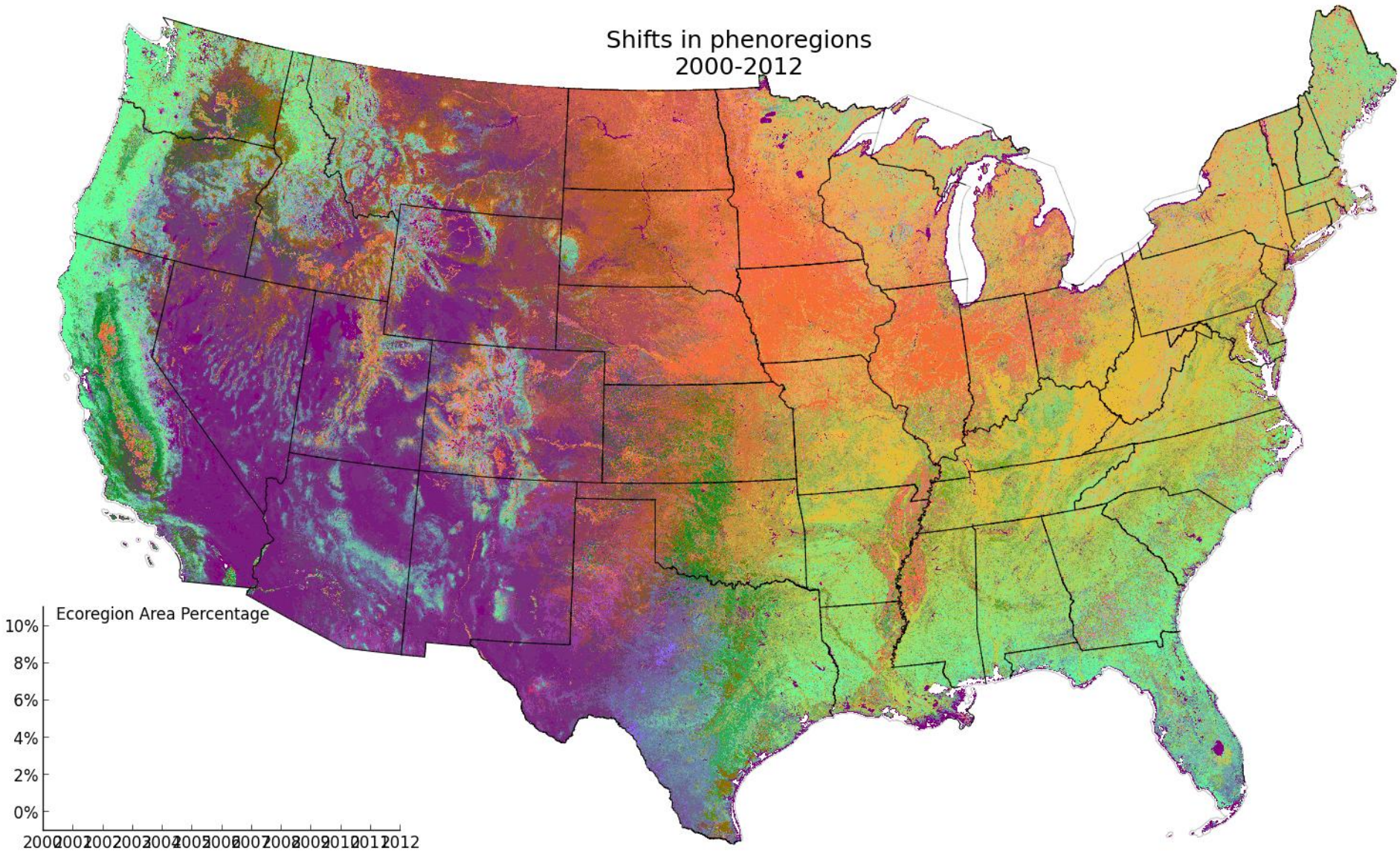- Includes NDVI time series and change maps

http://forwarn.forestthreats.org

% Change in NDVI
- 61% to -99%
- 30 %
- 20 %
- 15 %
- 12.5 %
- 10 %
- 5 %
- 3 %
- 1.5 %
0 %
+ 25 %
+ 100 %
Snow

Example: Biscuit Fire

Reference conditions as phenology of adjacent unburned area
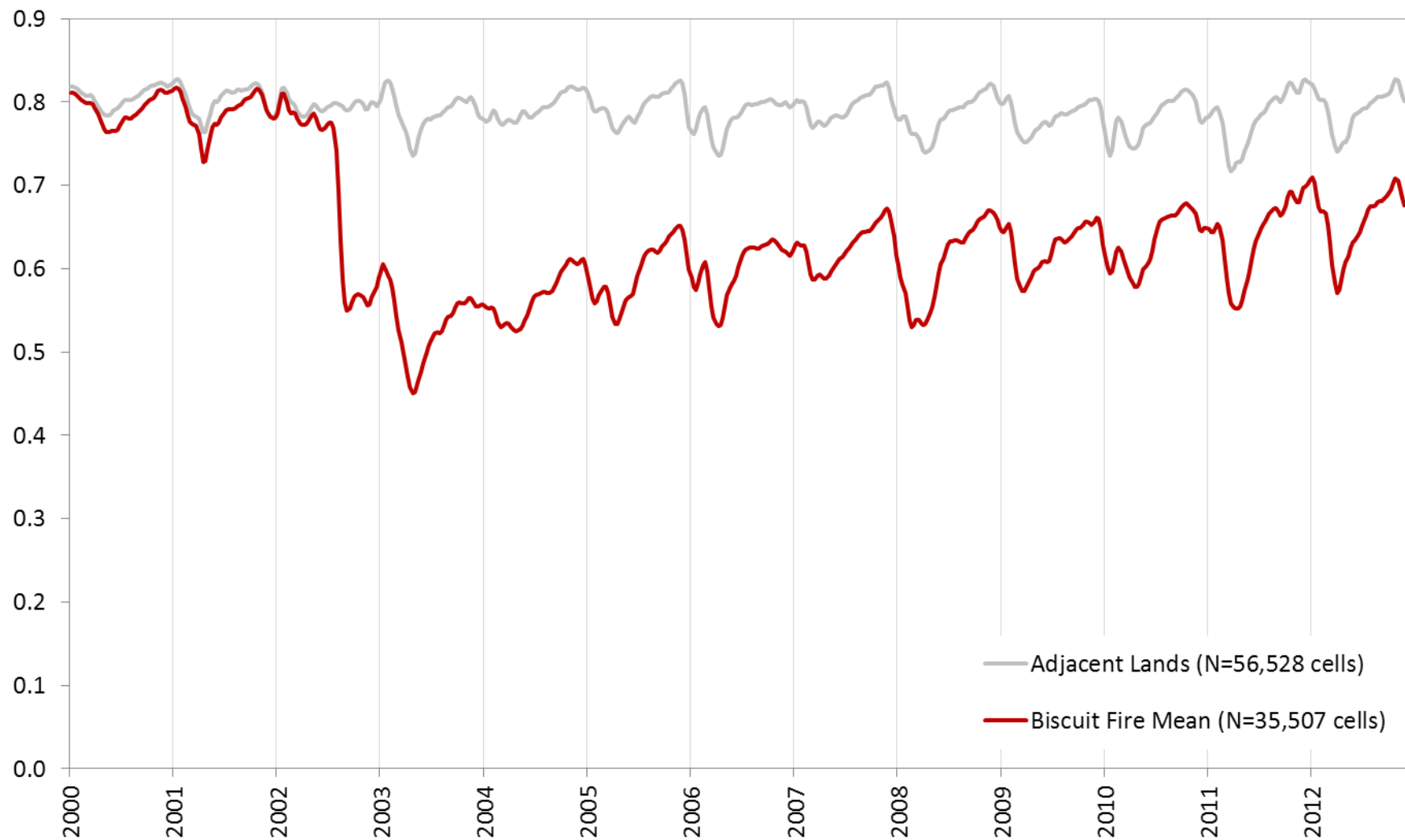
Shifts in phenoregions
2000-2012

Ecoregion Area Percentage
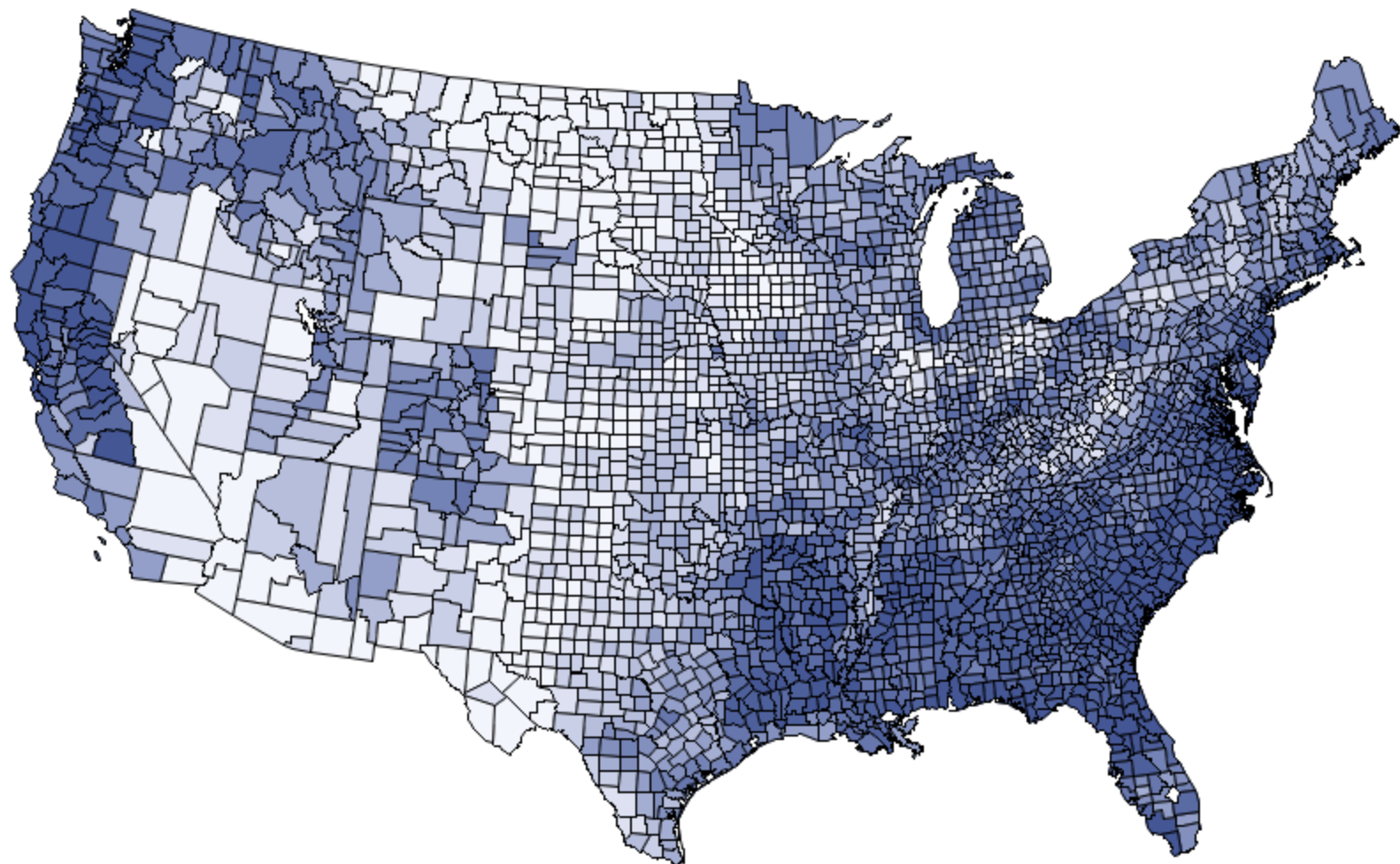
Ecological Measures based on Information Theory

- **Phenodiversity** – Shannon's diversity index
- **Mutual Information** – The degree to which year t+1 is conditioned on year t
- **Ascendency** – Mutual Information scaled by average productivity (NDVI)
- **Overhead** – Measure of disorganization
- **Capacity** – Sum of ascendency and overhead

System Ascendency

11.0 - 36.6	36.6 - 48.2	48.3 - 58.8	58.9 - 67.5
67.5 - 75.9	75.9 - 83.9	83.9 - 91.5	91.5 - 99.4
99.5 - 109.0	109.1 - 118.3	118.3 - 130.2	130.2 - 178.5

Lessons Learned (or reinforced)

- Synthetic, national-level analyses are tough.
- The greatest challenges are not technical or analytical, but sociopolitical.
- Beware the multiple agendas
- Manage expectations—of self and others
- Right-size the task at hand: right number, right skills
- Funding (likely) will end before the work is complete

Conclusions

- The Cohesive Strategy has been a remarkable and unique opportunity to engage scientists, managers, and stakeholders across the country.

- The scientific community responded to the challenge

- The CS effort has created opportunities for additional novel and challenging research, development, and application

- Executive leadership moving forward will be essential to fully realize the promise of the CS.

Questions?

For further information, visit http://www.forestsandrangelands.gov